# Satellite Imagery Interpretation Guide

Zaatari Camp
Photo Credit: UNHCR

## Displaced Population Camps

Harvard
Humanitarian
Initiative

Signal Program on Human Security and Technology

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## About The Signal Program on Human Security and Technology

The Signal Program on Human Security and Technology (Signal Program) was founded by the Harvard Humanitarian Initiative in 2012. Signal Program staff, fellows, and partners work to advance the safe, ethical, and effective use of information technologies by communities of practice during humanitarian and human rights emergencies.

The program addresses critical gaps in research and practice HHI encountered while designing and manging the pilot phase of the Satellite Sentinel Project (SSP) from December 2010 to the summer of 2012. Through the analysis of satellite imagery and open source reports from Sudan, SSP was a watershed moment in the use of remote sensing to monitor the human security of civilians during and armed conflict.

The program's ongoing research and scholarship focuses on the following three areas:

***Tools and Methods***
Design and scientifically test tools and methods that remotely collect and analyze data about humanitarian emergencies;

***Standards and Ethics***
Help lead the development of technical standards and professional ethics for the responsible use of technology to assist disaster-affected populations;

***Mass Atrocity Remote Sensing***
And conduct retrospective analysis of satellite imagery and other related data to identify remotely observable forensic evidence of alleged mass atrocities.

## About the Harvard Humanitarian Initiative

The Harvard Humanitarian Initiative is a university-wide center involving multiple entities within the Harvard community that provide expertise in public health, medicine, social science, management, and other disciplines to promote evidence-based approaches to humanitarian assistance. The mission of HHI is to relieve human suffering in war and disaster by advancing the science and practice of humanitarian response worldwide.

HHI fosters interdisciplinary collaboration in order to:

- Improve the effectiveness of humanitarian strategies for relief, protection and prevention;
- Instill human rights principles and practices in these strategies; and
- Educate and train the next generation of humanitarian leaders.

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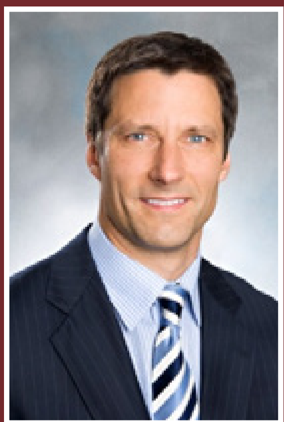

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# Preface

Remote sensing analysis by humanitarian organizations to detect and document changes related to displaced population camps has been employed, in various iterations, by the field for as long as two decades. The use of remote sensing to support responses to civilian displacement can prove valuable for site planning, identifying patterns of population change, and capturing key data for program planning and evaluation purposes.

Recent advances in the amount of satellite imagery that is commercially accessible, as well as the adoption of technologies such as Google Earth, has enabled this form of analysis to become more prevalent among humanitarians. The rise of voluntary technical organizations (VTO) as part of the crisis mapping movement is a crucial factor in remote sensing's more central role in supporting operations that assist displaced populations.

What was once only the domain of UN or government-based experts supporting humanitarian operations at the headquarters level is now considered a standard tool in the humanitarian toolbox. However, basic reference guides and publicly available training materials that can equip humanitarian practitioners attempting to apply remote sensing to the analysis of displaced population centers have, until now, not been available.

The Signal Program on Human Security and Technology has, with this study, begun to address this critical gap in practice and pedagogy. *Satellite Imagery Interpretation Guide: Displaced Population Camps* provides the first set of case studies of displaced persons camps in East Africa and the Middle East specifically intended to teach and guide those analyzing satellite imagery of refugee and IDP camps.

This guide makes two core contributions to the broader humanitarian sector: 1) It presents an approach for organizing observable objects in satellite imagery in relationship to the categories of the UN's humanitarian cluster system; and 2) the guide identifies both situation specific and commonly found types of critical humanitarian infrastructure in imagery.

While only a first step in a larger, long-term process of building best practices and technical standards, this reference guide is a milestone in the professionalization of remote sensing analysis for humanitarian purposes. The guide is especially relevant at a time when ongoing armed conflicts in Syria, Central African Republic, Sudan, Nigeria, and elsewhere have recently displaced millions of civilians from their homes. The individuals and organizations that assist those populations will very likely be benefiting from the integral support of geospatial analysts and VTOs as they do their work.

Products such as *Satellite Imagery Interpretation Guide* will be key components of the evolving architecture of training and resources available to these practitioners. It is HHI's intent that this guide and other products like it will support these emerging digital humanitarians as they play an increasingly crucial role in humanitarian response.

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Director, Harvard Humanitarian Initiative

# Acronym List

| | |
|---|---|
| **ACTED** | Agency for Technical Cooperation and Development |
| **AVSI** | Association of Volunteers in International Service |
| **CARE** | Cooperative for Assistance and Relief Everywhere |
| **DRC** | Danish Refugee Council |
| **DWS** | Department for World Service - Lutheran World Federation |
| **FAO** | Food and Agriculture Organization of the United Nations |
| **FCA** | Finn Church Aid |
| **GIZ** | Deutsche Gesellschaft fur Internationale Zusammenarbeit |
| **HAD** | Humanitarian Aid & Development |
| **HHI** | Harvard Humanitarian Initiative |
| **HI** | Handicap International/Atlas Logistics |
| **IDP** | Internally Displaced Persons |
| **IFRC** | International Federation of the Red Cross and Red Crescent Societies |
| **IOM** | International Organization for Migration |
| **IMC** | International Medical Corps |
| **IRC** | International Rescue Committee |
| **IRD** | Internaitonal Relief and Development |
| **JEN** | Japan Emergency NGO |
| **JHAS** | Jordan Health Aid Society |
| **LWF** | Lutheran World Federation |
| **MdM** | Médecins du Monde |
| **MoE Jordan** | Ministry of Education - Jordan |
| **MoH Jordan** | Ministry of Health - Jordan |
| **MSF** | Médecins Sans Frontières |
| **NCCK** | National Council of Churches of Kenya |
| **NHF** | Noor Al Hussein Foundation |
| **NP** | Nonviolent Peaceforce |

| | |
|---|---|
| **RCK** | Refugee Consortium of Kenya |
| **RI** | Relief International |
| **SC** | Save the Children |
| **SCUK** | Save the Children UK |
| **SMoH** | State Ministry of Health |
| **SP** | Samaritan's Purse |
| **SPHO** | Sudan Peace Humanitarian Organization |
| **SRCS** | Sudanese Red Crescent Society |
| **UN OCHA** | United Nations Office for the Coordination of Humanitarian Affairs |
| **UNFPA** | United Nations Population Fund |
| **UNHCR** | United Nations High Commissioner for Refugees |
| **UNHCR-LCU** | United Nations High Commissioner for Refugees Logistics Coordination Unit |
| **UNICEF** | United Nations International Children's Emergency Fund |
| **UNITAR-UNOSAT** | United Nations Institute for Training and Research-Operational Satellite Applications Programme |
| **UNOCHA** | United Nations Office for the Coordination of Humanitarian Affairs |
| **UNOPS** | United Nations Office for Project Services |
| **UNV** | United Nations Volunteers |
| **UNWOMEN** | United Nations Women |
| **VTO** | Voluntary Technical Organization |
| **WASH** | Water, Sanitation, and Hygiene |
| **WES** | Water, Environmental, and Sanitation |
| **WFP** | World Food Programme |
| **WHO** | World Health Organization |
| **WTK** | Windle Trust Kenya |

# How to Access Imagery Features in this Guide

*Satellite Imagery Interpretation Guide: Displaced Population Camps* was produced in collaboration with Google's Skybox Imaging. In this project, the Signal Program used six images collected by Skybox; two of Yida and Zam Zam and one of Zaatari and Dagahaley. SpaceUnited also donated an image of Zaatari that was collected by Astrium.

The six Skybox images used to create this guide are publicly available online for viewing and interpretation at the following link: www.skybox.com/hhi-displaced-population-camps. This imagery is published by Google under Creative Commons by Attribution (CC BY 4.0)

Each camp location covered in the guide is marked with a pin on the map. To view the imagery on the Google Earth Engine website, click "Zoom to area" under the location name and the date you wish you explore. Once zoomed to the corresponding location, use your mouse or the "+" or "-" box in the lower left hand corner of your screen to zoom in or out.

Clicking on the pin for each location will show a box that contains the camp name, a brief description, and map coordinates. This box also contains links to download GeoTIFF imagery for offline use.

Users who have advanced skills in using geospatial software can also download a KML file for use in Google Earth and other mapping tools. To do so, click "Download KML" under "HHI - Satellite Imagery Interpretation Guide- Camps." Once opened in Google Earth, this file will show a pin for each camp. Clicking on a pin will show a description of the camp and the links to download the high resolution satellite imagery for offline use by experienced users in advanced geospatial software.

# Chapter 1: Uses and Methodology

## 1A. Need for an Interpretation Guide

According to the United Nations High Commissioner for Refugees (UNHCR), 51.2 million individuals were forcibly displaced due to persecution, conflict, generalized violence, and human rights violations in 2013. This figure is comprised of 16.7 million refugees, 33.3 million internally displaced persons (IDPs), and 1.2 million asylum-seekers.[1] The number of refugees and IDPs globally continued to rise throughout 2014. This was due, in large part, to the continuation of both protracted crises and more recent conflicts, such as Syria.

Voluntary technical organizations (VTOs), imagery analysts, and researchers often interpret remote sensing data of planned and self-settled displaced population camps that host IDPs and/ or refugees. This work is increasingly done to support humanitarian agencies working to assist these populations. The interpretation of satellite imagery can provide critical situational awareness to responders in the field.

A key source of remote sensing data for this diverse community of practitioners is high resolution commercial satellite imagery. The potential uses of satellite imagery for assisting displaced populations have been explored over the past two decades,[2] including the following applications:

- Map shelters and other buildings present at camps, including changes to the number and type of these structures that are visible over time.[3]
- Aid in the remote detection of displaced populations, often in non-permissive environments and/or over extremely large physical areas.[4]
- Support site selection, monitor camp construction, and conduct environmental assessments.[5]
- Conduct rapid assessments during or immediately after a mass displacement of civilians.[6]
- Document the impact of a natural disaster, man-made disaster (such as a fire), or violent incident that has occurred at a camp.[7]

One implication of the increasing adoption of remote sensing by humanitarian organizations is that little formal sector-specific research and pedagogy exists. The earliest adopters of remote sensing were governments and their militaries beginning in the 1950's. By comparison, the application of remote sensing to humanitarian operations, like IDP/refugee assistance, emerged in the 1980's and 1990's.[8] This technology was initially used exclusively by large agencies, particularly UN and governmental organizations.

However, recent advances in the commercial collection and access to satellite imagery has resulted in the expanding use of this data by humanitarian and human rights organizations, VTOs, and researchers. Thus, there is a critical gap in accepted methodologies, examples of observable objects, and general best practices to train and guide volunteers and humanitarian analysts as they remotely analyze displaced population camps.

## 1B. Addressing Gaps in Practice

This guide is intended to fill two specific, interconnected gaps in the current use of high resolution satellite imagery in support of refugee/IDP assistance operations. The first gap is the absence of public and standardized references for commonly observed objects visible in high resolution satellite imagery that are often present in certain refugee and IDP camp contexts (hereafter, "displaced population camps").

To address this gap, the guide aims to assist in the identification of certain individual objects and/or groups of objects. This identification may also help analysts identify operational contexts in which objects may be present. This guide lists the dimensions, colors, shape, and, when possible, unique identifying features about objects visible in high resolution imagery of displaced population camps.

These objects may include temporary shelters (e.g. tents), locally built shelters constructed from organic matter and/or other materials (e.g. tarps), and prefabricated structures (e.g. caravans). Additional objects covered by this guide include, but are not limited to, water and sanitation infrastructure, warehouses, markets, and mosques.

It is important to note that, in most cases, the identity and function of objects present in camp settings cannot be identified based on the imagery alone.

The second gap addressed by this guide is a framework for integrating these objects, and the observations made about them, with the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) humanitarian cluster system. The cluster system is the architecture by which humanitarian agencies, both UN organizations and NGOs, share information, coordinate response to specific crises, and manage the provision of services at specific locations, such as displaced population centers.[9]

While objects may relate to several different clusters at once, this guide sorts objects present at each camp by the cluster with which it has its primary relationship. The pre-existing cluster areas utilized for this method are Education, Food Security, Health, Logistics, Shelter, and Water, Sanitation, and Hygiene (WASH). For example, an object present in satellite imagery of a displaced population center consistent with a latrine facility would be placed under "WASH". The corresponding OCHA humanitarian icon for each of these clusters can be found on a chapter's first page.

Objects that either do not fit into a specific pre-existing cluster are placed into categories created by the authors. These categories are Agency-Use, Civilian-Use, and Security.

### 1C. Potential Users of the Guide

The guide is primarily intended as a reference and training resource for students studying humanitarian response and technology; volunteers supporting humanitarian operations; and general audiences interested in the application of these skills and technologies to humanitarian assistance. While the guide may be of some utility to professional geospatial analysts regularly engaged in humanitarian work, it is mainly designed to serve as an introduction to this work for those new to the field.

The guide presents information, suggested interpretation guidelines and techniques, and aggregated data resulting from case studies with the goal of supporting skill development in the following areas:

- Basic object identification of structures that may often be found at planned displaced population camps;
- Practical and operational considerations related to imagery interpretation of displaced population camps;
- Familiarity with the phenomena, activities, and issues that can affect the visual profile of a camp in satellite imagery;
- General understanding of how certain objects may be used by civilians and agencies in a camp context; and
- Initial approaches for integrating data derived from imagery interpretation with other forms of available humanitarian data about camp contexts.

### 1D. Data and Methods

#### *Camp Selection*

The reference guide includes case studies of four camps in East Africa and the Middle East. The camps are Yida Camp in South Sudan; Zaatari Camp in Jordan; Zam Zam Camp in the Darfur Region of Sudan; and Dagahaley Camp in Kenya. These camps and regions were chosen for two reasons. First, these camps provide examples of geographic regions where civilian displacement is an ongoing problem. Second, these camps present observable objects that may be found across a relatively diverse set of camp environments in multiple regions and operational contexts.

#### *Sources of Imagery Data*

The Signal Program at HHI's research staff analyzed high resolution satellite images of the camps over the course of six months. For each camp, two high resolution images collected in 2014 were interpreted. A total of seven images were analyzed over the course of the guide's development. SpaceUnited provided one image collected by Astrium to the Signal Program for this project. The other six images interpreted as part of the research were provided by Skybox Imaging.

### *Analysis Methodology*

Observable objects present in these images were cross-referenced with data from publicly available maps produced by UN agencies and other humanitarian organizations operating in these camps. Additional open source data, including situation reports, news articles, and ground photographs, were used to help identify, document, and describe objects present in the satellite imagery of the camps.

Signal Program researchers captured several standard fields of information about each object included within the report. These fields are an object's shape, color, and measurement in meters. Additional properties, when relevant, are noted. The researchers note, when possible, whether similar objects occur in other camps analyzed in the reference guide.

### *Limitations*

The Signal Program's identification of objects present at displaced population camps based on the interpretation of satellite imagery has three major limitations. First, any observable objects that could not be identified and cross-corroborated with open source data or contextual analysis are not included. Secondly, objects that are smaller than the resolution available for the satellite images received by the Signal Program are not included in the guide. Lastly, only objects present at the camps on the dates that the satellite images were captured are included in the guide.

Additionally, the intended functionality and/or current use of an apparent structure present in satellite imagery cannot be conclusively determined by imagery interpretation alone. While some structures, such as apparent civilian shelters like tents, may be more readily identifiable than other structures, such as a school or a hospital, analysts must always seek corroborating information from non-imagery sources whenever possible.

[For an expanded methodology, please see Appendix I]

# Chapter 2: Interpreting Imagery of Displaced Population Camps

## 2A. Defining and Identifying "Planned" Camps

This resource focuses explicitly on "planned" refugee or IDP camps. A planned camp, as defined in the context of this guide, is a displaced population camp of refugees and/or IDPs being serviced by international and non-governmental aid agencies in a specific location. Planned camps can develop from initially self-settled camps in some cases.

While planned camps are one type of displaced population camp, self-settled IDP and refugee settlements are often of interest to humanitarian and human rights groups as well. These camps occur spontaneously when civilian populations flee a natural disaster or violence to self-selected locations. Self-settled camps can occur organically when displaced populations cluster near a specific location in an often uncoordinated way. In later guides, the Signal Program and others may address some of the specific, often highly complex visual profiles encountered when interpreting self-settled camps.

Planned camps often have repeating visual properties and phenomena that reflect the ongoing presence of aid agencies and the sustained provision of humanitarian assistance to a specific population over time. Though these properties and phenomena vary across regions, these characteristics may sometimes even vary within the same region.

Some of these visual properties and phenomena often present in planned camps may include the following:

- Common types and/or models of civilian shelter structures;
- Established camp perimeter, such as a fence, trench, or official boundary line;
- Agency compounds for staff living quarters, program support structures, warehouses, and administrative buildings;
- Logistics infrastructure such as airstrips, motor pools, and ground transport operations; and
- Repeating arrangements of buildings, which may sometimes include Sphere-standard derived placements of certain infrastructure, such as washing facilities, kitchens, and other civilian-use facilities.[10]

In all cases, analysts must seek non-imagery data corroborating of the camp's location and the presence of specific agencies through reliable, often public sources. These sources may include maps, situation reports, news articles, and/or information acquired directly from humanitarian agencies.

## 2B. Practical and Operational Considerations When Interpreting Camp Imagery

There are several key practical and operational considerations that an analyst should be aware of when interpreting satellite imagery of displaced population camps. Issues an analyst might encounter will likely vary from camp to camp. However, some critical cross-cutting questions should always be discussed and answered prior to interpreting imagery of camps:

- What information do potential end-users need?
- What is the camp's history and context?
- What are the limitations of available imagery data?
- How will change be measured over time?
- What objects will be identified?
- What is the plan for data recording and storage?

### *What information do potential end-users need?*

In most cases, the interpretation of satellite imagery of a displaced population camp occurs in response to a request from a humanitarian agency directed to a VTO and/or institution-based analysts. Generally, these requests are highly time sensitive and occur under significant operational pressures to obtain information. Analysts should be sensitive to the time and resource constraints of operational agencies on the ground, and seek to pre-agree the objectives, key data, and potential outcomes as early in the process as possible.

The majority of the time these requests usually focus on counting the number or changes in the number of civilian shelters present at a particular camp. Counting shelter structures provides important data for humanitarian agencies that they either might not be able to collect themselves, or may not be able to collect as accurately, regularly, easily, and as quickly.

Information gained from imagery interpretation, in some cases, can help inform population estimates, corroborate current population counts, and support the completion of needs assessments. Specific data about shelters often of interest to humanitarian agencies can include the following:

- Number of certain structures present in an image and/or images;
- Types of structures (e.g. manufactured tents, locally-built shelters, etc.);
- Disposition of the shelters (e.g. where are the shelters are located, how they are spaced, and what services and/or other structures are nearby);
- Status of the shelters (e.g. are shelters damaged by fire, knocked over by wind, etc.); and,
- Capacity of the shelters (e.g. how many people are estimated to fit inside a specific shelter type or model).

***What is the camp's history and context?***

All analysts involved in imagery interpretation should have a common, well-informed knowledge of the history and context of each camp of interest. Understanding the unique characteristics of a camp are crucial for effectively interpreting imagery of the camp as each camp can present a distinct visual profile.

As discussed in detail in the following sections of this chapter, there are several key questions and dynamics analysts should consider before beginning interpretation of imagery (See Sections 2E and 2D). It may be helpful to create a camp profile that provides an overview of each camp of interest for all members of a team interpreting an image (See Chapter 3 for examples).

Camp profiles often prove extremely helpful in ensuring both the coherent interpretation of images by multiple analysts and providing end-users important contextual background on the camp. Key information that a camp profile or overview should contain may include the following information:

- Summary of climate and geography, including key features (e.g. elevation, topography, etc.) and weather activity (e.g. rainy seasons, flooding patterns, etc.);
- Available population estimates of the number of civilians at the camp, brief ethnographic information about them, and a breakdown of gender and age;
- Information about when the camp was created, how it came into being (e.g. planned camp, initially self-settled camp, etc.), and its evolution over time; and an
- Updated list of operational agencies and their responsibilities by humanitarian cluster.

***What are the limitations of available imagery data?***

Discussions about the potential value of imagery interpretation for supporting humanitarian response often center on questions of what imagery can and cannot be expected to show. To identify the limitations of imagery interpretation in a specific scenario, two separate but related lines of inquiry are required. First, general constraints of imagery interpretation must be addressed. Some questions that may help identify these constraints include, though are not limited to, the following:

- Are the objects of interest visible at the available resolution?
- What characteristics of these objects can be reasonably and reliably seen and scientifically measured throughout the image?

- What inferences about these objects can be drawn from this data?
- Are these inferences based on identifying characteristics unique to these objects and their function, or can they also be drawn about different objects for the same reasons?

Second, key questions should be asked about the quality, volume, and temporality (e.g. how recently the imagery was collected) of the imagery data. These questions may include the following:

- How recently was the imagery collected?
- Are there large amounts of clouds, sun glare, or other atmospheric phenomena that may corrupt the quality of the available imagery?
- How many images are available and over what time frame?
- What type of imagery was collected (e.g. panchromatic, high resolution, low resolution, near-infrared, etc.) and how does this imagery type affect completing the assigned task?

Analysts should discuss these issues both as a team and with the potential end-users of the resulting product, as well as any other key stakeholders. Having shared and informed expectations amongst all stakeholders about what can and cannot reasonably be determined from imagery interpretation of available data is essential to a successful project. Without these common expectations, the resulting products may not fulfill the objectives of all stakeholders and may not have the impact that was intended by the exercise.

***How will change be measured over time?***

Multi-temporal change detection is the process of comparing two or more images of the same location from different times against one another to make probabilistic inferences about changes at that location over a specific timeframe.[11] While how to perform change detection is not the focus of this edition of the guide, it is likely that information gained from imagery interpretation of camps may be used either immediately or at a later date to detect change over time.

To engage in change detection, a change metric needs to be identified (e.g. number of shelters visible in an image). Once the change metric is identified, additional imagery of that location needs to be accessed through archival imagery or the collection of fresh imagery of that location, depending on the time frame of interest to the analyst. It is important to ensure accuracy and consistency between how objects are identified between each image and over time to detect change to a scientifically reproducible standard.

***What objects will be identified?***

All stakeholders should come to agreement before imagery interpretation begins about what objects are of value to the project and how they will be identified. Given the large number of objects often present in an image of a camp, having a clearly defined scope of what objects are of value is crucial for guiding imagery interpretation.

When working in large groups, which is often the case in VTO deployments, common imagery examples of the key objects should be identified and shared with the group, including descriptions of notable visual characteristics. As the interpretation goes forward, a system for reporting and recording any variances to these examples and descriptions should be established, including a process for agreeing changes to the basis for object identification.

***What is the plan for data recording and storage?***

Consistency and accuracy in how analysts record, categorize data, and note who collected what data is essential for all imagery interpretation. Analysts should decide before interpreting imagery what data will be recorded, how data will be entered into a database or logging system, with what specifications (e.g. to what precision will latitude and longitude be shown, etc.), and how activities performed by each analyst will be captured. For an example of an imagery data log, see Appendix II in this guide.

Also, a data storage plan should be developed and agreed before interpretation of imagery begins. While data security is always crucial, it is especially important to ensure that data is secure and uncorrupted when dealing with information about the location and status of vulnerable populations, such as refugees and IDPs. If the goal of imagery interpretation is to support accountability proceedings in a judicial venue, extra steps and precautions should be taken.[12]

**2D. Visual Profiles of IDP/Refugee Camps**

The four displaced population camps studied in this guide are located in East Africa and the Middle East. These camps - Yida, Zam Zam, Zaatari, and Dadaab - are distinct products of their historical, cultural, environmental, and operational contexts. Satellite images of the camps reflect these contexts.

Regardless of where they are located, displaced population camps are shaped by a complex interplay of both situationally specific and cross-cutting factors. These factors play crucial roles in giving each camp its own unique profile of visual characteristics. The camp's visual profile is influenced by both the natural environment and what observable objects, such as shelters and other humanitarian infrastructure, may be present there.

Some, though not all, of these visual characteristics can be visible in high resolution satellite imagery. A camp with a predominantly Muslim population, for example, can reasonably be expected to contain mosques, which may be identifiable in satellite imagery by their architecture and their orientation towards Mecca.

In another example, a camp located in a cold weather environment may include family tents with "a fly-sheet, a cotton lining, and hole for a stove pipe," according to UNOCHA guidelines, which can change the shape and visual properties of the structures. In humid climates, the tents' flysheet may be raised to improve ventilation, also creating a unique visual feature observable in satellite imagery of the camp.[13]

The visual characteristics of a displaced population camp can change either suddenly or gradually over time. Changes to the visual profile of a camp can be due to the activity pattern of the population residing at the camp, seasonal weather, and the actions of the governmental and non-governmental organizations that operate within the camp or in its vicinity.

The introduction of a different ethnic or religious group to a camp may cause new types of buildings and arrangements of structures to occur in certain parts of the camp. A fire, flood, or sandstorm may damage or destroy critical civilian use infrastructure. This infrastructure may later be repaired, rebuilt elsewhere, or simply abandoned - all factors that affect the layout of the camp and its overall visual profile.

New humanitarian agencies may arrive with different forms of infrastructure, vehicles, and equipment than the groups that preceded them, changing the visual profile of the camp in the process. Groups that were previously operational at a location may withdraw abruptly due to security events, changes in funding, or because their particular services are no longer required at that stage of the response. While some factors will repeat across camps, each context should be treated as unique and assumptions made based on previous analyses should always be challenged.

**2E. Key Questions When Analyzing IDP/Refugee Camps**

A camp's unique visual characteristics and the complex mix of factors that affect them are critical for helping make sense of the objects present at displaced population centers when employing remote sensing analysis. Analysts should have three fundamental goals in mind as they ask critical questions about the factors that shape a camp's visual profile:

1. Understand why certain infrastructure are present at a camp.
2. Identify what population-specific patterns of behavior may create, remove, or alter infrastructure visible at the camp.
3. Anticipate how the camp's environmental and operational context may affect its visual profile.

Some of the major factors affecting the visual profile of a camp, as well as examples of key questions an analyst should ask about them, may include the following:

1.) Climate and geographic region of both the displaced population and where the camp is located (if different than the population's home area).

- How does the climate and seasonal weather affect what building materials are used and how shelters are built at this camp?
- Is the camp's environment different from where the displaced population originally lived? Is it similar?
- What environmental hazards, such as flooding or extreme cold, may affect how structures are built and arranged?

2.) Cultural traditions and ethnic identity of a displaced population, including gender dynamics and religious affiliations.

- Are the shelters at the camp similar to traditional dwellings? How are they different?
- What religious affiliations are present within the displaced population and what visible infrastructure may be created by these groups?
- How might the status of women in this culture affect the construction, position, and arrangement of certain types of physical infrastructure, such as sanitation, hygiene, and medical facilities?

3) Type of disaster that resulted in the displacement and the tempo of its impact on the population (e.g. rapid onset, slow onset, or ongoing disaster).

- Is the camp continuing to grow due to new arrivals, or is the population size relatively static?
- If the population was displaced due to violence, are they still vulnerable to attacks at this location?
- Does the disaster permanently preclude the population from returning to their original homes, or is this displacement truly temporary?

4) History of the camp, including the duration that the current population has been living there and the past uses of the area before it became a displaced population center.

- How has this location been utilized in the past and what pre-existing infrastructure was present when the camp was created?
- How long has this location been a displaced population center and have other populations from different ethnic groups or nationalities previously lived there?
- How long has this specific population been present at this specific location? How may they have altered or adapted structures there over time?

5) Security situation in and around the camp, which may affect where and how the camp is built, as well as the ability of humanitarian agencies to access the camp.

- If the camp has come under attack, how has the camp been assaulted in the past (e.g. airstrikes, artillery, or raids by ground forces)? What evidence of the attacks, such as craters, damaged buildings, or vehicle tracking may be visible?
- What protection concerns are present within the displaced population, such as sexual assault, conscription, or forced disappearance, and who is responsible for managing them?
- Does the security situation allow humanitarian agencies to operate regularly at the camp, or are they working remotely?

6) Operational agencies present at the camp, including governmental, non-governmental, and international organizations.

- What agencies are present at the camp and from what governments? Why are those governmental actors there?
- What NGOs are present at the camp and what are their specific roles?
- What UN and other international agencies are present at the camp? How big are their operational footprints?

## 2F. Types of Shelter Structures

As the imagery interpreted in this guide shows, the majority of objects that make up the visual profile of a camp are structures used for shelter by displaced persons. Most projects tasked with interpreting imagery of displaced population camps focus on civilian shelters. This task is often initiated by agencies for the purposes of detecting change in the number of shelters visible at a one location or multiple locations over short or long periods of time.

Changes in the number of shelters, where and how they are positioned over time, and what materials they appear to be made of are all important pieces of information to the analyst. Additionally, observing changes to shelters, either to their visual characteristics and/or their numbers, is often a main reason analysts review imagery of a camp.

When documenting information about shelters, there are three broad categories of shelter structures an analyst should be familiar with:

1.) Manufactured: Manufactured structures can include factory-produced tents, caravan trailers, and other prefabricated living, storage, and administrative structures. These types of structures are often used as either shelters for displaced populations or as buildings for humanitarian personnel and operations. Logos (e.g. “UNHCR”), colors, and markings of these agencies on tents and other structures may be present in a satellite image.

2.) Locally built: Locally built structures are often constructed from naturally available materials such as branches and mud. In some cases, they may be the same size and shape as the populations’ regular dwellings in their home communities, or smaller but similar versions of these structures. Locally built structures may incorporate materials provided by humanitarian agencies at the camp, particularly plastic tarps. These tarps may often be visible in satellite imagery. In the cases of camps, such as Dadaab, where populations have been living for some time, temporary structures may evolve over time into permanent structures with metal roofs, gardens, added wings, and outbuildings.

3.) Hybrid: In some cases analysts may see manufactured structures combined with locally built elements, such as animal corrals around a standard UN tent. Displaced populations will adapt, customize, and add-on to manufactured structures they are given with items purchased or provided and other locally available raw materials. Facilities used by humanitarian agencies are often organized into compounds containing temporary and permanent structures. These compounds can include manufactured tents, prefabricated buildings, or pre-existing or locally built structures.

## 2G. Organizing Observable Objects by Humanitarian Sectors

The observable objects featured in this guide are primarily organized using the categories of the UN Cluster System. The Cluster System was created as part of the UN Humanitarian Reform of 2005 and consists of nine main categories of clusters.[14]

The objective of organizing observable objects by UN cluster, when possible, is to provide a framework for relating specific objects to the sector of humanitarian response activities with which they may have the most relevance. This approach may provide analysts a tool to draw connections between changes in the number, position, and properties of these objects in satellite imagery with accepted humanitarian indicators present in other sources of data.

Of the nine UN clusters, this guide identifies six clusters that have observable objects with a primary functional relationship to those clusters that may be visible in satellite imagery of displaced population centers. These cluster categories with observable objects identified within this guide are the following:

- *Education*: Schools and other educational facilities present in a camp environment

- *Food Security*:  Warehouses, distribution points, and other infrastructure relevant to the provision of food aid to the camp's population.
- *Health*: Facilities such as hospitals and clinics.
- *Logistics*: Infrastructure relevant to the requisition, transportation, storage, and distribution of relief items and commodities.
- *Shelter*: Structures provided to or built by the displaced population as an interim dwelling while living at the camp.
- *WASH (Water, Sanitation, and Hygiene)*: Infrastructure for the storage, transportation, and distribution of water,  toileting, waste management/disposal, and washing and bathing.

In addition to the six cluster-based categories above, this guide identifies three additional categories outside the UN cluster system. The three categories unique to the approach of this guide are Agency-Use Structures, Civilian-Use Structures, and Security.

The Civilian-Use category includes observable objects primarily managed and used by the camp's population. This may include markets, religious buildings, meeting areas, recreational facilities, and other infrastructure utilized primarily by the camp's occupants other than their shelters.

The Agency-Use category includes permanent structures, tents, and other structures that humanitarian agencies use to provide services to the displaced population. These structures can be used for housing, offices, and other administrative purposes. Types of Agency-Use structures may include manufactured dome, keyhole, tunnel, and other shapes of tents, as well as prefabricated and locally built permanent or semi-permanent structures.

The Security category includes structures and infrastructure such as checkpoints, barracks, watchtowers, and similar facilities used by governments, international agencies, NGOs, and non-state actors in reference to a camp. A government security force, a local police agency, a paramilitary or civil defense group, or international peacekeepers seeking to protect the camp's population may control these objects.

# Chapter 3: Camp Overviews

## Yida Camp

### Background


Yida Camp is located in Yida, Unity State, South Sudan. The camp was established on 1 July 2011. The majority of the residents in the camp are IDPs from South Sudan and refugees from Sudan. As of 8 November 2014, the camp's population was 71,940.[15] Yida has a tropical climate and experiences distinct rainy and dry seasons. The rainy season lasts from April/May to October/November, while the dry season lasts from November/December to March/April.

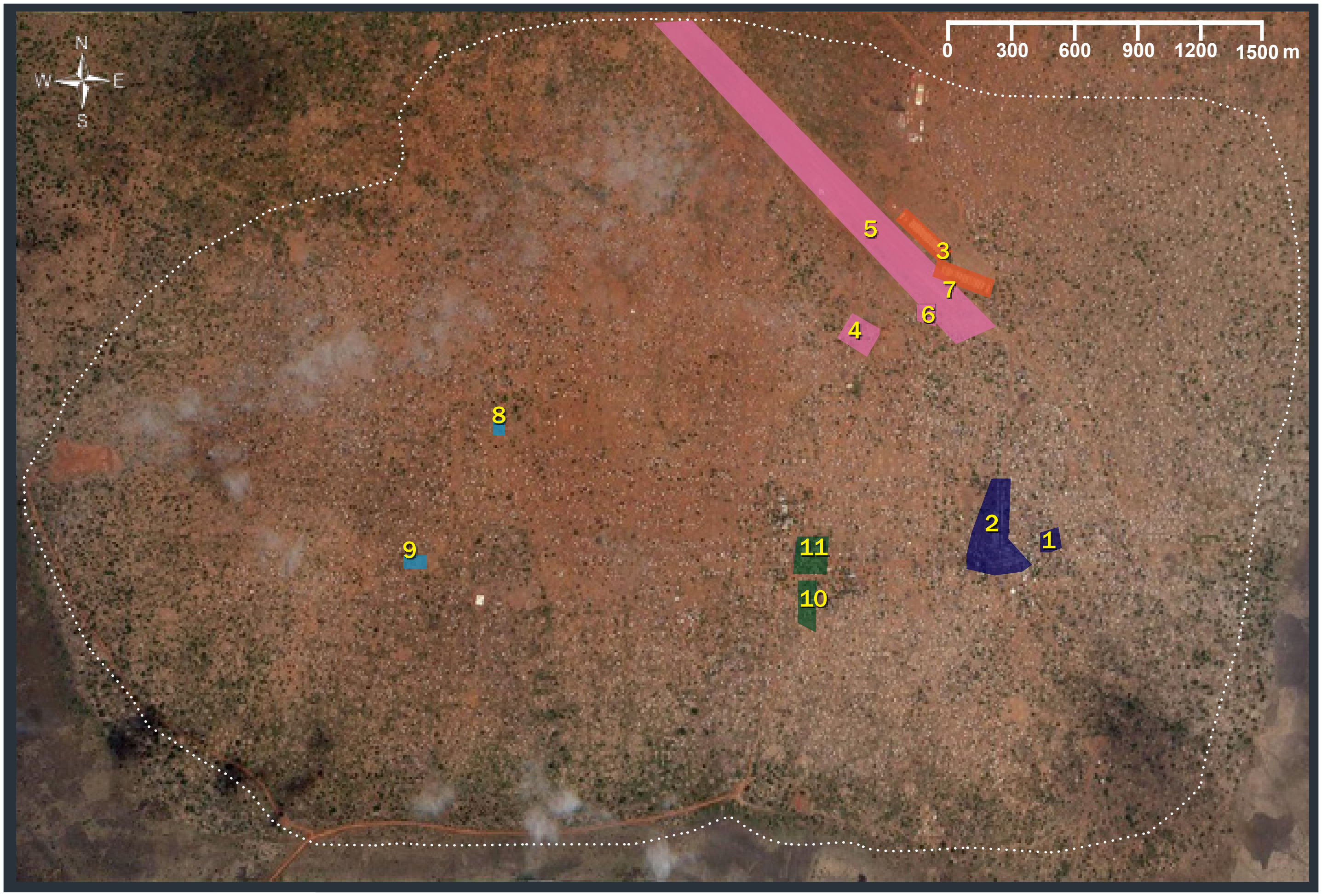
The table below outlines the agencies and organizations reported to be operational at Yida Camp.[16] On the following page an overview image of Yida Camp is provided. The location of infrastructure analyzed in later chapters are mapped.

Before examining specific structures, creating an overview map of points of interest on a satellite image helps orient an analyst to the overall layout of the camp and how the location of structures may be related to each other. For example, in Yida Camp the WFP Food Distribution Center and Samaritan's Purse Warehouses are located near the airstrip. Additionally, creating an overview map is especially helpful when multiple analysts are interpreting the same image simultaneously. Shared maps can capture information from diverse sources of data and prevent inaccurate or redundant identifications by the team.

### Agencies Operational at Yida Camp

| | |
|---|---|
| *Lead Agency* | UNHCR |
| *Camp Management* | UNHCR |
| *Child Protection* | NP |
| *Core Relief Items* | SP, UNHCR |
| *Food* | SP, WFP |
| *Gender-Based Violence* | IRC |
| *Health* | CARE, IRC, Seo |
| *Nutrition* | SP |
| *Protection* | ICRC, IRC, NP, UNHCR |
| *Registration* | UNHCR |
| *Water and Sanitation* | Solidarités, SP |

## Yida Camp Overview




| | |
|---|---|
| CIVILIAN | |
| EDUCATION | |
| FOOD SECURITY | |
| HEALTH | |
| LOGISTICS | |
| WASH | |
| AGENCY | |
| SECURITY | |

**Infrastructure interpreted in this guide:**

1) Mosque [p. 23]
2) Market [p. 23]
3) WFP Food Distribution Center [p. 36]
4) Samaritan's Purse Warehouses [p. 43]
5) Airstrip [p. 43]
6) Antonov An-26 [p. 43]
7) Fokker F27 [p. 43]
8) Latrine [p. 45]
9) Borehole [p. 45]
10) IRC Compound [p. 48]
11) UNHCR Compound [p.49]

Publicly available data from two maps was cross-referenced with satellite imagery data to aid in the identification of structures in Yida Camp. They are: (1) UNHCR, Refugee Crisis in Unity: Yida Camp Shelters, 28 November 2012; and (2) UNHCR, Refugee Crisis in Unity: Yida Camp Water Coverage, 12 February 2013. These maps can be found in Appendix III.

# Zaatari Camp

## Background


Zaatari Camp is located in Zaatari, Mafraq Governorate, Jordan. Established on 28 July 2012, the camp is populated by refugees from Syria. As of 11 November 2014, the camp's population was 81,321.[17] Zaatari is located in a desert climate and experiences both rainy and dry seasons. The rainy season lasts from October/November to April, while the dry season lasts from May to September/October.

The table below outlines the agencies and organizations reported to be operational at Zaatari Camp.[18] On the following page, an overview image of Zaatari Camp is provided. The location of infrastructure analyzed in later chapters are mapped. Before examining specific structures, creating an overview map of points of interest on a satellite image helps orient an analyst to the overall layout of the camp and how the location of structures may be related to each other. For example, New Arrivals Registration in Zaatari Camp is located along the perimeter near a camp entrance. Additionally, creating an overview map is especially helpful when multiple analysts are interpreting the same image simultaneously. Shared maps can capture information from diverse sources of data and prevent inaccurate or redundant identifications by the team.

## Agencies Operational at Zaatari Camp

| | |
|---|---|
| *Camp Management* | UNHCR |
| *Child Protection* | FCA, IMC, IRC, Mercy Cops, NHF, UNFPA, UNHCR, UNICEF |
| *Community Services* | NHF, UNHCR |
| *Coordination* | UNHCR |
| *Core Relief Items* | ACTED, IRD, JEN, NRC, UNHCR |
| *Education* | Children without borders-KnK, FCA, IRD, Mercy Corps, MoE Jordan, NRC, RI, SC, UNHCR, UNICEF |
| *Food Security* | SC, UNHCR, WFP |
| *Gender-Based Violence* | IRC, NHF, UNFPA, UNHCR, UNICEF |
| *Health* | IMC, IRC, IRD, JHAS, MdM, MoH Jordan, NHF, SC, UNHCR, UNICEF |

| | |
|---|---|
| *Mental Health and Psychological Support* | IMC, NHF |
| *Nutrition* | UNHCR |
| *Protection* | ACTED, IMC, IRC, IRD, LWF, MercyCorps, UNFPA, UNHCR, UNICEF, UN-WOMEN |
| *Registration* | UNHCR |
| *Reproductive Health* | UNFPA |
| *Shelter* | NRC, UNHCR, UNOPS |
| *Water and Sanitation* | ACTED, JEN, Oxfam, UNHCR, UNICEF |

## Zaatari Camp Overview


| | |
|---|---|
| CIVILIAN | |
| EDUCATION | |
| FOOD SECURITY | |
| HEALTH | |
| LOGISTICS | |
| WASH | |
| AGENCY | |
| SECURITY | |

**Infrastructure interpreted in this guide:**

1) Mosque [p. 25]

2) Market [p. 25]

3) Bahraini School [p. 31]

4) Saudi School [p. 31]

5) American School [p. 31]

6) WFP Compound [p. 36]

7) Communal Kitchens [p. 37]

8) Moroccan Hospital [p. 39]

9) KSA Hospital [p. 39]

10) WASH Facilities [p. 45]

11) Pumping Station Facility [p. 45]

12) UNHCR Registration [p. 50]

13) New Arrivals Registration [p. 50]

14) IOM Compound [p. 50]

15) NRC Distribution [p. 51]

16) Police [p. 55]

17) Civil Defense [p. 55]

Publicly available data from two maps was cross-referenced with satellite imagery data to aid in the identification of structures in Zaatari Camp. They are: (1) UNICEF, Jordan - Al Za'atari Camp: Households possessing a source of wastewater, 6 January 2014; and (2) UNICEF, Al Zaatari Refugee Camp - General Infrastructure, 4 September 2013. These maps can be found in Appendix III.

# Zam Zam Camp

## Background

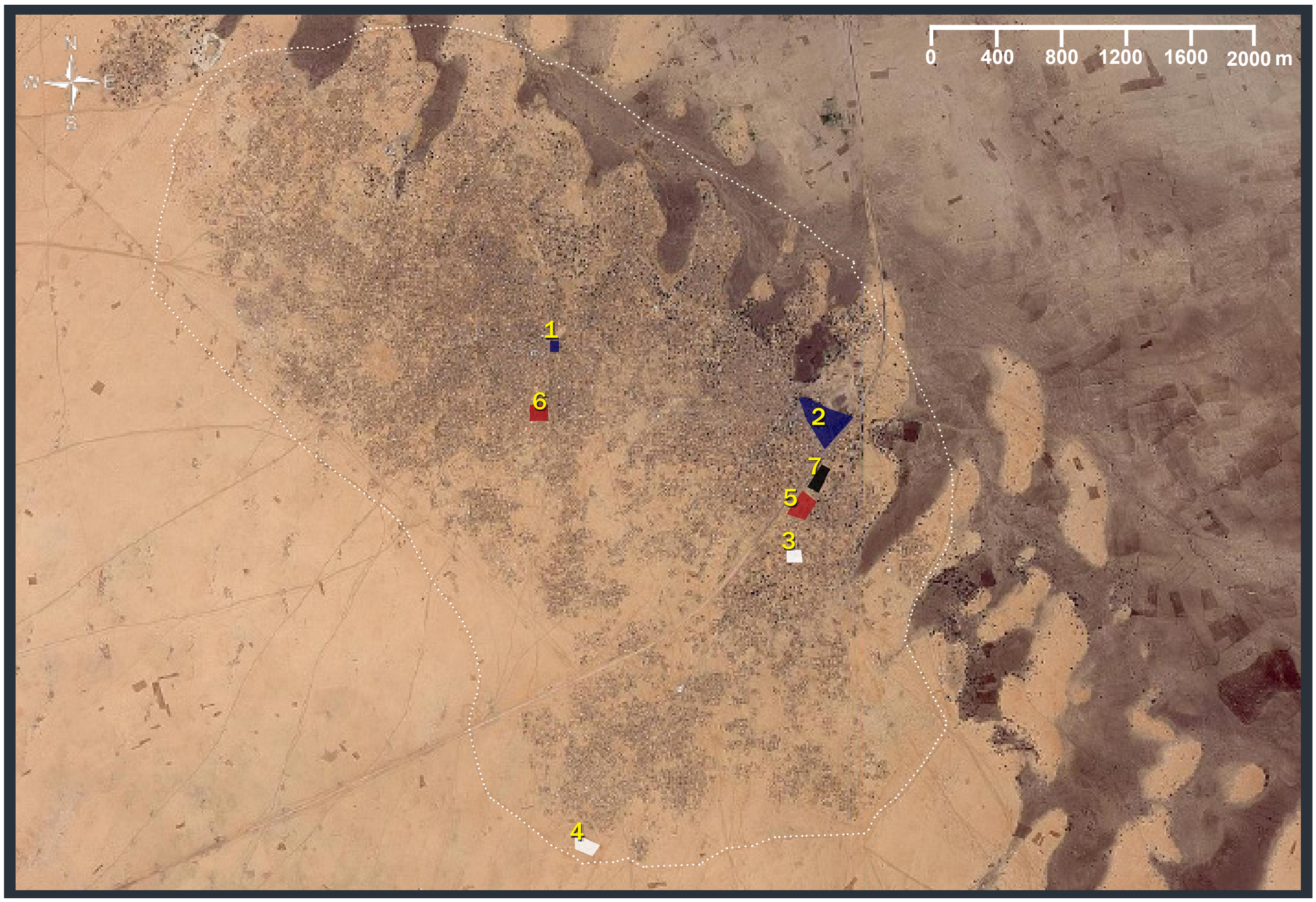

Zam Zam Camp was opened in El Fasher, North Darfur, Sudan in August 2004. A camp extension was later opened in February 2009. Residents of the camp are primarily IDPs from the Darfur Region of Sudan. The camp has hosted more than 100,000 people since it opened. The flow of displaced civilians to the camp continues, with more than 8,000 seeking refuge at the camp as of April 2014 due to violence that broke out two months earlier.[19] Located in a semi-arid climate, the camp experiences a rainy season from June until September and a dry season from October until May.

The table below outlines the agencies and organizations reported to be operational at Zam Zam Camp.[20] On the following page, an overview image of Zam Zam Camp is provided. The location of infrastructure analyzed in later chapters are mapped. Before examining specific structures, creating an overview map of points of interest on a satellite image helps orient an analyst to the overall layout of the camp and how the location of structures may be related to each other. For example, in Zam Zam a security checkpoint is located along a main road which leads into the camp. Additionally, creating an overview map is especially helpful when multiple analysts are interpreting the same image simultaneously. Shared maps can capture information from diverse sources of data and prevent inaccurate or redundant identifications by the team.

## Agencies Operational at Zam Zam Camp

| | |
|---|---|
| *Camp Coordination* | UNHCR |
| *Education* | UNICEF, Plan Sudan, SPHO |
| *Emergency Shelter and Non-Food Items* | UNHCR-LCU, Plan Sudan |
| *Food* | WFP, SRCS, DNW, IODRA |
| *Health* | WHO, SMoH, RI, Mercy Malaysia, HAD |
| *Nutrition* | SMoH, WHO, UNICEF, WFP, RI |
| *Protection* | UNHCR, UNAMID, Plan Sudan, SPHO |
| *Registration* | UNHCR |
| *Water and Sanitation* | UNICEF, WES, Plan Sudan |

## Zam Zam Camp Overview




| | |
|---|---|
| CIVILIAN | |
| EDUCATION | |
| FOOD SECURITY | |
| HEALTH | |
| LOGISTICS | |
| WASH | |
| AGENCY | |
| SECURITY | |

**Infrastructure interpreted in this guide:**

1) Mosque [p. 27]

2) Market [p. 27]

3) School 1 [p. 32]

4) School 2 [p. 32]

5) Relief International Health Center 1 [p. 40]

6) Relief International Health Center 2 [p. 40]

7) Security Checkpoint [p. 55]

Publicly available data from two maps was cross-referenced with satellite imagery data to aid in the identification of structures in Zam Zam Camp. They are: (1) OCHA, Sudan: Zamzam IDP Camp Profile, 9 May 2013; and (2) OCHA, Zamzam IDP Camp - Health Centres Density per Squared Kilometer, 16 June 2011. These maps can be found in Appendix III.

# Dadaab Camp

## Background

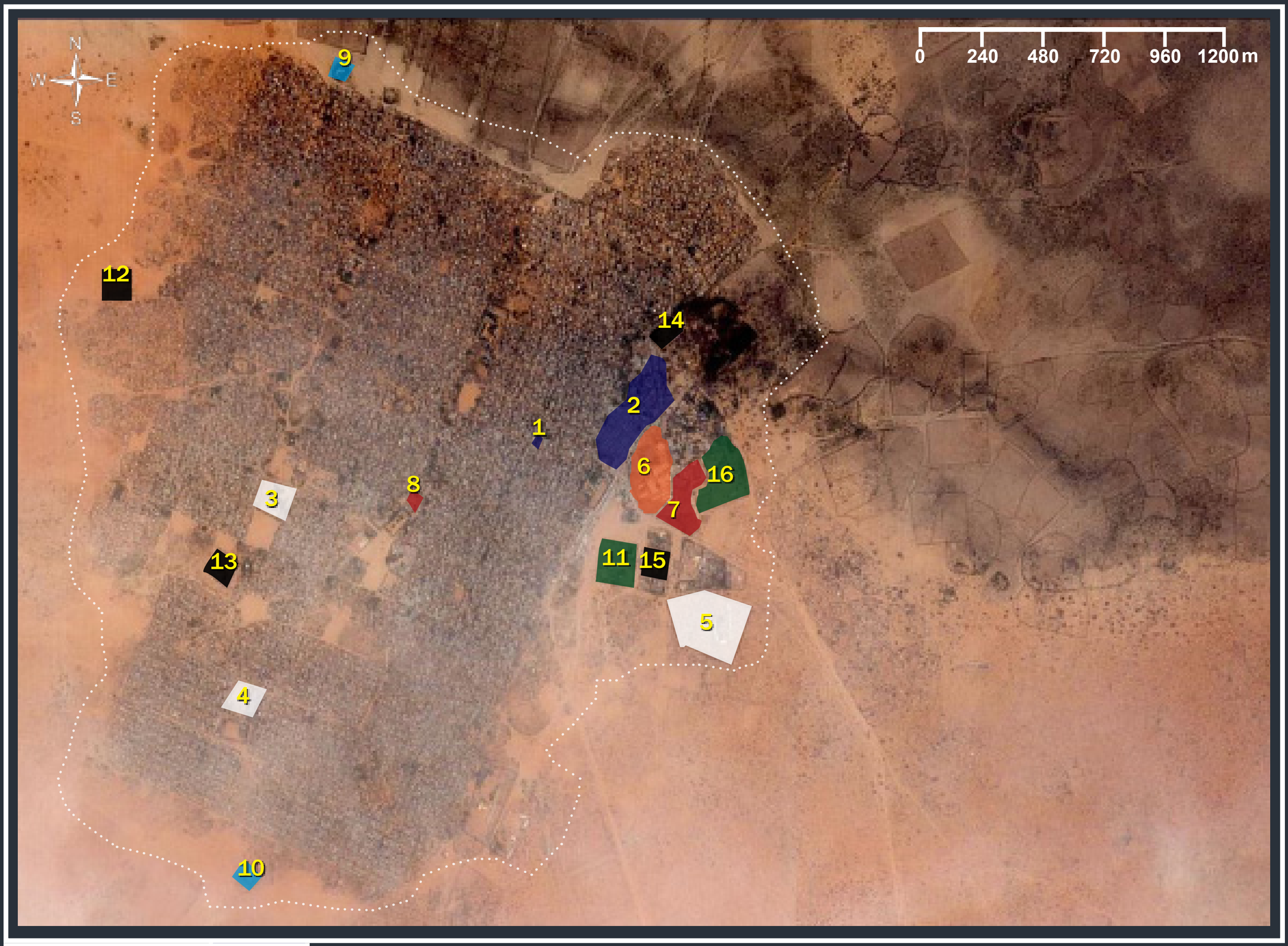

Dadaab Camp, located in Dadaab, North Eastern Province, Kenya, is comprised of five smaller camps: Ifo, Dagahaley, Hagadera, Ifo 2 and Kambioos. Ifo, Dagahaley, and Hagadera were established in 1991 and 1992. Ifo 2 and Kambioos were established in 2011. These camps are primarily home to Somali refugees. The camp's population was 104,896 as of 31 October 2014.[21] Located in a semi-arid climate, rainy seasons at this camp span from March until May and October to December. Dry seasons last from January to February and June to September.

This reference guide specifically examines Dagahaley Camp. The table below outlines the agencies and organizations reported to be operational at the camp.[22] On the following page, an overview image of Dagahaley Camp is provided. The location of infrastructure analyzed in later chapters are mapped. Before examining specific structures, creating an overview map of points of interest on a satellite image helps orient an analyst to the overall layout of the camp and how the location of structures may be related to each other. For example, two identified boreholes in Dagahaley are located on opposite ends of the camp's exterior. Additionally, creating an overview map is especially helpful when multiple analysts are interpreting the same image simultaneously. Shared maps can capture information from diverse sources of data and prevent inaccurate or redundant identifications by the team.

## Agencies Operational at Dagahaley Camp

| | |
|---|---|
| *Lead Agency* | UNHCR |
| *Child Protection* | SCUK |
| *Community Services* | CARE, LWF, UNV |
| *Core Relief Items* | CARE, GIZ, UNHCR |
| *Education* | AVSI, DRC, FilmAid, LWF, NRC, UNHCR, WTK |
| *Food* | CARE, NRC, SCUK, WFP |
| *Gender-Based Violence* | IRC |
| *Health* | FilmAid, DRC, NCCK, UNHCR, UNV |
| *HIV/AIDS* | CARE, FilmAid, HI, NCCK, SCUK, UNHCR, WTK |
| *Logistics* | CARE, GIZ, UNHCR |
| *Nutrition* | UNHCR |
| *Protection* | DRC, FilmAid, LWF, NCCK, RCK, SCUK, UNHCR |
| *Registration* | UNHCR |
| *Water and Sanitation* | CARE, NRC, UNHCR |

## Dagahaley Camp Overview Image




| | |
|---|---|
| CIVILIAN | |
| EDUCATION | |
| FOOD SECURITY | |
| HEALTH | |
| LOGISTICS | |
| WASH | |
| AGENCY | |
| SECURITY | |

**Infrastructure Interpreted in this Guide:**

1) Mosque/Islamic School [p. 29]

2) Market [p. 29]

3) Illeys Primary School [p. 33]

4) Wathajir Primary School [p. 33]

5) Community School [p. 34]

6) Food Distribution Center [p. 37]

7) Cholera Outbreak Center [p. 41]

8) Health Post 1 [p. 41]

9) Borehole 1 [p. 46]

10) Borehole 2 [p. 46]

11) UNHCR Field Office and Transit Center [p. 49]

12) Adminsitration Police [p. 56]

13) Police Base [p. 56]

14) Police Post at Market [p. 56]

15) Tango IV Base [p. 57]

16) Windle Trust Compound [p. 52]

Publicly available data from two maps was cross-referenced with satellite imagery data to aid in the identification of structures in Dadaab. They are: (1) UNHCR and LWF/DWS-Dadaab, Kenya - Dadaab District: Dagahaley Refugee Camp Overview, June 2013; and (2) UNHCR, LWF-Dadaab, and GeoVantage, Kenya - Lagdera District: Dagahaley Refugee Camp Overview, January 2012. These maps can be found in Appendix III.

# Chapter 4: Shelter and Civilian-Use Structures

## 4A. Shelter

The Global Shelter Cluster provides shelters to displaced populations and strengthens preparedness and technical capacity to improve humanitarian response in this area. The International Federation of the Red Cross and Red Crescent Societies (IFRC) and UNHCR are co-leads for the cluster at the global level. IFRC leads the Global Shelter Cluster in disaster situations and UNHCR leads in conflict situations.[23]

As previously mentioned, shelter structures are very often the primary focus of satellite imagery-based interpretation of displaced population camps. Changes to the number, position, and characteristics of shelters are often key metrics used by analysts to document and interpret macro-level changes to the status of people living in the camp.

In the following examples from each camp in the guide, repeating types of shelter structures, patterns of arrangement, repeating visual identifiers, and other phenomena associated with observable shelter structures are identified. Additionally, ground photographs used to help identify the shelters in the imagery are included. Analysts should be attuned to how climate, seasonal changes, and the ethnography of displaced populations affect how shelter structures are both initially built and adapted by displaced populations over time.

### *Yida*

The primary shelter type present in Yida Camp is a locally built dwelling composed of branches and other materials naturally occurring in the area of the camp. Animal corrals and other outbuildings constructed from naturally occurring materials are visible as well.

Some shelter structures have a blue, white, or translucent tarp placed over or underneath the top layer of branches. The repeating presence of these tarps is a critical visual identifier for many of these shelters. Without a visible tarp, these shelters appear in imagery as mound shaped objects which are brownish in color.

Within Yida, civilians largely manage the social organization of the camp. As a result, the majority of the camp, particularly the shelters within the camp, is organized according to pre-existing tribal structures in place before the population was dislodged from their home communities. Most roads and paths cleared to connect the airstrip, water points, and other infrastructure were established "to accommodate the meandering boundaries of tribal territories and to facilitate travel between them."[24]

### *Zaatari*

Two main types of shelter structures are present in Zaatari Camp: tents and caravan trailers. Tents were the primary shelter used by Syrian refugees when the camp was first established in July 2012, but officials began replacing tents with caravans in August 2012. At the time, refugees were living in "plastic triage tents," which reportedly failed to keep out sand or cold winds. The caravans were to act as "more permanent structures."[25]

The caravans were initially established in a grid system with spacing to provide access to vehicles, protect against fire, and promote hygiene. However, camp residents have moved the caravans to create "'little compounds' - typically with a U-shape or a courtyard shape - so that they may live together with their extended families. Other rearrangements of the camp allow refugees to move closer to people from their village."[26]

The shelters in Zaatari, in other cases, are still arranged in certain sectors of the camp in a city block style format. WASH facilities, communal kitchens, and other common use facilities can, in some areas of the camp, be seen in regular intervals co-located with groups of shelters. Identifying how shelters relate to other nearby structures from other response clusters is key for analysts to understand the camp's layout.

***Zam Zam***

The primary structures in Zam Zam Camp are UN-issued family tents and locally built structures, known as "rakubas." Zam Zam is characterized by a mix of distributed manufactured shelter structures and locally built structures often occurring together in close proximity.

These locally built structures include rakubas, which are huts with a sloped roof and bamboo walls covered with mats.[27] Often, a sunshade is placed over the rakuba to help provide covered shelter.[28] Between 2013 and 2014, new arrivals to the camp have reportedly sought shelter under trees, in abandoned houses, or in huts made from cloth and wood.[29]

***Dagahaley, Dadaab Camp***

The Dagahaley Camp at Dadaab is primarily comprised of two types of shelter structures. One type is a standard house shaped structure with mud walls and corrugated metal roofs. The other type is a domed shaped structure made of sticks with coverings comprised of cloth, paper, mud, or sticks.[30]

Due to the presence of the displaced Somali population at the camp for more than two decades, in some cases, it is not uncommon for many of these structures to have become more formal and permanent over time. Groups of shelters, in many cases, appear surrounded by a perimeter fence, likely constructed from naturally occurring materials, such as branches.

Médecins Sans Frontières (MSF) reported in March 2014 that the poor quality of their shelters was a common complaint from residents of Dadaab throughout 2013. Of the refugees MSF interviewed as part of a study, 41% responded that their shelters did not provide sufficient protection from the rain and only 50% reported they had access to shelter material, like from UNHCR.[31] According to Cooperative for Assistance and Relief Everywhere (CARE), tent shelters are regularly destroyed by severe weather and need to be replaced every six months.[32]

**4B. Civilian-Use Structures**

Civilian-use structures are defined as structures constructed and utilized by the displaced population itself for economic, religious, and community purposes, including governance and recreation. Some examples of civilian-use structures identified by maps can include, though are not limited to, mosques, churches, markets and shops, community gathering areas, and athletic facilities, such as soccer pitches. For example, a soccer pitch is located at the American School (see Figure 5-2 in Chapter 5: Education).

These structures provide evidence about the activities of camp residents and how they adapt the physical environment of a camp through their activity patterns over time. Additionally, these structures can provide key indicators about the ethnographic composition of a camp population.

Of the many types of civilian-use structures marked on maps of the camps, markets and mosques are the structures that could often be identified through satellite imagery analysis. These identifications are possible based on imagery data alone because of the unique visual properties of these facilities. Markets are identified by this analysis at each of the four camps. Mosques can be seen at three of the camps - Yida, Zaatari, and Zam Zam.

***Identifying Mosques***

One critical object in camps with a primarily Muslim population, such as those featured in this guide, is the mosque. Unlike churches that may be present in camps, which can often be difficult to identify based on architectural features alone, mosques are often uniquely identifiable in satellite imagery.

Their comparatively easier identification is because of their orientation to the qibla, the direction to the Kabaa shrine located in Mecca, which all Muslims face during prayer.[33] Analysts should identify the vector of the apparent mosque towards Mecca and measure whether the apparent front end of the building is facing in that direction. Drawing a directional line using Google Earth or similar programs from the Kabaa in Mecca through the middle of the building at the camp in question can help determine if the structure is facing that direction.

***Identifying Markets***

Markets and shops are often locations where crowds of residents of the camp can sometimes be visible in satellite imagery. These areas are often collections of makeshift stalls, tarps, and locally built structures clustered tightly together in a small area. As a population remains at a camp over a period of years, it can be expected that these areas become more established and built-up by the residents of the camp.

### *Yida Camp*

**Figure 4-1**


**Displaced Persons Shelters**
24 June 2014
Yida Camp, South Sudan

1) Tent
Shape: Rectangular
Color: Blue
Dimensions: 4.7 m x 3.9 m

2) Tent
Shape: Rectangular
Color: White
Dimensions: 4.7 m x 3.9 m

3) Tent
Shape: Rectangular
Color: White
Dimensions: 16.3 m x 7.6 m

**Figure 4-2**

Yida Camp, South Sudan
September 2012
Photo credit: UNHCR/ K. Mahoney

**Figure 4-3**

Yida Camp, South Sudan
February 2012
Photo credit: United to End Genocide/ Dan Sullivan

## *Yida Camp*

**Figure 4-4**


**Mosque**
24 June 2014
Yida Camp, South Sudan

<u>Mosque</u>

1) Tent
Shape: Rectangular
Color: White
Dimensions: 15.2 m x 8.1 m

2) Tent
Shape: Rectangular
Color: White
Dimensions: 6.8 m x 4.4 m

**Figure 4-5**

**Market**
16 March 2014
Yida Camp, South Sudan

The main market in Yida is composed of individually roofed stalls. Located in the eastern side of the camp, the market is a main source of household items, clothing, and fuel for civilians. It is also a major source of livelihoods for residents. On 13 March 2014, a fire reportedly broke out at a restaurant in the market, causing the destruction of more than 100 shops and 30 houses.[34] This image, captured three days after the fire, indicates widespread destruction in a confined area as a result of burning. Burn scars, destroyed structures, and some still intact structures are visible.

***Zaatari Camp***

**Figure 4-6**


**Displaced Persons Shelters**
31 January 2014
Zaatari Camp, Jordan

1) Caravan
Shape: Rectangular
Color: White
Dimensions: 6.4 m x 3.2 m

2) Tent
Shape: Hexagonal
Color: White
Dimensions: 6.6 m x 3.8 m

**Figure 4-7**

Zaatari Camp, Jordan
June 2014
Photo credit: World Bank/ Dominic Chavez

**Figure 4-8**


Zaatari Camp, Jordan
November 2012
Photo credit: UNHCR/ Brian Sokol

## *Zaatari Camp*

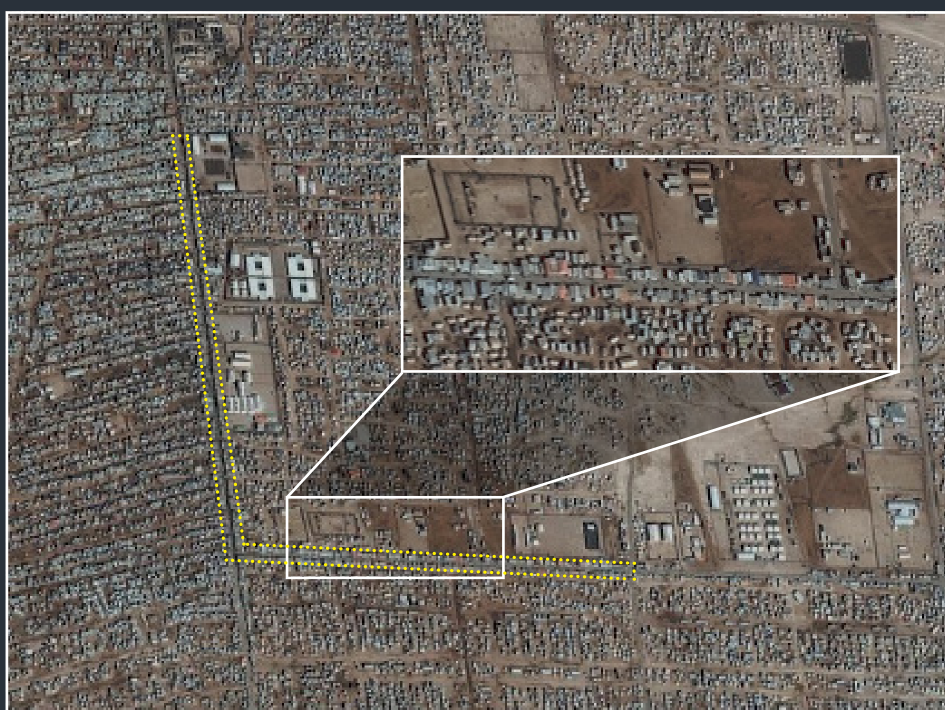
**Figure 4-9**


**Mosque**
31 January 2014
Zaatari Camp, Jordan

<u>Mosque</u>

1) Tent
Shape: Rectangular
Color: White
Dimensions: 25.5 m x 10 m

**Figure 4-10**



**Market**
31 January 2014
Zaatari Camp, Jordan

The market area in Zaatari, known as Champs-Élysées, contains stalls that are run by refugees who are living in the camp. In many cases, merchants who operated businesses before fleeing Syria have re-established their business in the camp. Many types of stores can be found in this area, including vegetable stands, clothing and footwear stores, falafel restaurants, and pet shops.[35] With hundreds of shops and businesses operating in this area, UNHCR encourages trade and the provision of services to attempt to provide camp residents a sense of normalcy.[36]

## *Zam Zam Camp*

**Figure 4-11**


**Displaced Persons Shelters**
17 July 2014
Zam Zam Camp, Sudan

1) Tukul
Shape: Circular
Color: Brown
Dimensions: 4.6 m x 4.6 m

2) Tent
Shape: Square
Color: Brown
Dimensions: 3.9 m x 3.9 m

3) Tent
Shape: Rectangular
Color: White
Dimensions: 4.3 m x 2.5 m

4) Tent
Shape: Rectangular
Color: Beige
Dimensions: 5.9 m x 3.5 m

5) Tent
Shape: Rectangular
Color: Blue
Dimensions: 4.2 m x 3.4 m

**Figure 4-12**

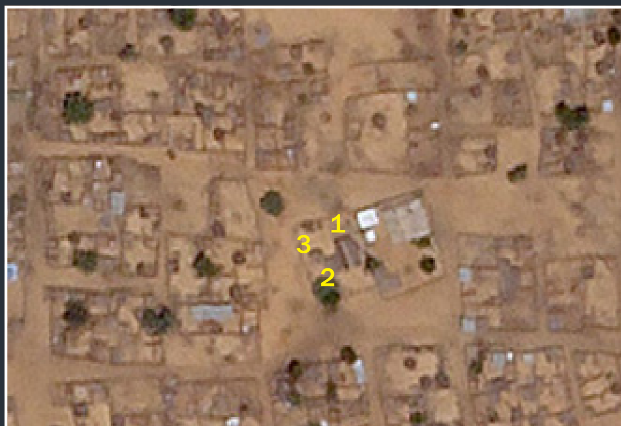
Zam Zam Camp, Sudan
June 2014
Photo credit: UNAMID/ Albert Gonzalez Farran

**Figure 4-13**

Zam Zam Camp, Sudan
April 2014
Photo credit: UNAMID/ Albert Gonzalez Farran

## *Zam Zam Camp*

**Figure 4-14**




**Mosque**
17 July 2014
Zam Zam Camp, Sudan

<u>Mosque</u>

1) Tent
Shape: Rectangular
Color: Brown
Dimensions: 10 m x 6.4 m

2) Tent
Shape: Rectangular
Color: Brown
Dimensions: 5.8 m x 4.4 m

3) Tent
Shape: Rectangular
Color: Brown
Dimensions: 4.2 m x 3.5 m

**Figure 4-15**

**Market**
17 July 2014
Zam Zam Camp, Sudan

In Zam Zam Camp, the market is comprised of more than a thousand shops and fifty sun shelters.[37] One example of the trade and commerce that exists as a result of the market, is the sale of fuel-efficient mud stoves built from local materials by women.[38] Unfortunately, the market, as in other camps, such as Yida, is at risk for incidental fires.[39] It has also been targeted as part of ongoing violence. For example, in October 2014, the market, along with other areas of the camp were reportedly attacked by the Central Reserve Police,[40] a paramilitary force active in Darfur and other parts of Sudan.

### *Dagahaley, Dadaab Camp*

**Figure 4-16**


**Displaced Persons Shelters**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

1) Tent
Shape: Rectangular
Color: White
Dimensions: 4.2 m x 3.2 m

2) Building
Shape: Rectangular
Color: Grey
Dimensions: 4.6 m x 4 m

3) Building
Shape: Rectangular
Color: Grey
Dimensions: 10 m x 4.9 m

4) Building
Shape: Rectangular
Color: Grey
Dimensions: 6.9 m x 4.8 m

**Figure 4-17**

Dadaab Camp, Kenya
May 2010
Photo credit: EC/ ECHO/ Daniel Dickinson

**Figure 4-18**

Dadaab Camp, Kenya
May 2010
Photo credit: EC/ ECHO/ Daniel Dickinson

## *Dagahaley, Dadaab Camp*

**Figure 4-19**


**Mosque / Islamic School**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

Mosque / Islamic School

1) Building
Shape: Rectangular
Color: Grey
Dimensions: 15.1 m x 22.7 m

**Figure 4-20**

**Market**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

As a result of its development over the past twenty years, the market in Dadaab camp is reportedly "congested and disorganized." Shops and stalls are located close together, and "unregulated electricity suppliers connecting shop owners to power lines" are reported. As a result, the market is at risk to large-scale fires. In July 2012, for example, an electrical fire destroyed 80% of the market.[41]

# Chapter 5: Education

The goal of the Global Education Cluster is to "enable a predictable, well coordinated response that addresses the education concerns of populations affected by humanitarian crises." At the global level, the cluster offers technical support and capacity development to country-level clusters. Led by the United Nation's International Children's Emergency Fund (UNICEF) and Save the Children, it is the only cluster co-led by a UN agency and a NGO.[42]

The number and type of education facilities can vary greatly across camps. School facilities can be for early childhood, primary, or secondary education. While in school, children also require additional services, such as WASH and food/nutrition. Thus, infrastructure from multiple clusters may be present at one education facility.

These services may not always be delivered proportionately to the size of the population being served. For example, in Zam Zam's basic schools one latrine is used by 103 students a day, 12 schools do not have a water facility, and 10 schools do not benefit from a school feeding program.[43]

As well as traditional NGO and UN agency-run facilities, sometimes specific infrastructure in the Education Cluster is provided by government donors. For example, the Bahraini Royal Charity Organization funded the construction of an "education complex," comprised of four schools, in Zaatari Camp.[44] This complex can be seen in Figure 4-1.

In two instances, education facilities with common shaped and sized infrastructure are seen in the analysis of the four camps. At Zam Zam, brown structures consistent with tents of a common shape and size are visible at each school facility at the locations designated as schools on the maps employed in the analysis. At Dagahaley, Dadaab Camp, commonly shaped, sized and colored tents are present at certain education centers. However, those tents were also visible at other locations throughout Dagahaley Camp corresponding to the activities of other clusters as well.

## *Zaatari Camp*

**Figure 5-1**


**Bahraini School**
31 January 2014
Zaatari Camp, Jordan


**Saudi School**
31 January 2014
Zaatari Camp, Jordan

<u>Bahraini School</u>

1) Building
Shape: Rectangular
Color: White
Dimensions: 29.4 m x 14.1 m

2) Building
Shape: Rectangular
Color: White
Dimensions: 15 m x 11.2 m

3) Building
Shape: Rectangular
Color: White
Dimensions: 8.1 m x 11.2 m

4) Tent
Shape: Rectangular
Color: White
Dimensions: 20.4 m x 13.5 m

5) Tent
Shape: Rectangular
Color: White
Dimensions: 9.8 m x 8.3 m

<u>Saudi School</u>

1) Tent
Shape: Rectangular
Color: White
Dimensions: 9.8 m x 8.3 m

2) Tent
Shape: Rectangular
Color: White
Dimensions: 32.1 m x 10.9 m

**Figure 5-2**


**American School**
31 January 2014
Zaatari Camp, Jordan

<u>American School</u>

1) Tent
Shape: Rectangular
Color: White
Dimensions: 32.2 m x 9.5 m

2) WASH facility
Shape: Rectangular
Color: Grey
Dimensions: 9.2 m x 3.6 m

3) Soccer pitch
Shape: Rectangular
Dimensions: 107 m x 85 m

## *Zam Zam Camp*

**Figure 5-3**


**School 1**
17 July 2014
Zam Zam Camp, Sudan

<u>School 1</u>

1) Tent
Shape: Rectangular
Color: Beige
Dimensions: 9.2 m x 5.5 m

2) Tent
Shape: Square
Color: White
Dimensions: 5.2 m x 5.2 m

3) Building
Shape: Rectangular
Color: Brown
Dimensions: 8.3 m x 5.3 m

**Figure 5-4**


**School 2**
17 July 2014
Zam Zam Camp, Sudan

<u>School 2</u>

1) Tent
Shape: Rectangular
Color: Brown
Dimensions: 9.2 m x 5.5 m

2) Building
Shape: Rectangular
Color: Beige
Dimensions: 20.1 m x 2.5 m

3) Tent
Shape: Rectangular
Color: Beige
Dimensions: 5.6 m x 2.8 m

4) Tent
Shape: Rectangular
Color: Beige
Dimensions: 8.3 m x 5.3 m

## *Dagahaley, Dadaab Camp*

Figure 5-5


**Illeys Primary School**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

Illeys Primary School

1) Tent
Shape: Rectangular
Color: White
Dimensions: 15.8 m x 6.2 m

2) Tent
Shape: Rectangular
Color: White
Dimensions: 22.6 m x 7 m

3) Building
Shape: Rectangular
Color: Grey
Dimensions: 45.4 m x 9.2 m

4) Building
Shape: Rectangular
Color: Grey
Dimensions: 60.4 m x 7 m

5) Building
Shape: Rectangular
Color: Grey
Dimensions: 40.2 m x 6.4 m

6) Building
Shape: Rectangular
Color: Grey
Dimensions: 10.8 m x 5.5 m

Figure 5-6


**Wathajir Primary School**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

Wathajir Primary School

1) Building
Shape: Rectangular
Color: Blue
Dimensions: 36.8 m x 11.3 m

2) Building
Shape: Rectangular
Color: Blue
Dimensions: 15.3 m x 8 m

3) Building
Shape: Rectangular
Color: Grey
Dimensions: 16.4 m x 4.6 m

**Figure 5-7**


**Community School**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

Community School

1) Tent
Shape: Rectangular
Color: Grey
Dimensions: 26.5 m x 7.7 m

2) Tent
Shape: Rectangular
Color: Grey
Dimensions: 17.4 m x 7.7 m

3) Tent
Shape: Rectangular
Color: Beige
Dimensions: 23.9 m x 10.6 m

4) Tent
Shape: Square
Color: Grey
Dimensions: 5.9 m x 5.9 m

5) Building
Shape: Rectangular
Color: Grey
Dimensions: 11.3 m x 9 m

# Chapter 6: Food Security

The Global Food Security Cluster is co-led by the World Food Programme (WFP) and the Food and Agriculture Organization of the United Nations (FAO). The cluster coordinates food security response, including issues of food availability and access, during humanitarian crises. They additionally provide training, capacity development, and best practices for country-level response.[45]

The Food Security Cluster requires designated infrastructure for food storage, preparation, and distribution. Some of the infrastructure identified across the four camps apparently employed for these purposes includes tents for storage, as well as prefabricated and/or locally built warehouses. In addition to distribution facilities, cooking areas for camp residents are also present. In Zaatari camp, communal kitchens allow residents to access shared areas where they can prepare food.

Tents with a consistent shape, size and colors at Food Security Cluster-related locations, according to UN and NGO maps, are visible at Yida and Dagahaley. In Yida, WFP and Samaritan's Purse co-lead Food Security operations. The WFP Food Distribution Center identified in this chapter (see Figure 6-1) is located next to the camp's airstrip. As noted earlier, it is important for analysts to understand the environment and climate that a camp is located within because seasonal changes can directly impact the operations of a camp. For example, during the rainy season, when roads become flooded, foodstuffs are air dropped to Yida camp by plane.[46]

Analysis of an object's use as part of food security operations requires comparison with ground-sourced information, particularly agency generated maps. Many of the structures included in this guide as part of the Food Security Cluster section may be used by other clusters as well. Analysts should be aware of their uses across clusters when attempting to identify these structures and ascertain their functions.

### *Yida Camp*

**Figure 6-1**


**WFP Food Distribution Center**
24 June 2014
Yida Camp, South Sudan

WFP Food Distribution Center

1) Tent
Shape: Rectangular
Color: Beige
Dimensions: 33 m x 12.4 m

2) Tent
Shape: Rectangular
Color: Beige
Dimensions: 25.4 m x 11.2 m

### *Zaatari Camp*

WFP Compound

In Zaatari Camp, WFP works as part of the Food Security Cluster. The compound is enclosed by a perimeter wall or fence approximately 600 m long. Storage tents consistent with the WFP tents in Yida and Dagahaley Camps are present.

**Figure 6-2**


**WFP Compound**
31 January 2014
Zaatari Camp, Jordan

1) Tent
Shape: Rectangular
Color: Grey
Dimensions: 6.7 m x 4.8 m

2) Tent
Shape: Rectangular
Color: White
Dimensions: 25 m x 9.5 m

3) Tent
Shape: Rectangular
Color: White
Dimensions: 17 m x 8.6 m

4) Tent
Shape: Rectangular
Color: Beige
Dimensions: 25 m x 9.5 m

5) Building
Shape: Rectangular
Color: Grey
Dimensions: 13.9 m x 5.8 m

6) Tent
Shape: Rectangular
Color: Red
Dimensions: 13.5 m x 6.3 m

7) Building
Shape: Rectangular
Color: Grey
Dimensions: 15.7 m x 6.9 m

8) Building
Shape: Square
Color: Grey
Dimensions: 8.9 m x 8.9 m

9) Building
Shape: Rectangular
Color: Grey
Dimensions: 8.9 m x 5.4 m

Figure 6-3


**Communal Kitchens**
31 January 2014
Zaatari Camp, Jordan

<u>Communal Kitchens</u>

1) Building
Shape: Rectangular
Color: Grey
Dimensions: 14.4 m x 4.8 m

## *Dagahaley, Dadaab Camp*

Figure 6-4


**Food Distribution Center**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

<u>Food Distribution Center</u>

1) Tent
Shape: Rectangular
Color: Beige
Dimensions: 32.2 m x 11.4 m

2) Tent
Shape: Rectangular
Color: Beige
Dimensions: 23.2 m x 8 m

3) Tent
Shape: Rectangular
Color: Blue
Dimensions: 17.5 m x 7.1 m

4) Building
Shape: Rectangular
Color: Grey
Dimensions: 10.2 m x 6.3 m

5) Tent
Shape: Square
Color: White
Dimensions: 4.2 m x 4.2 m

6) Building
Shape: Rectangular
Color: Grey
Dimensions: 29.5 m x 17 m

7) Building
Shape: Rectangular
Color: Grey
Dimensions: 17.6 m x 10.1 m

8) Building
Shape: Rectangular
Color: Grey
Dimensions: 34.2 m x 10.1 m

9) Tent
Shape: Square
Color: White
Dimensions: 7.4 m x 5.3 m

10) Building
Shape: Rectangular
Color: Grey
Dimensions: 21.9 m x 8.9 m

# Chapter 7: Health

Lead by the World Health Organization (WHO), the Global Health Cluster works to enhance humanitarian health actions on both global and country levels. At the global level, health partners aim to improve response through capacity building. At the country level, responsibilities of partners include information assessments and analysis, the prioritization of response, and the mobilization of resources.[47]

Hospitals, clinics, and health centers can take several forms in a displaced population camp. They can appear as multi-building compounds comprised of several large, manufactured tents that are easily identifiable. Additionally, they may be surrounded by demarcated walls or a fence-based perimeter surrounding several large, manufactured tents. These types of facilities can be found in Zaatari Camp (see Figures 7-1 and 7-2).

In other settings, smaller-scale facilities can be largely indistinguishable from other surrounding structures (see Figure 7-5). Disease-specific treatment centers may also be present. In Dagahaley, a Cholera Outbreak Center comprised of tents and buildings is present (see Figure 7-4). In the case of all health cluster facilities, a camp map or other non-imagery information source is required to clearly identify these structures.

## *Zaatari Camp*

**Figure 7-1**


**Moroccan Hospital**
31 January 2014
Zaatari Camp, Jordan

<u>Moroccan Hospital</u>

1) Tent
Shape: Rectangular
Color: Brown
Dimensions: 6.5 m x 5.5 m

2) Tent
Shape: Rectangular
Color: Brown
Dimensions: 6.9 m x 6.3 m

3) Tent
Shape: Rectangular
Color: Brown
Dimensions: 12.7 m x 6.3 m

4) Tent
Shape: Rectangular
Color: White
Dimensions: 12.7 m x 5.6 m

5) Building
Shape: Rectangular
Color: White
Dimensions: 9.4 m x 3.8 m

6) Building
Shape: L-shape
Color: Beige
Dimensions: 9.2 m x 3.6 m

**Figure 7-2**


**KSA Hospital**
31 January 2014
Zaatari Camp, Jordan

<u>KSA Hospital</u>

1) Tent
Shape: Rectangular
Color: White
Dimensions: 47.8 m x 10.8 m

2) Tent
Shape: Rectangular
Color: White
Dimensions: 12.4 m x 11.3 m

3) Tent
Shape: Rectangular
Color: White
Dimensions: 31.4 m x 15.2 m

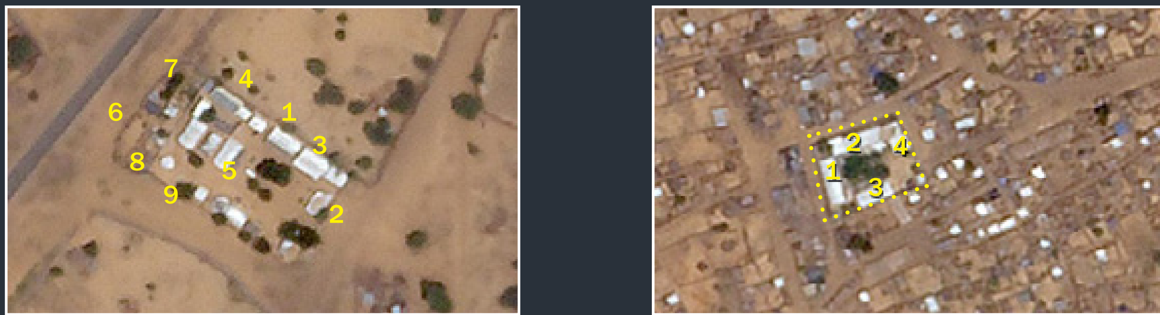
4) Tent
Shape: Rectangular
Color: Beige
Dimensions: 7.2 m x 5.9 m

5)Tent
Shape: Rectangular
Color: Beige
Dimensions: 12.2 m x 6.7 m

6) Tent
Shape: Rectangular
Color: Beige
Dimensions: 5 m x 3.4 m

## *Zam Zam Camp*

**Figure 7-3**




**Relief International Health Centers 1 and 2**
17 July 2014
Zam Zam Camp, Sudan

<u>Relief International Health Center 1</u>

1) Tent
Shape: Rectangular
Color: White
Dimensions: 12.3 m x 5.8 m

2) Tent
Shape: Rectangular
Color: Beige
Dimensions: 10.1 m x 4.9 m

3) Tent
Shape: Rectangular
Color: White
Dimensions: 13 m x 6.1 m

4) Tent
Shape: Rectangular
Color: White
Dimensions: 11.9 m x 5.7 m

5) Tent
Shape: Rectangular
Color: White
Dimensions: 12.6 m x 4.9 m

6) Tent
Shape: Rectangular
Color: Beige
Dimensions: 6.2 m x 4.3 m

7) Tent
Shape: Square
Color: White
Dimensions: 4.5 m x 4.5 m

8) Tent
Shape: Octagonal
Color: White
Dimensions: 6.5 m x 6.5 m

9) Tent
Shape: Octagonal
Color: White
Dimensions: 5.3 m x 5.3 m

<u>Relief International Health Center 2</u>

1) Tent
Shape: Rectangular
Color: White
Dimensions: 18.2 m x 8.9 m

2) Tent
Shape: Rectangular
Color: White
Dimensions: 12.9 m x 9.1 m

3) Tent
Shape: Rectangular
Color: White
Dimensions: 6.1 m x 4.7 m

4)Tent
Shape: Rectangular
Color: White
Dimensions: 3.5 m x 2 m

### *Dagahaley, Dadaab Camp*

**Figure 7-4**


**Cholera Outbreak Center**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

<u>Cholera Outbreak Center</u>

1) Tent
Shape: Rectangular
Color: Beige
Dimensions: 25.2 m x 9.3 m

2) Building
Shape: Rectangular
Color: Grey
Dimensions: 29.6 m x 6.2 m

3) Building
Shape: Rectangular
Color: Grey
Dimensions: 13.6 m x 5.8 m

4) Building
Shape: Rectangular
Color: Grey
Dimensions: 11.8 m x 8.1 m

**Figure 7-5**


**Health Post 1**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

<u>Health Post 1</u>

1) Building
Shape: Rectangular
Color: Grey
Dimensions: 25.1 m x 6.1 m

2) Building
Shape: Rectangular
Color: Grey
Dimensions: 12.4 m x 6.2 m

# Chapter 8: Logistics

The Global Logistics Cluster "provides coordination services to the logistics sector and, if needed, augments logistics infrastructure and provides common logistics services for the humanitarian community as a whole." The Logistics Cluster is also responsible for information management related to logistics, development of tools, and provision of training.[48]

Logistics operations are crucial for supplying camps with items such as food, water, building materials, and non-food items ranging from WASH kits to cooking utensils. Activities that can involve the Logistics Cluster include ground, air, maritime, and riverine transportation.

The visual profile of humanitarian logistics infrastructure observable in satellite imagery may vary between camps. Two critical factors affect what logistics infrastructure is visible in satellite imagery of a camp. These factors are 1) whether the camp is easy to access from the ground, and 2) whether it has a lack of natural resources on site, such as water aquifers and vegetation.

When humanitarians can't easily access and resupply a camp through ground transportation, agencies become more reliant on air assets. Impediments to cost-effectively and safely accessing the camp from the ground include insecurity due to ongoing hostilities in the area, poor or non-existent roads between the camp and regional supply hubs, and rainy seasons or other regional weather conditions regularly interrupting ground supply routes.

Yida Camp is an example of the visual profile created by logistics infrastructure at a camp in a moderately non-permissive environment. The dirt airstrip, clearly visible in the imagery of Yida, has a runway length of 1700 m and a width of 68 m. At the bottom left of the airstrip, near the Samaritan's Purse Warehouses, is a derelict Antonov An-26 aircraft. The WFP food distribution center, which is detailed in the Food Security chapter, and a derelict Fokker F27 aircraft are located at the bottom left of the airstrip. This airstrip is an important lifeline for Yida given the ongoing insecurity around the camp, as well as heavy seasonal rains and poor roads.

## *Yida Camp*

**Figure 8-1**


**Samaritan's Purse Warehouses**
16 March 2014
Yida Camp, South Sudan

<u>Samaritan's Purse Warehouses</u>

1) Building
Shape: Rectangular
Color: White body, red roof
Dimensions: 20.6 m x 19 m x 5 m

2) Building
Shape: Rectangular
Color: White body, red roof
Dimensions: 26.5 m x 17.5 m x 5 m

<u>Airstrip and Aircraft</u>

**Figure 8-2**


**Airstrip, Derelict Antonov An-26 and Fokker F27, and WFP Food Distribution Center**
16 March 2014
Yida Camp, South Sudan

1) Derelict Antonov An-26

2) Derelict Fokker F27

3) WFP Food Distribution Center (see Food Security Chapter for structure details)

4) Airstrip
Length: 1700 m
Width: 68 m

# Chapter 9: Water, Sanitation, and Hygiene (WASH)

The Global WASH Cluster delivers water, sanitation, and hygiene assistance during emergencies to affected populations. On a global scale, the Cluster works to enhance preparedness and technical capacity. UNICEF is the lead agency of the cluster.[49]

Types of WASH Cluster infrastructure that may be seen in a displaced persons camp may include several specific types of structures. Some common WASH structures can include latrines, communal washing and hygiene facilities, water extraction (boreholes) and distribution points, pumping stations, storage tanks, and water bladders.

Key indicators to look for when attempting to identify WASH Cluster infrastructure include standard shapes and positions for latrines and washing centers across the camp. Analysts should also take note of repeating water distribution points, water storage containers, and extraction infrastructure, such as borehole pump houses that may be present throughout the camp. Counting the number of WASH Cluster facilities and noting the pattern of their distribution is useful to help determine what WASH services are available proportionate to a camp's population.

A reliable approach for analysts attempting to identify WASH Cluster infrastructure in satellite imagery begins with asking the following core questions:

- How is water obtained at the camp? Is it delivered by tanker, pumped from boreholes, or obtained through other local water sources?
- Where is water stored at the camp?
- What type of latrines and washing facilities are used at the camp? Are they co-located with shelters in each sector of the camp or are they positioned in centralized facilities?
- How do cultural, religious, and gender differences affect how latrines and washing facilities are constructed and positioned?

By answering these questions through cross-referencing non-imagery data with imagery data, analysts should be able to identify repeating infrastructure in characteristics that occur throughout the camp.

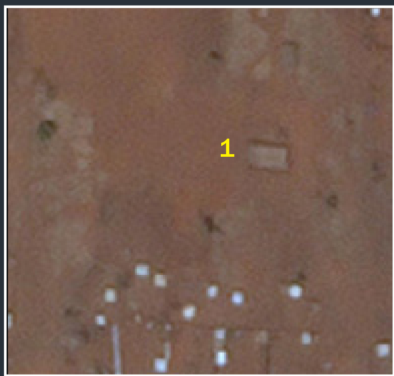
Water at Yida Camp, for example, is primarily obtained through boreholes drilled at the camp and maintained by agencies in the WASH Cluster. The structures present at boreholes in Yida have a common visual identifier: Either a brown colored tent or shed-like structure erected over the site of the borehole. This is likely where the pump used to extract water from the borehole is probably located.

In the case of Zaatari Camp, water is provided through local extraction via boreholes and through deliveries by tanker truck.[50] The presence of elevated platforms supporting water tanks is commonly observed throughout the camp. These elevated storage facilities can be seen near communal kitchens, washing facilities, and other structures.

Latrines and washing facilities are often highly identifiable in satellite imagery. In the case of Zaatari, for example, the WASH facilities are often visible every several blocks of clustered shelters, in some cases. At Zam Zam, the latrines are of standard size and shape, set apart from groups of shelters.

### *Yida Camp*

**Figure 9-1**




**Latrine**
24 June 2014
Yida Camp, South Sudan


**Borehole**
24 June 2014
Yida Camp, South Sudan

<u>Latrine</u>

1) Excavated area
Shape: Rectangular
Color: N/A
Dimensions: 14 m x 7.8 m

<u>Borehole</u>

2) Borehole
Shape: Rectangular
Color: Beige
Dimensions: 8.8 m x 4.4 m
Additional features: tent covering

### *Zaatari Camp*

**Figure 9-2**


**WASH Facilities**
31 January 2014
Zaatari Camp, Jordan


**Pumping Station Facility**
31 January 2014
Zaatari Camp, Jordan

<u>WASH Facilities- Male</u>

1) Building
Shape: Rectangular
Color: Grey
Dimensions: 9.2 m x 3.6 m

<u>WASH Facilities- Female</u>

2) Building
Shape: Rectangular
Color: Grey
Dimensions: 9.2 m x 3.6 m

<u>Pumping Station Facility</u>

1) Water tank
Shape: Circular
Color: White
Dimensions: 2.4 m x 2.4 m

2) Building
Shape: Rectangular
Color: Grey
Dimensions: 5.6 m x 3.2 m

3) Building
Shape: Rectangular
Color: Grey
Dimensions: 6.5 m x 3.6 m

4) Tent
Shape: Rectangular
Color: Grey
Dimensions: 4.3 m x 3.2 m

*Dagahaley, Dadaab Camp*

Figure 9-3


**Borehole 1**
21 February 2014
Dagahaley, Dadaab Camp, Kenya


**Borehole 2**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

Borehole 1

1) Tent
Shape: Rectangular
Color: Blue
Dimensions: 8.5 m x 5.1 m

2) Water Tank
Shape: Circular
Color: White
Dimensions: 5 m x 5 m

Borehole 2

1) Tent
Shape: Rectangular
Color: Blue
Dimensions: 8.5 m x 5.1 m

2) Water Tank
Shape: Circular
Color: White
Dimensions: 5 m x 5 m

# Chapter 10: Agency-Use Structures

Agency-use structures, as defined within the context of this guide, are observable objects where humanitarian personnel work and often live. These structures are relevant to the administrative and programmatic activities of humanitarian organizations, including registration and transit centers.

Analysts should take note of changes to the number and type of these structures when interpreting imagery of a camp. Documenting changes to these compounds can be valuable data for corroborating reports of agencies beginning, suspending, resuming, or ending operations at a camp.

