

The Vegetation Monitoring Project
For
The Bidwell Park Vegetation Management Plan
Chico, CA

**Effects of Goat Browsing on
Himalayan Blackberry**



Prepared for:
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Effects of Goat Browsing on Himalayan Blackberry

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Abstract

This study examines the effects of goat browsing on Himalayan blackberry (*Rubus discolor*) in lower Bidwell Park, Chico, CA as part of the Vegetation Monitoring Project² to eradicate the invasive non-native plant species. Variables measured include plant height and plant density. A goat-stocking level of 600-700 Spanish, Boer, Kiko, Alpine, and Angora goats was applied in the park for six weeks. Measured results include a decrease in average plant height of fifty cm, and 22% decrease in plant density compared to a control unstocked area. Effects of goat browsing, accompanied by an initial mechanical treatment, reduce plant cover and density.

Background

Himalayan blackberry occurs in 31 of the 58 counties in California, from San Diego and Riverside in the south, to Del Norte and Siskiyou counties in the

north (Figure 1). It grows along watercourses, roadsides, pastures, wastelands, and forests forming impenetrable thickets. This shrub has long, bending canes with prickling hooks and appears as tall mounds or banks. It takes root at its tips with white flowers in the spring yielding a fruity black berry later in the summer to fall (Bossard et al. 2000).

Source: Bossard et al. (2000)



Figure 1. Distribution of Himalayan Blackberries in California.

Goats are being used in Bidwell Park, Chico, CA, as a biological control measure to eradicate invasive, non-native plants. This manipulation and removal of plants will increase forage production, wildlife populations, and decrease fire hazard (Biswell 1954). Goat grazing has been recommended to manipulate vegetation and to reduce biomass accumulation in fuelbreaks (Tsiouvaras et al. 1989). In addition, it will minimize the use of herbicides in the park.

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² The Vegetation Monitoring Plan was developed from the Goat Grazing Program, which was implemented in 1998 as part of the modified Vegetation Management Plan of 1993.

The Goat Grazing Program was implemented in 1998 (City of Chico Parks and Recreation Department, 1998) as part of the modified Vegetation Management Plan (VMP) of 1993. The VMP is a product of the two earlier management documents, the Master Management Plan of 1990 and the Wildfire Management Plan of 1991, used to formulate a prescription burn plan.

On March 1, 1994, the city entered into a contract with the California Department of Forestry and Fire Protection (CDF) to do prescription burns in Bidwell Park. The agreement stated that the city would provide all personnel required, and CDF would provide the expertise and burn equipment. The initial plan called for rotational burns over 7 years in selected areas where there was a high percentage of non-native plants. This control measure was done using park personnel and volunteers to remove (by hand) non-native plants in impacted areas, and burn them in designated areas away from the park.

Other control measures that the Park Department utilized to achieve the management goal included thermal and mechanical measures. These measures consisted of pouring hot water over the plants to kill the root system, and using weed eaters to remove the non-native plants. There are many methods of brush removal, such as bulldozing, chemical, mechanical, and biological. However, the most effective treatment appears to be a combination of these methods (Biswell 1954).

Due to extreme labor intensity of these measures and the lack of park resources, the initial plan was modified to include the Goat Grazing Program. Goats were chosen for this program

because they do not disperse seeds when they defecate. In addition, they do not eat down to the root of the plant, therefore minimizing the root damages to native plants. Yacoub (2001) stated that grazing could be a good tool for managing weeds as an alternative to spraying and burning when used appropriately with the right animal at the right time.

Study Area

The study sites were located in lower Bidwell Park, Chico, CA, approximately 97 miles north of the state capitol in Sacramento. The monitored sites were located east and west of Highway 99 along North Park Drive in Bidwell Park (Figure 2). There were two monitored sites. Site 1 was a 2.5-acre area located near picnic area 39 and 40 (Figure 3). Site 2 was a 25-acre area in the vicinity of picnic area 20 and north of picnic area 21 and 22 (Figure 4).



Figure 2. Monitored blocks in Lower Bidwell Park, Chico, CA. (see attachment 1A for enlargement)

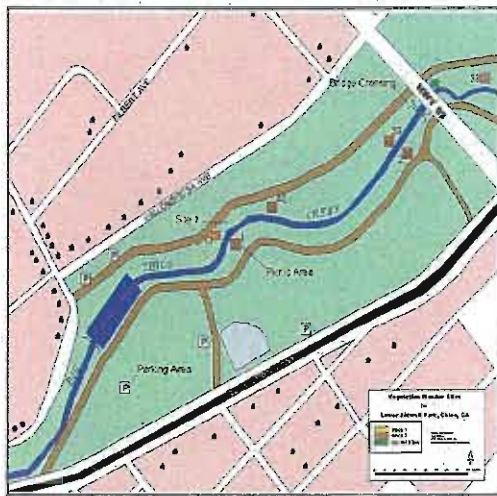


Figure 3. Site 1 with monitored block 1, 2 and control. (see attachment 1B for enlargement)

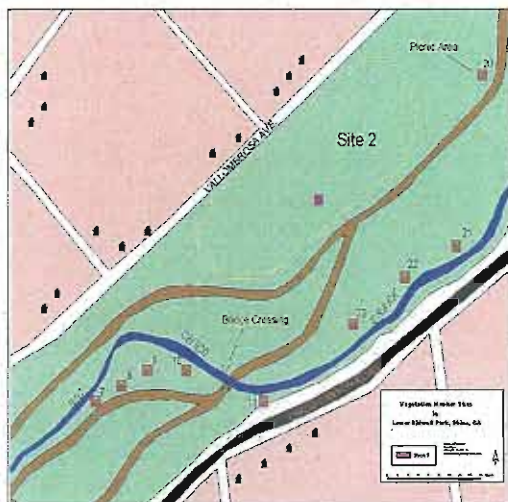


Figure 4. Site 2 with monitored block 3. (see attachment 1C for enlargement)

Methods

Experimental Design

Responses to goat browsing were measured in 3 Himalayan Blackberry blocks randomly chosen in each site. The blocks in site 1 were a six-meter and a ten-meter square block. Site 2 had one ten-meter square block. Each block was further divided into one-meter transects,

which resulted in two blocks with 11 lines and one block with 7 lines (Figure 5). An additional six-meter unbrowsed square block served as the control.

