

# Passive Water Management Strategies for the South Davis Greenbelt

## A Study in Earthworks

Richard Perez · LDA 193 Spring 2012



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## Abstract

The topic of my senior project is the redesign of a small portion of the Davis Greenbelt at Pescador Drive in South Davis from Chestnut Park to the former channel of Putah Creek. Today, the site is an overgrown and largely forgotten portion of the Davis Greenbelt that people pass through with little notice. Although this portion is largely unkempt, the precedents for the rest of the greenbelt, and for the surrounding neighborhoods, are high maintenance, high water use landscapes that have little to do with the Central Valley, and less to do with the former bed of Putah Creek.

By creating a site analysis of environmental factors such as, degree of sun exposure, topography, and drainage, and design elements such as view corridors, I attempted to create a design that would

use less water, require less maintenance, and utilize a more appropriate plant palette than most existing examples within the Davis Greenbelt. By using calculations using the WUCOLS system, I evaluated my design vis-à-vis what currently exists on the site, and a similarly sized area with conventional plantings in the Davis Greenbelt.

I found that earthworks were a multifunctional design feature that could help to reduce water use, make maintaining the site easier, and create dynamic designs that would enhance the experience of passing through the site. By implementing this design, it is my hope that community members become more aware of the critical issues of water within a regional context, and that its designs be useful enough to be replicated within the Greenbelt and beyond.

## Process and Goals

The portion of the Davis Greenbelt I redesigned was built in the 1990's with the surrounding subdivision. Consulting aerial photography and flood maps, I found that the site used to consist of field crops with some scattered trees. Observing the surrounding neighborhood and public open spaces, it becomes apparent that the conventional, high water use and high maintenance landscapes predominate. Cool season turf and an Eastern North American plant palette tend to predominate. These kinds of landscapes require more water and labor than is necessary, and are not a useful model for future Greenbelts. Further, the sterile repetition of suburban houses and their landscapes contribute to a wider sense of placelessness in Postmodern America as described in Robert Putnam's "Bowling Alone" (Putnam 311).

In the arid West, water is a precious resource. Its capture, delivery, and application has prompted dams, aqueducts, canals, and all kinds of intervention. From the 1870s' agricultural and water availability shaped the way California's Central Valley would develop (Parsons 377). Today, water is still precious and scarce, yet many urban residents are likely to take these systems for granted. By designing a low water use landscape, I seek to design a model for the greenbelt that uses less water, and that will also serve as an example to the surrounding community.

**Goal: Design a landscape that requires little water**

Similarly, it is also important that low maintenance strategies be implemented so that less labor and energy are expended on such large swaths of land.

**Goal: Design a site that is low maintenance, yet aesthetically pleasing.**

Especially on my site, the planting design lends itself to the reconstruction of a system resembling some of the different environments that exist in California. There are small wet spots on the northern half that are low lying and consist of tall London plane trees. It is both logical and practical to accentuate the specific features that exist on the site rather than making an effort to erase them in an attempt to sterilize the landscape. By doing this, I hope to encourage people to become aware of what may have once existed on the site, and then to how this may fit into a larger context.

## Goal: Design a site that resembles California ecotypes of the Central Valley

With the realization of the ecological destruction that is occurring in modern times, it is of utmost importance that designers of the landscape convince other members of our society that our relationship with nature is paramount. Of course the relationship between what kind of nature is as important a question as the relationship itself.

Understanding nature is coming to understand the complexities of the living world that exists beyond the confines of one's own boundaries and how one is linked to that larger system. Even people in the densest urban environments may one day be able to see that they too are part of a system that links us all, and with a more nuanced view of their part in the larger natural world will hopefully curb their destructive habits. By designing sites that dem-

onstrate these connections, designers can help to bridge the perceived dichotomy between what is wild, and natural, and what is manmade.

## Goal: Make the community aware of larger natural systems, and the scarcity of water

Goal: Design a landscape that requires little water

Goal: Design a site that is low maintenance, yet aesthetically pleasing.

Goal: Design a site that resembles California ecotypes of the Central Valley

Goal: Make the community aware of larger natural systems, and the scarcity of water



## Introduction to the Site

The site is located off of Pescador Drive in South Davis, and consists of a single asphalt path running from Chestnut Park in the North, to the Putah Creek Parkway in the South. The soil is a Sycamore Silt Loam, composed of alluvium deposited by Putah Creek. Its capacity for infiltration is moderate to high, and its available water capacity is 11.4 inches, which is also high. This makes it an excellent medium for plant growth. From site visits, it seems like the soil was more or less uniform, and was not greatly altered by the construction of the surrounding subdivision.

The site as it exists looks a bit unkempt. The site consists of several overgrown pyracantha shrubs, large expanses of bare earth with some type of moss or lichen growing over it. There is also some large expanses of rockrose, some

redbud, crepe myrtle, there are also some commendable valley oaks establishing themselves throughout the site.

Presumably some kind of riparian vegetation existed at the time, but today this does not exist. Since the site does straddle the interface between the rural areas of the Putah Creek Parkway and Chestnut Park, some type of naturalistic planting that could blend the two together is necessary. At the same time, the need to conserve water and provide for easier and more accessible maintenance needs to be incorporated into the design.



