



BEACONSFIELD CANYON PRELIMINARY CREEK RESTORATION PLAN

15 April 2010

Introduction

Cottonwood Creek (Sausal Creek Watershed) flows through Beaconsfield Canyon in the Oakland Hills. The creek flows partially in a storm pipe and partially in a parallel, unstable channel. The restoration objectives for Cottonwood Creek in Beaconsfield Canyon are to remove the storm pipe and create a revegetated and geomorphically stable creek channel and riparian floodplain.

Friends of Sausal Creek (FOSC) has requested that Restoration Design Group (RDG) prepare a preliminary restoration plan for the 500 foot reach of Cottonwood Creek in Beaconsfield Canyon Park. This preliminary restoration plan will serve as the basis for stakeholder coordination and the acquisition of funds for restoration designs and implementation. The document includes a brief, preliminary creek and watershed assessment, concept-level channel restoration and re-vegetation strategy, and estimates of the magnitude of cost of implementation. The State Coastal Conservancy generously provided the funds for this preliminary phase of design activity.

Study Methods

RDG reviewed USGS topographic maps and aerial photographs to identify the drainage basin for Beaconsfield Canyon. We calculated the drainage area, estimated the percent of urbanization and channelization, and toured the watershed to examine significant watershed conditions that could cause impacts to a restored channel at Beaconsfield Canyon. Using the Rantz regression equation, we estimated storm discharges and bankfull or channel forming discharges.

RDG surveyed four cross sections and a long profile to identify existing conditions in the project reach. RDG surveyed two more cross sections upstream of the project reach. These two additional surveys serve as reference reaches that offer insight into appropriate channel dimensions for the design reach. RDG plotted the sections and profiles for analysis. Cross sections in the project reach serve as the basis for design development.

Preliminary Watershed Assessment

Cottonwood Creek flows through Beaconsfield Canyon, a 4.2 acre city-owned park in the Oakland Hills. Cottonwood Creek is a tributary of Cobbledick Creek which flows into Sausal Creek.

Cottonwood Creek in Beaconsfield Canyon drains approximately 0.13 square miles or 80 acres from a high point of approximately 1,500 feet to a low point at the storm drain inlet of approximately 950 feet (See map below). The watershed above Beaconsfield Canyon

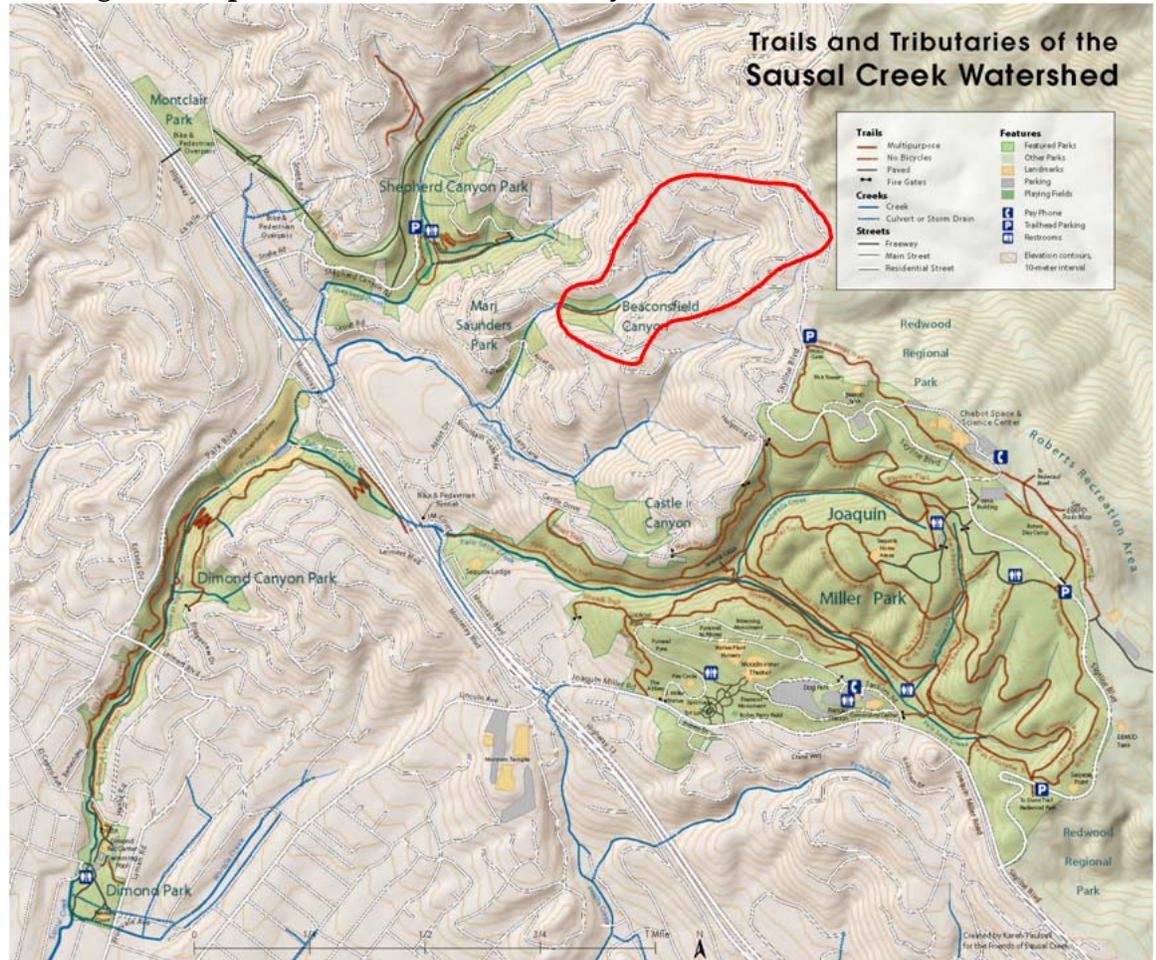
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is primarily single family residences, roads, and culverted stream crossings. Average precipitation in the area is 28 inches per year.

