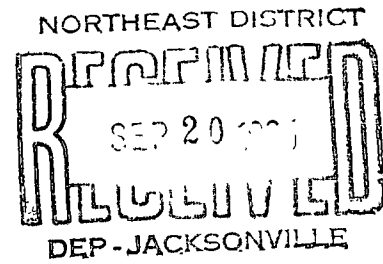


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**TRAIL RIDGE LANDFILL  
MITIGATION MONITORING REPORT NO. 6  
DER PERMITS 161821182 AND SC16-184444**

**24 August 1995**

**PREPARED FOR:**

**Mr. Scott McCallister  
Trail Ridge Landfill  
Waste Management of North America, Inc.  
Post Office Box 548  
5110 U.S. 301  
Baldwin, Florida 32234**

**PREPARED BY:**

**Environmental Services, Inc.  
8711 Perimeter Park Boulevard, Suite 11  
Jacksonville, Florida 32257**

**MITIGATION MONITORING REPORT NO. 6  
FOR  
TRAIL RIDGE LANDFILL**

**A. INTRODUCTION**

On 11 August 1995, Environmental Services, Inc. conducted the sixth monitoring of the forested wetland creation area located at the Trail Ridge Landfill site in Duval County (see Drawing 1). Pursuant to Conditions 6, 11, 12 13 and 14 of Permit # 12-031-055 (see Appendix A) this evaluation was undertaken to document the success of the creation area at the end of its third growing season, and to determine if the site meets success criteria. This report will discuss the status of the project in terms of the following:

- . Percent survival and density of planted species
- . Recruitment density and composition
- . Percent cover of herbaceous species
- . Recorded growth via established parameters for trees and shrubs
- . Hydrological conditions
- . Wildlife utilization

The earthwork phase of construction was completed during the summer of 1992. The mitigation area was over-excavated approximately 0.5 foot below the existing grade of the adjacent wetlands. The area was then backfilled with mulch consisting of the upper soil layer from impacted wetlands on-site to promote natural revegetation by herbaceous recruits. Planting of the forested creation area was completed on 16 November 1992. A mixture of 3-gallon trees and 1-gallon shrubs were planted on 10-foot centers throughout the mitigation area. A total of 2,095 native wetland trees and 125 native wetland shrubs were installed. A completion report of the species planted was submitted on 10 December 1992. Planted tree and shrub species included:

**Native Wetland Trees**

<u>Species</u>	<u>Size</u>	<u>Number</u>
Bald cypress ( <i>Taxodium distichum</i> )	3-gallon	419
Red Maple ( <i>Acer rubrum</i> )	3-gallon	419
Sweetgum ( <i>Liquidambar styraciflua</i> )	3-gallon	419
Black gum ( <i>Nyssa sylvatica</i> var. <i>biflora</i> )	3-gallon	95
Sweet bay ( <i>Magnolia virginiana</i> )	3-gallon	295
Water Tupelo ( <i>Nyssa aquatica</i> )	3-gallon	448

### Native Wetland Shrubs

<u>Species</u>	<u>Size</u>	<u>Number</u>
Wax myrtle ( <i>Myrica cerifera</i> )	1-gallon	31
Fetterbush ( <i>Lyonia lucida</i> )	1-gallon	46
Buttonbush ( <i>Cephalanthus occidentalis</i> )	1-gallon	31
Virginia willow ( <i>Itea virginica</i> )	1-gallon	17

#### **B. ANALYTICAL TECHNIQUES**

A total of eight (8) permanent belt transects were established within the forested mitigation area (Figure 2) and marked with 4-foot PVC stakes for reference. Four transects were orientated north-south, and four were orientated east-west to capture a uniform cross-section of the entire creation area. Each transect is 10 feet in width. All tree specimens within each transect were counted, and the health of each specimen was observed by noting new twig and leaf growth.

A total of ten (10) square meter plots were also permanently installed at each point of intersection between the various transects. The herbaceous density and growth parameters were noted by visual estimation. Recruitment of nuisance and non-nuisance species were noted throughout the mitigation area. Any observed wildlife in the vicinity of the mitigation area was also noted.

