

March 1, 1978

Honorable Reubin O'D. Askew
Honorable Lew Brantley
Honorable Donald L. Tucker

Honorable Reubin O'D. Askew
Governor of Florida
The Capitol
Tallahassee, Florida 32304

Honorable Lew Brantley
President of the Senate
The Capitol
Tallahassee, Florida 32304

Honorable Donald L. Tucker
Speaker of the House of
Representatives
The Capitol
Tallahassee, Florida 32304

Dear Sirs:

The Phosphate Land Reclamation Study Commission was created by Chapter 77-406, Laws of Florida, and directed to "make a study of the reclamation of land in this state disturbed by the severance of pebble phosphate rock." As a part of the study, the Commission was directed to inventory lands disturbed by the severance of pebble phosphate rock prior to July 1, 1975, which have not been reclaimed, noting with respect to such lands the ownership both of the land and of the mineral rights. The Commission was also directed to estimate the costs of reclaiming lands disturbed by the severance of phosphate rock. In addition, the Commission was authorized to recommend "legislation designed to promote and assure the restoration and reclamation of land disturbed by the severance of solid minerals which in the absence of incentives provided by law might not be restored or reclaimed" and to recommend "whether Paragraph (n) of Subsection (3) of Section 211.32, Florida Statutes, . . . [should] be amended, modified, or repealed." Chapter 77-406, s.2, Laws of Florida.

The Commission held an organizational meeting on July 20, 1977, in Tallahassee, Florida. On October 25, 1977, the Commission toured the phosphate area in Polk County, viewing mined lands, unmined lands, active mining areas, and plant operations. Public workshops were held on October 25 and 26, 1977, in Lakeland, Florida for the purpose of receiving public comment concerning reclamation. On December 13 and 14, 1977, and again on January 16, 1978, the Commission met in Tallahassee. On February 7, 1978, the Commission met in Tampa.

After due consideration, the Commission has developed its recommendations and is transmitting its study and recommendations to you, in discharge of its statutory duties. The attached report represents the majority opinion of the Commission.

The Commission members generally agreed upon the following concepts, which are elaborated upon in the report:

1. There exists substantial acreage which has been mined or disturbed by the severance of phosphate prior to July 1, 1975, which is not subject to mandatory reclamation (hereinafter "old lands"). Existing law, which presently offers no assurance that these lands will be reclaimed, should be amended.
2. Slime settling ponds pose the single greatest problem to be overcome in effecting reclamation, and should be given high priority.

The most important recommendations of the Commission may be summarized as follows:

1. Refunds from severance taxes levied before July 1, 1978, should be allowed as an incentive for the reclamation of old lands, but should not be allowed as an incentive for reclamation of lands disturbed after July 1, 1975 (except for lands covered by a reclamation program filed before July 1, 1977, in accordance with Chapter 77-406, s.2, Laws of Florida). This modifies Section 211.32(3)(n), Florida Statutes (1977).
2. No portion of severance taxes levied on or after July 1, 1978 should be credited to the Land Reclamation Trust Fund.
3. Two new trust funds should be created out of severance taxes levied on or after July 1, 1978, as follows:
 - (a) Non-Mandatory Land Reclamation Trust Fund - to provide incentives for reclamation of old lands and to provide funds for state acquisition of old lands;
 - (b) Phosphate Research Trust Fund - to provide research grants for a variety of subjects, including, but not limited to, slime settling ponds, water usage, and radiation.

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4. Beginning in 1980, the Department of Natural Resources shall report annually to the Legislature, as to the sufficiency of funds in the Non-Mandatory Land Reclamation Trust Fund. On July 1, 1983, the severance tax shall decrease from 10 percent to 8 percent, and the contribution of severance tax monies to the Non-Mandatory Land Reclamation Trust Fund shall terminate, unless the Legislature deems it necessary to continue contributions to the Non-Mandatory Land Reclamation Trust Fund.
5. A Land Use Advisory Committee composed of representatives of government and public citizens, should be created to assess old lands and to furnish an old lands reclamation plan to the Department of Natural Resources, by July 1, 1980. The old lands reclamation plan shall not be inconsistent with local government comprehensive plans prepared pursuant to the Local Government Comprehensive Planning Act.
6. The Department of Natural Resources should develop a master old lands reclamation program, based upon an on-site survey of old lands and utilizing the report of the Land Use Advisory Committee. The master program should specify which old lands need to be reclaimed by artificial means.
7. Reclamation programs for old lands should conform to the master reclamation programs developed by the Department of Natural Resources, in order to qualify for refunds.

The Commission has not formalized the text of legislation which would be necessary to implement its recommendations, but has asked the Department of Natural Resources to draft an appropriate bill.

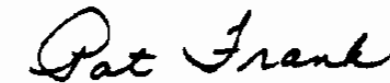
Sincerely yours,



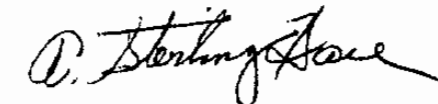
C. W. Hendry, Jr.
Chairman



Kenneth H. Mackay
Senator



Pat Frank
Representative



Sterling Hall



T. E. Holcom



Nathaniel Reed

PHOSPHATE LAND RECLAMATION STUDY COMMISSION

REPORT

To

Reubin O'D. Askew, Governor
Lew Brantley, President of the Senate
Donald L. Tucker, Speaker of the House
of Representatives

On

PHOSPHATE MINING AND RECLAMATION

TABLE OF CONTENTS

Introduction.....	1
History of Phosphate Mining.....	3
History of Reclamation.....	9
Cost of Reclamation.....	13
Mined and Disturbed Lands Inventory.....	21
Special Consideration - Radiation.....	23
Special Consideration - Water Resources.....	25
Summary and Conclusions.....	26
Recommendations.....	28
Appendix	
Index to Inventory Maps.....	32

LIST OF FIGURES

Figure		Page
1	A "Typical" High-Grade Bone Valley District Phosphate Deposit.....	4
2	Graph Illustrating the Cost of Tailings Backfill.....	14
3	Graph Illustrating the Cost of Overburden "Capping".....	15
4	Graph Illustrating the Cost of Overburden Spoil Redistribution by Sloping and Shaping (Land and Lakes).....	15
5	Graph Illustrating the Cost of Overburden Spoil Redistribution by Dredging.....	16
6	Graph Illustrating the Cost of Perimeter Ditching....	17
7	Graph Illustrating the Cost of Sand-Clay Mixes.....	18
8	Graph Illustrating the Cost of Transporting Overburden Fill.....	18
9	Summary of Revegetation Costs.....	19

INTRODUCTION

The 1977 Florida Legislature amended Section 211.32(3)(d), Florida Statutes, and added paragraphs (m) and (n) to said subsection to wit:

"(m) 1. There is hereby created a Phosphate Land Reclamation Study Commission composed of seven members to be appointed by the Governor. The Governor shall designate one member of the commission to serve as chairman and the commission shall meet at the call of the chairman. Members of the commission shall receive no compensation but shall receive travel and per diem as provided by s. 112.061.

2. The Department of Natural Resources shall provide the commission with the staff necessary to carry out the duties of the commission. Advice and expertise in economic matters shall be provided by the Division of Budget of the Department of Administration upon request of the commission.

3. The Phosphate Land Reclamation Study Commission shall make a study of the reclamation of land in this state disturbed by the severance of pebble phosphate rock. The commission in making its study shall consider but not be limited to:

1. An inventory of lands in the state disturbed by the severance of pebble phosphate rock prior to July 1, 1975, which lands have not been reclaimed. Such inventory shall consider the ownership of the land and the ownership of mineral rights in such lands.

b. An estimate of the present and future costs of reclaiming lands which have been disturbed by the severance of phosphate rock.

4. On or before March 1, 1978, the Phosphate Land Reclamation Study Commission shall report the results of its study to the Governor, the President of the Senate, and the Speaker of the House of Representatives.

At that time, it may also recommend (a) legislation designed to promote and insure the restoration and reclamation of land disturbed by the severance of solid minerals which in the absence of incentives provided by law might not be restored or reclaimed, and (b) whether paragraph (n) of subsection (3) of Section 211.32, Florida Statutes, as adopted herein, be amended, modified, or repealed.

5. There is hereby appropriated from the Land Reclamation Trust Fund to the Department of Natural Resources the sum of \$150,000. To further assist the commission, three time-limited, exempt positions are hereby created in the Department of Natural Resources.

(n) Notwithstanding any other provision in this part, refunds from the taxes levied under this part based upon the severance of solid minerals on or after July 1, 1978, shall be paid from the Land Reclamation Trust Fund only for the cost of restoration and reclamation of lands:

1. Disturbed by the severance of solid minerals prior to July 1, 1975;
or

2. Included within a site of severance on or before the effective date of this act with a restoration and reclamation program theretofore filed with the Department of Natural Resources."

On July 18, 1977, Governor Reuben O'D. Askew named the following persons to serve on the Phosphate Land Reclamation Study Commission:

Honorable Pat Frank

Honorable Kenneth H. MacKay, Jr.

Mr. Sterling Hall

Mr. Terry McDavid*

Charles W. Hendry, Jr., Chairman

Mr. Nathaniel Reed

Mr. T. E. Holcolm

*Resigned in November, 1977, and was replaced by Mr. Maywood Chesson.

Mr. Chesson resigned in February, 1978.

On July 20, 1977, the Phosphate Land Reclamation Study Commission held an organizational meeting in Tallahassee, Florida. At this meeting, the staff of the Department of Natural Resources (Section 211.32(3)(m)2., F.S.) presented a study recommendation to the Commission. This recommendation as approved is as follows:

A Study of the Reclamation of Land in this State Disturbed
by the Severance of Pebble Phosphate Rock

- A. History of land pebble phosphate mining in Florida.
- B. History of reclamation of land in Florida disturbed by the severance of pebble phosphate rock.
- C. Inventory and categorization of lands in the State disturbed by the severance of land pebble phosphate rock, which lands have not been reclaimed:
 - 1. prior to July 1, 1971
 - 2. prior to July 1, 1975
 - 3. prior to July 1, 1977.
- D. Inventory and categorization of lands in the State disturbed by the severance of land pebble phosphate rock, which lands have been reclaimed:
 - 1. prior to July 1, 1971
 - 2. prior to July 1, 1975
 - 3. prior to July 1, 1977.
- E. Inventory of the current surface and mineral ownership of disturbed lands mined prior to July 1, 1975.
- F. Estimate of present and future costs of reclaiming lands which have been disturbed by the severance of land pebble phosphate rock.

G. Correlation of "reclaimed" lands with radiological data provided by the U. S. EPA, and the Department of Health and Rehabilitative Services - Division of Health.

On October 25, 1977 the Phosphate Land Reclamation Study Commission convened in Lakeland, Florida for an all day field trip to survey the various places of the phosphate mining. The field trip reviewed current mining and beneficiation, waste disposal, new and old unreclaimed lands, new and old reclaimed and current reclamation programs. On the evening of October 25, 1977 and the morning of October 26, 1977, the Commission held two public hearings at the Lakeland, Florida Civic Center to receive public comment and to receive comment from the Southwest Florida Water Management District, the Central Florida Regional Planning Council and the Tampa Bay Regional Planning Council.

On December 13 and December 14, 1977, the Commission met in Tallahassee, Florida to receive and discuss the staff report, and to receive comments from the Florida Phosphate Council on the biological productivity of unreclaimed lands and the U. S. Geological Survey on current water resources studies in those areas affected by phosphate mining.

On January 16, 1977 the Commission met in Tallahassee, Florida to consider staff recommendations pertaining to the reclamation of lands mined or disturbed by the severance of phosphate rock prior to July 1, 1975.

On February 7, 1977 the Commission met in Tampa, Florida to consider the final report of the Commission.

On March 1, 1977 the Commission report and recommendations is respectfully submitted to the Governor of the State of Florida, the President of the Florida Senate and the Speaker of the Florida House of Representatives.

HISTORY OF PHOSPHATE MINING

Phosphate was discovered in the Bone Valley District of Central Florida around 1881 in the Peace River in the vicinity of the town of Fort Meade. The action of the river had eroded away the overburden and finer fractions of the Upper Bone Valley Formation, leaving behind concentrations of pebble-size phosphate rock exposed in the river bottoms. The earliest mining of these deposits was within the river channel by hydraulic dredging. The residual or spoil material was returned to the river thusly obliterating any visual record of the activity. Occasionally the extractive process was extended into the banks of the river, and in these cases, some visual record has occasionally been maintained by the abrupt artificial widening of the rivers. Mining of this type was rather spasmodic and records of ore removal are poor; however, it appears approximately 1.3 million tons were removed over a period of 25 years before extraction costs caused cessation of operations.

Phosphate on land was discovered in this area around 1888, again in the vicinity of Fort Meade. Land surface mining was principally by steam shovel, hydraulic pumps and dredges until 1920 when the first dragline was introduced into the area. These changes in extractive machinery increased the tonnage of ore mined; however, the phosphate rock recovery process remained essentially the same, in that only the pebble fraction of the ore zone was recovered. In 1929, the "flotation process" was developed which allowed for the recovery of the smaller sand size phosphate particles. Although discovered in 1929, the "flotation process" was not implemented industry wide until the 1940s.

The implementation of the "flotation process" had profound effects on the types of residual lands remaining after the mining process. Thus, the

discussion of residual land types is treated in a "before and after" flotation context. Your attention is directed to Figure 1 which provides a synopsis of the important parameters of a typical high grade Bone Valley phosphate deposit and from which the composition of residual lands can be described and quantified.

Prior to flotation, steam shovels, dredges and/or draglines stripped the overburden to expose the matrix (ore body). The overburden was cast aside and essentially inverted, with the soil horizon ending up at the base, the sands being intermediate and the leached zone now being the capping material. The matrix was then excavated, transported to the plant site, and processed where only the pebble (larger) fraction was recovered. According to Figure 1, this means that out of 100 tons of matrix mined which contained 36.2 tons of bone phosphate of lime (BPL), only 9 tons of pebble phosphate rock containing 6 tons of BPL were recovered. The remainder, 90 tons of matrix containing 30.2 tons of BPL, was discarded because of its small grain size. This particular by-product of the mining is generally referred to as "debris". Remining of the "debris" from an original 100 tons of matrix now would recover an additional 20.9 tons of phosphate rock with a BPL content of 15.8 tons. The "debris" normally was piled on virgin unmined lands which would also encourage their remining.

Thus prior to flotation, residual lands consisted of mined-out open pits with overburden piled in the pits in windrows and random piles of debris scattered on adjacent virgin unmined land. These older mined-out pits are now generally water-filled with steep sloped, vegetated overburden piles rising above the water level. The debris piles generally are now seen as steep sloped vegetated ridges or isolated hills rising above an otherwise relatively flat landscape.

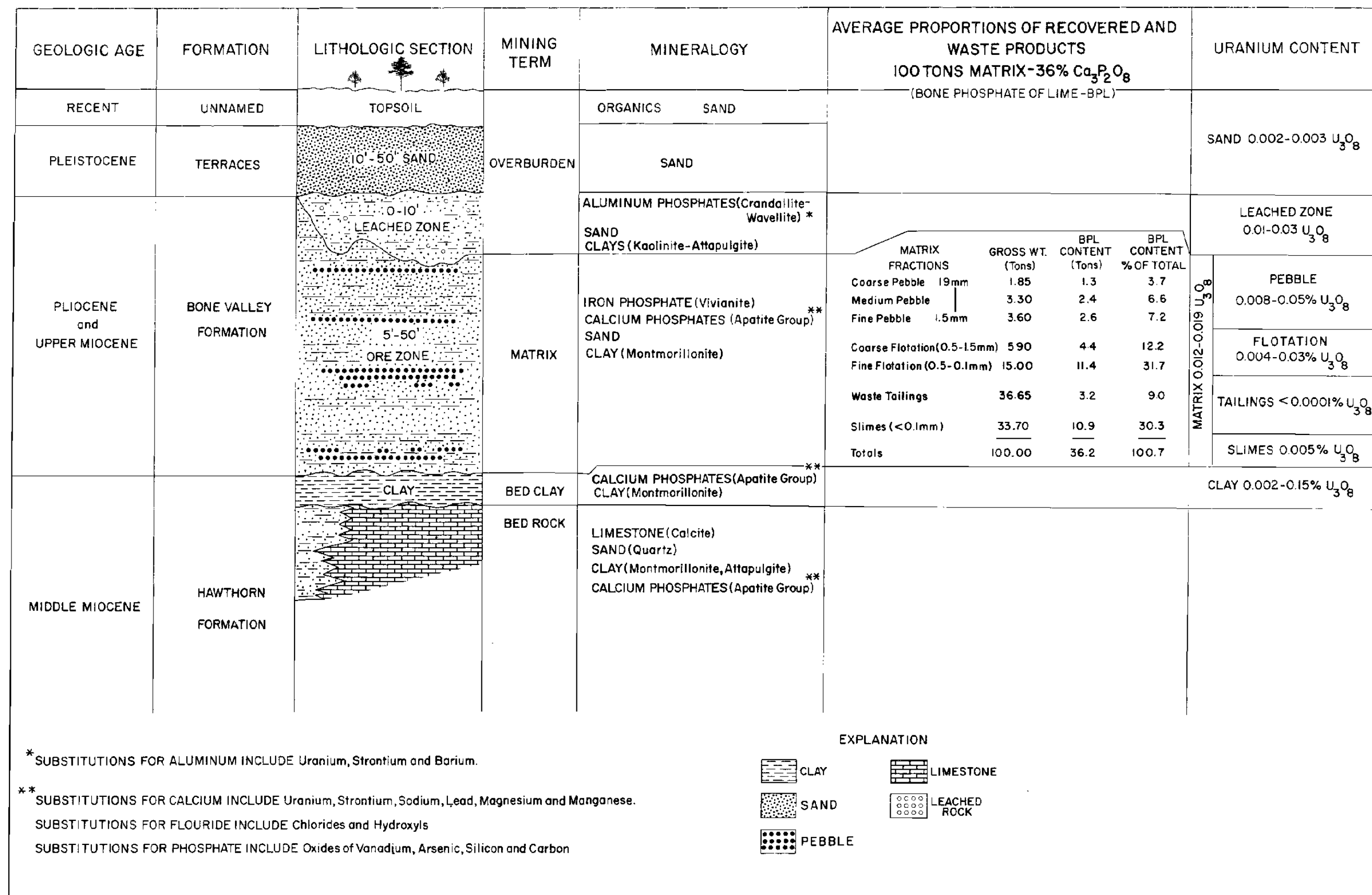


Figure 1. A "typical" High-Grade Bone Valley District Phosphate Deposit.

After the implementation of the "flotation process" which removes the fine phosphate particles (0.1 mm to 1.5 mm) from the matrix, the character of the residual lands changed appreciably. The mined-out open pits still contain windrows of overburden spoil and remain essentially as pre-flotation time. However, the final overall character of many of the mined-out pits may be quite dissimilar in that they are now used as retention areas for waste products (slimes) from the flotation process.

In the flotation process the removal of the 0.1 mm to 1.5 mm size fraction of the matrix dramatically increased the percentage of recovery of phosphate from the matrix. Figure 1 illustrates that the extraction of this size range removes an additional 20.90 tons of phosphate rock with a BPL content of 15.8 tons and increases the percentage of recovery of bone phosphate of lime from 17.5% in pre-flotation recovery to 61.4% in flotation recovery.

In the flotation process, there also are developed two waste products:

- (1) fine grained (0.1 mm - 1.5 mm) quartz sands called tailings,
- (2) clays and very fine grained silts (less than 0.1 mm) called slimes.

The slimes consist of approximately equal parts of phosphate, clay minerals and quartz.

Referring to Figure 1 and under the flotation process an original 100 tons of matrix contains 36.65 tons of tailings and 33.70 tons of slimes which are separated as by-products of the beneficiation of the matrix. The composition of the tailings fraction (36.65 tons) is relatively pure, containing only 3.2 tons BPL or 9% of the total bone phosphate of lime content of the 100 tons of matrix. The composition of the slime fraction (33.70 tons) is richer, containing 10.9 tons BPL or 30.3 percent of the total bone phosphate of lime content.

In addition to the weight analysis there can be made a volumetric comparison of the components of mined material. Again, referring to Figure 1, the total tonnage of the sample and the proportions of recovered and waste products can be arbitrarily converted to volumetric units. The hundred tons or 100 volumetric units represent dry matrix. However, when the matrix is extracted at the mine site, it weighs approximately 133 tons or occupies 133 volumetric units because of the water content (approximately 25%). In the beneficiation process, 29.65 volumetric units of phosphate rock are recovered and 70.35 volumetric units of solid waste (sand tailings and clays) are produced. These 70.35 volumetric units of waste leave the plant as water slurries. The tailings fraction dewater from its transport slurry so rapidly on disposal that it can be considered as its initial 36.65 volumetric units for disposal. The waste clays (33.70 volumetric units), however, are now in colloidal suspension (slimes) in their transport slurry and dewater extremely slowly. The characteristic settling behavior for a "typical" phosphate slime in a pond progresses very rapidly at first and is then followed by gradual settling of the particles. Particles settle relatively fast in a dilute mixture, but as the particles in suspension become more crowded, the settling rate slows to a point at which, for all practical purposes, an ultimate or limiting density is reached. Thus in comparison to our 133 volumetric units of original matrix and water, the slimes require an immediate retention area of 1,123 volumetric units for immediate storage (3% solids), a retention area of 258.70 volumetric units after one month (15% solids), and a long term storage capacity of 168.5 volumetric units (20% solids). This long term storage capacity of 168.5 volumetric units when added to the 36.65 volumetric units of tailings gives a total of 205.15 volumetric units of waste compared to an original extraction of 133 volumetric units of unseparated matrix.

During much of the flotation mining period, the tailings were pumped to the unmined areas adjacent to the plant sites while the slimes were pumped back into the mined-out pits. In a new mining operation where no mined-out pits are available, the first slimes retention area is, by necessity, an above grade diked retention area over unmined land. As the mining process proceeds, mined-out pits become available for the disposal of slimes. This process is altered frequently where mined-out pits from earlier mining operations can be acquired for the disposal of slimes, in which case the first slimes retention area also may be in mined-out areas. Because of the volumetric increase of the disposed by-products, there is never enough mined-out acreage to accommodate the increased volume of waste by-products of the mining operation. For this reason, the slime disposal areas are diked and the slimes stored below and above grade. The dikes surrounding the slime retention areas are normally constructed from overburden and/or tailings.

In the past few years, substantial activity has been directed toward an acceleration of the dewatering of the slimes. This activity can be related to the economic cost of above-grade storage of slimes and to the recovery of very large quantities of water which could be reclaimed for the water recirculation system. One method proposed for the accelerated dewatering of slimes is the mixing of tailings and slimes so that the residual land would contain a composite of these two by-products.

To summarize, the extractive process creates basically a singular type of residual land that is an open pit with internally arranged stacks or rows of overburden. The matrix has been removed to the plant for beneficiation so the remaining overburden will never fill the open pit. The void space in the pit is determined by the relative quantities of matrix and overburden. Where the overburden was thin and the matrix thick, much

void space remains; as the thickness of the overburden increases relative to the thickness of the matrix, less void space remains. Without additional fill materials, these areas remain or can be reclaimed only as a land and water combination with the water fraction proportional to the void space remaining.

The beneficiation process has created several different residual land types. Prior to flotation, the beneficiation of the ore produced "debris" which was not returned to the open pits but rather was discarded as random stacks, piles or rows adjacent to the plant sites. After flotation, the beneficiation of the ore produced two waste products, tailings and slimes. Both of these waste products are transported away from the plant site as a water slurry. The tailings, which dewater quickly generally were disposed of near the plant site in tailings piles or utilized to construct dikes around slime retention areas and as fill material for reclamation. Newly proposed sand clay mixes would also utilize tailings.

The slimes do not dewater easily, remaining in a fluid state for long periods of time. Thus, they are transported to diked retention areas which are either above grade, below-grade mined-out pits, or above-below grade, diked, mined-out pits.

Due to the volumetric increase of the slimes, disposal only below grade has not been possible. The number and volume of slimes retention areas are dependent on the amount of the < 0.1 mm size fraction in the matrix which varies considerably. In Polk and Hillsborough counties, the amount of slimes produced has averaged 1.5 times the volume of matrix mined. The acreage of slime retention ponds is dependent not only on the volume of slimes produced but also on the height of above-grade retention.

