AS-BUILT WETLAND CONSTRUCTION REPORT

ABC SITE
BEAUFORT COUNTY, NORTH CAROLINA

THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
RALEIGH, NORTH CAROLINA

TIP#: R-2510WM
Project #: 8.T221801

January 2001

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INTRODUCTION

The N.C. Department of Transportation (NCDOT) is developing wetland and stream mitigation sites within the upper Coastal Plain region of the Tar-Pamlico river basin. As part of this effort, NCDOT has implemented the detailed mitigation plans for the ABC Mitigation Site (Site), an approximately 75-hectare (187-acre) tract located along Acre Swamp, a tributary of Pungo Creek and the Pamlico River (Figure 1). The Site is situated approximately 18 kilometers (11 miles) northeast of Washington and approximately 77 kilometers (48 miles) west of the coast in Beaufort County, North Carolina.

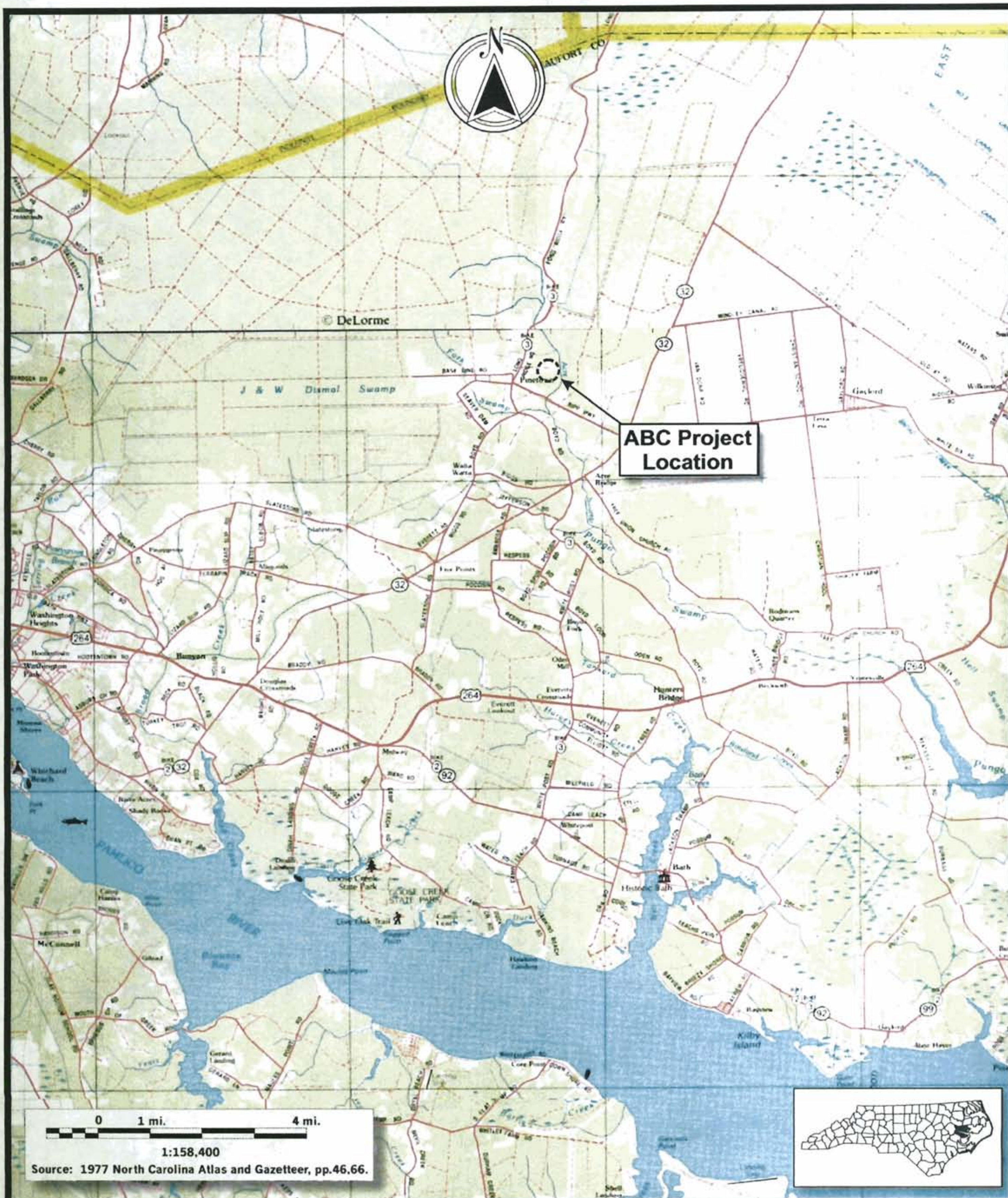
The Site is situated along lower portions of a Coastal Plain inter-stream divide (precipitation flat), groundwater slope, and abandoned riverine floodplains located immediately adjacent to Acre Swamp. A majority of the Site has been cleared, ditched, drained, with wetlands effectively eliminated. The drainage system was installed to facilitate agricultural production and to convey drainage from the precipitation flat and groundwater slope into Acre Swamp. The Acre Swamp channel has been dredged and straightened throughout the watershed, inducing abandonment of floodplains, stream instability, and loss of riverine wetlands in the region. Additional impacts to former wetland surfaces include leveling, crowning, and compaction designed to further facilitate agricultural production.

Wetland mitigation activities have been designed to restore wetland features and functions similar to those exhibited by reference wetlands in the region. Site alterations designed to restore characteristic wetland soil features and groundwater wetland hydrology include depression construction (B-horizon contouring), impervious ditch plug construction, ditch backfilling, field crown removal, and harrowing/ scarification of wetland soil surfaces. Tree and shrub planting be performed in February 2001 to facilitate establishment of diagnostic natural communities. Vegetation planting has not been documented as part of this as-built report.

After implementation, the Site is expected to support 37 hectares (92 acres) of restored non-riverine forested wetlands and 7 hectares (19 acres) of enhanced non-riverine wetland systems. Stream enhancement activities will also be undertaken along approximately 1252 meters (4107 ft) of Acre Swamp through shrub plantings and riparian forest buffer restoration. Upland buffers / ecotones, riparian buffers, and associated groundwater wetland recharge potential will also be restored within the remaining 31 hectares (76 acres) of uplands and stream-side management areas.

