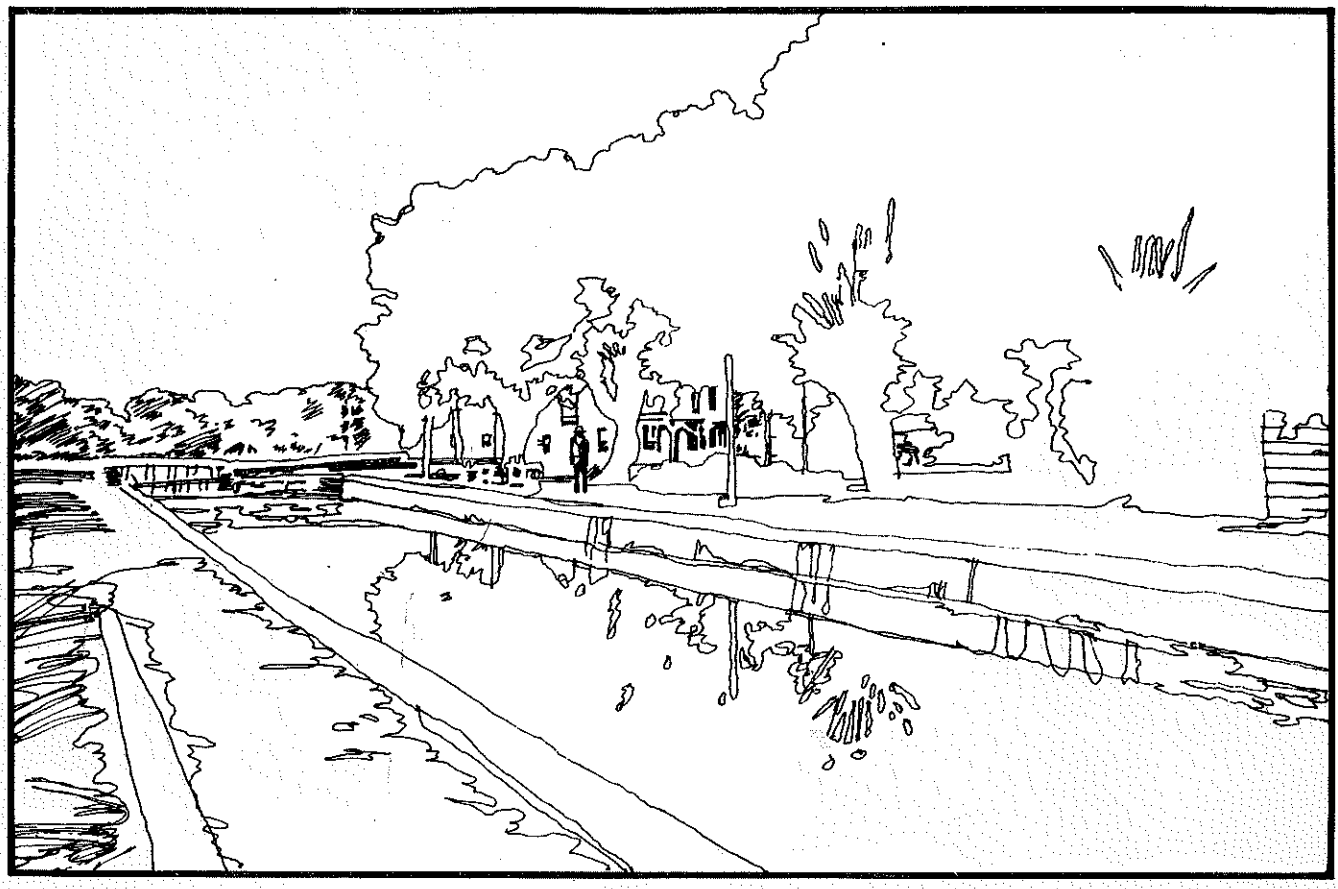

Delaware & Raritan Canal State Park Vegetation & Aquatic Buffer Zone Study

Delaware & Raritan
Canal Commission

New Jersey
Department of
Environmental Protection

Rogers & Golden
Philadelphia
1977

Foreword

Under the provisions of the Delaware & Raritan Canal State Park Law of 1974 (N.J.S.A. 13:13A-1, et seq.), the Delaware & Raritan Canal Commission in the State Department of Environmental Protection is charged with determining a Review Zone around the Canal Park. Within this Zone, the Commission will exercise review powers, with the intention of protecting the historic, physical, biological, and aesthetic integrity of Canal Park from adverse external impacts.

The Vegetation and Aquatic Buffer Zone Study is an initial element in the development of that Review Zone and in developing the Canal Park's future Master Plan.

Volume 1 of the Study is concerned with the Canal Corridor and its immediately adjacent land uses. Each Segment of the Canal was field surveyed in the summer and fall of 1976 to gather the data presented here. Available literature and aerial photography were also used, but the foundation of the Segment data is original fieldwork.

Two notebooks supplement Volume 1: a photo file composed by the field survey team, and the collection of field data sheets they used. These one-of-a-kind books are available for inspection at the Canal Commission's offices.

Volume 2 of the Study deals with the Regional Vegetation and Aquatic Buffer Zone of areas which drain into the Canal or into waterways closely linked with the Canal. At the regional scale, an assessment of visual elements along the Canal is also presented.

Acknowledgments

Rogers & Golden would like to express sincere appreciation to James C. Amon, Director of the Delaware & Raritan Canal Commission, and his staff for their invaluable assistance during the project.

The following people were responsible for preparing this study.

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The Importance of Vegetation

Vegetation includes all trees, shrubs, herbs, and field crops growing on land and the floating and submergent plants of ponds, swamps, rivers, and streams.

Plants provide people with many cost-free amenities and services. Vegetation is of fundamental importance in the oxygen, nutrient, and energy cycles upon which all life depends. However, it is not these inconspicuous roles which are widely valued. Vegetation is probably of more obvious importance to people because it moderates temperature, reduces noise, stabilizes soils, reduces runoff, absorbs and filters air and water pollutants, and provides food and shelter for both upland and aquatic wildlife.

Shade from streamside forests moderates water temperature in headwaters and along the stream banks, thus buffering aquatic organisms from temperature extremes. In headwaters (streams less than one meter wide) the base of the aquatic food chain is leaf litter or other forms of terrestrial detritus from off-stream areas.

When vegetation is used for noise abatement, the key factor is the vertical leaf and branch structure of plants. Belts of trees one hundred feet (30 m) wide, with a dense shrub layer, have been shown to be effective in noise attenuation.

Vegetation helps to control and prevent water and wind erosion by absorbing raindrop energy, by forming fibrous masses of roots within the soil, by transpiring water, and by depositing plant litter on the ground, thereby increasing organic material and rates of absorption.

Over time, change occurs in the species composition and vegetation structure of the landscape. The term "plant succession" is commonly applied to a sequence of change in which one community replaces another. However, succession is a very particular set of events which may only apply to particular communities (Niering and Egler, 1974). A broader concept is community dynamics. Community dynamics not only refers to the natural sequence of plant succession, but to the effects of man-induced disturbances as well. With or without man's interference, plant communities will change.

For design purposes, both the species present and their structures are important. Seasonal color, density of shade, leaf texture and density, and community pattern and shape are all important elements used in design. Being able to predict the occurrence of these changing elements, both now and in the

future, is a prerequisite to a well-conceived park design.

For planning purposes, vegetation, structure, and pattern are important considerations. The majority of scientific evidence relating to noise attenuation, runoff and erosion control, air pollution abatement, reduction of climatic impacts, and visual screening, speaks to the vertical density of leaf material and spatial pattern of vegetation in general as being more important than particular species of plants (Robinette, 1973). When planning the long and short term uses of land, one should consider what the present vegetation structure is and the functions it performs. One should also consider the longevity of the existing vegetation structure. Will the structure be naturally maintained over the next five, ten, twenty years, or will it change? If it does change, what will be the functional advantages or disadvantages of that change? A related consideration is the effect disturbances have on the existing structure. Some stands of trees are fire-prone, while others continually experience windthrow. Other stands are relatively hazard-free and are continually regenerating.

By knowing the current vegetation and understanding community dynamics, the present and potential roles of a plant community can be most effectively realized.

Table of Contents

Volume 1
The Canal Corridor

Summary of Recommendations

The land adjacent to the Delaware & Raritan Canal has been repeatedly disturbed since the Canal was built and land was cleared for a towpath over 145 years ago. The continuing role of disturbance is evident in the predominance of weedy, pioneer species of herbs, vines, and shrubs and the presence of short-lived trees. Particular site recommendations can be found in the Segment and Subsegment discussions which form the text of this Study. Along the entire length of the Canal, however, several management problems related to vegetation need to be rectified.

(1) Overgrowth of poison ivy and honeysuckle is common, especially along the pedestrian path. These vines can choke existing healthy trees and affect the future character of the Canal towpath.

The most economical and efficient control of both these nuisance species is the selective application of stem-foliage and stem-stump herbicide sprays (Niering & Goodwin, 1962 and 1963). Table 1 shows results of Niering and Goodwin's studies at the Connecticut Arboretum.

Table 1. Results of herbicide treatments on Japanese honeysuckle (*Lonerica japonica*) evaluated after two growing seasons.

Active Ingredients	*Ratio to carrier*	*Tablespoons per gal.*	*Carrier*	*Time of Treat.*	*Root-Kill*
Amino-triazole[1]	1/260	1	Water	Aug.	Good
Amino-triazole[1] and Kuron	1/260 1/50	1 5	Water	Sept.	95%
Amino-triazole[1] and 2,4-D	1/170 1/100	1.5 2.5	Water	Aug.	Good
2,4-D (Weedone)	1/100	2.5	Water[2]	April	95%
2,4-D (Weedone LV)	1/100	2.5	1 oil:60 water[2]	April	Good
2,4-D amine (duPont)	1/75	4	Water[2]	April	Poor
2,4-D amine (duPont)	1/75	4	1 oil: 150 water[2]	April	99%
2,4-D amine (duPont)	1/100	2.5	1 oil: 150 water[2]	April	Poor
2,4-D ester	1/100	2.5	Water	April	Good
2,4-D (Weedone)	1/20	13	Oil[2]	Jan.	Good
2,4-D (Weedone)	1/30	9	1 oil: 1 water	Jan.	95%
2,4-D and 2,4,5-T	1/7	37	Kerosene	May[3]	Good
2,4-D and 2,4,5-T	1/20	13	Oil	April	95%
2,4,5-T (Esteron)	1/100	2.5	Water[2]	April	Poor

Notes:
[1] 50% active ingredients.
[2] A sticker (wetting agent) added.
[3] Damage to the foliage of adjacent trees was observed.

Source: Niering and Goodwin, 1963, p. 28.

A similar treatment with herbicides could help control overall species composition as well. Dogwood trees, sweet pepper bush, red cedar and the like could be selectively maintained by applying herbicides to other species which are crowding these attractive species out. It should be pointed out that these techniques do not require mass spraying of all plants, as was done in the past along transmission lines. Selective spraying in a thoughtful and conscientious manner poses no serious threat to the environment.

(2) Other major problems along the pedestrian path are low-hanging vegetation, shrubs which crowd or obstruct the path, and the presence of fallen limbs and trees. In order for the path to be attractive to hikers and bikers, a certain amount of clearing is necessary. We recommend selective removal rather than wholesale cutting.

(3) A major challenge of the Canal Park is that its entire length comprises an edge community. Sunlight reaches all lower layers -- herb, shrub, and understory -- allowing the growth of sun-loving, weedy species. One management technique which should be given serious consideration in certain areas is the planting of species which would widen the vegetation band along the Canal and overcome the pervasive edge effect. Two alternatives are possible. One is to plant endemic tree species in such a way as to increase the total width of woodland. The other is to plant evergreens in narrow areas along the edge in order to shield the interior. The species selection would have to be such that a uniform screen could be produced which would retain its vertical density over time.

(4) Another common problem is the growth of trees out from the Canal bank. The bank is a perfect medium for plant growth -- moist and full of nutrient. As the young tree grows, the bank often slumps or the tree leans out over the Canal, only to fall in eventually. Many of these trees can be cut off while they are still young. The larger specimens can be cut back. Fallen trees and the exposure of roots and bare soil exacerbate the problems of sedimentation and water pollution. In many places, shoring of already slumping Canal banks could help to ensure against leakage from the Canal and the undercutting of vegetation along the bank.

(5) Since the Canal's abandonment over forty years ago, vegetation has regenerated between the Canal and the towpath. In some cases, this has benefited the Canal by stabilizing the terrace and the upper bank. On the other hand, these weedy species are often tangled with thick shrubs and briars, restricting access and views of the Canal. Selection of specific areas along the Canal to provide access and views should be considered. These selected areas will require periodic management.

(6) Throughout its length, the Canal Park has a diversity of cleared and wooded areas. If left unattended, many of the cleared areas will become shrubby and will eventually become wooded. This should occur over a period of 15 to 20 years and will result in a monotonous ribbon of woody thickets along the Canal. Keeping some of these cleared areas open would be desirable for both aesthetic and practical reasons. Areas kept open can be easily converted to playing fields in the future. Bluestem grasses (*Andropogon scoparius* and *Andropogon gerardi*) have been shown to hold back the growth of weed and scrub oldfield species. These could be used to retard succession in open areas.

Format & Terminology

In order to facilitate use of the *Vegetation & Aquatic Buffer Zone Study*, a brief discussion of format and terminology is provided here.

By convention, all references to direction or distance assume that the reader is looking downstream. This convention was necessitated by the fact that the Canal flows north, south, and east at various points along its course. Rather than refer to "east" or "west," compass points whose orientation toward the Canal varies as direction of the Canal flow changes, we use the terms "right" and "left," with the stipulation that the user is looking downstream. Under this convention, the text also refers to the "beginning" or "end" of a segment, assuming a starting point upstream and an end downstream.

A Glossary is provided in the report. The Glossary defines often used terms. It is suggested that the Glossary be reviewed prior to reading the text.

For clarity, each Segment discussion follows a uniform format. Also, the Canal Segment maps are integral to the text. Because much of the discussion in the text refers directly to the maps, maps should be kept at hand for repeated reference.

MAPS

The 28 Canal Segments are mapped on 11 sheets. Sheet 1 encompasses Segments 1, 2, 3, and 4. Sheet 2 picks up with Segment 5, and so forth. An index is provided with the maps to indicate which segments occur on which sheets.

Because there is too much data to map on a single sheet, the sheets are in two-part sets labeled "a" and "b".

On each a sheet are mapped area data; the Canal Corridor Subsegments, and the Contiguous Land Uses for each segment. The Canal Corridor Subsegments are shown on these maps as upper-case letters (A, B, C, etc.) in the white portion of the map. This white area in the corridor indicates land owned by the Canal Park. Contiguous Land Uses are mapped using lower-case letters (a, b, c, etc.) and are in the shaded portion of the maps. These lands are generally privately held.

The second sheet in each set, the b sheet, maps the location of point data. The three types of information mapped are the positions of topographic cross-sections which illustrate the text; the locations of Special Features; and the locations and view directions of photographs.

TEXT

Each of the 28 segments is discussed as a unit. The text for each segment begins with a description which serves as a title. The description includes location of each segment (from the Canal Commission's *Master Plan*) and vegetative cover type(s). The body of the text starts with an overall SEGMENT NARRATIVE which discusses the size and extent of the segment and gives a brief description of its component parts. At the close of the Segment Narrative is a sequential discussion of Access into Canal Corridor, Towpath, Ease of Passage on Canal, Wildlife, and Auditory Assessment. Access into Canal Corridor is concerned with the ease with which a prospective Canal Park user can enter the Canal corridor. Where particular points of entry are available, these are noted. Towpath is the general term used for any path closely paralleling the Canal. Although the path discussed may not be the original towpath, it is closely allied with the Canal. The discussion indicates the condition of this path and whether it has been superseded by the railroad or some other use. Ease of Passage on Canal is taken from a canoeist's perspective. Obstructions or impediments to navigation are noted. Wildlife deals with observed evidence of wildlife, such as foraging, and with the actual sighting of various fauna. Auditory Assessment takes note of any noises which could disturb Canal users. These noises include those from roads, the railroad, or adjacent land uses such as factories. By reviewing this general description of the segment, the reader will get an overview of the condition of the Canal and its vegetation and of the ambience of the segment.

Next, the component SUBSEGMENTS are discussed. These discussions isolate and detail the particular characteristics of the subsegments. The subsegments were defined by their generally homogeneous nature or by obvious differences from adjacent areas. Each subsegment discussion closes with a sequential assessment of Community Dynamics and Management Recommendations. Community Dynamics deals with the anticipated condition of the present vegetative cover in the future. Where changes are expected in the status of an area--from an oldfield to a young hardwood stand, for example--this is noted. Both natural succession and man-induced changes are taken into account. Thus, a powerline right-of-way is expected to retain its present character because of human intervention. In this sort of area, natural succession to more mature vegetation is not assumed to be a likely future. In areas which go unattended, natural succession is assumed to be the future of the vegetation. By reviewing the Subsegment discussions, including the section on Community Dynamics, and the Vegetation Data lists, the reader can gain an understanding of how the subsegment will look in the future. Management Recommendations take note of particular problems observed by the field survey teams. Such problems as deteriorating Canal banks, fallen trees, or overgrown trails are typical of this section of the report.

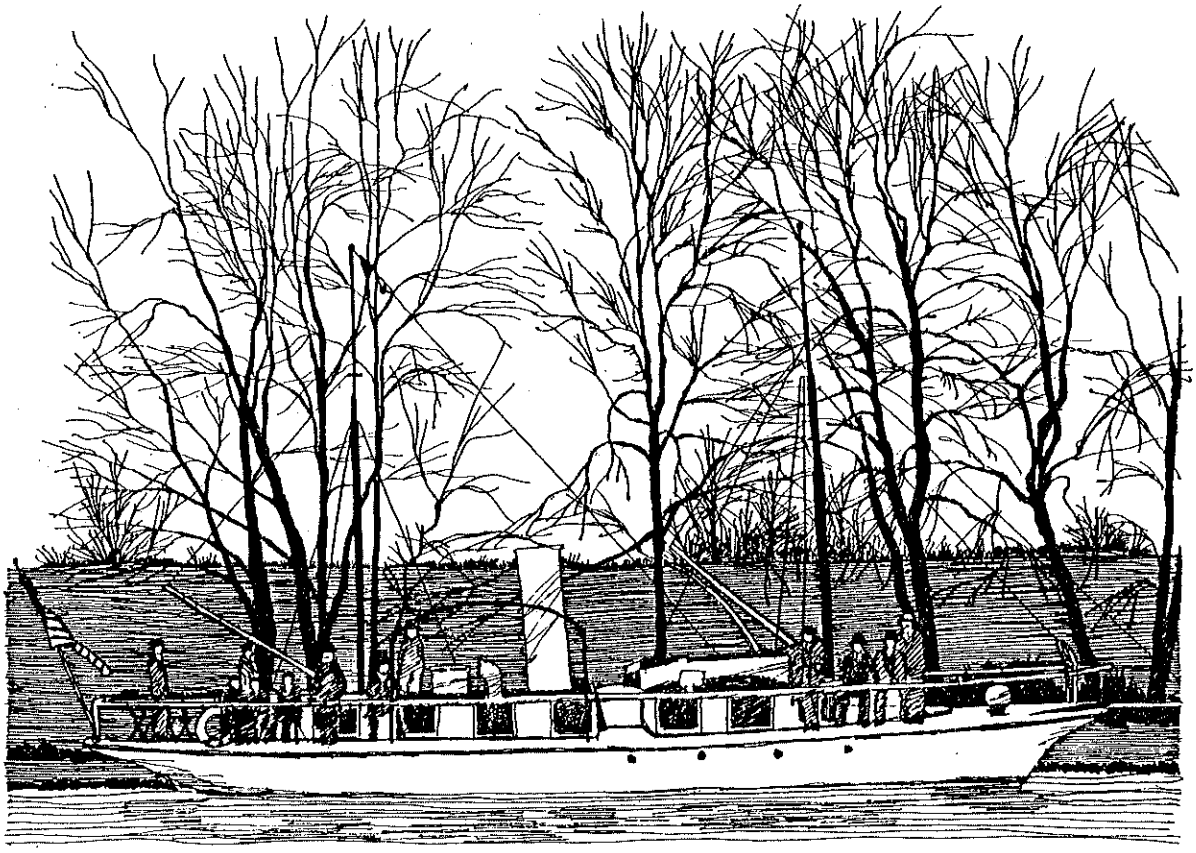
A listing of CONTIGUOUS LAND USE along the Canal corridor follows the subsegment discussions. The uses are mapped and listed by homogeneous areas. The Cover Type of each area is identified, as is the actual Land Use. Contiguous Land Uses are shown on each a map.

TOPOGRAPHIC CROSS-SECTIONS were drawn for many segments to illustrate hydrologic, topographic, and vegetative relationships. These are included in each segment discussion and are cross-referenced by letters (e.g., A-A', B-B') to the b sheet of the segment map.

SPECIAL FEATURES are listed by number (corresponding to b map sheet). These Special Features are trees, buildings, groves, paths or other elements which are noteworthy because of their uniqueness, size, age, or amenity.

A PHOTOGRAPHIC RECORD is supplied after the list of Special Features. This record lists photographs taken in each segment, with map and contact sheet references, and supplies a brief description of each photograph.

The last inclusion in each segment discussion is a table of VEGETATION DATA listed by subsegment. This table lists Cover Type, Current Land Use, Historic Disturbances, and Current Disturbances, in addition to Vegetation Data. The data is in the form of a list of species which occur within each vegetative stratum (canopy, understory, shrub, herb). These levels are determined by height, so it is possible to have one species in several levels. The density of each level is also indicated (thick, medium, thin, or none). This information is transcribed from the Field Data Sheets used in the survey.



Segment 1

DELAWARE RIVER FLOODPLAIN WOODLAND FROM BULLS ISLAND TO SMITH'S MILL

SEGMENT NARRATIVE

Segment 1 covers three miles of the northern end of the "feeder" of the Delaware & Raritan Canal, paralleling the Delaware River. This segment includes Bulls Island and extends south to Smith's Mill near Stockton. (See the map on Sheet 1a.) The vegetation in this segment of the Canal Corridor is dominated by a floodplain woodland community interrupted occasionally by small openings of from 0.5 to 10 acres (.2 to 4.05 hectares). The dominant species of this woodland include sycamore (*Plantanus occidentalis*), box elder (*Acer negundo*), silver maple (*Acer saccharinum*) and tulip poplar (*Liriodendron tulipifera*), which form a thick canopy cover about 60-80 ft (18.1-24.4 m) above the ground. The diameter at breast height (DBH) of the larger trees, for instance silver maple and sycamore, ranges up to 30" (76.2 cm) and 48" (122 cm), respectively. The understory layer is composed mostly of black locust (*Robinia pseudo-acacia*), slippery elm (*Ulmus rubra*), American elm (*Ulmus Americana*) and box elder. The shrub layer is dominated by spicebush (*Lindera benzoin*) and numerous climbing vines. The herb layer is less dense than the upper layers and is composed mostly of jewelweed (*Impatiens* spp.), stinging nettle (*Urtica* spp.) and rough horsetail (*Equisetum hiemale*).

Small variations in the composition of the woodland community are a function of changes in topography. For example, where the floodplain is wider (Subsegment E), the land tends to undulate in a series of mounds and depressions; the dominant species mix (or percentage of each of the dominant species) varies with these topographical changes, generally in response to varying moisture conditions.

Interspersed throughout the floodplain woods are openings in which there is little or no canopy cover. (These are designated as Subsegments G through K.) These are oldfield communities which are at various successional stages. Most of these fields contain a few woody plant species, such as black locust and red cedar (*Juniperus virginiana*), but the dominant vegetation is a dense ground cover of wild flowers, grasses (*Graminae* spp.), and brambles (*Rubus* spp.).

The railroad (Subsegment F) roughly parallels the Canal along its left side throughout Segment 1, affecting the vegetation in the rail bed and along its edges where they abut the floodplain woodland. The levee (Subsegment L), a narrow strip of land between the Delaware River and the Canal, has a vegetation community different from the rest of the segment, a dense thicket which is impassible in some places.

Segment 1 is used quite heavily for recreation. Bulls Island (Subsegments A through D) provides opportunities for activities including fishing, hiking, camping and picnicking. Despite these uses, few disturbances to the natural vegetation or landscape were observed.

There are no significant aquatic plants in the Canal itself or at the water's edge in this segment. Much of the Canal is shaded by overhanging vegetation. The Canal has a natural character exhibiting moderate plant diversity and a shaded aspect.

Access into Canal Corridor

Access to the segment is easy via the Bulls Island entrance. Further along the segment, numerous small footpaths permit access from Route 29 or the railroad.

Towpath

A trail exists along the left bank of the Canal, but it is discontinuous and has become overgrown, largely by floodplain species.

Ease of Passage on the Canal

Passage down the Canal in this section is impeded only by the lock/sluice gate at the head of Bulls Island.

Wildlife

Evidence of moderate use by animals, especially deer, suggests that this segment provides both food and shelter.

Auditory Assessment

Intermittent noise from Route 29, the railroad and a nearby quarry are noticeable, but in general the segment is well-buffered by vegetation and topography from visual and auditory disturbances.

SUBSEGMENT A

Subsegment A is the lower floodplain woodland lying in a ring around the perimeter of Bulls Island (Map, Sheet 1a. See Section B-B'.). Much of this ring is unmanaged floodplain woods, with dominant canopy species including sycamore, box elder, silver maple and tulip poplar. The understory comprises black locust, slippery and American elm and box elder. Spicebush and numerous climbing vines dominate the shrub layer. The herb layer is less dense than the upper layers and is composed mostly of jewelweed, stinging nettle and rough horsetail. Along the left, or Delaware River side of the Island, heavy recreational use in places (e.g., camping) retards growth in the shrub and herb layers. Consequently, most of the community members are mature canopy and understory trees.

In contrast, the section of the Subsegment A floodplain woodland ring which lies along the right side of the island, and which includes the land between the towpath and the Canal, is frequently mowed and managed. As a result, a natural, mature woodland community is prevented from developing along this stretch.

Because this entire community is subjected to more frequent flooding than the higher areas at the center of the island, the dominant species

mix differs from theirs. The areas that remain saturated for longer periods following floods feature jewelweed and stinging nettle, which have a high tolerance for wet soils. In areas that are slightly better drained, such species as sycamore, black locust, silver maple and ailanthus (*Ailanthus altissima*) are found more often, although they too can tolerate periods of saturation. Spicebush, American and slippery elm seedlings, and numerous vines like poison ivy (*Rhus radicans*), grape (*Vitis* spp.) and Virginia creeper (*Parthenocissus quinquefolia*) are found in the shrub and herb layers.

In managed areas, recreational use is heavy and access to the Canal is unlimited. In the unmanaged areas, however, access to the Canal is restricted to small footpaths.

Views of the Canal and Delaware River through the vegetation are very pleasant. Occasionally, noises from Route 29, the railroad and the river reach this subsegment, but such noises are intermittent and are somewhat absorbed by the vegetation. A wingdam across the Delaware River near the north end of the island gives a constant background sound of rushing water.

Community Dynamics

The vegetation community should remain stable with the present land uses and flood regime.

Management Recommendations

None

SUBSEGMENT B

Subsegment B is the largely unmanaged upper floodplain woodland occupying the center of Bulls Island. Reached via the bridge to Bulls Island, the subsegment is 4 to 10 ft (1.2 to 3 m) higher than the surrounding area of Subsegment A, and as a result is flooded less often and for shorter durations than Subsegment A. The vegetation composition differs somewhat from A, but in general resembles the sycamore-silver maple-box elder woodland described in the Segment Narrative. There are, however, several species present which are more often associated with upland woods. These include black and red oak (*Quercus velutina, Quercus rubra*) and tulip poplar. The canopy is dense, while the understory, which is dominated by box elder, is quite thin. The shrub layer (spicebush and black locust) and the herb layer (jewelweed, ferns and brambles) are both of medium density.

A distinct embankment characterized by large clumps of lady fern (*Athyrum felix-femina*) and Christmas fern (*Polystichum acrostichoides*) occurs where Subsegment B touches A around the southern half of the island. Animal trails and evidence of browsing were observed along the embankment.

Although the observer is totally surrounded by a thick mature woodland, the area appears spacious because of the sparse vegetation between the shrub and canopy layers. Several noteworthy specimen trees occur, including large sycamores and silver maples.

Community Dynamics

The community as a whole appears stable and does not appear threatened by disturbances, either natural or man-related. However, numerous tent caterpillar colonies were observed in many of the black walnuts.

Management Recommendations

A program to eradicate the tent caterpillars.

SUBSEGMENT C

Subsegment C is the area on Bulls Island designated specifically for camping (Map on Sheet 1a). It lies within the upper floodplain community of Subsegment B and is dominated by the same species. Many of the trees are 8 in. (20.32 cm) or less DBH, although a few larger ones (about 10%) reach 24 in. (61 cm). The heavy recreational use has reduced the herb and shrub layers to a minimum. Spicebush and grasses are the most abundant species in these layers. The high (50 to 60 ft or 15.2 to 18.3 m) closed overstory, composed mostly of black walnut, sycamore and box elder, dominates the camping area. (See Section A-A'.)

This area is quite open at ground level and is nearly 100% shaded. The Delaware River and Pennsylvania beyond are easily seen from within the campgrounds.

Community Dynamics

Continued recreational use will maintain the present community structure, but few young canopy trees are present to replace the older trees when they die.

Management Recommendations

Allow young saplings of canopy species to establish themselves for eventual replacement of older trees.

SUBSEGMENT D

Subsegment D is a managed, landscaped open space within the upper floodplain of Subsegment B. A few large black oaks and numerous planted conifers and deciduous ornamentals highlight the lawn.

The space provides a large open area within the park for passive recreation including picnicking.

Community Dynamics

Maintained

Management Recommendations

None

SUBSEGMENT E

Subsegment E, the land between the Canal and the railroad, running the entire length of Segment 1, is similar in composition to the floodplain communities described in subsegments A and B. Where land contiguous to the Canal is gently sloping, the dominant species percentages often resemble the lower floodplain vegetation of Subsegment A. Small topographic variations are prevalent. Where the land adjacent to the Canal's edge is steep, where the stress of flooding is less severe, the species mix resembles the upper floodplain on Bulls Island (Subsegment B). (See Section D-D'.)

Several small trails leading to the Canal cross the railroad from Route 29. Canoers, hikers and fishermen as well as the remains of small campfires were observed along the Canal's edge. Wildlife trails, nests and evidence of browsing were observed througout the subsegment. With these exceptions, and a few scattered windthrown trees and some selective cutting, little disturbance to the natural community was apparent.

There are two privately owned parcels of property in this subsegment north of Bulls Island State Park entrance. These plots of land have been only slightly altered, with some clearing for better Canal access.

The subsegment conveys an image of moderately dense, shady woodland through which passage is only slightly hampered by vegetation, except in some openings, where thickets and vines hinder the walker. Except for occasional noises from the nearby railroad and Route 29, one feels separated from civilization by a rich, forested environment.

Community Dynamics

The presence of several late successional saplings (canopy species) suggests that this community is stable and will retain its species composition in the future.

Management Recommendations

None

SUBSEGMENT F

Subsegment F is the railroad corridor (see the definition of *railroad corridor* for the purposes of this study in the Glossary), which passes through the strip of floodplain woodland to the left of the Canal. The subsegment can be reached by several paths from Route 29. The vegetation community along this corridor consists of two distinct forms: the raised railroad bed, and the two hedgerow/thicket strips which flank each side of the railroad. The traprock bed is dominated by low, drought-tolerant species which are able to grow in the ballast. The species include mullein (*Verbascum thapsus*),

grasses (*Graminae* family) and butter-and-eggs (*Linaria vulgaris*). The edges of each side of the railbed are more diverse where this community blends into the surrounding one. The species composition of the embankment vegetation changes where the railroad lies above, level with or below the adjacent road (Route 29). These changes are responses to variations in aspect and moisture. For example, where the embankment is steep, species requiring more moisture are found in the moist trough below, e.g., sensitive fern (*Onoclea sensibilis*). Where the embankment is less steep and there is no trough, typical hedgerow species -- sassafras (*Sassafras albidum*), staghorn sumac (*Rhus typhina*), elms, black locust and ashes -- occur.

As one walks along the railroad, the thicket/hedgerow community alternately screens and exposes to view the Canal on one side and the road on the other. The herb and shrub layers include woody saplings and a dense, diverse collection of plants such as honeysuckle (*Lonicera japonica*), Virginia creeper, poison ivy, foxtail grass and roses (*Rosa* spp.).

Little use was being made of the corridor and few disturbances were observed. The corridor offers a good vantage point for viewing the adjacent landscape, including a long view of Raven Rock. If the railroad is abandoned, the roadbed could be an excellent foundation for a scenic biking trail.

Community Dynamics

The structures of the ballast and edge communities are maintained by management practices, including the use of herbicides and cutting.

Management Recommendations

None

SUBSEGMENT G

Subsegment G is a large (at least 10 acres or 4.05 hectares), early successional oldfield community located within the Delaware River floodplain woods of Subsegment E, north of Bulls Island. It appears that this land was last cut back about five years ago. Three of its boundary edges are delineated by floodplain woodland as described in Subsegments A and B; the fourth side is the railroad corridor (See Subsegment F). Isolated overstory species including box elder, black walnut (*Juglans nigra*), silver maple, black cherry (*Prunus serotina*) and staghorn sumac, dot the field, growing to heights of 15 to 25 ft (4.6 to 7.63 m). In contrast, the herbaceous layer is dense, composed of numerous brambles, wild flowers-- Queen-Anne's lace (*Daucus carota*), goldenrod (*Solidago* spp.), asters (*Aster* spp.)-- and steeple-bush (*Spiraea tomentosa*).

Few natural or man-related disturbances were observed, although evidence of some animal use (deer, rabbit) was noted. Occasional noise from the railroad and Route 29 penetrates the area.

This large open area, a pleasant contrast to the adjacent dense, shaded woods, is suitable for park development (e.g., for ball fields, playground). The large size, level nature and dominant herbaceous vegetation provide few environmental or financial constraints for development when compared to the nearby woodland potential.

Community Dynamics

This field remains unmanaged and will probably continue to develop later successional stages if left undisturbed.

Management Recommendations

None

SUBSEGMENT H

Subsegment H is a small (0.5 acre or .2 hectare) open area, within the floodplain woods between the Canal and the railroad, roughly opposite the southern end of Bulls Island (map, Sheet 1a). It is occupied by black walnuts which are from 6 to 25 ft (1.8 to 7.6 m) high. Beneath this thin, broken black walnut canopy lies a herb layer of grasses, horsetail (*Equisetum* spp.), snakeroot (*Eupatorium rugosum*), and sunflowers (*Helianthus* spp.). The walnut trees release a chemical which prevents other woody species from establishing themselves. A ring of black locusts lies between the walnut stand and the typical surrounding floodplain vegetation. Subsegment H shows evidence of browsing wildlife, especially deer. The grove shows little other evidence of disturbance or human use. Visually, the openness and unshaded character contrasts with the adjacent woodland.

Community Dynamics

The presence of walnut saplings and the chemical produced by the walnut trees indicate that this community should remain stable.

Management Recommendations

None

SUBSEGMENT I

Subsegment I is another opening in the floodplain woodland between the Canal and the railroad. This area (approximately one acre or .405 hectare) has no canopy species and is dominated by a thick growth of pokeweed (*Phytolacca americana*), sunflowers, purple bergamot (*Uvularia* spp.) and assorted grasses to a height of 6 to 8 ft (1.8 to 2.4 m). The thick and lush vege-

tation and the damp ground make this opening worthy of note. The edges are dominated by species typical of the early successional stages of the floodplain woodland (e.g., black locust).

Community Dynamics

This field represents a typical meadow/oldfield successional stage, currently dominated by pokeweed. It will continue the successional pattern if left undisturbed.

Management Recommendations

None

SUBSEGMENT J

Subsegment J is a small (about an acre or .405 hectare) opening in the floodplain woods downstream from Bulls Island. The species composition and general appearance are nearly the same as Subsegment G, with isolated overstory trees and a dense herbaceous layer of Queen-Anne's lace, golden rod, asters and steeple-bush. In this smaller opening, however, there are fewer trees to provide canopy cover. In addition, the opening is framed by black locust and black walnuts which often enjoy such a sunny edge community. The railroad provides access into this subsegment.

Community Dynamics

This is a typical early successional oldfield and should continue in succession if it is left undisturbed.

Management Recommendations

None

SUBSEGMENT K

This is the largest opening in the Segment 1 floodplain woods -- 20 to 30 feet wide by 450 feet long (6 to 9 meters by 110.6 meters). It differs from the other openings because its species character is more typical of drier upland oldfield. The field is dotted with a few large (25 to 50 ft or 7.7 to 15 m) trees, including hickory (*Carya* spp), dogwood (*Cornus* spp) and black cherry. The edge is typically lined with black locust and black walnut, blending into the surrounding floodplain woodland. The side along the railroad is edged by intermittent hedgerows in which species were observed which often inhabit disturbed sites -- bigtooth aspen (*Populus grandidentata*), red cedar and sassafras. The predominant vegetation in the oldfield is low-growing grasses and northern dewberry (*Rubus* spp.), interspersed with wild flowers such as jewelweed, evening primrose (*Oenothera biennis*), black-eyed Susan (*Rudbeckia hirta*) and yarrow (*Achillea*

millefolium).

The large, open flat field offers a landscape which could be used for park recreational facilities (e.g., ball fields) with a minimum of environmental or financial constraints.

Community Dynamics

The dry mid-successional thicket and oldfield progression should continue to evolve if not disturbed.

Management Recommendations

None

SUBSEGMENT L

The levee subsegment begins at the southern tip of Bulls Island and parallels the right side of the Canal down to Smith's Mill, a distance of three miles (4.83 km). It is a narrow strip varying from approximately 10 feet in width to about 75 feet at its widest (3 to 23 m). Topographic changes are small and for the most part confined to narrow depressions perpendicular to the Canal at spillways. Major topographic variations in the relationship of the Canal to the river occur along the banks of the levee. (See Section C-C'.)

This area has a thin canopy comprising box elder, green ash (*Fraxinus americana*), silver maple and slippery elm, with the green ash and silver maple dominant. The shrub layer is dominated by spicebush and poison ivy, with silky dogwood (*Cornus Amomum*) and buttonbush (*Cephalanthus occidentalis*) occasionally present. In the herb layer, there are nettles, grape and ferns, with poison ivy as the dominant species. The levee is, for all practical purposes, impenetrable. The shrub and herb layers are extremely dense, and in places, grow up to 8 ft (2.5 m) high, making land passage very difficult.

Generally, the levee is covered by a tangle of dense vegetation, with occasional breaks in the canopy. In these breaks, the herb and shrub layers grow only to eye level. Several trampled paths were observed, probably canoe portages.

In several places, the canopy arches over the highest, most walkable portion of the levee, forming a vegetation "tunnel" that is pleasant to walk through. The most impressive of these tunnels is right at the southern tip of Bulls Island, where a well-trod path keeps the understory and shrub layers down. Just past this point, the levee has been replaced by a concrete bulkhead for some distance.

A number of "exotic" species were found along the levee, probably deposited by floods. These include English plantain (*Plantago lanceolata*) and asparagus (*Asparagus officinalis*).

The levee could be developed into a pedestrian link with Bulls Island and the rest of the Canal park, but with the extensive work of levelling the walkable area and reducing the density of the vegetation.

Community Dynamics

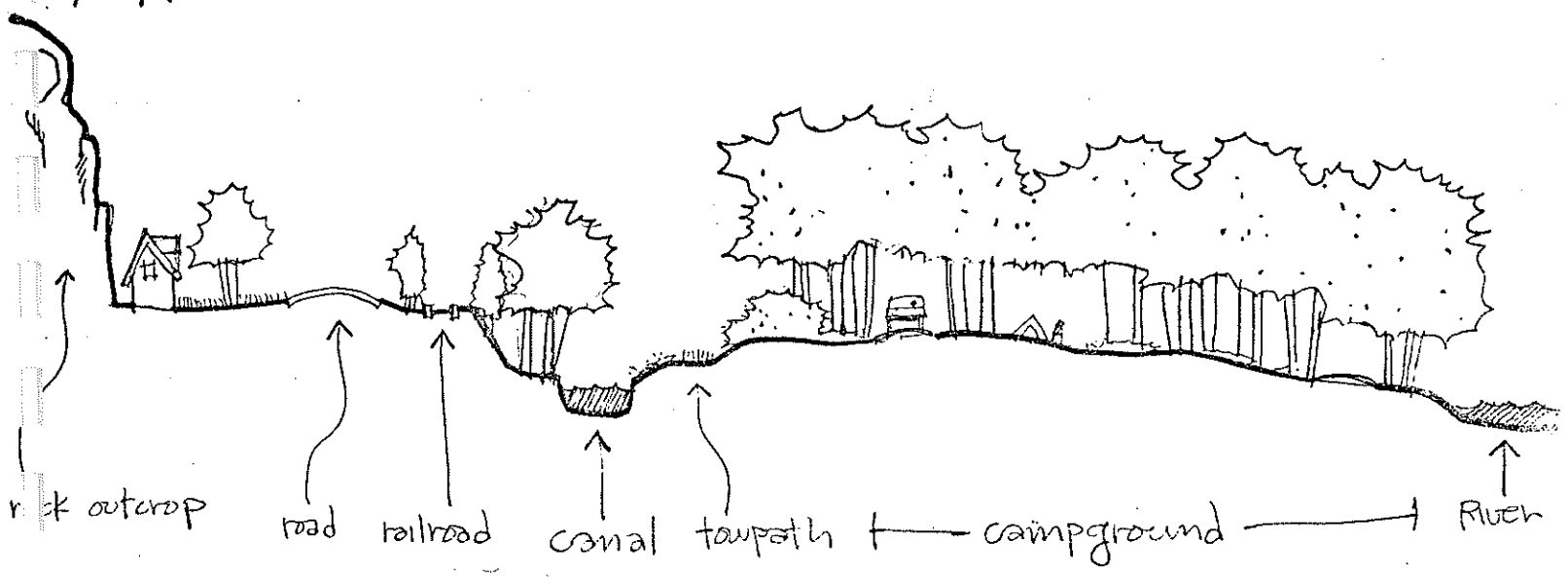
Although the base of the levee is prone to flooding by the Delaware River, hedgerow/thicket vegetation should remain in a steady state.

Management Recommendations

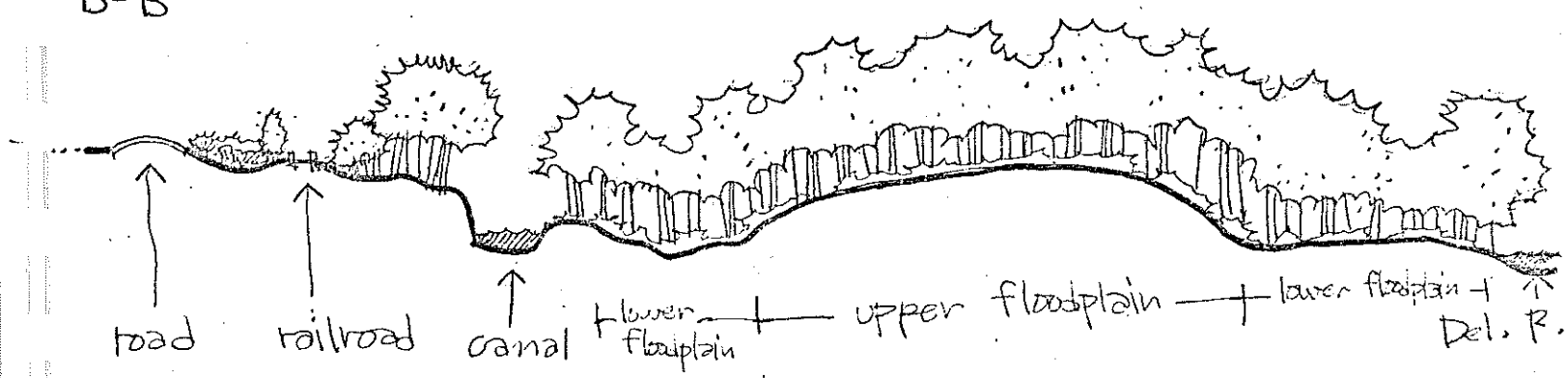
None

Sections

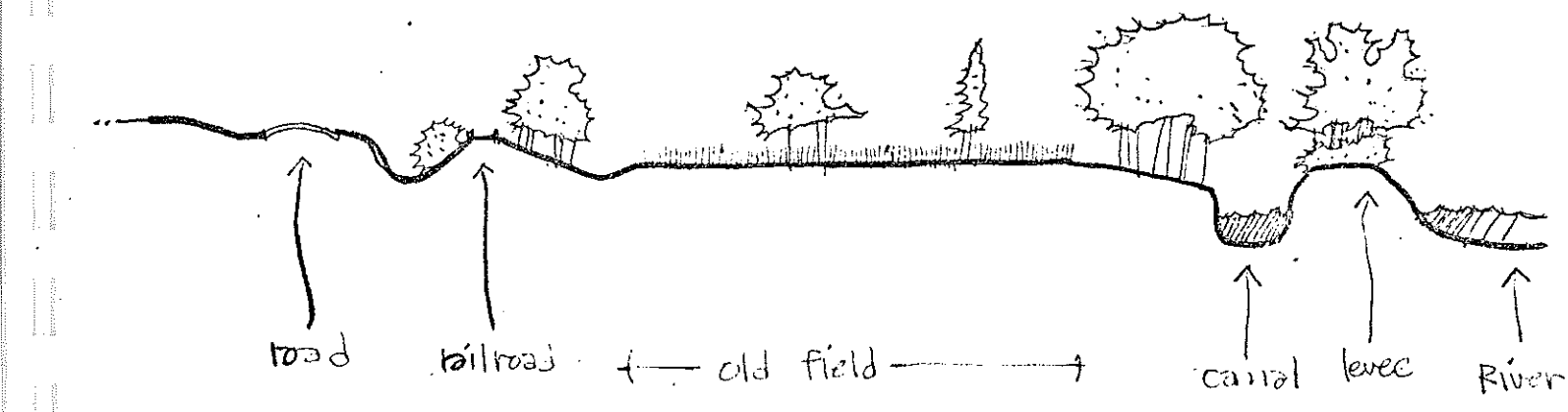
A-A′

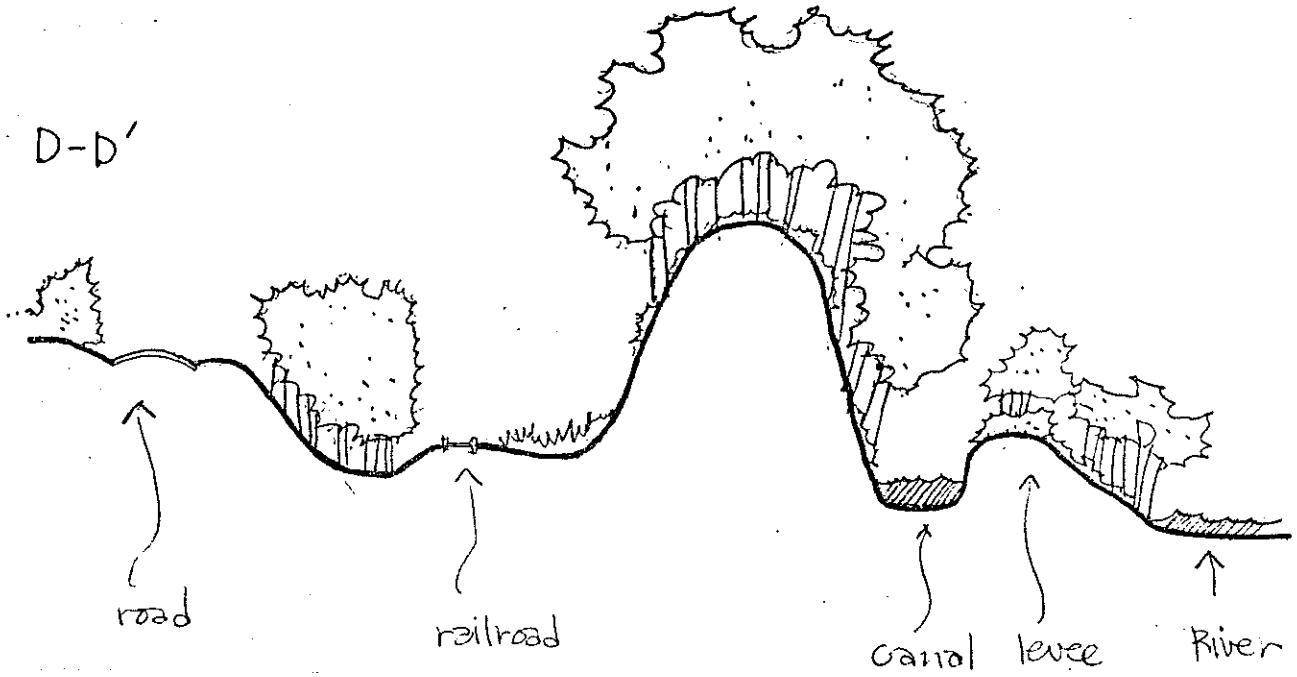


B-B′



C-C′




D-D'
road
railroad
canal
levee
River

CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	residential trees	single houses (with yards)
b	moist upland woods	unmanaged land (apparently unused)
c	dry upland woods	unmanaged land (apparently unused)
d	agricultural field	tilled field (cropland)
e	Delaware River floodplain wooded swamp	unmanaged land (apparently unused)
f	Delaware River floodplain	unmanaged land (apparently unused)
g	residential saplings	single houses (with yards)
h	Delaware River floodplain	picnicking
i	thicket and hedgerow	unmanaged land (apparently unused)
j	pasture	pasture
k	successional oldfield	unmanaged land (apparently unused)
l	moist upland woods	unmanaged land (apparently unused)
m	impervious	industrial

TOPOGRAPHIC CROSS-SECTIONS

A-A' -- Through campground
B-B' -- East of camp office
C-C' -- 1/4 mile by Lockatong Creek Mouth
D-D' -- Opposite Eagle Island

SPECIAL FEATURES

1. Specimen Norway maple: three trunks, 30" (76 cm) DBH, 60' (18m) tall
2. Specimen hackberry: 18" (45.7 cm) DBH, 40' (21.1 m) tall
3. Specimen sycamore: two trunks, 48" (122 cm) DBH, 70' (21.4 m) tall
4. Walnut stand
5. Stone towpath roadbed, 12" (30 cm) wide

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Down path just south of Bulls Island Bridge	1	1b
2	Maintained Canal towpath (note intermittent screening)	2	"
3	Camp ground at Bulls Island	2	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
4	Floodway through Bulls Island	2	1b
5	Bulls Island State Park--landscaped open space	2	"
6	Along right side of Canal on path	1	"
7	Wooded area (floodplain woods), interior Bulls Island	1	"
8	Railroad corridor (note relation to Route 29)	2	"
9	Railroad corridor	2	"
10	Open area dominanted by 5-6' pokeweed	2	"
11	Levee	1	"
12	Levee side of Canal looking upstream	1	"
13	Levee side of Canal looking downstream	1	"
14	Sandbags on levee along Canal	1	"
15	Railroad (note hedgerow screen)	2	"
16	Railroad (note hedgerow screen)	2	"
17	Vegetation along Delaware River	1	"
18	Oldfield ringed by black walnut and black locust	2	"
19	Levee in southern part of segment	1	"
20	Railroad (road elevated to left, swale to right)	1	"
21	Levee	1	"

SEGMENT 1 VEGETATION DATA

SUBSEGMENT A

Cover Type: Delaware River floodplain

Current Land Use: Unmanaged land, fishing, boating, camping, passive use, picnicking

Vegetation Data:

CANOPY (Density- thick)	UNDERSTORY (Density-thick)	SHRUB (Density-thick)	HERB (Density-thick)
Silver maple	Ailanthus	Slippery elm	Poison ivy
Sycamore	Mulberry	American elm	Virginia creeper
Box elder	Box elder	Black locust	Smartweed,
Black locust	Tulip poplar	Willow	Gill-over-the-ground
Black walnut	Honeylocust	Grape	Phlox
	Sugar maple	Spicebush	Snakeroot
	Black locust	Rose	Violet
	Black walnut	Ailanthus	Sensitive fern
	Slippery elm	Purple loosestrife	Japanese hop
	American elm		Dayflower
			Grasses
			Jewelweed
			Rough horsetail
			Brambles
			Stinging nettle
			Bergamot
			Pokeweed

Historic Disturbances: Flooding, pipe

Current Disturbances: Flooding, debris, siltation, trampling, mowing, insect invasion, browsing

SUBSEGMENT B

Cover Type: Delaware River floodplain

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY (Density- thick)	UNDERSTORY (Density-thick)	SHRUB (Density- medium)	HERB (Density- medium)
Sycamore	Box elder	Spicebush	Christmas fern
Tulip poplar	Hickory	Black locust	Poison ivy
American elm		Pokeweed	Sheep sorrel
Black walnut			Gill-over-the-ground
Silver maple			Jewelweed
Black oak			Unknown ferns and grasses
Hackberry			Goldenrod
Sugar maple			Brambles
			Grape
			Ragweed
			Dodder
			Hayscented fern
			Sensitive fern

Historic Disturbances: Flooding

Current Disturbances: Trampling, cutting, browsing, dumping, insect invasion

SUBSEGMENT C

Cover Type: Delaware River floodplain, roadway

Current Land Use: Managed woodland, camping, picnicking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- medium)	(Density- medium)	(Density- thin)	(Density- medium)
Green ash	Box elder	Spicebush	Poison ivy
Black walnut	Red cedar		Unknown grasses
Sycamore	Mulberry		Grape
American elm			Japanese hop
Black locust			Gill-over-the-ground
Black Oak			

Historic Disturbances: Flooding

Current Disturbances: Cutting

SUBSEGMENT D

Cover Type: Delaware River floodplain, roadway, landscaped open space

Current Land Use: Single house, passive use, picnicking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- thin)	(Density- thin)	(Density- thin)	(Density- thick)
Black oak	Typical landscape species	Typical landscape species	Grasses
Typical landscape species			

Historic Disturbances: Flooding

Current Disturbances: Mowing

SUBSEGMENT E

Cover Type: Delaware River floodplain

Current Land Use: Unmanaged land, hiking, fishing, camping, hunting, picnicking, passive use

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- thick)	(Density- thick)	(Density- medium)	(Density- medium)
American elm	Black locust	Red oak	Jewelweed
Silver maple	Box elder	Spicebush	Stinging nettle
Sycamore	Tulip poplar		Dayflower
Black locust	Hop tree (rare)		Sensitve fern
Tulip poplar	River birch		Cinnamon fern
Black walnut	Common apple		Unknown fern
Red oak	Slippery elm		Gill-over-the-ground
River birch	American elm		Grasses
Green ash			Rough horsetail
White ash			Jack-in-the-pulpit
			Smartweed
			Snakeroot
			Violet

Historic Disturbances: Flooding

Current Disturbances: Trampling, cutting, browsing, campfire, insect invasion

SUBSEGMENT F

Cover Type: Thicket and hedgerow, railroad

Current Land Use: Railroad, hunting

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- broken)	(Density- broken)	(Density- medium)	(Density- medium)
Sassafras	Flowering dogwood	Red cedar	Mullein

CANOPY	UNDERSTORY	SHRUB	HERB
Ailanthus	Sassafras	Willow	Foxtail grass
Basswood	Box elder	Speckled alder	Yarrow
Black cherry	Black oak	Bigtooth aspen	Brambles
Slippery elm	Sugar maple	Tulip poplar	Grasses
American elm	Red maple	Greenbriar	Grape
Silver maple	American and slippery elm	Black locust	Sycamore
Green and white ash		Red oak	Poison ivy
			Virginia creeper
			Sedges
			Japanese honeysuckle
			Butter-and-eggs
			Queen-Anne's lace
			Sheep sorrel
			Hayscented fern
			Purple loosestrife
			Greenbriar
			Snakeroot
			Phlox

Historic Disturbances: Cutting, herbiciding, railroad

Current Disturbances: Herbiciding, insect invasion, trampling, cutting

SUBSEGMENT G

Cover Type: Successional oldfield

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- none)	(Density- thin)	(Density- thick)	(Density- thick)
None	Box elder	Raspberry	Raspberry
	Black walnut		Goldenrod
	Silver maple		Purple loosestrife
	Black cherry		Queen-Anne's lace
	Staghorn sumac		Steeple-bush
			Grape
			Bergamot

Historic Disturbances: Undetermined

Current Disturbances: Browsing

SUBSEGMENT H

Cover Type: Successional oldfield

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- thin)	(Density- thin)	(Density- thick)	(Density- thick)
Black walnut	Black walnut	Sunflower	Grasses
			Rough horsetail
			Sunflower
			Snakeroot

Historic Disturbances: Undetermined

Current Disturbances: Browsing

SUBSEGMENT I

Cover Type: Successional oldfield

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- none)	(Density- none)	(Density- thick)	(Density- thick)
None	None	Pokeweed	Pokeweed
		Sunflower	Grasses
		Bergamot	Sunflower
			Bergamot

Historic Disturbances: Undetermined

Current Disturbances: None

SUBSEGMENT J

Cover Type: Successional oldfield

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- none)	(Density- thin)	(Density- thick)	(Density- thick)
None	Black locust	Raspberry	Grasses
		Bergamot	Goldenrod
			Bergamot
			Japanese honeysuckle
			Raspberry

Historic Disturbances: Undetermined

Current Disturbances: None

SUBSEGMENT K

Cover Type: Successional oldfield

Current LandUse: Unmanaged land, fishing, camping, hunting

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- thin)	(Density- thin)	(Density- thin)	(Density- thick)
Hickory	Bigtooth aspen	Red cedar	Black-eyed Susan
Black cherry	Flowering dogwood	Sassafras	Yarrow
Black walnut	Red cedar		Evening primrose
Black locust	Black locust		Jewelweed
	Black walnut		Prickly dewberry
			Grasses

Historic Disturbances: Undetermined

Current Disturbances: None

SUBSEGMENT L

Cover Type: Delaware River floodplain, thicket and hedgerow

Current Land Use: Unmanaged land, fishing, camping, hunting

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- scattered)	(Density- scattered)	(Density- thick)	(Density- thick)
Box elder	Same as canopy	Spicebush	Stinging nettle
Green ash		Poison ivy	Violet
Silver maple		Silky dogwood	Grape
Slippery elm		Buttonbush	Poison ivy
American elm			Japanese honeysuckle
Basswood			Virginia creeper
Sycamore			Phlox
Black cherry			Sensitive fern
			Grasses
			Bog-hemp
			Burdock

Historic Disturbances: Flooding, levee

Current Disturbances: Flooding, campfires

Segment 2

SPECIAL NODE, FROM NORTH OF SMITH'S MILL TO FIRST TIMBER BRIDGE SOUTH OF SMITH'S MILL

SEGMENT NARRATIVE

Segment 2 is designated as a special node in the Canal Commission's 1976 Master Plan because it is distinctly different in character from the two adjoining segments. Route 29, which usually runs immediately alongside the Canal, here bends inland to join Route 519 at the Wickecheoke Bridge. (See the map on Sheet 1a.) The Park property is bounded by the Delaware River on the south and by these two roads on the east and west. It extends several hundred yards north of their junction. Segment 2 contains six subsegments--the two banks of the Wickecheoke Creek above Route 29; an "island" bounded by the creek, Route 29, and the railroad; the parkland at Smith's Mill; the Canal levee; and the railroad corridor.

Wickecheoke Creek is bordered on the southeast by steeply sloping, moist woodland (Subsegment A). Tulip poplar and beech (*Fagus grandifolia*) appear in the canopy layer, which ranges as high as 60 ft (18 m). Red and black oaks and beech dominate the understory, although hemlock (*Tsuga canadensis*) and sycamore are also found. Rhododendron, spicebush, and flowering dogwood (*Cornus florida*) fill the shrub layer. In the herb layer, Christmas fern, poison ivy, and brambles and grasses are found.

Northwest of the creek (Subsegment B) is rock-strewn floodplain woodland. Sycamore and sugar maple (*Acer saccharum*), the latter with 16 in (40.6 cm) average DBH, dominate the canopy and understory. The dense shrub layer is composed mostly of spicebush, with some witch hazel (*Hamamelis virginiana*). The sparse herb layer consists mainly of grasses, with a few vines and wildflowers.

A triangular "island" interesting for its variety of community types, Subsegment C was included in the survey, although new maps indicate that it is not part of the Canal Park. Delaware River floodplain woodland, upland woods and successional oldfield are all found in this area. These communities reflect slope, aspect, and moisture conditions, as well as land use (e.g., quarrying).

The old buildings at Smith's Mill (Subsegment D) are set in a lawn with large native and ornamental shade trees, including mimosa and black walnut.

A bridge carries the railroad over the Wickecheoke. After it passes under the bridge, the creek flows into the Canal. The Canal is separated from the Delaware River at this point by a concrete retaining wall which replaces the levee (Subsegment F). Excess water from the Canal and creek can flow over the wall into the river.

The Canal levee (Subsegment F) is a continuation of levee subsegment L (Segment 1) from Bulls Island, although it is a bit wider in Segment 2 and has a lower canopy (box elder and green ash) and a denser shrub layer. Poison ivy and spicebush make up most of the shrub community.

Subsegment E, the railroad corridor, also has the same vegetation communities as are found along the railroad in Segment 1. The trestle bridge has no vegetation.

While the mill area could be developed for fairly intensive activity, the Wickecheoke floodplain and steep woods are suitable only for passive use because of current and potential erosion. The triangular island could be developed as a low-capacity trail system and for use as an ecological study site. The train tracks were in use by the railroad at the time of this survey.

Access into Canal Corridor

Route 29 provides easy access to all parts of Segment 2, except for the levee (Subsegment F), which separates the Canal and the Delaware River. The levee can only be reached from adjacent segments or from the river.

Towpath

The towpath is clear along the railroad, but the overgrown levee is impassable.

Ease of Passage on the Canal

Passage down the Canal in this segment is unimpeded.

Wildlife

Various woodland and thicket birds and a little blue heron at one of the quarry ponds were observed. There was evidence of rabbits in the oldfield area.

Auditory Assessment

Highway traffic noise is distinctly audible in this segment.

SUBSEGMENT A

The cool, moist northwest facing slope along the Wickecheoke Creek is steep and wooded in most places. The major components of the medium-dense, 40 to 50 foot (12 to 15 m) canopy are beech, tulip poplar, red maple (*Acer rubrum*) and sugar maple in fairly even proportions. The hemlocks in the mixed beech-maple understory are indicative of the cool, shady conditions. Ironwood (*Carpinus caroliniana*) is also present in the understory, and there is an occasional river birch (*Betula nigra*) at the creek's edge. Flowering dogwood and rhododendron, along with spicebush and small hemlocks, are found in the dense shrub layer. The medium-dense groundcover has Christmas fern as its most conspicuous element, while rolling mounds of dayflower (*Commelina spp.*) and a number of creeping vines border a gravel road above the creek (See Section A-A'.)

Recent disturbance to the area appears to be minimal, with the exception of the lower portion of the slope, which clearly has undergone erosion and slumping of the banks.

One area above the road was apparently quarried in the past. This land use has resulted in a depression with a high percentage of typical bottomland tree species, such as sycamore and ash (*Fraxinus* spp.) as well as luxuriant patches of jewelweed in the wetter spots. Exposed rock ledges make this area texturally different from the surrounding loamy woodlands.

These woods give a sense of enclosure and are far enough removed from traffic to be relatively quiet. The flowing creek adds a pleasant sound.

Community Dynamics

The steep northwest-facing slope of these moist upland woods will continue to influence the composition of this community, which should remain stable.

Management Recommendations

Because of the steep slopes, access to the creek from Subsegment A is treacherous as well as damaging to the creek bank. Care should be taken to discourage trampling. The vegetative cover on this bank should be maintained in order to retard erosion and slumping.

SUBSEGMENT B

The rock-strewn floodplain woods along the much flatter northwest bank of the Wickecheoke Creek is Subsegment B. By far the dominant species in the medium-dense, 30 ft (9m) canopy is sugar maple, overtopped here and there by a large (up to 25 in or 0.6m DBH) sycamore or white ash (*Fraxinus americana*) reaching 60 ft (18m) in height. The shrub layer is dominated by spicebush, with occasional witch hazel. The groundcover is generally sparse, consisting of various sedges (*Cyperaceae spp.*) and grasses, nettles, and creeping vines, as well as an occasional Jack-in-the-pulpit (*Arisaema triphyllum*). In places, poison ivy is dominant, sometimes reaching into the canopy.

Where the floodplain woods meet Route 519 there is a dense, low growth of jewelweed, creeping vines, and a number of other herbs and shrubs.

Intermittent traffic noise is audible from this side of the creek.

As these woods are often inundated by flood and because the ground is rock-strewn, the area would not be suitable for camping, but picnicking and other passive uses might be appropriate.

Community Dynamics

Flooding should continue to influence the composition of these woods and control the success of regeneration and establishment of new members.

Management Recommendations

None

SUBSEGMENT C

Wedged between Route 29, the Wickecheoke Creek, and the railroad lies a triangular parcel of land (about 10 acres or 4 hectares) which contains a wide variety of vegetation communities. They range from moist wooded floodplain to dry upland woods, along with a number of special features and transitional communities. The vegetation differences reflect a variety of slopes, aspects and moisture conditions, as well as past and current disturbances. This diversity is attractive to wildlife.

The most distinctive features have resulted from past quarrying. A deep, water-filled quarry pit lies at the base of an imposing rock face which rises about 50 ft (15m). The pond is carpeted with duckweed (*Lemna minor*). A little blue heron was seen in this pond. The narrow rim of the quarry, accessible by a steep footpath, provides a vantage point from which to view the Delaware River Valley.

An oldfield to one side of the pond extends to the railroad corridor. It consists of several small stands (up to 30 ft or 9m high) of black locust, black cherry, tulip poplar, white ash, red maple, red oak and bigtooth aspen. The shrub layer is dominated by Tartarian honeysuckle (*Lonicera tartarica*), along with flowering dogwood, staghorn sumac, and saplings of white oak (*Quercus alba*). The dense herbaceous layer consists of grasses, sedges, ebony spleenwort (*Asplenium platyneuron*), yellow iris (*Iris* spp.), and a number of creeping vines.

The swampy bottom of another nearby quarry pit supports a 60 ft (18m) closed canopy of typical floodplain species such as green and white ash, with spicebush in the shrub stratum, and jewelweed, blackberry (*Rubus allegheniensis*), Japanese honeysuckle in the herb stratum.

The woodland in the remainder of the subsegment stabilizes the steep slopes. The canopy reaches about 60 to 70 ft (18+ m) and is populated by large black oaks (36" or 91 cm DBH), tulip poplar (24" or 61 cm DBH), red oak, and red maple. White oak and sugar maple dominate the woods at the top of the slopes. Drier conditions there make the canopy lower and thinner than lower down the slopes. The understory is a mixture of flowering dogwood, red maple, beech, and black cherry. Shrubs include spicebush, along with black oak, flowering dogwood, Tartarian honeysuckle, and arrowwood (*Viburnum dentatum*). Conspicuous in the herb layer are Christmas fern and lady fern, with Japanese honeysuckle, poison ivy, maple leaf viburnum (*Viburnum* spp.), sugar maple, and hickory sprouts also.

In places, the dominant species mix changes. Beech groves and a bigtooth aspen stand result from differences in topography and microclimate.

At the time of the survey, it was believed that Subsegment C was a part of the Canal Park. New maps published to accompany the Canal Commission's Proposed Master Plan (December 1976) indicate that the area is actually a contiguous land use. Because this subsegment contains so many vegetational community types, demonstrating influences of slope, aspect, and moisture conditions (as well as past land uses), it is well suited to ecological study and to development of a low-capacity scenic trail system.

Community Dynamics

Because the saplings are the same species found in the canopy, the upland woods community of Subsegment C should remain stable. If not disturbed, the oldfield area will probably continue its sucession. From all indications, the floodplain woodland will retain its existing character and will remain subject to water disturbance and erosion.

Management Recommendations

Care must be taken to protect the steep, highly erodible upper slopes of the footpath. Stabilizing vegetation should be planted on bare areas.

SUBSEGMENT D

Subsegment D consists of Smith's Mill and the adjoining property along the left bank of Wickecheoke Creek. The subsegment is an open parkland with numerous large specimen trees in a mowed lawn. Floodplain species, as well as planted trees, shrubs and flowers, occupy this area, forming a pleasant and diverse community. While most of the property is maintained by mowing and cutting, some areas, particularly adjacent to the Canal, have been neglected. These support typical floodplain meadow and thicket species such as evening primrose, ragweed (*Ambrosia* spp.), pokeweed, jewelweed, and purple loosestrife (*Lythrum salicaria*) with an assortment of grasses.

While the mill buildings themselves appear to be unused, the grounds are put to active use by neighborhood children who play and fish there.

Community Dynamics

If young trees are not planted, the large specimen trees of this parkland area will not be replaced when they eventually die off.

Management Recommendations

Plant young trees.

SUBSEGMENT E

The railroad corridor through Segment 2 is generally similar in character and species composition to that of Segment 1, Subsegment F. Opposite the Smith's Mill buildings, however, a trestle bridge carries the railroad over the Wickecheoke Creek before it flows into the Canal. From this vantage point, one can see the mill buildings in one direction, and a clear view of the Delaware River in the other direction.

Community Dynamics

The ballast and edge communities are maintained by the railroad's management practices, including the use of herbicides and cutting.

Management Recommendations

None

SUBSEGMENT F

Although similar in vegetation and character to the levee subsegment previously discussed (Segment 1, Subsegment L) the levee is wider here, with a higher canopy and very dense shrub layer. As previously mentioned in the segment narrative, a concrete retaining wall replaces the levee at the confluence of the creek and the Canal. The gravel bar downstream from the confluence is included in Subsegment F.

Comunity Dynamics

Although the base of the levee is subject to flooding by the Delaware River, hedgerow/thicket vegetation should remain in a steady state.

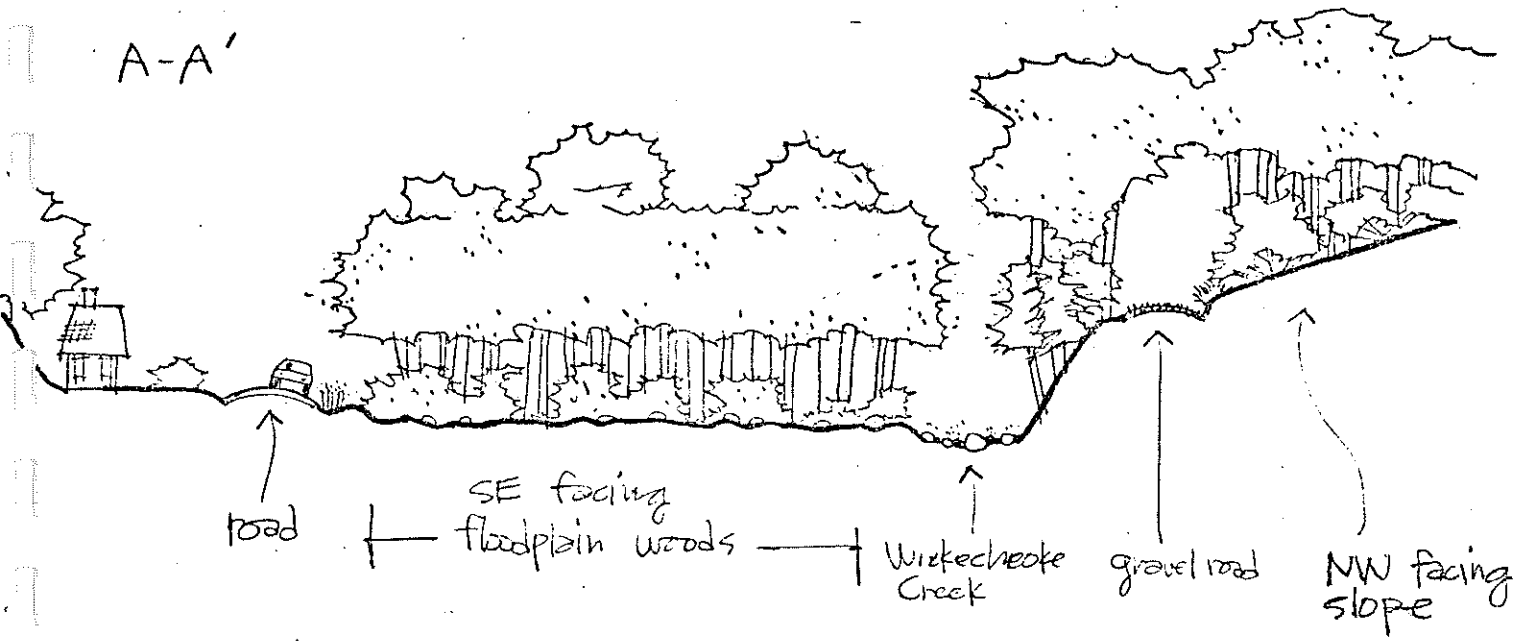
Management Recommendations

None

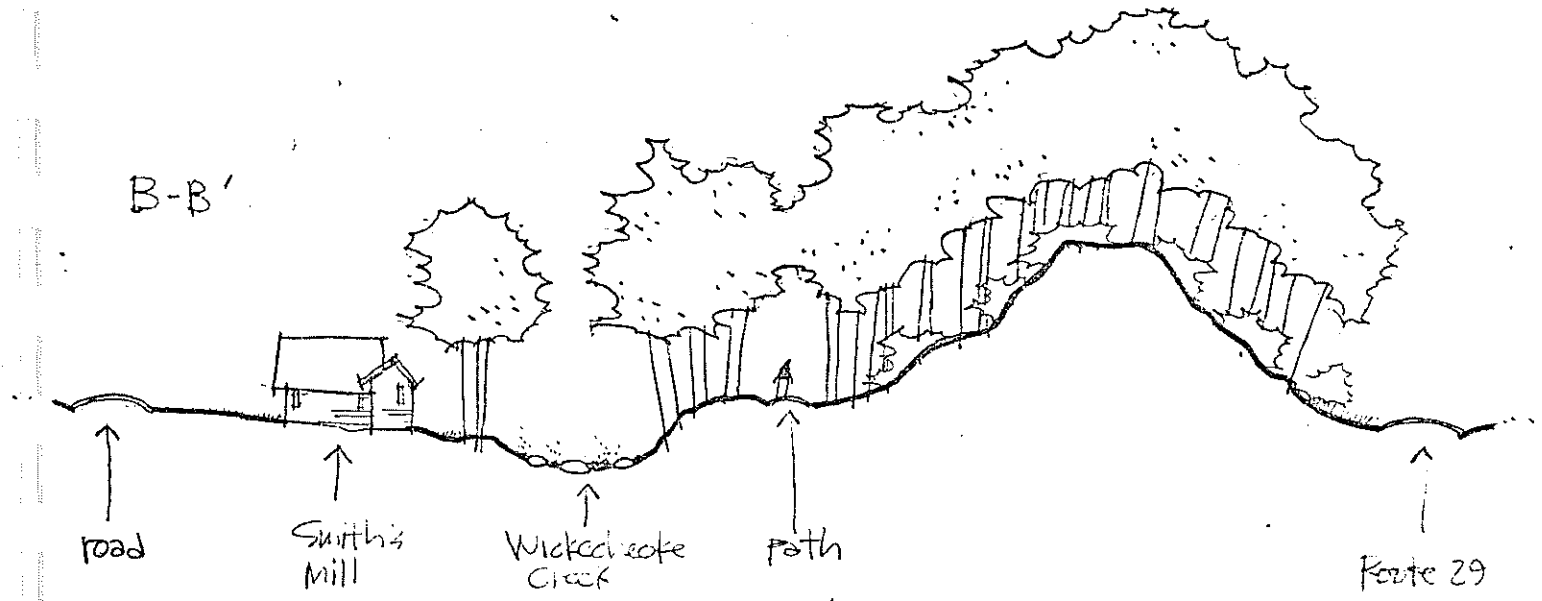
Segment 2

Sections

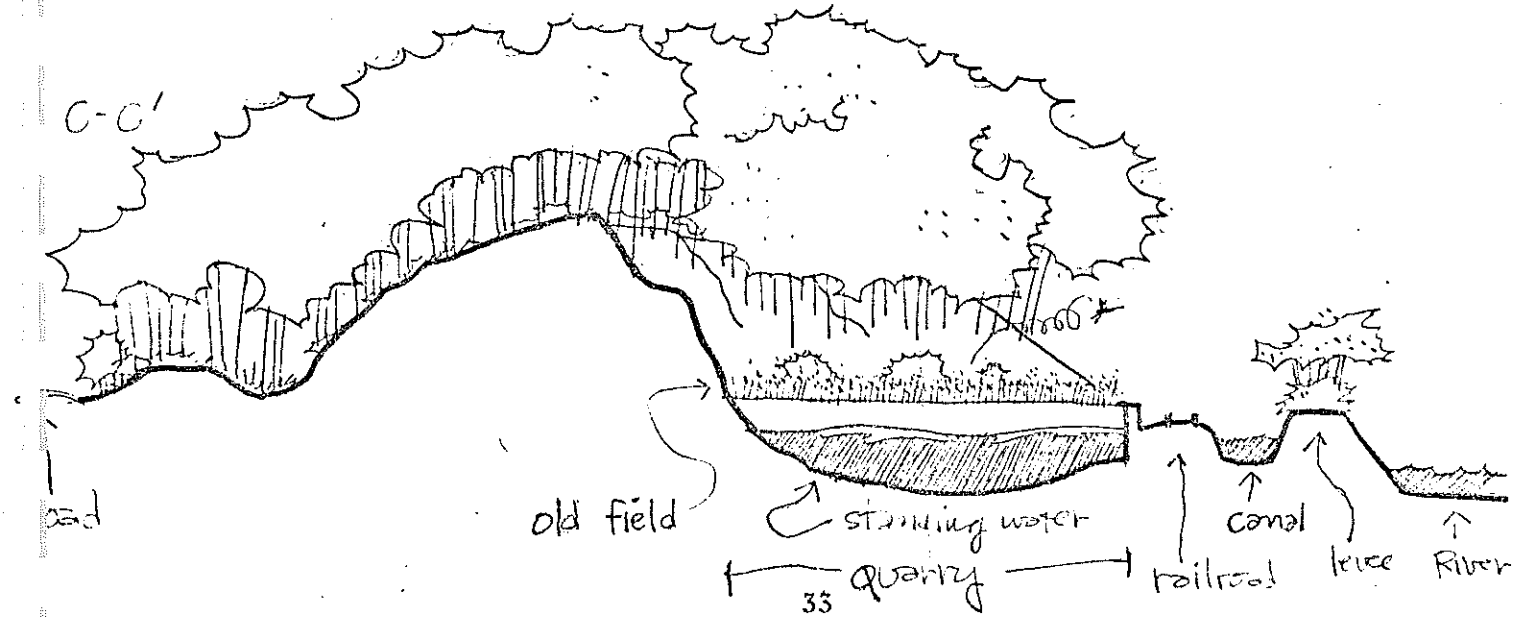
A-A'



B-B'



C-C'



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	residential trees	single houses (with yards)
b	moist upland woods	unmanaged land
c	residential trees	single houses (with yards)
d	moist upland woods	unmanaged land

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Through Subsegments A and B
B-B' --- Across Subsegment C and Mill Park
C-C' --- Across Subsegment C through pinnacle and pond

SPECIAL FEATURES

1 --- Historic buildings at Smith's Mill

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Weir at end of levee near Smith's Mill	1	1b
2	Wickecheoke floodway	1	"
3	Floodplain woods (note dense sugar maple saplings, few larger trees)	1	"
4	Wickecheoke woods	1	"
5	From pinnacle toward Delaware River	1	"
6	Subsegment D--general view of Smith's Mill buildings	1	"
7	Spillway and floodplain at mouth of Wickecheoke	1	"

SEGMENT 2 VEGETATION DATA

SUBSEGMENT A

Cover Type: Moist upland woods

Current Land Use: Unmanaged land, hiking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-medium)	(Density-medium)	(Density-thick)	(Density-medium)
Beech	Ironwood	Rhododendron	Christmas fern
Tulip poplar	Hemlock	Spicebush	Poison ivy
Red maple	Beech	Flowering dogwood	Virginia creeper
Sugar maple	Sycamore	Hemlock	Jewelweed
River birch	Hickory		Snakeroot
	Red oak		Smartweed
	White ash		Aster
	Black oak		Dayflower
	Red maple		Japanese honeysuckle
	Sugar maple		Unknown grasses
			Gill-over-the-ground
			Violet
			Brambles

Historic Disturbances: Partial flooding

Current Disturbances: Flooding, siltation, erosion, windthrow

SUBSEGMENT B

Cover Type: Delaware floodplain woods

Current Land Use: Unmanaged land, hiking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-medium)	(Density-medium)	(Density-thick)	(Density-thin)
Sugar maple	Sugar maple	Witch hazel	Unknown grasses
Slippery elm	Poison ivy	Spicebush	Virginia creeper
Beech		Poison ivy	Sedges
Sycamore			Stinging nettle
Hickory			Christmas fern
Red oak			Strawberry
White ash			Jack-in-the-pulpit
Black oak			Ragweed
			Japanese honeysuckle
			Poison ivy
			Jewelweed

Historic Disturbances: Flooding

Current Disturbances: Flooding, siltation, erosion, windthrow

SUBSEGMENT C

Cover Type: Steep woods, pond, transitional communities

Current Land Use: Unmanaged land, hiking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-varies)	(Density-varies)	(Density-varies)	(Density-varies)
Tulip poplar	Flowering dogwood	Spicebush	Christmas fern
Red oak	Red maple	Flowering dogwood	Japanese honeysuckle
White ash	Tulip poplar	Black oak	Maple-leaved viburnum
White oak	Beech	Hemlock	Poison ivy
Red maple	Black cherry	Sassafras	Lady fern
Black oak	Staghorn sumac	Blueberry	Sugar maple
Hemlock		Tartarian honeysuckle	Hickory
Bigtooth aspen		Arrowwood	Cinnamon fern

CANOPY	UNDERSTORY	SHRUB	HERB
Black locust			Uvularia
Beech			Black locust
Green ash			White oak
Sugar maple			Red cedar
			Moss
			Vetch
			Yarrow
			Duckweed
			Sedges
			Ebony spleenwort
			Yellow iris
			Jewelweed
			Blackberry

Historic Disturbances: Erosion, excavation

Current Disturbances: Erosion

SUBSEGMENT D

Cover Type: Parkland

Current Land Use: Hiking, fishing, bicycling, picnicking, garden

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-	(Density-	(Density-	(Density-
Black walnut		Lilac	Unknown grasses
White ash		Vitex spp.	Foxtail grass
Mimosa		Rose	Red clover
		Flowering dogwood	Ragweed
			Purple loosestrife
			Jewelweed
			Pokeweed
			Evening primrose

Historic Disturbances: Flooding, trampling

Current Disturbances: Trampling, flooding, mowing, cutting

SUBSEGMENT E

Cover Type: Thicket and hedgerow, railroad

Current Land Use: Railroad

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-broken)	(Density-broken)	(Density-medium)	(Density-medium)
Sassafras	Flowering dogwood	Red cedar	Mullein
Ailanthus	Sassafras	Willow	Foxtail grass
Basswood	Box elder	Speckled alder	Yarrow
Black cherry	Black oak	Bigtooth aspen	Brambles
Slippery elm	Sugar maple	Tulip poplar	Grasses
American elm	Red maple	Greenbrier	Grape
Silver maple	American and	Black locust	Sycamore
Green and white ash	slippery elm	Red oak	Poison ivy
			Virginia creeper
			Sedges
			Japanese honeysuckle
			Butter-and-eggs
			Queen-Anne's lace
			Sheep sorrel
			Hayscented fern
			Purple loosestrife
			Greenbrier
			Snakeroot
			Phlox

Historic Disturbances: Mowing, cutting, herbiciding

Current Disturbances: Cutting, herbiciding

SUBSEGMENT F

Cover Type: Delaware River floodplain, thicket and hedgerow

Current Land Use: Unmanaged land, fishing, camping, hunting

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-scattered)	(Density-None)	(Density-thick)	(Density-thick)
Box elder		Spicebush	Stinging nettle
Green ash		Poison ivy	Violet
Silver maple		Silky dogwood	Grape
Slippery elm		Buttonbush	Poison ivy
American elm			Japanese honeysuckle
Basswood			Virginia creeper
Sycamore			Phlox
Black cherry			Sensitive fern
			Grasses
			Bog hemp
			Burdock

Historic Disturbances: Flooding, levee

Current Disturbances: Flooding, campfires

Segment 3

LEVEE, OLDFIELD, AND RESIDENTIAL EDGE THROUGH STOCKTON

SEGMENT NARRATIVE

Segment 3 is composed of subsegments which vary widely in vegetation and character. On the right side is the levee which separates the Canal from the Delaware River; the left side borders the town complex of Stockton. The railroad runs parallel to the Canal on the left side of the segment. (See the map on Sheet 1a.)