The methodology used in assessing growth and survivorship of planted trees and shrubs was as follows:

1. **Survivorship.** All trees and shrubs growing within each transect were counted. This number was divided by the total number of trees or shrubs originally planted within that belt transect to obtain the percent survivorship of planted species.
2. **Growth.** Two (2) trees in each transect were permanently marked with an identifying numbered tag.
  - a. **Caliper.** The width of tree trunks was measured six (6) inches from the ground.
3. **Recruitment.** The natural recruitment of wetland trees, shrubs and herbs in each transect was determined by visual assessment.

The methodology used in assessing growth and coverage of herbaceous vegetation was as follows:

- a. **Growth and Coverage.** The percent cover by wetland species of the total area of each square meter plot was determined and recorded.
- b. **Recruitment.** The natural recruitment of herbaceous wetland species within each plot was determined by visual assessment. Any recruited herbs observed throughout the mitigation area were also noted.

## C. RESULTS

**Survivorship.** The creation area at Trail Ridge has shown excellent survivorship throughout the entire monitoring period. The overall survivorship for all of the transects remains at 92 percent. Numerous black gum, red maple, and sweetgum have recruited into the creation area adding to the overall survivorship. This high survival rate is indicative of excellent growing conditions within the creation area. All of the trees and shrubs were exhibiting new twig and leaf growth. No signs of stress were observed, and all observed specimens appeared healthy. Please refer to Table 1 for the data on the survivorship. The site currently exceeds the 80 percent survival criteria as defined by the permit.

**Growth.** The marked trees were measured for changes in diameter at a height of 6 inches above ground level. Several of the specimens have grown slightly since the previous iteration. The increase in diameter as compared with the data from the first monitoring iteration ranged from 233% to 43% with an average of 122 percent. All species were healthy and normal leaf growth was observed. Growth data are also provided in Table 1.

**Coverage.** The coverage of the mitigation area by natural herbaceous recruits has given the area a natural appearance. The percent coverage by the herbaceous recruits in the area is approximately 80 percent. This also is a very good indicator of the overall success of the creation area, since all of the coverage is a result of natural recruitment. Data from the sample quadrats are provided in Table 2. The diversity of the herbaceous species is very good for a site of this type. The data collected from the quadrats is not indicative of overall site conditions. Several of the sample plots were originally placed in very sandy areas that subsequently were eroded, and infilling has thus been slow. The coverage of the site can be best observed by the enclosed photographs or a site visit. Based on the following frequency equation ( $p = \frac{\text{\# plots occupied}}{\text{total \# plots examined}}$ ), the most frequently encountered species within the creation area are *Panicum* spp. (100%), *Eleocharis* sp. (90%), *Iris virginica* (50%), *Xyris* spp. (40%), and *Lachnanthes caroliniana* (30%). For example, this reveals that *Xyris* spp. occurs throughout 40% of the creation area.

**Recruitment.** A large variety of herbaceous species have naturally recruited into the mitigation area, contributing to the formation of a diverse and thickly vegetated



community. Notable recruits include beak rushes (*Rhynchospora* spp.), sphagnum moss (*Sphagnum* sp.), various sedges (*Cyperus* sp.), rush (*Juncus* sp.), pennywort (*Hydrocotyle umbellata*), bamboo briar (*Smilax laurifolia*), spikerush (*Eleocharis* sp.), red root (*Lachnanthes caroliniana*), low panicum (*Panicum* sp.), St. Johns wort (*Hypericum fasciculatum*), yellow-eyed grass (*Xyris* sp.), blue maidencane (*Amphicarpum muhlenbergianum*), red ludwigia (*Ludwigia repens*), bladderwort (*Utricularia* spp.), iris (*Iris virginica*), and Asiatic coinwort (*Centella asiatica*). Several tree and shrub species have also started to recruit into the creation area. These include red maple, sweetgum, loblolly bay (*Gordonia lasianthus*), fetterbush, groundsel tree (*Baccharis halimifolia*), and black gum. The adjacent wetland system is apparently providing the seeds for these specimens. The average number of recruited species per plot has increased from 2.7 from the first monitoring iteration to 5.3 during the most recent iteration. At least 20 species have been recorded on the site during the various monitoring events.

**Nuisance Species.** No nuisance species such as cattails (*Typha* sp.) were observed within the mitigation area. This may be attributed to the site's location adjacent to a healthy and mature wetland system that lacks significant coverage by any nuisance species.

**Hydrologic Conditions.** The data collected from the piezometers revealed that the water table was very close to the surface. Levels ranged from +0.2 feet to -0.7 feet with the average being -0.1 feet. All piezometer data are provided in Table 3.