Experience shows that restoring wetlands requires specialized knowledge both from a design and construction perspective. As a relatively new science, the task of designing and implementing these systems necessitates field evaluations and on-the-spot alterations during the course of construction. The "prior converted", non-riverine wetland at the ABC mitigation site is no exception. Several important changes were made with respect to the original design in order to facilitate the process and ultimately increase the site's chances for success.

The purpose of this project is to restore non-riverine wet hardwood forest impacted by Traffic Improvement Projects (TIPs) in the region. This document summarizes the step-wise implementation procedure used to restore the "prior converted" non-riverine wetlands at the ABC wetland mitigation site. Restoration construction activities were begun on September 5, 2000 and completed on January 5, 2001.



EcoScience Corporation
Raleigh, North Carolina

SITE LOCATION
ABC MITIGATION SITE
Beaufort County, North Carolina

Dwn. by:	MAF
Ckd by:	JG
Date:	JAN 2001
Project:	98-007B

FIGURE 1

MAJOR TYPES OF EQUIPMENT USED IN WETLAND CONSTRUCTION ACTIVITIES

Three major types of heavy equipment were used during construction of the ABC mitigation Site: bulldozer, excavator, and tractor/pan combination. Tasks descriptions are listed below.

Dozer

- Topsoil removal and stockpiling
- Depression contouring
- Ditch backfill and compaction
- Topsoil redistribution
- Microrelief creation
- Sub-soiling

Excavator

- Ditch clean-out
- Embedded ditch plug excavation
- B-horizon contouring (Depression construction)
- Barrow material excavation
- Tip mound construction

Tractor and Pan combination (Scrapper)

- **B-horizon excavation and hauling**
- **Ditch Backfilling**

SEQUENCING FOR WETLAND HYDROLOGY AND SOIL RESTORATION

Site alterations designed to restore characteristic wetland soil features and groundwater wetland hydrology include: 1) ditch cleaning and ditch plug placement; 2) topsoil removal and stockpiling; 3) B-horizon contouring (depression construction) and ditch backfill material extraction; 4) ditch backfilling; 5) water bar construction; 6) topsoil redistribution (crown removal). The as-built hydrology and soil restoration plan is depicted in Figure 2. The sequence of restoration activities as depicted in the as-built plan is described below.

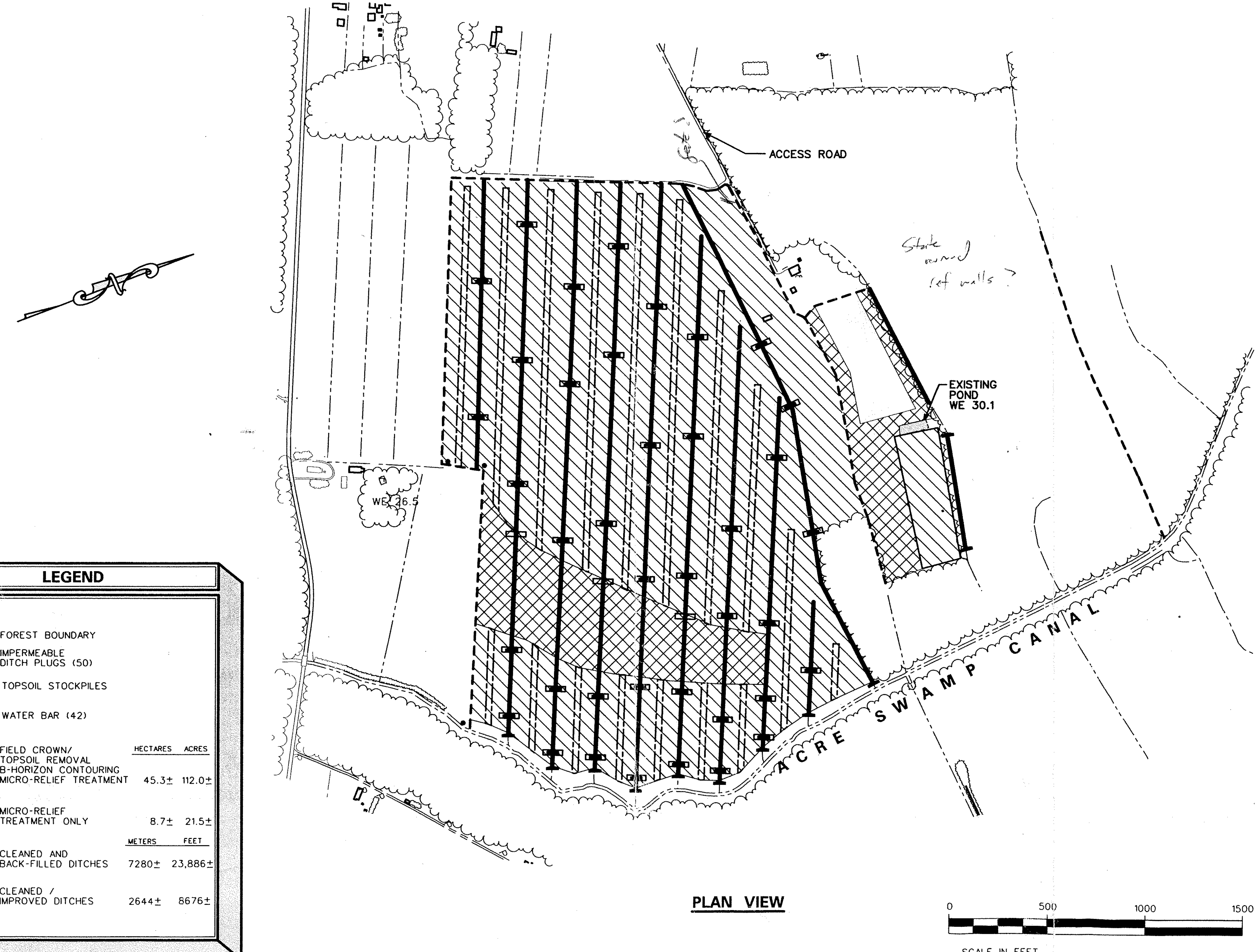
Pro-Construction Conditions

Features which establish hydrodynamic wetland functions, such as surface microtopography, ephemeral ponding, forest vegetation, and characteristic wetland soil properties have been eliminated from agricultural use. On-site reference conditions which represent conditions prior to land clearing and farming activity are shown in Photo 1. Under agricultural land uses, much of the Site exhibits negligible wetland functions. Hydrodynamic functions had been effectively eliminated from the site due to removal of forest vegetation, construction of a drainage network, crown construction, and compaction (plow pan). The pre-construction conditions showing crop land and lack of wetland functions are shown in photo 2 and 3. A diagrammatic depiction of pre-construction conditions is shown in Figure 3.