The levee (Subsegment A) has natural Delaware River floodplain vegetation. Basswood (*Tilia americana*), sycamore, and other species make a fairly thick canopy cover at about 40 ft (12.2 m). The medium-dense understory contains flowering dogwood, spicebush, and hackberry (*Celtis occidentalis*). The shrub and herb layers are very sparse. Occasionally, breaks in the canopy allow the shrub and herb layers to flourish: here, they form a thick, eye-level zone of nettles, pokeweed, and spicebush. The original stone retaining wall of the levee is intact, and those species on the higher, drier (better-drained) levee sides and top include black oak, hickory, basswood, hackberry. At the base of the levee, water-tolerant species (silver maple, buttonbush, spicebush, etc.) thrive.

The Park land which borders Stockton and the railroad corridor (Subsegments C and D) includes scattered residential and commercial parcels of land. Several open areas in Subsegment C are oldfields and landscaped open areas, including a town park. The vegetation ranges from short thickets along the railroad (Subsegment B) to a willow (*Salix* spp.) and river birch canopy along the Canal adjacent to the town park (Subsegment C). The field survey team noted an 80 ft (24.4 m) river birch at the Canal's edge, a specimen tree.

Southeast of Stockton is a very large, flat, very young successional oldfield (Subsegment D) in which loosestrife, ragweed, Queen-Anne's lace, and daisies (*Chrysanthemum* spp.) predominate.

The levee forms a ready-made path along the Canal. Shade from the canopy which lines most of the levee keeps the shrubs down and provides a pleasant experience for pedestrians. The scattered residential and commercial areas on the opposite side of the Canal are rarely noticed, and the overall feeling of the area is relaxed and natural.

The levee on the right side of the Canal could be used as part of a path system. Unlike the levee area in Segment 1, this portion is wide. Some clearing of vegetation and grading would be needed to create an unimpeded path.

Access into Canal Corridor

The Canal is easily accessible from the pedestrian bridge at the lock which begins Segment 3 and from the highway bridge across the Delaware at Stockton.

Towpath

The path on the levee side of the Canal (Subsegment A) is in good condition. On the other side (Subsegments C and D), the path is largely obliterated by vegetation.

Ease of Passage on Canal

Passage on the Canal is hampered only by the lock at the beginning of the segment.

Wildlife

No unusual wildlife was observed in Segment 3.

Auditory Assessment

Infrequent noise from railroad traffic and light residential traffic in and contiguous to Segment 3 are audible within the segment.

SUBSEGMENT A

Subsegment A is the levee which separates the Canal and the river. The vegetation here varies. Typical floodplain species occur in the lower, wetter portion. These floodplain species are mixed with basswood, and oak in the higher, less flood-prone portion that comprises the levee structure. Basswood is dominant, with a DBH of 6" (15 cm). The canopy is thick; the shrub and herb layers, which include spicebush (dominant), various grasses, ferns, and vines, are of medium density.

The levee is an area which appears natural in character. A relatively narrow strip of land, it buffers the Canal from the river. The physical impact of the Canal is obvious in the contrast of gently natural contours and the extremely sharp edge of parts of the levee structure.

Walking along the top of the levee provides excellent views of the floodplain, river, and Canal all at once. The river provides a natural auditory background, except for an occasional motorboat. Vegetation provides a nearly complete visual buffer of the Canal. The thick canopy provides considerable shade.

Access into the subsegment is good; and with minimal clearing and grading efforts, the path along the top of the levee could be improved to form part of a pedestrian system.

Community Dynamics

On the levee, the floodplain woodland is only occasionally disturbed by flood, and presence of seedlings and saplings of canopy species should ensure its continuity. The area at the base of the levee is affected by more frequent and severe flooding.

Management Recommendations

None

SUBSEGMENT B

The railroad corridor (Subsegment B), which comprises about 75% of the Segment 3 land bordering Stockton, contains the low drought-tolerant species (in the ballast) and thicket/hedgerow community (at the edges) which characterize the railroad corridor farther upstream (Segments 1 and 2). Honeylocust (*Gleditsa triacanthos*) and tulip poplar are also found in the thin canopy layer.

Residential and commercial land uses in Stockton abut Subsegment B and can be seen from the corridor. A park/playground in Subsegment C is also adjacent and visible. (See Section A-A'.) Intermittent traffic noise is audible from the railroad corridor, and railroad was still being used several times a day at the time of the survey. Access into the subsegment is easy from several roads which cross the tracks. (See the map on Sheet 1a.)

Community Dynamics

The railroad's management practices (e.g., cutting, herbiciding) should keep the herbaceous community and thicket/hedgerow in their current states.

Management Recommendations

None

SUBSEGMENT C

This subsegment comprises the area between the railroad corridor and the Canal. Scattered, fairly new residential areas, with some commercial and institutional zones also, are within the boundary lines delineated by the Canal Commission.

Subsegment C is bisected by the road which leads from Stockton to the Delaware River Bridge, and several other paved roads run between and parallel to the Canal and railroad through much of the subsegment.

Although there is residential property with ornamental plantings very near the Canal, the State retains a narrow strip of the Canal bank (See Section B-B'.). On this strip, natural vegetation forms a definite edge along the Canal. This situation is most pronounced in the eastern (downstream) third of the segment, below the road which divides the segment and leads to the Stockton Bridge across the Delaware.

This subsegment is generally flat, with minor topographic changes. The vegetation is spotty, but thick where it occurs. A small park in the western end of the subsegment is largely turf surrounded by a typical thicket community. which includes *rubus* species, pokeweed, nettles, and sumac (*Rhus* spp.). In the edge community of the Canal bank, there are a number of willows and river birches, including a multi-stemmed specimen river birch 80 ft (24.4 m) high and 3 ft (1 m) in diameter at breast height.

Little to no vegetative cover offers shade along passable pedestrianways in Subsegment C. The narrow, dense edge community and close proximity to residential property inhibits access to the Canal bank in many areas. In fact, the path of least resistance often breaks visual contact with the Canal completely. Traffic on the residential roads and infrequent railroad noise are audible throughout Subsegment C.

Its proximity to Stockton, the availability of parking facilities, and the ease of access to the Canal corridor from the Delaware bridge road make this area valuable for consideration as a possible entranceway into the Canal park. Facilities such as parking lots and canoe rental areas might be considered.

Community Dynamics

Residential land uses and management (e.g., mowing, cutting) control much of the vegetation in Segment 3.

Management Recommendations

None

SUBSEGMENT D

Subsegment D is a very young successional oldfield. This area is a large, flat, natural open space adjacent to the residential area in the eastern part of Segment 3. It is bounded by the Canal to the south and by Route 29 to the north. The railroad corridor (Subsegment B) passes through this area.

The predominant species are loosestrife, ragweed, Queen-Anne's lace, and daisies. Red clover (*Trifolium pratense*) and bergamot were also observed.

This oldfield abuts the residential areas and paved road at the eastern end of Subsegment C. A path extends from the end of the paved road well into the field, and the vehicle tracks on this path contained water when observed, on the day after a rainstorm. The field itself was dry. Because the field is treeless, there is no shade, and in the summer the midday sun bakes the field and anyone who is in it. However, the flowers are fragrant and their diversity is subtle and pleasing to the eye.

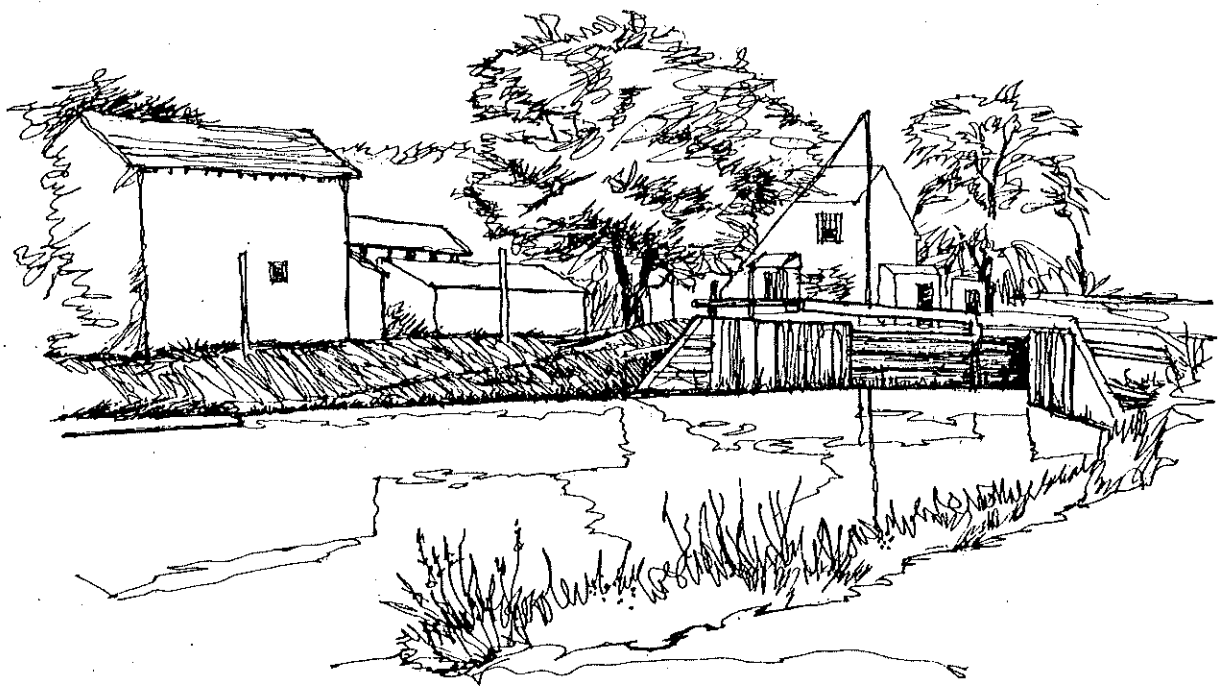
Because this is one of the few large, uniformly flat open areas, Subsegment D should be considered for uses compatible with such qualities (i.e., parking, playing fields, etc.). If the northern portion of the field were used, access to the Canal would have to be provided through the railroad corridor and thicket.

Community Dynamics

This oldfield is unmanaged and should continue to develop through later successional stages if left undisturbed.

Management Recommendations

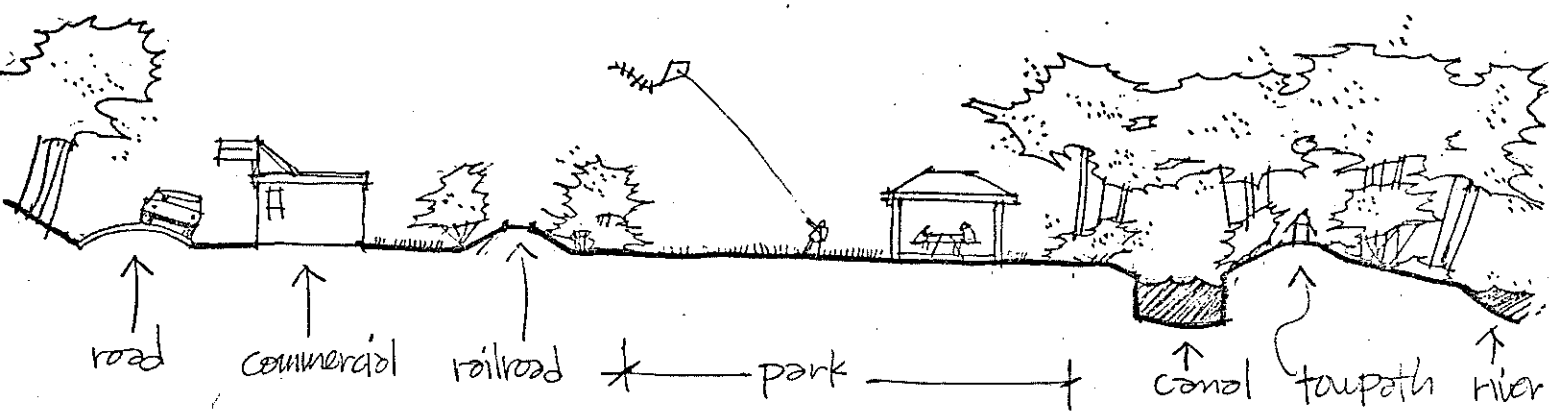
None



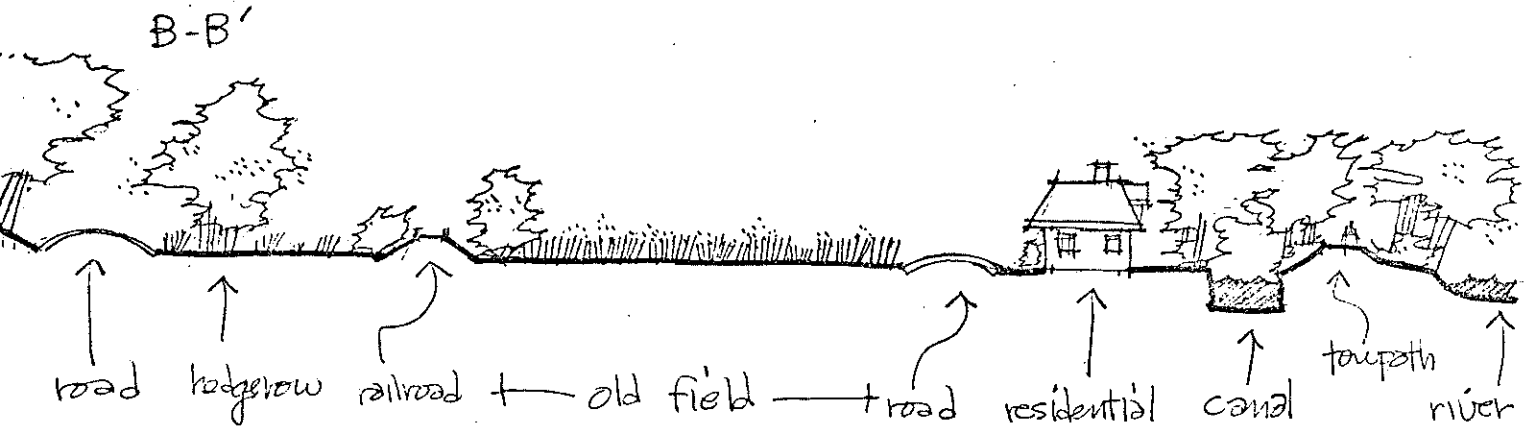
Segment 3

Sections

A-A′



B-B′



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	residential trees asphalt/concrete roadway	single houses (with yards) commercial, industrial
b	moist upland woods	unmanaged land

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Across park to river at Stockton
B-B' --- Residential area next to oldfield in Stockton

SPECIAL FEATURES

1 --- Specimen river birch: multi-stemmed, 36" (80 cm) DBH, 80' (24.2 m) tall

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Adjacent residential land use near Stockton	2	1b
2	Hedgerow trees in middle of oldfield	2	"
3	Early successional oldfield, dotted with wild flowers	2	"
4	Opening in floodplain woods, heavy cover of grape vines	2	"

SEGMENT 3 VEGETATION DATA

SUBSEGMENT A

Cover Type: Delaware River floodplain (levee)

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-thick)	SHRUB (Density-medium)	HERB (Density-medium)
Basswood	Box elder	Staghorn sumac	Poison ivy
Sycamore	Black walnut	Raspberry	Unknown ferns
Black walnut	Hickory	Spicebush	Virginia creeper
Silver maple	Hackberry	Mulberry	Unknown grasses
Norway maple	Slippery elm	Box elder	Smartweed
Tulip poplar	Staghorn sumac	Poison ivy	Phlox
Green ash	Grape	Privet	Stinging nettle
Hickory	Poison ivy	Rose	Gill-over-the-ground
Sugar maple		Buttonbush	Pokeweed
Black oak		Catalpa	Field horsetail
			Japanese honeysuckle
			Snakeroot
			Sensitive fern
			Christmas fern
			Foxtail grass
			Cinnamon fern

Historic Disturbances: Flooding, levee

Current Disturbances: Flooding

SUBSEGMENT B

Cover Type: Thicket and hedgerow, railroad

Current Land Use: Railroad

Vegetation Data:

CANOPY (Density-thin)	UNDERSTORY (Density-thin)	SHRUB (Density-thick)	HERB (Density-medium)
Honeylocust	Flowering dogwood	Silky dogwood	Mullein
Tulip poplar	Sassafras	Black oak	Foxtail grass
Sassafras	Box elder	Red cedar	Yarrow
Ailanthus	Black oak	Willow	Brambles
Basswood	Sugar maple	Speckled alder	Unknown grasses
Black cherry	Red maple	Bigtooth aspen	Grape
Slippery elm	American and slippery elm	Tulip poplar	Sycamore
American elm		Greenbrier	Poison ivy
Silver maple		Black locust	Virginia creeper
Green and white ash		Red oak	Sedges
			Japanese honeysuckle
			Butter-and-eggs
			Queen-Anne's lace
			Sheep sorrel
			Hayscented fern
			Purple loosestrife
			Greenbrier
			Snakeroot
			Phlox

Historic Disturbances: Cutting, herbiciding

Current Disturbances: Cutting, herbiciding

SUBSEGMENT C

Cover Type: Residential saplings

Current Land Use: Single houses (with yards), commercial, institutional, road

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-medium)	(Density-medium)	(Density-thin)	(Density-thick)
Willow	Flowering dogwood	Staghorn sumac	Jewelweed
River birch	River birch	Brambles	Smartweed
	Silky dogwood		Pokeweed
	Staghorn sumac		Prickly dewberry
	Mulberry		Nettles
	Black locust		Brambles

Historic Disturbances: Mowing, cutting, excavation

Current Disturbances: Mowing, cutting, excavation

SUBSEGMENT D

Cover Type: Successional oldfield

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-None)	(Density-None)	(Density-None)	(Density-thick)
			Purple loosestrife
			Bergamot
			Ragweed
			Queen-Anne's lace
			Ox-eye daisy
			Red clover

Historic Disturbances: Cropland

Current Disturbances: Trampling

Segment 4

DELAWARE RIVER FLOODPLAIN WOODLAND AND FIELDS, STOCKTON RAILROAD BRIDGE TO ROUTE 202 ABOVE LAMBERTVILLE

SEGMENT NARRATIVE

Segment 4 is a narrow 2-mile (3.2-km) corridor bounded by Route 29 and the Delaware River, the railroad/Canal crossover south of Stockton, and the 202 Expressway bridge north of Lambertville. (See the map on Sheet 1a.) Communities in Segment 4 include the Route 29 embankment (Subsegment A) which drops to the Canal, the railroad (B), and the wooded floodplain falling to the River (C). (See Section A-A'.) In the southern part of the segment the floodplain widens into an oldfield (D) bisected by a mown pipeline right-of-way (E). Subsegment F, a pasture, is at the end of Segment 4. A large traprock quarry to the left of the segment, (Contiguous Land Use e) generates vibration, explosion noise, and dust during working hours. Other quarry sites, now unused, indicate that this segment has been a quarry area for a long time. The Canal Park could capitalize on these sites to show the economic relationship between rock quarrying and Canal commerce.

Other contiguous land uses include houses in the northern end of the segment whose yards come down to the water's edge and a farm near the south end (Special Feature 5). One drainage problem was observed; a 24 in. (61 cm) diameter pipe (Special Feature 4) carrying waste or runoff from the quarry into the Canal. This culvert has created a gravel bar downstream in the Canal.

Along the embankment of Route 29, which borders the Canal Park on the northeast, is Subsegment A, a thicket/hedgerow of medium density. Hackberry, black walnut, and white ash are dominant in the canopy and understory. A gradient herb and shrub community occupies the bank.

In Segment 4, the railroad corridor (Subsegment B) resembles that of earlier segments. (See Segment 1, Subsegment F.) The thicket/hedgerow here, with the thicket of Subsegment A, buffers the other subsegments from traffic and residential noises. Clumps of various types of fern along the corridor are points of interest. The towpath has apparently been superseded by the railroad bed. If the railroad is abandoned, this would be a good location for a hiking/bicycle trail.

Subsegment C is a floodplain woodland between the railroad and the Delaware River in the first half of Segment 4. In this area, sycamore, silver maple, and box elder are dominants; black walnut, sassafras, basswood, and river birch are also present. Jewelweed, nettles, and spicebush are dominant in the herb and shrub strata. Under breaks in the canopy, Joe-Pye-weed, pokeweed, and wild flowers grow in dense clumps to a height of 6 feet (2 m).

In the last part of the segment, oldfield (Subsegment D) and pasture (Subsegment F) replace the floodplain woodland between the railroad and the Delaware. The mid-successional oldfield, with a dense herb growth (milkweed dominant), has a scattering of trees and shrubs. Along the river bank is a narrow community of sycamore, silver maple, and box elder similar to the association noted in Subsegment C. A pipeline right-of-way (Subsegment E)

bisects the oldfield. This right-of-way is mowed, and vegetation is limited to grasses, vines, and the stumps of small woody plants. The pasture at the south end of the segment could be developed for parking or recreational use.

A bridge over the Canal connects the quarry rail spur to the main railroad and provides access to the railroad corridor (Subsegment B). The residential areas at the beginning of the segment and the cemetery at the southern end (Contiguous Land Use 1) provide access to Segment 4; however, extensive use of these areas may raise questions of trespass.

For much of its length, the Canal is not shaded. The land uses in and around the Canal Park in Segment 4 are varied, but the topography and vegetation do not allow interesting views from the railroad corridor.

Access into Canal Corridor

The Canal corridor can be reached easily from the Stockton railroad bridge at the beginning of the segment and from the bridge near the farm, at Special Feature 5. The sloping roadbank makes access from Route 29 difficult.

Towpath

The towpath has apparently been superseded by the railroad along the entire length of the segment.

Ease of Passage on Canal

Passage along the Canal is clear throughout Segment 4.

Wildlife

Squirrels and a woodchuck were observed along Route 29.

Auditory Assessment

Passage of trains along the railroad in Segment 4 creates infrequent noise. Traffic noise from Route 29 is intermittent and clearly audible in Subsegments A and B, less so in other areas. Constant quarrying sounds can be heard in the central portions of A and B, constant traffic along the Route 202 bridge is audible in Subsegments D, E, and F.

SUBSEGMENT A

Extending the entire length of Segment 4, Subsegment A comprises the narrow, sloping embankment between Route 29 and the Canal. This bank ranges in width from 3 to 30 feet (1 to 9 m); the roadway is between 4 and 15 feet (1.2 and 5 m) above the Canal in this subsegment.

At the beginning of the subsegment, the distance between Canal and roadway is at its greatest in Segment 4. In this area, a medium-dense canopy covers a jewelweed-nettle herb layer like that of the nearby floodplain (Subsegment C). Along most of the subsegment, the medium-dense thicket/hedgerow on the roadbank is composed of monospecific clusters of hackberry, black walnut, and white ash.

Shrub and herb layers reflect the moisture gradient of the bank. Nearer the Canal (lower on the bank) are elderberry, Tartarian honeysuckle, and poison ivy. Species which are less water-tolerant--common milkweed (*Asclepias* spp.), blackberry, red cedar, and sassafras--grow along the higher portions of the bank.

Residential uses sometimes extend into the area included in this survey. Chairs and swimming equipment were observed behind nearby houses and some yards seemed to extend to the Canal edge. Litter and trash were observed along the roadbank. Constant traffic along Route 29 can be heard throughout the subsegment.

Community Dynamics

The community close to Route 29 is maintained by occasional trimming, possible herbiciding, and traffic along the road. Vines (grape, poison ivy, and honeysuckle) present a disturbance to the other plants, crowding or shading them out.

Management Recommendations

Maintenance should include periodic removal of litter and trash and clearing of vines.

SUBSEGMENT B

Still used twice daily, the railroad corridor (Subsegment B) manifests the same types of herbaceous ballast and thicket/hedgerow edge communities found in earlier segments. The tracks are sometimes separated from the Canal by a traprock bank; in other places a square "hedge" of sassafras and silver maple trimmed by passing trains divides the two corridors. One distinguishing feature of this area is the many clumps of ferns growing in the ballast on the sunny embankment next to the Canal--lady fern, sensitive fern, and hayscented fern (*Dennstaedtia punctilobula*). In the ballast between the rails grow many types of vines: Virginia creeper, dewberry (*Rubus hispidus*), grape, and wild roses. Also in this low growth seedlings, sycamore and box elder sprouts are occasionally found. Foxtail grass is very common.

On the top and sides of the embankment, black cherry, sugar maple, white ash, sassafras (dominant), dogwood, basswood, and staghorn sumac comprise understory and shrub layers of medium density.

In areas where the slope of the embankment becomes less steep, trees are higher and the understory and herb layers are more prominent. Just below the railroad bridge at the beginning of the segment, in the 75-foot (23 m) space between the Canal and the railroad, the hedgerow/thicket broadens to a stand of black locust, silver maple, willow 50 to 60 feet (15-18 m) high, with a thick herbaceous layer of jewelweed, vegetation typical of floodplain woods.

If the railroad is abandoned, the Canal Park could convert the corridor to a foot or bike trail. Such a use would be particularly important in Segment 4, where there is no path at present.

Community Dynamics

The structures of the ballast and edge communities are maintained by management practices, including the use of herbicides and cutting.

Management Recommendations

None

SUBSEGMENT C

Between the railroad and Delaware River lies Subsegment C, a Delaware River floodplain woodland similar to those seen in Segments 1 (Subsegment B) and 3 (Subsegment A). (See Section A-A'.) The sycamore/silver maple/box elder association is occasionally interrupted by groves of black walnut, sassafras, basswood, and river birch. In wooded areas, jewelweed, nettles, and spicebush dominate herb and shrub strata. Small meadows of Joe-Pye-weed (*Eupatorium* spp.), pokeweed, sunflowers, and evening primrose grow up to 6 ft (2 m) tall in the canopy breaks. Clearings along the river are occasionally carpeted in Japanese hop (*Humulus japonicus*). Grape, Japanese honeysuckle, and poison ivy infest the shrub layer in many areas.

Thick undergrowth limits access to Subsegment C. Due to the periodic flooding evidenced by debris, this area would be difficult to use for any but passive activities or as a boating area. It acts as a visual and auditory buffer between the Canal and the river, offering a sense of enclosure.

Community Dynamics

Barring severe disturbance, the woodland of Subsegment C should retain its species composition and vegetational dynamics.

Management Recommendations

None

SUBSEGMENT D

Near the southeastern end of Segment 4, the river and railroad/Canal corridor are separated by 400 to 500 ft (122 to 152 M), and much of this wide area is an oldfield (Subsegment D) entering a mid-successional stage. A few trees(sycamore, white ash, box elder) and some shrubs (silky dogwood, box elder, staghorn sumac, red cedar) stand out about 15 ft (5m) above the thick mosaic of meadow herbs: Queen Anne's lace, hyssops (*Hyssops* spp.), goldenrod, bergamot, ragweed (dominant), milkweed, and wild roses. Poison ivy is also abundant. Along the river is a 25 to 75 foot (7.6 to 22.9 m) margin of sycamore, silver maple, and box elder thicket, broken in places. The thickets along both river and railroad corridor protect the subsegment and give it an isolated, undisturbed, quiet atmosphere.

The subsegment is traversed by a gas pipeline right-of-way (Subsegment E) 200 feet (61 m) wide.

Subsegment D, close to the Route 202 bridge over the Delaware, could become a multi-use area for Canal and/or river activities, offering picnicking space, dock facilities, and so on.

Community Dynamics

Woody vegetation will become more prominent as this field undergoes succession.

Management Recommendations

None

SUBSEGMENT E

Subsegment E is the right-of-way for a gas pipeline. About 200 feet (61 m) wide, this swath cuts through the middle of the oldfield (Subsegment D). At the time of the survey, it had been recently mowed, and only the stumps of small woody plants were evident. A thick carpet of grasses, brambles, Japanese honeysuckle, poison ivy, and Virginia creeper makes up the herb layer.

Community Dynamics

Continued maintenance will keep Subsegment E in its current state.

Management Recommendations

None

SUBSEGMENT F

Subsegment F, at the end of Segment 4, is pasture which slopes down toward the river from the Canal and railroad corridors. At the foot of the railroad bank is a marshy swale abundant in purple loosestrife, cattails (*Typhus* spp.), iris, jewelweed, silky dogwood, and elderberry.

The massive 202 bridge, with its concomitant highway noise, stands in sharp contrast to the otherwise rural character of this subsegment.

Community Dynamics

Management practices (e.g., mowing, possible grazing) appear to have kept this pasture in its current state. If they are discontinued, the pasture should undergo succession.

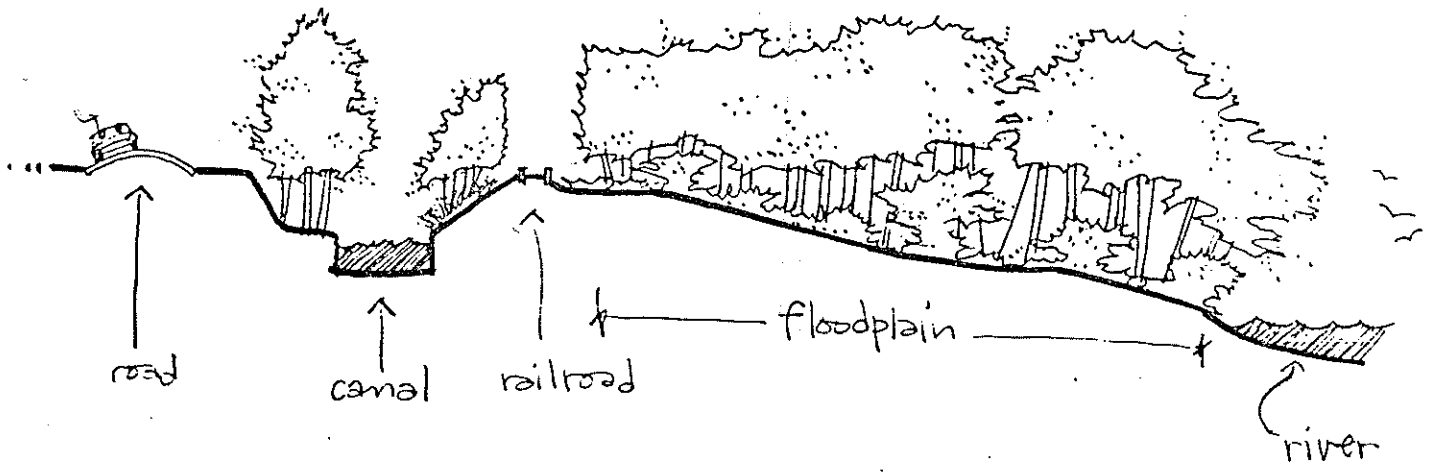
Management Recommendations

None

Segment 4

Sections

A-A'



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	residential trees	passive uses single houses (with yards)
b	moist upland woods	unmanaged land
c	Piedmont floodplain	unmanaged land
d	moist upland woods	unmanaged land
e	quarry	industrial
f	moist upland woods	unmanaged land
g	Piedmont floodplain	unmanaged land, hiking
h	successional oldfield	unmanaged land
i	pasture	agriculture, pasture
j	successional oldfield	unmanaged land
k	landscaped open space	utility corridor (cemetery)
l	landscaped open space	road or highway

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- About ½ mile south of quarry

SPECIAL FEATURES

1 --- View downriver to Route 202 bridge
2 --- Concrete foundation next to quarry road, 3' (1 m) high
3 --- Concrete foundations next to road, 12" (30 cm) high
4 --- Quarry
5 --- Farmhouse and bridge

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Route 29 and its proximity to Canal	1	1b
2	Canal, railroad corridor, and broken floodplain woodland	1	"
3	Quarry buildings along Route 29	1	"
4	Oldfield between railroad and Delaware River in southern part of segment	1	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
5	Railroad and Canal corridor looking toward Route 202 bridge	1	1b
6	Railroad and Canal association (note intermittent edge vegetation and pruning by railroad traffic)	1	"

SEGMENT 4 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow

Current Land Use: Unmanaged land, road or highway

Vegetation Data:

CANOPY (Density-medium)	UNDERSTORY (Density-medium)	SHRUB (Density-thick)	HERB (Density-medium)
Norway maple (rare)	Hickory	Silky dogwood	Jewelweed
Hackberry	American elm	Elderberry	Nettles
White ash	River birch	Red cedar	Wild garlic
Sassafras	Silver maple	Cinnamon fern	Poison ivy
Black cherry	Mulberry	Tartarian honeysuckle	Blackberry
Box elder	Black cherry	Speckled alder	Queen-Anne's lace
Black walnut	Green ash	Willow	Grape
Tulip poplar	Slippery elm		Sunflower
			Goldenrod
			Greenbrier
			Field horsetail
			Butter-and-eggs
			Japanese honeysuckle
			Prince's feather
			Evening primrose
			Pokeweed
			Common morning glory
			Carrion flower
			Burdock
			Unknown grasses
			Rough horsetail
			Asparagus
			Ragweed
			Virginia creeper
			Milkweed

Historic Disturbances: Cutting, litter and trash, excavation

Current Disturbances: None

SUBSEGMENT B

Cover Type: Thicket and hedgerow, railroad

Current Land Use: Railroad, hunting

Vegetation Data:

CANOPY (Density-None)	UNDERSTORY (Density-medium)	SHRUB (Density-medium)	HERB (Density-thick)
	Silver maple	Elderberry	Sycamore
	Black cherry	Staghorn sumac	Box elder
	Sassafras	Rose	Jewelweed
	Slippery elm	Silky dogwood	Bog hemp
	White ash	Prince's feather	Blackberry
	Sugar maple		Sensitive fern
	Black locust		Virginia creeper
	Red cedar		Hayscented fern
	Flowering dogwood		Asparagus
	Basswood		Unknown grasses
	Sycamore		Foxtail grass
	Dogwood		Grape
	Staghorn sumac		Snakeroot
	Willow		Japanese honeysuckle
			Prickly dewberry
			Poison ivy
			Indian hemp
			Lady fern
			Dewberry
			Rose

Historic Disturbances: Cutting, excavation, dikes, dams, levees

Current Disturbances: Train

SUBSEGMENT C

Cover Type: Delaware River floodplain

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thick)	(Density-thick)	(Density-medium)	(Density-thick)
Silver maple	Willow	Staghorn sumac	Poison ivy
Black locust	Sassafras	Tartarian honeysuckle	Jewelweed
River birch	Slippery elm	Spicebush	Stinging nettle
Sycamore	Green ash	Grasses	Sedges
Black walnut	Box elder		Evening primrose
Basswood			Gill-over-the-ground
White ash			Pokeweed
Box elder			Blackberry
			Joe-Pye-weed
			Ragweed
			Sunflower
			Unknown grasses
			Nettles
			Japanese hop
			Grape
			Japanese honeysuckle

Historic Disturbances: Flooding, siltation

Current Disturbances: Debris accumulation

SUBSEGMENT D

Cover Type: Successional oldfield

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thin)	(Density-thin)	(Density-medium)	(Density-thick)
Sycamore	Box elder	Silky dogwood	Goldenrod
White ash		Red cedar	Wild garlic
Silver maple		Rose	Poison ivy
		Staghorn sumac	Dayflower
		Box elder	Queen-Anne's lace
			Grasses
			Hyssops
			Virginia creeper
			Sunflower
			Bergamot
			Japanese honeysuckle
			Yarrow
			Ragweed
			Grape
			Dayflower
			Prickly dewberry
			Milkweed
			Rose

Historic Disturbances: Flooding, cutting

Current Disturbances:

SUBSEGMENT E

Cover Type: Landscaped open space

Current Land Use: Utility corridor

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-None)	(Density-None)	(Density-None)	(Density-thick)
			Grasses
			Brambles
			Japanese honeysuckle
			Poison ivy
			Virginia creeper

Historic Disturbances: Cutting

Current Disturbances: Mowing

SUBSEGMENT F

Cover Type: Pasture

Current Land Use: Pasture

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-None)	(Density-None)	(Density-None)	(Density-thick)
			Unknown grasses
			Purple loosestrife
			Cattail
			Iris
			Jewelweed
			Silky dogwood
			Elderberry

Historic Disturbances: Cutting, grazing, browsing

Current Disturbances: Trampling, mowing

Segment 5

FLOODPLAIN WOODLAND AND OPEN SPACES, TOWN COMPLEX OF LAMBERTVILLE

SEGMENT NARRATIVE

Segment 5 begins at the new Route 202 bridge and extends south 1¼ miles (2.0 km) to Swan Creek in Lambertville. (See the map on Sheet 2a.) Much of the natural floodplain woodland has given way to numerous other land uses. These include a railroad corridor and residential, commercial, and industrial uses. The segment terminates at a special feature, a lock/sluice in an aqueduct under which flows Swan Creek.

The vegetation of the floodplain woodland of Subsegment C, which is in the northwest section of Lambertville, is dominated by sycamore, silver maple, and box elder. The canopy is thick and reaches a height of approximately 60 feet (18.3 m). The shrub layer, very often dominated by spicebush, is also thick. These dense upper layers limit the amount of sunlight which can reach the ground, and as a consequence, the herb layer is somewhat thin. Dominant herbs include violets (*Viola* spp.), jewelweed, grasses, and numerous vines-- poison ivy, Japanese honeysuckle, and brambles. A backwater channel extending north from the Delaware River penetrates this woodland area and separates Lambertville from Holcombe Island.

Much of the floodplain vegetation within the state property lines is altered because of present land use demands. For example, the management of the vegetation within the railroad corridor (Subsegment B) keeps the community in an early successional state. Stresses include periodic railroad traffic and management practices such as cutting and herbiciding. Typically, the railroad bed is occupied by low-growing weedy plants such as mullein, butter-and-eggs, foxtail and other assorted grasses. The edges of the corridor are occupied by hedgerow/thickets dominated by slippery elm, sassafras, white and green ashes, and staghorn sumac. This intermittent vegetation in the edge community often blocks the Canal or contiguous land from view. Nonetheless, the railroad provides easy access to the Canal: it closely parallels the Canal's right bank.

The narrow (3 ft, 1 m) community along most of the Canal's left bank in Lambertville (Subsegment D) is a strip of managed vegetation. The species composition is diverse, and the community is structurally accented by intermittent hedgerows of mullein, mulberry (*Morus* spp.), ailanthus, box elder, and silver maple. This hedgerow both screens the Canal from adjacent residential, commercial, and industrial land parcels and provides some shade to this otherwise exposed segment of the Canal. Beneath the hedgerow is a thick herb layer which is kept low by management practices (e.g., cutting). In its present form, vegetation does not hamper access to the Canal from a footpath.

The floodplain woods is also bordered by a powerline right-of-way which cuts across the Canal and railroad in the northern part of Segment 5. An oldfield community dominated by grasses, vines such as Japanese hop, and wildflowers (including jewelweed, goldenrod, and Queen-Anne's lace) inhabits this right-of-way (Subsegment A). The subsegment roughly parallels Alexauken Creek.

Today, as during its period of peak utility, the Canal is an important component of the town complex. It is presently used primarily for recreation and appears to have been successfully integrated with present land use needs. The Canal remains a useful and visually aesthetic asset to Lambertville.

Access into Canal Corridor

Accessibility is excellent in Segment 5. A path provides access on the left; the railroad, on the right; and the canal corridor is served by numerous roads.

Towpath

The path is mowed, maintained, and used for walking and biking.

Ease of Passage on the Canal

Passage on the Canal is hampered by the Lambertville lock/sluice (at Special Feature 2, Sheet 2b).

Wildlife

Ducks were observed on the Canal.

Auditory Assessment

The segment is subject to continuous noise, both natural (water falling) and man-related (sounds emanating from the town). Traffic, trains, and boats in the contiguous areas create intermittent noise which is audible in Segment 5.

SUBSEGMENT A

Subsegment A is an open area within the floodplain woods at the northern end of Segment 5. This open area, which is approximately 150 feet (49.5 m) wide, transects the Canal corridor. To the left (east) of the Canal, the surveyed land follows Alexauken Creek; it lies inland farther west, on Holcombe Island.

The vegetation closely resembles that of a low-growing early successional oldfield. The community is canopy-free, with a very thin shrub layer of isolated slippery elms. The herb layer, on the other hand, is very dense and is dominated by Japanese hop. It also includes various grasses and wildflowers including jewelweed, Queen-Anne's lace, and goldenrod. The subsegment is apparently kept at its present successional stage by the electric company's management practices.

Along the right of way, the edge community where the oldfield meets the floodplain woods has a special character. Sun-loving early successional woody species such as black locust, slippery elm, and staghorn sumac line the edge.

When the Delaware River flow is high, the backwater channel which extends from the southern part of the segment fills a depression in this subsegment (see map). At the time of year (low flow) during which this study was made the depression was dry. Evidence of flooding indicates, however, that when the Delaware River floods, the backwater channel fills as far north as the right-of-way portion.

No disturbances other than electric company's management practices were observed. Some distant highway noise is slightly audible and the waterfalls of a small nearby creek are detectable in some locations. The low-growing vegetation and the linear character of the opening provide clear views across the Canal corridor. Access into the subsegment is easily gained from the railroad on the right and the towpath on the left.

Community Dynamics

Management practices of the electric company hold this oldfield community in check.

Management Recommendations

None

SUBSEGMENT B

Subsegment B covers the infrequently used railroad corridor which parallels the Canal as it passes through Segment 5. Because the Canal and railroad corridor lie so close to each other, it is likely that the railroad bed occupies the old towpath. The Canal is easily seen and reached from the railroad corridor along the entire length of the subsegment.

In most parts of Subsegment B, the community is similar in composition and structure to that of the ballast and edge areas of the railroad corridor in Segment 1 (Subsegment F). When the Canal bank nearly abuts the railbed in Segment 5, Subsegment B, there is either extremely scarce vegetation in the traprock bank or a narrow strip community like that described in Subsegment D (this segment).

Management practices associated with the railroad and adjacent land uses (including small industrial and commercial parcels) control the vegetation of the railroad corridor. No evidence of other disturbances was observed. The railroad bed offers some interesting view opportunities, especially where the tracks are elevated above the surrounding landscape.

Community Dynamics

The structures of the edge and ballast communities are maintained by management practices, including the use of herbicides and cutting.

Management Recommendations

None

SUBSEGMENT C

Subsegment C is floodplain woodland which lies to the left and right of the Canal and railroad corridors in the northern part of Segment 5. These wooded areas are similar in species composition and community structure to the thick sycamore/silver maple/box elder association found in Segment 1 (Subsegments A,B,C).

One special feature of this woods community is the backwater channel referred to in Subsegment A. The mouth of this backwater is navigable by small boat, but the upper reaches are narrow and shallow. Flood debris suggests that this channel absorbs the impact of high flow periods on the Delaware by filling and overflowing into the adjacent floodplain woods.

The floodplain woods are easily reached from the railroad corridor. Few man-related disturbances were observed. The tone here is natural and quiet, except for occasional boating noise from the Delaware River. The vegetation is thick and provides a good visual buffer from the industrial uses close by. Good views from the bank of the Delaware enhance the potential of this area for recreation.

The privately owned wooded land lying between the State boundary and the Delaware River is property which might be considered for acquisition for the Canal Park. This area, approximately 35 acres (14.1 hectares), comprises the western half of Holcombe Island, which offers natural wooded land along the river with high recreational potential. Only a small (1-1.5 or 0.4 to 0.6 hectares) parcel is presently inhabited.

Community Dynamics

The vegetation community of this Delaware River floodplain woodland should retain its existing structure, given the present land uses and flood regime.

Management Recommendations

None

SUBSEGMENT D

Subsegment D is a very narrow, flat strip two to three feet (0.6-1 m) wide along the left side of the Canal within Lambertville. The backyards of residential and small commercial properties abut this narrow State-owned buffer, and a well-trodden grass path separates Park from private property. The path was observed to be used for biking, strolling, dog-walking, and fishing. The Canal is intermittently screened by isolated species and short hedgerows of medium density. The community includes willow, mulberry, ailanthus, box elder, and silver maple. The remaining vegetation is kept quite low by frequent maintenance (cutting and mowing). In many locations the natural community is invaded by residential escapees (e.g., lilac, mimosa). The herb layer is dense and diverse; it is dominated

by smartweed (*Polygonum pennsylvanicum*), jewelweed, pokeweed, phlox (*Phlox* spp.) and various vines including raspberries, dewberries, Virginia creeper, and poison ivy.

Several pipes which enter the Canal were observed. These range from 5 to 24 inches (12 to 57.6 cm) and appear to carry storm runoff water.

At the end of the subsegment is a lock/sluice that passes over Swan Creek. When observed, the sluice was discharging excess water directly into the creek, creating a small waterfall that provides a positive visual and auditory experience. A small wooden observation deck has been built beside the sluice to allow passers-by to enjoy the sights and sounds of the water.

The path along the Canal is easily reached and makes the Canal itself readily accessible. Sounds of Lambertville are audible only as background noise.

Community Dynamics

Mowing and cutting retard successional growth in this hedgerow/thicket community, which will retain its present structure if these practices are continued.

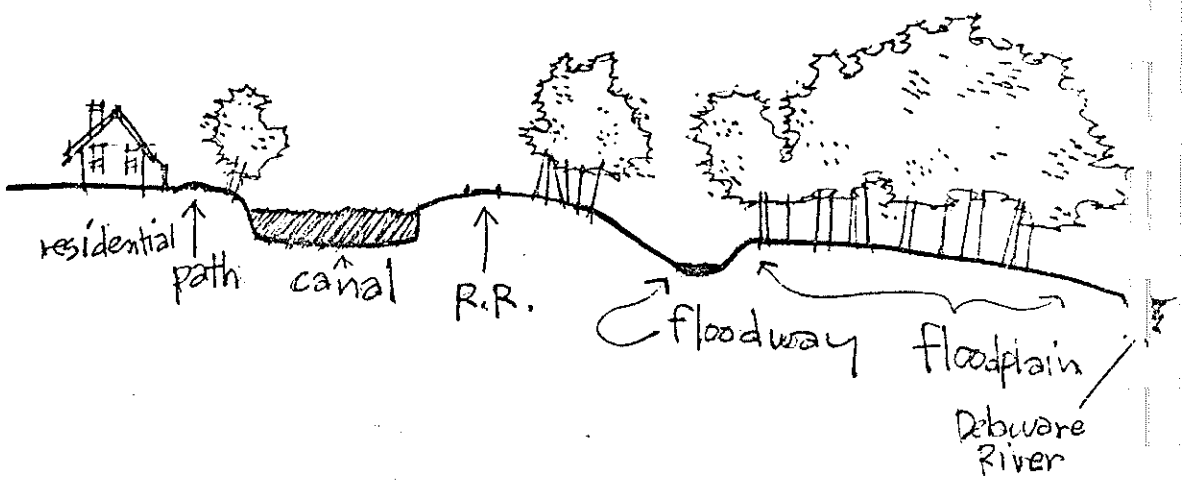
Management Recommendations

None

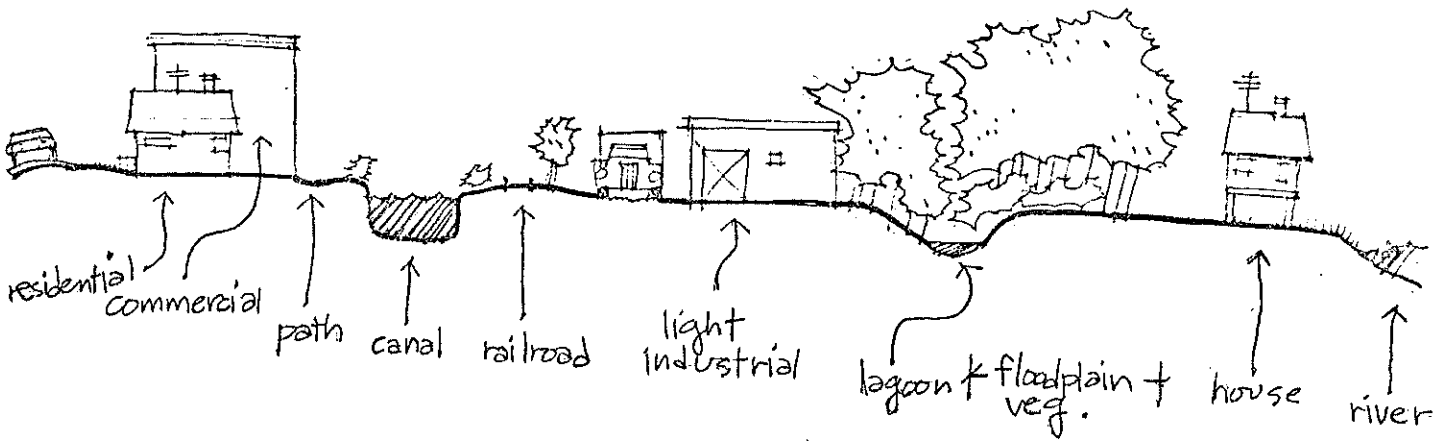
Segment 5

Sections

A-A'



B-B'



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	residential saplings	single houses, institutional, commercial
b	gravel/dirt roadway asphalt/concrete roadway	commercial
c	gravel/dirt roadway asphalt/concrete roadway	industrial
d	pasture	single houses (with yards) pasture, unmanaged land
e	agricultural field gravel/dirt roadway	tilled field (cropland) road or highway
f	Delaware River floodplain residential trees	unmanaged land, fishing, boating, single houses (with yards)
g	gravel/dirt roadway parking lot	industrial
h	residential trees	single houses (with yards)
i	landscaped open space	road or highway
j	flowing water (e.g., stream, canal, river)	recreation

TOPOGRAPHIC CROSS-SECTIONS

A-A' -- Northern edge of Lambertville village boundary
B-B' -- Just north of Lambertville Bridge

SPECIAL FEATURES

1 --- Alexauken Creek passing under Canal south of 202 bridge
2 --- Swan Creek passing under Canal south at Lambertville lock

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Subsegment A--powerline right-of-way	2	2b
2	Railroad and contiguous residential land use	2	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
3	Vista of Canal through Lambertville (looking north)	2	2b
4	Vista of Canal through Lambertville (looking south)	2	"

SEGMENT 5 VEGETATION DATA

SUBSEGMENT A

Cover Type: Successional oldfield

Current Land Use: Utility corridor

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-none)	(Density-none)	(Density-thin)	(Density-thick)
		Slippery elm	Jewelweed
		Rose	Queen-Anne's lace
		Black locust	Unknown grasses
		Staghorn sumac	Goldenrod
			Japanese hop

Historic Disturbances: Flooding, siltation, cutting

Current Disturbances: Cutting, right-of-way

SUBSEGMENT B

Cover Type: Thicket and hedgerow

Current Land Use: Railroad

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-broken)	(Density-broken)	(Density-medium)	(Density-medium)
Sassafras	Sassafras	Raspberry	Milkweed
American and slippery elms	Box elder	Red cedar	Sedges
	Black oak	Willow	Snakeroot
Silver maple	Red maple	Tulip poplar	Mullein
Ailanthus	American and slippery elms	Speckled alder	Foxtail grass
White and green ash	Honeylocust	Black locust	Yarrow
		Red oak	Brambles
Tulip poplar		Staghorn sumac	Grape
Black cherry			Sycamore
Basswood			Poison ivy
			Virginia creeper
			Butter-and-eggs
			Hayscented fern
			Sheep sorrel
			Unknown grasses
			Purple loosestrife
			Japanese honeysuckle
			Phlox

Historic Disturbances: Cutting, dikes, dams, levees, herbiciding

Current Disturbances: Cutting, herbiciding

SUBSEGMENT C

Cover Type: Delaware River floodplain

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thick)	(Density-thick)	(Density-thick)	(Density-medium)
American elm	Black locust	Pokeweed	Jewelweed
River birch	Tulip poplar	Spicebush	Stinging nettle
Red oak	River birch	Rose	Dayflower
Black walnut	Ailanthus	Grape	Sensitive fern

Tulip poplar	Box elder	Ailanthus	Japanese honeysuckle
Black locust	Mulberry	Raspberry	Ragweed
Sycamore	American and slippery elms	Black locust	Gill-over-the-ground
Silver maple		Purple loosestrife	Unknown grasses
Box elder			Rough horsetail
Black oak			Sheep sorrel
Hackberry			Jack-in-the-pulpit
Sugar maple			Smartweed
			Snakeroot
			Violet
			Brambles
			Bergamot
			Christmas fern
			Poison ivy
			Virginia creeper
			Unknown fern

Historic Disturbances: Flooding, siltation

Current Disturbances: Flooding, siltation

SUBSEGMENT D

Cover Type: Thicket and hedgerow

Current Land Use: Hiking, fishing, boating, bicycling, passive use

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-medium)	(Density-medium)	(Density-medium)	(Density-thick)
White and green ash	White and green ash	Staghorn sumac	Virginia creeper
Ailanthus	Ailanthus	Silky dogwood	Pokeweed
Mulberry	Mulberry	Rose	Phlox
Sycamore	Sycamore	Lilac	Raspberry
Box elder	Box elder	Mimosa	Jewelweed
Willow	Willow		Smartweed
Silver maple	Silver maple		Butter-and-eggs
			Unknown grasses
			Purple loosestrife
			Evening primrose
			Queen-Anne's lace
			Poison ivy
			Sensitive fern
			Common morning glory
			Milkweed
			Mullein
			Dewberry

Historic Disturbances: Mowing, cutting

Current Disturbances: Trampling, sewer outlet, mowing, cutting

Segment 6

WOODLAND, HEDGEROW/THICKET, AND LANDSCAPED OPEN SPACE FROM LAMBERTVILLE LOCK TO UPPER FERRY ROAD

SEGMENT NARRATIVE

Segment 6, a 9.5 mile (14 km) corridor, extends from Lambertville Lock to Upper Ferry Road. (See the maps on Sheets 2a and 3a.) Much of the land contiguous to the Canal is occupied by single-family homes. A quarry (Special Feature 8) is also adjacent to the Canal Park. Route 29, a main transportation artery, closely flanks the left side of the Canal; the railroad corridor (Subsegment A) runs along the Canal's right bank between the Canal and the Delaware River. Except for a small island (Subsegment D) in Lambertville and a wide portion of floodplain woodland (Subsegment E) near the beginning of the segment, the Canal Park in Segment 6 is fairly narrow. Near the beginning of the segment, the river and the Canal are at roughly the same elevation. Farther on where the river drops more rapidly than the Canal, the Canal is at the top of a steep slope above the river floodplain. (Compare Sections A-A' and C-C'.)

The recently abandoned railroad (Subsegment A) has a bipartite community similar to that described in Segment 1, Subsegment F. No towpath currently exists in Segment 6; it has apparently been superseded by the railroad bed. On a hot summer's day, there is little relief from the sun for anyone walking along the tracks, as the hedgerow/thicket provides no appreciable shade. The walk is monotonous, although it is relieved occasionally by breaks in the vegetation. Through breaks on the right, one can see the Delaware River and Pennsylvania shore. The hedgerow/thicket on the left side of the corridor is lower and less dense, with frequent views of the Canal and the opposite bank.

Route 29 forms the eastern boundary of the Canal Park. The roadbank (Subsegment B) drops down to the Canal with varying degrees of slope. (See sections.) In the places where it is close to level with the Canal, the roadbank is often maintained by mowing. The steep (25-50%) slopes are wooded and appear unmanaged. Walking along this side of the Canal is only possible in the landscaped open areas. Where there are steep, wooded slopes, one is forced to walk along the road shoulder, which is dangerous and nerve-wracking. Just past Washington Crossing State Park, a short service road runs along the left bank of the Canal at the foot of the Route 29 embankment. Along the same stretch, the Canal has been cut through rock. This bare rock embankment (Special Feature 1), which can be seen from the railroad corridor, is a marked change from the vegetation-covered embankments of most of the Canal. At the southern end of the segment (Special Feature 16) is a row of large red oaks planted by the Daughters of the American Revolution in the 1920s.

Delaware River floodplain woodland is found in Subsegment E, which runs along the river in the first few miles of the segment (where the Canal and the river are basically on the same level). Dominant canopy species here are sycamore, silver maple, and box elder. A transitional mix which includes black oak, tulip poplar, and ash can also be identified. A sewage treatment plant is at the beginning of this subsegment (Contiguous Land Use c).

Where the area between river and railroad/Canal corridors widens and the transition between woodland communities begins, there is a contiguous land use (1) of special interest, an early successional oldfield owned by Public Service Electric and Gas. The field is dominated by herbaceous plants of even height (1½ ft; 0.5 m), with foxtail grass, smartweed, and numerous wildflowers (goldenrod, evening primrose, ragweed, Queen-Anne's lace) dominant. Clusters of loosestrife and jewelweed also inhabit the field, and a few young red maple and box elder saplings are interspersed with the herbs. There is a hedgerow surrounding a swale which runs through the center of the field; no other canopy-height trees are present. A dirt access road also traverses the field. Easily viewed from the railroad corridor, this quiet piece of open space is large (50 to 63 acres; 20 to 25 hectares) and will develop woody species if it is not managed.

The steeper slopes between the Canal and the Delaware comprise Subsegment C. The moist upland woods of these slopes have white ash (12" or 106 cm DBH) and tulip poplar (48" or 114 cm DBH) as canopy dominants.

The Canal itself and the gradient communities along both its edges are Subsegment G. (See Glossary for definition of *gradient community*.) The top of the railroad corridor next to the Canal is occupied by a hedgerow/thicket like that of Segment 1, Subsegment F. More herbaceous vegetation exists lower on the bank: it includes such species as purple loosestrife, jewelweed (*Hemerocallis fulva*), tearthumb (*Polygonum* spp.), smartweed, and sensitive fern, which are more moisture-tolerant than herbs found in the higher, drier areas. At the bottom of the gradient are aquatic species such as arrow-arum (*Peltandra virginica*), duckweed, arrowhead (*Sagittaria* spp.), and marsh grass. Lock/sluices, weirs, and other water-control apparatus are located in the Canal at Special Features 1, 3, 4, 6, 7, 9, 10, and 12. Portage around these obstacles is easy in most parts of Segment 6. Views are varied and interesting. The Canal is largely unshaded, except in places where trees in nearby residential areas (Contiguous Land Use a) offer canopy cover.

Subsegment D is a small island in Lambertville, at the beginning of the segment. The island, partly State-owned, is bounded by the Canal and a loop (jughandle) of the Canal. At the lower confluence, the Canal widens, forming a large turning basin. A public playground (Special Feature 2) lies across the loop to the north. Both the island and the playground were surveyed, although maps provided to the survey team indicated that only the Canal edges here are a part of the Canal Park. The playground is mowed and maintained. The eastern portion of the island is vegetated by species typically found in the Delaware River floodplain. The thick canopy includes ash, silver maple, Norway maple (*Acer platanoides*), sycamore, and the understory has black locust, ailanthus, and sassafras. The shrub stratum is a thin layer of spicebush and elderberry and the herb stratum, of medium density, is composed of grasses and violets. The rest of the island is maintained as mowed open space and is traversed by a dirt path. A lockkeeper's house and a fenced-off sluice gate are the only structures on the island. Access to the island is easy by one-lane bridges at either end.

More than halfway along Segment 6 lies Washington Crossing State Park (Special Feature 11). The Canal passes through a small section of the Park; this area is designated as Subsegment F. Washington Crossing State Park is

landscaped and formal, with lawns, large trees, and other ornamental plantings. A contrast to its unmanicured surroundings, the Park provides a welcome rest area and picnicking facilities along the Canal bank.

Management recommendations, discussed more fully at the subsegment level, include control of woody invaders along the abandoned stretches of the railroad, the mowing of old pastures (if it is desired to keep these areas open), and the prevention of dumping and motorbiking.

Access into Canal Corridor

A number of bridges and roads along the segment provide access into the Canal corridor.

Towpath

The path appears to have been superseded by the railroad bed.

Ease of Passage on Canal

Passage along the Canal is hampered by a skimming boom at Special Feature 1.

Wildlife

Ducks and a heron were observed on the Canal.

Auditory Assessment

The constant sound of falling water is present along the Canal/railroad/roadbank corridor. Traffic noises on Route 29 can also be heard in adjacent subsegments. The sewage treatment plant at the beginning of the segment can be heard in Subsegment E and contiguous quarrying activity can be heard from Subsegments A, B, and G. Boating on the Delaware is audible in Subsegments C and E.

SUBSEGMENT A

The railroad corridor (Subsegment A) runs alongside the Canal's right bank, but at various distances in Segment 6. In some places, the tracks nearly touch the Canal bank; in other areas, there is a narrow buffer of hedgerow/thicket between the tracks and the Canal. For a short distance south of Lambertville, the tracks are apparently used; in the rest of the segment, the railroad appears to be abandoned. The vegetation and dynamics of the Segment 6 railroad corridor are much the same as those described in Segment 1, Subsegment F, except that the tracks are somewhat overgrown in Segment 6. Of special note here were several small (4" or 10 cm DBH) dead elms near the middle of the segment.

Several points of interest add diversity to the largely monotonous hedgerow-bordered railroad. The hedgerow/thicket is only occasionally broken, providing views of nearby quarrying, upland woods, oldfields, and other contiguous land uses. Several striking vistas across the Delaware River to Pennsylvania can be seen from spots where the railroad and the Canal are higher than the river. The two most impressive views occur at the southern tip of Lambertville (Special Feature 5), and at Washington Crossing State Park (Subsegment F).

At some locations, the thicket could be opened to increase visual contact with the river and improve the visual experience in the railroad corridor. Also, small rest spots with drinking water (feasible near residential areas with existing public water lines) could be provided for hikers, cyclists, and others traveling along Segment 6.

Community Dynamics

In the area where the railroad is used, its use and management practices control the vegetation. In abandoned sections, herbaceous and woody vegetation is becoming established between the rails.

Management Recommendations

Clean vegetation from the railroad bed. If the railroad corridor is to be used for biking and hiking the sooner it is paved, the fewer woody sprouts will have be be removed.

SUBSEGMENT B

The area between the edge of Route 29 and the Canal edge comprises Subsegment B, which extends the entire length of the segment. The roadbank displays several changes of topography along its length: in some places, it is a wooded slope running steeply down from the road to the Canal; where the road and Canal are at approximately equal elevation, it is a mowed strip containing rows of mature trees. In places where the slope is not too severe, the highway department apparently maintains the roadside, and where the slope is severe (15+%), the natural vegetation is left intact.

The vegetation on the steeper slopes has characteristic moist upland species, including black locust, black oak, and tulip poplar. The medium-dense shrub layer includes Tartarian honeysuckle, mulberry, and rose. In the areas which are maintained, there are monospecific rows of "street trees," including stretches of red oak and white ash. Herbs in Subsegment B include Virginia creeper, poison ivy, wild garlic (*Allium* spp.), crown vetch (*Coronilla varia*), yarrow, smartweed, ragweed, Queen-Anne's lace, hayscented fern, and assorted grasses.

The general character of the subsegment, except in Lambertville and Titusville, is rural. On the other side (east) of Route 29 are some large estates, particularly

near the end of the segment. Just past Washington Crossing State Park is a short dead-end service road. At the southern end of the subsegment is a row of red oaks planted by the Daughters of the American Revolution in the 1920s. On the Canal side of the road, there is a stone marker noting the trees. An extremely pleasant edge to the Canal, these oaks are planted in a row, 20 ft (6 m) from center to center, and they stand 60 to 80 ft (18 to 24 m) high.

Community Dynamics

The moist upland woods of this subsegment, which are not managed, should remain stable.

Management Recommendations

None

SUBSEGMENT C

Subsegment C is the transitional woodland community and moist upland woods which occupy the bank of the Delaware River below Contiguous Land Use d, a short riverside corridor not owned by the Park. In Segment 6, approximately the first quarter of riverbank land is designated as Subsegment E, a floodplain woodland. In Contiguous Land Use d the topography dictates a gradual change from floodplain vegetation to moist upland woods. The transition continues in the beginning of Subsegment C, as the topography continues to change, and when the slopes become steep enough (soon after the beginning of the subsegment), the community becomes a true upland woods.

In general, where floodplain woodland predominates (as in Subsegment E), the land lying between the river and the Canal is flat; its slopes (if any) are gentle. Moisture-tolerant species inhabit the floodplain. On the other hand, where the land becomes steep-sloping and the Canal is high above and set back from the river (Subsegment C), flooding is no longer a threat or a factor of community dynamics. The vegetation does not have to cope with stresses such as scouring by flood waters or soils which remain damp for extended periods. Black oak, red oak, and American beech are commonly associated with steeper slopes and better drained soils. Many species (silver maple, box elder, river birch) are found in both types of community, but the dominant species mix differs. Sycamore, for example, a very common component of the floodplain woodland, is only an occasional component of the moist upland woods.

Typically, the moist upland woods has a dense canopy which may reach 70 feet (231 m). Tulip poplar, white ash, black oak, white oak, and red oak are common components. The understory members may include box elder, hackberry, black cherry, sugar maple, Norway maple, and river birch. The shrub layer may be any density and may have young black cherry, ash, and basswood, as well as elderberry and dogwood, as dominants. The shady herb layer is often thin. It includes poison ivy, Virginia creeper, jewelweed, and smartweed.

The upland woods of Subsegment C run true to form for the most part. The shrub layer is of medium density, with slippery elm, basswood, black cherry, and elderberry. The herb layer is thick. Poison ivy is dominant, and raspberry (*Rubus occidentalis*), Jack-in-the pulpit, brambles, stinging nettle, groundnut (*Apios americana*), rough horsetail, and unknown grasses are found, as well as the other herbs mentioned above. Much of this stable community is influenced by residential land use. Such disturbances include management (e.g., pruning, cutting) for views and river access, as well as the addition of ornamental species which have spread from nearby residential planting.

Subsegment C has an undisturbed, shady, quiet, character. Noise of boats on the river and distant auto traffic on Route 29 is very well buffered by the vegetation. The railroad corridor (Subsegment A) provides access, as does the road which runs along the river (and into the subsegment) northeast of Titusville. Some dumping (e.g., trash, building materials) was observed on the sides of this road.

Long view to the Delaware River and Pennsylvania shoreline are very pleasant. Canoeists were observed portaging through the woods from the Canal to the River. In addition, fishing, picnicking and biking were observed in areas of Subsegment C.

Community Dynamics

The moist upland woods of Subsegment C should remain stable. Residential uses have kept the lower strata clear in some areas.

Management Recommendations

None

SUBSEGMENT D

A public playground lies on the mainland to the north of the Canal loop. Subsegment D is a small island in Lambertville surrounded by the Canal and a short Canal loop. The Canal forms a basin below its junction with the loop.

The island has two types of vegetation communities. The eastern portion (along the loop) is wooded. Species are typical of the Delaware River floodplain woodland. The dominant canopy vegetation includes ash, silver maple, Norway maple, and sycamore. Black locust, ailanthus, and sassafras are characteristic species in the understory. The shrub layer (spicebush, elderberry) is quite thin, and the herb layer is medium-dense, composed of grasses and violets.

The portion which abuts the Canal itself is mowed open space, as is the playground. A dirt path runs through the grassed area. A few isolated canopy-height trees are also in this area, offering shade, but no impediments to the views. Aquatic vegetation (e.g., arrow-arum) occupies spots along the Canal.

A lock/sluice crosses the Canal near the southern end of the island.

The island is accessible from the northern and southern ends by small (one-lane) bridges over the bypass. Removed from the contiguous residential-commercial land uses, this small (2 to 3 acres or about one hectare) parcel is a good area for passive recreation. Fishing, swimming, motorbiking, and strolling were observed. The area offers both sun and shade, as well as nice views of the Canal, the Delaware River, and the Pennsylvania shore. The Lambertville sewage treatment plant (Contiguous Land Use c) is also visible. The island and adjacent playground appear to be important recreational areas for Lambertville residents and visitors.

Community Dynamics

This community is maintained.

Management Recommendations

None

SUBSEGMENT E

Subsegment E is Delaware River floodplain woodland at the beginning of Segment 6. The dominant sycamore/silver maple/box elder association of the floodplain woodland is discussed in detail in Segment 1, Subsegments A, B, and E. The shrub layer is medium-dense and includes spicebush and slippery elm. The herb layer is also of medium density and includes many of the species mentioned in Segment 1, Subsegment A.

Subsegment E is accessible from the railroad corridor and from roads which service nearby land uses. A dirt road extends into the end of the subsegment from the contiguous oldfield owned by Public Service Electric and Gas and runs down to the river. It could be improved and used as an access route for launching boats. Some litter was observed along this road. Other disturbances (e.g., grazing and browsing by animals, trampling, and campfires) were also noted.

Views of the river from Subsegment E are pleasant, and there is little noise, except for natural sound and recreational activity on the Delaware. Shade is abundant.

Community Dynamics

The woodland of Subsegment E should remain stable, given the present land uses and flood regime.

Management Recommendations

None

SUBSEGMENT F

A portion of the Canal corridor (Subsegment F) passes through Washington Crossing State Park, which fronts on the Delaware River. Subsegment F is bordered by the George Washington Bridge, the Canal, and Route 29, and it can be reached from nearby roads. Traffic on the bridge is intermittent and audible within the subsegment.

A landscaped area, this subsegment has an almost urban atmosphere. The land has been graded and contoured into a rather formal setting. Planting consists of introduced ornamentals typically found in park design.

This area does not resemble most of the rest of the Canal corridor. A smooth, finished appearance characterizes it. This urbanity provides a refreshing contrast with the rural and relatively unmanaged land nearby. Several commercial establishments adjacent to the bridge and the Park provide refreshments or immediate provision needs for Canal travelers. Subsegment F provides a natural resting place, an obvious zone of relaxation.

Community Dynamics

The Park is managed by the State.

Management Recommendations

None

SUBSEGMENT G

Subsegment G comprises the embankments and the Canal as it runs 9.5 miles (14 km) through Segment 6. The Canal is discussed as a separate subsegment here because its banks comprise a gradient community for the first time. The composition of this community follows moisture changes: species on the upper part of the bank thrive in drier soils and those lower down prefer damp to saturated soils. Throughout the segment, the Canal is very close to the railroad (on the right) and Route 29 (on the left).

At the top of the right bank, bordering the railroad corridor, is a hedgerow/thicket. Its composition is discussed in Subsegment A. The upper slopes along the roadside (left bank of Canal) are either wooded strips along steep slopes (with some upland species), woody, intermittent hedgerow/thicket, or landscaped open space. (See Subsegment B.) Progressing down to the Canal, the vegetation becomes more moisture-tolerant, and the herb layer becomes more important. Vegetation along the Canal edge often includes purple loosestrife, jewelweed, day lilies, tearthumb, smartweed, and sensitive fern. Less abundant are buttonbush and elderberry. The gradient vegetation ends with aquatic species (e.g., arrow-arum, duckweed, arrowhead, marsh grass) which occur in thin ribbons or protruding clumps along the bank. These communities do not block passage on the Canal.

