



## Bolinas Community Public Utility District & Bolinas Fire Protection District

### **Hazard Tree Mitigation Report**

#### **Introduction**

This report documents the identification of **108 trees for removal** and **16 additional trees for pruning**, actions necessary to reduce hazards and protect public safety. The work is being carried out through a partnership between the Bolinas Community Public Utility District (BCPUD) and the Bolinas Fire Protection District (BFPD), reflecting a shared commitment to community resilience and emergency preparedness.

The purpose of this report is to identify **hazardous trees as defined under Governor Gavin Newsom's Emergency Proclamation**, using criteria and metrics established in two professional arborist assessments:

- **Tom Gaman's Zone 5 Eucalyptus Inventory**
- **Ray Moritz's Tree Risk Assessment and Recommendations**

This work is urgent. Removing and pruning these hazardous trees is essential to maintain safe ingress and egress for residents and emergency responders and to reduce the risk of catastrophic impacts during severe storms or wildfire events.

In addition to these arborist reports, an **engineering survey prepared for the pedestrian and bike path rehabilitation project** identifies a handful of trees located within two feet of the path alignment. These trees present a blowdown risk and have been incorporated into this hazard mitigation plan. The path rehabilitation project will serve as a **critical**

**emergency ingress and egress route** for pedestrians during natural disasters or road closures, and its design includes ADA-compliant slopes (longitudinal <5%, cross slope <2%) and a width of 5 feet, ensuring safe and manageable passage for all users. Removing these trees ensures the path remains unobstructed and safe during high wind or storm events.

## Emergency Proclamation Alignment

Governor Gavin Newsom's **Emergency Proclamation on Forest Management** authorizes expedited removal of vegetation that poses a hazard to public safety, emergency access, or critical infrastructure. Under this directive, **hazardous trees** are defined as:

- Dead, dying, or diseased trees.
- Structurally compromised trees with decay, weak attachments, or severe canopy asymmetry.
- Trees located along **primary ingress/egress routes** or adjacent to pedestrian evacuation paths where failure could block emergency response or evacuation.

The actions proposed in this report—removing and pruning trees along roadsides, pedestrian trails, and those identified by the engineering survey near the pedestrian path—are consistent with the Emergency Proclamation's priorities for **community defensible space** and **safe ingress/egress routes**.

## Methodology and Criteria for Hazard Identification

The trees identified in this report were selected based on Governor Gavin Newsom's Emergency Proclamation and professional arboricultural standards. Two comprehensive studies have informed this process:

- **Tom Gaman's Zone 5 Eucalyptus Inventory (March 2023)**

Provided a full inventory of trees within Zone 5, including health classification (Good, Fair, Poor), structural defects, and hazard targets such as roads and trails.

- **Ray Moritz's Tree Risk Assessment and Recommendations (July 2023)**

Applied Internation Society of Arboriculture (ISA) Tree Risk Assessment Qualification (TRAQ) standards to evaluate likelihood of failure, target occupancy, and severity of consequences.

#### **Additional Engineering Input:**

A third source of data—the engineering survey for the pedestrian/bike path rehabilitation project—identified several trees within two feet of the path footprint. These trees were flagged as hazards due to their proximity and blowdown risk and have been added to the removal list to ensure the path remains safe and functional as an emergency route.

#### **Selection Criteria:**

- Health Condition: Poor or severely declining.
- Structural Defects: Decay, weak attachments, topping history, or over-extended limbs.
- Ingress/Egress Risk: Trees located along primary access routes and the pedestrian path.
- Immediate Hazard Potential: High likelihood of failure during storms or high winds.

## **Recommended Actions & Coordination with other Agencies**

This report identifies **108 trees for removal** and **16 for pruning** to mitigate hazards along critical ingress and egress routes. These priorities are based on criteria from the Gaman and Moritz arborist reports and supplemented by the engineering survey for the pedestrian path project.

Many of the hazardous trees are located along **Mesa Road and Olema-Bolinas Road**, both maintained by the County of Marin. Several fall within **county rights-of-way (ROW)** and are near **PG&E power lines and related infrastructure**, requiring close coordination among BCPUD, BFPD, PG&E, and the Marin County Department of Public Works. Under the Governor's Emergency Proclamation, we are pursuing authorization to remove and/or prune all the hazardous trees identified herein, including those that lie within the County ROW and/or are proximal to PG&E infrastructure.

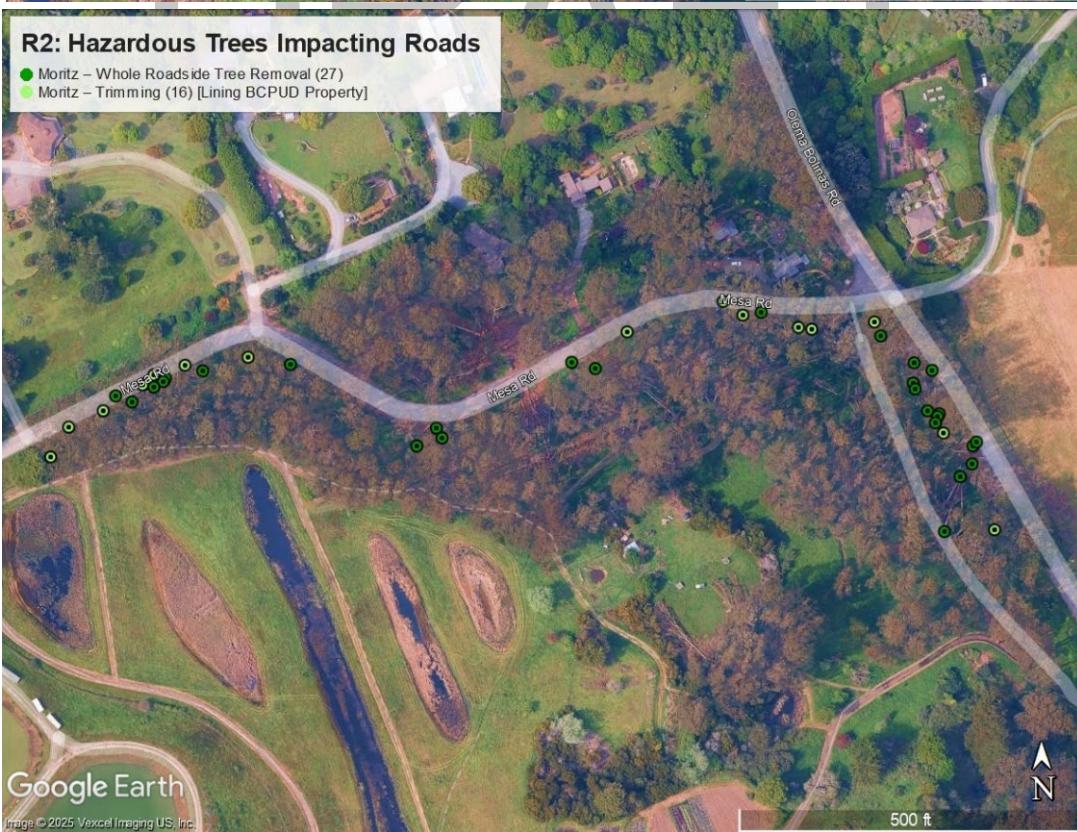
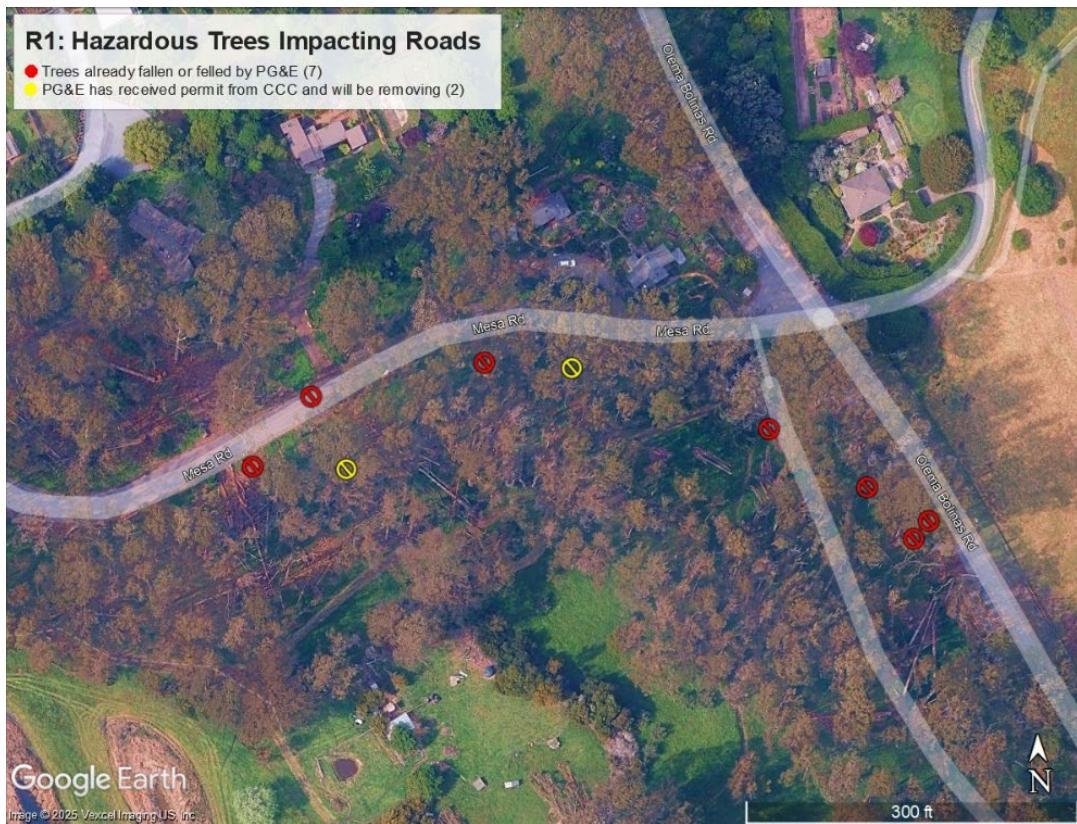
Trees within **10 feet of PG&E lines**, particularly along lower Mesa Road near Olema-Bolinas Road, must be pruned or removed by PG&E or its subcontractors. Others, especially near downtown Bolinas, lie in County ROW and are the responsibility of the Marin County Roads Department. Once permissions are granted, all work will proceed in

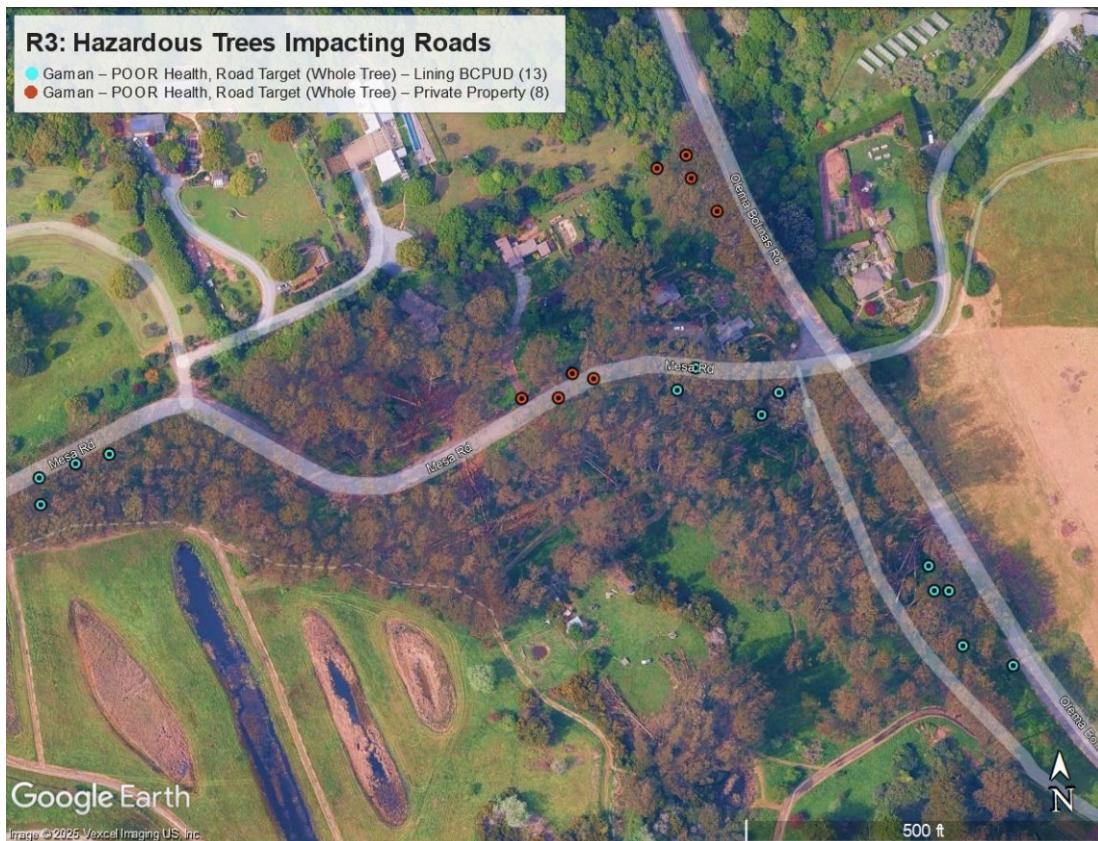
collaboration with PG&E and the County to ensure efficient scheduling and strict adherence to electrical safety protocols. (See Appendix 6 for ROW survey and electrical line locations.)

For the **16 trees recommended for pruning**, whole tree removal may ultimately be required if trimming—or the removal of adjacent trees—compromises structural integrity or increases blowdown risk. If pruning or neighboring tree removal results in root destabilization or canopy imbalance that elevates hazard potential, full removal will be warranted and necessary to ensure public safety. This will be evaluated during tree work by the qualified professional performing removal and/or trimming.

**Table 1: Hazardous Trees Impacting Roads**

Map ID	Category Name	# of Trees
R1	Trees already fallen or felled by PG&E (7) or PG&E has received permit from CCC and will be removing (2)	9
R2	Moritz – Whole Roadside Tree Removal (27) or Trimming (16) – Lining BCPUD Property	43
R3	Gaman – POOR Health, Road Target (Whole Tree) – Lining BCPUD (13) or Private Property (8)	21
R4	Gaman – FAIR Health, Road Target (Whole Tree) – Lining BCPUD (15) or Private Property (4)	19
<b>Total Road-Related Whole Tree Removals</b>		<b>76</b>
<b>Total Roadside Tree Prunings</b>		<b>16</b>





**Table 2: Hazardous Trees Impacting Pedestrian Path**

MAP ID	Category Name	# of Trees
P1	Gaman – POOR Health Pedestrian Path Target (Whole Tree) – BCPUD Property	10
P1	Gaman – FAIR Health, Pedestrian Path Target (Whole Tree) – BCPUD Property	4
P1	Engineer – Too close to Pedestrian Pathway (Whole Tree) – BCPUD Property	18
<b>Total Path-Related Whole Tree Removals</b>		<b>32</b>



## Supporting Documentation and Ecological Context

This report proposes removal of only a small fraction—less than 10%—of the Zone 5 eucalyptus grove, focusing exclusively on trees that present the most immediate hazard to critical ingress and egress routes. Our recommendations account for the cumulative impact of all proposed removals by PG&E and public agencies. While the grove contains more than **1,100 trees**, the actions outlined here target **108 trees for removal** and **16 for pruning**, based on professional assessments of structural condition, health, and proximity to essential access corridors.

Zone 5 is in a state of progressive decline. Professional arborist and forestry reports confirm that this eucalyptus grove has become increasingly hazardous due to its age, overcrowding, and history of inadequate management. Over the past two storm seasons, dozens of trees have fallen, blocking roads, taking down power lines, and cutting off access to much of Bolinas for days at a time. The latest storm in February 2024 reinforced this pattern, with additional failures that underscore the grove's instability.

While future tree removal may be necessary as the grove continues to deteriorate, this report proposes removal of the most hazardous trees now to secure safe ingress and egress for emergency access and evacuation. This includes trees identified during engineering review of the pedestrian path rehabilitation project, which will serve as a critical emergency route.

## Appendices

The following appendices provide the technical foundation and supporting documentation for this report. They include detailed data tables, professional arborist assessments, ecological considerations, and engineering design plans for the pedestrian path rehabilitation project. Together, these documents demonstrate that the proposed hazard mitigation actions are evidence-based, consistent with state emergency directives, and integrated with broader community safety improvements:

- **Appendix 1:** A detailed and expanded version of the summary table, including latitude, longitude, DBH, and other tree-specific data for all recommended removals and pruning actions.
- **Appendix 2:** *Tom Gaman's Zone 5 Eucalyptus Inventory* – A comprehensive forestry analysis documenting stand composition, health, and hazard metrics.

- **Appendix 3: Ray Moritz's Tree Risk Assessment and Recommendations** – An ISA-qualified risk evaluation prioritizing mitigation actions based on likelihood of failure and potential consequences.
- **Appendix 4: Bolinas Eucalyptus Project Monarch Assessment** by Stuart B. Weiss – This appendix provides ecological context regarding monarch butterfly overwintering habitat and underscores that Zone 5 is a habitat in decline. It outlines considerations for balancing urgent public safety needs with future habitat restoration planning. Importantly, none of the trees identified for removal or pruning in this proposal have been observed to host roosting monarch butterflies.
- **Appendix 5: Project Description and Engineering Design – Pedestrian/Bike Path Rehabilitation**. It describes the project and identifies Trees within the footprint of the path.
- **Appendix 6: Right of Way Survey from County of Marin**. This survey identifies roadside trees within Zone 5, in relation to the ROWs along Mesa Road and Olema-Bolinas Road.

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## Appendix 1: Detailed Metrics on Hazardous Trees Impacting Ingress/Egress

Category	Whole Tree Removal (GW)	Condition (TG)	Target hazard (TG)	Waypoint (TG)	Latitude (TG)	Longitude (TG)	Tree Species (TG)	DBH (in) (TG)	Height (ft) (TG)	Observation of Roosting Butterflies? (From TG Report where observation is either "Yes, Butterfly Use" vs. "Unknown")	Comments (RM)	Recommendations (RM)
Tree Gone	n/a	Poor	1. Road	F12	37.9116061	-122.6902297	Blue Gum	55	170	None Observed	The tree is in decline and targets road. Severe dieback.	Whole tree removal.
Tree Gone	n/a	Good	1. Road	J49	37.9114766	-122.6900872	Blue Gum	48	195	None Observed	Deadwood up to 6" diameter targeting the road.	Remove deadwood 3" or larger on road side. Remove large deadwood (~3 large limbs) on trail side.
Tree Gone	n/a	Poor	1. Road	H50	37.9115198	-122.6900391	Blue Gum	61	175	None Observed	Leans into canopy of T-51. Trunk lean appears to have increased at some point in the past. Fungal damage present on lower trunk and roots.	Whole tree removal.
Tree Gone	n/a	Poor	1. Road	C57	37.9116888	-122.6921508	Blue Gum	35	160	None Observed	On cut bank. Trunk is failing away from the road, but could kick back into the road when it falls.	Whole tree removal.
Tree Gone	n/a	Poor	1. Road	C58	37.911859	-122.6919638	Blue Gum	38	160	None Observed	Targets power lines. It may have been impacted by the row of eucalyptus trees across the road. Low live crown ratio. Two red dots painted on lower trunk likely from PG&E.	Whole tree removal. Contact PG&E to inquire about them removing this tree.
Tree Gone	n/a	Poor	1. Road	E64	37.911934	-122.6914193	Blue Gum	40	100	None Observed	Dense ivy obscuring stems. Curved top interfering with subordinate stem of T2204	Whole tree removal. Fell into grove.
Tree Gone	n/a	Poor	1. Road	F68	37.9117552	-122.6905328	Blue Gum	22	90	None Observed	The tree is dead. It targets trail and road. Two red dots painted on lower trunk. Contact PG&E about planned maintenance.	Whole tree removal.
PGE has CCC approval to remove whole tree	Whole Tree Removal	Poor	1. Road	E71	37.9119162	-122.6911458	Blue Gum	61	160	None Observed	Top of stem closest to street bows heavily east into canopy of adjacent tree.	Reduce the bowed top back to a vertical secondary, 10" diameter cut.
PGE has CCC approval to remove whole tree	Whole Tree Removal	Fair	0. None	C63	37.9116777	-122.6918581	Blue Gum	20	140	None Observed		
9												
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	J01	37.9113647	-122.6899719	Blue Gum	60	120	None Observed		Remove 12" declining eucalyptus growing under this tree.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	B16	37.91147	-122.6927769	Blue Gum	37	30	None Observed	Topped at 25'. The only living sprout is extremely long and leggy. It's attachment to the main trunk is weak and leans over the road and powerlines.	Remove the stem over the road.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	B18	37.9115003	-122.6926489	Blue Gum	28	100	None Observed	Leaning into and conflicting with a tree directly behind it.	Remove seven (7) small trees in clump, and remove tree behind 18.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	F18	37.9116668	-122.6902536	Blue Gum	59	160	None Observed	Many dead limbs over road.	Remove deadwood three inches in diameter or larger on road side and reduce the length of live limbs over the road by approximately 10 feet.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	B19	37.91154	-122.6926765	Blue Gum	28	110	None Observed	Topped by PGE. Stem failed and hung up. No target	Fell it into forest. See Recom'd for Tree-18.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Good	2. Trail	H29	37.9110963	-122.6901167	Blue Gum	29	160	None Observed	Large adjacent eucalyptus tree fell. The failure appears to have damaged the supportive roots of this tree. The tree could potentially reach the road and target the trail.	Whole tree removal.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	A35	37.9118033	-122.6934091	Blue Gum	21	110	None Observed	Tree exhibits fair health. The top of the tree and scaffold limbs toward the top are dead.	Whole tree removal.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	J37	37.9114367	-122.6899663	Blue Gum	48	170	None Observed	Top of tree bows southeast and is long and leggy.	Remove the bowed top with an approximate 10" heading cut.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Fair	1. Road	A45	37.9117826	-122.6938527	Blue Gum	30	100	None Observed	Decay cavity in main trunk at old stem removal wound. The tree bows away from road and exhibits declining health.	Whole tree removal. Fell into stand
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Fair	1. Road	A46	37.9117555	-122.6940419	Blue Gum	25	75	None Observed	Strong canopy asymmetry over the road.	Whole tree removal.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	A50	37.9117425	-122.6940534	Blue Gum	24	65	None Observed	Strong bow in main stem. Tree targets road.	Whole tree removal.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	A52	37.9117209	-122.6941014	Monterey Cypress	23	85	None Observed	Lowest 10" diameter scaffold limb over the road is overextended.	Remove heavy 10" limb extending over the road.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	A55	37.911663	-122.6942127	Blue Gum	23	90	None Observed	12" stem over road is declining.	Remove the stem indicated in the photo.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Fair	1. Road	C56	37.9117943	-122.6919873	Blue Gum	32	160	None Observed	Located at top of cut bank. The tree has insufficient root anchorage, given its height.	Whole tree removal.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	A58	37.9116881	-122.6942949	Blue Gum	20	70	None Observed	Established decay hollow in the lower trunk and near the common attachment of stems.	Whole tree removal.

Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Fair	1. Road	C59	37.9117682	-122.6918689	Blue Gum	34	160	None Observed	Two red dots painted on lower trunk. On cut bank directly above high voltage lines and pole. Many long limbs over the road and powerlines.	Either remove the tree or prune the tree focusing on removing/shortening the longest limbs over the road. Contact PG&E about them removing it.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	3. Building	E74	37.9119822	-122.6910259	Blue Gum	44	140	None Observed	Bowed top. Two red dots and blue x painted on trunk.	Contact PG&E about potential plans for work.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	F85	37.9118809	-122.6904239	Blue Gum	53	125	None Observed	Large deadwood over road and path. High scaffold limb over road is long and leggy.	Remove deadwood three inches in diameter or larger over trail and road. Inspect old heading cuts over road. Reduce the high scaffold limb over the road with a reduction cut approximately 6" in diameter.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	H85	37.9114517	-122.6899479	Blue Gum	52	110	None Observed	Large deadwood over road.	Remove deadwood on roadside three inches in diameter or larger.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	F88	37.9115558	-122.690143	Blue Gum	55	170	None Observed	Decline at end of old heading cuts on limbs over road.	Remove the right fork that was headed back. Reduce end weight on left fork. See photo.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	F89	37.9115308	-122.690154	Blue Gum	33	120	None Observed	Topped in past. It is suppressed in the row.	Whole tree removal. Fell into stand.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	F96	37.9117401	-122.690167	Blue Gum	53	160	None Observed		Reduce top of tree with reduction cuts up to 4" in diameter if possible.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	F665	37.9115666	-122.6901343	Blue Gum	38	100	None Observed	Declining tree suppressed in the row.	Whole tree removal.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	F860	37.9116906	-122.6902632	Blue Gum	33	60	None Observed	Mature fungal fruiting bodies on trunk. The tree is in decline.	Whole tree removal.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	F866	37.9115789	-122.6901926	Blue Gum	38	170	None Observed	Exhibits poor vigor. Sprout growth along trunk and top comprises the majority of the canopy. Top bows over road.	Whole tree removal.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Poor	1. Road	F889	37.9117716	-122.6902568	Blue Gum	54	155	None Observed	Top of tree bows over road.	Reduce limbs arising from the top of the tree.
Moritz Report: Whole Tree Removal-BCPUD/DPW	Whole Tree Removal	Fair	0. None	H46	37.9113142	-122.6900328	Blue Gum	34	180	None Observed	Large deadwood and canopy dieback. Predominantly targets trail.	Whole tree removal.
27										27		
Moritz Report: Pruning-BCPUD/DPW	Pruning	Good	1. Road	J00	37.9114896	-122.6901143	Blue Gum	79	190	None Observed	Many long limbs over road in upper canopy.	Prune to reduce limb end weight over road by approximately 10 feet focusing on the longest limbs toward the top.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Fair	1. Road	A29	37.9118345	-122.6936226	Blue Gum	27	110	None Observed	Located approximately 15' from road cut bank. Tree collected to tie into this stand of trees.	None
Moritz Report: Pruning-BCPUD/DPW	Pruning	Good	1. Road	H47	37.9111004	-122.6898632	Blue Gum	52	160	None Observed	Limbs at top of tree in road side are long and target the road and power lines.	Reduce limb end weight over road with reduction cuts up to 6 inches in diameter.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Fair	1. Road	A48	37.9118061	-122.6939419	Blue Gum	55	100	None Observed	Limbs over road are long and declining in health.	Remove 2 1/2' & 1 sm scaffold limbs over the road.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Good	1. Road	A51	37.9117698	-122.6941007	Blue Gum	35	105	None Observed	8" acute crotch stem over road is declining but not likely to fail in the short term.	Remove 8" stem.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Good	1. Road	A53	37.9115664	-122.6945347	Blue Gum	43	130	None Observed	Long scaffold limbs over road.	Reduce the length of two lowest scaffold limbs over the road by approximately 10 feet
Moritz Report: Pruning-BCPUD/DPW	Pruning	Fair	1. Road	A53	37.9117356	-122.6941448	Blue Gum	28	95	None Observed	Unstable trunk targets road.	Remove 12" stem extending over the road.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Fair	1. Road	A54	37.9117302	-122.694158	Blue Gum	28	100	None Observed		Remove two long thin scaffold limbs that extend over the road. See photo.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Fair	2. Trail	A59	37.9116295	-122.6943589	Blue Gum	28	100	None Observed	Three declining limbs extend over road.	Remove three limbs with over the road as indicated in the photo.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Fair	1. Road	E67	37.9120281	-122.6912179	Blue Gum	43	160	None Observed	Sparse canopy. Solo leader oriented over road. Two red dots on lower trunk..	Contact PG&E about tree removal.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Good	1. Road	E70	37.9119724	-122.6911185	Blue Gum	50	160	None Observed		Remove lowest scaffold limb extending over the road.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Fair	3. Building	E75	37.9119201	-122.6908389	Blue Gum	57	160	None Observed	Common point of attachment of stems at 25'. Bow in top.	Remove two limbs extending north over road. Another option is to make an approximate 10" removal cut. See photo.

Moritz Report: Pruning-BCPUD/DPW	Pruning	Good	1. Road	F82	37.911937	-122.6904545	Blue Gum	58	160	None Observed	Large deadwood over trail. Long limbs extending over road and power lines.	Remove deadwood three inches or larger over the trail. Reduce branch end weight over road focusing on the longest limbs in the upper canopy.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Good	2. Trail	A99	37.9114483	-122.6946283	Blue Gum	34	112	None Observed	Long scaffold limbs over road.	Reduce the vertical branch and the 90/90 length of two lowest limbs over road by approximately 10 feet.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Fair	1. Road	C69	37.9119125	-122.6917049	Blue Gum	37	160	None Observed	Trunk lean away from road. Two red dots.	Contact PG&E to inquire about any of their planned maintenance of this tree.
Moritz Report: Pruning-BCPUD/DPW	Pruning	Fair	3. Building	E77	37.9119119	-122.6907717	Blue Gum	51	160	None Observed		Remove lowest scaffold limb and reduce the length of limbs extending over the road by 5-10'.
16											16	
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	J40	37.911232	-122.6899591	Blue Gum	30	80	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	A47	37.9117491	-122.6939592	Blue Gum	26	90	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	B48	37.9116647	-122.6943057	Blue Gum	28	90	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	A49	37.9117158	-122.6941259	Blue Gum	33	90	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	A51	37.911561	-122.6943005	Blue Gum	24	120	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	H55	37.9111359	-122.6899351	Monterey Cypress	67	130	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	H56	37.9111335	-122.6898638	Monterey Cypress	72	80	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	H59	37.9109204	-122.6898041	Monterey Cypress	81	99	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	H64	37.9108395	-122.6895613	Blue Gum	20	100	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	E69	37.9119377	-122.6911647	Blue Gum	38	100	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	E72	37.9120221	-122.6910723	Blue Gum	28	25	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	E79	37.9119178	-122.6906656	Monterey Cypress	22	50	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	1. Road	E81	37.9118331	-122.6907542	Blue Gum	21	90	None Observed		
13											14	
Gaman Report: Poor Health Rd is a Target (Whole Tree)-DPW/Private Property	Whole Tree Removal	Poor	1. Road	K80	37.9126287	-122.6909432	Blue Gum	38	125	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-DPW/Private Property	Whole Tree Removal	Poor	1. Road	K83	37.9127603	-122.6910657	Blue Gum	27	40	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-DPW/Private Property	Whole Tree Removal	Poor	1. Road	K84	37.9128505	-122.6910876	Blue Gum	33	100	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-DPW/Private Property	Whole Tree Removal	Poor	1. Road	K86	37.9128026	-122.6912331	Blue Gum	61	130	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-DPW/Private Property	Whole Tree Removal	Poor	1. Road	L92	37.9119908	-122.691574	Blue Gum	33	100	None Observed		

Gaman Report: Poor Health Rd is a Target (Whole Tree)-DPV/Private Property	Whole Tree Removal	Poor	1. Road	L93	37.9120133	-122.6916773	Blue Gum	27	60	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-DPV/Private Property	Whole Tree Removal	Poor	1. Road	L96	37.9119199	-122.6917492	Blue Gum	63	130	None Observed		
Gaman Report: Poor Health Rd is a Target (Whole Tree)-DPV/Private Property	Whole Tree Removal	Poor	1. Road	L98	37.9119216	-122.6919294	Blue Gum	25	24	None Observed		
8										8		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Fair	1. Road	B20	37.911498	-122.6925745	Blue Gum	23	135	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Fair	1. Road	B31	37.9114753	-122.6925909	Blue Gum	26	130	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property		Fair	1. Road	A34	37.9117955	-122.6934795	Blue Gum	30	120	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Fair	1. Road	A37	37.91177	-122.6934156	Blue Gum	38	775	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property		Fair	1. Road	B44	37.9115249	-122.6923304	Blue Gum	25	135	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Fair	1. Road	B45	37.9115239	-122.6923277	Blue Gum	32	155	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property		Fair	1. Road	H51	37.9115603	-122.6899964	Blue Gum	75	175	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Blue Gum	Fair	1. Road	F60	37.9118298	-122.6908632	Blue Gum	20	140	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Blue Gum	Fair	1. Road	E63	37.9119398	-122.6914634	Blue Gum	50	160	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Blue Gum	Fair	1. Road	E65	37.9120252	-122.6912661	Blue Gum	46	150	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Blue Gum	Fair	1. Road	C68	37.9118292	-122.6917664	Blue Gum	30	160	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Blue Gum	Fair	1. Road	E68	37.9119257	-122.6912149	Blue Gum	44	160	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Blue Gum	Fair	1. Road	C70	37.9117191	-122.6915772	Blue Gum	29	160	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Blue Gum	Fair	1. Road	C88	37.9118473	-122.6915414	Blue Gum	27	160	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-BCPUD Property	Blue Gum	Fair	1. Road	C89	37.911881	-122.6915513	Blue Gum	22	160	None Observed		
15										15		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-DPV/Private Property	Blue Gum	Fair	1. Road	L94	37.912024	-122.6918172	Blue Gum	54	135	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-DPV/Private Property	Blue Gum	Fair	1. Road	K77	37.9125567	-122.6909712	Blue Gum	46	150	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-DPV/Private Property	Blue Gum	Fair	1. Road	K78	37.9125359	-122.6908718	Blue Gum	83	150	None Observed		
Gaman Report: FAIR Health Rd is a Target (Whole Tree)-DPV/Private Property	Blue Gum	Fair	1. Road	K85	37.9128332	-122.6910777	Blue Gum	37	150	None Observed		

