

Principles of Archery Range Architecture

A Redesign of the Yolo Bowmen South Range



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June 13, 2008



Principles of Archery Range Architecture: A Redesign of the Yolo Bowmen South Range



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Abstract

This project is an attempt to incorporate broader environmental design principles into the existing (and limited) body of literature concerning the design of field archery ranges. I have organized these design considerations into four principles that archery clubs and land planners can utilize. Observing sensitivity to the environment, providing a layout for safe shooting, making the space comfortable, and programming inclusive spaces makes a range that serves its community well. These principles are to explain concisely how a range can be made not only to accommodate archers but also to exist harmoniously with neighboring land as well as function as a valuable community building asset. Finally, an example design treatment to the Yolo Bowmen Archery Range of Grasslands Regional Park will help to clarify the principles set forth in Part I.

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The Yolo Bowmen

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Dedicated to

The archers of the Pasadena Arroyo who rekindled my interest in traditional archery

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Introduction

Archery is a sport that has existed for thousands of years. Nearly every culture in the world can recall a time when the bow and arrow occupied a special place within their material culture. Even today a growing population has discovered that archery satisfies their atavistic urges to find common ground with their practical and innovative ancestors (most of whom used a bent, strung stick and a few companion arrows to great effect). But this sport is not just for enthusiasts of the past. To many, a chance to practice an Olympic sport makes archery attractive. To others, hunting with modern archery tackle is more engaging and satisfying than using a rifle or shotgun.

As this sport becomes more popular and diverse in its forms and audience, so must the places in which it is practiced. An archery range, if designed following a set of guidelines that incorporate the needs of its users and environment, can truly become a valuable place.

In Part I of this document I have developed my own set of guidelines for designing an outdoor field archery range. I have chosen to discuss archery range architecture in consideration of safety, comfort, engagement through shooting challenges, inclusiveness, and sensitivity to the environment. Though part of this project's purpose is to distinguish one principle from another, significant overlap exists between these principles. For instance, a range may be safe by its careful layout, but can become safer and more comfortable if its users can establish a strong sense of community brought forth by an inclusive design.

Field archery as a sport is like golf. On a field archery range, archers shoot one or more arrows per target, score their arrows, and move to the next target. Like shooting 18 holes of golf, one National Field Archery Association (NFAA) Field Round involves trekking through fourteen targets. In this official round, archers shoot 4 arrows from a marked distance, explains Paul Davison (Davison 1). No points are awarded if the shooter misses the circular target. An arrow that lands within 1 of the three bands of the target receives 3 (touching outer band), 4 (touching second band), or 5 points (touching the innermost band or the bull's eye) for a maximum of 20 points. The field round shares another similarity to golf in that each target is composed differently. For archers, this translates to shooting at distances from 5 to 80 yards and occasionally shooting up-slope and down-slope (Davison 1).

Part I

Principles of Archery Range Architecture



An archery range can and should accommodate more than just its human users. Field archery courses are already planned to mimic the wild areas where people hunt, so a range architect needs only to ensure that these areas will actually function like wild places. With some planning a range architect can set aside land as habitat for local plant and animal species as well as ensure that these habitats connect to adjacent land areas and ecosystems. For sites that have not been previously disturbed, the range can simply limit the area that it impacts. Planners can also design elements into the landscape that improve existing habitats on a range site if it has been heavily disturbed by previous land uses.

Minimizing Habitat Disturbance

If a club is fortunate enough to find a natural setting for its range, it should be responsible for stewarding that land. Whether it is a prairie, forest, desert, or other natural landscape, many species of plants and animals depend on it to survive. A responsible range architect should consider a range layout that is both safe for its shooters and carefully planned to limit habitat disturbances (Hurdzan 220). Maintaining large patches of unaltered and undisturbed land, limiting the area used by maintenance and recreation trails, using signage to mark sensitive habitats, and maintaining habitat corridors that connect to surrounding lands are a few design approaches that will ensure the health of the local environment.

Since a field archery range must have buffer zones for safety reasons, a range architect can simply spread the targets out as much as possible to maintain wild buffer areas. As long as safety guidelines are still met, a range can also concentrate its targets in certain

areas to maximize the undisturbed land area into several larger plots. These larger patches better preserve a site's biodiversity as long as they can connect to other habitat patches. Also, maximizing edge habitats and using transitional vegetation will maximize the species richness of the range (Fogg 15).

Another strategy for minimizing environmental impact on the range is to reduce the amount of graded areas that are used for maintenance access, trails, and target shooting lanes (Fogg 13). For example, a comfortable shooting lane needs enough room to allow about 4 archers comfortably on the line at once (about 20-25 feet), but they need only enough room down the lane to retrieve their arrows. As long as the vegetation's height along the edge of the shooting lane does not obstruct the archers' views or shots, the graded lane can narrow significantly toward the target.

The trails laid out for range maintenance, fire protection, recreation, and traveling between targets should also be kept to a minimum. In fact, some of these graded areas or trails can be combined into multiuse roads. For example, a 15 foot firebreak has enough room for trail users as well as range maintenance vehicles. The trails and roads can separate when necessary to follow landforms, but around the perimeter of the range, combining road uses will maximize the natural habitat area.

Improving Range Habitat

When archery range architect plans a field course for a site that is heavily disturbed, they can design several landscaping elements into the layout that will increase the site's habitat and biodiversity. (US Golf Association). These include planning the re-establishment of native vegetation on the site, design-

ing hedgerows of native plants, re-grading to stabilize eroded zones, and returning diversity to the landscape with artificially landforms.

As the range layout develops, particular parts of the range can be designated for native vegetation reestablishment. If there are many exotic plants on the site, it may be necessary to reduce their population while increasing the native plant population in a multiple phased process. For grasses and sedges, consider the use of plug-planting instead of seeding if the exotic species out-compete native species (Robins, Edges 69). Since the natives are naturally adapted to survive on the site, they will fare well without much maintenance if they can successfully establish themselves, and will be able to out-compete weed species.

Hedgerows, if designed properly, can become excellent habitat enhancements (Figure 1). Not only can certain wildlife live along the hedgerow, they can use the hedgerows as a highway to travel between existing habitat patches. However, a hedgerow must be wide enough to allow room for these species, and it won't function if it is not connected to other habitats. Standards for hedgerow size vary, but a larger hedgerow is definitely preferable to a smaller one. Also, native shrubs and tree species will make the most effective hedgerows since wildlife species are adapted to using them within their natural habitats. Hedgerows can function in various places such as along roads, fences, and streams or canals (Robins, Capay 61).