The Canal also has several Special Features throughout this segment. (See the maps on Sheets 2b and 3b.) A number of flood control weirs are present, as well as lock/sluice structures which can be adjusted to control flow. These locks hamper boat passage along the Canal, but portage is easy in Segment 6. Otherwise, passage by water is unhampered and offers views of bank vegetation, nearby historic buildings, rock quarries, Washington Crossing State Park, and other areas. Boat rental and supply facilities are located in Titusville. In several locations, the Canal can be crossed via auto and railroad bridges.

Disturbances are relatively few along this sunny stretch of the Canal. Traffic along Route 29 does produce frequent noise, but the road is far enough above and away from the Canal that noise is generally not a disturbance. Several road runoff pipes which drain into the Canal were observed, and there was some litter along the Canal.

Community Dynamics

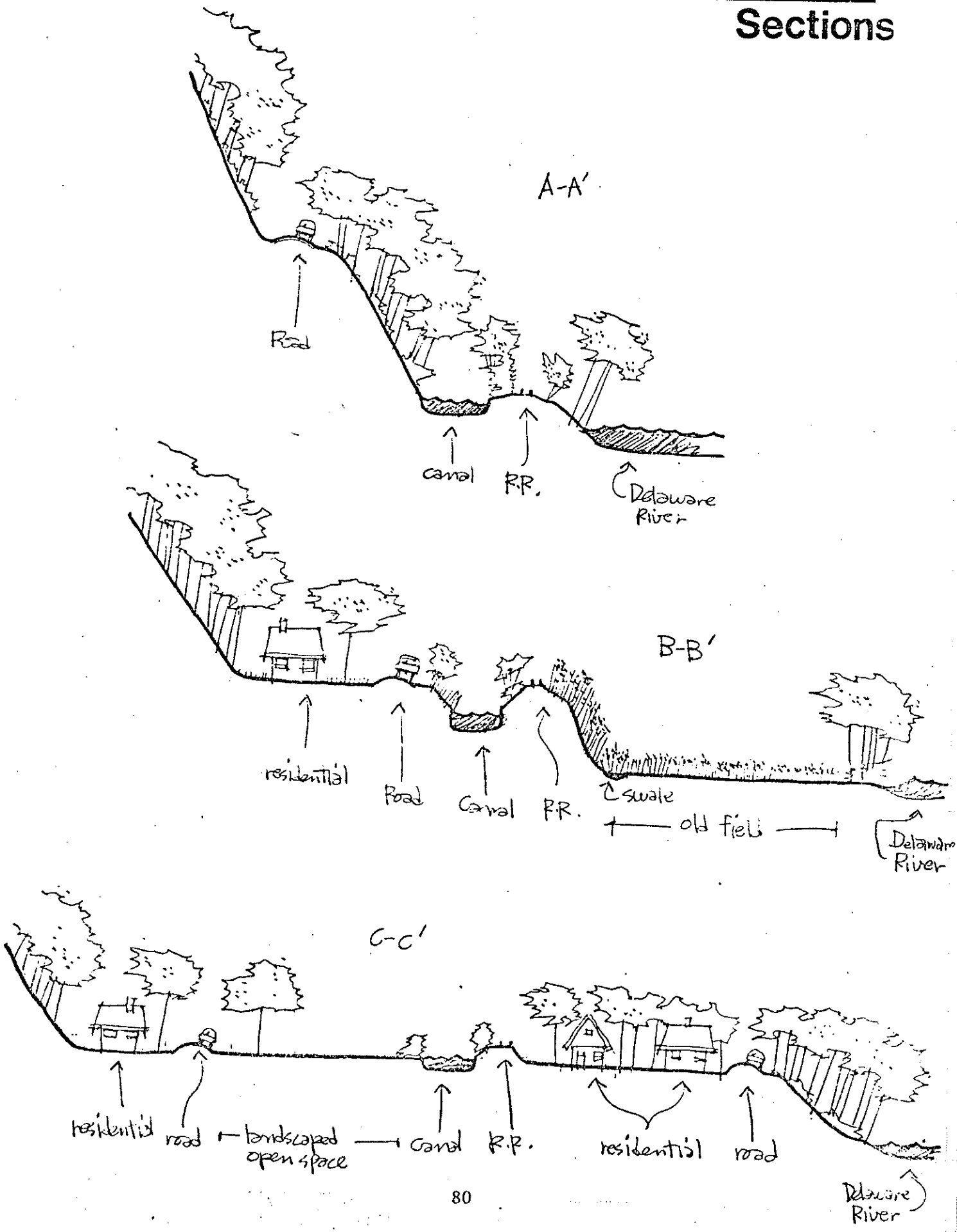
The Canal edge communities reflect the moisture gradient of the banks and should remain stable if the current water level and flow persist.

Management Recommendations

None

Segment 6

Sections



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	residential saplings asphalt/concrete roadway parking lot, buildings gravel/dirt roadways	single houses (with yards) commercial, road or highway
b	moist upland woods residential trees residential saplings	managed woodland unmanaged woodland
c	buildings and tanks	utility
d	moist upland woods (transitional)	unmanaged land, hiking hunting, picnicking, camping, passive use
e	gravel/dirt roadway asphalt/concrete roadway parking lot, buildings	commercial
f	agricultural field	tilled field (cropland)
g	gravel/dirt roadway asphalt/concrete roadway parking lot	industrial (quarry)
h	successional oldfield	shrub swamp
i	gravel/dirt roadway asphalt/concrete roadway parking lot	institutional
j	pasture	pasture
k	asphalt/concrete roadway landscaped open space	road or highway
l	successional oldfield	utility corridor unmanaged land
m	landscaped open space	unmanaged land recreation

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Immediately south of Lambertville
B-B' --- Approximately ½ distance between Goat Hill and Bell Mountain
C-C' --- Between Titusville and Washington Crossing State Park

SPECIAL FEATURES

1 --- Rock ledges below Washington Crossing
2 --- Lambertville Island and playground
3 --- Lock/sluice at Lambertville Island
4 --- Water control device
5 --- Views of and across Delaware River
6 --- Water control device
7 --- Water control device
8 --- Rock quarry
9 --- Water control device
10 --- Water control device
11 --- Washington Crossing State Park
12 --- Lock/sluice at Washington Crossing

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Playground in Lambertville	3	2b
2	Lambertville Island	3	"
3	Canal and Delaware River, separated by Canal embankment	3	"
4	Railroad corridor and view across Delaware River	3	"
5	Tree row and mowed grass near county line	3	"
6	Intermittent railroad edge thicket	1	"
7	Railroad, Canal, and steep bank to Delaware River	3	"
8	Drainage pipes passing under railroad to ditch along east edge of P S E & G oldfield	3	"
9	Near county workhouse, break in hedgerow exposing rock face	3	"
10	Overgrown railroad corridor in close proximity to Canal	1	"
11	Floodplain trees open, thick grape and honeysuckle layer	1	"
12	Canal, road, and railroad parallel (note relief relationship)	3	"
13	River to left, floodplain woods open, rails overgrown, marginal aquatics	1	"
14	Near northern River Road bridge (note aquatics of gradient community)	1	3b
15	Washington Crossing State Park--foot bridge crossing Route 29 and Canal	2	"
16	D. A. R. oaks planted along Route 29 south of Scudders Falls	2	"
17	Road edge community near southern end of segment	2	"

SEGMENT 6 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow, railroad

Current Land Use: Unmanaged land, railroad

Vegetation Data:

CANOPY (Density-thin)	UNDERSTORY (Density-thin)	SHRUB (Density-medium)	HERB (Density-thick)
American elm	Black cherry	Staghorn sumac	Queen-Anne's lace
Slippery elm	Slippery elm	Sassafras	Wild garlic
White ash	Red maple	Red cedar	Sensitive fern
Green ash	Silver maple	Tulip poplar	Milkweed
Tulip poplar	Sugar maple	Red maple	Brambles
Sycamore	Box elder	Box elder	Foxtail grass
Red oak	American elm	Silky dogwood	Rose
Basswood	White ash		Nightshade
Black walnut	Green ash		Mullein
Silver maple	Catalpa		Common morning glory
Honeylocust	Sycamore		Hayscented fern
Red maple			Prickly dewberry
Sugar maple			Phlox
Black locust			Unknown grasses
			Purple loosestrife
			Dayflower
			Japanese honeysuckle
			Jewelweed
			Pokeweed
			Sunflower
			Poison ivy
			Virginia creeper
			Snakeroot
			Ragweed
			Goldenrod

Historic Disturbances: Culvert, cutting, earthworks, excavation

Current Disturbances: None

SUBSEGMENT B

Cover Type: Thicket and hedgerow, landscaped open space, moist upland woods

Current Land Use: Unmanaged land, road or highway

Vegetation Data:

CANOPY (Density-thin)	UNDERSTORY (Density-thin)	SHRUB (Density-medium)	HERB (Density-thick)
Red oak	Red oak	Tartarian honeysuckle	Wild garlic
Catalpa	Catalpa	Mulberry	Crown vetch
Slippery elm	Slippery elm	Rose	Virginia creeper
White ash	White ash		Unknown grasses
Common alder	Common alder		Smartweed
Black walnut	Black walnut		Queen-Anne's lace
American elm	American elm		Hayscented fern
Black locust	Black locust		Japanese honeysuckle
Black oak	Black oak		Poison ivy
Tulip poplar	Tulip poplar		Ragweed
			Yarrow

Historic Disturbances: Cutting, excavation

Current Disturbances: Mowing

SUBSEGMENT C

Cover Type: Delaware River floodplain, moist upland woods

Current Land Use: Unmanaged land, single houses, road or highway, fishing, boating, swimming

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thick)	(Density-thick)	(Density-medium)	(Density-thick)
Tulip poplar	White ash	Basswood	Virginia creeper
White ash	Box elder	Slippery elm	Jewelweed
Black locust	River birch	Elderberry	Smartweed
Sycamore	Sugar maple	Black cherry	Unknown grasses
Black oak	Hackberry		Brambles
Silver maple	Beech		Poison ivy
Hackberry	Black gum (Sour gum)		Raspberry
White oak	Sassafras		Jack-in-the-pulpit
Green ash	Black cherry		Stinging nettle
Basswood	Norway maple		Groundnut
Red oak	Black walnut		Rough horsetail
Swamp white oak	Mulberry		
Chestnut oak			

Historic Disturbances: Flooding, siltation

Current Disturbances: Debris accumulation, dumping, mowing

SUBSEGMENT D

Cover Type: Delaware River floodplain(sycamore, hackberry, walnut), thicket and hedgerow, landscaped open space, gravel/dirt roadway

Current Land Use: Protected area (refuge, preserve, etc.) from cited sources, managed woodland, swimming, fishing, boating, bicycling, trail biking, passive use, picnicking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thick, where wooded)	(Density-thick, where wooded)	(Density-thin)	(Density-medium)
White ash	Black locust	Spicebush	Unknown grasses
Silver maple	Ailanthus	Elderberry	Violet
Norway maple	Sassafras		
Sycamore			
Black locust			

Historic Disturbances: None

Current Disturbances: Trampling, mowing

SUBSEGMENT E

Cover Type: Delaware River floodplain (sycamore, hackberry, walnut)

Current Land Use: Unmanaged land, hiking, fishing, hunting, passive use, picnicking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thick)	(Density-thick)	(Density-medium)	(Density-medium)
Sycamore	Box elder	Spicebush	Jewelweed
Tulip poplar	Black locust	Slippery elm	Stinging nettle
American elm	River birch		Unknown grasses
Black walnut	American elm		Jack-in-the pulpit
Silver maple			Sensitive fern
Box elder			Violet
River birch			Dayflower
White ash			Unknown fern
			Smartweed
			Snakeroot
			Poison ivy
			Brambles
			Grape
			Japanese hop

Historic Disturbances: Flooding

Current Disturbances: Trampling, cutting, grazing, browsing, dumping, camp fires

SUBSEGMENT F

Cover Type: Delaware River floodplain (sycamore, hackberry, walnut), landscaped open space

Current Land Use: Protected area (refuge, preserve, etc,) from cited sources, managed woodland, hiking, fishing, passive use, picnicking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-broken)	(Density-broken)	(Density-broken)	(Density-thick)
Ornamental trees	Ornamental trees	Ornamental shrubs	Unknown grasses

Historic Disturbances: Flooding, mowing, cutting

Current Disturbances: Moving, cutting

SUBSEGMENT G

Cover Type: Flowing water (e.g., stream, canal, river)

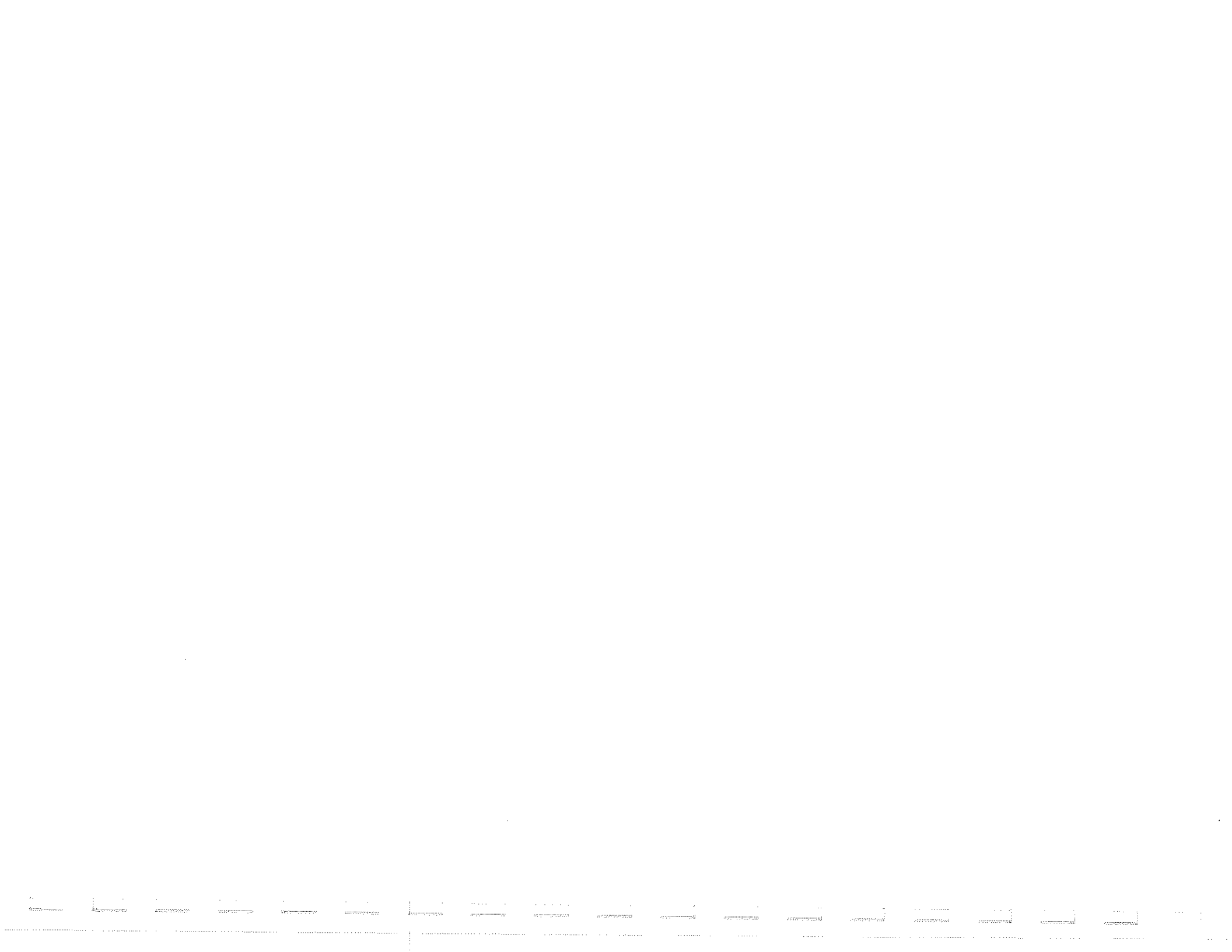
Current Land Use: Swimming, fishing, boating, passive use

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density- none)	(Density-none)	(Density-thin)	(Density-thick)
None	None	Buttonbush	Loosestrife, purple
		Elderberry	Jewelweed
			Day lily
			Tearthumb
			Smartweed
			Sensitive fern
			Unknown grasses
			Arrow-arum
			Duckweed
			Arrowhead

Historic Disturbances: Siltation, culvert, excavation

Current Disturbances: Siltation, culvert, mowing, cutting, litter and trash



Segment 7

THICKET/HEDGEROW FROM UPPER FERRY ROAD TO LOWER FERRY ROAD

SEGMENT NARRATIVE

Segment 7 extends for a distance of 1½ miles (2.4 km) between Upper Ferry Road and Lower Ferry Road. (See the map on Sheet 4a.) It is a very narrow corridor, comprising only the Canal and its edges (Subsegment A) and the railroad corridor (Subsegment B). Where the railroad edge thicket meets contiguous upland woods, a few moist upland species, including tulip poplar and pin oak (*Quercus palustris*), have begun to colonize the thicket.

On the left bank of the Canal is a woodland extending to the Canal edge. Species here include staghorn sumac, ash, black locust, and tulip poplar. In areas where the railroad and Canal are separated by more than about 15 feet (about 5 m), a similar woodland covers the right bank. In several places, the canopy of each bank meets and completely shades the Canal. One such place is adjacent to a stone-cutting establishment (Special Feature 1) that lies between the Canal and the railroad. Cut stone is stored along the Canal and an access road serves the storage area. This use has apparently disturbed the vegetation, causing a break in the canopy. Thicket has grown up in some places around the stoneyard.

The dynamics of this area are controlled by the Canal and the railroad. The strong Canal current generally prohibits the invasion of aquatics, except in a few relatively sheltered areas. Purple loosestrife and arrow-arum inhabit the Canal edges, and duckweed is occasionally seen in the water. Although the railroad has been abandoned, past management practices (e.g., cutting, herbiciding) and disturbances caused by passing trains have affected the vegetation. Grasses, vines, and woody sprouts are becoming established in the ballast now, however, and some have reached heights of up to 6 feet (2 m).

The general character of this segment is rural. However, construction of several multi-family housing units was observed adjacent to the existing apartment complex on the right side of the Canal (Contiguous Land Use m). If additional development occurs, the rural character here would be changed.

Single residential homes were observed, but the thick vegetation that consistently borders the left side of the Canal is an effective visual buffer. At the end of the segment (Lower Ferry Road), there is an unusual and interesting feature (Special Feature 3). Fourteen concrete pipes (3 ft or 1 m in diameter) carry Gold Run under the Canal. Creek water first passes over a weir, then passes under the Canal through the pipes and discharges onto a concrete base, causing fourteen miniature waterfalls. The Canal can be crossed by means of a timber railroad bridge (Special Feature 2) near the end of the segment.

The railroad corridor offers few pleasing views (in fact, the most satisfying visual experiences are often found where the railroad is farthest from the Canal). The left side of the Canal is generally impassable due to thick vegetation, but it offers more interesting views.

Access into Canal Corridor

The Canal is accessible at both ends, from Upper Ferry and Lower Ferry Roads.

Towpath

The towpath appears to have been superseded by the railroad bed.

Ease of Passage on Canal

Except for the bridge at Upper Ferry Road , passage on the Canal is clear throughout Segment 7.

Wildlife

No unusual wildlife was observed.

Auditory Assessment

Traffic on Wilburtha Road and infrequent railroad traffic on the trestle bridge near the end of the segment can be heard in adjacent areas of Segment 7. The creek and waterfall (Special Feature 3) have a pleasant natural sound.

SUBSEGMENT A

The Canal banks (Subsegment A) present two very different land and vegetation types. The left bank is characterized by upland species such as staghorn sumac, ash, black locust, and tulip poplar. The trees extend right to the Canal edge and the canopy shades the left side of the Canal for nearly the entire segment. From the bank, the land rises sharply to heights varying from 20 to 40 feet (6 to 12 m) above the Canal.

The right bank of the Canal is canopy-free except for a few spots where the railroad veers away from the Canal and the moist upland woods species have established themselves, shading the Canal. The right bank has purple loosestrife and arrow-arum at the water's edge, with occasional duckweed patches on the water.

The Canal itself provides the most pleasant sensory experience in the entire segment. The areas in which the canopy closes over the Canal provide shade and a feeling of enclosure. Canoeing there would be a ride over black water through a tunnel of leaves. The Canal is accessible from Upper and Lower Ferry Roads and at Wilburtha Road.

Community Dynamics

The current keeps the Canal largely free of vegetation. Edge communities appear stable and should continue to be so.

Management Recommendations

None

SUBSEGMENT B

Subsegment B is the abandoned railroad corridor. For much of the subsegment there is a siding a foot or two lower than the main line, on the side away from the Canal. An intermittent thicket of ash, tulip poplar, black locust, and sumac separates the railroad from the Canal. Near Wilburtha Road, this strip is wider and is semi-wooded. Part of this wider section is used as a sorting area for a stoneyard.

The right side of the railroad embankment is covered by a thicket of black cherry, sumac, red maple, and pin oak as high as fifty feet. Virginia creeper and grape extend from this thicket to cover the tracks.

The ballast and rails are being overgrown by grasses and vines, and sprouts of sycamore, box elder, and pin oak are coming up on both sides.

Community Dynamics

The abandonment of the railroad has allowed the surrounding moist upland vegetation to begin to establish itself in the corridor. If not kept clear, the railroad will eventually become completely reclaimed by vegetation, making development of a pedestrianway more difficult.

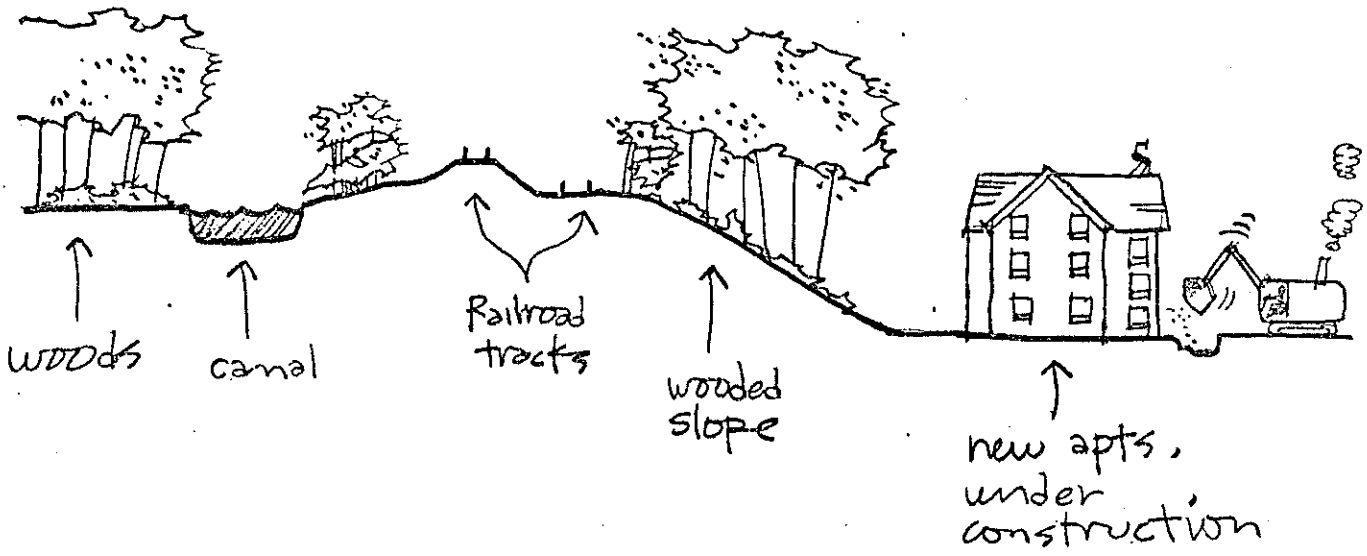
Management Recommendations

Clear vegetation from the railroad bed. If the railroad is to be used for biking and hiking, the sooner it is paved, the fewer woody sprouts will have to be removed. Allow the thicket to grow up and shield the passersby from new apartments.

Segment 7

Section

A-A'



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	residential trees	single houses (with yards)
b	moist upland woods wooded swamp	unmanaged land
c	residential	single houses (with yards)
d	wooded swamp	unmanaged land
e	successional oldfield	unmanaged land
f	Delaware River floodplain	unmanaged land
g	other	excavation
h	residential saplings	single houses (with yards)
i	thicket and hedgerow successional oldfield	unmanaged land
j	wooded swamp	unmanaged land
k	residential trees	single houses (with yards)
l	gravel/dirt roadway	commercial
m	residential saplings	garden apartments
n	successional oldfield	unmanaged land
o	wooded swamp	unmanaged land
p	residential trees	single houses (with yards)

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- ¼ mile southeast of Wilburtha Road

SPECIAL FEATURES

1 --- Stoneyard between Canal and railroad
2 --- Bridge across Canal
3 --- 14-pipe weir provides noise of tumbling water under railroad, interesting scenic point

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Railroad corridor near stoneyard (note adjacent residential land use)	3	4b

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
2	Canal flanked by lush tree vegetation on left, slightly overgrown railroad bed on right, and bridges downstream near Lower Ferry Road	3	4b

SEGMENT 7 VEGETATION DATA

SUBSEGMENT A

Cover Type: Flowing water, moist upland woods

Current Land Use: Boating, protected area (refuge, preserve, etc.) from cited sources

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thick)	(Density-thick)	(Density-medium)	(Density-thin)
White ash	White ash	Staghorn sumac	Arrow-arum
Black locust	Black locust	Tulip poplar	Duckweed
Tulip poplar	Tulip poplar		Purple loosestrife
Pin oak	Pin oak		

Historic Disturbances: Earthworks, cutting, excavation

Current Disturbances: None

SUBSEGMENT B

Cover Type: Thicket and hedgerow, railroad

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-None)	(Density-medium)	(Density-medium)	(Density-thick)
None	Black cherry	Sumac	Virginia creeper
	White ash	Black cherry	Japanese honeysuckle
	Tulip poplar	Pin oak	Purple loosestrife
	Black locust	Red maple	Prickly dewberry
		Box elder	Unknown grasses
			Grape
			Sycamore

Historic Disturbances: Earthworks, excavation

Current Disturbances: Trampling, litter and trash, dumping

Segment 8

GRADIENT COMMUNITY AND THICKET/HEDGEROW FROM LOWER FERRY ROAD TO OLD ROSE STREET

SEGMENT NARRATIVE

Segment 8 is a 4-mile (6.4 km) corridor which passes through the City of Trenton, beginning at Lower Ferry Road and ending at Old Rose Street, where the Canal enters a culvert under a section of Route 1. (See the map on Sheet 4a.) Subsegment A comprises the Canal vegetation at the end of the segment, where the Canal flows between concrete retaining walls. Where the bank is natural (through much of the segment), the Canal and edge vegetation form Subsegment B. Subsegment C is the railroad corridor, which flanks the Canal on the right for most of the segment. Because the Canal property is uniformly narrow in Segment 8, a description of the corridor alone would not convey the character of the areas through which the Canal flows. Therefore, narrative for this segment describes in greater detail than usual the areas contiguous to the Canal.

In Subsegment A, concrete retaining walls and chain link fencing isolate the Canal from its surroundings. Because the banks are vertical walls, there is no place within this corridor for plants to become established, although underwater grasses in the Canal are thick enough to require periodic removal by maintenance crews. Litter is evident both in and near the Canal. There is no shading of the Canal in this subsegment, which has little to offer in the way of positive visual attributes. Loud highway noise further detracts from this area. Less stringent management and more selective cutting, which would allow the establishment and expansion of species present in contiguous areas, could result in a landscape which provides better views and relief from the sun. Noise from the nearby highways could be buffered and a more pleasing experience could be achieved.

In Subsegment B, the Canal is bordered by a sloping bank. Vegetation has become established according to a moisture gradient. Submergent and emergent aquatics (duckweed and arrowhead) give way to typical streambank vegetation, predominantly purple loosestrife and sensitive fern. A chain link fence borders much of the Canal here, separating it from its surroundings. Where breaks in the canopy of contiguous areas admit sufficient light, vines enmesh the fence.

The railroad community, Subsegment C, is characteristically a community of low-growing herbs and thicket/hedgerow. From the beginning of the segment to Sullivan Way, the same overgrown conditions exist as in Segment 7, Subsegment B. Farther on the subsegment, the railroad appears to be used, and shrubs and saplings closely bordering the tracks have been pruned (either by passing trains or as part of a maintenance program) and are short and multi-stemmed. The corridor is essentially a barren strip closely wedged between the Canal and the properties backing up to the railroad right-of-way. Visually, it serves to widen the Canal corridor. Because there are few trees to shade the Canal, more lush bank and aquatic vegetation can develop than on the shaded portions of the opposite bank. The herb layer is diverse, including dominant Japanese honeysuckle, Virginia creeper, ragweed, Queen-Anne's lace, evening primrose, goldenrod, and unknown grasses, and many other species.

CONTIGUOUS LAND USES

Land uses contiguous to the Canal largely define the character of the Canal corridor. Landscaped open spaces include the Trenton Country Club golf course and Cadwalader Park in Trenton. There are two aqueducts (Sections A-A') through which the Canal passes: one at Sullivan Way (Special Feature 1) and one at Parkside Avenue (Special Feature 2). Residential uses contiguous to the Canal in Segment 8 are designated as multi-family (row houses and garden apartments); single-family, medium density; single-family, low density, older residences, often in a "wooded" setting. Industrial uses and areas where commercial and residential land uses mingle are present in the latter part of the segment.

At the beginning of the segment, the Trenton Country Club golf course (Contiguous Land Use f) lies along both sides of the Canal. (See Section A-A'.) A planted grove of large trees (ash and black locust) borders the Canal here but does not block the view of the open landscaped greens beyond.

Low density, single-family houses (d) with copious residential plantings abut the golf course. The Canal is elevated above them and is visible only intermittently. Canopy trees screen the Canal, giving it a sense of enclosure and filtering out some of the urban sounds.

The multi-family residential area (e), on the right side of the Canal after the Sullivan Way aqueduct, has an urban character. It includes rowhouses and 3-to 4-story apartments with landscaped grounds. Plantings consist mostly of shrubbery, with only a few trees. The long view from the Canal is generally restricted by the buildings, even though the Canal is at a higher elevation. An intermittent thicket screens the Canal corridor, but one is generally very much aware of the urban surroundings.

Landscaped open space (c) and Cadwalader Park are across the Canal from the multi-family dwellings. Here, large trees form an intermittent canopy over manicured lawn. There are some dense groves of red maple, black locust, sassafras, slippery elm, and Norway maple along the Canal. (See Appendix.) The Trenton Leaf Dump, a play area, and parking space are in an area adjacent to the Canal. There is an old canoe landing on the Canal at the end of the Park. Where the Canal passes through the Parkside Avenue aqueduct, the elevation difference and the wooded thicket bordering the Park sometimes obscure the view of the Park from the Canal.

After Cadwalader Park, between Parkside Avenue and the vicinity of Hermitage Avenue on the left side of the Canal, is a high wooded slope which drops steeply to the Canal edge. Large upland trees, principally black oak, form a dense canopy, with willow on the lower portion of the slope, overhanging the water. Children playing on some fallen trees by the water's edge indicates that although the slope is steep, access to the Canal is possible through this woods. Low density, single-family houses (d) are in this area and across the Canal. (See Section B-B'.)

At about this point, where the Canal begins to follow a bending course through Trenton, the railroad crosses the Canal and does not parallel it again until the very end of the segment. Much of the land to the right of the Canal here has been earmarked by Trenton for redevelopment. Land use is mixed commercial and residential.

In the residential areas (b) are medium density, single-family dwellings whose backyards face directly on the Canal. Where residential and commercial areas mix, the vegetation consists of intermittent thickets of sumac and ailanthus, with scattered low-growing herbaceous material such as ragweed and mullein. (See Section C-C'.) Industrial areas (h) bordering the Canal exhibit the same type of community. In the more pleasant medium-density residential uses, a gravel and dirt roadway runs between the backyards and the Canal, and cool, shady groves of beech, sweetgum (*Liquidambar styraciflua*), and honeylocust partially shade the Canal in some of these areas.

To the left of the Canal, just past its first major bend, is a triangular area of landscaped woods (Special Feature 3). Another Special Feature is a spot at North Broad Street (Special Feature 4) from which the Trenton Battle Monument can be viewed.

Access into Canal Corridor

Access and pedestrian passage along the Canal are mostly easy along one side or the other, with the railroad tracks, footpaths, and small roadways allowing easy walking. Along portions of the left side of the Canal, passage is impossible due to steep slopes. In some places, fences or low bridge supports must be scaled.

Towpath

The towpath appears to have been superseded by the railroad bed in Segment 8. In some places, paths parallel the Canal on the left bank; in other areas, the bank is steep and impassable.

Ease of Passage on the Canal

Low bridges impede passage on the Canal in the latter half of the segment.

Wildlife

No unusual wildlife was observed in Segment 8. In general, Segment 8 does not provide a good habitat.

Auditory Assessment

The beginning of the segment is fairly quiet, but constant traffic noise becomes increasingly audible, particularly in Subsegments C (in the latter part of the segment) and A. A factory in Contiguous Land Use h also generates noise. After Sullivan Way, railroad traffic is noisy.

SUBSEGMENT A

Subsegment A is the Canal and its concrete retaining wall in the urban area (a) at the end of the segment. Subsegment A is bounded by noisy highways and paralleled by a railroad right-of-way (Subsegment C). Concrete retaining walls, cyclone fences, and a strict management regime inhibit vegetation and public use in this subsegment.

The Canal supports a thick growth of unknown aquatic grass, which is periodically cleared and removed by maintenance crews. Otherwise, except for a few hardy plants growing from cracks in the concrete, the narrow corridor is barren of vegetation.

The adjacent property, a railroad and highway right-of-way, is managed by severe pruning and cutting and perhaps by herbiciding also. Multi-stemmed saplings and shrubs in these adjacent areas include red maple, Norway maple, box elder, American and slippery elm, and mulberry. The mowed area has assorted grasses, along with a multitude of herbs typical of dry, sunny locations.

Several people were using the areas adjacent to Subsegment A to exercise their dogs and a few people appeared to be using it as a short-cut route. No other activities were observed.

Community Dynamics

The concrete bank prevents growth of vegetation in Subsegment A.

Management Recommendations

If a more natural environment is desired, selectively maintain vegetation along the top of the concrete bank.

SUBSEGMENT B

Subsegment B comprises the Canal and its sloping embankments along the initial part of Segment 8. These banks have a luxuriant growth of emergent aquatics and typical streambank vegetation. The community follows a moisture gradient. The aquatics most commonly found are duckweed and arrowhead, but halberd-leaf tearthumb (*Polygonun arifolium*), arrow-arum, and blue flag iris (*Iris versicolor*) were also observed. Moisture-loving and moisture-tolerant vines and herbs covering the upper portion of the bank include the dominant purple loosestrife and sensitive fern, along with jewelweed, smartweed, dayflower, nightshade (*Solanum nigrum*), Japanese honeysuckle, sunflower, dodder (*Cuscuta gronovii*), oxalis *Oxalis* spp.), and pokeweed. Mulberry and silver maple at shrub height occur sporadically in Subsegment B and contiguous areas, as well as elms, ash, maple, sycamore, ailanthus, and willow of canopy and understory height. These species, along with pin oak, occasionally overhang the Canal, providing shade.

Despite the chain link fence which often separates Canal property from adjacent areas, debris, litter, and trash have accumulated in Subsegment B.

Community Dynamics

If the Canal remains open to the sun, aquatic vegetation should continue to thrive.

Management Recommendations

Clean up litter, trash, and debris.

SUBSEGMENT C

The railroad closely parallels the Canal for most of its length. However, the Canal and the railroad separate just after the factory at h and do not rejoin until near the end of the segment.

In general, the species found along the railroad are similar to those described in Segment 1, Subsegment F. The herb layer is more diverse, however. Japanese honeysuckle, Virginia creeper, ragweed, Queen-Anne's lace, evening primrose, goldenrod, and unknown grasses are dominant. English plantain, red clover, dandelion (*Taraxacum officinale*), butter-and-eggs, aster, milkweed, and common morning glory (*Impomoea purpurea*) are among the wildflowers present. The herb stratum in Subsegment F also includes Indian hemp (*Apocynum cannabinum*), chicory (*Cichorium intybus*), burdock (*Arctium* spp.), heal-all (*Prunella vulgaris*), Japanese snakeroot, Japanese hop, and foxtail grass. Blackberry, groundnut, and poison ivy were observed among the vines; and many of the species present in Subsegment B were also noted here.

At the beginning of the segment, up to Sullivan Way, the railroad corridor appears to be unused and is becoming overgrown, as it is in Segment 7. The eastern portion of the tracks seems to be in use, possibly to service contiguous industrial and commercial uses.

Traffic is audible along the subsegment, particularly in its latter portion. Noise from the factory (Contiguous Land Use h) can be heard nearby. Trains are also a source of noise.

Community Dynamics

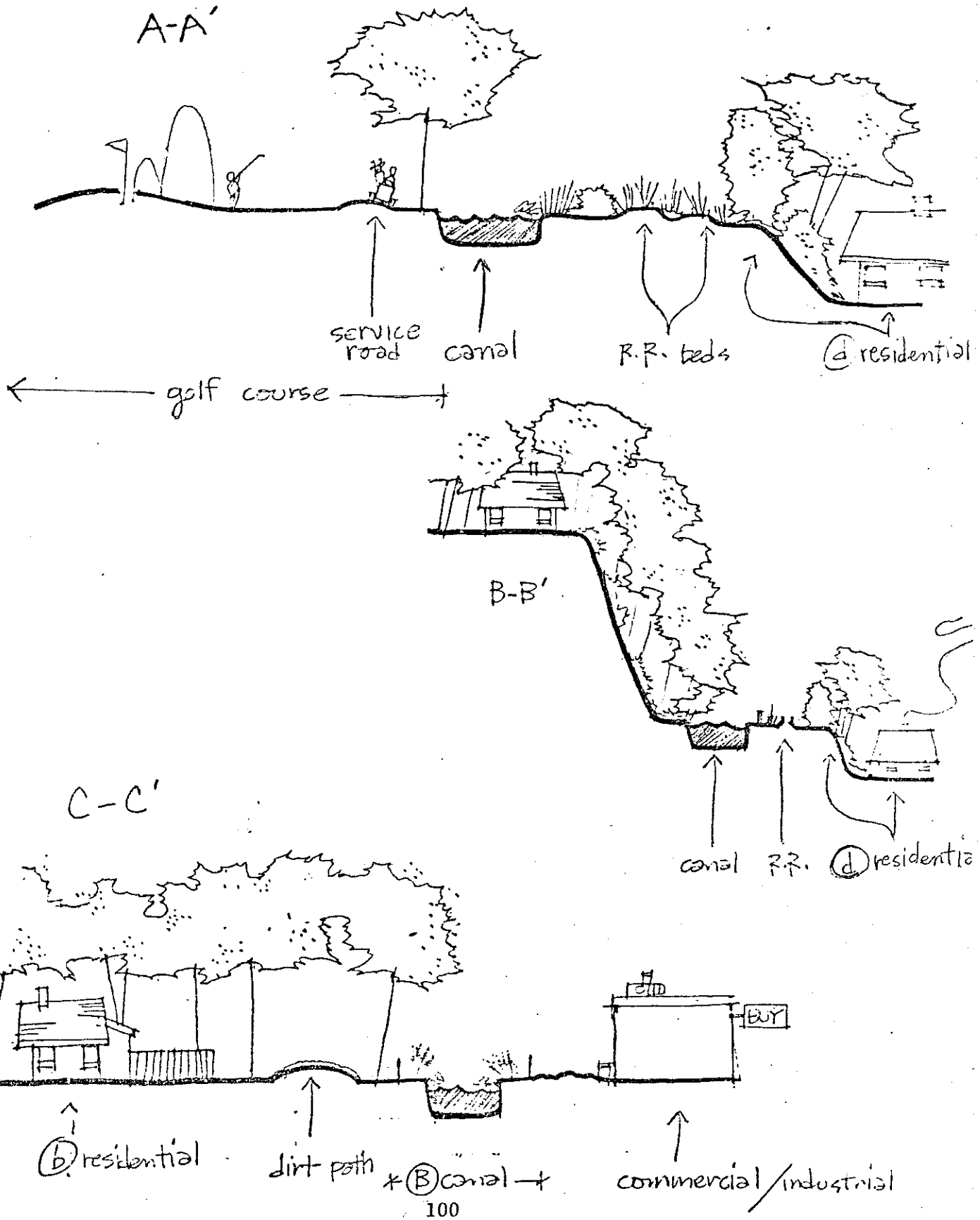
In areas where the tracks are becoming overgrown, herbaceous and woody species should continue to establish themselves. The latter part of the railroad corridor is maintained.

Management Recommendations

If a trail is desired, clear the vegetation where it has overgrown the tracks. Pursue a periodic trash removal program.

Segment 8

Sections



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	railroad	railroad
	gravel/dirt road	road or highway
b	residential saplings	single homes (with yards: medium density)
c	landscaped open space	bicycling
		passive use
		picnicking
d	residential trees	single houses (with yards: low-density)
e	residential saplings	row houses
		multi-unit buildings
f	landscaped open space	golf
g	residential saplings	row houses
	parking lot	commercial
h	asphalt/concrete roadway	institutional
	parking lot	

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- At golf course
B-B' --- Residential areas at mid-segment
C-C' --- Residential and commercial uses where railroad diverges from Canal

SPECIAL FEATURES

1 --- Aqueduct-Sullivan Way
2 --- Aqueduct-Parkside Avenue
3 --- Triangular woods
4 --- View to Trenton Battle Monument

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	14-pipe aqueduct at Lower Ferry Road	3	4b
2	Trenton Country Club, small lagoon in foreground	3	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
3	Railroad bed and Canal edge community	3	4b
4	Overgrown railroad corridor on Canal's right side	3	"
5	Fenced Canal, passing through Trenton city limits	3	"

SEGMENT 8 VEGETATION DATA

SUBSEGMENT A

Cover Type: Flowing water

Current Land Use: Protected area (inaccessible)

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-None)	(Density-None)	(Density-None)	Density-thin)
None	None	None	Unknown grasses

Historic Disturbances: Debris accumulation, litter and trash, concrete bank

Current Disturbances: Debris accumulation, undertermined, litter and trash, (mowing, cutting, herbiciding adjacent)

SUBSEGMENT B

Cover Type: Flowing water

Current Land Use: Protected area (much is fenced)

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thin)	Density-thin)	(Density-thin)	(Density-thick)
American elm	Ailanthus	Mulberry	Jewelweed
Pin oak (overhang)	Willow	Silver maple	Dayflower
Sycamore	American elm		Pokeweed
	Red maple		Phlox
	White ash		Oxalis
	Slippery elm		Duckweed
			Sensitive fern
			Smartweed
			Dodder
			Sunflower
			Arrowhead
			Purple loosestrife
			Unknown grasses
			Blue flag iris
			Nightshade
			Japanese honeysuckle
			Arrow-arum
			Halberd-leaf tearthumb

Historic Disturbances: Debris accumulation, litter and trash, siltation

Current Disturbances: Debris accumulation, litter and trash, siltation

SUBSEGMENT C

Cover Type: Railroad, thicket and hedgerow

Current Land Use: Dog walking, railroad

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thin)	(Density- thin)	(Density-medium)	(Density-thin)
Ailanthus	Slippery elm	Mulberry	Japanese honeysuckle
Black locust	Box elder	White ash	Goldenrod
Sycamore	Willow	Norway maple	Dayflower
Willow	American elm	Ailanthus	English plantain
Princesstree		Viburnum	Japanese hop
Honeylocust			Foxtail grass
Box elder			Virginia creeper
			Common morning glory
			Heal-all
			Jewelweed
			Butter-and-eggs (Toad flax)

CANOPY	UNDERSTORY	SHRUB	HERB
			Milkweed
			Unknown grasses
			Phlox
			Snakeroot
			Aster
			Smartweed
			Poison ivy
			Ragweed
			Queen-Anne's lace
			Red clover
			Dandelion
			Blackberry
			Indian hemp
			Groundnut
			Evening primrose
			Chicory
			Burdock
			Oxalis

Historic Disturbances: Herbiciding (possible), mowing, cutting

Current Disturbances: Herbiciding (possible), litter and trash, mowing, cutting

Segment 9

FLOODPLAIN WOODLAND, THICKET/HEDGEROW, AND MARSH AT ENTRANCE OF ORIGINAL CANAL

SEGMENT NARRATIVE

Segment 9 is an abandoned portion of the original Canal. The segment stretches from the mouth of Crosswicks Creek (at Bordentown) to Sturgeon Pond, a distance of 3.6 miles (5.8 km). (See the map on Sheet 11a.) The segment is bordered on the east (right) by a gravel or dirt access road and a railway. Beyond these lie the Hamilton Marshes (Special Feature 1). On the west (left), the segment is bounded by Duck Creek, industrial land uses, and unmanaged land. Thicket/hedgerow in the Canal corridor (Subsegment A) covers a levee (left bank) and intermittently vegetates the railroad edge. Delaware River floodplain woodland is found at the beginning of the Canal (Subsegment C). A small portion of Canal Park land (Subsegment B) lies within the Hamilton Marshes.

The thicket/hedgerow and floodplain woodland are similar to those described in Segment 1, Subsegments F and L and Segment 1, Subsegment A, respectively. The floodplain woodland exhibits the sycamore/silver maple/box elder association, and black locust and river birch are prominent in both communities. For much of its length, the Canal would be shaded in the summertime. Because the segment was surveyed in the winter, low-growing herbaceous vegetation was difficult to discern. Undoubtedly, the slow-moving water in the Canal fosters the growth of aquatic vegetation. Vegetation in the marsh has been documented in a study by Whigham and Simpson of Rider College. The study lists dominants in the marsh as yellow water lily (*Nymphaea* spp.), pickerelweed (*Pontederia* spp.), water smartweed (*Polygonum punctatum*), arrow-arum, wild rice (*Zizania aquatica*), swamp loosestrife (*Decodon verticillatus*), and cattail.

The Canal in Segment 9 is in disrepair. Wooden pilings along the bank at the entrance to the Canal have deteriorated, and siltation is considerable in this area. Farther along the Canal, the banks are severely slumped and trees have fallen into the water. At one location about halfway through the segment, the large number of fallen trees makes the Canal almost walkable. Shortly after this portion, a railroad siding runs across the Canal into the contiguous power plant at (b). The tracks run on a man-made levee which appears to block the Canal. Just past this siding, the remains of an old barge lie in midstream.

Segment 9 is bisected by two powerline rights-of-way, one into the power plant at Contiguous Land Use b, and the next near the end of the segment. Some excavation activity appeared to be going on between these rights-of-way. Entrance to both rights-of-way (and thus to the access road which parallels the Canal) was blocked at the time of the survey. Several hundred yards short of Sturgeon Pond, the Canal ends: it is covered by a landfill.

Access into Canal Corridor

Access to the segment is only possible by boat or by crossing a railroad trestle bridge over Crosswicks Creek at Bordentown. The railroad is still used in this segment of the Canal Park, however, and the trestle bridge is narrow. The northern half of the segment is accessible from Lamberton Road (on the left), but there are no public parking spaces.

Towpath

A towpath runs intermittently along the levee (left bank) of the Canal. It is overgrown and rarely passable.

Ease of Passage on the Canal

The Canal is often blocked by fallen trees and becomes impassable about halfway through the segment.

Wildlife

No unusual wildlife was observed. The contiguous marsh offers an ideal habitat for many species, however.

Auditory Assessment

Intermittent noise of boating activity on the Delaware is audible in Subsegment C. Intermittent railroad traffic is audible throughout the corridor, and constant traffic on Lambertville Road and noise from contiguous industry can be heard in the middle of the segment. The sounds of ice cracking on the Delaware, adjacent creeks, and the Canal entrance are audible in the first half of the segment.

SUBSEGMENT A

Subsegment A encompasses the Canal and its banks in Segment 9. To the left of the Canal is a levee; on the right is a railroad corridor which is not included in the Canal Park. A discontinous dirt or gravel access road lies between the Canal and the tracks. This road appears to be used and in better condition in the latter half of the segment.

Thicket/hedgerow covers the levee and left bank of the Canal for much of its length. Vegetation is similar to that described in Segment 1, Subsegment L. River birch and black locust with DBH of 12" (30 cm) were observed. Generally, the herb and shrub layers are dense, with a thin to medium-dense understory and canopy. A path runs along the top of the levee. Overgrown by herbs and woody growth, the path is nearly impassable in places.

The Canal itself is in various stages of disrepair. Severe bank slumping was observed all along its length, and large fallen trees crisscross the Canal, in places completely blocking passage via water. The Canal is also interrupted by a railroad siding for the nearby industrial land uses: by an abandoned, rotting barge (Special Feature 2); and by an access road for the first powerline right-of-way. Bank slumping causes the Canal to narrow considerably after this point, and a landfill buries it completely several hundred yards short of Sturgeon Pond, a body of water on the right which marks the end of the segment.

The right bank of the Canal is the railroad edge. Use of the railroad corridor and possible management practices (e.g., cutting, herbiciding) have disturbed the vegetation. Along much of the corridor, herbaceous material like that described in Segment 1, Subsegment F, grows in the ballast; in places where the distance between railroad and Canal is greater, a thin growth of woody species has occurred. Where the bank slumps, many of these trees have fallen into the Canal.

Contiguous land uses to the left of the Canal add a dreary note to the subsegment and create intermittent noise which is audible in the northern half of Subsegment A. Views are largely uninteresting, as landfills, excavation, and heavy industry dot the area. In the summer, trees along the banks would shade much of the Canal.

The subsegment is accessible from Subsegment C. There are no paved roads in or contiguous to the Canal Park in the first half of the segment. Access is easy at the powerline rights-of-way and possible from Lamberton Road, despite thick vegetation and slopes created by landfill and excavation.

Community Dynamics

Bank slumping and windthrow are causing trees to fall into the Canal along many portions of this subsegment. Vegetation in the ballast along the railroad corridor (right bank of the Canal) is affected by management practices. The presence of saplings of canopy species on the levee top and sides (left bank) should ensure the continuity of this community.

Management Recommendations

Management recommendations depend on the projected land use for this segment. The Canal and towpath are in serious disrepair.

SUBSEGMENT B

The State owns a small parcel of marshland (Subsegment B) to the right of the Canal just above the Canal entrance. (See Section B-B'.) This marshland is a part of the Hamilton Marshes, an area of approximately 2000 acres (500 hectares) to the right (east) of the Canal Park. The Hamilton Marshes, freshwater tidal marshland, form an important wildlife habitat and an area of interest for ecological study.

Vegetation in these marshes has been thoroughly documented in a 1975 study by Whigham and Simpson of Rider College. Because our field survey was made during the winter and the ground was covered with snow, we consulted the Rider College study, which lists dominant species as yellow water lily, pickerelweed, water smartweed, arrow arum, wild rice, swamp loosestrife, and cattail. The study offers detailed descriptions of the marsh habitats.

The marshland offers broad, sweeping views and a quiet, undisturbed atmosphere. Wildlife (particularly waterfowl) is abundant. Hunting and hiking were observed recreational uses. Subsegment B appeared undisturbed, although sewage treatment plants, landfills, and industrial uses to the north and east of the Hamilton Marshes may have an impact on the ecosystem as a whole.

Access to Subsegment B presents a considerable problem. No vehicular or pedestrian entry (unless the trestle bridge, currently in use by the railroad, is counted) is available from Bordentown. Crosswicks Creek prohibits access from the east. To enter Subsegment B, one must travel south for about 1 1/2 miles (2.4 km) along the Canal/railroad corridor from the access areas along Lamberton Road.

If the Hamilton Marshes are used for a Township environmental education program, as was suggested in the Rider College study, Canal Park land could also be used for educational purposes, and the first half of Subsegment A would increase in importance as an access route to the southeast portion of the Marshes.

Community Dynamics

Barring major disturbances, this marshland should remain stable.

Management Recommendations

None

SUBSEGMENT C

Subsegment C is Delaware River floodplain woodland on both sides of the entrance to the Canal. The subsegment cannot be reached from Bordentown except by crossing a high trestle bridge over Crosswicks Creek. This bridge offers good views of the creek, the Canal entrance, the Delaware River, and the Pennsylvania shoreline, but the railway is currently in use and crossing the bridge is dangerous. Subsegment A provides access from the north.

The floodplain woodland is similar to that observed in Segment 1, Subsegment A. Snow cover and bare trees made study of the vegetation (particularly the herb layer) difficult, but the sycamore/silver maple/box elder association was noted. All strata are of medium to thick density. In some places, vines enter the shrub layer and occasionally penetrate the understory.

Passage of trains and possible management practices (e.g., cutting, herbiciding) have disturbed the vegetation along the railroad edges. Siltation has affected the Canal, especially after the entrance, where the Canal widens to form a wide basin. Camp fires were observed in the woods, and hikers and hunters were in Subsegment C at the time of the survey.

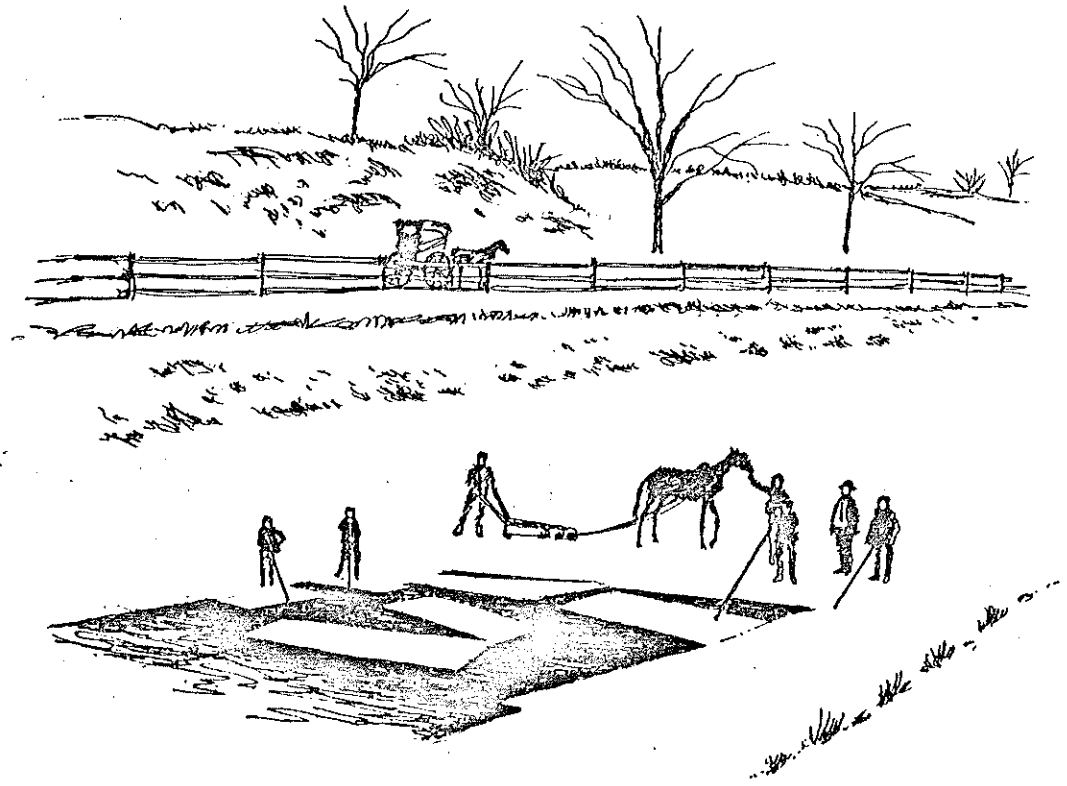
Views of the basin and the curving Canal are interesting. Pilings and the remains of disused boat slips along the Canal edges, wooded banks, and formations of silt and ice in the water contribute to the visual experience. Distant noise from ports and industry on the Delaware can be heard. The cracking ice provided the only loud sounds within the subsegment at the time of the survey. Passing trains contribute occasional noise which is most audible in the woodland on the right bank.

Community Dynamics

Given the present land uses and flood regime, the floodplain woodland of Subsegment C should remain stable.

Management Recommendations

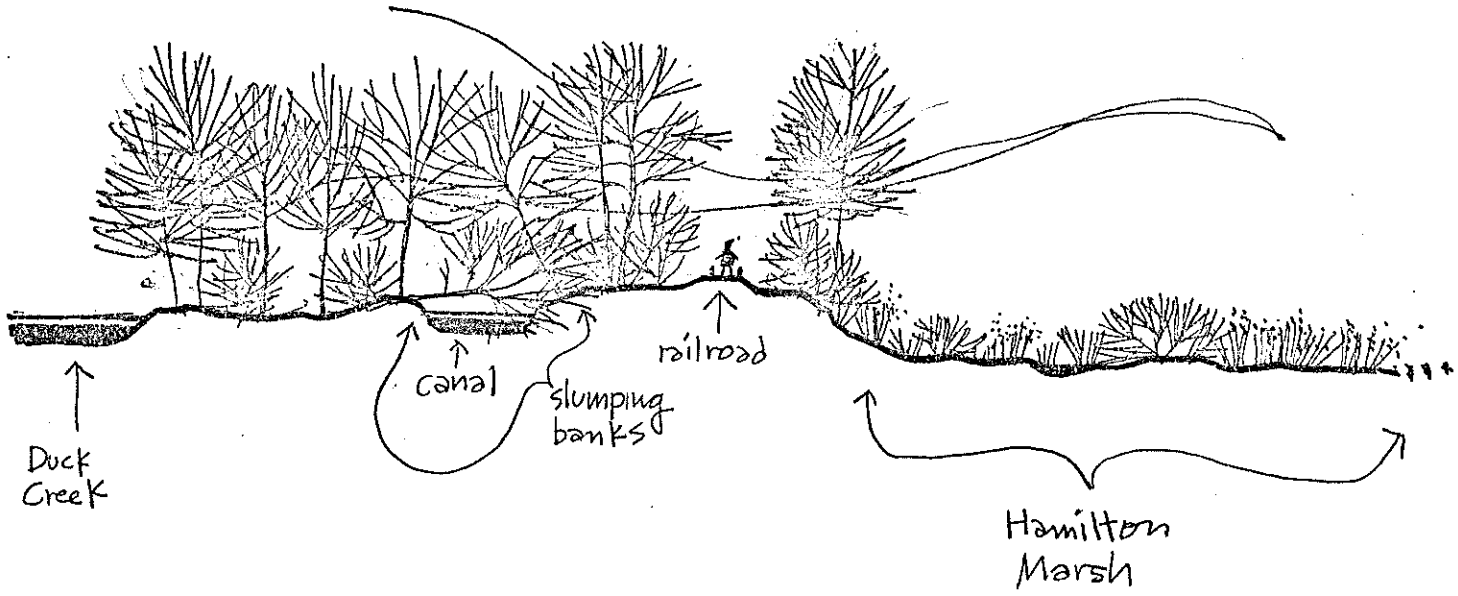
None



Segment 9

Sections

A - A



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	Delaware River floodplain	unmanaged land
b	asphalt/concrete roadway	industrial
c	landscaped open space	utility corridor
d	marsh	utility corridor
e	landfill	landfill
f	marsh	unmanaged land
g	thicket and hedgerow	railroad
	gravel/dirt roadway	road or highway

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Near mouth of Duck Creek, across Canal and north

SPECIAL FEATURES

1 --- Hamilton Marshes
2 --- Barge in Canal

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Entrance to Canal at Crosswicks Creek	8	11b
2	Railroad bridge across Crosswicks Creek	8	"
3	Across Canal at basin	8	"
4	Canal at basin	8	"
5	Canal near powerline right-of-way	8	"
6	Powerlines crossing Hamilton Marshes	8	"
7	Canal, access road, and railroad	8	"
8	Powerlines and contiguous industrial use	8	"
9	Contiguous landfill	8	"
10	Canal and thicket	8	"
11	Towpath	8	"

SEGMENT 9 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow

Current Land Use: Railroad

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-thick)	SHRUB (Density-thick)	HERB (Density-thin)
Ailanthus	Box elder	Slippery elm	Foxtail grass
Black cherry	Black oak	Spicebush	Brambles
Slippery elm	Sugar maple	Silky dogwood	Unknown grasses
Green ash	Ailanthus	Poison ivy	Poison ivy
Silver maple			Stinging nettles
Black locust			Grape

Historic Disturbances: Cutting, herbiciding

Current Disturbances: Cutting, herbiciding

SUBSEGMENT B

Cover Type: Marsh

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY (Density-none)	UNDERSTORY (Density-none)	SHRUB (Density-none)	HERB (Density-thick)
			Yellow water lily
			Pickerelweed
			Water smartweed
			Arrow arum
			Wild rice
			Swamp loosestrife
			Cattail

Historic Disturbances: Flooding

Current Disturbances: Flooding

SUBSEGMENT C

Cover Type: Delaware River floodplain

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-thick)	SHRUB (Density-medium)	HERB (Density-thin)
Silver maple	Silver maple	Slippery elm	Poison ivy
Sycamore	Black locust	Black locust	Smartweed
Box elder	Slippery elm	Willow	Unknown grasses
Black locust	River birch	Ailanthus	Brambles
River birch		Spicebush	Stinging nettles
Black oak			Goldenrod
			Ragweed

Historic Disturbances: Flooding

Current Disturbances: Flooding

NOTE: Segments 10 and 11 are in Trenton.

In Segment 10, the Canal has apparently been filled;
in Segment 11, it passes through an underground culvert.

Segment 12

URBAN AREA FROM MULBERRY STREET TO WHITEHEAD ROAD

SEGMENT NARRATIVE

The first mile of the Canal corridor (after the Canal emerges from the pipe that carries it through downtown Trenton) is designated as Segment 12. (See the map on Sheet 5a.) The narrow Canal corridor is flanked on the right by an urban complex along Route 1; on the left, by industrial and commercial land uses. (See Section A-A'.) Subsegment A is the Canal and Canal banks; Subsegment B is the railroad corridor to the left of the Canal.

The Canal itself varies in character throughout Segment 12. At the beginning of the segment, the Canal flows between concrete retaining walls. In two locations, series of steel reinforcing beams (Special Features 1 and 2) span the Canal at a height of 1 to 2 feet (½ m). In the latter part of the segment, the Canal walls are stone. A concrete weir (Special Feature 4) which allows excess water to flow into Assunpink Creek comprises about 75 feet (22 m) of the Canal's right wall.

The vegetation along the Canal embankments (Subsegment A) is a gradient community. The upper bank on both sides is covered by an intermittent hedgerow/thicket which reaches a height of 25 to 30 feet (6 to 8 m). The hedgerow is composed of woody species including red maple, black cherry (DBH 7", or 17.5 cm), red oak, black locust, and willow (DBH 6", or 15 cm). Lying below this layer is a dense thicket dominanted by young woody saplings and shrubs, as well as vines, grasses, and other herbaceous plants. The lower banks are dominanted by moisture-tolerant herbaceous species (e.g., purple loosestrife). In many areas, the lower bank vegetation grades into community of emergent and submergent aquatics (e.g., arrowhead, duckweed). In several locations, the upper bank vegetation overhangs and shades small portions of the Canal, but the Canal is unshaded along most of its length. Where Route 1 and the Canal are very close, there is no vegetation other than a mowed herb layer beneath the guard rail.

Where the Canal edge community abuts the railroad corridor (Subsegment B), the community composition and structure change slightly. The upper layers contain a large proportion of ailanthus, staghorn sumac, and bigtooth aspen. Lower layers include mulberry, speckled alder, roses, and slippery elm. In the herb layer are foxtail grass and mullein. A damp swale, with water lily prominent, was observed below the thicket at Special Feature 3.

Views in Segment 12 are hampered by the hedgerow/thicket community. The segment is heavily littered, and the Canal appears to be used for dumping. It receives runoff and industrial spoils. Odors emanating from contiguous land uses (industry, sewage treatment plant) are omnipresent.

The Canal and adjacent State land in Segment 12 have little to offer the Park as recreational facilities. Care should be exercised to prevent abuse of the Canal water as it passes through the segment. Existing management practices maintain the flow, the Canal walls, and the weir. Segment 12 would not make a strong contribution to a trail system along the Canal.

Access into Canal Corridor

Segment 12 is accessible from Mulberry Street and Whitehead Road. Subsegment A is accessible from Route 1. Access to Subsegment B from contiguous land uses necessitates trespassing.

Towpath

The towpath has apparently been superseded by the railroad bed. Use of the railway endangers pedestrians in the corridor.

Ease of Passage on Canal

Passage is hampered by the steel beams at the beginning of the segment. Portage is difficult in some areas because of the elevation difference between the top of the Canal wall and water level.

Wildlife

Segment 12 does not provide a good habitat for wildlife.

Auditory Assessment

Infrequent noise from the railroad is audible within the segment. Route 1 is a source of loud, constant noise, and contiguous industrial uses also make frequent noises.

SUBSEGMENT A

Subsegment A is the Canal and its right and left embankments through a one-mile section of east Trenton. The subsegment begins at Mulberry Street, where the Canal emerges from the covered channel which carries it through downtown Trenton. From this point to the end of the segment at Whitehead Road, the Canal follows a straight path successively defined by walls of poured concrete, corrugated steel, and natural stone.

The right side of the Canal is paralleled closely by Route 1. The space between the roadway and Canal varies in width. Where the two are very close (2 to 3 feet; 1 m), the vegetation under the guard rail is primarily mowed herbaceous material (grasses, etc.). As the space between the two corridors widens, the vegetation becomes more diverse. Covering the bank is a gradient community. On the upper bank is an intermittent hedgerow/thicket strip ranging in width from 3 to 15 feet (1 to 5 m). The woody hedgerow reaches a height of 30 feet (19 m) in places. Prevalent species include black cherry, willow, red maple, red oak, and black locust. Beneath these are woody saplings and shrubs (e.g., speckled alder, arrowwood, viburnum, silky dogwood) and a dense population of vines, grasses, and other herbaceous plants. The latter include honeysuckle, grape, Virginia creeper, foxtail grass, snakeroot, milkweed, ragweed, brambles, prickly dewberry, and wild flowers. As the bank slopes down to the Canal, the

number of woody species decreases while the herbaceous community increases in density. Species more tolerant of wet soils (purple loosestrife, jewelweed, smartweed, and sensitive fern) grow at the water's edge. Where Canal current is slow and direct sunlight is available, aquatic submergent and emergent plants (arrow-arum, arrowhead, marsh grass, and duckweed) line the Canal.

The vegetation on the left side of the Canal is similar. Generally, the woody community is somewhat lower (15 to 20 feet; 3 to 4 ½ m) and sparser. Where the upper bank vegetation abuts the railroad edge community, species include a greater abundance of stress-tolerant plants such as ailanthus and staghorn sumac.

Access to Subsegment A is usually easy from both sides and at both ends of the subsegment. In places, however, the strip of vegetation hampers access to the Canal. In several spots near the Mulberry Street end, access to the Canal is made difficult by the fact that the Canal lies 10 feet (3 m) below the top of the wall which contains it. In two locations within the subsegment, the Canal can be crossed by walking on steel cross-beams.

About 3/4 miles (1.2 km) from the Mulberry Street end, a concrete weir forms the right wall of the Canal for about 75 feet (22 m). During periods of high flow, this structure allows excess water to spill and drain (via pipe) under Route 1 into the nearby Assunpink Creek.

Disturbances to the vegetation and the Canal were observed in Segment 12. In places (particularly near Route 1), vegetation is cut and mowed. Litter (e.g., cans, paper, etc.) was observed within the subsegment. Several pipes carrying drainage and industrial spoils into the Canal were also noticed. Annoying and often overbearing noise from Route 1 (along the right) and from the adjacent railroad and contiguous industries (along the left) readily reaches this subsegment. Odors from a nearby sewage treatment plant and industrial plants are obnoxious.

Community Dynamics

Continued maintenance will keep the vegetation of Segment 12 in its current state.

Management Recommendations

None

SUBSEGMENT B

Subsegment B is the railroad corridor, which parallels the Canal on the left. The railroad right-of-way separates the upper Canal bank vegetation (Subsegment A) from contiguous industrial/commercial land uses. In general, the

hedgerow/thicket along the corridor edges is similar to that described in Segment 1, Subsegment F. Willow, cherry, and black locust are major components. The community in the ballast between the rails is primarily composed of low-growing herbaceous plants. Its density ranges from thick to thin according to the degree of shading from overhanging trees. The dominant species include Virginia creeper, prickly dewberry, foxtail grass, mullein, and butter-and-eggs. The light freight traffic affects the vegetation.

The community which separates the railroad from the adjacent industrial/commercial uses is an intermittent hedgerow/thicket like that on the opposite side of the tracks, but several new species are major components of the overstory. Ailanthus, staghorn sumac, bigtooth aspen, sassafras, and sycamore accompany the willow, black cherry, and black locust. In some places, tall trees grow close enough on both sides of the track to form a nearly closed vegetational tunnel over the corridor. Ailanthus, black locust, and staghorn sumac are dominant. The thickets below these trees are broken, often because industrial uses (parking lots and roads) adjacent to the tracks have replaced the vegetation strip. The thicket community includes woody saplings and shrubs, vines, and assorted herbaceous plants. In one area, a damp swale (Special Feature 3) was observed between the railroad edge thicket and an adjacent oldfield. Water lily inhabits the swale, and its presence suggests that the swale is wet for an extended period during the year. Several similar depressions observed next to industrial plants appeared to be used as ditches for seepage or chemical spoils. These ditches did not appear to enter the Canal directly.

Access to the railroad corridor and into the Canal corridor is unrestricted, although travel through contiguous land uses may involve trespassing. Litter was observed along the tracks. Nearby noises and unattractive views are not well buffered by the intermittent railroad edge community.

Community Dynamics

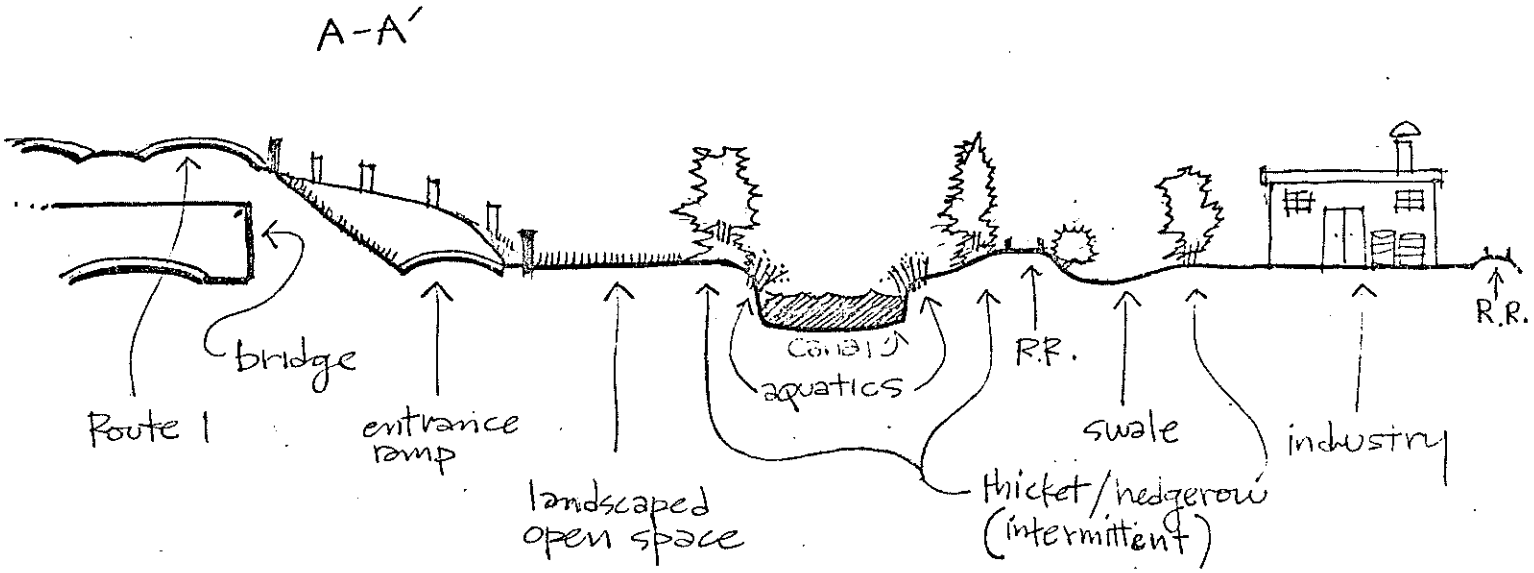
The railroad's managment practices (e.g., cutting, herbiciding) should keep the ballast and edge communities in their current states. Effluent materials from adjacent industrial/commercial land uses may also affect the vegetation.

Management Recommendations

Determine extent of waste discharge into the Canal Park and correct it.

Segment 12

Section



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	parking lot	industrial
b	asphalt/dirt roadway	road or highway
c	parking lot	commercial
d	landscaped open space	road or highway (embankment)
e	successional oldfield gravel/dirt roadway	unmanaged land
f	successional oldfield	unmanaged land
g	successional oldfield	unmanaged land
h	dump	auto dump

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Approximately 1/8 mile upstream of Whitehead Road

SPECIAL FEATURES

1 --- Steel grid across Canal
2 --- Steel grid across Canal
3 --- Damp swale
4 --- 75-foot (22 m) weir into Assunpink Creek

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Typical industry adjacent to Canal along Trenton urban fringe	2	5b
2	Canal through Trenton (from Whitehead Road bridge)--intermittent hedgerow and canopy row buffering Canal from adjacent land use (industrial and commercial)	2	"

SEGMENT 12 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow, flowing water (e.g., stream, Canal, river)

Current Land Use: Road or highway

Vegetation Data:

CANOPY (Density-thin)	UNDERSTORY (Density-thin-broken)	SHRUB (Density-medium)	HERB (Density-thick)
Black cherry	Staghorn sumac	Arrowood	Poison ivy
Red maple	Black cherry	Hemlock	Butter-and-eggs
Willow	Silver maple	Silky dogwood	Meadow rue
Red oak	River birch	Speckled alder	Japanese honeysuckle
Pumpkin ash	Beaked hazel	Black locust	Sensitive fern
Black locust	Black gum (sour gum)	Mulberry	Smartweed
Ailanthus	Ailantus	Norway maple	Foxtail grass
		Green ash	Unknown grasses
		Catalpa	Virginia creeper
		Red cedar	Queen-Anne's lace
		Honeylocust	Milkweed
		Sassafras	Heal-all
		Viburnum	Jewelweed
			Snakeroot
			Dodder
			Grape
			Prickly dewberry
			Hemlock
			Steeple-bush
			Brambles
			Arrowhead
			Marsh grass
			Ragweed
			Purple loosestrife
			Arrow-arum
			Cinquefoil
			Yarrow
			Evening primrose
			Duckweed

Historic Disturbances: Culvert, bulkheading, cutting, beams

Current Disturbances: Sewer outlet, mowing, cutting, litter and trash

SUBSEGMENT B

Cover Type: Thicket and hedgerow, railroad

Current Land Use: Railroad

Vegetation Data:

CANOPY (Density-thin)	UNDERSTORY (Density-thin-broken)	SHRUB (Density-medium)	HERB (Density-thick)
Black locust	Red maple	Smooth sumac	Foxtail grass
Black cherry	Sycamore	Privet	Brambles
Willow	Bigtooth aspen	Sassafras	Unknown grasses
Pin oak	Staghorn sumac	Rose	Dayflower
Ailanthus	Speckled alder	Mulberry	Goldenrod
Bigtooth aspen	Sweetgum	Pokeweed	Jewelweed
	Black cherry	Greenbrier	Japanese honeysuckle
	Ailanthus	Sensitive fern	Mullein
	Slippery elm	Hemlock	Moth mullein
	Black locust	Sycamore	Virginia creeper
	Sassafras	Green ash	Evening primrose
			Aster
			Water lily
			Butter-and-eggs
			Japanese hop
			Prickly dewberry

Historic Disturbances: Earthworks

Current Disturbances: Toxic substances and chemical spoils, litter and trash, herbiciding, sewer outlet, cutting

Segment 13

COASTAL PLAIN FLOODPLAIN WOODLAND, HEDGEROW/THICKET, AND OLDFIELD, FROM WHITEHEAD ROAD TO ROUTE 1/INTERSTATE 295

SEGMENT NARRATIVE

Segment 13 extends from Whitehead Road to the point where Route 1 and Interstate 295 cross the Canal, a distance of 3 miles (5 km). (See the map on Sheet 5a.) The railroad parallels the Canal's left bank to Carnegie Road (slightly more than half of the segment): the railroad corridor is Subsegment A. A sewage treatment plant (Contiguous Land Use c) abuts the Canal corridor on the right at the beginning of the segment. After it is a Coastal Plain floodplain and upland woods (Subsegment B) on the Canal embankment. Subsegment B also encompasses the bank community on the left side of the Canal below Carnegie Road, where the railway diverges and a very overgrown path begins to parallel the Canal in its place. Subsegment C is the Coastal Plain/Piedmont floodplain woodland between Subsegment B (right bank of the Canal) and Assunpink Creek. Shortly after the sewage treatment plant, in an area bounded by Canal and creek edge communities, is a small old field opening (Subsegment D). Several streams run under the Canal and into Assunpink Creek: a feeder channel from Colonial Lake (Special Feature 1) and Little Shabakunk Creek (Special Feature 3).

In Segment 13, we see a transition between the woodland of the Piedmont (the Delaware River floodplain woodland and upland woods of Segments 1 through 12) and the woodland of the Coastal Plain. Some of the species which were abundant in earlier segments (sycamore, for example) are rarely seen in the Coastal Plain; other species--sweetgum, beech, ironwood, speckled alder, and hazel (*Corylus* spp.)--become more prominent.