4													
Gaman Report: Poor Health Path is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	2. Trail	B4	37.9113864	-122.6929731	Blue Gum	22	125	None Observed			
Gaman Report: Poor Health Path is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	2. Trail	H04	37.9115656	-122.6903842	Blue Gum	23	145	None Observed			
Gaman Report: Poor Health Path is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	2. Trail	H23	37.9114597	-122.6902249	Blue Gum	20	140	None Observed			
Gaman Report: Poor Health Path is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	2. Trail	H28	37.9110681	-122.6901951	Blue Gum	39	160	None Observed			
Gaman Report: Poor Health Path is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	2. Trail	B32	37.9111735	-122.6922334	Blue Gum	22	110	None Observed			
Gaman Report: Poor Health Path is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	2. Trail	A33	37.9117465	-122.6934457	Blue Gum	20	110	None Observed			
Gaman Report: Poor Health Path is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	2. Trail	H48	37.9113676	-122.6906264	Blue Gum	27	130	None Observed			
Gaman Report: Poor Health Path is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	2. Trail	H09	37.9115014	-122.6904001	Blue Gum	20	140	None Observed			
Gaman Report: Poor Health Path is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	2. Trail	F70	37.9112061	-122.6907856	Blue Gum	20	150	None Observed			
Gaman Report: Poor Health Path is a Target (Whole Tree)-BCPUD Property	Whole Tree Removal	Poor	2. Trail	H99	37.9115219	-122.690439	Blue Gum	20	130	None Observed			
10													
Gaman Report: Fair Health Path is a Target (Whole Tree)	Whole Tree Removal	Fair	2. Trail	H08	37.9115517	-122.69032	Blue Gum	20	130	1			
Gaman Report: Fair Health Path is a Target (Whole Tree)	Whole Tree Removal	Fair	2. Trail	H22	37.9114019	-122.6902624	Blue Gum	36	160	None Observed			
Gaman Report: Fair Health Path is a Target (Whole Tree)	Whole Tree Removal	Fair	2. Trail	H33	37.9111173	-122.6901149	Blue Gum	31	160	None Observed			
Gaman Report: Fair Health Path is a Target (Whole Tree)	Whole Tree Removal (doublet Tree)	Fair	2. Trail	H39	37.911008	-122.6900517	Blue Gum	33	160	None Observed			
4													
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-10	37.9114243	-122.6944373	Blue Gum	12	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-1	37.911755	-122.693694	Blue Gum	10	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-2	37.9103369	-122.6914338	Blue Gum	48	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-11	37.9103726	-122.6913403	Blue Gum	13	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-12	37.91037	-122.6913221	Blue Gum	8	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-2.3	37.9104153	-122.6912914	Blue Gum	unknown	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-2.4	37.9104078	-122.6912744	Blue Gum	unknown	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-3	37.9104794	-122.6912789	Blue Gum	20	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-13	37.9104425	-122.6912541	Blue Gum	22	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	3.2	37.9104502	-122.6912291	Blue Gum	unknown	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-4	37.9104753	-122.6911647	Blue Gum	20	unknown	None Observed			
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Good	2. Trail	IC-5 (H17)	37.9111217	-122.6906691	Blue Gum	23	140	None Observed			

Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-15	37.9112193	-122.6906588	Blue Gum	13	unknown	None Observed		
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-16	37.9113428	-122.6906446	Blue Gum	13	unknown	None Observed		
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Poor	2. Trail	IC-7 (H45)	37.9113015	-122.6901857	Blue Gum	27	160	None Observed		
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-7.1	37.9112835	-122.6901916	Blue Gum	38	unknown	None Observed		
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-7.2	37.9112378	-122.6901626	Blue Gum	40	unknown	None Observed		
Engineer (IC) Assessment: Tree too Close Bike Path	Tree Fell	Unknown	2. Trail	IC-8	37.9111477	37.9111477	Blue Gum	unknown	unknown	None Observed		
Engineer (IC) Assessment: Tree too Close Bike Path	Tree Fell	Unknown	2. Trail	IC-9	37.9110636	-122.6901792	Blue Gum	unknown	unknown	None Observed		
Engineer (IC) Assessment: Tree too Close Bike Path	Whole Tree Removal	Unknown	2. Trail	IC-19	37.9106598	-122.6897513	Blue Gum	42	unknown	None Observed		

20

11

DRAFT



*Figure 1 Zone 5 PG&E crews repair destruction caused by falling trees along Mesa Road*

**DRAFT**



## **The Bolinas Eucalyptus Project Inventory: Zone 5**

**A REPORT ON THE INVENTORY OF BOLINAS PUBLIC UTILITY DISTRICT AND  
ADJOINING TREES IN ZONE 5**

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**MARCH 2023**

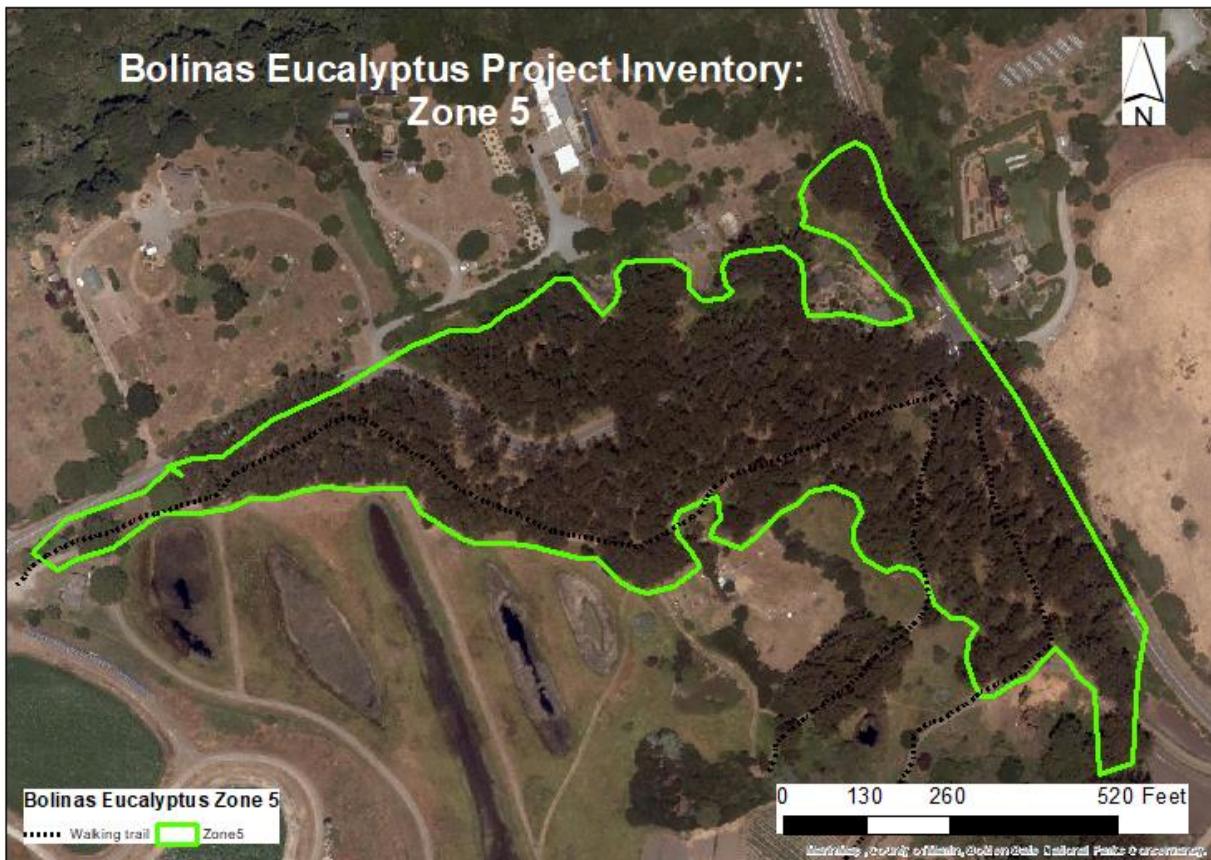


Figure 2 Zone 5 11.9 acres

## 1. INTRODUCTION

Iconic stands of Tasmanian blue gum (*Eucalyptus globulus*) trees have been a part of California's cultural heritage since the 1860's. They were to be the timber solution for a state about to run out of wood (Farmer, 2014). Millions of blue gums were planted throughout the Bay Area. Today Eucalyptus trees are the fading Bay Area tree giants. Stands of Eucalyptus are experiencing decline and tree mortality due to drought, winds, the maturation of over-crowded stands and disease (Dowd 2021).

The Eucalyptus trees in Bolinas are no exception. Blue gum woodlands were planted around 1900 at several locations. The stand known today as "Zone 5" at Mesa Road and Olema-Bolinas Road was most likely established as a windbreak. The trees survived and thrived. They grew rapidly and apparently also sprouted or seeded into adjoining areas that today comprise a pure 11.9 acre stand. Bolinas Public Utility District (BPUD) owns 7.6 acres and another 2.9 acres are owned by adjoining private landowners. The trees overhang the roadway on the remaining 1.4 acres. Roadside trees were topped when quite young and they responded by sprouting vigorously. Those same trees were topped again during the 1960's. Today Eucalyptus trees

have grown up to 170 feet tall and many are over 60" in diameter at breast height. In 2011 BPUD, cognizant of increasing risks of wildfire and need for safer emergency ingress/egress, thinned and reduced the grove's woody fuels. This was done by removing the thicket of smaller trees, the understory shed bark, fallen branches, climbing ivy vines, accumulated leaf litter and decomposing wood on the forest floor of its portion of the stand (south of Mesa Road). Meanwhile many backyard Eucalypts on the northern 3 residential parcels have been pruned, thinned or removed, while others are in a wild condition untended for a century by the landowners and residents.

More recently the Bolinas Eucalyptus Project has been calling for the removal of the hazardous trees. The call for removal has become more urgent following the 2023 January chain of atmospheric river events which, over the course of a few days, blew down 24 large trees measuring up to 63" in diameter. Luckily nobody was killed although 2 persons were severely injured in their vehicle when it was crushed by a falling tree. Several vulnerable homes are located nearby and when blue gums blow down, the results can be catastrophic. Another cause for concern is that the popular public walking trails through Zone 5 place users at risk from falling debris.

Recent blow down has apparently also enlarged wind corridors increasing the likelihood of ongoing windthrow. The large old trees are falling, so the call has come from many members of the community to remove the Zone 5 Eucalypts and embark upon a native forest habitat restoration project.

Tree work is extremely expensive and environmental constraints in the coastal zone are many. It makes sense to physically quantify any large vegetation management project as part of the planning process. When the BEP contacted Tom Gaman, a Registered Professional Forester who lives nearby, he recommended, with approval of resident and BEP leader Jon Cozzi, a 100% tree inventory project. Gaman designed an inventory which includes detailed maps, and a count of all trees so the community knows exactly what is there, and where. This report is the analysis of measurement of all the trees. It includes assessment of stand condition, "target" hazards of falling branches on trails, roads and buildings, Monarch observances, analysis of 2023 blowdown, estimation of surface fuels, a calculated figure of total cubic foot volume, biomass with carbon equivalents, online ground and aerial imagery, the base field data, and other information.

## **2. ZONE 5 LOCATION**

The village of Bolinas includes several Eucalyptus stands. The largest is known as Zone 5, an 11.9 acre stand, surrounding the intersection of the Olema-Bolinas Road and Mesa Road and extending along both roads. All residential, commercial and tourist traffic coming and going passes through this intersection, a 3-way stop.

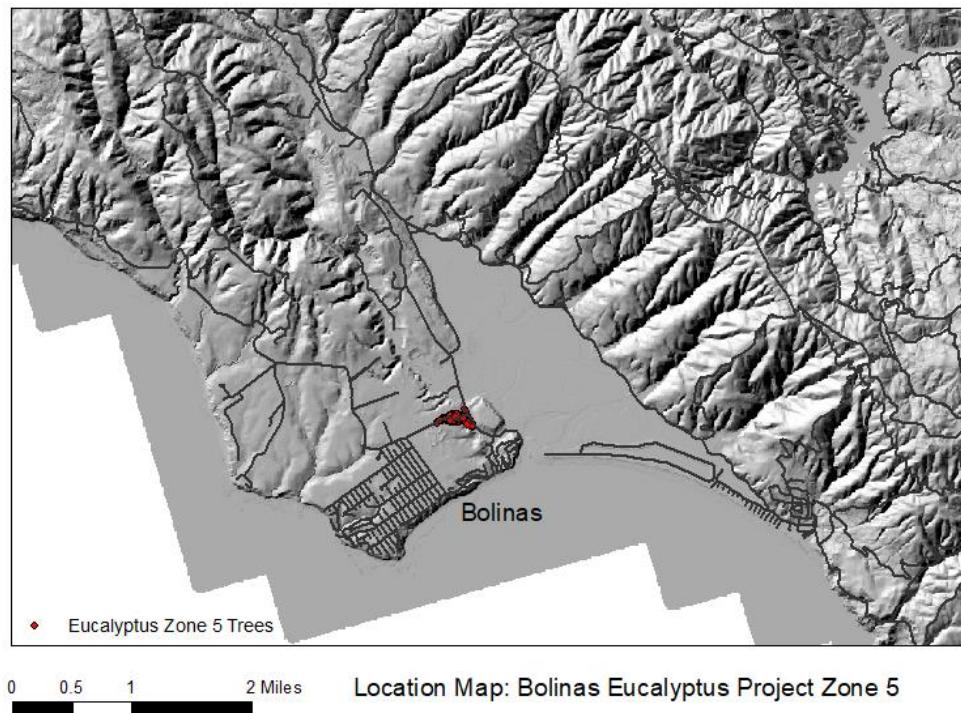


Figure 3 Zone 5 location map

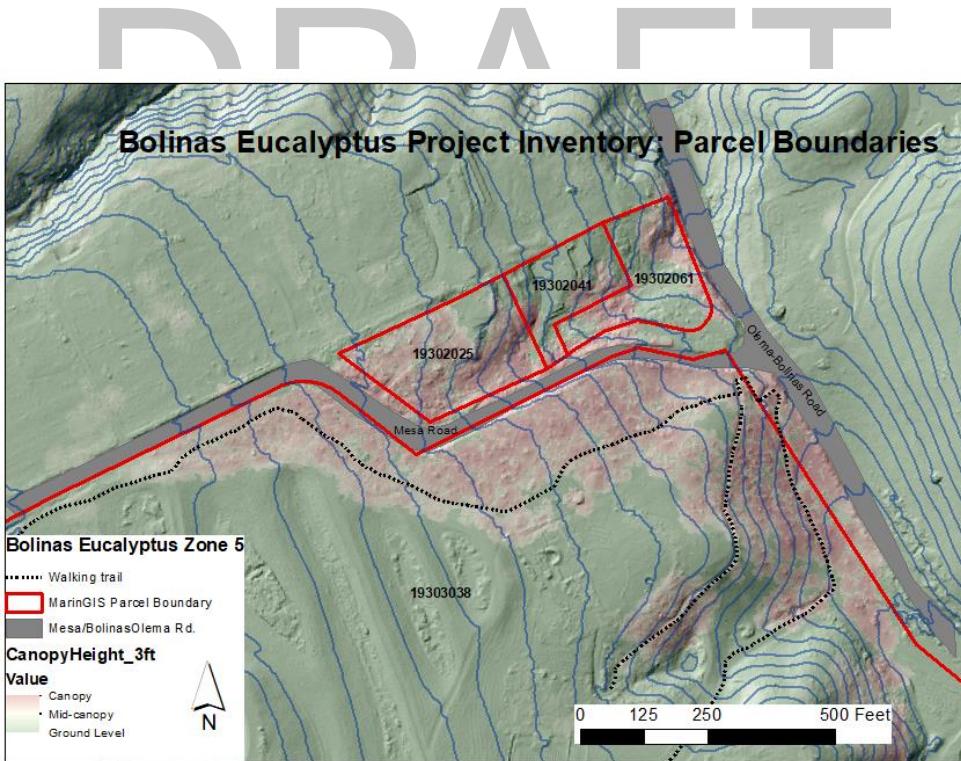


Figure 4 Zone 5 Marin Parcels. The 3 smaller parcels are privately owned, and the large southern parcel belongs to the Bolinas Public Utility District

### 3. METHODS

This 100% georeferenced inventory of the grove provides necessary baseline planning information. The forester designed the inventory to include measurements and a GPS waypoint for every tree in 20+” diameter-at breast height” (dbh) classes and to provide sufficient georeferencing. Diameter of each of the smaller trees surrounding each 20+ inch larger measure tree, when present, was estimated and the total number of smaller co-located trees was also recorded at each location. Smaller trees were assigned randomized coordinates on a 10x10 meter grid surrounding the applicable nearest larger measure tree so location of each could be approximated and mapped with reasonable accuracy.

Round aluminum 16d nails were used to attach aluminum numbered tags near the base of each measure tree. Prior to field work, each tag and nail was lightly sprayed with brown paint at the office so that tags would blend in well and trail users would not notice them. Each tree was assigned a tag numbered from 00 to 99, and the GPS assigned waypoints of the same number prefixed with a single letter (A through N) to avoid possible confusion of duplicated tree tags. The waypoints were collected using a Garmin Csx60 GPS that, under ideal conditions, is capable of 3- to 5-meter accuracy.

In the field the forester measured each 20”+ diameter class tree with a steel diameter tape and/or a Biltmore stick (which triangulates diameter). The forester used a survey grade Impulse 200 laser with a built-in clinometer to measure a subset of tree heights throughout the grove and estimated the others so that height was recorded for 100% of the measure trees. With a few minor exceptions each tree with 19.5” or greater diameter (20”+ class) is tagged near its base with an aluminum numbered tag. The diameter, height, canopy width, live crown ratio (crown status), condition, position, rot defect, Monarch observations, and potential local hazard target was recorded for each of these “measure” trees. All data variables are listed below:

Table 1: Measure Trees >=19.5" at breast height (20"+ diameter classes)

<b>For measure trees (20+ inches diameter classes) the following data were recorded:</b>
Grove name
Date
Tree Tag #
Waypoint ID
Tree Species
# Stems (of measure tree plus surrounding dbh only count trees)
DBH1 (in)
Height (ft)
% Defect
Crown Diameter (ft)
Position
Condition
Tree Photo
Branch/Bole Structure
Target hazard
Live Crown Ratio
Photo Series Fuels (tag 10x)
Butterfly Use observation
Notes

It is also important to have an accurate count of the smaller trees but detailed data is not as important. Therefore the smaller trees, as explained above, were counted and attributed with estimated diameter and approximate location.

Table 2 Trees <20" diameter at breast height

<b>For smaller "satellite" trees diameter only was estimated for each tree up to a maximum of 7 trees (including the measure tree (DBH1)).</b>
<b>Species</b>
DBH2
DBH3
DBH4
DBH5
DBH6
DBH7
Instrument Longitude
Instrument Latitude

The tabular data items were collected using the smart phone app “GISCloud”. At the end of each field day data were downloaded and imported to Excel and into ArcGIS 10.8.4. The forester also randomly photographed approximately half of the trees measured and GISCloud attached the photo to the applicable tree data set. The individual photographs with accompanying tree numbers are included in the Excel file named “Bolinas\_Zone5\_photo\_report.xlsx” available as an 80 Megabyte download<sup>1</sup>.

Given the thousands of data items the GISCloud app served as an excellent tool with which to keep data collection organized and efficient.

## MAPPING

Standard GIS mapping tool ArcGIS served to georeference and map all of the Zone 5 trees. Standard topographic contours, LIDAR “Hillshade” raster data, vector data for roads, and NRCS “NAIP Imagery” provide locational context for the maps. In the office the technician digitized the local roadway using the Hillshade model as a base map<sup>2</sup>. Given the dense stand of trees it turned out that the Garmin GPS and the Android smart phone GPS did not in many cases provide the exact location of trees. For example, many roadside trees appeared in the middle of the road. The maps show adjusted locations for many roadside trees to improve mapping accuracy. Within the stand some trees may be mapped outside of the 3-5 meter locational tolerance that the Garmin device had estimated in the field.

## BLOWDOWN

During January 2023 severe rainfall and windy weather struck the Northern California coast in the form of a string of 9 “atmospheric river” storms. Over several nights 24 trees in the stand blew down. All trees in the blowdown area were measured after the storm when they were already on the ground. As such, post-storm blow down inventory and standing tree inventory are independent of each other and reported separately here. Please refer to the blowdown section below under “Results”.

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<sup>1</sup> Photos, Excel files, aerial video, and maps located for public access at [https://drive.google.com/drive/folders/1CV\\_BGTtmhURdHhsIrPEJJqJ9wqpd7PXe?usp=sharing](https://drive.google.com/drive/folders/1CV_BGTtmhURdHhsIrPEJJqJ9wqpd7PXe?usp=sharing)

<sup>2</sup> See <https://gisopendata.marincounty.org/>

## 4. RESULTS

### THE TREES

The grove at Zone 5 is one of many stands of Tasmanian blue gum (*Eucalyptus globulus*) in the Bolinas area. Based on a ring count of one roadside tree that fell in January 2023, this grove of *Eucalyptus* was planted around 1900. Untended trees within the grove soon spread and developed to dominate 11.9 acres in 2 age groups, “roadside” and “sprouts”. Trees within the grove are largely untended except that some understory fuels and trees up to 8” in diameter were in 2011 thinned from the BPUD parcel to reduce fire hazard, resulting in the clean, open and parklike understory ground cover that is mowed each year and still exists there. Electric and phone wires are strung on poles running along Mesa Road and Olema-Bolinas Road. The trees themselves have long been in competition with each other for sunlight, moisture, and nutrients. The recent drought has also affected the stand. Throughout the stand dead branches are scattered within the crowns of all but those trees (27% of total) assessed as in “Good” condition. In some areas, particularly on the private parcels, English ivy (*Hedera helix*) and Cape ivy (*Delairea odorata*) are covering the ground and clinging to the trees. A few coast live oaks (*Quercus agrifolia*) and even two understory Douglas-fir (*Pseudotsuga menziesii*) trees have survived in less-shaded areas, but the ground understory does not support any other significant native vegetation.

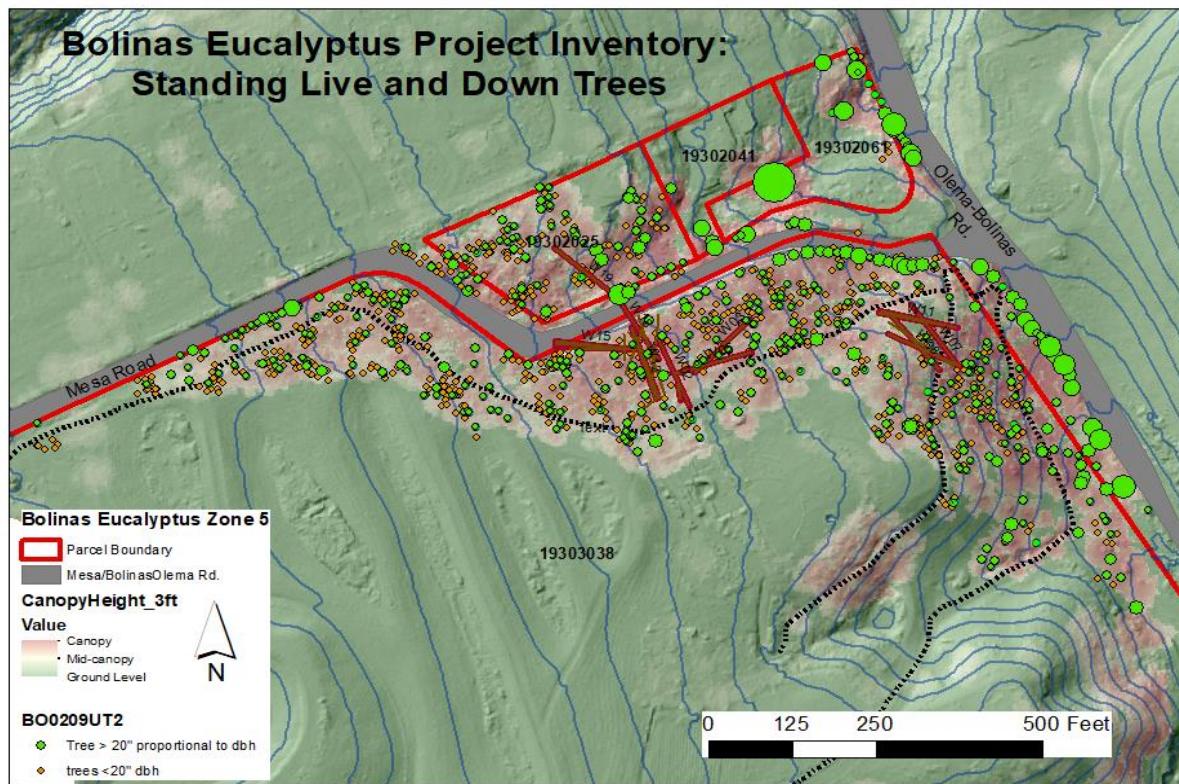


Figure 5 1139 trees. 11.9 acres. The size of each green dot represents relative tree diameter

## GPS TREE LOCATION

As noted above the GPS files identified only the approximate locations of each tree. Trees obviously in the incorrect locations, and streetside trees, were checked in the field and, where inadequate, the map locations were manually adjusted accordingly. On-site aluminum tags can be used to confirm tree identity in the field.

## THE INVENTORY

Measure trees. Four hundred thirteen (413) live trees over 19.5" dbh were measured and GPS locations were recorded in the field. Detailed data items described above were recorded for each tree. The raw data are included in a file named "linkfile022323.xlsx" and this file is reproduced here in Appendix 5.

Tree Species. Of the large trees measured 399 (95.7%) were blue gum (*E. globulus*), the largest of which is a 140" Eucalyptus (which splits into 4 stems) near a house on the north side of Mesa Road. There were 12 Monterey cypress (*Cupressus macrocarpa*) and 6 Monterey pine (*Pinus radiata*), all of which are located at perimeter of the grove. A very small number of coast live oaks and Douglas-fir are also present at the edges of Zone 5 but none met the threshold for measurement.

# Stems by Diameter. Tree diameters were measured to the nearest inch of diameter at breast height (4.5 feet off the ground on the uphill side of the tree) and assigned to diameter classes. For instance, a 19.6" tree is included within the 20" diameter class. There are 413 "Measure"

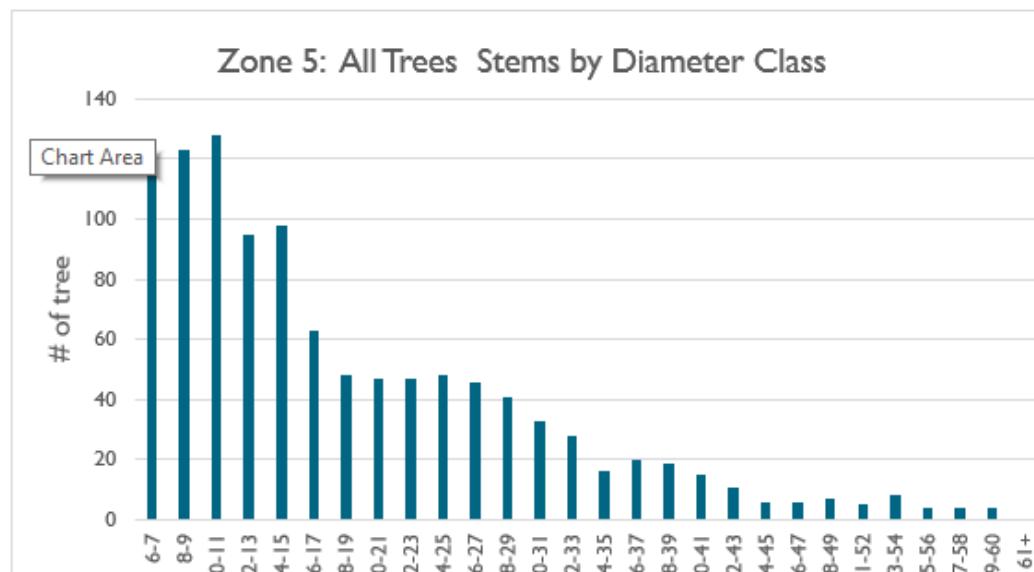


Figure 6 Number of trees by diameter class

trees in the 20" and above diameter classes in Zone 5 and 1139 trees including all trees 6" and larger. Figure 6 shows the number of trees in each 2-inch diameter class grouping.

Height (Ht). Individual “measure” trees were each assigned a measured or estimated height. Smaller trees were assigned heights in the office using a regression equation. Mature tree heights generally varied from 120’ tall to 170’ or more on better sites. Height competition is intense. Many of the smaller trees are almost equal in height to their more robust neighbors. Of the 413 large trees measured the average height was 132’.

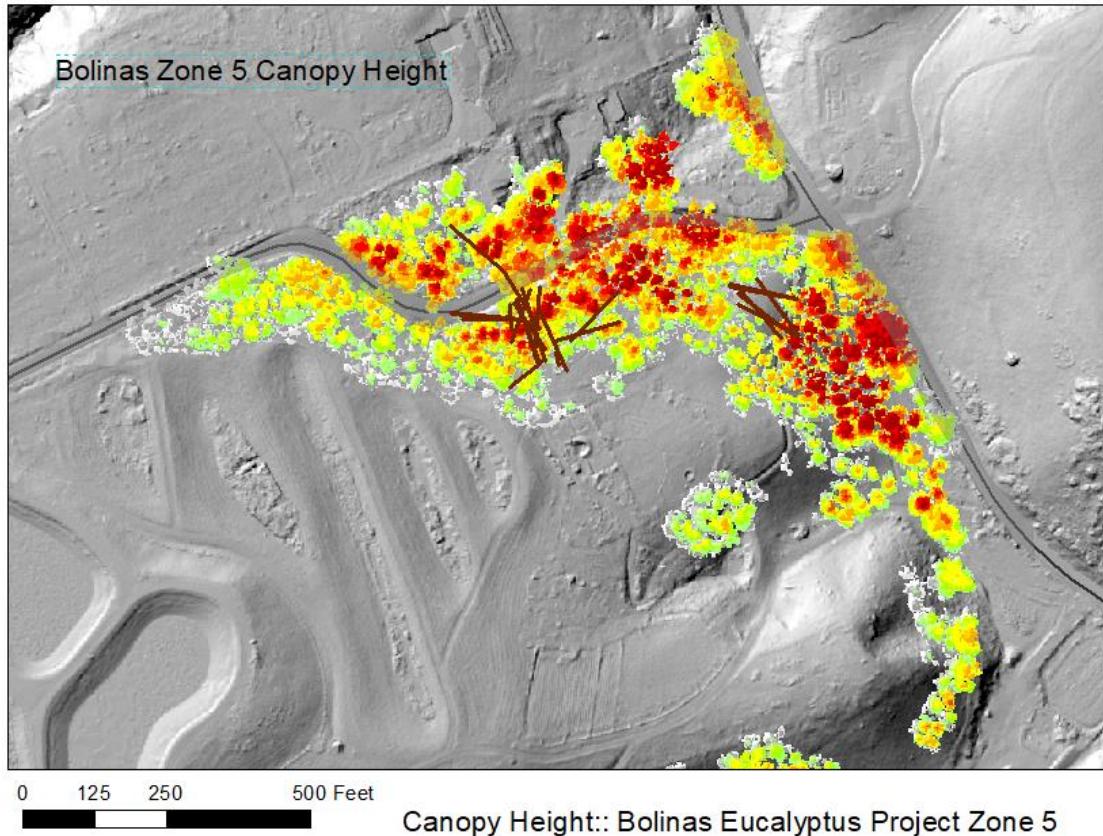


Figure 7 Canopy height: low to tall trees in white, green, yellow, orange and red respectively.

Crown Diameter. Crown width varied dramatically. Open grown trees and dominant trees without significant competition from neighbors had crowns spreading 40 to 60 feet or more. The many tall but smaller-in-diameter trees that are in crown competition with neighbors, and have endured prolonged drought, commonly had live crowns as low as 5 to 10 feet in diameter. The average crown width was 26 feet per ocular estimation of 413 “measure” crowns.

Live Crown Ratio. Live Crown ratio is the percentage of the total tree height which supports green live branching. The value is commonly used in assessing forest health and in modeling predicted future forest conditions. In natural stands in the Sierra and Coast ranges of California healthy trees normally exhibit a live crown ratio of 40% or more. In this stand the average live crown ratio is 24% reflecting intense competition among unhealthy tree crowns struggling for access to sunlight. Dead branches are interspersed with live branching.



*Figure 8 Typical view of Zone 5 sparse Eucalyptus crown looking upwards*

To further investigate the canopy and crown condition of the trees aerial drone imagery (flown March 1, 2023) vertical aerial photography and video demonstrates the crowded condition, branch mortality, and sparse foliage of the trees. The high-resolution photos and video are viewable online at the link in the footnote on page 7. Note the crowded stem density, sparse crowns and dead branches.

**Canopy Closure.** An important metric in forest stand assessment is canopy closure. This inventory does include a crown diameter estimate for each large measure tree. When all the trees' crown areas are compiled the large ("measure") tree canopy closure on the 11.9 acres is 55%. Placing a grid over Zone 5 and counting squares reveals a canopy density of 90%. The crowns are mostly non overlapping so this measurement indicates that 700+ trees less than 19.5" in diameter collectively share 35% of the crown space. As such the available canopy area represents insufficient crown availability for the codominant trees in the lower diameter classes. Throughout the inventory it was clear that most such smaller tree crowns are very sparse and most of those trees are severely stressed as a result.



Figure 9 Looking west toward sparse tree tops and crowded canopies at Zone 5. Aerial imagery March 2023.