**Wildlife Utilization.** During the site visit various species of minnows (*Fundulus* sp.), mosquito fish (*Gambusia* sp.), frogs and tadpoles were observed in the areas of standing water within the creation area. These organisms represent pioneer species which would be expected to colonize developing wetlands, indicating the emergence of a stable ecosystem. Evidence of armadillo (*Dasypus novemcinctus*) and deer (*Odocoileus virginianus*) were once again observed. Some crayfish burrows were also observed indicating saturation at the surface since the previous iteration. Several unidentified passerine species were observed in and around the creation area during the site visit. A red-shouldered hawk, (*Buteo lineatus*) was observed flying over the creation area. The site is providing valuable habitat and a food source for a variety of species.

#### **D. CONCLUSION**

The wetland creation area at Trail Ridge Landfill continues to exhibit signs of success at the end of the third growing season. Planted trees and shrubs appear to be healthy and growing as evidenced by new leaf and twig growth. Percent cover by herbaceous species has been excellent thus far, with herbaceous natural recruits accounting for approximately 80 percent overall coverage of the creation area. No nuisance species have been observed within the project site. Evidence of proper

hydrology and the presence of pioneer wetland/aquatic faunal species indicate the early successional development of a healthy, viable wetland ecosystem. Upon our most recent field inspection, it appears that the wetland creation area meets all success criteria, and we respectfully request final approval on the area.

Attachments

(JH\dmm\MIT-181.01\91-297.04\91-297.MR6)

TABLE 1  
Percent Survival & Growth Data of Planted Trees

Transect Number	No of Planted Trees	No of Trees Living						Percent Survival						Tree Number - Species	Spring 1993 Caliper (inches)		Fall 1993 Caliper (inches)		Spring 1994 Caliper (inches)		Fall 1994 Caliper (inches)		Spring 1995 Caliper (inches)		Fall 1995 Caliper (inches)	
		M <sup>1</sup>	M <sup>2</sup>	M <sup>3</sup>	M <sup>4</sup>	M <sup>5</sup>	M <sup>6</sup>	M <sup>1</sup>	M <sup>2</sup>	M <sup>3</sup>	M <sup>4</sup>	M <sup>5</sup>	M <sup>6</sup>		Spring 1993 Caliper (inches)	Fall 1993 Caliper (inches)	Spring 1994 Caliper (inches)	Fall 1994 Caliper (inches)	Spring 1995 Caliper (inches)	Fall 1995 Caliper (inches)	Spring 1995 Caliper (inches)	Fall 1995 Caliper (inches)	Spring 1995 Caliper (inches)	Fall 1995 Caliper (inches)	Spring 1995 Caliper (inches)	Fall 1995 Caliper (inches)
1	37	37	36	35	35	33	33	*	97	95	95	89	89	T1-1 (Taxodium distichum) T1-2 (Liquidambar styraciflua)	0.4 0.5	0.4 0.5	0.5 0.5	0.9 0.6	1.2 0.9	1.2 0.9	1.3 1.0	1.3 1.0	1.3 1.0	1.3 1.0	1.3 1.0	1.3 1.0
2	40	40	37	37	36	36	36	*	93	93	90	90	90	T2-1 (Taxodium distichum) T2-2 (Nyssa sylvatica var biflora)	0.5 0.3	0.6 0.4	0.6 0.5	1.0 0.5	1.2 0.6	1.2 0.6	1.2 0.7	1.2 0.7	1.2 0.6	1.2 0.7	1.2 0.7	1.2 0.7
3	45	45	44	44	44	43	43	*	98	98	98	96	96	T3-1 (Taxodium distichum) T3-2 (Magnolia virginiana)	0.6 0.5	0.6 0.5	0.7 0.7	0.9 0.7	1.2 0.8	1.2 0.8	1.2 0.8	1.2 0.8	1.2 0.8	1.2 0.8	1.2 0.8	1.2 0.8
4	31	31	31	31	30	29	29	*	10 0	10 0	97	97	94	T4-1 (Acer rubrum) T4-2 (Acer rubrum)	0.5 0.3	0.5 0.4	0.6 0.4	0.7 0.6	1.0 0.9	1.0 0.9	1.0 0.9	1.1 1.0	1.1 1.0	1.1 1.0	1.1 1.0	1.1 1.0
5	91	91	91	91	88	85	84	*	10 0	10 0	97	93	92	T5-1 (Acer rubrum) T5-2 (Acer rubrum)	0.4 0.5	0.4 0.5	0.4 0.5	0.7 0.7	1.0 0.7	1.0 0.7	1.0 0.7	1.0 0.8	1.0 0.8	1.0 0.8	1.0 0.8	1.0 0.8
6	80	80	80	79	78	75	75	*	10 0	10 0	98	94	94	T6-1 (Magnolia virginiana) T6-2 (Magnolia virginiana)	0.7 0.8	0.8 0.8	0.8 0.9	0.8 0.8	0.9 0.9	0.9 0.9	0.9 0.8	1.0 0.8	1.0 0.8	1.0 0.8	1.0 0.8	1.0 0.8
7	46	46	46	46	46	44	43	*	10 0	10 0	10	96	93	T7-1 (Acer rubrum) T7-2 (Liquidambar styraciflua)	0.4 0.6	0.6 0.6	0.6 0.7	0.8 0.8	0.9 0.9	0.9 0.9	0.9 0.8	0.9 0.8	0.9 0.8	0.9 0.8	0.9 0.8	0.9 0.8
8	44	44	36	36	36	36	36	*	82	10	82	82	82	T8-1 (Acer rubrum) T8-2 (Taxodium distichum)	0.4 0.7	0.5 0.7	0.5 0.7	0.7 1.0	0.8 1.3	0.8 1.3	0.9 1.4	0.9 1.4	0.9 1.4	0.9 1.4	0.9 1.4	0.9 1.4

