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## Topical Report

# Pipeline Corridors through Wetlands — Impacts on Plant Communities: Mill Creek Tributary Crossing, Jefferson County, New York, 1991 Survey

*Prepared by:*
*Center for Environmental Restoration Systems*
*Energy Systems Division*
*Argonne National Laboratory*



**Gas Research Institute**

*Environment and Safety Research Group*
*December 1994*

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# PIPELINE CORRIDORS THROUGH WETLANDS — IMPACTS ON PLANT COMMUNITIES: MILL CREEK TRIBUTARY CROSSING, JEFFERSON COUNTY, NEW YORK, 1991 SURVEY

TOPICAL REPORT

(June 1991-April 1993)

Prepared by

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December 1994

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The goal of the Gas Research Institute Wetland Corridors Program is to document impacts of existing pipelines on the wetlands they traverse. To accomplish this goal, 12 existing wetland crossings were surveyed. These sites varied in elapsed time since pipeline construction, wetland type, pipeline installation techniques, and right-of-way (ROW) management practices. This report presents the results of a survey conducted in June 1991 at the Mill Creek tributary crossing, Jefferson County, New York. One pipeline had been installed through the wetland in 1966, and another was scheduled to be installed later in 1991. Data were collected along the existing pipeline ROW and also along the planned ROW for use as baseline data in future studies. Four separate communities were surveyed. A scrub-shrub wetland and a forested wetland were sampled along the existing ROW where the planned pipeline was to be installed. A mixed vegetation community was sampled along the existing ROW, west of where the planned pipeline would join the ROW. A marsh community was sampled along the route of the planned pipeline. All plant species found on the ROW of the scrub-shrub community were also present in the adjacent natural areas. The vegetation on the ROW of the forested wetland community also consisted mostly of species found in the adjacent natural areas. In the mixed vegetation community, a small drainage channel present on the ROW, possibly resulting from the pipeline construction, provided habitat for a number of obligate species not found in other areas of this community. Differences noted among different areas of this community were also attributed to slight variations in elevation.

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## Research Summary

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| Title | Pipeline Corridors through Wetlands — Impacts on Plant Communities: Mill Creek Tributary Crossing, Jefferson County, New York, 1991 Survey |
| Contractor | Argonne National Laboratory |
| Principal Investigators | G.D. Van Dyke, L.M. Shem, and R.E. Zimmerman |
| Report Period | June 1991-April 1993 |
| Objective | Document the historical impacts of pipeline rights-of-way (ROWs) on wetlands. |
| Technical Perspective | The impact of pipeline construction in wetlands is a very sensitive issue and one that is under strict regulatory control. Neither the natural gas industry nor the regulatory community has a documented basis to define the type, value, or environmental consequences of past pipeline activities in wetlands. This report is one of a series documenting these impacts. This data report is the result of field studies in three wetland community types along a 25-year-old pipeline and in an emergent wetland community along the ROW of a proposed pipeline in the state of New York. |
| Results | Observable impacts of the ROW on hydrology and vegetation varied by community. The topography of the ROW in the forested wetland community and the scrub-shrub community was similar to that in the adjacent natural areas (NAs) unaffected by pipeline installation. The ROW in the mixed vegetative community contained a shallow drainage channel over the pipeline. Differences in the vegetative community between the ROW and the NAs were minor in the scrub-shrub and the mixed vegetative communities. No trees were present on the ROW in the forested wetland community; however, shrub-size specimens of trees did occur on the ROW, and the ROW was completely shaded by overhanging trees from the NAs. The high degree of similarity between plant communities on the ROW in the three communities and the plant communities in the adjacent NAs can be attributed to minimal maintenance activity on the ROW. There had been no apparent cutting or spraying of woody vegetation. Sampling within the emergent marsh community will provide baseline data for future sampling after installation of the proposed pipeline through that area. |

Technical Approach

An attempt was made to select a relatively homogeneous study site within each of the four vegetative community types studied: the forested wetland, the scrub-shrub wetland, the mixed vegetation wetland, and the emergent marsh. These sites occupied at least 150 meters along the ROW in the scrub-shrub and emergent communities and were sampled by establishing five transects across the ROW at each site. No such sites were available in the forested wetland or the mixed vegetation wetland; therefore, a single transect was sampled within these two communities. Data were collected on soils, hydrology, and plant cover from transect plots within both sides of the ROW and the NAs on either side of the ROW. Plant data were analyzed to determine similarities and differences between the two sides of the ROW and the two adjacent NAs.

Project Implications

This study shows that within 25 years after installation of the 1966 pipeline in this wetland, the ROW had developed vegetative communities within each of the three community types that were similar to those in the adjacent NAs. In the forested wetland and the scrub-shrub wetland, the sizes of the woody plants within the ROW were smaller than those in the adjacent NAs. Species composition of the vegetative communities with the ROW was similar to that of those in the NAs. The emergent marsh data will serve as baseline data for a study to be conducted following the installation of a proposed pipeline through this area. The data from the scrub-shrub and the forested wetlands will also serve as baseline data for such a future study, because the new pipeline will be installed within the existing ROW in these communities. The high degree of similarity between the vegetation within the ROW, in the three communities along the 1966 pipeline, and in the adjacent NAs is attributed to minimal maintenance of the ROW.

Ted A. Williams
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## Contents


Acknowledgment ..... xi

1 Introduction ..... 1

1.1 Background ..... 1
1.2 Goals and Objectives ..... 2

2 Description of Study Area ..... 4

2.1 Site Selection and Location ..... 4
2.2 Soils ..... 5
2.3 Hydrology ..... 6
2.4 Climate ..... 6
2.5 History and Management Practices ..... 7

3 Approach and Methods ..... 8

3.1 General Approach ..... 8
3.2 Habitat Description ..... 8
3.3 Sampling Design for Vegetational Studies ..... 8
3.4 Data Analysis ..... 12

4 Results ..... 15

4.1 Scrub-Shrub Community ..... 15
4.1.1 General Ecology ..... 15
4.1.2 Plant Community ..... 17
4.2 Emergent Marsh Community ..... 27
4.2.1 General Ecology ..... 27
4.2.2 Plant Community ..... 27
4.3 Forested Wetland Community ..... 36
4.3.1 General Ecology ..... 36
4.3.2 Plant Community ..... 36
4.4 Mixed Vegetation Community ..... 40
4.4.1 General Ecology ..... 40
4.4.2 Plant Community ..... 41

5 Discussion ..... 53

5.1 Scrub-Shrub Community ..... 53
5.2 Emergent Marsh Community ..... 53
5.3 Forested Wetland Community ..... 54
5.4 Mixed Vegetation Community ..... 54

6 Summary and Conclusions ..... 56

6.1 Summary ..... 56
6.2 Conclusions ..... 57

7 References ..... 58

## Contents (Cont.)

Appendix A: Definition of Jurisdictional Wetlands ..... 59

Appendix B: Data Analysis — Definitions and Equations ..... 63

Appendix C: Plant Species List, Areal Coverage Data, and Species Distribution ..... 69

## Tables

1 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NAs and the ROW of the Scrub-Shrub Community ..... 19

2 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the North and South Sides of the ROW of the Scrub-Shrub Community ..... 20

3 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NNA and SNA of the Scrub-Shrub Community ..... 21

4 Dominant Species by Vegetative Stratum for Each Area in the Scrub-Shrub Community ..... 24

5 Coefficient of Community Values Comparing Similarity of Species Occurring in Study Plots in the Scrub-Shrub Community ..... 25

6 Prevalence Index and Average Wetland Values for All Species and Dominant Species Found in the NAs and on the ROW of the Scrub-Shrub Community ..... 26

7 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NAs and the ROW of the Marsh Community ..... 29

8 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the East and West Sides of the ROW of the Marsh Community ..... 30

9 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the ENA and WNA of the Marsh Community ..... 31

10 Dominant Species by Vegetative Stratum for Each Area in the Marsh Community ..... 34

11 Coefficient of Community Values Comparing Similarity of Species Occurring in Study Plots in the Marsh Community ..... 34

12 Prevalence Index and Average Wetland Values for All Species and Dominant Species Found in the NAs and on the ROW of the Marsh Community ..... 35

## Tables (Cont.)


13 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NAs and the ROW of the Forested Community ..... 37

14 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the North and South Sides of the ROW of the Forested Community ..... 38

15 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NNA and the SNA of the Forested Community ..... 39

16 Dominant Species by Vegetative Stratum for Each Area in the Forested Community ..... 43

17 Coefficient of Community Values Comparing Similarities of Species Occurring in Study Plots in the Forested Community ..... 43

18 Prevalence Index and Average Wetland Values for All Species and Dominant Species Found in the NAs and on the ROW of the Forested Community ..... 44

19 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NAs and the ROW of the Mixed Vegetation Community ..... 45

20 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the North and South Sides of the ROW of the Mixed Vegetation Community ..... 47

21 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NNA and SNA of the Mixed Vegetation Community ..... 48

22 Dominant Species by Vegetative Stratum for Each Area in the Mixed Vegetation Community ..... 51

23 Coefficient of Community Values Comparing Similarity of Species Occurring in Study Plots in the Mixed Vegetation Community ..... 51

24 Prevalence Index and Average Wetland Values for All Species and Dominant Species Found in the NAs and on the ROW of the Mixed Vegetation Community ..... 52

C.1 Plant Species List for the Scrub-Shrub Community ..... 71

C.2 Areal Coverage Estimates for Plants by Stratum in the Scrub-Shrub Community ..... 72

C.3 Areal Coverage Estimates and Frequencies for Plants by Stratum in the Scrub-Shrub Community ..... 74

C.4 Plant Species List for the Emergent Marsh Community ..... 77

## Tables (Cont.)


C.5 Areal Coverage Estimates for Plants by Stratum in the Emergent Marsh Community ..... 79

C.6 Areal Coverage Estimates and Frequencies for Plants by Stratum in the Emergent Marsh Community ..... 82

C.7 Plant Species List for the Forested Wetland Community ..... 85

C.8 Areal Coverage Estimates for Plants by Stratum in the Forested Wetland Community ..... 86

C.9 Plant Species List for the Mixed Vegetation Community ..... 88

C.10 Areal Coverage Estimates for Plants by Stratum in the Mixed Vegetation Community ..... 90


## Figures


1 Location of the Mill Creek Tributary Study Site in Jefferson County, New York ..... 5

2 Relative Locations of the Four Wetland Communities Studied ..... 6

3 Plan View Showing Belt Transects and Study-Plot Sizes for the Scrub-Shrub Community ..... 10

4 Plan View Showing Belt Transects and Study-Plot Sizes for the Emergent Marsh Community ..... 11

5 Generalized Cross-Section Showing the Pipeline Location and Vegetation Types in the Scrub-Shrub Community ..... 16

6 Generalized Cross-Section Showing the ROW of the Planned Pipeline and Vegetation Types in the Emergent Marsh Community ..... 16

7 Generalized Cross-Section Showing the Pipeline and Vegetation Types of the Forested Wetland Community ..... 16

8 Generalized Cross-Section Showing the ROW, Pipeline Location, and Vegetation Types in the Mixed Vegetation Community ..... 17

9 Number of Plant Species in Each Wetland Indicator Category by Area in the Scrub-Shrub Community ..... 22

10 Percentage of Species in Each Wetland Indicator Category by Area in the Scrub-Shrub Community ..... 23

11 Number of Species in Each Wetland Indicator Category by Area in the Emergent Marsh Community ..... 32

## Figures (Cont.)


12 Percentage of Species in Each Wetland Indicator Category by Area in the Emergent Marsh Community ..... 33

13 Number of Species in Each Wetland Indicator Category by Area in the Forested Wetland Community ..... 41

14 Percentage of Species in Each Wetland Indicator Category by Area in the Forested Wetland Community ..... 42

15 Number of Species in Each Wetland Indicator Category by Area in the Mixed Vegetation Community ..... 49

16 Percentage of Species in Each Wetland Indicator Category by Area in the Mixed Vegetation Community ..... 50

A.1 Schematic Diagram of the Wetland Delineation Process ..... 62

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# Pipeline Corridors through Wetlands — Impacts on Plant Communities: Mill Creek Tributary Crossing, Jefferson County, New York, 1991 Survey

by

G.D. Van Dyke, L.M. Shem, and R.E. Zimmerman

## 1 Introduction

### 1.1 Background

Pipelines for the distribution of natural gas traverse all types of terrain, including wetlands. Prior to the wetlands regulatory climate of the late 1980s and the early 1990s, the construction of right-of-way (ROW) corridors through wetlands was often welcomed by landowners and local communities; ROW corridors opened up wetlands, thereby providing public access. With the promulgation of more stringent regulations related to development activities (including no-net-loss wetland policies), an assessment of the historical impacts of pipeline ROWs through wetlands is needed to evaluate construction and reclamation methods, assist in future permit application processes, and evaluate future construction costs.

The Gas Research Institute (GRI) Wetland Corridors Program was designed to evaluate impacts of gas-pipeline construction and subsequent maintenance on wetlands. The data gathered through this GRI program provide a better understanding of the type, degree, and duration of impacts of various pipeline-construction techniques. This information will enable the industry to evaluate current construction practices and provide factual input to regulatory bodies.

Careful evaluation of the impacts of pipeline installation on wetlands is necessary because specific impacts may be beneficial to some plant and/or animal species and detrimental to others. Some impacts may appear to be detrimental when, in fact, they improve conditions for certain sensitive species or provide for greater diversity of species and habitat.

The initial questions addressed by the GRI Wetland Corridors Program are as follows:

1. Do ROW construction and/or management practices lead to differences in ROW plant communities with respect to adjacent wetland communities?

2. Does the ROW alter the diversity of the adjacent wetland community? If so, how far do the impacts extend?

3. Does the ROW enhance species diversity of the wetland?

4. Are there ROW construction and management practices that can enhance the positive contributions of ROWs to wetlands and minimize detrimental impacts?

Answers to these broad questions will provide information related to a number of more specific questions. Data on the type of plant communities that develop on ROWs in various wetlands when specific pipeline construction and management practices are utilized and comparison of the ROW plant communities with the plant communities in areas adjacent to the ROW will provide a basis for comparing environmental impacts of previous and current construction and management practices. Valuable data for such comparisons include numbers of plant species present, species that are dominant, percentage of the species that are native to the area, and fidelity of the plants to wetlands. Other measures of the quality of species present are also valuable, but those data are not available at present.

Concern exists as to whether pipeline corridors provide avenues of access for nonnative and invasive plants. Whether such plants become established along pipeline ROWs and from there invade adjacent areas, and the extent to which such invaders modify the plant communities in adjacent areas, are important to determining potential impacts of pipelines on wetlands.

Potential positive impacts are also important to assess. The degree to which ROWs provide habitat for rare or endangered species and other desirable species that are poorly represented in the adjacent areas is important information. Assessments of impacts of pipeline corridors on wetlands should also include the contribution of corridors to both plant and animal species diversity.

Answers to the above questions will assist the industry and regulatory agencies in evaluating current installation and management practices and making modifications that are beneficial to wetland quality enhancement.

## 1.2 Goals and Objectives

The goal of the GRI Wetland Corridors Program is to document impacts of existing pipelines on the wetlands they transverse. To accomplish this goal, 12 existing wetland crossings were surveyed. The sites evaluated differed in years since pipeline installation (ranging from 8 months to 31 years), wetland type, installation technology used, and management practices. Each wetland survey had the following specific objectives:

- Document vegetative communities existing in the ROW and in adjacent wetland communities;

- Evaluate similarities and differences between the plant communities in the ROW and in the adjacent wetland communities;

- Document qualitative changes to the topography, soils, and hydrology attributable to ROW construction; and

- Identify impacts caused by ROW construction on rare, threatened, endangered, or sensitive species.

These individual wetland objectives were fulfilled by the collection and analysis of field data and the presentation of those data and their analysis in nine individual site reports. An upcoming summary report further synthesizes and interprets the data from all individual sites.

The following sections constitute a site report of field studies conducted during June 1991, along a 25-year-old existing pipeline corridor traversing a marsh-swamp wetland just southwest of the south-southwest boundary of the city of Watertown, New York.

# 2 Description of Study Area

## 2.1 Site Selection and Location

Personnel from a local gas distribution company assisted a team from Argonne National Laboratory (ANL) in selecting an area classified as "Jurisdictional Wetlands" under Section 404 of the Clean Water Act. An area near Watertown, New York, was selected because it included several types of wetland plant communities. Figure 1 shows the location of the wetland adjacent to the south-southwest boundary of the city of Watertown. Along the city boundary, the wetland is bordered by Holcomb Street on the west and extends for approximately 600 m east-southeast (ESE) toward Washington Street.

This Watertown site was particularly interesting because of the opportunity it provided to collect data from an existing ROW and to establish a predisturbance baseline for a planned second pipeline. The second pipeline was to be installed through this same wetland in the summer of 1991, scheduled just after ANL's field survey.

Because the route of the planned pipeline joined the existing ROW approximately midway across the wetland, several different study sites were available: an emergent marsh along the planned pipeline; a mixed vegetation site along the existing pipeline, which would not be affected by installation of the planned pipeline; a scrub-shrub wetland and a forested wetland along the existing pipeline, where the planned pipeline would be installed on the same ROW.

Pipeline company personnel expressed interest in doing baseline and follow-up studies on innovative installation techniques to be used in the emergent marsh. These techniques would involve removing the vegetative mat intact and later replacing it (with minimal disturbance) following pipeline installation.

The existing pipeline ROW, with its 8-in. (20-cm)* pipeline, was constructed in 1966. The new 12-in. (30-cm) pipeline was installed during the summer of 1991 after the survey for this report was conducted. Since the new pipeline was not yet installed at the time of sample collection, it is referred to in this document as the "planned pipeline." Figure 2 illustrates the location of the existing and planned pipelines as they traverse the wetland. The north-south segment of the planned pipeline passes through about 150 m of emergent cattail marsh before it enters a scrub-shrub habitat about 30 m north of the existing ROW. At its junction with the existing ROW, the planned pipeline angles ESE and follows the existing ROW through the remainder of the wetland. From the point where the planned ROW joins the existing ROW, the scrub-shrub community extends ESE along the ROW for about 150 m before intergrading into a forested wetland. Continuing on in an ESE direction, the forested wetland intergrades into a lowland forest.

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* Measurements are given in metric units except where they were actually taken in English units; in these cases, metric equivalents are given in parentheses.

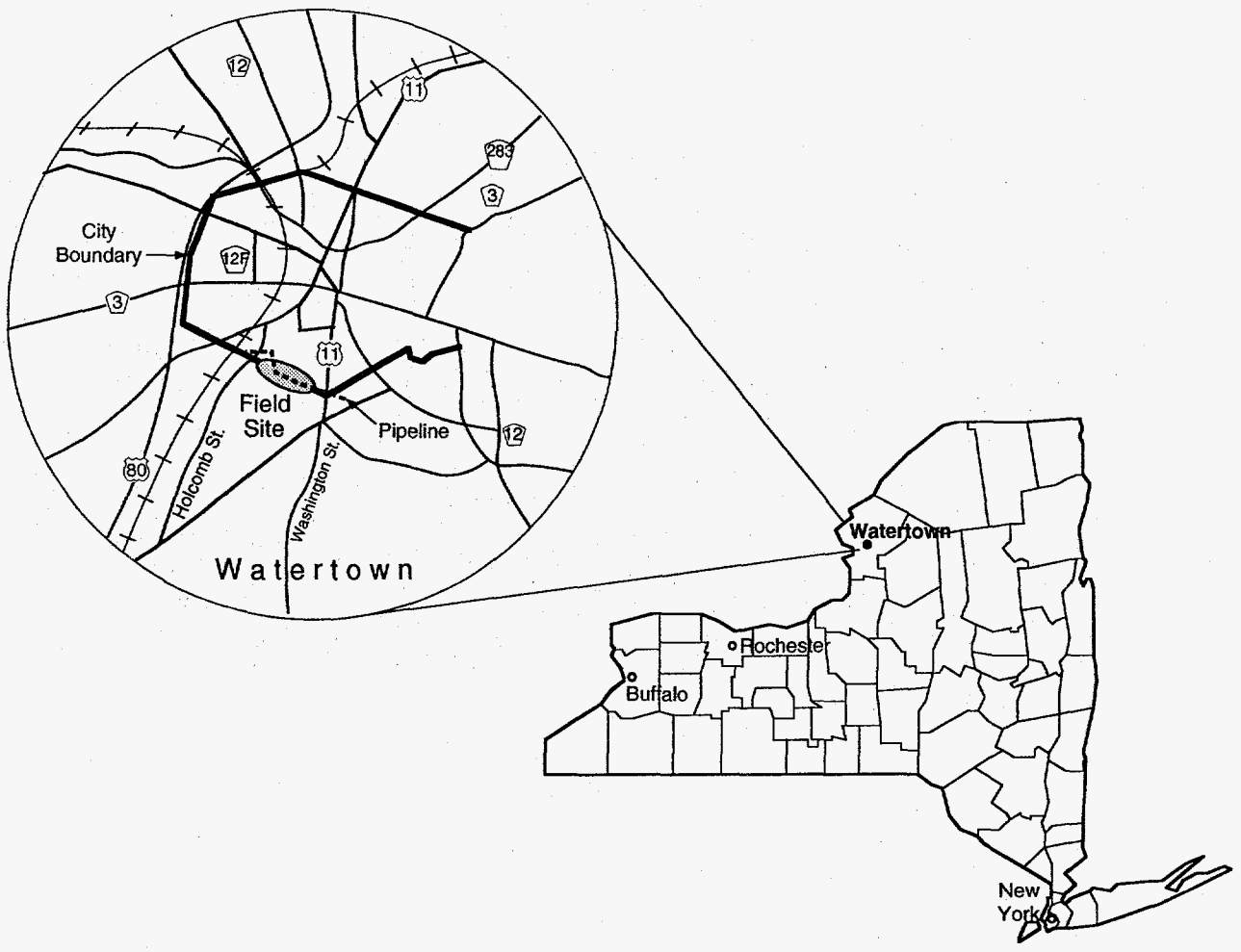


FIGURE 1 Location of the Mill Creek Tributary Study Site in Jefferson County, New York

## 2.2 Soils

The soils found at the subject wetland consisted mainly of four types: Lamson fine sandy loam, Canadaiqua silt loam, Minoa fine sandy loam, and Palms muck (Soil Conservation Service [SCS] 1989). The soils at the study sites consisted mostly of Lamson soils, which are very deep, poorly to very poorly drained soils that form in stream- or lake-laid sediments, dominated by fine to very fine sand. Canadaiqua soils are very deep, poorly to very poorly drained soils that formed in lake deposits on glacial lake plains. Minoa soils are very deep, somewhat poorly drained soils that formed in water-sorted sediments, dominated by fine to very fine sand. Palms muck soils are very poorly drained soils that formed in deposits of organic materials, 16 to 50 in. thick, over loamy mineral soil deposits in bogs and depressions on lake plains, till plains, and outwash plains. All four of these soil types are found in areas with slopes ranging from 0 to 3 in. (0 to 8 cm). All but Minoa are listed as hydric soils in *Hydric Soils of the United States* (SCS 1991).

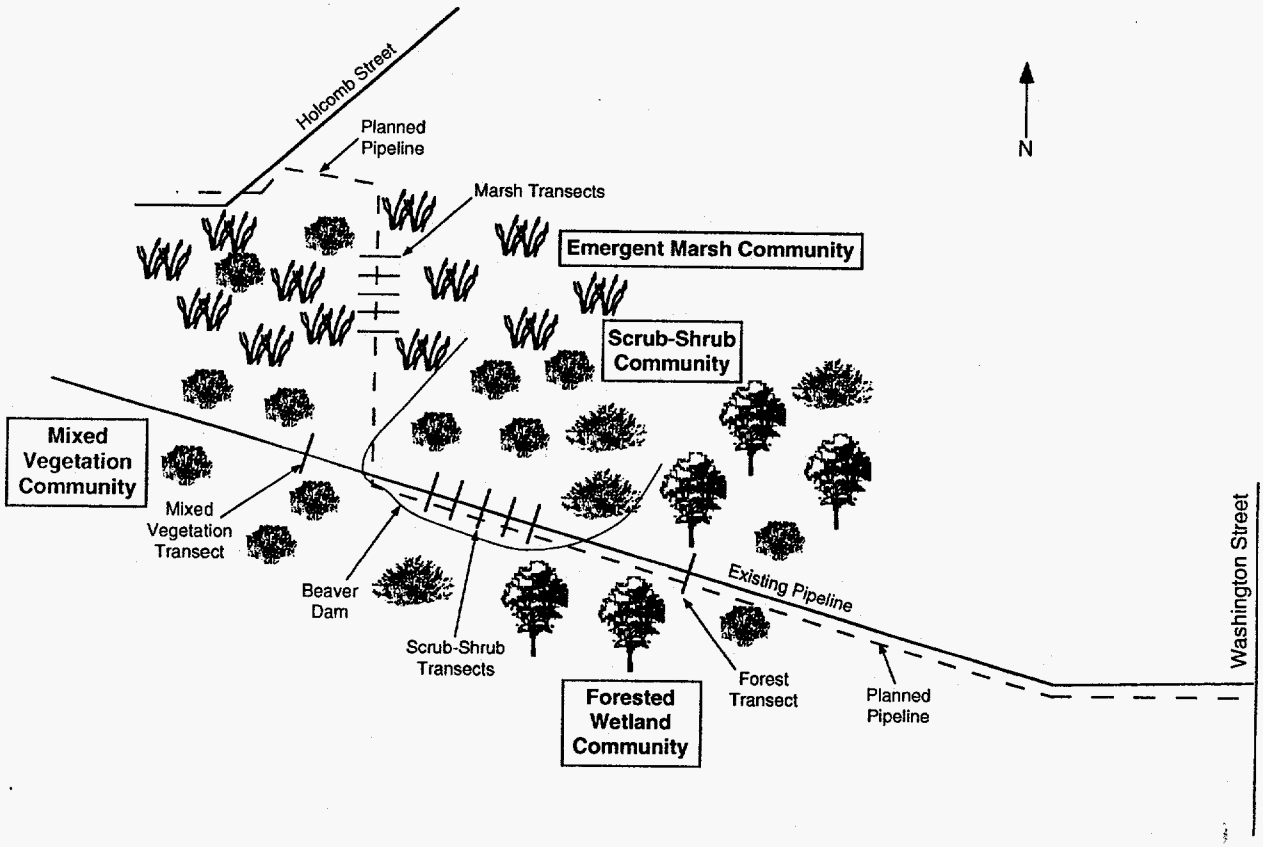


FIGURE 2 Relative Locations of the Four Wetland Communities Studied

## 2.3 Hydrology

The soil surface of the wide valley floor along the route of the 1966 pipeline shows little relief from its western edge, just east of Holcomb Street, for about 400 m, until it slopes upward very gradually to its forested eastern edge. There are no well-defined drainage channels in the valley floor. Sheet water flow is from north-northeast to south-southwest, crossing the pipeline ROW at a right angle. Sewage effluent is discharged into the wetland at its western edge near the pipeline ROW.

Although attempts have been made to improve drainage, and the wetland has been drained in the past, water levels at the pipeline crossing are presently at or above the soil surface in much of the wetland throughout most of the year. An extensive U-shaped beaver dam maintains standing water over an area approximately 100 m × 100 m just east of the center of the wetland along the ROW. The location of this dam is shown in Figure 2.

## 2.4 Climate

Jefferson County has a temperate climate of cold winters and moderately warm summers, with occasional hot spells (SCS 1989). The average winter temperature is 21°F (-6°C), and the

average daily minimum temperature is 12°F (-11°C). The lowest recorded temperature at Watertown is -32°F (-35°C). Summer temperatures average 68°F (20°C), with average daily highs of 77°F (25°C). The highest recorded temperature at Watertown is 97°F (36°C).

