MITIGATED NEGATIVE DECLARATION

FOR

MATTOLE HEADWATERS DROUGHT RELIEF PROJECT- VANAUKEN PONDS

March 2025

Lead Agency:

County of Humboldt

Lead Agency Contact:

Trevor Estlow

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ATTACHMENTS

Attachment A: Basis of Design (BOD) Report for the Mattole Headwaters Drought Relief Project – Vanauken Ponds, Humboldt County, California (Stillwater Sciences, December 2024)

Attachment B: Project Emissions Background Documentation (CalEEMod)

Attachment C: Bullfrog management plan

Attachment D: Cultural Resources Report (William Rich and Associates, December 2024)

I. PROJECT INFORMATION

Date: March 2025

Project Title: Mattole Headwaters Drought Relief Project – Vanauken Ponds

Lead Agency: County of Humboldt

Lead Agency Contact:
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Applicant:
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Preparers:
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Stillwater Sciences
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Current General Plan Designation: Timberland (T)

Current Zoning: Timberland Production Zone (TPZ)

Property Owners and Parcels:

Humboldt County				
Landowner	**Location**	**Parcel #**	**Contact**	**Phone**
Lost Coast Forestlands	Whitethorn, CA	215-162-021& 215-162-022	Tim Metz	(707) 496-0322

II. PROJECT DESCRIPTION

This project seeks to improve habitat for coho salmon (*Oncorhynchus kisutch*) and steelhead (*Oncorhynchus mykiss*) in Vanauken Creek, an important salmon bearing tributary to the Mattole River, by addressing the limiting factor of low summer streamflows. Vanauken Creek is a critical tributary to the Mattole River that historically supported coho and Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead. The Mattole Headwaters Drought Relief Project – Vanauken Ponds (Project) will store rainwater and winter runoff in approximately 6 million gallons of off-channel ponds and release the stored water into Vanauken Creek during the dry season. Sanctuary Forest (SFI) is the project lead and Stillwater Sciences is the technical lead for the Project. The Project is located on property owned by Lost Coast Forestlands (LCF) near Whitethorn, in Southern Humboldt County, CA (Figure 1).

Construction of two off-channel ponds shown on Figure 2 will include excavation and placement of earthen berms and spillways built into the natural topography. As an initial phase of grading, topsoil will be removed, stockpiled, and spread on top of compacted fill to promote vegetation growth at the completion of the project. All critical fill placement will be subject to compaction standards to ensure appropriate compaction. The ponds will be sealed with HDPE liners, each equipped with an underlying French drain system to control groundwater levels under the pond liner. The HDPE liner will be under and over-laid by woven geotextile fabric and a gravel topping. Both ponds have rock-lined spillways sized for the 100-yr storm discharge. All pond outflows will have screened outlets. Valves, pumps and flow meters will control and monitor the amount of water that is released from the ponds. Water will be directed into cooling/filtration galleries that utilize natural hyporheic cooling of the flow release through the existing soil. This approach is being used at the nearby Marshall Ranch Project and is proving effective at maintaining desirable water quality and temperature of the flow releases. Operational infrastructure will include a solar array, battery bank, inverter, transfer pump, valving and small control center shed. The power will be used to operate a sump pump under the West Pond liner, and pumped flow release from the West Pond to cooling/filtration galleries.

Existing well-maintained private gravel roads provide access to both pond sites. These permanent roads serve the landowner's timber operations. Pond construction including the use of temporary staging and access areas will adhere to all relevant protection measures including observing weather related work windows, protocols to prevent spread of invasive species, using well maintained equipment that is regularly inspected for fuel and oil leaks, using proper storage of hazardous materials such as fuel, revegetating disturbed areas, using silt fences, mulch, and other erosion control measures as needed, and complying with the terms of all permits issued for the project.

The ponds have been designed to fill during the wet season from direct precipitation and sheet flow based on 48 inches of annual precipitation. To facilitate sheet flow delivery to the ponds, inboard ditches and shallow French drains along existing roadways will be utilized. Most precipitation falls as rain during the winter months, with averages ranging from 70-85 inches per year (Downie et al. 2002). More recent rainfall records from the PRISM Climate Group and the Sanctuary Forest rain gauge at Whitethorn Junction show that average rainfall over the last 20 years is currently in the range of 70-85 inches per year with only 1 year (2014) at less than 48 inches with 44 inches.

The ponds are sized to release 25 gallons per minute over a 4-month period after subtracting evaporation losses estimated at 25% by volume. The start date and rate of flow augmentation will vary based on the hydrologic conditions in the watershed each year and will generally occur between July1 and November 1. It is anticipated that flow releases will begin when Vanauken Creek flows are approximately 50 gallons per minute. Flow releases will continue until significant rainfall occurs within the watershed increasing streamflow to above approximately 50 gallons per minute within Vanauken Creek at its confluence with the Mattole River.

In the event of an extremely low rainfall year, the flow augmentation rate and schedule would be adjusted to make best use of the reduced pond storage. The project is sized at 6 million gallons to provide flexibility as follows: The minimum amount of flow augmentation needed for pool connectivity is 15 gallons per minute which totals 2.64 million gallons released over a 4- month period and 3.51 million gallons of total pond water storage (accounting for evaporation) or 58% of the capacity. Therefore, the project can provide measurable significant improvements in drought years. In wet years, water not needed for streamflow can be retained and stored to make up for potential rainfall shortages in the following year.

Information related to the project including 65% design plans and associated technical studies are described in the Project's Basis of Design Report which is Attachment A of this MND.

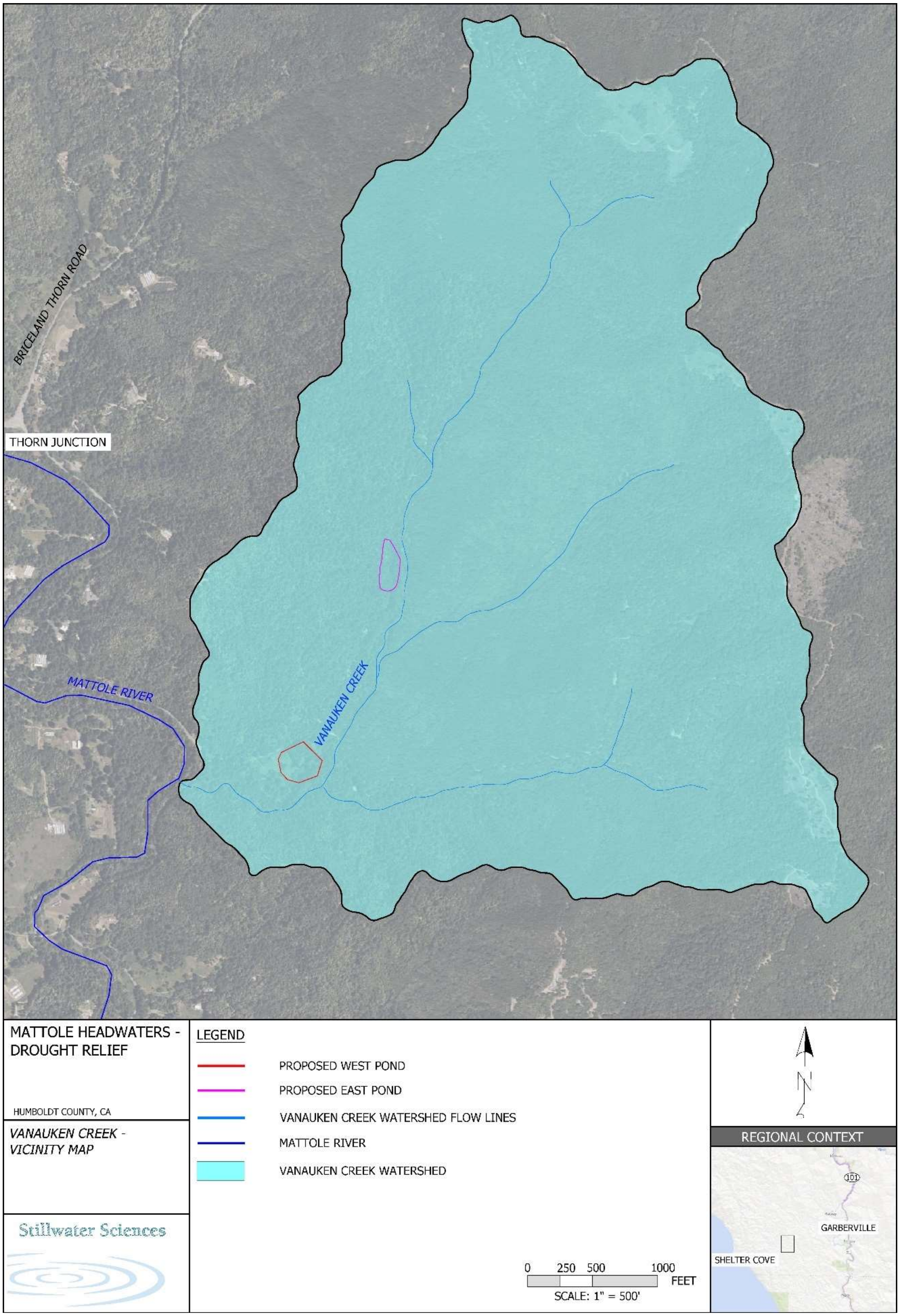

Figure 1: Project Location Map

Figure 2: Project Overview

Background:

Historically, Vanauken Creek has been identified as an important salmon producing stream with its cool, shaded, low-gradient streams that traverse the Property; however, populations have declined since the 1950s. Changes in rainfall patterns combined with other human-caused factors, such as the legacy of historic logging and other land-use impacts, have led to a significant reduction of summertime streamflows which is one of the primary limiting factors for Coho. Some reaches of Vanauken Creek drying up altogether or becoming a series of disconnected pools in the late summer. This pattern of diminished streamflows has been particularly well documented for the Mattole headwaters, beginning in 2002 with CDFW's Mattole River Watershed Assessment Report, and subsequently by SFI, the Mattole Restoration Council, the Mattole Salmon Group and others. Sanctuary Forest performed baseline streamflow monitoring for 15 headwaters tributaries including Vanauken Creek for the years 2007-2011. Similarly to the other east side creeks, flows stopped in September for the years 2007, 2008 and 2009. On August 24, 2021, Vanauken Creek was dry with only a few isolated pools in the lower 1500 ft where conditions were assessed.

The Project aims to provide sufficient instream flow for salmonid rearing during the lowest flow months from mid- August through October or when the winter rains begin. Recent flow enhancement initiatives in lower Russian River tributaries are analogous to this Project and have displayed that direct augment is one of the most successful approaches to date for enhancing dry-season streamflow. Flow releases from agricultural ponds in Green Valley Creek and Porter Creek have resulted in significant instream benefits (Grantham et.al. 2018, RRCWRP 2019). As described in Ruiz et al. (2018) of California Sea Grant, the project began in 2015 and is ongoing. Data shows that flow augmentations in all years from 2015–2018 were able to appreciably increase wetted channel habitat, increase dissolved oxygen in the stream, and decrease water temperature downstream from the flow augmentation release points. For example, releases into Dutch Bill Creek averaging 36 gallons per minute (gpm) beginning in late August of 2015 and were able to cumulatively re-wet more than 2,300 feet (ft) of stream channel with effects measurable up to 1.8 miles downstream. The Marshall Ranch Project located several miles from the Vanauken Creek watershed began augmenting flow in Redwood Creek (South Fork Eel River tributary) on July 1, 2024. The performance of the Marshall Ranch Project is being closely monitored and analyzed to inform the design of this Project.

The release of approximately 20 gpm in Vanauken Creek is expected to significantly improve summer streamflow and summer rearing habitat in Vanauken Creek. The Project will also provide streamflow benefits for the mainstem Mattole River between Vanauken Creek and Bridge Creek, a reach that has also been identified as having both a low flow problem, and a high intrinsic potential in the Southern Oregon/Northern California Coastal (SONCC) Recovery Plan (NMFS 2024). Streamflow at the Sanctuary Forest monitoring site MS6, located on the mainstem Mattole immediately upstream of the Bridge Creek confluence near Thorn Junction, has dropped below 20 gpm in 10 of the last 19 years.

Surrounding Land Uses: The lands surrounding the project consist primarily of large private holdings used for timber production. The proposed pond construction site is located on terraces above Vanauken Creek.

Project Consistency with Local and Regional Plans: The Project addresses many of the goals and policies included in the Humboldt County General Plan's Water Resources element:

- WR-G2 - Water Resource Habitat**.** River and stream habitat supporting the recovery and continued viability of wild, native salmonid and other abundant cold water fish populations supporting a thriving commercial, sport, and tribal fishery.
- WR-G9 - Restored Water Quality and Watersheds. All water bodies de-listed and watersheds restored, providing high quality habitat and a full range of beneficial uses and ecosystem services.
- WR-P23 - Watershed and Community Based Efforts. Support the efforts of local community watershed groups to protect, restore, and monitor water resources and work with local groups to ensure decisions and programs take into account local priorities and needs.
- WR-P25 - State and Federal Watershed Initiatives. Support implementation of state and federal watershed initiatives such as the Total Maximum Daily Loads (TMDLs), the North Coast Regional Water Quality Control Board's (NCRWQCB) Watershed Management Initiative, the National Marine Fisheries Services and Department of Fish and Game coho recovery plans and the California Non-Point Source Program Plan.
- WR-IMP19 - Coordinate and Support Watershed Efforts. Seek funding and work with land and water management agencies, community-based watershed restoration groups, and private property owners to implement programs for maintaining and improving watershed conditions that contribute to improved water quality and supply.

Additionally, the project also addresses the goals of important statewide and federal plans. The project directly addresses the goals of the California Water Action Plan (SWRCB 2019) and will ensure the restoration of critically important habitat. The Project supports the following actions: 1) Restoration of degraded stream ecosystems to assist in natural water management and improved habitat; 2) Enhancement of water flows in stream systems statewide; 3) Expansion of water storage capacity and improvement of groundwater management; and 4) Management and preparation for dry periods.

The Project also aligns with Goal 2 of the State Wildlife Action Plan (CDFW 2015) – Enhance Ecosystem Conditions, and Goal 3 – Enhance Ecosystem Functions and Processes: Maintain and improve ecological conditions vital for sustaining ecosystems in California. Specifically, the project objective is to enhance dry season flows thereby increasing water quantity and availability vital for sustaining aquatic ecosystems during the summer and early fall months.

NOAA Fisheries has prioritized a list of recovery actions for coho salmon in the Mattole River Population chapter of their SONCC Recovery Plan (NMFS 2014). Two of the four highest priority recovery actions identify "Improve flow timing or volume" as the recommended recovery strategy for the Mattole River. Additionally, the southern subbasin is identified as having the best potential for recovery and Vanauken Creek is specifically identified as having high Intrinsic Potential for coho recovery.

Other Public Agencies Whose Approval Is Required This Project will require a Grading Permit from the Humboldt County Building Department, a Less Than 3-acre Conversion Exemption from CALFIRE, and a Construction Stormwater General Permit from the State Water Resources Control Board. The Project may require a NPDES Low Threat Discharge Permit from the North Coast Regional Water Quality Control Board.

Planning, design, and implementation funding for the Project has been provided in full by the California Department of Water Resources through an Urban and Multibenefit Drought Relief Grant. This Initial Study and MND describe and analyze the potential significant impacts of all Project treatments at all sites. The Project will also include operations, monitoring and adaptive management. Construction is expected to be completed during the 2025 dry season.

Construction will be performed with standard heavy equipment including excavators, sheepsfoot compactor, bulldozer, and offroad dump trucks. Heavy equipment will be transported to the LCF property on lowboy gooseneck trailers.

Have California Native American tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code section 21080.3.1? If so, is there a plan for consultation that includes, for example, the determination of significance of impacts to tribal cultural resources, procedures regarding confidentiality, etc.?

On January 6, 2025, Humboldt County Staff sent AB52 referral letters to the tribes who have a cultural interest in the area, including the Bear River Band of the Rohnerville Rancheria, the InterTribal Sinkyone Wilderness Council, the Round Valley Reservation/Covelo Indian Community and the Wailaki Tribe. As of February 6, 2025, the Bear River Band of the Rohnerville Rancheria was the only tribe to respond. They recommended the standard inadvertent discovery condition which is included as mitigation measure CR-1.

In addition to the formal AB52 outreach conducted by the County, tribal outreach was conducted by William Rich and Associates (WRA) for the Project and included an email request on October 30, 2024 to the Native American Heritage Commission (NAHC) for a search of the Sacred Lands File (SLF) and for a suggested list of Native American contacts for the project vicinity. The NAHC responded on October 31, 2024 with a negative SLF search. Letters were sent to tribal representatives of the Bear River Band of the Rohnerville Rancheria, InterTribal Sinkyone Wilderness Council, Round Valley Reservation/Covelo Indian Community, and the Wailaki Tribe on October 30, 2024 with a description of the Project and a map showing the location.

Two responses were received; the first from Tribal Historic Preservation Officer (THPO) Edwin Smith of the Bear River Band of the Rohnerville Rancheria who indicated his office had knowledge of the isolated projectile point, found in 2016 by Forester Todd Truesdell, that was located close to the Project boundary. Mr. Rich called THPO Smith on November 4, 2024 and discussed the site record, and that a thorough survey of this location had been completed on multiple occasions and that the artifact nor an accompanying archaeological site has been relocated at this time. Mr. Rich also invited THPO Smith to visit the Project area, and a site visit took place on November 7, 2024. During this visit, Mr. Smith, William Rich and Tasha McKee of Sanctuary Forest were able to investigate the Project footprints again. Both pond areas and the West Pond pipeline route were walked and surveyed for any exposed archaeological materials; none were found.

Additionally, WRA heard from Chairwoman Dorothy Hoaglin of the Wailaki Tribe who attended an onsite Technical Advisory Committee (TAC) meeting for the Project on August 6, 2024 and shared that the Project area "does not pose a significant threat to tribal cultural resources, it aligns with the natural resource goals of the Wailaki Tribe, focusing on enhancing wildlife habitat, ethnobiological knowledge, and botanical resources in the region." No other responses were received.

CEQA Requirement: The Project is subject to the requirements of the CEQA. The Lead Agency is the County of Humboldt (County), per CEQA Guidelines Section 21067. The purpose of this Initial Study is to provide a basis for determining whether to prepare an Environmental Impact Report (EIR) or a Negative Declaration. This Initial Study is intended to satisfy the requirements of CEQA (Public Resources Code, Div 13, Sec 21000-21177) and the State CEQA Guidelines (California Code of Regulations, Title 14, Sec 15000-15387).

CEQA encourages lead agencies and applicants to modify their projects to avoid potentially significant adverse impacts (CEQA Section 20180[c][2] and State CEQA Guidelines Section 15070[b][2]).

Section 15063(d) of the State CEQA Guidelines states that an IS shall contain the following information in brief form:

1) A description of the project including the project location
2) Identification of the environmental setting
3) Identification of environmental effects by use of a checklist, matrix, or other method, provided that entries on a checklist or other form are briefly explained to provide evidence to support the entries
4) Discussion of means to mitigate significant effects identified
5) Examination of whether the project would be consistent with existing zoning, plans, and other applicable land use controls
6) The name of the person or persons who prepared and/or participated in the Initial Study

The Finding: Although the Project may have the potential to cause minor short-term impacts on soil, vegetation, wildlife, water quality, and aquatic life, the measures that shall be incorporated into the Project will lessen such impacts to a level that is less than significant (see initial study and environmental impacts checklist).

Basis for the Finding: Based on the initial study, it was determined there would be no significant adverse environmental effects resulting from implementing the proposed Project. The Project is designed to provide environmental benefit by enhancing and maintaining quality salmonid rearing habitat in the downstream reach of Vanauken Creek and the Mattole River through augmentation of dry season stream flows.

Humboldt County finds that implementing the proposed Project will have no significant environmental impact. Therefore, this mitigated negative declaration is filed pursuant to CEQA, Public Resources Code § 21080 (c2). This proposed mitigated negative declaration consists of all of the following:

III. ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a **"Potentially Significant Impact"** as indicated by the checklist on the following pages.

❑ Aesthetics	❑ Agricultural and Forestry Resources	❑ Air Quality
❑ Biological Resources	❑ Cultural Resources	❑ Energy
❑ Geology/Soils	❑ Greenhouse Gas Emissions	❑ Mineral Resources
❑ Hazards/Hazardous Materials	❑ Land Use/Planning	❑ Noise
❑ Hydrology/Water Quality	❑ Population/Housing	❑ Public Services
❑ Recreation	❑ Transportation/Traffic	❑ Tribal Cultural Resources
❑ Utilities/Service	❑ Mandatory Findings of Significance	❑ Wildfire

An explanation for all checklist responses is included, and all answers take into account the whole action involved, including off-site as well as on-site; cumulative as well as project-level; indirect as well as direct; and construction as well as operational impacts. In the checklist the following definitions are used:

"**Potentially Significant Impact**" means there is substantial evidence that an effect may be significant.
"**Potentially Significant Unless Mitigation Incorporated**" means the incorporation of one or more mitigation measures can reduce the effect from potentially significant to a less than significant level.
"**Less Than Significant Impact"** means that the effect is less than significant and no mitigation is necessary to reduce the impact to a lesser level.
"**No Impact"** means that the effect does not apply to the Project, or clearly will not impact nor be impacted by the Project.

DETERMINATION: (To be completed by the Lead Agency on the basis of this initial evaluation)

- ☐ I find that the proposed project **could not** have a significant effect on the environment, and a **Negative Declaration** will be prepared.
- ☑ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A **Mitigated Negative Declaration** will be prepared.
- ☐ I find that the proposed project **may** have a significant effect on the environment, and an **Environmental Impact Report** (EIR) is required.
- ☐ I find that the proposed project **may** have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An **Environmental Impact Report** is required, but it must analyze only those effects that remain to be addressed.
- ☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier **EIR** or **Negative Declaration** pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier **EIR** or **Negative Declaration**, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature	3/6/2025 Date
Trevor Estlow, Senior Planner	Humboldt County Planning and Building Department

EVALUATION OF ENVIRONMENTAL IMPACTS

1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).

2) All answers must take account of the whole action involved, including offsite as well as onsite, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.

3) Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.

4) "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from Section XVII, "Earlier Analyses," may be cross-referenced).

5) Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:

   a) Earlier Analysis Used. Identify and state where they are available for review.

   b) Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.

   c) Mitigation Measures. For effects that are "Less Than Significant with Mitigation Measures Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.

6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.

7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

8) This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.

9) The analysis of each issue should identify:

    a) the significance criteria or threshold used to evaluate each question; and
    b) the mitigation measure identified, if any, to reduce the impact to less than significance.

1. Aesthetics: Except as provided in Public Resources Code Section 21099, would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Have a substantial adverse effect on a scenic vista?				X
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?				X
c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from a publicly accessible vantage point). If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?				X
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?			X	

Discussion:

(a) No Impact: The project will not impact a scenic vista. Such an impact will not occur because the project will not be readily visible from any traveled local roadway. The project has been designed with consideration of maintaining low visibility and will serve to restore the watershed to a more natural condition with water flowing in Vanauken Creek during the dry season.

(b) No Impact: The project will not damage scenic resources such as trees, rock outcroppings, and historic buildings within a state scenic highway. Such an impact will not occur because the project is not located in the vicinity of a state scenic highway.

(c) No Impact: The project will not degrade the existing visual character or quality public views of the sites and their surroundings because there are no publicly accessible vantage points overlooking the project site. Access to the site is via a private drive and any overlooking locations are within Lost Coast Forestlands ownership or adjacent private properties. Through careful planning and design, the natural character of the site will be maintained to the greatest extent practical while still achieving the project objectives. Final berm grading will be blended in with natural topographic features. In addition, native vegetation will be planted within all disturbed areas. It is also important to consider that the overall goal of this project is to enhance dry season flows in Vanauken which will restore the natural character of a significant portion of the watershed.

(d) Less Than Significant Impact: The project will not create a new source of substantial light which would adversely affect day or nighttime views in the vicinity of the worksites. Such an impact will not occur because the restoration project does not require installation of artificial lighting. It is possible that some glare may be created by the solar array. However, any receptors of glare created by the solar panels would be expected to occur to the south of the project area based on the southern orientation of the panels. The land to the south of the project is almost entirely large parcels utilized for timber and there are no residences located to the south of the project. Therefore, the project would have a less than significant impact.

2. Agriculture and Forestry Resources. In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?			X	
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?				X
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?				X
d) Result in the loss of forest land or conversion of forest land to non-forest use?			X	
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?			X	

Discussion:
The project is located on land that is zoned by Humboldt County as Timberland Production Zone (TPZ). The proposed ponds will have no negative impact on agricultural activities and will be compatible with forest uses. While the project will cause the loss of approximately 3 acres of forest land, the project will result in fish and wildlife management benefits and improved protection of forest resources from wildfire.

(a) Less Than Significant Impact: Based on Humboldt County Web GIS, the project area is located within Prime Agricultural Soils. However, the zoning and the general plan designation are both consistent with the actual land use, which is timber production. Additionally, the only area that is meadow is within a Meadow Conservation Area mapped in a conservation easement held by Sanctuary Forest and is reserved in perpetuity for ecological, recreational, and streamflow enhancement purposes. Therefore, the effect on farmland is less than significant.

(b) No Impact: The project will not conflict with existing zoning for agricultural use or a Williamson Act contract. The project is located on land that is zoned by Humboldt County as TPZ and is used for timber production. Fish and wildlife management (one of the primary purposes of the project) is an allowable use on this zoning. The project parcel is not under a Williamson Act contract, therefore there would be no impact.

(c) No Impact: Both ponds are or on parcels zoned TPZ. Fish and wildlife management (the primary purpose of the project) is an allowable use on this zoning. Therefore, there is no zoning conflict caused by this project.

(d) Less Than Significant Impact: Approximately 3 acres of trees will be removed during implementation of this project which represents a very small percentage of the overall ownership. Additionally, the ponds will improve access to water in the event of wildfire which enhances the resiliency of the surrounding forestlands. Lastly, this project supports fish and wildlife management which is an allowable use on this zoning. For these reasons this project will have a less than significant impact on forest land conversion.

(e) Less Than Significant Impact: The project will not involve other changes in the existing environment, which due to their location or nature, could result in significant conversion of farmland to non-agricultural use or forestland to non-forest use. Fisheries habitat restoration actions are compatible with existing forest uses. The ponds will result in the loss of approximately 3 acres of forest land but will improve access to water during wildfire to protect the remaining forest land. Additionally, the proposed pond site will enhance water availability for downstream agricultural water users.

3. Air Quality. Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Conflict with or obstruct implementation of the applicable air quality plan?			X	
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard?			X	
c) Expose sensitive receptors to substantial pollutant concentrations?			X	
d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?				X

Discussion:
Humboldt County is designated as 'in attainment' for all National Ambient Air Quality Standards (NAAQS or federal standards). Humboldt County is designated as 'in attainment' for all California Ambient Air Quality Standards (CAAQS or State standards) pollutants except PM_{10}. The North Coast Unified Air Quality Management District (NCUAQMD) has not formally adopted significance thresholds that would apply to projects such as this. For construction emissions, the NCUAQMD has indicated that construction emissions are not considered regionally significant for projects that will be of relatively short duration (less than one year) (NCUAQMD 2015).

Impacts related to construction dust are considered significant if dust is allowed to leave the site (NCUAQMD 2015). Construction activities are subject to Rule 104 (Prohibitions) Section D (Fugitive Dust Emission). Pursuant to Section D, the handling, transporting, or open storage of materials in such a manner, which allows or may allow unnecessary amounts of particulate matter to become airborne, shall not be permitted. Reasonable precautions shall be taken to prevent particulate matter from becoming airborne, including, but not limited to: 1) covering open bodied trucks when used for transporting materials likely to give rise to airborne dust; and 2) the use of water during the grading of roads or the clearing of land.

(a) Less than significant: The construction portion of the project will last for less than one year (June 1 to November 1). During this period, the project will comply with Rule 104, Section D and cover open body trucks hauling materials off site and use water during the grading of roads, excavation, and land clearing. Additionally, any burning of vegetation will be conducted consistent with the terms of a NCUAQMD Smoke Management Plan

(b) Less than significant: Humboldt County is in attainment of all air quality standards, except PM_{10}. The project will comply with Rule 104, Section D and cover open body trucks hauling materials off site and use water during the grading of roads, excavation, and land clearing. Construction work will be primarily comprised of onsite earthwork expected to be completed in approximately 4 months. Therefore, the project will not result in a cumulatively considerable net increase of any criteria pollutant for which the project region is in non-attainment under applicable federal or state ambient air quality standards.

(c) Less than significant: The project will not expose sensitive receptors to substantial pollutant concentrations. Such an impact will not occur because the project will not increase pollutant concentrations and is designed to operate utilizing solar energy. There is the potential for fugitive dust to travel off site and expose neighbors. However, the project will comply with Rule 104, Section D and cover open body trucks hauling materials off site and use water during the grading of roads, excavation, and land clearing. Therefore, it is not expected that sensitive receptors would be exposed to substantial concentrations of PM_{10}.

(d) No Impact: The project will not create other emissions (such as objectionable odors) affecting a substantial number of people.

4. Biological Resources. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?		X		
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?		X		
c) Have a substantial adverse effect on federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?				X
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?			X	
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?				X
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?				X

Discussion:

Special-status species are defined in this ISMND as those that are:

- listed as endangered or threatened, rare, or proposed/candidates for listing under the ESA and/or CESA;
- designated by CDFW as a Species of Special Concern;
- have a California Rare Plant Rank (CRPR) of 1, 2, 3 or 4; and/or
- have a state ranking of S1, S2, or S3 (critically imperiled, imperiled, or vulnerable, respectively) on CDFW's California Sensitive Natural Communities List (CDFW 2018a).

An in-depth review of the project site and surrounding area was conducted using desktop and field reviews (Appendix C of the BOD Report). The desktop review included querying the following resources:

- The U.S. Fish and Wildlife Service (USFWS) online Information for Planning and Consultation (IPaC),
- The California Native Plant Society's (CNPS) online Inventory of Rare and Endangered Vascular Plants of California,
- CDFW's California Natural Diversity Database (CNDDB),
- CDFW's CNDDB northern spotted owl viewer, and

- National Marine Fisheries Service's (NMFS) California Species List Tools database.

The desktop review generated a list of special status plant and wildlife species with potential to inhabit the project area (Tables 1 and 2). The field visits conducted on May 28, 2024 and July 16, 2024 were used to assess habitat for the species on the list, determine their potential to be present, and identify what project-related effects on these species would occur, if any. Please see Appendix C of the BOD report in Attachment A for more detailed information.

Table 1. Special status plant species with the potential to be present in or around the Project Area.

Scientific name (common name)	Status (Federal, State, CRPR[1])	Habitat association[2]	Source	Likelihood of occurrence
Gilia capitata ssp. pacifica (Pacific gilia)	None/None/1B.2	Coastal bluff scrub, openings in chaparral, coastal prairie, valley and foothill grassland; 15–5,465 ft. Blooming period: April–August	CNPS, CDFW	**Moderate:** Suitable habitat present within Project area. Four occurrences within 5 mi of the Project area.
Listera cordata (heart-leaved twayblade)	None/None/4.2	Bogs and fens, lower montane coniferous forest, North Coast coniferous forest; 15–4,495 ft. Blooming period: February–July.	CNPS, CDFW	**Moderate:** North coast coniferous forest habitat present within the Project area. One personal observation in 2022 within 5 mi of the Project area on Sanctuary Forest property.
Piperia candida (white-flowered rein orchid)	None/None/1B.2	Sometimes serpentinite areas in broadleafed upland forest, lower montane coniferous forest, north coast coniferous forest; 95–4,300 ft. Blooming period: (March) May–September	CNPS, CDFW	**Moderate:** North coast coniferous forest habitat present within Project area. Many occurrences within 5–10 mi of the Project area.
Usnea longissima (Methuselah's beard lichen)	None/None/4.2	On tree branches; usually on old-growth hardwoods and conifers in broadleafed upland forest and north coast coniferous forest; 160–4,790 ft. Blooming period: N/A (lichen)	CNPS, CDFW	**Moderate:** North coast coniferous forest and broadleafed upland forest habitat present within Project area. Multiple scattered colonies mapped within 10 mi of the Project.

[1] Status:

Federal

FT Federal Threatened

State

ST Threatened

SSC CDFW species of special concern

Table 2. Special status wildlife species with the potential to be present in or around the Project Area.

Species name	Status[1] Federal/ State	Distribution and habitat associations	Location of suitable habitat in Project area	Likelihood of occurrence
Fish				
Oncorhynchus kisutch (Coho salmon – southern Oregon/northern California coast Evolutionarily Significant Unit)	FT, CH/ST	Spawn in coastal streams and large mainstem rivers in riffles and pool tails-outs and rear in pools ≥ 3 ft deep with overhead cover with high levels oxygen and temperatures between 50–59°F.	Suitable habitat occurs in the upper Mattole and Project area. Coho redds have been infrequently observed in the Project area. Designated critical habitat includes all river reaches and estuarine areas accessible to listed coho within their range. Designated critical habitat is present in the Project area.	**High:** Present in Vanauken Creek.
Oncorhynchus tshawytscha (Chinook salmon – California Coastal ESU)	FT, CH/None	Wild coastal, spring, and fall-run Chinook found in streams and rivers between Redwood Creek, Humboldt County to the north and the Russian River, Sonoma County to the south.	Suitable habitat occurs in the upper Mattole River. Fair quality spawning habitat for this species is present in Vanauken Creek. Designated critical habitat is present in the Project area.	**High:** Potentially present in Vanauken Creek.
Oncorhynchus mykiss (Steelhead – northern California coast Distinct Population Segment)	FT, CH/None	Inhabits small coastal streams to large mainstem rivers with gravel-bottomed, fast-flowing habitat for spawning. However, habitat criteria for different life stages (spawning, fry rearing, juvenile rearing) can vary significantly.	Suitable habitat occurs in the upper Mattole and Project area. Designated critical habitat is present in the Project area.	**High:** Present in Vanauken Creek.

Species name	Status[1] Federal/ State	Distribution and habitat associations	Location of suitable habitat in Project area	Likelihood of occurrence
Amphibians				
Rana boylii (foothill yellow-legged frog)	None/SSC, CT	Associated with partially shaded, shallow streams, and riffles with rocky substrate. Some cobble-sized substrate required for egg laying. Adults move into smaller tributaries after breeding.	Suitable habitat for foothill yellow-legged frog breeding occurs in the Mattole River where the channel widens, and the tree canopy opens to allow sun to reach the channel for several hours a day. Vanauken Creek may be used by adults and juveniles of this species for dispersal.	**Moderate**: Suitable dispersal habitat present.
Rana aurora (Northern red-legged frog)	None/SSC	Humid forests, woodlands, grasslands, and streamsides usually near dense cover. Generally near permanent water but can be found far from water in damp woods and meadows during non-breeding season.	Suitable habitat is present in habitat types associated with water nearby uplands, and existing ponded areas.	**High:** Likely to be present within or adjacent to the Project area.
Taricha rivularis (red-bellied newt)	None/SSC	Found along the coast from near Bodega, Sonoma County, to near Honeydew, Humboldt County, and inland to Lower Lake and Kelsey Creek, Lake County. It lives in coastal woodlands, especially redwood forests.	Habitat is present within the Mattole River and its tributaries adjacent to the Project area. An individual was documented in the Mattole River downstream of Thorn Junction (CDFW 2018).	**Moderate**: Suitable habitat may be present.
Rhyacotriton variegatus (southern torrent salamander)	None/SSC	Rocky headwater streams in mesic late-successional forest or nearby riparian forests, though the species may be found in younger stage forests in coastal northern California	Suitable habitat occurs within high gradient reaches upstream of the Project area.	**Moderate**: High-gradient seeps and perennial flow may be present upstream of the Project area.
Dicamptodon tenebrosus (Coastal giant salamander)	None/SSC	Northern Mendocino County to British Columbia. Wet coastal forests in or near clear, cold permanent and semi-permanent streams and seepages.	Suitable habitat occurs in Vanauken Creek and its tributaries.	**High**: Habitat is present within the Mattole River and its tributaries within and adjacent to the Project area.

Species name	Status[1] Federal/ State	Distribution and habitat associations	Location of suitable habitat in Project area	Likelihood of occurrence
Birds				
Strix occidentalis caurina (Northern spotted owl)	FT/ST	Typically found in large, contiguous stands of mature and old-growth coniferous forest with dense multi-layered structure.	Suitable foraging habitat for northern spotted owl is present in patches adjacent to the Project area. However, there are no northern spotted owl activity centers within 724 m (0.45 miles [mi]) of the Project areas. The nearest activity center is HUM0924, which is about 0.48 mi to the north of the Vanauken project.	**Moderate**: Suitable foraging habitat exists in the Project area.
Contopus cooperi *(*Olive-sided flycatcher)	None/SSC	Occupy a wide variety of forested habitats in California, including mixed conifer, Douglas-fir, redwood, and montane hardwood-conifer forests with open canopies, near forest edges or forest openings (e.g., meadows, rivers, harvest units).	Suitable habitat occurs in the Project area. The nearest sighting was approximately 5 mi to the northeast (eBird 2024).	**High:** Suitable habitat occurs in Project area.
Dendroica petechia (Yellow warbler)	None/SSC	Throughout California. Preferred habitat includes open-canopy, deciduous riparian vegetation in close proximity to water, often along streams or wet meadows.	Suitable habitat occurs in the Project area. The nearest sighting was in 1995 approximately 5 mi to the northeast of the Project area (eBird 2024).	**Moderate:** Suitable habitat present in the Project areas
Reptiles				
Emys marmorata (western pond turtle)	None/SSC	Ponds, marshes, rivers, streams, and irrigation ditches with abundant vegetation, and either rocky or muddy bottoms, in woodland forest and grasslands. Below 6,000 ft elevation. Basking sites are required. Egg-laying sites are located on suitable upland habitats (grassy open fields) up to 1,640 ft from water.	Suitable habitat occurs in the middle and lower Mattole River. Present in stock ponds in the upper Mattole watershed. A sighting was reported near Thompson Creek.	**Low:** Present in the Mattole River. No suitable habitat in Vanauken Creek.

Species name	Status[1] Federal/ State	Distribution and habitat associations	Location of suitable habitat in Project area	Likelihood of occurrence
Mammals				
Arborimus pomo(Sonoma tree vole)	None/SSC	Associated nearly exclusively with Douglas-fir trees and occasionally grand fir trees within the north coast fog belt between the northern Oregon border and Sonoma County. Eats Douglas-fir needles exclusively.	Douglas-fir are present within the Project area, which could provide nesting and foraging habitat.	**High:** Suitable habitat is present
Pekania pennanti (Pacific fisher – West Coast DPS)	None/SSC	Associated with dense advanced-successional conifer forests, with complex forest structure and high percent canopy closure; den in hollow trees and snags.	Habitat in the Project area does not correspond to the dense advanced-successional forest this species prefers. Nearest recorded sighting is approximately 7 mi to the southeast near Cooks Valley.	**Moderate:** Potential suitable habitat is present in the Project area.
Corynorhinus townsendii (Townsend's big-eared bat)	None/SSC, CT	Found throughout California in all but subalpine and alpine habitats. Roosts in cavernous habitats, usually in tunnels, caves, buildings, mines, and basal hollows of trees, but also rock shelters, preferentially close to water. Caves near water's edge are favored. Forages in riparian zone and follows creeks and river drainages on foraging bouts. Feeds primarily on moths. Drinks at stream pools.	Suitable foraging habitat throughout most of the Project area; however, barns, old buildings, and bridges for roosting are not present within the Project area.	**Moderate:** May forage in the Project area. May be present in some of the barns and older structures adjacent to the Project area.
Antrozous pallidus (pallid bat)	None/SSC	Found throughout California. Roosts in rock crevices, outcrops, cliffs, mines, and caves; trees (underneath exfoliating bark of pine and oak) and in basal hollows; and a variety of vacant and occupied structures (e.g., bridges) or buildings. Roost individually or in small to large colonies (hundreds of individuals).	Suitable foraging habitat throughout most of the Project area. An old hunting cabin is in the Project area.	**Moderate**: May forage in the Project area. May roost in some of the barns and older structures adjacent to the Project area

Species name	Status[1] Federal/ State	Distribution and habitat associations	Location of suitable habitat in Project area	Likelihood of occurrence
Insects				
Bombus occidentalis (Western bumble bee)	-/SCE	Forages on flowering plants in chaparral scrub, shrubby areas, open grasslands, forested openings, mountain meadows, and urban parks and gardens. Host plant genera include, but are not limited to, *Ceanothus, Centaurea, Chrysothamnus, Cirsium, Eriogonum, Geranium, Grindellia, Lupinus, Melilotus, Monardella, Rubus, Solidago,* and *Trifolium.* Nests underground in pre-existing cavities (abandoned small mammal burrows) but can also nest above ground in grass tussocks, brush piles, fallen logs, and human-made structures.	Suitable foraging and nesting habitat are present in Study area 1.	**Moderate:** May forage and nest within the grasslands and shrublands adjacent to the West Pond. The Project area is within the historic range of the species, but outside of the current range. The most recent occurrence within the Project vicinity is from 1977, six miles east of the Project area.
Bombus caliginosus (Obscure bumble bee)	-/SSC	Coastal habitats from Santa Barbabra County north to the California border, with scattered records from the east side of the Central Valley. Forages on flowering plants in grasslands, coastal scrub, open coastal prairies, and Coast Range meadows. Host plant genera include, but are not limited to, *Baccharis*, *Ceanothus*, *Cirsium*, *Clarkia*, *Grindelia*, *Keckiella*, *Lathyrus*, *Lotus*, *Lupinus*, *Phacelia*,	Suitable foraging and nesting habitat are present in Study area 1.	**Moderate:** May forage and nest within the grasslands and shrublands of the West Pond. The Project area is within the range of the species. The nearest CNDDB occurrence is within three miles of the Project area from 1976. The most recent occurrence

Species name	Status[1] Federal/ State	Distribution and habitat associations	Location of suitable habitat in Project area	Likelihood of occurrence
		Rhododendron, *Rubus*, *Trifolium*, and *Vaccinium.* Nests underground in pre-existing cavities but can also nest above ground in abandoned bird nests, grass tussocks, brush piles, fallen logs, and human-made structures.		within the Project vicinity is from 2022.

[1] Status:

Federal

FT Federal Threatened

State

ST Threatened

SSC CDFW species of special concern

(a) Less Than Significant with Mitigation Incorporated: The project will not have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status in local or regional plans, policies, or regulations, or by CDFW, National Oceanic and Atmospheric Administration (NOAA) or USFWS. All effects will be less than significant with the incorporation of the mitigation measures listed below.

Plants

No special-status plant species were observed during the protocol-level botanical survey conducted in the Project area on May 28 and July 16, 2024 (see Appendix C of BOD Report). In addition, there are no records of special-status plant occurrences within the Project area based on the 2022 CDFW CNDDB queries and collection records in the Consortium of California Herbaria (ucjeps.berkeley.edu/consortium). As such, Project activities will have no impact on known special-status plant populations. To further reduce potential impacts to special status plants, the following avoidance and minimization measures have been incorporated into the project design and construction approach:

- The ponds have been designed to minimize the Project footprint to the greatest extent possible.
- Ground disturbance and vegetation clearing and/or trimming will be confined to the minimum amount necessary to facilitate Project implementation.
- Removal of established native vegetation during construction activities will be limited to the extent possible.
- Post-construction, any temporary laydown of construction materials on native soil surfaces will be removed promptly to promote the re-establishment of any persistent native vegetation.
- Heavy equipment and vehicles will use existing access roads to the extent possible.
- Construction materials will be stored in designated staging areas.

Fish
Coho and Chinook salmon, steelhead, and Pacific lamprey are special-status fish species known to occur in Vanauken Creek both upstream and downstream from the Project area. Project-related impacts on these species could result from discharge of sediment from pond construction or the direct release of warm water from the ponds. However, based on the inclusion of cooling/filtration galleries in the project design, it is expected that coho salmon and steelhead will benefit from the flow augmentation during the summer and fall months in the downstream reaches of Vanauken Creek and the Mattole River.

The following measures will be employed by the Project to avoid, minimize, or mitigate indirect impacts on special-status fish species and their habitat. Additionally, these mitigation measures will be beneficial to amphibians residing in the downstream watercourses.

BIO-1: Discharge of sediment will be controlled and minimized with the implementation of best management practices (BMPs) on all disturbed soils that have the potential to discharge into area watercourses. Applicable BMPs include, but are not limited to, installation of silt fences, straw wattles, and placement of seed-free rice straw. BMPs will be installed at all access points to the work sites, which will minimize the potential for sediment delivery and deleterious effects on salmonids.

BIO-2: Sanctuary Forest will deploy temperature loggers upstream and downstream of each flow release site. Temperatures will be monitored twice a month during flow releases and any significant increase in temperature attributed to the project above a Maximum Weekly Average Temperature (MWAT) of 18 degrees C will result in adaptive management of the flow releases with the goal of reducing temperatures to a suitable level.

BIO-3: Following project implementation, effectiveness monitoring will be conducted for a minimum of three years to evaluate project success. If a dry year has not occurred during the first 3 years, then monitoring would be performed in the next dry year as needed to evaluate dry year effectiveness. Complete evaluation of the project will be conducted after the required monitoring has been completed in collaboration with the Technical Advisory Committee (TAC). Additional monitoring if needed, will be added. Monitoring will occur from 200 ft upstream of the most upstream point of discharge down to the confluence at the Mattole River. Wet/dry mapping will be performed 3 times per year as follows: before augmentation, once mid augmentation (~August) and once near end of augmentation (~October) to assess project effects on the amount of wetted channel. A qualified biologist will also evaluate broad-level changes in distribution and relative abundance of special status species 2 times per year, corresponding with the wet/dry mapping mid augmentation and near the end of augmentation.

BIO-4: During final design, an operations and management plan will be developed and reviewed by the TAC that further refines approaches and protocols for avoidance of impacts to special status species including a final monitoring plan. The operations and management plan will contain a decision matrix tool identifying the conditions for flow release and variations in discharge rate based on receiving water and pond conditions. This will consider impacts to special status species in the downstream watercourses as well as the proposed ponds themselves to account for amphibian species that may inhabit the ponds after they are constructed.

Amphibians

Flow augmentation associated with the Project would result in the persistence of surface flows, which may provide benefits to amphibians by maintaining and potentially expanding the amount of available habitat. No negative impacts on stream temperature are expected due to flow releases passing through an infiltration gallery and native soils prior to entering the stream. The ponds themselves may provide breeding/rearing habitat for native amphibians. Fully draining the ponds may result in mortality so the operations and management plan described above in BIO-4 should take both the downstream watercourses and ponds themselves into consideration to address potential amphibian impacts. Although no construction work is proposed within typical amphibian habitat, it is possible that some amphibians may stray into the work area.

BIO-5: The Project manager or qualified designee will conduct daily morning inspections of the area slated for work to determine if amphibians have entered the areas overnight. Any individuals will be captured and relocated prior to the start of the day's work.

BIO-6: Terrestrial woody debris will be left in place to the greatest extent practicable during operations within the riparian areas.

BIO-7: To reduce the risk of amphibian entrapment, the Project will follow the Fish Screening Criteria for Salmonids in Appendix S of the California Salmonid Stream Habitat Restoration Manual (Flosi et. al 2010), as well as NOAA Restoration Center/Army Corps of Engineers programmatic biological opinion requirements for all outflow structures.

Other Wildlife

Northern spotted owl

The closest northern spotted owl activity center to the Project is approximately 0.5 mi away from the Project area and recent surveys (i.e., within the last four years) have not documented nesting within this activity center (Appendix C of the BOD Report). Nesting habitat does not occur within the Project area but does within the adjacent forest. The Project activities do not include removal of any trees that could provide habitat for owls. Therefore, there will not be any direct impacts on northern spotted owls or their habitat. However, there is the potential for construction-related noise to affect northern spotted owls that may be on adjacent properties or away from the Project area.

The potential for Project construction to indirectly impact nesting northern spotted owls was preliminary evaluated using USFWS (2006) guidelines. Owls can be affected by noise-related, visual, or physical disturbances, such as created by heavy equipment. USFWS (2006) identifies the distance that sound associated with different types of construction equipment is estimated to disturb northern spotted owls during the breeding season, relative to ambient noise levels. Most types of standard construction equipment (e.g., backhoes, bulldozers, construction vehicles, etc.) would require disturbance buffers of 330–1,320 ft from nesting spotted owl activity centers. No Project activities utilizing these types of equipment are expected to occur within 1,320 ft of a northern spotted owl nest. In addition, as stated above, recent surveys have not found nesting northern spotted owls with the closest known activity center (0.5 mi from the Project area). Therefore, project effects on northern spotted owls would be less than significant.

BIO-8: A pre-construction nesting bird survey will be conducted during the breeding season and within two weeks of the start of construction. Appropriate buffers will be established around all active northern spotted owl nests within the Project vicinity. CDFW shall be consulted if other nests are found within trees that need to be removed as part of the project.

<u>Olive-sided flycatcher & yellow warbler</u>
Suitable habitat for olive-sided flycatcher and yellow warbler may occur within the Project area. Per BIO-8, a qualified biologist will conduct a nesting survey up to two weeks prior to any future tree removal. If no nests are observed, then operations may proceed. These surveys will be good for two weeks. If construction doesn’t begin within those two weeks, then the survey shall be repeated.

<u>Sonoma tree vole</u>
Suitable habitat for Sonoma tree voles is present in the timber stands within the Project area. The Project footprint was adjusted to avoid mature Douglas-fir trees that have a higher likelihood of providing Sonoma tree vole habitat as compared to the young trees within the pond footprint that will be removed. Therefore, impacts to Sonoma tree vole habitat is expected to be less than significant. However, to further reduce impacts, per BIO-8, a qualified biologist will conduct a nesting survey up to two weeks prior to any future tree removal. If no nests are observed, then operations may proceed. These surveys will be good for two weeks. If construction doesn’t begin within those two weeks, then the survey shall be repeated.

<u>Pallid bat & Townsend’s big-eared bat</u>
Suitable habitat for pallid bats and townsend’s big-eared bat is present in the timber stands within the Project area. The Project footprint was adjusted to avoid mature Douglas-fir trees that have a higher likelihood of providing pallid bat habitat as compared to the young trees within the pond footprint that will be removed. Therefore, impacts to bat habitat is expected to be less than significant.

<u>Pacific fisher</u>
There may be trees containing basal hollows and downed logs scattered throughout the Project area. The Project will remove some smaller, less vigorous Douglas-fir trees. However, these trees would not have the cavity characteristics necessary for fisher use. In addition, all large trees that could contain suitable habitat will be retained. Therefore, impacts to pacific fisher habitat is expected to be less than significant.

<u>Western pond turtle</u>
Turtles have been reported in the Mattole River. However, suitable habitat is lacking in Vanauken Creek due to the closed canopies that would limit the basking opportunities for turtles. In addition, water flow during the summer months is very low or intermittent, which is not the preferred habitat for turtles. In addition, no ponds are in the Project area that could contain this species. The Project does not include any instream work, so there will be no impact to turtle basking habitat. However, there is a very low potential for impacts to turtle nesting habitat. The following mitigation measure will be employed to avoid or minimize impacts to western pond turtles:

BIO-9: Prior to the initiation of any ground disturbance work, a qualified biologist will survey the site to determine presence of any turtle nests. If a nest is encountered within the project footprint, CDFW will be consulted.

<u>Western bumble bee and obscure bumble bee</u>
The Project area is within the historic range of both bumble bee species. Suitable foraging and nesting habitat is present within the grasslands and shrublands adjacent to the western pond site. Bumblebees might nest in tufts of grass, abandoned rodent holes, and/or within woody

debris. The following mitigation measure will be employed to avoid or minimize impacts to bumble bees.

BIO-10: Prior to the initiation of any vegetation removal or earthwork during the Colony Active Period, a qualified biologist will survey the site to determine the presence of western bumble bees and available nesting and foraging habitat. CDFW will be consulted if an individual or nest is found within the Project area prior to proceeding with work. If western bumble bees are not found during the focused surveys, but suitable habitat is present within the disturbance footprint and Project activities take place during the species Colony Active Period, it is recommended that a biological monitor be onsite during vegetation removal and/or initial ground disturbing activities.

<u>Bullfrogs</u>
The construction and operations of the pond has the potential to create habitat for bullfrogs and subsequently impact native species. The following avoidance and minimization measures will be incorporated in the project design, monitoring and maintenance plan. The following strategies will be implemented to minimize the potential for bullfrogs to infest the project sites:

a) Landowner and resident education is one of the most important strategies, as people have been known to intentionally introduce bullfrogs to local bodies of water as a source of food.
b) Monitoring of project sites will also be very important as early detection, before populations can get established, is a key component of control. Monitoring will be conducted as per Attachment C of this ISMND: Bullfrog Monitoring and Management Plan prepared by CDFW.
c) If needed, the off-channel pond may be drained. David Manthorne, CDFW Senior Environmental Scientist recommends draining of ponds if invasive bullfrogs are present to interrupt their life cycle (CDFW Compliance Guidance). According to research by Doubledee et al. (2007), "*Bullfrogs*, *Disturbance Regimes*, *and the Persistence of California Red-Legged Frogs* ", draining of ponds can be effective for bullfrog management if draining occurs at least every 2 years.
d) If annual monitoring shows that bullfrogs are present, active measures will be taken in consultation with CDFW and will follow the methods described in Attachment C of this ISMND.

(b) Less than Significant with Mitigation Incorporated: The project will not have a substantial adverse effect on any riparian habitat or other sensitive natural communities identified in local or regional plans, policies and regulations, or by CDFW or USFWS.

Where the sensitive natural community (Pteridium aquilinum – Grass Association) occurs, in addition to minimizing the Project's overall footprint and disturbance as described in the avoidance and minimization measures above, the following mitigation measures will be incorporated into the project to reduce impacts to a less than significant level:

BIO-11: A special-status species survey will be conducted by a qualified biologist prior to future ground disturbance activities. Special status species will be flagged and avoided to the greatest extent possible. If avoidance is not feasible, seed harvesting and/or plant salvage and relocation to a suitable site will occur.

BIO-12: Planting of seedlings for native revegetation shall begin after December 1, or when sufficient rainfall has occurred to ensure the best chance of survival of the seedlings, but in no case after April 1.

BIO-13: Disturbed and compacted areas shall be re-vegetated with a diversity of native plant species that mimics native communities. Unless otherwise specified, the standard for success is 80 percent survival of plantings or 80 percent ground cover for broadcast planting of seed after a period of 3 years.

BIO-14: To ensure that the spread or introduction of invasive exotic plants shall be avoided to the maximum extent possible, equipment shall be cleaned of all dirt, mud, and plant material prior to entering a work site. When possible, invasive exotic plants at the work site shall be removed. Areas disturbed by project activities will be restored and planted with native plants.

BIO-15: Mulching and seeding shall be done on all exposed soil which may deliver sediment to a stream. Soils exposed by project operations shall be mulched to prevent sediment runoff and transport. Mulches shall be applied so that not less than 90% of the disturbed areas are covered. All mulches, except hydro-mulch, shall be applied in a layer not less than two (2) inches deep. Where feasible, all mulches shall be kneaded or tracked-in with track marks parallel to the contour, and tackified as necessary to prevent excessive movement. All exposed soils and fills shall be reseeded with a mix of native grasses common to the area, free from seeds of noxious or invasive weed species, and applied at a rate which will ensure establishment.

BIO-16: To retain grassland habitat, Douglas-fir saplings and seedlings shall removed from within the grassland boundaries to reduce encroachment and future conversion of this sensitive natural community to Douglas-fir forest.

(c) No impact: The project will not have a substantial adverse effect on federally protected wetlands as defined by § 404 of the Clean Water Act because there are no USACE jurisdictional wetlands within the project area. Stillwater Sciences conducted a wetland assessment on May 28, 2024 and did not identify any wetlands withing the project footprint as described in Section 4 of the Biological Resources Technical Report for the project included as Appendix C of the BOD report (Attachment A of this MND). No wetlands have been identified within the Project footprint and therefore the project actions will have no effect on wetlands.

(d) Less Than Significant: The Project does not propose any instream construction in anadromous habitat so it will not directly affect migration of fish between habitat units. Once completed, the project will result in a substantial improvement in the ability of juvenile fish to migrate between habitat units during the dry season. It is expected that the flow augmentation will help maintain connectivity between habitat units that is currently lacking during dry years. Therefore, impacts to fish are less than significant.

(e) No Impact: The project will not conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance. Such an impact will not occur because project actions are designed to restore and enhance biological resources. The Humboldt County Streamside Management Area Ordinance requires a Special Permit (SP) for all activities within Streamside Management Areas. This project includes the approval of a SP.

(f) No Impact: The project will not conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or State habitat conservation plan. Such a conflict will not occur because the project restoration actions will not have a significant adverse impact on any species or habitat. Project actions are designed to restore the natural character of the fish and wildlife habitat at the project work sites. The project specifically supports the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act (Fish and Game Code § 6900 et. seq.).

5. Cultural Resources. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?		X		
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?		X		
c) Disturb any human remains, including those interred outside of formal cemeteries?		X		

Discussion:

(a) Less Than Significant with Mitigation Incorporated: The project will not cause a substantial adverse change in the significance of a historical resource as defined in CEQA Guidelines § 15064.5.

No resources were identified during site-specific surveys. However, ground disturbance will be required to implement the project at some work sites that could still have the potential to affect historical resources that weren't identified during the site-specific surveys. This potential impact will be minimized to a less than significant level through implementation of the protective measures presented below and in the Project's Cultural Resources Report (Attachment D of this MND). As a result, any potentially significant impacts will be avoided or mitigated to below a level of significance.

CR-1: Inadvertent Discovery of Cultural Resources - If cultural resources are encountered during construction activities, all onsite work shall cease in the immediate area and within a 50-foot buffer of the discovery location. A qualified archaeologist will be retained to evaluate and assess the significance of the discovery, and develop and implement an avoidance or mitigation plan, as appropriate. For discoveries known or likely to be associated with Native American heritage (prehistoric sites and select historic period sites), the tribes listed in Section 6.2 and those that the County has on file shall also be contacted immediately to evaluate the discovery and, in consultation with the project proponent, the County, and consulting archaeologist, develop a treatment plan in any instance where significant impacts cannot be avoided. Prehistoric materials which could be encountered include obsidian and chert debitage or formal tools, grinding implements, (e.g., pestles, handstones, bowl mortars, slabs), locally darkened midden, deposits of shell, faunal remains, and human burials. Historic archaeological discoveries may include nineteenth century building foundations, structural remains, or concentrations of artifacts made of glass, ceramics, metal or other materials found in buried pits, wells or privies.

(b) Less Than Significant with Mitigation Incorporated: The project will not cause a substantial adverse change in the significance of an archaeological resource pursuant to CEQA Guidelines § 15064.5. While ground disturbance will be required to implement the project at some work sites that have the potential to affect archaeological resources, this potential impact will be avoided through implementation of the protective measures described above and presented in the Project's Cultural Resources Report (Attachment D of this MND). As a result, mitigation measures will ensure that any potentially significant impacts are avoided or mitigated to below a level of significance.

(c) Less Than Significant with Mitigation Incorporated: The project is highly unlikely to disturb any human remains, including those interred outside of formal cemeteries. While ground disturbance will be required to implement the project at some work sites that have the potential to affect these resources, this potential impact will be avoided through implementation of the protective measures presented in the Project's Cultural Resources Report. An archeological monitor will be present during excavation in critical areas.

CR-2: Inadvertent Discovery of Human Remains - If human remains are discovered during project construction, work shall stop at the discovery location, within 20 meters (66 feet), and any nearby area reasonably suspected to overlie adjacent human remains (Public Resources Code, Section 7050.5). The county coroner shall be contacted to determine if the cause of death must be investigated. If the coroner determines that the remains are of Native American origin, it is necessary to comply with state laws relating to the disposition of Native American burials, which fall within the jurisdiction of the Native American heritage Commission (NAHC) (Public Resources Code, Section 5097). The coroner will contact the NAHC. The descendants or most likely descendants of the deceased will be contacted, and work shall not resume until they have made a recommendation to the landowner or the person responsible for the excavation work for means of treatment and disposition, with appropriate dignity, of the human remains and any associated grave goods, as provided in Public Resources Code, Section 5097.98.

CR-3: Procedures for treatment of an inadvertent discovery of human remains:

a) Immediately following discovery of known or potential human remains all ground-disturbing activities at the point of discovery shall be halted.

b) No material remains shall be removed from the discovery site, a reasonable exclusion zone shall be cordoned off.

c) The property owner shall be notified and the Permittee Project Manager shall contact the county coroner.

d) The Permittee shall retain the services of a professional archaeologist to immediately examine the find and assist the process.

e) All ground-disturbing construction activities in the discovery site exclusion area shall be suspended.

f) The discovery site shall be secured to protect the remains from desecration or disturbance, with 24-hour surveillance, if prudent.

g) Discovery of Native American remains is a very sensitive issue, and all project personnel shall hold any information about such a discovery in confidence and divulge it only on a need-to-know basis, as determined by the CDFW.

h) The coroner has two working days to examine the remains after being notified. If the remains are Native American, the coroner has 24 hours to notify the NAHC in Sacramento (telephone 916/653-4082).

i) The NAHC is responsible for identifying and immediately notifying the Most Likely Descendant (MLD) of the deceased Native American.

j) The MLD may, with the permission of the landowner, or their representative, inspect the site of the discovered Native American remains and may recommend to the landowner and

Permittee means for treating or disposing, with appropriate dignity, the human remains and any associated grave goods. The descendants shall complete their inspection and make recommendations or preferences for treatment within 48 hours of being granted access to the site (Public Resource Code, Section 5097.98(a)). The recommendation may include the scientific removal and non-destructive or destructive analysis of human remains and items associated with Native American burials.

k) Whenever the NAHC is unable to identify a MLD, or the MLD identified fails to make a recommendation, or the landowner or his/her authorized representative rejects the recommendation of the MLD and mediation between the parties by the NAHC fails to provide measures acceptable to the landowner, the landowner or his/her authorized representatives shall re-inter the human remains and associated grave offerings with appropriate dignity on the property in a location not subject to further subsurface disturbance in accordance with Public Resource Code, Section 5097.98(e).

l) Following final treatment measures, the Permittee shall ensure that a report is prepared that describes the circumstances, nature and location of the discovery, its treatment, including results of analysis (if permitted), and final disposition, including a confidential map showing the reburial location. Appended to the report shall be a formal record about the discovery site prepared to current California standards on DPR 523 form(s). Permittee shall ensure that report copies are distributed to the appropriate California Historic Information Center, NAHC, and MLD.

6. Energy. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?			X	
b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?				X

Discussion:

(a) Less Than Significant: The Project will not result in wasteful, inefficient, or unnecessary consumption or energy resources during construction or operations. The construction contractors will be using heavy equipment as effectively as possible to reduce fuel and labor costs and generation of greenhouse gasses. In addition, Project operations will be powered by an off-grid solar power system that will be sized appropriately. The project will not include any generator use.

(b) No impact: The Project will not conflict with or obstruct a state or local plan for renewable energy or energy efficiency. The Project includes the installation of an off-grid energy system.

7. Geology and Soils. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.				X
ii) Strong seismic ground shaking?				X
iii) Seismic-related ground failure, including liquefaction?			X	
iv) Landslides?			X	
b) Result in substantial soil erosion or the loss of topsoil?		X		
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?			X	
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?			X	
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?				X
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?		X		

Discussion:

(a) No Impact and Less Than Significant Impact:

(i) The project site is not located in an Earthquake Fault Zone (CGS 2018). The nearest active fault is the San Andreas fault, which is approximately 6 miles west of the project site. Therefore, there would be no impact.

(ii) The project would not result in strong seismic ground shaking or involve construction of features that would be at risk of structural failure due to strong seismic ground shaking. Therefore, there would be no impact.

(iii) Based on the geologic setting and results from the geophysical investigation (Appendix B of the BOD Report), the materials comprising the proposed pond site have low potential for liquefaction under sustained ground shaking. No human habitation structures are being proposed on these sites. Therefore, there would be a less than significant impact.

(iv) The proposed pond site is located within an alluvial terrace setting with gentle topography and therefore mass wasting is unlikely. In addition, the pond design contains multiple safety features as described in the BOD Report that would further limit the potential for failure. Therefore, there would be a less than significant impact.

(b) Less Than Significant Impact with Mitigation Incorporated: The project will not result in substantial soil erosion or the loss of topsoil. Such an impact will not occur because the Project is designed based on Best Management Practices (BMPs). Existing roads will be used to access work sites wherever possible. The potential for substantial soil loss associated with pond construction will be avoided through implementation of the design features described in the BOD report and mitigation measures below.

GEO-1: Work sites shall be winterized at the end of each day during the work period when rainfall greater than 1/2 inch is forecasted to minimize the eroding of unfinished excavations. Winterization procedures shall be supervised by a professional trained in erosion control techniques and involve taking necessary measures to minimize erosion on unfinished work surfaces. Winterization includes the following: smoothing unfinished surfaces to allow water to freely drain across them without concentration or ponding; compacting unfinished surfaces where concentrated runoff may flow with an excavator bucket or similar tool, to minimize surface erosion and the formation of rills; and installation of culverts, silt fences, and other erosion control devices where necessary to convey concentrated water across unfinished surfaces, and trap exposed sediment before it leaves the work site.

GEO-2: Effective erosion control measures shall be in-place at all times during construction. Construction shall not begin until all temporary erosion controls (i.e., straw bales or silt fences that are effectively keyed-in) are in place down slope or down stream of project activities within the riparian area. Erosion control measures shall be maintained throughout the construction period. If continued erosion is likely to occur after construction is completed, then appropriate erosion prevention measures shall be implemented and maintained until erosion has subsided.

GEO-3: An adequate supply of erosion control materials (gravel, straw bales, shovels, etc.) shall be maintained onsite to facilitate a quick response to unanticipated storm events or emergencies.

GEO-4: Upon project completion, all exposed soil present in and around the project site shall be stabilized within 7 days. Soils exposed by project operations shall be mulched to prevent sediment runoff and transport. Mulches shall be applied so that not less than 90% of the disturbed areas are covered. All mulches, except hydro-mulch, shall be applied in a layer not less than two (2) inches deep. Where feasible, all mulches shall be kneaded or tracked-in with track marks parallel to the contour, and tackified as necessary to prevent excessive movement. All exposed soils and fills, including the downstream face of the road prism adjacent to the outlet of culverts, shall be reseeded with a mix of native grasses common to the area, free from seeds of noxious or invasive weed species, and applied at a rate which will ensure establishment.

(c) Less Than Significant impact: To minimize the risk of the project interacting with or creating geologic instabilities, a geomorphic assessment of the greater project area was conducted. Geomorphic mapping did not identify any landslides within the project vicinity. Additionally, best practices for construction will be maintained, including adherence to detailed compaction specifications as well as construction oversight by senior geology and engineering staff.

(d) Less Than Significant Impact: Expansive soils shrink and swell in response to soil moisture levels and generally have a large clay component. The geotechnical investigation suggests that there are clay soils onsite that have low to medium plasticity and have a potential for expansion and contraction. This project proposes earthen fills and hydraulic appurtenances that will be designed to withstand soil expansion and contraction. In addition, the engineered fills will meet compaction standards and a High-density Polyethylene (HDPE) liner is proposed to reduce risks associated with expansive soil. Therefore, the potential for substantial direct or indirect risks to life or property from this project being located on expansive soils is less than significant.

(e) No Impact: The project will not create any sources of wastewater requiring a septic system.

(f) Less Than Significant Impact With Mitigation Incorporated: There are no unique paleontological resources or sites or unique geologic features known to occur within the Project vicinity. However, if such features are discovered during construction, impacts will be reduced to a less than significant level by following mitigation measure below.

GEO-5: Inadvertent Discovery of Unique Paleontological Resources or Unique Geologic Features – If unique paleontological resources or unique geologic features are discovered during project construction, work shall stop at the discovery location, within 20 meters (66 feet), and any nearby area reasonably suspected to overlie the features. State laws relating to such discoveries will be followed to document findings and work will only proceed after authorization by all relevant jurisdictions.

8. Greenhouse Gas Emissions. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?			X	
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?				X

Discussion:

(a) Less Than Significant Impact: The project will emit greenhouse gases (GHG) primarily through the burning of fuel to operate vehicles and heavy equipment during the construction phase of the project.

Construction and operational emissions were estimated using the CalEEMod (version 2016.3.2). CalEEMod is a statewide land use emissions computer model designed to provide a uniform platform for government agencies, land use planners, and environmental professionals to quantify potential criteria pollutant and GHG emissions associated with both construction and operation of a variety of land use projects. The model quantifies direct emissions from construction and operations (including vehicle use), as well as indirect emissions, such as GHG emissions from energy use, solid waste disposal, vegetation planting and/or removal, and water use.

The model was developed in collaboration with the air districts in California. Default data (emission factors, trip lengths, meteorology, source inventory, etc.) have been provided by the various California air districts to account for local requirements and conditions. The model is an accurate and comprehensive tool for quantifying air quality impacts from land use projects throughout California. The model can be used for a variety of situations where an air quality analysis is necessary or desirable such as CEQA documents. Input data and full results from CalEEMod is included in Attachment B of this MND.

The North Coast Unified Air Quality Management District (NCUAQMD) has not identified or recommended any GHG standards or thresholds of significance for the evaluation of construction projects. NCUAQMD has issued a rule stating that stationary sources emitting less than 25,000 tons per year of CO2 equivalent are exempt from compliance determination. Utilizing stationary source compliance rules is not recommended for the evaluation of projects subject to CEQA review and therefore we look to other jurisdictions that have developed thresholds, namely other California air districts, to show the emissions associated with this project in a state-wide context. These thresholds are as follows:

- South Coast Air Quality Management District (SCAQMD): SCAQMD's GHG Working Group has proposed a significance screening level of 3,000 metric tons CO2 equivalent (MT CO2e) per year for residential and commercial projects (SCAQMD 2015).
- Bay Area Air Quality Management District (BAAQMD) has adopted a project-level, operational threshold of significance that requires compliance with a qualified GHG reduction strategy or similar plan, maximum annual emissions of 1,100 MT CO2e per year or less, or achievement of a GHG efficiency rate of no more than 4.6 MT CO2e per

service population per year (BAAQMD 2017). BAAQMD has not adopted a project-level threshold of significance for construction-related GHG emissions.

- Sacramento Metro Air Quality Management District (SMAQMD) has adopted construction and operational GHG thresholds of 1,100 MT CO2e per year for land development and construction projects (SMAQMD 2015).

In the absence of NCUAQMD thresholds, the GHG emissions from this project will be compared to the SMAQMD threshold of 1,100 MT CO2e per year for construction emissions. This is because the SMAQMD has updated their guideline to account for the SB 32 2030 targets for GHG emissions. While utilized for comparative purposes, the significance of the project's potential impact is ultimately based on its long-term interaction with the state's GHG reduction goals as stated in California Air Resources Board's (CARB) 2017 Scoping Plan.

When considering the project's long-term interaction with the state's GHG reduction goals, it is critical to consider the increasing contribution that wildfires have on California's greenhouse gas emissions. Between January 1, and September 18, 2020, fires in California burned through 3.4 million acres and generated an estimated 91 million MT CO2e, or ~26.8 MT CO2e per acre burned (Alberts 2020). These emissions are 25% more than California's annual emissions from fossil fuels. Considering that wildfires are becoming a major source of GHG emissions, this project will almost certainly result in a net reduction of GHG emissions over the life of the project due to the project's secondary objective of providing long-term water supply for fire suppression.

The project would emit GHG emissions during construction from off-road equipment, worker vehicles, and any hauling that may occur. Construction emissions would be generated from the exhaust of equipment, the exhaust of construction hauling trips, and worker commuter trips. The construction phases include site preparation, site grading, and other construction activities. CalEEMod inputs and results are included as Attachment B of this MND. Note that the CalEEMod analyses was conducted for a similar nearby project design estimating 713 MT CO2e for a 15.3-million-gallon storage project. Considering that this project includes ~6-million-gallons of storage, it has an estimated CO2e of 285 MT based on a proportional emission reduction-based project size. The estimated emissions of 285 MT CO2e are below the SMAQMD construction threshold of 1,100 MT CO2e per year.

Based on the current project design, there will be no long term GHG emissions because all energy use will be offset by solar energy generation.

In summary, GHGs emitted by this proposed project fall below typical state thresholds for construction projects. Additionally, long term GHG emission from fire suppression benefits are likely to far offset the construction GHG emissions. In addition to providing streamflow augmentation, the pond is expected to be used to combat wildfires by providing a water source for CalFire. Based on estimated GHG emission from 2020 wildfires in CA (Alberts 2020), 26.8 MT CO2e per acre burned were produced by the fires. Therefore, the project will offset the construction related GHG emission if it prevents approximately 11 acres of wildfire. Based on fire history and climatic trends, it is highly likely that this project will help prevent far greater than 11 acres of wildfire over the 50+ year lifespan of the project. Based on these factors, the project-generated GHG emissions will have a less than significant impact on the environment.

(b) No impact: The project will not conflict with any applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases. GHG emissions in

California are regulated under several state-wide measures, most prominently the California Global Warming Solutions Act of 2006, widely known as Assembly Bill (AB) 32, which requires the CARB to develop and enforce regulations for the reporting and verification of statewide GHG emissions and sets limits on state emissions with a mandate to reduce GHG emissions to 1990 levels by 2020. AB 32 has been followed up by additional legislation and orders mandating efficiency-based thresholds:

- SB 32 requires statewide GHG emissions to 40 percent below 1990 levels by 2030
- B-30-15 provides an interim 2030 goal with the ultimate goal of reducing emissions by 80 percent below 1990 levels by 2050. The B-30-15 interim 2030 emission reduction goal is consistent with SB 32 and represents 'substantial progress' towards the 2050 emissions reduction goal.
- EO S-03-05 directs the state to reduce GHG emissions to 80 percent below 1990 levels by 2050.

Locally, the NCUAQMD maintains air quality conditions in Humboldt County and administers a series of air pollution reduction programs, including open burning permits, grants, permitting of stationary sources, emission inventory and air quality monitoring, and planning and rule development. The NCUAQMD adopted Rule 111 in 2015, which evaluates stationary sources subject to NSR and Title V permitting. Pursuant to Rule 111, stationary sources emitting less than 25,000 tons per year of CO2 equivalent are exempt from compliance determination.

The Humboldt County General Plan commits to actions to further reduce countywide GHG emissions. The County, in cooperation with all the cities, is currently preparing a regional Climate Action Plan (CAP). Although not yet finalized, the regional CAP targets GHG emission reduction of 40 percent below 1990 levels by 2030 and net zero emissions by 2045.As previously described, this project will generate GHG emissions during the construction phase, but all long-term operational energy use will be powered and/or offset by renewable energy. Furthermore, the project will provide a dry season water source to combat wildfires in the region which is expected to offset the construction GHG emissions. In summary, this project does not conflict with any plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases.

9. Hazards and Hazardous Materials. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?		X		
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?		X		
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?				X
d) Be located on a site which is included on a list of hazardous materials sites complied pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?				X
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?				X
f) Impair implementation of, or physically interfere with an adopted emergency response plan or emergency evacuation plan?				X
g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury or death involving wildland fires?		X		

Discussion:

(a-b) Less Than Significant with Mitigation Incorporated: The project will not create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials. The only hazardous materials that would be used on site are fuels, lube oil, coolant, and hydraulic fluid associated with heavy equipment used for the construction phase of the project. Any potential significant hazard associated with the accidental release of petroleum and coolant products used with equipment during construction will be minimized through implementation of the mitigation measures below. As a result, mitigation measures will ensure that any potentially significant impacts are avoided or mitigated to below a level of significance.

HAZ-1: Heavy equipment that will be used in these activities will be in good condition and will be inspected for leakage of coolant and petroleum products and repaired, if necessary, before work is started.

HAZ-2: When operating vehicles within or adjacent to riparian vegetation, the responsible party shall, at a minimum, do the following:

a) All equipment shall be cleaned to remove external oil, grease, dirt, or mud. Wash sites shall be located in upland locations so that dirty wash water does not flow into riparian areas;
b) Check and maintain daily any vehicles to prevent leaks of materials that, if introduced to water, could be deleterious to aquatic life, wildlife, or riparian habitat.

HAZ-3: All equipment operators shall be trained in the procedures to be taken should an accident occur. Prior to the onset of work, the Permittee shall prepare a Spill Prevention/Response plan to help avoid spills and allow a prompt and effective response should an accidental spill occur. All workers shall be informed of the importance of preventing spills. Operators shall have spill clean-up supplies on site and be knowledgeable in their proper deployment.

HAZ-4: Absorbent materials designed to clean up leaks of hydraulic fluid and other contaminants will be stored in the cab of all heavy equipment operating in or near a stream to provide spill containment and cleanup in case of an accidental spill. In the event of a spill, work shall cease immediately. Clean-up of all spills shall begin immediately. The responsible party shall notify the State Office of Emergency Services at 1-800-852-7550 and the CDFW immediately after any spill occurs and shall consult with the CDFW regarding clean-up procedures.

HAZ-5: All fueling and maintenance of vehicles and other equipment and staging areas shall occur at least 65 feet from any riparian habitat or water body and place fuel absorbent mats under pump while fueling. The USACE and the CDFW will ensure contamination of habitat does not occur during such operations. Prior to the onset of work, the Permittee shall prepare a plan to allow a prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur.

HAZ-6: Location of staging/storage areas for equipment, materials, fuels, lubricants, and solvents, will be located outside of the streams high water channel and associated riparian area. The number of access routes, number and size of staging areas, and the total area of the work site's activity shall be limited to the minimum necessary to complete the restoration action. To avoid contamination of habitat during restoration activities, trash will be contained, removed, and disposed of throughout the project.

HAZ-7: Petroleum products, fresh cement/concrete, and other deleterious materials shall not enter the stream channel.

HAZ-8: Stationary equipment such as motors, pumps, generators, compressors, and welders, located within the dry portion of the stream channel or adjacent to the stream, will be positioned over drip-pans.

(c) No Impact: The project will not emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school. Such impact is avoided because the project will not create any feature that will emit hazardous substances.

(d) No Impact: The project worksites are not located on any site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5**.**

(e) No Impact: No project work site is located within an airport land use plan or within two miles of a public airport or public use airport.

(f) No Impact: The project will not impair implementation of, or physically interfere with, an adopted emergency response plan or emergency evacuation plan. The project has no effect on access. The project will include installation of firefighting infrastructure including a pond suitable for helicopters and ground-based water withdrawals.

(g) Less Than Significant with Mitigation Incorporated: The project will not expose people or structures directly or indirectly to a significant risk of loss, injury, or death involving wild land fires. At work sites requiring the use of heavy equipment, there is a small risk of an accidental spark from equipment igniting a fire. Firefighting equipment (bulldozer, excavator, fire extinguishers, and hand tools) will be on site during construction. The project's pond will be suitable and available for use by helicopter or ground-based firefighting efforts. The potential for accidental fire will be reduced to a less than significant level through implementation of the project design and mitigation measures presented in this MND.

HAZ-9: All internal combustion engines shall be fitted with spark arrestors.

HAZ-10: The Permittee shall always have an appropriate fire extinguisher(s) and firefighting tools (shovel and axe at a minimum) present when there is a risk of fire.

HAZ-11: Vehicles shall not be parked in tall grass or any other location where heat from the exhaust system could ignite a fire.

HAZ-12: The Permitee shall follow any additional rules the landowner has for fire prevention.

10. Hydrology and Water Quality. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality?		X		
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?			X	
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner, which would:				
(i) result in substantial erosion or siltation on- or off-site;		X		
(ii) substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite;			X	
(iii) create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or			X	
(iv) impede or redirect flood flows?			X	
d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?			X	
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?			X	

Discussion:

(a) Less Than Significant with Mitigation Incorporated: The Mattole River watershed has a total maximum daily load (TMDL) established for water temperature and sediment. There is the potential for minor short-term increase in turbidity during construction. The goal of the project is to increase water quantity and improve water quality in the dry season by adding cool water from the off-stream pond to Vanauken Creek. Impacts on water quality and temperature are anticipated to be less than significant because of the use of infiltration/cooling galleries, which will work similarly to a septic system, and allow cool and clean water to seep towards the stream through natural subsurface flow paths.

Close collaboration with regulatory agency staff and project Technical Advisory Committee during the final design, permitting, and implementation phases of the project will also ensure that downstream impacts are avoided. Adaptive management during project operations will be guided by monitoring results to further ensure that downstream impacts are avoided or mitigated to below a level of significance as described in **HYD-1**.

HYD-1: Project operations will be adaptively managed based on flow, temperature and aquatic habitat monitoring results. In coordination with the TAC, the project team will adapt project operations as necessary to optimize aquatic habitat benefits resulting from the project while reducing impacts to a less than significant level. This may include changes to flow release timing/rates and/or other changes to project operations.

(b) Less Than Significant: The project will not substantially deplete groundwater supplies, interfere substantially with groundwater recharge, or impede sustainable groundwater management in the basin. This is because the project site is underlain by the Coastal terrane bedrock of the Franciscan Complex Coastal Belt, with minimal groundwater recharge potential. In addition, the project is located in an area that was determined to be of low priority by the California Department of Water Resources for the development of a sustainable groundwater management plan. However, there is localized shallow groundwater that is perched on top of the Coastal terrane bedrock. The project is expected to result in changes to the dynamics of this existing shallow groundwater within the project vicinity because construction of the pond will reduce the ground surface area that recharges the shallow groundwater. Based on groundwater well monitoring at other nearby projects (Stillwater Sciences 2021), most of the water stored in the shallow groundwater aquifer drains within a few weeks following significant precipitation. Therefore, there are no groundwater wells or other existing land uses that rely on this shallow aquifer. It is also important to consider the objective of this project is to provide a significant benefit to riparian and aquatic habitat along Vanauken Creek and its tributaries. Based on these considerations, the project impacts on local groundwater will be less than significant.

(c) the project would not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river.

> **(i) Less Than Significant with Mitigation:** The project would not result in substantial erosion or siltation on- or off-site. Such an impact will not occur because the road crossing upgrade component of the project will decrease overall erosion and sediment delivery. Further, the erosion control mitigation measures (**GEO 1–4**) described above will assure that all project actions, including construction activities, are in compliance with water quality standards, which would reduce impacts to a less than significant level.
>
> **(ii) Less Than Significant:** The project will not significantly alter the existing drainage pattern of the work sites, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on- or off-site. The project will capture wet-season runoff in the pond. The construction of the proposed pond and associated infrastructure could result in an increased flood risk if the pond suffers a catastrophic failure. However, the project is designed to minimize such a failure by being located within a geologically stable setting, having an armored outflow structure, and HDPE liner. These design features would reduce the potential for failure and associated downstream flood risk to a less than significant level.
>
> **(iii) Less Than Significant:** The project will not create or contribute runoff water that would exceed the capacity of existing or planned storm-water drainage systems, or provide substantial additional sources of polluted runoff. The project is expected to reduce overall storm water runoff through capture of wet-season runoff and release of stored water during the dry season to improve instream habitat. Therefore, this impact would be less than significant.
>
> **(iv) Less Than Significant:** The project will not place structures within a 100-year flood hazard area, which would significantly impede or redirect flood flows. The pond is

outside of the 100-year floodplain as shown in hydraulic modeling described in Section 7.4 of BOD (Attachment A)

(d) Less Than Significant: The project is not located in tsunami, or seiche zones. While the project lies partially within a flood zone mapped by FEMA, site-specific hydraulic modeling in HEC-RAS conducted by Stillwater Sciences (Section 7.4 of BOD) shows that all project components (pond, fill areas, and electrical/plumbing components) are well outside of the 100-year flood zone. As such, the risk of release of pollutants due to inundation of the project is less than significant.

