As-built report for the Brigmon Mitigation Site, Paint Fork Creek, Madison County

North Carolina Wildlife Resources Commission

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October 31, 2000

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Project Objectives

The objectives at this mitigation site were to improve the water quality, fisheries habitat, riparian quality and stability of Paint Fork Creek. A number of activities were undertaken to accomplish these primary objectives. On eroding sections, the stream bank was reshaped to a more stable cross-sectional profile. Areas of high bank stress were protected using vanes and rootwad revetments. Cross-vanes were used to improve habitat through pool creation. Channel sections that were over wide were narrowed to concentrate flow and improve habitat. Disturbed sections of the riparian zone were planted with native vegetation. Livestock were excluded from the riparian zone to protect vegetation and alternative watering options were provided. Initially grasses, sedges, rushes, and other herbaceous vegetation was seeded throughout the riparian zone. Some bare rooted trees and live stakes, of tolerant species were planted during construction. Additional stock will be planted extensively from the bankfull elevation up-slope to the easement line during the dormant winter season.

Specific objectives at the Brigmon mitigation site were the following:

1. Protect the stream and riparian zone through placing them in a conservation easement.

2. Protect riparian zone vegetation from grazing by fencing livestock out of the easement area and installing those practices made necessary by fencing (watering tanks, stream crossings, etc.)

3. Enhance stability by establishing the correct width/depth ratio, reducing entrenchment, sloping banks and planting woody vegetation on unnamed tributaries and Paint Fork Creek.

4. Install J-hook vanes along eroding sections of Paint Fork Creek to reduce erosion and provide fish habitat.

5. Stabilize the "big bend" in Paint Fork Creek by removing the auto parts presently used and constructing a bankfull bench with boulders and a rootwad revetment.

6. Enhance instream habitat by constructing a series of cross-vanes, primarily in the lower half of Paint Fork Creek.

7. Establish the proper width/depth ratio below the "big bend" by narrowing the channel and establishing a floodplain. Narrowing of the channel and floodplain enhancement will also be done on unnamed tributaries that are over-wide.

8. Plant native trees, bushes and ground cover that will stabilize the creek banks, shade the stream, and provide wildlife cover and food.

General Construction Narrative

Construction at this site was carried out through an informal contract with Autrey Tree & Landscaping Co., Incorporated. Equipment work began on April 24, 2000 and was completed on June 9, 2000. For a total of 33 days spent working at this site. The contractor provided two track-hoes, one rubber tired loader, dump trucks and hand labor, as needed. Access to the site was from Paint Fork Road (SR-1530), Angel Road (SR-1539), and across the landowner's

property. Work began by hauling approximately 15 dump truck loads of rock to the site from various spots on the landowner's property. Rock was stock piled at various locations where structures were planned and moved as needed by the rubber tired loader. Construction began at the top and continued downstream with work on the tributaries being done as they were encountered. Vertical eroding banks were sloped, vegetated and erosion control materials installed. Soil was graded or moved into the adjoining field. J-hook vanes, cross-vanes, rootwad revetments and floodplain benches were constructed at particular locations along the channel to mitigate erosion problems and improve stability. The site was vegetated with a native, riparian, seed mix and a cover crop. The cover crop developed well and stabilized the ground surface. A portion of the site was planted with live stakes and bare rooted trees. However, since this site was completed after the dormant season ended, planting of woody vegetation was not completed and survival of those trees planted may be reduced. Trees have been ordered for this site and will be planted during the coming dormant season, winter 2001. Live stake material will also be collected and planted at this site. An attempt to establish 350 to 500 trees per acre will be made. Stability data will be collected at this site during fall or winter 2001. At this site, this project has resulted in the restoration and protection of 5175 linear feet of stream and riparian area.

Preconstruction Site Conditions:

The Brigmon site is located in the Little Ivy Creek watershed on Paint Fork Creek. The lower end of the site begins approximately 1.65 miles upstream from the mouth. The watershed is developed with a medium to low density of homes. The primary land disturbing activity in the watershed is agriculture. Most of the flatter valleys are used to raise tobacco and cattle are grazed on steeper pastureland. Forestland in the watershed was converted to agricultural land during the1800's and early 1900's. A significant portion of the watershed remains in secondary growth forest. At the present time, there is some conversion of agricultural land to single family home sites. The construction of a major interstate through the county should increase this trend. Little Ivy Creek has suffered from land disturbing activities within the watershed. Much of the creek has been channelized or moved, to protect and consolidate fields. Sedimentation of the creek has continued for many years as soil from fields, pastures and gravel roads has eroded into the creek. Biological samples indicate fair to poor water quality conditions in Paint Fork Creek.

The Paint Fork channel at this site is confined by a narrow valley, which drops approximately 21.3 feet in a 2925-foot reach (slope is .0073) and has a drainage area of 13.6 square miles. The two tributaries have small watersheds of .15 (upper) and .16 (lower) square miles, but are steep having water surface slopes of .07 and .05, respectively. All three channels are single thread channels that closely follow the valleys. The tributaries were severely degraded by livestock trampling the channel and eating riparian vegetation. At many areas the tributary banks were eroding, while in other areas the channel was over-wide due to degradation of the channel. While these tributaries do not carry large discharges they have been significant sources of sediment for the main channel. Paint Fork Creek changes over this reach. Upstream of the driveway bridge the stream is somewhat steeper and has exposed bedrock. There are deeper pools and the width/depth ratio is low. Downstream of the bridge is a sever bend that was stabilized in the past using junked automobiles. Below this bend was an over-wide section of approximately 100-feet. The lower channel below the over-wide section, has a lower slope, long riffle sections and a higher width/depth ratio. Bankfull was determined using field-identified indicators, primarily a scour line, and evaluated using regional curve information (NCSU, unpublished data). An entrenchment ratio of approximately 2.4 and a width/depth ratio of 12.8

indicate that this is a B type stream. Medium to course gravel (16 mm) is the D50 of the bed material in the project reach. Water surface slope across the project reach is .0073, which is more indicative of a C type stream. When taken together these criteria indicate that the project reach is a B4c, according to the Rosgen stream classification system.

Pool habitat in the lower section of the Paint Fork reach was limited, with only one large pool present in this section. The remaining pools were small scour pools with limited length and depth. Within the lower reach of Paint Fork Creek were 300-foot long riffles. This condition had resulted in a limited number of quality pools to support aquatic organisms. The D_{50} of the bed is medium to coarse gravel; however, the size distribution of bed material sampled during pre-project pebble counts indicated a multimodal particle size distribution. The size distribution of the pebble count gives a better description of the bed than the D_{50}. Inspection of the bed indicated one composed of cobble, gravel and a few boulders, with some bedrock in areas. The larger particles were embedded by finer sand and silt material. The absence of high quality pools and the presence of embedded substrate had resulted in limited spawning areas for fish, particularly gravel spawning species such as trout. Improvements to the channel that result in deeper pools that tail out into sorted gravel should improve spawning conditions and provide a diversity of bed conditions that benefit many aquatic organisms.

Riparian conditions were poor on the two tributaries, and only fair on the main stem. With the exception of one small area, this site includes both sides of all the creeks involved. At spots along the Paint Fork channel the stream had developed a narrow floodplain and an interberm. The riparian zone of Paint Fork Creek at this site was vegetated primarily with herbaceous plants and some woody vegetation. The right bank between the creek and the road had a good diversity and density of woody vegetation. The left bank between the creek and the tobacco fields had little woody vegetation. This bank was vegetated by *multiflora rose,* black berry, sumac, various vines and an occasional tree. Erosion was occurring at the bankfull elevation along this bank and a small berm had been built along the stream at a number of spots. The existing riparian vegetation varied between 10 and 30 feet in width and provided minimal shade, which trout streams need to maintain the cold water. The banks along the tributaries were vegetated primarily with pasture grasses, except where the banks were to steep for livestock and these sites had some woody species such as ironwood and hemlock. The tributary banks were degraded and rutted by livestock. Livestock access was the primary problem on the tributaries; while a lack of woody vegetation and steep banks were the problems on the main stem. Past stabilization of eroding stream banks consisted of placing junked automobiles or tires on the banks. Historically, this was a common practice advocated by some government agencies, but it has become apparent that this is not desirable for stream bank stabilization.

Channel Modifications:

Work at this site progressed in this order: Paint Fork Creek above the driveway bridge, the upper tributary, Paint Fork Creek below the driveway bridge and the lower tributary. Two J-hook vanes were installed along the left bank above the upper field where erosion was occurring (see the map showing all structure locations). Two boulder cross-vanes were installed in the lower section of Paint Fork Creek to protect eroding banks and to create needed deep water habitat. Boulders weighing 300 to 500 pounds were used to construct these vanes. Most of this rock was fieldstone that had been moved out of fields in the past and discarded at various sites on the farm. The first order of business at this site was to collect these boulders and move them to structure sites. J-hook vanes started with two or three offset boulders (J-hook) to create a scour

pool and rose in a downstream direction to the bankfull elevation on the bank. Cross-vanes were built in a similar manner but they consisted of two arms, each of which meets in the center of the stream and rises to the bankfull elevation downstream on the bank. Large footer rocks supported all top rocks in the vanes. Holes were dug at the convergence points of the water vortices to accelerate pool formation. Excess bed material was placed near the bank, upstream of the vanes where natural deposition would be expected. The middle cross-vane in the lower section was built out of boulders and hemlock logs. The logs formed the arms of the vane and boulders provided support and pinned the logs in place. This type cross-vane provided a much more consistent slope across the arms but may experience erosion of bed material in front of the arms. This will have to be evaluated on a yearly basis. The placement of this series of vanes was designed to reduce erosion and to create pool habitat below the vanes.

