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AERIAL PHOTOGRAPHIC MONITORING, FLORIDA POWER CORPORATION, CRYSTAL RIVER POWER PLANT SALT DRIFT STUDY

FINAL REPORT 1995 AERIAL PHOTOGRAPHY

Submitted to:

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January 18, 1996

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1.0 INTRODUCTION

The 1995 aerial photographic monitoring of the Florida Power Corporation (FPC) Crystal River Plant was conducted in compliance with the National Pollutant Discharge Elimination System permit requirements. Aerial monitoring missions were flown during the year to document and interpret site conditions, as has been done for the past several monitoring years.

Objectives of the annual aerial photographic monitoring included: documentation of the condition of plant communities in the vicinity of the power plant; photointerpretation of the aerial photography; and site inspections to verify present conditions of plant communities occurring in the vicinity of the various salt deposition monitoring sites.

Results and interpretation of the aerial monitoring and the site inspections were documented in brief reports. This report summarizes the observations and conclusions of the 1995 aerial monitoring.

2.0 METHODS

The aerial flights are typically spaced throughout the growing season in order to document foliage conditions at representative times of the year, as has been standard in previous monitoring years. The 1995 missions were flown on the following dates: May 23 and October 29, 1995. Only two missions were completed during the year. The second mission, typically flown in mid-to-late summer, was unsuccessful due to the continued inclement weather conditions during this period.

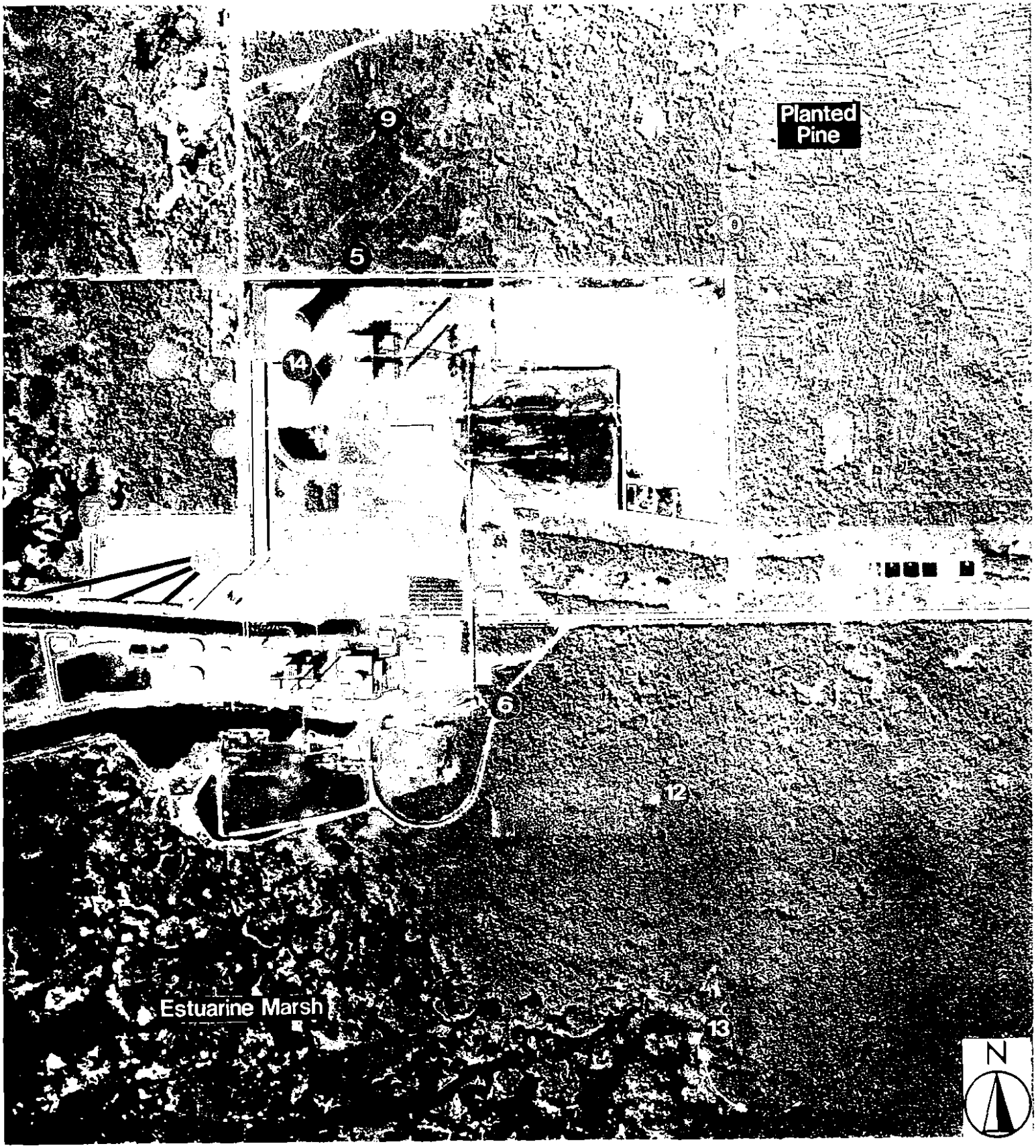
The first aerial mission was flown using a Cessna 180 fixed-wing aircraft with a Hasselblad 70 mm camera system mounted in the floor of the fuselage. Filters were used to obtain the highest quality photographs under the varying conditions of haze, humidity, and sunlight at different altitudes. Low-, middle-, and high-altitude photographs were shot along standard flight paths to obtain coverage of the entire power plant facility and surroundings, in addition to those areas where permanent monitoring stations are located. The final (fall) mission was flown by Aerial Cartographics of America, Inc. (ACA) using a 9 x 9 format camera system, in order to provide high resolution photography during late growing season conditions. In establishing the permanent monitoring stations and the aerial monitoring program, emphasis was placed on the natural communities in the vicinity of the cooling towers.

All of the aerial photographs were photointerpreted to assess the conditions of vegetative communities in all portions of the project area. The images were analyzed under optical magnification to determine the presence of any large-scale changes in the overall health of foliage conditions in the various plant communities. Primary indicators used in this procedure include color and texture patterns. Photo signatures considered to be atypical or suspicious were checked against

actual field conditions, as well as photography from previous years, to verify whether any significant changes had occurred in the general conditions of the particular plant community.

A site inspection was conducted in spring, at the beginning of the growing season, to review the overall site conditions and inspect specific sites representing the various plant communities. The typical fall site inspection was conducted in November. Several of the permanent monitoring sites were visited to record observations on the general health and conditions of canopy and understory vegetation. Several of the 9 x 9 aerial photographs were utilized during the inspection to verify color photo signatures. This process facilitates year-to-year comparisons of the representative color patterns produced by evergreen and deciduous species occurring in the various wetland and upland communities throughout the project area.

Figure 1 is a high-altitude color-infrared (CIR) photograph of the Crystal River Power Plant and vicinity, showing the locations of permanently established monitoring sites.



Legend.

1. Pine Site
2. Hardwood Site
3. Northwest Open Test Site
4. West Open Pine Site
5. Northeast Open Test Site
6. Control Site
7. Southwest Open Hammock Site
8. Northwest Open Pine Site
9. North Open Pine Site
10. Northeast Open Pine Site
11. East Open Pine Site
12. Open Hardwood Control Site
13. Coastal Control Site
14. Natural Draft Cooling Towers for Units 4 and 5
15. Mechanical Draft Cooling Towers for Units 1, 2 and 3

Figure 1. High-Altitude Color-Infrared Aerial Photography of the Florida Power Corporation Crystal River Power Plant and Vicinity, Fall 1995.