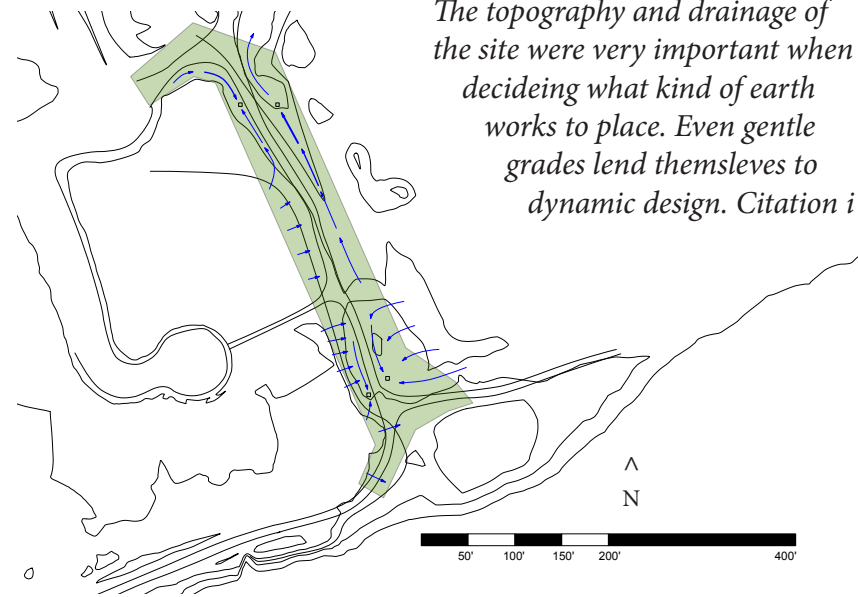
*Top: approach from the park  
Middle: Crepe myrtles  
Bottom: Parkway approach  
citations e, f, g*

## Site Analysis

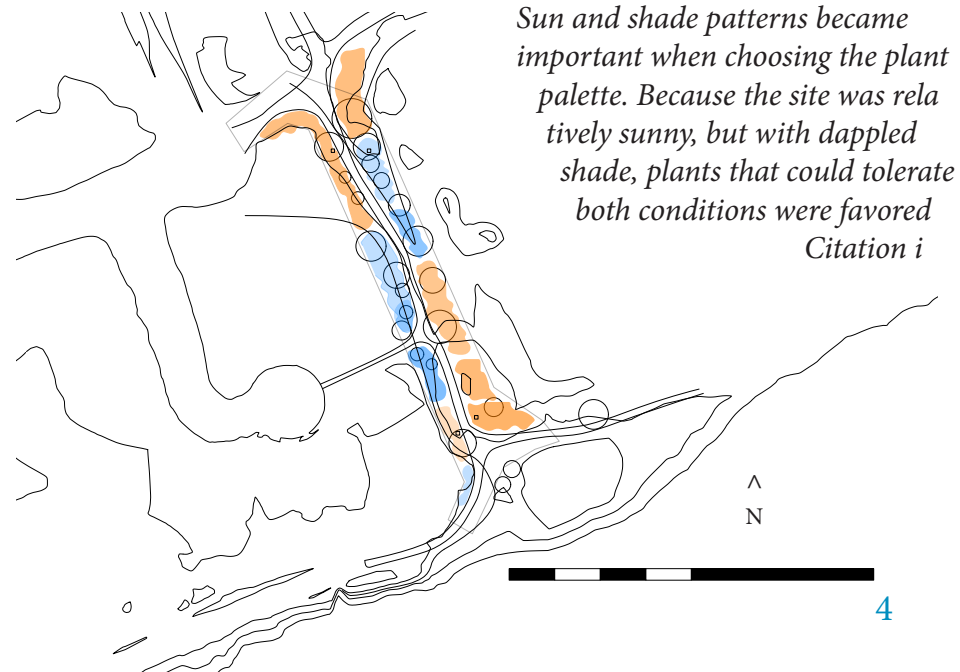
The most important factors for the implementation of my design were topography and drainage, sun and shade patterns, and viewshed.

The topography of the site consists of gentle slopes generally sloping from Southwest toward the Northeast. There are no truly dramatic grades on the site, but over a distance of 30 feet, the difference in elevation can be 2 feet. These gentle grades lend themselves to small interventions using earthworks. There are four drain boxes on site, all surrounded by slight depressions, although at times it is hard to recognize these because of siltation and plant growth.

Although there is no site that is completely shady, the map at right shows sun and shade pattern in more relative terms.



*The topography and drainage of the site were very important when deciding what kind of earth works to place. Even gentle grades lend themselves to dynamic design. Citation i*