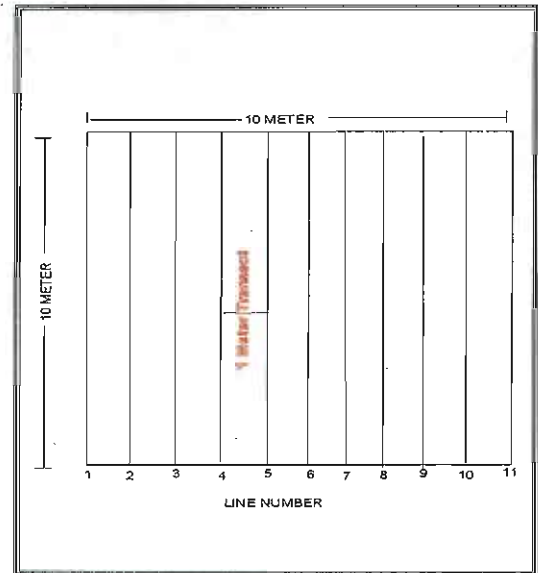


Figure 5. Example of the 10-meter square block layout.

The stock sites received three intensity levels of 600-700 goats of all types³ in a two-year period. However, only the data from the second stocking was used in the study due to modifications done between the first and second treatments and between the second and last treatments.

The first stocking occurred in November 1999 and was applied for five weeks. Due to the thickness of the blackberry, there was very little effect caused by the goats. Therefore, the blackberry vegetation within the two monitored sites was hand removed by volunteers and park personnel on the last week of February 2000, and finished on March 6 of that same year. Davis et al (1975) states, "There are several important management considerations

³ The types of goats used in this study are Spanish, Boer, Kiko, Alpine, and Angora.

involved in obtaining the maximum benefit from the goats. The brush must first be treated mechanically to allow the animals full access to the foliage”.

The second stocking started later that same year in April, shortly after the hand removal treatment and lasted for six weeks.

A scheduled stocking for November 2000 was canceled.

The third stocking was in July 2001, and lasted for six weeks. However, the last stocking was canceled early due to scheduling conflicts followed by an incident with a domestic dog.

The high intensity, short duration of treatments in the monitored sites was intended to maximize browsing effects on all vegetation within those sites.

Sampling Methods

The height and density of Himalayan blackberries was determined by line point method, which is equally reliable to the line interception method developed by Canfield (1942). This method takes less time and is recommended for smaller sample areas to measure percentage of species density and composition on the basis of ground cover (Heady et al. 1959).

The corner of each block was identified with wooden stakes. Eleven lines, each ten-meters long at one-meter intervals, ran across the plot. At each line, measurements were taken at the one, five, and ten-meter points along the line (Figure 6). This data collection method was duplicated with the six-meter block at site 1 with the exception of measurements at the one, three, and six-meter points instead.

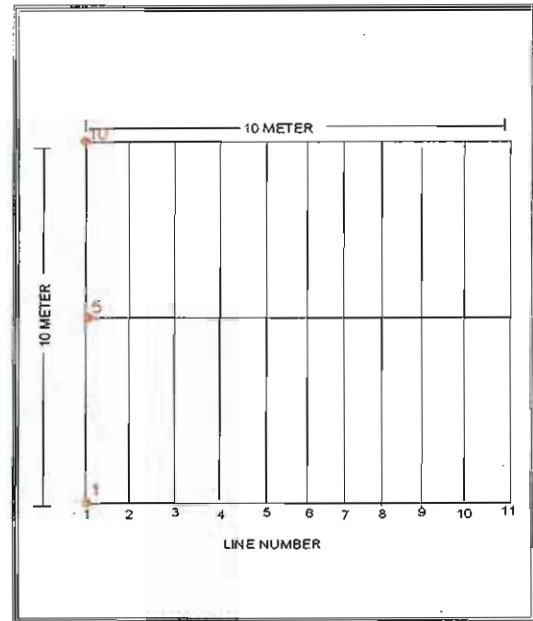


Figure 6. Example of data collection at the 1, 5, and 10 meter points along each line.

Direct measurements of height and density were made on all plants growing directly under the line at those monitored points. Only plants encountered at that point were measured for height and then classified.

Data Analysis

All height data from the monitored blocks for the second stocking were averaged to compare with the control block. For example, blocks 1, 2, and 3 averaged heights were 28 cm, 30 cm, and 28 cm, respectively. However, since all the blocks were monitoring the same plant species, Himalayan blackberry, all averaged heights were further averaged and compared to the control block. Table 1 shows the average heights of all three monitored blocks compared to the control block, and the changes in plant heights due to goat grazing.

	<u>BLOCK</u>			
	1	2	3	Control
<u>Ave. Height (cm)</u>	28	30	28	79
<u>Ave. Height (cm)</u>	block 1+3			
	29cm			
<u>Changes in Plant Heights</u>	<u>Unstocked Stocked</u>			
	79-29=50cm			

Table 1. Comparison of the average heights between unstocked and stocked blocks.

Plant density was measured by recording the presence of a plant species under the point. If there was a plant found under the point, the plant species was recorded. However, if there was no plant under the point, suggesting a decrease in plant number, the block was interpreted as becoming less dense (Table 2).

Line Point Method

Project: Vegetation Monitoring Date: 4/22/2000
 Length: 6-meter square Location: Block 1 at site 1
 Measured By: P.L.