Agency-use structures are present across all four camps analyzed in this guide. While each humanitarian agency's footprint differs from camp to camp, as well as within camps, in some cases, there are some common characteristics to these facilities.

Agency housing and administrative areas tend to almost always have a compound lay-out, which includes a perimeter wall or fence in the camps studied in this guide. In most cases, the compounds contain an apparent mix of structure types. The structures can include locally built structures, small dome tents or keyhole shaped tents, prefabricated buildings, and large UNHCR-style hexagonal tents, in some cases.

Yida Camp shows aid groups employing dome and keyhole shaped tents alongside locally built structures at several agency compounds. At Zaatari, hexagonal UNHCR-style tents, caravans, tunnel tents, and prefabricated housing units are visible at various UN agency and NGO compounds.

White and beige tents and uniquely shaped white colored octagonal tents are visible at two Relief International compounds at Zam Zam Camp. UNHCR, CARE, Norwegian Refugee Council (NRC) have major compounds that are visible in imagery of Dagahaley Camp, Dadaab. These compounds contain apparent locally built structures with corrugated roofs and hexagonal tents consistent with UNHCR-style tents.

This analysis also identified registration centers for incoming displaced persons to a camp and transit centers for the transport of civilians. UNHCR registration centers are seen at Zaatari and Yida. Additionally, a crowd of people can be seen outside the New Arrivals Registration area in Zaatari Camp (see Figure 10-3). A UNHCR transit center is also identified at Dagahaley.

### *Yida Camp*

IRC Compounds

The International Rescue Committee (IRC) area is composed of at least two neighboring, non-contiguous compounds comprised of approximately 70 tent-like structures and one building. The north compound is enclosed by a perimeter wall or fence approximately 305 meters in length. The south compound is enclosed by a perimeter wall or fence approximately 340 meters in length, with a large unenclosed area approximately 35 meters long visible. Within each compound there are additional fences or walls present. In Yida Camp, IRC works as part of the Gender-Based Violence, Health, and Protection Clusters.

**Figure 10-1**


**IRC Compounds**
24 June 2014
Yida Camp, South Sudan

1) Tent
Shape: Keyhole
Color: White
Dimensions: 6.9 m x 5.8 m

2) Tent
Shape: Square
Color: White
Dimensions: 5 m x 5 m

3) Tent
Shape: Square
Color: White
Dimensions: 3.8 m x 3.8 m

4) Tent
Shape: Rectangular
Color: Blue
Dimensions: 12 m x 6.5 m

5) Tent
Shape: Rectangular
Color: Blue
Dimensions: 9.5 m x 5.5 m

6) Tent
Shape: Rectangular
Color: Blue
Dimensions: 8.3 m x 4.6 m

7) Tent
Shape: Rectangular
Color: Blue
Dimensions: 5.3 m x 6.3 m

8) Tent
Shape: Rectangular
Color: White
Dimensions: 21.1 m x 8.8 m

9) Building
Shape: Rectangular
Color: Grey
Dimensions: 17.5 m x 6.1 m

## UNHCR Compound

Approximately 90 structures enclosed by a 551 meter perimeter wall or fence are present in the UNHCR compound. The majority of the structures appear to be tents. UNHCR is the lead agency at Yida Camp and also works as part of the Camp Management, Core Relief Items, Protection, and Registration Clusters.

**Figure 10-2**


**UNHCR Compound**
24 June 2014
Yida Camp, South Sudan

1) Tent
Shape: Square
Color: Blue
Dimensions: 12.4 m x 12.4 m
Additional Features: Pyramid roof

2) Tent
Shape: Square
Color: Blue
Dimensions: 4.2 m x 4.2 m

3) Tent
Shape: Rectangular
Color: Grey
Dimensions: 13.8 x 4.9 m

4) Tent
Shape: Keyhole
Color: White
Dimensions: 6.9 m x 5.8 m

5) Tent
Shape: Rectangular
Color: Red
Dimensions: 24.3 m x 7.8 m

6) Tent
Shape: Square
Color: Blue
Dimensions: 5 m x 5 m

7) Tukul
Shape: Circular
Color: Brown
Dimensions: 8.4 m x 8.4 m

### *Zaatari Camp*

UNHCR Registration, New Arrivals Registration, and IOM Compound

This enclosed multi-NGO compound contains three distinct areas: UNHCR Registration, New Arrivals Registration, and an International Organization for Migration (IOM) Compound. The compound is surrounded by a perimeter wall or fence approximately 720 m long. A crowd of people appears to be gathered outside the New Arrivals Registration area. UNHCR leads the Registration Cluster in Zaatari Camp.

**Figure 10-3**


**UNHCR Registration, New Arrivals Registration, and IOM Compound**
31 January 2014
Zaatari Camp, Jordan

UNHCR Registration

1) Building
Shape: Rectangular
Color: Grey
Dimensions: 8.3 m x 4.1 m

2) Building
Shape: Rectangular
Color: Grey
Dimensions: 25.7 m x 3.9 m

3) Building
Shape: Rectangular
Color: Grey
Dimensions: 12.4 m x 4.2 m

4) Building
Shape: Rectangular
Color: Grey
Dimensions: 5.5 m x 4.9 m

New Arrivals Registration

5) Tent
Shape: Rectangular
Color: Beige
Dimensions: 20 m x 8.8 m

6) Caravan
Shape: Rectangular
Color: White
Dimensions: 8.9 m x 3.2 m

7) Building
Shape: Rectangular
Color: White
Dimensions: 25.5 m x 10 m

8) Building
Shape: Rectangular
Color: White
Dimensions: 31.3 m x 10.6 m

IOM Compound

9) Tent
Shape: Rectangular
Color: Beige
Dimensions: 14 m x 8.8 m

10) Water tank
Shape: Rectangular
Color: Grey with white sides
Dimensions: 5.4 m x 3.1 m

## NRC Distribution Center

An NRC Distribution Center is an enclosed compound surrounded by a perimeter wall or fence approximately 800 m long. NRC works as part of the Core Relief Items and Education Clusters.

Figure 10-4


**NRC Distribution Center**
31 January 2014
Zaatari Camp, Jordan

1) Tent
Shape: Rectangular
Color: White
Dimensions: 24.2 m x 11.6 m

2) Tent
Shape: Rectangular
Color: White
Dimensions: 27.1 m x 11.8 m

3) Tent
Shape: Rectangular
Color: White
Dimensions: 6.4 m x 3.2 m

4) Tent
Shape: Rectangular
Color: White
Dimensions: 12.1 m x 4.6 m

### *Dagahaley, Dadaab Camp*

## UNHCR Field Office and Transit Center

In Dadaab, UNHCR is the lead agency of the camp and works as part of multiple other clusters. The UNHCR Field Office and Transit Center are located in the same compound, which is surrounded by a perimeter wall or fence 600 m long.

Figure 10-5


**UNHCR Field Office and Transit Center**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

UNHCR Field Office and Transit Center

1) Caravan
Shape: Rectangular
Color: White
Dimensions: 6.7 m x 4.5 m

2) Building
Shape: Rectangular
Color: Grey
Dimensions: 15.2 m x 7.5 m

3) Tent
Shape: Rectangular
Color: Blue
Dimensions: 15. 7 m x 8.1 m

4) Building
Shape: Rectangular
Color: Grey
Dimensions: 16.6 m x 5.7 m

5) Building
Shape: L-shaped
Color: Grey
Dimensions: 42.7 m x 8 m

6) Building
Shape: Rectangular
Color: Grey
Dimensions: 13.2 m x 6.3 m

7) Building
Shape: Rectangular
Color: Grey
Dimensions: 19.7 m x 5.8 m

8) Tent
Shape: Rectangular
Color: White
Dimensions: 9.7 m x 5.5 m

9) Tent
Shape: Rectangular
Color: Beige
Dimensions: 22.8 m x 9.1 m

10) Building
Shape: Square
Color: Grey
Dimensions: 7 m x 7 m

Windle Trust Compound

The compound of the Windle Trust, which works as part of the Education and HIV/AIDS Clusters, is located adjacent to the hospital in Dagahaley.

**Figure 10-6**


**Windle Trust Compound**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

1) Building
Shape: Rectangular
Color: Blue
Dimensions: 22.7 m x 6.5 m

2) Building
Shape: Rectangular
Color: Blue
Dimensions: 11.5 m x 6.3 m

3) Building
Shape: Square
Color: Blue
Dimensions: 6.9 m x 6.9 m

4) Building
Shape: Square
Color: Blue
Dimensions: 4.9 m x 4.9 m

5) Building
Shape: Rectangular
Color: Grey
Dimensions: 13 m x 7.8 m

6) Building
Shape: Square
Color: Grey
Dimensions: 5.8 m x 5.8 m

7) Building
Shape: Rectangular
Color: Grey
Dimensions: 17.9 m x 6.7 m

8) Building
Shape: Square
Color: Grey
Dimensions: 11 m x 9.2 m

9) Building
Shape: Rectangular
Color: Grey
Dimensions: 22.6 m x 7.6 m

## CARE Compound

The CARE compound, enclosed by a 700 m perimeter wall or fence, is comprised of both and buildings and tents.

**Figure 10-7**


**CARE Compound**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

CARE Compound

1) Tent
Shape: Rectangular
Color: Blue
Dimensions: 9.5 m x 8.5 m

2) Building
Shape: Rectangular
Color: Grey
Dimensions: 8.5 m x 7.5 m

3) Tent
Shape: Rectangular
Color: Blue
Dimensions: 39.2 m x 9.6 m

4) Tent
Shape: Rectangular
Color: Grey
Dimensions: 25.8 m x 7.5 m

5) Tent
Shape: Rectangular
Color: Beige
Dimensions: 25.6 m x 6.7 m

6) Building
Shape: Rectangular
Color: Grey
Dimensions: 9.7 m x 6.6 m

7) Tent
Shape: Rectangular
Color: Blue
Dimensions: 25.7 m x 10.5 m

8) Tent
Shape: Square
Color: Blue
Dimensions: 11.3 m x 11.3 m

9) Building
Shape: Rectangular
Color: Grey
Dimensions: 14.9 m x 5.3 m

10) Building
Shape: Rectangular
Color: Grey
Dimensions: 21.6 m x 6.7 m

# Chapter 11: Security

Security infrastructure is defined in the context of this guide as checkpoints, camp perimeter fencing, troops barracks and police stations, and other infrastructure. These objects are often used by local law enforcement from the camp's host nation, internal camp security personnel, and international protection forces, such as UN peacekeepers.

While each camp has its own unique security context, it should be expected that more than one security-related agency will likely be operational at each camp in most cases. Security infrastructure, particularly perimeter trenches, fences, and checkpoints are often highly observable in satellite imagery.

At Zam Zam camp, for example, a security checkpoint is visible along a road. Also at Zaatari, a large perimeter trench is clearly visible on the north side of the camp. According to an interview by the Signal Program with a humanitarian responder who had worked at the camp, that trench is part of Zaatari's security perimeter.[51] Imagery interpreted of Dagahaley shows the presence of several similar structures at installations marked as local police compounds.

Analysts should make note of changes to the position, apparent size of the deployment in terms of vehicles, and deployment patterns of security forces over time. This information, which can be derived in many cases through imagery interpretation, may be of value in cross-corroborating reports of troop deployments, insecurity, or other major security events that have allegedly occurred at the camp.

## *Zaatari Camp*

**Figure 11-1**


**Civil Defence and Police**
31 January 2014
Zaatari Camp, Jordan

Civil Defence

1) Building
Shape: Rectangular
Color: Grey
Dimensions: 9.7 m x 5.2 m

2) Building
Shape: Rectangular
Color: Grey
Dimensions: 4.2 m x 3.2 m

Police

3) Building
Shape: Rectangular
Color: White
Dimensions: 21.1 m x 8.9 m

4) Building
Shape: Rectangular
Color: White
Dimensions: 10 m x 4.3 m

5) Building
Shape: Rectangular
Color: White
Dimensions: 18 m x 9.2 m

6) Building
Shape: Rectangular
Color: White
Dimensions: 4.1 m x 3.3 m

## *Zam Zam Camp*

**Figure 11-2**


**Security Checkpoint**
17 July 2014
Zam Zam Camp, Sudan

Security Checkpoint

1) Building
Shape: Rectangular
Color: Brown
Dimensions: 10.9 m x 7.8 m

2) Building
Shape: Rectangular
Color: White
Dimensions: 24 m x 7 m

3) Booth
Shape: Square
Color: White
Dimensions: 2.9 m x 2.9 m

4) Tent
Shape: Rectangular
Color: Beige
Dimensions: 9.3 m x 5.3 m

## *Dagahaley, Dadaab Camp*

**Figure 11-3**


**Administration Police**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

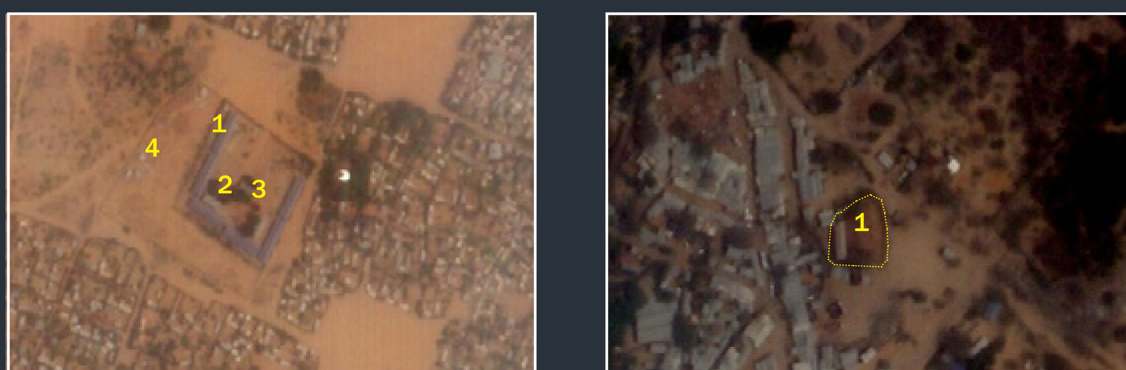
<u>Administration Police</u>

1) Tent
Shape: Rectangular
Color: Blue
Dimensions: 25.6 m x 7.7 m

2) Tent
Shape: Rectangular
Color: Blue
Dimensions: 7.8 m x 6.6 m

3) Tent
Shape: Square
Color: White
Dimensions: 3.6 m x 3.6 m

**Figure 11-4**




**Police Base**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

**Police Post at Market**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

<u>Police Base</u>

1) Tent
Shape: Rectangular
Color: Blue
Dimensions: 37.7 m x 8.5 m

2) Building
Shape: Rectangular
Color: Grey
Dimensions: 16.6 m x 6.7 m

3) Building
Shape: Rectangular
Color: Grey
Dimensions: 13 m x 5 m

4) Building
Shape: Square
Color: Grey
Dimensions: 5.3 m x 5.3 m

<u>Police Post at Market</u>

1) Tent
Shape: Rectangular
Color: Grey
Dimensions: 24.4 m x 6.9 m

**Figure 11-5**


**Tango IV Base**
21 February 2014
Dagahaley, Dadaab Camp, Kenya

“Tango IV” Base

1) Building
Shape: Rectangular
Color: Grey
Dimensions: 24.4 m x 6.9 m

2) Tent
Shape: Rectangular
Color: Blue
Dimensions: 25.9 m x 8.3 m

3) Tent
Shape: Rectangular
Color: Blue
Dimensions: 10.2 m x 8.8 m

4) Building
Shape: Rectangular
Color: Grey
Dimensions: 12.2 m x 8.7 m

5) Building
Shape: Rectangular
Color: Grey
Dimensions: 6.8 m x 5.5 m

# Appendix I: Expanded Methodology

**Tent and Building Identification**

This guide identifies structures as being consistent with one of three categories of objects: tent, building, or caravan. These determinations are made through a multi-step process. Ground photographs of tents and buildings in each camp were examined to identify the materials used in a structure's construction, along with its shape, color, and additional properties, like a pitched roof. These findings were then applied throughout a camp to identify additional structures because, regardless of a structure's size, the previously identified attributes remained consistent at that facility.

The term "tent" is used in this guide to represent two types of structures. First, this term describes manufactured tents, such as a UNHCR family tent or WFP storage tent. Additionally, the term "tent" is used to describe structures whose roofs are made of materials such as tarps or cloth. These structures are identified as tents because the materials used in the construction of their roofs are similar. In some case the material may even be the same as the materials used in manufactured tents. For example, these structures can be found in Yida Camp as locally built structures.

The term "building" is used in this guide to represent structures constructed from materials such as stone, concrete, and metal. In particular, metal roofs can be identified in satellite imagery because of their reflective properties and coloring. These types of structures are commonly found in Dagahaley.

Caravan trailers are specifically identifiable because of their unique shape, uniform size, and color. Ground photographs were used to corroborate these properties. However, when identifying any object it's important be aware of the visual changes that occur over time due to the environment and climate of a camp. For instance, in a desert region such as Zaatari, the analyst needs to consider how sand and dirt can change the appearance of an object overtime. For example, an originally white tent in a desert can eventually become a brown one. If possible, it would be beneficial to view multiple images of the camps on different days throughout several different months and seasons.

**Imagery Analysis Software Platforms Used**

The imagery analysis of the four camps were conducted primarily in the remote sensing software ERDAS Imagine. The imagery acquired by Signal that is already geo-referenced (embedded with geographic referencing information such as longitude and latitude coordinates) has had their geographic data cross-referenced between Imagine and two other platforms: Google Earth Pro and ArcGIS' ArcMap. This step is to ensure accuracy and consistency of the geo-referenced information throughout all imagery. Additionally, in the case of all camps, the imagery loaded in Imagine is synced to Google Earth via Imagine's interface.

**Imagery Data**

A combination of both high resolution (HR) and very high resolution (VHR) imagery was analyzed by the Signal Program over the course of six months. HR imagery has a resolution of 1 to 5 meters per pixel, whereas VHR imagery has a resolution of less than 1 meter per pixel. All sets of imagery provided by Skybox for this guide are categorized as HR due to being approximately 1 meters per pixel in resolution. The one VHR image, which was collected by Astrium over the Zaatari camp on 31 January 2014, is approximately 0.6 meters in resolution. Due to the limitations of not being able to accurately identify structures and their measurements with imagery higher than 5 meters per pixel, it is not recommended to conduct this analysis with imagery that is not HR or VHR.

For each camp, two images collected in 2014 were used, with the exception of a single image for Dagahaley Camp in Dadaab. In total, seven images were interpreted over the course of the guide's development. The dates of the imagery collections, listed in the order they were interpreted, are as follows:

| Camp | Date | Satellite |
|---|---|---|
| Yida | 16 March 2014 | SkySat-1 |
| Yida | 24 June 2014 | SkySat-1 |
| Zaatari | 31 January 2014 | Pléiades |
| Zaatari | 16 March 2014 | SkySat-1 |
| Zam Zam | 17 July 2014 | SkySat-1 |
| Zam Zam | 10 October 2014 | SkySat-1 |
| Dagahaley, Dadaab | 21 February 2014 | SkySat-1 |

The image of Zaatari from 31 January was collected by Astrium and was provided to the Signal Program by SpaceUnited. The other six images employed as part of this research were provided to the Signal Program by Skybox Imaging.

**Imagery Analysis Techniques**

All imagery, with the exception of Zaatari from 31 January 2014, was acquired with embedded geo-referenced information. The 31 January image was geo-referenced in ArcMap and the coordinates were verified for accuracy with Imagine linked to Google Earth Pro. To ensure consistency, the coordinates of all imagery used in the guide has been verified across software platforms.

Imagery was primarily analyzed in Imagine and initially situated in a north-facing vector. Adjustments to the vector are often made to examine alternate angles of structures. The final presentation of the imagery for the report is pictured in a north-facing vector. All imagery data was projected in the WGS 84 Mercator coordinate system. The same coordinate system was used across images to ensure consistency in the recording of measurements and locations. Before any measurements of objects were made, the imagery was subjected to cubic convolution sampling to reduce initial pixelation of object edges. Using Imagine's multispectral toolbar, a min-max automatic adjustment to the contrast and brightness was performed for accurate color and light representation of the natural color imagery.

Measurements of all observable objects presented in the guide were taken using the measuring function tool in Imagine. Each measurement was also cross-referenced with archived imagery in Google Earth Pro, if available, as well as appropriately overlaid image extractions on Google Earth Pro's platform. The Google Earth Pro measurements were conducted with the path ruler function. Lengths and widths were taken for each object. When a high off-nadir angle allowed the height of an object to be measured, that data was recorded as well.

Colors of all objects were analyzed without any manipulation of the color layers. However, the objects were cross-referenced across multiple platforms for color accuracy. This was especially important in the case of Dagahaley, Dadaab Camp. In Dagahaley, color verification was critical for determining that the materials used for the roofs of objects were primarily consistent with corrugated metal.

Additionally, all images of the camps were topographically analyzed with Google Earth Pro to determine the topographic context in which the camp is situated. Particular attention was paid to the terrain and elevation level of the camp.

**Integration of Non-imagery Data**

Non-imagery data that was integrated into the analysis process conducted for this guide includes maps, ground photos, NGO situation reports, news reports, and similar products. One of the most critical steps in the imagery analysis process was the utilization of open source maps of the camps produced by UN agencies and other humanitarian organizations.

These maps provide a crucial guide to identifying specific objects in the camps. It is important to note that, in some cases, maps may not be available for certain camps. Signal analysts geo-referenced the maps used in the analysis process in ArcMap to ensure that the locations in the imagery matched with the locations presented in the maps.

Analysts also noted the surrounding context of an object to assist in its identification. Some of these contextual identification approaches include identifying other similar structures or patterns of recurring groups of different structures, such as a WASH facility present near shelters in a city block formation.

Additionally, NGO situation reports, news articles, and publicly available ground photographs, were used to help identify, document, and describe objects present in the satellite imagery of the camps. This data helped to provide another contextual approach by introducing evidence of cultural, geographic, and operational attributes that shape the visual profile of camps presented in this guide.

**Recording Analysis Data**

As previously mentioned, Signal Program researchers captured several standard fields of information about each object included within the report. These fields are an object's shape, color, and dimensions in meters. Additional notable patterns and properties of the object are presented when applicable.

The researchers note, when possible, whether similar objects occur in the other camps analyzed in this guide. In Google Earth Pro, linked with the imagery uploaded on the ERDAS Imagine platform and in conjunction with the geo-referenced maps, individual objects were counted and stored on KMZ files within folders labeled for the compounds and sectors in which they are found inside of the camps.

The object-specific fields collected and documented in the chapters of this guide are also presented in spreadsheet format in Appendix II. Though data logs will vary depending on what data is being captured and for what purposes, the log presented is meant to provide a general example of what imagery data logs should normally capture.

# Appendix II: Camp Structure Data

## Yida Camp, South Sudan

| Chapter | Description | Observable Object | Latitude | Longitude | Shape | Color | Length | Width |
|---|---|---|---|---|---|---|---|---|
| Agency-Use Structures | Samaritan's Purse Compound | Tukul | 10.0963 | 30.0847 | Circular | Brown | 8.4 m | 8.4 m |
| Agency-Use Structures | Samaritan's Purse Compound | Tent | 10.0962 | 30.0847 | Rectangular | Beige | 24.2 m | 11.7 m |
| Agency-Use Structures | Samaritan's Purse Compound | Tent | 10.0963 | 30.0847 | Rectangular | Beige | 5 m | 2.8 m |
| Agency-Use Structures | Samaritan's Purse Compound | Tent | 10.0961 | 30.0847 | Rectangular | Brown | 9.2 m | 3.8 m |
| Agency-Use Structures | Samaritan's Purse Compound | Tent | 10.0963 | 30.0845 | Rectangular | Grey | 17 m | 11.5 m |
| Agency-Use Structures | Samaritan's Purse Compound | Tent | 10.0962 | 30.0845 | Rectangular | Grey | 13.5 m | 7.8 m |
| Agency-Use Structures | Samaritan's Purse Compound | Tent | 10.0963 | 30.0847 | Rectangular | Blue | 8.3 m | 4.8 m |
| Agency-Use Structures | Samaritan's Purse Compound | Tent | 10.0963 | 30.0847 | Rectangular | Grey | 9.9 m | 6.8 m |
| Agency-Use Structures | Samaritan's Purse Compound | Tent | 10.0963 | 30.0847 | Rectangular | Blue | 9.6 m | 7.7 m |
| Agency-Use Structures | Samaritan's Purse Compound | Tent | 10.0962 | 30.0847 | Square | Grey | 5.5 m | 5.5 m |
| Agency-Use Structures | IRC Compound | Tent | 10.0969 | 30.0842 | Keyhole | White | 6.9 m | 5.8 m |
| Agency-Use Structures | IRC Compound | Tent | 10.0969 | 30.0842 | Square | White | 5 m | 5 m |
| Agency-Use Structures | IRC Compound | Tent | 10.0969 | 30.0842 | Square | White | 3.8 m | 3.8 m |
| Agency-Use Structures | IRC Compound | Tent | 10.0968 | 30.0842 | Rectangular | Blue | 12 m | 6.5 m |
| Agency-Use Structures | IRC Compound | Tent | 10.0969 | 30.0843 | Rectangular | Blue | 9.5 m | 5.5 m |
| Agency-Use Structures | IRC Compound | Tent | 10.0969 | 30.0841 | Rectangular | Blue | 8.3 m | 4.6 m |
| Agency-Use Structures | IRC Compound | Tent | 10.0971 | 30.0842 | Rectangular | Blue | 5.3 m | 6.3 m |
| Agency-Use Structures | IRC Compound | Tent | 10.0969 | 30.084 | Rectangular | White | 21.1 m | 8.8 m |
| Agency-Use Structures | IRC Compound | Building | 10.0969 | 30.0842 | Rectangular | Grey | 17.5 m | 6.1 m |
| Agency-Use Structures | UNHCR Compound | Tent | 10.0974 | 30.0833 | Square | Blue | 12.4 m | 12.4 m |
| Agency-Use Structures | UNHCR Compound | Tent | 10.0974 | 30.0834 | Square | Blue | 4.2 m | 4.2 m |
| Agency-Use Structures | UNHCR Compound | Tent | 10.0973 | 30.0835 | Rectangular | Grey | 13.8 m | 4.9 m |
| Agency-Use Structures | UNHCR Compound | Tent | 10.0974 | 30.0835 | Keyhole | White | 6.9 m | 5.8 m |
| Agency-Use Structures | UNHCR Compound | Tent | 10.0972 | 30.0835 | Rectangular | Red | 24.3 m | 7.8 m |
| Agency-Use Structures | UNHCR Compound | Tent | 10.0973 | 30.0833 | Square | Blue | 5 m | 5 m |
| Agency-Use Structures | UNHCR Compound | Tukul | 10.0973 | 30.0834 | Circular | Brown | 8.4 m | 8.4 m |
| Food Security | WFP Food Distribution Centers | Tent | 10.1068 | 30.0889 | Rectangular | Beige | 33 m | 12.4 m |
| Food Security | WFP Food Distribution Centers | Tent | 10.1067 | 30.0889 | Rectangular | Beige | 25.4 m | 11.2 m |
| Logistics | Samaritan's Purse Warehouses | Building | 10.1047 | 30.0865 | Rectangular | White body, Red roof | 20.6 m | 19 m |
| Logistics | Airstrip | N/A | 10.1068 | 30.0889 | Rectangular | N/A | 1700 m | 68 m |
| Logistics | Antonov An-26 | N/A | 10.1068 | 30.0889 | N/A | White | 24 m | 29 m |
| WASH | Latrine | Excavated area | 10.1053 | 30.0774 | Rectangular | N/A | 14 m | 7.8 m |
| WASH | Borehole | Structure on east side | 10.0984 | 30.0809 | Rectangular | Beige | 8.8 m | 4.4 m |
| Shelter | Displaced Persons Shelter | Tent | 10.1011 | 30.0965 | Rectangular | White | 4.7 m | 3.9 m |
| Shelter | Displaced Persons Shelter | Tent | | | Rectangular | Blue | 4.7 m | 3.9 m |
| Shelter | Displaced Persons Shelter | Tent | 10.1011 | 30.0965 | Rectangular | White | 16.3 m | 7.6 m |
| Civilian-Use Infrastructure | Mosque | Tent | 10.0987 | 10.0948 | Rectangular | White | 15.2 m | 8.1 m |
| Civilian-Use Infrastructure | Mosque | Tent | 10.0987 | 10.0947 | Rectangular | White | 6.8 m | 4.4 m |

# Zaatari Camp, Jordan

| Cluster | Description | Observable Object | Latitude | Longitude | Shape | Color | Length (meters) | Width (meters) |
|---|---|---|---|---|---|---|---|---|
| Agency-Use Structures | ICRC building | Building | 32.2993 | 36.3205 | Rectangular | White | 30.1 | 7.5 |
| Agency-Use Structures | ICRC building | Caravan trailer | 32.2993 | 36.3205 | Rectangular | White | 8.7 | 4.1 |
| Agency-Use Structures | IOM Compound | Tent | 32.3027 | 36.3254 | Rectangular | Beige | 14 | 8.8 |
| Agency-Use Structures | IOM Compound | Water tank | 32.3027 | 36.3254 | Rectangular | Grey with white sides | 5.4 | 3.1 |
| Agency-Use Structures | New Arrivals Registration | Tent | 32.3028 | 36.3251 | Rectangular | Beige | 20 | 8.8 |
| Agency-Use Structures | New Arrivals Registration | Building | 32.3031 | 36.3242 | Rectangular | White | 25.5 | 10 |
| Agency-Use Structures | New Arrivals Registration | Building | 32.3031 | 36.3242 | Rectangular | White | 31.3 | 10.6 |
| Agency-Use Structures | New Arrivals Registration | Caravan trailer | 32.3028 | 36.3251 | Rectangular | White | 8.9 | 3.2 |
| Agency-Use Structures | NRC Distribution Center | Tent | 32.2979 | 36.3379 | Rectangular | White | 24.2 | 11.6 |
| Agency-Use Structures | NRC Distribution Center | Tent | 32.2979 | 36.3379 | Rectangular | White | 27.1 | 11.8 |
| Agency-Use Structures | NRC Distribution Center | Caravan trailer | 32.2979 | 36.3379 | Rectangular | White | 6.4 | 3.2 |
| Agency-Use Structures | NRC Distribution Center | Tent | 32.2979 | 36.3379 | Rectangular | White | 12.1 | 4.6 |
| Agency-Use Structures | UNFPA - Women's Center | Tent | 32.2993 | 36.3201 | Rectangular | White | 9.8 | 4.8 |
| Agency-Use Structures | UNFPA - Women's Center | Caravan trailer | 32.2993 | 36.3201 | Rectangular | White | 8.7 | 4.1 |
| Agency-Use Structures | UNHCR Registration | Building | 32.3035 | 36.3232 | Rectangular | Grey | 8.3 | 4.1 |
| Agency-Use Structures | UNHCR Registration | Building | 32.3035 | 36.3232 | Rectangular | Grey | 25.7 | 3.9 |
| Agency-Use Structures | UNHCR Registration | Building | 32.3035 | 36.3232 | Rectangular | Grey | 12.4 | 4.2 |
| Agency-Use Structures | UNHCR Registration | Building | 32.3035 | 36.3232 | Rectangular | Grey | 5.5 | 4.9 |
| Agency-Use Structures | UNICEF/UNHCR Offices and Stores | Tent | 32.3041 | 36.3217 | Rectangular | Beige | 25 | 9.5 |
| Agency-Use Structures | UNICEF/UNHCR Offices and Stores | Tent | 32.3041 | 36.3217 | Rectangular | White | 24.2 | 8.8 |
| Civilian-Use Infrastructure | Mosque | Tent | 32.3017 | 36.3193 | Rectangular | White | 25.5 | 10 |
| Education | American School | Tent | 32.3008 | 36.3214 | Rectangular | White | 32.2 | 9.5 |
| Education | American School | Wash facility | 32.3008 | 36.3214 | Rectangular | Grey | 9.2 | 3.6 |
| Education | Bahraini-Funded School | Building | 32.2988 | 36.3215 | Rectangular | White | 29.4 | 14.1 |
| Education | Bahraini-Funded School | Building | 32.2988 | 36.3215 | Rectangular | White | 15 | 11.2 |
| Education | Bahraini-Funded School | Building | 32.2988 | 36.3215 | Rectangular | White | 8.1 | 11.2 |
| Education | Bahraini-Funded School | Tent | 32.2988 | 36.3215 | Rectangular | White | 25.4 | 13.5 |
| Education | Bahraini-Funded School | Tent | 32.2988 | 36.3215 | Rectangular | White | 10.3 | 11.4 |
| Education | Saudi-Funded School | Tent | 32.2931 | 36.3278 | Rectangular | White | 10.3 | 11.4 |
| Education | Saudi-Funded School | Tent | 32.2931 | 36.3278 | Rectangular | White | 32.1 | 10.9 |
| Education | Save The Children's Rainbow Kindergarten | Tent | 32.3001 | 36.3233 | Rectangular | Red | 11.7 | 6.5 |
| Education | Save The Children's Rainbow Kindergarten | Tent | 32.3001 | 36.3233 | Rectangular | White | 18.8 | 10.1 |
| Education | Save The Children's Rainbow Kindergarten | Tent | 32.3001 | 36.3233 | Rectangular | White | 10.3 | 9.8 |
| Food Security | Common Kitchens | Building | 32.2983 | 36.3294 | Rectangular | Grey | 14.4 | 4.8 |
| Food Security | WFP Compound | Tent | 32.2981 | 36.3205 | Rectangular | Beige | 25 | 9.5 |
| Food Security | WFP Compound | Building | 32.2981 | 36.3205 | Rectangular | Grey | 13.9 | 5.8 |
| Food Security | WFP Compound | Building | 32.2981 | 36.3205 | Rectangular | Grey | 15.7 | 6.9 |
| Food Security | WFP Compound | Building | 32.2981 | 36.3205 | Square | Grey | 8.9 | 8.9 |
| Food Security | WFP Compound | Building | 32.2981 | 36.3205 | Rectangular | Grey | 8.9 | 5.4 |
| Food Security | WFP Compound | Tent | 32.2981 | 36.3205 | Rectangular | Red | 13.5 | 6.3 |
| Food Security | WFP Compound | Tent | 32.2981 | 36.3205 | Rectangular | White | 6.7 | 4.8 |
| Food Security | WFP Compound | Tent | 32.2981 | 36.3205 | Rectangular | White | 25 | 9.5 |

# Zaatari Camp, Jordan

| Cluster | Description | Observable Object | Latitude | Longitude | Shape | Color | Length (meters) | Width (meters) |
|---|---|---|---|---|---|---|---|---|
| Food Security | WFP Compound | Tent | 32.2981 | 36.3205 | Rectangular | White | 17 | 8.6 |
| Health | KSA Hospital | Tent | 32.2924 | 36.3302 | Rectangular | Beige | 7.2 | 5.9 |
| Health | KSA Hospital | Tent | 32.2924 | 36.3302 | Rectangular | Beige | 12.2 | 6.7 |
| Health | KSA Hospital | Tent | 32.2924 | 36.3302 | Rectangular | Beige | 5 | 3.4 |
| Health | KSA Hospital | Tent | 32.2924 | 36.3302 | Rectangular | White | 47.8 | 10.8 |
| Health | KSA Hospital | Tent | 32.2924 | 36.3302 | Rectangular | White | 12.4 | 11.3 |
| Health | KSA Hospital | Tent | 32.2924 | 36.3302 | Rectangular | White | 31.4 | 15.2 |
| Health | Moroccan Hospital | Building | 36.3223 | 36.3223 | L-shape | Beige | 8.3 | 2.5 |
| Health | Moroccan Hospital | Tent | 32.3026 | 36.3223 | Rectangular | Brown | 6.5 | 5.5 |
| Health | Moroccan Hospital | Tent | 32.3026 | 36.3223 | Rectangular | Brown | 6.9 | 6.3 |
| Health | Moroccan Hospital | Tent | 32.3023 | 36.3223 | Rectangular | Brown | 12.7 | 6.3 |
| Health | Moroccan Hospital | Tent | 32.3023 | 36.3223 | Rectangular | White | 12.7 | 5.6 |
| Health | Moroccan Hospital | Building | 32.3023 | 36.3223 | Rectangular | White | 9.4 | 3.8 |
| Security | Civil Defence | Building | 32.3018 | 36.3286 | Rectangular | Grey | 9.7 | 5.2 |
| Security | Civil Defence | Building | 32.3018 | 36.3286 | Rectangular | Grey | 4.2 | 3.2 |
| Security | Police | Building | 32.3018 | 36.3286 | Rectangular | White | 21.1 | 8.9 |
| Security | Police | Building | 32.3018 | 36.3286 | Rectangular | White | 10 | 4.3 |
| Security | Police | Building | 32.3018 | 36.3286 | Rectangular | White | 18 | 9.2 |
| Security | Police | Building | 32.3018 | 36.3286 | Rectangular | White | 4.1 | 3.3 |
| Shelter | Displaced Persons Shelter | Tent | 32.2951 | 36.3296 | Hexagonal | White | 6.6 | 3.8 |
| Shelter | Displaced Persons Shelter | Caravan trailer | 32.2951 | 36.3304 | Rectangular | White | 6.4 | 3.2 |
| WASH | Pumping Station Facility | Building | 32.2868 | 36.3279 | Rectangular | Grey | 6.5 | 3.6 |
| WASH | Pumping Station Facility | Tent | 32.2868 | 36.3279 | Rectangular | Grey | 4.3 | 3.2 |
| WASH | Pumping Station Facility | Water tank | 32.2868 | 36.3279 | Circular | White | 2.4 | 2.4 |
| WASH | Pumping Station Facility | Building | 32.2868 | 36.3279 | Rectangular | Grey | 5.6 | 3.2 |
| WASH | WASH - Female | Building | 32.3028 | 37.3354 | Rectangular | Grey | 9.2 | 3.6 |
| WASH | WASH - Male | Building | 32.3028 | 37.3354 | Rectangular | Grey | 9.2 | 3.6 |

## Zam Zam Camp, Sudan

| Cluster | Description | Observable Object | Latitude | Longitude | Shape | Color | Length (meters) | Width (meters) |
|---|---|---|---|---|---|---|---|---|
| Civilian | Mosque | Tent | 13.49457 | 25.30025 | Rectangular | Brown | 10 | 6.4 |
| Civilian | Mosque | Tent | 13.49456 | 25.30025 | Rectangular | Brown | 5.8 | 4.4 |
| Civilian | Mosque | Tent | 13.49456 | 25.30024 | Rectangular | Brown | 4.2 | 3.5 |
| Shelter | Displaced Persons Shelter | Tukul | 13.48625 | 25.30575 | Circular | Brown | 4.6 | 4.6 |
| Shelter | Displaced Persons Shelter | Tent | 13.48625 | 25.30565 | Square | Brown | 3.9 | 3.9 |
| Shelter | Displaced Persons Shelter | Tent | 13.48625 | 25.30566 | Rectangular | White | 4.3 | 2.5 |
| Shelter | Displaced Persons Shelter | Tent | 13.49216 | 25.30674 | Rectangular | Beige | 5.9 | 3.5 |
| Shelter | Displaced Persons Shelter | Tent | 13.49216 | 25.30674 | Rectangular | Blue | 4.2 | 3.4 |
| Security | Security Checkpoint | Building | 13.48427 | 25.31004 | Rectangular | Brown | 10.9 | 7.8 |
| Security | Security Checkpoint | Building | 13.48426 | 25.31003 | Rectangular | White | 24 | 7 |
| Security | Security Checkpoint | Booth | 13.48427 | 25.31004 | Square | White | 2.9 | 2.9 |
| Security | Security Checkpoint | Tent | 13.48427 | 25.31005 | Rectangular | Beige | 9.3 | 5.3 |
| Education | School 1 | Tent | 13.48003 | 25.30767 | Rectangular | Beige | 9.2 | 5.5 |
| Education | School 1 | Tent | 13.48003 | 25.30767 | Square | White | 5.2 | 5.2 |
| Education | School 1 | Building | 13.48003 | 25.30767 | Rectangular | Brown | 8.3 | 5.3 |
| Education | School 2 | Tent | 13.49299 | 25.30001 | Rectangular | Brown | 9.2 | 5.5 |
| Education | School 2 | Building | 13.49299 | 25.30002 | Rectangular | Beige | 20.1 | 2.5 |
| Education | School 2 | Tent | 13.49298 | 25.30001 | Rectangular | Beige | 5.6 | 2.8 |
| Education | School 2 | Tent | 13.49299 | 25.30001 | Rectangular | Beige | 8.3 | 5.3 |
| Health | Relief International Health Center 1 | Tent | 13.48332 | 25.30898 | Rectangular | White | 12.3 | 5.8 |
| Health | Relief International Health Center 1 | Tent | 13.48333 | 25.30897 | Rectangular | Beige | 10.1 | 4.9 |
| Health | Relief International Health Center 1 | Tent | 13.48332 | 25.30897 | Rectangular | White | 13 | 6.1 |
| Health | Relief International Health Center 1 | Tent | 13.48331 | 25.30898 | Rectangular | White | 11.9 | 5.7 |
| Health | Relief International Health Center 1 | Tent | 13.48332 | 25.30899 | Rectangular | White | 12.6 | 4.9 |
| Health | Relief International Health Center 1 | Tent | 13.48334 | 25.30898 | Rectangular | White | 6.2 | 4.3 |
| Health | Relief International Health Center 1 | Tent | 13.48333 | 25.30898 | Square | White | 4.5 | 4.5 |
| Health | Relief International Health Center 1 | Tent | 13.48333 | 25.30897 | Octogonal | White | 6.5 | 6.5 |
| Health | Relief International Health Center 1 | Tent | 13.48333 | 25.30898 | Octogonal | White | 5.3 | 5.3 |
| Health | Relief International Health Center 2 | Tent | 13.49313 | 25.29467 | Rectangular | White | 18.2 | 8.9 |
| Health | Relief International Health Center 2 | Tent | 13.49312 | 25.29466 | Rectangular | White | 12.9 | 9.1 |
| Health | Relief International Health Center 2 | Tent | 13.49312 | 25.29467 | Rectangular | White | 6.1 | 4.7 |
| Health | Relief International Health Center 2 | Tent | 13.49314 | 25.29467 | Rectangular | White | 3.5 | 2 |

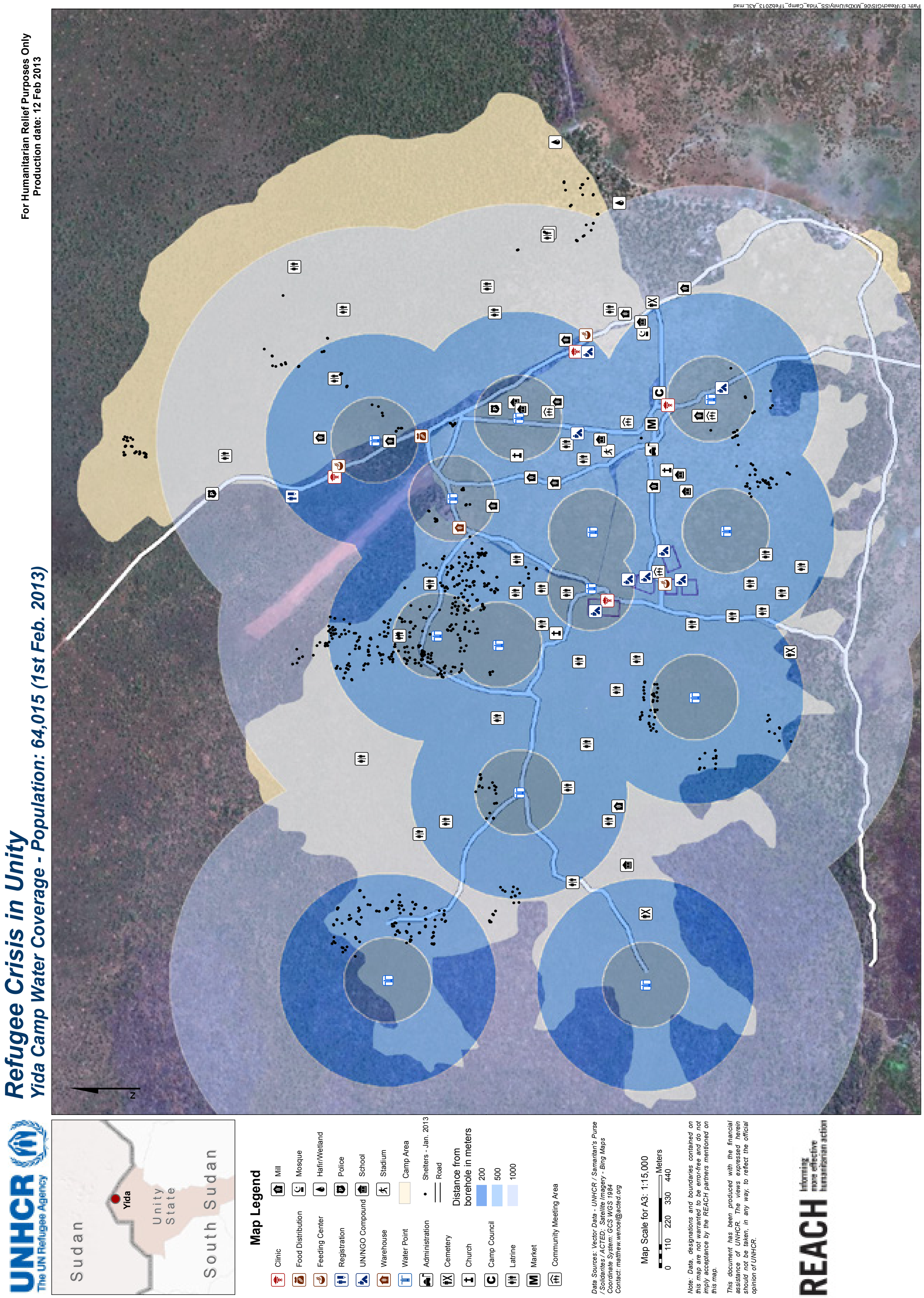
## Dagahaley, Dadaab Camp, Kenya

| Cluster | Description | Observable Object | Latitude | Longitude | Shape | Color | Length (meters) | Width (meters) |
|---|---|---|---|---|---|---|---|---|
| Agency-Use Structures | CARE Compound | Tent | 0.1882 | 40.2981 | Rectangular | Blue | 9.5 | 8.5 |
| Agency-Use Structures | CARE | Building | 0.1883 | 40.2981 | Rectangular | Grey | 8.5 | 7.5 |
| Agency-Use Structures | CARE | Tent | 0.1883 | 40.2982 | Rectangular | Blue | 39.2 | 9.6 |
| Agency-Use Structures | CARE | Tent | 0.1881 | 40.2981 | Rectangular | Grey | 25.8 | 7.5 |
| Agency-Use Structures | CARE | Tent | 0.1883 | 40.2981 | Rectangular | Beige | 25.6 | 6.7 |
| Agency-Use Structures | CARE | Building | 0.1882 | 40.2981 | Rectangular | Grey | 9.7 | 6.6 |
| Agency-Use Structures | CARE | Tent | 0.1883 | 40.2981 | Rectangular | Blue | 25.7 | 10.5 |
| Agency-Use Structures | CARE | Tent | 0.1883 | 40.2982 | Square | Blue | 11.3 | 11.3 |
| Agency-Use Structures | CARE | Building | 0.1883 | 40.2981 | Rectangular | Grey | 14.9 | 5.3 |
| Agency-Use Structures | CARE | Building | 0.1881 | 40.2981 | Rectangular | Grey | 21.6 | 6.7 |
| Agency-Use Structures | Windle Trust | Building | 0.1861 | 40.2981 | Rectangular | Grey | 11 | 9.2 |
| Agency-Use Structures | Windle Trust | Building | 0.1861 | 40.2982 | Rectangular | Grey | 22.6 | 7.6 |
| Agency-Use Structures | UNHCR Field Office | Caravan | 0.1841 | 40.2942 | Rectangular | White | 6.7 | 4.5 |
| Agency-Use Structures | UNHCR Field Office | Building | 0.1842 | 40.2942 | Rectangular | Grey | 15.2 | 7.5 |
| Agency-Use Structures | UNHCR Field Office | Tent | 0.1841 | 40.2941 | Rectangular | Blue | 15.7 | 8.1 |
| Agency-Use Structures | UNHCR Field Office | Building | 0.1841 | 40.2943 | Rectangular | Grey | 16.6 | 5.7 |
| Agency-Use Structures | UNHCR Field Office | Building | 0.1843 | 40.2942 | L-shaped | Grey | 42.7 | 8 |
| Agency-Use Structures | UNHCR Field Office | Building | 0.1842 | 40.2941 | Rectangular | Grey | 13.2 | 6.3 |
| Agency-Use Structures | UNHCR Transit Center | Building | 0.1832 | 40.2942 | Rectangular | Grey | 19.7 | 5.8 |
| Agency-Use Structures | UNHCR Transit Center | Tent | 0.1832 | 40.2941 | Rectangular | White | 9.7 | 5.5 |
| Agency-Use Structures | UNHCR Transit Center | Tent | 0.1833 | 40.2942 | Rectangular | Beige | 22.8 | 9.1 |
| Agency-Use Structures | UNHCR Transit Center | Building | 0.1833 | 40.2941 | Square | Grey | 7 | 7 |
| Shelter | Civilian Home | Building | 0.1905 | 40.2909 | Rectangular | Grey | 4.6 | 4 |
| Shelter | Civilian Home | Building | 0.1905 | 40.2909 | Rectangular | Grey | 10 | 4.9 |
| Shelter | Civilian Home | Building | 0.1905 | 40.2909 | Rectangular | Grey | 6.9 | 4.8 |
| Civilian | Mosque/Islamic School | Building | 0.1882 | 40.2924 | Rectangular | Grey | 15.1 | 22.71 |
| Civilian | Market | Buildings | 0.1884 | 40.2955 | Rectangular | Grey | n/a | n/a |
| Education | Illeys Primary School | Tent | 0.1875 | 40.2831 | Rectangular | White | 15.8 | 6.2 |
| Education | Illeys Primary School | Tent | 0.1876 | 40.2831 | Rectangular | White | 22.6 | 7 |
| Education | Illeys Primary School | Building | 0.1874 | 40.2831 | Rectangular | Grey | 45.4 | 9.2 |
| Education | Illeys Primary School | Building | 0.1876 | 40.2831 | Rectangular | Grey | 60.4 | 7 |
| Education | Illeys Primary School | Building | 0.1876 | 40.2832 | Rectangular | Grey | 40.2 | 6.4 |
| Education | Illeys Primary School | Building | 0.1876 | 40.2831 | Rectangular | Grey | 10.8 | 5.5 |
| Education | Community School | Tent | 0.1816 | 40.2968 | Rectangular | Grey | 26.5 | 7.7 |
| Education | Community School | Tent | 0.1815 | 40.2967 | Rectangular | Grey | 17.4 | 7.7 |
| Education | Community School | Tent | 0.1814 | 40.2968 | Rectangular | Beige | 23.9 | 10.6 |
| Education | Community School | Tent | 0.1816 | 40.2966 | Square | Grey | 5.9 | 5.9 |
| Education | Community School | Building | 0.1815 | 40.2967 | Rectangular | Grey | 11.3 | 9 |
| Education | Wathajir Primary School | Building | 0.1811 | 40.2811 | Rectangular | Blue | 36.8 | 11.3 |
| Education | Wathajir Primary School | Building | 0.1812 | 40.2812 | Rectangular | Blue | 15.3 | 8 |

## Dagahaley, Dadaab Camp, Kenya

| Cluster | Description | Observable Object | Latitude | Longitude | Shape | Color | Length (meters) | Width (meters) |
|---|---|---|---|---|---|---|---|---|
| Education | Wathajir Primary School | Building | 0.1812 | 40.2811 | Rectangular | Grey | 16.4 | 4.6 |
| Food Security | Food Distribution Center | Tent | 0.1864 | 40.2961 | Rectangular | Beige | 32.2 | 11.4 |
| Food Security | Food Distribution Center | Tent | 0.1863 | 40.2959 | Rectangular | Beige | 23.2 | 8 |
| Food Security | Food Distribution Center | Tent | 0.1865 | 40.2961 | Rectangular | Blue | 17.5 | 7.1 |
| Food Security | Food Distribution Center | Building | 0.1865 | 40.2959 | Rectangular | Grey | 10.2 | 6.3 |
| Food Security | Food Distribution Center | Tent | 0.1864 | 40.2961 | Square | White | 4.2 | 4.2 |
| Food Security | Food Distribution Center | Building | 0.1865 | 40.2962 | Rectangular | Grey | 29.5 | 17 |
| Food Security | Food Distribution Center | Building | 0.1865 | 40.2961 | Rectangular | Grey | 17.6 | 10.1 |
| Food Security | Food Distribution Center | Building | 0.1863 | 40.2962 | Rectangular | Grey | 34.2 | 10.1 |
| Food Security | Food Distribution Center | Tent | 0.1864 | 40.2962 | Square | White | 7.4 | 5.3 |
| Food Security | Food Distribution Center | Building | 0.1865 | 40.2962 | Rectangular | Grey | 21.9 | 8.9 |
| Health | Cholera Outbreak Center | Tent | 0.1861 | 40.2967 | Rectangular | Beige | 25.2 | 9.3 |
| Health | Cholera Outbreak Center | Building | 0.1859 | 40.2967 | Rectangular | Grey | 29.6 | 6.2 |
| Health | Cholera Outbreak Center | Building | 0.1861 | 40.2966 | Rectangular | Grey | 13.6 | 5.8 |
| Health | Cholera Outbreak Center | Building | 0.1862 | 40.2967 | Rectangular | Grey | 11.8 | 8.1 |
| Health | Health Post (1) | Building | 0.1866 | 40.2875 | Rectangular | Grey | 25.1 | 6.1 |
| Health | Health Post (1) | Building | 0.1861 | 40.2875 | Rectangular | Grey | 12.4 | 6.2 |

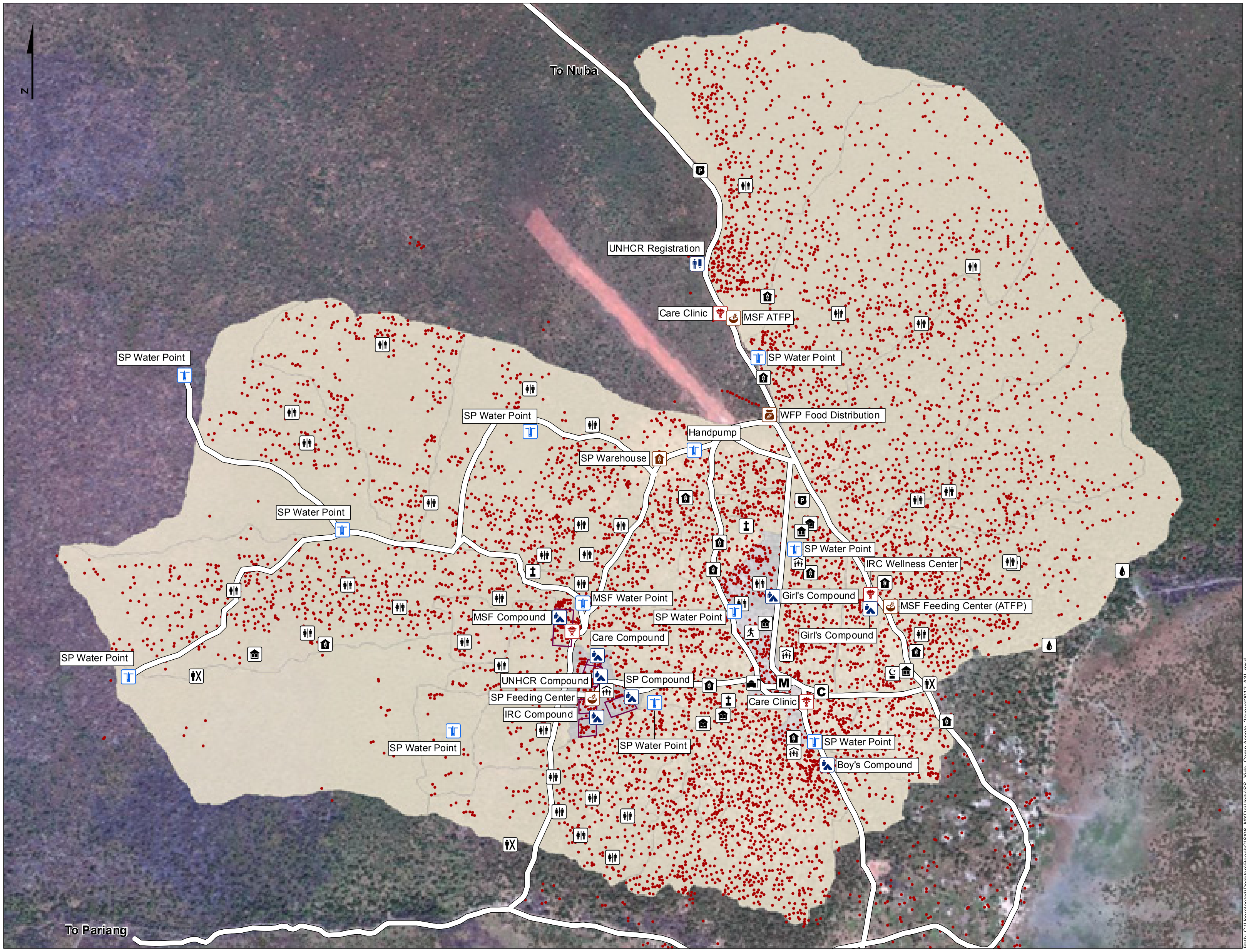
# Appendix III: Maps Used For Analysis



# Refugee Crisis in Unity

## Yida Camp - Shelters: 7,843 (OCT 2012) Population: 67,918 (NOV 2012)

For Humanitarian Relief Purposes Only
Production date: 28 Nov 2012


### Map Legend

- Clinic
- Food Distribution
- Feeding Center
- Registration
- UN/NGO Compound
- Warehouse
- Water Point
- Administration
- Cemetery
- Church
- Community Meeting Area
- Camp Council
- Latrine
- Market
- Mill
- Mosque
- Hafir/Wetland
- Police
- School
- Stadium
- Camp Area
- Shelter
- Road

*Data Sources: Vector Data - UNHCR / Samaritan's Purse / Solidarites / ACTED; Satellite Imagery - Bing Maps*
*Coordinate System: GCS WGS 1984*
*Contact: matthew.wencel@acted.org*

Map Scale for A3: 1:14,000

0 100 200 300 400 Meters

*Note: Data, designations and boundaries contained on this map are not warranted to be error-free and do not imply acceptance by the REACH partners mentioned on this map.*

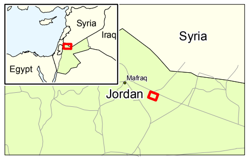
*This document has been produced with the financial assistance of UNHCR. The views expressed herein should not be taken, in any way, to reflect the official opinion of UNHCR.*



Path: C:\Users\acted\Desktop\Reach\GIS\06_MXDs\Unity\SS_Yida_Camp Assets_2august2012_A3L.mxd unicef

# Al Zaatari Refugee Camp - General Infrastructure

Production Date: 09/04/2013
Draft version - work in progress
For Humanitarian Relief Purposes Only




**Legend**

Camp entrance

**Roads**

- Market road
- Asphalted road
- Main road
- Small road

**WASH facilities**

- WASH Centre: female
- WASH Centre: male
- Septic tank
- Elevated water tank
- Waterpoint
- Borehole or Pumping Station
- Mobile or Temporary Toilet

**Garbage collection points**

- Bin, $1m^3$
- Bin, $10m^3$

**Camp facilities**

- Shop
- Recreation Area
- Child Friendly Space or Play area
- Registration
- Offices
- Clinic / Health Facility
- Distribution Center
- Storage / Warehouse
- Common Space
- Mosque or Musallah
- Police
- School
- Kitchen

**Facility status**

- Under construction
- Damaged or unusable

0 50 100 200 300 400 Meters

Projection: WGS 1984 UTM Zone 37N
Graticule: WGS84 DMS

Thematic data: ACTED/REACH - last update March 2013
Satellite Imagery: 01/04/2013 by Astrium Services / Spot Image

Contact: reach.mapping@impact-initiatives.org

Note: Data, designations and boundaries contained on this map are not warranted to be error-free and do not imply acceptance by the REACH partners, associates or donors mentioned on this map.

*A product of*

REACH Informing more effective humanitarian action

*In partnership with*

unitar ACTED UNOSAT IMPACT Initiatives

# JORDAN - Al Za'atari Camp

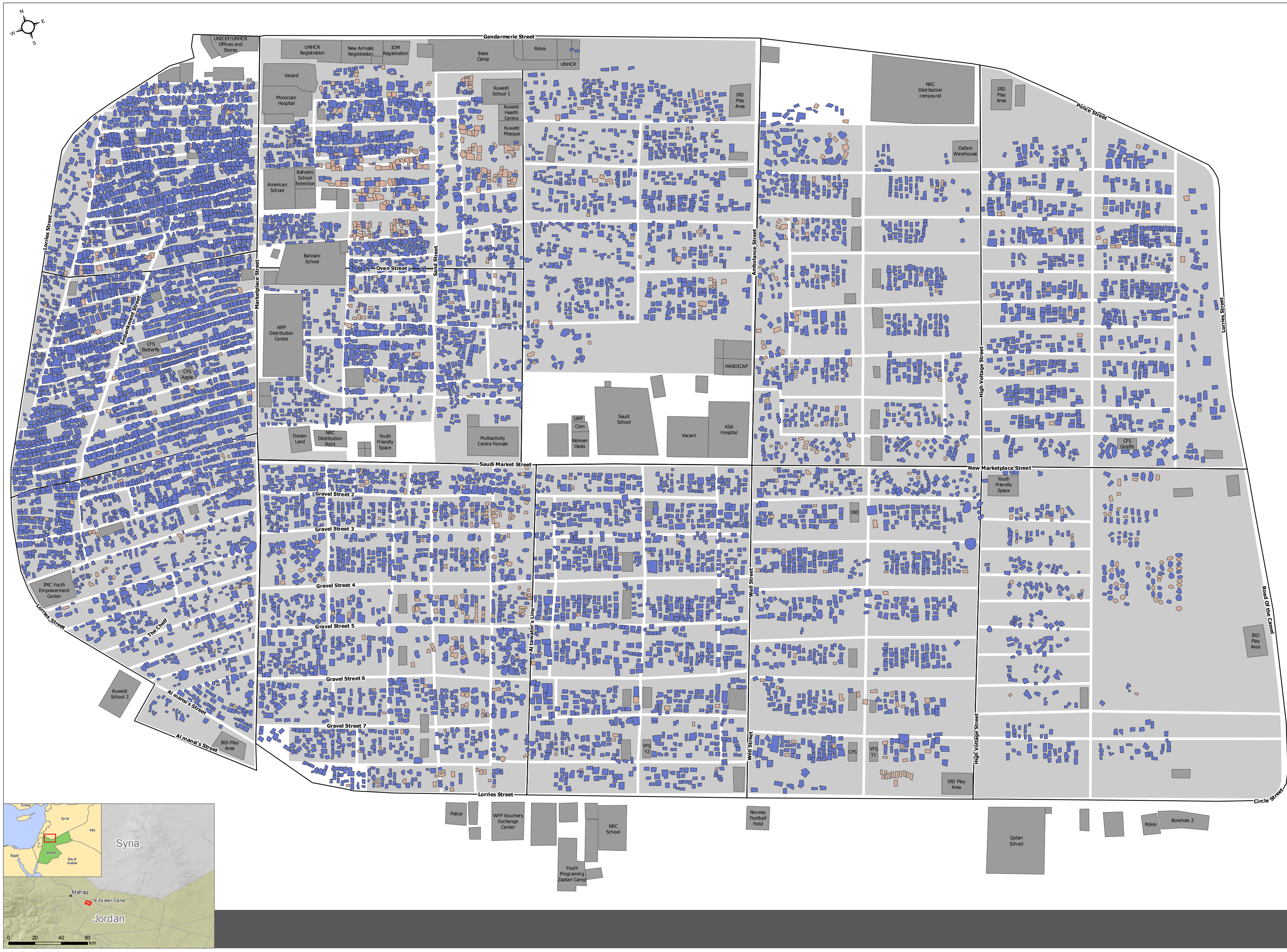
*Households possessing a source of wastewater*

For Humanitarian Relief Purposes Only

Draft Version - Work in Progress

Production Date: 1/6/2014

For more information scan to visit the Open Street Map




**Household Locations**

- Houses with wastewater source
- Houses without wastewater source
- Camp Facilties
- District Boundaries

0 50 100 150 200 250 300 m

Data Source: REACH

Projection: WGS 1984 UTM Zone 37N

Waste Water data collection: ACTED / REACH
24 September - 11 December 2013

Map Reference:
JOR_Zaatari_WWA_wastewater_presence

Contact:
reach.mena@impact-initiatives.org

Note: Data, designations and boundaries contained on this map are not warranted to be error-free and do not imply acceptance by the REACH partners, associates or donors mentioned on this map.

REACH informing more effective humanitarian action

# Sudan: Zamzam IDP Camp Profile (09 May 2013)

OCHA

**Zamzam IDP camp is located about 14 km south of El Fasher town. The camp was opened in August 2004 and since then it has been receiving new IDPs from different locations even from other Darfur states. It currently has estimated population of 164,000. This figure is based on information from UN agencies and NGOs working in Zamzam. This figure is subject to change as more information becomes available.**

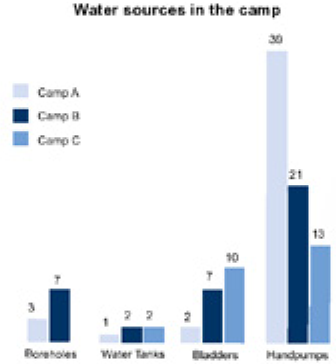
**Who is Doing What in Zamzam?**

| WASH | Nutrition | NFI/ES | Health | FSL | Education | Camp coordination | Protection |
|---|---|---|---|---|---|---|---|
| UNICEF, WES, Plan Sudan | SMoH, WHO, UNICEF, WFP, RI | UNHCR ILCU, Plan Sudan | WHO, SMoH, RI, Mercy Malaysia, HAD | WFP, SRCs, DNW, ICDRA | UNICEF, Plan Sudan, SPHO | Plan Sudan | UNHCR, UNAMID, Plan Sudan, SPHO |

## WASH

Presently, in the camp 4 water sources. As per the rapid assessment presently 19 liters water is provided to per capita in a day and one latrine is used by 18 persons.

**Water sources in the camp**

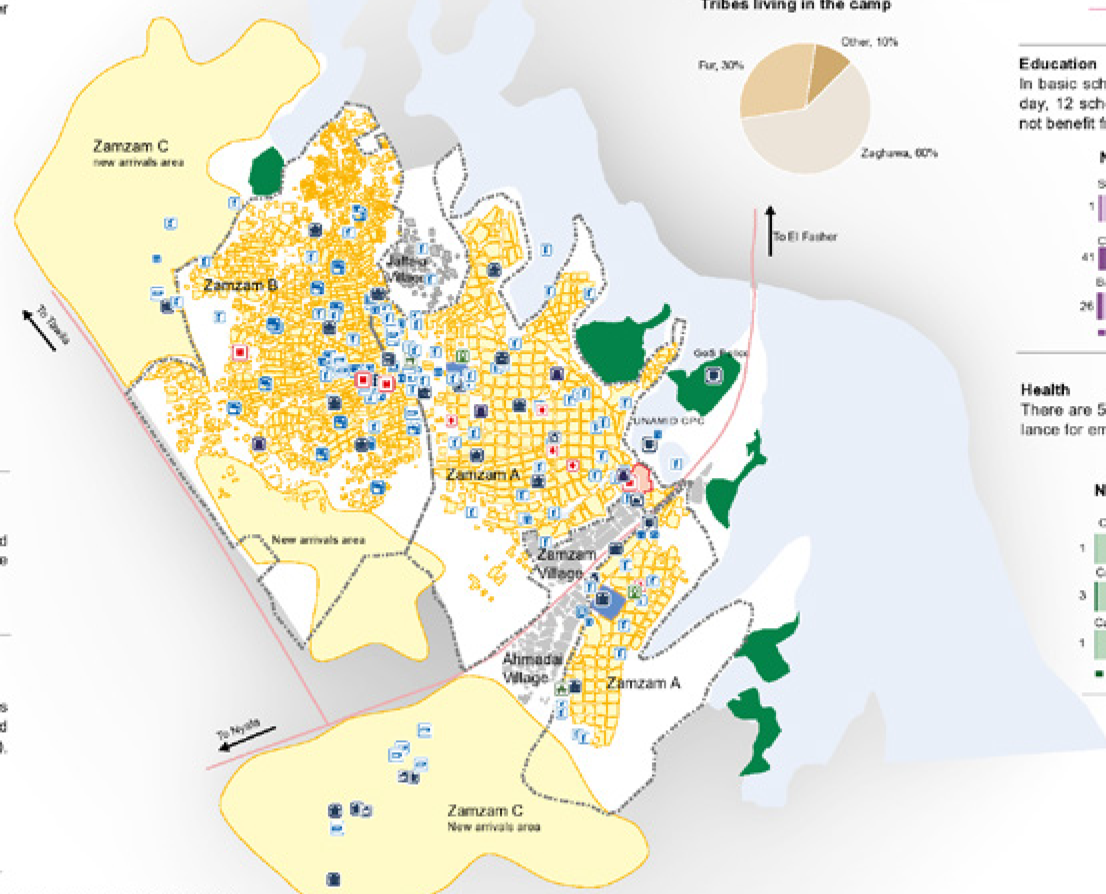



## Food

GFD take place every 2 months with two months food provided to the IDPs, simultaneously 17 basic schools are supported with food for education.

## NFIs/ES

Jerri cans, plastic sheets, cooking sets and plastic mats have been provided to new arrivals (10,035 people) and household affected by disaster and fire (235 people), since Jannuary 2013.




**Tribes living in the camp**



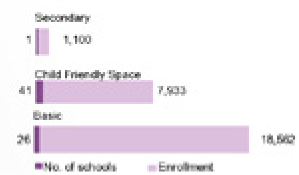
**Legend**

Bore Hole (Water Yard)
Dug Well
Hand Pump
Tap Stand
Water Tank
Water Bladder
Food Distribution Centre
Health Centre
Child Friendly Space
School
Community Centre
Camp Boundary
Main Roads
Youth Centre
Women's Centre
Market
Flour Mill
Mosque
Cemetery
Security / Checkpoints
Land Use
Camp Area
Institutional
Market
Surrounding Settlements
Flood Prone Area
Wooded Area

## Education

In basic schools one latrine is used by 103 students per day, 12 schools are without water facility, 10 schools do not benefit from school feeding program.

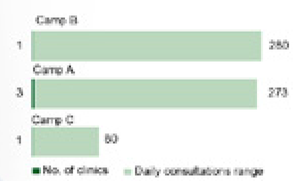
**Number of schools and enrollment**

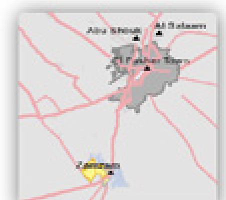



## Health

There are 5 clinics operating in the camp and one ambulance for emergency referral to El-fasher hospital.

**No. of clinics and daily consultations range**

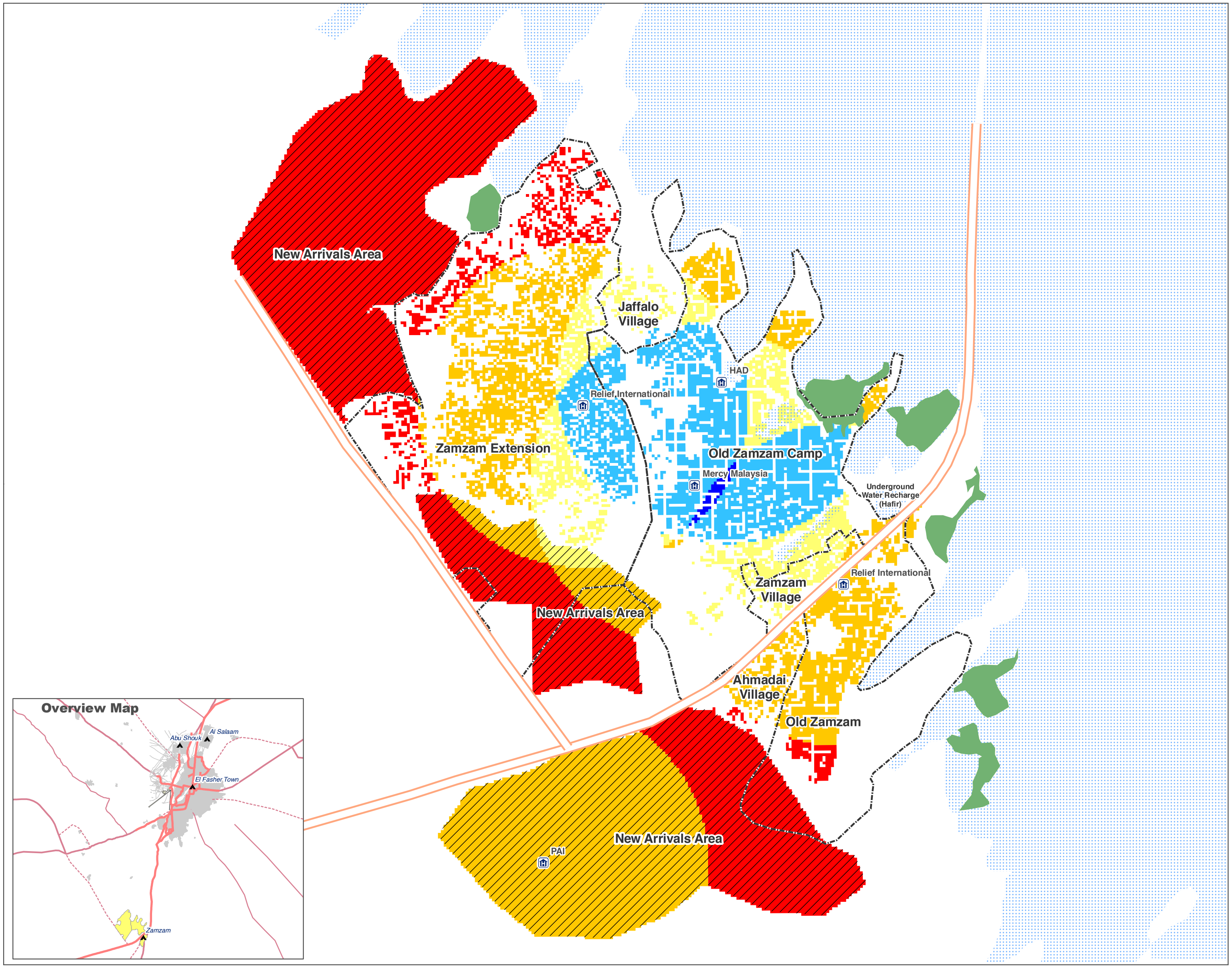



**Creation date:** 09 May 2013
**Sources:** Camp data [UN agencies, INGOs working in the camp], Land cover [digitized from Quickbird image dated 16 Dec 10].
**Feedback:** ochasudan_feedback@un.org www.unocha.org/Sudan www.reliefweb.int

# NORTH DARFUR, SUDAN: Zamzam IDP Camp - Health Centres Density per Squared Kilometer

16 June 2011




**Legend**

Health Centre

**Health Centres Density per Squared Kilometer**

- 0
- 1
- 2
- 3
- 4

**Land Use**

- New Arrivals Areas
- Flood Prone Area
- Wooded Area
- Camp Boundary
- Main Roads


OCHA Sudan is funded by:
Common Humanitarian Fund (Denmark, Ireland, Netherlands, Norway, Spain, Sweden, DFID) Switzerland, ECHO, USAID/OFDA and Italy


**Map Doc Name:** SU-DAR-CAMP-02_A2_110616_Northern_Darfur_Zamzam_Camp
**Creation Date:** 16 June 2011
**Projection/Datum:** Geographic / WGS 1984
**Web Resources:** http://ochaonline.un.org/sudan
**Nominal Scale at A2 paper size:** 1:22,000

0 200 400 600 800 1,000 Meters

Map jointly produced by CRMA/UNDP, OCHA and UNAMID GIS

**Map data source(s):**
Camp data from UN agencies and I/NGOs.
Land cover digitized from Quickbird image dated 16 Dec 10.
Water points - UNICEF
Proposed extension layout - UNHCR

**Disclaimer:**
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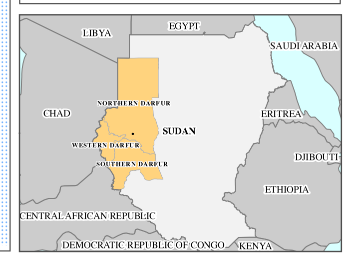

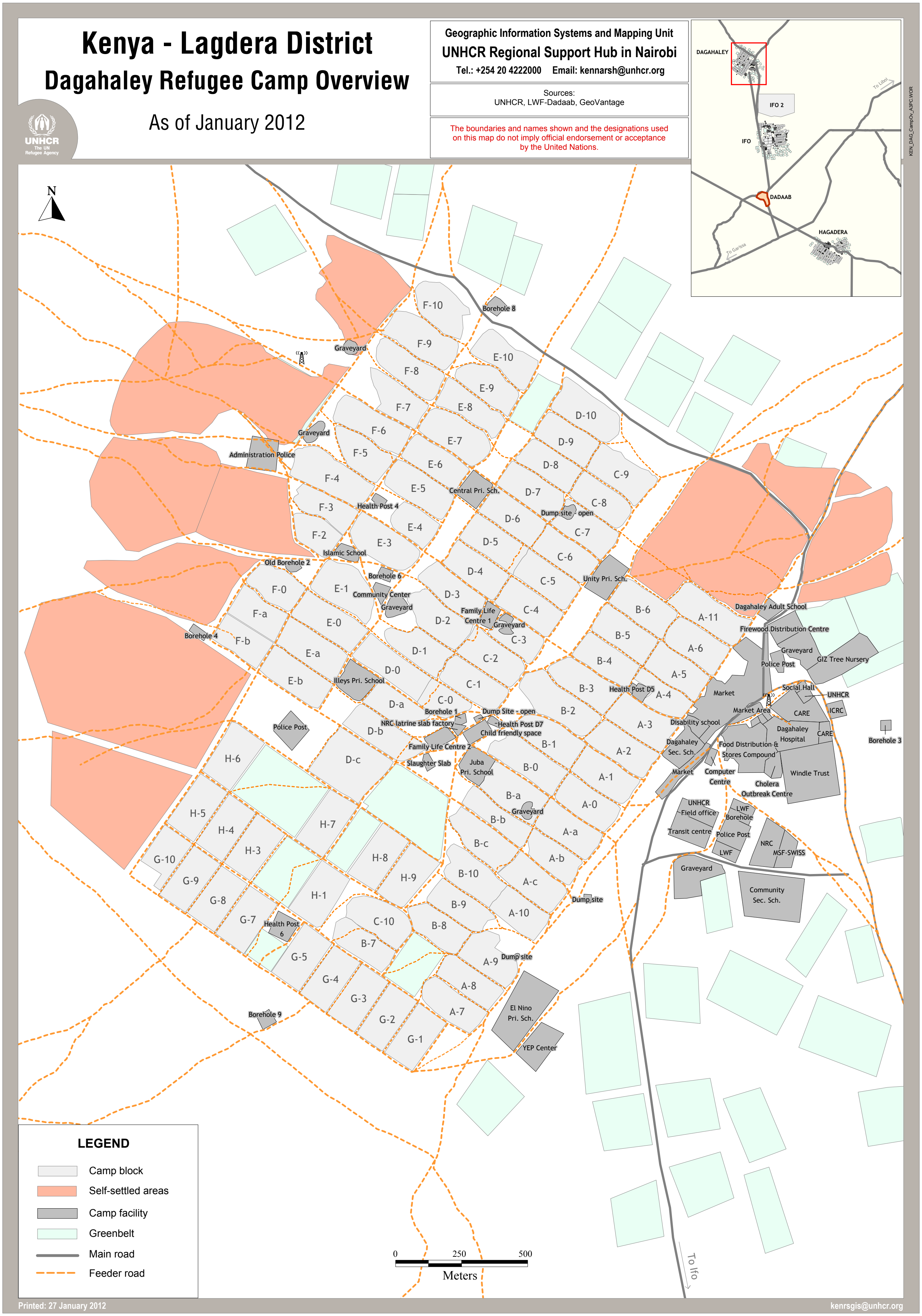

Kenya - Lagdera District
Dagahaley Refugee Camp Overview
As of January 2012
UNHCR The UN Refugee Agency
Geographic Information Systems and Mapping Unit
UNHCR Regional Support Hub in Nairobi
Tel.: +254 20 4222000 Email: kennarsh@unhcr.org
Sources:
UNHCR, LWF-Dadaab, GeoVantage
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DAGAHALEY
IFO 2
IFO
DADAAB
HAGADERA
To Liboi
To Garissa
KEN_DAG_CampOv_A3PC.WOR
N
F-10
Borehole 8
F-9
Graveyard
E-10
F-8
E-9
F-7
E-8
D-10
F-6
Graveyard
E-7
D-9
Administration Police
F-5
E-6
D-8
C-9
F-4
E-5
Central Pri. Sch.
D-7
C-8
F-3
Health Post 4
Dump site - open
D-6
E-4
C-7
F-2
E-3
D-5
Islamic School
C-6
Old Borehole 2
Borehole 6
D-4
C-5
Unity Pri. Sch.
F-0
E-1
Community Center
D-3
Graveyard
B-6
F-a
E-0
Family Life Centre 1
C-4
A-11
D-2
Graveyard
Dagahaley Adult School
Borehole 4
F-b
C-3
B-5
Firewood Distribution Centre
E-a
D-1
A-6
Graveyard
C-2
B-4
GIZ Tree Nursery
D-0
Police Post
E-b
Illeys Pri. School
A-5
C-1
B-3
Health Post D5
Social Hall
A-4
Market
UNHCR
D-a
C-0
B-2
Market Area
ICRC
Borehole 1
Dump Site - open
CARE
Police Post
D-b
NRC latrine slab factory
Health Post D7
A-3
Disability school
Dagahaley Hospital
CARE
Child friendly space
Borehole 3
Family Life Centre 2
B-1
Dagahaley Sec. Sch.
Food Distribution & Stores Compound
H-6
D-c
A-2
Slaughter Slab
Juba Pri. School
B-0
Market
Computer Centre
Windle Trust
A-1
Cholera Outbreak Centre
B-a
A-0
UNHCR Field office
LWF Borehole
H-5
Graveyard
H-7
B-b
H-4
A-a
Transit centre
Police Post
NRC
H-3
B-c
LWF
MSF-SWISS
G-10
H-8
A-b
Graveyard
G-9
H-9
B-10
A-c
Community Sec. Sch.
H-1
G-8
B-9
Dump site
A-10
G-7
Health Post 6
C-10
B-8
B-7
G-5
A-9
Dump site
G-4
A-8
G-3
Borehole 9
A-7
El Nino Pri. Sch.
G-2
G-1
YEP Center
To Ifo
LEGEND
Camp block
Self-settled areas
Camp facility
Greenbelt
Main road
Feeder road
0 250 500
Meters
Printed: 27 January 2012
kenrsgis@unhcr.org

# Kenya - Dadaab District

## Dagahaley Refugee Camp Overview

As of June 2013

Geographic Information Systems unit
LWF/DWS-Dadaab
©2013
Sources; UNHCR, LWF/DWS-Dadaab

Datum: WGS 1984
Projection: UTM Zone 37

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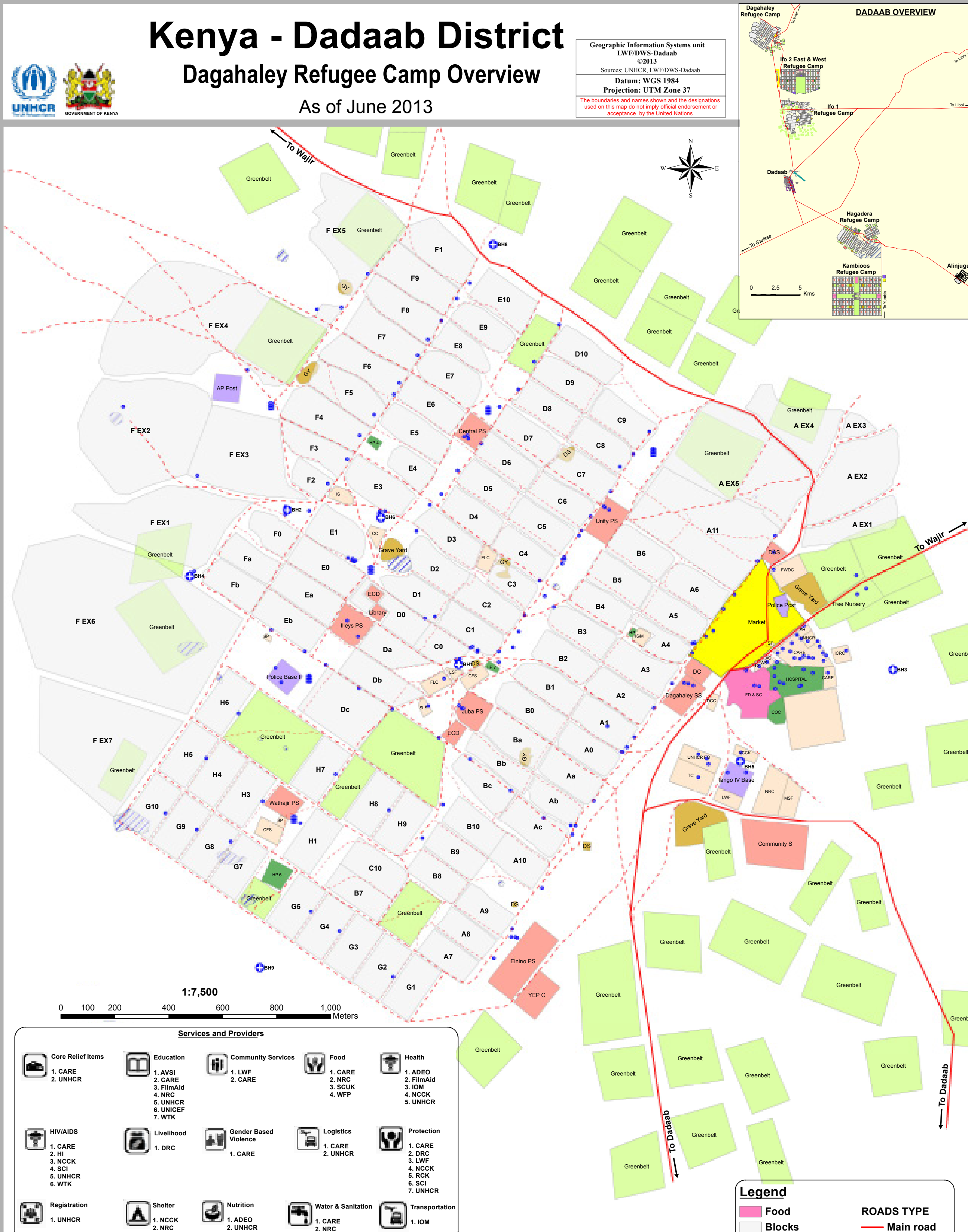


### Services and Providers

| | |
|---|---|
| Core Relief Items | 1. CARE 2. UNHCR |
| Education | 1. AVSI 2. CARE 3. FilmAid 4. NRC 5. UNHCR 6. UNICEF 7. WTK |
| Community Services | 1. LWF 2. CARE |
| Food | 1. CARE 2. NRC 3. SCUK 4. WFP |
| Health | 1. ADEO 2. FilmAid 3. IOM 4. NCCK 5. UNHCR |
| HIV/AIDS | 1. CARE 2. HI 3. NCCK 4. SCI 5. UNHCR 6. WTK |
| Livelihood | 1. DRC |
| Gender Based Violence | 1. CARE |
| Logistics | 1. CARE 2. UNHCR |
| Protection | 1. CARE 2. DRC 3. LWF 4. NCCK 5. RCK 6. SCI 7. UNHCR |
| Registration | 1. UNHCR |
| Shelter | 1. NCCK 2. NRC |
| Nutrition | 1. ADEO 2. UNHCR |
| Water & Sanitation | 1. CARE 2. NRC 3. UNHCR |
| Transportation | 1. IOM |

### Key

AC - Atlas Computers
CC - Community Centre
CFS - Child Friendly Space
COC - Cholera Outbreak Centre
DAS - Dagahaley Adult School
DC - Disability Centre
DCC - Dagahaley Computer Centre
DS - Disposal Site
FD & SC - Food Distribution & Centre
FLC - Family Life Centre
FO - Field Office
FWDC - Fire Wood Distribution Centre
HP - Health Post
GY - Grave Yard
IS/M - Islamic School/Mosque
LWF - Lutheran World Federation
NCCK - National Council of Churches in Kenya
NRC - Norwegian Refugee Council
MSF - Medicines San Frontiers
PS - Primary school
SH - Social Hall
SLS - Slaughter Slab
ST - Safaricom Tower
SO - Satellite Office
SS - Secondary School
TC - Transit Centre
TS - Tailoring School
UNHCR - United Nations High Commissioner for Refugees
WS - Welding Shed
YEP C - Youth Education Pack Centre

Population; 98,700 Persons
Camp size
1. Hectares - 820.9563
2. Kilometers Squared - 8.21

### Legend

Food
Blocks
Health
Market
Security
Boreholes
Education
Sanitation
Environment
Camp Facilities
Flood Prone Areas

ROADS TYPE
Main road
Utility road
Trails
Water points
Water Tanks

# Footnotes

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# Satellite Imagery Interpretation Guide


## Intentional Burning of Tukuls

Harvard Humanitarian Initative

Signal Program on Human Security and Technology

## Authors

All research, analysis, writing, editing and layout for *Satellite Imagery Interpretation Guide: Intentional Burning of Tukuls* was completed by the Signal Program on Human Security and Technology at the Harvard Humanitarian Initiative.

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Brittany L. Card, Program Coordinator
Nathaniel A. Raymond, Director

## About The Signal Program on Human Security and Technology

The Signal Program on Human Security and Technology (Signal Program) was founded by the Harvard Humanitarian Initiative in 2012. Signal Program staff, fellows, and partners work to advance the safe, ethical, and effective use of information technologies by communities of practice during humanitarian and human rights emergencies.

The program addresses critical gaps in research and practice HHI encountered while designing and manging the pilot phase of the Satellite Sentinel Project (SSP) from December 2010 to the summer of 2012. Through the analysis of satellite imagery and open source reports from Sudan, SSP was a watershed moment in the use of remote sensing to monitor the human security of civilians during and armed conflict.

The program's ongoing research and scholarship focuses on the following three areas:

***Tools and Methods***
Design and scientifically test tools and methods that remotely collect and analyze data about humanitarian emergencies;

***Standards and Ethics***
Help lead the development of technical standards and professional ethics for the responsible use of technology to assist disaster-affected populations;

***Mass Atrocity Remote Sensing***
And conduct retrospective analysis of satellite imagery and other related data to identify remotely observable forensic evidence of alleged mass atrocities.

## About the Harvard Humanitarian Initiative

The Harvard Humanitarian Initiative (HHI) is a university-wide center involving multiple entities within the Harvard community that provide expertise in public health, medicine, social science, management, and other disciplines to promote evidence-based approaches to humanitarian assistance. The mission of HHI is to relieve human suffering in war and disaster by advancing the science and practice of humanitarian response worldwide.

HHI fosters interdisciplinary collaboration in order to:

- Improve the effectiveness of humanitarian strategies for relief, protection and prevention;
- Instill human rights principles and practices in these strategies; and
- Educate and train the next generation of humanitarian leaders.

# Table of Contents

# Foreword

It is my pleasure to introduce this invaluable guide by the Harvard Humanitarian Initiative's Signal Program on Human Security & Technology on the use of satellite imagery to remotely assess and document the deliberate burning of traditional family housing or tukuls in East and Central Africa--a method of warfare against civilians that is tragically commonplace across the region.

At a time when the commercial availability of satellite data is at an all-time high, the Signal Program has identified the critical need for practical and authoritative guidance to professionals and interested volunteer communities alike to meet the growing demand for satellite-derived information relevant to the work of human rights and humanitarian organizations.

*The Satellite Imagery Interpretation Guide: Intentional Burning of Tukuls* draws upon years of practical experience and lessons learned from the author's ground-breaking work on conflict monitoring in Sudan as well as the work of many other academics, aid workers and researchers in the same field. It provides clear and detailed guidance on the technical requirements, methods and challenges commonly faced by practitioners to accurately identify and assess the deliberate burning of tukuls with satellite imagery.

This guide represents a significant contribution to the growing body of research on the role of new technology in human rights and humanitarian work, and is an essential educational resource for those new to this exciting and dynamic field. Most importantly, this guide is only the second in a series of innovative and timely research products by the Signal Program that hopefully will continue in the years to come.

Josh Lyons
Satellite Imagery Analyst
Human Rights Watch
Geneva, Switzerland
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# Acronym List

| | |
|---|---|
| **AOI** | Areas of interest |
| **HR** | High resolution |
| **HRW** | Human Rights Watch |
| **HHI** | Harvard Humanitarian Initiative |
| **IDP** | Internally displaced persons |
| **UNITAR-UNOSAT** | United Nations Institute for Training and Research-Operational Satellite Applications Programme |
| **VHR** | Very high resolution |
| **VTO** | Voluntary technical organizations |

# Chapter 1: Uses and Methodology

## 1A. Need for an Interpretation Guide

The intentional targeting and razing of apparent civilian structures is a well-documented phenomena that routinely occurs during armed conflict throughout Africa, notably in East and Central Africa. Buildings that may often be targeted include civilian dwellings, humanitarian aid facilities, religious buildings, and schools. One of the most common and defining tactics of this violence is the widespread burning of traditional civilian dwellings, known generally as tukuls.

The intentional destruction of these dwellings, given their prevalence in these regions, is often one of the only available indicators of the intentional targeting of civilians observable in satellite imagery. It must be noted that damage analysis is often performed on other types of structures and infrastructure present in the same area and at the same time as the analysis of apparently destroyed tukuls.

This guide focuses on tukuls because they are a uniquely valuable metric for both documenting attacks on civilians during armed conflicts and assessing potential mass displacement that can result from these incidents. Future satellite imagery interpretation guides from the Signal Program may focus on other, related phenomena and structures present in similar operational contexts.

*Tukuls and Armed Conflict in Africa*
Tukuls are traditional civilian dwellings common in many areas of Africa. Built largely from organic, locally found material, tukuls are primarily circular mud and grass-thatch structures.[1] In some instances, tukuls may also be square or rectangular-shaped. Sometimes tukuls can be built from materials other than mud, including brick, stone, or concrete. Often, the roofs of tukuls are cone shaped.[2] However, the roofs can sometimes be pitched[3] or pyramidal as well.[4]

Tukuls are primarily found throughout countries in East and Central Africa, including the Central African Republic[5], Sudan,[6] and South Sudan,[7] where tukuls are burned as part of these ongoing armed conflicts. The destruction of tukuls as part of attacks on villages often result in the mass displacement of the civilians who live in these dwellings. For example, recent systematic attacks against civilian populations, including the burning of homes, in Unity state, South Sudan were reportedly undertaken with the intent to displace civilians.[8]

In many cases, civilian communities in these conflict zones are located in remote, insecure environments that cover large geographic areas. As a result, it may be difficult or impossible to collect first-hand information about attacks committed against communities living in these non-permissive environments. However, the interpretation of satellite imagery can provide organizations a means for more quickly and safely documenting and corroborating events that may have occurred in these difficult to access areas.