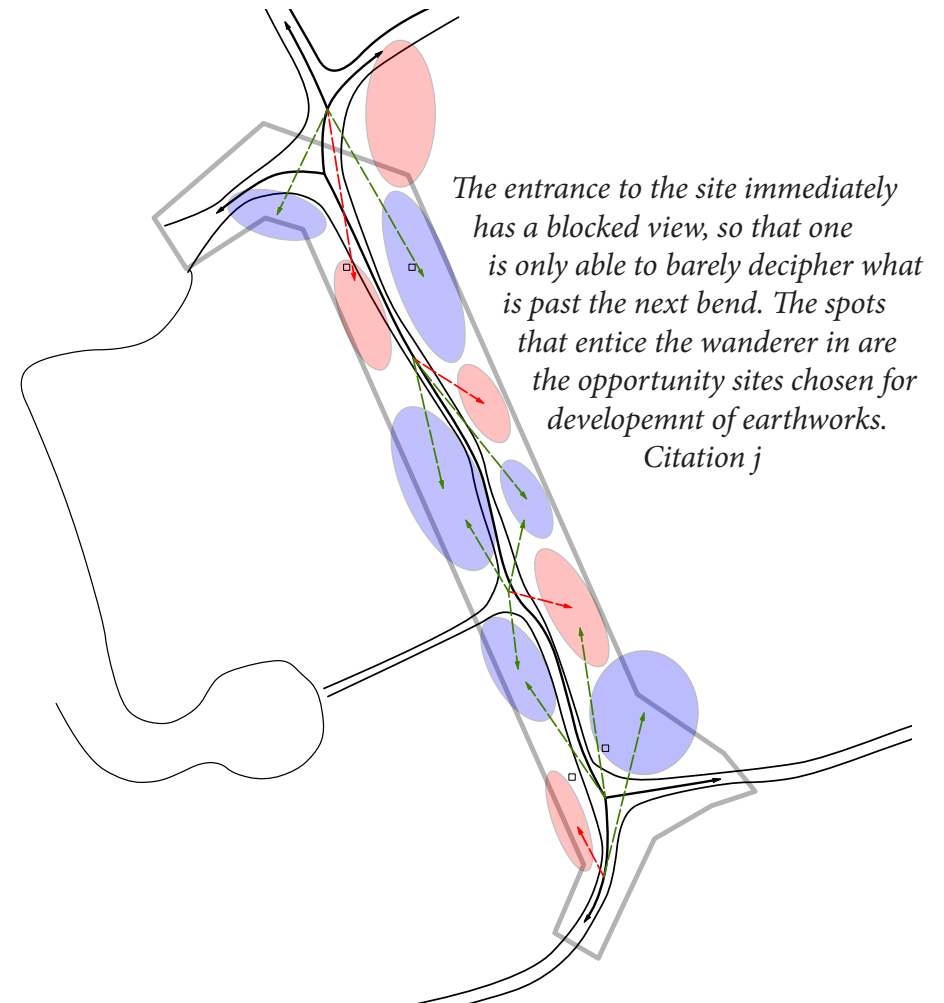
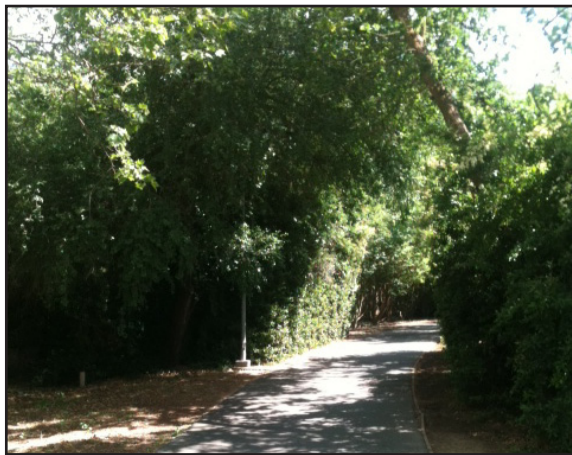
*Sun and shade patterns became important when choosing the plant palette. Because the site was relatively sunny, but with dappled shade, plants that could tolerate both conditions were favored. Citation i*

## Viewshed

One of the existing site features I wanted to try to maintain was the sense of hide and reveal one experienced through the space.

Because the path is linear, overgrown bushes hide open spaces, giving glimpses of what lies beyond, but only affording views after passing the hedge.

I would like to implement a similar strategy but use more attractive plantings. By planning the experience of walking through the site, I found areas on which to focus.



I planned areas in which to plant view blocking plantings, here highlighted in red, along with opportunity areas where particular design Features could be highlighted, here, in blue. The rays represent what can be seen standing on a particular point.

## A Functional Landscape

The redesign would not just lend itself aesthetically to recreating a natural looking environment for the Davis dweller, it also is a functional and necessary complement to the built up area. California native plants use less water, and are lower maintenance than imported East Coast plants. By employing lower water use plants, California natives, and earthworks, the site can be functional as well as aesthetically pleasing.



*The basins in the front yards of Milagro Cohousing double as storm water detention basins. Citation b*

## Water

The plant palette I would like to use consists of mostly arboretum all-stars. By virtue of that classification, many are low water use plants (Arboretum All-Star). In choosing the plant palette, it was important to group plants with similar water requirements together into hydrozones. Up to four hydrozones; High, Moderate, Low, and Very Low, is a good classification system, as it not overly complicated, but provides a basis to begin to group plants (Knopf 2). Often, plants that share similar water requirements hail from similar environments. This coincidence is convenient when trying to design certain features and evoke certain ecotypes.

Because the City of Davis does not have water meters installed, it is impossible to tell what the exact amount of water used for a given

area is. However, using the Water Use Classification of Landscape Species (WUCOLS) publication from the year 2000, I was able to make estimates about the amount of water it would take to the three model landscapes listed below. Noting that the current site is not planted very densely, the water used on the landscape may be significantly increased in any new design. This prompts an appropriate comparison to be made. Another site exists on Dogwood Place and Eucalyptus Street, in South Davis. This landscape employs a conventional plant palette and landscaping. Because of these conventions, and because of its density and groupings, this site had the highest average water use. By reducing density and encouraging plants to grow naturally, there is less of a need for hedging and trimming (Cook and Vanderzanden 28).