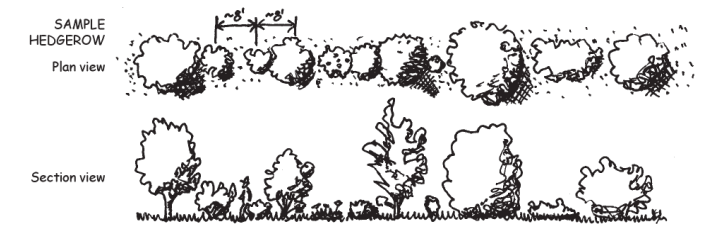


Figure 1: Sample Hedgerow

Eroded zones on a site should be identified, especially waterways with eroding banks, and the range design needs to address how these zones will be improved. A range architect can plan to re-grade the area to make it suitable as a site for one of the targets and even take advantage of the erosion to create unique topography that challenges shooters. If regarding is not an option, erosion control blankets can be used and planted with native grasses to stabilize the area. At the least, the erosion should be addressed in a way that it can be used by archers or wildlife. For instance, stream banks that are eroding can be cut back and vegetated to create more habitat area for riparian plants. Stabilized, vegetated banks keep sediment from flowing downstream and provide more space for riparian wildlife, especially local waterfowl.

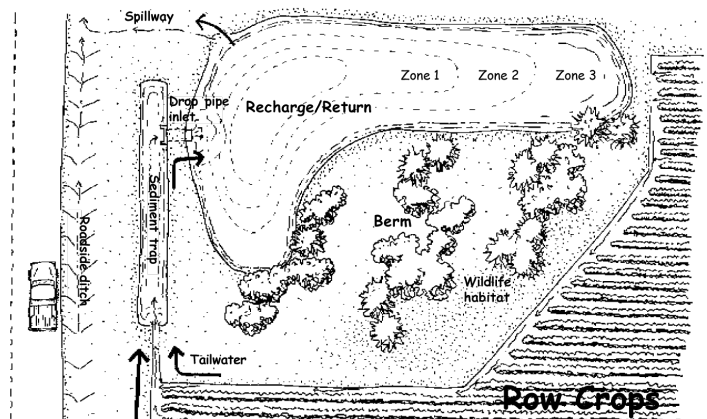


Figure 2: Vegetated Tailwater Pond and Berm

Sometimes a site has been leveled for irrigation, temporary parking, or for the storage of equipment that has long since been taken away, stolen, or abandoned. In this case, using cut and fill soil from the site (off-site soil may contain chemicals or exotic seeds) to return some topographical variation to the range. Planting the new landforms with appropriate native plants that can inhabit these new landforms will return biodiversity to the landscape (Figure 2). One

example of this is a habitat restoration design that involves excavating land to create an artificial pond and using the resulting cut for a landscaped hill, both of which can be planted with native vegetation (Robins, Edges 25).

Habitat Signage

Along a parallel with safe range design, using signage is a simple and effective way to protect wildlife areas on the range. A bulletin on the clubhouse wall can explain which areas of the range have been dedicated to the preservation of wildlife habitat. The habitat sites can be added to a general range map and signs can be placed at each of these habitat sites.

My first research for information about archery range design involved gathering as much literature from official archery organizations as possible. Of the relatively small amount of range design material published by the NFAA, the majority focuses on criteria for creating a safe shooting environment. This prompted me to ask, Isn't there more to planning a successful range? Yes, there is, as I have seen through personal experience as an archer and through my research. But archery range safety is an important factor that will influence the layout and other features of an archery range.

Target Butt Safety

To begin envisioning how a safe range can be laid out, first we need to ensure that our targets will be sturdy against wind, rain, sun, or snow (Figure 1). Target butts can be made of waterproof materials, but the target itself (usually pasted onto cardboard and pinned to the butt) is not. The target butts that are sheltered from the elements can be inspected less frequently, and are less likely to be leaky, that is, to allow arrows to pass completely through them (Davison 13). Stacked hay bales, still the most common material

used for permanent range vtargets, tend to leak at their softer corners.

Site Topography

Secondly, a range architect will spend the time to study the land that has been set aside for shooting. In North America archery ranges are often built on leased land, whether private or public. If the club or planner that plans to build a new range has a choice, they should strive to find land that has significant topographical variation. Having natural "hills and dales" on a range can greatly reduce the effort and space needed to make each target safely separated from the next (Davison 7). Since the targets can be set up against the hills, archers who miss the targets will merely stick their arrows into the slope. A natural arroyo or canyon that has no risk of flooding is ideal for safe shooting as long as the planner mimimizes local habitat disturbances to ensure that wildlife can still roam the canyon too. Archery can alternate shooting from either bank to take advantage of the natural backstops on either side of a dry (or wet) stream. The Pasadena Roving Archery Range in Southern California is a great example of how an arroyo setting can accommodate archery activities (Figure 4).

