Title

Understanding the water, understanding the canyon: establishing a baseline study of the Redwood Canyon reach of Cerrito Creek in Blake Garden

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Understanding the Water, Understanding the Canyon

ESTABLISHING A BASELINE STUDY OF THE REDWOOD CANYON REACH OF CERRITO CREEK IN BLAKE GARDEN

CAMILLE THOMA & DULCE RIVAS

Contents

Abstract

This paper establishes a cross sectional baseline of the Redwood Canyon reach of Cerrito Creek in Blake Garden to be compared with future surveys and to assist with any decision making about the area by garden staff. We created a topographic survey of the main stream channel, historical and potential side channels and tributaries fllowing from neighboring properties. While the main stream channel is stable with a low seasonal flow, water entering the property from neighboring Jessen Court is sustpected to have caused damage leading to the removal of 2 large Redwoods and has the potential to cause more damage if these tributaries continue to incise and migrate.

Problem Statement

While the southern branch of the Cerrito Creek that runs through Blake Garden has been the subject of numerous studies and reports (Ludy 2007, Behrends 2007, Greenberg 2010, Sasaki 2018 & Barrera Lopez 2019), the north branch which runs through the Redwood Canyon has been mostly overlooked. With a low seasonal flow, the channel morphology is relatively stable compared to its counterpart on the southern edge of the property and has thus been deprioritized in terms of study. With new data, it could be helpful for the Blake Garden staff to make decisions on how to make changes and address the issues of illegal water diversion from neighboring properties on Jessen Court and causing potential damage to the century-old Redwoods and the path system in that area.

This project was developed with Timothy Cole, Blake Garden Horticulturist, who oversees this area of the Blake Garden.

Site Description

The Blake Garden sits in Kensington, CA. Kensington is an unincorporated residential community within Contra Costa County on the border of the City of Berkeley within Alameda County. The property, four miles north of the UC Berkeley campus, is owned and operated by the Department of Landscape Architecture and The College of Environmental Design as a public garden, outdoor laboratory, and teaching facility. Originally planned as a ceanothus wood, the Redwood Canyon was planted by Anita Blake and Mabel Symmes around 1920. The space was transformed into a shady redwood forest with rhododendrons and other moisture-loving understory plants.

The property declines over 100 feet in elevation over a horizontal distance of 750 feet, consistent with the topography of Kensington. Serpentine Rock lies beneath much of the garden and emerges at the eastern edge of the property. On the western slope of Blake Garden, a large outcropping of Lawsonite, a mineral known only to appear along the earth's fault lines, rises twenty feet (Eischid, 1999).

The Hayward Fault runs along the garden's northeastern property line. The garden is within the Alquist-Priola Special Study Zone, a fault area defined as highly susceptible to movement. The area is also within the Blakemont Slide Zone. The Blakemont Slide Zone is 19-acre residential area that was built over many small streams in the 1940s and 1950s. The ground movement in the Blakemont slide zone has destroyed several homes in the area and damaged many more. A home directly west of Blake Garden across Highgate Road has been

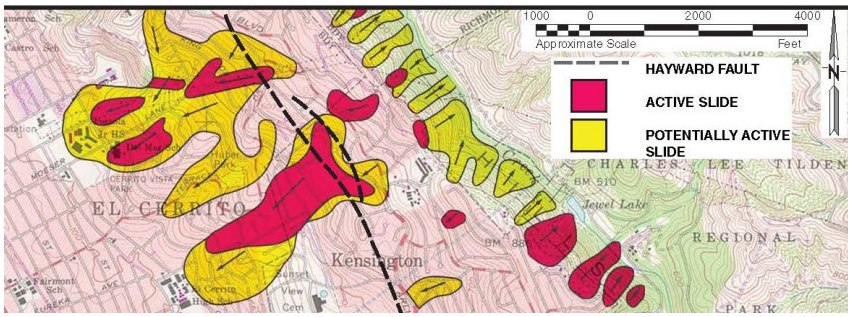

Figure 1. Blakemont Slide Zone. Image: Kropp & Associates.

condemned. The tendency for earth movement at the site forces questions as to how these particular geologic conditions might influence the shape of the stream in addition to seasonal flows and human intervention.

Julian Waeber, Phd candidate in Geological Engineering at U.C. Berkeley, installed a device at the western edge of the property in 2012 to track the landslide in the garden. The solar powered device communicates with a satellite daily to track the amount of movement of the landslide. Also installed was a USGS seismograph to monitor the Hayward fault that runs through the upper part of the garden. The device has tracked an annual slide of approximately 4mm (Interview with Timothy Cole).

Figure 2. 1947 aerial photo of Kensington with Blake Garden property indicated. Image from Blake Garden: A History of Landscape Change, courtesy Pacific Aerial Surveys, Oakland, CA

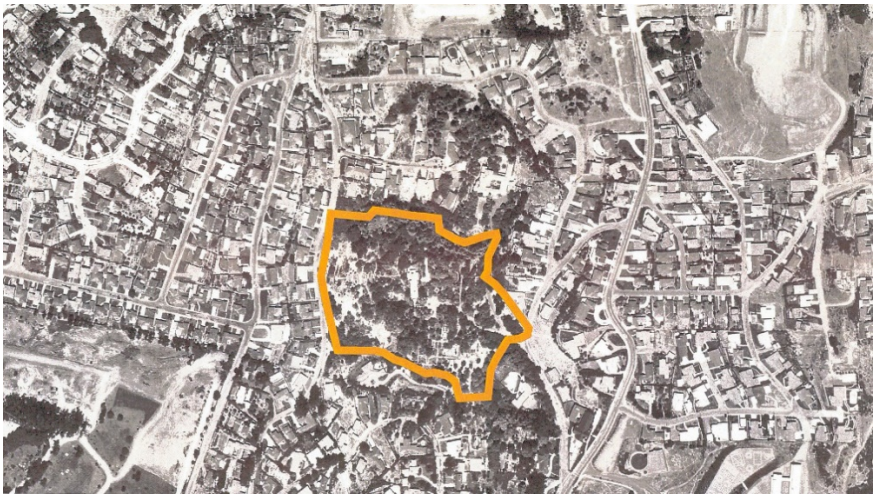

Figure 3. 1959 aerial photo of Kensington with Blake Garden property indicated. Just 12 years later, we see an enormous amount of development in the post-war period. Image from Blake Garden: A History of Landscape Change, courtesy Pacific Aerial Surveys, Oakland, CA

Figure 4. 2019 aerial image of Kensington with Blake Garden property indicated. We see just a small amount of additional development from the 1959 image. Image from Google Earth.

During the post-war boom, the town of Kensington was rapidly developed into the residential community it is today. The rolling grassland became what is now estimated at 65% impervious surfaces (Sasaki, 2019). With the addition of sewer and drainage systems resulted in the diversion of water from the Redwood Canyon reach of Cerrito Creek resulting in a reduced flow into the Redwood Canyon reach of Cerrito Creek.

The development of the property below the Carmelite Monastery into Jessen Court has affected the hydrology of the site. The properties covered existing ponds and a stream that ran into the Redwood Canyon Reach (see Figure 6. Symmes plan). In 2007 there was an unresolved conflict between the garden and neighbors over the cause and responsibility for damage associated with changes in drainage. The redirected water resulted in the loss of two Coast Redwoods (*Sequoia sempervirens*) due to water damage to their roots. (Blake Garden archive).

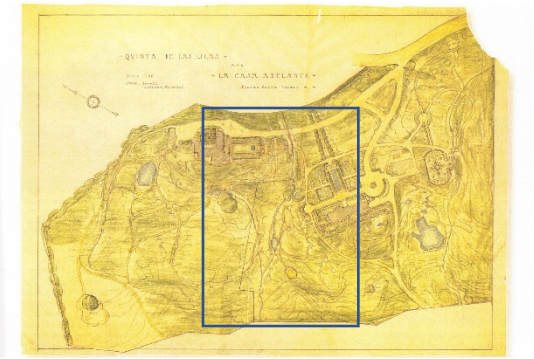

Figure 5. Mabel Symmes' drawing of the Blake Properties. Anson Blake's home (now Blake Garden) on the right and Edwin Blake's home (now the Carmelite Monastery) on the left. Drawing circa 1922. Image from Blake Garden: A History of Landscape Change, courtesy of the College of Environmental Design Archives, Blake Garden Collection.

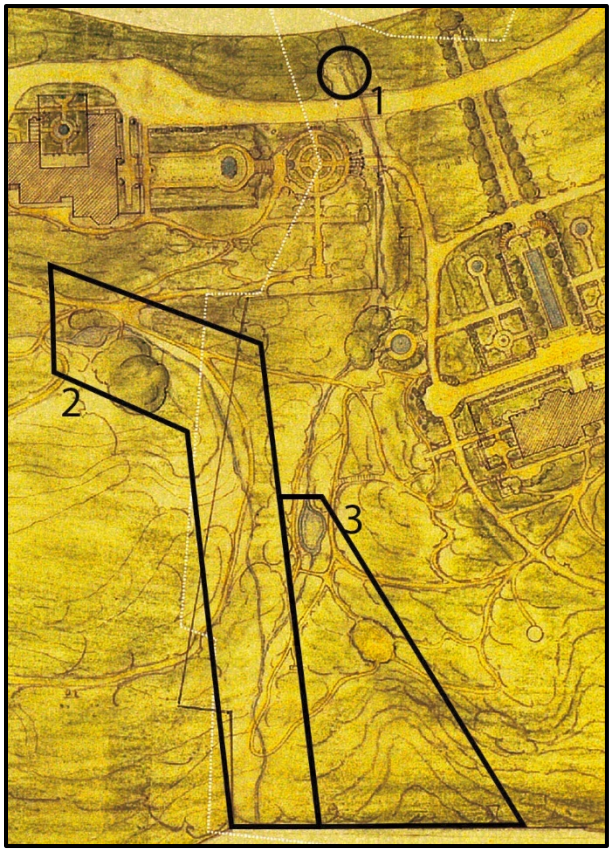

Figure 6. Inset of Symmes plan shows (1) spring above driveway that feeds the Redwood Canyon Reach. (2) The pond and stream where Jessen Court is now located. (3) The Redwood Canyon Reach formerly jogged to the northwest after the pool, where it now turns southwest.