(e) Less Than significant: The project is in a basin that was determined to be of low priority by the California Department of Water Resources for the development of a sustainable groundwater management plan. Therefore, there is no sustainable groundwater management plan for this basin. The project will not conflict with or obstruct the implementation of a water quality control plan.

11. Land Use and Planning. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Physically divide an established community?				X
b) Cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?				X

Discussion:

(a) No Impact: The project will not physically divide an established community. This impact will not occur because the project is being entirely conducted on a single private property, outside of the public viewshed.

(b) No Impact: The activities that compose this project do not conflict with any applicable land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect. Such an impact will not occur because the project's activities are designed to be consistent with the County's General Plan Water Resources element goals and policies WR-G2, WR-G9, WR-P23, WR-P25, and WR-IMP19.

WR-G2 - Water Resource Habitat. River and stream habitat supporting the recovery and continued viability of wild, native salmonid and other abundant coldwater fish populations supporting a thriving commercial, sport, and tribal fishery.

Relevant project actions: Deliver cool water to Vanauken Creek during the summer low flow period, which will improve dry season survivability of juvenile anadromous salmonids.

WR-G9 - Restored Water Quality and Watersheds. All water bodies de-listed and watersheds restored, providing high quality habitat and a full range of beneficial uses and ecosystem services.

Relevant project actions: Vanauken Creek currently experiences low flows during the summer and early fall months. Flow augmentation from the Project will improve instream habitat quality and anadromous salmonid rearing habitat.

WR-P23 - Watershed and Community Based Efforts. Support the efforts of local community watershed groups to protect, restore, and monitor water resources and work with local groups to ensure decisions and programs consider local priorities and needs.

Relevant project actions: The Project is a collaboration of Sanctuary Forest, Lost Coast Forestlands, and state agencies with the goal of restoring cool water flow to Vanauken Creek during the summer dry season.

WR-P25 - State and Federal Watershed Initiatives. Support implementation of state and federal watershed initiatives such as the TMDLs, the NCRWQCB Watershed Management Initiative, the NMFS and CDFW coho recovery plans and the California Non-Point Source Program Plan.

Relevant project actions: The Project addresses the goals of the California Water Action Plan (SWRCB 2019), Goal B of the WCB strategic plan (WCB 2014), Goal 2 of the State Wildlife Action

Plan (CDFW 2015), and host of NOAA Fisheries' recovery actions for coho salmon in the Mattole River. See below for additional details regarding these goals.

WR-IMP19 - Coordinate and Support Watershed Efforts. Seek funding and work with land and water management agencies, community-based watershed restoration groups, and private property owners to implement programs for maintaining and improving watershed conditions that contribute to improved water quality and supply.

Relevant project actions: The Project is a collaboration of Sanctuary Forest, Lost Coast Forestlands, and state agencies. Funding for the Project planning, design and preliminary permitting was funded by DWR Drought Relief program. This Project is part of a comprehensive multipronged approach by Sanctuary Forest to restore instream flows and fisheries in the Mattole River headwaters.

Additionally, as previously discussed, this project was specifically designed to directly address the goals of the California Water Action Plan (SWRCB 2019) and will ensure the restoration of critically important habitat. The project also addresses Goal B of the WCB strategic plan (WCB, 2014). The Project also aligns with Goal 2 of the State Wildlife Action Plan (CDFW 2015) – Enhance Ecosystem Conditions, and Goal 3 – Enhance Ecosystem Functions and Processes: Maintain and improve ecological conditions vital for sustaining ecosystems in California. Most specifically, the project improves the hydrologic regime and increases water quantity and availability vital for sustaining ecosystems.

12. Mineral Resources. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?				X
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?				X

Discussion:

(a) No Impact: The project will not result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state. Such an impact will not occur because no valuable mineral resources are known to exist at the project site.

(b) No Impact: The project will not result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan. Such an impact will not occur because no mineral resource recovery sites occur at the project site.

13. Noise. Would the project result in:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?		X		
b) Generation of excessive ground-borne vibration or ground-borne noise levels?				X
c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?			X	

Discussion:

(a) Less Than Significant with Mitigation Incorporated: The project will not result in significant exposure of persons to, or generation of noise levels in excess of, standards established in the local general plan or noise ordinance, or applicable standards of other agencies. There will be a temporary increase in noise levels at those work sites requiring the use of heavy equipment. It is expected that the highest noise levels would be about 88 dB at 50 ft and would come from bulldozers. However, noise attenuation is expected to be about 7.5 dB per doubling of distance from the source. The nearest residence is approximately 2,400 feet from the edge of the work area. Therefore, it is estimated that the noise level received by the nearby residence would be below 50 dB. Following construction, project operations will utilize a small pump, but it will not generate excessive noise.

The project will include several mitigation measures to reduce construction noise impacts to a less than significant level. Operational noise will constitute a less than significant impact. Mitigation measures for construction noise include:

NOISE 1: To reduce the possibility of the construction noise and vibrations becoming an annoyance to sensitive receptors near the Project, exterior construction activity shall be confined to the weekday hours of 7:00 am to 7:00 pm or until sunset, whichever is later, and weekend hours of 8:00 am to 6:00 pm or until sunset, whichever is later. No heavy equipment construction activities shall be allowed on Sundays or holidays.

NOISE 2: Construction equipment shall be properly maintained and equipped with noise control devices, such as mufflers and shrouds, in accordance with manufacturers' specifications.

(b) No Impact: The project will not result in exposure of persons to, or generation of, excessive ground-borne vibration or ground-borne noise levels. Such an impact will not occur because only minor amounts of ground-borne vibration or noise will be generated in the short-term at those work sites requiring the use of heavy equipment.

(c) Less Than Significant: None of the project work sites are located within two miles of a public airport or public use airport. The nearest private airstrip is located approximately 4200 feet south of the project site. It is expected that the highest noise levels would be about 88 dB at 50 ft and would come from bulldozers. However, noise attenuation is expected to be about 7.5 dB per doubling of distance from the source. Therefore, it is estimated that the noise level received by private airstrip would be well below 50 dB.

14. Population and Housing. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Induce substantial population growth in an area, either directly (e.g., by proposing new homes and/or businesses) or indirectly (e.g., through extension of roads or other infrastructure)?				X
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?				X

Discussion:

(a) No Impact: The project will not induce substantial population growth in an area, either directly or indirectly. Such an impact will not occur because the project will not construct any new homes, businesses, roads, or other infrastructure related to human habitation.

(b) No Impact: The project will not displace any existing people or housing and will not necessitate the construction of replacement housing elsewhere.

15. Public Services. Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Fire protection?				X
b) Police protection?				X
c) Schools?				X
d) Parks?				X
e) Other public facilities?				X

Discussion:

(a-e) No Impact: The project will not have any significant environmental impacts associated with new or physically altered governmental facilities. Issuance of restoration grants to government agencies could, in some cases, lead to minor increases in staffing to complete projects. Such increases will not lead to any significant adverse impacts, because the increases are short term, and no significant construction will be required to accommodate additional staff.

16. Recreation.	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?				X
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?				X

Discussion:

(a) No Impact: The project would not increase the use of existing neighborhood and regional parks, or other recreational facilities. Such an impact will not occur because the project actions will restore anadromous fish habitat and do not significantly alter human use or facilities at existing parks or recreational facilities. Overall, the project is expected to increase recreation opportunities by assisting in restoring populations of anadromous fish.

(b) No Impact: The project does not include recreational facilities and does not require the construction or expansion of recreational facilities.

17. Tribal Cultural Resources. Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resource Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resource Code section 5020.1(k), or		X		
b) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.		X		

Discussion:
(a and b) Less Than Significant with Mitigation Incorporated: The project will not cause a substantial adverse change in the significance of a tribal cultural resource as defined Public Resource Code Section 5020.1(k) or Section 5024.1. No resources were identified during site-specific surveys. However, ground disturbance will be required to implement the project at some work sites that could still have the potential to affect cultural resources that weren't identified during the site-specific surveys. This potential impact will be minimized to a less than significant level through implementation of the protective measures CR-1 through CR-3 described above and the Cultural Resources Report (Attachment D of this MND). As a result, any potentially significant impacts will be avoided or mitigated to below a level of significance.

18. Transportation. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Conflict with an applicable plan, ordinance or policy addressing the circulation system including transit, roadway, bicycle and pedestrian facilities?				X
b) Conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?				X
c) Substantially increase hazards due to design features (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?				X
d) Result in inadequate emergency access?				X

Discussion:

(a) No Impact: The project will not conflict with any applicable plans, ordinances or policies that address the circulation systems, transit, roadway, bicycle, and pedestrian facilities in or around the project area.

(b) No Impact: Construction of the proposed project would not directly impact any roadways. During the construction phase which is expected to last approximately 4 months, approximately 20 trips per day by workers and equipment/materials delivery will utilize Briceland-Thorn Road. However, these trips would be small compared to existing traffic and would not lead to a significant increase in roadway congestion. Long-term operations and maintenance requirements are minimal (approximately one trip per month) so any long-term traffic volume increase resulting from the project would be negligible. Therefore, the project will not conflict, either individually or cumulatively, with CEQA Guidelines section 15064.3, subdivision (b).

(c) No Impact: The project does not involve any design features that will increase hazards on roadways in the vicinity.

(d) No Impact: The project will not result in inadequate emergency access. The pond would be an available water source for helicopter bucket dipping in the event of a wildfire.

19. Utilities and Service Systems. Would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Require or result in the relocation or construction of new expanded water or wastewater treatment or stormwater drainage, electric power, natural gas, or telecommunications facilities or expansion of existing facilities, the construction or relocation of which could cause significant environmental effects?		X		
b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years?			X	
c) Result in a determination by the wastewater treatment provider, which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?				X
d) Generate solid waste in excess of State or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?				X
e) Comply with federal, state, and local management and reduction statutes and regulations related to solid waste?				X

Discussion:

(a) Less Than Significant with Mitigation Incorporated: The project does not involve relocation or construction of new expanded water or wastewater treatment or stormwater drainage, natural gas, or telecommunications facilities or expansion of existing facilities. The project will construct a facility to store water during the wet season and release water during the dry season to enhance aquatic habitat, so the project is not expected to cause significant negative environmental impacts. The project also includes construction and operation of small-scale solar energy system for operational energy use. Impacts that could occur during installation will be primarily associated with ground disturbance. Impacts will be reduced to a less than significant level by the installation of erosion control BMPs and revegetation and other mitigation measures (**GEO 1–4**) detailed in the Geology Section above.

(b) Less Than Significant: The project relies on rain water catchment to fill the ponds. A preliminary hydrologic analyses has been conducted for the project and is summarized in the BOD Report (Attachment A of this MND). This analysis shows that there is sufficient water supply during the wet season to fill the pond in all but the driest of years. In the very dry years, the ponds may not fill but will still store sufficient water for the project to remain effective.

(c) No Impact: The project will not produce wastewater or be served by a wastewater facility.

(d) No Impact: The project will not generate a significant volume of solid waste requiring disposal in a landfill. Any waste generated will be minimal and only occur during construction. No waste will be produced during operations.

(e) No Impact: The project will not violate any federal, state, or local statutes or regulations related to solid waste.

20. Wildfire. If located in or near state responsibility areas of lands classified as very high fire hazard severity zones, would the project:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Substantially impair an adopted emergency response plan or emergency evacuation plan?				X
b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to, pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?				X
c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?			X	
d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?				X

(a) No impact: The project will not substantially impair an adopted emergency response plan or emergency evacuation plan. In addition, the proposed pond will provide water necessary for emergency fire responses.

(b) No impact: The project does not propose to construct structures that would be used for human habitation. The project reduces wildfire risk by installing a pond that provides a water supply that could be used to fight wildfires.

(c) Less than significant: The project will include the installation of electrical/plumbing infrastructure. The pond can be called upon to supply water in the event of a wildfire, which is a significant improvement compared to current conditions. All new onsite power supply lines will be installed via underground burial and would not increase the risk of wildfire.

(d) Less than significant: The project is located on a relatively flat terrace and not prone to landslides as described in the BOD Report. Further, there are no nearby residences downslope from the project area.

21. Mandatory Findings of Significance.	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?		X		
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects).				X
c) Does the project have environmental effects, which will cause substantial adverse effects on human beings, either directly or indirectly?				X

Discussion:

(a) Less Than Significant with Mitigation Incorporated: The project does have the potential to degrade the quality of the environment. However, the potential is reduced to a less than significant level by design and through implementing the mitigation measures described above. The project shall be implemented in a manner that will avoid short-term adverse impacts to rare plants and animals, and cultural resources during construction. The project activities are designed to improve and restore stream habitat, thereby providing long-term benefits to both anadromous salmonids and other fish and wildlife.

(b) No Impact: The project does not have adverse impacts that are individually limited, but cumulatively considerable. Cumulative adverse impacts will not occur because potential adverse impacts of the project are only minor and temporary in nature and will be mitigated to the extent possible. It is the goal of the project that the beneficial effects of habitat enhancement actions will be cumulative over time and contribute to the recovery of listed anadromous salmonids.

(c) No Impact: The project does not have the potential to cause substantial adverse effects on human beings. Effects on human beings will not occur because the project is located in a rural setting far from any dwellings or other infrastructure used by the public. Furthermore, measures implemented as part of this project will contribute to significant fire safety improvements for the local community through availability of the pond water for CalFire to fight wildfires.

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Mattole Headwaters Drought Relief Project- Vanauken Ponds

MND Attachment A

Basis of Design Report

(Stillwater Sciences, December 2024)

DECEMBER 2024

Basis of Design Report and Feasibility Analyses for Mattole Headwaters Drought Relief Project – Vanauken Ponds

PREPARED FOR

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Suggested citation:
Stillwater Sciences. 2024. Basis of Design Report and Feasibility Analyses for Mattole Headwaters Drought Relief Project – Vanauken Ponds. Prepared by Stillwater Sciences, Arcata, California for Sanctuary Forest, Whitehorn, California.

Cover photo:
Dry reach of Vanauken Creek approximately 550 ft upstream from the Mattole River Confluence taken by Tasha McKee on August 24, 2021.

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1 INTRODUCTION

This report provides the basis of design for the Mattole Headwaters Drought Relief Project – Streamflow Augmentation (Project) in the Mattole River watershed comprised of two off stream ponds. Current design work is being funded through the California Department of Water Resources (DWR). The Project will capture and store winter runoff in approximately 6 million gallons of off-channel water storage and release the stored water into Vanauken Creek during the dry season. This Project seeks to improve habitat for coho salmon (*Oncorhynchus kisutch*) and steelhead (*Oncorhynchus mykiss*) in Vanauken Creek, an important salmon bearing tributary to the Mattole River, by addressing the limiting factor of low summer streamflows. Vanauken Creek is a critical tributary to the Mattole River that historically supported coho and Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead.

Sanctuary Forest (SFI) is the project lead and Stillwater Sciences is the technical lead for the project. The project is located on 1320 acres owned by Lost Coast Forestlands (LCF) near Whitethorn, in Southern Humboldt County, CA (Figure 1). Vanauken Creek has been identified as one of the highest priority tributaries by Sanctuary Forest for Coho recovery in the Mattole River headwaters because of documented Coho presence in recent years and habitat recovery potential. The entire watershed is conserved and there are no human water diversions in Vanauken Creek.

This Basis of Design (BOD) Report presents existing site conditions and the preferred design approach, informed by agency feedback, alternative analysis, and comprehensive field and office-based analyses. Following the 30% Technical Advisory Committee (TAC) meeting, an alternatives analysis (detailed in Section 9.5) was conducted, leading to the selection of the preferred alternative, which has now been developed to the 65% design level. The preferred alternative maintains the general pond footprints and engineering approach from the 30% design, but incorporates an HDPE liner for both ponds, refinements in cut/fill optimization, engineered spillways, flow augmentation strategies, complete plumbing design, and detailed planting and erosion control measures. The 65% design is included in Appendix A. The 65% design will be provided to the TAC and feedback will be incorporated into the final 100% design. The Tac is comprised of representatives from the California Department of Fish and Wildlife (CDFW), the National Marine Fisheries Service (NMFS), and the North Coast Regional Water Quality Control Board, will review this 65% design.

Recent flow enhancement initiatives in lower Russian River tributaries are analogous to this Project and have displayed that direct augment is one of the most successful approaches to date for enhancing dry-season streamflow. Flow releases from agricultural ponds in Green Valley Creek and Porter Creek have resulted in significant instream benefits (Grantham et.al. 2018, RRCWRP 2019). As described in Ruiz et al. (2018) of California Sea Grant, the project began in 2015 and is ongoing. Data shows that flow augmentations in all years from 2015–2018 were able to appreciably increase wetted channel habitat, increase dissolved oxygen in the stream, and decrease water temperature downstream from the flow augmentation release points. For example, releases into Dutch Bill Creek averaging 36 gallons per minute (gpm) beginning in late August of 2015 and were able to cumulatively re-wet more than 2,300 feet (ft) of stream channel with effects measurable up to 1.8 miles downstream.

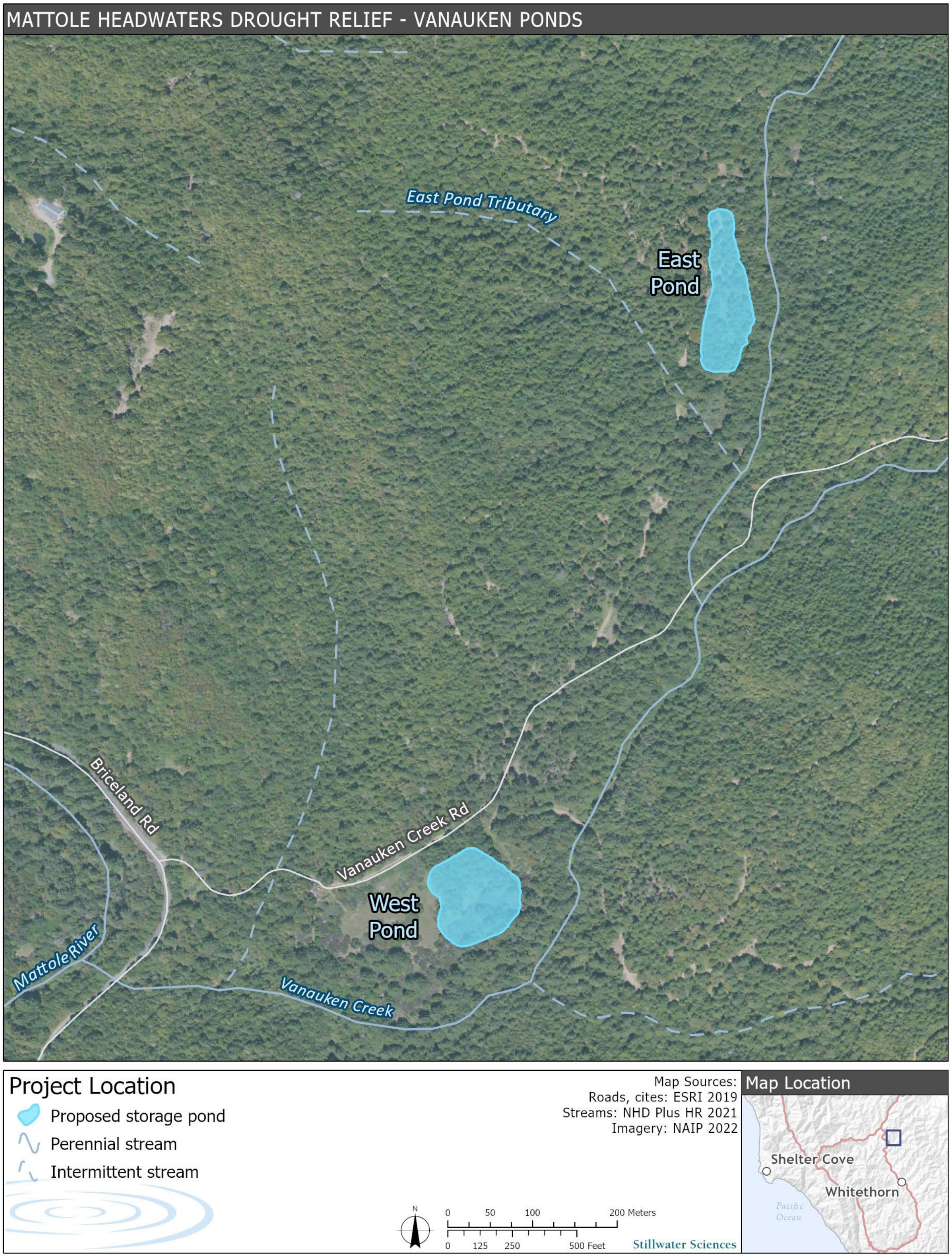

Figure 1. Project Location map.

The Marshall Ranch Project located several miles from the Vanauken Creek watershed began augmenting flow in Redwood Creek (South Fork Eel River tributary) on July 1, 2024. The performance of the Marshall Ranch Project is being closely monitored and analyzed to inform the design of this Project and TAC members visited the Marshall Ranch project in August 2024.

While modest compared to winter flows, these augmentations have the potential to increase pool connectivity and water quality. A foundational hypothesis for this Project, that increased pool connectivity will bolster over-summer salmonid survival, is strongly supported by the work of Obedzinski et al. (2018). Their study found that days of disconnected surface flow showed a strong negative correlation with juvenile coho salmon survival rate in four tributaries to the Russian River. Provided with this evidence, it is anticipated that the Project's flow release will result in significant aquatic habitat benefit.

2 SITE DESCRIPTION

The proposed Project is located along Vanauken Creek, a tributary of the Mattole River, north of the community of Whitethorn. The 1320-acre property is located approximately 16.0 road miles from Garberville and Highway 101. To access, drive west and south from Garberville 15.0 miles to Whitethorn Junction; proceed south along Briceland-Thorn Road for another ~ 1.0 mile to the entrance of Vanuaken Creek; turn east at this road through a locked gate, and proceed to the property. The project is located on two terraces above Vanauken Creek at approximately 3,000 ft and 6,000 ft upstream of the Mattole confluence.

2.1 Ownership, Conservation and Stewardship

The property is owned by LCF and protected by a conservation easement held by SFI with funding from CDFW Rivers and Streams Grant Program, WCB Climate Adaptation and Resiliency Program, Weeden Foundation and Grace Us Foundation. SFI donors contributed $595,000 providing critical community support and cost share needed to leverage the state funding. This easement resulted in the permanent protection of fish and wildlife habitat and allows for ecologically restorative and economically viable forest and stream management activities to take place. The easement dissolved over twenty subdivision and development rights, reserving only one, ensuring minimal future water diversion impacts. The property will be managed as a working forest with the landowner engaging in commercial sustainable forestry practices in accordance with the terms of the easement. The easement also allows for SFI to conduct forest management and land stewardship activities designed to improve riparian conditions through promoting large wood recruitment and implementing habitat and streamflow enhancement projects. The easement allows SFI to develop a public access program including pedestrian and mountain bike trail access, public participation in habitat restoration, research, and monitoring, and demonstrations of sustainable forestry and other best management practices.

The Vanauken Creek watershed is on the west side of the watershed divide between the Mattole and South Fork Eel Rivers. This ridge is an important wildlife corridor allowing for cross basin migration as well as wildlife movement along several miles of the east side of the Mattole River headwaters. Several landscape-scale conserved areas adjoin the Vanauken Creek watershed lie nearby. Immediately to the south is a ~1,400-acre working forest conservation easement (Johanessen Family) and another ~2,400-acre working forest conservation easement in progress (Baker Creek owned by LCF). These lands further connect to multiple working forest conservation easements (some held by SFI and others by North Coast Regional Land Trust), adjoining with several thousand acres in the Mattole headwaters to form a patchwork of conserved lands, protecting most of the remaining old growth redwood forest in the Mattole, including the CDFW-owned Mattole River Ecological Reserve.

2.2 Climate

The Property's climate has been described as a Mediterranean climate characterized by cool wet winters with high run off and dry warm summers. Temperatures can range from sub-freezing to above 100 degrees F. Most precipitation falls as rain during the winter months, with averages ranging from 70-85 inches per year (Downie et al. 2002). Over the past two decades, however, rainfall in this region has been lower than throughout most of the last century and has been occurring in a shorter period of the year, extending the dry season beyond historic norms.

3 PROBLEM STATEMENT AND PROJECT OBJECTIVES

Vanauken Creek and the upper mainstem Mattole provides habitat for the three species of native salmonids that inhabit the Mattole River, all of which are either federal- or state-listed species. These are: Coho salmon (*Oncorhynchus kisutch*, Southern Oregon/Northern California coastal, SONCC); Winter-run steelhead trout (*Oncorhynchus mykiss*, Northern California), and Chinook salmon (*Oncorhynchus tshawytscha*, California coastal). Coho salmon have experienced precipitous declines in abundance and are currently on the verge of extirpation from the Mattole River watershed (Mattole Coho Recovery Strategy 2011). Numerous factors are responsible for the declines in Coho salmon abundance, and many of these limiting factors are also impacting Chinook salmon (*Oncorhynchus tshawytcha*) and steelhead, which are also severely depressed in abundance relative to historic estimates.

Changes in rainfall patterns combined with other human-caused factors, such as the legacy of historic logging and other land-use impacts, have led to a significant reduction of summertime streamflows which is one of the primary limiting factors for Coho. Some reaches of Vanauken Creek dry up altogether or become a series of disconnected pools in the late summer. This pattern of diminished streamflows has been particularly well documented for the Mattole headwaters, beginning in 2002 with CDFW's Mattole River Watershed Assessment Report, and subsequently by SFI, the Mattole Restoration Council, the Mattole Salmon Group and others. Sanctuary Forest performed baseline streamflow monitoring for 15 headwaters tributaries including Vanauken Creek for the years 2007-2011. Similarly to the other east side creeks, flows stopped in September for the years 2007, 2008 and 2009. On August 24, 2021, Vanauken Creek was dry with only a few isolated pools in the lower 1500 ft where conditions were assessed (see photo on cover of report). As of July 24, 2024, Vanauken flows have dropped to 0.08 cubic feet per second (cfs) and based on 2009 data, flow is expected to stop altogether by the end of August.

Historically, Vanauken Creek has been identified as an important salmon producing stream with its cool, shaded, low-gradient streams that traverse the Property; however, populations have declined since the 1950s. In the 1980s and 1990s, many log jams were removed which increased channel velocities, scoured the streambed down to bedrock and significantly decreased winter habitat for juvenile coho salmon. In 2024, a coho redd and numerous juvenile coho were observed in Vanauken Creek by the Mattole Salmon Group distributed from near the Mattole confluence to several thousand feet upstream. Additionally, surveys conducted by CDFG have documented the presence of coho juveniles from 1985-2010, and the Mattole Salmon Group have documented coho in 5 out of 20 years sampled from 1980-2015. Chinook salmon generally favor similar habitat conditions as coho but tend to spawn in slightly larger streams. A dozen adult Chinook were observed just downstream of the Vanauken middle fork in December of 2016, a year with above average rainfall. Steelhead are abundant in Vanauken Creek, and several hundred juveniles have been observed trapped in isolated pools in the low flow years of the last decade.

Salmonid recovery actions have been prioritized in the SONCC Recovery Plan and while the plan focuses on coho, these actions are also important for steelhead. Key limiting stresses are "lack of floodplain and channel structure and altered hydrologic function" and 3 out of 6 highest priority recovery actions are: "secure and maintain sufficient instream flows"; increase water retention (i.e., storage and recharge) and "increase large wood debris, boulders or other instream structure".

The Project aims to provide sufficient instream flow for salmonid rearing during the lowest flow months from mid- August through October or when the winter rains begin. This will be achieved through construction of two off channel ponds totaling 6 million gallons. The increased storage and flow augmentation is needed to ensure the benefits of a recently completed planning project funded by CDFW and the State Coastal Conservancy, Mattole Headwaters Enhancement and Planning – Vanauken Creek. The planning project aims to improve instream habitat in 4400 ft of stream (from the Mattole confluence to the middle fork Vanauken Creek). The planning project was designed with TAC and tribal input and is now shovel ready at 100% design and SERP concurrence. The Project is fully funded for design, permitting and implementation by the DWR's Urban and Multi-Benefit Drought Relief Grant Program with an implementation completion deadline of October 30, 2025. The two projects combined address all 3 of the SONCC Recovery plan high priority actions including: 1) secure and maintain sufficient instream flows", 2) increase water retention (i.e., storage and recharge), and 3) increase large wood debris, boulders or other instream structure.

The Project will also provide streamflow benefits for the mainstem Mattole River between Vanauken Creek and Bridge Creek, a reach that has been identified as having high IP in the SONCC Recovery Plan. Streamflow at the Sanctuary Forest monitoring site MS6, located immediately upstream of the Bridge Creek confluence, has dropped below 20 gpm in 10 of the last 19 years. The release of approximately 20 gpm in Vanauken Creek is likely to significantly improve summer streamflow and summer rearing habitat in the Mattole mainstem between Vanauken and Bridge Creeks during dry years.

4 GEOLOGY AND TECTONICS

The upper Mattole watershed occurs within the Coast Ranges Geomorphic Province of California (CGS 2002) and is underlain by a series of geologic terranes comprised primarily of marine sedimentary rocks (McLaughlin et al. 2000, Davenport et al. 2002). The terranes are located in a tectonically active plate-boundary deformation zone, defined by right-lateral movement along the San Andreas fault system (including the King Range thrust zone and Whale Gulch-Bear Harbor fault zone, discussed below), which forms the plate boundary interface with the Pacific plate to the west and North American plate to the east (Kelsey and Carver 1988). Northward progression of the San Andreas fault system is characterized by lateral shearing and vertical compression due to the major westward turn in the fault system upon reaching the Mendocino Triple Junction near the mouth of the Mattole River and Cape Mendocino. These primary deformation styles are what create the dominant NNW-SSE trending topographic and structural grain in the region (Kelsey and Carver 1988). The evolution of this regional topographic and structural grain has been developed through pervasive shearing, folding, fracturing, and faulting throughout the north coast of California.

The Vanauken Creek watershed is underlain by the Coastal terrane of the Franciscan Complex Coastal Belt (Davenport et al. 2002) (Figure 2). These rocks are Pliocene to late-Cretaceous in age and in the Vanauken watershed consist primarily of intact sandstone and argillite that exhibit sharp-crested topography with a regular, well-incised system of sidehill drainage (Davenport et al. 2002). The majority of the upper Mattole watershed (i.e., the Southern Mattole watershed subbasin of Davenport et al. 2002) is underlain by the same Coastal terrane sandstone and argillite unit, which is the most intact and stable bedrock (from a landslide perspective) in the entire Mattole watershed. The Project reach along mainstem Vanauken Creek flows through deposits of unconsolidated to weakly consolidated stream alluvium and colluvium shed from the steep bedrock hillslopes. These deposits are Holocene to Pleistocene and near the confluence with Mattole River the valley bottom widens and contains uplifted fluvial terraces on both sides of the creek (Spittler 1984).

The Whale Gulch-Bear Harbor fault zone and King Range thrust zone trend NNW-SSE and lie approximately 3.2 to 4.5 miles west of the Project area (Bryant 2017). These zones are prominent components of the San Andreas fault system in the Mattole watershed. The Whale-Gulch-Bear Harbor fault zone is considered late Quaternary in age (i.e., active within the last 130,000 years). Recent displacement along the King Range thrust zone is undifferentiated, but it is considered Quaternary in age (i.e., active within the last 1.6 million years). The Shelter Cove section of the San Andreas fault, which ruptured in the great 1906 San Francisco earthquake, is approximately 6 mi west of the project site.

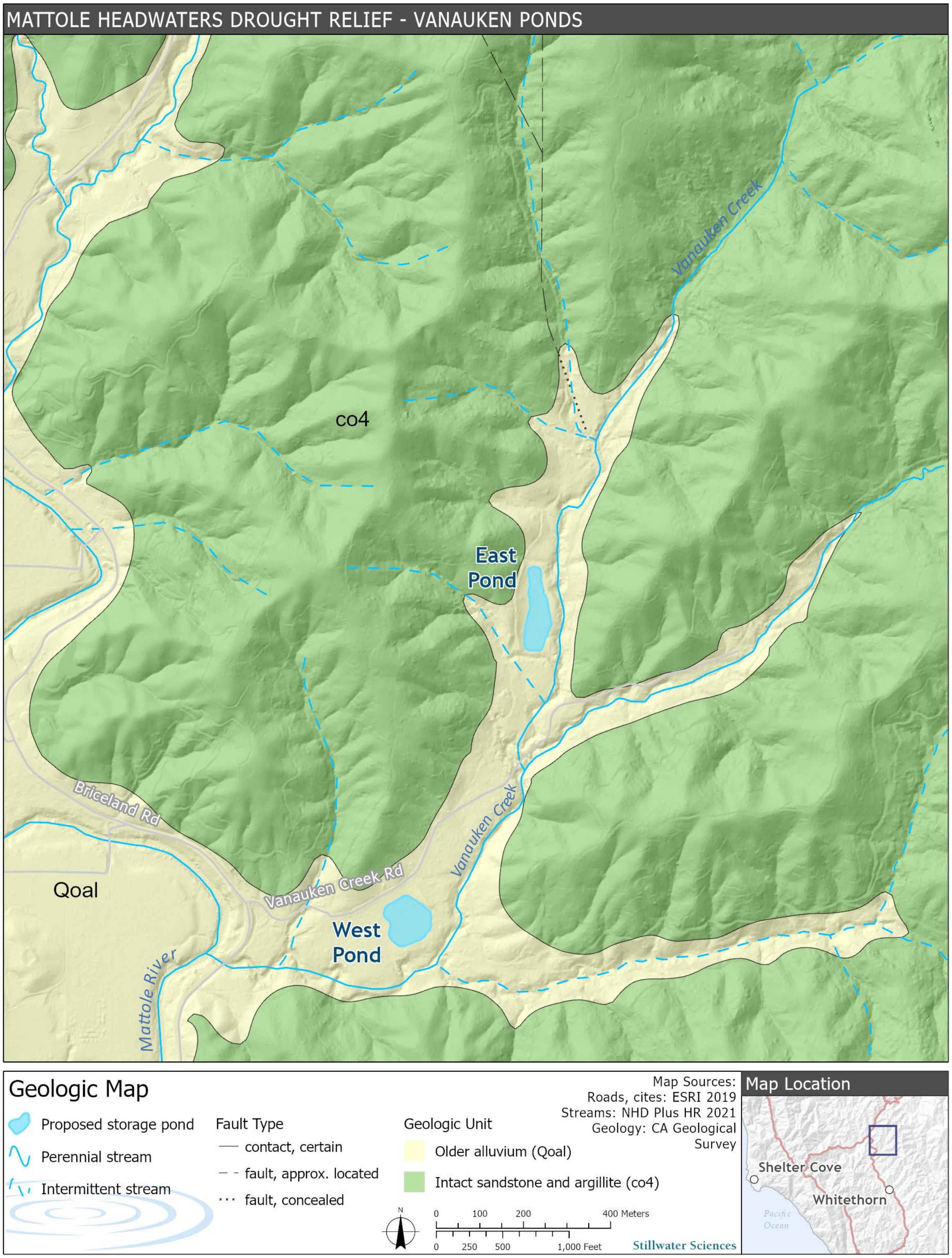

Figure 2. Generalized geologic map of the project vicinity.

5 GEOMORPHOLOGY

Hillslope and stream channel morphologies in the Vanauken Creek watershed are similar to those throughout the Mattole headwaters, which is the Southern Mattole subbasin from Davenport et al. (2002). The geomorphic similarity is due to the prevalence of the underlying Franciscan Complex Coastal terrane bedrock, which consists almost entirely of intact sandstone and argillite. The strength and relatively unfractured nature of the bedrock results in ridge-and-valley topography with organized sidehill drainage networks, as described above in Section 4. The Vanauken Creek watershed and Southern Mattole subbasin are underlain by the most intact bedrock (i.e., stable) of the entire Mattole River watershed and, consequently, have the lowest relative proportion of modeled landslide potential and mapped historical and dormant landslides (Davenport et al. 2002). No landslides are mapped by Davenport et al. (2002) within the vicinity of the proposed ponds. Davenport et al. did map numerous dormant translational/rotational landslides in the headwaters of the Vanauken watershed upstream of the Project.

The lack of large landslide features and widespread intact bedrock have resulted in relatively stable hillslopes and uniform stream profile with a channel slope ranging from approximately 1.1% to 1.7% within the stream reach adjacent to the proposed ponds (Figure 4). The channel in the Project reach flows through relatively wide terrace and floodplain deposits with some steep hillslopes to the south and east. Davenport et al. (2002) mapped multiple hillslope areas along the creek corridor as “debris slide slopes”, which are characterized as steep to very steep slopes that are usually well-vegetated and have been sculpted by numerous debris slides over geologic time. These types of slopes are very common throughout the Mattole headwaters and other watersheds on the north coast.

There are several degrees of channel incision evident in Vanauken Creek. The proposed ponds are located on terraces that are 25 to 35 ft above the channel, likely resulting from ongoing tectonic uplift and subsequent channel incision related to the nearby Mendocino Triple Junction. Recent anthropogenic impacts associated with extensive logging and removal of instream large wood has resulted in smaller scale and more recent incision of approximately 3 to 6 ft below the floodplains in many locations, resulting in floodplains that are only connected during large flood events. Hydraulic controls in Vanauken Creek adjacent to the Project consist of competent bedrock outcrops. Bankfull widths vary from approximately 16 to 32 ft in the Project reaches. The channel bed consists of sand and gravel-dominated substrate (Figure 4) in some reaches, while others are cobble dominated and/or bedrock interspersed with sand, gravel and cobble.

Additional site-specific geomorphic and geotechnical characterization of the Project site and vicinity will be conducted during the 65% design phase.

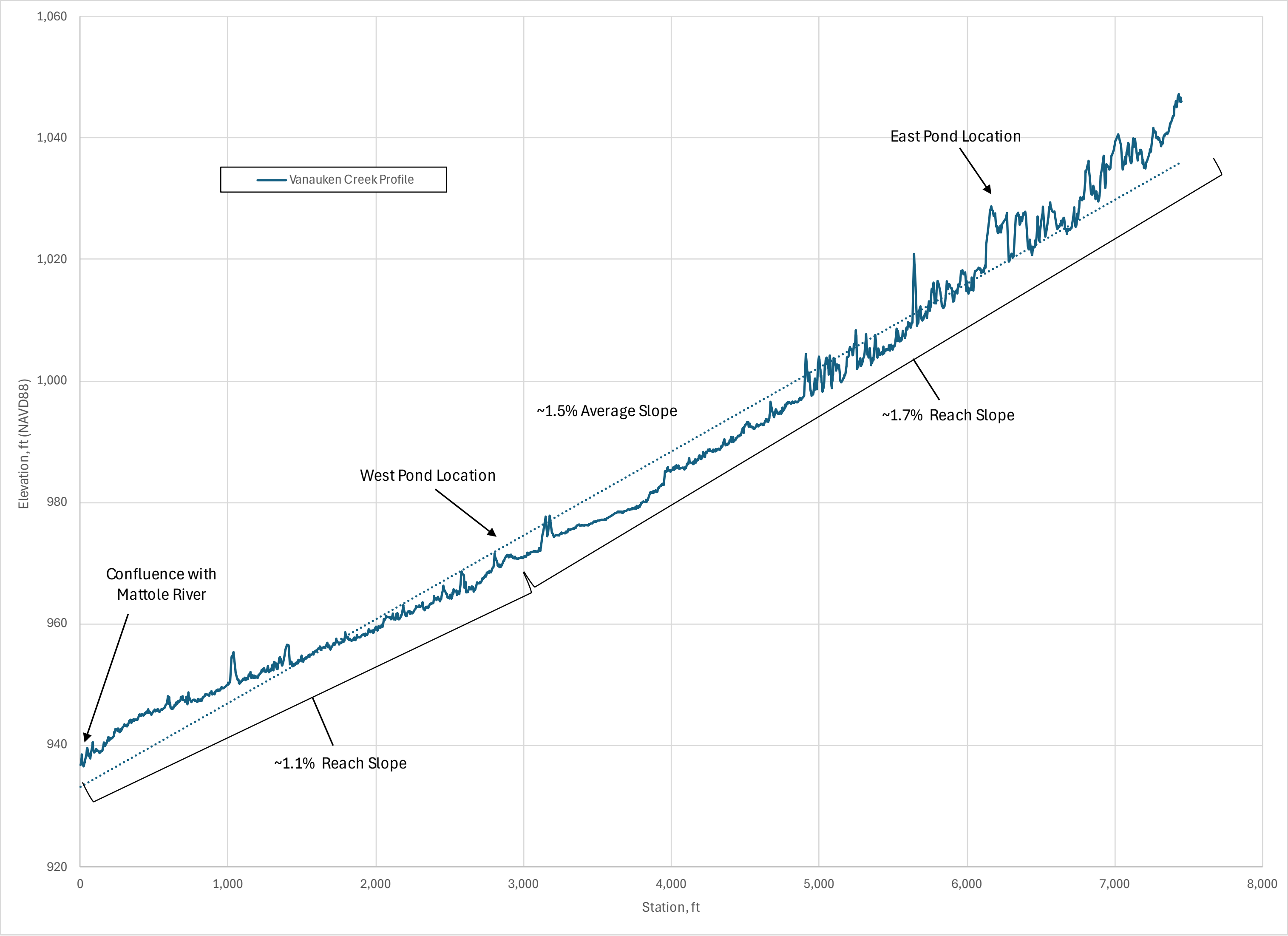

Figure 3. Longitudinal profile of Vanauken Creek adjacent to the proposed ponds.

Figure 4. Vanauken Creek typical site conditions.

6 TOPOGRAPHIC DATA

6.1 Datums

Project mapping and analyses are referenced to the California State Plane Zone 1, North American Datum of 1983 (NAD83 2011) in units of U.S. survey feet and the North American Vertical Datum of 1988 (NAVD88 – Geoid 18) in units of U.S. survey feet. All elevations referenced in this report are with respect to NAVD88 unless otherwise noted.

6.2 Topographic Data

Topography for the Project is primarily 2018 USGS LiDAR. Stillwater staff conducted field surveys using a total station and differential GPS within Vanauken Creek adjacent to the West Pond. The primary goal of the survey was to characterize site topography throughout the Project area where work is proposed and to map existing features (e.g., trees, roads, and groundwater wells). A differential GPS (approximately 0.4 ft horizontal accuracy and 0.7 ft vertical accuracy) was used to geolocate several control points used in the total station survey. The total station survey was then georeferenced and integrated with 2018 USGS LiDAR data.

The field survey data were then merged with 2018 USGS LiDAR point cloud data in AutoCAD Civil3D. The combined topographic dataset was used to create a digital terrain model (DTM) of existing conditions in the Project area. The DTM was used in the geomorphic assessment, hydraulic modeling, and engineering design. The upper portion of Vanauken Creek adjacent to the East Pond has not been surveyed and is topography is based entirely 2018 USGS LiDAR.

7 HYDROLOGIC AND HYDRAULIC ANALYSIS

An assessment of site hydrology has been conducted to inform the 65% design alternatives analyses and design process. There are five key components of the hydrologic assessment:

1. Determine key regulatory considerations that influence pond size and the ability to fill pond from surface water diversion;
2. Determining the best approach to fill the ponds through a combination of direct rainfall input, sheet flow from the hillside, and diversions from surface water;
3. Utilize existing flow monitoring data to determine a realistic/desirable flow enhancement benefit that the project can achieve;
4. Assess 100-year storm flows to determine run-off and inundation dynamics.
5. Assess groundwater data and how groundwater dynamics are expected to affect the project.

Each of these components are discussed below. During the 65% design phase several alternative approaches were assessed to fill the ponds during the wet season. Initially, surface water diversions were proposed in the draft 65% design. However, based on regulatory and project cost considerations, the final 65% design included in Appendix A have removed the surface water diversion component of the project and include sheet flow capture and direct precipitation only.

7.1 Regulatory Considerations

There are three primary state agencies that could have jurisdiction over this project. These include:

1. CA Department of Water Resources – Division of Safety of Dams (DSOD) regulates dams above a certain size;
2. CA State Water Resources Control Board (SWRCB) requires Water Right or Registration for diverting water from a stream and storing it for more than 30 days; and
3. CA Department of Fish and Wildlife (CDFW) requires a Lake and Streambed Alteration Agreement (LSAA) for installing infrastructure and diverting water from a stream.

7.1.1 DSOD jurisdiction

Jurisdictional dams are dams that are under the regulatory powers of the State of California. A “dam” is any artificial barrier, together with appurtenant works as described in the California Water Code. If the dam height is more than 6 ft and it impounds 50 acre-feet or more of water, or if the dam is 25 ft or higher and impounds more than 15 acre-feet of water, it will be under DSOD jurisdictional oversight, unless it is exempted. The DSOD Jurisdictional Size Chart (Figure 5) summarizes the above criteria. Jurisdictional height of a dam, as determined by DSOD, is the vertical distance measured from the lowest point at the downstream toe of the dam to its maximum storage elevation, which is typically the spillway crest.

There are significant annual reporting requirements and fees associated with jurisdictional dams, so from a long-term operations perspective, falling outside of DSOD is desirable. Therefore, it is desirable to stay below a 25-foot dam height and 15 acre-feet (16.3 million gallons) of water storage.

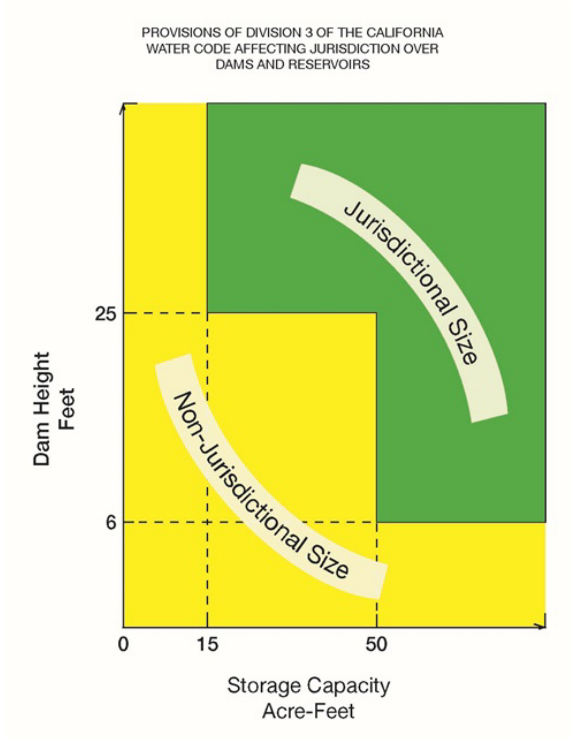

Figure 5. DSOD jurisdictional chart.

7.1.2 SWRCB water right or registration

Based on site geometry, the project has been designed to capture rainwater and sheet flow only. Therefore, the Project does not require a water right or registration from the SRWCB to divert surface water from a stream and store that water for more than 30 days.

7.1.3 CDFW LSAA

Based on discussions with local staff, CDFW is generally supportive of the Project. Considering that there is no surface water diversion or other work proposed within stream channel bed or bank, an LSAA is not required for the project.

7.1.4 Other regulatory requirements

Other permits will be required for the Project but the conditions/stipulations of those permits are not anticipated to govern the project design. These additional permits include:

1. CEQA coverage through a Humboldt County Special Permit and Initial Study - Mitigated Negative Declaration (IS-MND);
2. Grading Permit from Humboldt County for construction of project infrastructure.

3. Construction Stormwater General Permit from SWRCB for discharges of stormwater associated with construction activity.
4. National Pollutant Discharge Elimination System (NPDES) Low Threat Discharge Permit for the discharge of stormwater to receiving waters of the state.

7.2 Filling the Ponds During the Wet Season

Three different sources for filling the pond were analyzed:

1. Direct precipitation falling into the ponds and along the pond berms;
2. Sheet flow from the hillslopes that drain into the ponds; and
3. Surface water diversion from tributaries and Vanauken Creek (based on calculations for pond fill from direct precipitation and sheet flow it was determined that surface water diversion was not required to fill the ponds).

7.2.1 Water availability from upslope sources

To assess the water availability from Sources 1-3 listed above, the Rational Method (also known as the Rational Formula) was used to calculate expected seasonal runoff. The Rational Formula incorporates a combination of rainfall intensity, drainage area and runoff coefficient to estimate maximum flows and is defined as follows:

$$Q = CIA$$

Where:
- Q = Flow Discharge
- C = Runoff Coefficient
- I = Rainfall Intensity
- A = Area

Typical applications of the Rational Method focuses on peak flow determination, however, in this study, the rational method was modified to determine runoff volume. This modification was specifically tailored to quantify runoff during low-flow or drought years, providing insights for water resource management-based flow augmentation design approaches.

7.2.2 Expected annual rainfall

For project design, the historic annual rainfall for Thorn Junction, CA was determined using the Parameter-Elevation Regressions on Independent Slopes Model (PRISM) developed by Oregon State University's PRISM Climate Group. This data source indicates an average annual rainfall of approximately 83.2 inches for the period 1950-2023 (Figure 6). A design precipitation of 48 inches was selected, representing very dry conditions.

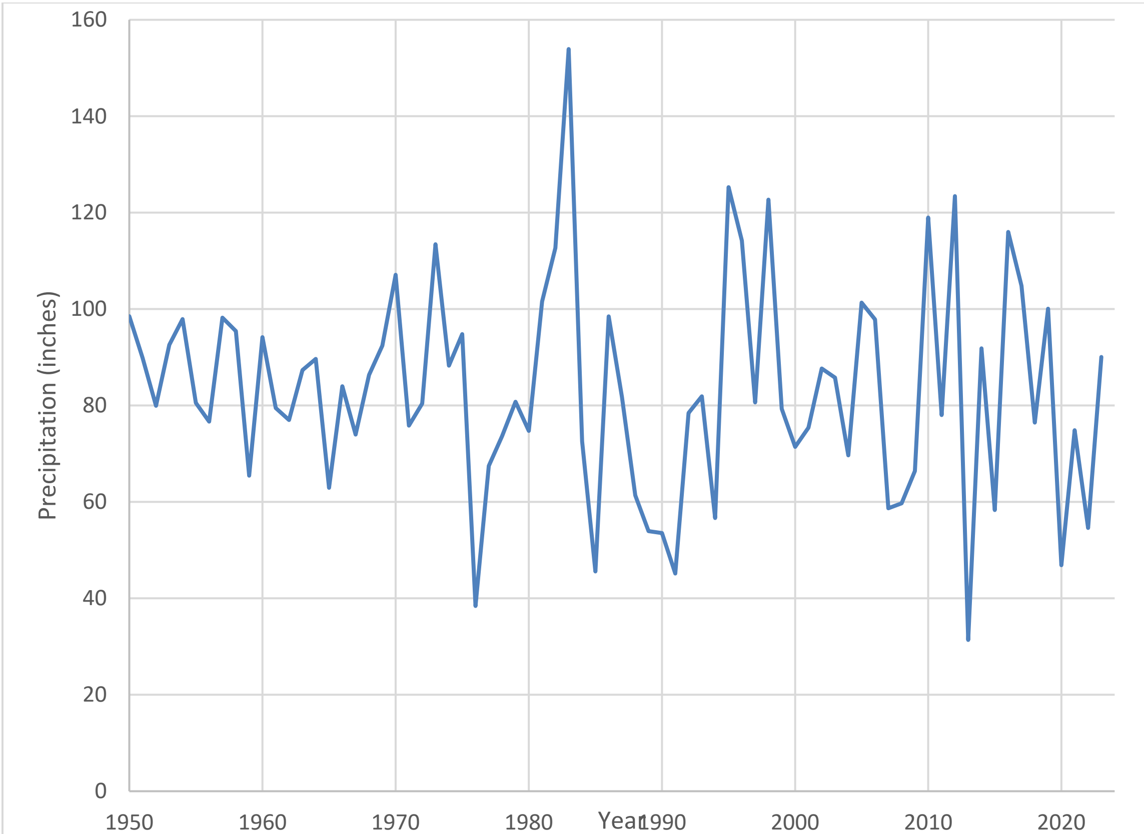

Figure 6. Thorn Junction annual precipitation (PRISM).

7.2.3 Calculations

Table 1 below summarizes expected pond fill volumes generated from direct precipitation and sheet flow based on 48 inches of annual precipitation. The table is separated into totals for each pond and values are rounded to the nearest thousand gallons.

Table 1. Summary of rational method calculations for direct precipitation and sheet flow water sources.

	Source	Area (acres)	Runoff coefficient	Intensity/Annual precipitation (inches)	Volume (gallons)
East Pond	Eastern Pond Interior (direct precipitation)	1.17	1.0	48	1,520,000
	Eastern Pond Berm (direct precipitation)	0.22	0.5	48	142,000
	Hillslope draining into Eastern Pond	2.65	0.2	48	692,000
				East Pond Total Volume	**2,354,000**
West Pond	Western Pond Interior (direct precipitation)	1.30	1.0	48	1,689,000
	Western Pond Berm (direct precipitation)	0.33	0.5	48	213,000
	Hillslope draining into Western Pond	6.57	0.2	48	1,712,000
				West Pond Total Volume	**3,614,000**
				Combined Total Volume	**5,968,000**

Based on the results shown in Table 1, direct precipitation and sheet flow have the combined volume to fill the approximately 6 million gallon capacity of the two ponds based on 48 inches of annual precipitation.

7.3 Existing Flow Data and Expected Flow Enhancement Benefit

As described above, low flow conditions during the dry season have been well documented in the Mattole headwaters. Sanctuary Forest performed baseline streamflow monitoring for 15 headwaters tributaries including Vanauken Creek during the period of 2007-2011 (Table 2). During September 2007, 2008, and 2009, streamflow in Vanauken Creek completely dried. Flow monitoring by Sanctuary Forest started again in June of 2024. By August 22nd flows in Vanauken Creek had dropped to 0 cfs, with extensive dry reaches being observed by October 3rd. Although flow monitoring data was not collected in the years of 2012–2023, periodic observations in Vanauken Creek during the height of the dry season have confirmed that low-and no-flow conditions persist.

Table 2. Vanauken Creek baseline streamflow monitoring.

Date	Discharge (cfs)	Discharge (gpm)
8/10/2007	0.049	22
8/28/2007	0.010	4
9/25/2007	0.000	0
7/1/2008	0.217	97
8/5/2008	0.013	6
9/4/2008	0.000	0
8/12/2009	0.059	26
9/2/2009	0.000	0
10/2/2009	0.000	0
8/5/2010	0.360	162
9/29/2011	0.020	9

The scale of the Project with a total water storage volume of approximately 6 million gallons has been generally sized to provide a flow augmentation rate that will be measurable and provide meaningful benefits to Vanauken Creek salmonids and other aquatic habitat during the dry season. The ponds are sized to release 25 gallons per minute over a 4-month period after subtracting evaporation losses estimated at 25% by volume. The start date and rate of flow augmentation will vary based on the hydrologic conditions in the watershed each year and generally occur between July1 and November 1. It is anticipated that flow releases will begin when Vanauken Creek flow drops to approximately 50 gallons per minute. Flow releases will continue until significant rainfall occurs within the watershed increasing streamflow to above approximately 50 gallons per minute within Vanauken Creek at its confluence with the Mattole River.

In the event of a low rainfall year, the flow augmentation rate and schedule would be adjusted to make best use of the reduced pond storage. The project is sized at 6 million gallons to provide flexibility as follows: The minimum amount of flow augmentation needed for pool connectivity is estimated to be 15 gallons per minute which totals 2.64 million gallons released over a 4-month period and 3.51 million gallons of total pond water storage (accounting for evaporation) or 58% of the capacity. Therefore, the project can provide measurable significant improvements in drought years. In wet years, water not needed for streamflow can be retained and stored to make up for potential rainfall shortages in the following year.

7.4 100-year Storm Event Analysis

The 100-year storm event analyses was conducted to determine peak flows for the proposed pond spillways and utilized Rational Method runoff calculations.

7.4.1 100-year storm event rational method calculations

Based on the Rational Formula defined in Section 7.2.1 above, 100-year discharges were calculated for the outfalls of the ponds as well as the eastern pond tributary. This method is appropriate for determining flow rates for relatively small drainage areas of less than 200 acres according to Cafferata et. al. (2004).

7.4.1.1 Determining storm duration

For the Rational Method analysis, the total area, slope, and longest flow path for each drainage was determined based on 2018 LiDAR. Based on these values summarized on Table 3, the "Time to Concentration" was estimated using the Airport Drainage Formula. The "Time to Concentration" is defined as the time it takes runoff to travel along the longest flow path within the contributing watershed and arrive at a site crossing. Per Cafferata et. al., the "Time to Concentration" can be found with the following Airport Drainage Formula[1]:

$$T_c = \frac{1.8(1.1 - C)D^{0.5}}{S^{0.33}}$$

Where:

Tc = Time of Concentration (minutes)
C = Runoff Coefficient (dimensionless, 0<C<1.0)
D = Distance (in feet from the point of interest to the point in the watershed from which the time of flow is the greatest)
S = Slope (percent)

Table 3. Summary of time-to-concentration analyses.

Site	Drainage area (ac)	Longest flow path (ft)	Maximum elevation change (ft)	Slope (%)	Time to concentration (min)*	100-year intensity (in/hr)
Eastern Pond Interior (direct precipitation)	1.17	0	0	0	15	3.1
Eastern Pond Berm (direct precipitation)	0.22	8	0	3	15	3.1
Hillslope draining to Eastern Pond	2.65	674	153	23	15	3.1
Western Pond Interior (direct precipitation)	1.3	0	0	0	13	3.5
Western Pond Berm (direct precipitation)	0.33	15	0	3	13	3.5
Hillslope draining to Western Pond	6.57	548	151	27	13	3.5
East Pond (Composite)	4.04					3.5
West Pond (Composite)	8.2					3.8

* Time to concentration for Eastern and Western Ponds match associated hillslope time to concentrations.

[1] Note that two methods for determining Time to Concentration were described in Cafferata et. al. (2004) including: (1) the Kirpich formula and (2) the Airport Drainage equation. The Kirpich Formula was developed in 1940 based on precipitation and runoff data from seven rural watersheds in Tennessee with average slopes ranging from 3% to 10%. Stillwater believes that the Kirpich Formula does not provide good estimates for Time to Concentrations on steeper northern California watersheds. Additionally, Yee (1994) recommends use of the Airport Drainage equation.

7.4.1.2 Precipitation data

The intensity-duration-frequency (IDF) curve used for the Rational Method analysis came from National Oceanic and Atmospheric Administration's National Weather Service Hydrometeorological Design Studies Center Precipitation Frequency Data Server (PFDS).[2] Rainfall intensity was determined from the IDF curves for the 100-year recurrence interval for storm durations equivalent to the "Time to Concentration" for the project sites. The 100-year rainfall intensity from the PFDS for each site is also shown on Table 3.

7.4.1.3 Runoff coefficients

Cafferata et. al. suggests a runoff coefficient ranging from 0.30 to 0.45, depending on the specific setting. Per Buxton et. al. (1996), as cited in Cafferata et. al., a runoff coefficient value of 0.4 is recommended for North Coast California specifically. Additionally, a runoff coefficient of 0.4 reflects woodland with heavy clay soil, soil with a shallow impeding horizon, or shallow soil over bedrock per Figure 7 taken from Appendix A, Table A-1 of *The Handbook for Forest, Ranch and Rural Roads* (Weaver et al. 2015).

For the east pond tributary, we have used a Runoff Coefficient of 0.4 because the drainage areas consist of mostly woodland with soil with a shallow impeding horizon. For the rain falling directly on the ponds, the runoff coefficient is 1.0 and a coefficient of 0.5 was used for direct precipitation landing on the pond berm. The pond berm has been graded at a 40:1 slope to drain back into the pond.

Soils	Land use or type	C value
Sandy and gravelly soils	Cultivated	0.20
	Pasture	0.15
	Woodland	0.10
Loams and similar soils without impeded horizons	Cultivated	0.40
	Pasture	0.35
	Woodland	0.30
Heavy clay soil or those with a shallow impeding horizon; shallow over bedrock	Cultivated	0.50
	Pasture	0.45
	Woodland	0.40

Figure 7. Runoff coefficients (adopted from Appendix A, Table A-1 of the *Handbook for Forest, Ranch and Rural Roads* [Weaver et al. 2015]).

7.4.1.4 Storm discharges

Discharges from the Rational Method calculations for 100-year storm events are shown on Table 4.

[2] http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

Table 4. 100-year discharges.

Site	100-year discharge (cfs)
Eastern Pond Interior (direct precipitation)	3.7
Eastern Pond Berm (direct precipitation)	0.3
Hillslope draining to Eastern Pond	1.7
Western Pond Interior (direct precipitation)	4.6
Western Pond Berm (direct precipitation)	0.6
Hillslope draining to Western Pond	4.6
East Pond (Composite)	5.5
West Pond (Composite)	11.3

7.4.1.5 Spillway sizing

New spillway structures will be needed for the outlets of the ponds with runoff generated from the "hillslope draining to" each pond and the "direct rainfall on" each pond. These drainage structures are required to carry 100-year discharges and are sized using the FHWA Culvert Capacity Inlet Control Nomograph (Figure A-1 of Weaver et. al. 2015) using an HW/D ratio of 0.67, as shown in Figure 8 below. Based on this analysis, 30-inch-diameter culverts are required for the spillway of the two ponds. However, rather than culverts, armored spillways are proposed and will be sized to achieve similar flow cross section to a 30-inch culvert, while maintaining a minimum freeboard of 2 ft.

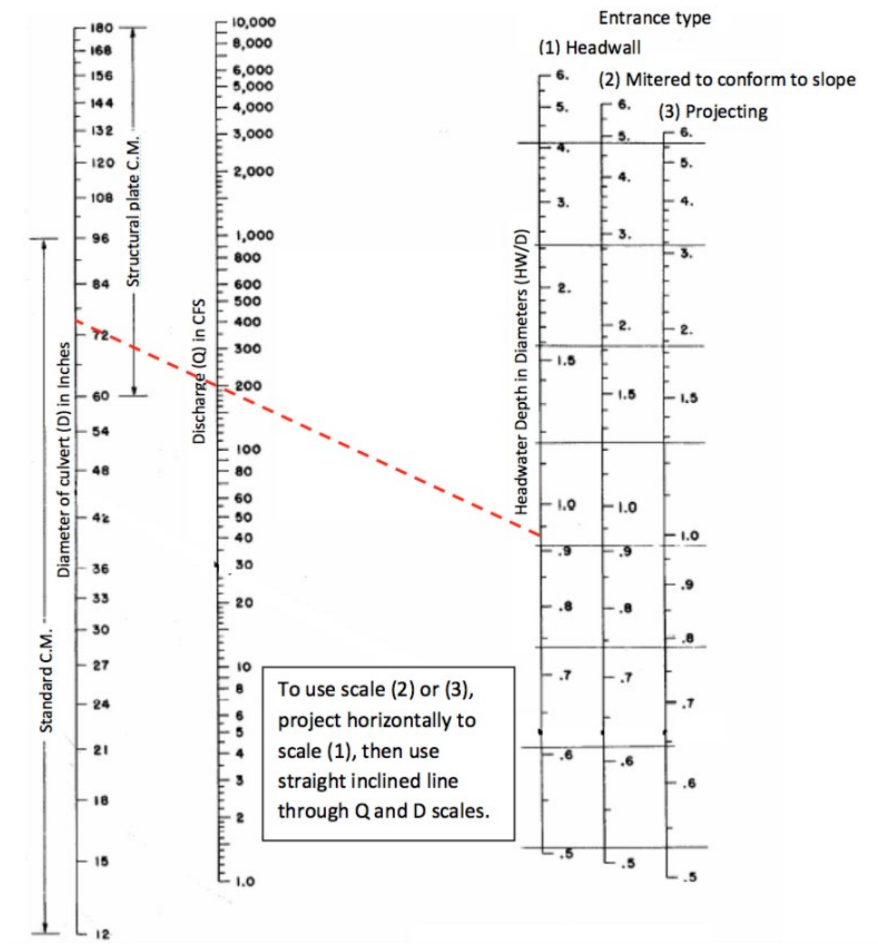

Figure 8. Culvert Capacity Inlet Control Nomograph (adopted from Appendix A, Table A-1 of *The Handbook for Forest, Ranch and Rural Roads* [Weaver et. al. 2015]).

7.4.2 Hydrologic and hydraulic overview for Vanauken Creek mainstem

To understand potential impacts of Vanauken Creek flood flows on the proposed ponds, flow hydraulics were modeled using the U.S. Army Corps of Engineers' (USACE) *Hydrologic Engineering Center's River Analysis System (*HEC-RAS). HEC-RAS is a one-dimensional hydraulic model that is widely used for floodplain mapping and estimating general flow characteristics. This one-dimensional model assumes uniform flow direction and constant velocity distribution within the channel and floodplain portion of each cross section. Flow is modeled based on topography at a channel cross section without considering the effects of channel topography between cross sections. Therefore, it is important that these limitations are closely considered during hydraulic model setup, calibration, and application.

7.4.2.1 Hydrologic data overview

The first step in this hydraulic modeling process is to determine the hydrologic data that will be the principal input to HEC-RAS. The primary hydrologic data sets analyzed for this project were flood frequency flows (also known as recurrence interval flows) which represent higher flows that are expected to occur at a specific frequency (i.e., a 100-year flow would be expected to occur every 100 years on average). For this analysis, only the 100-year flood frequency flow was used to compare hydraulic modeling results against current FEMA flood map extents.

A flood frequency analysis (FFA) was performed on annual peaks recorded at USGS stream gage Mattole River near Ettersburg (USGS 11468900) in accordance with USGS Bulletin 17C (USGS 2019) using the Hydrologic Engineering Center's statistical software package (HEC-SSP) (USACE 2019). Station skew was applied to all FFA calculations. For proration calculations, a drainage area of 2 square miles was used for Vanauken Creek at the confluence with the Mattole River, which has a total drainage area of 70.9 square miles. Peak flow estimates were prorated for the project reach following the Waananen and Crippen (1977) transference equation described in Section 7.2.4.

Additional peak flow estimates were acquired from the interactive USGS StreamStats website (http://water.usgs.gov/osw/streamstats/california.html). For ungaged streams, StreamStats provides peak flow estimates for 2-, 5-, 10-, 25-, 50-, and 100-year flood events. In general, the StreamStats results agreed well with the prorated discharge estimates from the USGS gage. Table 5 summarizes flood frequency estimates for the Project reach averaging the two hydrologic data sources.

Table 5. Vanauken Creek estimated flood frequency.

Return period (years)	Discharge (cfs)*
1.1	181
2	274
5	460
10	572
25	701
50	821
100	928

* Average of HEC-SSP and StreamStats.

7.4.2.2 Existing conditions hydraulic modeling

Topographic data for the Project is based on field-based survey and LiDAR as described above in Section 6. Cross-sections of the channel were cut from the Triangular Irregular Network (TIN) surface in AutoCAD and exported directly to HEC-RAS in order to create the hydraulic model. Manning's "n" roughness values used in HEC-RAS were 0.04 for the channel, based on the HEC-RAS Reference Manual recommendations for a "clean and winding natural stream with some pools, shoals, weeds and stones", and 0.08 for all banks and floodplains to reflect the typical conditions of "medium to dense brush". Downstream boundary conditions for completing normal depth equations were assumed to be an average of 0.9% and were approximated from field observations and available topographic data. Flow was simulated in a subcritical regime with steady flow for each model run.

For this project, a relatively coarse HEC-RAS model was developed with cross sections placed at 100-ft increments. The objective of this modeling was to determine general 100-year floodplain mapping, inundation, and extents.

7.4.2.3 Existing conditions hydraulic model results

Hydraulic modeling was conducted for the existing conditions along Vanauken Creek within the channel from the confluence with the Mattole River to slightly upstream of the East Pond. 100-year flood flows are entirely confined within the channel with peak velocities approaching 15 feet per second (ft/s) in constrained areas of the channel. The results of the hydraulic model at both pond locations are shown in Figures 9 and 10 below and compare the hydraulic model results with existing FEMA flood hazard mapping for Vanauken Creek. Full model results are included in Appendix B.

Based on this analysis, the FEMA flood inundation mapping is extremely coarse and should be superseded by Stillwater's site-specific hydraulic analysis. The primary conclusion from the hydraulic modeling results for the 100-year flood event flow is that the proposed ponds should be largely unaffected by large storm events and flows in Vanauken Creek.

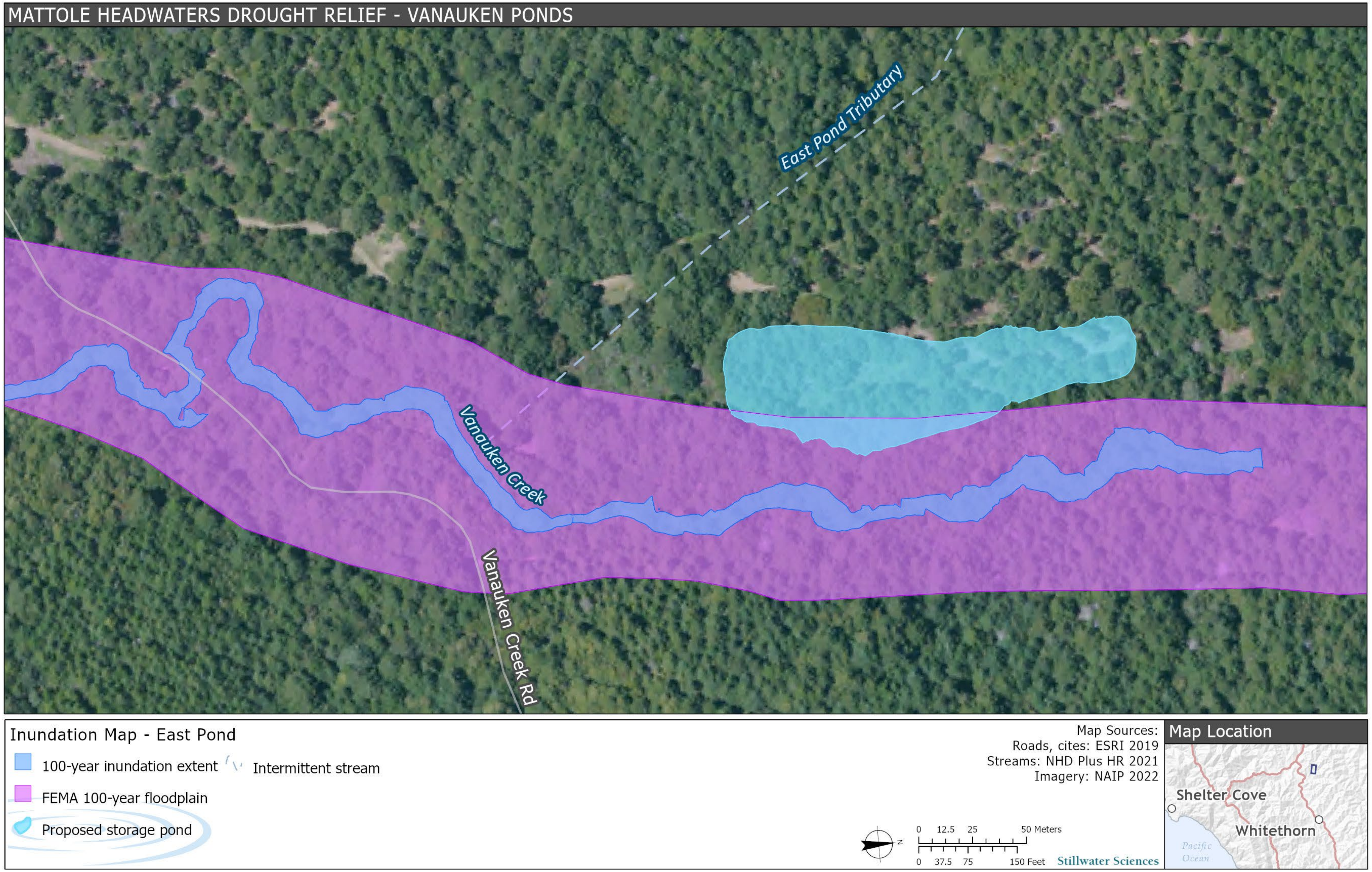

Figure 9. Vanauken Creek 100-year inundation adjacent to East Pond.

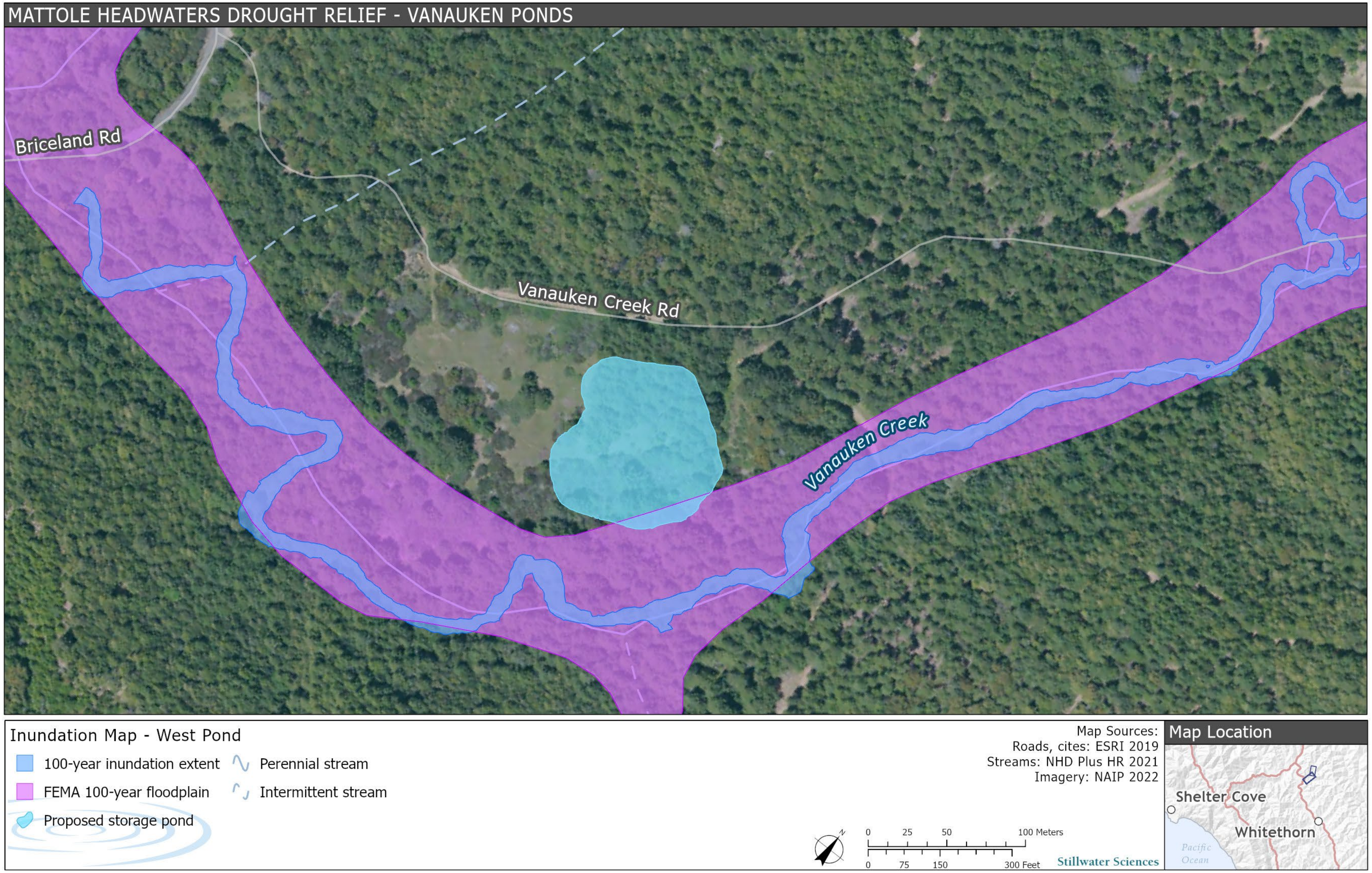

Figure 10. Inundation at various flows within the project reach.

7.5 Groundwater

No groundwater wells have been installed specifically for this project. However, Sanctuary Forest has installed and monitored numerous groundwater wells within the Mattole River headwaters vicinity and t groundwater conditions at this site are expected to behave similar to other sites with groundwater levels fluctuating from approximately 20 ft below ground surface (bgs) during the dry season to near the ground surface during the peak of the wet season. The project design has taken these groundwater conditions into consideration.

8 ADDITIONAL SITE EVALUATIONS

8.1 Cultural Resources

A cultural resources study is underway and will be finalized soon. Previous cultural resources have been conducted for other restoration projects including the adjacent Mattole Headwaters Enhancement and Planning Project. No new resources were identified within the Vanauken Creek portion of the project area and there are no avoidance recommendations.

8.2 Biological Resources

Stillwater Sciences has completed a Biological Resources Evaluation to support the 65% design. The proposed project design is being developed with the goal of enhancing local aquatic habitat. The assessment shows one sensitive natural plant community (*Pteridium aquilinum* – Grass Association) occurring within the Project area. Where the sensitive natural community occurs, in addition to minimizing the overall footprint of disturbance in this habitat to the extent possible, avoidance, minimization, and mitigation measures will be incorporated to mitigate for impacts to this community and are outlined in the Biological Resources Technical Report included in Appendix C.

8.3 Soil Conditions

In August 2024, Stillwater Sciences conducted soil sampling at six locations within the Project site to assess existing soil conditions and analyze parameters relevant to Project objectives. These objectives included: establishing baseline conditions, evaluating constructability, assessing soil suitability for percolation and infiltration, and determining feasibility for project alternatives requiring specific soil characteristics. Three sample locations were selected at the proposed East Pond footprint, two at the West Pond, and one at the proposed infiltration location. Soil testing was performed by SHN's material lab in Eureka, California, included moisture/density analysis, particle size analysis (D422), compaction curve determination, and plasticity index measurement. A comprehensive soils report based on a site assessment, soil sampling and lab analyses results is included in Appendix D.

9 PROJECT DESIGN

The primary objective for the Mattole Headwaters Drought Relief Project is to construct two ponds with approximately 6 million gallons of off-stream water storage that are intended to deliver approximately 25 gpm of flow augmentation to Vanauken Creek and the Mattole River mainstem during the four-month dry season. Project features are described below and shown in the 65% design plans in Appendix A.

9.1 Ponds

Construction of two off-channel ponds will include excavation and placement of earthen berms and spillways built into the natural topography. Construction will include removal of topsoil from the reservoir area. The topsoil will be saved and spread around the reservoir area along with mulch after construction. All critical fill placement will be subject to compaction standards to ensure appropriate compaction. Cut/fill is expected to be balanced onsite with current earthwork estimates at approximately 21,000 cubic yards.

Section 9.5 describes the alternatives analysis that resulted in selection of the preferred design alternative which was carried forward to the 65% design included herein. The preferred alternative is comprised of two HDPE-lined ponds, each equipped with an underlying French drain system to control groundwater levels under the pond liner. The HDPE liner will be under- and over-laid by woven geotextile fabric and a gravel topping.

Each pond will have a dedicated flow augmentation location, will be hydraulically isolated from each other, and be independently operated. Both ponds have rock-lined spillways sized for the 100-year storm discharge as shown on the design plans. The West Pond's spillway also acts as a cooling/filtration gallery as described in section 9.3.2 below.

9.1.1 Pond stage storage

The West Pond is designed to store approximately 4 million gallons and has a maximum water depth of 25 ft. Its side slopes are graded at 3:1 except for the northwest corner which is graded at a gentler 5:1 slope to provide safer access for potential public use. The East Pond is designed for 2 million gallons of storage with a maximum depth of 19 ft and 3:1 side slope with no plans for public access. A complete stage-storage table for both ponds is provided in Table 6 below.

Table 6. Pond stage-storage table.

Water depth (ft)	Eastern Pond volume (gal)	Eastern Pond surface area (sq ft)	Western Pond volume (gal)	Western Pond surface area (sq ft)
0	-	33	-	4,184
1	1,440	427	34,371	5,019
2	7,022	1,120	75,180	5,904
3	18,823	2,085	122,869	6,858
4	38,838	3,313	178,058	7,910
5	68,940	4,779	241,470	9,057
6	110,816	6,459	13,810	10,297
7	165,708	8,254	395,765	11,628
8	234,466	10,162	488,022	13,052
9	318,039	12,213	591,277	14,568
10	417,558	14,425	706,210	16,175
11	534,276	16,811	833,466	17,863
12	669,520	19,379	973,656	19,633
13	824,769	22,160	1,127,399	21,486
14	1,001,614	25,153	1,295,318	23,423
15	1,201,220	28,244	1,478,056	25,448
16	1,424,191	31,398	1,676,282	27,564
17	1,670,986	34,612	1,890,686	29,774
18	1,942,052	37,885	2,121,994	32,084
19	2,237,821	41,215	2,370,937	34,488
20			2,638,178	36,976
21			2,924,319	39,542
22			3,229,942	42,184
23			3,555,617	44,903
24			3,901,896	47,693
25			4,269,334	50,560

9.1.2 Existing materials on-site

An existing spoils pile, situated on the eastern boundary of the West Pond project site, is designated for utilization as a non-load bearing fill. This pile comprises an estimated 4,500 cubic yards of material, originating from a past restoration project on Vanauken Creek when a culvert was removed and replaced with a bridge in 2005. Notably, the prior project was supervised by this project's lead engineer, Joel Monschke, P.E., ensuring familiarity with the material's properties and suitability for the intended application.

9.2 Hillslope Sheet-flow Capture

Shallow French drains will be installed along the inboard ditch of the existing private access road as shown on Sheets 6 and 12 in Appendix A. These drains will capture road runoff and subsurface flow with perforated PVC pipe and convey it via gravity to the East and West Ponds. The captured water will be stored during the wet season and then released as needed to augment during the dry season.

9.3 Flow Enhancement Delivery System and Cooling/Filtration Galleries

All pond outflows will have screened outlets. Valves, pumps and flow meters will control and monitor the amount of water that is released from the ponds. Water will be directed into cooling/filtration galleries that utilize natural hyporheic cooling of the flow release through the existing soil. This approach is being used at the nearby Marshall Ranch Project and is proving effective at maintaining desirable water quality and temperature of the flow releases. The three primary infiltration locations are shown in the 65% design plans in Appendix A and discussed below.

9.3.1 Primary West Pond release

To facilitate water extraction from the lower strata of the West Pond, a pumped suction pipeline will be installed above the liner. This system will enable the transfer of water to two designated discharge points. The primary discharge location, situated along Vanauken Creek Road approximately 850 feet upstream of the pond and facilitates subsurface flow augmentation while extending the wetted reach within the creek.