Position. Each tree is evaluated as to its status relative to neighboring trees. Classifications are Open-grown, Dominant, CoDominant, Intermediate, and Suppressed as defined in the Forest Inventory and Analysis Field Handbook (Appendix 3, USFS 2021); 86% of trees were Dominant or Codominant<sup>3</sup>

Row Labels	Count of Position
1 Dominant	171
2. Codominant	184
3. Intermediate	48
4. Suppressed	5
5. n/a (broken)	5
<b>Grand Total</b>	<b>413</b>

Structure and Defect. Tree structure was also recorded for “measure” trees. Options were “None”, “Previously topped”, “Falling Branches” and “Shedding Bark” and combinations of these classifications. Fifty-six (56) trees, mostly roadside trees, had clearly been previously topped wherein the top of tree was removed and the live tree had responded by sprouting multiple tops, often leaving a structural wound vulnerable to wind throw, moisture accumulation and subsequent rot or breakage at a weak point. One hundred ninety-six trees had “Falling Branches” which means that there were “top heavy” or fully dead branches in the crown that can unpredictably fail even in calm weather. Nineteen trees had “Shedding Bark”

<sup>3</sup> See Appendix 2 US Forest Service 2021 FIA Manual

which could add to the fuel bed and fire hazard, and 156 trees had no structural issues. Many trees had “defect” which means that there are areas where rotten wood or another irregularity is evident. Defect is the percentage of visible wood volume in the stem of the tree suspected to include rotten areas often at risk of breakage that also would not be suitable for carbon storage or forest products. Most trees in the grove are defect free but some exhibited rotten bole or other areas of rot. Overall defect averaged 3.3% by volume. The internal effects of visible structural defects are classically illustrated by Alex Shigo (Shigo 1983) who spent his career investigating rot and woody defect in many species.

Condition. The forester used his experience and judgement to classify each measure tree according to its overall vigor into 3 groups: Good, Fair or Poor. Both “Fair” and “Poor” classifications outnumbered the “Good”. The reason for this is that these mature trees were never thinned and lived long lives in intense competition with one another for light, water and nutrients, and the condition of most reflects those life-long struggles. Also Dowd (2021) reports that Matteo Garbelotto, UC Berkeley Forest Pathologist, found two fungi, *Diaporthe foeniculina* and *Dothiorella viticola*, that seem to be ubiquitous in these trees, and may be negatively impacting Eucalyptus stands here. Voracious leaf chewing Australian tortoise beetles (Family *Chrysomelidae*) are also known to consume vast quantities of tree leaves in this stand of trees (Cozzi, 2023). With only 27% of trees in the “Good” condition group this begs the question of whether it is possible to sustain this fragile overstocked woodland much longer. Thinning is not the answer to improve health as this stand is highly exposed and vulnerable to severe and increasing wind disturbances.

DRAFT

Tree Condition

Classification	Count of Condition	% of total
Good	112	27.1%
Fair	177	42.7%
Poor	124	30.0%

Number of trees and basal area. There are 413 measure trees, and another 726 smaller trees growing among the larger measure trees. The diameter distribution is shown on Figure 6 above. Basal area is a commonly used forestry metric that describes stand stocking measured as the total combined area of stems at 4.5' above the ground. For instance, a forest with 400 6" dbh trees per acre has the same basal area ( $\sigma \pi \times \text{radius}^2$ ; 78.5 sq. ft./acre in this example) as a stand with 100 12" dbh trees. When added together the trees at Zone 5 account for a basal area of 288 square feet of live growing stem per acre and represent an extremely densely stocked hardwood stand of trees. By comparison using the example above, a well-stocked coast live oak stand has about 80 to 100 square feet of basal area. This means that this area, a native coast live oak woodland, is now supporting about 3 times the woody basal

area of its native condition, and the trees themselves are double the height of the natives, resulting in perhaps as much as 6 times the native biomass stocking by volume.

Biomass and Carbon. Trees in the inventory ranged from 6 inches to 140 inches in diameter at breast height. The overall average diameter is 19.4 inches for 1139 trees. Pillsbury et al. (1989) produced the volume equations for central California coastal Eucalyptus that became the basis for volume calculations. A portion of the Pillsbury report is replicated with tree tables and notes below:

DBH inches	Total height in feet:														
	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
4	1	1	2	2	3	3	3	4	4	5					
6	2	3	4	5	6	6	7	8	9	10					
8	4	5	6	8	10	11	13	14	16	18	19				
10	6	8	10	12	14	17	19	22	24	27	29	32			
12		11	14	17	20	24	27	30	34	37	41	45	48	52	
14		14	18	23	27	31	36	41	45	50	55	59	64	69	74
16		18	24	29	35	40	46	52	58	64	70	76	82	89	95
18		30	36	43	50	58	65	72	80	87	95	103	111	118	
20		36	44	53	61	70	79	88	97	106	116	125	135	144	
22		43	53	63	73	84	94	105	116	127	138	150	161	172	
24		62	74	86	99	111	124	137	150	163	176	189	203		
26		72	86	100	114	129	144	159	174	189	204	220	236		
28			99	115	131	148	165	182	200	217	235	253	271		
30				112	131	150	169	188	207	227	247	267	287	308	
32					127	148	169	190	212	234	256	279	301	324	347
34						142	165	189	213	237	262	287	312	337	363
36							158	184	210	237	264	291	319	347	375
38								203	233	262	292	322	353	384	415
40									224	256	289	321	355	389	423

NOTES: The equation for this table is: Volume (cubic feet) = 0.0015658 x DBH (in)<sup>1.86903</sup> x Tot Ht (ft)<sup>1.13556</sup>.  
Data shown are gross cubic foot volumes (outside bark) to a 2-inch top.

Figure 10 From Pillsbury et al. 1989

Heights were not recorded for trees <19.6" dbh. Using Excel the technician calculated the height for each of those trees via linear regression, then used the volume equation for English values (above) to calculate the cubic foot volume (Vol) for each Eucalyptus tree. Altogether, this process accounts for 163,852 net cubic feet of above-ground wood including bark but not branches. At the generally accepted cordwood volume denominator (85 solid cubic feet per cord, not including the airspace in a 128 cubic-foot cord of stacked firewood) the stand contains 1,927 cords of wood.

Tejedor calculated the specific gravity of *Eucalyptus globulus* at 571 kg per metric ton. Volume and carbon were calculated for the Eucalyptus trees only. The biomass of the Zone 5 Eucalyptus trees calculates to be 2,415 metric tons of which 79% is in the large trees. Three hundred ten (310) Eucalyptus "measure" trees, averaging 31" dbh and totaling 1391 metric tons above ground biomass, are located south of Mesa Road on BPUD property. Eighty-One (81) trees averaging 38" dbh, with 522 tons of biomass, are on north side private parcels. There are many

trees among both groups likely located within the county road right of way. Biomass metric tons and carbon dioxide equivalents for above ground Eucalyptus are provided in the table below.

Table 3 Eucalyptus Biomass and Carbon Dioxide Equivalents

<b>Bolinas Zone 5 Eucalyptus Only</b>		<b>Biomass metric dry tons above ground</b>	<b>CO2 Equivalent metric tons</b>
<b>Area</b>			
South of Mesa Road 20"+ measure trees		1,391	2,548
North of Mesa Road 20"+ measure trees		522	956
Grand Total for all Zone 5 Eucalyptus Trees down to 6" dbh		2,415	4,424

Target Hazards. The grove is located at a sensitive area along main roads, near houses, and in an area with popular recreational trails. Tree failures have been dramatic. I assessed the immediate area around each tree for “local target” in the event of failure of branches or breakage of the upper stem. All measure trees were assessed plus 4 individuals that became place markers for smaller trees, which were not assessed for target hazards. Targets further than about 50 feet from each tree were not considered unless tree condition is poor and the tree is leaning in the particular direction of a clear “target”. Overall almost 69% of trees had some local target in the immediate vicinity. Fifty-nine percent of the trees could potentially impact a road or trail.

<b>Row Labels</b>	<b>Count of “Local Target” hazard</b>	<b>% of total</b>
0. None	131	31.4%
1. Road	126	30.2%
2. Trail	120	28.8%
3. Building	40	9.6%

When great weather disturbances happen and Eucalyptus trees fail in the spectacular manner of the trees in this stand, and entire 150' tall trees and enormous branches collapse without warning, these numbers are not applicable. In such cases every tree is clearly a hazard tree. It

is quite impossible to predict what will happen next, but it is at the same time very clear that this stand of trees at the gateway to Bolinas and Point Reyes National Seashore creates extraordinarily threatening roadside conditions.

Forest Fuels. Eucalypts are known for dropping branches that establish understory fuels and for creating fuel ladders simply by shedding bark, and for their highly combustible fragrant oils in the bark and leaves. The 1991 Oakland fire storm was unstoppable, partially due to blue gums burning out of control. Forest fuels accumulate in the understory and on the ground and, in times of drought when dry autumn winds reduce moisture content of the vegetation to very low levels, Eucalyptus stands pose a serious threat to nearby communities.

As part of the inventory the forester assessed woody forest fuels under most of the measure trees. The quick assessment was completed with the aid of the Wright and Vihnanek photo series which measured the woody ground fuels and classified them for field comparison with a photo series which includes photos of East Bay Eucalyptus stands classified from Low (1) up to High (7) categories.

#### Forest Ground Woody Fuels

Row Labels	Count of Woody Fuels	Tons per Acre per Wright and Vihanaek
1. EBE1	23	5.27
2. EBE2	91	8.23
3. EBE3	111	9.79
4. EBE4	83	13.43
5. EBE5	33	16.35
6. EBE6	22	13.91
7. HiF03 (estimated)	16	20

In an ideal world where the fuels reported by Wright and Vihnanek correspond perfectly with the conditions viewed in Zone 5 at Bolinas, the forest floor at present would be supporting 11 tons of woody debris per acre, but of course this is just an estimate. The fact remains, however, that the woody fuels on the forest floor vary dramatically over the area encompassed by Zone 5 as shown in the map below. Cognizant of the fire hazard, BPUD did some work in the grove in 2011 and the understory fuels were thinned out. Each year BPUD mows the area under the trees to maintain understory fuels at levels as low as possible. The map below shows the accumulation of fuels to be widely distributed (from low to high) throughout the grove.

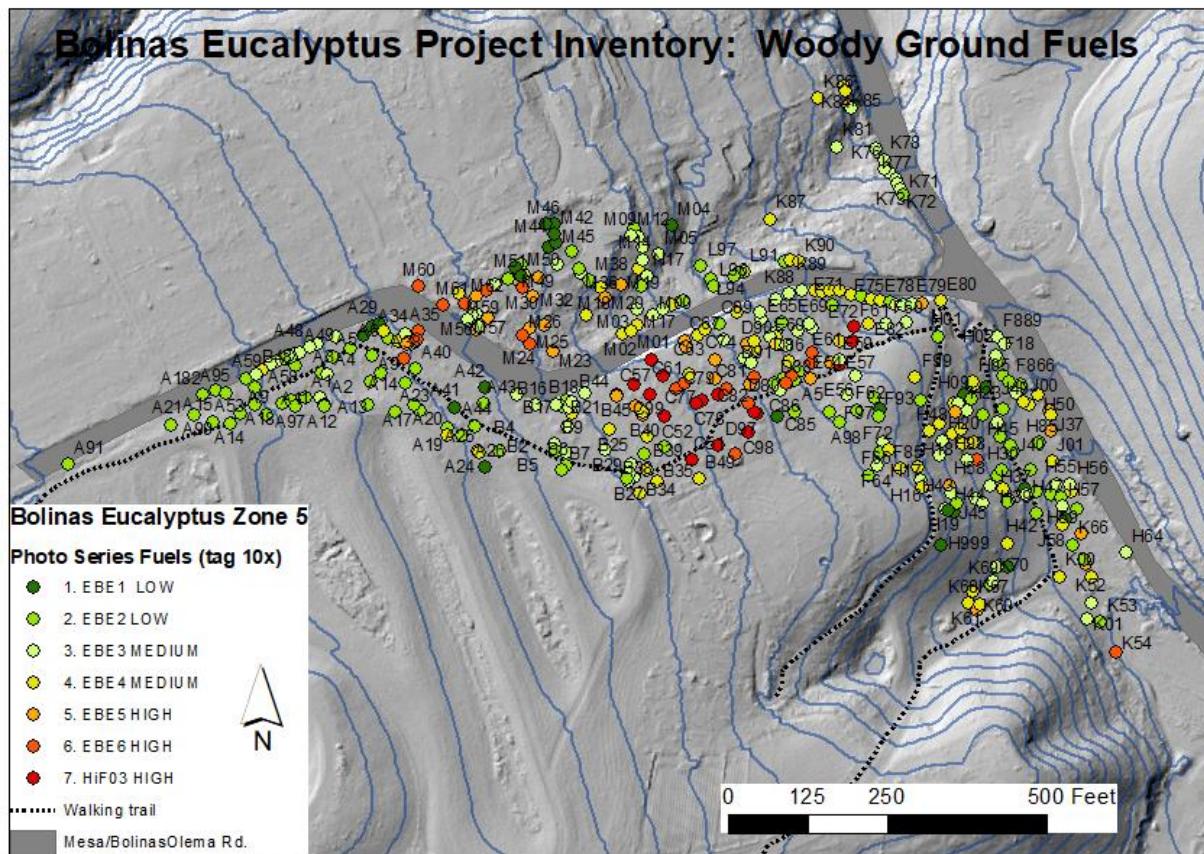


Figure 11 Woody ground fuels (Low in green and High in red)

#### WINDFALL AND BLOWDOWN TREES, ROOT STRUCTURE

During the January 2023 storm series 24 trees within the grove blew down over several nights. These trees were 14" to 63" in diameter and each had been over 100' tall. Half of the blown down trees were over 20" in diameter and 5 of them were 30" and larger. Several smaller but tall trees were hit by falling trees. They broke and they fell. A small number of other trees are "leaners", supported by their neighbors, and they could fall at any time. Aside from the damage to the stand of trees the impacts of the storm included major injuries to 2 persons in a passing vehicle. The forester reviewed the damage to the stand and measured each fallen tree's diameter, GPS location and direction of fall. Most windfall trees were lying on the ground with azimuth of west to northwest. The exceptions were the very large 63" blue gum that fell across the road, and collateral damage of fallen trees struck by adjacent blown down trees. The elimination of 24 trees created new gaps in the canopy which render residual trees increasingly vulnerable to ongoing blow down. Though most trees that fall are blown down by the south or northerly winds during saturated soils conditions, it does not seem possible to predict which trees will fall next, or in which direction.

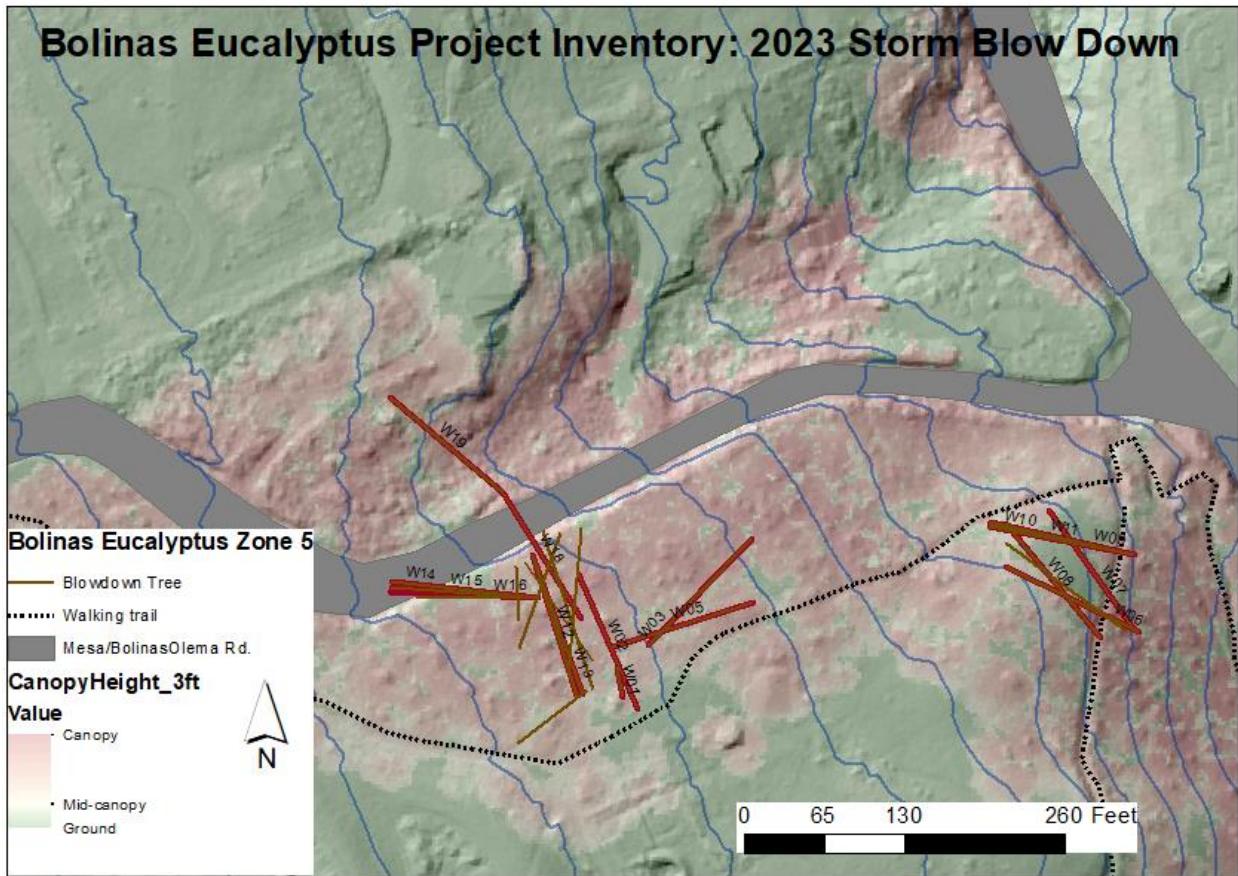


Figure 12 Trees blown down in the January 2023 winds

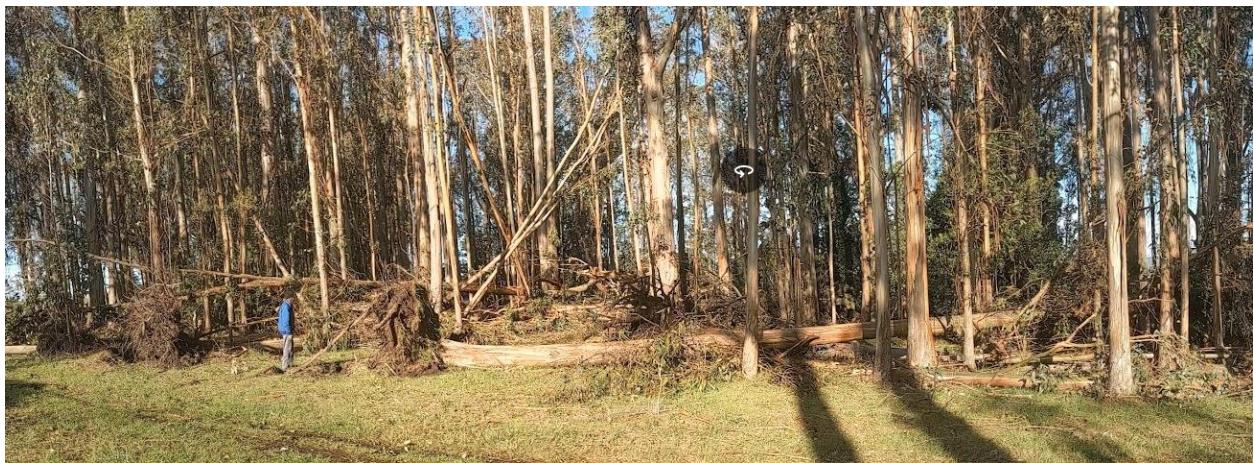


Figure 13 Some January 2023 wind thrown blown down trees

On March 3, 2023, a month after the January storms another tree, nearby the 63" tree that had fallen earlier, failed during calm clear conditions. Its collapse caused 2 of its neighboring trees also to fall. Those trees and large broken branches descended onto Mesa Road, destroying a power pole and wires, extinguishing electricity service to the local area for some time. PG&E

crews worked day and night (Figure 1). Fortunately, no vehicles were traveling the road as the trees fell. Others were not so lucky. On March 22 falling trees killed 3 persons in separate Bay Area incidents during a “bomb cyclone” event.



*Figure 14 Two large trees fell across Mesa Road on March 3, 2023*

The photo below shows the ground saturation that occurred shortly after a tree along Mesa Road blew down. The root balls had been consistently anchored each with a large number of 1-2" diameter roots. In Figure 15 the water table had risen to the point that the large tree structure was not supportable given the wet soil conditions, but earlier in the same week, other trees had blown down without a high level of root ball saturation. The trees at Zone 5 today are up to 3 times the height of the native oak woodland trees that most likely occupied the site in pre-European times. This suggests that the soils in the area have not evolved with large, and tall trees that are vulnerable to the high gusts of southerly winds characteristic of Pacific coastal winter storms.



Figure 15 Root ball alongside Mesa Road

## MONARCH BUTTERFLY USE

**DRAFT**

The Monarch butterfly migration occurred during the period of the inventory project and this is a phenomenon of great interest. The forester, accompanied by local butterfly experts, on a single occasion observed four blue gum trees being used by butterflies for roosting or daytime activities. Three of those trees were at the edge of the grove with sunny south-facing exposure, during calm temperate conditions which evidently created a suitable microclimate on that late-autumn day. Campbell (2022) cites many native and non-native host tree species each that “provides a dense and mature canopy”. Over time, use of the Zone 5 stand represents 1.45% of Bolinas Thanksgiving Count Monarch observations over the last 25 years (Xerces, 2023). New Year’s counts conducted from 2018 to 2023 have likewise only produced 22 Monarchs over the 7-year period, or an average of 3 butterflies a year. Given the sparse and deteriorating canopy conditions of this stand, the fact that no Monarch use has been reported at the site for 14 of the past 22 years, and supposing that the Monarchs have been utilizing coastal woodland habitats for many thousands of years, the evidence suggests that a native woodland restoration project could be developed that would enhance future Monarch habitat here.

Monarch butterfly populations and ecology will be covered in detail by the forthcoming WRA biological report.

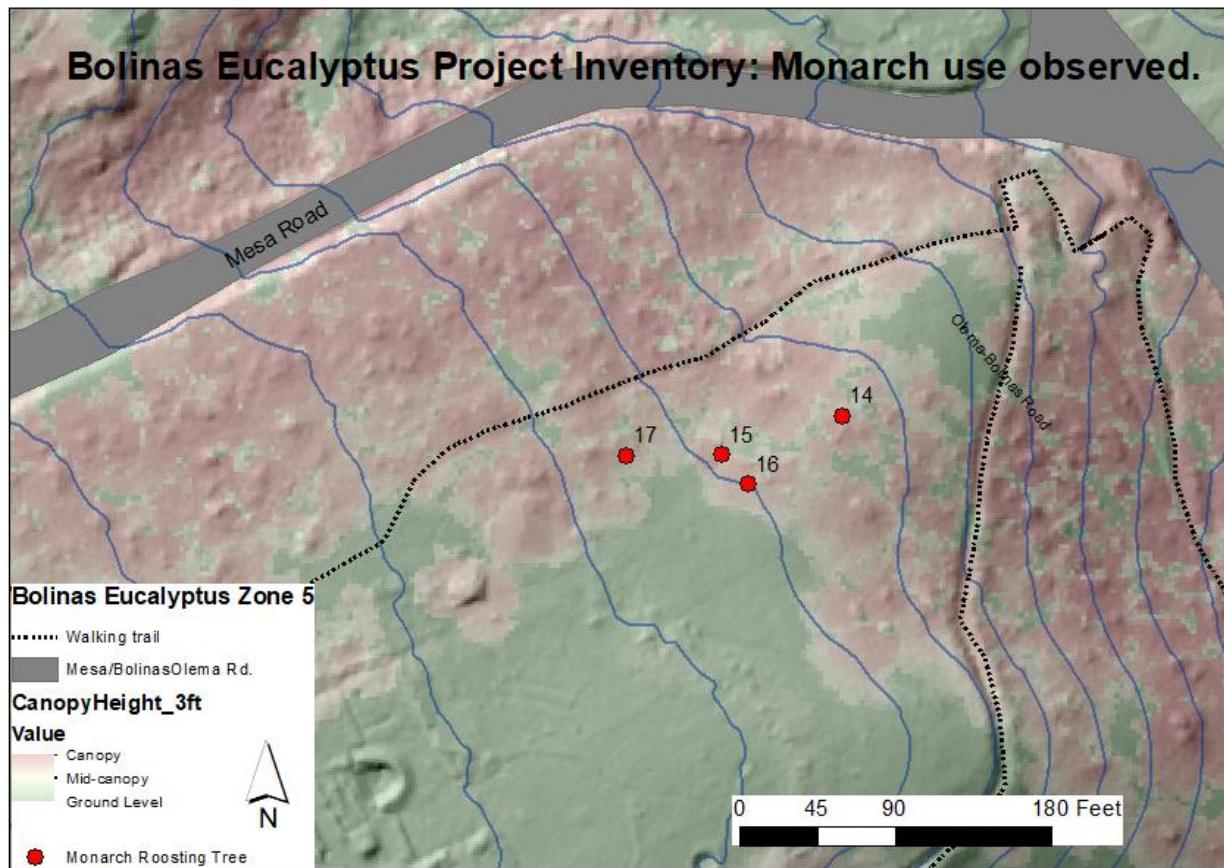


Figure 16 Monarch use observed December 2022

## IVY AND INVASIVE PLANTS



Figure 17 Vines of English ivy and Cape ivy climbing trees on a private parcel

There is extensive vine cover of English ivy and Cape Ivy spreading mostly on the northerly parcels. Suffice it to say that the allelopathic nature of Eucalyptus stands effectively eliminates native flora and instead results in fire- and windthrow-prone monocultures that attract hardy invasives such as broom, English Ivy, cape ivy, and Acacias. Such conditions are common around the Bay Area and they create artificial exotic vegetative conditions that beg for the restoration of oak woodland biodiversity that supports the broad array of native flora and fauna.

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## 6. APPENDICES

Appendix 1. Digital TREE PHOTO REPORT linkfile021023\_photo\_report.xlsx Photos, Excel files, and maps located for public access at <https://1drv.ms/u/s!AihFbfICwtAwgahAx7p5-r4ESYk2VA?e=IjZl91>

## Appendix 2. High Resolution MAPS (see below)

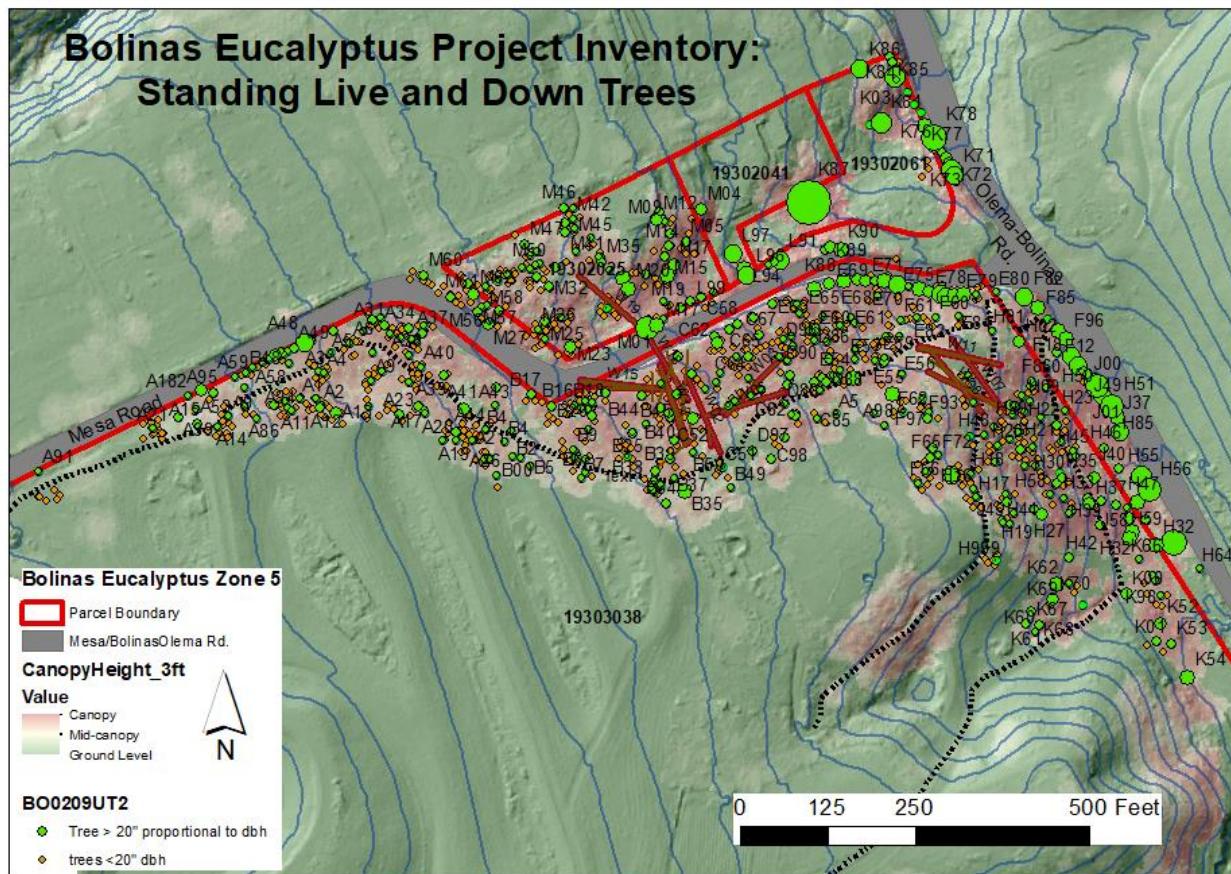


Figure 18 This is Figure 5 with tree numbers included

High Resolution Maps 1 to 3. Please note that these slightly adjusted GPS positions are per Garmin CSX60 capabilities under dense canopy.