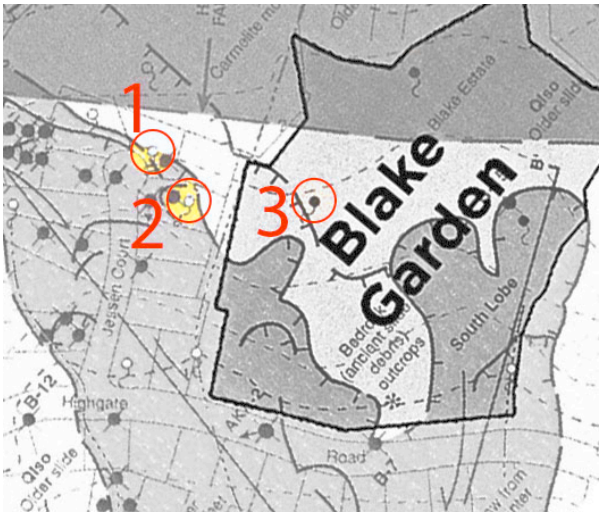

Figure 7. Geologic map of the area around Blake Garden and its slide zones also shows springs in the area. (1) and (2) are located where the ponds below what is now the Carmelite Monastery and (3) spring located approximately located of water emerging beneath Cross Section E. . Image from Blake Garden: A History of Landscape Change, courtesy of the College of Environmental Design Archives, Blake Garden Collection.

The Symmes plan (circa 1922) provides insight to the conditions of the creek prior to the Jessen Court development. In the drawing, there are two ponds below the Edwin Blake home, now the Carmelite Monastery. Those ponds drain to a stream channel that meets the Redwood Canyon Reach on the Blake Garden Property in the area west of the Redwood Canyon. The drawing also shows that the Redwood Canyon reach formerly jogged to the northwest, exiting the property closer to the northwest corner of the property along what is now Highgate Road. The creek now jogs southwest below the pool exiting the property at a culvert that leads under Highgate.

A 2002 geologic report identifies a number of springs on the site and in the neighboring Jessen Court development. These springs are the source of flow in the main channel and in the tributary channels during the dry season. This map (Figure 7) correlates with the Symmes Plan (Figure 6). The geologic report states that a diminishing water table will likely reduce the flows coming from these springs in the future.

Methods

A cross section survey is designed to create a better understanding of the watercourse of the creek. The objective of our study was to establish baseline cross sections of the Redwood Canyon reach of Cerrito Creek in Blake Garden and to be compared with future surveys and serve as reference for monitoring incision at the small tributary streams. This data will assist with any decision making about the area by garden staff. We chose to complete a series of cross sections through the portion of the creek that falls within the Redwood Canyon. Beyond the Redwood Canyon to the western fence line, the creek drops into a heavily vegetated ephemeral wetland that would have been extremely difficult to accurately survey with limited time and hands.

The goal was to complete a survey that encompassed the main creek and the area of the small tributaries originating in the area that was built over during the Jessen Court development. Fourteen section lines were spaced out perpendicularly to the creek and labeled A to K for the main channel and Tributary 1-3 for the small streams at the northern fence line (Appendix A). We selected sections that were representative of the flow changes at multiple elevations and captured areas of change between the channel and the property line. To do this all cross sections run from fence on the northern side of the property across the stream channel to a marker at, roughly, the same elevation (Harrelson, 1994). Measurement were taken at any visible change in slope and/or permanent feature (i.e. path). Cross sections were measured using a domed tri-pod (Forestry Service, Inc), level (Leitz) and a 16.5 foot surveying rod. Flags were temporarily used to mark sections and instrument stations. As a reference for future research, these temporary flags will be replaced shortly with permanent, labeled rebar markers.

Due to the current Corona virus restrictions, access to the garden and neighboring properties was limited. Following these restrictions there are plans for a longitudinal study and to measure the flows from the springs on the garden property and in the neighboring Jessen Court properties. Pebble counts were not undertaken. The stream is essentially dammed and is starved for pebbles and cobble. The stream channel is filled with leaf litter and the pools with ultra-fine sediment.

Field work took place on November 8, 15, 22, and 29, 2020, late in the dry season. The surveying team was comprised of the paper's authors and Timothy Cole, Blake Garden Horticulturist. We also had extensive conversation with Cole about the garden and his experiences observations of the main channel and tributaries.

Results

As the main stream channel is dry most of the year and receives relatively low flows in the rainy season, the channel has remained stable for many decades. The cross sections did help discern the form of the Redwood Canyon in areas with dense vegetation can obscure the topography. One such area are the low points between the channel and the fence line in sections I, J and K which appear to likely the former stream channel seen in the Symmes plan that connected the springs and ponds below the Carmelite Monastery to the Redwood Canyon reach.

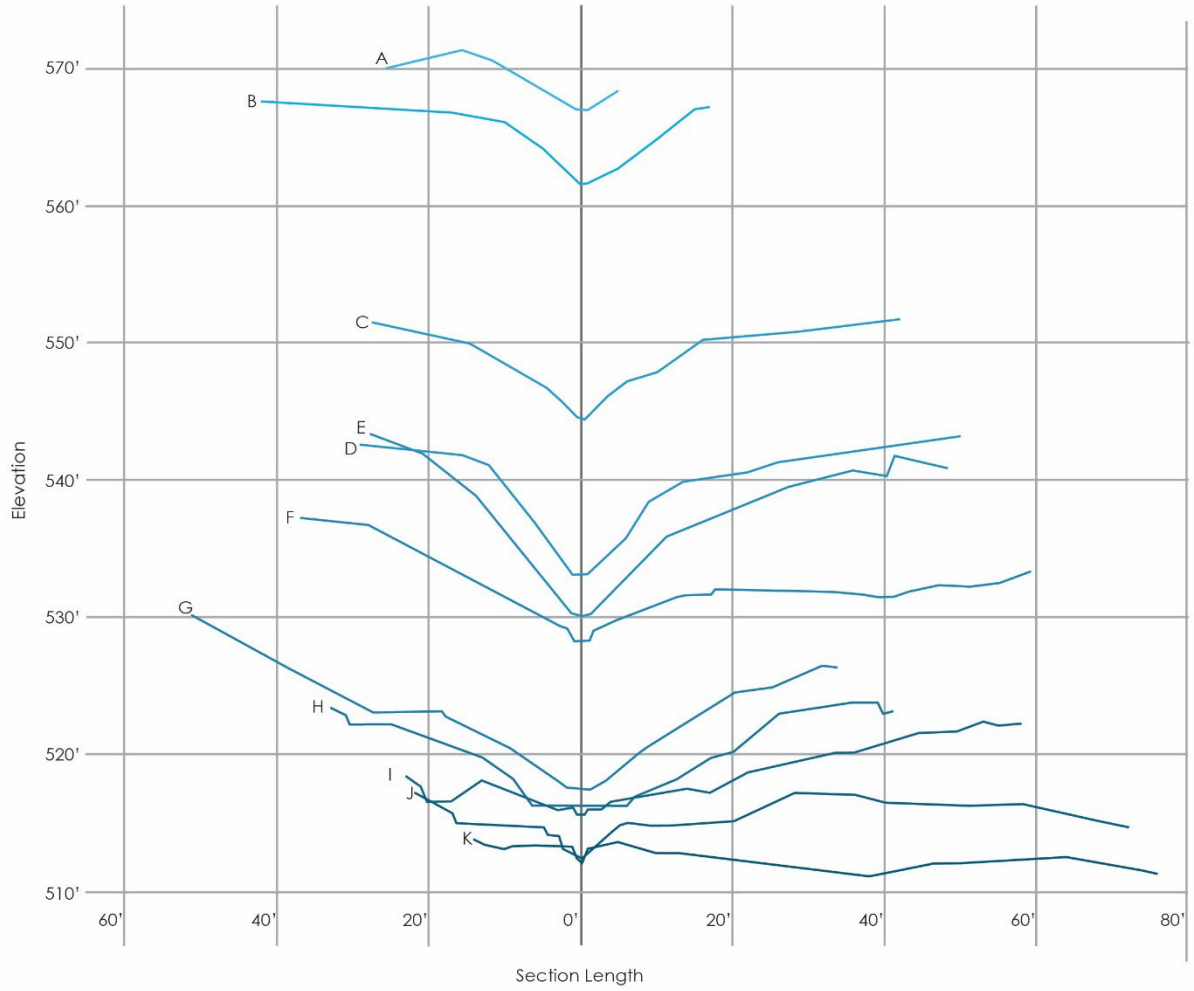

Figure 8. Compiled cross sections for main stream channel with thalwegs aligned.

The following cross sections show the small tributaries and how the water is entering the property at the fence line adjacent to 22 Jessen Court. Two streams (Trib 2 & 3) enter from the fence before merging into one stream (Trib 1) that runs into the first pool.

Cross Section Trib1 (see Appendix B for individual cross sections) shows incision of just under one foot (.8 and .95). There is undercutting along the channel, which could impact the redwood to the south of the channel if the undercutting continued and the channel migrated.

During high intensity storms, the path between station points 5-10 floods from water that is seeping under the current berms. Cross Section Trib3 shows where water moves around the trees to the low point at station point 22.. The cross section reveals how flat the slope is in this area which is difficult to discern with the eye.