9.3.2 West Pond spillway/infiltration gallery

The West Pond's pumped flow augmentation system offers operational flexibility with two discharge options. The primary discharge, detailed in Section 9.3.1, allows for controlled release of extracted water upstream of the West Pond. Alternatively, water can be directed to the West Pond spillway/infiltration gallery. This gallery is designed to enhance subsurface flow through the soils underlying the open meadow west of the project site.

9.3.3 East Pond flow augmentation dry well

The primary flow release will be installed in the East Pond on top of the proposed HDPE liner and will act via siphon to deliver water to a flow augmentation dry well situated immediately southeast of the East Pond footprint. This location is out of any active channel and due to its proximity to both the East Pond tributary and Vanauken Creek, has potential augmentation benefits to both watercourses.

9.4 Off-grid Energy System

A solar array, battery bank, inverter, transfer pump, valving and small control center shed will provide power to operate a sump pump under the West Pond liner and the pumped flow release from the West Pond to cooling/filtration galleries. The energy system will be further designed during the 100% design phase.

9.5 Alternative Analysis

An alternatives analysis was conducted during the 30% and 65% design phases focused on the liner type to be used for the West Pond. Table 7 contains an alternative comparison with regard to design considerations and Table 8 contains a cost comparison and breakdown. As described above in Section 7, a separate alternatives analysis was conducted to select the most appropriate approach for filling the ponds during the wet season.

Table 7. Alternative comparisons.

Design consideration	Alternative 1: clay-lined West Pond	Alternative 2: HDPE-lined West Pond	Alternative 3: cutoff wall West Pond
Flow Augmentation Benefit	Significant flow release would occur outside of critical low flow period	Flow release targeted to address critical low flow period	Flow release targeted to address critical low flow period; minimal leakage would reduce volume available for release
Operations and Maintenance Costs	Passive flow release to require less maintenance over time	Managed flow release to require more maintenance over time	Managed flow release to require more maintenance over time
Longevity and Durability	Clay liner likely to wear out over time with erosion and vegetation	HDPE liner degrades with exposure to sunlight but can last significantly longer when covered. Gravel topping expected to increase longevity.	Cutoff wall expected to function well for several decades or more unless there are contaminants or salt water.
Water Temperature	Likely lower water temperature with clay liner, but proposing cooling/filtration galleries with either alternative	Likely higher water temperature than unlined, but may be offset by maintaining deeper water column through early summer	Likely lower water temperature than HDPE liner, but proposing cooling/filtration galleries with all alternatives
Water Quality	Higher likelihood of ongoing turbidity issues, but probably not a big issue considering the anticipated passive release approach	Better water quality	Water quality expected to be better than clay lined but slightly more turbid than HDPE lined (depending on gravel material used top the liner)
Materials	Use of more natural materials, although would likely require import of significant bentonite clay from out of state which has very high carbon footprint	Utilizes HDPE liner and more piping than Alternative 1	Use of more natural materials, although would likely require import of significant bentonite clay from out of state which has very high carbon footprint

Table 8. Alternative cost comparison.

	Alternative 1: clay-lined West Pond	**Alternative 2: HDPE-lined West Pond**	**Alternative 3: cutoff wall West Pond**
Total Cost	$596,410	$363,054	$750,000
Specifications	Clay blanket 2'thick (mix of native soil and 15% bentonite) 6" native soil to cap clay blanket Final cap of 3" pea gravel	70,000 sq ft BTL-40 liner 2 layers black geotextile 2,259 CY gravel for 1'thick cap over entire surface	Soil bentonite cutoff wall, installed with the slurry method. 30' deep by 1000' long
Cost of Materials	Bentonite – $274,500 Pea gravel – $28,250	BTL-40 liner, black geo & shipping – $80,159 Imported gravel – $101,655	All materials included in sq ft pricing
Cost of Labor	Mix & install clay blanket - $225,900 Install native soil cap & pea gravel – $67,760	Liner install – $45,500 Gravel cap install – $135,540	$20/sq ft for 30,000 sq ft with mobilization – $150,000

9.5.1 Alternative 1 – clay liner in West Pond

It may be possible to achieve some degree of low impermeability with a clay liner, but based on past experience it should be anticipated that the pond will experience significant seepage loss that generally follows the natural hydrograph trends of highest rates in the early spring when rainfall stops and pond levels are high and lowest rates at the driest time of year. This seepage would enter Vanauken Creek and provide a flow benefit, but that benefit would mostly be achieved in the spring and early summer. This flow release dynamic would be partially offset by using the HDPE-lined East Pond to maintain higher augmentation rates during the critical low flow period of August to October.

9.5.2 Alternative 2 – HDPE liner in West Pond

HDPE liners have proven to be a good solution for achieving complete impermeability for ponds, especially if topped with a gravel liner to prevent wearing from wildlife ingress/egress and solar radiation. This alternative would allow for a managed flow release that targets the critical low flow period in Vanauken Creek.

9.5.3 Alternative 3 – cutoff wall in West Pond berm

Cutoff walls are another option for reducing pond leakage rate and if effective, have many benefits as compared to pond liners. Because they are constructed within the center of the berm rather than applied to the surface, they do not cause turbidity or become damaged and leaky from large animals such as bear and elk, or vegetation. Depending on subsurface site conditions, cutoff walls can be constructed with minimal leakage and operated for a managed flow release similar to HDPE lined ponds.

However, to be effective, the cutoff wall needs to key into a non-transmissive stratigraphic layer of clay or bedrock. The project team has learned from past projects with cutoff walls (also referred to as subsurface clay restrictive barriers) that the native “blue clay” layer commonly observed immediately above the bedrock elevation is not an effective foundation. As per analysis by EBA Engineering, permeability values from a bulk sample of this material were 3.0×10^{-6} cm/sec corresponding to 37 ft/year. In addition, variability was observed between test holes with a higher sand content in some locations and would likely result in higher leakage rates along sections of the foundation.

Sanctuary Forest consulted with Tino Maestas, Technical Director at ODIN Environmental to assess the feasibility of a soil bentonite cutoff wall utilizing a slurry trenching technique and keyed into the bedrock. ODIN has constructed hundreds of cutoff walls for levee systems in California and reservoirs in Colorado. They are able to achieve maximum hydraulic conductivities of 1×10^{-7} cm/sec depending on both the foundation material and subsurface fines content.

Investigation of the subsurface soil stratigraphy at the pond sites was conducted by Stillwater Sciences and Sanctuary Forest. Four test holes were dug at the West Pond site with an excavator to determine depth to bedrock and obtain representative soil samples. The test hole results indicated bedrock elevations ~ 6 ft higher than the bottom of the pond and highly variable composition of soft fractured mudstone interspersed with harder sandstone. For the cutoff wall to be effective, it would require keying into the more competent sandstone. Given the bedrock variability observed, it is unlikely that there is a uniform low permeability bedrock surface under the pond footprint and therefore the site is not a good candidate for a cutoff wall.

If a cutoff wall is selected instead of a liner, the flow augmentation would be through managed flow release, similar to the HDPE liner. However, some leakage would be expected and contribute to substantial passive seepage.

10 OPERATION AND MAINTENANCE

Following construction, the Project will be operated and maintained to achieve long term flow enhancement objectives.

10.1 Project Operations

The following sections describe components of Project operations.

10.1.1 Pond water quality maintenance

During the dry season, pond water quality including temperature will be closely monitored.

The primary target water quality target is flow releases with a dissolved oxygen level above 5.0 mg/L. Additional water quality indicators for assessing pond water will be evaluated during final permitting and initial operations phases.

10.1.2 Dry season flow augmentation

Water will be released from the ponds to Vanauken Creek during the dry season. The start date and rate of flow augmentation will vary based on the hydrologic conditions in the watershed each year. It is anticipated that flow releases will begin when Vanauken Creek flows are approximately 50 gallons per minute. Flow releases will continue until significant rainfall occurs within the watershed increasing streamflow to above approximately 50 gallons per minute within Vanauken Creek in proximity to the flow augmentation ponds. The flow augmentation period will generally be from July 1st to October 31st but varies from season to season. Specific goals and objectives for the flow release are described above in Section 3.

10.1.3 Yearly flow augmentation plan and agency coordination

Based on annual hydrologic conditions including pond volume and Vanauken Creek streamflow projections, a brief Annual Flow Augmentation Plan will be compiled that includes the following:

- Pond water volume available for release
- Anticipated initiation of flow augmentation
- Projected rate and duration of flow augmentation

The Plan will be submitted to a TAC and/or permitting agencies for review/input and will be adjusted accordingly.

10.2 Flow Augmentation Monitoring

SF will monitor dry season flows in Vanauken Creek to document project results. Two years of post-project monitoring will include effectiveness monitoring and streamflow monitoring protocols.

10.2.1 Post-project effectiveness monitoring

Monitoring is needed to measure the streamflow enhancement benefits of the Project, to determine if the project is performing as designed, and to identify adaptive management needs.

Assessment questions include the following output and outcome performance measures of the project:

Output performance measures:

- Was the project built as per the design? Are the ponds and other features functioning properly?
- Was the site planted with native vegetation as planned?

Outcome performance measures:

- Protect and enhance salmonid populations in Vanauken Creek
    - Specifically targeting Coho salmon, winter-run steelhead trout, and Chinook salmon, all of which are threatened or endangered species.
- Improve summertime streamflows
    - Critical for salmonid survival, especially during low-flow periods in late summer and early fall when Vanauken Creek dries up or becomes fragmented into pools.
- Implement key recovery actions from the SONCC Recovery Plan
    - Addressing limiting stresses and promoting the recovery of endangered salmonid populations.
- What is the survival of the planted vegetation?

10.2.2 Monitoring parameters and protocols

The following specific metrics, methods and protocols will be used.

10.2.3 Pre-project

Output performance measures:

- Topographic survey of the site and mapping of the stream channel and adjacent terraces (completed).
- Establish photo points and photo document pre-project site conditions.

Outcome performance measures (characterization of pre-project conditions):

- Seasonal streamflow monitoring twice monthly at a previously established SF Vanauken Creek mainstem monitoring stations using standard cross-section and velocity measurements with Marsh McBirney or Electromagnetic flow meter or “bucket & stopwatch” along with installation of staff gages to develop water level & discharge relationship.

- Juvenile salmon survey within 1 year of the project. Mattole Salmon Group will perform monitoring based on protocols developed from the collaborative monitoring program with CDFW. Additional protocol TBD.

10.2.4 Post-project (two years)

Output performance measures:

- Topographic survey of the site to document as-built conditions
- Photo documentation from established photo points showing all changes to the site.

Outcome performance measures (includes characterization of post project conditions):

- Seasonal streamflow monitoring twice monthly at a previously established SF Vanauken Creek mainstem monitoring stations using standard cross-section and velocity measurements with Marsh McBirney or Electromagnetic flow meter or "bucket & stopwatch" along with installation of staff gages to develop water level & discharge relationship.
- Temperature and dissolved oxygen monitoring every two weeks.
- Dry reach mapping to assess pool connectivity once monthly during the lowest flow months of September and October or when flows at the downstream end of Vanauken Creek drop below 0.044 cfs (20 GPM).
- Juvenile salmon survey for 2 years post-project. Mattole Salmon Group will perform monitoring based on protocols developed from the collaborative monitoring program with CDFW. Additional protocol TBD.

10.2.5 Responsibility and timeframe for attaining performance standards

Sanctuary Forest is responsible for analyzing the data and issuing the reports. Streamflow data is analyzed with technical review from Stillwater Sciences. Technical collaborating partners from agencies participating in the TAC for Vanauken Creek Flow Enhancement Planning will also provide input. Complete evaluation of the project will be conducted after two years of post-project monitoring.

10.2.6 Annual reporting schedule

Sanctuary Forest will prepare an annual monitoring report by Jan 15^{th} of the following year. The reports will include a description of the monitoring strategies/goals and describe specific results for each performance measure listed under Section 6.2.2 including: 1) monitoring results, 2) project performance observations and evaluation results, 3) lessons learned and adaptive management needs, 4) maintenance activities or operational changes implemented in the previous year with photos based on adaptive management guidance, and 5) maintenance activities or operational changes planned for the upcoming year based on adaptive management guidance.

10.3 Infrastructure Monitoring & Maintenance

The project team will conduct periodical on-the-ground monitoring of project features and equipment. The exact schedule is TBD but will also be guided by any questionable data from the online monitoring system. Onsite inspections will focus on the following project features:

- Flow augmentation delivery (dry season) – inspection of cooling/filtration gallery and augmentation outfall.

- Ponds – check for any issues with the liner, slumping/rilling of earthwork, general conditions.
- Other infrastructure – Check/inspect pump condition/performance and general inspection of project vicinity.

10.4 Adaptive Management and Coordination with Other Projects

As appropriate, operations of this project will be coordinated with other flow enhancement efforts in the Mattole headwaters. This may include adaptive management of flow augmentation rates, timing, and/or approach to improve downstream aquatic habitat conditions based on monitoring results and/or other relevant information that becomes available.

11 PROJECT RISK AND PERFORMANCE ASSESSMENT

A summary of project risks and risk management is summarized below.

11.1 Risk and Management of Pond and Hydraulic Appurtenances Failure

1. Risk: Failure of the earthen fill that constitutes the pond berm is a project risk that could result in damage to downslope property and infrastructure, or natural resources.

   Management: Informed by lessons learned from the Marshall Ranch project, the total storage volume has been distributed across two ponds to minimize berm height and earthen fill requirements. The West Pond, with a storage capacity of 4 million gallons, is strategically situated adjacent to Vanauken Creek, ensuring minimal risk to downslope property and infrastructure. The East Pond, further mitigating potential impact, features a storage capacity of 2 million gallons and is constructed via excess cut to reduce berm height.

   Post-construction, a comprehensive monitoring program will be implemented to ensure the ponds' operational integrity and adherence to design parameters. Throughout all project phases, a collaborative approach with Sanctuary Forest will be maintained, employing best engineering practices and rigorous oversight to minimize risk and optimize system performance.

2. Risk: The most common failure mechanism of ponds and reservoirs is the failure of the overflow/spillway system. This can lead to significant erosion and mass wasting and can ultimately cause complete failure of the storage pond if left untreated.

   Management: The project design includes spillways sized to pass 100-year storm discharges, with an additional factor of safety.

3. Risk: Although it would likely not result in catastrophic failure of the Project, there is a risk of failure or malfunction of the flow enhancement piping, flow meter, valves, and cooling gallery.

   Management: These systems will be constructed with redundancy wherever practicable.

Secured funding will provide resources for monitoring, operations, and maintenance of these systems.

11.2 Overall Risks and Management Approaches Associated with Long-term Project Results

1. Risk: Water quality and temperature produced by the pond is not suitable for aquatic species in the downstream channel.

   Management: The project planning process has taken these risks into consideration with the pond and water delivery systems designed such that appropriate temperature and water quality are maintained, with emphasis on use of cooling/filtration galleries. The water delivery system will draw water out of the bottom of the pond which will have lower temperatures for most of the year. Cooling/filtration galleries will be utilized to decrease the temperature of flow releases. Detailed post-project monitoring and adaptive management actions will be utilized to change pond operations as necessary. Furthermore, case studies from Russian River tributaries have shown that similar projects greatly improved water quality and specifically dissolved oxygen (RRCWRP 2017, Grantham et. al. 2018, RRCWRP 2019).

2. Risk: Although we know that fish need water to survive, there is some uncertainty regarding how the aquatic habitat will respond to enhanced flows, how to measure and quantify that response, and how to adjust the project flow delivery to maximize aquatic habitat benefit.

   Management: Based on similar projects conducted in Sonoma County in lower Russian River tributaries over the past several years, direct flow augmentation has been very effective in improving downstream aquatic habitat (Ruiz et al. 2018, Obedzinski et al. 2018, RRCWRP 2017, Grantham et. al. 2018, and RRCWRP 2019). However, as this habitat enhancement approach continues to develop, the risk can be addressed by post project monitoring of downstream discharge, temperature, dissolved oxygen levels, fish abundance, and fish health. Based on monitoring results from this and other projects, the Project operations can be adjusted to maximize aquatic habitat benefit.

12 CONCLUSION

Although there are risks associated with this project, the management actions described in Section 11 above reduce project risk to an acceptable level when compared to the expected project benefits. The “no-project alternative” will result in continued degradation of dry-season aquatic habitat in Vanauken Creek.

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Appendices

Appendix A

65% Design Plans

MATTOLE HEADWATERS - DROUGHT RELIEF

PROJECT PROPONENT:

SANCTUARY FOREST
315 SHELTER COVE ROAD
WHITETHORN, CA 95589

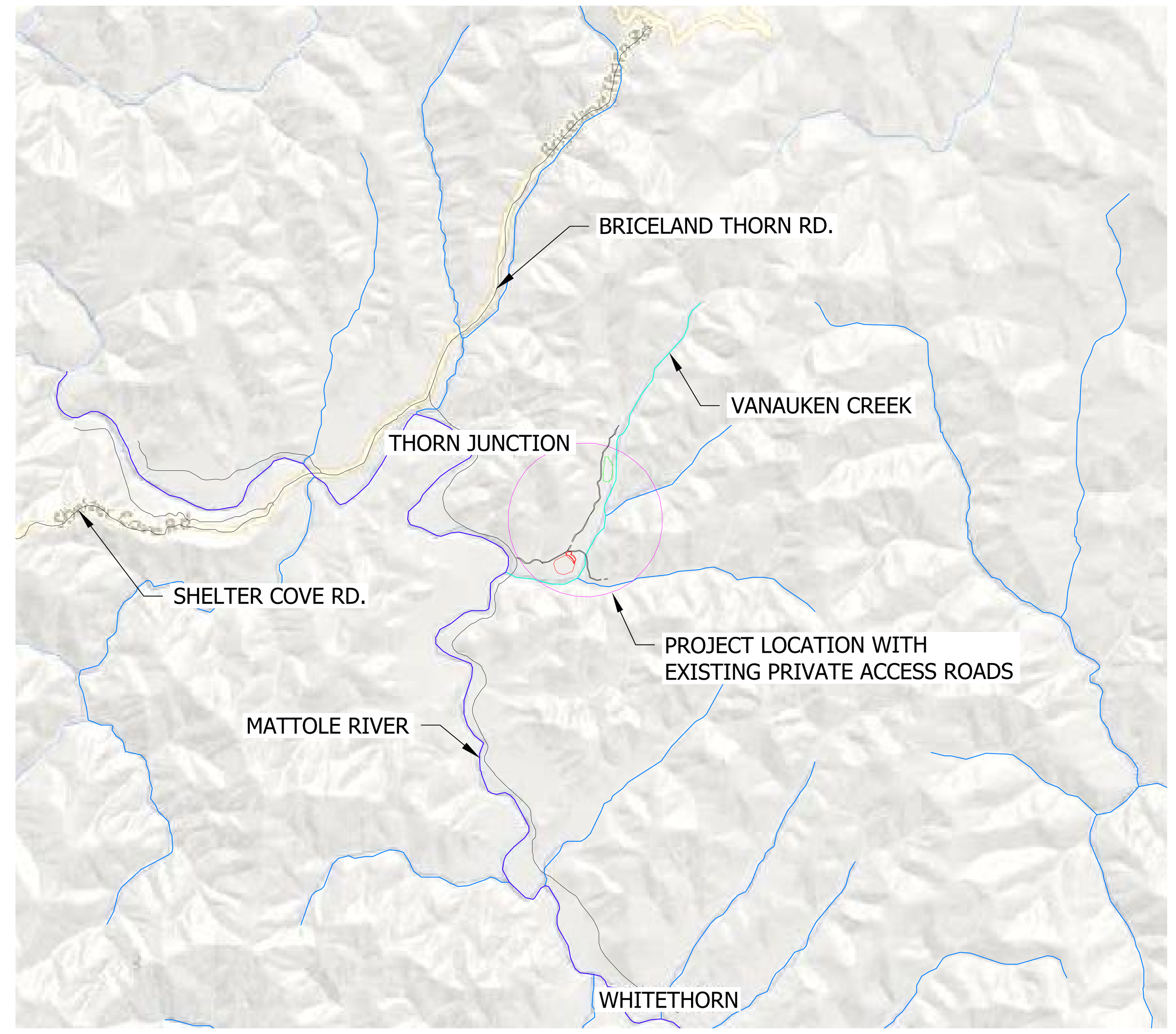
(707) 986-1087
TASHA@SANCTUARYFOREST.ORG

AGENT:

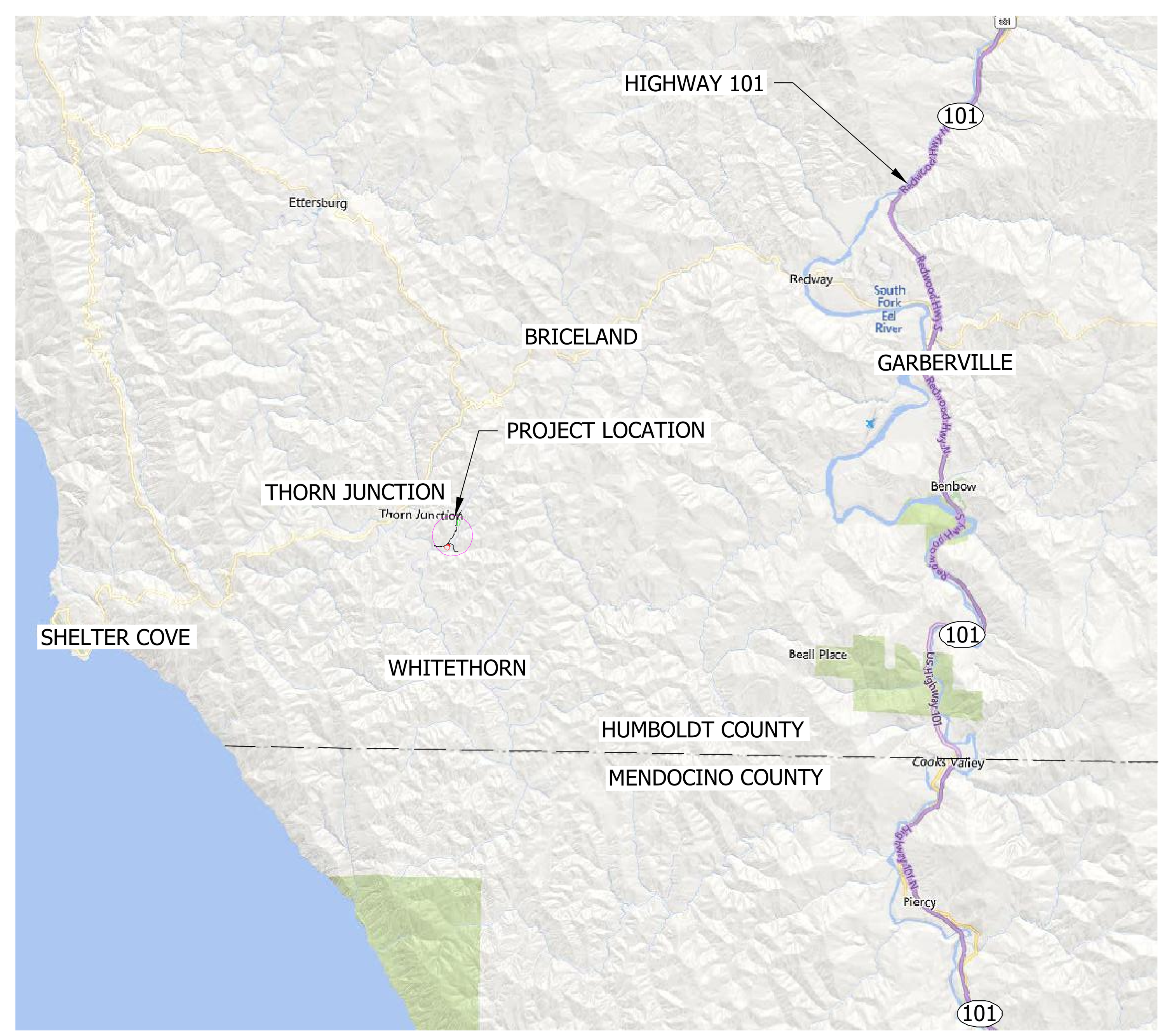
STILLWATER SCIENCES
850 G STREET, SUITE K
ARCATA, CA 95521

707-496-7075
JMONSCHKE@STILLWATERSCI.COM

VICINITY MAP



PROXIMITY MAP



GENERAL NOTES, TERMS, & CONDITIONS:

1. **DESIGN INTENT.** THESE DRAWINGS REPRESENT THE GENERAL DESIGN INTENT TO BE IMPLEMENTED AND CONTRACTOR IS RESPONSIBLE FOR ALL ITEMS SHOWN ON THESE PLANS. CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING THE PROJECT MANAGER FOR ANY CLARIFICATIONS OR FURTHER DETAILS NECESSARY TO ACCOMMODATE ACTUAL SITE CONDITIONS. ANY DEVIATION FROM THESE PLANS WITHOUT THE RCD'S REPRESENTATIVE APPROVAL ARE AT THE CONTRACTOR'S OWN RISK AND EXPENSE. NOTIFY PROJECT MANAGER IMMEDIATELY OF ANY UNEXPECTED AND CHANGED CONDITIONS, SAFETY HAZARDS, AND ENVIRONMENTAL PROBLEMS ENCOUNTERED.

2. **JOB SITE CONDITIONS AND CONTRACTOR RESPONSIBILITY.** CONTRACTOR SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR SITE CONDITIONS DURING THE COURSE OF THE CONSTRUCTION OF THIS PROJECT, INCLUDING THE SAFETY OF ALL PERSONS AND PROPERTY, AND ALL ENVIRONMENTAL PROTECTION ELEMENTS, WHETHER SHOWN ON THESE DRAWINGS OR NOT. CONTRACTOR SHALL FOLLOW ALL APPLICABLE CONSTRUCTION AND SAFETY REGULATIONS. THESE REQUIREMENTS SHALL APPLY CONTINUOUSLY AND WILL NOT BE LIMITED TO NORMAL WORKING HOURS. THE CONTRACTOR SHALL DEFEND, INDEMNIFY, AND HOLD THE CLIENT OR THE ENGINEER (STILLWATER SCIENCES) HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPT FROM LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE CLIENT OR ENGINEER.

3. **DAMAGE.** CONTRACTOR SHALL EXERCISE CARE TO AVOID DAMAGE TO EXISTING PUBLIC AND PRIVATE PROPERTY, INCLUDING NATIVE TREES AND SHRUBS, AND OTHER PROPERTY IMPROVEMENTS. IF CONTRACTOR CAUSES DAMAGES TO SUCH ITEMS, HE SHALL BE RESPONSIBLE FOR REPAIR OR REPLACEMENT IN LIKE NUMBER, KIND, CONDITION, AND SIZE. ANY SUCH COST MAY BE DEDUCTED BY OWNER FROM MONIES DUE CONTRACTOR UNDER THIS CONTRACT.

4. **LIMITS OF WORK, ACCESS, STAGING AND MOBILIZATION AREAS.** THE APPROXIMATE LIMITS OF WORK ARE SHOWN ON THE DRAWINGS. EXACT LIMITS OF WORK, POINTS OF INGRESS-EGRESS, CREEK CHANNEL ACCESS, MOBILIZATION, STAGING, AND WORK AREAS WILL BE FLAGGED IN THE FIELD BY THE ENGINEER. EQUIPMENT MAINTENANCE AND FUELING MUST OCCUR OUTSIDE OF THE CHANNEL AREA AS DESCRIBED IN THE ENVIRONMENTAL PERMITS FOR THE PROJECT.

5. **EARTHWORK QUANTITIES.** CONTRACTOR IS RESPONSIBLE FOR ALL EARTHWORK, INCLUDING GRADING, PROVISION AND PLACEMENT OF ROCK MEETING SIZE LIMITS, AS SHOWN ON DRAWINGS, AND DISPOSAL OF ALL EXCESS SOIL AND RUBBLE. EARTHWORK QUANTITIES, INCLUDING GRADING, PLACED ROCK RIP-RAP AND OFF-HAUL QUANTITY ESTIMATES PROVIDED BY THE ENGINEER ARE ESTIMATES ONLY. CLIENT AND ENGINEER DO NOT, EXPRESSLY OR OTHERWISE BY IMPLICATION, EXTEND ANY WARRANTY TO EARTHWORK CALCULATIONS.

6. AREAS TO BE GRADED SHALL BE CLEARED OF ALL VEGETATION INCLUDING ROOTS AND OTHER UNSUITABLE MATERIAL FOR A STRUCTURAL FILL, THEN SCARIFIED TO A DEPTH OF 6 INCHES PRIOR TO PLACING OF ANY FILL.

7. AREAS WITH EXISTING SLOPES WHICH ARE TO RECEIVE FILL MATERIAL SHALL BE KEYED AND BENCHED.

8. FILL MATERIAL SHALL BE SPREAD IN LIFTS NOT EXCEEDING 6 INCHES IN COMPACTED THICKNESS, MOISTENED OR DRIED AS NECESSARY TO NEAR OPTIMUM MOISTURE CONTENT AND COMPACTED BY AN APPROVED METHOD. FILL MATERIAL SHALL BE COMPACTED TO A MINIMUM OF 85% MAXIMUM DENSITY AS DETERMINED BY 1957 ASTM D - 1557 - 91 MODIFIED PROCTOR (AASHO) TEST OR SIMILAR APPROVED METHODS.

9. CUT SLOPES SHALL NOT EXCEED A GRADE OF 3 HORIZONTAL TO 1 VERTICAL. FILL AND COMBINATION FILL AND CUT SLOPES SHALL NOT EXCEED 3 HORIZONTAL TO 1 VERTICAL. SLOPES OVER THREE FEET IN VERTICAL HEIGHT SHALL BE PLANTED WITH APPROVED PERENNIAL OR TREATED WITH EQUALLY APPROVED EROSION CONTROL MEASURES PRIOR TO FINAL INSPECTION.

10. BEST MANAGEMENT PRACTICES FOR CONSTRUCTION ACTIVITIES: ERODED SEDIMENTS AND OTHER POLLUTANTS MUST BE RETAINED ONSITE AND MAY NOT BE TRANSPORTED FROM THE SITE VIA SHEET FLOW, SWALES, AREA DRAINS, NATURAL DRAINAGE COURSES, OR WIND. STOCKPILES OF EARTH AND OTHER CONSTRUCTION RELATED MATERIALS MUST BE PROTECTED FROM BEING TRANSPORTED FROM THE SITE BY THE FORCES OF WIND OR WATER. FUELS, OILS, SOLVENTS, AND OTHER TOXIC MATERIALS MUST BE STORED IN ACCORDANCE WITH THEIR LISTING AND ARE NOT TO CONTAMINATE THE SOIL AND SURFACE WATERS. ALL APPROVED STORAGE CONTAINERS ARE TO BE PROTECTED FROM THE WEATHER. SPILLS MAY NOT BE WASHED INTO THE DRAINAGE SYSTEM. EXCESS OR WASTE CONCRETE MAY NOT BE WASHED INTO PUBLIC WAY OR ANY OTHER DRAINAGE SYSTEM. PROVISIONS MUST BE MADE TO RETAIN CONCRETE WASTES ON SITE UNTIL THEY CAN BE DISPOSED AS A SOLID WASTE. TRASH AND CONSTRUCTION RELATED SOLID WASTE MUST BE DEPOSITED INTO A COVERED WASTE RECEPTACLE TO PREVENT CONTAMINATION OF RAINWATER AND DISPERSAL BY WIND. SEDIMENTS AND OTHER MATERIAL MAY NOT BE TRACKED FROM TO THE SITE BY VEHICLE TRAFFIC.

Sheet List Table

EARTHWORK ESTIMATES:

CUT: ~21000 CY

FILL: ~21000 CY ON-SITE

ABBREVIATIONS AND SYMBOLS:

<E> EXISTING

<P> PROPOSED

3 — DETAIL # ON SHEET
8 — SHEET #

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

Stillwater Sciences
850 G STREET SUITE K
ARCATA, CA 95521 P: (707) 822-9607

REVISIONS

NO.	DESCRIPTION	DATE

65% DESIGN REVIEW DRAWINGS

PROJECT NUMBER: 588.11
SCALE: AS NOTED
DATE: 12/12/24

DESIGN: JB/JM
DRAWN: JB
CHECKED: JM
APPROVED: JM

TITLE SHEET

NOTE:

NO NEW ROADS ARE PROPOSED FOR THIS PROJECT.
ALL AVAILABLE ACCESS ROUTES ARE EXISTING.

1 OVERVIEW - PLAN
Scale: 1:200

0 100 200 400 FEET
SCALE: 1" = 200'

MATTOLE HEADWATERS - DROUGHT RELIEF

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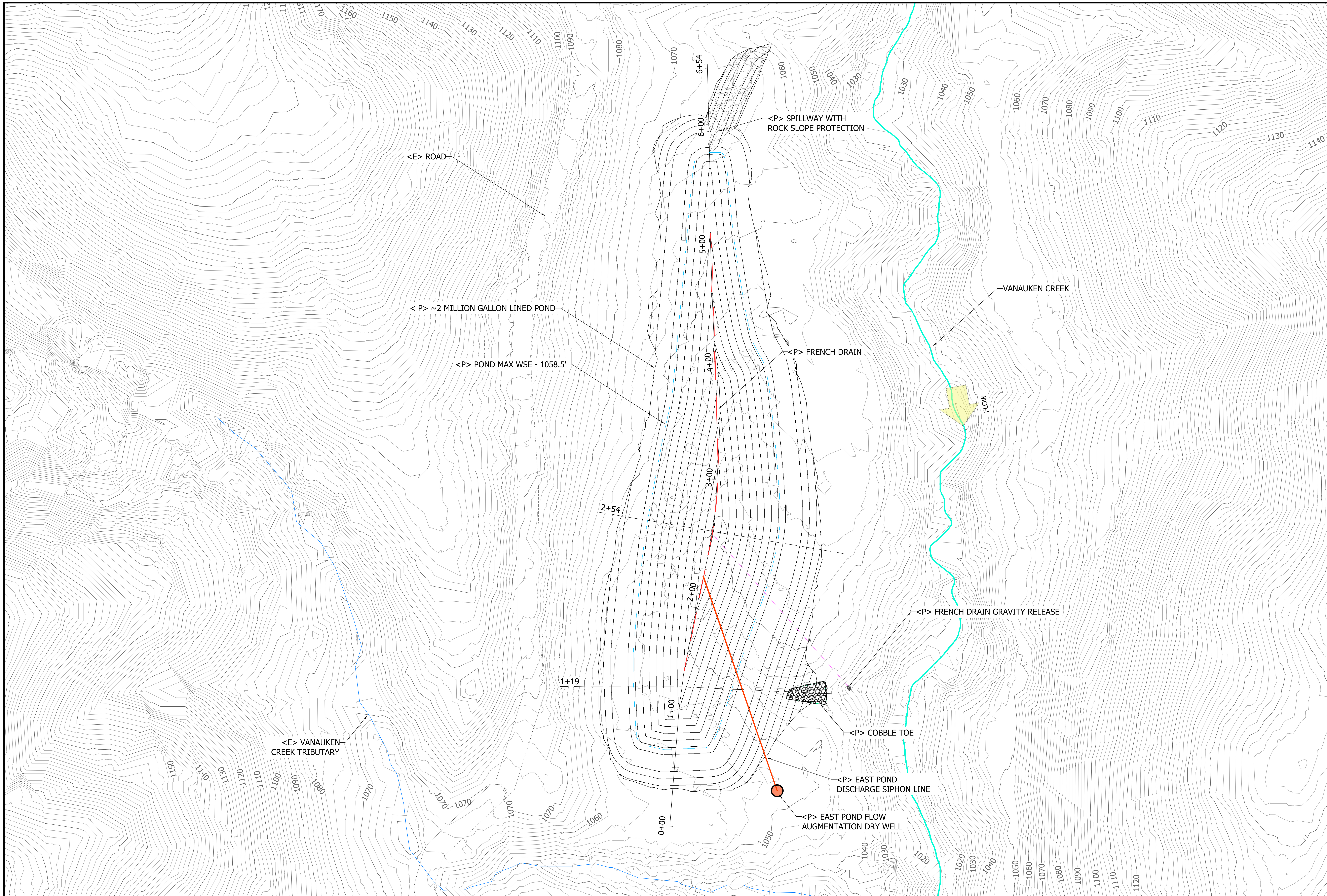
OVERVIEW



1 EAST POND - PLAN
Scale: 1:40

0 20 40 80 FEET
SCALE: 1" = 40'

MATTOLE HEADWATERS - DROUGHT RELIEF

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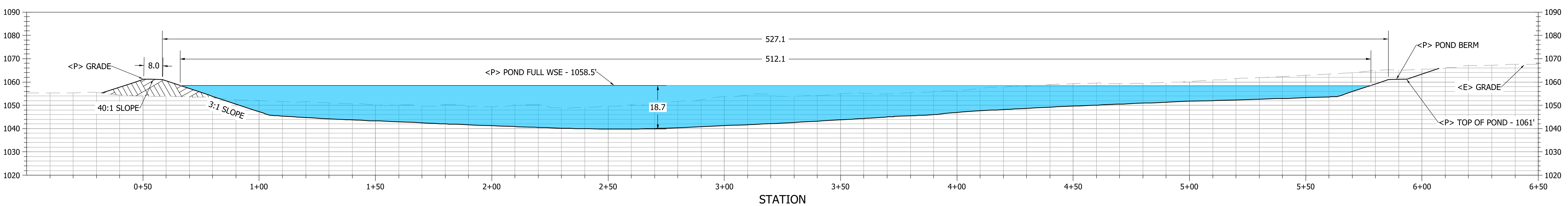
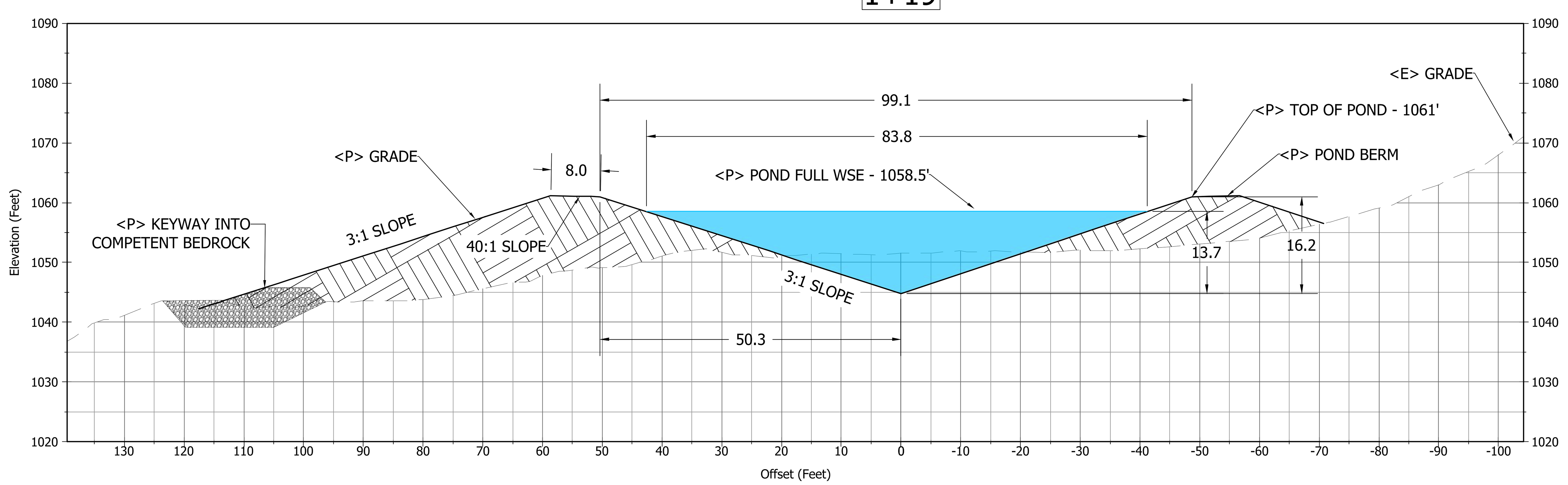
EAST POND - PLAN

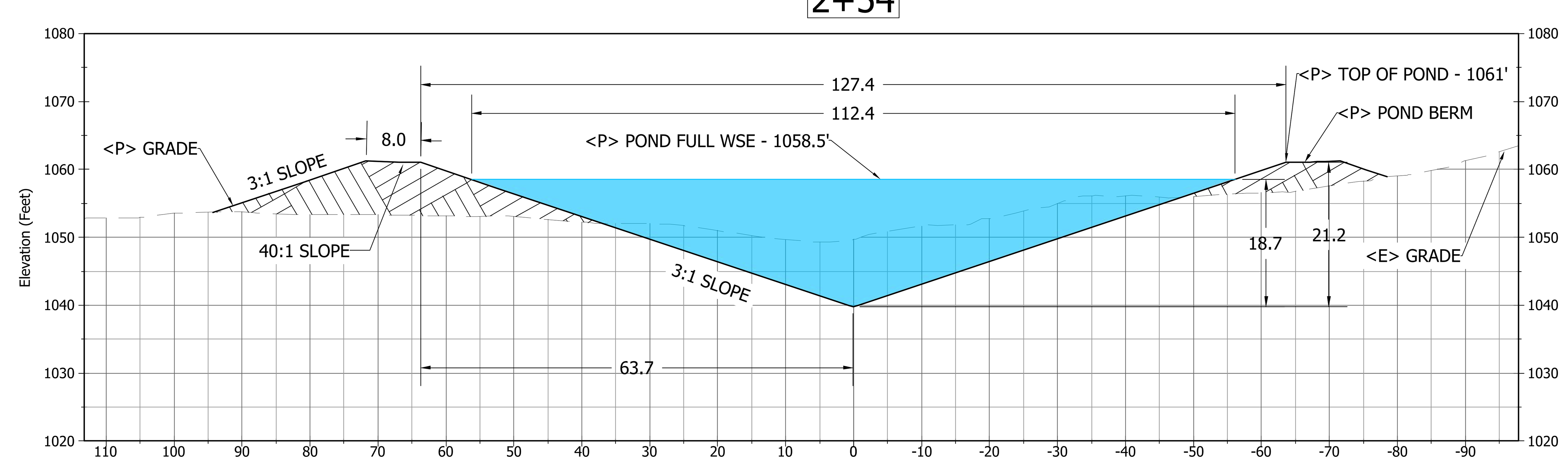


1 EAST POND - PROFILE
NTS

1+19



2+54



2 EAST POND - SECTIONS
NTS

MATTOLE HEADWATERS - DROUGHT RELIEF

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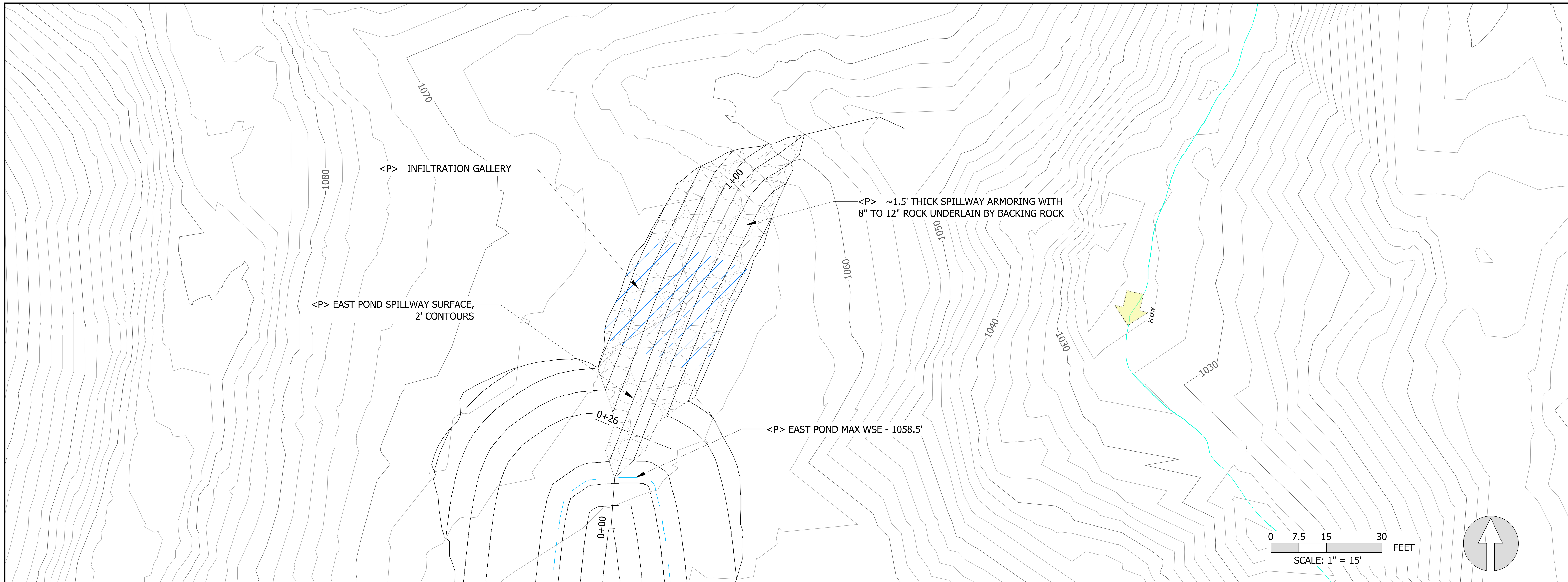
APPROVED: JM

EAST POND - PROFILE AND SECTIONS

SHEET 4 OF 17



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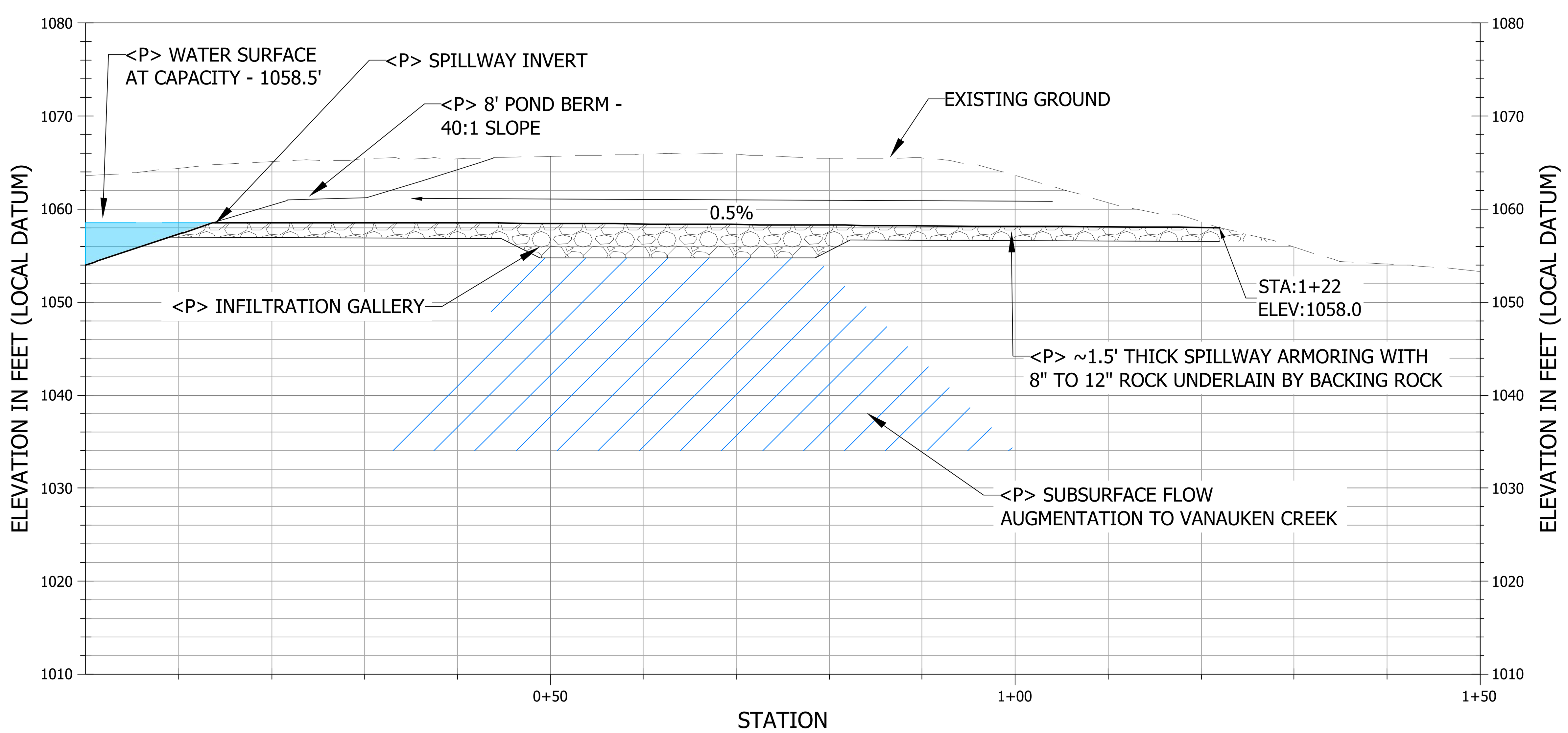
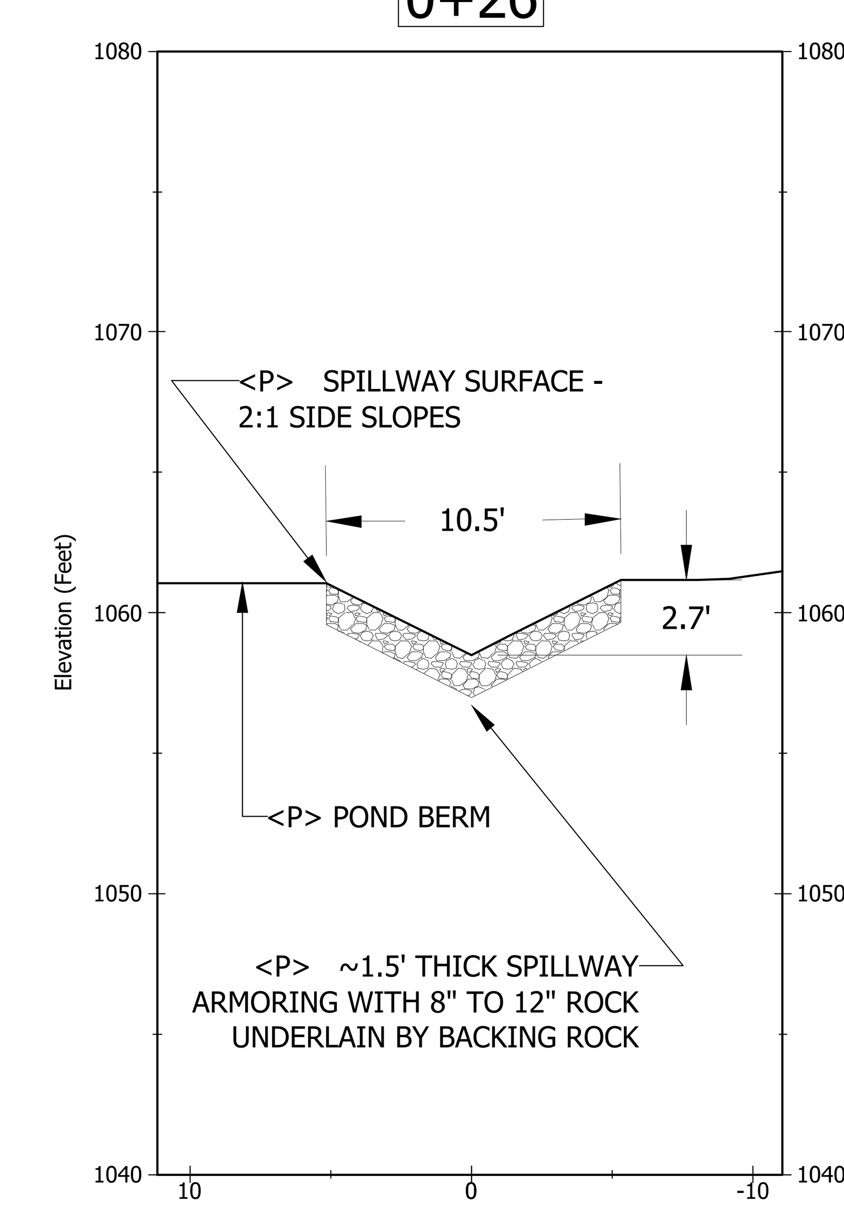
SCALE: 1:10



1 EAST POND SPILLWAY - PROFILE
NTS

0+26



1 EAST POND SPILLWAY - SECTION
NTS

MATTOLE HEADWATERS - DROUGHT RELIEF

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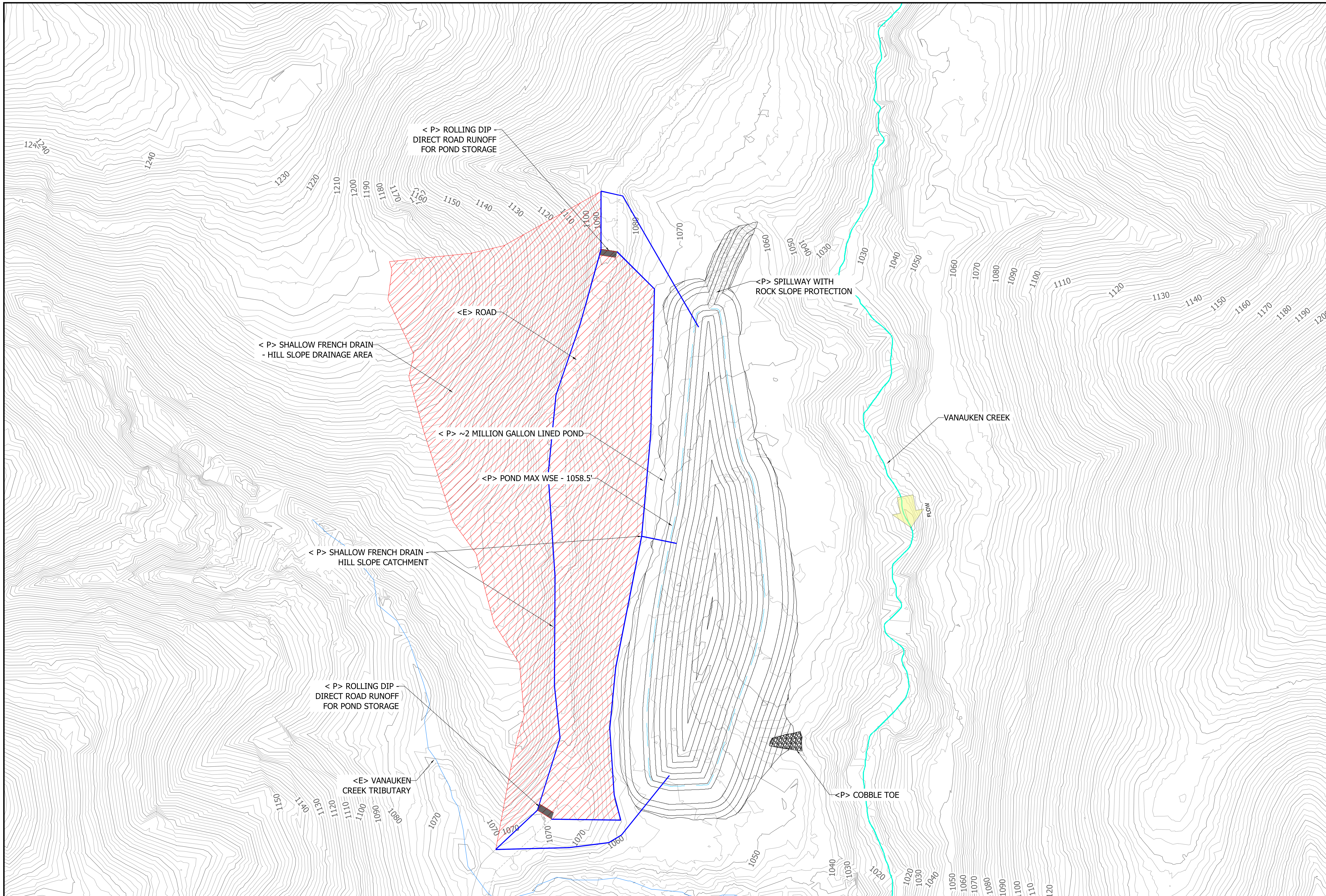
EAST POND - SPILLWAY

SHEET 5 OF 17



1 EAST POND - HILLSLOPE DRAINAGE PLAN
Scale: 1:50

0 25 50 100 FEET
SCALE: 1" = 50'

MATTOLE HEADWATERS - DROUGHT RELIEF

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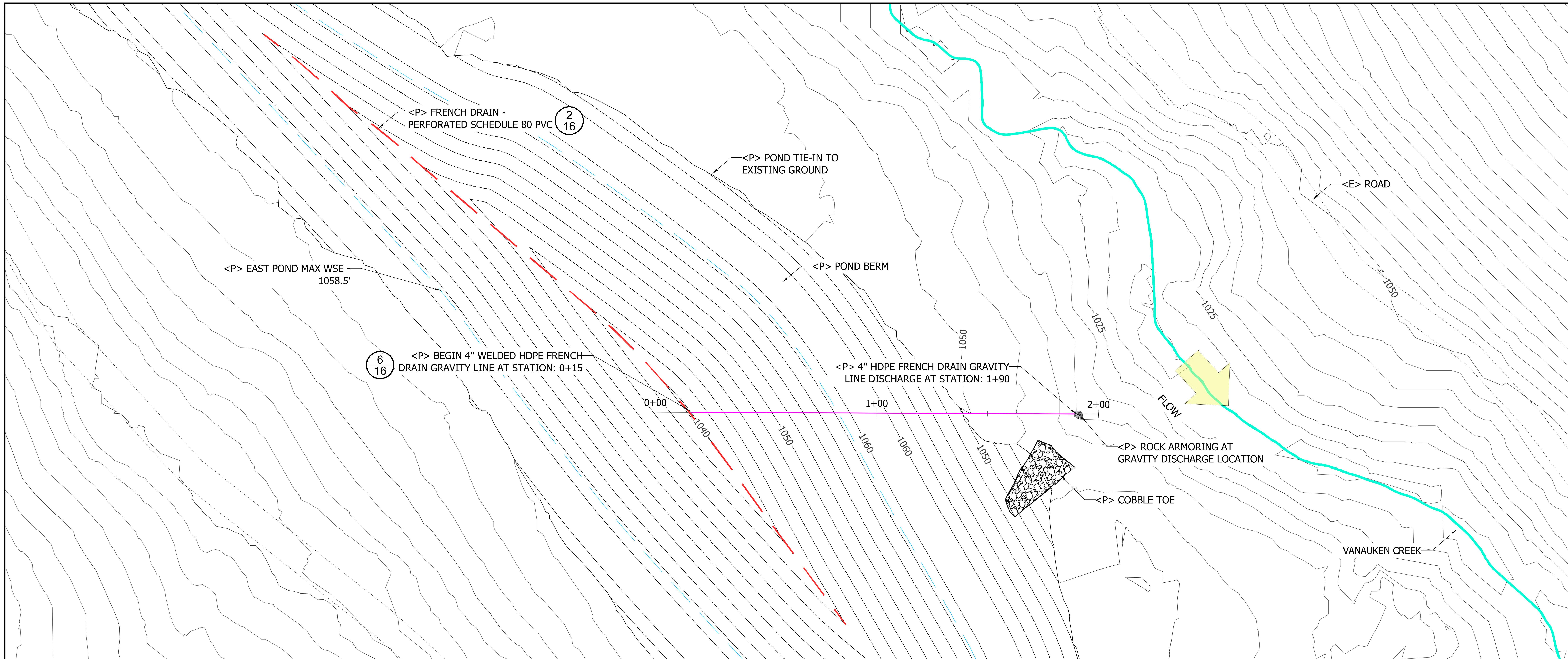
APPROVED: JM

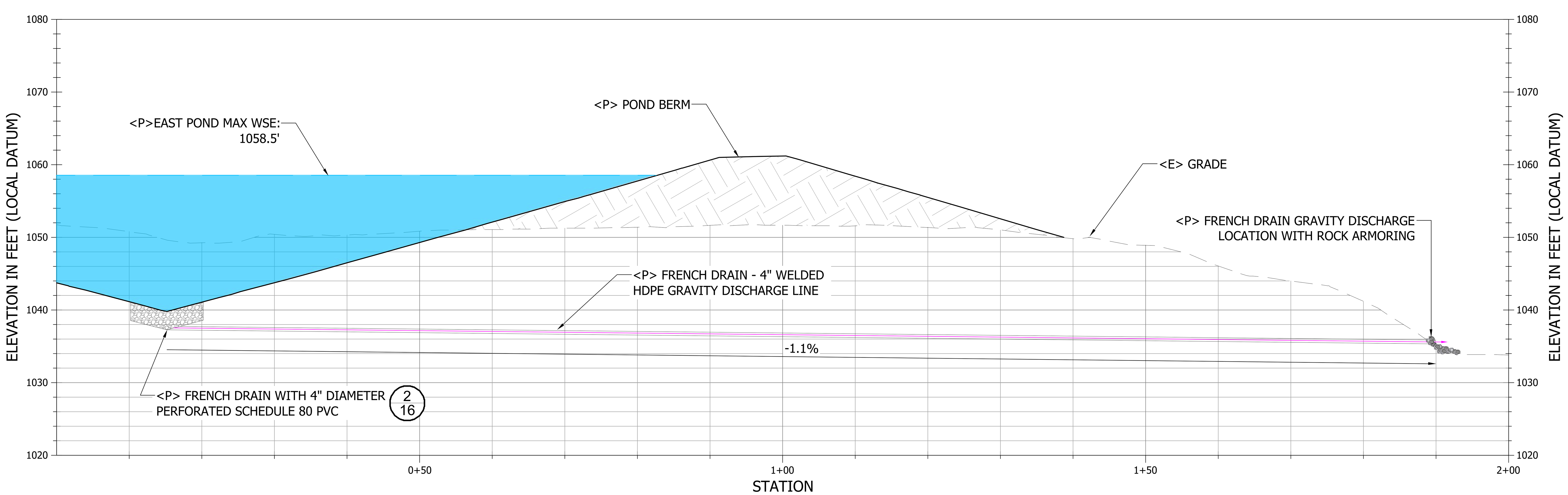
EAST POND - HILL SLOPE DRAINAGE PLAN

SHEET 6 OF 17



1 EAST POND FRENCH DRAIN RELEASE - PLAN
Scale: 1:25

0 12.5 25 50 FEET
SCALE: 1" = 25'



2 EAST POND FRENCH DRAIN RELEASE - PROFILE
Scale: 1:10

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

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DESIGN: JB/JM
DRAWN: JB
CHECKED: JM
APPROVED: JM

EAST POND - FRENCH DRAIN

SHEET 7 OF 17

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

Stillwater Sciences
850 G STREET SUITE K
ARCATA, CA 95521
P: (707) 822-9607

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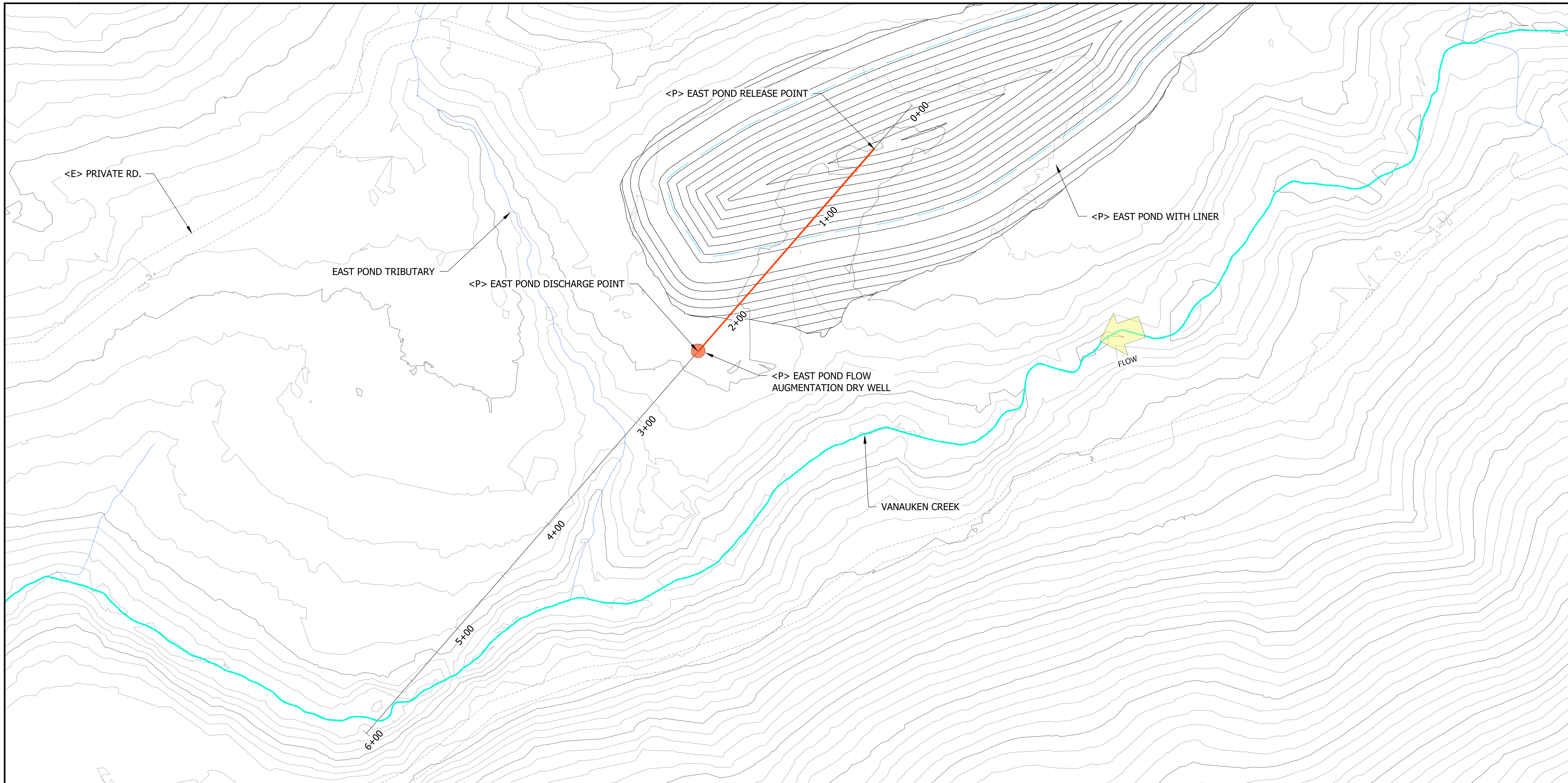

1 POND RELEASE LINE - PLAN
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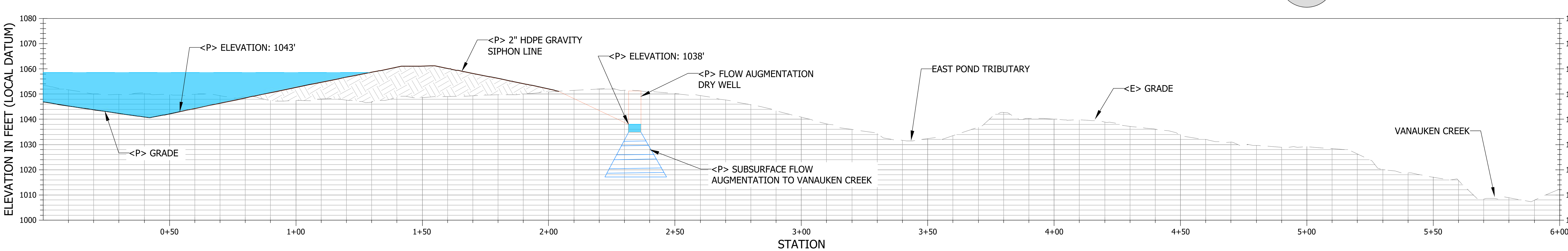
SCALE: 1" = 40'



2 POND RELEASE LINE - PROFILE
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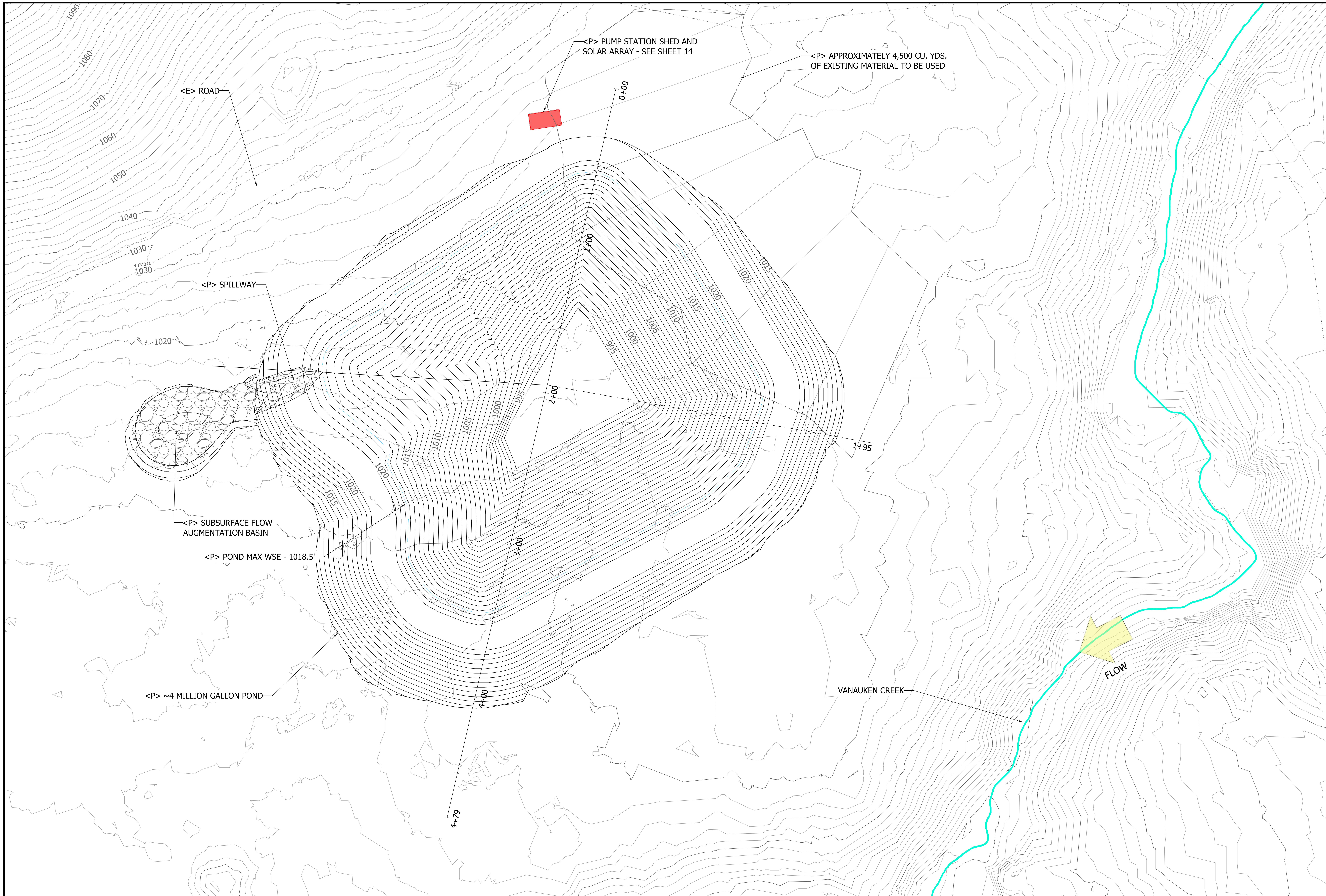
65% DESIGN REVIEW DRAWINGS

PROJECT NUMBER: 588.11
SCALE: AS NOTED
DATE: 12/12/24

DESIGN: JB/JM
DRAWN: JB
CHECKED: JM
APPROVED: JM

EAST POND - FLOW AUGMENTATION PLAN

SHEET 8 OF 17



1 WEST POND - PLAN
Scale: 1:30

0 15 30 60 FEET
SCALE: 1" = 30'

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

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ARCATA, CA 95521
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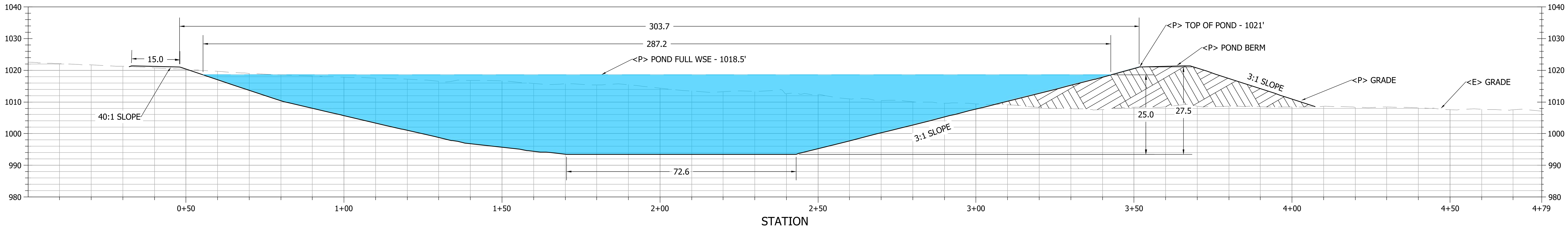
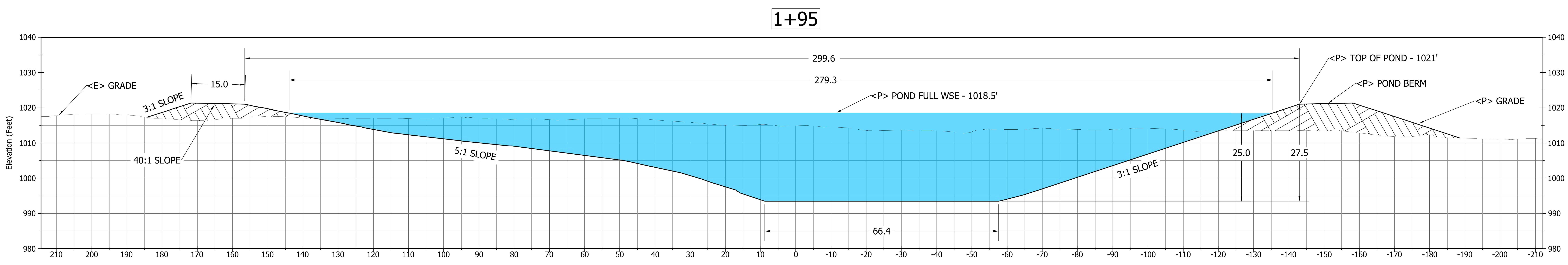
WEST POND - PLAN



1 WEST POND - PROFILE
NTS



2 WEST POND - SECTION
NTS

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

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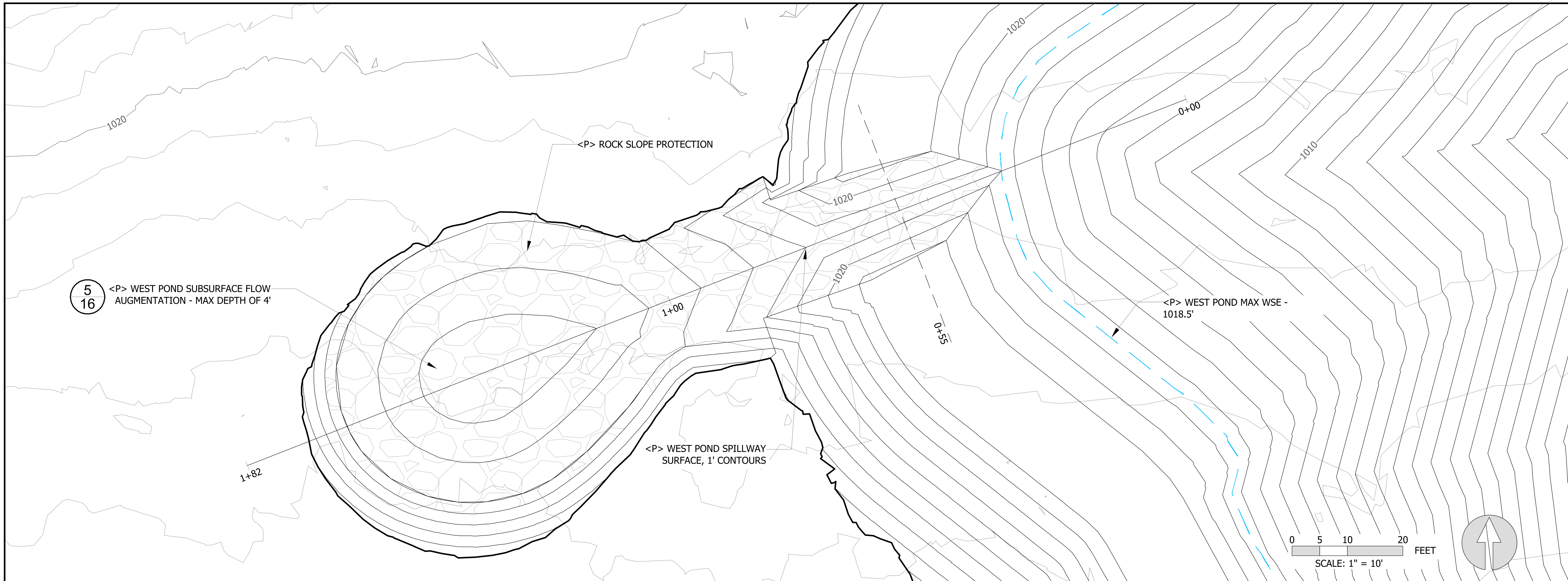
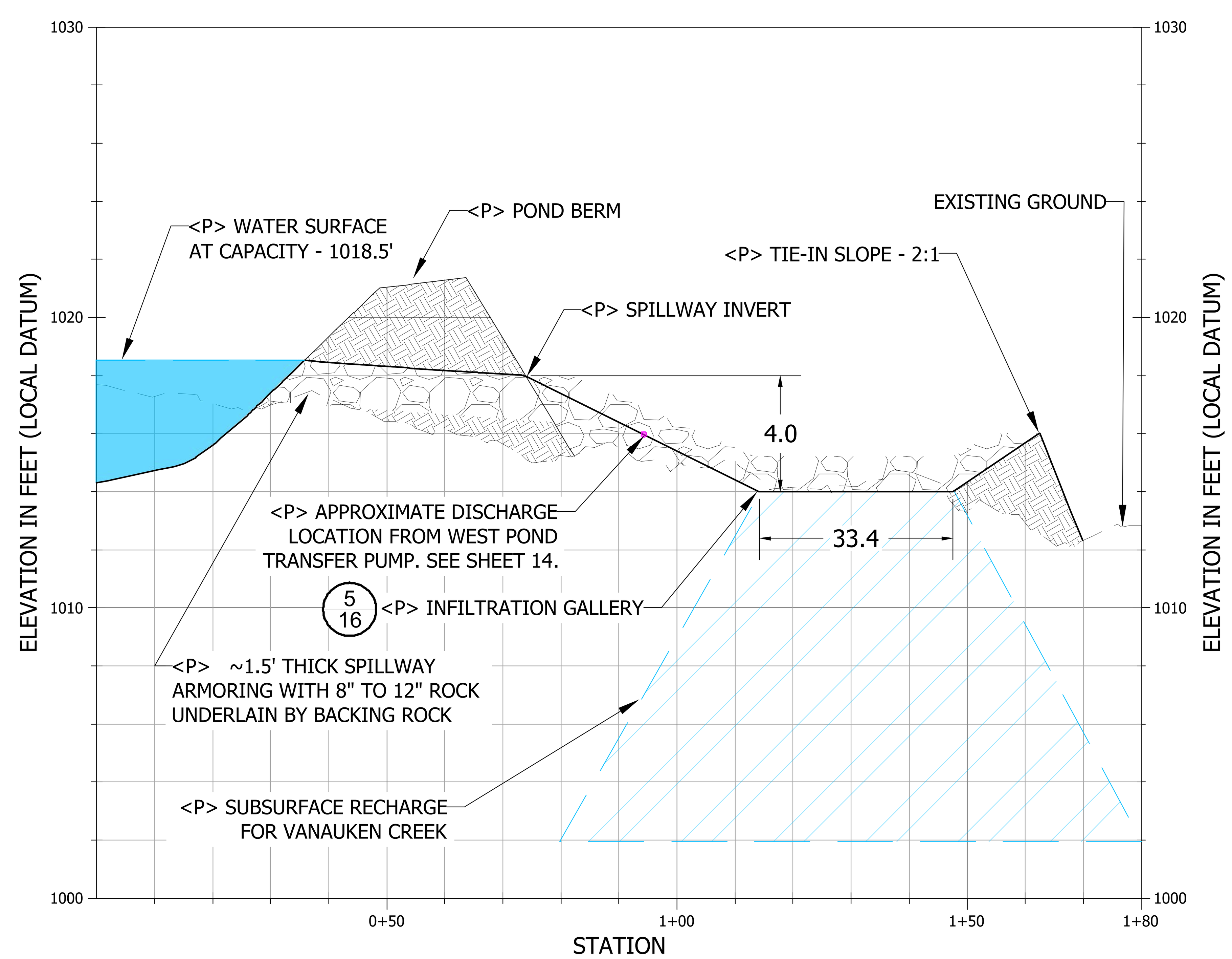
DESIGN: JB/JM
DRAWN: JB
CHECKED: JM
APPROVED: JM