3.0 RESULTS

The aerial missions on May 23 and October 29, 1995 provided good quality photographic documentation of the FPC Crystal River Plant and the surrounding natural areas. The first mission, flown in a Cessna 180 aircraft using a Hasselblad 70mm camera system, produced a total of 25 CIR exposures at high and low altitudes. The fall mission was flown by ACA at high, middle and low altitudes to provide a total of 56 CIR exposures. Tables 1 and 2 summarize the record of exposures and altitudes during these missions.

The photointerpretation of the 1995 aerial photography combined with a groundtruthing inspection have indicated that conditions of the plant communities at the Crystal River site are generally similar to conditions observed in previous monitoring years. Figures of aerial and ground photography are incorporated into the report as documentation of these interpretations.

Broad areas of interest in portions of the study area are encompassed in the mid-altitude coverage taken in the fall 1995 mission. Figure 2 is such an area of interest, located to the west of the Natural Draft Cooling Towers. The forested communities transition from pine (*Pinus* sp.) flatwoods and mixed hardwood hammocks into the lower, wetter zones adjacent to the large brackish marshes. A significant portion of this area has experienced a moderate to high amount of stress or mortality to the woody species over the last several years. This stress is mainly observed in the areas of low elevation, however there appears to be a trend for expansion into the edges of upland communities such as pine and live oaks (*Quercus virginiana*). Changes in hydrologic conditions are suspected.

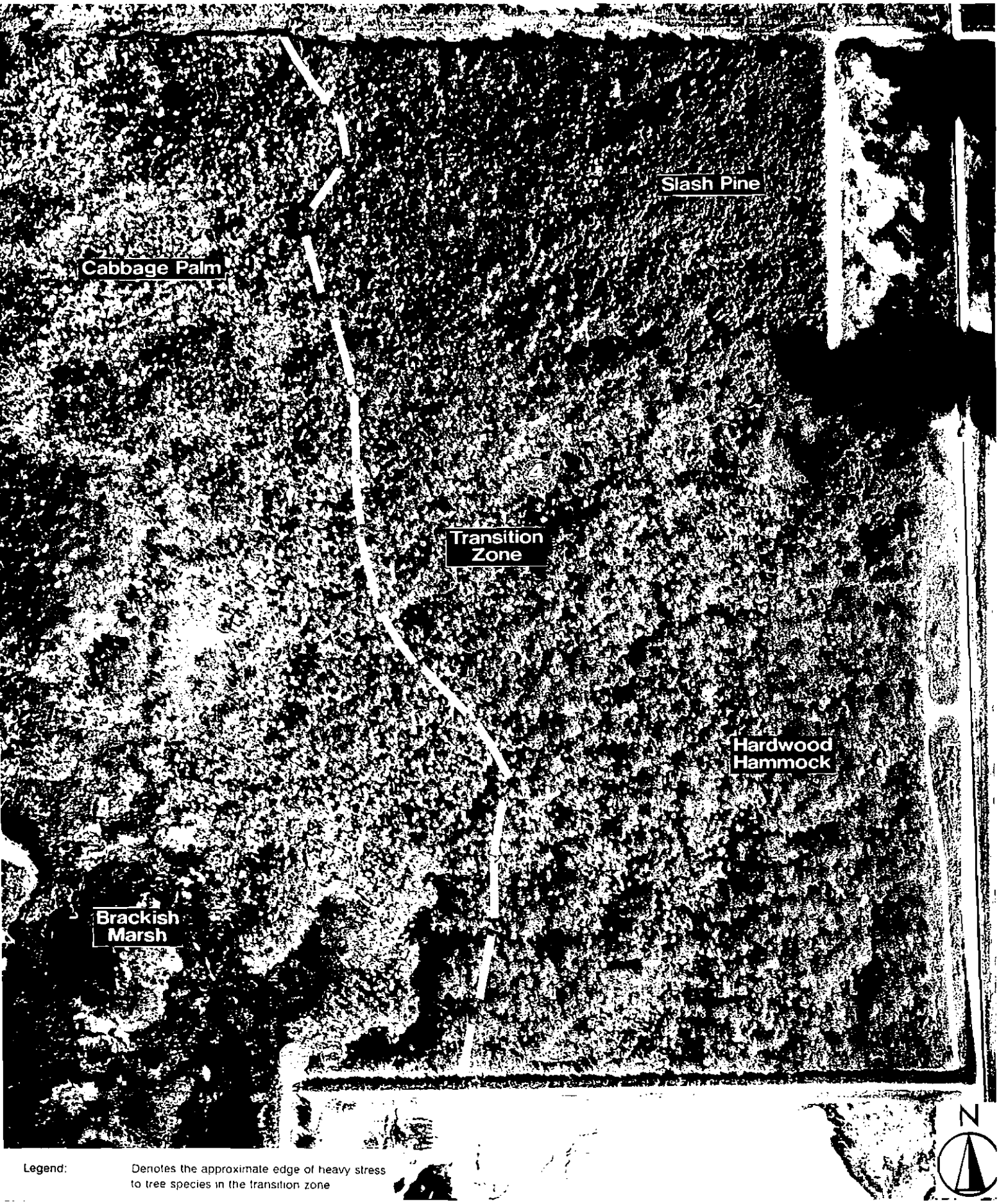


Figure 2. Areas of Interest Immediately West of the Natural Draft Cooling Towers, Fall 1995.

Table 1. Areas of Coverage, First Aerial Flight for Crystal River Power Plant, May 23, 1995.

Page	Frame (Left to Right)	Station/Coverage
1	1	Areas north and south of entrance road to plant facility.
	2-3	Vicinity of fish hatchery, just east of plant.
	4-9	Power plant facility, vicinity of transition forested areas and coastal marsh.
2	10-12	High altitude, vicinity of plant facility.
3	13-15	Vicinity of northeast open pine site.
	16-21	Forested and freshwater marsh areas immediately north of power plant facility.
4	22-25	Forested and freshwater marsh areas. Near the northwest open pine site.
	26-30	Vicinity of the north open pine site.
5	31-32	Vicinity of the northwest open pine site.
	33-35	Dense forested canopy, vicinity of the west open pine site.
	36-37	Transition areas near the southwest open hammock site.
	38-39	New cooling towers.
6	40-41	Marsh and transitional forest, vicinity of southwest open hammock site.
	42	Dense hardwood community, hardwood control site.
	43-46	Transitional forest near coastal control site.
	47	Hardwood forest near control site.
7	48-50	Transition areas near railroad loop, south of control site.
	51-53	Transition areas west of northwest open pine site.
	54-56	Mixed pine and hardwood areas north of northwest open pine site.

Table 2. Areas of Coverage, Fall Aerial Flight for the Crystal River Power Plant, October 29, 1995.

Frame	Scale	Coverage
9-1	1:35,000	High altitude, study area
9-2	1:35,000	High altitude, power plant centered
9-3	1:35,000	Coastal edge at power plant
1-4, 1-5	1:3,000	9
8-6, 8-7	1:3,000	13
7-8	1:3,000	12
7-9	1:3,000	6, 12
5-10, 5-11	1:3,000	11
6-12, 6-13	1:3,000	7
4-14, 4-15	1:3,000	5
3-16	1:3,000	8
3-17	1:3,000	Coastal edge west of 8
2-18, 2-19	1:3,000	10
10-20, 10-21	1:65,000	Coastal edge transition areas
10-22	1:6,500	1, 2, 3, 4
11-23, 11-24	1:6,500	6, 12
11-25	1:6,500	Coastal edge south of power plant

In contrast, other isolated depressional areas and transition edges further to the east do not appear to have symptoms of large-scale stress; this can be seen, for instance, in the vicinity of the Northeast Open Test site (Figure 3) and the North Open Pine site (Figure 4). Although occasional stressed or dead individual trees have been observed in these areas, there has been no evidence of increasing numbers of stressed vegetation.