Total annual precipitation is 40 in. (102 cm), which is distributed fairly evenly throughout the year and is almost always adequate for all crops. Monthly precipitation ranges from 2.65 to 4.01 in. (6.73 to 10.19 cm); the lower value occurs in the late winter and the higher value in the late summer and fall. The average seasonal snowfall is 101 in. (257 cm).

In nine out of ten years, the growing season ranges from 122 to 181 days, depending on the daily minimum temperature. In one out of ten years, the growing season ranges from 173 to 234 days.

## 2.5 History and Management Practices

**Area History.** The wetland area, designated as "W-2" on the New York Department of Environmental Conservation map for Jefferson County, is described in the pipeline application permit to the U.S. Army Corps of Engineers as an emergent wet meadow with an outer area consisting of abandoned former hayfields that are presently used for septic disposal. A verbal account of the wetland's history was given by Tim Wright.* Wright indicated that the area had been partially drained by plowed furrows along the drainage gradient to allow pasturing during the 1950s and 1960s. Following the installation of nearby Interstate Highway 81 (approximately 1960), the water levels were elevated and the natural vegetation was allowed to grow back. Water levels in the area have been further elevated by an extensive series of low, expansive beaver dams. Most of these dams are less than 20 in. (50 cm) in height.

**Pipeline Construction.** The existing 8-in. pipeline was installed in 1966 by using the conventional methods of the time. These methods involved clearing the ROW of vegetation, excavating a trench, installing the pipe, and backfilling with a minimum of 3 ft (1 m) of soil over the pipe. Specific information on this construction site was not available; however, if typical pipeline corporation guidelines were followed, it is likely that the slash from clearing was used as corduroy, or access pads were used for equipment access. Information was not available on any maintenance activity that may have occurred on the ROW. During the survey for this study, it appeared that little or no maintenance activity had been performed at this site. The ROW was vegetated with shrubs and young trees, except for a path in the center that had been hand-cleared to facilitate recent survey work.

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* Personal communication with Tim Wright, Harroun Lumber Corporation (located adjacent to the wetland), June 13, 1991.

# 3 Approach and Methods

## 3.1 General Approach

The primary objectives listed in the Introduction (Section 1.2) provided the general guidelines for this study. To allow comparison of results across sites, methodologies for site reconnaissance, vegetation data collection, and data analysis used at this site were similar to those used at the other sites.

Three vegetative communities for sampling were identified along the route of an existing pipeline within this wetland: a scrub-shrub community, a mixed vegetative community, and a forested wetland. A fourth vegetative community — an emergent marsh located along the route of a pipeline to be installed later in summer 1991 — was sampled to provide baseline data for comparison with data to be collected after the new pipeline installation.

## 3.2 Habitat Description

General site habitat data, including topography, water levels, water flow direction, soil conditions, and structure of the plant communities, were recorded on the basis of general reconnaissance of the sites. Soil characteristics were compared with descriptions of the area soils in the SCS soil survey for Jefferson County, New York (SCS 1989). ROW boundaries were identified on the basis of construction plan information and field observations.

## 3.3 Sampling Design for Vegetational Studies

At each of the four study sites, four areas were defined on the basis of their relationship to the midline of the ROW. These four areas consisted of the two sides of the ROW and the two natural areas (NAs), undisturbed by pipeline installation, on either side of the ROW. Defining these four areas in this way allows comparisons between the two vegetative communities in the NAs on either side of the ROW, between the vegetative communities developing on the two sides of the ROW, and between the vegetative communities developing on the ROW and those occurring in the NAs. For convenience, these four areas are designated at each site by the direction in which they lie from the midline of the ROW.

**Transects.** Sampling sites were established in each of the four communities; the data for each community are presented in separate sections. One sampling site was established along the existing pipeline ROW within the scrub-shrub community. Five stations were established, at 30-m intervals, along the center of the ROW at this site. The first, westernmost station was located randomly. Sixty-meter-long transects perpendicular to and centered on the existing pipeline were established at each station. Five belt transects, each 20 m wide and 60 m long, were established

by using the station transects as a centerline for each belt transect. Each belt transect was divided into four segments. The first 10-m segments on either side of the approximate pipeline location represented the north and south sides of the ROW, forming the two 10 × 20-m sampling plots for each transect in the ROW. The 20-m segments beyond these (between 10 and 30 m on either side) represented the NAs to the north and south of the ROW, forming the two 20 × 20 m sampling plots for each transect in the NAs. These transects and plots are illustrated in Figure 3. It would have been desirable to use the actual boundaries of the ROW and the pipeline as boundaries between the four segments of each belt transect, but it was not possible to establish the actual ROW boundaries or location of the pipeline at the time of this survey because no permanent markers were present and there was no distinct edge to the vegetation communities.

A second site was established in the emergent marsh along the planned ROW. This site was centered on the line of flagged survey stakes present at the time of sampling. As with the scrub-shrub site, five stations were established at 30-m intervals. The first, northernmost station was located randomly at a point a sufficient distance into the marsh (approximately 80 m into the marsh, along the planned ROW) to avoid wetland edge effects. At each station, a 60-m transect was established perpendicular to the line of survey stakes, using the stake as a center point. Five belt transects, each 10 m wide, were established by using each of the station transects as a northern boundary. Each belt transect was divided into four segments. Two 10 × 10-m segments, consisting of the first 10 m on either side of the survey line, were used as the sampling plots to collect data on the planned ROW. The outer two 10 × 20-m segments, extending from 10 to 30 m on either side of the survey line, were used as the sampling plots to provide data on the NAs that would remain undisturbed during pipeline installation. Figure 4 shows a layout of these transects and plots.

A third site, consisting of a single station, was established in the forested wetland east of the scrub-shrub habitat along the existing ROW. A single station was used because no sufficient area of relative uniformity existed for multiple stations; the wetland gradually increased in elevation along the ROW from west to east after exiting the scrub-shrub habitat. A station was randomly located approximately 100 m east of the nearest transect in the scrub-shrub community. The transect and four sampling plots were established by using the same procedures and dimensions as those used in the scrub-shrub community.

A fourth site, also consisting of a single station, was established just west of the juncture of the existing and planned pipeline ROWs. This area was west of the beaver dam and was not covered with standing water. The vegetation at this site, mostly shrubs north of the pipeline and mostly mixed herbaceous vegetation south of the pipeline, is referred to here as the mixed vegetation site. Again, insufficient uniform habitat was available for multiple transects; therefore, one belt transect, segmented into four sampling plots of the same dimensions as those used for the scrub-shrub community, was used for this site.

Delineated in Figure 2 are the five transects of the scrub-shrub study site on the existing ROW, the single transect study sites in the forest and mixed vegetation communities on the existing ROW, and the five transects of the study site in the cattail marsh along the planned ROW.

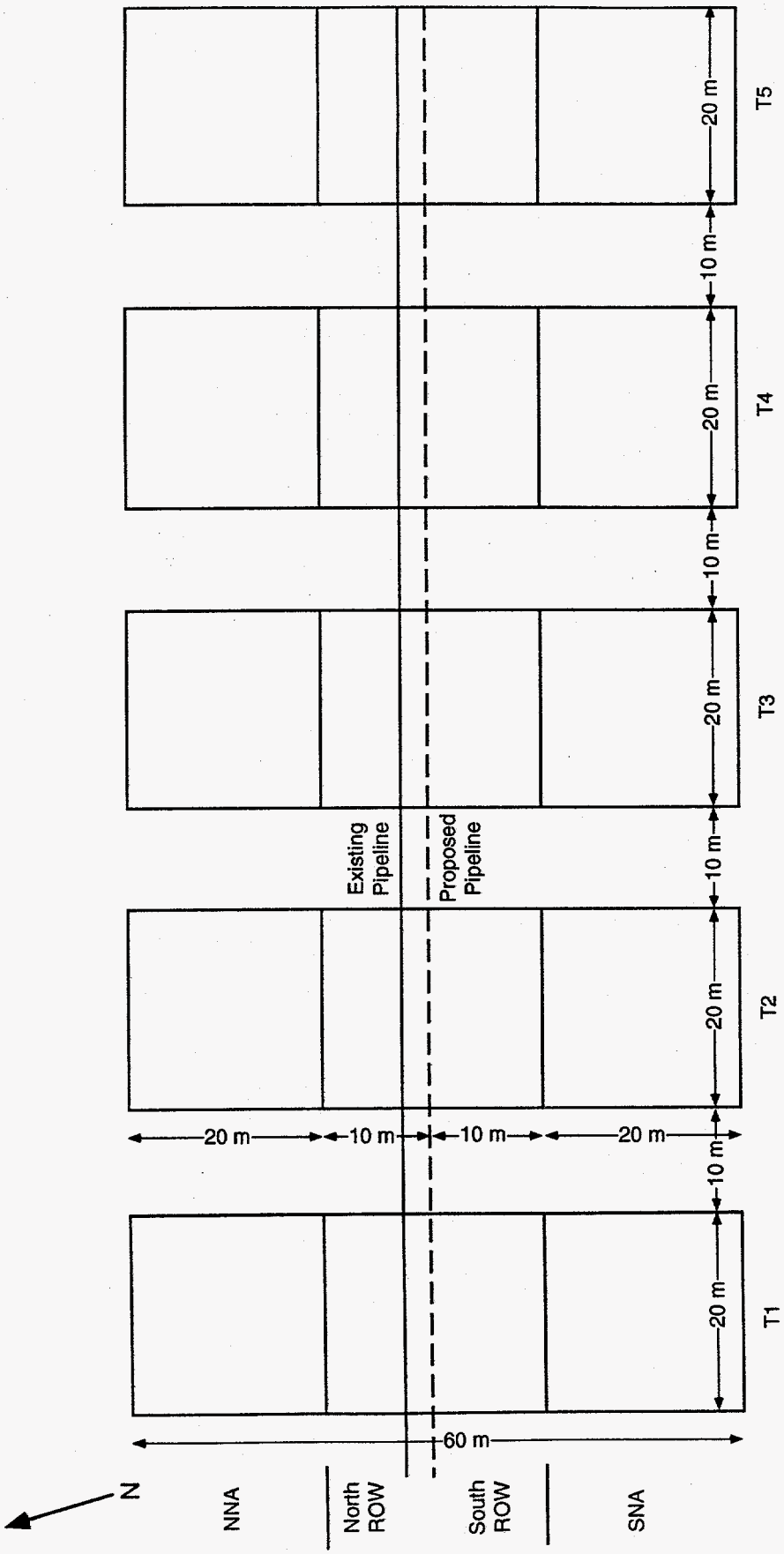


FIGURE 3 Plan View Showing Belt Transects and Study-Plot Sizes for the Scrub-Shrub Community

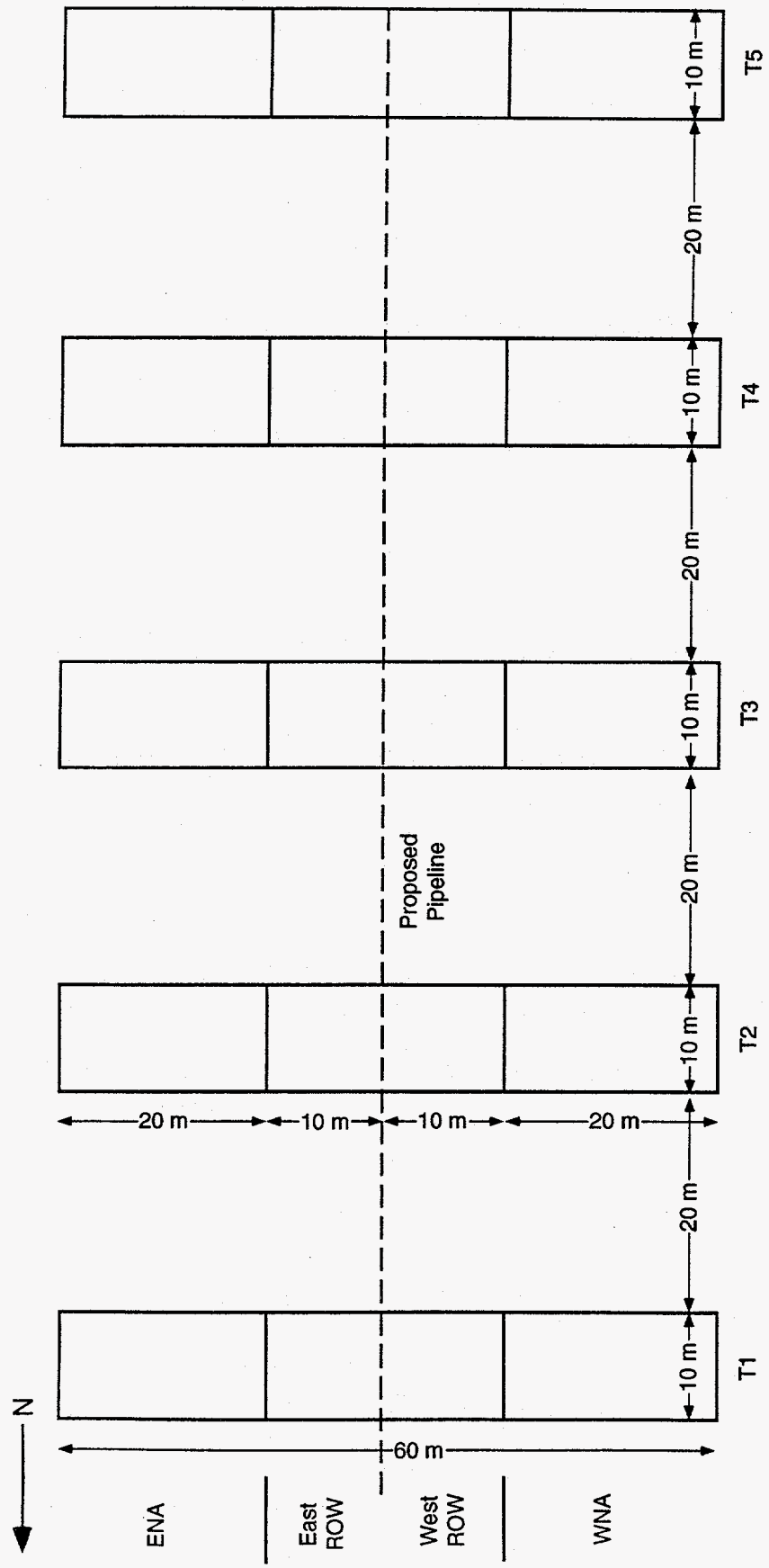


FIGURE 4 Plan View Showing Belt Transects and Study-Plot Sizes for the Emergent Marsh Community

**Sampling Procedures.** Vegetational data were collected on each of the measured plots at each of the four sites. Two specimens of each plant species found on or near the plots were collected as voucher specimens. Plant names, wetland indicator categories, life-forms, and the origin of each species were derived from the national list of plant species (Reed 1988). Vegetational data were collected by using areal cover estimates within sampling plots. At each site, estimates were made separately for the herb stratum, the shrub stratum, the sapling stratum, and the tree stratum, as defined in the 1989 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (FICDW 1989), hereafter referred to as "the 1989 Federal Manual." The herbs are defined as herbaceous plants, including graminoids, forbs, ferns, herbaceous vines, and woody species under 3 ft (1 m) in height. Shrubs include multistemmed, bushy shrubs, small trees, and saplings between 3 and 20 ft (1 and 6 m). Saplings are defined as having a diameter at breast height (dbh) of 0.4 to 4.9 in. (1 to 12 cm) and a height exceeding 20 ft (6 m). Trees are defined as having a dbh of greater than or equal to 5.0 in. (12 cm) and a height exceeding 20 ft (6 m).

One plant species could occur in any or all strata. When strata were combined, each species was considered only once, independent of the number of strata in which it occurred. Estimates of surface area cover were also recorded for standing water and bryophytes in each plot.

## 3.4 Data Analysis

Analyses of vegetative data collected from sampling plots for all 17 sites studied as part of the GRI Wetland Corridors Program were consistent. Analyses focused on comparing the plant communities on the ROW with those in the NAs and determining hydrophytic characteristics of the plant communities in each area. Particular attention was given to dominant species because they are used in several wetland delineation methods. Although the number of species dominant, species richness, and the variety of plant life-forms present are all aspects of community diversity, no diversity indices were calculated. Diversity indices that use coverage values as measures of species importance were considered, but they were judged inappropriate because of differences in the number of strata in the ROW and NAs for the sites included in the Wetland Corridors Program and because coverage values are not additive across strata.

**Species Richness, Wetland Indicator Categories, and Species Characteristics.** The total number of species present (species richness) was determined for each side of the ROW, for the total ROW, for each NA, and for the NAs combined. Wetland indicator categories (Reed 1988) were identified for each species in the study plots. These categories are defined in Appendix B, Section B.1. The number of species in each category was determined for each area by stratum and for all strata combined. Because one plant species could occur in any or all strata, when data from different strata were combined, each species was considered only once, independent of the number of strata in which it occurred. Species characteristics, including life-forms and origins, were also determined from Reed (1988). Symbols for life-forms and species origins are given in Appendix B, Section B.2.

**Dominant Species.** The definition of and methodology for the determination of dominant species in this study were taken from the 1989 Federal Manual (FICWD 1989). In the manual, dominance refers "strictly to the spatial extent of a species that is directly discernible or measurable in the field," as opposed to number of individuals present. Using this definition, dominant species were identified by plant stratum, rather than by total community. For each area, the dominant species were determined for each stratum by ranking each species in a plant stratum in descending order relative to total areal coverage of all plants in that stratum. The highest ranking species, which make up 50% of the total areal coverage or half of the total relative percent coverage (RPC), are the dominant species for that stratum. Any remaining species with 20% or more RPC are also considered dominant.

**Community Similarity Indices.** Sørensen's coefficient of community index ($CC_s$) was used to measure similarity between vegetative communities (Brower, Zar, and von Ende 1990). This index uses the following formula:

$$CC_s = 2c/(a+b) \quad (1)$$

where

a = the number of species in community A,

b = the number of species in community B, and

c = the number of species in common between communities A and B.

A $CC_s$ value of 1.00 indicates 100% similarity in species composition between communities A and B. A value of 0.00 represents no species in common. Community similarity indices that use coverage values as measures of species importance were considered, but they were judged inappropriate because of differences in the strata present in the plant communities on the ROW compared to those in the NAs and because of the nonadditive characteristic of coverage data.

Comparisons were made between the combined ROWs and combined NAs, the two portions of the ROW, each portion of the ROW and its adjacent NA, and the two NAs.

**Prevalence Index Values.** Prevalence index values (PIVs) were calculated according to methods outlined in the 1989 Federal Manual (FICWD 1989), substituting RPC data from quadrat coverage estimates for relative frequencies from intercept data. This substitution is logical because both relative frequency and RPC are estimates of relative coverage (Bonham 1989). The PIV is an average wetland indicator value ranging from 1.0 to 5.0 and weighted by the RPC. Because areal coverage was determined by stratum, the PIVs were calculated for each area by stratum only. The average RPCs for each species in the five plots in each area were used in calculating the PIV for the area. The equation for calculating a PIV is presented in Appendix B, Section B.3.

**Average Wetland Values.** Average wetland values (AWVs) (Zimmerman et al. 1991) were calculated for the species in each of the five areas. This index is an average of the wetland indicator values for all plants present. It differs from the PIV in that it is not weighted by RPC; rather, all plants present are represented equally, regardless of their frequency of occurrence. Because areal coverage is not considered, the calculation of an index value is not restricted to one vegetative stratum. An overall site AWV was determined, as well as values for each stratum. See Appendix B, Section B.4, for the equation.

# 4 Results

Several wetland vegetational communities were identified along the route of the 25-year-old pipeline. These included forested wetland, scrub-shrub wetland, and mixed emergent wetlands. Only the scrub-shrub wetland was relatively uniform for a sufficient distance along the existing ROW to permit extensive sampling. Figure 5 depicts a generalized profile of the vegetation along a north-south line perpendicular to the ROW. The vegetation ranged from mostly shrubs north of the ROW to mostly saplings and trees south of the ROW. Shallow, standing water was maintained throughout the area by a low, extensive beaver dam. The forested wetland intergraded into a forested lowland to the east. The mixed emergent wetlands to the west of the scrub-shrub community contained scattered dead shrubs that appear to have been altered by effluent from a sewage plant located near where the ROW exits the west edge of the wetland. The route of the planned pipeline enters the wetland just east of Holcomb Street and passes south through an emergent cattail marsh community until it enters the scrub-shrub community just north of where it joins the existing pipeline ROW. Figure 6 is a generalized profile of the vegetation along an east-west line perpendicular to the planned ROW in the emergent cattail marsh.

Two primary sampling sites were established, one along the existing pipeline ROW in the scrub-shrub vegetation and one in the emergent marsh vegetation along the planned pipeline ROW. Two secondary sites were established along the existing ROW, one in a forested area just east of the scrub-shrub community and one just west of the scrub-shrub community where it intergrades into emergent marsh vegetation. Generalized cross-sectional profiles of the vegetation of these two secondary sites are shown in Figures 7 and 8. Figure 2 shows the location of each of these sampling sites. All sites were sampled approximately one month prior to construction of the planned pipeline. At the time of sampling, the only clearing that had been done was the hand-cutting of a few small shrubs over the existing pipeline to allow for preliminary surveying.

Vascular plants belonging to 111 different taxa were collected from the four study sites. Of these, 100 were identified to species. The 11 plants not identified to species were immature at the time of sampling. Site-specific lists of species are presented in Appendix C (Tables C.1, C.4, C.7, and C.10).

## 4.1 Scrub-Shrub Community

### 4.1.1 General Ecology

The scrub-shrub community site (traversed by the existing pipeline and through which the planned pipeline will be placed) is a nearly level area, with water covering the entire site (Figure 2). At the time of sampling, there was no evidence of an elevated roadway on the working side of the ROW, nor was there evidence that any maintenance had been performed to prevent shrubs or woody plants from invading the ROW. The standing water was retained about

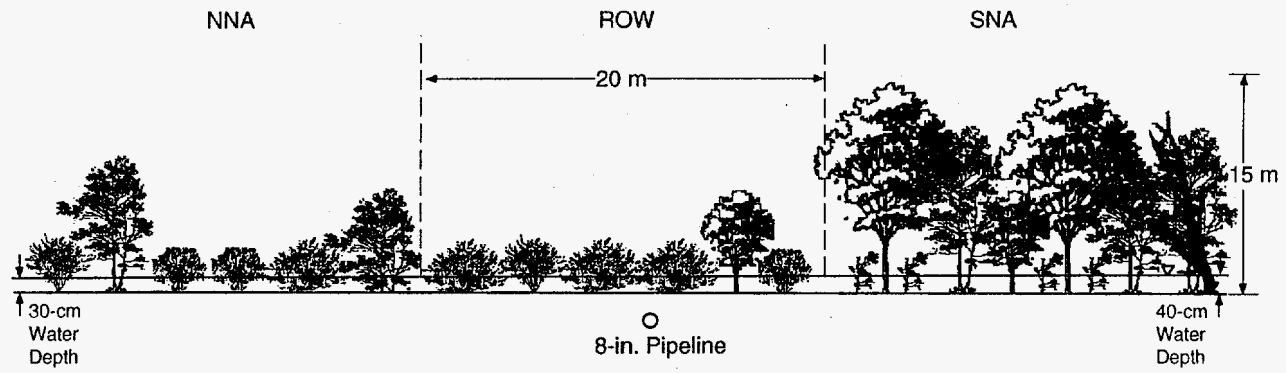


FIGURE 5 Generalized Cross-Section Showing the Pipeline Location and Vegetation Types in the Scrub-Shrub Community

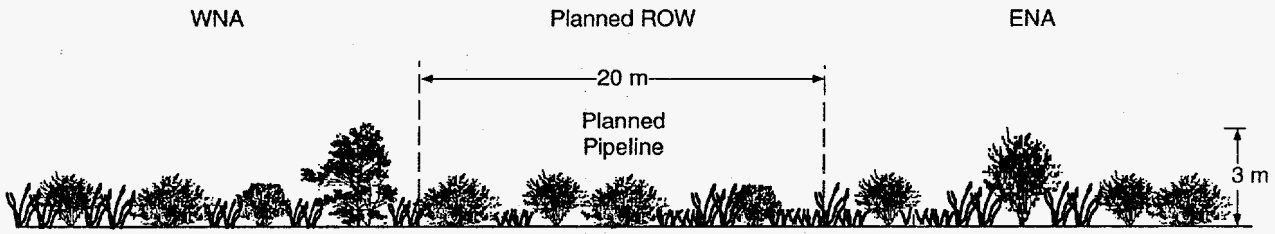


FIGURE 6 Generalized Cross-Section Showing the ROW of the Planned Pipeline and Vegetation Types in the Emergent Marsh Community

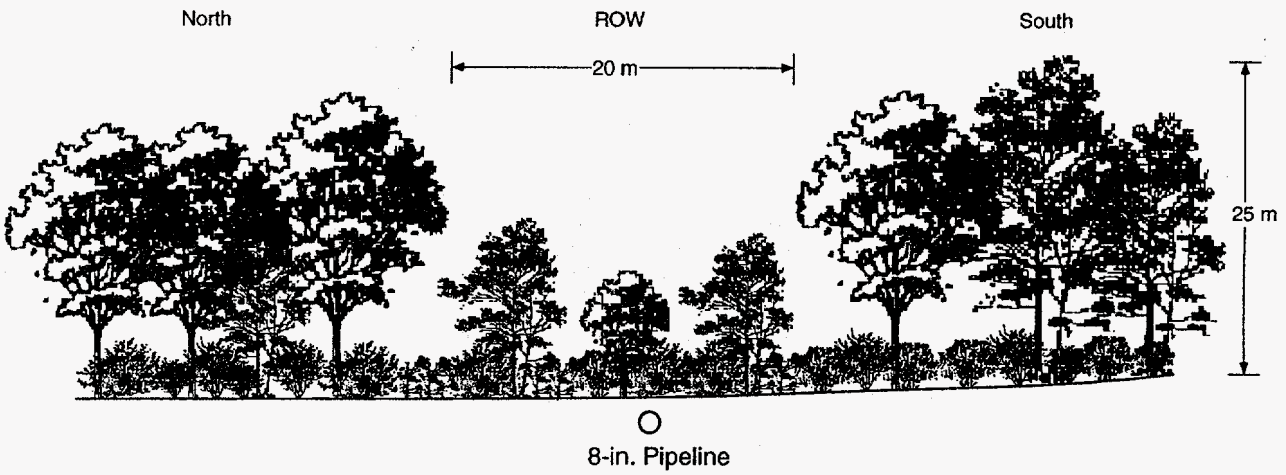


FIGURE 7 Generalized Cross-Section Showing the Pipeline and Vegetation Types of the Forested Wetland Community

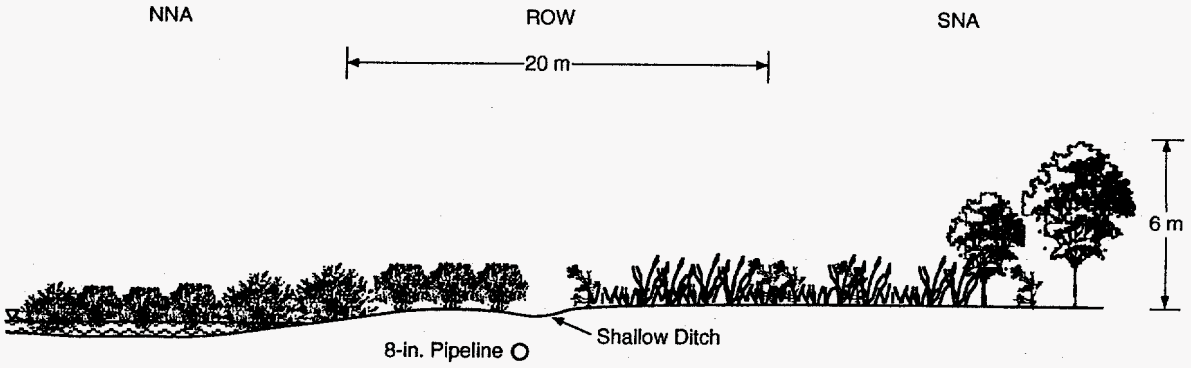


FIGURE 8 Generalized Cross-Section Showing the ROW, Pipeline Location, and Vegetation Types in the Mixed Vegetation Community

20-50 cm higher in the sampling area of the site by an extensive, U-shaped stick-and-mud beaver dam that encompassed the site on the south, east, and west sides. Some standing water was also present on the low side of the dam. Deeper channels occurred over the pipeline, just to the north of the beaver dam at the southern edge of the site and extending in a north-south direction in several places. These channels contained water to depths of 100 cm. Channels also were present on the low side of the dam. It was not possible to determine to what extent these channels were due to previous human activity, beaver activity, or a combination of both. On the basis of vegetational differences between the area encompassed by the dam and the adjacent areas beyond the dam, it appeared that this dam had been in place for several years.