WEST POND - PROFILE AND SECTION

SHEET 10 OF 17

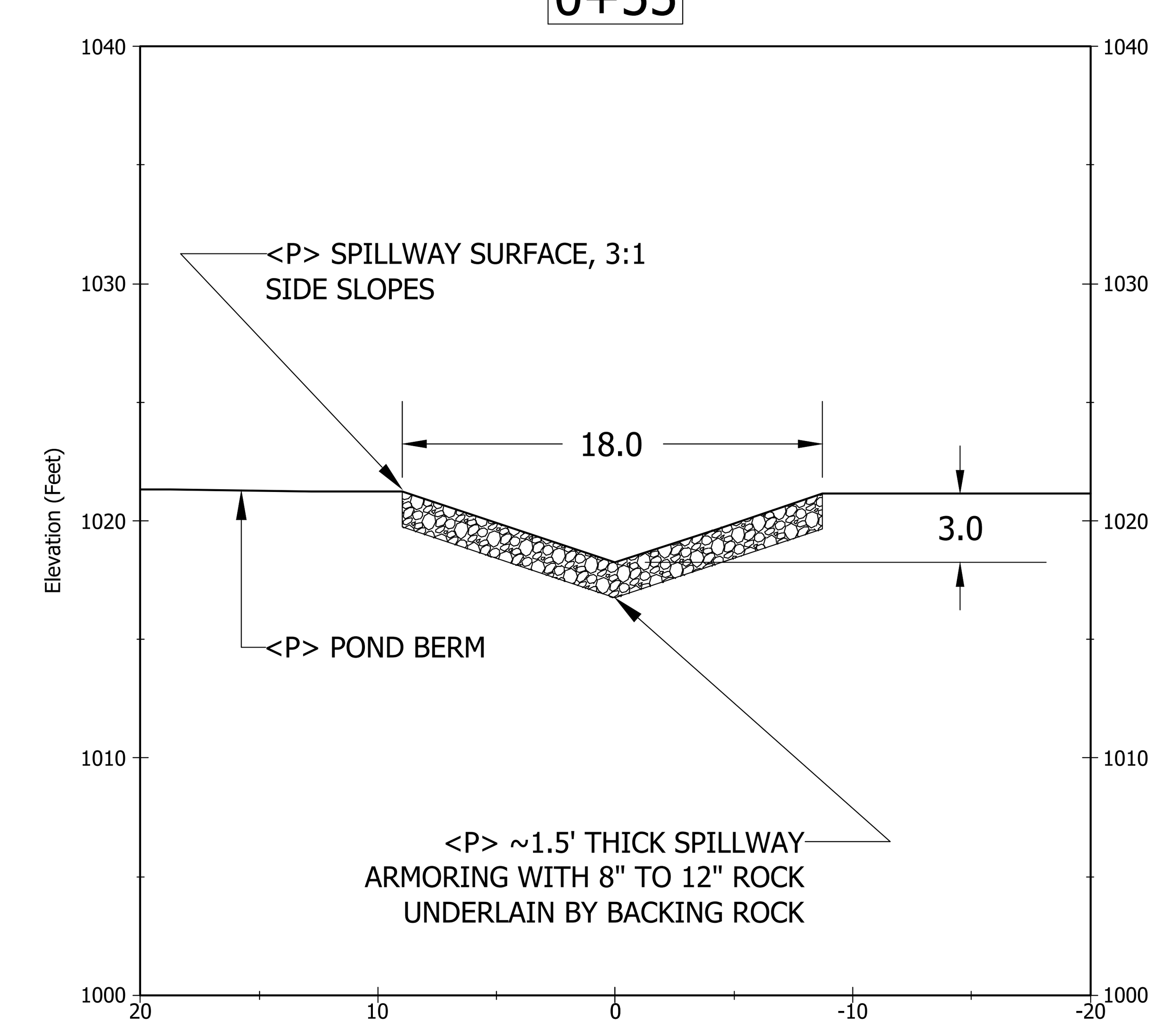


1 WEST POND SPILLWAY - PLAN
SCALE: 1:10



1 WEST POND SPILLWAY - PROFILE
NTS

0+55



1 WEST POND SPILLWAY - SECTION
NTS

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

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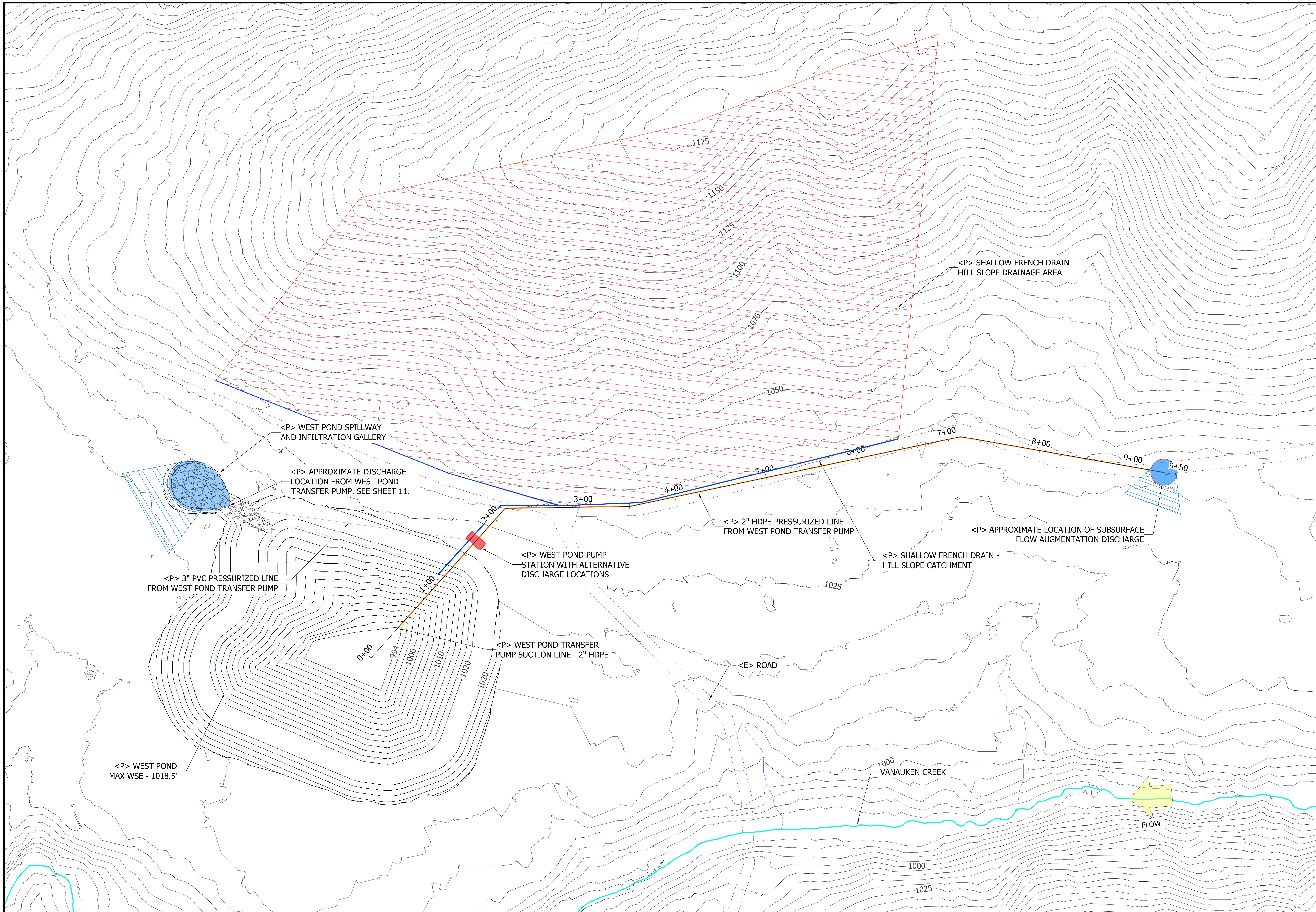
DESIGN: JB/JM
DRAWN: JB
CHECKED: JM
APPROVED: JM

WEST POND - SPILLWAY AND INFILTRATION GALLERY

SHEET 11 OF 17



1 WEST POND HILLSLOPE DRAINAGE - PLAN
Scale: 1:50

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

Stillwater Sciences
850 G STREET SUITE K
ARCATA, CA 95521
P: (707) 822-9607

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DESIGN: JB/JM
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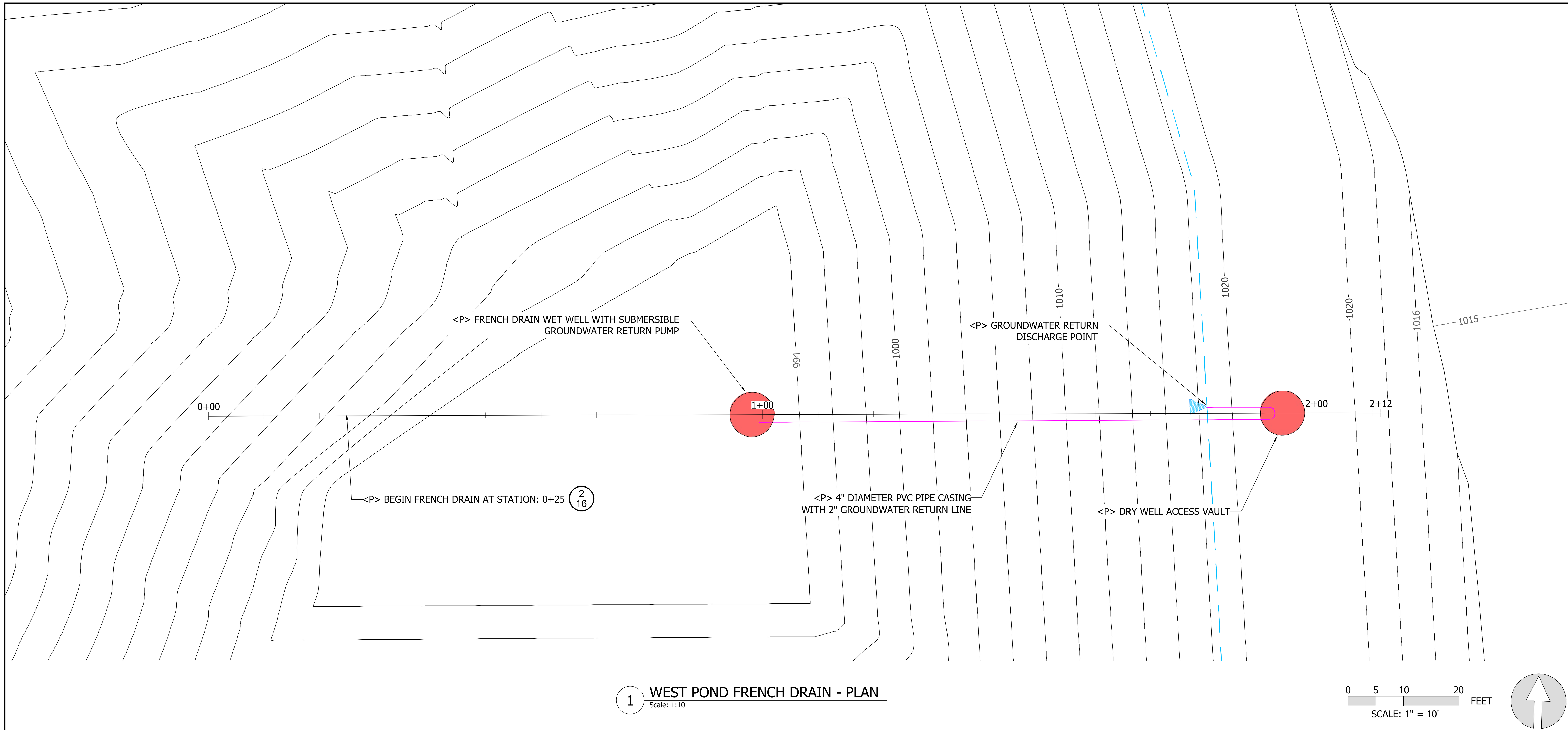
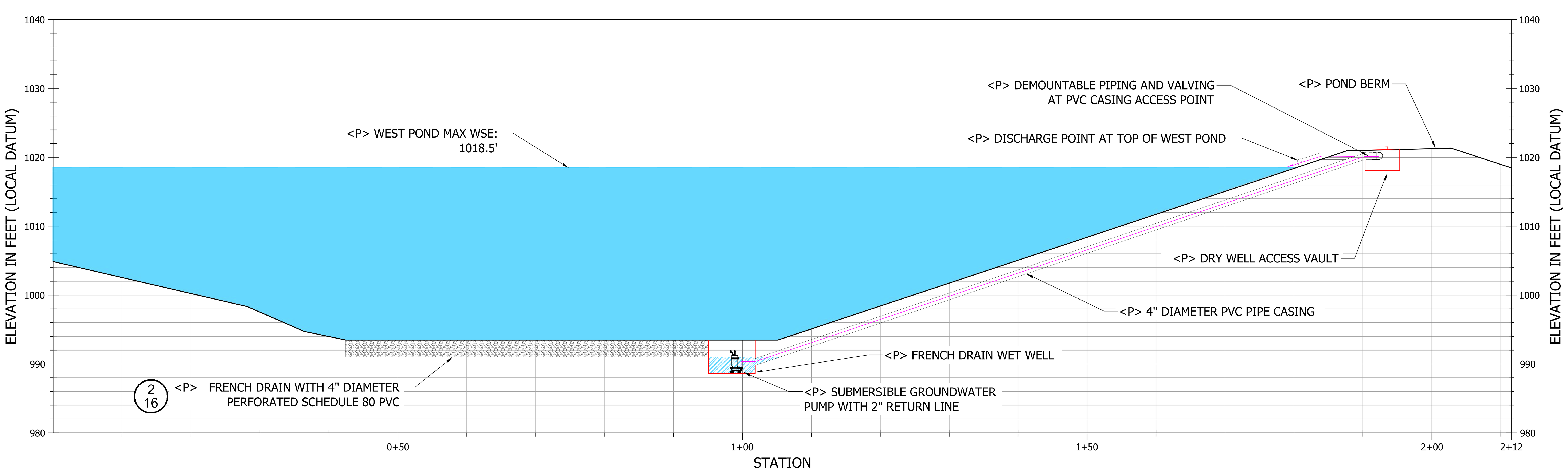
CHECKED: JM
APPROVED: JM

WEST POND - HILL SLOPE DRAINAGE PLAN



1 WEST POND FRENCH DRAIN - PLAN
Scale: 1:10



2 WEST POND FRENCH DRAIN - PROFILE
Scale: 1:10

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

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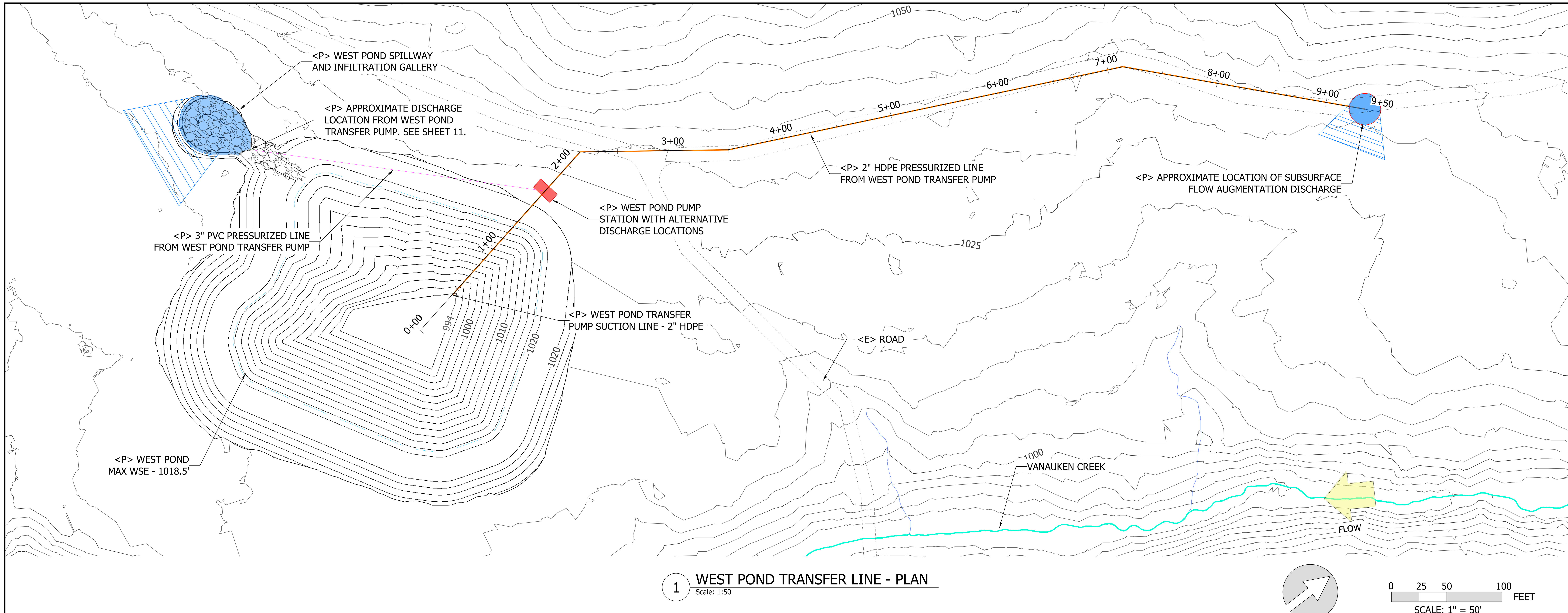
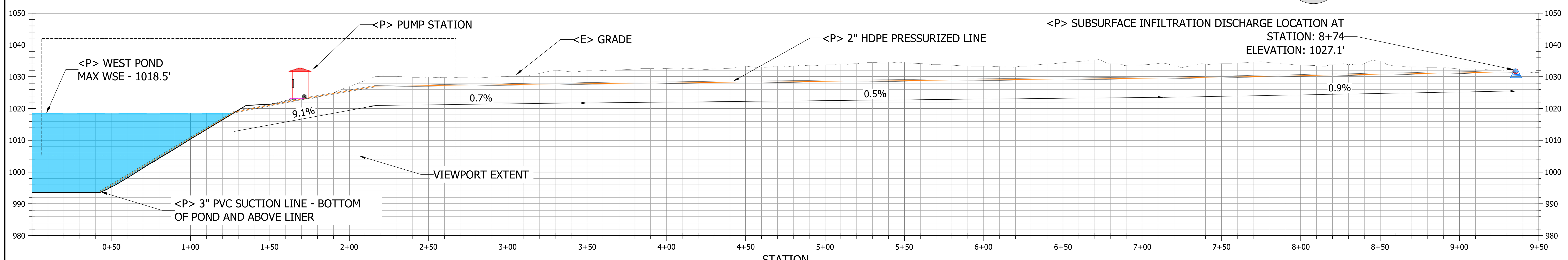
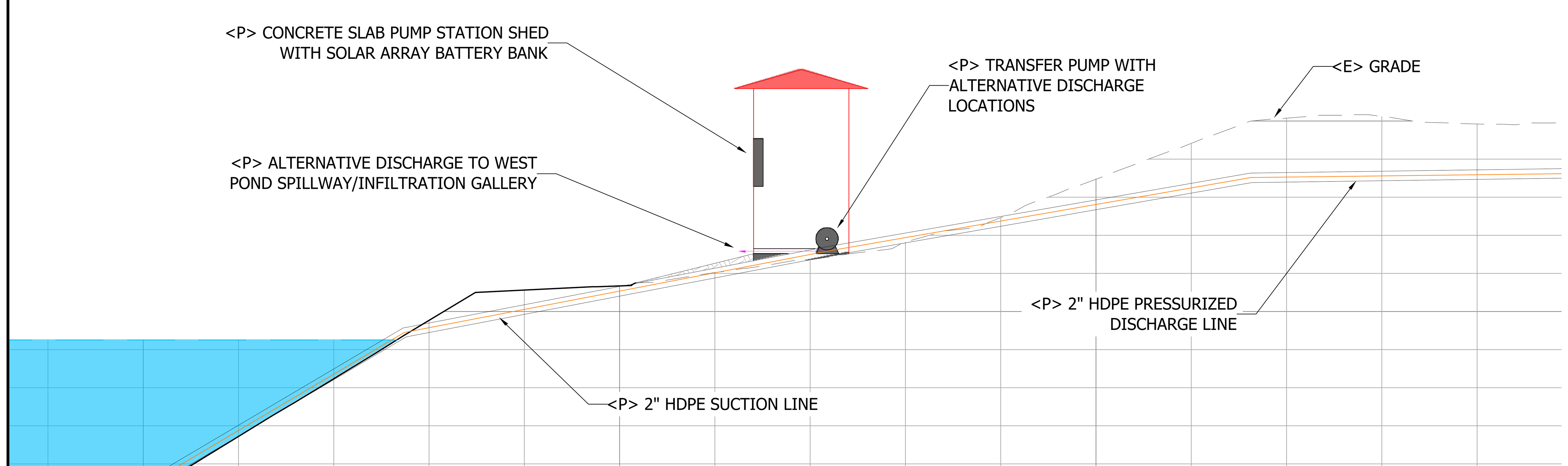
WEST POND - FRENCH DRAIN

SHEET 13 OF 17



1 WEST POND TRANSFER LINE - PLAN
Scale: 1:50





2 WEST POND TRANSFER LINE AND PUMP STATION - PROFILES
NTS

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

Stillwater Sciences
850 G STREET SUITE K
ARCATA, CA 95521
P: (707) 822-9607

REVISIONS

NO.	DESCRIPTION	DATE

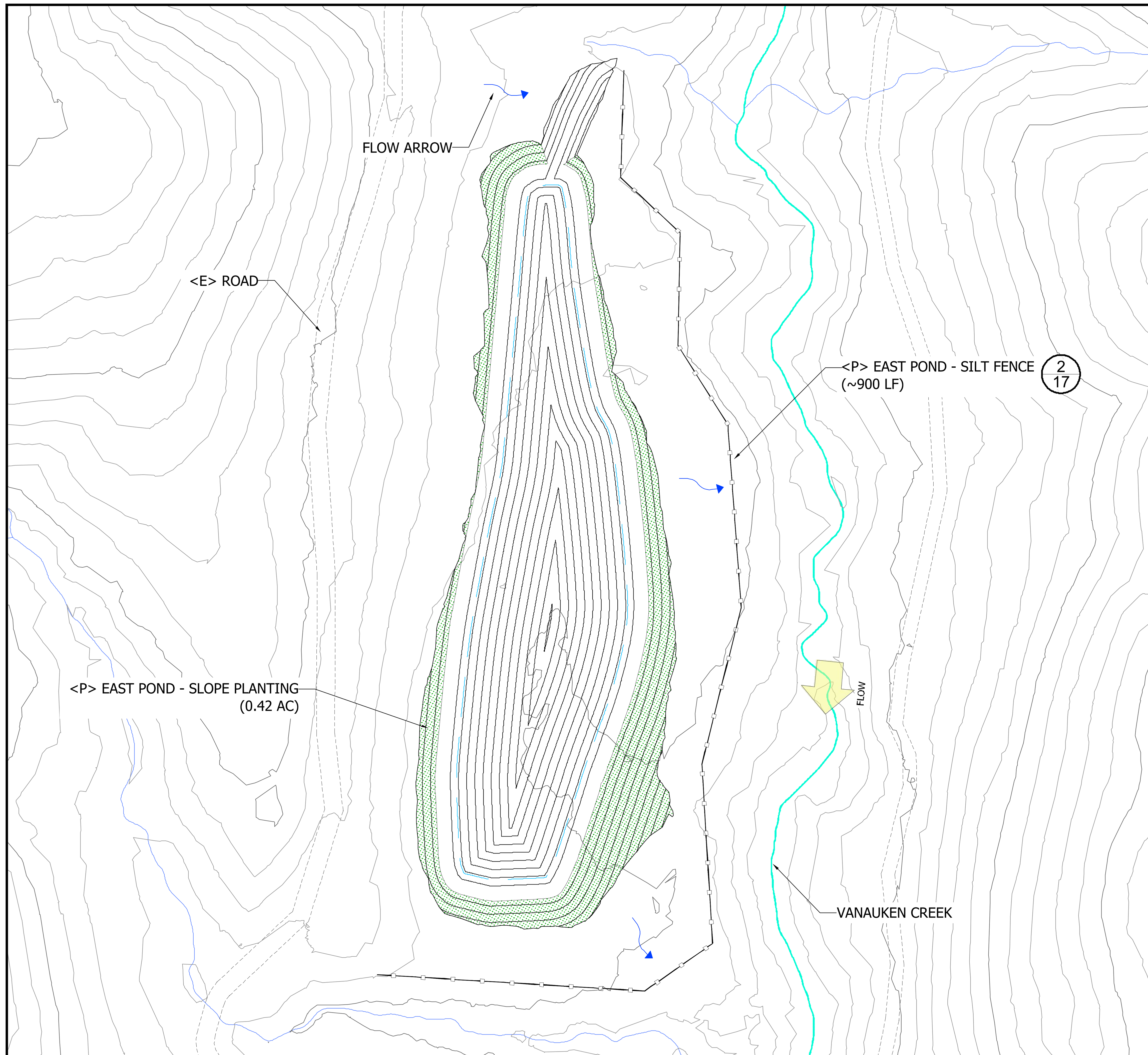
65% DESIGN REVIEW DRAWINGS

PROJECT NUMBER: 588.11
SCALE: AS NOTED
DATE: 12/12/24

DESIGN: JB/JM
DRAWN: JB
CHECKED: JM
APPROVED: JM

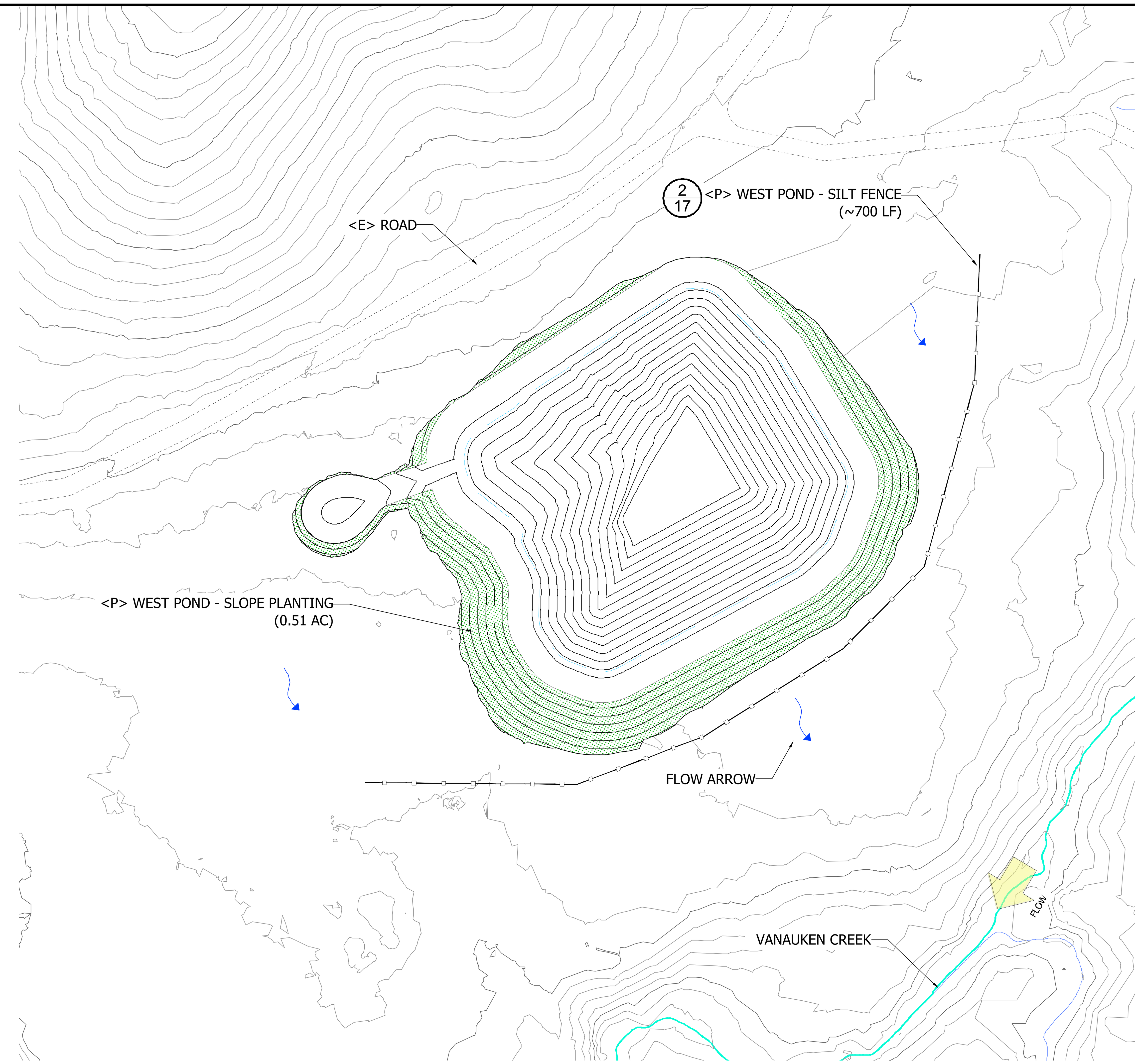
WEST POND - FLOW AUGMENTATION PLAN

SHEET 14 OF 17



0 30 60 120 FEET
SCALE: 1" = 60'

1 EAST POND EROSION CONTROL - PLAN
Scale: 1:60



2 WEST POND EROSION CONTROL - PLAN
Scale: 1:60

0 30 60 120 FEET
SCALE: 1" = 60'

SEEDING TABLE:

TOTAL AREA (ACRES):			1.45	
Type of seed	**Scientific name**	**Common name**	**Species composition**	**Amount of seed (lbs)**
Native grasses	*Bromus Carinatus*	California brome	40%	14.5
	Elymus glaucus subsp.	Blue wild rye	40%	14.5
Native forbs	*Achillea millefolium*	Common yarrow	2%	0.7
	Eschscholzia californica	California poppy	5%	1.8
	Lupinus bicolor	Miniature lupine	8%	2.9
	Sisyrinchium bellum	Western blue-eyed-grass	5%	1.8
Total			**100%**	**36.2**

3 COMBINED SEEDING TABLE

NOTE:

ADDITIONAL 1-2 ACRES OF STAGING AND DISTURBANCE AREA AROUND THE POND FOOTPRINT ANTICIPATED TO BE SEEDED WITH SAME MIX.

MATTOLE HEADWATERS - DROUGHT RELIEF

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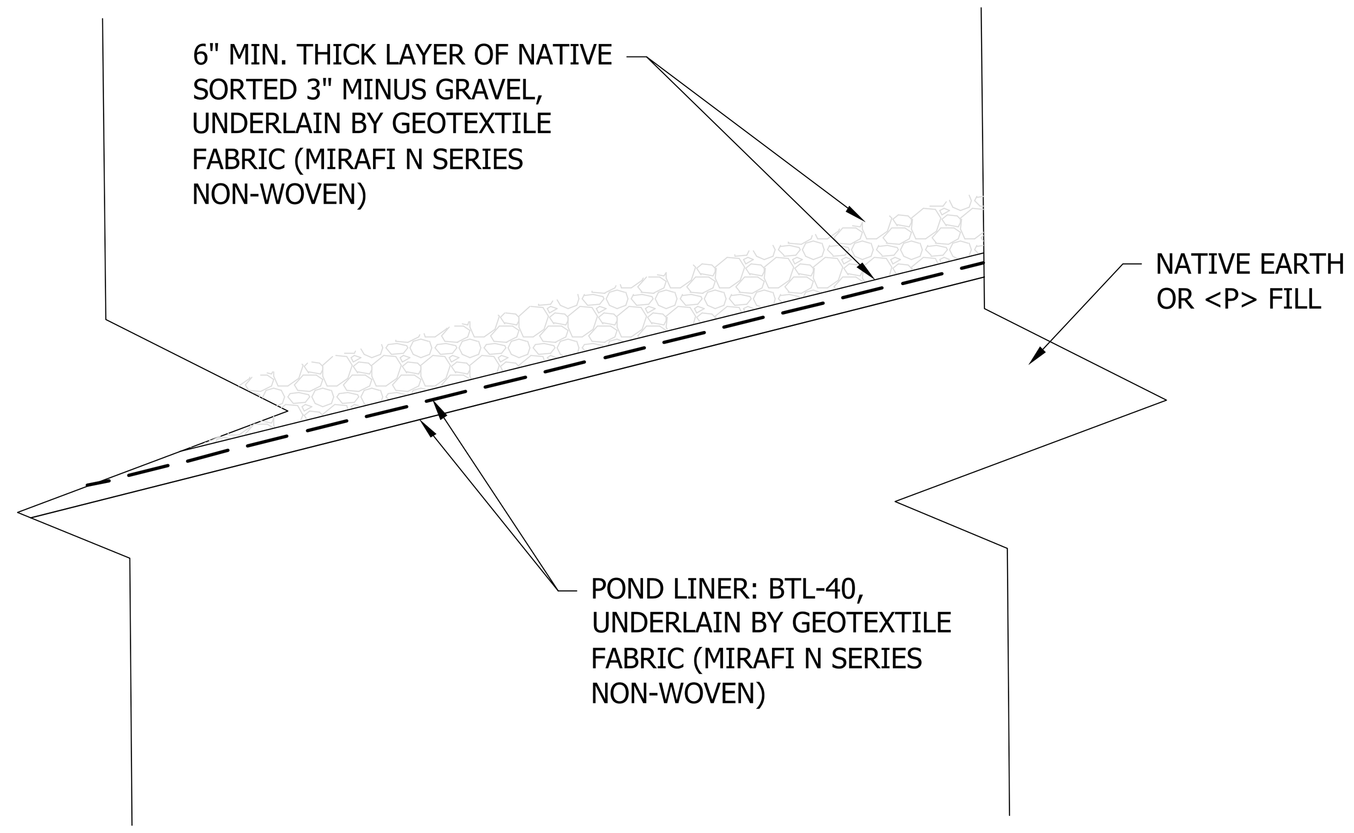
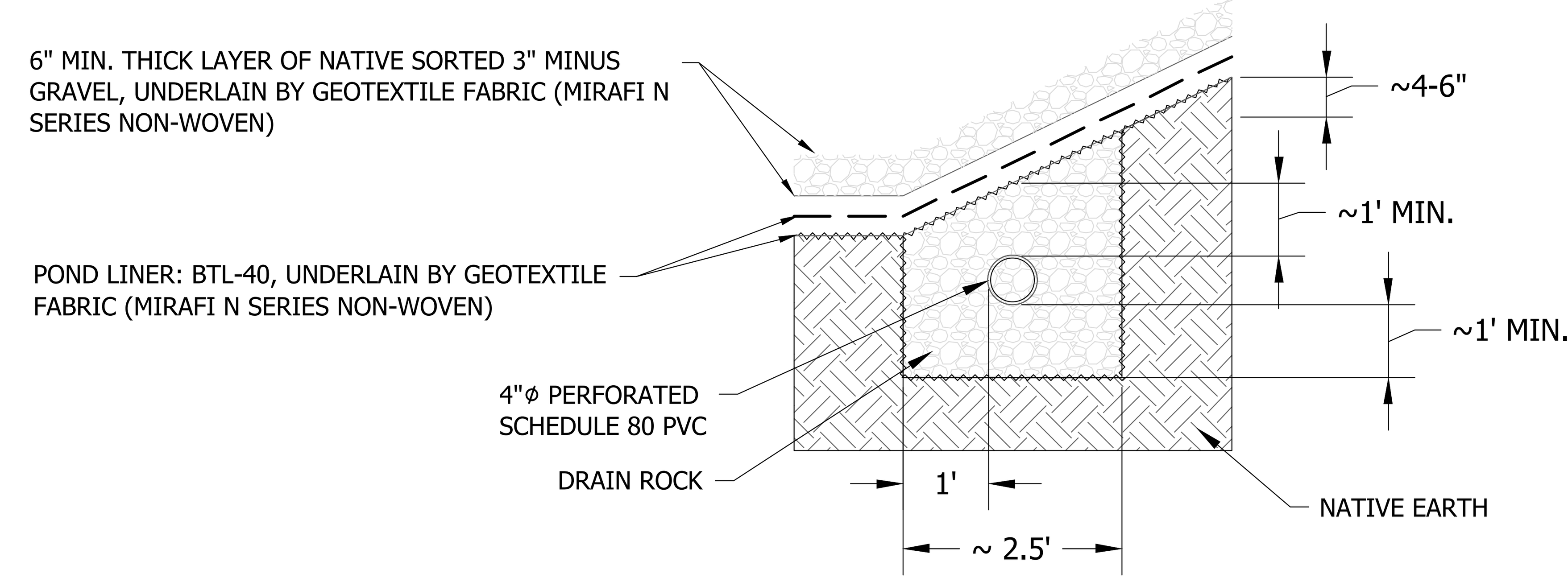
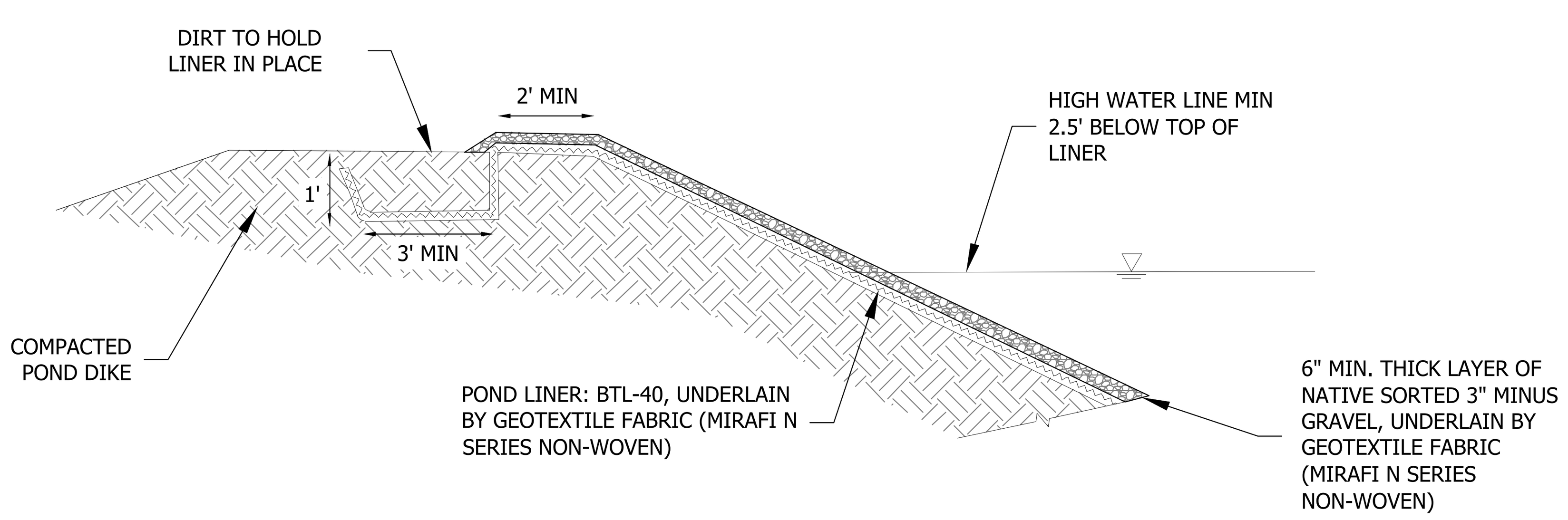
EROSION CONTROL AND SEEDING PLAN



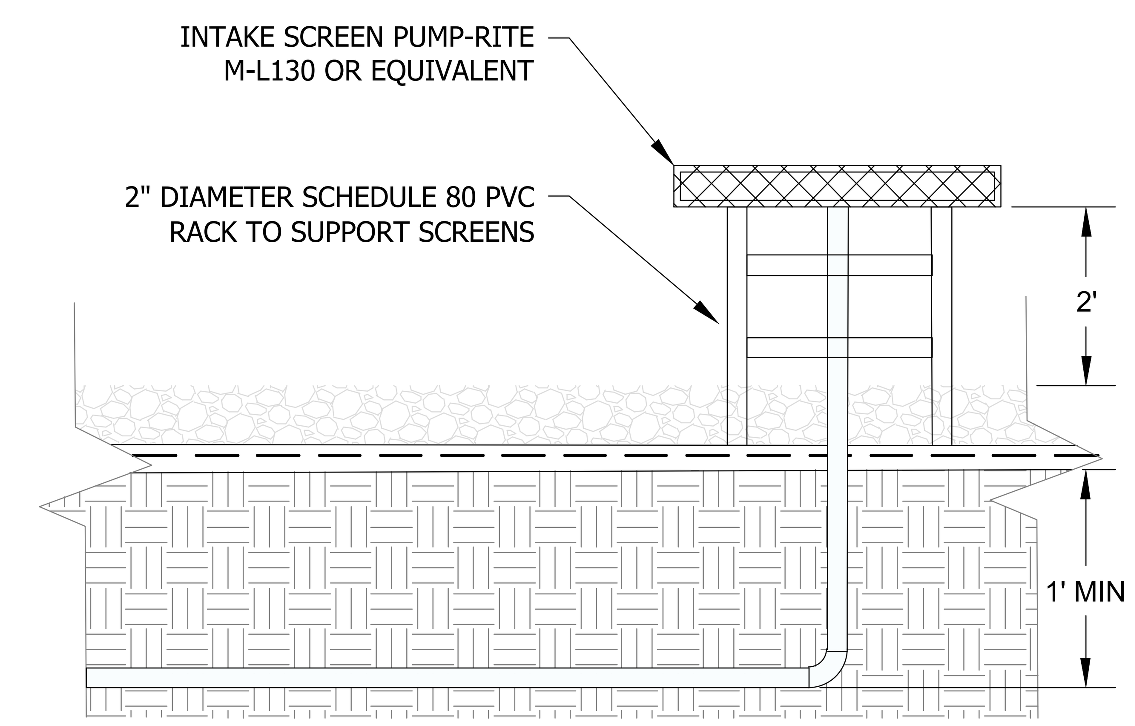
1 **POND LINER DETAIL**
NTS



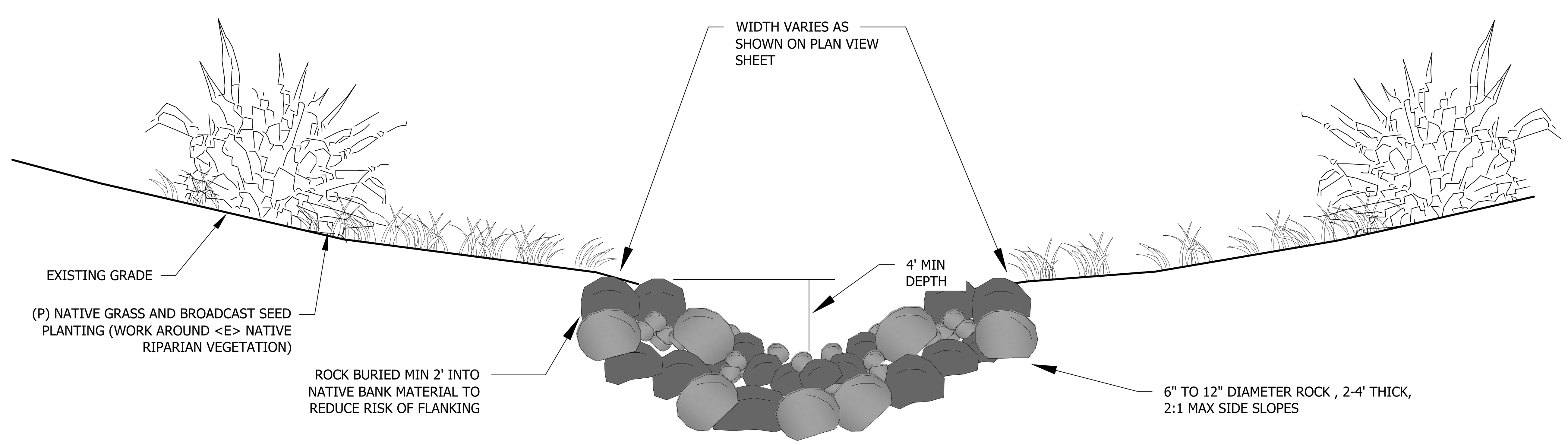
2 **FRENCH DRAIN DETAIL**
NTS



3 **POND EDGE DETAIL**
NTS



4 **POND OUTFLOW DETAIL**
NTS



5 **INFILTRATION GALLERY**
NTS

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

Stillwater Sciences
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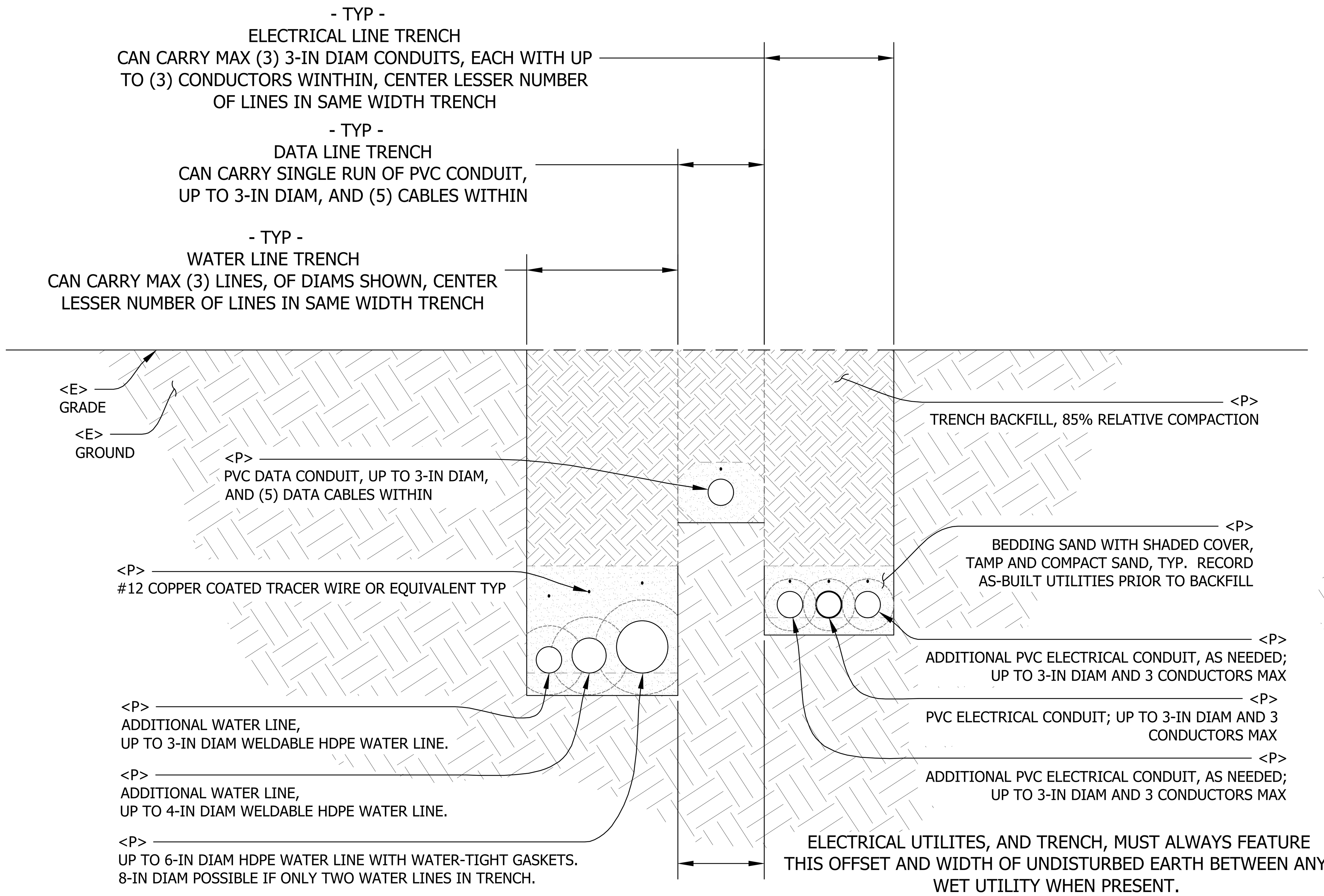
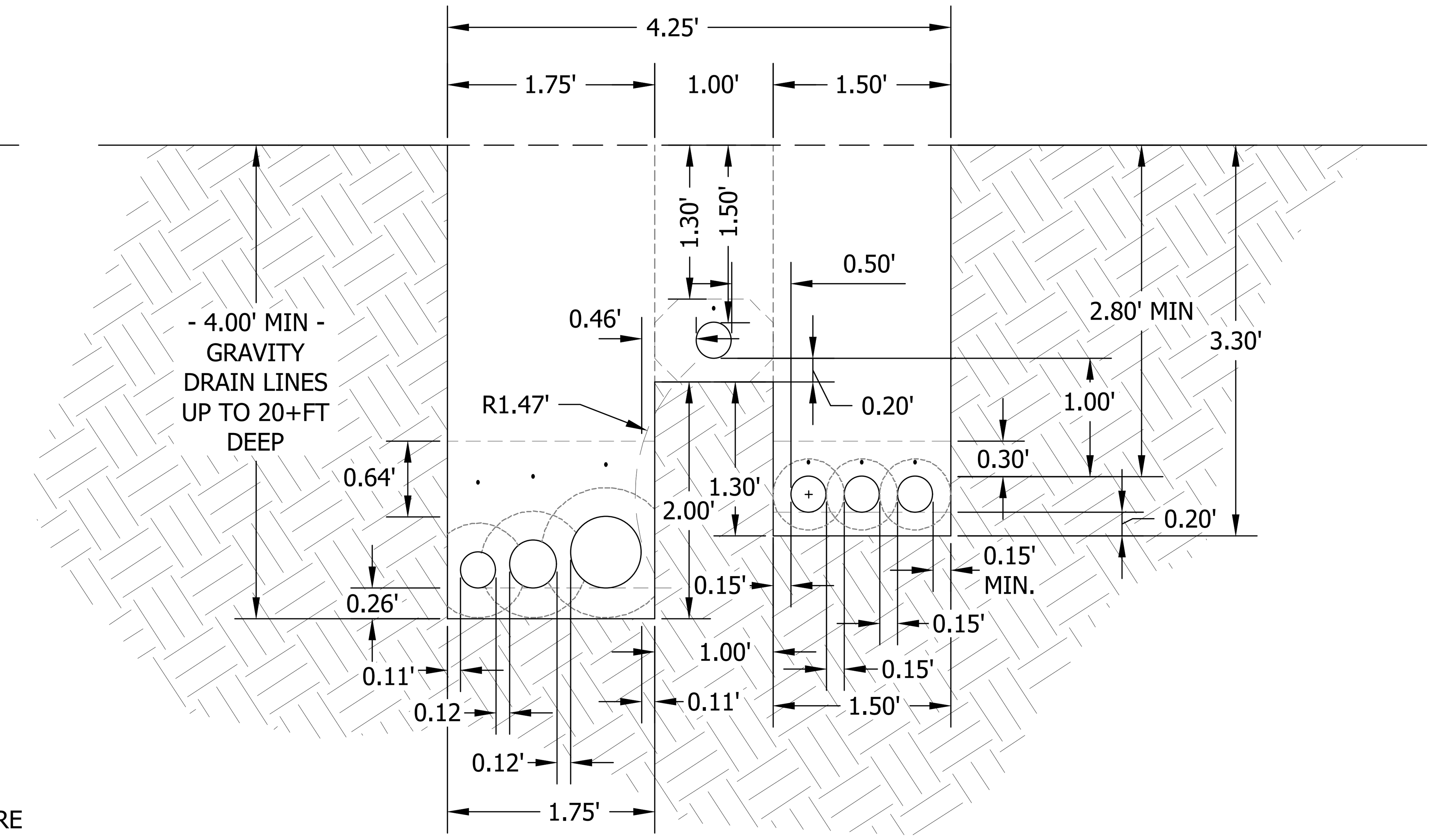
DRAWN: JB
CHECKED: JM
APPROVED: JM

PLUMBING DETAILS

SHEET 16 OF 17



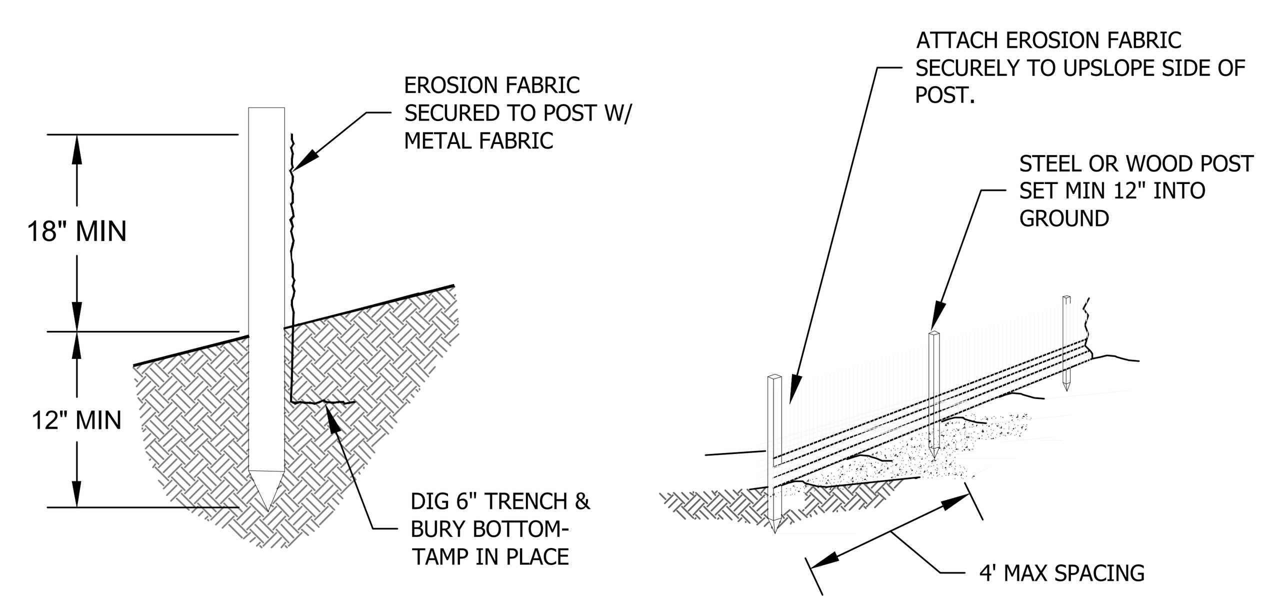


1 UNIVERSAL TRENCH SECTION

NTS

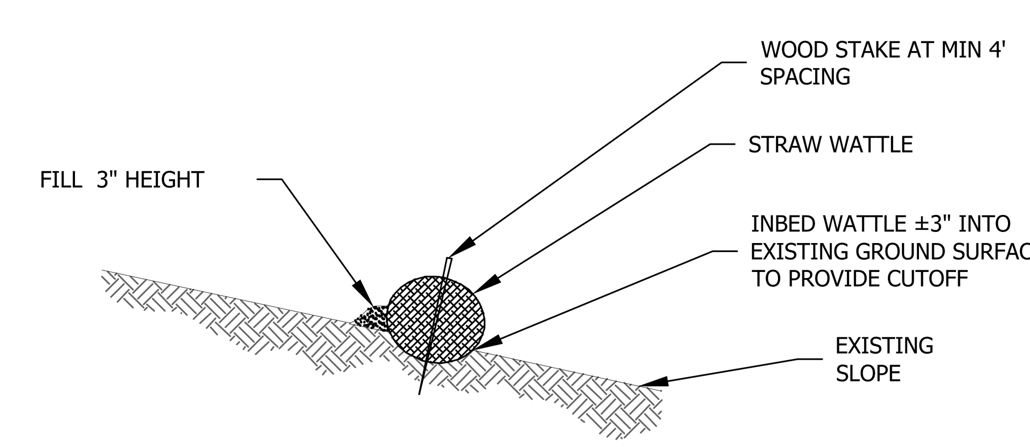
EROSION AND SEDIMENT CONTROL NOTES:

1. EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (BMPS) SHALL BE INSTALLED PRIOR TO THE WET SEASON (OCTOBER 1 THROUGH APRIL 30).
2. SENSITIVE AREAS AND AREAS WHERE EXISTING VEGETATION IS BEING PRESERVED SHALL BE PROTECTED WITH CONSTRUCTION FENCING; FENCING SHALL BE MAINTAINED THROUGHOUT CONSTRUCTION ACTIVITIES.
3. ALL AREAS DISTURBED DURING GRADING ACTIVITIES SHALL BE SEEDED WITH NATIVE GRASS SEED AND MULCHED WITH RICE STRAW.
4. PRIOR TO SEEDING AND STRAW, DISTURBED AREAS SHOULD BE ROUGHENED BY TRACK WALKING WITH A DOZER.
5. STRAW SHALL BE APPLIED AT A UNIFORM RATE OF APPROXIMATELY 4000 LBS PER ACRE BY HAND.
6. AT THE COMPLETION OF THE PROJECT, STRAW WATTLES SHALL BE PLACED AS DIRECTED BY ENGINEER.
7. ALL SEDIMENT CONTROL BMPS SHALL BE MAINTAINED THROUGHOUT THE WET SEASON UNTIL NEW VEGETATION HAS BECOME ESTABLISHED ON ALL GRADED AREAS.



2 SILT FENCING

NTS



3 STRAW WATTLE

NTS

MATTOLE HEADWATERS - DROUGHT RELIEF

HUMBOLDT COUNTY, CA

Stillwater Sciences
850 G STREET SUITE K
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APPROVED: JM

TRENCH AND EROSION CONTROL DETAILS

SHEET 17 OF 17

Appendix B

HEC-RAS Modeling Results

HEC-RAS Plan: Vanauken EXTENDED River: VANAUKEN EXT Reach: VANAUKEN EXT

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
VANAUKEN EXT	6632	Juvenile Low	1.00	1035.55	1035.90	1035.90	1035.97	0.027374	2.15	0.47	2.11	0.80
VANAUKEN EXT	6632	Adult Low	3.00	1035.55	1036.04	1036.04	1036.25	0.055329	3.74	0.80	2.64	1.20
VANAUKEN EXT	6632	Juvenile High	27.00	1035.55	1036.95	1036.95	1037.44	0.036235	5.61	4.82	6.14	1.12
VANAUKEN EXT	6632	Adult High	137.00	1035.55	1038.46	1038.46	1039.23	0.023728	7.00	19.58	13.13	1.01
VANAUKEN EXT	6632	1.1-year	181.00	1035.55	1038.80	1038.80	1039.67	0.022925	7.46	24.25	14.33	1.01
VANAUKEN EXT	6632	2-year	274.00	1035.55	1039.41	1039.41	1040.44	0.021650	8.16	33.56	16.53	1.01
VANAUKEN EXT	6632	5-year	460.00	1035.55	1040.34	1040.34	1041.63	0.020271	9.09	50.63	20.17	1.01
VANAUKEN EXT	6632	10-year	572.00	1035.55	1040.83	1040.83	1042.19	0.019603	9.36	61.11	22.81	1.01
VANAUKEN EXT	6632	25-year	701.00	1035.55	1041.34	1041.34	1042.75	0.019091	9.54	73.45	26.32	1.01
VANAUKEN EXT	6632	50-year	821.00	1035.55	1041.74	1041.74	1043.20	0.018769	9.71	84.56	29.34	1.01
VANAUKEN EXT	6632	100-year	928.00	1035.55	1042.04	1042.04	1043.56	0.018527	9.87	93.99	31.61	1.01
VANAUKEN EXT	6532	Juvenile Low	1.00	1025.41	1027.35		1027.35	0.000006	0.09	11.52	10.97	0.01
VANAUKEN EXT	6532	Adult Low	3.00	1025.41	1027.66		1027.66	0.000024	0.20	15.18	12.50	0.03
VANAUKEN EXT	6532	Juvenile High	27.00	1025.41	1028.79		1028.80	0.000251	0.84	32.31	17.81	0.11
VANAUKEN EXT	6532	Adult High	137.00	1025.41	1030.46		1030.52	0.000837	2.00	68.60	25.03	0.21
VANAUKEN EXT	6532	1.1-year	181.00	1025.41	1030.85		1030.93	0.000992	2.30	78.64	26.19	0.23
VANAUKEN EXT	6532	2-year	274.00	1025.41	1031.53		1031.65	0.001236	2.82	97.16	28.17	0.27
VANAUKEN EXT	6532	5-year	460.00	1025.41	1032.57		1032.77	0.001555	3.62	127.91	31.08	0.31
VANAUKEN EXT	6532	10-year	572.00	1025.41	1033.07		1033.32	0.001719	4.01	143.86	32.52	0.33
VANAUKEN EXT	6532	25-year	701.00	1025.41	1033.58		1033.88	0.001889	4.42	160.71	33.96	0.35
VANAUKEN EXT	6532	50-year	821.00	1025.41	1033.99		1034.34	0.002048	4.77	174.84	35.13	0.37
VANAUKEN EXT	6532	100-year	928.00	1025.41	1034.33		1034.73	0.002185	5.05	187.26	36.42	0.38
VANAUKEN EXT	6432	Juvenile Low	1.00	1023.48	1027.35		1027.35	0.000000	0.01	70.80	29.90	0.00
VANAUKEN EXT	6432	Adult Low	3.00	1023.48	1027.66		1027.66	0.000000	0.04	80.42	31.61	0.00
VANAUKEN EXT	6432	Juvenile High	27.00	1023.48	1028.79		1028.79	0.000009	0.23	119.87	38.05	0.02
VANAUKEN EXT	6432	Adult High	137.00	1023.48	1030.48		1030.49	0.000060	0.72	189.42	43.83	0.06
VANAUKEN EXT	6432	1.1-year	181.00	1023.48	1030.88		1030.89	0.000081	0.87	207.15	45.12	0.07
VANAUKEN EXT	6432	2-year	274.00	1023.48	1031.57		1031.60	0.000119	1.15	239.44	47.77	0.09
VANAUKEN EXT	6432	5-year	460.00	1023.48	1032.64		1032.68	0.000179	1.59	293.19	52.97	0.11
VANAUKEN EXT	6432	10-year	572.00	1023.48	1033.16		1033.21	0.000211	1.83	321.38	55.59	0.12
VANAUKEN EXT	6432	25-year	701.00	1023.48	1033.69		1033.75	0.000246	2.07	351.36	58.21	0.14
VANAUKEN EXT	6432	50-year	821.00	1023.48	1034.12		1034.20	0.000277	2.28	376.70	60.23	0.14
VANAUKEN EXT	6432	100-year	928.00	1023.48	1034.48		1034.57	0.000302	2.46	398.87	61.95	0.15
VANAUKEN EXT	6325	Juvenile Low	1.00	1026.78	1027.33	1027.13	1027.35	0.002381	0.83	1.21	3.73	0.26
VANAUKEN EXT	6325	Adult Low	3.00	1026.78	1027.64	1027.26	1027.66	0.002804	1.17	2.57	5.34	0.30
VANAUKEN EXT	6325	Juvenile High	27.00	1026.78	1028.69	1028.05	1028.78	0.004544	2.45	11.02	10.69	0.43
VANAUKEN EXT	6325	Adult High	137.00	1026.78	1030.15	1029.43	1030.44	0.006776	4.32	31.69	17.55	0.57
VANAUKEN EXT	6325	1.1-year	181.00	1026.78	1030.47	1029.76	1030.83	0.007555	4.83	37.50	19.10	0.61
VANAUKEN EXT	6325	2-year	274.00	1026.78	1031.02	1030.32	1031.51	0.008557	5.62	48.78	21.68	0.66
VANAUKEN EXT	6325	5-year	460.00	1026.78	1031.85	1031.17	1032.56	0.009667	6.73	68.40	25.35	0.72
VANAUKEN EXT	6325	10-year	572.00	1026.78	1032.25	1031.60	1033.07	0.010237	7.26	78.74	27.10	0.75
VANAUKEN EXT	6325	25-year	701.00	1026.78	1032.63	1032.03	1033.59	0.010859	7.83	89.53	28.75	0.78
VANAUKEN EXT	6325	50-year	821.00	1026.78	1032.90	1032.39	1034.01	0.011864	8.44	97.30	29.80	0.82
VANAUKEN EXT	6325	100-year	928.00	1026.78	1033.14	1032.68	1034.36	0.012510	8.88	104.56	30.86	0.85
VANAUKEN EXT	6200	Juvenile Low	1.00	1026.23	1026.50	1026.50	1026.58	0.045557	2.26	0.44	2.84	1.01
VANAUKEN EXT	6200	Adult Low	3.00	1026.23	1026.70	1026.70	1026.80	0.027183	2.46	1.22	4.68	0.85
VANAUKEN EXT	6200	Juvenile High	27.00	1026.23	1027.30	1027.30	1027.57	0.029337	4.17	6.48	11.96	1.00
VANAUKEN EXT	6200	Adult High	137.00	1026.23	1028.32	1028.32	1028.92	0.023137	6.21	22.08	18.61	1.00
VANAUKEN EXT	6200	1.1-year	181.00	1026.23	1028.60	1028.60	1029.27	0.021885	6.58	27.49	20.29	1.00
VANAUKEN EXT	6200	2-year	274.00	1026.23	1029.07	1029.07	1029.89	0.020555	7.25	37.79	22.95	1.00
VANAUKEN EXT	6200	5-year	460.00	1026.23	1029.81	1029.81	1030.85	0.019581	8.17	56.27	27.46	1.01
VANAUKEN EXT	6200	10-year	572.00	1026.23	1030.19	1030.19	1031.31	0.019082	8.52	67.12	30.18	1.01
VANAUKEN EXT	6200	25-year	701.00	1026.23	1030.55	1030.55	1031.79	0.018921	8.92	78.56	32.76	1.02
VANAUKEN EXT	6200	50-year	821.00	1026.23	1030.93	1030.93	1032.17	0.018156	8.94	91.85	37.11	1.00
VANAUKEN EXT	6200	100-year	928.00	1026.23	1031.20	1031.20	1032.48	0.018341	9.09	102.14	40.65	1.01
VANAUKEN EXT	6100	Juvenile Low	1.00	1019.78	1025.05		1025.05	0.000000	0.01	71.33	22.15	0.00
VANAUKEN EXT	6100	Adult Low	3.00	1019.78	1025.23		1025.23	0.000000	0.04	75.23	22.76	0.00
VANAUKEN EXT	6100	Juvenile High	27.00	1019.78	1025.96		1025.97	0.000013	0.29	93.05	25.48	0.03
VANAUKEN EXT	6100	Adult High	137.00	1019.78	1027.48		1027.50	0.000124	1.01	136.25	31.31	0.08
VANAUKEN EXT	6100	1.1-year	181.00	1019.78	1027.90		1027.92	0.000169	1.21	149.64	32.87	0.10
VANAUKEN EXT	6100	2-year	274.00	1019.78	1028.63		1028.67	0.000258	1.57	174.58	35.70	0.13
VANAUKEN EXT	6100	5-year	460.00	1019.78	1029.71		1029.79	0.000416	2.13	215.62	39.91	0.16
VANAUKEN EXT	6100	10-year	572.00	1019.78	1030.25		1030.34	0.000480	2.41	237.60	41.91	0.18
VANAUKEN EXT	6100	25-year	701.00	1019.78	1030.81		1030.92	0.000545	2.70	261.41	43.96	0.19
VANAUKEN EXT	6100	50-year	821.00	1019.78	1031.28		1031.42	0.000597	2.93	282.72	45.82	0.20
VANAUKEN EXT	6100	100-year	928.00	1019.78	1031.67		1031.82	0.000631	3.13	300.84	47.93	0.21
VANAUKEN EXT	6000	Juvenile Low	1.00	1024.80	1025.01	1025.01	1025.05	0.030558	1.61	0.62	5.03	0.81
VANAUKEN EXT	6000	Adult Low	3.00	1024.80	1025.08	1025.08	1025.21	0.064691	2.90	1.03	6.05	1.24
VANAUKEN EXT	6000	Juvenile High	27.00	1024.80	1025.61	1025.61	1025.93	0.036012	4.55	5.94	11.26	1.10
VANAUKEN EXT	6000	Adult High	137.00	1024.80	1026.71	1026.71	1027.39	0.023050	6.61	20.73	15.51	1.01
VANAUKEN EXT	6000	1.1-year	181.00	1024.80	1027.01	1027.01	1027.79	0.022449	7.10	25.50	16.71	1.01
VANAUKEN EXT	6000	2-year	274.00	1024.80	1027.54	1027.54	1028.49	0.021762	7.83	34.98	19.19	1.02
VANAUKEN EXT	6000	5-year	460.00	1024.80	1028.37	1028.37	1029.55	0.020418	8.69	52.93	23.55	1.02
VANAUKEN EXT	6000	10-year	572.00	1024.80	1028.74	1028.74	1030.07	0.020157	9.27	61.70	24.49	1.03
VANAUKEN EXT	6000	25-year	701.00	1024.80	1029.14	1029.14	1030.62	0.019485	9.78	71.70	25.42	1.03

HEC-RAS Plan: Vanauken EXTENDED River: VANAUKEN EXT Reach: VANAUKEN EXT (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
VANAUKEN EXT	6000	50-year	821.00	1024.80	1029.48	1029.48	1031.10	0.019094	10.20	80.50	26.21	1.03
VANAUKEN EXT	6000	100-year	928.00	1024.80	1029.82	1029.82	1031.49	0.017877	10.35	89.63	26.99	1.00
VANAUKEN EXT	5900	Juvenile Low	1.00	1017.97	1018.08	1018.08	1018.13	0.051844	1.69	0.59	6.65	0.99
VANAUKEN EXT	5900	Adult Low	3.00	1017.97	1018.18	1018.18	1018.27	0.043818	2.37	1.26	7.45	1.02
VANAUKEN EXT	5900	Juvenile High	27.00	1017.97	1018.65	1018.65	1019.03	0.040989	4.96	5.44	9.92	1.18
VANAUKEN EXT	5900	Adult High	137.00	1017.97	1019.88	1019.88	1020.58	0.022497	6.73	20.35	14.47	1.00
VANAUKEN EXT	5900	1.1-year	181.00	1017.97	1020.20	1020.20	1021.00	0.021570	7.17	25.23	15.72	1.00
VANAUKEN EXT	5900	2-year	274.00	1017.97	1020.79	1020.79	1021.72	0.020479	7.73	35.43	18.95	1.00
VANAUKEN EXT	5900	5-year	460.00	1017.97	1021.63	1021.63	1022.81	0.019125	8.73	52.69	22.07	1.00
VANAUKEN EXT	5900	10-year	572.00	1017.97	1022.04	1022.04	1023.36	0.018617	9.21	62.12	23.39	1.00
VANAUKEN EXT	5900	25-year	701.00	1017.97	1022.45	1022.45	1023.93	0.018695	9.77	71.76	24.67	1.01
VANAUKEN EXT	5900	50-year	821.00	1017.97	1022.80	1022.80	1024.41	0.018373	10.17	80.74	25.65	1.01
VANAUKEN EXT	5900	100-year	928.00	1017.97	1023.13	1023.13	1024.81	0.017592	10.38	89.40	26.51	1.00
VANAUKEN EXT	5800	Juvenile Low	1.00	1013.93	1014.34		1014.35	0.004771	0.95	1.05	4.56	0.35
VANAUKEN EXT	5800	Adult Low	3.00	1013.93	1014.73		1014.75	0.001648	0.94	3.20	6.22	0.23
VANAUKEN EXT	5800	Juvenile High	27.00	1013.93	1016.21		1016.26	0.001388	1.66	16.31	11.29	0.24
VANAUKEN EXT	5800	Adult High	137.00	1013.93	1018.30		1018.41	0.002058	2.74	49.93	21.77	0.32
VANAUKEN EXT	5800	1.1-year	181.00	1013.93	1018.76		1018.90	0.002252	2.97	60.95	25.41	0.34
VANAUKEN EXT	5800	2-year	274.00	1013.93	1019.47		1019.65	0.002395	3.42	80.11	28.19	0.36
VANAUKEN EXT	5800	5-year	460.00	1013.93	1020.55		1020.81	0.002581	4.09	112.57	31.85	0.38
VANAUKEN EXT	5800	10-year	572.00	1013.93	1021.10		1021.40	0.002630	4.39	130.34	33.46	0.39
VANAUKEN EXT	5800	25-year	701.00	1013.93	1021.64		1021.98	0.002710	4.71	148.94	35.08	0.40
VANAUKEN EXT	5800	50-year	821.00	1013.93	1022.11		1022.49	0.002763	4.95	165.90	36.71	0.41
VANAUKEN EXT	5800	100-year	928.00	1013.93	1022.50		1022.91	0.002763	5.15	180.33	37.99	0.41
VANAUKEN EXT	5700	Juvenile Low	1.00	1013.34	1014.28		1014.28	0.000315	0.41	2.41	4.37	0.10
VANAUKEN EXT	5700	Adult Low	3.00	1013.34	1014.64		1014.65	0.000623	0.71	4.22	5.57	0.14
VANAUKEN EXT	5700	Juvenile High	27.00	1013.34	1016.06		1016.11	0.001533	1.74	15.53	10.28	0.25
VANAUKEN EXT	5700	Adult High	137.00	1013.34	1018.00		1018.17	0.002859	3.30	41.57	16.62	0.37
VANAUKEN EXT	5700	1.1-year	181.00	1013.34	1018.40		1018.62	0.003305	3.73	48.53	17.94	0.40
VANAUKEN EXT	5700	2-year	274.00	1013.34	1019.00		1019.32	0.004342	4.58	59.81	19.90	0.47
VANAUKEN EXT	5700	5-year	460.00	1013.34	1019.88		1020.41	0.005882	5.85	78.66	22.73	0.55
VANAUKEN EXT	5700	10-year	572.00	1013.34	1020.33		1020.97	0.006521	6.42	89.13	24.21	0.59
VANAUKEN EXT	5700	25-year	701.00	1013.34	1020.76		1021.52	0.007340	7.02	99.83	25.99	0.63
VANAUKEN EXT	5700	50-year	821.00	1013.34	1021.15		1022.01	0.007784	7.43	110.45	27.69	0.66
VANAUKEN EXT	5700	100-year	928.00	1013.34	1021.49		1022.42	0.008030	7.73	120.11	29.16	0.67
VANAUKEN EXT	5600	Juvenile Low	1.00	1013.65	1014.05	1014.05	1014.12	0.026717	2.15	0.47	2.03	0.79
VANAUKEN EXT	5600	Adult Low	3.00	1013.65	1014.20	1014.20	1014.41	0.051818	3.67	0.82	2.60	1.15
VANAUKEN EXT	5600	Juvenile High	27.00	1013.65	1015.34	1015.34	1015.70	0.022167	4.84	5.58	5.78	0.87
VANAUKEN EXT	5600	Adult High	137.00	1013.65	1016.92	1016.92	1017.49	0.025026	6.04	22.68	19.90	1.00
VANAUKEN EXT	5600	1.1-year	181.00	1013.65	1017.10	1017.10	1017.83	0.029342	6.82	26.53	21.97	1.09
VANAUKEN EXT	5600	2-year	274.00	1013.65	1017.58	1017.58	1018.41	0.024006	7.29	37.59	24.22	1.03
VANAUKEN EXT	5600	5-year	460.00	1013.65	1018.29	1018.29	1019.35	0.021082	8.29	55.51	26.59	1.01
VANAUKEN EXT	5600	10-year	572.00	1013.65	1018.62	1018.62	1019.84	0.020781	8.86	64.54	27.54	1.02
VANAUKEN EXT	5600	25-year	701.00	1013.65	1019.03	1019.03	1020.35	0.019065	9.20	76.20	28.67	0.99
VANAUKEN EXT	5600	50-year	821.00	1013.65	1019.32	1019.32	1020.79	0.019204	9.70	84.61	29.44	1.01
VANAUKEN EXT	5600	100-year	928.00	1013.65	1019.55	1019.55	1021.15	0.019632	10.17	91.27	30.00	1.03
VANAUKEN EXT	5500	Juvenile Low	1.00	1009.97	1010.31	1010.15	1010.32	0.002639	0.66	1.51	7.38	0.26
VANAUKEN EXT	5500	Adult Low	3.00	1009.97	1010.53		1010.54	0.002276	0.88	3.42	9.74	0.26
VANAUKEN EXT	5500	Juvenile High	27.00	1009.97	1011.44		1011.50	0.002688	1.97	13.70	12.54	0.33
VANAUKEN EXT	5500	Adult High	137.00	1009.97	1013.04		1013.26	0.003959	3.78	36.24	15.51	0.44
VANAUKEN EXT	5500	1.1-year	181.00	1009.97	1013.48		1013.75	0.004179	4.19	43.25	16.28	0.45
VANAUKEN EXT	5500	2-year	274.00	1009.97	1014.25		1014.62	0.004565	4.87	56.30	17.63	0.48
VANAUKEN EXT	5500	5-year	460.00	1009.97	1015.46		1015.99	0.005073	5.84	78.81	19.71	0.51
VANAUKEN EXT	5500	10-year	572.00	1009.97	1016.07		1016.68	0.005274	6.28	91.12	20.77	0.53
VANAUKEN EXT	5500	25-year	701.00	1009.97	1016.69		1017.39	0.005451	6.70	104.55	21.88	0.54
VANAUKEN EXT	5500	50-year	821.00	1009.97	1017.23		1018.00	0.005578	7.05	116.53	22.83	0.55
VANAUKEN EXT	5500	100-year	928.00	1009.97	1017.68		1018.51	0.005670	7.32	126.85	23.62	0.56
VANAUKEN EXT	5400	Juvenile Low	1.00	1009.35	1009.65	1009.54	1009.69	0.020923	1.72	0.58	3.14	0.70
VANAUKEN EXT	5400	Adult Low	3.00	1009.35	1009.77	1009.77	1009.89	0.042135	2.85	1.05	4.47	1.04
VANAUKEN EXT	5400	Juvenile High	27.00	1009.35	1010.45	1010.45	1010.85	0.032019	5.10	5.30	7.41	1.06
VANAUKEN EXT	5400	Adult High	137.00	1009.35	1011.70	1011.70	1012.43	0.023329	6.85	19.99	13.58	1.00
VANAUKEN EXT	5400	1.1-year	181.00	1009.35	1012.01	1012.01	1012.87	0.022669	7.43	24.35	14.11	1.00
VANAUKEN EXT	5400	2-year	274.00	1009.35	1012.58	1012.58	1013.68	0.022089	8.41	32.59	15.02	1.01
VANAUKEN EXT	5400	5-year	460.00	1009.35	1013.53	1013.53	1014.98	0.020951	9.66	47.63	16.55	1.00
VANAUKEN EXT	5400	10-year	572.00	1009.35	1014.03	1014.03	1015.65	0.020528	10.22	55.99	17.34	1.00
VANAUKEN EXT	5400	25-year	701.00	1009.35	1014.55	1014.55	1016.34	0.020124	10.75	65.22	18.18	1.00
VANAUKEN EXT	5400	50-year	821.00	1009.35	1014.99	1014.99	1016.93	0.019850	11.18	73.45	18.89	1.00
VANAUKEN EXT	5400	100-year	928.00	1009.35	1015.36	1015.36	1017.42	0.019646	11.52	80.56	19.49	1.00
VANAUKEN EXT	5300	Juvenile Low	1.00	1005.41	1005.58	1005.58	1005.70	0.104332	2.76	0.36	3.24	1.46
VANAUKEN EXT	5300	Adult Low	3.00	1005.41	1005.82	1005.82	1005.89	0.019414	2.09	1.43	5.47	0.72
VANAUKEN EXT	5300	Juvenile High	27.00	1005.41	1006.63		1006.79	0.011927	3.26	8.29	11.19	0.67
VANAUKEN EXT	5300	Adult High	137.00	1005.41	1008.33		1008.60	0.005843	4.16	32.93	17.28	0.53
VANAUKEN EXT	5300	1.1-year	181.00	1005.41	1008.78		1009.08	0.005545	4.43	40.89	18.62	0.53
VANAUKEN EXT	5300	2-year	274.00	1005.41	1009.54		1009.91	0.005329	4.90	55.92	20.95	0.53