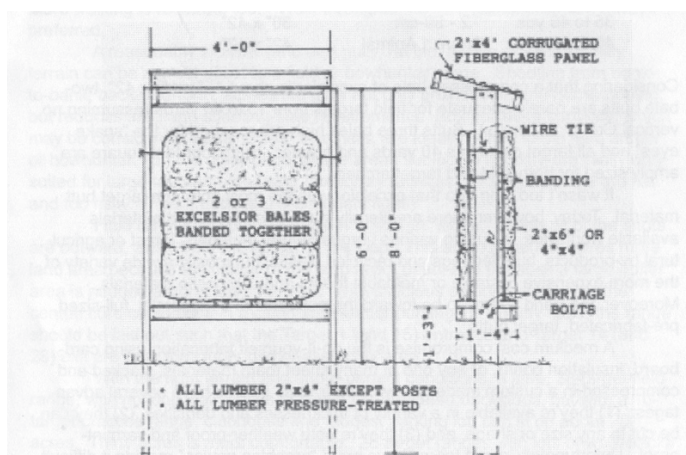


Figure 3: Covered Target Butt

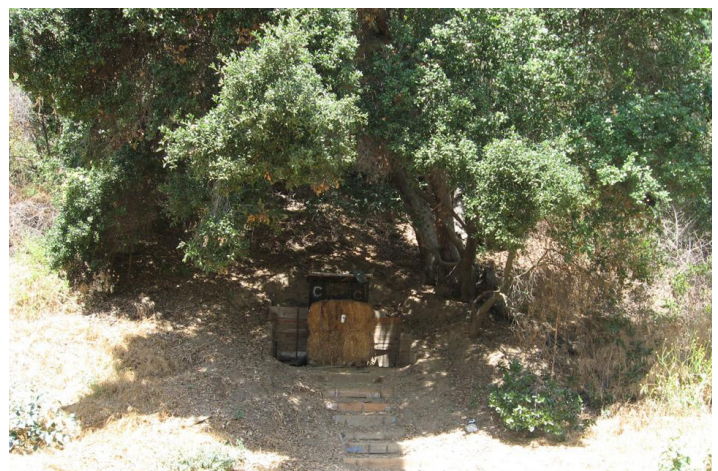


Figure 4: A Target in the Arroyo Seco, Pasadena

Buffer Zones

After a general layout has been decided (depending greatly on the landform), we consider how to apply a new safety feature: buffer zones. In another parallel with golf course architecture, a certain sector (about 27 degrees to right or left of the shooting lane) along the ground should be reserved as a “no man’s land.” However, the buffer zone guidelines that Davison provides relate to rangeland that is too flat to take advantage of natural hill backstops (6). In this situation, he calls for a buffer zone of half the target distance to either side of the target butt, as well as 25 yards behind the target (Figure 5). For shots longer than 50 yards, one half of the shot length behind the target is sufficient as a rear buffer. In the case that an adequate backstop is available, either natural (arroyo or hilly landscape) or man-made (log wall, earth berm), the buffer zone behind the target can be

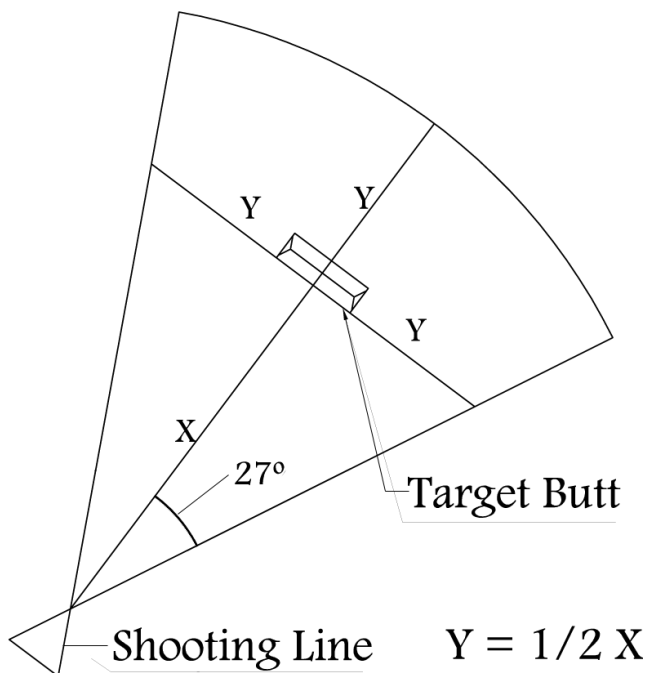


Figure 5: Safety Buffer Diagram

negated (Figure 6). Davison says that a sufficient backstop size is at least twice the height of the target butt and three times the width. The butt size itself depends on the shot distance (Table 1). For example, a proper target size for a 35 – 45 yard distance shot, the target butt (face-on) should be at least 30 inches high and 42 inches wide (Davison 9). Therefore, a reasonable backstop would be at least 5 feet high and 10.5 feet wide.

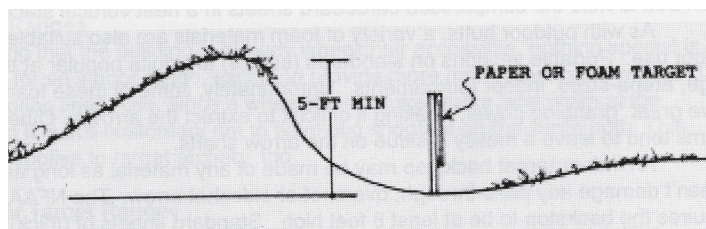


Figure 6: Earthen Target Backstop

Target Orientation

Another consideration for safety is the orientation of the targets. If the land on one or more sides of the range is heavily used or if a road passes close to one side of the range, the targets should be oriented away from the activity. Even if a proper backstop or buffer zone is in place, having a target that faces the road or activity is dangerous. If an archer sees sudden movement (especially from large vehicles or objects) in his or her peripheral vision while releasing an arrow, he or she may prematurely release the arrow on a wild course and exceed the limit of normal buffer zones. Although vegetation may reduce this risk, the shot will still be dangerous unless the shrub, tree, or vine foliage has thick enough to completely block sight to the area in question (only evergreen vegetation would serve here!)

Safety Signage

Finally, plan to use safety signage liberally at any archery range. As an element that requires the least space but carries the most importance, signage that clearly communicates the range layout and safe trails is the final defense against shooting accidents and injuries. From my experience, I suggest placing several site maps throughout the range, specifically at a central gathering point (range clubhouse) and at the start of each 14 target field course. The site map needs to clearly communicate where each course starts, the trail layout, and the buffer zones throughout the course. Ideally, signs at and between each target will guide users along the safe trail and indicate which target they are currently shooting. Also, signs in the form of posts (set flush into the ground) need to accurately indicate the official distance of the shot so that archers who use sights on their bows will not adjust their equipment incorrectly (Figure 7). This basic element of range signage is most critical for short distance shots where any bow sight adjustment will translate into a dramatic change in the bow's angle of trajectory.



Figure 7: Target Distance Post at Shooting Line

Making a field archery range comfortable for its users requires some forethought in park planning: in this case, an archer's needs are much like the average park user. Archers enjoy the outdoor recreation opportunities at the range and the field courses that resemble a round of hunting in the wild, but still appreciate access to some basic amenities. Shade, shelter from wind, rain, and snow, seating, access to water, and a bathroom will keep archers comfortable so that they can enjoy their visit.

Using Trees

Incorporating trees into an archery range design allows a range to have a more stable and enjoyable microclimate. Depending on the range site, trees may already exist. Ideally, these trees are native to the site and the surrounding ecosystem. If they are, plan to save as many as possible without compromising the range layout's safety. If there are few trees on the site, plan to plant some at least near the target shooting line and at the target butt, where archers spend most of their time (shooting and collecting arrows). These trees will provide natural protection from the sun and the wind, keeping archers warmer in winter months and cool in the summer (Figure 8). Trees also form a

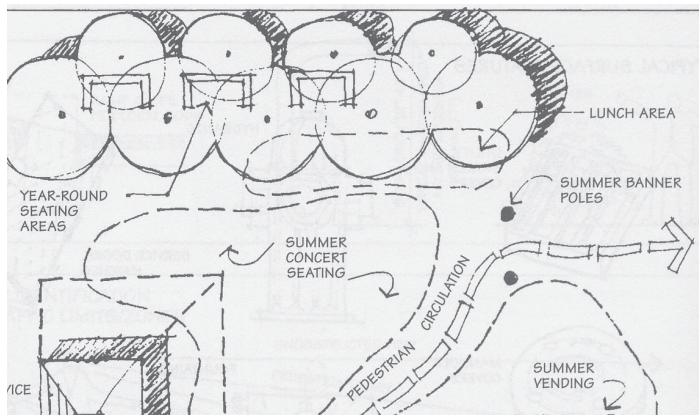


Figure 8: Trees Used as a Windbreak

natural windbreak if aligned perpendicularly to a site's prevailing wind. For an area that receives intermittent winds, try to find a balance between the preservation or use of deciduous trees and evergreen trees. In colder parts of the country, deciduous trees will allow more sunlight on the course in the winter but will let more chilling and shot-affecting wind through as well.