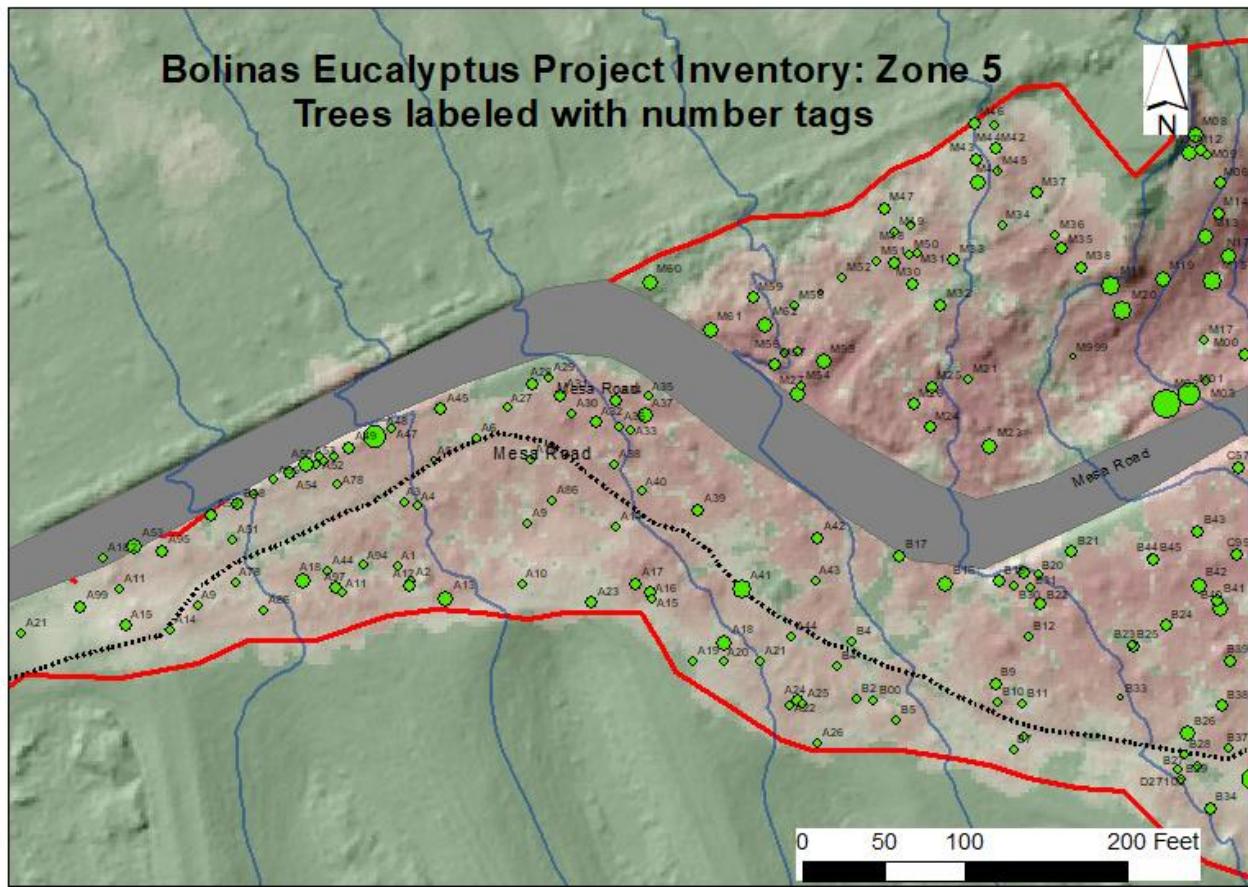


Figure 17 Field Map West

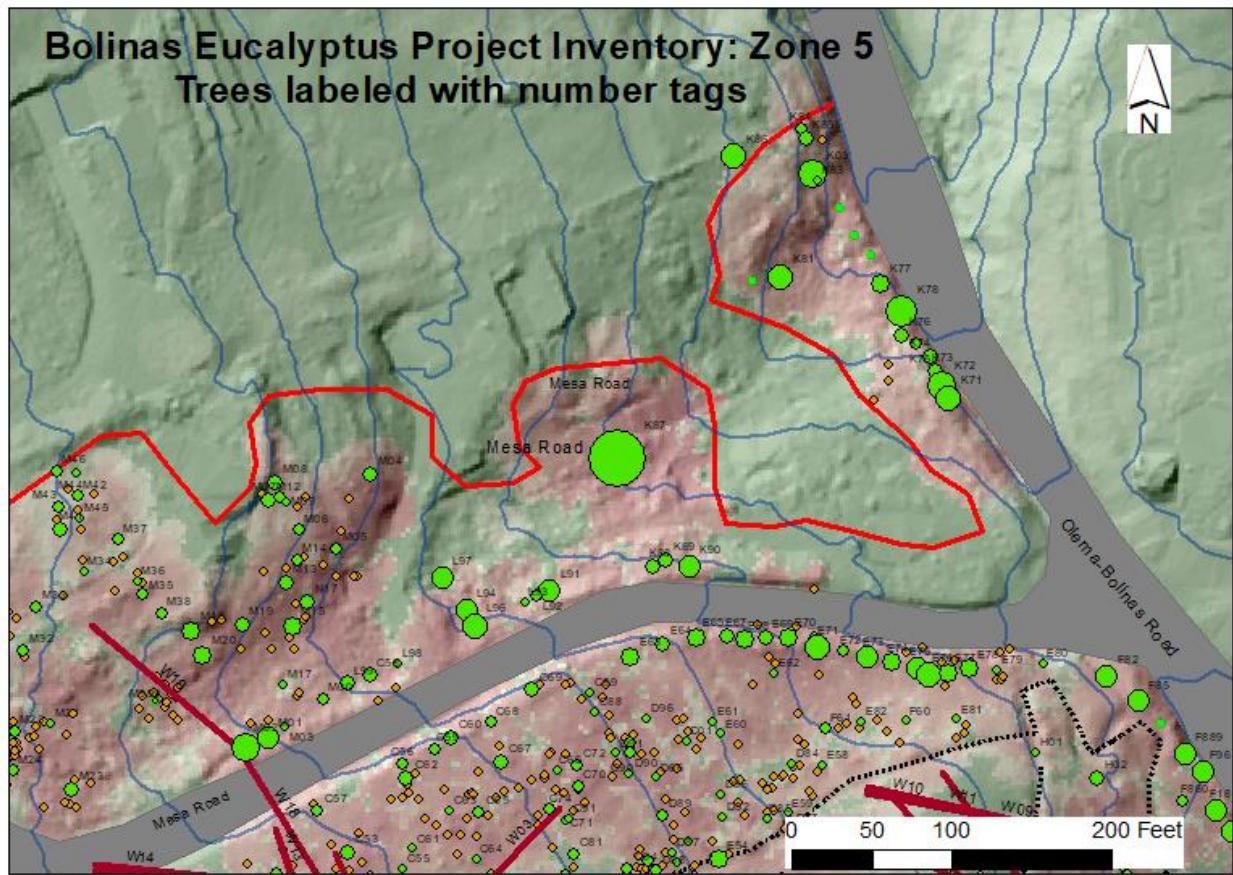


Figure 20 Trees with Tag Numbers Northeast

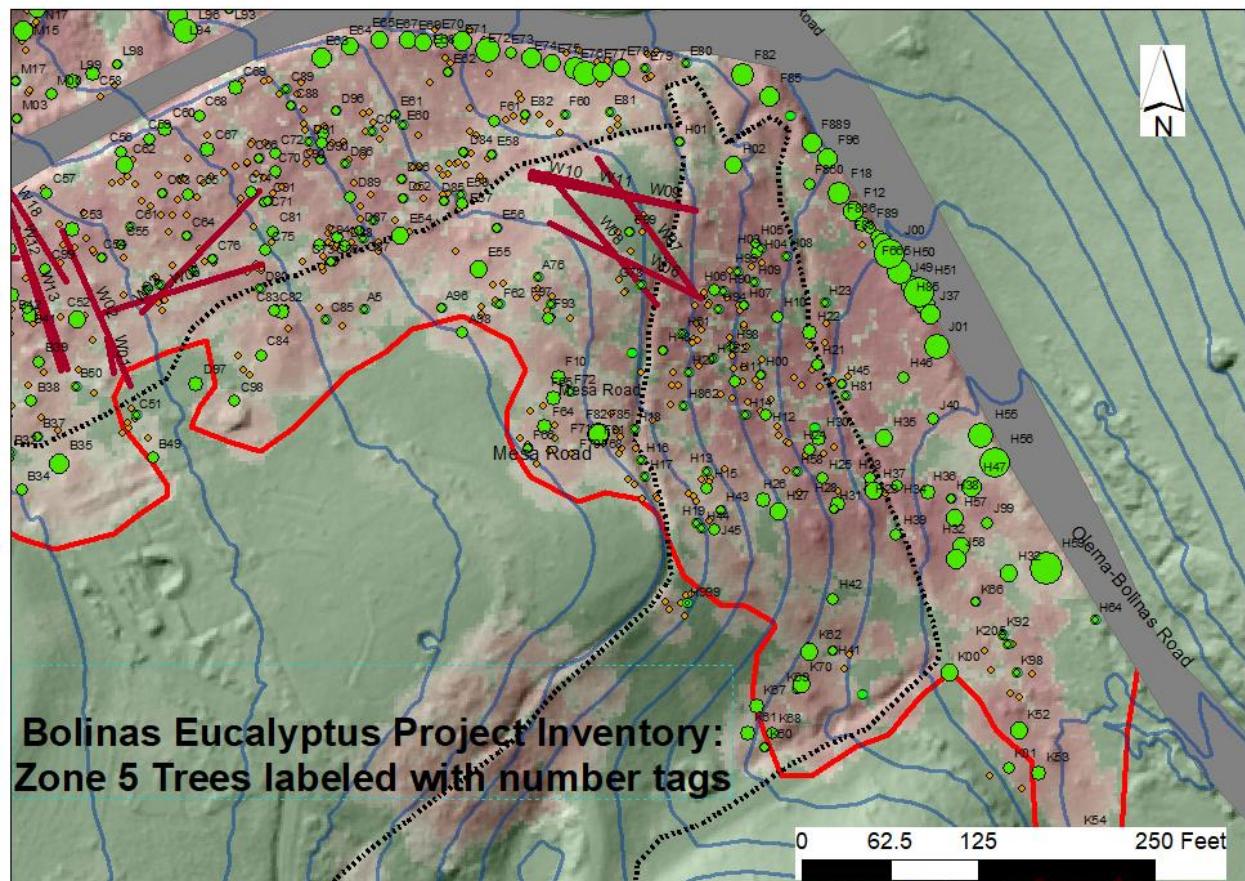


Figure 21 Trees with tag numbers southeast

Appendix 3. This Appendix is included to inform readers on “Crown Class”.

**FIELD INSTRUCTIONS**  
**FOR THE ANNUAL INVENTORY OF**  
**CALIFORNIA, OREGON, AND WASHINGTON**  
**2021**

When GROWTH SAMPLE TREE = N, the CROWN CLASS from the previous visit will be downloaded.  
Update this value if there is an obvious error or change.

When Collected:	All live tally trees $\geq 1.0$ inch DBH/DRC	
Field width:	1 digit	
Tolerance:	No errors	
Values:	Code	Description
	1	Open Grown – trees with crowns that received full light from above and from all sides throughout most of its life, particularly during its early developmental period.

	2	Dominant – trees with crown extending above the general level of the crown canopy and receiving full light from above and partly from the sides. These trees are taller than the average trees in the stand and their crowns are well developed, but they could be somewhat crowded on the sides. Also, trees whose crowns have received full light from above and from all sides during early development and most of their life. Their crown form or shape appears to be free of influence from neighboring trees.
	3	Co-dominant – trees with crowns at the general level of the crown canopy. Crowns receive full light from above but little direct sunlight penetrates their sides. Usually they have medium-sized crowns and are somewhat crowded from the sides. In stagnated stands, co-dominant trees have small-sized crowns and are crowded on the sides.
	4	Intermediate – trees that are shorter than dominants and co-dominant, but their crowns extend into the canopy of co-dominant and dominant trees. They receive little direct light from above and none from the sides. As a result, intermediate trees usually have small crowns and are very crowded from the sides.
	5	Overtopped – trees with crowns entirely below the general level of the crown canopy that receive no direct sunlight either from above or the sides.

Appendix 4: Photos, Excel files, aerial video, and maps located online for public access at  
<https://1drv.ms/u/s!AihFbfICwtAwgahAx7p5-r4ESYk2VA?e=ljZl91>

Appendix 5: Inventory Field Data

Appendix 3: Moritz Report on  
Hazardous Roadside Trees



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## ***Eucalyptus and Monterey Cypress Tree Failure Analysis and Risk Assessment***

### **Prepared for:**

**Bolinas Community Public Utility District**  
270 Elm Road  
Bolinas, CA. 94924

### **Prepared by:**

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**ASSIGNMENT:**

Ray Moritz, Senior Urban Forestry Consultant for Urban Forestry Associates (UFA), was contacted by Jennifer Blackman, General Manager of the Bolinas Community Public Utility District (BCPUD) to inspect several sites for the cause(s) of tree failures and the potential risk of associated trees. Ray Moritz is a SAF Certified Forester #241, NW ISA Chapter Certified Tree Risk Assessor, and ISA Tree Risk Assessor Qualified (TRAQ). I inspected the 270 Elm Road and the East Mesa Road X Olema Bolinas Road grove (aka Zone 5) sites on numerous occasions from January, 1983 to July 12, 2023. I inspected the 290 Mesa Road "tank farm" trees on May 12, 2023 and July 5, 2023.

**LOCATIONS:**

1. 270 Elm Road - (Cypress trees along the west side of Elm Rd. and north side of Nymph/Jute Road)
2. East Mesa Road eucalyptus grove (70 Mesa Road to 16 Olema Bolinas Road)
3. 290 Mesa Road (along frontage of water tank facility)

**TREE RISK ASSESSMENT:**

Risk assessment is the analysis of the likelihood of a failure event and the severity of potential consequences. Tree risk assessment combines the likelihood of a tree failure and impacting a target with the severity of its associated consequences (personal injury, property damage, or disruption of activities). All trees or tree parts have some level of risk if they are likely to impact a target of significant value. Where there is no target of significant value, there is no risk. The level of risk aversion of the tree owner or property manager determines what action, if any, is taken. The manager also decides what trees are to be assessed and the level of assessment. The role tree risk assessor is to identify, analyze and evaluate tree risk, and recommend mitigation or abatement practices. Recommendations may also include target management practices.

***Levels of Risk Assessment (as defined by the ANSI A300 Standards for Tree Care Operations)***

- Level 1 - Limited Visual: A limited visual risk assessment is sometimes referred to as a *walk by* or *drive by* assessment. It is most common in urban forest scenarios where trees are abundant and resources for inspection are relatively scarce. A limited visual is not necessarily a complete 360-degree inspection and may be employed in situations where access is limited. Professionals conducting a limited visual assessment identify high-risk trees that are mitigation priorities. This level of assessment is the most common level used by cities, government agencies and large forested property owners. This level of assessment may include recommendations for higher assessment levels for specific trees.
- Level 2 – Basic Visual: A basic visual assessment is a 360-degree inspection from the ground that is more thorough and typically includes height and diameter measurements. An assessor may use binoculars for crown inspections, a mallet for sounding hollows, a probe for inspecting cavities, and other common tools to conduct the inspection. This is the most common level used on residential properties.
- Level 3 – Advance Assessment: An advanced assessment can be an aerial assessment or an assessment that includes quantitative decay detection, health evaluation, wind load assessment, and static load assessment. Given the more advanced tools and methodologies employed, this service is often offered at a premium to the customer and typically reserved for heritage or high value trees.

The recommended level for this assessment was a Level 1 inspection, but in practice a Level 2 inspections were performed on trees with serious defects targeting sites with moderate or frequent occupancy, potentially medium to high impacts, with potentially significant to severe consequences. (See Figure below)

### Target Occupancy Rates:

1. Constant: Target(s) is or are constantly present or a steady stream of mobile targets in the target zone.
2. Frequent: A target that is occupied during a large portion of the day or week. A target zone with moderate volumes of traffic such as, a suburban street, playgrounds or sidewalks in shopping areas.
3. Occasional: Sites infrequently occupied by targets of value, such as country roads, low-use foot paths, or low-use sections of parks.
4. Rare: Rarely used trails or roads, remote areas of parks, areas with low mobile occupancy resident time for only part of the day, such as a low-use trail or country road with virtually no use at night.

Condition number	Tree part	Conditions of concern	Part size	Fall distance	Target number	Target protection	Risk Categorization										Risk rating of part (from Matrix 2)	
							Likelihood											
							Failure		Impact			Failure & Impact (from Matrix 1)						
							Improbable	Possible	Probable	Imminent	Very low	Low	Medium	High	Unlikely	Somewhat likely	Likely	Very likely
1																		
2																		
3																		
4																		

Matrix 1. Likelihood matrix.

Likelihood of Failure	Likelihood of Impacting Target			
	Very low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2. Risk rating matrix.

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

### **Target Occupancy rates:**

1. 270 Elm Road: Frequent occupancy by partially protected targets (people in cars), occasional use at night, except during events. Frequent occupancy for parked cars during the day and frequent occupancy for people protected by vehicles or the building.

2. Nymph/Jute Road: Occasional occupancy for exposed people. Frequent occupancy for protected people. Constant occupancy by house, but low impact with minor consequences.
3. 290 Mesa Road: Occasional occupancy by mobile targets during the day by partially protected people. Rare occupancy at night by mobile targets with partially protected people.
4. 70 Mesa Road to 16 Olema Bolinas Road: Frequent use by mobile targets with partially protected people. Occasional use late night to early morning by mobile targets with partially protected people.
5. "Zone 5" east Mesa and Olema Bolinas Roads Eucalyptus Grove trail and bike path: Occasional occupancy by mobile, exposed people during the day, rare occupancy at night.

#### Disruption of Activities:

1. 270 Elm Road: Moderate disruption.
2. Nymph/Jute Road: Minor disruption.
3. Maple Road: Moderate inconvenience.
4. 290 Mesa Road: Highly significant impact.
5. Travel along East Mesa Road from 70 Mesa Road to Olema Bolinas Road: Highly Significant disruption.
6. Olema Bolinas Road from Masa Road to 16 Olema Bolinas Road: Highly Significant disruption.
7. Emergency access/egress: Highly significant disruption and delays.

#### SPECIES CHARACTERISTICS:

##### **Blue Gum (*Eucalyptus globulus* 'globulus') WCISA group #4 class coast #5, inland #3**

Tasmanian Blue Gum (*Eucalyptus globulus* 'globulus'), commonly known as Blue Gum is a shallow rooted species, often with poor anchorage relative to the height and mass of mature trees. This species frequently grows rapidly to a mature height and canopy spread far greater than the available growing space in urbanized landscapes. It is one of the fastest growing trees in the world. This species resprouts prolifically from dormant buds below the bark when it is been aggressively topped or cut to a stump.

This species is one of the more failure prone species in northern California, along with Monterey pine, coast live oak and Monterey cypress. It has heavy wood and is prone to developing over-extended limbs. Tasmanian Blue Gum may grow rapidly to a mature height and spread far greater than the available growing space. It sprouts prolifically from dormant buds below the bark when it has been aggressively trimmed or topped.

Fire hazard studies have found that Blue Gum produces more dead and down material (branches, exfoliated bark, twigs and leaves) per annum than any other species in California. It contains approximately 8,500 BTU's to the pound and an unmaintained mature forest may contain 30.84 tons per acre of down and dead debris.

The leaves and bark contain high amounts of volatile oils. It has deciduous bark that may litter the ground around the tree, collect in crotches and persist in long hanging strips on the trunks and branches. Unmainted Blue Gum forest may support high intensity fire and is highly prone to "fire brand" production that can ignite wildland, landscape and structural fuels well ahead of the flame front.

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Excerpt from Gilman, E.F. 1997. Trees for Urban and Suburban Landscape. Delamar Publishers. Albany, NY.

**Height:** 60 to 165 feet

**Width:** 30 to 80 feet

**Form:** strongly decurrent (spreading umbrella canopy); massive trunk and limbs

**Fruit:** persistent, woody capsule

**Growth Rate:** rapid, 36 inches per year

**Habit:** decurrent; evergreen, moderate density; symmetrical; coarse texture

**Light Requirements:** full sun

**Heat Tolerances:** can tolerate cool coastal or intense heat

**Soil Tolerances:** all textures; slightly alkaline to acidic; droughty

**Pest Problems:** Eucalyptus Longhorn Borer tortoise shell beetle, psyllid

**Diseases:** Armillaria, Phytophthora root rots

**Pruning Requirements:** needs occasional safety pruning, deadwood removal

**Limb Breakage:** medium weak

**Water Requirement:** No irrigation to moderate water once established

**Climactic Zones:** Sunset Western Garden Book Zones: 5, 6, 8-24; H1, H2

### Monterey Cypress (*Hesperocyparis macrocarpa*) WCISA group #2 class coast #3, inland #3

Monterey cypress is considered to long-lived but its life and utility in the urban environment may be much shorter. "Trees from 14 to 19 inches in diameter are from 60 to 85 years old. Some of the larger trees are doubtless over 200 years old." "It is most important as one of the rare forest trees capable of forming a cover on the wind-swept coast." (1908, Sudworth, "Forest Trees of the Pacific Slope) It is highly valued for its dense, dark green foliage, its spreading, craggy, contorted form, and its rapid growth up to maturity but it can be maintained as a clipped hedge.

This tree is well-adapted to developed sites. It can thrive under an extraordinary amount of site development. This species is one the most commonly used landscape trees in California. It is typically recommended as specimen tree but also as a hedge or windbreak. Under ideal conditions it lives for more than 200 years but in many urban settings its useful life may be 100 years or less.

**Height:** 40 to 80 feet (often pruned to a lower height by sea blast).

**Width:** 25 to 35 feet

**Form:** strongly pyramidal in youth; developing a massive trunk and limbs

**Fruit:** persistent, woody one inch round cones

**Growth Rate:** rapid, 36 inches per year

**Habit:** excurrent in youth, becoming decurrent at maturity; evergreen, moderate density

**Light Requirements:** full sun to partial

**Heat Tolerances:** can tolerate cool coastal or heat

**Soil Tolerances:** prefers well-drained, but tolerates all textures; slightly alkaline to acidic; droughty

**Pest Problems:** Cypress Tip Miner, cedar, and cypress Bark Beetles, and termites.

**Diseases:** Armillaria root disease, Phytophthora root rots, cypress canker (*Cytospora cardinalis*), *Coryneum* Canker, brown-rots enter through wounds and fractures

**Pruning Requirements:** needs occasional safety pruning in advanced age, poor wound closure.

**Limb Breakage:** medium weak, often forming poor attachments

**Water Requirement:** Irrigate until established; no irrigation once established

**Climactic Zones:** Sunset Western Garden Book Zones: 17, 16 and 15

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1. Excerpt from Gilman, E.F. 1997. Trees for Urban and Suburban Landscape. Delamar Publishers. Albany, NY
2. SelecTree. UFEI. "Hesperocyparis macrocarpa Tree Record." 1995-2023. Cal Poly State University, San Luis Obispo. Accessed on Jul 22, 2023. <https://selectree.calpoly.edu/tree-detail/476>

## 270 ELM ROAD RISK ASSESSMENT

Limb and whole tree failures have been occurring in this cypress boundary/roadside planting for many years. The major storms of 1982, 1983, 1986, 1995, 2005/2006, 2016/2017, the 2013-2016 drought, the 2020-2022 drought and now in 2023 seven atmospheric rivers and two other severe storms have all had significant impact on these trees, weakening their stability with a long chain of storm blasts. These environmental impacts are in addition to the fact that these Monterey cypresses have far outlived their utility life expectancy.

Like many Monterey pine, Monterey cypress and blue gum wind rows or boundary plantings, these trees were planted too close to one another, causing them to interfere with each other's root systems as well as providing very limited growing space for canopy spread (See Figures 2, 3 & 4). Consequently, there has been severe competition for light and growing space resulting in excessive height growth and unbalanced canopies (See Figures 3 & 4). The canopies have been "lion's tailed" by competition and lower limb failures. This created tall lever arms exerting force on the inadequate root systems and resulted in long trunk and branch wave lengths under wind loads. The remaining trees are now at maximum height for the species, 85 feet. (See Figure 3)

The depletion down to just 17 trees remaining from the original planting of about 50 trees along these two roads attest to the common structural defects of the entire windrow.

**Recommendation:** Directional fell the entire windrow into the field. Remove and chip branches for fire prevention. If the border planting is replaced consult a consulting arborist about species selection and spacing.



**Crowding = Deformed Root System**

Figure 1 – The crowded planting of the cypress border planting allowed little room for root growth.



Figure 2 – The crowding of the trees has led to abnormal root and canopy development.



**Crowded planting = Lion's Tailing & Excessive Height**

Figure 3 - Competition for growing space has led to excessive height growth, lion's tailing and lever force on the compromised root systems.



Figure 4 - Lack of adequate growing space has asymmetric canopies with over-extended limbs and in many cases lion's tailed branches.

## **290 MESA ROAD EUCALYPTUS WINDROW**

The Blue Gum Eucalyptus windrow along the 290 Mesa Road tank farm was planted too densely. The high density caused some trees to be dominant over less vigorous trees that became suppressed. (See Figure 5) Crowding also caused inadequate canopy growing space, which deformed the canopies and individual branches. (See Figure 6) The east-west orientation of the windrow and a second windrow across the road also contribute to the poor form and vigor of the trees.

The health and stability of the windrow can be improved by removing subordinate/suppressed trees and safety pruning the trees recommended for retention.

### **Methods:**

Transect: A transect (measured line along which trees are located) was started at the east end of the windrow at the center of Tree 1 and continued west 246 feet to tree number 17. A transect number was taken for each tree at the approximate center of each tree. Notes were taken of the tree numbers and recommended pruning or removals.

Photographs were taken of the bases and canopies of the trees. The photographs were then marked for the recommended pruning. (See APPENDIX A)



Figure 5– Suppressed trees left, dominant tree center, deformed tree right.



Figure 6- Crowding resulted in crossing branches and asymmetric canopies.

## 290 Mesa Rd. Tree Data:

### Tree 1:

Transect: 000.0' Condition: T-1 is the east most tree in the windrow, closest to the gate to the tank area.  
 Recommendation: T-1 is a dominant tree. It has two over-extended limbs to the south (S) & southeast (SE)  
 Shorten these tow limb with reduction cuts. See APPENDIX A Photos 1 & 2

### Tree 2:

Transect: 022.0' Condition: T-2 is less crowded than many of the trees in the windrow, but the canopy is overtopped  
 Recommendation: T-2 is in the intermediate crown class. Crowded canopy. Two over-extended branches.  
 Shorten two over extended limbs with reduction cuts. See APPENDIX A Photo 2

### Tree 3:

Transect: 040.0' Condition: T-3 is dominant and crowds both T-2 and T-3b. There is a stump between T-3 and T-3b.  
 Recommendation: T-3 is asymmetric to the SE. It has one massive over-extended limb to the ESE into T-2  
 Remove the over-extended limb extending ESE into the canopy of T-2

### Tree 3b:

Transect: 048.5' Condition: T-3b is severely crowded by T-3 & T-4. See APPENDIX A Photo 3  
 Recommendation: T-3b is suppressed and malformed. It has two leaders with a weak acute angle crotch  
 The subordinate leader could be removed or it could be removed, benefiting T-3 & T-4

**Tree 4:**

Transect: 061.0' Condition: T-4 is a dominant tree that suppresses T-3b, T-5 and T-6. APPENDIX A, Photo 5  
Recommendation: T-4 has an asymmetric canopy to the south and has 3 over extended limbs to the S. Reduce the asymmetry with reduction cuts on the three over-extended limbs. Photo 6.

**Tree 5:**

Transect: 066.5' Condition: T-5 is severely suppressed by T-4. See APPENDIX A, Photo 5  
Recommendation: T-5 is suppressed and over-extended with poor taper. Photo 6 Remove and well cover stump with black plastic topped by black geotextile to kill..

**Tree 6:**

Transect: 069.0' Condition: T-6 is severely suppressed by T-4. See APPENDIX A, Photo 5  
Recommendation: T-6 is suppressed and over-extended with poor taper. Photo 6 Remove and well cover stump with black plastic topped by black geotextile to kill..

**Tree 7:**

Transect: 078.0' Condition: T-7 has a Dominant Canopy height over T-5 & T-6. See APPENDIX A, Photo 5  
Recommendation: T-7 has a relatively small canopy behind T-8  
No Action necessary.

**Tree 8:**

Transect: 090.5' Condition: T-8 is a dominant tree. It forces T-9 to the north and the T-9 canopy to the west. Photo 7  
Recommendation: T-8 is rooted at the base of the cut bank and has cracked the pavement. Its canopy is asymmetric to the south over the road. It has 4 over-extended limbs over the road. Remove one limb with poor taper and reduce three as shown in Photo 8.

**Tree 9:**

Transect: 096.0' Condition: T-9 is rooted close to and somewhat behind T-8. APPENDIX A, Photo 7.  
Recommendation: T-9 has been extensively pruned in the past. Its canopy is asymmetric to the west. Reduce one SW extending limb See Photo 8.

**Tree 10:**

Transect: 115.0' Condition: T-10 is rooted within a few feet of T-11 and is in the suppressed crown class. Photo 9.  
Recommendation: It is subordinated/suppressed by T-11 and has a small canopy to the north of T-10. Remove and well cover stump with black plastic topped by black geotextile to kill.

**Tree 11:**

Transect: 121.0' Condition: T-11 is in the dominant crown class.  
Recommendation: T-11 has four over-extended limbs with poor taper. See APPENDIX A, Photo 9  
Remove one over-extending limb to the south and reduce one limb. Photo 10

**Tree 12:**

Transect: 130.5' Condition: T-12 is highly suppressed between T-11 and T-13 See APPENDIX A, Photo 11  
Recommendation: T-12 is a highly suppressed stump sprout (second growth) Photo 11.  
Remove and well cover stump with black plastic topped by black geotextile to kill.

**Tree 13:**

Transect: 139.5' Condition: T-13 is a codominant two stem tree. See APPENDIX A, Photo 11  
Recommendation: It has one south over-extended branch with poor taper. See Photo 12  
Reduce over-extended branch. Photo 12

**Tree 14:**

Transect: 149.0' Condition: T-14 is rooted close to T-15 and slightly up slope. See APPENDIX A, Photo 13  
It is forced to the north by the more dominant Trees 13, 15 & 16. See Photo 14.

Recommendation: No action necessary on T-14..

**Tree 15:**

Transect: 153.0' T-15 is rooted down the cut bank. See APPENDIX A, Photo 13  
Condition: It has one SW over-extending limb. See Photo 14.  
Recommendation: Reduce the over-extended limb as shown in Photo 14.

**Tree 16:**

Transect: 164.0' T-16 is upslope and NW of the base of T-15 See APPENDIX A, Photo 13  
Condition: It has one over-extended limb to the south.  
Recommendation: Remove over-extended limb as shown in Photo 14.

**Tree 17:**

Transect: 246.0' T-17 stands alone 80 west of T-16 See APPENDIX A, Photo 15  
Condition: T-17 has two trunks, one of which is heavily bowed to the SW. See Photo 15.  
Recommendation: Remove SW bowed trunk.

**EAST MESA ROAD GROVE (ZONE 5)**

This approximate seven acre grove largely composed of Blue Gum Eucalyptus (*Eucalyptus globulus 'globulus'*) has expanded from Mesa and Olema Bolinas roadside plantings of Blue Gums and Monterey Cypress on both BCPUD and private properties, and has been under active management of many years. In 1964 PG&E cut back the Mesa and Olema Bolinas roadside Blue Gums to high stumps that sprouted second growth stems which are now over-mature. Pacific Slope Tree Cooperative, founded in 1978, has safety-pruned these roadside trees for decades, particularly after severe storm years. In 2011 debris and undergrowth were removed and the stand was aggressively thinned for fire hazard mitigation.

During the almost unprecedented 2022/2023 storm season of seven atmospheric rivers and two other severe storms, soils became highly saturated and heavy sea blast up to 100 mph caused the failure of numerous Monterey Cypress and Blue Gum Eucalyptuses throughout the San Francisco Bay area and beyond.

Private and BCPUD trees in the east Mesa Road stand failed.

**March, 2023 Gaman report: The Bolinas Eucalyptus Project Inventory: Zone 5**

Tom Gaman, a highly respected Registered Professional Forester, produced an inventory and a diagnosis of the "Zone 5" Eucalyptus grove. His survey and analysis is rigorous and thorough. However, I believe he makes a number of errors, or attributes the conditions of some original roadside trees to the entire grove.

Mr. Gaman typifies the East Mesa grove as a stand in decline or senescence due to drought, winds, over-crowding, over-maturity, disease and poor management practices, such as topping to high stumps and then allowing unrestrained sprout growth. Below please find my counter opinions:

- While the original planting of roadside trees may date back to the early 1900s, the majority of "volunteer" trees are much younger than the original roadside trees.
- While he states that "Today Eucalyptus trees have grown up to 170 feet tall and many are over 60" in diameter at breast height. ***Only the original roadside trees reach have grown to 60" in diameter.*** ***The vast majority of trees in the grove are far smaller. The 63" tree that fell was a road side tree on private property. Three other Mesa road side trees located on private property also fell.***
- Mr. Gaman's statement that in 2023 over a few days, storms "... blew down 24 large trees measuring up to 63" in diameter." ***Actually, one approximate 63" diameter Blue Gum tree on the edge of a ponding area on private property fell due to poor soil cohesion due to saturation, poor canopy***

*balance and root disease. The majority, if not all, of the BCPUD trees in this failure zone were not blown down. They were felled by the impact of the massive original growth tree that fell from the private property. I counted 15 BCPUD trees that were felled by this “domino effect”.*

*Of the other BCPUD trees that suffered storm related failures, most were “edge trees” around a small meadow in the NE corner of the grove and across the grove on the south side of the lower grove. Fewer than ten trees fell due to a combination of seven atmospheric river storm blast events, extreme soil saturation, poor root to shoot ratio, and root and canopy decline due to recent droughts.*

- Mr. Gaman did consider the potential for tree or branch failure. *However, he is not a qualified tree risk assessor (ISA TRAQ qualified), and he did not conduct a standard tree risk assessment.*
- He concluded the 69% of the surveyed trees (greater than 19.5 “ DBH) had “some local target”, and “Fifty-nine percent of the trees could potentially impact a road or trail.” *However, he did not differentiate between the “local targets” which are not equivalent to one another, and he did not address the likelihood that a tree would impact a failure zone when a significant target was present. A road or trail is not a significant target unless it is occupied by a significant target such as a hiker, a bicyclist, driven vehicle or pedestrian. A low use trail, particularly during a storm, has a very low probability of harm.*
- Mr. Gaman thoroughly documents the over-stocking of the stand which is a significant issue for tree health and form. *Stand density has been an issue for years in the East Mesa Grove. That is why it has been thinned twice, once in 1989 and again in 2011. While stand density is an important issue, canopy and root decline is also caused by drought and prolonged soil saturation. Additional thinning should be considered in ongoing stand management.*
- Turning his attention to fuels and fire behavior, he cites the role of Eucalyptus fuels as a contributing factor to the intense fire behavior in the 1991 Oakland/Berkeley “Tunnel Fire”. *The initial fuels of the Tunnel Fire were brush, an unfinished structure, habited structures and Monterey pine forest. Fire modeling has ignored the role of houses (zero enthalpy), but residential structures have many times the enthalpy (combustion heat yield) of forest types, including Eucalyptus. This is not to say that Eucalyptus crowning fire did not play an important role in the Tunnel Fire, but canopy fire can be controlled with undergrowth management, especially where the trees have high canopies. The 2011 thinning and undergrowth management significantly reduced the possibility of canopy fire in the grove. After the 2011 fire management treatment most of the grove was comparable to a Wright and Vihnanek EBE 2 level. Measuring understory branch debris and grass fuels after a series of severe storms does not provide an accurate picture of long-term fuel loading and architecture. Ongoing undergrowth management is critical to reduce the probability of crowning fire to a low level of significance. My inspection of the grove indicates that most of the grove is still at a EBE 2 level (8.2 tons per acre) (See Figures 7, 8 & 9)*

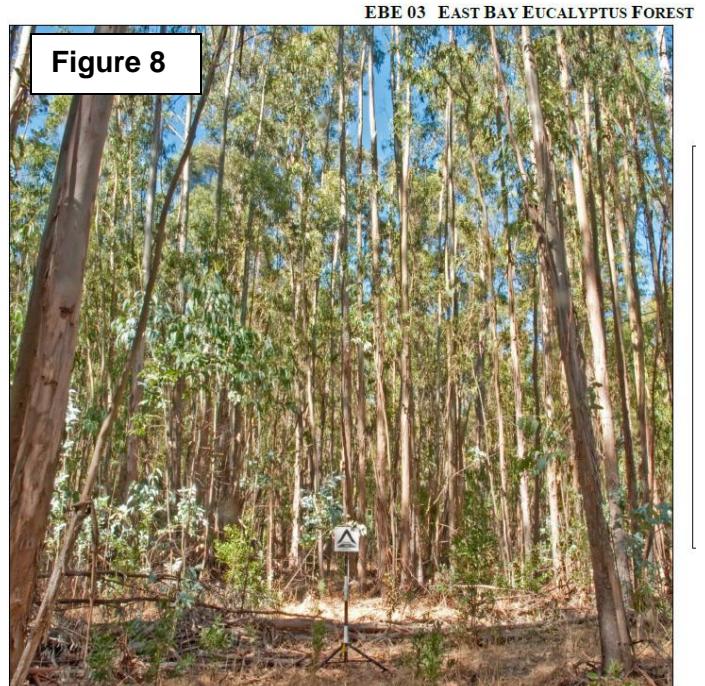
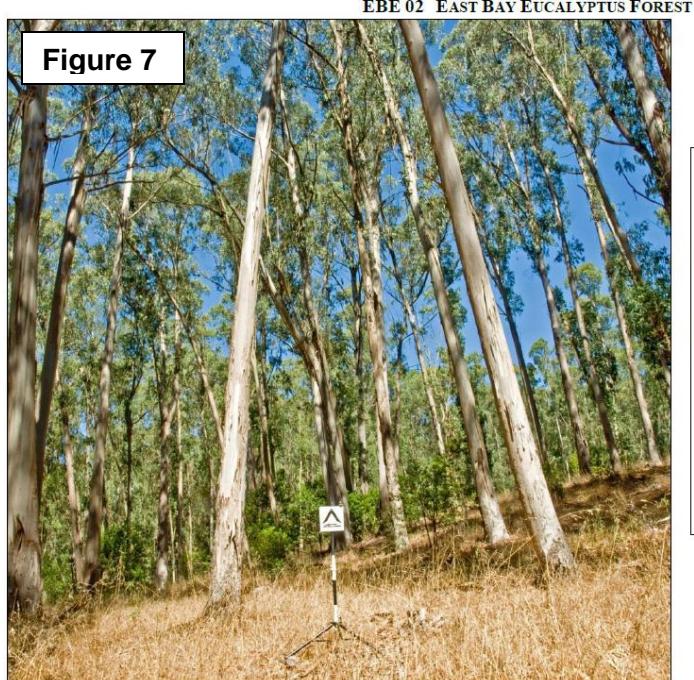
#### June 21, 2023 Julin Eucalyptus Hazard Assessment and Management Recommendations Zone 5

Kent Julin an experienced, respected Registered Professional Forester and ISA Certified Arborist. He came to many of the same conclusions regarding tree health and stability as Tom Gaman.