The mining, beneficiation, and waste disposal reviewed thus far have

An understanding of the mining process and its historical development is essential to any consideration of reclamation. Certain residual land types result from the mining process and the timeliness and type of reclamation feasible is dependent thereon. Past changes in the mining process to increase the recovery of phosphate affected reclamation potential adversely; however, there are much needed modifications which could increase the phosphate recovery, conserve water resources and enhance the timeliness of reclamation. In summary, these points are again emphasized:

1. The most significant technological improvement in the recovery of the resource from 1888 to 1977 was the discovery and implementation of the flotation process. Introduced industry-wide in the 1940's, the flotation process increased the recovery of phosphate from the matrix from approximately 17% to 61%.

2. The implementation of the flotation process produced a new waste product, slimes, which because of its water absorption capacity and its water retention characteristics is a major disposal and reclamation problem. Thirty to forty million tons of waste clays (dry-weight) are being produced annually which are removed from the beneficiation plant in a water slurry of less than 3% solids (slimes), and which may require 20 years or longer to naturally stabilize (dewater).

3. The visual impact of the phosphate mining industry on the landscape is intensified in that while the industry has existed since 1888, 79% of the total phosphate extracted and 81% of the total slimes produced has taken place since 1956. Of the total 127,578 acres of mined out lands inventoried, approximately 100,000 have been mined since 1956. Of the total 58,704 acres of slime retention areas inventoried, an estimated 47,500 acres have been developed since 1956.

4. The beneficiation of phosphate ore has pointed out the need for:
 - a. technology to economically extract the phosphate from slimes, and
 - b. technology to economically dewater the slimes rapidly.

HISTORY OF RECLAMATION

In the early years of land pebble phosphate mining, the sparsity of people, the scattered occurrence of mines and the "unlimited" abundance of land engendered an environment of unconcern relative to reclamation. While there were scattered examples of individuals acquiring mined-out lands at virtually no cost and utilizing portions thereof, or of isolated industry projects, there was no concerted effort toward reclamation until the late 1940's.

In 1947, the mining of phosphate was in such close proximity to the City of Lakeland in Polk County, the Lakeland Chamber of Commerce attempted to have legislation passed by the Florida Legislature requiring reclamation. Although no immediate reclamation legislation resulted from this effort, agreements were reached between the Chamber and the phosphate industry to initiate reclamation. In the 1950's, as an outgrowth of these negotiations, several members of the phosphate industry made serious efforts to reclaim mined-out land.

These first large scale reclamation efforts demonstrated that while reclamation was possible, the feasibility was not enhanced because of the expense involved. In 1960, the eight companies mining phosphate rock in Polk and Hillsborough counties established a Land Use and Reclamation Committee through the Florida Phosphate Council to coordinate and promote reclamation.

This decade witnessed significant changes in the industry's approach to reclamation. For the first time, real emphasis was given to the development of mining plans, which included a plan for reclamation. These efforts resulted in the type of reclamation known today as land and lakes and demonstrated the economic feasibility of reclamation with proper planning.

The efforts of the individual companies through the Land Use and Reclamation Committee were not directed solely toward land reclamation but also toward a broader land use concept involving the public need for land. Mined-out lands were leased to the Florida Game and Fresh Water Fish Commission to manage for public fishing and hunting and substantial acreage was leased to the Audubon Society for bird sanctuaries. Park and school sites and road rights-of-way were donated or leased to counties and cities and landfill garbage disposal areas were provided to both Polk and Hillsborough counties. Pastures were made available to schools in both counties for use by vocational agricultural students for cattle projects.

The following tabulation demonstrates the types of reclamation activities carried out by the phosphate industry during the 1960's:

Examples of Land Reclamation Activities of Various Phosphate Companies

<u>Example</u>	<u>Company</u>	<u>Description of Project</u>
1	IMC	Southwest Bartow-100 acres-A tract adjoining IMC's Bartow offices. Mined 1965-66. Residential sites.
2	IMC	U.S. 17 strip-135 acres-south of Bartow. Right-of-way for anticipated 4-lane road. Good for commercial.
3	IMC	West Mulberry-31 acres-2,500 ft. frontage on Fla. 60. Sold to out-of-state industrial firm.
4	IMC	Noralyn recovery plant site-20 acres-office, lab, on reclaimed land.
5	IMC	Mulberry area-1,000 acres-north, south and southeast of Mulberry; all acreage fronting on a highway. One part recreational, another agricultural, rest of reclaimed area for residential or commercial uses.

6	(Armour)	West Bartow Elementary School-Dedicated in May, 1966. Deeded to City in 1960.
7	(Armour)	Clark Property-170 acres. A real estate subdivision.
8	(Cyanamid)	Saddle Creek Park-740 acres; land has been donated to people of Polk County for recreational area. Swimming, fishing, picnicing, & other activities. East of Lakeland.
9	(Cyanamid)	Orange Park, north of Lakeland-2,224 acres reclaimed-mining and simultaneous reclamation. Reclamation completed within a month after mining.
10	(Cyanamid)	315 acres-east of Lakeland-donated to Florida Audubon Society as a wildlife sanctuary. Largest reserve owned by society in State.
11	(Mobil)	Peace River Park-donated to City of Bartow (east of city limits) as recreational area.
12	(Mobil)	Christina Park-1,100 acres-Large area south of Lakeland. Sold to private interests for housing development.
13	(Cyanamid)	Pleasant Grove Fish Management area, east of Tampa-1,160 acres. Under supervision of Florida Game & Fresh Water Fish Commission.
14	(IMC)	Bartow Civic Center-10 acres-1966, land was donated to City for civic center.
15	(Cyanamid)	Sydney-1,613 acres reclaimed-15 miles east of Tampa. Sold portion of reclaimed land for 18-hole golf course.
16	(W.R.Grace)	Sylvester Shores-residential subdivision built on reclaimed land in southeast Lakeland. Mined in 1955. Reclaimed in 1960.
17	(W.R.Grace)	North of Mulberry area - 367 acres fronting on SR 37 and Carter Road. Potential commercial and residential property. 2,600 feet reclaimed on SR 37.
18	(W.R.Grace)	East of Mulberry area - 155 acres with 4,400 feet on SR 60. Potential commercial property.

The inventory of lands voluntarily reclaimed by industry prior to July 1, 1971 is approximately 20,700 acres. This total was calculated by inventorying company records and those of the Department of Natural Resources, Bureau of Geology. All of these parcels of land were inspected by Department of Natural Resources, Bureau of Geology personnel or employees under contract to the Department of Natural Resources, Bureau of Geology between July 1, 1976 and July 1, 1977. Because these inspections were related to an evaluation of the composition of subsurface materials (radiological potential) and not specifically to the quality or categorization of the reclaimed surface, the Department of Natural Resources, Bureau of Geology records do not indicate these lands as being reclaimed in accordance with the rules and regulations promulgated by the Department of Natural Resources in 1975.

The 1971 Florida Legislature amended Chapter 211, Florida Statutes, by adding Part II, which imposed an excise tax on the severance of solid minerals from the soils or waters of Florida. An important aspect of this legislation was the encouragement of a more conscientious effort by mining companies to reclaim the lands they disturb.

Reclamation program records of the Department of Natural Resources - Bureau of Geology indicate that from July 1, 1971 to December 31, 1974, 3865 acres of phosphate lands were reclaimed. Originally, the staff proposed to provide reclamation statistics from July 1, 1971 to July 1, 1975. However, summation given in this report will cover from July 1, 1971 through December 31, 1974 because the reporting of completed reclamation is tabulated on a calendar year basis.

A summary of the reclamation, classification, acreage and potential land use, for lands reclaimed from 1971 to 1974, is as follows:

Reclamation Classification	Acreage	Potential Land Use
Land filled with overburden	226.9	Agricultural, Industrial, Pasture, Residential
Land & Lakes	2239.40	Agricultural, Industrial, Pasture, Recreational, Residential
Land filled with sand	497.7	Industrial, Pasture, Residential
Land filled with sand and capped with overburden	55.0	Agricultural, Industrial, Pasture, Residential
Settling pond filled with clay	373	Pasture
Settling pond filled with clay and capped with sand	106.7	Pasture
Settling pond filled with clay, capped with sand	366.3	Agricultural, Pasture
	<u>3,865.0</u>	TOTAL

In 1975, the Florida Legislature revised Chapter 211, Part II and amended the Act as follows:

- a. imposed mandatory reclamation of lands subject to the tax,
- b. authorized the Department of Natural Resources to establish time schedules for the completion of reclamation and restoration programs,
- c. eliminated the division of refunds between old lands and new lands,
- d. provided for holding back a portion of the Land Reclamation Trust Fund until reclamation is complete,
- e. provided for injunctive relief if the taxpayer failed to reclaim mandatory lands.

On September 30, 1975, the Executive Board of the Department of Natural Resources adopted the proposed "General Rules Governing the Reclamation of

Sites of Severance of Solid Minerals" which were filed with the Florida Secretary of State on October 2, 1975 as Chapter 16C-16, Florida Administrative

In general, the July 1, 1975 amendments appear to have been effective in promoting more reclamation. Statistics compiled from the Department of Natural Resources - Bureau of Geology records indicate that in 1975 reclamation was completed on 2,565 acres of mined-out lands while mining was conducted on approximately 6,000 acres. In 1976, reclamation was completed on 4,305 acres while mining was conducted on approximately 5,800 acres. The 6,869 acres of completed reclamation during 1975 and 1976 only involved lands mined prior to July 1, 1975. Much of the reclamation completed during this time period represented lands on which reclamation has been instituted earlier, sometime between 1971 and 1975.

Reclamation Classification	1975 Acreage	Potential Land Use
Land filled w/overburden	170.1	Agricultural, Industrial, Pasture, Residential
Land & Lakes	1,139.70	Agricultural, Industrial, Pasture, Recreational, Residential
Land filled with sand	160.3	Industrial, Pasture, Residential
Land filled with sand & capped w/overburden	103.6	Agricultural, Industrial, Pasture, Residential
Settling ponds filled w/clay	458.0	Pasture
Settling ponds filled w/clay & capped w/sand	391.40	Pasture
Settling ponds filled w/clay, capped w/sand and overburden	141.00	Agricultural, Pasture
	<u>2,560 acres</u>	TOTAL

Reclamation Classification	1976 Acreage	Potential Land Use
Land filled with overburden	83.3	Agricultural, Industrial, Pasture, Residential
Land & Lakes	2,205.60	Agricultural, Industrial, Pasture, Recreational, Residential
Land filled with sand	542.0	Industrial, Pasture, Residential
Land filled with sand and capped w/over- burden	351.3	Agricultural, Industrial, Pasture, Residential
Settling ponds filled w/clay	680.0	Pasture
Settling ponds filled w/clay & capped w/overburden	168.3	Pasture
Settling ponds filled w/clay & capped w/overburden and sand	275	Agricultural, Pasture
	4,305 Acres	TOTAL

The history of reclamation in Florida reflects a subtle change in the definition of the term "reclamation". Earlier voluntary reclamation returned selected parcels of land to an immediate beneficial use to meet a specific need or desire of the local community. Voluntary reclamation was largely controlled by the economic wellbeing of the phosphate industry. In the early 1960's the phosphate industry was in a stronger economic position than in the late 1960's and most of the voluntary reclamation occurred in the early 1960's, diminishing in the late 1960's.

The implementation of incentives for reclamation in 1971 and of mandatory reclamation in 1975 changed reclamation considerably. No longer was reclamation to meet an immediate specific need of the community but rather to return

broad areas of mined or disturbed land to a stage of potential beneficial use. This type of reclamation is not land-use oriented but rather emphasizes restructuring and stabilizing new land forms in a timely manner to eliminate the visual scars of mining, to eliminate safety hazards and to control water quality exiting the area. Specifically, these actions are to reduce precipitous slopes both on land and in water areas to a more aesthetically pleasing rolling topography with less hazards to animals and people from falls and drowning; to remove old machinery, wires, pipes and other physical evidence of mining from the ground surface; to alleviate any toxic or sediment-laden waters from exiting the mined area and entering other lakes or streams and to stabilize the newly contoured land by establishing a ground cover of vegetation. All of these above actions are to be conducted in a timely manner to restrict the adverse impacts of the mining operation as much as possible to the current mined area and to allow the new landforms to develop into new environmental systems or to be developed into other land use categories as dictated by economics and need.

In inventorying lands to be reclaimed which were mined or disturbed by the severance of phosphate prior to July 1, 1975 (old lands) one situation becomes apparent where current reclamation standards are difficult to apply. Since the "old land" category includes lands mined from the early 1900's substantial acreage has naturally developed vegetative cover and productive wildlife systems. These ecosystems cover a wide quality spectrum, largely dependent on age, however, the biomass of the older ecosystems is estimated to be appreciably greater in some cases than the before-mining ecosystem. Comparisons of the quality of the biomass before and after mining are much more difficult because the wildlife composition is of different species.

If these "old lands" are recontoured to meet current standards of slope,

health and safety or to develop lands with potential uses other than wildlife areas, the current ecosystems will be destroyed and the land surface laid bare once again. It would appear that it is a more reasonable course of action to exempt "old lands" with well developed ecosystems from reclamation and to focus the state's attention on newer "old lands". Partial exceptions may be appropriate where selective reclamation would appreciably enhance the quality of the ecosystem or diversify the potential land use.

Since the "old lands" grade in time from 1888 to 1975 it will be necessary to perform an on-site evaluation to determine which old lands should be completely reclaimed to current minimum standards, which partially reclaimed to minimum standards, and which are exempt. It is anticipated that a substantial percentage of the mined or disturbed lands in non-company ownership will have naturally developed productive ecosystems. Most of these lands passed out of company ownership some years ago and generally represent early mined land. It is anticipated that a much smaller percentage of company owned lands will fall into this category because of the larger amount of mining that has taken place in the past twenty years in comparison to acreage mined prior to that time.

COST OF RECLAMATION

The basic cost of reclaiming can be divided into earthmoving or physical restoration of the land and revegetation based on land use objectives.

Earthmoving - Reclamation methods by material movement classification that are in use by industry are primarily (1) sand tailings fill, (2) overburden spoil redistribution, (3) drainage and consolidation of clays existing in above grade impoundments, (4) sand-clay mix, and (5) overburden fill.

Sand Tailings Fill - The back filling of mined out areas with flotation sand tailings (waste) is a common method of land restoration. The method consists of backfilling an area to the desired grade and costs are primarily those of material movement. The phosphate ore mined contains approximately 1/3 silica sand waste. This material is favorable backfill from the standpoint of transportation and integration in to mining operations, and the resulting ground stability. The tailings are moved from the plant site to the reclamation area by pumping as a slurry. The cost of filling an area with tailings is directly dependent on the depth or the amount of fill material required and the transportation distance. Cost estimation for pumping of tailings is reasonably straightforward, based on certain slurry densities and pumping efficiencies. Operationally, most tailings pumping is confined within a 2-3 mile radius of the plant, due to cost, maintenance, and facilitating slurry water return. Figure 2 is a graph illustrating the cost of tailings backfill as a function of the depth of the area to be filled and its distance from the plant or source area.

Tailings are by no means sterile but are comparatively low nutrient value and due to their coarse texture, exhibit poor moisture retention properties. Exposed soil windrows within a mined area or surrounding

SUMMARY - TAILINGS FILL

Power (Elect)	Pump Maint	Pipe Maint	Direct Labor	Super- vision*	Engineer- ing*	Heavy Equipment	Supplies	Surveying	Ditches & Control Structure	Outside Services
\$45.16/ Acre Ft Mile	\$12.10/ Acre Ft Mile	\$6.50/ Acre Ft Mile	\$217.50/ Acre	\$37.50/ Acre	\$150.00/ Acre	\$350.00/ Acre	\$35.00/ Acre	\$25.00/ Acre	\$30.00/ Acre	\$20.00/ Acre

*Includes overhead.

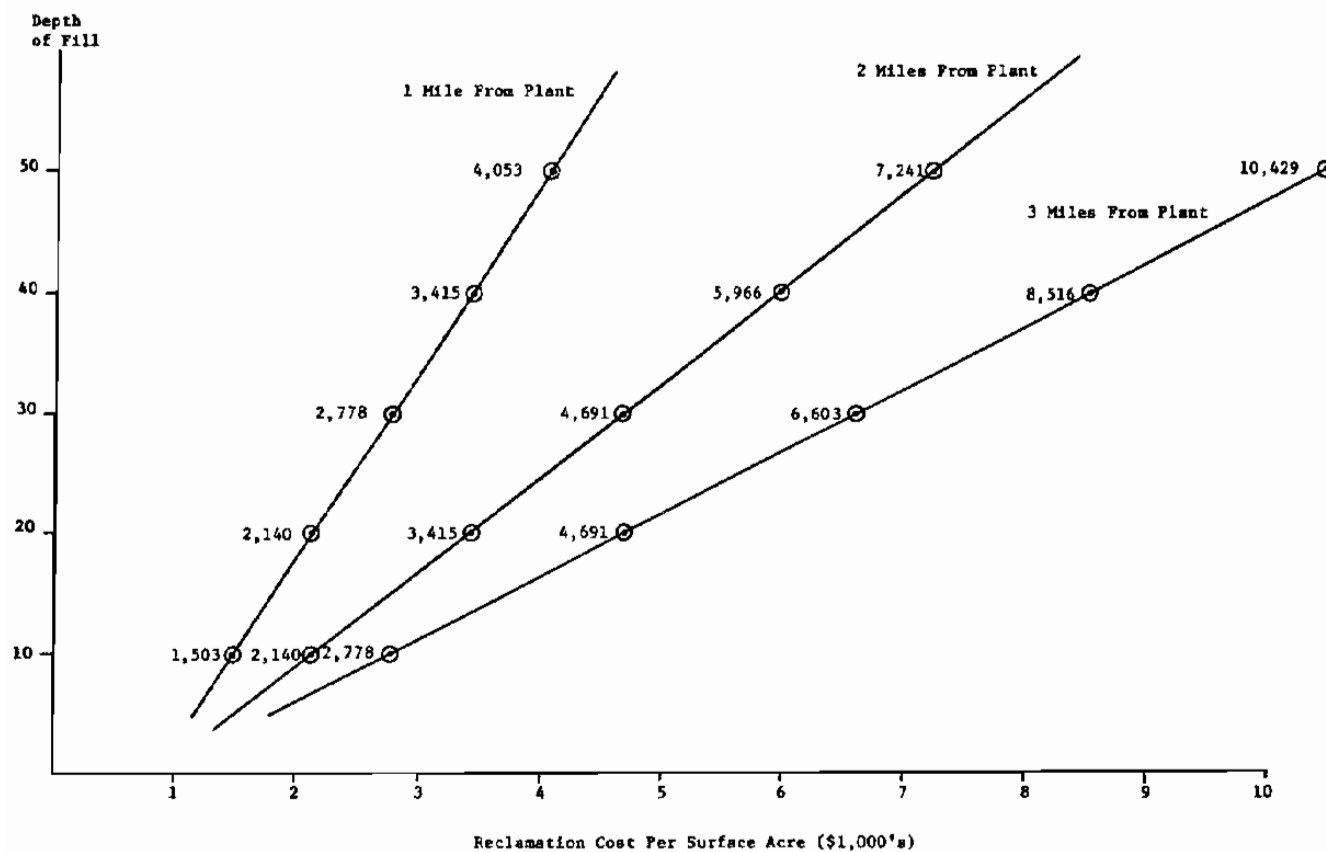


Figure 2. Graph Illustrating the Cost of Tailings Backfill.

overburden may be distributed over the filled and graded tailings to improve the agricultural capability of the site. The cost of this overburden "capping" is illustrated on Figure 3.

Overburden Spoils - In cases where it is impractical to backfill or it is economically or aesthetically desirable to create a lake system, mined sites are often reclaimed by redistributing the spoiled windrows stacked by the draglines. The method most often employed has been the grading and sloping of the long spoil windrows to create elongated finger-like peninsulas separated by narrow water bodies that comprised the open pit between the windrows. After an initial period of settling, the graded spoils create reasonably stable ground and the interrelated land and water landscape can be attractive.

The cost of the site reclamation is dependent on the amount of spoil redistribution required, and the percentage or resulting land area to open water, as shown on Figure 4. An alternative to the sloping and shaping of the spoil windrows is the dredging of the spoils and redistribution of the material into a perimeter land area with a central water body. The unit earthmoving cost and the increase in amount of material movement for such a method make the total site cost very large as opposed to finger lakes as shown in Figure 5. The magnitude of this differential discourages this type of reclamation except in areas of unusual incentive.

Clay Filled Areas - Most clay settling areas were constructed by impounding the waste with above natural grade perimeter dikes, although there are some cases of clay disposal below or near surrounding natural grade which pose difficult restoration problems. Impounded clays entrain water in large amounts (about 80 percent) and will not dry naturally or allow

If the tailings fill area is in a mining area with spoil windrows the capping costs are calculated using the land and lakes capping method.

This consists of calculating the land area the spoils occupy at natural ground level. Knowing this acreage, the percent land can be calculated. A direct readout on capping cost can then be had using the overburden capping graph.

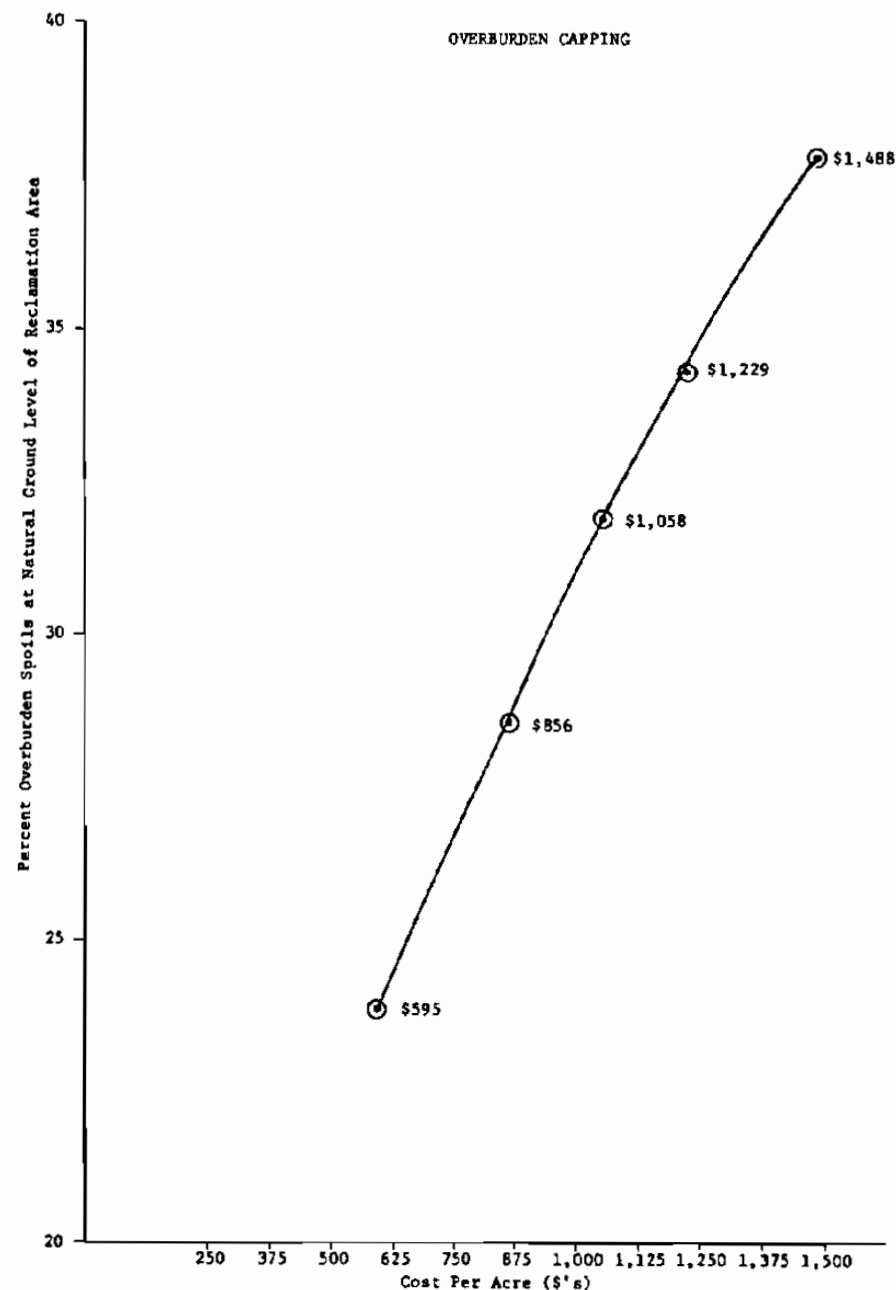


Figure 3. Graph Illustrating the Cost of Overburden "Capping".