Shelter Structures

Building a roofed and/or walled structure at the range is another method of providing shelter from the elements. This may take the form of a covered area at one or more of the target shooting lines or even be a clubhouse for an archery club (Figure 9). If placed between two archery courses or in the middle of a larger range, it can become a gathering spot for archers before and after shooting a round. If more than one shelter or building will fit on the range, choose one to become the most important. For example, I might intend to have a hut by the first target of my archery course, but also plan to erect a building to house club meetings and other events. I should try to place this building along an axis of the trails that go from one target loop to another. I would place the shade hut off to the side to make it feel more available to a particu-

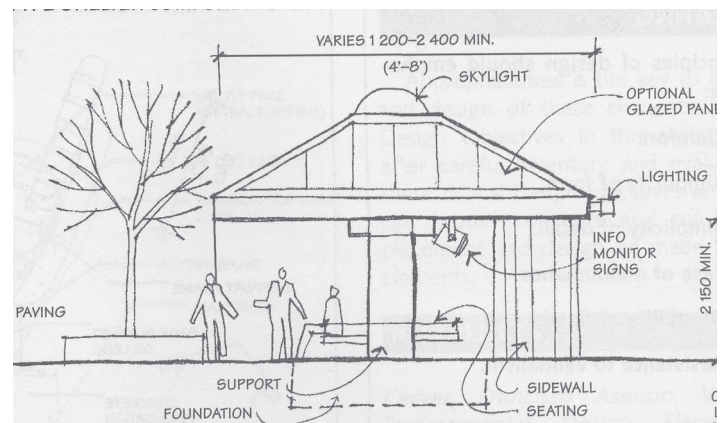


Figure 9: Shelter between field courses

lar loop of targets. Also, try to complement the architectural style of existing buildings if planning to erect a new structure.

Seating

In an ideal world, matching all the seats would be nice too. However, it is more important to place seating throughout a field archery range in a way that encourages visitors to linger at the safer parts of the range (Figure 10). In a range setting, benches are

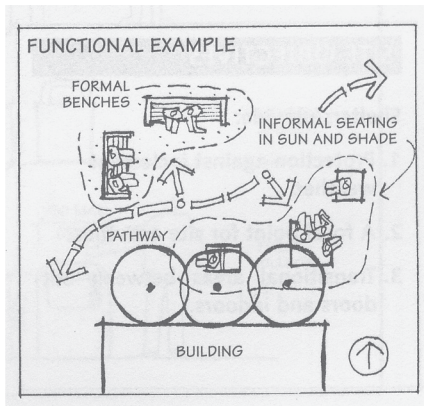


Figure 10: Seating Options in the Landscape

placed behind the shooting line of targets, especially at “walk-ups,” targets where each progressive arrow is fired at a closer, fixed distance. During a competition, people will have to wait for the current shooters to finish their walk-up, so a bench is a welcome element. If a range architect doesn’t have the resources to put a bench at each target, she should at least try to place one every few targets and one at both of the standard walk-up shots as well.

Water and Utilities

Water and bathroom access at the range may require a significant investment if the range site is not connected to municipal sources. A range architect can set aside a location for the construction of a well if the local aquifer will yield potable water. He can also design a compost bathroom system or even a septic system as long as it does not destroy local habitat.

I have described design elements that can make a field archery range functional for the archers who use it and the native species that inhabit it. A successful range design should also encourage a more general population of park visitors and outdoor recreation enthusiasts. If a range can attract a diverse group of users, its local club will have a larger, more diverse membership and the range will receive the maintenance and attention it deserves. A range with a diverse user group has the potential to become a valuable community resource.

Accommodating other Forms of Archery

A first step in planning an inclusive range design is to program spaces where other forms of archery can be practiced. Other styles of archery recreation and competition, such as target, Olympic, bowhunter, and 3D can fit into a field course if a range architect makes a few additions to his range layout. Most field archers prefer to have warm-up targets to shoot before starting a field round, and a design for this warm-up area can easily be modified to accommodate target and Olympic style archery. First, the area needs to be relatively flat to support multiple shooting lanes and target butts. Generally, 2 targets of each distance (10-80 yards in 10 yard increments) works for a practice range. One of the 80 yard targets can be easily adapted into an Olympic length target since Olympic archers shoot at 70 meters (76.5 yards). To accommodate target style archers who shoot at 20 yards, the practice range will serve, since it has 2 such targets (Figure 11). For a tournament, the range architect can design the practice range butts to be mobile. To accommodate Hunter rounds and 3D rounds, the field course itself can be modified. A hunter round

shoots almost exactly like a field round except that the shooting distances as marked on the ground are not in increments of 5 yards. For example, a 48 yard hunter round shot can fit onto a 50 yard field round target. A range architect needs only to design extra shooting markers into the field range plan.

Much like hunter round archers, young archers can easily find a place to shoot on a field course. A range architect can simply plan to use additional distance ground posts that correspond to official distances for the “youth stakes” for each archery style.

Of all archery styles, 3D rounds most closely resemble an actual hunting environment. A 3D course is always set up temporarily for weekend shoots or tournaments because it involves using 3D foam animals as targets. Archers shoot from unmarked distances determined by the course designer. To accommodate 3D shooters, a range architect needs to plan alternate shooting spots along the shooting lane of each target. Small spaces recessed into the shrubs and trees along the shooting lane work well as shooting spots because they more closely resemble actual hunting shots.