The upland pine and hardwood communities to the north and east of the power plant are in overall good health, as seen in Figures 5 and 6. Foliage conditions of the canopy species and the understory have appeared consistently good in the early part of the growing season, and loss of foliage with the onset of fall leaf senescence is seen to be similar to the previous years of observation.

Figures 7 through 10 are a combination of aerial photography and ground photography which document the conditions of the plant communities in the coastal transition zone near the Southwest Open Hammock site, southwest of the Natural Draft Cooling Towers. These photographs clearly demonstrate the conditions of stress to the common woody species that have historically established along this zone; specifically, cabbage palm (*Sabal palmetto*), southern red cedar (*Juniperus silicicola*), and live oak. Although some regeneration is evident in many of the red cedars that have experienced partial or total loss of foliage, there seems to be a gradual, continued loss of a large number of these trees along the transition zone. This trend is much more pronounced in areas of lower elevations.

The Coastal Control site shows a similar pattern of stress; however, the transition edge between upland communities at higher elevations and the brackish marsh seems to be much sharper,

Figure 3. Low-Altitude Coverage of the Northeast Open Test Site, Fall 1995.

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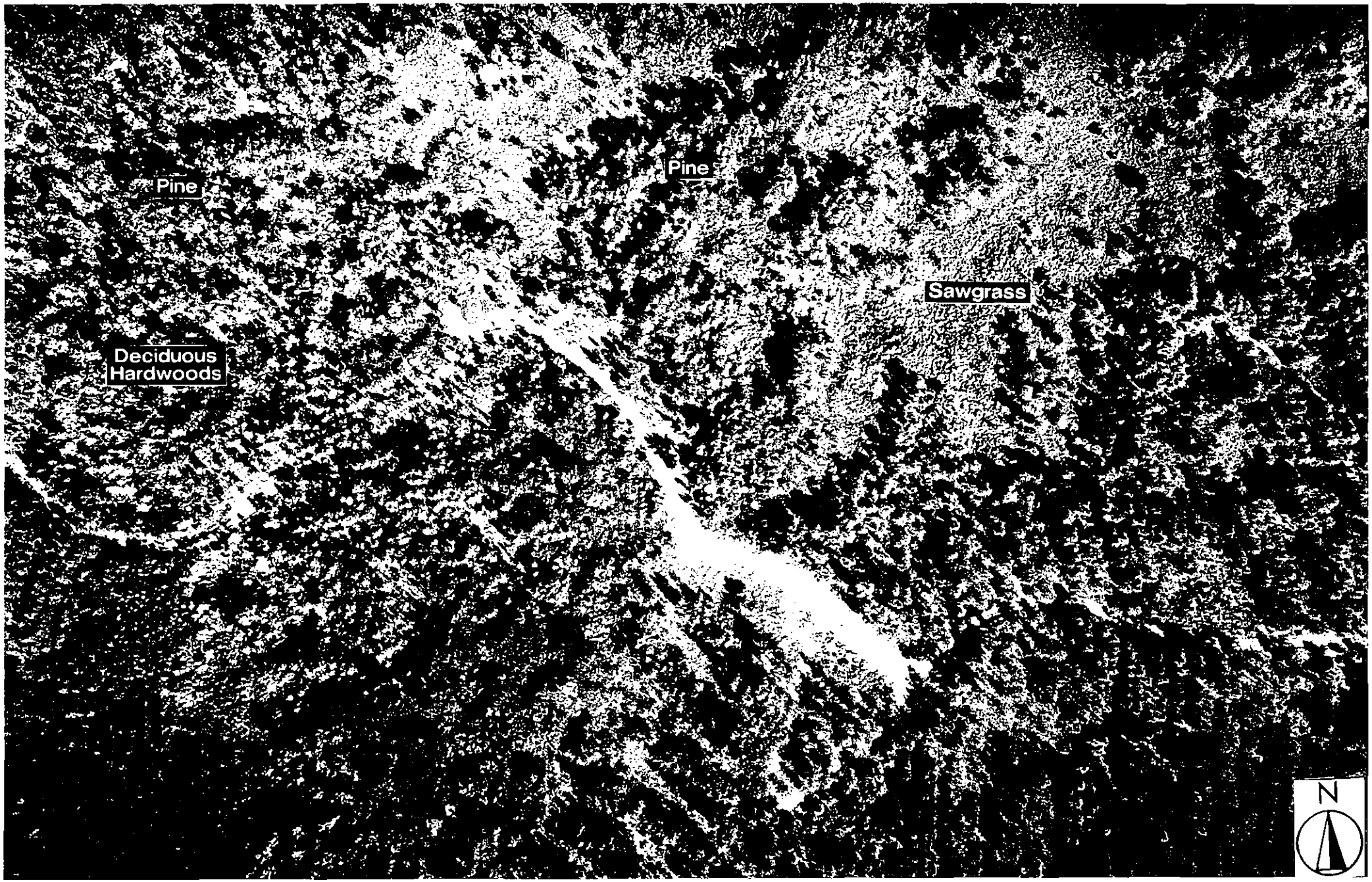

Figure 4. Low-Altitude Coverage of the North Open Pine Site, Fall 1995.

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Figure 5. Low-Altitude Coverage of the Northeast Open Pine Site, Fall 1995.