Pumping Cost	Direct Labor Cost	Heavy Equipment Perimeter Dewater	Heavy Equipment Interior Dewater	Heavy Equipment Overburden Capping	Maint Spray Joints	Super- vision (Inc O'head)	Engineer (Inc O'head)	Survey	Water Control	Outside Service
\$45.16/ Acre Foot Sand Clay Area	\$326.25/ Acre of Sand Clay Mix	\$2.81/ Foot of Lineal Sand Clay Area	\$104.00/ Acre of Sand Clay Area	See Graph	\$200/ Acre of Sand Clay Area	\$37.50/ Acre	\$150/ Acre	\$25.00/ Acre	\$30.00/ Acre	\$20.00/ Acre

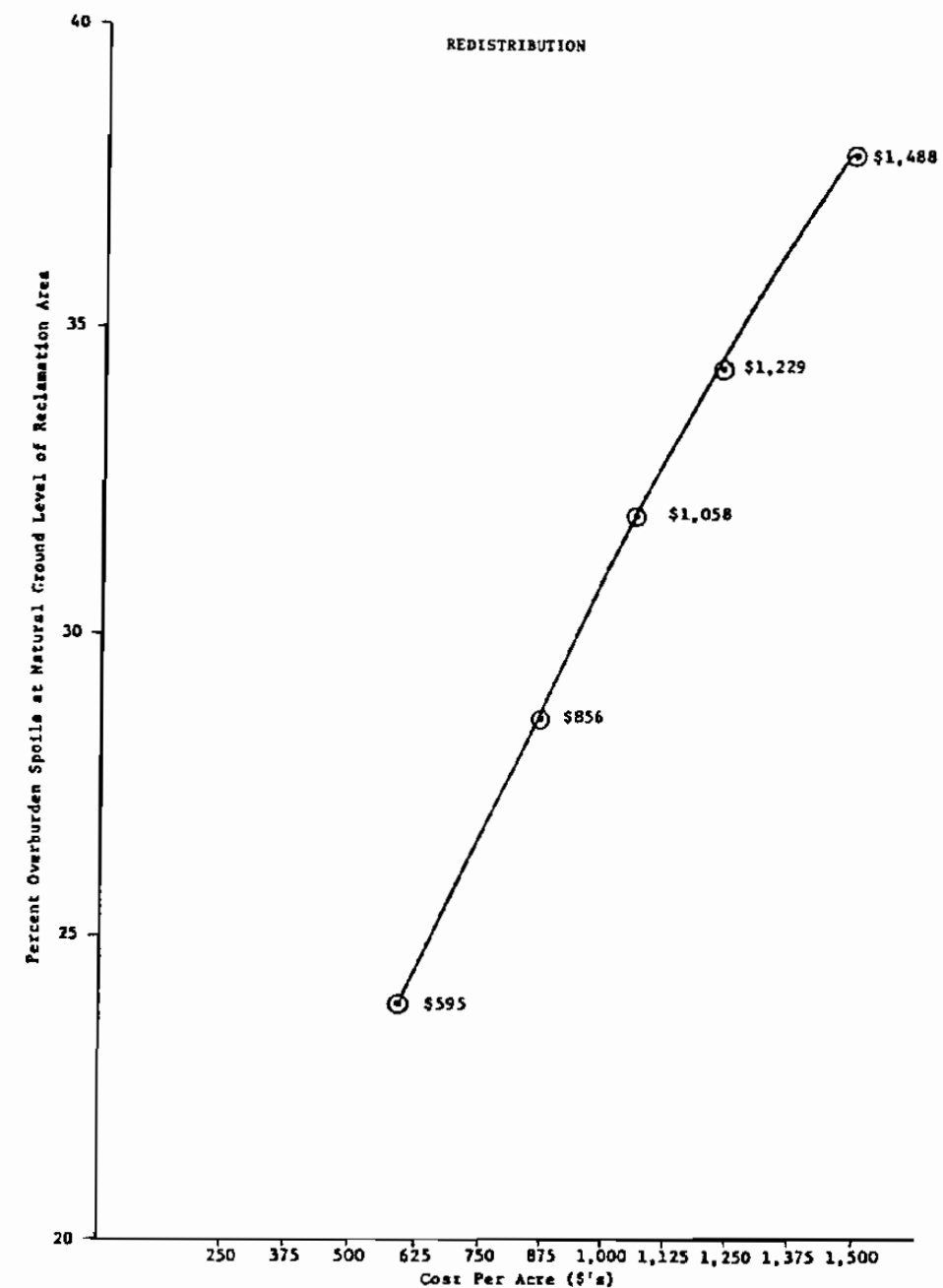


Figure 4. Graph Illustrating the Cost of Overburden Spoil Redistribution by Sloping and Shaping (Land and Lakes).

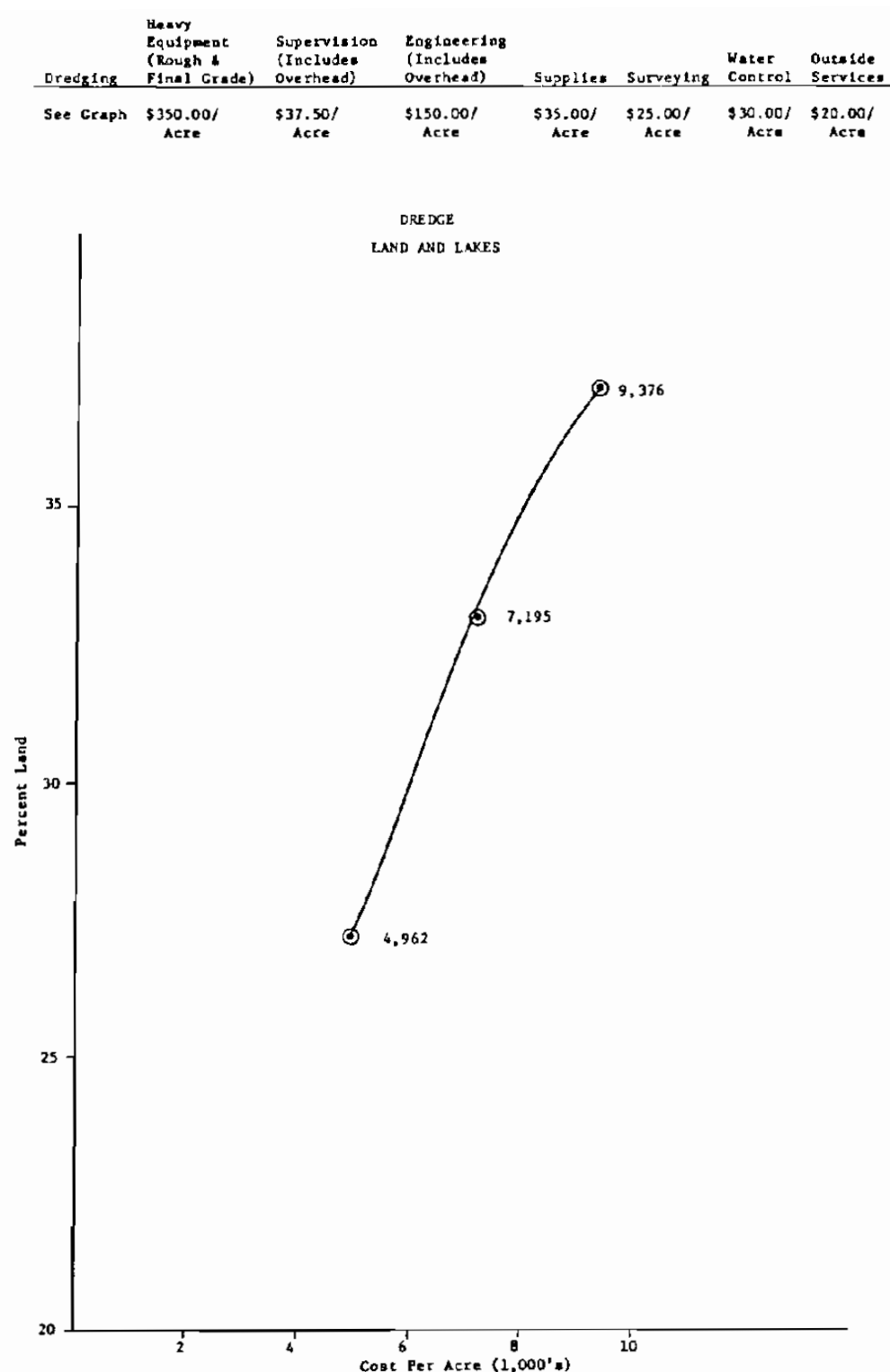


Figure 5. Graph Illustrating the Cost of Overburden Spoil Redistribution by Dredging.

stabilization. For those areas filled above grade, the technique of reclamation involves the drainage and drying of the surficial layer of clay to the extent that it will support light agricultural machinery.

The interior areas, particularly of the more recent ones, are too soft to support normal earthmoving equipment. Drainage is induced by the digging of perimeter ditches and interior ditches where possible, the cost of which is shown in Figure 6. Special low ground pressure machines are often required for internal ditching operations.

Some mines have developed the specialized low bearing pressure machinery required to maintain drainage and expose the surface to air drying. Over a period of time drying will produce a top layer of sufficient competence to support low bearing pressure vehicles that will further turn and drain the clay. Clay filled areas are usually very productive in specific hardy hydric vegetation including willows, cattails, and other thick brush. This volunteer growth is removed or controlled to enhance access and air exposure. Complete removal is required prior to revegetation of desired permanent species.

In addition to interior drainage and stabilization, several methods are employed for additional improvement in surface stability including capping with pumped tailings, redistribution of surrounding dike "overburden" type material over the interior clays, or a combination of both methods. The decision to apply such stabilization material is dependent on its availability, and it is not necessarily required for the completion of the reclamation as the clays are acceptable soils for certain revegetation types, particularly pasture grasses.

Sand-Clay Mix - In the past few years applied research by the Industry and Bureau of Mines has led several operating companies to experiment

Perimeter Ditch Required	Spillway Drainage	Interior Ditching	Surveying	Outside Services	Cover Chop	Movement of Dike Material	Obd Cap (Opt)	Supver (Inc 0'head)	Engineer (Inc 0'head)
\$2.81 x Linear Foot of Dike/ Acre = Cost/ Acre (See Graph)	\$5.50/ Acre	\$104.00/ Acre	\$25.00/ Acre	\$20.00/ Acre	\$200/ Acre	\$13.12 x Linear Foot of Dike/ Acre = Cost/ Acre (See Graph)		\$37.50/ Acre	\$150.00/ Acre

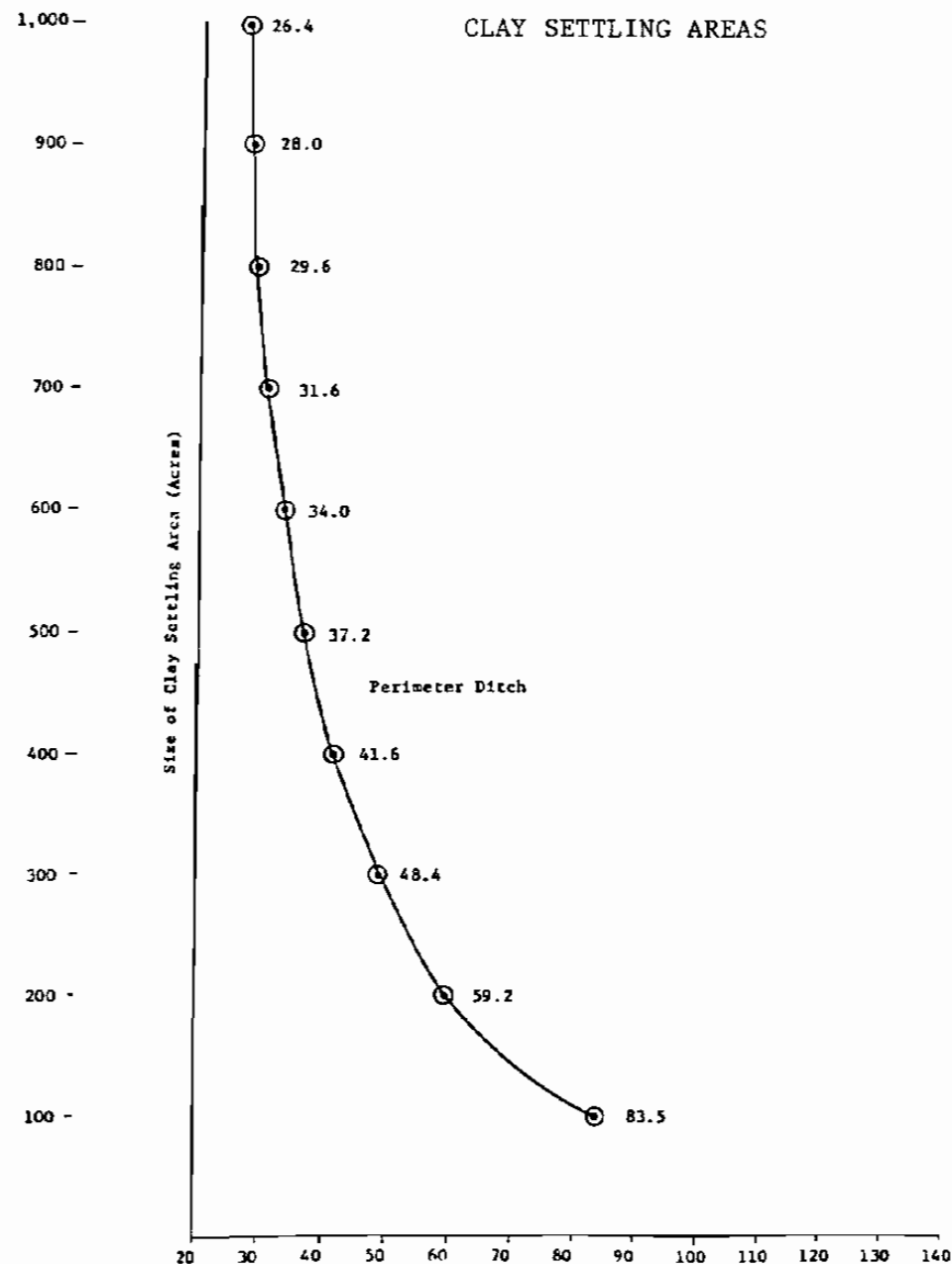


Figure 6. Graph Illustrating the Cost of Perimeter Ditching.

with a method of waste disposal that employs the remixing of tailings sand with the clay waste, rather than disposal into separate areas. Its use is growing in the field but is limited by present state-of-the-art technology and economics, as well as the unique constituency of the ore at the operating mine. A number of methods of remixing the sand and clay are being studied, and thus far there is insufficient data available for formulation of a cost case. For purposes of this study, cost estimations are premised on the assumption that sand-clay filled areas would be similar in some respects to clay settling areas. However, sand-clay areas incur a tailings pumping cost and are, therefore, most expensive from the standpoint of material movement. If the pumping cost of clays were considered for clay settling areas, the situation would be reversed. This is offset, however, by less difficulty in the stabilization of the impounded mixture. As in clay settling areas, the mixture may be capped by surrounding dikes or interior spoils, or optionally capped by pumped tailings. Sand-clay mix type soils are likely to be agronomically superior to the materials used to cap them, and from this standpoint would be preferably left uncapped. Figure 7 illustrates cost factors.

Overburden Fill - Due to regulatory time requirements, the unavailability of other fill, or economic incentive, it is often necessary or desired to transport overburden for use as a fill material. The estimation of cost for this study considered using dozers and scrapers, although in certain cases overburden has been hauled by truck. This method is extremely costly and is a direct function of haul distance and material volume, although the cost is also dependent on the availability and condition of haul routes and weather. Figure 8 illustrates cost factors.

Pumping Cost	Direct Labor Cost	Heavy Equipment Perimeter Dewater	Heavy Equipment Interior Dewater	Heavy Equipment Overburden Capping	Maint Spray Joints	Super- vision (Inc O'head)	Engineer (Inc O'head)	Survey	Water Control	Outside Service
\$45.16/ Acre Foot Sand Clay Area	\$326.25/ Acre of Sand Clay Mix Area	\$2.81/ Lineal Foot of Sand Clay Area	\$104.00/ Acre of Sand Clay Area	See Graph	\$200/ Acre of Sand Clay Area	\$37.50/ Acre	\$150/ Acre	\$25.00/ Acre	\$30.00/ Acre	\$20.00/ Acre

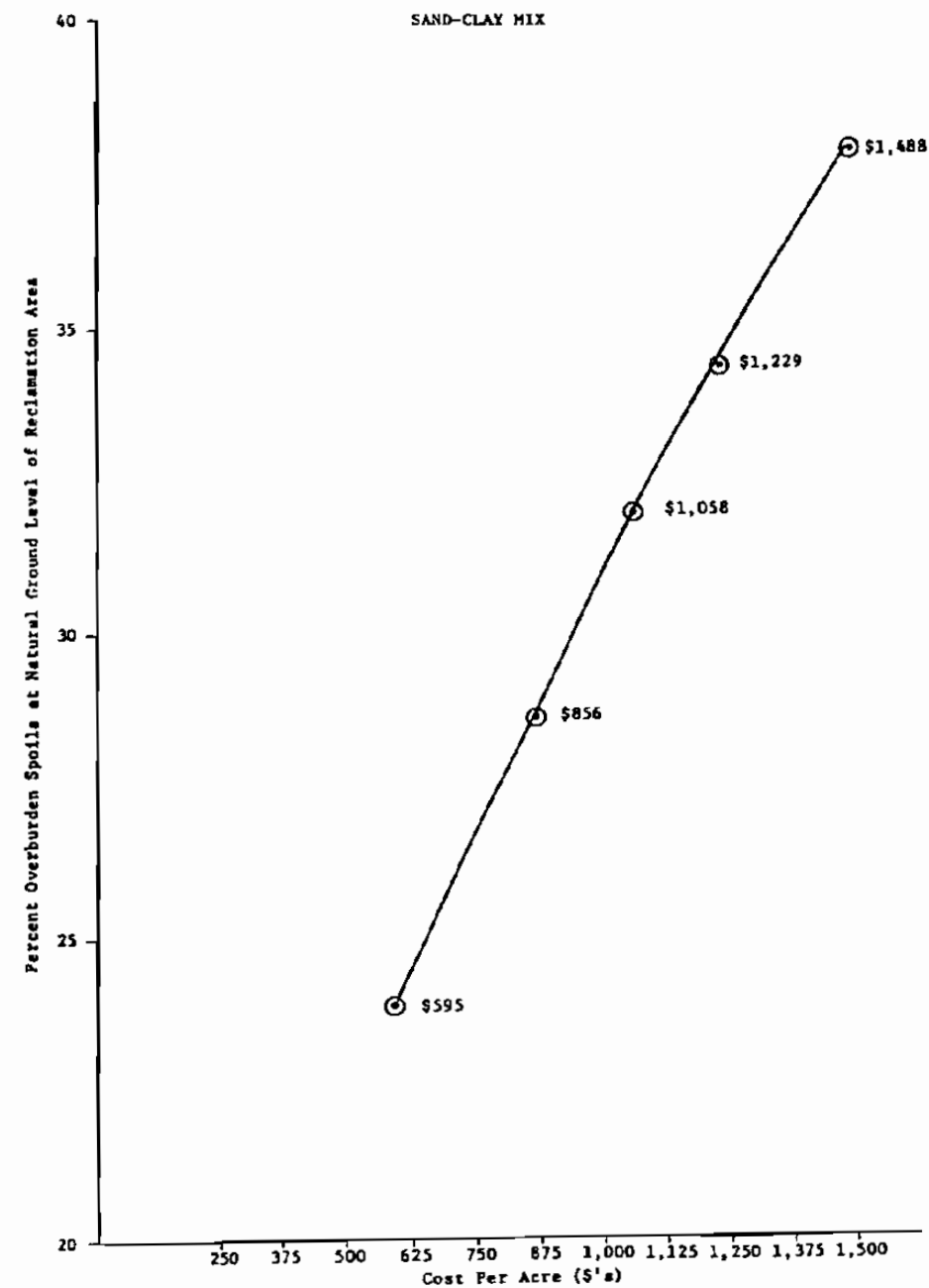


Figure 7. Graph Illustrating the Cost of Sand-Clay Mixes.

Hauling & Support Equipment	Grading	Supervision (Includes Overhead)	Engineering (Includes Overhead)	Surveying	Water Control	Outside Services
See Graph	\$143.50/ Acre	\$37.50/ Acre	\$150.00/ Acre	\$25.00/ Acre	\$30.00/ Acre	\$20.00/ Acre

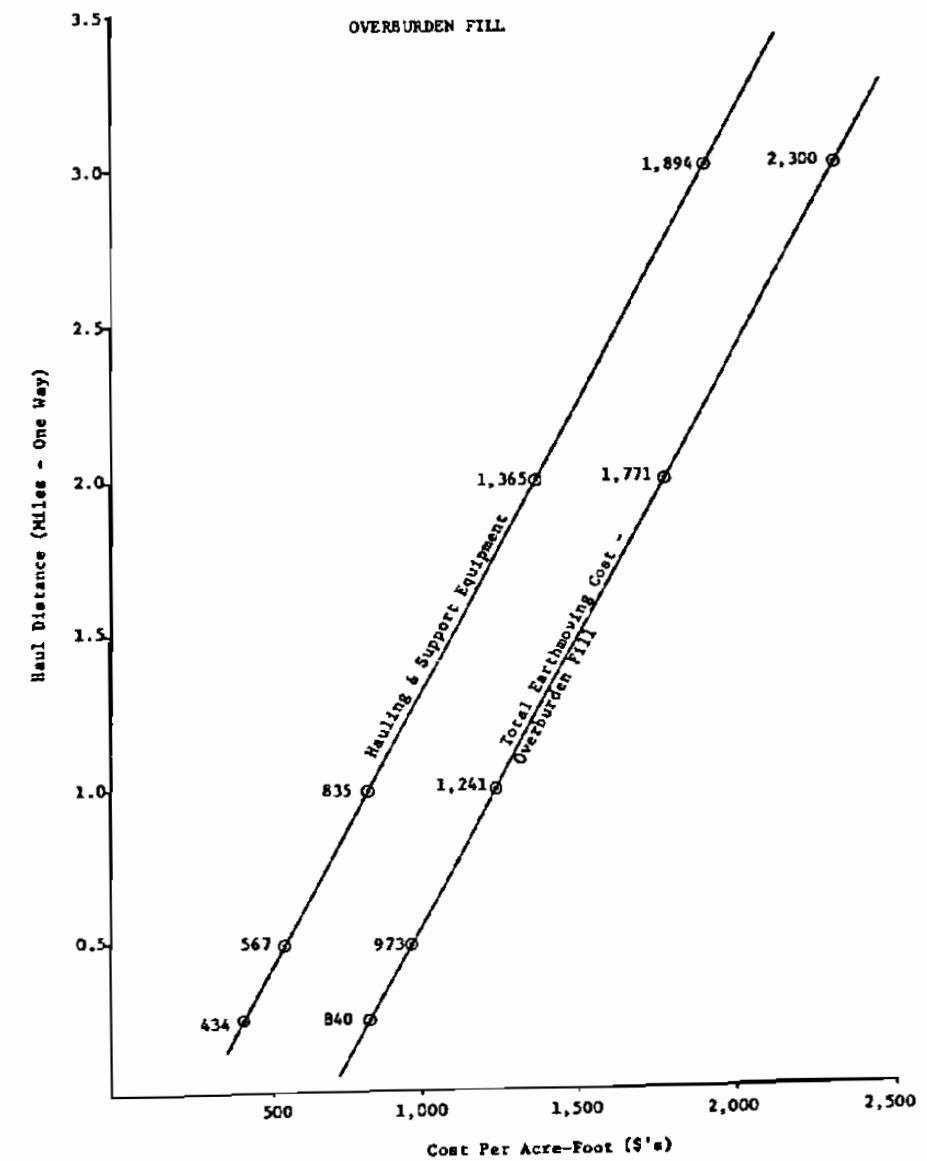


Figure 8. Graph Illustrating the Cost of Transporting Overburden Fill.