Slope has a great deal to do with the difference between Piedmont and Coastal Plain vegetation. In the Piedmont, the region in which the first half of the Delaware and Raritan Canal lies, slopes are generally steeper than on the Coastal Plain. Vegetational changes in response to those steeper slopes are more abrupt. In the Coastal Plain, slopes are gentler and have less effect on the vegetation.

Differences in the underlying bedrock cause streams in the Piedmont and Coastal Plain to take two distinct forms. Piedmont streams tend to be incised, with steep banks and narrow floodplains. Coastal Plain streams do not down cut; they meander or flow sluggishly and have a broad, flat floodplain. Adjacent to typical Coastal Plain streambeds are banks characterized by sandy soils (deposited by flood). These areas (the outer floodplain) are somewhat higher and drier than the floodplain areas farther from the streams (the inner floodplain). (See Glossary for illustration.) Because the elevation of the inner floodplain is lower and the soils are less well drained than on the outer floodplain, the inner floodplain contains species which are more moisture-tolerant than those of the outer floodplain.

Subsidiary stream channels called yazoos, often discontinuous or dry during parts of the year, appear in the inner floodplain, and disused meanders (parts of old stream beds) may appear as marshy clearings in the woods. The lethargic flow

of streams in the Coastal Plain deposits silt on the stream edges, allowing aquatics to establish themselves in a marshy band along the streams.

The vegetation of the Assunpink Creek floodplain includes species found in both the Piedmont and the Coastal Plain regions. In Segment 13, vegetation typical of the latter is more prominent, and it is found in Subsegments B and C.

The communities which inhabit the ballast and edges of the railroad corridor (Subsegment A) are similar to those found in the corresponding corridor in Segment 1. An added feature here is a stone wall which buttresses the tracks on the Canal side. Marshy vegetation is found between this wall and the Canal.

To the right of the Canal is a high embankment (Subsegment B), with a well-maintained towpath running along its top. A mixture of Coastal Plain floodplain and upland woods species covers this berm. Canopy and understory layers are thick. Sweetgum is dominant, and other species include sassafras, shagbark hickory (*Carya ovata*), red and black oaks, red maple, black locust, black cherry, river birch, and beech.

Arrowwood dominates the dense shrub stratum, and in the medium-dense herb layer are found woody seedlings and saplings, vines, grasses, and wildflowers. Species in Subsegment B across the Canal (in the latter part of Segment 13) are similar.

In Subsegment C, between B and Assunpink Creek, Piedmont and Coastal Plain floodplain species also merge. Pin oak, red oak, river birch, and willow are common in the medium-dense canopy; the understory, dominanted by river birch, is thick. The medium-dense shrub layer includes buttonbush and silky dogwood, which are especially prominent near the creek edge. A grove of red maple and green ash was noted within this community as Special Feature 2. Density of the stratum varies. In shadier woodland areas, the herb layer is thin. Marshy spots are thickly vegetated by purple loosestrife, swamp rose mallow (*Hibiscus palustris*), and arrowhead.

The canopy trees within Segment 13 differ in age and size as a result of their location. In the Assunpink floodplain (Subsegment C), the flood regime affects the vegetation, and trees average approximately 6 to 9 inches (15 to 23 cm) DBH. On the higher, less floodprone Canal embankment (Subsegment B), trees of the same species average 16 to 24 inches (40 to 60 cm) DBH.

Subsegment D is an oldfield-type community which appears to have been used as a landfill in the past. Vegetation in Subsegment D differs markedly from that of its surroundings and that of other oldfields found in the Canal Park. The understory is composed of individual and clumps of willow, grey birch (*Betula populifolia*), sweetgum, red oak, and big-tooth aspen. Among the shrubs are blueberry (*Vaccinium* spp.) silky dogwood, and black cherry. The herb layer, like the others, is patchy; it includes grasses, ragweed, purple loosestrife, goldenrod, and some black-eyed Susan.

Segment 13 has two distinct characters: part of it is natural, and part is disturbed by transportation and utility land uses. To the left of the Canal are

the railroad and Route 1, both of which parallel the Canal closely for over half of this segment's length. (See the map and Section A-A'.) Where a Route 1 ramp crosses the Canal at the beginning of the segment, supports for the road are footed in the Canal itself. The left side of the Canal in this first portion of the segment is noisy and dangerous. The constant sounds of vehicles moving at 55 plus m.p.h. is disturbing, as is the occasional passage of trains.

Where the railroad track veers away from the Canal at Carnegie Road, the left side assumes a more natural character, becoming more densely vegetated. The path which replaces the railroad bed is overgrown by poison ivy, increasing the difficulty of passage.

The right side of the Canal corridor begins with the sewage treatment plant, which causes odors and discharges into Assunpink Creek. There is an old mill dam on the Creek across from the plant, and the resultant backwater, coupled with the nutrient effluent from the sewage treatment plant, creates a Mecca for aquatic and marshy vegetation. Dense mounds of smartweed and purple loosestrife line both banks of the creek here. The treatment plant has fenced its property, impeding access to the path along the Canal. Management practices limit the vegetation near the plant to the shrub and herb layers. Past the plant, the path is shaded by canopy foliage. Views into the floodplain and marshy areas by the Creek are pleasing. Except for a mowed gas pipeline right-of-way which cuts through a small portion of Subsegments B and C, the area is generally undisturbed and quiet. The Canal is partially shaded in the first part of Segment 13; the latter part of the segment, with canopy foliage on both banks, is more fully shaded. Hiking, fishing, and trail biking were observed.

Land use recommendations include the possibility of incorporating parts of the Assunpink floodplain into a path system which could be of educational as well as recreational value. The problem of access to the path in the area of the sewage treatment plant should be resolved, perhaps by circumventing the facility. A path could be developed on the left bank at the beginning of the segment and access to the right bank could be provided at a point just past the facility.

Access into Canal Corridor

Segment 13 is accessible from Whitehead, Carnegie, and Denow Roads.

Towpath

The towpath on the right side of the Canal is in good condition. On the left side, it has apparently been superseded by the railroad bed in the first part of the segment; beyond Carnegie Road, it is very overgrown. Route 1 prevents continuity of the path.

Ease of Passage on Canal

Passage on the Canal is clear throughout the segment.

Wildlife

No unusual wildlife was observed.

Auditory Assessment

Constant noise from traffic on Route 1 and the occasional passage of trains are audible in the first half of the segment (particularly in Subsegment A and B). When motorcycles use the towpath, they can be heard in most parts of Segment 13.

SUBSEGMENT A

Subsegment A includes the ballast and edge communities of the railroad corridor which abut the Canal on the left in Segment 13. The corridor is accessible from Whitehead and Carnegie Roads. A portion of Route 1 crosses the Canal near the beginning of the subsegment. Beneath the bridge structure in Subsegment A is bare earth which is eroding. A stone wall forms the bank of the Canal and parallels the railroad tracks. The railbed is supported by this structure, which is elevated approximately 4 feet (1.3 m) above the Canal surface. (See Sections.) Herbaceous species occupy the marshy strip between the stone structure and the Canal. These include purple loosestrife, blackberry, mullein, foxtail grass, pokeweed, and smartweed.

Bordering the railroad corridor on both sides is a hedgerow/thicket composed of sassafras, sycamore, sweetgum, staghorn sumac, and black cherry. On the left side of the tracks, this hedgerow/thicket ranges from approximately 40 feet (13.3 m) to 50 feet (16.6 m) high, is several trees deep, and is broken in several places. In these breaks are found the same herbaceous species that occupy the strip next to the stone Canal wall. The ballast community is similar to that of Segment 1, Subsegment F. On the right side of the tracks is a thicket/hedgerow containing the same species which are found on the left; but these range from 30 to 40 feet (10 to 13.3 m) high. Vegetation on this side is less dense, and the strip community is narrower, only a few trees deep, before the Canal wall is reached.

The railroad corridor is paralleled by Route 1 for nearly all its length and traffic noise is noticeable all along the corridor. The hedgerow/thicket buffers the noise somewhat, but it can still be heard. The highway and occasional trains prevent any real relaxation in this area. Just past mid-segment, before Carnegie Road, the tracks veer to the north. The vegetation on the left side of the Canal beyond this point is part of Subsegment B.

Community Dynamics

The ballast and edge communities are maintained.

Management Recommendations

None

SUBSEGMENT B

Subsegment B encompasses the embankment on the right side of the Canal. A well-maintained path runs along the top of this embankment. Piedmont and Coastal Plain floodplain species are both present in Subsegment B. This subsegment also includes a portion of the left side of the Canal corridor past Carnegie Road, where the railroad tracks veer away from the Canal. In this latter part of the subsegment, vegetation along both sides of the Canal is generally the same. The communities differ in that the left side has no relationship to the Assunpink floodplain and in that the path on the left side is densely overgrown.

The canopy in Subsegment B is composed mainly of sassafras, shagbark hickory, red oak, black oak, sweetgum (dominant), and river birch. Several large (36" or 1 m DBH) sassafras and sweetgum trees were observed. Understory species include red maple, black locust, shagbark hickory, black cherry, and beech. Arrowwood is the dominant shrub, with speckled alder, black raspberry (*Rubus occidentalis*), pokeweed, and winged sumac (*Rhus copallina*) also numerous. The canopy, understory, and shrub layers are all dense. The herb layer (of medium density) includes many seedlings of woody species, vines, grasses, and some wildflowers.

The fenced sewage treatment plant on the right at the beginning of the subsegment prohibits access to the only easily negotiable path, which cannot be easily reached until Carnegie Road (mid-segment). At the sewage treatment plant, the path is apparently used as a service road. In this area, there are several manhole structures adjacent to the path, and vegetation is cut and otherwise maintained. There is no canopy or understory here; herbaceous species are thick.

Beyond this area, however, the path provides a very pleasant experience. The canopy forms a tunnel over the path and the understory and shrub layers are usually not thick enough to block views of the Canal and the Assunpink floodplain. The path provides an interesting visual perspective into the floodplain. An observer is sometimes at eye level with the understory and can see over the treetops into the floodplain woods. The path is maintained by trampling. People use the area for fishing and hiking, and adolescents on trail bikes were observed. Pathside vegetation is apparently cut.

Periodically, noises from Route 1 can be heard, but it is generally quiet along the path. A gas pipeline crosses the subsegment and the vegetation has been cleared in this right-of-way.

Tighter use controls might be necessary for the path area. The trail bikes rocketing down the path are incompatible with the otherwise passive uses observed along the Canal. Resolution of the problem concerning access to the path in relation to the sewage facility will also be necessary. It might be possible to develop portions of the left side of the Canal corridor as a connector route at the beginning of the segment.

Community Dynamics

Except for sweetgum, of which no seedlings or saplings were observed, the woodland of Subsegment B appears stable.

Management Recommendations

None

SUBSEGMENT C

Subsegment C comprises most of the area between Subsegment B (the towpath and right embankment of the Canal) and Assunpink Creek, which meanders to the east of Segment 13. Vegetation in Subsegment C, like that of B, is a blend of Coastal Plain and Piedmont species, with emphasis on the former.

Near the Canal, on the inner floodplain of the Assunpink, pin oak and red oak are common in the canopy, which is of medium density. Sycamore, common in the Piedmont region, only rarely occurs here. The shrub stratum is of thin to medium density, with arrowwood dominant. Where it is thin, a dense herb layer is present. Open areas in the inner floodplain are densely vegetated with marshy species such as purple loosestrife, swamp rose mallow, arrowhead, and grasses.

In one area (Special Feature 2) of the inner floodplain, the vegetation has been disturbed, probably by flood damage or windthrow, and an even-aged, dense stand of young (1 to 2", or 2.5 to 5 cm DBH; 20 ft or 6 m tall) green ash and red maple forms the understory. Scattered throughout are taller, older red maples which form a very thick canopy. The shrub stratum, with dominant arrowwood, is also thick, and the herb layer is sparse.

In the outer floodplain, willow, river birch, and black locust are prominent in the canopy, with river birch as the dominant species in the dense understory. Buttonbush and silky dogwood are in the thin to medium-dense shrub layer, and they become more prominent closer to the creek. In the silty areas at the creek's edge is a marshy band of purple loosestrife, arrowhead, swamp rose mallow, and smartweed.

Subsegment C is generally a quiet, shady area with pleasant views of the creek and the sloping embankment of the Canal. An oldfield-like opening (Subsegment D) is near the Canal at the beginning of the subsegment. Just beyond this area are an outlet channel (Special Feature 1) from Colonial Lake to Assunpink Creek and another small stream (Little Shabakunk Creek, Special Feature 3) which also runs into the Assunpink. A gas pipeline right-of-way also cuts through the subsegment. Subsegment C is accessible from Subsegments B and D, and from Carnegie Road, near the end of the subsegment.

Community Dynamics

Flooding should continue to influence the composition of these woods and control the success of regeneration and establishment of new members.

Management Recommendations

None

SUBSEGMENT D

Between the sewage treatment plant and the channel that links Colonial Lake with Assunpink Creek lies an area which resembles a successional oldfield (Subsegment D). This area appears to have some type of landfill history. The soil surface is hard and compacted, with an appearance different from the soils in the surrounding Assunpink floodplain. Species generally associated with higher, drier elevations are found here.

The canopy species have not attained much height (approximately 20 to 30 feet or 6 to 9 m) and occur singly or in small clumps. The community includes willow, grey birch, sweetgum, red oak, and bigtooth aspen. The shrub stratum includes blueberry, silky dogwood, black cherry. The herb layer is composed of grasses, ragweed, purple loosestrife, goldenrod, and black-eyed Susan. The shrub and herb species also grow singly or in clusters, leaving areas of bare soil.

This area is very different from the surrounding floodplain and even different from other oldfields encountered. The apparent compaction of the soil has limited the typical oldfield and nearby floodplain species, giving some atypical species (e.g., blueberry and grey birch) an opportunity to become established.

This oldfield-like opening forms a bowl between the higher banks of the Canal and Assunpink Creek. (See Section A-A'.) A contrast to the surrounding land, it offers views of open expanses and different tree species growing at lower heights than elsewhere.

The south bank of the Colonial Lake channel, just beyond Subsegment D, is being used by motorcycles; their tracks crisscross the embankment and continue down into the field. As a result of this ongoing disturbance, the channel bank is eroding.

Community Dynamics

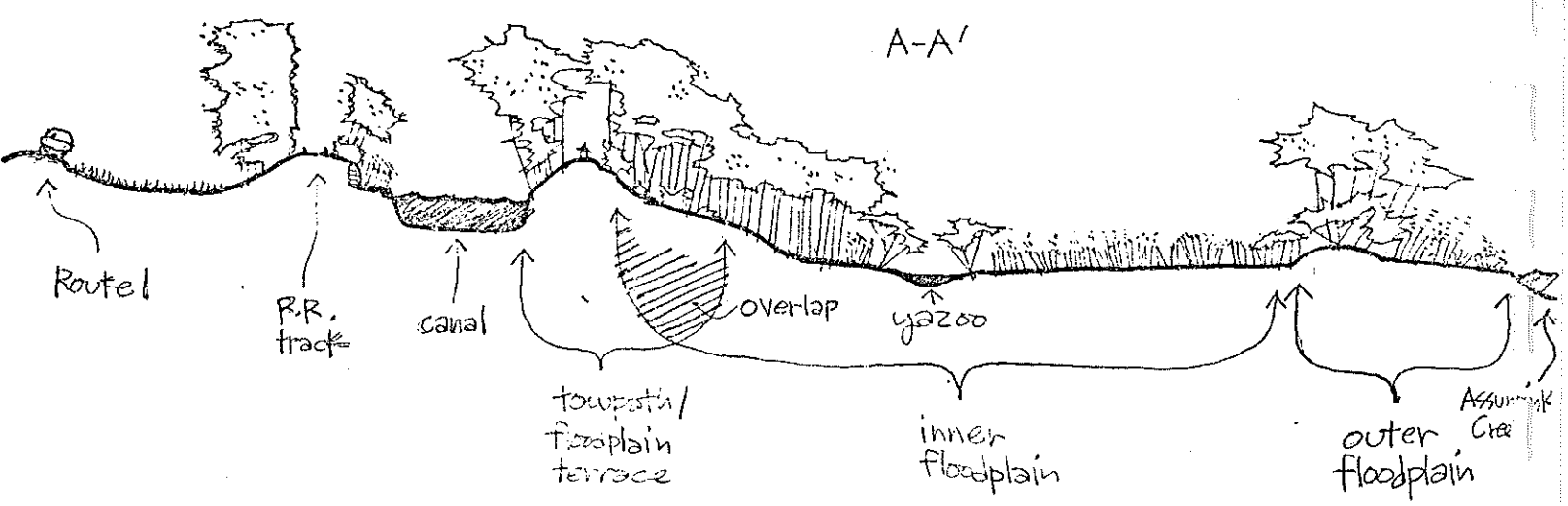
Due to the unusual nature of soil and species encountered in Subsegment D, field surveyors found community dynamics difficult to predict.

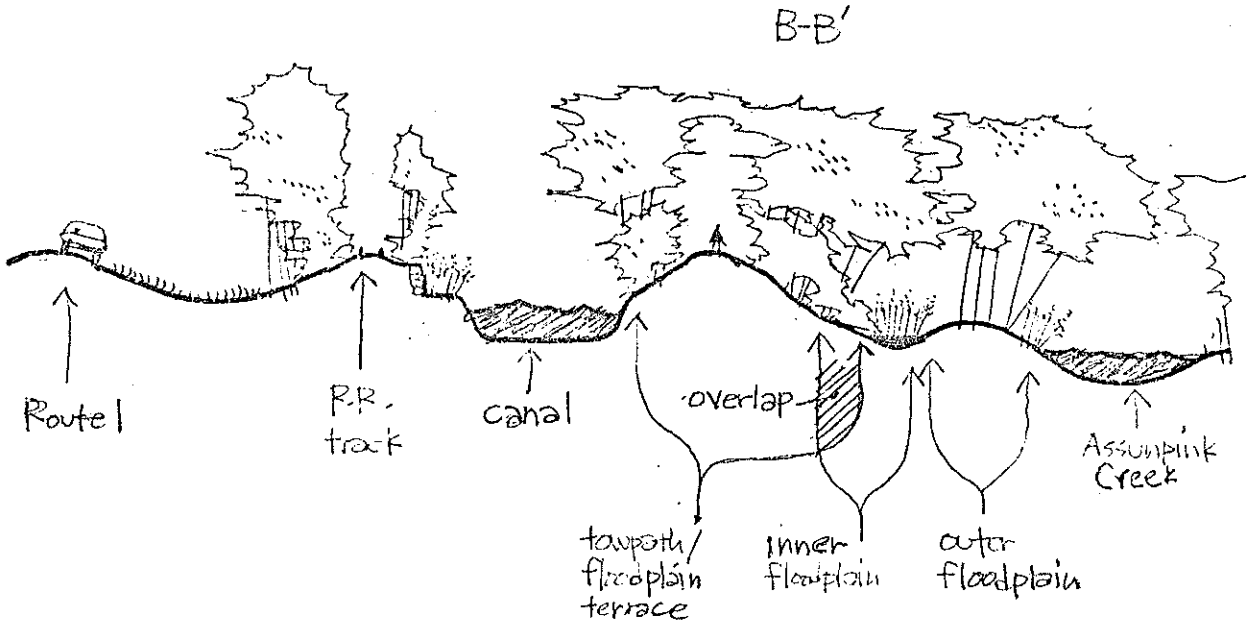
Management Recommendations

None

Segment 13

Sections





CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	landscaped open space	commercial
b	landscaped open space	road or highway
c	landscaped open space gravel/dirt roadway	utility
d	successional oldfield	unmanaged land
e	Piedmont floodplain Coastal Plain floodplain	unmanaged land
f	successional oldfield	unmanaged land
g	residential saplings	single houses (with yards)
h	marsh	unmanaged land

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Downstream from Colonial Lake feeder channel
B-B' --- 800 yards farther downstream

SPECIAL FEATURES

1 --- Feeder channel from Colonial Lake into Assunpink Creek
2 --- Maple-ash grove in Assunpink floodplain
3 --- Little Shabakunk Creek passes under Canal and joins Assunpink Creek

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Route 1 ramp crossing Canal	2	5b
2	Railroad (Canal on right side)	2	"
3	Assunpink marsh--entrance of Colonial Lake	5	"
4	Towpath along right side of Canal	2	"
5	Marsh area highlighted by rose mallow (Carnegie Road)	5	"
6	Marsh area highlighted by rose mallow (Carnegie Road)	5	"
7	Clean landfill	5	"
8	Across Canal from right side	2	"
9	Clean landfill--marsh background	5	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
10	Sandy area before confluence of stream and Assunpink Creek	2	"
11	Canal buffered by canopy-height vegetation row (Carnegie Road)	2	"
12	Path along Canal edge (right side)	5	"
13	State utility road (left bank along Canal at Lawrence Road)	5	"
14	Bank slumping where new bridge conduit meets old stone bank	5	"

SEGMENT 13 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow

Current Land Use: Railroad

Vegetation Data:

CANOPY (Density-broken)	UNDERSTORY (Density-broken)	SHRUB (Density-medium)	HERB (Density-thick)
Sassafras	Sassafras	Staghorn sumac	Mullein
Sycamore	Sycamore	Sassafras	Unknown grasses
Sweetgum	Sweetgum	Sycamore	Purple loosestrife
Black cherry	Black cherry	Sweetgum	Blackberry
		Black cherry	Foxtail grass
			Pokeweed
			Smartweed

Historic Disturbances: Cutting, undetermined

Current Disturbances: Cutting, undetermined

SUBSEGMENT B

Cover Type: Coastal Plain floodplain, upland woods

Current Land Use: Managed woodland, hiking, fishing, trail biking, passive use

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-thick)	SHRUB (Density-thick)	HERB (Density-thick)
Sassafras	River birch	Speckled alder	White oak
Red maple	Black cherry	Hemlock	Poison ivy
Hickory	Black locust	Elderberry	Sensitive fern
Shagbark hickory	Hickory	Spicebush	Unknown grasses
Sweetgum	Norway maple	Black cherry	Japanese honeysuckle
Red oak	Staghorn sumac	Raspberry	Violet
River birch	Beech	Pokeweed	Virginia creeper
Black oak	Shagbark hickory	Winged sumac	Black oak
Black cherry	Ironwood	Beech	Dayflower
Box elder	Red maple	Arrowwood	Virginia knotweed
Black locust			Unknown fern
			Greenbrier
			False solomon's seal
			Groundnut
			Snakeroot
			Bristly dewberry
			Sassafras
			Red oak
			Black cherry
			Pin oak

Historic Disturbances: Mowing, cutting

Current Disturbances: Trampling, mowing, cutting, sewer outlet (man hole)

SUBSEGMENT C

Cover Type: Coastal Plain floodplain

Current Land Use: Unmanaged land, hiking, fishing, trail biking, passive use

Vegetation Data:

CANOPY (Density-medium)	UNDERSTORY (Density-medium)	SHRUB (Density-medium/thin)	HERB (Density-thick/thin)
Willow	Willow	Buttonbush	Sedges
Black locust	River birch	Silky dogwood	Arrow-arum

CANOPY	UNDERSTORY	SHRUB	HERB
Pin oak	Red maple	Willow	Purple loosestrife
Pumpkin ash	Green ash	Hemlock	Arrowhead
Green ash	Mulberry	Green ash	Smartweed
Red maple	Black cherry	Arrowwood	Swamp rose mallow
Red oak	Ailanthus		Unknown grasses
Silver maple	Sycamore		Broad-leaved cattail
River birch	Sweetgum		Common reed
			Jewelweed
			Grape
			Sensitive fern
			Brambles
			Moon seed vine
			Joe-Pye-weed
			Rose
			Poison ivy
			Greenbrier
			Dodder
			Japanese honeysuckle
			Stinging nettle
			Pokeweed
			Virginia knotweed
			Goldenrod

Historic Disturbances: Flooding, debris accumulation, siltation, erosion

Current Disturbances: Flooding, debris accumulation, siltation, erosion

SUBSEGMENT D

Cover Type: Successional oldfield

Current Land Use: Unmanaged land, trail biking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-none)	(Density-thin)	(Density-medium)	(Density-medium/thin--patchy, bare in places)
	Bigtooth aspen	Blueberry	Blueberry
	Gray birch	Red oak	Moss
	Black cherry	Black cherry	Joe-Pye-weed
	Sweetgum	Silky dogwood	Spiraea
	Red maple		Goldenrod
	White birch		Black cherry
	Willow		Unknown grasses
			Cinnamon fern
			Purple loosestrife
			Black-eyed Susan

Historic Disturbances: Cutting, earthworks, compaction

Current Disturbances: Erosion, trampling, earthworks, undetermined

Segment 14

COASTAL PLAIN FLOODPLAIN WOODLAND, PASTURE, AND LANDSCAPED OPEN SPACE, ROUTE 1/I-295 TO PROVINCE LINE ROAD

SEGMENT NARRATIVE

This stretch of the Delaware and Raritan Canal extends from the Route 1/ Interstate 295 bridge to Province Line Road, a distance of 1.3 miles (2.4 km). (See the map on Sheet 5a.) At the beginning of the segment, where Route 1 and Interstate 295 cross the Canal, is a mowed open space (Subsegment D). Beyond this landscaped area, the Canal flows through a Coastal Plain floodplain woodland (Subsegment A). This woodland is briefly interrupted near its beginning by a maintained utility right-of-way (Subsegment C). On the right bank of the Canal near the end of Segment 14 is a pasture (Subsegment B).

Along each side of the Canal is a 4 to 6'(1 to 2 m) high gently sloping man-made embankment (or berm). A service road (Special Feature 2) runs along the west (left side) berm in Subsegment A. At Special Feature 3, a dredging operation pumps sludge and gravel from the Canal and deposits it along both sides of the Canal. Within the spoil areas, all vegetation but the largest trees has been obliterated. Dredge spoils are also found farther along in the segment (Special Feature 4). Shipetaukin Creek runs to the west of the Canal. (See Section A-A'.)

At the expressway crossing (Subsegment D) which begins Segment 14, mowing keeps all herbaceous growth under control, and the visual effect is that of a mowed lawn with a few small ornamental trees. The edges of the Canal have been allowed to develop as a low thicket. Loud traffic noise is constantly audible and the grassy expanse offers no shade. A Canal gauging station (Special Feature 1) is to the right of the Canal at the end of the subsegment.

Most of Segment 14 is Coastal Plain floodplain woodland (Subsegment A). The dominant species in the broken 60 foot (18 m) high canopy are white ash, red and silver maple, and pin oak. The sparse understory contains box elder as the dominant. The shrub and herb layers are sparse, except where shrub swamps occupy the lower areas. Here, silky dogwood, purple loosestrife, and spirea (*Spirea* spp.) predominate. Vines are thick in the canopy breaks.

In Subsegment C, the utility right-of-way near the beginning of the segment, there are no canopy trees because of the power company's management practices. Silky dogwood and white ash form occasional shrub-level clusters, and the thick herb layer is composed mainly of marsh grasses and purple loosestrife.

Land uses near the end of Segment 14 are agricultural. To the right of the Canal (Subsegment B) is a pasture grazed by animals from nearby farms (Contiguous Land d). (See Section B-B'.) Along the Canal edge is a thicket composed of sycamore (dominant), sweetgum, and ash. Cattle grazing and trampling have disturbed the vegetation so that there is no shrub layer and very little herb stratum, except for patches of nettles, and grasses at the water's edge. The bank appears to be eroding here. Aquatics are present in the Canal in Subsegment D. A foot-path runs along the top of the berm for the entire length of Subsegment B. Disturbances observed included several pipes carrying drainage from nearby agricultural uses into the Canal; fences running into the water near the farm at d; and dredging spoil near the sod farms at Contiguous Land Use e. A road

serving the sod farms parallels the Canal bank toward the end of the subsegment.

Boating was observed along the Canal in Segment 14. In mid-segment, where floodplain woods line the Canal on both sides, shade is more abundant than at the beginning or the end of the segment. Views in Segment 14 are varied.

Access into Canal Corridor

The left bank of Segment 14 is accessible at Province Line Road (end of segment). Contiguous land uses offer several back roads, but their use may raise questions of trespass.

Towpath

Paths run along the tops of both berms, but the path to the right of the Canal is nearly impassable in the woodland which covers much of the segment, and fences in the pasture also inhibit passage along it. Near the end of the segment, the path on the left is also overgrown.

Ease of Passage on Canal

Passage on the Canal is unhampered in Segment 14.

Wildlife

Evidence of deer was observed throughout the segment. Small blue herons were also seen, a box turtle was found in Subsegment D.

Auditory Assessment

Traffic noise from highways is constantly audible and is especially loud at the beginning of the segment. Dredging operations and contiguous farms create intermittent noise which can be heard at the end of the segment.

SUBSEGMENT A

Subsegment A is Coastal Plain floodplain woodland. The subsegment extends along both banks of the Canal after the mowed open space which abuts the Route 1/ Interstate 295 highway interchange. On the right bank near the end of the segment, pasture (Subsegment B) replaces the woodland. The Canal is flanked on both sides by a gently sloping berm 4 to 6 feet (1 to 2 m) high and a service road at Special Feature 2 runs along this berm for a short distance. Paths run atop both berms. The path along the berm to the right of the Canal is very overgrown; the one on the left is generally better, except near the end of of the subsegment.

The canopy of the woodland is of medium density and is dominated by white ash, red maple, pin oak, and silver maple, with some sycamore, black walnut, willow, and locust trees as well. The canopy is broken and irregular and ranges

from 40 to 60 feet (12 to 18 m) high. Box elder dominates the sparse understory, and spicebush, spirea, and silky dogwood are dominant in the thin to medium-dense shrub layer. Jewelweed, grape, purple loosestrife, sedges, and grasses are common in the herb layer, and vines are thick in the canopy breaks. This damp woodland has few large trees; their absence suggests a historical disturbance by flood and/or windthrow.

Edge species along the service road and the berms of Subsegment A include woody saplings (black locust, black cherry, and box elder), Virginia knotweed (*Tovara virginiaria*), blackberry, Japanese honeysuckle, poison ivy, dayflower, pokeweed, bittersweet (*Celastrus scandens*), and (at the water's edge) cardinal flower (*Lobelia cardinalis*). The canopy trees on the berms are among the largest in the woodland, possibly because drainage is better there.

Considering its proximity to Route 1 and Princeton, the character of Subsegment A is surprisingly natural. Traffic noise from the contiguous roads can be heard in most areas of the woodland, however. Near mid-segment, dredging operations in the Canal leave spoil on both sides. The vegetation in the spoil areas is sparse, comprising only a few trees of canopy height.

Access to Subsegment A is possible from the other subsegments and from Province Line Road.

Community Dynamics

Flooding will continue to influence the success of regeneration and establishment of new members in this Coastal Plain floodplain woods. It should continue to limit growth in the herb and shrub layers.

Management Recommendations

Clear vegetation from the path on the left side of the Canal.

SUBSEGMENT B

Subsegment B, a pasture, continues along the Canal's right bank where the floodplain woodland ends. A livestock farm and sod farms are contiguous to it. Several fences from the farms run over the berm and into the Canal to keep the cattle enclosed. These fences block the path along the top of the berm. Pipes draining the contiguous agricultural areas were observed entering the Canal, and Canal dredging has left spoil areas near the bank bare of all vegetation except well-established canopy trees.

Cattle have grazed and trampled the vegetation until there is no shrub layer and very little herbaceous cover in Subsegment B. A few large canopy trees are in the pasture, but otherwise there is no shade. Because of the cattle grazing and trampling, the Canal bank is eroding in this subsegment. Along the embankment is a thicket of sycamore (dominant), box elder, sweetgum, American elm, white ash, maples, and black cherry. At the water's edge are a few patches of clearweed,

jewelweed, stinging nettle, and grasses. Arrowhead and duckweed are found in the Canal.

If this subsegment is to be used for hiking, biking, or other passive uses, the presence of the cattle may cause problems. The cattle can be watered by a pump and trough system; this solution would also put an end to the erosion of the Canal bank in this subsegment.

Subsegment B can be reached from the floodplain woods of Subsegment A. Highway noise is audible, although somewhat buffered by the vegetation of the woodland.

Community Dynamics

Agricultural use and flooding affect the vegetation on Subsegment B. If grazing continues, it is unlikely that new canopy species will establish themselves in this pasture.

Management Recommendations

Limit grazing on the Canal embankment so that ground cover can become established and prevent erosion.

SUBSEGMENT C

A 150 to 200 foot (45 to 60 m) wide right-of-way for the power company cuts across Subsegment A near its beginning. It lies perpendicular to the Canal. Cutting and herbiciding have kept canopy species out of this area. White ash, silky dogwood, and privet (*Ligustrum* spp.) grow in small clumps at shrub height. For the most part, the cover is a dense layer of purple loosestrife and grasses. At the edges of the Canal are found blue flag iris and a number of moisture-loving species, among them common reed (*Phragmites communis*) and swamp rose mallow.

The subsegment is accessible from Subsegments A and C. Traffic noise from the highway area at the beginning of the segment can be heard, although it is somewhat buffered by the intervening woodland area. Views of the open, marshy area with its high herbaceous cover are pleasant, except for the powerline pylons. Subsegment C could be developed for low-intensity use (e.g., boat launching, parking, storage).

Community Dynamics

The community is maintained.

Management Recommendations

None

SUBSEGMENT D

Subsegment D, the mowed open space at the beginning of Segment 14, has only a grass cover for the most part. Slopes of the highway embankments have a few ornamental evergreens. Several bridges cross the Canal at the beginning of the subsegment, and under them the Canal is retained by steel bulkheading, which inhibits all vegetation.

Farther along the subsegment, a low (5 feet or 1.5 m) thicket lines the Canal edge. In this thicket are black gum (*Nyssa sylvatica*), pin oak, black locust, blackberry, speckled alder, and silky dogwood. Shipetaukin Creek runs close to the Canal's left bank here. It is rich in aquatic vegetation such as purple loosestrife and cattail.

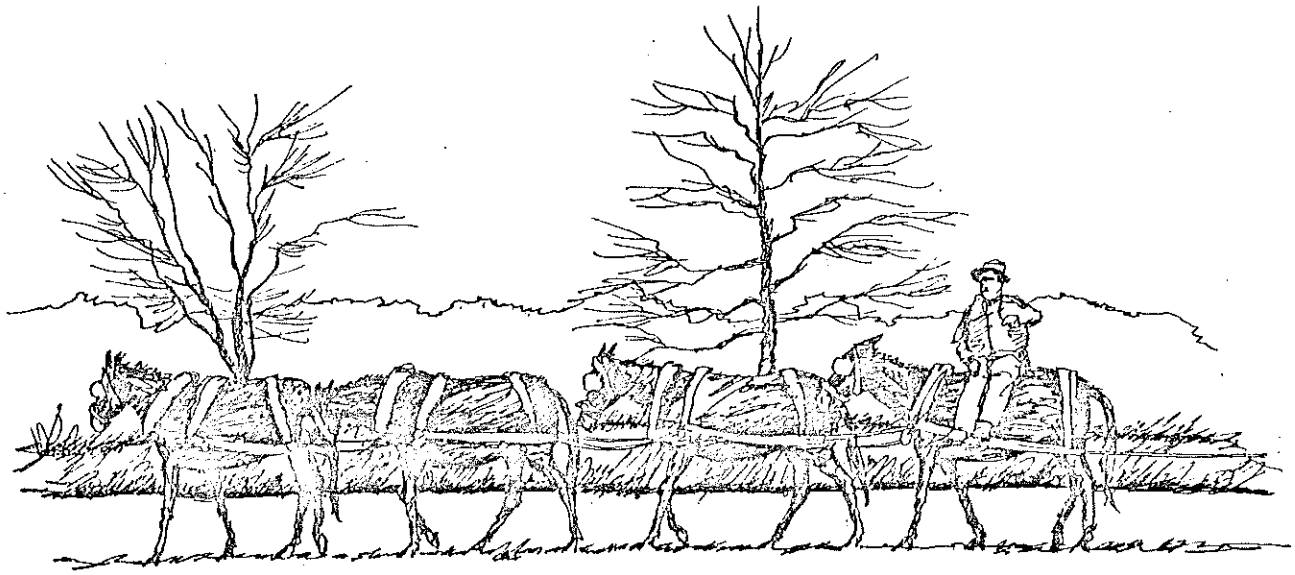
Subsegment D is accessible from the highways. The noise of traffic is constant and loud. There is no vegetation in the subsegment to buffer either noise or sunlight, which is intense on clear days.

Community Dynamics

The community is maintained.

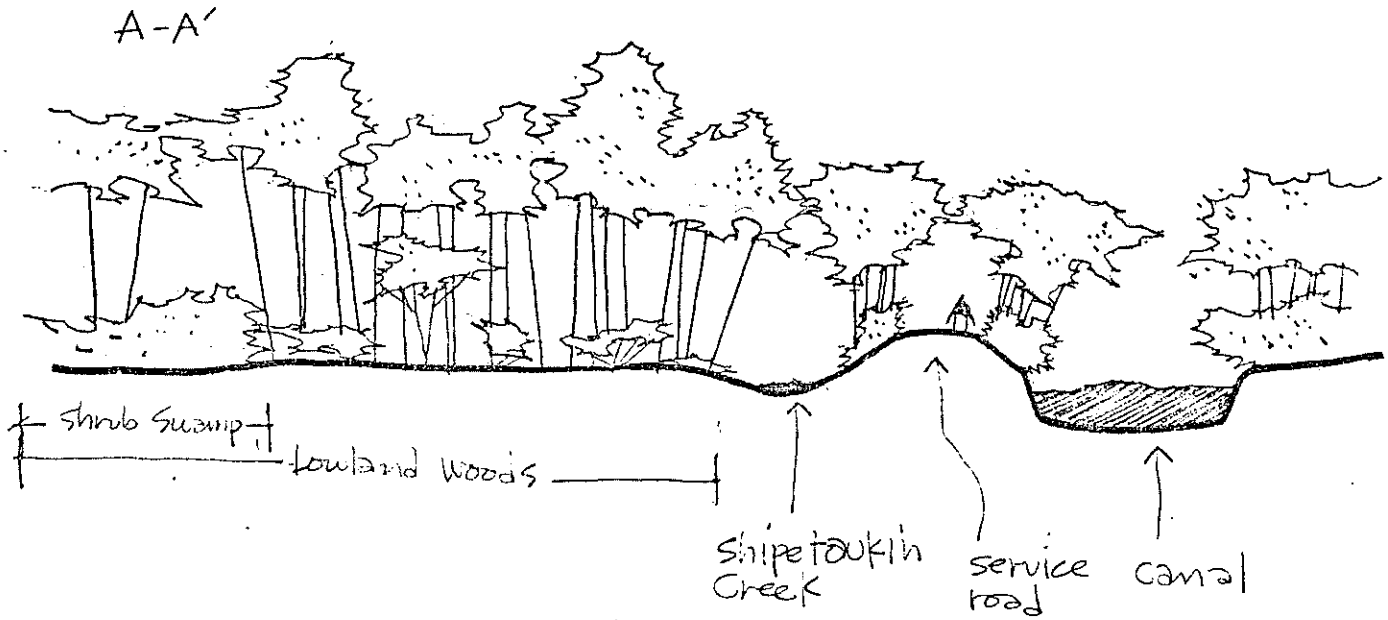
Management Recommendations

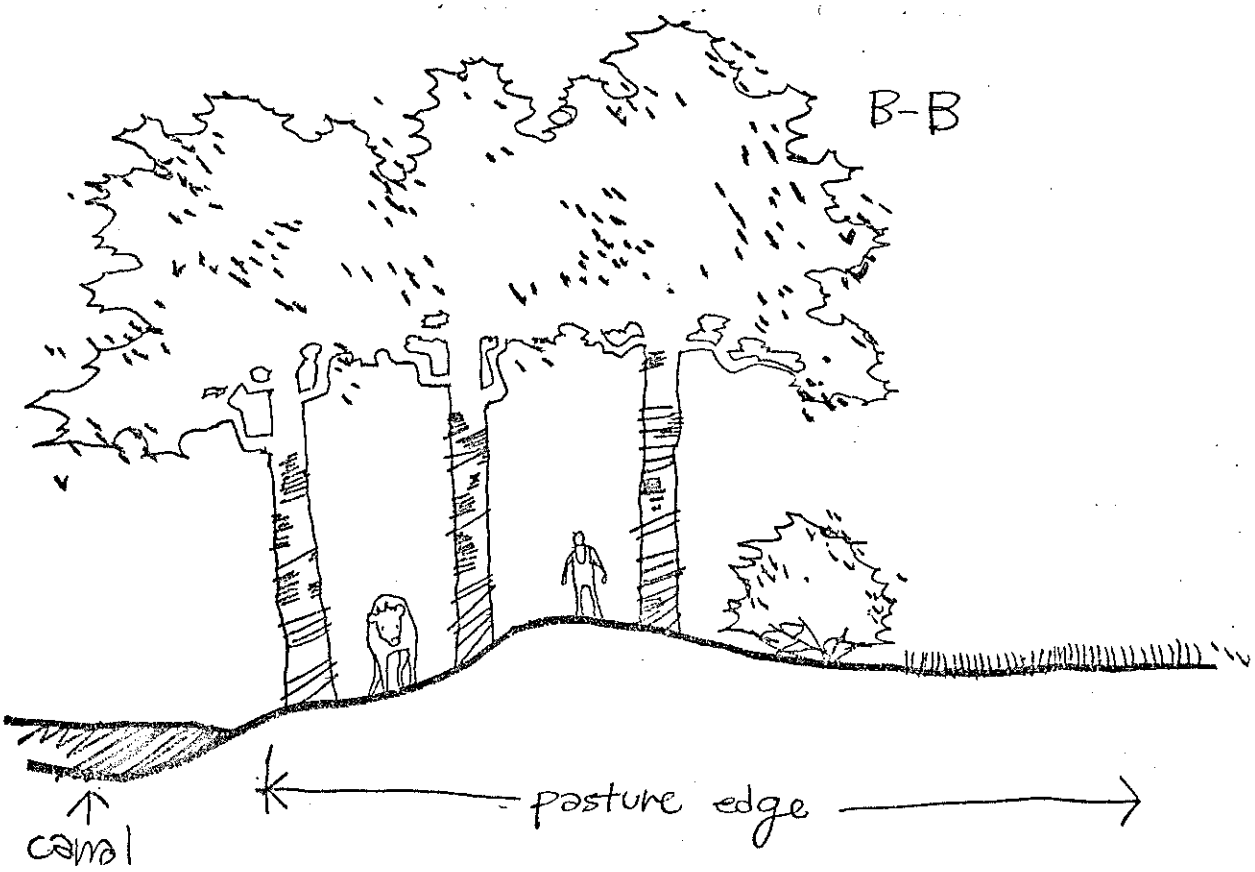
None



Segment 14

Sections





CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	landscaped open space asphalt/concrete roadway	road or highway
b	utility row	utility corridor
c	Coastal Plain floodplain	protected area, unmanaged land
d	successional oldfield	agriculture
e	pasture	pasture, sod and nursery

TOPOGRAPHIC CROSS-SECTIONS

A-A' -- 200 yards north of powerline right-of-way
B-B' -- Shows pastured Canal edge

SPECIAL FEATURES

1 --- Gauging station and utility building
2 --- Service road
3 --- Dredging operation
4 --- Cottage and possible former dredge spoils

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Route 1 bridge/culvert	3	5b
2	Route 295 bridges (Canal on left, Shipetaukin Creek on right)	3	"
3	Powerline pylon	3	"
4	Road along Canal	3	"
5	Dredge along Canal	3	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
6	Service road on left bank	3	5b
7	Bare ground by cottage (perhaps dredge spoils, possible non-point source of pollution)	3	"
8	Pump and end of cattle barn (note proximity of barn to Canal)	3	"

SEGMENT 14 VEGETATION DATA

SUBSEGMENT A

Cover Type: Coastal Plain floodplain, shrub swamp, wooded swamp, gravel/dirt roadway (in part), dredge spoils

Current Land Use: Protected area (in part), unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-broken)	(Density-thin)	(Density-thin/medium)	(Density-thin/thick)
Pin oak	Box elder	Spicebush	Grape
White ash		Silky dogwood	Climbing false buckwheat
Red maple		Privet	Halberd-leaf tearthumb
Silver maple		Pokeweed	Blackberry
Black walnut		Swamp spiraea	Poison ivy
Sycamore		Spiraea	Japanese honeysuckle
Willow			Milkweed
Black locust			Cardinal flower
Honeylocust			Purple loosestrife
			Jewelweed
			Unknown grasses
			Dayflower
			Sedges
			Virginia knotweed
			Bittersweet

Historic Disturbances: Flooding, debris accumulation, siltation, erosion

Current Disturbances: Flooding, debris accumulation, siltation, erosion

SUBSEGMENT B

Cover Type: Pasture, thicket and hedgerow

Current Land Use: Pasture, boating

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-medium)	(Density-thin)	(Density-none)	(Density-thin)
Sycamore	Box elder		Clearweed
White ash	Sugar maple		Stinging nettle
Black cherry	Sweetgum		Unknown grasses
Sugar maple	Black cherry		Jewelweed
Red maple			Arrowhead
Silver maple			Duckweed
Sweetgum			
American elm			

Historic Disturbances: Flooding, debris accumulation, siltation

Current Disturbances: Flooding, debris accumulation, siltation, trampling, grazing, browsing

SUBSEGMENT C

Cover Type: Thicket and hedgerow, successional oldfield, shrub swamp

Current Land Use: Utility corridor

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-None)	(Density-None)	(Density-medium/thick)	(Density-thick)
		Silky dogwood	Common reed
		Privet	Purple loosestrife
		White ash	Swamp rose mallow
		Purple loosestrife	Blue flag iris
			Evening primrose
			Unknown grasses

Historic Disturbances: Flooding, cutting

Current Disturbances: Flooding, cutting, herbiciding

SUBSEGMENT J)

Cover Type: Landscaped open space

Current Land Use: Road or highway, utility corridor

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-None)	(Density-None)	(Density-dense edge)	(Density-thick)
		Black gum (Sourgum)	Unknown grasses
		Pin oak	(mowed)
		Black locust	
		Blackberry	
		Silky dogwood	
		Speckled alder	

Historic Disturbances: Earth moving, herbiciding

Current Disturbances: Mowing, cutting

Segment 15

FLOODPLAIN WOODLAND FROM PROVINCE LINE ROAD TO QUAKER ROAD

SEGMENT/SUBSEGMENT NARRATIVE

Segment 15, designated by the Canal Commission's 1976 Master Plan as a special node, is a narrow corridor .5 miles (0.9 km) in length. Bisected by Quaker Bridge Road, the segment runs from Province Line Road to the point where Quaker Road bends away from the Canal to the west. (See the map on Sheet 5a.) Subsegment A (the only subsegment) is a floodplain woodland on both sides of the Canal. A path runs intermittently along the right side of the Canal. Land uses contiguous to the Canal corridor include unmanaged shrub swamp, successional oldfield, floodplain woodland, sod farms, single-family residences, and highway right-of-way.

On the right side of the Canal at the beginning of the segment, the woods are thin, barely screening the Canal from a gravel road which connects Quaker Bridge Road and the sod farm at g. Here the intermittent canopy is largely ash and black walnut, with mulberry, box elder, and slippery elm spanning the intervening strata. The grassy edge of the road is mowed clear to the Canal in places, and embankment is broken down. A water company right-of-way runs near the Canal in this area.

After the sod farm and Quaker Bridge Road, the woodland along the right side of the Canal is thicker. Below the residential area at f, a berm like those found in Segment 14 extends along the right bank. At the time of the survey, the water's edge was about 30 feet (9 m) inside this berm. A broken canopy of silver maple and river birch 30 to 40 feet (9 to 12 m) high covers the area between the berm and the Canal. The thick understory and shrub strata are dominated by box elder. This woodland appears to be frequently flooded, and its silt-laden and debris-littered floor is covered with low-growing patches of clearweed, false nettle (*Bohemeria cylindrica*), and smartweed. Much of the berm itself is covered by a dense mass of bittersweet, Japanese honeysuckle, and other creeping vines. Lying outside the berm is a woodland with hickory and silver maple as canopy dominants, with medium-dense understory (box elder) and shrub (spicebush) strata. The herb layer is sparse in most places, except for vines (notably poison ivy) which have taken hold and have reached the canopy in some areas.

Along the left side of the Canal corridor at the beginning of the segment, ash dominates the woodland, reaching 50 feet (15 m) in height and 30" (75 cm) DBH. Black locust, honeylocust, and silver maple are also important in the broken canopy, while the understory dominant is box elder: Black cherry, spicebush and box elder compete for the dominant position in the shrub layers. The herb stratum is fairly dense, including many creeping vines, flowering herbs, and grasses. Below the intersection of Quaker Road and Quaker Bridge Road, where the contiguous land use (c) is sod farming, the woodland resembles that of the right bank near the sod farm at g.

Special Features of the segment are a duck pond (Special Feature 1) behind a residence in Contiguous Land Use f and a pump and water line (Special Feature 2), which appear to serve an adjacent sod farm. (See Sheet 5b.)

Overhanging trees shade much of the Canal, particularly in the more heavily wooded areas at the end of the segment, creating pleasant enclosures which are occasionally broken by open views across mowed areas near the beginning.

Access into Canal Corridor

Segment 15 is easily accessible from roads on left at both ends; from Quaker Road, which parallels the segment on the left; and from Quaker Bridge Road, which bisects the segment.

Towpath

There is no towpath on the left side of the Canal. The embankment on the right side is broken down for the most part, and the path is discontinous. Near the end of the segment, the path runs along a berm, but vines hamper passage.

Ease of Passage on Canal

Passage on the water is clear throughout Segment 15.

Wildlife

Blue heron was observed, and an Eastern ribbon snake (nonpoisonous) was found in the woodland beyond the berm on the right side of the Canal.

Auditory Assessment

Noise from intermittent traffic is audible throughout the segment.

Community Dynamics

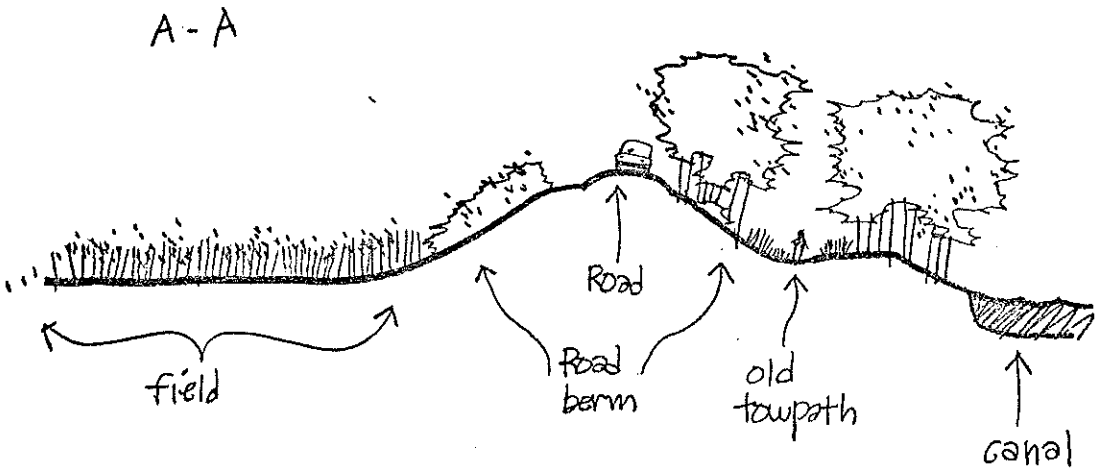
With the present land uses and flood regime, most of the community should remain stable. In the woodland between the berm and the Canal, severe flooding will probably continue to keep the herb and shrub layers sparse.

Management Recommendations

Clear the vines which have overgrown the towpath on the right side of the Canal.

Segment 15

Section



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	shrub swamp	unmanaged land
b	successional oldfield	unmanaged land
c	sod farm	sod and nursery
d	Coastal Plain floodplain	unmanaged land
e	shrub swamp	unmanaged land
f	residential trees	single houses (with yards) road or highway
g	lawn	sod and nursery

TOPOGRAPHIC CROSS-SECTIONS

A-A' -- 100 yards north of Quaker Bridge

SPECIAL FEATURES

1 --- Pond
2 --- Pump and pipe up to farm

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Elizabethtown Water Co. right-of-way, recently graded and seeded	3	5b
2	Landscaped open space (sod farm) and farm building, intermittent hedgerow along Canal	3	"
3	Vegetation buffer along Canal edge	3	"
4	Floodplain terrace along Canal's right side (small box elder, silver maple dominant)	3	"
5	Canoe entry point into Canal at junction of Segments 15 and 16	5	"

SEGMENT 15 VEGETATION DATA

Cover Type: Piedmont/Coastal Plain floodplain woodland

Current Land Use: Unmanaged land, road or highway

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thin)	(Density-medium)	(Density-medium)	(Density-medium)
White ash	Box elder	Black cherry	Clearweed
Black locust	Silver maple	Box elder	False nettle
Black walnut	River birch	Spicebush	Virginia creeper
Honeylocust		Rose	Jewelweed
Silver maple		Mulberry	Smartweed
River birch			Dayflower
Sycamore			Jack-in-the-pulpit
American elm			Great ragweed
Slippery elm			Queen-Anne's lace
Hickory			Evening primrose
			Sedges
			Grape
			Violet
			Milkweed
			Japanese honeysuckle
			Poison ivy
			Black oak
			Unknown grasses
			Virginia knotweed
			Gill-over-the-ground
			Cardinal flower
			Bittersweet

Historic Disturbances: Flooding, debris accumulation, siltation

Current Disturbances: Flooding, debris accumulation, siltation

Segment 16

HEDGEROW/THICKET AND SWEETGUM/TULIP POPLAR STAND, QUAKER ROAD TO ALEXANDER ROAD

SEGMENT NARRATIVE

Segment 16 is in a rural setting beginning at Quaker Road (northeast of Port Mercer) and extending 2.2 miles (3.5 km) to Alexander Road. (See the map on Sheet 6a.) The State presently owns a narrow strip of land which flanks the Canal. The majority of vegetation within that strip is a hedgerow/thicket (Subsegment A) which lines the Canal and the towpath along its left bank. Near the mid-segment, to the right of the Canal, is a stand of sweetgum and tulip poplar (Subsegment B). Stony Brook, which crosses under the Canal near the beginning of the segment, runs roughly parallel to the left bank for the rest of Segment 16.

Canopy species in the hedgerow/thicket of Subsegment A include pin oak, silver and red maple, white ash, sweetgum, and shagbark hickory. The canopy often exceeds 50 feet (15 m) in height. Members of the understory join the canopy to provide an abundant amount of shade to the lower layers or towpath below. Typical species of this layer include black cherry, hawthorn (*Creteagus* spp.), river birch, slippery elm, and red maple. In the shady areas, spicebush dominates a thin shrub layer. The herb layer is usually a mixture of vines, grasses, and other herbaceous plants.

At the golf course (Contiguous Land Use f) in the first half of the segment as well as a few other places, the hedgerow ends and thicket growth becomes more prominent. Shrub-height vegetation, including rose, Japanese barberry (*Berberis thunbergii*), and red cedar, mixes with vines such a Japanese honeysuckle, greenbrier (*Smilax* spp.), and Virginia creeper.

Where Stony Brook nears the Canal toward the end of the segment, the Canal Park property includes a small portion of floodplain woodland. (See the map on Sheet 6a. Woodland is found near Contiguous Land Use b.) Species are similar to those found in shady areas of the hedgerow (e.g., sweetgum, pin oak, red maple, white ash, spicebush), but the community has a denser canopy and understory and thinner, more flood-prone herb and shrub layers.

Near mid-segment on the right side of the Canal is a dense stand of sweetgum and tulip poplar (Subsegment B). The trunks of these canopy trees (1 to 3 feet or 0.3 to 1 m DBH) are prominent features in the lower strata. The broken understory layer is composed of box elder, red maple, and sassafras. In the shrub stratum is spicebush, and vines and a few herbs occupy a very thin herb layer.

Special Features of Segment 16 include a specimen shagbark hickory (2) and an area near the towpath where beech trees (seldom seen near the paths of the Canal Park) are prominent (3). At several points along the Canal (Special Features 1, 4, 5) water is extracted, presumably for use by nearby sod farms.

The towpath on the left bank offers easy access to the Canal, as well as views of the Canal and the surrounding rural landscape. The Canal Park in Segment 16 is used for many recreational activities, but neither these uses nor the

extraction of water which has created significant disturbance.

Access into Canal Corridor

Segment 16 is accessible from Quaker Road at the beginning of the segment (left side); from roads near mid-segment (right side); and from Alexander Road at the end of the segment (both sides).

Towpath

The towpath is in excellent condition.

Ease of Passage on Canal

A fallen tree just north of mid-segment blocks passage by water.

Wildlife

Turtles, a heron, and a rabbit were observed in Segment 16.

Auditory Assessment

For the most part, sounds audible in the Canal corridor are natural and the segment is quiet. Intermittent traffic can be heard near the beginning and end of the segment.

SUBSEGMENT A

Subsegment A is the hedgerow/thicket along the edges of the Canal and towpath through Segment 16. A variety of species are canopy members of the hedgerow. Among the most abundant are pin oak, shagbark hickory, silver and red maple, white ash, and sweetgum. Elms, red oak, black walnut are also common in a canopy which can reach 60 to 70 feet (18 to 21 m). The shagbark hickories, which are larger and more abundant in this segment than in previous ones, are a Special Feature (2). In many areas, the understory is also dense and diverse. Black cherry, hawthorn, box elder, red maple, river birch, and elm are prominent. Occasional stems of elm, beech, tulip poplar, sassafras, and basswood are variations. Because of the shady conditions, much of the shrub layer is thin. Spicebush is a common constitutent; dogwood, ironwood, and blackberry are occasionally seen. The herb layer is a diverse mixture of vines (honeysuckle, grape, bittersweet, poison ivy), grasses (foxtail), and herbaceous plants [gill-over-the-ground (*Glechoma hederacea*), violets, smartweed].

In terms of overall structure, the community is closed and high. The overstories of each side meet over the towpath and form a vegetation tunnel. (See Section A-A'.) As a result, most of the path has a mixture of shade and filtered sunlight. The community, does, however, open periodically, and the abundance of sunlight gives rise to a thicket/hedgerow in which low-growing

plants dominate shrub and herb strata. The thicket is dominated by sun-loving vines (honeysuckle, grape, greenbrier, Virginia creeper) and occasional woody species such as red cedar, Japanese barberry, and rose. The Canal edges which abut the golf course are mowed in places. (See Section B-B'.)

Toward the end of this segment, where Stony Brook comes close to the Canal, the boundary extends to the Brook and includes a small area of floodplain woods. This wooded community resembles the Millstone River floodplain (Segments 21-26). The canopy is mostly closed and thick. Dominant species include sweetgum, pin oak, red maple, white ash. Occasionally, sycamore and box elder occupy part of the canopy. The dominant shrub in the shady lower layers is spicebush. Because this stratum and the herb layer [honeysuckle, poison ivy, clearweed (*Pilea pumila*), and others] are often thin, one can experience unobstructed views through portions of the woods. Windthrown trees and small variations in relief (mounds, depressions) commonly interrupt the floodplain, which is otherwise flat.

The Canal through this segment is mostly free-flowing, but there are two obstacles to its enjoyment. A fallen tree blocks flow just north of mid-segment; and flying golf balls are a problem. (The Canal is a water hazard for golfers.) The banks are in good condition with their rock walls intact for the most part, but bank slumping was observed in a few locations. The bank vegetation includes smartweed, jewelweed, and cardinal flower. Occasional communities of aquatic plants (water lily, arrowhead, arrow-arum, and duckweed) are found in the Canal. The Canal is often partly shaded, occasionally completely so by overhanging canopy trees of the hedgerow.

The towpath is in good condition. Management practices (e.g., cutting, pruning) are apparent. Several large fallen canopy trees lie across the path. Their spacing and location suggest that the trees have been deliberately placed to control unfavorable towpath uses such as motor biking. Pedestrians are hampered only slightly by these trees.

In several locations along this subsegment (Special Features 1, 4, 5), water is being extracted from the Canal. Uses include irrigation for contiguous sod farms and perhaps for the golf course. A water treatment plant (Contiguous Land Use c) just south of Alexander Road (end of the segment) is also withdrawing Canal water.

Throughout this subsegment, the Canal and towpath provide a tranquil recreational facility. Observed uses include canoeing, strolling, and fishing. The subsegment is easily entered from either end (Quaker Road or Alexander Road) and from roads near the golf course. The towpath lying along the Canal's left bank provides easy access to the Canal. There is no continuous trail along the right side, although it is passable in some locations.

Community Dynamics

The presence of seedlings and saplings of canopy species should ensure the continuity of vegetation in Subsegment A. The community on the Stony Brook floodplain at the end of the subsegment will continue to be influenced by the

flood regime. Vegetation along the towpath appears to have been cut.

Management Recommendations

Repair slumping banks along parts of the Canal. Remove fallen tree which blocks Canal passage. Continue to block trail biking along the towpath.

SUBSEGMENT B

Subsegment B is a mature, isolated stand dominated by sweetgum and tulip poplar. It offers an interesting contrast to the hedgerow/thicket and floodplain woods which dominate the rest of this segment. The stand is located to the right of the Canal just beyond mid-segment. It is set back from the Canal and undergrowth hampers access to it.

Lying just under the sweetgum/tulip poplar canopy is an intermittent understory composed primarily of box elder, red maple, and sassafras. Most of the lower layers are thin and dominated by the large straight trunks of the canopy trees (1 to 3 ft or 0.3 to 1 m DBH). The remainder of space in the shady shrub layer is filled by a fairly uniform layer of spicebush. Vines which include bittersweet, poison ivy, and Virginia creeper, originates in the herb layer but often climb high into the upper layers. Honeysuckle, violets, and Christmas fern are other components of a very thin and intermittent ground layer.

Within this stand, one experiences an openness broken only by the large column-like trunks and scattered shrub clusters. The thick umbrella of canopy trees makes the area shady and cool. The sunlight which reaches the ground is evenly dispersed. This node offers an undisturbed, natural environment. Because the stand is tightly packed, windfall (which often plagues tulip poplar) is not a frequent disturbance in the area.

Community Dynamics

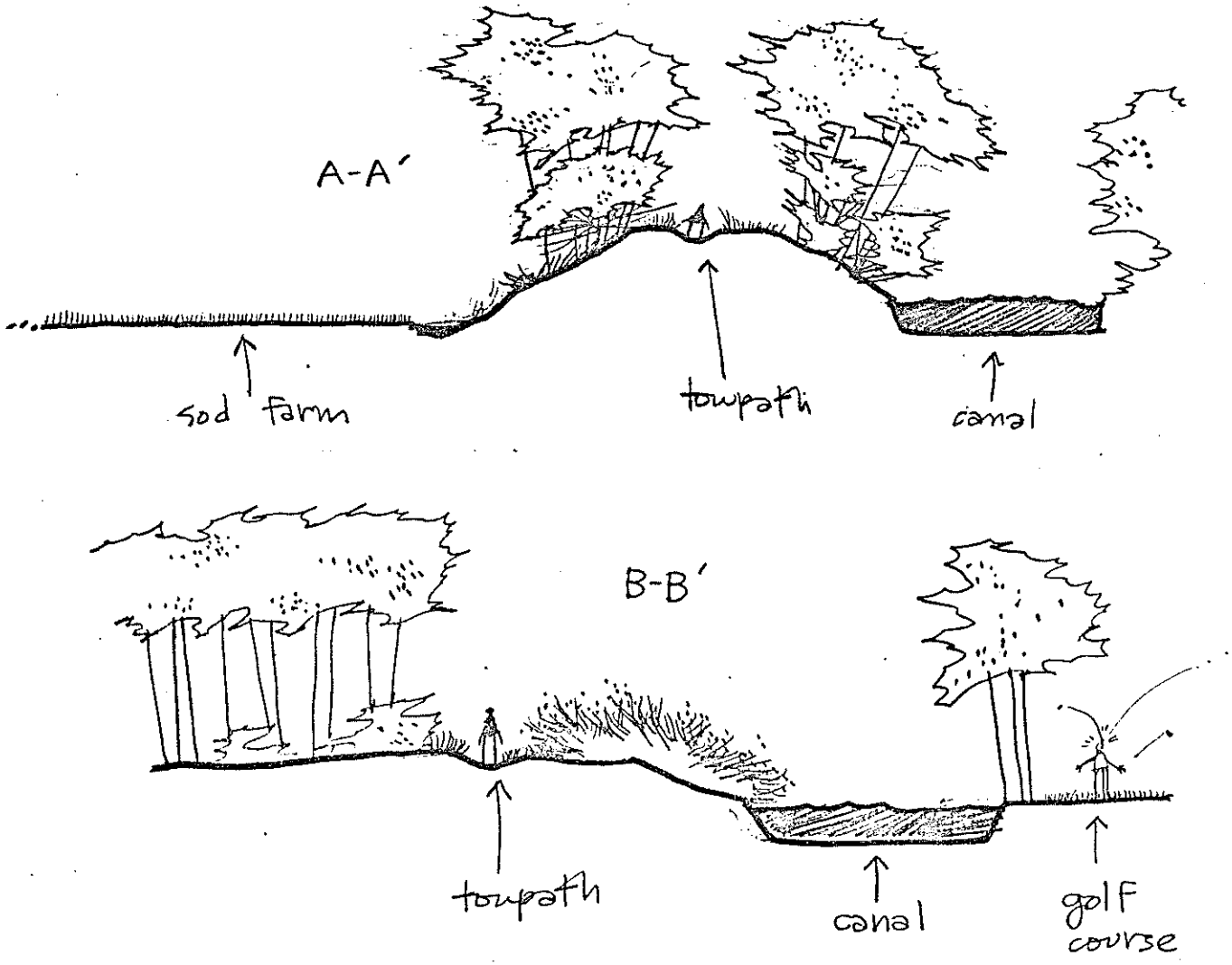
Dominant canopy species are not evident in the lower strata, which may mean that the compositon of this community will change over time.

Management Recommendations

Selective cutting of the upper layers might encourage regeneration of tulip poplar and sweetgum.

Segment 16

Sections



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	landscaped open space	sod and nursery
b	Piedmont floodplain Coastal Plain floodplain	unmanaged land
c	gravel/dirt roadway asphalt/concrete roadway building	utility
d	successional oldfield	unmanaged land
e	residential saplings	single houses (with yards)
f	landscaped open space	golf
g	orchard	unmanaged land

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Near the beginning of Segment 16, Quaker Road
B-B' --- Near the beginning of Segment 16, before golf course

SPECIAL FEATURES

1 --- Water extraction (water treatment, agricultural)
2 --- Specimen shagbark hickory
3 --- Rare occurence of beech trees on towpath
4 --- Water extraction (water treatment, agricultural)
5 --- Water extraction (water treatment, agricultural)

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Contiguous land use (sod farm) from Canal	5	6b
2	Vines climbing trees (5" diameter)	5	"
3	Contiguous golf course	5	"
4	Sweetgum-tulip poplar woods (Subsegment B) open lower layers	5	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
5	Left side of towpath	5	"
6	Water treatment plant intake (withdrawal from Canal)	5	"
7	Aquatic growth in Canal	5	"
8	Canal from Alexander Road upstream	5	"

SEGMENT 16 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow

Current Land Use: Hiking, fishing, boating, bicycling, hunting, trail biking, passive use, picnicking

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-thick)	SHRUB (Density-thin/medium)	HERB (Density-thick)
Pin oak	Swamp white oak	Sassafras	Grape
Silver maple	Honeylocust	Spicebush	Smartweed
American elm	Green ash	Black gum (Sour gum)	Virginia creeper
Slippery elm	Hawthorn	Red cedar	Cinquefoil
Black walnut	Hickory	Box elder	Green ash
Hickory	Black walnut	Ironwood	White ash
White ash	Box elder	Black locust	Japanese honeysuckle
Green ash	Red oak	Japanese barberry	Bristly dewberry
Sweetgum	Sassafras	Tartarian honeysuckle	Gill-over-the-ground
Black locust	Basswood	Rose	Box elder
Red oak	Slippery elm	Speckled alder	Milkweed
Shagbark hickory	Shagbark hickory	Norway maple	Unknown grasses
Red maple	Black oak	White oak	Sheep sorrel
Willow	River birch	Hemlock	Virginia knotweed
Sycamore	Tulip poplar	Silky dogwood	Greenbrier
	Beech	Blackberry	Canada thistle
	Red maple		Solomon's seal
	Speckled alder		Goldenrod
	Gray birch		White avens
	Black cherry		Violet
			Lady fern
			Sunflower
			Bittersweet
			Poison ivy
			Jewelweed
			Cardinal flower

Historic Disturbances: Trampling, bulkheading, cutting, earthworks

Current Disturbances: Cutting, windthrow

SUBSEGMENT B

Cover Type: Sweetgum-tulip poplar stand

Current Land Use: Unmanaged land, recreation

Vegetation Data:

CANOPY (Density-None)	UNDERSTORY (Density-thick)	SHRUB (Density-medium)	HERB (Density-thin)
Tulip poplar	Red maple	Spicebush	Christmas fern
Sweetgum	Sassafras		Japanese honeysuckle
	Box elder		Brambles
			Milkweed
			Virginia creeper
			Poison ivy
			Bittersweet

Historic Disturbances: None

Current Disturbances: None

Segment 17

HEDGEROW/THICKET, ALEXANDER ROAD TO RAILROAD "SWING" BRIDGE

SEGMENT NARRATIVE

Segment 17 is a short special node along the Canal corridor. (See the map on Sheet 6a.) The segment begins at Alexander Road and ends at an old Pennsylvania Railroad swing bridge (Special Feature 2). The node is apparently of special interest because the surrounding area is being developed by Princeton Township and Princeton Historical Society for its historic value. Paths run along both sides of the Canal. The segment offers easy access into the next segment (18), which is maintained by Princeton University and offers a very attractive recreational area.

Subsegment A (the only subsegment) is the narrow edge community which lines both the edges of the Canal and the paths. (See Section A-A'.) The community closely resembles the hedgerow/thicket described in Segment 16, Subsegment A. Perhaps the only noticeable differences are that the community is shorter in length and that it is less enclosed by canopy vegetation (and hence, is sunnier). Contiguous to the Canal's right side is a small dirt road which runs through a narrow corridor of early oldfield vegetation to a pump house (apparently abandoned).

The canopy of the hedgerow/thicket is thick. Sycamore, white ash, pin oak, silver maple, black locust, and American elm are among the most abundant members. Mulberry, river birch, and red maple are common in the dense understory. The shrub layer, of medium density, includes Tartarian honeysuckle, arrowwood, and slippery elm. In the dense herb layer are Virginia knotweed, pokeweed, raspberry (*Rubus occidentalis*), grasses, Virginia creeper, and poison ivy (dominant, and present in all strata).

Outside the path to the left of the Canal, the vegetation assumes the character of the contiguous floodplain woodland (a) of Stony Brook. This community is described in detail in Segment 16, Subsegment A.

Recreation appears to be the primary use of the Canal Park in Segment 17. Water is extracted from the Canal via a pump at Special Feature 1. Views in this segment are not exceptional, but the swing bridge is of interest. The edges of the Canal are shaded by the hedgerow/thicket.

Access into Canal Corridor

Segment 17 is easily accessible from Alexander Road.

Ease of Passage on Canal

Passage on the Canal is unhampered throughout the segment.

Towpath

Both paths along the Canal are in good condition.

Wildlife

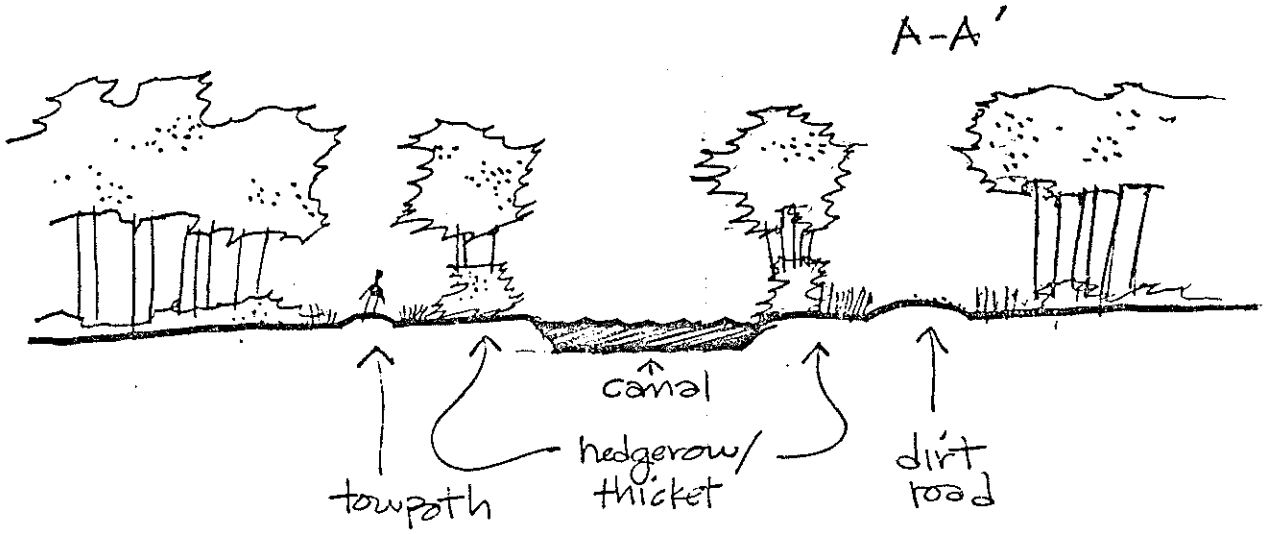
Turtles were observed.

Auditory Assessment

Frequent traffic along Alexander Road is audible within Segment 17. When the pump is in use, it can also be heard within the segment. Otherwise, the sounds of the Canal corridor are natural.

Segment 17

Section



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	Piedmont floodplain Coastal Plain floodplain	unmanaged land
b	successional oldfield Coastal Plain floodplain	road or highway
c	successional oldfield	utility corridor
d	railroad (bridge)	railroad
e	still water	none apparent

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Between Alexander Road and Pennsylvania Railroad Bridge

SPECIAL FEATURES

1 --- Pump; extraction of water from Canal
2 --- Railroad "swing" bridge

No photographs

SEGMENT 17 VEGETATION DATA

Cover Type: Thicket and hedgerow

Current Land Use: Hiking, fishing, boating, bicycling, trail biking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thick)	(Density-thick)	(Density-medium)	(Density-thick)
Sycamore	Black locust	Catalpa	Meadowrue
Pin oak	Catalpa	Spicebush	Rose
Box elder	River birch	Hemlock	Queen-Anne's lace
Black cherry	Red maple	Slippery elm	Milkweed
White ash	Mulberry	Red cedar	Yarrow
Black walnut	White ash	Ailanthus	Virginia creeper
Black locust	Black locust	Tartarian honeysuckle	Virginia knotweed
Silver maple	Poison ivy	Arrowwood	Tartarian honeysuckle
American elm		Poison ivy	Cinquefoil
Sweetgum			Unknown grasses
Poison ivy			Evening primrose
			Jewelweed
			Purple loosestrife
			Poison ivy
			Raspberry
			Japanese honeysuckle
			Pokeweed
			Japanese barberry

Historic Disturbances: Trampling, culvert, cutting, earthworks, excavation

Current Disturbances: Trampling, cutting, culvert

Segment 18

THICKET/HEDGEROW AND EDGE COMMUNITY FROM RAILROAD "SWING" BRIDGE TO MILLSTONE AQUEDUCT

SEGMENT NARRATIVE

Segment 18 begins at the railroad bridge across the Canal north of Alexander Road and extends 1.2 miles (1.9 km) north to the beginning of the Canal aqueduct over the Millstone River. (See the map on Sheet 6a.) The State owns only a narrow strip along each side of the Canal. The land to the west of the Canal boundary is owned and maintained by Princeton University, and the two areas provide a large, attractive recreational space. Along each side of the Canal lies a single-lane dirt road or path. These paths offer access to the Canal and numerous vantage points of the Princeton campus and Carnegie Lake. Subsegment A encompasses the Park land from Canal edges through the paths; Subsegment B is the Canal and associated edge vegetation.

Although the Princeton land is contiguous to the Park, it is an integral part of the impression conveyed to users of Canal Park land. The vegetation ranges from small unmanaged parcels which are wooded, mid-successional oldfields, or managed, landscaped open spaces.

Subsegment A comprises the vegetation between the Canal edges and the Canal property lines outside the paths. It is a strip community with occasional thicket openings, particularly in the early part of the subsegment. In most places, the strip vegetation is a homogeneous mix of canopy trees above (up to 35 feet) and thicket below. The canopy is dominated by red maple, pin oak, black cherry, silver maple, and box elder. River birch, slippery elm, alder (*Alnus* spp.), and green and white ash are frequent understory components. Many of these trees overhang the Canal and provide considerable shade along most of the Canal segment.

The shrub layer is more diverse than the canopy and understory. It varies from thin to medium density: denser near the beginning of the subsegment, it includes more species in the latter part (below Washington Road). Dogwood, alder, and slippery elm appear to be dominant. The dense herb layer is composed of nearly thirty species: among them are poison ivy (dominant), Japanese honeysuckle, Joe-Pye-weed, milkweed, ragweed, and numerous wild flowers. Special Features in Subsegment A are large red and silver maples and river birches (1) and a red maple grove (2).

The Canal and water's edge (Subsegment B) often contain small areas of aquatic vegetation. Where the water movement is slow and there is abundant sunlight, aquatic plants proliferate. These include water lily, arrowhead, arrow-arum, and duckweed. Along the edge of the water, species tolerant of wet soil (e.g., purple loosestrife, iris, jewelweed, and smartweed) inhabit the bank. At one point near the end of the segment is a dense "cove" of smartweed (Special Feature 3). The quiet and the long views of Carnegie Lake, Princeton University, and the rural surroundings combine to highlight this segment of the Canal corridor. Numerous passive recreational uses were observed. Among them were hiking, fishing, boating, bicycling, and picnicking.