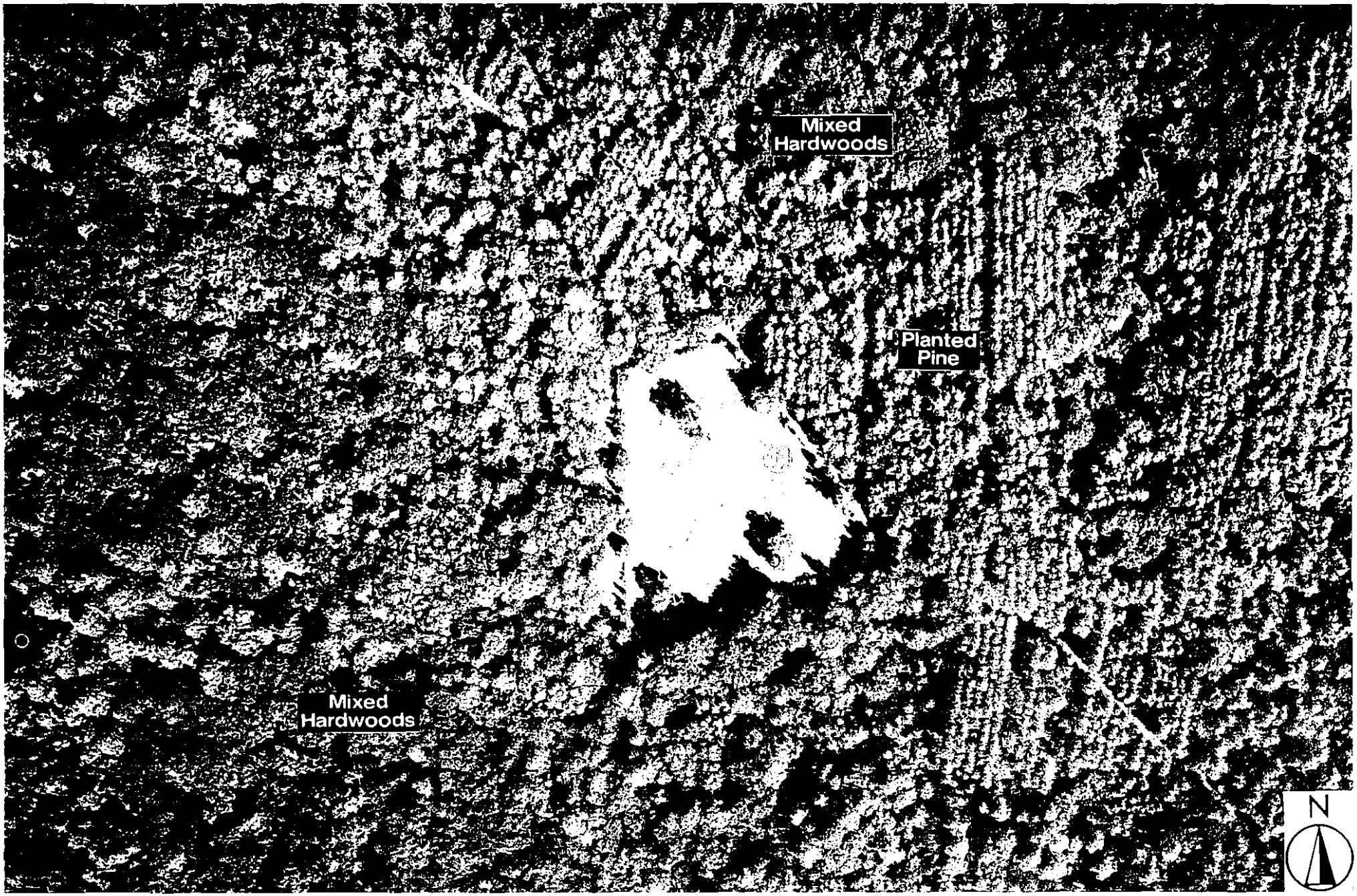

Figure 6. Low-Altitude Coverage of the East Open Pine Site, Fall 1995.

Figure 7. Low-Altitude Coverage in Vicinity of the Southwest Open Hammock Site, Fall 1995.

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Figure 8. Panoramic lammock Site, Fall 1995.

Figure 9. Open Water Area Just East of the Southwest Open Hammock Site; Showing Stressed and Dead Cabbage Palm, Cedar, Live Oak, Fall 1995.

Figure 10. Oak/Cabbage Palm/Cedar Hammock Area, Just East of the Southwest Open Hammock Site; Showing Some Dead or Stressed Trees Along Edge of Dense Canopy 17.

resulting in comparatively smaller areas and densities of stress or mortality. Affected cabbage palm and cedar can be observed as somewhat isolated specimens or small clusters. Figures 11 and 12 demonstrate this pattern. A nearby upland oak (*Quercus* sp.) and pine community, shown in Figure 13, shows no signs of stress as are apparent in the lower edges of the coastal transition zone where these same species occur.

Appendix A shows the flight lines used for the fall aerial photographic coverage of the Crystal River Power Plant area. For consistency, they are similar to the flight path as used in the previous monitoring years. Appendix B provides a composite record of additional aerial and ground photography taken of plant communities in the vicinity of several of the permanent monitoring stations at the power plant site.

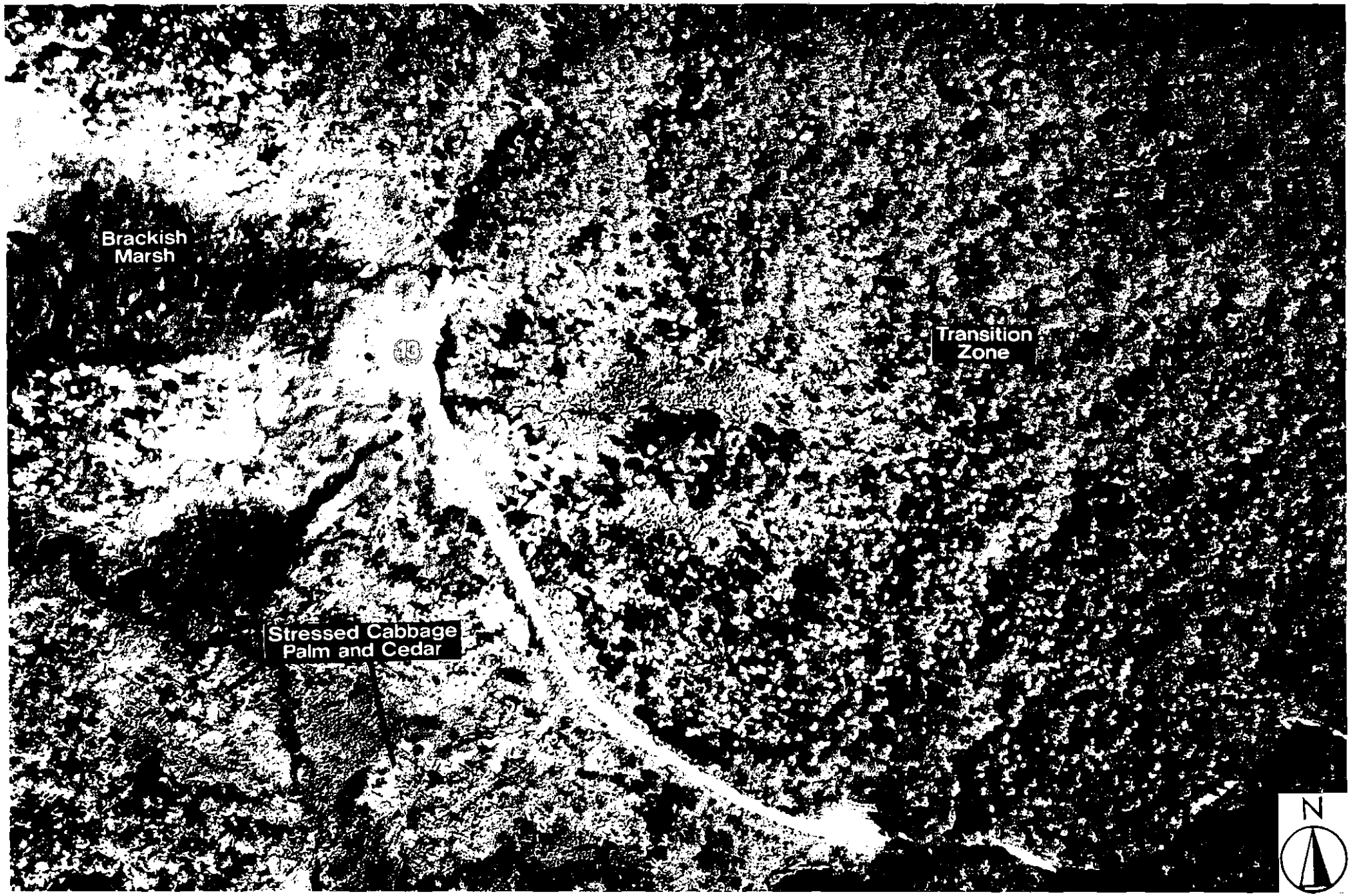


Figure 11. Low-Altitude Coverage in Vicinity of the Coastal Control Site, Fall 1995.