Drainage Area Upstream of Beaconsfield Canyon

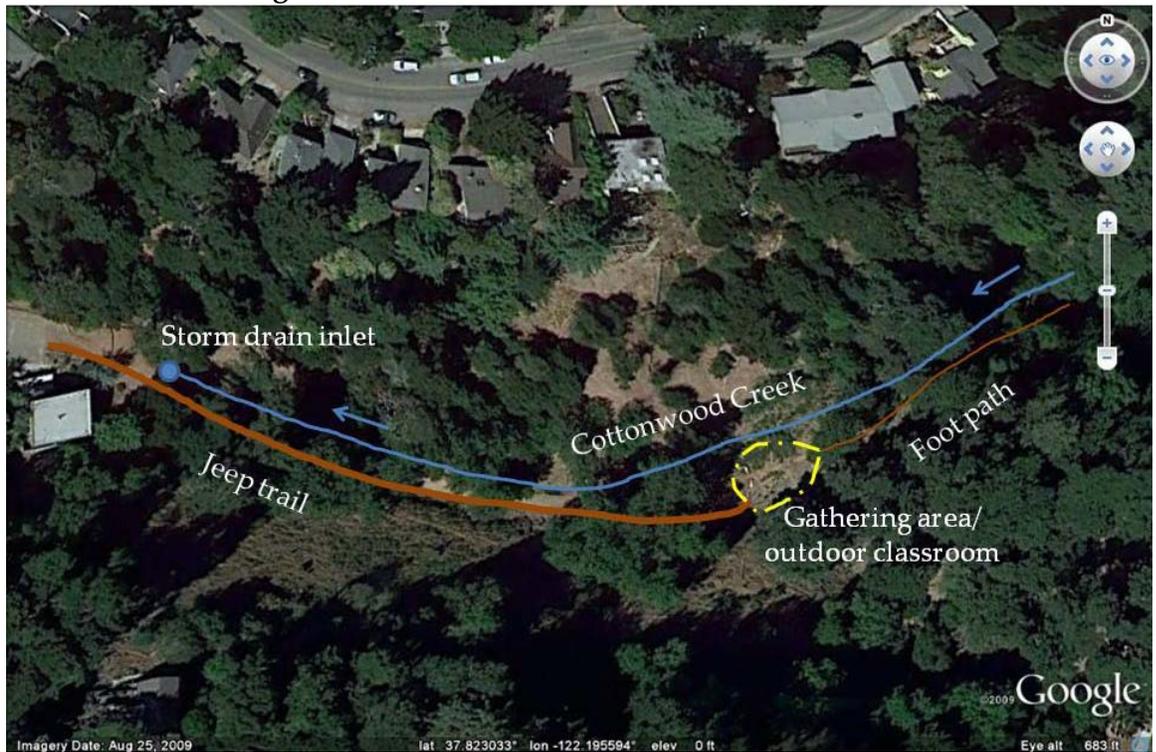


(Map courtesy of Friends of Sausal Creek)

Beaconsfield Canyon is a moderately confined canyon with black cottonwoods along the stream channel. Friends of Sausal Creek and other parties have been managing the vegetation to remove invasives, promote native vegetation, and reduce fire risk.

The downstream end of the project reach is an eroding storm drain inlet. The project reach extends upstream approximately 500 feet to the point where the canyon narrows.

Schematic of Existing Site Features



RDG estimated discharges for the 1.5, 2, 5, 10, 25, 50, and 100- year recurrence intervals using S.E. Rantz, U.S. Geological Survey. The 1.5 to 2-year flow event typically serves as the channel forming or bankfull channel discharge. Flows of this magnitude tend to have enough stream power to move sediment and occur frequently enough that over time they are most responsible for the channel form.

RDG assumed a drainage area of 0.13 mi², annual precipitation of 28 inches, less than 30% impervious surfaces and 15% of channels in sewers or culverts. The table below lists the flow estimates.

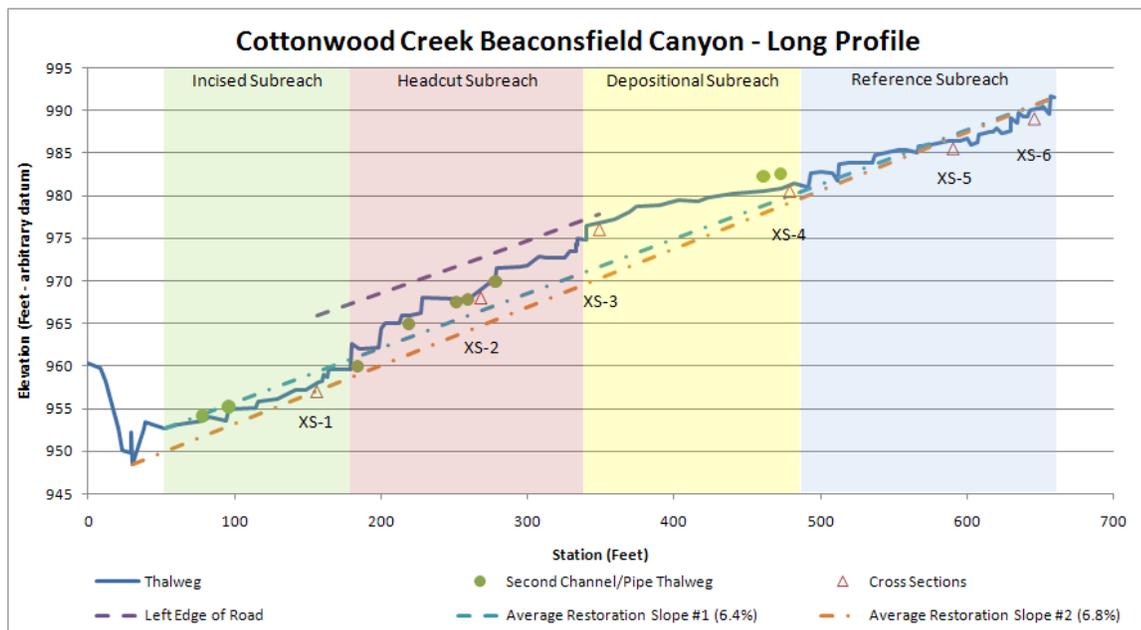
Estimated Discharges on Cottonwood Creek at Beaconsfield Canyon

Recurrence Interval (years)	Estimated Discharge (cfs)
1.5	7
2	11
5	22
10	31
25	44
50	81
100	102

Survey Results

Longitudinal Profile

The figure below displays the results of the longitudinal profile through both the project reach and the reference reach that extends upstream.