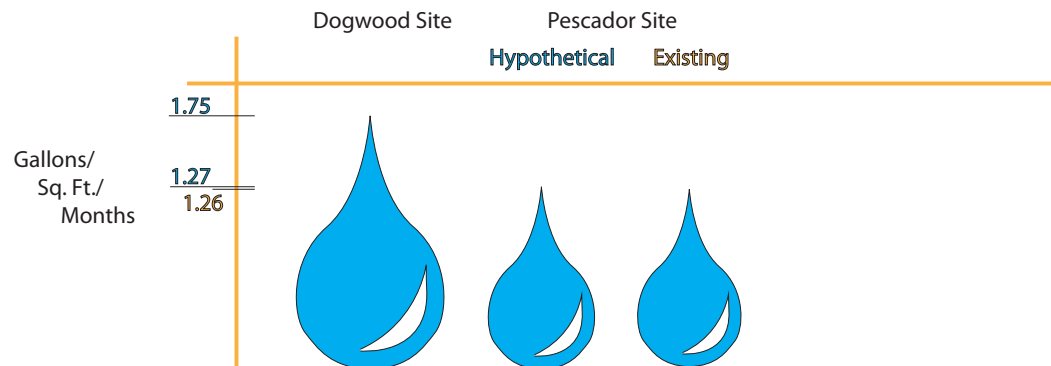
One of the reasons that conventional landscapes use so much water is because the irrigation regime is planned around the highest water use plant in the zone. When trees are grouped with shrubs or turf, not only must you irrigate according to the combined requirements for all of the vegetation levels, but you must irrigate for the highest water use planting you have put in. In the case of the site at Dogwood Street., there is a mix of vegetation levels, ranging from ground cover to medium sized shrubs to large shrubs to trees. Using a conservative estimate derived from WUCOLS 2000, that site uses an average of 1.75 gallons of water per foot for every month (WUCOLS).

What becomes the worst about planning irrigation for the highest water use plants is that the cycle is self perpetuating. Many drought tolerant natives and exotics can be killed by disease or seriously

stressed by being overwatered. For example, when oaks are planted amongst turf with high water requirements, the trees are killed.

Because planting by hydrozone is of upmost importance to the health of drought tolerant plants, my design incorporates different levels of plantings, separated by grade and irrigation line. Planting a water wise landscape also will result in similar in an aesthetic appeal due to the ability to reconstruct an environment resembling the natural community of plants.

Estimating using the WUCOLS system, the site currently uses 1.27 gallons per foot for every month. Implementing my design would only use 1.26 gallons per foot per month, compare this to the 1.75 gallons per foot for the Dogwood site. Most of the savings here is due to the plant palette and the plant density of my design. Because the plantings are grouped in the appropriate hydrozone, and the highest water use landscape coefficients were minimized, the site would use no more water than what is prescribed for the existing plantings.



## Mulching

Minimizing the amount of water needed by the landscape requires that all water be available to the plant. Here, mulching and earthworks become an essential portion of my design. Mulching helps to infiltrate water and to keep water from evaporating from bare earth. Earthworks intercept water that runs off after either precipitation or an application, and channel it to where it can be used by the plant. Mulching is an important aspect of both a lower water use as well as lower maintenance design. By mulching, weed growth and erosion are minimized. Mulching also helps to infiltrate water by offering a very porous surface to the oncoming water from above and beside. Water falling onto a mulched surface as rain does not have the same erosive power as a raindrop falling onto a bare surface; the spongy material softens the blow

(Lancaster 155). It also helps the soil retain the water afterwards because it shades the soil from the rays of the sun, which would desiccate the soil surface (Lancaster 153). Mulch also helps to shade the roots of plants, and creates a healthy environment for important macro and micro organisms within the soil, ranging from earthworms to beneficial fungi (Lancaster 155). As the mulch decomposes, reapplication will be coupled with falling leaves and cuttings from the plants on site, reducing the waste created which must be dealt with, reducing labor inputs (Cook and Vanderzanden 28).



*Mulching is an important part of reducing water use and maintenance. Citation d.*

## Earthworks

Earthworks are a simple way of helping to recharge some of the shallow groundwater that regularly runs off the site. Used in arid environments for millennia, the general principal is that the longer water sits in depressions, the more chance it will have to infiltrate the soil and become available to plant. A generous heaping of mulch and shading from plants leads to lower evaporation rates and reduces the need to irrigate as often, and for some low water use plants, the need for any irrigation at all (Lancaster 18).

Knowing our position within an arid region, it is becoming increasingly viewed that using potable water on landscape plantings is no longer acceptable. Increasingly, landscape designers are looking for alternative irrigation strategies including greywater and other

types of reclaimed water. Because this can be of variable quality, it makes sense to retain as much water in the soil as possible not just for water savings, but also because relying on rainfall and minimizing irrigation will lower salts and keep the plants from injury. Earthworks lend themselves more towards the implementation of these alternative water sources. Different irrigation strategies can complement earthworks because however the water is broadcast, earthworks will recapture it as it flows as runoff (Lancaster 17). Currently, a sprinkler irrigation system is in place, and a drip system is impractical. By implementing earthworks, with some modifications due to grade change, the same system could be used.

Earthworks used to harvest rainwater naturally lend themselves to dynamic designs. A wide range of materiality, size shape and color

can be used that have all been decided and implemented on the logic of their ability to help infiltrate rainwater. Establishing a typology of earthworks for use on this site, and while still being functional, their design is still largely driven by aesthetic reasons.