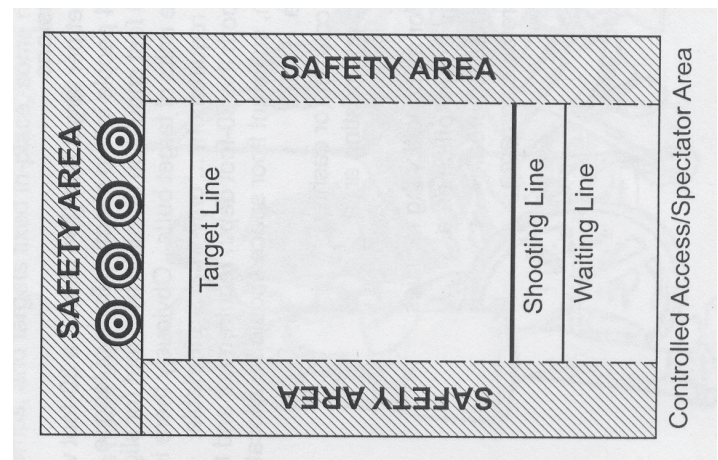


Figure 11: Typical Target Archery Range Layout

Open Trails and General Recreation Spaces

Farsighted field range architects will realize that a design should include trails, spaces, and amenities that encourage other outdoor enthusiasts to visit and enjoy an archery range. If they can incorporate wildlife lookouts along a range trail that safely flows around targets on the range, place sheltered seating in areas that can be used by all site visitors, and find places for picnicking, the range will draw a wide audience of park visitors to the site.

Since the trail that archers use run from target butt to shooting post, hikers and other outdoor enthusiasts who want to walk the range need a separate trail so that they can walk around each target safely. This trail should follow the land and be minimally graded to reduce loss of habitat and cause wildlife disturbances (Fogg 32). Range planners can design small to medium sized lookout spots or decks that allow visitors to experience the site's plants and wildlife without disturbing it (Figure 12).

Seating and picnic areas on a range can serve park goers as well as archers who want to decide to

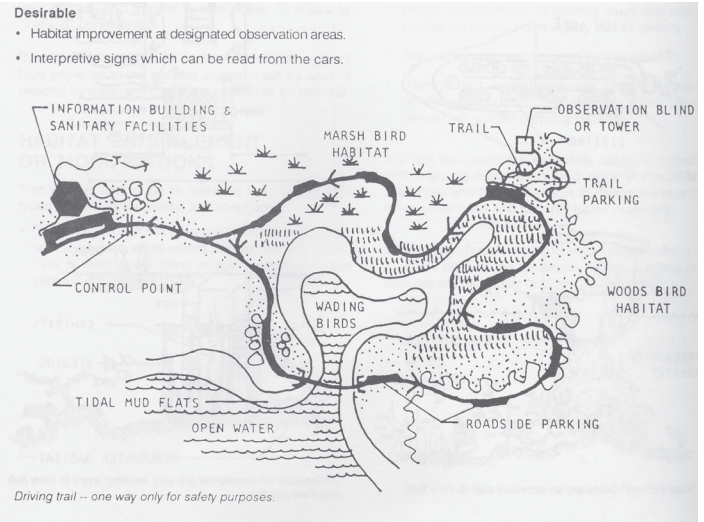


Figure 12: Lookout Placed along a Trail (in Northeast)

take a break from shooting. Most importantly, they should be placed away from all targets and their buffer zones. Range architects should take advantage of trailside open spaces on the behind target shooting lines since sitters and picnickers can observe archers from a safe distance as they shoot. With luck, range visitors may even decide to start shooting a bow after striking up a friendly conversation with a local archer.

Part II

A Redesign of the Yolo Bowmen South Range



The Yolo Bowmen Archery Range

The Yolo Bowmen Archery Range is located about 3.5 miles south of Davis along County Road 104 (Mace Blvd). It occupies about 60 acres of Yolo County Grasslands Regional Park. About 20 of those acres are undeveloped buffer land and are now fenced off from the rest of the park. The range is split into 2 courses, one North of the entrance road, parking lot and clubhouse, and a southern course to the south of the entrance road. Two groups of horseshoe pits are located in the central clubhouse area, and the local horseshoe club has an informal use agreement with the archery club.

Grasslands Park has existed since 1973, when the Air Force deeded 323 acres to Yolo County. Currently the rest of the Air Force land is being considered as an addition to the park. This would double the park's size. The Sacramento Valley Soaring Society maintains a turf area for model gliding to the east of the range. Though it is not officially open, visitors use the dog park to south of the range. Also, environmental education groups and birdwatchers frequent the park.

To the west of the range, agricultural land is used for both crops and cow grazing. Road 104 receives a moderate amount of use by tractors, agri-

cultural freight trucks, and conventional autos. More agricultural land lies to the North and South of the park.

The Yolo Bowmen, an archery club that founded the range at Grasslands Park, has existed for 50 years. However, its members didn't begin leasing land at Grasslands Park until 1978. Since then, the club has planned, planted, and maintained 2 NFAA Field Archery courses of 14 targets each. The current park entrance road cuts the range in half and continues eastward to the model glider launch. A gravel parking lot planted with valley oaks exists to the north of the road between the two field courses. A clubhouse, 2 sheds, a cafeteria/bathroom facility, and 2 horseshoe pitching areas are situated between the North and South course as well. The Yolo Horseshoe pitching club shares the clubhouse and cafeteria with the archers.

Over the years, the Yolo Bowmen have planted both courses of the range with a variety of trees and shrubs, many of them exotic (Table 2). Many fast growing eucalyptus, poplar, and pine trees provide shade and protection from the prevailing northerly and southeasterly winds. In fact, most of the trees within the county park are within the range borders.

Site Inventory: The South Range

Site Inventory: The South Course

The south course, my area of focus, is much like the rest of the range: it has been planted with many eucalyptus and pine trees, as well as some poplars, junipers, and other exotic tree species. The site has a slight slope to the East and most of the water infiltrates the soil or drains to the East.

On the southern end of the South course, a narrow swale runs from target 8 to target 12. It collects water from the range's buffer zone meadow and carries water further into the park, where several vernal pools exist. Other wet spots include the trail, vehicle access, and shooting lanes. The soil in these spots is hard-packed from use and its clay content retards the infiltration of rainwater. According to a soil map from the USDA NRCS (Natural Resources Conservation Service), most of the park (and range) consists of Brentwood silty clay loam. The Brentwood series consists of well-drained silty clay loams on alluvial fans. Brentwood soils are used for irrigated orchards, row crops, forage crops, dry-farmed small grain, wildlife habitat, and recreation (USDA NRCS). A second soil type, Martin silty clay loam, consists of somewhat poorly drained silty clay loams on basin rims. It cuts across the range in a strip about 300 feet south of the entrance road. This strip widens to the East outside the range boundaries where vernal pool