Vegetation Intercepted at the 1, 3, and 6 meter points along each line

Line No.	Point	Height of Plant (cm)	Plant Species Intercepted
1	1	26	HBB
	3	30	HBB
	6	0	n
2	1	47	HBB
	3	35	HBB
	6	29	HBB
3	1	20	HBB
	3	0	n
	6	43	HBB
4	1	50	HBB
	3	28	HBB
	6	36	HBB
5	1	34	HBB
	3	31	HBB
	6	0	n
6	1	42	HBB
	3	31	HBB
	6	35	HBB
7	1	0	n
	3	31	HBB
	6	42	HBB

n means no plant species was intercepted at that point along the line.
 HBB = Himalayan Blackberry

Average Height = 28 cm
 Standard Deviation = 16 cm

Table 2. Example of the data collection for density measurements. (see attachment 2 for field records)

Results and Discussion

Photographic Documentation

The monitored blocks were photographed before and after grazing for comparison to the control block. The purpose of this documentation was to have a visual sense of the changes in plant height and density over time with the effects of goat grazing. In addition, the effectiveness of mechanical (hand removal) and biological (goat grazing) treatments can be compared (Attachment 3A, 3B, 3C, 3D, 3E).

Vegetation Response

Brush Height

One stocking of intense grazing over a 6-week period showed an average reduction in plant height of 50 cm. Earlier studies by Tsiouvaras et al. (1989) came to a similar conclusion. In their study, California blackberry (*Rubus vitifolius*), a related species of the Himalayan blackberry, experienced the largest reduction in plant cover when exposed to goat grazing. Severson and Debano (1991) showed a decrease of 38% in plant cover over a 4-1/2 year period compared to an unstocked control.

Brush Density

This study showed a 22% decrease in plant density (table 3).

	<u>BLOCK</u>			
	1	2	3	Control
<u># of points with no plants</u>				
<u>interception at point measured</u>	4 out of 21	10 out of 33	6 out of 33	0 out of 21
<u>% Density at each block</u>	81	70	82	100
<u>Changes in % Density</u>	<u>Unstocked-Stocked</u>			
	100 - 78 = 22*			

*there was a decrease of 22% in plant density compared to the control block

Table 3. Comparison of plant density between stocked and unstocked blocks

However, a study by Riggs and Urness (1989) showed no change in plant density over a 3-year grazing period. This difference could have been caused by the number of stocking and the length of the study conducted.

Summary

Himalayan blackberry was reduced by goat browsing in this study. First, plant height cover showed a reduction of 50 cm. Second, plant density decreased by 22%. This study concluded that the use of goats to eradicate or control this species was successful with mechanical treatments. However, long-term effects are yet to be assessed. Continuation of monitoring is recommended.