In the NNA, the vegetation consisted predominantly of shrubs, with scattered saplings and young trees. The SNA vegetation consisted mainly of saplings and young trees. A number of large willows were present near the beaver dam, just beyond the southern limit of the site. Some of these willows were lodging to the north and overhanging the ends of several transects; the soil entrapped in the exposed root masses of these lodged willows was the only soil exposed above the standing water throughout the site. In some places, the ROW was well-vegetated with shrubs and young trees, while in others, especially where depressions occurred, there was little or no vegetation. Very little emergent herbaceous vegetation was present at this site. In areas with sufficient sunlight, duckweed covered most of the water surface.

Soil profiles throughout this site were consistent with Lamson soils, as described earlier (Section 2.2). Ninety-nine percent of the ground surface was covered by standing water. Estimates of the standing water for each plot are given in Table C.2.

### 4.1.2 Plant Community

**Plant Species, Life-Forms, and Species Origins.** Table C.1 lists the total of 27 taxa observed at this site. Twenty-six of these taxa were identified to species, and their wetland indicator categories, life-forms, and whether they are native to the area were determined from the *National List of Plant Species that Occur in Wetlands, Region 1* (Reed 1988). Three of

the species — common buckthorn (*Rhamnus catharticus*), glossy buckthorn (*Rhamnus frangula*), and crack willow (*Salix fragilis*) — are listed as regionally introduced species. Twenty-three of the taxa occurred in the transect sampling plots. Cover values for each species in each plot are given in Table C.2. The average cover for each species in each area and stratum, based on five plots, is given in Table C.3.

**Species Richness and Wetland Indicator Categories.** Table 1 lists the number of plant species found in the combined NAs and the combined ROW. Species counts are given by wetland indicator categories in the vegetative strata. Although the same species might have occurred in several strata, when strata were combined, a species was counted only once, independent of the number of strata in which it occurred. Definitions of the strata are provided in Section 3.3.

Columns 3 and 4 of Table 1 give the total number of species found in each of the two habitats, column 5 gives the number of species found in both habitats, and columns 6 and 7 give the number of species that occurred in one of the habitats but not in the other. A total of 23 taxa of vascular plants occurred in the transects at this site. All 23 taxa were present in the NAs, while only 18 were present on the ROW. Distributions of species across the wetland indicator categories were similar for all strata, the highest number of species in each stratum being FACW species. Although the herb stratum was very sparse, it had the greatest number of species and the most OBL species. No facultative-upland (FACU) species occurred in any stratum; however, a single upland (UPL) species, common buckthorn, did occur in the shrub stratum. No members of the tree stratum were OBL. One taxon was not identified to species and therefore could not be classified.

Although eight species in the herb stratum, two species in the sapling stratum, and one species in the tree stratum were unique to the NAs, only five species were unique to the NAs when all of the strata were combined. This outcome results because some species that occurred only in the NAs in a given stratum may have occurred in the ROW in another stratum, so that when the strata are combined, fewer differences occur. Five of the eight species in the herb stratum that were unique to the NAs — stalk-grain sedge (*Carex × stipata*), spotted touch-me-not (*Impatiens capensis*), wild black currant (*Ribes americana*), goldenrod (*Solidago sp.*), and seedlings of crack willow — occurred only on the raised soil associated with the lodged willows.

Table 2 summarizes the distribution of plants in the plots from the south and north sides of the ROW. Of the 18 species found on the ROW, 78% occurred on both the north and south sides, and 22% occurred on the north side only. Again, different strata may have had one or more species limited to one or the other side of the ROW, but when strata were combined, these differences were eliminated because species were present in other strata within the habitat.

The NAs contained a total of 23 taxa, with 52% of these occurring in both the NNA and SNA when all strata were combined (Table 3). Thirty percent were unique to the NNA; 17% were unique to the SNA. Each stratum had species unique to one area or the other. The single UPL

TABLE 1 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NAs and the ROW (by individual stratum and combined strata) of the Scrub-Shrub Community

| | | Number of Species | | | | | |
|---|---|---|---|---|---|---|---|
| Stratum | Wetland Indicator Category[a] | Occurring in NAs | Occurring in ROWs | Common to Both Areas | Unique to NAs | Unique to ROWs | Total |
| Herb | OBL | 5 | 3 | 3 | 2 | 0 | 5 |
| | FACW | 9 | 5 | 5 | 4 | 0 | 9 |
| | FAC | 5 | 4 | 4 | 1 | 0 | 5 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid[b] | 1 | 0 | 0 | 1 | 0 | 1 |
| | Total | 20 | 12 | 12 | 8 | 0 | 20 |
| Shrub | OBL | 1 | 1 | 1 | 0 | 0 | 1 |
| | FACW | 7 | 7 | 7 | 0 | 0 | 7 |
| | FAC | 3 | 3 | 3 | 0 | 0 | 3 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 12 | 12 | 12 | 0 | 0 | 12 |
| Sapling | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 4 | 3 | 3 | 1 | 0 | 4 |
| | FAC | 1 | 0 | 0 | 1 | 0 | 1 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 5 | 3 | 3 | 2 | 0 | 5 |
| Tree | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 2 | 2 | 1 | 1 | 1 | 3 |
| | FAC | 2 | 2 | 2 | 0 | 0 | 2 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 4 | 4 | 3 | 1 | 1 | 5 |
| Combined | OBL | 5 | 4 | 4 | 1 | 0 | 5 |
| | FACW | 10 | 7 | 7 | 3 | 0 | 10 |
| | FAC | 6 | 6 | 6 | 0 | 0 | 6 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 1 | 0 | 0 | 1 | 0 | 1 |
| | Total | 23 | 18 | 18 | 5 | 0 | 23 |

[a] OBL = obligate wetland; FACW = facultative wetland; FAC = facultative; FACU = facultative upland; UPL = obligate upland; see Appendix B for more detailed information on wetland indicator categories.

[b] Unid = unidentified; includes plants not identified to species or category not determined for this region.

TABLE 2 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the North and South Sides of the ROW (by individual stratum and combined strata) of the Scrub-Shrub Community

| | | Number of Species | | | | | |
|---|---|---|---|---|---|---|---|
| Stratum | Wetland Indicator Category | Occurring in North ROW | Occurring in South ROW | Common to Both ROWs | Unique to North ROW | Unique to South ROW | Total |
| Herb | OBL | 3 | 1 | 1 | 2 | 0 | 3 |
| | FACW | 5 | 4 | 4 | 1 | 0 | 5 |
| | FAC | 4 | 3 | 3 | 1 | 0 | 4 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 12 | 8 | 8 | 4 | 0 | 12 |
| Shrub | OBL | 1 | 1 | 1 | 0 | 0 | 1 |
| | FACW | 7 | 6 | 6 | 1 | 0 | 7 |
| | FAC | 2 | 2 | 1 | 1 | 1 | 3 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Total | 11 | 10 | 9 | 2 | 1 | 12 |
| Sapling | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 2 | 3 | 2 | 0 | 1 | 3 |
| | FAC | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 2 | 3 | 2 | 0 | 1 | 3 |
| Tree | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 2 | 2 | 2 | 0 | 0 | 2 |
| | FAC | 1 | 1 | 1 | 0 | 0 | 1 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 3 | 3 | 3 | 0 | 0 | 3 |
| Combined | OBL | 4 | 2 | 2 | 2 | 0 | 4 |
| | FACW | 7 | 6 | 6 | 1 | 0 | 7 |
| | FAC | 6 | 5 | 5 | 1 | 0 | 6 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Total | 18 | 14 | 14 | 4 | 0 | 18 |

TABLE 3 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NNA and SNA (by individual stratum and combined strata) of the Scrub-Shrub Community

| Stratum | Wetland Indicator Category | Number of Species: Occurring in NNA | Occurring in SNA | Common to Both NAs | Unique to NNA | Unique to SNA | Total |
|---|---|---|---|---|---|---|---|
| Herb | OBL | 4 | 3 | 2 | 2 | 1 | 5 |
| | FACW | 7 | 7 | 5 | 2 | 2 | 9 |
| | FAC | 4 | 3 | 2 | 2 | 1 | 5 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid[a] | 0 | 1 | 0 | 0 | 1 | 1 |
| | Total | 15 | 14 | 9 | 6 | 5 | 20 |
| Shrub | OBL | 1 | 0 | 0 | 1 | 0 | 1 |
| | FACW | 7 | 6 | 6 | 1 | 0 | 7 |
| | FAC | 3 | 1 | 1 | 2 | 0 | 3 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 1 | 0 | 0 | 1 | 0 | 1 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 12 | 7 | 7 | 5 | 0 | 12 |
| Sapling | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 1 | 4 | 1 | 0 | 3 | 4 |
| | FAC | 0 | 1 | 0 | 0 | 1 | 1 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 1 | 5 | 1 | 0 | 4 | 5 |
| Tree | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 1 | 2 | 1 | 0 | 1 | 2 |
| | FAC | 2 | 1 | 1 | 1 | 0 | 2 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 3 | 3 | 2 | 1 | 1 | 4 |
| Combined | OBL | 4 | 3 | 2 | 2 | 1 | 5 |
| | FACW | 8 | 9 | 7 | 1 | 2 | 10 |
| | FAC | 6 | 3 | 3 | 3 | 0 | 6 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 1 | 0 | 0 | 1 | 0 | 1 |
| | Unid | 0 | 1 | 0 | 0 | 1 | 1 |
| | Total | 19 | 16 | 12 | 7 | 4 | 23 |

[a] Unid = unidentified; includes plants not identified to species or category not determined for this region.

species, common buckthorn, occurred only in the NNA. The four taxa unique to the SNA all occurred only on the exposed soil in the root masses of the lodged crack willow trees. The NNA had five species of shrubs not found in the SNA, where the shrub stratum was composed primarily of shrub-sized silver maples.

Figure 9 indicates the numbers of species on the ROW and the NAs by habitat and by wetland indicator category. The percent of species by wetland indicator category and by habitat are given in Figure 10. The south portion of the ROW, which is shaded by the forest in the SNA, has both the fewest total species and the fewest OBL species. Over 90% of the species in each habitat were FAC, FACW, or OBL species.

**Dominance.** The dominant species in each stratum of the scrub-shrub community are listed with RPCs in Table 4. All strata in both habitats were dominated by wetland vegetation, except for the tree stratum in the ROW, which was dominated by two facultative (FAC) species.

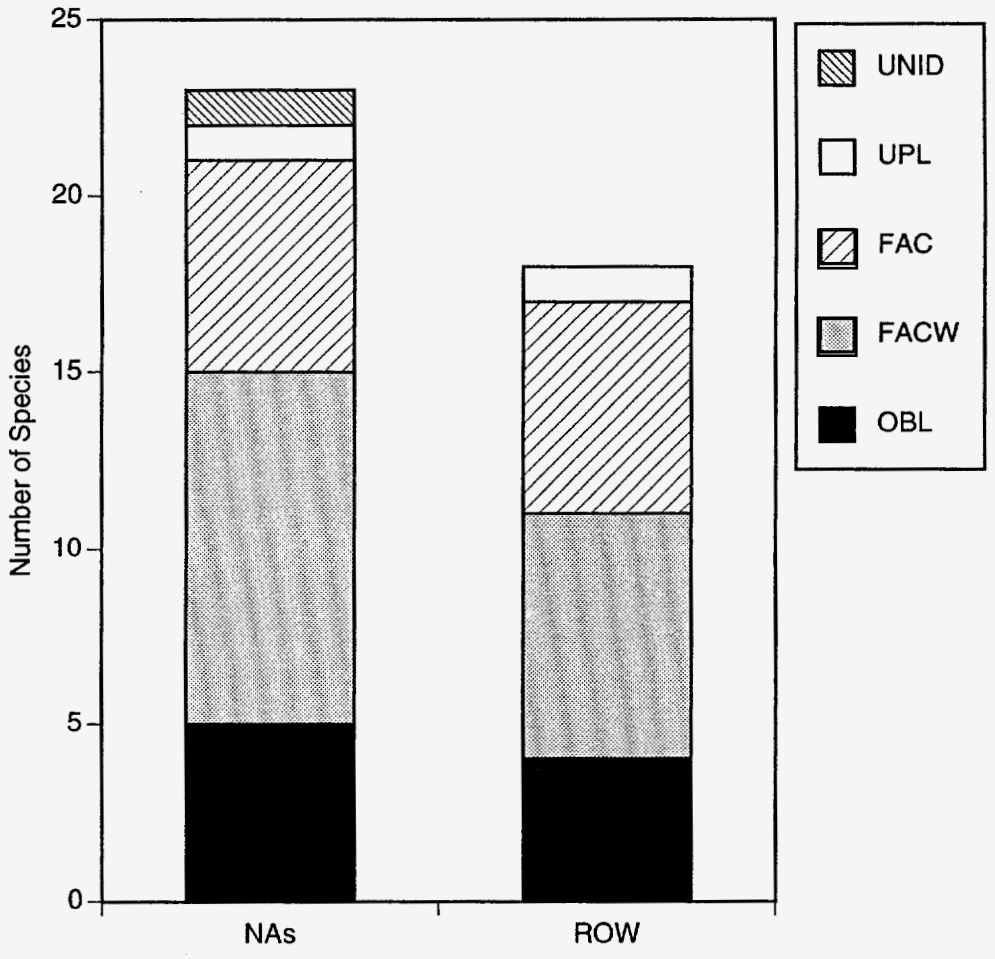


FIGURE 9 Number of Plant Species in Each Wetland Indicator Category by Area in the Scrub-Shrub Community

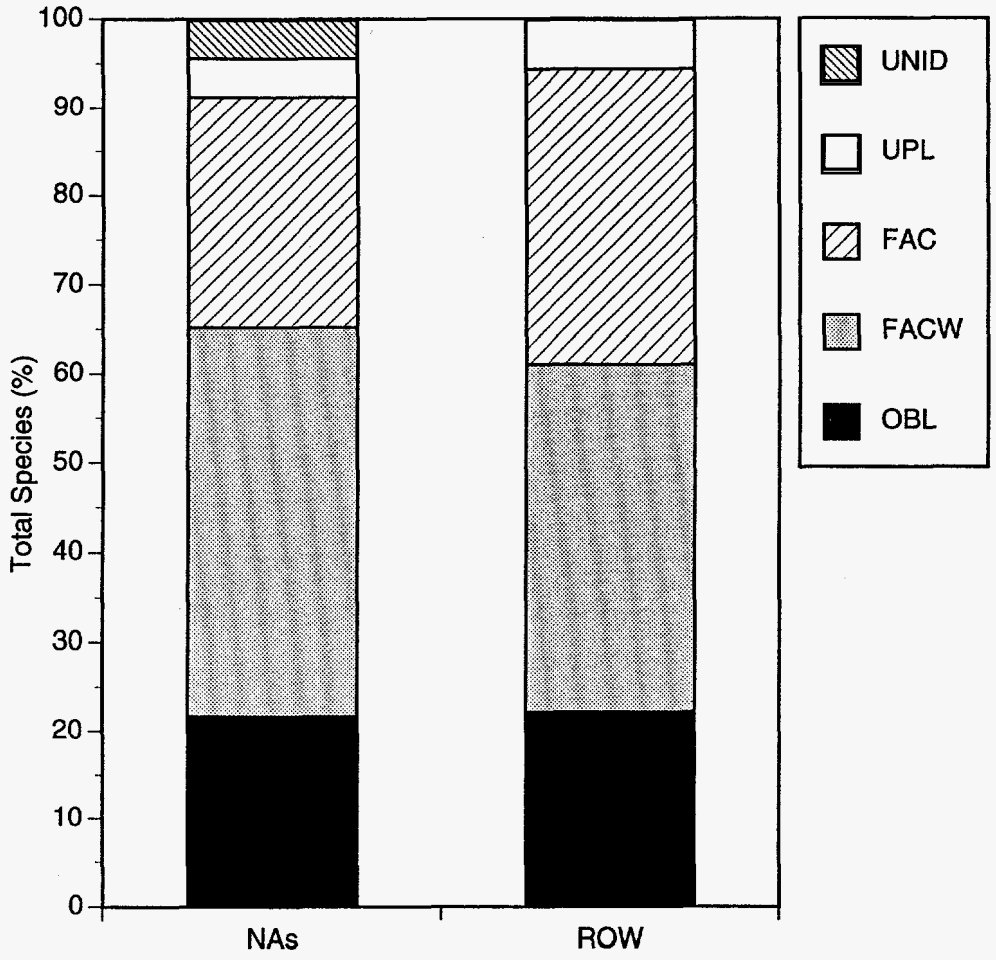


FIGURE 10 Percentage of Species in Each Wetland Indicator Category by Area in the Scrub-Shrub Community

The herb stratum was dominated by the small, floating common duckweed (*Lemna minor*), with an RPC of 95.7% in the NAs and 94.6% in the ROW. Very few herbaceous plants were present, except on the exposed soil in the roots of the lodged willows. The seedlings of woody species constituted most of the herb stratum.

The dominant species in the shrub stratum were pussy willow (*Salix discolor*), silver maple (*Acer saccharinum*), and meadow willow (*Salix petiolaris*) (see Table 4 for RPCs). All species were obligate (OBL) or facultative-wetland (FACW) species.

The sapling stratum was dominated by silver maple in both the NAs and the ROW, accounting for 78.3% and 73.3% RPCs, respectively. Green ash (*Fraxinus pennsylvanicum*) was the second dominant species in the ROW, with a 23.3% RPC. Both are FACW species.

TABLE 4 Dominant Species by Vegetative Stratum for Each Area in the Scrub-Shrub Community

| Stratum | Area | Scientific Name | Common Name | Wetland Indicator Category | RPC | Sum of RPCs |
|---|---|---|---|---|---|---|
| Herb | NAs | *Lemna minor* | Common duckweed | OBL | 95.7 | 95.7 |
| | ROW | *Lemna minor* | Common duckweed | OBL | 94.6 | 94.6 |
| Shrub | NAs | *Salix discolor* | Pussy willow | FACW | 26.5 | |
| | | *Acer saccharinum* | Silver maple | FACW | 22.8 | |
| | | *Salix petiolaris* | Meadow willow | OBL | 12.8 | 62.1 |
| | ROW | *Salix petiolaris* | Meadow willow | OBL | 25.4 | |
| | | *Fraxinus pennsylvanicum* | Green ash | FACW | 20.0 | |
| | | *Salix discolor* | Pussy willow | FACW | 13.8 | 59.2 |
| Sapling | NAs | *Acer saccharinum* | Silver maple | FACW | 78.3 | 78.3 |
| | ROW | *Acer saccharinum* | Silver maple | FACW | 73.3 | |
| | | *Fraxinus pennsylvanicum* | Green ash | FACW | 23.3 | 96.6 |
| Tree | NAs | *Acer saccharinum* | Silver maple | FACW | 58.5 | |
| | | *Salix fragilis* | Crack willow | FAC | 31.6 | 90.1 |
| | ROW | *Populus deltoides* | Eastern cottonwood | FAC | 58.8 | |
| | | *Salix fragilis* | Crack willow | FAC | 35.3 | 94.1 |

The tree stratum in the NAs was dominated by silver maple and crack willow, which together accounted for an RPC of 90.1% in each area. Eastern cottonwood (*Populus deltoides)* and crack willow dominated the tree stratum in the ROW, constituting 58.8% and 35.3% of the RPC, respectively.

**Coefficient of Community Values.** Table 5 lists Sørensen's coefficient of community values ($CC_S$), derived by comparing the various areas. The $CC_S$ values (by stratum and combined strata) comparing the two sides of the ROW were higher than the same indices comparing the two NAs. When the combined ROW was compared with the combined NAs, the $CC_S$ was higher than was the $CC_S$ comparing the two NAs. Even so, the combined-stratum $CC_S$ between the two NAs was 0.84, indicating considerable overall similarity. This would seem to indicate that ROW effects on species composition were less important than the effects of the 20-m distance between the north and south NAs. The combined-strata comparisons yielded a relatively high $CC_S$ of 0.88 between the combined NAs and the combined ROW and between the north and south sides of the ROW.

TABLE 5 Coefficient of Community Values Comparing Similarity of Species Occurring in Study Plots in the Scrub-Shrub Community

| | $CC_s$ for Given Comparison | | |
|---|---|---|---|
| Stratum | NAs to ROW | North ROW to South ROW | NNA to SNA |
| Herb | 0.73 | 0.80 | 0.62 |
| Shrub | 1.00 | 0.86 | 0.74 |
| Sapling | 0.75 | 0.80 | 0.33 |
| Tree | 0.75 | 1.00 | 0.67 |
| Combined | 0.88 | 0.88 | 0.84 |

**Prevalence Index Values and Average Wetland Values.** Table 6 presents the PIVs and AWVs for the ROW and the NAs by stratum, for all species and for dominants only. With one exception, all PIVs and AWVs were less than 3.0 (indicating wetland vegetation) in every stratum in both habitats. Both the PIV and AWV for dominant species only in the tree stratum on the ROW had values of 3.0. These values may or may not meet wetland criteria, depending on hydrologic and soil characteristics.

The largest difference in PIVs and AWVs between the ROW and the NAs occurred in the tree stratum, due to the presence of eastern cottonwood, a FAC species, occurring as a dominant species on the ROW. Large differences occurred between the AWVs and the PIVs when all species in the herb stratum were considered, because of the weighting of the PIV by the extreme dominance of common duckweed (an OBL species) at this site. AWVs calculated on the basis of all species were higher than the comparable PIVs, except for the tree stratum on the ROW. This is a result of the dominant species having lower wetland indicator values. The dominant species PIVs and AWVs for the herb and shrub strata were lower than when all species were considered.

The tree stratum had the highest PIVs and AWVs, indicating that the selection pressure of the standing water had not yet eliminated the larger plants even though they have less fidelity to wetlands.

TABLE 6 Prevalence Index and Average Wetland Values for All Species and Dominant Species Found in the NAs and on the ROW (by individual stratum and combined strata) of the Scrub-Shrub Community

| Stratum | Area | Species | Prevalence Index Value | Average Wetland Value |
|---|---|---|---|---|
| Herb | NAs | All | 1.04 | 2.00 |
| | | Dominant only | 1.00 | 1.00 |
| | ROW | All | 1.06 | 2.08 |
| | | Dominant only | 1.00 | 1.00 |
| Shrub | NAs | All | 1.96 | 2.42 |
| | | Dominant only | 1.79 | 1.67 |
| | ROW | All | 1.86 | 2.42 |
| | | Dominant only | 1.57 | 1.67 |
| Sapling | NAs | All | 2.00 | 2.20 |
| | | Dominant only | 2.00 | 2.00 |
| | ROW | All | 2.00 | 2.00 |
| | | Dominant only | 2.00 | 2.00 |
| Tree | NAs | All | 2.38 | 2.50 |
| | | Dominant only | 2.35 | 2.50 |
| | ROW | All | 2.94 | 2.67 |
| | | Dominant only | 3.00 | 3.00 |
| Combined | NAs | All | NC[a] | 2.18 |
| | | Dominant only | NC | 1.86 |
| | ROW | All | NC | 2.28 |
| | | Dominant only | NC | 2.00 |

[a] NC = not calculated; PIVs could not be calculated for combined strata because areal cover, used in the calculation, is not additive.

## 4.2 Emergent Marsh Community

### 4.2.1 General Ecology

The marsh community site through which the planned pipeline will be installed was a nearly level area, with the soil surface partially covered by standing water in each transect (Figure 2). The portions (%) of the surface covered by standing water, by transect, from north to south were 7, 15, 27, 42, and 57%. These data depict a slight decrease in elevation from north to south. The dense vegetative cover consisted predominantly of cattails, horsetails, and shrubs. A wide variety of forbs was present in the herb stratum. Shrubs were more abundant in the center of the site than toward either the north or south end.

The soils in this area are mapped as Lamson soils on the Jefferson County soil maps. The description of that soil is given in Section 2.2. Observations of hand-augered soil cores taken along each transect confirmed the presence of Lamson soils throughout the study site.

### 4.2.2 Plant Community

Although the ROW of the planned pipeline at the time of sampling consisted of undisturbed natural vegetation, the ROW and NAs were sampled separately to allow direct comparison between baseline data and data to be collected from the ROW and NAs after pipeline installation.

**Plant Species, Life-Forms, and Species Origins.** A total of 62 different plant taxa were represented in the transects in the marsh community. Of these, 57 were identified to species; their wetland indicator values, life-forms, and origin (Reed 1988) are given in Appendix C, Table C.4. Nine species (one grass, seven forbs, and one shrub) are listed as introduced. Cover values for each species in each plot are given in Table C.5.

The herb stratum was composed of 59 plant taxa, consisting of one species of fern, two species of horsetails, 14 species of sedges, three grasses, three rushes, 22 forbs, nine woody species, and five taxa that could not be identified to species. All eight introduced species were represented in the herb stratum.

The shrub stratum contained 10 species, including shrub-sized specimens of two tree species. A single plant, located in the planned ROW, was of sufficient size to meet the 1989 Federal Manual's definition of a tree.

**Species Richness and Wetland Indicator Categories.** Sampling was carried out prior to clearing of the planned ROW, so the only differences between the four areas (ENA, the east portion of the planned ROW, the west portion of the planned ROW, and the WNA), were those occurring naturally or resulting from previous disturbances unrelated to pipeline activities.

The numbers of species found in the transects on the NAs and on the planned ROW are given by wetland indicator category and stratum in Table 7. The combined-strata data show that 74% of the 62 species found in the marsh transects occurred in both the planned pipeline ROW and in the NAs. Twenty-three percent of the species occurred in the NAs only, and 3% occurred in the planned ROW only. Some of these differences might be attributable to limited sampling and differences in plot sizes; the plots in the NAs were twice as large as those on the planned ROW. (The plots on the ROW were limited to a width of 10 m because the ROW was only 20 m wide.) Larger plots would likely result in more species being encountered.

Fifty-nine species occurred in the herb stratum, 20% of those occurring only in the NAs and 5% only in the planned ROW. Ten species were present in the shrub stratum, with 40% occurring in the NAs but not on the planned ROW, and a single species in the planned ROW but not in the NAs. The only tree present was in the planned ROW.