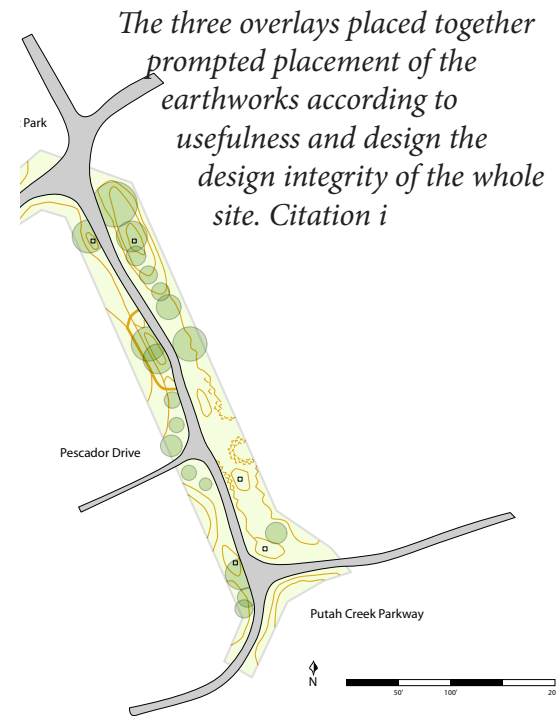
*Native American check dams kept silt and water behind the wall for farming into the dry season with the moisture stored in the soil*

## Earthwork Typology

The traditional techniques that are used to capture rainwater draining off of a sloped area can easily add a splash of color and dynamic line and horizontality by using an interesting material. Recalling previous works of art already in place in the Davis Greenbelt, there is also a wide range of materiality that could potentially serve for earthworks.

These materials can be decided on the basis of which goals one seeks to accomplish. Aesthetics are important, but they are not the only factor. Another important factor is the sustainability of the materials used. Much of the overall sustainability of the site may be the external imports one uses. The

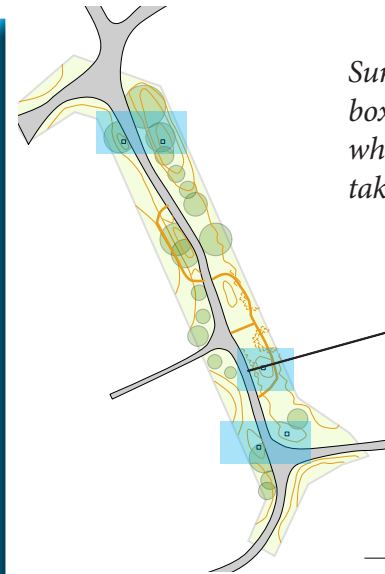
embodied energy of such materials as cement, and metal are comparatively high. and in this case, with all of the dense, unwanted vegetation currently on site, the long, *Pyracantha* shoots coupled with stakes and the potential wood chips may be used to build the tops of berms. Interesting berms of rammed earth might double as paths and could include interesting patterns and earthy color to contrast with the brightness of annual blooms. These berms recall an existing art piece, Troy Corliss' "Alluvium" which is a rammed earth sculpture that represents the sinuous curves of Putah Creek.





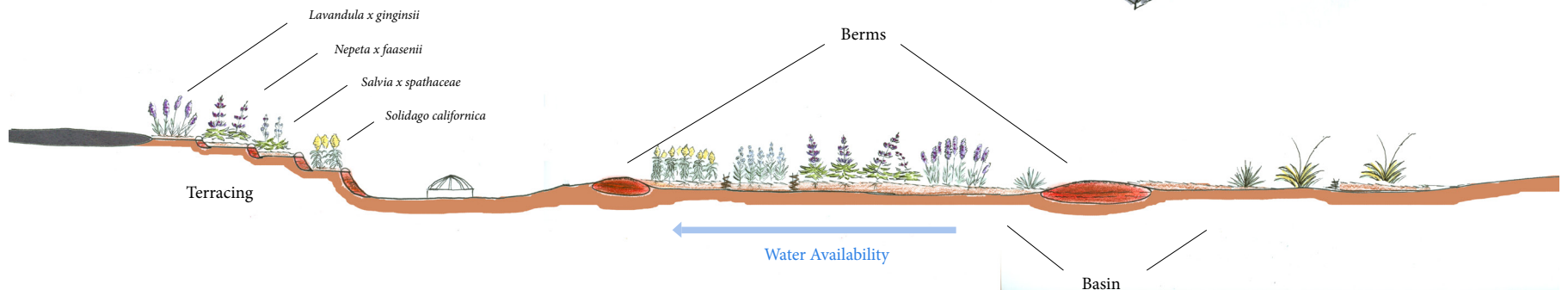
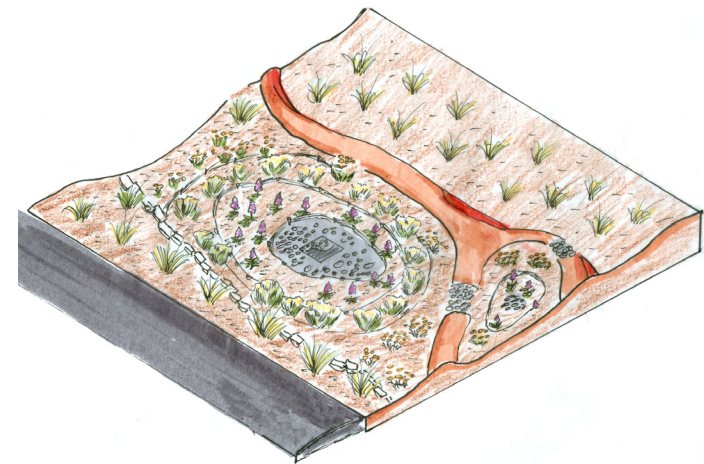
## Sunken Basin

Sunken basins are vegetated depressions that are used to infiltrate water at low points and on flat ground. Because terms like “Rain Garden”, “Bio-swale”, and retention ponds can become confusing, here I will refer only to it as a basin, an earthwork which is used to infiltrate runoff. Basins collect, infiltrate, and utilize for plants the rain that falls within them as well as whatever runoff comes from the surrounding area (Lancaster 119). Because of their geometry, sunken basins have a large capacity to store water, reducing plant needs for water by up to 50% according to Brad Lancaster (118). In the case of my site, there are many silted drain boxes, all already located at the bottom of shallow depressions. By raising their height, and by adding a spill-way of gravel, the infiltration of water will be maximized, and there will be less siltation and debris.