*Role of Tukuls in Corroborating Reported Attacks*
In these contexts, several major humanitarian agencies, human rights organizations, and researchers are increasingly employing high-resolution satellite imagery to capture information about these alleged attacks. As part of this work, satellite imagery is often collected of a location after an attack occurs to determine if civilian structures, such as tukuls, appear visibly damaged or destroyed.

For example, Human Rights Watch (HRW) used remote sensing to confirm the reported destruction of over 2,800 buildings, including tukuls, in the village of Abu Jeradil, Central Darfur, Sudan, as well as in surrounding villages nearby. HRW concluded, based on imagery analysis, that these structures were most likely burned down. This destruction occurred during an alleged April 2013 attack on the area by Sudanese government forces.[9]

Additionally, the United Nations Institute for Training and Research-Operational Satellite Applications Programme (UNITAR-UNOSAT) analyzed satellite imagery collected in February 2014 of Leer, South Sudan. Based on its

analysis, UNITAR-UNOSAT concluded that 1,556 burned or destroyed structures, including tukuls and other civilian structures, appear present in the town. Active fires and smoke plumes are also visible.[10]
Voluntary technical organizations (VTOs) are also increasingly being utilized to assist in the interpretation of remote sensing data related to these types of phenomena. This work is being done both to support humanitarian agencies assisting affected populations and human rights organizations seeking to collect evidence of alleged crimes.

As these and other examples show, remotely counting tukuls present in high resolution satellite imagery captured after a reported attack is becoming a widely accepted and reliable corroborative indicator of these alleged events having occurred. It should be expected that this type of analysis will likely become a more standard part of remotely determining the impact of armed conflicts on civilian populations in East and Central Africa.

*Addressing the Pedagogy Gap in Tukul Analysis*
The increasing adoption of remote sensing by humanitarian and human rights agencies for this purpose presents a critical operational challenge. Little formal, sector-specific research and pedagogy exist to guide the use of these methodologies in either a humanitarian or human rights context. The implications of this "pedagogy gap" may affect the accuracy, speed, and reproducibility of these types of analyses.

Understanding the history of the development and past use of remote sensing is helpful for addressing this gap. The earliest adopters of remote sensing were governments and militaries in the 1950's. By comparison, the application of remote sensing to humanitarian operations first began in the late 1980's and early 1990's. Initially, this technology was used primarily by large agencies, particularly UN and governmental organizations. Their adoption was a result of the growing commercialization of remote sensing.

However, the recent explosion in the volume of commercial satellite imagery collection has resulted in major growth in the number of humanitarian, human rights organizations, VTOs, and researchers accessing and employing this data as well. Additionally, the purposes for which it is being commonly used are expanding in breadth, depth and complexity.

Thus, rapid adoption and adaptation of this source of data has created a critical gap in accepted methodologies, examples of observable objects, and general best practices. Systematically and comprehensively addressing this gap will help ensure more accurate, actionable, and scientific data is generated by humanitarian and human rights analysts.

To help address this gap, *Satellite Imagery Interpretation Guide: Intentional Burning of Tukuls* provides an overview of the visual profile and characteristics of burned tukuls; common methodologies for this analysis; recommended best practices and operational considerations for analysts; and imagery examples of conflict-related burnings of traditional African dwellings.

This is the second publication in the Signal Program's *Satellite Imagery Interpretation Guide* series. The first was 2015's *Satellite Imagery Interpretation Guide: Displaced Population Camps*.[11]

**1B. Intended Users and Potential Uses of the Guide**

This interpretation guide is primarily intended as a reference and training resource for students studying humanitarian response and technology; volunteers supporting humanitarian operations; and general audiences interested in the application of these skills and technologies to humanitarian operations. While the guide may be of some utility to professional geospatial analysts, it is designed to serve primarily as an introduction to this work for those new to the field.

The goal of the guide is to provide suggested interpretation guidelines, tested techniques, and examples of data aggregated from case studies to develop skills in the following areas:

- Performing standardized counts of tukuls and other structures present in imagery;
- Identifying apparently burned tukuls versus apparently intact tukuls;
- Conducting basic forms of change detection using pre- and post-event imagery; and
- Assessing whether the burning of tukuls appears to be intentional.

Users will learn how these skills are applied to the interpretation of satellite imagery related to the alleged intentional destruction of tukuls in relevant regions and operational contexts. The guide will also provide reference examples of common, repeating scenarios to help standardize this type of interpretation and data set creation across communities of practice.

### 1C. Data and Methods

#### *Imagery Selection*

The guide includes case studies of 10 locations where standing and/or burned tukuls are present in Central and East Africa. The locations are Algheden, Eritrea; Bossangoa, Central African Republic; Gambella, Ethiopia; Mitwaba, Demoratic Republic of Congo; Kadugli, Sudan; Leer, South Sudan; and Maker Abior, Dungop, Tajalei, and Abyei Town, which are located in the contested region between Sudan and South Sudan known as the Abyei Area.[12] The case studies are based both on four new examples and images from past reporting by organizations who have engaged in this type of analysis.

These locations were selected for two reasons. First, tukuls are the primary traditional civilian dwelling type in these locations, including both rural and urban settings. Second, these areas provide examples of geographic regions where the intentional burning of tukuls is an ongoing and endemic part of armed conflict.

#### *Imagery Data Sources and Analysis Methodologies*

The following chart provides an overview of all sources of imagery discussed in this guide:

| Figure Number | Location | Date | Source | Provider |
|---|---|---|---|---|
| 3.1 | Gambela, Ethiopia | 20 January 2015 | Google Earth | DigitalGlobe |
| 3.1 | Bossangoa, Central African Republic | 03 November 2014 | Google Earth | DigitalGlobe |
| 3.1 | Rumbek, South Sudan | 14 January 2015 | Google Earth | DigitalGlobe |
| 3.2 | Abyei Town, Abyei Region | 28 January 2015 | Google Earth | DigitalGlobe |
| 3.3 | Kadugli, Sudan | 03 February 2015 | Google Earth | DigitalGlobe |
| 3.4 | Abyei Town, Abyei Region | 28 January 2015 | Google Earth | DigitalGlobe |
| 3.5 | Maker Abior, Abyei Region | 06 March 2011 | DigitalGlobe | DigitalGlobe |
| 3.6 | Tajalei, Abyei Region | 06 March 2011 | DigitalGlobe | DigitalGlobe |
| 3.7 | Dungop, Abyei Region | 03 February 2011 | DigitalGlobe | DigitalGlobe |
| 3.7 | Dungop, Abyei Region | 24 May 2011 | DigitalGlobe | DigitalGlobe |
| 3.7 | Dungop, Abyei Region | 26 May 2011 | DigitalGlobe | DigitalGlobe |
| 3.8 | Leer, South Sudan | 02 February 2014 | UNITAR/UNOSAT | DigitalGlobe |
| 3.9 | Democratic Republic of Congo | 20 July 2013 | Google Earth | DigitalGlobe |
| 4.1 | Abyei Town, Abyei Region | 15 February 2011 | Google Earth | DigitalGlobe |
| 4.1 | Abyei Town, Abyei Region | 26 May 2011 | Google Earth | DigitalGlobe |
| 4.1 | Abyei Town, Abyei Region | 28 February 2013 | Google Earth | DigitalGlobe |
| 4.1 | Abyei Town, Abyei Region | 03 September 2013 | Google Earth | DigitalGlobe |
| 4.2 | Bossangoa, Central African Republic | 15 December 2013 | Google Earth | DigitalGlobe |
| 4.2 | Bossangoa, Central African Republic | 07 January 2014 | Google Earth | DigitalGlobe |
| 4.2 | Bossangoa, Central African Republic | 03 November 2014 | Google Earth | DigitalGlobe |

All DigitalGlobe imagery dating from 2011 was previously acquired during the pilot phase of the Satellite Sentinel Project. The Google Earth imagery was downloaded directly through the platform's 'Save Image' function by analysts at the Signal Program.

The majority of  imagery used in this guide was analyzed in ERDAS Imagine software, utilizing a dual-viewer function that allows analysis across temporal resolutions. Temporal resolution is the amount of time passed between shots collected over one area.[13] In ERDAS Imagine, imagery was analyzed at multiple different vectors. However, each are presented in this guide at a north-facing vector unless otherwise annotated with a directional marker.

Additionally, keeping count of destroyed and standing tukuls, was done using ERDAS Imagine's 'Count Feature' function. This tool allowed the analysts to perform counts of different objects with disambiguating symbols so that both standing and and burned tukuls could be accounted for, even if they are found within the same image. This function also allowed the analysts to save and store the results for future use.

Google Earth imagery was analyzed primarily within the Google Earth Pro platform by primarily utilizing the time-slider function to view archival imagery of an area. The directional tool was also employed when analyzing imagery at different angles. Additionally, imagery in Google Earth was compared with imagery analyzed in ERDAS Imagine through the 'Sync To Google Earth' function in the Imagine software.

# Chapter 2: Interpreting Imagery of Razed Tukuls

**2A**: **Operational Uses of Tukul-related Data**

The use of satellite imagery as a corroborative indicator of an attack having occurred, and as a means of assessing the scope and impact of the event, can support different types of operations performed by a range of actors. These actors include governments, inter-governmental organizations, humanitarian organizations, human rights groups, and researchers.

In some cases, different types of organizations may perform these applications during either the same or different operational stages, depending on their mission and access to imagery data. For example, information about the number of civilian structures apparently destroyed may help inform the response planning of humanitarian organizations. A count of the number of apparent standing civilian structures present in imagery collected before an alleged attack may help inform a population estimate for a specific area.

The presence of destroyed tukuls or other structures in imagery captured after an alleged event can act as an indicator that humanitarian assistance for the affected community's population may be required. These attacks on civilian areas often result in widespread displacement, destruction of livelihoods, and casualties. Humanitarian organizations may use this information to inform rapid needs assessments of where operations should take place and the amount of relief goods that should be requisitioned, prepositioned, and delivered.

Satellite imagery can also be used to collect and document evidence of an event having occurred. Human rights organizations can employ this information as part of advocacy campaigns to protect vulnerable populations by corroborating and documenting alleged acts that may have been committed against them. This data is particularly valuable when corroborating eyewitness reports of gross human rights violations that these groups often collect.[14]

Sometimes imagery analysis of alleged attacks can also be a source of primary evidence in criminal cases, especially when witness reports are unavailable. However, it is critical to note that not all phenomena human rights groups work to document are visible in satellite imagery due to limitations of the technology. These limitations can include its spatial[15] and temporal resolutions.

Utilizing satellite imagery to document attacks against multiple communities over a period of time can also help individuals and agencies better understand, and in some cases anticipate, the attack patterns of certain armed actors.[16] If captured and analyzed in near-real time, this data can help support early warning activities by corroborating reports and providing otherwise unobtainable information from non-permissive environments.

In addition to having strong operational applications, satellite imagery can also be used by researchers to develop additional methods and tools for use by humanitarian and human rights organizations. Through this research, tools can be developed that may help standardize, enhance, and speed future civil society applications of satellite imagery analysis.

For example, algorithms may be developed to help analysts identify where observable objects, like burned tukuls or tents used by displaced populations, may be located.[17] The automation of this identification process is critical for the advancement of humanitarian applications of satellite imagery because, currently, images are manually interpreted by analysts - often a laborious and time consuming process.

**2B: Operational Postures and Methods**

There are two main operational postures for the use of satellite imagery analysis to capture and understand information about alleged attacks on communities. These postures - detection and documentation - are core to identifying and obtaining information about the disposition of, and changes to observable objects related to this phenomena over time.

*Detection Posture*
Detection is a two-step process. First, analysts must identify the areas of interest (AOIs) out of the total possible geographic scope that might be relevant. The identification of these locations can be accomplished in two ways. Public and/or confidential reports claiming that an attack has occurred can help inform what imagery should be obtained from which locations during what timeframes. Second, an analyst may visually discover evidence of intentionally burned tukuls while reviewing imagery of locations for evidence of destruction or other conflict-related phenomena.

Once the area of interest is identified and relevant imagery has been obtained, then the analyst can begin to identify specific structures that are present and ascertain the observable status of these objects. In the context of this guide, these structures could be apparently intact or apparently destroyed tukuls. In many cases, if an attack has occurred, a combination of standing and destroyed tukuls are often visible.

As part of this process, an analyst must be able to determine how both intact and destroyed tukuls can present in imagery across a variety of contexts. These commonly repeating visual properties are explained in detail in Chapter 3.

*Documentation Posture*
Following the identification of both standing and destroyed tukuls, documentation of data related to these observable objects and their ascertainable features can then be performed. Documentation is the process of ascertaining and capturing specific data about both objects and the surrounding physical characteristics of the AOI. In the case of burned tukuls, a numerical count of the destroyed, and, when applicable, the apparently intact structures is performed.

Documentation can be performed using two types of imagery sets. First, detection and documentation can only be performed if imagery captured after the reported event has allegedly occurred can be obtained. It is critical that any post-event imagery is captured as soon after the date when the reported event may have occurred as possible.

Capturing post-event imagery as close to the date of the event is critical to prevent or mitigate the impact of a variety of commonly occurring variable factors. These variable factors can include seasonal weather patterns, such as heavy rains; natural disaster-related events; conflict-related events; or population influxes and displacements that may impact the landscape or the size and disposition of a community's population.

If an image of the area before the attack can also be obtained, information from this pre-event imagery can then be used to build a baseline data set that better informs the analysis of any available post-event imagery. This baseline data allows an analyst to conduct what is referred to as "multi-temporal change detection".

*Multi-temporal Change Detection*
Multi-temporal change detection is the process of comparing two or more images of the same location from different times against one another to make probabilistic inferences about changes at that location over a specific time frame. [18] In most contexts of satellite imagery analysis, multi-temporal change detection is a core analysis methodology.

To engage in change detection, a differential change metric needs to be identified (e.g. number of burned tukuls versus intact tukuls). Once the change metric is identified, this pre-event imagery can be compared to post-event imagery, captured as close to the date of the event as possible.

By performing change detection, changes in the number of standing tukuls present before and after an attack can be more easily determined because the images can be compared in order to ascertain data about the structures. It also must be considered that some locations can be attacked multiple times, often in a relatively short timeframe. Repeated attacks on the same location can complicate assessing what apparent damage was caused by which attack and when.

If pre-event imagery is not available, an analyst can instead use post-event imagery only to count burned tukuls in the area. While this scenario is not optimal, it can still produce data sets that have both actionable and evidentiary value for responders and investigators.

### 2C: Key Practical and Operational Considerations

There are several key practical and operational considerations that an analyst should be aware of when interpreting satellite imagery of intentionally burned tukuls. Issues an analyst might encounter will likely vary from location to location. No matter what the primary goal of the project might be, some critical cross-cutting questions should always be discussed and answered prior to interpreting imagery. These include identifying the purpose of the project; deciding what objects will be identified; ascertaining the limitations of available imagery data; and determining how the data will be processed, recorded and stored.

#### What is the purpose of this project?

It is always essential for all stakeholders involved in a project to identify what are the purposes and goals of the project before it begins. Establishing the purpose will help identify for the team what information should be captured, what data is required, and at what tempo it should be collected. Additionally, this process can help determine how that data will be analyzed and presented, and how that data will be used and preserved.

Projects are usually initiated for multiple purposes. All potential applications of the project should be identified at it's inception, if possible. Some of the types of purposes that can be identified at the start of a project include the following:

- **Evidence** of alleged gross human rights violations, including civilian displacement
- **Situational awareness** for use by affected populations and responding agencies
- **Advocacy** to promote improved responses and encourage political actions
- **Research** on dynamics of an armed conflict and its impact on civilians

#### What objects will be identified?

Before imagery interpretation begins, the objects required for identification must be determined. When working in large groups, which is often the case in VTO deployments, common imagery examples of key objects should be identified and shared with the group. Descriptions of notable visual characteristics should be provided as well. A system for reporting and recording any variances to these examples and descriptions should be established, including a process for agreeing changes to the basis for object identification.

#### What are the limitations of available imagery data?

The potential value of imagery interpretation for supporting humanitarian response often depends on what imagery can and cannot show. To identify the limitations of imagery interpretation in a specific scenario, two separate but related lines of inquiry are required.

First, general constraints of imagery interpretation must be addressed. Some questions that may help identify these constraints include, though are not limited to, the following:

- Are the objects of interest visible at the available resolution?
- If so, what characteristics of these objects can be seen and scientifically measured throughout the image?
- What inferences about these objects of value can be drawn from this data?
- Are these inferences based on identifying characteristics unique to these objects and their function, or can they also be drawn about different objects and for what reasons?

*Assessing Available Imagery Data*
Analysts will also need to determine whether the minimum pixel resolution of available satellite imagery is appropriate for identifying observable changes to objects consistent with tukuls. The minimum pixel resolution required is dependent on the objects or phenomena that an analyst needs to document.

Due to the small size of the objects discussed in this guide (e.g. tukuls), the imagery interpreted consists entirely of either high resolution (HR) or very high resolution (VHR) satellite imagery. HR imagery is characterized by having a resolution of approximately 1 to 5 meters per pixel, whereas VHR imagery has a resolution less than 1 meter per pixel. Currently, all satellite imagery is composed of pixels, and the resolution of an image is characterized by the size of the pixel that constitutes the image. For example, a VHR image with a resolution of .50 meters, would be an image entirely composed of .50 meter pixels. Taking this into account, the smaller a pixel is in measurement, the more pixels could constitute an image, thus making the resolution greater and smaller objects within the imagery better defined.[19]

Second, other key questions should be asked about the quality, volume, and temporality (e.g. how recently the imagery was collected) of the imagery data available for the project. These questions may include the following:

- How recently was available imagery collected?
- Are there large amounts of clouds, sun glare, or other factors that may corrupt the quality of the imagery available?
- How many images are available and over what time frame?
- What type of imagery was collected (e.g. panchromatic, high resolution, low resolution, near-infrared, etc.) and how does this imagery type affect completing the assigned task?

These questions are imperative to answer because the availability of imagery will determine its usability by the project. However, even if imagery is available, but its quality does not allow analysts to document the objects and phenomena they are interested in, then the imagery will not be useful to the project.

**How will data be processed, recorded, and stored?**

One of the first things that must be determined is what software will be used to process the imagery. For example, all raw imagery data for this guide was analyzed in ERDAS Imagine, with additional tasks performed with Google Earth Pro.

Once imagery interpretation begins, consistency and accuracy in how analysts record, categorize, and note who collected what data is essential. Decide before interpreting imagery what data will be recorded; how data will be entered into a database or logging system, with what specifications (e.g. to what precision will latitude and longitude be shown, etc.); and how activities performed by each analyst will be captured.

Also, a data storage plan should be developed and agreed upon. While data security is always crucial, it is especially important to ensure that data is secure and uncorrupted when dealing with information about the location and status of vulnerable populations, such as refugees and internally displaced persons (IDPs).

*Collecting and Storing Data as Evidence*
If the goal of imagery interpretation is to support accountability proceedings in a judicial venue, extra steps and precautions should be taken to ensure that potential evidence is not contaminated and the chain-of-custody is preserved.[12]

Some of these extra steps and precautions may potentially include the following:

- Storing potential evidence in a secure, encrypted offline server;
- Ensuring version and access control procedures, including an access log to preserve chain-of-custody; and
- the creation of corresponding time and date stamped narrative notes by each analyst documenting what they did with the data and how they processed it.

**How will images be annotated and presented?**

Analysts must determine how they will annotate and present images and findings in a way that clearly conveys the results of the analysis to both general and specialist audiences. Different icons including dots, chevrons, and lines can be used to indicate burned or intact tukuls, however, it is critical that minimal amounts of annotations are added to the image so that they do not distract from the image itself.

# Chapter 3: Visual Characteristics of Tukuls and Their Intentional Destruction

### 3A: Identification of Intact, Undamaged Tukuls

In order to assess whether or not a tukul has apparently been intentionally damaged by fire, analysts must be able to first identify apparently intact, undamaged tukuls. To perform this identification, analysts should be aware that tukuls, as mentioned previously, are not uniform in shape and size. A circular tukul with a conical roof is the most common variation. Tukuls may also have pyramidal and pitched roofs. Additionally, they can be square or rectangular (Image 3.1). Being aware of these visual variations across regions, and sometimes even within regions, is crucial.

Analysts should be mindful to the sometimes subtle differences that exist amongst tukuls across different ethnic groups, and that sometimes exist even within the same tribe or cultural demographic. For example, in Unity state, South Sudan, the Nuer tribe, who are mostly located in the central and southern counties of the state, construct primarily square-shaped tukuls. However, the Dinka tribe, who mostly inhabit the northern counties, mainly construct circular tukuls.[20]

The walls of a tukul are most often constructed with a wattle framework that is supported by a daub filling.[21] Mud bricks and concrete bricks can also be used. The conical roofs on circular tukuls are usually constructed out of thatch or other organically occurring materials. In some cases, tarps have been observed as being present ontop of a roof or integrated as part of it.

The square and rectangular tukuls, whose roofs can be sloped or pyramidal, can also be constructed out of thatch. However, depending on the region and its cultural demographics, other materials, such as metal, are used. It is important to note that the shape of a roof, especially a conical roof, can be difficult to identify in satellite imagery unless a shadow is cast to reveal the profile of the structure.

*Shadows Cast by Different Tukul Types*

The analyst should note the different types of shadows that can be cast by a tukul that may be relevant to identifying its shape and proportions. The importance of noting specific patterns of shadows on individual structures and groups of structures can help an analyst determine if an object is consistent with a tukul. Shadows can help an analyst disambiguate a tukul from other objects, such as trees or rocks. Tukuls can cast three types of shadows: “peak” shadow, “body” shadow, and “overhang” shadow.

An additional visual indicator that often accompanies these shadow types is the reflection, or glare, from the sun on the tukul roofs. On the surface of conical roofs, this glare can often be identified as a white mark directly opposite the side of the peak shadow, or on the side where the sunlight hits the roof. Similarly, on pyramidal and pitched roofs, this glare can be present on the angular edges of the roofs sunlit side.

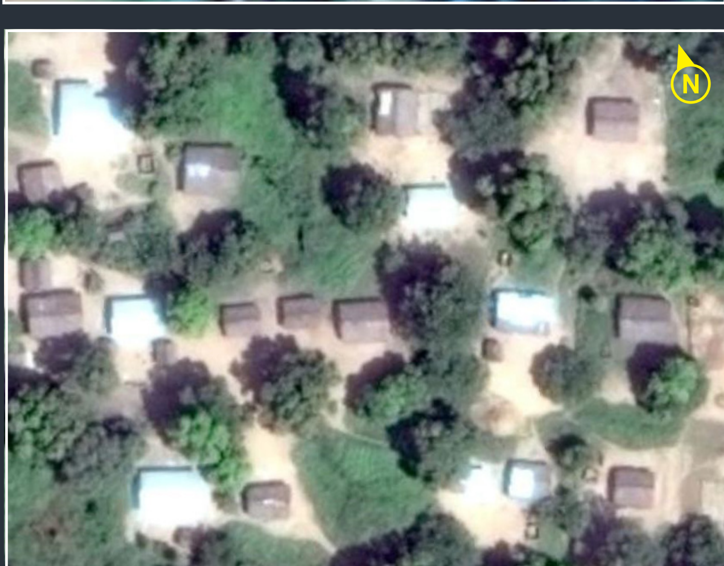
The first type of shadow that may be present is peak shadow, which is often visible on the conical roofs of circular tukuls. When sunlight falls on the tukul, the peak of the conical roof can cast a shadow on the roof of the tukul itself. The peak shadow emphasizes the conical shape of the roof.

Thus, the peak shadow assists in disambiguating tukuls with conical roofs from objects with potentially similar visual characteristics. Without a peak shadow, a conical tukul can sometimes appear as a circular object, with little to no other disambiguating visual indicators.

The peak shadow is also evident in both pyramidal and pitched roofs. However, their shadowing effect is different in size and shape than that of the shadowing effect of conical roofs. The peak shadowing on these types of roofs will likely cover more surface area compared to the narrow peaks of conical tukuls. This phenomenon is caused by the larger, angular face of pyramidal and pitched roofs obstructing more sunlight than the conical roof.

Image 3.1


**Circular Tukuls With Conical Roofs**
20 January 2015
Gambela, Ethiopia




**Rectangular Tukuls With Pitched Roofs**
03 November 2014
Bossangoa, Central African Republic


**Square Tukuls With Pyramidal Roofs**
14 January 2015
Rumbek, South Sudan

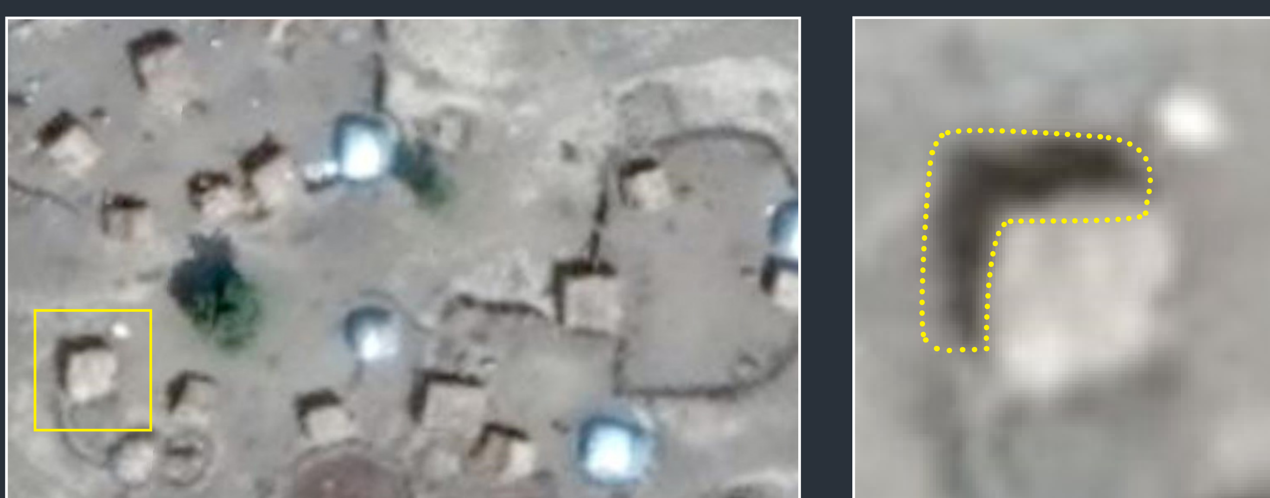
In Image 3.2, peak shadows are visible on circular and pyramidal tukuls present in the Abyei area, a disputed region between Sudan and South Sudan. On the circular tukul, a peak shadow is located on the northwest side of the roof, just below the peak. A peak shadow is also present on the northwest side of the pyramidal tukul.

**Image 3.2**


**Pitch Shadow**
28 January 2015
Abyei Town, Abyei Region

The second type of shadow that can be created by a tukul is body shadow. The body shadow can often be more evident in square or rectangular tukuls constructed with roofs that do not significantly extend beyond the walls of the tukul. Sunlight falling on the tukuls casts angular shadows. These shadows are visible in the direction opposite from which the sun is shining. In Image 3.3, this angular body shadow can be identified coming from the square-shaped tukuls found in the western outskirts of the town of Kadugli in Sudan.

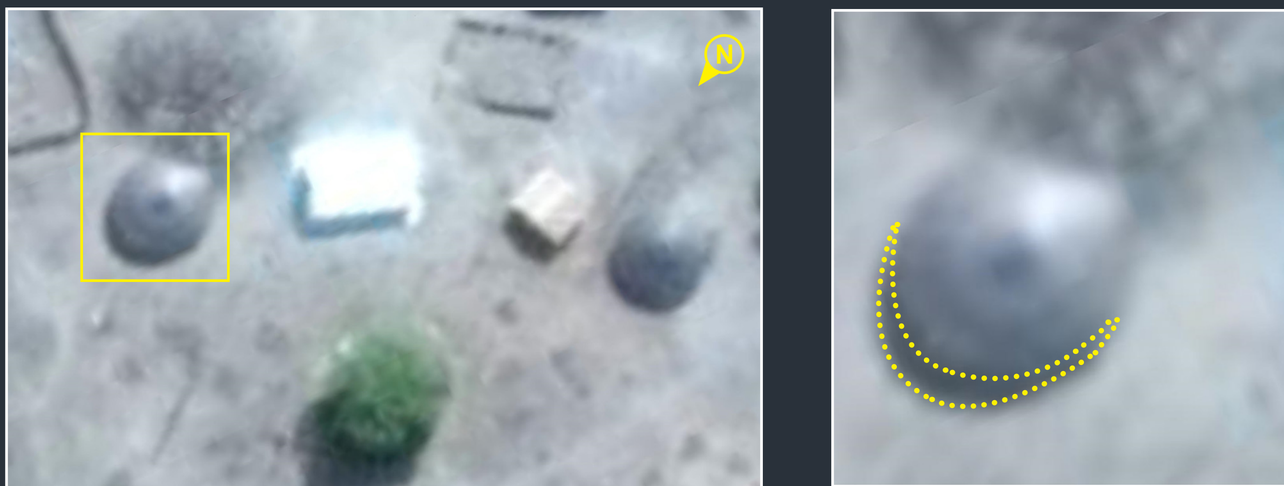
**Image 3.3**



**Body Shadow**
03 February 2015
Kadugli, Sudan

The final type of shadow is overhang shadow. While this type of shadow can be observed on square or rectangular tukuls, overhang shadows are most often cast by the edge of the roof of circular tukuls. This shadow is more common in circular tukuls because the majority of these structures have roofs that overhang the walls of the structure. In Image 3.4, the overhang shadows cast by circular tukuls in this area of Abyei town can be identified coming from the circular-shaped tukuls.

**Image 3.4**




**Overhang Shadow**
28 January 2015
Abyei Town, Abyei Region

*Factors that Affect Shadowing*

A critical factor to consider when interpreting shadow types is that commercial satellites pass over areas on a relatively routine schedule. This operational factor results in imagery of areas being collected at roughly the same time of day each time when they are collected. Thus, the orbital patterns of satellites tend to regularly produce imagery of an area with the sunlight casting shadows in relatively the same direction and in relatively similar shapes in most every image.

One aspect of satellite imagery that analysts should consider is the angle at which satellites capture an image. The nadir, when referring to satellite imagery, is the point on the ground directly vertical from the center point of the satellite's sensor.[22] The off-nadir angle is the measurement of any point on the ground that is not at nadir. Thus, the off-nadir angle is point not directly vertically above from center point of the lens.[23]

The higher the degree of the off-nadir angle, the more the objects within the imagery may appear skewed, stretched, and distorted. Imagery collected at a high off-nadir angle can be useful in particularly urban settings, where the sides of larger structures can be better seen at an angle. However, when trying to interpret visual data, such as shape and size, a very high off-nadir could prove problematic by providing a less accurate representation of ground objects captured in the imagery. Many commercial satellite companies provide imagery with maximum off-nadir angles that range from 30 to 60 degrees.

### 3B: Identification of Recently Burned Tukuls

Burned tukuls, whether intentionally or unintentionally burned, have certain repeating visual characteristics that can be observed in satellite imagery. These characteristics relate to both how tukuls are usually ignited, what they are made out of, and the repeating patterns in which tukuls are often consumed by fires as they burn.

*Seat of fire*

Regardless of whether lit internally or externally, the roofs - because they are made from thatch or other dried, organic materials - are highly combustible and burn quickly. Thus, the roofs often appear as the origin point of the fire that destroys the tukul, a concept known in fire science as the "seat of fire."[24]

Villages that have been intentionally burned have multiple seats of fire because each structure has likely been burned individually. Sometimes structures can be burned by fires that originate from another structure that has been ignited nearby. However, analysts should first look for evidence of multiple individual structures being burned.

*Four critical indicators of burned tukuls*

Analysts should be aware of these four critical indicators when detecting evidence of apparently burned tukuls at any temporal resolution:

- **Charred walls:** Black in color and circular, rectangular, or square in shape depending on the type of tukul;
- **External ash**: An outline of ash caused by a roof that overhangs the exterior of the tukul being burned may be present around what remains of the tukul. This outline will likely be proportionate to what was the shape and size of the roof. Additionally, ash can be blown by wind in proximity to a burned structure, often scattering in a way consistent with the wind's direction;
- **Interior ash**: Ash resulting from the burning of the tukuls that may vary in color. The color of the ash is most often determined by the severity of the fire. Fires of medium severity often result in dark colored ash, whereas high severity fires result in grey or white ash.[25] Interior ash can be generated by the burning of the tukul's roof and walls, along with any objects inside that are combustible.
- **Ground scorching:** Lit tukuls can cause ground scorching by either the burning tukuls causing the ground vegetation to catch fire and/or the smoke, ash and heat of the tukul scorching the ground around it. Ground scorching is usually black in color.

**3C: Visual Indicators of Intentionally Burned Tukuls**

Determining whether tukuls have been intentionally burned through the analysis of satellite imagery alone is always based on a probabilistic assessment of available evidence. In the absence of ground confirmation, analysts must identify a few key indicators that are routinely consistent with the apparent intentional burning of tukuls. Three key visual indicators are critical for assessing evidence of apparent intentionality:

- **Spacing:** Observable unburnt spaces between burnt tukuls is the most critical visual indicator that an individual structure or group of structures has likely been intentionally burned. The unburnt ground between burnt structures indicates the deliberate targeting of individual structures;
- **Selection:** A related indicator to spacing is "selection" (e.g. some buildings or infrastructure being burnt when others are left untouched). When ground scorching obscures any visual evidence of spacing, selection becomes a key indicator of apparent intentionality. Evidence of selection may show intent to target certain types of structures (e.g. civilian dwellings) over others; and
- **Clustering:** Clusters of burnt structures, including entire villages, can be an indicator of intentionality. Clustering, a related manifestation of selection, is valuable for both showing apparent macro-patterns of perpetrators over time, as well as helping to rule out incidental, non-conflict related fires as the cause of combustion.

The properties of burned, and most importantly, intentionally burned tukuls are present in imagery of Maker Abior, Abyei Region, captured on 6 March 2011 (Image 3.5). This image was captured three days after a reported attack on the area. Approximately 20 circular tukuls of varying sizes appear to have been intentionally destroyed.[26]

Charred walls, circular and black in color, surround the perimeter of what used to be a standing, intact tukul. Inside the charred walls, white, black and grey interior ash is present. As stated previously, various ash colors indicate the intensity of the fire that previously burned. Additionally, exterior ash can be identified next to some of the burned structures. Ground scorching stemming from some of the structures is indicated by the black color and larger surface area, than compared to external ash.

Most critically, the unburnt spacing between the burned tukuls indicates that these structures were intentionally targeted. Standing, intact tukuls are also present nearby. The presence of these untouched structures, amongst clustered targeted structures, indicates these tukuls were individually selected by the perpetrator.

Image 3.5


**Apparently Intentionally Burned Tukuls**
06 March 2011
Maker Abior, Abyei Region

Additionally, in image 3.6 of Tajalei, Abyei Region captured on 6 March 2011, key characteristics are also demonstrated. Multiple burned structures, including both circular and rectangular tukuls, are present with the ground between them remaining unburnt. This pattern of destruction is consistent with that documented in Maker Abior. Black and white/grey ash are additionally present inside the remains of the burned tukuls. In some cases, ground scorching is also present next to the burned structures. Additionally, like in Maker Abior, trees throughout the attacked area remain intact.

Image 3.6


**Multiple Burned Structures**
06 March 2011
Tajalei, Abyei Region

*Non-conflict Related Fires*
In addition to the intentional burning of civilian dwellings during conflict, parts of Central and East Africa are prone to large-scale wildfires when vegetation becomes desiccated during the dry season. This seasonal phenomena often results in naturally occurring fires. These fires can spread over several square kilometers and have the ability to raze traditional structures when the fire is not quickly contained.[27]

Accidental fires, such as fires from cooking stoves, that damage structures and displace communities may occur. Further, the intentional burning of land for clearance or agricultural purposes, known as the slash-and-burn technique, is prevalent as well. During slash-and-burn, forests or wooded areas are cleared to to create fields for planting. Already cleared areas can also be lit prior to planting. The resulting ash is used to add nutrients to the soil for crop cultivation.[28] These fires often create large burned areas.

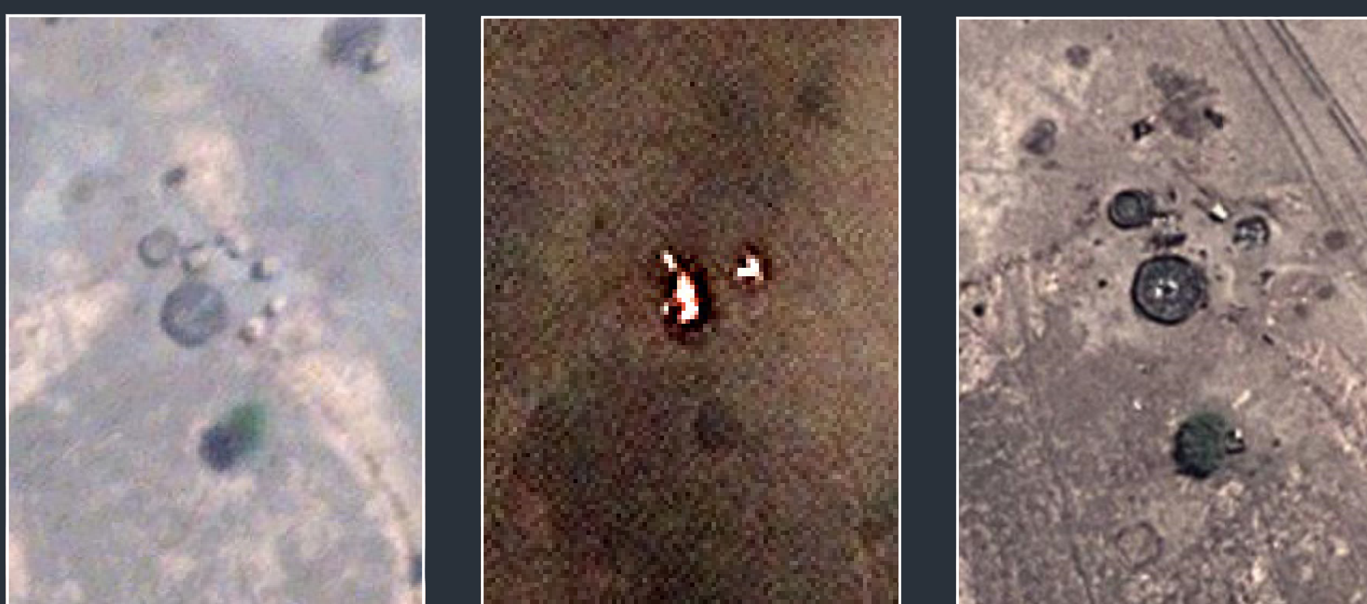
**3D: Identification of Ongoing Burning and Smoke**

In some instances, imagery can also reveal the presence of ongoing fires and smoke which can range in color from yellow to red and white to black, respectively. Factors that can affect the coloration of the fire and smoke include the materials being burned[29] and the level of moisture present in the environment.[30]

In the case of imagery collected of conflict areas, this active burning can occur during, or recently following, an attack, where tukuls or other objects are still burning. As seen in Image 3.7, a progression of three images reveals a standing tukul from 15 February 2011, fire burning in the location of the tukul during an attack on 24 May 2011,[31] and imagery of the destroyed tukul after the fire has subsided from 26 May 2011.

The burning tukul is partially obscured with smoke and clouds, however, the fire can be identified due to the stark contrast and luminosity of the flames. When comparing multiple georeferenced images of the same area, it can be determined that the coordinates of the fire are exactly the same location as the tukul identified in the other two images.

**Image 3.7**



**Before, During, and After Images of a Burning Tukul**
05 February 2011 | 24 May 2011 | 26 May 2011
Dungop, Abyei Region

Imagery analyzed by UNITAR-UNOSAT additionally reveals a structure still on fire and multiple clouds of smoke (See Image 3.8). This fire, in Leer, South Sudan, is burning in an area where approximately 1,500 structures, including tukuls, were destroyed and damaged over a large geographic area. UNITAR-UNOSAT notes that the majority of the destruction was caused by fire.

**Image 3.8**

**Burning Tukul**
02 February 2014
Leer, South Sudan

Most commonly, active burning is seen in imagery of agricultural fires or incidental wildfires during the dry seasons, as large amounts of forested or vegetative areas in these regions can often be subject to burning. Fires and the smoke extending upwards from the flames can be detected in the imagery.

As seen in Image 3.9, a fire is visible in a forested region located in the Democratic Republic of Congo. The fire covers a long strip of ground, where vegetation is present, and light-colored smoke is extending from the flames. While this burn pattern can be consistent with that of slash-and-burn agriculture, it can’t be disambiguated from a natural wildfire without verification.

**Image 3.9**

**Forest Fire**
20 July 2013
Democratic Republic of Congo

# Chapter 4: Techniques and Limitations

## 4A. Multi-temporal Change Detection and Its Limitations

One of the most frequently employed techniques in the analysis of imagery of damaged structures is multi-temporal change detection. To conduct change detection, the analyst compares a minimum of two images, once collected before the reported event and one collected after. By comparing the images, changes to the number and visual indicators of objects can be observed and a relative timeframe of when the destruction occurred can be assessed.

A major limitation of this technique is that the post-event imagery must be captured as close to after the reported event as possible. Depending on the length of time between the pre- and post-event imagery, characteristics will be observed to lesser and greater degrees due to seasonal weather and changes to the environment. For example, in the case of identifying burned tukuls, ash may be washed away if it rained soon after the tukul was razed. Whereas charred walls and any remaining structural components may be visible for sometime after the tukul was burned.

Visual indicators consistent with the intentional burning of tukuls may also become less apparent over time. Ground scorching and the dark charred remains of individual tukuls can fade over time due to natural factors, especially during rainy seasons when heavy rainfall can wash away traces of scorching that remain.

Vegetation can regrow in many areas, which can potentially obscure evidence of intentionally burned tukuls. This occurrence is especially prevalent following a rainy season, when grass and other vegetation regrows. This further emphasizes the critical need to acquire post-event imagery that is captured as close to the date of the attack as possible. Additionally, if structures are quickly rebuilt following an attack, before a post-event image can be captured, then evidence of damage may not be present.

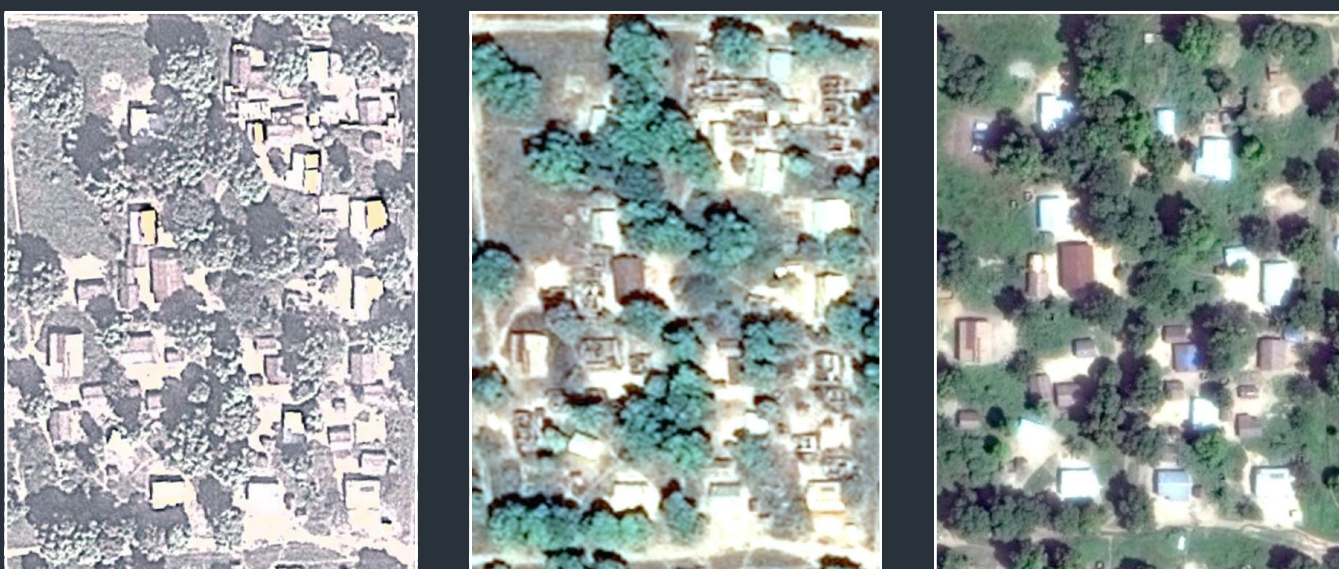
**Image 4.1**


**Vegetation Regrowth Following Destruction**
15 February 2011 | 26 May 2011 | 28 February 2013 | 03 September 2013
Abyei Town, Abyei Region

Following a large scale attack on Abyei Town on 24 May 2011[32], several structures, including a large number of circular and square tukuls, tents, and other buildings were destroyed and burned to the ground. Individually burned tukuls, yet no widespread ground scorching, are present in imagery captured after the event. However, subsequent imagery indicates that most of the destroyed structures were not rebuilt, and the area has since become overgrown with vegetation (See Image 4.1).

Additionally, in Image 4.2 , collected on 7 January 2014, just 5 days after an attack in the city of Bossangoa, the majority of the structures, primarily rectangular buildings of varying sizes, are seen without roofs.[33] Ground photos taken during the attack show that not only are these structures primarily composed of a type of mud brick with thatched roof, the roofs themselves were set on fire. While some ground scorching is present throughout the area, the majority of structures have no ground scorching between them. The absence of ground scorching indicates potential evidence that these structures were intentionally destroyed. However, subsequent imagery taken 10 months later reveals that some tukuls destroyed in the attack were rebuilt, while entirely new tukuls were also constructed in the vicinity.

**Image 4.2**



**New and Rebuilt Tukuls Following Destruction**
15 December 2013 | 07 January 2014 | 03 November 2014
Bossangoa, Central African Republic

Another major variable that can affect the temporal analysis of tukul destruction are cases when an area has been subjected to several attacks over a period of time. For areas that have been attacked repeatedly, it can prove difficult for an analyst to accurately assess what structures were damaged in which attack because remnants of razed structures from past attacks may still be visible.

### 4B. Limitations and Variables Affecting Analysis of Burned Tukuls

In addition to the limitation described in Chapter 3E relating to multi-temporal change detection, there are two additional limitations and variables that can affect the identification of visual characteristics of burned tukuls present in satellite imagery. These three categories of factors should always be taken into account when conducting an analysis and numerical count of apparently burned tukuls:

- Presence of apparently standing, intact structures; and
- Presence of objects that may resemble tukuls.

*Presence of Apparently Standing, Intact Structures*
The first variable that should be taken into account is the common occurrence of intact structures still present after an attack has taken place. This phenomena can be due to A) the structure not being targeted or B) the damage not being visible to the analyst.

In the latter case, it is likely that the tukul could become a “false negative” in any dataset created by the review of the imagery. This happens when a tukul is fire damaged internally but the roof is not ignited.

Depending on the size of the fire, or if the fire was extinguished before it could damage the roof, the tukul could suffer damage internally while still appearing intact externally. This is more likely to happen when tukul walls and roofs are built with less combustible materials, such as concrete and metal.

*Presence of Objects that May Resemble Tukuls*
Finally, the presence of objects similar to shape, size, and color to tukuls, both standing and destroyed, needs to be take into account. Especially when interpreting imagery of circular tukuls, there are several objects that the analyst needs to cognizant of that could be mistaken for both standing and destroyed tukuls. Trees and boulders, which can appear as similar to the circular shape and brown color of a standing tukul appear often in imagery, and objects such as wells and corrals can resemble a destroyed tukul’s circular base.

### 4C. Limitations and Variables Affecting Assessment of Intentionality

There are also two additional major limitations and variables that must be taken into consideration when assessing the intentionality of the destruction of tukuls:

- Presence of ground scorching; and
- Areas subject to repeated attacks.

*Presence of Ground Scorching*
Analysts must be careful to note any ground scorching surrounding burned tukuls. Following a large-scale attack resulting in widespread fire, ground vegetation can be ignited and cause fire damage over a large area. Sometimes ground scorching and secondary fires can be evidence of intentionality or, in some cases, obscure indicators of intentionality.

As previously noted, the absence of ground scorching between destroyed structures is often the primary indicator of intentionality. However, it can also be the case that the presence of highly concentrated ground scorching around several structures can, itself, be an indicator of intentionality as well.

In some rare cases, intentionally attacked villages with large amounts of ground scorching may appear almost identical to a village affected by an unintentional incidental fire. Most often, though, tightly targeted clusters of ground scorching will generally present as an indicator of intentionality.

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# Imagery Interpretation Guide

## Assessing Wind Disaster Damage To Structures

Harvard
Humanitarian
Initative

Signal Program on Human Security and Technology

**About This Project**

The methodology was developed by the Signal Program to specifically address gaps in current practice identified by the World Bank. The World Bank communicated its need for this methodology to the Signal Program after financing an Unmanned Aerial Vehicle (UAV) damage assessment of the impact of Cyclone Pam on Vanuatu in 2015.

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**The Signal Program on Human Security and Technology**

The Signal Program on Human Security and Technology (Signal Program) was founded by the Harvard Humanitarian Initiative in 2012. Signal Program staff, fellows, and partners work to advance the safe, ethical, and effective use of information technologies by communities of practice during humanitarian and human rights emergencies.

The program addresses critical gaps in research and practice that HHI encountered while designing and managing the pilot phase of the Satellite Sentinel Project (SSP) from December 2010 to the summer of 2012. As part of SSP, HHI analyzed satellite imagery and open source reports from Sudan and South Sudan to assess the human security status of civilians.

The program's ongoing research and scholarship focuses on the following three areas:

- *Tools and Methods:* Design and scientifically test tools and methods that remotely collect and analyze data about humanitarian emergencies;
- *Standards and Ethics*: Lead the development of technical standards and professional ethics for the responsible use of technology to assist disaster-affected populations; and
- *Mass Atrocity Remote Sensing:* Conduct retrospective analysis of satellite imagery and other related data to identify remotely observable forensic evidence of alleged mass atrocities.

**The Harvard Humanitarian Initiative**

HHI is a university-wide center involving multiple entities within the Harvard community that provide expertise in public health, medicine, social science, management, and other disciplines to promote evidence-based approaches to humanitarian assistance. The mission of HHI is to relieve human suffering in war and disaster by advancing the science and practice of humanitarian response worldwide.

HHI fosters interdisciplinary collaboration in order to:

- Improve the effectiveness of humanitarian strategies for relief, protection and prevention;
- Instill human rights principles and practices in these strategies; and
- Educate and train the next generation of humanitarian leaders.

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Ray Shirkhodai

Executive Director,
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# Foreword

It was not very long ago that hazards were viewed as inevitable furies of nature, and disasters as the tragic outcomes, countered only by transfer of the risk through insurance and statistical loss estimation. Then came those committed to changing that helpless narrative, arguing that disasters – defined as the intersection of hazard forces destructively impacting the human-built environment and overwhelming the related systems – can be reduced by minimizing the intersection of hazards and human systems. Through their efforts, Disaster Risk Reduction (DRR) was coined and disaster management entered a new era.

Today, DRR research and practices encompass a wide array of activities: hazard avoidance, increasing coping capacities, and improving recovery capabilities. Yet, try as we may to reduce risks, we cannot entirely eliminate the destructive impacts of all hazards for all exposed communities. And, when destruction does occur, every second saved in assessing the damage and obtaining accurate and actionable information could literally translate into lives saved.

As critical as rapid damage assessment is to effective relief and response operations, to-date it relies heavily on eye-witness, on-the-ground reports from the responders. This is very problematic, not only because remote locations, where damage may be most extensive, are hard to reach; but also because it presumes responders' knowledge of and ability to quickly reach the hardest-hit areas and appropriately communicate what they see. Even so, uniformly mapping the reports and sharing the results take additional valuable time. At the same time, various methodologies for assessing damage remotely require obtaining and maintaining large volumes and inventories of pre-impact data, which again is neither practical nor scalable. Finally, ad hoc methodologies used for remote assessments lack standardization, chain-of-custody, and a common baseline necessary for wide sharing of the information among the participating communities.

The authors of this study at the Harvard Humanitarian Initiative (HHI) considered means of addressing these challenges by offering a uniform approach, using commonly available high-resolution imagery, spatial analytical tools, and a standard visualization system that does not demand high proficiency in a specific language or jargon. Even though focused on wind damage assessment, the approach described here could well serve as a means of establishing a common baseline for rapid damage assessment regardless of the hazard type, and may begin to establish standards for all such remote assessments.

Since 1996, Pacific Disaster Center has been looked upon as an important innovator in applying scientific methods and emerging technologies toward disaster management, and a contributing partner in the DRR efforts worldwide. Our colleagues at HHI may just have given us all another important innovation: a fresh look at technologies used toward a common, scalable, and practical approach to remote damage assessment.

This proposed HHI approach has the potential to contribute significantly to DRR as a whole, but more importantly, may lead to valuable, actionable information for decision makers, precisely at the point when every second matters the most.

Ray Shirkhodai

Executive Director, Pacific Disaster Center

# Chapter 1: Standardizing Remote Assessments of Wind Disaster Damage

## 1A. Introduction

The ability to rapidly assess wind disaster* damage to structures is a critical necessity for responding agencies. However, the assessment process is complicated by the lack of common standards and scalable methodologies for the use of remote sensing in damage assessments. At present, accepted methodologies for wind disaster damage assessments rely almost exclusively on responders having ground access to the affected area to document damage to housing structures.[1]

This approach to rapid needs assessments in these scenarios can prove time consuming and inefficient, particularly in the critical period immediately following a storm's impact when this data is potentially most useful. Geospatially-based damage assessments may provide actionable information to responding agencies about hard-to-reach, often non-permissive environments.

Agencies are increasingly using geospatial technologies to conduct wind disaster damage assessments of structures without agreed methodologies for doing so. The primary problem facing these agencies is the absence of a "theory of actionability" for how and why the provision of geospatial data to responding agencies can enhance ground operations.

The absence of a common theory of actionability has created a significant gap in the current practice of geospatial analysis-supported ground operations. This gap in current practice has real implications for humanitarian agencies that can operationally manifest themselves in some of the following ways:

- *Conflicting counts of damaged structures:* Without a common methodology, different analysts can come to different and conflicting counts of how many structures have been visibly damaged by a wind disaster event;
- *Varying damage scales:* The severity of damage assigned to one structure may vary between assessments of the same structure by different analysts, or teams of analysts, due to the lack of a common method for agreeing damage scales; and
- *Slower response and reduced actionability:* Lacking common, agreed standards for what information is most required, what formats and metrics are most actionable, and without a shared basis for understanding how this information should be used by ground responders may slow response and reduce the ability of non-geospatial experts to operationally apply information gained from these assessments. Additionally, the absence of these guidelines can lead to conflicting or duplicated information, further hindering the response.

The goal of this guide is to address these gaps by providing the foundation of a common approach for conducting geospatially-based damage assessments of the impact of wind disasters on structures. The guide is aimed at institutional analysts, voluntary technical organizations (VTOs), and affected communities who may be utilizing geospatially-derived data to support ground operations in the initial phase of a wind disaster response through seeking to improve situational awareness for responding agencies and communities.

The method presented in this guide is the "Baker, Achkar, Raymond" methodology (hereafter, "BAR"). It was developed by the Signal Program on Human Security and Technology (Signal Program) at the Harvard Humanitarian Initiative (HHI) at the request of the World Bank to standardize the categorization of structures visible in geospatial data and create a common severity scale for assessing apparently visible damage to these objects.

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* Wind disasters can include cyclones, typhoons, hurricanes, tornadoes, and other similar phenomena.

Satellite and UAV imagery of the aftermath of Cyclone Pam, which hit the island of Vanuatu in March 2015, is utilized as a case study for demonstrating the potential application of the BAR methodology. While each wind disaster event will differ in terms of context and impact, the aim of the BAR methodology is to provide the first common, scalable approach for conducting these assessments through geospatial data across contexts and varying types of wind disasters.

### 1B. Current State of the Art

The Signal Program surveyed all available literature related to remote and ground-based assessments of damage to structures caused by wind disasters in preparing to conduct the research presented in this guide. The goal of the survey was to identify any relevant approaches for guiding geospatially-based damage assessments of areas affected by these types of disaster events.** No method specific to remote assessment of damage to structures caused by wind disasters was found in this review.

However, two major ground-based methodologies - Economic Community for Latin and America and the Caribbean (ECLAC) assessment and the Enhanced Fujita Scale (EF) - appear to be the most commonly used at various points as part of some geospatially-based assessments. The Signal Program finds, though, that these two models do not provide a methodological approach sufficient to comprehensively document damage to structures using data produced by geospatial and remote sensing-based approaches.

Moreover, the literature on damage assessment shows a general absence of a common theory and corresponding methodology for assessing storm damage to structures that is scalable across contexts and geographic regions. As mentioned previously, these methodologies are fundamentally designed for ground-based assessments, and thus are not intentionally tailored to be used with geospatial data.

*ECLAC Handbook for Disaster Assessment*
The ECLAC approach focuses broadly on determining the socio-economic impacts of damage inflicted by a natural disaster. ECLAC-based data may provide some useful insights when conducting a damage assessment specifically focusing on the monetary cost of damage to housing stock. A well-established pre-disaster event baseline of data about existing types and common conditions of regionally specific dwellings and structures, which is often not available in many contexts, is required to conduct an accurate and actionable assessment. [2]

The ECLAC approach categorizes different housing units by distinct types to indicate the extent of damage to specific classes of housing units. The ECLAC assessment methodology focuses on ascertaining the estimated costs of event's damage to inform post-disaster needs assessments as part of reconstruction efforts. While useful for medium and long term reconstruction activities, this approach does not adequately support initial rapid needs assessment activities.

There are multiple reasons why ECLAC is not a strong "tool-to-task" match for rapid needs assessments, regardless of the involvement of geospatial data. The method is time consuming and requires pre-existing, in-depth data on a region's specific housing infrastructure, market prices, and income of occupants. Additionally, ECLAC relies heavily on ground-based visits which are often not permissible or cost-effective in the immediate aftermath of a disaster.

*Enhanced Fujita Scale*
The EF Scale is the most widely used method for assessing the severity of a wind disaster event, and it was developed specifically to assess damage caused by tornadoes. The EF Scale was developed to fill the gaps that existed in the previous model, known as the Fujita Scale.[3] The authors of the revised 2006 assessment noted that the limitations to the Fujita Scale "are a lack of damage indicators, no account of construction quality and variability and no definitive correlation between damage and wind speed." [4]

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** "Geospatially-based damage assessments" are defined in the context of this document as efforts to ascertain the number and severity of structures damaged by a wind disaster based initially on imagery derived from earth orbiting satellites and/or UAVs, as opposed to efforts to corroborate a ground-based assessment of wind disaster damage to structures.

The new model established 28 damage indicators (DIs) ranging from structures, to trees, and telecommunications poles; each of which can possess various degrees of damage (DODs) based on the identified DIs.[5] Both Fujita models were created to determine wind speeds and therefore accurately assess the strength of a tornado based on the damage occurred to the identifiable DIs.

The EF model provides useful steps to creating a wind-related damage assessment model in terms of providing a detailed list of DIs and DODs. While valuable in certain scenarios, the model is largely reliant on responders having the ground access necessary to assess damage for the explicit purpose of estimating wind speed and tornado strength, rather than to provide a comprehensive overview of the total degree of damage to an area.

The enhanced model improves upon the previous Fujita Scale as a ground-based assessment tool, but it does not provide a directly transferrable metric and method for geospatially-based analysis of the total scope of damage present in wind disaster affected areas. Regardless, EF has been used in some remote sensing-based assessments of wind damage, most notably crowdsourced assessments of tornado damage in the United States.[6, 7]

### 1C. Gaps in Current Practice

The Signal Program's analysis of the current state of the art in this field indicates that there is no common methodology for performing this specific task intentionally with a remote sensor. The following are the three most urgent gaps the Signal Program has identified that illustrate this problem, which the method presented in this guide seeks to address:

- *No Common Damage Scale:* There does not exist a method specific to assessing the severity of damage to structures through remote sensing data during the initial "rapid assessment phase" with the aim of intentionally supporting critical decision making by ground responders.
- *No Common Structure Categorization System:* No common categorization system for broadly categorizing types of structures and levels of damage repeatedly observed across these categories appears to exist.
- *No Agreed Imagery Annotation Approach:* In the absence of a common structure type and damage level classification system, there are no shared standards for annotating imagery data of disaster affected areas, which prevents generating aggregated data sets from different assessments over time and across contexts, significantly limiting the potential actionable value of this data.

Addressing these gaps is critical because NGOs, governments, and researchers are increasingly using remote sensing to perform initial damage assessments after wind disasters. The rise in the use of this technology can likely be anecdotally attributed to ongoing improvement to technical and market access to geospatial data and related platforms.[8]

However, as evidenced by the Signal Program's survey of the literature, this work is being done without common methods and standards for data capture, analysis, and presentation. This lack of accepted methods and standards for wind disaster damage assessments appears to have resulted in no clear theory of expected impact for why, when, where, and how these assessments are performed.

# Chapter 2: Applying the BAR Methodology

## 2A. Overview of the BAR Methodology

The BAR method proposed by the Signal Program provides a standardized and replicable approach to damage assessment of wind disasters through the analysis of geospatial data. As part of this methodology, assessments, outputs, notation and presentations of the data collected and analyzed are standardized to support responders by delivering information in a common format that is believed to be most actionable in the rapid needs assessment phase.

The proposed methodology is not meant to eliminate the need for ground-based assessment - rather it provides a complementary approach to support humanitarian operators simultaneous to the deployment of ground assessment teams. Ideally, assessments conducted using the BAR methodology will help target ground assessment teams, speeding the completion and cross-corroboration of their assessments.

BAR is based on two preconditions to be deployed: First, baseline data (e.g. imagery captured prior to the wind disaster event occurring) must be available to compare post-event imagery against to determine the pre-disaster disposition of apparently affected structures; and second, analysts and digital volunteers deploying BAR must have basic fluency in commonly available software platforms and methods of imagery comparison analysis. For the first criteria, it is important to note that high resolution baseline satellite imagery does not necessarily have to be acquired commercially, and can often be found for no cost on online digital platforms, such as GoogleEarth.

The core components of the BAR methodology in the order that they should be applied are as follows

1) **Setting Parameters:** First, an alphanumeric grid frame is overlaid on satellite imagery of the Area of Interest (AOI) with software which can include ArcGIS or InDesign. The grid will serve to guide the imagery analysis of the image(s) by the analyst(s). Though an important part of the process, the absence of the grid should not impede the users application of the methodology. (See *Appendix I*)

2) **Assigning Structure Categories:** Second, all potential structure types apparently visible in the imagery, regardless of region and contexts, are sorted into three categories: A) Light strength structures (the most vulnerable); B) Medium strength structures (moderately vulnerable); and C) Heavy strength structures (usually the least vulnerable). Each analyst or group of analysts performing a damage assessment through the BAR Methodology must agree what constitutes light, moderate and heavy structures in their specific operational context. (See *Section 2B* below)

3) **Assigning Damage Scale:** Each object in every structure class is assigned a specific color that corresponds to the damage scale. The damage scale is a point based scoring system that ranges from 0 to 3. These classifications remain the same for each structure class and are used to assess the damage of each building to give it a point ranking. The point system is as follows: 0 = no visible damage to the structure; 1 = visible partial roof damage while; 2 = the roof has suffered significant damage or is completely off, but the walls remain standing; and 3 = the walls and the roofs are down and the structure integrity is completely compromised.

4) **Calculate Point Totals:** The point total for each object and for each structure category are aggregated together into a total score for each grid square and the entire AOI. The aggregated results of BAR are a points based damage score that can be visualized as either a numeric chart or a map. The long-term goal of this point total system is to eventually support the creation of computer supervised classification algorithms.

## 2B. Assigning Structure Categories

Establishing set criterions in order to classify observed structures into three categories is a critical first step that will allow the user to appropriately deploy the methodology. A poorly established categorization will negatively impact the viability and accuracy of the assessment conducted. Categorizing structures allows analysts to provide a rapid assessment of damage caused by wind-related disasters to the areas observed. Through categorization and classification, analyst(s) can provide a snapshot of damages relating to specific type of infrastructures and establish a preliminary understanding of areas most vulnerable and in need of immediate help. Categorization has an added benefit of assessing the strength of the disaster based on damage done to structures that are considered structurally stable and not vulnerable.

The characteristics of types of structures defined below will help users classify observable structures into the categories that are best suited. In each situation this methodology is applied, the defined characteristics and parameters will help users easily classify structures into three defined categories: light, medium and heavy. It is expected that structure classification will differ across countries and regions due to infrastructure and socio-economic differences from one area to the other.

Cultural differences and regional dynamics will affect defining parameters for each of the classes established below. These differences will be especially impactful in regards to the light structures definition as this class is the most sensitive to these differences and is often dominated by traditional methods of construction in the regions observed. Understanding cultural preferences and techniques in construction is therefore a necessary task to undertake in order to properly categorize the different structures. As part of any study, the team will need to clearly articulate which structures fits into the different categories and provide a rationale for doing so prior to starting any imagery analysis. When applying the BAR methodology, analysts should document and publish the criteria they choose for assigning each category.

- △ *Light Structures:* This category, annotated with a triangle, encompasses structures that are built predominantly from light material or locally sourced materials. These structures may be mobile or possess no real hard roof, in some cases, roofs are made of metal or light material; they are often small in size. As such, these structures are likely to be the most vulnerable structures in any impacted region. Examples of these types of structures can include huts, tukuls or mobile trailers.
- ○ *Medium Structures:* This category, annotated with a circle, encompasses structures that are built from semi-hard materials or mixed products. These structures have solid frames built using wood, steel or cement. These type of structures are fixed and possess hardened walls and roofs which can be made out of wood or cement. Unlike light structures, these types of structures are able to withstand moderate level of wind, with no to little damage, while maintaining their structural integrity. These types of structures can be individual or multi family houses, small stores, places of worship and similar structures.
- □ *Heavy Structures*: This category, annotated with a square, encompasses structures that are built from hard materials such as reinforced cement and steel. Infrastructure of this type is the least structurally vulnerable in any observed region. These structures are designed to withstand high level winds without receiving heavy damage or endangering the structural integrity of the structure. In many areas, these may include multiple story buildings, strip malls, hospital buildings, or public utilities.

### 2C. Assigning Damage Scale

The Signal Program BAR Methodology applies a color-coded damage scale across all structure types based on repeating, visible damage patterns. Damage in the BAR scale is classified in 4 distinct categories: Green, Yellow, Orange and Red.

- *No Visible Damage*: This category, classified by the color green, signifies no visible damage to the structures. In these cases, the roof is virtually undamaged and the walls, in effect, remain standing. The structure appears to have complete structural integrity and does not appear to need repair.
- *Minimal Visible Damage*: This category, classified by the color yellow, signifies that some minimal visible damage has been sustained. In these structures, the roof remains largely intact, but presents partial damage to the roof's surface, with minimal exposure beneath. In oblique aerial and satellite imagery, minimal damage may be able to be observed within the structure and to the exterior walls. The structure appears to have general structural integrity but needs minor repairs.
- *Significant Visible Damage*: This category, classified by the color orange, signifies that partial but extensive visible damage has been sustained. In these structures, the roof is entirely damaged or missing. The walls of the structure remain upright. However, the interior wall partitions can be partially damaged. Debris inside the structure can also potentially be visible. The structure does not appear to have complete structural integrity and is in need of significant repair.
- *Critical Visible Damage*: This category, classified by the color red, signifies severe visible damage has been sustained. In these structures, the roof is completely destroyed or missing, and the walls have been destroyed or collapsed. The support structures are completely leveled, and interior objects have also suffered visibly heavy damage or destruction. The structure does not appear to have any structural integrity and requires comprehensive reconstruction or demolition of the entire structure.

### 2D. Limitations and Variables

Certain limitations and variables can impact remote sensing based damage assessments, whether these assessments use the BAR or any other methodology. Chief among these limitations and variables are the following:

- Lack of access to either high-resolution satellite imagery captured soon after the wind disaster event occurred and/or pre-event baseline imagery captured prior to the event;
- UAV imagery captured may not be georeferenced, which would require time and further resources to orient the analysts. Additionally, this limits some of the functionality of a georeferenced image such as measuring and precise coordinates which are often critical in conducting an accurate damage assessment;
- Cloud coverage and other phenomena can affect the quality of satellite imagery, though is a less of a limiting factor for UAVs;
- Reconstruction efforts may begin before satellites are able to image an area therefore reducing the numbers of apparently visible damaged structures present in the imagery. In some cases, reconstruction of light structures can occur within 48-72 hours following the event;
- In areas that are hit repeatedly by multiple disasters, assessing damage done by the specific event may be complicated by the fact that reconstructions efforts were not completed following the previous disasters. In these cases, it is crucial to have baseline imagery available as close to the date of the specific event examined as possible;
- The presence of standing water after a flood that obscures walls and interiors of a structure, hindering the analysts abilities to assess the damage
- Analysts are often unable to assess potential damage done to the interior of structures through the use of remote sensing platforms exclusively; and
- Every type of remote sensing data has its own potential dynamics that may distort the image in both repeating and isolated ways.

# Chapter 3: Case Study: Applying BAR to Cyclone Pam's Impact on Vanuatu

### 3A. Background

The Republic of Vanuatu is an archipelago made up of close to 80 islands in the South Pacific Ocean. It has an estimated population of 270,000. According to available data, two thirds of the population make their living from small scale agriculture.[9] The United Nations World Risk Index 2014 ranks Vanuatu as the topmost exposed country to natural disasters. Additionally, Vanuatu has poor disaster preparations and response mechanisms.[10]

Cyclone Pam was a category 5 cyclone that swept throughVanuatu and neighboring countries in March of 2015. The cyclone caused serious damage to the infrastructure of the country and affected the lives of tens of thousands of people.[11] According to the government of Vanuatu, close to 170,000 people were displaced by the cyclone - nearly 60% of the total population of the country. 320 km/h winds led to widespread destruction across the islands.[12] The cyclone wiped out food production across Vanuatu, with 96% of food crops reportedly destroyed. The damage to the agricultural sector will have significant financial and economic impacts.[13]

Traditional dwellings on Vanuatu utilize long-standing methods of construction and materials that are easily accessible in the area such as timber, bamboo and "natangura leaf (thatch) roof."[14] These traditional dwellings remain popular, as they are both inexpensive and easy to build. The roofs of these dwelling are generally triangular or spherical in nature, allowing water to slide off the sides and reducing tension on the roof. Traditional dwellings vary between different villages and across the islands due to the availability of resources, but their fundamentals remain the same across different areas.

Impact of Cyclone Pam

Along the path of Cyclone Pam, UNOSAT-UNITAR reported that the percentage of affected buildings in damaged zones ranged from 50% on the main island of Efate where the capital Port Vila is located to 100% on the island of Buninga.[15] The death toll, analysts estimate, would have been higher but for the traditional housing structures, or huts, that are commonly used in rural villages. The composition of these structures resulted, in part, in a death toll that was realtively low. The early warning SMS system activated by the Government of Vanuatu played a vital role in limiting the potential death toll, as citizens were warned about the approaching cyclone.[16] Traditional houses are easy to produce and use locally available resources to build.[17] Rebuilding efforts were documented a few days following the cyclone.[18]

### 3B. Imagery Data

The imagery data analyzed for this guide consisted of two types: very high resolution (VHR) satellite imagery and oblique aerial imagery. The satellite imagery was open source data downloaded directly from Google Earth Pro. Several images were collected over Vanuatu immediately following the landfall of Cyclone Pam in March of 2015. The oblique aerial imagery was collected by an Unmanned Aerial Vehicle (UAV) operated by users on the ground in Vanuatu, as part of the World Bank's UAVs for Resilience Program. This imagery was shared electronically with the Signal Program for the purposes of this report.

The satellite imagery used for analysis from Google Earth Pro was selected based on the sharpest resolution and the least amount of cloud obfuscation. A satellite image, which predates the cyclone landfall, was also used as a baseline image for damage assessment comparison. This imagery was used for a broader overall damage assessment of structures in a particular area. The aerial imagery, which has a greater resolution than the satellite imagery analyzed, was used to get a more granular assessment of the level of damage sustained by the structures present.

Prior to analysis, the downloaded imagery from Google Earth Pro was georeferenced in ArcMap so that it could be analyzed with remote sensing software. The baseline and post-event imagery was then uploaded into the remote sensing program ERDAS Imagine, where they were presented in two concurrent and geospatially synchronized windows. A manual before-and-after analysis was conducted by comparing specific structures between the two images. The program's 'count feature' tool was then used to annotate structures and log the visible damage according to the scale developed by the Signal Program.

The aerial imagery was then used to verify and amend the assessments made by the satellite imagery analysis. The aerial imagery also helped flag damaged structures that may have been missed in the initial analysis. Because the aerial imagery was not georeferenced, Signal Program analysts oriented themselves by cross-referencing key landmarks within the aerial imagery to match with the satellite imagery. Through this approach, analysts were able to better validate satellite imagery analysis with the oblique aerial imagery to accomplish a more accurate assessment of the damaged structures.

### 3C. Criteria for Assigning Structure Categories and Applying Damage Scale

*Structure Category Criteria*
Structures were assigned to the three categories used in the BAR methodology based on the criteria in the bullets below. The three categories encompass all visible structures observed in imagery of Vanuatu analyzed for this case study.

As per the BAR methodology, the criteria that the Signal Program used for assigning the three structure categories are as follows:

- The light structures category is assigned to traditional structures built using, cinder blocks, bricks, organic or locally sourced material with the roof built using thatch.
- The medium structures category is assigned to single-level, small to medium sized structures built using cement walls with roofs made out of metal or prefabricated material.
- The heavy structures category is assigned to multi-level and/or large structures built using cement walls or prefabricated material with a metal or prefabricated roofs.

*Damage Scale Criteria*
The Signal Program assigned damage levels to structures observed in the imagery according to the damage scale of the BAR methodology. The context-specific criteria an analyst uses for assigning the damage scale should be documented and made public with every use of the BAR methodology. In this case, the damage observed in the imagery of Vanuatu was applied based on the criteria below:

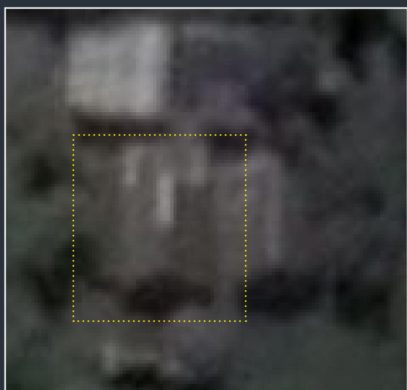
- The "No Visible Damage" category was applied to structure that appear virtually undamaged with no identifiable damage to the roof or the walls.
- The "Minimal Damage" category was applied to the structures that appear to have sustained limited damage with only parts of the roof appearing to be either damaged or missing.
- The "Significant Damage" category was applied to structures that appear to have sustained damage with large parts of the roof damaged or missing. These structures, however, remain standing with the walls appearing largely intact
- The "Critical Damage" category was applied to structures that have completely lost their roofs and have sustained heavy damage to their walls. These structures have sustained massive damage to their structural integrity and have largely or completely collapsed.

### 3E. Damage Examples

**Figure 3.1: Green Triangle**
Imagery shows a light structure with thatched roof and wooden walls. In imagery collected after the event, the roof appears to be completely intact and the walls appear to remain upright, showing no visible signs of damage.

Light structure with no visible damage

**Figure 3.1**



**Baselayer Satellite Image**
19 November 2014
Mele, Vanuatu

**Post-Event Satellite Image**
15 March 2015
Mele, Vanuatu

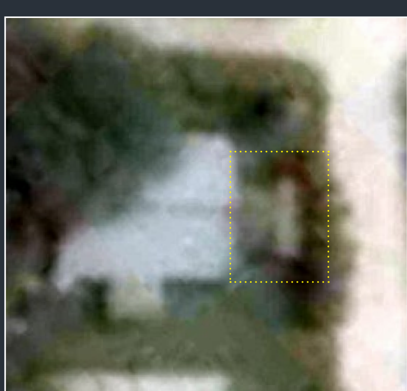
**Post-Event UAV Image**
02 April 2015
Mele, Vanuatu

Latitiude/Longitude: 17.688239 S, 168.269392 E

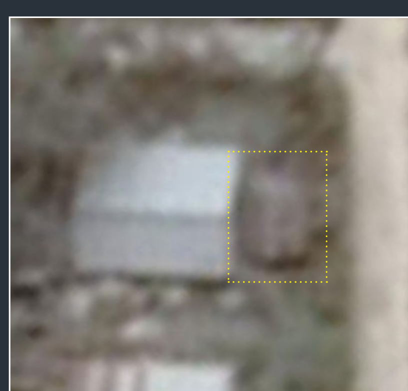
**Figure 3.2: Yellow Triangle**
Imagery shows a light structure with thatch on the roof that is partially removed with scaffolding that is visible underneath. No internal damage is apparent.

Light structure with minimal visible damage

**Figure 3.2**



**Baselayer Satellite Image**
19 November 2014
Mele, Vanuatu



**Post-Event Satellite Image**
15 March 2015
Mele, Vanuatu

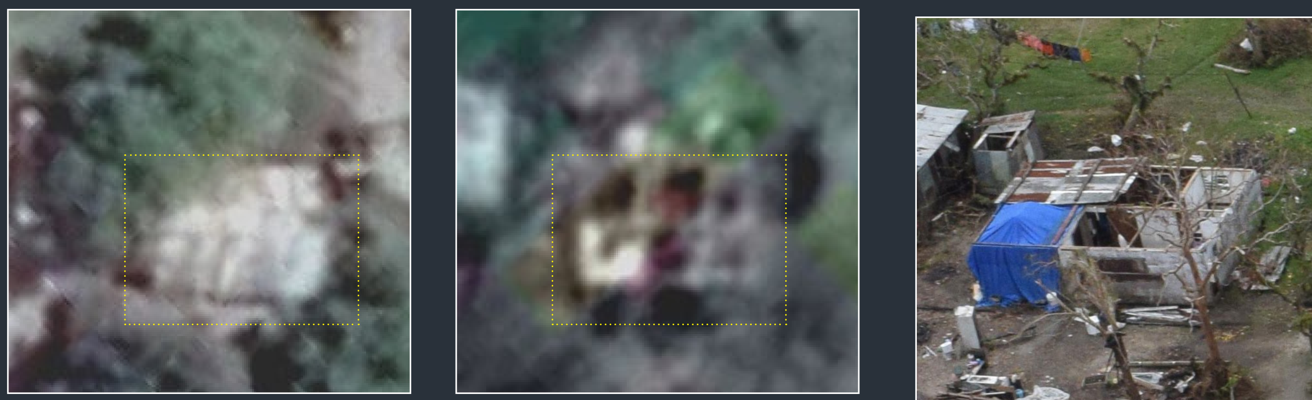
**Post-Event UAV Image**
02 April 2015
Mele, Vanuatu

Latitiude/Longitude: 17.688941 S, 168.270919 E

**Figure 3.3: Orange Triangle**
Imagery shows a light structure with cinder block walls and a roof that is completely destroyed or has been removed. There is no apparent damage sustained by the outer walls or the interior partitions.

Light structure with partial but extensive damage

**Figure 3.3**



**Baselayer Satellite Image**
19 November 2014
Mele, Vanuatu

**Post-Event Satellite Image**
15 March 2015
Mele, Vanuatu

**Post-Event UAV Image**
02 April 2015
Mele, Vanuatu

Latitiude/Longitude: 17.686299 S, 168.270826 E

**Figure 3.4: Red Triangle**
Imagery shows a light structure with brick walls that is almost entirely destroyed along with the roof collapsed. Considerable amount of debris can be seen in the southwestern portion of the structure.

Light structure with complete visible damage

**Figure 3.4**

**Baselayer Satellite Image**
19 November 2014
Mele, Vanuatu

**Post-Event Satellite Image**
15 March 2015
Mele, Vanuatu

**Post-Event UAV Image**
02 April 2015
Mele, Vanuatu

Latitiude/Longitude: 17.686320 S, 168.271056 E

**Figure 3.5: Green Circle**
Imagery shows a building with concrete walls with metal roof that is consistent with medium type structures showing no apparent damage to the roof or visible walls.

Medium structure with no visible damage

**Figure 3.5**

**Baselayer Satellite Image**
19 November 2014
Mele, Vanuatu

**Post-Event Satellite Image**
15 March 2015
Mele, Vanuatu

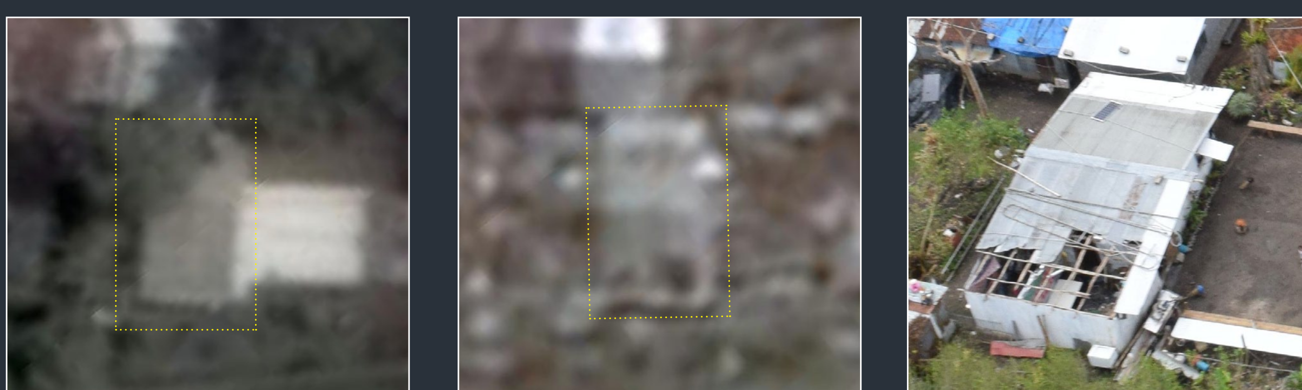
**Post-Event UAV Image**
02 April 2015
Mele, Vanuatu

Latitiude/Longitude: 17.689767 S, 168.269971 E

**Figure 3.6: Yellow Circle**
In the imagery, a medium structure with concrete walls and a metal roof has apparently sustained partial damage to the roof, with no apparent damage to the outer walls. A portion of the interior is exposed, but no apparent signs of extensive damage are present.

Medium structure with minimal visible damage

**Figure 3.6**



**Baselayer Satellite Image**
19 November 2014
Mele, Vanuatu

**Post-Event Satellite Image**
15 March 2015
Mele, Vanuatu

**Post-Event UAV Image**
02 April 2015
Mele, Vanuatu

Latitiude/Longitude: 17.688690 S, 168.270321 E

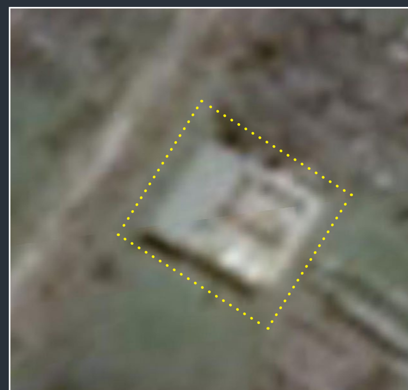
**Figure 3.7: Orange Circle**

Imagery shows a medium structure with walls and roof built from fabricated materials. The roof with sustained substantial damage, with no apparent damage to the walls or interior are visible.

Medium structure with partial but extensive damage

**Figure 3.7**

**Baselayer Satellite Image**
19 November 2014
Baofatu, Vanuatu



**Post-Event Satellite Image**
15 March 2015
Baofatu, Vanuatu

**Post-Event UAV Image**
02 April 2015
Baofatu, Vanuatu

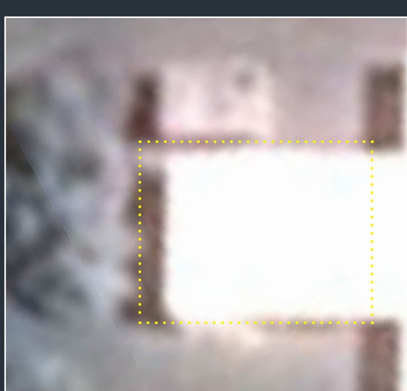
Latitiude/Longitude: 17.687990 S, 168.269727 E

**Figure 3.8: Red Circle**

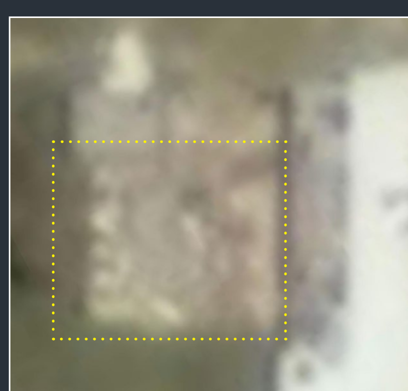
In the imagery, a medium structure with concrete walls and roof made out of prefabricated material has sustained heavy damage resulting in the collapse of the entire structure. Extensive amount of debris is apparent in the interior.

Medium structure with complete visible damage

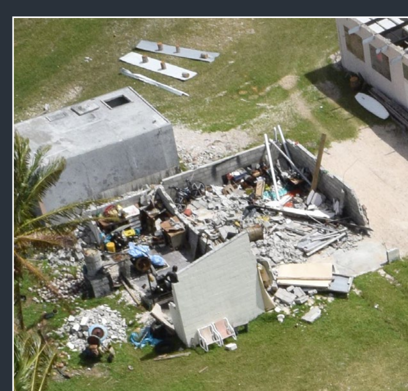
**Figure 3.8**



**Baselayer Satellite Image**
19 November 2014
Baofatu Vanuatu



**Post-Event Satellite Image**
15 March 2015
Baofatu, Vanuatu



**Post-Event UAV Image**
07 April 2015
Baofatu, Vanuatu

Latitiude/Longitude: 17.535971 S, 168.449820 E

**Figure 3.9: Green Square**
Imagery shows a multi-level, heavy structure constructed with what appears to be pre-fabricated material. The imagery does not indicate any damage sustained by the structure following the event.

Heavy structure with no visible damage

**Figure 3.9**

**Baselayer Satellite Image**
19 November 2014
Mele, Vanuatu

**Post-Event Satellite Image**
15 March 2015
Mele, Vanuatu

**Post-Event UAV Image**
02 April 2015
Mele, Vanuatu

Latitiude/Longitude: 17.743313 S, 168.316151 E

**Figure 3.10: Yellow Square**
Imagery shows a heavy structure with concrete walls and metal roof. The imagery indicates partial damage sustained to the roof with no clear apparent damage to the interior.

Heavy structure with minimal visible damage

**Figure 3.10**

**Baselayer Satellite Image**
19 November 2014
Mele, Vanuatu

**Post-Event Satellite Image**
15 March 2015
Mele, Vanuatu

**Post-Event UAV Image**
02 April 2015
Mele, Vanuatu

Latitiude/Longitude: 17.689551 S, 168.269695 E

**Figure 3.11: Orange Square**
Imagery shows a large structure with walls and roof made from fabricated materials. Structure sustained substantial, extensive damage to the roof as well as the walls, and visible debris is apparent in the interior.

Heavy structure with partial but extensive damage

**Figure 3.11**

**Baselayer Satellite Image**
11 June 2014
Baofatu, Vanuatu

**Post-Event Satellite Image**
15 March 2015
Baofatu, Vanuatu

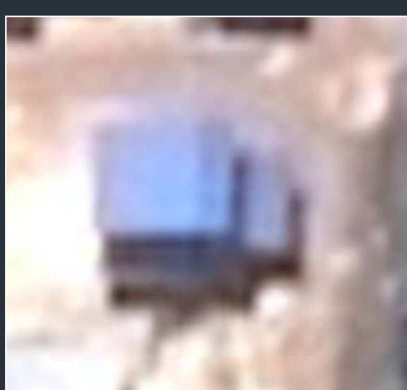
**Post-Event UAV Image**
02 April 2015
Baofatu, Vanuatu

Latitiude/Longitude: 17.536119 S, 168.449663 E

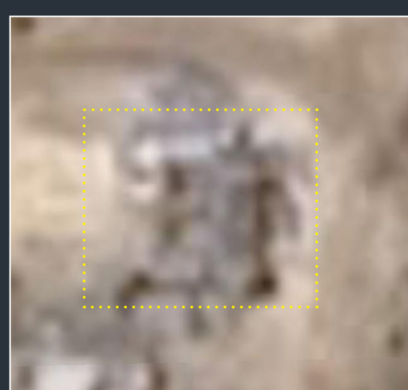
**Figure 3.12: Red Square**
Satellite imagery shows a heavy, multi-level structure with walls and roof built from fabricated materials. In post-event imagery, the walls and roof of the structure has been destroyed, with some of the foundation of the structure remaining.

Heavy structure with complete visible damage

**Figure 3.12**



**Baselayer Satellite Image**
29 January 2014
Port Vila, Vanuatu



**Post-Event Satellite Image**
15 March 2015
Port Vila, Vanuatu

Latitiude/Longitude: 17.743324 S, 168.316134 E

Results

In this grid AOI, 358 structures are identified. The structures identified are divided into the three distinct categories: 144 light structures, 190 medium structures and 24 heavy structures. (See *Appendix I*)

An analysis of the damage sustained by these structures utilizing the BAR methodology revealed that 56.70% of all structures, or 203 structures, examined have sustained some level of damage. The damage to each category of structure is as follows:

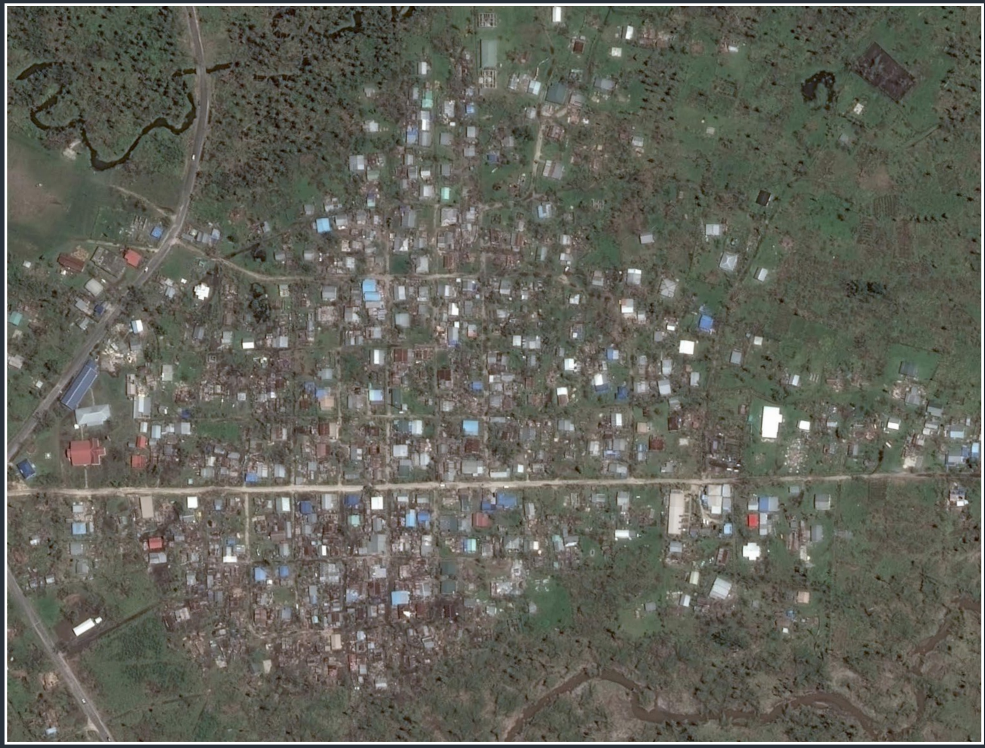
- Light Structures: 49 structures sustained no visible damage, 35 structures sustained minimal damage, 29 structures sustained significant damage and 31 structures sustained critical damage
- Medium Structures: 83 structures sustained no visible damage, 81 structures sustained minimal damage, 14 structures have sustained significant damage and 12 structures sustained critical damage.
- Heavy structures: 23 structures sustained no visible damage, 1 structure appear to have sustained minimal damage and no structure appear to have sustained significant or critical damage in the grid analyzed.

A deeper analysis of results indicate that 65.97% of light structures sustained some level of damage; 56.32% of medium structures sustained some level of damage; and 4.17% of heavy structures sustained some level of damage.

