THE LIVING WATERSHED

A stormwater design for the Sisters of Social Service

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Beginning Stormwater Management, Tom Rau, UCLA Extension
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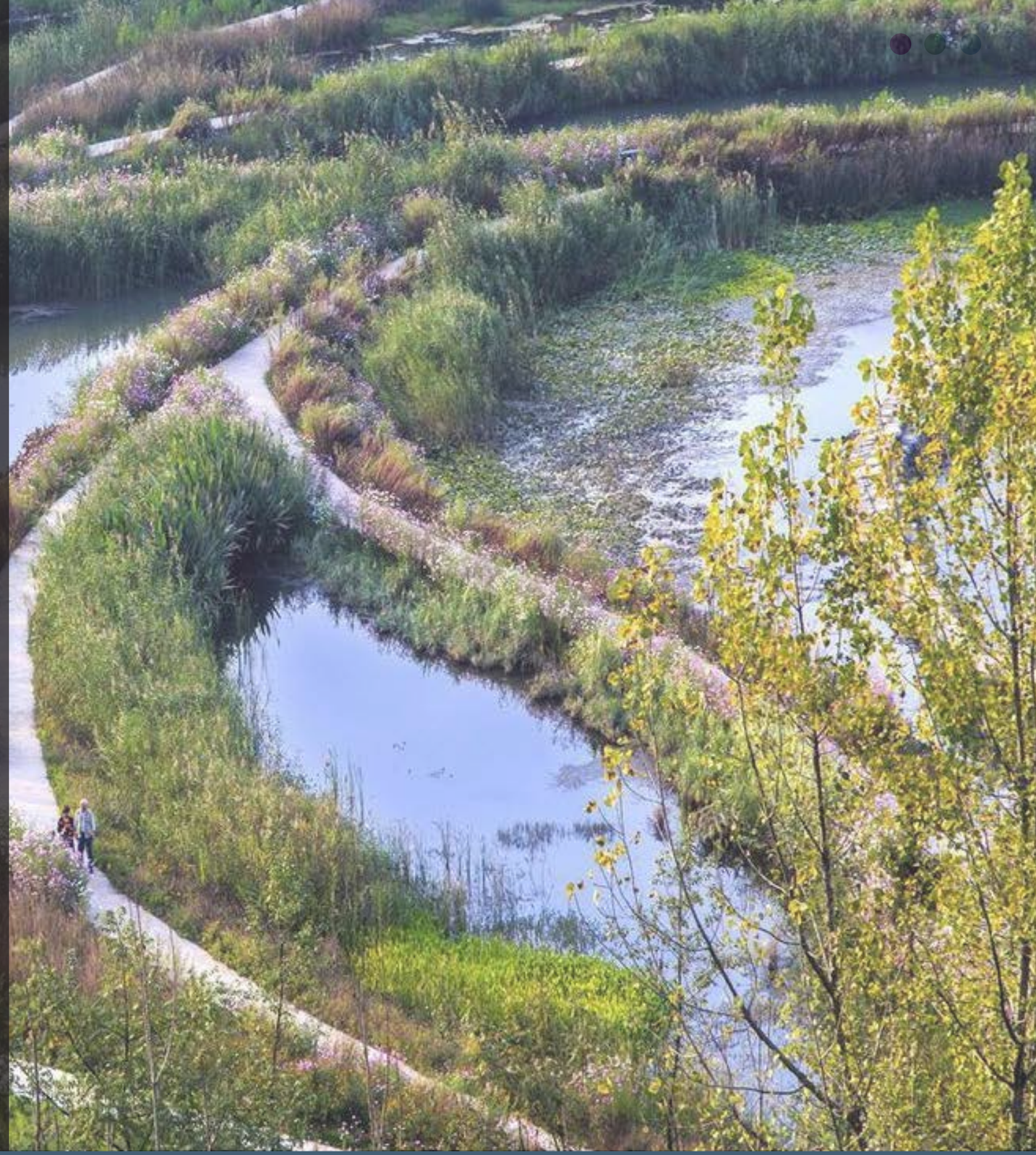


The Living Watershed: Healing Land, Healing Community

Objectives

Transform the site into a teaching landscape where stormwater challenges become opportunities for ecological restoration, community healing, and environmental education. By embracing the natural movement of water across the steep slopes, hillsides, flats, and low-lying areas, the Sisters of Social Service can steward the land into a living example of resilience: where every drop of water nurtures life, strengthens community, and tells a story of renewal.

The property can be turned into a water-wise teaching landscape where every landform has a simple job in the water cycle: catch, slow, spread, sink, or celebrate - through low-tech, volunteer-buildable interventions and native dryland plant communities. The Sisters of Social Service become stewards of a site that models dignity and care: for people who gather here, for trainees who learn here, and for the land that holds the water.

Design Narrative

The Sisters of Social Service have long nurtured human dignity through service, compassion, and community building. This proposal extends that mission to the land itself: to transform stormwater problems into a source of shared healing.

The site will no longer be a place where water is leaking, stagnating, or eroding, but instead a place where water nourishes the soil, supports biodiversity, and creates opportunities for education and engagement, aligning with the mission of the Pando Populus Biophilia structure.

Design Concepts

The Pond: Seasonal Reflecting Basin + Fringe Marsh

- Embrace the leak, shrink the burden. Rather than an expensive relining or other possible leak solutions, potentially downsize the open-water area and convert some of the volleyball court edge to a vegetated fringe marsh. If the lake's surface becomes smaller, it will lead to less evaporation + less maintenance, while a shallow marsh handles inflows and supports habitat.

The Hillsides: a Demonstration of Resilience

- Turn some of the steep slopes most susceptible to erosion into an educational hillside with terracing, reinforced with native grasses and shrubs to slow stormwater and provide teaching plots.
- Reinforce the slopes that are not necessarily eroded with drought-tolerant infill planting to stabilize the slopes.
- Use rock mulch rundowns to mediate erosions in identified areas
- Use zuni bowls to slow water from culverts and other steep drops
- Remove ivy

Flatlands and Mounded Hills: Rain Garden Mosaic

- In flatter areas and mounded terrain, stormwater is spread out, slowed down, and sunk into the soil. A patchwork of community-built rain gardens and small infiltration basins doubles as a pollinator corridor. These spaces invite walking paths, benches, and local art, making stormwater visible and celebratory rather than hidden.
- Use techniques like one rock dams and media lunas to slow and sink water.

Low Point: Convert to Wet Meadow

- Transform mucky low point into a seasonal wet meadow
- Excavate 2-3 ft. of soil and add gravel / crushed stone with sub-drains or overflow
- Remove invasive plants (ivy...)
- Vegetate with native wet meadow plants:
  - » Plant facultative wet species that thrive in seasonal inundation but tolerate summer drought. (e.g. juncus, carex, etc.)
  - » Dense vegetation will filter runoff, absorb water quickly, and reduce mosquito breeding.

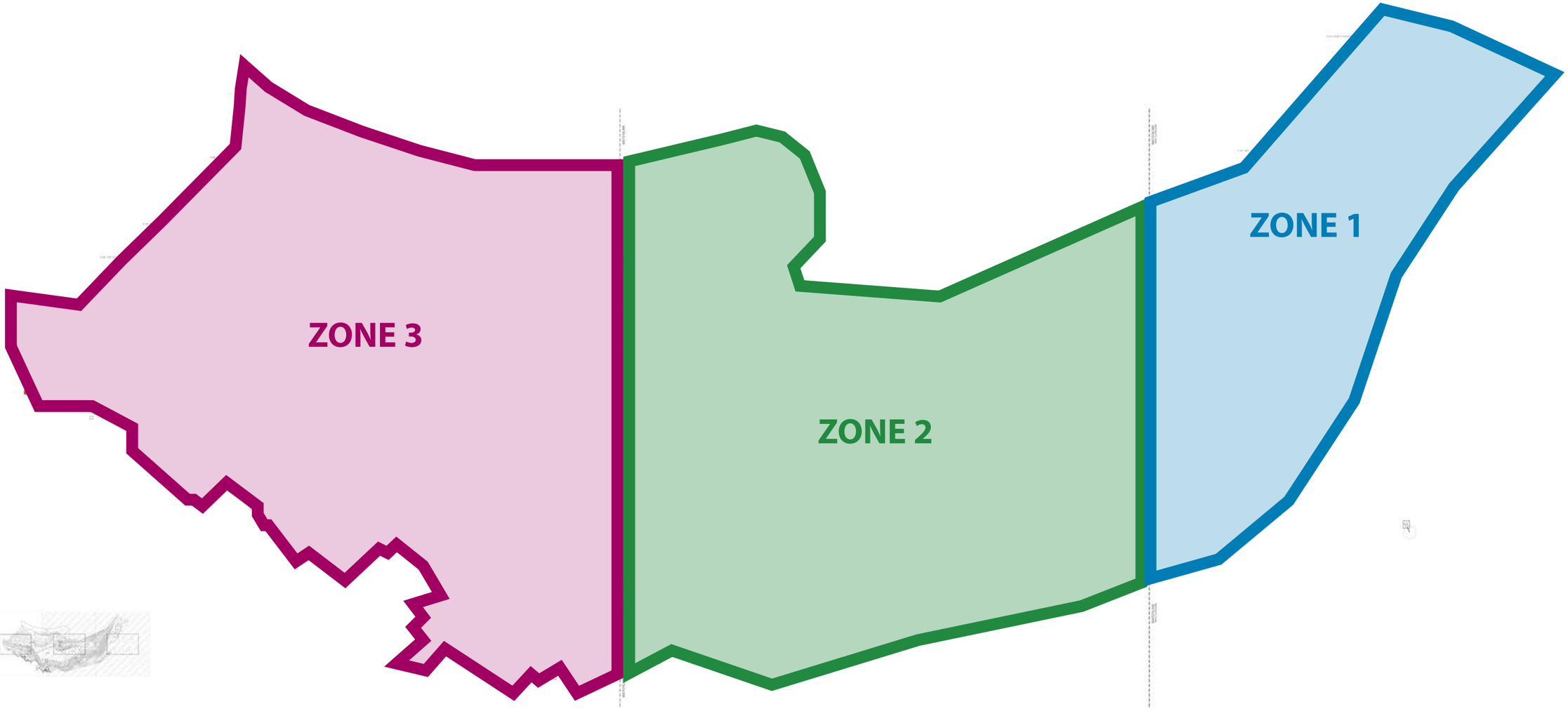
Rooftops become a Visible Water Bank

- Rain from buildings onsite is captured, filtered, and stored in a landmark cistern that doubles as a teaching tool.
- Downspouts from building roofs with filters
- Overflow goes to rain garden?
- Solar pump pumps water to upper portion of the site where it is drier? (alt: if we want to use it within the site boundaries we could also gravity feed the rain gardens during the dry season if needed)
- Educational panels: wrap the cistern with panels that describe the BMPs used on site, gallons saved per year, ecosystems / habitat supported, etc.
- Map the water journey: Include a map that details how the water moves throughout the site to illustrate BMP impacts.