In addition to the vane structures, rootwad revetments were also constructed to improve stability, decrease width and improve aquatic habitat. Rootwads were used at one site along the upper field to stabilize an eroding bank. A rootwad revetment was installed in the big bend downstream of the driveway bridge to stabilize this bend after three truck loads of automobile parts were removed. Junk automobiles had been used in the past to stabilize this bend, but they were beginning to fall apart and litter the stream. After removal, a bankfull bench was constructed using boulders and rootwads. The surface of this bench was covered to the bankfull elevation with soil and vegetated. This bench copied and continued a natural feature downstream and into a bedrock outcrop. Downstream of this feature the stream had become overwide and was developing a mid-stream bar and eroding the right bank during high water. The channel was narrowed at this point using boulders to demarcate the new bank and back filled with waste rock. The entire area was filled with soil and vegetated. Rootwads were installed at a site upstream of the lower cross-vane to promote channel narrowing. The channel was just slightly overwide at this point and if deposition could be promoted along one bank the channel would narrow over time and correct this problem. The rootwads were installed on the left bank so that they directed the water toward the right bank and reduced flow on the left bank. Deposition has already been observed in this area, so this approach appears to be working. The last structure used to alter the channel morphology was the placing of coir rolls to define channels on overwide sections of the two unnamed tributaries. This involved pinning the rolls in place and filling behind them with soil to a bankfull elevation. The area was then vegetated. All of these methods defined the appropriate channel dimension, stabilized that dimension in away that will be maintained naturally and promoted good vegetative cover.

The attached longitudinal profile shows how vane construction has increased the deep-water habitat. The scour action of these vanes can be observed from this profile. The attached pebble count information, which was taken below the three cross-vanes, shows the decrease in fines below these vanes and the increase in smaller cobbles. To some extent this data reflects constructed conditions and not hydraulic influences; however, the site has had some high water over it since project completion, so direct alterations during construction do not account for all observed improved conditions. The vanes are creating the desired deep-water habitat and sorting bed material in a way that will provide needed spawning gravel. Dry conditions have been experienced most of this summer and fall so the functioning of these structures over a long period of high water has not yet been evaluated. No further erosion has been observed at this site. The attached cross-sections show post-construction conditions (with some also showing pre-conditions) and will be used to monitor channel stability. Additional cross-sections may be

added to these to evaluate areas of concern. Long-term stability of these sites will be accessed beginning next year, by implementing our monitoring protocol.

Riparian Improvements:

The first step in restoring the riparian zone of this stream was to slope the vertical banks back to the easement line, starting at the back of the interberm. On Paint Fork Creek sloping only occurred on the south bank since the north bank was stable. This also was done on the tributaries as needed. The primary difference was that the tributaries did not have an interberm feature. A coir log was placed on the interberm and staked into place. Coir logs were used to define and stabilize the bank at the bankfull elevation. The cross-sectional area of the channel was maintained as the coir logs were installed. After logs were pinned in place the area behind the log was filled with soil to the top of the log, which was the bankfull elevation. This soil was then sloped to the easement line to create a floodplain. Both the floodplain and the interberm were fertilized, limed and seeded. After seeding, either an eight-foot wide, coir/straw blanket or coir "net" type blanket was used to cover the area above the log. Two types of blankets were used to test which would be better for this application on future projects. Above these erosion control blankets a 4-foot width of jute fabric was laid down. All of these erosion control materials were pinned using landscape staples. An attempt was made to cover the entire sloped bank with fabric. These blankets were used to stabilize the soil surface until a vegetative cover could be achieved and to contribute to soil stability after vegetation was established. As these materials decompose over a projected 3-year period, permanent vegetation should become well established.

Seeding was done with a native riparian mix and a cover crop of millet. The millet germinated and grew through the erosion control materials quickly. When seeded areas received rain, the seed would sprout within 3 to 5 days. This provided a very stable ground surface. All of the seeded areas developed an excellent cover crop that produced seed and died by fall. By fall both the riparian mix and volunteer plants had began growing within the easement area. It may take 2 to 3 years for these perennials to establish good populations. A large quantity of live stakes was planted at this site as construction proceeded. These consisted of black willow, silky willow, and silky dogwood. A number of bare rooted trees were planted, these plantings consisted of black willow, red-osier dogwood, willow oak, river birch, black walnut, persimmon, green ash and red maple. Because these plantings occurred at the end of the dormant season, survival may be limited. This will be assessed during the spring of 2001. A greater number of trees were planted on the areas worked early in the project, such as upper Paint Fork. Live stakes and bare rooted material ran out before the site was completed. More live stakes and bare rooted trees will be planted at this site during late winter 2001. An attempt will be made to plant the site with woody vegetation to a density of 350 to 500 trees per acre. The site will be monitored to insure that a good stand of trees is established. During a number of site visits since construction was completed, the riparian area was found to be stable and vegetation in excellent condition. The standard NCWRC Monitoring Protocol will be established and continued at this site, using the data that accompanies this report as well as vegetative analysis, when planting is completed.

Livestock Management:

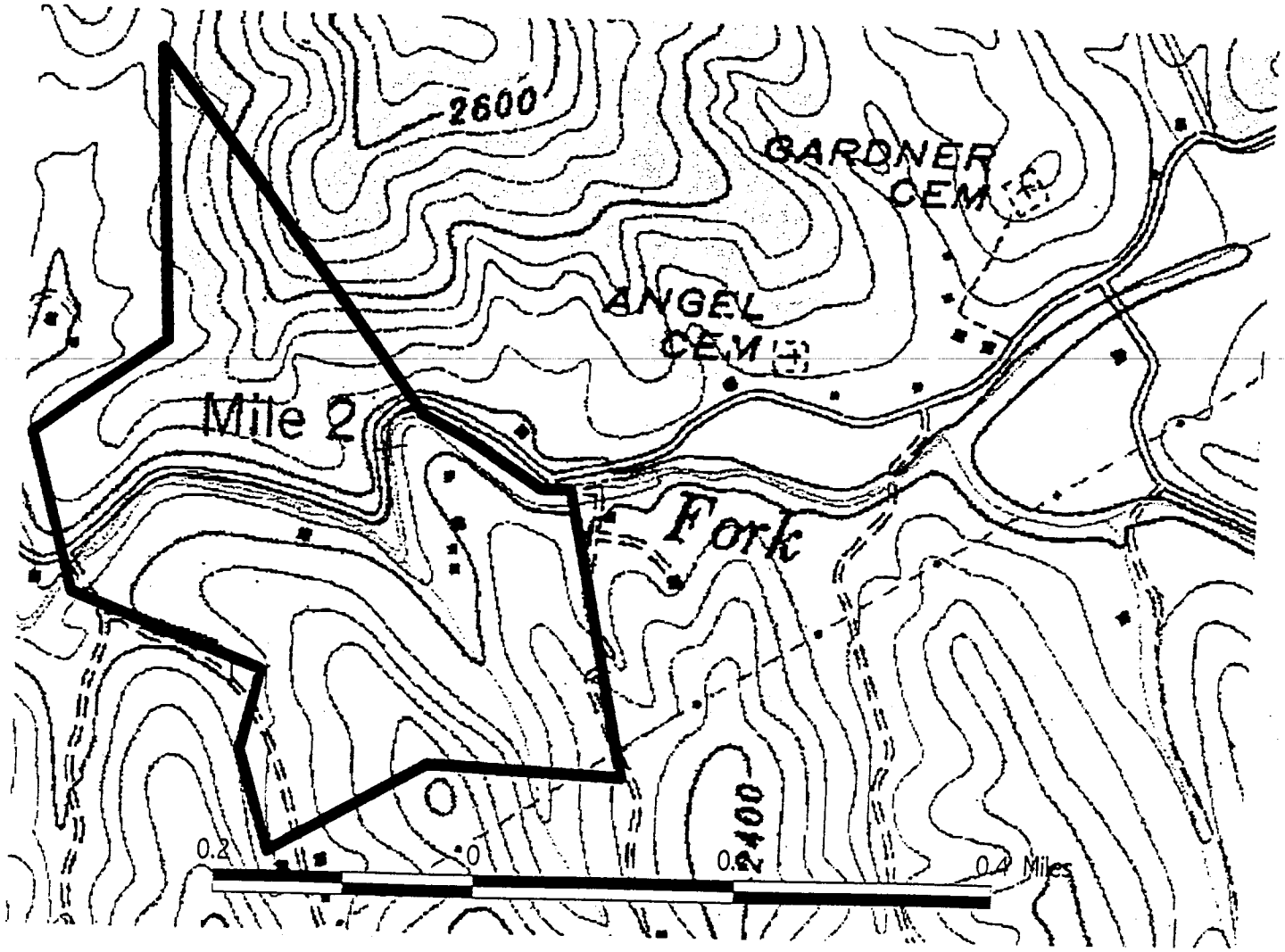
The Natural Resource Conservation Service (NRCS) was responsible for the planning and installation of livestock management practices associated with this project. Practices where

installed that mitigated the impacts of establishing a conservation easement on the livestock operation at this site. Practices installed at this site include stream crossings, a watering system and fencing. The watering system at this site included seven watering tanks, capturing and piping 3 springs and hardening the areas around the tanks to avoid degradation and sedimentation of the areas by livestock. The watering system was installed before the channel work was done so that there would not be a need for the livestock to access the stream. Stream crossings were installed at three locations where there were failing culvert crossings. After the stream work was completed, a 5-strand barbed-wire fence was constructed to exclude livestock from the stream. The fencing of this easement required approximately eight miles of fence. The fence was built along the conservation easement line with turning post at calls along the survey. All turns were made with 4x4 pressure treated posts, gateposts where high use was expected were installed with concreted 6x6 posts, and straight sections of fence were installed using metal T-post. The NRCS standards do not call for these pressure treated materials but they were used because they should require less maintenance and provide longer life. The posts are guaranteed for 40 years, so the life of the fence should approximate this time period, with occasional maintenance. The standard NRCS fence only has a life expectance of 20 years. To date the landowner is satisfied with the livestock practices installed at this site. Some fence maintenance has already been required due to tree limbs falling on the fence. The fence will be inspected 2-4 times a year and the landowner was told that he should call us if maintenance is needed.