HEC-RAS Plan: Vanauken EXTENDED River: VANAUKEN EXT Reach: VANAUKEN EXT (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
VANAUKEN EXT	5300	5-year	460.00	1005.41	1010.69		1011.18	0.005310	5.59	82.28	24.93	0.54
VANAUKEN EXT	5300	10-year	572.00	1005.41	1011.25		1011.80	0.005263	5.91	96.75	26.63	0.55
VANAUKEN EXT	5300	25-year	701.00	1005.41	1011.83		1012.43	0.005180	6.22	112.65	28.18	0.55
VANAUKEN EXT	5300	50-year	821.00	1005.41	1012.31		1012.96	0.005160	6.50	126.37	29.36	0.55
VANAUKEN EXT	5300	100-year	928.00	1005.41	1012.70		1013.40	0.005172	6.73	137.98	30.38	0.56
VANAUKEN EXT	5200	Juvenile Low	1.00	1004.21	1004.71		1004.71	0.000869	0.54	1.84	5.06	0.16
VANAUKEN EXT	5200	Adult Low	3.00	1004.21	1004.98		1005.00	0.001344	0.89	3.36	5.93	0.21
VANAUKEN EXT	5200	Juvenile High	27.00	1004.21	1006.00		1006.10	0.003931	2.43	11.10	9.24	0.39
VANAUKEN EXT	5200	Adult High	137.00	1004.21	1007.71		1008.00	0.006118	4.36	31.39	14.56	0.52
VANAUKEN EXT	5200	1.1-year	181.00	1004.21	1008.11		1008.47	0.006640	4.83	37.50	15.82	0.55
VANAUKEN EXT	5200	2-year	274.00	1004.21	1008.78		1009.27	0.007521	5.61	48.85	17.94	0.60
VANAUKEN EXT	5200	5-year	460.00	1004.21	1009.79		1010.49	0.008454	6.74	68.23	20.47	0.65
VANAUKEN EXT	5200	10-year	572.00	1004.21	1010.25		1011.09	0.009048	7.34	77.95	21.52	0.68
VANAUKEN EXT	5200	25-year	701.00	1004.21	1010.73		1011.70	0.009575	7.92	88.56	22.63	0.71
VANAUKEN EXT	5200	50-year	821.00	1004.21	1011.11		1012.22	0.010152	8.43	97.35	23.55	0.73
VANAUKEN EXT	5200	100-year	928.00	1004.21	1011.41		1012.64	0.010691	8.88	104.55	24.29	0.75
VANAUKEN EXT	5100	Juvenile Low	1.00	1002.99	1004.70		1004.70	0.000014	0.13	7.90	8.44	0.02
VANAUKEN EXT	5100	Adult Low	3.00	1002.99	1004.97		1004.98	0.000062	0.29	10.34	9.64	0.05
VANAUKEN EXT	5100	Juvenile High	27.00	1002.99	1005.91		1005.93	0.000734	1.27	21.26	13.75	0.18
VANAUKEN EXT	5100	Adult High	137.00	1002.99	1007.49		1007.62	0.002085	2.82	48.56	20.68	0.32
VANAUKEN EXT	5100	1.1-year	181.00	1002.99	1007.88		1008.03	0.002404	3.19	56.79	22.41	0.35
VANAUKEN EXT	5100	2-year	274.00	1002.99	1008.53		1008.75	0.002875	3.79	72.29	25.12	0.39
VANAUKEN EXT	5100	5-year	460.00	1002.99	1009.55		1009.88	0.003311	4.62	99.67	28.40	0.43
VANAUKEN EXT	5100	10-year	572.00	1002.99	1010.02		1010.41	0.003573	5.05	113.36	29.77	0.46
VANAUKEN EXT	5100	25-year	701.00	1002.99	1010.51		1010.97	0.003787	5.45	128.51	31.23	0.47
VANAUKEN EXT	5100	50-year	821.00	1002.99	1010.91		1011.44	0.003946	5.82	141.21	32.44	0.49
VANAUKEN EXT	5100	100-year	928.00	1002.99	1011.23		1011.82	0.004053	6.12	151.78	33.39	0.50
VANAUKEN EXT	5000	Juvenile Low	1.00	1004.33	1004.65	1004.65	1004.69	0.021421	1.78	0.56	2.93	0.71
VANAUKEN EXT	5000	Adult Low	3.00	1004.33	1004.89	1004.76	1004.95	0.013971	1.87	1.60	5.59	0.62
VANAUKEN EXT	5000	Juvenile High	27.00	1004.33	1005.52	1005.48	1005.72	0.018703	3.58	7.54	12.46	0.81
VANAUKEN EXT	5000	Adult High	137.00	1004.33	1006.58	1006.46	1007.10	0.017415	5.77	23.73	17.86	0.88
VANAUKEN EXT	5000	1.1-year	181.00	1004.33	1006.88	1006.75	1007.47	0.016802	6.18	29.28	19.30	0.88
VANAUKEN EXT	5000	2-year	274.00	1004.33	1007.42	1007.25	1008.14	0.015531	6.78	40.41	21.73	0.88
VANAUKEN EXT	5000	5-year	460.00	1004.33	1008.03	1008.03	1009.14	0.018987	8.44	54.51	24.43	1.00
VANAUKEN EXT	5000	10-year	572.00	1004.33	1008.43	1008.43	1009.65	0.018487	8.86	64.52	26.26	1.00
VANAUKEN EXT	5000	25-year	701.00	1004.33	1008.81	1008.81	1010.17	0.018493	9.37	74.84	27.99	1.01
VANAUKEN EXT	5000	50-year	821.00	1004.33	1009.14	1009.14	1010.61	0.018141	9.72	84.48	29.40	1.01
VANAUKEN EXT	5000	100-year	928.00	1004.33	1009.42	1009.42	1010.98	0.017886	10.01	92.71	30.47	1.01
VANAUKEN EXT	4900	Juvenile Low	1.00	1001.88	1002.13	1002.13	1002.18	0.023916	1.78	0.56	3.20	0.75
VANAUKEN EXT	4900	Adult Low	3.00	1001.88	1002.23	1002.23	1002.40	0.053328	3.26	0.92	3.82	1.17
VANAUKEN EXT	4900	Juvenile High	27.00	1001.88	1003.02	1003.02	1003.39	0.028320	4.89	5.52	7.47	1.00
VANAUKEN EXT	4900	Adult High	137.00	1001.88	1004.39	1004.39	1005.10	0.023073	6.77	20.23	14.07	1.00
VANAUKEN EXT	4900	1.1-year	181.00	1001.88	1004.72	1004.72	1005.53	0.022519	7.19	25.16	15.66	1.00
VANAUKEN EXT	4900	2-year	274.00	1001.88	1005.35	1005.35	1006.25	0.021467	7.59	36.12	20.11	1.00
VANAUKEN EXT	4900	5-year	460.00	1001.88	1006.18	1006.18	1007.14	0.020658	7.85	58.63	30.69	1.00
VANAUKEN EXT	4900	10-year	572.00	1001.88	1006.49	1006.49	1007.58	0.020352	8.38	68.29	32.00	1.01
VANAUKEN EXT	4900	25-year	701.00	1001.88	1006.82	1006.82	1008.04	0.019977	8.87	79.06	33.49	1.02
VANAUKEN EXT	4900	50-year	821.00	1001.88	1007.10	1007.10	1008.44	0.019650	9.27	88.55	34.55	1.02
VANAUKEN EXT	4900	100-year	928.00	1001.88	1007.34	1007.34	1008.76	0.019145	9.57	96.99	35.29	1.02
VANAUKEN EXT	4800	Juvenile Low	1.00	998.18	998.74		998.75	0.000849	0.53	1.89	5.37	0.16
VANAUKEN EXT	4800	Adult Low	3.00	998.18	999.01		999.02	0.001310	0.86	3.47	6.41	0.21
VANAUKEN EXT	4800	Juvenile High	27.00	998.18	1000.01		1000.10	0.003566	2.37	11.39	9.37	0.38
VANAUKEN EXT	4800	Adult High	137.00	998.18	1001.56		1001.91	0.006922	4.76	28.76	12.89	0.56
VANAUKEN EXT	4800	1.1-year	181.00	998.18	1001.89		1002.36	0.008164	5.45	33.21	13.66	0.62
VANAUKEN EXT	4800	2-year	274.00	998.18	1002.61		1003.22	0.009007	6.29	43.56	15.36	0.66
VANAUKEN EXT	4800	5-year	460.00	998.18	1003.74		1004.57	0.010317	7.29	63.12	20.01	0.72
VANAUKEN EXT	4800	10-year	572.00	998.18	1004.28		1005.19	0.010744	7.67	74.62	22.87	0.75
VANAUKEN EXT	4800	25-year	701.00	998.18	1004.79		1005.80	0.010771	8.05	87.05	25.15	0.76
VANAUKEN EXT	4800	50-year	821.00	998.18	1005.26		1006.32	0.011854	8.27	99.49	30.74	0.80
VANAUKEN EXT	4800	100-year	928.00	998.18	1005.69		1006.74	0.010594	8.24	113.22	32.83	0.77
VANAUKEN EXT	4700	Juvenile Low	1.00	998.07	998.26	998.26	998.41	0.121253	3.14	0.32	2.57	1.57
VANAUKEN EXT	4700	Adult Low	3.00	998.07	998.46	998.46	998.58	0.040672	2.75	1.09	4.73	1.01
VANAUKEN EXT	4700	Juvenile High	27.00	998.07	999.14	999.14	999.35	0.023933	3.71	7.27	13.48	0.89
VANAUKEN EXT	4700	Adult High	137.00	998.07	1000.16	1000.08	1000.76	0.019725	6.24	21.97	15.36	0.92
VANAUKEN EXT	4700	1.1-year	181.00	998.07	1000.52	1000.52	1001.18	0.017248	6.54	27.68	16.08	0.88
VANAUKEN EXT	4700	2-year	274.00	998.07	1000.95	1000.90	1001.91	0.020129	7.86	34.86	17.06	0.97
VANAUKEN EXT	4700	5-year	460.00	998.07	1001.78	1001.78	1003.11	0.020502	9.23	49.86	19.14	1.01
VANAUKEN EXT	4700	10-year	572.00	998.07	1002.24	1002.24	1003.71	0.019946	9.71	58.89	20.40	1.01
VANAUKEN EXT	4700	25-year	701.00	998.07	1002.71	1002.71	1004.32	0.019473	10.19	68.81	21.67	1.01
VANAUKEN EXT	4700	50-year	821.00	998.07	1003.11	1003.11	1004.85	0.019103	10.57	77.71	22.76	1.01
VANAUKEN EXT	4700	100-year	928.00	998.07	1003.44	1003.44	1005.28	0.018874	10.87	85.34	23.65	1.01
VANAUKEN EXT	4600	Juvenile Low	1.00	995.48	995.85	995.81	995.87	0.009826	1.24	0.81	3.98	0.48
VANAUKEN EXT	4600	Adult Low	3.00	995.48	996.09	995.91	996.12	0.007225	1.51	1.99	5.75	0.45
VANAUKEN EXT	4600	Juvenile High	27.00	995.48	996.81	996.67	997.00	0.013561	3.53	7.65	9.65	0.70

HEC-RAS Plan: Vanauken EXTENDED River: VANAUKEN EXT Reach: VANAUKEN EXT (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
VANAUKEN EXT	4600	Adult High	137.00	995.48	997.81	997.81	998.56	0.025023	6.92	19.79	14.01	1.03
VANAUKEN EXT	4600	1.1-year	181.00	995.48	998.12	998.12	998.99	0.024206	7.49	24.17	14.66	1.03
VANAUKEN EXT	4600	2-year	274.00	995.48	998.70	998.70	999.77	0.022346	8.29	33.04	15.86	1.01
VANAUKEN EXT	4600	5-year	460.00	995.48	999.63	999.63	1001.01	0.021004	9.43	48.79	18.11	1.01
VANAUKEN EXT	4600	10-year	572.00	995.48	1000.11	1000.11	1001.63	0.020244	9.89	57.84	19.32	1.01
VANAUKEN EXT	4600	25-year	701.00	995.48	1000.63	1000.63	1002.27	0.019604	10.27	68.25	20.98	1.00
VANAUKEN EXT	4600	50-year	821.00	995.48	1001.06	1001.06	1002.80	0.019370	10.57	77.67	22.70	1.01
VANAUKEN EXT	4600	100-year	928.00	995.48	1001.42	1001.42	1003.23	0.019170	10.78	86.05	24.27	1.01
VANAUKEN EXT	4500	Juvenile Low	1.00	993.97	994.22	994.22	994.28	0.030919	1.83	0.55	3.63	0.83
VANAUKEN EXT	4500	Adult Low	3.00	993.97	994.32	994.32	994.48	0.058427	3.12	0.96	4.64	1.21
VANAUKEN EXT	4500	Juvenile High	27.00	993.97	995.05	995.05	995.27	0.022203	3.82	7.07	12.06	0.88
VANAUKEN EXT	4500	Adult High	137.00	993.97	996.28		996.51	0.008242	3.83	35.73	28.62	0.60
VANAUKEN EXT	4500	1.1-year	181.00	993.97	996.61		996.86	0.006817	3.99	45.39	29.54	0.57
VANAUKEN EXT	4500	2-year	274.00	993.97	997.21		997.50	0.005942	4.28	64.02	34.17	0.55
VANAUKEN EXT	4500	5-year	460.00	993.97	998.14		998.49	0.004751	4.70	99.35	40.05	0.51
VANAUKEN EXT	4500	10-year	572.00	993.97	998.57		998.95	0.004558	5.02	116.48	41.39	0.51
VANAUKEN EXT	4500	25-year	701.00	993.97	999.03		999.46	0.004376	5.31	135.87	43.17	0.51
VANAUKEN EXT	4500	50-year	821.00	993.97	999.36		999.85	0.004509	5.63	150.55	44.81	0.52
VANAUKEN EXT	4500	100-year	928.00	993.97	999.60		1000.14	0.004744	5.95	161.52	46.01	0.54
VANAUKEN EXT	4400	Juvenile Low	1.00	992.69	993.16		993.16	0.000614	0.43	2.32	7.13	0.13
VANAUKEN EXT	4400	Adult Low	3.00	992.69	993.35		993.36	0.001233	0.78	3.83	7.99	0.20
VANAUKEN EXT	4400	Juvenile High	27.00	992.69	994.22		994.30	0.003499	2.21	12.31	12.79	0.38
VANAUKEN EXT	4400	Adult High	137.00	992.69	995.42		995.72	0.007751	4.52	33.42	21.70	0.60
VANAUKEN EXT	4400	1.1-year	181.00	992.69	995.66		996.06	0.009131	5.17	38.95	23.08	0.66
VANAUKEN EXT	4400	2-year	274.00	992.69	996.09		996.67	0.011450	6.28	49.20	25.40	0.76
VANAUKEN EXT	4400	5-year	460.00	992.69	996.77		997.63	0.014790	7.72	67.99	30.38	0.87
VANAUKEN EXT	4400	10-year	572.00	992.69	997.06	996.90	998.10	0.016667	8.46	77.43	32.70	0.94
VANAUKEN EXT	4400	25-year	701.00	992.69	997.37	997.33	998.58	0.018624	9.16	87.81	35.42	1.00
VANAUKEN EXT	4400	50-year	821.00	992.69	997.80	997.80	998.95	0.019413	8.98	104.42	43.63	1.01
VANAUKEN EXT	4400	100-year	928.00	992.69	998.11	998.11	999.26	0.017271	8.97	118.51	46.26	0.97
VANAUKEN EXT	4300	Juvenile Low	1.00	992.58	992.83	992.83	992.88	0.050427	1.80	0.55	5.45	1.00
VANAUKEN EXT	4300	Adult Low	3.00	992.58	993.02		993.05	0.014194	1.54	1.94	9.25	0.59
VANAUKEN EXT	4300	Juvenile High	27.00	992.58	993.55	993.55	993.67	0.015100	2.76	9.77	20.30	0.70
VANAUKEN EXT	4300	Adult High	137.00	992.58	994.39		994.69	0.013522	4.44	30.88	29.03	0.76
VANAUKEN EXT	4300	1.1-year	181.00	992.58	994.65		994.99	0.011891	4.68	38.66	30.36	0.73
VANAUKEN EXT	4300	2-year	274.00	992.58	995.13		995.53	0.010505	5.09	53.80	33.84	0.71
VANAUKEN EXT	4300	5-year	460.00	992.58	995.86		996.36	0.009438	5.66	81.26	40.21	0.70
VANAUKEN EXT	4300	10-year	572.00	992.58	996.29		996.81	0.008090	5.77	99.16	42.39	0.66
VANAUKEN EXT	4300	25-year	701.00	992.58	996.77		997.30	0.006774	5.86	119.79	44.54	0.62
VANAUKEN EXT	4300	50-year	821.00	992.58	997.18		997.73	0.005903	5.95	138.74	46.39	0.59
VANAUKEN EXT	4300	100-year	928.00	992.58	997.55		998.11	0.005271	6.00	156.13	47.98	0.57
VANAUKEN EXT	4200	Juvenile Low	1.00	990.04	990.35		990.38	0.015726	1.48	0.68	3.71	0.61
VANAUKEN EXT	4200	Adult Low	3.00	990.04	990.42	990.42	990.57	0.054681	3.16	0.95	4.24	1.18
VANAUKEN EXT	4200	Juvenile High	27.00	990.04	991.23		991.50	0.020124	4.17	6.48	8.83	0.86
VANAUKEN EXT	4200	Adult High	137.00	990.04	992.51	992.43	993.12	0.019392	6.29	21.79	15.36	0.93
VANAUKEN EXT	4200	1.1-year	181.00	990.04	992.86	992.75	993.53	0.018474	6.56	27.60	17.63	0.92
VANAUKEN EXT	4200	2-year	274.00	990.04	993.52		994.21	0.015322	6.68	41.01	22.13	0.87
VANAUKEN EXT	4200	5-year	460.00	990.04	994.58		995.32	0.010753	6.91	66.62	25.79	0.76
VANAUKEN EXT	4200	10-year	572.00	990.04	995.15		995.91	0.009455	6.98	81.97	28.17	0.72
VANAUKEN EXT	4200	25-year	701.00	990.04	995.77		996.53	0.008387	6.97	100.53	31.50	0.69
VANAUKEN EXT	4200	50-year	821.00	990.04	996.28		997.05	0.007514	7.01	117.17	33.40	0.66
VANAUKEN EXT	4200	100-year	928.00	990.04	996.72		997.49	0.006933	7.02	132.12	35.22	0.64
VANAUKEN EXT	4100	Juvenile Low	1.00	988.45	988.86	988.79	988.89	0.013388	1.51	0.66	3.02	0.57
VANAUKEN EXT	4100	Adult Low	3.00	988.45	989.20	988.91	989.23	0.005725	1.44	2.08	5.39	0.41
VANAUKEN EXT	4100	Juvenile High	27.00	988.45	989.91	989.58	990.05	0.009680	2.99	9.02	11.49	0.60
VANAUKEN EXT	4100	Adult High	137.00	988.45	991.21	990.77	991.65	0.010696	5.28	25.92	14.37	0.69
VANAUKEN EXT	4100	1.1-year	181.00	988.45	991.55	991.10	992.08	0.011272	5.86	30.89	15.10	0.72
VANAUKEN EXT	4100	2-year	274.00	988.45	992.16	991.69	992.87	0.011906	6.75	40.57	16.41	0.76
VANAUKEN EXT	4100	5-year	460.00	988.45	993.12	992.64	994.12	0.012862	8.05	57.16	18.45	0.81
VANAUKEN EXT	4100	10-year	572.00	988.45	993.57	993.12	994.75	0.013453	8.69	65.84	19.43	0.83
VANAUKEN EXT	4100	25-year	701.00	988.45	994.01	993.62	995.39	0.014326	9.40	74.59	20.36	0.87
VANAUKEN EXT	4100	50-year	821.00	988.45	994.35	994.05	995.93	0.015355	10.06	81.61	21.07	0.90
VANAUKEN EXT	4100	100-year	928.00	988.45	994.64	994.41	996.38	0.016106	10.58	87.75	21.71	0.93
VANAUKEN EXT	4000	Juvenile Low	1.00	987.11	987.29	987.29	987.31	0.017166	1.24	0.81	6.23	0.61
VANAUKEN EXT	4000	Adult Low	3.00	987.11	987.29	987.29	987.50	0.154498	3.72	0.81	6.23	1.83
VANAUKEN EXT	4000	Juvenile High	27.00	987.11	987.92	987.92	988.30	0.033118	4.93	5.48	8.39	1.07
VANAUKEN EXT	4000	Adult High	137.00	987.11	989.27	989.27	990.03	0.022779	7.02	19.52	12.68	1.00
VANAUKEN EXT	4000	1.1-year	181.00	987.11	989.62	989.62	990.49	0.022076	7.47	24.22	13.86	1.00
VANAUKEN EXT	4000	2-year	274.00	987.11	990.24	990.24	991.28	0.021085	8.19	33.45	15.94	1.00
VANAUKEN EXT	4000	5-year	460.00	987.11	991.18	991.18	992.51	0.019962	9.23	49.82	18.76	1.00
VANAUKEN EXT	4000	10-year	572.00	987.11	991.66	991.66	993.11	0.019521	9.67	59.14	20.33	1.00
VANAUKEN EXT	4000	25-year	701.00	987.11	992.17	992.17	993.73	0.019090	10.01	70.03	22.47	1.00
VANAUKEN EXT	4000	50-year	821.00	987.11	992.62	992.62	994.23	0.018830	10.19	80.59	25.02	1.00
VANAUKEN EXT	4000	100-year	928.00	987.11	992.95	992.95	994.63	0.018633	10.39	89.35	26.77	1.00

HEC-RAS Plan: Vanauken EXTENDED River: VANAUKEN EXT Reach: VANAUKEN EXT (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
VANAUKEN EXT	3900	Juvenile Low	1.00	985.64	985.97		985.97	0.002666	0.69	1.45	6.64	0.26
VANAUKEN EXT	3900	Adult Low	3.00	985.64	986.20		986.21	0.002322	0.96	3.12	7.77	0.27
VANAUKEN EXT	3900	Juvenile High	27.00	985.64	987.08		987.17	0.004046	2.28	11.85	11.97	0.40
VANAUKEN EXT	3900	Adult High	137.00	985.64	988.55		988.77	0.006282	3.79	36.17	23.49	0.54
VANAUKEN EXT	3900	1.1-year	181.00	985.64	988.95		989.19	0.005873	3.91	46.26	26.95	0.53
VANAUKEN EXT	3900	2-year	274.00	985.64	989.59		989.86	0.005615	4.19	65.37	32.96	0.52
VANAUKEN EXT	3900	5-year	460.00	985.64	990.48		990.84	0.004862	4.80	95.77	34.75	0.51
VANAUKEN EXT	3900	10-year	572.00	985.64	990.98		991.38	0.004511	5.04	113.43	35.90	0.50
VANAUKEN EXT	3900	25-year	701.00	985.64	991.52		991.95	0.004274	5.26	133.15	37.79	0.49
VANAUKEN EXT	3900	50-year	821.00	985.64	991.97		992.43	0.004093	5.46	150.48	39.03	0.49
VANAUKEN EXT	3900	100-year	928.00	985.64	992.34		992.83	0.003966	5.62	165.17	39.84	0.49
VANAUKEN EXT	3800	Juvenile Low	1.00	985.15	985.35	985.35	985.37	0.015574	1.18	0.85	6.53	0.58
VANAUKEN EXT	3800	Adult Low	3.00	985.15	985.35	985.35	985.54	0.140163	3.55	0.85	6.53	1.74
VANAUKEN EXT	3800	Juvenile High	27.00	985.15	985.92	985.92	986.19	0.029747	4.10	6.58	12.67	1.00
VANAUKEN EXT	3800	Adult High	137.00	985.15	986.87	986.87	987.60	0.026111	6.88	19.90	15.39	1.07
VANAUKEN EXT	3800	1.1-year	181.00	985.15	987.17	987.17	988.01	0.024345	7.36	24.59	16.15	1.05
VANAUKEN EXT	3800	2-year	274.00	985.15	987.72	987.72	988.73	0.021983	8.08	33.93	17.71	1.03
VANAUKEN EXT	3800	5-year	460.00	985.15	988.60	988.60	989.88	0.019992	9.09	50.63	20.30	1.01
VANAUKEN EXT	3800	10-year	572.00	985.15	989.05	989.05	990.46	0.019264	9.52	60.09	21.75	1.01
VANAUKEN EXT	3800	25-year	701.00	985.15	989.50	989.50	991.05	0.018806	9.99	70.19	23.08	1.01
VANAUKEN EXT	3800	50-year	821.00	985.15	989.89	989.89	991.55	0.018416	10.34	79.40	24.31	1.01
VANAUKEN EXT	3800	100-year	928.00	985.15	990.21	990.21	991.96	0.018134	10.63	87.32	25.29	1.01
VANAUKEN EXT	3700	Juvenile Low	1.00	981.72	981.97	981.90	982.00	0.016915	1.36	0.73	4.85	0.62
VANAUKEN EXT	3700	Adult Low	3.00	981.72	982.18	982.08	982.21	0.008885	1.46	2.06	7.62	0.49
VANAUKEN EXT	3700	Juvenile High	27.00	981.72	982.70	982.62	982.90	0.020028	3.60	7.51	13.07	0.84
VANAUKEN EXT	3700	Adult High	137.00	981.72	983.61	983.61	984.27	0.023320	6.54	20.95	16.23	1.01
VANAUKEN EXT	3700	1.1-year	181.00	981.72	983.90	983.90	984.66	0.021996	7.03	25.76	16.99	1.01
VANAUKEN EXT	3700	2-year	274.00	981.72	984.41	984.41	985.37	0.020877	7.87	34.82	18.36	1.01
VANAUKEN EXT	3700	5-year	460.00	981.72	985.23	985.23	986.51	0.019670	9.05	50.81	20.31	1.01
VANAUKEN EXT	3700	10-year	572.00	981.72	985.65	985.65	987.09	0.019216	9.61	59.53	21.12	1.01
VANAUKEN EXT	3700	25-year	701.00	981.72	986.10	986.10	987.70	0.018760	10.13	69.23	22.07	1.01
VANAUKEN EXT	3700	50-year	821.00	981.72	986.48	986.48	988.22	0.018503	10.56	77.73	22.81	1.01
VANAUKEN EXT	3700	100-year	928.00	981.72	986.80	986.80	988.65	0.018328	10.92	85.00	23.38	1.01
VANAUKEN EXT	3600	Juvenile Low	1.00	979.84	980.00		980.02	0.023356	1.10	0.91	10.71	0.66
VANAUKEN EXT	3600	Adult Low	3.00	979.84	980.03	980.02	980.13	0.103031	2.61	1.15	11.21	1.44
VANAUKEN EXT	3600	Juvenile High	27.00	979.84	980.49	980.40	980.68	0.024926	3.50	7.72	16.69	0.91
VANAUKEN EXT	3600	Adult High	137.00	979.84	981.46		981.83	0.014352	4.88	28.07	23.97	0.80
VANAUKEN EXT	3600	1.1-year	181.00	979.84	981.78		982.18	0.011805	5.04	35.92	25.09	0.74
VANAUKEN EXT	3600	2-year	274.00	979.84	982.31		982.79	0.010189	5.52	49.65	26.85	0.72
VANAUKEN EXT	3600	5-year	460.00	979.84	983.20		983.79	0.008561	6.15	74.83	29.79	0.68
VANAUKEN EXT	3600	10-year	572.00	979.84	983.66		984.31	0.008037	6.44	88.88	31.31	0.67
VANAUKEN EXT	3600	25-year	701.00	979.84	984.13		984.84	0.007671	6.75	103.91	32.73	0.67
VANAUKEN EXT	3600	50-year	821.00	979.84	984.53		985.30	0.007403	7.00	117.31	33.88	0.66
VANAUKEN EXT	3600	100-year	928.00	979.84	984.87		985.67	0.007208	7.21	128.70	34.66	0.66
VANAUKEN EXT	3500	Juvenile Low	1.00	978.62	978.78		978.79	0.007726	0.74	1.35	12.57	0.40
VANAUKEN EXT	3500	Adult Low	3.00	978.62	978.92		978.94	0.004293	0.92	3.27	14.06	0.34
VANAUKEN EXT	3500	Juvenile High	27.00	978.62	979.49		979.57	0.005647	2.22	12.15	16.80	0.46
VANAUKEN EXT	3500	Adult High	137.00	978.62	980.60		980.87	0.007126	4.18	32.79	20.37	0.58
VANAUKEN EXT	3500	1.1-year	181.00	978.62	980.85		981.21	0.008070	4.77	37.98	21.13	0.63
VANAUKEN EXT	3500	2-year	274.00	978.62	981.32		981.82	0.009246	5.69	48.17	22.55	0.69
VANAUKEN EXT	3500	5-year	460.00	978.62	982.04		982.81	0.010914	7.05	65.20	24.70	0.77
VANAUKEN EXT	3500	10-year	572.00	978.62	982.42		983.33	0.011441	7.65	74.74	25.81	0.79
VANAUKEN EXT	3500	25-year	701.00	978.62	982.83		983.87	0.011714	8.19	85.58	27.00	0.81
VANAUKEN EXT	3500	50-year	821.00	978.62	983.19		984.34	0.011739	8.58	95.68	28.04	0.82
VANAUKEN EXT	3500	100-year	928.00	978.62	983.48		984.72	0.011916	8.93	103.92	28.89	0.83
VANAUKEN EXT	3400	Juvenile Low	1.00	977.84	978.01	977.95	978.02	0.008259	0.78	1.28	11.43	0.41
VANAUKEN EXT	3400	Adult Low	3.00	977.84	978.07	978.01	978.11	0.020437	1.56	1.92	12.00	0.69
VANAUKEN EXT	3400	Juvenile High	27.00	977.84	978.57		978.72	0.014559	3.08	8.77	15.17	0.71
VANAUKEN EXT	3400	Adult High	137.00	977.84	979.67		979.98	0.012126	4.46	30.71	26.51	0.73
VANAUKEN EXT	3400	1.1-year	181.00	977.84	979.95		980.30	0.010331	4.71	38.59	27.95	0.69
VANAUKEN EXT	3400	2-year	274.00	977.84	980.42		980.87	0.009434	5.34	52.22	30.11	0.69
VANAUKEN EXT	3400	5-year	460.00	977.84	981.24		981.82	0.008084	6.11	78.32	33.63	0.67
VANAUKEN EXT	3400	10-year	572.00	977.84	981.72		982.34	0.007279	6.37	94.72	35.89	0.65
VANAUKEN EXT	3400	25-year	701.00	977.84	982.23		982.89	0.006540	6.59	113.81	38.12	0.63
VANAUKEN EXT	3400	50-year	821.00	977.84	982.67		983.37	0.006059	6.77	131.05	39.74	0.62
VANAUKEN EXT	3400	100-year	928.00	977.84	983.05		983.77	0.005705	6.91	146.28	40.84	0.60
VANAUKEN EXT	3300	Juvenile Low	1.00	976.93	977.04		977.06	0.010610	0.83	1.21	11.98	0.46
VANAUKEN EXT	3300	Adult Low	3.00	976.93	977.20		977.21	0.004654	0.95	3.15	13.60	0.35
VANAUKEN EXT	3300	Juvenile High	27.00	976.93	977.74		977.82	0.006935	2.32	11.64	17.72	0.50
VANAUKEN EXT	3300	Adult High	137.00	976.93	978.93		979.13	0.005722	3.64	37.67	24.85	0.52
VANAUKEN EXT	3300	1.1-year	181.00	976.93	979.29		979.52	0.005681	3.81	47.45	28.97	0.53
VANAUKEN EXT	3300	2-year	274.00	976.93	979.89		980.15	0.005034	4.10	67.41	35.45	0.51
VANAUKEN EXT	3300	5-year	460.00	976.93	980.89		981.21	0.003749	4.54	104.51	38.53	0.47
VANAUKEN EXT	3300	10-year	572.00	976.93	981.43		981.78	0.003357	4.74	125.70	40.19	0.45
VANAUKEN EXT	3300	25-year	701.00	976.93	981.99		982.37	0.003084	4.97	148.81	41.93	0.44

HEC-RAS Plan: Vanauken EXTENDED River: VANAUKEN EXT Reach: VANAUKEN EXT (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
VANAUKEN EXT	3300	50-year	821.00	976.93	982.46		982.87	0.002946	5.17	168.81	43.40	0.44
VANAUKEN EXT	3300	100-year	928.00	976.93	982.86		983.29	0.002850	5.34	186.18	44.65	0.43
VANAUKEN EXT	3200	Juvenile Low	1.00	976.16	976.36	976.36	976.37	0.004181	0.63	1.59	11.89	0.30
VANAUKEN EXT	3200	Adult Low	3.00	976.16	976.39	976.36	976.43	0.019376	1.53	1.96	12.21	0.67
VANAUKEN EXT	3200	Juvenile High	27.00	976.16	976.97		977.09	0.009398	2.68	10.08	15.46	0.58
VANAUKEN EXT	3200	Adult High	137.00	976.16	978.08		978.42	0.009395	4.65	29.49	19.23	0.66
VANAUKEN EXT	3200	1.1-year	181.00	976.16	978.42		978.81	0.009018	5.01	36.14	20.26	0.66
VANAUKEN EXT	3200	2-year	274.00	976.16	979.02		979.51	0.008589	5.61	48.82	21.97	0.66
VANAUKEN EXT	3200	5-year	460.00	976.16	980.04		980.66	0.007700	6.31	72.87	24.89	0.65
VANAUKEN EXT	3200	10-year	572.00	976.16	980.61		981.27	0.007145	6.55	87.29	26.44	0.64
VANAUKEN EXT	3200	25-year	701.00	976.16	981.17		981.89	0.006797	6.83	102.59	27.88	0.63
VANAUKEN EXT	3200	50-year	821.00	976.16	981.62		982.40	0.006699	7.12	115.27	28.92	0.63
VANAUKEN EXT	3200	100-year	928.00	976.16	981.99		982.83	0.006622	7.34	126.35	29.86	0.63
VANAUKEN EXT	3100	Juvenile Low	1.00	975.00	975.26	975.19	975.27	0.006875	0.89	1.13	7.25	0.40
VANAUKEN EXT	3100	Adult Low	3.00	975.00	975.41		975.44	0.006767	1.22	2.47	9.78	0.43
VANAUKEN EXT	3100	Juvenile High	27.00	975.00	975.99		976.10	0.009510	2.72	9.91	14.91	0.59
VANAUKEN EXT	3100	Adult High	137.00	975.00	977.20	976.69	977.52	0.008408	4.59	29.86	17.92	0.63
VANAUKEN EXT	3100	1.1-year	181.00	975.00	977.46	976.98	977.88	0.009428	5.22	34.66	18.50	0.67
VANAUKEN EXT	3100	2-year	274.00	975.00	977.94	977.49	978.55	0.010799	6.24	43.90	19.57	0.73
VANAUKEN EXT	3100	5-year	460.00	975.00	978.58	978.31	979.60	0.014404	8.09	56.87	20.99	0.87
VANAUKEN EXT	3100	10-year	572.00	975.00	978.84	978.74	980.15	0.017145	9.18	62.31	21.55	0.95
VANAUKEN EXT	3100	25-year	701.00	975.00	979.17	979.17	980.75	0.018819	10.08	69.53	22.23	1.01
VANAUKEN EXT	3100	50-year	821.00	975.00	979.55	979.55	981.27	0.018569	10.52	78.08	23.01	1.01
VANAUKEN EXT	3100	100-year	928.00	975.00	979.86	979.86	981.70	0.018416	10.87	85.40	23.67	1.01
VANAUKEN EXT	3000	Juvenile Low	1.00	974.20	974.42		974.43	0.012742	0.87	1.15	12.24	0.50
VANAUKEN EXT	3000	Adult Low	3.00	974.20	974.53		974.55	0.009210	1.15	2.60	14.07	0.47
VANAUKEN EXT	3000	Juvenile High	27.00	974.20	974.99		975.09	0.010468	2.54	10.65	19.40	0.60
VANAUKEN EXT	3000	Adult High	137.00	974.20	975.61	975.61	976.14	0.023405	5.83	23.50	22.12	1.00
VANAUKEN EXT	3000	1.1-year	181.00	974.20	975.84	975.84	976.46	0.022222	6.32	28.65	23.09	1.00
VANAUKEN EXT	3000	2-year	274.00	974.20	976.26	976.26	977.04	0.020435	7.10	38.79	25.22	0.99
VANAUKEN EXT	3000	5-year	460.00	974.20	976.95	976.95	977.98	0.018446	8.15	57.44	28.67	0.99
VANAUKEN EXT	3000	10-year	572.00	974.20	977.46	977.29	978.47	0.014621	8.08	72.69	31.00	0.90
VANAUKEN EXT	3000	25-year	701.00	974.20	978.08		979.02	0.011159	7.84	92.62	33.78	0.81
VANAUKEN EXT	3000	50-year	821.00	974.20	978.58		979.51	0.009411	7.75	110.38	36.05	0.76
VANAUKEN EXT	3000	100-year	928.00	974.20	978.98		979.91	0.008519	7.76	125.16	37.83	0.73
VANAUKEN EXT	2900	Juvenile Low	1.00	972.03	972.26	972.26	972.31	0.040758	1.69	0.59	5.52	0.91
VANAUKEN EXT	2900	Adult Low	3.00	972.03	972.34	972.34	972.46	0.070842	2.77	1.08	7.27	1.26
VANAUKEN EXT	2900	Juvenile High	27.00	972.03	972.74	972.74	973.09	0.053578	4.75	5.68	13.63	1.30
VANAUKEN EXT	2900	Adult High	137.00	972.03	974.60		974.70	0.003186	2.66	58.33	42.04	0.39
VANAUKEN EXT	2900	1.1-year	181.00	972.03	975.05		975.15	0.002292	2.65	77.64	43.53	0.34
VANAUKEN EXT	2900	2-year	274.00	972.03	975.88		975.98	0.001587	2.74	114.86	46.28	0.30
VANAUKEN EXT	2900	5-year	460.00	972.03	977.16		977.28	0.001308	2.95	180.71	56.69	0.28
VANAUKEN EXT	2900	10-year	572.00	972.03	977.76		977.90	0.001159	3.10	216.64	61.43	0.27
VANAUKEN EXT	2900	25-year	701.00	972.03	978.37		978.52	0.001073	3.28	254.33	63.09	0.27
VANAUKEN EXT	2900	50-year	821.00	972.03	978.87		979.04	0.001029	3.45	286.50	64.39	0.27
VANAUKEN EXT	2900	100-year	928.00	972.03	979.27		979.45	0.001014	3.60	312.52	65.42	0.27
VANAUKEN EXT	2800	Juvenile Low	1.00	970.88	971.22		971.23	0.000399	0.32	3.11	10.79	0.11
VANAUKEN EXT	2800	Adult Low	3.00	970.88	971.47		971.48	0.000486	0.50	6.02	12.52	0.13
VANAUKEN EXT	2800	Juvenile High	27.00	970.88	972.60		972.62	0.000669	1.14	23.65	17.50	0.17
VANAUKEN EXT	2800	Adult High	137.00	970.88	974.43		974.51	0.001161	2.32	58.99	21.43	0.25
VANAUKEN EXT	2800	1.1-year	181.00	970.88	974.87		974.98	0.001327	2.64	68.66	22.60	0.27
VANAUKEN EXT	2800	2-year	274.00	970.88	975.67		975.82	0.001556	3.12	87.79	24.98	0.29
VANAUKEN EXT	2800	5-year	460.00	970.88	976.89		977.12	0.001846	3.83	120.16	28.11	0.33
VANAUKEN EXT	2800	10-year	572.00	970.88	977.46		977.73	0.002034	4.18	136.69	29.98	0.35
VANAUKEN EXT	2800	25-year	701.00	970.88	978.03		978.35	0.002255	4.54	154.38	32.35	0.37
VANAUKEN EXT	2800	50-year	821.00	970.88	978.50		978.87	0.002474	4.82	170.36	35.11	0.39
VANAUKEN EXT	2800	100-year	928.00	970.88	978.88		979.28	0.002605	5.04	184.00	37.17	0.40
VANAUKEN EXT	2700	Juvenile Low	1.00	970.66	971.11		971.12	0.002564	0.80	1.26	4.43	0.26
VANAUKEN EXT	2700	Adult Low	3.00	970.66	971.38	971.06	971.40	0.002802	1.16	2.58	5.42	0.30
VANAUKEN EXT	2700	Juvenile High	27.00	970.66	972.31	971.83	972.45	0.006541	2.95	9.16	8.64	0.50
VANAUKEN EXT	2700	Adult High	137.00	970.66	973.75	973.26	974.21	0.010928	5.45	25.14	13.54	0.71
VANAUKEN EXT	2700	1.1-year	181.00	970.66	973.99	973.63	974.61	0.013561	6.34	28.54	14.37	0.79
VANAUKEN EXT	2700	2-year	274.00	970.66	974.52	974.28	975.39	0.015980	7.47	36.70	16.31	0.88
VANAUKEN EXT	2700	5-year	460.00	970.66	975.28	975.28	976.59	0.019993	9.16	50.24	19.44	1.00
VANAUKEN EXT	2700	10-year	572.00	970.66	975.79	975.79	977.16	0.019601	9.40	60.82	22.40	1.01
VANAUKEN EXT	2700	25-year	701.00	970.66	976.26	976.26	977.74	0.019167	9.75	71.93	24.74	1.01
VANAUKEN EXT	2700	50-year	821.00	970.66	976.64	976.64	978.21	0.018890	10.05	81.68	26.56	1.01
VANAUKEN EXT	2700	100-year	928.00	970.66	976.95	976.95	978.60	0.018607	10.29	90.16	27.99	1.01
VANAUKEN EXT	2600	Juvenile Low	1.00	970.04	970.30	970.30	970.36	0.058169	1.99	0.50	4.72	1.08
VANAUKEN EXT	2600	Adult Low	3.00	970.04	970.38	970.38	970.54	0.080240	3.18	0.94	5.61	1.36
VANAUKEN EXT	2600	Juvenile High	27.00	970.04	971.08	971.08	971.29	0.021166	3.70	7.30	12.64	0.86
VANAUKEN EXT	2600	Adult High	137.00	970.04	972.01	972.01	972.60	0.023105	6.18	22.18	18.79	1.00
VANAUKEN EXT	2600	1.1-year	181.00	970.04	972.27	972.27	972.95	0.022239	6.62	27.33	20.21	1.00
VANAUKEN EXT	2600	2-year	274.00	970.04	972.75	972.75	973.57	0.020607	7.26	37.74	22.85	1.00

HEC-RAS Plan: Vanauken EXTENDED River: VANAUKEN EXT Reach: VANAUKEN EXT (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
VANAUKEN EXT	2600	5-year	460.00	970.04	973.49	973.49	974.54	0.019598	8.22	55.96	26.95	1.01
VANAUKEN EXT	2600	10-year	572.00	970.04	973.83	973.83	975.01	0.019596	8.72	65.56	28.82	1.02
VANAUKEN EXT	2600	25-year	701.00	970.04	974.23	974.23	975.50	0.018572	9.05	77.46	30.89	1.01
VANAUKEN EXT	2600	50-year	821.00	970.04	974.55	974.55	975.92	0.017758	9.40	87.47	32.76	1.00
VANAUKEN EXT	2600	100-year	928.00	970.04	974.77	974.77	976.26	0.017643	9.79	95.19	34.52	1.01
VANAUKEN EXT	2500	Juvenile Low	1.00	966.64	966.88		966.88	0.002052	0.52	1.92	11.18	0.22
VANAUKEN EXT	2500	Adult Low	3.00	966.64	967.07		967.07	0.001662	0.70	4.29	13.60	0.22
VANAUKEN EXT	2500	Juvenile High	27.00	966.64	968.05		968.08	0.001158	1.32	20.40	18.57	0.22
VANAUKEN EXT	2500	Adult High	137.00	966.64	970.02		970.09	0.001067	2.20	62.23	23.37	0.24
VANAUKEN EXT	2500	1.1-year	181.00	966.64	970.52		970.62	0.001108	2.44	74.22	24.20	0.25
VANAUKEN EXT	2500	2-year	274.00	966.64	971.38		971.50	0.001226	2.87	95.46	25.69	0.26
VANAUKEN EXT	2500	5-year	460.00	966.64	972.68		972.87	0.001425	3.52	130.54	28.13	0.29
VANAUKEN EXT	2500	10-year	572.00	966.64	973.31		973.54	0.001530	3.84	148.83	29.40	0.30
VANAUKEN EXT	2500	25-year	701.00	966.64	973.96		974.23	0.001646	4.17	168.30	30.90	0.31
VANAUKEN EXT	2500	50-year	821.00	966.64	974.50		974.81	0.001755	4.43	185.47	32.51	0.33
VANAUKEN EXT	2500	100-year	928.00	966.64	974.95		975.28	0.001852	4.63	200.35	34.22	0.34
VANAUKEN EXT	2400	Juvenile Low	1.00	965.83	966.16	966.16	966.26	0.043489	2.58	0.39	1.89	1.00
VANAUKEN EXT	2400	Adult Low	3.00	965.83	966.41	966.41	966.53	0.029245	2.86	1.05	3.18	0.88
VANAUKEN EXT	2400	Juvenile High	27.00	965.83	967.25	967.25	967.72	0.032476	5.45	4.95	5.97	1.06
VANAUKEN EXT	2400	Adult High	137.00	965.83	968.85	968.85	969.71	0.024209	7.44	18.42	10.89	1.01
VANAUKEN EXT	2400	1.1-year	181.00	965.83	969.25	969.25	970.22	0.023410	7.89	22.95	12.08	1.01
VANAUKEN EXT	2400	2-year	274.00	965.83	969.93	969.93	971.08	0.022388	8.62	31.80	14.10	1.01
VANAUKEN EXT	2400	5-year	460.00	965.83	970.95	970.95	972.39	0.021117	9.62	47.84	17.10	1.01
VANAUKEN EXT	2400	10-year	572.00	965.83	971.45	971.45	973.03	0.020558	10.08	56.76	18.44	1.01
VANAUKEN EXT	2400	25-year	701.00	965.83	971.97	971.97	973.69	0.020052	10.52	66.66	19.88	1.01
VANAUKEN EXT	2400	50-year	821.00	965.83	972.40	972.40	974.24	0.019701	10.87	75.50	21.09	1.01
VANAUKEN EXT	2400	100-year	928.00	965.83	972.76	972.76	974.69	0.019418	11.16	83.13	22.02	1.01
VANAUKEN EXT	2300	Juvenile Low	1.00	964.16	964.69		964.69	0.000222	0.29	3.49	9.23	0.08
VANAUKEN EXT	2300	Adult Low	3.00	964.16	964.93		964.93	0.000450	0.52	5.77	10.55	0.12
VANAUKEN EXT	2300	Juvenile High	27.00	964.16	966.00		966.03	0.001012	1.35	19.97	15.61	0.21
VANAUKEN EXT	2300	Adult High	137.00	964.16	967.86		967.95	0.001479	2.47	55.44	22.53	0.28
VANAUKEN EXT	2300	1.1-year	181.00	964.16	968.35		968.46	0.001564	2.70	67.05	24.76	0.29
VANAUKEN EXT	2300	2-year	274.00	964.16	969.19		969.33	0.001723	3.05	89.86	29.63	0.31
VANAUKEN EXT	2300	5-year	460.00	964.16	970.42		970.62	0.001709	3.55	129.78	34.83	0.32
VANAUKEN EXT	2300	10-year	572.00	964.16	971.01		971.23	0.001687	3.83	150.89	37.10	0.32
VANAUKEN EXT	2300	25-year	701.00	964.16	971.57		971.84	0.001722	4.15	172.63	39.30	0.33
VANAUKEN EXT	2300	50-year	821.00	964.16	972.04		972.35	0.001767	4.42	191.53	41.17	0.34
VANAUKEN EXT	2300	100-year	928.00	964.16	972.41		972.75	0.001827	4.67	206.96	42.64	0.34
VANAUKEN EXT	2200	Juvenile Low	1.00	964.17	964.55		964.57	0.008349	1.17	0.86	4.14	0.45
VANAUKEN EXT	2200	Adult Low	3.00	964.17	964.76		964.80	0.007582	1.52	1.97	5.94	0.47
VANAUKEN EXT	2200	Juvenile High	27.00	964.17	965.59		965.76	0.009693	3.29	8.21	9.04	0.61
VANAUKEN EXT	2200	Adult High	137.00	964.17	967.29		967.64	0.007979	4.74	28.88	15.45	0.61
VANAUKEN EXT	2200	1.1-year	181.00	964.17	967.77		968.14	0.007300	4.93	36.75	17.34	0.60
VANAUKEN EXT	2200	2-year	274.00	964.17	968.57		969.00	0.006659	5.27	52.01	20.67	0.59
VANAUKEN EXT	2200	5-year	460.00	964.17	969.78		970.29	0.006049	5.73	80.21	26.12	0.58
VANAUKEN EXT	2200	10-year	572.00	964.17	970.37		970.92	0.005902	5.92	96.61	29.55	0.58
VANAUKEN EXT	2200	25-year	701.00	964.17	970.94		971.52	0.005815	6.14	114.24	32.84	0.58
VANAUKEN EXT	2200	50-year	821.00	964.17	971.41		972.02	0.005700	6.30	130.30	35.53	0.58
VANAUKEN EXT	2200	100-year	928.00	964.17	971.77		972.42	0.005480	6.47	143.67	37.65	0.58
VANAUKEN EXT	2100	Juvenile Low	1.00	962.94	963.25		963.31	0.021845	1.84	0.54	2.68	0.72
VANAUKEN EXT	2100	Adult Low	3.00	962.94	963.44		963.55	0.025551	2.61	1.15	3.76	0.83
VANAUKEN EXT	2100	Juvenile High	27.00	962.94	964.45		964.67	0.012488	3.76	7.18	7.53	0.68
VANAUKEN EXT	2100	Adult High	137.00	962.94	966.01	965.69	966.60	0.014411	6.18	22.19	11.70	0.79
VANAUKEN EXT	2100	1.1-year	181.00	962.94	966.36	966.06	967.09	0.015696	6.83	26.50	12.76	0.84
VANAUKEN EXT	2100	2-year	274.00	962.94	966.95	966.76	967.93	0.017994	7.93	34.54	14.67	0.91
VANAUKEN EXT	2100	5-year	460.00	962.94	967.85	967.83	969.20	0.020590	9.34	49.24	18.16	1.00
VANAUKEN EXT	2100	10-year	572.00	962.94	968.34	968.34	969.82	0.020324	9.76	58.59	20.06	1.01
VANAUKEN EXT	2100	25-year	701.00	962.94	968.84	968.84	970.44	0.019819	10.14	69.13	21.97	1.01
VANAUKEN EXT	2100	50-year	821.00	962.94	969.26	969.26	970.95	0.019434	10.44	78.61	23.56	1.01
VANAUKEN EXT	2100	100-year	928.00	962.94	969.60	969.60	971.37	0.019135	10.69	86.84	24.88	1.01
VANAUKEN EXT	2000	Juvenile Low	1.00	961.43	961.79	961.68	961.82	0.010290	1.36	0.74	3.29	0.51
VANAUKEN EXT	2000	Adult Low	3.00	961.43	962.01		962.07	0.010520	1.88	1.60	4.43	0.55
VANAUKEN EXT	2000	Juvenile High	27.00	961.43	962.75	962.75	963.04	0.021150	4.36	6.20	8.06	0.88
VANAUKEN EXT	2000	Adult High	137.00	961.43	964.00	964.00	964.76	0.023065	7.01	19.55	13.00	1.01
VANAUKEN EXT	2000	1.1-year	181.00	961.43	964.35	964.35	965.21	0.022208	7.45	24.30	14.28	1.01
VANAUKEN EXT	2000	2-year	274.00	961.43	964.96	964.96	965.98	0.021078	8.11	33.80	16.76	1.01
VANAUKEN EXT	2000	5-year	460.00	961.43	965.87	965.87	967.16	0.019846	9.09	50.63	20.07	1.01
VANAUKEN EXT	2000	10-year	572.00	961.43	966.32	966.32	967.74	0.019363	9.55	59.91	21.56	1.01
VANAUKEN EXT	2000	25-year	701.00	961.43	966.78	966.78	968.33	0.018920	10.00	70.09	23.02	1.01
VANAUKEN EXT	2000	50-year	821.00	961.43	967.17	967.17	968.83	0.018562	10.35	79.34	24.35	1.01
VANAUKEN EXT	2000	100-year	928.00	961.43	967.49	967.49	969.24	0.018304	10.63	87.27	25.39	1.01
VANAUKEN EXT	1900	Juvenile Low	1.00	960.90	961.01		961.02	0.006553	0.63	1.60	16.80	0.36
VANAUKEN EXT	1900	Adult Low	3.00	960.90	961.09		961.10	0.009007	1.04	2.88	17.92	0.46
VANAUKEN EXT	1900	Juvenile High	27.00	960.90	961.53		961.61	0.008818	2.35	11.51	20.67	0.55

HEC-RAS Plan: Vanauken EXTENDED River: VANAUKEN EXT Reach: VANAUKEN EXT (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
VANAUKEN EXT	1900	Adult High	137.00	960.90	962.44		962.73	0.009481	4.33	31.66	23.42	0.66
VANAUKEN EXT	1900	1.1-year	181.00	960.90	962.74		963.08	0.008854	4.66	38.83	24.25	0.65
VANAUKEN EXT	1900	2-year	274.00	960.90	963.33		963.74	0.007580	5.11	53.58	25.51	0.62
VANAUKEN EXT	1900	5-year	460.00	960.90	964.37		964.87	0.006150	5.67	81.08	27.53	0.58
VANAUKEN EXT	1900	10-year	572.00	960.90	964.91		965.46	0.005713	5.94	96.26	28.45	0.57
VANAUKEN EXT	1900	25-year	701.00	960.90	965.48		966.08	0.005384	6.21	112.86	29.47	0.56
VANAUKEN EXT	1900	50-year	821.00	960.90	965.98		966.62	0.005169	6.43	127.65	30.38	0.55
VANAUKEN EXT	1900	100-year	928.00	960.90	966.39		967.07	0.005022	6.60	140.50	31.23	0.55
VANAUKEN EXT	1800	Juvenile Low	1.00	959.30	959.45	959.45	959.48	0.066895	1.51	0.66	10.61	1.06
VANAUKEN EXT	1800	Adult Low	3.00	959.30	959.54	959.54	959.59	0.027404	1.69	1.77	12.21	0.78
VANAUKEN EXT	1800	Juvenile High	27.00	959.30	959.92	959.92	960.17	0.031414	4.04	6.69	13.61	1.02
VANAUKEN EXT	1800	Adult High	137.00	959.30	961.20		961.64	0.012084	5.27	26.01	16.37	0.74
VANAUKEN EXT	1800	1.1-year	181.00	959.30	961.58		962.07	0.011089	5.60	32.32	17.17	0.72
VANAUKEN EXT	1800	2-year	274.00	959.30	962.24		962.84	0.010292	6.23	43.96	18.37	0.71
VANAUKEN EXT	1800	5-year	460.00	959.30	963.22		964.05	0.010299	7.31	62.92	20.09	0.73
VANAUKEN EXT	1800	10-year	572.00	959.30	963.69		964.65	0.010648	7.90	72.44	20.85	0.75
VANAUKEN EXT	1800	25-year	701.00	959.30	964.16		965.28	0.011024	8.49	82.56	21.57	0.77
VANAUKEN EXT	1800	50-year	821.00	959.30	964.56		965.82	0.011392	9.00	91.26	22.17	0.78
VANAUKEN EXT	1800	100-year	928.00	959.30	964.89		966.26	0.011719	9.41	98.57	22.66	0.80
VANAUKEN EXT	1700	Juvenile Low	1.00	957.84	958.40		958.40	0.000187	0.26	3.83	10.25	0.08
VANAUKEN EXT	1700	Adult Low	3.00	957.84	958.63		958.63	0.000398	0.46	6.46	12.81	0.12
VANAUKEN EXT	1700	Juvenile High	27.00	957.84	959.55		959.57	0.001054	1.34	20.09	16.36	0.21
VANAUKEN EXT	1700	Adult High	137.00	957.84	960.94		961.08	0.002455	3.00	45.61	20.15	0.35
VANAUKEN EXT	1700	1.1-year	181.00	957.84	961.30		961.48	0.002792	3.42	52.99	21.11	0.38
VANAUKEN EXT	1700	2-year	274.00	957.84	961.93		962.19	0.003311	4.09	66.99	22.87	0.42
VANAUKEN EXT	1700	5-year	460.00	957.84	962.91		963.31	0.004032	5.08	90.61	25.56	0.48
VANAUKEN EXT	1700	10-year	572.00	957.84	963.37		963.85	0.004377	5.57	102.72	26.61	0.50
VANAUKEN EXT	1700	25-year	701.00	957.84	963.86		964.42	0.004682	6.05	115.86	27.65	0.52
VANAUKEN EXT	1700	50-year	821.00	957.84	964.26		964.91	0.004933	6.45	127.30	28.52	0.54
VANAUKEN EXT	1700	100-year	928.00	957.84	964.60		965.31	0.005134	6.77	137.02	29.24	0.55
VANAUKEN EXT	1600	Juvenile Low	1.00	957.97	958.28	958.28	958.31	0.016785	1.42	0.71	4.34	0.62
VANAUKEN EXT	1600	Adult Low	3.00	957.97	958.37	958.37	958.48	0.040905	2.64	1.14	5.33	1.01
VANAUKEN EXT	1600	Juvenile High	27.00	957.97	959.04	959.04	959.26	0.022215	3.70	7.29	12.92	0.87
VANAUKEN EXT	1600	Adult High	137.00	957.97	959.91	959.91	960.48	0.023802	6.04	22.69	20.11	1.00
VANAUKEN EXT	1600	1.1-year	181.00	957.97	960.16	960.16	960.82	0.022513	6.53	27.70	20.80	1.00
VANAUKEN EXT	1600	2-year	274.00	957.97	960.59	960.59	961.44	0.021529	7.41	36.96	21.98	1.01
VANAUKEN EXT	1600	5-year	460.00	957.97	961.34	961.34	962.46	0.019417	8.48	54.22	24.03	1.00
VANAUKEN EXT	1600	10-year	572.00	957.97	961.73	961.73	962.98	0.018887	8.98	63.73	25.30	1.00
VANAUKEN EXT	1600	25-year	701.00	957.97	962.14	962.14	963.52	0.018471	9.42	74.43	26.94	1.00
VANAUKEN EXT	1600	50-year	821.00	957.97	962.46	962.46	963.97	0.018177	9.85	83.38	27.74	1.00
VANAUKEN EXT	1600	100-year	928.00	957.97	962.74	962.74	964.35	0.017904	10.18	91.15	28.38	1.00
VANAUKEN EXT	1500	Juvenile Low	1.00	956.01	956.62		956.62	0.000080	0.19	5.14	11.39	0.05
VANAUKEN EXT	1500	Adult Low	3.00	956.01	956.71		956.72	0.000417	0.49	6.18	11.90	0.12
VANAUKEN EXT	1500	Juvenile High	27.00	956.01	957.19		957.26	0.004212	2.16	12.49	14.37	0.41
VANAUKEN EXT	1500	Adult High	137.00	956.01	958.35		958.64	0.007618	4.26	32.13	20.42	0.60
VANAUKEN EXT	1500	1.1-year	181.00	956.01	958.69		959.02	0.007632	4.61	39.23	22.12	0.61
VANAUKEN EXT	1500	2-year	274.00	956.01	959.27		959.69	0.007354	5.19	52.84	24.09	0.62
VANAUKEN EXT	1500	5-year	460.00	956.01	960.20		960.76	0.007264	6.01	76.48	27.37	0.63
VANAUKEN EXT	1500	10-year	572.00	956.01	960.64		961.28	0.007350	6.42	89.13	29.09	0.65
VANAUKEN EXT	1500	25-year	701.00	956.01	961.11		961.83	0.007387	6.81	103.00	30.80	0.66
VANAUKEN EXT	1500	50-year	821.00	956.01	961.50		962.29	0.007408	7.13	115.21	32.11	0.66
VANAUKEN EXT	1500	100-year	928.00	956.01	961.82		962.67	0.007397	7.37	125.84	33.19	0.67
VANAUKEN EXT	1400	Juvenile Low	1.00	955.45	956.62		956.62	0.000002	0.04	24.73	33.85	0.01
VANAUKEN EXT	1400	Adult Low	3.00	955.45	956.71		956.71	0.000011	0.11	27.74	34.30	0.02
VANAUKEN EXT	1400	Juvenile High	27.00	955.45	957.18		957.19	0.000215	0.64	44.35	36.62	0.10
VANAUKEN EXT	1400	Adult High	137.00	955.45	958.37		958.41	0.000627	1.63	90.91	41.27	0.19
VANAUKEN EXT	1400	1.1-year	181.00	955.45	958.71		958.76	0.000707	1.86	105.25	42.40	0.20
VANAUKEN EXT	1400	2-year	274.00	955.45	959.32		959.40	0.000835	2.27	131.81	44.60	0.23
VANAUKEN EXT	1400	5-year	460.00	955.45	960.28		960.40	0.001037	2.86	176.98	49.61	0.26
VANAUKEN EXT	1400	10-year	572.00	955.45	960.76		960.91	0.001073	3.15	201.24	51.76	0.27
VANAUKEN EXT	1400	25-year	701.00	955.45	961.25		961.43	0.001112	3.45	227.18	53.63	0.28
VANAUKEN EXT	1400	50-year	821.00	955.45	961.67		961.87	0.001151	3.71	249.59	55.29	0.29
VANAUKEN EXT	1400	100-year	928.00	955.45	962.01		962.23	0.001180	3.92	268.86	56.73	0.29
VANAUKEN EXT	1300	Juvenile Low	1.00	954.19	956.62		956.62	0.000000	0.03	30.05	17.54	0.00
VANAUKEN EXT	1300	Adult Low	3.00	954.19	956.71		956.71	0.000003	0.09	31.60	17.81	0.01
VANAUKEN EXT	1300	Juvenile High	27.00	954.19	957.16		957.17	0.000138	0.68	39.94	19.20	0.08
VANAUKEN EXT	1300	Adult High	137.00	954.19	958.25		958.33	0.001010	2.18	62.88	22.98	0.23
VANAUKEN EXT	1300	1.1-year	181.00	954.19	958.56		958.67	0.001315	2.58	70.15	24.22	0.27
VANAUKEN EXT	1300	2-year	274.00	954.19	959.11		959.27	0.001853	3.27	83.87	26.18	0.32
VANAUKEN EXT	1300	5-year	460.00	954.19	959.94		960.23	0.002685	4.30	107.01	29.08	0.40
VANAUKEN EXT	1300	10-year	572.00	954.19	960.36		960.72	0.003070	4.79	119.45	30.43	0.43
VANAUKEN EXT	1300	25-year	701.00	954.19	960.79		961.22	0.003453	5.28	132.76	31.82	0.46
VANAUKEN EXT	1300	50-year	821.00	954.19	961.14		961.65	0.003784	5.69	144.22	33.01	0.48
VANAUKEN EXT	1300	100-year	928.00	954.19	961.44		962.00	0.004035	6.02	154.15	34.00	0.50

HEC-RAS Plan: Vanauken EXTENDED River: VANAUKEN EXT Reach: VANAUKEN EXT (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
VANAUKEN EXT	1200	Juvenile Low	1.00	956.44	956.58	956.58	956.62	0.084147	1.57	0.64	11.43	1.17
VANAUKEN EXT	1200	Adult Low	3.00	956.44	956.67	956.67	956.71	0.030955	1.48	2.02	18.68	0.79
VANAUKEN EXT	1200	Juvenile High	27.00	956.44	956.91	956.91	957.10	0.044985	3.50	7.71	25.88	1.13
VANAUKEN EXT	1200	Adult High	137.00	956.44	957.56	957.56	958.01	0.024670	5.33	25.71	29.01	1.00
VANAUKEN EXT	1200	1.1-year	181.00	956.44	957.75	957.75	958.27	0.023693	5.83	31.07	29.65	1.00
VANAUKEN EXT	1200	2-year	274.00	956.44	958.08	958.08	958.77	0.022776	6.68	41.01	30.78	1.02
VANAUKEN EXT	1200	5-year	460.00	956.44	958.66	958.66	959.59	0.020075	7.72	59.62	32.50	1.00
VANAUKEN EXT	1200	10-year	572.00	956.44	958.97	958.97	960.02	0.019246	8.21	69.69	33.39	1.00
VANAUKEN EXT	1200	25-year	701.00	956.44	959.29	959.29	960.47	0.018561	8.69	80.65	34.35	1.00
VANAUKEN EXT	1200	50-year	821.00	956.44	959.57	959.57	960.86	0.018070	9.09	90.36	35.15	1.00
VANAUKEN EXT	1200	100-year	928.00	956.44	959.81	959.81	961.18	0.017710	9.40	98.71	35.83	1.00
VANAUKEN EXT	1100	Juvenile Low	1.00	952.46	952.78	952.66	952.80	0.009090	1.01	0.99	6.47	0.45
VANAUKEN EXT	1100	Adult Low	3.00	952.46	952.90		952.94	0.018757	1.46	2.06	13.39	0.65
VANAUKEN EXT	1100	Juvenile High	27.00	952.46	953.35		953.45	0.011030	2.48	10.88	21.15	0.61
VANAUKEN EXT	1100	Adult High	137.00	952.46	954.21		954.53	0.011500	4.56	30.07	23.78	0.71
VANAUKEN EXT	1100	1.1-year	181.00	952.46	954.47		954.86	0.010967	4.95	36.56	24.47	0.71
VANAUKEN EXT	1100	2-year	274.00	952.46	955.00		955.47	0.009740	5.49	49.89	25.82	0.70
VANAUKEN EXT	1100	5-year	460.00	952.46	955.89		956.49	0.008740	6.23	73.85	28.74	0.69
VANAUKEN EXT	1100	10-year	572.00	952.46	956.34		957.01	0.008378	6.56	87.23	30.26	0.68
VANAUKEN EXT	1100	25-year	701.00	952.46	956.79		957.54	0.008110	6.93	101.11	31.21	0.68
VANAUKEN EXT	1100	50-year	821.00	952.46	957.19		958.00	0.007901	7.23	113.61	32.08	0.68
VANAUKEN EXT	1100	100-year	928.00	952.46	957.52		958.39	0.007689	7.45	124.58	32.72	0.67
VANAUKEN EXT	1000	Juvenile Low	1.00	951.03	951.24	951.24	951.28	0.033089	1.67	0.60	4.82	0.84
VANAUKEN EXT	1000	Adult Low	3.00	951.03	951.44		951.48	0.012613	1.63	1.84	7.48	0.58
VANAUKEN EXT	1000	Juvenile High	27.00	951.03	952.01		952.16	0.016350	3.15	8.56	15.61	0.75
VANAUKEN EXT	1000	Adult High	137.00	951.03	953.30		953.56	0.007494	4.13	33.19	22.09	0.59
VANAUKEN EXT	1000	1.1-year	181.00	951.03	953.67		953.96	0.006799	4.34	41.67	23.78	0.58
VANAUKEN EXT	1000	2-year	274.00	951.03	954.33		954.67	0.006127	4.68	58.54	27.52	0.57
VANAUKEN EXT	1000	5-year	460.00	951.03	955.34		955.75	0.005398	5.15	89.35	32.89	0.55
VANAUKEN EXT	1000	10-year	572.00	951.03	955.85		956.30	0.005088	5.36	106.72	35.20	0.54
VANAUKEN EXT	1000	25-year	701.00	951.03	956.37		956.86	0.004620	5.60	125.44	36.70	0.53
VANAUKEN EXT	1000	50-year	821.00	951.03	956.81		957.34	0.004352	5.82	141.93	38.97	0.52
VANAUKEN EXT	1000	100-year	928.00	951.03	957.18		957.74	0.004158	5.99	156.77	40.49	0.51
VANAUKEN EXT	900	Juvenile Low	1.00	950.36	950.76		950.76	0.001588	0.52	1.91	9.00	0.20
VANAUKEN EXT	900	Adult Low	3.00	950.36	950.94		950.95	0.002369	0.78	3.87	13.66	0.26
VANAUKEN EXT	900	Juvenile High	27.00	950.36	951.64		951.67	0.002110	1.47	18.43	22.64	0.29
VANAUKEN EXT	900	Adult High	137.00	950.36	953.06		953.16	0.002013	2.56	53.43	26.56	0.32
VANAUKEN EXT	900	1.1-year	181.00	950.36	953.44		953.56	0.002085	2.84	63.66	27.66	0.33
VANAUKEN EXT	900	2-year	274.00	950.36	954.10		954.27	0.002233	3.32	82.50	29.61	0.35
VANAUKEN EXT	900	5-year	460.00	950.36	955.09		955.35	0.002569	4.03	114.10	33.79	0.39
VANAUKEN EXT	900	10-year	572.00	950.36	955.60		955.89	0.002660	4.35	131.64	35.57	0.40
VANAUKEN EXT	900	25-year	701.00	950.36	956.13		956.46	0.002728	4.64	150.95	37.44	0.41
VANAUKEN EXT	900	50-year	821.00	950.36	956.58		956.95	0.002669	4.89	168.34	39.28	0.41
VANAUKEN EXT	900	100-year	928.00	950.36	956.97		957.37	0.002623	5.08	183.91	42.32	0.41
VANAUKEN EXT	800	Juvenile Low	1.00	949.94	950.18	950.18	950.26	0.058135	2.32	0.43	3.23	1.12
VANAUKEN EXT	800	Adult Low	3.00	949.94	950.40	950.40	950.46	0.024292	2.09	1.44	6.56	0.79
VANAUKEN EXT	800	Juvenile High	27.00	949.94	950.95	950.86	951.21	0.025081	4.11	6.57	10.96	0.94
VANAUKEN EXT	800	Adult High	137.00	949.94	952.06	952.02	952.66	0.021029	6.24	21.95	16.75	0.96
VANAUKEN EXT	800	1.1-year	181.00	949.94	952.38	952.32	953.05	0.019324	6.53	27.72	18.47	0.94
VANAUKEN EXT	800	2-year	274.00	949.94	952.95	952.83	953.72	0.017381	7.04	38.91	21.25	0.92
VANAUKEN EXT	800	5-year	460.00	949.94	953.91		954.78	0.013400	7.47	61.56	24.96	0.84
VANAUKEN EXT	800	10-year	572.00	949.94	954.42		955.33	0.011915	7.68	74.50	26.33	0.80
VANAUKEN EXT	800	25-year	701.00	949.94	954.96		955.92	0.010635	7.88	88.99	27.49	0.77
VANAUKEN EXT	800	50-year	821.00	949.94	955.42		956.43	0.009788	8.04	102.09	28.48	0.75
VANAUKEN EXT	800	100-year	928.00	949.94	955.82		956.86	0.009211	8.18	113.44	29.24	0.73
VANAUKEN EXT	700	Juvenile Low	1.00	948.37	948.67		948.68	0.003729	0.78	1.28	6.27	0.31
VANAUKEN EXT	700	Adult Low	3.00	948.37	948.85		948.87	0.004409	1.18	2.53	7.50	0.36
VANAUKEN EXT	700	Juvenile High	27.00	948.37	949.52		949.66	0.009602	3.07	8.81	11.02	0.60
VANAUKEN EXT	700	Adult High	137.00	948.37	950.91		951.28	0.009336	4.86	28.17	16.82	0.66
VANAUKEN EXT	700	1.1-year	181.00	948.37	951.31		951.72	0.008707	5.14	35.20	18.22	0.65
VANAUKEN EXT	700	2-year	274.00	948.37	952.02		952.51	0.007824	5.60	48.89	20.23	0.64
VANAUKEN EXT	700	5-year	460.00	948.37	953.15		953.76	0.007042	6.27	73.36	23.24	0.62
VANAUKEN EXT	700	10-year	572.00	948.37	953.71		954.39	0.006729	6.60	86.73	24.26	0.62
VANAUKEN EXT	700	25-year	701.00	948.37	954.29		955.04	0.006515	6.93	101.10	25.24	0.61
VANAUKEN EXT	700	50-year	821.00	948.37	954.78		955.59	0.006400	7.22	113.70	26.04	0.61
VANAUKEN EXT	700	100-year	928.00	948.37	955.19		956.05	0.006346	7.46	124.37	26.70	0.61
VANAUKEN EXT	600	Juvenile Low	1.00	947.54	947.80		947.84	0.023890	1.52	0.66	4.81	0.72
VANAUKEN EXT	600	Adult Low	3.00	947.54	947.93		948.00	0.030358	2.13	1.41	7.45	0.86
VANAUKEN EXT	600	Juvenile High	27.00	947.54	948.78		948.88	0.005469	2.42	11.15	13.03	0.46
VANAUKEN EXT	600	Adult High	137.00	947.54	950.33		950.58	0.005026	3.99	34.33	16.85	0.49
VANAUKEN EXT	600	1.1-year	181.00	947.54	950.74		951.04	0.005148	4.38	41.36	17.81	0.51
VANAUKEN EXT	600	2-year	274.00	947.54	951.46		951.85	0.005349	5.01	54.68	19.43	0.53
VANAUKEN EXT	600	5-year	460.00	947.54	952.56		953.11	0.005679	5.94	77.48	21.78	0.56
VANAUKEN EXT	600	10-year	572.00	947.54	953.12		953.75	0.005821	6.36	89.89	22.96	0.57
VANAUKEN EXT	600	25-year	701.00	947.54	953.69		954.40	0.005955	6.78	103.35	24.18	0.58

HEC-RAS Plan: Vanauken EXTENDED   River: VANAUKEN EXT   Reach: VANAUKEN EXT (Continued)

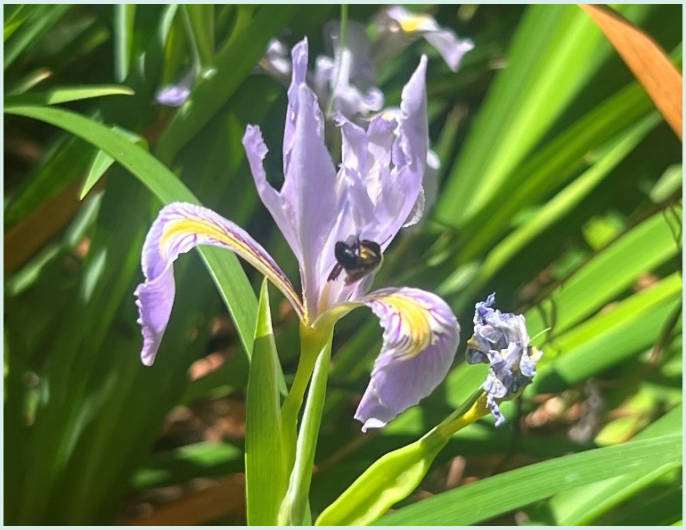
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
VANAUKEN EXT	600	50-year	821.00	947.54	954.16		954.95	0.006077	7.13	115.11	25.16	0.59
VANAUKEN EXT	600	100-year	928.00	947.54	954.56		955.41	0.006183	7.42	125.11	25.97	0.60
VANAUKEN EXT	500	Juvenile Low	1.00	947.29	947.53		947.53	0.001289	0.42	2.39	13.51	0.18
VANAUKEN EXT	500	Adult Low	3.00	947.29	947.75		947.76	0.000768	0.52	5.74	15.79	0.15
VANAUKEN EXT	500	Juvenile High	27.00	947.29	948.63		948.65	0.001066	1.25	21.61	20.19	0.21
VANAUKEN EXT	500	Adult High	137.00	947.29	950.20		950.29	0.001455	2.37	57.87	25.37	0.28
VANAUKEN EXT	500	1.1-year	181.00	947.29	950.61		950.72	0.001533	2.64	68.54	26.24	0.29
VANAUKEN EXT	500	2-year	274.00	947.29	951.34		951.49	0.001664	3.11	88.12	27.51	0.31
VANAUKEN EXT	500	5-year	460.00	947.29	952.48		952.70	0.001914	3.79	121.39	30.73	0.34
VANAUKEN EXT	500	10-year	572.00	947.29	953.05		953.32	0.002002	4.10	139.40	32.13	0.35
VANAUKEN EXT	500	25-year	701.00	947.29	953.65		953.95	0.002082	4.41	158.83	33.50	0.36
VANAUKEN EXT	500	50-year	821.00	947.29	954.14		954.48	0.002155	4.67	175.67	34.69	0.37
VANAUKEN EXT	500	100-year	928.00	947.29	954.54		954.92	0.002236	4.89	189.91	35.96	0.37
VANAUKEN EXT	400	Juvenile Low	1.00	946.91	947.17	947.17	947.22	0.029361	1.78	0.56	3.72	0.81
VANAUKEN EXT	400	Adult Low	3.00	946.91	947.28	947.28	947.42	0.053955	3.05	0.98	4.59	1.16
VANAUKEN EXT	400	Juvenile High	27.00	946.91	947.99	947.99	948.31	0.028853	4.57	5.91	9.28	1.01
VANAUKEN EXT	400	Adult High	137.00	946.91	949.17	949.17	949.85	0.022463	6.64	20.64	14.94	1.00
VANAUKEN EXT	400	1.1-year	181.00	946.91	949.47	949.47	950.26	0.021694	7.13	25.37	15.95	1.00
VANAUKEN EXT	400	2-year	274.00	946.91	950.00	950.00	951.00	0.021100	7.99	34.30	17.62	1.01
VANAUKEN EXT	400	5-year	460.00	946.91	950.87	950.87	952.15	0.019532	9.07	50.72	19.94	1.00
VANAUKEN EXT	400	10-year	572.00	946.91	951.30	951.30	952.74	0.019160	9.61	59.52	20.96	1.01
VANAUKEN EXT	400	25-year	701.00	946.91	951.76	951.76	953.35	0.018755	10.12	69.29	22.00	1.00
VANAUKEN EXT	400	50-year	821.00	946.91	952.17	952.17	953.86	0.018529	10.44	78.65	23.54	1.01
VANAUKEN EXT	400	100-year	928.00	946.91	952.52	952.52	954.28	0.018242	10.67	87.00	24.84	1.00
VANAUKEN EXT	300	Juvenile Low	1.00	945.54	945.83	945.76	945.83	0.005969	0.62	1.60	15.71	0.34
VANAUKEN EXT	300	Adult Low	3.00	945.54	945.96		945.97	0.003367	0.64	4.68	28.67	0.28
VANAUKEN EXT	300	Juvenile High	27.00	945.54	946.39		946.42	0.003324	1.42	19.01	34.72	0.34
VANAUKEN EXT	300	Adult High	137.00	945.54	947.44		947.53	0.002525	2.44	56.25	36.07	0.34
VANAUKEN EXT	300	1.1-year	181.00	945.54	947.74		947.86	0.002496	2.69	67.22	36.45	0.35
VANAUKEN EXT	300	2-year	274.00	945.54	948.30		948.45	0.002481	3.13	87.54	37.13	0.36
VANAUKEN EXT	300	5-year	460.00	945.54	949.28		949.50	0.002282	3.69	124.85	38.48	0.36
VANAUKEN EXT	300	10-year	572.00	945.54	949.79		950.03	0.002225	3.97	144.49	39.38	0.36
VANAUKEN EXT	300	25-year	701.00	945.54	950.32		950.60	0.002194	4.27	165.50	40.30	0.36
VANAUKEN EXT	300	50-year	821.00	945.54	950.78		951.09	0.002168	4.51	184.24	41.09	0.37
VANAUKEN EXT	300	100-year	928.00	945.54	951.16		951.51	0.002153	4.70	200.26	41.76	0.37
VANAUKEN EXT	200	Juvenile Low	1.00	944.88	945.05	945.05	945.06	0.009460	0.90	1.11	8.94	0.45
VANAUKEN EXT	200	Adult Low	3.00	944.88	945.09	945.05	945.15	0.034400	1.95	1.54	10.17	0.89
VANAUKEN EXT	200	Juvenile High	27.00	944.88	945.49	945.49	945.71	0.034252	3.81	7.08	17.04	1.04
VANAUKEN EXT	200	Adult High	137.00	944.88	946.31	946.31	946.89	0.024314	6.10	22.46	20.22	1.02
VANAUKEN EXT	200	1.1-year	181.00	944.88	946.56	946.56	947.23	0.022363	6.54	27.66	20.90	1.00
VANAUKEN EXT	200	2-year	274.00	944.88	947.01	947.01	947.85	0.020731	7.38	37.11	21.76	1.00
VANAUKEN EXT	200	5-year	460.00	944.88	947.72	947.72	948.88	0.019612	8.65	53.20	23.07	1.00
VANAUKEN EXT	200	10-year	572.00	944.88	948.11	948.11	949.42	0.018848	9.18	62.33	23.67	1.00
VANAUKEN EXT	200	25-year	701.00	944.88	948.50	948.50	949.99	0.018816	9.80	71.50	24.28	1.01
VANAUKEN EXT	200	50-year	821.00	944.88	948.85	948.85	950.48	0.018491	10.25	80.12	24.89	1.01
VANAUKEN EXT	200	100-year	928.00	944.88	949.14	949.14	950.89	0.018257	10.60	87.51	25.38	1.01
VANAUKEN EXT	100	Juvenile Low	1.00	943.13	943.39	943.33	943.40	0.009447	0.80	1.25	12.01	0.44
VANAUKEN EXT	100	Adult Low	3.00	943.13	943.50	943.47	943.51	0.009449	0.97	3.09	22.20	0.46
VANAUKEN EXT	100	Juvenile High	27.00	943.13	943.87	943.79	943.95	0.009443	2.17	12.44	26.55	0.56
VANAUKEN EXT	100	Adult High	137.00	943.13	944.66	944.30	944.88	0.009441	3.80	36.02	32.98	0.64
VANAUKEN EXT	100	1.1-year	181.00	943.13	944.87	944.51	945.15	0.009448	4.20	43.08	33.92	0.66
VANAUKEN EXT	100	2-year	274.00	943.13	945.25	944.87	945.62	0.009444	4.86	56.38	35.50	0.68
VANAUKEN EXT	100	5-year	460.00	943.13	945.87	945.41	946.40	0.009442	5.82	78.98	37.60	0.71
VANAUKEN EXT	100	10-year	572.00	943.13	946.19	945.69	946.80	0.009441	6.28	91.15	38.62	0.72
VANAUKEN EXT	100	25-year	701.00	943.13	946.53	945.98	947.23	0.009452	6.72	104.29	39.73	0.73
VANAUKEN EXT	100	50-year	821.00	943.13	946.82	946.24	947.60	0.009448	7.08	115.92	40.68	0.74
VANAUKEN EXT	100	100-year	928.00	943.13	947.06	946.45	947.90	0.009446	7.37	125.88	41.46	0.75

Appendix C

Biological Resources Technical Report

NOVEMBER 2024

Biological Resources Technical Report for the Mattole Headwaters Drought Relief Project – Vanauken Ponds, Humboldt County, CA



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Cover photos: (Clockwise from upper left) Douglas-fir forest; Douglas iris; Douglas-fir forest; and grasslands within the Project area.

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1 PROJECT BACKGROUND

The upper Mattole River is subject to extremely low and often intermittent flows during the late summer and fall. The low-flow or no-flow conditions substantially impact instream salmonid rearing habitat quality and quantity. Although seasonal low flows are a part of the natural hydrologic pattern, conditions in the upper Mattole River have been exacerbated due to historical and current land uses. Historical logging, dense conifer and hardwood regrowth, removal of instream large woody debris (LWD), and increased water use by landowners has reduced stream flows, negatively affected instream habitat and salmonid resources, and has led to poor water quality conditions in the Mattole River.

Historical timber harvest resulted in regrowth of dense, mixed hardwood stands. These vigorous young stands consume more water than older forests and likely play a dominant role in reduced streamflows in the upper watershed (Jassal et al. 2009). Locally, instream LWD accumulations in stream channels raised bed elevations, connected channels to adjacent floodplains, created seasonal wetlands, and allowed fish access to important off-channel habitat. Removal of that LWD released trapped gravel and resulted in deeply incised channels, disconnected floodplains, and dramatically reduced the volume of seasonal groundwater stored within the alluvial terraces. The reduced capacity for groundwater storage coupled with dense regrowth of vegetation following timber harvest are two major factors that have resulted in reduced late-summer base stream flows.

To help address this condition, Sanctuary Forest is planning to implement a flow enhancement/drought relief project in Vanauken Creek, a tributary of the Mattole River (hereinafter referred to as the Project). The Project objectives include improved summer streamflow and enhanced habitat conditions for salmonids and other species in Vanauken Creek. Flow augmentation will be achieved through the strategic construction of two ponds designed to capture and store excess winter flows from direct precipitation and hillslope runoff for a total volume of roughly six million gallons. The stored water will then be released gradually during the drier summer months, ensuring a more consistent and adequate flow regime in the creek. The enhanced flows will create a more favorable habitat for fish populations, particularly salmonids, by improving water quality, increasing available habitat, and facilitating migration. Moreover, the augmented flows will contribute to a more resilient ecosystem, capable of withstanding the challenges posed by drought and climate change. This pond-based approach represents a sustainable and targeted solution to the issue of low summer flows in Vanauken Creek.

1.1 Project Location and Project Area

The Project is located within Humboldt County at elevations that range from approximately 940 to 1,060 feet (ft) above mean sea level. The Project is situated along approximately 6,500 ft of Vanauken Creek, starting from its confluence with the Mattole River. Two ponds are planned within this stretch, located at approximately 3,000 ft and 6,200 ft, respectively, from the confluence. The surveyed areas were limited to key priority areas in the Project where project implementation is most likely to cause significant ground disturbance, vegetation clearing, and/or other temporary impacts to the site from construction activities, access, and staging (collectively the Project area) (Figure 1-1). The Project area was modified after the 2024 biological assessment. The Project area that was surveyed in 2024 was reduced and additional survey extents were added (Figure 1-1). The Biological assessments of the updated Project area will be conducted in 2025 and before Project implementation. The results of the biological assessment in the updated Project area will be included in an updated Biological Resources Technical Report in 2025.