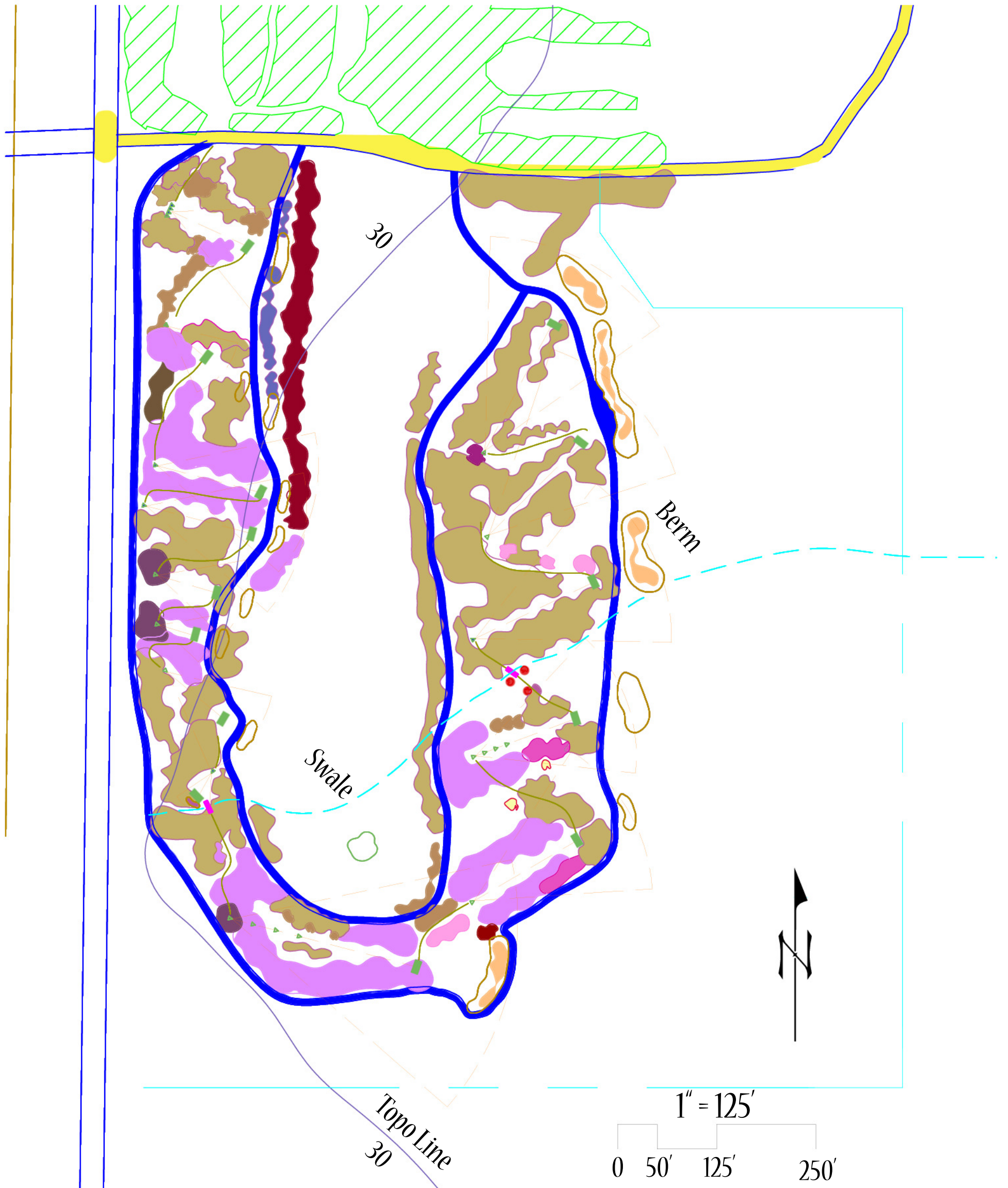
habitat exists. Martin soils are used for row crops, field crops, dry-farmed grain, wildlife habitat, and recreation (USDA NRCS).

In terms of the actual course layout, there are several features worth mentioning. Every target has an earthen berm behind it. They are too small to be full backstops by NFAA standards, so rear buffer zones exist for all of the 14 targets. Every target also has a bench near the shooting line. Trash cans and 2 bow racks (one at the shooting line and one at the target butt) have been placed at these 14 targets. The target butts consist of hay bales stacked 3 high and two wide, and are covered with black plastic sheets, a rubber mat on top which is all tied down with wire to a concrete base. Some of the individual targets are leaky at the corners of the hay bales.

Most of the vegetation on site is currently irrigated by drip lines that use water from one of 2 park wells. Most of the trees on the South course depend on regularly scheduled irrigation to survive. The larger primary well is owned by the county and the smaller well was built by the archery club. Both are situated to the north entrance road.

Electrical power comes in from the northwest from standard power lines that run along County Road 104 and connect to the central range area (clubhouse, etc.) north of the South course.

South Range: Existing Conditions



Elements

- Main Entrance
- - - Range Perimeter Fence
- ▬ Range Service Road
- ▬ Target Butt
- ▲ Target Shooting Line