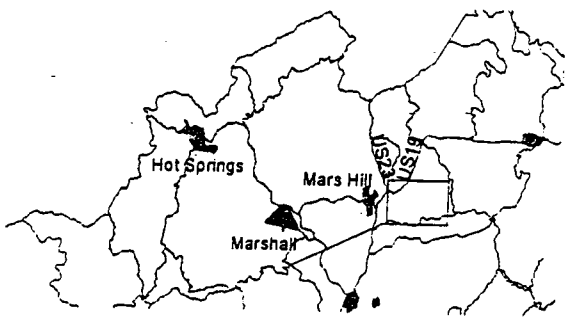
Other Benefits:

In addition to the benefits that have been realized from the mitigation work that has been described above, additional conservation measures were put in place at this site. The landowner worked through the NRCS to secure matching funds to construct a feeding structure on his property. This structure was sited well away from the stream and allows the landowner to reduce the hay wasted by livestock and the structure collects animal waste through the winter for field application in the spring. The landowner was able to cost share this structure using the money he was paid for his easement rights. This project allowed him to move his winter feeding site off of the lower unnamed tributary, thereby greatly reducing the flow of animal waste from this site into the stream. This was the first such structure built in Madison County and started a very popular movement within the county. The NRCS has built a number of these structures since this first one and has a waiting list of landowners that want to participate.