This AOI sustained 332 total damage points out of a possible 1074 damage points. In other words, 30.91% of total potential damage to structures possible was inflicted by the cyclone. Light structures sustained 186 damage points out of potential 432 points, representing 43.06% of total potential damage points for this category. Medium structures sustained 145 damage points out of a potential 570 points, representing 25.90% of total potential damage points for this category. Heavy structures sustained 1 damage point out of a potential 72 points, which represents 1.39% of total potential damage points for this category. (See *Appendix II*)

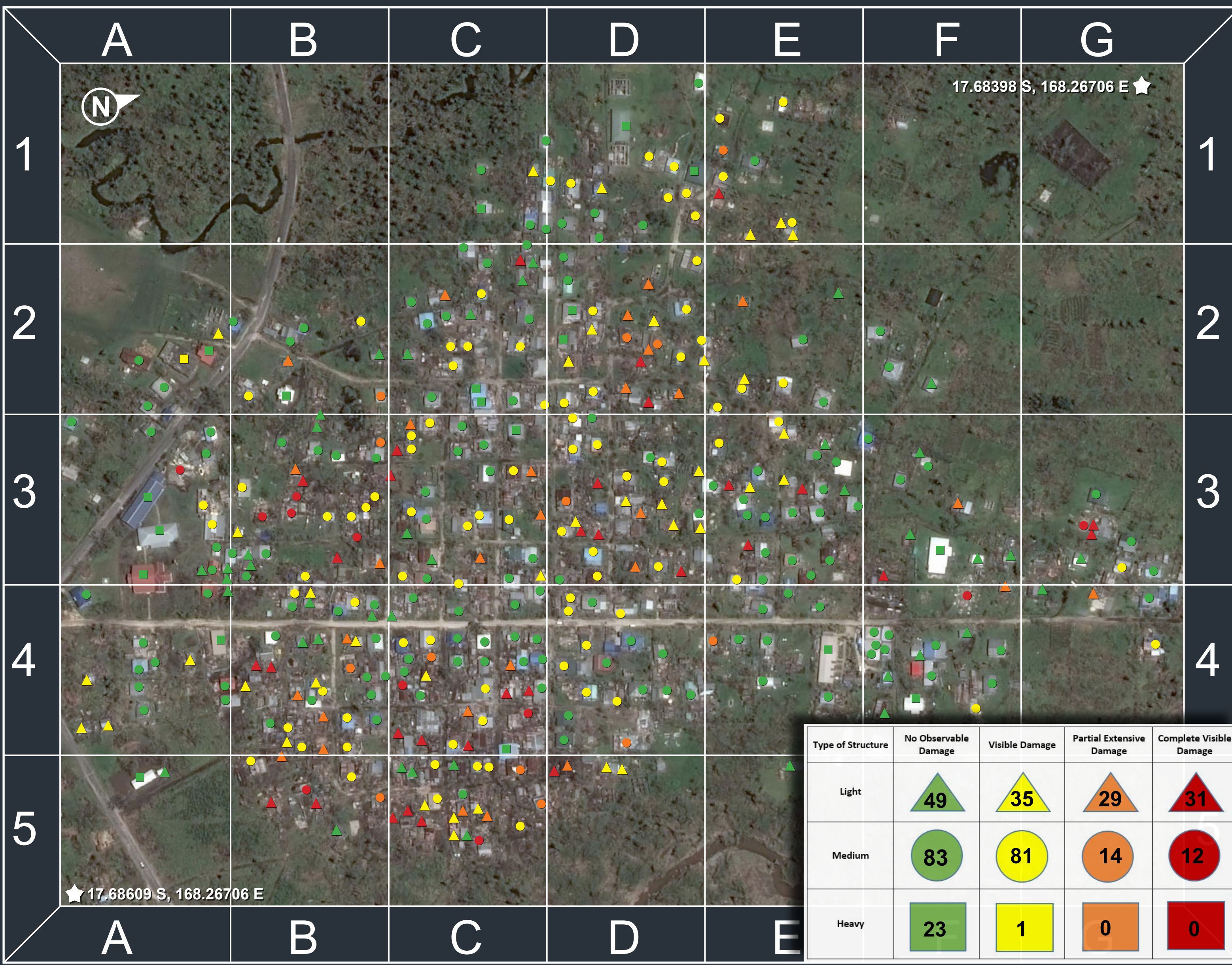
# Appendix I: Analysis of Structural Damage from Cyclone Pam

Pre-Event Image
19 November 2014
Mele, Vanuatu



Post-Event Image
15 March 2015
Mele, Vanuatu

# GRID Application and Damage Assessment of Structure Types




| Type of Structure | No Observable Damage | Visible Damage | Partial Extensive Damage | Complete Visible Damage |
|---|---|---|---|---|
| Light | 49 | 35 | 29 | 31 |
| Medium | 83 | 81 | 14 | 12 |
| Heavy | 23 | 1 | 0 | 0 |

# Comparison of Satellite and UAV Imagery View of Quadrant B-4


**Satellite Image**

**UAV Image**

# Appendix II: Data Metrics

Impact Report Card

| Types of Structures | Number of observed structures | Damage Scale | | | |
|---|---|---|---|---|---|
| | | **No Visible Damage** | **Minimal Damage** | **Significant Damage** | **Critical Damage** |
| Damage Points | | 0 | 1 | 2 | 3 |
| | | | | | |
| Light | 144 | 49 | 35 | 29 | 31 |
| Medium | 190 | 83 | 81 | 14 | 12 |
| Heavy | 24 | 23 | 1 | 0 | 0 |
| | | | | | |
| **Total amount of structures** | 358 | 155 | 117 | 43 | 43 |
| **Total Number of Structures Damaged** | 203 | | | | |
| **Percentage of Total Damaged Structures** | 56.70% | | | | |

**Damage By Structure Type**

| | **Percentage of Structures Damaged** | **Damage Points Accumulated Per Structures** | **Percentage of Total Potential Points** |
|---|---|---|---|
| Light Structures | 65.97% | 186 | 43.06% |
| Medium Structures | 56.32% | 145 | 25.44% |
| Heavy Structures | 4.17% | 1 | 1.39% |

**Damage Impact**

| | |
|---|---|
| **Potential of Total Accumulated Damage Points** | 1074 |
| **Total Damage Points Accumulated** | 332 |
| | |
| **Percentage of Total Potential Damage Having Occurred** | 30.91% |

**Total Damage Points accumulated by Damage Level**

| | | |
|---|---|---|
| | | Percentage of Total Damage Points |
| **No Visible Damage** | 0 | 0.00% |
| **Minimal Damage** | 117 | 35.24% |
| **Significant Damage** | 86 | 25.90% |
| **Critical Damage** | 129 | 38.86% |

**Damage Breakdown by Type**

| | **No Visible Damage** | **Minimal Damage** | **Significant Damage** | **Critical Damage** |
|---|---|---|---|---|
| | | | | |
| Light | 34.03% | 24.31% | 20.14% | 21.53% |
| Medium | 43.68% | 42.63% | 7.37% | 6.32% |
| Heavy | 95.83% | 4.17% | 0.00% | 0.00% |

| **Structure Type** | **No Visible Damage** | **Minimal Damage** | **Significant Damage** | **Critical Damage** |
|---|---|---|---|---|
| **Light** | 49 | 35 | 29 | 31 |
| **Medium** | 83 | 81 | 14 | 12 |
| **Heavy** | 23 | 1 | 0 | 0 |

# Endnotes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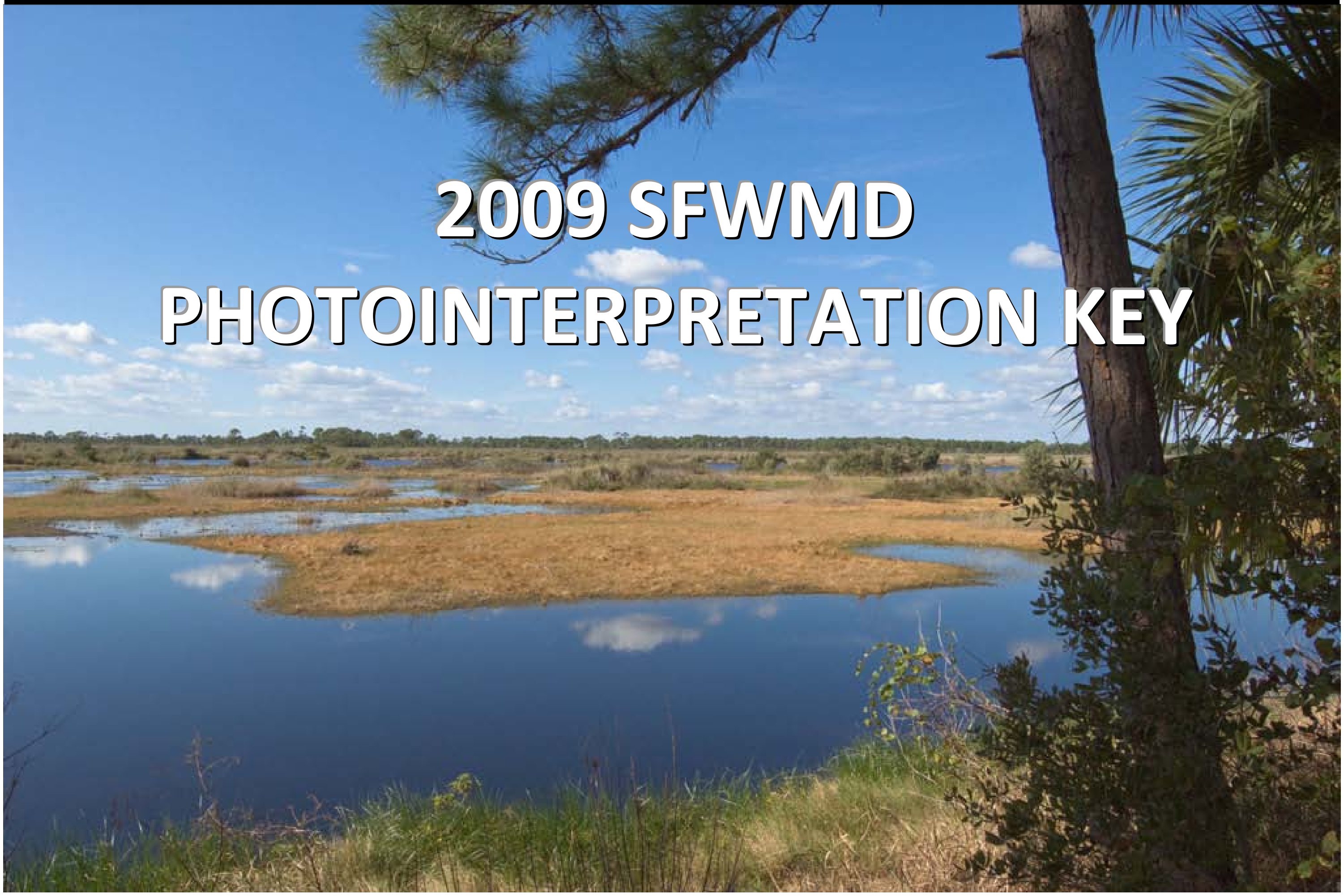
18. Lincoln Feat, “Vanuatu provides lessons in cyclone survival.” Reuters, March 19, 2015. http://www.reuters.com/article/2015/03/19/weather-vanuatu-cyclone-pix-tv-graphicup-idUSL3N0WL1S220150319




In 2009 the South Florida Water Management District implemented the 2009 LCLU project to update the ArcGIS Land Cover/ Land Use (LCLU) dataset using 2008 – 2009 aerial photographs produced and funded by Florida Department of Revenue (FDOR) as the source imagery. Delineation updates from 2004 -05 dataset were made on-screen during the photointerpretation process.

The classification system used for this project was the Florida Land Use, Cover and Forms Classification System (FLUCCS), which was originally compiled by the Florida Department of Transportation, State Topographic Bureau. The classification system was amended by the District for use on this project and these amendments are described within this document.

The following photointerpretation key was developed in order to document the decisions and mapping conventions applied during the photointerpretation process. The key was used to assist the photointerpreters in compiling the Land Cover/Land Use 2009 Mapping Project and helped to ensure that the photointerpretation was consistent throughout the project. It was designed to provide descriptions of the visual and spatial distribution characteristics of the classification types used for the project.

The photointerpretation key documents any special mapping conventions that were applied during the mapping effort. All photointerpretation was conducted in accordance with the Florida Land Use, Cover and Forms Classification System unless otherwise indicated within the photointerpretation key. The key also serves to provide insight for future users into the rationale for the delineations and classifications appearing within the database.

# CREDITS

This South Florida Water Management District (SFWMD) Land Cover/Land Use (LCLU) 2009 Mapping Project PI Key was derived from a combination of materials relevant to land cover, land use mapping. The document was originally produced by Avineon, Inc. (formerly AGRA-Baymont, Inc. and Geonex Corporation) in 1995 as part of the St. Johns River Water Management District (SJRWMD) 1995 Land Use/Land Cover Mapping Project. The document has since been improved and updated by Photo Science, Inc. in 2003, and the SFWMD in 2009 to include additional reference information intended to assist users in accurately photo interpretation and mapping land cover and land use.

Classification codes are based on the Florida Land Use, Cover, and Forms Classification System; Department of Transportation, State Topographic Bureau, Thematic Mapping Section; January 1999 Edition.

The following individuals played a critical role in the development of the SFWMD LCLU 2009 Mapping Project PI Key:

James Cameron - SFWMD GIS Director
Kurt Saari - SFWMD GIS Manager
Kuang-Yao Lee - SFWMD Sr. GIS Data Steward
Jenifer Barnes - SFWMD Subject Matter Expert
Jim Kramp - SFWMD Subject Matter Expert
Cindy Bowes – Photointerpreter
Gary Krasovetz - Photointerpreter

## UPDATE HISTORY

Revision 1.5 (8/1/2011):

- Updated natural color aerial photography and PI-Key descriptions for each classification

Revision 1.4 (6/15/2011):

- Moved “Abandoned Groves” from 3230 to 2240, which is consistent to FDOT FLUCCS 224

Revision 1.1 (1/10/2011):

- Added a page to describe the procedure to re-classify 1310 to 1210 (see Bookmark on “High-Density Residential Modification”)

The SFWMD LCLU 2009 Mapping Project PI Key, version 1.0, was updated by:
SFWMD LCLU Project Team, November 2010.
Changes from the 2004-05 version include the following:

- Added a 4th bullet under 5420 “Keys to Photo interpretation”.
- 2130 Woodland Pastures – Changed dual coding convention from a land cover class to a land use class where a separate land cover code is always required.
- Removed 6430 and consolidated into 6410. Removed all links in all PI Keys to 6430.
- Updated 6410 to include text pertaining to removal of 6430.

The SFWMD LCLU 2004-05 Mapping Project PI Key was updated by:
Photo Science, Inc., St. Petersburg, Florida

The SFWMD LCLU 1999 Mapping Project PI Key was originally designed and developed in 2003 by:
Avineon, Inc., Clearwater, Florida.

# USER GUIDE

## HOW TO ACCESS THE PI-KEY

This User Guide contains information on how to access and understand the Land Cover / Land Use (LCLU) classification system used by the South Florida Water Management District (SFWMD). Users can click the Classification Code bookmark in the left navigation menu to directly access the FLUCCS Photointerpretation Key page which describes the selected code.

If you do not see the bookmark links, click on the bookmark icon to open the menu.

The “Photointerpretation Structure Key” page provides an outline view of all the PI Keys in the document.

## PAGE CONTENT DESCRIPTION

This LCLU classification system is arranged in hierarchical levels with each level containing land information of increasing specificity. The various categories and subcategories listed and defined herein reflect the types of data and information which were extracted from aerial images. The images that were used as part of the photointerpretation processes are displayed on each key page. Ground level field pictures, representing each classification type, are also included on each key page. For the 2009 update, natural color aerial photography from 2008-09 was used for photointerpretation. This updated color aerial photography, along with color infrared photography from 2004-05 are included in this document.

Each FLUCCS Photointerpretation Key page describes a unique FLUCCS code. The following sections are included on each page of the key:

1. **CLASSIFICATION CODE:** Located in the left navigation and at the top of each page is the entire four-digit FLUCCS code as applied during photointerpretation.
2. **LEVEL:** Lists each level within the four-digit FLUCCS code.
3. **DESCRIPTION:** This is the description of the classification code as it is used by the SFWMD in this dataset. Classification codes are based on the Florida Land Use, Cover, and Forms Classification System; Department of Transportation, State Topographic Bureau, Thematic Mapping Section; January 1999 Edition. They are modified as needed by the District to meet their mapping objectives.
4. **KEYS TO PHOTOINTERPRETATION:** These are descriptions which consist of the typical characteristics of each class. Features which are associated with the class and which are visible on the imagery are described. The apparent signature (colors, tones, textures, etc.) of the class on the imagery may be described as well as its typical location within the landscape.
5. **CONTEXT:** This section describes the context within which each class is typically found. It briefly describes (where applicable) one or more of the following characteristics: Landscape Position, Vegetation, Soils, and Hydrology.
6. **SIMILAR CLASSES:** Other FLUCCS classes which may share one or more of the same characteristics as the classification code being described are indicated in this section.
7. **SPECIAL MAPPING CONVENTIONS:** Describes the photointerpretation or mapping rules established to address the particular classification code. This section also describes differences

between the original FLUCCS system, as defined by the Department of Transportation (DOT), and the SFWMD system, which has been modified from the original DOT system.

8. **DUAL CODING CONVENTIONS:** This section describes the Land Cover/Land Use code combinations as applied to each class. Generally, the Land Cover code (LCCODE) and the Land Use code (LUCODE) are the same. However, instances where they are different are noted here.

**Note:** There are also PI Key pages for **MODIFIERS.** These are added to LCLU codes to denote types of vegetation or impact that are not classified under a particular FLUCCS code.

# Photointerpretation Key Structure

You can click on any of the classifications in the structure below to access the detail page with a full description.

## *1000 URBAN AND BUILT UP (not used in map)

### *1100 Residential, Low Density (not used in map)

- 1110 Fixed Single Family Units
- 1120 Mobile Home Units
- 1130 Mixed Units, Fixed and Mobile Home Units
- 1180 Rural Residential
- 1190 Low Density Under Construction

### *1200 Residential, Medium Density (not used in map)

- 1210 Fixed Single Family Units
- 1220 Mobile Home Units
- 1230 Mixed Units, Fixed and Mobile Home Units
- 1290 Medium Density Under Construction

### *1300 Residential, High Density (not used in map)

- 1310 Fixed Single Family Units
- 1320 Mobile Home Units
- 1330 Multiple Dwelling Units, Low Rise
- 1340 Multiple Dwelling Units, High Rise
- 1350 Mixed Units, Fixed and Mobile Home Units
- 1390 High Density Under Construction

### 1400 Commercial and Services

- **1410 Retail Sales and Services (not used in map)*
  - 1411 Shopping Centers
- **1420 Wholesale Sales & Services (not used in map)*
  - 1423 Wholesale Sales & Services - Junk Yards
- 1460 Oil and Gas Storage - not Industrial or Manufacturing.
- 1480 Cemeteries
- 1490 Commercial and Services Under Construction.

### 1500 Industrial

- 1540 Oil and Gas Processing
- 1550 Other Light Industry
- 1560 Other Heavy Industrial

### 1600 Extractive

- 1610 Strip mines

- 1620 Sand and Gravel Pits
- 1630 Rock Quarries
- 1640 Oil and Gas Fields
- 1650 Reclaimed Lands
- 1660 Holding Ponds
- 1670 Abandoned Mining Lands

**1700 Institutional**

- 1710 Educational Facilities
- 1730 Military
- 1760 Correctional

**1800 Recreational**

- 1810 Swimming Beach
- 1820 Golf Course
- 1830 Race Tracks
- 1840 Marinas and Fish Camps
- 1850 Parks and Zoos
- 1870 Stadiums: Not Academic

**1900 Open Land**

- 1920 Inactive Land with Street Pattern

## *2000 AGRICULTURE* (not used in map)

***2100 Cropland and Pastureland** (not used in map)*

- 2110 Improved Pastures
- 2120 Unimproved Pastures
- 2130 Woodland Pastures
- 2140 Row Crops
- 2150 Field Crops
  - 2156 Sugar Cane
- 2160 Mixed Crops

***2200 Tree Crops** (not used in map)*

- 2210 Citrus Groves
- 2230 Other Groves
- 2240 Abandoned Groves

**2300 Feeding Operations**

- 2310 Cattle Feeding Operations
- 2320 Poultry Feeding Operations

**2400 Nurseries and Vineyards**

2410 Tree Nurseries
2420 Sod Farms
2430 Ornamentals

**2500 Specialty Farms**

2510 Horse Farms
2520 Dairies
2540 Aquaculture

***2600 Other Open Lands - Rural** (not used in map)*

2610 Fallow Cropland

## **3000 UPLAND NONFORESTED** (not used in map)*

**3100 Herbaceous (Dry Prairie)**

**3200 Upland Shrub and Brushland**

3210 Palmetto Prairies
3220 Coastal Shrub

**3300 Mixed Rangeland**

## **4000 UPLAND FORESTS** (not used in map)*

**4100 Upland Coniferous Forests**

4110 Pine Flatwoods
4120 Longleaf Pine - Xeric Oak
4130 Sand Pine
4140 Pine - Mesic Oak

**4200 Upland Hardwood Forests**

4210 Xeric Oak
4220 Brazilian Pepper
4240 Melaleuca
4270 Live Oak
4271 Oak - Cabbage Palm Forests
4280 Cabbage Palm

***4300 Upland Mixed Forests** (not used in map)*

4340 Upland Mixed Coniferous / Hardwood
4370 Australian Pine

**4400 Tree Plantations**

4410 Coniferous Plantations
4420 Hardwood Plantations
4430 Forest Regeneration Areas

## *5000 WATER ***(not used in map)***

### *5100 Streams and Waterways (not used in map)*

5110 Natural River, Stream, Waterway
5120 Channelized Waterways, Canals

### 5200 Lakes

### 5300 Reservoirs

### *5400 Bays and Estuaries (not used in map)*

5410 Embayments Opening Directly to Gulf or Ocean
5420 Embayments Not Opening Directly to Gulf or Ocean
5430 Saltwater Ponds

### 5600 Slough Waters

### *5700 Ocean and Gulf (not used in map)*

5710 Atlantic Ocean
5720 Gulf of Mexico

## *6000 WETLANDS ***(not used in map)***

### 6100 Wetland Hardwood Forests

6110 Bay Swamps
6111 Bayhead
6120 Mangrove Swamp
6170 Mixed Wetland Hardwoods
6172 Mixed Shrubs
6180 Cabbage Palm Wetland
**6190 Exotic Wetland Hardwoods (not used in map)*
6191 Wet Melaleuca

### 6200 Wetland Coniferous Forests

6210 Cypress
6215 Cypress- Domes/Heads
6216 Cypress - Mixed Hardwoods
6240 Cypress - Pine - Cabbage Palm

6250 Wet Pinelands Hydric Pine
6260 Pine Savannah

**6300 Wetland Forested Mixed**

****6400 Vegetated Non-Forested Wetlands** (not used in map)*

6410 Freshwater Marshes / Graminoid Prairie - Marsh
6411 Freshwater Marshes - Sawgrass

6420 Saltwater Marshes / Halophytic Herbaceous Prairie
6440 Emergent Aquatic Vegetation

**6500 Non-Vegetated Wetland**

6510 Tidal Flats

## **7000 BARREN LAND **(not used in map)***

**7200 Sand Other Than Beaches**

**7300 Exposed Rock**

**7400 Disturbed Land**

7420 Borrow Areas
7430 Spoil Areas
7470 Dikes and Levees

## **8000 TRANSPORTATION, COMMUNICATION & UTILITIES **(not used in map)***

**8100 Transportation**

8110 Airports
8113 Private Airports

8115 Grass Airports

8120 Railroads and Railyards
8140 Roads and Highways
8150 Port Facilities

**8200 Communications**

**8300 Utilities**

8310 Electrical Power Facilities
8320 Electrical Power Transmission Lines
8330 Water Supply Plants - Including Pumping Stations
8340 Sewage Treatment
8350 Solid Waste Disposal

8360 Other Treatment Ponds

***MODIFIERS***

**Impact Modifiers (Burned, Off-Road Vehicles)**

**Species Modifiers (Brazilian Pepper, Melaleuca)**

**Vegetation Modifiers (Dead Trees, Exotics, Tree Islands)**

# 1000
# Urban and Built-Up

This Level 1 class is not used in the actual map. A more specific subclass must be selected. The Level 2 subclasses are:

- 1100 Residential, Low Density
- 1200 Residential, Medium Density
- 1300 Residential, High Density
- 1400 Commercial and Services
- 1500 Industrial
- 1600 Extractive
- 1700 Institutional
- 1800 Recreational
- 1900 Open Land

The following is a general description that applies to all the classes in the 1000 category.

## BACKGROUND

Included in this very general category are cities, towns, villages, residential developments, malls, shopping centers, industrial and commercial complexes, institutions and mining operations. Some of the 1000 categories are not truly urban in nature - in particular, the Extractive, or mining classes. But all of the 1000 classes define the land use, as opposed to cover. In several of the classes (1180, 1650, 1670, 1900 and 1920) a separate land cover code must also be assigned to each polygon.

The Urban and Built-Up classes are **Land Use** classes. For most of the 1000 classes the land use takes precedence when the criteria for more than one class are met. For example, residential areas that have sufficient tree canopy cover to satisfy the 4200 Upland Forest criteria will still be classified as Residential, not forest. The exception to this is with 1180 Rural Residential, for which a land cover code is also required.

Residential land uses range from high-density urban housing developments to low-density rural areas. The variation extends from the multi-family apartment complexes generally located in larger urban centers to single-family houses with lot sizes of more than two acres.

## MAPPING CONVENTIONS

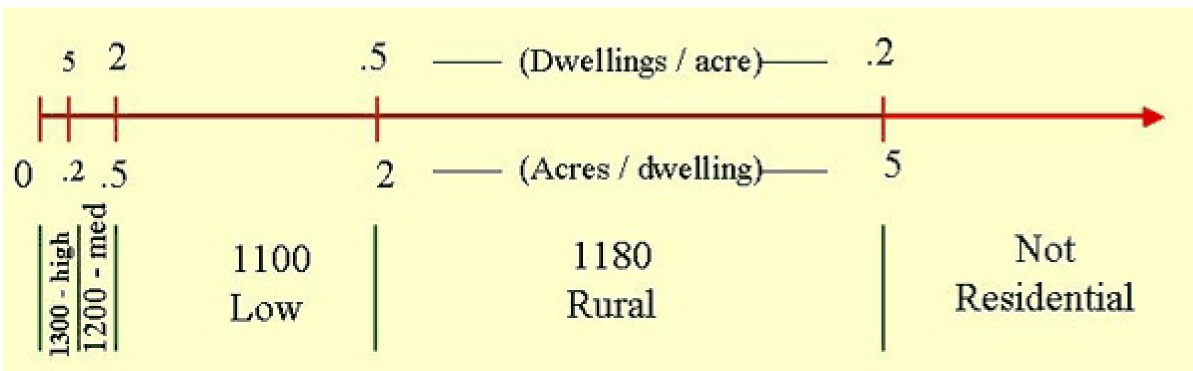
If a residential area is under construction and the ultimate land use is discernible, it should be classified as 1190, 1290, or 1390, depending on density. For example, a medium density residential development under construction should be coded 1290. If other built-up land uses (1500 through 1800) are under construction, they are classified as though the construction were complete. The exception to this rule is 1490 Commercial and Services Under Construction, which is classified separately.

**Minimum mapping units:** The minimum mapping unit (MMU) for all uplands classes, including the 1000 class, is 5 acres.

**Differentiating subclasses:** Residential classes are differentiated based on the average density of dwellings in each mapping unit. It is not the intent of this map to precisely break out every possible change in density - rather, a reasonable grouping of homogeneous properties into larger mapping units is required. Many of these polygons will include some dwellings with larger or smaller acreage, but the density is based on an average. Note that property boundaries are not visible on photography, and groupings are to some extent arbitrary. Photointerpreters (PI's) attempt to delineate the polygons to be as non-linear and compact in shape as possible. This produces a useable model of the landscape without excessive complexity.

Inconsistencies between residential density codes in the 1999 LCLU dataset were recognized and the parcel data was utilized in an effort to alleviate these inconsistencies. County parcel data was used as reference material in the production process as visual overlays in the editing windows. The parcel data was symbolized according to the acres per dwelling and helped categorize neighborhood polygon densities. In areas of disagreement (eg. empty lots) a five acre template was applied over the dataset, the dwellings were counted and calculated for appropriate code assignment. No line work was transferred from the county parcel data.

The drawing below illustrates how the residential classes are differentiated by density. Note that the relationship is far from linear. The top numbers indicate the number of dwellings per acre, while the lower numbers indicate the acreage per dwelling. The 1180 Rural Residential class was added by the District in the 1999 map - in prior maps any density between 1/2 and 5 acres per dwelling was defined as 1100 Residential Low Density.




Notes on differentiating subclasses for the other built-up categories are included in the general descriptions for 1400, 1500, 1600, 1700, and 1800.

## DUAL CODING CONVENTION

All of the 1000 classes are **Land Use** classes. The LUCODE and the LCCODE are the same **except** for the following, which **require a separate Land Cover code:** 1180 Rural Residential, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land, 1900 Open Land, and 1920 Inactive Land with Street Pattern.

## SIMILAR CLASSES

Classes in the Urban and Built-Up categories can be confused with those from other categories. The definitions have been constructed with the intention that only one set of Land Cover and Land Use codes should fit for any given location. See the notes under "Similar Classes" in each of the individual PI keys to help resolve potential conflicts.

Residential sections may occur as components of other land uses, such as institutions, farms, parks, airports and businesses. In those cases the dwellings are usually included in the surrounding use rather than coded as residential. For example, in the Institutional category residential units may be found on military bases in the form of barracks, apartments, dormitories or homes and on college and university campuses in the form of apartments and dormitories in close proximity to instructional buildings. Agricultural field operations and resort facilities commonly provide temporary lodging for their employees and these areas should be classified under Agriculture and Commercial and Services respectively. Look to specific PI keys for guidance in each case.

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

# 1100
# Residential, Low Density

This Level 2 class is not active in the map itself. A more specific subclass must be selected. The subclasses include:

- 1110 Fixed Single Family Units
- 1120 Mobile Home Units
- 1130 Mixed Units, Fixed and Mobile Home Units
- 1180 Rural Residential
- 1190 Low Density, Under Construction

For details on each active subclass, see the respective PI Key description. The following general description applies to all subclasses.

## BACKGROUND

The 1100 class is reserved for Low Density Residential areas that have from 1/2 to 2 acres for each Dwelling Unit and areas with parcels averaging more than 2 acres per dwelling, which are classified as 1180 Rural Residential.

Areas of very low intensity residential land use (over five acres per dwelling), such as farmsteads will be incorporated into the surrounding land use, and the residential component ignored. Mapping units that have less than five acres per dwelling are considered residential, even though forest or open areas may be present.

Boundaries between new housing developments and agricultural areas tend to be distinct. Conversely, the boundaries may be vague and difficult to discern in areas with mixed or rural land uses when housing develops in smaller isolated units over an extended period of time. Polygon boundaries are determined by average housing densities and the relationship to the total urban complex.

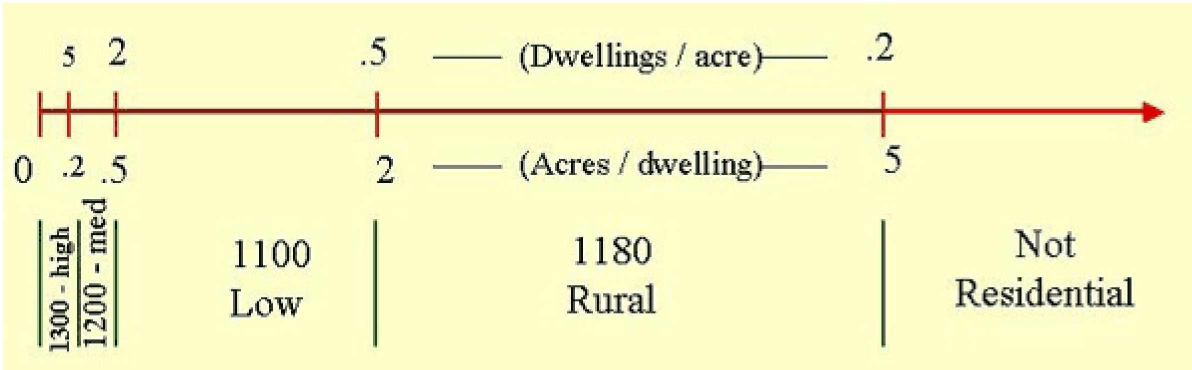
Low Density Residential areas can be found throughout the District. They are often located in newly established sections of large urban areas or on the urban-rural fringe.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit is always 5 acres for the 1100 classes.

**Differentiating subclasses:** The specific types of residential areas that are 1100 subclasses are not difficult to differentiate from each other. See the respective PI Key pages for more detailed information.

The drawing below illustrates how the residential classes are differentiated by density. Note that the relationship is far from linear. The top numbers indicate the number of dwellings per acre, while the lower numbers indicate the acreage per dwelling. The 1180 Rural Residential class was added by the District in the 1999 map - in prior maps any density between 1/2 and 5 acres per dwelling was defined as 1100 Residential Low Density.




## DUAL CODING CONVENTION

All 1100 classes are **Land Use** classes that do not require separate **Land Cover** coding **except 1180 Rural Residential**. The LUCODE 1180 **always** requires a different LCCODE.

## SIMILAR CLASSES

Some Residential classes may be confused with classes in other categories such as 1400 Commercial and Services. The individual PI key pages provide details about how to differentiate these similar classes.

For those areas that have a mixture of residential and other such uses, where each land use is below MMU criteria, the PI must determine the predominant use and code accordingly.

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

# 1110
# Fixed Single Family Units

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1100 Residential, Low Density - less than two dwelling units per acre
**LEVEL 3: 1110 Fixed Single Family Units**

## DESCRIPTION

Fixed single-family structures are usually easily identified by their sizes, shapes, and the character of the associated developed area. Residential areas include the main houses, garages and other out-buildings, and the developed portions of the lot (lawns, gardens, mowed areas, fenced land, drives and paths, etc.). In some areas swimming pools are common, usually appearing as small flat rectangles, dark in tone on CIR film (unless not filled with water -- in which case they often appear light blue). Structures are commonly rectangular, ranging from 25' x 40' in size to 60' x 60'. Structures smaller or larger than this, but having general residential characteristics must be closely examined. Barns and sheds are usually distinguished from houses by their locations away from a main road, and by having few breaks in the roof line. Older structures are often differentiated by referring to a topographic map, where dwellings are shown as solid, while barns are open rectangles.

In poor rural areas, debris is noticeable around the houses and roof materials may be light-toned on one part of the house and dark-toned on another. Houses with dark roofs may be missed altogether due to significant tree cover; look for driveways and other signs of activity. Lawns and woody vegetation are dark magenta on winter CIR photography if the leaf area index is high; as vegetation becomes sparser, soil tones appear and the magenta fades to a light grayish-pink. Bare dry soil shows greenish-gray tones. Clay tile roofs also show greenish-gray tones, which may cause the interpreter to miss houses with clay tile roofs against a background of bare or nearly-bare soil.

Older subdivision developments are most often low-density areas, with a regular, rectilinear pattern of rectangular lots fronting the subdivision streets. Houses are usually set in the middle or toward the rear of the lot. Densities generally range from 1.0 Dwelling Units (D.U.) per acre (1-acre lots) to 0.1 D.U. per acre (10-acre lots) or less. This category also includes the estates of wealthy landowners, where the developed portion of the lot includes employee residences as well as a considerable amount of natural vegetation. In wealthier areas, what were once large single-family structures may have been converted into group residences or trade/service establishments (e.g., a small, private school). Typically, automobile parking areas associated with these converted structures are much larger than parking areas for private residences.

Areas of very low-density housing (between 2 and 5 acres for each dwelling), which may include some amount of woodland, grassland, or orchard, are classified as 1180 Rural Residential if the primary use is residential (e.g., suburban "ranchettes").

## KEYS TO PHOTOINTERPRETATION

- Relatively small buildings, with garages and driveways present.
- Large yards and open areas between houses, with pools and other outdoor structures.
- Well watered or maintained lawns, with a moderate amount of trees and shrubs.
- Absence of large parking areas or large structures.

## CONTEXT

**Landscape Position** - Dwellings of this density can be found throughout the District. They are often located in newly-established sections of large urban areas, or on the urban-rural fringe. In exurban areas these structures tend to aggregate as linear "strip developments" along roads or shorelines. They are mapped as residential areas when residential structures predominate. With increasing densities in peri-urban areas, sub-division and street patterns are encountered in housing developments (or "housing estates"); very few non-residential uses occur in these denser areas.

## SIMILAR CLASSES

- 1180 Rural Residential - Residential density is 2 to 5 acres per dwelling unit.

## SPECIAL MAPPING CONVENTIONS

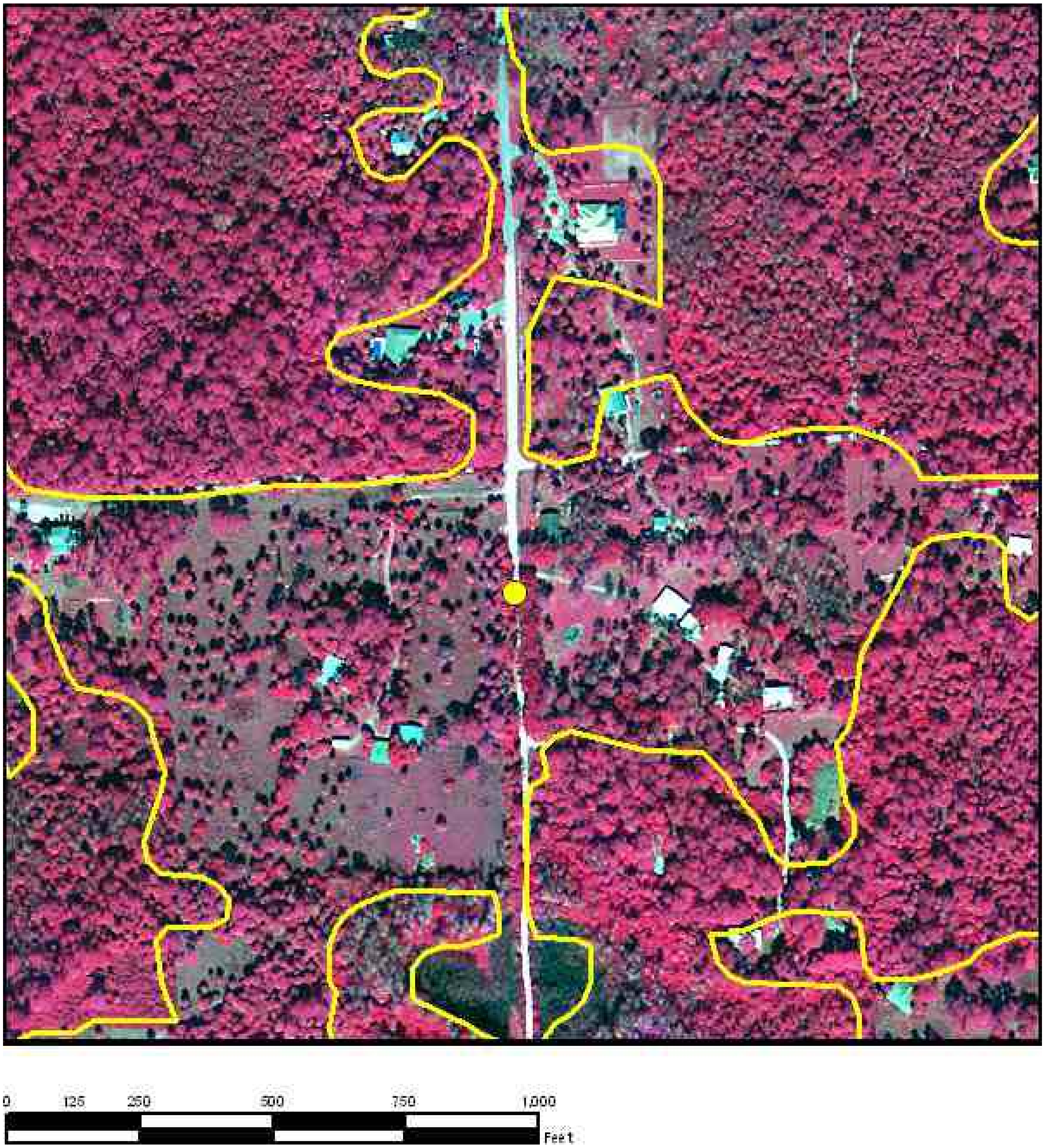
The polygon boundary should encompass the active residential area, corresponding to the "operational boundary" of adjacent land uses. Non-residential features should be excluded, to the extent practicable, from this polygon. Open areas, such as pastures and forests, that are adjacent to the residential area should be classed with the land cover value, and not dual-coded. All features that are inside the residential area are coded 1110, including gardens, lawns, fields, pools, stables, garages, out-buildings, etc. Polygon boundaries may not necessarily coincide with ownership boundaries. The PI is not required to replicate collateral property data, and should err on the side of land cover and environmental function.

Priority classes such as water bodies, wetlands, golf courses and cemeteries are always broken out if they meet minimum size criteria.

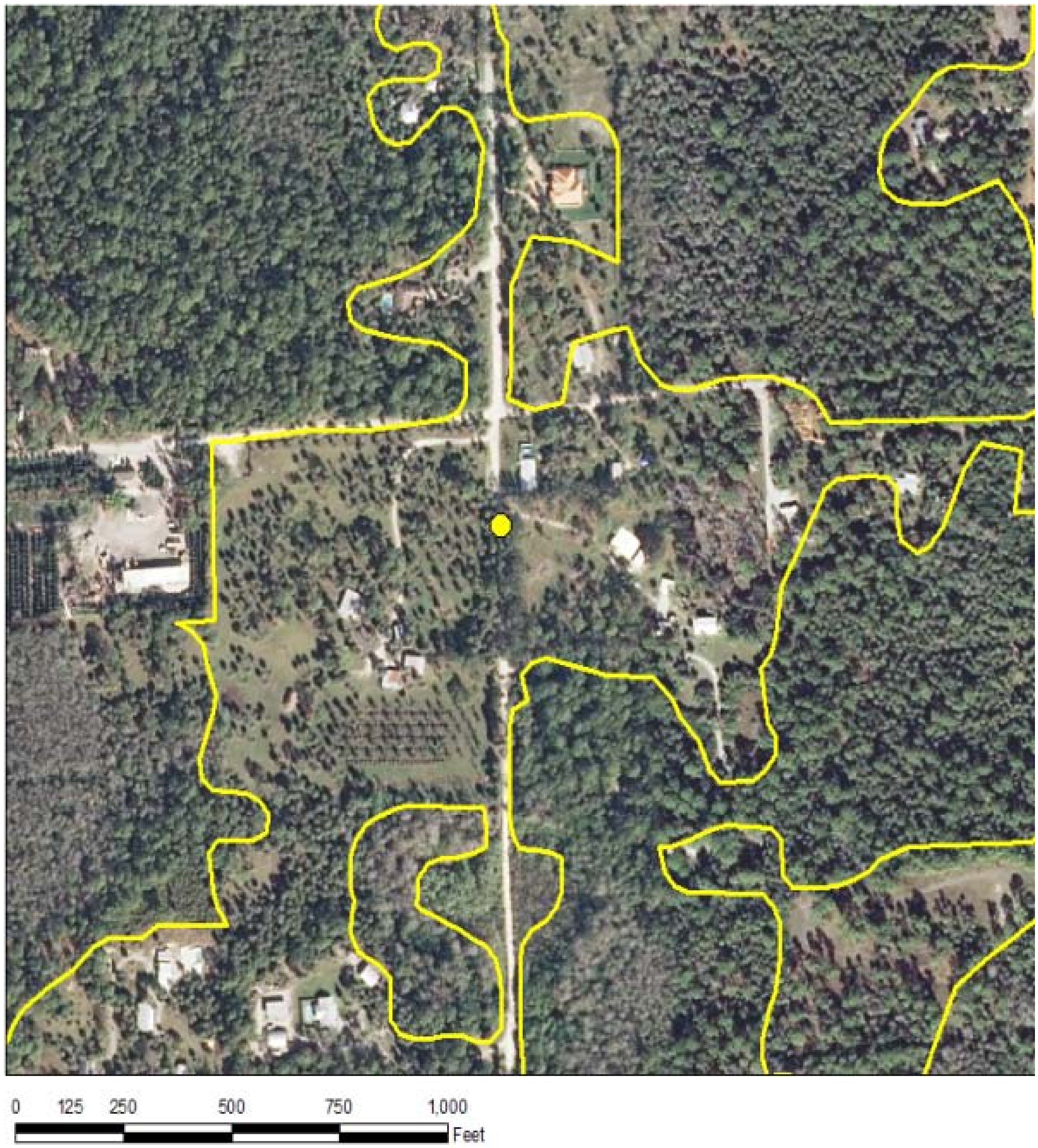
## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
442799.3 702798.26

# 1120
# Mobile Home Units

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1100 Residential, Low Density - less than two dwelling units per acre
**LEVEL 3: 1120 Mobile Home Units**

## DESCRIPTION

Mobile homes are rectangular and light-toned, from 8' to 12' wide and 30' to 50' long. They may or may not be on permanent foundations. Any similar structure less than 30' long and 8' wide is assumed to be a travel trailer. In some cases, pull-out sections and awnings alter the basic rectangular shape, although the flat-roofed, rectangular body is still evident upon close inspection.

Mobile home parks (or areas of at least five acres) where each unit occupies a lot of over 0.5 acre are relatively rare. Mobile home parks are usually developed as medium- and high-density areas, with the units usually arranged as regular arrays with their narrow dimension fronting the streets. At high densities, very closely - spaced units may be placed at an angle to the street.

New mobile home parks appear very similar to new high-density fixed-unit single-family developments, including the use of storm-drainage ponds as water bodies integral to the development. The mobile homes, as a group, will show narrower, more rectangular shapes.

Mobile home parks often have associated storage areas for use by park residents for boats and travel trailers/campers/RVs. These storage areas should be mapped with the park. If ponds and storm water retention areas are present and can be connected to create a two acre or greater area, then these water bodies are mapped as 5300 Reservoirs.

A mobile home sales lot could be mistaken for a mobile home park unless it is noted that the mobile homes are much closer together and parked in a much more regular pattern in a sales lot than in a mobile home park. The sales lot will show no signs of landscaping. Groups of travel trailers may be parked closely together in these sales lots, too. The interpreter should also beware of office trailers parked at or near construction sites.

## KEYS TO PHOTOINTERPRETATION

- Relatively small buildings
- Narrow, rectangular shape
- Distinctive, regular pattern clearly distinguished from surrounding uses.

## CONTEXT

**Landscape Position** - Mobile home residential areas are found almost anywhere that fixed-unit single-family residential areas are found. They occur in rural areas, at the urban fringe (often as infill among older, lower-density residential areas), and in medium-and high-density residential areas (often either adjacent to or incorporated within the newer subdivision developments or "housing estates"). In most instances, mobile home areas have clear boundaries which abut other residential areas, open areas, agricultural areas, limited-access highways, and large water bodies.

## SIMILAR CLASSES

- 1110 Fixed Single Family Units - These will generally be larger structures.
- 1220 Mobile Home Units - these will be higher density

## SPECIAL MAPPING CONVENTIONS

This class should only be used for areas of less than 2 mobile home units per acre.

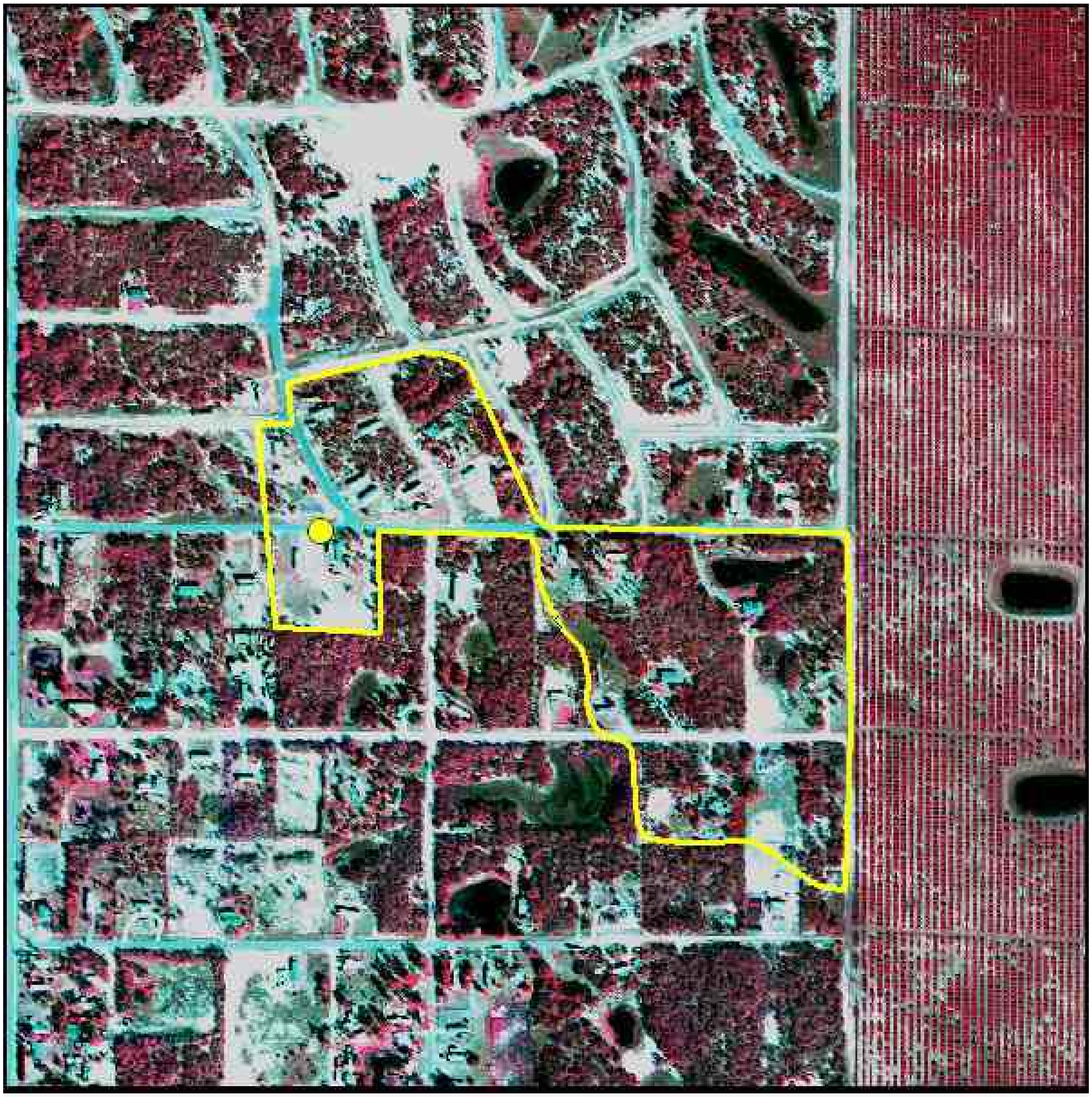
The polygon boundary should encompass the active mobile home area, corresponding to the "operational boundary" of adjacent land uses. Non-residential features should be excluded, to the extent practicable, from this polygon. All features that are inside the mobile home area are coded 1120, including gardens, lawns, fields, pools, garages, out-buildings, etc.

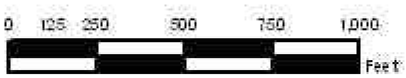
Priority classes such as water bodies and wetlands are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/03/07

**COORDINATES**
557012.69 1054243.72

# 1130
# Mixed Units, Fixed and Mobile Home Units

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1100 Residential, Low Density - less than two dwelling units per acre
**LEVEL 3: 1120 Mixed Units, Fixed and Mobile Home Units**

## DESCRIPTION

The description and keys to interpretation for mobile homes and fixed-units at the three different densities have been covered in the class descriptions for each type.

These "Mixed Units" classes will be used when: (1) there is a consistent mixture of both types of units; and (2) the only way possible to meet the five-acre minimum requirement for a residential area is by mixing both types of units.

## KEYS TO PHOTOINTERPRETATION

- Fixed and Mobile Home Units appear intermixed.
- Separate delineation would result in linear or overly complex polygons.
- Separate delineation would result in polygons below the Minimum Mapping Unit (5 acres).

## CONTEXT

**Landscape Position** - In exurban areas these structures tend to occur scattered among fixed-unit single-family detached structures in linear "strip developments", either along highways or fringing water bodies. They also occur in suburban areas as small sites set aside for mobile homes within a large high-density subdivision of fixed-unit single-family units.

## SIMILAR CLASSES

1110 Fixed Single Family Units - dominated by fixed dwelling
1120 Mobile Home Units - dominated by mobile homes

## SPECIAL MAPPING CONVENTIONS

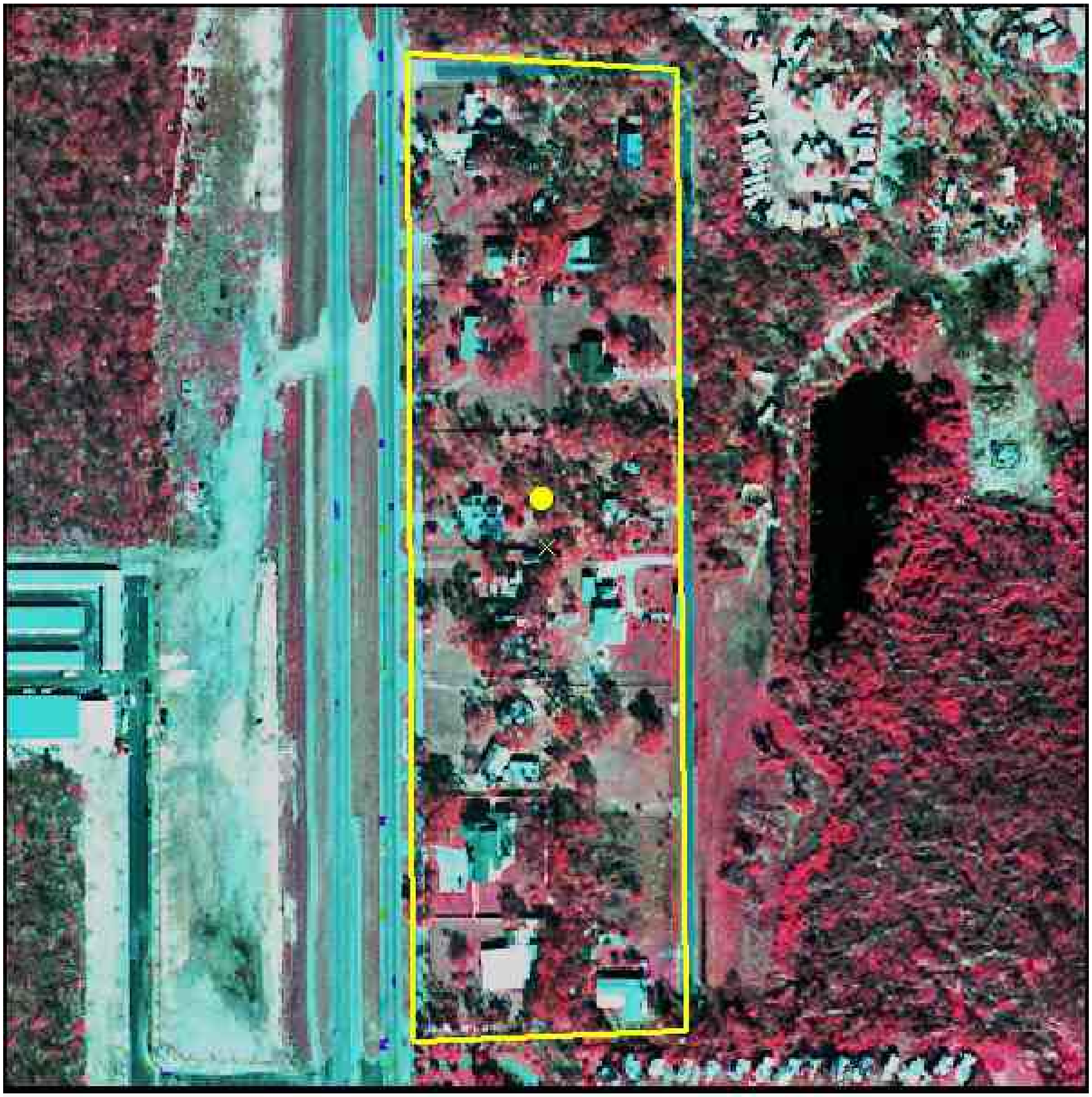
The polygon boundary should encompass the active residential area, corresponding to the "operational boundary" of adjacent land uses. Non residential features should be excluded, to the extent practicable, from this polygon. Open areas, such as pastures and forests, that are adjacent to the residential area should be classed with the land cover value, and not dual-coded. All features that are inside the residential area are coded 1130, including gardens, lawns, fields, pools, stables, garages, out-buildings, etc. Polygon boundaries may not necessarily coincide with ownership boundaries. The PI is not required to replicate collateral property data, and should err on the side of land cover and environmental function.

Priority classes such as water bodies, wetlands, golf courses and cemeteries are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

This is a Land Use class. The LUCODE and LCCODE are the same. A separate Land Cover code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/04/07

**COORDINATES**
514635.41 1391364.64

# 1180
# Rural Residential

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1100 Residential, Low Density - less than two dwelling units per acre
**LEVEL 3: 1180 Rural Residential**

## DESCRIPTION

This new subclass of 1100 is a SFWMD addition to the FLUCCS system. The density is 2 to 5 acres per dwelling. It is used for areas with low dwelling unit densities, but not low enough to be put into a non-residential category, as with farmsteads. The former 1100 Residential Low Density class did not differentiate between fairly dense residential areas and very low density rural areas - homes on 1/2 acre manicured lots were in the same category as homes surrounded by several acres of open or forested areas. 1180 Rural Residential applies to the lower density category.

Areas of very low intensity residential land use (over five acres per dwelling), such as farmsteads, will be given the appropriate non-residential category code(s), ignoring the residence. 1180 is used where the mapping unit is primarily residential, with rural or recreational uses sometimes present. It may contain a mosaic of small open areas, natural vegetation or miscellaneous covers/uses that cannot easily be broken out by the interpreter otherwise. Housing may be mixed in with other land covers and uses with no clear spatial pattern. Boundaries may not be distinct.

Photo interpreters should study graphic examples of how this class is correctly delineated.

## KEYS TO PHOTOINTERPRETATION

- There are roughly two to five acres per dwelling unit.
- Density is low, but the aggregate area is primarily residential.
- Open or natural areas are patchy and too small (<2 acres) to be broken out separately from dwellings.
- Open areas reflect activities (cutting, digging, grazing and fencing) of many small landowners in close proximity. There may be a lack of general pattern or order.
- Large parking areas or pavement are typically absent.

## CONTEXT

**Landscape Position** - Dwellings of this density can be found throughout the District, mostly in a rural context, or on urban-rural fringes.

## SIMILAR CLASSES

- 1110 Fixed Single Family Units - Will have more of a 'neighborhood' appearance, not rural.
- 2000, 4000 - Agricultural or Forested areas usually show a broad spatial pattern related to the landform, vegetation or cropping.

## SPECIAL MAPPING CONVENTIONS

1180 is an SFWMD modification to the FLUCCS system. The lowest density FLUCCS class is 1100 Residential Low Density, with over 1/2 acre per dwelling.

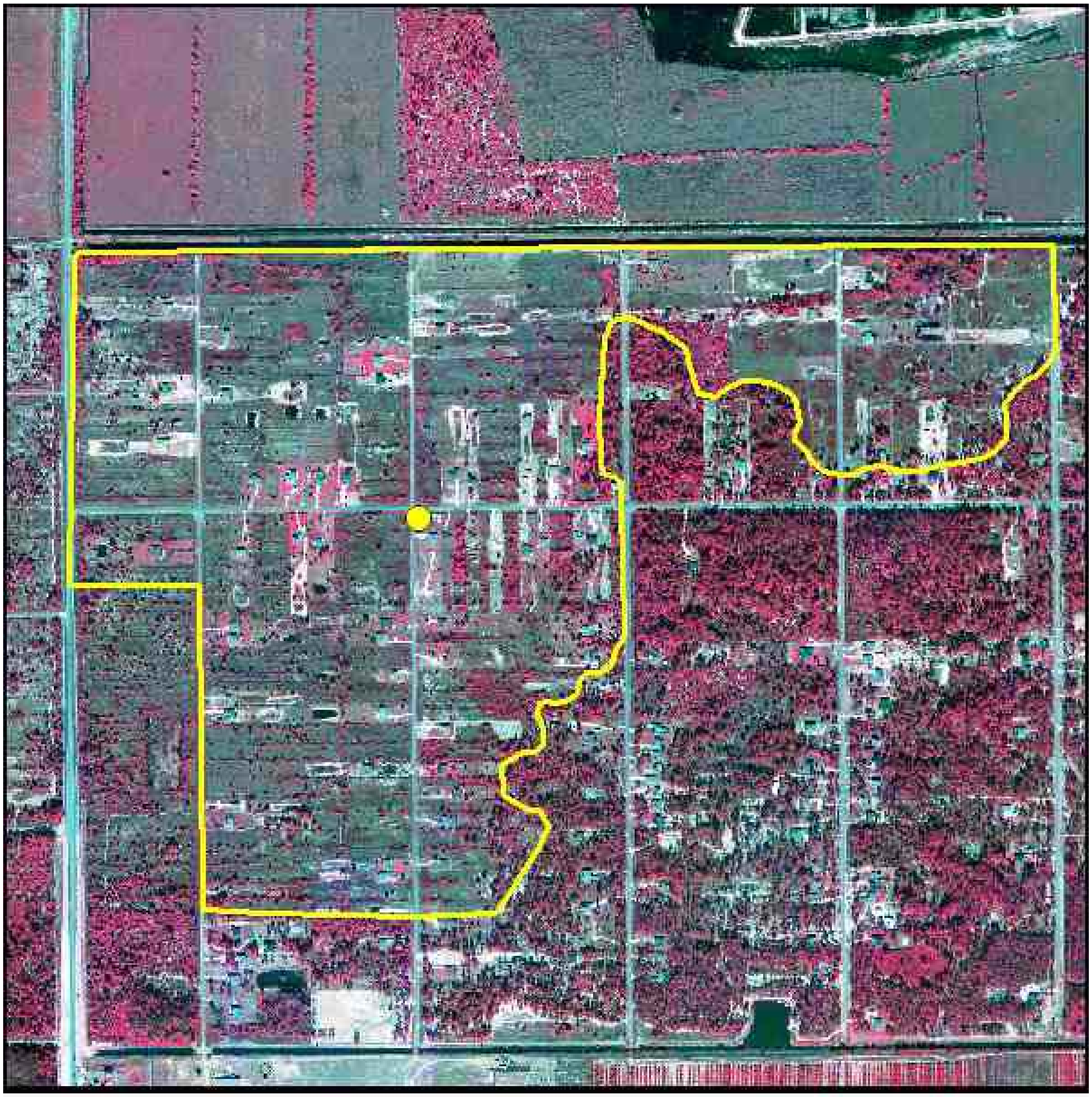
The polygon boundary should encompass the active residential area. All features that are inside the residential area are coded 1180, including gardens, lawns, fields, pools, stables, garages, out-buildings, etc. Polygon boundaries may not necessarily coincide with ownership boundaries. The PI is not required to replicate collateral property data and should err on the side of capturing land cover and environmental function.

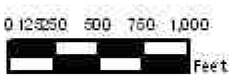
Priority classes such as water bodies, wetlands, golf courses and cemeteries are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

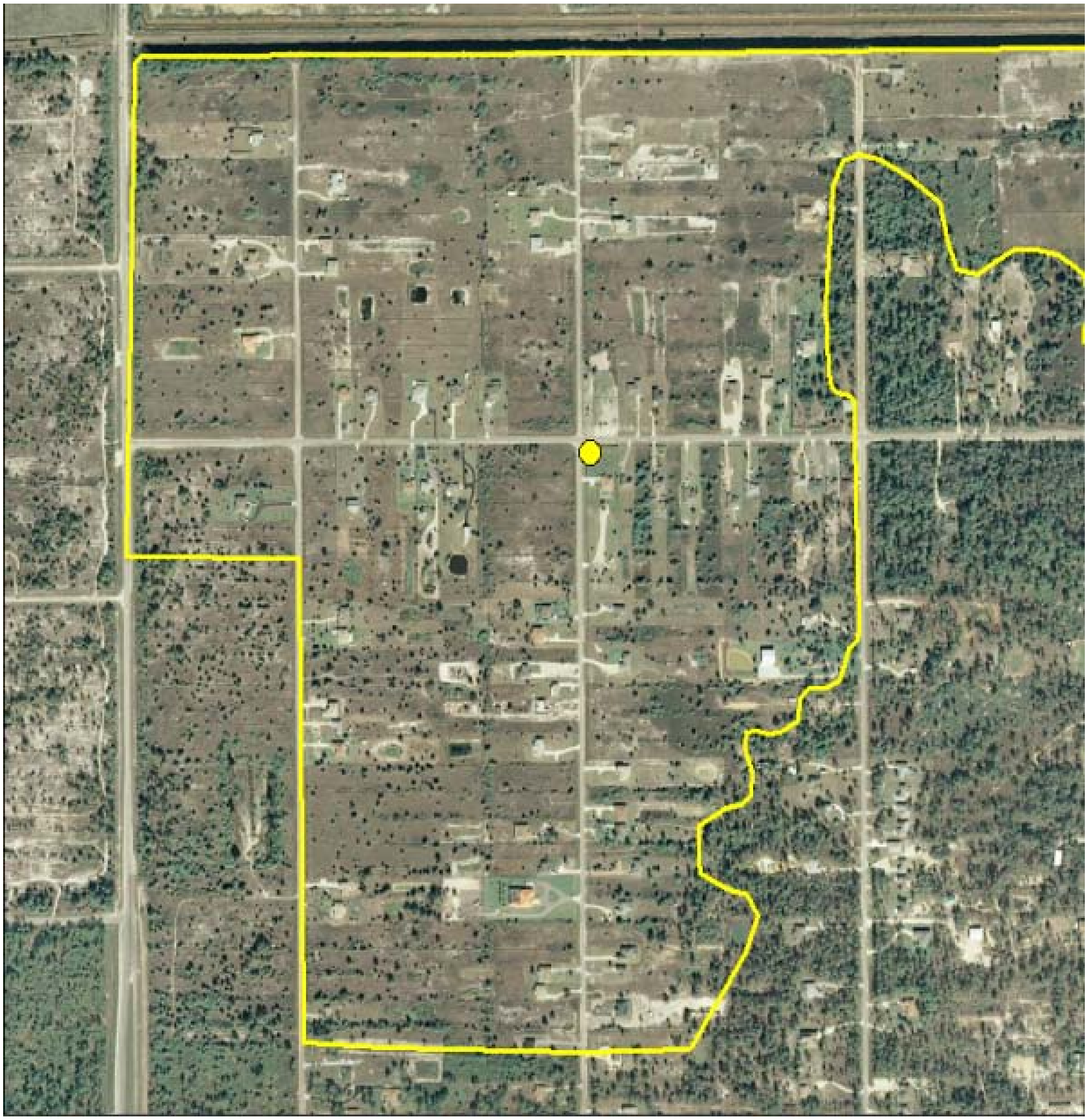
This is a **Land Use** class. **A separate Land Cover code is always required.**

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE



0 125250 500 750 1,000

Feet

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
463444.84 721477.09

# 1190
# Low Density Under Construction

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1100 Residential, Low Density - less than two dwelling units per acre
**LEVEL 3: 1190 Low Density Under Construction**

## DESCRIPTION

This class refers to low density residential areas that are in the process of construction, with more than 1/2 and less than 2 acres per dwelling. When completed they will be placed into the appropriate 1100 class. The existing infrastructure and construction at time of photography indicate the intended pattern and density, and show that the development is likely to be completed. Some of the dwellings are usually present already. If more than two thirds (67%) of the area is constructed, and work is in progress, the area should be coded with the appropriate Level 3 code, as though complete.

Future construction may be fast or slow - there is no time limit set on completion of the areas under construction. However, if the in-fill process is indefinitely stalled, the code 1920 Inactive Land with Street Pattern is used instead. Progress is indicated by cleared, un-vegetated areas, construction equipment, infrastructure such as roads, driveways and utilities, and by surrounding patterns of land use.

## KEYS TO PHOTOINTERPRETATION

- Infrastructure such as roads, driveways and utilities, is present.
- Infrastructure shows the intended street patterns and housing density for most of the delineated area.
- Space for houses, roads and utilities has been cleared, leaving a bright (unvegetated) signature.
- Surrounding land uses show growth is occurring. This may include new schools and malls, new or expanded roads, and other changes.

## CONTEXT

**Landscape Position** -Dwellings of this density can be found throughout the District. They are often located in large urban areas, or on the urban-rural fringe.

## SIMILAR CLASSES

- 1110 Fixed Single Family Units - No evidence of current construction is apparent.
- 1290 Medium Density Under Construction - There are 2 to 5 dwellings per acre.
- 1920 Inactive Land with Street Patterns - No evidence of current construction is apparent.

## SPECIAL MAPPING CONVENTIONS

Housing may be in a pre-construction state, with development appearing imminent. One indication is prepared lands adjacent to newly built subdivisions. Surrounding development densities may be used as a guide to assign appropriate density (1190, 1290 or 1390); however 1190 may be used as the default in areas in which it is impossible to determine the ultimate density. Areas that have had no recent activity, or are indefinitely stalled, should be coded 1920 - Inactive Land with Street Pattern.

In transitional areas where species-specific wetland (2 acre MMU) and upland (5 acre MMU) polygons are below the appropriate MMU some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

**COORDINATES**
92039.56 765206.88 (Images)

## FIELD PICTURE

**DATE**
10/02/07

**COORDINATES**
468213.47 1511210.58 (Field Picture)

# 1200
# Residential, Medium Density

This Level 2 class is not active in the map itself - a more specific subclass must be selected. The subclasses include:

- 1210 Fixed Single Family Units
- 1220 Mobile Home Units
- 1230 Mixed Units, Fixed and Mobile Home Units
- 1290 Low Density, Under Construction

For details on each active subclass, see the respective PI Key description. The following general description applies to all subclasses.

## BACKGROUND

The 1200 class is reserved for Medium Density Residential areas that have from 2 to 5 dwelling units per acre.

Rural and recreational types of subdivisions will be included in the Residential category since this land is almost entirely committed to residential use even though forest or open areas may be present also.

Boundaries between new housing developments and agricultural areas tend to be distinct. Conversely, the boundaries may be vague and difficult to discern in areas with mixed or rural land uses when housing develops in smaller isolated units over an extended period of time. Polygon boundaries are determined by average housing densities and the relationship to the total urban complex.

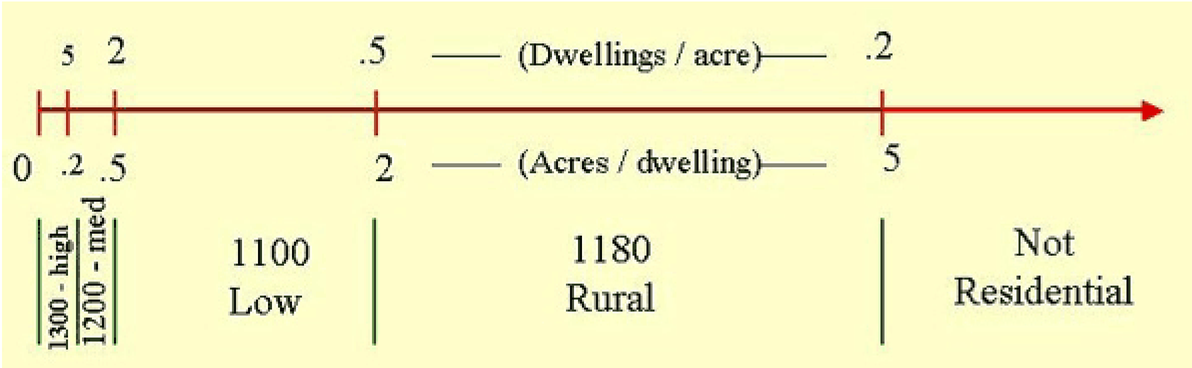
Dwellings of this density can be found throughout the District. They are often located in large urban areas or on urban-rural fringe.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit is always 5 acres for the 1200 classes.

**Differentiating subclasses:** The specific types of residential areas that are 1200 subclasses are not difficult to differentiate from each other. See the respective PI Key pages for more detailed information.

The drawing below illustrates how the residential classes are differentiated by density. Note that the relationship is far from linear. The top numbers indicate the number of dwellings per acre, while the lower numbers indicate the acreage per dwelling.




## DUAL CODING CONVENTION

All 1200 classes are **Land Use** classes. The LUCODE and LCCODE are always the same. A separate **Land Cover** code is not required.

## SIMILAR CLASSES

Some Residential classes may be confused with classes in other categories such 1400 Commercial and Services. The individual PI key pages provide details about how to differentiate these similar classes.

For those areas that have a mixture of residential and other such uses, where each land use is below MMU criteria, the PI must determine the predominant use and code accordingly.

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

# 1210
# Fixed Single Family Units

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1200 Residential, Medium Density - two to five dwelling units per acre
**LEVEL 3: 1210 Fixed Single Family Units**

## DESCRIPTION

Two to five single-family structures per acre meet density requirements for this class. Fixed single-family structures are usually easily identified by their sizes, shapes, and character of the associated developed area. Structures range from square, 50' x 50', to rectangular, 25' x 40', or somewhat smaller. The roof area appears to cover less than half of the lot area.

The overall pattern of many of these areas is an open mosaic of light-roofed structures against a magenta background (CIR). The mosaic may be a regular, rectilinear array of roofs, or a curving pattern, with streets readily visible within the pattern. When ponds or lakes are integral to the subdivision, if the water is connected by canal to navigable waterways, many of the waterfront lots will have piers, and boats will be docked there. If canals are present and connected to another water body, they would be mapped as 5120 Channelized River, Stream, Waterway. If ponds and storm water retention areas are present and can be connected to create a two acre MMU, then these water bodies are mapped as 5300 Reservoirs.

In some areas swimming pools are common, appearing either as small flat rectangles or small elevated, circular tanks, usually dark in tone on CIR unless not filled with water. (Swimming pools may appear light blue if dry.) The area of the house lot not covered by the roof is usually light magenta (grass) or dark magenta (shrubs). The roofs cast deep black shadows. (Skylight reflected from shaded areas is not caught on CIR film.) Roofs are generally white or light-toned.

Occasionally a dark-toned roof occurs. These, or roofs with irregular outlines, combined with the black shadows and the occasional black-toned swimming pool or evergreen shrub, can create a somewhat confusing image. If the interpreter gives such an area a cursory glance, some of the houses may be "lost" in the background "noise", giving the area lower apparent density than the actual density.

## KEYS TO PHOTOINTERPRETATION

- Relatively small buildings, with garages and driveways present.
- Large yards and open areas between houses, with pools and other outdoor structures.
- Well watered or maintained lawns, with a moderate amount of trees and shrubs.
- Absence of large parking areas or large structures.

## CONTEXT

**Landscape Position** - Medium-density housing areas occur within urban and suburban areas anywhere that sub-division or urban street patterns are encountered. Very few non-residential uses occur in medium-density fixed-unit single-family housing areas. Newer subdivision developments or "housing estates" commonly occur at the urban fringe, often as infill among older residential areas. New medium-density developments generally have clear boundaries abutting lower-density residential areas, agricultural areas, limited-access highways or large water bodies. They may surround golf courses and include other recreational amenities. However, many residential areas within older urban lands are also medium-density. Here, boundaries may be vague and difficult to discern when development is sporadic and occurs in isolated units over an extended period of time, especially in areas which abut mixed land uses.

## SIMILAR CLASSES

1110 Fixed Single Family Units - Some Low Density Residential areas may appear similar.
1310 Fixed Single Family Units - Some High Density Residential areas may appear similar.

## SPECIAL MAPPING CONVENTIONS

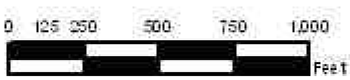
The polygon boundary should encompass the active residential area, corresponding to the "operational boundary" of adjacent land uses. Non-residential features should be excluded, to the extent practicable, from this polygon. Open areas, such as pastures and forests, that are adjacent to the residential area should be classed with the land cover value, and not dual-coded. All features that are inside the residential area are coded 1210, including gardens, lawns, fields, pools, stables, garages, out-buildings, etc. Polygon boundaries may not necessarily coincide with ownership boundaries. The PI is not required to replicate collateral property data, and should err on the side of land cover and environmental function.

Priority classes such as water bodies, wetlands, golf courses and cemeteries are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
03/16/07

**COORDINATES**
925489.21 715241.90

# 1220
# Mobile Home Units

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1200 Residential, Medium Density - two to five dwelling units per acre
**LEVEL 3: 1220 Mobile Home Units**

## DESCRIPTION

Mobile homes are rectangular and light-toned, from 8' to 12' wide and 30' to 50' long. They may or may not be on permanent foundations. Any similar structure less than 30' long and 8' wide is assumed to be a travel trailer. In some cases, pull-out sections and awnings alter the basic rectangular shape, although the flat-roofed, rectangular body is still evident upon close inspection.

Mobile home parks (or areas of at least five acres) where each unit occupies a lot of over 0.5 acre are relatively rare. Mobile home parks are usually developed as medium- and high-density areas, with the units usually arranged as regular arrays with their narrow dimension fronting the streets. At high densities, very closely-spaced units may be placed at an angle to the street.

New mobile home parks appear very similar to new high-density fixed-unit single-family developments, including the use of storm-drainage ponds as water bodies integral to the development. The mobile homes, as a group, will show narrower, more rectangular shapes.

Mobile home parks often have associated storage areas for use by park residents for boats and travel trailers/campers/RVs. These storage areas should be mapped with the park. If ponds and storm water retention areas are present and can be connected to create a two acre or greater area, then these water bodies are mapped as 5300 Reservoirs.

A mobile home sales lot could be mistaken for a mobile home park unless it is noted that the mobile homes are much closer together and parked in a much more regular pattern in a sales lot than in a mobile home park. The sales lot will show no signs of landscaping. Groups of travel trailers may be parked closely together in these sales lots, too. The interpreter should also beware of office trailers parked at or near construction sites.

## KEYS TO PHOTOINTERPRETATION

- Relatively small buildings
- Narrow, rectangular shapes
- Distinctive, regular pattern clearly distinguished from surrounding uses.

## CONTEXT

**Landscape Position** - Mobile home residential areas are found almost anywhere that fixed-unit single-family residential areas are found. They occur in rural areas, at the urban fringe (often as infill among older, lower-density residential areas), and in medium- and high-density residential areas (often either adjacent to or incorporated within the newer subdivision developments or "housing estates"). In most instances, mobile home areas have clear boundaries which abut other residential areas, open areas, agricultural areas, limited-access highways, and large water bodies.

## SIMILAR CLASSES

1120 Mobile Home Units - these will be lower density
1210 Fixed Single Family Units - these will be generally larger structures
1320 Mobile Home Units - these will be higher density

## SPECIAL MAPPING CONVENTIONS

This class should only be used for areas consisting of 2 to 5 mobile home units per acre.

The polygon boundary should encompass the active mobile home area, corresponding to the "operational boundary" of adjacent land uses. Non-residential features should be excluded, to the extent practicable, from this polygon. All features that are inside the mobile home area are coded 1220, including gardens, lawns, fields, pools, garages, out-buildings, etc.

Priority classes such as water bodies and wetlands are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/03/07

**COORDINATES**
499671.83 1450272.57

# 1230
# Mixed Units, Fixed and Mobile Home Units

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1200 Residential, Medium Density - two to five dwelling units per acre
**LEVEL 3: 1230 Mixed Units, Fixed and Mobile Home Units**

## DESCRIPTION

The description and keys to interpretation for mobile homes and fixed-units at the three different densities have been covered in the class descriptions for each type.

These "Mixed Units" classes will be used when: (1) there is a consistent mixture of both types of units; and (2) the only way possible to meet the five-acre minimum requirement for a residential area is by mixing both types of units.

## KEYS TO PHOTOINTERPRETATION

- Fixed and Mobile Home Units appear intermixed.
- Separate delineation would result in linear or overly complex polygons.
- Separate delineation would result in polygons below the Minimum Mapping Unit (5 acres).

## CONTEXT

**Landscape Position** - In exurban areas these structures tend to occur scattered among fixed-unit single-family detached structures in linear "strip developments", either along highways or fringing water bodies. They also occur in suburban areas as small sites set aside for mobile homes within a large high-density subdivision of fixed-unit single-family units.

## SIMILAR CLASSES

1210 Fixed Single Family Units - Dominated by fixed dwelling
1220 Mobile Home Units - Dominated by mobile homes

## SPECIAL MAPPING CONVENTIONS

The polygon boundary should encompass the active residential area, corresponding to the "operational boundary" of adjacent land uses. Non residential features should be excluded, to the extent practicable, from this polygon. Open areas, such as pastures and forests, that are adjacent to the residential area should be classed with the land cover value, and not dual-coded. All features that are inside the residential area are coded 1230, including gardens, lawns, fields, pools, stables, garages, out-buildings, etc. Polygon boundaries may not necessarily coincide with ownership boundaries. The PI is not required to replicate collateral property data, and should err on the side of land cover and environmental function.

Priority classes such as water bodies, wetlands, golf courses and cemeteries are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/03/07

**COORDINATES**
493006.96 1427093.91

# 1290
# Medium Density Under Construction

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1200 Residential, Medium Density - two to five dwelling units per acre
**LEVEL 3: 1290 Medium Density Under Construction**

## DESCRIPTION

This class refers to medium density residential areas that are in the process of construction, with between two and five dwellings per acre when completed. The existing infrastructure and construction at time of photography are sufficient to show the intended pattern and density, and to conclude that the development is likely to be completed. In most cases, some of the dwellings are already present. If more than two thirds (67%) of the area is constructed, and work is in progress, these areas should be coded with the appropriate Level 3 code, as though complete.

There is no time limit set on completion of the areas under construction - progress may be fast or slow. However, if the in-fill process is indefinitely stalled, the code 1920 Inactive Land with Street Pattern is used instead. Progress is indicated by cleared, non-vegetated areas, construction equipment, infrastructure such as roads, driveways and utilities, and by surrounding patterns of land use.

## KEYS TO PHOTOINTERPRETATION

- Infrastructure such as roads, driveways and utilities, is present.
- The infrastructure shows the intended street patterns and housing density for most of the delineated area.
- Space, for houses, roads, utilities, has been cleared, leaving a bright (non-vegetated) signature.
- Surrounding land uses show growth is occurring. This may include new schools and malls, new or expanded roads, and other changes.

## CONTEXT

**Landscape Position** - Dwellings of this density can be found throughout the District. They are often located in large urban areas or on the urban-rural fringe.

## SIMILAR CLASSES

1190 Low Density Under Construction - Some areas may appear similar.
1390 High Density Under Construction - Some areas may appear similar.
1920 Inactive Lands with Street Pattern - No evidence of current construction is visible.

## SPECIAL MAPPING CONVENTIONS

Housing may be in a pre-construction state, with development appearing imminent. One indication is prepared lands adjacent to newly built subdivisions. Surrounding development densities may be used as a guide to assign appropriate density (1190, 1290 or 1390); however 1190 may be used as the default in areas in which it is impossible to determine the ultimate density. Areas that have had no recent activity, or are indefinitely stalled, should be coded 1920 Inactive Lands with Street Pattern.

To reduce mapping costs, areas that have different housing densities may be aggregated, and the average density assigned to the polygon. Polygon shapes should be compact if possible, avoiding linear or convoluted shapes.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

**COORDINATES**
578884.35   1468948.81 (Images)

## FIELD PICTURE

**DATE**
10/02/07

**COORDINATES**
468215.66 1525828.53 (Field Picture)

# 1300
# Residential, High Density

This Level 2 class is not active in the map itself - a more specific subclass must be selected. The subclasses include:

1310 Fixed Single Family Units
1320 Mobile Home Units
1330 Multiple Dwelling Units, Low Rise
1340 Multiple Dwelling Units, High Rise
1350 Mixed Units, Fixed and Mobile Home Units
1390 High Density Under Construction

For details on each active subclass, see the respective PI Key description. The following general description applies to all subclasses

## BACKGROUND

The 1300 class is reserved for High Density Residential areas that have more than 5 dwelling units per acre.

Rural and recreational types of subdivisions will be included in the Residential category since this land is almost entirely committed to residential use even though forest or open areas may be present also.

Boundaries between new housing developments and agricultural areas tend to be distinct. Conversely, the boundaries may be vague and difficult to discern in areas with mixed or rural land uses when housing develops in smaller isolated units over an extended period of time. Polygon boundaries are determined by average housing density and the relationship to the total urban complex.

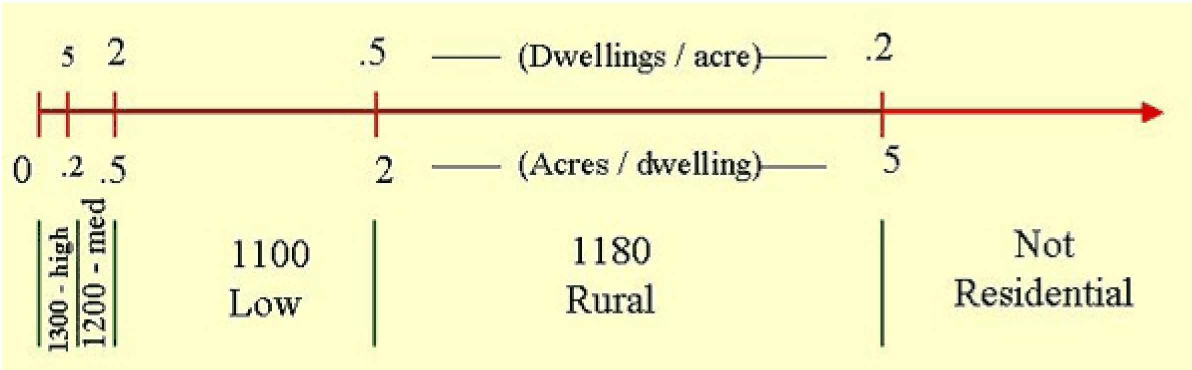
Dwellings of this density can be found throughout the District. They are often located in large urban areas or on urban-rural fringe.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit is always 5 acres for the 1300 classes.

**Differentiating subclasses:** The specific types of residential areas that are 1300 subclasses are not difficult to differentiate from each other. See the respective PI Key pages for more detailed information.

The drawing below illustrates how the residential classes are differentiated by density. Note that the relationship is far from linear. The top numbers indicate the number of dwellings per acre, while the lower numbers indicate the acreage per dwelling.




## DUAL CODING CONVENTION

All 1300 classes are **Land Use** classes. The LUCODE and LCCODE are always the same. A separate **Land Cover** code is not required.

## SIMILAR CLASSES

Some Residential classes may be confused with classes in other categories such as 1400 Commercial and Services. The individual PI key pages provide details about how to differentiate these similar classes.

For those areas that have a mixture of residential and other such uses, where each land use is below MMU criteria, the PI must determine the predominant use and code accordingly.

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

# 1310
# Fixed Single Family Units

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1300 Residential, High Density - six or more dwelling units per acre
**LEVEL 3: 1310 Fixed Single Family Units**

## DESCRIPTION

Six or more single-family structures per acre meet density requirements for this class. Fixed single-family structures are usually easily identified by their sizes, shapes, and character of the associated developed area. Structures range from square, 50' x 50', to rectangular, 25' x 40', or somewhat smaller. The roof area appears to cover more than half of the lot area. Roads, small recreational areas, and small public spaces serving the development are included; small water supply and "package" sewage treatment plants are not included if they can be mapped separately.

The overall pattern of most of these areas is a tight mosaic of light-roofed structures against a light background. The mosaic may be a regular, rectilinear array of roofs, or a curving pattern, with streets showing as fine white lines within the pattern. The areas generally have a crisp, "clean" appearance. When ponds or lakes are integral to the subdivision, if the water is connected by canal to navigable waterways, many of the waterfront lots will have piers, and boats will be docked there. If canals are present and connected to another water body, they would be mapped as 5120 Channelized River, Stream, Waterway. If ponds and storm water retention areas are present and can be connected to create a two acre MMU, then these water bodies are mapped as 5300 Reservoirs.

The newest subdivision developments are most often high-density areas, or a mix of high- and medium-density areas. Maximum densities in these new residential developments are usually high enough to include them in this class.

Occasionally a dark-toned roof is visible. These, or roofs with irregular outlines, combined with the black shadows and the occasional swimming pool or evergreen shrub, can create a somewhat confusing image. If the interpreter gives such an area a cursory glance, some of the houses may be "lost" in the background "noise", giving the area lower apparent density than the actual density.

## KEYS TO PHOTOINTERPRETATION

- Relatively small buildings, with garages and driveways present.
- Large yards and open areas between houses, with pools and other outdoor structures.
- Well watered or maintained lawns, with a moderate amount of trees and shrubs.
- Absence of large parking areas or large structures.

## CONTEXT

**Landscape Position** - High-density housing areas occur within urban and suburban areas-anywhere that sub-division or urban street patterns are encountered. Very few non-residential uses occur in high-density fixed-unit single-family housing areas. Newer subdivision developments or "housing estates" commonly occur at the urban fringe, often as infill among older residential areas. New high-density developments generally have clear boundaries abutting lower-density residential areas, agricultural areas, limited-access highways or large water bodies. They may surround golf courses and include other recreational amenities. However, many residential areas within older urban lands are also high-density. Here, boundaries may be vague and difficult to discern when development is sporadic and occurs in isolated units over an extended period of time, especially in areas which abut mixed land uses.

## SIMILAR CLASSES

- 1210 Fixed Single Family Units - Some Medium Density Residential Areas may appear similar

## SPECIAL MAPPING CONVENTIONS

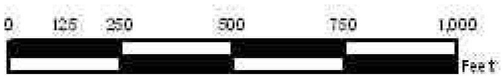
The polygon boundary should encompass the active residential area, corresponding to the "operational boundary" of adjacent land uses. Non residential features should be excluded, to the extent practicable, from this polygon. Open areas, such as pastures and forests, that are adjacent to the residential area should be classed with the land cover value and not dual-coded. All features that are inside the residential area are coded 1310, including gardens, lawns, fields, pools, stables, garages, out-buildings, etc. Polygon boundaries may not necessarily coincide with ownership boundaries. The PI is not required to replicate collateral property data, and should err on the side of land cover and environmental function.

Priority classes such as water bodies, wetlands, golf courses and cemeteries are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
1/12/07

**COORDINATES**
828494.77 1171636.72

# High-Density Residential Modification

## Review of Residential Density for LUCODE

Some of the high-density residential land use codes in the 2004 - 05 dataset may have been attributed improperly based on the empirical experience of LCLU Subject Matter Exports (SME). Since the 2008-09 dataset is being updated, based on the 2004-05, the assigned residential LU codes needed to be re-evaluated based on the acreage of each parcel property within a 1310 polygon (i.e., High-Density Residential, Fixed Single Family Unit). In other words, some of the high-density residential polygons need to be re-classed to medium-density residential as shown in the table below.

## Adjustments of Residential Classes

| 2004-05 | 2008-09 | LU Description |
|---|---|---|
| 0.00 – 0.20 | 0.00 – 0.15 | High |
| > 0.20 – 0.50 | >0.15 - 0.50 | Medium |
| > 0.50 - 2.00 | >0.50 - 2.00 | Low |

Unit: Acres/Parcel

## LU Code adjustment for LUCODE = 1310

The process workflow is described below:

1. **Query** polygon attribute records with LUCODE = 1310 (High Density Residential)
2. **Export** the selected features to a new featureclass
3. **Create** a new field called ***iAcres*** (floating)
4. **Populate** the polygon area (acres) in ***iAcres*** using the syntax

   ***iAcres*** = SHAPE_Area (sq. ft) / 43560 (sq. ft * acre$^{-1}$ )
5. **Clip** the parcel data for the area of interest using the boundary of the Priority Area to reduce process time
6. **Create** a point featureclass of parcel centroids from step #5
7. **Intersect** the featureclass from step#2 with point centroids (step #6) with “Join Attribute”, which results in a point featureclass
8. **Create** a frequency table based on FID
9. **Join** the frequency table with the featureclass from step #2
10. **Create** a table field called ***iDensity***
11. **Populate** iDensity with iAcres / [frequency field]
12. **Select** records that are attributed with 0.15 < ***iDensity*** <=0.5
13. **Reassign** LUCODE to 1210 of LCLU dataset[1]
14. **Save** the dataset and complete the edits

[1] In the event that the parcel data for a specific polygon is incomplete, a representative area within the polygon is measured and the houses are counted by hand.

# 1320
# Mobile Home Units

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1300 Residential, High Density - six or more dwelling units per acre
**LEVEL 3: 1320 Mobile Home Units**

## DESCRIPTION

Mobile homes are rectangular and light-toned, from 8' to 12' wide and 30' to 50' long. They may or may not be on permanent foundations. Any similar structure less than 30' long and 8' wide is assumed to be a travel trailer. In some cases, pull-out sections and awnings alter the basic rectangular shape, although the flat-roofed, rectangular body is still evident upon close inspection.

Mobile home parks (or areas of at least five acres) where each unit occupies a lot of over 0.5 acre are relatively rare. Mobile home parks are usually developed as medium- and high-density areas, with the units usually arranged as regular arrays with their narrow dimension fronting the streets. At high densities, very closely-spaced units may be placed at an angle to the street.

New mobile home parks appear very similar to new high-density fixed-unit single-family developments, including the use of storm-drainage ponds as water bodies integral to the development. The mobile homes, as a group, will show narrower, more rectangular shapes.

Mobile home parks often have associated storage areas for use by park residents for boats and travel trailers/campers/RVs. These storage areas should be mapped with the park. If ponds and storm water retention areas are present and can be connected to create a two acre or greater area, then these water bodies are mapped as 5300 Reservoirs.

A mobile home sales lot could be mistaken for a mobile home park unless it is noted that the mobile homes are much closer together and parked in a much more regular pattern in a sales lot than in a mobile home park. The sales lot will show no signs of landscaping. Groups of travel trailers may be parked closely together in these sales lots, too. The interpreter should also beware of office trailers parked at or near construction sites.

## KEYS TO PHOTOINTERPRETATION

- Relatively small buildings
- Narrow, rectangular shapes
- Distinctive, regular pattern clearly distinguished from surrounding uses.

## CONTEXT

**Landscape Position** - Mobile home residential areas are found almost anywhere that fixed-unit single-family residential areas are found. They occur in rural areas, at the urban fringe (often as infill among older, lower-density residential areas), and in medium- and high-density residential areas (often either adjacent to or incorporated within the newer subdivision developments or "housing estates"). In most instances, mobile home areas have clear boundaries which abut other residential areas, open areas, agricultural areas, limited-access highways, and large water bodies.

## SIMILAR CLASSES

1220 Mobile Home Units - these will be lower density.
1310 Fixed Single Family Units - These will generally be larger structures.

## SPECIAL MAPPING CONVENTIONS

This class should only be used for areas consisting of 6 or more mobile home units per acre.

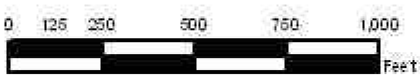
The polygon boundary should encompass the active mobile home area, corresponding to the "operational boundary" of adjacent land uses. Non-residential features should be excluded, to the extent practicable, from this polygon. All features that are inside the mobile home area are coded 1320, including gardens, lawns, fields, pools, garages, out-buildings, etc.

Priority classes such as water bodies and wetlands are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
05/08/07

**COORDINATES**
439218.24 621591.85

# 1330
# Multiple Dwelling Units, Low Rise

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1300 Residential, High Density - six or more dwelling units per acre
**LEVEL 3: 1330 Multiple Dwelling Units, Low Rise**

## DESCRIPTION

Low-Rise Multiple Dwelling Units include two-story town houses, one- or two-story "garden apartments" and duplexes.

Two-story detached structures in neighborhoods with densities less than two structures per acre are generally single-family structures, unless other evidence points to the contrary, such as large parking areas. In older neighborhoods with urban street patterns, two-family houses may occur in areas of one- or two-story detached structures (which are usually single-family houses). The two-family houses may sometimes be identified by a division line in the back yard or by some duplication of features, such as walkways and driveways.

Newer low-rise units often occur in groups, and show a regular or symmetrical geometric arrangement of structures within clearly-defined landscaped grounds, including parking areas and recreational amenities (swimming pools, etc.), associated with the units. Single- and multiple-story town houses and garden apartments generally have one dwelling unit per twenty feet of length; the dwelling units estimated this way should correspond to the number of front walkways or private back yards.

Off-street parking may give an indication of the number of units, since there should be roughly as many spaces (from 2/3 to 1-1/2) as dwelling units.

## KEYS TO PHOTOINTERPRETATION

- Often occur in groups
- Show a regular or symmetrical geometric arrangement of structures
- Some duplication of features such as walkways or driveways

## CONTEXT

**Landscape Position** - Most of the low-rise residential areas are newer developments. They commonly occur at the urban fringe, often as infill developments among older, lower-density residential areas. In most instances the low-density housing developments have clear boundaries which abut other residential areas, agricultural areas, limited-access highways, and large water bodies, etc.