Table 8 compares the east and west sides of the planned ROW. Sixty-seven percent of the 48 species occurring in the ROW occurred in plots in both sides of the ROW. The two sides of the ROW were similar in total numbers of species, 39 and 41. Most differences were accounted for by the herb stratum, with no shrub species occurring in either side of the ROW; the single tree was limited to one side of the ROW.

Differences between the two NAs, which were separated by the 20-m-wide planned ROW, were greater than the differences between the two sides of the ROW. Only 62% of the 60 species occurring in the NAs occurred in both NAs (Table 9). Again, most of the differences occurred in the herb stratum. However, only five of the nine shrub species present were common to both areas. This observation may be related to the greater variability in the amount of ground covered by standing water in plots in the ENA, ranging from 2% to 80%; standing water in plots in the WNA ranged from 20% to 40%.

Figure 11 compares the number of species by wetland indicator category and by habitat. Figure 12 compares the percent of species in each category by habitat. Although the numbers of species are slightly less for the ROW portions, the percents of OBL and FAC species are very similar across habitats. The differences in numbers may reflect smaller plot sizes on the ROW. The percent of species in the various wetland indicator categories for the combined NAs is very similar to that for the combined ROW.

**Dominance.** The dominant species for each habitat by stratum are listed along with the RPCs in Table 10, as is the average cover for each species on the basis of five plots. The shrub and herb strata in both NAs and the ROW were dominated by wetland vegetation, either OBL or FAC.

TABLE 7 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NAs and the ROW (by individual stratum and combined strata) of the Marsh Community

| | | Number of Species | | | | | |
|---|---|---|---|---|---|---|---|
| Stratum[a] | Wetland Indicator Category[a] | Occurring in NAs | Occurring in ROWs | Common to Both Areas | Unique to NAs | Unique to ROWs | Total |
| Herb | OBL | 26 | 21 | 21 | 5 | 0 | 26 |
| | FACW | 12 | 11 | 10 | 2 | 1 | 13 |
| | FAC | 7 | 5 | 4 | 3 | 1 | 8 |
| | FACU | 4 | 3 | 3 | 1 | 0 | 4 |
| | UPL | 3 | 3 | 3 | 0 | 0 | 3 |
| | Unid[b] | 4 | 4 | 3 | 1 | 1 | 5 |
| | Total | 56 | 47 | 44 | 12 | 3 | 59 |
| Shrub | OBL | 1 | 1 | 1 | 0 | 0 | 1 |
| | FACW | 4 | 2 | 2 | 2 | 0 | 4 |
| | FAC | 3 | 2 | 1 | 2 | 1 | 4 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 9 | 6 | 5 | 4 | 1 | 10 |
| Tree | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 0 | 0 | 0 | 0 | 0 | 0 |
| | FAC | 0 | 1 | 0 | 0 | 1 | 1 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 0 | 1 | 0 | 0 | 1 | 1 |
| Combined | OBL | 26 | 21 | 21 | 5 | 0 | 26 |
| | FACW | 14 | 11 | 11 | 3 | 0 | 14 |
| | FAC | 9 | 6 | 5 | 4 | 1 | 10 |
| | FACU | 4 | 3 | 3 | 1 | 0 | 4 |
| | UPL | 3 | 3 | 3 | 0 | 0 | 3 |
| | Unid | 4 | 4 | 3 | 1 | 1 | 5 |
| | Total | 60 | 48 | 46 | 14 | 2 | 62 |

[a] No saplings present.

[b] Unid = unidentified; includes plants not identified to species or category not determined for this region.

TABLE 8 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the East and West Sides of the ROW (by individual stratum and combined strata) of the Marsh Community

| Stratum[a] | Wetland Indicator Category[a] | Number of Species: Occurring in East ROW | Occurring in West ROW | Common to Both ROWs | Unique to East ROW | Unique to West ROW | Total |
|---|---|---|---|---|---|---|---|
| Herb | OBL | 17 | 20 | 16 | 1 | 4 | 21 |
| | FACW | 8 | 10 | 7 | 1 | 3 | 11 |
| | FAC | 4 | 4 | 3 | 1 | 1 | 5 |
| | FACU | 3 | 2 | 2 | 1 | 0 | 3 |
| | UPL | 3 | 1 | 1 | 2 | 0 | 3 |
| | Unid[b] | 3 | 4 | 3 | 0 | 1 | 4 |
| | Total | 38 | 41 | 32 | 6 | 9 | 47 |
| Shrub | OBL | 1 | 1 | 1 | 0 | 0 | 1 |
| | FACW | 2 | 2 | 2 | 0 | 0 | 2 |
| | FAC | 2 | 1 | 1 | 1 | 0 | 2 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 6 | 5 | 5 | 1 | 0 | 6 |
| Tree | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 0 | 0 | 0 | 0 | 0 | 0 |
| | FAC | 1 | 0 | 0 | 1 | 0 | 1 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 1 | 0 | 0 | 1 | 0 | 1 |
| Combined | OBL | 17 | 20 | 16 | 1 | 4 | 21 |
| | FACW | 8 | 10 | 7 | 1 | 3 | 11 |
| | FAC | 5 | 4 | 3 | 2 | 1 | 6 |
| | FACU | 3 | 2 | 2 | 1 | 0 | 3 |
| | UPL | 3 | 1 | 1 | 2 | 0 | 3 |
| | Unid | 3 | 4 | 3 | 0 | 1 | 4 |
| | Total | 39 | 41 | 32 | 7 | 9 | 48 |

[a] No saplings present.

[b] Unid = unidentified; includes plants not identified to species or category not determined for this region.

TABLE 9 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the ENA and WNA (by individual stratum and combined strata) of the Marsh Community

| | | Number of Species | | | | | |
|---|---|---|---|---|---|---|---|
| Stratum[a] | Wetland Indicator Category[a] | Occurring in ENA | Occurring in WNA | Common to Both NAs | Unique to ENA | Unique to WNA | Total |
| Herb | OBL | 22 | 23 | 19 | 3 | 4 | 26 |
| | FACW | 8 | 11 | 7 | 1 | 4 | 12 |
| | FAC | 7 | 3 | 3 | 4 | 0 | 7 |
| | FACU | 4 | 2 | 2 | 2 | 0 | 4 |
| | UPL | 3 | 1 | 1 | 2 | 0 | 3 |
| | Unid[b] | 4 | 3 | 3 | 1 | 0 | 4 |
| | Total | 48 | 43 | 35 | 13 | 8 | 56 |
| Shrub | OBL | 1 | 1 | 1 | 0 | 0 | 1 |
| | FACW | 3 | 3 | 2 | 1 | 1 | 4 |
| | FAC | 3 | 1 | 1 | 2 | 0 | 3 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 8 | 6 | 5 | 3 | 1 | 9 |
| Combined | OBL | 22 | 23 | 19 | 3 | 4 | 26 |
| | FACW | 10 | 12 | 8 | 2 | 4 | 14 |
| | FAC | 7 | 5 | 3 | 4 | 2 | 9 |
| | FACU | 4 | 2 | 2 | 2 | 0 | 4 |
| | UPL | 3 | 2 | 2 | 1 | 0 | 3 |
| | Unid | 4 | 3 | 3 | 1 | 0 | 4 |
| | Total | 50 | 47 | 37 | 13 | 10 | 60 |

[a] No saplings or trees present.

[b] Unid = unidentified; includes plants not identified to species or category not determined for this region.

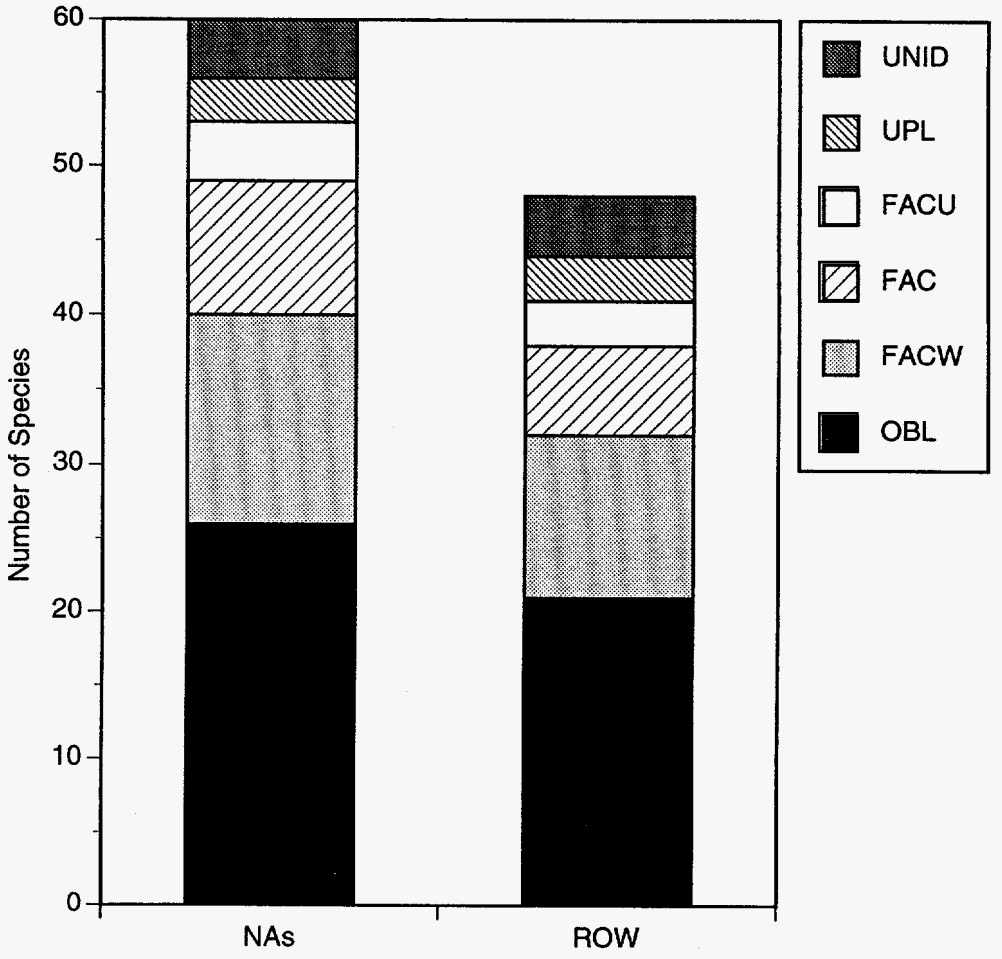


FIGURE 11 Number of Species in Each Wetland Indicator Category by Area in the Emergent Marsh Community

Two species, blue cattail (*Typha × glauca*), an OBL, and field horsetail (*Equisetum arvense*), a FAC, were dominants in the herb stratum in both the NAs off the planned ROW and the areas on the planned ROW. The similarity of their RPCs illustrates the homogeneity of the transect segment prior to pipeline construction.

The dominant species in the shrub stratum were meadow willow, red-osier dogwood (*Cornus stolonifera*), and silky dogwood (*Cornus amomum*) in the NAs and red-osier dogwood and meadow willow in the planned ROW. All dominant species are OBL or FACW.

The single tree occurring in the transects was a crack willow. It occurred in the ROW and is listed as a FAC species in the Region-1 List.

**Coefficient of Community Values.** The values of $CC_s$ between habitats by stratum are given in Table 11. These depict greater community similarity between the two contiguous sides of the planned ROW ($CC_s = 0.93$) than between the two NAs ($CC_s = 0.77$) that are separated by the

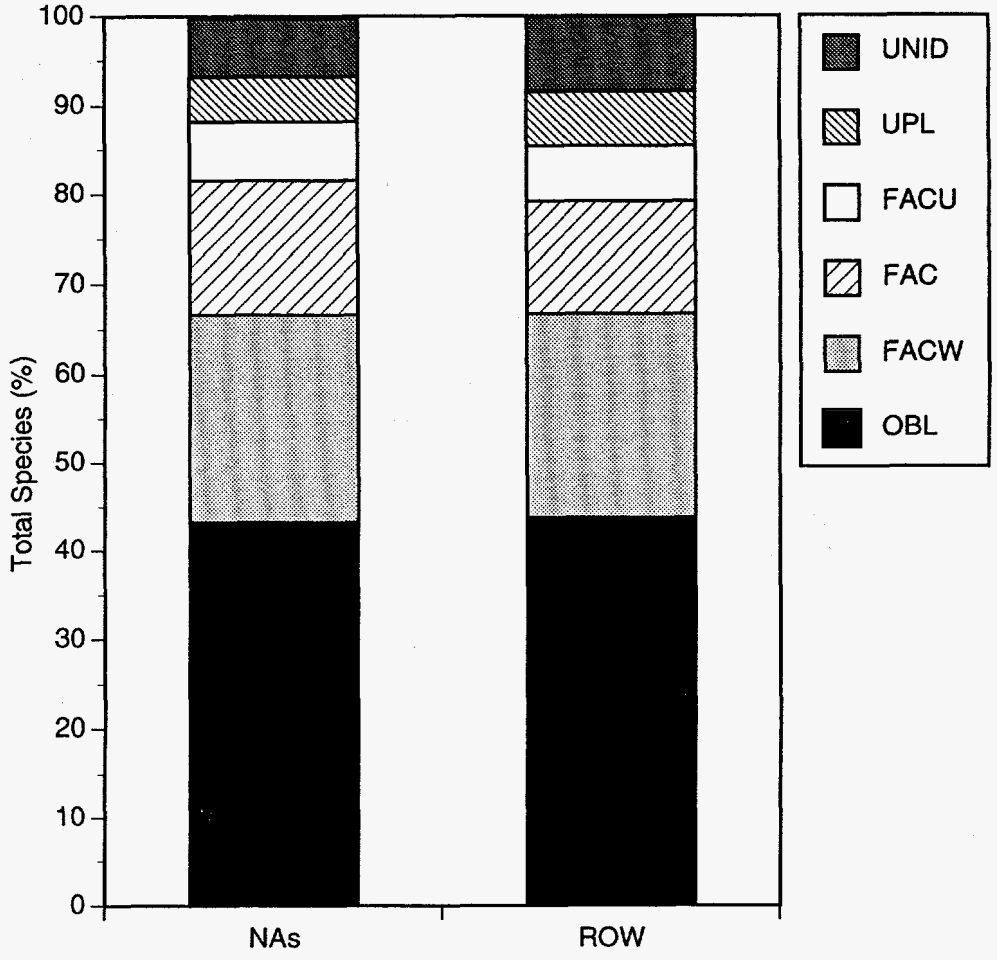


FIGURE 12 Percentage of Species in Each Wetland Indicator Category by Area in the Emergent Marsh Community

ROW. The low value for the shrub stratum for combined NAs vs. the combined ROW might have been raised by increasing the number of samples or taking larger plots. The 0.00 value for the tree stratum results from the presence of a single tree on one side of the ROW.

**Prevalence Index and Average Wetland Values.** All values, except for those of the tree stratum, were below 3.00, which indicates wetland vegetation. A comparison of AWVs and PIVs by stratum (Table 12) confirms the similarity of vegetation on the planned ROW with that in NAs. The AWVs for the NAs differed from those for the ROW by 0.04 within the herb stratum and 0.06 in the shrub stratum, when all species were considered. The PIVs were also similar, differing by 0.05 for the herb stratum and 0.22 for the shrub stratum. The presence of a single tree, a FAC species, resulted in identical values for all categories in the ROW.

When all of the strata were combined, the AWV for all species was 2.00 and that for dominant species was 1.80, which indicates the presence of wetland vegetation overall.

TABLE 10 Dominant Species by Vegetative Stratum for Each Area in the Marsh Community

| Stratum[a] | Area | Scientific Name | Common Name | Wetland Indicator Category | RPC | Sum of RPCs |
|---|---|---|---|---|---|---|
| Herb | NAs | *Typha × glauca* | Blue cattail | OBL | 37.9 | |
| | | *Equisetum arvense* | Field horsetail | FAC | 15.6 | 53.5 |
| | ROW | *Typha × glauca* | Blue cattail | OBL | 35.1 | |
| | | *Equisetum arvense* | Field horsetail | FAC | 16.1 | 51.2 |
| Shrub | NAs | *Salix petiolaris* | Meadow willow | OBL | 28.4 | |
| | | *Cornus stolnifera* | Red-osier dogwood | FACW | 27.6 | |
| | | *Cornus amomum* | Silky dogwood | FACW | 22.4 | 78.4 |
| | ROW | *Cornus stolnifera* | Red-osier dogwood | FACW | 40.0 | |
| | | *Salix petiolaris* | Meadow willow | OBL | 20.5 | 60.5 |
| Tree | NAs | No trees present | | | | |
| | ROW | *Salix fragilis* | Crack willow | FAC | 100.0 | 100.0 |

[a] No saplings present.

TABLE 11 Coefficient of Community Values Comparing Similarity of Species Occurring in Study Plots in the Marsh Community

| | $CC_s$ for Given Comparison | | |
|---|---|---|---|
| Stratum[a] | NAs to ROW | East ROW to West ROW | ENA to WNA |
| Herb | 0.85 | 0.93 | 0.77 |
| Shrub | 0.67 | 0.91 | 0.71 |
| Tree | 0.00 | 0.00 | NA |
| Combined | 0.85 | 0.92 | 0.76 |

[a] No sapling stratum was present.

TABLE 12 Prevalence Index and Average Wetland Values for All Species and Dominant Species Found in the NAs and on the ROW (by individual stratum and combined strata) of the Marsh Community

| Stratum[a] | Area | Species | Prevalence Index Value | Average Wetland Value |
|---|---|---|---|---|
| Herb | NAs | All | 1.55 | 1.90 |
| | | Dominant only | 1.59 | 2.00 |
| | ROW | All | 1.60 | 1.98 |
| | | Dominant only | 1.63 | 2.00 |
| Shrub | NAs | All | 2.05 | 2.56 |
| | | Dominant only | 1.64 | 1.67 |
| | ROW | All | 2.27 | 2.50 |
| | | Dominant only | 1.66 | 1.50 |
| Tree | NAs | No trees present | | |
| | ROW | All | 3.00 | 3.00 |
| | | Dominant only | 3.00 | 3.00 |
| Combined | NAs | All | NC[b] | 2.00 |
| | | Dominant only | NC | 1.80 |
| | ROW | All | NC | 1.98 |
| | | Dominant only | NC | 2.00 |

[a] No saplings were present.

[b] NC = not calculated; PIVs could not be calculated for combined strata because areal coverage, used in the calculation, is not additive.

## 4.3 Forested Wetland Community

### 4.3.1 General Ecology

The existing pipeline crossing through the forested community occurs on a gentle slope that rises to the east from the beaver dam at the east edge of the scrub-shrub community (Figure 2). Because of the limited extent of the forest community along the pipeline route, only one transect was sampled. The west edge of the transect was approximately 10 m east of the beaver dam. At the time of sampling, the transect contained no standing water. The SNA of the transect sloped upward to the south, rising to about 30 cm above the nearly level ROW and the NNA. Tree distribution varied, from scattered cottonwoods with up to 30-cm boles and elms with mostly 15- to 20-cm boles in the SNA to a dense stand of maples with 15- to 30-cm boles in the NNA. There were no trees rooted in the ROW. The SNA, with its less dense canopy, had a greater concentration of shrubs and herbs. The soils are mapped as Lamson.

### 4.3.2 Plant Community

**Plant Species, Life-Forms, and Species Origins.** A total of 31 taxa of vascular plants occurred within the transect. Of these, 28 were identified to species. Table C.7, Appendix C, lists these taxa with common names, wetland indicator categories, life-forms, and origins (Reed 1988). The 31 taxa consisted of two fern species, four sedges, three grasses, nine forbs (of which six were identified to species), three vines, and ten shrubs and trees. Table C.8 gives the distribution and areal cover for each species in the NAs and the two sides of the ROW. Two species were introduced shrubs; one was an introduced forb. All three introduced species occurred in both the ROW and the NAs.

**Species Richness and Wetland Indicator Categories.** Table 13 gives the numbers of species by wetland indicator category and by stratum found in the NAs and in the ROW, along with species unique to either. Sixty-five percent of the 31 species occurred in both the ROW and the NAs. All 31 species were represented in the herb stratum, with 55% of these occurring in both the ROW and the NAs. The NAs had one more species than the ROW. Most of the species (61%) were either FACW or FAC, with only three OBL, five FACU, and one UPL species.

Sixty-four percent of the 25 species that occurred on the ROW occurred on both sides of the ROW, with 20% unique to the north side and 16% unique to the south side (Table 14). The fact that a single plot was sampled in each side of the ROW may account for much of this difference.

Only 38% of the 26 species found in the NAs occurred in both the NNA and SNA sampling plots (Table 15). No tree species were common to both the NNA and SNA. Only 33%

TABLE 13 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NAs and the ROW (by individual stratum and combined strata) of the Forested Community

| Stratum | Wetland Indicator Category | Number of Species: Occurring in NAs | Occurring in ROWs | Common to Both Areas | Unique to NAs | Unique to ROWs | Total |
|---|---|---|---|---|---|---|---|
| Herb | OBL | 1 | 3 | 1 | 0 | 2 | 3 |
| | FACW | 9 | 10 | 8 | 1 | 2 | 11 |
| | FAC | 6 | 5 | 3 | 3 | 2 | 8 |
| | FACU | 4 | 4 | 3 | 1 | 1 | 5 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid[a] | 3 | 1 | 1 | 2 | 0 | 3 |
| | Total | 24 | 24 | 17 | 7 | 7 | 31 |
| Shrub | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 0 | 1 | 0 | 0 | 1 | 1 |
| | FAC | 1 | 0 | 0 | 1 | 0 | 1 |
| | FACU | 0 | 1 | 0 | 0 | 1 | 1 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 2 | 3 | 1 | 1 | 2 | 4 |
| Sapling | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 0 | 0 | 0 | 0 | 0 | 0 |
| | FAC | 0 | 1 | 0 | 0 | 1 | 1 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 0 | 1 | 0 | 0 | 1 | 1 |
| Tree | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 2 | 0 | 0 | 2 | 0 | 2 |
| | FAC | 2 | 0 | 0 | 2 | 0 | 2 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 4 | 0 | 0 | 4 | 0 | 4 |
| Combined | OBL | 1 | 3 | 1 | 0 | 2 | 3 |
| | FACW | 10 | 11 | 10 | 0 | 1 | 11 |
| | FAC | 7 | 5 | 4 | 3 | 1 | 8 |
| | FACU | 4 | 4 | 3 | 1 | 1 | 5 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 3 | 1 | 1 | 2 | 0 | 3 |
| | Total | 26 | 25 | 20 | 6 | 5 | 31 |

[a] Unid = unidentified; includes plants not identified to species or category not determined for this region.

TABLE 14 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the North and South Sides of the ROW (by individual stratum and combined strata) of the Forested Community

| Stratum[a] | Wetland Indicator Category | Number of Species: Occurring in North ROW | Occurring in South ROW | Common to Both ROWs | Unique to North ROW | Unique to South ROW | Total |
|---|---|---|---|---|---|---|---|
| Herb | OBL | 3 | 1 | 1 | 2 | 0 | 3 |
| | FACW | 9 | 9 | 8 | 1 | 1 | 10 |
| | FAC | 4 | 3 | 2 | 2 | 1 | 5 |
| | FACU | 2 | 3 | 1 | 1 | 2 | 4 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid[b] | 1 | 1 | 1 | 0 | 0 | 1 |
| | Total | 20 | 18 | 14 | 6 | 4 | 24 |
| Shrub | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 1 | 1 | 1 | 0 | 0 | 1 |
| | FAC | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACU | 0 | 1 | 0 | 0 | 1 | 1 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 2 | 3 | 2 | 0 | 1 | 3 |
| Sapling | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 0 | 0 | 0 | 0 | 0 | 0 |
| | FAC | 1 | 0 | 0 | 1 | 0 | 1 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 1 | 0 | 0 | 1 | 0 | 1 |
| Combined | OBL | 3 | 1 | 1 | 2 | 0 | 3 |
| | FACW | 10 | 10 | 9 | 1 | 1 | 11 |
| | FAC | 4 | 3 | 2 | 2 | 1 | 5 |
| | FACU | 2 | 4 | 2 | 0 | 2 | 4 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 1 | 1 | 1 | 0 | 0 | 1 |
| | Total | 21 | 20 | 16 | 5 | 4 | 25 |

[a] No trees were present.

[b] Unid = unidentified; includes plants not identified to species or category not determined for this region.

TABLE 15 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NNA and the SNA (by individual stratum and combined strata) of the Forested Community

| Stratum | Wetland Indicator Category | Number of Species: Occurring in NNA | Occurring in SNA | Common to Both NAs | Unique to NNA | Unique to SNA | Total |
|---|---|---|---|---|---|---|---|
| Herb | OBL | 0 | 1 | 0 | 0 | 1 | 1 |
| | FACW | 6 | 8 | 5 | 1 | 3 | 9 |
| | FAC | 3 | 4 | 1 | 2 | 3 | 6 |
| | FACU | 2 | 3 | 1 | 1 | 2 | 4 |
| | UPL | 1 | 0 | 0 | 1 | 0 | 1 |
| | Unid[a] | 1 | 3 | 1 | 0 | 2 | 3 |
| | Total | 13 | 19 | 8 | 5 | 11 | 24 |
| Shrub | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 0 | 0 | 0 | 0 | 0 | 0 |
| | FAC | 1 | 0 | 0 | 1 | 0 | 1 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 2 | 1 | 1 | 1 | 0 | 2 |
| Sapling | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 0 | 0 | 0 | 0 | 0 | 0 |
| | FAC | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 0 | 0 | 0 | 0 | 0 | 0 |
| Tree | OBL | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACW | 1 | 1 | 0 | 1 | 1 | 2 |
| | FAC | 1 | 1 | 0 | 1 | 1 | 2 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 2 | 2 | 0 | 2 | 2 | 4 |
| Combined | OBL | 0 | 1 | 0 | 0 | 1 | 1 |
| | FACW | 7 | 9 | 6 | 1 | 3 | 10 |
| | FAC | 4 | 4 | 1 | 3 | 3 | 7 |
| | FACU | 2 | 3 | 1 | 1 | 2 | 4 |
| | UPL | 1 | 1 | 1 | 0 | 0 | 1 |
| | Unid | 1 | 3 | 1 | 0 | 2 | 3 |
| | Total | 15 | 21 | 10 | 5 | 11 | 26 |

[a] Unid = unidentified; includes plants not identified to species or category not determined for this region.

of the 24 herb species occurred in both. Some of the differences may be due to differences in elevation and canopy density, the SNA being higher in elevation and having a less dense canopy, while other differences may be related to plot and sample size.

Figures 13 and 14 compare species by wetland indicator categories and by habitat. Figure 13 depicts more OBL species on the ROW, although it had slightly fewer species. The NNA plot, with its rather dense stand of red maples, had the fewest species. It had no OBL wetland species, whereas the SNA had one. About 50% of the species in each plot were FACW species.

**Dominance.** The dominant species and their associated RPCs are listed by strata in Table 16. Spotted touch-me-not was the leading dominant in both the ROW and the NAs in the herb stratum; however, codominants were different, with woody species as codominants in the NAs and grove bluegrass *(Poa alsodes)* in the ROW. All dominants were FACW species except Virginia creeper *(Parthenocissus quinquefolia)*, a FACU species.

Common buckthorn, an introduced shrub and UPL species, was dominant in both the ROW and the NAs in the shrub stratum. Red maple *(Acer rubrum)* occurred as saplings in the ROW and as trees in the NAs. The smaller sapling size of the red maples on the ROW is likely the result of clear-cutting of the ROW for pipeline installation in 1966.