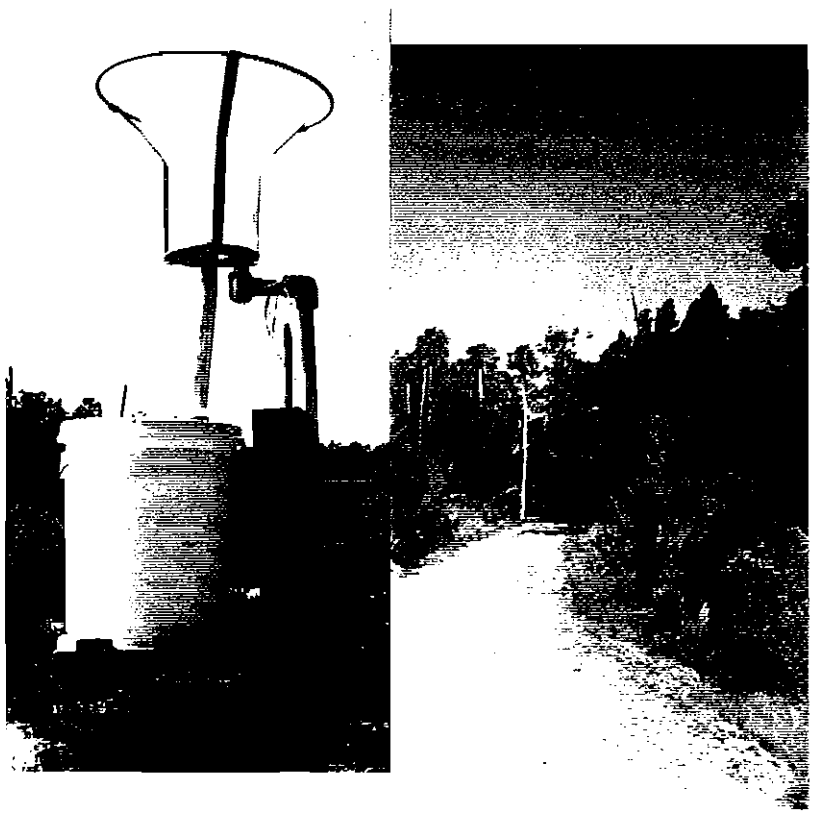


Figure 12. Panoramical Control Site, Fall 1995.

Figure 13. Live Oak/Pine Community North of the Coastal Control Site, Fall 1995.

4.0 CONCLUSIONS

The 1995 aerial photographic monitoring of the Crystal River plant consisted of two missions (spring and fall) to document the overall current conditions of vegetative communities, and to provide a continuing record of the conditions at 13 permanent monitoring stations. Additionally, two groundtruthing site inspections were conducted (spring and fall) to evaluate the photointerpretation of the color infrared aerials and determine the conditions of vegetative species at specific locations representing a variety of upland, wetland and transition habitats. Good quality, high resolution 9 x 9 aerial photographs were utilized as a means of interpreting the larger-scale conditions of vegetative communities.

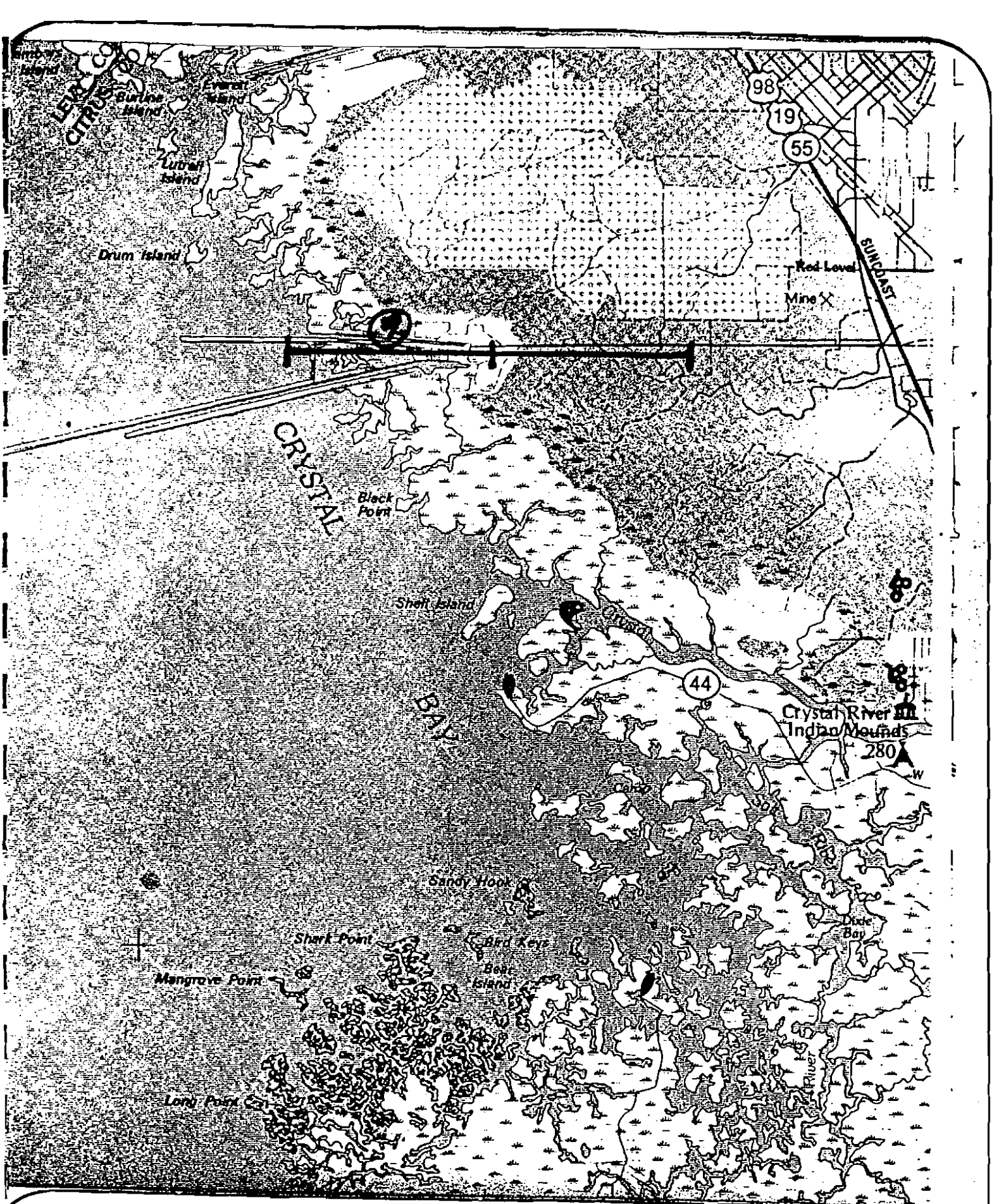
Observations and data accumulated during the monitoring year indicate that the overall conditions of vegetative communities (in terms of health and vitality) at the Crystal River plant are very good. This includes the upland forested and herbaceous communities, wet prairies and shallow marshes, freshwater forested wetlands, and brackish marsh along the coastline. The continued exception to this assessment is the stressed condition of (primarily) two or three woody species along the brackish marsh/forested transition zone, extending to the north and south of the power plant site. Large-scale changes in the hydrologic conditions (water levels) are suspected as a cause of this condition.

The photographic documentation, ground observations, and review of previous monitoring data for the power plant site all indicate that the natural plant communities, with the noted exception, are in good health, with no signs of foliage stress that would appear abnormal. It is concluded that

there continue to be no observable or detectable negative effects to the plant communities which are related to the background salt deposition from the Natural Draft cooling tower operations.