The average slope of the surveyed profile from the most upstream point of the survey to the end of the defined channel (approximately 20 feet upstream from the storm drain inlet) is 6.4%.

The surveyed profile can be divided into four subreaches: (upstream to downstream) reference; depositional; headcut¹; and incised.

The **reference subreach** extends from the upstream extend of the survey (6+60) to the point at which the canyon widens slightly (4+82). The subreach is characterized by in-channel woody debris, root structures, and vegetation that provide habitat structure and a step pool sequence. The average slope through the reference reach is 5.6%.

The **depositional subreach** extends from the widening of the canyon (4+82) to the first major headcut (3+40). The depositional reach is characterized by a flat depositional area with little to no large woody debris. The depositional feature begins where the stream debauches from the confined canyon. The widening of the canyon and the diversion of some of the water into a storm pipe reduce the creek's capacity to transport sediment. Through the lower half of the subreach the channel is poorly defined. The average slope through the depositional reach is 3.6%.

¹ A headcut is a sudden change in the elevation of a stream channel.

The **headcut subreach** is by far the steepest in the project area. It extends from the location of the most upstream headcut (3+40) to the most downstream major headcut (1+79). Average slope through the headcut reach is 11%. The subreach is characterized by a series of headcuts migrating upstream and reworking the foot of the canyon depositional feature. The reach is vegetated by black cottonwoods. These cottonwoods provide some stability but some are leaning severely suggesting that the headcuts are undermining the roots of the trees. The subreach is also characterized by a bi-furcated channel and rusty storm pipe that complicate channel formation and stability.

The **incised subreach** extends from the base of the most downstream of the major headcuts to the flood berm just beyond the storm drain inlet. The reach is characterized by a reduction in slope and a channel that runs alongside an abandoned storm pipe and other remnant infrastructure, such as a concrete “wall”. The defined channel ends approximately 20 feet before the storm drain inlet. The inlet is deteriorating (see photo below).

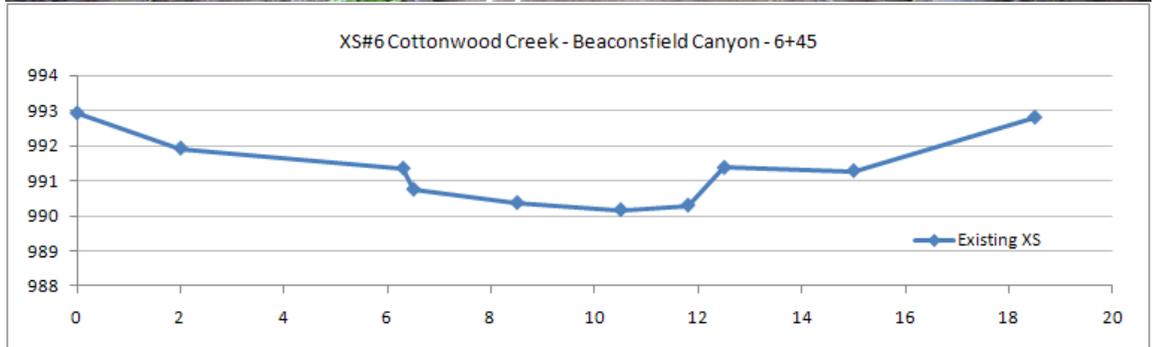


Reference Reach Cross Sections

RDG surveyed two cross sections upstream of the project area. The canyon is slightly more confined and the drainage area is slightly smaller than within the project area, but these can still provide valuable insight for designing restoration in the project area.

In the steep and urbanized setting of the Oakland Hills, it is challenging to locate reference reach cross sections that match project reach characteristics such as drainage area, valley slope, land cover, intensity of urbanization, and extent of upstream channelization. For this reason, RDG chose the reference sites in the relatively stable reach immediately upstream of the project area.

Cross Section #6 – 6+45 (Reference Subreach)

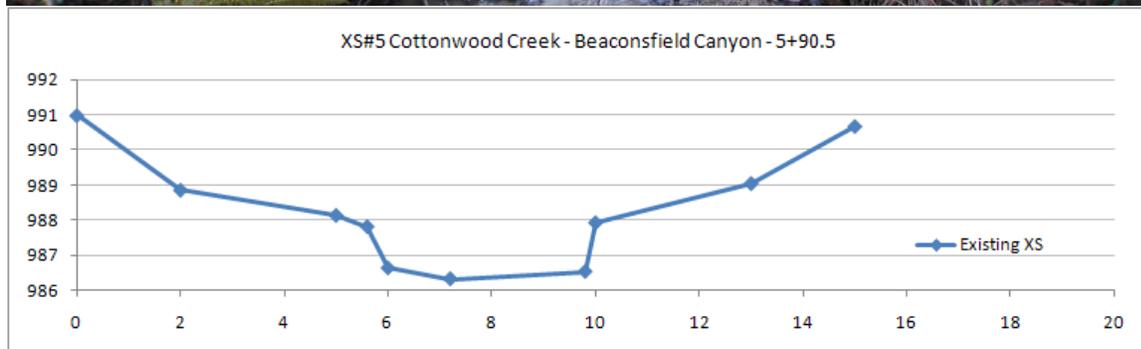


Cross section #6 is the upstream most cross section in the surveyed reach. It and cross section #5 serve as references for cross sections #1-#4 in the project reach further downstream.

The local stream gradient is 8%. The bankfull channel at cross section #6 is approximately 6 feet wide by 1 foot deep with a cross-sectional area of 5.7 square feet.

An abundance of in-channel woody debris serves as both structural habitat and grade control creating a step pool sequence through the subreach.