Greywater

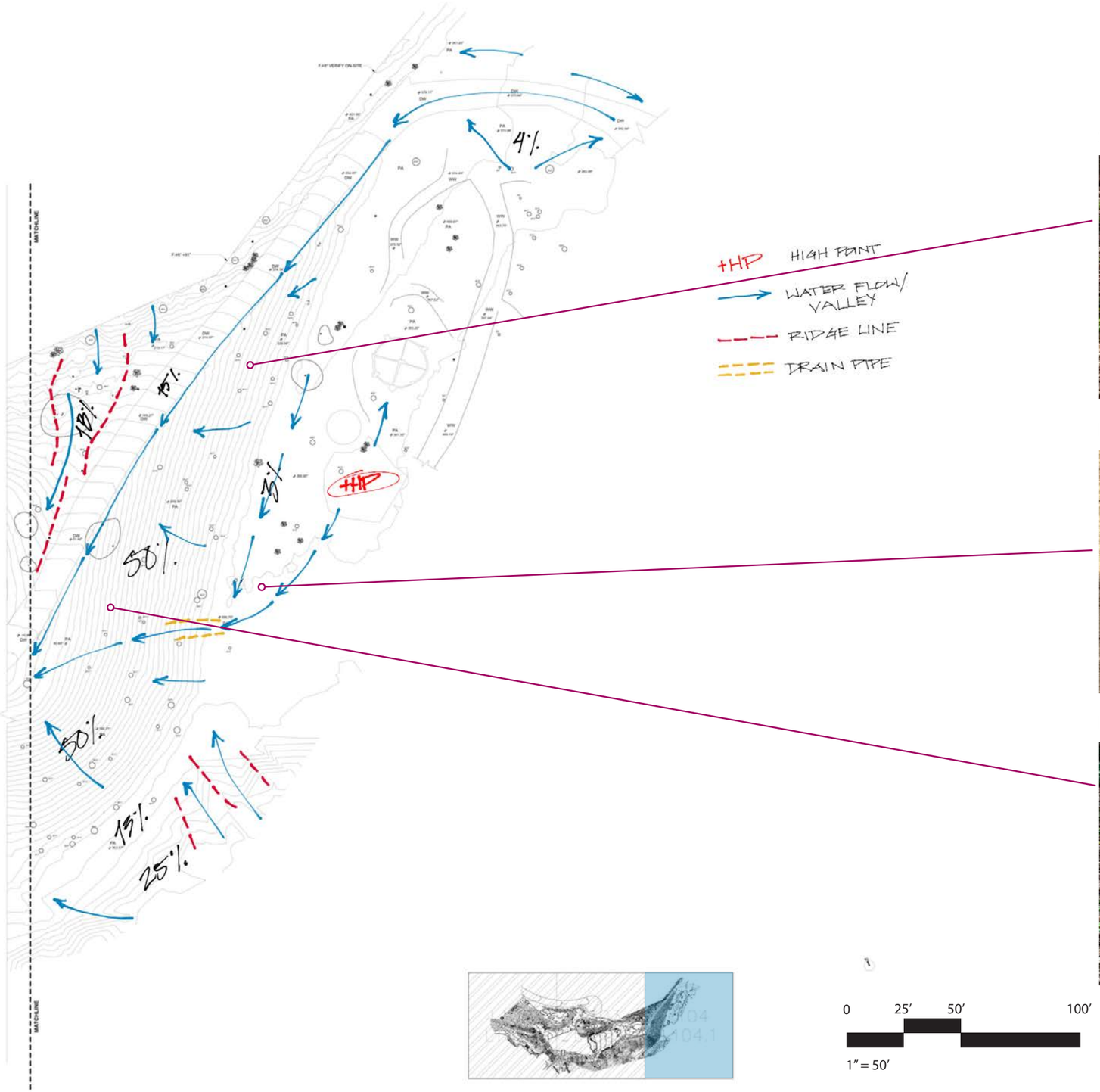
- Harvest greywater from showers and laundry facilities on site

ZONES



SITE ANALYSIS

ZONE 1



Steep slope

Erosion

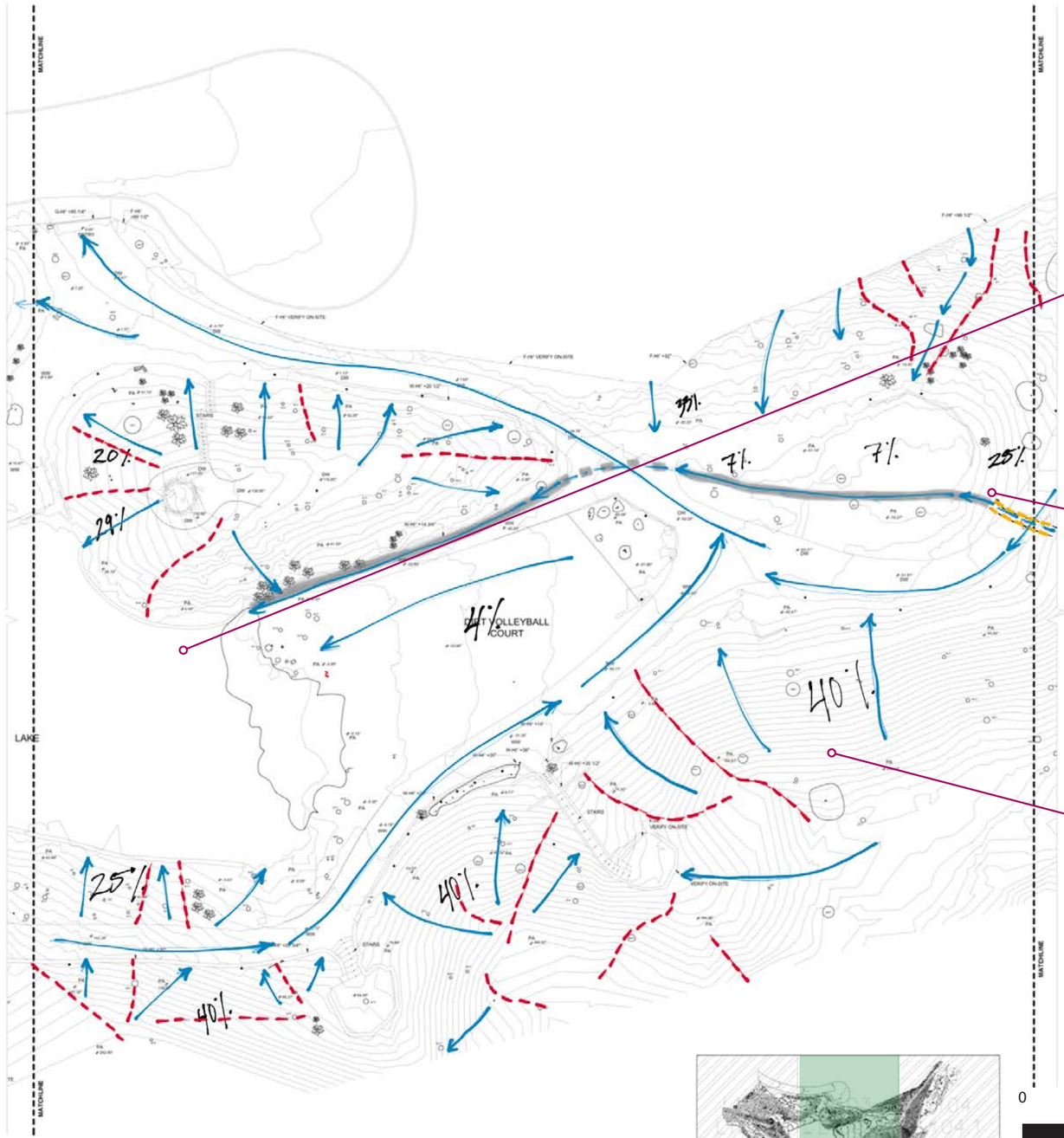
Invasive plants

0 25′ 50′ 100′

1″ = 50′

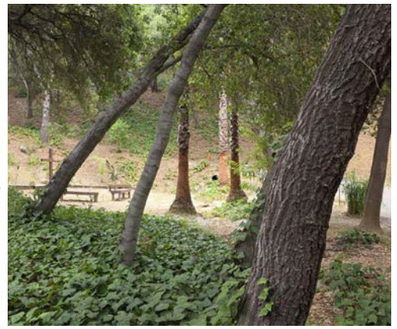
SITE ANALYSIS

ZONE 2



Leaky pond

Culvert outflow



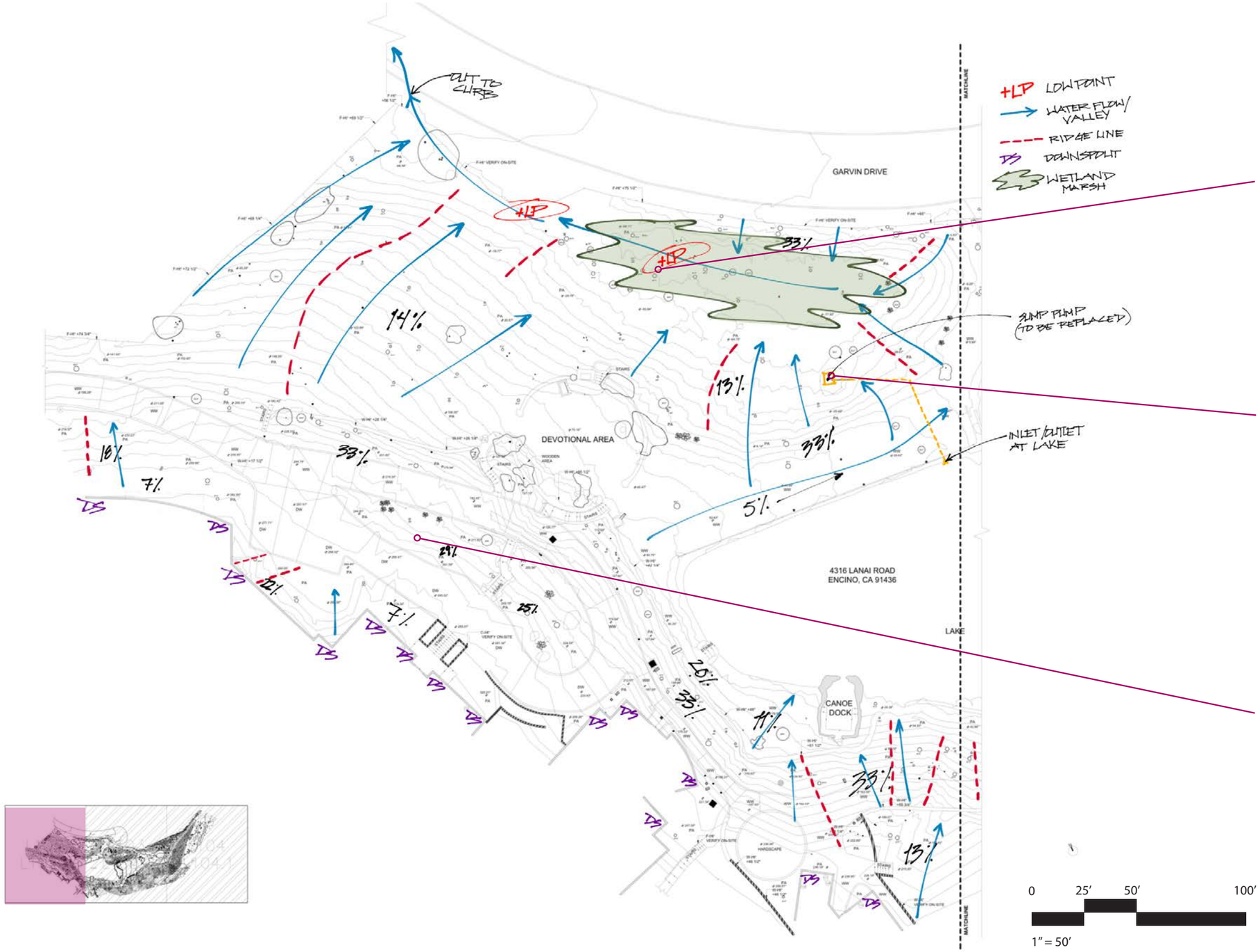
Steep terrain

0 25′ 50′ 100′

1″ = 50′

SITE ANALYSIS

ZONE 3



Mucky, anaerobic low point w/ invasive plants (English ivy pictured)