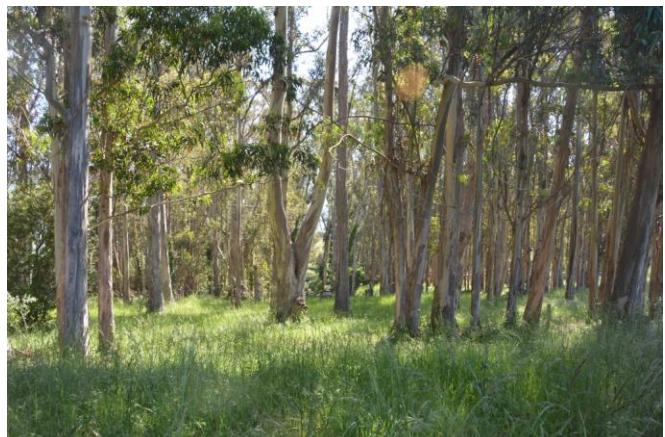
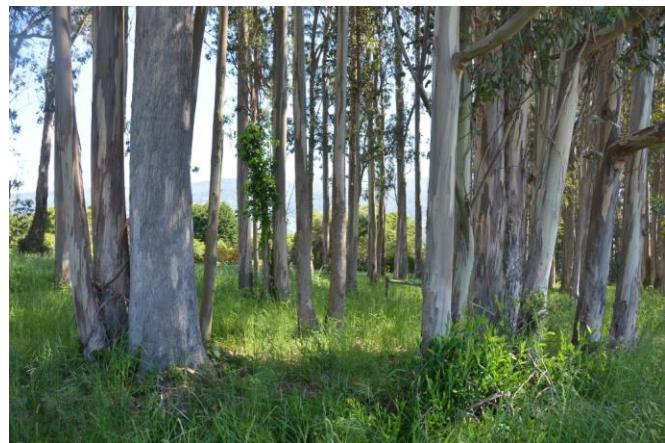
► Mr. Julin concludes tree taper and vigor were in decline due to a Eucalyptus Tortoise Beetle infestation. **Our close examination of the fallen leaves, leaves attached to fallen trees, and living leaves on standing trees indicate that Tortoise Beetles are not a significant defoliator in the grove. Canopy decline is more likely related to recent droughts and low taper is more likely due to stand density.**

► He concludes that “a strong earthquake would cause the high stump second growth trees to fail. **While UFA agrees that these trees have an elevated risk of failure, there are no published studies of tree stability under earthquake acceleration. I have studied earthquake photography and found such relationship.**

► Regarding the potential for severe wildfire behavior Mr. Julin acknowledges that high fire hazards are due to “leaves, bark and branches that collect in the understory.” **UFA recommends ongoing understory clearing.**



**Figure 9** - Grove Fuels in May, 2023 – Comparing grove fuels to Wright and Vihnanek Fuel load photo series.



**PEER REVIEW CONCLUSIONS:**

► While I do not agree with some of the conclusions of my colleagues. I find their alarmist and dramatic references to the Oakland Tunnel Fire and the Paradise Camp Fire were neither necessary or accurate. The Oakland Berkeley Tunnel Fire zone had high development densities mixed with fire prone urban forest. The Camp fire was on a butte in the Sierra foothills where extremely low humidity, high temperatures and poor over-night fuel moisture recovery prevails. Also, the fuel types were quite different. The forest types were dominated by Ponderosa pine and Douglas fir. UFA has done extensive consulting work on both of these fires. We have worked in Magalia and Paradise for three years. Both Magalia and Paradise had rough topography with steep ascending canyons, and areas of dense development. The forest and chapparal fuels were significantly different than the Bolinas urban forest and coastal scrub. The comparison to these devastating fires in their reports was obviously intended for more dramatic effect than for reasoned fire behavior analysis.

► That being said, I find that Mr. Gaman's data collection, research in his report are an important and useful resource for ongoing management of the East Mesa Grove.

► Mr. Julin's report states that he "prioritized treatment of 13 other Eucalyptus stands in Bolinas". Yet neither he nor Mr. Gaman prioritized treatments of the "Zone 5" stand. I would he would do the same for Zone 5.

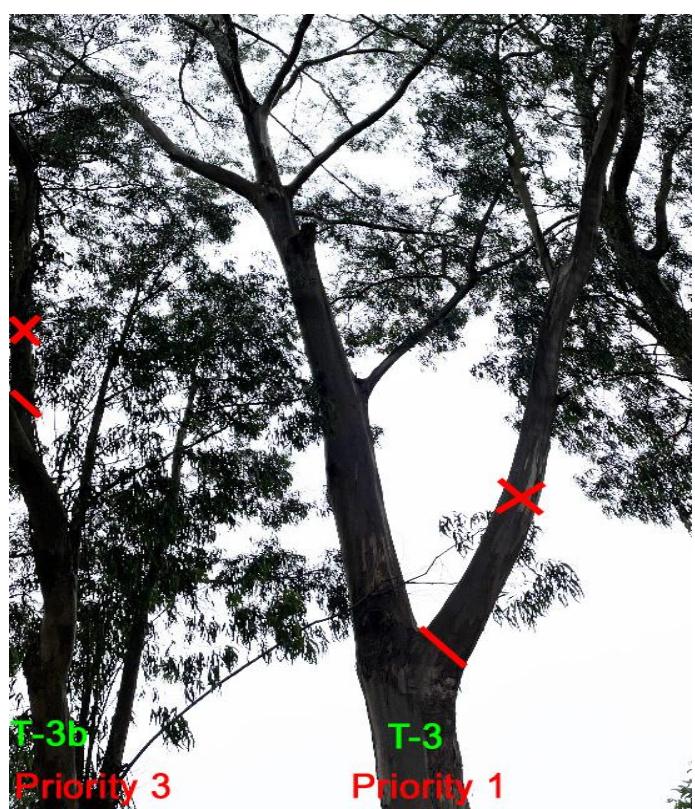
**EAST MESA GROVE FAILURE ANALYSIS:**

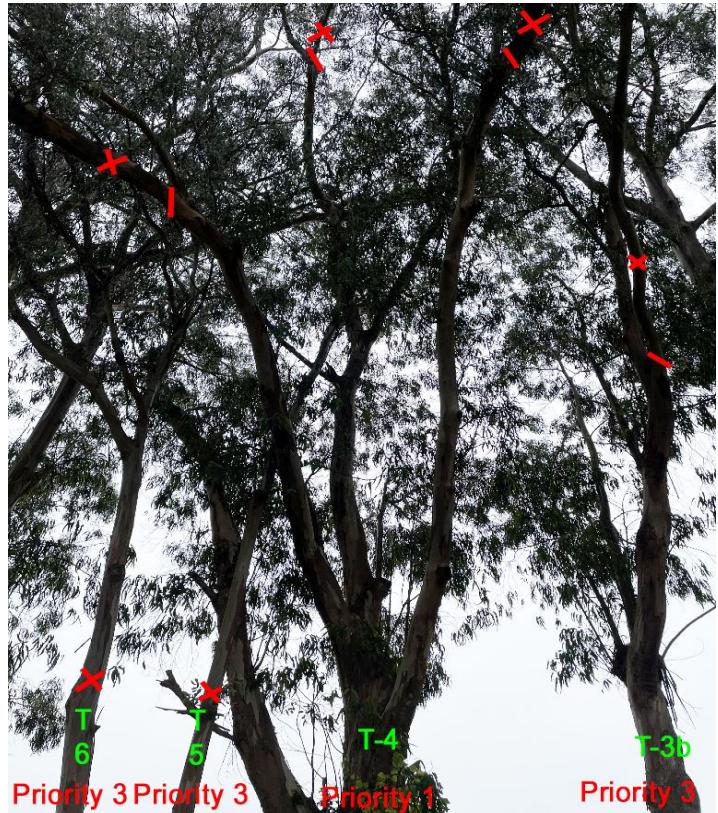
Urban Forestry Associates conducted an ISA Tree Risk Assessment of selected trees in the grove on July 5<sup>th</sup> & 6<sup>th</sup> 2023. For this assessment we inspected the trees and tree parts for structural defects. We rated the targets, tree defects, the likelihood of target impact, the severity of consequences, and prioritized our recommendations for risk mitigation.

**DRAFT**

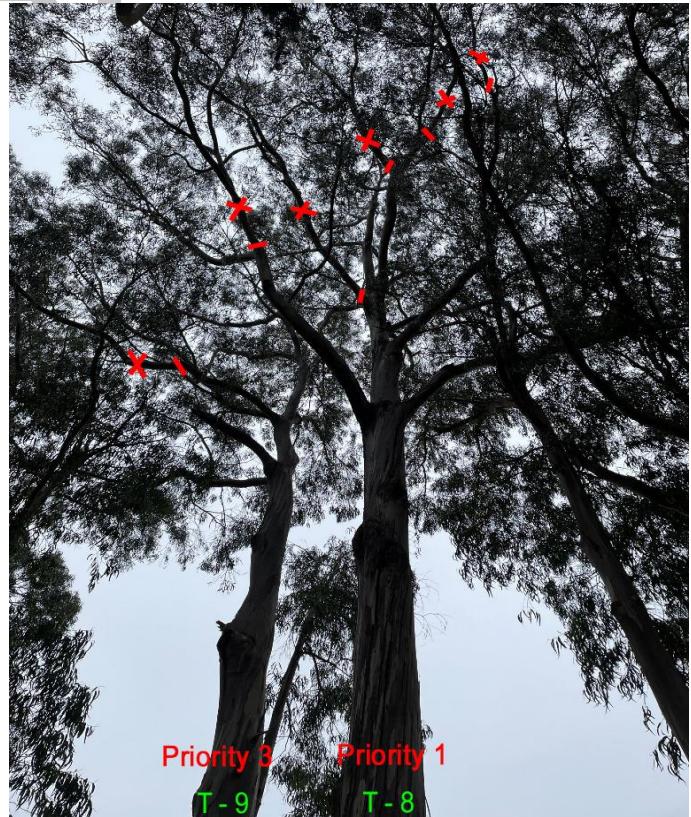
- A. The relatively low use of the trails, the fact that the trails are at most rarely used at night and during storms, and the fact that the potential targets are in motion indicate that the probability of impact to a trail target is very low. The potential for harm to people or property is quite low. Therefore, the priority for risk mitigation should be focused on Mesa and Olema Bolinas roads.
- B. The original roadside trees that were cut to high stumps and allowed to sprout deserve special consideration. They should be removed, or Level 3 inspections should be conducted of the sprout attachments. We have made recommendations for branch failure mitigation on the basis of Level 1 and Level 2 inspections.
- C. Trees that were not numbered in the Gaman survey but were inspected and recommendations were made were tagged by UFA and listed in our spread sheet. (See attached pdf of our spreadsheet)
- D. We have made our recommendations based on the assumption that the removal of the entire grove and forest type conversion is not feasible at this time and a prioritized tree risk mitigation plan is the only particle approach.
- E. We have provided a list of practical actions to significantly reduce risk to people and property. UFA's recommendations and prioritizations are presented in the attached pdf spreadsheet.
- F. We urge the BCPUD to consider what their long range goal is for the East Mesa Grove. If long term retention of the grove is the goal, then long term progressive thinning, annual ground and shrub layer fuels removal, and regular tree risk reduction inspections be conducted every 3 years and after severe storm seasons.

## APPENDIX A – 290 MESA ROAD TREE RISK MITIGATION PHOTOGRAPHY

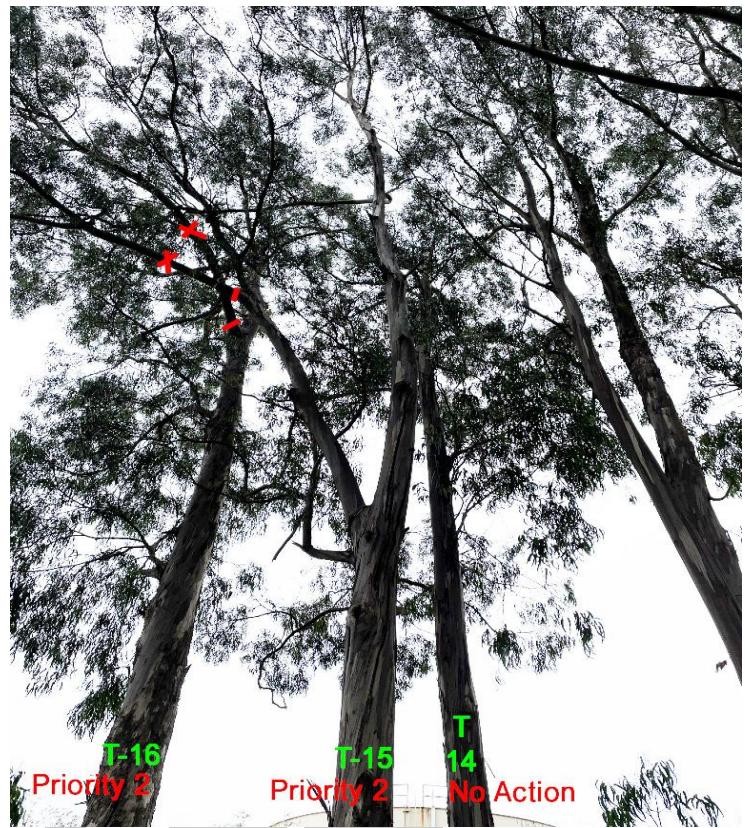




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## SCOPE OF WORK AND LIMITATIONS

All observations regarding trees in this report were made by UFA, independently, based on our education and experience. All determinations of health condition, structural condition, or hazard potential of a tree or trees at issue are based on our best professional judgment. The health and hazard assessments in this report are limited by the visual nature of the assessment. Defects may be obscured by soil, brush, vines, aerial foliage, branches, multiple trunks or other trees. Even structurally sound, healthy trees are wind thrown during severe storms or fail due to other weather conditions. Consequently, a conclusion that a tree does not require corrective surgery or removal is not a guarantee of no risk, hazard, or sound health.

Information regarding property boundaries, land ownership, and tree ownership was evident from property description.

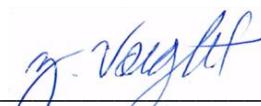
## TREE WORK STANDARDS AND QUALIFICATION

All tree work, removal, pruning, planting, shall be performed using industry standards as established by the International Society of Arboriculture. Contractors must have a State of California Contractors License for Tree Service (C61-D49) or Landscaping (C-27) with general liability, worker's compensation, and commercial auto/equipment insurance.

Contractor standards of workmanship shall adhere to current Best Management Practices (where possible) of the International Society of Arboriculture (ISA) and the American National Standards Institute (ANSI) for tree pruning, fertilization and safety (ANSI A300 and Z133.1). However, safety is the primary goal.



Ray Moritz, SAF Certified Forester #241  
ISA Qualified Tree Risk Assessor



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Zachary Vought, Urban Forester  
Registered Consulting Arborist #691  
ISA BCMA WE-9995B

# DRAFT

Tree Number	Comments	Recommendations	Work Priority
99	Long scaffold limbs over road.	Reduce the vertical branch and the 90° length of two lowest limbs over road by approximately 10 feet.	2
53	Long scaffold limbs over road.	Reduce the length of two lowest scaffold limbs over the road by approximately 10 feet	2
59	Three declining limbs extend over road.	Remove three limbs with over the road as indicated in the photo.	1
58	Established decay hollow in the lower trunk and near the common attachment of stems.	Whole tree removal.	1
56	Many long limbs over road.	Reduce branch end weight over road. Remove old broken stub and lowest limb over road. Make an approximate 6" reduction cut to relieve load in the bowed top.	2
55	12" stem over road is declining.	Remove the stem indicated in the photo.	1
54		Remove two long thin scaffold limbs that extend over the road. See photo.	2
53	Unstable trunk targets road	Remove 12" stem extending over the road.	2
52	Lowest 10" diameter scaffold limb over the road is overextended.	Remove heavy 10" limb extending over the road.	1
51	8" acute crotch stem over road is declining but not likely to fail in the short term.	Remove 8" stem.	3
50	Strong bow in main stem. Tree targets road.	Whole tree removal.	1
48	Limbs over road are long and declining in health.	Remove 2 lg & 1 sm scaffold limbs over the road.	1
46	Strong canopy asymmetry over the road.	Whole tree removal.	2
45	Decay cavity in main trunk at old stem removal wound. The tree bows away from road and exhibits declining health.	Whole tree removal. Fell into stand	2
29	Located approximately 15' from road cut bank. Tree collected to tie into this stand of trees.	None	N/A
35	Tree exhibits fair health. The top of the tree and scaffold limbs toward the top are dead.	Whole tree removal.	3
2201	Many long limbs over road attached to the stem closest to the road. Across from 30 Mesa.	Shorten limbs over the road by approximately ten feet. Remove long scaffold limb originating from the larger stem. Trim 12" tree east of 2201.	1
2202	If the lines are down, could fell across the road	Whole tree removal.	
16	Topped at 25'. The only living sprout is extremely long and leggy. It's attachment to the main trunk is weak and leans over the road and powerlines.	Remove the stem over the road.	1
18	Leaning into and conflicting with a tree directly behind it.	Remove seven (7) small trees in clump, and remove tree behind 18.	1
19	Topped by PGE. Stem failed and hung up. No target	Fell it into forest. See Recom'd for Tree-18.	1
57	On cut bank. Trunk is failing away from the road, but could kick back into the road when it fails.	Whole tree removal.	1
56	Located at top of cut bank. The tree has insufficient root anchorage, given its height.	Whole tree removal.	1
58	Targets power lines. It may have been impacted by the row of eucalyptus trees across the road. Low live crown ratio. Two red dots painted on lower trunk likely from PG&E.	Whole tree removal. Contact PG&E to inquire about them removing this tree.	1
59 60	Two red dots painted on lower trunk. On cut bank directly above high voltage lines and pole. Many long limbs over the road and powerlines.	Either remove the tree or prune the tree focusing on removing/shortening the longest limbs over the road. Contact PG&E about them removing it.	1
69	Trunk lean away from road. Two red dots.	Contact PG&E to inquiry about any of their planned maintenance of this tree.	1
2203	Poor health. The topped trunk is covered with ivy. Only two small live sprouts are visible.	Whole tree removal.	1
2204	Two large limbs high in the canopy over the powerlines and road. 2nd tree E. of Utility Pole.	Remove deadwood and two large limbs over road.	1

Tree Number	Comments	Recommendations	Work Priority
64	Dense ivy obscuring stems. Curved top interfering with subordinate stem of T2204	Whole tree removal. Fell into grove.	3
67	Sparse canopy. Solo leader oriented over road. Two red dots on lower trunk..	Contact PG&E about tree removal.	
70		Remove lowest scaffold limb extending over the road.	1
71	Top of stem closest to street bows heavily east into canopy of adjacent tree.	Reduce the bowed top back to a vertical secondary, 10" diameter cut.	1
74	Bowed top. Two red dots and blue x painted on trunk.	Contact PG&E about potential plans for work.	1
75	Common point of attachment of stems at 25'. Bow in top.	Remove two limbs extending north over road. Another option is to make an approximate 10" removal cut. See photo.	1
77		Remove lowest scaffold limb and reduce the length of limbs extending over the road by 5-10'.	1
91	The tree is in decline. It targets the trail and road.	Whole tree removal.	2
68	The tree is dead. It targets trail and road. Two red dots painted on lower trunk. Contact PG&E about planned maintenance.	Whole tree removal.	1
82	Large deadwood over trail. Long limbs extending over road and power lines.	Remove deadwood three inches or larger over the trail. Reduce branch end weight over road focusing on the longest limbs in the upper canopy.	1
85	Large deadwood over road and path. High scaffold limb over road is long and leggy.	Remove deadwood three inches in diameter or larger over trail and road. Inspect old heading cuts over road. Reduce the high scaffold limb over the road with a reduction cut approximately 6" in diameter.	1
00		Remove southeast overextended branch and deadwood three inches in diameter or larger. Remove group of five small trees between T-00 and T-889.	1
889	Top of tree bows over road.	Reduce limbs arising from the top of the tree.	1
96		Reduce top of tree with reduction cuts up to 4" in diameter if possible.	1
18	Many dead limbs over road.	Remove deadwood three inches in diameter or larger on road side and reduce the length of live limbs over the road by approximately 10 feet.	1
12	The tree is in decline and targets road. Severe dieback.	Whole tree removal.	1
665	Declining tree suppressed in the row.	Whole tree removal.	1
866	Exhibits poor vigor. Sprout growth along trunk and top comprises the majority of the canopy. Top bows over road.	Whole tree removal.	1
860	Mature fungal fruiting bodies on trunk. The tree is in decline.	Whole tree removal.	1
88	Decline at end of old heading cuts on limbs over road.	Remove the right fork that was headed back. Reduce end weight on left fork. See photo.	1
89	Topped in past. It is suppressed in the row.	Whole tree removal. Fell into stand.	2
00	Many long limbs over road in upper canopy.	Prune to reduce limb end weight over road by approximately 10 feet focusing on the longest limbs toward the top.	1
37	Top of tree bows southeast and is long and leggy.	Remove the bowed top with an approximate 10" heading cut.	1
49	Deadwood up to 6" diameter targeting the road.	Remove deadwood 3" or larger on road side. Remove large deadwood (~3 large limbs) on trail side.	1
50	Leans into canopy of T-51. Trunk lean appears to have increased at some point in the past. Fungal damage present on lower trunk and roots.	Whole tree removal.	1
85	Large deadwood over road.	Remove deadwood on roadside three inches in diameter or larger.	

Tree Number	Comments	Recommendations	Work Priority
01		Remove 12" declining eucalyptus growing under this tree.	
47	Limbs at top of tree in road side are long and target the road and power lines.	Reduce limb end weight over road with reduction cuts up to 6 inches in diameter.	1
	Row of five cypress trees.	Prune to reduce limb end weight over road with reduction and removal cuts up to four inches in diameter.	
29	Large adjacent eucalyptus tree fell. The failure appears to have damaged the supportive roots of this tree. The tree could potentially reach the road and target the trail.	Whole tree removal.	1
46	Large deadwood and canopy dieback. Predominantly targets trail.	Whole tree removal.	1

# DRAFT

**BPUD Eucalyptus Assessment Map #1**

MESA ROAD

MESA ROAD

- 99
- 53
- 59
- 58
- 56
- 55
- 54
- 53
- 52
- 51
- 50
- 48
- 46
- 45
- 29
- 35
- 2201
- 2202
- 16
- 18
- 19

0 0.01 0.01 0.02 Miles

65

N

## BPUD Eucalyptus Assessment Map #2

MESA RD.

OLEMA-BOLINAS RD.

57  
56  
58  
59 60  
69

2203  
2204  
64  
67  
70  
71

74 75

77  
91  
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82  
85  
00

889  
96  
18  
12

665  
866  
860  
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89  
00

37  
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50  
85  
01

46  
29

47

N

0 0.01 0.01 0.03 Miles

66

Maxar, Microsoft, Esri, HERE, Garmin, iPC

Created by Urban Forestry Associates July 2023



# Follow-up Memorandum on Bolinas Eucalyptus Project

Stuart B. Weiss  
Creekside Science  
June 2024

This memorandum is a follow-up to the March 2024 report on monarch butterflies and habitat in Bolinas, CA. The purpose is to examine some next steps so that the hazardous eucalyptus grove can be removed expeditiously while at the same time securing a future for monarchs in Bolinas.

## Summary of March 2024 Report

Key points from the previous report include:

- 1) The grove in question is on Bolinas Public Utility District (BPUD) property along Mesa Rd. and Olema-Bolinas Rd. and is a demonstrated public hazard, with poor structure and accelerating tree failures in 2023 and 2024 that block the roads, take down powerlines, and pose a direct threat to people and property. The forestry reports call for complete removal of the grove, and the Bolinas Eucalyptus Project (BEP) proposes establishment of an oak woodland.
- 2) The BPUD site in its current condition is not sustainable as overwintering monarch habitat because of the accelerating tree failures. A progressive loss of wind shelter is inevitable.
- 3) Monarch butterflies seek and stay at groves that have wind-sheltered and sunny microsites. In 2023-24, a few thousand monarchs primarily used three sites on the Bolinas Peninsula, shifting their distribution and abundance from day to day and week to week. No one site provided suitable conditions over the entire season, as monarchs would scatter away from the aggregation sites, and regroup among them.
- 4) Other sites had small numbers of monarchs for short periods. And there are several historic sites that are defunct now. All alternative sites are explored by some part of the local monarch population – if one site is not available or is unsuitable, they will likely use other sites on the Peninsula until those sites do not provide suitable microclimates during extreme weather.
- 5) Preliminary hemiphotograph analysis of wind and sun exposure patterns at five sites, including BPUD, identified site vulnerabilities, as well as outlining potential fixes. Some exploratory tree planting scenarios were sketched out as part of a first-cut feasibility study.

The main conclusion of the report is that there is ample opportunity for improvement of monarch habitat at several sites in Bolinas so that at least one monarch grove is well designed and managed for long-term habitat suitability. The exact site(s) and detailed plans are the next step.



## Moving forward

The goal is to have an expedited process that allow prompt relief from the urgent hazards posed by the BPUD eucalyptus grove, and initiation of short-, medium-, and long-term actions to secure and manage *some* high-quality overwintering monarch habitat on the Bolinas Peninsula. The current haphazard and *ad hoc* approach to overwintering monarch habitat in Bolinas (and elsewhere in California) is unlikely to succeed in the long-term.

The steps to that goal involve: 1) regulatory approval, 2) lining up funding, 3) deciding where efforts to secure, improve, and manage monarch habitat are feasible and appropriate, and 4) efficiently executing hazard reduction and monarch habitat improvement.

### Regulatory approval

An expedited regulatory process is highly desirable. Overwintering monarch habitat is a sensitive coastal resource (even in the absence of ESHA designation) and the butterfly is a candidate for “Threatened” listing under the Federal Endangered Species Act. In California, monarchs are included on the California Department of Fish and Wildlife's (CDFW) Terrestrial and Vernal Pool Invertebrates of Conservation Priority list and identified as a “Species of Greatest Conservation Need” in California's State Wildlife Action Plan. Some combination of approvals and permits from local, state, and federal entities will be necessary. There will likely be conditions applied to the BEP project to address monarch habitat issues and to ensure long-term [protection and maintenance of habitat].

Some 40 trees in the grove are on Marin County property and are the responsibility of the county. Dealing with multiple jurisdictions often can be complicated, and consolidating the permitting for both BPUD and Marin County is highly desirable and one way to expedite the process.

### Funding:

Removing the BPUD grove will be expensive. Informal estimates exceed \$1,000,000. BEP will likely have to obtain funding from multiple sources. Monarch habitat improvements offsite will be a very small fraction of any funding, as preliminary considerations suggest that a few dozen well-placed trees and some selected can address site vulnerabilities, so direct costs of implementation will be low. But planning and permitting, especially if there is a contentious process, can be a major cost and delay. The urgency of hazard reduction at BPUD emphasizes the need for starting work ASAP.

### Choosing and designing improvement sites

A formal systematic assessment of improvement sites would include considerations of use patterns by monarchs, current canopy conditions and vulnerabilities, and property ownership. Once sites are chosen, a more fine-grained microclimate analysis (using existing hemiphotos and LiDAR) will be the basis of a detailed planting/tree management plan. Some long-term assurances will likely be required, in the form of conservation easements or rigorous management agreements – property ownership may be the largest barrier.



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The candidate sites were identified in the March report. Of the sites considered, the “Toyon Site” on the southern BPUD may have the most favorable property configuration – the northern part of this site is on BPUD property, and the private property (parcel 19303003) to the south is open space and under single ownership. Some monarchs were observed clustering there, and many were flying in the vicinity during site visits. The “Bowl” on the same property also had flying monarchs, but the potential cluster locations are inaccessible because of scrub.

An “environmental subdivision” could be the basis for a conservation easement, but other arrangements could meet the needs for assurances.

Key canopy tree species to be considered are Douglas-fir, Monterey cypress, and Torrey pine, which thrive in Bolinas and have high potential growth rates. Coast live oaks, toyon, and wax myrtle can be incorporated into site designs as middle and understory. Incorporating Douglas-fir into the oak woodland restoration proposed for the BPUD site could eventually create a substitute monarch habitat. *The key element in site improvements is time for new trees to grow to heights where they form effective shelterbelts.*

## Assessment and Implementation Costs

These assessments and plans should be budgeted into any grant proposals as part of the environmental review and permitting. BEP has initiated the process by supporting the March 2024 report, after the forestry reports and other environmental documents. The actual detailed site assessments and planting plans will be well less than \$50,000; these assessments will leverage previous work on the LiDAR analysis and the arrays of hemiphotos taken in 2023-2024.

Based on the preliminary assessments in the March 2024 report, a few dozen well-placed trees (or even fewer) could ameliorate the site vulnerabilities at the Toyon and Bowl sites. Incorporating Douglas-fir (or other conifers) into native replanting plans for the BPUD grove will be a minor additional cost. Some monitoring of tree growth and monarch occupancy through time, and reporting on progress will be necessary as part of the assurances.

## Summary

In summary, the deteriorating BPUD grove at Mesa Rd/Olema-Bolinas Rd. is an urgent hazard, and is unsustainable as monarch habitat, and should be removed as soon as possible. There are opportunities to improve local monarch habitat with strategic planting of new trees. Some assurances of long-term management of one or more monarch sites will likely be part of the permitting. Two nearby sites south of BPUD property have promise, if arrangements can be made. Other sites on the Bolinas Peninsula could be considered, but may be more complicated

## Initial Assessment of Monarch Butterfly Overwintering Habitat in Bolinas, California:

Stuart B. Weiss  
Creekside Science  
February 2024



*Monarchs sunning at BPUD North Grove, Nov 7 2023. Photo by S.B. Weiss*

## Introduction and Background

The Bolinas Eucalyptus Project (BEP) has identified major public safety hazards from the grove of blue gum eucalyptus at Mesa Rd. and Olema-Bolinas Rd on Bolinas Public Utility District (BPUD) Lands. The site is also used by monarch butterflies during the overwintering season. This document provides a brief outline of the major issues and proposes alternatives and weighs their feasibility and ability to meet multiple objectives. Because of the urgent nature of decision-making, I am providing my professional opinions on the various issues, with more detailed analyses of the suitability of monarch habitats to follow in a second phase.

The ultimate goal is to secure public safety in the short-term and also provide suitable monarch habitat in the long-term in and near Bolinas.

## State of the BPUD North Grove

The professional arborist/forestry reports definitively conclude that this grove is a continuing hazard to public safety, as demonstrated by dozens of treefalls over the past two seasons that blocked the road, took down powerlines, and nearly killed some people. The latest storm in mid-February 2024 downed yet more trees and cut power and access to much of Bolinas for several days. The reports also concluded that the initial establishment of the grove, history of management (or lack thereof), and current structure will lead to continued deterioration of the stand and further treefalls, with positive feedback as thinning increases wind vulnerability, treefalls, and hazards. As such, the only way to mitigate the hazards is complete removal of the grove; partial thinning and removal will only delay the inevitable and maintain the hazardous conditions.

I concur with this assessment – the grove is an immediate urgent hazard to public safety, and its condition and future trajectory makes it unsustainable as monarch habitat. The question then becomes how to accommodate monarch butterfly habitat in Bolinas commensurate with public safety.

## Monarch Butterflies in Bolinas

As of 2023-24, Bolinas is the northern range limit of substantial numbers (>1000) of clustering monarchs. Small numbers (100 or fewer) have been observed at sites along the Sonoma Coast where monarchs formerly clustered in larger numbers (in the 1990s and before) when monarchs numbered in the millions in California. The large reductions in western monarch numbers are primarily a function of conditions in the breeding habitats extending from near-coastal California to the Rocky Mountains and north into the Pacific Northwest, as multiple generations of monarchs breed in milkweed stands. How they sort out among the various overwintering groves is a complex process whereby monarchs roost in groves and remain or leave depending on the microclimatic suitability (wind, temperature, and sun), eventually settling on a number of groves that can provide those microclimate conditions.