APPENDIX A

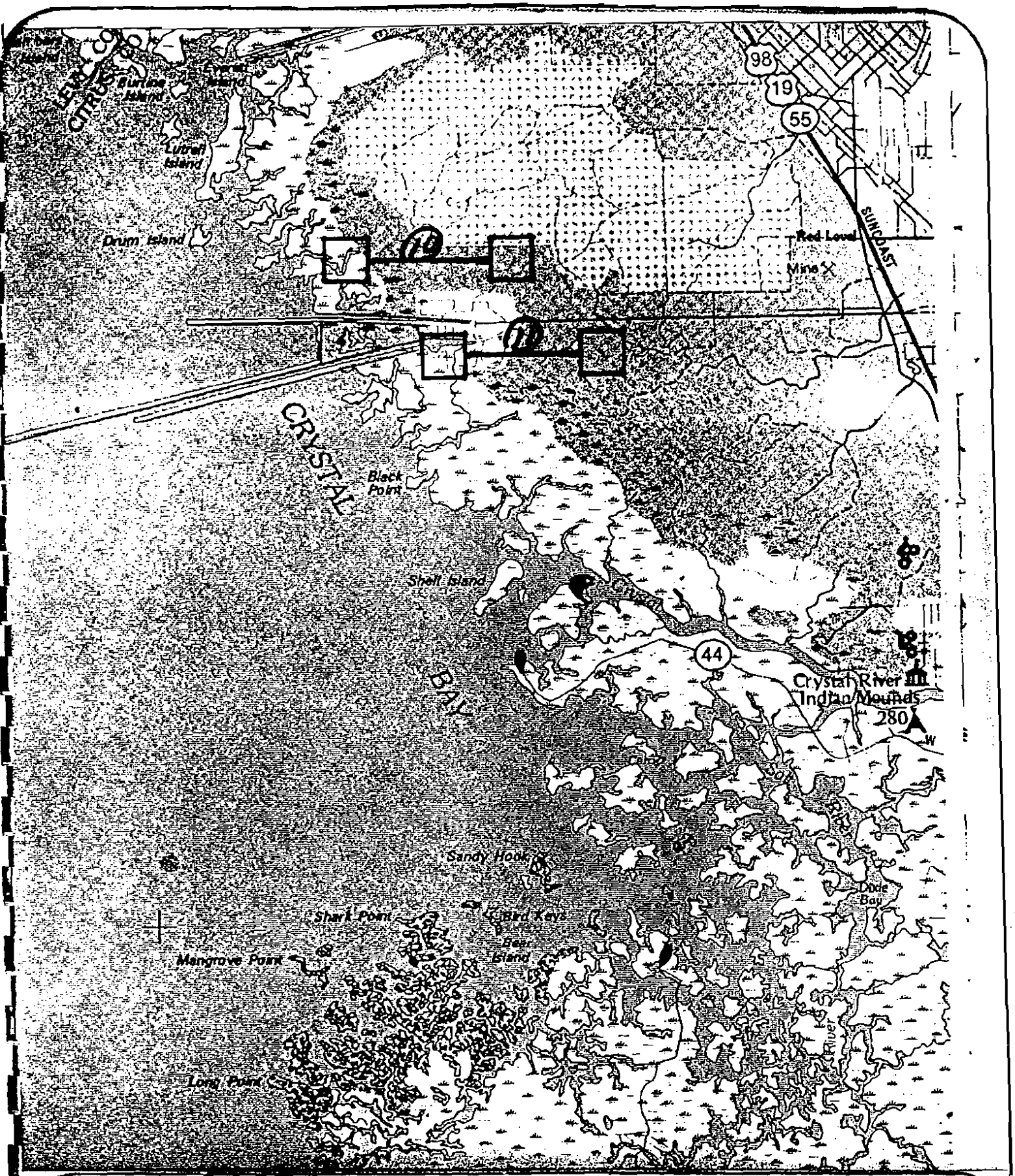
FLIGHT LINES FOR THE OCTOBER 1995 AERIAL PHOTOGRAPHY OF THE CRYSTAL RIVER ENERGY COMPLEX



PROJECT NAME Crystal River Energy Complex
ACA JOB # 94756 FLIGHT DATE 10-5-94
PHOTO SCALE 1:35000 FILM TYPE False Color INFRA-RED
PAGE 1 OF 3

(Same flight lines were used again in October 1995.)

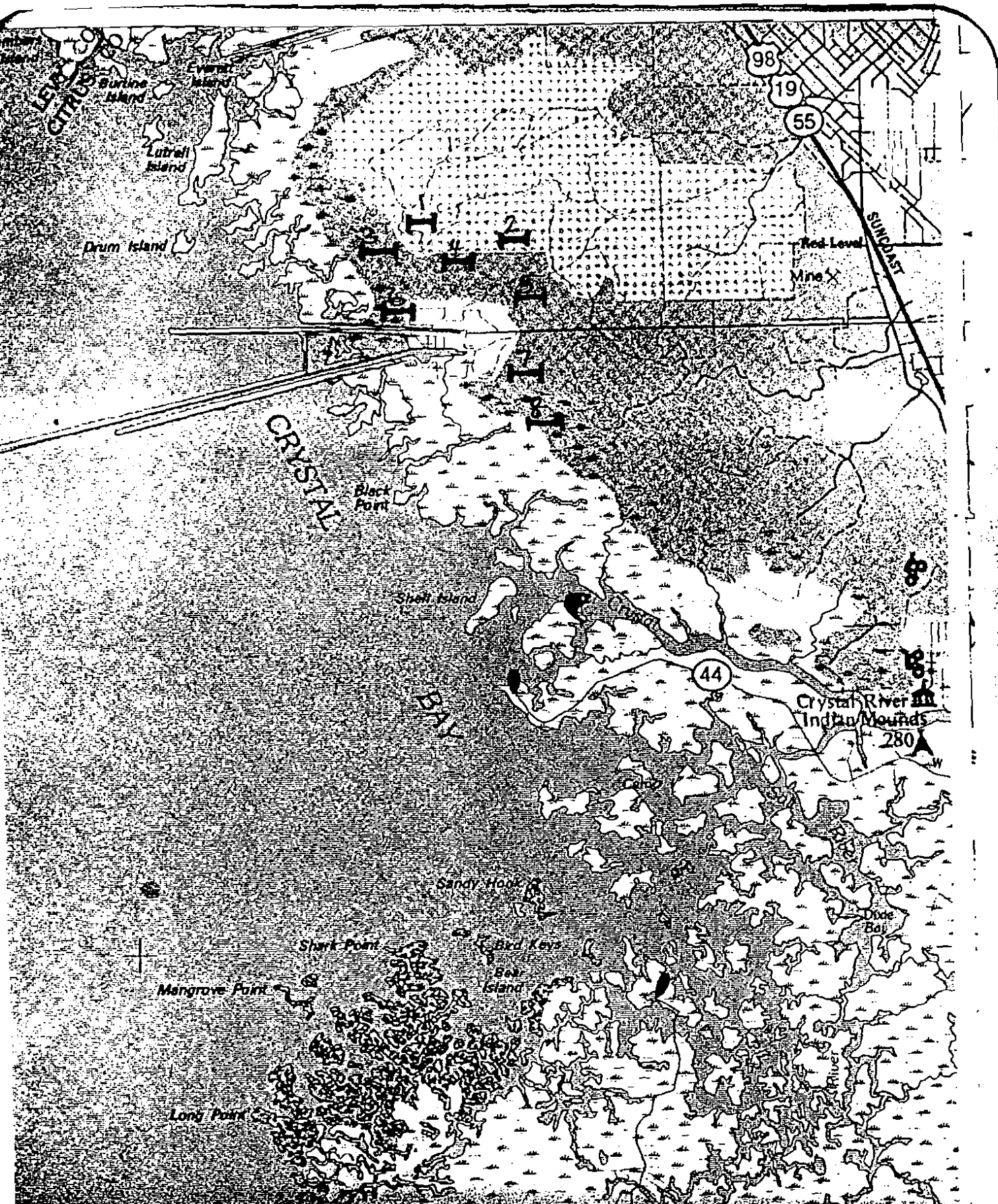
AERIAL CARTOGRAPHICS OF AMERICA



PROJECT NAME CRYSTAL RIVER ENERGY COMPLEX
ACA JOB # 94756 FLIGHT DATE 10-5-94
PHOTO SCALE 1:6500 FILM TYPE FALSE COLOR INFRA-RED
PAGE 2 OF 3

(Same flight lines were used again in October 1995.)

AERIAL CARTOGRAPHICS OF AMERICA



PROJECT NAME Crystal River Energy Complex
ACA JOB # 94756 FLIGHT DATE 10-5-94
PHOTO SCALE 1:3000 FILM TYPE False Color Infra-Red

PAGE 3 OF 3

(Same flight lines were used again in October 1995.)