**Coefficient of Community Values.** A comparison of the NAs with the ROW gave the highest $CC_s$ (0.80) for this community (Table 17). Other similarity indices are probably small because only a single plot was sampled in each habitat. The low $CC_s$ comparing the NNA and SNA probably reflects both differences in vegetation due to differences in elevation and the missing of species in the course of the very limited sampling.

**Prevalence Index and Average Wetland Values.** Table 18 gives the AWVs and PIVs are given for the NAs and for the ROW. Both AWVs and PIVs for all species in the herb stratum and for dominant species only are lower for the ROW than for the NAs. Values for the ROW and the NAs are almost identical for the shrub stratum and reflect the dominance of common buckthorn, an UPL shrub. No comparisons can be made for the sapling and tree strata because these strata did not occur both in the NAs and in the ROW. The overall value of 2.71, signifying a wetland, indicates the strong influence of the herb stratum.

## 4.4 Mixed Vegetation Community

### 4.4.1 General Ecology

The mixed vegetation community through which the existing pipeline extends lies just west of the junction of the planned pipeline ROW and the existing pipeline ROW (Figure 2). It is not

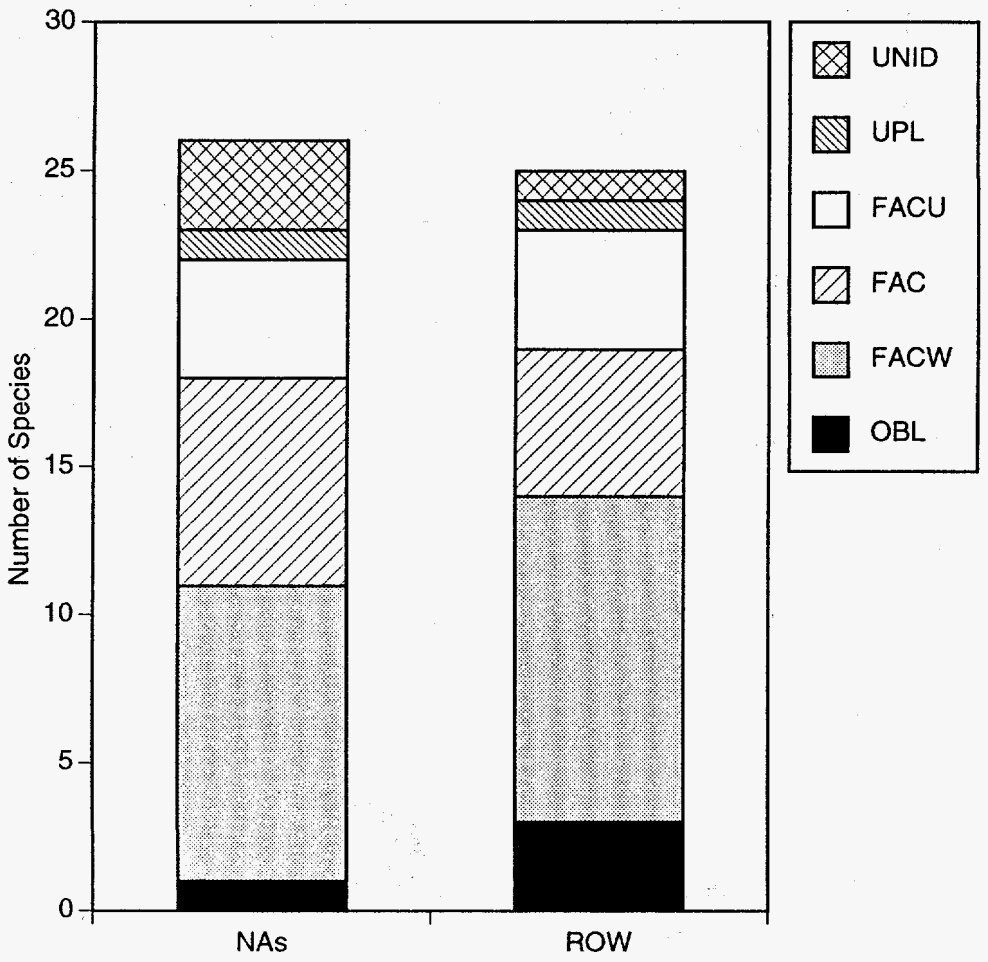


FIGURE 13 Number of Species in Each Wetland Indicator Category by Area in the Forested Wetland Community

enclosed by the beaver dam. The single station and transect established at this site were approximately 20 m west of this junction. A small drainage channel was located approximately over the pipeline at this point. Along the transect, the area to the north of the pipeline had standing water covering 20% of the soil, with another 10% of the soil unvegetated. This area was dominated by shrubs. The ROW and the area south of the pipeline had no exposed soil or standing water and few shrubs, except for the southernmost 5 m of the transect, where shrubs and shrub-sized young trees were more numerous. Trees were common to the south of the transect, and shrubs were common to the west of the transect.

### 4.4.2 Plant Community

**Plant Species, Life-Forms, and Species Origins.** A total of 51 taxa of vascular plants were found in this transect; 47 of them were identified to species. Appendix Table C.9 lists these taxa, along with their common names, wetland indicator categories, life-forms, and origins.

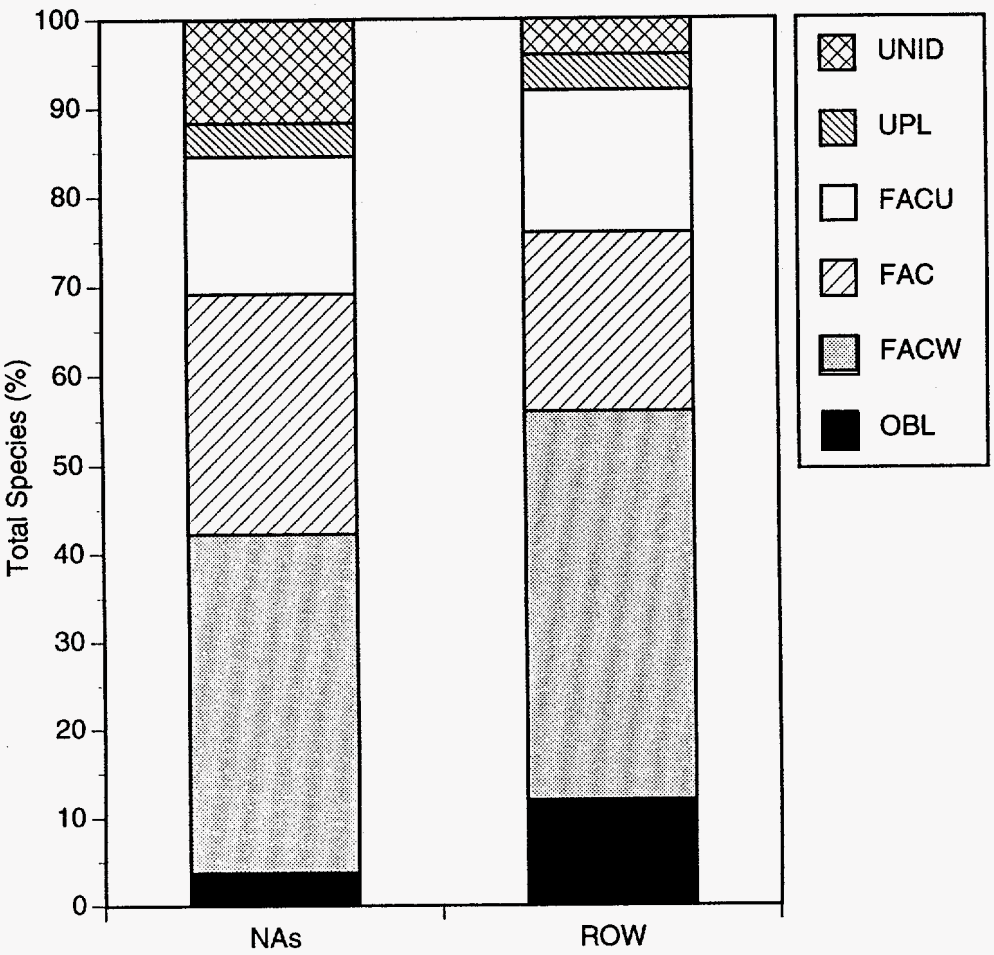


FIGURE 14 Percentage of Species in Each Wetland Indicator Category by Area in the Forested Wetland Community

Appendix Table C.10 gives distribution and areal cover by individual area, for the ROW, and for the NAs. Plants identified to species included two horsetails, one fern, 10 rushes and sedges, three grasses, 17 forbs, six shrubs, and two trees. Introduced species included one species of grass, three species of forbs, and two species of shrubs.

**Species Diversity and Wetland Indicator Categories.** Of the 51 species occurring in the plots of this transect, 63% occurred in both the ROW and the NAs, with 17% occurring in NAs but not in the ROW and 20% in the ROW but not in the NAs (Table 19). Sixty-nine percent of the 51 species were either OBL or FACW species. The ROW slightly exceeded the NAs in total numbers of species in each stratum and was similar to the NAs in distribution of species across wetland indicator categories. Three UPL and three FACU species occurred at this site, with two of each occurring in the ROW.

TABLE 16 Dominant Species by Vegetative Stratum for Each Area in the Forested Community

| Stratum | Area | Scientific Name | Common Name | Wetland Indicator Category | RPC | Sum of RPCs |
|---|---|---|---|---|---|---|
| Herb | NAs | *Impatiens capensis* | Spotted touch-me-not | FACW | 27.2 | |
| | | *Fraxinus pennsylvanica* | Green ash | FACW | 13.2 | |
| | | *Rubus pubescens* | Dwarf blackberry | FACW | 8.0 | |
| | | *Parthenocissus quinquefolia* | Virginia creeper | FACU | 8.0 | 56.4 |
| | ROW | *Impatiens capensis* | Spotted touch-me-not | FACW | 39.4 | |
| | | *Poa alsodes* | Grove bluegrass | FACW | 23.0 | 62.4 |
| Shrub | NAs | *Rhamnus cathartica* | Common buckthorn | UPL | 81.8 | 81.8 |
| | ROW | *Rhamnus cathartica* | Common buckthorn | UPL | 84.6 | 84.6 |
| Sapling | NAs | No saplings present | | | | |
| | ROW | *Acer rubum* | Red maple | FAC | 100.0 | 100.0 |
| Tree | NAs | *Acer rubum* | Red maple | FAC | 70.2 | 70.2 |
| | ROW | No trees present | | | | |

TABLE 17 Coefficient of Community Values Comparing Similarities of Species Occurring in Study Plots in the Forested Community

| | $CC_s$ for Given Comparison | | |
|---|---|---|---|
| Stratum | NAs to ROW | North ROW to South ROW | NNA to SNA |
| Herb | 0.71 | 0.59 | 0.50 |
| Shrub | 0.40 | 0.25 | 0.67 |
| Sapling | 0.00 | NA[a] | 0.00 |
| Tree | 0.00 | NA | NA |
| Combined | 0.80 | 0.68 | 0.56 |

[a] Plants of this type not present.

TABLE 18 Prevalence Index and Average Wetland Values for All Species and Dominant Species Found in the NAs and on the ROW (by individual stratum and combined strata) of the Forested Community

| Stratum | Area | Species | Prevalence Index Value | Average Wetland Value |
|---|---|---|---|---|
| Herb | NAs | All | 2.76 | 2.76 |
| | | Dominant only | 2.88 | 2.50 |
| | ROW | All | 2.09 | 2.57 |
| | | Dominant only | 2.00 | 2.00 |
| Shrub | NAs | All | 4.64 | 4.00 |
| | | Dominant only | 5.00 | 5.00 |
| | ROW | All | 4.62 | 3.67 |
| | | Dominant only | 5.00 | 5.00 |
| Sapling | NAs | No saplings present | | |
| | ROW | All | 3.00 | 3.00 |
| | | Dominant only | 3.00 | 3.00 |
| Tree | NAs | All | 2.87 | 2.50 |
| | | Dominant only | 3.00 | 3.00 |
| | ROW | No trees present | | |
| Combined | NAs | All | NC[a] | 2.74 |
| | ROW | All | NC | 2.54 |

[a] NC = not calculated; PIVs could not be calculated for combined strata because areal coverage, used in the calculation, is not additive.

TABLE 19 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NAs and the ROW (by individual stratum and combined strata) of the Mixed Vegetation Community

| Stratum[a] | Wetland Indicator Category | Number of Species: Occurring in NAs | Occurring in ROW | Common to Both NAs | Unique to NAs | Unique to ROW | Total |
|---|---|---|---|---|---|---|---|
| Herb | OBL | 16 | 16 | 11 | 5 | 5 | 21 |
| | FACW | 8 | 13 | 8 | 0 | 5 | 13 |
| | FAC | 4 | 5 | 3 | 1 | 2 | 6 |
| | FACU | 3 | 2 | 2 | 1 | 0 | 3 |
| | UPL | 3 | 1 | 1 | 2 | 0 | 3 |
| | Unid[b] | 4 | 4 | 4 | 0 | 0 | 4 |
| | Total | 38 | 41 | 29 | 9 | 12 | 50 |
| Shrub | OBL | 1 | 1 | 1 | 0 | 0 | 1 |
| | FACW | 4 | 5 | 4 | 0 | 1 | 5 |
| | FAC | 0 | 1 | 0 | 0 | 1 | 1 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 5 | 7 | 5 | 0 | 2 | 7 |
| Combined | OBL | 16 | 16 | 11 | 5 | 5 | 21 |
| | FACW | 11 | 14 | 11 | 0 | 3 | 14 |
| | FAC | 4 | 5 | 3 | 1 | 2 | 6 |
| | FACU | 3 | 2 | 2 | 1 | 0 | 3 |
| | UPL | 3 | 1 | 1 | 2 | 0 | 3 |
| | Unid | 4 | 4 | 4 | 0 | 0 | 4 |
| | Total | 41 | 42 | 32 | 9 | 10 | 51 |

[a] No saplings or trees present.

[b] Unid = unidentified; includes plants not identified to species or category not determined for this region.

A comparison of the two plots on the ROW is given in Table 20. Only 50% of the species on the ROW occurred in both plots. The south plot had more species, particularly more OBL species, but it had fewer shrubs. Only 44% of the 16 OBL species and 57% of the 14 FACW species occurred in both plots, while both FACU species were represented in both.

The NNA and SNA had less than half of their species in common (Table 21). Only 17 of the 38 species in the herb stratum and only two of the five shrubs occurred in both plots. Only eight of 16 OBL species and five of 11 FACW species occurred in both plots, while two of three FACU species and no UPL species were common to both. No saplings or trees occurred in either plot.

Figure 15 gives the number of species by wetland indicator category and by area. The OBL and FACW species accounted for a majority of the species in all plots; over 70% of the species in each plot fell into these two categories (Figure 16). The higher numbers of species in the south ROW and SNA plots reflect the greater diversity of herbaceous vegetation in these plots.

**Dominance.** The dominant species for this community, along with the RPCs, are listed in Table 22. Reflecting the diversity both within plots and between plots, five species occurred as dominant species in the herb stratum of the NAs and four species occurred as dominant species in the herb stratum in the ROW. Two of the ROW dominant species were also dominant species in the NAs. A single species, meadow willow, dominated the shrub stratum throughout. No sapling or tree strata were present.

**Coefficient of Community Values.** Table 23 gives the $CC_S$ values obtained from comparing the various single plots and combined plots at this site. Comparing the ROW and NAs resulted in higher $CC_S$ values for single strata and for combined strata than did comparisons between the two ROW plots or the two NA plots. Again, these values may be low because of the limited sampling; however, differences in soil surface elevation may account for some of the variance.

**Prevalence Index and Average Wetland Values.** All PIVs and AWVs had values of less than three, which indicates wetland vegetation (Table 24). Values for the NAs and the ROW were very similar, with values for the dominant species in the NAs being slightly lower for the herb stratum and for all species in the shrub stratum.

TABLE 20 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the North and South Sides of the ROW (by individual stratum and combined strata) of the Mixed Vegetation Community

| | | Number of Species | | | | | |
|---|---|---|---|---|---|---|---|
| Stratum | Wetland Indicator Category | Occurring in North ROW | Occurring in South ROW | Common to Both ROWs | Unique to North ROW | Unique to South ROW | Total |
| Herb | OBL | 7 | 15 | 6 | 1 | 9 | 16 |
| | FACW | 10 | 9 | 6 | 4 | 3 | 13 |
| | FAC | 2 | 4 | 1 | 1 | 3 | 5 |
| | FACU | 2 | 2 | 2 | 0 | 0 | 2 |
| | UPL | 0 | 1 | 0 | 0 | 1 | 1 |
| | Unid[a] | 3 | 3 | 2 | 1 | 1 | 4 |
| | Total | 24 | 34 | 17 | 7 | 17 | 41 |
| Shrub | OBL | 1 | 0 | 0 | 1 | 0 | 1 |
| | FACW | 5 | 1 | 1 | 4 | 0 | 5 |
| | FAC | 1 | 0 | 0 | 1 | 0 | 1 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 7 | 1 | 1 | 6 | 0 | 7 |
| Combined | OBL | 8 | 15 | 7 | 1 | 8 | 16 |
| | FACW | 13 | 9 | 8 | 5 | 1 | 14 |
| | FAC | 3 | 3 | 2 | 1 | 1 | 4 |
| | FACU | 2 | 2 | 2 | 0 | 0 | 2 |
| | UPL | 0 | 1 | 0 | 1 | 1 | 2 |
| | Unid | 3 | 3 | 2 | 1 | 1 | 4 |
| | Total | 29 | 33 | 21 | 9 | 12 | 42 |

[a] Unid = unidentified; includes plants not identified to species or category not determined for this region.

TABLE 21 Number of Plant Species by Wetland Indicator Category Found in the Study Plots in the NNA and SNA (by individual stratum and combined strata) of the Mixed Vegetation Community

| Stratum | Wetland Indicator Category | Number of Species: Occurring in NNA | Occurring in SNA | Common to Both NAs | Unique to NNA | Unique to SNA | Total |
|---|---|---|---|---|---|---|---|
| Herb | OBL | 11 | 12 | 7 | 4 | 5 | 16 |
| | FACW | 4 | 7 | 3 | 1 | 4 | 8 |
| | FAC | 3 | 4 | 3 | 0 | 1 | 4 |
| | FACU | 3 | 2 | 2 | 1 | 0 | 3 |
| | UPL | 1 | 2 | 0 | 1 | 2 | 3 |
| | Unid[a] | 3 | 3 | 2 | 1 | 1 | 4 |
| | Total | 25 | 30 | 17 | 8 | 13 | 38 |
| Shrub | OBL | 1 | 1 | 1 | 0 | 0 | 1 |
| | FACW | 3 | 2 | 1 | 2 | 1 | 4 |
| | FAC | 0 | 0 | 0 | 0 | 0 | 0 |
| | FACU | 0 | 0 | 0 | 0 | 0 | 0 |
| | UPL | 0 | 0 | 0 | 0 | 0 | 0 |
| | Unid | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 4 | 3 | 2 | 2 | 1 | 5 |
| Combined | OBL | 11 | 13 | 8 | 3 | 5 | 16 |
| | FACW | 7 | 9 | 5 | 2 | 4 | 11 |
| | FAC | 3 | 4 | 3 | 0 | 1 | 4 |
| | FACU | 3 | 2 | 2 | 1 | 0 | 3 |
| | UPL | 1 | 2 | 0 | 1 | 2 | 3 |
| | Unid | 3 | 3 | 2 | 1 | 1 | 4 |
| | Total | 28 | 33 | 20 | 8 | 13 | 41 |

[a] Unid = unidentified; includes plants not identified to species or category not determined for this region.

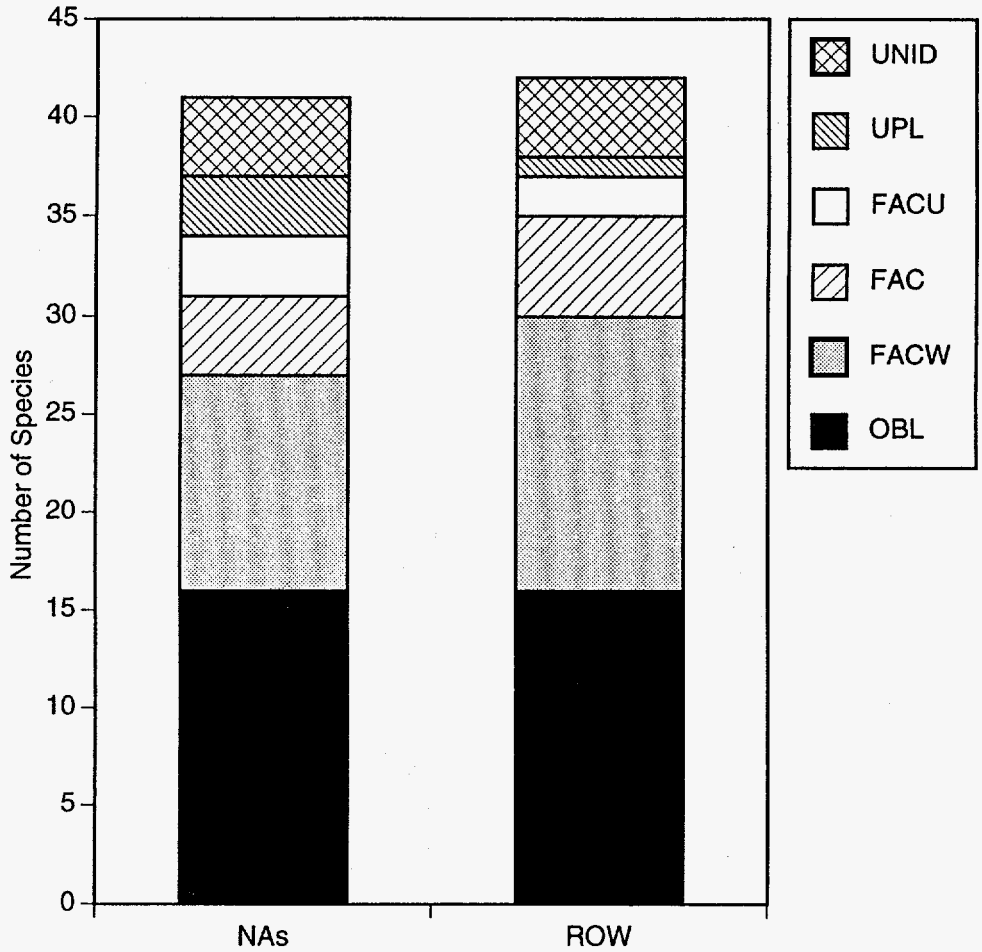


FIGURE 15 Number of Species in Each Wetland Indicator Category by Area in the Mixed Vegetation Community

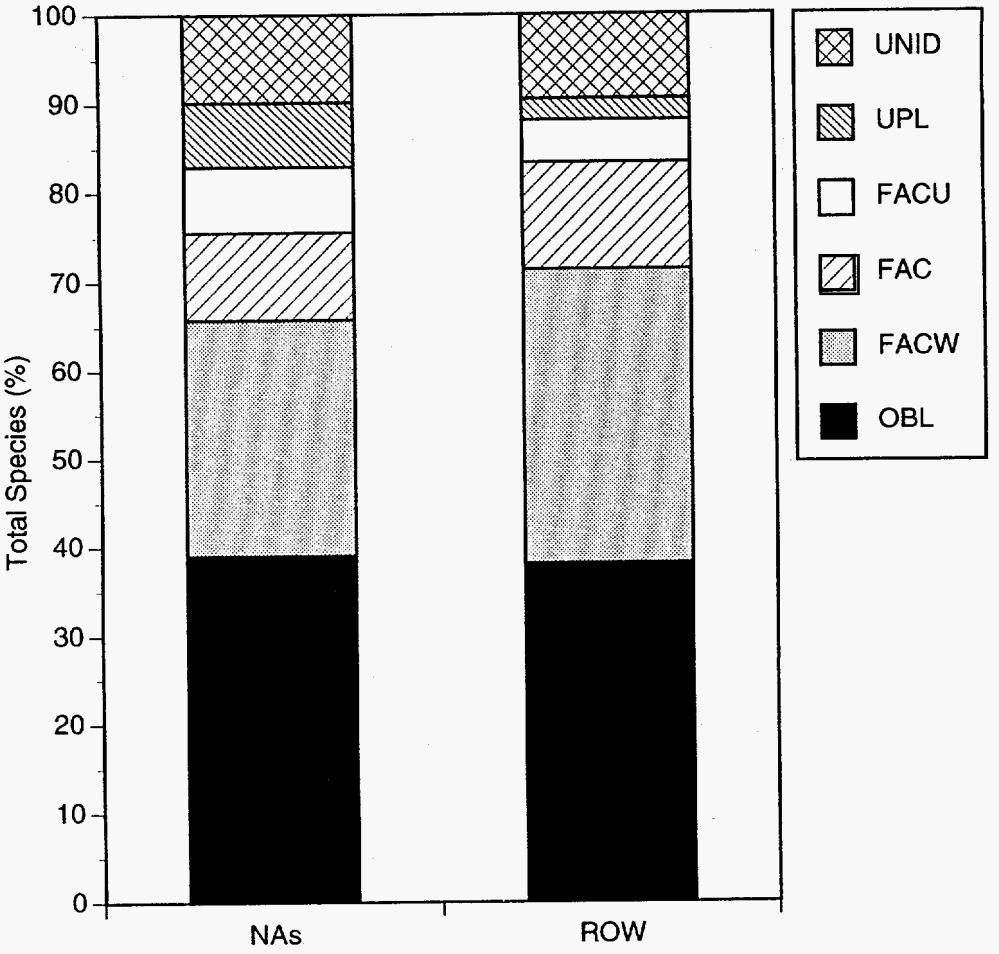


FIGURE 16 Percentage of Species in Each Wetland Indicator Category by Area in the Mixed Vegetation Community

TABLE 22 Dominant Species by Vegetative Stratum for Each Area in the Mixed Vegetation Community

| Stratum | Area | Scientific Name | Common Name | Wetland Indicator Category | RPC | Sum of RPCs |
|---|---|---|---|---|---|---|
| Herb | NAs | *Impatiens capensis* | Spotted touch-me-not | FACW | 22.9 | |
| | | *Eupatoriadelphus maculatus* | Spotted joe-pye-weed | FACW | 8.3 | |
| | | *Poa pratensis* | Kentucky bluegrass | FACU | 7.6 | |
| | | *Scirpus atrovirens* | Green bulrush | OBL | 7.6 | |
| | | *Poa alsodes* | Grove bluegrass | FACW | 6.4 | 53.0 |
| | ROW | *Poa alsodes* | Grove bluegrass | FACW | 23.5 | |
| | | *Cornus stolonifera* | Red-osier dogwood | FACW | 10.2 | |
| | | *Cornus foemina* | Stiff dogwood | FAC | 10.2 | |
| | | *Poa pratensis* | Kentucky bluegrass | FACU | 9.2 | 53.1 |
| Shrub | NAs | *Salix petiolaris* | Meadow willow | OBL | 86.0 | 86.0 |
| | ROW | *Salix petiolaris* | Meadow willow | OBL | 61.9 | 84.6 |

TABLE 23 Coefficient of Community Values Comparing Similarity of Species Occurring in Study Plots in the Mixed Vegetation Community

| | $CC_s$ for Given Comparison | | |
|---|---|---|---|
| Stratum | NAs to ROW | North ROW to South ROW | NNA to SNA |
| Herb | 0.73 | 0.59 | 0.62 |
| Shrub | 0.83 | 0.25 | 0.57 |
| Combined | 0.77 | 0.68 | 0.66 |

TABLE 24 Prevalence Index and Average Wetland Values for All Species and Dominant Species Found in the NAs and on the ROW (by individual stratum and combined strata) of the Mixed Vegetation Community

| Stratum | Area | Species | Prevalence Index Value | Average Wetland Value |
|---|---|---|---|---|
| Herb | NAs | All | 2.23 | 2.09 |
| | | Dominant only | 2.13 | 2.17 |
| | ROW | All | 2.20 | 1.89 |
| | | Dominant only | 2.54 | 2.75 |
| Shrub | NAs | All | 1.14 | 1.80 |
| | | Dominant only | 1.00 | 1.00 |
| | ROW | All | 1.40 | 2.00 |
| | | Dominant only | 1.00 | 1.00 |
| Combined | NAs | All | NC[a] | 2.08 |
| | ROW | All | NC | 1.89 |

[a] NC = not calculated; PIVs could not be calculated for combined strata because areal coverage, used in the calculation, is not additive.