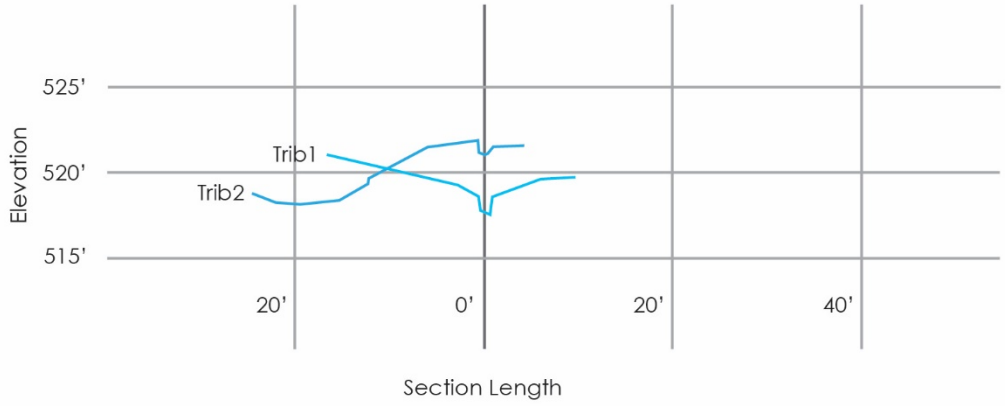

Figure 9. Compiled cross sections for Tributaries 1 and 2 which run parallel to the main stream channel.

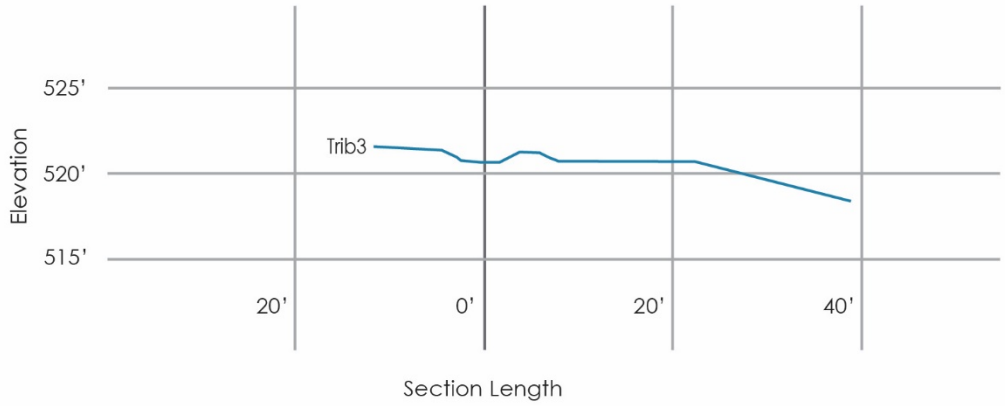

Figure 9. Compiled cross sections for Tributaries 1 and 2 which run parallel to the main stream channel.

Discussion

The cross section measurements provide valuable information about the Redwood Canyon, but further direct examination or survey on neighboring properties could locate the perennial spring sources and measure their flows, both in the dry and rainy seasons.

Garden staff will need more analysis to decide whether to armor these new channels to protect the trees in this novel ecosystem or to let the incisions continue and let the channel migrate on its own, potentially damaging other trees' roots.

Conclusion

As a preliminary study of the Redwood Canyon and its reach of Cerrito Creek, our research represents a first pass at understanding the form of the area. While the flows (Appendix D) into the creek are small relative to the major drainage on the other side of the garden, they are not insignificant and have already resulted in loss of some of the garden's beloved coast redwoods. Cross Section Tributary 1 (Figure 15), shows incision in the small but newly formed reach which threatened two more redwoods and could potentially incise, erode, and undercut more with heavy seasonal flows.

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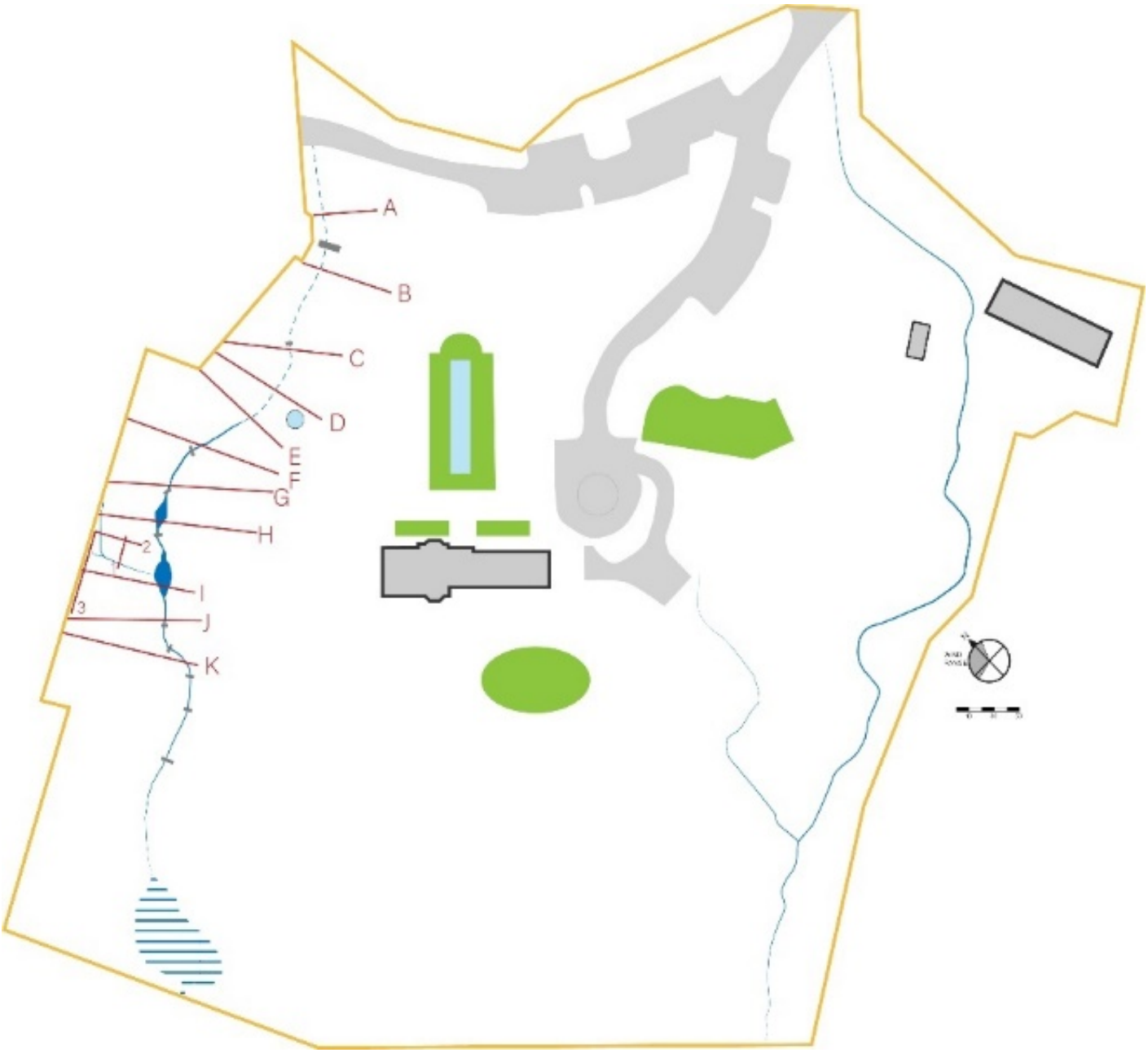
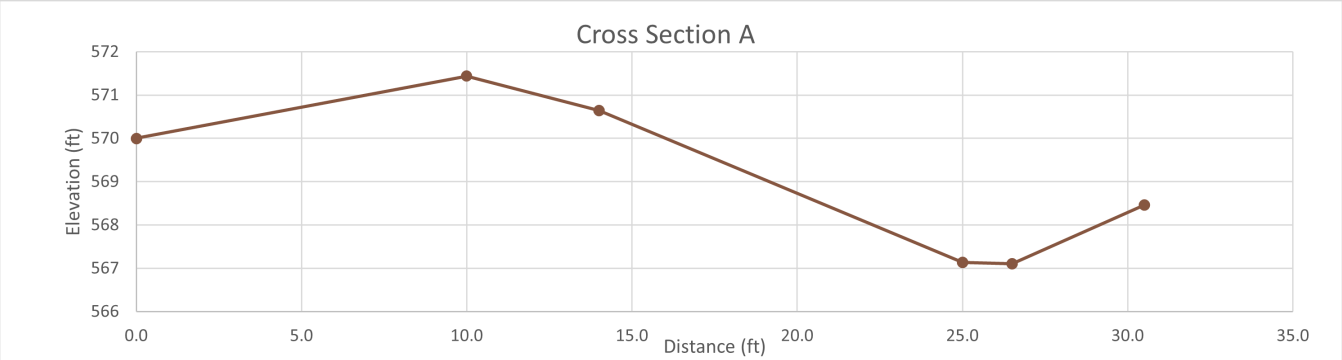
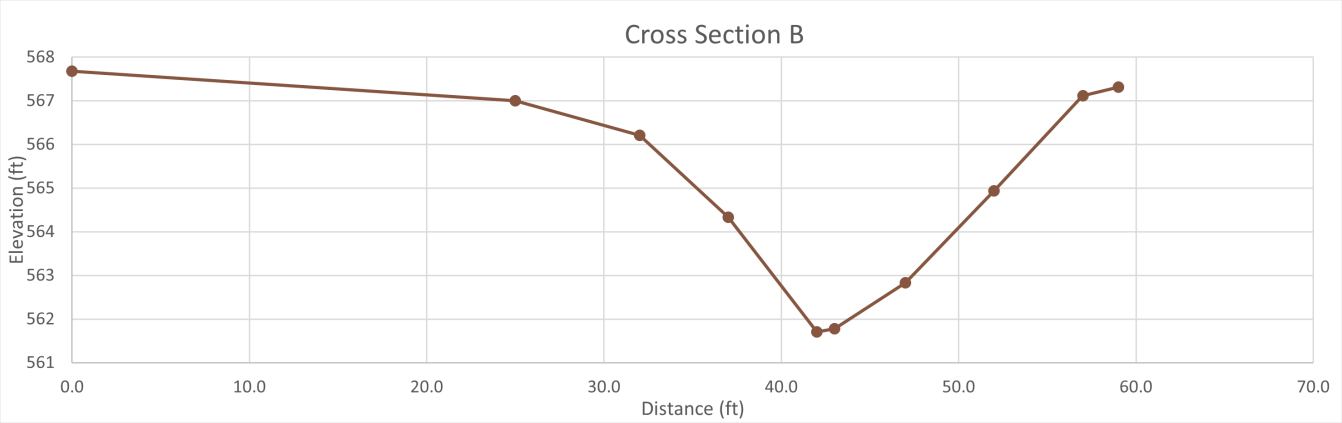
Appendix A