## SIMILAR CLASSES

1310 Fixed Single Family Units - Dominated by single family dwellings
1320 Mobile Home Units - Dominated by mobile homes
1340 Multiple Dwelling Units, High Rise - Units of more 3 or more stories.

## SPECIAL MAPPING CONVENTIONS

The polygon boundary should encompass the active residential area, corresponding to the "operational boundary" of adjacent land uses. Non residential features should be excluded, to the extent practicable, from this polygon. Open areas, such as pastures and forests, that are adjacent to the residential area should be classed with the land cover value, and not dual-coded. All features that are inside the residential area are coded 1330, including gardens, lawns, fields, pools, stables, garages, out-buildings, etc. Polygon boundaries may not necessarily coincide with ownership boundaries. The PI is not required to replicate collateral property data, and should err on the side of land cover and environmental function.

Priority classes such as water bodies, wetlands, golf courses and cemeteries are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
07/19/06

**COORDINATES**
862756.82 450106.43

# 1340
# Multiple Dwelling Units, High Rise

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1300 Residential, High Density - six or more dwelling units per acre
**LEVEL 3: 1340 Multiple Dwelling Units, High Rise**

## DESCRIPTION

High-Rise Multiple Dwelling Units include town houses, apartments and condominiums of three stories or more. Subsidiary parking, recreational and open landscaped areas are included. Small water supply and "package" sewage treatment plants are not included if they can be mapped separately.

In older urban areas of detached three-story units, multi-family structures are assumed at densities of six multi-story structures per acre or greater, with two dwelling units per story.

In newer developments, multi-story apartment buildings in suburban/urban areas on the average have one dwelling unit per 1,000 square feet of floor area per story, with correspondingly large parking areas. They often occur in groups, and show a regular or symmetrical geometric arrangement of structures. They are often cross-shaped, or with wings and ells which permit a large amount of window area per apartment. High-rise units are generally located on clearly-defined, landscaped grounds, including the parking areas and recreational amenities (swimming pools, etc.), associated with the development.

Single (isolated) high-rise residential structures may be distinguished from commercial or industrial buildings by their association with residential neighborhoods, and because their roofs, although usually flat, are without large roof-mounted air-conditioning or ventilating units. (Each apartment will usually have its own unit.) The structures may have off-street parking areas, but lack the loading docks of commercial or industrial buildings.

## KEYS TO PHOTOINTERPRETATION

- Often appear as groups of cross-shaped structures
- Show a regular or symmetrical geometric arrangement of structures
- Generally located on well-landscaped grounds
- Parking areas and recreational facilities often visible
- Using stereoscopic comparison to adjacent trees or garages for height reference could be helpful in defining height requirement

## CONTEXT

**Landscape Position** - Most of the high-rise residential areas are newer developments. They commonly occur within high-density areas of detached single-family housing and low-rise residential structures. They are often adjacent to shopping centers, commercial strip developments, and downtown commercial areas. In some instances groups of high-rise developments have clear, but irregular boundaries, with other intensive land uses, but equally often, they occur as scattered developments with a well-defined boundary for only a single building or a small group of buildings. This is common with newer developments.

## SIMILAR CLASSES

1330 Multiple Dwelling Units, Low Rise - Units of 2 stories or less

## SPECIAL MAPPING CONVENTIONS

The polygon boundary should encompass the active residential area, corresponding to the "operational boundary" of adjacent land uses. Non residential features should be excluded, to the extent practicable, from this polygon. Open areas, such as pastures and forests, that are adjacent to the residential area should be classed with the land cover value, and not dual-coded. All features that are inside the residential area are coded 1340, including gardens, lawns, fields, pools, stables, garages, out-buildings, etc. Polygon boundaries may not necessarily coincide with ownership boundaries. The PI is not required to replicate collateral property data, and should err on the side of land cover and environmental function.

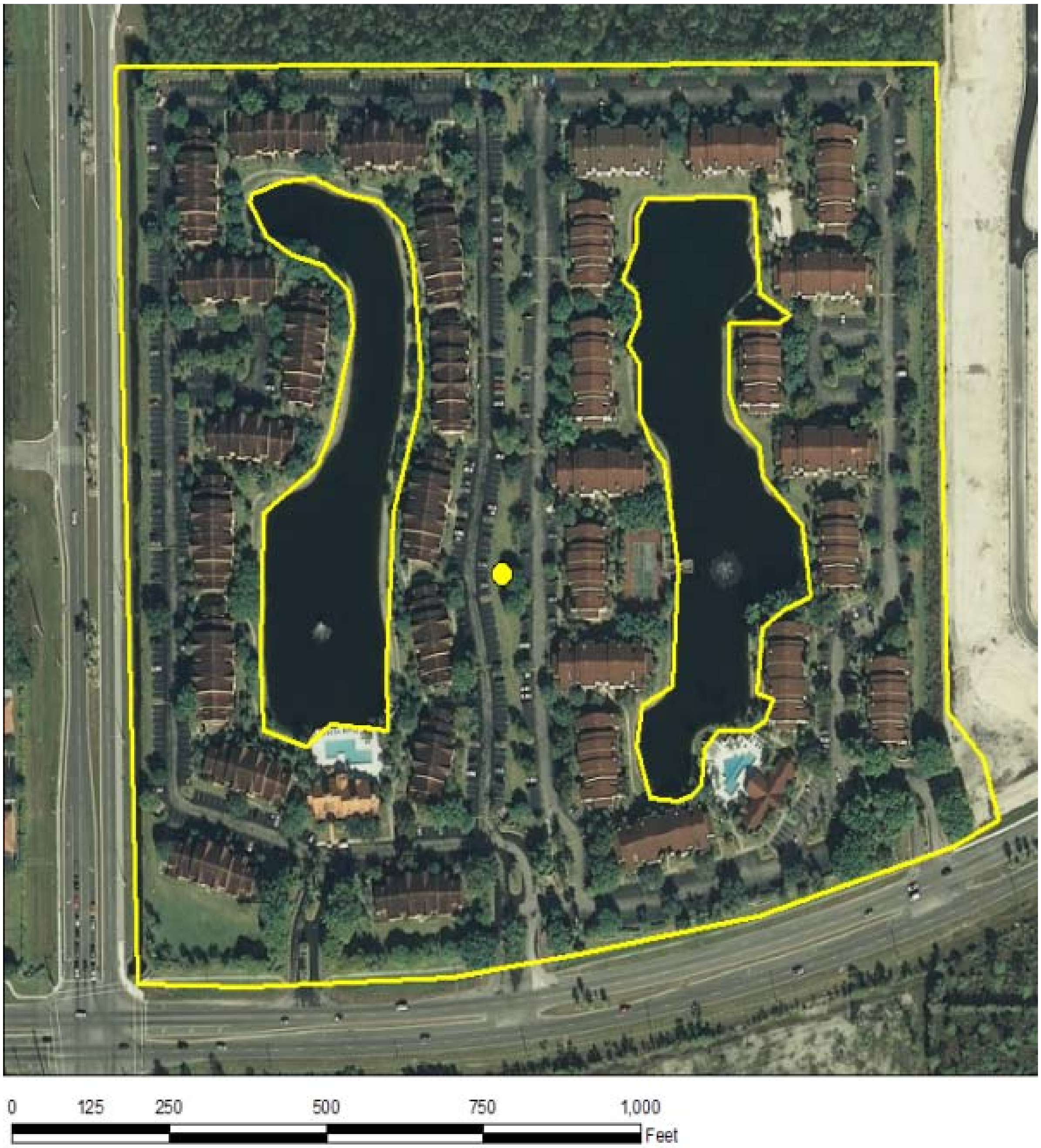
Priority classes such as water bodies, wetlands, golf courses and cemeteries are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
05/10/07

**COORDINATES**
382477.68 827083.16

# 1350
# Mixed Units, Fixed and Mobile Home Units

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1300 Residential, High Density - six or more dwelling units per acre
**LEVEL 3: 1350 Mixed Units, Fixed and Mobile Home Units**

## DESCRIPTION

The description and keys to interpretation for mobile homes and fixed-units at the three different densities have been covered in the class descriptions for each type.

These "Mixed Units" classes will be used when: (1) there is a consistent mixture of both types of units; and (2) the only way possible to meet the five-acre minimum requirement for a residential area is by mixing both types of units.

## KEYS TO PHOTOINTERPRETATION

- Fixed and Mobile Home Units appear intermixed.
- Separate delineation would result in linear or "gerrymandered" polygons.
- Separate delineation would result in polygons below the Minimum Mapping Unit (5 acres).

## CONTEXT

**Landscape Position** - In exurban areas these structures tend to occur scattered among fixed-unit single-family detached structures in linear "strip developments", either along highways or fringing water bodies. They also occur in suburban areas as small sites set aside for mobile homes within a large high-density subdivision of fixed-unit single-family units.

## SIMILAR CLASSES

1310 Fixed Single Family Units - Dominated by fixed dwelling
1320 Mobile Home Units - Dominated by mobile homes.

## SPECIAL MAPPING CONVENTIONS

The polygon boundary should encompass the active residential area, corresponding to the "operational boundary" of adjacent land uses. Non residential features should be excluded, to the extent practicable, from this polygon. Open areas, such as pastures and forests, that are adjacent to the residential area should be classed with the land cover value, and not dual-coded. All features that are inside the residential area are coded 1230, including gardens, lawns, fields, pools, stables, garages, out-buildings, etc. Polygon boundaries may not necessarily coincide with ownership boundaries. The PI is not required to replicate collateral property data, and should err on the side of land cover and environmental function.

Priority classes such as water bodies, wetlands, golf courses and cemeteries are always broken out if they meet minimum size criteria.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE


**COORDINATES**
637972.70  140917.22 (Images)

## FIELD PICTURE

**DATE**
10/02/07

**COORDINATES**
543134.12  1069232.40 (Field Picture)

# 1390
# High Density Under Construction

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1300 Residential, High Density - six or more dwelling units per acre
**LEVEL 3: 1390 High Density Under Construction**

## DESCRIPTION

This class refers to high density residential areas that are in the process of construction. The existing infrastructure and construction at time of photography are sufficient to show the intended pattern and density, and to conclude that the development is likely to be completed. In most cases, some of the dwellings are already present. If more than two thirds (67%) of the area is constructed, and work is in progress, these areas should be coded 1300, as though complete.

There is no time limit set on completion of the areas under construction. However, if the in-fill process is indefinitely stalled, the code 1920 Inactive Land with Street Pattern is used instead. Progress is indicated by cleared, non-vegetated areas, construction equipment, infrastructure such as roads, driveways and utilities, and by surrounding patterns of land use.

## KEYS TO PHOTOINTERPRETATION

- Houses are dense, usually in very regular pattern and orientation.
- Houses tend to be of similar design and appearance.
- Infrastructure, such as roads, driveways and utilities, is present.
- Infrastructure shows the intended street patterns and housing density for most of the delineated area.
- Space, for houses, roads and utilities, has been cleared, leaving a bright (non-vegetated) signature.

## CONTEXT

**Landscape Position** - Most high-density residential areas are new subdivision developments. They commonly occur at the urban fringe, often as infill developments among older, lower-density residential areas. In most instances the high - density developments have clear boundaries which abut lower-density residential areas, agricultural areas, limited-access highways, and large water bodies, etc.

## SIMILAR CLASSES

- 1290 Medium Density Under Construction - Some Medium Density UC Residential areas may appear similar.
- 1920 Inactive Land with Street Patterns - No current construction activity is visible.

## SPECIAL MAPPING CONVENTIONS

Housing may be in a pre-construction state, with development appearing imminent. One indication is prepared lands adjacent to newly built subdivisions. Surrounding development densities may be used as a guide to assign appropriate density (1190, 1290 or 1390); however 1190 may be used as the default in areas in which it is impossible to determine the ultimate density. Areas that have had no recent activity, or are indefinitely stalled, should be coded 1920 Inactive Land with Street Pattern.

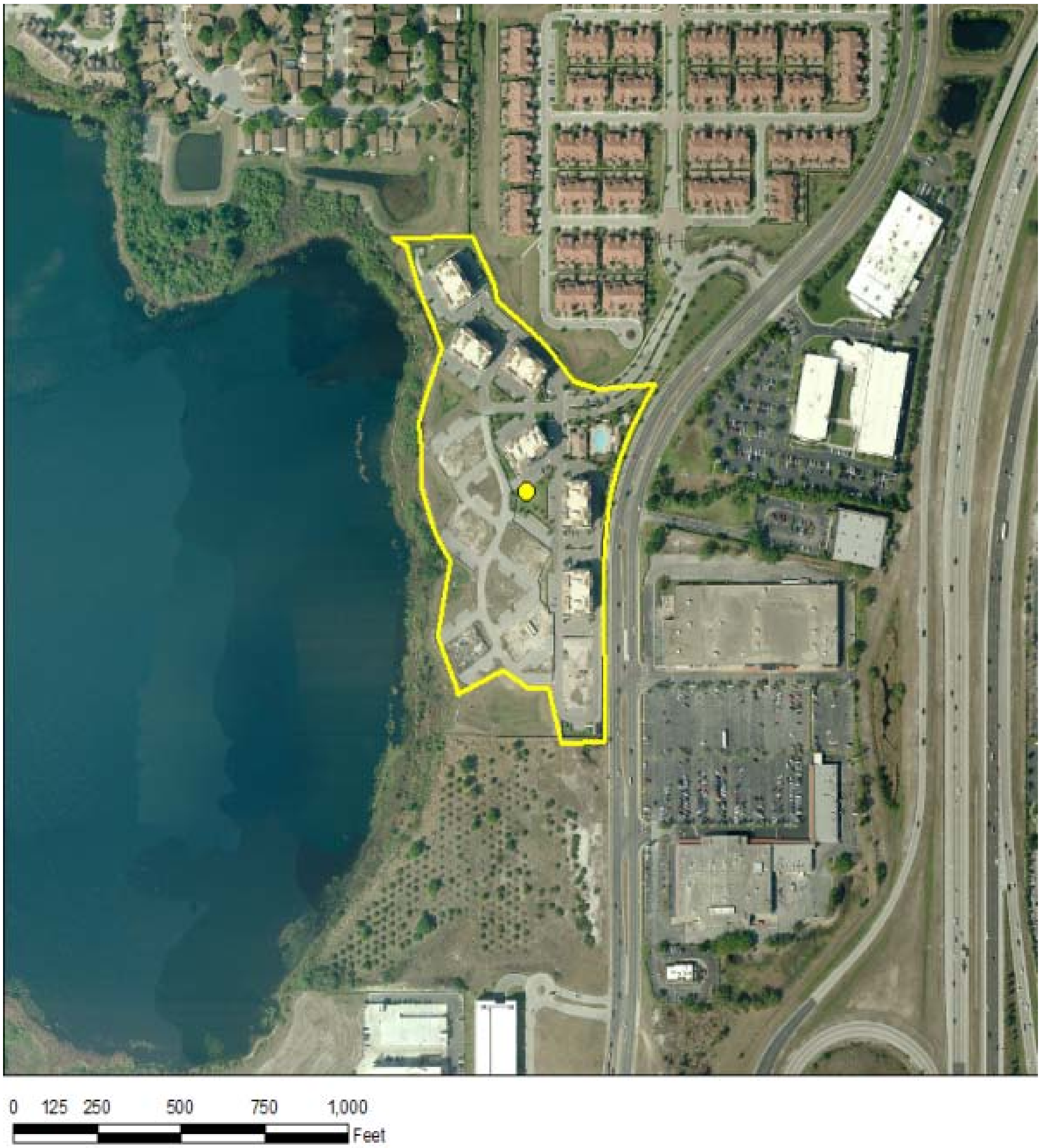
To reduce mapping costs, areas that have varying housing densities may be aggregated together, assigning the average density to the polygon. Polygon shapes should be compact if possible, avoiding linear or convoluted shapes.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE




**COORDINATES**
502380.58 1498564.22 (Images)

## FIELD PICTURE


**DATE**
07/21/06

**COORDINATES**
947212.24 936960.35 (Field Picture)

# 1400
# Commercial and Services

LEVEL 1: 1000 Urban and Built-Up
**LEVEL 2: 1400 Commercial and Services**

## DESCRIPTION

This is an active Level 2 class that includes a broad range of uses which can be difficult to differentiate individually. Only the Level 3 classes 1460 Oil and Gas Storage and 1480 Cemeteries, and the Level 4 classes 1411 Shopping Centers and 1423 Junk Yards are delineated separately. This broad class includes many operations providing diverse products and services which often occur in complex mixtures. Subclasses include retail and wholesale, professional, cultural and entertainment, and tourist services, as well as others. There are about 40 level 3 and level 4 subclasses listed in the FLUCCS Handbook in the 1400 general class - for a complete listing see the Handbook. All of these subclasses are represented in the LCLU 2009 data layer as 1400, except the four noted above.

The 1400 class also includes commercial resorts catering to tourists and vacationers. Resorts are difficult to identify on aerial photography and often contain recreational facilities such as swimming pools and ball courts. Also included in the 1400 class are warehouses, campgrounds and amusement parks.

The 1400 mapping unit should include all secondary structures associated with an enterprise in addition to the main building and integral areas assigned to support the base unit. Included are sheds, warehouses, office buildings, driveways, parking lots and landscaped areas. Also within the mapping units there are likely to be inclusions of other uses, such as light industrial and residential, that are below minimum mapping criteria.

This class can be difficult to differentiate from similar classes. Ancillary land use data (i.e. parcel maps) should be used if available.

## KEYS TO PHOTOINTERPRETATION

- The 1400 polygon often contains a diversity of commercial land uses, as well as non-commercial inclusions. Facility sizes may vary significantly.
- Commercial advertising signs or their shadows may be evident.
- Parking facilities will be located near structures to give patrons easy access to service. Parking geometry reflects easy access for passenger cars to each building.
- Sites are usually lacking natural vegetation, trees, or open space but may be nicely landscaped. Lots are generally well kept.
- There is an absence of heavy machinery, raw materials or fences.
- Larger facilities may show trucking or other transportation services for accepting shipment of goods or supplies.

## CONTEXT

- **Landscape Position** - This land use is not limited to a particular area of the District, but can be found in almost any urbanized or relatively built-up areas.
- **Vegetation** - Most is not natural, but a result of landscaping.

## SIMILAR CLASSES

- 1100 to 1300 Residential - Residential strips may look similar; parking is more dispersed and uniform in residential strips.
- 1500 Industrial - Tends to lack vegetation or planned landscaping
- 1700 Institutional - Tends to have large lawns and planned landscaping
- 1800 Recreational (indoor activities) - May require ancillary data to determine

## SPECIAL MAPPING CONVENTIONS

The SFWMD maps all Commercial and Services other than 1460 Oil and Gas Storage, 1480 Cemeteries, 1411 Shopping Centers and 1423 Junk Yards into this single Level 2 category. This decision was based on error assessments which indicated a high degree of difficulty in accurately differentiating between the various Commercial and Services subclasses, and a lack of user demand for this differentiation.

If an urban area is under construction and the ultimate land use is discernible as commercial, it should be classified as 1490 Commercial and Services Under Construction.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
07/20/06

**COORDINATES**
844086.16  481611.56

# 1410
# Retail Sales and Services

This Level 3 class is not used in the map itself - all retail areas are mapped as the more general Level 2 class 1400 Commercial and Services, except for 1411 Shopping Centers, 1423 Junk Yards and 1490 Commercial and Services Under Construction.

## BACKGROUND

This land use is comprised of varying size and shape buildings with attendant parking facilities for customers. Buildings are often single detached structures, for uses such as drug stores or grocery stores. Flat roofs are common for the larger buildings, and parking areas (public or private) are generally small in comparison with structure areas.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit (MMU) for all 1400 Commercial and Services classes is 5 acres.

**Differentiating subclasses:** Retail Sales and Services areas, as defined above, are difficult to distinguish from other land uses in central business districts on aerial photography, especially when the central business district includes large office buildings.

Most land uses in these business areas will therefore be mapped at the more general Level 2 class 1400 Commercial and Services.

See the PI key for the Level 4 class 1411 Shopping Centers for indicators that assist in differentiation.

## DUAL CODING CONVENTION

All of the 1400 classes are **Land Use** classes. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## SIMILAR CLASSES

- 1100 to 1300 Residential - Residential strips may look similar; parking is more dispersed and uniform in residential strips.
- 1500 Industrial - Tends to lack vegetation or planned landscaping
- 1700 Institutional - Tends to have large lawns and planned landscaping
- 1800 Recreational (indoor activities) - May require ancillary data to determine

**For more information:**

See the PI keys for both 1400 Commercial and Services and 1411 Shopping Centers for more information.

# 1411
# Shopping Centers

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1400 Commercial and Services and Services
LEVEL 3: 1410 Retail Sales and Services
**LEVEL 4: 1411 Shopping Centers**

## DESCRIPTION

This land use is comprised of varying size and shape buildings with common parking facilities for customers, having the structures arranged around the parking area. Buildings may be made up of single structures with multiple units (strip stores), single structures for a single unit (such as a department/discount store) or multiple unconnected buildings for multiple units (upscale "bungalow" or "cottage" units).

Parking areas are large in comparison with structure areas. The structures in a given shopping center are often uniform in size and arrangement. Many of the larger structures have loading docks on the side of the building away from the main parking area - as do most light manufacturing plants. Store managements make their employees park at the far end of the parking lot, giving customers the spaces closer to the stores. At industrial sites, no such concern exists. If the photography were taken on a weekend, it may differentiate the empty parking lot of a light manufacturing plant from the active parking lot of a shopping center.

## KEYS TO PHOTOINTERPRETATION

- Large flat roofs are the rule in shopping centers.
- Shopping centers usually have a unique "bi-modal" parking pattern which distinguishes them from light manufacturing plants.

## CONTEXT

**Landscape Position** - This land use type is found in urban and suburban settings throughout the project area, especially along major highways and at highway and road intersections. These land uses (especially smaller shopping centers) may also be adjacent to or within residential areas. The boundaries of shopping centers are usually regular and distinct.

## SIMILAR CLASSES

- 1550 Other Light Industrial - Loading docks and trucks may be visible.
- 1560 Other Heavy Industrial - These are usually large sites with large, complex buildings.

## SPECIAL MAPPING CONVENTIONS

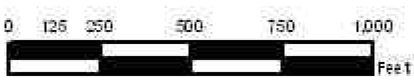
**Those areas that are not clearly related to the functions of the facility are not included.** Adjacent land cover areas, such as pastures and forests, are assigned the appropriate land cover value, and not dual-coded. Only those features that are inside the operational boundaries are coded 1411.

Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they are always broken out, even if located within the 1411 mapping unit.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE


**DATE**
05/09/07

**COORDINATES**
404219.43 765738.87

# 1420
# Wholesale Sales and Services

This Level 3 class is not used in the map itself - all wholesale areas are mapped as the more general Level 2 class 1400 Commercial and Services, except for 1423 Junk Yards, 1411 Shopping Centers and 1490 Commercial and Services Under Construction.

## BACKGROUND

This category is reserved for those land uses associated with the storage and wholesale distribution of products and materials, except for the storage of products and materials subsidiary to an industrial operation. The primary structures associated with this category are identified by their characteristic size, shape and adjacent features. Normally, these structures are large, one to two stories in height, box-like in shape, designed to hold large quantities of products. Active access roads (dark and well-defined on CIR photography), rail spurs, piers and conveyors, or other signs of materials movement should be evident. Loading docks may not be present if roads or rail spurs appear to enter the structure.

Wholesale Sales and Services are often associated with industrial areas or within commercial strip developments. Industrial areas and commercial strips commonly occur near urban areas, but may be found in suburban or rural areas adjacent to airports or in relatively open country. Look for Wholesale Sales and Services activities in any of these contexts.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit (MMU) for all 1400 Commercial and Services classes is 5 acres.

**Differentiating subclasses:** Wholesale Sales and Services areas, as defined above, are difficult to distinguish from other land uses in central business districts on aerial photography, especially when the central business district includes large office buildings.

Most land uses in these business areas will therefore be mapped at the more general Level 2 class 1400 Commercial and Services.

See the PI key for the Level 4 class 1423 Wholesale Sales and Services - Junk Yards for indicators that assist in differentiation.

## DUAL CODING CONVENTION

All of the 1400 classes are **Land Use** classes. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## SIMILAR CLASSES

- 1100 to 1300 Residential - Residential strips may look similar; parking is more dispersed and uniform in residential strips.
- 1500 Industrial - Tends to lack vegetation or planned landscaping
- 1700 Institutional - Tends to have large lawns and planned landscaping
- 1800 Recreational (indoor activities) - May require ancillary data to determine

**For more information:**

See the PI keys for both 1400 Commercial and Services and 1423 Wholesale Sales and Services - Junk Yards for more information.

# 1423
# Junk Yards

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1400 Commercial and Services
LEVEL 3: 1420 Wholesale Sales and Services
**LEVEL 4: 1423 Junk Yards**

## DESCRIPTION

Junk yards include all commercial scrap yards. Automobile junk yards are the most common and are identified by irregular rows of cars in lots usually screened from public view by high fences. Look for the fence shadows and a small office building near the street-side entrance to the lot, either inside or outside of the fence. Cars are visible, massed very close together, and sometimes piled atop one another. Commercial scrap yards storing metals and other materials for industrial use will appear somewhat similar, but without the rows of junked cars.

In addition, to qualify as a junk yard, an area must contain more than twenty junked automobiles or pieces of equipment. Some fields may contain scattered pieces of equipment and old cars, but are not junk yards.

Areas having the general appearance of junkyards, but in remote locations, must be examined closely for signs of commercial activity (an office and a perimeter fence) and activity in the yard (distinct roads and paths). If these activity indicators are missing, the area should be mapped as 8350 Solid Waste Disposal.

Scrap yards adjacent to an Industrial land use, used for storage of raw materials for the industrial operation, are mapped as part of that operation, and not included in this class.

## KEYS TO PHOTOINTERPRETATION

- Distinctive signature of cars massed together is a distinguishing feature.
- Vegetation, if present, appears unmanaged.

## CONTEXT

**Landscape Position** - Junk yards (scrap yards) are often associated with industrial areas or within commercial strip developments. Auto junk yards are especially common along major highways, extending back form the road for a considerable distance.

## SIMILAR CLASSES

- 1550 Other Light Industrial - Loading docks and trucks may be visible.
- 1560 Other Heavy Industrial - These are usually large sites with large, complex buildings.

## SPECIAL MAPPING CONVENTIONS

**Those areas that are not clearly related to the functions of the facility are not included.** Adjacent land cover areas, such as pastures and forests, are assigned the appropriate land cover value, and not dual-coded. Only those features that are inside the operational boundaries are coded 1423.

Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they are always broken out, even if located within the 1423 mapping unit.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/04/07

**COORDINATES**
505456.62  1426419.97

# 1460
# Oil and Gas Storage
# Not Attached to Industrial or Manufacturing Facilities

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1400 Commercial and Services
**LEVEL 3: 1460 Oil and Gas Storage; not attached to industrial or manufacturing facilities**

## DESCRIPTION

This class identifies storage facilities used in the retail and wholesale sales of petroleum, oil and lubricating type products. The storage facilities may be in or near an industrial or manufacturing area but are not directly associated with such a facility. The 1460 mapping unit will include tanks, spill enclosures, internal roads, railroads, spurs, piers, embankments, supervisory and maintenance facilities and all open areas associated with those features. Non-petroleum products such as soybean oil may also be stored. Heavy viscosity products may require steam generating plants.

## KEYS TO PHOTOINTERPRETATION

- Large cylindrical tanks, appearing as circular shapes
- Extensive pumping and transport facilities, including pipeline systems, service roads, piers, railroads and spurs
- Revetments (spill prevention enclosures with embankments) usually enclose storage areas. Evidence of spills may be present. Water may be ponded and treatment/stormwater lagoons may be present.
- Vegetation tends to be sparse in tank areas. Landscaping is controlled.

## CONTEXT

- **Landscape Position** - These facilities are often associated with industrial areas or may exist separately in open areas, where they have distinct, well-defined revetment boundaries with extensive land uses (agricultural, forest lands, etc.) or water. The industrial areas commonly occur near urban areas, but may be found in suburban or rural areas adjacent to airports or in relatively open country.

## SIMILAR CLASSES

- 1540 Oil and Gas Processing - These have extensive industrial operations on site.
- 1550 Other Light Industrial - Loading docks and trucks may be visible.
- 1560 Other Heavy Industrial - These are usually large sites with large, complex buildings.
- 1640 Oil and Gas Fields - These will not have major storage facilities.

## SPECIAL MAPPING CONVENTIONS

**Those areas that are not clearly related to the functions of the facility are not included.** Adjacent land cover areas, such as pastures and forests, are assigned the appropriate land cover value, and not dual-coded. Only those features that are inside the operational boundaries are coded 1460.

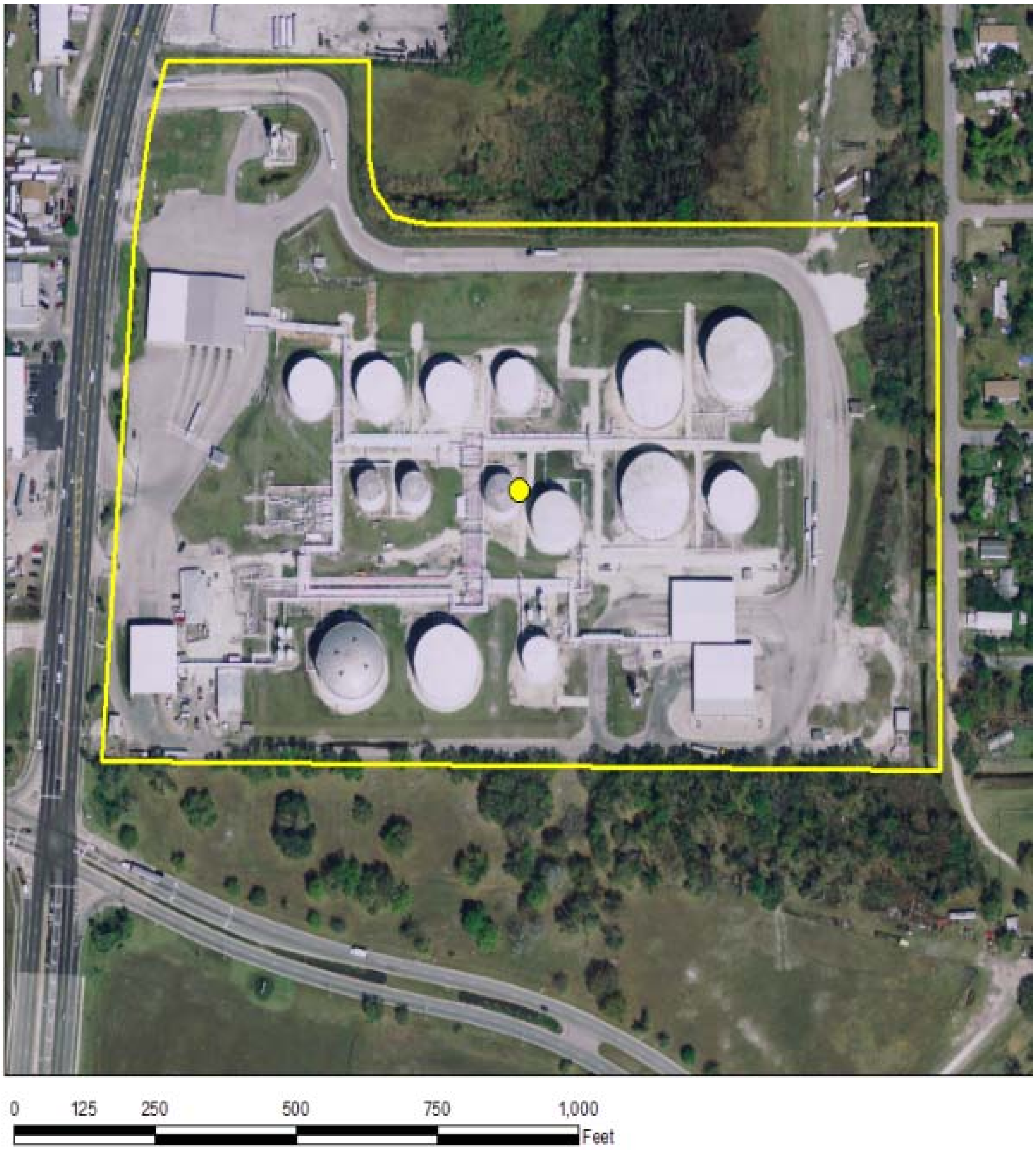
Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they are always broken out, even if located within the 1460 mapping unit.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
10/04/07

**COORDINATES**
537621.88 1486573.49

# 1480
# Cemeteries

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1400 Commercial and Services
**LEVEL 3: 1480 Cemeteries**

## DESCRIPTION

This class includes all burial grounds of any age and type. This is a diverse group, which includes both human and pet cemeteries; old, inactive cemeteries covered by dense canopy; brand new facilities with open expanses of lawn that are not yet "populated" and all combinations in between. Recognition of older cemeteries may be aided by collateral data.

## KEYS TO PHOTOINTERPRETATION

- Cemeteries are usually identified on topographic maps by point symbols.
- Newer facilities may have relatively smooth and even textured land with well maintained, irrigated lawns and paved roads.
- Newer facilities may have few or scattered trees. Older ones may be under dense canopy.
- There may be small to medium sized structures (e.g. mausoleums) dispersed about the facility.
- Road pattern and landscaping may have a formal, aesthetic appearance reflecting the religious functions. Roads may curve and wind through the site. There is usually a formal landscaped entrance.
- The headstones and their shadows may form a checker board pattern, or one of closely-spaced rows of white dots.
- Boundaries with adjacent land uses are usually distinct.

## CONTEXT

- **Landscape Position** - Cemeteries may be found throughout the District, but are usually closer to populated areas. Their size tends to correlate to the size of the surrounding communities, with larger cemeteries near major urban areas. Small cemeteries are often located next to churches, and should be coded as cemeteries if greater than the 5 acre MMU.

## SIMILAR CLASSES

- 1700 Institutional - Often have many smaller structures, including onsite residences
- 1900 Open Land - Does not have enough indication of a land use to assign another code
- 3000 Upland Non-Forested - Vegetation may be diverse in type, texture and pattern.

## SPECIAL MAPPING CONVENTIONS

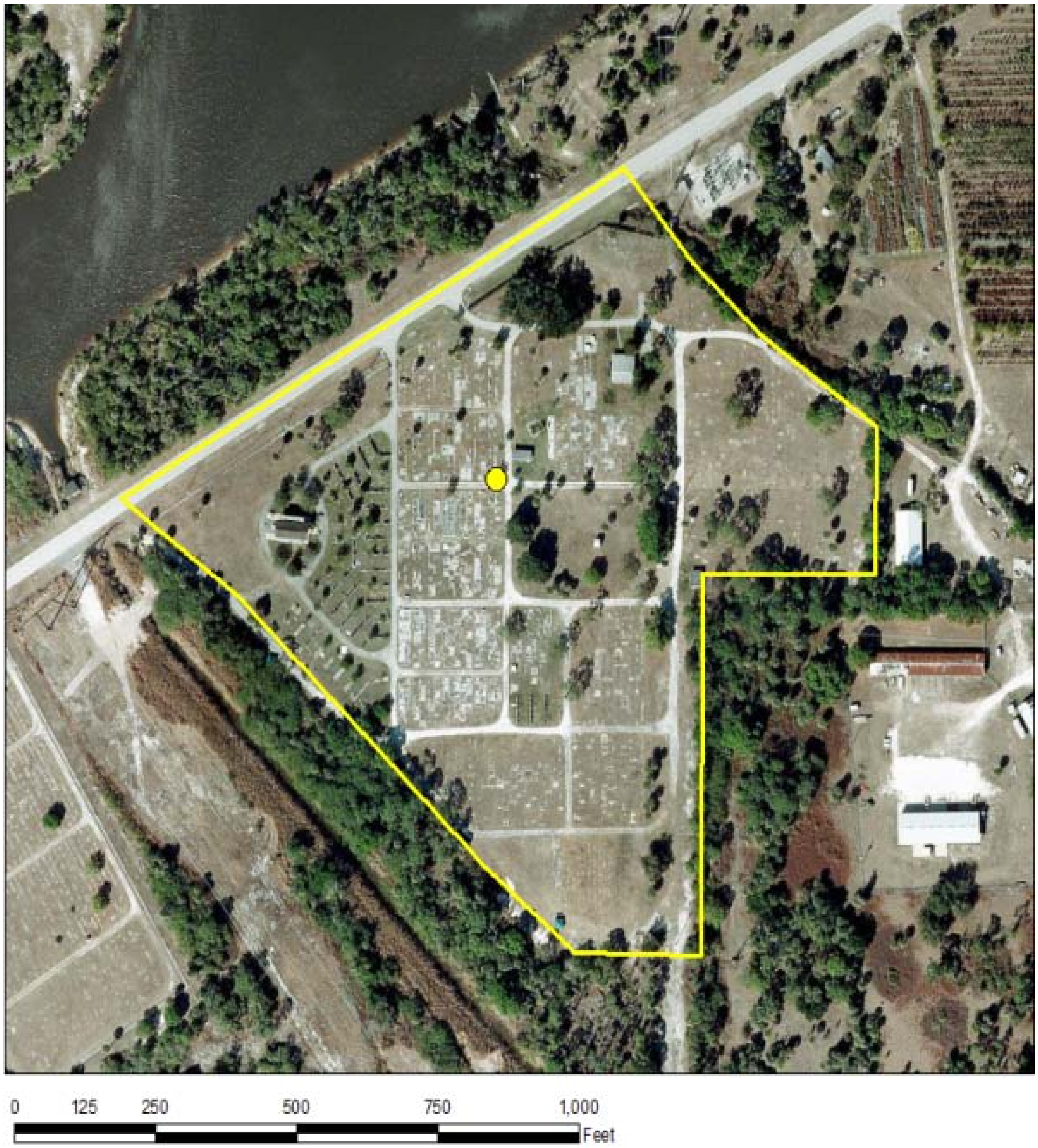
Cemeteries are a priority class and should always be broken out if they meet MMU criteria of 5 acres. Ancillary data should be used, if available, to locate and confirm the presence of cemeteries.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE


**DATE**
03/16/07

**COORDINATES**
792509.81 967602.99

# 1490
# Commercial and Services Under Construction

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1400 Commercial and Services
**LEVEL 3: 1490 Commercial and Services Under Construction**

## DESCRIPTION

This class includes all 1400 classes that are in the process of construction. It includes 1400 Commercial and Services, 1411 Shopping Centers and 1423 Junk Yards. For a detailed description of those classes see the PI key pages for each one.

This class can be difficult to differentiate from similar classes, especially when under construction. Ancillary land use data (i.e. parcel maps) should be used if available.

## KEYS TO PHOTOINTERPRETATION

- See descriptions for 1400, 1411 and 1423.
- Much of the land surface is likely to be un-vegetated and disturbed.
- Construction equipment and building  may be visible.
- There are likely to be mounds of fill material, temporary dirt roads, ponding, construction material, construction trailers and other signs of on-going construction.
- Areas under construction will be very light-toned, with a white signature where soil is exposed.

## CONTEXT

- **Landscape Position** - Commercial areas are located throughout the District, in association with developed areas and transportation volume. They may be within or independent from developed areas. They are usually located along main transportation routes or at the intersections of secondary transportation corridors.

## SIMILAR CLASSES

- 1190, 1290, 1390 - all Residential Under Construction Classes - Sill show the typical residential pattern; individual buildings generally smaller than commercial buildings.
- 7400 Disturbed Land - Evidence of current construction not usually evident; old machinery may be visible.
- 7420 Borrow Areas - Evidence of excavation such as pits and trenches

## SPECIAL MAPPING CONVENTIONS

Many of the indicators of the 1400 classes are not visible during the construction period. Ancillary data such as parcel or zoning maps may be needed to differentiate this code from other "under construction" classes.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/17/07

**COORDINATES**
502890.32 1480035.15

# 1500
# Industrial

LEVEL 1: 1000 Urban and Built-Up
**LEVEL 2: 1500 Industrial**

## DESCRIPTION

This class is an active Level 2 class and is used when none of the more specific Level 3 subclasses can be applied.

The Level 3 subclasses include:

1540 Oil and Gas Processing
1550 Other Light Industrial
1560 Other Heavy Industrial

The Industrial class includes those land uses where manufacturing, assembly or processing of materials and products occurs. Industrial areas include a wide array of industry types ranging from light manufacturing and industrial parks to heavy manufacturing plants. Also included are those facilities for administration and research, assembly, storage and warehousing, shipping and associated parking lots and grounds.

Typical examples of the Industrial class found in Florida are pulp and lumber mills, oil refineries with tank farms, chemical plants and brick making plants.

Areas that have mixed Industrial classes (multiple subclasses, each one below the MMU ) will be classified with the appropriate Level 3 code, if applicable, depending on the predominant type of industries in the polygon. If none of those are the predominant use, then the area is classified as 1500 Industrial.

If an Industrial area is under construction and the ultimate land use is discernible, it should be classified as if the construction were complete.

## KEYS TO PHOTOINTERPRETATION

- Visible indicators of industrial operations include stockpiles of raw materials, large power sources and waste management areas.
- Industrial areas may have an unkempt look in comparison with commercial or institutional areas, denoting private use.
- They tend to lack vegetation or planned landscaping.

## CONTEXT

- **Landscape Position** - Industrial facilities are often clustered together in larger areas with appropriate zoning, utilities, transportation and other factors. They tend to be located adjacent to urban areas, and with access to major transportation routes, including roads, railroads, water and airports. Heavy industrial concentration is often located by port or rail facilities. Finished products and warehouses tend to be located in urban fringe areas. Fabricating and assembly industries are usually located adjacent to central business districts.

## SIMILAR CLASSES

- 1400 Commercial and Services - Generally well-kept lots; may be nicely landscaped
- 1600 Extractive - Large areas of surface disturbance; waste piles, excavating equipment may be visible

## SPECIAL MAPPING CONVENTIONS

If an Industrial area is under construction and the ultimate land use is discernible as industrial, it should be classified as 1500 - Industrial.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/04/07

**COORDINATES**
533367.43 1487134.29

# 1540
# Oil and Gas Processing

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1500 Industrial
**LEVEL 3: 1540 Oil and Gas Processing**

## DESCRIPTION

This category includes facilities that produce gasoline, kerosene, jet fuel, asphalt, liquid gases and other petroleum products. It also includes the processing and recycling of used petroleum products and storage facilities for petroleum products. All subsidiary features, such as transportation, offices, cooling ponds and open areas that are within the operational boundaries and related to the operation are included in the mapping unit.

## KEYS TO PHOTOINTERPRETATION

- Complex arrangement of buildings, pipelines, towers, vessels, impoundments and lagoons
- Closed vessels for handling liquids, gases, chemicals and suspensions
- Tanks, pipelines and towers for cracking or distillation
- Steam generating plants for heating viscous liquids
- Located away from residential areas

## CONTEXT

- **Landscape Position** - These operations are generally located away from residential areas, but close to industrial areas where labor, transportation, and other resources are available. Pipelines, rail lines, harbors, and highways are likely features in the surrounding landscape.

## SIMILAR CLASSES

- 1460 Oil and Gas Storage - Revetments enclosing storage areas visible
- 1500 Industrial - Most classes in the Industrial class appear to have similar signatures. Oil and gas processing plants are differentiated by the concentration of tanks, pipelines, towers and stacks characteristic of such plants
- 1560 Other Heavy Industrial - Tends to have extensive handling, transport, and storage capabilities

## SPECIAL MAPPING CONVENTIONS

Only those features that are inside the facility boundaries and actively involved in its operation are coded as 1540. These may include parking and transportation areas, treatment facilities, ponds and impoundments, fuel storage, office buildings and open areas lying within the operational boundary.

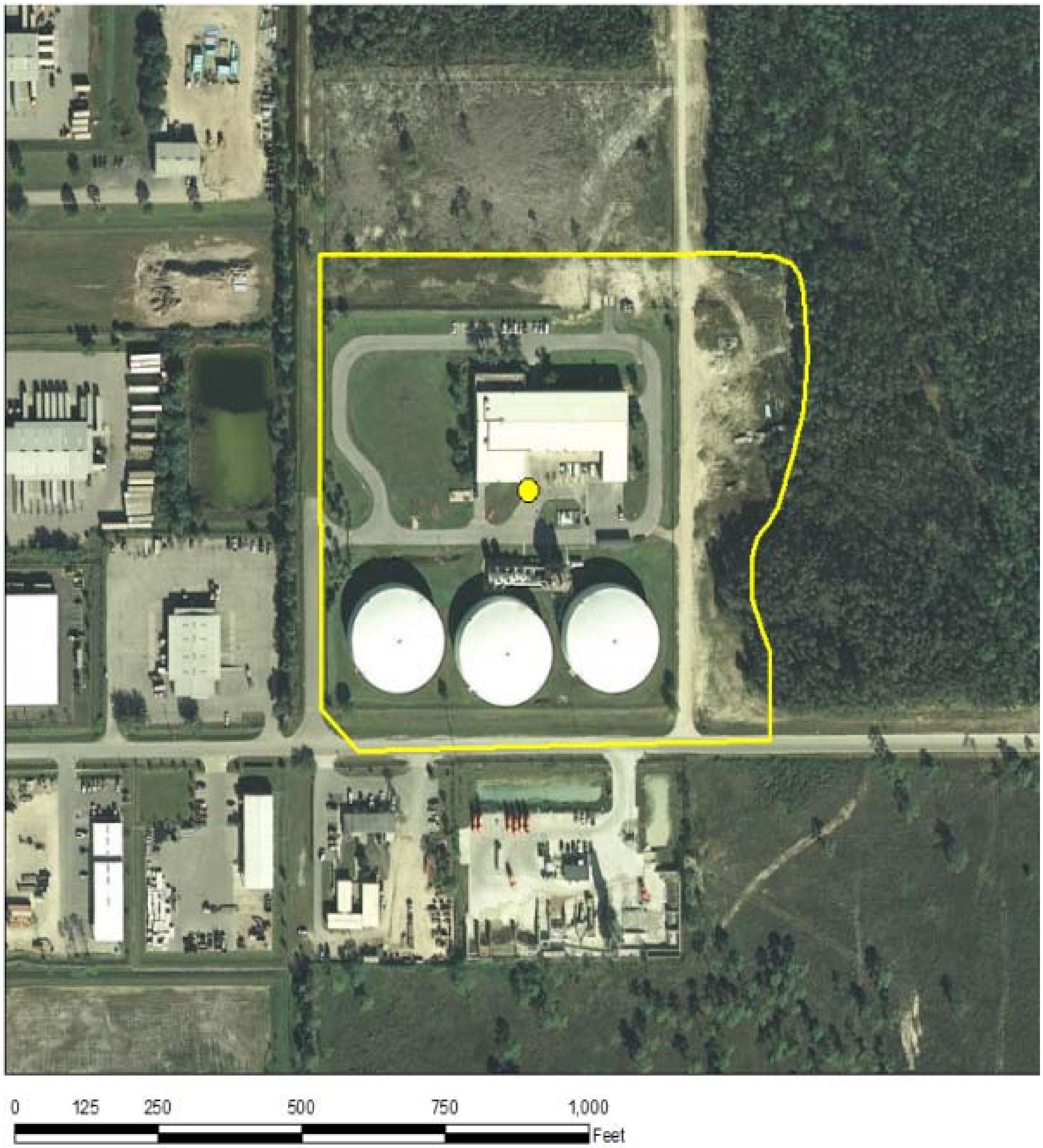
Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they are always broken out, even if located within the 1540 mapping unit.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and the LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
386122.27 834841.37

# 1550
# Other Light Industrial

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1500 Industrial
**LEVEL 3: 1550 Other Light Industrial**

## DESCRIPTION

This class is primarily for fabrication industries, which use the products from other processing and manufacturing industries to make parts and finished products. It also includes any light industries that do not fit in any of the other 1500 Industrial classes. Examples of this class are steel fabrication, small boat manufacturing and electronic manufacturing/assembly.

Light industries tend to be enclosed operations characterized by the buildings used for equipment, materials and manufacturing. They lack the extensive handling, transport, heavy lifting, storage, waste treatment and power facilities that characterize processing and heavy industrial operations.

Light manufacturing can also be distinguished from most commercial operations by the patterns of cars parked in the parking areas and by the size, arrangement and details of the structures. The cars all park as close as possible to the entrance and not in the more regular pattern associated with commercial operations. The buildings shapes are usually rectangular, similar to warehouses, but distinguished from wholesale operations by the subsidiary facilities.

There are a number of land use classes that have a similar appearance on aerial photography, characterized by rectangular buildings. Ancillary land use data should be checked, if available, to confirm this class. Light manufacturing may be mixed with other uses, in which case the predominant use should be established and assigned to the mapping unit.

In transitional areas where species-specific wetland (2 acre MMU) and upland (5 acre MMU) polygons are below the appropriate MMU some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## KEYS TO PHOTOINTERPRETATION

- Good highway access
- Medium size parking lots where cars may be parked in a somewhat irregular pattern
- Buildings are medium sized, usually one-story, rectangular; distinguishable from wholesale storage by subsidiary features.
- Storage, equipment and other features tend to be enclosed rather than outdoors.
- Typical roof types are flat, saw tooth and monitor. Ventilators and skylights are common at manufacturing sites.
- Loading docks and trucks may be visible.
- Landscaping may be planned, but there is little or no natural vegetation.

## CONTEXT

- **Landscape Position** - Light industry is found throughout the District, in the vicinity of heavy industry, industrial parks, commercial strips and major road intersections. The boundary between light industry areas, especially industrial parks, and other land uses are often regular and well-defined.

## SIMILAR CLASSES

- 1400 Commercial and Services - Tend to lack subsidiary features on site
- 1500 Industrial - Most classes in the Industrial class can appear to have similar signatures
- 1560 Other Heavy Industrial - Tends to have extensive handling, transport and storage capabilities

## SPECIAL MAPPING CONVENTIONS

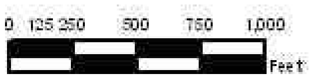
Only those features that are inside the facility boundaries and actively involved in its operation are coded as 1550. These may include parking and transportation areas, treatment facilities, fuel storage, office buildings and open areas lying within the operational boundary.

Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they are always broken out, even if located within the 1550 mapping unit.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE


**DATE**
07/19/06

**COORDINATES**
865855.72  458563.62

# 1560
# Other Heavy Industrial

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1500 Industrial
**LEVEL 3: 1560 Other Heavy Industrial**

## DESCRIPTION

This class is used for any processing or heavy manufacturing operations that are not included in the 1550 Light Industrial or 1560 Oil and Gas Processing classes. It includes such specific heavy industries as ship building and repair, pre-stressed concrete plants, metal fabrication and large lumber mills.

Heavy manufacturing plants that use any type of raw materials are included in this class. It also includes plants that require minerals or wood-based materials as long as they produce a finished manufacturing product. Facilities that produce primary materials from wood-based materials or minerals belong in the 1500 Industrial class.

Heavy manufacturing operations are characterized by large, heavy steel frame, one-story buildings which support overhead traveling cranes. Outside (open) storage of finished products is typical and large cranes are used for heavy lifting in those storage yards. Occasionally, outside storage of impervious raw materials and waste are seen, but such storage is not usual as with the heavy processing industries. Railroad lines and spurs are common, with the spurs often entering the buildings.

Size and other characteristic features help differentiate heavy industry from other Industrial classes. However, the class is primarily determined by the type of process and product, not by size or visible indicators alone. Manufacturing codes from ancillary data sources provide such information.

Heavy industries tend to have extensive handling, transport, heavy lifting, storage, waste treatment and power facilities. Light industrial operations, in comparison, are usually enclosed operations without such extensive outdoor activities.

Other Industrial, Extractive and Utility classes can have a similar appearance on aerial photography. Ancillary land use data should be checked, if available, to confirm this class. Heavy manufacturing may be mixed with other uses, in which case the predominant use should be determined and the polygon classified accordingly.

In transitional areas where species-specific wetland (2 acre MMU) and upland (5 acre MMU) polygons are below the appropriate MMU some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## KEYS TO PHOTOINTERPRETATION

- There is little or no vegetation or planned landscaping.
- There is often an unkempt, "industrial" look to the property.
- Operations are usually fenced and secured.
- They may have open areas for storage or outdoor equipment or parking.
- The sites are usually large;  buildings tend to be large and complex.

## CONTEXT

- **Landscape Position** - Heavy industries are often clustered in areas with appropriate zoning, utilities, transportation and other factors. They tend to be located adjacent to urban areas, with access to major transportation routes, including roads, railroads, water and airports. Heavy industrial concentration is often located by port or rail facilities. Alternatively, it may be located in more remote areas where raw materials, energy or water are available.

## SIMILAR CLASSES

- 1500 Industrial - Most classes in the Industrial group can appear to have similar signatures. Heavy industry is differentiated by size and other characteristics, but appearance alone will not differentiate it from similar classes. Ancillary land use data indicating the type of manufacturing will be critical in many cases.
- 1550 Other Light Industrial - Operations are mainly enclosed; buildings are simple rectangular.

## SPECIAL MAPPING CONVENTIONS

Only those features that are inside the facility boundaries and involved in its operation are included in the 1560 mapping unit. These may include parking and transportation areas, treatment facilities, fuel storage, office buildings and open areas within the operational boundary.

Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they are always broken out, even if located within the 1560 mapping unit.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
03/15/07

**COORDINATES**
815352.02 986358.07

# 1600
# Extractive

LEVEL 1: 1000 Urban and Built-Up
**LEVEL 2: 1600 Extractive**

## DESCRIPTION

This is an active Level 2 class that should be applied only when one of the more specific Level 3 and Level 4 subclasses cannot be determined. This may occur when the particular type of extractive activity is not discernible from the aerial photo. The subclasses include:

- 1610 Strip Mines
- 1620 Sand and Gravel Pits
- 1630 Rock Quarries
- 1640 Oil and Gas Fields
- 1650 Reclaimed Mine Land
- 1660 Holding Ponds
- 1670 Abandoned Mine Land

**General Description, modified from FDOT manual:**

Extractive areas encompass both surface and subsurface mining operations. Included are strip mines - clays, peat and heavy metals; sand and gravel pits; rock quarries - including limerock and phosphate; and oil and gas fields. Holding ponds, reclaimed and abandoned mines are also included. Industrial complexes where the extracted material is refined, packaged or further processed, belong in the 1500 Industrial class. The recognizable impacts of these activities on the landscape will vary from the giant pit mines covering vast areas to oil wells which cover only a few square feet. Consistent identification of these diverse mining areas can be difficult from remote sensing data alone.

Flooded pits and quarries, which may be part of a mining operation, will be classified as 1660 Holding Ponds. The presence of water bodies does not necessarily imply inactive or unused extractive areas. Ponds or lakes are often an integral part of an extractive operation.

Abandoned and inactive mining operations are a part of the extractive category. Reclaimed mine lands are also included with either managed or natural re-vegetation. Both 1650 Reclaimed Mine Land and 1670 Abandoned Mine Land are land use classes that require interpretation of land cover also. Areas of tailings and abandoned pits and quarries may remain recognizable for a long time. Such areas may be barren for decades after deposition. At some point of restoration the mining signature will not be recognizable, and such areas are mapped in other appropriate categories.

## KEYS TO PHOTOINTERPRETATION

- Large areas of surface disturbance; scouring and piling of land and overburden; often ponded
- Deep (rock quarry) or shallow (sand and gravel pits) excavations that are often ponded
- Presence of waste piles, piles of mined materials, and a variety of excavating equipment such as bulldozers, shovels, dredges and drag lines
- Transportation equipment such as trucks, mini cars, railway equipment and conveyors
- Some mining operations require considerable processing before shipping and will have large structures and associated refining equipment

- Most operations are quite large and impressive on the landscape

## CONTEXT

- **Landscape Position** - These land uses may be found in any area of the District, depending on the specific class of activity.

## SIMILAR CLASSES

All active mining classes have a potential for similar appearance on an aerial photo. When the particular type of extractive activity cannot be determined, the Level 2 1600 code should be used. Ancillary data, such as soils, should be used to help determine the type of mine prior to using the more general class.

- 7400 Disturbed Land - 7400 may be used as a land cover code with land uses 1650 or 1670, or it may be used by itself if the land use cannot be determined.

## SPECIAL MAPPING CONVENTIONS

This classification was modified by the District. Flooded open water pits and quarries that are part of *inactive* mining operations are classified as 5300 Reservoirs. If the mining operation is still active, these are classified as 1660 Holding Ponds.

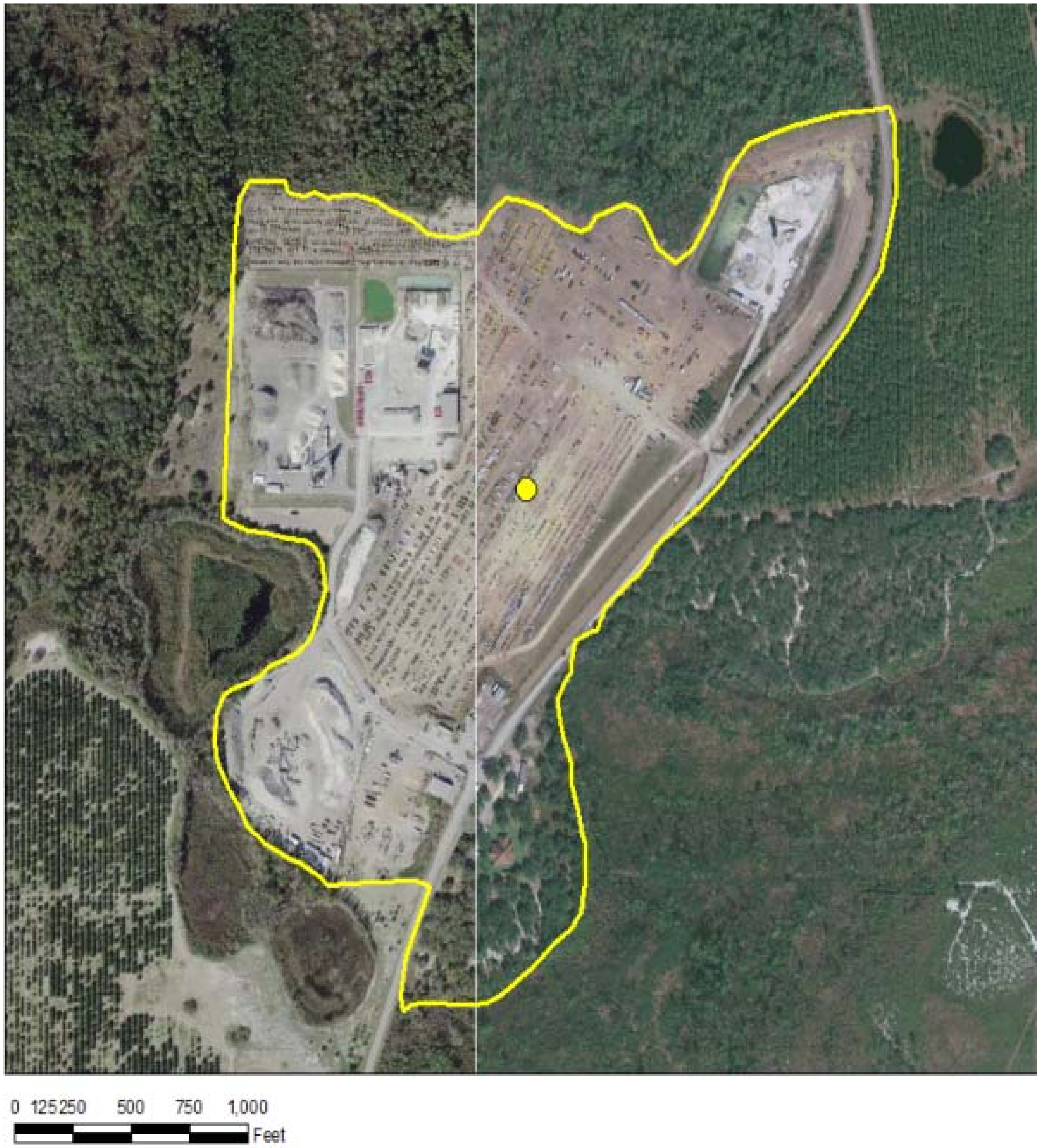
This Level 2 code may be used when it is impossible to distinguish between 1610 Strip Mines, 1620 Sand and Gravel Pits and 1630 Rock Quarries. The PI must always use the most specific class possible.

## DUAL CODING CONVENTION

All the 1600 classes are **Land Use** classes. The LUCODE and LCCODE are the same, **except** 1650 Reclaimed Mine Land and 1670 Reclaimed Mine Land. **These require a separate Land Cover code.**

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
10/03/07

**COORDINATES**
450210.73  1474121.31

# 1610
# Strip Mines

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1600 Extractive
**LEVEL 3: 1610 Strip Mines**

## DESCRIPTION

Strip mining is a method that accesses buried material by stripping off the top surface of the land. If the product is covered, all overburden is removed to gain access to the product. Two broad categories of strip mining are: area strip mining, which is practiced on relatively level terrain; and contour strip mining, which is done in hilly terrain.

The operations are easily identified by characteristic land scarring, either as enormous pits or in long shallow trenches with the overburden piles along the trenches. Active operations are indicated by the presence of power shovels, dredges or other heavy tracked construction equipment, bulldozers, trucks, maintenance and supervisory buildings.

Cooling canals for thermal electric or nuclear power plants might be confused with strip mines. The canals are a regularly spaced series of parallel trenches which cover many square miles. The canals are connected to each other and to the power plant discharge canal, whereas the water filled trenches of strip mines do not interconnect.

Abandoned or inactive strip mines are flooded. The water is a deep black and the surrounding area is reddish-gray as vegetation re-establishes itself on the overburden and open areas. Abandoned mines remain in the Extractive category until succession has produced a cover which appears as a dark magenta tone on CIR photography, unless there is evidence that the site is being reclaimed.

This Level 3 class also includes mining operations such as clay, peat and heavy metals.

## KEYS TO PHOTOINTERPRETATION

- This mining method is identified by its land scarring, either in pit form or in long trenches, with tailings along the trenching operation.
- A series of elongated piles of spoil is present.
- Clay and heavy metals mining tend to be large operations.

## CONTEXT

- **Landscape Position** - Strip mining operations are generally located in open, rural areas. The exact location depends on the geology of the area. Boundaries with adjacent land uses are distinct.

## SIMILAR CLASSES

- 1620 Sand and Gravel Pits - Conical piles of sand and gravel may be visible.
- 1630 Rock Quarries - Most quarries are flooded.
- 1650 Reclaimed Mine Land - Vegetation tends to have a planned, landscaped appearance.
- 1670 Abandoned Mine Land - Vegetation has a more random, unplanned appearance.

## SPECIAL MAPPING CONVENTIONS

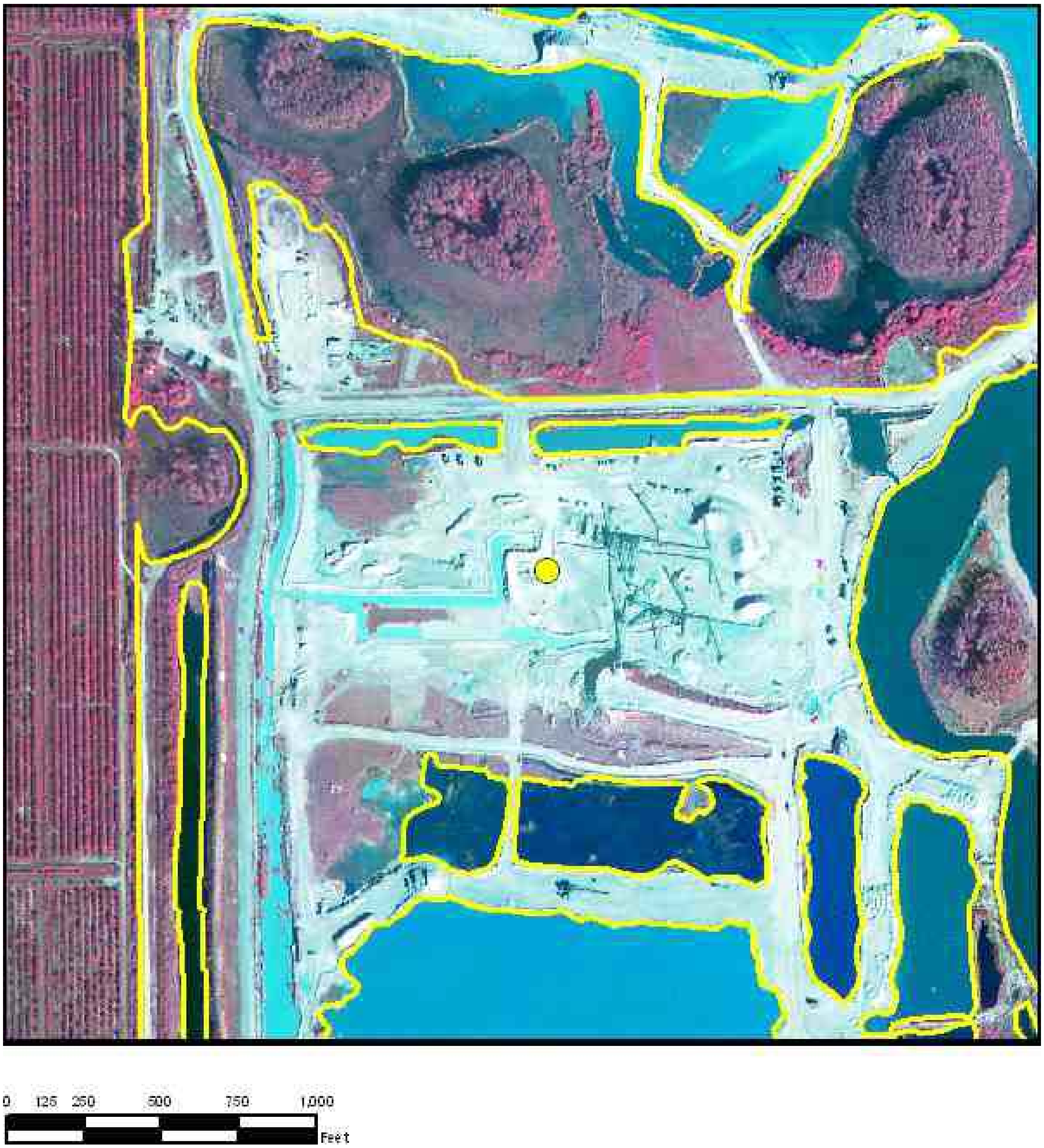
The 1610 mapping unit includes active and inactive mining operations and all other features that are part of the mining operation. This includes storage areas, material stockpiles, parking, offices and other buildings, roads and open areas that are inside the operational boundary. Those areas that are outside the active perimeter and not related to the operation are not included.

Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they should be broken out. Also broken out are 1660 Holding Ponds, 1650 Reclaimed Mine Land and 1670 Abandoned Mine Land areas, if they meet minimum size criteria. These classes can overlap and intermingle in mining areas, or change quickly with water level fluctuations. Portions of the site may be temporarily vegetated or water-filled. PIs should consider the predominant uses and avoid excessively detailed line work.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
415477.21 741030.45

# 1620
# Sand and Gravel Pits

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1600 Extractive
**LEVEL 3: 1620 Sand and Gravel Pits**

## DESCRIPTION

This class includes active sand and gravel mining operations and their associated features, as well as clay pits. The operations usually include processing facilities for sorting, cleaning, crushing, etc. Concrete batch plants or Portland cement operations may also be located at the mining sites. Active operations are indicated by the presence of power shovels, dredges, heavy tracked construction equipment, bulldozers, trucks, washing and screening equipment, and buildings for maintenance, storage, and supervision.

Sand and gravel operations are often located near built up areas, supporting local demands for construction materials. They tend to be relatively small in size compared to other strip mining operations such as metals and phosphates. Clay pits will appear similar to dry sand and gravel pits, but will lack processing equipment.

## KEYS TO PHOTOINTERPRETATION

- Signatures tend to be very light, bright tones for unsaturated areas.
- Stockpiles are conical, often found at the end of elevated conveyor belts.
- Sides of excavations are smooth, scalloped and sloping, compared to jagged vertical walls of rock quarries.
- NRCS county soil maps should assist in locating these sites.
- Pits may be flooded or dry, depending on depth, status, and water conditions.

## CONTEXT

- **Landscape Position** - These operations are generally located near built up areas, serving the local demand for construction materials.

## SIMILAR CLASSES

- 1610 Strip Mines - Major land scarring apparent on photo
- 1660 Holding Ponds - Almost always have a deep black signature
- 7200 Sand Other Than Beaches - Do not have construction equipment, trucks, etc.
- 7420 Borrow Areas - Appear as a depression, with a regular, often rectangular shape

## SPECIAL MAPPING CONVENTIONS

The 1620 mapping unit includes all active and inactive mining operations themselves and their other associated features. Those areas that are outside the active facility perimeter and not related to its functions are not included.

Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they should be broken out. Also broken out are 1660 Holding Ponds, 1650 Reclaimed Mine Land and 1670 Abandoned Mine Land, if they meet minimum size criteria. These classes can intermix on the sites, or change quickly with water level fluctuations. Portions of the site may be temporarily vegetated or filled with water. PIs should consider the predominant uses and avoid excessively detailed line work.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE


**DATE**
10/15/07

**COORDINATES**
430957.64 788086.89

# 1630
# Rock Quarries

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1600 Extractive
**LEVEL 3: 1630 Rock Quarries**

## DESCRIPTION

Limestone and phosphate are the rock materials quarried in the District. Limestone quarries are usually smaller operations that produce broken limestone which is crushed for use as roadway base material or for making concrete or cement. The rock may be crushed to make sand or gravel for local construction; in that case the operation is still mapped as a rock quarry.

Phosphate mining operations tend to be larger, intensive operations with characteristic site geometry, massive equipment, and settling ponds.

Most quarries are flooded because of the low, flat topography and high water table in limestone terrain. Blasting is carried out under water and draglines remove the broken rock, excavating to depths averaging forty feet in the process. Look for draglines, broken rock drying in "surge piles" at the edge of the quarry and trucks or conveyors moving the partially dried rock to the crushers of a nearby processing plant. Quarry edges, when visible, are vertical and jagged, unlike the edges of sand and gravel pits, or clay pits, which usually show smoother, scalloped, sloping edges. The water is very turbid in an active quarry, appearing a grayish green on CIR photography, while the active quarry area is a bright white.

## KEYS TO PHOTOINTERPRETATION

- The quarry pits are deep, with jagged, vertical walls, unlike sand, gravel and clay pits.
- Rock piles lack the smooth, uniform texture and color of finer materials.
- The excavation equipment is characteristic of rock quarrying, with draglines visible in active pits.
- Broken rock lies in "surge piles" at the edge of the quarry and is conveyed by trucks or conveyors to nearby processing plants, which may be on site.
- Rock quarries, which usually support local construction, may be small compared to intensive operations such as heavy metals and phosphates.

## CONTEXT

- **Landscape Position** - Rock quarries are moving away from populated areas to avoid impacts such as dust, noise and traffic. However, many are still near developed areas, to take advantage of lower transportation costs.

## SIMILAR CLASSES

- 1600 Extractive - Most classes in the extractive group can present similar signatures.
- 7000 Barren Land - Has a similar appearance, but no indicators characteristic of mining.

## SPECIAL MAPPING CONVENTIONS

The 1630 mapping unit includes all active and inactive mining operations and their associated features. Those areas that are outside the facility perimeter and not related to its functions are not included.

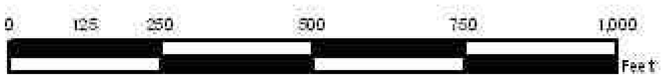
Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they should be broken out. Also broken out are 1660 Holding Ponds, 1650 Reclaimed Mine Land and 1670 Abandoned Mine Land areas, if they meet minimum size criteria. These classes can intermix on the sites, or change quickly with water level fluctuations.

Temporarily inactive sites remain in the 1630 category. Reclaimed sites are classified as 1650 Reclaimed Mine Land and abandoned sites as 1670 Abandoned Mine Land. At some point of restoration or re-growth the mining function may not be apparent from the aerial photography. If so, such areas are assigned to other appropriate classes.

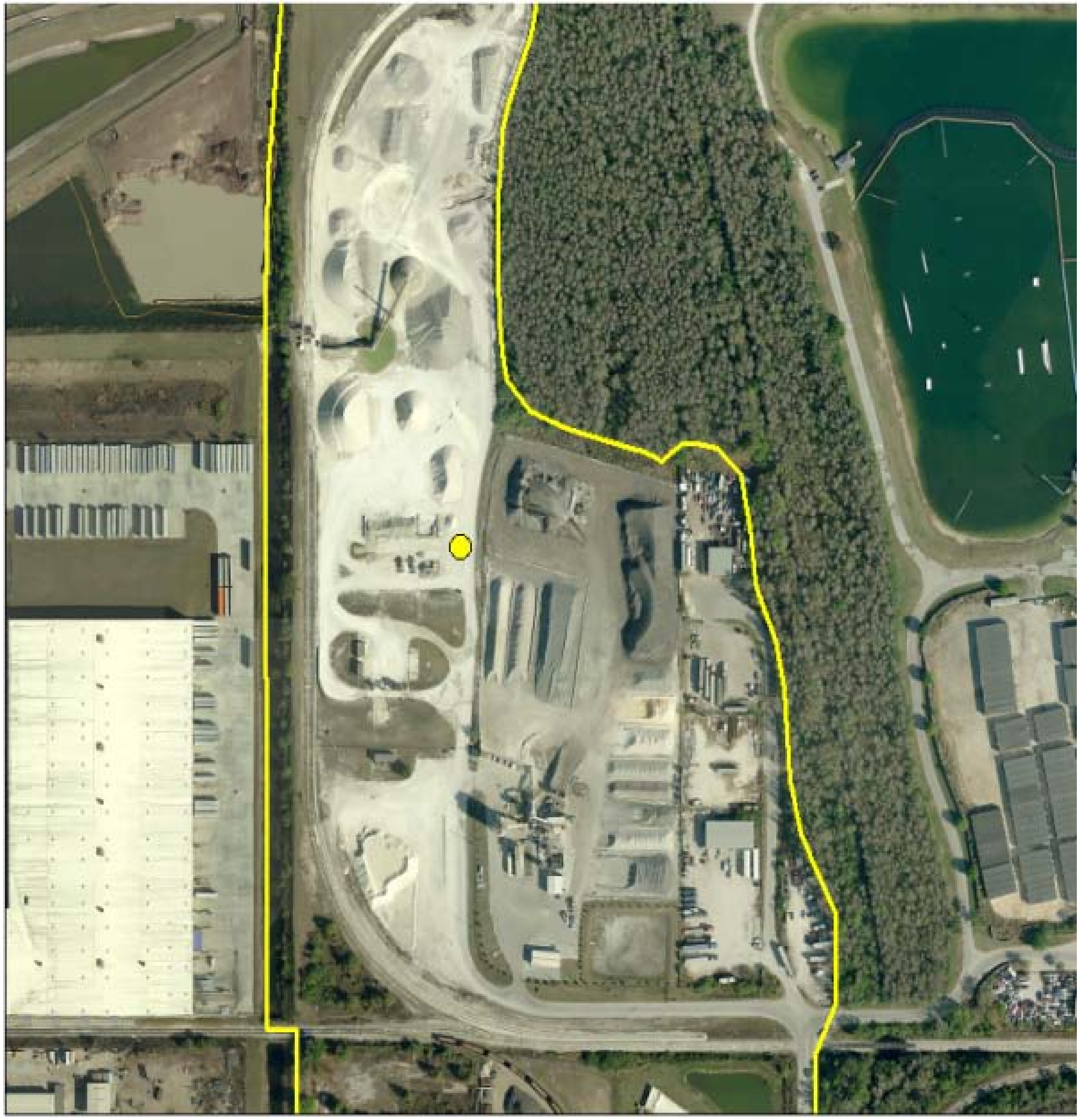
## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



0 125 250 500 750 1,000
Feet

## FIELD PICTURE

**DATE**
10/02/07

**COORDINATES**
535430.82 1493734.52

# 1640
# Oil and Gas Fields

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1600 Extractive
**LEVEL 3: 1640 Oil and Gas Fields**

## DESCRIPTION

These areas are the sources of crude petroleum products. No refining facilities are associated with these land uses and they are often difficult to recognize. Native vegetation is left intact where possible in an effort to minimize environmental impacts. The key features for identification of this land use are the well pads and numerous cleared linear corridors for access roads and pipes for the transport of the petroleum products to a central handling facility for shipping to the refinery.

Well pads are identified as clearings in the native vegetation, typically at the end of an access road or directly adjacent to such a road, with a regularly shaped area of crushed stone or other non-native material around the well head. With high resolution CIR photography, the well may be visible with sufficient magnification. Access roads and pipe corridors are visible as areas of cleared vegetation with varying amounts of herbaceous or shrubby growth depending on the amount of traffic and the status of maintenance. The vegetation will produce a magenta or greenish shade depending on the type of vegetation and the amount of moisture present. Wetter areas or winter dormant herbaceous vegetation typically present the greenish tones while shrubs and growing herbaceous materials produce magenta signatures. Storage facilities (e.g., tanks) are also present in the vicinity of the distribution center.

## KEYS TO PHOTOINTERPRETATION

- Well head pads and drilling equipment are present, visible as clearings in the native vegetation, typically at the end of an access road.
- Access roads and pipe corridors are visible as straight lines of cleared vegetation with varying herbaceous or shrub overgrowth.
- Flow control and storage tank facilities are present.
- In forested areas oil and gas fields may appear as a patchwork of small clearings connected by a grid system of access roads.

## CONTEXT

- **Landscape Position** - Oil and Gas Fields are located in undeveloped areas. Very few examples of this land use occur in Florida. The only area of oil and gas fields within the South Florida Water Management District is found east of Fort Myers and Naples, specifically the area of southeastern Charlotte, western Hendry and northern Collier Counties. Small exploratory well fields may also be found in other areas north of the Everglades.

## SIMILAR CLASSES

- 1460 Oil and Gas Storage - Gas storage tanks are often horizontal cylinders with rounded ends.

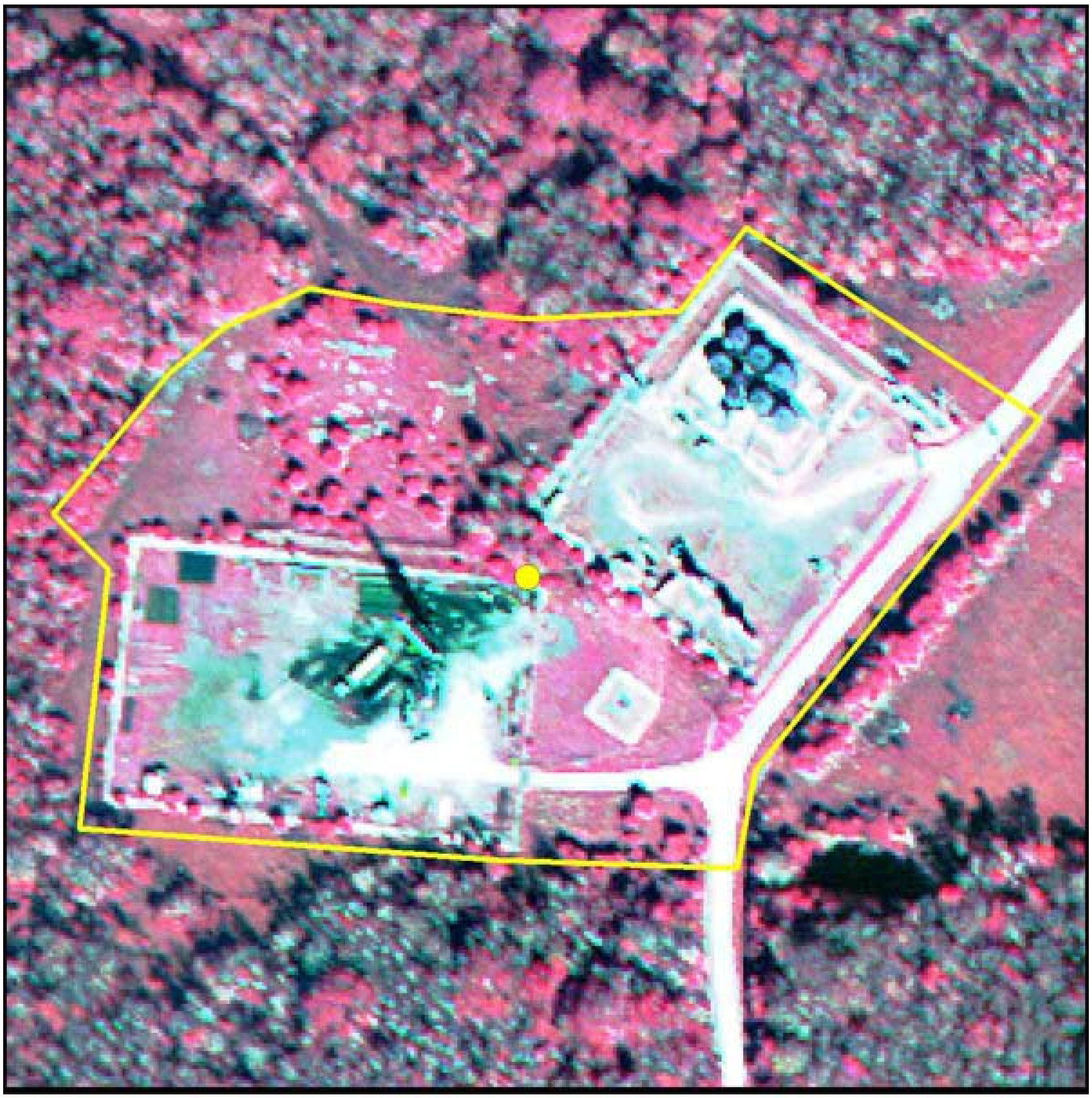
## SPECIAL MAPPING CONVENTIONS

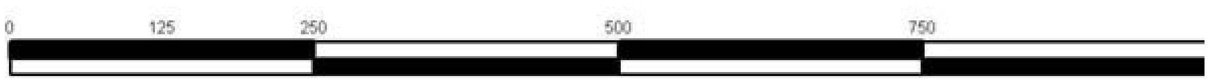
The 1640 mapping unit includes active and inactive mining operations and all associated features. Those areas that are outside the facility perimeter and not related to its functions are not included. Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they should be broken out.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** is not required.

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE

## FIELD PICTURE


**DATE**
11/20/07

**COORDINATES**
556744.34  699859.55

# 1650
# Reclaimed Mine Land

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1600 Extractive
**LEVEL 3: 1650 Reclaimed Mine Land**

## DESCRIPTION

This class is for mining sites that have been or are being restored to approximate a natural state or converted into other types of land use, such as pasture, recreation or development. It does not include portions of active mining areas that are temporarily inactive or abandoned mine lands.

On close inspection, the geometry of the site will reflect the extent of previous mining operations, examples of which may be active in the surrounding landscape.

## KEYS TO PHOTOINTERPRETATION

- Waste areas and spoil piles from mining operations may still remain. Portions of the site may be abandoned.
- Artificial water bodies created from the mining or reclamation activities are often present, in contrast to natural lakes or a lack of surface water features in the surrounding landscape.
- If there are no indications or signature of prior mining activities, the area should be classified as the natural cover type or appropriate land use class.

## CONTEXT

- **Landscape Position** - Reclaimed lands are generally located in rural areas with a history of mining activities, some of which may be currently active.
- **Vegetation** - Vegetation is likely to be sparse compared to natural areas, and tends to have a planned, landscaped appearance. Vegetative communities are usually not the same as adjacent natural areas.

## SIMILAR CLASSES

- 1600 Extractive- Most classes in the Extractive class can present similar signatures.
- 1610 Strip Mines - Major land scarring apparent on photo
- 1670 Abandoned Mine Lands - Vegetation has a more random, unplanned appearance.
- 3100 Herbaceous (Dry Prairie) - Shows no evidence of mining activity
- 3200 Shrub and Brushland - Vegetation has a natural appearance; no evidence of mining activity
- 3300 Upland Non-Forested (Mixed) - Vegetation has a natural appearance; no evidence of mining activity
- 7400 Disturbed Land - Has a more whitish, scoured appearance, with some active site preparation or other activity visible

## SPECIAL MAPPING CONVENTIONS

The 1650 mapping unit includes the former operational area of mining operations that have been reclaimed; this includes former storage areas, material stockpiles, parking, offices and other buildings, roads and open areas that were at one time inside the operational boundary.

Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they should be broken out. Also broken out are 5300 Reservoirs and 1670 Abandoned Mine Lands. These classes can be intermixed on mining sites - some aggregation may be required at the discretion of interpreters. PIs should consider the predominant uses or cover and avoid excessively detailed line work.

## DUAL CODING CONVENTION

This is a **Land Use** class. **Dual coding is always required - a land cover code must be assigned** in addition to the 1650 code. The **Land Cover** code is frequently from one of the 3000 classes, "Upland Non-Forested".

***No 2004-05 CIR image available:1650 not used in 2004-05 update***

## NATURAL COLOR IMAGE

**COORDINATES**
853487.96 564940.17 (Image)

## FIELD PICTURE

**DATE**
n/a

**COORDINATES**
n/a (Field Picture)

# 1660
# Holding Ponds

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1600 Extractive
**LEVEL 3: 1660 Holding Ponds**

## DESCRIPTION

This class includes the artificial bodies of water within the operational boundary of active mining sites. The ponds may be part of the active mining process or inactive at the time of photography. If they are clearly in a final state of reclamation or abandonment they should be classed as 5300 Reservoirs.

Man-made ponds and lakes often form an integral part of the extractive process. They serve a variety of purposes such as storm water treatment, settling ponds and the discharge point for de-watering operations.

Determination of the intended use of the ponds is usually not possible using aerial photos. Areas of open water on a mining site are therefore classed 5300 Reservoirs or 5200 Lakes rather than 1660 Holding Ponds, unless there is evidence (e.g. equipment present) that shows there is active mining in the pit.

## KEYS TO PHOTOINTERPRETATION

- Man-made ponds of varying size and shape, located in and around mining areas
- Ponds are almost always black on CIR photography or streaked with white from the reflection of ripple patterns. More turbid sites may appear grayish green, and active sites may also have an unnatural light blue color on CIR.

## CONTEXT

- **Landscape Position** - Holding Ponds can be found throughout the District in mostly remote, exurban areas.

## SIMILAR CLASSES

- 5300 Reservoirs - Evidence of active extraction not apparent

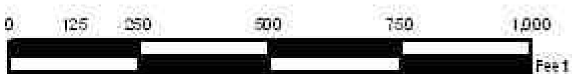
## SPECIAL MAPPING CONVENTIONS

Priority classes such as natural water bodies and wetlands are broken out if they meet their minimum size criteria of 2 acres. Ponds and quarries are usually classified as 5300 Reservoirs if they are clearly in a final state of reclamation or abandonment.

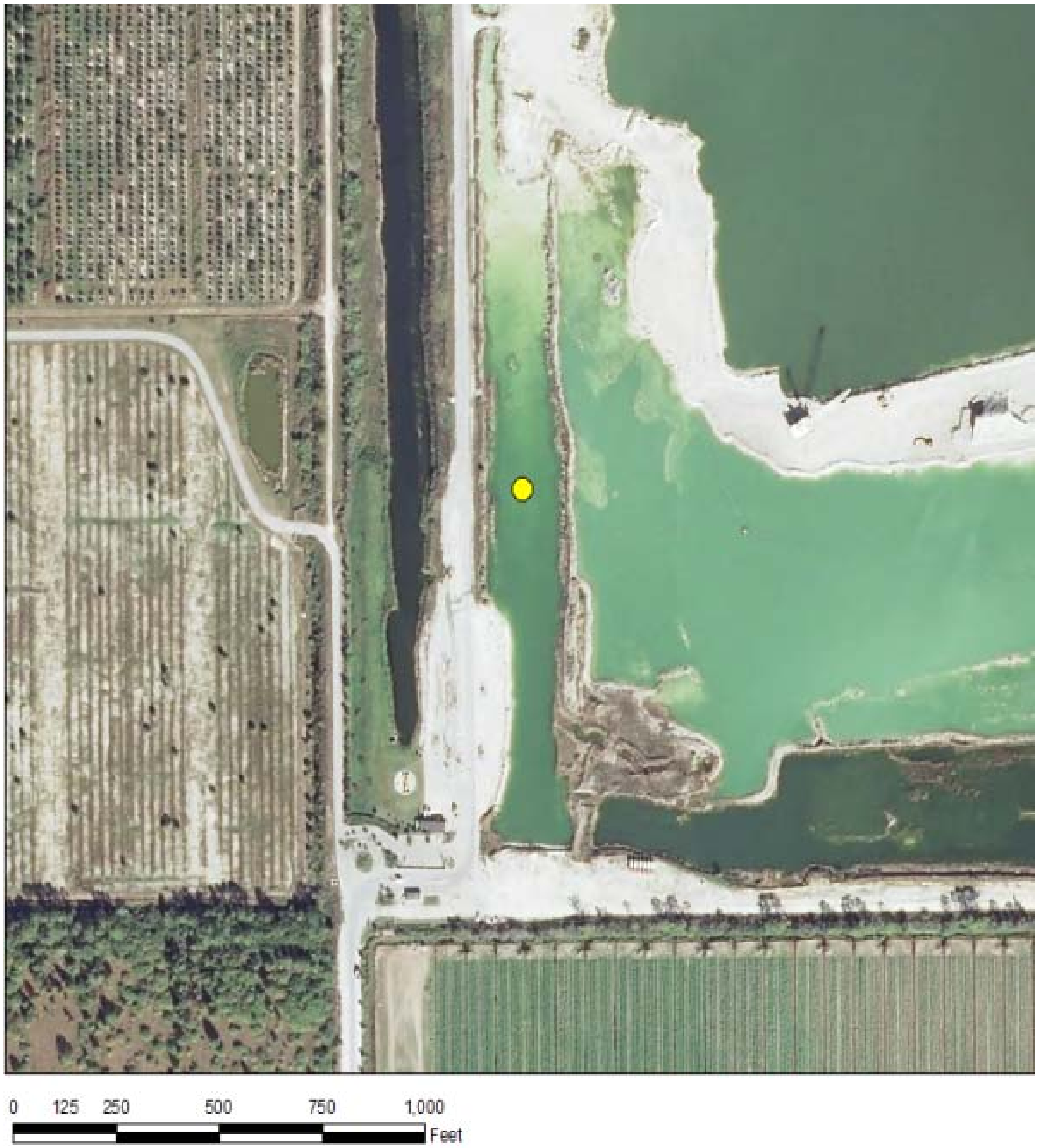
## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
414653.33 738398.32

# 1670
# Abandoned Mine Land

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1600 Extractive
**LEVEL 3: 1670 Abandoned Mine Land**

## DESCRIPTION

This class includes abandoned mining sites that have not been restored to a natural state or converted into other land uses. It does not include those portions of active mining areas that are temporarily inactive, or reclaimed mining lands.

On close inspection, the geometry of the site will reflect the extent of previous mining operations, which are likely to be active in other parts of the surrounding landscape. The topography may have a diverse, lumpy appearance, reflecting the former mining processes.

## KEYS TO PHOTOINTERPRETATION

- Spoil areas are reverting back to natural vegetation; usually grassy or scrub-shrub in appearance.
- There may be regularly spaced piles of spoil material created by swiveling drag lines.
- Waste areas and spoil piles from mining operations may still remain. Portions of the site may be reclaimed, although most of the area is not.
- Artificial water bodies created from the mining activities are often present, in contrast to natural lakes or even a lack of surface water features in the surrounding landscape.
- If there are no indications of prior mining activities, the area should be classified as the natural cover type or appropriate land use class.

## CONTEXT

- **Landscape Position** - Abandoned mining lands are generally located in rural areas with a history of mining activities. Surrounding areas may be currently active.
- **Vegetation** - Vegetation is likely to be sparse compared to natural areas and tends to have a random, chaotic appearance.

## SIMILAR CLASSES

- 1610 Strip Mines - Major land scarring apparent on photo
- 1650 Reclaimed Mine Land - Vegetation has a more planned, landscaped appearance.
- 3100 Herbaceous (Dry Prairie) - Shows no evidence of mining activity
- 3200 Shrub and Brushland - Vegetation has a natural appearance; no evidence of mining activity
- 7400 Disturbed Land - Has a more whitish, scoured appearance, with some active site preparation or other activity visible

## SPECIAL MAPPING CONVENTIONS

This is a SFWMD modification of the FLUCCS system, which does not have a class for abandoned mining lands.

The 1670 mapping unit includes the former operational area of mining operations, including former storage areas, material stockpiles, parking, offices and other buildings, roads and open areas that were at one time inside the operational boundary.

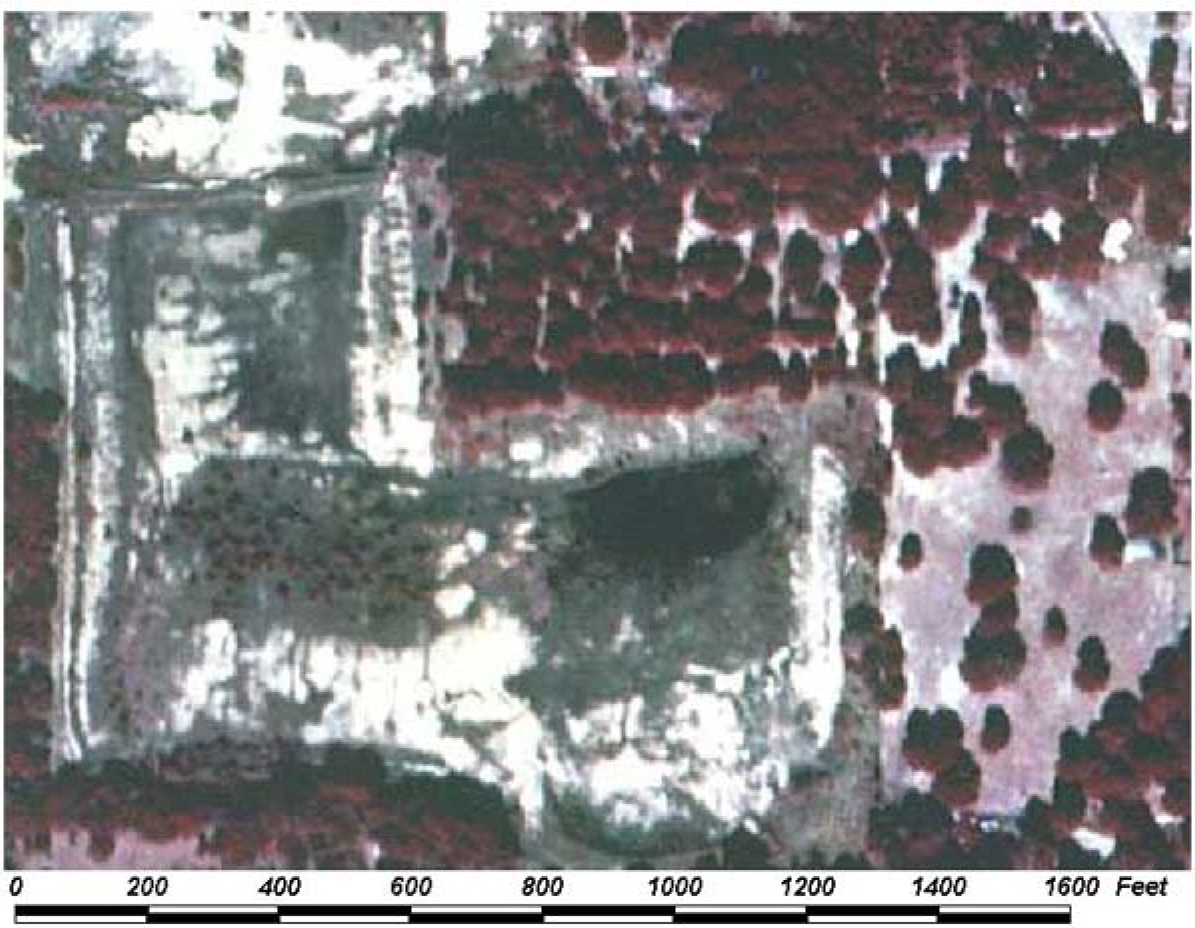
Priority classes such as water bodies and wetlands should be broken out if they meet their minimum size criteria of 2 acres.