Note: M<sup>1</sup> designates the first monitoring iteration, M<sup>2</sup> the second, etc.

\* Since no previous survivorship data has been taken, data from the first iteration will serve as background for future comparison

\*\* Dead

**TABLE 2**  
**Data From Sample Quadrats at Trail Ridge Landfill**

Quadrat #	Species	Percent Coverage					
		M1	M2	M3	M4	M5	M6
Q-1	<i>Eleocharis</i> sp.	3	15	30	15	2	5
	<i>Panicum</i> sp.			15	15	2	8
	<i>Lachnanthes caroliniana</i>		5		10		
	<i>Rhynchospora</i> spp.				5		5
	<i>Juncus elliotti</i>					2	1
	<i>Xyris</i> sp.					2	5
	<i>Hypericum</i> sp.						10
Q-2	<i>Panicum</i> sp.	3	2	50	35	40	40
	<i>Rhynchospora</i> sp.	5	5	10	10		5
	<i>Ludwigia repens</i>	3					
	<i>Hypericum fasciculatum</i>	4	2		1		8
	<i>Lachnanthes caroliniana</i>	5	5		10	8	10
	<i>Eleocharis</i> sp.	40	40		20	20	12
	<i>Centella asiatica</i>					10	6
	<i>Iris virginica</i>					8	3
Q-3	<i>Panicum</i> sp.	40	50	70	70	50	70
	<i>Eleocharis</i> sp.	30	20	10	8		2
	<i>Rhynchospora</i> sp.	10	10	10	8	2	2
	<i>Utricularia</i> spp.					4	
	<i>Iris virginica</i>						5

**TABLE 2 (Continued)**  
**Data From Sample Quadrats at Trail Ridge Landfill**

Quadrat #	Species	Percent Coverage					
		M1	M2	M3	M4	M5	M6
Q-4	<i>Panicum</i> sp.	20	10	40	35	35	50
	<i>Eleocharis</i> sp.	60	80	35	25	7	2
	<i>Rhynchospora</i> sp.	5	5	5	10		2
	<i>Xyris</i> sp.		2	2	5	8	
	<i>Lachnanthes caroliniana</i>		2		8	2	5
	<i>Ludwigia repens</i>	5					
	<i>N. sylvatica</i> v. <i>biflora</i>				2		2
	<i>Centella asiatica</i>					5	7
	<i>Hypericum</i> spp.					5	4
	<i>Eriocaulon</i> spp.					6	
	<i>Iris virginica</i>						5
Q-5	<i>Rhynchospora</i> sp.			2	5		18
	<i>Iris virginica</i>			1			3
	<i>Ludwigia repens</i>	2	2				
	<i>Panicum</i> spp.				10	7	10
	<i>Utricularia</i> spp.					3	
	<i>Xyris</i> sp.						5
Q-6	<i>Panicum</i> sp.			8	10	5	10
	<i>Eleocharis</i> sp.		2	10	5	5	10
	<i>Andropogon virginicus</i>			5	2		5
	<i>Rhynchospora</i> spp.				3	5	15
	<i>Utricularia</i> spp.					3	