Dysfunctional pump

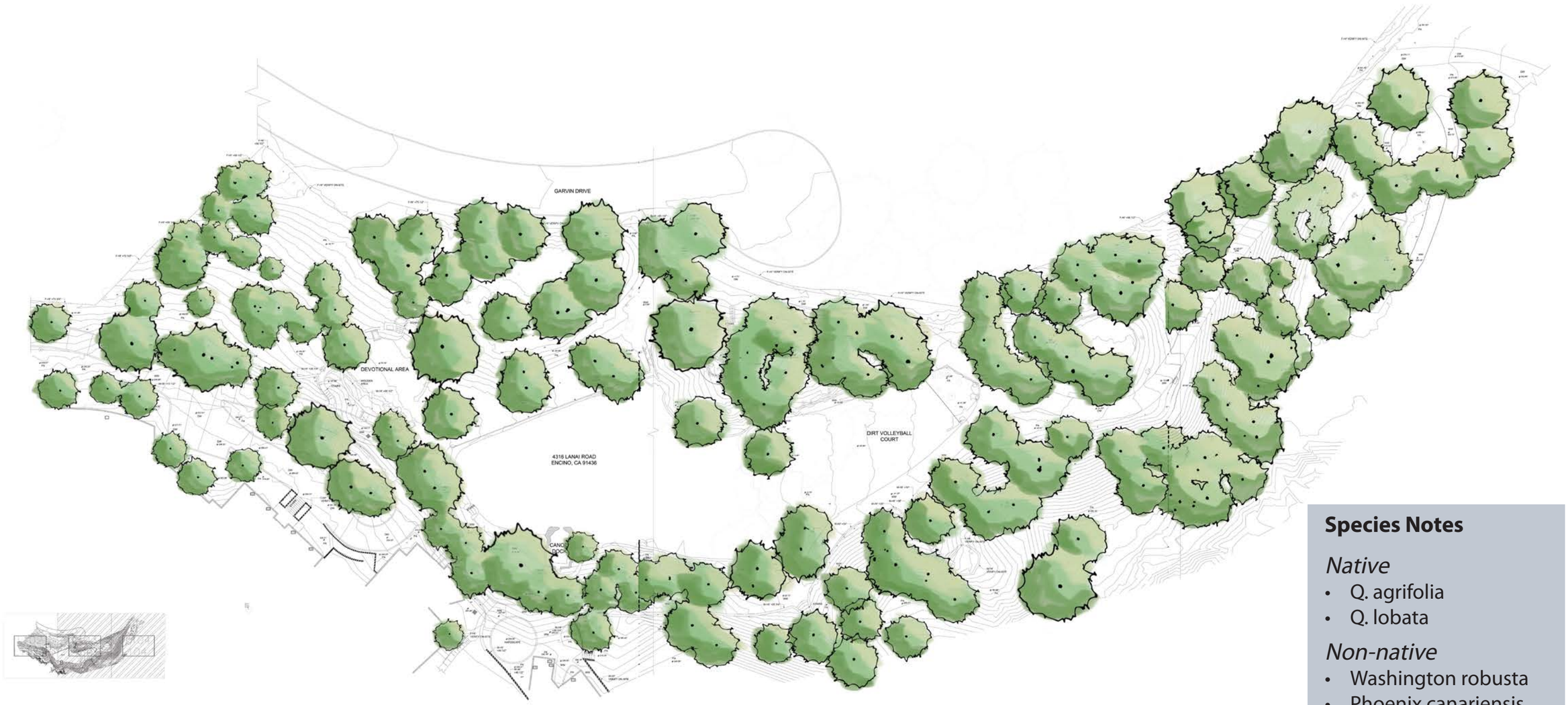
Erosion

0 25′ 50′ 100′

1″ = 50′

SITE INVENTORY

TREE CANOPY



Species Notes

Native
- Q. agrifolia
- Q. lobata

Non-native
- Washington robusta
- Phoenix canariensis
- Fraxinus udei

0 35′ 70′ 140′

1″ = 70′

SITE INVENTORY

FAUNA

REPTILES & AMPHIBIANS

Pacific Treefrog
Pseudacris regilla

- Most common native frog in coastal and foothill California.
- Famous "ribbit" call — the standard frog sound used in movies.
- Breeds in temporary pools, ponds, and even ornamental water features in suburban yards.

Western Fence Lizard
Sceloporus occidentalis

- Abundant in rocky, sunny areas of chaparral and oak woodland.
- Helps reduce human Lyme disease risk by neutralizing Borrelia bacteria in ticks.
- Eats insects, spiders, and small arthropods.

Cal. Slender Salamander
Batrachoseps attenuatus

- Native to moist microhabitats under leaf litter, logs, or rocks.
- Lungless salamander that breathes through skin.
- Active during wet months, estivates underground in summer.

SMALL MAMMALS

California Vole
Microtus californicus

- Native herbivorous rodent of grasslands and meadows.
- Provides a key food source for raptors, snakes, and coyotes.
- Populations fluctuate widely depending on rainfall cycles.

BIRDS

Allen's Hummingbird
Selasphorus sasin

- Native to coastal southern California; breeds in the region.
- Feeds on nectar of native plants like manzanita, sage, and monkeyflower.
- Plays an important role in pollination.

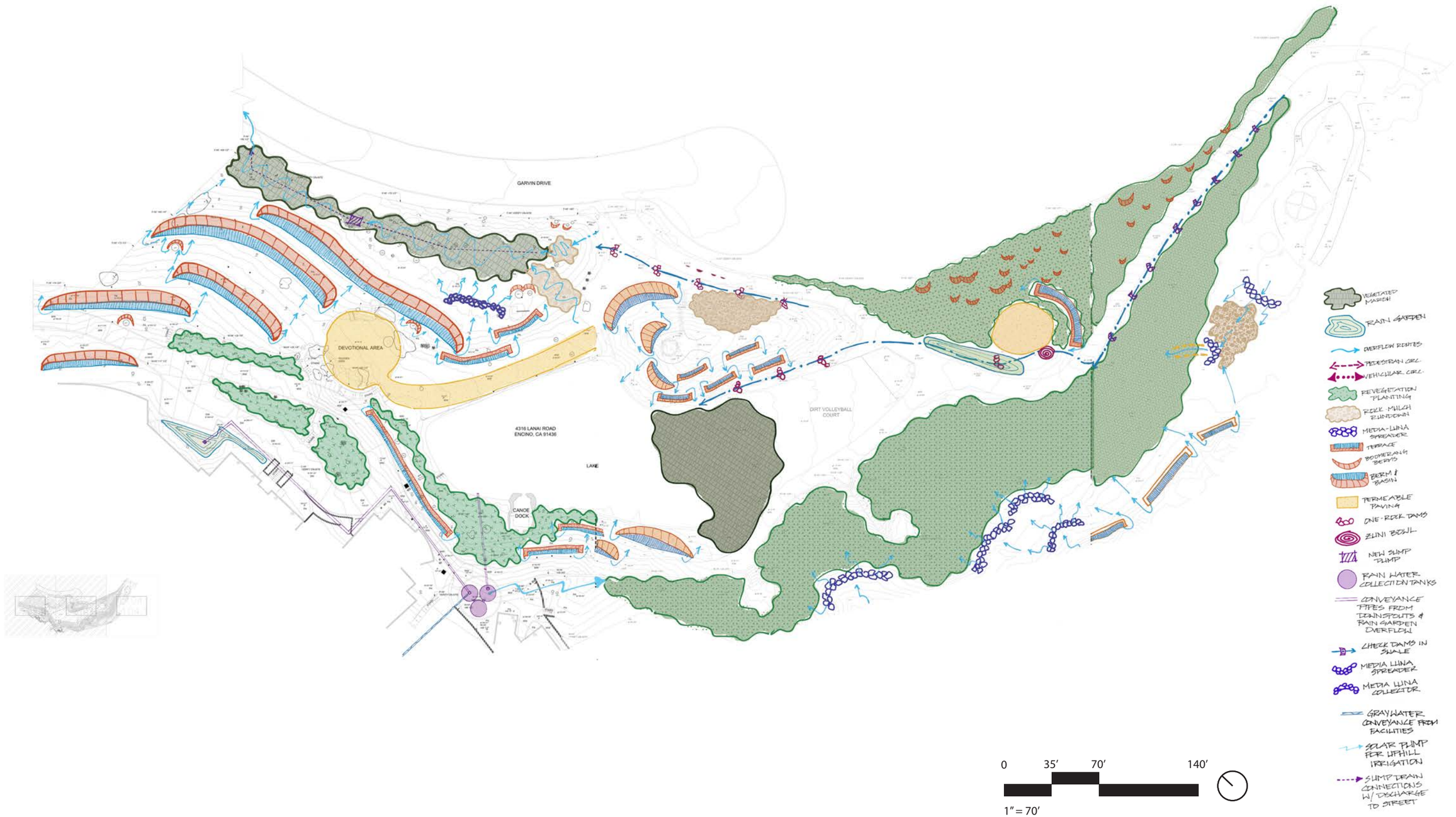
California Scrub-Jay
Aphelocoma californica

- Resident bird of oak woodlands and chaparral.
- Known for acorn caching, aiding in oak seed dispersal.
- Intelligent and social; often vocal in suburban areas bordering habitat.

Red-tailed Hawk
Buteo jamaicensis calurus

- Common raptor hunting over grasslands and canyons.
- Preys on rodents, rabbits, and snakes.
- Uses tall trees and utility poles for nesting.

SITE PLAN

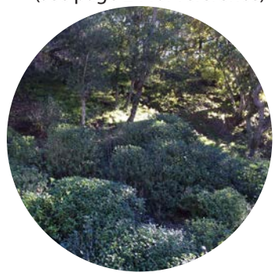

GARVIN DRIVE
DEVOTIONAL AREA
4316 LANAI ROAD
ENCINO, CA 91436
LAKE
CANOE DOCK
DIRT VOLLEYBALL COURT
VEGETATED MASSES
RAIN GARDEN
OVERFLOW ROUTES
PEDESTRIAN CIRC.
VEHICULAR CIRC.
REVEGETATION PLANTING
ROCK MULCH RUNDOWN
MEDIA-LUNA SPREADER
TERRACE
BOOMERANG BERMS
BERM & BASIN
PERMEABLE PAVING
ONE-ROCK DAMS
ZUNI BOWL
NEW SUMP PUMP
RAIN WATER COLLECTION TANKS
CONVEYANCE PIPES FROM DOWNSPOUTS & RAIN GARDEN OVERFLOW
CHECK DAMS IN SWALE
MEDIA LUNA SPREADER
MEDIA LUNA COLLECTOR
GRAYWATER CONVEYANCE FROM FACILITIES
SOLAR PUMP FOR UPHILL IRRIGATION
SUMP/DRAIN CONNECTIONS W/ DISCHARGE TO STREET
0
35′
70′
140′
1″ = 70′