## DUAL CODING CONVENTION

This is a **Land Use** class. **Dual coding is always required - a Land Cover code must be assigned** in addition to the 1670 code. The **Land Cover** code is frequently from one of the 3000 Upland Non-Forested or 4000 Upland Forested classes.

***No 2004-05 pictures available:1650 not used in 2004-05 update***

## CIR DOQQ IMAGE



## FIELD PICTURE

**DATE**
n/a

**COORDINATES**
n/a

# 1700
# Institutional

LEVEL 1: 1000 Urban and Built-Up
**LEVEL 2: 1700 Institutional**

## DESCRIPTION

This class includes a broad range of Institutional uses which can be difficult to differentiate individually. Only the 1710 Educational Facilities, 1730 Military and 1760 Correctional subclasses are broken out separately. 1700 includes uses such as educational, religious, medical and health care, governmental, correctional, commercial child care and others. Included within a particular Institutional unit are all buildings, grounds, parking lots, recreational areas, green houses, gardens and other features that are attached to the facility.

Educational institutions encompass all levels of public and private schools, colleges, universities, training centers, etc. The entire areas enclosing buildings, campus open space, dormitories, recreational facilities and parking lots are included into this category where they are identifiable.

## KEYS TO PHOTOINTERPRETATION

- Institutions often have many smaller structures, including on-site residences.
- Many facilities are self sufficient - they may have their own power generator and sanitary disposal systems.
- Institutions are often fenced - passage may be restricted or controlled. Correctional facilities tend to be confined facilities enclosed within multiple fence structures.
- They normally have good transportation access.
- They tend to have large lawns and planned landscaping, with an absence of natural vegetation.
- Some operations are quite large and impressive on the landscape.

## CONTEXT

- **Landscape Position** - The location depends on the type of institution. Most educational and medical facilities are located in populated areas. Military or correctional facilities are often in more isolated areas. Water Management District headquarters tend to be located next to airports.

## SIMILAR CLASSES

- 1400 Commercial and Services - Features such as office buildings may look the same whether public or private. Ancillary land use data may be used to differentiate.

## SPECIAL MAPPING CONVENTIONS

Those areas that are not clearly related to the functions of the institution are not included. Land cover areas, such as pastures and forests, that are adjacent to the facility should generally be classed with the land cover value and not dual coded. Only those features that are inside the facility boundaries and actively involved in its operation are coded 1700. These may include gardens, lawns, fields and recreational areas. Spatial integration and function determine whether features are included in the

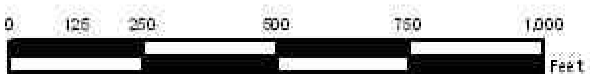
1700 mapping unit. The PI is not required to discern ownership or replicate property ancillary data and should err on the side of capturing land cover and environmental function.

Priority classes such as water bodies, wetlands, golf courses, landfills and treatment facilities, are exceptions to the above. If these features meet their minimum size criteria they are always broken out, even if located within the 1700 mapping unit.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
05/10/07

**COORDINATES**
385925.89 804480.38

# 1710
# Educational Facilities

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1700 Institutional
**LEVEL 3: 1710 Educational Facilities**

## DESCRIPTION

Educational facilities include all public and private schools, colleges, universities, training centers, etc. It is not possible to identify many smaller private schools or professional educational facilities from aerial photos as they can occupy the same types of structures, or parts of structures, used by non-educational land uses. Supplemental data is often necessary to accurately determine this class.

In rural areas, many of these structures have been abandoned and must be examined for signs of activity on the aerial photo if first identified from a topographic map. The important identifying features of these facilities are well known. The public school is one of the easier items to identify due to its size, shape, and the related and well-defined physical education areas. Even in the elementary schools, baseball diamonds are evident and often other playground equipment and use patterns can be seen. In the high schools, the baseball diamonds are joined by soccer and football fields and track facilities. Separate on-premise parking for staff and students is provided. Older school facilities in the central urban core are limited in area as compared to newer facilities and often the parking or physical education facilities may be in a separate location from the school building itself. A flagpole (or shadow of a flagpole) and landscaped areas can often be distinguished.

Universities, colleges and some private secondary schools often occupy large areas of land. Main buildings (administration and maintenance buildings, classrooms, libraries, cafeterias, student centers, dormitories, group residences and staff houses on or adjacent to the main campus), campus open spaces, parking lots, all supporting facilities and any other features that are functionally related to the educational institution are included in this class.

Also included are stadiums and other recreational facilities, experimental farms, greenhouses and research field station structures and other agricultural uses specifically associated with the campus where they are identifiable, as well as research parks operated by the university.

Nearby or adjacent industrial parks should be examined closely for signs of connections with the campus. If the aerial photo or supplemental data indicate university ownership, they are also included in the 1710 Educational Facilities class.

## KEYS TO PHOTOINTERPRETATION

- Often noted on topographic maps by either name or symbol
- Related and well defined physical education areas are visible
- High schools likely have visible baseball diamonds, soccer and/or football fields
- Universities often occupy large areas of land
- Collateral data may be needed to identify smaller educational facilities

## CONTEXT

- **Landscape Position** - Educational facilities are found throughout the District. They may be adjacent to almost any land use, including light industrial. In rural areas the campus boundaries are usually clearly defined. In urban or suburban areas, the campus may extend in irregular fashion into the surrounding land uses. Some facilities (stadiums or sports fields of urban universities) may be away from the main campus and unidentifiable as educational facilities without supplemental data.

## SIMILAR CLASSES

- 1400 Commercial and Services - Features such as office buildings may resemble educational facilities. Ancillary land use data may be used to differentiate these classes.
- 1700 Institutional - Ancillary data and context will help to determine whether the facility should be properly classified as educational.

## SPECIAL MAPPING CONVENTIONS

Those areas that are not clearly related to the functions of the educational institution are not included. Land cover areas, such as pastures and forests, that are adjacent to the facility should generally be classed with the land cover value and not dual coded. The PI must delineate the operational boundary of the educational facility as apparent on the aerial photo.

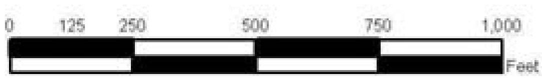
Only those features that are inside the facility boundary and actively involved in its operation are coded 1710 Educational Facilities. These may include gardens, lawns, fields and recreational areas. Spatial integration and function determine which features are included in the 1710 mapping unit. The PI is not required to discern ownership or replicate property ancillary data, and should err on the side of describing land cover and environmental function.

Priority classes such as water bodies, wetlands, golf courses, landfills and treatment facilities, are exceptions to the above. If these features meet their minimum size criteria they are always broken out, even if located within the 1710 mapping unit.

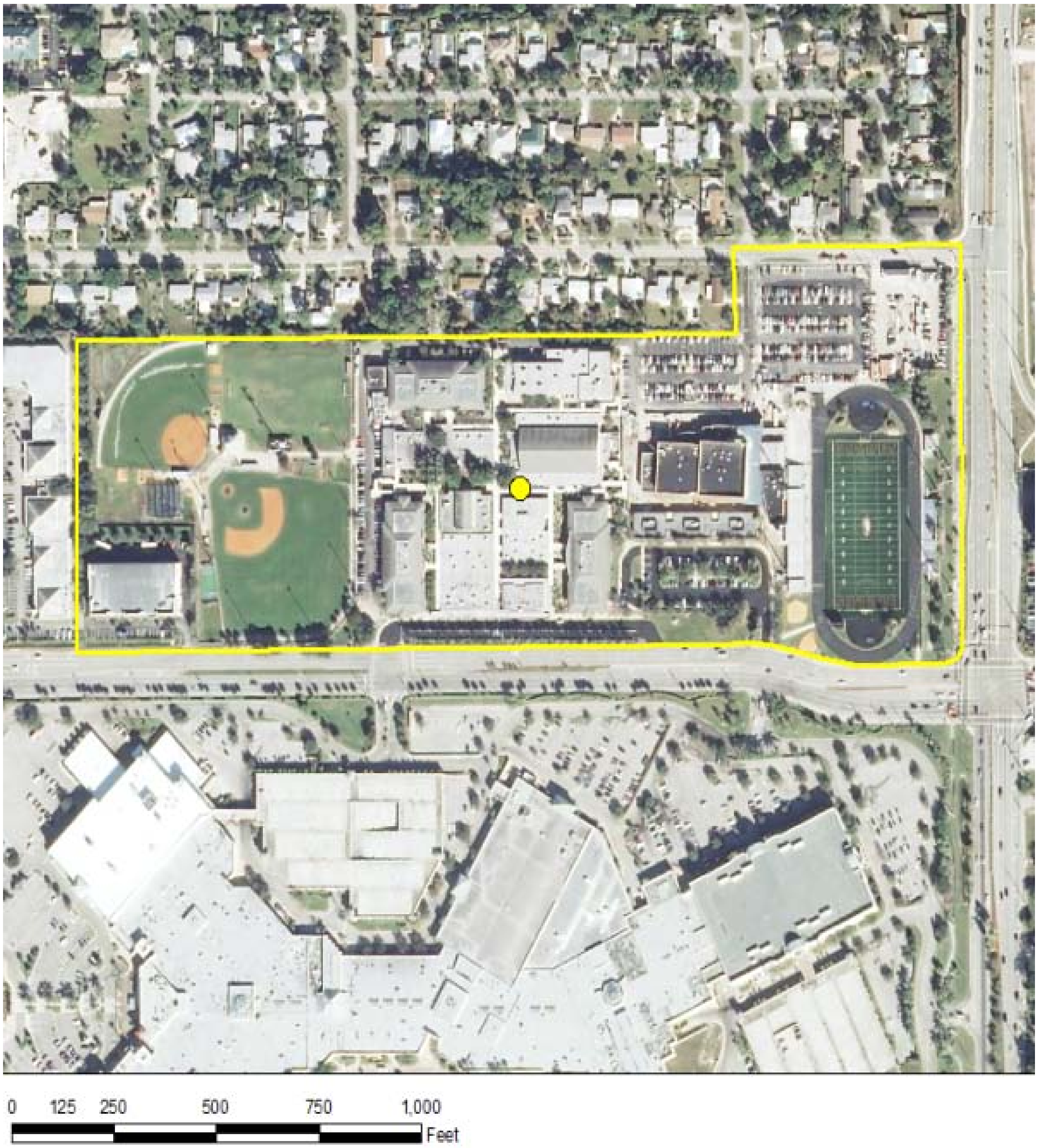
## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
11/20/07

**COORDINATES**
395424.10 669313.78

# 1730
# Military

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1700 Institutional
**LEVEL 3: 1730 Military**

## DESCRIPTION

This class includes areas used by the military, ranging from large bases, reservations and training camps to small installations, such as Coast Guard lighthouses and armories. Military facilities are characterized by a wide variety of features including training camps, missile sites, etc. Administration, storage, repair, security and other functional military buildings are included, along with practice ranges, storage lots and buffer zones. Auxiliary land uses, particularly residential, commercial and other supporting uses located within the operational boundary of the military base are included in this category.

## KEYS TO PHOTOINTERPRETATION

- Obvious military equipment; tanks, airplanes, missile silos, etc.
- Administration, storage, repair, security and other functional buildings
- Practice ranges, storage areas and/or equipment storage lots
- Presence of air strips or drop zones
- Usually the installation will be surrounded by chain link fence

## CONTEXT

- **Landscape Position** - Military bases are often located in isolated areas. However, they may support commercial, residential, and other uses that are located in close proximity to the base itself.

## SIMILAR CLASSES

- 1100 to 1300 Residential - Residential areas that are not within the operational boundary of the base should be coded as Residential.
- 1400 Commercial and Services - Features such as office buildings may look the same whether public or private. Ancillary land use data may be used to differentiate these classes.
- 1700 Institutional - Ancillary data and context will help to determine whether the facility is more properly classified as Institutional.

## SPECIAL MAPPING CONVENTIONS

Those areas that are not clearly related to the functions of the institution are not included. Land cover areas, such as pastures and forests, that are adjacent to the facility should generally be classed with the land cover value and not dual coded. The PI must delineate the general boundary of the base and differentiate it from non-military areas.

Only those features that are inside the facility boundary and actively involved in its operation are coded 1730. These may include gardens, lawns, fields and recreational areas. Spatial integration and function determine which features are included in the 1730 mapping unit. The PI is not required to discern ownership or replicate property ancillary data and should err on the side of describing land cover and environmental function.

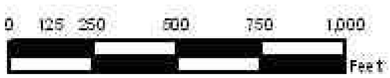
Priority classes such as water bodies, wetlands, golf courses, landfills and treatment facilities, are exceptions to the above. If these features meet their minimum size criteria they are always broken out, even if located within the 1730 mapping unit.

Transportation features (roads, railroads, airports, etc.) within Military installations that are large enough to be separately classified will be assigned an 8100 Transportation level code for land use rather than 1730 Military.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are generally the same; however wetlands or vegetated areas within the visibly apparent military boundary should be dual coded with the LUCODE = 1730 and the appropriate LCCODE.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/02/07

**COORDINATES**
545442.61  1487459.35

# 1760
# Correctional

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1700 Institutional
**LEVEL 3: 1760 Correctional**

## DESCRIPTION

Correctional institutions include federal, state and county prisons. All structures and grounds associated with this category are included; e.g., agricultural areas associated with prison farms. Identification of correctional facilities is accomplished through either the interpretation process or as the result of supporting supplemental data.

Prisons usually occupy large areas, especially when away from urban areas. They typically are set among well-developed and landscaped open areas, with the prison building or buildings surrounded by subsidiary structures such as staff residences, steam and power plants, water towers, maintenance buildings, recreational facilities and parking lots. Identification is confirmed by security features such as perimeter fences and guard towers (or the shadows of guard towers).

Normally, the prison buildings are enclosed by multiple fences. When a large number of structures are present, their regular and repetitive arrangement is similar to that seen in military installations. However military installations will have a clearly visible perimeter patrol road inside the fence, unlike prisons where the road may not be present or shows few signs of activity if detected.

Prison farms may also be fenced, and will show road and track patterns which connect the farm lands to the prison.

## KEYS TO PHOTOINTERPRETATION

- Multiple fences normally visible
- Normally occupy large tracts of land
- Usually located outside of urban areas
- Guard towers are an indicator of correctional facilities

## CONTEXT

- **Landscape Position** - Correctional Institutions can be found in any exurban area. Boundaries with adjoining land uses will be clearly defined.

## SIMILAR CLASSES

- 1100 to 1300 Residential - Residential areas that are not within the operational boundary of the facility should be coded residential.
- 1400 Commercial and Services - Features such as office buildings may look the same whether public or private. Ancillary land use data may be used to differentiate these classes.
- 1700 Institutional - Ancillary data and context will help to determine whether the facility is Correctional.

## SPECIAL MAPPING CONVENTIONS

Those areas that are not clearly related to the functions of the institution are not included. Land cover areas, such as pastures and forests, that are adjacent to the facility should generally be classed with the land cover value, and not dual coded. The PI must delineate the general boundary of the facility and differentiate it from non-correctional areas.

Only those features that are inside the facility boundary and actively involved in its operation are coded 1760. These may include gardens, lawns, fields and recreational areas. Spatial integration and function determine which features are included in the 1760 mapping unit. The PI is not required to discern ownership or replicate property ancillary data and should err on the side of describing land cover and environmental function.

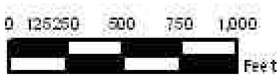
Priority classes such as water bodies, wetlands, golf courses, landfills and treatment facilities, are exceptions to the above. If these features meet their minimum size criteria they are always broken out, even if located within the 1760 mapping unit.

Transportation features (roads, railroads, airports, etc.) within correctional installations that are large enough to be separately classified will be assigned an 8100 Transportation level code for land use rather than 1760 Correctional.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
03/15/07

**COORDINATES**
713601.47 1080229.81

# 1800
# Recreational

LEVEL 1: 1000 Urban and Built-Up
**LEVEL 2: 1800 Recreational**

## DESCRIPTION

This is an active Level 2 class that should be used only when one of the more specific subclasses cannot be applied. The Level 3 subclasses are:

- 1810 Swimming Beach
- 1820 Golf Course
- 1830 Race Tracks
- 1840 Marinas and Fish Camps
- 1850 Parks and Zoos
- 1870 Stadiums - Not Academic

The 1800 code includes areas used for outdoor activities such as community sports, open-air performances, or those used as fairgrounds, as well as those areas where the apparent recreational activity does not fit into one of the Level 3 classes, or cannot be readily determined.

Those areas that are not clearly related to recreational functions are not included. Land cover areas such as pastures and forests that are adjacent to the facility should generally be classed with the land cover value and not dual coded. Only those features that are inside the recreational facility boundaries and actively involved in its operation are included in this class. These may include gardens, lawns, fields and recreational areas. Spatial integration is the key indicator. The PI is not required to use ownership or property ancillary data and should err on the side of land cover and environmental function.

This class does not include fields attached to other facilities where the primary use is different, such as commercial or institutional facilities. For those examples, the 1400 or 1700 codes would be used, respectively, and would include the attached athletic fields.

## KEYS TO PHOTOINTERPRETATION

- Well organized grounds with parking facilities; Parking areas are often not paved.
- Easily recognizable fields with shapes and markings associated with sports complexes
- Community recreational facilities for baseball, football, soccer, tennis etc.
- Small buildings on site used for food service, rest rooms and/or utilities

## CONTEXT

- **Landscape Position** - These land uses may be found in any area of the District, depending on the specific class of activity.

## SIMILAR CLASSES

Recreational areas are usually distinguishable by characteristic features. Features like golf courses and stadiums are distinctive and easy to interpret. Problems may arise with:

- Indoor recreational uses - These will be difficult to distinguish from commercial and institutional uses. The error is not significant.
- Resorts - These will often have recreational facilities, but are classified as 1400 Commercial and Services.
- Institutions - Schools will have recreational facilities that are to be included in the 1700 mapping units. To be classed as 1800, the recreational areas should be independent from commercial or institutional operations.

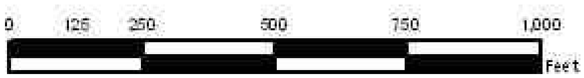
## SPECIAL MAPPING CONVENTIONS

This Level 2 code is to be used only when it is impossible to assign one of the more specific Level 3 subclasses. The PI must always use the most specific class possible.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
07/21/06

**COORDINATES**
958267.52 948497.38

# 1810
# Swimming Beach

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1800 Recreational
**LEVEL 3: 1810 Swimming Beach**

## DESCRIPTION

This class includes saltwater and freshwater beach areas, both public and private, that are accessible from land and available for recreational purposes. Recreational structures and features are not required to be evident, as long as public access is feasible.

This class includes most of the District's beach segments along the Atlantic Coast and the Gulf of Mexico. It also includes beaches along bays, estuaries and freshwater systems if they meet minimum size criteria.

## KEYS TO PHOTOINTERPRETATION

- The following features may be visible on the photography: picnic areas, service stands, piers and boardwalks, fenced areas, protected swimming areas, ball courts and other recreational areas.
- Parking areas are present, with no indication of purposes other than beach recreation. These may be actual paved parking lots, or simply cars that are visible along the access roads or on the beach itself. Note: winter photography may not show many cars due to decreased activity.
- Public beaches, if large enough, are usually indicated on topographic maps.

## CONTEXT

- **Landscape Position** - The presence of residential, commercial or other recreational uses in the vicinity of the beach is a confirmation of this class. Accessibility from land by roads is also sufficient to assume recreational uses. There are few beach segments along the Atlantic coast or Gulf of Mexico that are not used for recreational purposes.

## SIMILAR CLASSES

- 6500 Non-Vegetated Wetlands - Generally tidal flats and shorelines
- 7200 Sand Other Than Beaches - Dunes or other sand areas not part of a beach

## SPECIAL MAPPING CONVENTIONS

The SFWMD classifies most coastal beaches as 1810, based on their accessibility for recreation, whether or not constructed facilities are present.

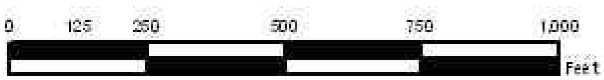
This class generally refers to a sandy, non-vegetated, recreational strip of land. The beach delineation includes all recreational area between the water line and the next inland land use or land cover. It may have inclusions of vegetation or other land uses that are too small to meet minimum size criteria.

Swimming beaches are mapped where visible if they meet the minimum area criteria of 5 acres.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
05/07/07

**COORDINATES**
401536.64 80302.37

# 1820
# Golf Courses

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1800 Recreational
**LEVEL 3: 1820 Golf Courses**

## DESCRIPTION

Golf courses are easily recognizable by their landscaped features and have no similar classes. They are a priority land use to the District due to their environmental significance and are always required to be broken out from other land uses. The 1820 mapping unit includes all facilities that are involved with the operation of the golf course and associated recreation, including club houses, storage buildings and parking lots. Other recreational facilities such as swimming pools and tennis courts are included if they are auxiliary to the golf club. This class does not include adjacent land uses not directly related to recreation. Water features and wetlands are common in and around the courses and must also be broken out wherever they meet the 2 acre MMU criteria

This class also includes golf courses under construction.

## KEYS TO PHOTOINTERPRETATION

- Distinctive pattern of well-watered and maintained grass areas
- Ponds and lakes of varying size and shape
- Fairway strips appear as a smooth light magenta tone, with similarly toned tees and greens at either end
- Sand traps generally appear as whitish "dots" or small rounded polygons in and around fairways
- Areas between fairways often shrubby or wooded with a darker magenta signature
- Likely to contain a large "clubhouse" structure
- Parking lot adjacent to facility

## CONTEXT

- **Landscape Position** - Golf courses are located throughout the state, usually in proximity to populated areas or transportation corridors. They are often constructed on low-lying ground such as pine flatwoods and may be adjacent to, or displace wetlands.

## SIMILAR CLASSES

Nothing else looks like a golf course. However, they may be woven into other land uses - Residential in particular. Many residential communities in the District are built around or adjacent to golf courses. They may also be mixed into Institutional or Commercial uses.

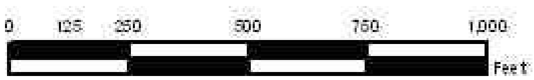
## SPECIAL MAPPING CONVENTIONS

The golf course itself must be broken out wherever possible. However, discretion should be used to avoid excessive interior linework. Housing areas around golf courses should be delineated and classified separately from the golf course, as long as the minimum mapping unit requirement of 5 acres is met.  Wooded or open areas that are inside the 1820 polygon are generally coded 1820.

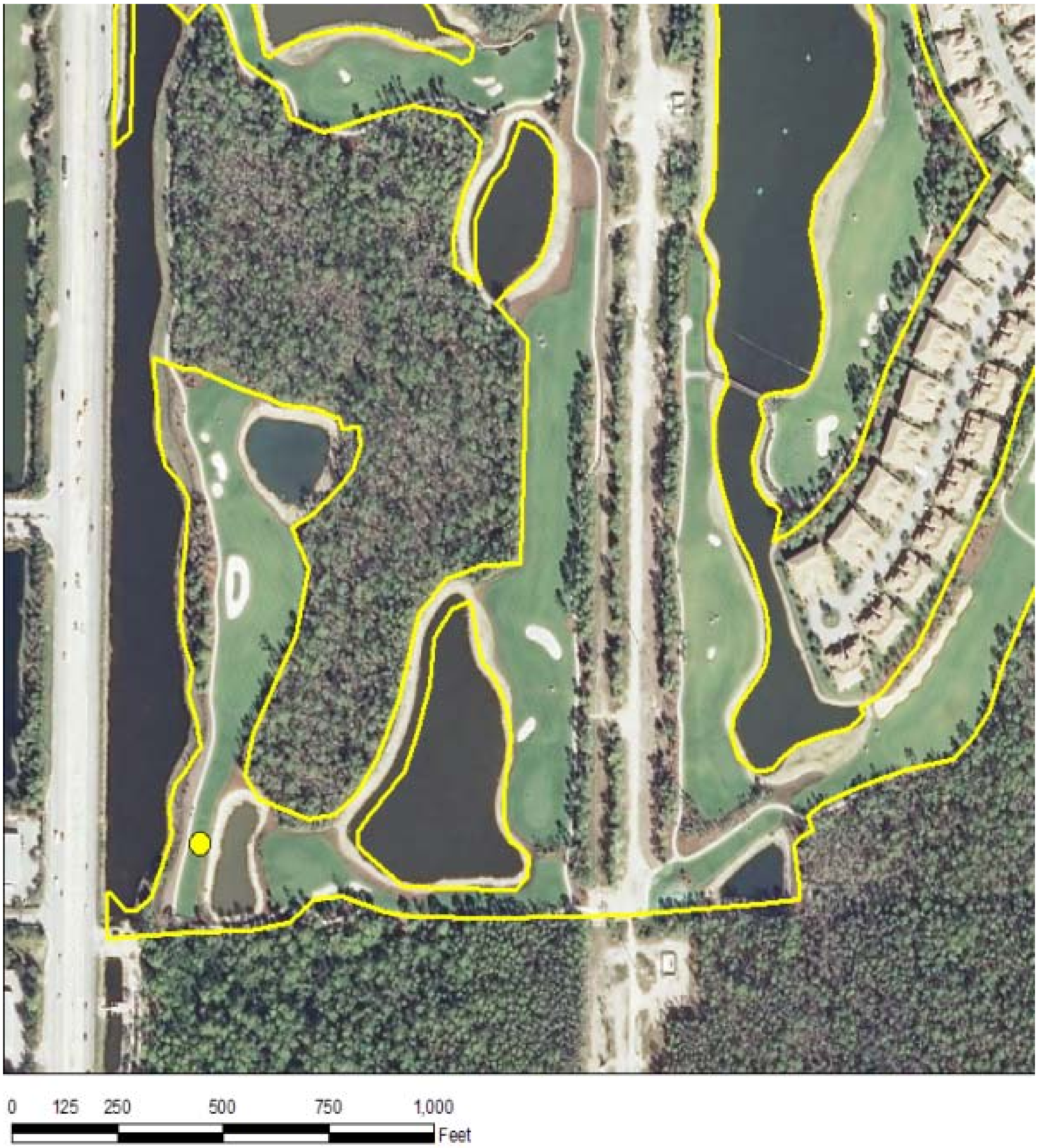
## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
05/09/07

**COORDINATES**
431148.38 657205.42

# 1830
# Race Tracks

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1800 Recreational
**LEVEL 3: 1830 Race Tracks**

## DESCRIPTION

This class includes a variety of racing operations that are readily identifiable on aerial photography. Examples are auto and motorcycle racing, drag strips, horse racing and dog racing. The mapping unit includes all features associated with the operation, including parking facilities, stadium and stands, storage and staging areas and open areas that are inside the operational boundary.

At many automobile and motorcycle race tracks, grandstands and other spectator areas flank only a small portion of the track, which itself is an irregular, closed loop. Drag strips may resemble an air strip due to their straight smooth design and two vehicle width. The distinguishing feature, however, will be the grandstands and the parking facilities, and the lack of hangars or aircraft service features.

## KEYS TO PHOTOINTERPRETATION

- Many racing tracks have a distinctive oval shape
- There are large parking areas adjacent to track, often unpaved
- Public area is likely to be well-kept and landscaped
- Stadium-type seating is usually present, except for very small operations. The stands themselves may be limited to a small portion of the total track area.

## CONTEXT

- **Landscape Position** - Large race tracks are found in urban or urban fringe areas. Various types of local interest racing are also located in rural areas.

## SIMILAR CLASSES

- 2510 Horse Farms - The lack of spectator seating or large parking areas helps distinguish these.
- 8113 Private Airports - Private air strips may appear similar to drag racing strips, but will not have stadiums and large parking areas.

## SPECIAL MAPPING CONVENTIONS

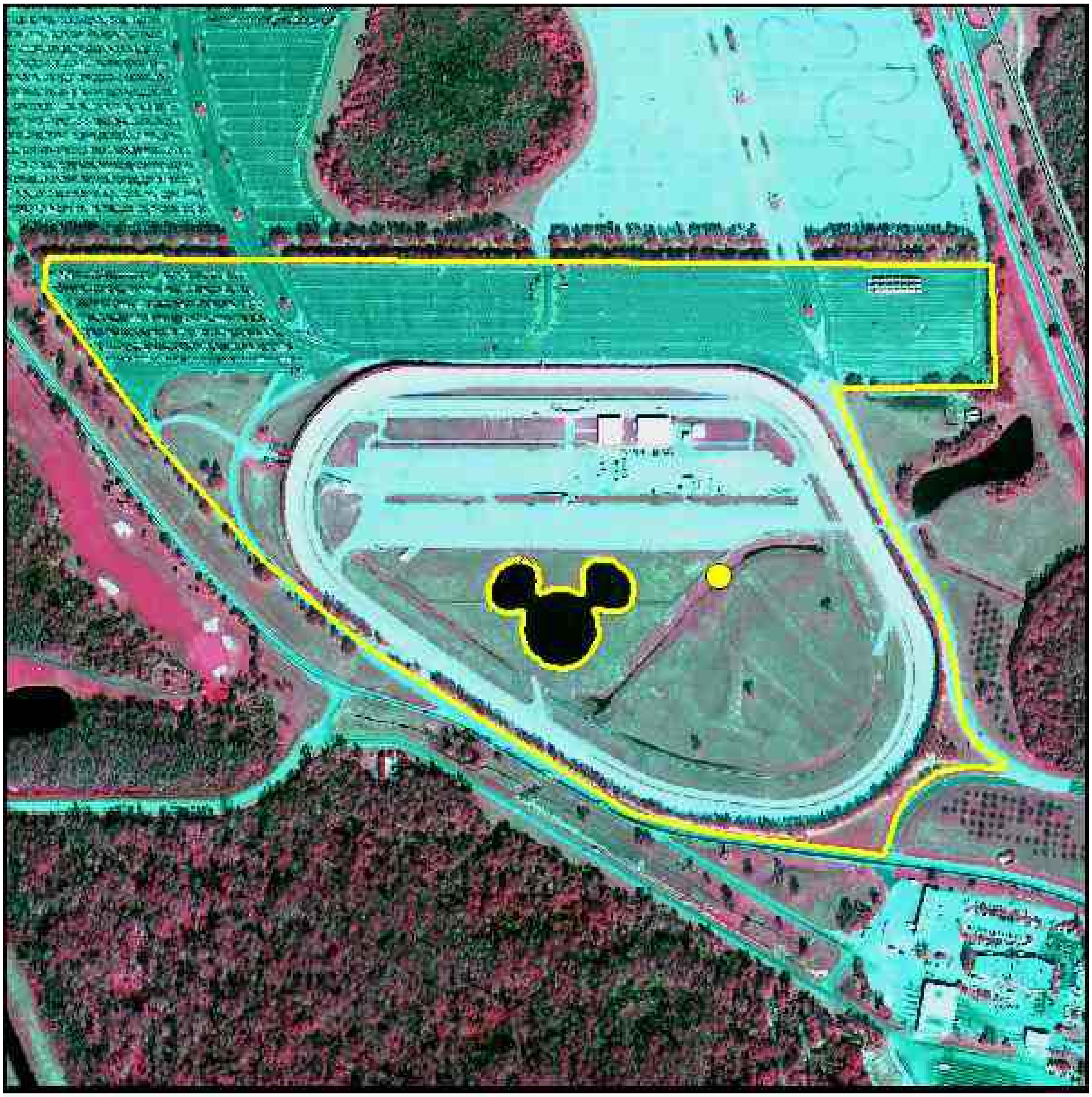
Included within the mapping unit are all buildings, grounds, parking lots, recreational areas and other features that appear to be part of the facility. Those areas that are not clearly related to the functions of the facility are not included. Adjacent open areas are assigned the appropriate land cover value. Only those features that are inside the operational boundaries are coded 1830.

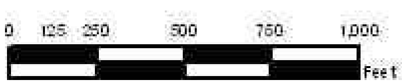
Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they are always broken out.

## DUAL CODING CONVENTION

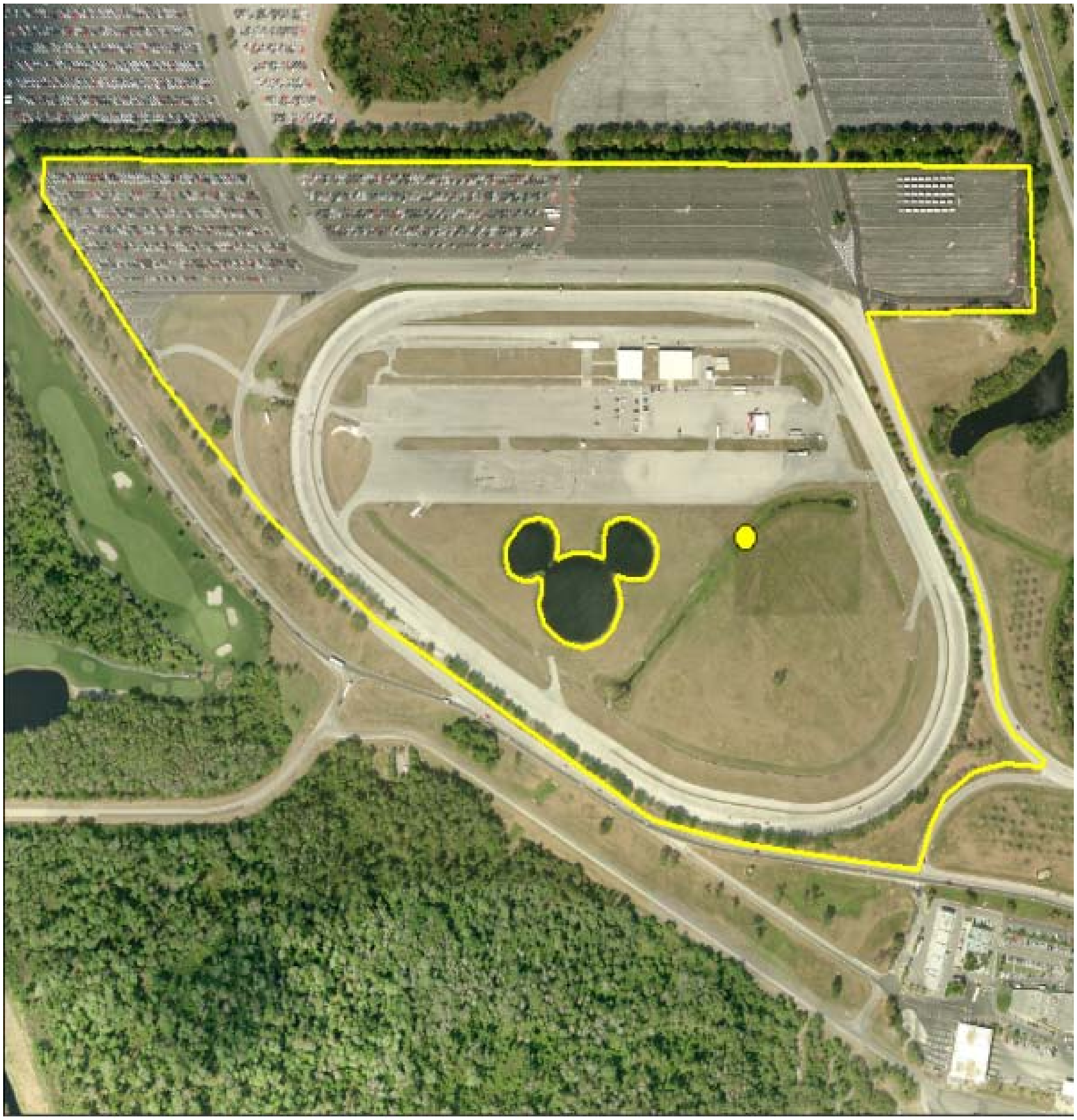
This is a **Land Use** class.; The LUCODE and LCCODE are the same. Separate **Land Cover** code is not required.

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE



0 125 250 500 750 1,000 Feet

## FIELD PICTURE

**DATE**
10/02/07

**COORDINATES**
470719.03 1477322.81

# 1840
# Marinas and Fish Camps

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1800 Recreational
**LEVEL 3: 1840 Marinas and Fish Camps**

## DESCRIPTION

Marinas include fresh water and marine harbors, yacht clubs and boat launching sites that are primarily used for recreational marine craft. Boat mooring areas near the marina are mapped as part of the marina area.

The shore facilities include storage sheds, maintenance buildings, club houses and restaurants, and parking areas. Boat launching sites are identified by a paved or unpaved parking area at the water's edge, with one or more short launching ramps leading to the water. Cars with boats on trailers or cars with empty boat trailers may be visible in the parking area.

Marine railways, boats in slings, or boats on cradles may be visible near the water.

Fish camps include boat launching sites, docking facilities, fishing piers, bait house and store facilities, and any lodging or camping facilities. Parking areas are generally not well developed, but provide space for vehicles and for trailers. Some fish camps provide rental water craft and may have storage facilities for these.

This class does not include associated boat yards used for building and repairing boats. The mapping unit does not include adjacent open areas, or those portions of piers and docks that extend out over a water body.

## KEYS TO PHOTOINTERPRETATION

- Indicator features include boats and boat ramps, docks, parking areas, land and water access routes, fueling facilities and buildings associated with the operations.
- Piers show distinctive rectilinear geometric patterns, bright white against the black tone of the water on CIR film.
- Buildings may include storage sheds, maintenance buildings, club houses and restaurants, and supply stores.
- Boat trailers and associated wide parking areas are usually present.
- Channels through adjacent water bodies or wetlands may provide access to the marina.

## CONTEXT

- **Landscape Position** - Marinas are shoreline uses that tend to occur in areas protected from storms by natural coves or bays, breakwaters, or inland areas connected by canals to an open water body. They are usually close to developed areas for better access. Fish camps are likely to be in more remote areas, often in association with parks, public lands, and other natural areas.

## SIMILAR CLASSES

- 1400 Commercial and Services - Boat repair service facilities may look similar, but will lack many of the above indicators.

- 1550 Light Industrial - Loading docks and trucks are a typical feature.

## SPECIAL MAPPING CONVENTIONS

Included within the mapping unit are all buildings, grounds, parking lots, recreational areas and other features that are attached to the facility. Those areas that are not clearly related to the functions of the facility are not included. Adjacent open areas are assigned the appropriate land cover value.

Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they are always broken out.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
05/07/07

**COORDINATES**
397289.21 83863.25

# 1850
# Parks and Zoos

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1800 Recreational
**LEVEL 3: 1850 Parks and Zoos**

## DESCRIPTION

This class covers the operational facilities that make up the active service areas of various outdoor and recreational land uses. The class includes public and private parks - both rural and urban, campgrounds, zoos, fairgrounds, botanical gardens and other. Note that amusement parks are not included in this class - they are classified as 1400 Commercial and Services. The parks may contain a variety of sub-activities, including play facilities, athletic fields, small museums, zoos, exhibit areas, campgrounds, swimming areas, monuments and fountains, gardens and other facilities. Some of these sub-activities would be assigned to other classes if they were not in the larger context of a park.

Zoos are indicated by animal houses/cages plus areas surrounded by fences or moats. They also contain numerous winding light-toned walkways and roads, and maintenance and storage buildings.

State parks and other public or private outdoor scenic/recreational areas are designed for more active recreation. They are largely left in natural cover, except for parking areas at public access points, camping areas, and visitor facilities. Roads and trails are visible leading to scenic and water access areas. Group or organized camps within the park are identified by a denser network of trails and dirt roads. Individual camping areas or cabins are spaced alongside these roads.

This class does not include the surrounding open and natural areas, even though they may be associated and/or on the same properties, unless they are an active, accessible part of the operations. The intent is to avoid mapping open or natural areas as a land use and thereby missing the land cover values. Open areas outside of the active park facilities are not dual coded with the land use value, since this Land Cover/Land Use data layer does not attempt to delineate ownership boundaries.

## KEYS TO PHOTOINTERPRETATION

- This class has many types of facilities - few indicators apply universally.
- Winding walkways and other landscaping features are designed for aesthetic appeal.
- Shaded picnic areas and/or food service facilities are usually present.
- Parking facilities must be present.

## CONTEXT

- **Landscape Position** - Leisure parks and zoos are usually near populated or high-access areas, and often are adjacent to residential neighborhoods. Boundaries with adjacent land uses are regular and distinct. Outdoor recreation parks tend to be in a rural context, associated with other open areas, public lands and water bodies.

## SIMILAR CLASSES

- 1400 Commercial and Services - Recreational vehicle parks and private campgrounds are classified as 1400 Commercial and Services. However, campgrounds that are subsidiary to larger park facilities, such as National Forests, are still classified as 1850 Parks and Zoos.
- 1700 Institutional - Institutional facilities may have many of the same features. The PI must determine which use - Institutional or Recreational - is predominant.
- 1800 Recreational - Other recreational classes such as beaches, marinas, community recreational, and other uses may occur within parks and zoos as sub-activities. These should not be broken out unless they are spatially and functionally independent.
- Natural areas such as 1900 Open Land, 3000 Upland Non-Forested, 4000 Upland Forests - May overlap this class and may be located on park lands. The key is to break out active, high access operational areas from low access areas with natural functions and values.

## SPECIAL MAPPING CONVENTIONS

This class can legitimately overlap with other classes that have similar indicators. PIs need to determine which use is predominant. Ancillary data, such as parcel data, should be used for that purpose, but PIs should use discretion when dissecting the mapping unit into recreational, institutional and commercial sub-units. PIs should avoid excessively detailed line work while capturing useful information. Linear or overly complex polygons should be avoided, in favor of ones with compact shapes. This is similar to conventions for mapping residential areas.

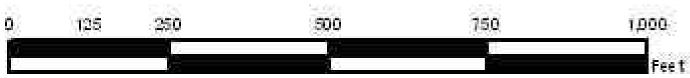
Included within the mapping unit are all buildings, grounds, parking lots, recreational areas, and other features that are attached to the park facility. Only those features that are inside the operational boundaries are coded 1850.

Priority classes such as water bodies, wetlands, golf courses and treatment facilities are exceptions to the above. If these features meet their minimum size criteria they are always broken out.

## DUAL CODING CONVENTION

This is a **Land Use** class. A separate **Land Cover** code is not required, unless large inclusions of other classes occur within operational boundaries. For example, a 5 acre patch of forest inside a municipal park could be dual coded as LC=4200/ LU=1850.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
01/09/07

**COORDINATES**
957960.52 75111760

# 1870
# Stadiums - Not Academic

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1800 Recreational
**LEVEL 3: 1850 Stadiums - Not Academic**

## DESCRIPTION

This class includes those stadiums designed for sports events and **not** associated with educational facilities such as high schools, colleges or universities. It does not include race tracks, parks, fairgrounds or community recreational facilities. Stadiums are characterized by large scale parking facilities and spectator structures.

The white markings of the playing fields, such as the base paths and sidelines of a baseball diamond, should stand out clearly against the dark background of the playing surface on high-contrast CIR film. Football field lines should also be visible and the shadows of the goal posts may be visible at either end of the field.

## KEYS TO PHOTOINTERPRETATION

- The structures and/or playing fields have a distinctive round or oval shape, depending on the sport.
- Stadiums may be enclosed by domed top.
- Field markings are recognizable and characteristic.
- Grounds are well maintained and landscaped.
- Very large parking areas are included in the mapping unit.
- Large scoreboards may be visible.

## CONTEXT

- **Landscape Position** - Stadiums are normally located in populated or high-access areas, but may be found in any area of the District.

## SIMILAR CLASSES

- 1830 Race Tracks - Have a distinct oval racing track

## SPECIAL MAPPING CONVENTIONS

The mapping unit includes all buildings, grounds, parking lots, recreational areas, and other features that are attached to the stadium.

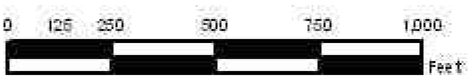
Adjacent open areas are assigned the appropriate land cover code. Only those features that are inside the operational boundaries of the stadium are coded 1870.

Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria of 2 acres they are always broken out.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE


**DATE**
10/02/07

**COORDINATES**
538877.06  1441803.86

# 1900
# Open Land

LEVEL 1: 1000 Urban and Built-Up
**LEVEL 2: 1900 Open Land**

## DESCRIPTION

This category includes open, undeveloped land within urban areas which tends to have transitional or uncertain land uses. The associated land cover types are typically from 3000 Upland Non-Forested or 7000 Barren Land classes. This class is not used to code forests or wetlands (classes for which land use tends to be more stable), except where they may occur as small inclusions within the 1900 polygon. The Level 3 subclass 1920 Inactive Land with Street Patterns is delineated separately.

Open Land has few if any structures, and there is not enough indication of the land use (current or intended) to justify assigning any other LCLU class. Often, urban inactive land may be in a transitional state and ultimately will be developed into one of the typical urban land uses. At the time of the inventory, however, the land use cannot be determined from the aerial photo.

Many different types of land cover can occur on open urban lands. For this reason, a separate land cover code is always required. The most common land covers are from the 3000 Upland Non-Forested classes.

## KEYS TO PHOTOINTERPRETATION

- Signatures may range from heavily vegetated to a disturbed, scoured, white appearance.
- There is not enough indication of the land use to justify any other LCLU code.

## CONTEXT

- **Landscape Position** - Land is considered to be in an urban context if it is situated within a larger matrix of development. This matrix is spatially defined by the concentration of land uses, transportation barriers and other constraints to movement and access. Open Land may be found in any area of the District.
- **Vegetation** - Ranges from barren land with no vegetation to grasses, shrubs or a combination of the two, and may even include scattered trees.

## SIMILAR CLASSES

- 1190, 1290, and 1390 - Residential Under Construction - These will have enough infrastructure, and usually buildings, to show that construction is in progress.
- 1920 Inactive Land with Street Pattern - Street patterns are evident, but development is either stalled or has been abandoned.
- 2120 Unimproved Pastures - Pasture will be in a more agricultural context.
- 3000 Upland Non-Forested - These classes are generally in a more rural and undeveloped setting.
- 7400 Disturbed Land - This class is characterized by man-made alterations.

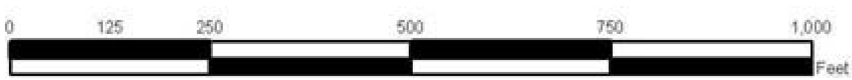
## SPECIAL MAPPING CONVENTIONS

This class should be delineated whenever possible in order to depict open areas situated in an urban context, since these areas are more likely to undergo rapid changes.

## DUAL CODING CONVENTION

This is a **Land Use** class. **Dual coding is always required - a Land Cover code must be assigned in addition to the 1900 code.** Typical **Land Cover** codes are from the 3000 and 7000 classes.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
07/21/06

**COORDINATES**
528148.78 1447592.57

# 1920
# Inactive Lands with Street Pattern

LEVEL 1: 1000 Urban and Built-Up
LEVEL 2: 1900 Open Land
**LEVEL 3: 1920 Inactive Lands with Street Pattern**

## DESCRIPTION

This class includes open areas where development had started but was for some reason halted and appears in an abandoned state at the time of the inventory. It does not include developments that are under construction, incomplete or that are slowly being completed. Lands in this class have street patterns but few if any buildings.

A site is probably abandoned when the soil tones are a grayish magenta and darker magenta on CIR "salt and pepper" patterns (of scattered weeds and shrubs) appear. Then, but for the street pattern, the area would be considered undeveloped land.

The examples of this class in the District are notable, usually sizable, and have a distinct, vacant appearance in contrast to developing areas.

Many different types of land cover can occur on open urban lands. For this reason, a separate land cover code is always required. The most common land covers are from the 3000 Upland Non-Forested and 4000 Upland Forested categories, but many other types of cover may be present.

## KEYS TO PHOTOINTERPRETATION

- A street pattern is visible, although the streets may not be maintained.
- There are few if any structures. If present, they tend to be spaced randomly in the polygon rather than in an organized or clustered manner.
- Absence of landscaping; the appearance is overgrown and indicates neglect.

## CONTEXT

- **Landscape Position** - This class may be found in urban or rural settings. It may be in lowland areas where the hydrology is an obstacle. It is likely to occur in areas where the land values were low, but other factors, such as remoteness or hydrology, rendered the project infeasible.

## SIMILAR CLASSES

- 1190, 1290, and 1390 Residential Under Construction - These will have enough infrastructure, and usually buildings, to give the appearance that construction is in progress. The appearance indicates activity.
- 1490 Commercial and Services Under Construction - same as above

## SPECIAL MAPPING CONVENTIONS

There may be a number of different land cover types occurring together and these communities may be patchy, intergraded and otherwise difficult to map. PIs need to determine which covers are predominant and avoid dissecting the mapping unit with excessively detailed linework. Convoluted polygons should be avoided in favor of ones with compact shapes.

## DUAL CODING CONVENTION

This is a **Land Use** class. **Dual coding is always required - a Land Cover code must be assigned** in addition to the 1920 code. Typically, the **Land Cover** codes are from the 2000, 3000, 4000, and 7000 classes.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
03/17/07

**COORDINATES**
709611.04 1100774.95

# 2000
# Agriculture

This Level 1 class is not used in the map itself - a more specific subclass must be selected. The Level 2 subclasses are:

- 2100 Cropland and Pastureland
- 2200 Tree Crops
- 2300 Feeding Operations
- 2400 Nurseries and Vineyards
- 2500 Specialty Farms
- 2600 Other Open Lands

## BACKGROUND

Agricultural uses cover a large percentage of the District and are very significant to the District's mission of water resource management. The preservation of farmland with its economic and natural resource benefits is a prime concern of the District. Agricultural activities have a significant effect on water supply, water quality, flooding and natural resources, and can vary significantly in their nutrient requirements, run-off and leaching, supplemental water needs and benefits to natural systems. Such variables are important inputs to the models and analysis conducted by the SFWMD and others to predict how watersheds will function. In view of the above, it is important to have clear definitions and accurate delineation of these classes.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit (MMU) for all agricultural classes is 5 acres.

**Differentiating subclasses:** The agricultural classes are generally open, cultivated lands that can look similar on aerial photography. The land uses can change very frequently from one class to another, depending on management. Also, the agricultural areas may be intermixed with other general uses, such as forestry, mining, rural residential, and rangelands, making context alone an unreliable indicator. As a result of all these factors, there is a strong possibility for confusion between the agricultural classes. In order to differentiate these classes it is necessary to look closely at the details in the PI key pages for each class.

## DUAL CODING CONVENTION

Most of the Agricultural classes are designated as **Land Cover** classes. These are generally defined as a certain type of crop, in which case the land cover can readily be inferred from what is being grown. Some of the subclasses are designated as **Land Use** classes. These are defined as a type of operation, such as Feeding Operations or Dairies, that define land use rather than cover. In almost all the subclasses, the LCCODE and LUCODE are the same. A separate dual code may be required in the case of Dairy and Feeding Operations, for example, which have a number of components that are differentiated by the use of different **Land Cover** codes.

## SIMILAR CLASSES

Agricultural lands can be confused with a number of other classes. These include 1180 Rural Residential, 1900 Open Lands, 3000 Upland Non-Forested and 4400 Tree Plantations. Also, agricultural lands that have hydric soils should be classed as Wetlands where wetland vegetation is visible on the aerial photography. In most cases these would be wet prairies being used for pasture.

Farmland that is temporarily flooded should not be classified as open water or wetlands, if it is clear that it is an active farming area.

**For more information:**

See the PI keys for each of the subclasses for more details and graphic examples.

# 2100
# Cropland and Pastureland

This Level 2 class is not used in the map itself - a more specific subclass must be selected. The Level 3 subclasses are:

2110 Improved Pasture
2120 Unimproved Pasture
2130 Woodland Pasture
2140 Row Crops
2150 Field Crops
2160 Mixed Crops

There is one Level 4 subclass:

2156 Sugar Cane

## BACKGROUND

The vast majority of farmland in the District falls under this general class. These classes vary significantly in their nutrient requirements, run-off and leaching potential, supplemental water needs and benefits to natural systems. For example, unimproved pastures are usually low intensity operations with significant habitat value and a low level of impacts. In comparison, row crops are intensively managed, have little habitat value, high nutrient requirements and significant potential for off-site impacts.

Cropland and pastureland uses can have a strong influence on water supply, water quality, flooding and natural resources. These in turn are important inputs to models and analysis conducted by the SFWMD and others to predict how watersheds will function.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit (MMU) for all agricultural classes is 5 acres.

**Differentiating subclasses:** The agricultural classes are generally open, cultivated lands that can have a similar appearance on aerial photography. The land uses can change very frequently from one to another. Also, agricultural areas may be mixed with other uses, such as forestry, mining, rural residential and rangelands, making context alone an unreliable indicator. As a result of these factors, there is a strong possibility for confusion. In order to differentiate these classes it is necessary to look closely at the details in the PI key pages for each class.

## DUAL CODING CONVENTION

All of the 2100 classes are **Land Cover** classes that do not require dual coding - the LCCODE and LUCODE are the same. However, some of the **Land Use** classes, such as 1180 Rural Residential and 1650 Reclaimed Mine Land, may use one of the 2100 classes as a **Land Cover** class.

## SIMILAR CLASSES

Pastureland in particular can be confused with a number of different other classes. These include 1180 Rural Residential, 1900 Open Land, 3000 Upland Non-Forested and 4400 Tree Plantations. Also, pasturelands that have hydric soils should be classed as wetlands. Farmland that is temporarily flooded can be confused with water bodies or wetlands. Such areas should be classified as farmland, if it is clear that it is an active farming area.

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

# 2110
# Improved Pasture

LEVEL 1: 2000 Agriculture
LEVEL 2: 2100 Cropland and Pastureland
**LEVEL 3: 2110 Improved Pastures**

## DESCRIPTION

Improved pastures are the most intensively managed of the pastureland classes. They are usually cleared, tilled, reseeded with specific grass types and periodically improved with brush control and fertilizer application. In most cases they show some direct evidence of cattle, such as watering ponds, troughs, feed bunkers, fencing, corrals, barns or cow trails. The signature is fairly smooth and uniform, but shade trees are often present. These fields may be cut for hay at some times of the year. Improved pastures are usually in areas associated with other agricultural and livestock activities.

The signature of improved pastures is generally very smooth and uniform. Management includes mechanical and chemical brush control, and application of fertilizers and other chemicals. Irrigation during dry seasons and water removal during wet periods may be accomplished by shallow, open ditch systems or underground drainage, and pumping systems.

(The interpreter should be aware that pumps and ditch irrigation are commonly used for unimproved pastures as well and the critical identifying factor for the Improved Pasture land use type is the monotypic appearance of the CIR signature.)

## KEYS TO PHOTOINTERPRETATION

- Water ponds, troughs and feed bunkers may be present.
- Cow trails may be visible.
- Visible fence lines may be observed.
- A distinct smooth pink signature is usually present indicating maintenance.
- Trees may be present for shading.
- Hay bales may be present at some times of the year.

## CONTEXT

- **Landscape Position** - Improved pastures are often found on broad flat areas that were formerly flatwoods. They tend to grade into unimproved pastures and woodlands pastures, and may be adjacent to wetlands. The context of the surrounding landscape is helpful in distinguishing this class from hay fields (2150 Field Crops) or grasslands (3100 Herbaceous - Dry Prairie).
- **Vegetation** - Improved pastures are dominated by a single grass species following clearing or brush removal activities, tilling and replanting. Some introduced species and weeds are present in most of these pastures. Shrubs such as wax myrtle may be present in very small numbers and are often very small in size due to the intensive brush control programs employed.
- **Soils** - This cover type occurs on a wide variety of soil types. Most are found on acidic, sandy soils or loamy sands of former pine flatwoods sites.
- **Hydrology** - These cover types are usually not inundated and often contain ditches as discussed above. High water tables may be present during the wet season depending on the soil type on which they occur and inundation, if it does occur, is brief.

## SIMILAR CLASSES

- 2120 Unimproved Pasture - Unimproved Pasture will have a rougher texture than Improved Pasture, due to more natural vegetation and less intense management.
- 2130 Woodland Pasture - Woodland Pastures will have at least 25% of the area in tree canopy.
- 2150 Field Crops - Field crops (wheat, oats and hay) may have a similar smooth signature and are easy to confuse with improved pasture. Spatial context is helpful in distinguishing field crop from improved pasture. Field crops are generally found in areas managed for agronomic crops, characterized by rectangular fields, farm roads, utility buildings, visible rotations, etc. Improved pastures are generally in less intensive areas managed for livestock and forage. If the area shows signatures of both field crops and pasture, it should be classified as 2110 Improved Pasture.
- 3100 Herbaceous (Dry Prairie) - The 3100 class should be reserved for areas where cattle are not present or are not likely to be present. These may be in more urban settings, or in more remote areas formerly considered as rangelands.

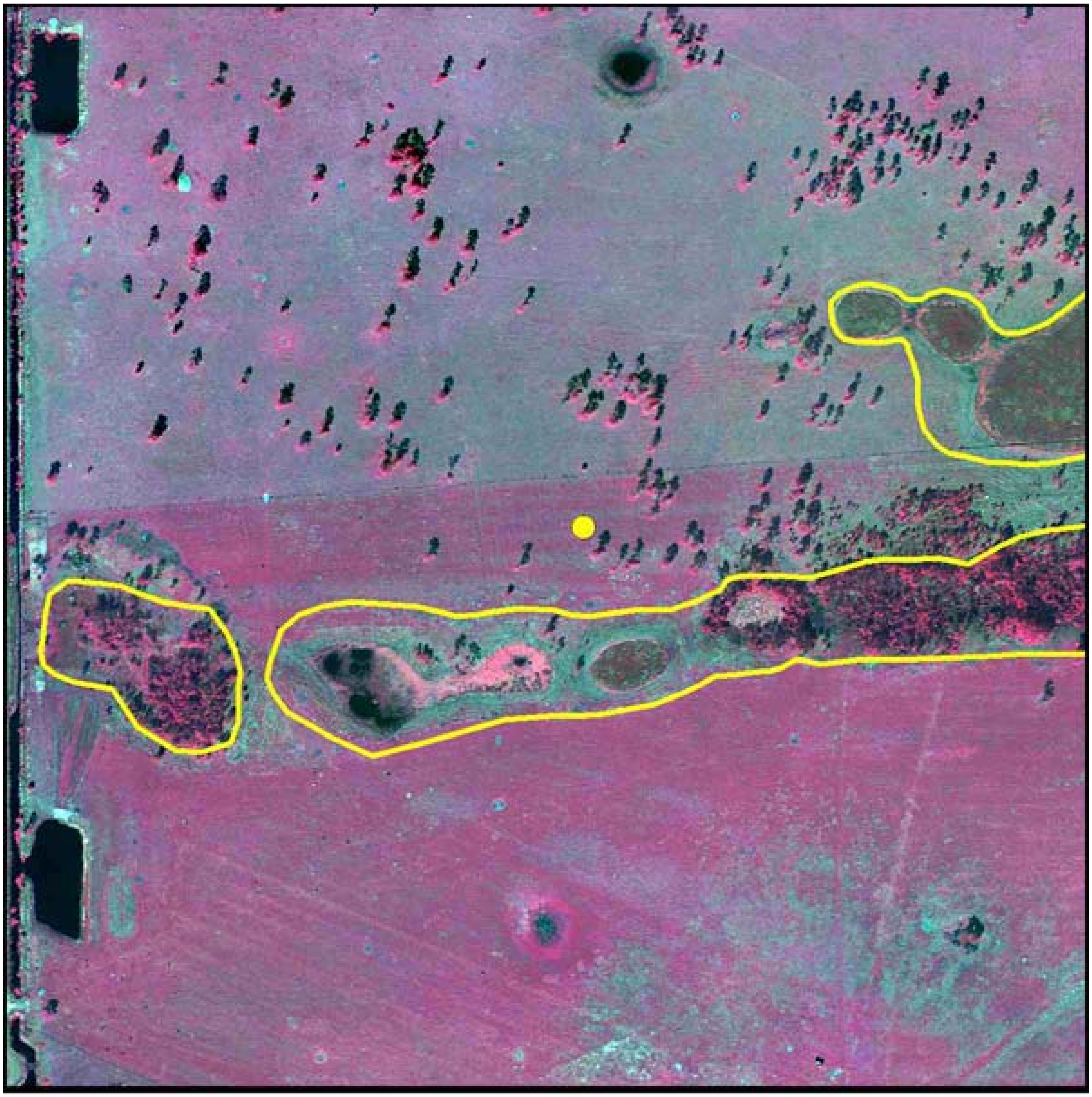
## SPECIAL MAPPING CONVENTIONS

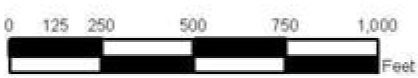
The mapping unit includes barns, ranch houses, trailers and other features common to the industry. Small inclusions of other land cover or land uses may also be included, if under the minimum size criteria. Tree canopy may be present up to 25% of the total area, but if it is in patches larger than 5 acres these patches must be broken out as 2130 Woodland Pasture. Priority classes such as water bodies, wetlands, dumps and feedlots must always be broken out separately, if they meet size criteria.

## DUAL CODING CONVENTION

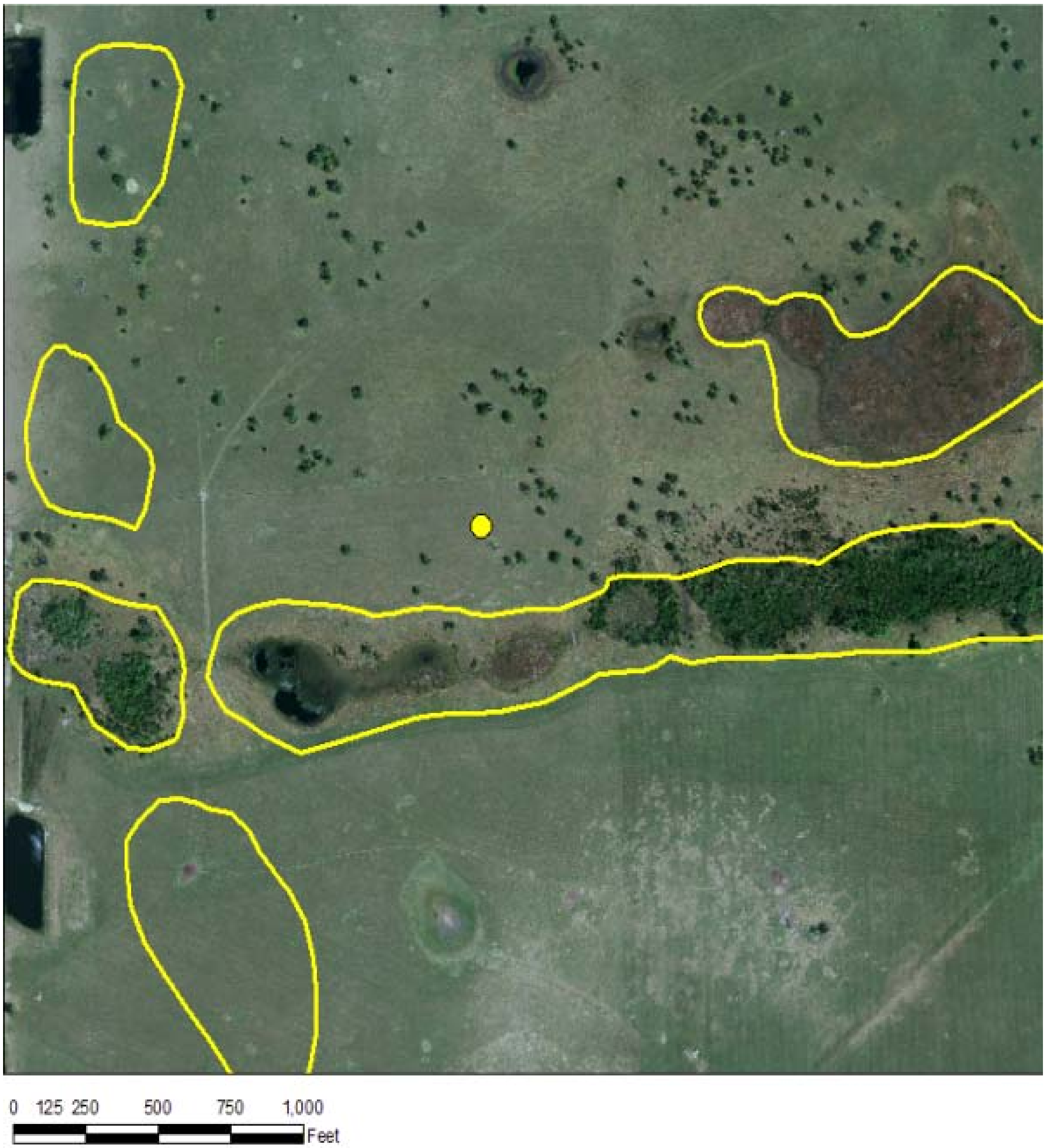
This is a **Land Cover** class. The LCCODE and LUCODE are the same. However, some of the **Land Use** classes - such as 1180 Rural Residential, 1650 Reclaimed Mine Land and 2520 Dairies - may use 2110 as a **Land Cover** class.

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
03/14/07

**COORDINATES**
756239.40  1080364.81

# 2120
# Unimproved Pasture

LEVEL 1: 2000 Agriculture
LEVEL 2: 2100 Cropland and Pastureland
**LEVEL 3: 2120 Unimproved Pasture**

## DESCRIPTION

This class is similar to 2110 Improved Pasture, but with lower intensity of management. The grasses are primarily a mixture of native grasses rather than a uniform, seeded pasture crop. Normally, this land will not be managed with brush control and/or fertilizer application.

The texture of unimproved pastures is less smooth and uniform than improved pastures. Colors may vary depending on the types and patterns of growth, producing a mottled appearance. Trees and shrubs may be present, either dispersed or patchy. Tree canopy, if present, covers less than 25% of the total area. If more than 25% tree canopy is present, the area is classified as 2130 Woodland Pasture.

This land use type results in a very smooth to slightly stippled texture with a color of greens with faint pink (CIR) occasionally present depending on the mixture of grasses and the presence of low saw palmetto. Mixed grasses (mainly native species) result in mottled appearance to the color and the texture. Additionally, pines or other trees (oaks or palms) may be present at varying densities and shrubs or patches of shrubs may be visible. These pastures may be ditched for water removal during wet periods and irrigate during dry weather. Ditches are generally widely spaced.

Management may include irregular mechanical brush control and application of fertilizers and other chemicals.

## KEYS TO PHOTOINTERPRETATION

- Cleared land with major stands of trees and brush where native grasses have been allowed to develop.
- Evidence of cattle may be observed on the photography, such as water ponds, troughs, feed bunkers and cattle trails.
- Hay bales may be present at some times of the year.
- The area is fenced and the fence lines may be visible. Boundaries at fence lines are generally distinct.

## CONTEXT

- **Landscape Position** - Unimproved pastures are often found on broad flat areas that were formerly pine flatwoods. They are usually associated with other agricultural and livestock activities. They tend to grade into improved pastures and woodlands pastures, but may grade in to almost any other land cover type, including wetlands. The surrounding landscape is helpful in distinguishing this class from hay fields (2150 Field Crops) or grasslands (3100 Herbaceous - Dry Prairie).
- **Vegetation** - Unimproved pastures are dominated by a variety of native grasses remaining following clearing or brush removal activities. Some introduced species are also present in most of these land cover types. Shrubs such as wax myrtle and saw palmetto are often scattered within the pasture.

- **Soils** - This cover type occurs on a wide variety of soil types. Most are found on acidic, sandy soils or loamy sands of former pine flatwoods sites.
- **Hydrology** - These cover types are usually not inundated and often contain ditches as discussed above. High water tables may be present during the wet season depending on the soil type on which they occur and inundation, if it does occur, is brief.

## SIMILAR CLASSES

- 1900 Open Land - A more natural area; generally not fenced
- 2110 Improved Pasture - Improved Pasture will have a smoother texture.
- 2130 Woodland Pasture - Woodland Pasture will have at least 25% of the area in tree canopy.
- 2150 Field crops - Field crops (wheat, oats and hay) may have a smoother signature similar to improved pasture. Field crops are generally found in areas managed for agronomic crops, characterized by rectangular fields, farm roads, utility buildings, visible rotations, etc. Unimproved pastures are generally in less intensive areas managed for livestock and forage.
- 2610 Fallow Cropland - Abandoned farm buildings, unmaintained roads and irrigation systems are characteristic of this class.
- 3100 Herbaceous (Dry Prairie) - The 3100 class should be reserved for areas where cattle are not present or are not likely to be present. These may be in more urban settings, or in more remote areas formerly considered as rangelands.

## SPECIAL MAPPING CONVENTIONS

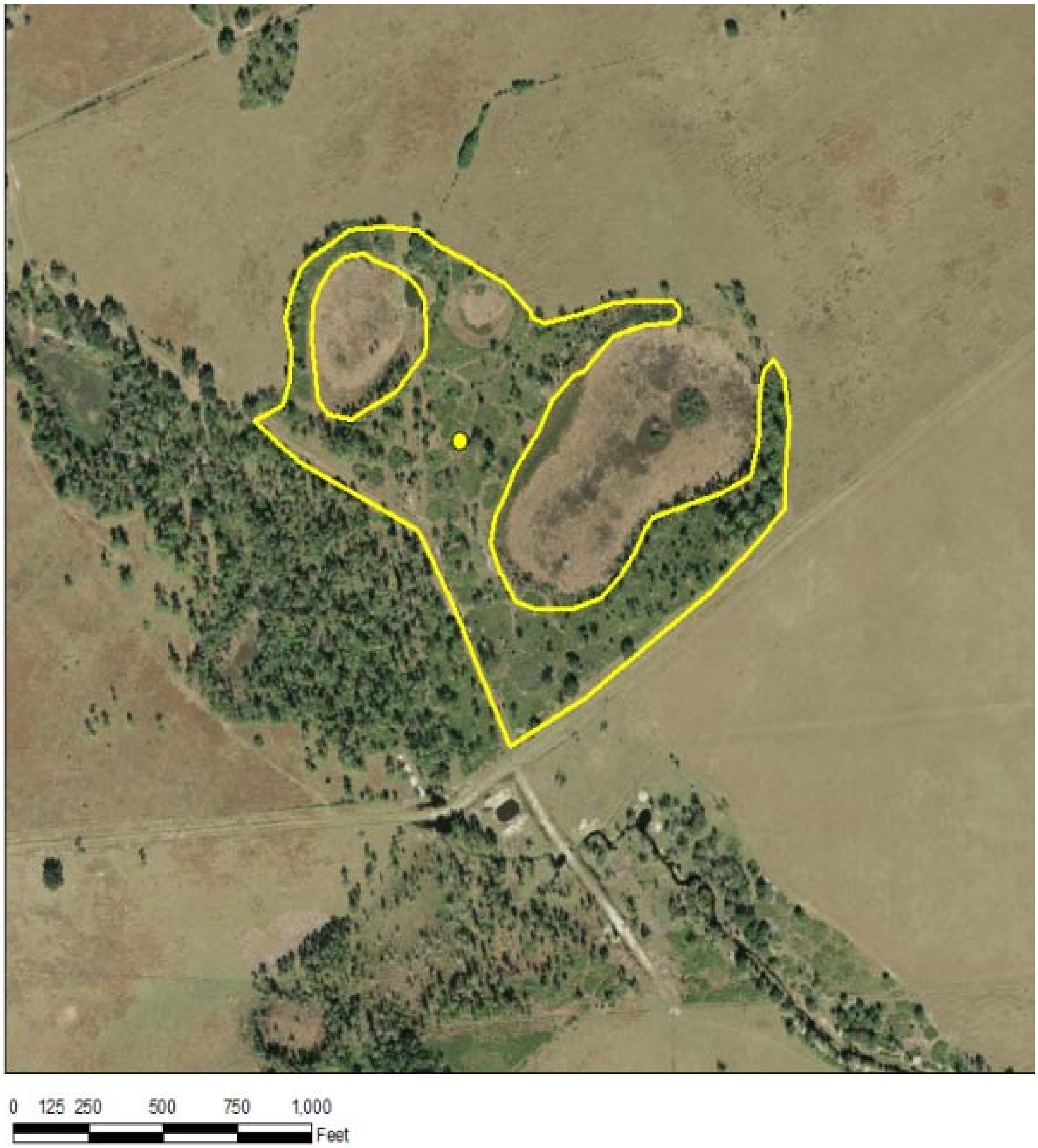
The mapping unit includes barns, ranch houses, trailers and other features common relevant to agriculture. Small inclusions of other land cover or land uses may also be included, if under the minimum size criteria. Tree canopy may cover up to 25% of the total area, but if canopy patches are larger than 5 acres they must be broken out as 2130 Woodland Pasture. Priority classes such as water bodies, wetlands, dumps, and feedlots must always be broken out separately, if they meet size criteria.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. However, some of the **Land Use** classes, such as 1180 Rural Residential and 1650 Reclaimed Mine Land, may use 2120 as a **Land Cover** class.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE




**COORDINATES**
526229.96 1253369.14 (Images)

## FIELD PICTURE

**DATE**
03/14/07

**COORDINATES**
754865.04 1080554.27 (Field Picture)

# 2130
# Woodland Pastures

LEVEL 1: 2000 Agriculture
LEVEL 2: 2100 Cropland and Pastureland
**LEVEL 3: 2130 Woodland Pastures**

## DESCRIPTION

Pasturelands that have from 25% to 100% forest canopy are included in this class.

Pastures are generally unimproved. Evidence of cattle grazing may be difficult to see on photography, due to tree cover. Such evidence, if visible, may include cattle trails leading to feed bunkers, salt licks and watering areas, or cattle themselves. Supplemental data and field verification may be needed to accurately map this class.

## KEYS TO PHOTOINTERPRETATION

- Twenty-five percent or more tree cover is present.
- Visible evidence of cattle activity may include cattle trails, feed bunkers, salt licks, hay bales or watering areas. Cattle crossings may be visible on the roads, defining a grazing boundary.
- Cattle themselves may be visible in some areas.
- Fence lines are usually obscured by canopy, but may be visible in open areas.

## CONTEXT

- **Landscape Position** - This type can be found in any forested area within the project limits. Wetlands may be present within woodland pastures.
- **Vegetation** - Woodland pastures are dominated by a variety of native tree and shrub species. Most often the type will be of the pine flatwoods or pine and oak types.
- **Soils** - This cover type occurs on a wide variety of soil types. Most are found on acidic, sandy soils or loamy sands of former pine flatwoods sites.
- **Hydrology** - These cover types are usually not inundated. High water tables may be present during the wet season depending on the soil type on which they occur and inundation, if it does occur, is brief.

## SIMILAR CLASSES

- 2120 Unimproved Pasture - Less than 25% of the total area is in tree canopy.
- 2230 Other Groves - Active pecan groves may show evidence of cattle grazing, but should not be classified as 2130 Woodland Pasture unless the grove is no longer active. They have a more uniform texture and color and trees are in rows.
- 2240 Abandoned Groves - No indication of grazing is present.
- 3200 Shrub and Brushland - These may look similar because shrub vegetation is present and tree canopy may comprise up to 25% of the cover. However, cattle are not present or likely to be present.
- 4110 Pine Flatwoods - No indication of grazing is present.

## SPECIAL MAPPING CONVENTIONS

The mapping unit includes barns, ranch houses, trailers and other operational features. Open areas may cover up to 75% of the total area, but if those areas are larger than 5 acres they should be broken out. In transitional areas where species-specific wetland (2 acre MMU) and upland (5 acre MMU) polygons are below the appropriate MMU some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit. PI's must use discretion to avoid excessive line work while adding useful information.

Priority classes such as water bodies, wetlands, dumps, and feedlots must always be broken out separately, if they meet their respective MMU.

## DUAL CODING CONVENTION

This is a Land Cover class. The **LCCODE** and **LUCODE** are the same. However, some of the Land Use classes, such as 1180 Rural Residential and 1650 Reclaimed Mine Lands, may use 2130 as a Land Cover class.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE


**COORDINATES**
457028.78 943489.62 (Images)

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
449746.77 704562.48 (Field Picture)

# 2140
# Row Crops

LEVEL 1: 2000 Agriculture
LEVEL 2: 2100 Cropland and Pastureland
**LEVEL 3: 2140 Row Crops**

## DESCRIPTION

This class is for cultivated annual crops that exhibit a narrow row spacing. It does not include field crops, which do not exhibit rows on photography or trees and shrubs, which tend to have a wider spacing. Also not included are farms specializing in ornamentals and flowers. Typical row crops include corn, tomatoes, potatoes, cabbage, beans, tobacco and a host of other plants used mainly for animal and human consumption.

Row crops range from vast mono-cultures of animal feeds to tiny commercial truck farms and everything in between. The appearance of the fields varies according to the specific crop and season, from bare smooth soil to ridges to fully covered fields. Some fields may also be in cover crops or in a fallow state. The reliable indicators are the agricultural context and the appearance of fine textured rows on most plots.

## KEYS TO PHOTOINTERPRETATION

- The active fields have straight rows of crops and furrows or plow lines.
- In wetter areas drainage ditches and levies or subsurface drains are present.
- Rows are visible even after harvesting of crops.
- Farm buildings and equipment are seen in surrounding areas.
- Irrigation systems are usually present.
- Bare soil may be visible with varying amounts of pink and/or reds (CIR) from the crops.

## CONTEXT

- **Landscape Position** - Row crops usually occur in an agricultural context. Truck farms may operate on urban fringes, especially if on-site marketing is used. A variety of other agricultural uses may be practiced in the surrounding area, including field cropping, pastures, nurseries and tree crops.
- **Soils** - Areas with naturally hydric soils are sometimes used for row cropping and other agricultural operations. If they are active farm operations they are coded as agricultural rather than wetlands or water bodies. PI's should check public lands maps to determine whether the operation is still active or in a process of restoration.

## SIMILAR CLASSES

- 2430 Ornamentals - Row spacing is wider than row crops.
- 2410 Tree Nurseries - individual crowns are generally more apparent - field verification may be needed.
- 2610 Fallow Cropland - Has a more shrubby, irregular appearance.

## SPECIAL MAPPING CONVENTIONS

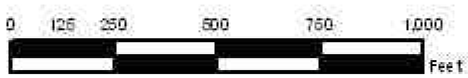
The mapping unit includes barns, offices, farm houses, warehouses, private air strips, farm roads and any other operational features.

Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria. However, areas that are active farm plots and only temporarily under water should not be coded as water bodies. A note may be added by the PI to indicate the field is inundated at the time of the photography.

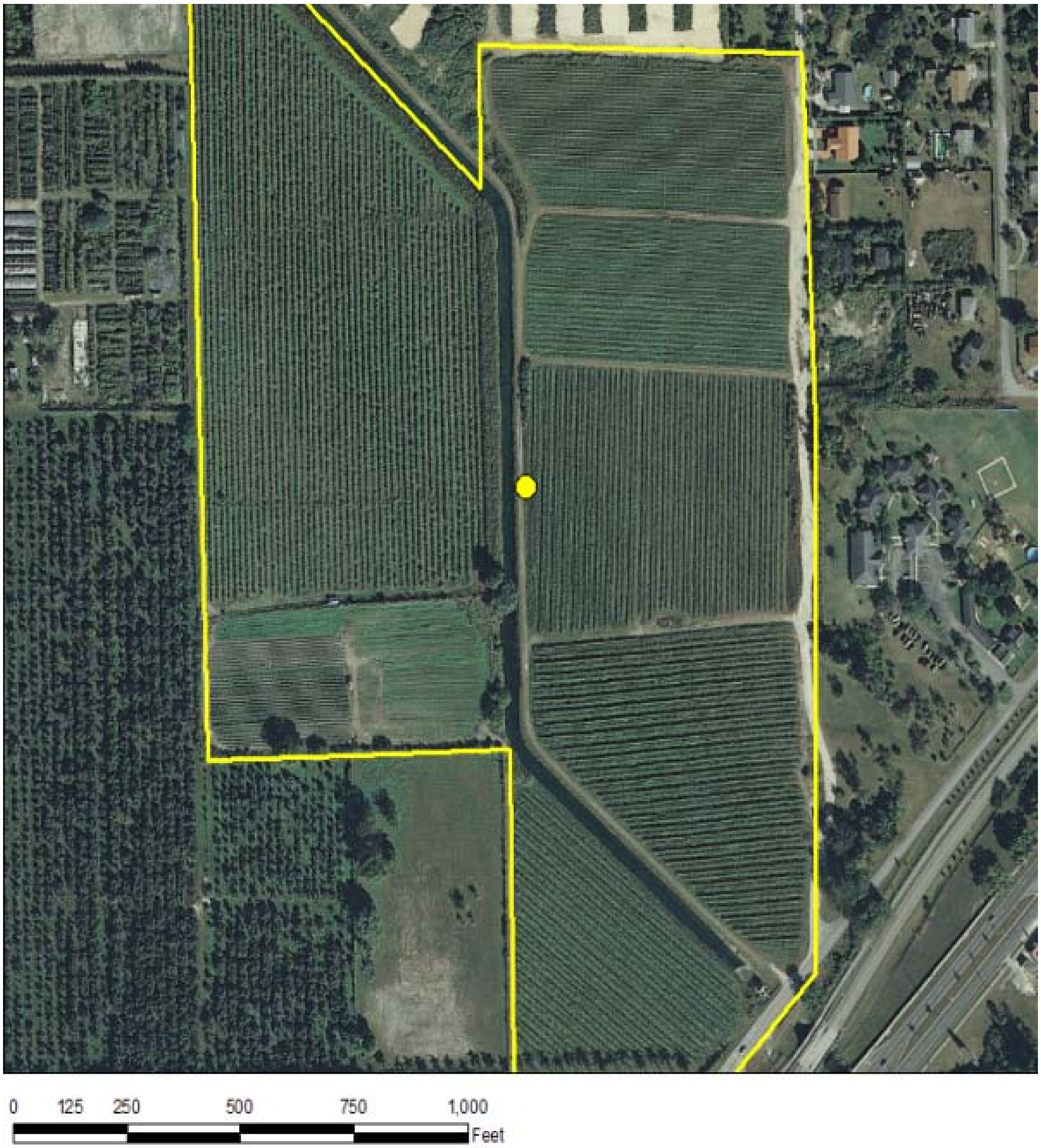
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LUCODE and LCCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
07/19/07

**COORDINATES**
854467.65 444277.31

# 2150
# Field Crops

LEVEL 1: 2000 Agriculture
LEVEL 2: 2100 Cropland and Pastureland
**LEVEL 3: 2150 Field Crops**

## DESCRIPTION

Field crops are agronomic crops that, due to spacing or growth habit, do not exhibit a pattern of parallel rows on the photography. Examples in Florida are wheat, oats, hay, other grasses, sugar cane and watermelons. **The fact that an area is mowed at some times is not sufficient for inclusion in this class** - it must be actively managed as a cultivated field crop. Fields are either rectangular or circular in shape, with the circular fields usually used for hay production. Hay crops tend to be isolated or will appear in clusters of only a few fields. Broad expanses of rectangular fields are generally sugar cane and are coded as 2156.

In the SFWMD the primary field crop types are hay, grasses and sugar cane. They may be very difficult to differentiate from improved pasture in many cases - context may be a decisive factor in distinguishing one from the other. Field checks may be the only way to determine the actual use of some fields, especially when crop growth is in the early stages. However, since hay crops are similar in function to other classes such as pasture, the error cost is low and does not warrant extensive checking. In fact, the farmer may rotate fields between pasture and hay over successive seasons or years.

## KEYS TO PHOTOINTERPRETATION

- Typical field crops are included as well as hay production areas.
- Flat, smooth signature from hay, grasses.
- Bright pink signature from fertilization and maintenance.
- Fence lines may be visible.
- Mow lines and hay bales are often visible.
- Subsurface or surface drainage, canals, and/or irrigation may be visible.
- No visible evidence of grazing livestock.
- Field shapes are regular or rectangular and have mostly straight edges.

## CONTEXT

- **Landscape Position** - The PI has to consider the context if other indicators are not conclusive. Cropland and pasture lands may occur together, but areas that are predominantly crop land will have more of the indicators shown above (fence lines, mow lines and rectangular fields) as well as other features such as storage buildings, cultivating equipment, vehicles, irrigation equipment, solid waste sites and processing facilities. Field crops may occur almost anywhere, but are typically found in areas of pasture and ranching or dairy/horse farms. Sugar cane fields are generally found around the southern portions of Lake Okeechobee.
- **Soils** - A wide variety of soils from sandy to peat, and varying drainage classes are used for Field Crops.

## SIMILAR CLASSES

- 2110 Improved Pasture - Will have evidence of grazing, or a grazing context
- 2160 Mixed Crops - Will have less uniformity than field crops
- 2610 Fallow Cropland - Will show signs of abandonment, overgrowth
- 3100 Herbaceous (Dry Prairie) - Not actively managed for crops, although cutting may occur

## SPECIAL MAPPING CONVENTIONS

This land cover type on the aerial photography often appears as pasture that is not supporting livestock at the time of photography but is rotated to field crop production, specifically hay. If the area shows any evidence of cattle, or its signature could be classed as either pasture or field crops, the area should be classified as 2110 Improved Pasture.

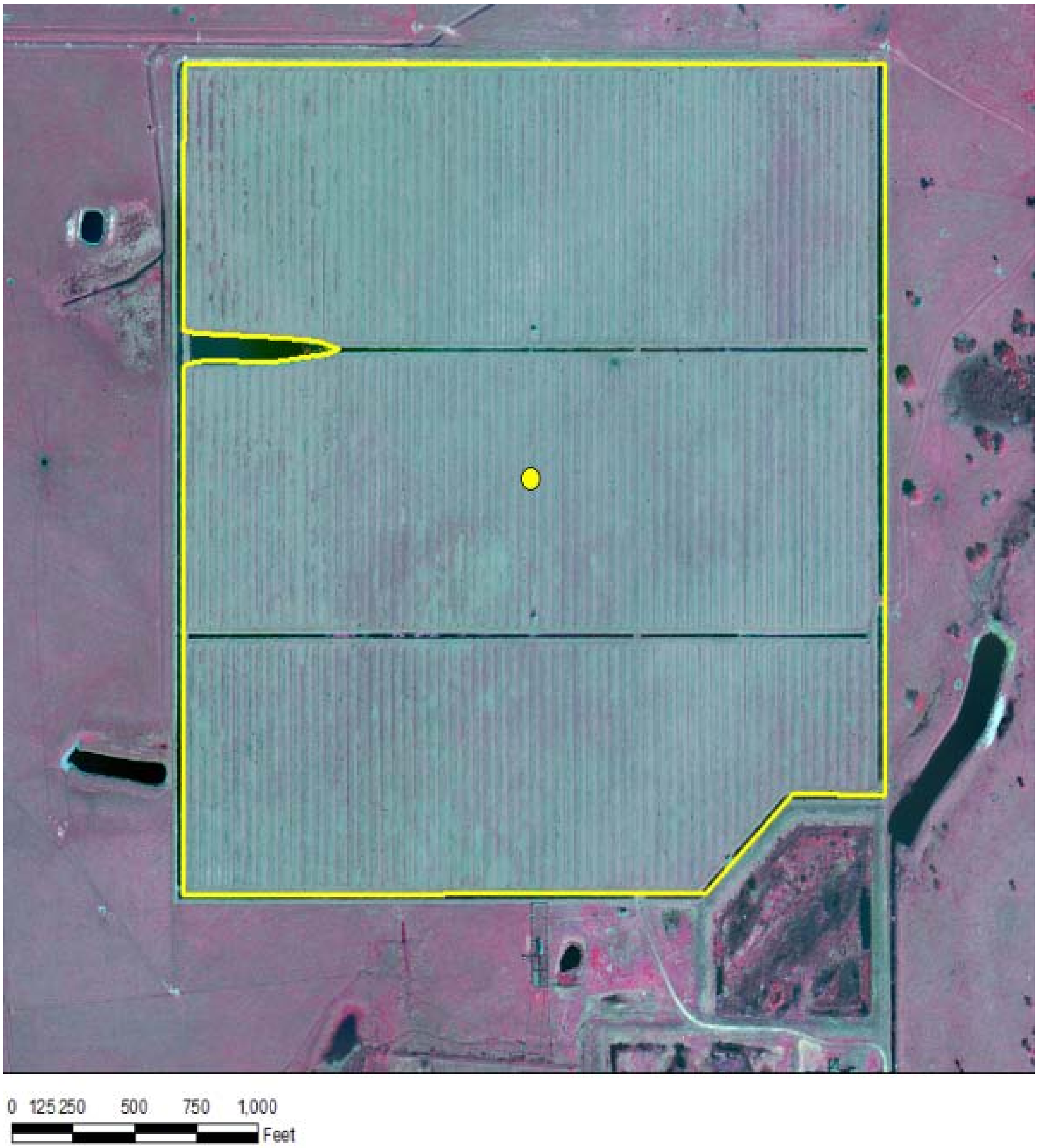
Spatial context is helpful in distinguishing this class from 2110 Improved Pasture. Field crops will generally be found in a more intensively managed setting, surrounded by similar areas with rectangular fields, farm roads, etc. Improved pasture will generally be found in a less intensively managed environment.

NOTE: Areas of field crops associated with a dairy shall be coded as part of the dairy operation and not coded as 2150.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE


**COORDINATES**
647839.63 1065502.39 (Images)

## FIELD PICTURE

**DATE**
n/a

**COORDINATES**
n/a (Field Picture)

# 2156
# Sugar Cane

LEVEL 1: 2000 Agriculture
LEVEL 2: 2100 Cropland and Pastureland
LEVEL 3: 2150 Field Crops
**LEVEL 4: 2156 Sugar Cane**

## DESCRIPTION

Sugar cane is a giant, robust tropical grass native to Asia. It is Florida's most valuable field crop.

Sugar cane fields occur as large expanses of regularly shaped fields and are generally found around the southern portions and shores of Lake Okeechobee.

In the SFWMD, Palm Beach County accounts for approximately 70% of the sugar cane acreage. The remainder is grown in the adjacent counties of Hendry, Glades and Martin.

These fields are sometimes rotated with other crops being produced in between cane crops. If cane is produced at any time, the field should be assigned to this class even if some other crop is being produced. Collateral data may be useful in determining sugar cane production areas.

## KEYS TO PHOTOINTERPRETATION

- Very smooth texture and even height with generally bright red color (CIR).
- Fields are rectangular in shape and extensive amounts of land in blocky pattern of many individual fields are visible.
- Larger irrigation ditches and access roads separate the fields with smaller ditches also present between fields.
- Harvested or fallow fields appear as any variation between light greenish color and black.
- Black returns often occur from fields which have recently been burned and harvested and not yet tilled for replanting.

## CONTEXT

- **Landscape Position** - The major cane production areas are generally away from centers of population due to the agricultural practices involved in harvesting the crop. Cane fields are burned prior to harvest and the smoke can be a problem in lands adjacent to urban areas.
- **Soils** - Generally restricted to organic muck soils.
- **Hydrology** - Due to their location in areas of organic muck soils and former Everglades or marsh systems, water is present in these fields during wet periods. Irrigation and drainage systems consisting of varying size canals and ditches are a prominent feature around, but generally not within (as with row crops) cane fields.

## SIMILAR CLASSES

- 2110 Improved Pastures - Will have evidence of grazing, or a grazing context
- 2610 Fallow Cropland - Will show signs of abandonment, overgrowth
- 3100 Herbaceous (Dry Prairie) - Not actively managed for crops, although cutting may occur

## SPECIAL MAPPING CONVENTIONS

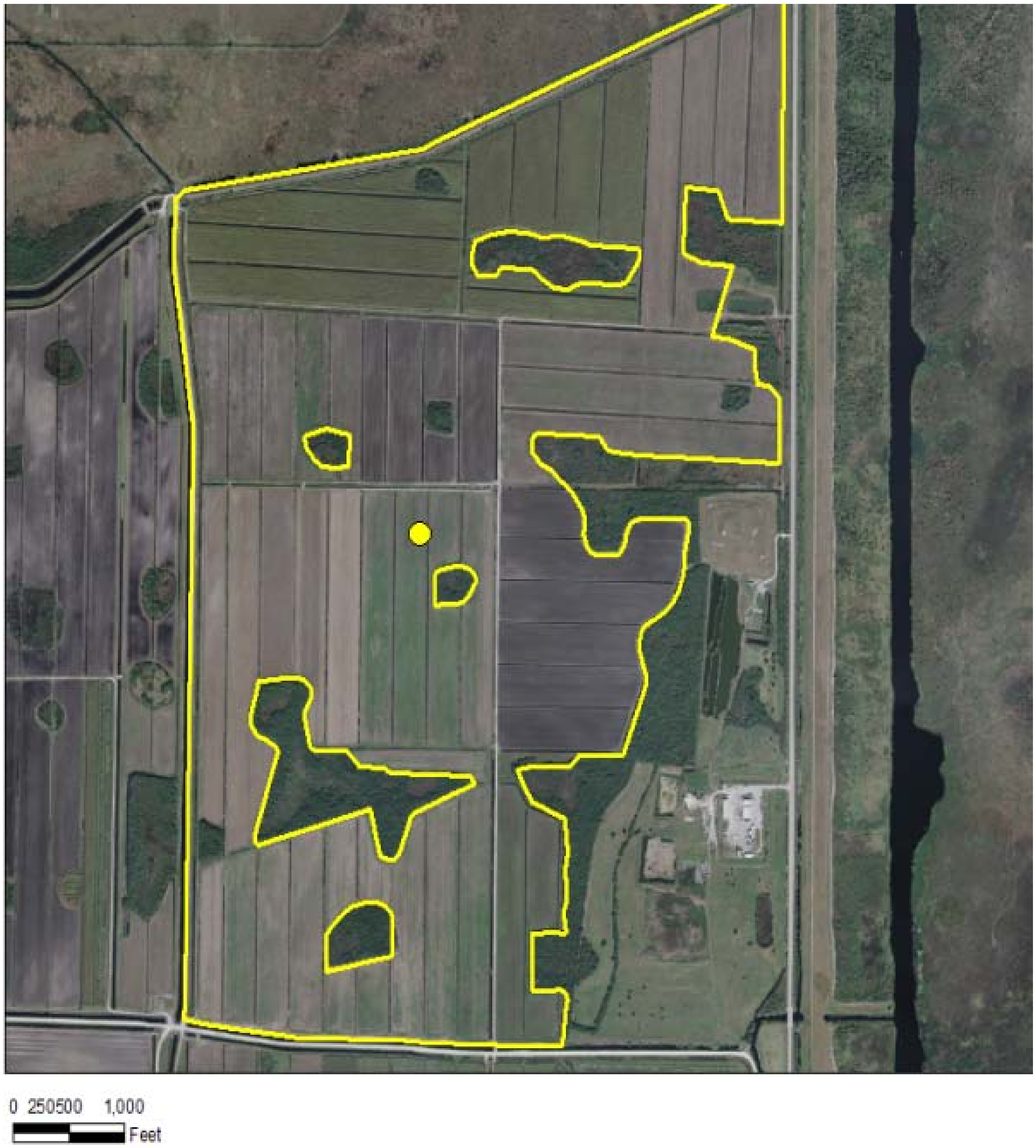
If sugar cane is produced at any time, the field should be assigned to this class even if some other crop is being produced.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE




**COORDINATES**
612797.49 931180.07 (Images)

## FIELD PICTURE

**DATE**
01/14/07

**COORDINATES**
861980.20 429677.30 (Field Picture)

# 2160
# Mixed Crops

LEVEL 1: 2000 Agriculture
LEVEL 2: 2100 Cropland and Pastureland
**LEVEL 3: 2160 Mixed Crops**

## DESCRIPTION

This class is used for areas where the type of crop cannot be determined, either because the photosignature does not indicate a specific type of crop or various crop types are in plots that cannot be delineated separately. It may not be possible to break out the different crop types if each plot is below the minimum mapping unit (5 acres), or if the stage of the rotation (e.g. freshly plowed) does not reveal what type of crop will be grown.