There are several sites in Bolinas that act as a “meta-colony” of monarchs, in which monarchs move in during the initial migration in October and redistribute themselves among the various discrete sites. As of 2023-24, the sites used by clustering monarchs include:

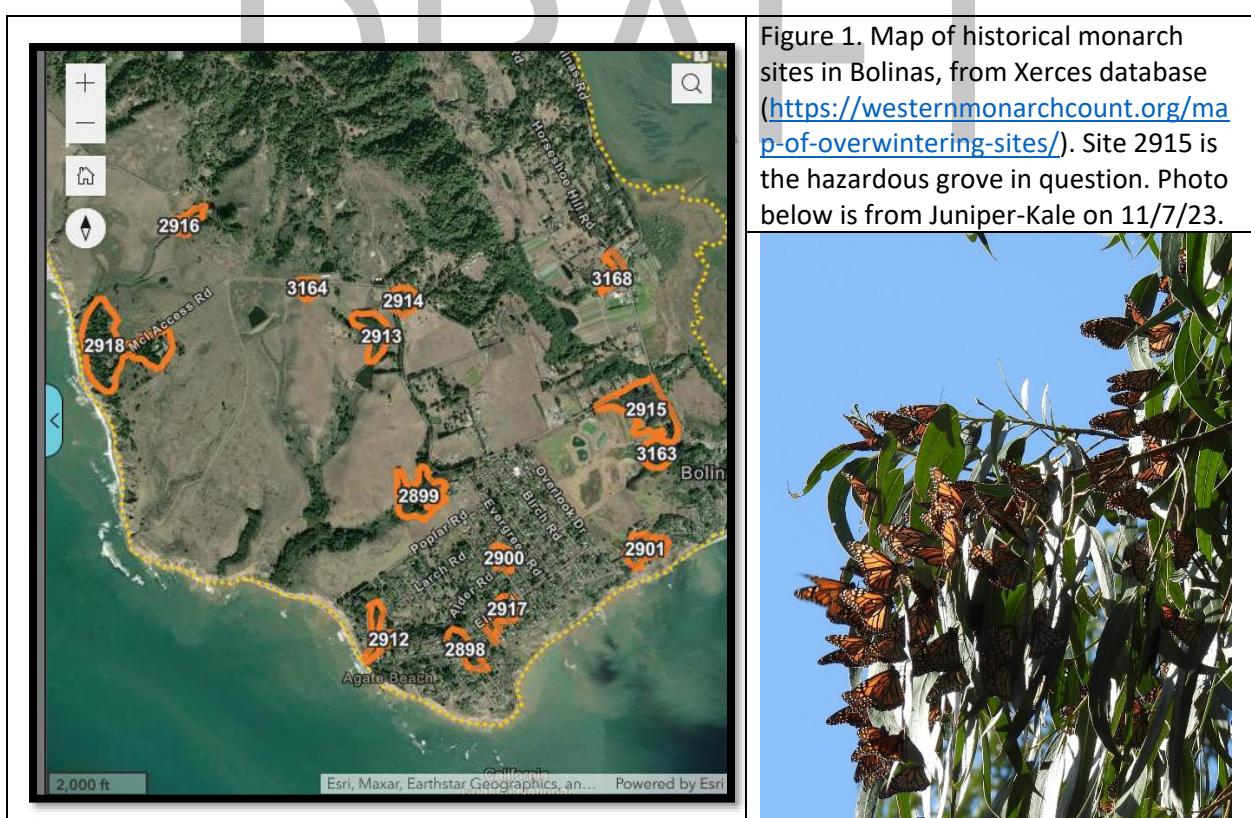
- 1) BPUD North (Site 2915) – this is the hazardous stand along Mesa Road and is also referred to as “Goat Pen.”.

- 2) Other BPUD sites (Site 3163) – south of the hazard stand are several areas where monarchs have clustered in the past and small numbers were observed in 2023-24. These sites include “Toyon” on the south border of BPUD, and a “Bowl” SE of the Toyon site.
- 3) Kale Ave (Site 3227)- the stand of blue gum eucalyptus south of Elm between Kale and Juniper on private land.
- 4) Agate Beach/Alder Vortex (Site 2912) – spread across multiple properties especially southern windbreak trees.
- 5) Purple Gate (Site 2899)
- 6) Mesa Road (Site 2913) – monarchs clustering observed only in 2022

Other sites in Bolinas proper appear to be degraded and unsuitable, notably Terrace Ave (2901), Hawthorne (2917) and Grove and Alder (2900) which do not have counts recorded and are unoccupied by clustering monarchs as far as we know. The full array of counts is in Table 1 below.

Farther afield, Palomarin Trailhead (Site 2904, N of the map) once supported monarchs in the 1990s, but no counts are reported since 1997. The MCI site (2918) and Sites 2916 and 2914 do not have annual counts.

An initial look at these sites using 2023-2024 hemiphotos and 2019 LiDAR data will be presented below. Some ideas for site enhancements are presented as well. But a full analysis of the existing conditions, and detailed suggestions for site enhancements will require future analysis as feasible options become more clear.



## Monarchs in Marin and Sonoma Counties 1997-2023

Table 1 has compiled Xerces Thanksgiving Count (TG) data for Marin County sites, and a total for Sonoma and a total for Bolinas. The limitations of the TG Counts are acknowledged (i.e., changing number of sites, sampling idiosyncrasies, illusory precision, etc.) but they are useful for a broad brush look at the overall population and relative contribution of different regions.

Monarch numbers in Bolinas exceeded 15,000 as recently as 2015-2017, with a peak >20,000 in 2015. During this period, they contributed 6-9% of the California total. During the 2020 collapse, Bolinas contributed 7%. In 2021, the overall California population recovered, but the Bay Area numbers remained low, so the contribution dropped to 0.1%. In 2022 and 2023 Bolinas contributed 1.2-1.4%.

The retention rate between Thanksgiving and New Year's counts (years designated by the Thanksgiving Count) ranged from 2-3% in 2016, 2018, 2019, and 2022 to ~50% in 2017, 2020, and 2021 (Figure 2).

Bolinas is at the northern range limit of overwintering monarchs in California. Sonoma sites have been nearly vacant since 2018, and (even if undercounted by an order of magnitude) do not provide a substantial source of migrants from the north.

SITE ID		2912	2915	2903	3226	2909	2675	3227	2913	2899	2901	2897		
SITE NAME	Sonoma Total	Alder Rd., vortex (Larch, Ocean St)	Bolinas Sewage Facility	Chapman Ravine, Stinson Beach	Charlotte, Muir Beach	Fort Baker, GGNRA	Fort Barry, Marin Headlands (Youth Hostel)	Juniper & Kale, Bolinas	Mesa Road, north of Bolinas	Purple Gate, Bolinas	Terrace Ave., Bolinas	Terwilliger Grove, Muir Beach	Total Bolinas	% of California
<b>1997</b>	6,660			15,500			2,550			12,000		2,100	12,000	1.0%
<b>1998</b>	1,600			4,000		1,600	0			8,050	2,050	500	10,100	1.8%
<b>1999</b>	750			3,000		200	0			1,500	1,000	500	2,500	0.9%
<b>2000</b>	3,206		1,500	15,150		310	0			12,050	2,000	305	15,550	4.0%
<b>2001</b>	7	0	1,000		15	0				3	0	0	3	0.0%
<b>2002</b>	0	2,300	0	2,000		0	0			2,000	0	35	4,300	4.3%
<b>2003</b>	160	10,400	5	2,000		9	0			300	0	54	10,705	4.2%
<b>2004</b>	34	8,880	122	8,050		2,200	0			7,200			16,202	7.9%
<b>2005</b>	0	950		0		0	1			130		365	1,080	0.5%
<b>2006</b>	0	3,520	0	0		550	0			2,600	0		6,120	2.8%
<b>2007</b>	0	1,000		0		0	0			0	0	0	1,000	1.2%
<b>2008</b>	0	390		3		5	0			20	0	0	410	0.3%
<b>2009</b>	0	1,700	0	49		0	0			27	0	0	1,727	3.0%
<b>2010</b>	0	0	0	0		0	0			0	0	0	0	0.0%
<b>2011</b>	600	7,700	0	800		500	0			400	0	0	8,100	3.6%
<b>2012</b>	10	150	0	0		10	5			530	0	0	680	0.5%
<b>2013</b>	5	1,013	0	503		0	0			0	2		1,013	0.5%
<b>2014</b>	8	3	0	2		0	2			0	2	0	5	0.0%
<b>2015</b>	911	4,050	3	8,200	8,000	250	5	10,200		8,000	0	0	22,253	7.6%
<b>2016</b>	50	13,375	0	4,000	1,206	259	0	4,060		1,020	0	0	18,455	6.2%
<b>2017</b>	15	12,360	410	210	414	5	1	4,310		625	1	0	17,706	9.2%
<b>2018</b>	5	1,256	0	1	8	0	0	200		975	0	9	2,431	8.8%
<b>2019</b>	0	200	5	0	0	5	0	113		10	0	0	328	1.1%
<b>2020</b>	7	100	10	5	2	0	0	19		5	0	5	134	7.0%
<b>2021</b>	13	105	10	5	0	25	0	20		0	0	0	135	0.1%
<b>2022</b>	3	1,012	432	56	30	3	0	1,042	29	1,393	0	0	3,908	1.2%
<b>2023</b>	3	925	1265	68		26	0	911	0	220		0	3,327	1.4%

New Years/Thanksgiving Ratio

Table 1. Thanksgiving Counts for Marin County and a sum of Sonoma sites, with percentage of California monarchs in Bolinas calculated.

Figure 2. Retention rate between TG and NY counts 2016-2022 (year designates the TG count year).

## Monarch Butterflies in Bolinas 2023-2024

We are fortunate to have a nearly daily record of clustering monarchs in 2023-2024 by Davis Ainley and Janice Tweedy that show some of the dynamics of the meta colony. The stacked area chart graph (Figure 1) shows daily counts at the three major aggregation sites. Because not all sites were surveyed on each day, a second graph (Figure 2) with the maximum weekly counts for Bolinas as a whole smooths over the sampling variability. The third graph shows the weekly maxima at each individual site so that the distribution among sites is apparent.

- 1) The raw daily counts (Figure 2) showed high short-term variability, with peak total counts >2500 butterflies. Some of the low numbers are days when not all the sites were counted, others are when monarchs abandoned sites temporarily.
- 2) All three sites had some clustering monarchs throughout the season. Juniper Kale attracted the most monarchs through late October, and ~50% moved primarily to Alder-Vortex in early November. The numbers at Juniper-Kale declined steadily through the season.
- 3) BPUD supported a small fraction until early-November, but increased to ~50% in November and December.
- 4) Smaller numbers of butterflies (<200) clustered in Bolinas in January.
- 5) On January 27, afternoon observations of dozens of butterflies flying and sunning at Juniper Kale and BPUD indicated that numerous monarchs were still present in Bolinas but were not clustering *en masse*.
- 6) Monarchs were observed flying and resting at other sites on and adjacent to BPUD lands, getting an accurate count is not feasible although there were likely dozens on the wing, and some unknown number resting and undetectable. The presence of some of these butterflies are noted in the Ainley/Tweedy data set. Monarchs are exploring numerous sites during good flight conditions.

### *Interpretations*

Based on my decades of experience with overwintering California monarchs, my interpretation of the monarch occupancy patterns is as follows:

- 1) Bolinas is the farthest north region that supports more than a handful of overwintering monarchs at present.
- 2) In October, monarchs from the North Coast Ranges and Pacific NW migrate in numbers into the Bolinas area and find the various eucalyptus stands in Bolinas. The presence of monarchs in a site attracts more monarchs that are flying by.
- 3) The high variability in overall numbers, and dynamic distribution among sites indicates that none of the three major sites is providing suitable microclimate conditions for season-long clustering.
- 4) The smoothed weekly abundance curve (Figure 4) shows the rise and fall of the entire Bolinas metacolony.
- 5) The lower numbers later in the season (January) are typical for monarch aggregations – attrition and emigration are normal population phenomena.
- 6) The pattern of high numbers, followed by low numbers, and recovery to higher numbers can be interpreted as monarchs leaving sites that are too exposed to wind, scattering across Bolinas,

## Bolinas Eucalyptus Project Monarch Assessment March 2024

and re-aggregating a few days later. This pattern was repeated several times over the season. Scattered monarchs are difficult to observe when roosting.

7) An alternative explanation of Bolinas being a stopping point on a directional migration is not supported by observations north and south of Bolinas, such as the very low numbers observed in Sonoma overwintering sites and lack of observations of monarchs on the move outside the overwintering sites.

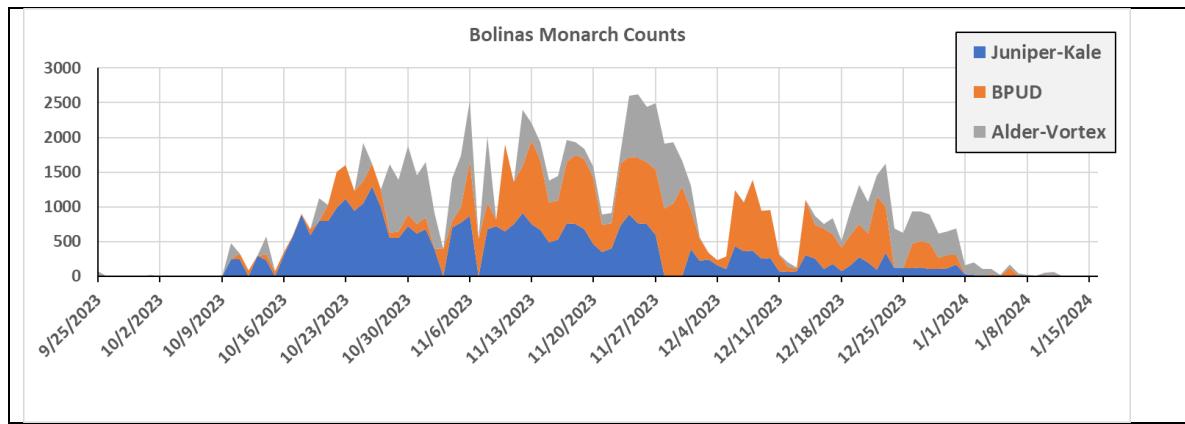


Figure 3. Stacked area daily counts of monarchs at three major sites in Bolinas.

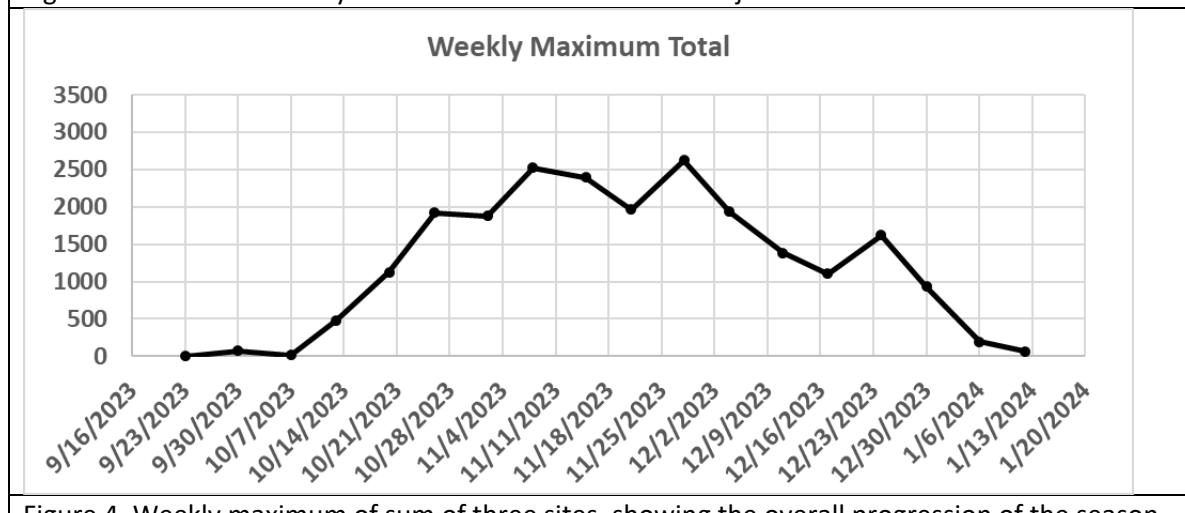
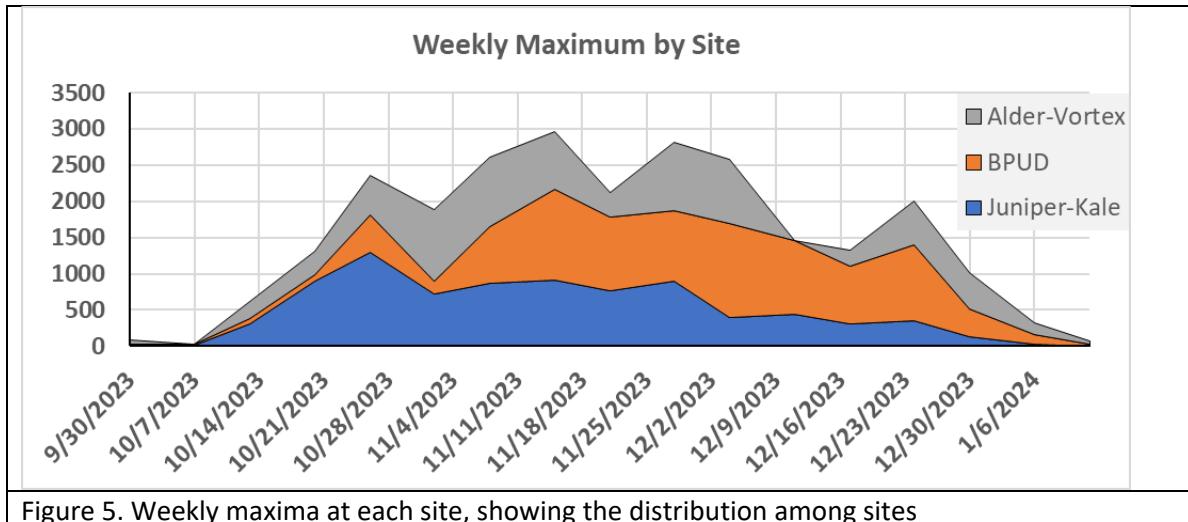
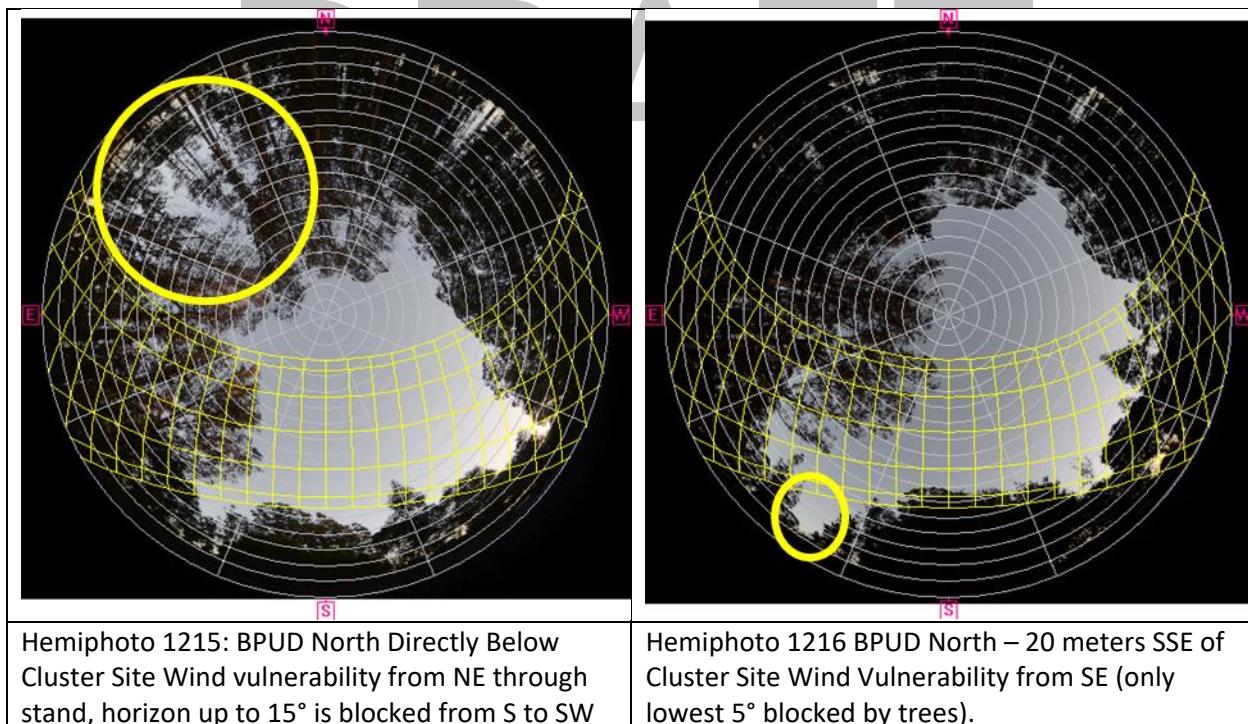


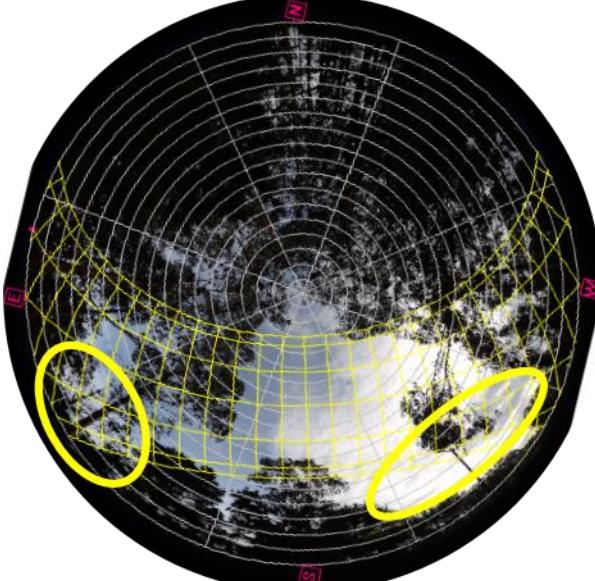
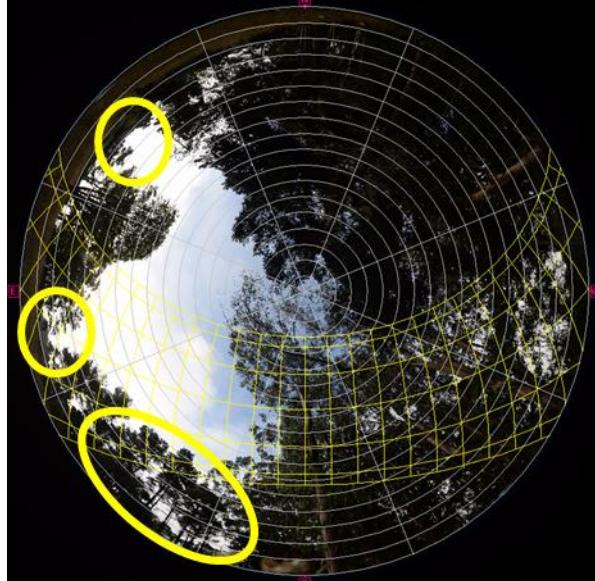
Figure 4. Weekly maximum of sum of three sites, showing the overall progression of the season.

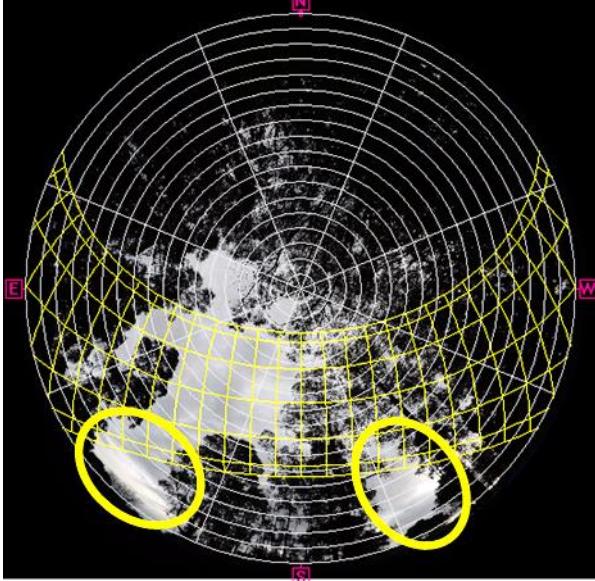
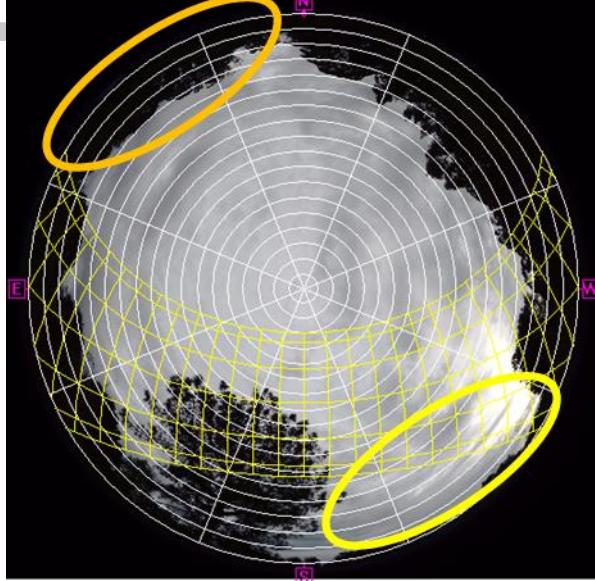


### Sample Hemiphotos at each site.

The hemiphotos below show an example from each site, usually a known cluster site, to qualitatively identify wind vulnerabilities where open sky is visible close to the horizon. Note that east and west are reversed from map views because the photos are taken looking up..



	
<p>Hemiphotograph 1235: Cluster site at Juniper-Kale. Vulnerability from SW, this sector is where PG&amp;E cut a eucalyptus tree that provided wind shelter. Additional wind vulnerability from SSE.</p>	<p>Hemiphotograph 1195: Alder-Vortex. Pines with open understories to SE, other wind vulnerabilities from E and NE. The relative directions of gaps varies along the row of cluster trees so short-distance movements can regain wind shelter.</p>

	
<p>Hemiphotograph 1251. Toyon site. Wind vulnerabilities from SE and SW. Resprouting eucalyptus to S allow some dappled sun mid-day near ground, and direct sun at heights..</p>	<p>Hemiphotograph 1257. At S edge of Bowl. Large Torrey Pine in SSE foreground. Large gap to SW could be filled with Torrey pines Potential monarch cluster trees in orange ellipse to NE across Bowl.</p>

## Potential for Monarch Habitat Enhancements in Bolinas

Because the BPUD North grove is unsustainable as monarch habitat given the demonstrated extreme hazards, looking elsewhere on the Bolinas Peninsula for opportunities to actively manage and enhance monarch overwintering habitats.

The following maps show LiDAR views of three sites, and some potential enhancements. Note that these are exploratory for now, and many issues need to be addressed regarding site ownership, long-term management, and the time lag for tree growth. Here are some initial thoughts to be explored.

**BPUD:** BPUD and adjacent properties have two sites that attract some monarchs, one of which supports clusters in some years (see photos 1251 and 1257).

**BPUD North (Hemiphotos 1215 and 1216):** It may be possible to design an aggregation site using Douglas-fir trees to replace N and E wind shelter that is currently provided by the eucalyptus stand. Trees would be planted just S of the existing eucalyptus, well away from the roads and powerlines. New healthy trees would not pose a threat to the trail. Some enhancement of the southerly wind shelter could create a sheltered cove with good sun exposure. Such a grove would take 10-15 years to grow tall enough to function as monarch habitat.

**BPUD South:** This infrequently used site will not be suitable once the main BPUD North grove is removed and there are no straightforward enhancements.

**Toyon: (Hemiphoto 1251)** Sealing up the SE and SW gaps at Toyon, while maintaining the thin eucalyptus canopy to the S would establish wind shelter and dappled light. Torrey pines might be ideal, as they thrive in the area and provide dappled light in addition to wind shelter. This site is largely on the parcel adjacent to BPUD (#19303003) and landowner participation would be essential.

**Bowl: (Hemiphotos 1257)** Planting additional Torrey pines at the S edge in line with the existing tree would establish wind shelter for the eucalyptus trees to the north. This site is entirely on the adjacent parcel (#19303003) and landowner participation would be essential.

The dense stand of eucalyptus and pine on BPUD north of Toyon may have potential with a gap cut to increase sun in the wind-sheltered interior. Such gaps have been cut at three other monarch sites; Monarch Lane in Los Osos, San Luis Obispo County, Andrew Molera State Park in Big Sur, and Point Pinole Regional Shoreline in Richmond.

**Juniper-Kale: (Hemiphoto 1235)** This site has been degraded by PG&E cutting and trimming trees to protect a powerline, which has opened the site to SW winds. A new row of fast-growing Douglas-fir planted an appropriate distance from the powerline could seal this vulnerability in a decade.

**Alder-Vortex (Hemiphoto 1195):** This site has some existing wind vulnerabilities that are ameliorated by short distance movements to avoid winds through the gaps. The major short-midterm threat is the loss of the older pines to the SE, some of which have already fallen. One idea is to plant a row of Douglas-fir at an optimal distance from the cluster row to eventually replace the wind shelter. The multiple ownerships of the overall site, including the wind shelter areas, could greatly complicate any management.

**Purple Gate:** This site once was one of the major sites in Bolinas. It has been opened up by recent removal of trees (2023) to ameliorate hazards and may not be salvageable as monarch habitat.

**Mesa Rd. North of Bolinas:** This site is just outside the LiDAR analysis footprint (but is within the 2019 LiDAR flight and can be analyzed. The dense stand in the drainage appears to have good wind shelter but may be too dense and dark for monarchs. It would benefit from a detailed LiDAR and hemiphotograph analysis. Numerous nectar plants have been established on the property with assistance from the Xerces Society, and the owner is willing and eager to improve the site for monarchs.