Cross Section #5 – 5+90.5 (Reference Subreach)

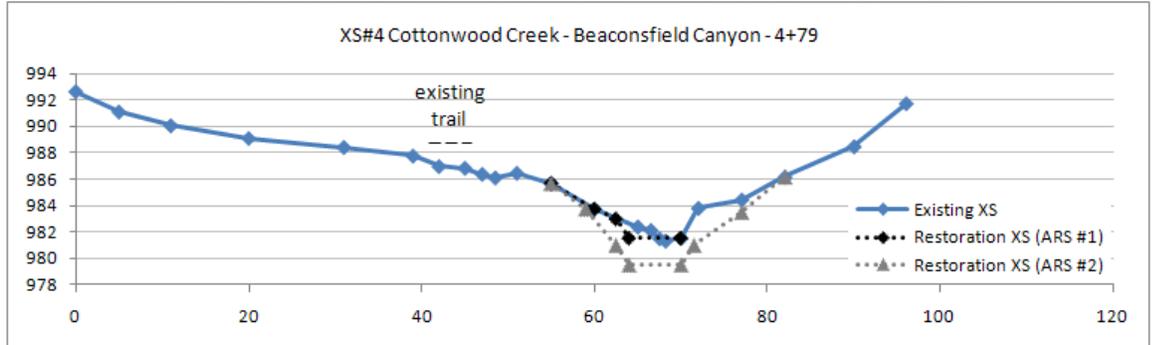


Cross section #5 is upstream of the project reach. The local stream gradient is approximately 3.9% and the canyon is slightly more confined than the downstream project reach. The bankfull channel is a little less than 4 feet x 1.5 feet with a cross sectional area of 5.6 square feet. The reach is characterized by a step-pool/plane bed sequence and in-channel vegetation and large sediment providing grade control.

Project Reach Cross Sections

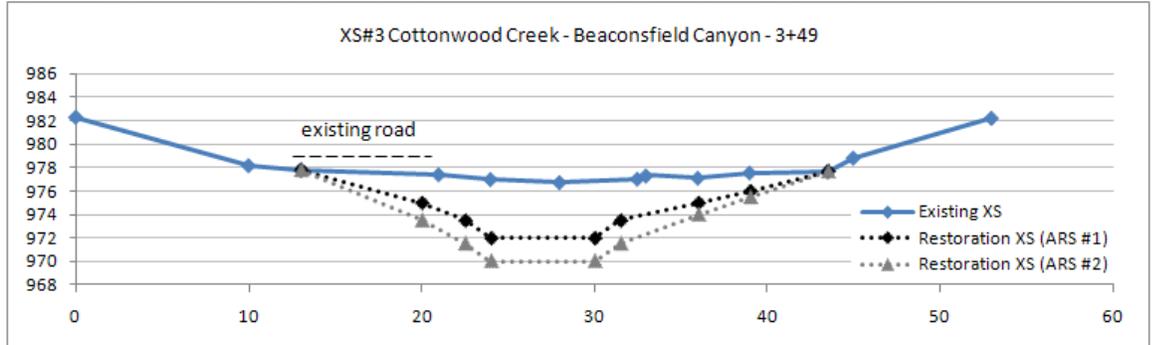
RDG surveyed four cross sections in the project reach. Included in the plots are restoration cross-sections labeled ARS #1 and ARS #2. The restoration cross-sections are included to assist in determining the amount of excavation and off-haul required to restore the creek to a more natural gradient (discussed later). The actual restored cross-sections will be much more complex and determined in later stages of design.

Cross Section #4 – 4+79 (Depositional Subreach)



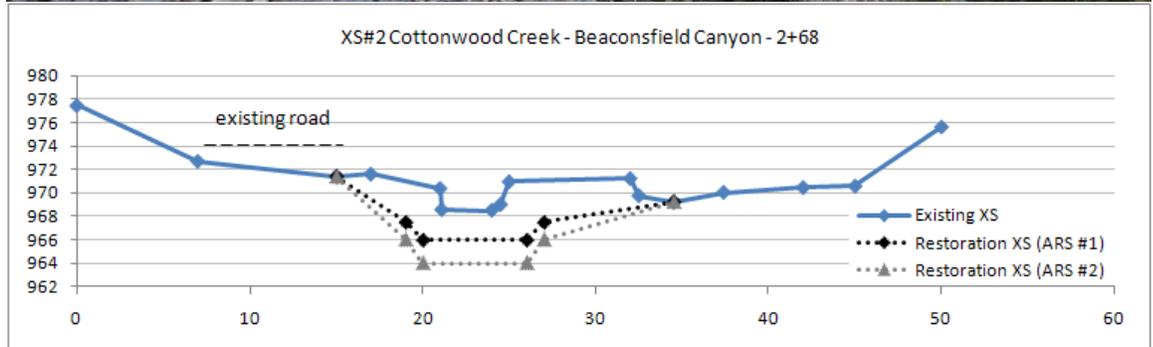
Cross section #4 is at the upstream end of the project reach and immediately downstream of the reference subreach. Cross section #4 is at the upstream end of the relatively gradual depositional subreach (3.6%). The left side of the surveyed cross section is a small, intermittent tributary that drains a southern sub-basin of Beaconsfield Canyon. The abandoned storm pipe remains along the right side of the channel, diverting water. No trees grow along the channel.

Cross Section #3 – 3+49 (Depositional Subreach)



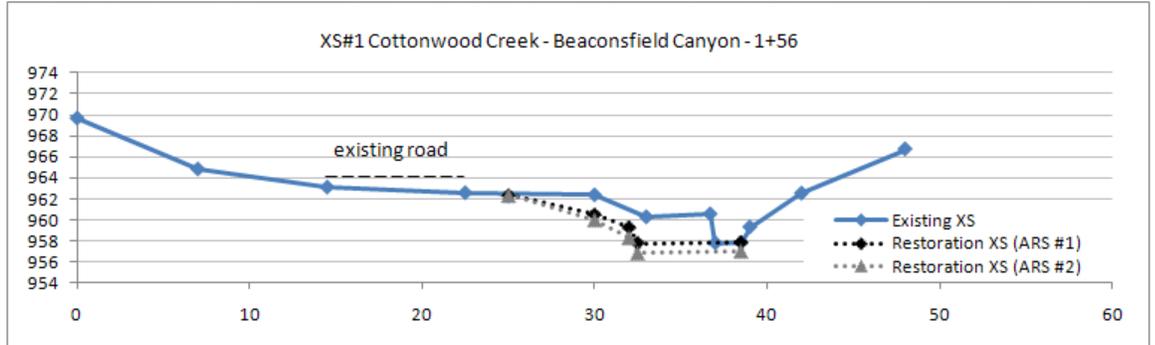
Cross section #3 is at the downstream end of a relatively flat subreach. The local slope is 3.6%; the least steep of all reaches in the surveyed profile. The channel is poorly defined and characterized by multiple, small distributary channels, common in streams with excess sediment deposition. No trees grow along the channel or floodplain.