Photo 1.

Photo 2.

Photo 3.



LEGEND

	FOREST BOUNDARY		
	IMPERMEABLE DITCH PLUGS (50)		
	TOPSOIL STOCKPILES		
	WATER BAR (42)		
		HECTARES	ACRES
	FIELD CROWN/ TOPSOIL REMOVAL B-HORIZON CONTOURING MICRO-RELIEF TREATMENT	45.3±	112.0±
	MICRO-RELIEF TREATMENT ONLY	8.7±	21.5±
		METERS	FEET
	CLEANED AND BACK-FILLED DITCHES	7280±	23,886±
	CLEANED / IMPROVED DITCHES	2644±	8676±

MAP COMPILED BY PHOTOGRAMMETRIC METHODS.

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REVISIONS

Client:

NC DEPARTMENT OF TRANSPORTATION
P.O. BOX 25201
RALEIGH, NORTH CAROLINA 27611

Project:

ABC MITIGATION PLAN

BEAUFORT COUNTY, NORTH CAROLINA

Title:

AS-BUILT GROUNDWATER AND SOIL RESTORATION PLAN

Dwn By: MAF	Date: JAN 2001
Ckd By: JG	Scale: 1"= 500'
ESC Project No.: 98-024.08	

FIGURE

2

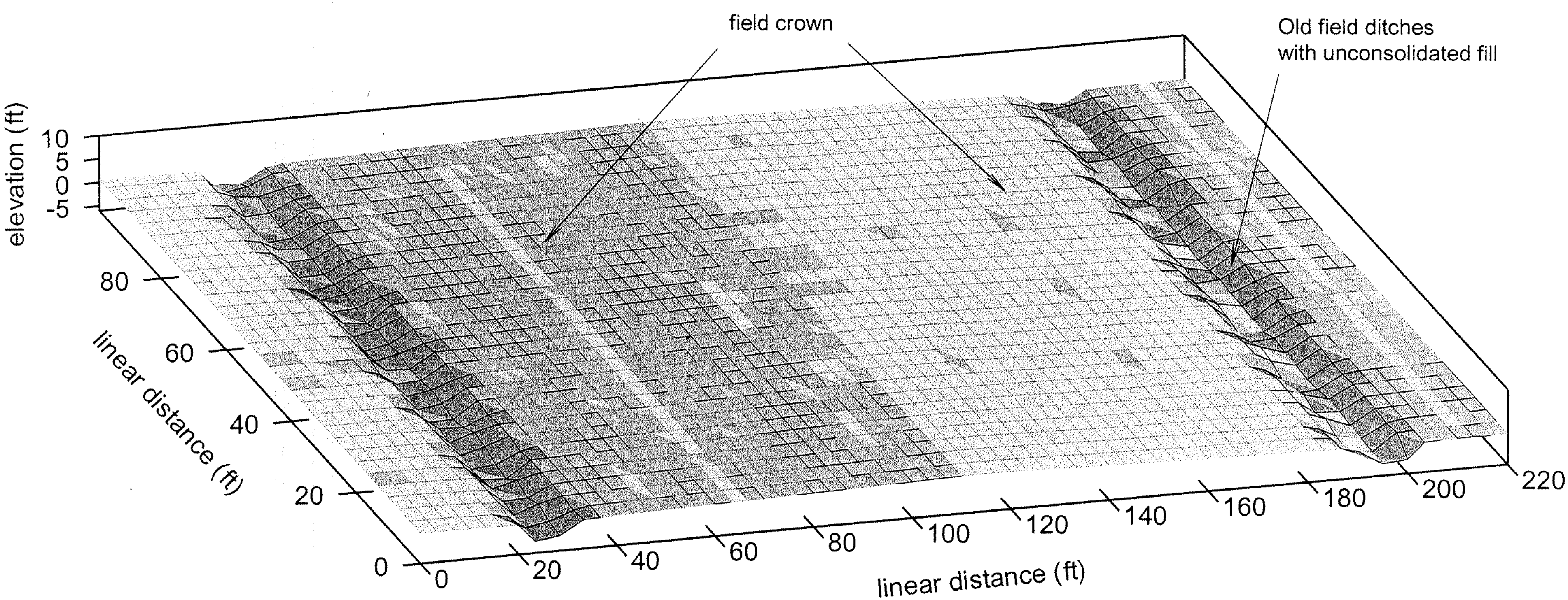

Figure 3. Diagrammatic representation of pre-restoration conditions; including field crown, field ditches, and smooth surface topography.

Ditch Cleaning and Ditch Plug Placement

Prior to any earth moving activities, a disk harrow was used to root up and chop the thick growth of herbaceous vegetation. Additionally, the ditch banks were mowed to ease ditch cleaning activities, improved visibility, and to alleviate clotting of soil with vegetation.

Ditches identified for backfilling in Figure 2 were cleaned to remove unconsolidated sediments from the sides and lower portion of the cross-section. Without removal, the relatively high permeability material accumulated within the ditches may act as a conduit for continued drainage after restoration. Using a tracked excavator, the unconsolidated sediments were lifted from the channel to expose the underlying, relatively impermeable clay substrate along the ditch invert. The sediment was placed on adjacent surfaces and incorporated with the topsoil, which was subsequently excavated and stockpiled during field crown removal. Approximately 9,924 m (32,562 ft) of ditches were cleaned including those on the perimeter of the Site and the off-site drainage redirection. The resultant V-ditch (one side complete) is shown in photo 4. Ditch cleaning and ditch plug placement is depicted in Figure 4.