DRAFT

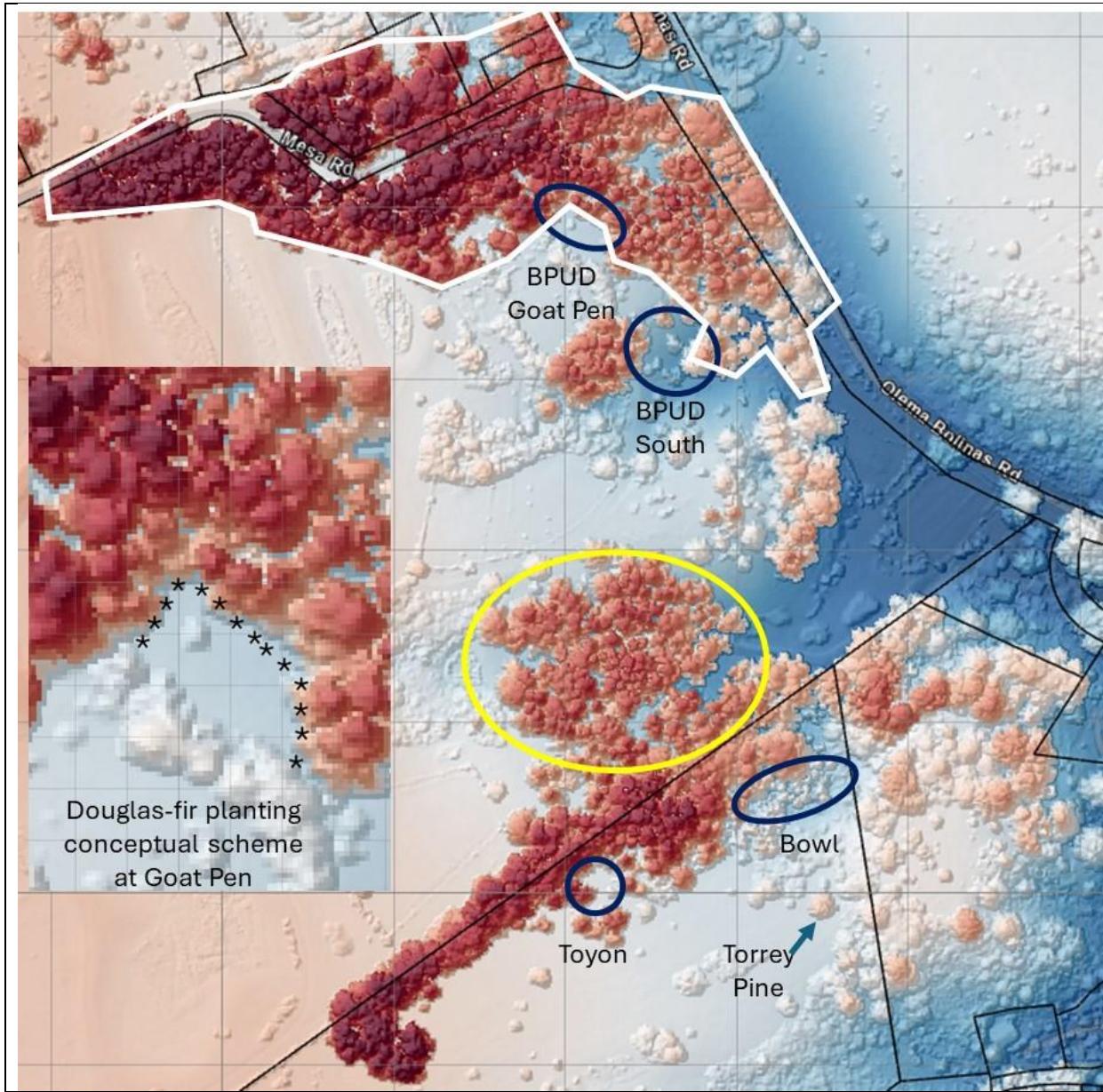
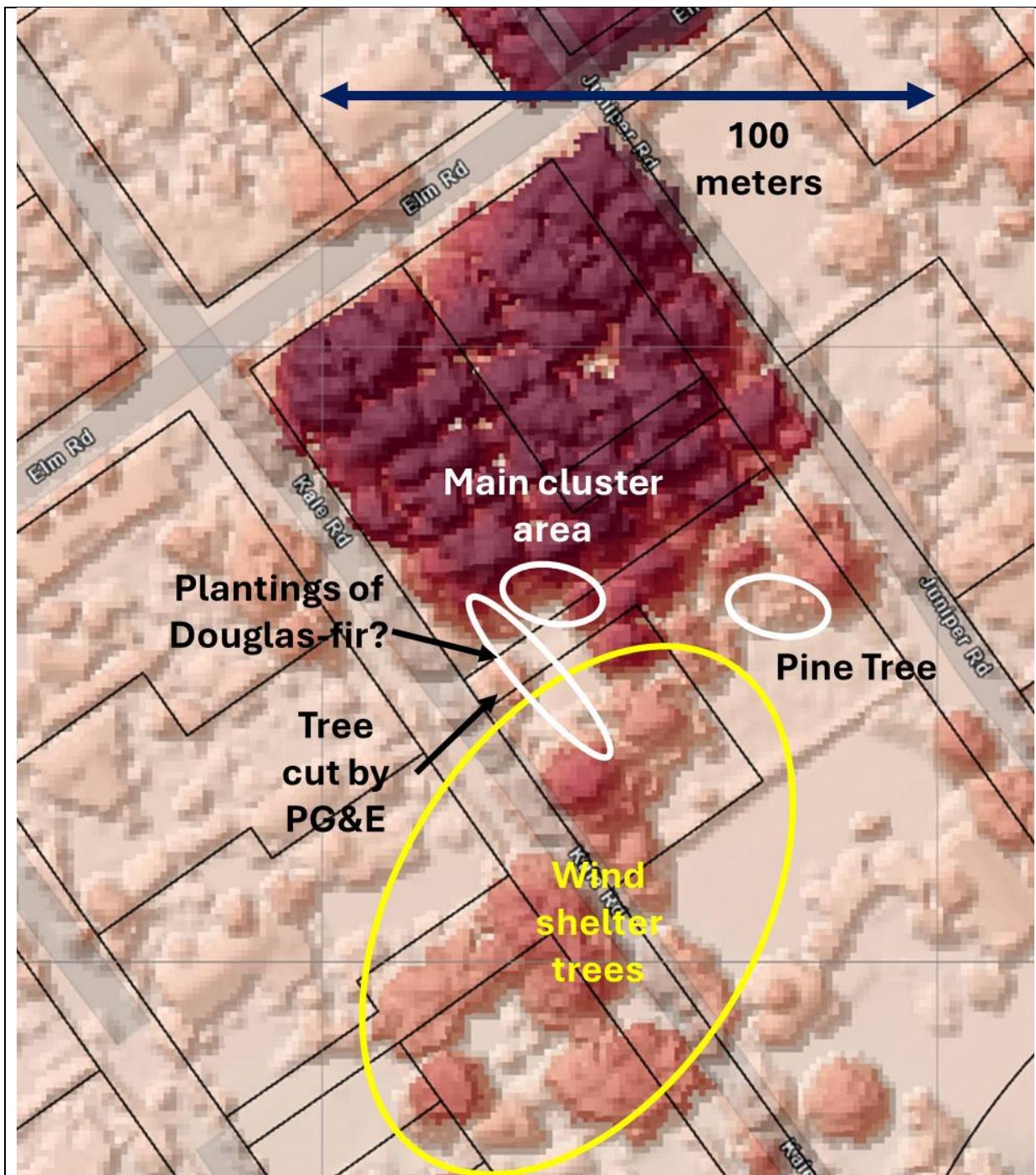
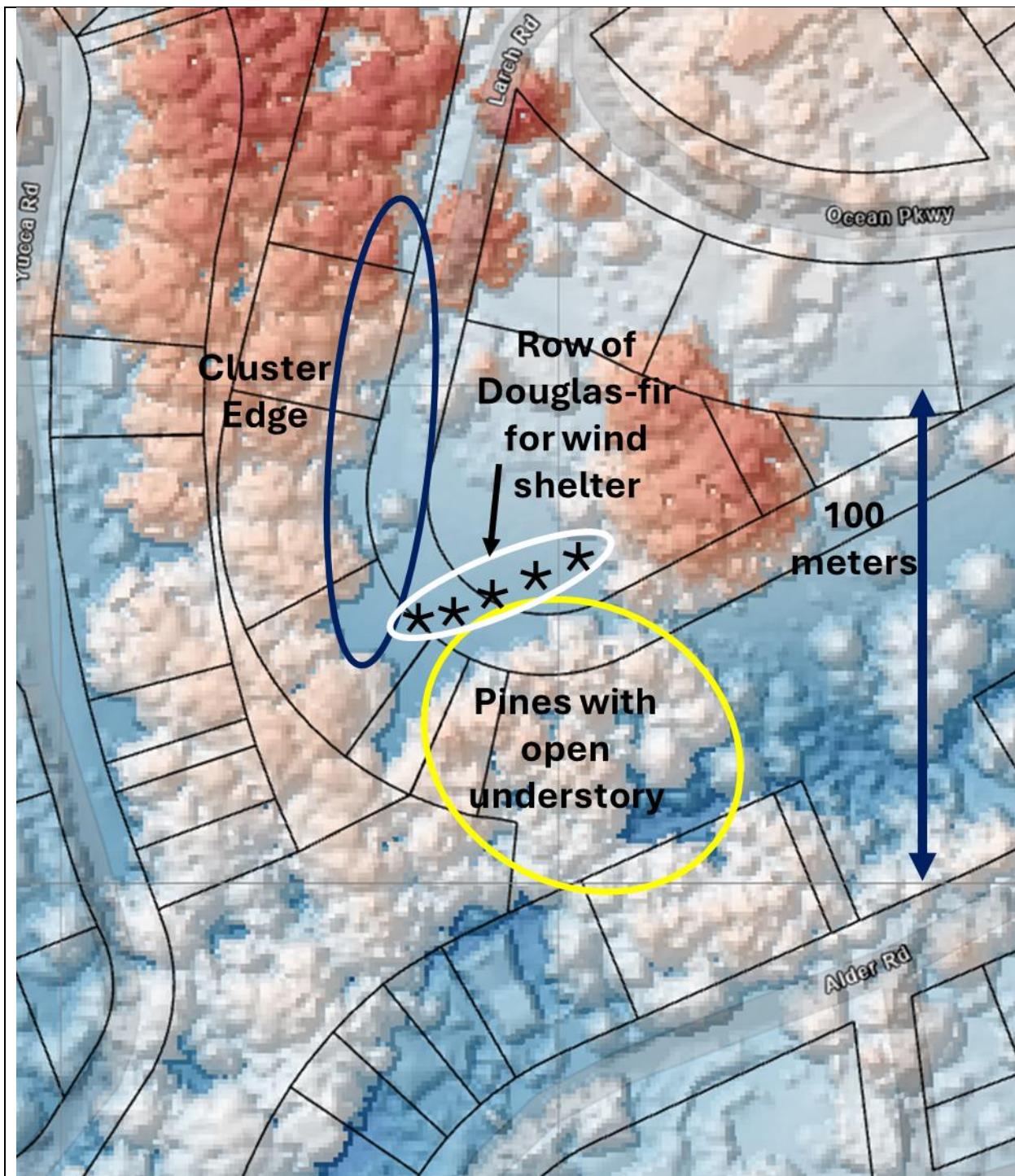


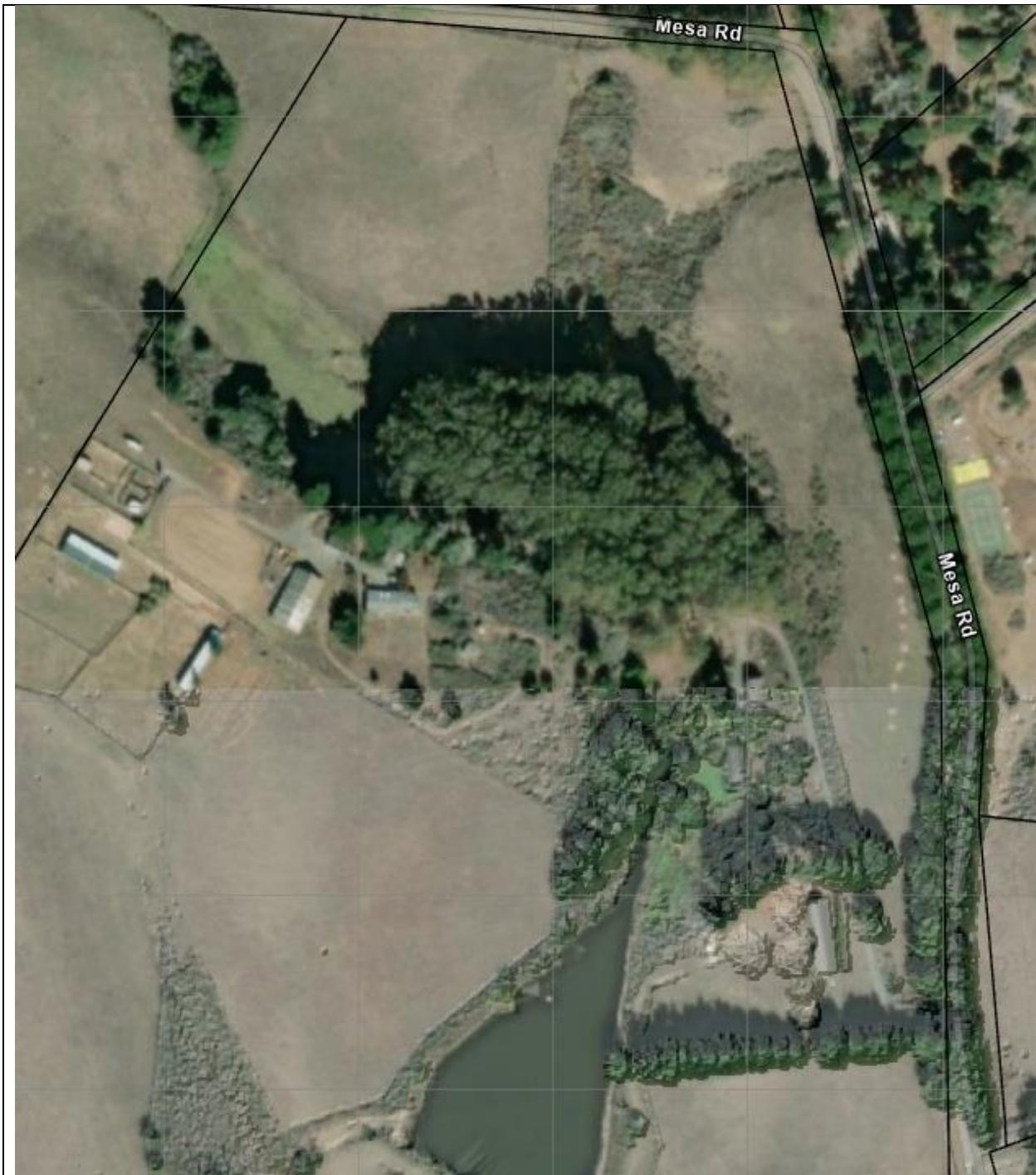
Figure 6. LiDAR map of BPUD area, with monarch sites identified. The white outline is the proposed grove removal. Toyon and Bowl on the adjacent property could provide alternative cluster sites with some additional shelterbelt plantings. The wind-sheltered interior of the grove of trees north of Toyon (yellow oval) does not receive enough sun to support monarchs, but a well-designed gap could be cut. The inset is a conceptual plan for planting Douglas-fir to eventually replace the wind shelter provided by the eucalyptus. A second row could be planted once the eucalyptus have been removed.



LiDAR view of Juniper-Kale. Monarchs cluster on the southern edge of the grove in a protected alcove. They also regularly sun themselves on a pine tree to the east during calm weather. The loss of the eucalyptus trees trimmed/cut by PG&E exposed the cluster area to SW winds. With some selected plantings of fast-growing Douglas-fir the wind shelter could be replaced in about a decade. The trees need to be planted far enough from the powerlines to not interfere. Most of the core site is owned by a single person, but the trees across Kale are on a different parcel.



LiDAR view of Alder-Vortex. Monarchs cluster along the E edge of the dense eucalyptus along a drainage. To the SE of the cluster edge, a stand of older pines has an open understory (see Hemiphoto 1195). One possibility to ameliorate the eventual loss of wind shelter is to establish a row of Douglas-fir in the area indicated (tree spacing and number not to scale). The multiple private parcels will make this a difficult site to manage.



Site # 2913 – Mesa Rd. North of Bolinas. This grove falls outside the current LiDAR analysis extent. The grove has potential – it may be too dense for monarchs, but a detailed microclimate analysis with hemiphotos and LiDARr is warranted. Selective thinning and gap creation may work here. Diverse nectar plants have been established on the property with assistance from Xerces Society, and the landowner is willing to consider monarch habitat improvements.

### PROJECT DESCRIPTION: BCPUD PEDESTRIAN/BIKE PATH REHABILITATION

#### Introduction

The Bolinas Community Public Utility District (BCPUD) is requesting Coastal Permit approval to rehabilitate an existing off-street bicycle and pedestrian path originally permitted and constructed under a Coastal Development Permit approved in 2007. The path was built to provide a safe, publicly accessible route between downtown Bolinas and the Mesa residential area. Over time, the path has fallen into disrepair due to weather, erosion, and natural wear.

BCPUD now seeks to restore the path within its existing footprint, improving safety, durability, and accessibility while maintaining its original alignment and community-serving purpose. The rehabilitation will include resurfacing the path with **asphalt**, which will significantly improve its longevity and reduce future maintenance needs.

#### Project Site

The existing path is located on District-owned property and extends approximately **4,700 feet (0.9 miles)** from the existing paved walkway adjacent to the Resource Recovery Green Waste Facility near Olema-Bolinas Road to the intersection of Mesa Road and Overlook Drive. The rehabilitation project will conform to the existing alignment and footprint, with improvements focused on surface stabilization, drainage, and minor grading. The new surface will be **asphalt**, providing a more durable and accessible route for pedestrians and cyclists.

#### Project Purpose

The purpose of this project is to restore a vital pedestrian and bicycle connection between downtown Bolinas and the Mesa neighborhood. The path serves multiple critical community functions:

1. It provides a **safe route for children** attending the Bolinas-Stinson School to walk or bike to and from school.
2. It enables children and families to access **after-school programs** held at the Bolinas Community Center.
3. It offers a practical solution to **limited parking** in downtown and near the beach by allowing visitors to the coast to park at Mesa Park and walk down to the Bolinas beach.
4. It serves as the **primary safe route** for the vast majority of Bolinas residents, who live on the Mesa, to access downtown services, businesses, and the beach without relying on vehicle travel along narrow, shoulder-less roads.
5. **It provides a critical emergency ingress and egress route for pedestrians during natural disasters or road closures.** The rehabilitated path will feature a consistent asphalt surface, a longitudinal slope of less than 5%, and a cross slope of less than 2%, in accordance with ADA requirements and guidelines, and a width of 5 feet, ensuring safe and manageable passage for all users. Located away from the ocean and outside flood-

prone areas, the path offers a reliable alternative for evacuation or emergency access when vehicular routes are compromised.

Without this path, pedestrians and cyclists are forced to travel along **County rights-of-way on Mesa Road and Olema-Bolinas Road**, which not only **lack sidewalks**, but also feature **steep grades, blind turns, and no shoulders**. These conditions pose serious safety risks to pedestrians, tourists, and schoolchildren, especially during peak traffic times and in low visibility conditions.

Rehabilitating the existing off-street path offers a **cost-effective public works solution** to these safety concerns. Compared to the high cost and complexity of widening or reconstructing County roads to accommodate non-motorized users, restoring this path is a **low-impact, high-benefit investment** that directly improves public safety and mobility.

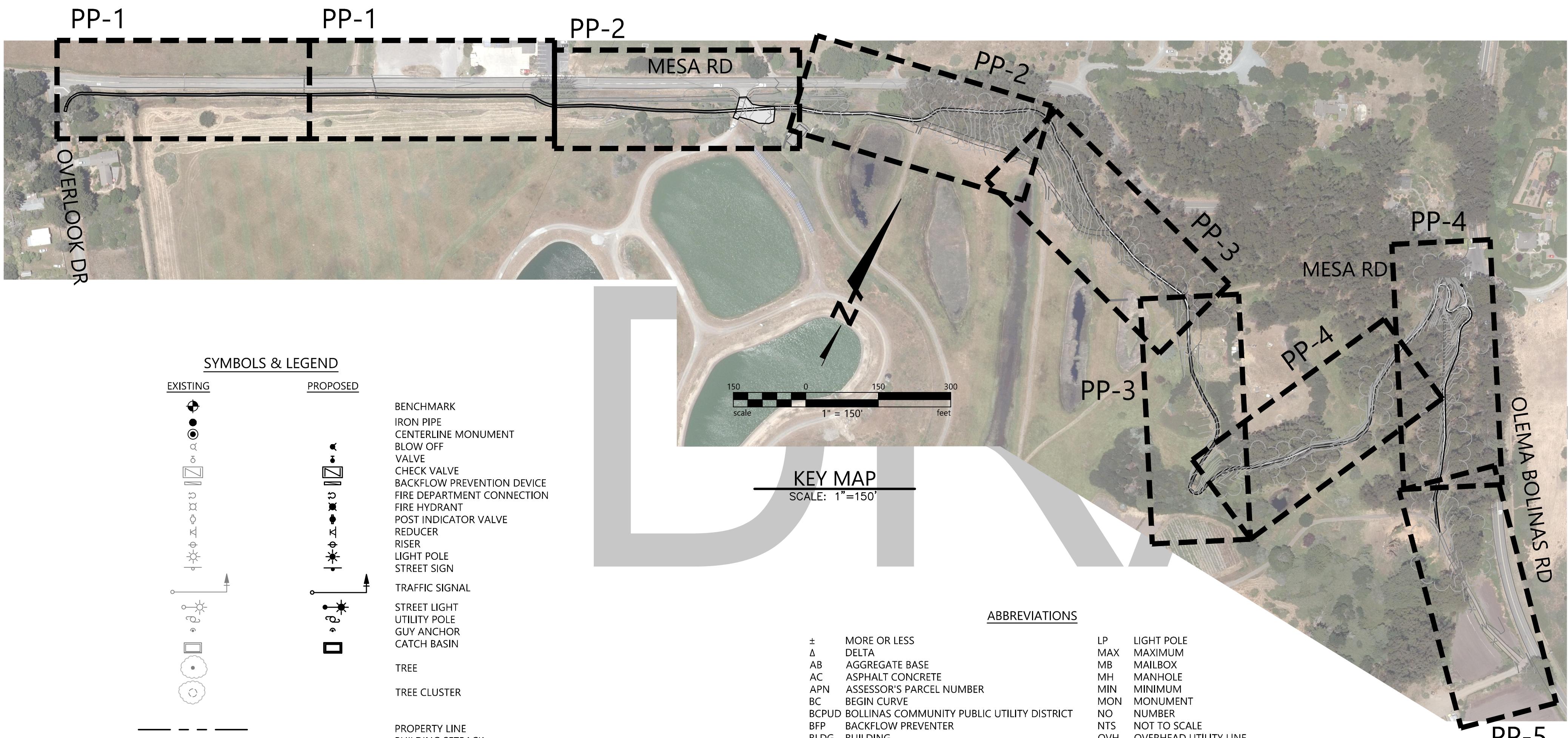
This is a **publicly funded project**, supported by a **\$355,000 grant from California State Parks**, a **\$66,000 allocation from BCPUD**, and an additional **\$47,000 raised through community donations**. However, **engineers currently estimate a \$150,000 construction shortfall** to complete the full rehabilitation of the path. BCPUD is actively seeking additional funding to close this gap and ensure the project can be completed as planned.

As a condition of the State Parks grant, the rehabilitated path must be **open to the public by January 2028**.

**DRAFT**

IMPROVEMENT DRAWINGS FOR  
**BOLINAS PATHWAY**  
BOLINAS, MARIN COUNTY CA  
OVERLOOK DR, MESA RD & OLEMA BOLINAS RD  
BCPUD PROPERTY APN 193-030-38

# FEBRUARY 2024



**LEGEND**

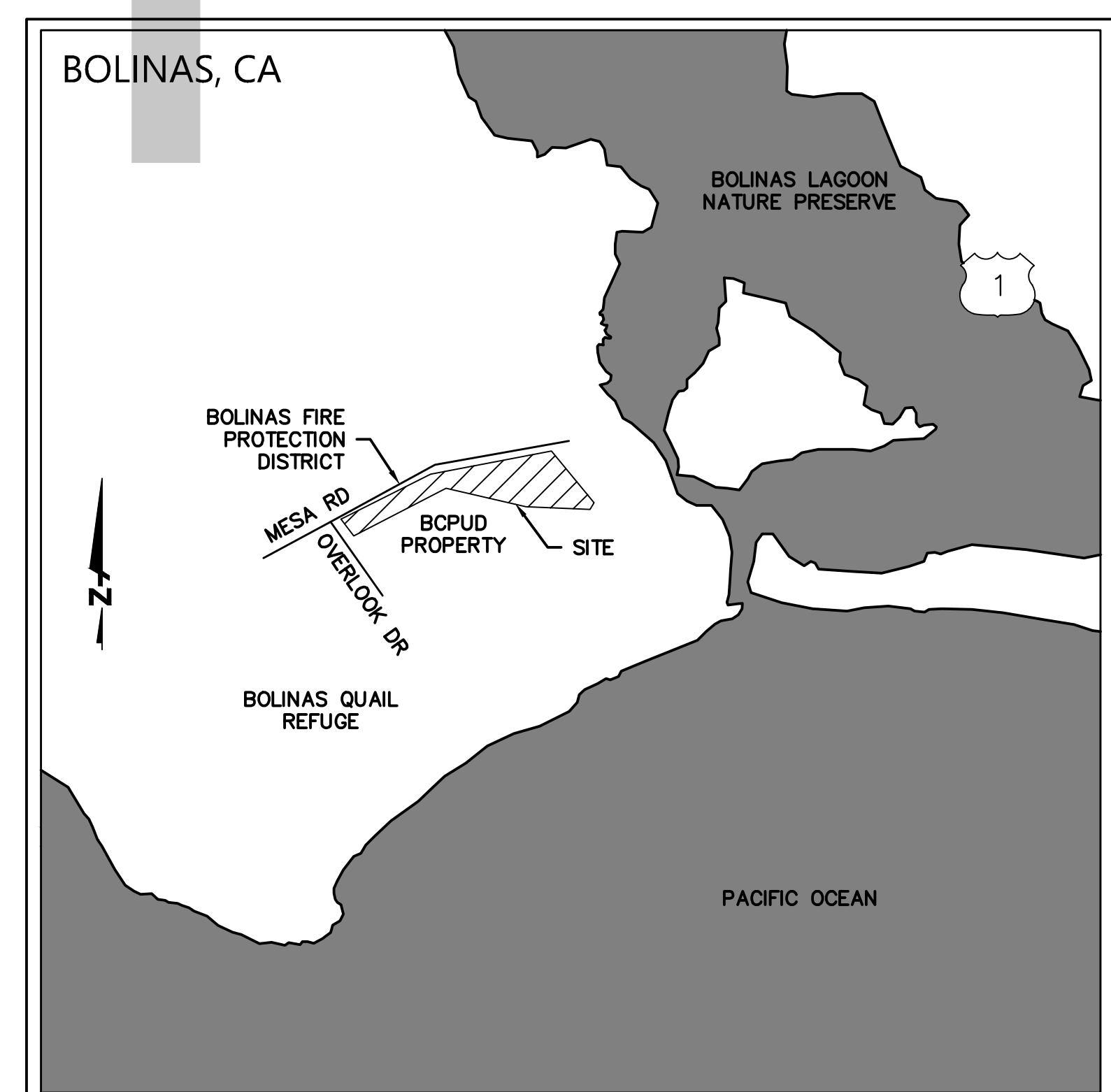
-  **TREE TO BE REMOVED (19)**
-  **FALLEN TREE (2)**

OWNER: BOLINAS COMMUNITY PUBLIC UTILITY DISTRICT  
270 ELM RD, P.O. BOX 390  
BOLINAS, CA 94924  
PH: (415) 868-1224  
FAX: (415) 868-9501

VIL ENGINEER: BKF ENGINEERS  
200 4TH ST, STE. 300  
SANTA ROSA, CA. 95401  
PH: (707) 583-8500  
FAX: (707) 583-8539

## INDEX OF DRAWINGS

1. COVER SHEET
2. TYPICAL SECTIONS
3. PATHWAY PLAN & PROFILE (STA 0+00 - STA 10+25)
4. PATHWAY PLAN & PROFILE (STA 10+25- STA 15+25)
5. PATHWAY PLAN & PROFILE (STA 15+25 - STA 20+75)
6. PATHWAY PLAN & PROFILE (STA 20+75 - STA 26+00)
7. PATHWAY PLAN & PROFILE (STA 26+00- STA 31+25)
8. PATHWAY PLAN & PROFILE (STA 31+25 - STA 36+00)
9. PATHWAY PLAN & PROFILE (STA 36+00 - STA 41+75)
10. PATHWAY PLAN & PROFILE (STA 41+75 - STA 43+13)



## VICINITY MAP

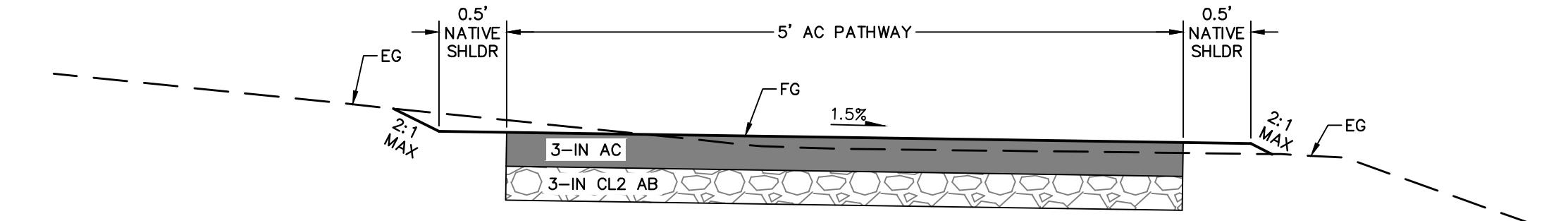
	
<p><b>PRELIMINARY</b></p>	
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<p>REBECCA DOWER</p>	

The logo for BKFF is displayed. It features the letters 'BKFF' in a large, bold, black sans-serif font. To the right of the letters is a graphic element consisting of a black triangle pointing to the right and a gray 'Z' shape.

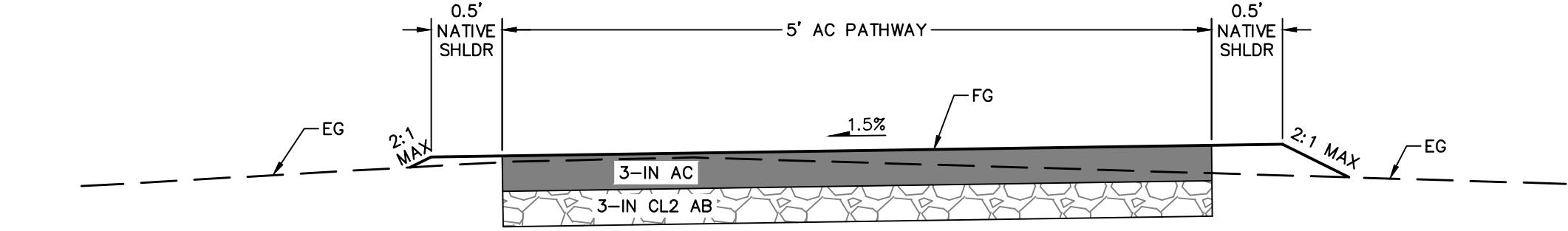
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APN 193-030-38  
MESA RD & OLEMA BOLINAS RD, BOLINAS, CA

**COVER SHEET**

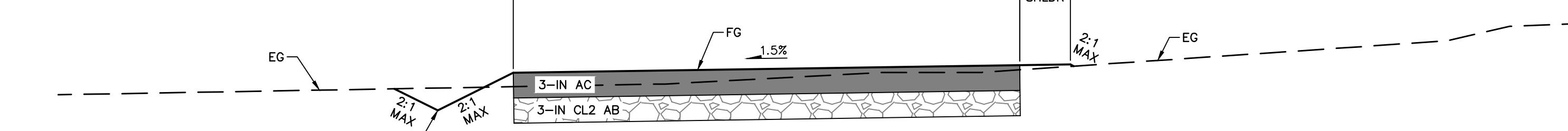
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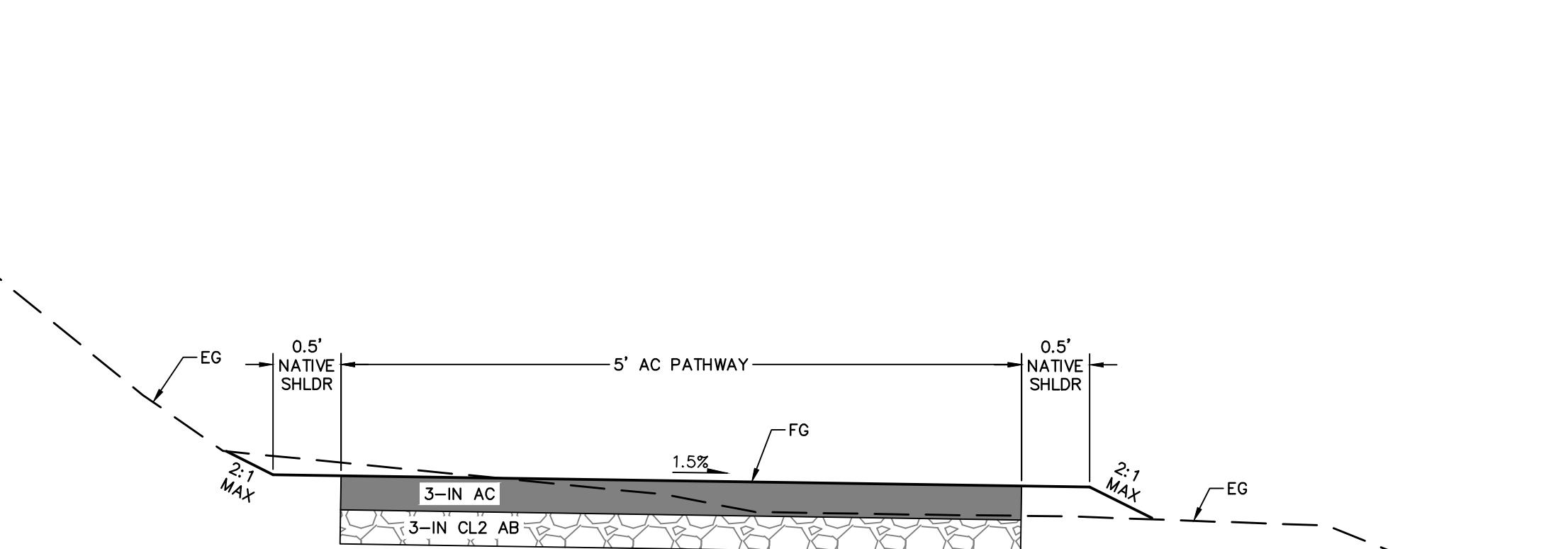
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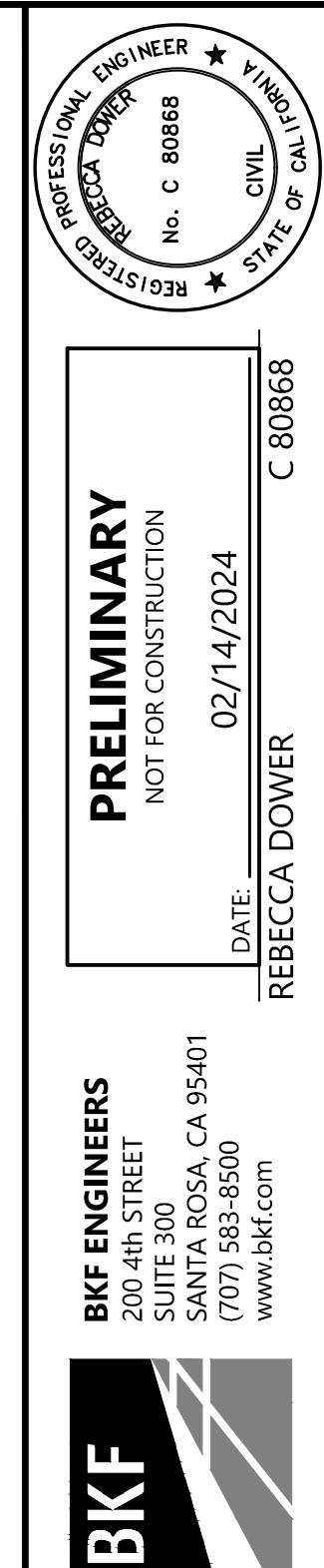
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3 TYPICAL PATHWAY SECTION 3  
NTS PATHWAY STA 25+50 - 31+00



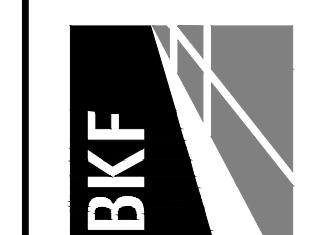
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NTS PATHWAY STA 31+00 - END



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MESA RD & OLEMA BOLINAS RD, BOLINAS, CA