# 5 Discussion

## 5.1 Scrub-Shrub Community

The vegetation on the ROW was composed entirely of species found in the NAs. Two introduced species occurred at this site. Common buckthorn occurred in the NNA and both portions of the ROW, while glossy buckthorn occurred in both NAs and both portions of the ROW. Because of the history of human and beaver disturbance within this wetland, it is not possible to determine whether the presence of the ROW is responsible for or contributed to the presence of these introduced species at this site. Both buckthorn species are widely distributed in wet soils throughout the northeastern United States and have invaded many relatively undisturbed habitats.

The abundance of green ash saplings and eastern cottonwood trees on the ROW may be the result of previous disturbances, including clearing for pipeline installation. Both species are opportunistic (Swink and Wilhelm 1979).

Although it is not possible to establish the structure of the vegetative community that existed at the time of pipeline installation, it is clear that, at the time of sampling, the ROW functioned much the same as the NAs; both were covered by standing water, which was as deep or slightly deeper on the ROW than in the NAs, and 18 of the 23 species found in the NAs constituted the vegetation on the ROW. If not for the presence of survey flags and some recently cut stems, it would have been difficult to identify the ROW. In general, however, the woody vegetation on the ROW tended to be smaller than the woody vegetation on the NAs. It is not known if this difference resulted only from initial clearing of the ROW or from maintenance activities that may have occurred after pipeline installation.

The lack of any OBL species in the tree and sapling strata may have resulted from a greater range of tolerance by these species, a limited history of flooding, or a combination of both. While the low PIVs and AWVs for the herb stratum might signify that these smaller species with shorter life cycles are better indicators of present conditions, it is also possible that smaller plants tend to have less ecological amplitude.

## 5.2 Emergent Marsh Community

Because the emergent marsh community involves a planned pipeline route rather than an existing ROW, data from it should be considered baseline data for future studies rather than information concerning the impacts of existing pipelines. This site is of particular interest because a new method of pipeline installation was to have been used. In this new method, the existing vegetative mat is removed intact, set aside, and then replaced over the pipeline after construction and backfilling. A subsequent analysis of the site should yield information about whether this

method minimized the duration and severity of pipeline installation impacts. Annual sampling of this site during the next several years could be a means to determine whether the cost of such procedures justifies the benefits.

Pipeline-related disturbances in the marsh site along the planned pipeline route were limited to a single foot trail along a line marked by flagging tape. Differences in vegetation between the east and west sides of the planned pipeline ROW and the ENA and WNA are attributable to random distribution or local variations in habitat.

Visual observation of the site indicated a greater concentration of shrubs and young trees in a linear area extending southwest to northeast across the site and including the east portion of transect 1 and all of transect 2. Plots composing the eastern segments of transects 1 and 2 had the least standing water of any plots in the marsh site, indicating slightly higher surface elevation in this area. Eight of the 13 species unique to the ENA occurred in these two transects. Fourteen species occurred in NAs that did not occur on the ROW, and only two were unique to the ROW. If one sets apart the eight species unique to transects 1 and 2 of the ENA, only five species unique to NAs and two unique to the ROW remain. This shows evidence of plant community differences related to elevation differences. Greater differences were apparent between the ends of the transects than between the two central segments. Differences in plot sizes also may have contributed to differences in species distribution between the NAs and the ROW. The fact that plot sizes varied is important for future sampling; the same plot sizes should be used in the future. Comparisons between present and future ROW plots and present and future NA plots will allow determination of plot-size effects.

## 5.3 Forested Wetland Community

Differences in elevation between the SNA and the NNA are most evident in terms of tree canopy vegetation, where no species were found in common between the SNA and the NNA. The NNA had the least number of unique species in the herb stratum. The lack of canopy tree components rooted in the ROW can be attributed to the relatively short time period, 25 years, since pipeline installation and to possible subsequent maintenance activity. The similarity between species on the ROW and those in the NAs again indicates revegetation by mostly local native species and vegetative succession leading to a community like that of the adjacent NA.

## 5.4 Mixed Vegetation Community

The habitats in the mixed vegetation transect were not homogeneous. The plot south of the ROW was relatively free of shrubs and trees, with only a single shrub-sized green ash at its southern end. This plot also had the highest number of unique species in the herb stratum. The ROW did not appear to be an important factor in determining species distribution; indeed, it was impossible to identify the edge of the ROW on the basis of vegetation. The higher elevation of the SNA plot was reflected in a higher PIV.

At the approximate center of the ROW, possibly over the pipeline, a small drainage channel ran west from the beaver dam. The edges of this drainage provided habitat for a number of OBL species. The northern portion of the ROW and the NNA had more standing water covering the soil surface than did the surrounding areas and were heavily vegetated by shrubs, mostly meadow willow and dogwoods. Thus, although the presence of the ROW may have had minor impacts on vegetation, no negative impacts, either influencing the type of vegetation present or resulting in fragmentation of the environment, were observed.

# 6 Summary and Conclusions

## 6.1 Summary

The primary goal of the GRI Wetland Corridors Program is to identify and evaluate the impacts of pipeline construction and ROW maintenance on the wetlands they traverse. To accomplish this goal, surveys were conducted of pipelines crossing various wetlands throughout the eastern United States. The objectives for each study site were to (1) document the vegetative communities on the ROW and on the adjacent NAs that were not disturbed by pipeline construction; (2) evaluate the similarities and differences between the plant communities on the ROW and the adjacent NAs; (3) document qualitative changes to the topography, soils, and hydrology attributable to ROW construction; and (4) identify impacts caused by ROW construction on rare, threatened, endangered, or sensitive species.

This study involved collecting and analyzing data at the W-2 wetland crossing on the south-southwest border of Watertown, New York. Four separate sites were surveyed at this crossing. These sites were the scrub-shrub community, the emergent marsh community, the forested wetland community, and the mixed vegetation community. Standing water was present throughout the scrub-shrub and the emergent marsh communities, as well as on the northern portion of the mixed vegetation community. All of the sites, with the exception of the marsh community, were along the ROW of a 25-year-old pipeline. Maintenance had not been performed on this ROW in some years, if at all. The installation of a planned pipeline was to take place one month following this survey. This line was to traverse the scrub-shrub, the emergent marsh, and the forested wetland communities. Clearing of a ROW had not yet occurred at the time of the survey, but a path had been hand-cut for survey work.

The data collected at these sites were valuable from two perspectives: (1) as data on an existing pipeline ROW, assessing the effects that pipeline construction and maintenance may have had on the wetland; and (2) as baseline data for the planned pipeline.

With respect to the existing ROW, plant data and general observations of the topography, hydrology, and soil of the site showed no clear detrimental effects attributable to the presence of the pipeline. Channels of up to 100 cm in depth were present in the submerged scrub-shrub community. These channels may have been the result of some previous human activity in the area, or they may have resulted from beaver activity associated with the extensive beaver dam that surrounded this site. A small ditch was present in the mixed vegetation site. Although this ditch may have followed an easy pathway for drainage that resulted from the construction of the pipeline, it is difficult to prove a relationship to an activity that occurred 25 years before. In any case, these features did not appear to affect the wetland as a natural community. No rare, threatened, endangered, or sensitive species were found during the survey.

Results of the vegetational survey indicated that the entire study site (including all communities sampled) remains a wetland. The majority of plant species found in all sites, both on

the ROW and in the adjacent NAs, were either OBL or FACW. This was also true for the dominant herbaceous species, but not for shrubs and trees. This finding may simply reflect wider ranges of tolerance by the larger species. All PIVs and AWVs had a value of 3.00 or less, which further confirms the classification of the site as a wetland.

The low level of maintenance (if any) on the existing pipeline ROW through the forested wetland, the flooded scrub-shrub wetland, and the mixed vegetation wetland west of the beaver dam has allowed the reestablishment of a predominantly native vegetation. This native vegetation on the existing ROW comprises many of the same species, has similar wetland indices, and has many of the same strata present in the NAs adjacent to the ROW. The lack of trees in the ROW, differences in the composition of the vegetation, and slight differences in density should not present a barrier to the movement of animal species, such as often occurs in fragmented habitats.

Because the data collected in this survey can be used as a baseline, this site will provide a unique opportunity for future studies following the 1991 installation of the planned pipeline. Preconstruction baseline data, such as those presented here for the marsh and for the NAs adjacent to the existing pipeline ROW, can be used for future comparisons. The effects of maintenance procedures can also be monitored if increased maintenance occurs on the planned ROW.

## 6.2 Conclusions

Impacts on the W-2 wetland due to the construction of a gas pipeline through three of the sites surveyed, as well as to any associated maintenance activity, appeared to be minimal. A few ditches or channels were present that may or may not have been the result of construction activity. The most obvious impact was an earlier stage of succession for the native vegetation on the ROW compared with that on the adjacent NAs. Members of tree species were generally younger on the ROW than in the NAs. However, all plant species that occurred on the ROW also occurred in the NAs, and after 25 years of natural reestablishment of vegetation on the ROW, it was not possible to visually distinguish the ROW boundaries in any of the three communities through which the 1966 pipeline passed. The usual impacts found in communities traversed by ROWs, such as increased species diversity resulting from creation of new habitat and fragmentation of the natural habitat (possibly impeding movement of some species and allowing for easier movement of others), were not found to apply to this site after so many years of recovery.

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# Appendix A:

# Definition of Jurisdictional Wetlands

## Appendix A: Definition of Jurisdictional Wetlands

Wetland identification and delineation necessary to implement Section 404 of the Clean Water Act and the "Swampbuster" (Subtitle B) provision of the Food Security Act of 1985 involves four agencies: the U.S. Army Corps of Engineers (COE), the U.S. Environmental Protection Agency (EPA), the U.S. Fish and Wildlife Service (FWS), and the Soil Conservation Service (SCS). On January 10, 1989, these agencies, which had operated with slightly different definitions of wetland, adopted a uniform definition based on hydrology, vegetation, and soils.

The joint agreement stipulates that to be classified as a Jurisdictional Wetland, an area must have hydrotrophytic vegetation, hydric soils, and a wetland hydrology. All three criteria are mandatory; without any one criterion, the area is not a Jurisdictional Wetland. A schematic diagram of this delineation process is shown in Figure A.1. See the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* for a more detailed discussion of the various terms and criteria (FICWD 1989).

Problems uncovered during field trials of the 1989 Federal Manual and disagreement among the four agencies on revisions in 1991 resulted in the EPA and the COE reverting to use of the 1987 *COE Wetlands Delineation Manual*, which also defines wetlands on the basis of vegetation, hydric soils, and hydrology, but with slightly different definitions of these parameters. In January 1994, the four agencies entered into a joint Memorandum of Agreement, "Concerning the Delineation of Wetlands for Purposes of Section 404 of the Clean Water Act and Subtitle B of the Food Security Act," which, in broad terms, stipulates that the EPA and the COE will accept SCS procedures for delineating wetlands (SCS 1988) on agricultural lands and that SCS will use the 1987 *COE Wetlands Delineation Manual* (COE 1987) for areas that are not agricultural lands.

The individual reports on the pipeline crossings through wetlands that are part of the GRI Corridors Program use the definition and criteria of the 1989 Federal Manual that were in effect during 1990 and 1991, the first two years of these studies. The use of the rigorous criteria of the 1989 manual should provide sufficient information for application to other procedures in the evolving field regulatory procedures for delineation and preservation of jurisdictional wetlands.

## References

COE: see U.S. Army Corps of Engineers.

Federal Interagency Committee for Wetland Delineation, 1989, *Federal Manual for Identifying and Delineating Jurisdictional Wetlands,* U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture, Cooperative Technical Publication, Washington, D.C.

FICWD: see Federal Interagency Committee for Wetland Delineation.

SCS: see Soil Conservation Service.

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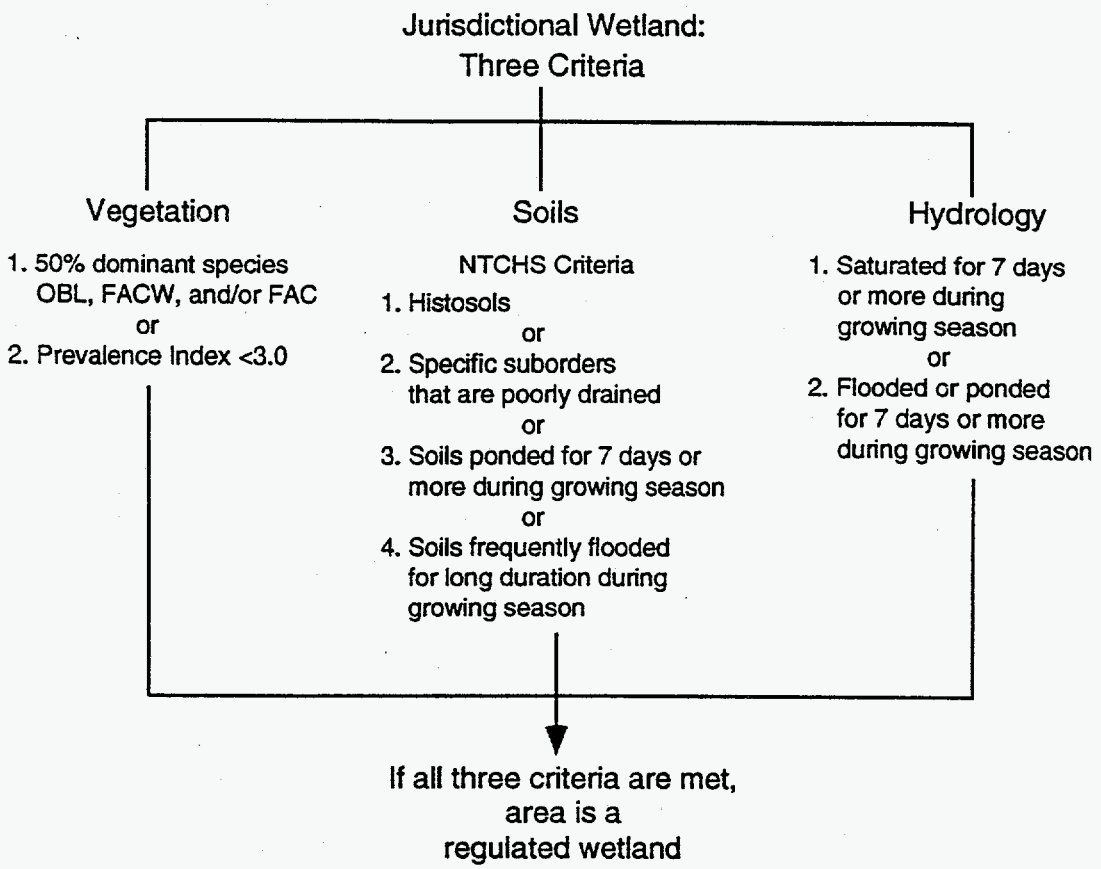


FIGURE A.1 Schematic Diagram of the Wetland Delineation Process (Source: FICWD 1989)

# Appendix B:

# Data Analysis — Definitions and Equations

# Appendix B: Data Analysis — Definitions and Equations

## B.1 Wetland Indicator Categories

Wetland indicator categories used in this report to classify the types of plant species were taken from Reed (1988). The five basic categories, commonly called the "wetland indicator status," are based on frequency of occurrence in wetlands. They are defined as follows:

| Category | Value | Definition |
|---|---|---|
| Obligate wetland (OBL) | 1.0 | Plants that almost always occur in wetlands under natural conditions (estimated probability >99%) |
| Facultative wetland (FACW) | 2.0 | Plants that usually occur in wetlands (estimated probability 67-99%) but occasionally are found in nonwetlands |
| Facultative (FAC) | 3.0 | Plants that are equally likely to occur in wetlands or nonwetlands (estimated probability 34-66%) |
| Facultative upland (FACU) | 4.0 | Plants that usually occur in nonwetlands (estimated probability 67-99%) but occasionally are found in wetlands (estimated probability 1-33%) |
| Obligate upland (UPL) | 5.0 | Plants that almost always occur in nonwetlands under natural conditions (estimated probability >99%) |

## B.2 Life-Form and Origin

The life-form and origin symbols are used for describing plant characteristics. The following symbols are used:

| Symbol | Life-Form or Origin |
|---|---|
| A | Annual |
| B | Biennial |
| E | Emergent |
| F | Forb |
| F3 | Fern |
| G | Grass |
| GL | Grasslike |
| H2 | Horsetail |
| I | Introduced |
| N | Native |
| P | Perennial |
| S | Shrub |
| T | Tree |
| V | Herbaceous vine |
| WV | Woody vine |

Symbols are combined to describe the life-form and origin; for example, ANG means annual native grass and PIEF means perennial introduced emergent forb. For further description refer to the report by Reed (1988).

## B.3 Prevalence Index Value

The prevalence index value (PIV) was determined by using the method outlined in the 1989 Federal Manual (FICWD 1989). The PIV, modified for this report to use relative percent areal coverage instead of relative frequencies as described in the 1989 Federal Manual, is defined as

$$PIV = \frac{RPC_o + 2RPC_{fw} + 3RPC_f + 4RPC_{fu} + 5RPC_u}{100} \quad (B.1)$$

where

$RPC_o$ = Relative percent coverage (RPC) of obligate wetland species,

$RPC_{fw}$ = RPC of facultative wetland species,

$RPC_f$ = RPC of facultative species,

$RPC_{fu}$ = RPC of facultative upland species, and

$RPC_u$ = RPC of upland species.

## B.4 Average Wetland Value

The average wetland value (AWV), defined in Zimmerman et al. (1991), differs from the PIV in that it is not coverage data or frequency of occurrence that is used in determining the AWV, but rather the total number of species present. Thus, all species present are represented equally in the AWV. The AWV is defined as

$$AWV = \frac{N_o + 2N_{fw} + 3N_f + 4N_{fu} + 5N_u}{N_o + N_{fw} + N_f + N_{fu} + N_u} \quad \text{(B.2)}$$

where

$N_o$ = number of obligate wetland species,

$N_{fw}$ = number of facultative wetland species,

$N_f$ = number of facultative species,

$N_{fu}$ = number of facultative upland species, and

$N_u$ = number of upland species.

## B.5 References

Federal Interagency Committee for Wetland Delineation, 1989, *Federal Manual for Identifying and Delineating Jurisdictional Wetlands,* U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture, Cooperative Technical Publication, Washington, D.C.

FICWD: see Federal Interagency Committee for Wetland Delineation.

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# Appendix C:

# Plant Species List, Areal Coverage Data, and Species Distribution

TABLE C.1 Plant Species List for the Scrub-Shrub Community

| Field No.[a] | Scientific Name and Authority | Common Name | Region 1 Wetland Indicator Category[b] | Life-Form/ Origin[c] |
|---|---|---|---|---|
| 41 | Acer rubrum L. | Red maple | FAC | NT |
| 42 | Acer saccharinum L. | Silver maple | FACW | NT |
| 7 | Carex x stipata Muhl. ex Willd. | Stalk-grain sedge | OBL | PNGL |
| 6 | Cornus amomum Mill. | Silky dogwood | FACW | NS |
| 90 | Cornus foemina Mill | Still dogwood | FAC | NS |
| 5 | Cornus stolonifera Michx. | Red-osier dogwood | FACW+ | NS |
| 38 | Fraxinus pennsylvanicum Marshall | Green ash | FACW | NT |
| 9 | Glyceria striata (Lam.) A. Hitchc. | Fowl manna grass | OBL | PNEG |
| 111 | Impatiens capensis Meerb. | Spotted touch-me-not | FACW | ANF |
| 84 | Juncus tenuis Willd. | Slender rush | FAC- | PNGL |
| 46 | Lemna minor L. | Common duckweed | OBL | PN/F |
| 215 | Mentha arvensis L. | Field mint | FACW | PNF |
| 8 | Onoclea sensibilis L. | Sensitive fern | FACW | PNEF3 |
| 221 | Polygonum lapathifolium L. | Willow-weed | FACW+ | ANF |
| 37 | Polygonum amphibium L. | Water smartweed | OBL | PNE/F |
| 220 | Polygonum pennsylvanicum L. | Pennsylvania smartweed | FACW | ANEF |
| 0 | Populus deltoides W. Bart. ex Marshall | Eastern cotton-wood | FAC | NT |
| 32 | Rhamnus catharticus L. | Common buckthorn | UPL | IS |
| 110 | Rhamnus frangula L. | Glossy buckthorn | FAC | IS |
| 114 | Ribes americana Mill. | Wild black currant | FACW | NS |
| 106 | Salix bebbiana Sarg. | Bebb willow | FACW | NS |
| 39 | Salix discolor Muhl. | Pussy willow | FACW | NS |
| 52 | Salix fragilis L. | Crack willow | FAC | IT |
| 71 | Salix petiolaris J.E. Smith | Meadow willow | OBL | NS |
| 214 | Scutellaria lateriflora L. | Blue skullcap | FACW+ | PNF |
| 87 | Solidago sp. | | | |
| 33 | Ulmus americana L. | American elm | FACW- | NT |

[a] Field number of zero indicates that no voucher specimen was collected.

[b] Wetland indicator categories are assigned to plants in the United States on a regional basis. New Jersey is located in Region 1. A "+" following an indicator indicates a frequency toward the high end of the category (more frequently found in wetlands), while a "-" indicates a frequency toward the low end (less frequently found in wetlands).

[c] Plant characteristics and life-forms assigned to each species are defined in Appendix B.

TABLE C.2 Areal Coverage Estimates for Plants by Stratum in the Scrub-Shrub Community

| Field No.[a] | Scientific Name and Authority | Areal Coverage (%) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NNA | | | | | North ROW | | | | | South ROW | | | | | SNA | | | | |
| | | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 |
| STANDING WATER | | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| HERB STRATUM | | | | | | | | | | | | | | | | | | | | | |
| 41 | Acer rubrum L. | 1 | 1 | - | 1 | - | 2 | 1 | 1 | 1 | - | 5 | - | 1 | - | - | 1 | - | - | - | - |
| 42 | Acer saccharinum L. | 1 | - | 1 | 1 | 3 | 6 | 2 | 1 | 2 | 1 | 1 | 2 | - | - | 1 | 1 | 1 | - | 1 | - |
| 7 | Carex × stipata Muhl. ex Willd. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | - | - | - |
| 6 | Cornus amomum Mill. | 1 | - | - | - | - | 4 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - |
| 90 | Cornus foemina Mill | 1 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| 5 | Cornus stolonifera Michx. | 1 | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| 38 | Fraxinus pennsylvanicum Marshall | 2 | 1 | 1 | 2 | 5 | 5 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | - | - | - |
| 9 | Glyceria striata (Lam.)A. Hitchc. | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 |
| 111 | Impatiens capensis Meerb. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 1 | 1 |
| 84 | Juncus tenuis Willd. | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 46 | Lemna minor L. | 99 | 99 | 70 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 95 | 99 |
| 8 | Onoclea sensibilis L. | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 37 | Polygonum amphibium L. | 1 | - | 2 | 1 | - | 3 | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| 110 | Rhamnus frangula L. | 1 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - |
| 114 | Ribes americana Mill. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| 39 | Salix discolor Muhl. | 1 | 1 | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| 52 | Salix fragilis L. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - |
| 71 | Salix petiolaris J.E. Smith | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 87 | Solidago sp. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 |
| 33 | Ulmus americana L. | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 | 1 | - | 1 | 1 | - | - | - | - | 1 | - | - | - |
| SHRUB STRATUM | | | | | | | | | | | | | | | | | | | | | |
| 41 | Acer rubrum L. | 2 | - | 2 | - | - | 1 | - | - | - | - | 1 | - | - | - | - | 5 | - | - | - | - |
| 42 | Acer saccharinum L. | 3 | 10 | 5 | 4 | 10 | 10 | 5 | 10 | 7 | 4 | 4 | 20 | 10 | 10 | 5 | 1 | 50 | 25 | 10 | 15 |
| 6 | Cornus amomum Mill. | 20 | - | - | - | - | 2 | 1 | - | - | - | 5 | - | - | - | - | 1 | - | - | - | - |
| 90 | Cornus foemina Mill | 30 | - | - | - | - | 60 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | Cornus stolonifera Michx. | 10 | - | 3 | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| 38 | Fraxinus pennsylvanicum Marshall | 3 | 7 | 3 | 6 | 25 | 30 | 2 | 1 | 3 | 10 | 30 | 5 | 15 | 5 | 25 | 7 | - | - | - | - |
| 32 | Rhamnus catharticus L. | 5 | - | - | - | - | 1 | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - |

TABLE C.2 (Cont.)

| Field No. | Scientific Name and Authority | Areal Coverage (%) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NNA | | | | | North ROW | | | | | South ROW | | | | | SNA | | | | |
| | | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 |
| SHRUB STRATUM (Cont.) | | | | | | | | | | | | | | | | | | | | | |
| 106 | Salix bebbiana Sarg. | 10 | - | - | 20 | 3 | - | - | - | 20 | - | - | 1 | 2 | 5 | - | 5 | - | - | - | - |
| 39 | Salix discolor Muhl. | 5 | 60 | 40 | 50 | - | 3 | 15 | 30 | 10 | - | 20 | 7 | - | 2 | - | - | - | - | - | - |
| 52 | Salix fragilis L. | - | 3 | - | - | 1 | - | - | - | - | - | 5 | - | - | - | - | - | - | - | - | - |
| 71 | Salix petiolaris J.E. Smith | 40 | 15 | 10 | 5 | 5 | - | 50 | 5 | 6 | 70 | 7 | 2 | 10 | - | 10 | - | - | - | - | - |
| 33 | Ulmus americana L. | 3 | 5 | - | 2 | 5 | 2 | 30 | - | 2 | - | 25 | - | - | 2 | 4 | 10 | - | 5 | 5 | 15 |
| SAPLING STRATUM | | | | | | | | | | | | | | | | | | | | | |
| 42 | Acer saccharinum L. | - | - | - | - | - | - | - | 2 | - | - | - | 5 | 30 | 7 | - | 30 | 60 | 25 | 65 | - |
| 38 | Fraxinus pennsylvanicum Marshall | - | - | - | - | - | 5 | - | - | - | - | - | 5 | - | 4 | - | 12 | - | - | 3 | - |
| 39 | Salix discolor Muhl. | - | 5 | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| 52 | Salix fragilis L. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| 33 | Ulmus americana L. | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | 25 | - | - | - | - |
| TREE STRATUM | | | | | | | | | | | | | | | | | | | | | |
| 42 | Acer saccharinum L. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 12 | 15 | 40 | 60 | 10 |
| 0 | Populus deltoides W. Bart. ex Marshall | - | - | - | - | 15 | - | 10 | - | - | - | - | 20 | - | - | - | - | - | - | - | - |
| 39 | Salix discolor Muhl. | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - |
| 52 | Salix fragilis L. | - | - | - | - | 4 | - | - | - | 3 | - | - | - | - | - | 15 | - | 20 | - | - | 50 |
| 33 | Ulmus americana L. | - | - | - | - | 5 | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - |
| PLANTS FOUND IN THE AREA BUT NOT IN SAMPLING PLOTS | | | | | | | | | | | | | | | | | | | | | |
| 215 | Mentha arvensis L. | | | | | | | | | | | | | | | | | | | | |
| 221 | Polygonum lapathifolium L. | | | | | | | | | | | | | | | | | | | | |
| 220 | Polygonum pensylvanicum L. | | | | | | | | | | | | | | | | | | | | |
| 214 | Scutellaria lateriflora L. | | | | | | | | | | | | | | | | | | | | |

[a] Field number of zero indicates that no specimen was collected.