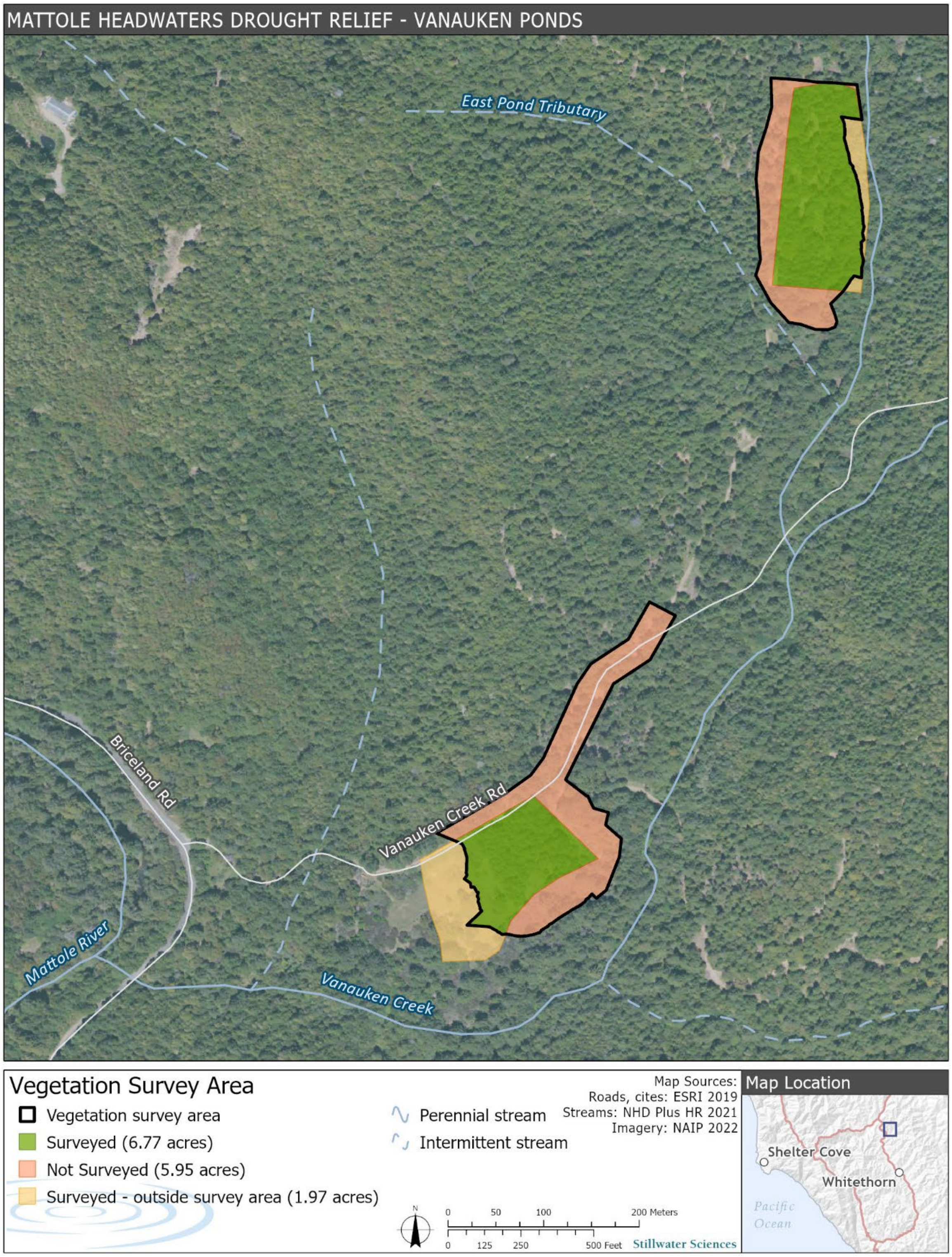

Figure 1-1. Project area

1.2 Report Purpose and Organization

This biological resources technical report has been developed to describe the special-status species and/or sensitive biological resources (plants, sensitive natural communities, fish, wildlife, and wetlands and waters) in or with potential to occur in the Project area that may be affected by Project activities. Furthermore, this report summarizes potential impacts on the identified biological resources within the Project area along with suggested avoidance and minimization measures to reduce impacts.

2 PROJECT DESCRIPTION AND OBJECTIVES

Vanauken Creek provides habitat for the three species of native salmonids that inhabit the Mattole River, all of which are either federal- or state-listed species. These are: coho salmon (*Oncorhynchus kisutch*, Southern Oregon/Northern California coastal, SONCC); winter-run steelhead trout (*Oncorhynchus mykiss*, Northern California), and Chinook salmon (*Oncorhynchus tshawytscha*, California coastal). Coho salmon have experienced precipitous declines in abundance and are currently on the verge of extirpation from the Mattole River watershed (Mattole Coho Recovery Strategy 2011). Numerous factors are responsible for the declines in Coho salmon abundance, and many of these limiting factors are also impacting Chinook salmon (*Oncorhynchus tshawytcha*) and steelhead, which are also severely depressed in abundance relative to historic estimates.

Changes in rainfall patterns combined with other human-caused factors, such as the legacy of historic logging and other land-use impacts, have led to a significant reduction of summertime streamflows which is one of the primary limiting factors for Coho. Some reaches of Vanauken Creek drying up altogether or becoming a series of disconnected pools in the late summer. This pattern of diminished streamflows has been particularly well documented for the Mattole headwaters, beginning in 2002 with CDFW's Mattole River Watershed Assessment Report, and subsequently by SFI, the Mattole Restoration Council, the Mattole Salmon Group and others. Sanctuary Forest performed baseline streamflow monitoring for 15 headwaters tributaries including Vanauken Creek for the years 2007–2011. Similarly to the other east side creeks, flows stopped in September for the years 2007, 2008 and 2009. On August 24, 2021, Vanauken Creek was dry with only a few isolated pools in the lower 1500 ft where conditions were assessed (see photo on cover of report). As of July 24, 2024 Vanauken Creek flows have dropped to 0.08 cfs and based on 2009 data, flow is expected to stop altogether by the end of August.

Historically, Vanauken Creek has been identified as an important salmon producing stream with its cool, shaded, low-gradient streams that traverse the Project vicinity; however, populations have declined since the 1950s. In the 1980s and 1990s, many log jams were removed which increased channel velocities, scoured the streambed down to bedrock and significantly decreased winter habitat for juvenile coho salmon. In 2024, a coho redd and numerous juvenile coho were observed in Vanauken Creek by the Mattole Salmon Group distributed from near the Mattole confluence to several thousand feet upstream. Additionally, surveys conducted by CDFG have documented the presence of coho juveniles from 1985–2010, and the Mattole Salmon Group have documented coho in 5 out of 20 years sampled from 1980–2015. Chinook salmon generally favor similar habitat conditions as coho but tend to spawn in slightly larger streams. A dozen adult Chinook were observed just downstream of the Vanauken middle fork in December of 2016, a year with above average rainfall. Steelhead are abundant in Vanauken Creek, and several hundred juveniles have been observed trapped in isolated pools in the low flow years of the last decade.

Salmonid recovery actions have been prioritized in the SONCC Recovery Plan and while the plan focuses on coho, these actions are also important for steelhead. Key limiting stresses are “lack of floodplain and channel structure and altered hydrologic function” and three out of the six highest priority recovery actions are: “secure and maintain sufficient instream flows”; increase water retention (i.e., storage and recharge) and “increase large wood debris, boulders or other instream structure”.

The Project aims to provide sufficient instream flow for salmonid rearing during the lowest flow months from mid- August through October or when the winter rains begin. This will be achieved through construction of two off channel ponds totaling six million gallons. The increased storage and flow augmentation is needed to ensure the benefits of a recently completed planning project funded by CDFW and the State Coastal Conservancy, Mattole Headwaters Enhancement and Planning – Vanauken Creek. The planning project aims to improve instream habitat in 4,400 ft of stream (from the Mattole confluence to the middle fork Vanauken Creek). The planning project was designed with TAC and tribal input and is now shovel ready at 100% design and SERP concurrence. The Project is fully funded for design, permitting and implementation by the DWR’s Urban and Multi-benefit Drought Relief Grant Program with an implementation completion deadline of October 30, 2025. The two projects combined address all three of the SONCC Recovery plan high priority actions including: (1) secure and maintain sufficient instream flows, (2) increase water retention (i.e., storage and recharge), and (3) increase large wood debris, boulders or other instream structure.

3 VEGETATION ASSESSMENT

A vegetation assessment was conducted on 28 May and 16 July 2024 to characterize dominant vegetation types and their plant associates within the Project area. Each vegetation type within the Project area was mapped in the field and defined to the vegetation alliance per classification described in *A Manual of California Vegetation*, online edition (MCV; CNPS 2024a). The resulting vegetation map was used to: (1) determine if any stands are sensitive natural communities[1]; (2) assess the likelihood of occurrence for special-status species in the Project area (see Sections 4 and 6); and (3) inform the Project’s potential impacts on special-status natural communities and plant species (see Section 6). Sensitive natural communities are defined as those with a state ranking of S1, S2, or S3 (critically imperiled, imperiled, or vulnerable, respectively) on CDFW’s *California Sensitive Natural Communities List* (CDFW 2023a).

The vegetation survey area was modified after the 2024 surveys (Figure 1-1). Vegetation assessments will be conducted in the updated Project area in 2025 and prior to project implementation. Results of these vegetation assessments will be included in an updated Biological Resources Technical Report in 2025.

3.1 Methods

3.1.1 Desktop review

Prior to the vegetation assessment, existing information from the CALVEG geodatabase (USDA Forest Service 2018) and the United States Geologic Survey (USGS) regional geologic map (McLaughlin et al. 2000) on vegetation and soils in the Project area were reviewed. The vegetation community map was created using a combination of field-based vegetation classification and mapping, and traditional photo-interpretive techniques, as described below. The vegetation classification follows the State of California standard vegetation classification system described in MCV (CNPS 2024a). Using heads up digitizing techniques, a photo interpreter delineated and classified each identifiable vegetation community using MCV classification procedures. Delineation of vegetation boundaries was conducted at on-screen scales between 1:1,200 and 1:5,000. Information collected during the vegetation assessment was used to refine vegetation type boundaries and assist with the photo interpretation process and accuracy.

The CDFW's California Natural Diversity Database (CNDDB) (CDFW 2024a) was queried for the USGS 7.5-minute quadrangles where the Project is located (Briceland), and the surrounding seven quadrangles (Honeydew, Ettersburg, Miranda, Shelter Cove, Garberville, Bear Harbor, Piercy,) (hereinafter Project vicinity) to determine if a sensitive natural community (i.e., legacy natural community) was recorded in the Project area. Table 3-1 lists sensitive natural communities identified from the CNDDB query.

Table 3-1. CNDDB sensitive natural communities with potential to occur in the Project area.

Legacy Natural Communities	Description	Corresponding MCV Alliances
Upland Douglas-fir Forest	A tall (60 meters [m] [197 ft]), mixed-age climax forest dominated (greater than 80%) by Douglas-fir. Climax stands appear restricted to droughty but not xeric conditions as caused by rain shadows, overly drained soils, or aspect. Sites typically occur on moderately deep, well-drained soils. Annual precipitation ranges from 58 to 309 cm (23 to 120 in) (Holland 1986). Stands within the Project vicinity are described as small pockets of old-growth conifers mixed with hardwoods along the south and west slopes of Gilham Butte between 1,200–3,000 feet elevation above sea level (CDFW 2024b).	*Pseudotsuga menziesii* - (*Notholithocarpus densiflorus* - *Arbutus menziesii*) Forest & Woodland Alliance (S4)[1]

[1] The Upland Douglas-fir Forest legacy natural community listed in CNDDB corresponds to a MCV alliance that has a state rank of S4 (apparently secure — uncommon but not rare; some cause for long-term concern due to declines or other factors.) by CDFW (2023a). This vegetation type is not considered a sensitive natural community.

The CNDDB legacy natural community Upland Douglas-fir Forest corresponds with the MCV alliance *Pseudotsuga menziesii* - (*Notholithocarpus densiflorus* - *Arbutus menziesii*) Forest & Woodland Alliance that has a state rank of S4 (apparently secure) (CNPS 2024a). As such, it is no longer considered a sensitive natural community. Although no additional legacy communities are listed in the CNDDB query, all final vegetation alliances in the Project area were reviewed against the latest CDFW's *California Sensitive Natural Communities List* (CDFW 2023a) to determine state ranking sensitivity.

3.1.2 Field survey

The field survey was conducted by a qualified botanist and ecologist with: (1) experience conducting floristic surveys; (2) knowledge of plant taxonomy and plant community ecology and classification; (3) familiarity with the plant species of the area; and (4) familiarity with appropriate state and federal statutes related to plants and plant collecting. The survey followed the methods of the *CDFW-CNPS Protocol for the Combined Vegetation Rapid Assessment and*

Relevé Method (CNPS and CDFW 2023a) and *Protocols for Surveying and Evaluating Impacts to Special-Status Native Plant Populations and Natural Communities* (CDFW 2018).

Field maps were reviewed and representative locations for each unique vegetation signature within the Project area were sampled using a modified rapid assessment method. A modified CNPS vegetation rapid assessment field data form (CNPS and CDFW 2023b) was used to document dominant species and their plant associates.

Field crews used the ArcGIS FieldMaps application on handheld tablets (Apple iPads) to map vegetation type boundaries and classification. Species composition data collected in the field was compiled and reviewed in the office to assign the appropriate MCV alliance to each sampled location. In cases where the species present were best described by an MCV association (a sub-category of the broader MCV alliance), one was assigned. Alliance and association boundaries were mapped to canopy extent from above (i.e., birds-eye view), as such mapped vegetation alliance and association boundaries sometimes included overstory canopy that extended over water features. Photographs were taken at each sampling location to document stand characteristics.

Final vegetation type classifications were appended to the spatial data collected in the field to refine the preliminary vegetation map using ESRI ArcGIS. Final classifications were checked against CDFW's *California Sensitive Natural Communities List* (CDFW 2023a) to determine if they were a sensitive natural community with a state rank of S1, S2, or S3 in the Project area. These alliances were also used to further assess the likelihood of occurrence for special-status plants in the Project (see Section 4).

3.2 Results

One sensitive natural community (*Bromus carinatus - Elymus glaucus* Herbaceous Alliance, S3) was identified within Study area 1 (Figure 3-1, Table 3-2). Vegetation types observed within the Project area include:

- *Pseudotsuga menziesii* / *Toxicodendron diversilobum* Association under the *Pseudotsuga menziesii* – (*Notholithocarpus densiflorus - Arbutus menziesii*) Forest & Woodland Alliance (Douglas fir - tanoak forest - madrone forest and woodland) (2.13 acres [ac])
- *Pteridium aquilinum* - Grass Association under the *Bromus carinatus - Elymus glaucus* Herbaceous Alliance (California brome - blue wildrye prairie) (0.93 ac)
- *Ceanothus integerrimus* Shrubland Alliance (deer brush chaparral) (1.15 ac)

All three vegetation types occurred in Study area 1 (Figure 3-1, Table 3-2). Study area 2 was entirely comprised by the *Pseudotsuga menziesii* / *Toxicodendron diversilobum* Forest Association (4.53 ac) (Figure 3-2, Table 3-2). Descriptions of the vegetation types are provided in the sub-sections below, along with representative photographs.

Table 3-2. Vegetation alliances and associations observed in the Project area.

`	State Ranking[1]	Study Area 1 (ac)	Study Area 2 (ac)	Total (ac)
Ceanothus integerrimus Shrubland Alliance	S4	1.15	-	1.15
Pseudotsuga menziesii / Toxicodendron diversilobum Association	S4	2.13	4.53	6.66
Pteridium aquilinum - Grass Association[2]	S3	0.93	-	0.93
Total		**4.21**	**4.53**	**8.74**

1 State ranks for special-status natural communities:
- S3 Vulnerable—Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation from the state.
- S4 Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

2 This association is listed as “sensitive” on the CDFW’s California Sensitive Natural Communities List (CDFW 2023a) therefore assumed a state status of S3.

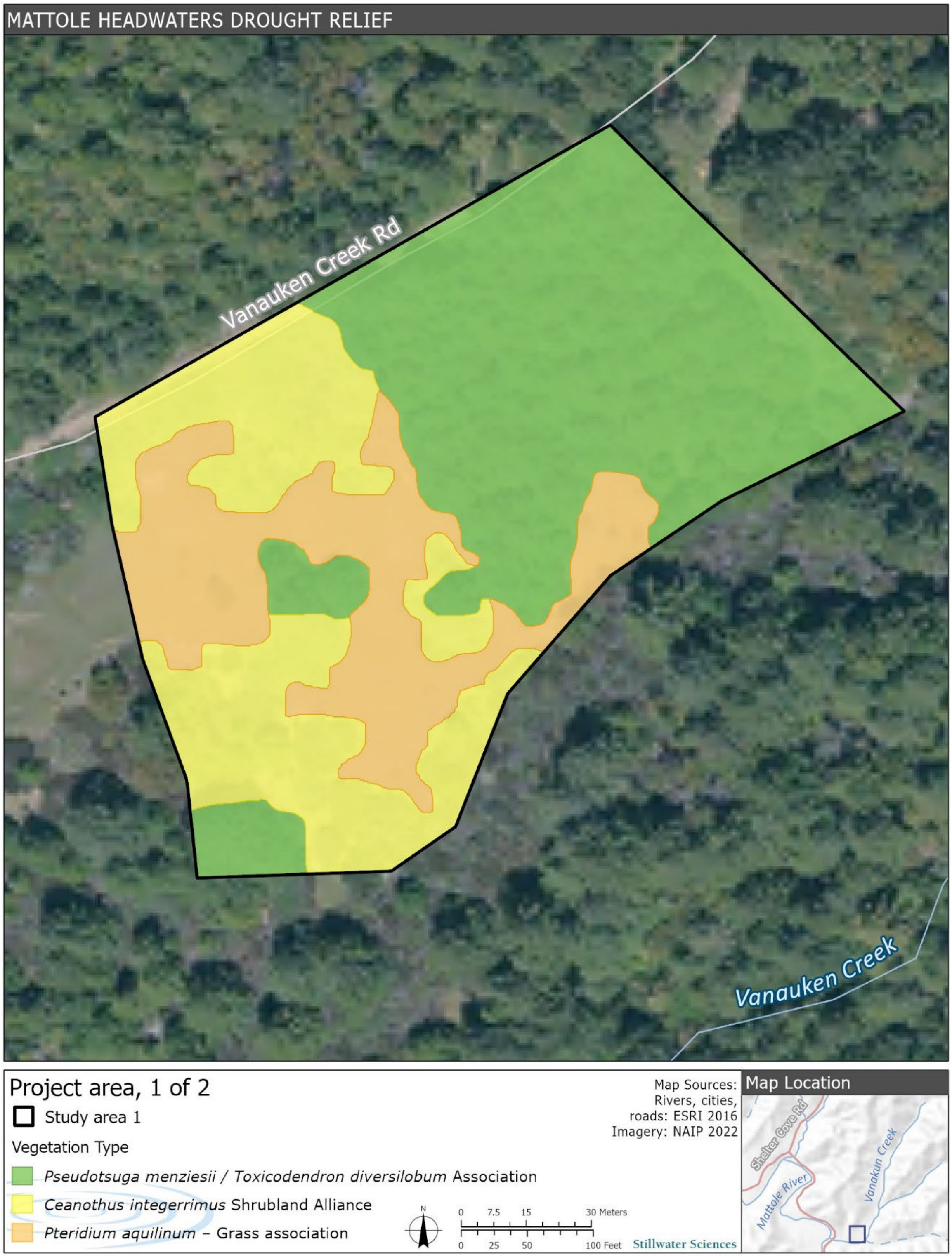

Figure 3-1. Vegetation communities within Study area 1.

Figure 3-2. Vegetation communities within Study area 2.

3.2.1 *Pseudotsuga menziesii/Toxicodendron diversilobum* Association (Pseudotsuga menziesii – [*Notholithocarpus densiflorus – Arbutus menziesii*] Forest and Woodland Alliance)

The *Pseudotsuga menziesii/Toxicodendron diversilobum* Association is a part of the *Pseudotsuga menziesii* - (*Notholithocarpus densiflorus* - *Arbutus menziesii*) Forest & Woodland Alliance (Douglas fir - tanoak forest - madrone forest and woodland). This alliance is composed of >50% relative cover in the tree canopy, or >30% relative cover with *Arbutus menziesii* (Pacific madrone), *Quercus agrifolia* (coast live oak), *Quercus chrysolepis* (canyon live oak), *Notholithocarpus densiflorus* (tanoak) or *Umbellularia californica* (California bay) (Buck-Diaz et al. 2021, Sikes et al. 2023, CNPS 2024a). This alliance typically occurs along raised stream benches, terraces, slopes, and ridges of all aspects where soils are deep, well drained, and mostly derived from sandstones and schists (CNPS 2024a). Associate tree species within the alliance included *Sequoia sempervirens* (redwood) and Pacific madrone. The shrub layer was sparse and primarily consisted of *Toxicodendron diversilobum* (poison oak), *Vaccinium ovatum* (evergreen huckleberry), and young tanoak. The *Pseudotsuga menziesii / Toxicodendron diversilobum* Association was mapped where cover by Douglas-fir exceeded 50% cover in the tree canopy and poison oak was a dominant member of the shrub layer. Herbaceous species observed throughout this alliance included *Pteridium aquilinum* (bracken fern), *Polystichum munitum* (western sword fern), *Whipplea modesta* (modesty), and *Festuca subuliflora* (crinkle-awn fescue).

The *Pseudotsuga menziesii / Toxicodendron diversilobum* Association is associated with broadleaved upland forest and north coast coniferous forest habitats. This association has a total geographic extent of 6.66 ac in the Project area (Table 3-2).

3.2.2 *Pteridium aquilinum* – Grass Association (*Bromus carinatus - Elymus glaucus* Herbaceous Alliance)

The *Pteridium aquilinum* – Grass Association is characterized within the *Bromus carinatus - Elymus glaucus* Herbaceous Alliance (blue wildrye prairie) and is composed of >30% relative cover of *Elymus glaucus* (blue wildrye) with bracken fern and various native and nonnative grasses also present in the herbaceous layer (Buck-Diaz et al. 2012, CNPS 2024a). This alliance is a sensitive natural community with a state rank of S3 (Table 3-1) that typically occurs on terraces, basins, dry floodplains, steep mesic slopes, and forest openings (CDFW 2023a). During the spring survey, the dominant herbaceous species was *Elymus glaucus* ssp. *glaucus* (blue wild rye), followed by lower cover of *Bromus* *hordeaceus* (soft brome), *Holcus lanatus* (velvet grass), *Aira caryophyllea* (silver hair grass) and bracken fern. During the summer survey, *Agrostis stolonifera* (creeping bent grass) was co-dominant with blue wild rye. Creeping bent grass is an invasive stoloniferous perennial grass that was growing in-between the tufts of blue wild rye (Cal-IPC 2024). This fire-sensitive grass forms its own nonnative vegetation type (semi-natural alliance) in areas once occupied by coastal prairie (CNPS 2024a). Several Douglas-fir saplings were observed growing within the grassland. The *Pteridium aquilinum* – Grass Association was mapped wherever the shrub and tree layer were absent and *Elymus glaucus* ssp. *glaucus* was the dominant species in the herbaceous layer.

The *Pteridium aquilinum* – Grass association has a total geographic extent of 0.93 ac in the Project area (Table 3-2). The Project will not entirely avoid this sensitive natural community and 0.29 acres (31% of the total habitat present) is anticipated to be impacted by Project activities. Where avoidance is not possible, potential enhancement and minimization measures will be applied as described in Section 7.1.

3.2.3 *Ceanothus integerrimus* Shrubland Alliance

The *Ceanothus integerrimus* Shrubland Alliance (deer brush chaparral) is composed of >30% relative cover of deer brush in the shrub layer (Klein et al. 2007, CNPS 2024a). This alliance typically occurs on ridges and upper slopes on well-drained soils and has a state ranking of S4 (CNPS 2024a). Associate shrub species within the alliance included common manzanita, California coffeeberry, and tanoak with scattered Douglas-fir saplings. Dominant herbaceous species observed throughout this alliance included natives' bracken fern and blue wildrye along with nonnative velvet grass. The *Ceanothus integerrimus* Shrubland Alliance was mapped where cover by deer brush ranged from 30-50 % relative cover in the Project area.

The *Ceanothus integerrimus* Shrubland Alliance has a total geographic extent of 1.15 ac in the Project area (Table 3-2)

4 WETLANDS AND WATERS

Waters and wetlands in the Project area are under U.S. Army Corps of Engineers (USACE) jurisdiction by Section 404 of the Clean Water Act (CWA) regulatory authority and under State Water Resources Control Board (SWRCB) jurisdiction by Section 401 of the CWA. Section 404 of the CWA applies to all waters including wetlands that have significant nexus to interstate commerce (USACE 1986).

Potential waters of the U.S. in the Project area are also considered potential waters of the State by CDFW. Furthermore, riparian vegetation adjacent to waters of the state is interpreted by CDFW as being within the streambed and thereby falls under CDFW jurisdiction.

A site inspection of potential jurisdictional features was conducted in conjunction with the vegetation assessment on 28 May 2024. No potential jurisdictional features were identified within the Project Area. Vanauken Creek occurs outside of the Project area and was, therefore, not included in the assessment. Dominant vegetation was compromised of upland and facultative plants and landscape position in the Project area did not support formation of wetland conditions as noted by understory vegetation plant assemblages and indicators of wetland hydrology, respectively.

5 SPECIAL-STATUS PLANTS

The purpose of the floristic survey was to document the presence of special-status plant species within the Project area. Special-status plant species are defined as those listed, proposed, or under review as threatened or endangered under the federal Endangered Species Act of 1973 (FESA) and/or the California Endangered Species Act (CESA); designated as rare under the California Native Plant Protection Act (CNPPA); taxa that meet the criteria for listing as described in Section 15380 of the California Environmental Quality Act of 1970 (CEQA) Guidelines, including species listed on California Department of Fish and Wildlife's (CDFW's) *Special Vascular Plants, Bryophytes, and Lichens List* (CDFW 2024b); plants with a California Rare Plant Rank (CRPR) of 1, 2, 3, or 4; and/or plants considered locally significant (i.e., rare or uncommon in the county or region).

The vegetation survey area was modified after the 2024 surveys (Figure 1-1). Special-status plant surveys will be conducted in the updated Project area in 2025 and prior to project implementation. Results of these special-status surveys will be included in an updated Biological Resources Technical Report in 2025.

5.1 Methods

5.1.1 Establishing the list of species that could occur in the Project area

A list of special-status plants that may occur in the Project area was developed by querying the following resources:

- U.S. Fish and Wildlife Service (USFWS) list of federally listed and proposed endangered and threatened species and designated critical habitat using the USFWS Information for Planning and Consultation (IPaC) portal (USFWS 2024),
- CDFW's CNDDB (CDFW 2024a), and
- California Native Plant Society's (CNPS) online Inventory of Rare and Endangered Vascular Plants of California (CNPS 2024b).

The CNPS and CDFW database queries were based on a search of Project vicinity (as defined in Section 3.1.1). The USFWS database query was based on a search of a digitized GIS shapefile of the Project area. Appendix A (Table A-1) lists special-status plants identified from the sources described above.

The potential for species meeting the above criteria to occur in the Project area was determined by: (1) reviewing the current distribution of each species (i.e., whether it overlaps with the Project area); (2) reviewing the documented occurrence information from the CNDDB; (3) reviewing results from plant surveys conducted in and adjacent to the Project area (Stillwater Sciences 2018); (4) comparing the habitat associations of each species with the vegetation alliances and habitat conditions documented in and adjacent to the Project area during the vegetation assessment; and (5) using professional judgement to evaluate habitat quality and the relevance of occurrence data, or lack thereof.

This review and analysis resulted in the following categories of the likelihood for a special-status species to occur in the Project area:

- None: the Project area is outside the species' current distribution or elevation range and/or the species' required habitat is lacking from the Project area (e.g., coastal dunes).
- Low: the species' known distribution and elevation range overlaps with the Project area, and the species' required habitat is of very low quality or quantity in the Project area.
- Moderate: The species' known distribution and elevation range overlaps with the Project area and the species' required habitat occurs in the Project area with varying quality and quantity, and/or the species has been documented in lands adjacent to the Project area.
- High: The species has been documented in the Project area and/or its required habitat occurs in the Project area and is of high quality.

A total of 37 special-status plant species were documented as occurring within the Project vicinity (Appendix A). Alliances documented during the vegetation assessment are associated with the following habitats: north coast coniferous forest, lower montane coniferous forest, riparian forest, riparian woodland, and grasslands. Based on these habitat associations along with landform, soils, and known elevation range within the Project area, 13 special-status plants have low potential to occur and four have moderate potential to occur in the Project area (Appendix A, Table 4-1). Of the four species with moderate potential to occur, none are federally or state listed species, two have a CRPR of 1B (rare, threatened, or endangered in California and elsewhere) and two have a CRPR of 4 (plants of limited distribution in California, a watch list species) (Table 4-1).

Table 4-1. Special-status plant species with moderate or high potential to occur in the Project area.

Scientific Name (Common Name)	Status (Federal/State /CRPR)[1]	Lifeform	Habitat Associations and Blooming Period[2]	Likelihood of Occurrence
Gilia capitata ssp. *pacifica* (Pacific gilia)	None/None/1B.2	annual herb	Coastal bluff scrub, openings in chaparral, coastal prairie, valley and foothill grassland; 15–5,465 ft. Blooming period: April–August	**Moderate:** Chaparral and valley and foothill grassland habitats present within Project area. Four occurrences within 5 miles (mi) of the Project.
Listera cordata (heart-leaved twayblade)	None/None/4.2	perennial herb	Bogs and fens, lower montane coniferous forest, North Coast coniferous forest; 15–4,495 ft. Blooming period: February–July.	**Moderate:** North coast coniferous forest and broadleafed upland forest habitat present within the Project area. One occurrence has been observed within 5 mi of the Project area on Sanctuary Forest property (K. Pow, Stillwater Sciences, pers. obs., 2022).
Piperia candida (white-flowered rein orchid)	None/None/1B.2	perennial herb	Sometimes serpentinite areas in broadleafed upland forest, lower montane coniferous forest, north coast coniferous forest; 95–4,300 ft. Blooming period: (March) May–September	**Moderate:** North coast coniferous forest habitat present within Project area. Many occurrences within 5–10 mi of the Project area.
Usnea longissima (Methuselah's beard lichen)	None/None/4.2	fruticose lichen (epiphytic)	On tree branches; usually on old-growth hardwoods and conifers in broadleafed upland forest and north coast coniferous forest; 160–4,790 ft. Blooming period: N/A (lichen)	**Moderate:** North coast coniferous forest and broadleafed upland forest habitat present within Project area. Multiple scattered colonies mapped within 10 mi of the Project.

1 Status:
California Rare Plant Rank (CRPR):
1B Plants rare, threatened, or endangered in California and elsewhere
4 Plants of limited distribution, on watchlist
CRPR Threat Ranks:
0.2 Moderately threatened in California (20–80% occurrences threatened / moderate degree and immediacy of threat)
2 Months in parentheses are uncommon; N/A = Not applicable

5.1.2 Pre-field review

Prior to field surveys a desktop review was conducted to:

- Review key identifying characteristics and life history stages (e.g., blooming period) of the targeted special-status plant species and sensitive natural communities with potential to occur in the Project area,
- Create field maps of known locations for targeted special-status plants within the Project area, and
- Prepare and plan for field surveys.

The timing of life history stages for each targeted species (Appendix A) was reviewed to determine survey periods that would coincide with the phenological stage (e.g., flowering or fruiting) during which the special-status plant species would be most easily identified in the field. A spring (May) and summer (July) survey captured all pertinent blooming periods of species with moderate or high potential to occur in the Project area (Table 4-1).

To familiarize surveyors with key characteristics and natural variation of those characteristics of each special-status plant species, information was obtained through a review of: (1) CNPS (2024a) and CDFW (2024b) data; (2) photographs on CalPhotos (University of California, Berkeley 2024); and (3) key characteristics using the online *Jepson eFlora* (Jepson Flora Project 2024).

Information on known occurrences of plant species and sensitive natural communities was compiled, plotted in Geographic Information System (GIS), and printed onto field maps.

5.1.3 Field surveys

A floristic survey for special-status plant species was conducted on May 28 and July 16, 2024, by qualified botanists with: (1) experience conducting floristic surveys; (2) knowledge of plant taxonomy and plant community ecology and classification; (3) familiarity with the plant species of the area; (4) familiarity with appropriate state and federal statutes related to plants and plant collecting; and (5) experience with analyzing impacts of a project on native plant species and natural communities. The survey followed the methods of the *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (USFWS 1996) and *Protocols for Surveying and Evaluating Impacts to Special-Status Native Plant Populations and Sensitive Natural Communities* (CDFW 2018). Specifically, surveys were comprehensive for vascular plants such that "every plant taxon that occurs in the Project area is identified to the taxonomic level necessary to determine rarity and listing status" (CDFW 2018). If identification was not possible in the field, the plants were collected for identification in the laboratory (using the "1 in 20" rule, Wagner 1991). If the species was potentially a special-status plant and a collection was required, then the collection was made for one voucher sheet according to the botanists' current CDFW plant voucher collection permit guidelines (e.g., not more than five individuals or two percent of the population, whichever is less). All plant species were identified following the taxonomy of the *Jepson eFlora* (Jepson Flora Project 2024).

5.2 Results

There were no special-status plant species documented within the Project area. A comprehensive list of all plant species observed within the Project area is provided in Appendix B.

6 SPECIAL-STATUS FISH AND WILDLIFE

6.1 Methods

An assessment of suitable habitat for special-status fish and wildlife was conducted to inform future analysis of the Project's potential to impact such species. Special-status species are defined as those that are:

- listed as endangered or threatened, or are proposed/candidates for listing, under ESA and/or CESA)
- designated by CDFW as a Species of Special Concern

6.1.1 Desktop review

The following biological databases were queried for records of special-status fish and wildlife or critical habitat that have potential to occur in the Project area:

- USFWS species list using the USFWS IPaC portal (USFWS 2024),
- CDFW's CNDDB (CDFW 2024a),
- CDFW's CNDDB northern spotted owl viewer (CDFW 2024c), and
- National Marine Fisheries Service's (NMFS) *California Species List Tools* database (NMFS 2022).

The database queries were each based on a search of the nine USGS 7.5-minute quadrangles in the Project vicinity (see Section 3.1.1). The NMFS database query was based on a query of the Briceland quadrangle.

Other information sources consulted to determine which special-status species could occur in the project area included:

- Environmental Assessment for the Baker Creek Groundwater Recharge Project (BLM 2012),
- Biological Assessment for the Baker Creek Groundwater Recharge Project (BLM 2016),
- several salmonid survey reports developed by the Mattole Salmon Group (MSG) (2011, 2012, 2013),
- Mattole Headwaters Flow Enhancement Project Biological Resources Technical Report (Stillwater Sciences 2018),
- other literature on recent occurrences of special-status species,
- input from CDFW on a nearby project regarding several special-status bird species that were not recorded on any of the queried State or Federal databases.

6.2 Results

A total of 27 special-status wildlife species were identified from the database queries as having potential to occur in the Project area (Table 5-1). In addition, several other bird species (yellow warbler, yellow-breasted chat, Bryant's savannah sparrow, grasshopper sparrow, and olive-sided flycatcher) were not recorded on any database but could potentially be present in the Project area. Similarly, the presence of coastal (formerly Pacific) giant salamander was not recorded in any of the queried databases; however, it was included in results because it is likely to be present in the Project area. However, suitable habitat for many of the recorded species does not occur in the

Project area and/or the Project area is outside of the species' known range. For example, tidewater gobies and snowy plovers were identified as having potential to exist in the Project area, but do not occupy terrestrial forested environments. Therefore, species without suitable habitat or with a low potential to occur in the Project area will not be discussed further in this document.

There are 15 special-status fish and wildlife species that have a moderate or high potential to occur and/or be affected by Project activities. These species are discussed in further detail in the sections below.

6.2.1 Fish

Fish-bearing watercourses in the Project area are inhabited by coho and Chinook salmon and steelhead. Brief life history discussions are below.

6.2.1.1 Coho salmon, Southern Oregon/Northern California Coast ESU

The Southern Oregon/Northern California Coast evolutionary significant unit (ESU) for coho salmon is listed as threatened under the federal ESA (NMFS 2005a) and was listed as threatened under the California ESA in 2005. Critical habitat was designated in 1999 between the Mattole River in California and the Elk River in Oregon, inclusive (NMFS 1999a). Critical habitat includes all accessible streams and waters of estuarine areas. Coho salmon are known to spawn and rear in the Mattole River and its tributaries. Upon emergence from the gravels, coho fry seek low-velocity areas along shallow stream margins (Shapovalov and Taft 1954). As they grow, juvenile coho move to deeper habitats, although they continue to prefer low-velocity habitat throughout the rearing period.

Coho salmon adults typically migrate upstream from October through December, and spawn from November through January. Spawning generally occurs in low-gradient stream reaches with gravel and cobble substrates. Females dig nests (redds) in the gravel, and deposit 2,500–5,000 eggs in a sequence of egg pockets, which are fertilized by one or more males (Beacham 1982, Sandercock 1991). Egg development is temperature-dependent, with fry emerging from the gravel in the spring, approximately three to four months after spawning. Upon emergence from the gravels, coho fry seek low-velocity areas along shallow stream margins (Shapovalov and Taft 1954). As they grow, juvenile coho move to deeper habitats, although they continue to prefer low-velocity habitat throughout the rearing period. Juveniles typically spend one to two years rearing in fresh water before migrating. Emigration from streams to the estuary and ocean generally takes place from February through June. Coho typically spend two years foraging at sea before returning to their natal streams to spawn.

Suitable habitat for coho spawning and rearing is located in the upper Mattole River watershed. An average of seven redds per year have been documented in the reach between Lost River and Ancestor Creek between 1994 and 2010 (MRRP 2011). However, coho redds have only been infrequently observed in Vanauken Creek (MRRP 2011). Juvenile coho salmon have been observed in Vanauken Creek between 2000 and 2009 (MRRP 2011). Maximum weekly average water temperatures in Vanauken Creek average <16.0ºC during the summer, which are suitable for coho rearing (MRRP 2011). Adult coho are most likely to be present in the Project area during upstream migration in October through January. Juveniles can be in Vanauken Creek all year round.

6.2.1.2 Chinook salmon, California coastal ESU

California coastal Chinook salmon were listed in 1999 as threatened under the federal ESA (NMFS 1999b). The California coastal Chinook salmon ESU extends from the Klamath River (exclusive) south to the Russian River (inclusive). Critical habitat for the species was designated in 2005 (NMFS 2005b) and includes the mainstem Mattole River up to Ancestor Creek.

Chinook salmon in the California coastal ESU exhibit life history characteristics of the fall-run ecotype. In California, most adult fall-run Chinook enter streams from August through November, with peak arrival usually occurring in October and November. Spawning occurs from early October through December. Upon arrival at the spawning grounds, adult females dig shallow depressions or pits in gravel and cobble substrate, deposit eggs in the bottom during the act of spawning and cover them with additional gravel. Female fall-run Chinook deposit an average of about 5,500 eggs. Egg incubation generally lasts between 40 to 90 days at water temperatures of 6 to 12°C (42.8 to 53.6°F), and the alevins remain in the gravel for two to three weeks before emerging from the gravel. Fall-run Chinook salmon fry usually begin migrating downstream soon after emergence in February or March, with outmigration continuing into late-July. Chinook spend two or more years at sea before migrating back to their natal streams to spawn.

Suitable habitat for Chinook spawning and rearing is present in the Mattole River. Adult Chinook salmon were observed in Vanauken Creek in 2016, which was a year of very high water.

6.2.1.3 Steelhead (winter-run), Northern California Coast DPS

The Northern California Coast steelhead DPS was listed as threatened in 2006 under the federal ESA (NMFS 2006). The Northern California Coast steelhead DPS extends from Redwood Creek in Humboldt County to the Gualala River in Mendocino County (inclusive). Critical habitat for the species was designated in 2005 (NMFS 2005b). Critical habitat includes the mainstem Mattole River; Lost River; and Baker, Vanauken, and McKee creeks.

Adult winter steelhead generally begin migrating to spawning areas in October, with the peak migration in December through February. Steelhead spawning occurs in mainstems, tributaries, and intermittent streams in December through May. Spawning occurs in gravel and cobble substrates where the female digs an egg pocket and deposits her eggs, which are fertilized externally by one or more males. Redds typically consist of a series of egg pockets that are excavated and subsequently covered during redd construction process. Unlike Chinook and coho salmon, steelhead typically do not remain on the spawning grounds for extended periods to defend the completed redd to reduce the potential for superimposition. Egg development time is inversely proportional to water temperature and varies from about 19 days at 16°C (60°F) to about 80 days at 6°C (42°F). Fry typically emerge from the gravel two to three weeks after hatching. Upon emerging from the gravel, fry move to shallow edgewater habitats to rear, and gradually move into deeper habitats as they grow. During winter, when water temperatures are cold, juveniles are less active and hide in the interstitial spaces between cobbles and bounders. Juvenile steelhead typically rear in fresh water for two to three years prior to migrating downstream to the estuary and ocean. Steelhead spend between six months and three years at sea before returning to their natal streams to spawn. Unlike salmon, steelhead are capable of repeat spawning.

Suitable habitat for steelhead spawning and rearing is present within Vanauken Creek, and this species has been frequently observed during surveys.

6.2.1.4 Steelhead (summer-run)

The summer-run steelhead was listed by the California Fish and Game Commission as endangered under the California Endangered Species Act on June 16, 2021. This listing covers summer steelhead in the Eel, Mad, and Mattole rivers as well as Redwood Creek (Humboldt County).

Summer steelhead normally return to natal rivers during the summer, between May and October, while still sexually immature, and hold over in pools for nine months to a year prior to spawning (Shapovalov and Taft 1954, Smith 1960, Everest 1973, Busby et al. 1996). Exact run timing can differ somewhat between streams. On the Mad River, summer steelhead enter fresh water between April and July and on the Mattole River, they return between March and June (Moyle et al. 2017). These fish hold over in deep pools prior to spawning in late fall or early winter after the rains increase river flows that allow them to migrate farther upstream to spawn. Juvenile steelhead typically rear in fresh water for two to three years prior to migrating downstream to the estuary and ocean. Steelhead spend between six months and three years at sea before returning to their natal streams to spawn.

Summer steelhead adults have been identified holding in the Mattole River downstream of McKee Creek (MSG 2011). It is likely that these fish spawn farther up the Mattole River and iits tributaries. Juvenile summer steelhead may rear in Vanauken Creek.

6.2.2 Wildlife

6.2.2.1 Northern red-legged frog

The northern red-legged frog is a California species of special concern. It is known to occur along the California coast from Mendocino County north to southwestern British Columbia, at elevations from sea level to 1,160 meters (m) (0–3,800 ft) (Lannoo 2005).

Northern red-legged frogs utilize a variety of habitats throughout their various life stages. Aquatic sites such as coastal lagoons, pools, marshes, ponds, or backwater areas are used for breeding. Deep pools are a particularly important breeding habitat feature, as they provide frogs better opportunity to evade predation. Streams are not used for breeding. Other sources of cover include emergent vegetation, undercut banks, and root-wads. Upland habitats such as open grasslands with seeps and springs may be used for over-summering and for foraging. In northwestern California, northern red-legged frogs have been observed in dense understory vegetation such as ferns and sedges in streamside flats stands of redwoods.

Breeding for northern red-legged frogs generally occurs in late winter through early spring, typically when water temperatures exceed 6–7°C (43–46°F) (Lannoo 2005). Eggs hatch in the spring (March–April) and tadpoles metamorphose in June or July (Lannoo 2005). Most northern red-legged frog males begin breeding after 2 years of age, and females begin breeding after 3 years of age (Lannoo 2005). Adults may move large distances (>300 m [1,000 ft]) from breeding ponds in riparian areas (Lannoo 2005).

Ponds suitable for, and potentially occupied by, northern red-legged frogs are located adjacent to the Project area.

6.2.2.2 Foothill yellow-legged frog

The foothill yellow-legged frog is a California species of special concern and has recently been designated as a candidate for threatened listing under the California Endangered Species Act. Within California, foothill yellow-legged frogs were historically found in the Sierra Nevada foothills, up to elevations of approximately 1,829 m (6,000 ft), and in the Coast Range from the Oregon state border south to the San Gabriel River in southern California (Stebbins 2003). Currently, populations are thought to have disappeared from the southern Sierra Nevada foothills, in areas south of the Transverse ranges, and along the coast south of Monterey County (Jennings and Hayes 1994).

Foothill yellow-legged frogs are typically found in perennial streams or rivers, and intermittent creeks with pools. The species often breeds in open and sunny, low-gradient stream reaches near junctions with tributary streams, due to the proximity of adult overwintering habitat in tributaries and to the presence of boulders and cobbles in these locations. Egg deposition usually occurs in cobble bars or under large boulders in areas of low-velocity flow. Tadpoles show affinity to the oviposition site, remaining in edgewater habitat with substrate interstices, vegetation, and/or detritus for cover. Adults prefer areas with exposed basking sites and cool, shady areas adjacent to the water’s edge.

Suitable habitat for foothill yellow-legged frog breeding occurs in the Mattole River where the channel widens, and the tree canopy opens to allow sun to reach the channel for several hours a day. Vanauken Creek may be used by adults and juveniles of this species for dispersal.

6.2.2.3 Red-bellied newt

The red-bellied newt is a California species of special concern. In California, this species is found along the coast from near Bodega, Sonoma County, to near Honeydew, Humboldt County, and inland to Lower Lake and Kelsey Creek, Lake County. It lives in coastal woodlands, especially redwood forests.

Adults are terrestrial and become aquatic when breeding. Terrestrial animals spend the dry summer in moist habitats under woody debris, rocks, in animal burrows. Adults forage on the forest floor for a variety of invertebrates. Adults move toward streams in late February at the start of the breeding season, which extends into May. This species avoids ponds or lakes. Females lay eggs under rocks or attached to submerged roots in rocky streams and rivers with moderate to fast flow. Incubation takes between two weeks to one month. Larval development to metamorphosis occurs in about four to six months, at which time they emerge from the streams and go terrestrial. Juveniles spend most of their time underground and are not active on the surface until near sexual maturity, which occurs at about four to six years of age.

Habitat is present within the Mattole River and its tributaries adjacent to the Project area. An individual was documented in the Mattole River downstream of Thorn Junction (CDFW 2018).

6.2.2.4 Coastal giant salamander

The coastal giant salamander is a CDFW species of special concern and is the largest terrestrial salamander in North America. This species occurs from northern Mendocino County to southwestern British Columbia. This species occurs in wet, humid coastal forests, particularly in Douglas fir, redwood, red fir, and montane and valley-foothill riparian habitats with cold permanent and semi-permanent rocky streams and seepages.

Breeding takes place mostly in the spring, usually in May, within hidden water-filled nest chambers beneath logs or stones. Males deposit up to 16 spermatophores. Females pick up one to a few of the sperm caps with their cloacas and deposit their entire clutch of 135 to 200 eggs (larger females deposit more eggs) in the nest chamber. The eggs are attached singly, side-by-side, usually on the roof of the nest chamber (Nussbaum et al. 1983). The female guards the nest. Larvae hatch in six to eight months. The larval period lasts for 18–24 months, depending on environmental conditions. Adults can be either aquatic or terrestrial forms. Aquatic adults use stream habitats and terrestrial adults use cover objects such as logs, leaf litter, rocks, or subterranean tunnels (Nussbaum et al. 1983). Terrestrial adults are active migrating on rainy nights (Zeiner et al. 1988).

Habitat is present within the Mattole River and its tributaries within and adjacent to the Project area.

6.2.2.5 Southern torrent salamander

Southern torrent salamander is a California species of special concern and is distributed in California along the humid coastal drainages from the Oregon border to approximately Point Arena in Mendocino County (Stebbins 2003). Southern torrent salamanders are found in rocky headwater streams in mesic late-successional forest or nearby riparian forests, though the species may be found in younger stage forests in coastal northern California (Welsh and Lind 1996, Jones et al. 2005).

Reproduction likely occurs along the shallow margins of streams, springs, and seeps (Jones et al. 2005). Egg development time is very slow; eggs from salamander species in the same genus generally take around 200 days to hatch (Jones et al. 2005). Larval development takes 3–3.5 years, and an additional 1–1.5 years is needed to reach sexual maturity (Jones et al. 2005). Larvae generally occur in cold (44–59°F [6.5–15°C]), low-velocity flows over loose, coarse rock or rubble substrates with low sedimentation (Welsh and Lind 1996). Adults are usually found in contact with cold water though may occasionally be found in moist upland areas (Jones et al. 2005). In previously logged forests, southern torrent salamanders have been found to be more abundant in higher-gradient reaches (Corn and Bury 1989, Diller and Wallace 1996), whereas in old-growth forests the species does not show as strong an association (Corn and Bury 1989, Welsh and Ollivier 1998).

Suitable habitat occurs within high gradient reaches upstream of the Project area.

6.2.2.6 Northern spotted owl

The northern spotted owl is federally and state listed as threatened. Critical habitat has been designated for this species and is present in the Project vicinity, but it is not present within or adjacent to the Project area. Northern spotted owls are uncommon year-round residents in the northern California coastal ranges from Marin County north, as well as within the Cascade Range in northern California, southeast to the Pit River in Shasta County below 2,300 m (7,600 ft) (Harris 1993, Gutiérrez et al. 1995, USFWS 2010). South of Burney in the southern Cascade Range and Sierra Nevada, the northern spotted owl is replaced by the California spotted owl (*Strix occidentalis occidentalis*) (Gutiérrez et al. 1995).

Northern spotted owls are typically associated with complex mature or old-growth stands dominated by conifers, particularly redwoods with hardwood understories (Pious 1994, USFWS

2011). Roosting sites are characterized by dense canopy cover dominated by large-diameter trees (i.e., greater than 76-cm [30-in] diameter at breast height [dbh]), multiple canopy layers, and north-facing slopes, often in cool shady areas (Gutiérrez et al. 1995, Courtney et al. 2004). Nests tend to be found in tree or snag cavities, on platforms (e.g., abandoned raptor or raven nests, squirrel nests, mistletoe brooms, or debris accumulations), or on broken-top snags (Zeiner et al. 1990a). Northern spotted owls are generally monogamous, forming long-term pair bonds that often last for life (Courtney et al. 2004). In late February or early March, pairs begin roosting in cavities, the tops of broken trees, or abandoned nests; nesting is followed by peak breeding in April and May (Zeiner et al. 1990a, Gutiérrez et al. 1995, Courtney et al. 2004). Northern spotted owls generally lay a single clutch of one to four eggs (Gutiérrez et al. 1995). A pair may use the same nesting location for several years, although breeding may not occur every year (Zeiner et al. 1990a).

Primary prey items for northern spotted owls are small mammals, but birds and insects are also taken (Forsman et al. 1984, Zeiner et al. 1990a). Foraging habitats vary more than roosting and nesting habitats but are similarly characterized by high canopy closure and complex structure (Thomas et al. 1990). Open areas are also important foraging areas in northern California, as the abundance and diversity of prey is higher in early successional habitats (Folliard et al. 2000). Spotted owls are likely to forage in stands that are young enough to contain an abundance of prey, such as woodrats, but are old enough to allow the owls to fly under the canopy (Thome et al. 1999).

Suitable foraging habitat for northern spotted owl is present in patches adjacent to the Project area. However, there are no northern spotted owl activity centers within 724 m (0.45 miles [mi]) of the Project areas. The nearest activity center is HUM0924, which is about 0.48 mi to the north of the Vanauken project. The last detection at this site was in 2000, when a nesting pair and young were detected. Barred owls have since been detected within a mile of the Project area (CDFW 2024d), which may reduce the potential for future NSO occupancy.

6.2.2.7 Olive-sided flycatcher

Olive-sided flycatchers are a CDFW Species of Special concern and are migratory and summer residents in California that typically breed in the Sierra Nevada foothills (CalPIF 2002, Widdowson 2008). Olive-sided flycatchers have been documented in a wide variety of forested habitats in California, including mixed conifer, Douglas-fir, redwood, and montane hardwood-conifer forests (Widdowson 2008). They primarily occur in advanced successional coniferous forests with open canopies, near forest edges or forest openings (e.g., meadows, rivers, harvest units), and with abundant perches (Zeiner et al. 1990a, Altman and Sallabanks 2000, CalPIF 2002, Widdowson 2008). The birds prefer nesting areas near water bodies, potentially due to increased insect abundance in these areas (Altman and Sallabanks 2000). In addition, studies have shown an increase in nesting olive-sided flycatchers with a reduction in forest canopy due to logging operations or fire (CalPIF 2002).

Suitable habitat occurs in the Project area. The nearest sighting was approximately 5 mi to the northeast (eBird 2024).

6.2.2.8 Yellow warbler

The yellow warbler, a California Species of Special Concern, is a summer resident that breeds throughout much of California, except the Central Valley, southern Californian deserts, and high Sierra Nevada (Zeiner et al. 1990a, Heath 2008). The largest concentrations of breeding pairs occur in northeastern California, in Modoc National Forest and Shasta County, as well as in the Cascade Range and Sierra Nevada (Heath 2008). The preferred habitat of yellow warbler includes open canopy or deciduous riparian vegetation, often along streams or wet meadows (Heath 2008).

This species frequently nests in small willows and alders, and is also associated with cottonwoods, Oregon ash, and other riparian shrubs and trees, depending upon the geographic region (Zeiner et al. 1990a, Heath 2008). This species also occasionally nests in montane chaparral in open coniferous forests (Heath 2008). Breeding occurs from mid-April through early August, with peak activity in June (Zeiner et al. 1990a). Yellow warblers nest 1–5 m (2–16 ft) above ground, at the bases of branches (branch forks) in small deciduous trees and shrubs, often in willow thickets (Zeiner et al. 1990a, Lowther et al. 1999). Birds forage for insects within the shrub and tree canopy, occasionally feeding on the wing or eating fruit (Zeiner et al. 1990a, Lowther et al. 1999).

Yellow warblers have not been recorded in the Project Area. The nearest sighting was approximately 5 mi to the northeast (eBird 2024). Habitat for this species is present in the meadow areas of the Project area.

6.2.2.9 Sonoma tree vole

The Sonoma tree vole is a candidate for state listing as threatened. In California, the Sonoma tree vole is restricted to coastal forests in the humid fog belt from Sonoma County north to the Klamath mountains (Williams 1986, Jameson and Peeters 2004, Adam and Hayes 1998). Distribution of Sonoma tree voles in many parts of their range is patchy (Hall 1981), but this species can be locally common (Williams 1986).

The Sonoma tree vole is a nocturnal rodent that is active year-round (Zeiner et al. 1990b). This species lives, nests, and feeds within the forest canopy, though males are rarely terrestrial (Williams 1986). The home range usually consists of one or more trees (Brown 1985, as cited in Carey 1991). Both sexes construct nests of Douglas-fir needles, typically located 6–18 m (20–60 ft) above the ground in branches or against trunks of Douglas-fir trees (Williams 1986). In cases where nests were found in species other than Douglas-fir, grand fir, and redwood, nests were on branches interlocking with branches of Douglas-fir. Breeding occurs throughout the year, peaking from February through September. Females breed 24 hours after giving birth to one to four young, with one or more litters per year. The young are weaned at 30–40 days (Zeiner et al. 1990b). The diet of the red tree vole consists of needles, buds, and the tender bark of twigs of Douglas-fir, western hemlock, grand fir, and Bishop pine (Williams 1986, Wooster 1996). Needle resin ducts are removed before the remaining part is eaten. Young needles may be consumed entirely (Harris 1990). Tree voles obtain water from food or by licking dew or rainwater from coniferous trees (Maser 1965). Where present, tree voles are a common component of spotted owl diets (Forsman et al. 2004).

In Mendocino County, nests have occasionally been located on open ridge tops and in previously heavily logged and/or grazed areas (Wooster 1996). The predominant tree species used by Sonoma tree voles is Douglas-fir, with larger trees able to support colonies of tree voles (Meiselman 1987, Carey 1991, Wooster 1996, Thompson and Diller 2002, Jones 2003). Based on a study by Thompson and Diller (2002), tree voles are hypothesized to start colonizing in tree stands as young as around 20 years old. Density of active vole nests increases significantly as stands mature beyond 20 years old (Thompson and Diller 2002). Tree voles have also been documented nesting in tanoak, presumably due to its common occurrence in many Douglas-fir stands (Thompson and Diller 2002).

Sonoma tree voles have been reported occupying timber stands within the upper Mattole River watershed (CDFW 2018). Suitable habitat for this species is present in the Project area.

6.2.2.10 Townsend's big-eared bat

Townsend's big-eared bat is a candidate for state listing as threatened, and a state species of special concern. This species occurs throughout California and is associated with caves and structures in a variety of habitats from deserts to coastal scrub to montane forests. Townsend's big-eared bats have been documented from sea level to 3,292 m (10,800 ft), although in California maternity roosts appear to be confined to elevations below 1,798 m (5,900 ft) (Pierson and Fellers 1998, Sherwin and Piaggio 2005).

This cavity-dwelling species roosts and hibernates in caves (commonly limestone or basaltic lava), mines, buildings, bridges (with a cave-like understructure), rock crevices, tunnels, basal hollows in large trees, and cave-like attics (Pierson and Fellers 1998, Pierson and Rainey 2007, Pierson et al. 2001, Pierson and Rainey 1996, Sherwin et al. 2000, Sherwin and Piaggio 2005). Townsend's big-eared bats breed in both transitory migratory sites and hibernacula between September or October and February (CDFW 2013). The maternity season extends from 1 March through 31 October, with colonies forming between March and June and breaking up by September or October (CDFW 2013). Maternity colonies and winter hibernacula (found in caves, tunnels, mines, and buildings [Zeiner et al. 1990b]) are particularly sensitive to disturbance. This species could be directly impacted by removal or disturbance of maternity roosts (e.g., trees, abandoned buildings) during the breeding season (March–October).

Townsend's big-eared bat is a moth specialist with over 90% of its diet composed of lepidopterans. Foraging habitat associations include edge habitats along streams, adjacent to and within a variety of wooded habitats. These bats often travel long distances while foraging, including movements of over 150 kilometers (km) (93 mi) during a single evening (Sherwin et al. 2000). Evidence of long foraging distances and large home ranges has also been documented in California (Pierson and Rainey 1996).

Snags and large trees may be important roosts for this species. In northwestern California, Fellers and Pierson (2002, as cited in Woodruff and Ferguson 2005) documented individual Townsend's bats using tree hollows created by fire or rot in very large redwood (*Sequoia sempervirens*) and California bay trees (*Umbellularia californica*). A nursery colony was found using the basal hollows of large redwood trees in northwestern California (Mazurek 2004, as cited in Woodruff and Ferguson 2005) and in Muir Woods National Monument near San Francisco (Heady and Frick 2001, as cited in Woodruff and Ferguson 2005).

The highest potential of roosting habitat for Townsend's big-eared bat in the Project area is in the older redwood and fir trees with the potential to have cavities or hollows.

6.2.2.11 Pallid bat

The pallid bat is a California species of special concern. This species occurs year-round in California. Pallid bat may forage in all habitat types and roost in forest stands (montane riparian, closed-cone pine cypress, redwood) and in buildings and bridges throughout the Project area.

Pallid bats are associated with a variety of habitats from desert to coastal regions. At low- to mid-elevations, they are particularly associated with oak habitat (oak savannah, black oak, and oak grasslands) (Pierson and Rainey 2002). In natural settings, day and night roosts are in rock crevices and cliffs but can also be found in trees (underneath exfoliating bark of pine and oak and in hollows) and caves (Sherwin and Rambaldini 2005, Hermanson and O'Shea 1983, Pierson et al. 2001, Pierson and Rainey 1996). However, in more urban settings (e.g., Central Valley and western Sierran foothills), day and night roosts are frequently associated with human structures such as abandoned buildings, old mine workings, and bridges (Sherwin and Rambaldini 2005, Pierson and Rainey 1996, Pierson et al. 2001). Overwintering roosts require relatively cool and stable temperatures out of direct sunlight. Pallid bats primarily forage in open spaces away from water. They can feed on the ground, on vegetation, and in the air by using a 'wing-cupping' method that forces the prey to the ground (Sherwin and Rambaldini 2005). Their generalist diet consists primarily of large ground-dwelling or slow flying insects and arachnids (Zeiner et al. 1990b) but can also include scorpions (pallid bats are immune to the sting), small rodents, and lizards.

Suitable pallid bat foraging habitat occurs throughout the Project area and roosting habitat is present in numerous trees and bridges in the Project area. No tunnels, caves, mines are known to occur in the Project area. This species could be directly impacted by removal of maternity roosts (e.g., trees, abandoned buildings) during the breeding season (April–September).

6.2.2.12 Pacific fisher

Pacific fisher, a subspecies of the fisher, has a fragmented and patchy distribution in the north coast and Klamath Province of California at elevations ranging from 25 to 1,000 m (83 to 3,300 ft) (Zielinski et al. 1995). This species is a candidate for listing under the federal ESA and a California species of special concern.

Landscapes dominated by old-growth forests with complex vertical and horizontal structure (Aubry and Raley 2006) are common habitat for fishers (Schempf and White 1977). Pacific fishers in California are typically associated with mixed conifer, Douglas-fir, and ponderosa pine forests with at least 50 percent canopy cover (Zielinski et al. 1997). Breeding and resting activities are often associated with large tracts of dense habitat with a substantial snag and large downed wood component (Schempf and White 1977). Small fisher home ranges reported in California include study areas with mast-producing hardwoods (e.g., tanoak and madrones) as a major forest component, presumably resulting in abundant prey, since such species provide substantial food sources for potential fisher prey species (Lofroth et al. 2011). Cavities located in the upper portions living trees or snags are often used for dens (Powell and Zielinski 1994). Large hardwoods may provide enhanced natal and maternal cavities (Thompson et al. 2007). Fishers will use cavities created by pileated woodpeckers in diseased trees for natal and maternal dens (Aubry et al. 1997). Resting substrate includes cavities in living trees or snags, downed wood, stumps, mistletoe brooms, squirrel and raptor nests, brush piles, rock falls, and holes in the ground (Powell and Zielinski 1994).

Male and female fishers reach reproductive age at one year and probably breed from early January to early April (Powell and Zielinski 1994, citing many authors). Birth likely occurs in late March and early April (Hall 1942, as cited in Powell and Zielinski 1994). Litter size averages 2 to 3 young (Zeiner et al. 1990b); up to three different den trees may be used during the three months after giving birth, April to June (Weir and Almuedo 2010). The fisher's diet changes in response to prey availability. The fisher's diverse range of prey includes small rodents (including deer mice, red-backed voles, and voles) and squirrels, skunks, hares, rabbits, porcupines, mountain beavers, gophers, and chipmunks (Grenfell 1979, Powell and Zielinski 1994, Golightly

1997). Fishers also feed on carrion, insects, and vegetable matter (Grenfell 1979, Zielinski et al. 1999).

Timber harvesting is likely the major factor responsible for the declines in fisher populations in the United States (Powell and Zielinski 1994). Removal of large trees, snags, and downed logs, and reduced canopy cover appear to negatively impact this species by removing denning and resting sites, as well as structural and species components associated with prey composition, abundance, and vulnerability (Thompson and Haerestad 1994, Sturtevant and Bissonette 1997, as cited in Cooperrider et al. 2000). In addition to habitat loss, disturbance caused by timber harvesting and road building may also decrease habitat quality for fishers.

There have been no recent confirmed sightings of Pacific fisher in the primary or secondary assessment areas (CDFW 2018). The nearest recorded sighting was approximately 11.6 km (7.2 mi) east of the Project area near Cooks Valley (CDFW 2024a).

6.2.2.13 Western pond turtle

Western pond turtle is a California species of special concern. In California, this species is found from the Oregon border along the Pacific Coast Ranges to the Mexican border, and west of the crest of the Cascades and Sierras.

Western pond turtles inhabit fresh or brackish water characterized by areas of deep water, low flow velocities, moderate amounts of riparian vegetation, warm water and/or ample basking sites, and underwater cover elements, such as large woody debris and rocks (Jennings and Hayes 1994). Along major rivers, western pond turtles are often concentrated in side channel and backwater areas. Turtles may move to off-channel habitats, such as oxbows, during periods of high flows (Holland 1994). Although adults are habitat generalists, hatchlings and juveniles require specialized habitat for survival through their first few years. Hatchlings spend much of their time feeding in shallow water with dense submerged or short emergent vegetation (Jennings and Hayes 1994). Although an aquatic reptile, western pond turtles require upland habitats for basking, overwintering, and nesting, typically within 0.6 mi of aquatic habitats (Holland 1994).

Western pond turtle eggs are typically laid in June and July, though they may be laid throughout the year (Holland 1994, Reese 1996). Egg-laying sites vary from sandy shoreline to forest soil types, though are generally located in grassy meadows, away from trees and shrubs (Holland 1994), with canopy cover commonly less than about 10% (Reese 1996). Young hatch in late fall or overwinter in the nest and emerge in early spring.

Western pond turtles are known to occupy the Mattole River, and one has been recorded near Thompson Creek. However, the Project area adjacent to Vanauken Creek contains unsuitable habitat. In addition, Vanauken Creek has a closed canopy, which limit the basking opportunities for turtles. In addition, water flow during the summer months is very low or intermittent, which is not the preferred habitat for turtles.

7 AVOIDANCE AND MINIMIZATION MEASURES

7.1 Special-status Plants and Natural Communities

The following measures will be employed during design implementation to minimize impacts on native plant species and to encourage vegetation establishment post-implementation within the Project design footprint and additional temporary disturbance areas:

- The Project footprint will be minimized to the extent possible.
- Special-status species will be flagged by a qualified botanist and avoided to the extent possible. If avoidance is not feasible, the botanist will harvest seed and/or salvage plant material for relocation to a suitable site.
- Post-construction, any temporary laydown of construction materials on native soil surfaces will be removed promptly to promote the re-establishment of any persistent native vegetation.
- Ground disturbance and vegetation clearing and/or trimming will be confined to the minimum amount necessary to facilitate Project implementation.
- Removal of established native vegetation during construction activities will be limited to the extent possible.
- Viable native plants within the Project design footprint will be salvaged for reuse. To support rapid vegetative cover establishment, all salvaged plant material will be relocated at specific elevation grades suitable for the species immediately following construction activities.
- Ponds will be positioned to minimize impacts on existing vegetation to the extent possible.
- Ground disturbance and vegetation clearing and/or trimming will be confined to the minimum amount necessary to facilitate Project implementation.
- Heavy equipment and vehicles will use existing and any associated temporary access roads and staging areas to the extent possible.
- Construction materials will be stored in designated staging areas.
- Measures to prevent the spread of invasive weeds and sudden oak death pathogens will be taken, including, where appropriate, inspecting equipment for soil, seeds, and vegetative matter, cleaning equipment, utilizing weed-free materials and native seed mixes for revegetation, and proper disposal of soil and vegetation. Prior to entering and leaving the work site, workers will remove all seeds, plant parts, leaves, and woody debris (e.g., branches, chips, bark) from clothing, vehicles, and equipment.
- Removal of established native vegetation during construction activities will be limited to the extent possible.
- Viable native plants within the Project design footprint will be salvaged for reuse. To support rapid vegetative cover establishment, all salvaged plant material will be relocated at specific elevation grades suitable for the species immediately following construction activities.

Where the sensitive natural community (*Pteridium aquilinum* – Grass Association) occurs, in addition to minimizing the overall footprint of disturbance by the Project, the following measures will be incorporated to mitigate for impacts on this community:

- Collect native seed prior to above ground disturbance (e.g., vegetation pruning, mowing) and ground disturbance in construction footprint to be redistributed in disturbed and/or bare ground features.

- Plant native grassland plugs and/or broadcast seed in temporarily disturbed areas within grassland habitats to promote native growth.
- Salvage any perennial plants where ground disturbance will occur and translocate to unaffected areas of the same habitat.
- To retain grassland habitat, Douglas-fir saplings and seedlings can be removed from within the grassland boundaries to reduce encroachment and future conversion of this sensitive natural community to Douglas-fir forest.

7.2 Special-status Fish and Wildlife

7.2.1 Fish

Coho and Chinook salmon and steelhead (winter- and summer-run) are the special-status fish species known to occur in Vanauken Creek. The pond construction would occur outside of any watercourse. Project-related impacts on these species would be limited to sediment delivery from disturbed soils at the pond.

There is the potential for instream project activities to indirectly impact salmonid species through habitat degradation resulting from sediment delivery. To minimize the potential for degradation of habitat, the following measures will be applied:

- Work around the seasonal watercourses is restricted to the period of June 15 through November 1 or the first significant rainfall, whichever comes first. However, construction would be timed to coincide with dry channel conditions. The actual Project start and end dates, within this timeframe, are at the discretion of CDFW.

Discharge of sediment will be controlled and minimized with the implementation of best management practices (BMPs) on all disturbed soils that have the potential to discharge into area watercourses. Applicable BMPs include, but are not limited to, installation of silt fences, straw wattles, and placement of seed-free rice straw. BMPs will be installed at all access points to the work sites, which will minimize the potential for sediment delivery and deleterious effects on salmonids.

There would be long-term beneficial effects resulting from flow augmentation during the dry season. While modest compared to winter flows, these augmentations have the potential to increase pool connectivity and water quality. A foundational hypothesis for this Project, that increased pool connectivity will bolster over-summer salmonid survival, is strongly supported by the work of Obedzinski et al. (2018). Their study found that days of disconnected surface flow showed a strong negative correlation with juvenile coho salmon survival rate in four tributaries to the Russian River.

Critical habitat for listed salmonids species would also benefit in the long-term. The input of water during the summer and late fall from the infiltration of pond water would increase summer and fall flow in Vanauken Creek and help maintain pool habitats.

7.3 Wildlife

7.3.1 Northern red-legged frog

There are no ponds in the construction areas, which would serve as breeding and holding areas. However, northern red-legged frogs may stray into work areas. The following conservation measures will be employed to avoid or minimize the potential take of red-legged frogs:
The Project manager or qualified designee will conduct daily morning inspections of the area slated for work to determine if red-legged frogs entered the areas overnight. Any individuals will be captured and relocated prior to the start of the day's work.

7.3.2 Foothill yellow-legged frog

Foothill yellow-legged are unlikely to be present in the Project construction areas, but individuals that stray out of Vanauken Creek could be affected by proposed Project.

The following conservation measures will be employed to avoid or minimize the potential for take of foothill yellow-legged frogs:

- The Project manager or qualified designee will conduct daily morning inspections of the area slated for work to determine if foothill yellow-legged frogs entered the areas overnight. Any individuals will be captured and relocated prior to the start of the day's work.

The Project's flow augmentation will result in the maintenance of instream habitat, which should benefit foothill yellow-legged frogs.

7.3.3 Red-bellied newt

Adult and juvenile red-bellied newts would likely be occupying terrestrial areas during the construction period and could be affected by heavy equipment that collapses burrows or moves woody debris. Larval newts could be present in Vanauken Creek but would be unlikely to be affected by the Project.

The following conservation measures will be employed to avoid or minimize the potential for take of red-bellied newt:

- Terrestrial woody debris will be left in place to the greatest extent practicable during operations.
- The Project manager or qualified designee will conduct daily morning inspections of the area slated for work to determine if adult newts are present on the ground surface. Any newts will be captured and relocated prior to the start of the day's work.

The Project's flow augmentation should benefit red-bellied newts by maintaining and potentially expanding the amount of instream habitat available for this species.

7.3.4 Coastal giant salamander

Construction operations will not occur within Vanauken Creek or seasonal watercourses with wet channels. However, adult coastal giant salamanders could be present in terrestrial areas during the operation period and could be affected by heavy equipment that collapses burrows or moves woody debris.

The following conservation measures will be employed to avoid or minimize the potential for take of coastal giant salamanders:

- Terrestrial woody debris will be left in place to the greatest extent practicable during operations within the riparian areas.
- The Project manager or qualified designee will conduct daily morning inspections of the area slated for work to determine if adult salamanders are present on the ground surface. Any salamanders will be captured and relocated prior to the start of the day's work.

The Project's flow augmentation should benefit coastal giant salamanders by maintaining and potentially expanding the amount of instream habitat available for this species during the dry season.

7.3.5 Northern spotted owls

The closest northern spotted owl activity center to the Project is nearly 724 m (0.45 mi) away. Therefore, there will not be any direct impacts on northern spotted owls or their activity center. However, pond construction would result in the removal of approximately 4.0acres of early successional mixed conifer/hardwood forest, which would reduce potential foraging habitat.

The potential for Project construction to indirectly impact nesting northern spotted owls was preliminary evaluated using USFWS (2006) guidelines. Owls can be affected by noise-related, visual, or physical disturbances, such as created by heavy equipment. USFWS (2006) identifies the distance that sound associated with different types of construction equipment is estimated to disturb northern spotted owls during the breeding season, relative to ambient noise levels. Most types of standard construction equipment (e.g., backhoes, cranes, construction vehicles, jackhammers) would require disturbance buffers of 100–400 m (330–1,320 ft) from nesting spotted owl activity centers. None of these types of construction activities are expected to occur within 400 m (1,320 ft) of a northern spotted owl nest. In addition, there are no northern spotted owl activity centers within 640 m (2,100 ft) of the Project. Therefore, northern spotted owls are unlikely to be indirectly affected by the Project.

7.3.6 Olive-sided flycatcher

The nearest sighting of an olive-sided flycatcher was approximately 4 mi to the northeast (eBird 2024). Since suitable habitat could occur in the Project area, a qualified biologist will conduct a nesting survey up to two weeks prior to start of excavation at specific project locations and a surrounding 100 ft buffer. If no nests are observed, then operations may proceed. These surveys will be good for two weeks. If construction doesn't begin within those two weeks, then the survey shall be repeated. CDFW will be consulted if a nest is found within the Project area prior to proceeding with work.

7.3.7 Yellow warbler

Yellow warblers have not been recorded in the Project Area. The nearest sighting was approximately 4 mi to the northeast (eBird 2024). Habitat for this species is present in the Project areas. To minimize impacts to this species, a qualified biologist will conduct a nesting survey up to two weeks prior to tree removal. If no nests are observed, then operations may proceed. These surveys will be good for two weeks. If construction doesn't begin within those two weeks, then the survey shall be repeated. CDFW will be consulted if a nest is found within the Project area prior to proceeding with work.

7.3.8 Sonoma tree vole

Sonoma tree voles have been reported occupying timber stands adjacent to the Project area (CDFW 2024a). The Project will take some smaller, less vigorous redwood and Douglas-fir trees that are growing within the construction area. The removal of trees has the potential to affect this species through nest destruction and loss of food resources (e.g., Douglas-fir needles). To minimize impacts to this species, a qualified biologist will conduct a nesting survey up to two weeks prior to tree removal. If no nests are observed, then operations may proceed. These surveys will be good for two weeks. If construction doesn't begin within those two weeks, then the survey shall be repeated. CDFW will be consulted if a nest is found within the Project area prior to proceeding with work.

7.3.9 Townsend's big-eared bat

There are no records of Townsend's big-eared bat near the Project area. However, there may be trees containing basal hollows suitable for roosting scattered throughout the Project area. The Project will take some smaller, less vigorous redwood and Douglas-fir trees. However, these trees would not have the cavity characteristics necessary for bat roosting. In addition, all large trees that could contain suitable habitat will be retained.

7.3.10 Pallid bat

There are no records of Pallid bats being near the Project area. However, there may be trees containing basal hollows and exfoliating bark suitable for roosting scattered throughout the Project area. The Project will take some smaller, less vigorous redwood and Douglas-fir trees. However, these trees would not have the cavity characteristics necessary for bat roosting. In addition, all large trees that could contain suitable habitat will be retained.

7.3.11 Pacific fisher

There are no records of Pacific fisher being near the Project area. However, there may be trees containing basal hollows and downed logs scattered throughout the Project area. The Project will take some smaller, less vigorous redwood and Douglas-fir trees. However, these trees would not have the cavity characteristics necessary for fisher use. In addition, all large trees that could contain suitable habitat will be retained.

7.3.12 Western pond turtle

Turtles have been reported in the Mattole River. However, suitable habitat is lacking in Vanauken Creek due to the closed canopies that would limit the basking opportunities for turtles. In addition, water flow during the summer months is very low or intermittent, which is not the preferred habitat for turtles. In addition, no ponds are in the Project area that could contain this species. The Project does not include any instream work, so there will be no impact to turtle basking habitat. However, there is a very low potential for impacts to turtle nesting habitat.

The following conservation measure will be employed to avoid or minimize impacts on western pond turtles:

- Prior to the initiation of any ground disturbance work, a qualified biologist will survey the site to determine presence of any turtle nests. If a nest is encountered within the project footprint, CDFW will be consulted.

7.3.13 Western bumble bee

The Project area is within the historic range of western bumble bees, but is outside of the current, restricted range (CDFW 2023b). Suitable foraging and nesting habitat is present within the grasslands and shrublands of Study area 1. In Study area 1, bumblebees might nest in tufts of grass, abandoned rodent holes, within fallen logs and woody debris, and near forest edges.
The following conservation measure will be employed to avoid or minimize impacts on western bumble bees:

- When feasible, vegetation removal and earthwork should occur outside of the Colony Active Period of western bumble bees (March – October).
- Prior to the initiation of any vegetation removal or earthwork during the Colony Active Period, a qualified biologist will survey the site to determine the presence of western bumble bees and available nesting and foraging habitat. CDFW will be consulted if an individual or nest is found within the Project area prior to proceeding with work.
- If western bumble bees are not found during the focused surveys, but suitable habitat is present within the disturbance footprint and Project activities take place during the species Colony Active Period, it is recommended that a biological monitor be onsite during initial vegetation removal and/or ground disturbing activities.

7.3.14 Obscure bumble bee

The Project area is within the range of the obscure bumble bee (Williams et. al. 2014). Suitable foraging and nesting habitat is present within the grasslands and shrublands of Study area 1. In Study area 1, bumblebees might nest in tufts of grass, abandoned rodent holes, within fallen logs and woody debris, and near forest edges.
The following conservation measure will be employed to avoid or minimize impacts on western bumble bees:

- When feasible, vegetation removal and earthwork should occur outside of the Colony Active Period of western bumble bees (April – September).
- Prior to the initiation of any vegetation removal or earthwork during Colony Active Period, a qualified biologist will survey the site to determine the presence of obscure bumble bees and available nesting and foraging habitat. CDFW will be consulted if an individual or nest is found within the Project area prior to proceeding with work.
- If obscure bumble bees are not found during the focused surveys, but suitable habitat is present within the disturbance footprint and Project activities take place during the species Colony Active Period, it is recommended that a biological monitor be onsite during initial vegetation or ground disturbing activities.

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Appendices

Appendix A

Comprehensive Scoping List of Special-status Plant and Wildlife Species in the Project Vicinity

Table A-1. Comprehensive scoping list of special-status plants in the Project vicinity.

Scientific Name (Common Name)	Status (Federal/State/CRPR)	Habitat Associations and Blooming Period	Source	Likelihood of Occurrence
Antennaria suffrutescens (evergreen everlasting)	None/None/4.3	Serpentine soils in lower montane coniferous forest. Blooming period: January–July. 1,640–5,250 ft.	CNPS	**None:** Ultramafic soils not present in Project area and outside of elevation range. No known occurrences within 10 mi of the Project area.
Astragalus agnicidus (Humboldt County milk-vetch)	None/CE/1B.1	Disturbed areas, openings, and sometimes roadsides of broadleafed upland forest and North Coast coniferous forest. Blooming period: April–September. 395–2,625 ft.	CNPS, CDFW	**Low:** North coast coniferous forest habitat present within Project area. One occurrence within 10 mi of the Project area.
Calamagrostis bolanderi (Bolander's reed grass)	None/None/4.2	Mesic areas of broadleafed upland forest, closed-cone coniferous forest, coastal scrub, and North Coast coniferous forest, bogs and fens, meadows and seeps, marshes and swamps. Blooming period: May–August. 0–1,495 ft.	CNPS	**None:** No suitable habitat present within the Project area. All occurrences within 10 mi are associated with coastal habitats.
Calamagrostis foliosa (leafy reed grass)	None/CR/4.2	Rocky areas of coastal bluff scrub and North Coast coniferous forest. Blooming period: May–September. 0–4,005 ft.	CNPS	**None:** No suitable habitat present within the Project area. All occurrences within 10 mi are associated with coastalal habitats.
Carex arcta (northern clustered sedge)	None/None/2B.2	Bogs and fens, North Coast coniferous forest (mesic). Blooming period: June–September. 195–4,595 ft.	CNPS	**None:** No suitable habitat present within the Project area. One occurrence from 1923 within 10 mi of the Project area.
Castilleja litoralis (Oregon coast paintbrush)	None/None/2B.2	Coastal bluff scrub, Coastal dunes, Coastal scrub. Blooming period: June. 50–330 ft.	CNPS	**None:** No suitable habitat present within the Project area and outside of elevation range. All occurrences within 10 mi are associated with coastalal habitats.

Scientific Name (Common Name)	Status (Federal/State/CRPR)	Habitat Associations and Blooming Period	Source	Likelihood of Occurrence
Castilleja mendocinensis (Mendocino Coast paintbrush)	None/None/1B.2	Closed-cone coniferous forest, Coastal bluff scrub, Coastal dunes, Coastal prairie, Coastal scrub. Blooming period: April–August. 0–525 ft.	CNPS	**None:** No suitable habitat present within the Project area and outside of elevation range. All occurrences within 10 mi are associated with coastalal habitats.
Ceanothus gloriosus var. *exaltatus* (glory brush)	None/None/4.3	Chaparral. Blooming period: March–June (August). 100–2,000 ft.	CNPS	**None:** No suitable habitat mapped or observed within Project area. No known occurrences within 10 mi of the Project
Clarkia amoena ssp. *whitneyi* (Whitney's farewell-to-spring)	None/None/1B.1	Coastal bluff scrub, Coastal scrub. Blooming period: June–August. 35–330 ft.	CNPS	**None:** No suitable habitat present within the Project area. One occurrence within 10 mi associated with coastal habitats.
Coptis laciniata (Oregon goldthread)	None/None/4.2	Mesic areas of meadows and seeps, streambanks in North Coast coniferous forest. Blooming period: (February) March–May (September–November). 0–3,280 ft.	CNPS, CDFW	**Low:** North coast coniferous forest habitat present within Project area, but mesic areas and streambanks are not. Two occurrences within 2 mi of the Project (CDFW). One personal occurrence observed along Vanauken creek (Stillwater Sciences 2023).
Epilobium septentrionale (Humboldt County fuchsia)	None/None/4.3	Generally on rocky and/or sandy areas of broadleafed upland forest, North Coast coniferous forest. Blooming period: July–September. 150–5,905 ft.	CNPS	**None:** No suitable habitat present within the Project area. No known occurrences within 10 mi of the Project area.
Erigeron biolettii (streamside daisy)	None/None/3	Mesic, rocky areas of broadleafed upland forest, cismontane woodland, North Coast coniferous forest. Blooming period: June–October. 100–3,610 ft.	CNPS	**None:** Suitable habitat not present within the Project area. No occurrences within 10 mi of the Project area.

Scientific Name (Common Name)	Status (Federal/State/CRPR)	Habitat Associations and Blooming Period	Source	Likelihood of Occurrence
Erythronium oregonum (giant fawn lily)	None/None/2B.2	Rocky, sometimes serpentinite openings in cismontane woodland, meadows and seeps. Blooming period: March–June (July). 330–3,775 ft.	CNPS	**None:** Suitable habitat not present within the Project area. No occurrences within 10 mi of the Project area.
Erythronium revolutum (coast fawn lily)	None/None/2B.2	Mesic sites and streambanks of broadleafed upland forest, North Coast coniferous forest, bogs and fens. Blooming period: March–July (August). 0–5,250 ft.	CNPS, CDFW	**Low**: Limited suitable habitat present within Project area. Two occurrences within 10 mi of the Project area.
Gilia capitata ssp. *pacifica* (Pacific gilia)	None/None/1B.2	Chaparral (openings), Coastal bluff scrub, Coastal prairie, Valley and foothill grassland. Blooming period: April–August. 15–5,465 ft.	CNPS	**Moderate**: Suitable habitat present within Project area. Four occurrences within 5 mi of the Project area.
Hemizonia congesta ssp. *tracyi* (Tracy's tarplant)	None/None/4.3	Sometimes on serpentine soils in openings of coastal prairie, lower montane coniferous forest, and North Coast coniferous forest. Blooming period: (March–April) May–October. 395–3,935 ft.	CNPS	**Low:** Suitable habitat present within the Project area. No occurrences within 10 mi of the Project area.
Hosackia gracilis (harlequin lotus)	None/None/4.2	Wetlands and roadsides of broadleafed upland forest, cismontane woodland, closed-cone coniferous forest, coastal bluff scrub, coastal prairie, coastal scrub, marshes and swamps, meadows and seeps, North Coast coniferous forest, valley and foothill grassland. Blooming period: March-July. 0–2,295 ft.	CNPS	**Low:** Limited suitable habitat present within Project area. One occurrence within 10 mi of the Project area.
Kopsiopsis hookeri (small groundcone)	None/None/2B.3	North Coast coniferous forest. Blooming period: April–August. 295–2,905 ft.	CNPS	**Low:** North coast coniferous forest habitat present within Project area. No known occurrences within 10 mi of the Project area.