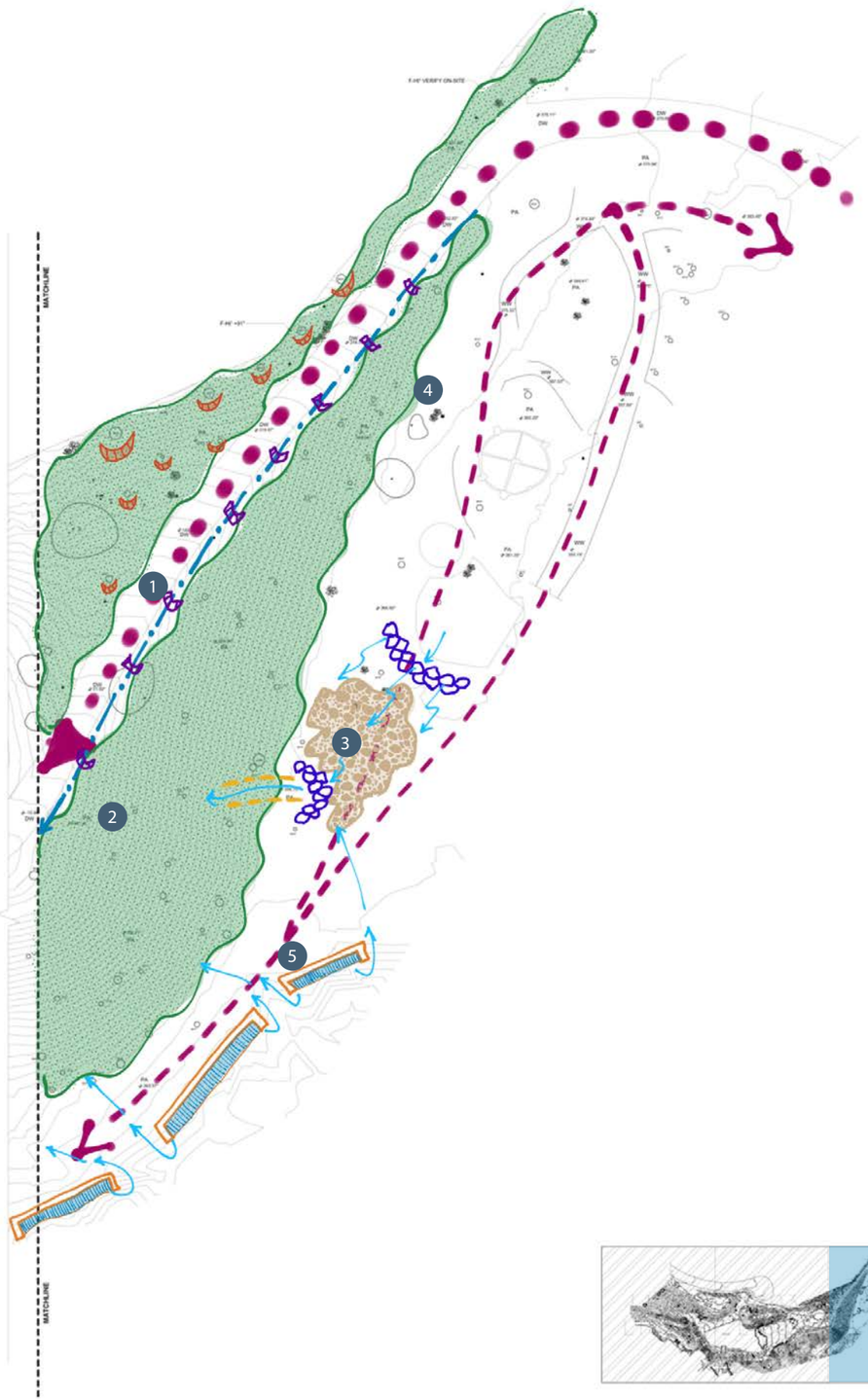
DESIGN PROPOSAL

ZONE 1

1 One Rock Dams in Swale, typ.
(see page 15 for reference)

2 Revegetation, typ.
(see page 24 for reference)





3 Rock Mulch Rundown, typ. (see page 16 for reference)

4 Media Lunas, typ.
(see page 16 for reference)

5 Terraces, typ.
(see page 17 for reference)

0 25′ 50′ 100′

1″ = 50′

DESIGN PROPOSAL

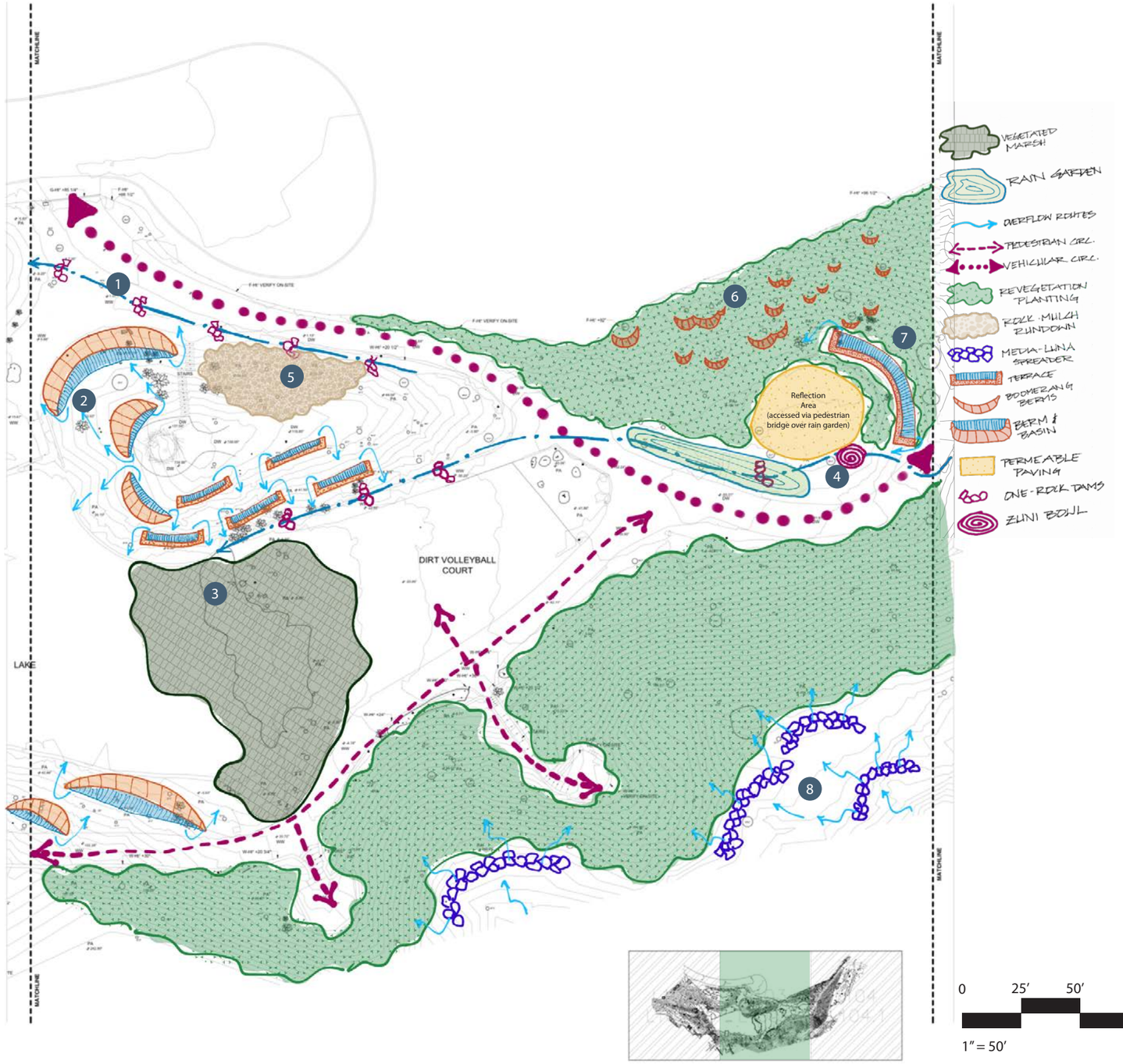
ZONE 2

1 One Rock Dam, typ.
(see page 16 for reference)

2 Berm & Basin, typ.
(see page 17 for reference)

3 Vegetated Marsh, typ.

4 Zuni Bowl, typ.
(see page 15 for reference)



5 Rock Mulch Rundown, typ. (see page 16 for reference)

6 Boomerang Berms, typ.
(see page 17 for reference)

7 Terraces, typ.
(see page 17 for reference)

8 Media Luna Spreaders, typ.
(see page 16 for reference)

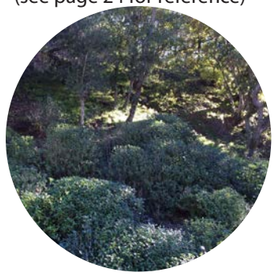
DESIGN PROPOSAL

ZONE 3

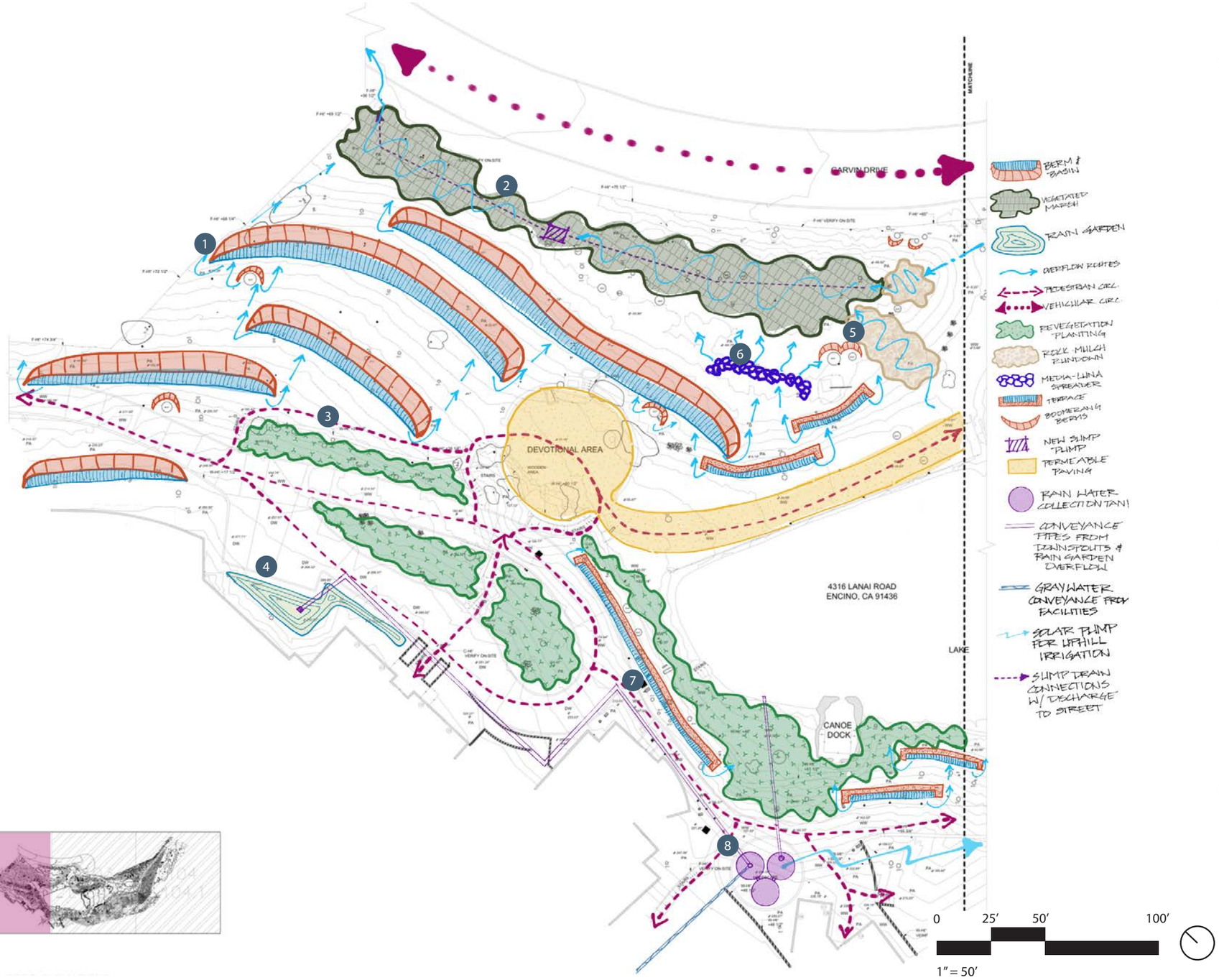
1 Berm & Basin, typ.
(see page 17 for reference)