Cross Section #2 – 2+68 (Headcut Subreach)



Cross section #2 occurs in the steepest subreach of the surveyed profile. The local slope through this subreach is almost 11%. The subreach is characterized by steep headcuts, a bi-furcated channel and exposed storm pipe. Black cottonwoods grow between the two channels and on the right bank. Some of the cottonwoods lean over the channel suggesting that the channel erosion is undermining tree stability. The steep headcuts indicate that the creek is actively re-working and eroding into the depositional feature that occupies the canyon floor.

Cross Section #1 – 1+56 (Lower subreach)



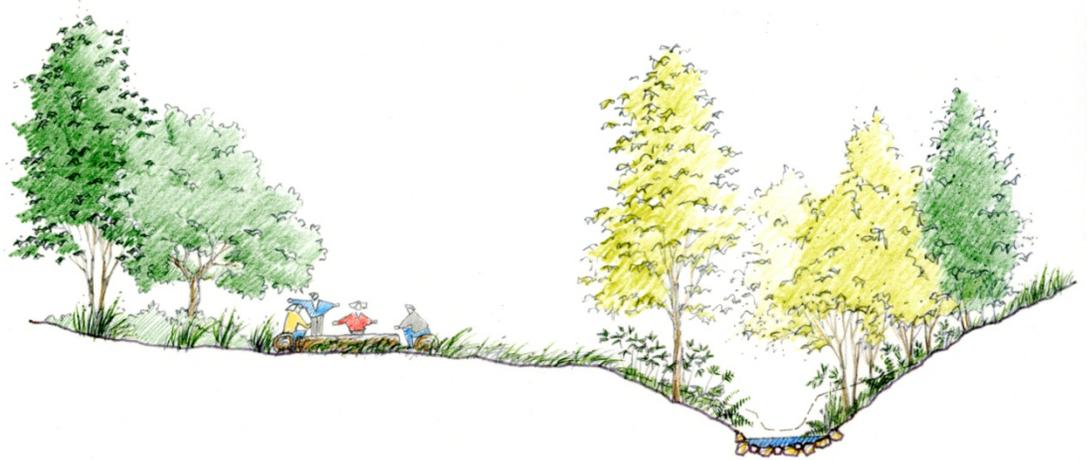
Cross section #1 is the lowest of the six cross sections. A small concrete “wall” forms the left bank of the low flow channel. A disconnected storm pipe is imbedded into the right bank. Trees grow on the hill slopes but not in the channel or floodplain. The localized slope is 5%, less than the average slope for the entire surveyed profile.

It appears that cross section #1 is in a subreach of creek where the channel has eroded through the excess deposition in the canyon floor.

Preliminary Restoration Plan – Issues and Recommendations

The headcuts, incised reaches, and loss of channel definition indicate that Cottonwood Creek is out of equilibrium. The strategy for restoration in Beaconsfield Canyons should be to recreate an equilibrium condition that transports sediment through the system and stabilizes the creek allowing for long-term establishment of riparian vegetation.

Restoration design should also accommodate a trail and outdoor classroom at the site. Plan view depiction is attached to the end of this document.



Summary of Preliminary Restoration Plan

The Beaconsfield Canyon restoration project will remove the abandoned pipe and other infrastructure from Cottonwood Creek and restore a stream gradient with an average slope of 6.4 to 6.8%. The dominant stream morphology will be step-pool. Steps will be formed by imported rock and onsite and imported large woody debris anchored into the banks. The cross sectional area of the initial bankfull channel will be approximately 6 to 9 square feet (varying around a cross section of 6' x 1.5'). Riparian plantings of fast-growing willow and black cottonwood will focus on providing root structure that will stabilize the stream gradient over the long term. A more diverse assemblage of riparian plantings will provide the foundation for the long-term successional riparian community. Soil bioengineering will stabilize unstable canyon slopes above the banks of the creek. The 8' wide Jeep trail alongside the creek will be replaced with a 2'-4' path. The project will enhance the outdoor classroom area and a footbridge will traverse a small tributary near the upstream end of the project reach.

The sections below explain the details and reasoning of the restoration approach.

Removal of Pipe and Other Infrastructure

The longitudinal profile survey reveals two primary factors destabilizing this reach of Cottonwood Creek. The first, obviously, is the remnant abandoned infrastructure; pipes and concrete. These features alter the way water and sediment are transported through

the reach and prevent the creek from forming a stable bankfull channel. The eroding inlet and flood berm further complicate natural stream function in the lower reach.

The primary restoration objectives for Cottonwood Creek in Beaconsfield Canyon Park are to remove the rusty storm pipe and create a revegetated and geomorphically stable creek channel and riparian floodplain. Removing the pipe and restoring a geomorphically stable creek are not separable objectives. Removing the pipe alone would further destabilize the channel. It will leave a linear gap parallel to the channel that is, in places, lower than the thalweg² of the existing parallel channel. In the incised subreach, the northern hillslope rests atop the pipe. Removing the pipe may destabilize this portion of the hillslope some. Once the pipe and other infrastructure are removed, the stream and some of the hillslopes will require regrading and reforming to transform it into a geomorphically stable channel.

An active sewer line runs beneath Beaconsfield Canyon. Future surveys will identify the depth and location of this sewer line and the restored creek layout will accommodate the sewer line if necessary.

Restoring an Equilibrium Stream Gradient

The second destabilizing factor is the large depositional feature in the middle of the surveyed reach. This is most easily recognized in the longitudinal profile as the “hump” that extends above the line labeled ARS #1 and extends between the depositional subreach and the headcut subreach.

Depositional features are not undesirable in steep gradient stream systems. To the contrary, depositional features are where the majority of biotic activity occurs in steep gradient systems. However, the headcuts in the headcut reach and the absence of a defined channel in the lower part of the depositional reach suggest that the feature present in Beaconsfield Canyon is unstable and has exceeded the creek’s capacity to transport sediment.

The scope of this project did not include investigations that would reveal the origin of this depositional feature. We speculate that upstream construction, paving, and culverts combined to modify the amount of sediment and the amount of stream force available during storm events, disrupting whatever equilibrium condition the stream and hillslopes had achieved. The installation of the storm drain likely diverted high flows (and energy) into the pipe that would otherwise have transported sediment through the depositional reach. In other words, the storm pipe diversion may have exacerbated the deposition in this subreach.