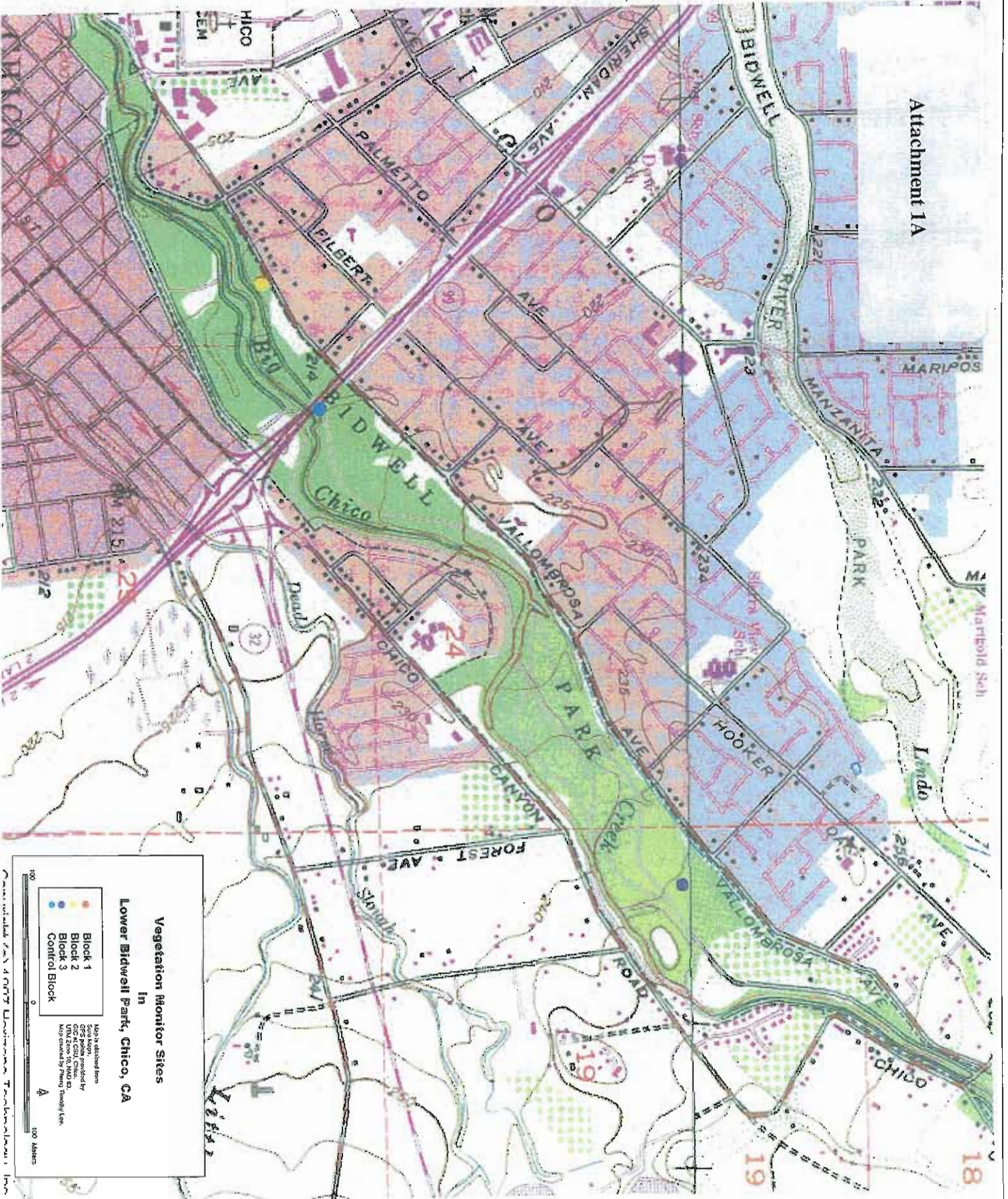
Literature Cited

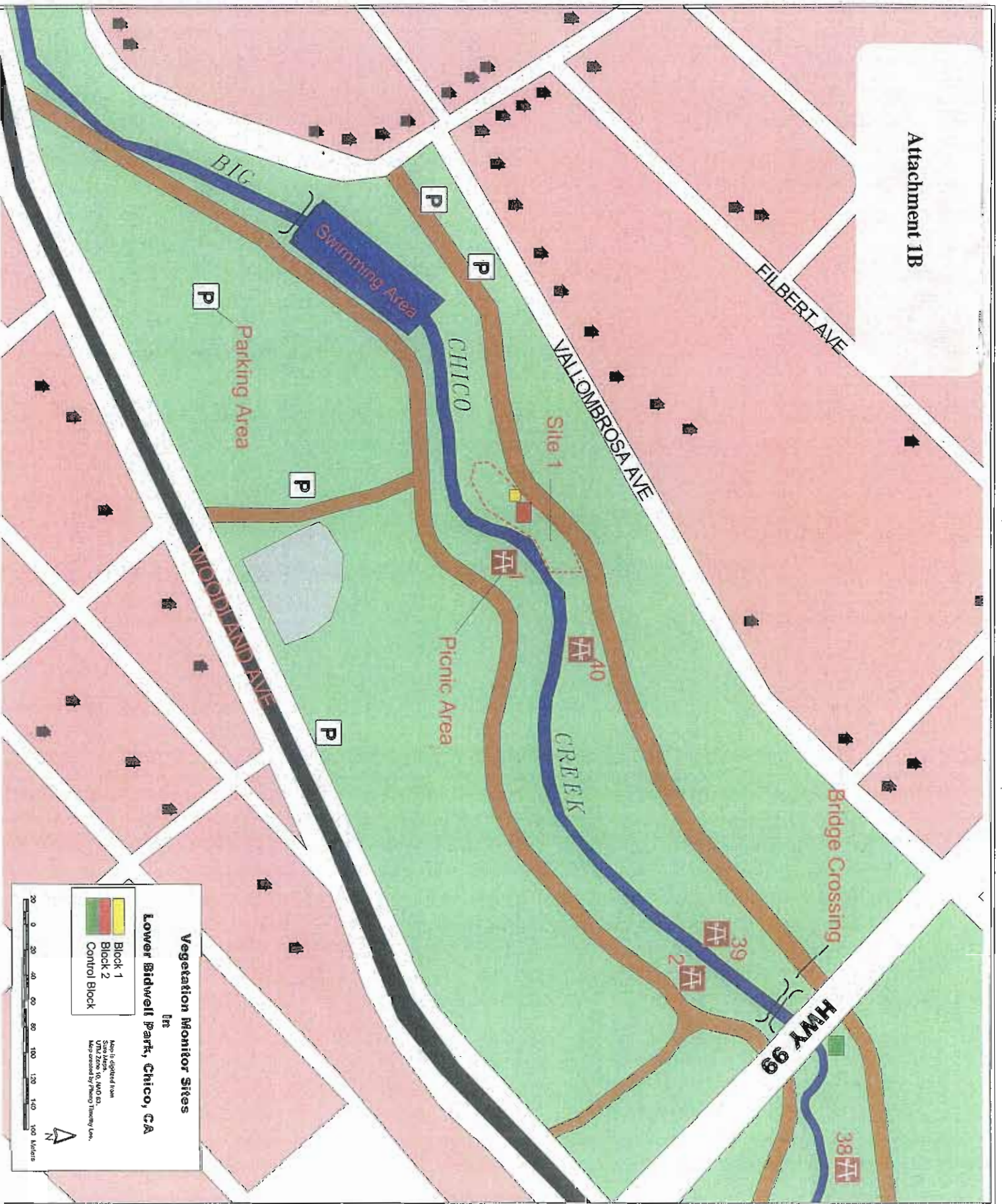
- Biswell, H.H.** 1954. The brush control problem in California. *J. Range Manage.* 7:57-62.
- Bossard, C.C., J.M. Randall, and M.C. Hoshovsky.** 2000. Invasive plants of California's wildlands. University of California Press, Berkeley, Los Angeles, London. pp227-281.
- Canfield, R.H.** 1942. Application of the line interception method of sampling range vegetation. *J. Forest.* 39:388-394.
- Davis, G.G., L.E. Bartel, and C.W. Cook.** 1975. Control of Gambel oak sprouts by goats. *J. Range Manage.* 28:216-218.
- Heady, H.F., R.P. Gibbens, and R.W. Powell.** 1959. A comparison of the charting, line intercept, and line point methods of sampling shrub types of vegetation. *J. Range Manage.* 12:180-188.
- Riggs, Robert A., and Phillip J. Urness.** 1989. Effects of goat browsing on Gambel oak communities in northern Utah. *J. Range Manage.* 42:354-360.
- Severson, K.E., and Leonard F. Debano.** 1991. Influence of Spanish goats on vegetation and soils in Arizona chaparral. *J. Range Manage.* 44:111-117.
- Tsiouvaras, C.N., N.A. Havlik, and J.W. Bartolone.** 1989. Effects of goats on understory vegetation and fire hazard reduction in a coastal forest in California. *Forest Science.* 25:1125-1131.
- Yacoub, Rosie.** 2001. Tolbox: Grazing and Weed control. *Noxious Time.* 3:6-7.
- City of Chico Parks and Recreation Department.** 1998. Receive and approve report on Vegetation Management Program-Bidwell Park. City of Chico Memorandum.

Attachment 1

- 1A. Enlargement of monitored blocks in lower Bidwell Park, Chico, CA.
- 1B. Enlargement of control block and monitored blocks in site 1.
- 1C. Enlargement of monitored block in site 2.