TABLE C.3 Areal Coverage Estimates and Frequencies for Plants by Stratum in the Scrub-Shrub Community

| Field No. | Scientific Name and Authority | Average Percentage of Areal Coverage/ Absolute Frequency[a] NNA | North ROW | South ROW | SNA |
|---|---|---|---|---|---|
| STANDING WATER | | 99/5 | 99/5 | 99/5 | 99/5 |
| HERB STRATUM | | | | | |
| Plants found in both NAs and both portions of the ROW | | | | | |
| 41 | Acer rubrum L. | 0/3 | 0.7/4 | 1.2/2 | 0.1/1 |
| 42 | Acer saccharinum L. | 1/4 | 2.2/5 | 0.7/3 | 0.3/3 |
| 6 | Cornus amomum Mill. | 0/1 | 0.8/1 | 0.2/2 | 0.2/1 |
| 38 | Fraxinus pennsylvanicum Marshall | 2/5 | 1.7/5 | 1.3/5 | 0.2/2 |
| 46 | Lemna minor L. | 93/5 | 99/5 | 99/5 | 98.2/5 |
| 110 | Rhamnus frangula L. | 0/1 | 0.1/1 | 0.1/1 | 0.1/1 |
| 33 | Ulmus americana L. | 1/4 | 0.5/4 | 0.3/2 | 0.1/1 |
| Plant found in both NAs and north portions of the ROW | | | | | |
| 9 | Glyceria striata (Lam.) A. Hitchc. | 0/1 | 0.1/1 | 0/0 | 0.2/0 |
| Plant found in both NAs only | | | | | |
| 5 | Cornus stolonifera Michx. | 0/2 | 0/0 | 0/0 | 0.1/1 |
| Plant found in NNA and both portions of the ROW | | | | | |
| 90 | Cornus foemina Mill | 0/1 | 0.1/1 | 0.2/2 | 0/0 |
| Plants found in NNA and north portion of the ROW | | | | | |
| 84 | Juncus tenuis Willd. | 0/1 | 0.2/1 | 0/0 | 0/0 |
| 37 | Polygonum amphibium L. | 1/3 | 0.7/2 | 0/0 | 0/0 |
| 39 | Salix discolor Muhl. | 0/3 | 0.1/1 | 0/0 | 0/0 |
| Plants found in NNA only | | | | | |
| 8 | Onoclea sensibilis L. | 0/1 | 0/0 | 0/0 | 0/0 |
| 71 | Salix petiolaris J.E. Smith | 0/1 | 0/0 | 0/0 | 0/0 |
| Plants found in SNA only | | | | | |
| 7 | Carex × stipata Muhl. ex Willd. | 0/0 | 0/0 | 0/0 | 0.2/2 |
| 111 | Impatiens capensis Meerb. | 0/0 | 0/0 | 0/0 | 0.3/3 |
| 114 | Ribes americana Mill. | 0/0 | 0/0 | 0/0 | 0.1/1 |
| 52 | Salix fragilis L. | 0/0 | 0/0 | 0/0 | 0.2/2 |
| 87 | Solidago sp. | 0/0 | 0/0 | 0/0 | 0.2/2 |

TABLE C.3 (Cont.)

| Field No. | Scientific Name and Authority | Average Percentage of Areal Coverage/ Absolute Frequency[a] NNA | North ROW | South ROW | SNA |
|---|---|---|---|---|---|
| SHRUB STRATUM | | | | | |
| Plants found in both NAs and both portions of the ROW | | | | | |
| 41 | Acer rubrum L. | 1/2 | 0.1/1 | 0.1/1 | 1/1 |
| 42 | Acer saccharinum L. | 6/5 | 7.2/5 | 9.8/5 | 20.2/5 |
| 6 | Cornus amomum Mill. | 4/1 | 0.6/2 | 1/1 | 0.1/1 |
| 38 | Fraxinus pennsylvanicum Marshall | 9/5 | 9.2/5 | 16/5 | 1.4/1 |
| 106 | Salix bebbiana Sarg. | 7/3 | 4/1 | 1.5/3 | 1/1 |
| 33 | Ulmus americana L. | 3/4 | 6/8/3 | 6.2/3 | 7/4 |
| Plant found in both NAs and the north portion of the ROW | | | | | |
| 5 | Cornus stolonifera Michx. | 3/2 | 0.2/1 | 0/0 | 0.1/1 |
| Plants found in NNA and both portions of the ROW | | | | | |
| 32 | Rhamnus catharticus L. | 1/1 | 0.2/1 | 0.4/1 | 0/0 |
| 39 | Salix discolor Muhl. | 31/4 | 11.6/4 | 5.8/3 | 0/0 |
| 71 | Salix petiolaris J.E. Smith | 15/5 | 26.2/4 | 5.8/4 | 0/0 |
| Plant found in NNA and north portion of the ROW | | | | | |
| 90 | Cornus foemina Mill | 6/1 | 12/1 | 0/0 | 0/0 |
| Plant found in NNA and south portion of the ROW | | | | | |
| 52 | Salix fragilis L. | 1/2 | 0/0 | 1/1 | 0/0 |
| SAPLING STRATUM | | | | | |
| Plant found in both NAs only | | | | | |
| 39 | Salix discolor Muhl. | 2/2 | 0/0 | 0/0 | 0.2/1 |
| Plants found in SNA and both portions of the ROW | | | | | |
| 38 | Fraxinus pennsylvanicum Marshall | 0/0 | 1/1 | 1.8/2 | 3/2 |
| 42 | Acer saccharinum L. | 0/0 | 0.4/1 | 8.4/3 | 36/4 |
| Plant found in SNA and south portion of the ROW | | | | | |
| 33 | Ulmus americana L. | 0/0 | 0/0 | 0.4/1 | 5/1 |
| Plant found in SNA only | | | | | |
| 52 | Salix fragilis L. | 0/0 | 0/0 | 0./0 | 0.4/1 |

TABLE C.3 (Cont.)

| Field No. | Scientific Name and Authority | Average Percentage of Areal Coverage/ Absolute Frequency[a] NNA | North ROW | South ROW | SNA |
|---|---|---|---|---|---|
| TREE STRATUM | | | | | |
| Plant found in both NAs and both portions of the ROW | | | | | |
| 52 | Salix fragilis L. | 1/1 | 0.6/1 | 3/1 | 14/2 |
| Plant found in both NAs only | | | | | |
| 33 | Ulmus americana L. | 1/1 | 0/0 | 0/0 | 0.6/1 |
| Plant found in NNA and both portions of the ROW | | | | | |
| 0[b] | Populus deltoides W. Bart. ex Marshall | 3/1 | 2/1 | 4/1 | 0/0 |
| Plant found in SNA only | | | | | |
| 42 | Acer saccharinum L. | 0/0 | 0/0 | 0/0 | 27.4/5 |
| Plant found on the south portion of ROW | | | | | |
| 39 | Salix discolor Muhl. | 0/0 | 0/0 | 0.6/1 | 0/0 |
| PLANTS FOUND IN THE AREA BUT NOT IN SAMPLING PLOTS | | | | | |
| 215 | Mentha arvensis L. | | | | |
| 221 | Polygonum lapathifolium L. | | | | |
| 220 | Polygonum pensylvanicum L. | | | | |
| 214 | Scutellaria lateriflora L. | | | | |

[a] Frequency on the basis of five plots.

[b] Field number of zero indicates that no specimen was collected.

TABLE C.4 Plant Species List for the Emergent Marsh Community

| Field No. | Scientific Name and Authority | Common Name | Region 1 Wetland Indicator Category[a] | Life-Form/ Origin[b] |
|---|---|---|---|---|
| 41 | Acer rubrum L. | Red maple | FAC | NT |
| 1 | Alisma plantago aquatica L. | Broad-leaf water plantain | OBL | PNEF |
| 92 | Anthoxanthum odoratum L. | Sweet vernal grass | FACU | PIG |
| 23 | Ascelpias incarnata L. | Swamp milkweed | OBL | PNF |
| 76 | Bidens sp. | | | |
| 64 | Calystegia sepium (L.) R.BR. | Hedge bindweed | FAC- | PIF |
| 17 | Carex bebbii (Bailey)Olney ex Fernald | Bebb's sedge | OBL | PNGL |
| 36 | Carex crinita Lam. | Fringed sedge | OBL | PNEGL |
| 82 | Carex flava L. | Yellow sedge | OBL | PNGL |
| 95 | Carex gracillima Schweintiz | Graceful sedge | FACU* | PNGL |
| 83 | Carex hystericina Muhl. ex Willd. | Porpucine sedge | OBL | PNEGL |
| 3 | Carex lacustris Willd. | Lakebank sedge | OBL | PNEGL |
| 12 | Carex lupulina Muhl. ex Willd. | Hop sedge | OBL | PNEGL |
| 66 | Carex normalis Mackenz. | Larger straw sedge | FACU | PNGL |
| 91 | Carex pallescens L. | Pale sedge | UPL | PNGL |
| 67 | Carex retrorsa Schweinitz | Retorse sedge | FACW+ | PNGL |
| 85 | Carex scoparia Schkuhr ex Willd. | Pointed broom sedge | FACW | PNGL |
| 75 | Carex suberecta (Olney)Britton | Prairie straw sedge | OBL | PNGL |
| 19 | Carex vulpinoidea Michx. | Fox sedge | OBL | PNEGL |
| 7 | Carex × stipata Muhl. ex Willd. | Stalk-grain sedge | OBL | PNGL |
| 218 | Cicuta bulbifera L. | Bulblet-bearing water-hemlock | OBL | PNF |
| 53 | Cicuta maculata L. | Spotted water-hemlock | OBL | PNF |
| 6 | Cornus amomum Mill. | Silky dogwood | FACW | NS |
| 90 | Cornus foemina Mill. | Stiff dogwood | FAC | NS |
| 5 | Cornus stolonmifera Michx. | Red-osier dogwood | FACW+ | NS |
| 102 | Epilobium hirsutum L. | Great-hairy willow-herb | FACW | PIF |
| 20 | Equisetum arvense L. | Field horsetail | FAC | PNH2 |
| 62 | Equisetum fluviatile L. | Water horsetail | OBL | PNH2 |
| 29 | Eupatoriadelphus maculatus (L.) R.M. King & H. Rob. | Spotted joe-pye-weed | FACW | PNF |
| 27 | Eupatorium perfoliatum L. | Common boneset | FACW | PNF |
| 38 | Fraxinus pennsylvanica Marshall | Green ash | FACW | NT |
| 61 | Galium palustre L. | Marsh bedstraw | OBL | PNF |
| 111 | Impatiens capensis Meerb. | Spotted touch-me-not | FACW | ANF |
| 57 | Iris versicolor L. | Blueflag | OBL | PNF |
| 84 | Juncus tenuis Willd. | Slender rush | FAC- | PNGL |
| 98 | Liparis loeslii (L.) L.C. Rich. | Fen orchid | FACW | PNF |
| 72 | Ludwegia palustris (L.) Elliott | Marsh seedbox | OBL | PNEF |
| 77 | Lycopus americanus Muhl. ex W. Barton | American bugle-weed | OBL | PNF |
| 93 | Lycopus uniflorus Michx. | Northern bugleweed | OBL | PNF |
| 26 | Lysimachia numularia L. | Creeping jennie | OBL | PIF |
| 74 | Lysimachia thyrsiflora L. | Tufted loosestrife | OBL | PIF |
| 101 | Mentha sp. | | | |

TABLE C.4 (Cont.)

| Field No. | Scientific Name and Authority | Common Name | Region 1 Wetland Indicator Category[a] | Life-Form/ Origin[b] |
|---|---|---|---|---|
| 97 | Nasturtium officional R. Br. in W.T. Ait. | True water-cress | OBL | PIZEF |
| 8 | Onoclea sensibilis L. | Sensitive fern | FACW | PNEF3 |
| 69 | Poa alodes Gray | Grove bluegrass | FACW- | PNG |
| 80 | Poa pratensis L. | Kentucky bluegrass | FACU | PNG |
| 59 | Ranunculus acris L. | Tall butter-cup | FAC+ | PIF |
| 32 | Rhamnus cathartica L. | Common buckthorn | UPL | IS |
| 39 | Salix discolor Muhl. | Pussy willow | FACW | NS |
| 52 | Salix fragilis L. | Crack willow | FAC+ | IT |
| 2 | Salix petiolaris Pursh | Meadow willow | OBL | NS |
| 10 | Scirpus atrovirens Willd. | Green bulrush | OBL | PNEGL |
| 96 | Scirpus validus Vahl | Soft-stem bulrush | OBL | PNEGL |
| 86 | Solidago sp. narrow lf. | | | |
| 87 | Solidago sp. wide lf. | | | |
| 54 | Stellaria graminea L. | Lesser starwort | FAC- | PNF |
| 112 | Typha × glauca Godr. | Blue cattail | OBL | PNEF |
| 33 | Ulmus americana L. | American elm | FACW- | NT |
| 63 | Unknown opp. lf. forb | | | |
| 22 | Viburnum dentatum L. | Arrow-wood | FAC | NTS |
| 81 | Viburnum lentago L. | Nannyberry | FAC | NTS |
| 55 | Vicia cracca L. | Cow-vetch | UPL | PIF |

[a] Wetland indicator categories are assigned to plants in the United States on a regional basis. New Jersey is located in Region 1. A "+" following an indicator indicates a frequency toward the high end of the category (more frequently found in wetlands), while a "-" indicates a frequency toward the low end (less frequently found in wetlands).

[b] Plant characteristics and life-forms assigned to each species are defined in Appendix B.

TABLE C.5 Areal Coverage Estimates for Plants by Stratum in the Emergent Marsh Community

| Field No. | Scientific Name and Authority | Areal Coverage (%) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ENA | | | | | East ROW | | | | | West ROW | | | | | WNA | | | | |
| | | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 |
| EXPOSED SOIL | | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 0 | 1 | 1 | 0 | 0 |
| STANDING WATER | | 2 | 2 | 20 | 80 | 80 | 2 | 10 | 30 | 20 | 80 | 5 | 10 | 30 | 10 | 30 | 20 | 40 | 30 | 20 | 40 |
| MOSSES | | 50 | 20 | 20 | 10 | 5 | 10 | 10 | 30 | 5 | 5 | 5 | 10 | 20 | 10 | 10 | 20 | 30 | 30 | 30 | 10 |
| HERB STRATUM | | | | | | | | | | | | | | | | | | | | | |
| 41 | Acer rubrum L. | 1 | - | - | - | - | 1 | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |
| 1 | Alisma plantago aquatica L. | - | - | - | - | - | - | 1 | - | - | - | - | 1 | 1 | 1 | - | - | 1 | 1 | 1 | 1 |
| 92 | Anthoxanthum odoratum L. | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | Ascelpias incarnata L. | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | - | 1 | - | - | - | 1 | - |
| 76 | Bidens sp. | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 64 | Calystegia sepium (L.) R. BR. | - | - | - | - | - | - | - | 1 | - | 1 | - | - | - | - | - | - | - | - | - | - |
| 17 | Carex bebbii (L.H. Bailey) Olney ex Fernald | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| 36 | Carex crinita Lam. | 1 | - | - | - | - | - | 2 | - | - | - | 1 | - | 1 | - | - | - | - | - | 3 | - |
| 82 | Carex flava L. | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 95 | Carex gracillima Schweintiz | - | 1 | - | - | - | - | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - | - |
| 83 | Carex hystericina Muhl. ex Willd. | 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0 | - | - | - |
| 3 | Carex lacustris Willd. | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | Carex lupulina Muhl. ex Willd. | 1 | 1 | - | 1 | - | - | 2 | 3 | - | - | 2 | 2 | 2 | 3 | - | 1 | 1 | 2 | 5 | 1 |
| 66 | Carex normalis Mackenz. | - | 1 | 1 | - | - | - | 1 | 1 | - | - | - | 1 | 1 | 1 | - | 1 | 1 | 1 | 1 | 1 |
| 91 | Carex pallescens L. | - | 1 | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - |
| 67 | Carex retrorsa Schweinitz | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| 85 | Carex scoparia Schkuhr ex Willd. | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 75 | Carex suberecta (Olney) Britton | - | 1 | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 19 | Carex vulpinoidea Michx. | 1 | 1 | 1 | - | - | - | - | 1 | - | - | 1 | - | 1 | 1 | - | - | - | 1 | 1 | - |
| 7 | Carex × stipata Muhl. ex Willd. | 1 | 1 | 1 | - | - | - | 5 | 1 | - | - | 1 | 5 | 4 | 2 | - | - | 2 | 2 | 4 | 1 |
| 218 | Cicuta bulbifera L. | - | - | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | 2 | - | - | 1 |
| 53 | Cicuta maculata L. | 3 | 5 | 3 | 1 | 1 | 4 | 15 | 10 | - | 1 | 6 | 15 | 10 | 2 | - | 40 | 10 | 10 | 5 | 2 |
| 6 | Cornus amomum Mill. | - | - | - | - | - | - | - | - | 2 | - | - | - | 3 | 2 | 1 | - | - | 3 | 2 | 2 |
| 90 | Cornus foemina Mill. | - | 1 | - | - | - | - | 5 | 1 | - | - | - | 5 | 1 | - | - | - | - | 2 | - | 1 |
| 5 | Cornus stolonmifera Michx. | 10 | 10 | 3 | - | - | 2 | 10 | 2 | 1 | - | 1 | 15 | 2 | 1 | 2 | - | 5 | 2 | 1 | 1 |
| 102 | Epilobium hirsutum L. | - | - | - | 1 | 2 | - | - | - | - | 3 | - | - | - | - | 3 | - | - | - | - | 2 |
| 20 | Equisetum arvense L. | 60 | 50 | 50 | 1 | - | 30 | 40 | 60 | 2 | 1 | 10 | 30 | 60 | 70 | 2 | 20 | 30 | 40 | 30 | 5 |
| 62 | Equisetum fluviatile L. | - | - | 1 | 80 | 90 | - | - | 1 | 80 | 80 | - | - | - | 3 | 70 | - | - | - | 40 | 40 |
| 29 | Eupatoriadelphus maculatus (L.) R.M. King & H. Rob. | 4 | 2 | 5 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 1 | 2 | 7 | 2 | 2 |

TABLE C.5 (Cont.)

| Field No. | Scientific Name and Authority | Areal Coverage (%) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ENA | | | | | East ROW | | | | | West ROW | | | | | WNA | | | | |
| | | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 |
| HERB STRATUM (Cont.) | | | | | | | | | | | | | | | | | | | | | |
| 27 | Eupatorium perfoliatum L. | - | 1 | - | - | - | - | 1 | - | - | - | - | 1 | 1 | - | - | - | 1 | - | - | - |
| 43 | Fraxinus pennsylvanica Marshall | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 61 | Galium palustre L. | 5 | 4 | 3 | 1 | 3 | 3 | 5 | 5 | 1 | 3 | 1 | 5 | 3 | 2 | 2 | 2 | 1 | 4 | 3 | 2 |
| 111 | Impatiens capensis Meerb. | 3 | 5 | 5 | 50 | 40 | 30 | 20 | 10 | 40 | 40 | 5 | 15 | 5 | 30 | 40 | 20 | 5 | 5 | 30 | 30 |
| 57 | Iris versicolor L. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | - | 1 | 2 | 4 | 1 | 1 | 2 | 2 | 2 | 2 | 1 |
| 84 | Juncus tenuis Willd. | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 98 | Liparis loeslii (L.) L.C. Rich. | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 1 | - | - | - |
| 72 | Ludwegia palustris (L.) Elliott | - | - | 1 | - | - | - | 10 | - | - | - | - | 10 | - | - | - | - | 1 | - | - | - |
| 77 | Lycopus americanus Muhl. ex W. Barton | 1 | 1 | 1 | - | - | 1 | 3 | 1 | - | - | 1 | 2 | 1 | - | - | 1 | 1 | 1 | - | - |
| 93 | Lycopus uniflorus Michx. | - | 1 | 1 | 1 | - | - | 2 | 1 | 1 | - | 1 | 3 | 2 | 1 | - | 1 | 1 | 1 | 1 | - |
| 26 | Lysimachia numularia L. | - | - | - | - | - | - | - | 1 | - | - | - | - | 5 | - | - | - | - | - | - | 3 |
| 74 | Lysimachia thyrsiflora L. | - | - | - | - | - | - | 2 | 1 | - | - | - | 2 | 1 | - | - | - | 1 | - | - | - |
| 101 | Mentha sp. | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| 97 | Nasturtium officional R. Br. in W.T. Ait. | - | - | 1 | 2 | - | - | 3 | 1 | 10 | - | - | 3 | 5 | 1 | - | - | 2 | 1 | 1 | 1 |
| 8 | Onoclea sensibilis L. | 1 | 5 | 10 | - | - | 1 | 1 | 3 | 5 | - | - | - | - | 5 | - | - | - | 2 | 10 | - |
| 69 | Poa alodes Gray | 3 | 2 | 1 | - | - | 10 | 5 | 3 | - | - | 15 | 5 | 2 | - | - | 15 | 4 | 3 | 2 | 3 |
| 80 | Poa pratensis L. | 2 | 1 | 2 | - | - | 5 | 1 | 1 | - | - | 5 | 1 | 1 | 1 | - | 1 | - | 1 | 1 | 1 |
| 59 | Ranunculus acris L. | 1 | 2 | - | - | - | - | 1 | - | - | - | - | 1 | 2 | - | - | - | - | 2 | - | 1 |
| 32 | Rhamnus cathartica L. | - | 2 | - | - | - | - | 2 | 1 | - | - | - | 3 | 3 | - | - | - | - | - | - | - |
| 52 | Salix fragilis L. | - | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | Salix petiolaris Pursh | 5 | 15 | 2 | 2 | - | - | 20 | 2 | 1 | - | - | 20 | - | 1 | - | - | 3 | - | 1 | - |
| 10 | Scirpus atrovirens Willd. | - | - | 1 | - | - | - | 1 | 2 | - | - | 1 | 1 | 2 | - | - | 2 | 4 | 2 | - | 1 |
| 96 | Scirpus validus Vahl | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 1 |
| 86 | Solidago sp. narrow lf. | 1 | 1 | 2 | - | - | - | - | - | 1 | - | 1 | 1 | - | - | - | - | 0 | - | 1 | - |
| 87 | Solidago sp. wide lf. | 2 | 2 | 2 | - | 2 | 1 | 5 | 2 | 2 | 2 | 5 | 5 | 2 | 2 | 4 | 1 | 2 | 2 | 3 | 2 |
| 54 | Stellaria graminea L. | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 112 | Typha × glauca Godr. | 70 | 50 | 60 | 100 | 100 | 90 | 40 | 50 | 95 | 100 | 90 | 40 | 40 | 40 | 80 | 90 | 80 | 60 | 40 | 40 |
| 33 | Ulmus americana L. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| 63 | Unknown opp. lf. forb | 1 | - | - | 1 | - | 1 | - | - | - | - | 1 | - | - | - | - | 0 | - | - | - | - |
| 55 | Vicia cracca L. | 5 | - | - | - | - | 1 | 1 | 1 | - | - | 1 | 1 | - | - | - | 1 | - | - | - | - |

TABLE C.5 (Cont.)

| Field No. | Scientific Name and Authority | Areal Coverage (%) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ENA | | | | | East ROW | | | | | West ROW | | | | | WNA | | | | |
| | | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 | T1 | T2 | T3 | T4 | T5 |
| | SHRUB STRATUM | | | | | | | | | | | | | | | | | | | | |
| 6 | Cornus amomum Mill. | - | - | - | - | - | - | 20 | 20 | 3 | - | - | - | 30 | 25 | 2 | - | - | 20 | 50 | 40 |
| 90 | Cornus foemina Mill. | 1 | 30 | 5 | - | - | - | 20 | 5 | - | - | - | 20 | 10 | 5 | - | - | 2 | 5 | 5 | 5 |
| 5 | Cornus stolonifera Michx. | 5 | 30 | 25 | - | - | 6 | 40 | 40 | 4 | - | - | 60 | 20 | 15 | 20 | - | 40 | 20 | 5 | 10 |
| 43 | Fraxinus pennsylvanica Marshall | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | Rhamnus cathartica L. | - | 30 | 5 | - | - | - | 10 | 30 | - | - | - | 7 | 10 | 5 | - | - | 1 | 1 | - | - |
| 39 | Salix discolor Muhl. | 1 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5 | 5 |
| 52 | Salix fragilis L. | - | - | - | - | - | - | 5 | 5 | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | Salix petiolaris Pursh | 25 | 20 | 5 | 2 | - | 10 | 20 | 15 | 5 | - | 8 | 25 | 10 | 10 | 2 | 7 | 30 | 20 | 10 | 20 |
| 22 | Viburnum dentatum L. | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 81 | Viburnum lentago L. | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | TREE STRATUM | | | | | | | | | | | | | | | | | | | | |
| 52 | Salix fragilis L. | - | - | - | - | - | - | 40 | - | - | - | - | - | - | - | - | - | - | - | - | - |