2 Wet Meadow, typ.
(see page 19 for reference)

3 Revegetation Planting, typ.
(see page 24 for reference)



4 Rain Garden, typ.
(see page 18 for reference)



5 Rock Mulch Rundown, typ. (see page 16 for reference)

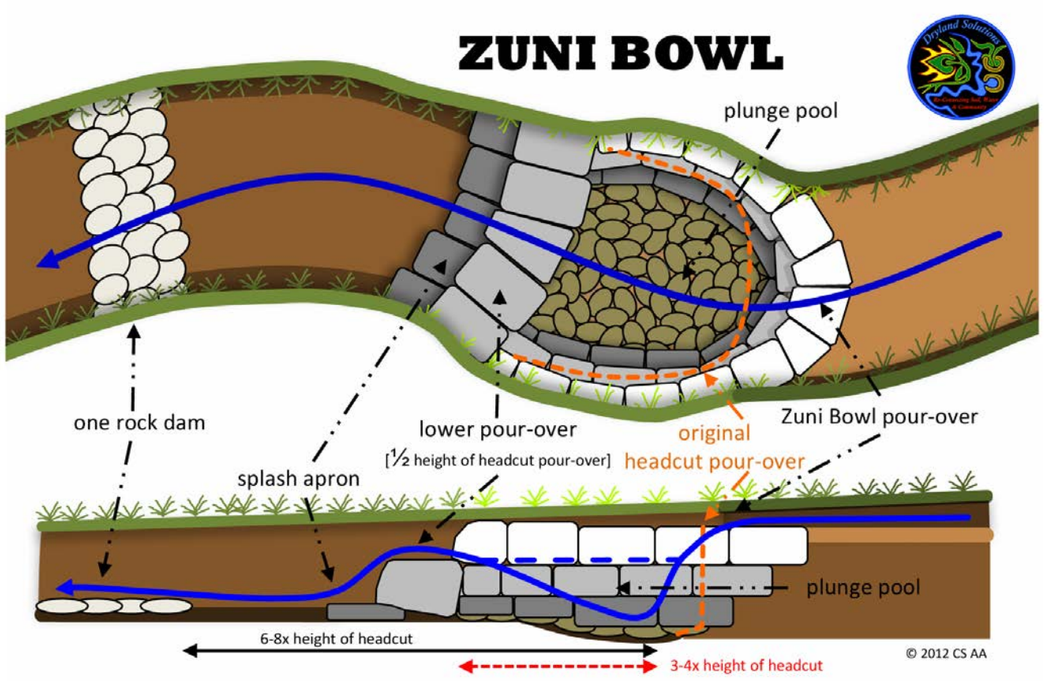
6 Media Luna Spreader, typ.
(see page 16 for reference)

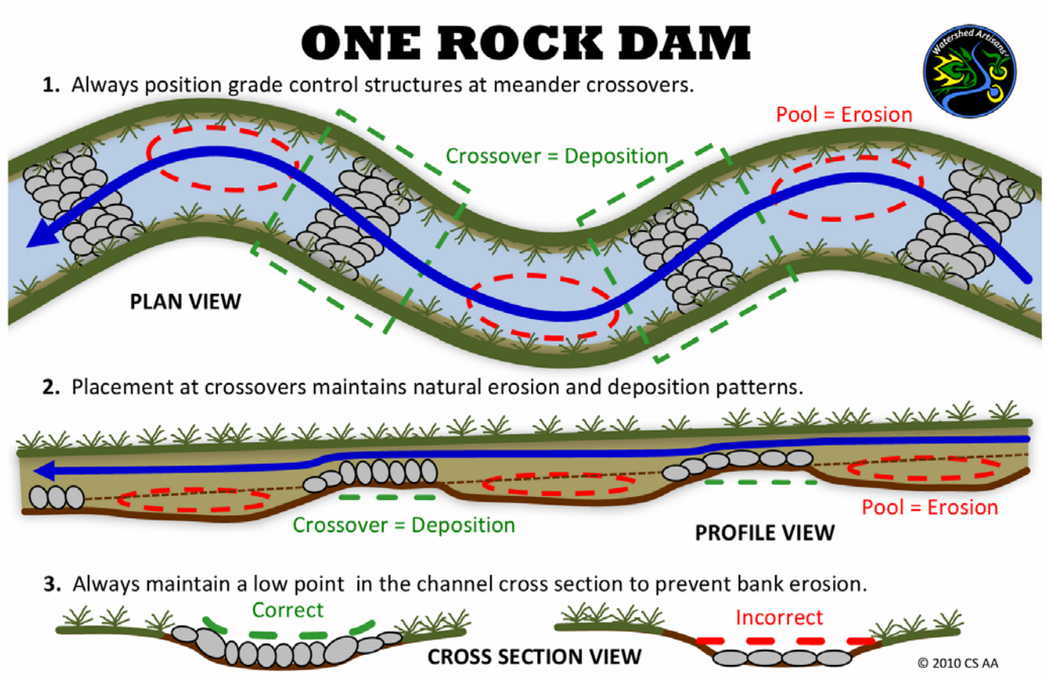
7 Terraces, typ.
(see page 17 for reference)

8 Rainwater Collection Tanks, typ. (see page 20 for reference)

INTERVENTIONS

ZUNI BOWL & ONE ROCK DAMS





Zuni Bowl

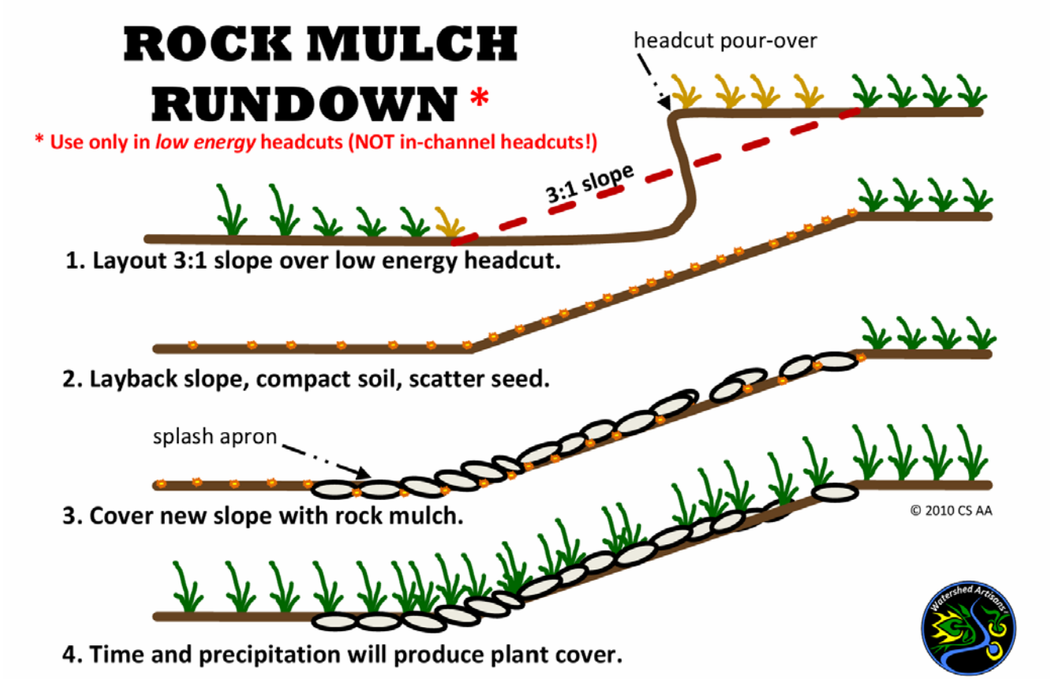
- A bowl of rocks built where fast water comes out of a pipe or slope
- Breaks the speed of rushing water so it doesn't carve deep gullies
- Helps spread water gently into the land

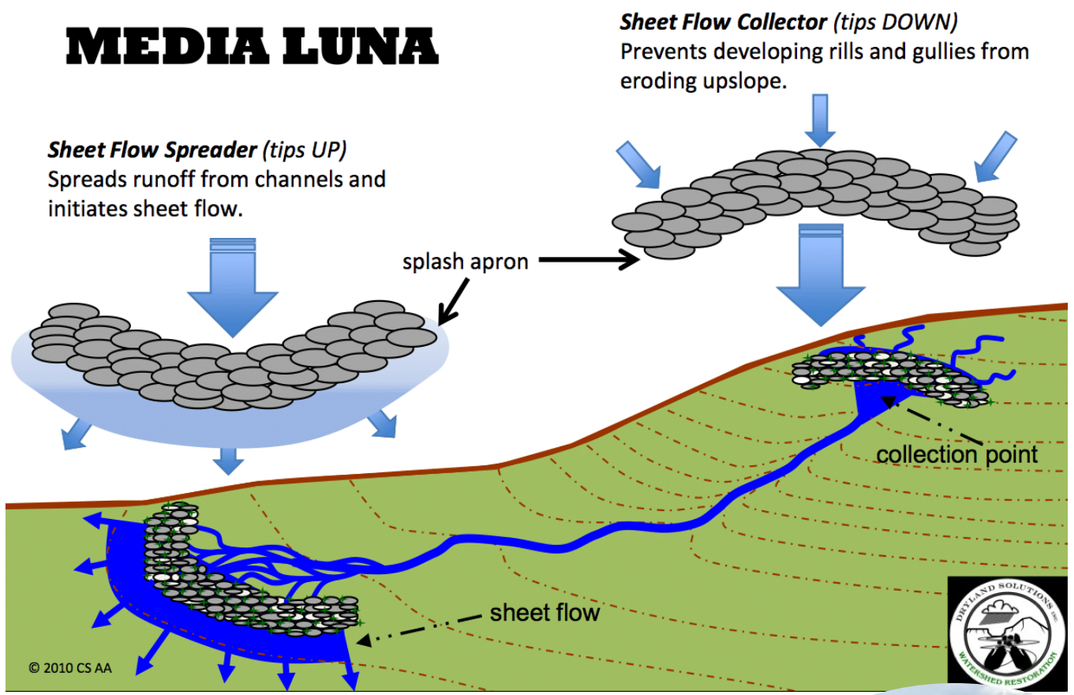
One Rock Dam / Swale & Check Dam

- A shallow ditch that catches rainwater as it runs downhill
- Small rock or log "speed bumps" slow the water even more
- Gives the ground time to drink up the water

INTERVENTIONS

ROCK MULCH RUNDOWN & MEDIALUNA



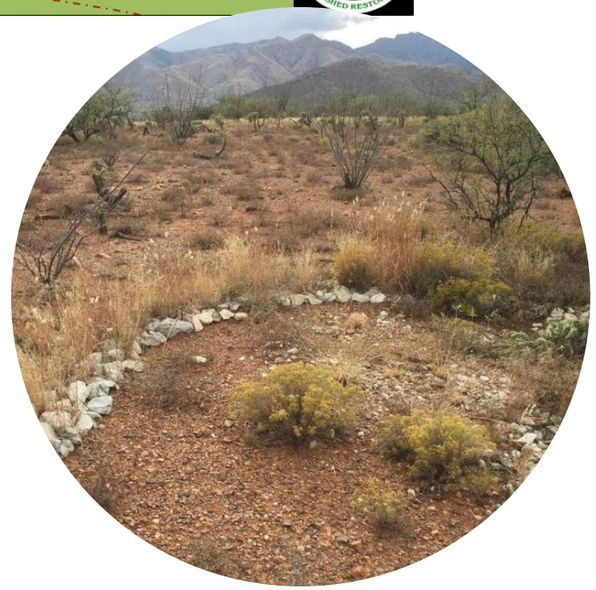


Rock-Mulch Rundown

- A rocky channel that guides rainwater safely downhill
- Slows the flow so soil doesn't wash away
- Lets some water soak into the ground along the way