Sunken basins occur at all drain boxes, as well as at a low point where the section cut below is taken

Section Cut



Berms

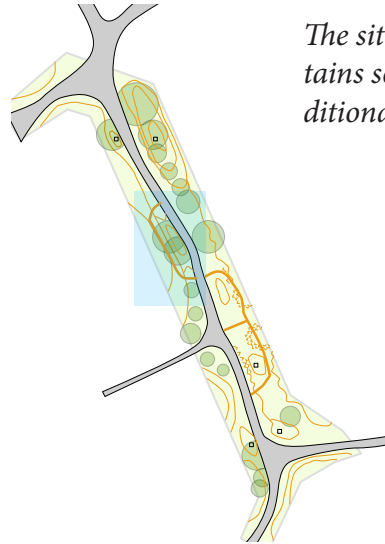
Terracing

Water Availability

Basin

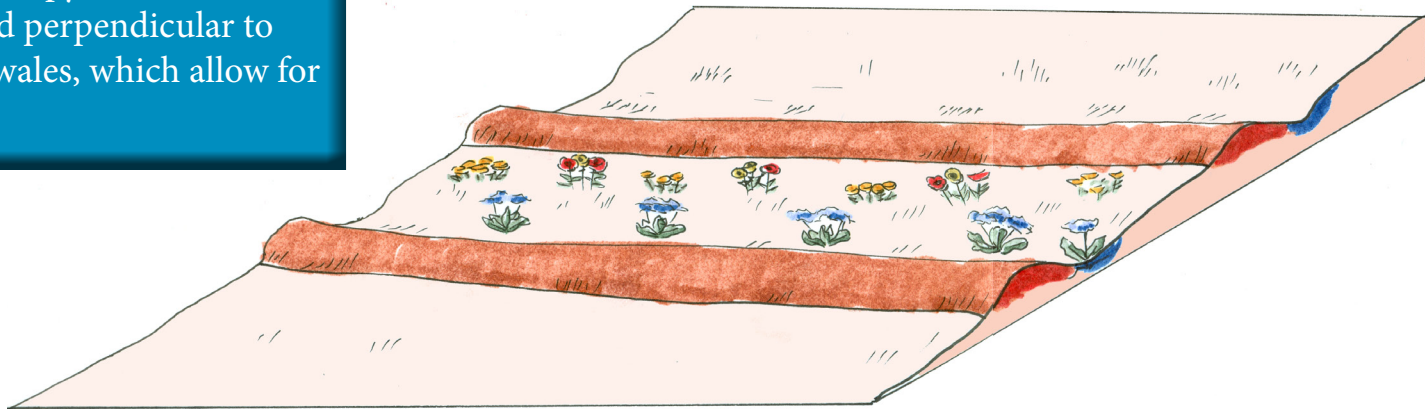
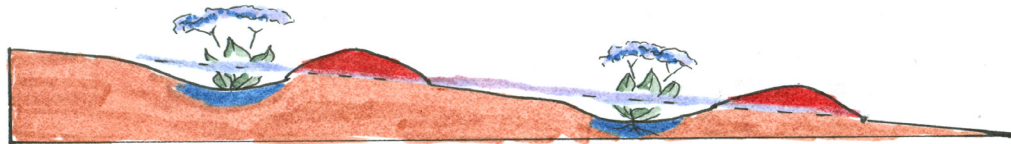
## Contour Berm

A berm and basin type earthwork is one of the simplest typologies. It consists of cut along the parallel of a sloping ground plane, with a small earthwork beside it on the downslope side (Lancaster 18). This earthwork creates an impediment that is perpendicular that slows, spreads and infiltrates the runoff instead of letting it flow downhill. There are two variants I am including within this larger category. One is made of rammed earth and is used on areas with a very gentle slope that are all above the surface of the path. The other type is made of pyracantha brush and is located perpendicular to the flow of swales, which allow for more runoff.



*The site with contour berms maintains some of the existing trees. Additionally, it includes a side path.*

*Water is retained in the soil in the basins, forming a lens of water for plant growth*