Photo 4.

Impermeable ditch plugs were located along drainage ditches at points identified in Figure 2. Approximately 40 plugs were placed at regular intervals, including locations directly above abrupt grade changes and prior to ditch **outfall** into Acre Swamp. An embedded plug foot print, measuring approximately 10 feet width by 10 feet in length by one foot in depth, was cut into both ditch banks and ditch bed at the desired plug location (Figure 4). The embedded nature of the plugs ensured the removal of any unconsolidated or permeable material, ensuring a tight inter-locking bond between the clayey B-horizon and low permeable backfill material. The terminal plugs at the ditch **outfalls** were later dressed with rip-rap to counter the erosive flows on the Acre Swamp side of the plugs. Partially completed embedded ditch plugs are shown in Photos 5 and 6.

Photo 5.

Photo 6.

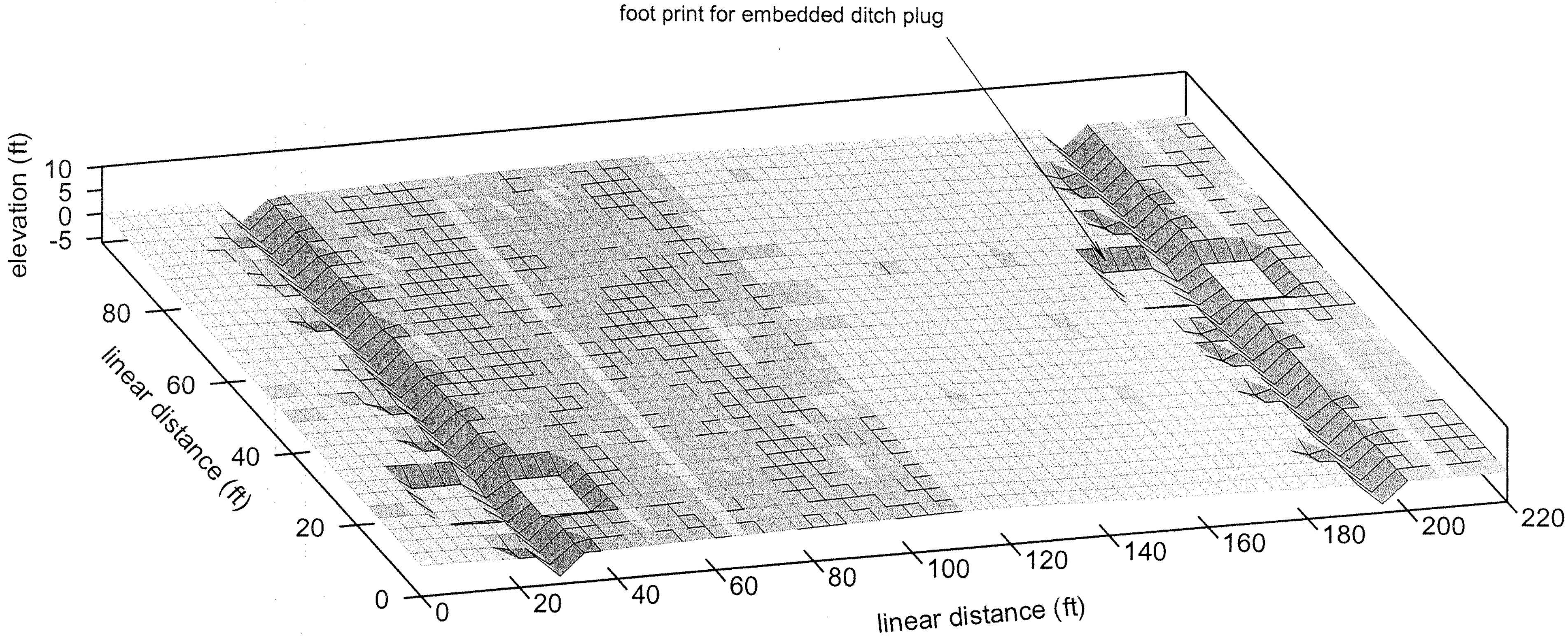

Figure 4. Diagrammatic representation of ditch clean-out and foot print for embedded ditch plugs.

Topsoil Excavation and Stockpiling

Topsoil excavation and stockpiling commenced as soon as the first ditches were cleaned. The topsoil, measuring approximately 1 foot in depth, was pushed to the center of each field. (i.e. the area between two parallel ditches). Topsoil excavation required the use of several large bulldozers to stay ahead of the ensuing sequence of activities. Several fields were excavated concurrently to expedite backfill operations and subsequent soil redistribution. Topsoil excavation and stockpiling is shown in photo 7 and 8 and depicted in Figure 5.

Photo 7.

Photo 8.