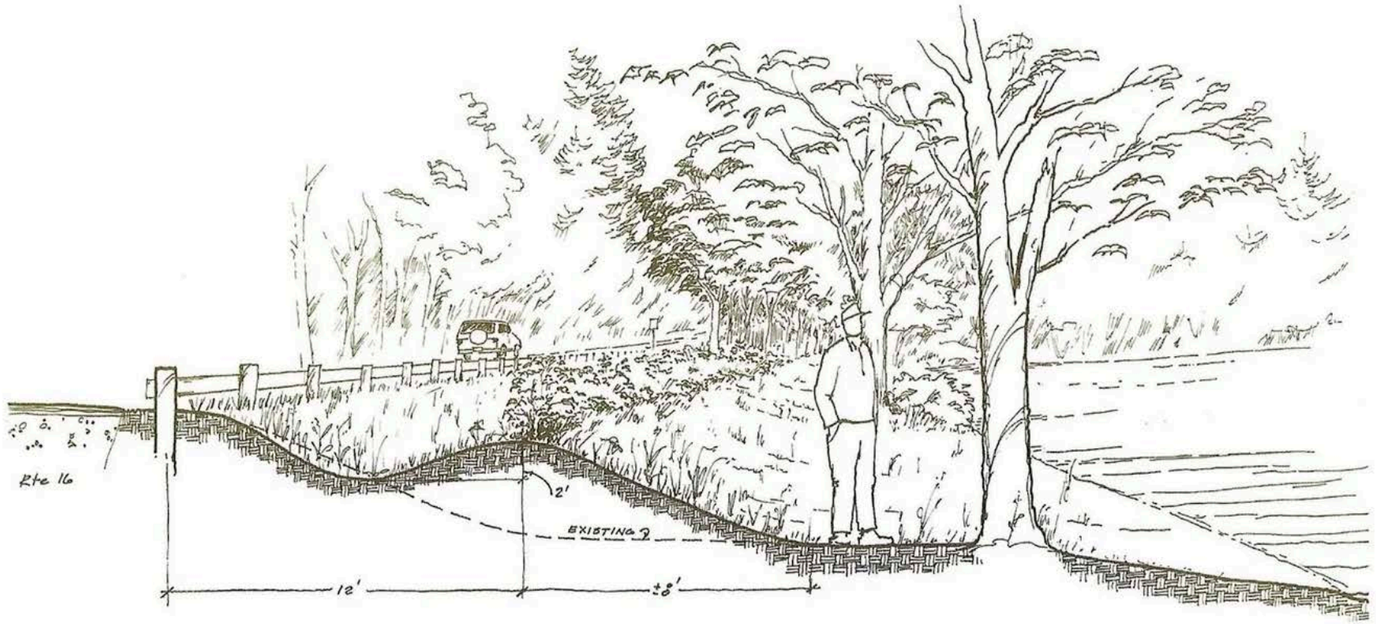
Media Luna

- Crescent-shaped mounds of soil that catch rainfall
- Help water soak in right where plants need it
- Simple and low-cost way to grow more with less water



INTERVENTIONS

SWALES, BERM & BASINS, BOOMERANG BERMS, & TERRACES



CHOCORUA LAKE BERM & SWALE 6-10-99

by Steve Weld

Toby asked Steve for a drawing of the design of berms + swales as the design evolved

SWALE

BERM & BASINS

TERRACES

Berm & Basin

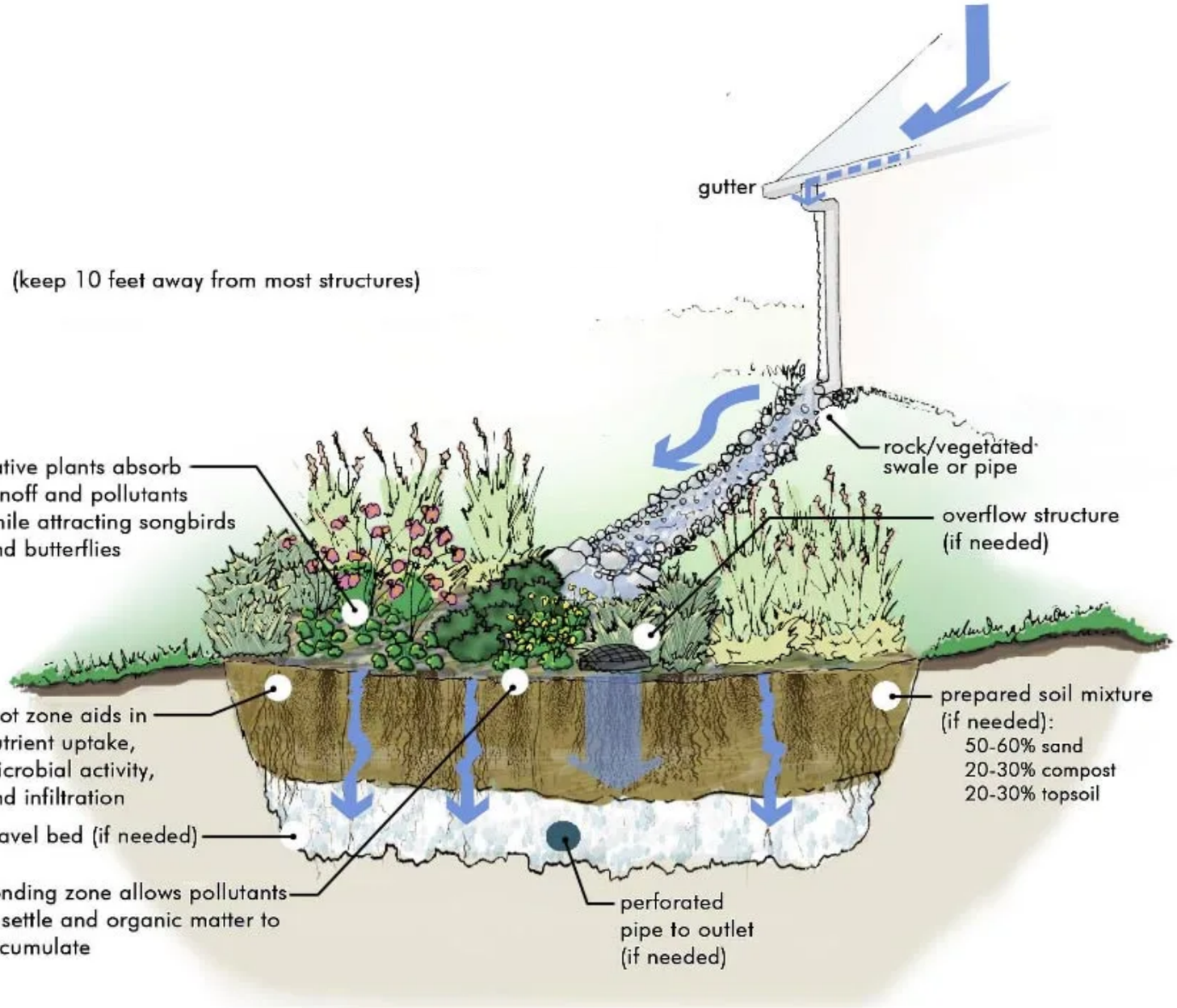
- A small dirt berm parallel to a slop with a basin above it
- Catches rainwater and retains it for absorption
- Keeps plants watered naturally after storms

Terrace

- Steps built into a hillside to slow down rain
- Turn steep slopes into flat areas that hold soil and water
- Make hillsides safer for planting and growing food