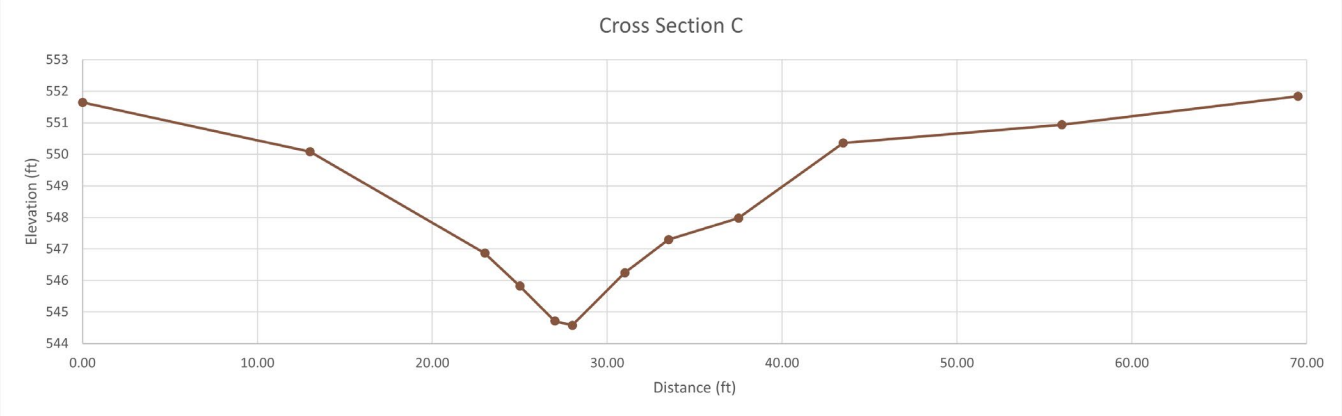


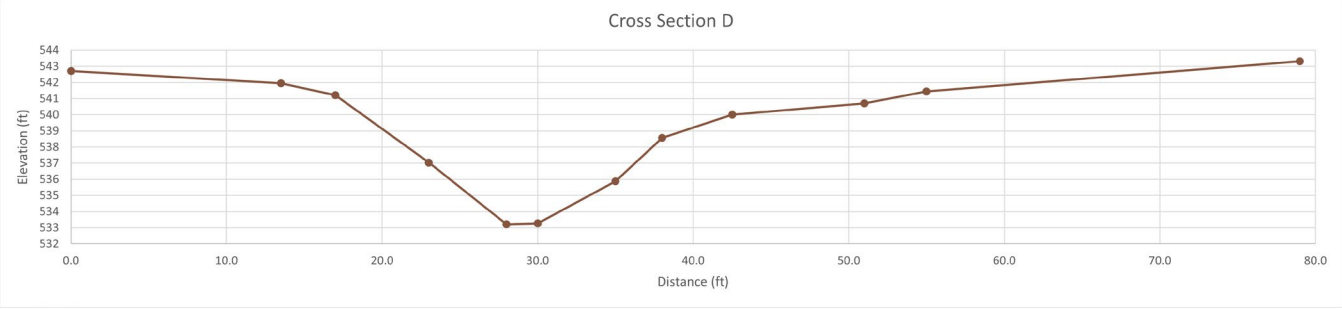
Map of Blake Garden and diagram and sections cut across stream channel.

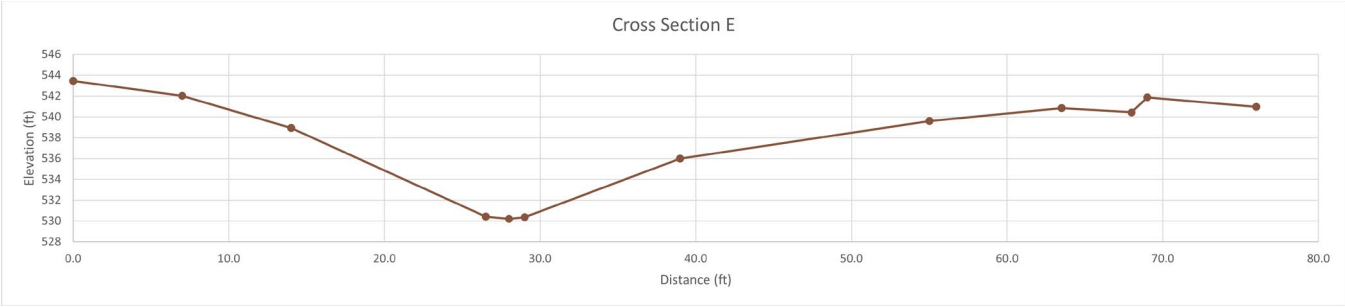
Appendix B

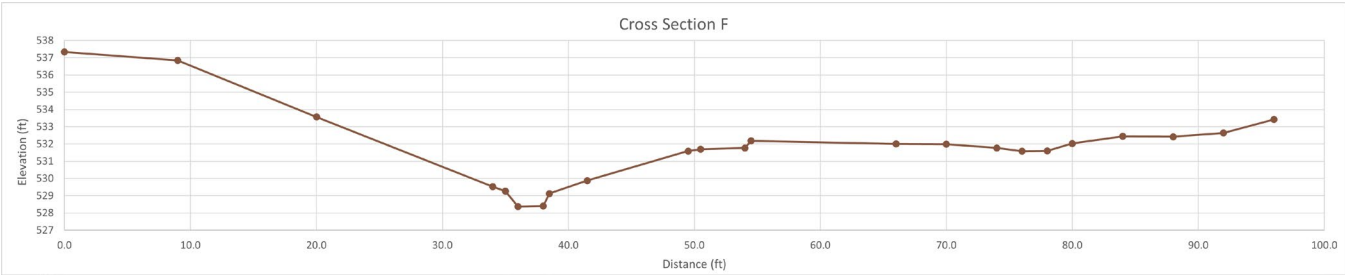

Cross Section A
Elevation (ft)
572
571
570
569
568
567
566
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
Distance (ft)


Cross Section B
Elevation (ft)
568
567
566
565
564
563
562
561
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
Distance (ft)


Cross Section C
Elevation (ft)
553
552
551
550
549
548
547
546
545
544
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
Distance (ft)


Cross Section D
Elevation (ft)
544
543
542
541
540
539
538
537
536
535
534
533
532
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
Distance (ft)


Cross Section E
Elevation (ft)
546
544
542
540
538
536
534
532
530
528
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
Distance (ft)


Cross Section F
Elevation (ft)
538
537
536
535
534
533
532
531
530
529
528
527
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Distance (ft)