Revegetation - Each fill type (i.e., overburden fill, sand tailings fill, clay fill, sand-clay mix, or land-lake) provides soils of a specific agronomic character. The vegetation options for these soils are also controlled by the reestablished hydroperiod or water table, and drainage of the area. A number of revegetation methods were considered, but primary emphasis was placed on those required to adequately restore a parcel to a selected land use. These included grasses for improved pastures, residential or industrial areas, forestry in the form of pine or eucalyptus plantings, citrus planting, cropland, as well as wetland restoration as either marshes or swamps.

Some costs in revegetation estimation are fairly standard for all types of reclaimed land, such as seed and fertilizer. Other costs may be extremely variable such as the cost of seedbed preparation, large tree plantings, or irrigation. Some judgment decisions were necessary in the cost estimation, e.g., the number and size of trees to be introduced into the pasture areas, the amount of disking, rotovating or seedbed preparation necessary in clay settling areas, the selection of two-stage seeding for certain type soils, and maintenance and irrigation requirements after planting.

In the case of wetlands restoration there is little applied cost experience in revegetation methodology. In the cases of swampland, the cost of revegetation is highly dependent on the number, size, and extent of transplanting of trees and the requirements for substrata preparation. In the cases of marshes, the decision may be to allow natural revegetation at no cost, or to induce a preferred type of grasses at some expense. Figure 9 summarizes the cost estimation of various schemes as related to preferred land use.

These basic cost data analyses are incorporated into seven hypothetical reclamation projects to provide a comprehension of the magnitude of the

LANDFILL TYPE	SUMMARY OF REVEGETATION COSTS									
	LAND USE									
	CITRUS	CROPLAND	FORESTRY (EUCALYPTUS)	FORESTRY (PINE)	INDUSTRIAL	PASTURE	RECREATIONAL	RESIDENTIAL	WETLAND (MARSH)	WETLAND (SWAMP)
Sand	-	-	-	-	\$205.54	\$279.70	-	\$292.48	-	-
Sand capped with overburden	\$1,914.18	\$311.43	\$191.39	\$189.81	\$236.06	\$311.43	-	\$323.00	-	-
Clay	-	-	-	-	-	\$511.81	-	-	-	\$640.00
Clay capped with overburden	-	\$311.43	\$191.39	\$189.81	-	\$311.43	-	-	-	\$640.00
Sand - Clay	-	\$275.23	\$167.92	\$151.33	-	\$275.23	-	-	-	\$640.00
None (Lake area)	\$1,914.18	-	\$191.39	\$189.81	\$236.06	\$311.43	\$323.00	\$323.00	-	-
Overburden	\$1,914.18	\$311.43	\$191.39	\$189.81	\$236.06	\$311.43	-	\$323.00	-	-

Figure 9. Summary of Revegetation Costs.

costs associated with the reclamation of lands mined or disturbed by phosphate mining. A comprehension of the range of costs can be ascertained by comparing these "given conditions" with the appropriate graphs on earth-moving. Without knowing the specifics of each land parcel to be reclaimed it would be impractical to assign a total or an average per acre cost to a broad area consisting of different land types, unknown sources of fill material, and unknown amounts of grading.

SAND CLAY MIX

EXAMPLE

Given: Sand-clay area one mile from plant, 20 feet fill, overburden spoils occupy 28% of area. Total area to be reclaimed - 100.

Pumping Cost	\$ 65,030
Direct Labor	23,490
Heavy Equipment (P.D.)	19,827
Heavy Equipment (I.D.)	7,488
Heavy Equipment (O.C.)	85,600
Maintenance	14,400
Supervision	3,750
Engineering	15,000
Surveying	2,500
Water Control	3,000
Outside Services	<u>2,000</u>
TOTAL	\$242,085, Cost/Acre - \$2,420.85

LAND & LAKES

EXAMPLE

Given: 100 Acre Block (Finger Lake - Land and Lakes - Graded Spoils)
35 Acres Land
65 Acres Lakes

Capped Spoils	\$129,000
Supervision	3,750
Engineering	15,000
Supplies	3,500
Surveying	2,500
Water Control	3,000
Outside Services	<u>2,000</u>
TOTAL	\$158,750, Cost/Acre - \$1,587.50

OVERBURDEN FILL

EXAMPLE

Given: 120 Acres, 1 mile haul distance, with an average of a 20 foot fill.

Hauling	\$1,502,400
Support Equipment	500,400
Grading	17,220
Supervision	4,500
Engineering	18,000
Surveying	3,000
Water Control	3,600
Outside Services	<u>2,400</u>
TOTAL	\$2,051,520, Cost/Acre - \$17,096

CLAY SETTLING AREAS

EXAMPLES

Given: 300 Acre Settling Pond for Reclamation.

Perimeter Ditch	\$ 40,801
Spillway Drainage	1,650
Interior Ditching	31,200
Cover Chopping	60,000
Dike Material Movement	190,502
Supervision	11,250
Engineering	45,000
Surveying	7,500
Outside Services	<u>6,000</u>
TOTAL	\$393,903, Cost/Acre - \$1,313.01

Given: 800 Acre Settling Pond for Reclamation.

Perimeter Ditch	\$ 66,555
Spillway Drainage	4,400
Interior Ditching	83,200
Cover Chopping	160,000
Dike Material Movement	310,682
Supervision	30,000
Engineering	120,000
Surveying	20,000
Outside Services	<u>16,000</u>
TOTAL	\$810,837, Cost/Acre - \$1,013.54

MINED AND DISTURBED LANDS INVENTORY

Present land conditions were separated into five categories. These categories are mined-out and left as is, disturbed, settling areas, reclaimed lands other than settling areas, and reclaimed settling areas. The "mined-out, left as is" category represents lands where the mineral was actually severed and then the land left in its mined-out state. "Disturbed lands" are lands that have been altered for use by the mining process. This includes lands used for haul roads, pipelines, debris piles, overburden dumps, and other uses needed in the mining and processing of the phosphate matrix. Specifically excluded from this category are plant sites and mined-out lands. All lands (both mined and unmined lands) covered by waste clays are included in the "settling areas" category. The "reclaimed lands other than settling areas" category includes all lands (both mined and disturbed) that have been reclaimed according to industry accepted reclamation techniques and in some cases to Department of Natural Resources criteria. Specifically excluded from this category are "reclaimed settling areas". These lands were put into a separate category and include "reclaimed settling areas" on both mined and unmined lands.

Reference materials utilized in the mined-out and disturbed land inventory included:

1. Set of unpublished industry airphotos, scale 1"=400', prepared in 1975 delineating reclaimed lands.
2. Set of Mark Hurd airphotos, scale 1"=24,000", flown in 1972 on file with the Department of Natural Resources - Bureau of Geology.
3. U. S. Geological Survey topographic maps, scale 1"=24,000", various dates on file with the Department of Natural Resources - Bureau of Geology.

DREDGING

EXAMPLE

Given: 100 Acre Block (Land and Lakes - Spoil, Grading and Dredging)	
35 Acres Land	
65 Acres Lakes	
Dredging	\$812,500
Heavy Equipment	35,000
Supervision	3,750
Engineering	15,000
Supplies	3,500
Surveying	2,500
Water Control	3,000
Outside Services	2,000
TOTAL	\$877,250, Cost/Acre - \$8,772.50

TAILINGS, FILL

EXAMPLE

Given: 40 Acre Block (pumped and graded tailings), 20' deep (effective), 2 miles from plant.	
Power	\$ 72,256
Pump Maintenance	19,360
Pipe Maintenance	10,400
Direct Labor	8,700
Supervision	1,500
Engineering	6,000
Tractors	14,000
Supplies	1,400
Surveying	1,000
Ditches	1,200
Outside Services	800
TOTAL	\$136,616, Cost/Acre - \$3,415

4. Soil Conservation Service soils maps 1916 and 1927 on file with the Department of Natural Resources - Bureau of Geology.
5. U. S. Geological Survey - Trace Elements Memorandum Report, 672 maps, 1953 on file with the Department of Natural Resources - Bureau of Geology.
6. Individual phosphate companies' pit take-up records, files and maps on file with individual companies.
7. Department of Natural Resources - Bureau of Geology Reclamation Programs - 1971-1977 on file with the Department of Natural Resources - Bureau of Geology.
8. Review by individual phosphate company personnel and consulting companies.

The mining and reclamation data were compiled using U. S. Geological Survey 7½ minute topographic maps as a base. The acreage of individual inventory categories was acquired by planimentering the completed map compilation. Statistical results of this inventory are as follows and the individual maps are carried in the Appendix of this report.

I. Mined-Out Lands	
1. Before 7-1-71	95,879
2. 7-1-74 to 7-1-75	19,886
3. 7-1-75 to 7-1-77	10,939
4. 7-1-77 to present	874
5. Total Mined-Out Lands	<u>127,578</u>
6. Mined-Out Lands left as-is	54,076
7. Mined-Out Lands under slimes (unreclaimed)	45,373
8. Mined-Out Lands that have been reclaimed	24,173
9. Mined-Out Lands under slimes that have been reclaimed	3,956
II. Disturbed Lands	
1. Disturbed Lands left as-is	18,038
2. Disturbed Lands under slimes (unreclaimed)	13,331
3. Disturbed Lands that have been reclaimed	5,941
4. Disturbed Lands under slimes that have been reclaimed	<u>1,375</u>
	<u>38,685</u>

III. Total Lands Disturbed by Mining	<u>165,753</u>
IV. Reclaimed Lands	
1. Reclaimed Lands other than slimes (I.8+II.3)	30,114
2. Reclaimed Lands under slimes (I.9+II.4)	<u>5,331</u>
3. Total Reclaimed Lands	35,445
4. Total Unreclaimed Lands (III - IV.3)	130,308
V. Total Lands under Slimes	58,704
VI. Land Ownership	
1. Lands in Company Ownership	125,601
2. Lands in Other Ownership	38,552
3. Reclaimed Lands in Company Ownership	21,800
4. Reclaimed Lands in Other Ownership	13,645
5. Unreclaimed Lands in Company Ownership	<u>103,801</u>
6. Unreclaimed Lands in Other Ownership	<u>24,907</u>

SPECIAL CONSIDERATION

RADIATION

In June, 1975, the U. S. Environmental Protection Agency initiated a study to determine the radiological impact of living and working in structures constructed on reclaimed phosphate-mine land in central Florida. From early data acquired by this study, the U. S. Environmental Protection Agency issued a report entitled "Preliminary Findings - Radon Daughter Levels in Structures Constructed on Reclaimed Florida Phosphate Land," which indicated elevated indoor radon daughter levels in some structures built on reclaimed lands as compared to structures built on unmined soils. As a result of these findings, in September, 1975, the Administrator of the Environmental Protection Agency informed the Governor of Florida by letter that a potential public health problem appeared to exist due to exposure to elevated radon daughter concentrations in some of these structures. The Administrator recommended to the Governor "as a prudent interim measure that the start of construction of new buildings on land reclaimed from phosphate mining areas be discouraged."

In September, 1975, the Governor of the State of Florida held a conference in Tallahassee to address this problem. Considerable input and discussion was made by State and Federal agencies. In summary, they concluded that the preliminary data might well indicate an area of significant concern but the data base was so localized and the results so premature that no positive remedial actions could be implemented without considerably more definitive and regionalized collection and analysis. One of the outgrowths of the Governor's conference was an intensification of investigations by the Florida Department of Health and Rehabilitative Services radiological studies in Polk and Hillsborough counties to supplement and

expand the data collection of the U. S. Environmental Protection Agency. The Florida Department of Health and Rehabilitative Services selected additional points for the collection of radiological data, bringing the total to approximately 1000 points between the two agencies.

The Florida Bureau of Geology and the U. S. Bureau of Mines became concerned how these point sources of data (whatever the results) could or would be translated into geographic areas of concern. From staff knowledge of the natural distribution of uranium in the Bone Valley district and the redistribution of uranium in the mining process, it was obvious that all reclaimed lands could not have comparable levels of radioactivity and that some reclaimed lands would have less radioactivity than some naturally occurring unmined areas. The recommendation by the Administrator of the U. S. Environmental Protection Agency to the Governor of Florida "as a prudent interim measure that the start of construction of new buildings on land reclaimed from phosphate mining areas be discouraged" was particularly disturbing in that there was a strong indication of lack of understanding by the investigators of the natural occurrence of uranium in Florida and of the redistribution of the resource in mining.

The Florida Bureau of Geology and the U. S. Bureau of Mines entered into a Cooperative Program in April, 1976, to map and categorize the reclaimed lands in the Land Pebble Phosphate district. This effort was to collect data principally from company records which would indicate not only the geographic area of a particular reclamation project but the subsurface composition of the reclaimed lands. The results have thus far been unsatisfactory as company records of the subsurface composition of reclaimed lands are not particularly accurate and there are essentially no records of the depth of burial or thickness of materials in many of the reclamation

projects. This lack of control is not to impugn the industry but rather points out that records are kept where reasons exist to do so and in this case, "the reason to do so" has just become apparent.

At the present time, the radiological inventory can be summarized as follows:

- (1) The U. S. Environmental Protection Agency has recognized that the radiological problem is not restricted to "reclaimed" lands. "It was originally believed that the problem of elevated indoor radiation levels existed only in structures built on reclaimed lands. However, further study indicated that several types, in addition to reclaimed land, may pose indoor radiation problems. These include mineralized phosphate areas where ore containing elevated radioactivity concentrations occur near the surface and on debris land."
- (2) The radiological data provided to the staff from the U. S. Environmental Protection Agency and the Florida Department of Health and Rehabilitative Services consists of measured instantaneous gamma radiation dose levels both inside and outside of approximately 1000 structures in the Polk and Hillsborough county areas.
- (3) According to the Texas Instruments, Incorporated's Environmental Impact Assessment of the Central Florida Phosphate Industry, Volume VI, Section 4, working paper on the Radiation Environment, "The conclusion drawn from these data is that while gamma exposure rates in air may be utilized as a predictor of radium concentration in

surface soil, the concentration of radium in surface soil is a poor predictor of radon-222 emanation rates"; also, "The correlation of radon emanation rate as a function of gamma exposure rates in air was poor, and therefore, gamma exposure rates could not be used to predict Radon-222 emanation rates."

- (4) According to the same source in "item (3)", none of the structures studied indicates action to provide protection against gamma radiation levels since all of the values are less than the "no action" limit quoted by the surgeon general.
- (5) Oral communication by the staff with the U. S. Environmental Protection Agency has indicated substantial concern on the Agency's part as to the reliability of the Radon-222 measurements that were made by the Agency in structures in the area. Also, according to the preliminary report of the Florida Department of Health and Rehabilitative Services, two track etch dosimeters were deployed at each of 200 different locations. The two track etch films were on the same cardboard backing, exposed to the same radiation field and received identical handling on each location. The difference between the track densities of these replicates was found to average 31% without regard to sign and the sign of the difference has been found to be random in nature. "This replication is considered to be very poor

and could represent a serious source of error in the reported results." "Individual structures reported as exceeding the guideline should be evaluated further before corrective actions are made."

- (6) The Florida Department of Health and Rehabilitative Services also reports "A major problem exists in evaluating land, which is presently unimproved to predict radiation exposure to occupants of structures which may be built on such land in the future... Such a model cannot be developed at this time from the data presented in this report."

The level of confidence in the measurement of the Radon-222 emanations, the low level of the gamma radiation and the lack of a technique or model to test lands prior to the building of structures does not justify specific reclamation recommendations at the present time. However, the lack of agreement as to the magnitude of the "problem" between various investigators is of substantial concern to the Commission. The Commission recommends a dedicated effort by the various State and Federal agencies and industry to provide a reliable data base from which the proper course of action can be charted.

SPECIAL CONSIDERATION

WATER RESOURCES

Recognizing water resources as one of the greatest assets of the State of Florida; recognizing the phosphate industry as a major water user; recognizing the potential for adverse effects on water quality by the resource users, and recognizing the increasing competition for the resource between the phosphate industry, agriculture and municipalities, the Phosphate Land Reclamation Study Commission must express its concern that the water resources be properly managed and protected.

In the course of the Commission's study of land reclamation problems, considerable inquiry by individual Commission members on potential water resource problems has demonstrated the depth of the concern. The non-treatment of the water resources topic in specificity by this report is not to be construed as a mitigation of the concerns of the members but rather as a practical limitation to the scope of the Commission's investigation.

Earlier sections of this report have commented on the need for technology to extract the remaining phosphate from slimes. Technology to rapidly dewater slimes can significantly increase the efficiency of water recirculation systems thus reducing the amount of water withdrawals necessary to the beneficiation of phosphate rock. In current plant operations, water losses are in the wet product, in tailings moisture, by evaporation, in clay absorption, by seepage and by discharge. A recent study funded by the U. S. Bureau of Mines indicates the most significant water loss is due to water absorption by clays during the beneficiation process. Technology to rapidly dewater the slimes would release significant quantities of water into the recirculation systems.

SUMMARY AND CONCLUSIONS

(1) There is a significant problem with old lands - lands mined or disturbed by the severance of phosphate rock prior to July 1, 1975. Since July 1, 1975, 11,813 acres of land have been mined for the extraction of phosphate rock while prior to July 1, 1975, 115,765 acres of land were mined for the extraction of phosphate rock. Of this total (115,765 acres), 89,000 acres are estimated to have been mined in the 20-year period from 1955 to 1975. It is concluded, therefore, that most of the visual impact of the land pebble phosphate district results from lands mined or disturbed by the severance of phosphate rock prior to July 1, 1975.

(2) The number of acres (85,070) in programs on file and the number of acres (19,613) in approved programs with the Department of Natural Resources - Bureau of Geology, in addition to the 78,981 acres not on file or in approved programs but mined or disturbed prior to July 1, 1975 and still in company ownership, spreads the incentive provided by the Land Reclamation Trust Fund in its present form over a spectrum too wide to assure the reclamation of old lands. Effective incentive will require the Land Reclamation Trust Fund to be used only for lands mined prior to July 1, 1975.

(3) Limiting the Land Reclamation Trust Fund either in terms of total funds to be expended for old lands reclamation or total time of contribution to the Land Reclamation Trust Fund is not appropriate for the following reasons:

(a) Costs cannot be developed for lands mined or disturbed prior to July 1, 1975 because of the reclamation cost variables (source and distance of transport of fill material, grading and revegetation) which may be applicable to each site.

(b) Although lands mined or disturbed prior to July 1, 1975 have been inventoried (acreage) and categorized (mined-out, slimes or disturbed),

mining has occurred over such a long time span that some of these lands have become stabilized landforms, have vegetative cover and are productive fish and/or wildlife systems. The effects of extensive land recontouring on such ecosystems and the cost of recontouring may be so adverse that the public interest is better served by allowing these lands to remain as is. Standards for this value judgment are not available but a site specific evaluation may provide the basis for reasonable judgment. Until such questions can be concluded, the total acreage of lands mined or disturbed by the severance of phosphate rock prior to July 1, 1975 for which reclamation is desired cannot be ascertained.

(c) Lands mined out prior to July 1, 1975 are exempt from mandatory reclamation. Such lands that are currently being utilized for waste disposal of slimes or will be utilized in the future for waste disposal of slimes cannot be reclaimed for some years because of the slow dewatering of the clays. A time limit or fund limit on the reclamation of old lands may create a situation whereby considerable slime retention areas are unreclaimed as old lands and also exempt from mandatory reclamation.

(4) A portion of the Land Reclamation Trust Fund should be earmarked for phosphate research. It is the opinion of the Phosphate Land Reclamation Study Commission that the slimes problem is the phosphate industry's greatest liability. In the past and to a certain degree now most of the emphasis on the "slimes problem" has been the emphasis placed on dam breaks, spills and resulting damage to surface water systems. Since dams were brought under regulation and the design criteria strengthened, this problem has been substantially mitigated. There are, however, very important problems related to slimes which tend to go unrecognized but which should be emphasized and dealt with in a constructive manner.

(a) The percent of clay in the total matrix varies considerably over the phosphate district. There is currently being produced annually some 40 million tons of clay containing an estimated 5 to 8 million tons of phosphate rock. Substantial effort and emphasis should be directed to developing technology to economically recover this resource. Such technology could have broad potential application including the recovery of additional phosphate from existing slime disposal areas, the reduction of any potential radiation hazard by extraction of the remaining phosphate, and the isolation of the clay minerals from the slimes. This latter potential could have significant impact in developing new industries requiring clay resources.

(b) The phosphate industry has always been categorized as a prodigious water user and rightfully so. Considerable progress has been made in the past few years to reduce the water requirements. The Southwest Florida Water Management District indicates that in 1969 the industry withdrew an average of approximately 4,300 gallons of water per ton of phosphate rock produced, while in 1974, the average withdrawal was 2,545 gallons to produce a ton of phosphate rock. Much of this reduction in withdrawal can be attributed to improved water recirculation systems.

If the slimes can be dewatered rapidly, the efficiency of the water recirculation systems of many mines can be improved greatly and significant reduction of water withdrawals accomplished. In current plant operations, there are encountered several types of water losses including wet product, tailings moisture, evaporation, clay absorption, seepage, and discharge. A recent study funded by the U. S. Bureau of Mines indicates the most significant water loss is due to water absorption by clays during the

beneficiation process.

(c) In reclaiming lands mined or disturbed by the severance of phosphate rock the storage, instability and longevity of slimes and the topographic inversion of the area create significant problems. Planned disposal of slimes and certain management options require mined-out pits to remain unreclaimed because of their use for slimes disposal or potential slimes disposal. The longevity of slimes disposal areas creates the impression that little or no reclamation is taking place and the visual scars of mining are extended over long periods of time.

RECOMMENDATION I

Amend Section 211.32(3)(n) F.S. as follows:

(n) Notwithstanding any other provision in this part, refunds from taxes levied under this part based upon the severance of solid minerals ~~on or~~ after before July 1, 1978, shall be paid from the Land Reclamation Trust Fund for so long as funds are available only for the cost of restoration and reclamation of lands:

1. Disturbed by the severance of solid minerals prior to July 1, 1975; or
2. Included within a site of severance ~~on or before the effective date of this Act with~~ on or before July 1, 1977 for which a restoration and reclamation program ~~theretofore was~~ is filed with the Department of Natural Resources on or before July 1, 1977.

RECOMMENDATION II

From July 1, 1978 to July 1, 1983 the excise tax upon persons engaged in the business of severing phosphate rock for commercial use shall be ten (10) percent of the value at the point of severance of the identifiable phosphate rock. The proceeds from the ten (10) percent tax imposed by this section excluding the amount credited for ad valorem tax payments, shall be paid into the State Treasury as follows:

1. Seventy-five (75) percent to the credit of the General Revenue Fund of the State.
2. Twenty (20) percent to the credit of the Non-Mandatory Reclamation Trust Fund established for refunds for reclamation of lands not subject to mandatory reclamation, for the costs of administering reclamation

and for acquisition of unreclaimed lands not subject to mandatory reclamation.

3. Five (5) percent to the credit of the Phosphate Research Trust Fund which is hereby created.

The Department of Natural Resources shall annually report to the Governor, the President of the Senate and the Speaker of the House of Representatives beginning on April 1, 1980, as to the sufficiency of the Non-Mandatory Land Reclamation Trust Fund. On July 1, 1983, the twenty (20) percent allocation to the Non-Mandatory Land Reclamation Trust Fund shall terminate and the excise tax upon persons engaged in the business of severing phosphate rock for commercial use shall be eight (8) percent of the value at the point of severance of the identifiable phosphate rock, unless the Legislature approves additional funding of the Non-Mandatory Land Reclamation Trust Fund. At such time as the excise tax is reduced from ten (10) percent to eight (8) percent, the proceeds from said tax, excluding the amount paid for ad valorem tax payments, shall be paid into the State Treasury as follows:

1. Ninety-three and three-fourths (93 3/4) percent to the credit of the General Revenue Fund of the State.
2. Six and one-fourth (6 1/4) percent to the credit of the Phosphate Research Trust Fund.