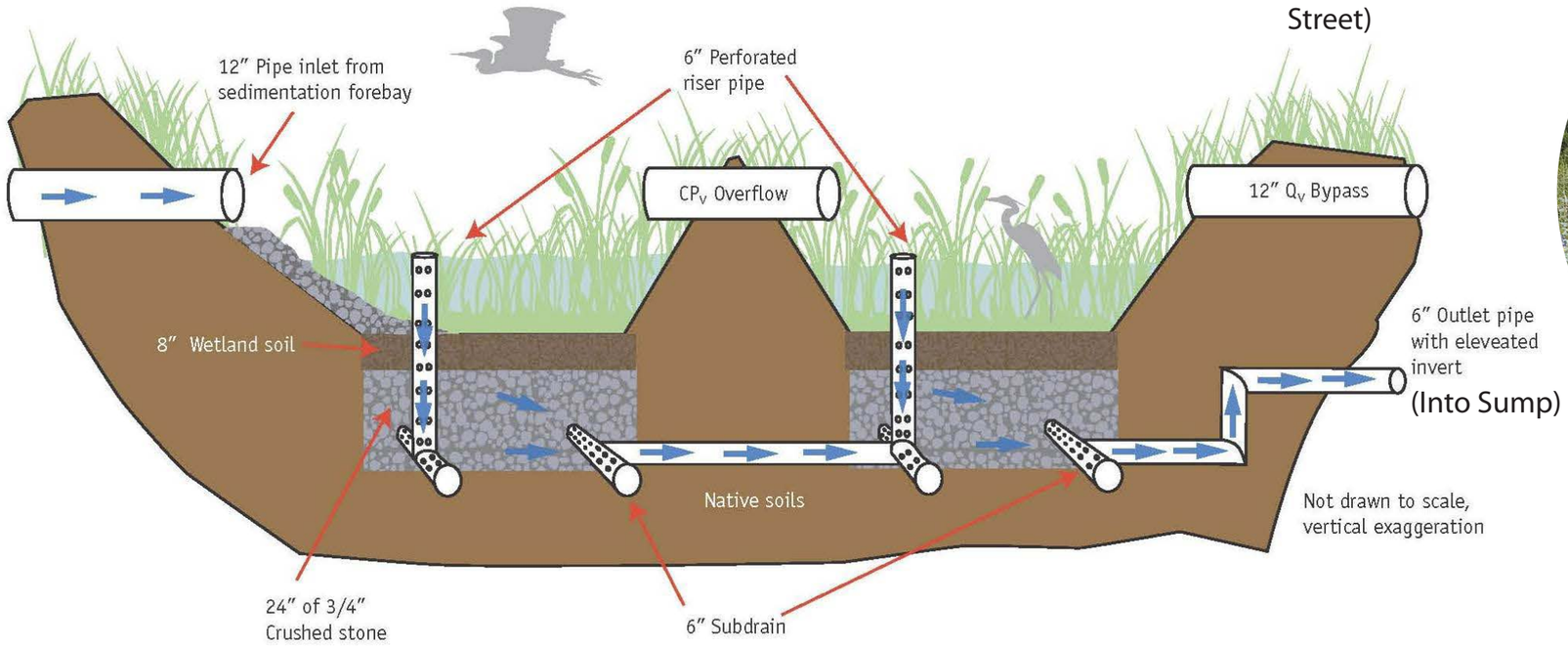
INTERVENTIONS

RAIN GARDEN



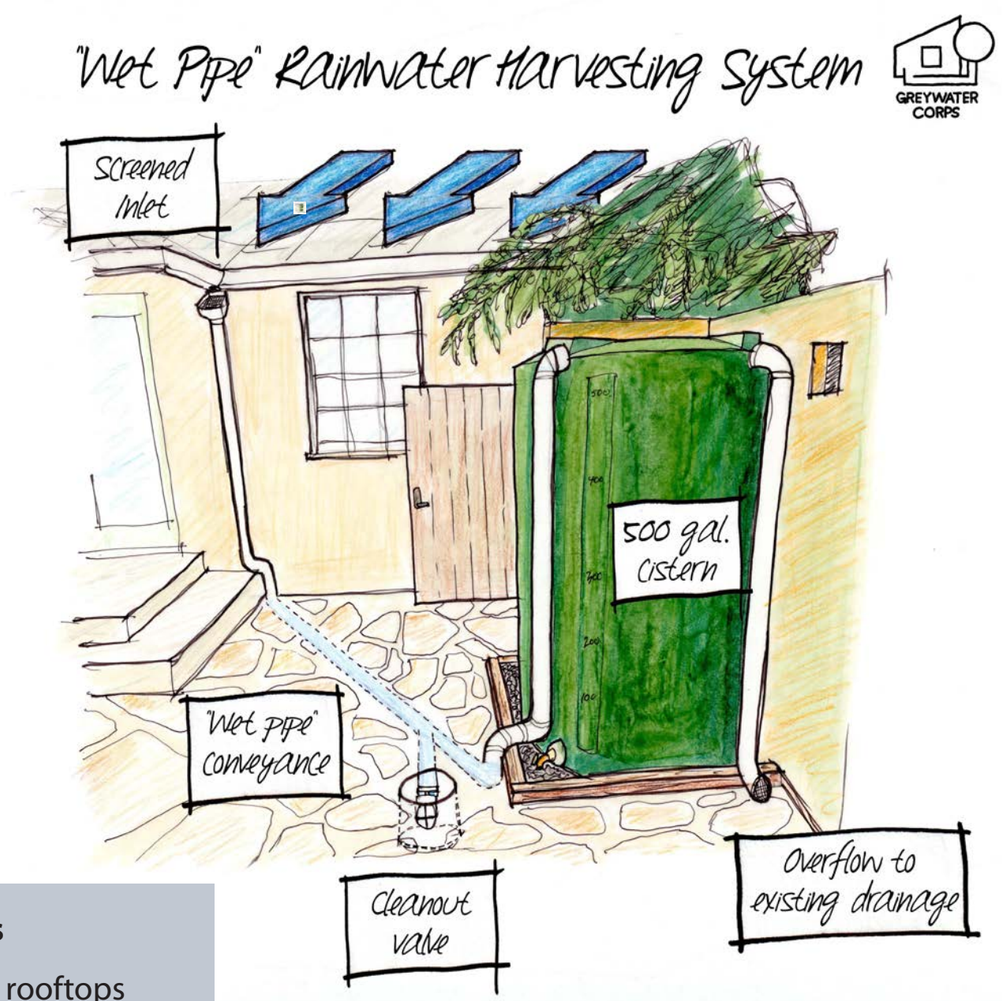
INTERVENTIONS

WET MEADOW



INTERVENTIONS

RAINWATER COLLECTION



Rainwater Storage Tanks

- Collects rainwater from rooftops during storms
- Stores it for use during dry days
- Reduces flooding and provides a free water source

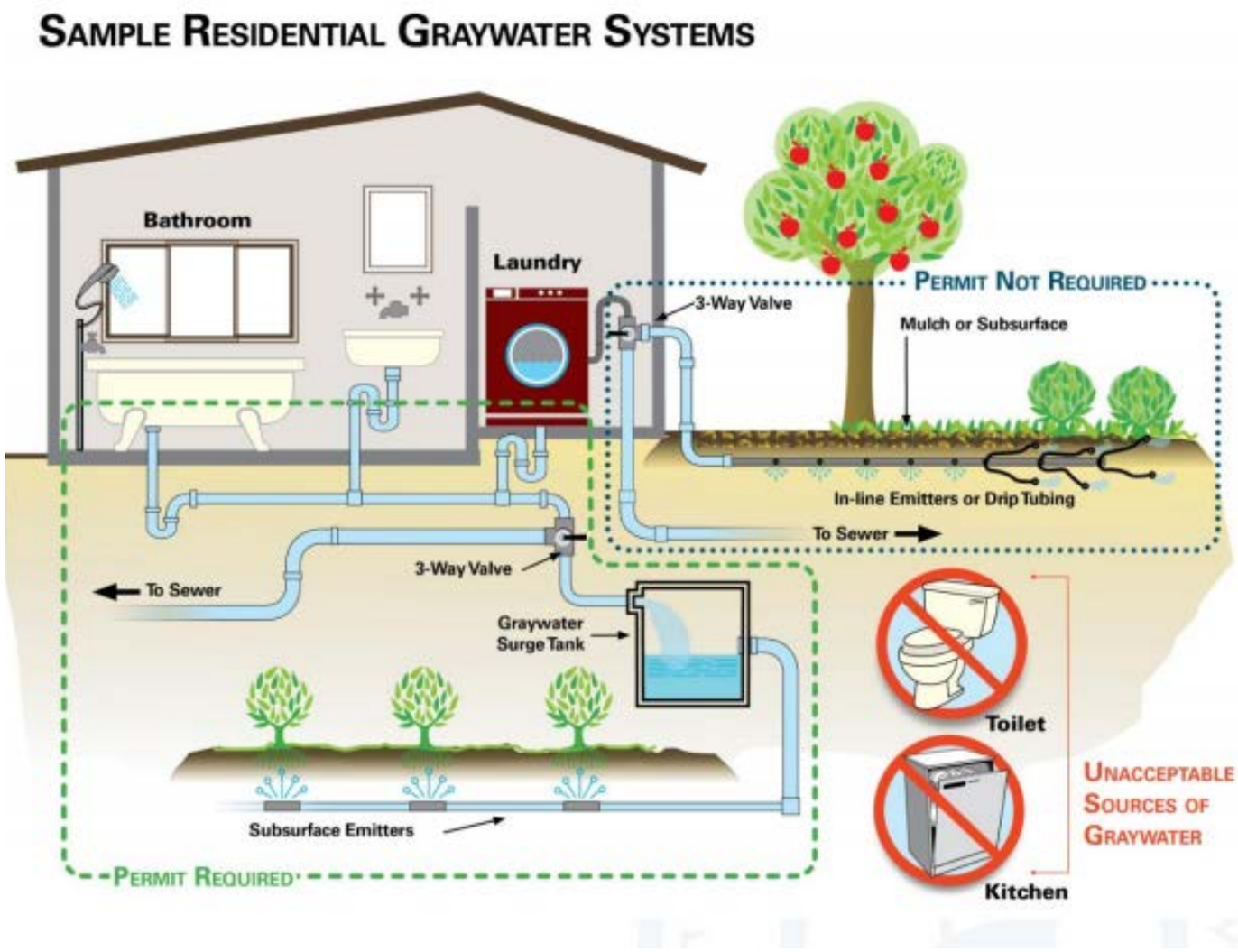
Pic	Description	Spec	Color	Part No.	Location	Diameter or Width	Overall Height	Length
	**10000 gallon** Round Tank	C-1	Black	30816	97	140"	160"	
			Mocha	30821	97			
			Dark Green	30670	97			

INTERVENTIONS

GREYWATER

Greywater

- Captures water from sinks, showers, and laundry, reusing it for irrigation.
- Simple greywater systems discharge untreated greywater to the landscape. User must be mindful of what goes down the drain.
- Advanced greywater systems treat greywater, cleaning impurities and making it similar to potable water. Recommended for larger facilities such as this one.
- Treatment removes concern over contents of greywater when a facility has many occupants who may not be familiar with greywater safe practices (soaps, detergents, cleaners, etc…).
- Treatment allows for management and storage of large amounts of greywater.



PLANT PALETTE

WET MEADOW

GRASSES & SEDGES

Clustered Field Sedge
Carex praegracilis

Valley Sedge
Carex barbarae

Common Rush
Juncus patens

Deergrass
Muhlenbergia rigens

FLOWERING PERENNIALS

California Fuchsia
Epilobium canum ssp. latifolium

Seep Monkeyflower
Mimulus guttatus

Western Verbena
Verbena lasiostachys

California Aster
Symphyotrichum chilense

WILDFLOWERS / GROUNDCOVERS

Blue-eyed Grass
Sisyrinchium bellum

Flatface Calico Flower
Downingia pulchella

PLANT PALETTE

WET MEADOW

Common Name *Botanical Name*	Family	Size	Bloom Time	Maintenance Requirements
Clustered Field Sedge *Carex praegracilis*	Cyperaceae	1–2 ft tall, spreads by rhizomes	Spring (inconspicuous)	Low; cut back occasionally to refresh growth, tolerates mowing
Valley Sedge *Carex barbarae*	Cyperaceae	1–3 ft tall, clumping	Spring (inconspicuous)	Low; prefers consistent moisture, trim dead foliage as needed
Common Rush *Juncus patens*	Juncaceae	1–3 ft tall, clumping	Summer (brown seedheads)	Low; cut back old stems to ground in late winter if desired
Deergrass *Muhlenbergia rigens*	Poaceae	3–5 ft tall, 4–5 ft wide	Summer–Fall	Low; cut back to 6 in every 2–3 years to rejuvenate
California Fuchsia *Epilobium canum ssp. latifolium*	Onagraceae	1–2 ft tall, spreading 3–4 ft	Late Summer–Fall	Low; shear after bloom to encourage dense growth
Seep Monkeyflower *Mimulus guttatus*	Phrymaceae	0.5–1.5 ft tall, spreading	Spring–Summer	Moderate; reseeds readily, may need thinning
Western Verbena *Verbena lasiostachys*	Verbenaceae	1–3 ft tall, spreading 2–4 ft	Spring–Summer	Low–Moderate; cut back after bloom to maintain shape
California Aster *Symphyotrichum chilense*	Asteraceae	1–3 ft tall, spreading 3–4 ft	Late Summer–Fall	Low–Moderate; cut back in winter, may spread aggressively
Blue-eyed Grass *Sisyrinchium bellum*	Iridaceae	0.5–1 ft tall, 0.5–1 ft wide	Spring	Low; summer dormant, allow reseeding
Calico Flower *Downingia pulchella*	Campanulaceae	0.25–1 ft tall, 0.25–0.5 ft wide (annual)	Spring	Low; reseeds in vernal-pool conditions, no maintenance once established

PLANT PALETTE

WET MEADOW - UPPER LAYER/TREE CANOPY

MEDIUM

Elderberry
Sambucus mexicana

Arroyo Willow
Salix lasiolepis

TALL

White Alder
Alnus rhombifolia

Western Sycamore
Platanus racemosa

Common Name *Botanical Name*	Family	Size	Bloom Time	Maintenance Requirements
Arroyo Willow *Salix lasiolepis*	Salicaceae	15-30 ft tall	Late Winter - Summer	Loves constant moisture; thrives full sun–part shade; very fast grower; tolerates hard pruning; can sucker and develop aggressive roots: plant away from pipes/foundations
Elderberry *Sambucus mexicana*	Adoxaceae	10–30 ft tall, forms colonies	Spring - Summer	Sun to part shade; low–moderate water once established (e.g., summer irrigation as little as 1×/month); tolerant of many soils; suckers to form colonies; prune after fruiting to shape
White Alder *Alnus rhombifolia*	Betulaceae	50–80 ft tall	Late Winter - Spring	Best in moist/wet soils; fast-growing riparian tree; deep water to establish; nitrogen-fixer; strong roots - keep clear of irrigation lines and foundations
Western Sycamore *Platanus racemosa*	Platanaceae	20--100 ft tall	Winter - Spring	Full sun; prefers deep, moist soils; establish with occasional deep summer watering. Fast grower; very “messy” (bark, leaves, seed balls). Roots can be vigorous: plant away from paving, pipes, and foundations (≥12 ft recommended); monitor for anthracnose in cool, wet springs