Overall, the most prevalent species in the canopy are red maple, pin oak, black cherry, silver maple (DBH 30" or 75 cm), and box elder. Some areas, however, do show proliferation of black locust, American elm, and sweetgum (DBH 12" or 30 cm). In addition to younger specimens of these canopy species, the understory often includes river birch, slippery elm, alder, and ash. Norway maple and ailanthus are also significant components. In many places, the shrub layer is diverse and dense with respect to the number of stems present. Slippery elm, dogwood, alder, and hazel are among the most numerous. The thick herb layer is evenly mixed. No species can be singled out as dominant, except perhaps poison ivy, which extends from the ground to the understory.

Among the most notable features of the strip vegetation are the numerous trees which overhang the edges of the Canal. The water's edge along most of the Canal is shaded by these trees. Often, the hanging limbs nearly touch the water surface. (See Section A-A'.) It is likely that the high degree of bank slumping has caused the vegetation to tilt and overhang a significant amount of water.

Paths run next to the strip community on both sides of the Canal. The path along the left side is a one-lane dirt road. From the beginning of the segment to Washington Road, the road is traveled by vehicles (frequently, at time of survey). The traffic keeps vegetation along this trail negligible. Contiguous to this portion of the path are marshy spots, oldfields dotted with wildflowers, and thinly wooded parcels. From Washington Road north to the Millstone aqueduct, the path is a dirt road, but posted to prohibit motorized vehicles. This portion appears to be frequently used by bikers, joggers, strollers, and others. An easily traversed route, this path offers pleasant views of both the nearby Canal and the contiguous land uses, which include stretches of landscaped open space, marshy edge communities, Carnegie Lake, and Princeton University.

The path along the right bank is a right-of-way for a buried Sun Oil Company pipe. Vehicular traffic is forbidden, although the tracks indicate occasional auto use. The trail is covered by a thick herbaceous layer, but it is used (or managed) enough to prevent the establishment of woody species. Recreational uses (e.g., camping) were noticed along the path.

To the north the path enters an oldfield and terminates at the edge of the Millstone River just upstream from where it intersects the Canal. The land contiguous to the trail along the right bank offers two Special Features. These include several very large canopy trees--silver and red maples and river birch (Special Feature 1). Another small (1/4 acre or 0.1 hectare) area is inhabited by an unusual community (Special Feature 2) which is almost 100% red maple (few silver maple, river birch). The community is canopy-height, with no shrub or herb layers filling the space beneath.

Access to the Canal from either path is easy, as is entrance to the paths themselves. Most of the subsegment is very quiet, except where Washington Road and Harrison Street intersect it. Distant highway noise from Route 1 is slightly audible.

Disturbances to the vegetation or Canal are few. In some areas along the left side of the Canal the vegetation is controlled by cutting and by light recreational traffic. Contiguous landscaped areas are mowed. Bank slumping, prominent throughout Segment 18, appears to be the most urgent problem.

Access into Canal Corridor

Access to Segment 18 is easy at the beginning of the segment and from Washington Road and Harrison Street, which transect the segment. Only the left side of the segment can be entered from Millstone Aqueduct (Segment 19).

Towpath

There is a path on each side of the Canal. For the most part, both are in good condition, except for the northern end of the trail to the right of the Canal.

Ease of Passage on Canal

Passage by water is clear throughout Segment 18, although several trees have fallen into the Canal.

Wildlife

The Canal corridor in Segment 18 provides a good habitat for wildlife. Evidence of rabbits, turtles, raccoons, muskrats, and birds was observed.

Auditory Assessment

Except near Washington Road and Harrison Street, the segment is fairly quiet. Distant highway noise from Route 1 can sometimes be heard.

SUBSEGMENT A

Subsegment A comprises the strips of vegetation and the adjacent paths which line the Canal on both sides of this 1.2-mile (1.9-km) segment. The structure of the vegetation is consistent along the entire segment. For the most part, the community is a dense row of canopy trees varying in height; under these trees grows a thicket. In some locations, the overstory opens for a short distance and the shrub layer is denser. The canopy layer along the right side of the Canal is higher (25 to 35 feet or 7.5 to 10.5 m) than the left. Management keeps the left side lower (15 to 20 feet or 4.5 to 6 m) so that a utility line running overhead can be kept clear. As a result, many species are multi-stemmed, both at the stem base and at a higher level (about 12 feet or 4 m). Frequently, the right side (with its denser canopy) has a less dense shrub layer than the left side.

Community Dynamics

The strip of vegetation lining the Canal appears to be a self-maintaining, stable community, with young canopy specimens occupying each community level. Some of the vegetation (e.g., along the utility line) appears to be maintained. Bank slumping has caused some trees to fall into the Canal, causing canopy breaks which provide sunlight and space for young specimens to become established.

Management Recommendations

Repair Canal walls and provide support for slumping banks. Clear overgrown trail at north end of segment on the right.

SUBSEGMENT B

Subsegment B is the Canal and associated aquatic and edge vegetation. As well as the species which comprise the dense canopy, thinner shrub layer, and dense, evenly mixed herb community of the path edges, a few wet-soil species were observed in abundance near the water's edge. These include purple loosestrife, marsh smartweed, iris, and jewelweed. The slumped banks of the Canal have allowed this gradient community to become denser than ones encountered in earlier segments. In addition, small zones of aquatic vegetation are present--arrow-arum, water lily, arrowhead, and duckweed are dominant. A large turtle population was observed in this rural portion of the Canal. Subsegment B appears to provide a good habitat for wildlife.

The vegetation at the Canal's edge takes on a different character just prior to the Millstone aqueduct (Segment 19): the edges are lined with a dense strip of smartweed. At one point along the right side, the bank of the Canal is indented for about 15 to 20 feet (4.5 to 6 m) and the edge community actually becomes a "cove" of this smartweed (Special Feature 3. See Section B-B'.) At the time of the survey, there was no standing water. The "cove" was strewn by litter, however, which suggests periodic inundations. Where the smartweed community meets the steep Canal embankment, the vegetation changes to bank vegetation (Subsegment A).

In general, the Canal flows freely despite several trees which have fallen into the water. In it present state, this problem is minor, but siltation may occur in the future if the problem is not corrected. The high degree of bank slumping is probably responsible for tree overhang and "fall-ins."

Several street runoff pipes discharging into the Canal were observed. Other than these and the litter in the smartweed "cove," no man-related disturbances were apparent. The Canal can easily be reached from the paths. Visual and auditory experiences are similar to those described in Subsegment A. Overhanging trees frame the views up and down this placid rural section of

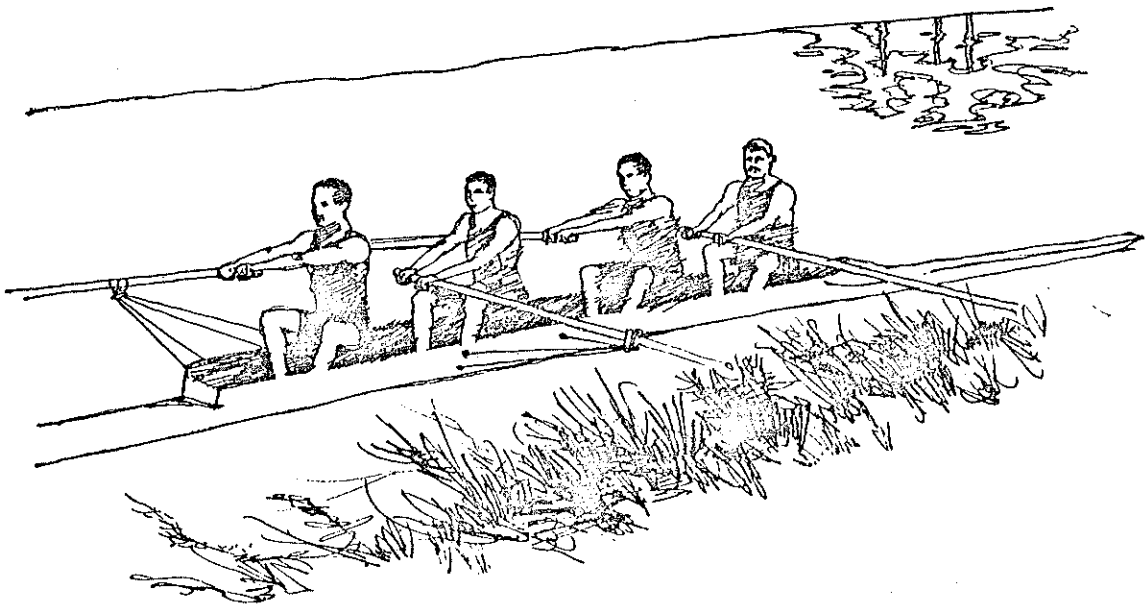
the Canal. Already used as a recreational facility, further uses might include cooperation with Princeton to provide picnic tables and/or other amenities.

Community Dynamics

Given current flow rate and volume of Canal water, the vegetation in the Canal and along the water's edge should remain in a steady state.

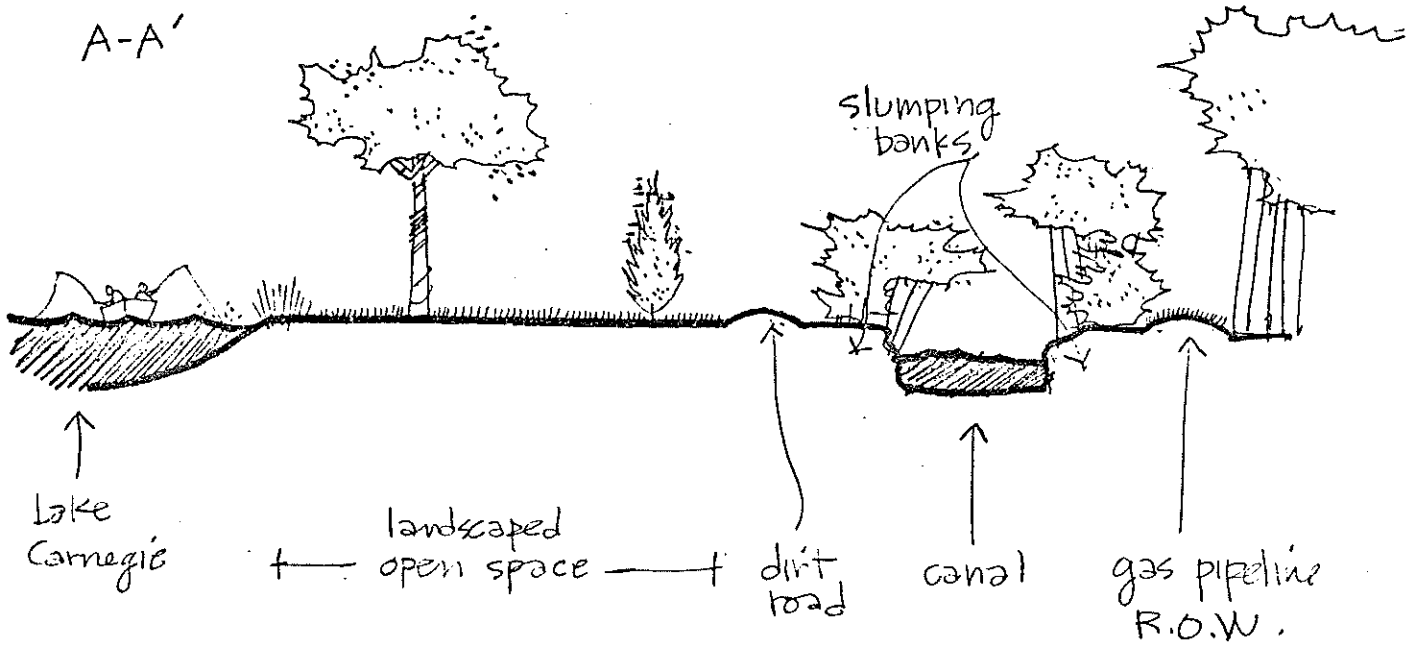
Management Recommendations

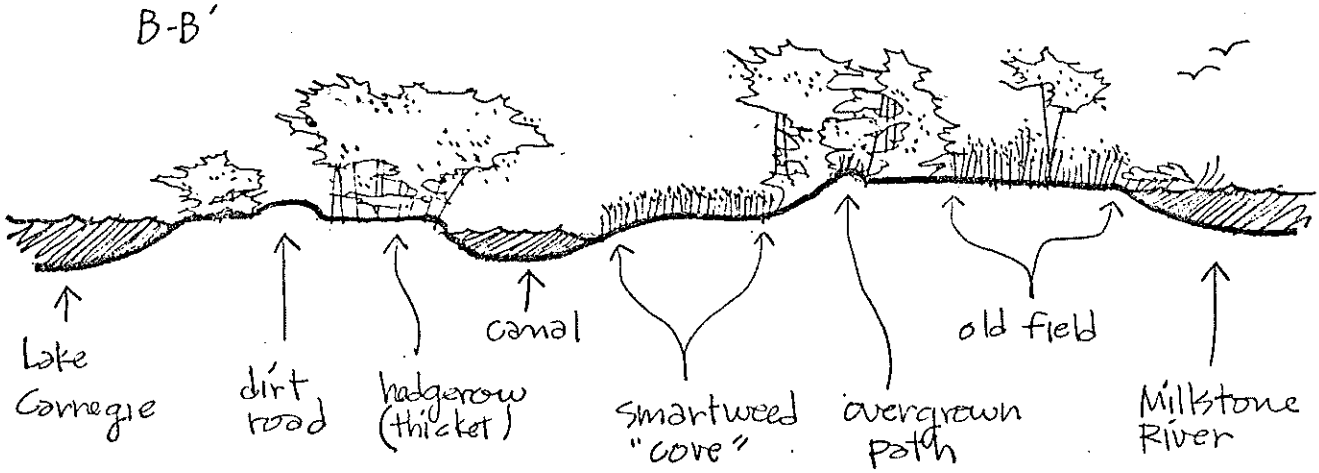
Repair of the slumping banks should reduce siltation in this segment and downstream. Clean up the litter in the smartweed "cove."



Segment 18

Sections





CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	gravel/dirt roadway	passive use, picnicking, bicycling, road or highway
b	successional oldfield	passive use
c	asphalt/concrete roadway	road or highway
d	landscaped open space	passive use
e	Coastal Plain floodplain	managed woodland, passive use
f	thicket and hedgerow	unmanaged land, passive use
g	marsh	passive use, boating, fishing
h	railroad	railroad

TOPOGRAPHIC CROSS-SECTION

A-A' -- Middle of segment, opposite Princeton campus
B-B' -- North part of segment, near convergence of Canal and Millstone River

SPECIAL FEATURES

1 --- Very large red and silver maple, river birch (South of Washington Road)
2 --- Red maple monoculture, about ¼ acre (north of Harrison Street)
3 --- Smartweed "cove"

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	From Canal footpath (left side) toward Princeton dormitories--Carnegie Lake foreground, near Pennsylvania Railroad Bridge	5	6b
2	Slumping banks, tree overhang, and pond lily patch	5	"
3	Path on right side of Canal; open, grassy area overlying Sun Oil Co. gas pipeline	5	"
4	Contiguous land use, Princeton Boat House and Carnegie Lake in background	5	"
5	Street runoff pipe at Harrison Street (enters Canal)	5	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
6	Contiguous landscaped open space left of Canal, Carnegie Lake in background	5	"
7	Towpath on left side of Canal by lake, aquatic vegetation	5	"
8	Use of path (left side)	5	"
9	Overhanging trees on bank	5	"
10	Across open space and lake from path (left side)	5	"
11	Section of rock wall of Canal	5	"
12	Smartweed "cove"	5	"

SEGMENT 18 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow, gravel/dirt roadway

Current Land Use: Managed woodland, road or highway, hiking, fishing, boating, camping, bicycling, passive use, picnicking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-None)	(Density-thick)	(Density-medium)	(Density-thick)
Slippery elm	Wild crabapple	Black locust	Unknown grasses
Red maple	White ash	Dewberry	Milkweed
Catalpa	Pin oak	Catalpa	Dayflower
White ash	Box elder	Black cherry	Purple loosestrife
Pin oak	Slippery elm	Slippery elm	Queen-Anne's lace
River birch	Speckled alder	White oak	Ragweed
Sycamore	Ailanthus	Hemlock	Goldenrod
Hickory	Sweetgum	White ash	Poison ivy
Mulberry	Norway maple	Rose	Japanese honeysuckle
Common apple	Green ash	Hazel	Pin oak
Willow	River birch	Speckled alder	Grape
Box elder		Tartarian honeysuckle	Evening primrose
Silver maple		Red cedar	Sunflower
Black locust		Ailanthus	Yarrow
Gray birch		Silky dogwood	Butter-and-eggs
Sweetgum		Norway maple	Jewelweed
American elm		Green ash	Meadowrue
		Hawthorn	Heal-all
		Beech	Virginia knotweed
		Elderberry	Violet
		Speckled alder	Sensitive fern
		Iris	Virginia creeper
			Pokeweed
			Japanese barberry
			Joe-Pye-weed
			Canada thistle
			Oxalis
			Cinquefoil
			Clearweed
			Day lily
			Bergamot

Historic Disturbances: Cutting, bank slumping

Current Disturbances: Cutting, bank slumping

SUBSEGMENT B

Cover Type: Flowing water, marsh

Current Land Use: None

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-None)	(Density-None)	(Density-None)	(Density-thin)
			Duckweed
			Arrow-arum
			Arrowhead
			Purple loosestrife
			Jewelweed
			Smartweed
			Dodder

Historic Disturbances: Flooding, debris accumulation, siltation, erosion, culvert

Current Disturbances: Sewer outlet, debris accumulation, siltation, erosion, litter and trash

Segment 19

CANAL AT MILLSTONE AQUEDUCT

SEGMENT/SUBSEGMENT NARRATIVE

Segment 19 is a special node located where the Millstone River, the Canal, and Carnegie Lake meet. (See the map on Sheet 6a. Subsegment A is the only subsegment.) Through this node, the Canal is carried in a concrete aqueduct. The Millstone widens to become pond-like (with associated marsh and aquatic vegetation) prior to its junction with the Canal. The river flows northwest, toward the aqueduct's right side. The right wall of the aqueduct has a small port which allows a small volume of water from the Millstone to enter the Canal. A slick of duckweed and debris covers the water surface of the river before it enters the opening. The aqueduct seems to function like a dam for the Millstone, creating the pond and marsh mentioned above by restricting the flow of the river, except at high-water times, when the low walls of the aqueduct allow water to spill over the Canal into Carnegie Lake.

The left aqueduct wall has adjustable sluice gates to control water passing between the Canal and Carnegie Lake, to the left of the Canal. The top of the left wall is covered by a small boardwalk which permits a pedestrian to traverse the aqueduct. The narrow right wall (6 to 8" or 15 to 20 cm) is difficult and dangerous to cross.

The vegetation within the boundaries of this special node is sparse. A few submergent and transient aquatic plants floating in mid-stream with the current were observed; they could not be identified, however. The contiguous marsh (Special Feature 1) is noteworthy, however, as it provides an excellent wildlife habitat and adds to the aesthetic appeal of the area.

The absence of all but aquatic vegetation makes the node sunny, with intermittent shade along the edges where contiguous tree cover exists. Long views overlooking the Millstone marsh and River to the right and Carnegie Lake to the left are visual highlights.

The aqueduct and associated areas are used for passive recreation. Activities observed included fishing, boating, strolling, and bicycling. Further development for passive recreation might include a picnic area.

Access into Canal Corridor

The right side of the segment is most easily reached from a parking area a short distance (0.2 miles or 0.3 km) from Route 1. Traversing the aqueduct along its narrow right edge is difficult and hazardous, however. The left side can be reached from Harrison Street in Segment 18, a short distance away, and a boardwalk runs along the Canal's left wall.

Towpath

No towpath as such exists alongside the aqueduct, but the boardwalk on the left connects to the paths in the preceding and following Segments (18 and 20).

Ease of Passage on Canal

Passage via water is unrestricted through this segment.

Wildlife

Fish and turtles were observed in the aqueduct. The adjacent areas (marsh, woodland, and Carnegie Lake) offer a variety of wildlife habitats.

Auditory Assessment

The predominant sound is the constant, slow motion of water through the aqueduct. Distant highway noises are audible but not disturbing.

Community Dynamics

Little vegetation was observed. The current and the unfavorable substrate material may be responsible for the scarcity of vegetation.

Management Recommendations

None

CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	flowing water	swimming, fishing, boating, passive use
b	still water	swimming, fishing, boating, passive use
c	thicket and hedgerow gravel/dirt roadway	hiking, bicycling, trail biking, passive use, picnicking
d	parking lot	passive use, road or highway

TOPOGRAPHIC CROSS-SECTIONS

None

SPECIAL FEATURES

1 --- Fresh marsh

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Millstone aqueduct from north end, right side (looking west from parking area)	5	6b
2	Marsh (Millstone River) above Millstone aqueduct from parking area	7	"
3	Marsh upstream of aqueduct from Route 1	7	"

SEGMENT 19 VEGETATION DATA

SUBSEGMENT A

Cover Type: Flowing water

Current Land Use: Hiking, swimming, fishing, boating, passive use, picnicking, other

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-None)	(Density-None)	(Density-None)	(Density -thin) Unknown grasses

Historic Disturbances: Flooding, bulkheading, earthworks, excavation, aqueduct

Current Disturbances: Debris accumulation (little), earthworks

Segment 20

THICKET/HEDGEROW AND MARSH FROM MILLSTONE AQUEDUCT TO NEW ROUTE 27 BRIDGE, KINGSTON

SEGMENT NARRATIVE

Segment 20 is a narrow corridor which extends from the Millstone aqueduct to the Route 27 crossing at Kingston, a distance of 2.1 miles (3.36 km). (See the map on Sheet 6a.) A levee (Subsegment A) separates the Canal from Carnegie Lake and its edges to the west (left bank). To the east (right bank) is a thicket/hedgerow and marsh (Subsegment B). A busy paved road (Canal Road) parallels the Canal on the right at the beginning of the segment. A mowed path replaces it and runs next to the Canal in the northern half of the segment.

Segment 20 has a rural character. Princeton Nursery manages much of the land to the left of the Canal. Contiguous properties on the right include a horse farm and St. Joseph's School (Contiguous Land Use f). St. Joseph's expansive landscaped grounds extend to the Canal, and the school has built a shrine (Special Feature 2) in an exposed rock outcrop, surrounding it with a grove of large sycamores and planted spruces.

In Subsegment A, the levee, vegetation includes a sparse hedgerow of black locust, silver maple, willow, and red maple, which grows to a height of about 30 feet (9 m). The medium-dense shrub layer includes box elder and smooth sumac (*Rhus glabra*). Herbs and vines, notably climbing hempweed (*Mikania scandens*), form a mat along the upper bank of the levee. Much of the Canal bank is unvegetated and is slumping in places. Where the water moves most slowly, aquatics have gained a roothold at the base of the levee.

On the right side of the Canal (Subsegment B) a thicket/hedgerow community also predominates. It is most dense at the northern and southern extremes of the segment. At the beginning of the segment, the thicket is at its widest, and a dense stand of young, even-aged black locust occupies the entire area between the Canal and the road. Later in the segment, thicket growth is less dense. River birch and silver maple are dominant, reaching a height of about 50 feet (15 M0 and a DBH of up to 10" (25 cm). Box elder dominates the understory, and rose, brambles, silky dogwood, and mulberry are in the shrub layers. A gradient community vegetates the bank. Ragweed is prevalent at the top, and loosestrife and jewelweed are found nearer to the water. Early in the subsegment, near the Millstone River's junction with the Canal, the edge community is marsh-like. In this marshy area are cattails, purple loosestrife, and smartweed.

Segment 20 is largely undisturbed. About two-thirds of a mile (1 km) from the beginning of the segment is a small brick building (Special Feature 1, apparently a water chlorination facility) to the right of the Canal, and

water (evidently from this source) is piped into the Canal here. Near the end of the segment is a small pond-like widening in the Canal (Special Feature 3).

Few trees overhang the Canal in Segment 20, and the water is largely unshaded. The path along the levee appears to be used often and it provides excellent views of the lake and the Canal. The grassed pathway to the right of the Canal in the latter half of the segment provided a very pleasant walking experience. It is also used for horseback riding, although this use seems to be infrequent, as no damage to the trail was observed. The grove and shrine at St. Joseph's School offer a quiet, peaceful enclosure on this side of the Canal. A pedestrian bridge could be constructed to connect the paths and enable people walking south to circumvent the Canal Road area and the narrow side of the Millstone aqueduct (Segment 19).

Access into Canal Corridor

The Canal corridor in Segment 20 is accessible from Millstone aqueduct (Segment 19) and from Route 27 at Kingston (end of segment).

Towpath

The path on the levee is in good condition. To the right of the Canal there is no path at the beginning of the segment; after the Canal Road bends away from the Canal (midway through the segment), there is a grassed pathway to the right of the Canal.

Ease of Passage on Canal

A lock/sluice at the end of the segment hampers passage on the Canal.

Wildlife

A blue heron and various ducks were observed in Segment 20.

Auditory Assessment

Intermittent traffic on Canal Road is audible, particularly in Subsegment B, in the initial part of the segment. In the latter part of the segment, vegetation in contiguous land uses largely buffers the road noise. Traffic on Route 27 can be heard at the end of the segment.

SUBSEGMENT A

The levee (Subsegment A) is very narrow along its entire length. It is accessible at both ends, and a path runs along its top. The levee is covered by an intermittent thicket. The sparse 30 foot (9 m) canopy is made up of

black locust, silver maple, willow, and red maple. Beneath the canopy are a number of shrub-height species, including box elder and smooth sumac. The shrub layer is of medium density. A thick mat of herbs and vines covers the ground, and aquatics (arrowhead, duckweed) are found in the Canal.

In some places, the herbs and vines reach down to the Canal, but along most of the subsegment the stone wall of the levee is exposed. In some places, the bank is slumping into the Canal.

The levee path is partly shaded. It offers excellent views of the lake and the Canal from a number of locations. The path is used frequently, especially by people fishing.

Community Dynamics

Trampling disturbs the herb layer in Subsegment A. The narrowness of the levee is probably responsible for the sparseness of the canopy. The community here should remain in its current state.

Management Recommendations

Repair slumping banks along the Canal.

SUBSEGMENT B

Subsegment B comprises the thicket/hedgerow and marsh along the right side of the Canal. The marshy area is at the beginning of the segment, near the Canal's junction with the Millstone River. Thicket/hedgerow runs along the Canal for the rest of its length. Canal Road closely parallels Subsegment B in the marshy area and through the first half of the subsegment; it is then separated from the Canal by various contiguous land uses (floodplain woodland, pasture, residential areas, and sod/nursery uses). A mowed path continues along the Canal edge where Canal Road veers away.

In the densely vegetated marshy area next to the Millstone, cattail and purple loosestrife are dominant. Smartweed occupies the area nearest to the water's edge. Just beyond the marsh, a grove of 30 foot (9 m) high, 1" (2.5 cm) DBH black locust trees occupies the area between the Canal and Canal Road.

Most of the subsegment is thicket/hedgerow between the Canal and the paved road and mowed path. The thicket is medium-dense and intermittently screens the view of the Canal from the road and path. Silver maple and river birch are dominants, reaching a height of about 50 feet (15 m) and a DBH of 10" (25 cm).

Box elder dominates the understory to about 30 feet (9 m). Black locust is also prevalent. Members of the medium-dense shrub layer include rose, brambles, silky dogwood, and mulberry. The dense herb stratum contains many species which grow along a moisture gradient from the bank top, where ragweed and woody species are common, to the loosestrife/jewelweed-dominated water's edge. The hedgerow is tallest and most dense at the beginning and end of the subsegment, thinning out in the middle.

No disturbances to the community (other than the mowing of the path) were observed, but Canal water may be affected by a water chlorination facility (Special Feature 1) near the beginning of the subsegment and an industrial use which appears to affect the pond-like widening (Special Feature 3) in the Canal at the end of Subsegment B. Except where the road is close to the Park land, the character of Subsegment B is rural and quiet. The grassy path is pleasant, and the shrine at St. Joseph's School (Special Feature 2), surrounded by ornamental sycamore and spruce trees, provides a peaceful place to rest. A pedestrian bridge connecting the path in Subsegment B to the path on the levee might be a worthwhile consideration for the future. There is a canoe rental establishment at the old Route 27 bridge near the end of the segment, and parking is available in the same area.

Community Dynamics

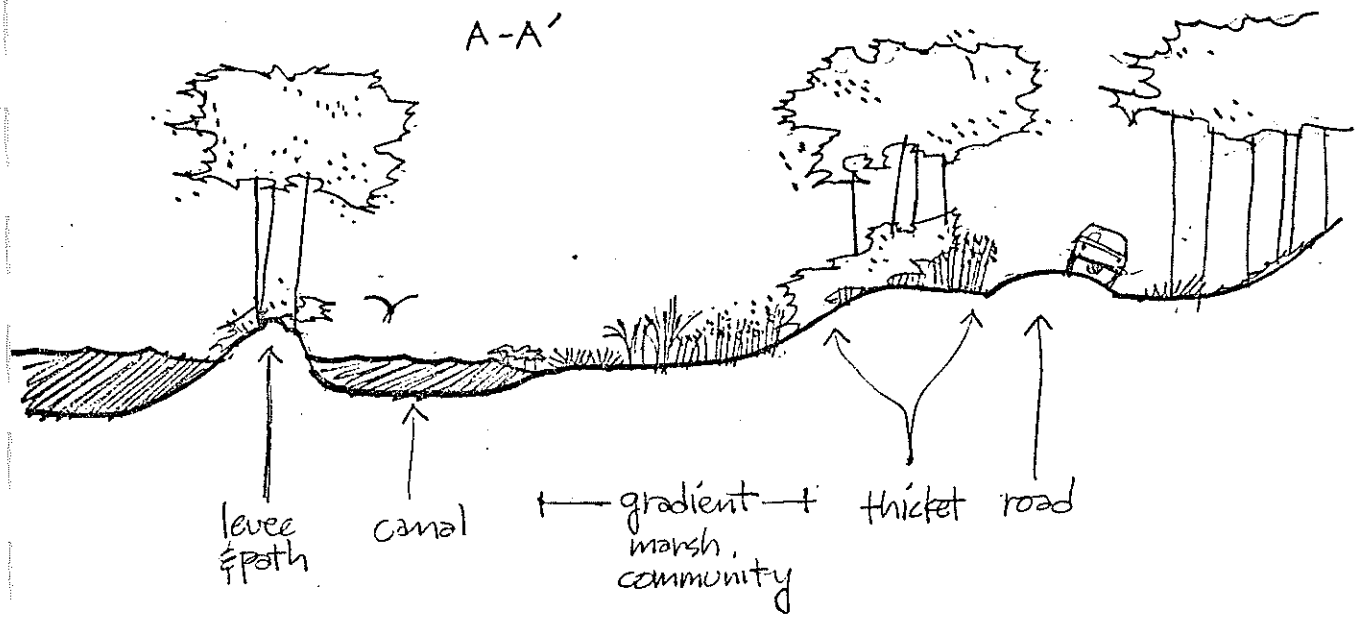
The marsh and thicket should continue in their current states.

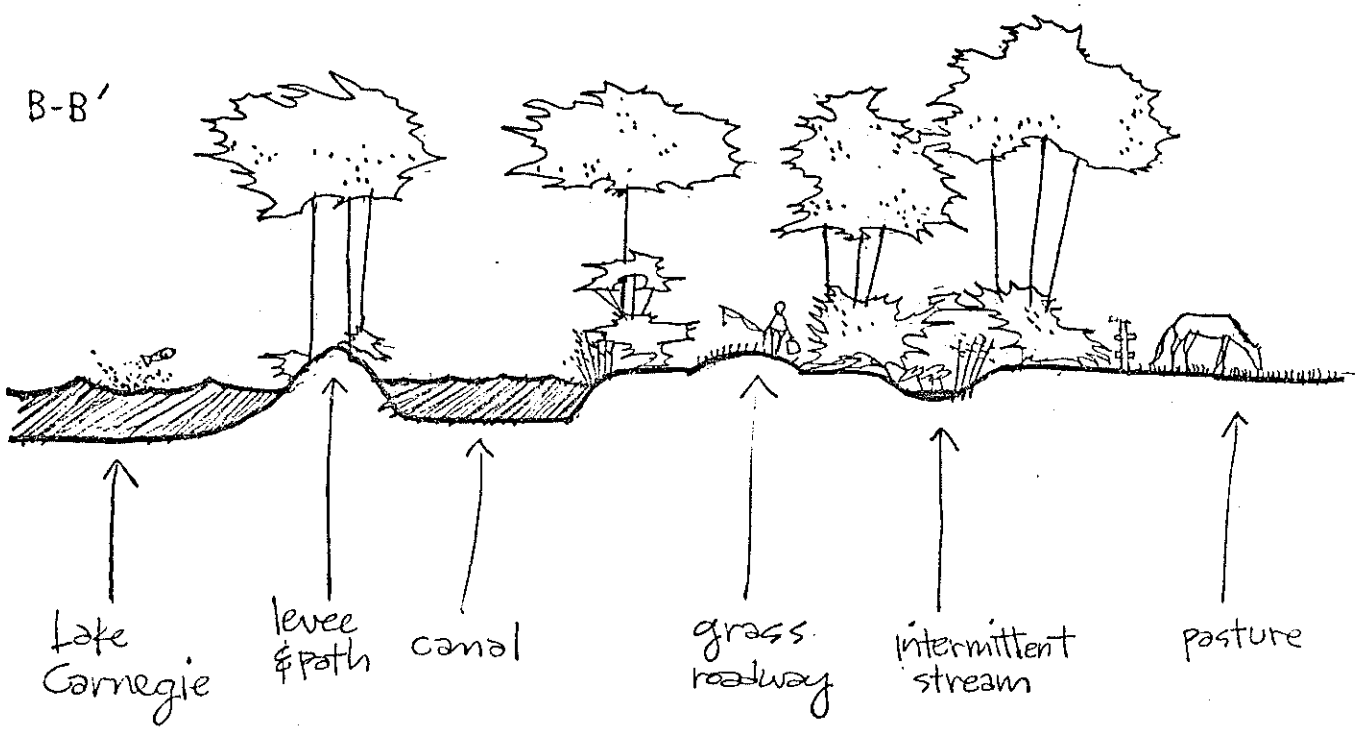
Management Recommendations

Investigate possible sources of pollution of Canal water and correct the situation.

Segment 20

Sections





CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	agricultural field	tilled field (cropland)
b	residential saplings	single houses (with yards)
c	nursery	sod and nursery
d	gravel/dirt roadway	industrial
e	gravel/dirt roadway	institutional
f	landscaped open space	institutional
g	thicket and hedgerow wooded swamp	unmanaged land (abandoned, apparently unused, etc.)
h	pasture	pasture
i	residential saplings	multi-unit buildings
j	Piedmont floodplain Coastal Plain floodplain	unmanaged land

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Above St. Joseph's shrine
B-B' --- Below St. Joseph's School

SPECIAL FEATURES

1 --- Water chlorination facility
2 --- St. Joseph's Shrine
3 --- Pond next to industrial use

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Levee between Canal in Carnegie Lake	4	6b
2	Across Canal toward Carnegie Lake	4	"
3	Shrine at St. Joseph's School (note planted trees)	4	"
4	Nun praying by Canal opposite St. Joseph's School (note grassed towpath)	4	"

SEGMENT 20 VEGETATION DATA

SUBSEGMENT A

Cover Type: Coastal Plain floodplain, thicket and hedgerow

Current Land Use: Fishing, passive use

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thin)	(Density-thin)	(Density-medium)	(Density-medium)
Black locust	Black locust	Smooth sumac	Bergamot
Willow		Box elder	Arrowhead
Silver maple			Duckweed
Red maple			Climbing hempweed

Historic Disturbances: Mowing, cutting

Current Disturbances: Flooding

SUBSEGMENT B

Cover Type: thicket and hedgerow

Current Land Use: Managed woodland, unmanaged land, hiking, fishing, passive use, horseback riding

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-medium)	(Density-medium)	(Density-medium)	(Density-thick)
Black locust	Box elder	Mulberry	Virginia creeper
Silver maple	Green ash	Smooth sumac	Smartweed
River birch	Slippery elm	Silky dogwood	Bergamot
Willow	Black locust	Red maple	Brambles
Sycamore		Willow	Duckweed
Green ash		Rose	Red clover
		Slippery elm	Arrowhead
		Brambles	Dodder
			Japanese honeysuckle
			Duckweed
			Purple loosestrife
			Queen-Anne's lace
			Cinquefoil
			Ragweed
			Green ash
			Swamp rose mallow
			Pokeweed
			Jewelweed
			Cattail

Historic Disturbances: Mowing, cutting

Current Disturbances: Mowing

Segment 21

THICKET/HEDGEROW AND MILLSTONE RIVER FLOODPLAIN WOODLAND FROM ROUTE 27, KINGSTON, TO WASHINGTON STREET (ROUTE 518), ROCKY HILL

SEGMENT NARRATIVE

Segment 21 is a 1.9 mile (3.1 km) long corridor of the Canal Park from Kingston to Rocky Hill. (See the map on Sheet 7a.) The Canal and its edge communities comprise Subsegment A. To the right of the Canal is the railroad corridor (Subsegment B). The railway has been abandoned, and the tracks disappear about two-thirds of the way through the subsegment. Contiguous to the corridor in the latter half of the subsegment is a large traprock quarry. To the left of the Canal is a floodplain woodland (Subsegment C) between the hedgerow/thicket at the Canal edge and the Millstone River. For this and the next four segments (21-25), the Millstone roughly parallels the Canal Park and part of its floodplain is State-owned land.

The Millstone floodplain in these five segments is in the Piedmont lowland, although certain characteristics are similar to the Coastal Plain. The land is flat to gently sloping and, in contrast to the floodplain of the Delaware River, the Millstone floodplain is broad and flat. Marsh vegetation frequently lines the banks of the river. Microtopographic variations are less pronounced here than in other Piedmont areas; the vegetation therefore has a tendency to assume a more homogeneous character.

The Millstone River has both an outer (nearest the water) and an inner (landward) floodplain, although the distinction is blurred in some areas, like Segment 21, where the floodplain is very narrow. In general, where the two floodplain areas are differentiable, the outer floodplain supports willow, river birch, sycamore, and silver maple. The wetter inner floodplain is characterized by a mix of lowland trees--green ash, pin oak, silver and red maple, American and slippery elm, and black gum. Box elder is commonly found in the understory throughout the floodplain. Spicebush is often the dominant shrub species, with arrowwood also common. Numerous herbs are present in a stratum which is usually sparse. Where natural disturbance has resulted in canopy openings, vines (honeysuckle, greenbriar, poison ivy, grape) are numerous and sometimes reach into the overstory. Wetter areas with canopy breaks support lush growth of marsh-type species.

For much of the length of the lower Millstone River, the Delaware and Raritan Canal either forms or lies close to the easternmost floodplain boundary. The thicket/hedgerow vegetation found along the Canal edge often includes many components of the floodplain communities. It is typical to see willow and river birch overhanging the left bank of the Canal and sharing dominance with pin oak, red maple, and silver maple. Understory dominants in the Canal edge community often include pin oak, box elder, red and silver maples, and elms. Spicebush, silky dogwood, and hazel usually occupy the dominant positions in the shrub strata. Where the State maintains a path along the Canal, the disturbance along the edge gives rise to a more thicket-like community. Vines occupy a significant place in the herb stratum, along with sun-loving wildflowers,

particularly where the canopy is open. Where the path is shaded, these are replaced by shade-tolerant species such as Virginia knotweed.

In Segment 21, as previously mentioned, the floodplain (Subsegment C) is narrow and the vegetation is fairly homogeneous. (See Section B-B'.) The thick canopy is dominated by box elder and silver maple which reach up to 50 feet (15 m) and 12" (30 cm) in DBH. Pin oak, green ash, and sycamore were also observed. Box elder, American elm, and slippery elm dominate the medium-dense understory, and spicebush is dominant in the sparse shrub layer. Among the herbs are Virginia knotweed, violet, meadowrue (*Thalictrum* spp.) and grasses, sparsely distributed in most of the floodplain woods. Where the canopy is broken, vines are numerous and the thick herb layer grows to a height of 6 feet (2 m). Canopy breaks are most prevalent near the Canal.

On the right side of the Canal at Special Feature 2, the State owns a piece of land. This land has been designated as a part of Subsegment C. It is a steep ravine which contains an intermittent streambed. (See Section A-A'.) The ravine is thickly overgrown with a number of shrubs, vines, and herbs typical of moist thickets. Canopy trees in a mix similar to that of the hedgerow along the towpath occupy the slopes next to the ravine.

The railroad corridor (Subsegment B) to the right of the Canal manifests vegetation similar to that encountered in other segments where the railroad has been abandoned. (See Segments 6, 7, 8.) The large Kingston traprock quarry lies to the right of the railroad corridor in the latter half of the subsegment. The tracks end near the middle of the portion of Subsegment B which abuts the quarry. A dirt service road for the quarry parallels the tracks and extends to Washington Street. (See Section C-C'.) The road and quarrying activity generate a large amount of dust which coats the vegetation nearby. Noise is constant and loud in the vicinity of this land use when it is in operation, and effluent from a quarry sediment basin is piped into the Canal.

Along the Canal banks (Subsegment A) is a gradient community. Water lily, duckweed, and iris are found in and directly adjacent to the Canal. Purple loosestrife and jewelweed occupy the banks above these species, and the upper portions of the banks are vegetated by less moisture-tolerant plants (brambles, Virginia knotweed, rose). The thicket of the railroad corridor is at the top of the right bank of the Canal; on the left bank is the towpath, surrounded by a hedgerow/thicket 40 feet (12 m) high. In the dense canopy of this hedgerow are box elder, river birch, and silver and red maple. Box elder and red maple dominate the understory, and spicebush, ironwood, and arrowwood are found in the medium-dense shrub layer. In the herb stratum are woody saplings, vines, and a few wild flowers.

The towpath offers pleasant views of the Canal and the floodplain. The towpath has recently been regraded, but the new edges are eroding in some places. The path is shaded, as are the Canal edges, by vegetation in the hedgerow/thickets. Joggers were observed along the towpath, as were horseshoe prints. The path is also used by people fishing in the Canal. Segment 21 is one of the few areas of the Canal Park which offers easy access to a parking area (at Special Feature 1).

Disturbances in Segment 21 itself are few. The quarry affects both the vegetation and the Canal, as mentioned previously, and an underground pipeline right-of-way (Special Feature 5) is mowed, transecting the floodplain. The towpath is maintained by use and occasional cutting. There are sand piles at Special Features 3 and 4. A sewage treatment plant (Special Feature 6) adds its discharge to the Millstone River.

Several of the recommendations for Segment 21 pertain to the contiguous quarry. Vegetation could be planted in Subsegment B to buffer the Canal corridor from noise and dust, and if the quarry service road were paved or oiled, the amount of dust in the air might be somewhat lessened. The edges of the towpath should be stabilized. A final recommendation is that care should be taken to preserve the quiet, natural character of the floodplain woodland along the Millstone. This area is best suited to passive uses.

Access into Canal Corridor

Segment 21 is easily accessible from Route 27 at its beginning and Washington Street at its end.

Ease of Passage on Canal

Passage along the Canal is clear throughout the segment.

Towpath

The towpath on the left side of the Canal is excellent. The railroad tracks to the right of the Canal are overgrown.

Wildlife

No unusual wildlife was observed.

Auditory Assessment

Constant noise from the contiguous quarry can be heard in the latter half of the segment. It is somewhat less noticeable in Subsegments A and C than in B.

SUBSEGMENT A

Subsegment A encompasses the Canal, its edge communities, and the hedgerow/thicket along the towpath to the left of the Canal in Segment 21. The towpath is about 4 feet (1.2 m) above the Canal and 6 to 12 feet (2 to 3.6 m) above the floodplain which abuts its left side.

A gradient community vegetates the Canal banks. Duckweed and water lily are in the Canal, with iris, purple loosestrife, and jewelweed on the lower part of the banks. Less moisture-tolerant species cover the upper part of

the banks, with a thicket/hedgerow in the railroad corridor (Subsegment B) to the right and a 40 foot (12 m) high hedgerow/thicket along the towpath to the left.

There is an almost even mix of canopy species in the hedgerow. Box elder, green ash, river birch, and silver and red maples are slightly more abundant than other species, which include pin oak, ailanthus, tulip poplar, willow, beech, black locust, and sycamore. In the understory, red maple and box elder are dominant with American elm, ironwood, flowering dogwood, and pin oak also numerous in some places. The shrub layer is of medium density and includes speckled alder, spicebush, and slippery elm as dominants. Poison ivy dominates the herb stratum, which also has other vines (Tartarian and Japanese honeysuckle, grape, Virginia creeper), black oak saplings, and a few wild flowers.

For the most part, the towpath is a pleasant area. The path is wide and has recently been regraded. Some of the new edges, however, have begun to erode. The path is accessible at the beginning and the end of the subsegment. Horseshoe prints were observed on the path. Several people jogging and people fishing in the Canal were also seen. The canopy forms a roof over the path, a feature that offers shade and a pleasant sense of enclosure. The shrub layer is not so tall that it blocks views to either the Canal or the floodplain, and the visual result is rewarding. The traprock quarry is visible from the path. (See Section C-C'.) This mining operation is linked to historic use of the Canal and is a reminder of when the Canal was a commercial avenue. Dust "fallout" from the quarry and dirt road coats the vegetation along the path in areas near the quarry. In addition, noise from the quarry is quite loud and is incongruous with the otherwise peaceful environment of the Millstone. It is difficult to determine by observation how much dust is generated by trucks rumbling along the road and how much is generated by quarry operations as such, but perhaps the impact of the quarry could be minimized by paving the road. Planting carefully selected vegetation in the railroad corridor (Subsegment B) might help to buffer some of the quarry noise from the Canal and towpath.

Community Dynamics

The hedgerow/thicket should continue to be stable, as seedlings and saplings of woody species are present. The path is maintained by cutting.

Management Recommendations

Regrade or fill edges of the path in eroded places and plant vegetative cover to stabilize the edges in order to prevent further erosion.

SUBSEGMENT B

Subsegment B is a narrow (10 to 15 feet or 3 to 4.5 m) strip of vegetation that parallels the right bank of the Canal throughout the segment. Abandoned

railroad tracks pass through the subsegment for the first two-thirds of its length. The traprock quarry is contiguous to the latter half of the subsegment, and a dirt service road for the quarry runs between it and the tracks, then between it and the Canal when the tracks end, to Washington Street.

The vegetation here is similar to that of the abandoned railroad corridor in Segments 6, 7, and 8. Willow and ailanthus are more prominent than in earlier segments, however, and the canopy is higher (up to 50 feet, or 15 m). Thicket-type growth prevails; thus views are more varied than in segments where hedgerow-type growth predominates. Near the beginning of the subsegment, black locusts 6 feet (2 m) high were observed between the tracks.

A noticeable feature of this subsegment is the layer of dust that covers the vegetation in the area next to the traprock quarry. The quarry apparently generates this dust with its excavation and its trucking on the service road directly adjacent to the thicket. This dust coats the leaves and dulls their color, muting the green even in direct sunlight. This is an obvious visual effect of the traprock quarry; whether or not the growth of the vegetation is adversely affected was not determined.

This is not a favorable area in terms of recreational use. The traprock quarry generates considerable noise, and the railroad bed is generally overrun with vegetation, making passage difficult.

Community Dynamics

Woody vegetation should continue to establish itself in the abandoned railroad corridor if it is not disturbed.

Management Recommendations

If the railroad corridor is to be used as a path, woody stems must be removed. If it is to be used as a buffer against the contiguous quarry, vegetation must selectively be cut to assure the thick growth of species which will reduce dust and noise.

SUBSEGMENT C

Subsegment C encompasses the area between the Millstone River and the towpath edge community. A small part of the floodplain across the river at the end of the segment and a ravine to the right of Subsegment B are also included in this subsegment. The ravine has canopy species like those of the towpath (Subsegment A) and dense lower layers characterized by moisture-loving thicket-type species. An intermittent streambed is on the floor of this ravine.

The floodplain between the river and the Canal is never very wide: its greatest width is about 400 feet (120 m); its narrowest, 50 feet (15 m). Because of its narrowness, the floodplain does not have a pronounced inner/outer distinction like that of other floodplains or of the Millstone floodplain in later segments.

The floodplain canopy is dominated by box elder and multi-stemmed silver maples, approximately 8 and 12" DBH respectively, reaching 40 to 50 feet (12 to 15 m) in height. Several large (25" or 62 cm DBH) pin oaks were observed, as were some 42" (105 cm) DBH green ash and 24" (60 cm) DBH sycamore. Box elder, American elm, and slippery elm are dominant in the understory, with river birch, red maple, red oak, and black locust numerous in some areas. Spicebush is dominant in the shrub layer. Herbs include various grasses, vines, and wildflowers.

Where the canopy is dense, the shrub layer is relatively low (4 feet or 1.3 m) and sparse, and the herb layer is very thin. In places where the canopy is broken, the shrub and herb layers are much thicker and grow to a greater height (6 feet or 2 m). Sun-loving vines, jewelweed, and grasses occupy many of these open spaces.

Canopy breaks are larger and more numerous where the river is near the Canal. The river edge community (jewelweed, smartweed) is also generally wider in these areas. (See Sections A-A' and B-B'.) The major observed difference between the Delaware and Millstone floodplains is topographical. The Delaware floodplain contains numerous microtopographic changes, usually in the form of sequential "shelves" that step down to the river, the Millstone is much flatter and its slopes are more gentle.

The Millstone floodplain has a more serene character than the Delaware, perhaps because of the gentler topography and the softer slopes. The relatively undeveloped contiguous land also helps avoid the "rat race" atmosphere often encountered along the Delaware River portion of the Canal. Only a few intrusions exist here. A mowed gas pipeline right-of-way at Special Feature 5 transects the floodplain and a few institutional facilities in Contiguous Land Uses f and b are visible through the trees. These "disturbances" are not difficult to ignore.

Great care should be taken when deciding what types of recreational uses are to be designated for the Millstone floodplain. Relatively passive uses (e.g., hiking, fishing, riding) appear to be most sympathetic to the existing character of the land.

Community Dynamics

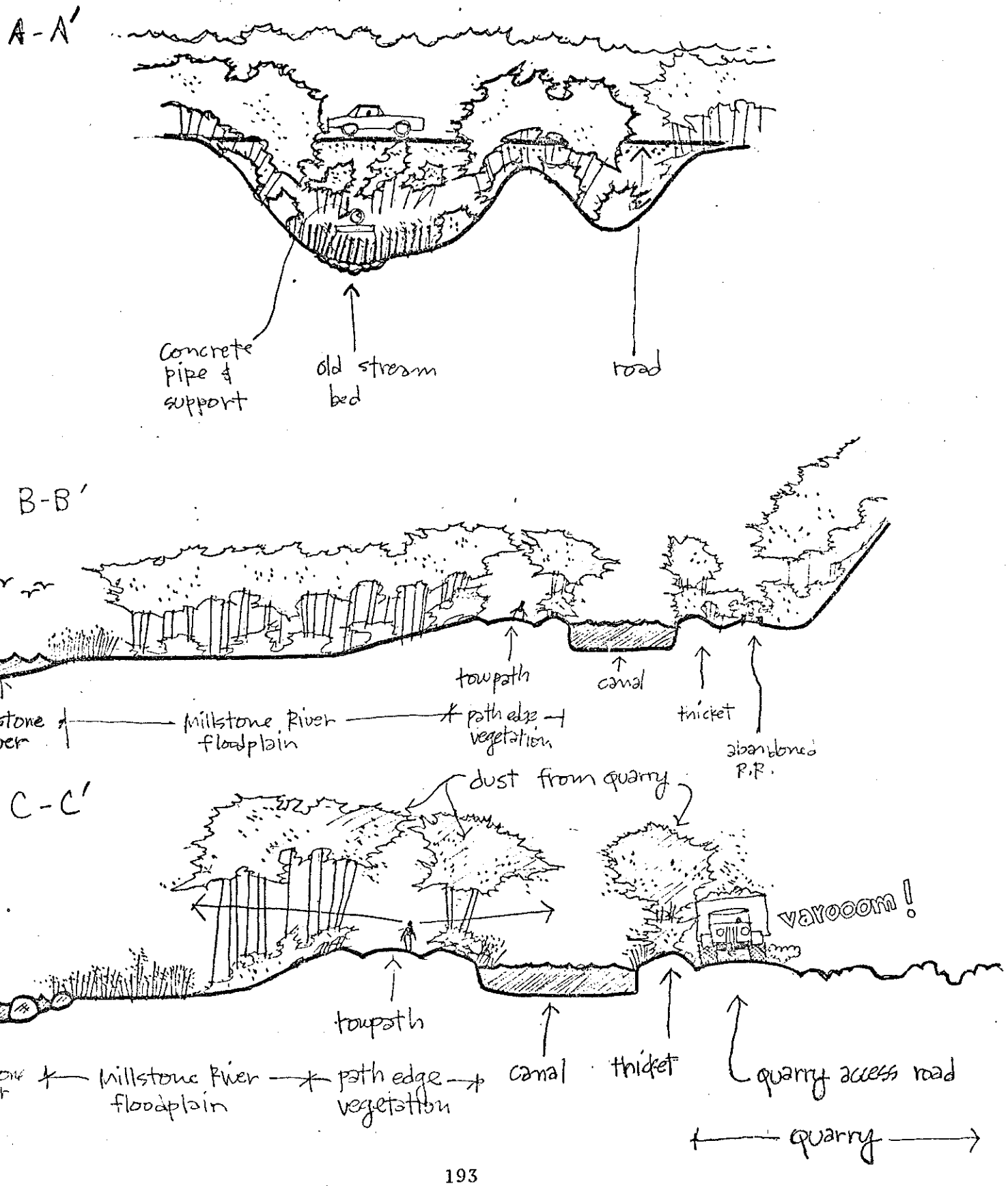
The floodplain woodland of the Millstone appears stable and should continue to be so, given the current land use and flood regime. The ravine community should remain in a steady state.

Management Recommendations

None

Segment 21

Sections



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	gravel/dirt roadway	industrial
b	landscaped open space gravel/dirt roadway	utility
c	residential trees	single houses (with yards)
d	successional oldfield	unmanaged land (abandoned, apparently unused, etc.)
e	Piedmont floodplain Coastal Plain floodplain	unmanaged land
f	landscaped open space	institutional
g	gravel/dirt roadway	other
h	pasture	pasture
i	moist upland woods	unmanaged land
j	residential saplings	single houses (with yards)

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Intermittent streambed below Kingston
B-B' --- Mid-segment, Millstone River to railroad corridor
C-C' --- Near end of segment, showing quarry

SPECIAL FEATURES

1 --- Parking area-low capacity
2 --- Ravine (intermittent streambed)
3 --- Quarry sand piles
4 --- Quarry sand piles
5 --- Underground pipeline right-of-way
6 --- Sewage treatment plant

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Canal and State service area from beginning of Segment 21 (Route 29, Kingston)	7	7b
2	Marshy area contiguous to right side	7	"
3	Pipe draining Canal (origin: quarry sediment ponds)	7	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
4	Path along left side of Canal (recently graded)	7	7b
5	From left side of Canal to contiguous quarry (right side)	7	"
6	Across Canal toward contiguous traprock quarry	7	"
7	Millstone floodplain woods at Route 518, Rocky Hill	7	"

SEGMENT 21 VEGETATION DATA

SUBSEGMENT A

Cover Type: Coastal Plain floodplain

Current Land Use: Managed woodland, hiking, horseback riding

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-thick)	SHRUB (Density-medium)	HERB (Density-thick)
Red maple	Ironwood	Slippery elm	Virginia knotweed
River birch	American elm	Spicebush	Grape
Silver maple	Slippery elm	Ironwood	Violet
Pin oak	Shagbark hickory	Flowering dogwood	Black oak
Box elder	River birch	Privet	Meadowrue
Green ash	Pin oak	Elderberry	Sensitive fern
Ailanthus	Red maple	Ailanthus	Pokeweed
Tulip poplar	Box elder	Shagbark hickory	False Solomon's seal
Willow	Green ash	Sassafras	Japanese honeysuckle
Beech	Sycamore	Arrowwood	Unknown grasses
Black locust	Flowering dogwood	Black oak	Rose
Sycamore	Sugar maple	Japanese barberry	Brambles
	Ailanthus	Speckled alder	Poison ivy
	Sassafras	Red cedar	Virginia creeper
		Silky dogwood	Asparagus
		Swamp white oak	Yarrow
		Hazel	Climbing hempweed
			Canada thistle
			Tartarian honeysuckle
			Duckweed
			Water lily
			Iris
			Jewelweed
			Purple loosestrife

Historic Disturbances: Cutting, trampling, earthworks

Current Disturbances: Cutting, trampling

SUBSEGMENT B

Cover Type: Thicket and hedgerow, railroad

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY (Density-thin)	UNDERSTORY (Density-thin)	SHRUB (Density-medium)	HERB (Density-thick)
Willow	Willow	Black locust	Brambles
Ailanthus	Ailanthus	Black cherry	Virginia creeper
	Black cherry	White ash	Japanese honeysuckle
	White ash	Tulip poplar	Unknown grasses
	Tulip poplar	Willow	Black locust
		Ailanthus	Grape

Historic Disturbances: Mowing, cutting, herbiciding

Current Disturbances: Undetermined

SUBSEGMENT C

Cover Type: Coastal Plain floodplain, thicket and hedgerow

Current Land Use: Protected area (refuge, preserve, etc.) from cited sources

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-thin/medium)	SHRUB (Density-medium)	HERB (Density-thin)
Box elder	Sycamore	Black cherry	Jewelweed
Silver maple	Slippery elm	Spicebush	Clearweed
Willow	Black locust	Silver maple	Foxtail grass
Green ash	Red maple	Silky dogwood	Goldenrod
Red oak	American elm	Slippery elm	Grape
Sycamore	Box elder	Elderberry	Smartweed
Red maple	Red oak		Great ragweed
Pin oak	River birch		Rose
River birch			Aster
			Unknown grasses
			Oxalis
			Poison ivy
			Greenbrier
			Virginia knotweed
			Bog hemp
			Meadowrue
			Sensitive fern
			White avens
			Violet

Historic Disturbances: Flooding, debris accumulation

Current Disturbances: Canopy damage

Segment 22

MILLSTONE RIVER FLOODPLAIN WOODLAND, OLDFIELDS, AND HEDGEROW/THICKET FROM WASHINGTON STREET, ROCKY HILL, TO GRIGGSTOWN CAUSEWAY

SEGMENT NARRATIVE

Segment 22 begins at Washington Street in Rocky Hill and extends approximately 2.5 miles (4 km) to the Griggstown Causeway. (See the map on Sheet 7a.) In this segment, the Canal Park land widens considerably to encompass not only the Canal and towpath, but also a large portion of the Millstone River floodplain. Most of the State-owned land here lies to the left of the Canal and in several locations extends west to River Road (Route 533). In addition, some of the State land lies along a tributary, Beden's Brook, which joins the Millstone near mid-segment. The land contiguous to State property is for the most part sparsely developed and rural in character. Single-family homes, agricultural parcels, and the town of Rocky Hill comprise the rural pattern which surrounds the Canal. There are three subsegments in Segment 22: Millstone River floodplain woodland (Subsegment A) between the left Canal embankment and the Millstone, at times extending west of the river to River Road; oldfield openings (Subsegment B) in the floodplain; and the Canal, its embankments, and the towpath to the left (Subsegment C). Canal Road forms the eastern (farthest right) boundary of Segment 22.

Roughly paralleling the Canal, the Millstone exhibits the inner/outer floodplain structure discussed in Segment 21, except in areas where the river is very close to the Canal embankment. In general, the floodplain is inhabited by a young woodland (Subsegment A) broken periodically by openings. Much of the land in the floodplain has an agricultural history (Van Vechten and Buell, 1959, pages 219-227). Each of the oldfield communities in the floodplain area thus represents a stage in vegetational succession. The character of each community is specific to the previous type of land use, the time that use ceased, and the disturbances encountered since abandonment.

The forested areas generally have a thick canopy composed primarily of silver maple, pin oak, and white and green ash. Shagbark hickory and swamp white oak are also frequent canopy members. Most abundant in the understory are river birch and red maple. The lower layers vary in composition and density with the amount of available sunlight. In the shady areas, which are prevalent, species include spicebush, arrowwood, smartweed, white avens (*Geum canadense*), and poison ivy. Long views through the low shrub and herb layers of the floodplain woodland are common. Sunny spots in the canopy breaks become overgrown by vines such as honeysuckle, grape, greenbrier, and poison ivy.

Oldfield openings (Subsegment B) throughout the floodplain are primarily herbaceous and of even height. Depending on the field, height ranges from knee-high to 7 or 8 feet (about 2.5 m). Smartweed, knotweed, tearthumb, great ragweed (*Ambrosia trifida*), silky dogwood, and various wildflowers form nearly impenetrable layers. Occasional canopy trees such

as white and green ash, black locust, and ailanthus tower over the fields. The oldfields have been divided into three types which are discussed in the Subsegment B narrative.

Subsegment C is the hedgerow/thicket which occupies the edges of the Canal and towpath. Species in all layers are diverse and mixed throughout the length of the subsegment. Variations in species composition depend upon the degree of openness. In general, the community members described in previous segments continue to characterize this edge vegetation.

Each community provides a pleasant experience. The warm, sunny, flower-covered fields contrast with the cool, damp woods. Views along the Canal from the towpath are highlights. Special features include a pond and waterfalls which lead to the Millstone at the beginning of the segment (Special Feature 1), large dead canopy trees at the confluence of the Millstone and Beden's Brook (2), a lock/sluice north of Copper Mine Road (3), and historic buildings at Griggstown (4). Attractively landscaped homes along the Canal's right side also provide pleasant views.

The segment is used for canoeing, jogging, biking, fishing, horseback riding, and picnicking. Despite heavy use, human-related disturbances are few. Some of the oldfield/pasture openings appear to be subject to seasonal mowing or periodic grazing. The recent regrading of the towpath has resulted in occasional erosion of the edges. There are several borrow pits near the towpath in mid-segment, and a utility line runs between the towpath and the Canal for a short distance near the end of the segment. In a few places, runoff from Canal Road enters the Canal, either through pipes or over unvegetated areas.

Natural disturbances include flooding of the Millstone, erosion, and windthrow. These are severe enough to cause occasional tree fall-ins and scouring of the herb layer in places. Numerous animal holes along the banks were also observed.

As well as the excellent towpath, there are a number of trails throughout the floodplain woods and oldfields. The area is generally natural and quiet in character and provides opportunities for numerous recreational activities.

Access into Canal Corridor

Segment 22 is accessible at both ends and from the lock/sluice and parking area near Copper Mine Road. Canal Road provides access along the right side of the Canal.

Towpath

The path along the Canal's left side is excellent and has recently been regraded and filled. Regrading has caused some erosion along the edges of the path.

Ease of Passage on Canal

Passage on the Canal is blocked by the lock/sluice near Copper Mine Road. However, paths make portaging around the structure easy.

Wildlife

Tracks and numerous animal burrows were observed, especially in the floodplain woodland. Browsing of vegetation suggests that the area is inhabited by deer and rabbit. Turtles, muskrats, snakes, and rabbits were observed.

Auditory Assessment

Natural sounds, including water falling and bird chatter, characterize Segment 22. Vehicles passing on contiguous roads are occasionally audible within parts of the segment, especially Subsegment C (towpath).

SUBSEGMENT A

Much of the land lying within State boundaries in Segment 22 is covered by Millstone River floodplain woods (Subsegment A). This subsegment includes the Park land flanking the Millstone River (exclusive of openings, which comprise Subsegment B), as well as land lining the edges of Beden's Brook near its confluence with the Millstone. The Millstone continues to parallel the Canal as it winds through the segment. In the first half of the segment, the floodplain is broad; later, the river often swings close to the Canal towpath embankment, leaving only a small floodplain woodland to separate the two. In locations where the floodplain between the Canal and river is wide, changes in relief are pronounced, and the inner and outer floodplains are distinguishable. (See Section A-A'.) The outer floodplain, with its better drained soils, has a higher proportion of sycamore, river birch, and silver maple. In the inner floodplain, vegetation reflects wetter conditions. Yazoos and their abandoned channels often lie where this floodplain nears the Canal embankment. These exist in both sunny and shady locations. Herbaceous species, tolerant of wet soils, are the primary inhabitants. Shadier spots include skunk cabbage (*Symplocarpus foetidus*), arrow-arum, arrowhead, jewelweed, and smartweed. Sunnier openings are often occupied by a variety of *polygona* (smartweed, knotweed, tearthumb), rose mallow, marsh grasses, and buttonbush.

In general, the species comprising the floodplain woodland are not extremely diverse. The canopy, which can reach 50 to 60 feet (15 to 18 m) is dominated by silver maple, pin oak, and white and green ash. DBH exceeds 2 feet (0.6 m) in a few locations, but most of the trees are young. Shagbark hickory, swamp white oak, and box elder are also commonly seen as constituents of the canopy. The understory contains, as well as species mentioned above, river birch and red maple, with occasional osage orange (*Maclura pomifera*), black walnut, and basswood.

Where the canopy and understory are dense, little direct sunlight reaches the lower layers. As a result, these layers are frequently quite thin. The dominant member in the shrub layer is spicebush, and slippery elm, hawthorn, and arrowwood are occasional constituents. Major components of the herb layer include white avens, clearweed, violet, smartweed, and poison ivy, which often climb into the upper layers. In some areas, the floodplain appears to have been scoured by flooding from the Millstone.

The density of the lower layers changes drastically where canopy breaks provide abundant sunlight. Vines (honeysuckle, grape, poison ivy, and greenbrier) proliferate and often form a vegetation mat over the shrub-height species. Grasses, smartweed, knotweed, violet, and clearweed are below or near this viny thicket, if light permits. These thick lower layers appear to inhibit the invasion of woody species.

Damage to the woodland as a whole appears mostly natural. Windthrow of shallow-rooted trees is common, as is debris from canopy damage and flooding. Bank erosion along the Millstone is often severe. As a result, much of the soil surrounding bankside tree roots has been washed away, leaving the trees prone to fall-ins. Animal holes in many of the multi-stemmed tree bases supplement other tree damages. Flooding seems to be a common occurrence. Flood debris was observed around tree bases, and some areas seemed to have been scoured clean by fast-moving flood waters. A fine layer of silt commonly covers these areas.

The vegetation offers evidence that animals (e.g., deer, rabbit) browse and nest throughout. In addition, tracks and numerous holes along the banks suggest that the woodland and river are providing a good habitat for other forms of wildlife such as muskrat and raccoon.

The visual experience of this floodplain woodland is pleasant, with the often low herb and shrub layer allowing long views. Shade is abundant, and there is little noise except for natural sounds. Several trails lead through the woodland and oldfields (Subsegment B) to the river and parallel the river through much of the subsegment. The floodplain is easily accessible from the towpath (Subsegment C).

Community Dynamics

The floodplain woodland of Subsegment A should remain stable, given the present land uses and flood regime. The health of some of the older trees may be threatened by animal burrowing in the tree bases, but canopy breaks resulting from natural disturbances allow the establishment of young specimens which should perpetuate the existing community.

Management Recommendations

None

SUBSEGMENT B

A number of openings which occur within the floodplain woods comprise Subsegment B. Much larger than the canopy breaks in the woodland, these are agricultural areas which have been recently abandoned. The openings vary in both composition and structure, reflecting both the type of previous agricultural use and the time at which that land use was discontinued. A survey of the communities demonstrates numerous stages (early, middle, late) of oldfield succession.

The early successional oldfield opening (B1) near Griggstown Causeway is dominated by 6 to 8 foot (2 to 2.7 m) high great ragweed. Specimens of white avens, New York ironweed (*Veronia noveboracensis*), sunflower, knotweed, and smartweed are interspersed throughout. Isolated canopy-height species, primarily black locust, silver maple, and ailanthus, tower above the tall herbaceous layer. A dirt road from Griggstown winds through the opening and provides easy access for motor vehicles and horseback riders. Some litter and dumping were observed. Historic buildings (Special Feature 4) are contiguous to this field.

Low-growing early successional oldfields (B2) are more typical of this subsegment. The knee to waist-high vegetation in these fields is a mixture of smartweed, knotweed, tearthumb, and wildflowers (sunflower, coneflower, aster, New York ironwood). Because the herb layer is often extremely thick and brambly, passage through these fields can be tough going. Woody thickets are common components and include rose, dogwood, elderberry, and hawthorn. Occasional small wet depressions within the field are inhabited by arrow-arum, marsh grasses and sedges, sensitive fern, and rose mallow. For the most part, the canopy layer is absent. Isolated species from 10 to 60 feet (3 to 18 m) high include black oak, pin oak, and white and green ash.

The first of these fields is just south of the junction of the Millstone River and Beden's Brook. The field is dominated by knee-high smartweed, knotweed, and Japanese hop. Dogwood thickets are abundant in this field. Wet spots and moisture-tolerant vegetation are frequently encountered. Several large dead canopy-height trees (Special Feature 2) break the flat aspect of this generally low-growing, even-height field. It abuts a pasture opening (B4) near the confluence of the Millstone and Beden's Brook. The second (B2) oldfield lies near Copper Mine Road and is easily reached from the lock/sluice, picnic, and parking area there. The third is near River Road and the end of the segment and was almost entirely blanketed by coneflower and sunflower at the time of the survey.

The opening labeled B3 has a greater proportion of woody species than a B1 and B2. These species reach levels of 15 to 20 feet (3 to 4.5 m). For the most part, these are tall clumps of hawthorn with an occasional ash at canopy height. The existing structure suggests that this field is presently at a later successional stage than those discussed above. A small path (posted: no motor vehicles) runs from Canal Road through Subsegment A and along the field edge. It continues down to the Millstone River and appears to be a major access route for fishermen, canoers, hikers, and campers.

The last opening type (B4) to be discussed is projected for Park acquisition. There are two of these fields and they are presently being grazed. (See Section B-B'.) As a result, vegetation is low-growing and the fields remain at an early successional stage. Members of the community include various grasses, milkweed, New York ironweed, and knotweed.

In general, these sunny openings provide pleasant visual experiences. For the most part, they are isolated from other nearby rural land uses and are quiet. These fields are at present ideal as passive recreation areas and wildlife habitats. These are also areas of potential use, if developed recreational facilities (e.g., campgrounds, playgrounds) are foreseen as future Canal Park needs.

Community Dynamics

These oldfield openings seem to be following typical successional progressions. If left undisturbed, succession should continue. The pasture (B4) has been maintained in early succession by periodic grazing by farm animals.

Management Recommendations

None, if succession is desired. If not, management practices such as cutting of woody stems and periodic mowing would inhibit succession. Clean up litter and debris in oldfield B1.

SUBSEGMENT C

Subsegment C comprises the Canal, its banks, and the community which lines the towpath on the left of the Canal. To the right of the Canal is Canal Road, and a narrow hedgerow/thicket lies between the two. The hedgerow/thicket lining the towpath is similar. Both are intermittent, with thickety openings inhabited by sun-loving species and closed areas where the canopy provides shade.

At times, the vegetation encloses the towpath producing a tunnel effect. Large overhanging canopy trees on the adjacent floodplain often enhance the shady condition. Canopy species lining the towpath are fairly diverse and mixed; ashes, pin oak, and silver and red maple are among the most prominent. Box elder, pin oak, river birch, and red maple fill an understory which varies in density. Where the lower layers are shaded, species which are frequently encountered in the floodplain are present. Spicebush is a typical example. The shade conditions are responsible for a thin herb layer. Nonetheless, the variety of species in this stratum remains high.

In the sunny thicket openings, black locust, black walnut, willow, ailanthus, and American and slippery elm comprise a thin canopy level, where a canopy exists. Lower levels are diverse and often include black cherry,

speckled alder, slippery elm, dogwood, roses, and staghorn sumac. The dense herb layer is often more complex, but honeysuckle, Virginia creeper, brambles, and poison ivy are among the most abundant. The presence of species such as ragweed, pokeweed, purple loosestrife, butter-and-eggs, and evening primrose testifies to the sunny and dry nature of these exposed spots.

The Canal edge community is intermittent and includes arrow-arum, water lily, duckweed, and pondweed (*Potamogeton* spp.) Flow of the Canal is only interrupted once in the segment, at the lock/sluice near Copper Mine Road. Ducks, turtles, and frogs were sighted near the Canal. Pipes which carry road runoff were observed exiting into the Canal, and several barren spots along the Canal bank allow runoff from Canal Road to enter the Canal directly. In a few areas, the Canal banks have been repaired with cement.

The towpath along this entire subsegment is in very good condition. Most of the path is a 6 to 8 foot (2 to 2.7 m) wide corridor which has recently be regraded. Along the edges, however, the new path is eroding in places. Some borrow pits are located near mid-segment. The towpath near Griggstown is gravel for a short distance. This allows access by auto to several residences adjacent to the towpath (Contiguous Land Use c). A utility line also runs between the path and the Canal in this location. Trees appear to be pruned in order to avoid interference with the lines.

Views across the Canal are facilitated by openings in the towpath community. At the beginning of subsegment (Special Feature 1) are a small pond and waterfalls near the Millstone. Several attractive homes and yards which lie along Canal Road provide pleasant views. Restored historic buildings (tool house, mule shed) at Special Feature 4, in Griggstown, also offer a quaint, rural setting. A local store offers supplies and canoe rentals. Canoers can launch along the Canal in several locations in this segment. Portaging is required around the lock/sluice (Special Feature 3) located just north of Copper Mine Road. This lock/sluice and surrounding land (mostly mowed) is maintained by the State as a small park for passive recreation (e.g., picnicking). There is a bridge across the Canal here which provides access to the towpath and one of the attractive wildflower-covered oldfields.

At the time of this survey, numerous recreational uses were observed in Subsegment C. These included horseback riding, biking, jogging, strolling, camping, and canoeing. Motorbiking and evidence of hunting were observed, although such activities are forbidden.

Community Dynamics

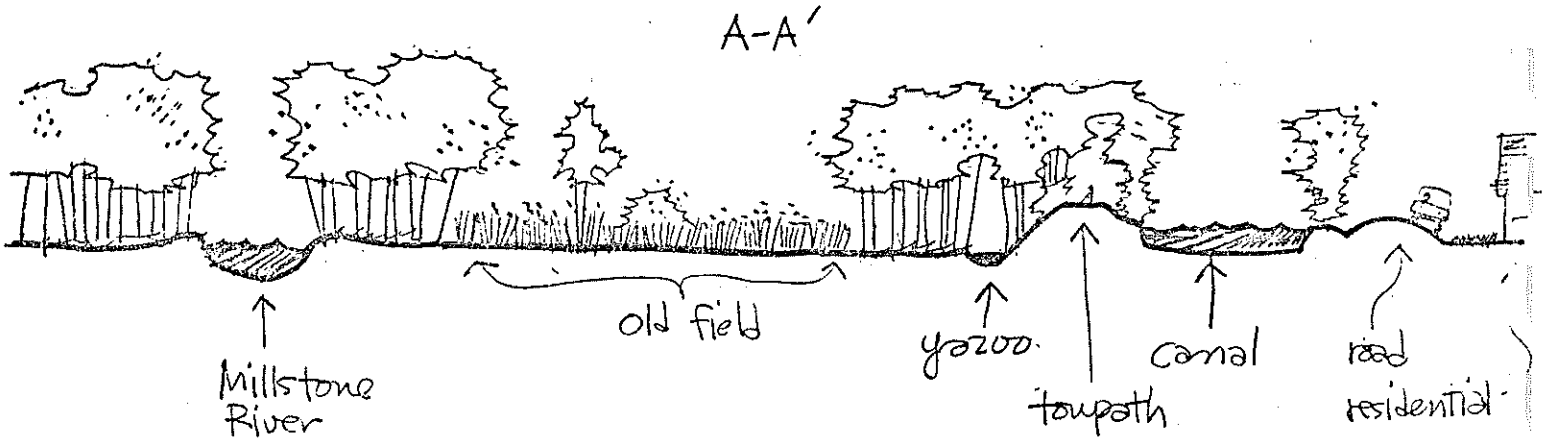
With time, as the community on the top of the bank becomes taller and thicker, shade-tolerant species may replace some of the earlier sun-loving colonizers. The open, sunny space along the Canal edges makes a stable establishment of sun-loving species likely.

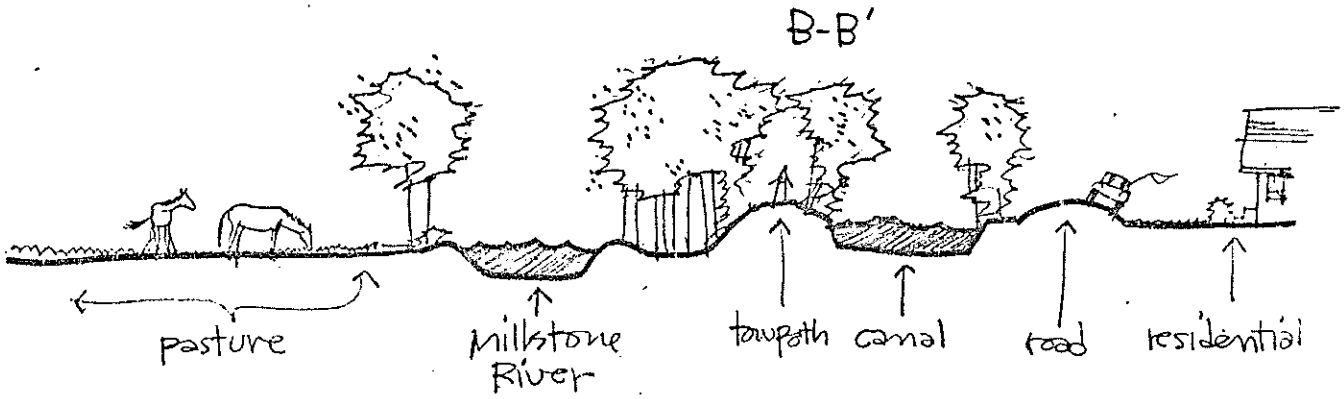
Management Recommendations

Regrade or fill edges of the path in eroded places and plant vegetative cover to stabilize the edges and prevent further erosion.