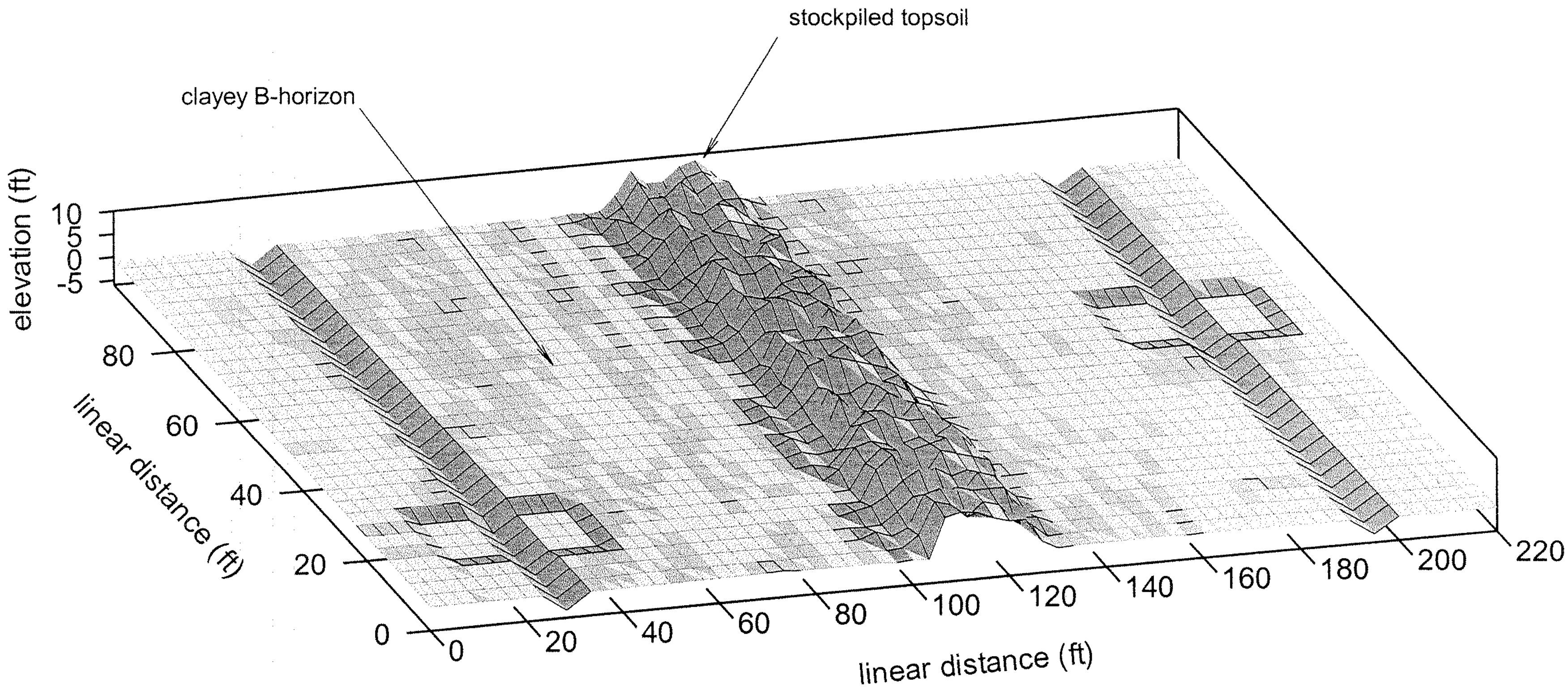

Figure 5. Diagrammatic representaion of topsoil/crown removal and stockpiling.

B-Horizon Contouring

Depressions were constructed into the surface of the clayey B-horizon to mimic the Bayboro (nonriverine swamp forest) depressions identified in reference wetlands. The depression were placed, shaped, and sized randomly throughout the exposed subsurface horizon at a frequency necessary to backfill adjacent ditch sections. The construction of the depressions provided suitable, low permeability material for backfilling ditches and ditch plugs as well as material to construct water bars. Functionally, the depression will contribute to the water storage potential within the wetland restoration area and increase potential for biological diversity within the community complex.

Depression construction always began at the top end (highest elevation) of the field to minimize hauling distances to coincide with ditch backfill activities. The area covered by each depression ranges from 0.02 ac 0.1 ac in size. The clay material was excavated to a depth of approximately 1 to 2 feet below the surface and utilized as backfill material on adjacent ditch sections. A tracked excavator was used to construct and remove material from the depression. Precaution was taken not to dig through the clayey B-horizon into the sandy soil layer below. A scraper (pan) attached to a large farm tractor was used to haul and deliver the material to where it was needed. Subsequently, the depression were contoured with a bulldozer to provide for approximate 8:1 slopes. Photos 9-11 show the work in progress. Figure 6 depicts the B-horizon contouring.

Photo 9.

Photo 10.

Photo 11.

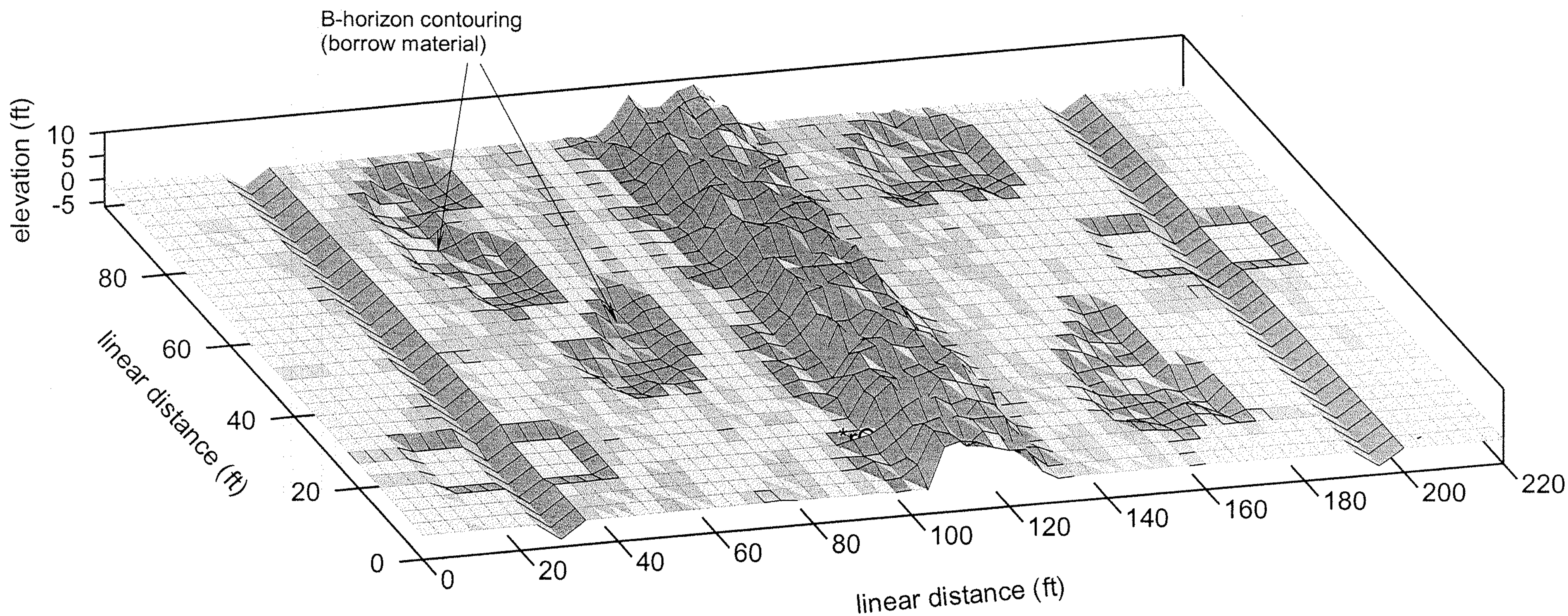

Figure 6. Diagrammatic representation of B-horizon contouring and borrow material for ditch backfill and ditch plugs.