Scientific Name (Common Name)	Status (Federal/State/CRPR)	Habitat Associations and Blooming Period	Source	Likelihood of Occurrence
Lasthenia burkei (Burke's goldfields)	FE/CE/1B.1	Meadows and seeps (mesic), Vernal pools. Blooming period: April–June. 50–1,970 ft.	USFWS	**None:** No suitable habitat present within the Project area. No known occurrences within 10 mi of the Project area.
Lasthenia californica ssp. *macrantha* (perennial goldfields)	None/None/1B.2	Coastal bluff scrub, Coastal dunes, Coastal scrub. Blooming period: January–November. 15–1,705 ft.	CNPS	**None:** No suitable habitat present within the Project area. All occurrences within 10 mi are associated with coastal habitats.
Lasthenia conjugens (Contra Costa goldfields)	FE/None/1B.1	Mesic areas of cismontane woodland, Playas (alkaline), Valley and foothill grassland, Vernal pools. Blooming period: March–June. 0–1,540 ft.	USFWS	**None:** No suitable habitat present within the Project area. No known occurrences within 10 mi of the Project area.
Lathyrus palustris (marsh pea)	None/None/2B.2	Mesic areas in coastal prairie, coastal scrub, lower montane coniferous forest, marshes and swamps, North Coast coniferous forest, bogs and fens. Blooming period: March–August. 5–330 ft.	CNPS	**None:** Project area is outside the species elevation range. All occurrences within 10 mi are associated with coastal habitats.
Leptosiphon aureus (bristly leptosiphon)	None/None/4.2	Chaparral, Cismontane woodland, Coastal prairie, Valley and foothill grassland. Blooming period: April–July. 180–4,920 ft.	CNPS	**None:** No suitable habitat present within the Project area. No known occurrences within 10 mi of the Project area.
Leptosiphon latisectus (broad-lobed leptosiphon)	None/None/4.3	Broadleafed upland forest, Cismontane woodland. Blooming period: April–June. 560–4,920 ft.	CNPS	**None:** No suitable habitat present within the Project area. No known occurrences within 10 mi of the Project area.

Scientific Name (Common Name)	Status (Federal/State/CRPR)	Habitat Associations and Blooming Period	Source	Likelihood of Occurrence
Lilium rubescens (redwood lily)	None/None/4.2	Serpentine soils (sometimes) of broadleafed upland forest, chaparral, lower montane coniferous forest, North Coast coniferous forest, and upper montane coniferous forest. Blooming period: (March) April–August (September). 100–6,265 ft.	CNPS	**Low**: Suitable habitat present within Project area. One occurrences within 5 mi of the Project area.
Listera cordata (heart-leaved twayblade)	None/None/4.2	Bogs and fens, lower montane coniferous forest, North Coast coniferous forest. Blooming period: February–July. 15–4,495 ft.	CNPS	**Moderate:** North coast coniferous forest habitat present within the Project area. One personal observation in 2022 within 5 mi of the Project area on Sanctuary Forest property.
Lupinus constancei (Lassics lupine)	FE/CE/1B.1	Lower montane coniferous forest on serpentine. Blooming period: July. 4,920–6,560 ft.	USFWS	**None:** No suitable habitat present and outside of species occurs outside the elevation range of the Project area. No known occurrences within 10 mi of the Project area.
Lycopus uniflorus (northern bugleweed)	None/None/4.3	Bogs and fens, Marshes and swamps. Blooming period: July–September. 15–6,560 ft.	CNPS	**None:** No suitable habitat present within the Project area. No occurrences within 10 mi of the Project area.
Mitellastra caulescens (leafy-stemmed mitrewort)	None/None/4.2	Mesic sites of broadleafed upland forest, lower montane coniferous forest, meadows and seeps, North Coast coniferous forest; sometimes on roadsides. Blooming period: (March) April–October. 15–5,580 ft.	CNPS, CDFW	**Low:** North coast coniferous forest habitat present within Project area, but limited mesic sites. One occurrence within 10 mi of the Project area.
Montia howellii (Howell's montia)	None/None/2B.2	Meadows and seeps, North Coast coniferous forest, Vernal pools; sometimes on roadsides. Blooming period: (Februry) March–May. 0–2,740 ft.	CNPS	**Low:** North coast coniferous forest habitat present within Project area, but limited mesic sites. One occurrence from 1923 within 5 mi of the Project area.

Scientific Name (Common Name)	Status (Federal/State/CRPR)	Habitat Associations and Blooming Period	Source	Likelihood of Occurrence
Piperia candida (white-flowered rein orchid)	None/None/1B.2	Serpentine soils (sometimes) in broadleafed upland forest, lower montane coniferous forest, North Coast coniferous forest. Blooming period: (March–April) May–September. 100–4,300 ft.	CNPS, CDFW	**Moderate:** North coast coniferous forest habitat present within Project area. No ultramafic soils mapped or observed within Project area. Many occurrences witin 5–10 mi of the Project area.
Pityopus californicus (California pinefoot)	None/None/4.2	Mesic sites in broadleafed upland forest, lower montane coniferous forest, North Coast coniferous forest, upper montane coniferous forest. Blooming period: (March–April) May–August. 50–7,300 ft.	CNPS	**Low:** North coast coniferous forest habitat present within Project area. No known occurrences within 10 mi of the Project area.
Pleuropogon hooverianus (North Coast semaphore grass)	None/CT/1B.1	Mesic sites in openings of broadleafed upland forest, Meadows and seeps, North Coast coniferous forest. Blooming period: April–June. 35–2,200 ft.	CNPS, CDFW	**Low:** Openings in North coast coniferous forest and grassland habitat is present within Project area. One occurrence within 10 mi of the Project area.
Sidalcea malachroides (maple-leaved checkerbloom)	None/None/4.2	Often in disturbed areas of broadleafed upland forest, coastal prairie, coastal scrub, North Coast coniferous forest, Riparian woodland. Blooming period: (March) April–August. 0–2,395 ft.	CNPS, CDFW	**Low:** North coast coniferous forest habitat present within Project area. One occurrence within 10 mi of the Project area.
Sidalcea malviflora ssp. *patula* (Siskiyou checkerbloom)	None/None/1B.2	Often on roadsides of Coastal bluff scrub, Coastal prairie, North Coast coniferous forest. Blooming period: (March) May–August. 50–4,035 ft.	CNPS	**None:** No suitable habitat present within the Project area. One occurrence within 10 mi of the Project area.
Tiarella trifoliata var. *trifoliata* (trifoliate laceflower)	None/None/3.2	Moist, shady banks and stream edges in Lower montane coniferous forest, North Coast coniferous forest. Blooming period: (May) June–August. 560–4,920 ft.	CNPS	**None:** No suitable habitat present within the Project area. No occurrences within 10 mi of the Project area.

Scientific Name (Common Name)	Status (Federal/State/CRPR)	Habitat Associations and Blooming Period	Source	Likelihood of Occurrence
Trifolium amoenum (showy indian clover)	FE/None/1B.1	Coastal bluff scrub, valley and foothill grassland (sometimes serpentinite). Blooming period: April–June. 15–1,360 ft.	USFWS	**None:** No suitable habitat present within the Project area. No ultramafic soils mapped or observed within the Project area and no known occurrences within 10 mi of the Project area.
Usnea longissima (Methuselah's beard lichen)	None/None/4.2	On tree branches; usually on old growth hardwoods and conifers in broadleafed upland forest, North Coast coniferous forest. Blooming period: N/A. 165–4,790 ft.	CNPS, CDFW	**Low:** No suitable habitat present within the Project area. Conifers within the Project area are in an early seral plantation. The nearest occurrence is within 7 mi of the Project area.

[1] Status:

Federal

FE Federally endangered
None Not listed

State

CE State endangered
CR State rare
None Not listed

California Rare Plant Rank (CRPR):

1B Plants rare, threatened, or endangered in California and elsewhere
2B Plants rare, threatened, or endangered in California, but more common elsewhere
3 Plants about which more information is needed, on review list
4 Plants of limited distribution, on watch list

CRPR Threat Ranks:

0.1 Seriously threatened in California (over 80% of occurrences threatened / high degree and immediacy of threat)
0.2 Moderately threatened in California (20–80% occurrences threatened / moderate degree and immediacy of threat)
0.3 Not very threatened in California (less than 20% of occurrences threatened / low degree and immediacy of threat or no current threats known)

[2] Months in parentheses are uncommon; N/A = Not applicable

Table A-2. Comprehensive scoping list of special-status fish and wildlife in the Project vicinity.

Species Name (Common Name)	Status[1] Federal/ State	Distribution and Habitat Associations	Location of Suitable Habitat in Project Area	Likelihood of Occurrence
Fish				
Coho salmon, southern Oregon/ northern California coast Evolutionarily Significant Unit (*Oncorhynchus kisutch*)	FT, CH/ST	Spawn in coastal streams and large mainstem rivers (i.e., Klamath/Trinity rivers) in riffles and pool tails-outs and rear in pools ≥ 1 m (3 ft) deep with overhead cover with high levels oxygen and temperatures between 10–15ºC (50–59ºF).	Suitable habitat occurs in the upper Mattole and Project area. Coho redds have been infrequently observed in the Project area. Designated critical habitat includes all river reaches and estuarine areas accessible to listed coho within their range. Designated critical habitat is present in the Project area.	**High**: Present in Vanauken Creek.
Chinook salmon, California coastal Evolutionarily Significant Unit (*Oncorhynchus tshawytscha*)	FT, CH/None	Wild coastal, spring, and fall-run Chinook found in streams and rivers between Redwood Creek, Humboldt County to the north and the Russian River, Sonoma County to the south.	Suitable habitat occurs in the upper Mattole River. Fair quality spawning habitat for this species is present in Vanauken Creek. Designated critical habitat is present in the Project area.	**High**: Potentially present in Vanauken Creek.
Steelhead (winter-run), northern California coast Distinct Population Segment (*Oncorhynchus mykiss*)	FT, CH/None	Inhabits small coastal streams to large mainstem rivers with gravel-bottomed, fast-flowing habitat for spawning. However, habitat criteria for different life stages (spawning, fry rearing, juvenile rearing) vary significantly.	Suitable habitat occurs in the upper Mattole and Project area. Designated critical habitat is present in the Project area.	**High**: Present in Vanauken Creek.

Species Name (Common Name)	Status[1] Federal/ State	Distribution and Habitat Associations	Location of Suitable Habitat in Project Area	Likelihood of Occurrence
Steelhead (summer-run) (*Oncorhynchus mykiss*)	None/SE	Inhabits small coastal streams to large mainstem rivers with gravel-bottomed, fast-flowing habitat for spawning. However, habitat criteria for different life stages (spawning, fry rearing, juvenile rearing) vary significantly. Adults enter rivers during April to July and hold in deep pools until fall or winter rains allow for upstream migration to spawning areas.	Suitable spawning and rearing habitat occurs in the upper Mattole River and tributaries. Adults have been observed holding in deep pools in the Mattole River downstream of McKee Creek. Adult holding habitat not present in Vanauken Creek. Designated critical habitat is present in the Project area.	**High**: Present in Vanauken Creek.
Tidewater Goby (*Eucyclogobius newberryi*)	FE/SSC	Tillas Slough (mouth of the Smith River, Del Norte County) to Agua Hedionda Lagoon (northern San Diego County)	Coastal lagoons and the uppermost zone of brackish large estuaries; prefer sandy substrate for spawning, but can be found on silt and rocky mud substrates; can occur in water up to 4 m (15 ft) in lagoons and within a wide range of salinity (0–42 parts per thousand)	**None:** No suitable habitat.
Amphibians				
Northern red-legged frog (*Rana aurora*)	None/SSC	Humid forests, woodlands, grasslands, and streamsides usually near dense cover. Generally near permanent water but can be found far from water in damp woods and meadows during non-breeding season.	Suitable habitat is present in habitat types associated with water, nearby uplands, and existing ponds.	**High**: Likely to be present within or adjacent to the Project area.
Foothill yellow-legged frog (*Rana boylii*)	None/SSC	Associated with partially shaded, shallow streams, and riffles with rocky substrate. Some cobble-sized substrate required for egg laying. Adults move into smaller tributaries after breeding.	Suitable breeding habitat occurs in the upper Mattole River. Dispersal habitat is present in the Mattole River tributaries.	**High**: Breeding habitat is present in the Mattole River. Dispersal habitat is present in the Mattole River tributaries.

Species Name (Common Name)	Status[1] Federal/ State	Distribution and Habitat Associations	Location of Suitable Habitat in Project Area	Likelihood of Occurrence
Red-bellied newt (*Taricha rivularis*)	None/SSC	Ranges from southern Humboldt to Sonoma counties. Found in streams during breeding season. Moist habitats under woody debris, rocks, and animal burrows.	Suitable habitat occurs in the Mattole River and larger tributaries. Documented to occur in the Mattole River near Thorn Junction.	**High**: Habitat present in Vanauken Creek adjacent to the Project area.
Coastal giant salmamander (*Dicamptodon tenebrosus*)	None/SSC	Northern Humboldt County to British Columbia. Wet coastal forests in or near clear, cold permanent and semi-permanent streams and seepages.	Suitable habitat occurs in the Mattole River and tributaries. Not documented in the Project area, but suitable habitat is present.	**High**: Likely to be present in Project area.
Pacific tailed frog (*Ascaphus truei*)	None/SSC	Associated with high-gradient, perennial and montane streams in hardwood conifer, redwood, Douglas-fir, and ponderosa pine habitats. Tadpoles require water temperatures below 15°C (59°F).	Suitable habitat may occur in high gradient watercourses adjacent to the Project area, but not likely within the Project area.	**Low**: High gradient perennial watercourses are not present in the Project area
Southern torrent salamander (*Rhyacotriton variegatus*)	None/SSC	Coastal redwood, Douglas-fir, mixed conifer, montane riparian and montane hardwood-conifer habitats. Seeps and small streams in coastal redwood, Douglas-fir, mixed conifer, montane riparian, and montane hardwood-conifer habitats. Seeps and springs need to be relatively unembedded with fine sediment.	Suitable habitat occurs in high-gradient gravelly seeps and springs upstream and upslope of the Project area.	**Low**: High-gradient perennial seeps and watercourses are not present in the Project area.

Species Name (Common Name)	Status[1] Federal/ State	Distribution and Habitat Associations	Location of Suitable Habitat in Project Area	Likelihood of Occurrence
Birds				
Northern spotted owl (*Strix occidentalis caurina*)	FT/ST	Typically found in large, contiguous stands of mature and old-growth coniferous forest with dense multi-layered structure.	Suitable foraging habitat is present within the Project area. Habitat within the Project area is unsuitable for breeding. The closest activity center (HUM0924) to the Vanauken project site is more than 0.48 mi away.	**Moderate**: Suitable foraging habitat exists in the Project area.
Marbled murrelet (*Brachyramphus marmoratus*)	FT, CH/SE	Associated with mature conifers (i.e., redwood and Douglas-fir) for nesting. During the breeding season, may be present 4–5 km (6–8 mi) inland.	No suitable habitat within at least 10 mi of the Project area. Project area is outside of critical habitat.	**None**: No suitable habitat.
Little willow flycatcher (*Empidonax traillii brewsteri*)	None/SE	Typically breeds in wet meadows and montane riparian habitats (with a significant shrub component within or near a taller overstory) from 600 to 2,440 m (2,000-8,000 ft) in elevation from Tulare County north, along the western side of the Sierra Nevada and Cascades. Common spring (mid-May to early June) and particularly fall (mid-August to early September) migrant in riparian habitats at lower elevations, including the north coast of California.	The nearest recorded sighting of this species was along the South Fork Eel River near Miranda in June 2000. Multi-storied riparian forest or woodland (e.g., alder, cottonwood, willow) habitat is not present in the Project Area.	**Low**: Suitable quality habitat is not present in the Project area.
Olive-sided flycatcher (*Contopus cooperi*)	None/SSC	Occupy a wide variety of forested habitats in California, including mixed conifer, Douglas-fir, redwood, and montane hardwood-conifer forests with open canopies, near forest edges or forest openings (e.g., meadows, rivers, harvest units).	Suitable habitat occurs in the Project area. The nearest sighting was approximately 5 mi to the northeast of the Project area (eBird 2024).	**High:** Suitable habitat occurs in Project area.

Species Name (Common Name)	Status[1] Federal/ State	Distribution and Habitat Associations	Location of Suitable Habitat in Project Area	Likelihood of Occurrence
Yellow warbler (*Dendroica petechia)*	None/SSC	Throughout California. Preferred habitat includes open-canopy, deciduous riparian vegetation in close proximity to water, often along streams or wet meadows.	Suitable habitat occurs in the Project area. The nearest sighting was in 1995 approximately 5 mi to the northeast of the Project area (eBird 2024).	**Moderate:** Suitable habitat present in the Project areas.
Bryant's savannah sparrow (*Passerculus sandwichensis alaudinus*)	None/SSC	North coastal California and the San Francisco Bay Area, from Humboldt County to northern Monterey County. This species resides in the narrow coastal fogbelt, its range extending approximately 9 mi (15 km) inland. Low tidal marshlands and adjacent ruderal communities, and within the fog belt, in mesic grasslands. Short herbaceous vegetation communities that lack woody plant cover; in all habitats bare ground is an important component	Suitable habitat may be present in the grasslands along the Briceland Thorn Road. The nearest sighting was along the Pacific coast approximately 4 mi southwest of the Lost River Project area (eBird 2023).	**Low:** Project areas are outside of the fog belt. In addition, suitable habitat is not present in Project area.
Grasshopper sparrow (*Ammodramus savannarum*)	None/SSC	Coastal California and sporadically through most of the Central Valley, as well as Siskiyou County and at the base of the Sierra Nevada in Kern County. In the northern California coast, despite the apparent lack of suitable habitat, breeding pairs are found in the patchwork of grasslands that occur in the matrix of coniferous forest.	The nearest sighting was approximately 5 mi east of the Project area near Garberville (eBird 2024). Suitable habitat may be present in the grasslands along the Briceland Thorn Road, but not along the watercourses of the Project.	**Low:** Marginal habitat is present in the Project area.

Species Name (Common Name)	Status[1] Federal/ State	Distribution and Habitat Associations	Location of Suitable Habitat in Project Area	Likelihood of Occurrence
Western snowy plover (*Charadrius alexandrinus nivosus*)	FT/None	Nests on barren to sparsely vegetated dune-backed beaches, barrier beaches, and salt-evaporation ponds, infrequently on bluff-backed beaches.	No ocean beaches or open large gravel bars are located within or adjacent to the Project Area	**None**: No suitable habitat.
Yellow-billed cuckoo (*Coccyzus americanus*)	FT/SE	Breeds in limited portions of the Sacramento River and the South Fork Kern River; small populations may nest in Butte, Yuba, Sutter, San Bernardino, Riverside, Inyo, Los Angeles, and Imperial counties	Summer resident of valley foothill and desert riparian habitats; nests in open woodland with clearings and low, dense, scrubby vegetation. The nearest recorded sighting of this species was in the Eel River delta area.	**None**: No suitable habitat.
Mammals				
Sonoma tree vole (*Arborimus pomo*)	None/SSC	Associated nearly exclusively with Douglas-fir trees and occasionally grand fir trees within the North Coast fog belt between the northern Oregon border and Sonoma County. Eats Douglas-fir needles exclusively.	Small patches of Douglas-fir are present within the Project area, which could provide nesting and foraging habitat.	**High**: Suitable habitat is present
Pacific fisher - West Coast DPS (*Pekania pennanti*)	FCT/SSC	Associated with dense advanced-successional conifer forests, with complex forest structure and high percent canopy closure; den in hollow trees and snags.	Habitat in most of the Project area does not correspond to the dense advanced-successional forest this species prefers. Nearest recorded sighting was approximately 14.5 km (9 mi) to the southeast near Cooks Valley.	**Moderate**: Potential suitable habitat is present in the Project area.

Species Name (Common Name)	Status[1] Federal/ State	Distribution and Habitat Associations	Location of Suitable Habitat in Project Area	Likelihood of Occurrence
Pacific martin (*Martes caurina*)	FT, PCH/None	Coastal Oregon and northwestern California including 20,747–km2 (8,010 mi2) of all or portions of Sonoma, Mendocino, Trinity, Humboldt, Siskiyou, and Del Norte counties Associated with older conifer forests, with complex forest structure and high percent canopy closure; den in hollow trees and snags.	The Project area has been repeatedly logged over the past decades and suitable habitat is limited to a few small patches of old-growth redwoods in lower Lost River/Redwoods Monastery areas. The entire Project area is outside proposed critical habitat.	**Low**: This species has not been recorded, but the Project area is within its range.
Townsend's big-eared bat (*Corynorhinus townsendii*)	None/SSC, CT	Found throughout California in all but subalpine and alpine habitats. Roosts in cavernous habitats, usually in tunnels, caves, buildings, mines, and basal hollows of trees, but also rock shelters, preferentially close to water. Caves near water's edge are favored. Forages in riparian zone and follows creeks and river drainages on foraging bouts. Feeds primarily on moths. Drinks at stream pools.	Suitable foraging habitat throughout most of the Project area; however, barns, old buildings, and bridges for roosting are not present within the Project area.	**Moderate**: May forage in the Project area. May be present in some of the barns and older structures adjacent to the Project area.

Species Name (Common Name)	Status[1] Federal/ State	Distribution and Habitat Associations	Location of Suitable Habitat in Project Area	Likelihood of Occurrence
Pallid bat (*Antrozous pallidus*)	None/SSC	Found throughout California. Roosts in rock crevices, outcrops, cliffs, mines, and caves; trees (underneath exfoliating bark of pine and oak) and in basal hollows; and a variety of vacant and occupied structures (e.g., bridges) or buildings. Roost individually or in small to large colonies (hundreds of individuals). Feeds low to or on the ground in a variety of open habitats, primarily on ground-dwelling arthropods. Forages most frequently in riparian zone, in open oak savannah, and open mixed deciduous forest. Drinks at stream pools.	Suitable foraging habitat throughout most of the Project area; some larger trees may provide roosting habitat but barns, old buildings, and bridges are not present within the Project area.	**Moderate**: May forage in the Project area. May roost in some of the barns and older structures adjacent to the Project area
Reptiles				
Western pond turtle (*Emys marmorata*)	PT/SSC	Ponds, marshes, rivers, streams, and irrigation ditches with abundant vegetation, and either rocky or muddy bottoms, in woodland forest and grasslands. Below 1,829 m (6,000 ft) elevation. Basking sites are required. Egg-laying sites are located on suitable upland habitats (grassy open fields) up to 500 m (1,640 ft) from water.	Suitable habitat occurs in the middle and lower Mattole River. Present in stock ponds in the upper Mattole watershed. A sighting was reported near Thompson Creek.	**Low**: Present in the Mattole River. No suitable habitat in Vanauken Creek.

Species Name (Common Name)	Status[1] Federal/ State	Distribution and Habitat Associations	Location of Suitable Habitat in Project Area	Likelihood of Occurrence
Insects				
Western bumble bee (*Bombus occidentalis*)	-/SCE	Forages on flowering plants in chaparral scrub, shrubby areas, open grasslands, forested openings, mountain meadows, and urban parks and gardens. Host plant genera include, but are not limited to, *Ceanothus, Centaurea, Chrysothamnus, Cirsium, Eriogonum, Geranium, Grindellia, Lupinus, Melilotus, Monardella, Rubus, Solidago,* and *Trifolium.* Nests underground in pre-existing cavities (abandoned small mammal burrows) but can also nest above ground in grass tussocks, brush piles, fallen logs, and human-made structures.	Suitable foraging and nesting habitat are present in Study area 1.	**Moderate:** May forage and nest within the grasslands and shrublands of Study area 1. The Project area is within the historic range of the species, but outside of the current range (CDFW 2023b). The most recent occurrence within the Project vicinity is from 1977, six miles east of the Project area (CDFW 2023a).

Species Name (Common Name)	Status[1] Federal/ State	Distribution and Habitat Associations	Location of Suitable Habitat in Project Area	Likelihood of Occurrence
Obscure bumble bee (*Bombus caliginosus*)	-/SSC	Coastal habitats from Santa Barbabra County north to the California border, with scattered records from the east side of the Central Valley. Forages on flowering plants in grasslands, coastal scrub, open coastal prairies, and Coast Range meadows. Host plant genera include, but are not limited to, *Baccharis*, *Ceanothus*, *Cirsium*, *Clarkia*, *Grindelia*, *Keckiella*, *Lathyrus*, *Lotus*, *Lupinus*, *Phacelia*, *Rhododendron*, *Rubus*, *Trifolium*, and *Vaccinium.* Nests underground in pre-existing cavities but can also nest above ground in abandoned bird nests, grass tussocks, brush piles, fallen logs, and human-made structures.	Suitable foraging and nesting habitat are present in Study area 1.	**Moderate:** May forage and nest within the grasslands and shrublands of Study area 1. The Project area is within the range of the species. The nearest CNDDB occurrence is within three miles of the Project area from 1976 (CDFW 2023a). The most recent occurrence within the Project vicinity is from 2022 (Xerces Society 2024).

[1] **Status:**

Federal

FT Federal Threatened
FC Federal Candidate
PT Proposed Threatened
CH Designated critical habitat within the Project vicinity
PCH Proposed critical habitat

State

ST State Threatened
SE State Endangered
SCT Candidate Threatened
SCE State Candidate Endangered
SSC CDFW species of special concern

Appendix B

Comprehensive Plant List

Table B-1. Comprehensive list of plant species observed in the Project area.

Species Name (Common Name)	Family	Native Status	Cal-IPC Rating[1]	Wetland Indicator Status[2]
Acer macrophyllum (bigleaf maple)	Sapindaceae	Native	N/A	FACU
Achillea millefolium (common yarrow)	Asteraceae	Native	N/A	FACU
Acmispon americanus var. *americanus* (American bird's-foot trefoil)	Fabaceae	Native	N/A	FACU
Acmispon parviflorus (desert deervetch)	Fabaceae	Native	N/A	UPL
Adenocaulon bicolor (American trailplant)	Asteraceae	Native	N/A	UPL
Agrostis stolonifera (creeping bentgrass)	Poaceae	Naturalized	Limited	FAC
Aira caryophyllea (silver hairgrass)	Poaceae	Naturalized	N/A	FACU
Anisocarpus madioides (woodland madia)	Asteraceae	Native	N/A	UPL
Anthoxanthum occidentale (California sweetgrass)	Poaceae	Native	N/A	UPL
Anthoxanthum odoratum (sweet vernalgrass)	Poaceae	Naturalized	Limited	FACU
Arbutus menziesii (Pacific madrone)	Ericaceae	Native	N/A	UPL
Arctostaphylos manzanita ssp. *manzanita* (whiteleaf manzanita)	Ericaceae	Native	N/A	UPL
Baccharis pilularis (coyotebrush)	Asteraceae	Native	N/A	UPL
Briza maxima (big quakinggrass)	Poaceae	Naturalized	Limited	UPL
Briza minor (little quakinggrass)	Poaceae	Naturalized	N/A	FAC
Brodiaea stellaris (starflower brodiaea)	Themidaceae	Native	N/A	UPL
Bromus diandrus (ripgut brome)	Poaceae	Naturalized	Moderate	UPL
Bromus hordeaceus (soft brome)	Poaceae	Naturalized	Limited	FACU
Bromus laevipes (Chinook brome)	Poaceae	Native	N/A	UPL
Bromus sitchensis var. *carinatus* (California brome)	Poaceae	Native	N/A	UPL
Bromus vulgaris (Columbia brome)	Poaceae	Native	N/A	FACU
Calypso bulbosa var. *occidentalis* (fairy slipper)	Orchidaceae	Native	N/A	FACU
Carduus pycnocephalus ssp. *pycnocephalus* (Italian thistle)	Asteraceae	Naturalized	Moderate	UPL
Carex bolanderi (Bolander's sedge)	Cyperaceae	Native	N/A	FAC
Carex multicaulis (manystem sedge)	Cyperaceae	Native	N/A	UPL

Species Name (Common Name)	Family	Native Status	Cal-IPC Rating[1]	Wetland Indicator Status[2]
Carex praegracilis (clustered field sedge)	Cyperaceae	Native	N/A	FACW
Carex subbracteata (smallbract sedge)	Cyperaceae	Native	N/A	FACW
Ceanothus integerrimus (deerbrush)	Rhamnaceae	Native	N/A	UPL
Cerastium fontanum ssp. *vulgare* (big chickweed)	Caryophyllaceae	Naturalized	N/A	FACU
Chlorogalum pomeridianum var. *divaricatum* (wavyleaf soap plant)	Agavaceae	Native	N/A	UPL
Clinopodium douglasii (yerba buena)	Lamiaceae	Native	N/A	FACU
Collomia heterophylla (variableleaf collomia)	Polemoniaceae	Native	N/A	UPL
Corallorhiza maculata (summer coralroot)	Orchidaceae	Native	N/A	UPL
Crepis capillaris (smooth hawksbeard)	Asteraceae	Naturalized	N/A	FACU
Cynosurus echinatus (bristly dogstail grass)	Poaceae	Naturalized	Moderate	UPL
Cytisus scoparius (Scotch broom)	Fabaceae	Naturalized	High	UPL
Danthonia californica (California oatgrass)	Poaceae	Native	N/A	FAC
Dicentra formosa (Pacific bleeding heart)	Papaveraceae	Native	N/A	FACU
Drymocallis glandulosa var. *glandulosa* (sticky cinquefoil)	Rosaceae	Native	N/A	FAC
Equisetum telmateia ssp. *braunii* (giant horsetail)	Equisetaceae	Native	N/A	FACW
Eschscholzia californica (California poppy)	Papaveraceae	Native	N/A	UPL
Festuca bromoides (brome fescue)	Poaceae	Naturalized	N/A	FAC
Festuca occidentalis (western fescue)	Poaceae	Native	N/A	UPL
Festuca subuliflora (crinkleawn fescue)	Poaceae	Native	N/A	UPL
Fragaria vesca (woodland strawberry)	Rosaceae	Native	N/A	FACU
Frangula californica ssp. *californica* (California coffeeberry)	Rhamnaceae	Native	N/A	UPL
Galium aparine (stickywilly)	Rubiaceae	Native	N/A	FACU
Galium porrigens var. *porrigens* (graceful bedstraw)	Rubiaceae	Native	N/A	UPL
Galium triflorum (fragrant bedstraw)	Rubiaceae	Native	N/A	FACU
Gaultheria shallon (salal)	Ericaceae	Native	N/A	FACU

Species Name (Common Name)	Family	Native Status	Cal-IPC Rating[1]	Wetland Indicator Status[2]
Genista monspessulana (French broom)	Fabaceae	Naturalized	High	UPL
Geranium dissectum (cutleaf geranium)	Geraniaceae	Naturalized	Limited	UPL
Goodyera oblongifolia (western rattlesnake plantain)	Orchidaceae	Native		FACU
Holcus lanatus (common velvetgrass)	Poaceae	Naturalized	Moderate	FAC
Hypochaeris glabra (smooth cat's ear)	Asteraceae	Naturalized	Limited	UPL
Ilex aquifolium (English holly)	Aquifoliaceae	Naturalized	Limited	FACU
Iris douglasiana (Douglas iris)	Iridaceae	Native	N/A	UPL
Juncus balticus ssp. *ater* (mountain rush)	Juncaceae	Native	N/A	FACW
Juncus bufonius (toad rush)	Juncaceae	Native	N/A	FACW
Juncus effusus ssp. *pacificus* (Pacific rush)	Juncaceae	Native	N/A	FACW
Juncus patens (spreading rush)	Juncaceae	Native	N/A	FACW
Linum bienne (pale flax)	Linaceae	Naturalized	N/A	UPL
Lonicera hispidula (pink honeysuckle)	Caprifoliaceae	Native	N/A	FACU
Luzula comosa var. *comosa* (hairy wood rush)	Juncaceae	Native	N/A	UPL
Lysimachia latifolia (Pacific starflower)	Myrsinaceae	Native	N/A	UPL
Marah oregana (coastal manroot)	Cucurbitaceae	Native	N/A	UPL
Melica harfordii (Harford's oniongrass)	Poaceae	Native	N/A	UPL
Myosotis discolor (changing forget-me-not)	Boraginaceae	Naturalized	N/A	FAC
Nemophila parviflora (smallflower nemophila)	Hydrophyllaceae	Native	N/A	UPL
Notholithocarpus densiflorus var. *densiflorus* (tanoak)	Fagaceae	Native	N/A	UPL
Osmorhiza berteroi (sweetcicely)	Apiaceae	Native	N/A	FACU
Oxalis oregana (redwood-sorrel)	Oxalidaceae	Native	N/A	FACU
Phacelia bolanderi (Bolander's phacelia)	Hydrophyllaceae	Native	N/A	UPL
Plantago lanceolata (narrowleaf plantain)	Plantaginaceae	Naturalized	Limited	FACU
Poa annua (annual bluegrass)	Poaceae	Naturalized	N/A	FAC

Species Name (Common Name)	Family	Native Status	Cal-IPC Rating[1]	Wetland Indicator Status[2]
Polystichum munitum (western swordfern)	Dryopteridaceae	Native	N/A	FACU
Prunella vulgaris var. *vulgaris* (common selfheal)	Lamiaceae	Naturalized	N/A	UPL
Pseudognaphalium luteoalbum (Jersey cudweed)	Asteraceae	Naturalized	N/A	FACW
Pseudotsuga menziesii var. *menziesii* (Douglas-fir)	Pinaceae	Native	N/A	FACU
Pteridium aquilinum var. *pubescens* (hairy brackenfern)	Dennstaedtiaceae	Native	N/A	FACU
Quercus chrysolepis (canyon live oak)	Fagaceae	Native	N/A	UPL
Ranunculus occidentalis var. *occidentalis* (western buttercup)	Ranunculaceae	Native	N/A	FACW
Rhinotropis californica (California milkwort)	Polygalaceae	Native	N/A	UPL
Rosa gymnocarpa (dwarf rose)	Rosaceae	Native	N/A	FACU
Rubus leucodermis (whitebark raspberry)	Rosaceae	Native	N/A	FACU
Rubus parviflorus (thimbleberry)	Rosaceae	Native	N/A	FACU
Rubus ursinus (California blackberry)	Rosaceae	Native	N/A	FACU
Rumex acetosella (common sheep sorrel)	Polygonaceae	Naturalized	Moderate	FACU
Sanicula crassicaulis (Pacific blacksnakeroot)	Apiaceae	Native	N/A	UPL
Sequoia sempervirens (redwood)	Cupressaceae	Native	N/A	UPL
Solanum xanti (chaparral nightshade)	Solanaceae	Native	N/A	UPL
Stachys rigida var. *rigida* (rough hedgenettle)	Lamiaceae	Native	N/A	UPL
Tiarella trifoliata var. *unifoliata* (oneleaf foamflower)	Saxifragaceae	Native	N/A	FAC
Toxicodendron diversilobum (Pacific poison oak)	Anacardiaceae	Native	N/A	FAC
Trifolium cyathiferum (cup clover)	Fabaceae	Native	N/A	FAC
Trifolium dubium (suckling clover)	Fabaceae	Naturalized	N/A	FACU
Trifolium glomeratum (clustered clover)	Fabaceae	Naturalized	N/A	UPL
Trifolium microcephalum (smallhead clover)	Fabaceae	Native	N/A	FAC
Trifolium microdon (thimble clover)	Fabaceae	Native	N/A	UPL
Umbellularia californica (California laurel)	Lauraceae	Native	N/A	FAC

Species Name (Common Name)	Family	Native Status	Cal-IPC Rating[1]	Wetland Indicator Status[2]
Vaccinium ovatum (California huckleberry)	Ericaceae	Native	N/A	FACU
Vancouveria hexandra (white insideout flower)	Berberidaceae	Native	N/A	UPL
Verbena lasiostachys var. *lasiostachys* (western vervain)	Verbenaceae	Native	N/A	UPL
Vicia sativa (garden vetch)	Fabaceae	Naturalized	N/A	UPL
Vicia tetrasperma (lentil vetch)	Fabaceae	Naturalized	N/A	UPL
Viola sempervirens (evergreen violet)	Violaceae	Native	N/A	UPL
Whipplea modesta (common whipplea)	Hydrangeaceae	Native	N/A	UPL

1 **Cal-IPC Rating**

High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Moderate – These species have substantial and apparent-but generally not severe-ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Limited – These species are invasive, but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

2 **Wetland indicator status for the Western Mountain, Valley, and Coast Region**

OBL Obligate Wetland Plants that almost always occur in wetlands
FACW Facultative Wetland Plants that usually occur in wetlands, but may also occur in non-wetlands
FAC Facultative Plants that occur in both wetlands and non-wetlands
FACU Facultative Upland Plants that usually occur in non-wetlands, but may also occur in wetlands
UPL Upland Plants that almost never occur in wetland

Appendix D

Soils Report

ENGINEERING GEOLOGIC SOILS REPORT ◦ OCTOBER 2024

Mattole Headwaters Drought Relief Project

Assessor's Parcel Numbers: 215-162-021 & 215-162-022

REGISTERED PROFESSIONAL ENGINEER
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Suggested citation:
Stillwater Sciences. 2024. Engineering Geologic Soils Report. Assessor's Parcel Numbers: 215-162-021 & 215-162-022. Mattole Headwaters Drought Relief Project. Prepared by Stillwater Sciences, Arcata, California for Sanctuary Forest, Whitehorn, California.

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1 INTRODUCTION

The following Engineering Geologic Soils Report was prepared for Sanctuary Forest's Mattole Headwaters Drought Relief Project (Project), located off Briceland Thorn Road near Thorn Junction with Assessor's Parcel Numbers (APNs) 215-162-021 and 215-162-022. The location of the Project is shown below in Figure 1 and on the grading plans associated with this report, which includes a site overview on Sheet 2. The proposed Project consists of constructing two off-channel ponds to supplement instream flows in Vanauken Creek during the dry season. This report was prepared to meet the R2 requirements as described in the Humboldt County General Plan, to evaluate site geologic and soil conditions as they relate to the Project.

This report includes an assessment of site soils, description of potential geologic hazards associated with the proposed Project construction activities, and recommendations to mitigate potential effects of such hazards. These recommendations should reduce, but may not always eliminate completely, the risks to life and property associated with this project. Also included in this report are recommendations for continued engagement of licensed professionals during construction activities.

2 PROJECT DESCRIPTION

The Project goals are to address instream flow impairments due to drought conditions. The proposed off-channel ponds will capture and store winter runoff that will be released into the creek during the dry season, which will improve aquatic habitat availability.

This report addresses geologic and site soil conditions as they relate to the Project. The approximate Project site locations are:

West Pond:
Latitude: 40.052830°
Longitude: -123.951764°

East Pond:
Latitude: 40.058850°
Longitude: -123.947977°

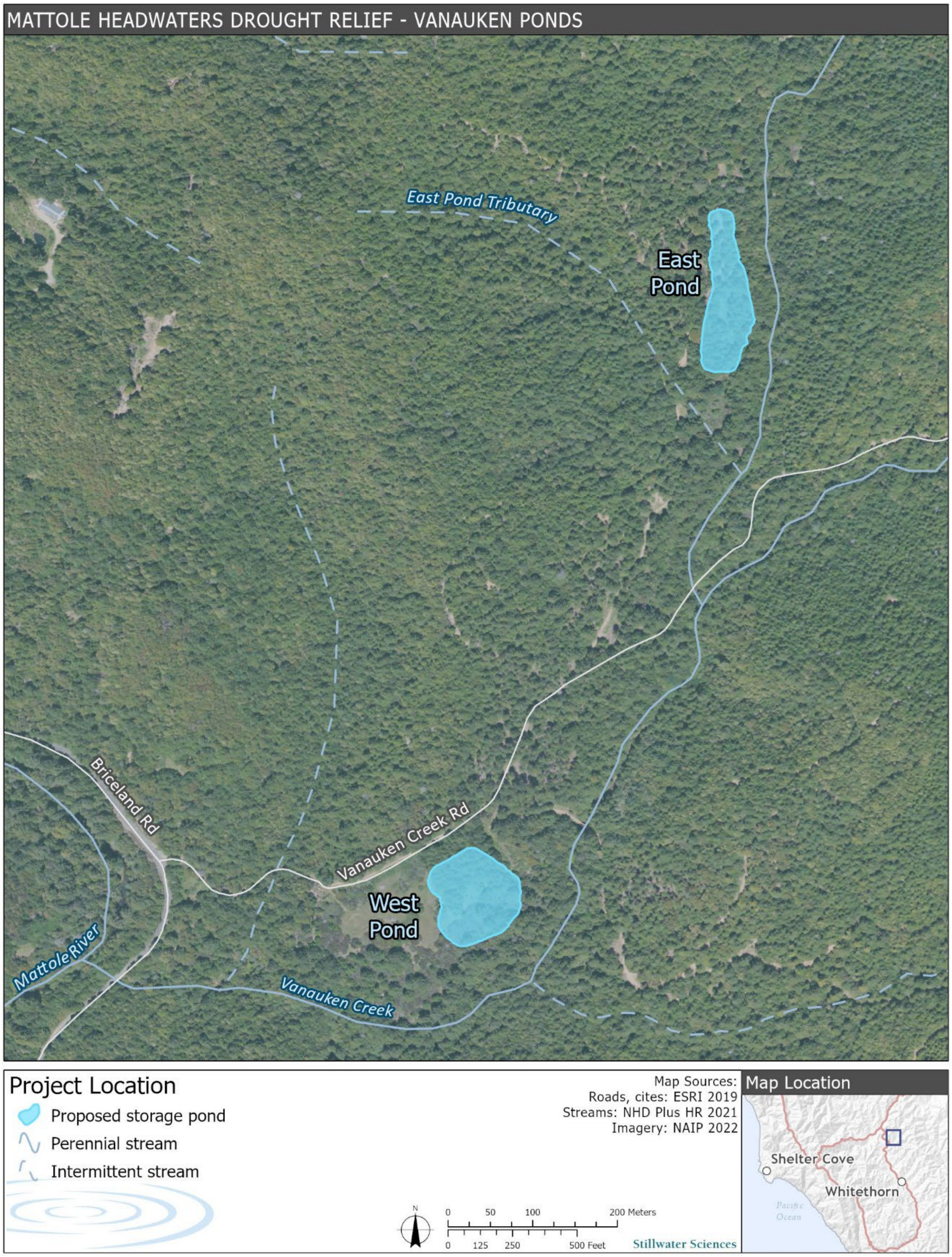

Figure 1. Project location map.

3 SCOPE OF THIS INVESTIGATION

Stillwater Sciences (Stillwater) was retained to prepare this Engineering Geologic Soils Report to meet the R2 requirements described in the Humboldt County General Plan. Stillwater staff evaluated site soils and potential geologic hazards to determine the suitability of the sites to support the proposed Project components. Potential geologic hazards on the subject properties include, but may not be limited to, differential and total settlement, strong earthquake ground motion, streambank erosion, slope instability, flooding, and drainage hazards.

Stillwater staff made site visits in November 2023 and August 2024 to conduct reconnaissance, characterize geologic and geomorphic conditions, and conduct geotechnical soils investigations. All work was performed under the supervision of Stillwater engineer, Joel Monschke, P.E., and engineering geologist, Dylan Caldwell, C.E.G.

Existing data that were reviewed for this investigation included 2018 LiDAR topographic data, geologic mapping (McLaughlin et al. 2000), geomorphic and landslide mapping (Spittler 1984 and Davenport et al. 2002), and historical aerial photographs from 1942, 1947, 1968, 1984, 1996, 2006, 2016, and 2019.

4 SITE DESCRIPTION

The Project sites are located along Vanauken Creek in the upper Mattole River watershed approximately 2 miles north of Whitethorn in southern Humboldt County, CA (Figure 1). The Project is located on two alluvial terraces above Vanauken Creek (Figure 2), approximately 3,000 feet (ft) and 6,000 ft upstream of the confluence with the Mattole River.

5 GEOLOGIC AND TECTONIC SETTING

The upper Mattole River watershed occurs within the Coast Ranges Geomorphic Province of California (CGS 2002) and is underlain by a series of geologic terranes comprised primarily of marine sedimentary rocks (McLaughlin et al. 2000, Davenport et al. 2002). The terranes are located in a tectonically active plate-boundary deformation zone, defined by right-lateral movement along the San Andreas fault system (including the King Range thrust zone and Whale Gulch-Bear Harbor fault zone, discussed below), which forms the plate boundary interface with the Pacific plate to the west and North American plate to the east (Kelsey and Carver 1988). Northward progression of the San Andreas fault system is characterized by lateral shearing and vertical compression due to the major westward turn in the fault system upon reaching the Mendocino Triple Junction near the mouth of the Mattole River and Cape Mendocino. These primary deformation styles are what create the dominant NNW-SSE trending topographic and structural grain in the region (Kelsey and Carver 1988). The evolution of this regional topographic and structural grain has been developed through pervasive shearing, folding, fracturing, and faulting throughout the north coast of California.

The Vanauken Creek watershed is underlain by the Coastal terrane of the Franciscan Complex Coastal Belt (Davenport et al. 2002) (Figure 2). These rocks are Pliocene to late-Cretaceous in age and in the Vanauken watershed consist primarily of intact sandstone and argillite that exhibit sharp-crested topography with a regular, well-incised system of sidehill drainage (Davenport et al. 2002). The majority of the upper Mattole watershed (i.e., the Southern Mattole watershed subbasin of Davenport et al. 2002) is underlain by the same Coastal terrane sandstone and argillite unit, which is the most intact and stable bedrock (from a landslide perspective) in the entire Mattole watershed. The Project reach along mainstem Vanauken Creek flows through deposits of unconsolidated to weakly consolidated stream alluvium and colluvium shed from the steep bedrock hillslopes. These deposits are Holocene to Pleistocene and near the confluence with the Mattole River the valley bottom widens and contains uplifted fluvial terraces on both sides of the creek (Spittler 1984).

The Whale Gulch-Bear Harbor fault zone and King Range thrust zone trend NNW-SSE and lie approximately 3 to 4.3 miles west of the Project area, respectively (Bryant 2017). These zones are prominent components of the San Andreas fault system in the Mattole watershed. The Whale Gulch-Bear Harbor fault zone is considered late Quaternary in age (i.e., active within the last 130,000 years). Recent displacement along the King Range thrust zone is undifferentiated, but it is considered Quaternary in age (i.e., active within the last 1.6 million years). The Shelter Cove section of the San Andreas fault, which ruptured in the great 1906 San Francisco earthquake, is approximately 6 miles west of the Project site.

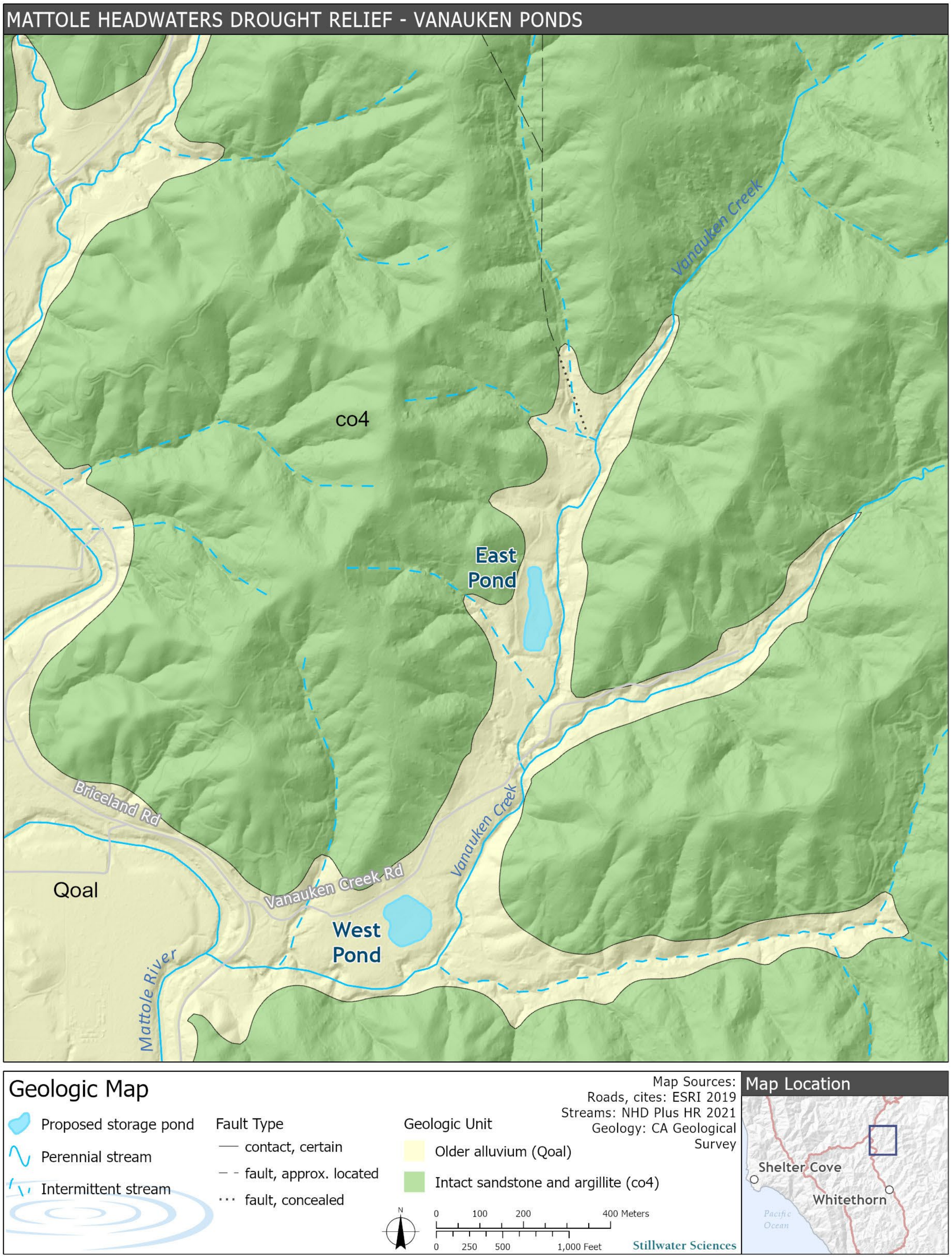

Figure 2. Generalized geologic map of the project vicinity.

6 FIELD INVESTIGATION AND LAB TESTING

During the site visits the Project site and surrounding area were investigated to characterize soil types, bedrock outcroppings, groundwater conditions, surface drainage features, and slope stability conditions. Six test pits were excavated at the Project site with locations selected to provide a representation of the subsurface conditions across the proposed Project features (see Figure 3). The test pits were logged to characterize the soil and stratigraphy at each site. The logs are provided in Appendix A. Bulk and tube soil samples were collected from the test pits and sent to SHN's material testing lab in Eureka, California for analysis. Tests performed include: moisture and density, particle size analysis, percent passing the #200 sieve, compaction curve/optimum moisture, and plasticity index. The analysis results are included in Appendix B.

Test Pit #1
Test Pit #1 (TP1) is located on the southeastern edge of the East Pond footprint within an existing swale. This location is at the lowest existing ground elevation within the pond footprint.

Test Pit #2
Test Pit #2 (TP2) is located in the center of the East Pond footprint, which corresponds to the deepest proposed grading for the pond.

Test Pit #3
Test Pit #3 (TP3) is located on the western edge of the East Pond footprint at the boundary of the existing road fill. This location is at the highest existing ground elevation within the pond footprint and is intended to provide stratigraphic information on the pond cutbank slope.

Test Pit #4
Test Pit #4 (TP4) is located along the proposed inter-pond gravity transfer line and is at flow augmentation location #1 in the grading plans associated with this report. Sampling at this location is intended to characterize the percolation capacity of the soil.

Test Pit #5
Test Pit #5 (TP5) is located at the center of the West Pond footprint, which corresponds to the deepest proposed grading for the pond.

Test Pit #6
Test Pit #6 (TP6) is located on the southern edge of the West Pond footprint within the existing meadow.

Additional Test Pits
Two additional pits were excavated within the West Pond footprint to assess the uniformity of subsurface conditions across the site. Soils exposed in these pits were only visually inspected and not logged or sampled.

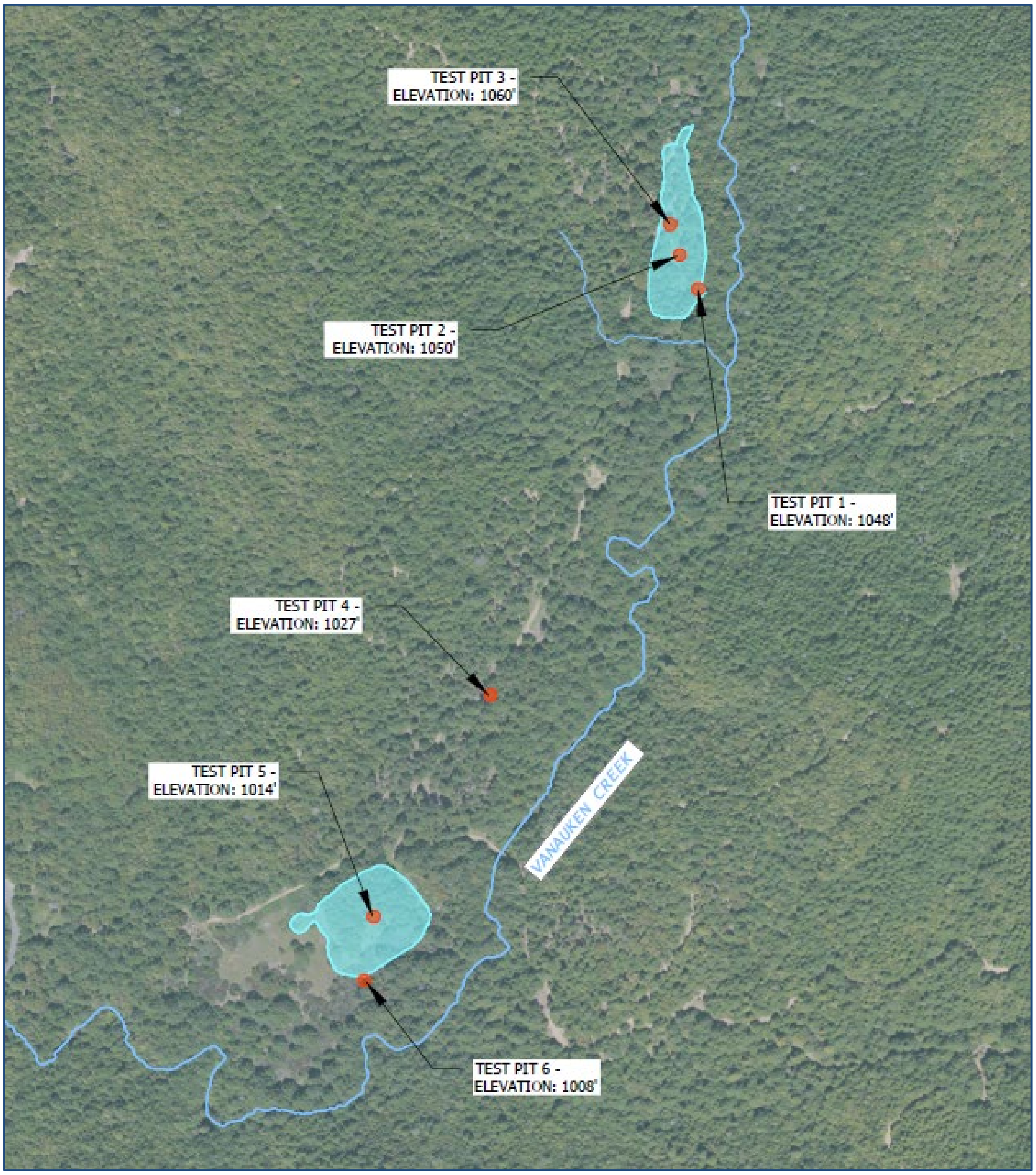

Figure 3. Test pit locations.

7 *IN-SITU* SOIL CONDITIONS

Soils exposed in the test pits were logged in general accordance with the Visual-Manual Procedures of ASTM D2488 and soil classifications following the Unified Soil Classification System (USCS). In general, the test pits exposed graded alluvial deposits overlying saprolite-mantled bedrock. Additional descriptions of each pit are provided below, and Appendix A provides the test pit logs. See Appendix B for the soils analysis lab results.

Test Pit #1
The soil profile at Test Pit #1 consists of silt topsoil and subsoil, with an increasing presence of fractured rock below 7 feet. The subsoil exhibits a shear strength of 0.75 tons per square foot (tsf)

by pocket Torvane and unconfined compressive strength of 2.75 tsf by pocket penetrometer (PP). Moisture content increases with depth, transitioning from dry to damp at 3 feet. The dry density is 109.5 pounds per cubic foot (pcf). Soil sample 24-882, taken at a depth of 7 feet, showed 59% passing the #200 sieve. The bottom of the pit was reached at 9 feet and consisted of fractured rock with a minor amount of clayey matrix. Groundwater was encountered at a depth of approximately 8.5 ft in this excavation.

Test Pit #2

Silt topsoil and subsoil are present at Test Pit #2, with the subsoil having a shear strength of 1.25 tsf by Torvane and unconfined compressive strength of 2.25 tsf by PP. Moisture content increases with depth, becoming damp at 6 feet. The dry density is 104.8 pcf. Soil sample 24-885, taken at a depth of 6 feet, showed 45% passing the #200 sieve. The bottom of the pit was reached at 15 feet and consisted of fractured sandstone and argillite bedrock with minor amounts of fine matrix containing strong brown sand and blue-gray silty clay. Groundwater was encountered at a depth of approximately 13.1 ft in the pit.

Test Pit #3

Test Pit #3 exposed silt topsoil and subsoil. The subsoil has a shear strength of 1.5 tsf by Torvane and unconfined compressive strength of 1.0 tsf by PP. Moisture content increases with depth, transitioning from dry to moist at 10 feet. Soil sample 24-887, taken at a depth of 10 feet, showed 49% passing the #200 sieve. The bottom of the pit was reached at a depth of 23 feet and consisted of fractured sandstone and argillite in a silty clayey matrix. Groundwater was encountered at a depth of approximately 22 feet.

Test Pit #4

Silt topsoil and subsoil are found at Test Pit #4, with the subsoil having a shear strength of 1.5 tsf by Torvane and unconfined compressive strength of 2.75 tsf by PP. Moisture content increases with depth, becoming moist at 11 feet. Soil sample 24-889, taken at a depth of 10 feet, showed 59% passing the #200 sieve. The bottom of the pit was reached at a depth of 16 feet and consisted of fractured siltstone and argillite in a clayey matrix. Groundwater was not encountered in this excavation.

Test Pit #5

Silt topsoil and subsoil are present at Test Pit #5, with the subsoil having a shear strength of 1.5 tsf by Torvane and unconfined compressive strength of 2.0 tsf by PP. Moisture content increases with depth, transitioning from dry to damp at 3 feet. The dry density is 104.1 pcf at a depth of 4 feet. The bottom of the pit was reached at a depth of 15 feet and consisted of fractured angular rock with abundant fine fragments and some clasts up to 8 inches. Groundwater was not encountered in this excavation.

Test Pit #6

Test Pit #6 exposes silt topsoil and silty clayey subsoil with low plasticity. The subsoil has a shear strength of 2.0 tsf by Torvane and 2.5 tsf by unconfined compressive strength of PP. Moisture content increases with depth, becoming moist at 3 feet. The dry density is 94.3 pcf at a depth of 4 feet. The bottom of the pit was reached at a depth of 17 feet and consisted of fractured rock in a silty clayey matrix. Groundwater was not encountered in this excavation.

Additional Test Pits
The two additional test pits at the West Pond exposed soils comparable to those in Test Pit #5 and Test Pit #6, indicating relatively uniform subsurface conditions across the West Pond area.

8 EXPANSIVE SOILS AND SETTLEMENT

The results of the geotechnical investigation indicate that soils at the Project site are predominantly graded alluvial deposits overlying saprolite-mantled bedrock. The particle size analyses show clay content is relatively low, ranging from approximately 4 to 8%. Based on this information, the potential for expansion and contraction of these soils is considered to be low.

Total settlement and differential settlement is expected to be in the range of several inches assuming that compaction standards described in this report are met. The earthen embankments with the proposed freeboard are intended to function as designed with this minor amount of anticipated settlement.

9 SLOPE STABILITY FEATURES AND CONDITIONS

The Vanauken Creek watershed is predominantly underlain by relatively stable bedrock with a low to moderate risk of landslides (Davenport et al. 2002). Neither Spittler (1984) nor Davenport et al. (2002) mapped landslides at or near the Project sites. No unstable features were observed downslope or upslope from the proposed grading locations. The potential for slope instability to affect the Project is considered minimal.

10 EXISTING FILLS

An existing spoils pile is located on the eastern boundary of the West Pond site and will be used on the outer edge of the West Pond embankment as non-structural fill to blend the embankment into existing topography. This pile contains approximately 4,500 cubic yards of material that was produced from a prior culvert replacement project supervised by Mr. Monschke.

The East Pond's western extent will be constructed adjacent to an existing private gravel road with fill material along its outboard edge. The proposed East Pond grading extent is set back from this fill with a bench running along the pond edge to stabilize the slope.

11 GROUNDWATER CONDITIONS

Groundwater was encountered in three of the six test pits during the geotechnical investigation. While excavating the test pits, we observed minor groundwater seepage through the side walls, resulting in moist soil. However, no groundwater flowed directly into the pits, which is atypical for the Mattole Headwaters. In contrast, at other terrace locations like Baker and Lost River, groundwater typically flows readily into trenches and test pits near the soil-bedrock contact or atop the blue clay layer when present. In Test Pit #1 groundwater was encountered at approximately 8.5 feet below ground surface (bgs); in Test Pit #2, it was encountered at approximately 13.1 feet bgs; and in Test Pit #3, it was encountered at approximately 22 feet bgs. Groundwater was not encountered in Test Pits #4, #5, or #6. Soil mottling was observed in some of the test pits, indicating that the site may be influenced by seasonally shallow groundwater. Periods of shallow groundwater less than approximately 5 feet bgs are likely very brief and should be expected to occur only occasionally in response to intervals of intense precipitation or very high flows in Vanauken Creek.

12 SURFACE DRAINAGE HAZARDS

There are several vegetated drainage swales running through the proposed pond footprints, but they were dry during site visits and show no sign of high-flow conveyance. The proposed ponds intend to capture this surface runoff during the wet season to fill. Runoff from existing upslope road prisms will also be directed into the ponds via small swales to increase wet-season filling of the ponds. Providing that the recommendations in this report are adhered to, surface drainage is not expected to pose a significant hazard to the proposed Project. The design should ensure that no erosion hazards are created by concentrating uncontrolled runoff on the property.

13 FLOODING

Hydraulic modeling of Vanauken Creek indicates that the FEMA flood inundation mapping is overly conservative. A site-specific HEC-RAS model of 100-year flood flow demonstrates that flows are fully contained within the channel. Peak velocities approach 15 ft/s in constricted reaches. The model predicts no flood impact to the proposed pond locations during a 100-year storm event.

14 SEISMIC HAZARDS

There are two primary areas of concern for evaluating seismic hazards for a site. These are (1) potential for ground rupture due to proximity to an active fault hazard zone, and (2) the anticipated magnitude and peak acceleration of the postulated seismic event. In response to the first area of concern, the project site lies approximately 3 miles from the nearest known active fault, so surface rupture is not likely. In response to the second area of concern, the Project site soils as described in Appendices A and B are primarily comprised of silt which is optimal for berm construction. Further, the grading plans specify a maximum slope of 3:1 (H:V) for all cut/fill slopes and 85% relative compaction for all new fill placement to promote slope stability during ground acceleration caused by a seismic event.

15 LIQUEFACTION HAZARD

Liquefaction is the loss of soil strength, resulting in fluid mobility through the soil. Liquefaction typically occurs when cohesionless, uniformly sized, loose, saturated sands or silts are subjected to repeated shaking in areas where the groundwater is typically less than 30 feet below ground surface. In addition to the necessary soil and groundwater conditions, the ground acceleration must be high enough and the duration of the shaking must be sufficient for liquefaction to occur. The results of the subsurface soil investigation indicate that the soils at the Project site are well graded alluvial deposits that are stiff or dense and commonly contain fractured rock. The potential for liquefaction to occur at the pond sites is very low.

16 DISCUSSION

Based on the field investigations, it is our opinion that the proposed Project will not contribute to, or be subject to, substantial geologic or soils engineering hazards, provided that the recommendations in this report are followed.

17 RECOMMENDATIONS

17.1 Grading Sequence

- All organic materials including wood, brush, and grass should be stripped from the site and moved offsite for processing.
- Topsoil should be stripped to a depth of approximately 6 inches and stockpiled.
- Grade benched keyways as shown on the plans.
- Where practicable, place stockpiled topsoil on top of disturbed soil to promote vegetation growth.

17.2 Cut and Fill Slopes

- Cut slopes should be limited to 3:1 (horizontal to vertical), unless otherwise justified by site-specific investigation.
- Fill slopes should be constructed at 3:1, unless otherwise justified by site-specific investigation.
- To limit the potential for erosion, bare soil in cut and fill slopes should be seeded and covered with straw.

17.3 Setbacks from Adjacent Slopes

- Footings or fills on or adjacent to sloped surfaces shall be founded in firm material with an embedment and/or set back from the sloped surface of a sufficient distance to provide vertical and lateral support for the footing or fill without detrimental settlement.
- Grading activities associated with this soils report include sufficient embedment in and/or setbacks from all slopes.
- For any new projects on the property, a typical setback is H/3, where H is the height of the slope.
- A licensed engineer or geologist should review any new grading or building projects to ensure that proposed setbacks and/or soil embedment are sufficient for the site-specific conditions where the new project will occur.

17.4 Structural Fills

- Structural fill should have no rocks greater than 4" diameter and be free of any organic material.
- Subgrade keyway benches under fill should be excavated to a suitable depth as shown on the plans and directed by the engineer.
- Fill material should be placed in loose lifts no more than 12 inches thick, at uniform moisture content at or near optimum, and compacted mechanically using a vibratory sheepsfoot compactor or other method approved by the engineer.
- Structural fills for pond embankments should be compacted, as specified in Compaction Standard below, to at least 85% relative compaction (RC).

17.5 Compaction Standard

- Materials processed in-place and utilized as compacted fill for the pond dike should be based on ASTM D-2922 *in-situ* measurement of dry unit weight. Maximum dry unit weight should be determined using ASTM Laboratory Test Method D-1557.

17.6 Settlement

- If the subgrade is prepared as recommended, and the fill is compacted as recommended, settlement is not expected to impact the project.

17.7 Grading and Drainage

- Grading should be conducted in such a manner to avoid concentrating runoff and to promote sheet flow drainage.

17.8 Seismic Design Criteria

Seismic Design Criteria are presented in the table below. Values were determined using the online SEAOC/OSHPD Seismic Design Maps Tool.

Table 1. Seismic design criteria (Reference: ASCE 7-16)

Latitude	40.05885°
Longitude	-123.94798°
Site Class	D-Default
S_S	1.533
S_1	0.829
F_a	1.2
F_v	1.7*
S_{MS}	1.839
S_{M1}	1.409*
S_{DS}	1.226
S_{D1}	0.940*
Risk Category	I
Seismic Design Category	E

* Where T ≤ 1.5*Ts. A ground motion hazard analysis may otherwise be required as per ASCE7-16 section 11.4.8.

Changes to the determination of certain seismic design criteria were made in the 2019 edition of the California Building Standards Code, effective January 1st, 2020, and are reflective of a change in reference from ASCE 7-10 to ASCE 7-16. Most significant to the scope of this report is an increase in the numerical value of F_v, the site amplification factor at 1 second, and a conditioning of this value with the restrictions set forth in ASCE7-16 section 11.4.8. Sites found to have soils of site class D or E and a mapped S_1 value equal to or exceeding 0.2 are now required to perform a ground motion hazard analysis in accordance with ASCE 7-16 Section 21.2, unless exempted by an exception listed in section 11.4.8.

As the project site soils are taken to be site class D (by default) and a mapped S_1 value greater than 0.2 was determined, those values shown with an asterisk in the above table were not provided by the SEAOC/OSHPD Seismic Design Maps Tool. The site's F_v value was taken from table 11.4-2 of ASCE 7-16 and the values of S_{m1} and S_{d1} were derived from it. These values are only valid under exception 2 to section 11.4.8, stating "Structures on Site Class D sites with S1 greater than or equal to 0.2, provided the value of the seismic response coefficient CS is determined by Eq. (12.8-2) for values of T <= 1.5*T_S and taken as equal to 1.5 times the value computed in accordance with either: Eq. (12.8-3) for 1.5T_S <= T <= T_L or Eq. (12.8-4) for T > T_L." It is therefore incumbent upon the designer of any building using the seismic design criteria values provided in this report to confirm that this exception is satisfied before proceeding.

17.9 Foundation Design Criteria

In accordance with Table 1806.2 of the 2024 California Building Code, the allowable foundation pressure (soil bearing capacity) for the soils prevalent on the property is 1.0 tsf. Allowable lateral bearing capacity is 150 psf/ft below natural grade. Allowable coefficient of friction for lateral sliding is 0.25.

This project consists of earthwork to construct two storage ponds, two water diversions, a flow augmentation system, and off grid-energy system, all of which are acceptable for the soil conditions on this property. If in the future, construction of new buildings is proposed on the property, they should consist of one or a combination of the following foundation types: slab-on-grade or perimeter spread footings. These types of foundations are acceptable for use on the property, provided that all foundation elements are founded on undisturbed native soils or compacted engineered fill as recommended in this report. All footings should, at minimum, comply with the 2019 California Building Code and it is recommended that a licensed engineer or geologist review any new grading or building project sites to ensure that the proposed foundation design and embedment is appropriate to minimize the risk of differential settlement that could be detrimental to the proposed structure.

18 REFERENCES

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Appendix A

Test Pit Logs

Stillwater Sciences

Test Pit Log

Project Name/#:	Vanauken Ponds (588.11 / 4000)	**Log #:**	TP1
Equipment:	CAT excavator - 4-ft bucket	**Date:**	8/20/2024
Datum:	Existing ground surface: 1048 ft NAVD88	**Page:**	1 of 1
Location:	East pond swale	**By:**	JB
		Checked:	DC

Laboratory Data

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	**Unified Soil Classification System (USCS)** symbol, texture, consistency, moisture, color
						0–1	**ML** - silt topsoil, soft, dry, dark brown. Becoming damp. Contains roots.
						1	
							UC by PP - 2.75 tsf Shear by Torvane - 0.75 tsf
						2	**SM** - silty sand, dense, moist, light grayish brown with redox mottling. Contains trace coarse sand and fine gravel clasts. Clasts are subrounded, highly weathered, and friable.
					Bulk	3	Roots continue down to ~3' BGS
			13.3	109.5	Bulk & Tube	4	
						5	
						6	**GC/GM** - saprolite, fractured siltstone and argillite clasts in silty clayey matrix, damp, dark brown matrix with some mottling, light gray clasts. Some rock clasts up to several inches.
		59			Bulk	7	Fractured rock content increases below 7' BGS. Becomes darker brown to black.
		6.2			Bulk	8	Becomes wet. ▽ Becomes dominantly fractured rock clasts with minor amount of clayey matrix.
						9	Bottom of pit in same at 9' BGS.
						10	

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Test Pit Log

Project Name/#:	Vanauken Ponds (588.11 / 4000)	**Log #:**	TP2
Equipment:	CAT excavator - 4-ft bucket	**Date:**	8/20/2024
Datum:	Existing ground surface: 1050 ft NAVD88	**Page:**	1 of 2
Location:	East pond middle	**By:**	JB
		Checked:	DC

Laboratory Data

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	Unified Soil Classification System (USCS) symbol, texture, consistency, moisture, color
						0–1.7	**ML** - silt topsoil, soft, dry, dark brown. Contains soil peds. Becoming damp. Contains roots.
						1.7–5.1	**ML** - silt subsoil, stiff to very stiff, dry, light brown with some redox mottling. UC by PP - 2.25 tsf Shear by Torvane - 1.25 tsf Roots continue down to ~3.1' BGS
			13.7	104.8	Bulk & Tube	~4.6	
						5.1–10	**GM** - silty sandy gravel, dense, damp, redox mottling with brown, reddish brown, and strong brown. Rock clasts are light gray, sub-angular, and friable.
		45			Bulk	~6	
					Bulk	10	

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Test Pit Log

Project Name/#: Vanauken Ponds (588.11 / 4000) **Log #:** TP2
Equipment: CAT excavator - 4-ft bucket **Datum:** Existing ground surface: 1050 ft NAVD88 **Date:** 8/20/2024
Location: East pond middle **Page:** 2 of 2
Laboratory Data **By:** JB **Checked:** DC

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	Unified Soil Classification System (USCS) symbol, texture, consistency, moisture, color
						11	
						12	**GC/GM** - saprolite, similar to above but becoming moist and increase in rock content. Rock is gray and some clasts up to several inches. ▽
						13	
					Bulk	14	**Bedrock** - fractured sandstone and argillite, friable, wet, very dark gray to black. Includes minor amounts of fine matrix containing strong brown sand and blue/gray silty clay.
						15	Bottom of pit in same at 15' BGS.
						16	
						17	
						18	
						19	
						20	

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Test Pit Log

Project Name/#: Vanauken Ponds (588.11 / 4000) **Log #:** TP3
Equipment: CAT excavator - 4-ft bucket **Datum:** Existing ground surface: 1060 ft NAVD88 **Date:** 8/20/2024
Location: East pond berm **Page:** 1 of 3
Laboratory Data **By:** JB **Checked:** DC

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	Unified Soil Classification System (USCS) symbol, texture, consistency, moisture, color
						0–1	**ML** - silt topsoil, soft, dry, dark brown. Contains roots.
						1–9	**ML** - silt with trace gravel, firm, dry, light brown and reddish brown. Fine gravel clasts are sub-angular and friable.
			13.4	93.6	Bulk & Tube	4	UC by PP - 1.0 tsf Shear by Torvane - 1.5 tsf Roots continue down to ~4' BGS
						~6.2	Rock clast size increase, some are coarse gravel.
						9–10	**SM/ML** - silty sand/sandy silt with some gravel clasts, stiff, moist, dark brown. Moisture produces minor cohesion and plasticity. Rock clasts are light brown, sandstone, and friable.
		49			Bulk	10	

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Test Pit Log

Project Name/#:	Vanauken Ponds (588.11 / 4000)	**Log #:**	TP3
Equipment:	CAT excavator - 4-ft bucket	**Date:**	8/20/2024
Location:	East pond berm	**Page:**	2 of 3
Datum:	Existing ground surface: 1060 ft NAVD88	**By:**	JB
		Checked:	DC

Laboratory Data

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	**Unified Soil Classification System (USCS)** symbol, texture, consistency, moisture, color
						11	Lenses of clay dominant with redox mottling and little to no rock clasts.
					Bulk	12	
						13	**ML** - silt with lenses of clayey silt, stiff, damp, redox mottling with gray, brown, and strong brown. Contains trace fine gravel clasts. Clasts are sandstone and siltstone, sub-angular, and friable. Clayey silt lenses have minor cohesion and plasticity.
						14	**CL** - silty clay, stiff, damp, dominantly blue-gray with some redox mottling. Chunks of rotten wood.
						15	
						16	
						17	
						18	
						19	
						20	

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Test Pit Log

Project Name/#: Vanauken Ponds (588.11 / 4000) **Log #:** TP3
Equipment: CAT excavator - 4-ft bucket **Datum:** Existing ground surface: 1060 ft NAVD88 **Date:** 8/20/2024
Location: East pond berm **Page:** 3 of 3
Laboratory Data **By:** JB **Checked:** DC

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	Unified Soil Classification System (USCS) symbol, texture, consistency, moisture, color
						21	**GC/GM** - saprolite, fractured sandstone and argillite in silty clayey matrix, moist, dark gray and blue.
					Bulk	22	▽
							Increase in rock fragments. Bedrock?
						23	Bottom of pit in same at 23' BGS.
						24	
						25	
						26	
						27	
						28	
						29	
						30	

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Test Pit Log

Project Name/#: Vanauken Ponds (588.11 / 4000) **Log #:** TP4
Equipment: CAT excavator - 4-ft bucket **Datum:** Existing ground surface: 1027 ft NAVD88 **Date:** 8/21/2024
Location: Infiltration location **Page:** 1 of 2
By: JB **Checked:** DC

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	Unified Soil Classification System (USCS) symbol, texture, consistency, moisture, color
						0–1	**ML** - silt topsoil, soft, dry, dark brown. Contains roots.
						1–5	**ML** - silt subsoil with trace fine angular gravels, stiff to very stiff, dry, brown. Roots continue down to ~2.0' BGS. UC by PP - 2.75 tsf Shear by Torvane - 1.5 tsf
					Bulk	4	
						5–10	**ML/GM** - similar to above but with more gravel and light brown.
		59			Bulk	10	*next page*

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Test Pit Log

Project Name/#:	Vanauken Ponds (588.11 / 4000)	**Log #:**	TP4
Equipment:	CAT excavator - 4-ft bucket	**Date:**	8/21/2024
Datum:	Existing ground surface: 1027 ft NAVD88	**Page:**	2 of 2
Location:	Infiltration location	**By:**	JB
		Checked:	DC

Laboratory Data

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	**Unified Soil Classification System (USCS)** symbol, texture, consistency, moisture, color
						-	
						-	
						-	**CL** - gravelly sandy clay, stiff, moist, dark brown. Low plasticity fines.
						-	Some rock clasts are coarse angular gravel.
						11	
						-	
						-	
						-	
						-	
						12	
						-	
						-	
						-	Some angular rock clasts up to several inches.
						-	
					Bulk	13	Dark brown and reddish brown.
						-	
						-	
						-	
						-	
						14	
						-	**GC/GM** - saprolite, fractured siltstone and argillite clasts in clayey
						-	matrix, moist, dark brown and strong brown matrix with some
						-	mottling, dark gray clasts. Some rock clasts up to several inches.
						-	
						15	
						-	
						-	Bedrock? Rock clasts are harder. Minor amounts of dark gray and
						-	strong brown clayey matrix.
						-	
						16	Bottom of pit in same at 16' BGS.
						-	
						-	
						-	
						-	
						17	
						-	
						-	
						-	
						-	
						18	
						-	
						-	
						-	
						-	
						19	
						-	
						-	
						-	
						-	
						20	

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Test Pit Log

Project Name/#: Vanauken Ponds (588.11 / 4000) **Log #:** TP5
Equipment: CAT excavator - 4-ft bucket **Datum:** Existing ground surface: 1014 ft NAVD88 **Date:** 8/21/2024
Location: West pond bottom **Page:** 1 of 2
Laboratory Data **By:** JB **Checked:** DC

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	Unified Soil Classification System (USCS) symbol, texture, consistency, moisture, color
						0–1	**ML** - silt topsoil, soft, dry, dark brown. Contains roots.
						1.5–2	**ML** - silt subsoil with trace fine angular gravels, stiff to very stiff, dry, brown. UC by PP - 2.0 tsf Shear by Torvane - 1.5 tsf
						3	Roots continue down to ~3.0' BGS
						3.6	Becoming damp
			16.7	104.1	Bulk & Tube	4	
						5	
						6	
						7	
						8	
						9	
						10	*next page*

Stillwater Sciences

Test Pit Log

Project Name/#:	Vanauken Ponds (588.11 / 4000)	**Log #:**	TP5
Equipment:	CAT excavator - 4-ft bucket	**Datum:** Existing ground surface: 1014 ft NAVD88	**Date:** 8/21/2024
Location:	West pond bottom	**Page:**	2 of 2
		By: JB	**Checked:** DC

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	Unified Soil Classification System (USCS) symbol, texture, consistency, moisture, color
						-	
						-	
						-	**ML-CL** - clayey silt/silty clay with sand and gravel, stiff, moist, dark gray and strong brown.
						-	
29	8	27.7			Bulk	11	Contains lenses with abundant angular sand. Sand and gravel clasts are fractured rock.
						-	
						-	
						-	
						-	
						12	
						-	
						-	
						-	
						-	**GC/GM** - saprolite, fractured angular rock with abundant fine fragments and some clasts up to 8", moist. Rock is sandstone and argillite, dark gray and blue, and friable. Some light brown and strong brown in matrix.
		36.4			Bulk	13	
						-	
						-	
						-	
						-	
						14	
						-	
						-	
						-	
						-	
						15	Bottom of pit in same at 15' BGS.
						-	
						-	
						-	
						-	
						16	
						-	
						-	
						-	
						-	
						17	
						-	
						-	
						-	
						-	
						18	
						-	
						-	
						-	
						-	
						19	
						-	
						-	
						-	
						-	
						20	

Stillwater Sciences

Test Pit Log

Project Name/#: Vanauken Ponds (588.11 / 4000) **Log #:** TP6
Equipment: CAT excavator - 4-ft bucket **Datum:** Existing ground surface: 1008 ft NAVD88 **Date:** 8/21/2024
Location: West pond berm **Page:** 1 of 2
By: JB **Checked:** DC

Laboratory Data							
LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	Unified Soil Classification System (USCS) symbol, texture, consistency, moisture, color
						0–1	**ML** - silt topsoil, soft, dry, dark brown. Contains roots. Roots continue down to ~1.7' BGS
						1.7–2.7	**ML-CL** - silty clayey subsoil, stiff to very stiff, moist, light brown with slight redox mottling. Low plasticity. UC by PP - 2.5 tsf Shear by Torvane - 2.0 tsf
25	7		14.0	94.3	Bulk & Tube	4	
		20.9			Bulk	7.2	**GM** - silty sandy gravel, dense, moist, brown, strong brown, and reddish brown. Abundant fine fractured rock.
					Bulk	9.2	**GM/GC** - similar to above but increase in larger angular rock clasts in minor amount of silty matrix.