Interest earned on funds within the Non-Mandatory Land Reclamation Trust Fund or the Phosphate Research Trust Fund shall be credited to those respective trust funds.

RECOMMENDATION III

(1) There is hereby created a Non-Mandatory Land Reclamation Trust Fund

(2) Money paid into the Non-Mandatory Land Reclamation Trust Fund shall be made available for funding of reclamation and restoration programs approved by the Department of Natural Resources for lands mined or disturbed by the severance of phosphate rock prior to July 1, 1975 and not subject to a mandatory obligation of reclamation and restoration. This funding shall be consistent with the objectives and criteria set out in the master old lands reclamation plan to be promulgated.

(3) Money paid into the Non-Mandatory Land Reclamation Trust Fund may also be used by the Department of Natural Resources to purchase land, mined or disturbed by the severance of phosphate rock prior to July 1, 1975, at a negotiated price where the Department of Natural Resources reasonably determines that such purchase will serve the public interest because of the exceptional need to accomplish particular reclamation and restoration.

Where property is obtained under this section, the Department of Natural Resources shall reclaim and restore such land as soon as practicable and thereafter sell such land at public auction with the proceeds of such sale payable into the Non-Mandatory Land Reclamation Trust Fund unless the public interest would be better served by retaining State ownership of the land.

RECOMMENDATION IV

(1) There is hereby created a Land Use Advisory Committee which shall be composed of the following:

- (a) One member representing the Department of Natural Resources, Bureau of Geology, as Chairman, to be appointed by the Executive Director of the Department of Natural Resources;

- (b) One member representing the Division of State Planning, Department of Administration, to be appointed by the Secretary of the Department of Administration;
- (c) One rotating member representing the Regional Planning Council in which the lands are located, to be appointed by the Director of the Regional Planning Council;
- (d) One rotating member or designee representing the appropriate Board of County Commissioners in which county the old lands are located, to be appointed by the Chairman of each Board of County Commissioners in which the lands are located;
- (e) One member representing the Game and Fresh Water Fish Commission, to be appointed by the Director of the Game and Fresh Water Fish Commission; and
- (f) Two members of the public to be appointed by the Governor.

The duties of the Land Use Advisory Committee shall be as follows:

- (a) To **evaluate** the potential land use needs of the area affected by the mining or disturbance of land in the severance of phosphate rock prior to July 1, 1975 which lands are not covered by mandatory reclamation.
- (b) To formulate a general old lands reclamation plan for the area affected by the mining or disturbance of land in the severance of phosphate rock prior to July 1, 1975, which plan shall not be inconsistent with local government plans prepared pursuant to the Local Government Comprehensive Planning Act.
- (c) To define the desired types of landforms, the desired surface water regimes and the desired types of vegetation. To enhance the natural recovery of the land into mature sites with high potential for the land use desired.
- (d) To evaluate old unreclaimed lands with naturally developed environmental

systems to determine if the quality and quantity of such systems enhance the overall environmental quality of the area, such that artificial reclamation need not be recommended.

(e) To provide a prioritization of lands to be reclaimed and potential land uses to best serve the public interest.

(f) To furnish its report to the Department of Natural Resources on or before July 1, 1980.

RECOMMENDATION V

(1) The Department of Natural Resources shall conduct an on-site evaluation of lands mined or disturbed by the severance of phosphate rock prior to July 1, 1975 which lands are not covered by mandatory reclamation for the purpose of:

- (a) Determining those lands where current reclamation standards (Section 211.32 (3)(a) F.S.) are to be applied and on which to provide an assessment of the residual land condition and the feasibility of various reclamation alternatives including approximate fill and revegetative costs.
- (b) Determining those lands where current reclamation standards, if applied, would be destructive of naturally developed environmental systems which in their current state enhance the overall environmental quality of the area; recommending exceptions to the current reclamation standards for such lands whereby such lands would not qualify for reclamation funding.
- (c) Develop a master old lands reclamation plan for lands mined or disturbed by the severance of phosphate rock prior to July 1, 1975 which lands are not subject to mandatory

reclamation based on the recommendations of the Land Use Advisory Committee and on the on-site evaluations conducted by the Department of Natural Resources.

(2) The master old lands reclamation plan shall be developed as soon as practicable, presented at a public hearing before the Executive Board of the Department of Natural Resources and on adoption shall be the guideline for programs submitted for funding from the Non-Mandatory Land Reclamation Trust Fund.

RECOMMENDATION VI

(1) Effective July 1, 1978, create a Florida Institute of Phosphate Research which shall be empowered:

(a) To administer the Phosphate Research Trust Fund and to expend funds therefrom for its administration and for carrying out the purposes hereinafter set forth;

(b) To conduct or cause to be conducted such environmental studies related to radiation and water consumption, or other environmental studies of the effects of phosphate mining and reclamation as may from time to time be deemed reasonably necessary for the health, welfare, safety and well-being of the citizens of this state and particularly the citizens of the regions where phosphate mining or processing occurs;

(c) To provide suitable and sufficient laboratory facilities and equipment, making use insofar as practical of the existing laboratory facilities and equipment of the state university system and others, for carrying out the research and studies herein authorized;

(d) To hold public hearings and consult with representatives of the

phosphate industry and all other interested parties; to assign priorities for its research and studies; to make public from time to time its intentions as to future research and study; and to allocate its resources and personnel for such research and studies as it may determine from time to time to be in the best interest of the public and the phosphate industry;

(e) To conduct or cause to be conducted a thorough and comprehensive study of phosphatic clay disposal and utilization as a part of phosphate mining, together with all environmental or land use related thereto;

(f) To conduct or cause to be conducted a thorough and comprehensive study of reclamation alternatives and technologies in the phosphate mining or processing industry including wetlands reclamation;

(g) To establish ways and means for better and more efficient phosphate recovery mining and processing in Florida as it may determine most beneficial to the economy, environment, and way of life of the citizens of this state;

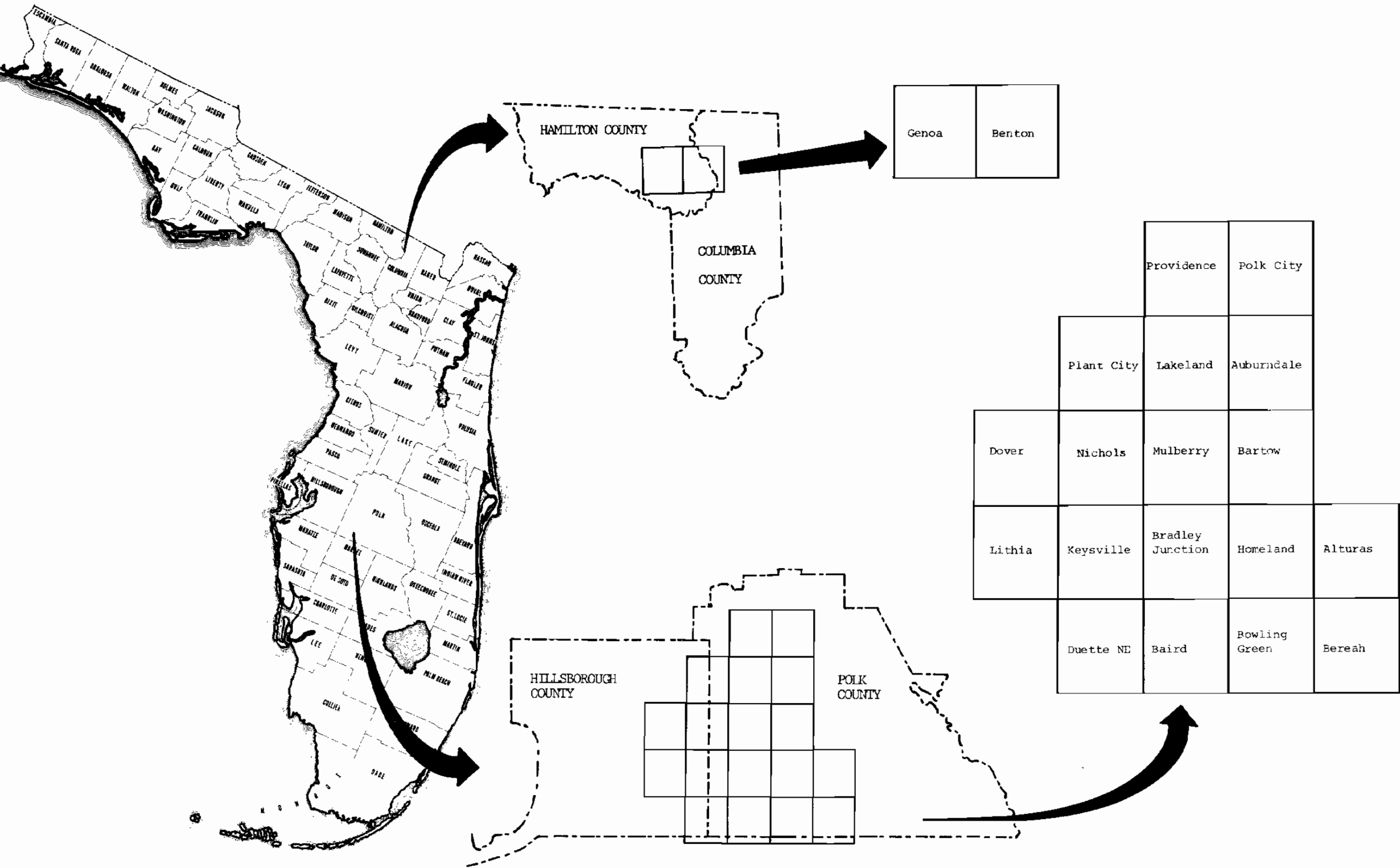
(h) To enter into any mutually satisfactory contract with any firm, institution, corporation, as well as federal or state agency, which is reasonably required or desirable in carrying out the research and studies herein authorized.

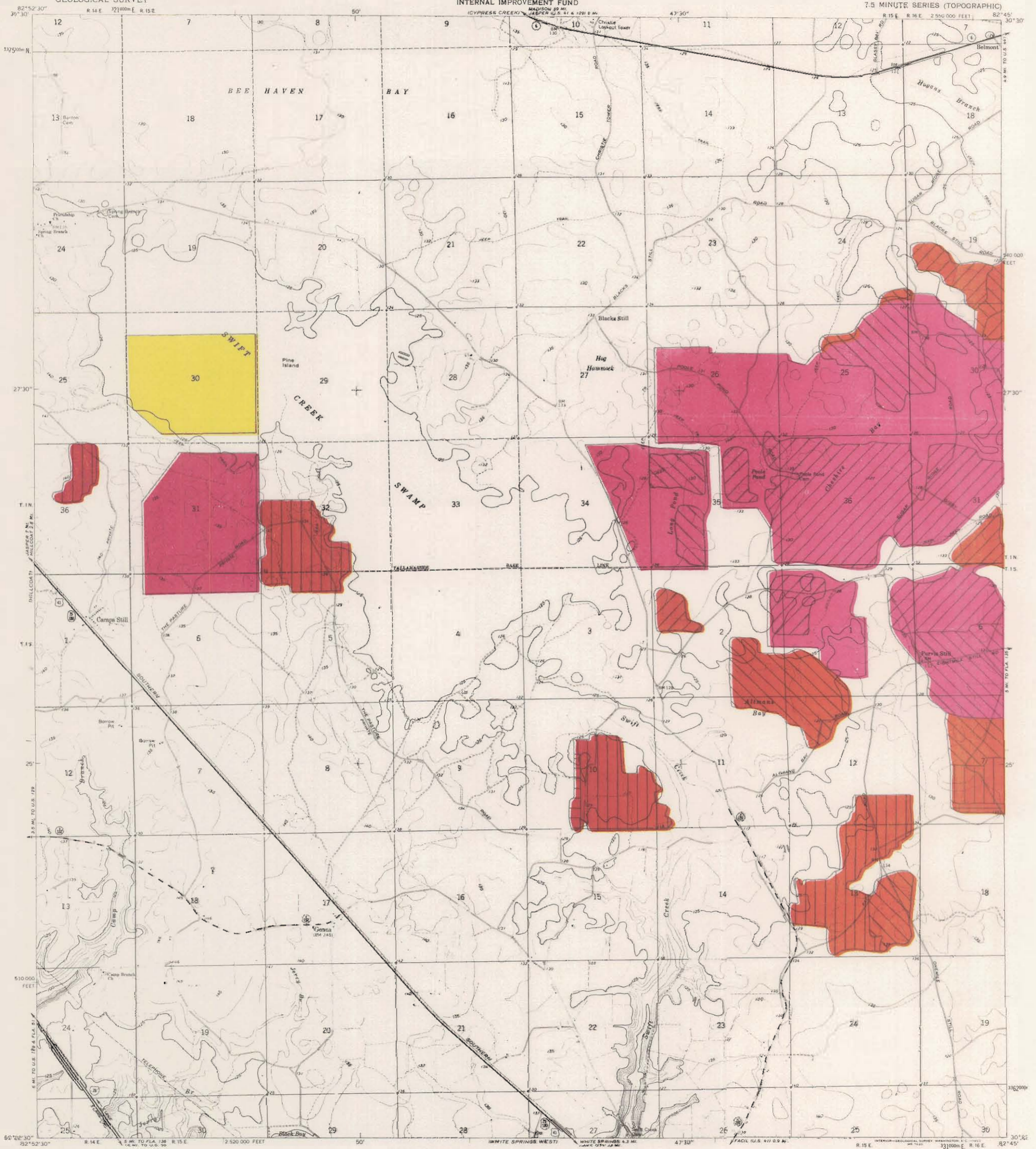
(i) To make available to the public the results of its research program so that the research efforts will result in the public being able to be better informed as to the effects of phosphate mining in the State of Florida.

(2) The work of the Florida Institute of Phosphate Research shall be directed by a three-member board appointed by and serving at the pleasure of the Governor. The Governor shall make these appointments on the basis of ability to set priorities for the phosphate research and otherwise give direction to a professional, efficient, and broad phosphate research effort.

In setting such priorities, emphasis shall be given to applied research which tends to solve real problems of the industry in which the public has a substantial interest. Theoretical research of indefinite proportion and time shall be discouraged. The policies and decisions of the board shall be implemented through an executive director chosen by the board on the basis of professional competence, both scientific and administrative.

INDEX TO INVENTORY MAPS





Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS.
Topography by photogrammetric methods from aerial photographs
taken 1958 and by planimetric surveys 1962.
Polyconic projection: 1927 North American datum
10,000-foot grid based on Florida coordinate system, north zone
1000-meter Universal Transverse Mercator grid ticks,
zone 17.

APPROXIMATE MEAN
DECLINATION, 1962

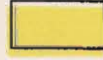
CONTOUR INTERVAL 5 FEET
(DOTTED LINES 4000' SEA LEVEL)

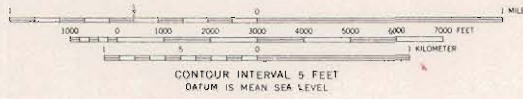
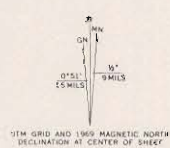
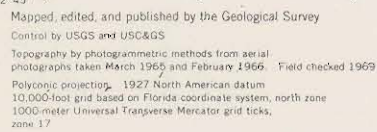
FLORIDA
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Heavy-duty ——— Light-duty ———
Medium-duty - - - - - Unimproved dirt - - - - -
○ Interstate Route □ U.S. Route ○ State Route

GENOA, FLA.
N3022 S - W8245 / 7.5
1962

EXPLANATION

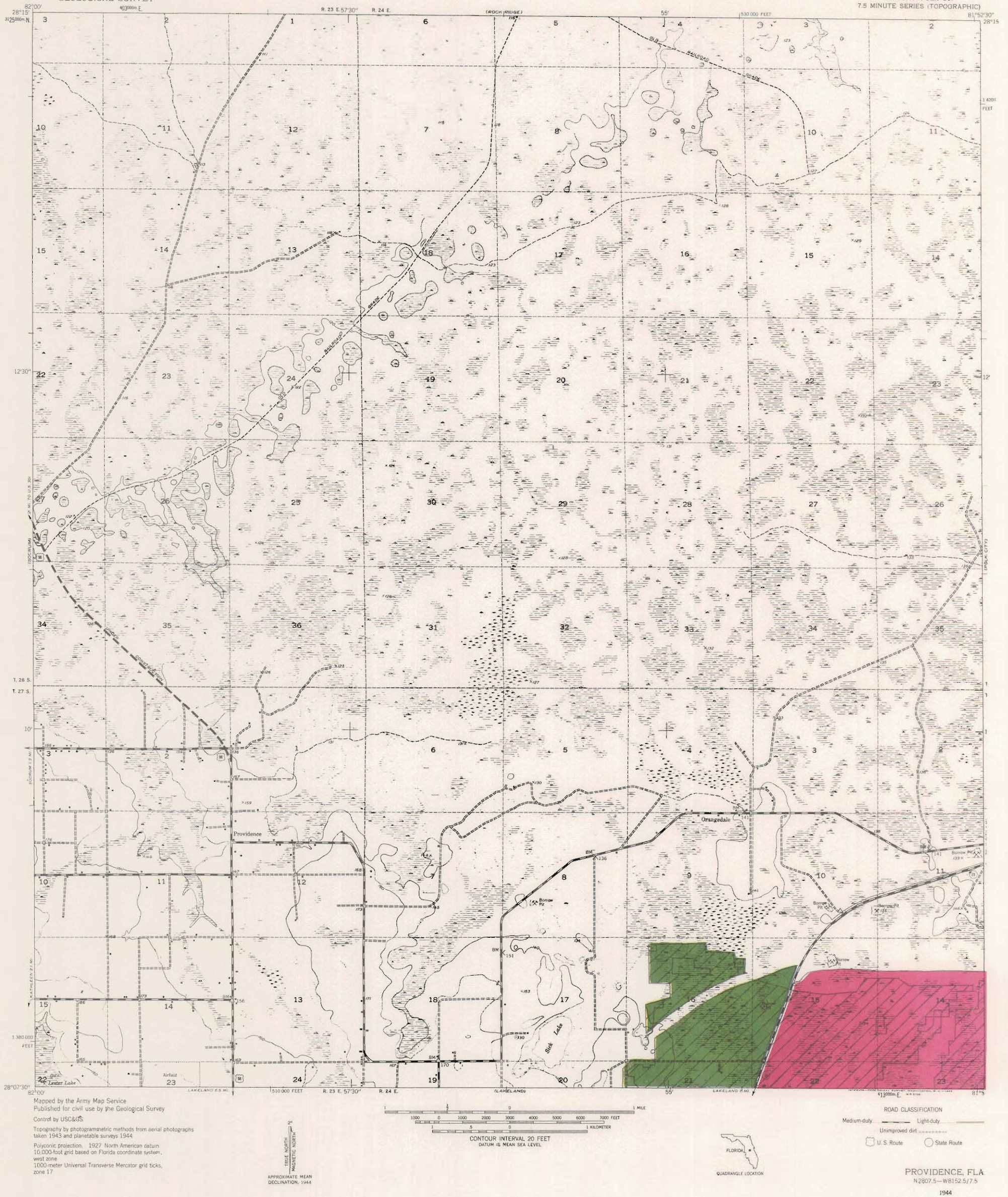
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|  MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 |  RECLAIMED LANDS OTHER THAN SETTLING AREAS |
|  MINED AFTER JULY 1, 1977 |  RECLAIMED SETTLING AREAS |
| |  DISTURBED LANDS OTHER THAN SETTLING AREAS |



ROAD CLASSIFICATION	
Primary highway, all weather, hard surface _____	Light-duty road, all weather, improved surface _____
Secondary highway, all weather, hard surface _____	Unimproved road, fair or dry weather _____
☒ U. S. Route	☐ State Route

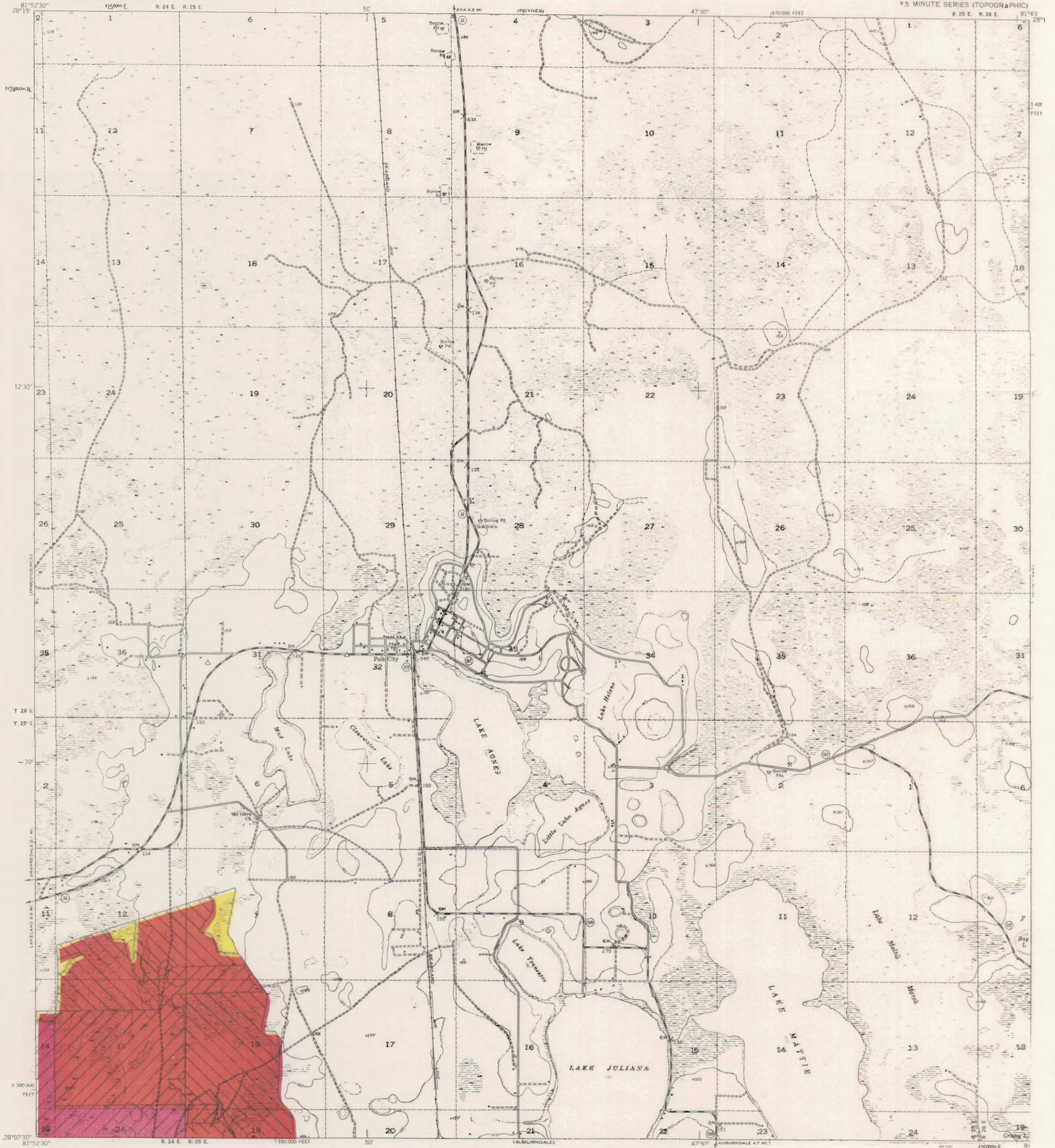
BENTON, FLA.
N3022.5—W8237.5/7.5
1969
MS 4444 | NW—SERIES V84

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	MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977		RECLAIMED LANDS OTHER THAN SETTLING AREAS
	MINED AFTER JULY 1, 1977		RECLAIMED SETTLING AREAS
			DISTURBED LANDS OTHER THAN SETTLING AREAS



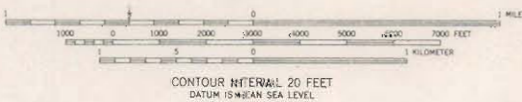
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|  MINED AFTER JULY 1, 1977 |  RECLAIMED SETTLING AREAS |
| |  DISTURBED LANDS OTHER THAN SETTLING AREAS |



Map by the Army Map Service
Published for civil use by the Geological Survey
Control by USC&GS
Topography by photogrammetric methods from aerial photographs
taken 1942 and planimetric surveys 1944
Polyconic projection. 1927 North American datum.
60,000-foot grid based on Florida coordinate system,
west zone.
1000-meter Universal Transverse Mercator grid ticks
zone 17.