Segment 22

Sections





CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	Piedmont floodplain	passive use
	Coastal Plain floodplain	unmanaged land
b	residential saplings	single houses (with yards)
c	residential trees	single houses (with yards)
d	agricultural field	tilled field (cropland)
e	residential saplings	single houses (with yards)
	successional oldfield	unmanaged land
	agricultural field	pasture
	pasture	tilled field
f	parking lot	industrial
g	landscaped open space	lawn
h	successional oldfield	unmanaged land
i	landscaped open space	camping
j	residential saplings	commercial
		single houses (with yards)

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Just upstream of confluence of Millstone and Beden's Brook
B-B' --- Just downstream of confluence of Millstone and Beden's Brook

SPECIAL FEATURES

1 --- Waterfall, pond, park entrance near Rocky Hill
2 --- Large specimen canopy trees at confluence of Beden's Brook and Millstone River
3 --- Lock/sluice north of Copper Mine Road
4 --- Historic buildings--Griggstown

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Floodplain woods along Millstone River (note open lower strata and sunlight filtering through)	7	7b
2	Large dead trees in oldfield opening (B2)	7	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
3	Towpath along Canal's left side	7	"
4	Specimen sycamore (note person)	7	"
5	Exposed roots along banks of Millstone	7	"
6	Millstone River oldfields in background (note bank erosion)	7	"
7	Cement wall repair along towpath	7	"
8	Contiguous home from Canal (towpath)	7	"
9	Lock/sluice and park area north of Copper Mine Road	7	"
10	Oldfield (B2) lying along Millstone River	7	"
11	Boundary of oldfield and Millstone (note gradient community and river overhang)	7	"
12	Horse on towpath	7	"
13	Millstone River from towpath	7	7b
14	Oldfield opening blanketed with yellow flowers (B2)	7	"
15	Oldfield (B1) Griggstown	7	"

SEGMENT 22 VEGETATION DATA

SUBSEGMENT A

Cover Type: Piedmont floodplain, Coastal Plain floodplain

Current Land Use: Unmanaged land, hiking, fishing, camping, hunting, passive use, picnicking

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-thin/medium)	SHRUB (Density-thin)	HERB (Density-medium)
Box elder	River birch	Arrowwood	Cinnamon fern
Silver maple	Green ash	Elderberry	Poison ivy
Red oak	Slippery elm	Spicebush	Smartweed
Shagbark hickory	Hickory	Slippery elm	Sensitive fern
Pin oak	Osage orange	Speckled alder	Japanese honeysuckle
White ash	Basswood	Hawthorn	Greenbrier
Green ash	Black walnut	Japanese barberry	Grape
Red maple	Red maple	Buttonbush	Arrow-arum
Black gum (Sour gum)	Sycamore		Halberd-leaf tearthumb
Hickory	River birch		Cardinal flower
Swamp white oak			Joe-Pye-weed
			Violet
			Foxtail grass
			Unknown grasses
			Arrowhead
			Purple loosestrife
			Aster
			Goldenrod
			Iris
			Skunk cabbage
			Jewelweed
			Swamp rose mallow
			Gill-over-the-ground
			White avens
			Clearweed
			Bog hemp
			Cocklebur

Historic Disturbances: Flooding, debris accumulation, siltation, erosion, windthrow, agriculture

Current Disturbances: Flooding, debris accumulation, siltation, windthrow, grazing, browsing, animal holes

SUBSEGMENT B1

Cover Type: Successional oldfield

Current Land Use: Unmanaged land, hiking, bicycling, hunting, trail biking, horseback riding, fishing

Vegetation Data:

CANOPY (Density-thin)	UNDERSTORY (Density-thin)	SHRUB (Density-none)	HERB (Density-thick)
Black locust	Silver maple		Great ragweed
Ailanthus	Mulberry		Ragweed
Catalpa	Catalpa		Aster
Silver maple	Ailanthus		Smartweed
	Box elder		Halberd-leaf tearthumb
	Black walnut		Sunflower
			New York ironweed

Historic Disturbances: Flooding, siltation, agriculture

Current Disturbances: Trampling, grazing, browsing

SUBSEGMENT B2

Cover Type: Successional oldfield

Current LandUse: Unmanaged land (some), hiking, fishing, passive use

Vegetation Data:

CANOPY (Density-thin)	UNDERSTORY (Density-thin)	SHRUB (Density-medium)	HERB (Density-thin)
White ash	Pin oak	Silky dogwood	Sunflower
Green ash	White ash	Hawthorn	Sensitive fern
Pin oak	Green ash	Elderberry	Common morning glory
Black oak	Black walnut	Red cedar	Milkweed
		Wild crabapple	Joe-Pye-weed
		Rose	Smartweed
		Staghorn sumac	Halberd-leaf tearthumb
		Swamp rose mallow	Jewelweed
			Dodder
			Arrow-leaved tearthumb
			Arrow-arum
			Unknown grasses
			Queen-Anne's lace
			Canada thistle
			Aster
			New York ironweed
			Sedges
			Green-headed coneflower
			Horsenettle

Historic Disturbances: Flooding, siltation, agriculture

Current Disturbances: Grazing, browsing, path, mowing (some)

SUBSEGMENT B3

Cover Type: Successional oldfield

Current Land Use: Unmanaged land (some), hiking, fishing, camping, hunting, passive use

Vegetation Data:

CANOPY (Density-thin)	UNDERSTORY (Density-thin)	SHRUB (Density-medium)	HERB (Density-thick)
Hawthorn	Hawthorn	Rose	Smartweed
White ash		Silky dogwood	Halberd-leaf tearthumb
Green ash		Blackberry	Arrow-leaved tearthumb
			Aster
			Great ragweed
			Goldenrod
			Ragweed
			Milkweed
			Brambles
			Yarrow
			Unknown grasses
			New York ironweed
			Green-headed coneflower

Historic Disburbances: Flooding, siltation, agriculture

Current Disturbances: Grazing, browsing, path

SUBSEGMENT B4

Cover Type: Pasture

Current Land Use: Pasture

Vegetation Data:

CANOPY (Density-none)	UNDERSTORY (Density-None)	SHRUB (Density-thin)	HERB (Density-thick)
		Silky dogwood	Unknown grasses
			New York ironweed
			Smartweed
			Halberd-leaf tearthumb
			Milkweed
			Heal-all
			Knotweed

Historic Disturbances: Grazing, browsing

Current Disturbances: Grazing, browsing

SUBSEGMENT C

Cover Type: Thicket and hedgerow

Current Land Use: Hiking, swimming, fishing, boating, bicycling, trail biking, passive use, picnicking, horseback riding

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-thick)	SHRUB (Density-medium)	HERB (Density-thick/thin)
Green ash	Box elder	Japanese barberry	Cinnamon fern
Pin oak	Pin oak	Silky dogwood	Iris
Black walnut	Black walnut	Rose	Jewelweed
Silver maple	Norway maple	Box elder	Goldenrod
Box elder	American elm	Black oak	Japanese honeysuckle
Hickory	Speckled alder	Elderberry	Grape
Sycamore	Green ash	Speckled alder	Japanese barberry
Swamp white oak	Silver maple	American hazel	Brambles
Tulip poplar	Slippery elm	Flowering dogwood	Poison ivy
Black locust	River birch	Spicebush	Dayflower
Red maple	Mulberry	Hickory	Greenbrier
Ailanthus	Basswood	Slippery elm	Groundnut
American elm	Willow	Common apple	Periwinkle
	Black locust	Black locust	Virginia creeper
	Red cedar	Wild crabapple	Meadowrue
	Red maple	Swamp white oak	Milkweed
	Black cherry	Red cedar	Stinging nettle
	Hackberry	Hackberry	Yarrow
	Ailanthus	Persimmon	Dodder
	Black oak	Black cherry	Virginia knotweed
		Sassafras	Ragweed
		Swamp white oak	Unknown grasses
			Pokeweed
			Purple loosestrife
			Butter-and-eggs
			Evening primrose
			Queen-Anne's lace
			Smartweed
			Arrow-leaved tearthumb
			Bog hemp
			Boneset
			Cocklebur
			Arrow-arum
			Pondweed
			Water lily
			Duckweed

Historic Disturbances: Cutting

Current Disturbances: Earthworks

Segment 23

HEDGEROW/THICKET, OLDFIELDS, AND MILLSTONE RIVER FLOODPLAIN WOODLAND
FROM GRIGGSTOWN CAUSEWAY TO SUYDAM ROAD

SEGMENT NARRATIVE

Segment 23 is a 2.2 mile (3.5 km) long corridor along the Millstone floodplain from Griggstown Causeway to Suydam Road. River Road roughly parallels the Canal and the Millstone on the left. There are four major communities in Segment 23: hedgerow/thicket along the Canal and towpath to its left (Subsegment A); the Millstone River floodplain woodland (Subsegment B); oldfield openings (Subsegment C) in the floodplain between the river and the Canal; wooded slopes along River Road and the predominant oldfield or pasture openings, usually wetter than those of Subsegment C, between the slopes and the Millstone (Subsegment D).

In the hedgerow/thicket (Subsegment A) along the towpath and Canal, green ash is dominant in the thick canopy, with American elm, mulberry, black locust, red oak, silver maple, and ailanthus also present. Willow and hickory are occasional components of the hedgerow. The understory includes black cherry, American elm, pin oak, apple *(Prunus malus)* and box elder (dominant). Medium-dense shrub and herb strata members include silky dogwood, black cherry, rose, barberry, and Norway maple.

The Millstone River floodplain woodland (Subsegment B) includes numerous green ash, box elder, silver maple, black oak, red oak, river birch, and pin oak in a canopy layer of medium to thick density. Silver maple and green ash are dominant. The understory layer is thin; it includes hawthorn and box elder. Arrowwood and spicebush dominate the thick shrub stratum. Greenbrier is dense on the trees here and climbs to heights of 15+ feet (5+ m). The herb layer is extremely sparse and includes sensitive fern, clearweed, poison ivy, Virginia knotweed, and white avens.

Between the Millstone River and the Canal are oldfields (Subsegment C) whose composition varies in relation to microtopographic changes. In drier zones, 15 to 20 foot (5 to 6.5 m) white ash and silver maple saplings are the predominant woody members, and silky dogwood is a frequently occurring shrub. Herbaceous species include numerous dense bands of coneflower, aster, goldenrod, ragweed, grasses, and New York ironweed. There are occasional mature, spreading pin oak, black oak, and ash trees scattered in the fields. (See Section A-A'.) Wetter areas evince more moisture-tolerant species (e.g., tearthumb, smartweed). A strip of floodplain woods like those of Subsegment B lines the river edge.

River Road forms the western (leftmost) boundary of the Canal Park in Segment 23. It is at a considerably higher elevation than the river in many places, and a steep wooded slope drops from the road. This slope is a part of Subsegment D. On it are found cedar, black locust, ash, shagbark hickory, sycamore, black cherry, black walnut, and silver maple, all in the canopy and understory strata. The upper layers are dense, so shrub and herb layers are very sparse.

Oldfield and abandoned pasture openings are generally found between the narrow slopes along River Road and the Millstone. These comprise the bulk of Subsegment D. (See Section B-B'.) Because the floodplain is bordered by a steep slope, soils are wetter, and species which are more moisture-tolerant than those of drier fields in Subsegment C are more prominent here. In addition to coneflower, several *polygonum* species (including arrow-leaved and halberd-leaf tearthumb) are frequent members of the herb stratum. Smartweed, patches of New York ironweed, grasses, and sedges are also present. Prominent woody species include willow and pin oak saplings 15 to 20 feet (5 to 6.5 m) tall. The abandoned pastures of Subsegment D appear to have very recently fallen into disuse, perhaps only one season ago. Grasses to 3 feet (0.7 to 1 m) in height are nearly exclusive vegetational occupants, with intermittent zones of Queen-Anne's lace.

The character of this segment is defined by the Millstone, which separates two areas that are structurally distinct. The area between the river and the Canal is very natural in character, composed largely of floodplain woods. Views through the woods are pleasant, and the oldfields provide a diversity of surroundings. Flooding severely controls undergrowth in certain zones, and the resulting freedom of movement in the woods is a welcome change. The towpath is well-defined and provides easy passage along the Canal. Where it has been recently graded, erosion is sometimes present, as in Segments 21 and 22. Canopy species close over the towpath, forming a vegetational tunnel. It is very quiet along most of the path, largely due to the vegetation buffer between the Canal Road and the Canal. The woods provide attractive views, and the river winds within sight of the path at various points.

On the other side of the Millstone, the character is quite different. Much of the community is in post-agricultural succession, and the vegetation is generally herbaceous and colorful. Coneflower, specifically, is of note, its bright yellow flowers forming bands of color throughout much of the area. The steep slopes along River Road provide a sharp visual contrast to the low, even fields.

Flooding is the only natural disturbance present in Segment 23. Cutting and use of the path keep it from becoming vegetated.

The Canal/river corridor in Segment 23 is used by people fishing, hiking, and pursuing other recreational activities. If additional land uses are desired, the path on the Canal side of the river could be extended so that it would include portions of the floodplain woods and offer access to the river and the fields on the opposite side. Intense recreational uses are a possibility in the old agricultural areas, but these areas would have to be maintained in order to keep out woody invaders.

Access into Canal Corridor

Griggstown Causeway (beginning of Segment) provides access into the Canal corridor.

Ease of Passage on Canal

Passage by water is somewhat hampered in Segment 23 by the low Griggstown bridge. Canoe passage, however, is possible.

Towpath

The towpath is excellent throughout the Segment.

Wildlife

No unusual wildlife was observed. Like Segment 22, Segment 23 provides a good habitat for many species.

Auditory Assessment

Infrequent traffic on River Road and Canal Road can be heard in some nearby areas of the Canal Park. For the most part, sounds are natural.

SUBSEGMENT A

Subsegment A is the Canal, the towpath to its left, and edge communities along both. The left side of the towpath slopes gently down to the Millstone River floodplain (Subsegments B and C).

Canopy species in the hedgerow/thicket edges include green ash (dominant), pin oak, red oak, basswood, black walnut, shagbark hickory, ailanthus, and black locust. Canopy height is approximately 30 to 40 feet (9 to 12 m), and the canopy is dense. The understory stratum includes pin oak, black cherry, American elm, apple, and box elder, box elder being dominant. Frequent members of the medium-dense shrub layer are silky dogwood, black cherry, and spicebush. In the herb stratum, also of medium density, are white and black oak seedlings, rose and numerous vines.

The path was in the process of being graded at the time of the field survey. It starts at the Griggstown Causeway and passes a small residential and commercial area where canoe rentals and supplies are available. Once past this initial developed area, the path maintains a thoroughly natural character to the end of the segment. Grading and some subsequent erosion were observed at the beginning of the Subsegment.

Canopy trees form a ceiling over the path, and curves along its length create sequential views. The effect of sunlight filtering through the vegetation, backlighting canopy foliage and falling in varying degrees of intensity

upon the path and adjacent floodplain floor is visually pleasant. The Canal itself is often shaded also. In general, the Subsegment is quiet, contiguous land uses buffer it from nearby Canal Road. Spur trails into the adjacent floodplain (Subsegment B) could be valuable assets to the recreational potential of Segment 23.

Community Dynamics

Seedlings and saplings of woody species indicate that this hedgerow/thicket will continue to be stable.

Management Recommendations

Regrade or fill edges of the path in eroded areas and plant vegetative cover to stabilize the edges in order to prevent further erosion.

SUBSEGMENT B

Much of the land lying within State boundaries in Segment 23 is covered by Millstone floodplain woodland (Subsegment B). The Subsegment encompasses all the woodland between the Canal embankment and the river. A similar woodland lines the river edge along much of Subsegment D.

In terms of specific vegetation, except for two areas where openings (the oldfields of Subsegment C) interrupt the floodplain woodland, the community is consistent in character. Midway through the Subsegment, the river swings close to the Canal towpath embankment, leaving only a small floodplain to separate the two. On the whole, the woodland canopy is dense, with fewer breaks than in Segments 22 and 24. It sometimes reaches a height of 60 feet (18 m) and is dominated by silver maple and green ash. Pin oak is also common. DBH of silver maple reaches 3 feet (1 m) at times. The understory contains these canopy species, as well as hawthorn and box elder. Spicebush and arrowwood dominate the dense shrub layer, and white avens, clearweed, smartweed, and poison ivy are members of the thin herb stratum. Animal holes and evidence of scouring by flood are present in Segment 23, as in the previous segment.

The Millstone River floodplain woodland provides a shaded, cool environment, free of unnatural noise and visual disturbances. In areas where the shrub and herb layers are thin, relatively unbroken views are possible through the woods and to the river. This subsegment provides valuable passive recreation space for the Canal Park.

Community Dynamics

This community should remain stable, given the present land uses and flood regime. Where the river is close to the Canal embankment, however,

flooding may limit growth in the lower layers.

Management Recommendations

None

SUBSEGMENT C

Oldfield openings in the floodplain woodland near the beginning and end of Segment 23 comprise Subsegment C. These two fields are in early succession, and 10 to 15 foot (3 to 4.5 m) high white ash and silver maple are the predominant woody invaders. Mature pin oak, black oak, and ash individuals punctuate the fields. Silky dogwood and rose are occasionally found at shrub height, but the herb layer is of primary importance.

Thick bands of coneflower, goldenrod, aster, ragweed, grasses, and smartweed cover the field. There are wet areas at the base of the towpath embankment and scattered throughout the fields, and moisture-tolerant herbs are found in these areas. On the left side of the Subsegment C openings, adjacent to the floodplain woods at the edge of the river, blackberry, burdock, rose, and New York ironweed are numerous.

The most striking visual element of these fields is the contrast between bands of bright yellow coneflower and the muted colors of other species present. The fields are almost wholly surrounded by woodland, offering a peaceful sense of enclosure. Occasional flooding seems to be the only disturbance in Subsegment C. These open areas could continue to be used for passive recreation or could be developed for more intense uses.

Community Dynamics

If left undisturbed, these oldfields should continue in succession.

Management Recommendations

If land use is anticipated, succession should be controlled by management (e.g., cutting, mowing).

SUBSEGMENT D

Subsegment D lies between the Millstone River and River Road. The predominant cover type is oldfield and pasture; along the river edge is a strip of floodplain woods like those of Subsegment B, and the slope which drops from the road to the floodplain is also wooded. Red cedar, black locust, black cherry, sycamore, ash, shagbark hickory, and silver maple are found in

dense canopy and understory of this well-drained woodland; the herb and shrub strata are sparsely vegetated by shade-loving species.

Floodplain woods along the river (outer floodplain) exhibit the same dominance of silver maple and green ash as in Subsegment B. At the edge of the fields, adjacent to the floodplain woods, are canopy specimens of ash and silver maple. Numerous blackberry and silky dogwood also form the edge to the woods. The fields and pastures themselves have a composition similar to that of Subsegment C, but species mix varies. The narrower floodplain and steep slopes abutting it cause the soil to be wet for longer periods, and moisture-tolerant species are found in greater proportions.

Coneflower is prominent, as are arrow-leaved and halberd-leaf tear-thumb, smartweed, grasses, and sedges. Clumps of New York ironweed are found throughout Subsegment D. Willow and pin oak saplings 15 to 20 feet (5 to 6.5 m) are found in the oldfield areas. In old pasture areas which appear to have been abandoned quite recently, 3 foot (1 m) grasses and Queen-Anne's lace are common in the herb layer. Isolated canopy specimens such as the large (3+ feet or 1+ m DBH) pin oak and black oak trees at Special Feature 1 occasionally interrupt the evenness of these pastures.

Subsegment D rests in a visual trough bounded by the slope and the floodplain woodland. The area is generally quiet, although road noise can occasionally be heard. This side of the Millstone River could be used for passive or intense recreational activity. Pedestrian links to the towpath and bridges across the Canal and the Millstone would make Subsegment D more accessible.

Community Dynamics

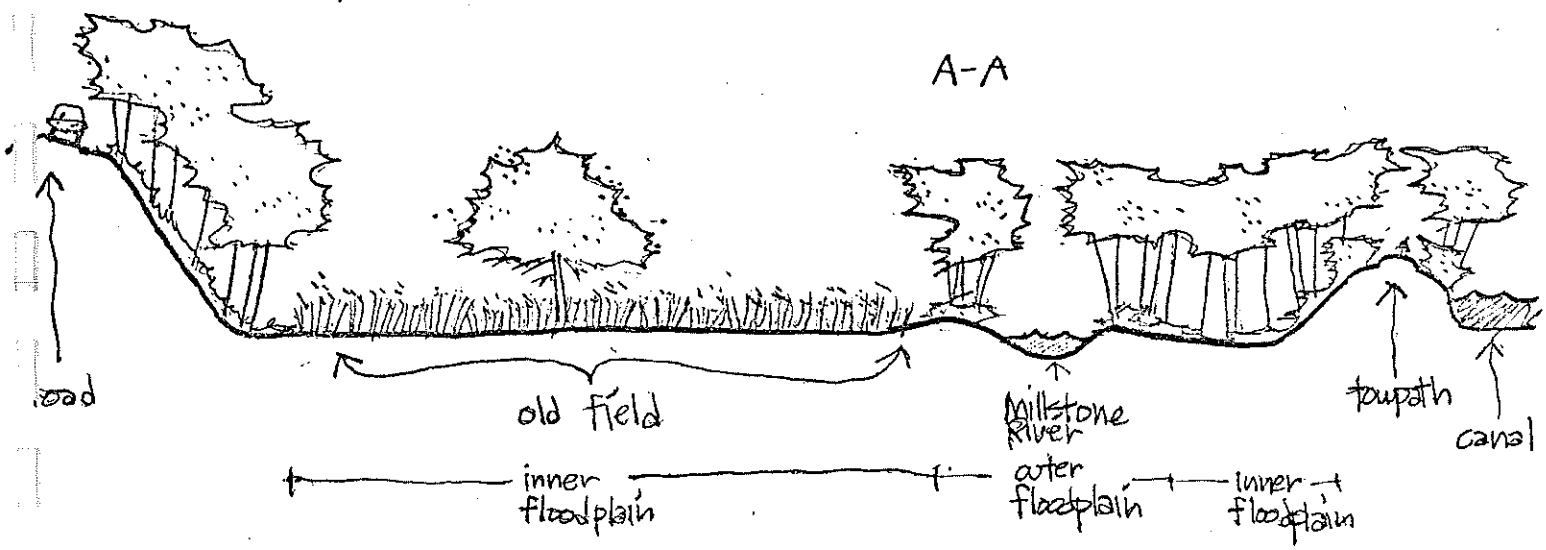
The floodplain woodland along the Millstone and wooded slopes below River Road should remain stable, given the present land uses and flood regime. Oldfield openings may continue in succession, although the prolonged wet soils will inhibit colonization of some woody species.

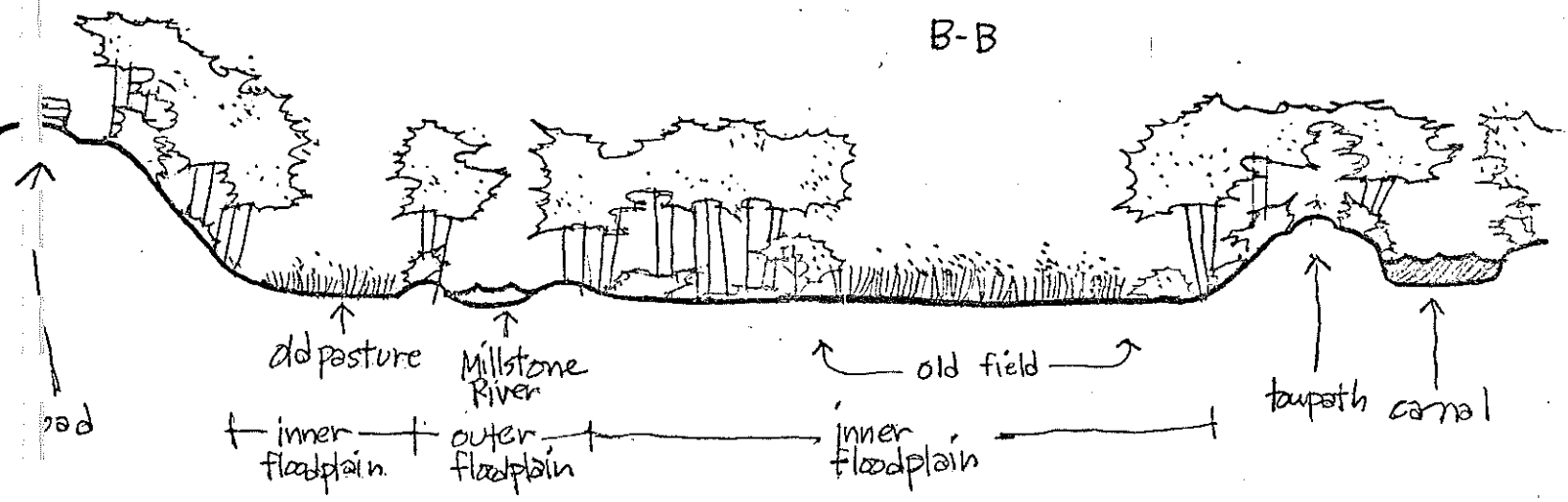
Management Recommendations

If land use is anticipated, succession should be controlled by management (e.g., cutting, mowing).

Segment 23

Sections





CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	moist upland woods	unmanaged land
b	residential trees	single house (with yards)
c	agricultural field	pasture tilled field(cropland)
d	residential	institutional
e	moist upland woods	managed woodland hunting

TOPOGRAPHIC CROSS-SECTIONS

A-A'--- Downstream from Township Line Road
B-B'--- Between Green Avenue and Township Line Road

SPECIAL FEATURES

1 --- Specimen oaks

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Oldfield opening	4	8b
2	Footpath along left side of Canal	4	"
3	Canoeist using Canal	4	"

SEGMENT 23 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow

Current Land Use: Managed woodland, hiking, fishing

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-medium/thin)	SHRUB (Density-medium)	HERB (Density-medium)
Green ash	Box elder	Silky dogwood	White oak
Box elder	Red oak	Japanese barberry	Black oak
American elm	Pin oak	Norway maple	Poison ivy
Basswood	Wild crabapple	Speckled alder	Rose
Red oak	Black cherry	Rose	Japanese barberry
Pin oak	American elm	Black cherry	Japanese honeysuckle
Black locust	Slippery elm	Spicebush	Blackberry
Red maple	Silver maple	Flowering dogwood	Virginia creeper
Silver maple		Hazel	Grape
Ailanthus			
River birch			
Red cedar (rare)			
Willow			
Shagbark hickory			
Mulberry			

Historic Disturbances: Cutting, trampling

Current Disturbances: Cutting, trampling

SUBSEGMENT B

Cover Type: Piedmont floodplain/Coastal Plain floodplain

Current Land Use: Managed woodland

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-thin)	SHRUB (Density-thick)	HERB (Density-thin)
Silver maple	Hawthorn	Spicebush	Virginia creeper
Pin oak	Box elder	Arrowwood	Sensitive fern
Red oak	Silver maple	Greenbrier	Bog hemp
Green ash	Green ash	Grape	Grape
River birch	Red oak		White avens
Box elder	Pin oak		Greenbrier
Black oak			Clearweed
			Poison ivy
			Smartweed
			Virginia knotweed

Historic Disturbances: Flooding, debris accumulation, siltation, culvert

Current Disturbances: Flooding, debris accumulation, siltation, culvert

SUBSEGMENT C

Cover Type: Successional oldfield

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY (Density-none)	UNDERSTORY (Density-thin)	SHRUB (Density-thin)	HERB (Density-thick)
	White ash	Silky dogwood	Aster
	Silver maple	Rose	Green-headed coneflower
	Pin oak		New York ironweed
	Black oak		Groundnut
			Blackberry

CANOPY	UNDERSTORY	SHRUB	HERB
			Rose
			Unknown grasses
			Sedges
			Goldenrod
			Great ragweed
			Smartweed
			Tearthumb
			Burdock

Historic Disturbances: Flooding, agricultural uses

Current Disturbances: Flooding

SUBSEGMENT J)

Cover Type: Successional oldfield, successional pasture, upland woods

Current LandUse: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thin/thick)	(Density-thin/thick)	(Density-medium)	(Density-thick)
Pin oak	Silver maple	Silky dogwood	Green-headed coneflower
Black oak	Green ash	Blackberry	New York ironweed
Red cedar	Red cedar	Rose	Smartweed
Black locust	Black locust		Arrow-leaved tearthumb
Shagbark hickory	Shagbark hickory		Halberd-leaf tearthumb
Sycamore	Sycamore		Sedges
Black cherry	Black cherry		Blackberry
Black walnut	Black walnut		Ragweed
			Great ragweed
			Goldenrod
			Aster
			Willow
			Pin oak
			Queen-Anne's lace

Historic Disturbances: Agricultural uses, flooding

Current Disturbances: Flooding

Segment 24

MILLSTONE RIVER FLOODPLAIN-WOODLAND, HEDGEROW/THICKET, OLDFIELDS, AND MEADOW FROM SUYDAM ROAD TO TEN MILE LOCK

SEGMENT NARRATIVE

Segment 24 encompasses a wide corridor along the Canal and the Millstone River from Suydam Road to Ten Mile Lock (5.4 miles or 8.7 km). (See the maps on Sheets 8a and 9a.) Part of the land to the west of the Millstone was surveyed at the request of the Canal Commission for possible acquisition by the Canal Park. There are four distinct communities in Segment 24: the hedgerow/thicket lining the Canal and towpath (Subsegment A); the Millstone River floodplain woodland (Subsegment B); oldfields which alternate with woodland on the left side of the river and one oldfield to the right of the Canal two miles (3.2 km) from the beginning of the segment (Subsegment C); and a wet, marshy meadow between the Canal and the river near the beginning of the segment (Subsegment D).

The vegetation and structure of the communities in Segment 24 closely resemble those of Segment 23. As in Segment 23, the towpath runs to the left of the Canal, and hedgerow/thicket (Subsegment A) lines both. About halfway through this segment (north of the East Millstone bridge), there are more frequent breaks in the canopy and the community has a more thicket-like character.

The Millstone River floodplain woodland, too, is similar to that of the prior segment, with dominant silver maple, pin oak, and white and green ash reaching heights of 60 feet (18 m) and DBHs of 2 to 3 feet (0.6 to 1 m). In the woodland of this segment (Subsegment B), there is a pronounced yazoo which generally parallels the Canal embankment; where it is wet, moisture-loving plants such as smartweed and knotweed thrive. Canopy breaks are more frequent in this woodland, particularly in the latter half of the subsegment. Here Japanese honeysuckle is dominant and reaches all strata, often shading out other undergrowth and prohibiting the establishment of woody seedlings and saplings.

The oldfield openings (Subsegment C) vary slightly as to successional period and species mix. Again, coneflower is prominent, with ragweed, goldenrod, aster, New York ironweed, sedges, and grasses also forming the thick herb layer. Smartweed and tearthumb are additional members of this stratum. Clumps of silky dogwood and rose are found in Subsegment C, with grasses surrounding them. On the outer floodplain (along the river) is a band of floodplain woods.

The wet meadow (Subsegment D) lying between Canal and river near the beginning of the segments is dominated by low-growing smartweed, knotweed, tussock sedge, reeds, and marsh grasses. Clusters of shrubs (e.g., buttonbush, dogwood) are also found here.

As in Segment 23, the diversity of surroundings provides interesting views and the segment is largely natural and quiet. Disturbances are few. A few private residences and active pasture areas within the land bounded by River Road and Canal Road were designated as contiguous land uses by the field survey team. The nearby town of East Millstone offers supplies and canoe rentals to users of the Canal Park, and historic buildings east of Manville (Special Features 1 and 2) add interest to the area.

People hiking and fishing were observed, and the segment offers potential for both passive and intense recreational uses. Spur trails from the towpath through the floodplain would provide additional recreational possibilities, and areas of the floodplain which are relatively free of undergrowth could be developed for overnight camping.

Access into Canal Corridor

The right side of Canal Corridor is accessible at the beginning and end of the segment. Three roads which cross the segment provide access to the Millstone River floodplain.

Towpath

The Towpath is in excellent condition along its entire length.

Ease of Passage on Canal

Passage on the Canal in Segment 24 is hampered by bridges, especially the one at Amwell Road (Millstone-East Millstone).

Wildlife

Pheasants, hawks, and a kingfisher were observed. Animal holes (e.g., muskrat, raccoon), deer tracks and snakes were found in the floodplain. The segment provides good habitats for a variety of species.

Auditory Assessment

Infrequent traffic noise is audible in parts of the segment which adjoin roads. Otherwise, sounds are natural.

SUBSEGMENT A

Subsegment A comprises the Canal and towpath and the hedgerow/thicket along them. The towpath runs along the left side of the Canal for the entire length of the segment.

The hedgerow/thicket resembles that of Segment 23. Canopy members reach 30 feet (10 m) and include shagbark hickory, red maple, silver maple, American elm, mulberry, box elder, pin oak, river birch, and green ash (dominant). The understory stratum is composed of willow, American elm, red oak, black locust, white ash, hawthorn, flowering dogwood, and mulberry (dominant). Shrub members are silky dogwood, speckled alder, hickory, hazelnut, slippery elm, ailanthus, and dominants spicebush and hackberry. The herb layer includes clumps of raspberry, Virginia creeper, blackberry, rose, and dominant Japanese honeysuckle.

In the first half of the subsegment, the hedgerow/thicket is largely continuous, as in Segment 23. A powerline right-of-way causes the only significant break in the canopy over the path.

In the latter portion of the subsegment, canopy breaks are more frequent. In openings, black locust, honeylocust, American elm, pin oak, and green ash are the occasional canopy members and vegetate the edges of the openings. Understory members are green ash, apple, cedar, black cherry, willow, pin oak, and silver maple. Shrubs include winged sumac, arrowwood, silky dogwood, and black cherry. Herbs are the primary vegetative cover here and include New York ironweed, grape, coneflower, tearthumb, aster, goldenrod, grasses, sedges, blackberry, rose, jewelweed, and ragweed. In wetter spots, arrow-arum, sedges and jewelweed are found.

The towpath area is primarily natural in character, maintained by use and periodic cutting. Its raised embankment provides excellent views into the various communities of the Millstone floodplain. Where the Millstone nears the canal, undergrowth is very sparse; in other areas, it is dense. On the right side of the Canal, the relatively narrow hedgerow/thicket screens the road next to it for the most part.

Here, as in other segments where the path is adjacent to the Millstone floodplain, spur trails through the floodplain to the river could be desirable additions to the path system. Some areas in the floodplain that are relatively free of undergrowth could be developed as primitive-type campsites (i.e., no shower facilities, etc.) for overnight use.

Community Dynamics

Seedlings and saplings of woody species indicate that this hedgerow/thicket will continue to be stable.

Management Recommendations

None

SUBSEGMENT B

In the woodland that covers much of the Millstone River floodplain in Segment 24, silver maple, white and, green ash, and pin oak are dominant. The canopy reaches a height of 60 feet (18 m) in places, and DBHs of 2 to 3 feet (0.6 to 1 m) are occasionally found. Shagbark hickory, swamp white oak, and box elder are also common constituents of the canopy. The understory contains canopy species, river birch, red maple, osage orange, black walnut, and basswood.

Canopy breaks are more frequent here than in Segment 23. These are especially noticeable in the latter half of the segment. Japanese honeysuckle becomes dominant in these areas and invades nearby upper strata. Grape, poison ivy, and greenbrier are also found. In shady areas below the canopy and understory, spicebush, arrowwood, and saplings form a thin shrub layer, and violet, white avens, clearweed, and smartweed are found in the herb stratum.

A pronounced yazoo parallels the Canal embankment in Subsegment B. Moisture-tolerant herbs thrive in this yazoo (e.g., smartweed, knotweed, arrow-arum, arrowhead, skunk cabbage).

The floodplain woodland is disturbed only by flooding, which scours herb and shrub strata in places. Animal holes are found near the Millstone, and the subsegment provides a good habitat. It is generally quiet and views are pleasant. Many recreational activities were observed, and the subsegment offers several potential overnight camp sites. Spur trails through the woods would supplement the towpath.

Community Dynamics

This community should remain stable, given the present land uses and flood regime. Where the river is close to the Canal embankment, however, flooding may limit growth in the lower layers.

Management Recommendations

None

SUBSEGMENT C

Several oldfields and abandoned pastures lie on the left side of the Millstone River between it and River Road, and one lies to the right of the Canal near mid-segment. These fields (Subsegment C) vary slightly as to successional period, and species mix, but their composition is basically similar. Also in this area are a few private residences and active pasture areas which were designated by the field survey team as contiguous land.

These old agricultural lands are vegetationally similar to those described in Segment 23, Subsegments C and D, with coneflower, ragweed, aster, New York ironweed, and goldenrod prominent.

There are a few zones composed almost exclusively of silky dogwood, rose, and grasses. The dogwood and rose form mounded clumps, and grasses occupy the ground surrounding the mounds. A band of floodplain woods (shagbark hickory, pin oak, sycamore, green ash, and occasional hawthorn) occupies the outer floodplain, except in one area where the road and river are at approximately the same elevation and an oldfield reaches completely to the river.

Visual and auditory experiences are like those of the oldfields of Segment 23.

Community Dynamics

If left undisturbed, these oldfields and old pastures should continue in succession. The Floodplain woodland strip along the Millstone should remain stable, given the present land uses and flood regime.

Management Recommendations

If land use is anticipated, succession in the oldfields and old pastures should be controlled by management (e.g., cutting, mowing).

SUBSEGMENT D

Subsegment D is a wet meadow which lies near the beginning of the segment between the Canal and Millstone River. The opening is linear in form and is surrounded by floodplain woods (Subsegment B). Overall, the meadow is fairly uniform in height and is dominated by low-growing herbaceous plants. The primary species include tussock sedge, smartweed, knotweed, various reeds, and marsh grasses. These species are not homogeneously mixed. Microtopographic variations and differing soil moisture conditions across the meadow cause small differences. Patches of vegetation reflect variations of environment and substrate.

The dense herbaceous stratum is occasionally interrupted by clusters of woody shrubs. The most abundant shrubs are buttonbush and dogwood. Near the meadow edge are several dead pin oaks. The variety of colors in this meadow enhance the views. Noise of infrequent traffic on Suydam Road is occasionally audible.

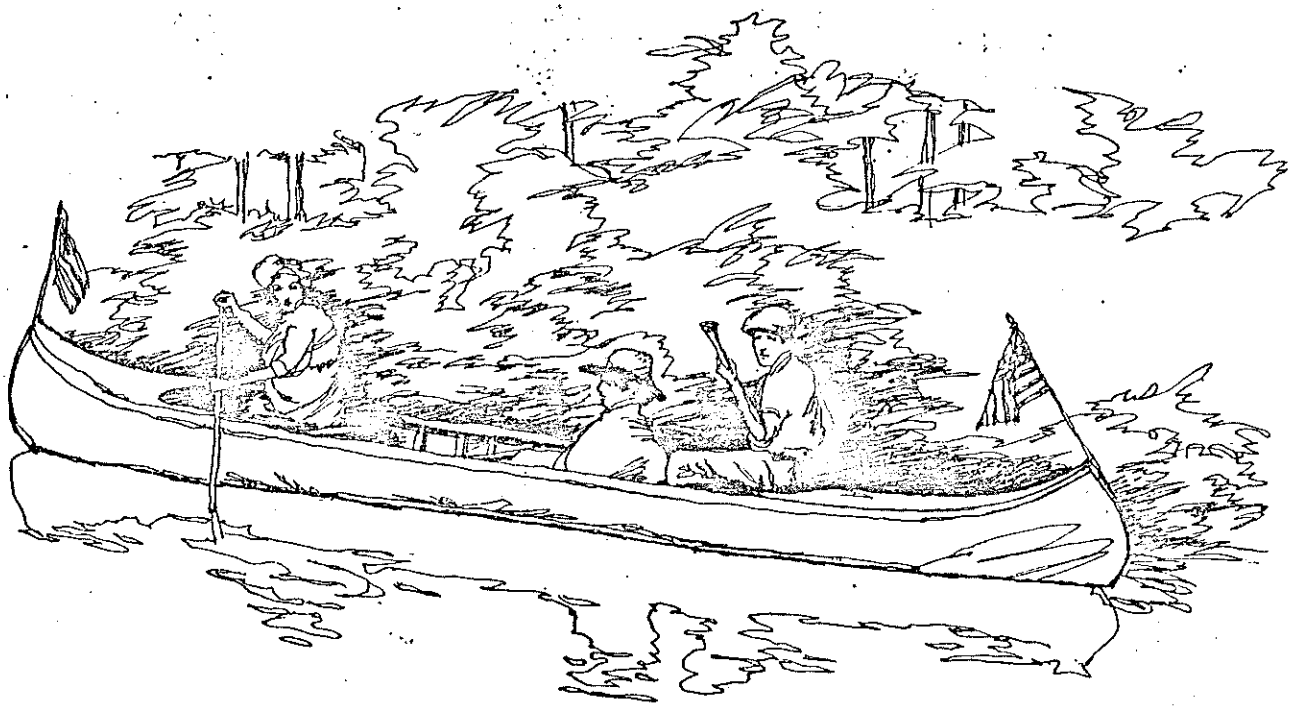
Because the herbaceous layer is so dense, travel through the meadow is difficult. At the same time, this thick vegetation offers a protected habitat for wildlife.

Community Dynamics

Prolonged soil saturation may inhibit colonization of some woody species.

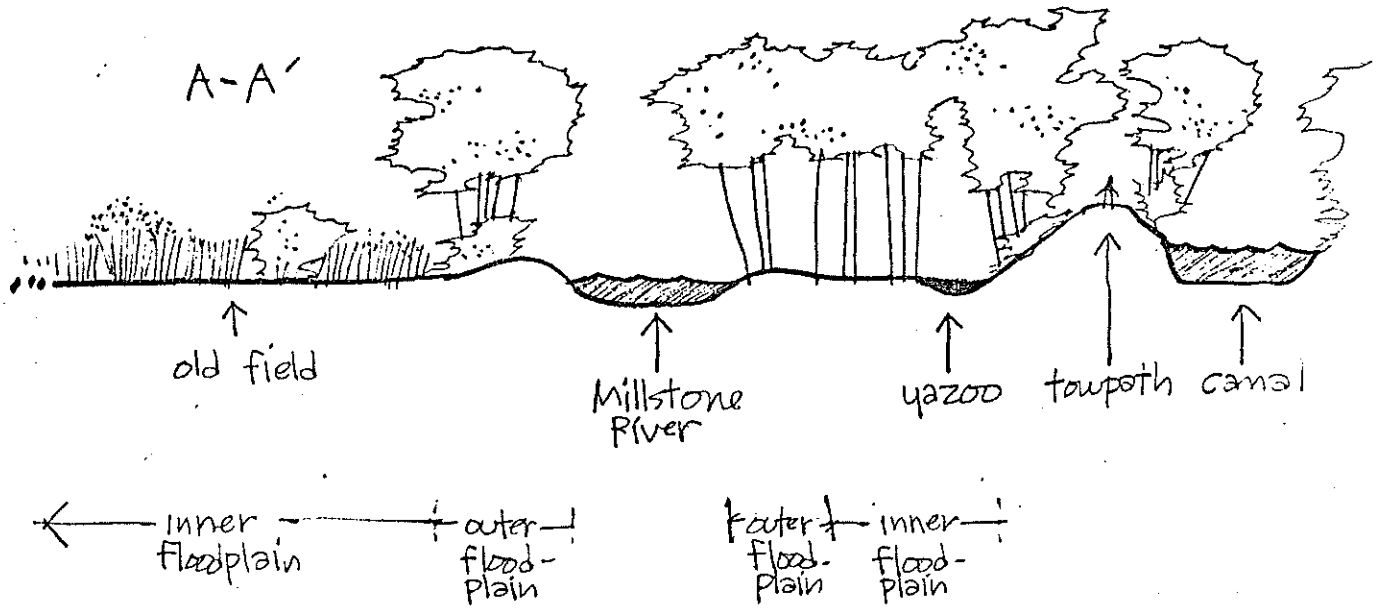
Management Recommendations

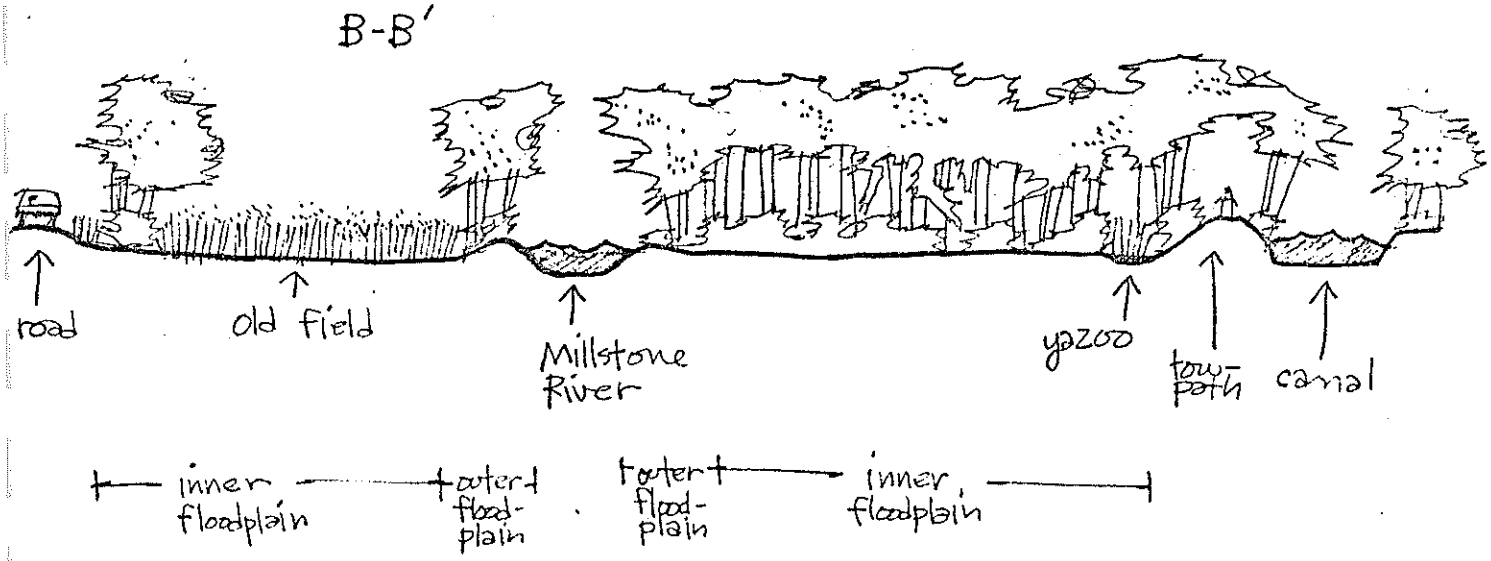
None



Segment 24

Sections





CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	moist upland woods	unmanaged land
b	residential trees	single houses (with yards)
c	agricultural field	pasture tilled field
d	residential	institutional
e	successional oldfield	unmanaged land
f	agricultural field	tilled field protected area (refuge, preserve, etc.)

TOPOGRAPHIC CROSS-SECTIONS

A-A'--- Between Griggstown and Millstone where river is close to Canal.
B-B'--- Between Griggstown and Millstone where river is farther from Canal.

SPECIAL FEATURES

1 --- Old toll house.
2 --- Old Mill house-1700's.

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Coneflower field	6	8b
2	Pasture	6	"
3	Canal from bridge at Blackwell's Mills	6	"
4	Honeysuckle along towpath	6	"
5	Oldfield	6	"
6	Dogwood along towpath	6	"
7	Towpath	6	"
8	Floodplain woods	6	"
9	Floodplain woods	6	"
10	Coneflower field	6	"
11	Across Canal	6	"
12	Millstone River	6	"
13	Across Canal	6	"
14	Floodplain woods	6	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
15	Old pasture/meadow	6	"
16	Sycamore	6	"
17	Wet area	6	"
18	Industrial use across Canal	6	"
19	Reflection of contiguous industrial land use	6	"
20	Pipe across Canal	6	"
21	Millstone floodplain--tree overhang and sunny opening	7	"
22	Oldfield opening (2 to 3' *Polygonum* spp.)	7	"
23	Grape-covered opening	7	9b
24	Windthrow on floodplain	7	"
25	Canal use-canoeing	7	9b
26	Undeveloped park/open space	7	"

SEGMENT 24 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow

Current Land Use: Managed woodland, hiking, fishing

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-medium)	SHRUB (Density-medium)	HERB (Density-medium)
Green ash	Box elder	Silky dogwood	White oak
American elm	Sugar maple	Japanese barberry	Black oak
Box elder	Common apple	Rose	Poison ivy
Basswood	Red maple	Norway maple	Rose
Red oak	Speckled alder	Black cherry	Japanese barberry
Silver maple	Beech	Spicebush	Japanese honeysuckle
Red maple	Red oak	Speckled alder	Blackberry
Honeylocust	Pin oak	Flowering dogwood	Virginia creeper
Pin oak	Wild crabapple	Ironwood	Grape
Ailanthus	Black cherry	Hazel	Groundnut
Black locust	Mulberry	Red cedar	Field horsetail
Red cedar	Silver maple	Arrowwood	Raspberry
River birch	Ironwood	Hickory	New York ironweed
Willow	Willow	Slippery elm	Coneflower
Black walnut	American elm	Ailanthus	Tearthumb
Mulberry	Black locust	Hackberry	Aster
	White ash	Winged sumac	Goldenrod
	Hawthorn		Sedges
	Flowering dogwood		Jewelweed
	Green ash		Ragweed
	Cedar		Arrow-arum

Historic Disturbances: Cutting, trampling

Current Disturbances: Cutting, trampling

SUBSEGMENT B

Cover Type: Gravel/dirt roadway, railroad

Current Land Use: Managed woodland

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-None)	SHRUB (Density-thick)	HERB (Density-thin)
Silver maple	Hawthorn	Spicebush	Virginia creeper
Green ash	Box elder	Hemlock	Sensitive fern
Pin oak	Silver maple	Greenbrier	Greenbrier
Red oak	Green ash	Grape	Grape
River birch	Mulberry	Elderberry	White avens
Willow	Pin oak	Slippery elm	Bog hemp
Shagbark hickory	Osage orange	Rose	Clearweed
Honeylocust	Basswood	Arrowwood	Poison ivy
Sycamore	Ailanthus		Smartweed
White ash	Sugar maple		Virginia knotweed
Swamp white oak	River birch		Violet
Box elder	Red maple		Halberd-leaf tearthumb
	Black walnut		Goldenrod
			Climbing false buckwheat
			Sedges
			Japanese honeysuckle
			Sunflower

Historic Disturbances: Flooding, debris accumulation, siltation, culvert

Current Disturbances: Flooding, debris accumulation, siltation, culvert

SUBSEGMENT C

Cover Type: Successional oldfield

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thin)	(Density-None)	(Density-medium)	(Density-thick)
Green ash	Silver maple	Silky dogwood	Green-headed coneflower
Sycamore	Green ash	Blackberry	New York ironweed
Pin oak	Hawthorn	Rose	Smartweed
Shagbark hickory	Pin oak		Arrow-leaved tearthumb
	Shagbark hickory		Halberd-leaf tearthumb
			Sedges
			Blackberry
			Great ragweed
			Ragweed
			Goldenrod
			Aster

Historic Disturbances: Agricultural use

Current Disturbances: Flooding

SUBSEGMENT D

Cover Type: Meadow

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERTORY	SHRUB	HERB
(Density-thin)	(Density-None)	(Density-medium)	(Density-thick)
Pin oak		Silky dogwood	Smartweed
Black oak		Buttonbush	Halberd-leaf tearthumb
			Common reed
			Sedges
			Knotweed

Historic Disturbances: Agricultural use

Current Disturbances: Flooding

Segment 25

LANDSCAPED OPEN SPACE AND FLOODPLAIN WOODLAND AT TEN MILE LOCK

SEGMENT NARRATIVE

Segment 25 is a special node (220 to 250 feet or 60 to 68 m long) between the Millstone River and Canal Road. The segment lies just upstream of the point where the Raritan joins the Millstone. (See the map on Sheet 9a.) This location has been labeled a "special node" by the Canal Commission because Ten Mile Lock is a focal point within the segment. The name is of interest because it signifies that this lock/sluice is located 10 miles (25 km) from the point where the Canal enters the Raritan in New Brunswick. Two subsegments compose the segment. Subsegment A is landscaped open space around the lock/sluice. Subsegment B is the floodplain woodland between it and the Millstone River.

On both sides of the lock/sluice is a strip of mowed lawn (Subsegment A) with a few canopy trees--Norway maple, for example. This well-maintained portion is also the location of a small renovated historic building (Special Feature 1). A path runs to the left of the Canal through Subsegment A.

The second community (Subsegment B) lies between the grassed opening and the Millstone River. Its cover type is floodplain woodland very similar in composition and structure to that described in previous segments. The canopy is dominated by white ash, silver maple, and pin oak. Box elder and black locust accompany the canopy species to form an overstory which is mostly continuous and thick. The shrub layer, usually thin, is dominated by spicebush, although elderberry and arrowwood are common constituents. The floodprone woodland floor is thinly covered by jewelweed, gill over-the-ground, violet, and white aven. Poison ivy is probably the most abundant herb, and it climbs high into the trees. Greenbrier is less abundant and exhibits similar climbing tendencies. In the few places where openings in the canopy occur, sunlight is plentiful and sun-loving vines, shrubs, and grasses (e.g., rose, honeysuckle, grape, Virginia creeper) proliferate. There are a number of trails through the woods.

The area is posted as "restricted," but it appears to have high appeal for recreation. Strolling, picnicking, fishing (Canal and river), and other passive uses were observed during inspection. Numerous hiking trails lead from the lock area and through the woods to the river. A number of factors combine to make this small area a popular retreat: ease of access to the river, Canal, towpath, and woods, as well as the variety of environments (sunny, mowed, open space around the Canal, or shady isolated woods). One noticeable drawback is the lack of parking space for those wishing to use the State property of this area. The segment is relatively undisturbed and attractive for passive recreation.

Access into Canal Corridor

Segment 25 can be easily entered from Canal Road. A footbridge across the head of the lock makes crossing the Canal no obstacle. However, access into the Canal Park in this segment is discouraged by signs which mark the area "restricted."

Towpath

The towpath runs next to the lock through the landscaped open space (Subsegment A).

Ease of Passage on Canal

Passage is blocked by the lock/sluice.

Wildlife

No wildlife was observed, but areas of the floodplain woods (Subsegment B) provide good habitats.

Auditory Assessment

In the area immediately surrounding the lock, the pleasant sound of moving water is omnipresent. Intermittent auto noise (from Canal Road) accompanies the water sounds. The woods (Subsegment B) are buffered from these sounds and are quiet and peaceful.

SUBSEGMENT A

Subsegment A is the landscaped open space, the Canal, and the lock/sluice (Special Feature 2). The vegetation is mostly mowed lawn. Several canopy trees (Norway maple) provide shade in this otherwise exposed area.

A small historic building has been recently restored on the premises (Special Feature 2). It appears that the building will be used as a residence.

The lock structure is of special interest. The water moves swiftly through the lock after passing through the sluice; the sound is a refreshing one. A slick of duckweed blankets the water behind the sluice. A smaller sluice just upstream from the lock permits water to leave the Canal and enter a small auxiliary ditch which parallels the Canal. This diversion may prevent flooding during periods of high flow.

This subsegment is well-managed and offers a pleasant developed recreation site. Long views up and down the Canal are an attraction. Fishing,

picnicking, and strolling were observed activities. Water was being extracted from the Canal at Special Feature 3 for irrigation of nearby agricultural land.

Community Dynamics

The open space immediately around the lock/sluice (Subsegment A) is maintained (e.g., mowing, cutting).

Management Recommendations

Clarify the availability of Ten Mile Lock as a recreational area ("restricted" notice, residential use of historic building).

SUBSEGMENT B

Subsegment B is a small area of floodplain woods which occupies the space lying between the landscaped open space around the lock (Subsegment A) and the Millstone River. The woodland is very similar to the woods lining the Millstone in Segments 21-24. The canopy is thick and reaches a height of 40 to 60 feet (12 to 18 m). Sycamore, white ash, and silver maple are common in this layer. Among the dominants in the understory are box elder, mulberry, and black locust. The shade produced by a thick canopy cause the shrub layer to be thin in many spots. Elderberry and spicebush dominate the shrub stratum, and arrowwood is quite common. Many areas on the floodplain floor also tend to be thinly covered due to shade and flooding. Poison ivy is dominant, and it climbs high into overstory trees. Jewelweed, violet, gill-over-the-ground, grape, and white aven also inhabit the herb layer. A small area within the woods near the lock is canopy-free. This opening is dominanted by low-growing shrubs, herbs and vines, honeysuckle, grape, and various grasses prominent among them.

The woods are laced with trails which are probably made and maintained by fishermen and strollers. Windthrow damage is apparent throughout the subsegment. The cool, damp, shady woods contrasts with the warm, sunny open area around the lock. The Millstone River and a waste water treatment plant near the Raritan River confluence are visible from the wooded banks of the floodplain. Despite the close proximity to urban areas (e.g., Manville, Bound Brook), Segment 25 is a pleasant, largely natural area which is free of auditory and visual disturbances.

Community Dynamics

The floodplain woodland should remain stable, given current land uses and flood regime.

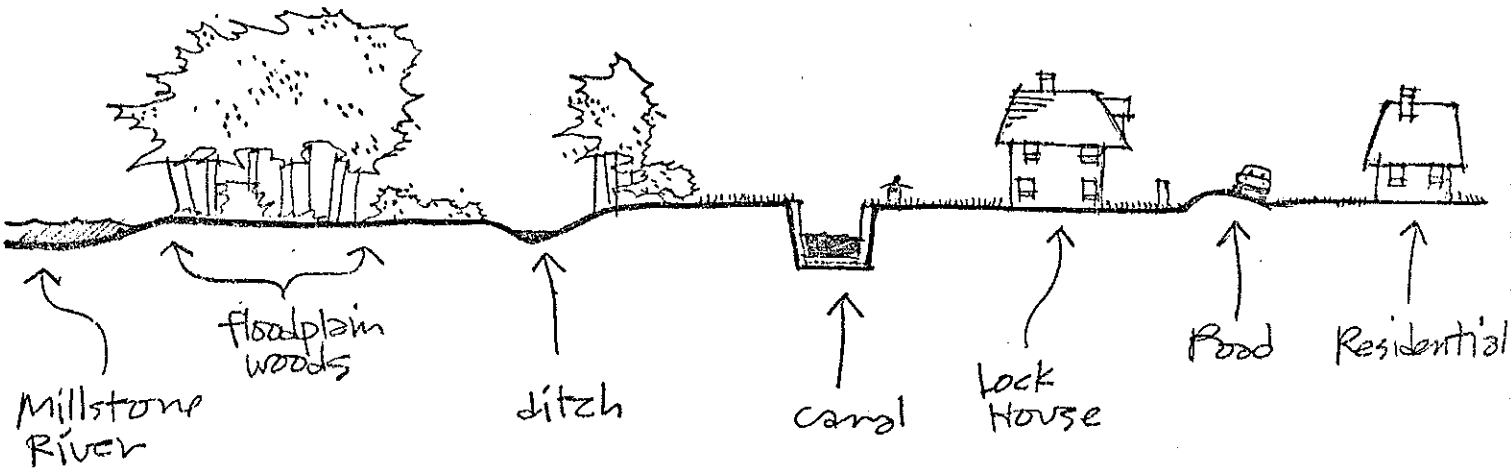
Management Recommendations

None, except as noted in Subsegment A.

Segment 25

Section

A-A'



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	residential saplings	single houses (with yards)

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- Upstream of lock house

SPECIAL FEATURES

1 --- Historic house being renovated on state property
2 --- Lock/sluice
3 --- Water withdrawal for agriculture

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Sign at Ten Mile Lock	4	9b
2	Ten Mile Lock	4	"
3	Recently renovated lock house at Ten Mile Lock	4	"

SEGMENT 25 VEGETATION DATA

SUBSEGMENT A

Cover Type: Landscaped open space

Current Land Use: Hiking, fishing, boating, passive use, picnicking, single houses

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thin)	(Density-thin)	(Density-None)	(Density-thick)

----------Mowed lawn and few landscape trees ----------

Historic Disturbances: Bulkheading, mowing, cutting, earthworks, excavation

Current Disturbances: Bulkheading, mowing

SUBSEGMENT B

Cover Type: Piedmont floodplain, Coastal Plain floodplain

Current Land Use: Hiking, fishing, hunting, passive use

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thick--intermittent)	(Density-broken)	(Density-thin)	(Density-thick--intermittent)
Sycamore	Black locust	Staghorn sumac	Jewelweed
American elm	Mulberry	Elderberry	Violet
Slippery elm	Catalpa	Rose	Grape
Black walnut	Box elder	Arrowwood	Greenbrier
White ash	River birch	Spicebush	Poison ivy
Silver maple			Smartweed
Honeylocust			Japanese honeysuckle
Pin oak			Greenbrier
Hickory			Unknown grasses
Shagbark hickory			Gill-over-the-ground
Red maple			Clearweed
Black gum (Sour gum)			White avens
			Rose
			Virginia creeper

Historic Disturbances: Flooding, debris accumulation, siltation, erosion, windthrow, trampling

Current Disturbances: Flooding, debris accumulation, siltation, erosion, windthrow, trampling

Segment 26

FLOODPLAIN WOODLAND AND THICKET/HEDGEROW FROM TEN MILE LOCK TO INTERSTATE 287 BRIDGE

SEGMENT NARRATIVE

Segment 26 extends for 1.2 miles (1.9 km) starting at Ten Mile Lock and ending at the Interstate 287 bridge over the Canal and the Raritan River. (See the Map on Sheet 9a.) The Raritan River flows to the north of the Canal Corridor in this segment, and the Millstone River joins it near the beginning of the segment. A levee to the left of the Canal and the bank along Canal Road (south, or to the right, of the Canal) comprise Subsegment A. Between the levee and the rivers is a floodplain woodland (Subsegment B), which is narrow for the most part, widening only in two areas where the rivers curve northward.

In the medium-dense canopy of the thicket/hedgerow (Subsegment A), which lines the Canal and towpath to its left, are silver, sugar, and Norway maple, red oak, basswood, sycamore, willow, and green ash. Black walnut, mulberry, and red oak comprise the understory. Silky dogwood, sumac, and speckled alder are common constituents of the shrub layer, and poison ivy is the dominant herb. The path is kept somewhat clear by cutting and use. Exposed tree roots make hiking and bicycling difficult, and hiking is hampered by prolific and overhanging poison ivy.

Due to the short distance between the Canal embankment and the Raritan (40 to 50 ft., or 12 to 15 m, on the average), Subsegment B has not developed a typical floodplain woodland. There is a wide triangular portion of land at the beginning of the segment, but for most of the segment the floodplain is very narrow. Its medium-dense canopy is dominated by silver maple and green ash, with numerous sugar and Norway maple, box elder, black walnut, and willow. Medium-density understory members include American elm, mulberry, and box elder, with occasional red oak, black walnut, and hawthorn. The thin shrub stratum consists of elderberry, silky dogwood, sumac, and speckled alder. The herb layer is of medium density and includes numerous grasses, Solomon's seal (*Polygonatum pubescens*), goldenrod, snakeroot (*Sanicula* spp.), Virginia creeper, grape, raspberry, Japanese honeysuckle and poison ivy (dominant).

A waterworks facility (Contiguous Land Use a) flanks the left side of the Raritan, and a small industrial park lies in contiguous land to the right of the Canal past Randolph Road. Directly adjacent to the Canal's right bank is Canal Road, which generates frequent and loud traffic noise, especially from heavy trucks. These industrial uses are prominent in views from the Canal Park.

On the Canal, slightly downstream (east) of the Millstone-Raritan confluence point, are a causeway (Special Feature 1) and a water intake station (Special Feature 2). The causeway provides pedestrian access across

the Canal.

Extensive development would be needed here to improve the path along the Canal. Exposed roots would have to be covered, and the overhanging poison ivy vines should be cleared. Because of the narrowness of Segment 26, recreational uses, except for activities suited to a linear area (e.g., hiking, canoeing) are limited.

Access into Canal Corridor

The Canal corridor is easily accessible from the lock at the beginning of the Segment and from the Causeway below the Raritan/Millstone confluence. Interstate 287 does not allow access to the towpath.

Towpath

Passage along the path is inconvenient because of exposed tree roots and extensive poison ivy growth.

Ease of Passage on Canal

Passage along the Canal is clear throughout Segment 26.

Wildlife

Two different species of turtles were observed.

Auditory Assessment

Constant traffic noise from adjacent roads, a loudspeaker from a contiguous industry, and other frequent noises from nearby land uses are audible within Segment 26.

SUBSEGMENT A

Subsegment A is the thicket/hedgerow bordering the Canal and towpath on its left side. Canopy species here include silver maple, box elder, red oak, basswood, sugar maple, Norway maple, black walnut, sycamore, willow, and green ash. The understory includes red oak, mulberry, black walnut, and occasional hawthorn. Both upper layers are of medium density. Numerous silky dogwood, sumac and speckled alder inhabit the thick shrub layer. Poison ivy is dominant among the herbs, which also include Solomon's seal, Queen-Anne's lace, goldenrod, Virginia creeper, grape, raspberry, and grasses.

The path along the levee top is extremely narrow (12 to 18" or 30-45 cm) and is maintained by use. On overthrown tree near the Causeway is an impediment to cyclists. The path is bordered on both sides by strips of herbaceous material. On the path itself are numerous exposed tree roots, and large poison ivy vines overhang the path. The Canal is generally unshaded.

The distance between the Canal and the river rarely exceeds 50 feet (15 m). Industrial land uses across the river and commercial and industrial uses across Canal Road are visible from the path. (See Section B-B'.) Constant traffic noise and intermittent noise from contiguous land uses can be heard.

Community Dynamics

Due to the presence of seedlings and saplings of canopy species, this thicket/hedgerow should remain in its current state.

Management Recommendations

Clear the poison ivy from the path area and cover exposed tree roots. Remove fallen tree blacking the path near the causeway.

SUBSEGMENT B

An abbreviated version of the Raritan floodplain woodland is found in Subsegment B. The Canal and the river are in close proximity through most of this subsegment, the Canal being elevated considerably (30+ ft or 9+ m) above the river. It is only in the beginning of the subsegment, just upstream from the confluence of the Millstone and the Raritan Rivers, that the floodplain is wide; beyond the confluence, it narrows considerably.

The medium-dense canopy of the wide triangular woodland at the beginning of the subsegment is almost entirely dominated by silver maple and green ash, both reaching to 60 feet (15 m). The understory, also of medium density, includes American and slippery elm, mulberry, and box elder as dominants. Box elder also appears in the thin shrub layer, along with elderberry. An herb stratum of medium density is established on the floor of the floodplain. Among its members are white avens, smartweed, violet, clearweed, sedges, grasses, and the dominant poison ivy, which often reaches the canopy.

For the remainder of the subsegment, the floodplain is very narrow, either restricted to the base of the steep slope from the towpath or confined to a thin strip of flat, damp land along the river. Where slopes drop steeply to the river, the trees are generally small, but a few large individuals cling tenuously to the slope. Among the species found here are sycamore, willow, black walnut, silver maple, and river birch. In the narrow, flat

floodplain strip, herbs grow in profusion beneath a canopy of medium density. Understory and shrub strata are almost always lacking. (See Section A-A'.) The herbs present are those which tolerate saturated conditions: dominants are smartweed and jewelweed. Grasses and sedges are also present. In the standing water of a yazoo along this floodplain are masses of duckweed. Flood and/or windthrow disturbance is evidenced by a few fallen trees and scattered dead wood on the floor of the woodland.

Community Dynamics

The flood regime of the Raritan controls the dynamics of this woodland. Where the floodplain is wide, the community should continue in a steady state; other areas are prone to severe flooding.

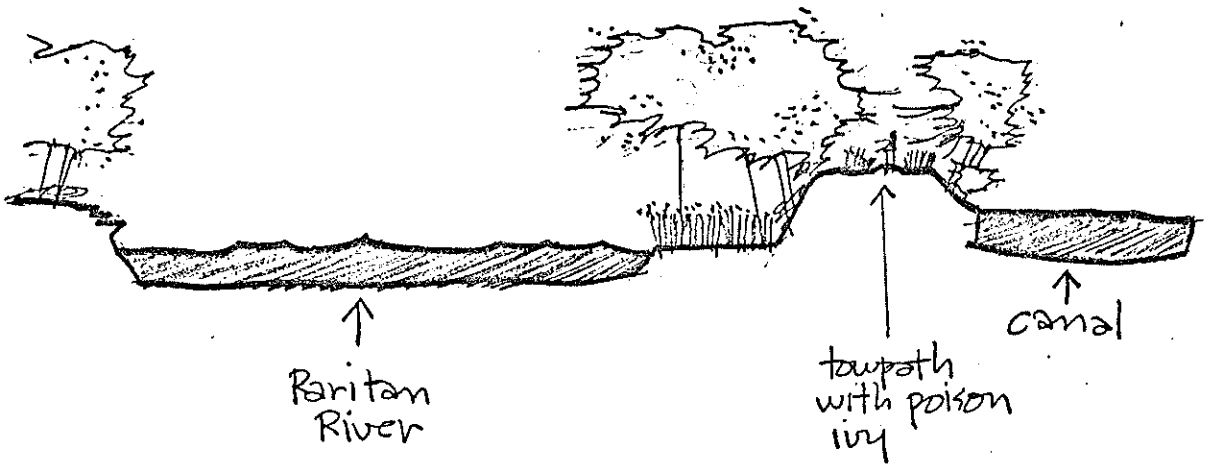
Management Recommendations

Clean up flood debris.

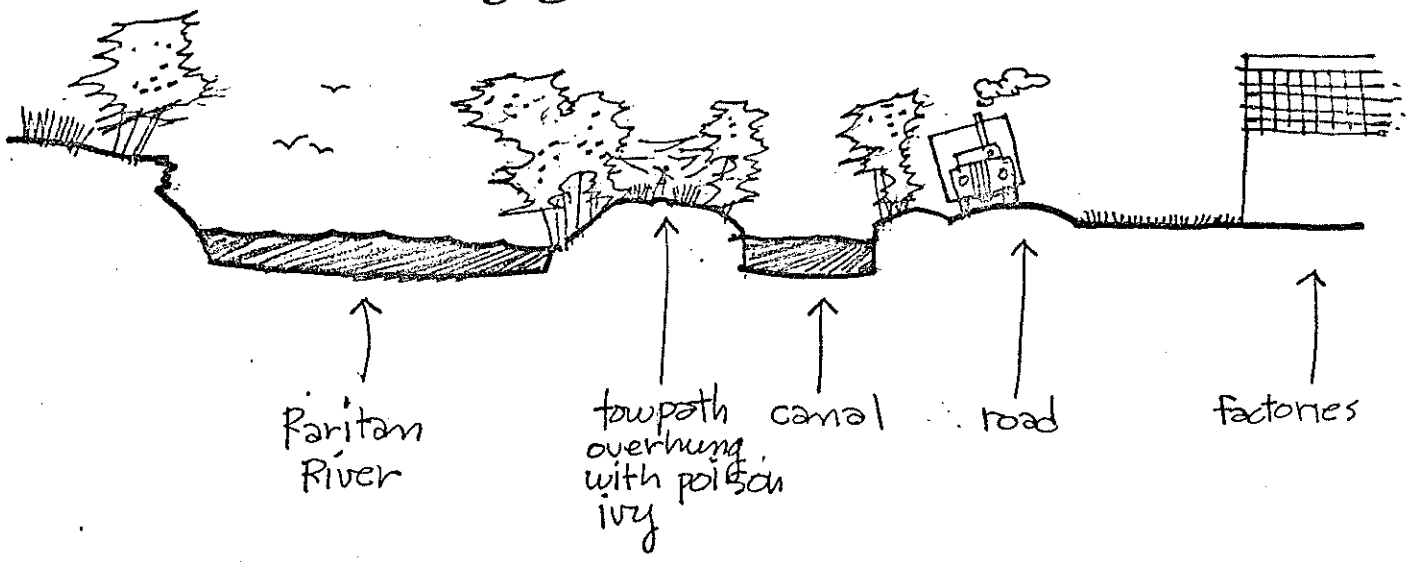
Segment 26

Sections

A-A'



B-B'



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	landscaped open space	industrial utility corridor
b	residential trees	single houses (with yards)
c	Piedmont floodplain moist upland woods	unmanaged land
d	agricultural field	tilled field

TOPOGRAPHIC CROSS-SECTIONS

A-A' --- ½ mile downstream of Millstone-Raritan confluence
B-B' --- 1 mile downstream of Millstone-Raritan confluence

SPECIAL FEATURES

1 --- Causeway across Canal
2 --- Water intake

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Confluence of Millstone River with Raritan River	4	9b
2	Raritan River, looking downstream (note establishment of vegetation--willow, smartweed on silt bars)	4	"
3	Volkswagen dumped in Raritan River	4	"
4	Woods along Raritan River	4	"

SEGMENT 26 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow

Current Land Use: Hiking

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-medium)	(Density-medium)	(Density-thick)	(Density-medium)
Honeylocust (rare)	Slippery elm	Rose	Poison ivy
Black locust	Green ash	Winged sumac	Pokeweed
Sycamore	Hawthorn	Blueberry	Solomon's seal
Norway maple	American elm	Black oak	Goldenrod
Red oak	Silver maple	Japanese barberry	Japanese honeysuckle
Common apple (rare)	Red oak	Speckled alder	Raspberry
Hackberry (rare)	Mulberry	American elm	Grape
Ailanthus	Black walnut	Slippery elm	Queen-Anne's lace
Black walnut		Green ash	Sunflower
Silver maple		Silky dogwood	Virginia creeper
Sugar maple			
Pin oak			
River birch			
Black cherry			
Basswood			
Box elder			
Willow			
Green ash			

Historic Disturbances: Cutting

Current Disturbances: Cutting, trampling, windthrow

SUBSEGMENT B

Cover Type: Raritan floodplain

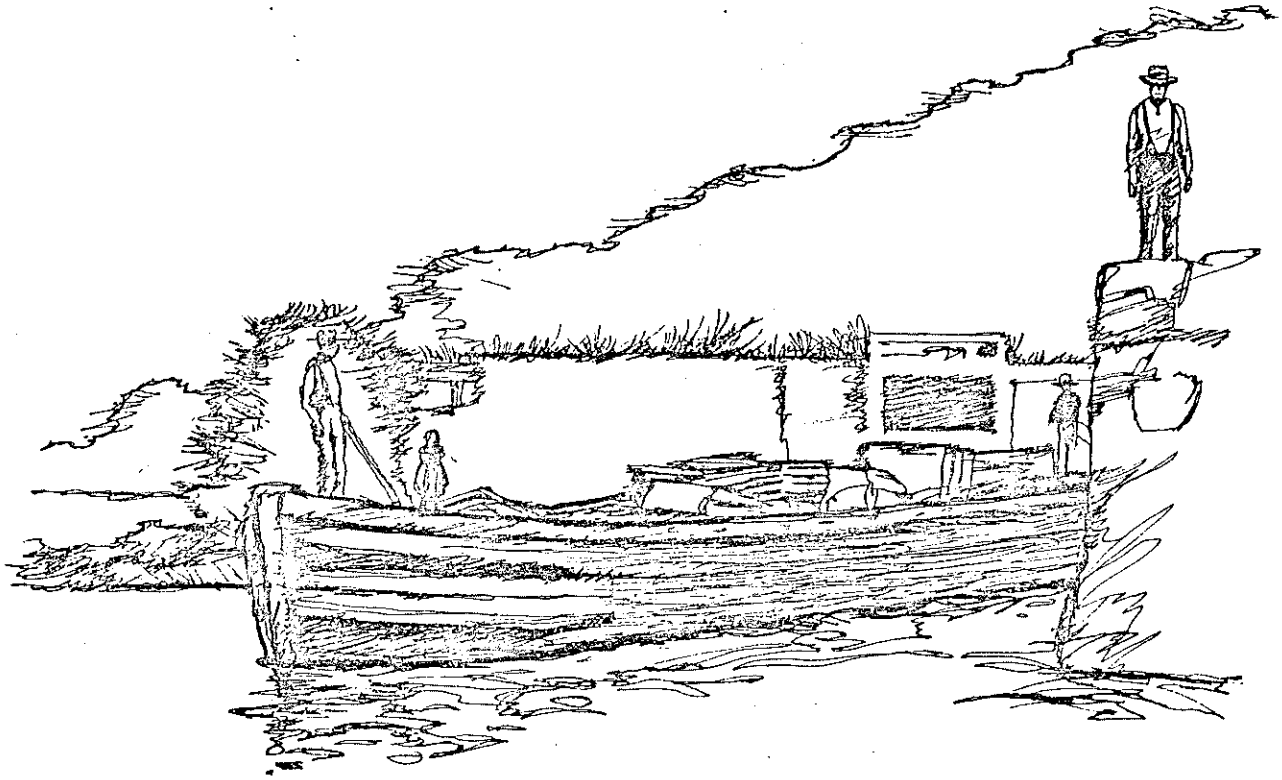
Current Land Use: Unmanaged land

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-medium)	(Density-medium)	(Density-thin)	(Density-medium)
Silver maple	American elm	Box elder	White avens
Green ash	Slippery elm	Elderberry	Violet
Pin oak	Mulberry	Silky dogwood	Clearweed
Willow	Box elder	Sumac	Poison ivy
Sycamore		Speckled alder	Smartweed
Red oak			Sedges
River birch			Unknown grasses
Black walnut			Solomon's seal
Sugar maple			Goldenrod
Norway maple			Snakeroot
Box elder			Virginia creeper
			Grape
			Raspberry
			Japanese honeysuckle

Historic Disturbances: Flooding, debris accumulation, siltation, windthrow

Current Disturbances: Flooding, debris accumulation, siltation, windthrow



Segment 27

FLOODPLAIN WOODLAND AND THICKET/HEDGEROW FROM INTERSTATE 287 BRIDGE TO FIVE MILE LOCK

SEGMENT NARRATIVE

Segment 27 starts at the Interstate 287 Bridge crossing and extends to Five Mile Lock. A well-traveled road parallels the segment on the right. Subsegment A is the Canal, levee, and roadbank. Subsegment B is the floodplain woodland of the Raritan River. (See the map on Sheet 9a.)