Attachment 1A



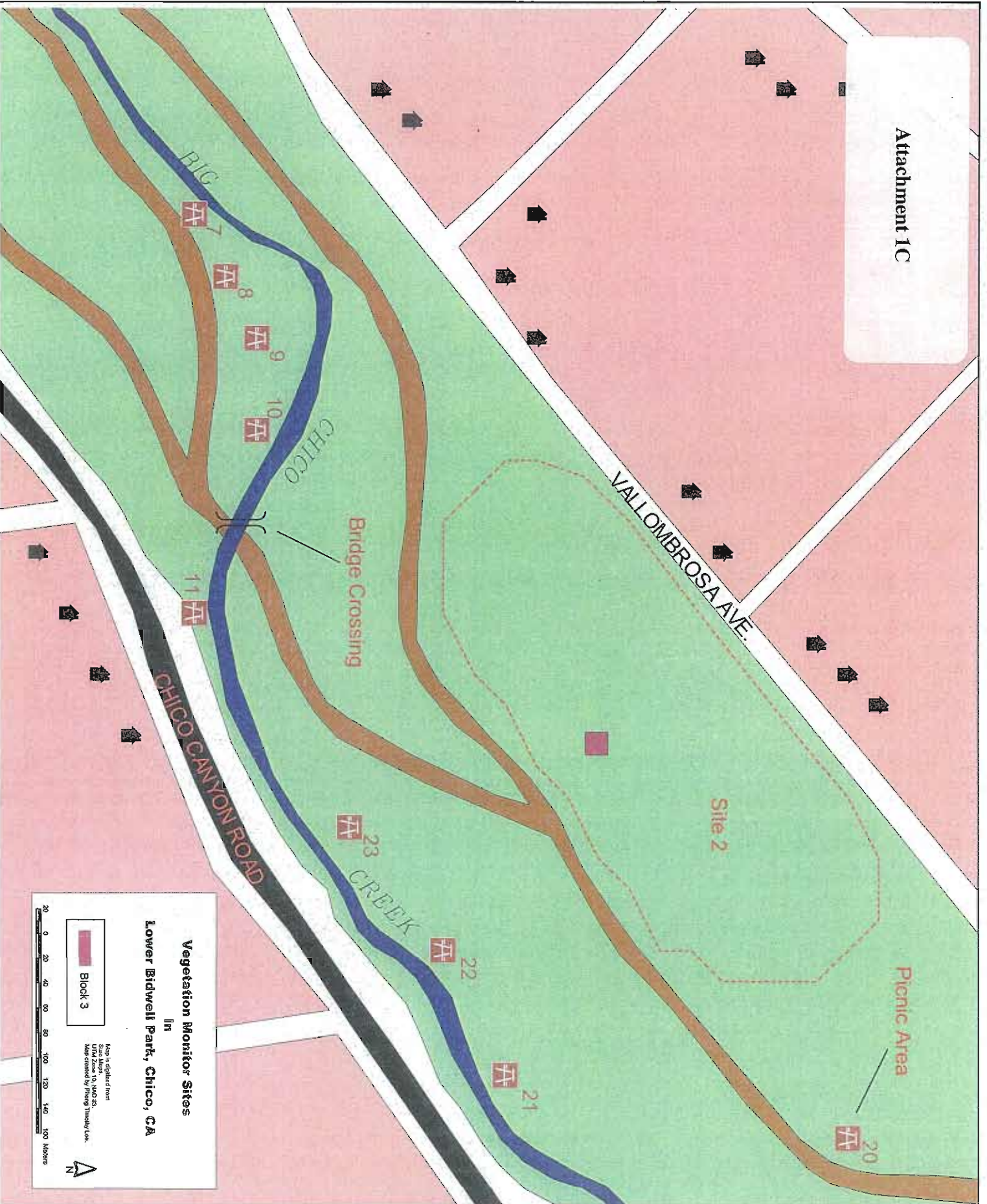


Vegetation Monitor Sites
in
Lower Bidwell Park, Chico, CA

- Block 1
- Block 2
- Control Block

Map is digitized from
State Maps, 10, 100, 1000
Map created by Planning Training Unit.





Attachment 2 Field Records

Line Point Method

Project Vegetation Monitoring
Length 6-meter square

Date 4/22/2000
Location Block 1 at site 1
Measured By P.L.

Vegetation Intercepted at the 1, 3, and 6 meter points along each line

<u>Line No.</u>	<u>Point</u>	<u>Height of Plant (cm)</u>	<u>Plant Species Intercepted</u>
1	1	26	HBB
	3	30	HBB
	6	0	n
2	1	47	HBB
	3	35	HBB
	6	29	HBB
3	1	20	HBB
	3	0	n
	6	43	HBB
4	1	50	HBB
	3	28	HBB
	6	36	HBB
5	1	34	HBB
	3	31	HBB
	6	0	n
6	1	42	HBB
	3	31	HBB
	6	35	HBB
7	1	0	n
	3	31	HBB
	6	42	HBB

n means no plant species was intercepted at that point along the line.

HBB = Himayalan Blackberry

Average Height = 28 cm
Standard Deviation = 16 cm

Line Point Method

Project Vegetation Monitoring
Length 10-meter square

Date 4/22/2000
Location Block 2 at site 1
Measured By P.L.

Vegetation Intercepted at the 1, 5, and 10 meter points along each line

<u>Line No.</u>	<u>Point</u>	<u>Height of Plant (cm)</u>	<u>Plant Species Intercepted</u>
1	1	23	HBB
	5	33	HBB
	10	0	n
2	1	0	n
	5	30	HBB
	10	39	HBB
3	1	40	HBB
	5	43	HBB
	10	45	HBB
4	1	0	n
	5	0	n
	10	0	n
5	1	41	HBB
	5	43	HBB
	10	47	HBB
6	1	0	n
	5	40	HBB
	10	45	HBB
7	1	38	HBB
	5	52	HBB
	10	0	n
8	1	0	n
	5	40	HBB
	10	53	HBB
9	1	44	HBB
	5	40	HBB
	10	38	HBB
10	1	45	HBB
	5	55	HBB
	10	51	HBB
11	1	0	n
	5	0	n
	10	50	HBB

n means no plant species was intercepted at that point along the line.