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MAGNETIC
DECLINATION, 1944



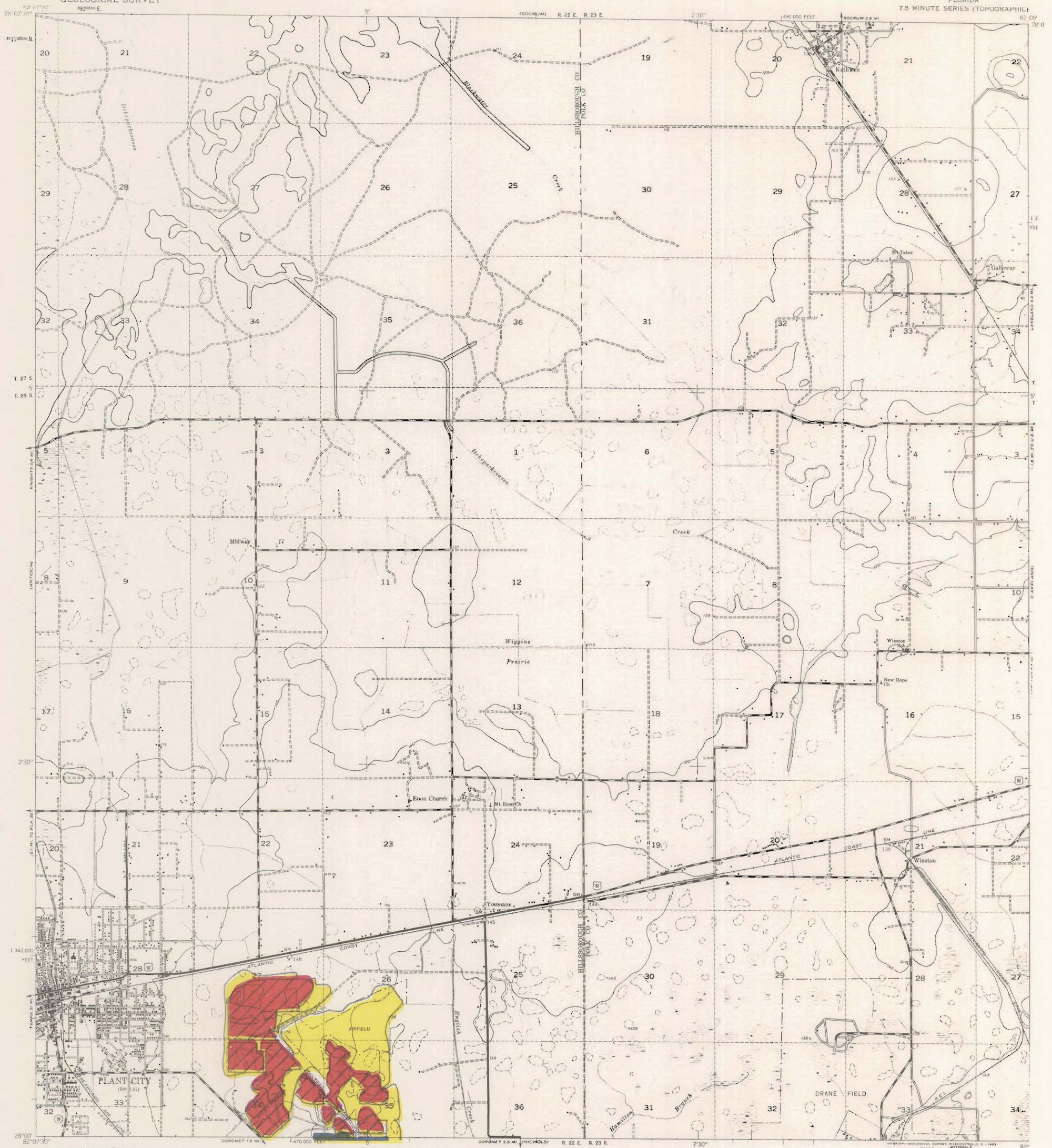
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Unimproved dirt ———
State Route ———



POLK CITY, FLA
N2807.5-W8145/7.5
1944

EXPLANATION

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| MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 | SETTLING AREAS |
| MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
| MINED AFTER JULY 1, 1977 | RECLAIMED SETTLING AREAS |
| | DISTURBED LANDS OTHER THAN SETTLING AREAS |



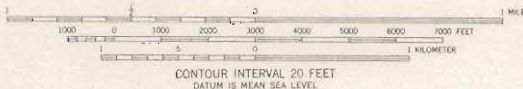
Map by the Army Map Service
Published for civil use by the Geological Survey

Control by USC&GS

Topography by photogrammetric methods from aerial photographs
taken 1942 and planetable surveys 1944

Polyconic projection 1927 North American datum
10,000-foot grid based on Florida coordinate system,
west zone
1000-meter Universal Transverse Mercator grid ticks,
zone 17

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN
DECLINATION, 1944



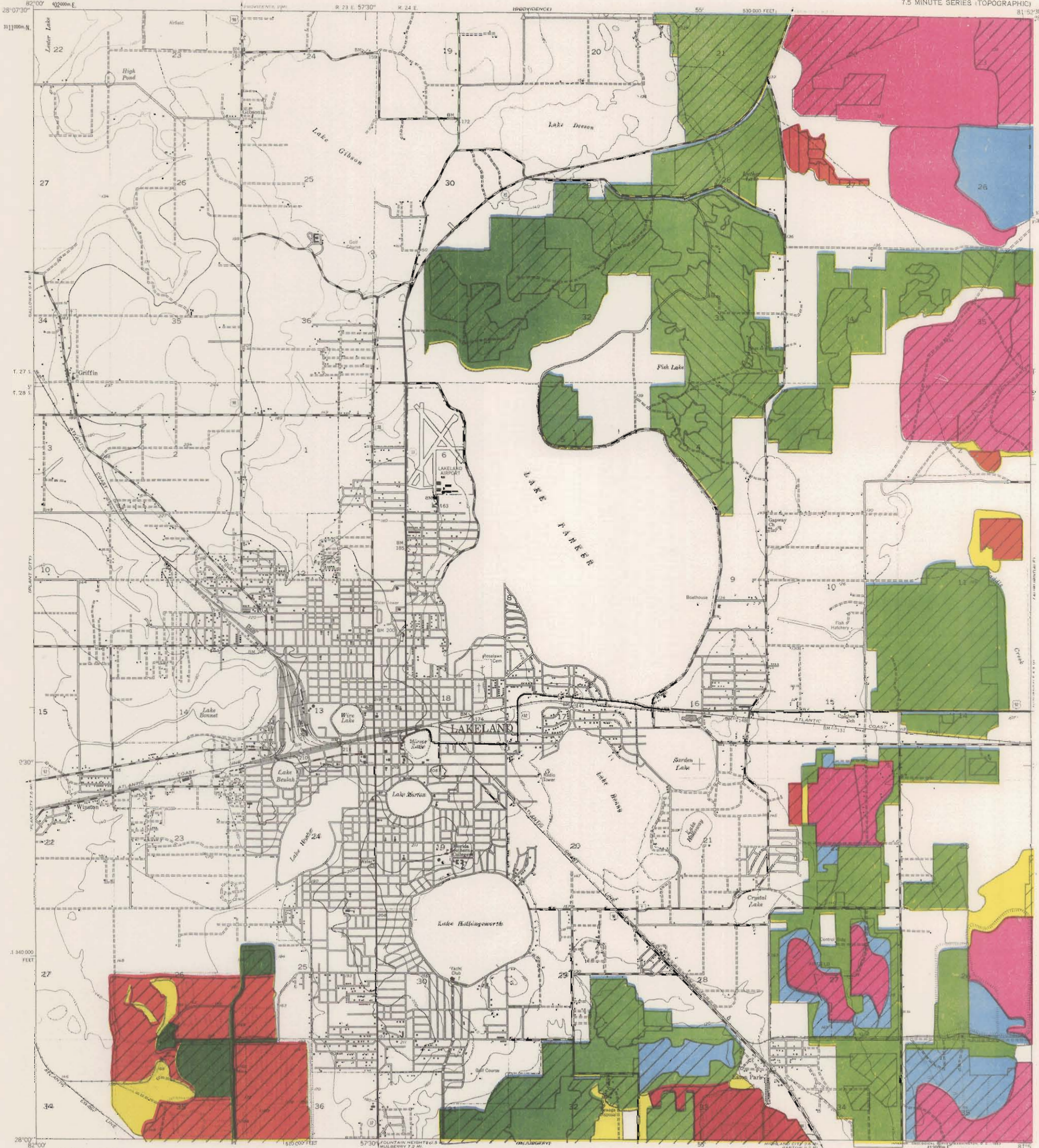
ROAD CLASSIFICATION
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Medium-duty ——— Unimproved dirt ———
U.S. Route ——— State Route ———



PLANT CITY, FLA
N2800-W8200/7.5
1944

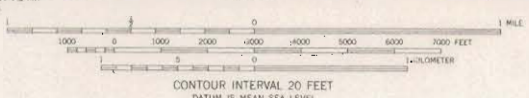
EXPLANATION

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|  MINED AFTER JULY 1, 1977 |  RECLAIMED SETTLING AREAS |
| |  DISTURBED LANDS OTHER THAN SETTLING AREAS |



Map by the Army Map Service
Published for civil use by the Geological Survey
Control by BSC&GS and Florida Geodetic Survey
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taken 1942 and planetable surveys 1944
Polyconic projection, 1927 North American datum
10,000-foot grid based on Florida coordinate system,
west zone
1000-meter Universal Transverse Mercator grid ticks,
zone 17

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN
DECLINATION, 1944



CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

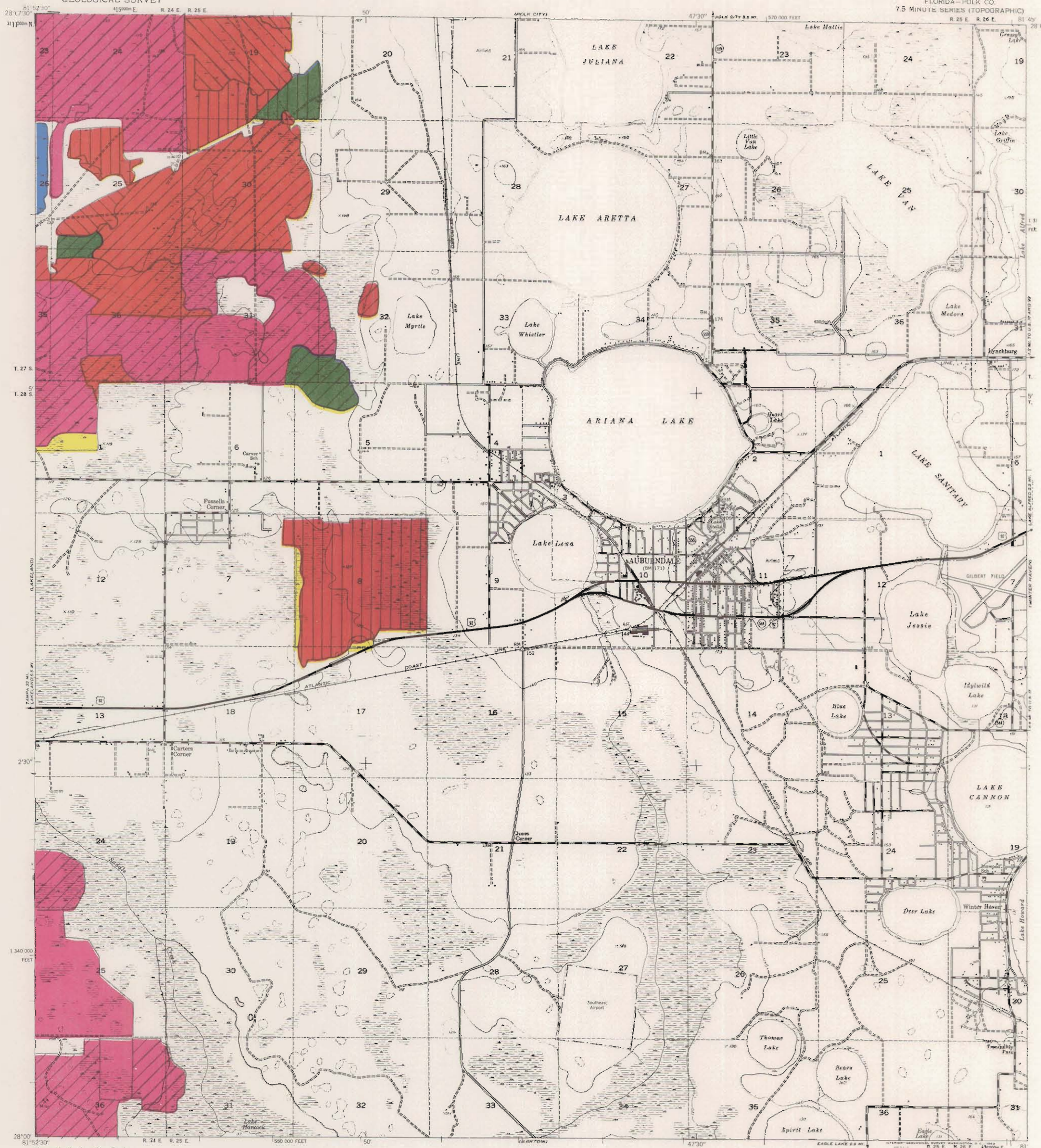
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Medium-duty ——— Unimproved dirt ———
U.S. Route ——— State Route ———



LAKELAND, FLA.
N2800-W8152.5/7.5
1944

EXPLANATION

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| MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
| MINED AFTER JULY 1, 1977 | RECLAIMED SETTLING AREAS |
| | DISTURBED LANDS OTHER THAN SETTLING AREAS |



Map by the Army Map Service
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Topography by photogrammetric methods from aerial photographs
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Polyconic projection, 1927 North American datum,
10,000-foot grid based on Florida coordinate system,
west zone
1000-meter Universal Transverse Mercator grid ticks,
zone 17.

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN
DECLINATION, 1944

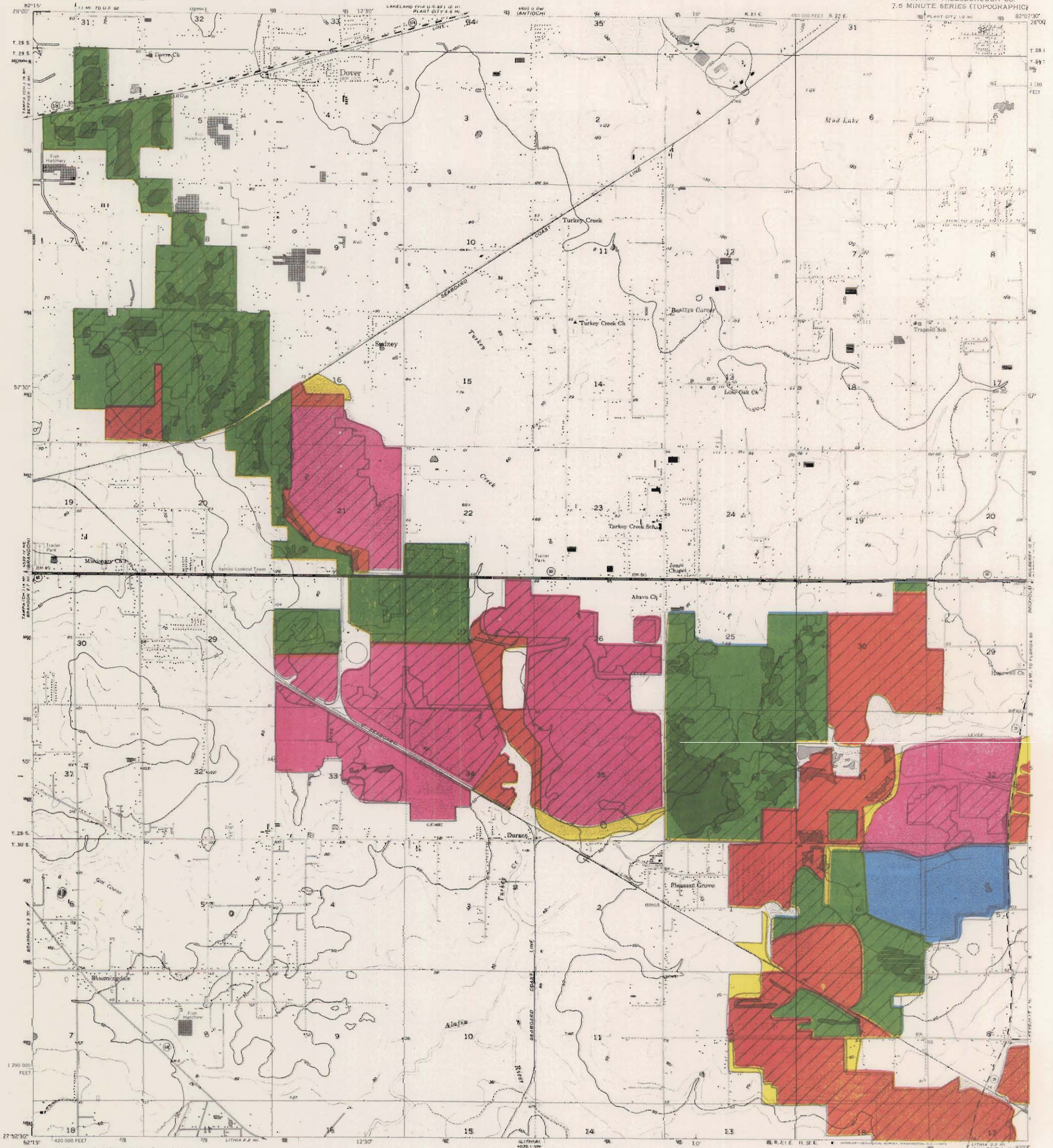


ROAD CLASSIFICATION
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Medium-duty ——— Unimproved dirt ———
U.S. Route ——— State Route ———

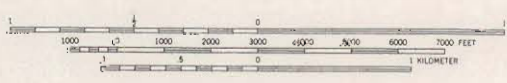
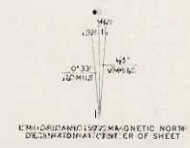
AUBURDLE, FLA.
N2800-W8145J7D
1946

EXPLANATION

- | | |
|---|---|
| MINED PRIOR TO JULY 1, 1971 | MINED OUT AREAS LEFT AS IS |
| MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 | SETTLING AREAS |
| MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
| MINED AFTER JULY 1, 1977 | RECLAIMED SETTLING AREAS |
| | DISTURBED LANDS OTHER THAN SETTLING AREAS |



Map produced, edited, and published by the Geological Survey.
Control by USGS and USC&GS.
Culture and drainage in part compiled from aerial photographs
taken 1947. Topography by: photostatic surveys 1955.
Polyconic projection. 1927 North American datum.
13,068 feet per inch based on Florida coordinate system.
Washington.
1000-meter Universal Transverse Mercator grid ticks,
zone 17.



CONTOUR INTERVAL 10 FEET
DATA IN PART FROM SEA LEVEL

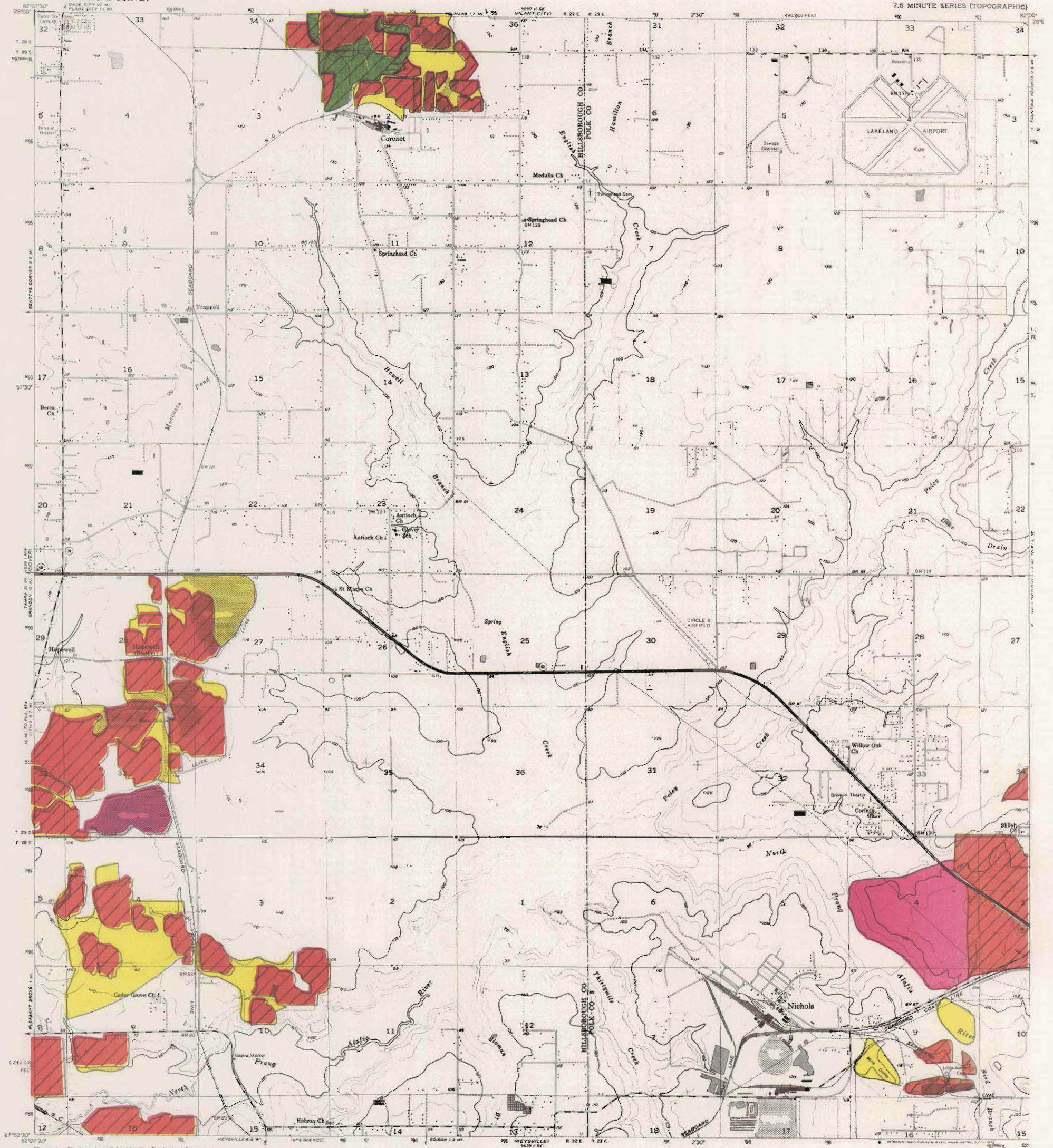


ROAD CLASSIFICATION
Heavy dirt ——— Light dirt ———
Medium dirt ——— Unimproved dirt ———
U.S. Route ——— State Route ———

DOVER, FLA.
N2752.5 W8207.5/7.5
1955
PHOTOREVISED 1972
AMS 4539 1 NW-SERIES 1987

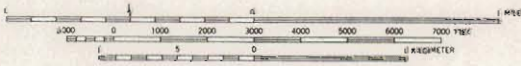
EXPLANATION

- | | |
|---|---|
| MINED PRIOR TO JULY 1, 1971 | MINED OUT AREAS LEFT AS IS |
| MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 | SETTLING AREAS |
| MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
| MINED AFTER JULY 1, 1977 | RECLAIMED SETTLING AREAS |
| | DISTURBED LANDS OTHER THAN SETTLING AREAS |



Mapped, edited, and published by the Geological Survey
Control by USGS, USCGS, and Florida Geodetic Survey
Culture and drainage in part compiled from aerial photographs
taken 1947. Topography by planetable surveys 1955
Polyconic projection. 1927 North American datum
10,000-foot grid based on Florida coordinate system,
west zone
1000-meter Universal Transverse Mercator grid ticks,
zone 17