The crop patterns in some areas can vary from season to season. Where mixtures of row crops, field crops, pastures, fallow cropland and other crops occur together, a precise delineation is not always cost effective - some aggregation or generalization may be justified. PI's must use discretion to avoid excessive line work while adding useful information.

This class should not be used if a reasonable assumption about the crop type can be made based on context, surrounding uses and other possible indicators. In general, it should be reserved only for mixtures of crops that are too complex to differentiate efficiently.

## KEYS TO PHOTOINTERPRETATION

- Crop type is not identifiable due to temporary inactivity or the stage of crop rotation. Some plots may be freshly tilled.
- Multiple crop types occur on small areas, each type below the minimum size criteria of 5 acres. Crop patterns appear somewhat random.
- The mixture of cropping methods indicates that the land use changes often.
- The specific crop type cannot be determined from the photography or supplemental data.

## CONTEXT

- **Landscape Position** - This class tends to be limited to mostly smaller operations, such as truck farms, or farms used for a second income. These are likely to be in agricultural zones in or near urban areas. A variety of other agricultural uses may be practiced in the surrounding area, including field cropping, pastures, nurseries and tree crops.

## SIMILAR CLASSES

- 2140 Row Crops - Have straight rows of crops and furrows or plow lines are visible
- 2150 Field Crops - Have a bright pink, flat, smooth signature from fertilization and maintenance
- 2430 Ornamentals - Row spacing is wider than for row crops; shade cloths may appear as black rectangles.

## SPECIAL MAPPING CONVENTIONS

This is a SFWMD modification to the FLUCCS system, which does not have a class for mixed crops.

This class should not be used if a reasonable assumption about the crop type can be made based on context and other indicators. It should be reserved mainly for mixtures where more specific classification is not possible.

The mapping unit includes any barns, offices, farm houses, green houses, warehouses, farm roads and other features that are part of the farming operation or inside the operational boundary. Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

**COORDINATES**
504737.78  878027.78 (Images)

## FIELD PICTURE

**DATE**
01/14/07

**COORDINATES**
504737.78 878027.78 (Field Picture)

# 2200
# Tree Crops

This Level 2 class is not used in the map itself - a more specific subclass must be selected. The Level 3 subclasses are:

2210 Citrus Groves
2230 Other Groves

## BACKGROUND

This class is used for tree crop operations that produce fruit, nuts or other resources not including wood products.

Examples in Florida include citrus fruit, peaches, mangos and avocados. It also includes pecans and other nut trees. This class does not include tree nurseries, vineyards, floriculture or ornamentals. It also does not include tree plantations or any uses that primarily produce wood products. If the groves are abandoned they should be classified as 2240 (Abandoned Groves).

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit for all Agricultural classes is 5 acres.

**Differentiating subclasses:** The agricultural classes are generally open, cultivated lands that can have a similar appearance on aerial photography. The land uses can change very frequently from one to another. Also, agricultural areas may be mixed with other uses, such as forestry, mining, rural residential and rangelands, making context alone an unreliable indicator. As a result of these factors, there is a strong possibility for confusion. In order to differentiate these classes it is necessary to look closely at the details in the PI key pages for each class.

## DUAL CODING CONVENTION

All of the 2200 classes are **Land Cover** classes. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## SIMILAR CLASSES

Tree Crops can be confused with other classes such as 2140 Row Crops, 4400 Tree Plantations and 2410 Tree Nurseries. Tree Crops have wider-spaced rows and trees that are generally visible, while some crop types may have visible rows, but no trees visible. Active pecan groves may show evidence of cattle grazing, but should not be classified as 2130 Woodland Pasture unless the grove is no longer active. Tree Crops also have a more uniform appearance than nurseries or vineyards, which can have a variety of species. Older abandoned groves show encroachment of other shrubs and should be classified as a Land Use in the Upland Non-Forested category as 2240 (Abandoned Groves).

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

# 2210
# Citrus Groves

LEVEL 1: 2000 Agriculture
LEVEL 2: 2200 Tree Crops
**LEVEL 3: 2210 Citrus Groves**

## DESCRIPTION

This class includes active citrus groves, such as oranges, grapefruits and tangerines. If the groves are abandoned they should be classified as 2240 (Abandoned Groves).

The mapping unit includes all facilities that are related to the citrus operation or located within the operational boundary of the enterprise.

## KEYS TO PHOTOINTERPRETATION

- Uniformly spaced rows of trees give the appearance of a grid pattern. There may be intermittent spaces within groves.
- The groves and its sub-units tend to be large, rectangular areas with straight rows. One operation may cover thousands of acres.
- Irrigation and drainage canals are usually present.
- Healthy trees produce circular crowns with a medium-dark green crown (dark brown/red color on CIR). Larger trees may grow together into what appear to be long, wide hedges.
- Groves appear to be well-managed and currently in production.

## CONTEXT

- **Landscape Position** - Citrus is typically planted on well-drained, sandier textured soils, but hydric soils have also been converted to citrus groves in some places. Artificial drainage and irrigation are used in most cases to keep soils in acceptable moisture ranges.
- **Soils** - Citrus groves are typically found on well-drained sandy soils.

## SIMILAR CLASSES

- 2140 Row Crops - Rows have more of a linear pattern, crowns are usually not distinct.
- 2230 Other Groves - Crowns can appear to be less rounded than citrus and often taller.
- 2240 Abandoned Groves - Groves will look unmanaged with underbrush, vines, and dead or dying trees.
- 2410 Tree Nurseries - Nurseries have smaller, tighter crowns-field verification may be necessary.
- 4410 Coniferous Pine - Characteristic pine signature.
- 4430 Forest Regeneration - Recently cleared areas, with lines of piled up slash and debris.

## SPECIAL MAPPING CONVENTIONS

The mapping unit includes offices, on-site marketing and processing facilities, permanent and temporary housing, warehouses, private air strips, farm roads and any other operational features. Any features not involved in the operation or not located within operational boundaries are not included.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

**COORDINATES**
589500.20  1302364.46 (Images)

## FIELD PICTURE

**DATE**
10/03/07

**COORDINATES**
450942.22 1509035.67 (Field Picture)

# 2230
# Other Groves

LEVEL 1: 2000 Agriculture
LEVEL 2: 2200 Tree Crops
**LEVEL 3: 2230 Other Groves**

## DESCRIPTION

This class includes tree crops such as fruit orchards, pecans and other nut trees, and also groves where the type of fruit being grown is unable to be determined. If the groves are abandoned they should be classified as 2240 (Abandoned Groves).

These groves appear as regularly spaced trees of similar size and crown shape/diameter in regular blocks. Trees do not necessarily produce circular crowns like citrus, however. Additionally they may be taller (when mature) than citrus and have varying reddish color return depending on the crop in production which is not as dark as the dark brown red color of most citrus. As trees become larger, they may form what appear as long hedges with each crown touching its neighbor along the long axis of the row of trees.

Varying amounts of bare soil are visible between the rows depending on the age of the grove and maintenance practices and/or schedules.

The type of grove is often not possible to determine without collateral data. Size and shape of trees, especially in more mature groves should distinguish this class from the more rounded crowns of citrus trees.

## KEYS TO PHOTOINTERPRETATION

- Uniformly spaced rows of trees give the appearance of a grid pattern. There may be intermittent spaces within grove.
- The groves and its sub-units tend to be large, rectangular areas with straight rows. One operation may cover thousands of acres.
- Irrigation and drainage canals are usually present.
- Healthy trees produce circular crowns with a dark brown/red color (CIR). Larger trees may grow together into what appear to be long, wide hedges.
- Groves appear to be well-managed and currently in production.

## CONTEXT

- **Landscape Position** - This land use type occupies much smaller areas than that of citrus groves. Irrigation and drainage canals are still present throughout the grove system providing water (pumped into the grove during dry times) and drainage for excess rain water and high water tables during wet periods. These other groves tend to be located in the southern portions of the District.
- **Soils** - This land use type is typically found on well-drained sands.

## SIMILAR CLASSES

- 2130 Woodland Pasture - Active pecan groves may show evidence of cattle grazing but will not be coded as 2130 unless the grove is no longer active.

- 2210 Citrus Groves - Trees have more rounded crowns.
- 2240 Abandoned Groves - Groves will look unmanaged with underbrush, vines, and dead or dying trees.
- 2410 Tree Nurseries - Nurseries have smaller, tighter crowns-field verification may be necessary.
- 4410 Coniferous Pine - Characteristic pine signature.
- 4430 Forest Regeneration - Recently cleared areas with lines of piled up slash and debris.

## SPECIAL MAPPING CONVENTIONS

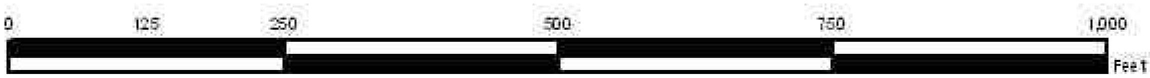
The mapping unit includes all associated offices, on-site marketing and processing facilities, permanent and temporary housing, warehouses, private air strips, farm roads and any other operational features. Any features not involved in the operation or not located within operational boundaries are not included.

Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/06/04

**COORDINATES**
399244.41 745246.06

# 2240
# Abandoned Groves

LEVEL 1: 2000 Agriculture
LEVEL 2: 2200 Tree Crops
**LEVEL 3: 2240 Abandoned Groves**

## DESCRIPTION

This classification is used to identify groves or orchards that are no longer being maintained and are basically out of production. Older abandoned groves show encroachment of other shrubs (Brazilian pepper and wax myrtle) and grasses in between the trees, and other species of shrubs and trees replacing stressed or dead trees.

## KEYS TO PHOTOINTERPRETATION

- Uniformly spaced rows of dead or dying trees give the appearance of a grid pattern.
- Significant understory will be visible.
- Groves appear unmanaged-dead trees, vine infestation, inconsistent spacing and irregular crown sizes.
- Tree canopy may become overgrown eliminating access needed for harvesting.

## CONTEXT

- **Landscape Position** - Abandoned groves are most likely to be found in agricultural areas transitioning to development. They may also be found in remote areas that were impacted by adverse climate or disease.
- **Soils** - Groves are typically found on well-drained sandy soils.

## SIMILAR CLASSES

- 2130 Woodland Pastures - Evidence of cattle grazing will be present.
- 2210 Citrus Groves - Crown sizes will appear consistent with no overgrowth of natural vegetation.
- 2230 Other Groves - Crown sizes will appear consistent with no overgrowth of natural vegetation.
- 3200 Shrub and Brushland - Natural shrubby vegetation is the dominant ground cover.
- 3300 Mixed Rangeland - Natural shrubby vegetation and grasslands are the dominant ground cover.

## SPECIAL MAPPING CONVENTIONS

This is a SFWMD modification to the FLUCCS system.

The 2240 Abandoned Grove class is used to indicate groves which have been abandoned and have returned to a naturally vegetated state. Many former grove areas have been cleared of their trees and have become maintained areas of Crops or Pasture and the appropriate 2000 Agriculture level III class should be used. These areas are often distinguishable by scars that appear as rows of dots where the trees were present. If trees have been removed and the area has not been replanted then 2610 Fallow Cropland should be used.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE


**COORDINATES**
747569.83 1099796.95 (Images)

## FIELD PICTURE

**DATE**
01/12/07

**COORDINATES**
852099.12 1124991.65 (Field Picture)

# 2300
# Feeding Operations

LEVEL 1: 2000 Agriculture
**LEVEL 2: 2300 Feeding Operations**

## DESCRIPTION

This Level 2 class should be used only for animal feeding operations that do not fall in to one of the two active subclasses of cattle or poultry feeding. The most common usage for this class is for swine production, which is not prevalent in the District at this time.

This class does not include facilities used to process livestock into consumer food products. These facilities, such as meat packing plants, are classified as 1500 Industrial.

Feeding operations are specialized livestock production enterprises. They have large animal populations restricted to relatively small areas, which results in a concentration of waste material that is an environmental concern. The attendant waste disposal and mitigation problems justify a separate category for these relatively small areas.

As with dairies, feeding operations may have a number of sub-components. If so, they are classified as follows:

- Central Buildings and Processing Facilities - LC 2300, LU 2300.
- Central, High-Intensity Pasture - LC 2300, LU 2300. (include with processing facility)
- Outlying Pasture - LC 2100s, LU 2100s.
- Treatment Ponds and Lagoons - LC 8360, LU 2300

## KEYS TO PHOTOINTERPRETATION

- Modern swine production facilities, if introduced, are large, industrial, indoor facilities rather than outdoor feedlots. Animals are not typically visible.
- Usually large, specialized livestock production areas with confined feeding.
- The concentration of livestock on small areas usually causes a severe impact to ground cover.
- Structures to shelter the animals and equipment are visible.
- Fences, access paths, and waste disposal ponds may be visible.

## CONTEXT

- **Landscape Position** - Some operations are located near urban areas to take advantage of proximity to transportation facilities and processing plants. However, environmental concerns usually dictate that these facilities be located a sufficient distance from residential areas.

## SIMILAR CLASSES

- 2520 Dairies - large buildings for shelter and/or milking apparent

## SPECIAL MAPPING CONVENTIONS

The 2300 Feeding Operations code applies to the buildings and adjacent high intensity areas which are an integral part of the feeding operation.

Related treatment ponds should be dual-coded. - e.g. 8360/2300.

Included within the 2300 polygon are all buildings, grounds, parking lots, storage areas and other related features.

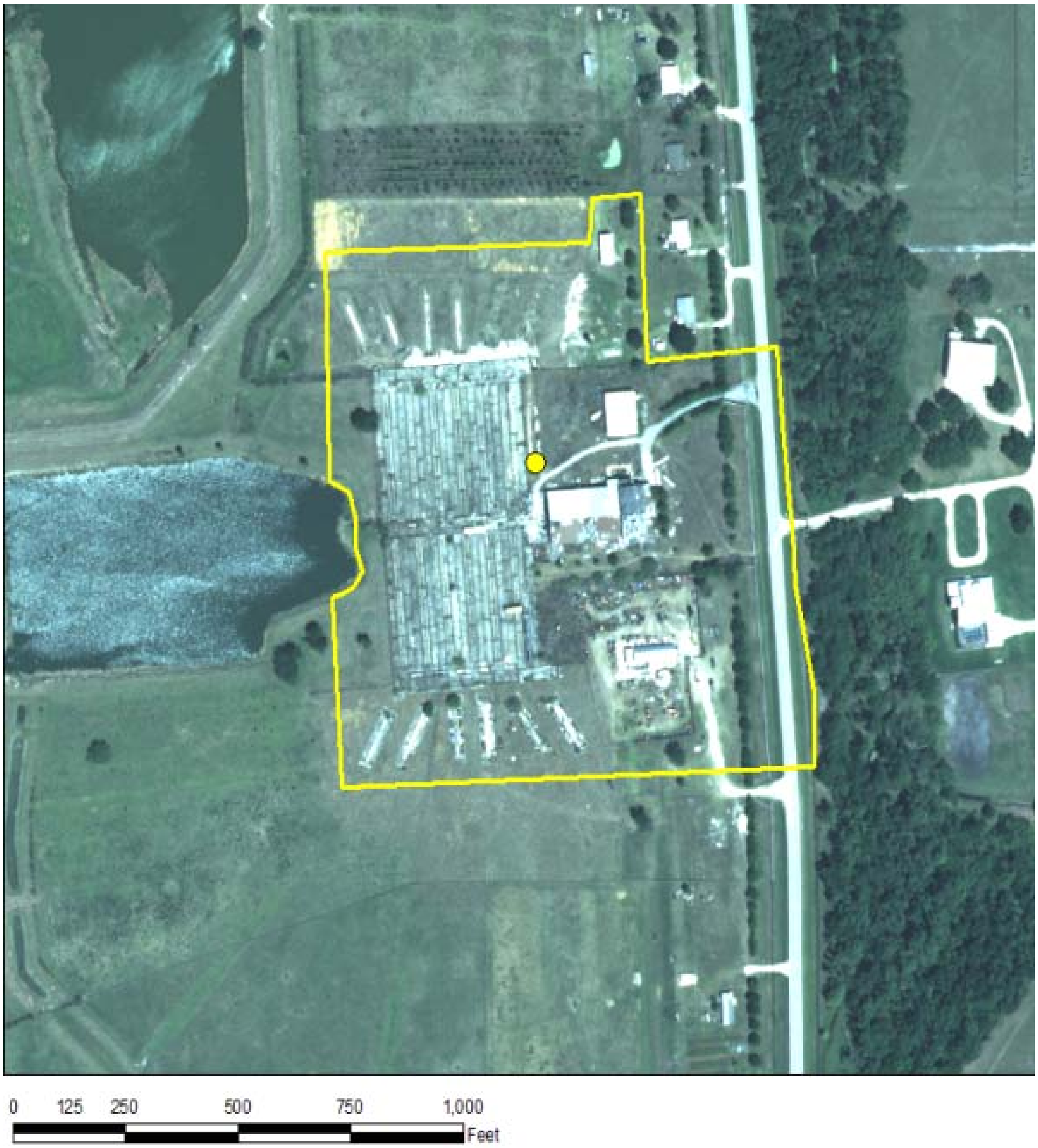
Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

## DUAL CODING CONVENTION

This is a **Land Use** class. A separate **Land Cover** code is only required as noted above.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



**COORDINATES**
755004.88    1037683.82 (Images)

## FIELD PICTURE

**DATE**
n/a

**COORDINATES**
n/a (Field Picture)

# 2310
# Cattle Feeding Operations

LEVEL 1: 2000 Agriculture
LEVEL 2: 2300 Feeding Operations
**LEVEL 3: 2310 Cattle Feeding Operations**

## DESCRIPTION

This class is for concentrated feedlot operations that produce accelerated growth of cattle prior to processing into food products. It is not for breeding, grazing or dairy operations, and it does not include facilities (meat packing plants) used to process the livestock into consumer food products.

Feeding operations are specialized, livestock production enterprises that are rare but highly significant wherever they do occur. They have large animal populations restricted to relatively small areas, which results in a concentration of waste material that is an environmental concern. The attendant waste disposal and mitigation problems justify a separate category for these relatively small areas.

The signature of this class is distinct - highly impacted ground cover around a core facility, with pronounced trails and ditches. In impacted areas the ground is wet, causing a characteristic dark color on CIR photos.

## KEYS TO PHOTOINTERPRETATION

- These are usually large, specialized livestock production areas with confined feeding.
- The concentration of livestock on small areas usually causes a severe impact to ground cover.
- Fences, heavily used trails, feeding troughs, shelters, and waste disposal features (treatment ponds, waste piles) may be visible.

## CONTEXT

- **Landscape Position** - Feedlots are rare, but highly significant in terms of water resources. Some operations are located near urban areas to take advantage of transportation facilities and processing plants. However, environmental concerns usually dictate a distance from residential areas.

## SIMILAR CLASSES

- 2110 Improved Pasture - Ground cover is not heavily impacted
- 2520 Dairies - Dairies may have concentrated feeding operations. Such areas are included as part of the dairy facility, and not delineated separately.

## SPECIAL MAPPING CONVENTIONS

## DUAL CODING CONVENTION

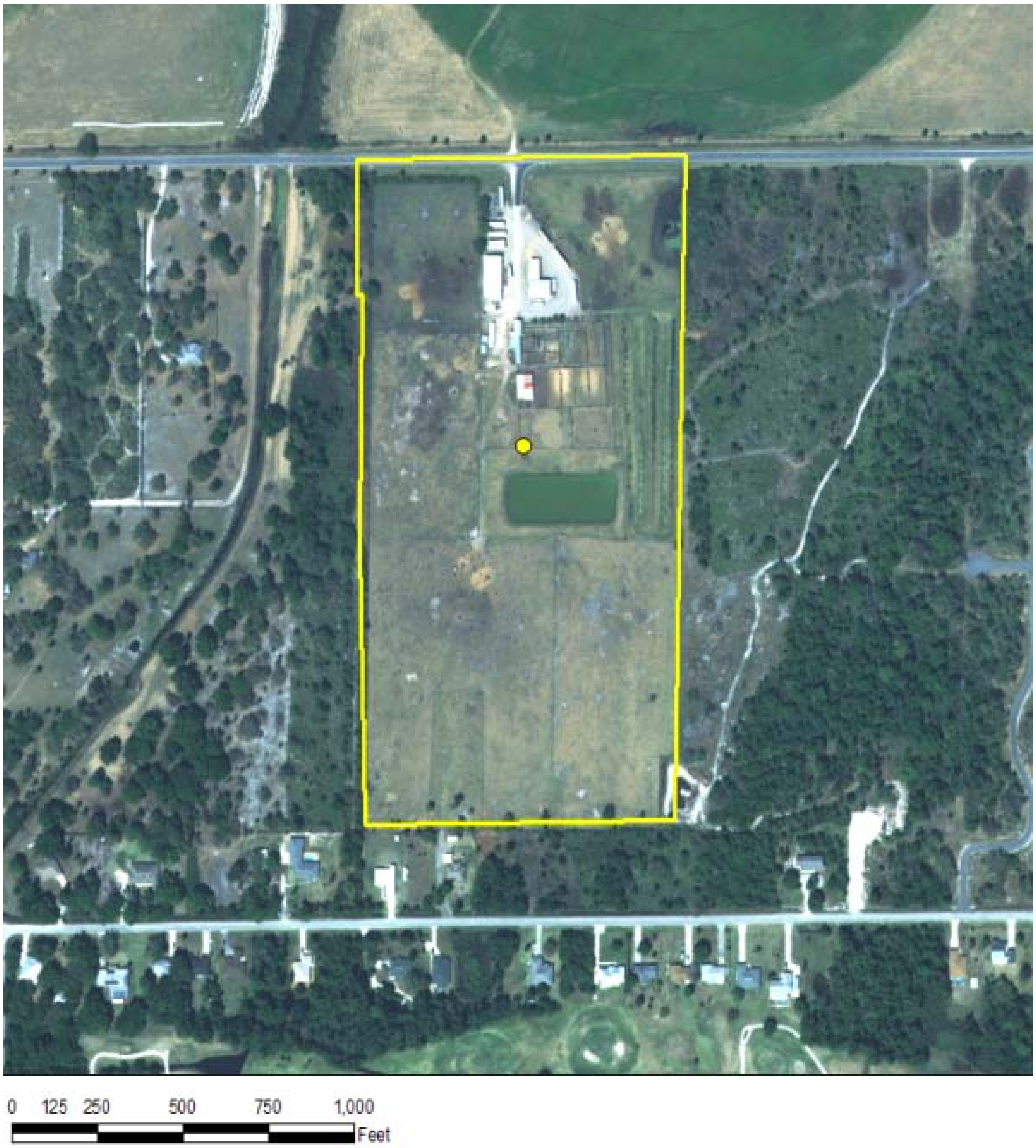
This is a **Land Use** class. A separate **Land Cover** code **may** be required, as described below.

- Central Buildings and Processing Facilities - LC 2310, LU 2310.
- Central, High-Intensity Pasture - LC 2310, LU 2310. (include with processing facility)

- Outlying Pasture - LC 2100s, LU 2100s.
- Other Treatment Ponds - LC 8360, LU 2310.

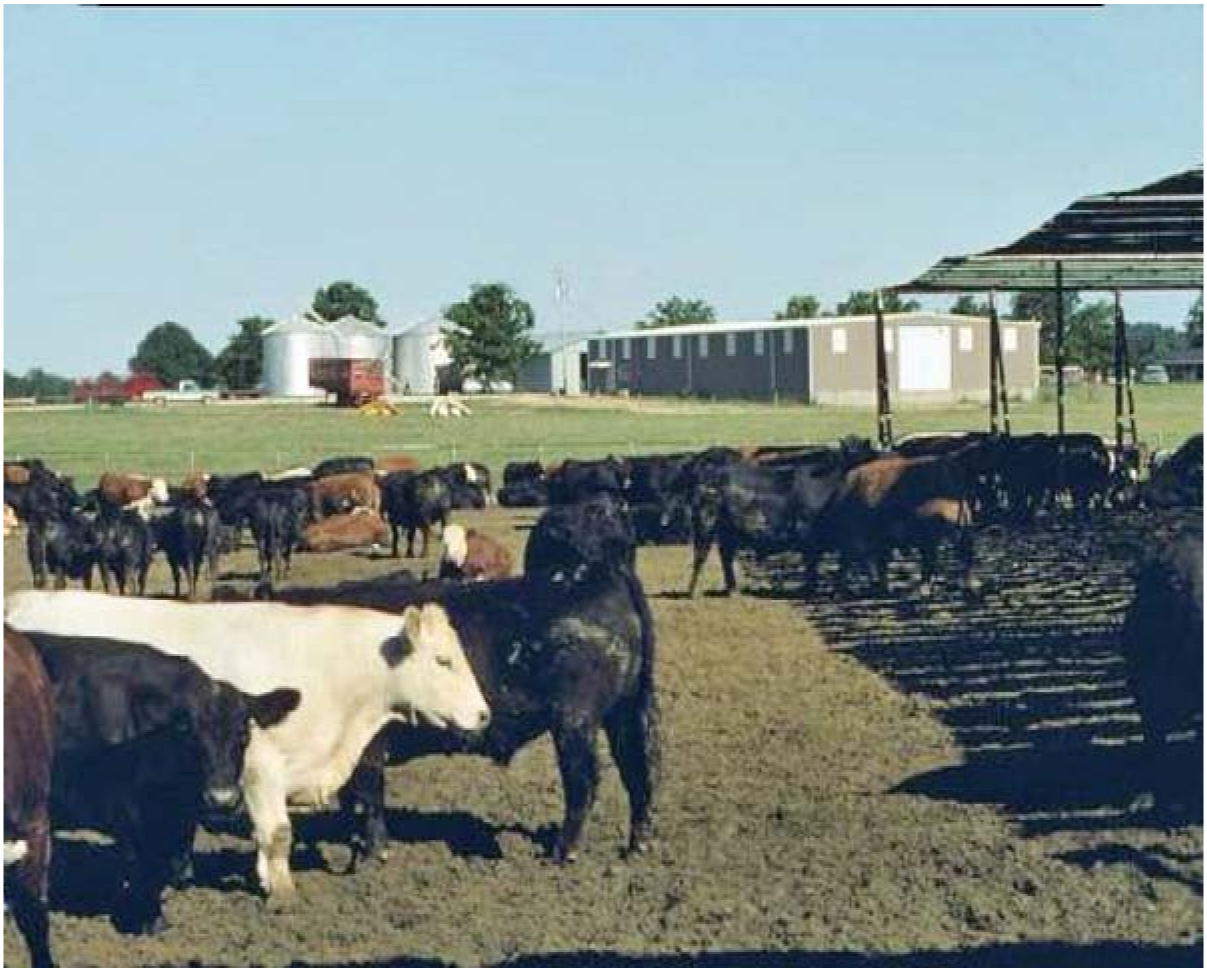
## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE




**COORDINATES**
713244.92 1105103.01 (Images)

## FIELD PICTURE



**DATE**
10/15/07

**COORDINATES**
665485.66 1110832.62 (Field Picture)

# 2320
# Poultry Feeding Operations

LEVEL 1: 2000 Agriculture
LEVEL 2: 2300 Feeding Operations
**LEVEL 3: 2320 Poultry Feeding Operations**

## DESCRIPTION

This class includes commercial facilities that raise chickens for human consumption. It does not include meat packing plants, which are classified as 1500 Industrial.

Poultry operations have a very distinctive appearance on aerial photos - very long, narrow, white buildings set in parallel, with relatively clean surrounding grounds. These are the opposite of cattle feedlots, which appear to be very impacted, and have a more "messy " appearance.

Poultry waste materials may be treated or spread on-site, or removed for outside uses such as fertilizer.

## KEYS TO PHOTOINTERPRETATION

- Long rectangular chicken coops are present.
- The surrounding area is relatively un-impacted.
- Small reservoirs may be seen adjacent to buildings, used for water supply and storm water and/or wastewater treatment.
- Fields around the facility may show varying degrees of enrichment (pinkish colors on CIR) due to waste spreading or wastewater irrigation activities.

## CONTEXT

- **Landscape Position** - Poultry operations are common in parts of the District, typically located in agricultural areas. They do not have waste mitigation issues to the degree that swine and cattle feeding operations do. However, odor and other environmental concerns usually require their being located a substantial distance from residential areas.

## SIMILAR CLASSES

- 2400 Nurseries and Vineyards - Greenhouses may resemble chicken coops. Context should be checked carefully. Other types of crop production may also have greenhouses.

## SPECIAL MAPPING CONVENTIONS

If there are sub-components to the operation, they are classified as follows:

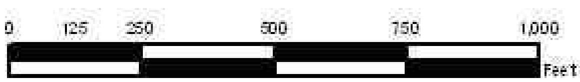
- Central Buildings and Processing Facilities - LC 2320, LU 2320
- Treatment Ponds - LC 8360, LU 2320

Included within the 2320 polygon are all buildings, grounds, storage areas and other features that are involved in the operation or within the operational boundary. Open lands adjacent to the facility are not coded 2320 unless there are indications of impacts from the poultry operation. Property boundaries are not expected to coincide with the 2320 mapping unit. Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

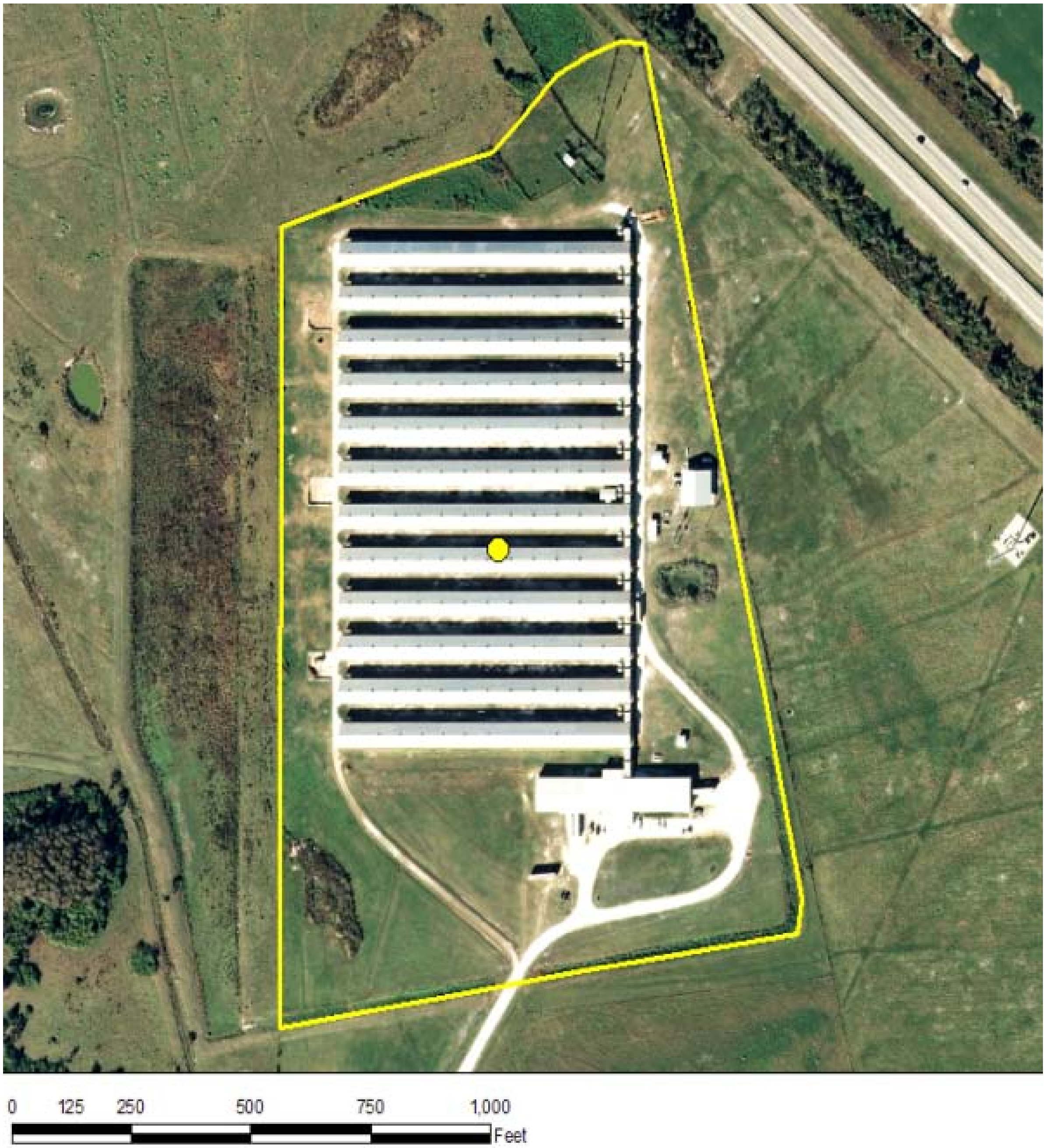
## DUAL CODING CONVENTION

This is a **Land Use** class. Dual coding is only required in the case of treatment ponds. (See above)

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
594478.55 1341820.74

# 2400
# Nurseries and Vineyards

LEVEL 1: 2000 Agriculture
**LEVEL 2: 2400 Nurseries and Vineyards**

## DESCRIPTION

This Level 2 class includes Nurseries and Vineyards that are not described by one of the three active subclasses. The subclasses are 2410 Tree Nurseries, 2420 Sod Farms and 2430 Ornamentals. The 2400 code is used for nurseries and vineyards whose purpose is other than tree production.

Some of the subclasses are very similar in both definition and appearance, and will be difficult to differentiate at farms that have a mixture of different uses. For example, one small retail nursery may grow ornamental trees, small ornamentals, ferns and flowers. In these cases the PI must try to determine the predominant use and code it accordingly. If the predominant use cannot be determined, then the general code 2400 may be used.

Greenhouses or nurseries that are attached and subsidiary to a larger farm operation of another type, such as row crops or citrus groves, are included in those land uses and not classified in the 2400 Nurseries and Vineyards class.

## KEYS TO PHOTOINTERPRETATION

- There are usually small plots focused around long narrow rows of greenhouses or long narrow rows of planted vines.
- There may be a number of different types of plants with various row widths.
- Typically have numerous short rows running perpendicular to longer rows
- These uses often found in areas of rich humus soils associated with rivers, wetlands and basin depressions.

## CONTEXT

- **Landscape Position** - Nurseries and vineyards may be associated with farm operations, forestry, landscaping or urban marketing operations. There are, in general, few environmental concerns or nuisance factors and they can be located almost anywhere. Sizes range from tiny plots to very large commercial operations.
- **Vegetation** - N/A
- **Soils** - N/A
- **Hydrology** - N/A

## SIMILAR CLASSES

2200 Tree Crops - Nurseries have multiple varieties, giving a less uniform appearance. Vineyards have a closer spacing and individual plants are not visible.

## SPECIAL MAPPING CONVENTIONS

This Level 2 classification code is used primarily for vineyards.

The mapping unit includes greenhouses, offices, residential buildings, parking areas, farm roads and any other operational features. Only features that are involved in the enterprise or within the operational boundary are included. Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
08/15/06

**COORDINATES**
769399.12  902734.41

# 2410
# Tree Nurseries

LEVEL 1: 2000 Agriculture
LEVEL 2: 2400 Nurseries and Vineyards
**LEVEL 3: 2410 Tree Nurseries**

## DESCRIPTION

This class includes nurseries which grow trees for transfer to other destinations. There may be other products grown at the facility, such as flowers and ornamentals, but they are not the predominant use. Trees may be grown in-ground or in containers.

Most tree nurseries are for ornamental trees used for landscaping. These trees can range from small potted plants to large specimens, and many varieties are typically present. Also included are timber nurseries, which have plants that appear small and uniform on the photography.

## KEYS TO PHOTOINTERPRETATION

- Trees are in rows similar to citrus groves, but there are many different types of trees with varying shaped crowns, texture and color. Some areas may be under artificial shading.
- Sizes range from tiny plots to very large commercial operations.
- Greenhouses and equipment storage areas are often present.

## CONTEXT

- **Landscape Position** - Nurseries may be associated with tree crops, forestry, landscaping or retail operations. They do not present environmental or nuisance concerns and can be located almost anywhere within the District.

## SIMILAR CLASSES

- 2200 Tree Crops - Trees tend to be mature and uniform, over large areas.
- 2430 Ornamentals - 2430 is used for smaller ornamentals, such as container grown plants.
- 4400 Tree Plantations and 4410 Coniferous Pine - These may contain nurseries, but the acreage is mostly in permanent plantation.
- 4430 Forest Regeneration - Trees are small but permanent, not for transplant.

## SPECIAL MAPPING CONVENTIONS

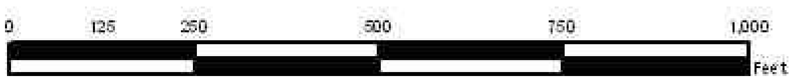
This class includes timber nurseries, which is a modification of the FLUCCS system. (In the FLUCCS system, timber nurseries are classified with the code 2460.)

The mapping unit includes greenhouses, offices, residential buildings, parking areas, and any other features involved in the enterprise or within the operational boundary. Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

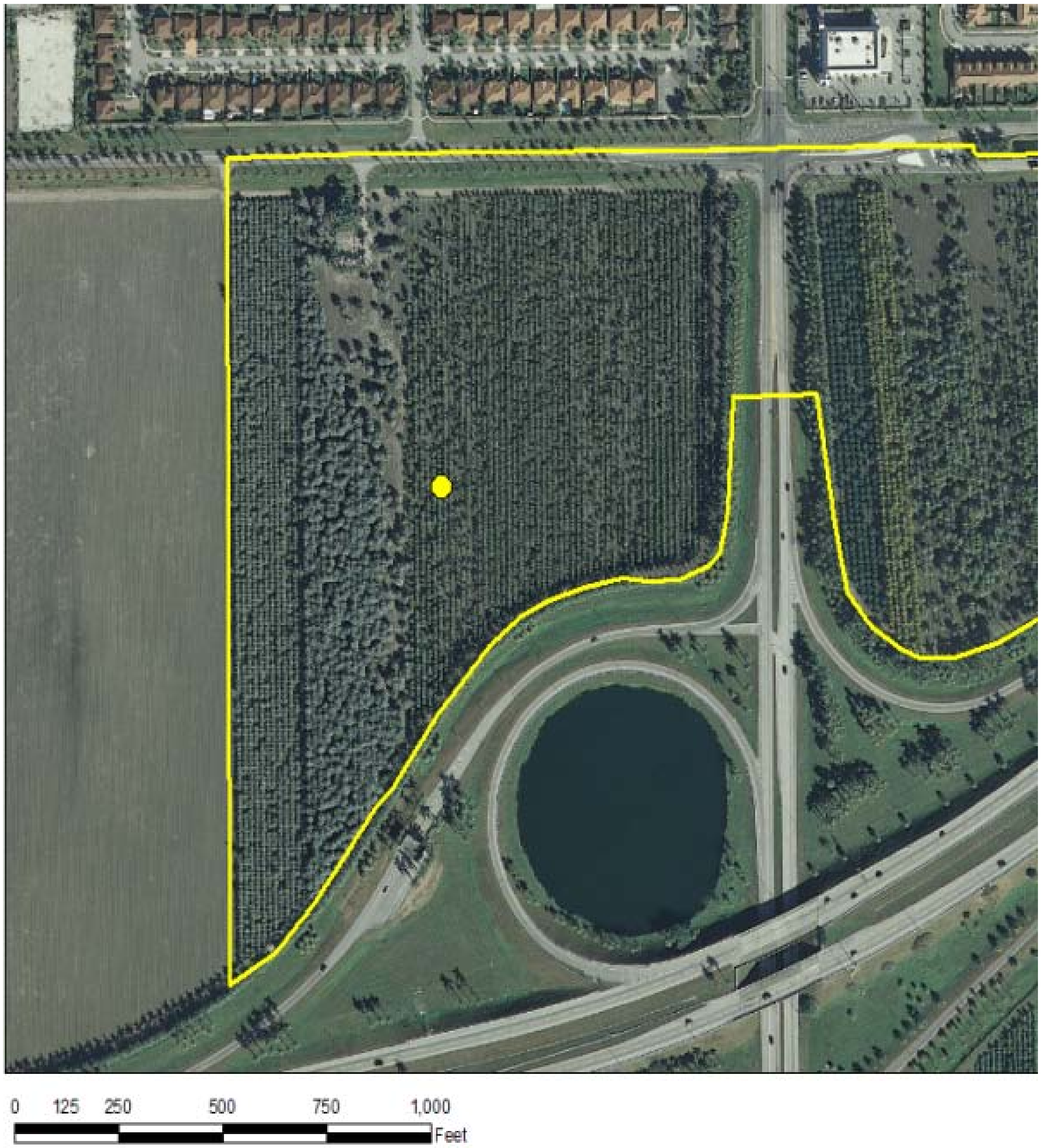
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
07/19/06

**COORDINATES**
862416.60 437247.82

# 2420
# Sod Farms

LEVEL 1: 2000 Agriculture
LEVEL 2: 2400 Nurseries and Vineyards
**LEVEL 3: 2420 Sod Farms**

## DESCRIPTION

This class describes sod (turf) farms. They are usually large, intensively managed areas of short, uniform turf. The crop requires extensive fertilization and machinery, indicated by the presence of buildings, tanks and storage areas.

Irrigation canals are usually present around the fields with the smaller irrigation/drainage ditches in between smaller blocks or fields of sod. These fields produce a very manicured look much the same as lawns without the landscaping shrubbery. Intensive management is apparent with small roads and maintenance and storage sheds for equipment and chemicals (fertilizers, herbicides and pesticides).

Harvested fields will either show as bare soil (light greenish or whitish color) or as intermixed narrow strips of bare soil and magenta or pinkish on CIR from the strips of sod left to grow the next crop. The strip harvest method is not commonly used in commercial sod fields, but may be observed in pastures which have been leased or sold for sod production.

Sod farms have signatures similar to well-manicured pastures, hay crops or urban lawns. Some pastures may be leased for sod production; these should be classified as 2420 Sod Farms if sod production appears to be the predominant use.

Sod farms are a priority class because, like golf courses, they use high rates of fertilizers and other chemicals that can migrate to ground or surface waters. Prolonged use as sod farms can also deplete surface soils.

## KEYS TO PHOTOINTERPRETATION

- Growing turf has an even green natural color signature (bright red on CIR).
- Areas may be patchy, rectangular and in different stages of growth.
- Ponds may be used for irrigation and irrigation patterns may be evident as circles or blocks of uniform signature.
- Irrigation and drainage canals and ditches are usually present, with smaller ditches in between fields or blocks of sod, to insure proper moisture conditions.
- Features such as cattle, hay bales, silos, etc. will not be present. Trees and shrubs are not present in the sod fields.
- Harvested areas appear as long strips or rectangular patches of bare soil in random locations.

## CONTEXT

- **Landscape Position** - This land use may occur anywhere within the project area but typically would be expected to occupy areas between urban development and remote agricultural lands so as to take advantage of readily available labor pools and distribution/marketing facilities.
- **Soils** - Sod farms require well-drained soils with uniform, controlled moisture conditions and fertilization for healthy growth.

## SIMILAR CLASSES

- 2110 Improved Pastures - Evidence of grazing will be present.
- 2150 Field Crops - Hay bales may be visible.

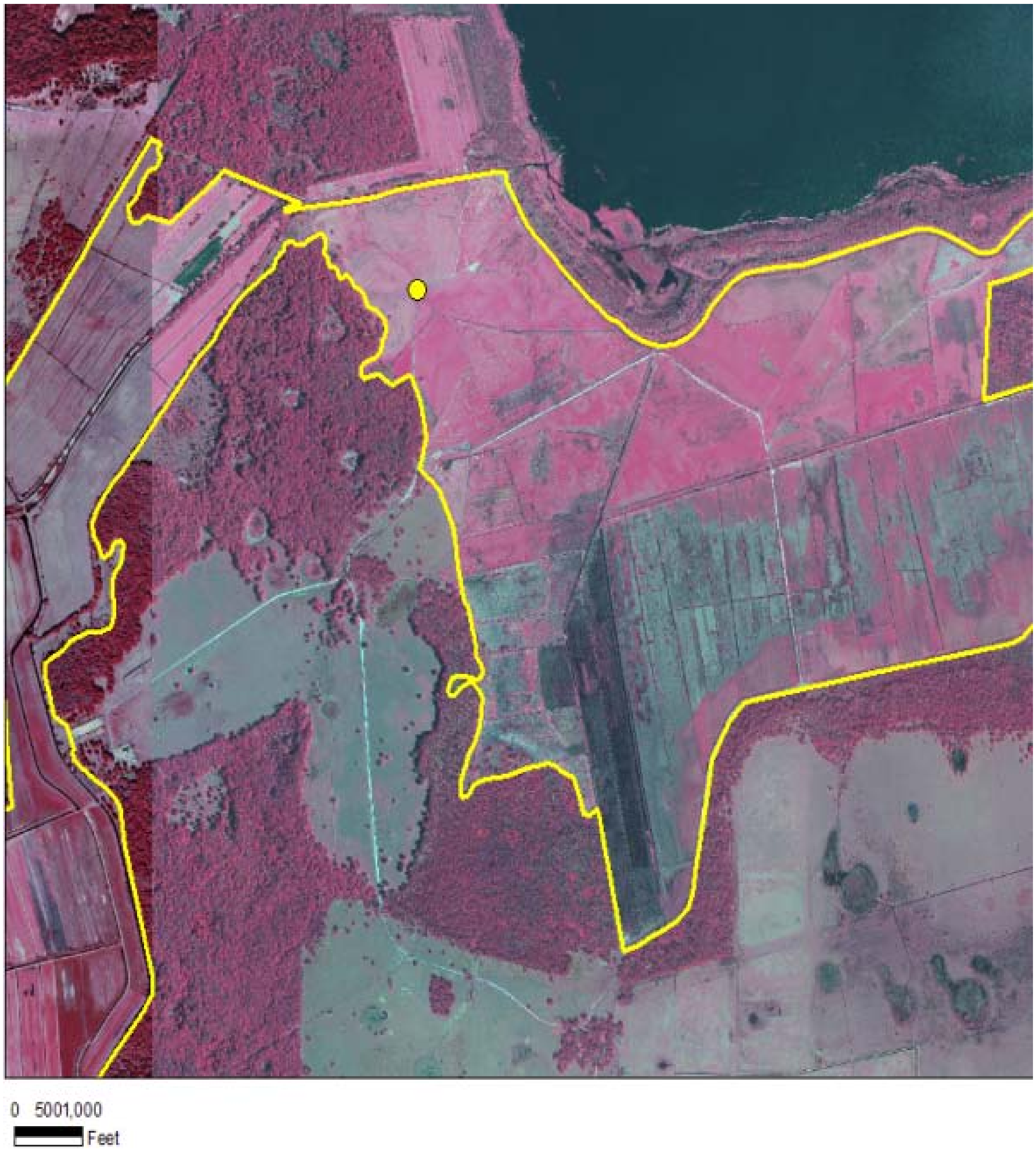
## SPECIAL MAPPING CONVENTIONS

The mapping unit includes offices, storage areas for equipment and materials, and any other features involved in the enterprise or within the operational boundary. Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

**COORDINATES**
518491.45 1332454.52 (Images)

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
507587.04  1416386.01 (Field Picture)

# 2430
# Ornamentals

LEVEL 1: 2000 Agriculture
LEVEL 2: 2400 Nurseries and Vineyards
**LEVEL 3: 2430 Ornamentals**

## DESCRIPTION

This class describes facilities that raise ornamental plants for off-site use. It does not include ornamental trees, which are classified as 2410 Tree Nurseries.

The signature is similar to 2410 Tree Nurseries, with rows of varying height, spacing, size and color tones producing a mottled texture on the photography. Plants are grown in containers arranged in different patterns of strips, blocks or rows. They may also be grown under black shade cloth or in greenhouses. Inclusions of other products, such as trees and flowers, may be present, but the predominant use is for ornamentals and the most common method is in containers, in rows, outdoors.

## KEYS TO PHOTOINTERPRETATION

- Plants are arranged in linear or rectangular patterns.
- Shade cloth may be used for artificial shading, appearing as rectangular areas with black returns similar to water. Black plastic may also be used for ground cover to control weeds.
- Row spacing is wider than row crops and narrower than tree crops or citrus.

## CONTEXT

- **Landscape Position** - Ornamental nurseries may be associated with other types of agriculture, tree crops, landscaping or retail operations. Combined production/retail operations in urban and suburban areas are common. Ornamental nurseries tend to be smaller in size than other agribusiness operations, but can be extensive, as shown in the image below. They do not present environmental or nuisance concerns in general and can be located almost anywhere within the District, most commonly near other agricultural areas or on the outer fringes of developed areas.

## SIMILAR CLASSES

- 2140 Row Crops - Management is less intensive; greenhouses, artificial shading, and other features are not prevalent.
- 2410 Tree Nurseries - Rows are wider and tree crowns are evident.
- 5300 Reservoirs - Shade cloth and ground covers can present a black return similar to water.

## SPECIAL MAPPING CONVENTIONS

The mapping unit includes greenhouses, offices, residential buildings, parking areas, and any other features involved in the enterprise or within the operational boundary. Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/03/07

**COORDINATES**
493542.29  1520335.61

# 2500
# Specialty Farms

LEVEL 1: 2000 Agriculture
**LEVEL 2: 2500 Specialty Farms**

## DESCRIPTION

This class describes operations that maintain animals and does not include pasture or feedlot operations. In the SFWMD classification system, 2500 is an active, general class that includes any specialty farms that are not described in one of three active subclasses - 2510 Horse Farms, 2520 Dairies or 2540 Aquaculture. Examples of this class are dog kennels, ostrich, llama, or buffalo farms, tropical fish farms and captive breeding programs. The 2500 class is considered an Agricultural class and does not include 1800 Recreational or 1700 Institutional facilities which may raise animals.

## KEYS TO PHOTOINTERPRETATION

- This class covers a large range of diverse activities - no indicators will apply precisely to all classes. Supplemental data is usually needed to recognize these uses.
- Operations are specialized for the production or breeding of show animals or specialty foods.
- Structures and acreage requirements will vary depending on operation.
- Operations are usually fenced and may contain groupings of small agricultural structures.
- The caretaker or owner dwelling is usually on premises as these tend to require a great deal of specialized attention.

## CONTEXT

- **Landscape Position** - Specialty farms can occur anywhere, but are more common in rural areas where open space, farm labor and privacy are available.

## SIMILAR CLASSES

- 1100 Residential, Low Density and 1180 Rural Residential - If rural residences operate a specialty farm on site they should be coded 2500.
- 1850 Parks and Zoos - Animal exhibits or research are usually in urban or urban fringe areas.
- 2300 Feeding Operations - These will usually have more visible impacts.
- 2430 Ornamentals - Evidence of horticulture should be visible.

## SPECIAL MAPPING CONVENTIONS

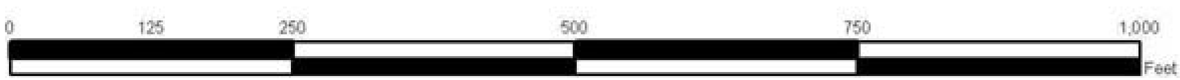
Included within the 2500 polygon are all buildings, grounds, cages, residences and other related features. The operational boundaries may not be the same as property boundaries.

Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
N/A

**COORDINATES**
376234.20 869407.90

# 2510
# Horse Farms

LEVEL 1: 2000 Agriculture
LEVEL 2: 2500 Specialty Farms
**LEVEL 3: 2510 Horse Farms**

## DESCRIPTION

This category defines farms which stable, breed and train horses for a variety of purposes. The purposes may include private or commercial use or for sporting uses such as hunting, exhibition, racing, riding and harness racing.

Horse farms are characterized by a grouping of buildings in a rural area surrounded by pasture, often having an oval or circular dirt "race" track for training of the horses. Small arenas which have hurdles or fences for training of jumping horses may also be present. These arenas may be covered with dirt or grass. Key features identifying this land use category would be improved (or "intensively managed" unimproved) pastures close to the main buildings, small pastures or holding areas near main buildings and the presence of long barns or stables capable of housing the horses.

This class does not include commercial stables set up just for riding, which should be assigned to the 1800 Recreational class. Riding stables are in urban areas and lack the extensive pastures, barns, fencing and other features of a farm. Where horses are clearly present, and the proper code is not apparent, the area should be classified as 2510.

Horse farms may be confused with other pastures, especially where a cattle operation may also have some horses and riding track present. In such cases one of the pasture categories (2110 to 2130) is preferable.

## KEYS TO PHOTOINTERPRETATION

- Extensive pasture areas are present, which may be mowed or cultivated for hay and other support crops. Pastures are usually well maintained.
- Barns or stalls for horses are present. Other buildings may include offices and residences.
- Stock ponds, tanks or feeding troughs may be visible.
- Track, training/exercise areas, pools, double fences are visible. Training areas may be large oval tracks or small circular facilities

## CONTEXT

- **Landscape Position** - Horse farms occur in an agricultural context or at the fringes of urban areas. They are found in rural areas of the District and are often adjacent to a paved road or at the end of a dirt road leading to the headquarters area from a paved road.

## SIMILAR CLASSES

- 1830 Race Tracks - Horse race tracks have extensive parking and stadium seating.
- 2110, 2120, 2130 - Pastures - Normally lack training facilities
- 2520 Dairies - Dairies have a variety of other indicators.

## SPECIAL MAPPING CONVENTIONS

Where horses are clearly present and there is doubt about which code to use, the PI should choose 2510 Horse Farms instead of 1800 Recreational.

Included within the 2510 polygon are all buildings, grounds, parking lots, recreational areas, and other related features. Adjacent areas that are not involved in the horse farm operation are not included. The boundaries of the horse farm may not be the same as property boundaries. Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE


**COORDINATES**
558539.67 1459499.10 (Images)

## FIELD PICTURE

**DATE**
10/16/07

**COORDINATES**
445774.93  703732.76 (Field Picture)

# 2520
# Dairies

LEVEL 1: 2000 Agriculture
LEVEL 2: 2500 Specialty Farms
**LEVEL 3: 2520 Dairies**

## DESCRIPTION

Dairies are commercial operations that produce, process and distribute milk and other dairy products. **Dairies have a number of sub-components that must be broken out separately.** These include the central barns and processing facilities, with associated high-use pasture, outlying pastures and dairy lagoons. All of these components are coded differently if they meet size criteria.

Solid waste facilities, including manure piles, may also be found within the operational boundaries of a dairy; however, they are not delineated separately, but are included in the 2520 polygon.

This land use is very similar in appearance to a Horse Farm except that there tends to be more barns and the barns tend to be longer. Additionally, the holding pens near the barns have more paths worn in them from an increased number of animals and definite trails lead to and from the barns. An oval or circular track will not be present in this land use. As with Horse Farms, only the headquarters, workers residences, barns/maintenance facilities, holding pens and immediately adjacent pastures should be included in this category. Out pastures, almost always improved, should be included in the appropriate pasture land use category.

Dairy sub-components are classified as follows:

- Central Barns, Processing Facilities - LC 2520, LU 2520
- Central, High-Intensity Pasture - LC 2520, LU 2520 (include with processing facility)
- Outlying Pasture - LC 2100s, LU 2100s
- Other Treatment Ponds - LC 8360, LU 2520

## KEYS TO PHOTOINTERPRETATION

- Facilities appear to be intensively managed. To maximize production, dairies maintain a high concentration of animals and equipment in a small area.
- Feed silos are typically present.
- Large buildings for shelter and/or milking are present.
- Dairies are always surrounded by areas of pasture.
- Cattle tracks may be visible, especially leading to barns.
- Manure piles and storage areas for feed, straw and other materials are present.

## CONTEXT

- **Landscape Position** - Dairies are found in rural areas of the District, usually located in agricultural areas to take advantage of open lands and minimize conflicts with adjacent land uses.

## SIMILAR CLASSES

- 2100 Pasture and Cropland - Will not have the large buildings and intensive management of dairies.
- 2310 Cattle Feeding Operations - Feed lots are even more intensive and show significant surface impact.
- 2510 Horse Farms - Cleaner, more uniform, less intense and less industrial appearance. Presence of riding/training facilities, such as oval tracks.

## SPECIAL MAPPING CONVENTIONS

The 2520 code applies to the buildings and adjacent high intensity areas which are an integral part of the managed enterprise. Related treatment ponds should be dual coded - e.g. 8360/2520.

Included within the 2520 polygon are all buildings, grounds, parking lots, storage areas and other related features. The boundaries of the dairy operation as apparent on the aerial photography may not coincide with its actual property boundaries.

Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

## DUAL CODING CONVENTION

This is a **Land Use** class. Dual coding is only required in the case of treatment ponds and lagoons. (See above)

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE


**DATE**
03/14/07

**COORDINATES**
756025.30 1060019.14

# 2540
# Aquaculture

LEVEL 1: 2000 Agriculture
LEVEL 2: 2500 Specialty Farms
**LEVEL 3: 2540 Aquaculture**

## DESCRIPTION

This class includes facilities that raise marine or aquatic plant and animal species under natural or artificial conditions for human and animal consumption. The operations may be very large and organized or small and informal. They tend to be easy to recognize, as a series of small ponds near each other, with peripheral structures and equipment on-site.

## KEYS TO PHOTOINTERPRETATION

- Aquaculture sites have a series of small, usually rectangular, excavated ponds, typically arranged in a parallel or rectangular pattern.
- Color tones are black unless shallow aquatic vegetation is present, which produces pink and reddish overtones on CIR and green on natural color to the water signature.
- Associated structures, reservoirs and drainage features are likely to be present.

## CONTEXT

- **Landscape Position** - Aquaculture sites are located where a sufficient water supply is available by way of a shallow water table, surface water or ground water source and effluent options are available. They are typically found in rural areas where site conditions, labor and other factors are favorable.

## SIMILAR CLASSES

- 5300 Reservoirs - These must be 2 acres to be mapped. Aquaculture ponds are typically smaller and exist in series.
- 8360/8340 Other Treatment Ponds/Wastewater Treatment Facilites - Rapid infiltration beds may look similar to aquaculture, but are only partially wetted and are more spread out.

## SPECIAL MAPPING CONVENTIONS

The mapping unit includes buildings, storage areas, drainage ditches and any other features involved in the enterprise or within the operational boundary. Priority classes such as water bodies and wetlands are always broken out if they meet their minimum size criteria of 2 acres.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE


**COORDINATES**
499626.68 993367.64 (Images)

**FIELD PICTURE**


**DATE**
01/17/07

**COORDINATES**
664696.18 776869.97 (Field Picture)

# 2600
# Other Open Lands - Rural

This Level 2 class is not used in the map itself - the only Other Open Lands class used is the Level 4 subclass:

2610 Fallow Cropland

## BACKGROUND

This class includes those agricultural lands whose intended usage cannot be determined. It includes fallow cropland, lands on the urban fringe that may be in the process of transition, but show no positive identifying features. It also includes dead or deserted crops.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit for all open land classes is 5 acres.

**Differentiating subclasses:** The only subclass used is the Level 4 class - 2610 Fallow Cropland

## DUAL CODING CONVENTION

All of the 2600 classes are **Land Use** classes. **A separate Land Cover code is always required.**

## SIMILAR CLASSES

Other Open Land can be confused with a number of different classes. These include 1180 Rural Residential, 1900 Open Land, 3000 Upland Non-Forested and 4400 Tree Plantations. Agricultural land that is temporarily flooded can be confused with water bodies or wetlands. Such areas should be classified as Agricultural if it is clear that it is an active agricultural area.

### For more information:

See the PI key for 2610 Fallow Cropland for more details and graphic examples.

# 2610
# Fallow Cropland

LEVEL 1: 2000 Agriculture
LEVEL 2: 2600 Other Open Lands - Rural
**LEVEL 3: 2610 Fallow Cropland**

## DESCRIPTION

This class includes agricultural land that is normally harvested, but has been taken out of the normal crop rotation. It does not include farmland that is temporarily unvegetated as part of the normal rotation, such as during the period of soil preparation prior to re-planting. This code is used for fallow crops or any other agricultural use types where the original crops have been removed. If citrus or other tree crops are present then 2240 Abandoned Groves should be used.

Fields do not have to be abandoned and the entire operation in disuse for this type to be present, however. Portions of an otherwise active agricultural operation may be lying fallow and fit within this category. Boundaries will generally be distinct and rectangular. Farmers usually try to maximize production by maintaining a tight rotation schedule, assisted by the use of synthetic fertilizers and irrigation. In the past, lands were kept fallow as a way to allow the soil to rest and rebuild, but now it is a less frequent practice that usually indicates some difficulty, transition or change of plans.

## KEYS TO PHOTOINTERPRETATION

- The former cropland is out of the normal annual rotation cycle - generally out of production for more than one year, and old rows may still be visible.
- Signatures range from the magenta or light pinkish color of low herbaceous vegetation to the dark magenta to bright to bright pink or red of medium height shrubs and trees (on CIR).
- Newer fallow cropland will have a smooth texture. The longer it is out of production the more irregular and shrubby its appearance.
- The presence of an ditch pattern between fields and the advanced condition of colonization by native vegetation in the absence of intensive land management necessary to produce crops will be readily visible.
- Abandoned farm buildings and un-maintained roads and irrigation systems.
- Fence lines may still be visible.
- Fallow land may include land set aside for cover crops - growing vegetation that will not be harvested, such as weeds or other non woody vegetation.

## CONTEXT

- **Landscape Position** - This class is only used for fields that are in an area normally used for harvested crops. Most adjacent fields and properties should be in normal rotation, unless for some reason the whole area is temporarily affected. Context is critical, because fallow fields could easily be confused with many other classes if only signature is considered. Fallow cropland may be found throughout the project area in rural settings.
- **Vegetation** - Low, herbaceous vegetation, with a possible scattering of shrubs.
- **Soils** - Fallow fields may be found on any upland soil type within the project limits, but will most often be present on well drained sands with low fertility.
- **Hydrology** - Variable depending on the disrepair of the irrigation/drainage system.

## SIMILAR CLASSES

- 2120 Unimproved Pasture - Tends to have a more shrubby and irregular signature
- 2140 Row Crops - Straight rows visible
- 2150 Field Crops - Mow lines and hay often visible
- 3000 Upland Non-Forested classes - Very little indication of management

## SPECIAL MAPPING CONVENTIONS

**NONE**

## DUAL CODING CONVENTION

This is a **Land Use** class. **A separate Land Cover code is always required.**

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE


**COORDINATES**
53263.58 690636.11 (Images)

## FIELD PICTURE

**DATE**
07/19/06

**COORDINATES**
864442.05 442904.85 (Field Picture)

# 3000
# Upland Non-Forested

This Level 1 class is not used in the map itself - a more specific subclass must be selected. The Level 2 subclasses are:

3100 Herbaceous
3200 Shrub and Brushland
3300 Mixed

For details on each, see their respective PI Key pages.

This SFWMD class is a departure from the original FLUCCS system. The class has been renamed from 'Rangeland' to 'Upland Non-Forested' to better describe land cover in open upland landscapes. However, while the name is different, the usage does not vary significantly from statewide practice. It is simply intended to be a more accurate description and expands the class to include open upland areas that do not fit the rangeland definition, such as open urban areas. More explanation of the changes follows.

## BACKGROUND

The historic meaning of 'Rangeland' comes from a national USDA definition, referring to natural plant cover composed of principally native grasses, forbs and shrubs that are valuable for forage. In Florida, such lands were frequently found at the margins of marshes and therefore characterized as transitional between uplands and wetlands. While they may be adjacent to wetlands and occasionally inundated, the 3000 classes never include wetland areas. It is the intent of the District to make a clear differentiation between uplands and wetlands. Any areas that meet wetlands definitions must be coded in the 6000 Wetlands class.

In the FLUCCS system, Rangeland had the following general characteristics:

- Capable of being grazed by cattle (although there may be no clear indications on photo).
- Management practices include brush control, regulation of grazing intensity and season of use.
- Predominantly native vegetation. If re-vegetated, it is managed like native vegetation.
- The land is not fertilized, cultivated or irrigated. It may be cut for hay or other purposes.

The above meaning still applies in the SFWMD system. There are many areas that are typical rangeland. However, there are also open, non-forested uplands in both rural and urban landscapes that do not fit the traditional definition or any other class. Rangeland was the most similar class to such areas, so they were usually mapped in the 3000s. Such landscapes are diverse in nature and may have any of the following characteristics:

- Land cover and/or use may be transitional and future use not evident.
- Prior use may have been agriculture, citrus, silviculture, mining or wetlands and is frequently not discernible from the aerial photo alone.
- Vegetation within the polygon is diverse in type, texture and pattern.
- The shape of the polygon is irregular, giving a natural appearance.
- Management is of very low intensity, but too low to qualify as unimproved pasture or hay crop.
- Clear indication of cattle is lacking. The presence or absence of cattle cannot be concluded.

Two FLUCCS codes that were historically used to classify such areas are 1900 Open Land and 2600 Other Open Land - Rural. These were catch-all categories for areas that were in transition or of indeterminate use or cover. Such attributes do not give a clear enough description of the polygon. Most importantly, they do not describe vegetation. Also, the fact that land use (vs. cover) is transitional or cannot be determined is not a useful definition. Rather, it is the case for much of the District, especially the "natural" areas. In the new system, the class 2600 is an inactive class; 1900 is still used to signify open lands in an urban context, but always in conjunction with a land cover code - generally from the 3000 Upland Non-Forested classes.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit (MMU) for differentiating between Level 2 classes **within** the 3000 series and **adjacent to each other** is 5 acres (i.e. 3100 vs. 3200 vs. 3300). This allows aggregation in order to conform to general mapping practice and to avoid unnecessary linework in areas that are very similar, intermixed, transitional or difficult to break out into distinct sub-areas.

**Differentiating subclasses:** The subclasses 3100, 3200, and 3300 are based on the proportions of herbaceous vs. shrub vegetation and the presence of trees. In general, if the vegetation is herbaceous over 67% of the area or more, then 3100 is used. If more than 67% of the area is composed of shrubs then it is classed as 3200. If there is a mixture and neither reaches 67% dominance, then the class 3300 is used. The herbaceous or shrub component may have up to 25% trees. If there are inclusions of solid forest patches within the polygon, then the proportion of herbs vs. shrubs applies to the remaining area.

## DUAL CODING CONVENTION

For most of the Upland Non-Forested classes, the **Land Cover** and **Land Use** codes are the same. However, there are many cases where they are different. These include land uses such as 1180 Rural Residential, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land, 1900 Open Land and 1920 Inactive Land with Street Pattern, which are land uses requiring a separate **Land Cover** code, which most often comes from the 3000 classes.

## SIMILAR CLASSES

2120 Unimproved Pasture or 2130 Woodland Pasture are used where livestock grazing is evident. Upland Non-Forested classes are commonly used to indicate citrus groves which have been abandoned for long periods of time (more than six years), have less than 50% citrus trees standing within the original grove and have returned to a naturally vegetated state.

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

# 3100
# Herbaceous (Dry Prairie)

LEVEL 1: 3000 Upland Non-Forested
**LEVEL 2: 3100 Herbaceous (Dry Prairie)**

## DESCRIPTION

This is one of three land cover classes used for upland non-agricultural, non-forested lands which exhibit no evidence of cattle grazing. 3100 Herbaceous (Dry Prairie) is used for areas that have over 67% herbaceous cover, not counting any forested inclusions, which may be up to 25% of the area. This class may be used with a separate land use code, such as 1180 Rural Residential or 1900 Open Lands or it may be used for both LCCODE and LUCODE when no other mapped land use code applies.

This class includes prairie grasses which occur on the upland margins of the wetland zone and inundation by water is infrequent. Generally, it is the marginal area between marsh and upland forested areas. These grasslands are generally treeless but in wet areas would have many types of soils resulting in a variety of vegetation types dominated by grasses, sedges, rushes and other herbs while dryer grass areas would be dominated by wire grasses with some saw palmetto present.

## KEYS TO PHOTOINTERPRETATION

- Sixty-seven percent or more herbaceous cover is present, not including forest patches. The cover may be naturally occurring grassland or an introduced mixture of species, depending on land use.
- Scattered shrubs and trees may be present. Forest patches cover less than 25% of total area and scattered trees cover less than 25% of the herbaceous area.
- Usually shows fine texture with smooth and mottled tones, unlike the smooth textures and uniform tones of planted or improved grassland.
- This class may be in a transition zone between forested and herbaceous communities, or in re-vegetated areas that have been disturbed.
- This class includes unimproved rural land or open urban areas that do not fit any other land use in the classification system.
- This class usually has natural shapes, follows landforms and frequently transitions to forested or brush communities.
- The land is typically not fertilized, cultivated or irrigated. Brush control or hay cutting may be practiced.

## CONTEXT

- **Landscape Position** - This land cover type typically occurs in broad flat expanses in central portions of the state and is geographically concentrated in two main areas of the project limits; the Kissimmee River valley (north and west of Lake Okeechobee) and in a corridor along Fisheating Creek from the western shore of Lake Okeechobee west-northwesterly to Arcadia. Other smaller occurrences of this type are scattered and may be dotted with cabbage palm hammocks. The land cover type usually grades into wet flatwoods, wet prairies (savannahs), marsh, stream swamps or hardwood hammocks along streams and creeks, or upland live oak or cabbage palm hammocks.
- **Vegetation** - Shrubs may be present but they must not be a dominant part of the community and therefore, are usually widely spaced and sparse. Typical species include the bluestems (Andropogon spp.), threeawns (Ansticia spp.), the panic grasses (Panicum spp.) and lovegrasses (Eragrostis spp.). Low shrubs such as fetterbush (Lyonia lucida), rusty Lyonia (L.

ferruginea), dwarf blueberry (Vaccinium myrsinites) and wax myrtle (Myrica cerifera) may also be scattered throughout the area.

- **Soils** - Generally moderately to well drained, acid sandy soils as are found in flatwoods communities.
- **Hydrology** - These communities have good drainage and are infrequently inundated. Water tables may be near the surface, however, during the wet season.

## SIMILAR CLASSES

- 2120 Unimproved Pasture and 2130 Woodland Pasture - These classes may look very similar to 3100, but livestock grazing is evident.
- 3300 Mixed Upland Non-Forested - Neither herbaceous vegetation or shrubs are dominant.

## SPECIAL MAPPING CONVENTIONS

This classification has been modified by the SFWMD. It is to be used solely for upland non-agricultural, non-forested lands which exhibit no evidence of cattle grazing.

## DUAL CODING CONVENTION

This is a **Land Cover** code. The LCCODE and LUCODE are usually the same. However, 3100 is often used as the LCCODE for various land uses, such as 1180 Rural Residential, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land, 1900 Open Land, 1920 Inactive Land with Street Pattern, 8320 Electrical Power Transmission Lines and 1850 Parks and Zoos. Herbaceous areas that are traditional rangelands or do not fit any other mapped **Land Use** class are coded as LC=3100/LU=3100.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
05/08/07

**COORDINATES**
439432.59  620532.0

# 3200
# Shrub and Brushland

LEVEL 1: 3000 Upland Non-Forested
**LEVEL 2: 3200 Shrub and Brushland**

## DESCRIPTION

This is one of three land cover classes used for upland non-agricultural, non-forested lands which contain no evidence of cattle grazing. 3200 Shrub and Brushland is used for areas that have over 67% shrub cover and less than 33% herbaceous cover. This proportion ignores any forested patches, which may cover up to 25% of the total area. Vegetation is usually native rather than introduced.

3200 Shrub and Brushland includes areas where tree species are regenerating naturally after clear cutting or fire, but are less than 20 feet tall. This includes native hardwood and coniferous species, but does not apply to plantations. Regenerating plantations are coded as 4430 Forest Regeneration.

This class does **not** include coastal scrub or areas where Brazilian pepper is the dominant shrub species. These are mappped at Level 3.

## KEYS TO PHOTOINTERPRETATION

- Sixty-seven percent or more of the cover is shrub and brush, not including forest patches.
- Brushland may have a wide variety of species of small woody shrubs or one dominant species that is well adapted for the site and terrain. (Except for those shrub classes mapped at Level 3.)
- The signature is typically a coarse texture with mottled tones, unlike the smoother textures of herbaceous cover.
- Often found on arid areas; a sandy or droughty understory may be visible.
- The land is not fertilized, cultivated or irrigated. No regular brush control is occurring.
- This class may be in a transition zone between forested and herbaceous communities, or in re-vegetated areas that have been disturbed.
- This class typically has natural shapes, follows landforms and frequently transitions to forested or herbaceous communities.

## CONTEXT

- **Landscape Position** - This land cover type usually grades into flatwoods, wet flatwoods, wet prairies (savannahs), marsh, stream swamps or hardwood hammocks along streams and creeks, or upland live oak or cabbage palm hammocks.
- **Vegetation** - Common species include gallberry, wax myrtle, saltbush, blueberries, rusty lyonia, fetterbush and other shrubs and brush, as well as various types of short herbs and grasses.
- **Soils** - Occurs on a wide variety of soils including acidic, well to somewhat poorly-drained sands, loamy sands and highly disturbed soils.
- **Hydrology** - This community is an upland association which may experience a high water table for portions of the growing season but rarely experiences inundation. If inundated, the duration is usually very short and results from a storm event.

## SIMILAR CLASSES

- 2240 Abandoned Groves - Groves will look unmanaged with underbrush, vines, and dead or dying trees
- 3210 Palmetto Prairies - Usually a more even-toned, reddish signature.
- 3220 Coastal Scrub - Found in coastal areas, with some sandy areas apparent

## SPECIAL MAPPING CONVENTIONS

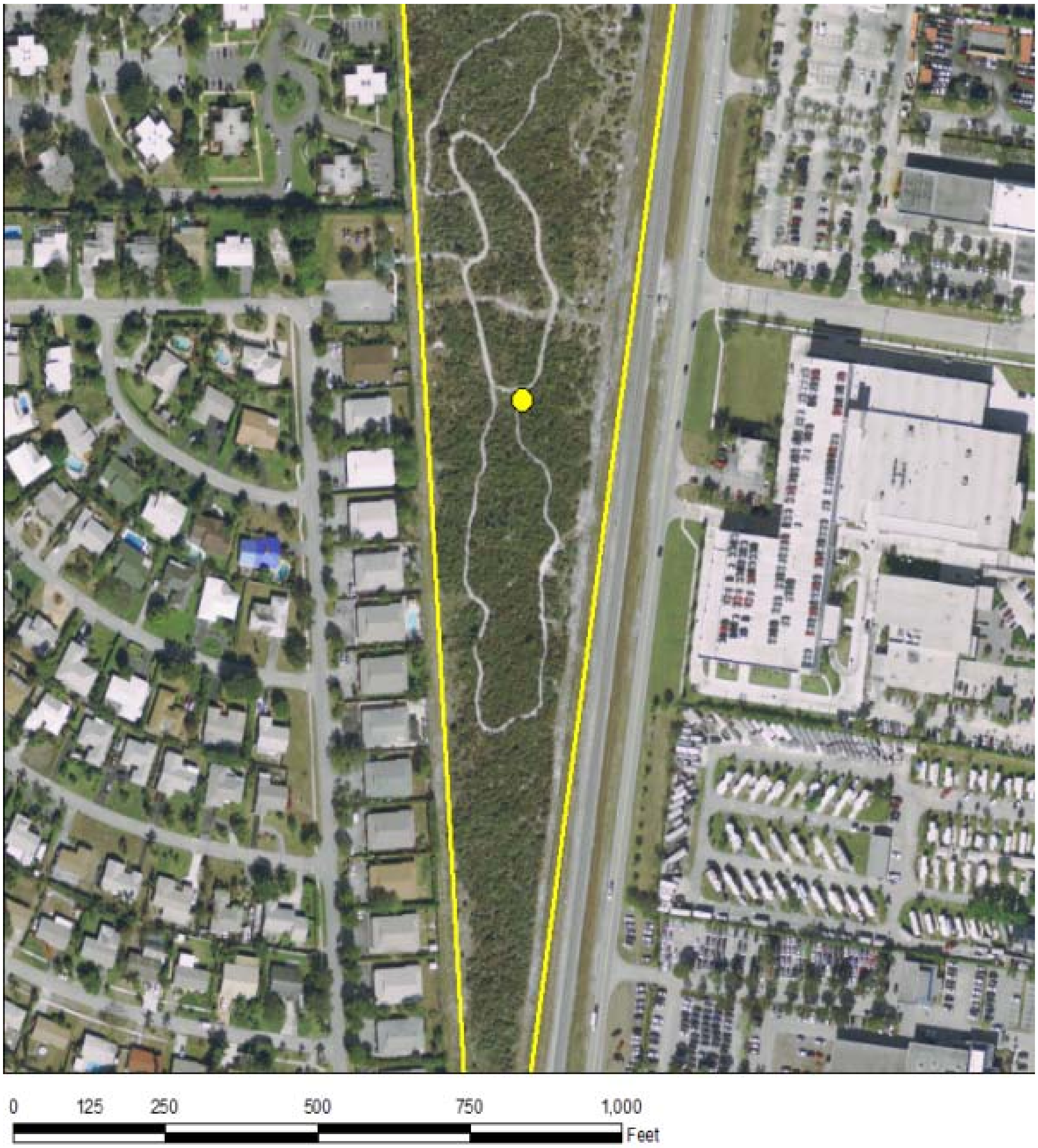
This classification has been modified by the SFWMD. It is to be used solely for upland non-agricultural, non-forested lands which have no evidence of cattle grazing.

## DUAL CODING CONVENTION

3200 is a **Land Cover** code. It is used as a dual code in conjunction with various land uses, including 1180 Rural Residential, 1650 Reclaimed Mining Land, 1670 Abandoned Mining Land, 1920 Inactive Land with Street Pattern, 8320 Utility Corridors and 1850 Parks and Zoos. Shrub and Brushland areas that are traditional rangelands or do not fit any other mapped **Land Use** class are coded as LC=3200/LU=3200.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
01/08/07

**COORDINATES**
958542.40  762880.30

# 3210
# Palmetto Prairies

LEVEL 1: 3000 Upland Non-Forested
LEVEL 2: 3200 Upland Shrub and Brushland
**LEVEL 3: 3210 Palmetto Prairies**

## DESCRIPTION

This class includes nearly treeless plains with a dense ground cover dominated by saw palmetto. It also may include grasses, herbs and other low shrubs, but saw palmetto must be the dominant species for inclusion in this class.

It is commonly found as the understory in pine flatwoods communities.

Depending on the amount of saw palmetto and its height, this class has a more mottled appearance than 3100 Herbaceous (Dry Prairie). Color returns are about the same and with a quick glance, some areas dominated by saw palmetto may be first identified as 3100 Herbaceous (Dry Prairie) due to the evenness of height of the saw palmetto or the washed out color return which may result from this species.

## KEYS TO PHOTOINTERPRETATION

- Sixty-seven percent or more of the vegetative cover is saw palmetto.
- Texture is more stippled due to the presence of saw palmetto.
- The land is not fertilized, cultivated or irrigated. No regular brush control is occurring.
- This class typically has natural shapes, follows landforms and frequently transitions to forested or herbaceous communities.

## CONTEXT

- **Landscape Position** - This land cover type typically occurs on broad flat expanses in central portions of the state and is geographically concentrated in two main areas of the project limits; the Kissimmee River valley (north and west of Lake Okeechobee) and in a corridor along Fisheating Creek from the western shore of Lake Okeechobee west-northwesterly to Arcadia. Other smaller occurrences of this type occur scattered within pine flatwoods areas. This land cover type usually grades into wet flatwoods, wet prairies (savannahs), marsh, stream swamps or hardwood hammocks along streams and creeks, or upland live oak or cabbage palm communities.
- **Vegetation** - Saw palmetto (Serenoa repens) is the dominant species in this land cover type. Other shrubs and grasses occur intermixed in openings between palmetto clusters. Typical species include the bluestems (Andropogon spp.), threeawns (Ansticia spp.), the panic grasses (Panicum spp.), lovegrasses (Eragrostis spp.), low shrubs such as fetterbush (Lyonia lucida), rusty Lyonia (L. ferruginea), dwarf blueberry (Vaccinium myrsinites), gallberry [Ilex glabra) and wax myrtle (Myrica cerifera).
- **Soils** - Generally moderately to well drained, acid sandy soils as are found in flatwoods communities.
- **Hydrology** - These communities have good drainage and are seldom inundated. Water tables may be near the surface, however, during the wet season.

## SIMILAR CLASSES

- 3100 Herbaceous (Dry Prairie) - A smoother, generally more grayish signature, with no discernible height
- 3200 Upland Shrub and Brushland - More diverse signature, due to a variety of shrub species
- 3220 Coastal Shrub - Found in coastal areas, with some sandy areas apparent

## SPECIAL MAPPING CONVENTIONS

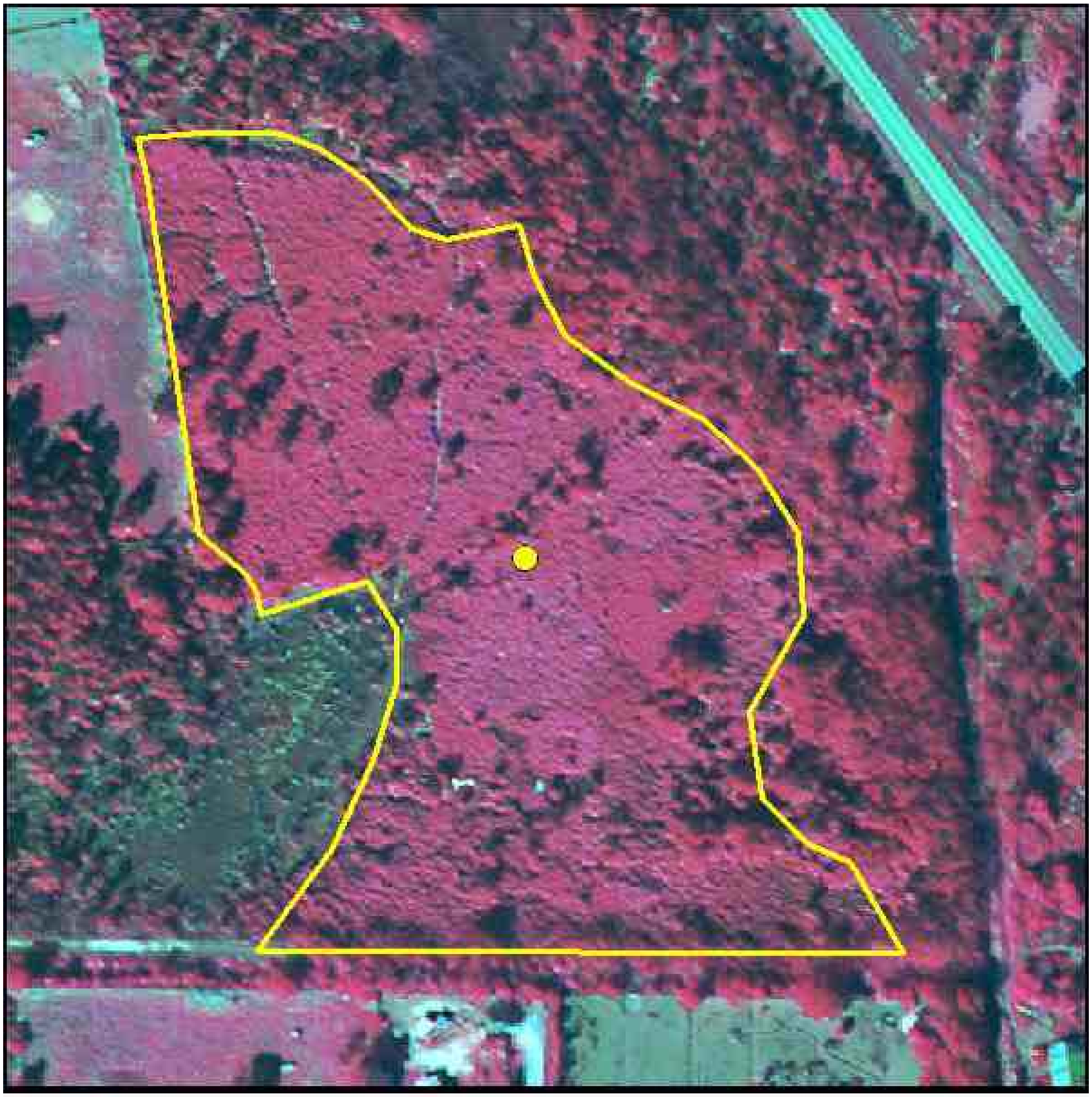
This classification has been modified by the SFWMD. It is to be used solely for upland non-agricultural, non-forested lands which have no evidence of cattle grazing and where saw palmetto is the dominant vegetative cover.

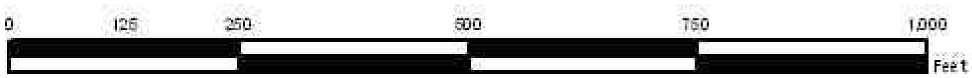
**Where found in pine flatwood communities, palmetto prairies may be separated out when sufficiently large enough (greater than 5 acres) and where pine canopy areal coverage is less than 10% of the polygon.**

## DUAL CODING CONVENTION

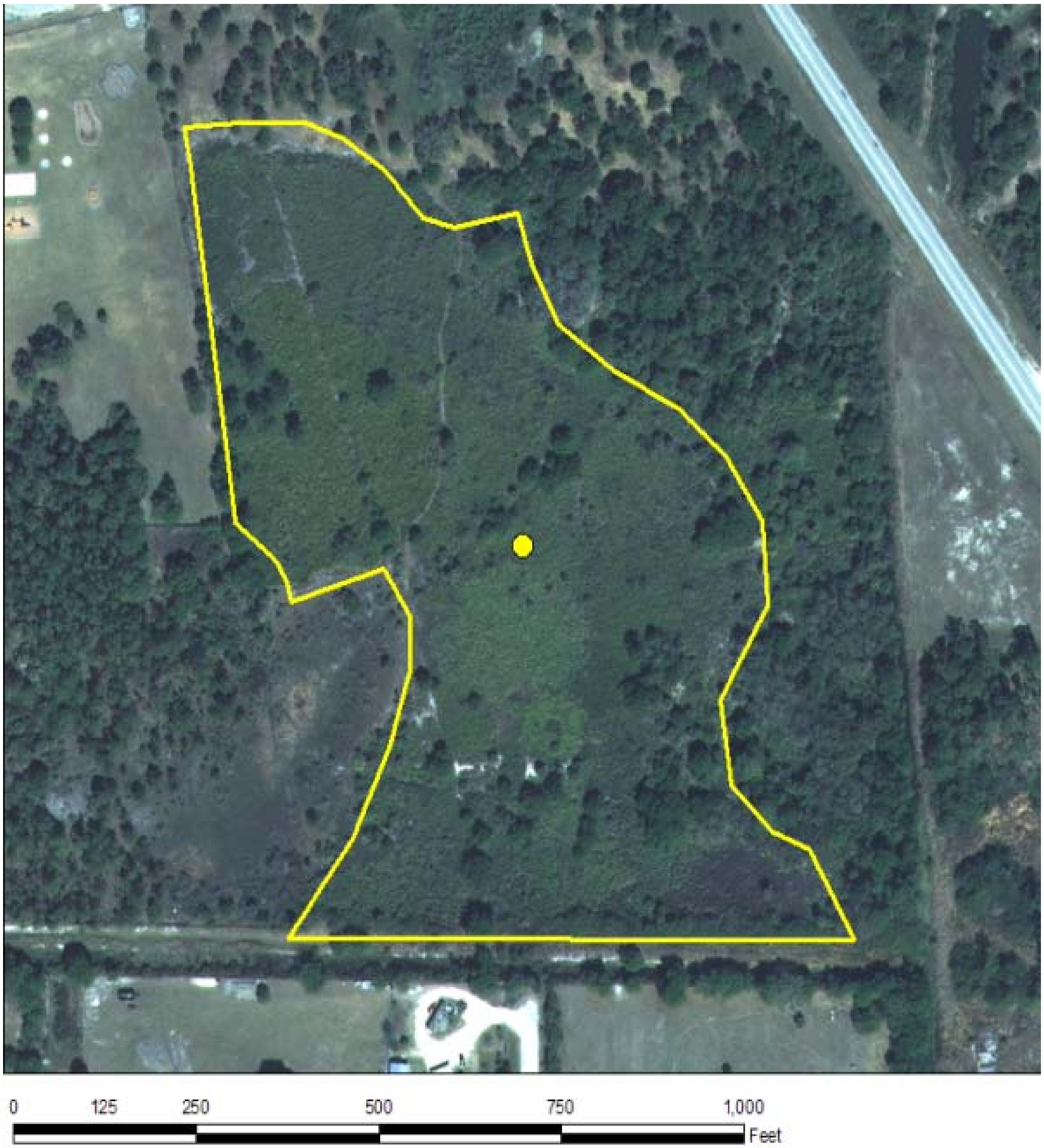
This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
07/15/06

**COORDINATES**
698857.45 1066172.42

# 3220
# Coastal Shrub

LEVEL 1: 3000 Upland Non-Forested
LEVEL 2: 3200 Upland Shrub and Brushland
**LEVEL 3: 3220 Coastal Shrub**

## DESCRIPTION

Coastal Shrub is characterized as stabilized, wind-deposited coastal dunes that are vegetated with a dense thicket of salt-tolerant shrubs, especially saw palmetto. Other typical vegetation includes sand live oak, cabbage palm, myrtle oak, yaupon and sea grape.

It is found on deep, wind-deposited sands which have been wind sorted and wave washed. Coastal Shrub dunes are generally quite stable but are susceptible to severe damage if the vegetation is disturbed. Coastal Shrub species are frequently dwarfed and pruned as a result of the salt spray-laden winds that kill twigs on the seaward side, producing a smooth, dense, upward- slanting canopy resembling a sheared hedge.

Coastal Shrub is probably the most rapidly disappearing community in Florida. It is most extensive along the Atlantic Coast where being elevated and next to the coast, it is considered a prime source of resort or residential property. Coastal Shrub originally comprised a nearly continuous band along the Atlantic shoreline. Now it occurs largely as broken and isolated small stretches. In South Florida, it has also been disturbed by invasions of exotic species, principally Brazilian pepper and Australian pine.

## KEYS TO PHOTOINTERPRETATION

- A mixture of shrubs and trees along coastal areas.
- Shrubs exhibit a fairly uniform height, fluffy or "cottony" texture (sometimes so uniform and monotypic that the texture is smooth) and a light, faded pink or reddish color on CIR.

## CONTEXT

- **Landscape Position** - This community occurs on the backside of the beach dune usually beginning just over or at the top. Proceeding downslope, the community grades into mangrove or, in the absence of grade to a lagoon, the community grades to an upland situation occupied by Tropical Hardwoods, Australian pine or Brazilian pepper.
- **Vegetation** - This community type is dominated by saw palmetto, sea grape, scrubby oaks, railroad vine, sea oats and other salt tolerant herbaceous and shrubby species. Australian pine and Brazilian pepper may be intermixed but are not dominant.
- **Soils** - Coastal marine sands which are well to excessively drained.
- **Hydrology** - Xeric conditions prevail except for occasional wash-over during heavy storm surge.

## SIMILAR CLASSES

- 3200 Upland Shrub and Brushland - Found in inland areas, away from the coast
- 3210 Palmetto Prairie - Found in inland areas, away from the coast; saw palmetto the dominant species

## SPECIAL MAPPING CONVENTIONS

This class is to be used only in coastal areas of the District.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
01/11/07

**COORDINATES**
904432.28 1094327.94

# 3300
# Mixed Upland Non-Forested

LEVEL 1: 3000 Upland Non-Forested
**LEVEL 2: 3300 Mixed Upland Non-Forested**

## DESCRIPTION

This is one of three land cover classes used for upland non-agricultural, non-forested lands which contain no evidence of cattle grazing. 3300 Mixed Upland Non-Forested is used for areas in which **neither** herbaceous species nor shrubs cover more than 67% of the area. If herbaceous vegetation covers more than 67% of the area, it is classed as 3100 Herbaceous. If shrubs cover more than 67% of the area, it is classed as 3200 Shrub and Brushland.

The 3300 Mixed class may include areas where tree species are regenerating naturally after clear cutting or fire, but are less than 20 feet tall. These include native hardwood and coniferous species, but does not apply to plantations. Regenerating plantations are coded as 4430 Forest Regeneration.

## KEYS TO PHOTOINTERPRETATION

- The percentage of both herbaceous cover and shrubs is between 33% and 67% - neither one covers more than 67% of the area.
- There is a mixture of rough and smooth texture usually showing two or more distinct tones (herbaceous vs. shrubs).
- There may be a mixture of trees (less than 25%) without a dominant understory vegetation.
- This class may be in a transition zone between forested and herbaceous communities, or in re-vegetated areas that have been disturbed.
- This class includes unimproved rural land that does not fit any other land use in the classification system.
- This class includes agricultural property where the farming use has been abandoned and natural vegetation has re-established.
- The land is typically not fertilized, cultivated or irrigated. Brush control or hay cutting may be practiced.

## CONTEXT

- **Landscape Position** - This land cover type usually grades into flatwoods, wet flatwoods, wet prairies (savannahs), marsh, stream swamps or hardwood hammocks along streams and creeks, or upland live oak or cabbage palm hammocks.
- **Vegetation** - Typical herbaceous species include the bluestems, threeawns, panic grasses, and lovegrasses. Typical shrubs include fetterbush, rusty Lyonia, dwarf blueberry and wax myrtle. Also included are saw palmetto and Brazilian pepper, but only where they are not the dominant species.
- **Soils** - Can be found on a wide variety of soils including acidic, well to somewhat poorly drained sands, loamy sands and highly disturbed soils.
- **Hydrology** - This community is an upland association which may experience a high water table for portions of the growing season but rarely experiences inundation. If inundated, the duration is usually very short and results from a storm event.