HBB = Himalayan Blackberry

Average Height = 30 cm

Standard Deviation = 21 cm

Line Point Method

Project Vegetation Monitoring
Length 10-meter square

Date 4/22/2000
Location Block 3 at site 2
Measured By P.L.

Vegetation Intercepted at the 1, 5, and 10 meter points along each line

<u>Line No.</u>	<u>Point</u>	<u>Height of Plant (cm)</u>	<u>Plant Species Intercepted</u>
1	1	40	HBB
	5	51	HBB
	10	42	HBB
2	1	41	HBB
	5	0	n
	10	32	HBB
3	1	40	HBB
	5	31	HBB
	10	0	n
4	1	0	n
	5	22	HBB
	10	20	HBB
5	1	19	HBB
	5	44	HBB
	10	30	HBB
6	1	37	HBB
	5	0	n
	10	31	HBB
7	1	35	HBB
	5	46	HBB
	10	33	HBB
8	1	37	HBB
	5	39	HBB
	10	0	n
9	1	0	n
	5	42	HBB
	10	22	HBB
10	1	30	HBB
	5	31	HBB
	10	39	HBB
11	1	34	HBB
	5	45	HBB
	10	20	HBB

n means no plant species was intercepted at that point along the line.

HBB = Himayalan Blackberry

Average Height = 28 cm

Standard Deviation= 16 cm

Line Point Method

Project Vegetation Monitoring
Length 6-meter square

Date 7/27/2001
Location Control Block
Measured By P.L.

Vegetation Intercepted at the 1, 3, and 6 meter points along each line

<u>Line No.</u>	<u>Point</u>	<u>Height of Plant (cm)</u>	<u>Plant Species Intercepted</u>
1	1	70	HBB
	3	109	HBB
	6	120	HBB
2	1	66	HBB
	3	101	HBB
	6	110	HBB
3	1	70	HBB
	3	110	HBB
	6	75	HBB
4	1	81	HBB
	3	90	HBB
	6	76	HBB
5	1	53	HBB
	3	77	HBB
	6	61	HBB
6	1	51	HBB
	3	80	HBB
	6	50	HBB
7	1	50	HBB
	3	67	HBB
	6	90	HBB

HBB = Himayalan Blackberry

Average Height = 79 cm
Standard Deviation = 21 cm

Attachment 3

3A. Monitored block before mechanical (hand-removal) treatment.

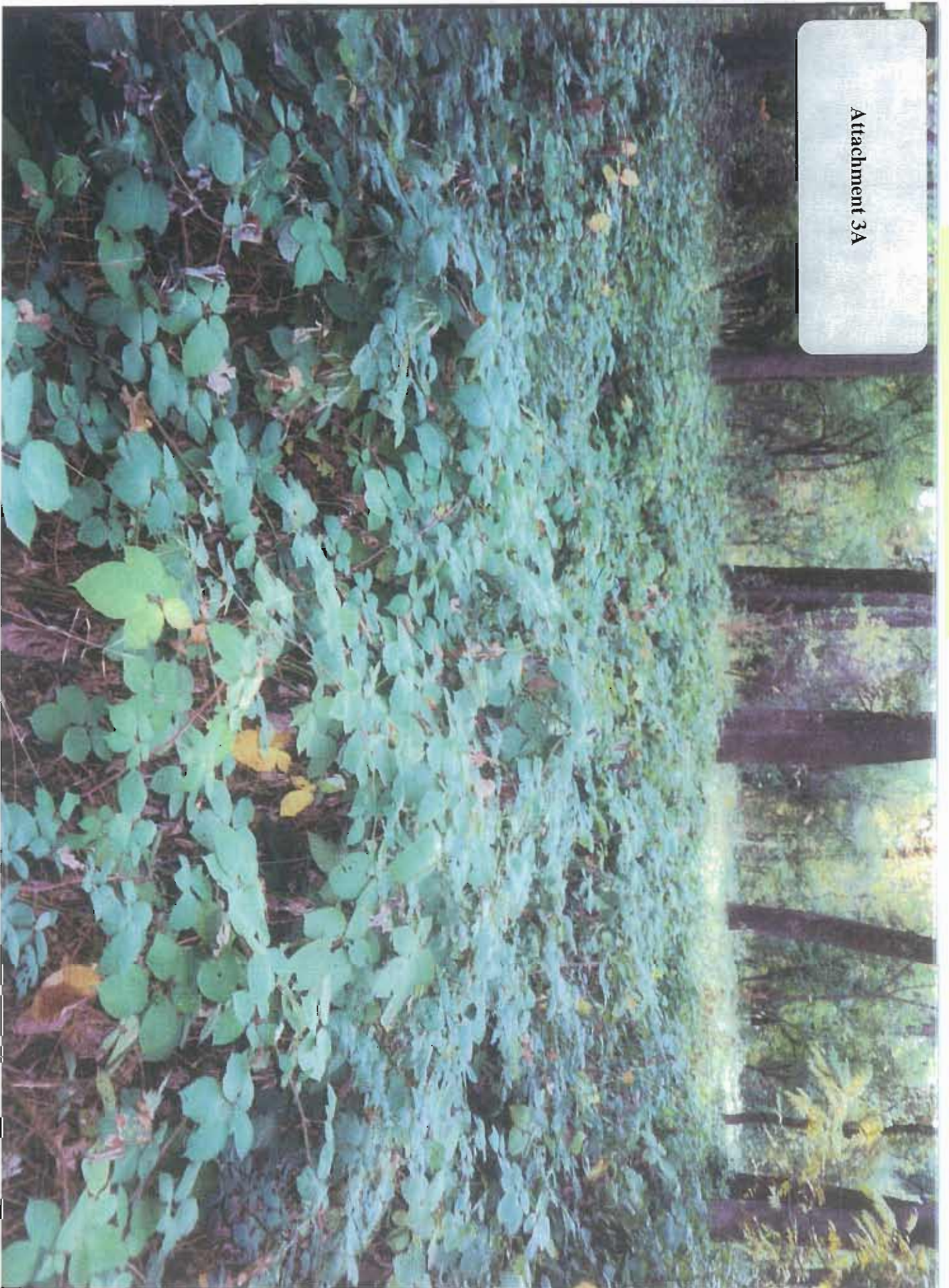
3B. Monitored block after mechanical treatment.