UTM GRID AND 1950 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



CONTOUR INTERVAL: 10 FEET
DATUM IS MEAN SEA LEVEL

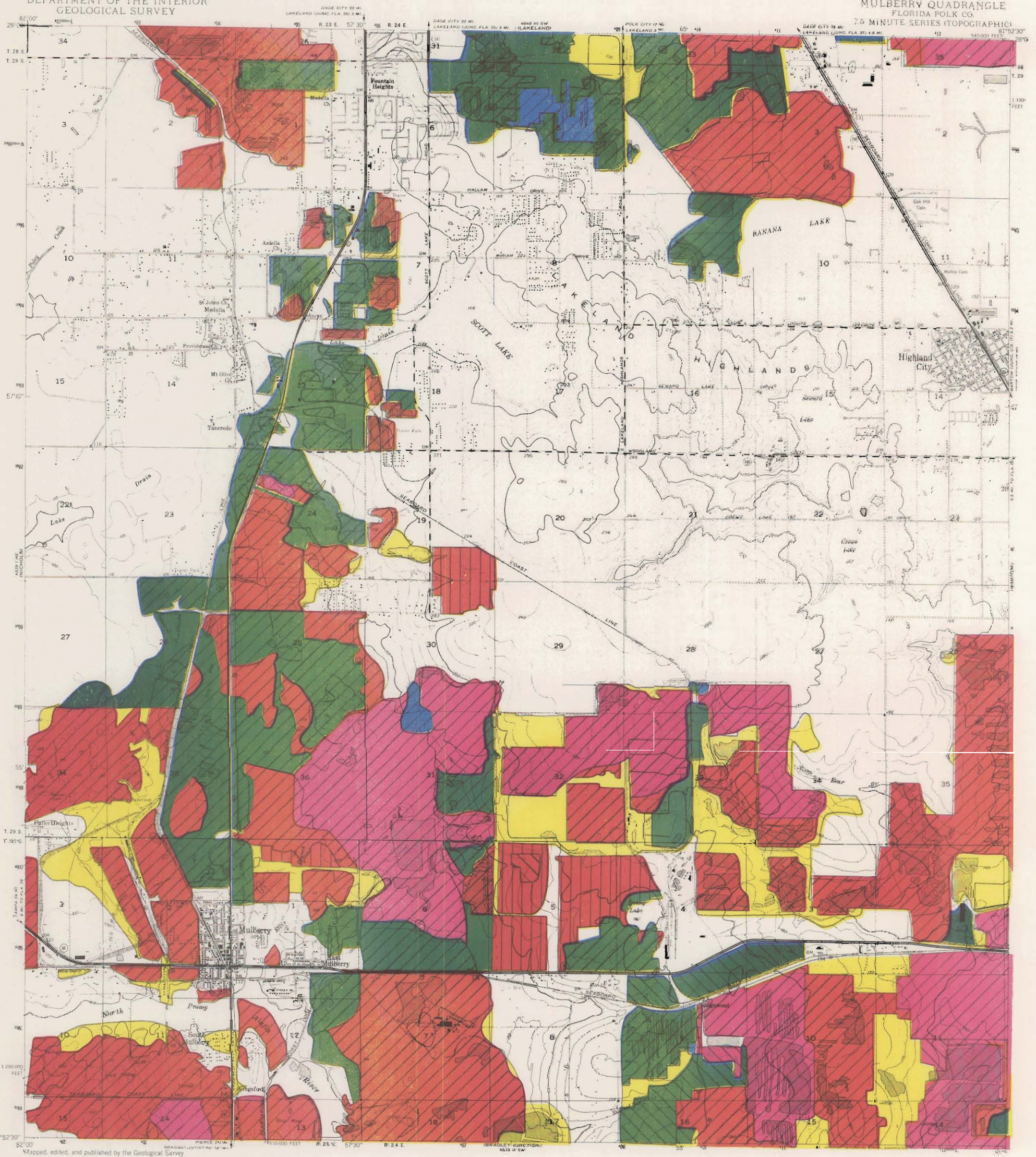


ROAD CLASSIFICATION
Heavy duty Light duty
Medium duty Unimproved dirt
U.S. Route State Route

NICHOLS, FLA
N2752.5-W4810.7
1956
PHOTOREVISED 1972
AMS 4539 I SE-SERIES 934

EXPLANATION

- | | | | |
|--|---|--|---|
| | MINED PRIOR TO JULY 1, 1971 | | MINED OUT AREAS LEFT AS IS |
| | MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 | | SETTLING AREAS |
| | MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 | | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
| | MINED AFTER JULY 1, 1977 | | RECLAIMED SETTLING AREAS |
| | | | DISTURBED LANDS OTHER THAN SETTLING AREAS |



Maped, edited, and published by the Geological Survey

(Control by USGS, USC&GS, and Florida Geodetic Survey)

Culture and drainage in part compiled from

aerial photographs taken 1941

Topography by plane-table methods 1949

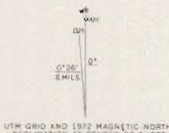
Polyconic projection, 1927 North American datum

10,000-foot grid based on Florida coordinate system,

first zone

1000-meter Universal Transverse Mercator grid ticks,

zone 17



ROAD CLASSIFICATION
HARD-SURFACE ALL-WEATHER ROADS DRY WEATHER ROADS
Heavy-duty Improved dirt
Medium-duty Unimproved dirt
Loose-surface, grades, or narrow hard-surface
State Route

MULBERRY, FLA.
N2752.5-W8152.5/7.5

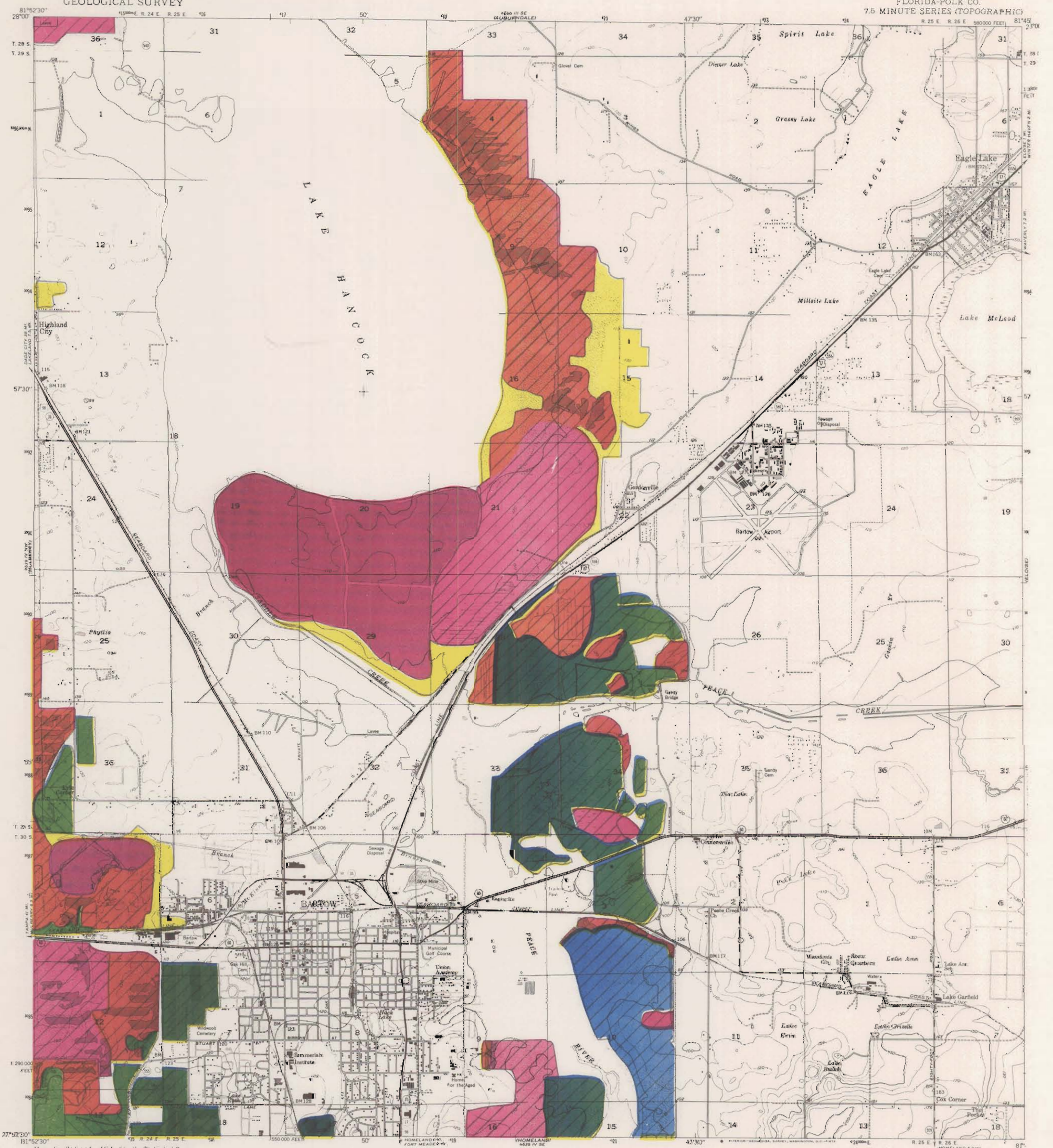
1949

PHOTOREVISED 1972

AMS 4659 IV N-1-SERIES 6847

EXPLANATION

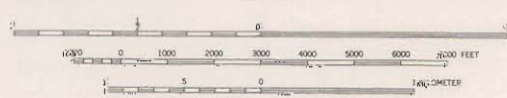
- | | |
|---|---|
| MINED PRIOR TO JULY 1, 1971 | MINED OUT AREAS LEFT AS IS |
| MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 | SETTLING AREAS |
| MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
| MINED AFTER JULY 1, 1977 | RECLAIMED SETTLING AREAS |
| | DISTURBED LANDS OTHER THAN SETTLING AREAS |



Map made, edited, and published by the Geological Survey
Control by USGS, USGS, and Florida Geological Survey
Culture and drainage: part compiled from
aerial photographs taken 1941 and 1947
Topography by plane-table methods 1946
Polyconic projection. 1827 North American datum.
10,000-foot grid based on Florida coordinate system,
west zone

1:100,000 (Universal Transverse Mercator grid ticks
are not shown)

UTM GRID AND 1972 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

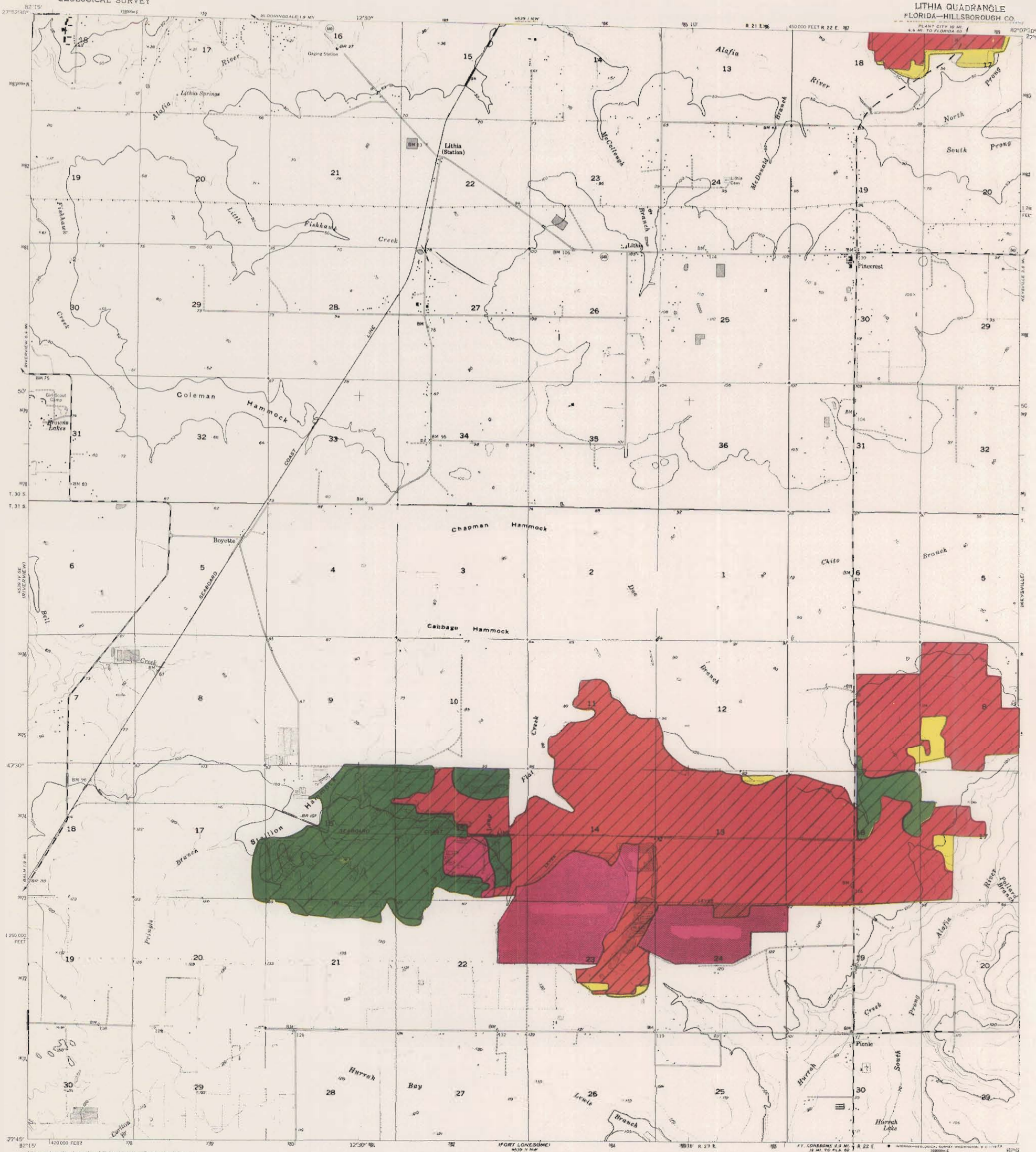


ROAD CLASSIFICATION
Heavy-duty Light-duty
Medium-duty Unimproved dirt
U.S. Route State Route

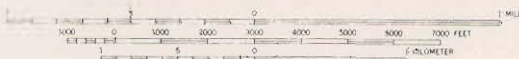
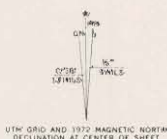
BARTOW, FLA.
N2752.5-W8145.7.5
1949
PHOTOREPRODUCED 1974
AMS 4639 IV RE SERIES 1949

EXPLANATION

- | | |
|---|---|
|  MINED PRIOR TO JULY 1, 1971 |  MINED OUT AREAS LEFT AS IS |
|  MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 |  SETTLING AREAS |
|  MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 |  RECLAIMED LANDS OTHER THAN SETTLING AREAS |
|  MINED AFTER JULY 1, 1977 |  RECLAIMED SETTLING AREAS |
| |  DISTURBED LANDS OTHER THAN SETTLING AREAS |



Mapped, edited, and published by the Geological Survey
Control by USGS, USC&GS, and Florida Geodetic Survey
Culture and drainage in part compiled from aerial photographs
taken 1947. Topography by plane-table surveys 1955
Polyconic projection. 3027 North American datum
10,000-foot grid based on Florida coordinate system,
west zone
1000-meter Universal Transverse Mercator grid ticks,
zone 17



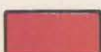
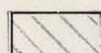
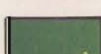
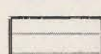
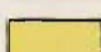
CONTOUR INTERVAL 10 FEET
DATUM TO MEAN SEA LEVEL

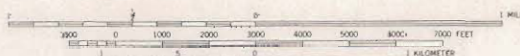
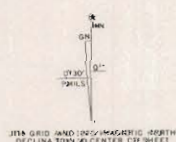
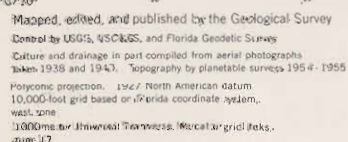


LITHIA, FLA.
N2745 W8207.5/1

1955
PHOTOREVISIT: 197
AMS 4539 I SW-SERIES Y8

EXPLANATION

- | | |
|---|---|
|  MINED PRIOR TO JULY 1, 1971 |  MINED OUT AREAS LEFT AS IS |
|  MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 |  SETTLING AREAS |
|  MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 |  RECLAIMED LANDS OTHER THAN SETTLING AREAS |
|  MINED AFTER JULY 1, 1977 |  RECLAIMED SETTLING AREAS |
| |  DISTURBED LANDS OTHER THAN SETTLING AREAS |



CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL



ROAD CLASSIFICATION

Heavy-duty		Light-duty	
Medium-duty		Unimproved dirt	
U.S. Route		State Route	

KEYSVILLE, FLA.

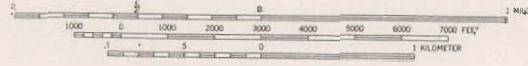
1955
PHOTOREVISED 1972
431 4530 1 GE-SERIES V847

	MINED PRIOR TO JULY 1, 1971		MINED OUT AREAS LEFT AS IS
	MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975		SETTLING AREAS
	MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977		RECLAIMED LANDS OTHER THAN SETTLING AREAS
	MINED AFTER JULY 1, 1977		RECLAIMED SETTLING AREAS
			DISTURBED LANDS OTHER THAN SETTLING AREAS



Maped, edited, and published by the Geological Survey
Control by USGS, USCGS, and Florida Geodetic Survey
Culture and drainage in part compiled from
aerial photographs taken 1947
Topography by plane-table methods 1949
Polyconic projection. 1927 North American datum.
10,000-foot grid based on Florida coordinate system,
west zone
1000-meter Universal Transverse-Mercator grid ticks,
zone 17

UTM GRID AND 1972 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



CONTOUR INTERVAL 10 FEET
DATUM: 1955 MEAN SEA LEVEL

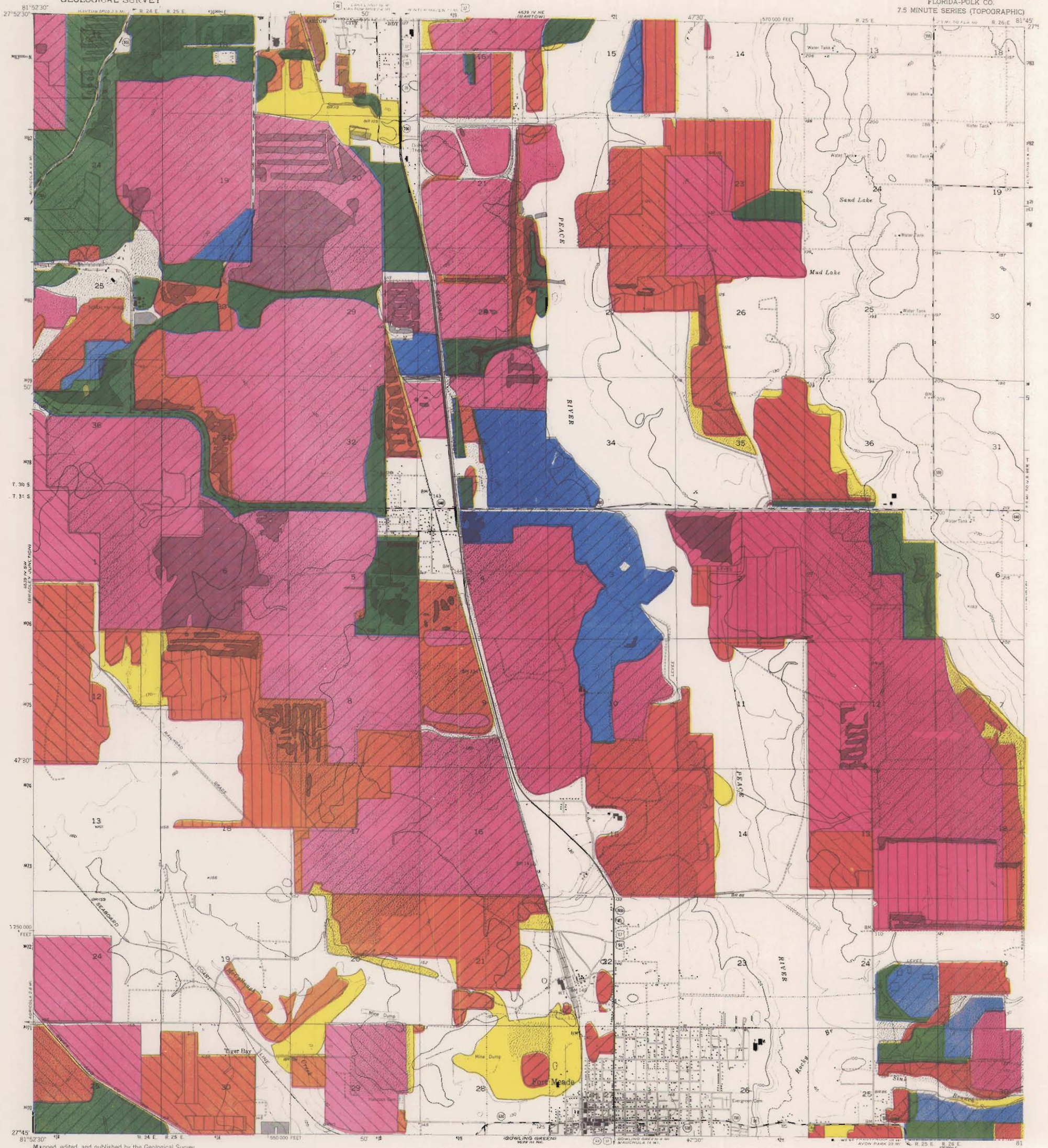


ROAD CLASSIFICATION
HARD-SURFACE ALL WEATHER ROADS DRY WEATHER ROADS
Heavy-duty ————— UNIMPROVED DIRT
Medium-duty ————— UNIMPROVED DIRT
Loose surface, graded, or narrow hard-surface
U. S. Route State Route

BRADLEY JUNCTION, FLA
N2745-W8152.5/7.5
1949
PHOTOREVISED 1972
AMS 4639 J SW-SERIES V847

EXPLANATION

- | | | | |
|--|---|--|---|
| | MINED PRIOR TO JULY 1, 1971 | | MINED OUT AREAS LEFT AS IS |
| | MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 | | SETTLING AREAS |
| | MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 | | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
| | MINED AFTER JULY 1, 1977 | | RECLAIMED SETTLING AREAS |
| | | | DISTURBED LANDS OTHER THAN SETTLING AREAS |



Mapped, edited, and published by the Geological Survey
Control by USGS, USCGS, and Florida Geodetic Survey
Culture and drainage in part compiled from aerial photographs
taken 1942 and 1947. Topography by plane-table surveys 1951-1952.
Polyconic projection. 1927 North American datum.
10,000-foot grid based on Florida coordinate system,
west zone.
1000-meter Universal Transverse Mercator grid ticks,
zone 17.