² The thalweg is the deepest point in a cross section of a stream channel. It tends to be the point in the cross section with the greatest velocity and stream power.

We further speculate that the mobilized sediment from upstream sources deposited in Beaconsfield Canyon and created the feature we see today. Sufficient amounts of sediment are available to overwhelm the creek's ability to transport sediment as evidenced by the lack of channel form in the lower half of the depositional subreach. Since the sediment deposited, the creek has been working to reestablish a profile slope that approaches its more natural slope angle. It does this primarily by headcutting into loose sediment as we see in the headcut reach. Any restoration plan for Beaconsfield Canyon will need to address this large, depositional feature and the channel gradients it creates.

Average restoration slopes #1 and #2 on the longitudinal profile represent two options for creek restoration. Average restoration slope #1 (ARS #1) represents the average slope between the top of the survey area and the downstream end of the defined channel. The downstream elevation is roughly equivalent to the storm drain inlet elevation. ARS #1 is the stream gradient toward which the stream has been adjusting since the inlet was installed.

Average restoration slope #2 is the average slope between the top of the survey and the invert of the downstream storm drain inlet (approximately 4 feet lower than the downstream elevation for ARS #1). ARS #2 is probably closer to the creek's natural average gradient prior to the installation of the storm drain inlet. Given the deterioration of the storm drain inlet, it may be wise to design a creek restoration that ties into the lower elevation (ARS #2).

Restoring to ARS #1 would require less excavation (lower costs). The disadvantage is that should the storm drain inlet fail, lowering the invert of the creek by four feet, a second wave of headcuts would migrate up the stream channel, jeopardizing the restoration. By modifying the storm drain inlet and anchoring the restoration to the invert elevation, we eliminate the possibility of additional headcuts. The restoration cross sections below show restoration at both average restoration slopes.

Using an average restoration slope does not imply that the restored creek will have a consistent gradient through the project area. As it does in the reference subreach, the thalweg of the restored creek will vary around the average slope. It is possible that further site investigations or excavations will reveal layers of bedrock beneath the stream that may dictate stream gradients in subreaches of the project area. Similarly, future surveys will identify the depth and location of the functioning sewer line beneath Beaconsfield Canyon. The sewer line may be deep enough to be inconsequential to the design or it may act as a design constraint on subreach stream gradients.

Step-Pool Sequence

In its equilibrium form, a creek with a gradient of 6.4% or 6.8% will most likely organize itself into a step-pool sequence. Step-pools channels have "steps" comprised of wood, roots, rocks, bedrock, or other clasts with intervening pools filled with finer grain

sediments. Pools are typically 1 to 4 times as long as the channel width. Cottonwood Creek exhibits this creek form in the upper end of the reference subreach and further upstream. Here, the steps seem mostly comprised of large woody debris that has fallen into the channel, roots across the channel, and rocks.

The local stream gradient may vary slightly, leading to varying stream forms in some subreaches, but the dominant stream morphology of the restored project reach will be step-pool. The size, height, spacing, and material composition of these step-pools will need to be determined later in the design process.

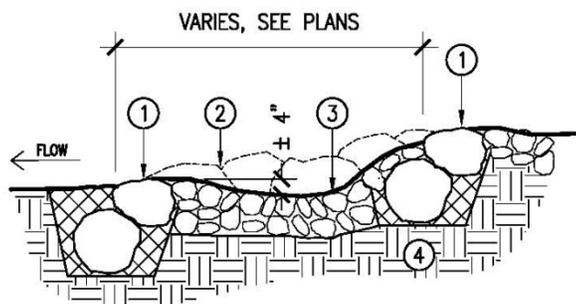
The bankfull cross sectional areas for reference cross sections #6 and #5 are 5.7 and 5.6 square feet respectively. The bankfull widths vary between 4 and 6 feet wide and the bankfull depths are between 1 and 1.5 feet deep. Downstream in the project reach, the drainage area is slightly larger. Designing bankfull channels that are slightly oversized is advisable as it allows the restored channel to capture passing sediment and form its own channel. For this preliminary restoration plan, we have sized the restoration cross sections at approximately 6 feet wide by 1.5 feet deep with bank slopes of 1:1. Width to depth ratios will vary in final design based on the cross sections relative location in any given step-pool. For example, cross sections near the base of the step will be deeper and cross sections near the top of the step will be shallower. The preliminary dimensions given here are mostly for the benefit of calculating excavation and off haul amounts.

The restoration cross sections above are drawn directly below the existing cross sections. Further design will place these cross sections laterally (left and right) so that they preserve the trail, avoid destabilizing the canyon slopes, achieve the desired stream gradient, and, if necessary, accommodate the existing sewer line or other infrastructure.

Examples of restored step-pools can be found nearby on Baxter Creek at Pointsett Park in El Cerrito and East Alamo Creek near San Ramon. Restoration efforts have used rocks, buried logs, and combinations of materials. Step-pool restoration in Beaconsfield Canyon would most likely use logs and rock material to create and anchor the initial steps.

Step-pool restoration design detail

- ① GRADE CONTROL, TOP OF GRADE CONTROL TO MATCH DESIGN CHANNEL ELEVATION AT CENTERLINE. SEE GRADE CONTROL DETAIL FOR ROCK SIZING, KEYING AND REQUIRED SIDE SLOPE TOWARDS CHANNEL.
- ② TOE ROCK WITH POLES, INTEGRATE WITH GRADE CONTROL ROCK AT CHANNEL EDGE, PER O.R. DIRECTION IN FIELD.
- ③ STEP-POOL COBBLE, 16" MIN. DEPTH.
- ④ SUBGRADE



Excavation and Off-haul

The biggest cost in most creek restoration projects is usually excavation and off-haul. Cross sections 1-4 above show restored cross sections at both average restoration slopes (6.4% and 6.8%). Cross sections 2 and 3 would require the most excavation to reach the equilibrium slope. Cross section 2 would require 1.5-2.5 cubic yards per linear foot of excavation. Cross section 3 would require 3-4.5 cubic yards per linear foot. The range is dependent on which average restoration slope is selected.