Cross Section G
Elevation (ft)
532
530
528
526
524
522
520
518
516
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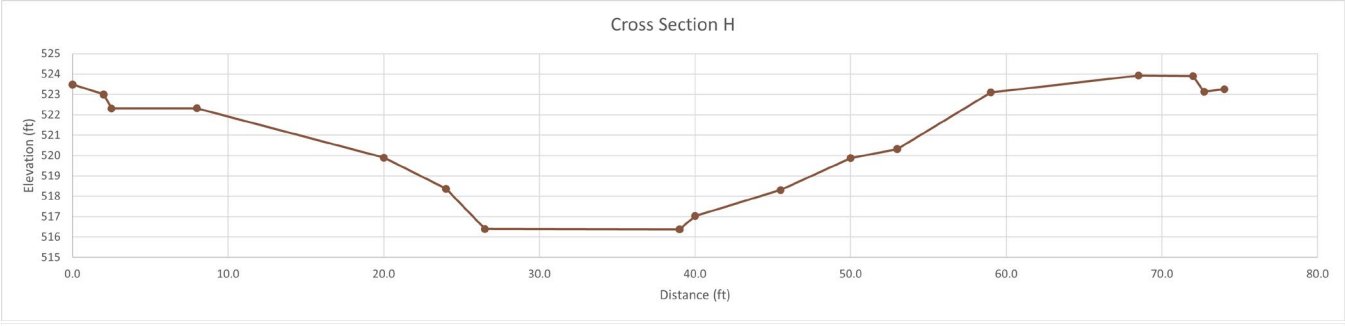
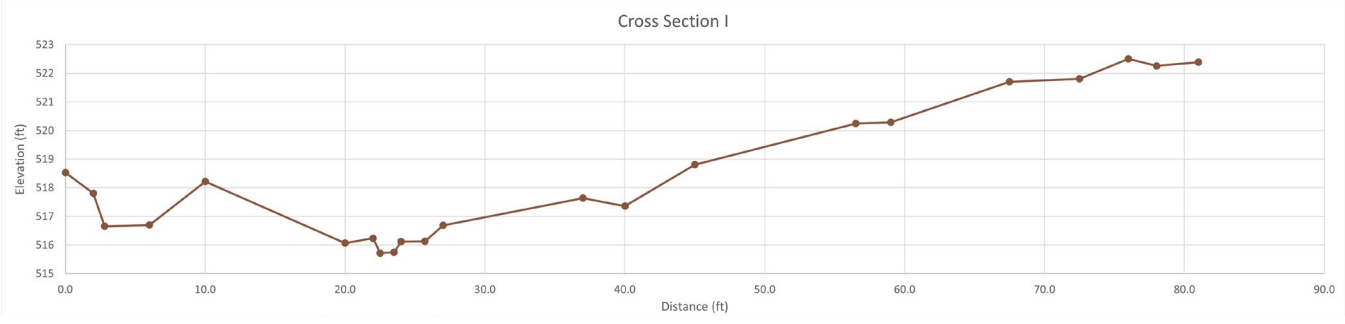
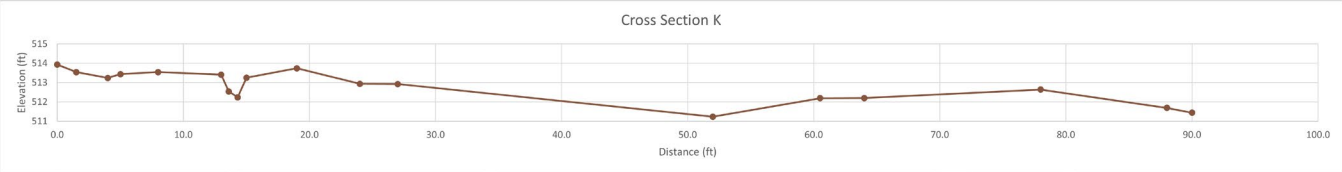
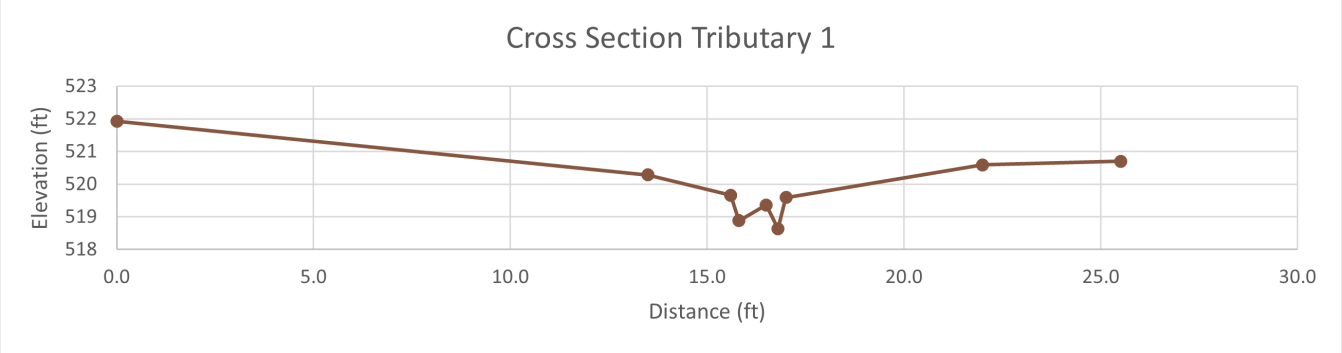
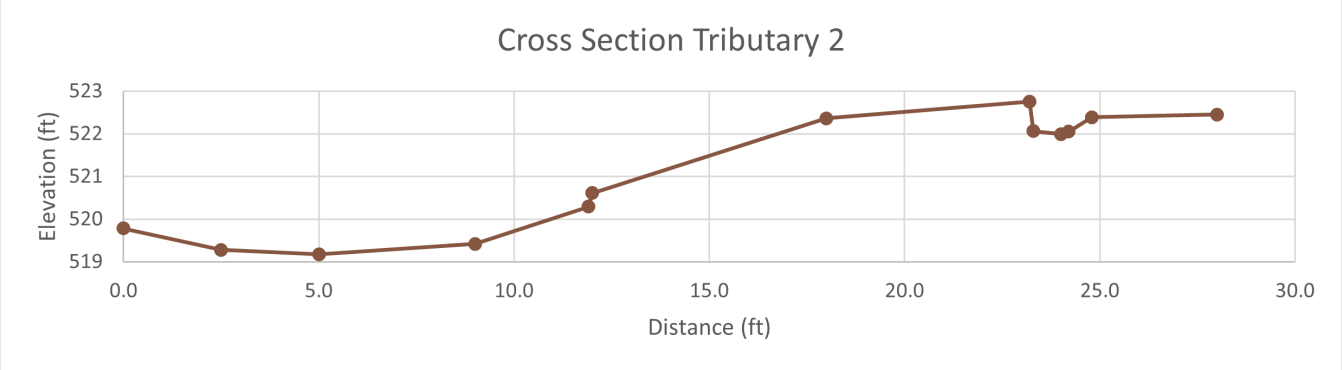
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
Distance (ft)


Cross Section H
Elevation (ft)
525
524
523
522
521
520
519
518
517
516
515
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
Distance (ft)


Cross Section I
Elevation (ft)
523
522
521
520
519
518
517
516
515
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
Distance (ft)







Appendix C

Cross Section A

HI1	Elevation	STN.	ROD	ANGLE	Station	Elevation	Notes
4.41	567.11	0.0	-2.82	0	0.0	570.00	
		10.0	-1.38	355	10.0	571.44	

		14.0	-2.18	339	14.0	570.64	Top of bank
		25.0	-5.68	323	25.0	567.14	Stream channel center
		26.5	-5.72	321	26.5	567.10	
		30.5	-4.36	316	30.5	568.46	Fence line

Runs from a young Prunus cerasifera to the first corner along the monastery property line across ivy (Hedera spp.).

Cross Section B

HI1		STN.	ROD	ANGLE	Station	Elevation	
4.41	567.11	0.0	-5.14	109	0.0	567.68	
		25.0	-5.82	176.7	25.0	567.00	
		32.0	-6.61	205	32.0	566.21	
		37.0	-8.49	225	37.0	564.33	
		42.0	-11.11	235	42.0	561.71	Stream channel edge
		43.0	-11.04	237	43.0	561.78	Stream channel edge
		47.0	-9.99	242.5	47.0	562.83	
		52.0	-7.88	248	52.0	564.94	
		57.0	-5.71	252	57.0	567.11	
		59.0	-5.51	253	59.0	567.31	Fence line

From base of Dodonea viscosa tree, through patch of Dietes varieties, across stream channel with Clivia to fence.

Cross Section C

HI2		STN.	ROD	ANGLE	Station	Elevation	
3.21	553.63	0.00	-1.49		0.0	551.64	
		13.00	-3.05		13.0	550.08	
		23.00	-6.26		23.0	546.87	
		25.00	-7.3		25.0	545.83	
		27.00	-8.41		27.0	544.72	Stream channel edge
		28.00	-8.55		28.0	544.58	Stream channel edge
		31.00	-6.89		31.0	546.24	
		33.50	-5.83		33.5	547.30	Edge of path
		37.50	-5.15		37.5	547.98	

		43.50	-2.77		43.5	550.36	
		56.00	-2.19		56.0	550.94	
		69.50	-1.29		69.5	551.84	Fence line

From base of young Port Orford Cedar (Chamaecyparis lawsoniana), through patch of mixed varieties, across stream channel with Clivia to fence.

Cross Section D

HI3		STN.	ROD	ANGLE	Station	Elevation	Notes
3.33	544.83	0.00	-2.12	211.00	0.0	542.71	
		13.50	-2.87	181.5	13.5	541.96	
		17.00	-3.62	174	17.0	541.21	
		23.00	-7.79	159	23.0	537.04	
		28.00	-11.61	148	28.0	533.22	
		30.00	-11.56	144	30.0	533.27	Stream channel bottom
		35.00	-8.95	137	35.0	535.88	
		38.00	-6.27	133	38.0	538.56	Base of Redwood
		42.50	-4.83	128	42.5	540	
		51.00	-4.13	121	51.0	540.7	Middle of path, 3' wide/4.5' on diagonal
		55.00	-3.39	118	55.0	541.44	
		79.00	-1.51	108	79.0	543.32	Fence line

From base of young Monterrey Cypress (Hesperocyparis macrocarpa), through patch of Dietes varieties, across stream channel with Clivia to fence. Redwood Sorrel (Oxalis oregana) on banks.