**TABLE 2 (Continued)**  
**Data From Sample Quadrats at Trail Ridge Landfill**

Quadrat #	Species	Percent Coverage					
		M1	M2	M3	M4	M5	M6
Q-7	<i>Panicum</i> sp.			25	25	30	40
	<i>Eleocharis</i> sp.	5	20	20	15	5	15
	<i>Rhynchospora</i> sp.		20	20	25	10	25
	<i>Juncus elliotii</i>				10	5	5
	<i>Xyris</i> spp.					7	5
	<i>Iris virginica</i>						5
Q-8	<i>Panicum</i> sp.	20	5	30	30	20	30
	<i>Rhynchospora</i> sp.	20	35	40	20	10	10
	<i>Eleocharis</i> sp.	30	35		20	8	5
	<i>Ilex glabra</i>						8
Q-9	<i>Panicum</i> sp.	10	5	10	15	20	25
	<i>Eleocharis</i> sp.	60	60	35	30	10	8
	<i>Rhynchospora</i> sp.			5	5	5	8
	<i>Cyperus</i> spp.	5	5				
	<i>Fuirena squarrosa</i>				5		
	<i>Xyris</i> spp.					8	5
	<i>Utricularia</i> spp.					7	
	<i>Ilex glabra</i>					2	5
Q-10	<i>Panicum</i> sp.	10	20	50	40	25	35
	<i>Rhynchospora</i> sp.	10	5	35	15	30	30
	<i>Eleocharis</i> sp.	55	50	3	10	10	5
	<i>Iris virginica</i>			2			
	<i>Juncus effusus</i>	10	15				
	<i>Juncus elliotii</i>				20		
	<i>Lachnanthes caroliniana</i>				10	5	10
	<i>Baccharis halimifolia</i>					5	10

**Table 3. Piezometer Data From Wetland Creation Area**

Depth of Water Table(feet)

Piez.#	Fall 1993	Spring 1994	Fall 1994	Spring 1995	Fall 1995
1	-3.0	-1.3	-2.5	-1.5	-0.7
2	-1.3	-1.7	-1.2	0.0	-0.2
3	-1.1	-0.6	-0.5	-0.1	-0.3
4	-1.5	-1.1	-1.7	-0.2	-0.5
5	0.0	0.0	-1.1	+0.1	+0.2
6	-1.0	-1.0	-1.3	0.0	+0.2
7	-1.7	-1.7	-2.3	-0.5	0.0
8	-2.5	-0.5	-1.7	-0.1	-0.2
9	+0.2	0.0	-2.1	-0.1	-0.2
10	-0.9	+0.4	0.0	+0.2	+0.2
11	*	-0.5	-1.6	0.0	0.0

## APPENDIX A

### PROJECT INFORMATION

Date: 22 August 1995	
Project Name: Trail Ridge Landfill	Project No: 91-297.3
Monitoring Period: Fall 1995	Monitoring Rep: 6 of 6
Permit No: <u>161821182 and SC16-184444</u>	
Total Wetlands Created: <u>± 4.76 acres</u>	
Monitoring Conditions: <u>Permit No. 161821182 - Specific Conditions 6, 11, 12, 13 and 14 (46, 51, 52, 53 and 54 for Permit No. SC16-184444).</u>	
6(46).	The mitigation plan, "Trail Ridge Landfill Wetland Impacts and Mitigation Plan," submitted on June 18, 1990, shall be appended as a Specific Condition of this permit. Any specific condition requirements listed herein, shall supersede or modify any requirements contained in the appended mitigation plan.
11(51).	The permittee shall furnish the Department with monitoring reports on the wetland creation areas describing: <ul style="list-style-type: none"><li>a. Percent survival and diversity of planted species within each stratum;</li><li>b. Recruitment density and composition within each stratum;</li><li>c. Recorded growth via established parameters for planted trees and shrubs;</li><li>d. Percent cover of herbaceous species;</li><li>e. Surface water elevations referenced to N.G.V.D., or if surface water is not present, groundwater elevation referenced to N.G.V.D.</li></ul> <p>The first monitoring year shall start as of the planting date and data shall be collected and submitted in accordance with Specific Condition Number 6. Reports to the Department must also include photographs, descriptions of problems encountered and solutions undertaken.</p>