In total, restoration to an equilibrium stream gradient along 500 feet of Cottonwood Creek in Beaconsfield Canyon would require excavation and off-haul of 600-1000 cubic yards.

Revegetation and Soil Bioengineering

Soil bioengineering employs live plant materials, often fast growing plants like willows, to control erosion, stabilize stream banks, and provide wildlife habitat.

Restoration to an equilibrium stream gradient in Beaconsfield Canyon will sacrifice the black cottonwoods growing near the channel. If desired, these cottonwoods could be reused to provide steps in the step-pools. Much like willows, black cottonwoods can regenerate from roots, shoots, and fragments. The black cottonwoods can be harvested, prepared, and reused to provide structural stability to the newly restored channel.

The planting strategy will be to secure and stabilize the creek channel with relatively fast-growing black cottonwood and willow and augment these with a diverse assemblage of native riparian trees and understory plants. The roots of the willow and black cottonwood will form a sort of vegetative “sling” beneath the stream channel, providing long-term stability.

FOSC operates a watershed nursery in Joaquin Miller Park. The final planting plan will incorporate their vast knowledge of local plants appropriate for the light, soil, and moisture conditions in Beaconsfield Canyon. Below we provide a preliminary planting list appropriate for steep gradient creeks in the Oakland Hills.

Container Plants

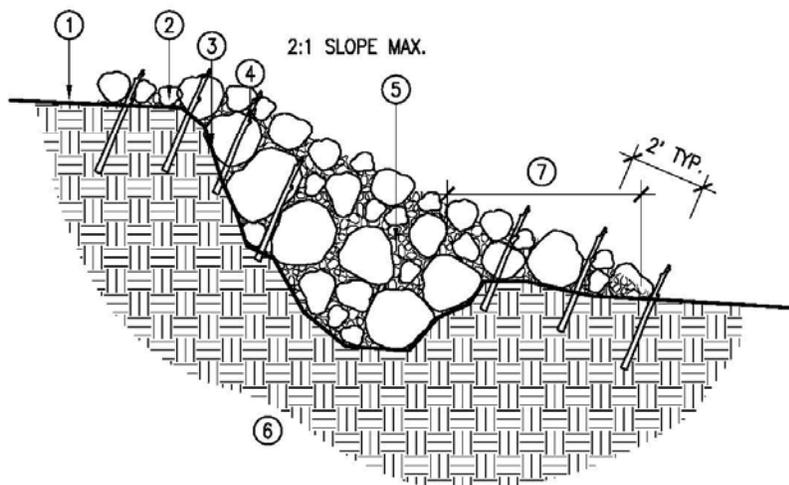
Acer Macrophyllum, Big-leaf Maple
Cornus sericea, Red-twig Dogwood
Alnus rhombifolia, White alder
Sambucus racemosa, Red elderberry
Corylus cornuta var. californica, California Hazelnut
Holodiscus discolor, Oceanspray
Juncus patens, Common Rush
Rubus ursinus, California Blackberry
Polystichum munitum, Western Sword Fern
Scrophularia californica ssp. californica, Bee Plant
Salix sp., Willow

Seed Mix

Achillea millefolium, Yarrow
Eschscholtzia californica, California Poppy
Festuca californica, California Fescue
Festuca rubra, ‘Molate’ Fescue
Hordeum brachyantherum, Meadow Barley
Iris douglasiana, Douglas Iris
Scrophularia californica ssp. californica Bee plant
Juncus patens, Spreading rush

Soil Bioengineering Detail

- | | |
|---|---|
| ① ACTIVE CHANNEL, F.G. | ⑤ BASE COURSE FILL IN VOIDS. |
| ② SELECT RIPRAP | ⑥ COMPACTED SUBGRADE |
| ③ (E) HEADCUT | ⑦ EXTEND ROCK DOWNSTREAM 5'-0"
BEYOND EXISTING HEADCUT |
| ④ SHORT POLES. MIN.
(.5) POLES PER SF. | |



Trail Changes and Amenities

Restoration of Cottonwood Creek presents an opportunity to modify the trail. Near the upstream end of the project reach, we recommend a small foot bridge to cross the intermittent tributary that enters from the south.

Currently, an 8-ft wide Jeep trail parallels the creek along almost all of the project reach. Restoration of the creek would benefit from reducing the trail to a 2-4 foot foot path alongside the creek. This would provide more room for the creek and riparian area. It is unclear whether or not the Jeep trail is necessary for maintenance of the canyon or storm or sewer infrastructure.

Cost Estimate

The table below estimates costs based on the preliminary design for Beaconsfield Canyon described above.

Description	Unit Cost	Qty	Unit	Sub-Total	Item Total
Planning, Design, Permitting					
CONSULTANT SERVICES					
Planning, Design, Engineering, Permitting	15%	1	Proj Cost	\$36,765	\$60,000
Construction Management	10%	1	Proj Cost	\$24,510	\$40,000
Subtotal for Preconstruction					\$100,000
Implementation/Construction					
STAGING					\$11,500
Dewatering	\$10,000	1	LS	\$10,000	
Construction Fencing, Utilizing Existing Fencing	\$1,500	1	LS	\$1,500	
DEMOLITION					\$26,200
Clearing and Grub	\$15,000	1	LS	\$15,000	
Demo Walls and CMP	\$210	20	TN	\$4,200	
Demo Stand Pipe	\$1,000	1	LS	\$1,000	
Haul, Recycle, Dispose of Misc. Debris	\$6,000	1	LS	\$6,000	
CHANNEL EXCAVATION					\$51,000
Excavation of new channel	\$30	900	CY	\$27,000	
Off Haul of Excess Excavated Soils	\$30	800	CY	\$24,000	
GRADE CONTROL STRUCTURES					\$4,500
Constructed Rock Riffle Starters (6)	\$150	30	TN	\$4,500	
REVEGETATION/EROSION CONTROL					\$30,400
Coir Erosion Control Fabric Installed	\$1.00	5,400	SF	\$5,400	
Revegetation Seeding	\$0.25	20,000	SF	\$5,000	
Live Stakes in Riparian Corridor	\$20,000	1	LS	\$20,000	
PLANTING/IRRIGATION					\$105,000
Container Planting Revegetation, Mulch	\$7	9,000	SF	\$63,000	
Irrigation for Revegetation and General Site	\$3	9,000	SF	\$27,000	
Irrigation Point of Connection Allowance	\$15,000	1	LS	\$15,000	
PATH and SITE FURNISHINGS					\$16,500
Soft Trail	\$20	450	LF	\$9,000	
Wooden Bridge	\$2,500	1	LS	\$2,500	
Outdoor Classroom	\$5,000	1	LS	\$5,000	
IMPLEMENTATION SUB-TOTAL					\$245,100
Planning, Design, Permitting Sub-Total					\$60,000
Contractor General Conditions					\$49,020

Conclusion/Further Studies

Preliminary restoration plans typically generate more questions than they answer. Often times, the final project looks little like what was originally conceived. The intent of this preliminary restoration plan is to serve as an initial straw proposal to focus discussion among stakeholders and reveal a path forward.