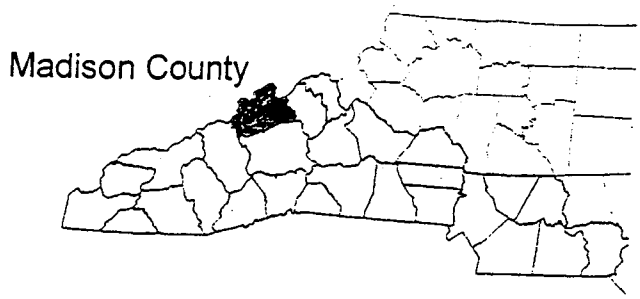
Brigmon Site



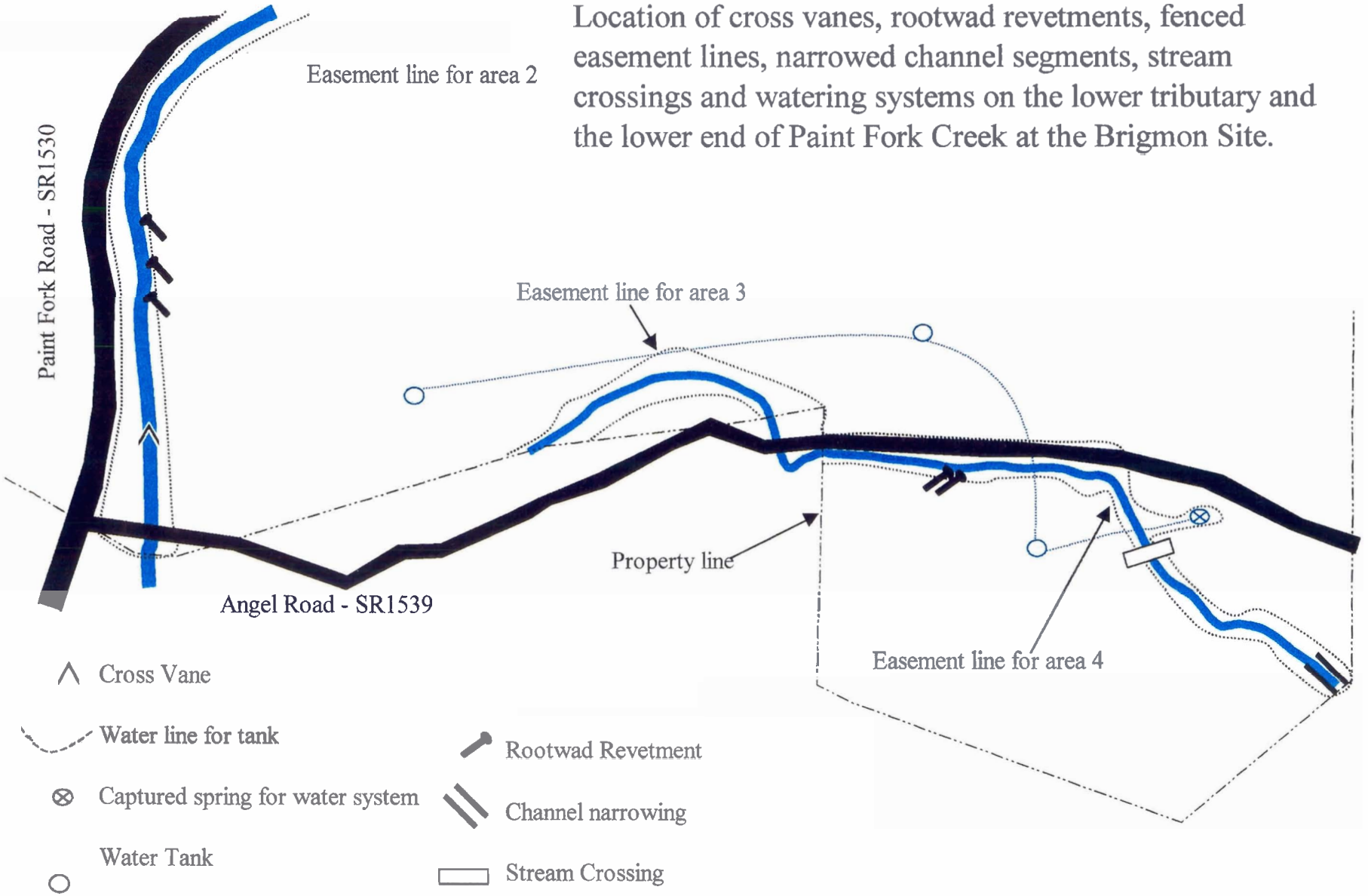
Madison County



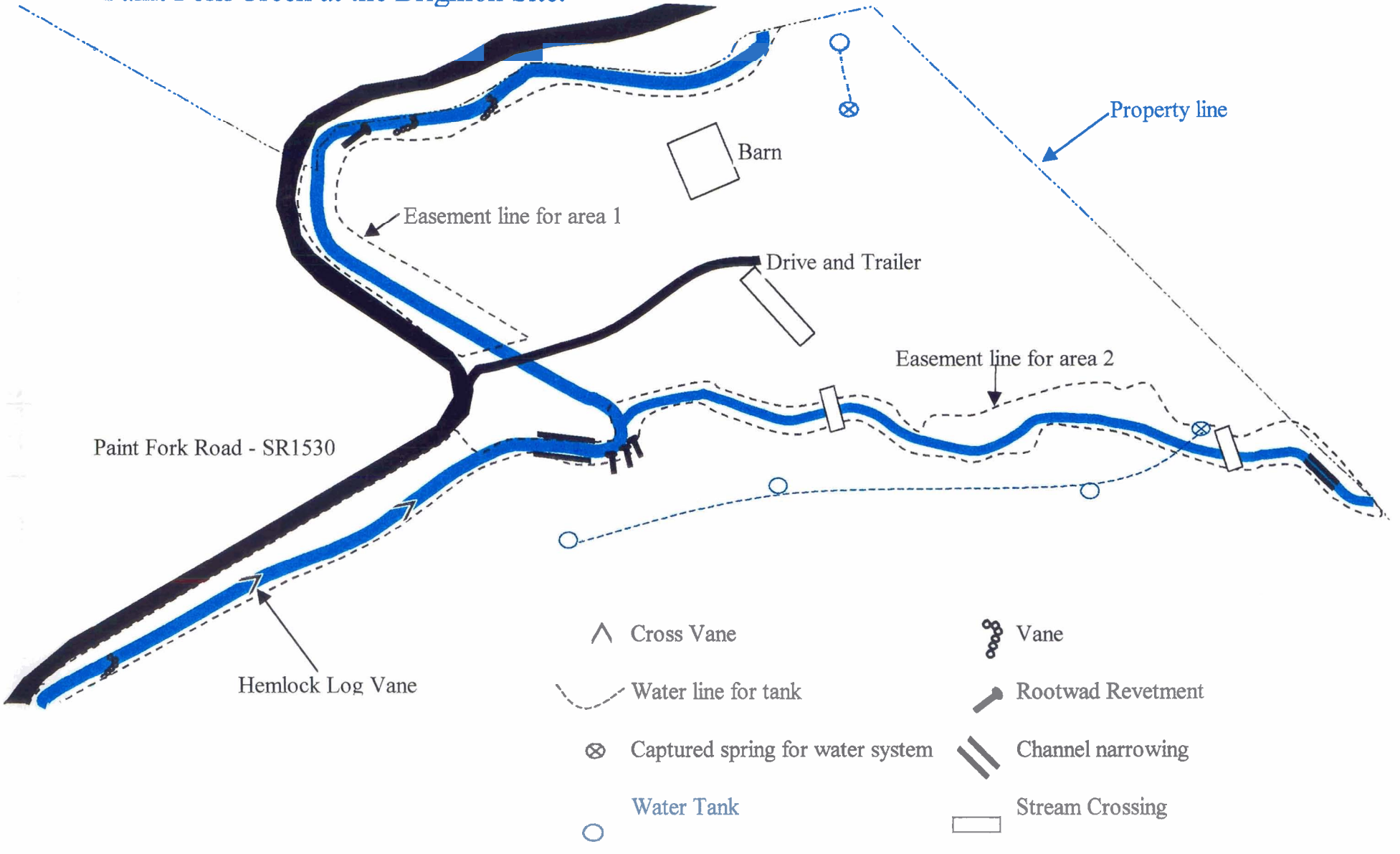
North Carolina

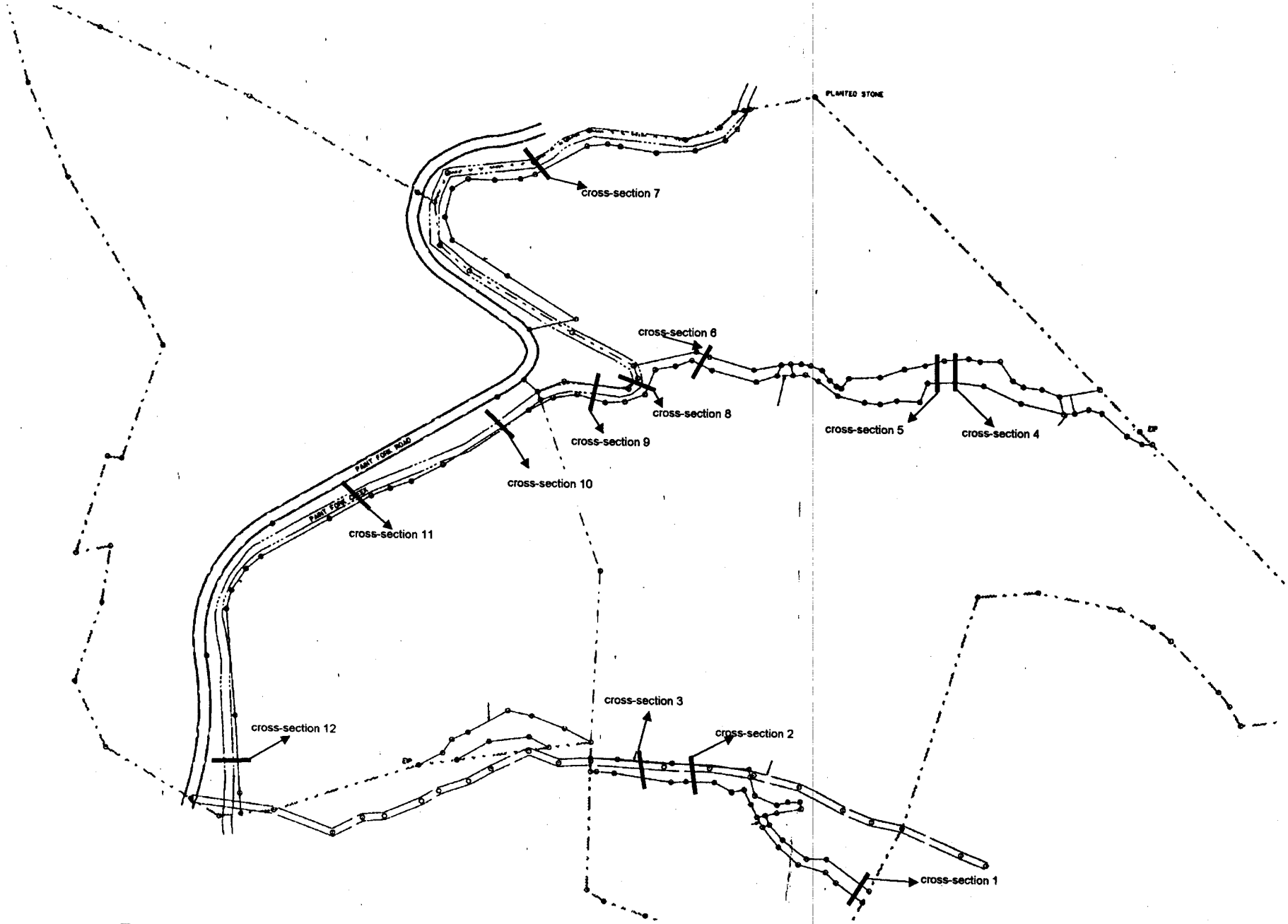


Location of cross vanes, rootwad revetments, fenced easement lines, narrowed channel segments, stream crossings and watering systems on the lower tributary and the lower end of Paint Fork Creek at the Brigmon Site.

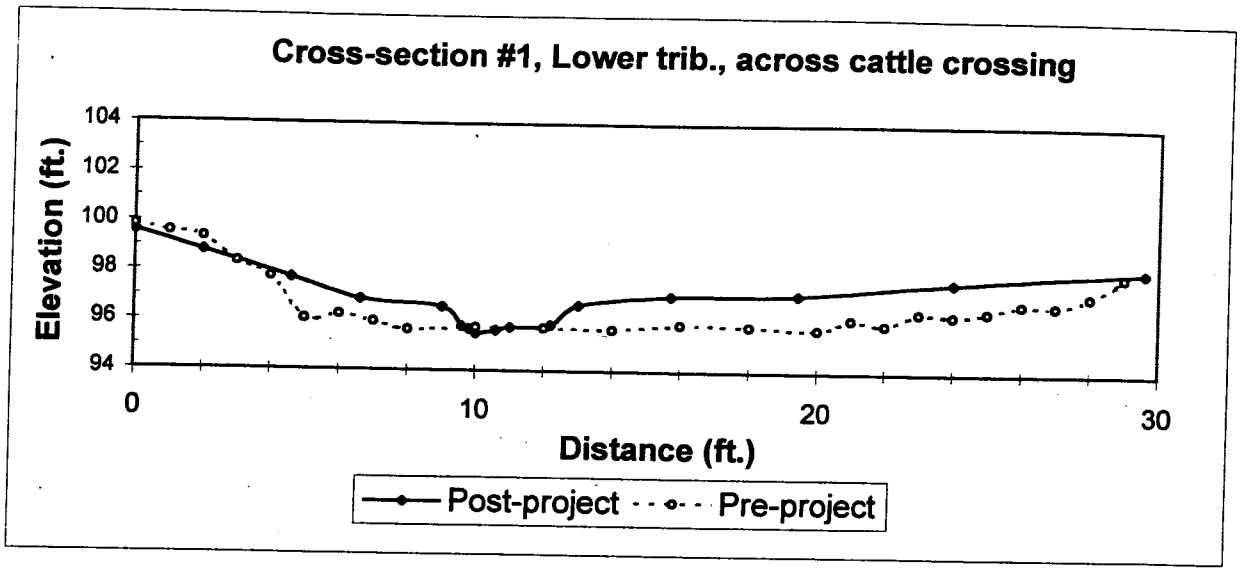


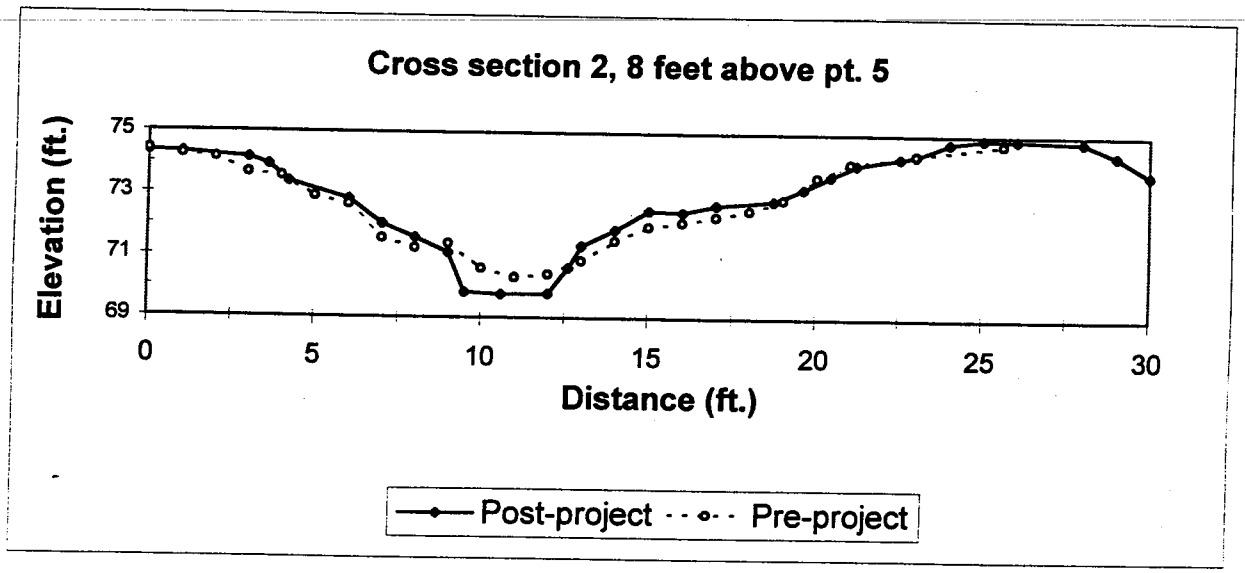
Location of cross vanes, rootwad revetments, fenced easement lines, narrowed channel segments, stream crossings and watering systems on the upper tributary and the upper end of Paint Fork Creek at the Brigmon Site.