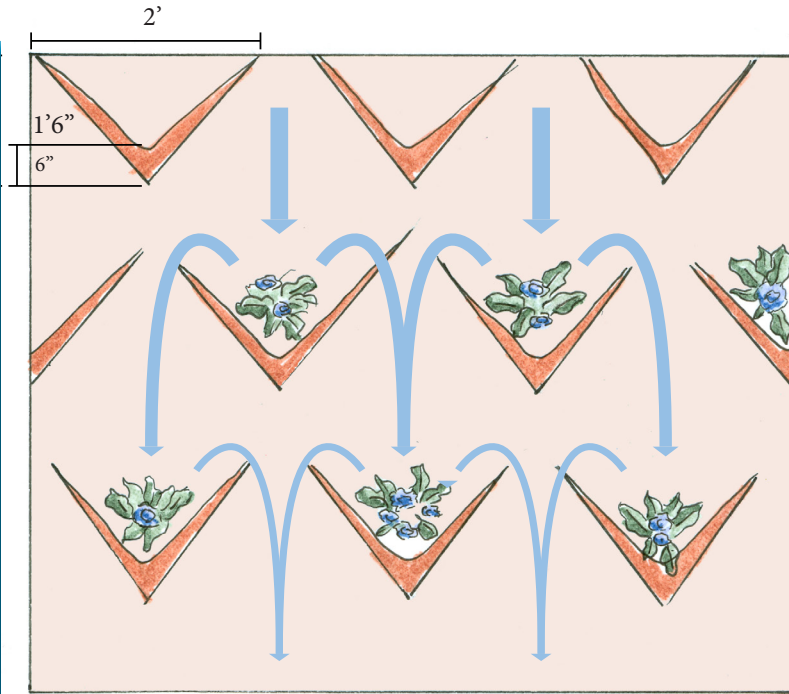




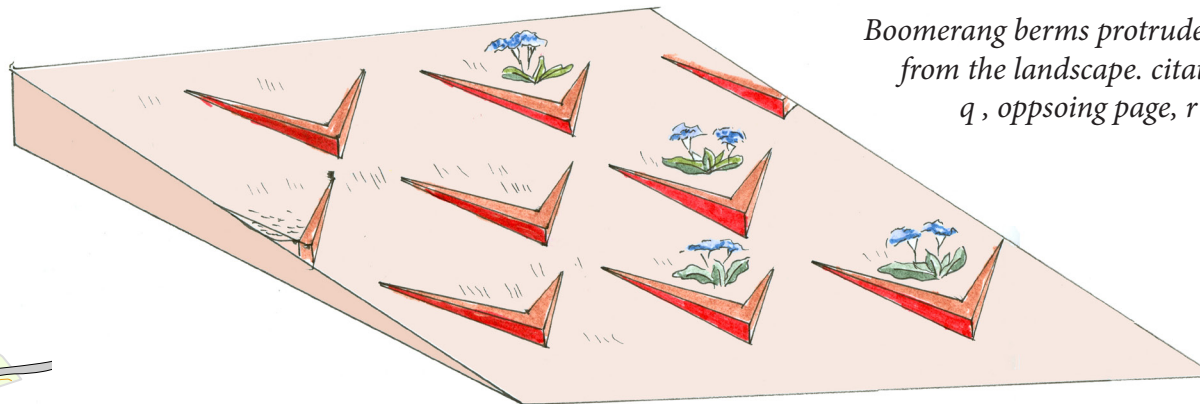
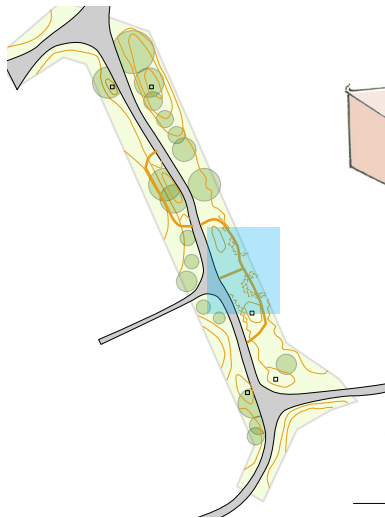
*The site's berms interconnect with a central path to form an interesting design. Plantings at the bottom of the berm (California Pipevine and Sea Lavender) are the highest water use*

## Boomerang Berm

Another type of berm and basin is a boomerang basin. This type consists of a basin that is surrounded on three sides with a berm, the open side facing upslope. Water is concentrated at one point, the bottom of the basin. In my case, I have implemented what Lancaster calls the 'net and pan' system, where one boomerang basin flows directly into another, concentrating particular points where I have placed my plants (80).



*As runoff flows from the top elevations to the bottom elevations, protruding berms act as a series of cups filling with water and then sending the excess towards the next berm. Bottom plants tend to get the greatest water in the surrounding soil. citation p*



*Boomerang berms protrude from the landscape. citation q , oppsoing page, r*



## Artistic Touches

Using artistic touches like this to serve what would otherwise be utilitarian structures would make a unified dynamic design that could echo the Putah Creek Parkway. Eventually, as plants grow, the rammed earth berms would erode and make a more naturalistic type of look. Brad Lancaster mentions that berms can also serve as informal paths that can lead people closer to the plants, letting them linger for a while. By making them just a little wider than the average berm, the paths can stay dry enough to maintaining foot traffic (80). In my landscape, a single large path will intersect with the smaller berms, showing a large earth colored arc with smaller veins radiating away from it. The material lends itself to organic shapes with a rustic, imprecise edge, recalling Putah Creek beyond, and the more naturalistic area ahead. By letting the earthworks naturally erode over time

as the plants begin to establish themselves, there will not be the static composition that requires a large amount of labor to maintain (Cook and Vanderzanden 84).

Other types of earthworks lend themselves to particular design concepts. A form of the “berm and basin technique, the “boomerang berms” are shaped like crescents or V’s rising with the grade and meeting each other at the middle of the next tier, resembling fish scales. With each plant essentially given a natural planter, I thought this would lend itself well towards perennial plantings. Using brightly colored plants against the earth colored berms, I thought it might look like a jewel box of flowers.

Other types of earthworks might lend themselves to features that resemble aspects of the California landscape. For example, sunken depressions used as rain gardens could be planted in tiers as well with concentric circles of wildflower-

er plantings with different bloom times to resemble vernal pools. Functional attributes would also guide aesthetic choices, such as a spillway around drain boxes with gravel to keep siltation to a minimum, and smaller check dams to infiltrate the water that would define the planting for the different species of wildflower. Although vernal pools are a specific and very rare type of California habitat, the natural principles and forms that nature provides us are used to recall the spirit of ephemerality and the scarcity of water.