Stakeholder Discussions

In that spirit, an early next step is to convene stakeholders, discuss the implications of the findings of this plan, make decisions, and contribute additional considerations. FOSC and others have invested a considerable amount of time and effort into Beaconsfield Canyon and the restoration design should be consistent with the desires of affected stakeholders.

Pebble Counts

The preliminary restoration plan did not include scope for pebble counts. These simple field examinations would assist in the assessment of sediment sizes available for step-pool creation, sediment transport capacity of the existing channels, and other sizing and design issues.

Hydrologic and Hydraulic Modeling

A necessary step in the design process will be modeling to ensure that the restoration design is stable. To an even greater level of detail than the pebble counts, the modeling will inform design and sizing of the step-pools and other restoration morphologies.

The hydraulic modeling should also evaluate the function of the downstream flood berm and storm drain inlet to determine if these require any modification to handle the design flood flows. It may be that restoring the stream gradient to the elevation of the storm drain invert will allow for the lowering of the berm, creating a much more inviting entrance into Beaconsfield Canyon.

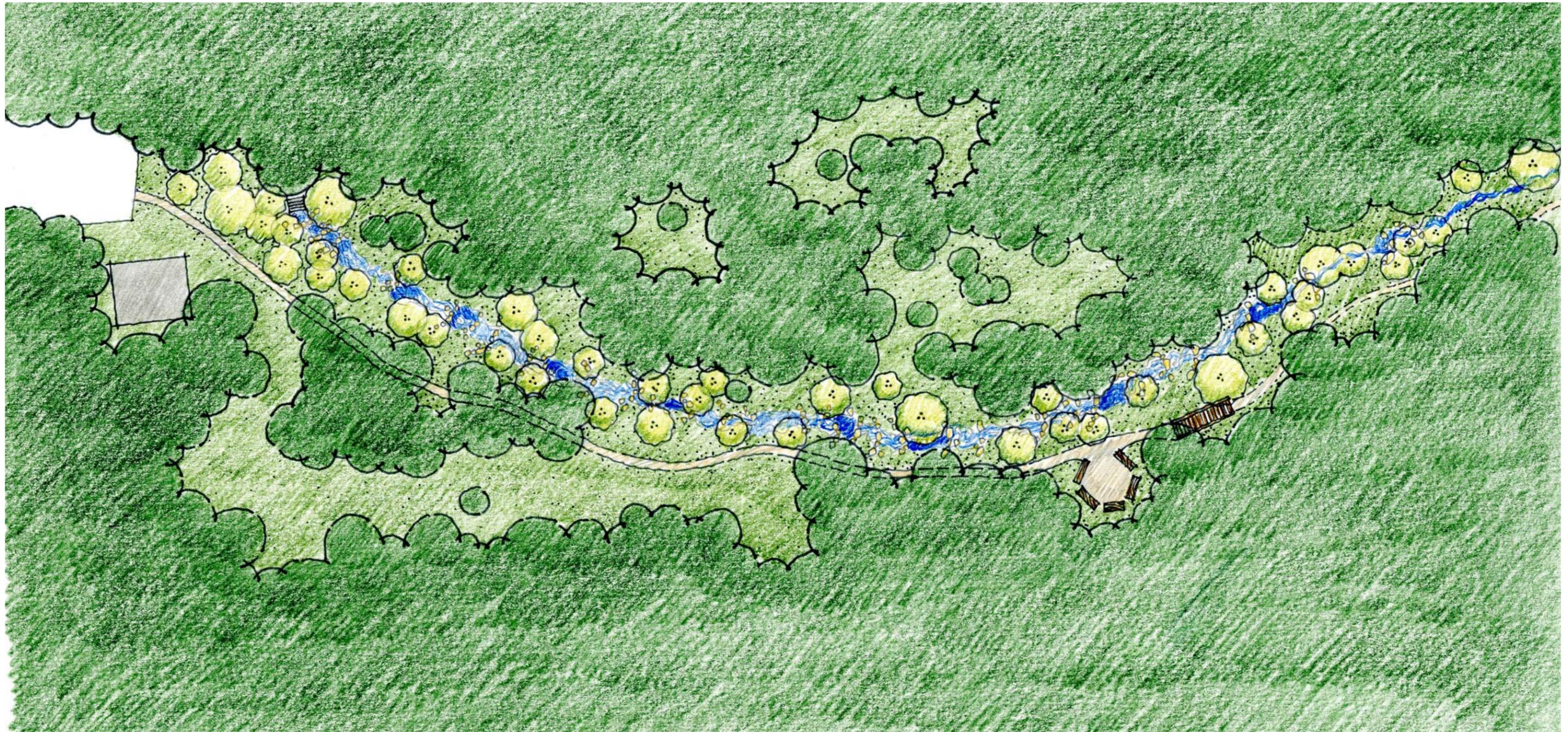
Infrastructure Constraints

The scope of this preliminary restoration plan did not include investigations into existing infrastructure in Beaconsfield Canyon that must remain. As described above, a functioning sewer line is situated beneath the stream channel. Its depth and location may or may not be a design constraint on creek restoration.

Any examination of existing infrastructure should evaluate the storm drain inlet at the downstream end of the project reach.

Geotechnical Evaluation

As mentioned previously, the northern slope in the incised subreach is perched above and on top of the abandoned pipe. Removing this pipe may cause some minor, local slope instability. A geotechnical engineer should evaluate the effects of removing the pipe and other grading or restoration activities on slope stabilities in the canyon.



Beaconsfield Canyon Conceptual Restoration Design

Plan View



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