3C. Monitored block before biological (goats) treatment.

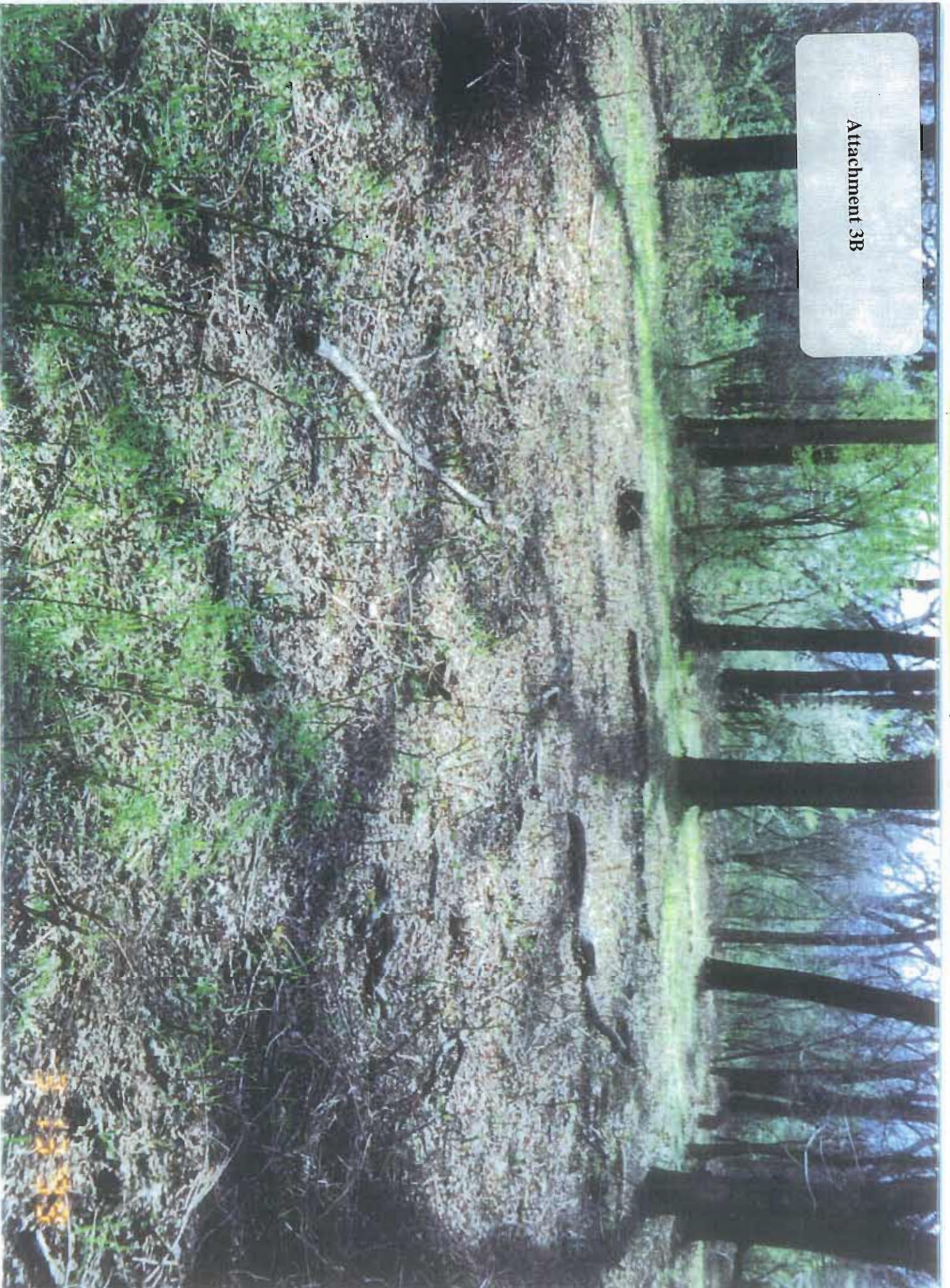
3D. Monitored block after biological treatment.

3E. Control block.