Stillwater Sciences

Test Pit Log

Project Name/#:	Vanauken Ponds (588.11 / 4000)	**Log #:**	TP6
Equipment:	CAT excavator - 4-ft bucket	**Date:**	8/21/2024
Datum:	Existing ground surface: 1008 ft NAVD88	**Page:**	2 of 2
Location:	West pond berm	**By:**	JB
		Checked:	DC

Laboratory Data

LL (%)	PI (%)	% Passing #200 sieve	Water content (%)	Dry density (pcf)	Sample type	Depth (ft)	Unified Soil Classification System (USCS) symbol, texture, consistency, moisture, color
						11	
						12	
						13	
		19.8			Bulk	14	**GC** - saprolite, fracatured rock in silty clayey matrix, medium dense, wet, dark gray and blue rock fragments. Low plasticity fines. Rock clasts are argillite and well graded up to 6", friable. Some clasts have glossy luster.
						15	
						16	
						17	Increase is rock content. Bedrock? Bottom of pit in same at 17' BGS.
						18	
						19	
						20	

Appendix B

Soil Analysis Lab Results

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PERCENT PASSING # 200 SIEVE (ASTM - D1140)

Project Name:	Stillwater-Vanauken ponds	**Project Number:**	024158
Performed By:	JMA	**Date:**	9/4/2024
Checked By:	KEW	**Date:**	9/23/2024
Project Manager:	KEW		

Lab Sample Number	24-882	24-885	24-888	24-889	
Boring Label	TP1 - B2	TP2 - B2	TP3 - B2	TP4 -B2	
Sample Depth (ft)	7'	6'	10'	10'	
Pan Number	ss17	ss18	ss19	ss20	
Dry Weight of Soil & Pan	691.7	787.1	710.9	733.6	
Pan Weight	253.0	253.7	258.3	257.6	
Weight of Dry Soil	438.7	533.4	452.6	476.0	
Soil Weight Retained on #200&Pan	433.0	546.6	490.8	450.6	
Soil Weight Passing #200	258.7	240.5	220.1	283.0	
Percent Passing #200	**59**	**45**	**49**	**59**	

Lab Sample Number					
Boring Label					
Sample Depth					
Pan Number					
Dry Weight of Soil & Pan					
Pan Weight					
Weight of Dry Soil					
Soil Weight Retained on #200&Pan					
Soil Weight Passing #200					
Percent Passing #200					

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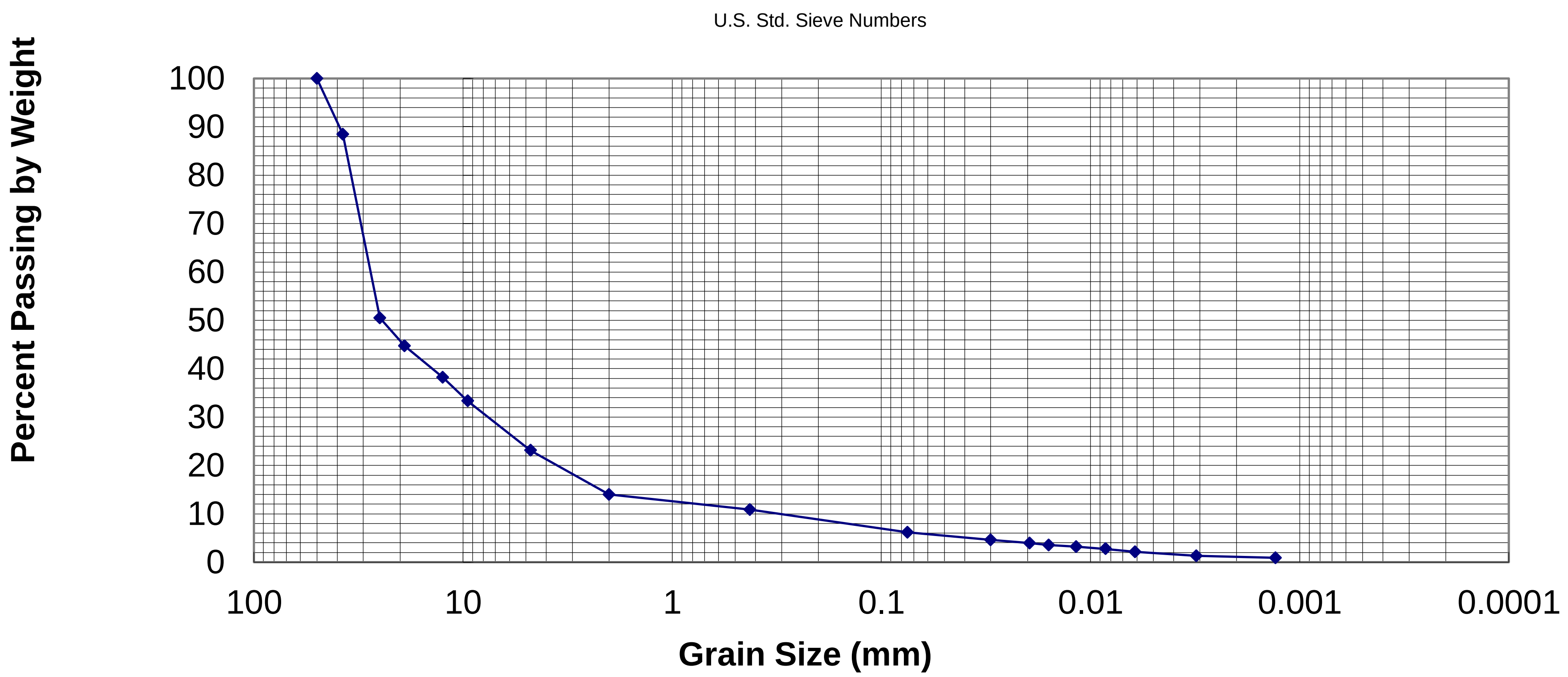
Project Name:	Stillwater-Vanauken PondS	Project Number:	024158
Boring ID:	SP1	Lab # :	24-880
Sample Depth:	8'	Checked By:	KEW
Sample Number:	SP1 @ 8'	Date :	10/15/24

SIEVE	2"	1.5"	1"	0.75"	0.5"	0.375"	#4	#10	#40	#200								
SIEVE SIZE (mm)	50	37.50	25	19.00	12.5	9.5	4.75	2.00	0.425	0.075	0.0300	0.0196	0.0158	0.0117	0.0084	0.0061	0.0031	0.0013
PERCENT PASSING	100.0	88.5	50.5	44.7	38.2	33.3	23.1	14.0	10.9	6.2	4.6	4.0	3.5	3.2	2.8	2.2	1.3	0.9

Gradation Test Results



GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		

% Gravel 76.9 % Sand 16.9 % Silt 4.2 % Clay 2.0

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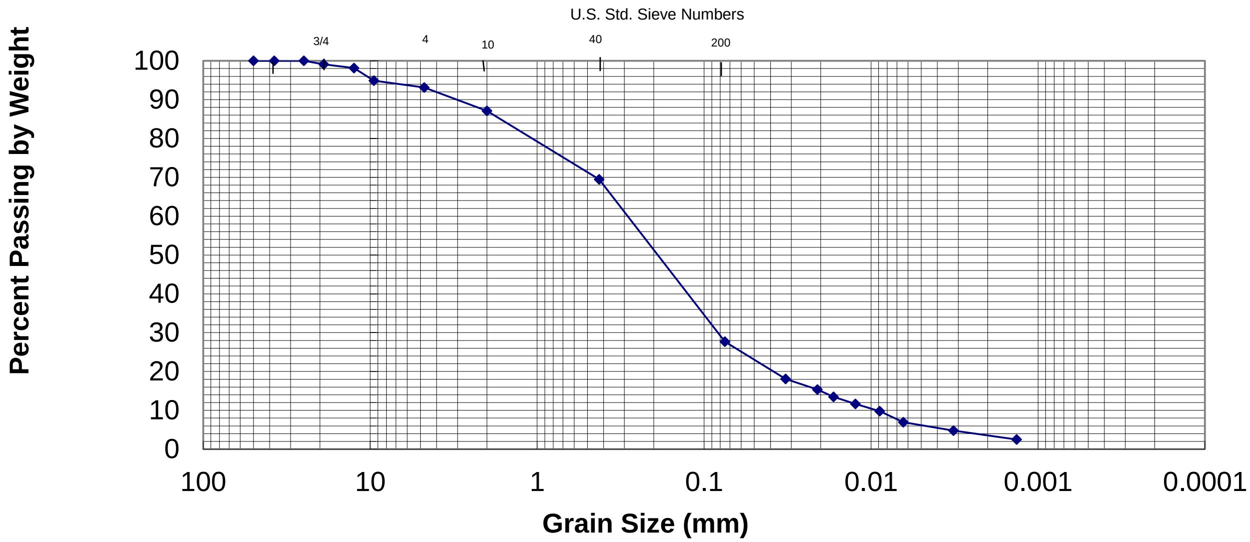
Project Name:	**Stillwater -Vanauken Ponds**	Project Number:	**024158**
Boring ID:	**TP5-B2 @ 11'**	Lab # :	**24-893**
Sample Depth:	**11'**	Checked By:	**KEW**
Sample Number:	**TP5-B2 @ 11'**	Date :	**9/23/24**

SIEVE	2"	1.5"	1"	0.75"	0.5"	0.375"	#4	#10	#40	#200								
SIEVE SIZE (mm)	50	37.50	25	19.00	12.5	9.5	4.75	2.00	0.425	0.075	0.0325	0.0210	0.0168	0.0124	0.0089	0.0064	0.0032	0.0013
PERCENT PASSING	100.0	100.0	100.0	99.1	98.1	94.9	93.2	87.1	69.5	27.7	18.1	15.3	13.5	11.6	9.8	6.9	4.8	2.5

Gradation Test Results



GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		

% Gravel 6.8 **% Sand** 65.5 **% Silt** 23.7 **% Clay** 4.0

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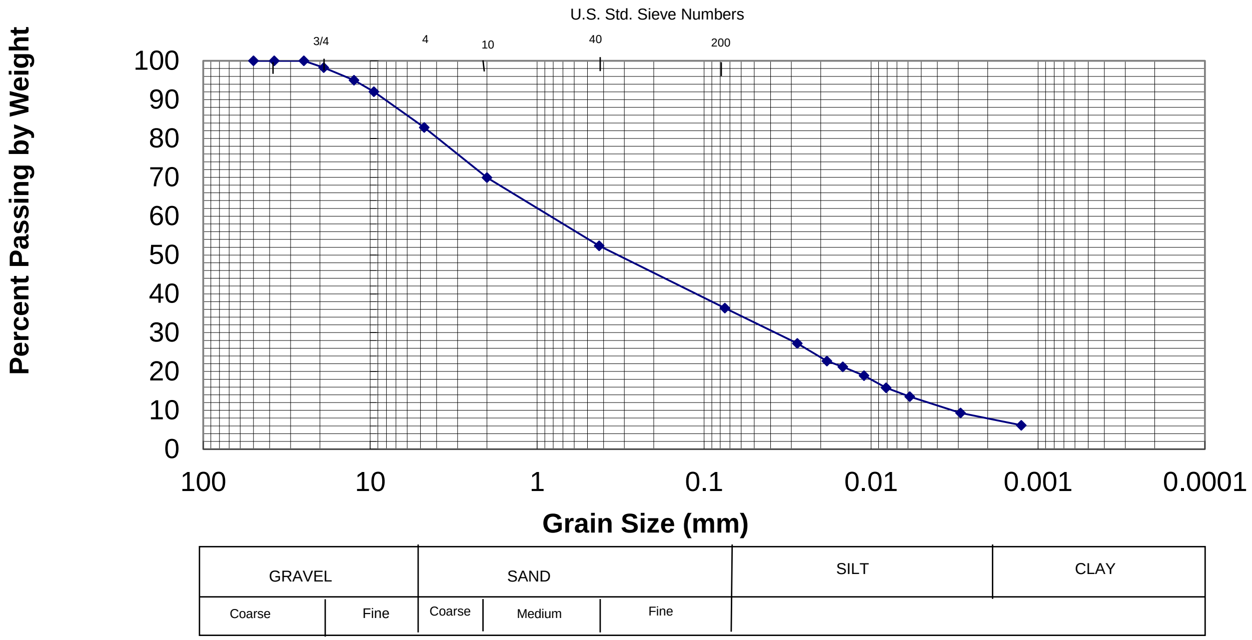
Project Name:	Stillwater-Vanauken Ponds	Project Number:	024158
Boring ID:	TP5-B3 @ 13'	Lab # :	24-894
Sample Depth:	13'	Checked By:	KEW
Sample Number:	TP5-B3 @ 13'	Date :	9/23/24

SIEVE	2"	1.5"	1"	0.75"	0.5"	0.375"	#4	#10	#40	#200								
SIEVE SIZE (mm)	50	37.50	25	19.00	12.5	9.5	4.75	2.00	0.425	0.075	0.0277	0.0184	0.0148	0.0110	0.0081	0.0059	0.0029	0.0013
PERCENT PASSING	100.0	100.0	100.0	98.3	95.0	92.0	82.8	69.9	52.4	36.4	27.2	22.7	21.2	18.9	15.8	13.5	9.3	6.2

Gradation Test Results



% Gravel 17.2 **% Sand** 46.5 **% Silt** 28.4 **% Clay** 8.0

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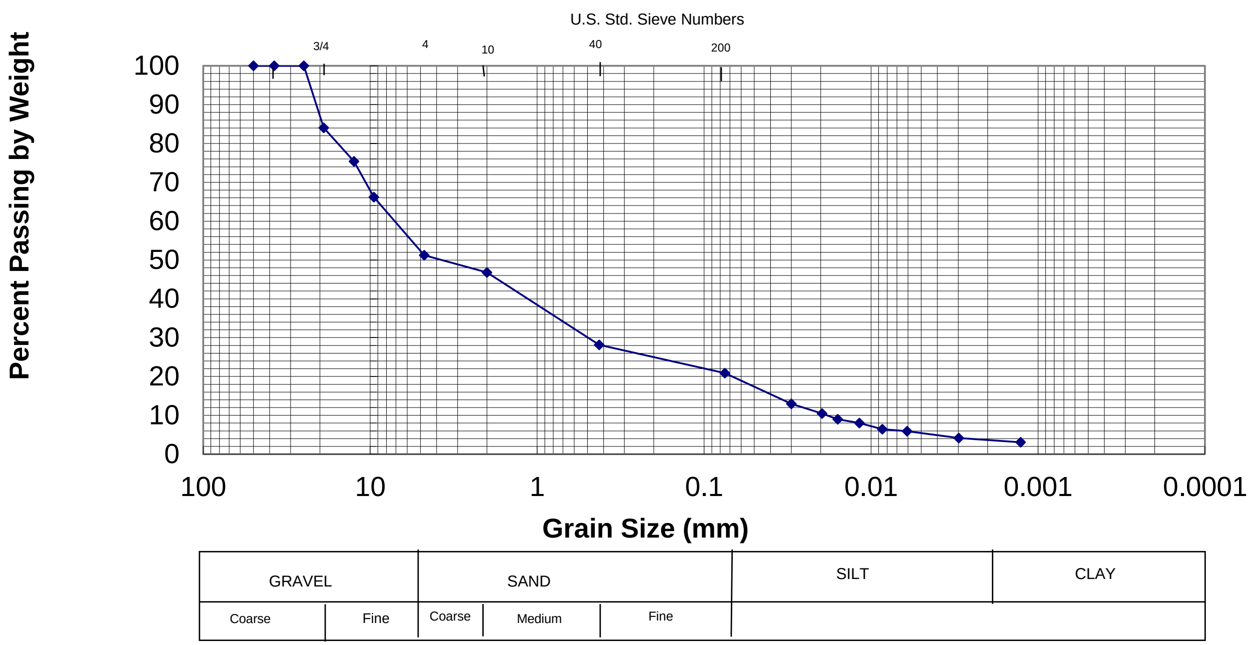
Project Name:	**Stillwater-Vanauken PondS**	Project Number:	**024158**
Boring ID:	**TP6-B2 @ 7'**	Lab # :	**24-898**
Sample Depth:	**7'**	Checked By:	**KEW**
Sample Number:	**TP6-B2 @ 7'**	Date :	**9/23/24**

SIEVE	2"	1.5"	1"	0.75"	0.5"	0.375"	#4	#10	#40	#200								
SIEVE SIZE (mm)	50	37.50	25	19.00	12.5	9.5	4.75	2.00	0.425	0.075	0.0300	0.0196	0.0159	0.0117	0.0086	0.0061	0.0030	0.0013
PERCENT PASSING	100.0	100.0	100.0	84.1	75.4	66.2	51.2	46.8	28.1	20.9	12.9	10.5	9.0	8.0	6.4	5.9	4.2	3.1

Gradation Test Results



% Gravel 48.8 **% Sand** 30.3 **% Silt** 16.9 **% Clay** 4.0

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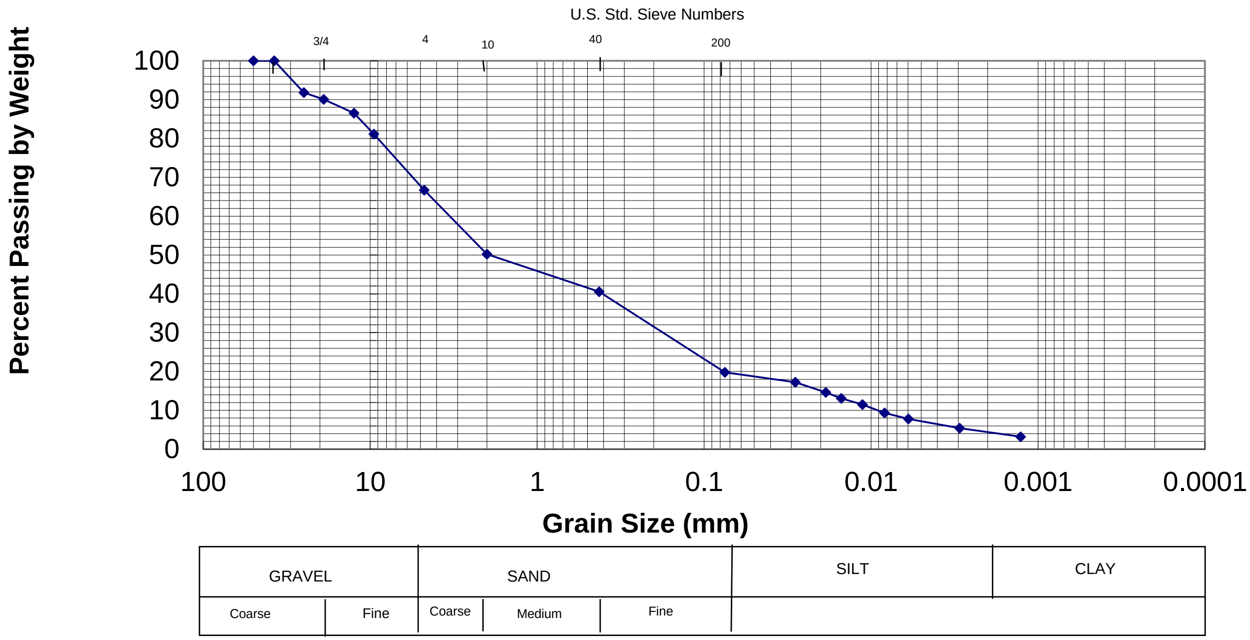
Project Name:	**Stillwater-Vanauken Ponds**	Project Number:	**024158**
Boring ID:	**TP6-B4 @ 13'**	Lab # :	**24-899**
Sample Depth:	**13'**	Checked By:	**KEW**
Sample Number:	**TP6-B4 @ 13'**	Date :	**9/23/24**

SIEVE	2"	1.5"	1"	0.75"	0.5"	0.375"	#4	#10	#40	#200								
SIEVE SIZE (mm)	50	37.50	25	19.00	12.5	9.5	4.75	2.00	0.425	0.075	0.0284	0.0187	0.0151	0.0113	0.0083	0.0060	0.0029	0.0013
PERCENT PASSING	100.0	100.0	91.8	90.1	86.6	81.2	66.7	50.2	40.6	19.8	17.2	14.6	13.1	11.5	9.3	7.8	5.4	3.2

Gradation Test Results



% Gravel 33.3 **% Sand** 46.9 **% Silt** 15.3 **% Clay** 4.5

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DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

Project Name:	**Stillwater -Vanauken Ponds**	**Project Number:**	**024158**
Performed By:	**SC**	**Date:**	**8/4/2024**
Checked By:	**KEW**	**Date:**	**9/23/2024**
Project Manager:	**KEW**		

Lab Sample Number	24-881	24-883	24-887	24-891	24-896
Boring Label	TP1 - C1	TP2 - C1	TP3 - C1	TP5 - C1	TP6 - C1
Sample Depth (ft)	4'	4.5'	4'	4'	4'
Diameter of Cylinder, in	2.38	2.38	2.38	2.38	2.38
Total Length of Cylinder, in.	6.10	6.00	6.00	5.90	7.87
Length of Empty Cylinder A, in.	0.00	0.00	0.00	0.00	0.00
Length of Empty Cylinder B, in.	1.52	1.83	1.85	1.66	2.65
Length of Cylinder Filled, in	4.58	4.17	4.15	4.24	5.22
Volume of Sample, in^3	20.38	18.55	18.46	18.86	23.22
Volume of Sample, cc.	333.89	304.00	302.55	309.11	380.55

Pan #	ss11	ss8	ss1	ss3	ss2
Weight of Wet Soil and Pan	855.9	772.9	709.0	798.7	848.5
Weight of Dry Soil and Pan	777.9	703.1	648.1	712.4	768.2
Weight of Water	78.0	69.8	60.9	86.3	80.3
Weight of Pan	192.5	192.8	194.7	197.1	193.3
Weight of Dry Soil	585.4	510.3	453.4	515.3	574.9
Percent Moisture	**13.3**	**13.7**	**13.4**	**16.7**	**14.0**
Dry Density, g/cc	1.75	1.68	1.50	1.67	1.51
Dry Density, lb/ft^3	**109.5**	**104.8**	**93.6**	**104.1**	**94.3**

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COMPACTION TEST DATA SHEET

Job Name:	**Stillwater-Vanauken Ponds**	Lab Sample Number:	**24-884**		
Job Number:	**024158**	Tested By:	**AB**	Date Tested:	**8/29/24**
Sample ID:	**TP2-A2 @ 6"**	Checked By:	**KW**	Date Checked:	**9/23/24**
Sample Description:	**Reddish Brown SILT with Gravel**				
Initial Gradation:	+ 3/4"= **4.8** %	+ 3/8"= **13.7** %	+ No.4= **26.3** %		
Moisture Correction	Gauge Number:	Correction Factor:			

TEST DATA

Mold + Wet Soil, lb	13.374	13.610	13.740	13.784	13.687
Mold, lbs	9.225	9.225	9.225	9.225	9.225
Moist Soil, lbs	4.149	4.385	4.515	4.559	4.462
Factor (1/Vol.), cu. ft	30.00	30.00	30.00	30.00	30.00
WET DENSITY, pcf	124.5	131.5	135.4	136.8	133.9
Drying Dish No.	s26	s22	ss24	ss22	ss23
Wet Soil and Dish*	741.2	887.0	864.5	918.0	932.7
Dry Soil and Dish	706.3	828.2	809.6	850.3	852.8
Moisture, g.	34.9	58.8	54.9	67.7	79.9
DIsh, grams	163.7	148.7	308.6	314.4	312.0
Dry Soil, g.	542.6	679.5	501.0	535.9	540.8
MST. CONTENT, %	**6.4**	**8.7**	**11.0**	**12.6**	**14.8**
DRY DENSITY, pcf	**116.9**	**121.1**	**122.1**	**121.4**	**116.6**
% Moist. Added	4	6	8	10	12

TEST METHOD

[ ] STANDARD ASTM D 698

5.5 lb hammer, 12" drop, 3 layers

[x] MODIFIED ASTM D 1557

10 lb hammer, 18" drop, 5 layers

[x] Manual hammer [ ] Mechanical hammer

ASTM	Soil	Mold, in.	Blows	Mold Wt.
B	GM	4	25	9.225

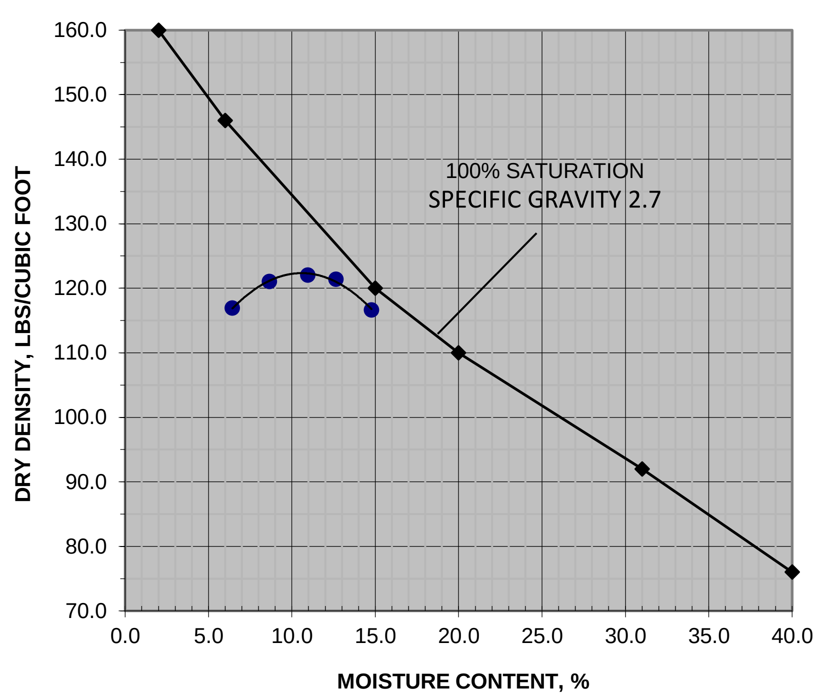
ASTM	*Moisture Sample	Grading	Mold Size/Material
A	100 g	Retained on No.4 ≤ 25%	4" Mold use passing No.4
B	500 g	No.4 ≥ 25% & 3/8" <25%	4" Mold use passing 3/8"
C	2500 g	3/8" ≥25% & 3/4" ≤30%	6" Mold use passing 3/4"

MAXIMUM DRY DENSITY (pcf)	**122.1**	**125.4** Rock Corr.
OPTIMUM MOISTURE CONTENT (%)	**11.0**	

INITIAL GRADATION

Total Weight (gm)	19828

Screen size	Wt. Screen	Wt. Cumulat
+ 3/4" screen	945	945
+ 3/8" screen	1778	2723
+ No.4 screen	2494	5217



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COMPACTION TEST DATA SHEET

Job Name:	**Stillwater-Vanauken Pond**	Lab Sample Number:	**24-886**
Job Number:	**024158**	Tested By: **AB**	Date Tested: **8/29/24**
Sample ID:	**TP3-A1 @ 4'**	Checked By: **KEW**	Date Checked: **9/23/24**
Sample Description:	**Reddish Brown SILT with Gravel**		
Initial Gradation:	+ 3/4"= **0.9** %	+ 3/8"= **7.2** %	+ No.4= **16.0** %
Moisture Correction	Gauge Number:	Correction Factor:	

TEST DATA

Mold + Wet Soil, lb	13.420	13.621	13.736	13.620	
Mold, lbs	9.226	9.226	9.226	9.226	
Moist Soil, lbs	4.194	4.395	4.510	4.394	
Factor (1/Vol.), cu. ft	30.00	30.00	30.00	30.00	
WET DENSITY, pcf	125.8	131.8	135.3	131.8	
Drying Dish No.	s20	s19	s18	s25	
Wet Soil and Dish*	394.5	402.5	382.0	316.2	
Dry Soil and Dish	380.4	385.6	363.7	294.0	
Moisture, g.	14.1	16.9	18.3	22.2	
DIsh, grams	222.0	226.5	222.2	144.5	
Dry Soil, g.	158.4	159.1	141.5	149.5	
MST. CONTENT, %	**8.9**	**10.6**	**12.9**	**14.8**	
DRY DENSITY, pcf	**115.5**	**119.2**	**119.8**	**114.8**	
% Moist. Added	6	8	10	12	

TEST METHOD

[ ] STANDARD ASTM D 698

5.5 lb hammer, 12" drop, 3 layers

[x] MODIFIED ASTM D 1557

10 lb hammer, 18" drop, 5 layers

[x] Manual hammer [ ] Mechanical hammer

ASTM	Soil	Mold, in.	Blows	Mold Wt.
A	GM	4	25	9.226

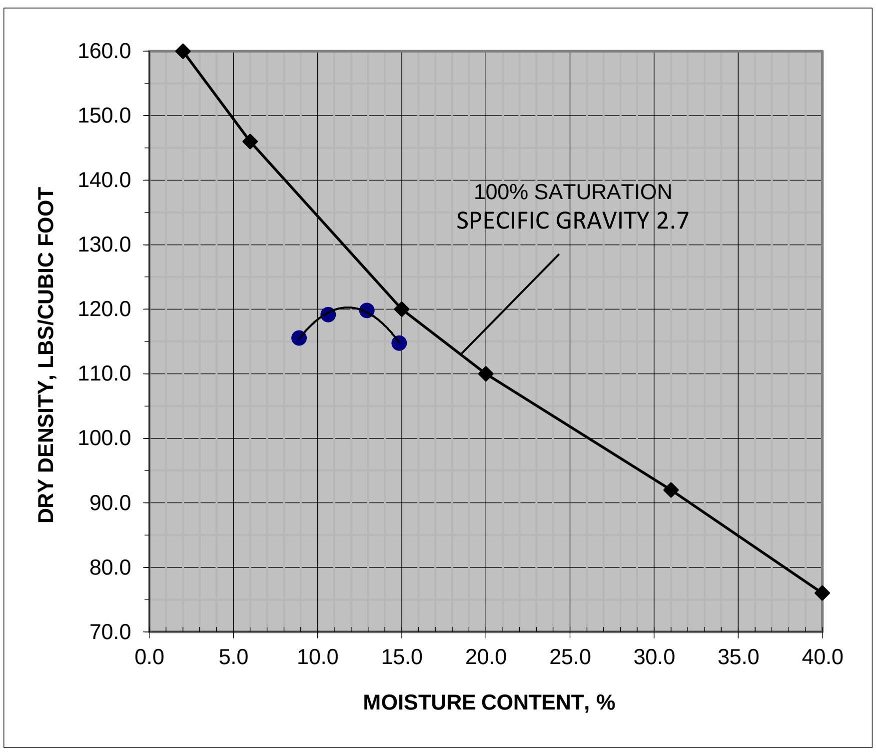
ASTM	*Moisture Sample	Grading	Mold Size/Material
A	100 g	Retained on No.4 ≤ 25%	4" Mold use passing No.4
B	500 g	No.4 ≥ 25% & 3/8" <25%	4" Mold use passing 3/8"
C	2500 g	3/8" ≥25% & 3/4" ≤30%	6" Mold use passing 3/4"

MAXIMUM DRY DENSITY (pcf)	**119.8**	**123.6** Rock Corr.
OPTIMUM MOISTURE CONTENT (%)	**12.9**	

INITIAL GRADATION

Total Weight (gm)	18552

Screen size	Wt. Screen	Wt. Cumulat
+ 3/4" screen	162	162
+ 3/8" screen	1174	1336
+ No.4 screen	1629	2965



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COMPACTION TEST DATA SHEET

Job Name:	**Stillwater (Vanauken Ponds)**	Lab Sample Number:	**24-890**		
Job Number:	**024158**	Tested By:	**ZA**	Date Tested:	**9/7/24**
Sample ID:	**TP5-A1 @ 4'**	Checked By:	**KW**	Date Checked:	**9/23/24**
Sample Description:	**SILT**				
Initial Gradation:	+ 3/4"= **0.0** %	+ 3/8"= **0.0** %	+ No.4= **0.1** %		
Moisture Correction	Gauge Number:	Correction Factor:			

TEST DATA

Mold + Wet Soil, lb	13.214	13.418	13.548	13.672	13.615
Mold, lbs	9.225	9.225	9.225	9.225	9.225
Moist Soil, lbs	3.989	4.193	4.323	4.447	4.390
Factor (1/Vol.), cu. ft	30.00	30.00	30.00	30.00	30.00
WET DENSITY, pcf	119.7	125.8	129.7	133.4	131.7
Drying Dish No.	t5	t4	t9	t1	t3
Wet Soil and Dish*	617.3	584.0	534.0	562.5	669.0
Dry Soil and Dish	578.1	539.9	487.2	505.6	589.4
Moisture, g.	39.2	44.1	46.8	56.9	79.6
DIsh, grams	114.0	111.9	113.6	114.2	114.8
Dry Soil, g.	464.1	428.0	373.6	391.4	474.6
MST. CONTENT, %	**8.4**	**10.3**	**12.5**	**14.5**	**16.8**
DRY DENSITY, pcf	**110.3**	**114.0**	**115.2**	**116.5**	**112.8**
% Moist. Added	6	8	10	12	*

TEST METHOD

[ ] STANDARD ASTM D 698

5.5 lb hammer, 12" drop, 3 layers

x MODIFIED ASTM D 1557

10 lb hammer, 18" drop, 5 layers

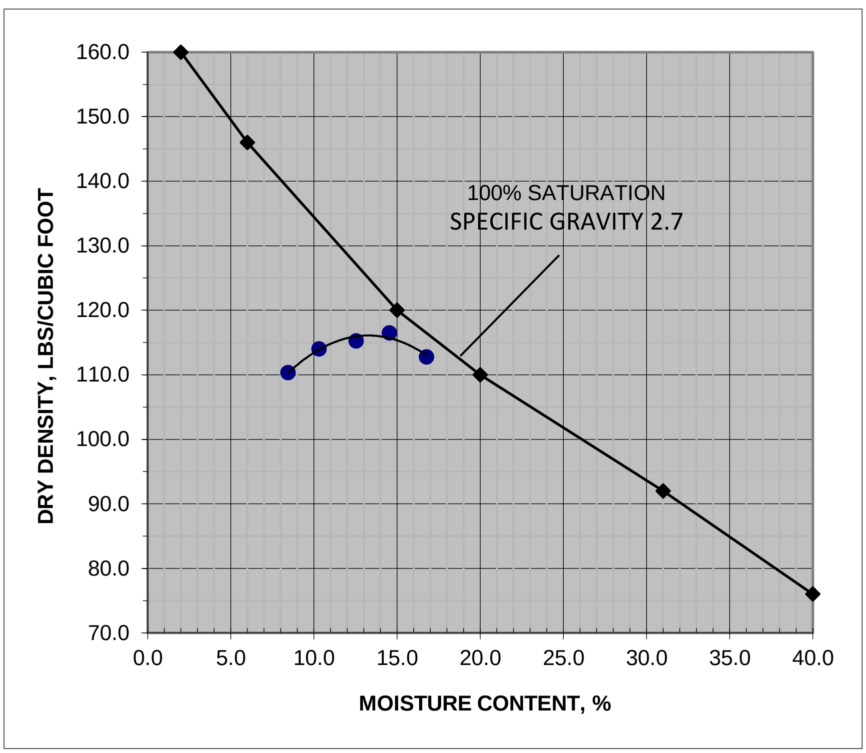
X Manual hammer [ ] Mechanical hammer

ASTM	Soil	Mold, in.	Blows	Mold Wt.
A	ML	4	25	9.225

ASTM	*Moisture Sample	Grading	Mold Size/Material
A	100 g	Retained on No.4 ≤ 25%	4" Mold use passing No.4
B	500 g	No.4 ≥ 25% & 3/8" <25%	4" Mold use passing 3/8"
C	2500 g	3/8" ≥25% & 3/4" ≤30%	6" Mold use passing 3/4"

***Free water on base plate**

MAXIMUM DRY DENSITY (pcf)	**116.5**	
OPTIMUM MOISTURE CONTENT (%)	**14.5**	Rock Corr.



INITIAL GRADATION

Total Weight (gm)	18809

Screen size	Wt. Screen	Wt. Cumulat
+ 3/4" screen	0	0
+ 3/8" screen	4	4
+ No.4 screen	19	23

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COMPACTION TEST DATA SHEET

Job Name:	**Stillwater-Vanauken Ponds**	Lab Sample Number:	**24-897**		
Job Number:	**024158**	Tested By:	**ZA**	Date Tested:	**9/7/24**
Sample ID:	**TP6-A2 @ 7'**	Checked By:	**KEW**	Date Checked:	**9/23/24**
Sample Description:	**Gravelly SILT**				
Initial Gradation:	+ 3/4"= **3.9** %	+ 3/8"= **13.8** %	+ No.4= **25.7** %		
Moisture Correction	Gauge Number:	Correction Factor:			

TEST DATA

Mold + Wet Soil, lb	13.444	13.601	13.788	13.773	
Mold, lbs	9.225	9.225	9.225	9.225	
Moist Soil, lbs	4.219	4.376	4.563	4.548	
Factor (1/Vol.), cu. ft	30.00	30.00	30.00	30.00	
WET DENSITY, pcf	126.6	131.3	136.9	136.4	
Drying Dish No.	T8	t12	t11	t2	
Wet Soil and Dish*	587.6	627.5	598.3	719.2	
Dry Soil and Dish	550.9	578.0	543.9	641.9	
Moisture, g.	36.7	49.5	54.4	77.3	
DIsh, grams	115.3	112.8	113.2	112.4	
Dry Soil, g.	435.6	465.2	430.7	529.5	
MST. CONTENT, %	**8.4**	**10.6**	**12.6**	**14.6**	
DRY DENSITY, pcf	**116.7**	**118.6**	**121.5**	**119.1**	
% Moist. Added	6	8	10	*	

TEST METHOD

[ ] STANDARD ASTM D 698

5.5 lb hammer, 12" drop, 3 layers

x MODIFIED ASTM D 1557

10 lb hammer, 18" drop, 5 layers

x Manual hammer [ ] Mechanical hammer

ASTM	Soil	Mold, in.	Blows	Mold Wt.
B	ML	4	25	9.225

ASTM	*Moisture Sample	Grading	Mold Size/Material
A	100 g	Retained on No.4 ≤ 25%	4" Mold use passing No.4
B	500 g	No.4 ≥ 25% & 3/8" <25%	4" Mold use passing 3/8"
C	2500 g	3/8" ≥25% & 3/4" ≤30%	6" Mold use passing 3/4"

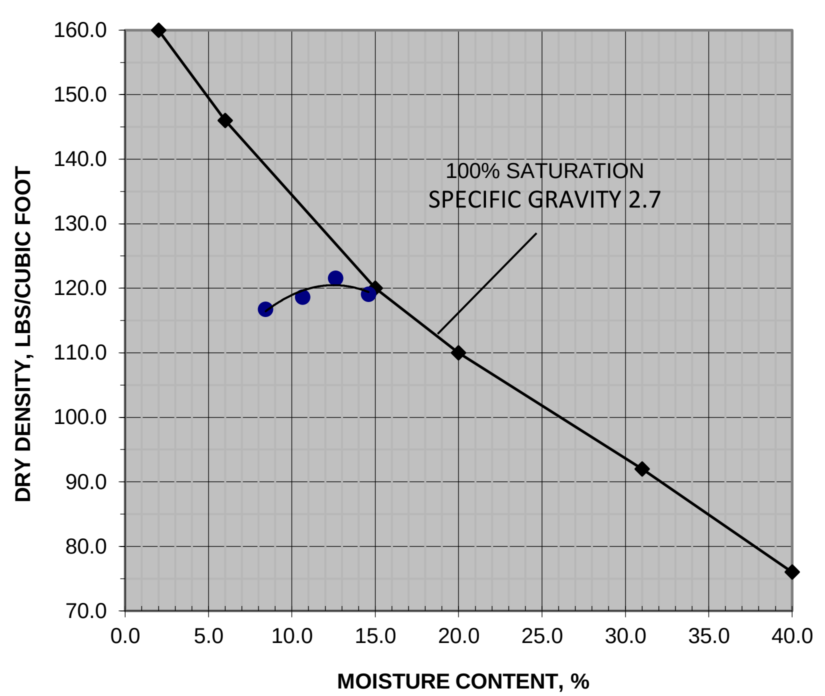
***Free water on base plate**

MAXIMUM DRY DENSITY (pcf)	**121.5**	**126.3** Rock Corr.
OPTIMUM MOISTURE CONTENT (%)	**12.6**	

INITIAL GRADATION

Total Weight (gm)	17616

Screen size	Wt. Screen	Wt. Cumulat
+ 3/4" screen	683.1	683
+ 3/8" screen	1741	2424
+ No.4 screen	2111	4535



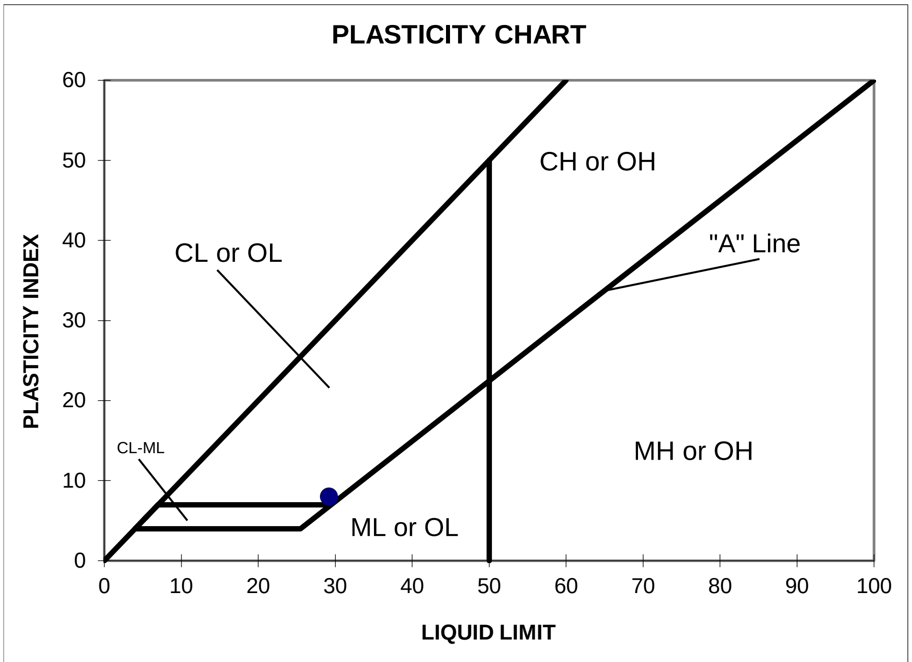
Phone: (707) 441-8855 Email: info@shn-engr.com Web: shn-engr.com
812 W. Wabash Avenue, Eureka, CA 95501-2138

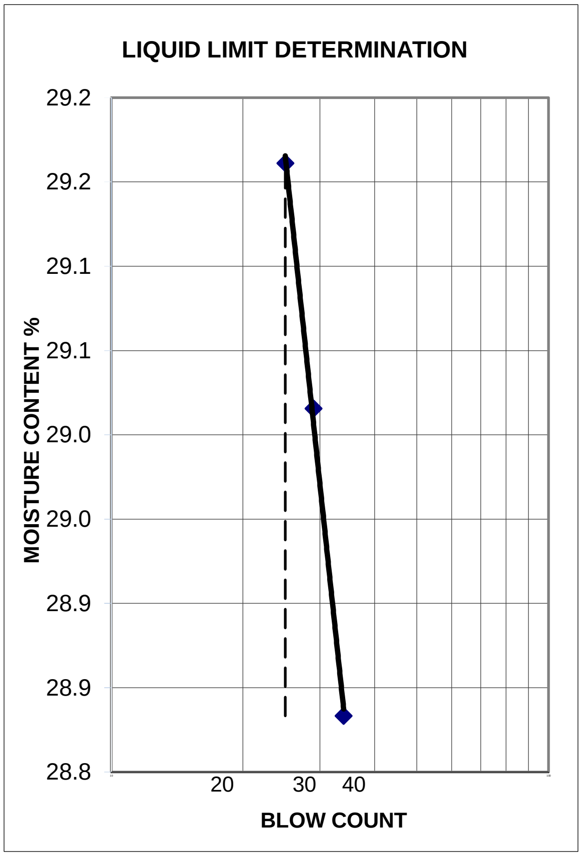
LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM D4318)

PROJECT NAME:	**Stillwater**	PROJECT NUMBER:	**024158**	LAB SAMPLE ID:	**24-892**
SAMPLE ID:	**TP5-A2 at 11'**	PERFORMED BY:	**SC**	DATE:	**9/5/24**
PROJECT MANAGER:	**JM**	CHECKED BY:	**KW**	DATE:	**9/23/24**

LINE NO.		TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 3
A	PAN #	17	18	7	8	9
B	PAN WT. (g)	20.21	20.13	28.83	29.02	28.55
C	WT. WET SOIL & PAN (g)	27.29	27.24	36.56	38.98	38.25
D	WT. DRY SOIL & PAN (g)	26.06	25.99	34.83	36.74	36.06
E	WT. WATER (C-D)	1.23	1.25	1.730	2.24	2.19
F	WT. DRY SOIL (D-B)	5.85	5.86	6.00	7.72	7.51
G	BLOW COUNT	--	--	34	29	25
H	MOISTURE CONTENT (E/F*100)	21.0	21.3	28.8	29.0	29.2

LIQUID LIMIT	**PLASTIC INDEX**	PLASTIC LIMIT
29	**8**	21





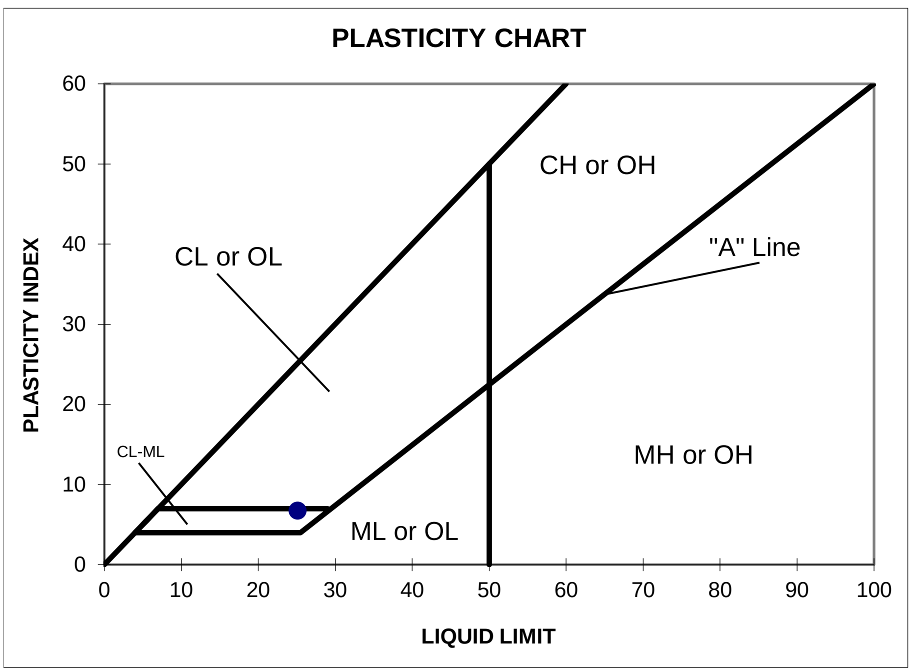
Phone: (707) 441-8855 Email: info@shn-engr.com Web: shn-engr.com
812 W. Wabash Avenue, Eureka, CA 95501-2138

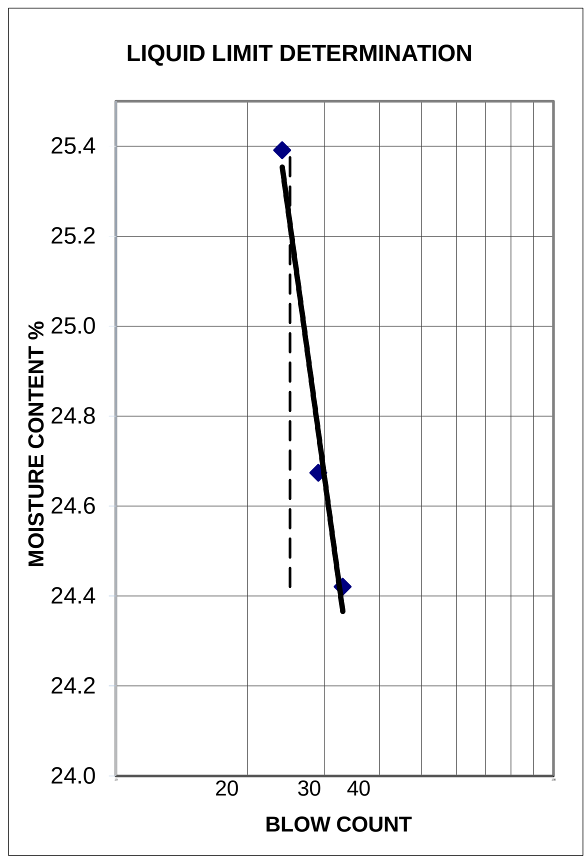
LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM D4318)

PROJECT NAME:	**Stillwater**	PROJECT NUMBER:	**024158**	LAB SAMPLE ID:	**24-895**
SAMPLE ID:	**TP6-A1 at 4'**	PERFORMED BY:	**SC**	DATE:	**9/10/24**
PROJECT MANAGER:	**JM**	CHECKED BY:	**KW**	DATE:	**9/23/24**

LINE NO.		TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 3
A	PAN #	15	16	4	5	6
B	PAN WT. (g)	21.11	20.32	29.20	28.77	29.53
C	WT. WET SOIL & PAN (g)	28.36	27.63	43.16	41.20	39.95
D	WT. DRY SOIL & PAN (g)	27.24	26.49	40.42	38.74	37.84
E	WT. WATER (C-D)	1.12	1.14	2.740	2.46	2.11
F	WT. DRY SOIL (D-B)	6.13	6.17	11.22	9.97	8.31
G	BLOW COUNT	--	--	33	29	24
H	MOISTURE CONTENT (E/F*100)	18.3	18.5	24.4	24.7	25.4

LIQUID LIMIT	**PLASTIC INDEX**	PLASTIC LIMIT
25	**7**	18





Mattole Headwaters Drought Relief Project- Vanauken Ponds

MND Attachment B

Project Emissions Background Documentation

(CalEEMod)

Marshall Ranch Flow Enhancement

Humboldt County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Recreational Swimming Pool	140.00	1000sqft	3.21	140,000.00	0

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	103
Climate Zone	1			**Operational Year**	2022
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	641.35	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - This project does not fit the pre-defined land use types or subtypes so the nearest possible landuse was selected - recreational swimming pool.

Grading -

Construction Phase - Modified construction start time so all work will occur in one year. Modified proportion of grading vs proportion of building to better align with this project type. Overlapped grading and building phases to match reality of likely construction sequencing. Minimized days of paving and architectural coating because this project only involves a minor amount of those tasks.

Off-road Equipment - Modifed equipment to match equipment that will be used for this project.

Off-road Equipment - Modified equipment based on what will be used for this project.

Off-road Equipment - Modifed equipment to match equipment that will be used for this project.

Off-road Equipment - Modifed equipment to match equipment that will be used for this project.

Off-road Equipment -

Off-road Equipment -

Stationary Sources - Emergency Generators and Fire Pumps - For this analyses, diesel fire pump substituted for electric pump with similar horsepower; Assumes pump runs 30 days/year.

Road Dust -

Water And Wastewater - Energy used for pumping and cooling water entered seperately.

Solid Waste - Project will generate minimal solid waste.

Stationary Sources - User Defined -

Stationary Sources - Process Boilers - For this analyses, diesel boiler substituted for electric water chiller with similar energy usage; Assumes that it runs 7 days/year.

Land Use Change -

Energy Mitigation -

Vehicle Trips - There is no actual recreation at this pool.

Table Name	Column Name	Default Value	New Value
tblConstructionPhase	NumDays	8.00	181.00
tblConstructionPhase	NumDays	230.00	67.00
tblConstructionPhase	NumDays	18.00	1.00
tblConstructionPhase	NumDays	18.00	1.00

tblConstructionPhase	PhaseEndDate	2/16/2021	10/15/2021
tblConstructionPhase	PhaseEndDate	1/4/2022	10/15/2021
tblConstructionPhase	PhaseEndDate	1/28/2022	10/16/2021
tblConstructionPhase	PhaseEndDate	2/23/2022	10/18/2021
tblConstructionPhase	PhaseStartDate	2/17/2021	7/15/2021
tblConstructionPhase	PhaseStartDate	1/5/2022	10/15/2021
tblConstructionPhase	PhaseStartDate	1/29/2022	10/17/2021
tblGrading	AcresOfGrading	90.50	4.00
tblGrading	AcresOfGrading	7.50	0.00
tblOffRoadEquipment	HorsePower	84.00	81.00
tblOffRoadEquipment	HorsePower	212.00	247.00
tblOffRoadEquipment	HorsePower	212.00	247.00
tblOffRoadEquipment	HorsePower	158.00	97.00
tblOffRoadEquipment	LoadFactor	0.74	0.73
tblOffRoadEquipment	LoadFactor	0.43	0.40
tblOffRoadEquipment	LoadFactor	0.43	0.40
tblOffRoadEquipment	LoadFactor	0.38	0.37
tblOffRoadEquipment	LoadFactor	0.50	0.50
tblOffRoadEquipment	OffRoadEquipmentType	Concrete/Industrial Saws	Generator Sets
tblOffRoadEquipment	OffRoadEquipmentType	Rubber Tired Dozers	Crawler Tractors
tblOffRoadEquipment	OffRoadEquipmentType	Rubber Tired Dozers	Crawler Tractors
tblOffRoadEquipment	OffRoadEquipmentType	Tractors/Loaders/Backhoes	Excavators
tblOffRoadEquipment	OffRoadEquipmentType		Off-Highway Trucks
tblOffRoadEquipment	OffRoadEquipmentType		Bore/Drill Rigs
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural
tblSolidWaste	LandfillCaptureGasFlare	94.00	0.00
tblSolidWaste	LandfillNoGasCapture	6.00	0.00

tblSolidWaste	SolidWasteGenerationRate	798.00	1.00
tblStationaryBoilersUse	AnnualHeatInput	0.00	24.02
tblStationaryBoilersUse	BoilerRatingValue	0.00	1.43
tblStationaryBoilersUse	DailyHeatInput	0.00	0.07
tblStationaryBoilersUse	NumberOfEquipment	0.00	1.00
tblStationaryGeneratorsPumpsEF	CH4_EF	0.07	0.07
tblStationaryGeneratorsPumpsEF	ROG_EF	2.2480e-003	2.2477e-003
tblStationaryGeneratorsPumpsUse	HorsePowerValue	0.00	7.50
tblStationaryGeneratorsPumpsUse	HoursPerDay	0.00	2.00
tblStationaryGeneratorsPumpsUse	HoursPerYear	0.00	720.00
tblStationaryGeneratorsPumpsUse	NumberOfEquipment	0.00	1.00
tblTripsAndVMT	HaulingTripNumber	0.00	625.00
tblTripsAndVMT	WorkerTripNumber	23.00	15.00
tblTripsAndVMT	WorkerTripNumber	35.00	18.00
tblVehicleTrips	ST_TR	9.10	0.00
tblVehicleTrips	SU_TR	13.60	0.00
tblVehicleTrips	WD_TR	33.82	0.00
tblWater	IndoorWaterUseRate	8,280,040.17	0.00
tblWater	OutdoorWaterUseRate	5,074,863.33	0.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2021	0.5062	4.7807	3.4721	8.0300e-003	0.6498	0.2078	0.8576	0.3401	0.1921	0.5322	0.0000	708.1022	708.1022	0.1967	0.0000	713.0190
Maximum	**0.5062**	**4.7807**	**3.4721**	**8.0300e-003**	**0.6498**	**0.2078**	**0.8576**	**0.3401**	**0.1921**	**0.5322**	**0.0000**	**708.1022**	**708.1022**	**0.1967**	**0.0000**	**713.0190**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2021	0.5062	4.7807	3.4720	8.0300e-003	0.6498	0.2078	0.8576	0.3401	0.1921	0.5322	0.0000	708.1014	708.1014	0.1967	0.0000	713.0183
Maximum	**0.5062**	**4.7807**	**3.4720**	**8.0300e-003**	**0.6498**	**0.2078**	**0.8576**	**0.3401**	**0.1921**	**0.5322**	**0.0000**	**708.1014**	**708.1014**	**0.1967**	**0.0000**	**713.0183**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	1-1-2021	3-31-2021	1.5314	1.5314
2	4-1-2021	6-30-2021	1.3076	1.3076
3	7-1-2021	9-30-2021	2.0627	2.0627
		Highest	2.0627	2.0627

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.1300e-003	1.0000e-005	1.2900e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-003	2.5000e-003	1.0000e-005	0.0000	2.6700e-003
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Stationary	4.1600e-003	0.0222	0.0248	4.0000e-005		1.3000e-003	1.3000e-003		1.2400e-003	1.2400e-003	0.0000	3.8648	3.8648	2.9000e-004	0.0000	3.8720
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**5.2900e-003**	**0.0222**	**0.0261**	**4.0000e-005**	**0.0000**	**1.3000e-003**	**1.3000e-003**	**0.0000**	**1.2400e-003**	**1.2400e-003**	**0.0000**	**3.8673**	**3.8673**	**3.0000e-004**	**0.0000**	**3.8747**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.1300e-003	1.0000e-005	1.2900e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-003	2.5000e-003	1.0000e-005	0.0000	2.6700e-003
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	-3.7819	-3.7819	-0.0002	0.0000	-3.7967
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Stationary	4.1600e-003	0.0222	0.0248	4.0000e-005		1.3000e-003	1.3000e-003		1.2400e-003	1.2400e-003	0.0000	3.8648	3.8648	2.9000e-004	0.0000	3.8720
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**5.2900e-003**	**0.0222**	**0.0261**	**4.0000e-005**	**0.0000**	**1.3000e-003**	**1.3000e-003**	**0.0000**	**1.2400e-003**	**1.2400e-003**	**0.0000**	**0.0855**	**0.0855**	**1.3000e-004**	**0.0000**	**0.0780**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**97.79**	**97.79**	**56.67**	**0.00**	**97.99**

2.3 Vegetation

Vegetation

	CO2e
Category	MT
Vegetation Land Change	-17.2400
Total	**-17.2400**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/1/2021	1/28/2021	5	20	
2	Site Preparation	Site Preparation	1/29/2021	2/4/2021	5	5	
3	Grading	Grading	2/5/2021	10/15/2021	5	181	
4	Building Construction	Building Construction	7/15/2021	10/15/2021	5	67	
5	Paving	Paving	10/15/2021	10/16/2021	5	1	
6	Architectural Coating	Architectural Coating	10/17/2021	10/18/2021	5	1	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 4

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 300; Non-Residential Outdoor: 100; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Generator Sets	1	8.00	81	0.73
Demolition	Crawler Tractors	2	8.00	247	0.40
Demolition	Excavators	3	8.00	158	0.38
Grading	Excavators	1	8.00	158	0.38
Site Preparation	Crawler Tractors	3	8.00	247	0.40
Site Preparation	Excavators	4	8.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Tractors/Loaders/Backhoes	3	8.00	97	0.37
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Building Construction	Welders	1	8.00	46	0.45
Paving	Cement and Mortar Mixers	2	6.00	9	0.56
Paving	Pavers	1	8.00	130	0.42
Paving	Paving Equipment	2	6.00	132	0.36
Paving	Rollers	2	6.00	80	0.38
Paving	Tractors/Loaders/Backhoes	1	8.00	97	0.37
Architectural Coating	Air Compressors	1	6.00	78	0.48
Grading	Off-Highway Trucks	2	8.00	402	0.38
Building Construction	Bore/Drill Rigs	1	8.00	221	0.50
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	9	15.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	14	18.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Grading	8	20.00	0.00	625.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	10	59.00	23.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Paving	8	20.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	12.00	0.00	0.00	16.80	6.60	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demolition - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0470	0.4956	0.3035	6.2000e-004		0.0228	0.0228		0.0212	0.0212	0.0000	54.3293	54.3293	0.0147	0.0000	54.6963
Total	**0.0470**	**0.4956**	**0.3035**	**6.2000e-004**		**0.0228**	**0.0228**		**0.0212**	**0.0212**	**0.0000**	**54.3293**	**54.3293**	**0.0147**	**0.0000**	**54.6963**

3.2 Demolition - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.6700e-003	1.5000e-003	0.0118	2.0000e-005	1.8000e-003	2.0000e-005	1.8200e-003	4.8000e-004	2.0000e-005	4.9000e-004	0.0000	1.6014	1.6014	1.0000e-004	0.0000	1.6040
Total	**1.6700e-003**	**1.5000e-003**	**0.0118**	**2.0000e-005**	**1.8000e-003**	**2.0000e-005**	**1.8200e-003**	**4.8000e-004**	**2.0000e-005**	**4.9000e-004**	**0.0000**	**1.6014**	**1.6014**	**1.0000e-004**	**0.0000**	**1.6040**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0470	0.4956	0.3035	6.2000e-004		0.0228	0.0228		0.0212	0.0212	0.0000	54.3293	54.3293	0.0147	0.0000	54.6963
Total	**0.0470**	**0.4956**	**0.3035**	**6.2000e-004**		**0.0228**	**0.0228**		**0.0212**	**0.0212**	**0.0000**	**54.3293**	**54.3293**	**0.0147**	**0.0000**	**54.6963**

3.2 Demolition - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.6700e-003	1.5000e-003	0.0118	2.0000e-005	1.8000e-003	2.0000e-005	1.8200e-003	4.8000e-004	2.0000e-005	4.9000e-004	0.0000	1.6014	1.6014	1.0000e-004	0.0000	1.6040
Total	**1.6700e-003**	**1.5000e-003**	**0.0118**	**2.0000e-005**	**1.8000e-003**	**2.0000e-005**	**1.8200e-003**	**4.8000e-004**	**2.0000e-005**	**4.9000e-004**	**0.0000**	**1.6014**	**1.6014**	**1.0000e-004**	**0.0000**	**1.6040**

3.3 Site Preparation - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0452	0.0000	0.0452	0.0248	0.0000	0.0248	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0159	0.1759	0.0948	1.9000e-004		8.2600e-003	8.2600e-003		7.6000e-003	7.6000e-003	0.0000	16.6522	16.6522	5.3900e-003	0.0000	16.7868
Total	**0.0159**	**0.1759**	**0.0948**	**1.9000e-004**	**0.0452**	**8.2600e-003**	**0.0534**	**0.0248**	**7.6000e-003**	**0.0324**	**0.0000**	**16.6522**	**16.6522**	**5.3900e-003**	**0.0000**	**16.7868**

3.3 Site Preparation - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.0000e-004	4.5000e-004	3.5300e-003	1.0000e-005	5.4000e-004	1.0000e-005	5.4000e-004	1.4000e-004	0.0000	1.5000e-004	0.0000	0.4804	0.4804	3.0000e-005	0.0000	0.4812
Total	**5.0000e-004**	**4.5000e-004**	**3.5300e-003**	**1.0000e-005**	**5.4000e-004**	**1.0000e-005**	**5.4000e-004**	**1.4000e-004**	**0.0000**	**1.5000e-004**	**0.0000**	**0.4804**	**0.4804**	**3.0000e-005**	**0.0000**	**0.4812**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0452	0.0000	0.0452	0.0248	0.0000	0.0248	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0159	0.1759	0.0948	1.9000e-004		8.2600e-003	8.2600e-003		7.6000e-003	7.6000e-003	0.0000	16.6521	16.6521	5.3900e-003	0.0000	16.7868
Total	**0.0159**	**0.1759**	**0.0948**	**1.9000e-004**	**0.0452**	**8.2600e-003**	**0.0534**	**0.0248**	**7.6000e-003**	**0.0324**	**0.0000**	**16.6521**	**16.6521**	**5.3900e-003**	**0.0000**	**16.7868**

3.3 Site Preparation - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.0000e-004	4.5000e-004	3.5300e-003	1.0000e-005	5.4000e-004	1.0000e-005	5.4000e-004	1.4000e-004	0.0000	1.5000e-004	0.0000	0.4804	0.4804	3.0000e-005	0.0000	0.4812
Total	**5.0000e-004**	**4.5000e-004**	**3.5300e-003**	**1.0000e-005**	**5.4000e-004**	**1.0000e-005**	**5.4000e-004**	**1.4000e-004**	**0.0000**	**1.5000e-004**	**0.0000**	**0.4804**	**0.4804**	**3.0000e-005**	**0.0000**	**0.4812**

3.4 Grading - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.5471	0.0000	0.5471	0.2998	0.0000	0.2998	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.3169	3.1913	2.0875	5.0700e-003		0.1399	0.1399		0.1287	0.1287	0.0000	445.7200	445.7200	0.1442	0.0000	449.3239
Total	**0.3169**	**3.1913**	**2.0875**	**5.0700e-003**	**0.5471**	**0.1399**	**0.6870**	**0.2998**	**0.1287**	**0.4285**	**0.0000**	**445.7200**	**445.7200**	**0.1442**	**0.0000**	**449.3239**

3.4 Grading - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	2.7900e-003	0.0953	0.0155	2.5000e-004	5.1400e-003	4.3000e-004	5.5700e-003	1.4100e-003	4.2000e-004	1.8300e-003	0.0000	23.5520	23.5520	7.2000e-004	0.0000	23.5700
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0202	0.0181	0.1422	2.1000e-004	0.0217	2.0000e-004	0.0219	5.7800e-003	1.9000e-004	5.9700e-003	0.0000	19.3236	19.3236	1.2600e-003	0.0000	19.3550
Total	**0.0230**	**0.1134**	**0.1577**	**4.6000e-004**	**0.0268**	**6.3000e-004**	**0.0275**	**7.1900e-003**	**6.1000e-004**	**7.8000e-003**	**0.0000**	**42.8756**	**42.8756**	**1.9800e-003**	**0.0000**	**42.9249**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.5471	0.0000	0.5471	0.2998	0.0000	0.2998	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.3169	3.1913	2.0875	5.0700e-003		0.1399	0.1399		0.1287	0.1287	0.0000	445.7195	445.7195	0.1442	0.0000	449.3233
Total	**0.3169**	**3.1913**	**2.0875**	**5.0700e-003**	**0.5471**	**0.1399**	**0.6870**	**0.2998**	**0.1287**	**0.4285**	**0.0000**	**445.7195**	**445.7195**	**0.1442**	**0.0000**	**449.3233**

3.4 Grading - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	2.7900e-003	0.0953	0.0155	2.5000e-004	5.1400e-003	4.3000e-004	5.5700e-003	1.4100e-003	4.2000e-004	1.8300e-003	0.0000	23.5520	23.5520	7.2000e-004	0.0000	23.5700
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0202	0.0181	0.1422	2.1000e-004	0.0217	2.0000e-004	0.0219	5.7800e-003	1.9000e-004	5.9700e-003	0.0000	19.3236	19.3236	1.2600e-003	0.0000	19.3550
Total	**0.0230**	**0.1134**	**0.1577**	**4.6000e-004**	**0.0268**	**6.3000e-004**	**0.0275**	**7.1900e-003**	**6.1000e-004**	**7.8000e-003**	**0.0000**	**42.8756**	**42.8756**	**1.9800e-003**	**0.0000**	**42.9249**

3.5 Building Construction - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0724	0.6857	0.6251	1.2200e-003		0.0352	0.0352		0.0330	0.0330	0.0000	105.4553	105.4553	0.0277	0.0000	106.1486
Total	**0.0724**	**0.6857**	**0.6251**	**1.2200e-003**		**0.0352**	**0.0352**		**0.0330**	**0.0330**	**0.0000**	**105.4553**	**105.4553**	**0.0277**	**0.0000**	**106.1486**

3.5 Building Construction - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	3.5600e-003	0.0907	0.0247	2.0000e-004	4.4700e-003	3.7000e-004	4.8400e-003	1.3000e-003	3.5000e-004	1.6500e-003	0.0000	18.7699	18.7699	9.7000e-004	0.0000	18.7940
Worker	0.0221	0.0198	0.1552	2.3000e-004	0.0237	2.2000e-004	0.0239	6.3100e-003	2.0000e-004	6.5200e-003	0.0000	21.1011	21.1011	1.3700e-003	0.0000	21.1354
Total	**0.0256**	**0.1105**	**0.1799**	**4.3000e-004**	**0.0282**	**5.9000e-004**	**0.0288**	**7.6100e-003**	**5.5000e-004**	**8.1700e-003**	**0.0000**	**39.8710**	**39.8710**	**2.3400e-003**	**0.0000**	**39.9294**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0724	0.6857	0.6251	1.2200e-003		0.0352	0.0352		0.0330	0.0330	0.0000	105.4552	105.4552	0.0277	0.0000	106.1484
Total	**0.0724**	**0.6857**	**0.6251**	**1.2200e-003**		**0.0352**	**0.0352**		**0.0330**	**0.0330**	**0.0000**	**105.4552**	**105.4552**	**0.0277**	**0.0000**	**106.1484**

3.5 Building Construction - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	3.5600e-003	0.0907	0.0247	2.0000e-004	4.4700e-003	3.7000e-004	4.8400e-003	1.3000e-003	3.5000e-004	1.6500e-003	0.0000	18.7699	18.7699	9.7000e-004	0.0000	18.7940
Worker	0.0221	0.0198	0.1552	2.3000e-004	0.0237	2.2000e-004	0.0239	6.3100e-003	2.0000e-004	6.5200e-003	0.0000	21.1011	21.1011	1.3700e-003	0.0000	21.1354
Total	**0.0256**	**0.1105**	**0.1799**	**4.3000e-004**	**0.0282**	**5.9000e-004**	**0.0288**	**7.6100e-003**	**5.5000e-004**	**8.1700e-003**	**0.0000**	**39.8710**	**39.8710**	**2.3400e-003**	**0.0000**	**39.9294**

3.6 Paving - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	5.5000e-004	5.4200e-003	6.1300e-003	1.0000e-005		2.9000e-004	2.9000e-004		2.7000e-004	2.7000e-004	0.0000	0.8185	0.8185	2.6000e-004	0.0000	0.8250
Paving	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**5.5000e-004**	**5.4200e-003**	**6.1300e-003**	**1.0000e-005**		**2.9000e-004**	**2.9000e-004**		**2.7000e-004**	**2.7000e-004**	**0.0000**	**0.8185**	**0.8185**	**2.6000e-004**	**0.0000**	**0.8250**

3.6 Paving - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.1000e-004	1.0000e-004	7.9000e-004	0.0000	1.2000e-004	0.0000	1.2000e-004	3.0000e-005	0.0000	3.0000e-005	0.0000	0.1068	0.1068	1.0000e-005	0.0000	0.1069
Total	**1.1000e-004**	**1.0000e-004**	**7.9000e-004**	**0.0000**	**1.2000e-004**	**0.0000**	**1.2000e-004**	**3.0000e-005**	**0.0000**	**3.0000e-005**	**0.0000**	**0.1068**	**0.1068**	**1.0000e-005**	**0.0000**	**0.1069**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	5.5000e-004	5.4200e-003	6.1300e-003	1.0000e-005		2.9000e-004	2.9000e-004		2.7000e-004	2.7000e-004	0.0000	0.8185	0.8185	2.6000e-004	0.0000	0.8250
Paving	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**5.5000e-004**	**5.4200e-003**	**6.1300e-003**	**1.0000e-005**		**2.9000e-004**	**2.9000e-004**		**2.7000e-004**	**2.7000e-004**	**0.0000**	**0.8185**	**0.8185**	**2.6000e-004**	**0.0000**	**0.8250**

3.6 Paving - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.1000e-004	1.0000e-004	7.9000e-004	0.0000	1.2000e-004	0.0000	1.2000e-004	3.0000e-005	0.0000	3.0000e-005	0.0000	0.1068	0.1068	1.0000e-005	0.0000	0.1069
Total	**1.1000e-004**	**1.0000e-004**	**7.9000e-004**	**0.0000**	**1.2000e-004**	**0.0000**	**1.2000e-004**	**3.0000e-005**	**0.0000**	**3.0000e-005**	**0.0000**	**0.1068**	**0.1068**	**1.0000e-005**	**0.0000**	**0.1069**

3.7 Architectural Coating - 2021

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	2.3200e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	1.1000e-004	7.6000e-004	9.1000e-004	0.0000		5.0000e-005	5.0000e-005		5.0000e-005	5.0000e-005	0.0000	0.1277	0.1277	1.0000e-005	0.0000	0.1279
Total	**2.4300e-003**	**7.6000e-004**	**9.1000e-004**	**0.0000**		**5.0000e-005**	**5.0000e-005**		**5.0000e-005**	**5.0000e-005**	**0.0000**	**0.1277**	**0.1277**	**1.0000e-005**	**0.0000**	**0.1279**

3.7 Architectural Coating - 2021

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	7.0000e-005	6.0000e-005	4.7000e-004	0.0000	7.0000e-005	0.0000	7.0000e-005	2.0000e-005	0.0000	2.0000e-005	0.0000	0.0641	0.0641	0.0000	0.0000	0.0642
Total	**7.0000e-005**	**6.0000e-005**	**4.7000e-004**	**0.0000**	**7.0000e-005**	**0.0000**	**7.0000e-005**	**2.0000e-005**	**0.0000**	**2.0000e-005**	**0.0000**	**0.0641**	**0.0641**	**0.0000**	**0.0000**	**0.0642**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	2.3200e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	1.1000e-004	7.6000e-004	9.1000e-004	0.0000		5.0000e-005	5.0000e-005		5.0000e-005	5.0000e-005	0.0000	0.1277	0.1277	1.0000e-005	0.0000	0.1279
Total	**2.4300e-003**	**7.6000e-004**	**9.1000e-004**	**0.0000**		**5.0000e-005**	**5.0000e-005**		**5.0000e-005**	**5.0000e-005**	**0.0000**	**0.1277**	**0.1277**	**1.0000e-005**	**0.0000**	**0.1279**

3.7 Architectural Coating - 2021

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	7.0000e-005	6.0000e-005	4.7000e-004	0.0000	7.0000e-005	0.0000	7.0000e-005	2.0000e-005	0.0000	2.0000e-005	0.0000	0.0641	0.0641	0.0000	0.0000	0.0642
Total	**7.0000e-005**	**6.0000e-005**	**4.7000e-004**	**0.0000**	**7.0000e-005**	**0.0000**	**7.0000e-005**	**2.0000e-005**	**0.0000**	**2.0000e-005**	**0.0000**	**0.0641**	**0.0641**	**0.0000**	**0.0000**	**0.0642**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Recreational Swimming Pool	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Recreational Swimming Pool	14.70	6.60	6.60	33.00	48.00	19.00	52	39	9

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
Recreational Swimming Pool	0.489041	0.045286	0.209606	0.134980	0.040724	0.006674	0.014654	0.046205	0.003398	0.001529	0.005553	0.001505	0.000846

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

Kilowatt Hours of Renewable Electricity Generated

Percent of Electricity Use Generated with Renewable Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	-3.7819	-3.7819	-0.0002	0.0000	-3.7967
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Recreational Swimming Pool	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Recreational Swimming Pool	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Recreational Swimming Pool	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Recreational Swimming Pool	-13000	-3.7819	-0.0002	0.0000	-3.7967
Total		**-3.7819**	**-0.0002**	**0.0000**	**-3.7967**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	1.1300e-003	1.0000e-005	1.2900e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-003	2.5000e-003	1.0000e-005	0.0000	2.6700e-003
Unmitigated	1.1300e-003	1.0000e-005	1.2900e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-003	2.5000e-003	1.0000e-005	0.0000	2.6700e-003

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	2.3000e-004					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	7.8000e-004					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	1.2000e-004	1.0000e-005	1.2900e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-003	2.5000e-003	1.0000e-005	0.0000	2.6700e-003
Total	**1.1300e-003**	**1.0000e-005**	**1.2900e-003**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.5000e-003**	**2.5000e-003**	**1.0000e-005**	**0.0000**	**2.6700e-003**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	2.3000e-004					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	7.8000e-004					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	1.2000e-004	1.0000e-005	1.2900e-003	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-003	2.5000e-003	1.0000e-005	0.0000	2.6700e-003
Total	**1.1300e-003**	**1.0000e-005**	**1.2900e-003**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.5000e-003**	**2.5000e-003**	**1.0000e-005**	**0.0000**	**2.6700e-003**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Recreational Swimming Pool	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Recreational Swimming Pool	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Recreational Swimming Pool	1	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Recreational Swimming Pool	1	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type
Fire Pump	1	2	720	7.5	0.73	Diesel

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type
Boiler	1	0.07	24.02	1.43	Diesel

User Defined Equipment

Equipment Type	Number

10.1 Stationary Sources

Unmitigated/Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Equipment Type	tons/yr										MT/yr					
Boiler - Diesel (0 - 9999 MMBTU)	3.0000e-005	6.2000e-004	4.3000e-004	2.0000e-005		9.0000e-005	9.0000e-005		2.0000e-005	2.0000e-005	0.0000	1.9456	1.9456	2.0000e-005	0.0000	1.9460
Fire Pump - Diesel (0 - 11 HP)	4.1300e-003	0.0216	0.0243	2.0000e-005		1.2200e-003	1.2200e-003		1.2200e-003	1.2200e-003	0.0000	1.9192	1.9192	2.7000e-004	0.0000	1.9259
Total	**4.1600e-003**	**0.0222**	**0.0248**	**4.0000e-005**		**1.3100e-003**	**1.3100e-003**		**1.2400e-003**	**1.2400e-003**	**0.0000**	**3.8648**	**3.8648**	**2.9000e-004**	**0.0000**	**3.8720**

11.0 Vegetation

	Total CO2	CH4	N2O	CO2e
Category	MT			
Unmitigated	-17.2400	0.0000	0.0000	-17.2400

11.1 Vegetation Land Change

Vegetation Type

	Initial/Final	Total CO2	CH4	N2O	CO2e
	Acres	MT			
Grassland	20 / 16	-17.2400	0.0000	0.0000	-17.2400
Total		**-17.2400**	**0.0000**	**0.0000**	**-17.2400**

Mattole Headwaters Drought Relief Project- Vanauken Ponds

MND Attachment C

Bullfrog Management Plan

(CDFW)

EXHIBIT A.

BULLFROG MONITORING AND MANAGEMENT PLAN FOR GROUNDWATER RECHARGE PONDS

GENERAL BULLFROG INFORMATION

The American bullfrog (*Lithobates catesbeianus = Rana catesbeiana*); hereafter bullfrog, is an invasive non-native species in California and poses a significant threat to California's native fish and wildlife resources. Bullfrogs were introduced in California over 100 years ago from eastern parts of the United States as a food supply, but have since caused substantial ecological consequences. Bullfrogs are considered highly invasive and are well documented to be prey upon a variety of fish and wildlife species, including some that are rare, threatened, and endangered. Human modifications to the environment provide favorable condition to bullfrogs such as artificially created agricultural ponds, canals and ditches where warm still water occurs. As a result bullfrogs have spread throughout California.

Efforts to control bullfrogs have been met with varying degrees of success because: 1) bullfrogs can be difficult to detect and go dormant from fall through winter, 2) bullfrogs often take cover in difficult areas to manage (e.g. dense vegetation), 3) they can travel long distances to colonize and re-colonize areas, 4) they have high reproductive output, 5) they are weary and readily flee perceived threats, and 6) they can survive physical trauma remarkably well. CDFW scientific staff recognizes there is an urgent and immediate need to develop improved bullfrog management strategies to protect California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. Public support and implementation of bullfrog control in California is an important conservation strategy that will help protect natural resources for future generations.

MONITORING

The Project reservoir(s) shall be monitored for bullfrog presence on an annual basis with a minimum of five total surveys, no less than two weeks apart, throughout the months of May-July

- All pond survey effort must be made by a person knowledgeable in bullfrog identification (see Appendix A for reference photos);
- Survey efforts shall include listening for bullfrog calls and slowly walking the complete perimeter of the pond at night* (dusk or later) while shining a flashlight to detect movement and eye-shine

If bullfrogs are not detected upon completion of five total surveys, or at any other time of the year incidentally, removal efforts are not required that year.

*Day time monitoring can also be conducted to aid detection but is not required under this plan.

SUCCESS CRITERIA

The level of effort needed to successfully manage bullfrog populations varies with infestation levels. This plan shall be considered successfully implemented if sufficient effort is provided to prevent adult bullfrogs from reproducing in the reservoir(s) each year, and no bullfrog life-stages can be detected. Bullfrogs are capable of traveling long distances over-land, and on-going efforts will be required to ensure dispersing bullfrogs do not colonize the reservoir(s) at a future time.

OPTIONS FOR MANAGEMENT

Two removal methods may by employed for controlling bullfrogs under this plan and include:

- Manual direct removal
- Reservoir de-watering (Hydro-modification)

Implementing both reservoir de-watering and manual direct removal is currently believed to be the most effective method of managing bullfrog infestations. For reservoirs that are heavily infested with juvenile bullfrogs and/or tadpoles, reservoir dewatering may be necessary to break the bullfrog's life cycle and prevent on-going reproduction. Prior to conducting reservoir dewatering activities, please coordinate with CDFW Environmental Scientist David Manthorne by phone at (707) 441-5900 or via email at david.manthorne@wildlife.ca.gov.

Direct Removal

All direct removal efforts must be made by a person knowledgeable in bullfrog identification.

- Removal efforts must occur during, but are not be limited to the active/breeding season, occurring May – July;
- A minimum of ***five*** efforts throughout the season are considered necessary;
- Direct removal efforts are typically most effective when conducted at night with use of lights but can also be conducted during the day;
- Direct removal must include working the entire perimeter of the reservoir;
- A rubber raft or small boat may be necessary to successfully remove some individuals;
- A team of two individuals or more is often helpful, one person for shining lights and/or operating a boat and the other person to perform removal efforts;
- Bullfrog tadpoles must be removed and dispatched and must not be relocated or kept as pets.

Management Authorization

Take of bullfrogs is specifically allowed in the California Code of Regulations (CCR), Title 14 (T-14) section 5.05(a)(28), under the authority of a sport fishing license. There is no daily bag limit, possession limit or hour restriction, but bullfrogs can only be taken by hand, hand-held dip net, hook and line, lights, spears, gigs, grabs, paddles, bow and arrow or fish tackle.

Alternatively, FGC Section 5501 allows CDFW, as limited by the commission, to issue a permit to destroy fish that are harmful to other wildlife. The regulations have addressed this under Section CCR T-14 226.5 Issuance of Permits to Destroy Harmful Species of Fish in Private Waters for Management Purposes. This allows the CDFW to issue free permits to destroy harmful aquatic species by seining and draining.

Pond Dewatering

Pond dewatering may be appropriate if the reservoir can be successfully dewatered without adversely affecting stream resources. Careful planning and coordination with CDFW, is necessary to ensure potential impacts to stream resources can be addressed, prior to commencing with pond draining. Discharge of polluted water to waters of the state may require permitting from other agencies with permitting authority, such as the Regional Water Quality Control Board.

In general, bullfrog tadpoles require two years to develop into frogs, whereas native amphibians only require one year. Therefore, draining a reservoir every two years (or less) is intended to interrupt bullfrog tadpole development, dramatically decrease bullfrog populations and allow for reduced efforts as a measure of adaptive management. Typically in Northern California, reservoir draining should occur in September through October to avoid impacts to sensitive native amphibian and fishery resources. While draining occurs, direct removal efforts should be employed as described above if possible.

REPORTING

A written log shall be kept of monitoring and management efforts and shall be provided to CDFW **each year** by December 31. The written log shall include: 1) date and time of each monitoring and management effort, 2) approximate number of each bullfrog life stage detected and/or removed per effort, and 3) amount of time spent for each monitoring and management effort.

APPENDIX A. BULLFROG REFERENCE PHOTOS

This is a photo of a Bullfrog tadpole. (Photo taken by Mike van Hattem).

The photos shown in this Appendix demonstrate a medium sized adult bullfrog that was removed from Ten Mile Creek, Mendocino County. Note the bullfrog has a large tympanum, (circular ear drum shown with an arrow) and **does not** have distinct ridges along its back (dorsolateral folds). Photo taken by Wes Stokes.

The bullfrog has somewhat distinct mottling and **the underside of the bullfrogs hind legs are not shaded pink or red.**

Mattole Headwaters Drought Relief Project- Vanauken Ponds

MND Attachment D

Cultural Resources Report

(William Rich and Associates)

Confidential and on file with Humboldt County

Planning and Building Department