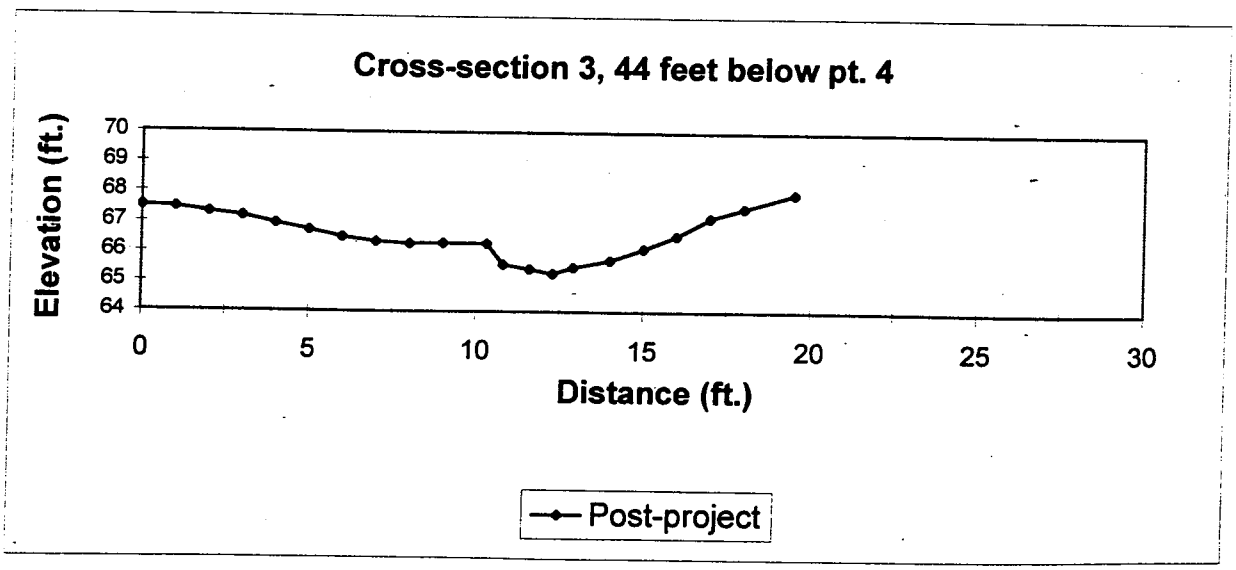


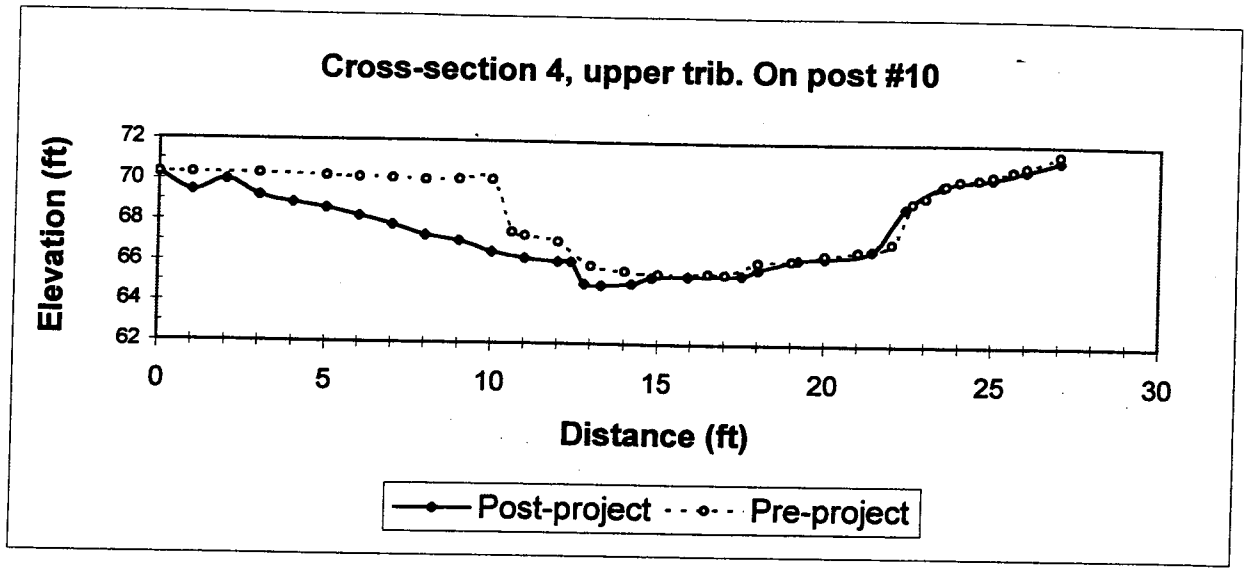


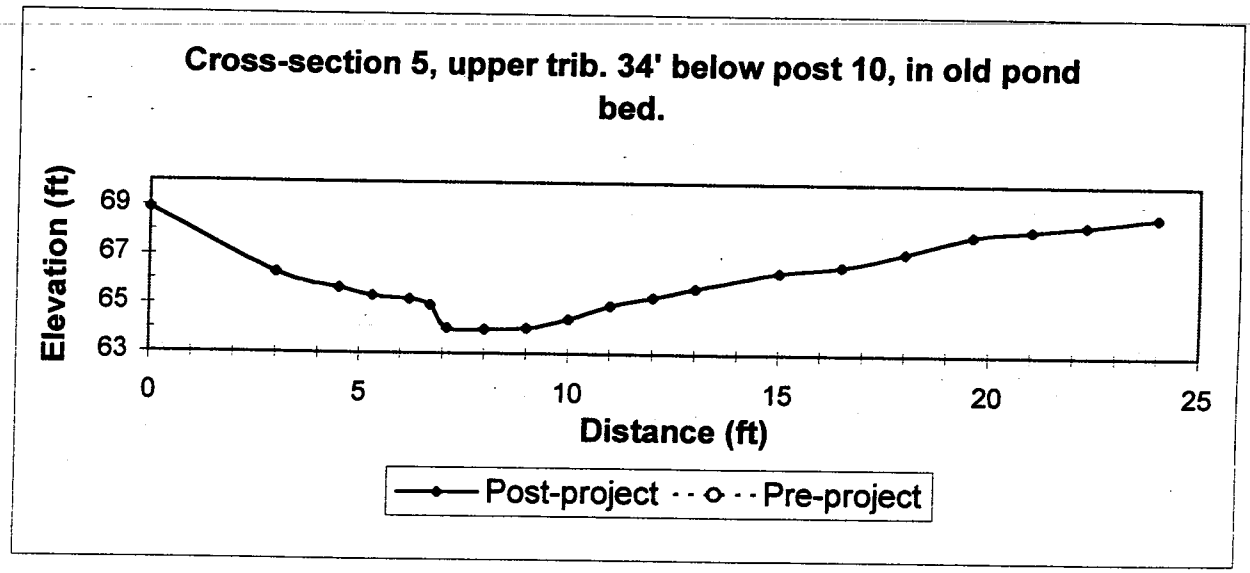
Location of each monitoring cross-section taken on the two unnamed tributaries and Paint Fork Creek at the Brigmon Site.

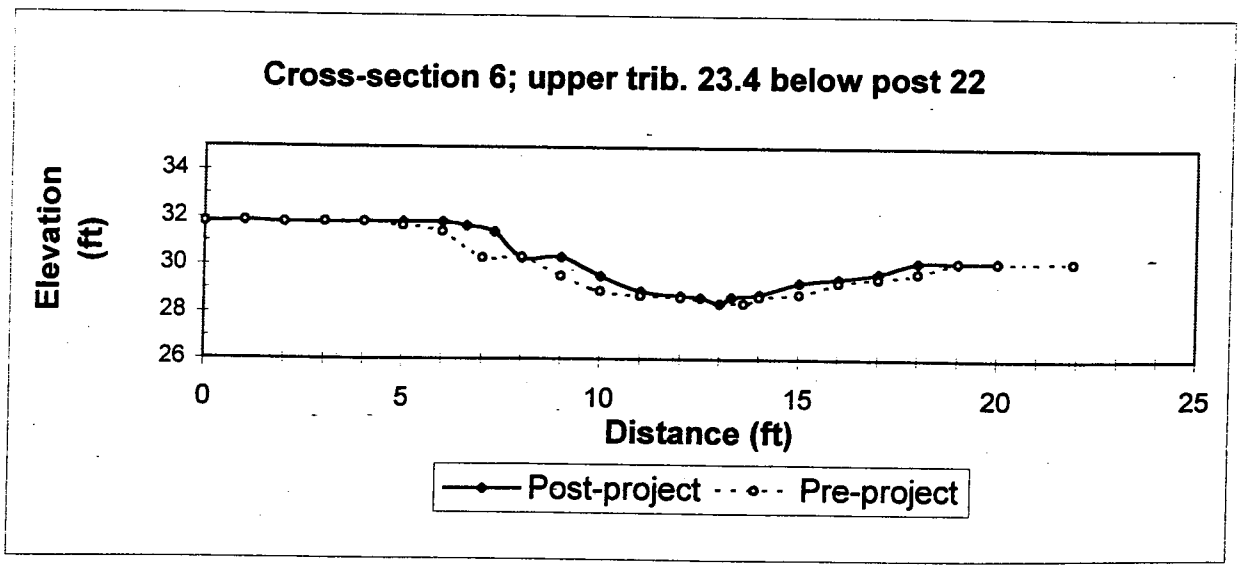

Cross-section #1, Lower trib., across cattle crossing
Elevation (ft.)
104
102
100
98
96
94
0
10
20
30
Distance (ft.)
Post-project
Pre-project

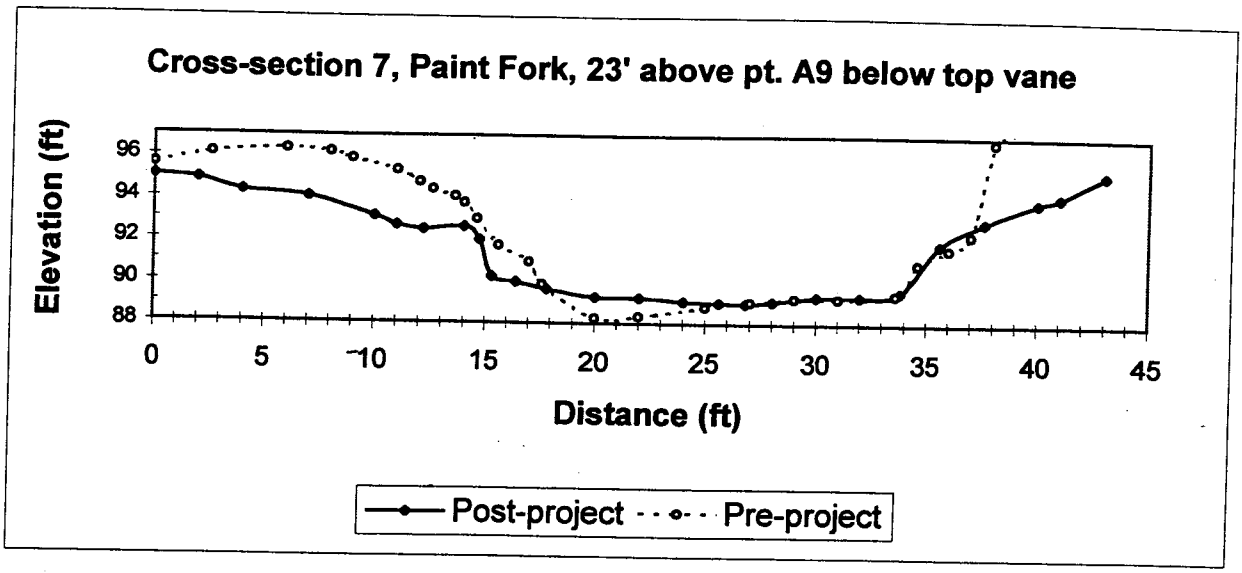

Cross section 2, 8 feet above pt. 5
Elevation (ft.)
75
73
71
69
0
5
10
15
20
25
30
Distance (ft.)
Post-project
Pre-project