Cross Section E

HI3		STN.	ROD	ANGLE	Station	Elevation	Notes
3.33	544.83	0.00	-0.39	0	0.0	543.44	
		7.00	-1.8	340	7.0	542.03	
		14.00	-4.91	314	14.0	538.92	
		26.50	-13.42	279	26.5	530.41	Actively eroding
		28.00	-13.63	276	28.0	530.2	
		29.00	-13.47	274	29.0	530.36	

		39.00	-7.84	262	39.0	535.99	
		55.00	-4.23	253	55.0	539.6	
		63.50	-3	250	63.5	540.83	Edge of stair
		68.00	-3.4	249	68.0	540.43	Bottom of Step
		69.00	-1.96	247	69.0	541.87	
		76.00	-2.86	248	76.0	540.97	On the stair

From base of large Coast Redwood (Sequoia sempervirens), across stream channel with Redwood leaf litter. African Broom Fern (Asparagus virgatus), English Holly (Ilex aquifolium), snowberry (Symphoricarpos albus) and Ocean Spray Cream Bush (Holodiscus discolor) on banks. Just below Cross Section E water appears in the stream channel

Cross Section F

HI4		STN.	ROD	ANGLE	Station	Elevation	Notes
4.10	543.83	0.00	-6.5	0.00	0.0	537.33	Along path
		9.00	-6.98	18	9.0	536.85	Along path
		20.00	-10.26	67.5	20.0	533.57	Along path
		34.00	-14.3	102	34.0	529.53	
		35.00	-14.56	103	35.0	529.27	Stream channel, first wet area (below fault)
		36.00	14.84	106		558.67	Top of incision
		36.00	-15.45	106	36.0	528.38	Bottom of incision
		38.00	-15.42	107	38.0	528.41	Bottom of incision
		38.50	-14.7	109	38.5	529.13	Top of incision
		41.50	-13.95	112	41.5	529.88	
		49.50	-12.24	118	49.5	531.59	Next to steps down (L)
		50.50	-12.14	119	50.5	531.69	
		54.00	-12.06	120.5	54.0	531.77	
		54.50	-11.65	120.5	54.5	532.18	
		66.00	-11.82	124	66.0	532.01	Red cestrum from here to fence. Hard to visibly detect grade change due to dense vegetation.
		70.00	-11.84	124	70.0	531.99	
		74.00	-12.06	125	74.0	531.77	

76.00	-12.25	125	76.0	531.58	Appears to be bottom of dominant channel in this area.
78.00	-12.23	125	78.0	531.6	
80.00	-11.8	125	80.0	532.03	(2) New Zealand Lacebacks (Hoheria populnea) ~10yrs. Drip line of trunk at 80.5
84.00	-11.38	126	84.0	532.45	
88.00	-11.41	126.5	88.0	532.42	
92.00	-11.19	126.9	92.0	532.64	
96.00	-10.4	127	96.0	533.43	Fence line

From base of sprinkler on main path, across stream channel with Redwood leaf litter. Five Finger Fern (Adiantium aleuticum), Wild Ginger (Asarum caudatum), Holly Leaf Cherry Tree (Prunus Ilicifolia) on banks. From path to fence, dense thicket of Red Cestrum (Cestrum newellii).

Cross Section G

HI5

2.63	529.13	STN.	ROD	ANGLE	Station	Elevation	Notes
		0.00	1.14		0.0	530.27	
		13.00	-2.74	0	13.0	526.39	
		24.00	-5.95	28	24.0	523.18	S. edge of path
		33.00	-5.86	55	33.0	523.27	Still on path
		33.50	-6.21	55.5	33.5	522.92	Jusat off path
		42.00	-8.56	74	42.0	520.57	In bankfull area/clivia escarpment
		48.50	-11.04	85	48.5	518.09	Top of bank -> small incision
		49.50	-11.41	86	49.5	517.72	Stream bed
		52.50	-11.58	89.5	52.5	517.55	End of apparent stream bed.
		54.50	-10.94	92	54.5	518.19	Just out of channel
		60.00	-8.48	96	60.0	520.65	Redwood between 59.5-60.5
		71.50	-4.5	104	71.5	524.63	S. edge of path
		76.50	-4.1	105.5	76.5	525.03	
		83.00	-2.55	108	83.0	526.58	
		85.00	-2.63	108	85.0	526.5	Fence line

From base of Coast Redwood (Sequoia sempervirens), down slope of Lady Fern (Athyrium filix-femina) and Ladder Fern (Nephrolepis cordifolia) across stream channel with Redwood leaf litter, Clivia and Oxalis.

Cross Section H

HI5

2.63	529.13	STN.	ROD	ANGLE	Station	Elevation	Notes
		0.00	-5.64	15	0.0	523.49	
		2.00	-6.13	17.5	2.0	523	
		2.50	-6.82	18.25	2.5	522.31	Inside south of path
		8.00	-6.81	27	8.0	522.32	Other side of path
		20.00	-9.23	44.5	20.0	519.9	
		24.00	-10.76	51	24.0	518.37	
		26.50	-12.73	54	26.5	516.4	Actively eroding at edge of pool
		39.00	-12.76	67	39.0	516.37	Pool depth varies slightly, between 1-2". Fine muck
		40.00	-12.1	68.5	40.0	517.03	
		45.50	-10.82	73	45.5	518.31	Redwood's lowside center 1.5" to the west. 45'-48.5'
		50.00	-9.26	77	50.0	519.87	High side
		53.00	-8.81	79	53.0	520.32	Log 50.5-53' at edge of path.
		59.00	-6.03	84.5	59.0	523.1	Edge of path
		68.50	-5.2	87	68.5	523.93	
		72.00	-5.23	89	72.0	523.9	Top of log
		72.70	-6	89	72.7	523.13	Undercut back to 72.5
		74.00	-5.87	89.5	74.0	523.26	
				Water	26.2	516.6	
					39.3	516.6	

From base of sprinkler on main path, down slope of Lady Fern (Athyrium filix-femina) and Ladder Fern (Nephrolepis cordifolia) across stream channel with Redwood leaf litter, Clivia and Oxalis oregana. Between pool and fence, Ruscus (Ruscus hypoglossum).

Cross Section I

HI5

2.63	529.13	STN.	ROD	ANGLE	Station	Elevation	Notes
		0.00	-10.6	28	0.0	518.53	Edge of path
		2.00	-11.32	29	2.0	517.81	Edge of planting bed
		2.80	-12.47	29	2.8	516.66	S. edge of path
		6.00	-12.43	31.5	6.0	516.7	
		10.00	-10.91	33	10.0	518.22	
		20.00	-13.06	39.5	20.0	516.07	Depression
		22.00	-12.89	40.5	22.0	516.24	Top of bank
		22.50	-13.41	40	22.5	515.72	
		23.50	-13.38	41	23.5	515.75	
		24.00	-13.01	42	24.0	516.12	
		25.70	-13	43	25.7	516.13	Edge of channel
		27.00	-12.44	44	27.0	516.69	Bed area
		37.00	-11.49	50	37.0	517.64	Edge of path
		40.00	-11.77	52	40.0	517.36	
		45.00	-10.32	55	45.0	518.81	
		56.50	-8.88	62	56.5	520.25	Edge of path
		59.00	-8.84	63	59.0	520.29	Edge of path
		67.50	-7.42	68	67.5	521.71	
		72.50	-7.32		72.5	521.81	Depression
		76.00	-6.62		76.0	522.51	
		78.00	-6.87	73	78.0	522.26	
		81.00	-6.74	75	81.0	522.39	

From base of sprinkler on main path. Mostly leaf litter floor with some Wild Ginger and Calla Lily at edge of pool. Between pool and fence, Ruscus (Ruscus hypoglossum and Ruscus ruscifolium).

Cross Section J

HI6

3.75	524.14	STN.	ROD	ANGLE	Station	Elevation	Notes
		0.00	-6.82	0	0.0	517.32	

5.00	-8.28	2	5.0	515.86	End of bed
5.50	-9.03	2.5	5.5	515.11	Edge of path
8.50	-9.09	5	8.5	515.05	
17.00	-9.32	7	17.0	514.82	
17.50	-9.82	7.5	17.5	514.32	Rock edge, likely submerged when flooded.
19.00	-9.91	8	19.0	514.23	Edge of pool
19.50	-10.89	8	19.5	513.25	Water depth .8 ft.
22.00	-11.59		22.0	512.55	Center
26.00	-9.59		26.0	514.55	
27.00	-9.19		27.0	514.95	
28.00	-9		28.0	515.14	
31.00	-9.19	15	31.0	514.95	Edge of path
34.00	-9.21	17	34.0	514.93	
42.00	-8.89	23	42.0	515.25	
50.00	-6.82	32	50.0	517.32	
58.00	-6.93	42	58.0	517.21	Edge of path
62.00	-7.52	47	62.0	516.62	Other edge of path
73.00	-7.73	65.5	73.0	516.41	Redwood diam from 67-70, center at 68.5,1.25' from tape west to redwood
80.00	-7.64	77	80.0	516.5	
90.00	-8.83	92	90.0	515.31	
94.00	-9.32	96.5	94.0	514.82	Fence line

From base of rock outcrop on main path. Through patch of a variety of irises (Iris douglasiana, Iris confusa, Iris foetidissima) and other bulbs. Between stream channel and fence, Ruscus (Ruscus hypoglossum).

Cross Section K

HI6

3.75	524.14	STN.	ROD	DTT	ANGLE	Station	Elevation	Notes
		0.00	-10.21		18	0.0	513.93	
		1.50		-0.9		1.5	513.54	
		4.00		-1.2		4.0	513.24	

5.00		-1		5.0	513.44	
8.00		-0.9		8.0	513.54	
13.00	-10.73		25	13.0	513.41	Top of bank
13.60	-11.6		25	13.6	512.54	In the channel, armored flagstone
14.30	-11.9		25	14.3	512.24	Other side of channel
15.00	-10.89		25.25	15.0	513.25	Top of bank
19.00		-0.7		19.0	513.74	
24.00	-11.2	-1.2	32.00	24.0	512.94	Edge of path
27.00	-11.22		34	27.0	512.92	
52.00	-12.9		54	52.0	511.24	Honeysuckle bed east of path
60.50	-11.95		63	60.5	512.19	Tree east of tape from 57-60.6
64.00	-12.24	-2.24	66.00	64.0	512.2	
78.00		-1.8		78.0	512.64	
88.00		-2.75		88.0	511.69	
90.00		-3		90.0	511.44	Fence line

From base of rock outcrop on main path. Through patch of a variety of dianella, Japanese Anemone (Anemone hupehensis), Trident Maple (Acer Buergerianum), Kousa Dogwood (Cornus kousa)., Ruscus (Ruscus hypoglossum and Ruscus ruscifolium) along fence. Stream Channel is armored in this stretch with large stones, likely from elsewhere on the site.