PLANT PALETTE

HILLSIDE REVEGETATION

Bush Sunflower
Encelia californica

California Buckwheat
Eriogonum fasciculatum

California Sagebrush
Artemisia californica

Cleveland Sage
Salvia clevelandii

Lemonade Berry
Rhus integrifolia

Pigeon Point' Coyote Bush
Baccharis pilularis

Purple Sage
Salvia leucophylla

Quailbush
Atriplex lentiformis ssp. breweri

Spice Bush
Calycanthus occidentalis

Toyon
Heteromeles arbutifolia

PLANT PALETTE

HILLSIDE REVEGETATION

Common Name *Botanical Name*	Family	Size	Bloom Time	Maintenance Requirements
Bush Sunflower *Encelia californica*	Asteraceae	2-5 ft tall, mounding	Winter - Spring	Very low water once established; thrives in full sun and well-draining soil; aggressive spreader—valuable for ground-cover and slope erosion control
California Buckwheat *Eriogonum fasciculatum*	Polygonaceae	~3 ft, 5 ft wide	Late spring to summer	Very drought-tolerant; low water; full sun; supports pollinators; erosion control
California Sagebrush *Artemisia californica*	Asteraceae	~3–5 ft tall	Late summer to autumn/ winter	Extremely drought-tolerant; little summer water; full sun; helps restore coastal sage scrub habitat
Cleveland Sage *Salvia clevelandii*	Lamiaceae	3–5 ft × 4–6 ft	Late Spring - Summer	Low water; prefers full sun and good drainage; aromatic foliage, attracts pollinators
Lemonade Berry *Rhus integrifolia*	Anacardiaceae	4–10 ft × 10–20 ft	Winter - Spring	Very low water; prune to shape if needed; dense roots and foliage stabilize slopes
Pigeon Point' Coyote Bush *Baccharis pilularis*	Asteraceae	~1–2 ft × up to 8 ft high	Summer	Low water; very drought-tolerant; spreads well, excellent for full sun and various soils
Purple Sage *Salvia leucophylla*	Lamiaceae	~2.5 ft high × ~8 ft spread	Spring - Summer	Low water; full sun; fast-draining soil; attractive to hummingbirds and bees
Quailbush *Atriplex lentiformis ssp. breweri*	Chenopodiaceae	up to 8 ft	Summer - Fall	Fast growing, great for bank stabilization & erosion control. Attracts wildlife
Spice Bush *Calycanthus occidentalis*	Calycanthaceae	6-12 ft	Spring - Summer	Large & fast growing; does best in partial sun/shade. Tolerant of sandy/clay soil
Toyon *Heteromeles arbutifolia*	Rosaceae	6–10 ft × 6–8 ft	Summer - Fall (red berries in winter)	Low water; prune lightly if needed; great for erosion control and wildlife habitat

PLANT PALETTE

HILLSIDE REVEGETATION - UNDERSTORY PLANTINGS

GRASSES (to hold the soil)

Creeping wildrye
Elymus triticoides

Purple needlegrass
Stipa pulchra

SHADE-TOLERANT UNDERSTORY

Coffeeberry
Frangula californica

California Barberry
Berberis pinnata ssp. pinnata

Woodland Strawberry
Fragaria vesca

Common Name *Botanical Name*	Family	Size	Bloom Time	Maintenance Requirements
Creeping wildrye *Elymus triticoides*	Poaceae	1-4 ft tall, spreads by rhizomes	Spring - Summer	Spreading rhizomes bind soil; sun to part shade; tolerates many soils and seasonal moisture
Purple needlegrass *Stipa pulchra*	Poaceae	2–3 ft tall	Spring - Summer	Deep-rooted bunchgrass; full sun to light shade; very low water; classic slope stabilizer
Coffeeberry *Frangula californica*	Rhamnaceae	6–12 ft tall	Spring	Understory shrub; part shade friendly; low water once established; good hedge/wildlife value
California Barberry *Berberis pinnata ssp. pinnata*	Berberidaceae	4-10 ft tall	Winter - Spring	Shade-tolerant understory; low–moderate water; suckers slowly; prune after bloom
Woodland Strawberry *Fragaria vesca*	Rosaceae	1 ft tall	Spring	Handles full sun to deep shade overall; moderate water; spreads by runners, great for knitting soil under part shade

Implementation Plan: "Built by Many Hands"

The design is structured around partnerships, volunteerism, and education:

- Environmental Non-profits provide expertise in wetland planting, erosion control, and native seed sourcing.
- At-risk workforce training programs lead construction of swales, rain gardens, and planting areas—building job skills while restoring land.
- Volunteer Workdays (students, neighbors, congregants) focus on planting days, trail building, and art installations.
- Pro-bono Professionals (landscape architects, hydrologists, artists) contribute design details, permitting advice, and signage.
- Grant Funding supports materials like erosion-control fabric, native seed mixes, signage, and small tools.
- Partnership with UCLAx Landscape Architecture Program: ongoing development and maintenance consultations

ANNEX:
CALCULATIONS & SOURCES

CALCULATIONS

ZONE 1

Formulas	
Grade	G = D / L
Differance in Elevation	D = E x G
Horizontal Length	L = D / G

ZONE 1			
General Area	Inputs		
	G	D	L
Slope from garden by parking lot to road	0.50	1	2
Slope on road	0.15	1	6.5
Slope on other side of road	0.18	1	5.5
Slope on south side of plan	0.25	1	4
	0.13	1	8
Slope north of plan next to road leaving parking lot	0.04	1	25
Slope in garden area to drain pipe	0.03	1	36

PROPOSED INTERVENTIONS

1. Revegetation planting on the steep slope between garden and road (the slope is currently not eroded so no real need for stormwater management on the slope itself)
2. Rock-Mulch rundown to distribute the water down slope towards drain pipe
3. Media-luna/one-rock dams at edge of garden before slope to prevent any possible future erosion (spreaders for dispersing water, collectors for gathering it to send down the pipe)
4. Terracing between driveway to parking lot and garden pathway
5. Terracing between road and edge of site

Proposed Collection Area Potential Rain Capture (Gal/Inch) (non-paved)	
Runoff Coefficient	0.20
Conversion Factor	0.62
1st Flush Event (inches)	1
Zone 1 Collection Area (sq ft)	29808.7
Gallons per inch	3696.28

Proposed Collection Area Potential Rain Capture (Gal/Inch) (paved)	
Runoff Coefficient	0.20
Conversion Factor	0.62
1st Flush Event (inches)	1
Zone 1 Collection Area (sq ft)	2746.1
Gallons per inch	340.52

CALCULATIONS

ZONE 2

Formulas	
Grade	G = D / L
Differance in Elevation	D = E x G
Horizontal Length	L = D / G

ZONE 2			
General Area	Inputs		
	G	D	L
Slope from Biophilia to lake	0.29	1	3.5
Slope from Biophilia to wetland	0.20	1	5
Slope from Biophilia to road	0.40	1	2.5
Slope from Biophilia to volleyball	0.33	1	3
Slope from Biophilia to corner of road	0.29	1	3.5
Slope on Biophilia hill	0.13	1	8
Volleyball court	0.04	1	24
Slopes to reflection area	0.50	1	2
	0.25	1	4
	0.33	1	3
	0.07	1	15
Slope to walkway/road	0.40	1	2.5
Slope to lake from walkway	0.25	1	4

PROPOSED INTERVENTIONS

1. Terracing around reflective garden area (can be used for educational water management purposes as well as slope stabilization)
2. Zuni bowl in swale under outlet pipe from road (4 feet down from inlet, max length 16' (4'x4))
3. One-rock dams in swale (32' from zuni bowl and each other max (2' x 16))
4. Rock-mulch rundown
5. Revegatation planting
6. Boomerang berms
7. Berm & Basin (8' wide)
8. Rain Garden (3' from road hardscape)

Proposed Collection Area Potential Rain Capture (Gal/Inch) (non-paved)	
Runoff Coefficient	0.20
Conversion Factor	0.62
1st Flush Event (inches)	1
Zone 1 Collection Area (sq ft)	47847.02
Gallons per inch	5933.03

Proposed Collection Area Potential Rain Capture (Gal/Inch) (paved)	
Runoff Coefficient	0.20
Conversion Factor	0.62
1st Flush Event (inches)	1
Zone 1 Collection Area (sq ft)	6215.76
Gallons per inch	770.75

CALCULATIONS

ZONE 3

Formulas	
Grade	G = D / L
Differance in Elevation	D = E x G
Horizontal Length	L = D / G
Rain garden volume (cu. ft.)	Volume = total gal/ in * first flush (in.)/ 7.48 gallons per cu.ft.
Rain garden area (ft.)	Area (sq. ft.) = volume in cubic feet / av. depth (ft.)
Rain garden average depth (ft.)	Av. depth (ft.) = maximum ponding depth / 2

Permeable Paving	
Target Area (sq ft)	5744.00
Rainfall (inches)	2.00
Conversion	0.17
Required Volume (cu ft)	**957.33**
Porosity	0.30
Depth	0.56

ZONE 3			
General Area	Inputs		
	G	D	L
Wetland low area	0.14	1	7
Slope from lake to wetland	0.33	1	3
To Low Point in wetland	0.13	1	8
Along walkway	0.33	1	3
In between walkways	0.29	1	3.5
	0.25	1	4
Along building edge (steep)	0.22	1	4.5
	0.18	1	5.5
Along building edge (flat)	0.07	1	14
Upper slope to lake	0.33	1	3
Lower slope to lake	0.20	1	5
	0.11	1	9
By buildings	0.13	1	8
Path along lake	0.05	1	20
Along Garvin Dr to wetland	0.33	1	3

Rain Garden	
Setback from building (ft)	10
Setback from hardscape (ft)	3
Slope	3:1
Contour line spacing (inches)	**18**
First Flush Event (inches)	2
Runoff Coeff.	0.95
Conversion	0.62
Relevant roof collection area (sq ft)	4500
Total Gal/in	**2650.5**
Volume	**708.69**
Avg Ponding Depth (inches)	28
Avg Depth (inches)	14
Avg Depth (ft)	1.2
Required RG Area	**607**

Proposed Collection Area Potential Rain Capture (Gal/Inch) (non-paved)	
Runoff Coefficient	0.20
Conversion Factor	0.62
1st Flush Event (inches)	1
Zone 1 Collection Area (sq ft)	41623
Gallons per inch	5161.25

PROPOSED INTERVENTIONS

1. Terracing (2' wide, at least 12' apart)
2. Rain water collection tanks (3 x 10,000 gallon Bushman tanks, see Rooftop Runoff)
3. Vegetated wet meadow
4. Rock-mulch rundowns
5. Revegatation planting
6. Boomerang berms
7. Berm & Basin (8' wide, at least 17' apart)
8. Media luna
9. Permeable paving (957.33 cubic feet needed)
10. Remove existing broken pump, replace with new pump in vegetated wet meadow
11. Rain garden (to hold up to 2650.5 gallons (709 cu ft volume) for a 2" flush event, overflow to collection tanks)

Proposed Collection Area Potential Rain Capture (Gal/Inch) (paved)	
Runoff Coefficient	0.20
Conversion Factor	0.62
1st Flush Event (inches)	1
Zone 1 Collection Area (sq ft)	9859.2
Gallons per inch	1222.54

CALCULATIONS

ROOFWATER HARVESTING

	Collection Area SqFt	Runoff Coefficient	Conversion Factor	Total Gallons (per inch)
Adjacent Roof Area	24552.99	0.95	0.62	14461.71

Total Tank Capacity to Store 2" of Rain			
Gal/in collected * target inches = Total gallons storage			
Using Adjacent Roof Area Runoff (Gal/in)	28923.42	**Solution:**	*3 10,000 gallon Bushman tanks*

Tank Fill Height (inches)	
Height of gutters at DS - friction loss allowance (18) - tank elevation = max tank fill height	
Gutter Height (inches)	360
Friction Loss Allowance	18
Tank Elevation (same height as buildings)	0
Max Tank Fill Height (inches)	342

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5. San Marcos Growers. *San Marcos Growers*. https://www.smgrowers.com/