Ditch and Plug Backfilling

Ditches and ditch plugs located adjacent to the constructed depressions were back-filled with clay-based material excavated from the depressions. The ditch backfill operation always began from the highest ditch elevation to avoid flooding problems. An excavator working with the tractor and pan combination was used for this construction activity. Approximately 7,280 m (23,886 ft) of ditches were filled, compacted, and graded approximately 0.5 -0.8 foot above the elevation of the adjacent B-horizon surface. The additional fill material was added to allow for any future settling. Ditch and plug backfilling operations are shown in photo 12 and 13 and depicted in Figure 7. A bulldozer was used to both move the material into the ditch and for compaction (photo 14).

Photo 12.

Photo 13.

Photo 14.

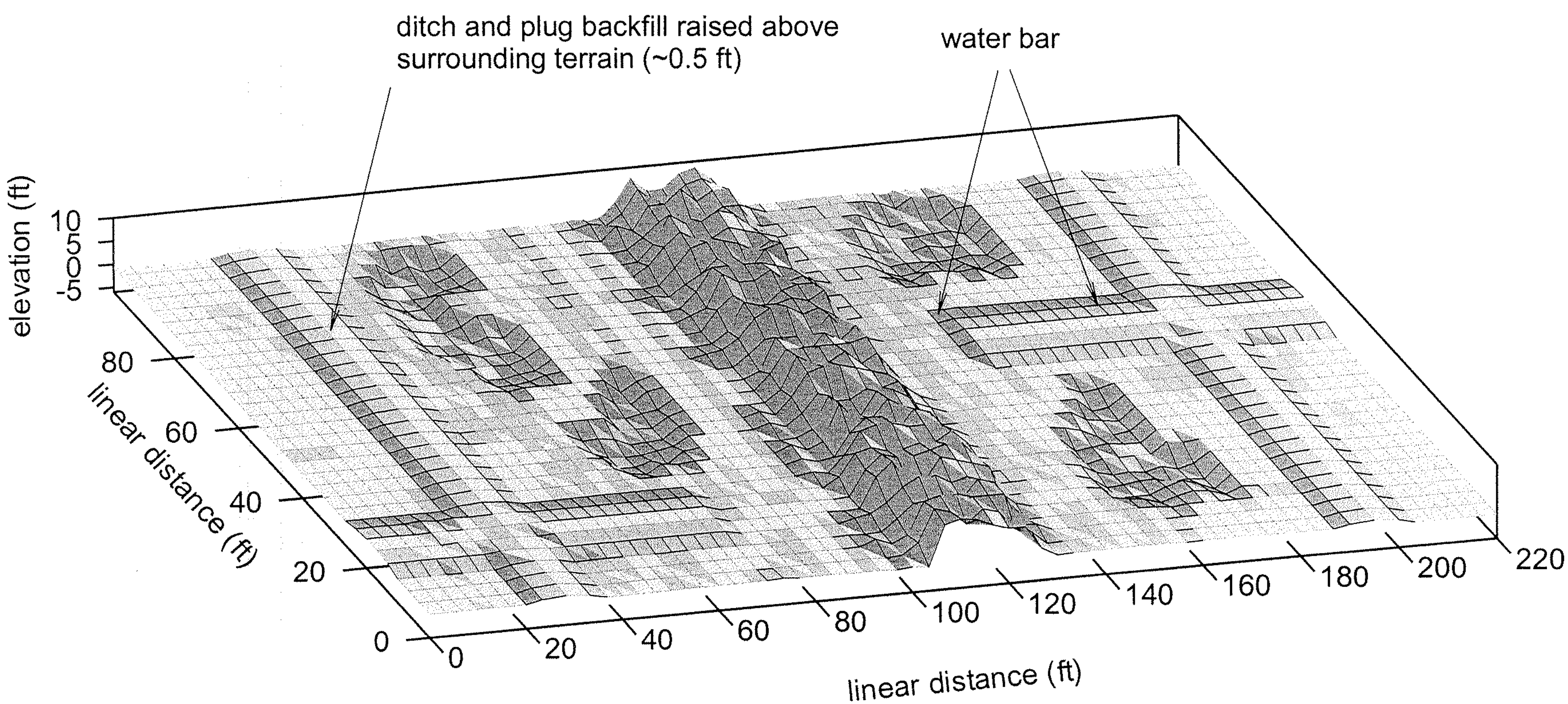

Figure 7. Diagrammatic representation of ditch and plug backfill; and water bar construction.

Water Bars

Water bars were installed to counteract drainage from a potential hardpan i.e. flattened B-horizon surface) and moderate sheet flow in the downhill direction of the site. The bars were installed perpendicular to the drainage ditches at locations identified in Figure 2. The water bars were generally placed at the same location as the ditch plugs and typically became extensions of the ditch plugs (see Figure 7).

The water bars were placed directly on the B-horizon to both sides of the ditch and constructed from the low permeable materials excavated from the adjacent depressions. The water bars were compacted and graded to from a long mound approximately 50 feet in length by 10 feet in depth by 1 to 1.5 feet in height. Photo 15 shows a completed water bar.

Photo 15

Topsoil **redistribution/Crown** removal

Upon completion of the B-horizon contouring, ditch backfilling, and water bar construction the topsoil was redistributed over the entire area at a nominal depth of one foot. Several dozers were employed for a majority of this task. Care was taken to redistribute topsoil evenly throughout, including areas within constructed depressions. During construction, depressional areas often filled with water from groundwater or precipitation events, making topsoil redistribution in these areas difficult. An excavator was used to place topsoil within depressional areas when conditions warranted. The excavator was also used to distribute topsoil on the water bars. With regular monitoring of topsoil depths and elevations the redistribution of the topsoil effectively eliminated the field crown. Photos 16 and 17 show the topsoil being redistributed. Figure 8 depicts completed site construction activities including: topsoil redistribution, crown removal, and microrelief modifications.