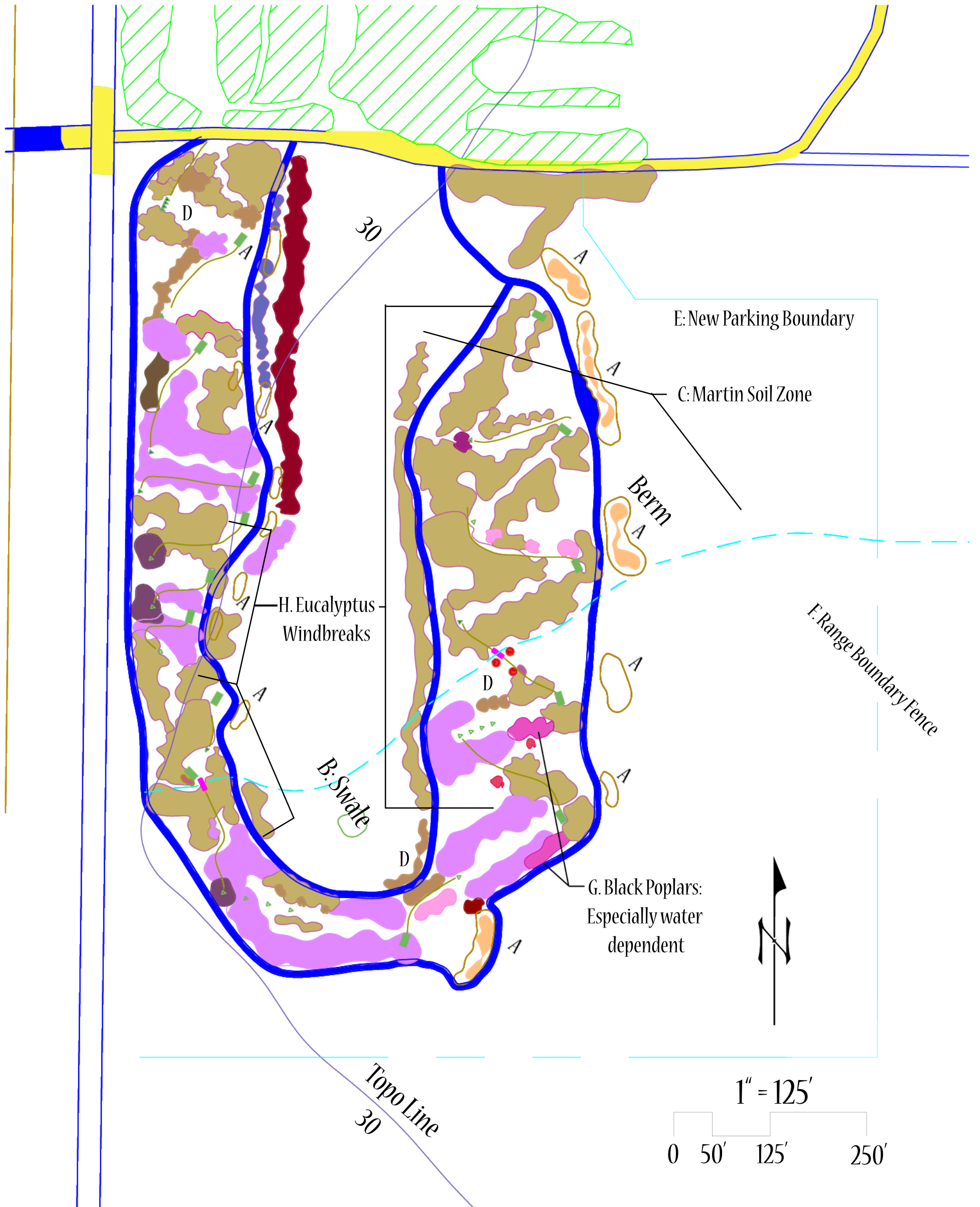
Trees

- *Abies concolor*
- *Casuarina cunninghamiana*
- *Morus alba*
- *Populus nigra*
- *Quercus lobata*
- *Aesculus californica*
- *Eucalyptus sp.*
- *Prunus cerasifera*
- *Pinus sabiniana*

Shrubs

- *Agave americana*
- *Cercis occidentalis*
- *Cortaderia selloana*
- *Nerium oleander*
- *Sylybum marianum*

Opportunities and Constraints



Opportunities

- A. Existing Berms: can become upland habitat for native species if expanded
- B. Existing swale can be improved with native vegetation and serve as a seasonal water feature.
- C. Poorer draining Martin soil could be used as a pond or vernal pool type feature.

Constraints

- D. Abundant exotic species, especially eucalyptus and oleander, are reducing chances for native reestablishment.
- E. Proposed additional parking limits range layout
- F. Existing range boundaries: restricts course layout
- G. Exotic Vegetation requires frequent well use for irrigation
- H. Difficult to establish native flora because archers rely on current species for wind protection

Redesign of the South Range

Concept

In its current condition, the South course is dominated by exotic species. Most of these plants require regular watering especially in the summer. My redesign is an attempt to reintegrate the park's grassland and oak stand habitat into the site, improve the variety of shots for the archers, and to design elements into the range that will attract other outdoor enthusiasts to the site.

I chose habitat regeneration as my first design consideration. I decided to treat the range as a distinct patch of habitat within the larger Grasslands Park ecosystem. Since the archery course needs trees and shrubs to provide shade and soften seasonal wind, it can become a densely vegetated patch that transitions to open grasslands.

Archers will benefit from the site improvements to the targets and the addition of a practice range. The course itself now has a complete field round, hunter round, and room for multiple 3D rounds. Also, a practice range in the Northeast provides a place for warming up, target style shooting and Olympic style shooting. The course layout provides a more varied walk between targets and several shots on the east side of varying topography. The course now starts closer to the range clubhouse instead in the northwest by the current park entrance.

For a general audience of outdoor enthusiasts, such as hikers, picnickers and bird watchers I have provided a trail loop and several features that will invite them to spend time on the range. Several lookouts along the trail give visitors a place to see the land both inside and outside range boundaries. They also serve as good birdwatching stops. Finally, seating and picnic areas stand off of the pedestrian trail loop for both visitors and archers to use.

Goals and Objectives

Goal 1: Improve Habitat

- A: Remove Invasive Species Milk Thistle, Exotic Grasses
- B: Remove all Remaining Exotic Species
- C: Install Native Plantings to Simulate a Patch of Central Valley Oak Woodland
- D. Arrange Course to fit into the Woodland-Grassland Matrix

Goal 2: Improve Archery Experience

- A.Design Perimeter Firebreak/Range Maintenance Access
- B.Locate Course Entrance neat Trail to Existing Archery Clubhouse
- C.Provide More Topographical Variation for High-Low Shots
- D.Program a Practice Range That Also Serves Target and Olympic Style Shooters
- E.Provide Non-linear Trails between Targets

Goal 3: Invite General Recreation

- A.Create a General Access Trail Loop
- B.Designate several Lookout Spots for Habitat and Wildlife Viewing
- C.Locate multiple Picnic and Seating Spots that serve both General Visitors and Archers

Goal 4: Implement Course Design

A. Year 1

1. Plant Southeast Course with Trees and Shrubs in future Practice Range area
2. Spray/Burn Interior Meadow of the South Course Before Spring Seeding
3. Begin Removing Oleander and Eucalyptus from Targets 1, 9, 10 and 14 v (Interior sides only)
4. Seed Interior Meadow with a combination of native grasses (see Table 3)
4. Plant new location for targets 1, 2, and 14 with Interior Live Oak, Coffeeberry, and Redberry as future windbreak (four or more years until functional)
5. Plant new location of targets 7 and 8, same species and structure

B. Year 2

1. Begin removing eucalyptus, poplars, and oleander from innermost targets on each side of course loop
2. Enlarge Berms at each target after clearing exotic species
3. Begin planting natives on new Berms
2. Continue burning and reseeding Inner Meadow as necessary
3. Replant all cleared areas with Interior Live Oak for upper story of windbreak and Coffeeberry/Redberry for lower windbreak canopy as per the new target and trail layout
4. Use Valley Oak in stands where wind protection is not critical since it is de-

ciduous

5. Plant Blue Oak to create upland habitat on the enlarged berms.

C. Year Three:

1. Continue moving outwards from center of the range with extraction of exotic plants and installment of Oaks, native shrubs, and new grasses
2. Finalize new trails as each target is moved or reoriented.