Attachment 3A

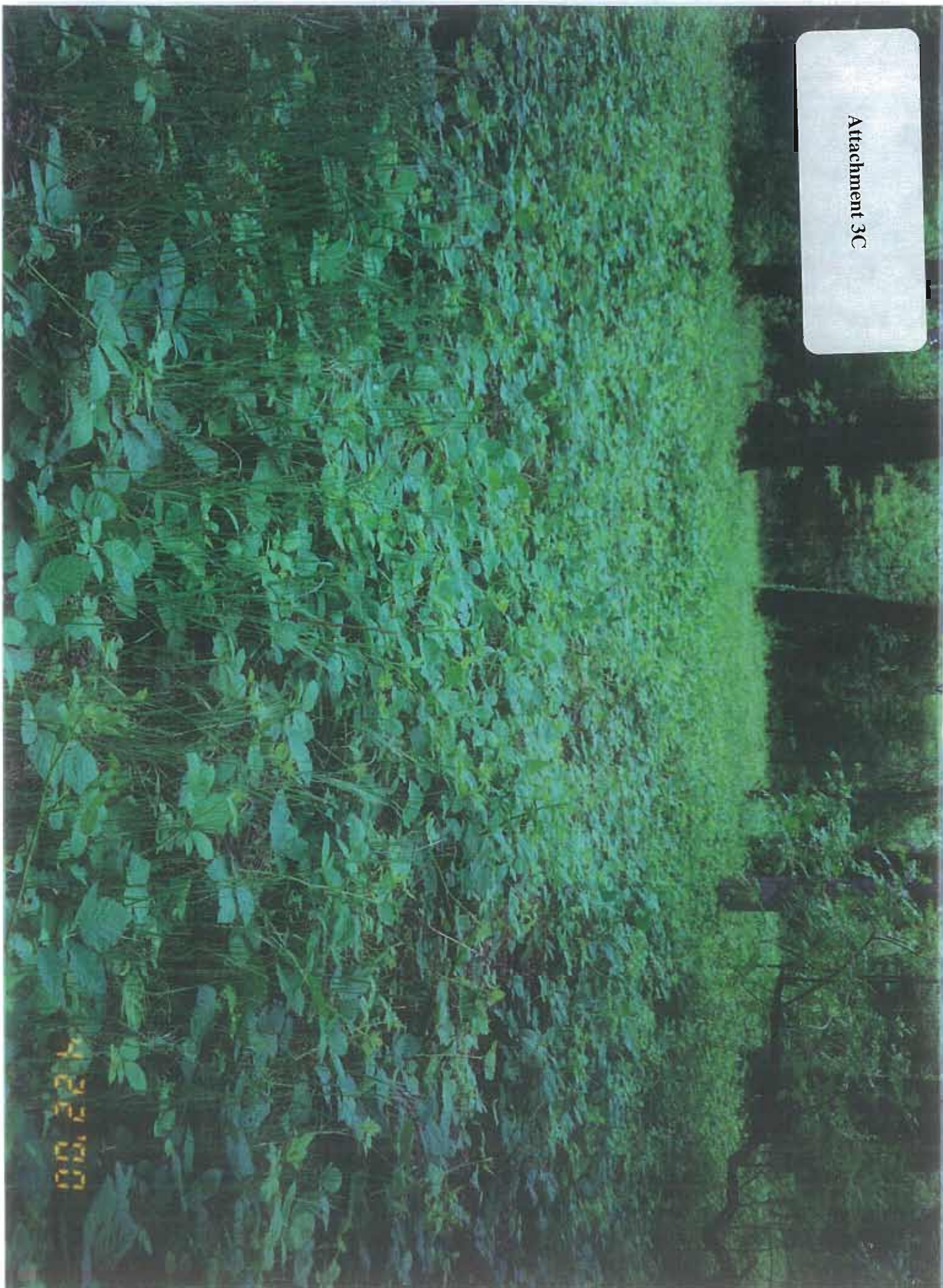


Attachment 3B

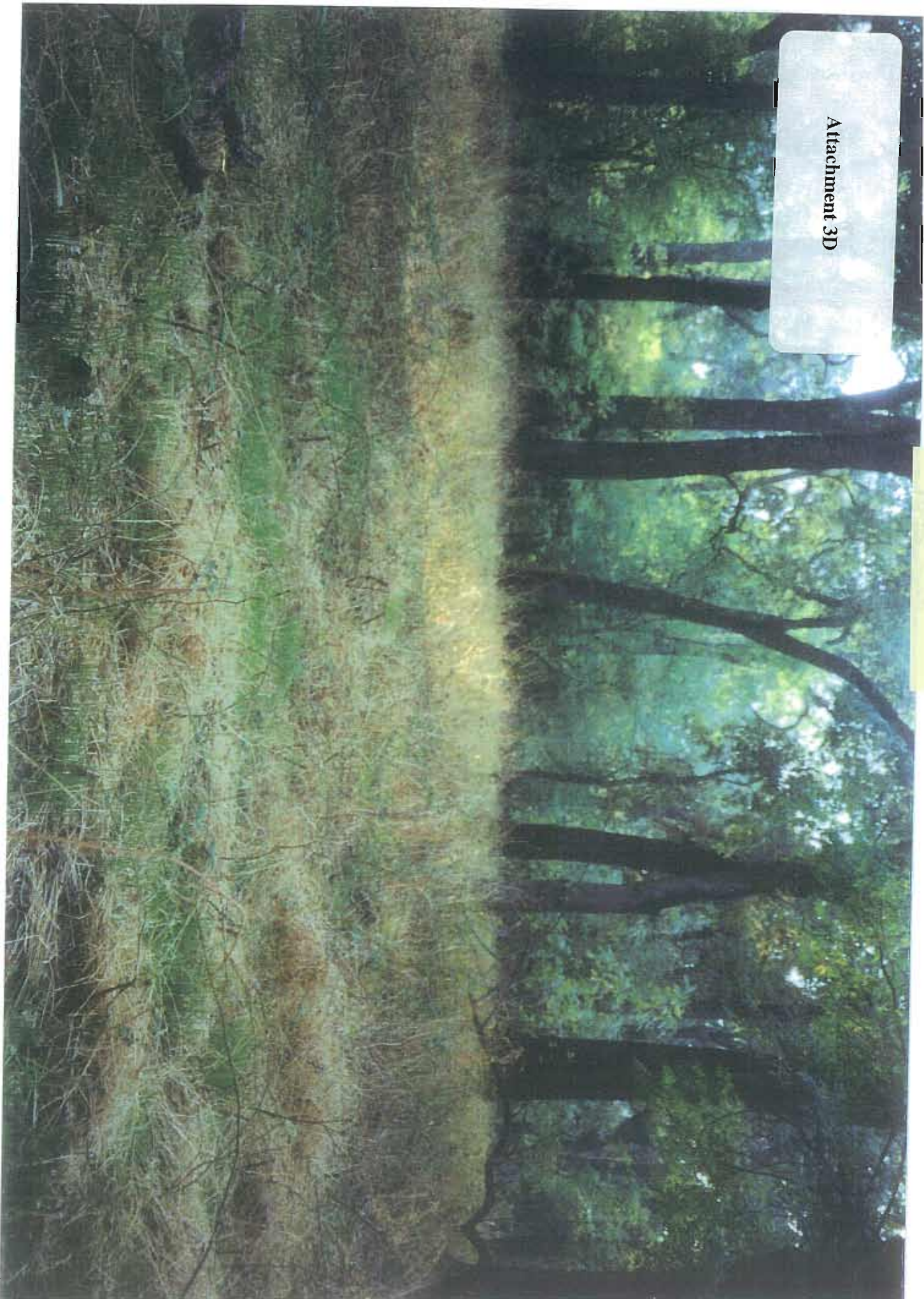


Attachment 3C

4/22/00



Attachment 3D



Attachment 3E





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