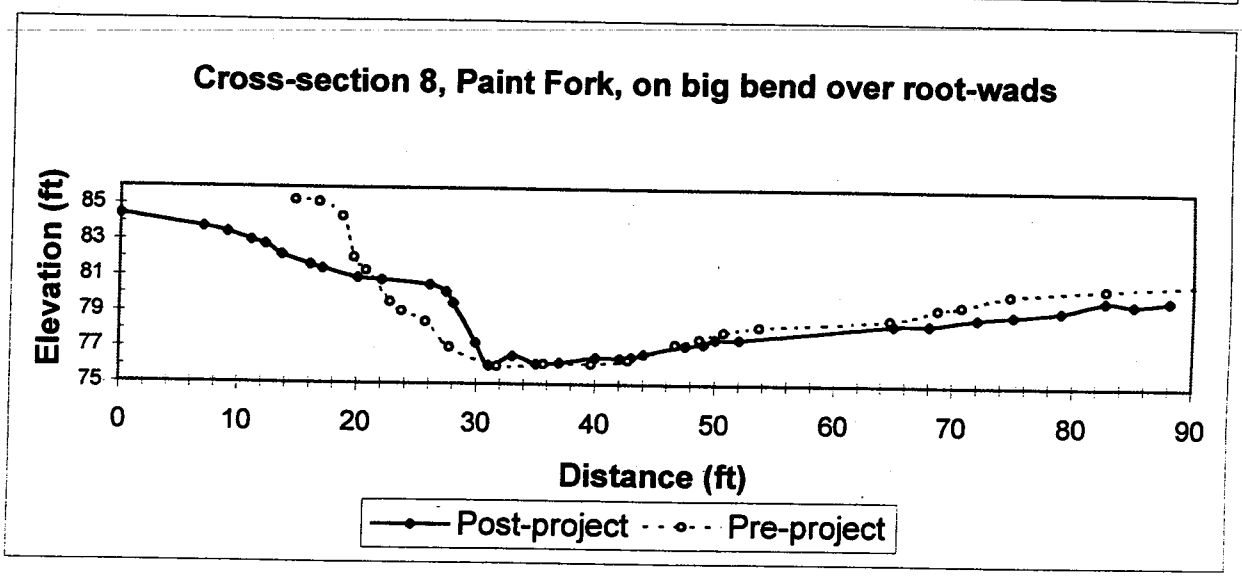

Cross-section 3, 44 feet below pt. 4
Elevation (ft.)
70
69
68
67
66
65
64
0
5
10
15
20
25
30
Distance (ft.)
Post-project

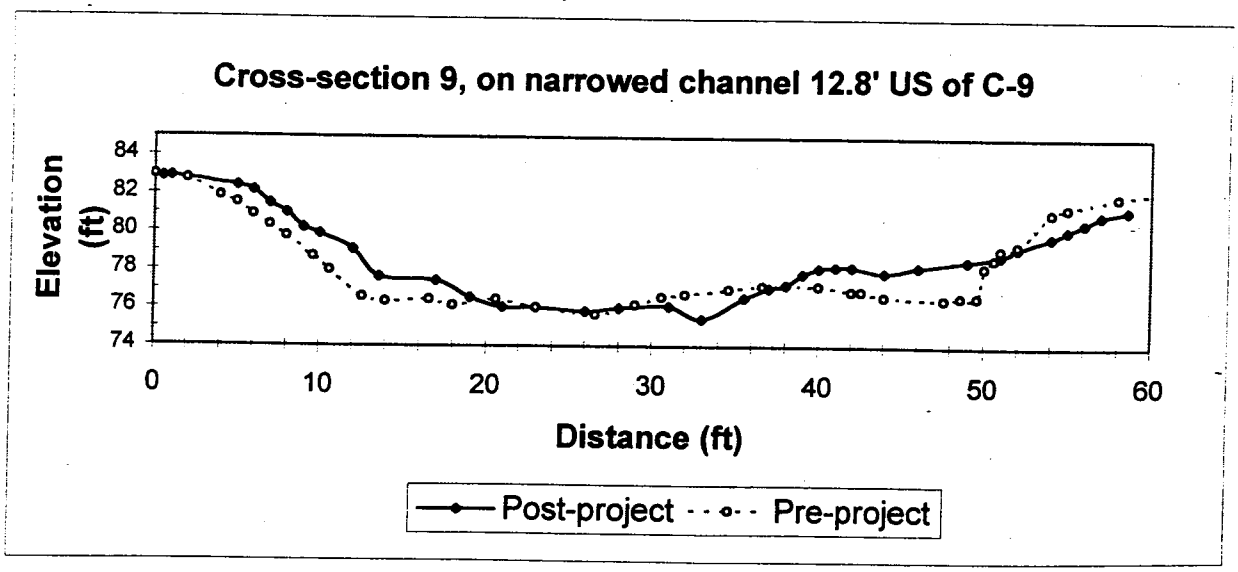

Cross-section 4, upper trib. On post #10
Elevation (ft)
72
70
68
66
64
62
0
5
10
15
20
25
30
Distance (ft)
Post-project
Pre-project

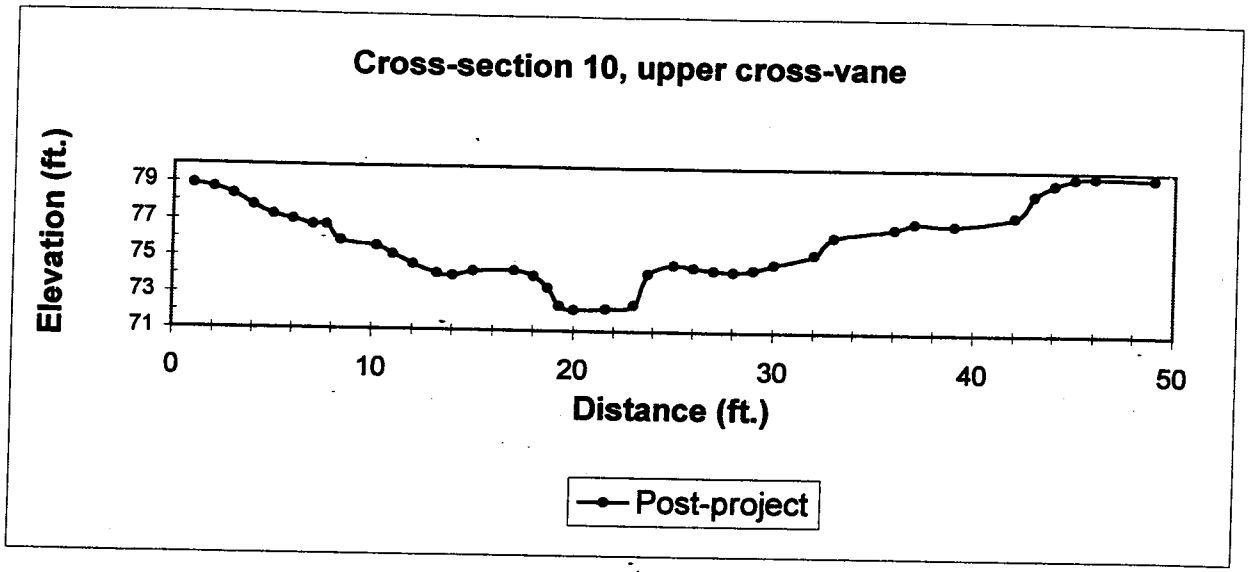

Cross-section 5, upper trib. 34' below post 10, in old pond bed.
Elevation (ft)
69
67
65
63
0
5
10
15
20
25
Distance (ft)
Post-project
Pre-project

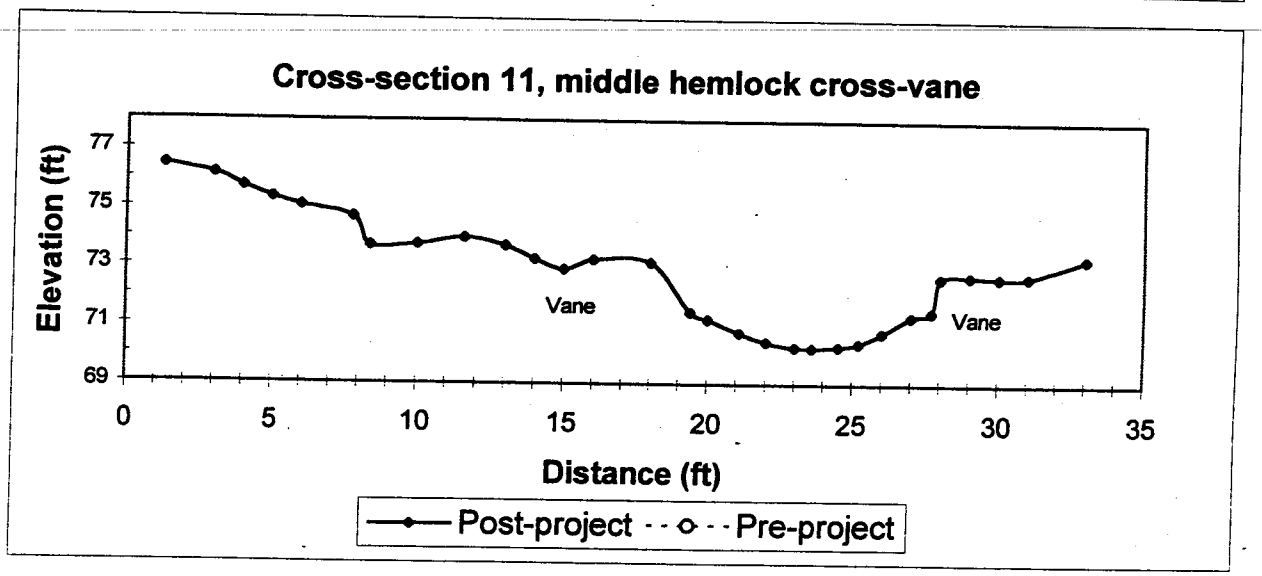

Cross-section 6; upper trib. 23.4 below post 22
Elevation (ft)
34
32
30
28
26
0
5
10
15
20
25
Distance (ft)
Post-project
Pre-project