**TYPICAL SECTIONS**

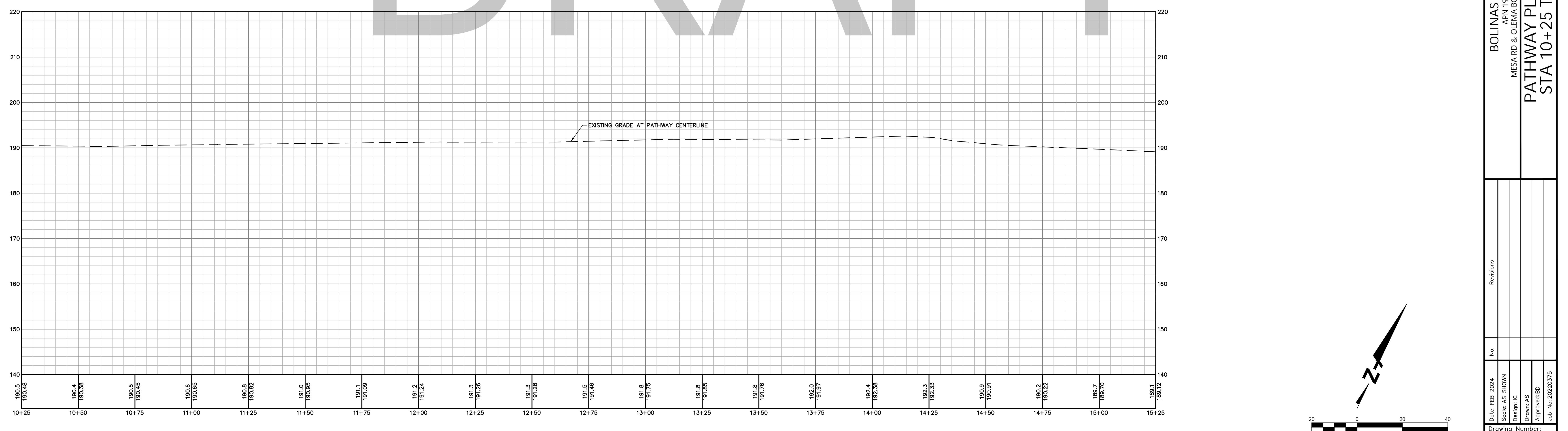
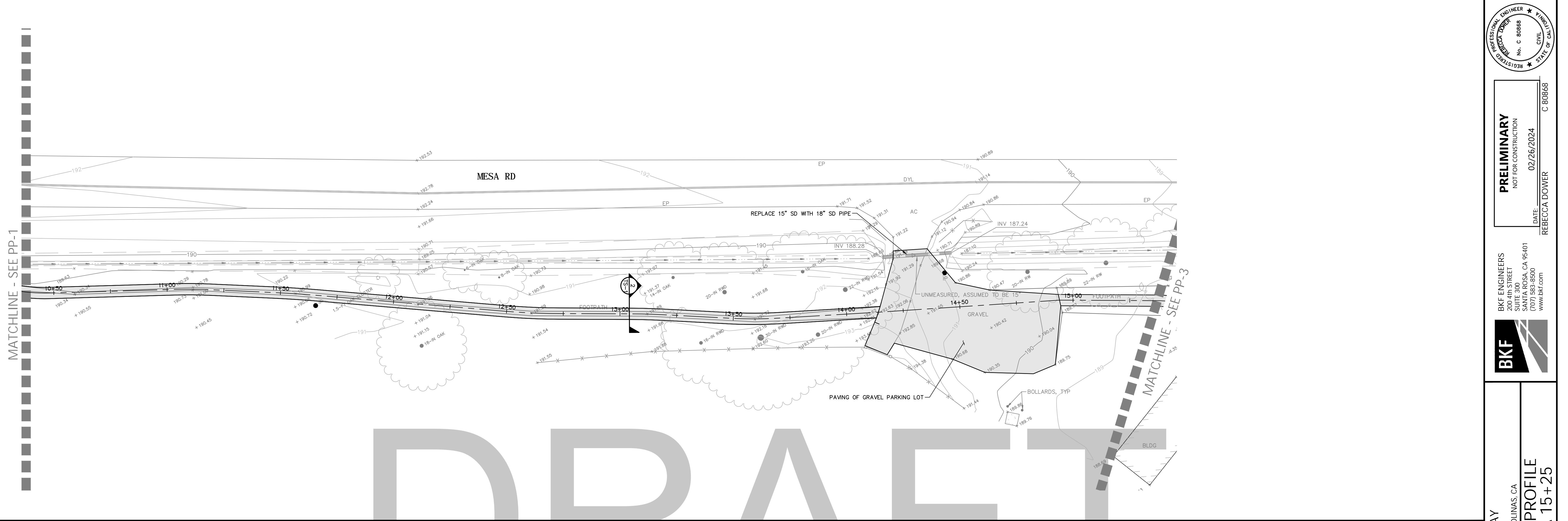
**PRELIMINARY**  
NOT FOR CONSTRUCTION  
02/14/2024  
REBECCA DOWER  
DATE  
C 30868

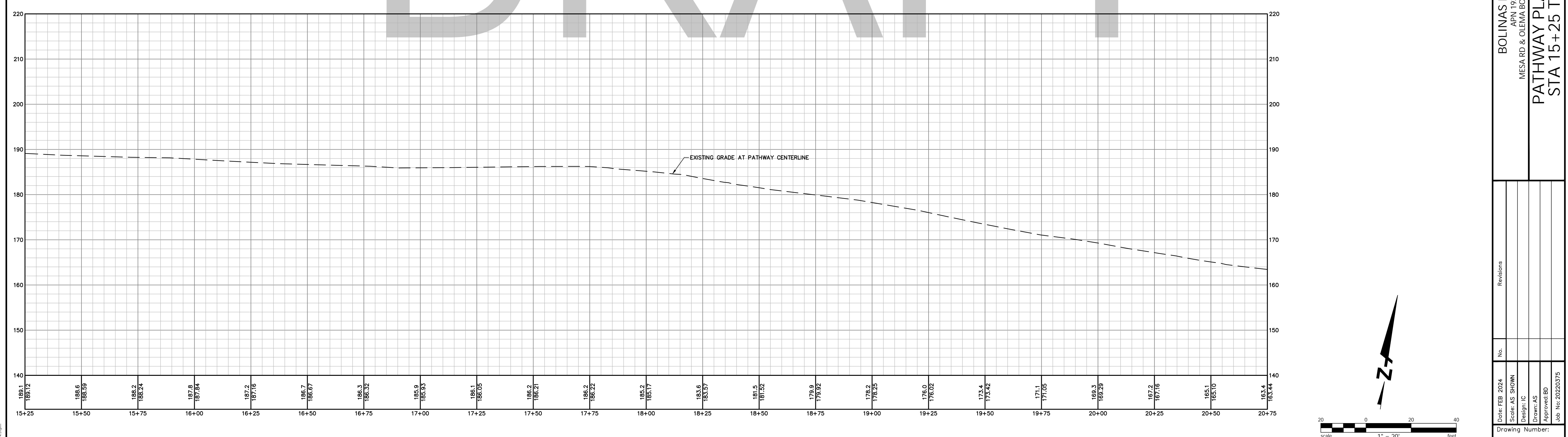
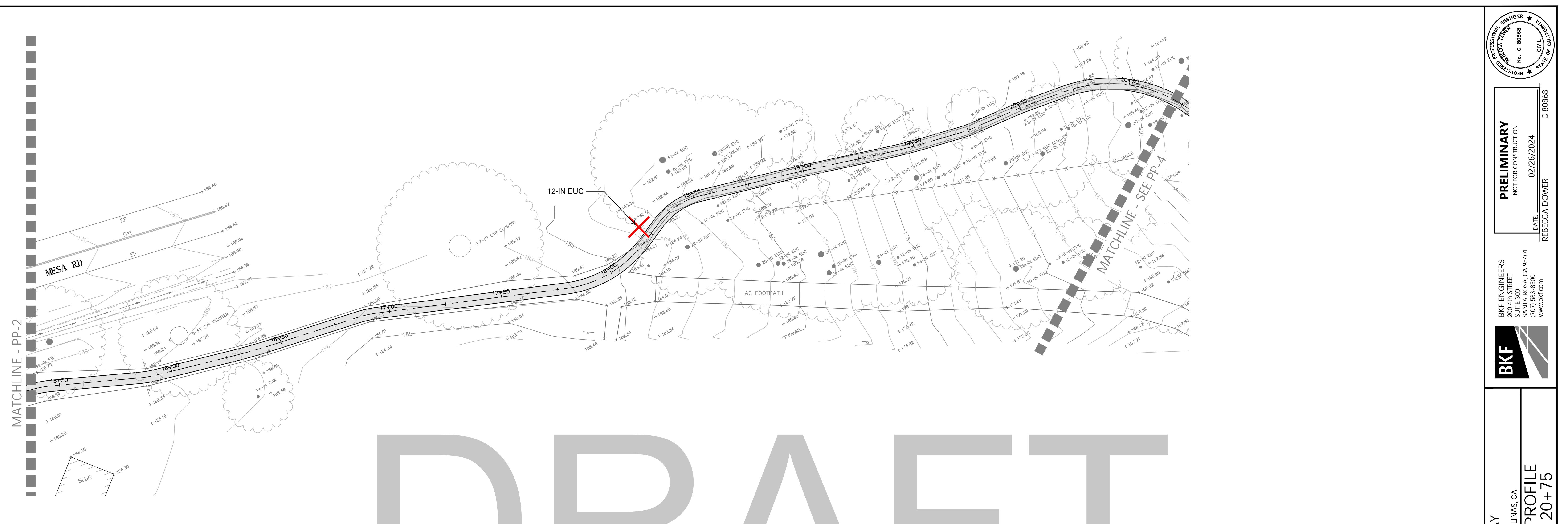


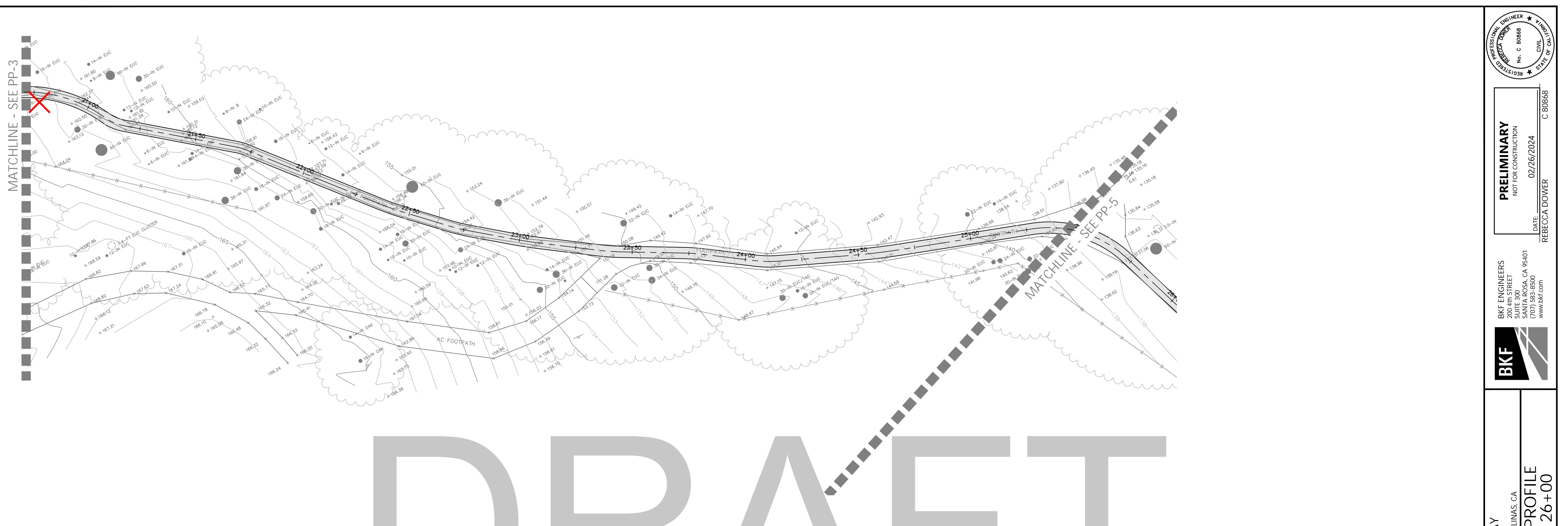
**BKF ENGINEERS**  
200 4th STREET  
SUITE 300  
SANTA ROSA, CA 95401  
(707) 563-8500  
www.bkf.com

Date: FEB 2024  
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Approved: BD  
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**TS-1**  
2 OF 10

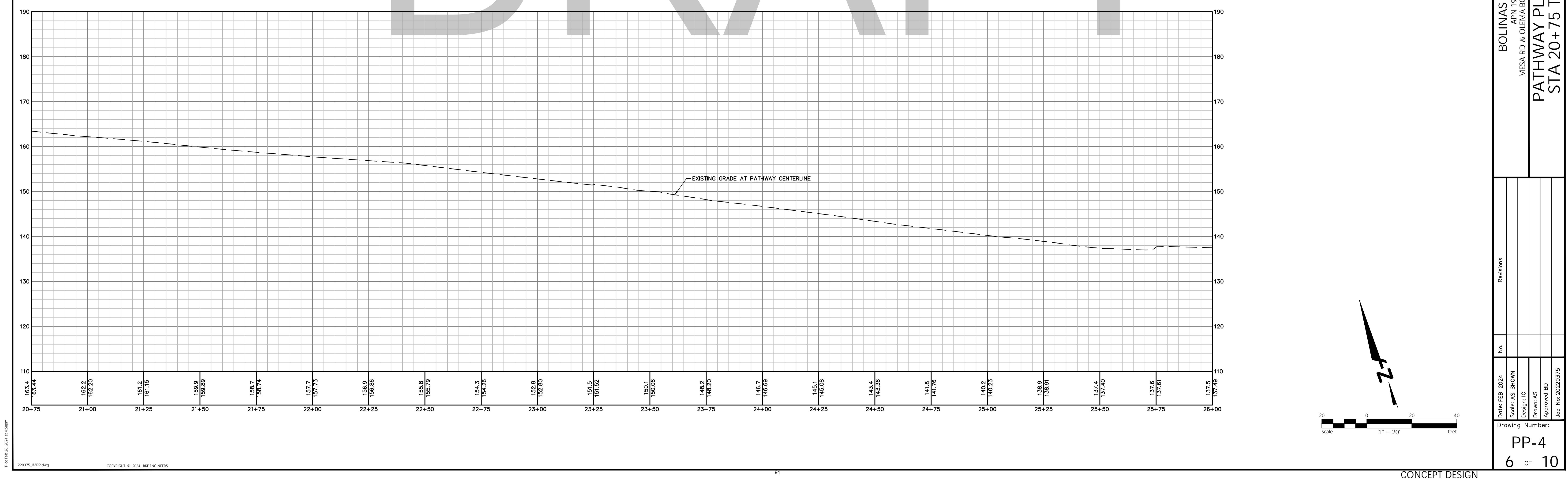








# DATA



MATCHLINE - SEE PP-6

**MATCHLINE - SEE PP-4**

This figure is a construction plan for Matchline - SEE PP-4, showing a road alignment with various elevations, utility crossings, and construction notes. The plan includes a vertical scale on the left and a horizontal scale at the bottom.

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**Key Features and Labels:**

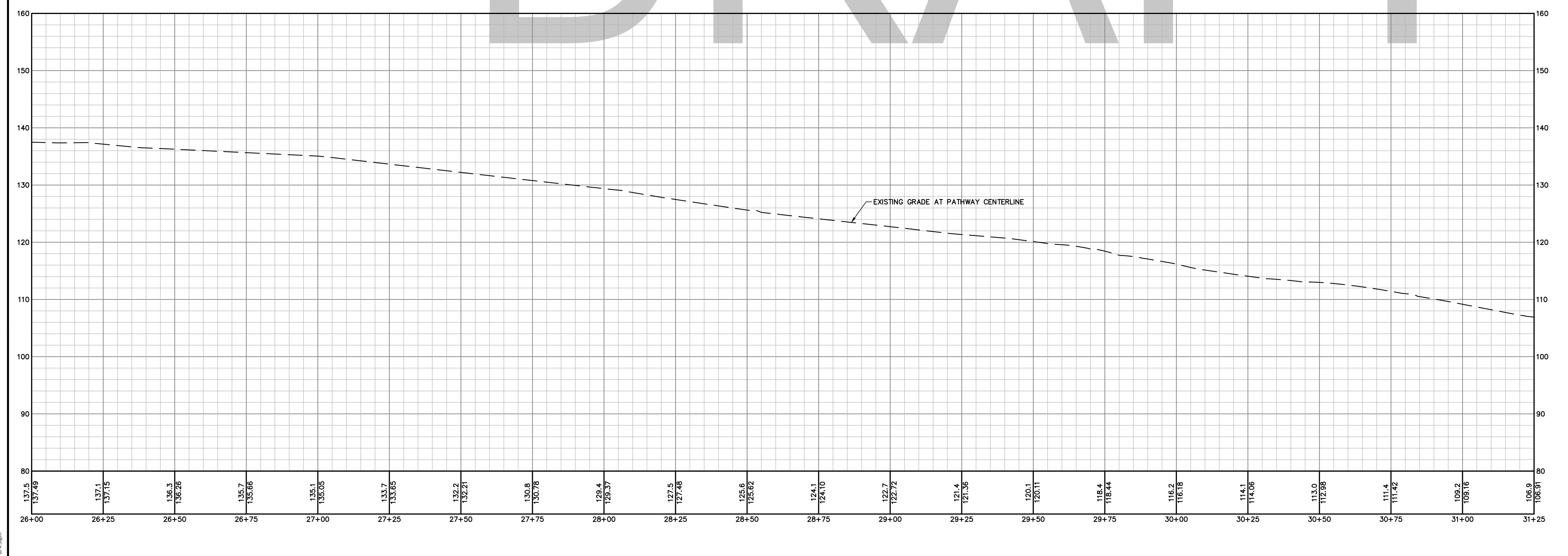
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- Construction Notes:** 3TS-1, REPLACE 12" SD, FOOTPATH.

	
<p><b>PRELIMINARY</b></p> <p>NOT FOR CONSTRUCTION</p> <p>DATE: <u>02/26/2024</u></p> <p>REBECCA DOWER</p>	
<p>BKF ENGINEERS 200 4th STREET SUITE 300 SANTA ROSA, CA 95401 (707) 583-8500 <a href="http://www.bkf.com">www.bkf.com</a></p>	
	

The logo for the Black Kid Film Festival (BKFF) is displayed. It features the letters 'BKFF' in a bold, white, sans-serif font. The letters are partially cut off by a thick, black diagonal wedge that slants from the top-left towards the bottom-right. To the right of the wedge, there is a vertical grey bar with a white diagonal line running through it.

**BOLINAS PATHWAY**  
APN 193-030-38  
MESA RD & OLEMA BOLINAS RD, BOLINAS

**PATHWAY PLAN & PR  
STA 26+00 TO STA 31**



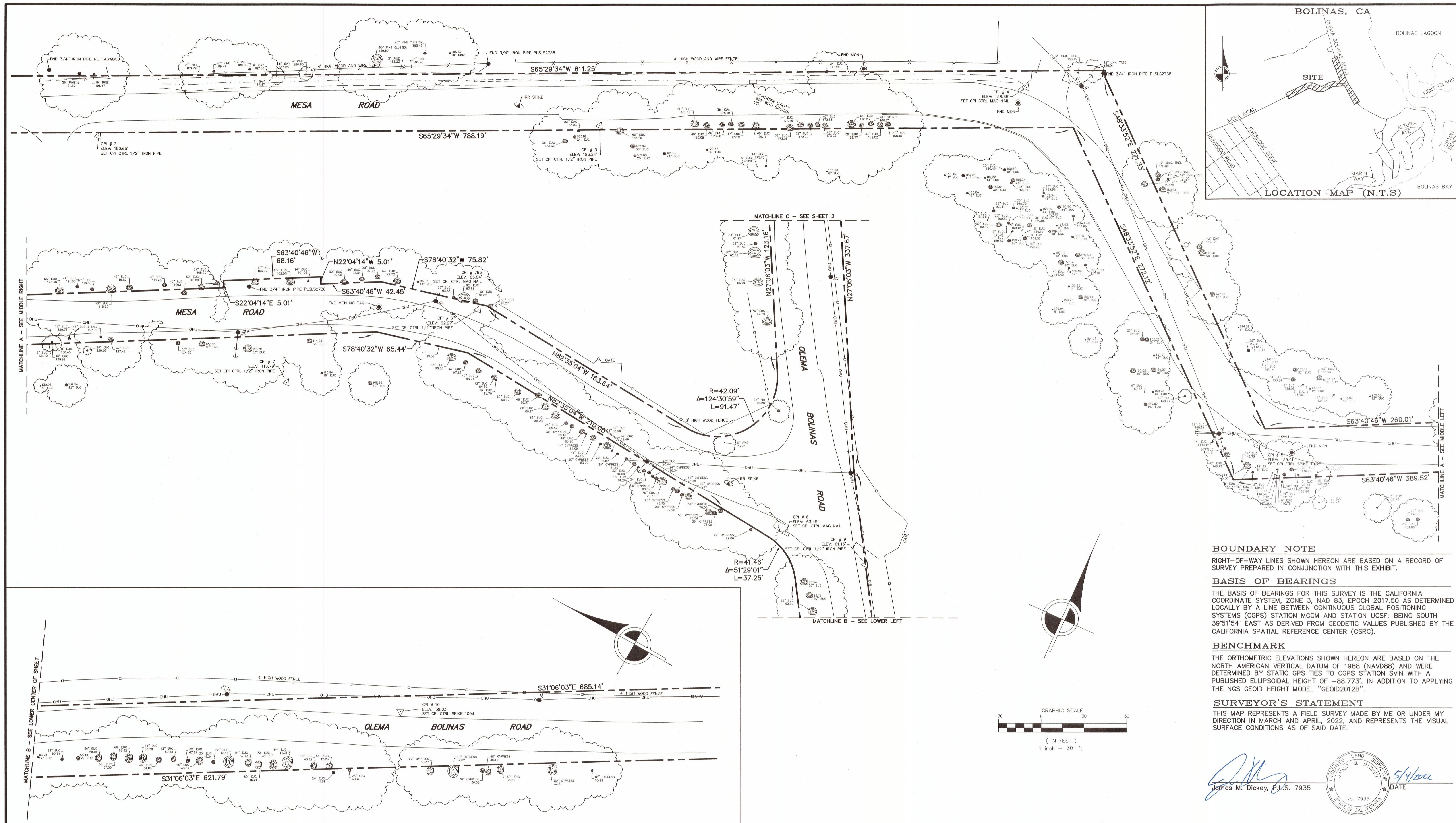
An architectural section drawing of a building's gable end. The main structure is a large, dark, wedge-shaped block. To its right, a smaller, lighter-colored block is attached, forming a stepped profile. The drawing includes a scale bar at the bottom with markings for 0, 20, and 40 feet, and a scale indicator of 1" = 20'.

Drawing Number:  
**PP-5**  
**7** OF **10**







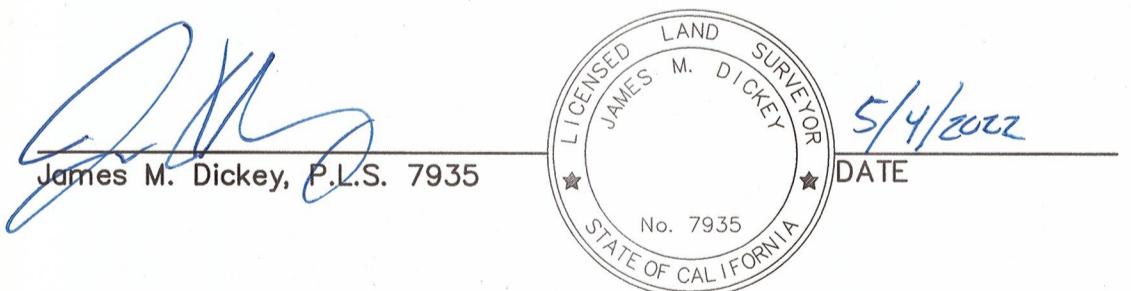


**LEGEND (ALL SYMBOLS MAY NOT APPLY)**

BIR.	<b>BIRCH</b>	BFPCV	<b>BACK FLOW PREVENTION CHECK VALVE</b>
B.O.	<b>BLACK OAK</b>	BLDG	<b>BUILDING</b>
EUC	<b>EUCALYPTUS</b>	BSW	<b>BACK OF SIDEWALK</b>
L.A.	<b>LIQUID AMBER</b>	CMP	<b>CORRUGATED METAL PIPE</b>
L.O.	<b>LIVE OAK</b>	DI	<b>DRAINAGE INLET</b>
MAD	<b>MADRONE</b>	DN	<b>DOCUMENT NUMBER</b>
ORN	<b>ORNAMENTAL</b>	DG	<b>DECOMPOSED GRANITE</b>
RWD	<b>REDWOOD</b>	DYBUT	<b>DOUBLE YELLOW BUTTON</b>
W.O.	<b>WHITE OAK</b>	EP	<b>EDGE PAVING</b>
ED AND	<b>SYCAMORE</b>	ER	<b>EDGE OF ROAD</b>
P LINE	<b>WILLOW</b>	ETW	<b>EDGE TRAVELED WAY</b>
	<b>ASPHALT</b>		

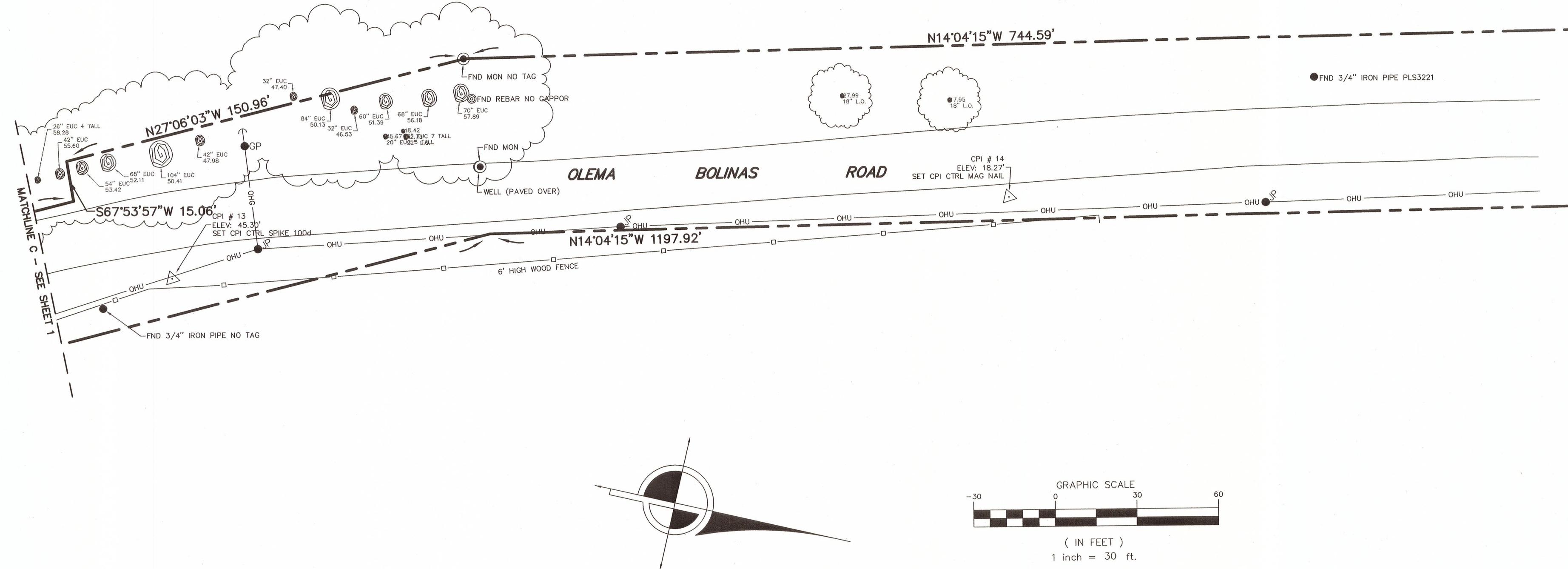
FL	FLOWLINE	RWB
FG	FINISH GRADE	RWT
GB	GRADE BREAK	SD
HC	HANDICAPPED PARKING SPACE	SLB
DE	HIGH DENSITY POLYETHYLENE	SWBUT
M NO.)	TITLE REPORT ITEM NUMBER	SYBUT
JB	JUNCTION BOX	TB
LIP	LIP OF GUTTER	TOE
NG	NATURAL GROUND	TC
R.	OFFICIAL RECORDS	BRC
PL	PROPERTY LINE	TSB
NL	FENCE LINE	TW
C/FNI	FENCE CORNER/INTERSECTION	OH

<b>Job Name:</b>  MESA ROAD, BOLINAS RIGHT-OF-WAY SURVEY SERVICES	<b>DRAWN BY:</b> TJN	
	<b>CHECKED BY:</b> JMD	
	<b>SCALE:</b> 1" = 30'	
<b>Description:</b>  RIGHT-OF-WAY EXHIBIT	<b>SHEET:</b> 1 OF 2	<b>JOB NUMBER:</b> 9674-22
	<b>DWG. PATH:</b> Y:\9674\Cad\	
	<b>DWG. FILE:</b> 9674EXHT-VERTICAL.dwg	
<b>DATE/TIME:</b> May 04, 2022 - 3:05pm		



James M. Dickey, P.L.S. 7935

— 1 —



<b>LEGEND (ALL SYMBOLS MAY NOT APPLY)</b>	
— — — — —	SUBJECT PROPERTY BOUNDARY
— OHE — —	OHE — OVERHEAD ELECTRIC LINE
— OHT — —	OHT — OVERHEAD TELEPHONE LINE
— OHU — —	OHU — OVERHEAD UTILITY LINES (MULTIPLE)
— OHE-HV — —	OHE-HV — OVERHEAD ELECTRIC (HIGH VOLTAGE)
— G — —	G — GAS LINE
— SD — —	SD — STORM DRAIN LINE
— SS — —	SS — SANITARY SEWER LINE
— W — —	W — WATER LINE
— UGTS — —	UGTS — UNDERGROUND TRAFFIC SIGNAL WIRE
— O — O — O —	CHAINLINK FENCE
— □ — □ — □ —	WOOD FENCE
— X — X — X —	WIRE FENCE
	CONCRETE
	TRUNCATED DOMES
	WOOD DECK/STAIRS
	ROCK WALL/RIPRAP
	PERIMETER OF BUILD
	△ SURVEY CONTROL P
	+ 100.00 SPOT ELEVATION
	CO SANITARY SEWER CL
	SS SANITARY SEWER MA
	SD STORM DRAIN MAH
	○ STORM DRAIN CATCH

□ □	DRAINAGE INLETS	● PP	POWER POLE
● RW	DRAINAGE DOWNSPOUT	● JP	JOINT UTILITY POLE
□ I	IRRIGATION CONTROL VALVE	● JP	JOINT POLE W/STREET LIGHT
ℳ	MONITORING WELL	● S	TRAFFIC SIGNAL
ℳ W	WELL	● S	TRAFFIC SIGNAL POLE W/STREET
HOH	FIRE HYDRANT	● T	TELEPHONE POLE
Ⓐ	WATER VALVE	●	STREET LIGHT
ℳ	WATER METER	●	LANDSCAPE LIGHT
UT	HOSE BIB	■	STREET LIGHT BOX
E	ELECTRIC BOXS	TS	TRAFFIC SIGNAL LIGHT BOX
PG&E	PG&E BOX	● DP	TRAFFIC DETECTOR LID
P	PG&E MANHOLE	■	TELEPHONE BOX
		● T	TELEPHONE MANHOLE

<input type="checkbox"/> C	CABLE TV BOX
<input type="checkbox"/> T	TELEPHONE VAULT
<input checked="" type="checkbox"/> A	GAS VALVE
<input type="checkbox"/> G	GAS METER
<input type="checkbox"/> O	BOLLARD
<input type="checkbox"/> S	SIGN
<input type="checkbox"/> M	MAILBOX
<input type="checkbox"/> I	FOUND IRON PIPE, SIZE TAGGED AS NOTED
<input checked="" type="checkbox"/> M	FOUND MONUMENT, SIZE STAMPED, AS NOTED
	TREE SYMBOL AND DRI

BIR.	BIRCH	
B.O.	BLACK OAK	
EUC	EUCALYPTUS	
L.A.	LIQUID AMBER	
L.O.	LIVE OAK	
MAD	MADRONE	
ORN	ORNAMENTAL	
RWD	REDWOOD	
W.O.	WHITE OAK	
ND	SYC	SYCAMORE
E	WIL	WILLOW
	AC	ASPHALT

BFPCV	BACK FLOW PREVENTION CHECK VALVE
BLDG	BUILDING
BSW	BACK OF SIDEWALK
CMP	CORRUGATED METAL PIPE
DI	DRAINAGE INLET
DN	DOCUMENT NUMBER
DG	DECOMPOSED GRANITE
DYBUT	DOUBLE YELLOW BUTTON
EP	EDGE PAVING
ER	EDGE OF ROAD
ETW	EDGE TRAVELED WAY

FL	FLOWLINE	RWB	RETAINING WALL BOTTOM
FG	FINISH GRADE	RWT	RETAINING WALL TOP
GB	GRADE BREAK	SD	STORM DRAIN
HC	HANDICAPPED PARKING SPACE	SLB	STREET LIGHT BOX
HDPE	HIGH DENSITY POLYETHYLENE	SWBUT	SINGLE WHITE BUTTON
ITEM NO.)	TITLE REPORT ITEM NUMBER	SYBUT	SINGLE YELLOW BUTTON
JB	JUNCTION BOX	TB	TOP OF BANK
LIP	LIP OF GUTTER	TOE	TOE OF BANK
NG	NATURAL GROUND	TC	TOP OF CURB
O.R.	OFFICIAL RECORDS	BRC	BACK OF ROLLED CURB
PL	PROPERTY LINE	TSB	TRAFFIC SIGNAL BOX
FNL	FENCE LINE	TW	TOP OF WALL
FNC/FNI	FENCE CORNER/INTERSECTION	OH	OVERHEAD

<b>Job Name:</b> <b>MESA ROAD, BOLINAS</b> <b>RIGHT-OF-WAY SURVEY SERVICES</b>	<b>DRAWN BY:</b> TJN	<b>CHECKED BY:</b> JMD
	<b>SCALE:</b> 1" = 30'	
	<b>Sheet:</b> 2 of 2	<b>Job Number:</b> 9674-22
<b>Description:</b> <b>RIGHT-OF-WAY EXHIBIT</b>	<b>DWG. PATH:</b>	Y:\9674\Cad\
	<b>DWG. FILE:</b>	9674EXHT-VERTICAL.dwg
	<b>DATE/TIME:</b>	May 04, 2022 - 3:05pm