Cross Section Tribuary 1

HI6

3.75	524.14	STN.	ROD	DTT	ANGLE	Station	Elevation	Notes
		0.00	-2.21		275.00	0.0	521.93	
		13.50	-3.86		284.00	13.5	520.28	
		15.60	-4.48		284.00	15.6	519.66	Edge of channel
		15.80	-5.26		285.00	15.8	518.88	incision
		16.50	-4.78		285.00	16.5	519.36	top of raock in channel center. Large rock, attempt to secure channel?
		16.80	-5.5		285.00	16.8	518.64	Back down into incision
		17.00	-4.55	-2	285.00	17.0	519.59	Undercut ~1"
		22.00		-1		22.0	520.59	

		25.50	-3.44		293.00	25.5	520.7	

Cross Section Tribuary 2

HI6

3.75	524.14	STN.	ROD	DTT	ANGLE	Station	Elevation	Notes
		0.00		-2.2		0.0	519.78	On a redwood rootball
		2.50		-2.7		2.5	519.28	Redwood log/berm
		5.00	-4.96	-2.8	284.00	5.0	519.18	other side of redwood log/berm
		9.00	-4.72		281	9.0	519.42	Edge of path
		11.90	-3.85		279	11.9	520.29	Dropping off a root
		12.00	-3.53		278.5	12.0	520.61	On a root(root runs perp to cross section)
		18.00	-1.78		272	18.0	522.36	
		23.20	-1.39		268	23.2	522.75	Up on log/berm
		23.30	-2.08		268	23.3	522.06	Still in channel
		24.00	-2.15		267	24.0	521.99	Living root in bottom of chanel
		24.20	-2.09		267	24.2	522.05	in the channel
		24.80	-1.75		266	24.8	522.39	bank of channel
		28.00	-1.69		262.5	28.0	522.45	

Cross Section Tribuary 3

HI6

3.75	524.14	STN.	ROD	DTT	ANGLE	Station	Elevation	Notes
		0.00	-1.69		262.50	0.0	522.45	
		7.00	-1.89		261.50	7.0	522.25	
		8.50	-2.23		261.00	8.5	521.91	Foundation of fence port. Broken, not flat concrete.
		9.00	-2.49		261.00	9.0	521.65	Off of the concrete, into the water
		11.00	-2.57		260.50	11.0	521.57	Channel filled with softball sized rock placed by someone. Site rock not from stream
		13.00	-2.56		260.25	13.0	521.58	Edge of channel

		15.00	-2.01		259.50	15.0	522.13	Top of bank
		17.00	-2		259.00	17.0	522.14	
		18.00	-2.29		258.50	18.0	521.85	
		19.00	-2.48		258.00	19.0	521.66	
		26.00	-2.45		254.00	26.0	521.69	
		33.00	-2.49		246.00	33.0	521.65	
		49.00	-4.73		162.00	49.0	519.41	

Cross Section A

HI1	Elevation	STN.	ROD	ANGLE	Station	Elevation	Notes
4.41	567.11	0.0	-2.82	0	0.0	570.00	
		10.0	-1.38	355	10.0	571.44	
		14.0	-2.18	339	14.0	570.64	Top of bank
		25.0	-5.68	323	25.0	567.14	Stream channel center
		26.5	-5.72	321	26.5	567.10	
		30.5	-4.36	316	30.5	568.46	Fence line

Cross Section B

HI1		STN.	ROD	ANGLE	Station	Elevation	
4.41	567.11	0.0	-5.14	109	0.0	567.68	
		25.0	-5.82	176.7	25.0	567.00	
		32.0	-6.61	205	32.0	566.21	
		37.0	-8.49	225	37.0	564.33	
		42.0	-11.11	235	42.0	561.71	Stream channel edge
		43.0	-11.04	237	43.0	561.78	Stream channel edge
		47.0	-9.99	242.5	47.0	562.83	
		52.0	-7.88	248	52.0	564.94	
		57.0	-5.71	252	57.0	567.11	
		59.0	-5.51	253	59.0	567.31	Fence line

Cross Section C

HI2		STN.	ROD	ANGLE	Station	Elevation	
3.21	553.63	0.00	-1.49		0.0	551.64	
		13.00	-3.05		13.0	550.08	
		23.00	-6.26		23.0	546.87	
		25.00	-7.3		25.0	545.83	
		27.00	-8.41		27.0	544.72	Stream channel edge
		28.00	-8.55		28.0	544.58	Stream channel edge
		31.00	-6.89		31.0	546.24	
		33.50	-5.83		33.5	547.30	Edge of path
		37.50	-5.15		37.5	547.98	
		43.50	-2.77		43.5	550.36	

		56.00	-2.19		56.0	550.94	
		69.50	-1.29		69.5	551.84	Fence line

Cross Section D

HI3		STN.	ROD	ANGLE	Station	Elevation	Notes
3.33	544.83	0.00	-2.12	211.00	0.0	542.71	
		13.50	-2.87	181.5	13.5	541.96	
		17.00	-3.62	174	17.0	541.21	
		23.00	-7.79	159	23.0	537.04	
		28.00	-11.61	148	28.0	533.22	
		30.00	-11.56	144	30.0	533.27	Stream channel bottom
		35.00	-8.95	137	35.0	535.88	
		38.00	-6.27	133	38.0	538.56	Base of Redwood
		42.50	-4.83	128	42.5	540	
		51.00	-4.13	121	51.0	540.7	Middle of path, 3' wide/4.5' on diagonal
		55.00	-3.39	118	55.0	541.44	
		79.00	-1.51	108	79.0	543.32	Fence line

Cross Section E

HI3		STN.	ROD	ANGLE	Station	Elevation	Notes
3.33	544.83	0.00	-0.39	0	0.0	543.44	
		7.00	-1.8	340	7.0	542.03	
		14.00	-4.91	314	14.0	538.92	
		26.50	-13.42	279	26.5	530.41	Actively eroding
		28.00	-13.63	276	28.0	530.2	
		29.00	-13.47	274	29.0	530.36	
		39.00	-7.84	262	39.0	535.99	
		55.00	-4.23	253	55.0	539.6	
		63.50	-3	250	63.5	540.83	Edge of stair
		68.00	-3.4	249	68.0	540.43	Bottom of Step
		69.00	-1.96	247	69.0	541.87	
		76.00	-2.86	248	76.0	540.97	On the stair

Cross Section F

HI4		STN.	ROD	ANGLE	Station	Elevation	Notes
4.10	543.83	0.00	-6.5	0.00	0.0	537.33	Along path
		9.00	-6.98	18	9.0	536.85	Along path
		20.00	-10.26	67.5	20.0	533.57	Along path
		34.00	-14.3	102	34.0	529.53	
		35.00	-14.56	103	35.0	529.27	Stream channel, first wet area (below fault)
		36.00	14.84	106		558.67	Top of incision
		36.00	-15.45	106	36.0	528.38	Bottom of incision
		38.00	-15.42	107	38.0	528.41	Bottom of incision
		38.50	-14.7	109	38.5	529.13	Top of incision

		41.50	-13.95	112	41.5	529.88	
		49.50	-12.24	118	49.5	531.59	Next to steps down (L)
		50.50	-12.14	119	50.5	531.69	
		54.00	-12.06	120.5	54.0	531.77	
		54.50	-11.65	120.5	54.5	532.18	
		66.00	-11.82	124	66.0	532.01	Red cestrum from here to fence. Hard to visibly detect grade change due to dense vegetation.
		70.00	-11.84	124	70.0	531.99	
		74.00	-12.06	125	74.0	531.77	
		76.00	-12.25	125	76.0	531.58	Appears to be bottom of dominant channel in this area.
		78.00	-12.23	125	78.0	531.6	
		80.00	-11.8	125	80.0	532.03	(2) New Zealand Lacebacks (Hoheria populnea) ~10yrs. Drip line of trunk at 80.5
		84.00	-11.38	126	84.0	532.45	
		88.00	-11.41	126.5	88.0	532.42	
		92.00	-11.19	126.9	92.0	532.64	
		96.00	-10.4	127	96.0	533.43	Fence line

Cross Section G

HI5

2.63	529.13	STN.	ROD	ANGLE	Station	Elevation	Notes
		0.00	1.14		0.0	530.27	
		13.00	-2.74	0	13.0	526.39	
		24.00	-5.95	28	24.0	523.18	S. edge of path
		33.00	-5.86	55	33.0	523.27	Still on path
		33.50	-6.21	55.5	33.5	522.92	Jusat off path
		42.00	-8.56	74	42.0	520.57	In bankfull area/clivia escarpment
		48.50	-11.04	85	48.5	518.09	Top of bank -> small incision
		49.50	-11.41	86	49.5	517.72	Stream bed
		52.50	-11.58	89.5	52.5	517.55	End of apparent stream bed.
		54.50	-10.94	92	54.5	518.19	Just out of channel
		60.00	-8.48	96	60.0	520.65	Redwood between 59.5-60.5
		71.50	-4.5	104	71.5	524.63	S. edge of path
		76.50	-4.1	105.5	76.5	525.03	
		83.00	-2.55	108	83.0	526.58	
		85.00	-2.63	108	85.0	526.5	Fence line

Cross Section H

HI5

2.63	529.13	STN.	ROD	ANGLE	Station	Elevation	Notes
		0.00	-5.64	15	0.0	523.49	
		2.00	-6.13	17.5	2.0	523	
		2.50	-6.82	18.25	2.5	522.31	Inside south of path