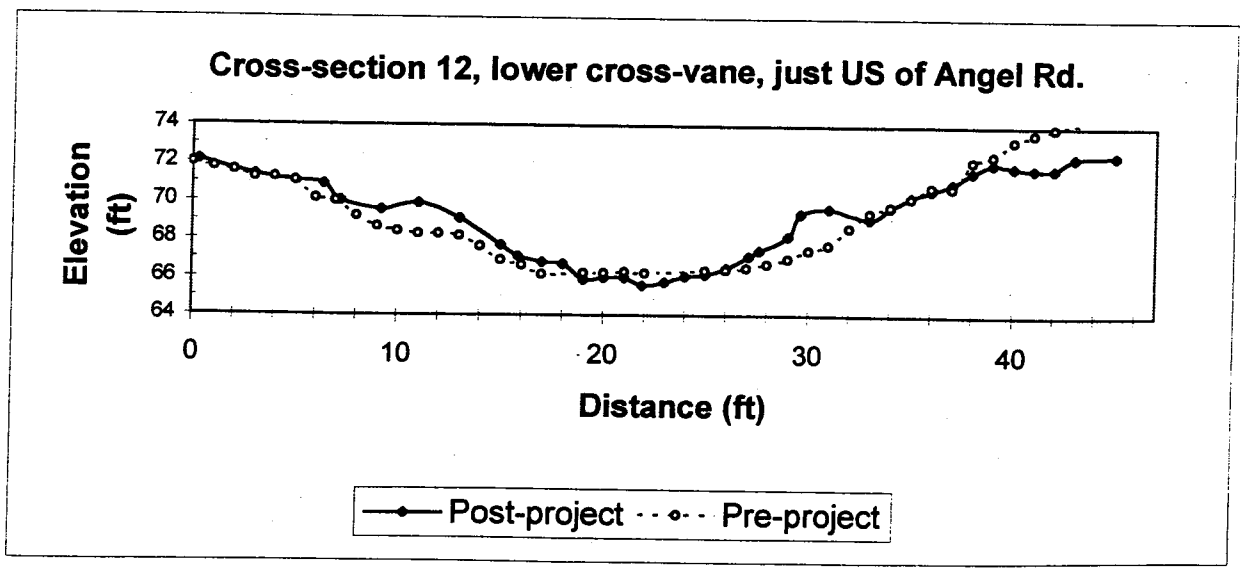

Cross-section 7, Paint Fork, 23' above pt. A9 below top vane
Elevation (ft)
96
94
92
90
88
0
5
10
15
20
25
30
35
40
45
Distance (ft)
Post-project
Pre-project


Cross-section 8, Paint Fork, on big bend over root-wads
Elevation (ft)
85
83
81
79
77
75
0
10
20
30
40
50
60
70
80
90
Distance (ft)
Post-project
Pre-project

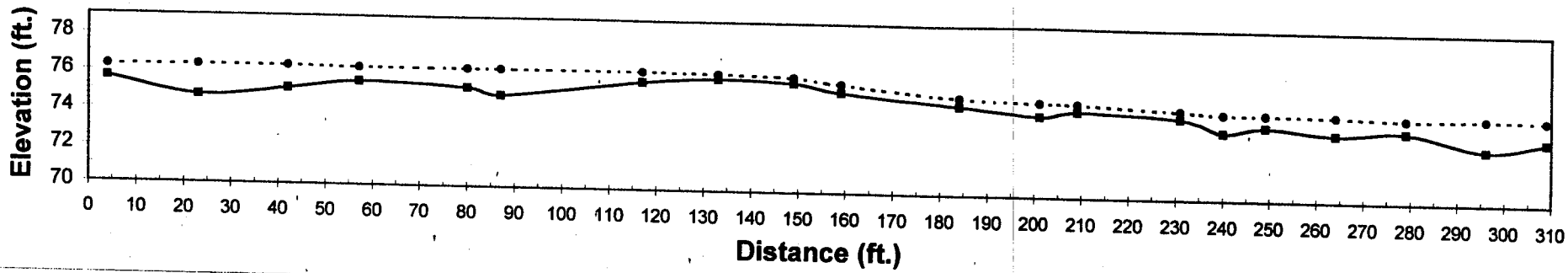

Cross-section 9, on narrowed channel 12.8' US of C-9
Elevation (ft)
84
82
80
78
76
74
0
10
20
30
40
50
60
Distance (ft)
Post-project
Pre-project


Cross-section 10, upper cross-vane
Elevation (ft.)
79
77
75
73
71
0
10
20
30
40
50
Distance (ft.)
Post-project

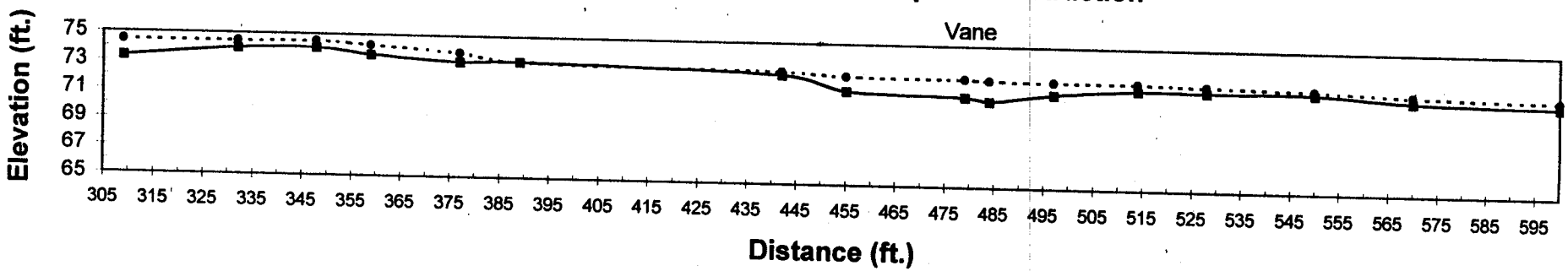

Cross-section 11, middle hemlock cross-vane
Elevation (ft)
77
75
73
71
69
Vane
Vane
0
5
10
15
20
25
30
35
Distance (ft)
Post-project
Pre-project


Cross-section 12, lower cross-vane, just US of Angel Rd.
Elevation (ft)
74
72
70
68
66
64
0
10
20
30
40
Distance (ft)
Post-project
Pre-project

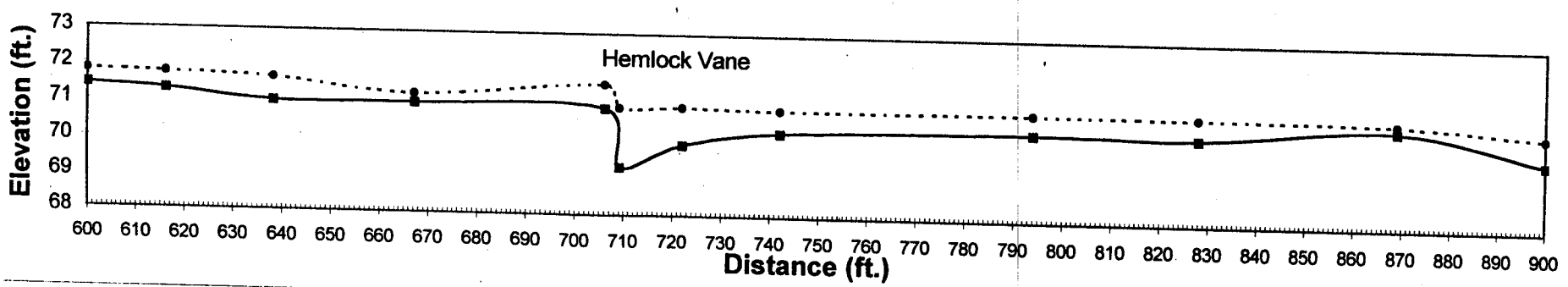
Longitudinal Profile - Brigman site post construction