Photo 16.

Photo 17.

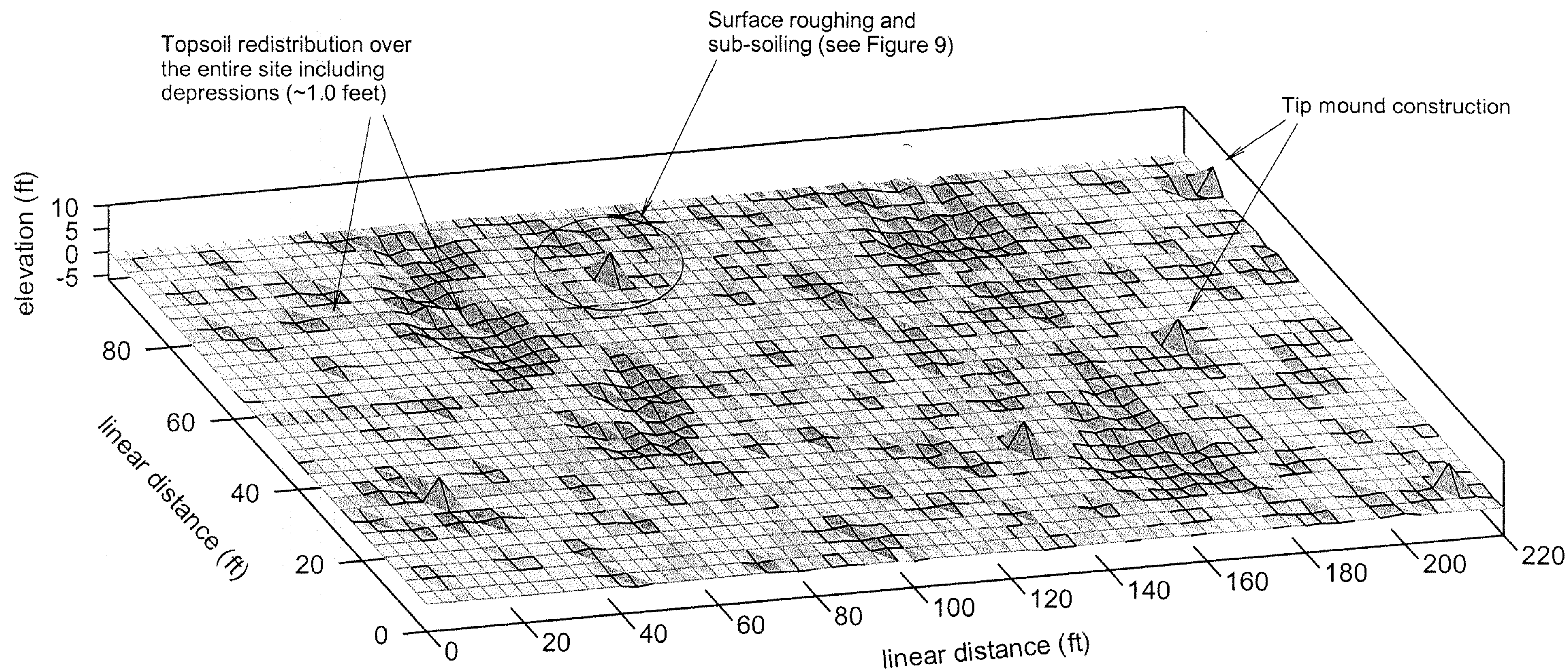

Figure 8. Diagrammatic representation of topsoil redistribution, subsequent crown removal, and microrelief modifications.

Microrelief Modifications

Reference wetlands exhibit complex surface microtopographic relief (microrelief). Small concavities (ephemeral pools), swales, exposed root systems, and hummocks associated with vegetative growth and hydrological patterns are scattered throughout the system. Large woody debris and partially decomposed litter provide additional complexity across the wetland soil surface. Although vegetative components of surface storage capacity will not develop in restored wetlands for several decades, efforts to advance the development of characteristic surface roughness were implemented on the Site. Microtorelief modifications are expected to restore and enhance near-surface and above-surface hydrodynamics. A three stage effort was undertaken to ensure a random, complex, surface microrelief (Figure 9).

The first stage of microrelief development involved the construction of mounds and pits [Figure 9b). Under natural conditions the disturbance of uprooted trees is a means of maintaining species riches and diversity in many forests. Mounds and pits influence tree seedling distribution through differences in soil morphology, nutrition, and moisture content. For further details on microtopography research, refer to the reference section located at the end of the document.

Mounds were constructed with an excavator using barrow material from an adjacent pit. The soil for the mounds were loosely piled approximately 4-5 feet in heigh, with a base diameter of approximately 8 feet. The adjacent pit was not excavated greater than one foot deep, with a diameter of approximately 10 feet. The mounds were spaced randomly around the site at a density of approximately one per acre. Approximately 0.15 acres is covered by mounds. Photo 18 shows an example of a completed mound and pit.