TABLE C.6 Areal Coverage Estimates and Frequencies for Plants by Stratum in the Emergent Marsh Community

| Field No. | Scientific Name and Authority | Average Percentage of Areal Coverage/ Absolute Frequency[a] ENA | East ROW | West ROW | WNA |
|---|---|---|---|---|---|
| EXPOSED SOIL | | 0.4/1 | 0.5/4 | 1/5 | 0.2/2 |
| STANDING WATER | | 37/5 | 28/5 | 17/5 | 30/5 |
| MOSSES | | 21/5 | 12/5 | 11/5 | 24/5 |
| HERB STRATUM | | | | | |
| Plants found in both NAs and both portions of the ROW | | | | | |
| 23 | Ascelpias incarnata L. | 0.1/1 | 0.1/1 | 0.1/1 | 0.1/1 |
| 36 | Carex crinita Lam. | 0.1/1 | 0.4/1 | 0.3/2 | 0.6/1 |
| 12 | Carex lupulina Muhl. ex Willd. | 0.4/3 | 1/2 | 1.8/4 | 1.9/5 |
| 66 | Carex normalis Mackenz. | 0.2/2 | 0.3/2 | 0.4/3 | 0.7/5 |
| 19 | Carex vulpinoidea Michx. | 0.4/3 | 0.1/1 | 0.5/3 | 0.3/2 |
| 7 | Carex × stipata Muhl. ex Willd. | 0.4/3 | 1.2/2 | 2.3/4 | 1.7/4 |
| 53 | Cicuta maculata L. | 2.5/5 | 6/3 | 6.6/4 | 13/5 |
| 90 | Cornus foemina Mill. | 0.1/1 | 1.2/2 | 1.2/2 | 0.6/2 |
| 5 | Cornus stolonifera Michx. | 4.6/3 | 3/4 | 4.1/5 | 1.8/4 |
| 102 | Epilobium hirsutum L. | 0.6/2 | 0.6/1 | 0.6/1 | 0.4/1 |
| 20 | Equisetum arvense L. | 32/4 | 27/5 | 34/5 | 25/5 |
| 62 | Equisetum fluviatile L. | 34/3 | 32/3 | 15/2 | 16/2 |
| 29 | Eupatoriadelphus maculatus (L.) R.M. King & H. Rob. | 2.8/5 | 2.2/5 | 2.6/5 | 2.8/5 |
| 27 | Eupatorium perfoliatum L. | 0.1/1 | 0.1/1 | 0.2/2 | 0.1/1 |
| 61 | Galium palustre L. | 3.2/5 | 3.4/5 | 2.6/5 | 2.4/5 |
| 111 | Impatiens capensis Meerb. | 21/5 | 28/5 | 19/5 | 18/5 |
| 57 | Iris versicolor L. | 0.8/5 | 0.9/4 | 1.8/5 | 1.8/5 |
| 72 | Ludwegia palustris (L.) Elliott | 0.1/1 | 2/1 | 2/1 | 0.1/1 |
| 77 | Lycopus americanus Muhl. ex W. Barton | 0.5/3 | 0.9/3 | 0.8/3 | 0.5/3 |
| 93 | Lycopus uniflorus Michx. | 0.6/3 | 0.8/3 | 1.3/4 | 0.6/4 |
| 97 | Nasturtium officional R. Br. in W.T. Ait. | 0.6/2 | 2.8/3 | 1.8/3 | 0.9/4 |
| 8 | Onoclea sensibilis L. | 3.1/3 | 1.9/4 | 1/1 | 2.4/2 |
| 69 | Poa alodes Gray | 1.1/3 | 3.6/3 | 4.4/3 | 5.4/5 |
| 80 | Poa pratensis L. | 1/3 | 1.3/3 | 1.5/4 | 0.7/4 |
| 59 | Ranunculus acris L. | 0.5/2 | 0.2/1 | 0.6/2 | 0.5/2 |
| 71 | Salix petiolaris Pursh | 4.8/4 | 4.6/3 | 4.2/2 | 0.8/2 |
| 10 | Scirpus atrovirens Willd. | 0.1/1 | 0.5/2 | 0.6/3 | 1.7/4 |
| 86 | Solidago sp. narrow lf. | 0.6/3 | 0.2/1 | 0.2/2 | 0.2/2 |
| 87 | Solidago sp. wide lf. | 1.6/3 | 2.4/5 | 3.6/5 | 1.9/5 |
| 112 | Typha × glauca Godr. | 76/5 | 75/5 | 58/5 | 62/5 |
| 63 | Unknown opp. lf. forb | 0.2/2 | 0.1/1 | 0.1/1 | 0/1 |
| 55 | Vicia cracca L. | 1/1 | 0.5/3 | 0.3/2 | 0.2/1 |

TABLE C.6 (Cont.)

| Field No. | Scientific Name and Authority | Average Percentage of Areal Coverage/ Absolute Frequency[a] ENA | East ROW | West ROW | WNA |
|---|---|---|---|---|---|
| Plants found in both NAs only | | | | | |
| 17 | Carex bebbii (Bailey) Olney ex Fernald | 0.2/2 | 0/0 | 0/0 | 0.1/1 |
| 83 | Carex hystericina Muhl. ex Willd. | 0.2/2 | 0/0 | 0/0 | 0/1 |
| 96 | Scirpus validus Vahl | 0.4/0 | 0/0 | 0/0 | 0.4/2 |
| Plants found in the ENA and both portions of the ROW | | | | | |
| 41 | Acer rubrum L. | 0.1/1 | 0.1/1 | 0.1/1 | 0/0 |
| 95 | Carex gracillima Schweintiz | 0.1/1 | 0.4/1 | 0.4/1 | 0/0 |
| 32 | Rhamnus cathartica L. | 0.4/1 | 0.6/2 | 1.2/2 | 0/0 |
| Plant found in the ENA and the east portion of the ROW | | | | | |
| 75 | Carex suberecta (Olney) Britton | 0.1/1 | 0.1/1 | 0/0 | 0/0 |
| Plant found in the ENA and west portion of the ROW | | | | | |
| 91 | Carex pallescens L. | 0.2/1 | 0/0 | 0.4/1 | 0/0 |
| Plants found in the ENA only | | | | | |
| 92 | Anthoxanthum odoratum L. | 0.2/1 | 0/0 | 0/0 | 0/0 |
| 76 | Bidens sp. | 0.1/1 | 0/0 | 0/0 | 0/0 |
| 82 | Carex flava L. | 0.2/2 | 0/0 | 0/0 | 0/0 |
| 3 | Carex lacustris Willd. | 0.1/1 | 0/0 | 0/0 | 0/0 |
| 85 | Carex scoparia Schkuhr ex Willd. | 0.2/2 | 0/0 | 0/0 | 0/0 |
| 84 | Juncus tenuis Willd. | 0/1 | 0/0 | 0/0 | 0/0 |
| 52 | Salix fragilis L. | 1/1 | 0/0 | 0/0 | 0/0 |
| 54 | Stellaria graminea L. | 0.1/1 | 0/0 | 0/0 | 0/0 |
| Plants found in the WNA and both portions of the ROW | | | | | |
| 1 | Alisma plantago aquatica L. | 0/0 | 0.1/1 | 0.3/3 | 0.5/4 |
| 218 | Cicuta bulbifera L. | 0/0 | 0.1/1 | 0.1/1 | 0.5/2 |
| 6 | Cornus amomum Mill. | 0/0 | 0.4/1 | 1.2/3 | 1.4/3 |
| 26 | Lysimachia numularia L. | 0/0 | 0.1/1 | 1/1 | 0.6/1 |
| 74 | Lysimachia thyrsiflora L. | 0/0 | 0.5/2 | 0.5/2 | 0.1/1 |
| Plant found in the WNA and west portion of the ROW | | | | | |
| 98 | Liparis loeslii (L.) L.C. Rich. | 0/0 | 0/0 | 0.1/1 | 0.1/1 |
| Plants found in the WNA only | | | | | |
| 67 | Carex retrorsa Schweinitz | 0/0 | 0/0 | 0/0 | 0.2/1 |
| 33 | Ulmus americana L. | 0/0 | 0/0 | 0/0 | 0.1/1 |
| Plants found only on the east portion of the ROW | | | | | |
| 64 | Calystegia sepium (L.) R.BR. | 0/0 | 0.2/2 | 0/0 | 0/0 |
| 43 | Fraxinus pennsylvanica Marshall | 0/0 | 0.1/1 | 0/0 | 0/0 |

TABLE C.6 (Cont.)

| Field No. | Scientific Name and Authority | Average Percentage of Areal Coverage/ Absolute Frequency[a] ENA | East ROW | West ROW | WNA |
|---|---|---|---|---|---|
| Plant found only on the west portion of the ROW | | | | | |
| 101 | Mentha sp. | 0/0 | 0/0 | 0.2/1 | 0/0 |
| SHRUB STRATUM | | | | | |
| Plants found in both NAs and both portions of the ROW | | | | | |
| 90 | Cornus foemina Mill. | 7.1/3 | 5/2 | 7/3 | 3.4/4 |
| 5 | Cornus stolonifera Michx. | 12/3 | 18/4 | 23/4 | 15/4 |
| 32 | Rhamnus cathartica L. | 7/2 | 8/2 | 4.4/3 | 0.2/2 |
| 2 | Salix petiolaris Pursh | 10/4 | 10/4 | 11/5 | 17/5 |
| Plant found in the NAs only | | | | | |
| 39 | Salix discolor Muhl. | 0.6/2 | 0/0 | 0/0 | 2/2 |
| Plants found only in the ENA | | | | | |
| 43 | Fraxinus pennsylvanica Marshall | 0.1/1 | 0/0 | 0/0 | 0/0 |
| 22 | Viburnum dentatum L. | 0.4/1 | 0/0 | 0/0 | 0/0 |
| 81 | Viburnum lentago L. | 0.4/1 | 0/0 | 0/0 | 0/0 |
| Plant found in the WNA and both portions of the ROW | | | | | |
| 6 | Cornus amomum Mill. | 0/0 | 8.6/3 | 11/3 | 22/3 |
| Plant found only on the east portion of the ROW | | | | | |
| 52 | Salix fragilis L. | 0/0 | 2/2 | 0/0 | 0/0 |
| TREE STRATUM | | | | | |
| Plant found only on the east portion of the ROW | | | | | |
| 52 | Salix fragilis L. | 0/0 | 8/1 | 0/0 | 0/0 |

[a] Frequency on the basis of five plots.

TABLE C.7 Plant Species List for the Forested Wetland Community

| Field No.[a] | Scientific Name and Authority | Common Name | Region 1 Wetland Indicator Category[b] | Life-Form/ Origin[c] |
|---|---|---|---|---|
| 41 | Acer rubrum L. | Red maple | FAC | NT |
| 0 | Arisaema triphyllum (L.) Schoot (1) | Green dragon | FACW- | PNF |
| 113 | Athyrium felix femina (L.) Roth | Subartic lady fern | FAC | PNF3 |
| 17 | Carex bebbii (Bailey) Olney ex Fernald | Bebb's sedge | OBL | PNGL |
| 105 | Carex brunnescens (Pers.) Poir. | Brownish sedge | FACW | PNGL |
| 88 | Carex crinita Lam. | Fringed sedge | OBL | PNEGL |
| 95 | Carex gracillima Schweintiz | Graceful sedge | FACU[d] | PNGL |
| 90 | Cornus foemina Mill. | Stiff dogwood | FAC | NS |
| 0 | Fragaria sp. | Strawberry | | |
| 43 | Fraxinus pennsylvanica Marshall | Green ash | FACW | NT |
| 216 | Geum canadense Murray | White avens | FACU | PNF |
| 9 | Glyceria striata (Lam.) A. Hitchc. | Fowl manna grass | OBL | PNEG |
| 111 | Impatiens capensis Meerb. | Spotted touch-me-not | FACW | ANF |
| 44 | Lonicera tartarica L. | Tartarian honeysuckle | FACU | IS |
| 8 | Onoclea sensibilis L. | Sensitive fern | FACW | PNEF3 |
| 237 | Parthenocissus quinquefolia (L.) Planch. | Virginia creeper | FACU | NWV |
| 235 | Pilea pumila (L.) Gray | Canada clearweed | FACW | ANF |
| 79 | Poa alsodes Gray | Grove bluegrass | FACW- | PNG |
| 80 | Poa pratensis L. | Kentucky bluegrass | FACU | PNG |
| 0 | Populus deltoides W. Bart. ex Marshall | Eastern cotton-wood | FAC | NT |
| 100 | Ranunculus acris L. | Tall butter-cup | FAC+ | PIF |
| 32 | Rhamnus cathartica L. | Common buckthorn | UPL | IS |
| 34 | Ribes americana Mill. | Wild black currant | FACW | NS |
| 117 | Rubus pubescens Raf. | Dwarf blackberry | FACW | PNF |
| 87 | Solidago sp. | Goldenrod | | |
| 0 | Toxicodendron radicans (L.) Knutze | Poison ivy | FAC | NWVS |
| 33 | Ulmus americana L. | American elm | FACW- | NT |
| 99 | Viburnum dentatum L. | Arrow-wood | FAC | NTS |
| 81 | Viburnum lentago L. | Nannyberry | FAC | NTS |
| 0 | Viola sp. | Violet | | |
| 230 | Vitis riparia Michx. | River-bank grape | FACW | NWV |

[a] Field number of zero indicates that no voucher specimen was collected.

[b] Wetland indicator categories are assigned to plants in the United States on a regional basis. New Jersey is located in Region 1. A "+" following an indicator indicates a frequency toward the high end of the category (more frequently found in wetlands), while a "-" indicates a frequency toward the low end (less frequently found in wetlands).

[c] Plant characteristics and life-forms assigned to each species are defined in Appendix B.

[d] Represents a tentative assignment of a regional indicator.

TABLE C.8 Areal Coverage Estimates for Plants by Stratum in the Forested Wetland Community

| Field No.[a] | Scientific Name and Authority | Areal Coverage (%) NNA | North ROW | South ROW | SNA |
|---|---|---|---|---|---|
| GROUND STRATUM | | | | | |
| 0 | Moss | - | - | - | 10 |
| HERB STRATUM | | | | | |
| Plants found in both NAs and both portions of the ROW | | | | | |
| 0 | Arisaema triphyllum (L.) Schoot | 1 | 1 | 0.5 | 1 |
| 113 | Athyrium felix femina (L.) Roth | 5 | 1 | 2 | 5 |
| 111 | Impatiens capensis Meerb. | 40 | 50 | 4 | 1 |
| 8 | Onoclea sensibilis L. | 2 | 1 | 3 | 2 |
| 34 | Ribes americana Mill. | 2 | 1 | 3 | 2 |
| 87 | Solidago sp. | 5 | 1 | 3 | 1 |
| Plant found in both NAs and the north portion of the ROW | | | | | |
| 117 | Rubus pubescens Raf. | 10 | 2 | - | 2 |
| Plant found in both NAs and the south portion of the ROW | | | | | |
| 237 | Parthenocissus quinquefolia (L.) Planch. | 2 | - | 2 | 10 |
| Plants found in the NNA and both portions of the ROW | | | | | |
| 105 | Carex brunnescens (Pers.) Poir. | 1 | 2 | 2 | - |
| 32 | Rhamnus cathartica L. | 10 | 1 | 1 | - |
| Plants found in the NNA and the north portion of the ROW | | | | | |
| 44 | Lonicera tartarica L. | 2 | 0.5 | - | - |
| 99 | Viburnum dentatum L. | 1 | 0.5 | - | - |
| Plant found in the NNA only | | | | | |
| 90 | Cornus foemina Mill. | 2 | - | - | - |
| Plants found in the SNA and both portions of the ROW | | | | | |
| 9 | Glyceria striata (Lam.) A. Hitchc. | - | 5 | 1 | 1 |
| 79 | Poa alsodes Gray | - | 2 | 30 | 10 |
| Plants found in the SNA and south portion of the ROW | | | | | |
| 216 | Geum canadense Murray | - | - | 1 | 2 |
| 235 | Pilea pumila (L.) Gray | - | - | 1 | 2 |
| 100 | Ranunculus acris L. | - | - | 1 | 1 |

TABLE C.8 (Cont.)

| Field No.[a] | Scientific Name and Authority | Areal Coverage (%) NNA | North ROW | South ROW | SNA |
|---|---|---|---|---|---|
| Plants found in the SNA only | | | | | |
| 0 | Fragaria sp. | - | - | - | 2 |
| 43 | Fraxinus pennsylvanica Marshall | - | - | - | 20 |
| 80 | Poa pratensis L. | - | - | - | 2 |
| 0 | Populus deltoides W. Bart. ex Marshall | - | - | - | 1 |
| 0 | Toxicodendron radicans (L.) Knutze | - | - | - | 2 |
| 0 | Viola sp. | - | - | - | 1 |
| Plants found on both portions of the ROW | | | | | |
| 41 | Acer rubrum L. | - | 1 | 1 | - |
| 95 | Carex gracillima Schweintiz | - | 1 | 2 | - |
| 33 | Ulmus americana L. | - | 1 | 3 | - |
| 230 | Vitis riparia Michx. | - | 1 | 1 | - |
| Plants found on the north portion of the ROW only | | | | | |
| 17 | Carex bebbii (Bailey) Olney ex Fernald | - | 0.5 | - | - |
| 88 | Carex crinita Lam. | - | 1 | - | - |
| 81 | Viburnum lentago L. | - | 2 | - | - |
| SHRUB STRATUM | | | | | |
| 32 | Rhamnus cathartica L. | 30 | 20 | 2 | 60 |
| 90 | Cornus foemina Mill. | 20 | - | - | - |
| 43 | Fraxinus pennsylvanica Marshall | - | 1 | 2 | - |
| 44 | Lonicera tartarica L. | - | - | 1 | - |
| SAPLING STRATUM | | | | | |
| 41 | Acer rubrum L. | - | 3 | - | - |
| TREE STRATUM | | | | | |
| 41 | Acer rubrum L. | 80 | - | - | - |
| 43 | Fraxinus pennsylvanica Marshall | 4 | - | - | - |
| 0 | Populus deltoides W. Bart. ex Marshall | - | - | - | 20 |
| 33 | Ulmus americana L. | - | - | - | 10 |

[a] Plant number of zero indicates no voucher specimen collected.

TABLE C.9 Plant Species List for the Mixed Vegetation Community

| Field No.[a] | Scientific Name and Authority | Common Name | Region 1 Wetland Indicator Category[b] | Life-Form/ Origin[c] |
|---|---|---|---|---|
| 41 | Acer rubrum L. | Red maple | FAC | NT |
| 42 | Acer saccharinum L. | Silver maple | FACW | NT |
| 23 | Asclepias incarnata L. | Swamp milkweed | OBL | PNF |
| 88 | Carex crinita Lam. | Fringed sedge | OBL | PNEGL |
| 94 | Carex flava L. | Yellow sedge | OBL | PNGL |
| 68 | Carex lupulina Muhl. ex Willd. | Hop sedge | OBL | PNEGL |
| 107 | Carex normalis Mackenz. | Larger straw sedge | FACU | PNGL |
| 91 | Carex pallescens L. | Pale sedge | UPL | PNGL |
| 67 | Carex retrorsa Schweintiz | Retrorse sedge | FACW+ | PNGL |
| 75 | Carex suberecta (Olney) Britton | Prairie straw sedge | OBL | PNGL |
| 70 | Carex × stipata Muhl. ex Willd | Stalk-grain sedge | OBL | PNGL |
| 218 | Cicuta bulbifera L. | Bulblet-bearing water-hemlock | OBL | PNF |
| 53 | Cicuta maculata L. | Spotted water-hemlock | OBL | PNF |
| 6 | Cornus amomum Mill. | Silky dogwood | FACW | NS |
| 90 | Cornus foemina Mill. | Stiff dogwood | FAC | NS |
| 5 | Cornus stolonmifera Michx. | Red-osier dogwood | FACW+ | NS |
| 20 | Equisetum arvense L. | Field horsetail | FAC | PNH2 |
| 62 | Equisetum fluviatile L. | Water horsetail | OBL | PNH2 |
| 29 | Eupatoriadelphus maculatus (L.) R.M. King and H. Rob. | Spotted joe-pye-weed | FACW | PNF |
| 27 | Eupatorium perfoliatum L. | Common boneset | FACW+ | PNF |
| 38 | Fraxinus pennsylvanica Marshall | Green ash | FACW | NT |
| 61 | Galium palustre L. | Marsh bedstraw | OBL | PNF |
| 9 | Glyceria striata (Lam.) A. Hitchc. | Fowl manna grass | OBL | PNEG |
| 111 | Impatiens capensis Meerb. | Spotted touch-me-not | FACW | ANF |
| 57 | Iris versicolor L. | Blueflag | OBL | PNF |
| 115 | Juncus effusus L. | Soft rush | FACW+ | PNEGL |
| 84 | Juncus tenuis Willd. | Slender rush | FAC- | PNGL |
| 77 | Lycopus americana Muhl. ex W. Barton | American bugleweed | OBL | PNF |
| 93 | Lycopus uniflorus Michx. | Northern bugleweed | OBL | PNF |
| 0 | Lycopus virginiana L. | Virginia bugleweed | OBL | PNF |
| 74 | Lysimachia thyrsiflora L. | Tufted loosestrife | OBL | PIF |
| 116 | Mentha sp. | Mint | | |
| 8 | Onoclea sensibilis L. | Sensitive fern | FACW | PNEF3 |
| 104 | Phleum pratense L. | Timothy | FACU | PIG |
| 69 | Poa alsodes Gray | Grove bluegrass | FACW- | PNG |
| 14 | Poa pratensis L. | Kentucky bluegrass | FACU | PNG |
| 108 | Polygonum sp. | Smartweed | | |
| 100 | Ranunculus acris L. | Tall Butter-cup | FAC+ | PIF |
| 32 | Rhamnus cathartica L. | Common buckthorn | UPL | IS |
| 110 | Rhamnus frangula L. | Glossy buckthorn | FAC | IS |
| 39 | Salix discolor Muhl. | Pussy willow | FACW | NS |
| 4 | Salix petiolaris Pursh | Meadow willow | OBL | NS |
| 10 | Scirpus atrovirens Willd. | Green bulrush | OBL | PNEGL |

TABLE C.9 (Cont.)

| Field No.[a] | Scientific Name and Authority | Common Name | Region 1 Wetland Indicator Category[b] | Life-Form/ Origin[c] |
|---|---|---|---|---|
| 103 | Sium suave Walter | Hemlock water-parsnip | OBL | PNEF |
| 87 | Solidago sp . (wide leaves) | Goldenrod | | |
| 86 | Solidago sp. (narrow lvs.) | Goldenrod | | |
| 0 | Typha latifolia L. | Broad-leaf cattail | OBL | PNEF |
| 112 | Typha x glauca Godr. | Blue cattail | OBL | PNEF |
| 33 | Ulmus americana L. | American elm | FACW+ | NT |
| 109 | Verbena hastata L. | Blue vervain | FACW+ | PNF |
| 55 | Vicia cracca L. | Cow-vetch | UPL | PIF |

[a] Field number of zero indicates that no voucher specimen was collected.

[b] Wetland indicator categories are assigned to plants in the United States on a regional basis. New Jersey is located in Region 1. A "+" following an indicator indicates a frequency toward the high end of the category (more frequently found in wetlands), while a "-" indicates a frequency toward the low end (less frequently found in wetlands).

[c] Plant characteristics and life-forms assigned to each species are defined in Appendix B.

TABLE C.10 Areal Coverage Estimates for Plants by Stratum in the Mixed Vegetation Community

| Field No.[a] | Scientific Name and Authority | Areal Coverage (%) NNA | North ROW | South ROW | SNA |
|---|---|---|---|---|---|
| EXPOSED SOIL | | 10 | - | - | - |
| STANDING WATER | | 20 | - | - | - |
| HERB STRATUM | | | | | |
| Plants found in both NAs and both portions of the ROW | | | | | |
| 107 | Carex normalis Mackenz. | 1 | 1 | 2 | 3 |
| 70 | Carex × stipata Muhl. ex Willd | 1 | 1 | 2 | 5 |
| 53 | Cicuta maculata L. | 1 | 1 | 1 | 0.5 |
| 29 | Eupatoriadelphus maculatus (L.) R.M. King & H. Rob. | 3 | 3 | 10 | 10 |
| 27 | Eupatorium perfoliatum L. | 1 | 1 | 2 | 2 |
| 61 | Galium palustre L. | 0.5 | 2 | 0.5 | 3 |
| 111 | Impatiens capensis Meerb. | 30 | 10 | 2 | 5 |
| 57 | Iris versicolor L. | 1 | 1 | 0.5 | 1 |
| 77 | Lycopus americana Muhl. ex W. Barton | 1 | 1 | 1 | 1 |
| 14 | Poa pratensis L. | 2 | 3 | 15 | 10 |
| 87 | Solidago sp . | 2 | 1 | 1 | 2 |
| Plants found in both NAs and the north portion of the ROW | | | | | |
| 20 | Equisetum arvense L. | 2 | 2 | - | 2 |
| 116 | Mentha sp. | 2 | 1 | - | 1 |
| Plants found in both NAs and the south portion of the ROW | | | | | |
| 23 | Ascelpias incarnata L. | 0.5 | - | 1 | 1 |
| 100 | Ranunculus acris L. | 1 | - | 1 | 1 |
| 10 | Scirpus atrovirens Willd. | 2 | - | 2 | 10 |
| Plant found in both NAs only | | | | | |
| 110 | Rhamnus frangula L. | 2 | - | - | 1 |
| Plants found in the NNA and both portions of the ROW | | | | | |
| 69 | Poa alsodes Gray | 10 | 15 | 30 | - |
| 108 | Polygonum sp. | 3 | 1 | 1 | - |
| Plants found in the NNA and the south portion of the ROW | | | | | |
| 218 | Cicuta bulbifera L. | 1 | - | 1 | - |
| 4 | Salix petiolaris Pursh | 0.5 | - | 10 | - |
| Plants found in the NNA only | | | | | |
| 62 | Equisetum fluviatile L. | 0.5 | - | - | - |
| 93 | Lycopus uniflorus Michx. | 1 | - | - | - |
| 104 | Phleum pratense L. | 0.5 | - | - | - |
| 32 | Rhamnus cathartica L. | 2 | - | - | - |

TABLE C.10 (Cont.)

| Field No.[a] | Scientific Name and Authority | Areal Coverage (%) NNA | North ROW | South ROW | SNA |
|---|---|---|---|---|---|
| | Plants found in the SNA and both portions of the ROW | | | | |
| 41 | Acer rubrum L. | - | 1 | 0.5 | 2 |
| 112 | Typha × glauca Godr. | - | 2 | 3 | 0.5 |
| | Plants found in the SNA and the north portion of the ROW | | | | |
| 67 | Carex retrorsa Schweintiz | - | 1 | - | 2 |
| 115 | Juncus effusus L. | - | 1 | - | 3 |
| 8 | Onoclea sensibilis L. | - | 1 | - | 2 |
| | Plants found in the SNA and the south portion of the ROW | | | | |
| 5 | Cornus stolonifera Michx. | - | - | 20 | 10 |
| 86 | Solidago sp. (narrow lvs.) | - | - | 0.5 | 1 |
| 0 | Typha latifolia L. | - | - | 0.5 | 1 |
| 55 | Vicia cracca L. | - | - | 0.5 | 1 |
| | Plants found in the SNA only | | | | |
| 88 | Carex crinita Lam. | - | - | - | 0.5 |
| 68 | Carex lupulina Muhl. ex Willd. | - | - | - | 1 |
| 91 | Carex pallescens L. | - | - | - | 2 |
| 0 | Lycopus virginiana L. | - | - | - | 1 |
| | Plants found on both portions of the ROW | | | | |
| 39 | Salix discolor Muhl. | - | 1 | 3 | - |
| 33 | Ulmus americana L. | - | 1 | 1 | - |
| | Plants found on the north portion of the ROW only | | | | |
| 42 | Acer saccharinum L. | - | 1 | - | - |
| 74 | Lysimachia thyrsiflora L. | - | 1 | - | - |
| | Plants found on the south portion of the ROW only | | | | |
| 94 | Carex flava L. | - | - | 2 | - |
| 75 | Carex suberecta (Olney) Britton | - | - | 1 | - |
| 90 | Cornus foemina Mill. | - | - | 20 | - |
| 38 | Fraxinus pennsylvanica Marshall | - | - | 2 | - |
| 9 | Glyceria striata (Lam.) A. Hitchc. | - | - | 2 | - |
| 84 | Juncus tenuis Willd. | - | - | 1 | - |
| 103 | Sium suave Walter | - | - | 1 | - |
| 109 | Verbena hastata L. | - | - | 1 | - |
| | SHRUB STRATUM | | | | |
| | Plants found in both NAs and the north portion of the ROW | | | | |
| 4 | Salix petiolaris Pursh | 60 | 60 | - | 20 |
| 33 | Ulmus americana L. | 2 | 5 | - | 1 |

TABLE C.10 (Cont.)

| Field No.[a] | Scientific Name and Authority | Areal Coverage (%) NNA | North ROW | South ROW | SNA |
|---|---|---|---|---|---|
| Plants found in the NNA and north portion of the ROW | | | | | |
| 6 | Cornus amomum Mill. | 4 | 2 | - | - |
| 5 | Cornus stolonifera Michx. | 1 | 20 | - | - |
| Plants found in the SNA and both portions of the ROW | | | | | |
| 43 | Fraxinus pennsylvanica Marshall | - | 5 | 2 | 5 |
| Plants found on the north portion of the ROW only | | | | | |
| 42 | Acer saccharinum L. | - | 1 | - | - |
| 90 | Cornus foemina Mill. | - | 2 | - | - |

[a] Field number of zero indicates that no specimen was collected.