The thicket/hedgerow (Subsegment A) along the levee and roadbank which flank the Canal are similar, except that the path runs along the levee, dividing the thicket, and the vegetation along the roadbank has no understory.

The canopy in Subsegment A is of medium density and contains silver maple and green ash as dominants, along with sugar and Norway maple, box elder, black walnut, and willow. The understory, also of medium density, contains American and slippery elm, mulberry, and box elder as dominants, with an occasional red oak, black walnut, and hawthorn. The thin shrub stratum consists of elderberry, silky dogwood, sumac, speckled alder, and buttonbush. These tend to occur in patches.

The floodplain woodland (Subsegment B) is mostly restricted to a narrow bank, as in Segment 26. In the latter portion of Subsegment B, a stream runs under the Canal and into the Raritan. The medium-dense canopy and understory in the woodland strip and wider area near this stream (Special Feature 3) include silver maple, green ash, black walnut, river birch, American and slippery elm, and box elder. Box elder and elderberry form a thin shrub layer. Herbs include white aven, clearweed, smartweed, violet, poison ivy, sedges, and grasses.

There is a concrete spillway (Special Feature 1) approximately one mile (1.6 km) from the beginning of the segment. This structure allows water from the Canal to enter the Raritan. The area contiguous to the Canal corridor within this segment is urban in character, with a large industrial use (GAF factory) located near the intersection of Canal Road and Main Street in South Bound Brook, and other industrial and commercial uses flanking the Canal on the right.

Disturbances include flooding, windthrow, and the accumulation of debris along the river. An oil pipeline right-of-way (Special Feature 2) traverses the floodplain woodland near the end of the segment.

Hiking and fishing were observed recreational activities. As in Segment 26, the linear character of the Park limits possible recreational uses.

Access into Canal Corridor

On the left side of the Canal, South Bound Brook lock, Bridge Street, and Five Mile Lock provide access. Canal Road provides access to the right side along the entire segment.

Towpath

A good path follows the left bank all along the segment, except at the spillway approximately 1 mile (1.6 km) from the beginning of the segment. There is no path on the right side.

Ease of Passage on Canal

Ten Mile Lock, South Bound Brook Lock, and Five Mile Lock hamper passage along the Canal.

Wildlife

Several different types of turtles were observed and there were large flocks of birds in the first half of the segment.

Auditory Assessment

Traffic noise from Canal Road is very noticeable everywhere except in the floodplain woodland (Subsegment B) near the stream in the latter part of the segment. In addition, industrial noise from contiguous land uses are constant and loud in the first half of the segment.

SUBSEGMENT A

The thicket/hedgerow along the Canal, towpath, and roadbank comprises Subsegment A. The medium-dense canopy is dominated by silver maple and green ash. Box elder, sugar and Norway maple, black walnut, and willow are also found at the canopy level. American and slippery elm, mulberry, and box elder dominate the medium-dense understory. Red oak, black walnut, and hawthorn are other components. In the thin shrub layer are clumps of elderberry, winged sumac, speckled alder, buttonbush, and black oak and elm seedlings and saplings. There is one Special Feature in Subsegment A. Approximately one mile (1.6 km) from the beginning of the subsegment at Interstate 287 is a concrete spillway (1) which allows excess water from the Canal to exit into the Raritan. (See Section.) No water was passing over it at the time of the field survey, but the survey team noted that the narrow concrete top of the spillway might be dangerous to traverse. Otherwise, the path is uninterrupted.

Vegetation in the thicket/hedgerows and adjacent woodland shades the towpath and both sides of the Canal. Poison ivy is present, but not as

ubiquitous as in Segment 26. Views from the towpath encompass the woodland, the river, and contiguous industrial and commercial land uses in South Bound Brook. Noise from these land uses and traffic on nearby roads is constant and unavoidable along the towpath.

Community Dynamics

The presence of woody seedlings and saplings should insure the continuity of this community.

Management Recommendations

None

SUBSEGMENT B

As in Segment 26, the floodplain woodland of the Raritan River (Subsegment B) generally lies along a narrow bank. The medium-dense canopy and understory have green ash and box elder as dominants. Silver maple, black walnut, river birch, willow, sycamore, and oaks are also present in the canopy, and American and slippery elm and mulberry comprise the remainder of the understory stratum. In the sparse shrub layer are box elder and elderberry. An herb layer of medium density includes white aven, violet, clearweed, smartweed, grasses, sedges, and poison ivy. The yazoo present in Segment 26 was also observed here. It was dry at the time of the survey.

In the latter portion of the subsegment, the floodplain widens near a stream (Special Feature 3) which empties into the Raritan. These open woods beneath the overstory of ash and box elder provide relief from the noise and views of urban surroundings. The shrub stratum is almost absent, and the herbaceous growth is sparse, restricted to patches of such shade-tolerant woodland herbs as Jack-in-the-pulpit, violet, bog nettle, and sedges, with grasses and smartweed in the more open areas. This area would be worth preserving in its present state.

Traversing this woodland is an oil pipeline right-of-way (Special Feature 2). It is an infrequently mowed meadow with an herb layer of grasses, ragweed, and coneflower. Other disturbances include flooding and windthrow and accumulation of debris in the floodplain.

Community Dynamics

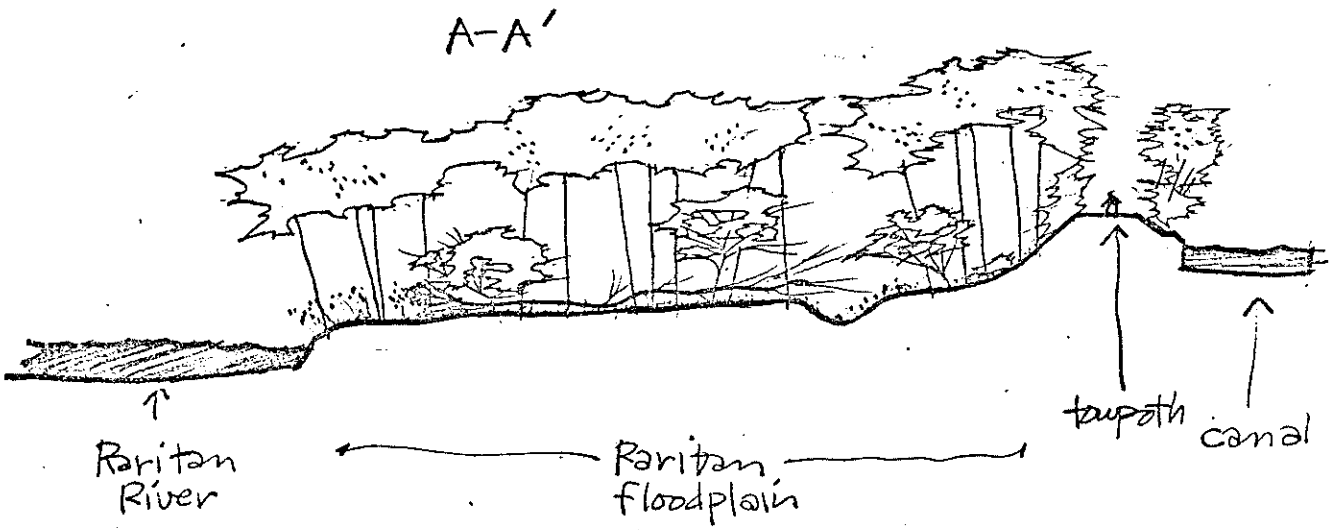
Given current land uses and flood regime, this community should remain stable.

Management Recommendations

Clean up debris.

Segment 27

Section



CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	factory and parking	industrial
b	asphalt/concrete	industrial and commercial

TOPOGRAPHIC CROSS-SECTIONS

A-A'--- Through Special Feature 1

SPECIAL FEATURES

1 --- Spillway
2 --- Oil right-of-way
3 --- Floodplain woodland

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	From floodplain woods (Special Feature 3) toward Raritan River, showing patchy herbaceous growth of smartweed beneath more open canopy	4	9b
2	In floodplain woods (note absence of shrubs and openness of views)	4	"
3	Sign warning of oil pipeline crossing river	4	"
4	Stream crossing under Canal to Raritan River, west of Davidson's Road-Main Street intersection	4	"
5	Towpath on left side of Canal, looking upstream	4	"
6	Upstream of deteriorating dam on Raritan River	4	"
7	Upstream of lock and lock house	4	"
8	Expressway bridge over Canal as seen from Five Mile Lock, looking downstream	4	"

SEGMENT 27 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow

Current Land Use: Hiking, fishing

Vegetation Data:

CANOPY (Density-medium)	UNDERSTORY (Density-medium)	SHRUB (Density-thin)	HERB (Density-medium)
Honeylocust	Slippery elm	Rose	Poison ivy
Black locust	Green ash	Winged sumac	Pokeweed
Sycamore	American elm	Blueberry	Solomon's seal
Norway maple	Hawthorn	Black oak	Goldenrod
Hackberry	Silver maple	Japanese barberry	Japanese honeysuckle
Common apple	Mulberry	American elm	Raspberry
Ailanthus	Box elder	Slippery elm	Grape
Black walnut	Red oak	Silky dogwood	Queen Anne's lace
Silver maple	Black walnut	Green ash	Sunflower
Sugar maple		Elderberry	Virginia creeper
Pin oak		Speckled alder	
Red oak		Buttonbush	
River birch			
Black cherry			
Green ash			
Box elder			
Willow			

Historic Disturbances: Cutting

Current Disturbances: Cutting, trampling, windthrow

SUBSEGMENT B

Cover Type: Raritan floodplain

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY (Density-medium)	UNDERSTORY (Density-medium)	SHRUB (Density-thin)	HERB (Density-medium)
Silver Maple	American elm	Box elder	White avens
Green ash	Slippery elm	Elderberry	Violet
Pin oak	Mulberry		Clearweed
Red oak	Box elder		Unknown grasses
River birch			Smartweed
Willow			Sedges
Black walnut			Poison ivy
Sycamore			Jack-in-the-pulpit
			Bog nettle
			Coneflower
			Ragweed

Historic Disturbances: Flooding, debris accumulation, siltation, windthrow

Current Disturbances: Flooding, debris accumulation, siltation, windthrow

Segment 28

RARITAN RIVER FLOODPLAIN WOODLAND, THICKET/HEDGEROW, AND OLD LANDFILL
FROM FIVE MILE LOCK TO LANDING LANE BRIDGE

SEGMENT NARRATIVE

This is the final segment of the Canal. It runs from Five Mile Lock to Landing Lane Bridge and is composed of a narrow strip of land on both sides of the Canal. Subsegment A includes both banks of the Canal and a levee between the Canal and the Raritan River. A narrow strip of floodplain vegetation directly adjacent to the Raritan River comprises Subsegment B. Subsegment C is an old landfill next to Easton Road near mid-segment.

The character and structure of the hedgerow/thicket (Subsegment A) bordering the Canal and path to its left are generally similar to those found in corresponding subsegments of Segments 26 and 27. Black locust dominates the dense canopy, which also includes box elder, silver and Norway maple, green ash, willow, and often poison ivy. Almost all the canopy species are found in the understory. The thick shrub layer is composed of silky dogwood, barberry, privet, and spicebush, and vines flourish in the herb stratum.

In the narrow Raritan River floodplain woodland (Subsegment B), the medium-dense canopy is composed of black locust, silver maple, black walnut, and green ash. These species are the most numerous, with honeylocust, maple, and oak also present. The understory is of medium density and consists largely of mulberry, slippery elm, box elder, and hawthorn. Numerous shrub members include elderberry, box elder, silky dogwood, and winged sumac. shrub layer is thick. In the medium-dense herb layer are poison ivy, sedges, white avens, violets, clearweed, and sunflower.

There is an old landfill site (Subsegment C) within State boundaries. This subsegment includes a large stream which flows under the Canal to the Raritan River. On the landfill site are several mounds of various fill materials. The past use of this subsegment has caused all strata to be thin. Canopy and understory species include silver maple, green ash, black locust, box elder, and American elm. Smooth sumac and staghorn sumac are also found in the understory. In the shrub layer are black locust and black cherry saplings, silky dogwood, and Tartarian honeysuckle. Chicory, grasses, and pokeweed are common herbs.

As in Segment 27, contiguous commercial and industrial uses largely determine the character of the visual and auditory experience along the Canal corridor. Rutgers Preparatory School (Special Feature 1) offers a contrast to the land uses which surround it, and residential uses adjoin the Canal Park in the latter quarter of the segment. In this area, traffic noise is minimal and views of the river and the Canal are pleasant.

Disturbances in Segment 28 are few. They include flooding, wind-

throw, siltation, and accumulation of debris in the floodplain; cutting and trampling, which maintain the towpath; historic disturbances in the landfill area; and runoff (from contiguous parking lots) which enters the Canal.

Hiking and fishing were observed activities in this final segment of the Canal Park. Possible future land uses could include parking, canoe rental, and other intense uses for Subsegment C.

Access into Canal Corridor

Segment 28 is accessible from Five Mile Lock (beginning of segment) and Landing Lane Bridge (end of segment). The right side of the corridor can be reached from Easton Road at several points.

Towpath

An excellent towpath runs along the levee on the left side of the Canal for the whole segment. There is no continuous path on the right, but there are intermittent trails.

Ease of Passage on Canal

Passage on the Canal is clear throughout the segment.

Wildlife

No unusual wildlife was observed.

Auditory Assessment

Easton Road generates considerable traffic noise which is clearly audible where the road nears to the Canal (Ukranian Village and Franklin).

SUBSEGMENT A

For the majority of the length of Subsegment A, the thicket/hedgerow resembles those sections in Segments 26 and 27. The towpath here also rests on the narrow levee between the Canal and the Raritan, but the path is generally wider and better maintained than in earlier segments. In the last quarter of the segment, the character of views from the towpath changes as the Canal passes through residential areas.

Norway maple, box elder, hackberry, black cherry, willow, silver maple,

green ash, and black locust (dominant) comprise the thick canopy. Poison ivy frequently climbs into this layer. Hawthorn, sweet cherry, and nearly all the canopy species are found in the medium-dense understory. Silky dogwood, barberry, privet, and spicebush are numerous in the thick shrub layer. Honeysuckle and poison ivy are dominant in the herb stratum.

Runoff from parking lots in adjacent land uses drains into the Canal at some places in Subsegment A. The towpath is maintained by cutting.

Contiguous land uses largely determine the views and sounds experienced along the Canal and towpath. The subsegment assumes a more natural, quiet aspect as the Canal and towpath near wooded residential areas and the Rutgers University campus at the end of the Canal Park.

Community Dynamics

The presence of woody seedlings and saplings should ensure the continuity of this community.

Management Recommendations

Determine the effect of water runoff into the Canal and correct it if necessary.

SUBSEGMENT B

As in earlier segments, the Raritan River floodplain woodland (Subsegment B) covers only a narrow corridor between the Canal and the river. (See Section A-A'.) Canopy and understory layers are generally of medium density, as is the herb stratum; the shrub layer is thick. Black locust, silver maple, black walnut, and green ash dominate the canopy; honeylocust, maple, and oaks are also present. In the understory are mulberry, American and slippery elm, box elder, and hawthorn. Herbs include white avens, violet, clearweed, smartweed, sedges, poison ivy, sunflower, and grasses.

Flooding, siltation, windthrow, and debris accumulation indicate that the Raritan periodically overflows its banks. For the most part, the subsegment is quiet. The steepness of the levee often inhibits access.

Community Dynamics

Given current land uses and flood regime, the Raritan floodplain woodland of Subsegment B should remain stable.

Management Recommendations

Clean up debris.

SUBSEGMENT C

Where the Canal and river near Easton Road in the latter half of Segment 28, an old landfill comprises Subsegment C. This area has a history of disturbed soils. Mounds of different fill material can be seen, and vegetation has established itself on them in varying degrees. In general, all strata are of thin density.

Canopy species here include silver maple, green ash, willow, black locust, box elder, and American elm. These species are also found in the understory layer, as are smooth and staghorn sumac. Silky dogwood, black locust, black cherry, and Tartarian honeysuckle vegetate the shrub layer. Black locust seedlings are also found in the herb layer, with chicory, aster, goldenrod, pokeweed, and grasses.

A large stream at the beginning of this subsegment flows under the Canal. This old landfill could be employed for parking, canoe rental, or other intense uses.

Community Dynamics

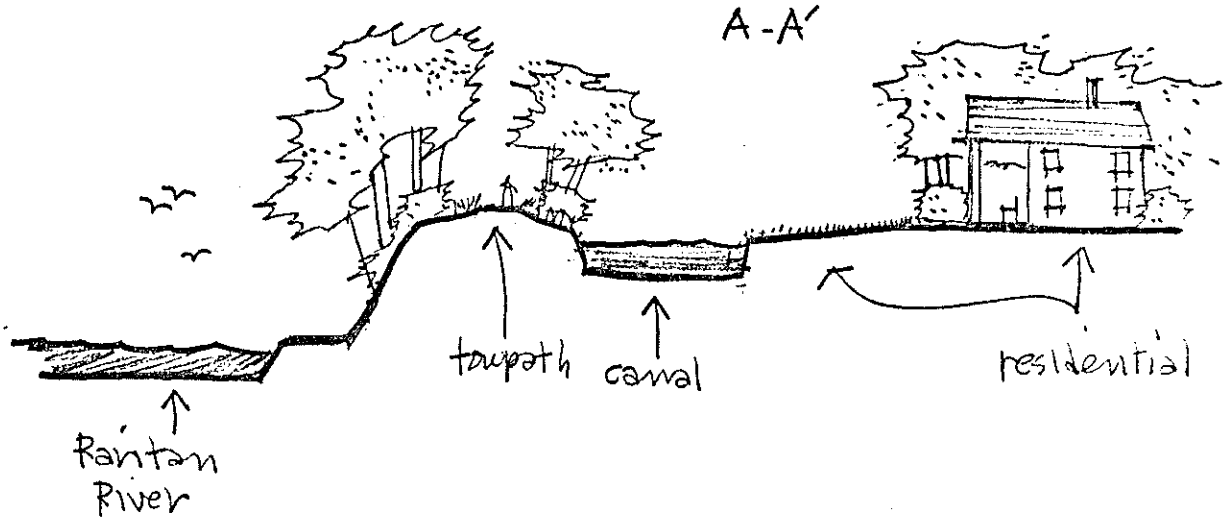
Because of historic disturbances, this area is in an early successional stage. If left undisturbed, woody species will mature.

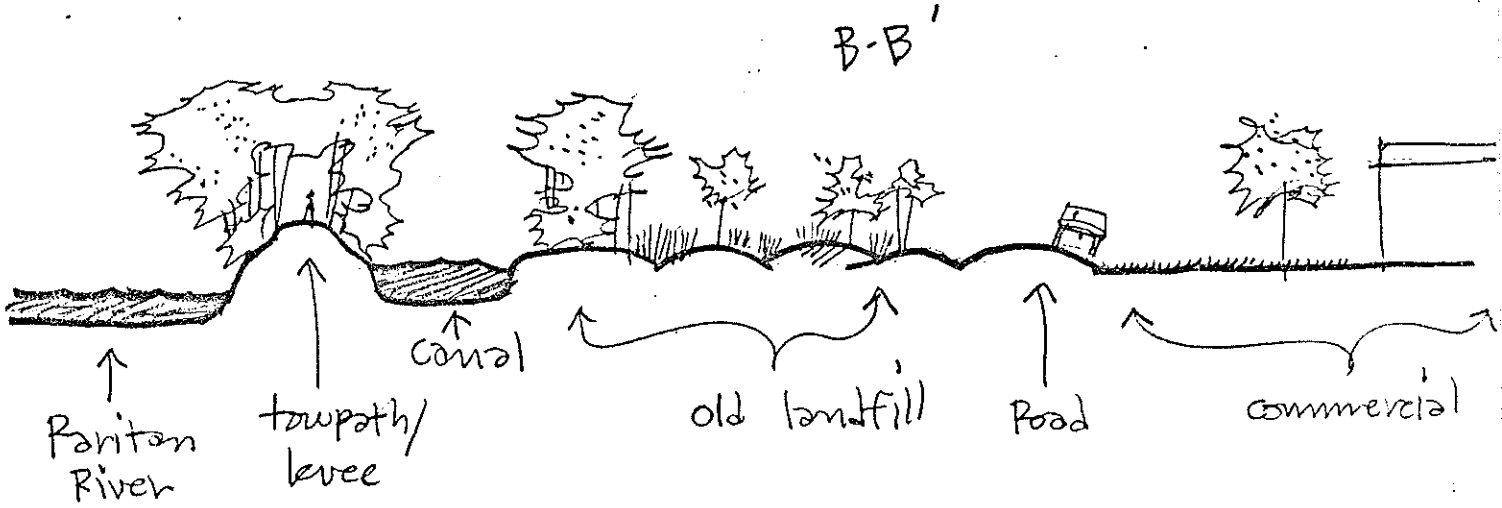
Management Recommendations

None, unless intense land uses are anticipated.

Segment 28

Sections





CONTIGUOUS LAND USE

Contiguous Area	Cover Type	Land Use
a	impervious	commercial
b	residential trees	single houses (with yards) multi-unit buildings
c	landscaped open space	institutional
d	landfills	unmanaged land

TOPOGRAPHIC CROSS-SECTIONS

A-A'--- Near Landing Lane Bridge
B-B'--- Old landfill site next to Easton Road

SPECIAL FEATURES

1 --- Rutgers Prep School

PHOTOGRAPHIC RECORD

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Intermittent path on right side of Canal	4	10b
2	Ditch on right side of Canal near supermarket	4	"
3	Culvert carrying stream under Easton Road--view from Canal bank	4	"
4	Looking downstream along Canal toward apartment building	4	"
5	Overgrown towpath on right side of Canal	4	"
6	Raritan River, looking upstream from Landing Lane Bridge	4	"
7	Upstream of Canal from Landing Lane Bridge	4	"

SEGMENT 28 VEGETATION DATA

SUBSEGMENT A

Cover Type: Thicket and hedgerow

Current Land Use: Hiking, fishing

Vegetation Data:

CANOPY (Density-thick)	UNDERSTORY (Density-medium)	SHRUB (Density-thick)	HERB (Density-medium)
Honeylocust	Slippery elm	Rose	Poison ivy
Black locust	Silver maple	Winged sumac	Pokeweed
Sycamore	American elm	Blueberry	Solomon's seal
Norway maple	Green ash	Black oak	Goldenrod
Hackberry	Hawthorn	Japanese barberry	Japanese honeysuckle
Common apple			Raspberry
Ailanthus		American elm	Grape
Black walnut		Slippery elm	Queen-Anne's lace
Silver maple		Silky dogwood	Sunflower
Sugar maple		Green ash	Virginia creeper
Pin oak			
Red oak			
River birch			
Black cherry			

Historic Disturbances: Cutting

Current Disturbances: Cutting, trampling, windthrow

SUBSEGMENT B

Cover Type: Raritan River floodplain woodland

Current Land Use: Unmanaged land

Vegetation Data:

CANOPY (Density-medium)	UNDERSTORY (Density-medium)	SHRUB (Density-thick)	HERB (Density-medium)
Silver maple	American elm	Box elder	White avens
Green ash	Slippery elm	Elderberry	Violet
Pin oak	Mulberry	Winged sumac	Clearweed
Red oak	Box elder		Unknown grasses
River birch	Hawthorn		Smartweed
Willow			Sedges
Black walnut			Poison ivy
Sycamore			Sunflower

Historic Disturbances: Flooding, debris accumulation, siltation, windthrow

Current Disturbances: Flooding, debris accumulation, siltation, windthrow

SUBSEGMENT C

Cover Type: Landfill

Current Land Use: Landfill, excavation

Vegetation Data:

CANOPY	UNDERSTORY	SHRUB	HERB
(Density-thin)	(Density-thin)	(Density-thin)	(Density-thin)
Silver maple	Smooth sumac	Silky dogwood	Black locust
Willow	Staghorn sumac	Black locust	Chicory
Box elder	Black locust	Tartarian honeysuckle	Aster
Green ash	Silver maple	Black cherry	Goldenrod
American elm	Willow		Unknown grasses
Black locust	Box elder		Pokeweed
	Green ash		
	American elm		
	Black locust		

Historic Disturbances: Landfill, excavation

Current Disturbances: Litter and trash

Glossary

Canal Corridor -- The Canal and all adjoining, related State-owned land.

Community -- Any assemblage of vegetation species occurring in a prescribed area or physical habitat.

Community composition -- The species makeup of a community.

Contiguous land use -- Use being made of land which abuts the Canal Corridor. Designated on Segment maps by lower-case letters.

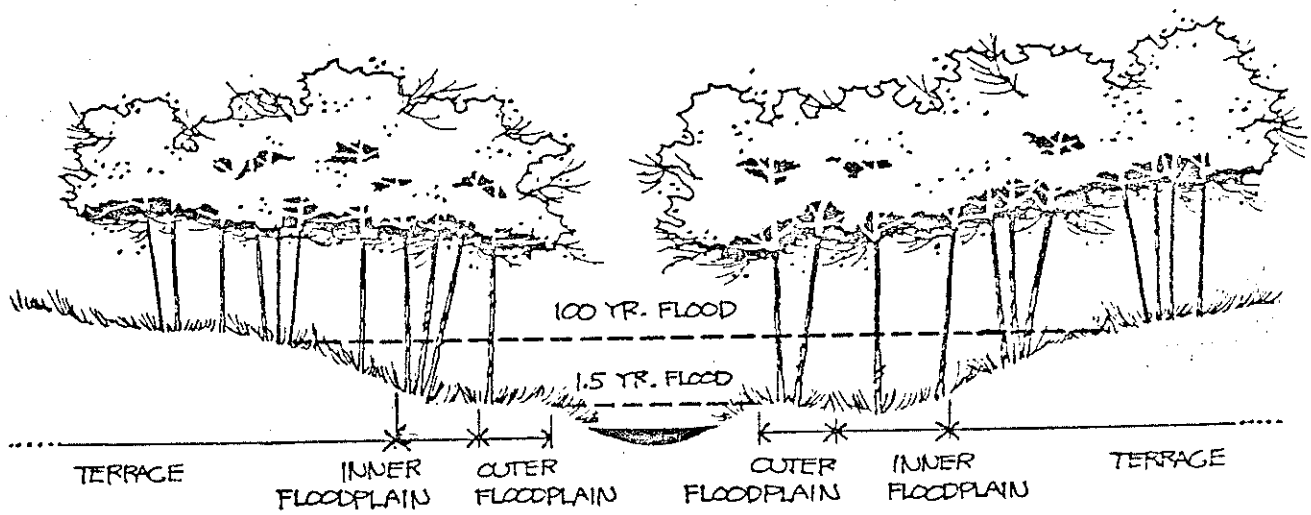
DBH -- Diameter of a tree at breast height (4.5 ft or 1.37 m above ground).

Disturbance -- A disruption or perturbation of an ecosystem through natural or human activity.

Dominant species mix -- The relative proportions of the predominant plants in a community.

Edge community -- The vegetation characteristic of the zone of transition from one distinct, well-defined community into another of a significantly different structure. For instance, the merging of woodland and meadow, with some saplings sprouting in the grasses and some grasses and wildflowers under the trees at the edge of the woods.

Floodplain -- Any area, generally flat, bordering a river or stream, which is flooded only at times of high water. See the sketch below.



Gradient community -- The particular vegetation community which occupies the Canal embankment in most places. The vegetation types vary with the moisture gradient which extends from the well-drained top of the embankment down to standing or flowing water (relatively xeric to hydric).

Hedgerow/thicket -- A narrow, linear or strip community composed of sapling woody canopy species (thicket) and low-growing shrubs, vines and herbs (hedgerow). The hedgerow element might be intermittent, but in general the community has a greater proportion of hedgerow than thicket.

Hydric -- A very wet environment having standing water at some time during the year.

Intermittent Stream -- A watercourse which flows only during and following storms. (See also Yazoo)

Land Use Recommendation -- A brief statement offering recommendations on the subsegment level regarding potential land use within the Canal Corridor or nearby. For instance, a flat early oldfield may be a potentially good ball field site because of minimal environmental and construction constraints.

Levee -- A narrow, raised strip of land (often man-made and maintained, e.g., bulkheaded), separating the Canal and another body of water, such as the Delaware, Millstone or Raritan River.

Management Recommendation -- A brief clean-up or maintenance recommendation where particular problems were observed along the Canal Corridor (e.g., bank slumping; tree fall).

Mesic -- An environment needing or having a moderate amount of moisture.

Microtopographic variations -- Small changes in land surface relief, usually confined to a small area (e.g., small mounds and depressions).

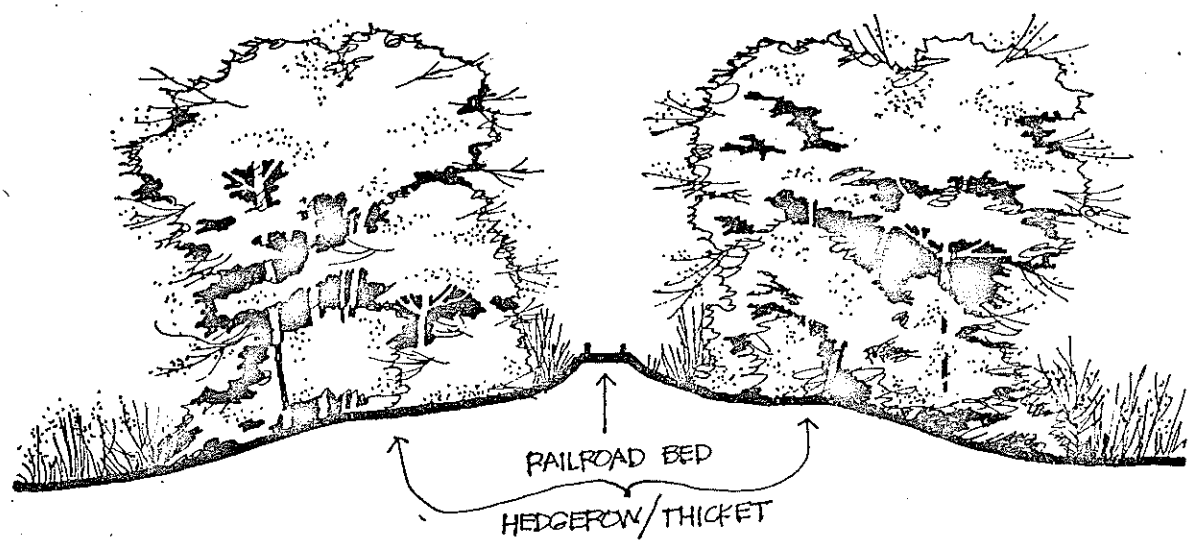
Natural Levee -- Raised berm or crest lying on the outer floodplain surface, resulting from coarser materials being deposited during floods.

Node -- A term used by the Canal Commission's Master Plan for the Delaware and Raritan Canal State Park (pp. 23-28) to describe a shore segment usually having a special feature (e.g., lock, aqueduct).

Overstory -- Combined canopy and understory layers of vegetation structure; the combined layer is evaluated for density on the Data Sheets.

Passive recreation site -- Land suitable for recreational use without intensive alteration of landscape (e.g., bulldozing). Installation of signs and limited clearing are examples of acceptable low-cost, low-impact changes.

Railroad Corridor -- The railroad and its associated hedgerow/thicket communities; included within the Canal Corridor. See sketch below.



Segment -- One of the twenty-eight units into which the Canal Corridor has been sectioned for study by the Canal Commission. Each is numbered, beginning at Bulls Island.

Specimen tree -- Any tree which by its size, shape or age is exceptional when compared to others of its kind in the area.

Sub-community-- Within a community, a distinguishable area where one of the dominant species occurs more frequently (exhibits greater dominance) than elsewhere in the community.

Subsegment -- One of the divisions into which each segment has been divided by the field survey team, who have distinguished it by its vegetation community or other notable characteristics.

Successional stage -- A point along a line of historic change in the vegetative composition of a community.

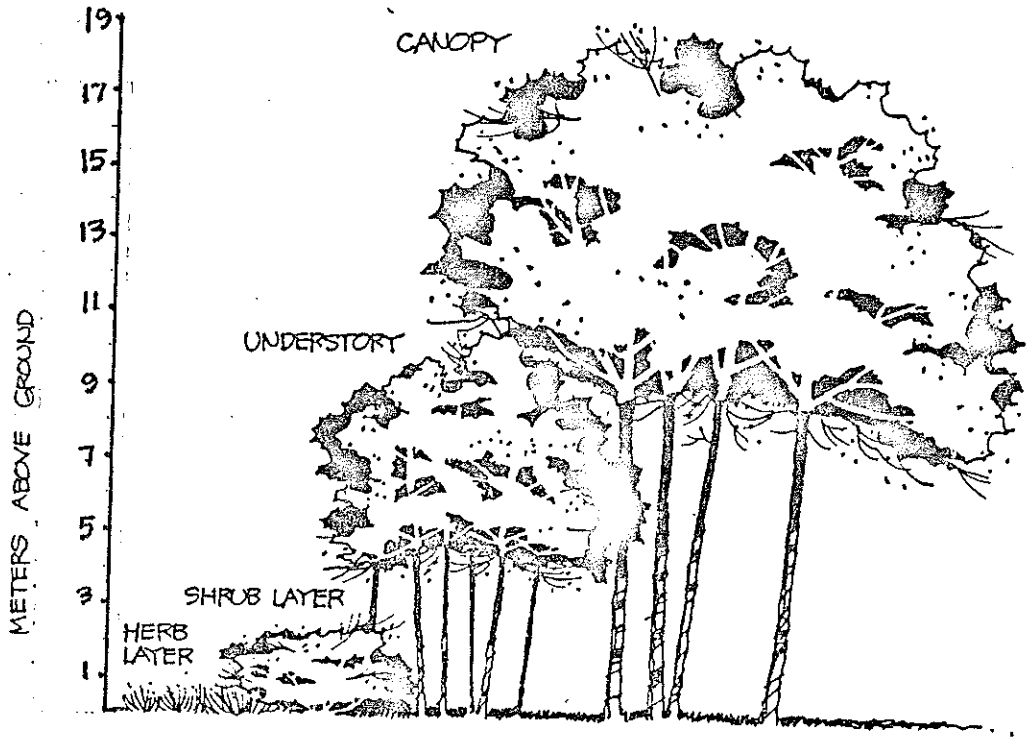
Thicket/hedgerow -- A community type with the same basic constituents as hedgerow/thicket, but in which the thicket dominates.

Town or village complex -- In order to simplify contiguous land use identification, any small rural community (like Stockton) was defined by the field survey team as a town or village complex. Such a complex includes some combination of residential, commercial, small-industrial and open space parcels of land.

Towpath -- For the purposes of this study, the trodden path which parallels the Canal on either or both sides; portions vary with respect to passability, width, management and access. Not necessarily confirmed as the old towpath of the Canal's commercial days.

Vegetation layers -- Species are identified as occurring in the canopy, understory, shrub or herb layer, regardless of the type of plant. Thus, a typical woody canopy species may be listed under herb where it is observed as a seedling. This method helps to identify community futures, i.e., which species are replacing themselves and which are newcomers.

Canopy	30+ ft (9.15+ m)
Understory	10 - 30 ft (3.05 - 9.15 m)
Shrub	3 - 10 ft (.915 - 3.05 m)
Herb	3 ft (.915 m)



Vegetation structure -- The physical character of a community, both vertically and horizontally. Described by physical and quantitative measurements, including mean height, stem diameter, degree of layer development and dominance, and color. Less specifically: a qualitative, aesthetic characterization.

Xeric -- An environment characterized by dry conditions (e.g., sun-exposed area of thin soils overlying bedrock).

Yazoo -- Small intermittent or ephemeral streams, or their vestiges (long patches of standing or sluggish water, or low, wet areas) in the inner floodplain between the Canal and a river or stream.

Sources

Anderson-Nichols & Company. 1972. Delineation of Flood Hazard Areas--Raritan River Basin: Beden Brook. Trenton, N.J.: New Jersey Department of Environmental Protection, Division of Water Resources. Flood Hazard Report No. 5.

_____. 1973. Delineation of Flood Hazard Areas--Raritan River Basin: Millstone River and Rocky Brook. Trenton, N.J.: New Jersey Department of Environmental Protection, Division of Water Resources. Flood Hazard Report No. 12.

Bard, Gily E. 1952. "Secondary Succession on the Piedmont of New Jersey." Ecological Monographs 22 (July): 195-215.

Buell, Murray F., and Wistendahl, Warren A. 1955. "Flood Plain Forests of the Raritan River." Bulletin of the Torrey Botanical Club 82 (November): 463-72.

Cantlon, J. E. 1953. "Vegetation & Microclimates on North and South Slopes of Cushetunk Mountain, N.J." Ecological Monographs, Vol. 23, No. 23.

Caputo, Darryl, Hochman, Michael, and Hougen, Stewart. 1973. "Ecological Planning: Water Resource Study on the Assunpink Watershed." Volume 1. Philadelphia: University of Pennsylvania, Department of Landscape Architecture and Regional Planning. Master's Thesis.

Cooperative Extension Service. 1974. List of New Jersey's Biggest Trees. New Brunswick, N.J.: Cooperative Extension Service, Cook College, Rutgers University.

Delaware and Raritan Canal Commission. 1976. Master Plan for the Delaware and Raritan Canal State Park: First Draft, May 1976. Trenton, N.J.: D & R Canal Commission.

Golden, B. Fritts. 1973. The Delaware & Raritan Canal: The Nature of Its Surroundings. Princeton, N.J.: The D & R Canal Coalition.

Hotchkiss, Neil. 1972. Common Marsh, Underwater and Floating-leaved Plants of the United States and Canada. New York: Dover Publications.

Jaques, H. E. 1959. How to Know the Weeds. Dubuque, Iowa: Wm. C. Brown Co.

Kuchler, A. W. 1967. Vegetation Mapping. New York: The Ronald Press Company.

Langford, Ronald C. 1974. Forest Land-Use Handbook for Urban Development. Pottstown, Pa.: Pennsylvania Department of Environmental Resources, Bureau of Forestry.

Monk, Carl D. 1957. "Plant Communities of Hutcheson Memorial Forest Based on Shrub Distribution." Bulletin of the Torrey Botanical Club 84 (May): 198-218.

_____. 1961. "Past & Present Influences on Reproduction in the William L. Hutcheson Memorial Forest, New Jersey." Bulletin of the Torrey Botanical Club 88 (May): 167-75.

New Jersey Department of Environmental Protection. 1972-1973. Aerial Photographs Corresponding to USGS Quadrangles. 17 Quads covering Canal and adjacent watersheds. 1:24,000.

_____. No date. Delaware River Access Area Project A-71. Four sheets. Courtesy D & R Canal Commission Staff. (Used in delineating Canal property lines.)

New Jersey Department of Planning and Development. 1975. The Delaware & Raritan Canal-Cadwalader Park Study. Trenton, N.J.: City of Trenton.

New Jersey State Department of Conservation and Economic Development. 1963. Green Acres Program, Millstone River 1963. 1 sheet. Courtesy of D & R Canal Commission Staff. (Used in delineating Canal property lines.)

Niering, William A. 1958. "Principles of Sound Right-of-Way Vegetation Management." Economic Botany 12: 140-44.

Niering, William A. and Goodwin, Richard H. 1963. Creating New Landscapes: A Homeowner's Guide. The Connecticut Arboretum Bulletin No. 14. New London, Conn.: Connecticut College.

_____. 1962. "What Is Happening Along Connecticut's Roadsides?" The Connecticut Arboretum Bulletin No. 13. New London, Conn.: Connecticut College.

Pennsylvania Railroad. 1934. Map Showing Delaware and Raritan Canal in the State of New Jersey as of June 12, 1934. Courtesy of D & R Canal Commission Staff. (Used in delineating Canal property lines.) 1" = 400'.

Petrides, George. 1958. A Field Guide to Trees and Shrubs. Boston: Houghton Mifflin.

Robichaud, Beryl, and Buell, Murray F. 1973. Vegetation of New Jersey: A Study of Landscape Diversity. New Brunswick, N.J.: Rutgers University Press.

Rogers and Golden, Inc. 1975. Maryland Uplands Natural Areas Study. Volumes 1 & 2. Annapolis, Md.: Maryland Department of Natural Resources, Coastal Zone Management Program.

Society of American Foresters. 1932. "Forest Cover Types of the Eastern United States." Journal of Forestry 30: 451-98. Reprinted in Maryland Department of State Planning, Forest Vegetation in Maryland, 1974.

Stony Brook Regional Sewerage Authority. No date. "Vegetation Study." Interim draft, unpublished. Stony Brook, N.J.: Regional Sewerage Authority.

U.S., Department of Agriculture, Soil Conservation Service and New Jersey Agricultural Experiment Station. 1972. Soil Survey of Mercer County, New Jersey. Washington, D.C.: Government Printing Office.

Van Vechten, George W., and Buell, Murray F. 1959. "The Flood Plain Vegetation of the Millstone River, New Jersey." Bulletin of the Torrey Botanical Club 86 (July): 219-27.

Vollmer Associates. 1970. Master Plan Report: Recreational and Historical Development, Delaware & Raritan Canal. Trenton, N.J.: New Jersey Department of Environmental Protection.

Westendahl, Warren. 1958. "The Flood Plain of the Raritan River." Ecological Monographs, Vol. 28, No. 2, pp. 129-53.

Whigham, Dennis F., and Simpson, Robert L. 1975. Ecological Studies of the Hamilton Marshes: Progress Report for the Period June, 1974-January, 1975. Trenton, N.J.: Rider College, Biology Department.

Volume 2
Regional Vegetation & Aquatic Buffer Zone

INTRODUCTION

Vegetation is a major element in the natural landscape and plays an important role in shaping man's built environment. It is the basic biotic component of the ecology of any area, and it is also the resource most easily subject to modification or destruction. As integral parts of oxygen, nutrient, and energy cycles, plants sustain life. As soil stabilizers, natural filters, and scenic resources, they act as control agents for runoff, erosion, climate, air quality, and nutrient and chemical contaminants, while providing variety and texture in our visual environment. Knowledge of the vegetation of an area allows the planner to preserve existing stands for use as visual and acoustic screens, wind breaks, and traffic barriers, and for their general aesthetic or scientific value.

In landscape design, variations in the species present and their structure and arrangement are important. Seasonal color and leaf cover, as well as shading, leaf texture and density, community pattern, and shape are all important characteristics which must be incorporated in any landscape design. Furthermore, vegetation types are often indicators of other site conditions, including ground water depth, soil texture and chemistry, land-use history, and frequency of disturbance. Because of the dependence of animals on vegetation for food and cover, the distribution of animals and the population levels that can be maintained can be inferred from vegetation data.

Of major importance to the Canal's water quality is the bank and terrace vegetation along the Canal. For most practical purposes, the Canal is a man-made stream. As it flows, people fish in it, drink from it (after some processing), boat on it and on occasion, swim in it.

Vegetation on the Canal edges and in the region drained by the Canal is important in maintaining the biological and chemical integrity of Canal water. If the vegetation is removed, more sunlight penetrates the water's surface and diurnal (night-day) temperature fluctuations may exceed the tolerance levels of aquatic organisms (Dorfman and Westman, 1970; Auberton and Patrick, 1965; Patrick, 1974, personal communication). In addition, the organic material necessary for trophic (food-chain) relationships in the stream may be affected, and erosion, sedimentation, and storm runoff will be increased. Removal of the buffering vegetation also leaves the surface water vulnerable to all types of non-point pollutants. As rainwater washes over these areas, a murky cocktail of sediment, oils, pesticides, fertilizers, salts, and other chemicals drains off the land and into the water. Vegetation acts as a buffer along the watercourse to detain and retain rainwater, allowing for filtration by soils.

Soils and vegetation data for the region can be analyzed in order to identify those stream-related areas likely to act as major sources of storm water runoff. With appropriate management and protection the natural functions of these high runoff potential areas can be retained to act as buffers for the aquatic system, thereby protecting natural or existing conditions in the system.

As we noted, an important aspect of vegetation is its ability to create or enhance scenic experiences and to shield undesirable views. Knowing the topography, vegetation types, and land uses along a corridor--in this case, the Canal--it is possible to anticipate which areas will offer long vistas and which will present enclosed experiences. In parallel fashion, it is possible to anticipate the sections of the corridor in which external visual impacts will be high and those in which such impacts will be low.

The prominent and multi-faceted position vegetation occupies in the landscape and in natural systems led the Canal Commission to study it in relation to the Canal Park. The first step was to develop the base data--a vegetation map for the region. The map categories used in the Regional Vegetation map reflect the range of conditions from naturally vegetated through agricultural and suburban uses to totally man-replaced.

Available soils data was interpreted to identify the areas of potential high runoff. The vegetation data was interpreted in conjunction with soils/runoff data to discern which of these areas are in a vegetated state to act as buffers to the aquatic system and which have been disturbed or replaced, thereby offering little protection to watercourses. The Aquatic Buffer Zone map shows these areas.

Landscape elements along the Canal, vegetation, structures, and landforms control view opportunities. The interplay of these three elements is reflected in the Visual Elements map, which shows the view conditions for a half mile on both sides of the Canal.

The Regional Vegetation, Aquatic Buffer Zone, and Visual Elements maps are at a scale of 1:48,000 (1"=4,000). Method, sources, and legends of these maps are explained in corresponding sections of the text.

REGIONAL SETTING

Central New Jersey--the region through which the Delaware and Raritan Canal flows--is generally rural in character, providing a major open space in the metropolitan corridor between New York and Philadelphia. The Canal itself links the urban-suburban areas of Trenton (on the Delaware River) and New Brunswick (on the Raritan).

As well as its predominantly rural character, the region has retained much of the atmosphere of its colonial past. The entire region, not just the Canal, has preserved elements of its heritage in its small boroughs, architecture and local building materials, interesting bridges, and generally pastoral pattern of land use.

Conspicuous green ribbons of forest follow the sinuous patterns of streams and wetlands. From aerials photographs it becomes clear that the drainage areas of streams in the western section of the region are much smaller than their counterparts across Route 1, in the eastern section. Another noticeable feature is the presence of many marshlands east of Route 1.

There are topographic reasons for these different patterns to the east and west of Route 1. The region can be divided physiographically. To the west, the undulating hills of the Piedmont (with its hard, consolidated bedrock, controlled drainage pattern, incised stream channels, and often rocky or very silty soils) contrasts with the flatter Coastal Plain (with its unconsolidated geology, sluggish stream flow, dendritic drainage pattern, and marshy, relatively flat floodplains) to the east. Between Trenton and New Brunswick, the Canal generally follows the dividing line between these different physiographic areas.

The distinctions of the two areas are often subtle but are important, not only to vegetation but to land use as well. For example, when looking at the regional vegetation map, one can see fewer oldfields in the Coastal Plain to the east than in the Piedmont. The soils and topography of the Piedmont are much less conducive to intensive farming than the soils of the Coastal Plain.

Another important consideration is water. In the Piedmont, water is stored in the cracks and fissures of fractured rocks. Water supply is difficult to predict and costly to acquire. Several wells may have to be dug before a sufficient yield is found. Coastal Plain water is found in sandy formations, access to it is fairly predictable, and it is abundant.

In considering regional differences in vegetation, it is important to note distinctions between the Piedmont and Coastal Plain floodplain forests, terrain, and moisture conditions. It should be noted here that many species are present in both physiographic regions; differences in woodland composition are due to regional variations in the dominance of species, rather than to the presence of different species in each region.

In the Piedmont floodplain, where the stream flow is rapid, hardwoods abut the water's edge. Along the Delaware River, sycamore, silver maple, and a mixture of oaks generally dominate the canopy. Disturbance species such as black walnut, hawthorn, tree-of-heaven (*Ailanthus* spp.) and poplars are also common where thin soils and steep slopes restrict the deep rooting of woody species.

Smaller Piedmont streams such as Stony Brook, Beden's Brook, and Jacob's Creek have sugar maple, silver maple, pin oak, and other hardwoods arching over the water, shading the streams from the sun. The floodplain here is relatively narrow with large (8" to 20" or 20 to 50 cm DBH), firmly rooted trees. The understory is commonly made up of dogwood, ironwood, and basswood, with spicebush and assorted briars in the shrub layer. Above the floodplain on the stream terrace a mixture of tulip poplar, beech, oaks, and maples is common.

In the Coastal Plain, on the other hand, the floodplains are relatively broad and the stream flow is sluggish. Considerable sediment deposition and rooting of aquatic plants due to this sluggish flow allow for the establishment of marshes along Coastal Plain streams. Distinctive bands of buttonbush, loosestrife, rose mallow, yellow water lily, cattail, and an occasional purple or white iris often follow the borders of Coastal Plain streams.

The trees in the floodplains are principally sweetgum, red maple, willow, black gum, and occasionally swamp white oak or pin oak. The understory is dominated by dogwood, ironwood, and hop hornbeam. The shrub layer is generally thick with spicebush and tangled with vines. The floodplain terraces in the Coastal Plain are usually dominated by upland oaks, beech, and tulip poplar (8" to 10" or 20 to 25 cm DBH), with an understory of dogwood, oak, cottonwood, and beech. The shrub layer on the stream terrace is generally thick with greenbrier, blueberries, blackberries, poison ivy, and Virginia creeper.

The rapid and flashy nature of Piedmont streams allows for very few aquatic plants to take root in the bottom sediments. Those which take root temporarily will likely be uprooted and washed downstream with the next flood. Rapid stream flow also has a tendency to downcut the stream bottom, producing the characteristic "V" shaped valleys and leaving very little bottom sediment. Because of the incised nature of the stream valley, the soils are usually deep and relatively undisturbed right up to the water's edge. Trees at the water's edge often have roots exposed by the stream flow which has scoured the banks.

Historic land uses, as well as physiographic differentiation, are responsible for the character of the vegetation in the Central New Jersey region. Of the remaining forests in both Coastal Plain and Piedmont parts of the region, few are over 200 years old. Most appear to be younger than a century. The absence of the older forests is largely the result of cultural disturbances.

Large-scale man-related disturbances apparently predate the landing of Columbus. According to historic record, early settlers did not find vast expanses of unbroken virgin forest in central New Jersey--particularly along the river valleys occupied by the Lenape Indians. The Indians deliberately burned the woods in the spring and fall: "many early explorers of the New World observed smoking forests" (Buell and Robichaud, 1973). A good deal of the land not cleared for villages or cropland was "park-like," with considerable openings in the wooded areas. This produced conditions more favorable for game, human forage, travel and observation. Several stately beech stands in the region reflect a forest character similar to that experienced by the first European settlers.

Agricultural settlement by the immigrants produced probably the greatest human impact on local climate, soil erosion, and water quality. A good example of the continued consequences is seen in the sediment loads of local streams. For the most part, the woodlands which still remain cover lands too steep, too wet, or too stony to be easily cultivated or developed. Yet even on the stony soils of the Sourland Mountains (western portion of the study region), signs of early attempts at farming are evident. Rock fences can be found amidst tall hardwoods.

By 1788 agriculture had cleared much of the forest land well suited for farming, but in central New Jersey agricultural acreage has decreased from 46% in 1899 to 24% in 1970 (Robichaud and Buell, 1973). Abandoned farmland not put to other uses naturally reverts to forest over a period of years.

In the region of the Canal, forest land has increased considerably since the turn of the century, when the land was at its most completely cleared state. These changes are seen in the data below from Robichaud and Buell's Vegetation of New Jersey (1973).

Percent of Forest Cover

	1899	1970
Hunterdon County	14%	31%
Mercer County	11%	26%
Somerset County	15%	32%
Middlesex County	31%	24%

Although forest land has increased, compared to farmland, over the past century, man's nonagricultural uses have also disturbed the woodlands of central New Jersey. Until recently, pipe and transmission line corridors crossing woodlands were often maintained by unrestricted use of herbicides. Herbicide damage to forests in New Jersey has been shown to be extensive (Dill, 1962, 1963). Use of the most harmful herbicides has been curtailed, but the influence of their past use on present and future vegetation is still unknown.

As well as man-induced changes, natural disturbances such as disease, fire, hurricanes, and floods also alter the vegetation. Both natural and man-induced disturbances (with the possible exception of floods) are not restricted to given vegetation types; they cross many boundaries. Moreover, each area, through time, has experienced different kinds and intensities of disturbance. On the whole, however, human influence has far exceeded the natural disruptions of the past few centuries in terms of both area covered and intensity.

Management of woodland areas is aided by an understanding of the responses of species to disturbance. Table 1 provides data on how species prevalent in the central New Jersey region respond to different disturbances.

In summary, it has been noted that vegetation in central New Jersey may be categorized, to some degree, in terms of the two physiographic regions (Piedmont and Coastal Plain) of the land. All the woodlands have been subject to natural and man-related disturbances, and the long-range effects of the latter have not yet been determined. Human use has created, and will no doubt continue to create, the most extensive changes in the character of central New Jersey's vegetation.

TABLE 1

CHARACTERISTICS OF TREES COMMON TO THE DELAWARE AND RARITAN CANAL AND CENTRAL NEW JERSEY

SPECIES NAME	Mature height (ft.)	Mature DBH (in.)	Root System	Longevity	Shade Tolerance	Growth Rate	SUSCEPTIBILITY TO DAMAGE FROM: Wounding	Water Table Change	Fill over roots	Fire Damage	REMARKS
White ash	80	36	D-S	M	M	M-R	M	T	M-I	M	Moderately prone to insect infestation
Green ash	60	24	D	M	I-N	M	M	M	M-I	M	Prone to insect infestation; windfirm
Bigtooth aspen	60	18	S	S	I	R	I	T	M-I	I	
American beech	90	28	S	L	T	S	M	M	I	I	Relatively free of disease; cannot withstand prolonged soil wetness or compaction of roots
Gray birch	30	10	S	S	I	R	I	M	I	I	
River birch	70	24	S	M	M	M	I	M	I-M	I	
Box elder	40	15	S	S	I	R	I	I	I	I	Disease-prone
Black cherry	60	24	M-D	M	M	R	I	M	I	I	Attracts tent catepillars
Flowering dogwood	35	12	D	S	VT	VS	I	M	I-M	I	
American elm	100	48	M-D	L	M	M	I	T	I	I	Disease-prone; cannot withstand flooding
Slippery elm	70	24	M-D	L	M	M	I	T	I	I	Disease-prone
Black gum	60	24	M	M	M	M	M	I	I	M	Relatively free of disease
Hickories	80	24	D	L	T	S	M	M	M-I	M	
Honeylocust	80	24	D	M	M	R	M	M	M-I	M	Relatively free of disease
Hop hornbeam	25	8	M-D	M	T	S	M	M	M	I	Relatively free of disease
Ironwood	25	8	M-D	M	T	S	M	M	M	I	
Black locust	60	18	S	M	I	R	I	M	I	I	
Norway maple	80	24	S	M	M	R	I	M	I	I	
Red maple	70	20	S	M	M	M	I	T	I	I	Insect- and disease-prone
Sugar maple	100	36	D	L	T	M	I	T	M	I	
Silver maple	80	24	S	M	M	R	I	M	I	I	Insect- and disease-prone
Black oak	70	26	D	L	M	M	I-M	M	M	M	
Chestnut oak	80	30	D	L	M	S	I	T	M	T	
Pin oak	75	30	D	L	I	R	S	M	M-I	I	Susceptible to fire damage
Red oak	90	24	D	L	M	M	I	M	M-I	M	Oak wilt can kill tree in one year
Scarlet oak	75	36	D	M-S	I	M	I	M	M-I	I	Susceptible to fire damage
Swamp white oak	65	36	M	M	M	M	M	M	I	T	Relatively free of disease
White oak	100	36	D	L	I	S	M	M	M-I	M	
Persimmon	50	18	M-S	M	VT	S	M	I	I	M	Relatively free of disease
Eastern red cedar	50	18	D	M	I	S	I	T	M	I	Disease-resistant
Sassafras	50	20	S	S	T	S	I	T	I	I	
Sweetgum	80	30	M-S	M	I	R	M	T	I	I	Disease- and insect-resistant; susceptible to fire
Sycamore	120	36	S	M	I	R	M	T	I	I	
Tulip poplar	100	30	D	L	I	R	I	T	M	I	Disease-resistant; crowns are subject to wind damage
Black walnut	90	24	D	L	I	R	I	M	M	T	
Willow	40	14	S	S	I	R	I	I	I	I	

KEY

Root System
- (S) Shallow
- (M) Moderate
- (D) Deep

Longevity
- (L) Long
- (M) Moderate
- (S) Short

Shade Tolerance
- (VT) Very Tolerant
- (T) Tolerant
- (M) Moderate
- (I) Intolerant

Growth Rate
- (R) Rapid
- (M) Moderate
- (S) Slow
- (VS) Very Slow

Susceptibility to damage from:

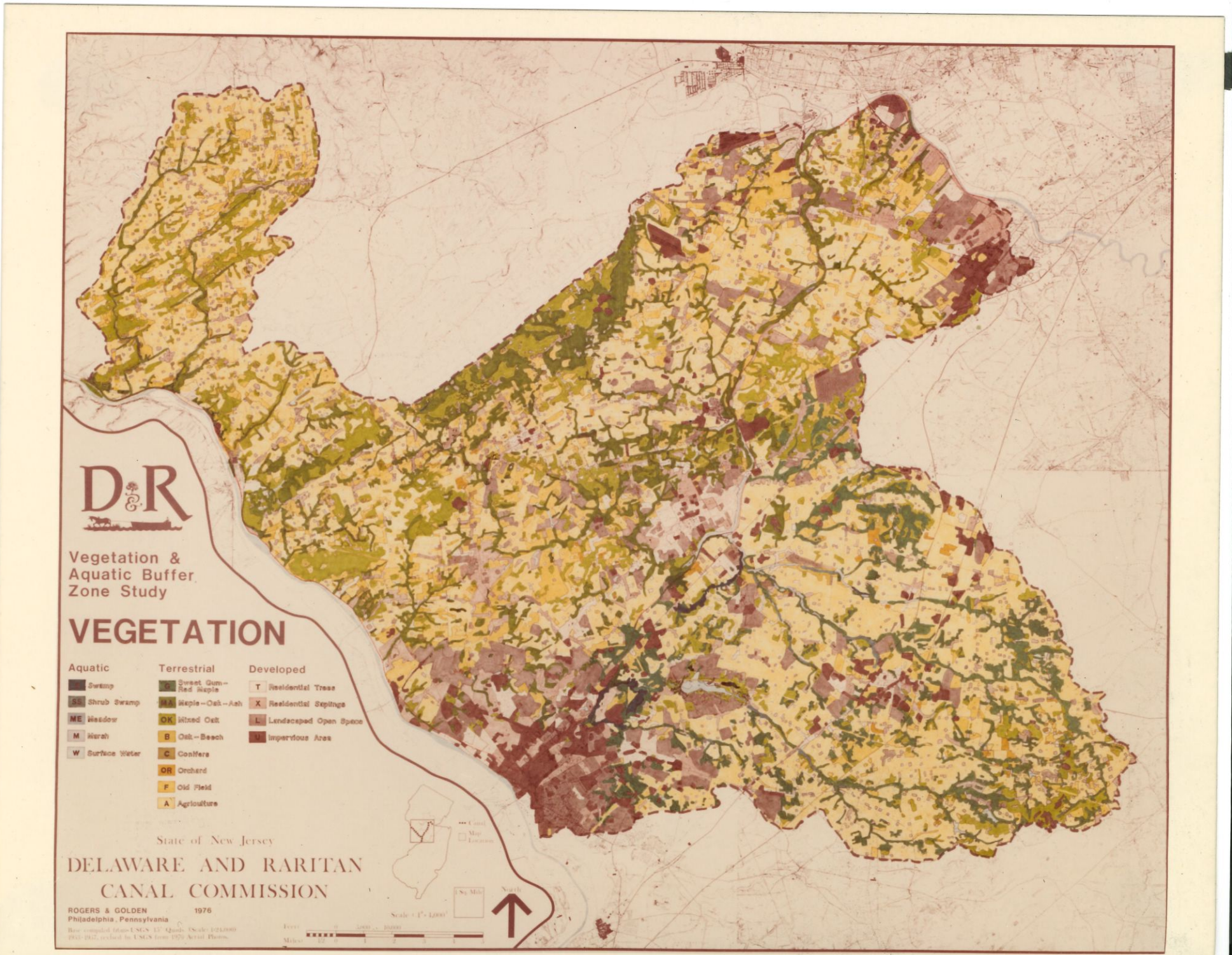
Wounding
- (S) Susceptible to disease
- (M) Moderately susceptible
- (I) Low susceptibility

Water Table Change
- (T) Tolerant
- (M) Moderate
- (I) Intolerant

Fill Over Roots
- (T) Tolerant
- (M) Moderate
- (I) Intolerant

Fire Damage
- (T) Tolerant
- (M) Moderate
- (I) Intolerant

SOURCES Fowells, 1965; Collingwood and Brush, 1974; Brown and Brown, 1973.


D&R
Vegetation &
Aquatic Buffer
Zone Study
VEGETATION
Aquatic
Swamp
SS Shrub Swamp
ME Meadow
M Marsh
W Surface Water
Terrestrial
SG Sweet Gum–Red Maple
MA Maple–Oak–Ash
OK Mixed Oak
B Oak–Beach
C Conifers
OR Orchard
F Old Field
A Agriculture
Developed
T Residential Trees
X Residential Saplings
L Landscaped Open Space
U Impervious Area
State of New Jersey
DELAWARE AND RARITAN
CANAL COMMISSION
ROGERS & GOLDEN 1976
Philadelphia, Pennsylvania
North
Scale 1" = 1,000'

WETLANDS

Swamp

Swamps are lowlands on which standing water is present for only part of the year, most often in spring and fall. Though swamps and floodplains differ in origin, their moisture conditions tend to be similar, resulting in the same groups of plants being common to both. Shallow depressions underlain by clay act to contain water where the water table is high. In these areas, swamps are commonly found if tree cover exists.

Swamp vegetation is fairly uniform. Nearly pure stands of even-aged sweetgums often develop on these sites. More mature stands contain swamp white oak, red maple, pin oak, ash, slippery elm, and black gum. Common shrubs include arrowwood, spicebush, bush high blueberry, low-bush blueberry, sweet pepper bush, and swamp azalea. Poison ivy and honeysuckle are abundant in certain areas, frequently creating a dense thicket with a shrubby appearance.

Shrub Swamp

Shrub swamps occur intermittently along streams in the region. Their soils are usually waterlogged during the growing season. Unlike typical swamps, they lack a canopy layer. Vegetation includes alders, willows, buttonbush, and swamp privet. A good example is the shrub swamp at the Princeton Wildlife Refuge.

Meadow

Meadows occur along streams on poorly-drained flats which rise as much as two feet above the level of stream base flow.

These areas are periodically inundated by floodwater. The soil is usually without standing water throughout most of the growing season but is waterlogged within a few inches of the surface. Vegetation includes grasses, rushes, and various broad-leaved plants such as loosestrife and assorted polygona.

Marsh

Marshes are broad wet areas on which grasses and sedges grow along with many emergent plants such as yellow water lily. Along the edge, cattails, arrow-arum, arrowhead, impatiens, and swamp milkweed occur. The Hamilton Marshes exemplify this type of vegetation.

Management

Wetlands should be preserved where possible. The amenities and services they provide can only be replaced by flood control programs, stocking streams with fish, and the creation of artificial wildlife habitats.

Wetlands and floodplains contain a great diversity of wildlife. The combination of moist, nutrient-rich soils, varied topography, and proximity

of water to dry land provides food, shelter, and nesting sites for many species.

Any development in these wetland areas poses hazards to the integrity of the ground water and surface water resources of the areas, as well as hazards to the development itself. Water pollution would be a hazard due to the proximity of the water table to the surface of the ground. Hazards to people would include flooding, bacterial populations in the moist nutrient-rich soils, and the high incidence of tree fall which occurs in these areas.

LOWLAND FOREST

Lowland forests usually occupy somewhat poorly drained to poorly drained sites in floodplains, along ravines and drainageways, on flat areas at higher elevations or lower slopes along ridges.

Sweetgum-Red Maple

The floodplains of the Coastal Plain area of Central New Jersey support forests which are dominated principally by sweetgum and red maple. White ash, tulip poplar, black gum, pin oak, and an occasional willow oak are also found. Most of these forests appear to be roughly the same age, with trees usually having a range in DBH from 6" to 12" (15 to 30 cm).

The understory is composed of dogwoods, ironwood, sweetgum, and red maple. The shrub layer is less dense than upland forests and is dominated by spicebush. Viburnums are common but are dominant less often than spicebush. Blueberry, huckleberry, and blackberry are also common. Vines such as poison ivy, Virginia creeper, honeysuckle, and greenbrier occur from the understory on down. In some areas these choke out other vegetation. The herbaceous layer is dominated by ferns and wildflowers.

In some cases, where the canopy is dense, there is very little vegetation in either the shrub or herb layer, making travel through these areas fairly easy, providing you can stay out of the mud.

Maple-Ash-Oak

These forests occur predominantly on the lower slopes and in the ravines on the ridges or along the floodplains in the Piedmont. White and green ash, silver and sugar maples, pin and red oak, and tulip poplar are the most common trees. Sweetgum is also found but is only occasionally dominant. Because these forests occupy a variety of locales, from deep floodplain soils to rocky, shallow soils, their range in tree size is extremely wide. Along the Stony Brook and Millstone River, the typical DBH is between 12" and 30" (30 and 73 cm). An occasional sycamore along the floodplain might be as great as four feet (1.3 m) around. Along the lower slopes of the ridges the tree size appears to be more uniform, with trees of over 12" (29 cm) DBH being common. Unlike similar areas in nearby Pennsylvania

(e.g., the Wissahickon Watershed), very few hemlocks or mountain laurel are present in the lower slope areas. The few small hemlocks that do exist occur near landscaped areas where other hemlocks are present.

Spicebush is the most often dominant shrub, while dogwood, ironwood, hop hornbeam, and cottonwood are common in the understory. Black haw and arrowwood are also common in the understory. Of all the vines present, poison ivy is the most conspicuous. Vines of poison ivy with stems as large as 2.5" (6 cm) in diameter can be found. Honeysuckle takes a close second to poison ivy, particularly in areas of open canopy. Herbs in these areas include jewelweed, violet, grasses and sedges, bog nettle, stinging nettle, and Jack-in-the-pulpit.

Management

Lowland forests generally occur in areas too wet to be easily developed. Sweetgum trees are more susceptible to windthrow and drought than oaks. Sweetgum and tulip poplar are intolerant of shade and will not regenerate effectively in stands where they are mixed with oaks and maples. Willow oak, swamp white oak, willow, and sweetgum may be killed if the swamps are drained or if the water table is altered considerably through development or drawn-down from nearby water table wells.

In many lowland forests, grape, poison ivy, Virginia creeper, and other vines form a dense cover on many trees. Over time these vines can literally choke the life out of the trees.

UPLAND FOREST

Upland forests usually occupy moderately to well drained uplands, taking the form of woodlots among agricultural land or covering the ridges.

Mixed Oak Forest

The mixed oak forest is ubiquitous in the uplands of central New Jersey. The 60 to 100 foot (18 to 30 m) canopy of these forests is usually dominated by white, black, and red oaks, with, to a lesser extent, scarlet and chestnut oaks, several species of hickory, tulip poplar, sugar maple, white ash, beech, and black cherry. Tulip poplar and sweetgum appear to be more common in the Coastal Plain mixed forest canopy than in Lower Piedmont forests.

Below the canopy, the 25 to 50 foot (7 to 15 m) understory, with its preponderance of dogwood, often grows distinctly separated from the layers above and below it. Ironwood is also very common, as are hop hornbeam, sassafras, and saplings of red, white, and black oaks. Beech is found in this understory, but more sporadically. In the often thick and continuous shrub layer, field reconnaissance has shown the mixed oak forests of the Lower Piedmont to vary slightly from those of the Coastal Plain. Both forests have abundant viburnums and spicebush; however, the Coastal Plain

forests have a higher percentage of acid-loving blueberries, huckleberries, and blackberries, probably due to the sandier, more acid Coastal Plain soils. Viny species like poison ivy, Virginia creeper, Japanese honeysuckle, and wild grape are familiar to both Coastal Plain and Piedmont mixed oak forests, often tangling with the understory as well as the shrub layer.

The herbaceous plant mixture changes seasonally as well as with location. Spring is an intriguing time to walk these forests, when delicately colored herbs like violets, May apple, Solomon's seal, both yellow and orange jewelweed, and others are in bloom. In the fall, asters and goldenrod are the most conspicuous flowers. Common to these forests year-round are a variety of ferns, including New York, Christmas fern, and bracken. As well as the distinctions between the Lower Piedmont and the Coastal Plain mixed oak forests, a distinction can be made between the mixed oak forests of the valleys and those of the ridges. Generally the ridge forest shrub layer is less dense than that in the valley. Also, the ridge trees are usually spaces farther apart.

Mixed oak stands contain hardy, long-lived species. Regeneration in these areas is generally good, resulting in a steady species composition over time. Where beech and sugar maple are present, the composition will probably shift in their favor in the future.

Because these forests occupy dry places, they are good sites for camping and picnicking, although the shrub layer is often so thick and filled with briars as to make the undergrowth difficult to walk through.

Oak-Beech

Beech trees occur sporadically throughout the uplands of Central New Jersey. For the most part, they are sapling- or understory-size trees having a DBH less than 9" (23 cm). There are, however, stands of stately beech trees mixed with red, black, and white oaks which often have canopy heights of over 100 feet (30 m). These impressive stands have been mapped under this category.

Beech trees are usually found on moderately well-drained to poorly drained soils with fairly high clay fractions (Haines, 1965). Beech cannot survive in areas covered with standing water for extended periods of time (Fowells, 1965). From our observations, they are not usually found in floodplains or swamps. They are commonly found on stream terraces, steep slopes, and well-drained plateaus.

As beech trees, with their dense canopy foliage, produce a very dense shade, very few shrubs or herbs grow in the understories. This paucity gives the stands a feeling of openness and permits easy travel through the areas. Beech stands have well-groomed appearances, their columns of smooth gray bark contrasting with the darker barks of oaks (white, red, black, pin, and scarlet), sweetgum, and sugar maple, which also occur in these stands.

The oak-beech stands represent some of the older, more mature forests in the region. In most instances, beech, oak, and maple saplings dot the understory. The character of these areas will be retained indefinitely, barring severe disturbance. Although these areas do provide habitats for wildlife, they are not the best habitats, as the lack of shrubs and herbs restricts the diversity of animal species which can survive in these areas. Perching birds and larger mammals are the principal inhabitants.

Oak-beech stands provide excellent recreational opportunities with little maintenance. One precaution is that the roots of the beech trees are sensitive to compaction (Fowells, 1965). For most passive recreational uses, however, this will not pose problems.

Management

Upland forests are generally stable communities. The soils are generally better drained than those of lowland forests, making them better sites for most recreational activities. But several considerations should be noted. The crowns of the tulip poplar tree are easily blown down during high winds. This creates a hazard to any building constructed in these stands and is the major reason tulip poplars are not used as roadside trees. The trunks of beech trees, when exposed to the sun, develop sun scald, which splits the bark in winter and opens the trees to disease. The roots of beech are sensitive to heavy compaction. Residential or passive recreational use of beech stands should have little effect on the life of the trees provided that heavy equipment is prevented from driving over the root zone. Sugar maple trees are extremely intolerant of salt (i.e., road salt) and will be severly damaged or killed if exposed to it in large quantities. Oaks are susceptible to several insects and diseases but are generally considered good trees for shade and amenity.

CONIFERS

These plantations or old abandoned fields contain stands of pines, spruce, red cedar, and fir trees. In most cases the trees are over 10 feet (3+ m). In old abandoned fields, saplings of poplar, oaks, hawthorn, dogwoods, or maples are also common. In many cases these stands are useful as noise attenuators, visual screens, and wind buffers when they are not planted for harvest.

These are not particularly good wildlife areas except for the shelter they provide. They are excellent areas for rainwater interception.

ORCHARDS

These plantations are rows of deciduous fruit trees and nursery stock, usually not more than 15 feet (4.5 m) tall. Wildlife fares much better here, particularly once the orchards have been abandoned, as many of them have been.

OLDFIELDS

Oldfields are areas undergoing a change in vegetation, generally following the abandonment of several kinds of land uses. These uses include cultivated fields, pastures, and bare soil areas which have been abandoned for several years.

Little blue stem, panicum grass, timothy, and brome grass are the dominant grasses. These are bunched among the more conspicuous goldenrod, asters, wild carrot, and other broad-leaved plants. Woody shrubs such as blackberry, strawberry, and elderberry are conspicuous and often dominant in these areas. Red cedar, sassafras, poplar, black cherry, and even sugar maple, hawthorn, black locust, and pin oak are tree seedlings and saplings common to these areas.

Transitional fields are good sources of food and shelter for most terrestrial wildlife. Of particular importance is the high percentage of fruit bearing cover and the extent of thicket.

These areas are generally very difficult to walk through and provide little noise or visual buffering. If abandoned for 15 to 20 years, a dense vertical profile of foliage would occur in most places and would provide benefits similar to young hardwood stands.

AGRICULTURAL LAND

This category includes both cultivated fields and pastures. Depending on use, the vegetation of these areas generally changes on an annual or semi-annual basis. The vegetation is restricted for the most part to the herb layer.

RESIDENTIAL TREES

More than 50% of the ground is shaded by trees, usually greater than 30 feet (9 m) tall. Included in this category would be parks (e.g., Cadawalader Park, in Trenton) and residential areas where mature trees arch over the grounds and buildings. The shrub layer is sparse, usually confined to rows and clusters of both endemic and ornamental species. Less than 20% of these areas are impervious.

For wildlife, these areas provide good structural variations in vegetation habitats. Berries, nuts, and seeds are often plentiful. In terms of runoff, the canopy in these areas helps to intercept and transpire rainwater, thus helping to absorb water on site.

RESIDENTIAL SAPLINGS

Included in this category are residential neighborhoods or homesites which have less than 50% but more than 20% of the ground shaded by trees. Impervious surface covers less than 50% of the site. Many of these homes are 15 to 20 years old, judging from the vegetation. Some are older

neighborhoods with scattered large trees. As with residential tree areas, the shrub layer in residential sapling areas is sparse and confined to rows and clusters. The herb layer is usually covered with manicured grass.

These areas provide some habitats and food sources for wildlife.

LANDSCAPED OPEN SPACE

This category includes those areas where at least 75% of the ground surface is covered with unshaded, manicured grass. Few or no trees and shrubs exist. Land uses included in this category are new homes, office and light industrial parks, cemeteries, golf courses, and the like.

For wildlife, very few opportunities exist. In terms of runoff, these areas can act somewhat like impervious surfaces due to the compaction of the ground and the occasional matting of the grass under intense storm conditions.

IMPERVIOUS AREA

This category includes those areas where pavement or compacted surfaces cover the majority of the site. Land uses within this category might include shopping centers, industrial areas, apartment complexes, quarries, and landfills.

AQUATIC BUFFER ZONE MAP

While it is often useful to follow the segmentation of the natural world by scientists needing to facilitate their research, it is the genuinely integrated nature of natural systems which must be central in our thinking when we develop methods for predicting, avoiding, or managing changes in the environment. We are finding that the need for knowledge of natural linkage and of causal effects is nowhere more important than in dealing with terrestrial and aquatic ecosystems.

Over three decades ago, Aldo Leopold eloquently described the great natural concert between land and water:

> Soil and water are not two organic systems, but one. Both are organs of a single landscape; a derangement in either affects the health of both. . . . All land represents a downhill flow of nutrients from the hills to the sea. This flow has a rolling motion. Plants and animals suck nutrients out of the soil and air and pump them upward through the food chains; the gravity of death spills thems back into the soil and air. Mineral nutrients, between their successive trips through this circuit, tend to be washed downhill. Lakes retard this downhill wash, and so do soils. . . . The continuity and stability of inland communities probably depend on this retardation and storage. . . . The downhill flow is carried by gravity, the uphill flow by animals. There is a deficit in uphill transport, which is met by the decomposition of rocks (Leopold, 1941).

In the long term, infrequent major events (geologic uplift, for example) can move massive amounts of material from topographically lower to higher systems. Most of the usual mechanisms of transport tend to facilitate the downward trend, however.

Normally, mature terrestrial ecosystems develop efficient nutrient cycles. These are characterized as "tight" nutrient cycles (Likens and Bormann, 1974) because they lose only small amounts of their nutrient capital to drainage waters. The loss of particulate matter is also low because of the reduction in erosion which is facilitated by the structure of the biologic community. It is this mature, efficient terrestrial ecosystem which maintains a balanced relationship with the aquatic system-- controlling nutrient and sediment loads and preventing damaging rushes of stormwater runoff while providing a steady baseflow to the stream channel.

Disturbance can upset this homeostasis. And man's insertion into the environment of himself, his machines, and his outline is the most pervasive disturbance we know of. Disturbance accelerates the downhill trend that Leopold describes. Alterations in the terrestrial ecosystem increase its nutrient and particulate loss to the aquatic system. Removal of vegetation in the terrestrial spere leads to major problems of soil loss. Dislodged soil fills low-lying areas and when it is transported to the drainage network,

its movement results in dramatic and far-reaching effects in the aquatic sphere. The entire physical appearance and morphology of stream channels and lakes can be altered, as scouring and redeposition of materials give testimony to the watercourse's response to overloading. Periods of high flood flow followed by excessively low flow periods are common when stormwater runs rapidly off land which no longer has the means to retain it. Channel and bank erosion result and leave little water to replenish stream baseflow.