AERIAL CARTOGRAPHICS OF AMERICA

APPENDIX B

COMPOSITE OF ADDITIONAL PHOTOGRAPHY FOR THE CRYSTAL RIVER ENERGY COMPLEX

Figure B-1. High-Altitude Coverage of Forested Communities to the East of the Florida Power Corporation Crystal River Power Plant, Fall 1995.

Figure B-2. **Mid-Altitude Coverage of the Forested and Brackish Marsh Communities to the West of the Natural Draft Cooling Towers; Showing the Cabbage Palm/Cedar Islands Transition Area and Upland Forest Communities, Fall 1995.**

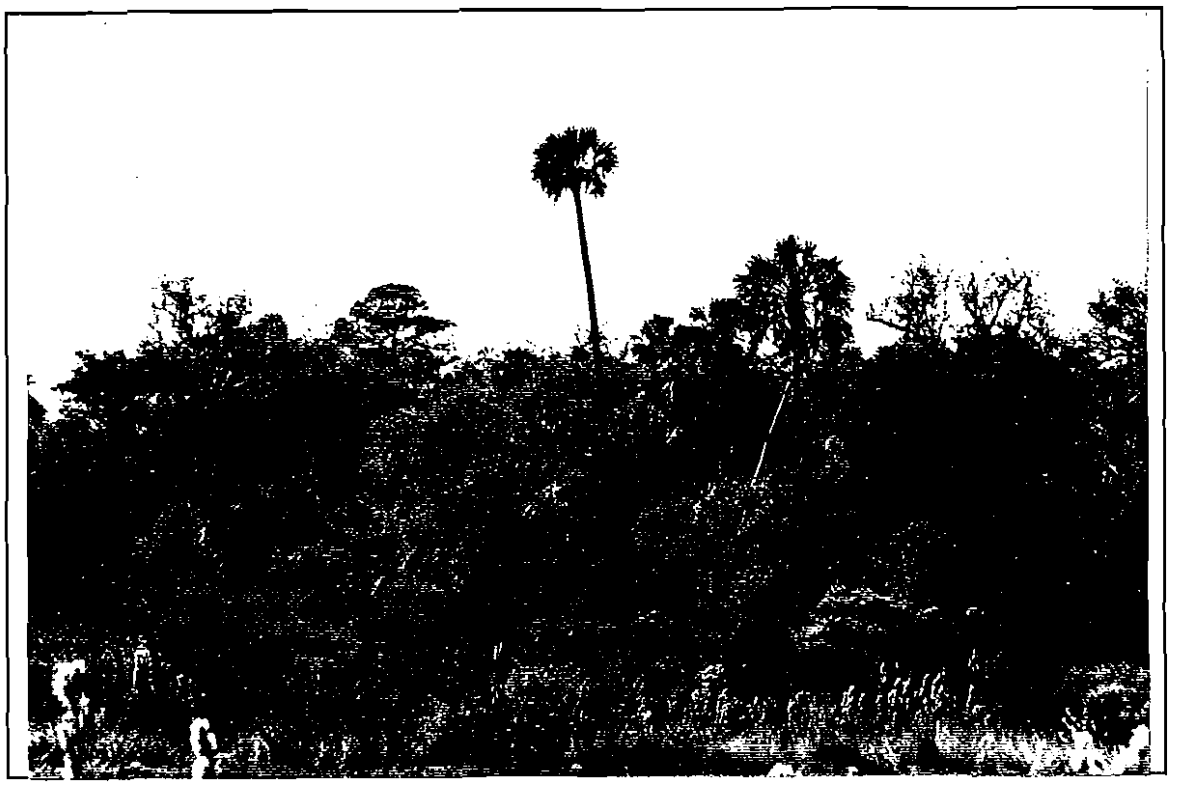


Figure B-3. **Mixed Hardwood and Cabbage Palm Community in the Vicinity of the Hardwood Site, Fall 1995.**

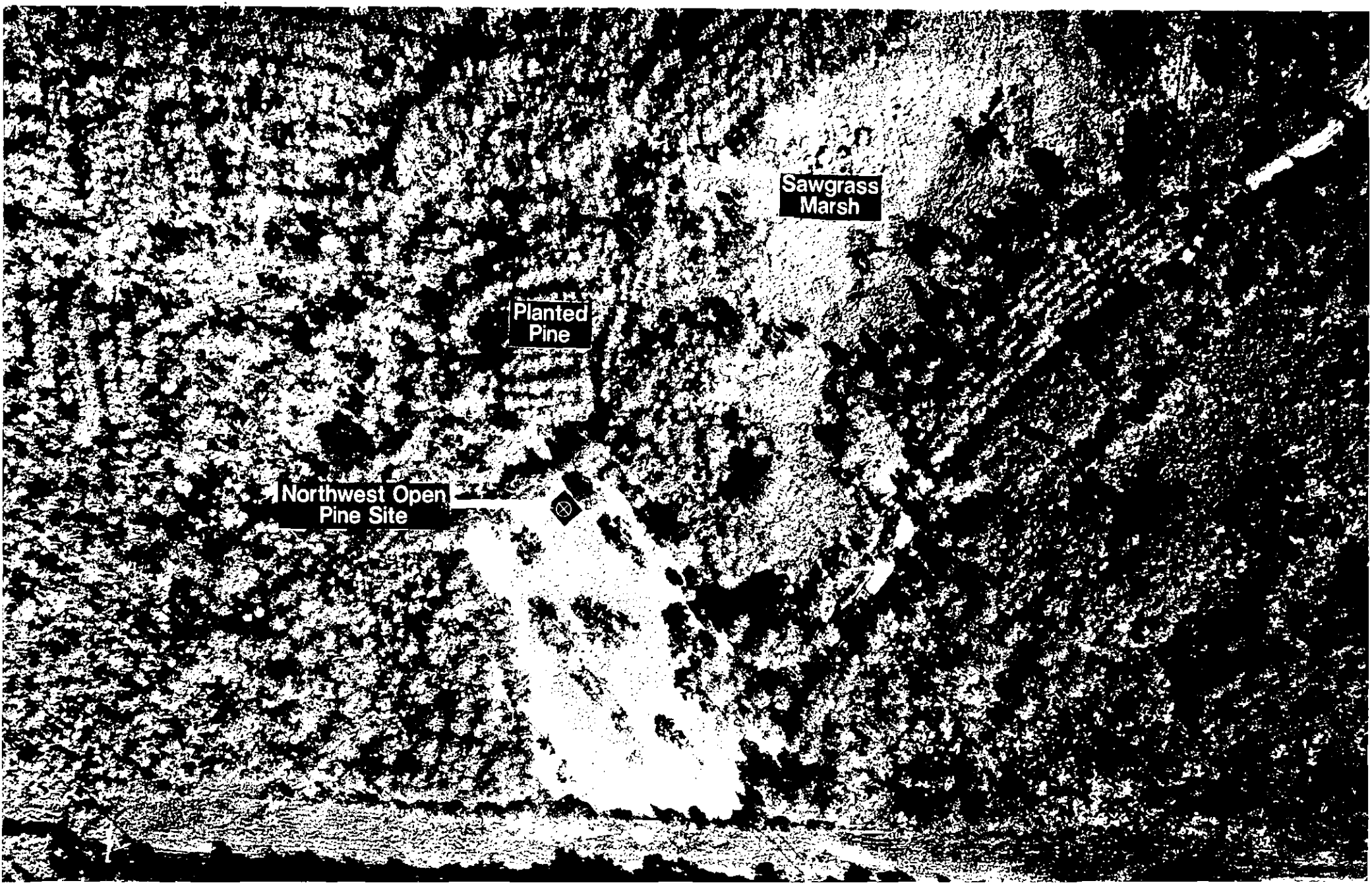


Figure B-4. Aerial View of the Northwest Open Pine Site and Adjacent Areas.