		8.00	-6.81	27	8.0	522.32	Other side of path
		20.00	-9.23	44.5	20.0	519.9	
		24.00	-10.76	51	24.0	518.37	
		26.50	-12.73	54	26.5	516.4	Actively eroding at edge of pool
							Pool depth varies slightly, between 1-2".
		39.00	-12.76	67	39.0	516.37	Fine muck
		40.00	-12.1	68.5	40.0	517.03	
							Redwood's lowside center 1.5" to the west.
		45.50	-10.82	73	45.5	518.31	45'-48.5'
		50.00	-9.26	77	50.0	519.87	High side
		53.00	-8.81	79	53.0	520.32	Log 50.5-53' at edge of path.
		59.00	-6.03	84.5	59.0	523.1	Edge of path
		68.50	-5.2	87	68.5	523.93	
		72.00	-5.23	89	72.0	523.9	Top of log
		72.70	-6	89	72.7	523.13	Undercut back to 72.5
		74.00	-5.87	89.5	74.0	523.26	
				Water	26.2	516.6	
					39.3	516.6	

Cross Section I

HI5

2.63	529.13	STN.	ROD	ANGLE	Station	Elevation	Notes
		0.00	-10.6	28	0.0	518.53	Edge of path
		2.00	-11.32	29	2.0	517.81	Edge of planting bed
		2.80	-12.47	29	2.8	516.66	S. edge of path
		6.00	-12.43	31.5	6.0	516.7	
		10.00	-10.91	33	10.0	518.22	
		20.00	-13.06	39.5	20.0	516.07	Depression
		22.00	-12.89	40.5	22.0	516.24	Top of bank
		22.50	-13.41	40	22.5	515.72	
		23.50	-13.38	41	23.5	515.75	
		24.00	-13.01	42	24.0	516.12	
		25.70	-13	43	25.7	516.13	Edge of channel
		27.00	-12.44	44	27.0	516.69	Bed area
		37.00	-11.49	50	37.0	517.64	Edge of path
		40.00	-11.77	52	40.0	517.36	
		45.00	-10.32	55	45.0	518.81	
		56.50	-8.88	62	56.5	520.25	Edge of path
		59.00	-8.84	63	59.0	520.29	Edge of path
		67.50	-7.42	68	67.5	521.71	
		72.50	-7.32		72.5	521.81	Depression
		76.00	-6.62		76.0	522.51	
		78.00	-6.87	73	78.0	522.26	
		81.00	-6.74	75	81.0	522.39	

Cross Section J

HI6

3.75	524.14	STN.	ROD	ANGLE	Station	Elevation	Notes
		0.00	-6.82	0	0.0	517.32	
		5.00	-8.28	2	5.0	515.86	End of bed
		5.50	-9.03	2.5	5.5	515.11	Edge of path
		8.50	-9.09	5	8.5	515.05	
		17.00	-9.32	7	17.0	514.82	
		17.50	-9.82	7.5	17.5	514.32	Rock edge, likely submerged when flooded.
		19.00	-9.91	8	19.0	514.23	Edge of pool
		19.50	-10.89	8	19.5	513.25	Water depth .8 ft.
		22.00	-11.59		22.0	512.55	Center
		26.00	-9.59		26.0	514.55	
		27.00	-9.19		27.0	514.95	
		28.00	-9		28.0	515.14	
		31.00	-9.19	15	31.0	514.95	Edge of path
		34.00	-9.21	17	34.0	514.93	
		42.00	-8.89	23	42.0	515.25	
		50.00	-6.82	32	50.0	517.32	
		58.00	-6.93	42	58.0	517.21	Edge of path
		62.00	-7.52	47	62.0	516.62	Other edge of path
		73.00	-7.73	65.5	73.0	516.41	Redwood diam from 67-70, center at 68.5,1.25' from tape west to redwood
		80.00	-7.64	77	80.0	516.5	
		90.00	-8.83	92	90.0	515.31	
		94.00	-9.32	96.5	94.0	514.82	Fence line

Cross Section K

HI6

3.75	524.14	STN.	ROD	DTT	ANGLE	Station	Elevation	Notes
		0.00	-10.21		18	0.0	513.93	
		1.50		-0.9		1.5	513.54	
		4.00		-1.2		4.0	513.24	
		5.00		-1		5.0	513.44	
		8.00		-0.9		8.0	513.54	
		13.00	-10.73		25	13.0	513.41	Top of bank
		13.60	-11.6		25	13.6	512.54	In the channel, armored flagstone
		14.30	-11.9		25	14.3	512.24	Other side of channel
		15.00	-10.89		25.25	15.0	513.25	Top of bank
		19.00		-0.7		19.0	513.74	
		24.00	-11.2	-1.2	32.00	24.0	512.94	Edge of path
		27.00	-11.22		34	27.0	512.92	
		52.00	-12.9		54	52.0	511.24	Honeysuckle bed east of path
		60.50	-11.95		63	60.5	512.19	Tree east of tape from 57-60.6

		64.00	-12.24	-2.24	66.00	64.0	512.2	
		78.00		-1.8		78.0	512.64	
		88.00		-2.75		88.0	511.69	
		90.00		-3		90.0	511.44	Fence line

Cross Section
Tribuary1

HI6

3.75	524.14	STN.	ROD	DTT	ANGLE	Station	Elevation	Notes
		0.00	-2.21		275.00	0.0	521.93	
		13.50	-3.86		284.00	13.5	520.28	
		15.60	-4.48		284.00	15.6	519.66	Edge of channel
		15.80	-5.26		285.00	15.8	518.88	incision
		16.50	-4.78		285.00	16.5	519.36	top of rock in channel center. Large rock, attempt to secure channel?
		16.80	-5.5		285.00	16.8	518.64	Back down into incision
		17.00	-4.55	-2	285.00	17.0	519.59	Undercut ~1"
		22.00		-1		22.0	520.59	
		25.50	-3.44		293.00	25.5	520.7	

Cross Section
Tribuary2

HI6

3.75	524.14	STN.	ROD	DTT	ANGLE	Station	Elevation	Notes
		0.00		-2.2		0.0	519.78	On a redwood root ball
		2.50		-2.7		2.5	519.28	Redwood log/berm
		5.00	-4.96	-2.8	284.00	5.0	519.18	other side of redwood log/berm
		9.00	-4.72		281	9.0	519.42	Edge of path
		11.90	-3.85		279	11.9	520.29	Dropping off a root
		12.00	-3.53		278.5	12.0	520.61	On a root(root runs perp to cross section)
		18.00	-1.78		272	18.0	522.36	
		23.20	-1.39		268	23.2	522.75	Up on log/berm
		23.30	-2.08		268	23.3	522.06	Still in channel
		24.00	-2.15		267	24.0	521.99	Living root in bottom of channel
		24.20	-2.09		267	24.2	522.05	in the channel
		24.80	-1.75		266	24.8	522.39	bank of channel
		28.00	-1.69		262.5	28.0	522.45	

Cross Section
Tribuary3

HI6

3.75	524.14	STN.	ROD	DTT	ANGLE	Station	Elevation	Notes
		0.00	-1.69		262.50	0.0	522.45	
		7.00	-1.89		261.50	7.0	522.25	
		8.50	-2.23		261.00	8.5	521.91	Foundation of fence port. Broken, not flat concrete.

9.00	-2.49	261.00	9.0	521.65	Off of the concrete, into the water Channel filled with softball sized rock placed by someone. Site rock not from stream
11.00	-2.57	260.50	11.0	521.57	
13.00	-2.56	260.25	13.0	521.58	Edge of channel
15.00	-2.01	259.50	15.0	522.13	Top of bank
17.00	-2	259.00	17.0	522.14	
18.00	-2.29	258.50	18.0	521.85	
19.00	-2.48	258.00	19.0	521.66	
26.00	-2.45	254.00	26.0	521.69	
33.00	-2.49	246.00	33.0	521.65	
49.00	-4.73	162.00	49.0	519.41	

Appendix D

Redwood Canyon Reach

	Run Off (cu. ft/sec)	Coefficient	Intensity (in/hr)	Area (acres)
5yr Occurrence	1.272	0.6	0.8	2.65
10yr Occurrence	1.431	0.6	0.9	2.65
25yr Occurrence	1.7808	0.6	1.12	2.65
50yr Occurrence	2.0511	0.6	1.29	2.65
100yr Occurrence	2.226	0.6	1.4	2.65

South Reach

	Run Off (cu. ft/sec)	Coefficient	Intensity (in/hr)	Area (acres)
5yr Occurrence	22.44	0.6	0.8	46.75
10yr Occurrence	25.245	0.6	0.9	46.75
25yr Occurrence	31.416	0.6	1.12	46.75
50yr Occurrence	36.1845	0.6	1.29	46.75
100yr Occurrence	39.27	0.6	1.4	46.75

Based on Contra Costa County Mean Seasonal Isohyet Map and Precipitation-Frequency-Depth Curves

Appendix E

Figure E1 Area above driveway to Carmelite Monastery and site of spring that feeds the Redwood Canyon Reach of the Cerrito Creek.

Figure E2 Area of Cross Section A.

Figure E3 Area of Cross Section B.

Figure E4 View Upstream of area with Cross Sections C & D.

Figure A5 View looking downstream from Cross Section E. There is increased vegetation starting where water emerges for the first time in the stream bed.

Figure EA6 Incomplete view of Cross Section F.

FigureE5 First emergence of water in the main stream channel, just below Cross Section E.

Figure E8 Cross View north across the first pool at Cross Section H.

Figure E9 Tributary streams coming from neighboring properties. To the right, a stump of a Coast Redwood that was removed in 2007 from water damaged roots.

Figure E10 Looking upstream to Cross Section Tributary 1.