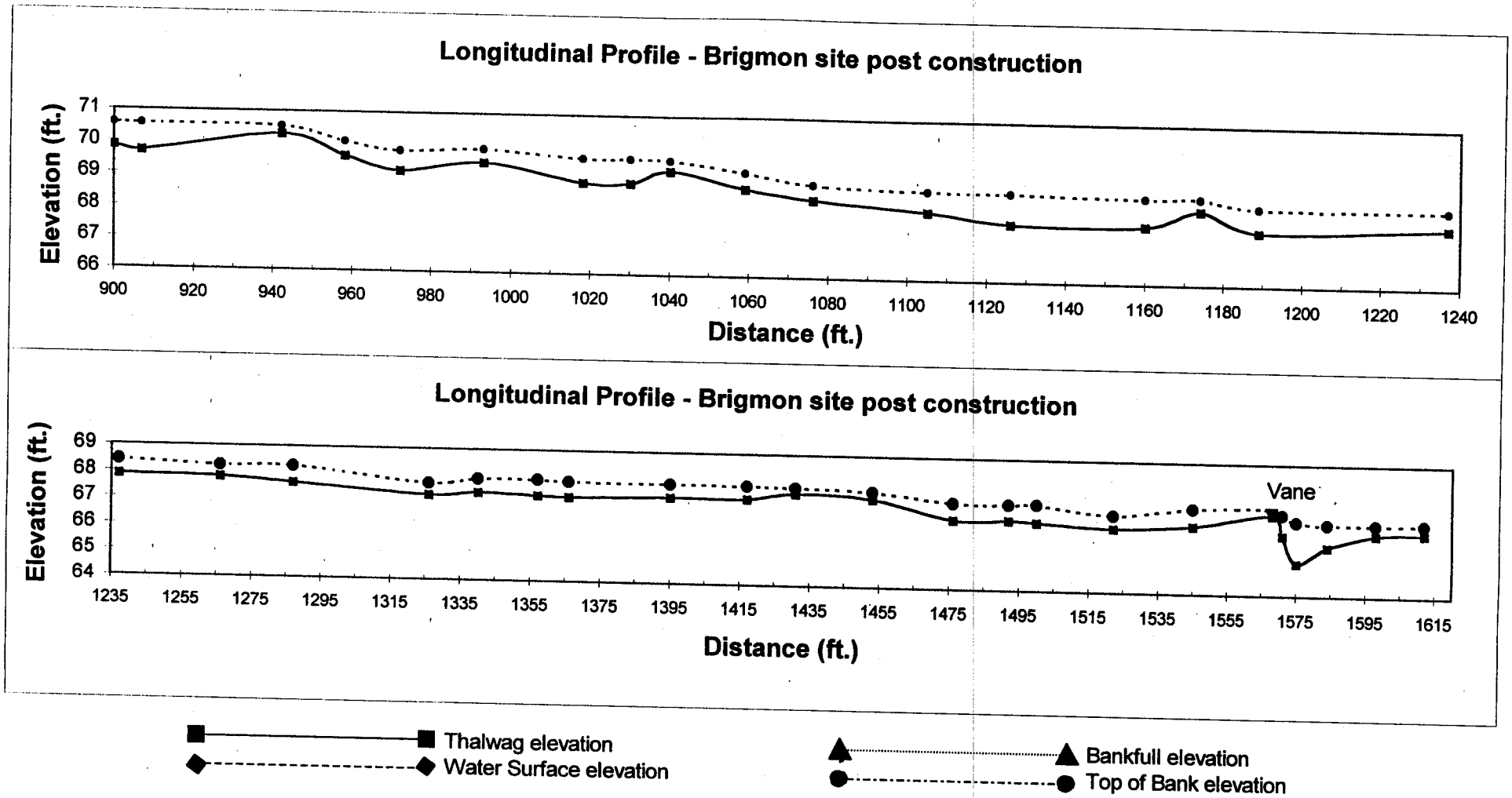


Longitudinal Profile - Brigman site post construction

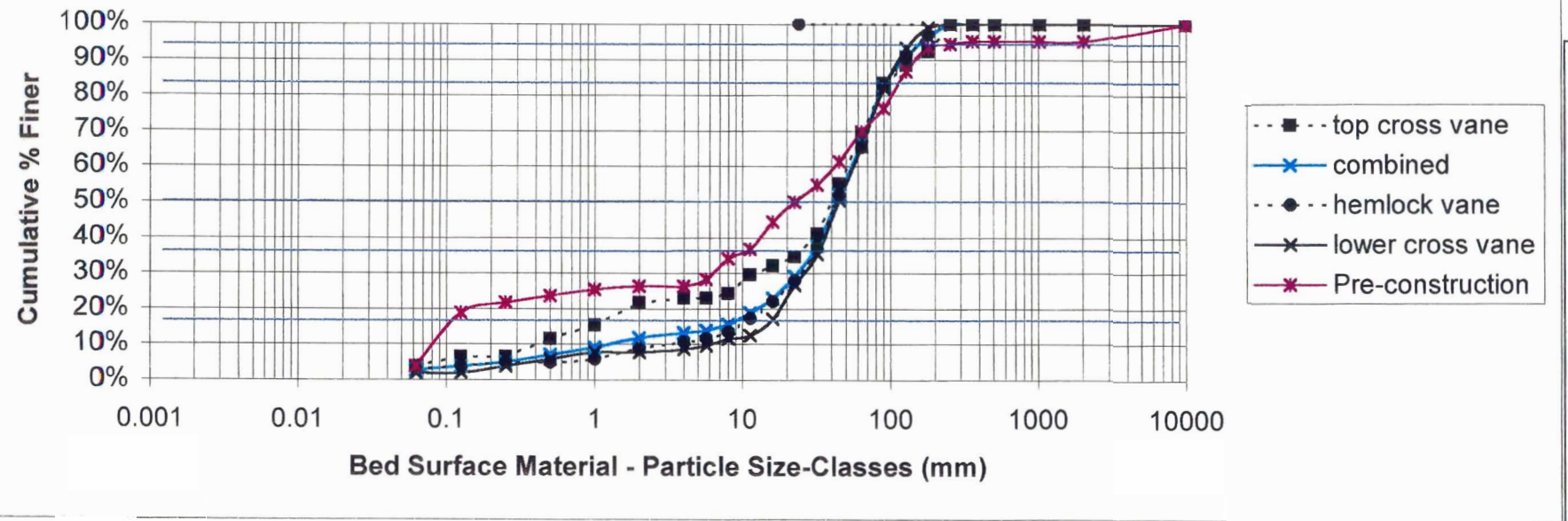


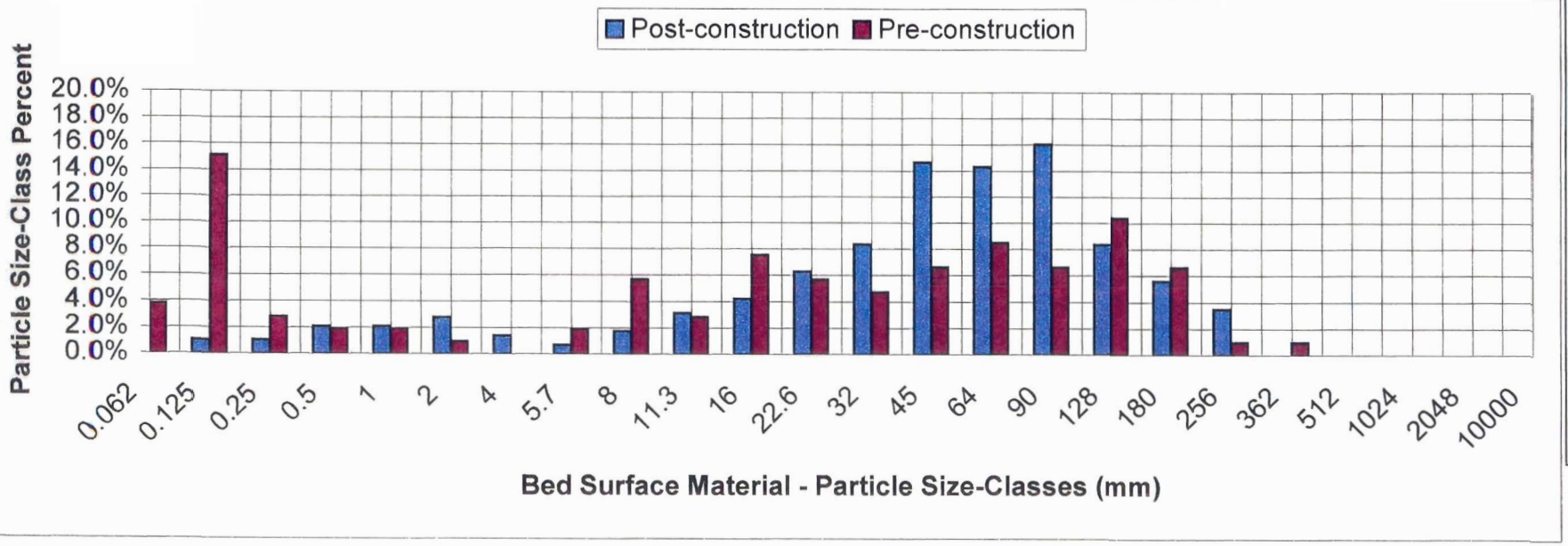
Longitudinal Profile - Brigmon site post construction




Longitudinal Profile - Brigmon site post construction
Elevation (ft.)
71
70
69
68
67
66
900
920
940
960
980
1000
1020
1040
1060
1080
1100
1120
1140
1160
1180
1200
1220
1240
Distance (ft.)
Longitudinal Profile - Brigmon site post construction
Elevation (ft.)
69
68
67
66
65
64
Vane
1235
1255
1275
1295
1315
1335
1355
1375
1395
1415
1435
1455
1475
1495
1515
1535
1555
1575
1595
1615
Distance (ft.)
Thalwag elevation
Water Surface elevation
Bankfull elevation
Top of Bank elevation

PEBBLE COUNT INFORMATION





Top photo shows typical condition of stream banks at this site prior to construction.
Bottom photo shows typical construction methods used to address vertical bank conditions. Banks are sloped, fertilized, limed, seeded and erosion mating installed. Coir logs are pinned at the bankfull elevation and trees are planted behind this log to provide long-term stability.

Top photo shows condition of a site that livestock were using to water and cross the stream. Bottom photo shows the same site after coir logs were used to define the channel and the banks were filled and sloped up to the logs. The site was seeded and protected with erosion control blankets. Trees were planted and the stream fenced.

Top photo shows the lower end of the upper, unnamed tributary prior to construction. Bottom photo shows the same site after construction. Banks were sloped and seeded and livestock were fenced out of the site. Prior to construction, the two small unnamed tributaries at this site were major sources of sediment during high water periods.

Top photo is along the lower, unnamed tributary looking up stream from the bottom of the reach. Bottom photo is the same site after construction. Vegetation has grown thick on the banks. Livestock were fenced out of this site and one of the water tanks installed at this site can be seen in the background. A covey of quail was flushed at this site when taking this photo.

Big bend below driveway bridge. Top photo shows the existing conditions with erosion and auto parts as stabilizing material. Bottom photo shows removing auto parts and trash and installing root-wads and creating floodplain to match existing bench upstream.

Top photo shows concave side of meander after construction and installation of erosion control material and root-wads. Bottom photo shows flood-plain bench matching the upstream bank with cover crop vegetation, trees and fence 3 months after construction.