Figure B-5. **Northwest Open Pine Site and Adjacent Forested Area, Showing Pine-Dominant Community.**

Figure B-6. **Wet Transition Edge of Sawgrass Marsh to the East of the Northwest Open Pine Site, Fall 1995.**

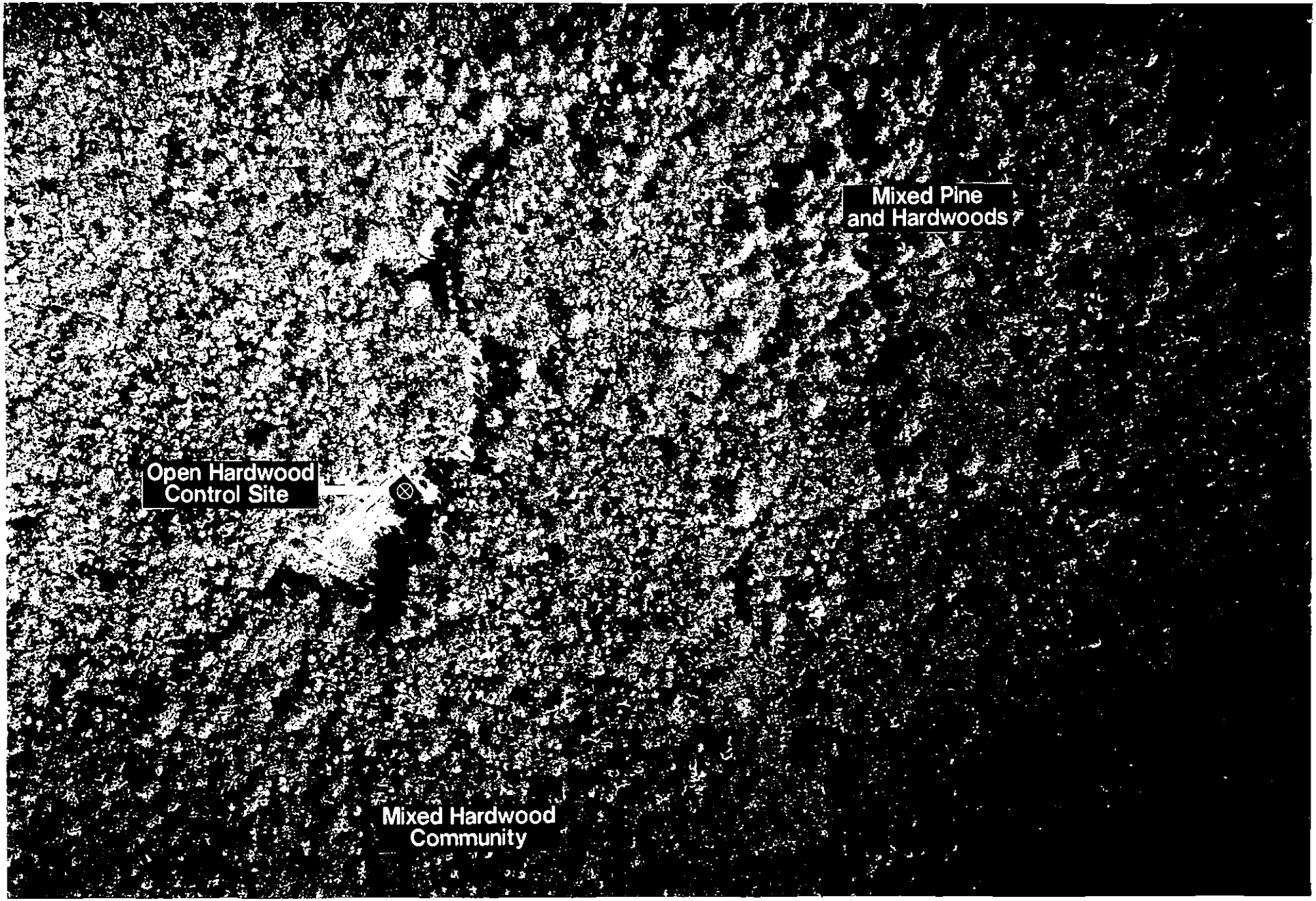


Figure B-7. Aerial Photograph of the Open Hardwood Control Site.

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Figure B-8. **Current Conditions of Areas to the East of the Southwest Open Hammock Site.**

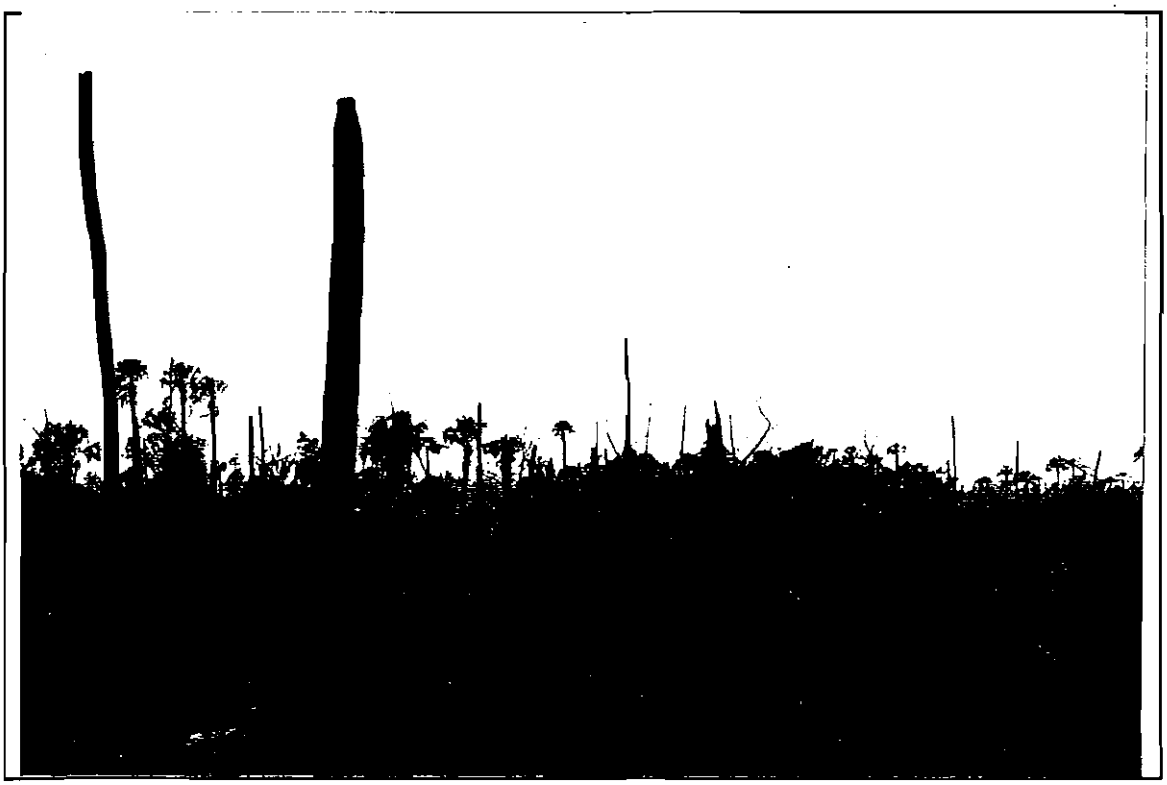

Figure B-9. **Current Conditions of Coastal Areas Immediately South of the Power Plant Site.**

Figure B-10. **Brackish Marsh and Transition Edge to the South of the Coastal Control Site, Fall 1995.**