Change, especially when wrought by man, has continuous effects in addition to its obvious initial impacts. The removal of vegetation and disturbance of the soil generally heralds a change in long-term land use. Cultural features enter the landscape. Farms, parking lots, streets, houses, lawns, and industries all begin to contribute their own nutrients, chemicals, and runoff water to the aquatic system.

Thus, the terrestrial-aquatic balance is changed by both the disturbance and the range of new contributing agents which follows it. Both tend to accelerate the downhill trend of the systems. The terrestrial and aquatic ecosystems strike a new balance at what is considered to be, from a human perspective, a much lower level.

Prevention of radical alterations and fluctuations in natural systems requires sound management and carefully planned intrusion into the landscape. The key to both is a clear understanding of how natural systems function and an early identification of where they are most sensitive and where most resilient. Recent formulations on runoff mechanisms (and hence on how materials and substances are transferred from the terrestrial to the aquatic system) are emerging as a prime basis for new land management tools.

Just as there are variations in topography, geology, or vegetation over a geographic area, so too are there variations in the way precipitation moves overland and through the ground toward a drainage network. Work in the last two decades has demonstrated that only particular areas of a watershed will contribute overland runoff to a stream. In large portions of most watersheds (at least in the humid northeastern United States), the capacity of the earth to absorb water exceeds the rate of rainfall: there is thus no runoff from these areas. Therefore, it is possible to discern that there are areas which are hydrologically active, contributing stormwater runoff (and anything it carries with it) to the drainage network; other areas are relatively inactive in terms of hydrologic significance and immediate linkage to the aquatic system. More detail is provided below.

Runoff

Whether an area contributes to runoff or to the groundwater depends on its position with respect to the aquatic system, its soils properties, and the characteristics of the storm. In most instances it is the properties of the soil which determine whether precipitation will infiltrate the ground or move overland as runoff. If the rate of rainfall is greater than the capacity of the soil to absorb it, or if the soil is already saturated, the unabsorbed excess becomes overland flow, and the water and its contents can reach the aquatic system.

If the precipitation is absorbed by the soil, it may move underground toward the surface water system by a variety of paths. If the soil is deep and of fairly uniform permeability, the subsurface water moves downward to the zone of saturation and then flows along a downhill gradient within the soil to the nearest watercourses. This flow is at a much slower rate than surface runoff (Dunne et al., 1975). Therefore, most underground flow contributes only to the stream's baseflow, the basic between-storm stream flow.

Soils with shallow depths to bedrock or the water table or soils which contain impeding layers may complicate this simple pattern. For example, if percolating water encounters an impeding horizon (claypan or fragipan) at some shallow depth, in the subsoil, part of the water will be diverted horizontally over the impeding layer. This diversion through the soils, often along the impeding surface, is called subsurface flow, and is one form of groundflow. Where water follows this shorter path or where steeper slope gradients occur, water may reach the stream channel more quickly than by typical groundwater flow. This water may contribute to the storm peak-flow of the stream (Weyman, 1970, Ragan, 1968). On some slopes, where the impeding layer intersects the ground surface or where already saturated soils occur, subsurface flow may emerge as a spring or seep. The water may then traverse the surface of a saturated area as return flow.

Precipitation falling directly onto saturated soils near streams cannot infiltrate the wet soil: rather, it runs over the surface to the stream channel. This is termed saturated overland flow. It is impossible to separate saturated overland flow from return flow, and the two together are usually considered saturated overland flow (Dunne et al., 1975).

In summary, precipitation may follow three general pathways. It may strike an already saturated area or be delivered at a rate greater than the capacity of an area to absorb it, thus becoming overland runoff. It may be absorbed into the soil and eventually join the groundwater system, which contributes to the aquatic system slowly. Or it may initially enter the ground but be diverted because of impedence or an excessively steep slope and flow faster than most groundwater toward the aquatic system. This subsurface flow may emerge in seeps or springs to join saturated overland flow.

Partial Areas

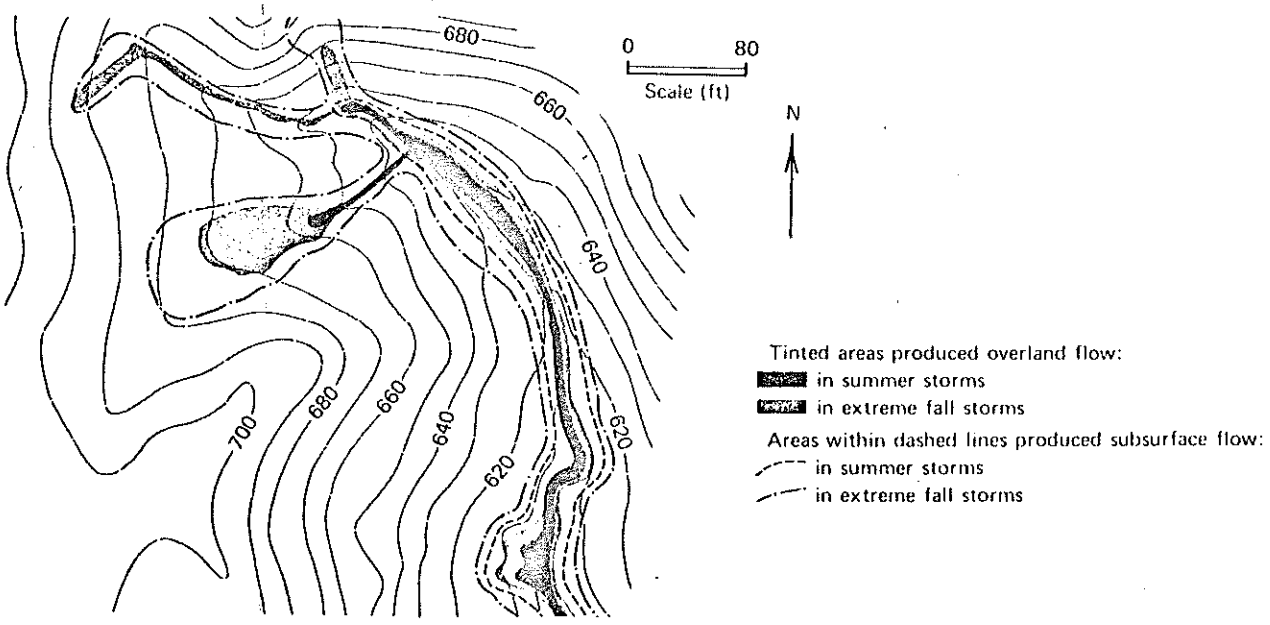
The occurrence of each terrestrial water flow process is a complex function of geology, physiography, soil properties, vegetation and land use. Recent studies in undeveloped watersheds of the eastern United States and in England have shown that a saturated area adjacent to streams contributes the greatest stormwater runoff volume. A number of investigations (see below) support the finding that most overland flow occurs from areas that make up usually no more than 10% and often only 1-3% of a drainage basin (Dunne and Black, 1970). Betson (1964) first discovered these areas when he realized that only partial areas of entire basins in the Tennessee Valley area he was examining could be contributing runoff to storm flow. He coined the term "partial area" for the these saturated, often shallow, stony, or compacted areas. Betson's work modified the classic runoff theory of Horton (1933), which implied that most rainfall events exceed the infiltration capacity of the soil and that overland flow is commonly widespread in a watershed.

SELECTED RESEARCH ON PARTIAL AREAS

Researchers	Type	Place
Betson, 1964	Postulate	Tennessee
Ragan, 1968	Field Study	Vermont
Dunne and Black, 1971	Field Study	Vermont
Chiang, 1971	Computer Model	Pennsylvania
Hills, 1971	Field Study	England
Freeze, 1972	Computer Model (Subsurface Runoff)	New York
Grubek and Heald, 1974	Field Study (Phosphate Transport)	Pennsylvania

Partial areas are dynamic areas, expanding and contracting their geographic extent seasonally and during storms of varying duration and intensity. When expanded during storms, the outer edges of these areas can be considered the outer edges of the functional aquatic system, since they become linked through runoff with the aquatic system. Under dry conditions, the partial areas contract. This variability in geographic extent is to be expected. During wet seasons, the area of saturated soils is greater; therefore the source area for runoff is larger. Similarily, during a storm event, more and more land area becomes saturated as time passes and the area becomes a hydrologically active area for runoff. Figure 1 illustrates the dynamic nature of the partial area.

Figure 1. Areas Contributing Surface Runoff Under Various Storm Conditions



Source: Dunne, 1966.

Other considerations not discussed here, but important when developing sites adjacent to aquatic systems, are contour configuration, slope shape and stability, soil erosion potential, bulk density of soil, specific nutrient and food cycles, trophic relationships, and the relationship of headwaters to mainstreams. Soil erosion potential is particularly important because in developing watersheds, where soils are denuded of vegetation, the sediment yields in streams can increase to 100 times the natural rate (Wolman, 1964).

Additional Basis for the Aquatic Buffer Zone

By outlining the partial area, we have only circumscribed the area which, left to itself, contributes most of the overland runoff reaching the aquatic system. We need now to examine some of the more detailed aspects of how runoff mechanisms, soils, vegetation, and man interact. Then we shall be in a position to describe what makes an adequate buffer to the aquatic system.

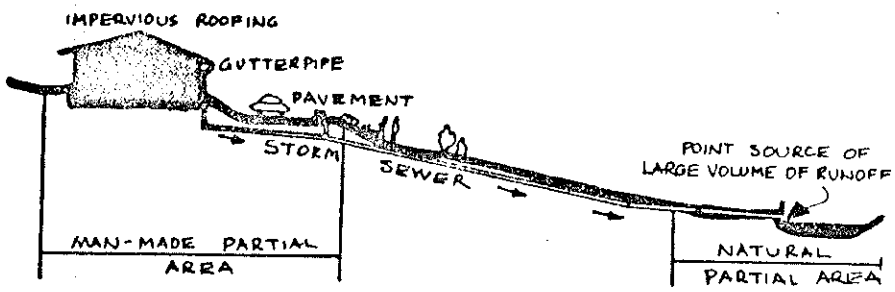
Infiltration

Several processes combine to reduce the infiltration capacity of the soil during a storm. When soils are cleared of vegetation, the filling of fine pores with water reduces capillary forces drawing water into the soil, and the storage potential of the soil is more quickly reached. If clay is present in the soil, the clay particles swell as they become wet, reducing soil pore size. The impact of the raindrops, the major cause of erosion (Young and Weirsma, 1973), breaks up soil aggregates, splashing fine particles over the surface and washing them into pores where they impede infiltration. At the beginning of a storm, percolation generally exceeds rainfall intensity and there is a little accumulation of water on the soil surface. As either the intensity increases or the infiltration rate is decreased by saturation, rainfall exceeds infiltration capacity. At first, this excess rainfall fills surface depressions. When the depressions are filled, the excess becomes overland flow traversing the land in a system of rills (Emmett, 1970).

Urbanization

In an urbanizing watershed, the path of surface water flow is largely determined by sewers, roads, rooftops, and other impervious surfaces and by land use practices. The two factors governing the stream flow regime are the percentage of the watershed area made impervious and the rate at which the water is transmitted to stream channels. The former is governed by the type of land use, the latter by the density, size and characteristics of tributary channels and storm sewers (Leopold, 1968). Impervious surfaces in uplands which are connected to aquatic systems by sewers are, in effect, man-made partial areas. (See Figure 2.) Alternative methods for infiltrating water on-site, such as pervious pavement and rooftop or other types of detention ponds, should be given serious consideration over shunting water directly to aquatic systems via sewers.

Figure 2. Man-Made Partial Areas



Surfaces such as lawns, pastures, and trails are usually compacted and may act as impervious surface. In intense storms, lawns become matted and runoff occurs in sheets and rills. When next to aquatic systems, these surfaces do not provide the impediment to runoff necessary for the system's protection. Vegetation undergoing natural succession is much more effective in detaining and retaining runoff.

Vegetation

Vegetation protects the soil from raindrop impact, traps sediment, and impedes overland flow. At the same time, root systems, particularly in partial areas, absorb significant volumes of soil water during the growing season, thereby potentially increasing the infiltration capacity of streamside soils.

The foliage and roots of trees such as black gum, willow, red maple, and beech are substantially more efficient than other plants at removing water from the soil (Fowells, 1965; Lee, 1942). Trees also provide litter and humus which absorb and store water. Roots which penetrate deep into the ground aerate the soil, maintaining its porosity and granular structure (Buckman and Brady, 1974). Shade from floodplain or streamside forests moderates temperatures in the stream, buffering aquatic organisms from temperature extremes. Leaf material also serves as a significant source of food and nutrient for aquatic flora and fauna (Vannote, 1975). If vegetation is removed and more sunlight is allowed to penetrate the water surface, diurnal temperature fluctuations may exceed the tolerance of aquatic fauna during one or all of their life phases (Auberton and Patrick, 1965). Meanwhile, the food necessary for certain organisms may be eliminated by tree removal (Vannote, 1975).

Biological Contamination

The soil is a rich medium for culturing both pathogenic and nonpathogenic bacteria. The nutrient-rich, moist soils of partial areas are especially important in this respect.

Bacteria and viruses move through the soil with groundwater flow. The movement of the pollution in the soils is connected with and dependent upon the rise and fall of the groundwater table and the alternation of wet

and dry weather conditions.

The soil between the highest water table level and one foot below the lowest water table level is called the bacterial danger zone (Stiles and Crohurst, 1923). Here the conditions are ideal for bacterial growth. Partial areas often have a seasonal high water table at or near the surface: therefore, the bacterial danger zone is at or near the surface in these areas.

The properties of the soil in contact with bacterial or virulent sources play a dominant role in the subsequent life and movement of the contaminant. Soils which are very fine to fine-grained sands with a high clay content are best suited to remove biological contamination. Bacteria in wet, nutrient-rich soils have been known to survive up to five years. However, 60 to 100 days is probably a more common life span in temperate climates (Romero, 1972).

Most controlled experiments indicate that viruses have a tendency to deteriorate within 10 feet of their source (Romero, 1972). Significant concentrations of anaerobic bacteria can probably travel 50 feet, according to Caldwell (1938, 1937); and Romero concludes that under ideal conditions the maximum travel distance of biological contaminants within groundwater ranges from 50 to 100 feet. (However, contaminant movement in nonsaturated soils is considerably less than in saturated soils, with maximum lengths of travel appearing to be about 10 feet.) Bacteria or viruses might travel considerably further than predicted if contaminated water is intercepted by a stream druing the course of travel. If they are impregnated with bacteria and viruses from septic tanks or leaky sewers, partial areas, which shed surface waters to streams, may become contaminanted and create a health hazard.

Setbacks

The United States Public Health standards suggest a minimum setback of 100 feet between wells or watercourses and septic tanks (Romero, 1972). The New Jersey Health Department requires a minimum setback of 50 feet from wells and watercourses. Like the U.S. Public Health standards, Romero (1972) recommends a 100 foot setback from all wells and water bodies unless it can be shown that a shorter distance will not increase the probability of contamination. Aquatic biologists and hydrologists realize that circumstances dictate different setbacks, and that a setback of 300 feet should be recognized as a standard if all bacteria and nutrients are to be filtered out by the soils (Leopold, 1968; Patrick, personal communication).

Using partial areas as the edge of the aquatic system will increase the adequacy of the length of setbacks. The setback should be delineated from the landward edge of the partial areas. Thus, while the setback is a standard length, the actual distance from the water body is variable, depending on the width of the partial area. As noted above, setbacks less than 50 feet will probably not filter out the biological and nutrient contaminants.

Adequacy of the Aquatic Buffer Zone

With the principal unit of concern (the partial area) closely approximated by the mapping of soils data, the next step is to determine if existing ground cover provides an adequate buffer for the aquatic system.

Two land areas concern us: land within the partial area and land along the outside margin of the partial area. To avoid an increase in peak discharge, the infiltration capacity of the D and +D soils (partial areas) must be maintained and no new areas must be allowed to drop into the D or +D class through change in land cover.

These two provisos necessitate a twin management strategy. First, the vegetation within the partial area must be maintained: runoff from this area will definitely reach the drainage network. Disturbances within this area will lead to increased runoff and will disturb the chemical-sediment inflow to the aquatic system. Second, to prevent degradation of the partial area by upland uses, a buffer or margin must be left between the two. Because the partial area is so well integrated with the aquatic system, it is logical to think of it as a part of that system. All the restrictions which are typically applied to stream-edge development should be applied to the edge of the partial area. For example, setbacks for septic tanks should be calculated from the outside edge of the partial area.

The width of vegetated land necessary to satisfactorily buffer partial areas varies. It depends on the adjoining soil's ability to store water and the type and extent of vegetation in the adjoining area. Buffers can be rated in the following manner:

Adequate: A cover of natural or successional vegetation 300 feet in width from the outside edge of the partial area.

Questionable: A belt of natural or successional vegetation from 50 to 300 feet wide along the outside edge of the partial area.

Inadequate: Vegetation absent or less than 50 feet wide from outside edge of partial area.

The same assessment of buffer adequacy is applicable to the area between the watercourse and the outside edge of the partial area.

Final Map Preparation

At the map scale used (1"=4,000'), a buffer 300 feet wide along the outside edge of a partial area is 0.075" wide on the map. Given the accuracy problems inherent in transcribing spatial data from one map and scale to another (i.e., soil survey data to regional base map), this rather narrow buffer could not be mapped precisely. The most worthwhile information suitable for mapping at this scale is the adequacy of the existing ground cover to buffer partial areas. Given the properties of runoff from various land uses, it has been assumed that natural vegetation is an adequate buffer: it is the terrestrial component which has been involved, our time, in establishing a homeostatic relationship with the aquatic ecosystem. All other land cover

is assumed to be either questionable or inadequate.

The map legend and data coding are keyed relative to the presence of an adequate buffer. If a woodland is present, the buffer is assumed to be adequate. The other categories, disturbed and absent, are more judgmental. For example, an orchard is considered a disturbed buffer, but it may actually be more of an absent buffer if the earth is kept plowed beneath the trees.

The map of the aquatic buffer zone, then, shows the partial area and the presence, absence, or disturbed nature of the ground cover in the partial area.

The partial area data is interpreted from Soil Conservation Service data and mapping. The buffer adequacy estimate has been derived from the regional vegetation map discussed in the first chapter of this report. The buffer classification scheme is given below.

Buffer	Vegetation
Present:	All Aquatics
	Sweetgum-Red Maple
	Maple-Oak-Ash
	Mixed Oak
	Oak-Beech
	Conifers
Disturbed:	Orchard
	Oldfield
Absent:	Agriculture
	Landscaped Open Space
	Impervious Area
	Residential Trees
	Residential Saplings

References

Auberton, G.M., and Patrick, J. 1972. "Quality water from clear-cut forest land." Northern Logger and Timber Processor 20(8): 14-15.

Betson, R.P. 1964. "What is watershed runoff?" Journal of Geophysical Research 69(8):1541-1552.

Buckman, H.O., and Brady, N.C. 1974. The Nature and Properties of Soils. New York: MacMillan.

Caldwell, E.L. 1937. "Pollution flow from pit latrines when an impervious stratum closely underlines the flow." Infectious Disease 61:270-88.

Caldwell, E.L. 1938. "Studies of subsoil pollution in relation to possible contamination of ground water from human excreta deposited in experimental latrines." Water Quality in a Stressed Environment, ed Wayne A. Pettyjohn. 1972. Minneapolis: Burgess.

Chiang, Sie-Ling. 1971. "A runoff potential rating table for soils." Journal of Hydrology 13:54-62.

Dunne, T., More, T.R., and Taylor, C.H. 1975. "Recognition and Prediction of Runoff-Producing Zones In Humid Regions." Hydrological Sciences Bulletin 20:305-327.

Dunne, T., and Black, R.D. 1970. "An experimental investigation of runoff production in permeable soils." Water Resources Research 6(2):478-90.

Emmett, W.W. 1970. "The hydraulics of overland flow on hillslopes." U.S. Geological Survey Prof. Pater 662-A.

Freeze, R.A. 1972. "Role of subsurface flow in generating surface runoff." Water Resources Research 8(5):1272-1283.

Grubek, W.J., and Heald, W.R. 1974. "Soluble phosphate output of an agricultural watershed in pennsylvania." Water Resource Research 10(1): 113-118.

Hewlett, J.D., and Hibbert, A.R. 1967. "Factors affecting the response of small watersheds to precipitation in humid areas." Forest Hydrology. Sopper and Lull, eds. Pp. 275-90.

Hewlett, J.D., and Nutter, W.L. 1970. "The varying source flow of streamflow from upland basins." American Society of Civil Engineers. Procedures of the Symposium of Interdisciplinary Aspects of Watershed Management. Bozeman: Montana State University. Pp. 65-83.

Hills, R.C. 1971. "The influence of land management and soil characteristics on infiltration and the occurrence of overland flow.: Journal of Hydrology 13:163-81.

Horton, R.E., 1933. "The role of infiltration in the hydrologic cycle." Transactions of the American Geographic Union 14:446-60.

Lee, C.H. 1942. "Transpiration and total evaporation." Mienzer O.E., ed. Hydrology. New York: Dover.

Leopold, A. 1941. "Lakes in Relation to Terrestrial Life Patterns. University of Wisconsin Symposium: Hydrology. Pp. 17-22.

Leopold, Luna B. 1974. Water, A Primer. San Francisco: W.H. Freeman.

Leopold, Luna B. 1968. Hydrology for urban land planning-- A guidebook on the hydrologic effects of urban land use. U.S. Geological Survey Circular 554. Washington, D.C.: USGS.

Likens, G.E., and Bormann, F.H. 1974. "Linkages Between Terrestrial and Aquatic Ecosystems." Bioscience 24 (8).

Ragan, R. M. 1968. "An Experimental Investigation of Partial Area Contributions." Hydrological Aspects of the Utilization of Water (Vol II of Proceedings of the General Assembly of Bern, 1967). Pp. 241-51. IAHS Publication No. 76.

Romero, J.D. 1972 "The movement of bacteria and viruses through porous media. Pettyjohn, W.A. ed. Water Quality in a Stress Environment. Minneapolis, Minn.: Burgess. Pp. 200-24.

Stiles and Crohurst. 1923. "Movement of B. Coli in ground water with resulting pollution of well." Engineering Contracting 60:100-102.

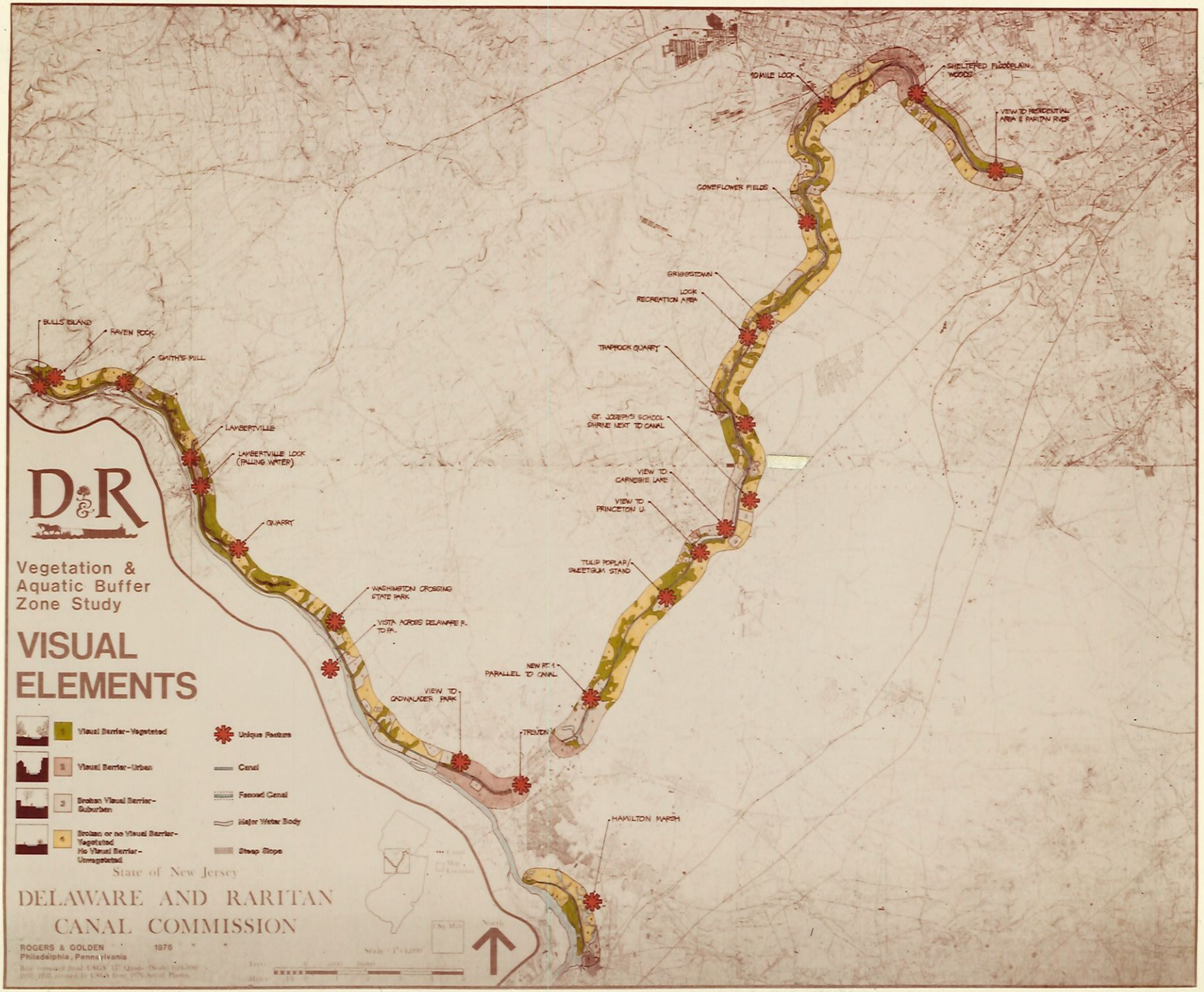
Vannote, Robin. 1975. Stroud Laboratory, Academy of Natural Sciences, Philadelphia, Pa. Personal Communication.

Weyman, D.R. 1970 "Throughflow on hillslopes and its relation to the stream hydrograph." Bulletin of the International Association of Scientific Hydrology 15(2):25-33.

Whipkey. 1965. "Subsurface stormflow from forested slopes.: Bulletin of the International Association of Scientific Hydrology 10(2):74-85.

Wolman, G.M. 1964. Problems posed by sediment derived from construction activities in Maryland. Report of the Maryland Water Pollution Control Commission. Annapolis, Md.:MWPCC.

Young, R.A. and Wiersma. 1973. "The Role of rainfall impact in soil detachment and transport." Water Resources Research 9(6):370-375.


10 MILE LOCK
SHELTERED FLOODPLAIN WOODS
VIEW TO RESIDENTIAL AREA & RARITAN RIVER
CONEFLOWER FIELDS
GRIGGSTOWN
LOCK RECREATION AREA
TRAPROCK QUARRY
ST. JOSEPH'S SCHOOL SHRINE NEXT TO CANAL
VIEW TO CARNEGIE LAKE
VIEW TO PRINCETON U.
TULIP POPLAR/ SWEETGUM STAND
NEW RT. 1 PARALLEL TO CANAL
TRENTON
HAMILTON MARSH
VIEW TO CADWALADER PARK
WASHINGTON CROSSING STATE PARK
VISTA ACROSS DELAWARE R. TO PA.
QUARRY
LAMBERTVILLE
LAMBERTVILLE LOCK (FALLING WATER)
SMITH'S MILL
RAVEN ROCK
BULL'S ISLAND
D&R
Vegetation & Aquatic Buffer Zone Study
VISUAL ELEMENTS
1 Visual Barrier-Vegetated
2 Visual Barrier-Urban
3 Broken Visual Barrier-Suburban
4 Broken or no Visual Barrier-Vegetated
No Visual Barrier-Unvegetated
Unique Feature
Canal
Fenced Canal
Major Water Body
Steep Slope
State of New Jersey
DELAWARE AND RARITAN CANAL COMMISSION
ROGERS & GOLDEN
Philadelphia, Pennsylvania
1976
Scale 1"=4,000'
North

VISUAL ELEMENTS MAP

The Canal flows through varying natural and man-made environments, both offering visual elements which enhance or limit the visual experience along the Canal. In order to further improve the experience, adequate visual guidelines should be established for protecting sensitive areas and also for improving certain areas. The Visual Element map presents a holistic picture of what is happening along the Canal.

For purposes of this initial mapping, a half-mile wide visual corridor along each side of the Canal was selected and the visual elements within the corridor were summarized in map form. The major map categories represent an interpretation of vegetation and land use information as they relate to views from the Canal. The half-mile distance was adopted because it includes both the foreground and the middle ground of the view. Objects within this distance are discernible (USFS, 1973).

The map identifies four general visual conditions.

Visual Barriers--Vegetated: In this situation dense vegetation limits the long views from the Canal. Occasionally this barrier edge drifts away from the Canal to form enclosures of varying sizes.

Visual Barriers--Urban: In this case views are restricted by the structures down the Canal.

Broken Visual Barriers--Suburban: This situation offers long views from the sides of the Canal, but they are occasionally obstructed by the structures or thinned-out vegetation.

Broken or No Visual Barrier--Vegetated and No Visual Barrier--Unvegetated: These situations offer long views from the sides of the Canal, chiefly across open or sparsely populated fields or across large unvegetated areas such as parking lots.

Other items of interest identified on the map include unique features, fenced Canal, major water bodies, and steep slopes.

Unique Features: These features are structures, views, and other areas of interest unique to the Canal as a whole.

Fenced Canal: For this area there is continuous chain-link fence on both sides of the Canal. This fencing interferes somewhat with views.

Major Water Bodies: These include the important Canal-related bodies which offer opportunities for additional visual experiences along the Canal.

Steep Slopes: These slopes present a strong visual impression and they also limit or guide views along certain directions.

The Visual Elements map should not be approached as a guide to all the subtle changes in visual conditions. These conditions can change radically in a few yards' travel down the Canal. But as a generalized statement, the Visual Elements map can be helpful in the initial assessment of the visual impact of developments along the Canal. As one can observe from the map, certain areas are more exposed than others to view by persons walking or canoeing along the Canal. New developments occuring in such open areas have a greater impact on the visual experience along the Canal than developments in other areas. For example, the most profound impact on the visual experience will result from a development occuring in or at the edge of a Broken or No Visual Barrier area. The least noticeable impact will be if it occurs on the opposite side of a visual barrier from the Canal. The map will also be useful in planning the management of the Canal vegetation (in terms of visual experience) so as to create occasional vegetation enclosures in densely vegetated areas or to open up selected views.

Legend for Unique Features

Bulls Island. A part of the Canal State Park, this island provides overnight camping facilities and is covered by a mature Delaware River floodplain woodland.

Raven Rock. An escarpment that rises beside the left side of the Canal and forms a dramatic backdrop for the Park.

Smith's Mill. An old mill and cluster of historic buildings on State property.

Lambertville. The town provides a change from the rural character preceding it. Commercial establishments and residential areas present a more urban environment.

Lambertville Lock. The lock incorporates a spillway for Swan Creek and the falling water is pleasant.

Quarry. A large man-made rock exposure.

Washington Crossing State Park. A large landscaped park of historic interest, mowed and formally planted.

Vista Across Delaware River to Pennsylvania. A break in the hedgerow/thicket presents a beautiful view of the river and hills of Pennsylvania.

View to Cadwalader Park. In the midst of the fenced-in portion of the Canal the park appears next to the left bank.

Trenton. An intensely urban area that offers a striking contrast to the rest of the Canal Park.

New Route 1 Parallel to the Canal. Heavy traffic and distracting noise characterize the highway, which closely follows the left side of the Canal.

Tulip Poplar/Sweetgum Stand. A striking woods composed entirely of spicebush, tulip poplar, and sweetgum.

View to Princeton University. A long view to the neo-Gothic architecture of the University.

View to Carnegie Lake. Vacation homes, boats, and woods are visible across the lake.

St. Joseph's School Shrine. A tiny spot surrounded by sycamore and spruce, this shrine imparts a serene mood to the portion of Canal Park near it.

Traprock Quarry. Rubble, noise, and dust are generated by this huge quarry, an interesting area which covers about one square mile to the right of the Canal.

Lock Recreation Area. Just north of Copper Hill road is a small, pleasant picnic area with a bridge leading to the towpath on the other side of the Canal and the floodplain of the Millstone River.

Griggstown. The town has a resort character. An ice cream shop and canoe rental are directly adjacent to the Canal at the causeway.

Coneflower Fields. A very striking zone of bright yellow coneflowers in oldfields next to the Millstone River.

Ten Mile Lock. At Ten Mile Lock is a historic locktender's house. People use this area to stroll, hike, fish, and picnic.

Sheltered Floodplain Woods. An area of natural character in a predominantly urban/suburban setting. Sheltered by topography and very pleasant.

View to Residential Area and Raritan River. The homes are spacious and incorporate the left bank of the Canal as part of their effective use area. The Raritan River is wide and flows very near the Canal, though at a lower elevation.

Hamilton Marsh. A large wetland and bird habitat near Bordentown.

Photo File

INTRODUCTION

This photograph file contains the photographs taken during the field investigation of vegetation in the Delaware and Raritan Canal corridor. Photographs of Segments 1-8 and 12-28 were taken during August and September 1976; in December 1976, Segment 9 was photographed.

Photos are keyed to the second sheet (b sheet) of each set of strip maps. On each map, photographs are numbered consecutively by segment. An encircled number identifies the photograph and an arrow indicates the direction in which the shot was taken.

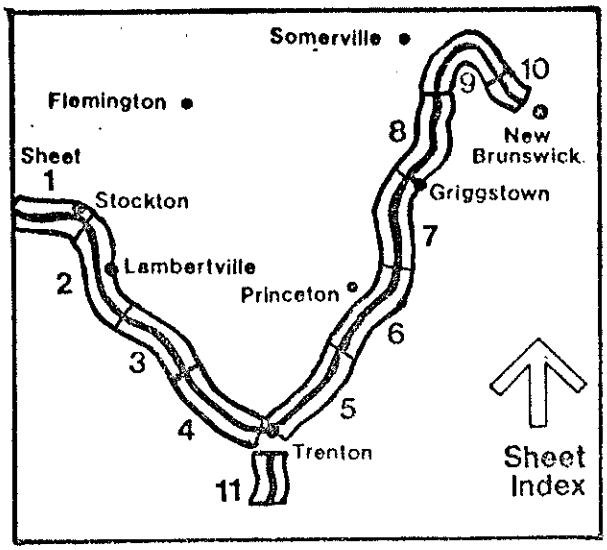
Negatives are included in the back of the photograph file.

USING THE FILE AND MAPS

There are eight contact sheets in the photo file. Each photograph is labeled with two numbers (e.g., 1-3, 18-11). The first number identifies the segment; the second is the photo number. Thus, the photograph labeled 4-3 may be located on the map of Segment 4, where there is a circle and arrow numbered 4.

A photographic record is included with the file. In it are given the photo number, number of the contact sheet on which the photo can be found, number of the sheet (map) on which the photo location and direction are given, and brief description of the subject of the photograph.

Map Index



SHEET NUMBER	SEGMENTS
1a, b	1, 2, 3, 4
2a, b	5, 6a
3a, b	6b
4a, b	7, 8
5a, b	*12, 13, 14, 15
6a, b	16, 17, 18, 19, 20
7a, b	21, 22
8a, b	23, 24a
9a, b	24b, 25, 26, 27
10a, b	28
11a, b	9

*Note: Segments 10 and 11 are in Trenton.
In Segment 10, the Canal has apparently been filled; in Segment 11, the Canal passes through an underground culvert.

Photographic Record

Segment 1

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Down path just south of Bulls Island Bridge	1	1b
2	Maintained Canal towpath (note intermittent screening)	2	"
3	Camp ground at Bulls Island	2	"
4	Floodway through Bulls Island	2	"
5	Bulls Island State Park--landscaped open space	2	"
6	Along right side of Canal on path	1	"
7	Wooded area (floodplain woods), interior Bulls Island	1	"
8	Railroad corridor (note relation to Route 29)	2	"
9	Railroad corridor	2	"
10	Open area dominanted by 5-6' pokeweed	2	"
11	Levee	1	"
12	Levee side of Canal looking upstream	1	"
13	Levee side of Canal looking downstream	1	"
14	Sandbags on levee along Canal	1	"
15	Railroad (note hedgerow screen)	2	"
16	Railroad (note hedgerow screen)	2	"
17	Vegetation along Delaware River	1	"
18	Oldfield ringed by black walnut and black locust	2	"
19	Levee in southern part of segment	1	"
20	Railroad (road elevated to left, swale to right)	1	"
21	Levee	1	"

Segment 2

1	Weir at end of levee near Smith's Mill	1	1b
2	Wickecheoke floodway	1	"
3	Floodplain woods (note dense sugar maple saplings, few larger trees)	1	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
4	Wickecheoke woods	1	1b
5	From pinnacle toward Delaware River	1	"
6	Subsegment D--general view of Smith's Mill buildings	1	"
7	Spillway and floodplain at mouth of Wickecheoke	1	"

SEGMENT 3

1	Adjacent residential land use near Stockton	2	1b
2	Hedgerow trees in middle of oldfield	2	"
3	Early successional oldfield, dotted with wild flowers	2	"
4	Opening in floodplain woods, heavy cover of grape vines	2	"

SEGMENT 4

1	Route 29 and its proximity to Canal	1	1b
2	Canal, railroad corridor, and broken floodplain woodland	1	"
3	Quarry buildings along Route 29	1	"
4	Oldfield between railroad and Delaware River in southern part of segment	1	"
5	Railroad and Canal corridor looking toward Route 202 bridge	1	"
6	Railroad and Canal association (note intermittent edge vegetation and pruning by railroad traffic)	1	"

SEGMENT 5

1	Subsegment A--powerline right-of-way	2	2b
2	Railroad and contiguous residential land use	2	"
3	Vista of Canal through Lambertville (looking north)	2	"
4	Vista of Canal through Lambertville (looking south)	2	"

SEGMENT 6

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Playground in Lambertville	3	2b
2	Lambertville Island	3	"
3	Canal and Delaware River, separated by Canal embankment	3	"
4	Railroad corridor and view across Delaware River	3	"
5	Tree row and mowed grass near county line	3	"
6	Intermittent railroad edge thicket	1	"
7	Railroad, Canal, and steep bank to Delaware River	3	"
8	Drainage pipes passing under railroad to ditch along east edge of P S E & G oldfield	3	"
9	Near county workhouse, break in hedgerow exposing rock face	3	"
10	Overgrown railroad corridor in close proximity to Canal	1	"
11	Floodplain trees open, thick grape and honeysuckle layer	1	"
12	Canal, road, and railroad parallel (note relief relationship)	3	"
13	River to left, floodplain woods open, rails overgrown, marginal aquatics	1	"
14	Near northern River Road bridge (note aquatics of gradient community)	1	3b
15	Washington Crossing State Park--foot bridge crossing Route 29 and Canal	2	"
16	D. A. R. oaks planted along Route 29 south of Scudders Falls	2	"
17	Road edge community near southern end of segment	2	"

SEGMENT 7

1	Railroad corridor near stoneyard (note adjacent residential land use)	3	4b
2	Canal flanked by lush tree vegetation on left, slightly overgrown railroad bed on right, and bridges downstream near Lower Ferry Road	3	"

SEGMENT 8

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	14-pipe aqueduct at Lower Ferry Road	3	4b
2	Trenton Country Club, small lagoon in foreground	3	"
3	Railroad bed and Canal edge community	3	"
4	Overgrown railroad corridor on Canal's right side	3	"
5	Fenced Canal, passing through Trenton city limits	3	"

SEGMENT 9

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Entrance to Canal at Crosswicks Creek	8	11b
2	Railroad bridge across Crosswicks Creek	8	"
3	Across Canal at basin	8	"
4	Canal at basin	8	"
5	Canal near powerline right-of-way	8	"
6	Powerlines crossing Hamilton Marshes	8	"
7	Canal, access road, and railroad	8	"
8	Powerlines and contiguous industrial use	8	"
9	Contiguous landfill	8	"
10	Canal and thicket	8	"
11	Towpath	8	"

SEGMENT 10

SEGMENT 11

No photographs

SEGMENT 12

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Typical industry adjacent to Canal along Trenton urban fringe	2	5b
2	Canal through Trenton (from Whitehead Road bridge)--intermittent hedgerow and canopy row buffering Canal from adjacent land use (industrial and commercial)	2	"

SEGMENT 13

1	Route 1 ramp crossing Canal	2	5b
2	Railroad (Canal on right side)	2	"
3	Assunpink marsh--entrance of Colonial Lake	5	"
4	Towpath along right side of Canal	2	"
5	Marsh area highlighted by rose mallow (Carnegie Road)	5	"
6	Marsh area highlighted by rose mallow (Carnegie Road)	5	"
7	Clean landfill	5	"
8	Across Canal from right side	2	"
9	Clean landfill--marsh background	5	"
10	Sandy area before confluence of stream and Assunpink Creek	2	"
11	Canal buffered by canopy-height vegetation row (Carnegie Road)	2	"
12	Path along Canal edge (right side)	5	"
13	State utility road (left bank along Canal at Lawrence Road)	5	"
14	Bank slumping where new bridge conduit meets old stone bank	5	"

SEGMENT 14

1	Route 1 bridge/culvert	3	5b
2	Route 295 bridges (Canal on left, Shipetaukin Creek on right)	3	"
3	Powerline pylon	3	"
4	Road along Canal	3	"
5	Dredge along Canal	3	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
6	Service road on left bank	3	5b
7	Bare ground by cottage (perhaps dredge spoils, possible non-point source of pollution)	3	"
8	Pump and end of cattle barn (note proximity of barn to Canal)	3	"

SEGMENT 15

1	Elizabethtown Water Co. right-of-way, recently graded and seeded	3	5b
2	Landscaped open space (sod farm) and farm building, intermittent hedgerow along Canal	3	"
3	Vegetation buffer along Canal edge	3	"
4	Floodplain terrace along Canal's right side (small box elder, silver maple dominant)	3	"
5	Canoe entry point into Canal at junction of Segments 15 and 16	5	"

SEGMENT 16

1	Contiguous land use (sod farm) from Canal	5	6b
2	Vines climbing trees (5" diameter)	5	"
3	Contiguous golf course	5	"
4	Sweetgum-tulip poplar woods (Subsegment B) open lower layers	5	"
5	Left side of towpath	5	"
6	Water treatment plant intake (withdrawal from Canal)	5	"
7	Aquatic growth in Canal	5	"
8	Canal from Alexander Road upstream	5	"

SEGMENT 17

No photographs

SEGMENT 18

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	From Canal footpath (left side) toward Princeton dormitories--Carnegie Lake foreground, near Pennsylvania Railroad Bridge	5	6b
2	Slumping banks, tree overhang, and pond lily patch	5	"
3	Path on right side of Canal; open, grassy area overlying Sun Oil Co. gas pipeline	5	"
4	Contiguous land use, Princeton Boat House and Carnegie Lake in background	5	"
5	Street runoff pipe at Harrison Street (enters Canal)	5	"
6	Contiguous landscaped open space left of Canal, Carnegie Lake in background	5	"
7	Towpath on left side of Canal by lake, aquatic vegetation	5	"
8	Use of path (left side)	5	"
9	Overhanging trees on bank	5	"
10	Across open space and lake from path (left side)	5	"
11	Section of rock wall of Canal	5	"
12	Smartweed "cove"	5	"

SEGMENT 19

1	Millstone aqueduct from north end, right side (looking west from parking area)	5	6b
2	Marsh (Millstone River) above Millstone aqueduct from parking area	7	"
3	Marsh upstream of aqueduct from Route 1	7	"

SEGMENT 20

1	Levee between Canal in Carnegie Lake	4	6b
2	Across Canal toward Carnegie Lake	4	"
3	Shrine at St. Joseph's School (note planted trees)	4	"
4	Nun praying by Canal opposite St. Joseph's School (note grassed towpath)	4	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
5	Sluice gate next canoe rental in Kingston	4	6b
6	Canoe rental at end of segment--Kingston	4	"
7	Sign designating already developed Canal Park facility	7	"

SEGMENT 21

1	Canal and State service area from beginning of Segment 21 (Route 29, Kingston)	7	7b
2	Marshy area contiguous to right side	7	"
3	Pipe draining Canal (origin: quarry sediment ponds)	7	"
4	Path along left side of Canal (recently graded)	7	"
5	From left side of Canal to contiguous quarry (right side)	7	"
6	Across Canal toward contiguous traprock quarry	7	"
7	Millstone floodplain woods at Route 518, Rocky Hill	7	"

SEGMENT 22

1	Floodplain woods along Millstone River (note open lower strata and sunlight filtering through)	7	7b
2	Large dead trees in oldfield opening (B2)	7	"
3	Towpath along Canal's left side	7	"
4	Specimen sycamore (note person)	7	"
5	Exposed roots along banks of Millstone	7	"
6	Millstone River oldfields in background (note bank erosion)	7	"
7	Cement wall repair along towpath	7	"
8	Contiguous home from Canal (towpath)	7	"
9	Lock/sluice and park area north of Copper Hill Road	7	"
10	Oldfield (B2) lying along Millstone River	7	"
11	Boundary of oldfield and Millstone (note gradient community and river overhang)	7	"
12	Horse on towpath	7	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
13	Millstone River from towpath	7	7b
14	Oldfield opening blanketed with yellow flowers (B2)	7	"
15	Oldfield (B1) Griggstown	7	"

SEGMENT 23

1	Oldfield opening	4	8b
2	Footpath along left side of Canal	4	"
3	Canoeist using Canal	4	"

SEGMENT 24

1	Coneflower field	6	8b
2	Pasture	6	"
3	Canal from bridge at Blackwell's Mills	6	"
4	Honeysuckle along towpath	6	"
5	Oldfield	6	"
6	Dogwood along towpath	6	"
7	Towpath	6	"
8	Floodplain woods	6	"
9	Floodplain woods	6	"
10	Coneflower field	6	"
11	Across Canal	6	"
12	Millstone River	6	"
13	Across Canal	6	"
14	Floodplain woods	6	"
15	Old pasture/meadow	6	"
16	Sycamore	6	"
17	Wet area	6	"
18	Industrial use across Canal	6	"
19	Reflection of contiguous industrial land use	6	"
20	Pipe across Canal	6	"
21	Millstone floodplain--tree overhang and sunny opening	7	"
22	Oldfield opening (2 to 3' *Polygonum* spp.)	7	"
23	Grape-covered opening	7	9b
24	Windthrow on floodplain	7	"

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
25	Canal use-canoeing	7	9b
26	Undeveloped park/open space	7	"

SEGMENT 25

1	Sign at Ten Mile Lock	4	9b
2	Ten Mile Lock	4	"
3	Recently renovated lock house at Ten Mile Lock	4	"

SEGMENT 26

1	Confluence of Millstone River with Raritan River	4	9b
2	Raritan River, looking downstream (note establishment of vegetation--willow, smartweed on silt bars)	4	"
3	Volkswagen dumped in Raritan River	4	"
4	Woods along Raritan River	4	"

SEGMENT 27

1	From floodplain woods (Special Feature 3) toward Raritan River, showing patchy herbaceous growth of smartweed beneath more open canopy	4	9b
2	In floodplain woods (note absence of shrubs and openness of views)	4	"
3	Sign warning of oil pipeline crossing river	4	"
4	Stream crossing under Canal to Raritan River, west of Davidson's Road-Main Street intersection	4	"
5	Towpath on left side of Canal, looking upstream	4	"
6	Upstream of deteriorating dam on Raritan River	4	"
7	Upstream of lock and lock house	4	"
8	Expressway bridge over Canal as seen from Five Mile Lock, looking downstream	4	"

SEGMENT 28

Photo Number	Description	Contact Sheet Number	Map Sheet Reference
1	Intermittent path on right side of Canal	4	10b
2	Ditch on right side of Canal near supermarket	4	"
3	Culvert carrying stream under Easton Road--view from Canal bank	4	"
4	Looking downstream along Canal toward apartment building	4	"
5	Overgrown towpath on right side of Canal	4	"
6	Raritan River, looking upstream from Landing Lane Bridge	4	"
7	Upstream of Canal from Landing Lane Bridge	4	"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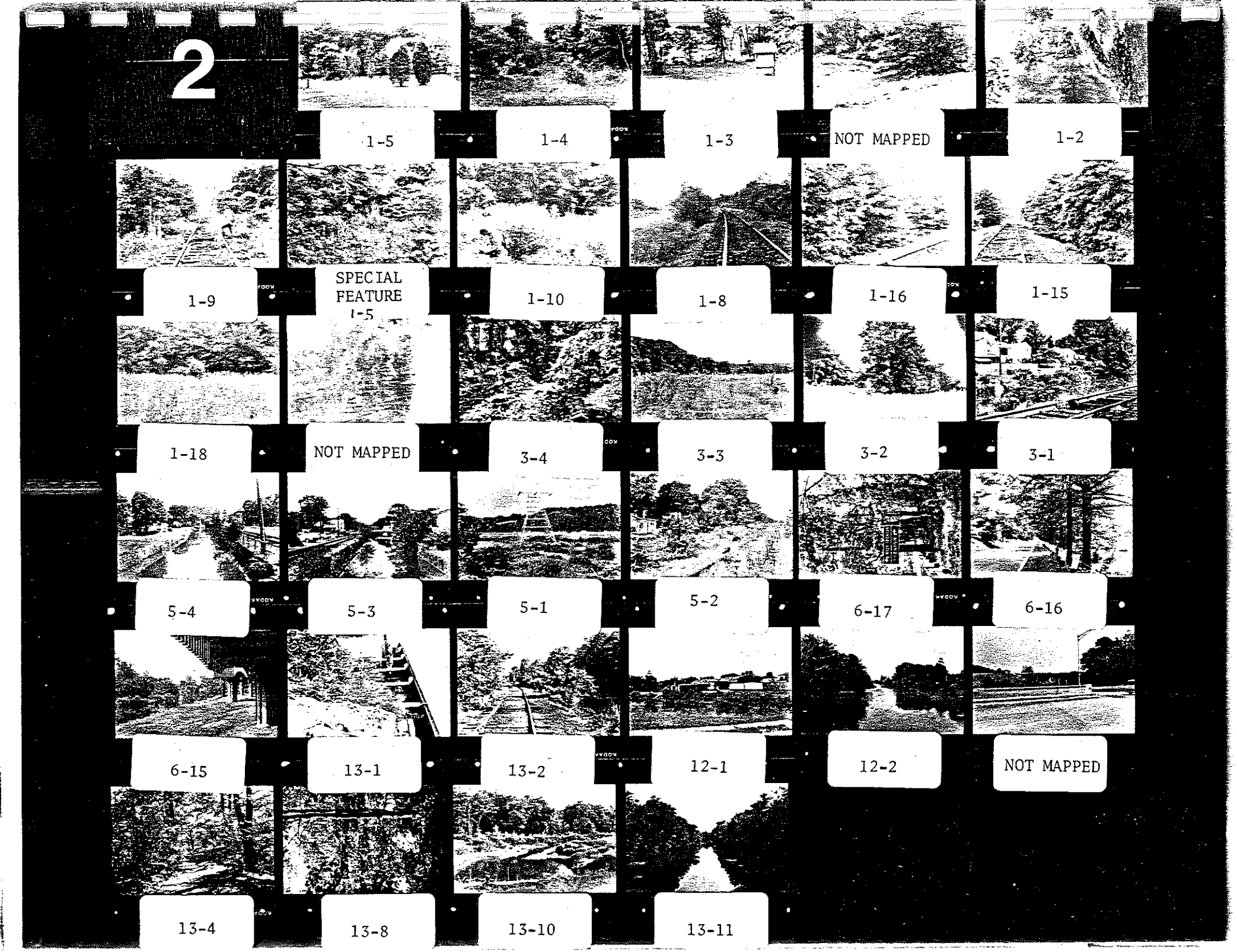
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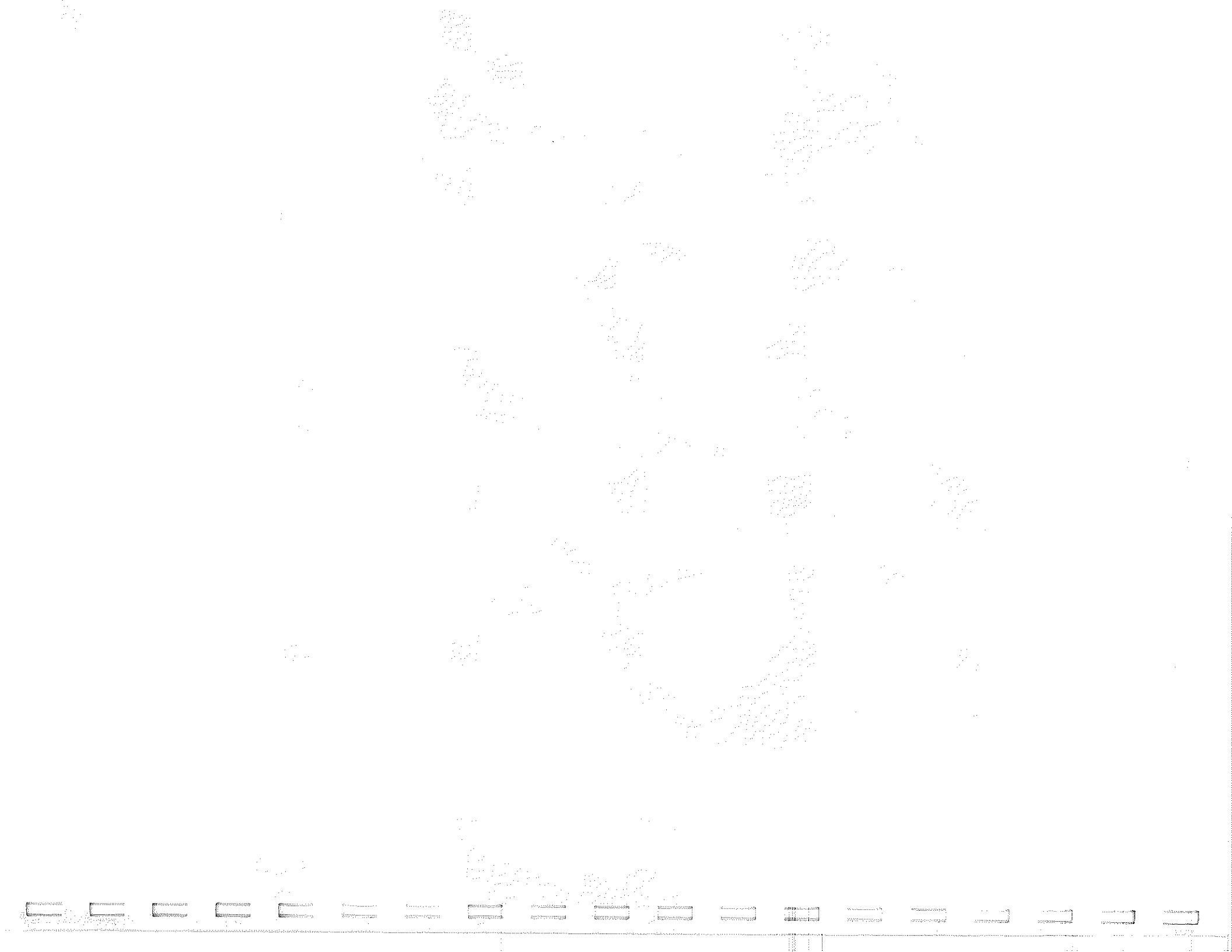

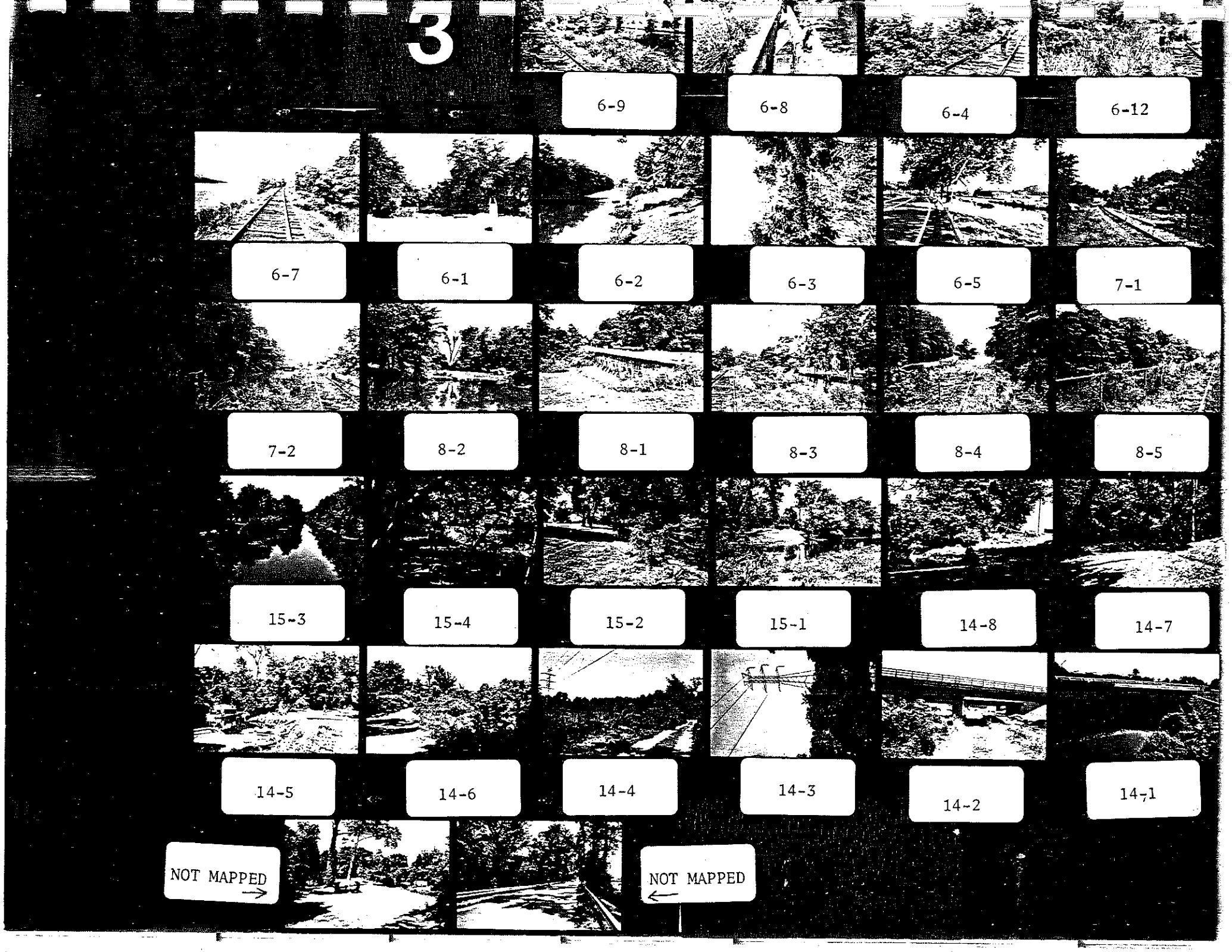
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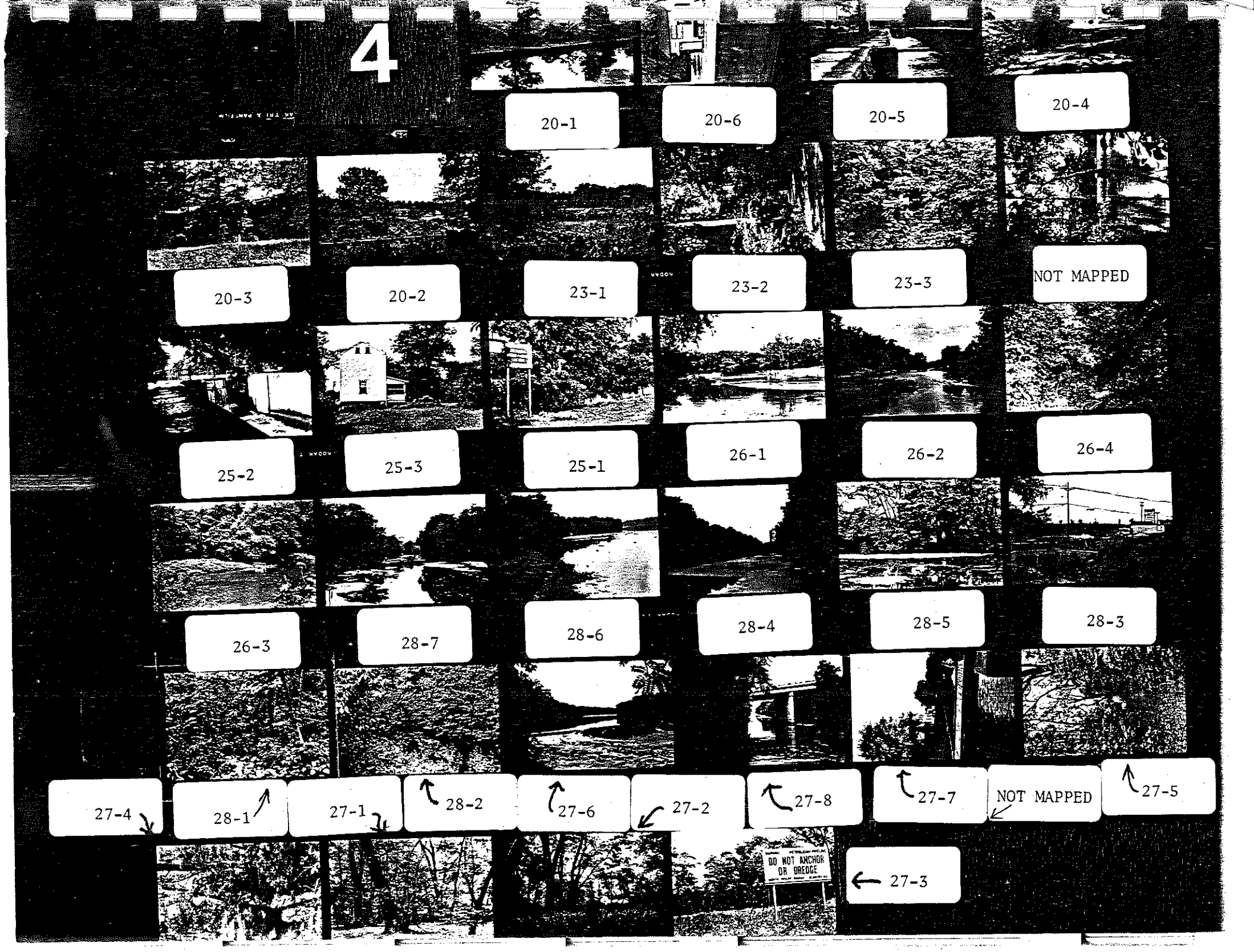
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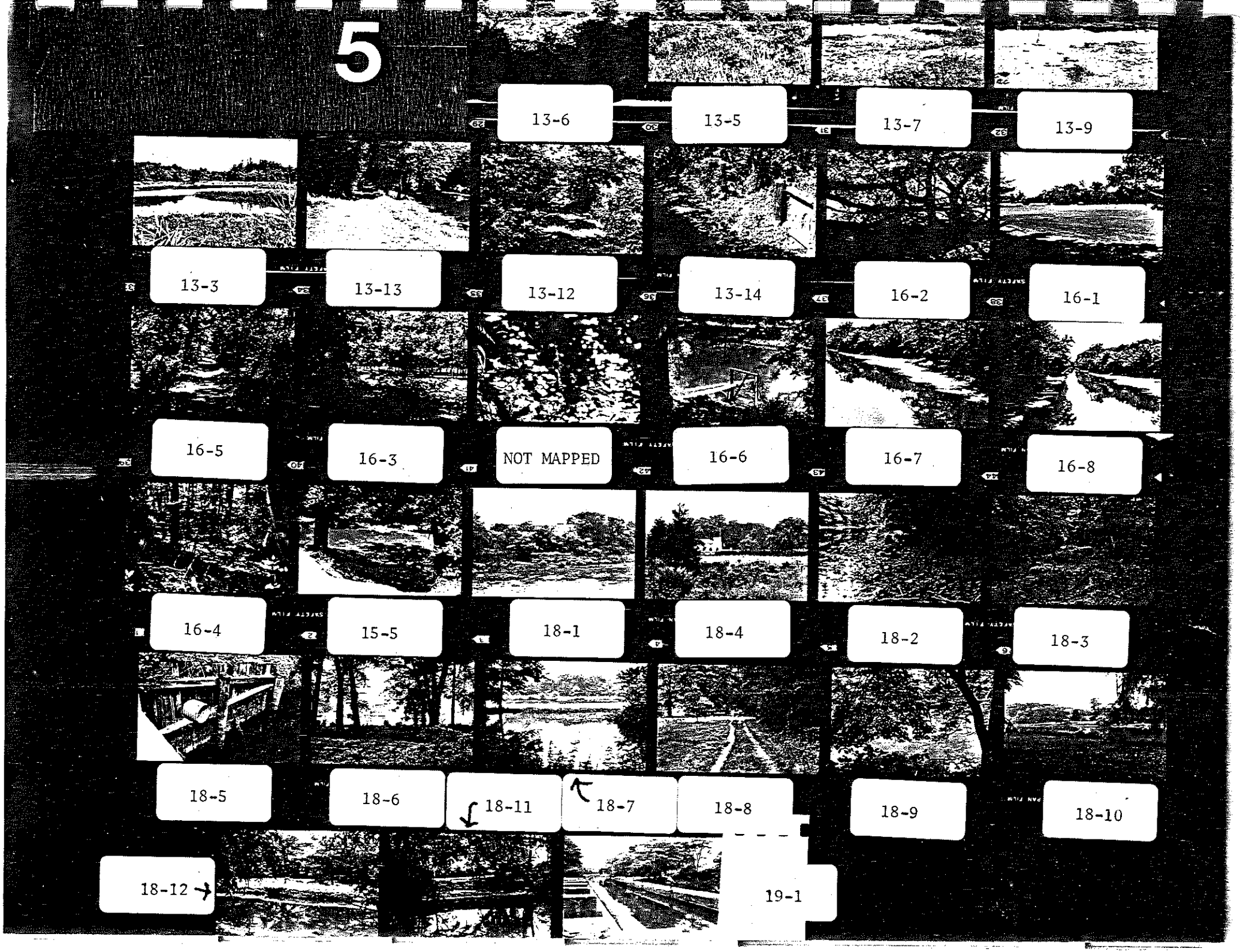
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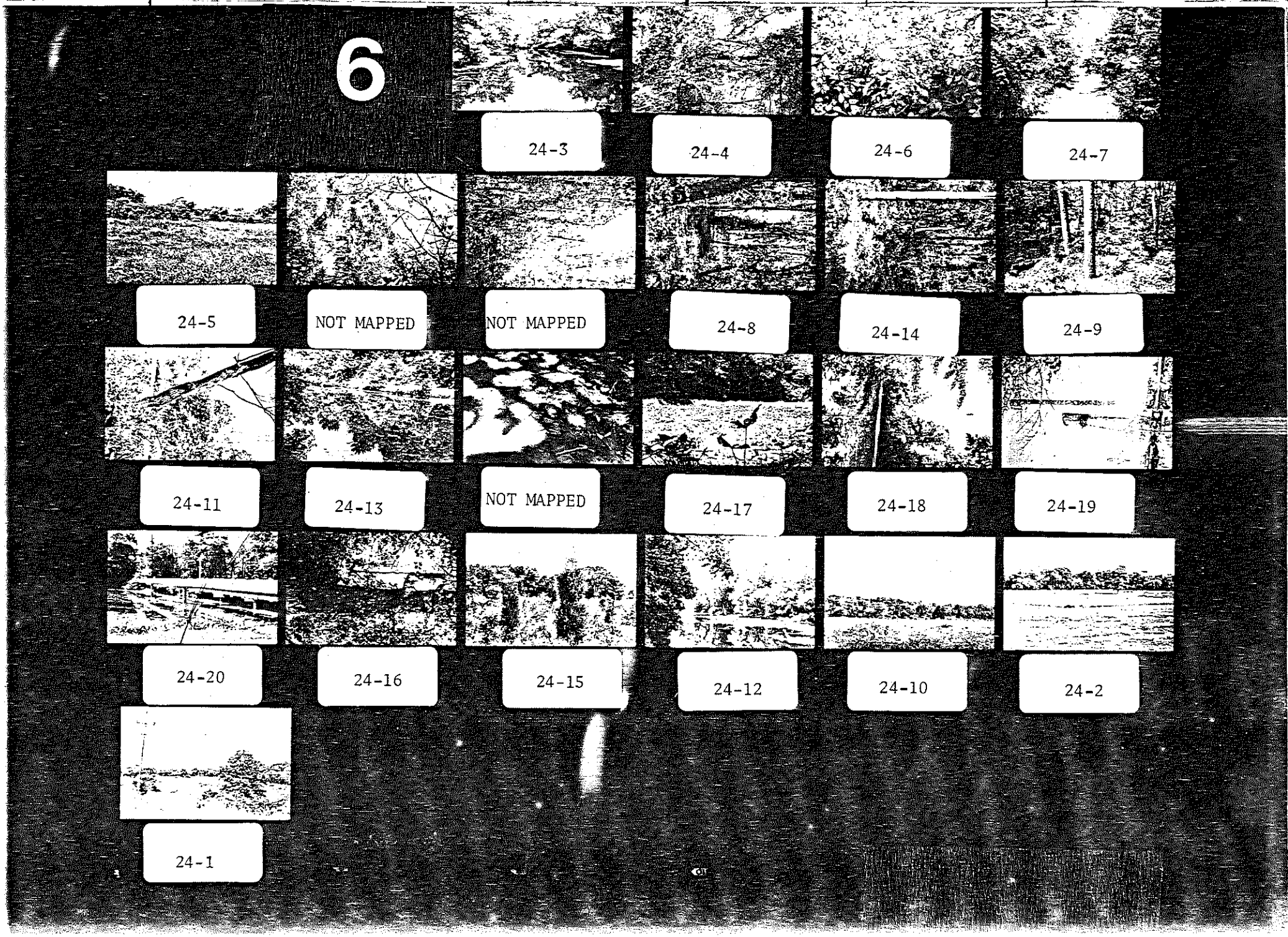
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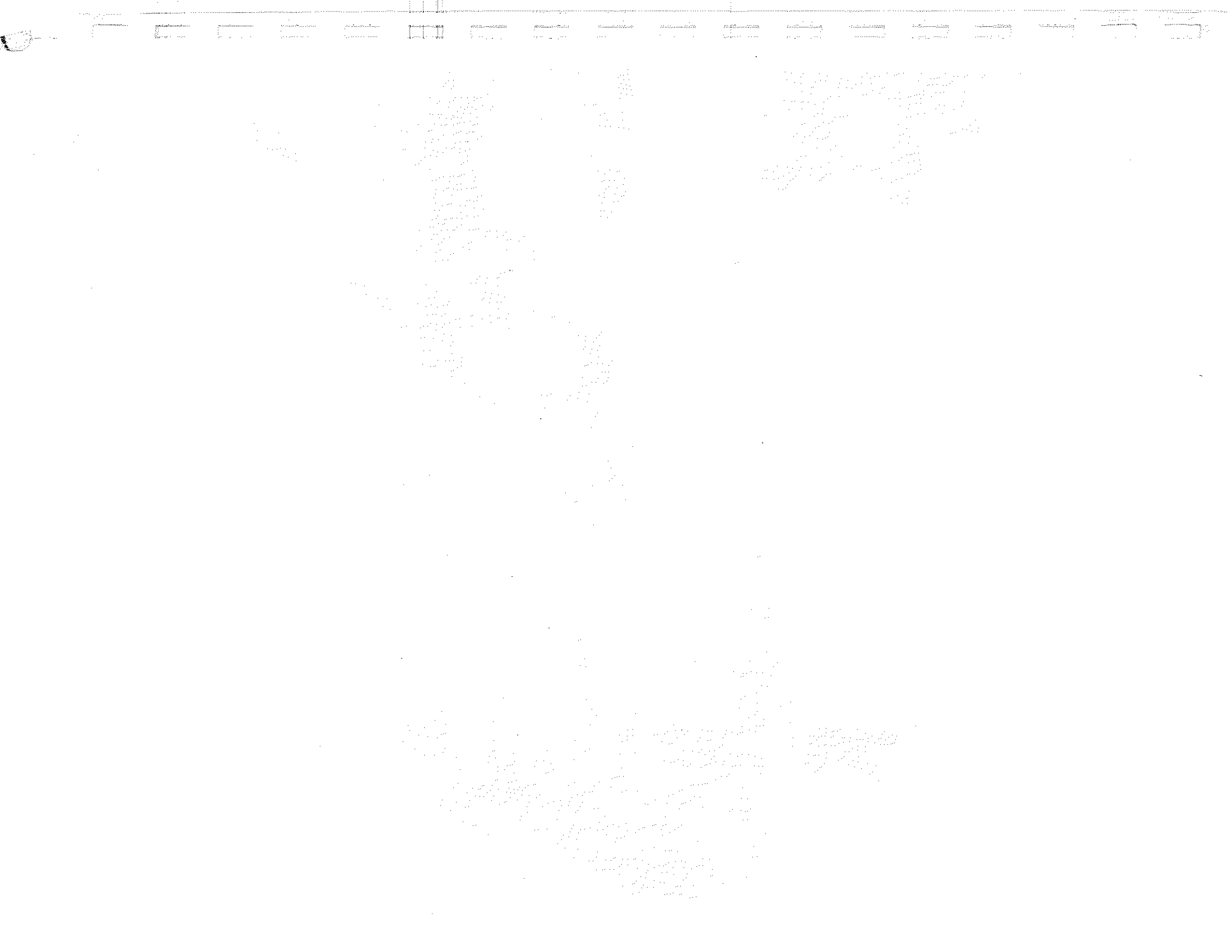

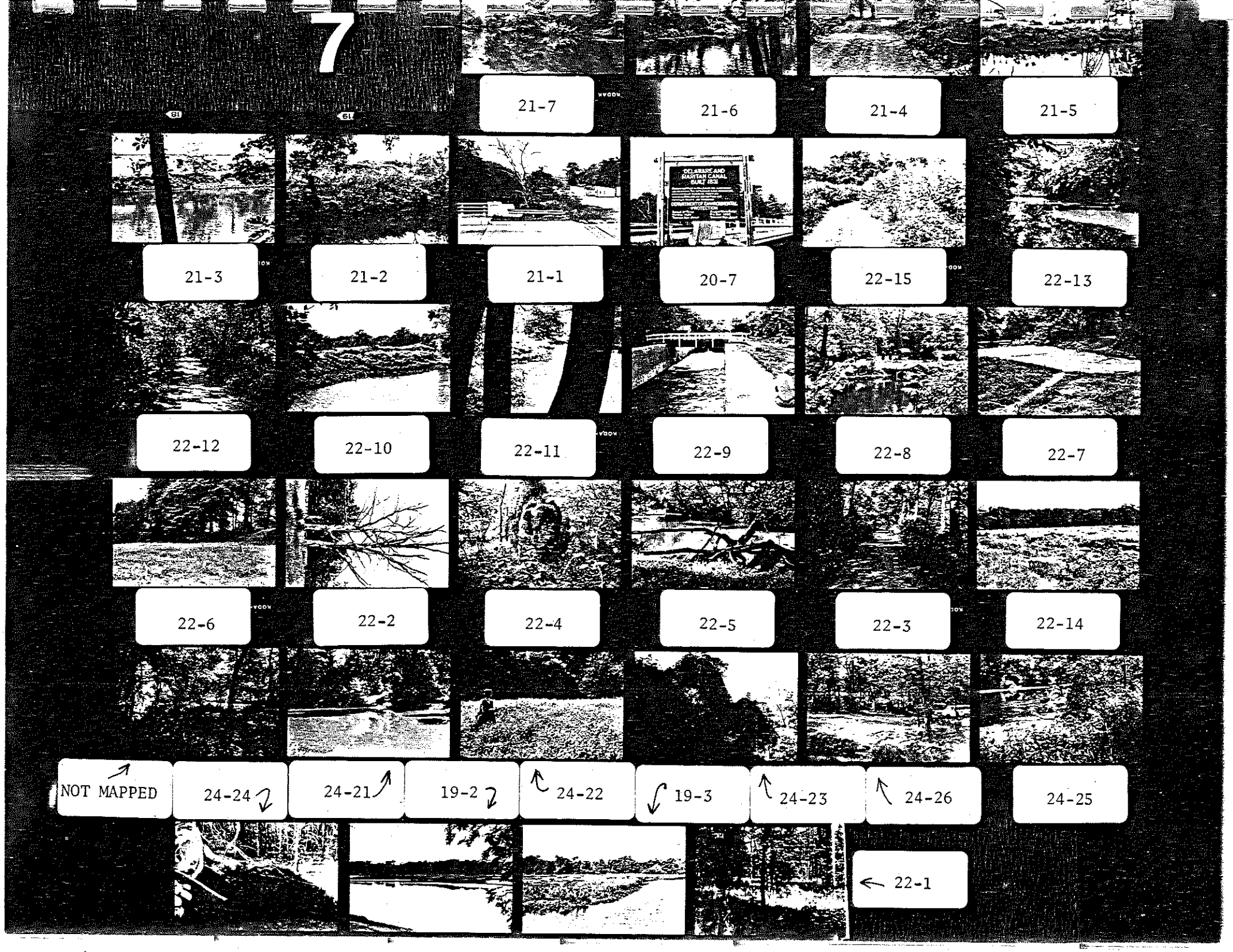
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