Photo 18

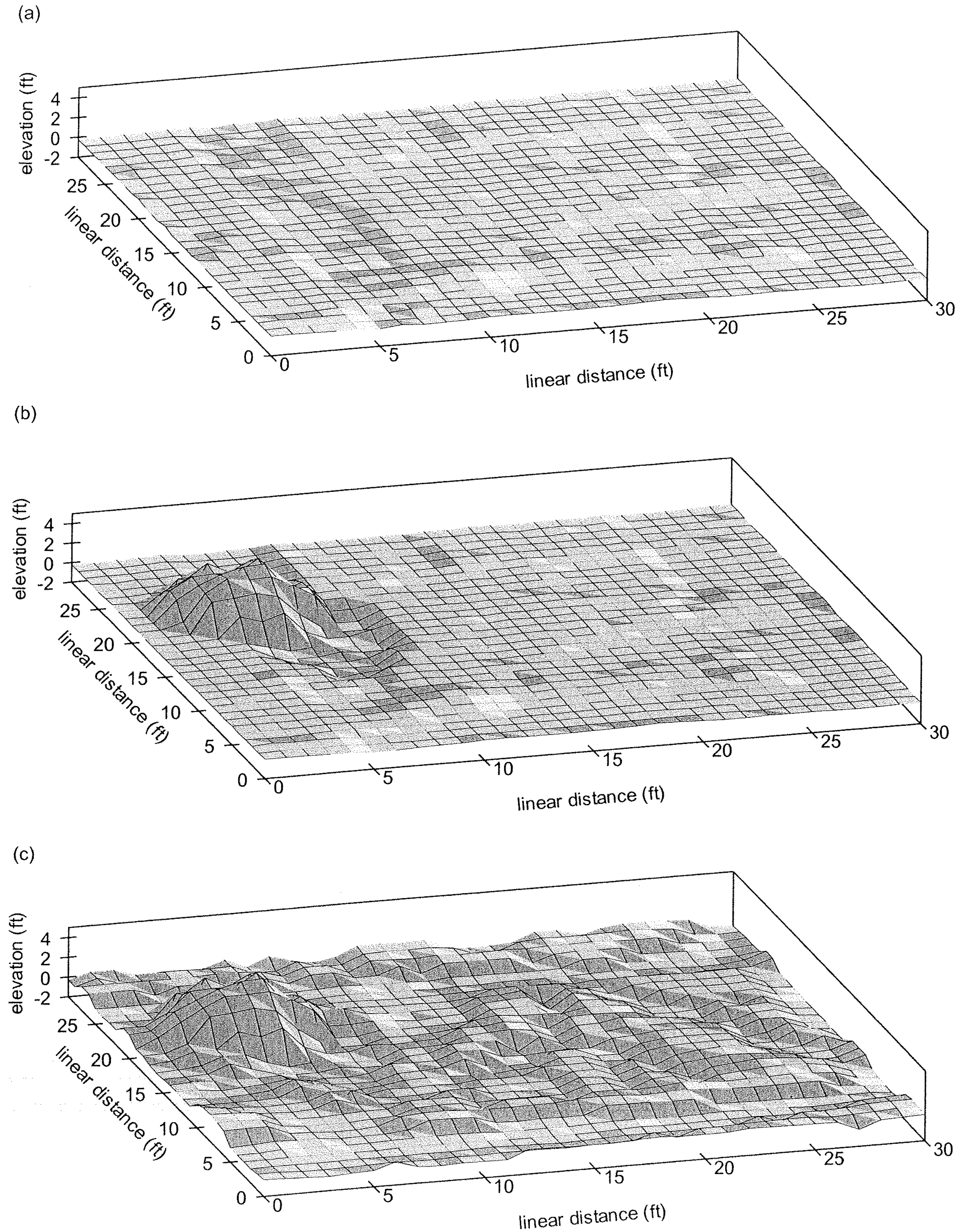

Figure 9. Diagrammatic representation of microrelief treatment: (a) pre-treatment (i.e after topsoil redistribution), b) mound and pit construction, and (c) finish contouring and sub-soiling treatment.

The second stage in microrelief development required a contouring treatment. The contouring treatment was created by use of a dozer with a tilted blade (photo 19). Topsoil was scraped out of one location and piled off to the side in a randomized ridge and trough pattern. The resultant surface ranged in approximately 2 foot vertical asymmetry across reaches of the landscape.

Photo 19

The third stage in microrelief development was the sub-soiling treatment (Figure 9c). This treatment required the use of a large sub-soiler equipment attached to a dozer (Photo 20). During use, the tines on the sub-soiler extended approximately 1.5 feet below the surface. This depth was sufficient to break-up the topsoil layer, as well as scarify the top portion the B-horizon. The sub-soiling treatment was performed in a uniform manor perpendicular to the slope of the site. Reasons for subsoiling included clod and compaction re-mediation, B-horizon scarification (i.e. to impede water movement between soil layers), and contour finishing. The results of the collective microrelief treatments are shown in Photos 21 and 22

Photo 20.

Photo 20.

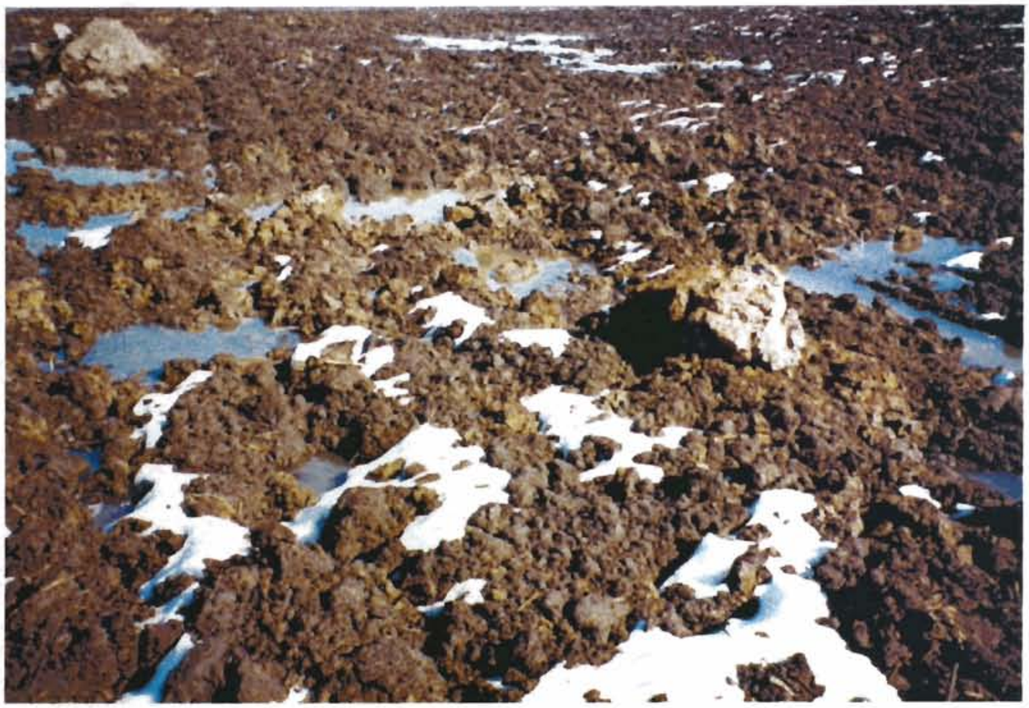

Photo 21.

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