Expected Time Until Full Redesign is complete: 15 years

SOUTH COURSE REDESIGN



- | | | | |
|--------------------------------|--------------------------|----------------------------|---------------|
| <i>Aesculus californica</i> | <i>Lupinus sp.</i> | <i>Q. lobata</i> | PATH |
| <i>Cercis occidentalis</i> | <i>Pinus sabiniana</i> | <i>Q. wislizenii</i> | Expanded Berm |
| <i>Escscholzia californica</i> | <i>Quercus agrifolia</i> | <i>Rhamnus crocea</i> | |
| <i>Heteromeles arbutifolia</i> | <i>Q. douglasii</i> | <i>Rhamnus californica</i> | |
| Target Butt | Shooting Line | Target Buffer Zone | |

1" = 125'

Conclusion

Despite the design restrictions that come from necessary safety regulations, outdoor archery ranges can be diverse places that support wildlife, outdoor enthusiasts, and of course, archers. But they can serve not only as great places to visit, but also as places that can bring people and communities together through informal educational programs. Take Pasadena's archery range in California's Arroyo Seco. Every Sunday, a group of archers and craftspeople get together to promote traditional archery. They raise awareness of the natives who once hunted in the Arroyo and teach others how to make primitive bows and arrows. But the programs don't have to be about archery. If an archery range is designed successfully as a multiuse place, it will be able to support groups that can raise local environmental and cultural awareness.

Tables

Table 1

Shooting distances and Target Sizes												
ADULT STAKES				YOUTH STAKES			CUB STAKES		TARGET FACE SIZE OR GROUP			
FIELD ROUND	HUNTER ROUND	ANIMAL ROUND MAX-MIN YARDS	INTERNATIONAL ROUND	FIELD ROUND	HUNTER ROUND	INTERNATIONAL ROUND	FIELD, R HUNTER OR ANIMAL ROUND	INTERNATIONAL ROUND	FIELD ROUND	HUNTER ROUND	ANIMAL ROUND	INTERNATIONAL ROUND
35-30-25- 20 Ft	11 Yds	20-10 Yds		SAME AS ADULT	SAME AS ADULT	SAME AS ADULT	20 Ft		20 cm	20 cm	Grp 4	
15 Yds	15-14	20-10					10 Yds		35	35	4	
20	19-17	20-10	20 Yds				10	10 Yds	35	35	4	35 cm
25	23-20	20-10	25				10	10	35	35	4	35
30	28 Fan	35-20	30				10	10	35	35	3	35
35 Fan	32 Fan	35-20	35				15	15	50	35	3	50
40	40	35-20	40				18	18	50	50	3	50
45-40-35- 30	36 Fan	35-20					20		50	50	3	
45	44	45-30	45				20	20	50	50	2	50
50	48	45-30	50				20	20	50	50	2	50
55	53-48-44- 41	45-30	55	40 Yds	41 Yds	40 Yds	20	20	65	50	2	65
60	58-53-48- 45	60-45	60	45	45	45	25	25	65	65	1	65
65	64-59-55- 52	60-45	65	50	50	50	30	30	65	65	1	65
80-70-60- 50	70-65-61- 58	60-45		50	50		30		65	65	1	
FOR 15-TARGET, "300" ROUND, DELETE TARGET ROW ABOVE AND ADD THESE TWO TARGETS BELOW												
65-60-55- 50	58	60-45		50	50		30		65	65	1	
30-25-20- 15	32-28-24- 20	20-10		SAME AS ADULT			10		65	35	4	

Tables

Table 2

South Range: Current Plant Inventory

Species	Common Name	Location	Status	Misc.
<i>Abies concolor</i>	White Fir	Targets 1-3	Exotic	
<i>Aesculus californica</i>	California Buckeye	Between Targets 10 and 11	Native	
<i>Agave americana</i>	Century Plant	Target 10	Exotic	
<i>Casuarina cunninghamiana</i>	River Sheoak	Targets 9, 12, 13	Exotic	
<i>Cercis occidentalis</i>	Western Redbud	Between Target 11 and 12	Native	
<i>Cortaderia selloana</i>	Pampas Grass	Between Targets 2 and 3	Exotic	
<i>Eucalyptus</i> sp.	Eucalyptus	Targets 1-14	Exotic	
<i>Morus alba</i>	White Mulberry	Targets 5, 6, 9	Exotic	
<i>Nerium oleander</i>	Oleander	Targets 1, 2, 8, 9, 10, 11	Exotic	Toxic
<i>Pinus sabiniana</i>	Foothill Pine	Targets 1-6, 9-11	Native	
<i>Populus nigra</i> 'Italica'	Lombardy Poplar	Targets 2, 10, 11		
<i>Prunus cerasifera</i>	Purple-Leafed Plum	Target 14	Exotic	
<i>Quercus lobata</i>	Valley Oak	Targets 1, 2	Native	
<i>Silybum marianum</i>	Milk Thistle	Targets 10, 12-14 (Berm)	Exotic	Invasive

Table 2

South Range Redesign: Plant Palette

Species	Common Name	Location	Status
<i>Aesculus californica</i>	California Buckeye	Already Exist on Site	CA
<i>Cercis occidentalis</i>	Western Redbud	Already Exist on Site	CA
<i>Elymus glaucus</i>	Blue Wildrye	Grassland	Native
<i>Elymus trachycaulus</i>	Slender Wheatgrass	Grassland	Native
<i>Eschscholzia californica</i>	California poppy	Edge of Grassland and Swale	Native
<i>Heteromeles arbutifolia</i>	Toyon	Transitional along site edges	Native
<i>Hordeum brachyantherum</i>	Meadow Barley	Grassland	Native
<i>Leymus triticoides</i>	Creeping Wildrye	Grassland	Native
<i>Lupinus</i> sp.	Lupines	Edge of Grassland and Swale	Native
<i>Melica californica</i>	California Melica	Grassland	Native
<i>Nassella pulchra</i>	Purple Needlegrass	Grassland	Native
<i>Pinus sabiniana</i>	Foothill Pine	Already Exist on Site	Native
<i>Quercus agrifolia</i>	Coast Live Oak	Upland	Native
<i>Quercus douglasii</i>	Blue Oak	Upland	Native
<i>Quercus lobata</i>	Valley Oak	Fill in lowland and grassland edge	Native
<i>Quercus wislizenii</i>	Interior Live Oak	Primary Shade and Windbreak Trees	Native
<i>Rhamnus californica</i>	Coffeeberry	Along trails	Native
<i>Rhamnus crocea</i>	Redberry	Along trails	Native

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