NTM GRID AND 1972 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

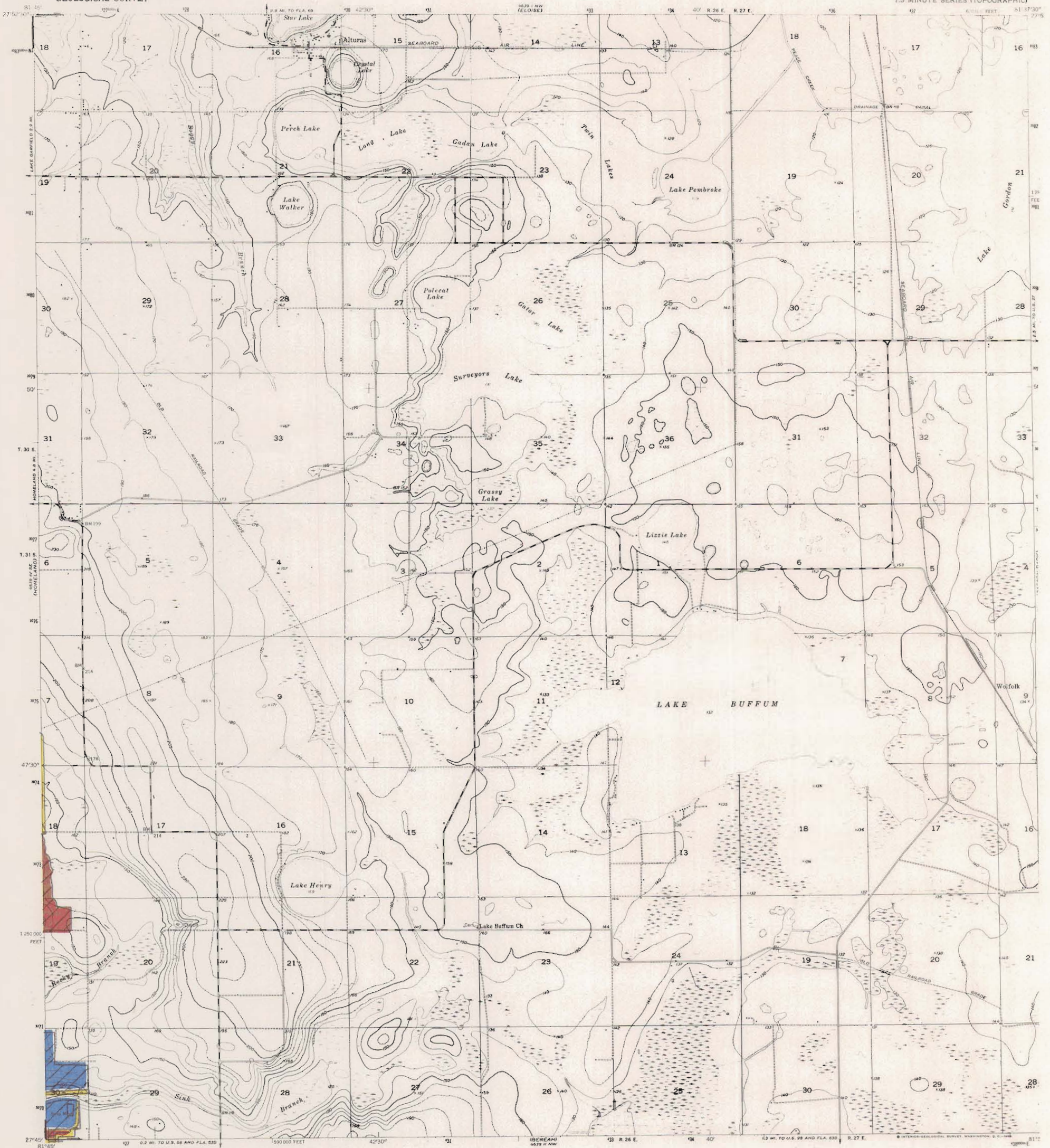
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION
Heavy-duty 4 LANE 6 LANE Light-duty
Medium-duty 4 LANE 6 LANE Unimproved dirt
U.S. Route State Route

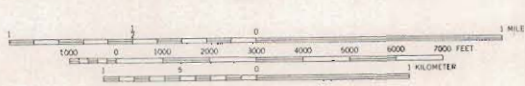
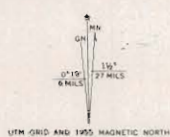
HOMELAND, FLA.
N2745-W8145/7.5
1952
PHOTOGRAPHED 1972
AMS 4439 IV SE SERIES V84

EXPLANATION

- | | |
|---|---|
| MINED PRIOR TO JULY 1, 1971 | MINED OUT AREAS LEFT AS IS |
| MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 | SETTLING AREAS |
| MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
| MINED AFTER JULY 1, 1977 | RECLAIMED SETTLING AREAS |
| | DISTURBED LANDS OTHER THAN SETTLING AREAS |



Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS
Culture and drainage in part compiled from aerial photographs
taken 1947. Topography by plane-table surveys 1955
Polyconic projection, 1927 North American datum
10,000-foot grid based on Florida coordinate system,
west zone
1000-meter Universal Transverse Mercator grid ticks,
zone 17



CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

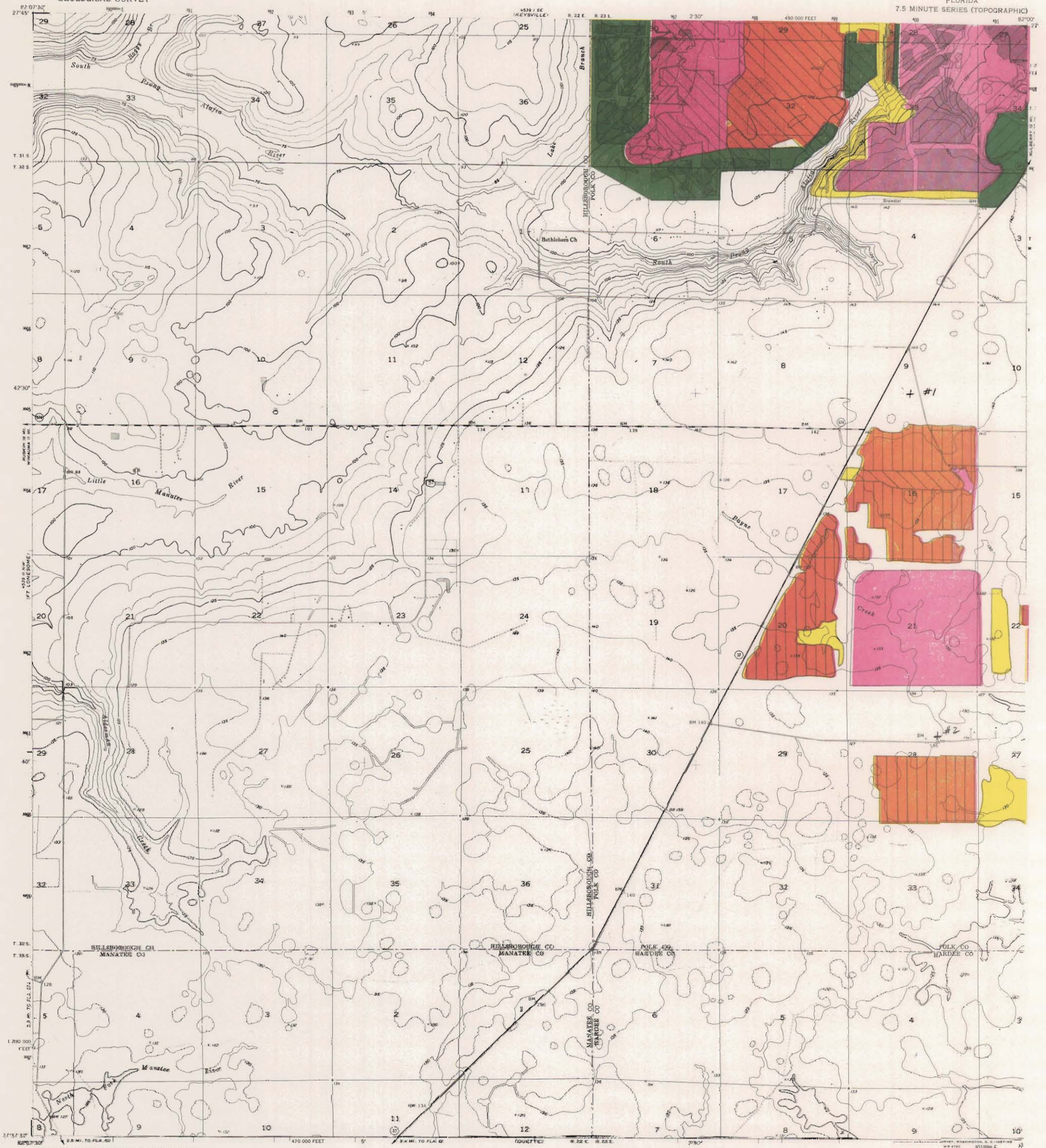


ROAD CLASSIFICATION
Heavy-duty — 4 LANE ROAD Light-duty — 2 LANE ROAD
Medium-duty — 2 LANE ROAD Unimproved dirt —
U.S. Route State Route

ALTURAS, FLA
N2745-W8137.5/1.1
1955
AMS 4639 I SW—SERIES V84

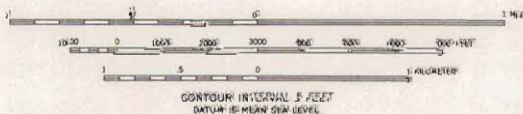
EXPLANATION

- | | |
|---|---|
| MINED PRIOR TO JULY 1, 1971 | MINED OUT AREAS LEFT AS IS |
| MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 | SETTLING AREAS |
| MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
| MINED AFTER JULY 1, 1977 | RECLAIMED SETTLING AREAS |
| | DISTURBED LANDS OTHER THAN SETTLING AREAS |



Mapped, edited, and published by the Geological Survey.
Control by USGS, USCGS, and Florida Coastal Survey.
Culture and drainage from aerial photographs taken 1962.
Topography by photostereoscopy 1955-1958.
Polyconic projection. 1927 North American datum.
10,000-foot grid based on Raytheon coordinate system, wgs84.
1000-meter Universal Transverse Mercator Grid ticks.
Zone 17.

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN
DECLINATION, 1956:

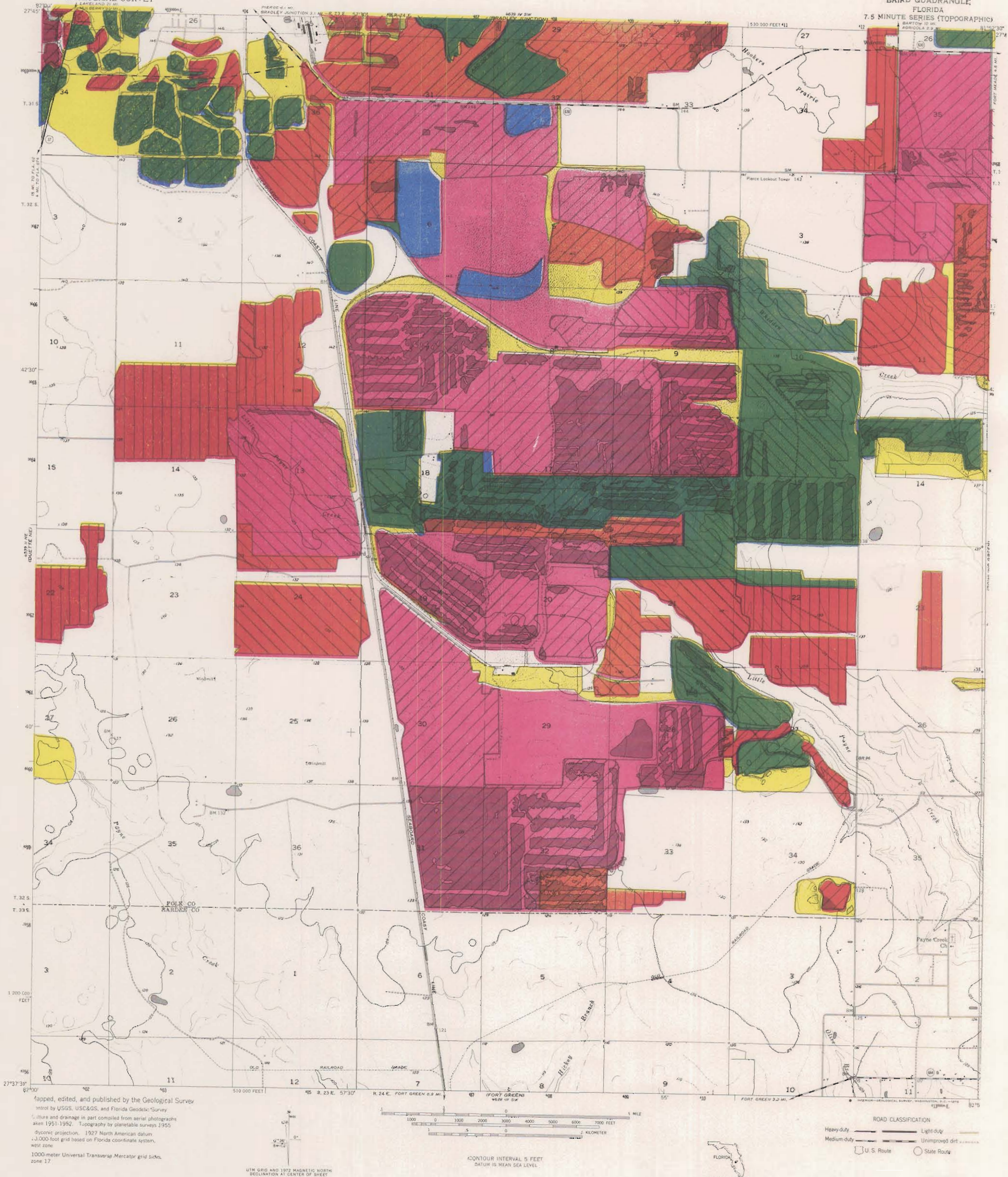


ROADS CLASSIFICATION
Heavy duty ——— Light duty ———
Medium duty ——— Unimproved dirt ———
State Route ———

DUETTE NE, FL.
N2737.5-W9003.7-4
1956
AMS 4539 II NE-SERIES 414

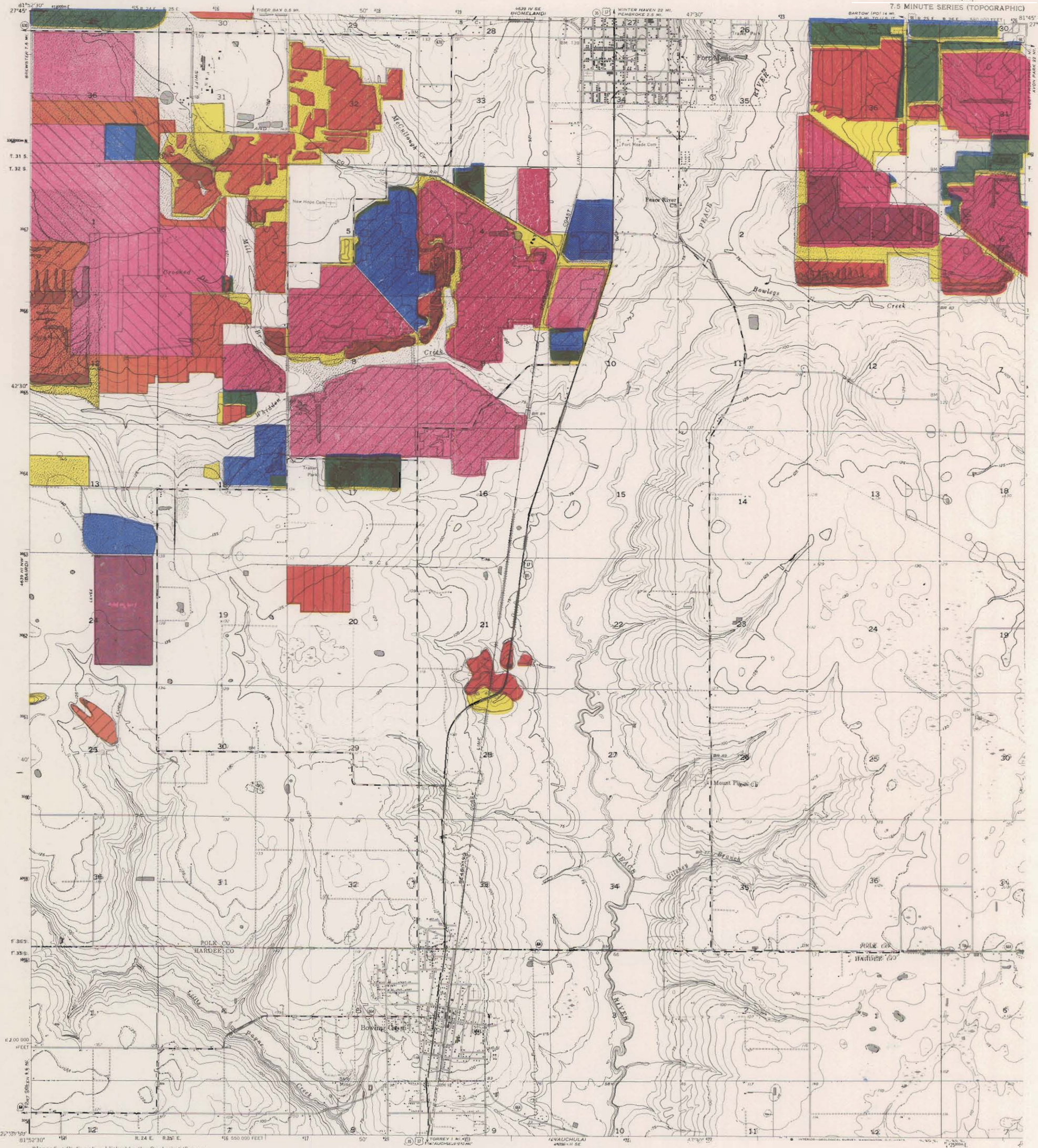
EXPLANATION

- | | |
|---|---|
|  MINED PRIOR TO JULY 1, 1971 |  MINED OUT ARE AS LEFT AS IS |
|  MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 |  SETTLING AREAS |
|  MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 |  RECLAIMED LANDS OTHER THAN SETTLING AREAS |
|  MINED AFTER JULY 1, 1977 |  RECLAIMED SETTLING AREAS |
| |  DISTURBED LANDS OTHER THAN SETTLING AREAS |



EXPLANATION

- | | |
|---|---|
| MINED PRIOR TO JULY 1, 1971 | MINED OUT AREAS LEFT AS IS |
| MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 | SETTLING AREAS |
| MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
| MINED AFTER JULY 1, 1977 | RECLAIMED SETTLING AREAS |
| | DISTURBED LANDS OTHER THAN SETTLING AREAS |



Map compiled, edited, and published by the Geological Survey
Control by USGS, USC&GS, and Florida Geodetic Survey
Culture and drainage in part compiled from aerial photographs
taken 1949-1952. Topography by planetable surveys 1955
Polyconic projection. 1925 North American datum.
110,000-foot grid based on Florida coordinate system,
WGS-84 zone
1000-ft UTM Universal Transverse Mercator grid ticks,
zone 17N

UTM GRID AND 1972 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

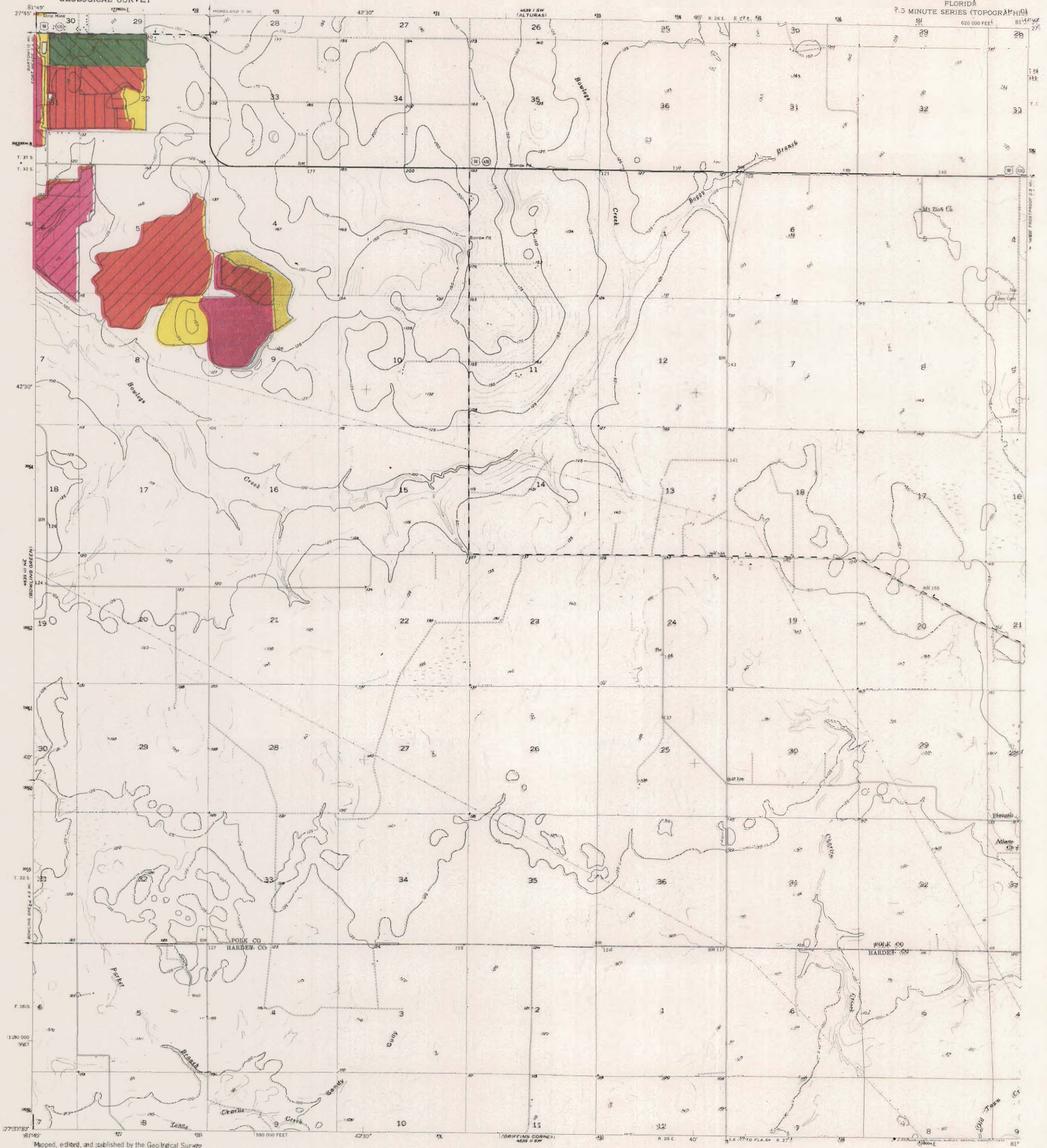


ROAD CLASSIFICATION
Heavy-duty Light-duty
Medium-duty Unimproved dirt
U.S. Route State Route

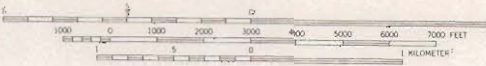
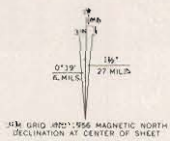
BOWLING GREEN, FL
N2737.5-W8145.7.5
1955
PHOTOREVISED 1974
AMS 4439 III NE-SERIES V847

EXPLANATION

- | | | | |
|---|---|---|---|
|  | MINED PRIOR TO JULY 1, 1971 |  | MINED OUT AREAS LEFT AS IS |
|  | MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 |  | SETTLING AREAS |
|  | MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 |  | RECLAIMED LANDS OTHER THAN SETTLING AREAS |
|  | MINED AFTER JULY 1, 1977 |  | RECLAIMED SETTLING AREAS |
| | |  | DISTURBED LANDS OTHER THAN SETTLING AREAS |



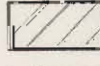
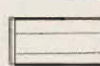
Mapped, edited, and published by the Geological Survey
Geographic Information Systems Division
Cultural features in part compiled from aerial photographs
taken 1962. Topography by planimetric surveys 1956.
Polyconic projection. 1957 North American datum.
10000-foot grid based on Florida coordinate system.
Zone 18.
10000-meter Universal Transverse Mercator grid
zone 17 shown in blue.
Map photograph dated 1970.
No major culture or drainage changes observed.



ROAD CLASSIFICATION
Heavy-duty ——— Light-duty ———
Medium-duty ——— Unimproved dirt ———
U. S. Route ——— State Route ———

BEREAH, FLA
N2737.5-W8137.5/7.
1977
PHOTOGRAPHIC
AMS 4539 II (1977) SERIES

EXPLANATION

- | | |
|---|---|
|  MINED PRIOR TO JULY 1, 1971 |  MINED OUT AREAS LEFT AS IS |
|  MINED BETWEEN JULY 1, 1971 AND JULY 1, 1975 |  SETTLING AREAS |
|  MINED BETWEEN JULY 1, 1975 AND JULY 1, 1977 |  RECLAIMED LANDS OTHER THAN SETTLING AREAS |
|  MINED AFTER JULY 1, 1977 |  RECLAIMED SETTLING AREAS |
| |  DISTURBED LANDS OTHER THAN SETTLING AREAS |