*Rammed earth is an important part of my materiality. Citation c*

## Case Study: Milagro Cohousing Project

Earthworks presented themselves to me because of their versatility and their ability to satisfy my goals. In the case of the Milagro Cohousing Project, the designers succeeded immensely. The site consists of a series of small infiltration basins that overflow over sidewalks into each other, negating the need for a large detention basin. Using this method, the project can hold seven times the amount of stormwater that a conventional detention basin could. The basins filling with water eventually spill into a community orchard and then to a wildlife habitat with a series of check dams. As opposed to a conventional detention basin, this system is incorporated seamlessly into the yards of its homeowners and makes for functional and beautiful front yards (Lancaster 137).



Citation b.



## California Landscape Garden

The first settlers of the Sacramento Valley had a deep relationship with water. Many of the original farmhouses in Yolo County had working tankhouses near the farmhouse. Water was a crucial part of their lives, and significant effort was spent trying to capture it and keep it for use when the land was dry. The immigrant Eden that sprung from the land was directly tied to reworking the hydrology of the whole state. Without the canals, levees and rivers, there would never have been a society like that which exists in California today (Francis and Reimann 24).

It was through the prosperous farms that spouted along these water lines and artificial shores that paved the way for cities. The ever accelerating development within California with the rapid pace of

water management strategies led to a vast supply of inexpensive water. People in cities began to forget how precious water was, and used it for all sorts of inappropriate, badly planned landscapes, taking the abundance for granted. How can we add places in the greenbelt that remind people of the delicate line they stride between abundance and total ruin.

The greenbelt represents a haven for nature within the city. A green area set amongst buildings. Most of the Davis greenbelt surrounding my site was constructed during the 1990's along with the subdivision that was connected to it. Greenbelts were planned with the community in mind. Their design and content directly reflect the community they serve.

It consists of a very limited plant palette largely reflecting the norms of the Eastern United States. Usually, the consists of large trees such

as London plane trees over medium sized shrubs with some kind of groundcover, often a separate patch of turf.

Many seem to share the view that Mark Francis comments on in, "The California Landscape Garden", "Nature is something found in Alaska or Yosemite, but not at home or nearby" (Francis and Reimann 29).

Conceivably, landscape designers built parks in the past that were supposed to be oases of nature within an urban environment, this started with Central Park and Frederick Law Olmstead. This was done as a way of civilizing the city through the creation of Arcadian inspired pockets of nature that would morally uplift people and programmed for strolling where they could recreate their souls amongst nature. Although not always the best fit for the populace and although often an imposition



of Romantic-era ideals on people who could care less, park designers' ideals were noble, and the idea that man is connected on an intrinsic level to the natural world is one of the core tents of our role as an environmental designer.

Again this begs the question, what type of nature is being reflected in the design of the Davis Greenbelt?

Why is a landscape reminiscent of Eastern North America, and ultimately the English Countryside sitting here, in the Central Valley of California in the middle of the arid West? This question prompts more questions than it does answers. The greenbelt in Davis California could be a reflection of the landscape that used to exist here before it was regraded for agriculture, and developed for houses. Being in such close proximity to Putah Creek, there is a great opportunity to reflect a connection to nature in the spirit of park design, but with

a California plant palette and that recalls the California landscape.

A California landscape garden would help us to create our own little piece of human built nature. Although habitat restoration and preservation are lofty goals, they are often ill suited to the sites offered within urban areas. Because of this, urban open space does not always need to aspire to something it can never be, but it can still be functional, aesthetically pleasing, and make urbanites more aware of the place, and nature. In short, it is not my goal to restore habitat, but to suggest the real natural landscapes in spirit if not in actuality. Appropriate signage with plants clearly demarcated and artistic pieces and signage depicting the natural systems that take place within the Greenbelt would inform and inspire residents with the potential to transform their own plots of manmade paradise.



*Homes in the surrounding neighborhood. Citation p q r*

## Public Art

Informative displays of signage about natural systems and plant nomenclature convey scientific information well, but there is always something lacking when experience becomes reduced to that. Spectacle can be just as important as words and graphs to make things truly understood. Artistic endeavors convey subtle messages that can nonetheless be very powerful, so much more so when the subject matter is the future of life as we know it.

Although artistic elements such as earthwork's inspired by Troy Corliss' designs would be incorporated, pieces of art that address water would be appropriate. "In her book on landscapes shaped by water in Boulder Colorado, Joan Woodward describes a "water-stain" as "an anomaly, something found in a normally dry environ-

ment... a rather blunt report of water's former or hidden presence". Some of the evocative images of the California Central Valley; tank-houses from old farms, lone cottonwoods and oaks in a field, and the vernal pools that vanish with each passing day of spring are local examples her "waterstains". An art piece combined with some water feature within the site could draw people towards it and make them contemplate for a moment where they are and why this exists. A windmill that gathers water from an unknown source beneath the ground and then splashes it onto rocks and gravel before it mysteriously disappears again might remind the viewer of the scarcity but the presence and importance of water.



*Troy Corliss' rammed earth design recalls the meander of the North Fork of Putah Creek. The material he chose would be appropriate for earthworks. citation a.*



## Conclusion

The Davis Greenbelt is a major amenity for the community. In a time of water scarcity, in order to serve its purpose, it must be redesigned so that it can be maintained with less water and less labor.

I attempted to design a site that was aesthetically pleasing, functional and low maintenance. By using earthworks, I was able to implement all of my goals with the single design element.

Most importantly, I tried to make people aware of the context of their environment. That in California, water is a precious resource.

Public open spaces are a reflection of the communities that build them. What are the views of the residents of a university who appreciate the value of nature untamed, but also realize their place within the con

tinuum of an ever evolving landscape. It should not be in the form of an English meadow or Central Park, it should be a beautiful, functional, natural, California Garden

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## Images

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e-v . Creator Richard Perez