**Monitoring Conditions 6, 11, 12, 13 and 14 (46, 51, 52, 53 and 54) Continued**

- 12(52). Within the wetland creation areas, non-native vegetation and nuisance vegetation such as *Typha* sp. shall be controlled by hand clearing or other methods approved by the Department so that they constitute no more than 10% of the areal cover at any monitoring period.
- 13(53). Successful establishment of the wetland creation shall occur when:
- a. On an annual basis at least 80 percent of the planted individuals in each stratum have survived and are showing signs of normal annual growth, based on standard growth parameters such as height and base diameter, or canopy circumference; and
  - b. The above criteria has been achieved and maintained for a three (3) year period following initial planting.
- 14(54). In the event that the success criteria as stated in Specific Condition Number 13 are not achieved by the expiration date of this permit, the permittee shall enter into a long term agreement with the Department so as to insure the success of the mitigation plan.

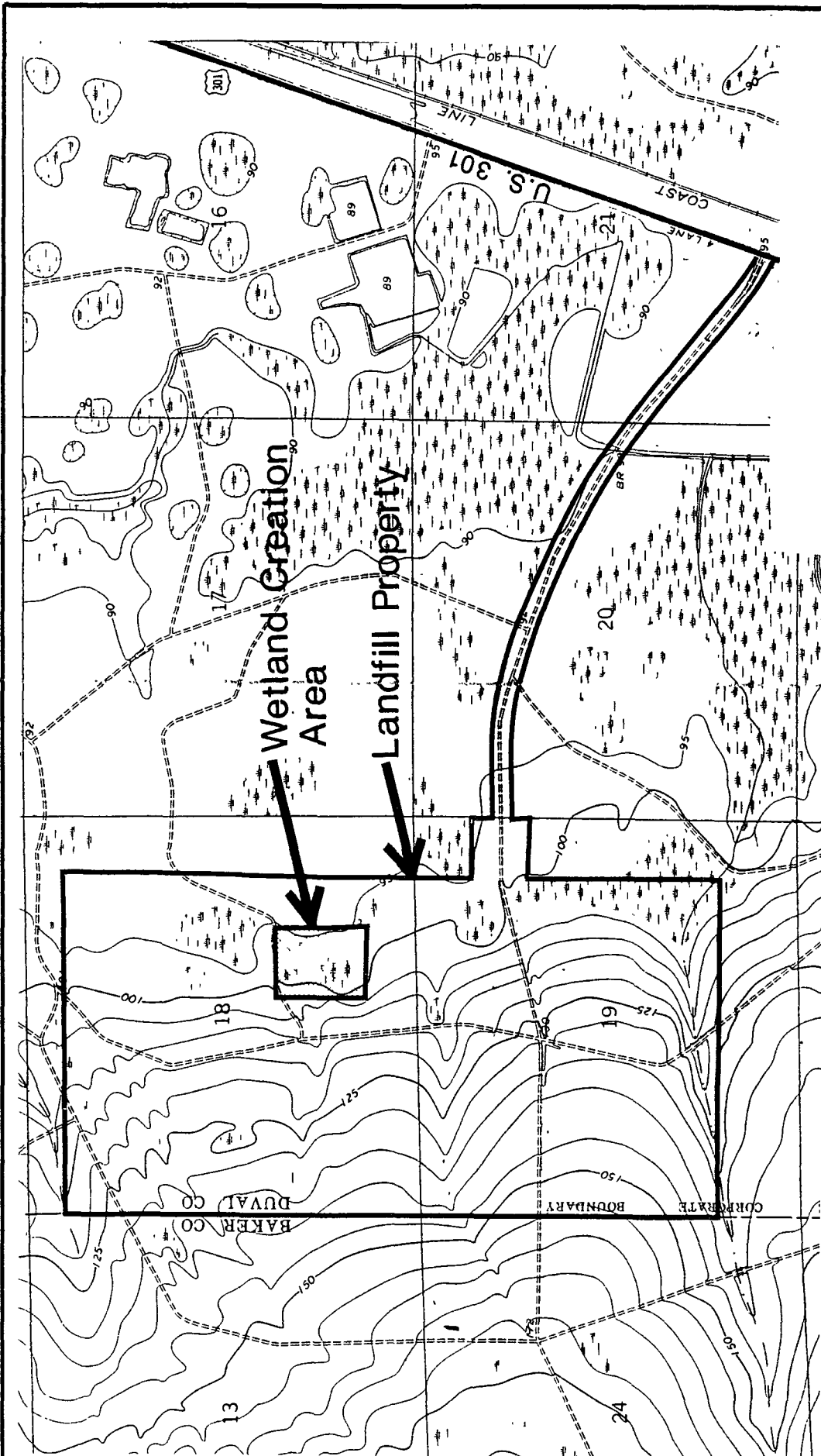
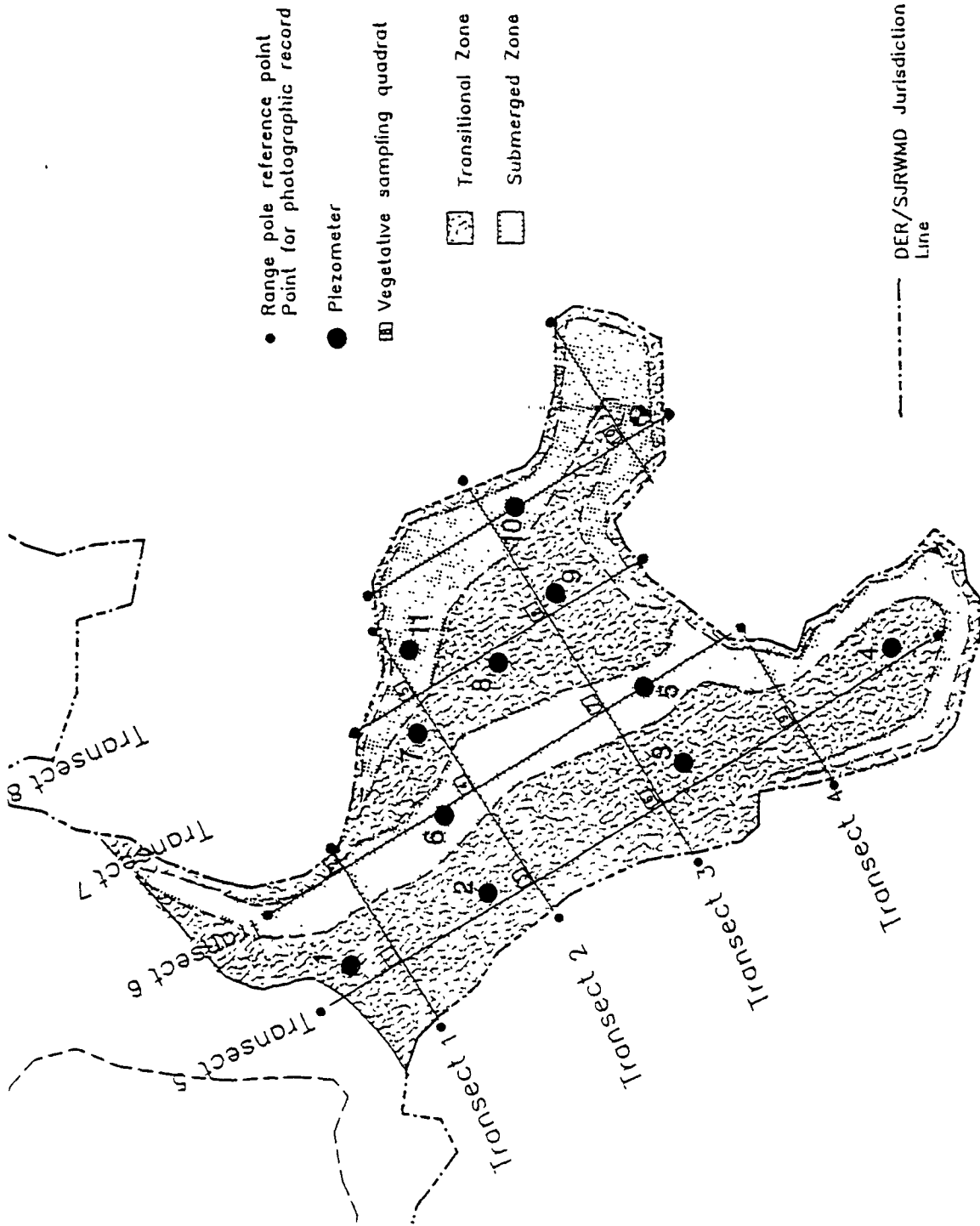


Figure 1  
Location Map

Source: U.S.G.S. Topographical Survey,  
Maxville, FL., Quadrangle. (1970)

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			Date 5/26/93
			Scale 1"=2000'
			Drawing No. 1 of 2



# Trail Ridge Landfill Mitigation Plan 4.76 Acres



ENVIRONMENTAL  
SERVICES, INC.

Project No.	91-297.3
Date	5/26/93
Scale	1"=150'
Drawing No.	2 of 2



TRAIL RIDGE LANDFILL  
WETLAND CREATION AREA  
FALL 1995



Transect 1 - Panoramic View



Transect 2 - Panoramic View



TRAIL RIDGE LANDFILL  
WETLAND CREATION AREA  
FALL 1995



Transect 3 - Panoramic View



Transect 4 - Panoramic View



TRAIL RIDGE LANDFILL  
WETLAND CREATION AREA  
FALL 1995



Transect 5 - Panoramic View



Transect 5 - Additional View



TRAIL RIDGE LANDFILL  
WETLAND CREATION AREA  
FALL 1995



Transect 6 - Panoramic View



Transect 7 - Panoramic View



TRAIL RIDGE LANDFILL  
WETLAND CREATION AREA  
FALL 1995



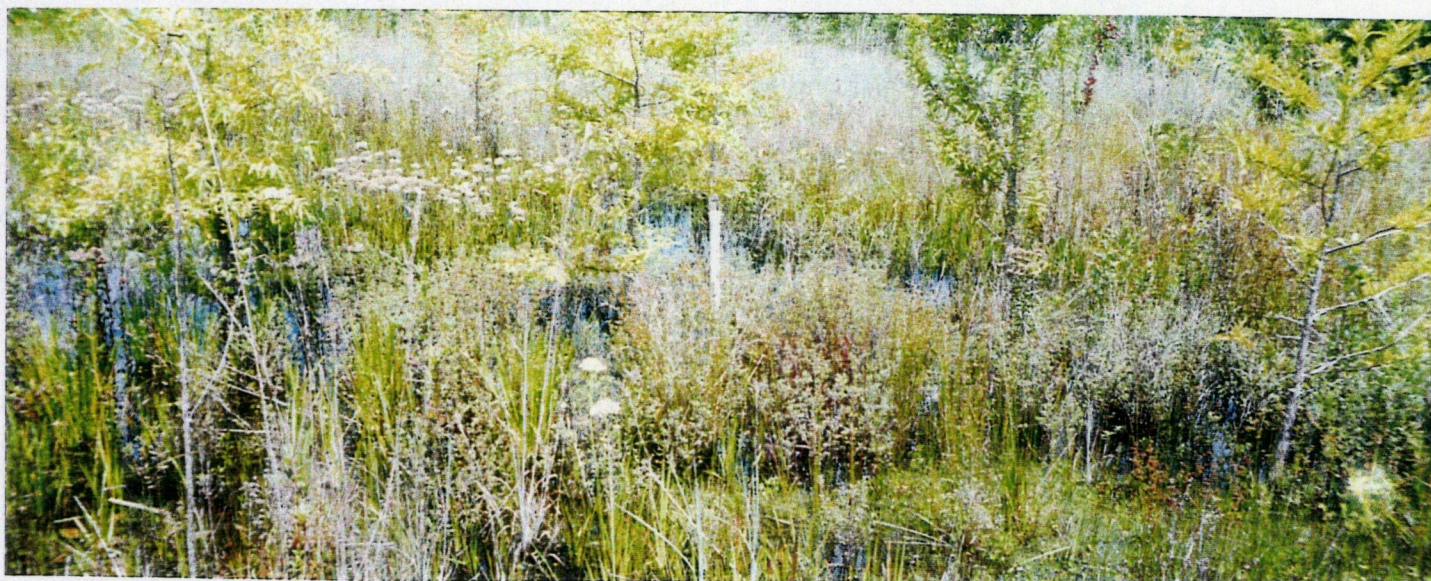
Transect 8 - Panoramic View



Photograph of Sample Quadrat



TRAIL RIDGE LANDFILL  
WETLAND CREATION AREA  
FALL 1995



Photograph of Herbaceous Coverage



Photograph of Herbaceous Coverage