## SIMILAR CLASSES

- 2120 Unimproved Pasture and 2130 Woodland Pasture - These classes may look very similar to 3300, but livestock grazing is evident.
- 2240 Abandoned Groves - Groves will look unmanaged with underbrush, vines, and dead or dying trees.
- 3200 Shrub and Brushland - Dominated by shrubs (>67%).

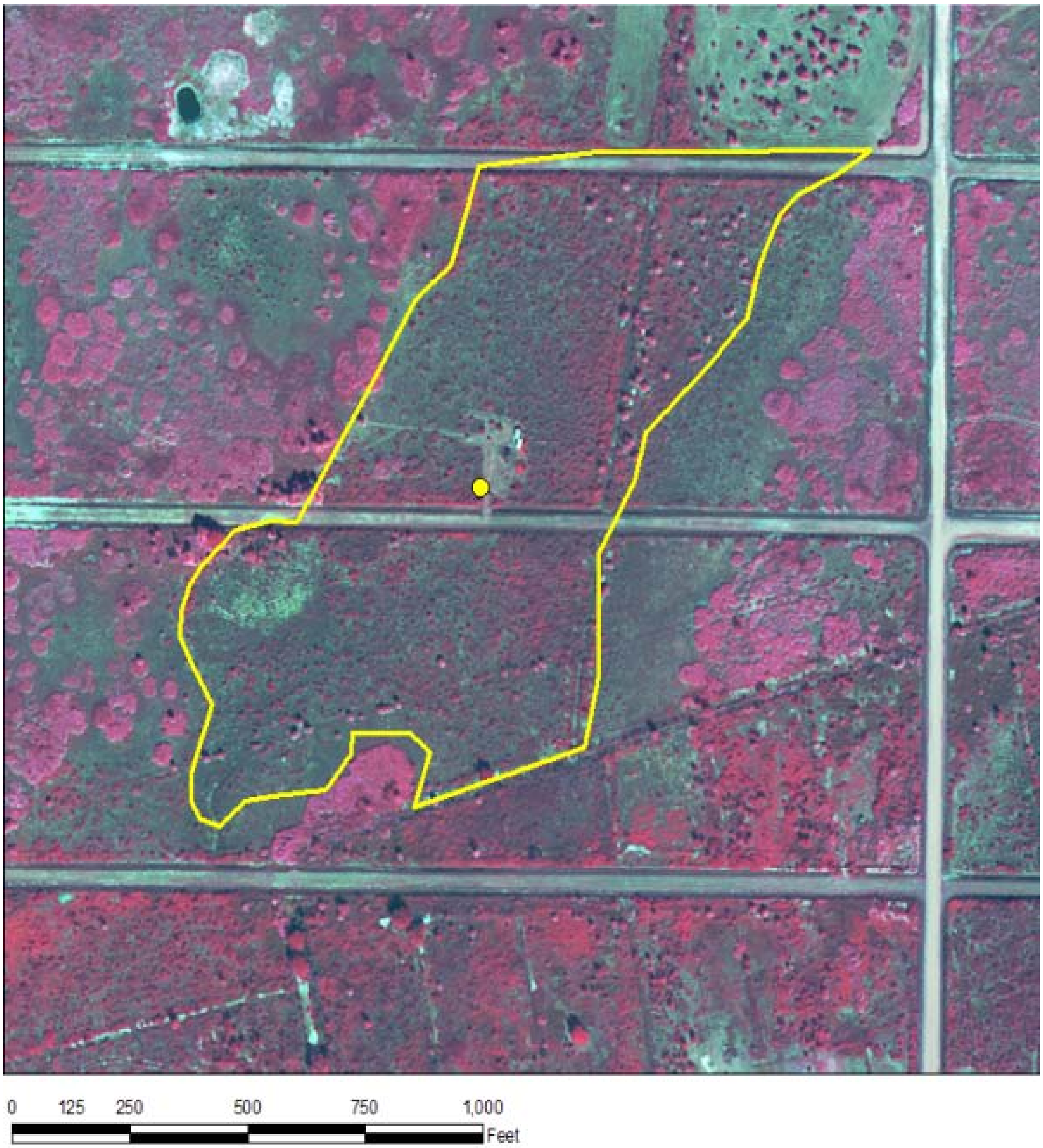
## SPECIAL MAPPING CONVENTIONS

This classification has been modified by the SFWMD. It is to be used solely for upland non-agricultural, non-forested lands which contain no evidence of cattle grazing.

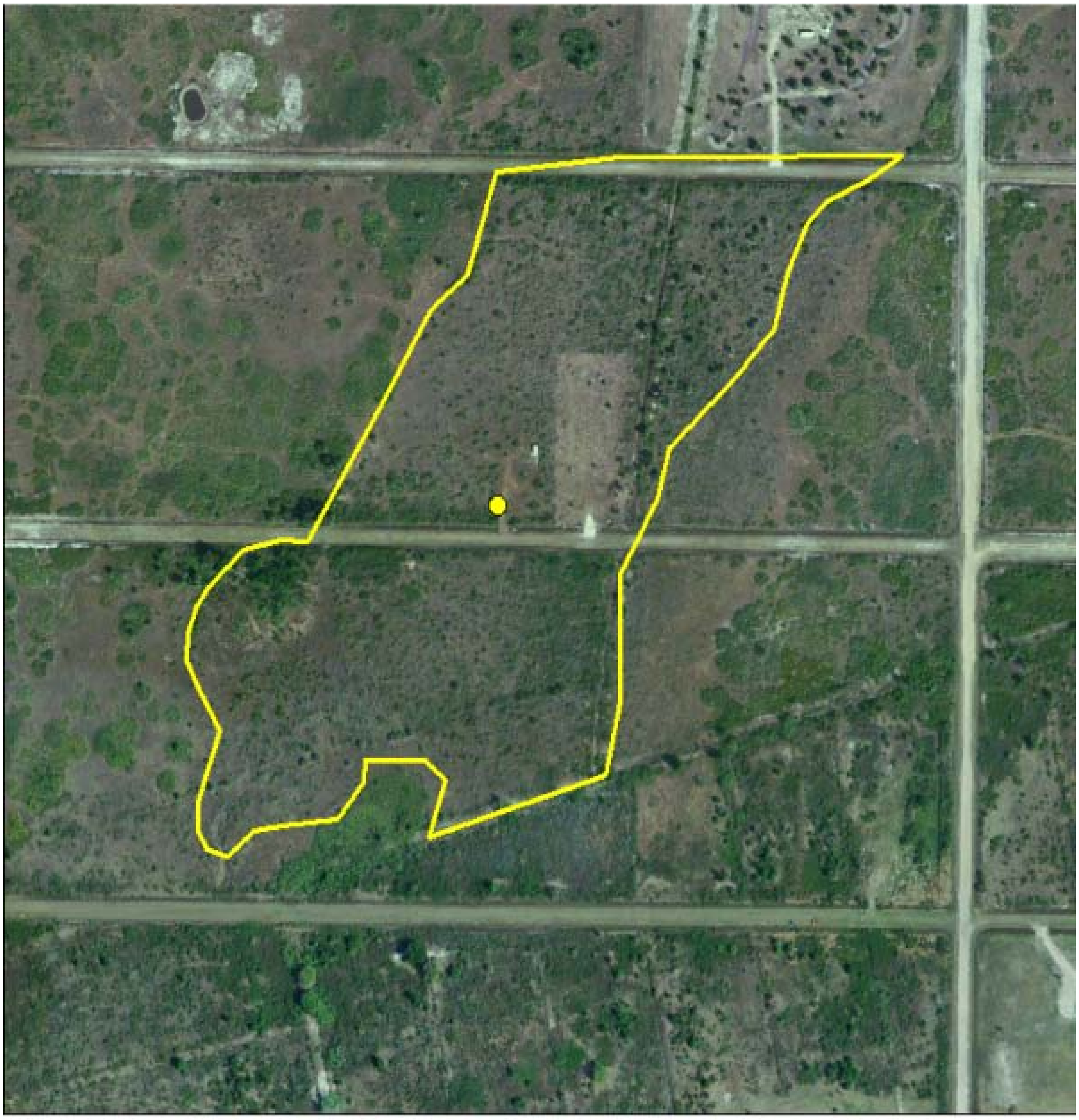
## DUAL CODING CONVENTION

3300 is a **Land Cover** code. It is used as a dual code in conjunction with various land uses, including 1180 Rural Residential, 1650 Reclaimed Mining Land, 1670 Abandoned Mining Land, 1920 Inactive Land with Street Patterns, 8320 Utility Corridors and 1850 Parks and Zoos. Mixed Upland Non-Forested areas that are traditional rangelands or do not fit any other mapped **Land Use** class are coded as LC=3300/LU=3300.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE




**COORDINATES**
642203.29 1150426.71 (Images)

## FIELD PICTURE

**DATE**
01/09/07

**COORDINATES**
791950.89  1003194.71 (Field Picture)

# 4000
# Upland Forests

This Level 1 class is not used in the map itself - a more specific subclass must be selected. The Level 2 subclasses are:

- 4100 Upland Coniferous Forests
- 4200 Upland Hardwood Forests
- 4300 Upland Mixed Forests
- 4400 Tree Plantations

Upland forests are landscape units which support a tree canopy closure of **25 percent or more**. This is a SFWMD modification of the FLUCCS system, which specifies a canopy closure of 10 percent or more. The SFWMD has also modified the Level 2 forest codes 4300. The FLUCCS class 4300 is a continuation of the Upland Hardwood Forest class; in the SFWMD 4300 is changed to Upland Mixed Forests, which in the FLUCCS system is 4340.

Trees are woody plants that are over 20 feet tall in their growth stage at the time of photography. Immature trees that are under 20 feet tall are considered shrubs.

## BACKGROUND

The Upland Forests include both xeric (dry) and mesic (moderately moist) forest communities. Wetland, or hydric, forest communities are classified in the 6000 Wetland classes. Also included in the Upland Forest category are areas in which timber harvesting has occurred but which exhibit no evidence of being developed for other intended uses Clear cuts in an area in which rotation forest management is practiced is a prime example of such a case.

Florida's forests serve as a vital resource from not only a commercial viewpoint, but also from an aesthetic and recreational one. In Florida, slightly less than 50 percent of the land base (17 million acres) is identified by the United States Forest Service as forest land. Approximately 40 percent is commercial timber land. A very significant portion of this land is allocated to pine plantation monoculture. Based on the 1980 Forest Service inventory, there are approximately six and one-half million acres of pure natural and planted longleaf and slash pine stands in Florida. There are also many stands of pure hardwood species groups occurring in Florida. However, the majority of forest lands occur as mixed communities of tree species and species groups. For purposes of classification, a class is assigned if 67 % or more of the total canopy can be assigned to that species or community group. If there is less than 67% dominance, the 4340 Upland Mixed Coniferous/Hardwood class is used. The classification is based upon the species composition of the tree canopy as interpreted from aerial imagery.

## MAPPING CONVENTIONS

**Minimum mapping units:** This general class is not active in the data layer; The most specific subclass that applies to the mapping unit must be always used.

Trees may occur in an herbaceous or shrub matrix which covers up to 75% of the area. The trees may be scattered and dispersed in the matrix as individual trees or small (<5 acre) patches. If distinct patches of trees or other classes are greater than 5 acres, they are broken out separately. In transitional areas where species specific wetland (2 acre MMU) and upland (5 acre MMU) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit. PIs must use discretion to avoid excessive linework while adding useful information.

**Differentiating subclasses:** Differentiating between natural forest communities requires extensive experience in photointerpretation. The communities can only be identified by the signatures of individual species, rather than by the general color, texture and patterns of the mixture or community. It is generally accepted that PIs cannot recognize these species unless they have extensive experience in the field comparing features on the ground against the exact same feature on recent photography. Also required is an understanding of the forest ecology. These skills are difficult to obtain, which accounts for the high levels of error sometimes found in mapping plant communities.

Photointerpreters consider the effects of seasonal changes on plant growth to interpret the signatures of different plant species. For example, most hardwoods are deciduous and subject to a period of winter dormancy. This dormancy period provides a contrast in color tones between hardwoods and conifers and is the reason why most land cover mapping projects try to obtain winter photography. Catching the "leaf off" period is difficult in Florida. The seasonal changes are often rapid and PIs must pay careful attention to the date of photography in order to interpret the signatures properly.

Photointerpretation of vegetation is a science and an art which is beyond the scope of this guide to document. The PI key pages will only focus on defining which species and communities are included in each class. Mapping teams are required to provide the necessary expertise from field work, training, reference materials and, most of all, actual mapping experience with proper quality control.

## DUAL CODING CONVENTION

All of the forest communities are **Land Cover** classes that do not normally require a separate **Land Use** code - LCCODE and LUCODE are normally the same. However, in some cases, a separate **Land Use** code is required. The following land uses must be classified where they occur in a forested polygon: 1180 Rural Residential, 1920 Inactive Land with Street Pattern, 1650 Reclaimed Mining Land, 1670 Abandoned Mining Land and 1850 Parks and Zoos.

## SIMILAR CLASSES

The most serious error in forest mapping is to confuse upland and wetlands forests. The District places a high priority on establishing a wetland/ upland boundary. Unfortunately, some forest species and communities stretch across this boundary and canopy signatures do not clearly indicate where hydric soils stop and upland soils begin. The problem is addressed with experience, ancillary data, magnified stereo viewing of imagery, field checking and tolerance of an acceptable level of error.

Upland forests may also be confused with woodland pastures and non-forested uplands. These classes often border each other, creating errors in transitional zones of a lesser significance than wetlands/uplands error.

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

# 4100
# Upland Coniferous Forests

LEVEL 1: 4000 Upland Forests
**LEVEL 2: 4100 Upland Coniferous Forests**

## DESCRIPTION

This Level 2 class should only be used for upland coniferous forests that do not meet the requirements of a more specific Level 3 subclass.

The canopy closure must be **25 % or more** with at least 67% dominance by coniferous species. The trees must average over 20 feet tall at the time of photography.

The Upland Coniferous class may include forest communities such as pine flatwoods, sand pine and mixed communities of pine-dominated xeric and mesic oaks.

Upland coniferous forests are naturally generated. They do not include tree plantations or planted groves of citrus or other tree crops. However, almost all forests are subject to human influence and the composition of the forests is, to a large or small degree, determined by management factors.

## KEYS TO PHOTOINTERPRETATION

- The canopy closure must be **25 % or more** with at least 67% dominance by coniferous tree species.
- Up to 33% of the canopy may be comprised of hardwood species.

## CONTEXT

- **Landscape Position** - Coniferous forests are found throughout the District wherever hydrology, fire and management practices permit. Forests may be found on any of the land uses and may occur as inclusions in most of the other land cover types. They may occur as scattered individual trees, as denser patches or both.
- **Vegetation** - see respective subclasses
- **Soils** - see respective subclasses
- **Hydrology** - see respective subclasses

## SIMILAR CLASSES

- 2130 Woodland Pastures - Pasture will show evidence of grazing.
- 2200 Tree Crops - Trees are grown in rows.
- 4340 Upland Mixed Coniferous/Hardwood - Some mixed classes may appear similar if coniferous species make up a significant portion of the area.

## SPECIAL MAPPING CONVENTIONS

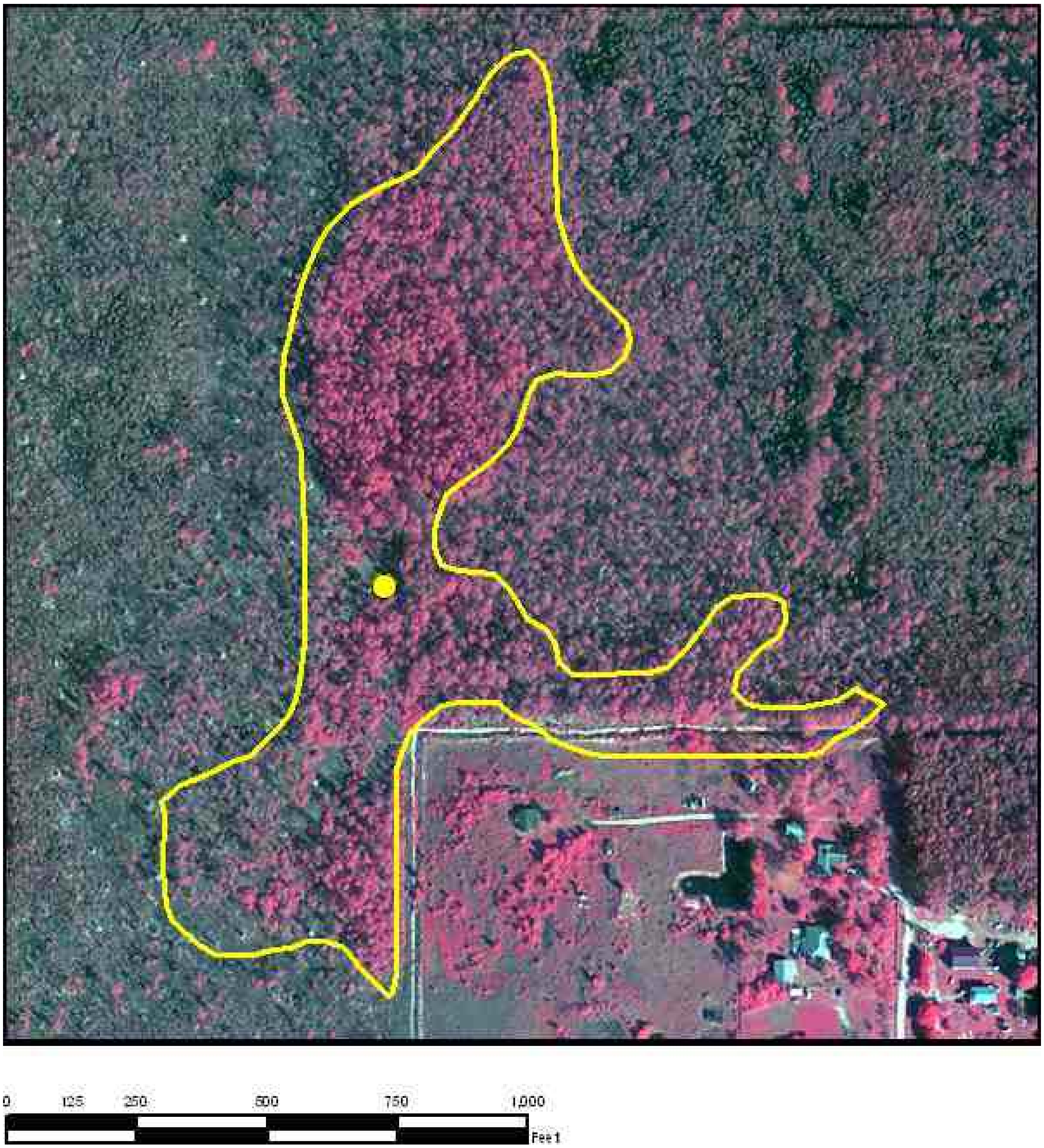
Trees may occur in a matrix of herbs, shrubs, and other cover types, which can cover up to 75% of the area. The trees may be scattered and dispersed in the matrix as individual trees or small (<5 acres) patches. If distinct patches of trees or other classes are greater than 5 acres, they are broken out separately.

In transitional areas where species-specific wetland (2 acre) and upland (5 acre) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

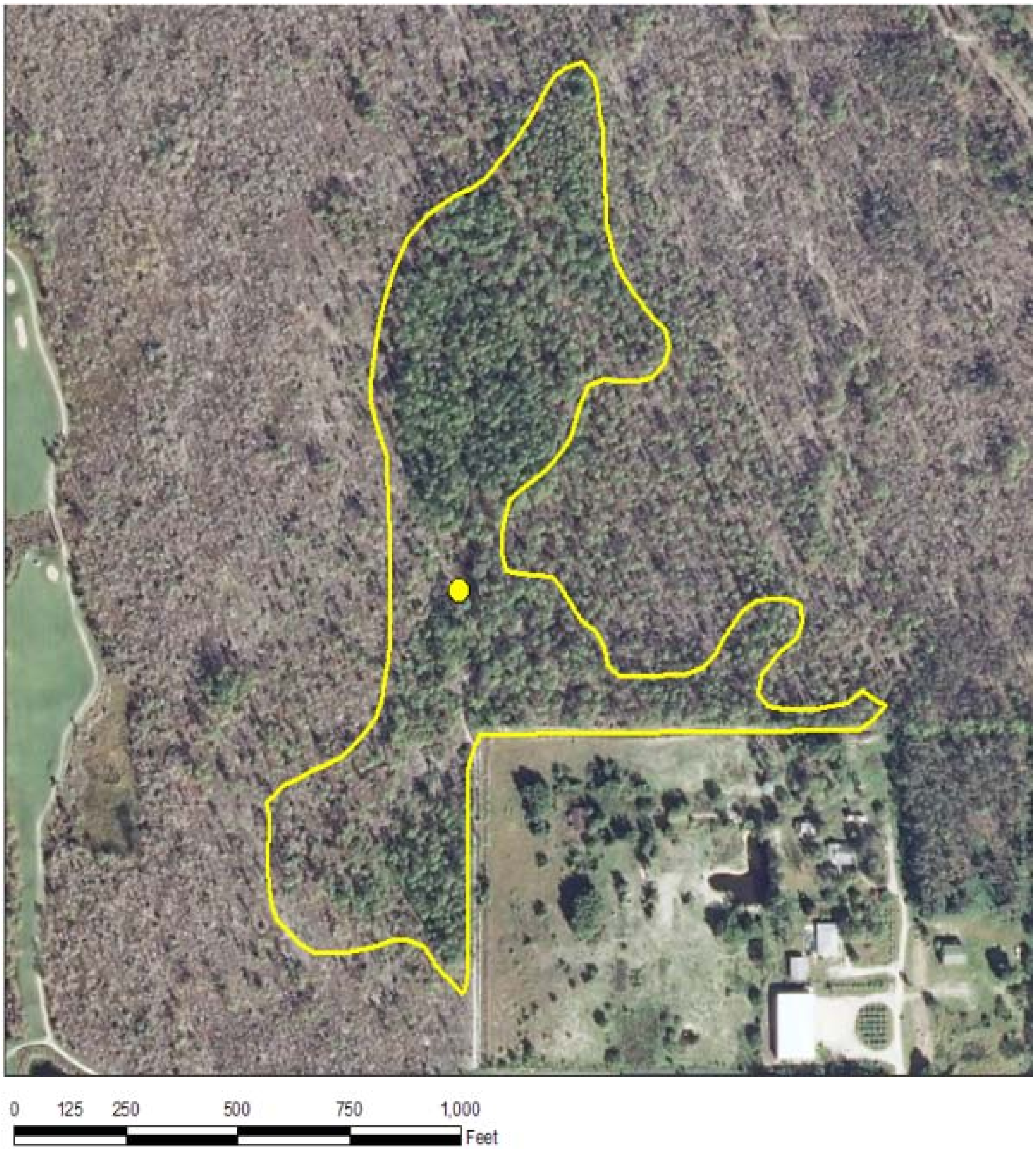
## DUAL CODING CONVENTION

This is a **Land Cover** class. It does not normally require a separate **Land Use** code. However, where coniferous forests occur in association with a mapped land use, a separate **Land Use** code may be required. Examples: 1180 Rural Residential, 1920 Inactve Land with Street Pattern, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land and 1850 Parks and Zoos.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
07/15/06

**COORDINATES**
424991.42 708547.63

# 4110
# Pine Flatwoods

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4100 Upland Coniferous Forests
**LEVEL 3: 4110 Pine Flatwoods**

## DESCRIPTION

This class includes naturally generated pine flatwoods. Pine species must achieve 67% crown canopy dominance and the trees must average over 20 feet tall at the time of photography. The pine flatwoods class in the SFWMD is dominated by slash pine.

Pine flatwoods are generally the most prevalent community type in undeveloped areas. Originally, longleaf pines were common on drier sites while slash pines, which are less fire-resistant, were confined to moist sites - wildfire being the contributing factor in this distribution. However, fire control and artificial reforestation have extended the range of slash pine into former longleaf sites.

This class also includes pine rockland communities of the Everglades and Lower Keys.

## KEYS TO PHOTOINTERPRETATION

- **The canopy closure must be 25% or more.**
- Saw palmetto is often visible as irregular shaped patches with detectable height.
- Rounded, asymmetrical and "feathered", medium to dark green canopies, brick red on CIR image; individual trees visible.
- Grassy understories are paler green, with various pinkish tones on CIR. Saw palmetto is visible as irregular shaped green patches, pink to pinkish red patches on CIR, with "feathered" edges and relatively smooth textured tops. Saw palmetto has detectable height whereas areas of grasses are generally smooth without any noticeable relief. More mesic areas may contain noticeable amounts of cabbage palm and/or shrubs yielding smooth bright red CIR signatures as an understory component.
- Flatwoods are often pockmarked with wet depressions dominated by prairie/marsh vegetation or cypress.

## CONTEXT

- **Landscape Position** - This community generally grades to hardwood communities (either wetland or upland) in more mesic areas along streams, rivers and other water bodies or may be found surrounded by pasture.
- **Vegetation** - Dominant species include slash pine, saw palmetto, gallberry and various grasses. More mesic areas may also contain cabbage palm, St. Johns wort and wet site grasses and grass-like plants. Pine rockland communities are vegetated by stunted slash pines with an understory of shrubs (palms) and herbs.
- **Soils** - Typical soils are represented by imperfectly or poorly drained, acidic sands with varying depth (typically 1-3 feet) to an organic or clay hardpan. The hardpan restricts downward movement of water. Drier areas have more depth to hardpan or poorly developed hardpan. Pine rockland communities occur on outcrops of Miami limestone.
- **Hydrology** - Typical flatwoods do not have saturation or inundation except following heavy rains.

## SIMILAR CLASSES

- 4120 Longleaf Pine - Xeric Oak - Crown canopy dominated by pine with mid-story of oak and visible sandy areas
- 4130 Sand Pine - Occurs on hilly terrain and sandy soils; has a dark red or purplish signature
- 6250 Wet Pinelands - Hydric Pine - Absence of saw palmetto and other upland shrubs; grasses predominate with darker, green tones in the understory. Hydric conditions produce muted color tones in the canopy, which may be wider spaced and appear stunted or ragged compared to upland pine

## SPECIAL MAPPING CONVENTIONS

Trees may occur in an herbaceous or shrub matrix that covers up to 75% of the area. The trees may be scattered and dispersed in the matrix as individual trees or small (<5 acre) patches. If distinct patches of trees or other classes are greater than 5 acres, they are broken out separately.

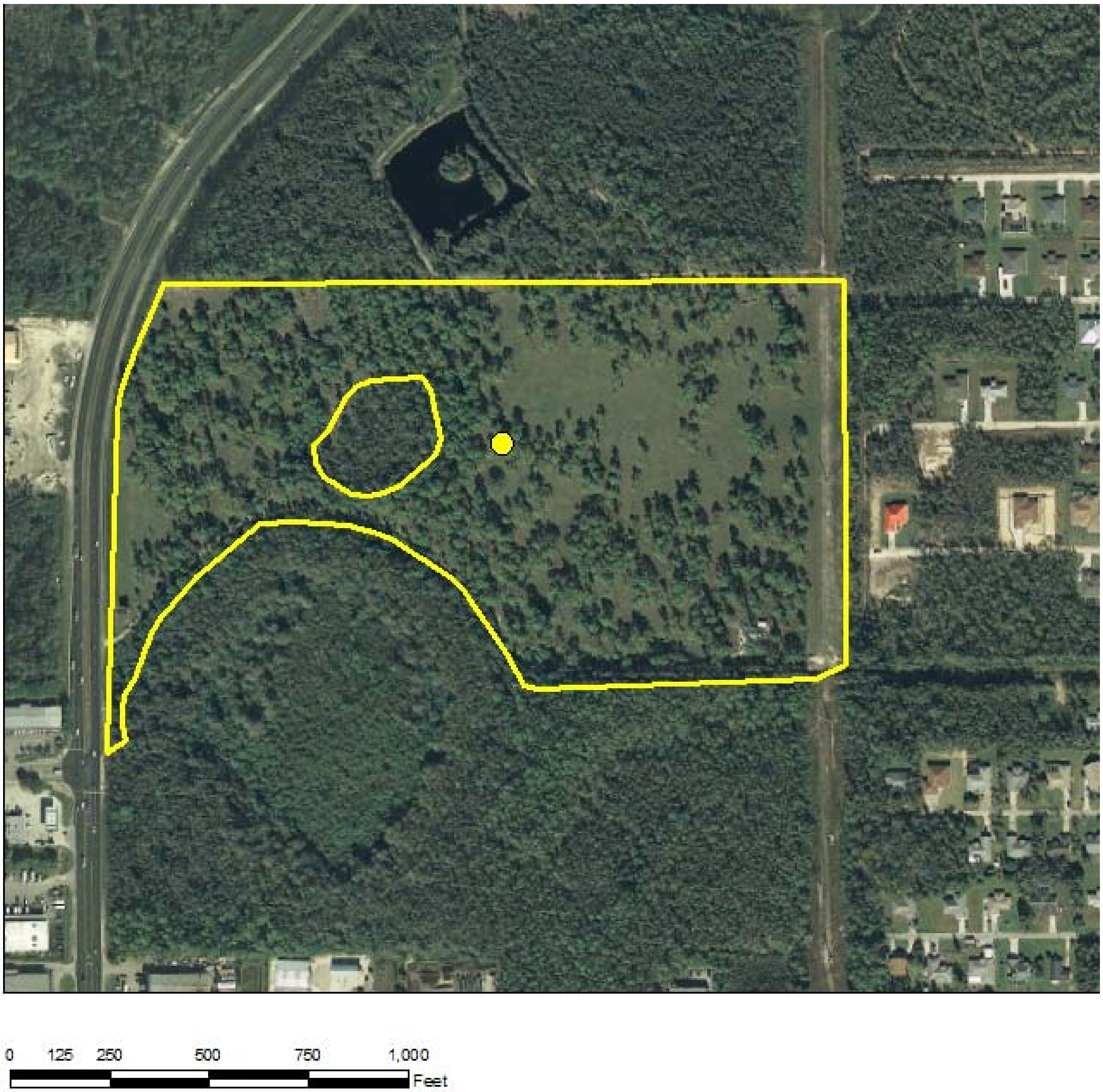
In transitional areas where species-specific wetland (2 acre) and upland (5 acre) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

This is a **Land Cover** class. It does not normally require a separate **Land Use** code. However, where pine flatwoods occur in association with another mapped **Land Use**, a separate **Land Use** code may be required. Examples: 1180 Rural Residential, 1920 Inactive Land with Street Pattern, and possibly 1650 Reclaimed Mine Land and 1670 Abandoned Mine Land.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
05/10/07

**COORDINATES**
378325.41 820411.02

# 4120
# Longleaf Pine - Xeric Oak

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4100 Upland Coniferous Forests
**LEVEL 3: 4120 Longleaf Pine - Xeric Oak**

## DESCRIPTION

This class includes naturally generated longleaf pine and xeric oaks. The canopy closure must be **25 % or more** and the trees must average over 20 feet tall at the time of photography. The pine canopy, dominated by longleaf pine, is typically sparse and irregular, revealing its oak mid-story, which may include bluejack oak, turkey oak, sand post oak and other drought-tolerant oaks and hardwoods.

The distribution of longleaf pine restricts this community to the following areas of the District: Osceola, Orange, Polk and Charlotte Counties; northwestern Lee County; western Glades County; northeastern, northwestern and southwestern Highlands County; northern and western Okeechobee County.

## KEYS TO PHOTOINTERPRETATION

- This community is similar to and occupies the same sites as the xeric oak community, except that longleaf pine is the dominant species.
- Longleaf pines are very tall with large flattened crowns.
- Natural color oak mid-story is often visible and is textured bluish-green. In CIR blue-gray in signature when leaves are on, and understory is dull pink or brownish pink low shrubs.
- Sandy areas can be seen through canopy.
- Brighter green signature grasses scattered among shrubs may be visible. Grayish-green in CIR.

## CONTEXT

- **Landscape Position** - This community is found on slight ridges within the flatwoods or in areas of pasture. Topographic relief should be apparent on either the aerial photography or the USGS topographic map. It often grades into 4210 Xeric Oak and 4110 Pine Flatwoods, but may be surrounded by 2120 Unimproved Pasture.
- **Vegetation** - Longleaf pine dominates the canopy with live oak, turkey oak, bluejack oak, sand live oak, fetterbush and varying amounts of saw palmetto and numerous grasses and forbs present.
- **Soils** - Comprised of deep, well-drained, infertile sands.
- **Hydrology** - This community is very dry and has a deep seasonal water table. Flooding or inundation is not a consideration in this community.

## SIMILAR CLASSES

- 4110 Pine Flatwoods - These lack the mid-story canopy of longleaf pine/xeric oaks as described above.
- 4210 Xeric Oak - Overstory pines are not present.

## SPECIAL MAPPING CONVENTIONS

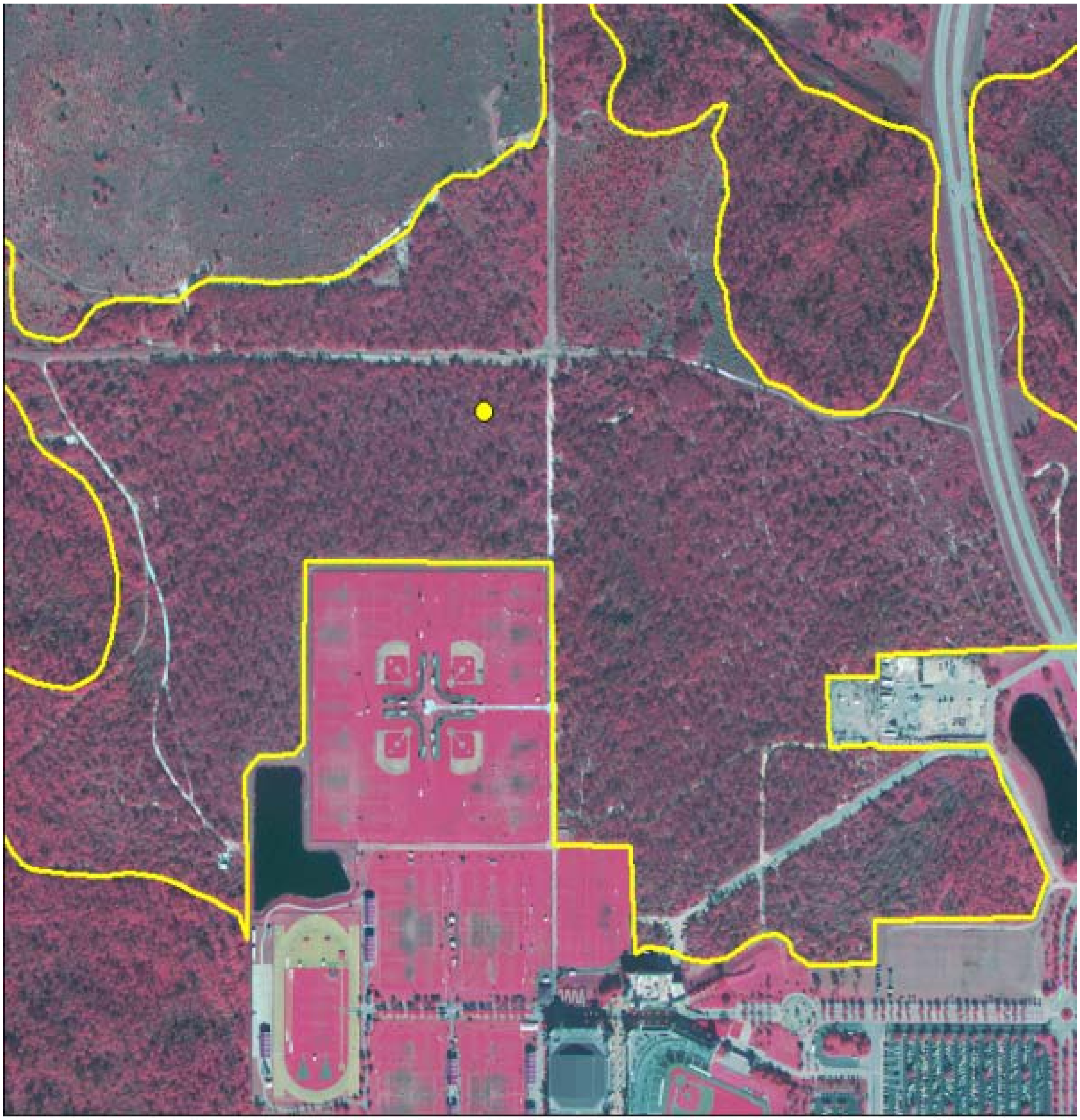
Trees may occur in an herbaceous or shrub matrix which covers up to 75% of the area. The trees may be scattered and dispersed in the matrix as individual trees or small (<5 acre) patches. If distinct patches of trees or other classes are greater than 5 acres, they are broken out separately.

In transitional areas where species-specific wetland (2 acre) and upland (5 acre) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

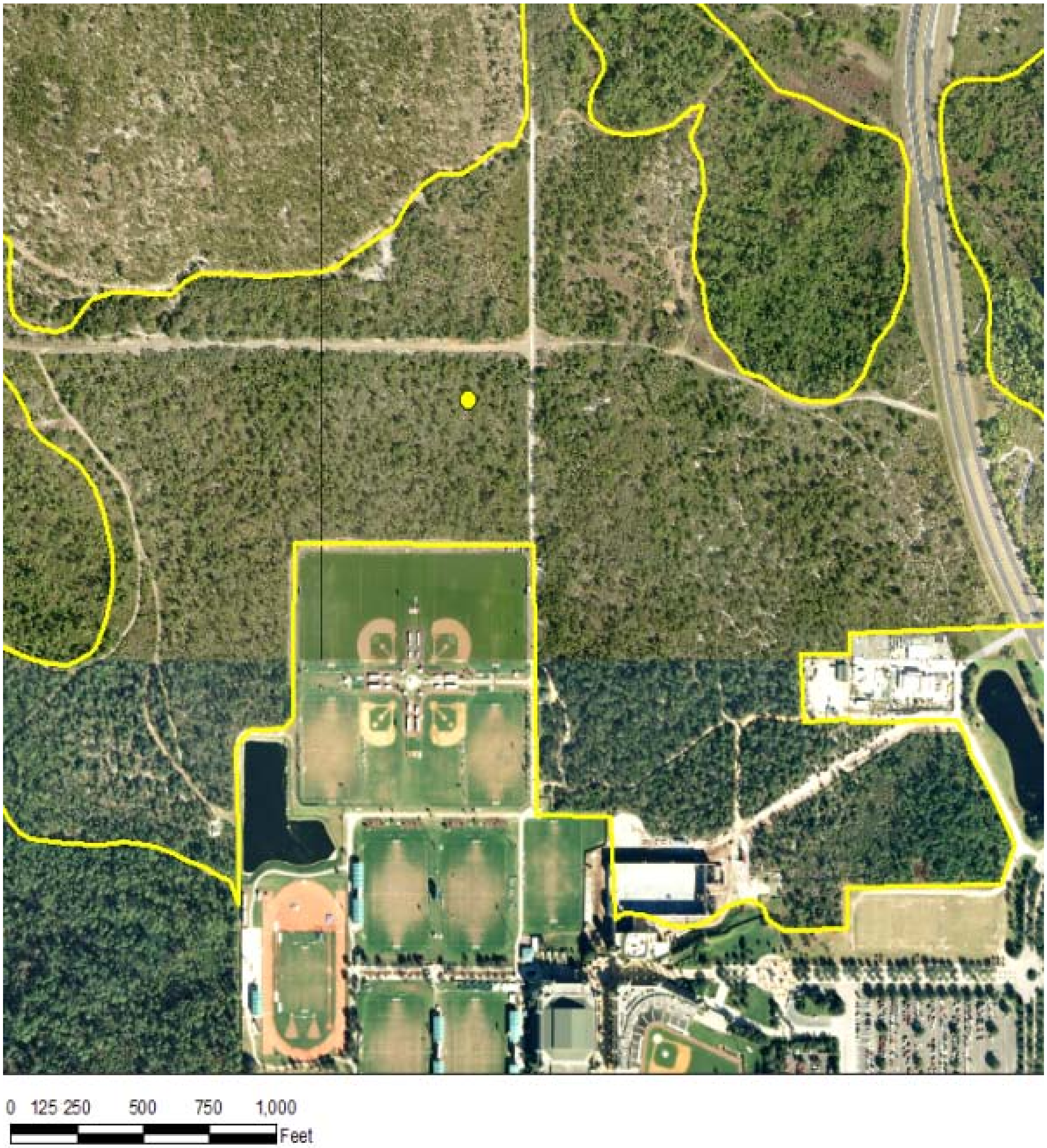
This is a **Land Cover** class. It does not normally require a separate **Land Use** code. However, where this class occurs in association with a mapped land use, a separate **Land Use** code may be required. Examples: 1180 Rural Residential, 1920 Inactive Land with Street Pattern, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land and 1850 Parks and Zoos.

## CIR DOQQ IMAGE



0 125 250 500 750 1,000
Feet

## NATURAL COLOR IMAGE




**COORDINATES**
476523.58 1457839.75 (Images

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
388803.05 727125.26 (Field Picture)

# 4130
# Sand Pine

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4100 Upland Coniferous Forests
**LEVEL 3: 4130 Sand Pine**

## DESCRIPTION

This class includes sand pines, generated either naturally or by aerial seeding. The canopy closure must be **25 percent or more** and the trees must average over 20 feet tall at the time of photography.

The distribution of sand pine limits this community to the following areas within the District: coastal and former dune ridges immediately inland of the coast in Broward, Palm Beach, and Martin Counties; St. Lucie County except the southwestern areas around Lake Okeechobee; all but southeast and south central Osceola County; Orange, Polk, Highlands, and Charlotte Counties; western Glades and Lee Counties; coastal Collier County.

## KEYS TO PHOTOINTERPRETATION

- A root disease complex gives many sand pine stands a disheveled appearance. Its dark crown coloration distinguishes it from other southern pines.
- Many stands have a uniform appearance due to the even-aged growth habit of this species. This may produce a carpet-like appearance and even-toned signature, which is medium green (dark red or purplish in color on CIR).
- Crowns are usually dense and overlapping in clusters, with a patchy distribution.
- The canopy may be tightly packed or open with visible patches of sand.
- Sand pine occurs on hilly terrain and sandy soils. Rolling topography should be evident on the aerials or topography maps.

## CONTEXT

- **Landscape Position** - As with the Longleaf Pine-Xeric Oak, this community occurs on the rolling sandhill areas and former dunes both inland and along the coast. Rolling topography should be evident on the photo or the USGS Quad collateral data. Examples may be found embedded within urban areas or tend to occupy higher positions grading downslope to 2110-2130 Pastures, 4110 Pine Flatwoods, 4120 Longleaf Pine-Xeric Oak, or more mesic to wet communities such as 6110 Bay Swamps.
- **Vegetation** - Dominant species include sand pine, sand live oak, other xeric oaks, rosemary, saw palmetto and various grasses and forbs.
- **Soils** - Occurring on deep, very well drained to excessively drained sandy soils of old dunes and ridges.
- **Hydrology** - This community has a deep water table and never experiences inundation unless during severe storm surge or catastrophic flooding.

## SIMILAR CLASSES

- 4110 Pine Flatwoods - The scrubby pine flatwoods on drier soils may appear similar.
- 4120 Longleaf Pine - Xeric Oak - The pine canopy is taller and a mid-story canopy of oaks is present.

## SPECIAL MAPPING CONVENTIONS

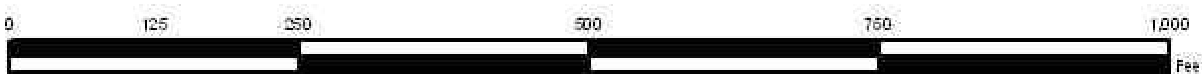
Trees may occur in an herbaceous or shrub matrix which covers up to 75% of the area. The trees may be scattered and dispersed in the matrix as individual trees or small (<5 acre) patches. If distinct patches of trees or other classes are greater than 5 acres, they are broken out separately.

In transitional areas where species-specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

4130 is a **Land Cover** class. It does not normally require a separate **Land Use** code. However, where sand pine occurs in association with a mapped land use, a separate **Land Use** code may be required. Examples: 1180 Rural Residential, 1920 Inactive Land with Street Pattern, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land and 1850 Parks and Zoos.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
387652.66 706589.92

# 4140
# Pine - Mesic Oak

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4100 Upland Coniferous Forests
**LEVEL 3: 4140 Pine - Mesic Oak**

## DESCRIPTION

This class includes naturally generated forests of slash pine and mesic oaks. The canopy closure must be **25 % or more** and the trees must average over 20 feet tall at the time of photography.

The Pine - Mesic Oak class often forms a transitional community between other communities and wetlands associated with lakes, rivers or streams. Pine and oak "hammocks" may also be left in unimproved pastures as shade for cattle.

Oaks must be well represented (at least 33% of the species) for this code to be applicable.

## KEYS TO PHOTOINTERPRETATION

- Open (>25% aerial cover) sparsely stocked, asymmetrical but generally rounded, "fluffy" crowns with feathered edges of pines (brick red to brownish red on CIR); more rounded and symmetrical crowns (red to dark red on CIR) of the oaks.
- Understory tones are variable, but generally greenish returns with pink CIR hues mixed in from grasses and low shrubs.
- In some instances, smooth areas are visible within or as part of the canopy layer resulting from grape vines growing in and on the trees (bright reds on CIR).

## CONTEXT bright reds

- **Landscape Position** - This community can be found almost anywhere in the project area where mesic conditions exist and trees have not been cleared.
- **Vegetation** - Slash pine dominates this land cover type with laurel oak, water oak and some live oak as the typical species mixed with the pines.
- **Soils** - This land cover type occurs on well drained to somewhat poorly drained mineral soils, usually acidic sands. Fairly high amounts of organic matter are common in the surface layers.
- **Hydrology** - This community is typically dry to moist with a seasonal high water table below the soil surface. Inundation and saturation are unlikely except following extreme storm events or in areas where the community forms the transition from wetland to upland and flooding occurs.

## SIMILAR CLASSES

- 4110 Pine Flatwoods - Oaks or other hardwood species, if present, will be less than 33% of the area.
- 4120 Longleaf Pine - Xeric Oak - Often a sparse canopy of pines, with sandy areas visible through the canopy

## SPECIAL MAPPING CONVENTIONS

Trees may occur in an herbaceous or shrub matrix which covers up to 75% of the area. The trees may be scattered and dispersed in the matrix as individual trees or small (<5 acre) patches. If distinct patches of trees or other classes are greater than 5 acres, they are broken out separately.

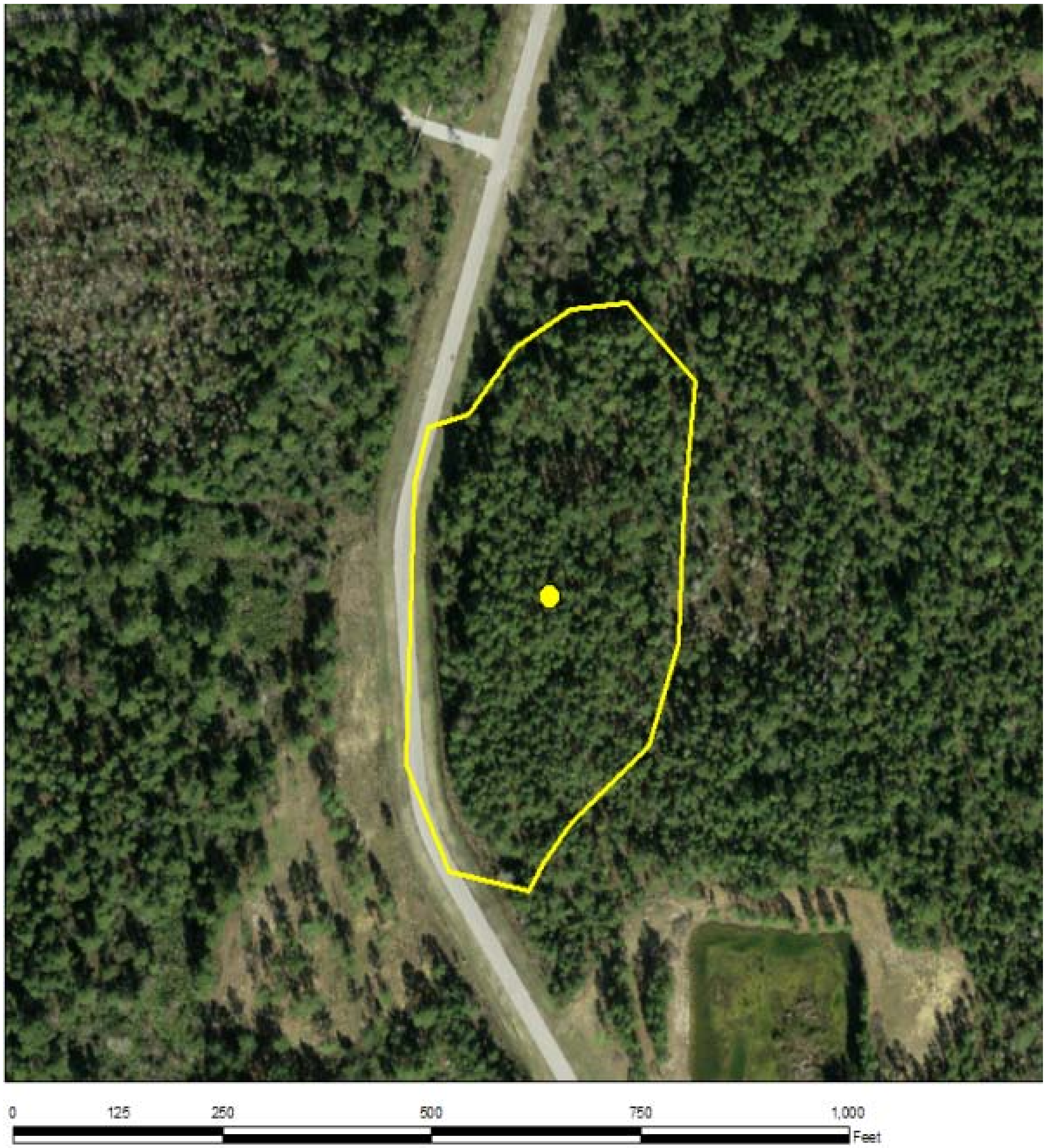
In transitional areas where species-specific wetland (2 acre) and upland (5 acre) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

This is a **Land Cover** class. It does not normally require a separate **Land Use** code. However, where this class occurs in association with a mapped land use, a separate **Land Use** code may be required. Examples: 1180 Rural Residential, 1920 Inactive Land with Street Pattern, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land and 1850 Parks and Zoos.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
n/a

**COORDINATES**
435641.93 143641.93

# 4200
# Upland Hardwood Forests

LEVEL 1: 4000 Upland Forests
**LEVEL 2: 4200 Upland Hardwood Forests**

## DESCRIPTION

This Level 2 class includes upland hardwood forests that do not meet the requirements of a more specific Level 3 or Level 4 subclass. The canopy closure must be **25 % or more** with at least 67 % dominance by hardwood species. The trees must average over 20 feet tall at the time of photography.

The Uplands Hardwoods class may include forest communities such as oak-pine-hickory, Brazilian pepper, live oak, wax myrtle-willow (non-hydric), mixed temperate or tropical hardwoods and beech-magnolia. Xeric oaks and cabbage palm forests must be broken out separately. Note that 4370 Australian pine, although a hardwood species, is not included here.

Uplands forests are naturally generated and do not include hardwood plantations or planted groves of citrus or pecans. However, almost all forests are subject to human influence, and the composition of the forests is, to a large or small degree, determined by management factors.

## KEYS TO PHOTOINTERPRETATION

- The canopy closure must be **25 % or more** with at least 67 % dominance by hardwood tree species.
- Up to 33% of the canopy may be comprised of coniferous species, generating a characteristic brick red return on CIR throughout the year.
- Hardwoods usually have large radial crowns and exhibit a fluffy and textured tone. The mixture of hardwood species may generate a slight variety of green tones on natural color. Healthy, growing deciduous trees will give a strong, bright red CIR return.
- Hardwoods are deciduous and are subject to a period of winter dormancy. This dormancy period provides a contrast in color tones between hardwoods and conifers. The seasonal changes are often rapid, and PIs must pay careful attention to the date of photography in order to interpret the signatures properly.

## CONTEXT

- **Landscape Position** - Hardwood forests are found throughout the District wherever hydrology, fire, and management practices permit. Forests may be found on any of the land uses and may occur as inclusions in most of the other land cover types. They may occur as scattered individual trees, as denser patches or both.
- **Vegetation** - see respective subclasses
- **Soils** - see respective subclasses
- **Hydrology** - see respective subclasses

## SIMILAR CLASSES

- 2130 Woodland Pastures - Pasture will show evidence of grazing.
- 2200 Tree Crops - Trees are grown in rows.

- 4340 Upland Mixed Coniferous / Hardwood - Some mixed classes may appear similar if coniferous species make up only a small portion of the area.

## SPECIAL MAPPING CONVENTIONS

Trees may occur in a matrix of herbs, shrubs and other cover types, which can cover up to 75% of the area. The trees may be scattered and dispersed in the matrix as individual trees or small (<5 acres) patches. If distinct patches of trees or other classes are greater than 5 acres, they are broken out separately.

In transitional areas where species-specific wetland (2 acre) and upland (5 acre) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

4200 is a **Land Cover** class. It does not normally require a separate **Land Use** code. However, where hardwood forests occur in association with a mapped land use, a separate **Land Use** code may be required. Examples: 1180 Rural Residential, 1920 Inactve Land with Street Pattern, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land and 1850 Parks and Zoos.

## CIR DOQQ IMAGE

0 125 250 500 750 1,000

Feet

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
01/09/07

**COORDINATES**
952803.03 762580.54

# 4210
# Xeric Oak

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4200 Upland Hardwood Forests
**LEVEL 3: 4210 Xeric Oak**

## DESCRIPTION

This class includes forest communities dominated by Xeric Oaks. The canopy closure must be **25% or more** with at least 67% dominance by xeric oak species, which include bluejack oak, turkey oak and sand post oak. The trees must average over 20 feet in height at the time of photography.

Trees are low in height and are not dense in coverage, in contrast to mesic oak forests. In openings between trees, various xeric herbs and shrubs are present, including wire grass, bluestems, saw palmetto, rusty lyonia and prickly pear cactus.

This forest community is similar to and occupies the same sites as the 4120 Longleaf Pine - Xeric Oak community except that the pines, if present, are not the dominant species. On many sites, longleaf pines may have been prevalent prior to harvesting but have never regenerated, leaving the xeric oak mid-story intact.

## KEYS TO PHOTOINTERPRETATION

- Color tones are dull, grayish-green on natural color; medium red to brownish red on CIR photography.
- Bare patches of sandy soil should show through tree canopy in at least a few places.
- Shrubs and herb species give a variable return depending on composition of species and time of year. It is generally greenish magenta or the light, washed out pinks of semi-dormant vegetation on CIR.

## CONTEXT

- **Landscape Position** - This land cover type is found on old dunes and sandy ridges in the interior of the state. They grade downslope into more mesic communities such as flatwoods, mesic hammocks and drainages or wetlands.
- **Vegetation** - Several species of xeric oaks such as turkey oak, bluejack oak and sand post oak are found as dominants in this land cover type. Shrubs and herbaceous species found in association may include wire grass, bluestems, saw palmetto, rusty Lyonia and prickly pear cactus.
- **Soils** - The cover type occurs on excessively drained infertile sandy soils of former dunes and ridges.
- **Hydrology** - This land cover type is excessively drained and on slightly higher positions in the landscape. Available water is low and inundation does not occur.

## SIMILAR CLASSES

- 3300 Mixed Upland Non-Forested - Will have more varied tree species
- 4120 Longleaf Pine - Xeric Oak - Pine will be the dominant species

## SPECIAL MAPPING CONVENTIONS

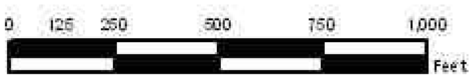
Trees may occur in an herbaceous or shrub matrix which covers up to 75% of the area. The trees may be scattered and dispersed in the matrix as individual trees or small (<5 acres) patches. If distinct patches of trees or other classes are greater than 5 acres, they are broken out separately.

In transitional areas where species-specific wetland (2 acre) and upland (5 acre) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

This is a **Land Cover** class. It does not normally require a separate **Land Use** code. However, where xeric oak forests occur in association with a mapped land use, a separate **Land Use** code may be required. Examples: 1180 Rural Residential, 1920 Inactive Land with Street Pattern, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land and 1850 Parks and Zoos.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/04/07

**COORDINATES**
493569.87 1350938.22

# 4220
# Brazilian Pepper

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4200 Upland Hardwood Forests
**LEVEL 3: 4220 Brazilian Pepper**

## DESCRIPTION

This exotic, pestilent tree species is found on peninsular Florida from the Tampa Bay area southward.

Brazilian pepper grows on a broad range of sites in South Florida, ranging from mangroves to pinelands. It thrives on disturbed soils and in newly created habitats resulting from drainage and farming. It is an early invader of disturbed sites, and it also becomes established in the understory of dense forests, then capturing the site when gaps occur in the canopy.

Brazilian pepper is a potential canopy tree in almost any forest in Florida.

The canopy closure must be **25 % or more** with at least 67% or more dominance by Brazilian pepper for inclusion in this class.

## KEYS TO PHOTOINTERPRETATION

- Medium to bright green (bright red on CIR), "fluffy," asymmetrical crowned shrubs of medium height.
- Shrubs are unevenly spaced, tend to clump and are of different ages and heights giving a "cottony" and mottled pattern to the area.

## CONTEXT

- **Landscape Position** - This community is disturbance dependent. Accordingly, it can occur anywhere within the landscape where disturbance or man's influence results in acceptable conditions for establishment of this aggressive and invasive exotic shrub. The community can be found along almost every roadway and canal throughout the district. Areas of former agriculture or abandoned development are also prime targets for invasion by this species.
- **Vegetation** - Brazilian pepper is the dominant species. Other shrubs and scattered trees may be interspersed depending on the community type previously occurring at the site prior to disturbance and the level to which that community has been removed. In the case of an invasion of native communities (in the advanced stages), almost any mixture of species may be found. Brazilian pepper must be the dominant species, however, before this classification can be applied.
- **Soils** - Generally disturbed, but can be on almost any soil type in wet to mesic areas.
- **Hydrology** - Variable; may occur from areas experiencing inundation to areas which only experience high water tables. Also found in well drained situations such as spoil areas.

## SIMILAR CLASSES

- 3200 Upland Shrub and Brushland - Context should be carefully examined to distinguish this class from Brazilian pepper, which thrives on disturbed soils and in habitats created by drainage and farming.
- 6172 Mixed Shrubs - Hydric Brazilian Pepper has same signature but is coded as 6172

## SPECIAL MAPPING CONVENTIONS

Brazilian pepper is considered a Forested class, even though it may appear in shrub form (less than 20 feet tall).

Brazilian pepper wetland communities are coded as 6172 Mixed Shrubs with the Brazilian Pepper modifier applied.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
01/11/07

**COORDINATES**
906502.19 1088169.60

# 4240
# Melaleuca

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4200 Upland Hardwood Forests
**LEVEL 3: 4240 Melaleuca**

## DESCRIPTION

This exotic tree species occurs in almost pure stands. It is an aggressive competitor, invading and often taking over a site, forming a dense and impenetrable stand.

It grows along roadsides, on ditch banks, in mesic prairies, in sawgrass marshes and on lake shorelines. Melaleuca generally is an indicator of a disturbed site. It becomes established more readily on sand than on marl but can survive on any disturbed soil in southern Florida.

The canopy closure must be 25% or more with at least 67% or more dominance by Melaleuca for inclusion in this class.

## KEYS TO PHOTOINTERPRETATION

- Dark grey-green (dark red on CIR) colors with a texture represented by a very narrow spike-like or pin-like appearance and very tightly packed or crowded together.
- Trees are of fairly even age, at least in sections of the community (i.e., younger and shorter trees may be present, especially near edges, but otherwise trees are of approximately same height).

## CONTEXT

- **Landscape Position** - This exotic species is very aggressive. It is generally found in conjunction with some form of disturbance, but is also seen in areas which may appear relatively undisturbed. Disturbance in remote, and particularly wetland areas, is often caused by off-road vehicles or logging.
- **Vegetation** - This species forms monotypic stands which are devoid of other vegetation and virtually impenetrable.
- **Soils** - Can be found on a wide variety of soil types including moderately well drained to poorly-drained sands. Disturbed soil types and soils of urban or agricultural areas also support this community.
- **Hydrology** - May occupy sites from dry uplands to lower positions which experience prolonged inundation during the wet season.

## SIMILAR CLASSES

- 4110 Pine Flatwoods - Pines have more rounded, asymmetrical and "feathered" canopies.
- 4370 Australian Pine - These have a fluffy, overlapping crown pattern; they overtower and crowd out other vegetation.

## SPECIAL MAPPING CONVENTIONS

**NONE**

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
03/15/07

**COORDINATES**
814441.21 997893.22

# 4270
# Live Oak

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4200 Upland Hardwood Forests
**LEVEL 3: 4270 Live Oak**

## DESCRIPTION

This class includes upland hardwood forests where Live Oak is found in pure stands or is dominant. This forest community is often referred to as upland temperate hammock.

The canopy closure must be **25 % or more** with at least 67% or more dominance by Live Oak for inclusion in this class.

## KEYS TO PHOTOINTERPRETATION

- Dull, medium-dark green (medium red on CIR) color return with a predominantly fluffy and irregular crown texture in which individual crowns are discernable.
- In some examples of this community, brighter green vines growing among the tree crowns may be evident (bright reds on CIR).
- Some cabbage palm may also be mixed into this community with the typical lollipop textured signature interspersed (pinkish or washed out pink-red on CIR).
- Palms must be only a minor component of this class.

## CONTEXT

- **Landscape Position** - This community occurs mainly in the northern portions of the project area and is generally found within 2110 Improved Pastures and 2120 Unimproved Pastures. It is also common along the upper banks of lakes and streams.
- **Vegetation** - Live oak is purely dominant in this community with vines (predominantly grape) also occurring and some cabbage palm as minor components. As these communities are generally in pastures, livestock impacts to understory vegetation are severe.
- **Soils** - This community typically occurs on fine sands which are well drained to somewhat poorly drained.
- **Hydrology** - Water tables are typically well below the surface in these communities, but may rise to near surface levels during wet periods. Inundation and surface saturation are rare occurrences.

## SIMILAR CLASSES

- 2130 Woodland Pastures - Where grazing is evident **within** the Live Oak community, 2130 is used. Evidence of grazing in adjacent pastures may not be sufficient to conclude this is occurring.
- 4200 Upland Hardwood Forest - The canopy is dominated by mixed hardwood species; Live Oak is less than 67% of the canopy.
- 4300 Upland Mixed Forest - Includes coniferous species, but neither hardwoods nor conifers achieve 67% of the canopy.

## SPECIAL MAPPING CONVENTIONS

None

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/04/07

**COORDINATES**
503951.72 1434316.35

# 4271
# Oak - Cabbage Palm Forests

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4200 Upland Hardwood Forests
LEVEL 3: 4270 Live Oak
**LEVEL 4: 4271 Oak - Cabbage Palm Forests**

## DESCRIPTION

This class is characterized by a closed canopy of hardwood species, primarily Live Oak and Cabbage Palm, that are naturally protected from fire by its position on the landscape.

This community has been heavily impacted by human activity, primarily clearing for agriculture and urbanization. Soils and understory vegetation, which are often the only shaded habitat in a landscape of prairie, pasture, pineland or marsh, are often trampled and compacted by cattle.

The canopy closure must be **25 percent or more** with at least 67% or more dominance by the **combination** of Live Oak and Cabbage Palm for inclusion in this class. (NOTE: If either Live Oak or Cabbage Palm individually makes up 67% of an area, it is classified as either 4270 Live Oak or 4280 Cabbage Palm.)

## KEYS TO PHOTOINTERPRETATION

- A combination of the dull, medium-dark green (medium red on CIR) color return of Live Oak, with its predominantly fluffy and irregular crown texture in which individual crowns are discernible and the lollipop-shaped, lighter colored Cabbage Palms (pinkish-red to washed-out red on CIR).
- In some examples of this community, brighter green (bright red on CIR) vines occurring on the tree crowns may be evident.
- The signature of live oaks and cabbage palm is stable, as they do not go through long dormancy periods. Live oak experiences only brief periods of dormancy.

## CONTEXT

- **Landscape Position** - This community is found primarily in four landscape positions: (1) as "islands" in a pine-cypress or pine-graminoid dominated community; (2) as "islands" on elevated areas within floodplain wetlands; (3) on levees of rivers; (4) midslope or ecotonal between xeric communities and low-lying wetland communities.
- **Vegetation** - Live Oak and Cabbage Palm are consistently present and are joined by other temperate hardwoods at many sites.
- **Soils** - Soils are somewhat better drained than surrounding or adjacent wetland communities, although dense litter accumulation and a closed canopy maintain relatively high soil moisture conditions at most times.
- **Hydrology** - Inundation and surface saturation are rare occurrences.

## SIMILAR CLASSES

- 2130 Woodland Pastures - Where grazing is evident **within** the Oak - Cabbage Palm community, 2130 is used. Evidence of grazing in adjacent pastures may not be sufficient to conclude this is occurring.
- 4200 Upland Hardwood Forests - Less than 67% of canopy is Live Oak and Cabbage Palm.

- 4280 Cabbage Palm - The canopy is 67% or more Cabbage Palm.
- 4340 Upland Mixed Coniferous / Hardwood - Less than 67% of canopy is Live Oak and Cabbage Palm.
- 6180 Cabbage Palm Wetland - signatures may appear similar-refer to soils data.

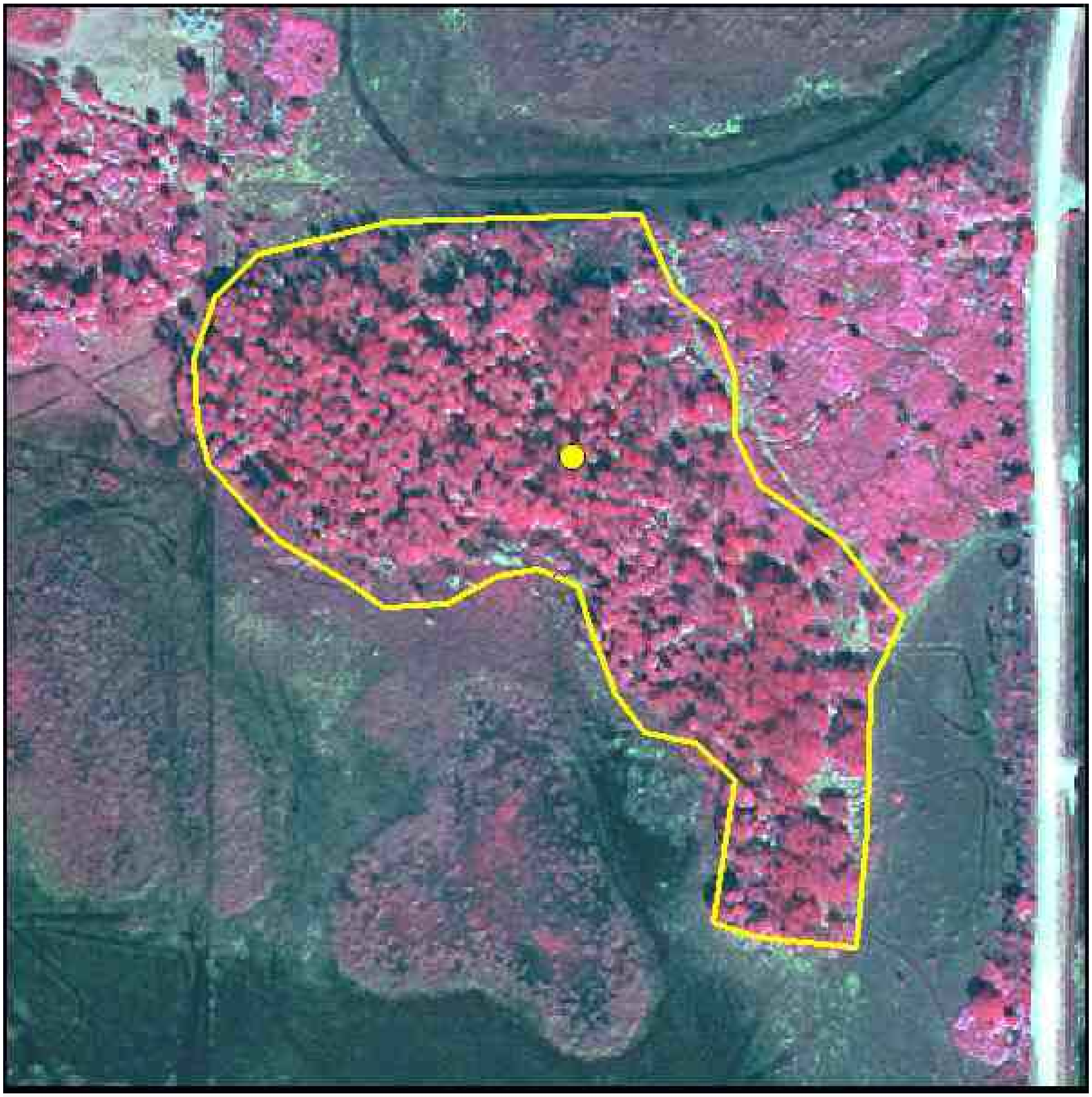
## SPECIAL MAPPING CONVENTIONS

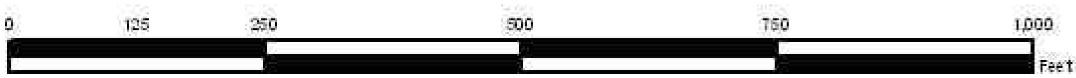
NONE

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use c**ode is not required.

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
638104.75 1142065.72

# 4280
# Cabbage Palm

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4200 Upland Hardwood Forests
**LEVEL 3: 4280 Cabbage Palm**

## DESCRIPTION

This forest community is commonly found as hammock communities on shallow rises within prairie communities. They are often intermixed with live oaks and may include a wide variety of large and small hardwoods. Understory vegetation tends to be sparse.

The canopy closure must be **25% or more** with at least 67% or more dominance by cabbage palms for inclusion in this class. The trees must average over 20 feet in height at the time of photography.

Cabbage palms occupy lower mesic positions on the landscape. Cattle grazing may be present on some sites.

## KEYS TO PHOTOINTERPRETATION

- Cabbage palm trees on aerial photos have small, round shape. CIR signatures are pinkish-red to washed out red.

## CONTEXT

- **Landscape Position** - Islands of cabbage palms are often located within pasture areas or dry prairies. This species grows well in transitional zones between hydric and mesic soils.
- **Vegetation** - This community is comprised of a virtual monoculture of cabbage palm with an occasional live oak possibly mixed in. As with live oak hammocks, livestock use within the cabbage palm hammocks is generally high and understory vegetation is sparse or absent. In South Florida, cabbage palm may be associated with slash and/or longleaf pine.
- **Soils** - The soils are usually alkaline due to underlying calcareous marl or limestone. Also, fine well drained sands will support cabbage palm.
- **Hydrology** - Inundation and surface saturation are rare occurrences.

## SIMILAR CLASSES

- 2130 Woodland Pastures - Where grazing is evident **within** the cabbage palm community, 2130 is used. Evidence of grazing in adjacent pastures may not be sufficient to conclude this is occurring.
- 4271 Oak-Cabbage Palm Forest - Less than 67% of canopy is cabbage palm.
- 4340 Upland Mixed Coniferous/Hardwood - Some mixed forests may appear similar if there is a significant presence of cabbage palm.
- 6180 Cabbage Palm Wetland - signatures may appear similar-refer to soils data.

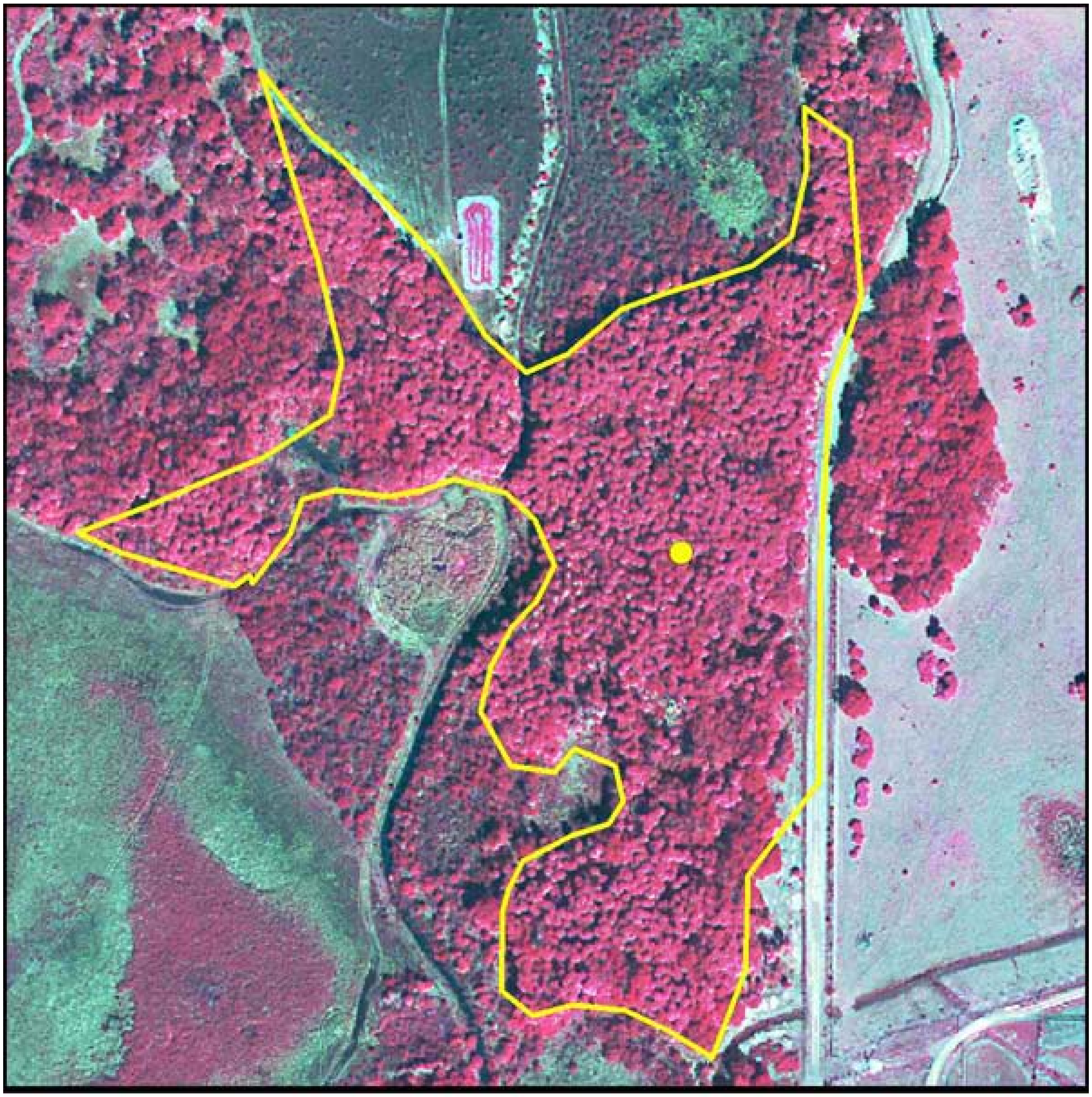
## SPECIAL MAPPING CONVENTIONS

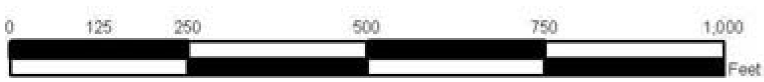
None

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
01/11/07

**COORDINATES**
610729.77 1156787.81

# 4300
# Upland Mixed Forests

This Level 2 class is not active in the map itself. One of the two active subclasses must be selected. The two subclasses are:

4340 Upland Mixed Coniferous/Hardwood
4370 Australian Pine

## DESCRIPTION

The SFWMD definition of forest requires a tree canopy closure of **25% or more**. Trees are woody plants that are over 20 feet tall in their growth stage at the time of photography. Immature trees that are under 20 feet tall are considered shrubs.

## MAPPING CONVENTIONS

Trees may occur in an herbaceous or shrub matrix which covers up to 75% of the area. The trees may be scattered and dispersed in the matrix as individual trees or small (<5 acre) patches. If distinct patches of trees or other classes are greater than 5 acres, they are broken out separately.

In transitional areas where species-specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

**Minimum mapping units:** The minimum mapping unit (MMU) for all upland forest classes is 5 acres.

**Differentiating subclasses:** The two active subclasses are distinct from each other in appearance. Australian pine grows as a monoculture and has a distinctive signature.

## DUAL CODING CONVENTION

These are **Land Cover** classes. They do not normally require a separate **Land Use** code. However, where hardwood forests occur in association with another mapped land use, a separate **Land Use** code may be required. Examples: 1180 Rural Residential, 1920 Inactive Land with Street Pattern, and possibly 1650 Reclaimed Mine Land and 1670 Abandoned Mine Land.

## SIMILAR CLASSES

Upland Mixed forests can easily be confused with Upland Hardwood or Upland Conifer forests in cases where the proportion of either is close to 67%. This proportion is difficult to judge, considering the infinite variety of forest expression and similarity of species signatures on aerial photography. The criteria explained above under Mapping Conventions helps to address this problem.

Upland mixed forests can be easily confused with 6170 Mixed Wetland Hardwoods. Various species, including pines and cabbage palms, can stretch across the wetlands boundary and canopy signatures do not always indicate a clear hydric/non-hydric boundary. The problem is addressed with experience, ancillary data, magnified stereo viewing and field checking.

Upland mixed forests may also be confused with woodland pastures and non-forested uplands. These classes often border each other, making delineation of transitional zones sometimes inexact.

**For more information:**

See the PI keys for each of the subclasses for more details and graphic examples.

# 4340
# Upland Mixed Coniferous / Hardwood

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4300 Upland Mixed Forests
**LEVEL 3: 4340 Upland Mixed Coniferous / Hardwood**

## DESCRIPTION

This class includes those forested areas in which neither upland conifers nor hardwoods achieve 67% crown canopy dominance. The 4340 code is applied when the area cannot be broken down into individual hardwood or conifer species. This can be due to minimum mapping unit constraints or that the intermixture of species is such that precise delineation would result in overly complex linework.

The canopy closure must be 25% or more and the trees must average over 20 feet tall at the time of photography.

## KEYS TO PHOTOINTERPRETATION

- A mixture of crown types is present - both large radial hardwood and smaller compact coniferous crowns with neither one being dominant (67% or more).
- As a result of the mixture of species, signatures are typically a complex blend of colors, textures, and crown shapes.
- On CIR photography conifers will appear as dull brick red to purple-red in color and hardwoods will exhibit bright red returns.
- Texture will be a mixture of smooth, cottony broad-leaved hardwoods, pin-like crowns of broad-leaved evergreens such as bays and rounded to "jagged" crowns of species of pine.
- Color returns will be a variety of green tones on natural color, with CIR returns of greenish, bluish, reds and dark brownish reds of all these varied species.

## CONTEXT

- **Landscape Position** - Mixed forests often occur on the upland areas adjacent to streams, waterways or surrounding wetland depressions. They can occur in almost any forested area with mesic soil conditions.
- **Vegetation** - The Uplands hardwoods component may include forest communities such as oak-pine-hickory, Brazilian pepper, live oak, wax myrtle-willow (non-hydric), mixed temperate or tropical hardwoods and beech-magnolia. Upland pine component includes slash, longleaf and sand pines.
- **Soils** - Generally found on mineral soils.
- **Hydrology** - Moist sites should support this community type in non-wetland situations.

## SIMILAR CLASSES

- 4110 Pine Flatwoods - Pines are the dominant species, with at least 67% canopy dominance.
- 4120 Longleaf Pine - Xeric Oak - Crown canopy is dominated by pine with a mid-story of oak and sandy areas are visible.
- 4200 Upland Hardwood Forests - Hardwood species dominate with at least 67% cover.

## SPECIAL MAPPING CONVENTIONS

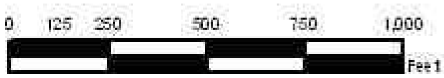
Trees may occur in an herbaceous or shrub matrix which covers up to 75% of the area. The trees may be scattered and dispersed in the matrix as individual trees or small (<5 acres) patches. If distinct patches of trees or other classes are greater than 5 acres, they should be delineated separately.

In transitional areas where species-specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

4340 is a **Land Cover** class. It does not normally require a separate **Land Use** code. However, where mixed forests occur in association with a mapped land use, a separate **Land Use** code may be required. Examples: 1180 Rural Residential, 1920 Inactive Land with Street Pattern, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land and 1850 Parks and Zoos.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
05/08/07

**COORDINATES**
460650.80 604147.00

# 4370
# Australian Pine

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4300 Upland Mixed Forests
**LEVEL 3: 4370 Australian Pine**

## DESCRIPTION

This class is used for Australian pine communities. The canopy closure is 25% or more with at least 67% dominance by Australian pine trees. Trees average at least 20 feet tall.

This class grows in tall, dense monocultures that preclude other vegetation.

Contrary to its name, this species is actually a hardwood that is also evergreen. Its name is derived from its needle-like leaves and its characteristic cone-shaped crown structure.

Australian pine was introduced to south Florida from Australia and is colonizing northward, where it is most common on disturbed sites and along the coasts. Coastal occurrences can be found on spoil areas and throughout the barrier islands. It tends to invade newly exposed sandy areas and is frequently planted as wind breaks and soil stabilizers.

## KEYS TO PHOTOINTERPRETATION

- Australian pine forms dense thickets. The texture is similar to dense broad-leaved canopies, with a fluffy overlapping crown pattern.
- This signature is variable with respect to color return. In some areas, generally inland, this community provides a bright red color while coastal occurrences result in a dark brownish red on CIR return. Natural color ranges from dull darker to medium green.
- The trees overtower and crowd out all other vegetation. Other species generally occur only at the edges of the Australian pine stands.

## CONTEXT

- **Landscape Position** -
- This community is another exotic invasive which is replacing native vegetation in areas of disturbance. Coastal occurrences can be found on spoil areas and throughout the barrier islands. Inland, this species has been planted as wind breaks and later escaped into areas of other disturbance such as agriculture and off road vehicle use.
- **Vegetation** - Australian pine is a mono-cultural community which precludes all other vegetation. The only other species occurring are found around the edges as the size of the community expands.
- **Soils** - Soils on which this community are found are highly variable. In coastal areas the substrate is made up of fine sands and shelly sand. Inland communities are found on fine sands of varying permeability and disturbance.
- **Hydrology** - Australian pine communities are an upland habitat type. Inundation and high water tables are infrequent and the exception rather than the rule.

## SIMILAR CLASSES

- 4200 Upland Hardwood Forests - Will have more varied tree species, with correspondingly diverse signatures.

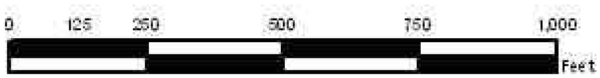
## SPECIAL MAPPING CONVENTIONS

NONE

## DUAL CODING CONVENTION

4370 is a **Land Cover** class. The LCCODE and LUCODE are usually the same. However, where Australian pine occurs in association with a mapped land use, a separate **Land Use** code may be required. Examples: 1180 Rural Residential, 1920 Inactive Land with Street Pattern, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land and 1850 Parks and Zoos.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

0 125 250 500 750 1,000 Feet

## FIELD PICTURE

**DATE**
01/08/07

**COORDINATES**
961117.92 746138.47

# 4400
# Tree Plantations

LEVEL 1: 4000 Upland Forests
**LEVEL 2: 4400 Tree Plantations**

## DESCRIPTION

This Level 2 class includes any tree plantations that do not meet the requirements of a more specific Level 3 subclass. It does not include tree crops such as citrus and pecan groves, which produce food crops, and it does not include tree nurseries. Trees from this class are harvested for lumber, pulp and other wood products, and not for food.

Most of the plantation acreage in the District is classified as 4410 Coniferous Plantation or 4430 Forest Regeneration Areas.

Plantations are almost universally planted in rows, which is the primary difference between plantations and "natural" forests. Recognizing the various types of tree plantations is a process of elimination. Plantations in this class do not have the characteristic signatures of pine plantations or orchards, for instance.

## KEYS TO PHOTOINTERPRETATION

- Ancillary data may be required to break these plantations out from similar classes.
- Christmas tree plantations have smaller size trees on generally smaller sites, with a patchy appearance due to harvesting patterns. Multiple species are typically present, in contrast to pine plantations.
- Hardwood plantations have a characteristic hardwood signature, but are planted in rows. Mature pecan groves may have an identical signature.
- Trees are usually grown in parallel rows on tracts of land with definite boundaries conforming to land ownership, section lines, etc.

## CONTEXT

- **Landscape Position** - Tree plantations can occur anywhere in the District, but are more common in rural areas. Retail Christmas tree operations are often on the outskirts of urban areas for better access to consumers.
- **Vegetation** - Species range from pines and associates to melaleuca and eucalyptus.
- **Soils** - Generally found on sandy, acidic soils.
- **Hydrology** - Often on mesic sites with moderate to poor drainage and a high water table during the wet season.

## SIMILAR CLASSES

- 2210 Citrus Groves - A citrus production context will be present.
- 2410 Tree Nurseries - May be container or green houses operations. Numerous varieties are grown in tightly spaced rows.
- 4100 Upland Coniferous Forests - These are not planted in rows.
- 4130 Sand Pine - Has a carpet-like appearance and even-toned signature.

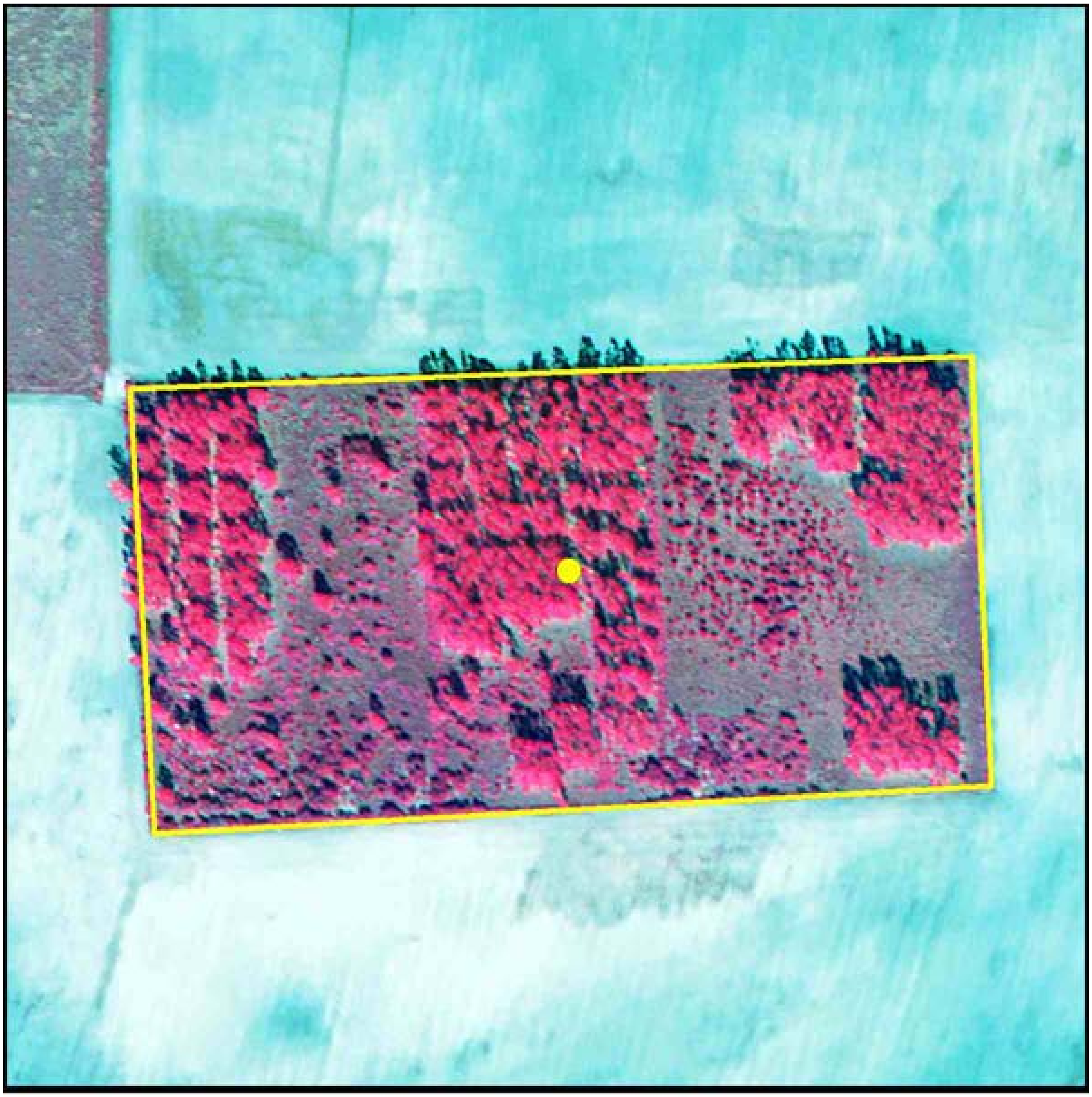
## SPECIAL MAPPING CONVENTIONS

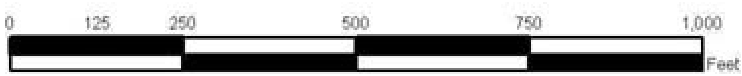
In order to be able to dual code tree plantations with wetlands, 4400 is considered a land use class, in contrast to other forest types. Wetland sites that have been planted over with trees are considered both tree plantation (LUCODE = 4400) and wetland (LCCODE = 6250 or 6300).

## DUAL CODING CONVENTION

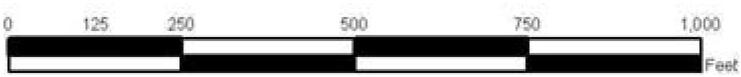
4400 is a **Land Use** class. It does not normally require a separate **Land Cover** code. Exceptions are trees planted over wetland sites as noted above.

## CIR DOQQ IMAGE





## COLOR DOQQ IMAGE



## FIELD PICTURE

**DATE**
11/20/07

**COORDINATES**
515066.34  895743.40

# 4410
# Coniferous Plantations

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4400 Tree Plantations
**LEVEL 3: 4410 Coniferous Plantations**

## DESCRIPTION

This class is used for pine plantations, which consist of pine species planted for purposes of pulp or wood production. The class is relatively easy to recognize due to the characteristic red brick colors, small crowns and straight rows.

Pine plantations are artificially generated by planting seedling stock or seeds. The stands are characterized by high numbers of trees per acre, characteristic red brick color tones and uniform appearance. Row patterns are almost always apparent. Pine plantations may also occur on wetland sites, requiring dual coding.

Young trees will have very narrow crowns as the growth is concentrated in an upward direction. Older plantations having more mature trees resemble flatwoods signatures, but the row pattern is still discernable separating this type from a native pine flatwoods community.

## KEYS TO PHOTOINTERPRETATION

- Straight rows of pine trees exhibit tightly packed crowns of nearly uniform extent.
- The pine canopy has a brick-red signature on CIR return with an even tone, dark green on natural color.
- The understory is visible if trees are not mature. It is generally composed of typical flatwoods species, including saw palmetto and gallberry.
- Pines in wet areas may appear stressed and ragged, but the rows are evident.

## CONTEXT

- **Landscape Position** - Pine plantations occur most often on sites formerly occupied by former flatwoods communities. They may occur in any rural area of the District except areas where highly productive agricultural soils make the area better suited for crop production.
- **Vegetation** - Species of pine and associates typically found in the flatwoods.
- **Soils** - Sandy, acidic soils typical of flatwoods sites.
- **Hydrology** - Often on mesic sites with moderate to poor drainage and high water table during the wet season.

## SIMILAR CLASSES

- 2210 Citrus Groves - Besides characteristic signatures, citrus has a higher intensity management and a citrus production context.
- 2410 Tree Nurseries - May be container or greenhouse operations. Numerous varieties are grown in tightly spaced rows.
- 4100 Upland Coniferous Forests - These are not planted in rows.
- 4130 Sand Pine - Has a carpet-like appearance and even-toned signature.
- 4430 Forest Regeneration - Trees are seedlings or saplings and barely visible on aerial photos.

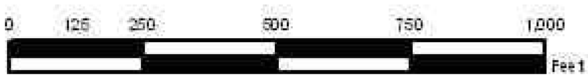
## SPECIAL MAPPING CONVENTIONS

In order to be able to dual code pine plantations with wetlands, 4410 is considered a land use class, in contrast to the other forest types. Wetland sites that have been planted over with pine are considered both pine plantation (LUCODE = 4410 or 4430) and wetland (LCCODE = 6250 or 6300).

## DUAL CODING CONVENTION

4410 is a **Land Use** class. It normally does not require separate **Land Cover** coding. Exceptions are pine planted over wetland sites, as noted above.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
07/14/07

**COORDINATES**
853503.61 478946.19

# 4420
# Hardwood Plantations

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4400 Tree Plantations
**LEVEL 3: 4420 Hardwood Plantations**

## DESCRIPTION

This class includes hardwood forests artificially generated by planting seedling stock or seeds for the purpose of pulp or wood production. The stands are characterized by high numbers of trees per acre and a uniform appearance. Row patterns are almost always apparent.

The typical hardwood species planted in South Florida are melaleuca and eucalyptus. Most other hardwoods are not planted.

Young trees will have very narrow crowns, as the growth is concentrated in an upward direction. Older plantations have more mature trees and more resemble natural forest signatures. However, the row pattern is still discernable, which differentiates this class from a natural forest community.

## KEYS TO PHOTOINTERPRETATION

- Straight rows of trees exhibiting tightly packed crowns of nearly uniform extent.
- The understory is visible if trees are not mature.
- Typical signature of hardwoods with broader, fluffy red colored crowns (on CIR), varying in size and shape depending on the age of the stand and species planted.
- When melaleuca has been planted, stands are often very dense with the typical signature return described under its land cover type description.
- Eucalyptus plantations are not as dense and more individual crowns should be visible. Leaf density of eucalyptus is also generally less than on melaleuca and the signature should be more "feathery" in appearance.

## CONTEXT

- **Landscape Position** - May occur in any rural area of the project limits except those areas of highly productive agricultural soils which are better used for crop production.
- **Vegetation** - Species typically planted in South Florida are melaleuca and eucalyptus. Most other hardwoods are not planted.
- **Soils** - Generally sandy, acidic soils. Melaleuca may be planted on somewhat wetter sites.
- **Hydrology** - Often on mesic sites with moderate to poor drainage and a high water table during the wet season.

## SIMILAR CLASSES

- 2210 Citrus Groves - Besides characteristic signatures, citrus has a higher intensity management and a citrus production context.
- 2410 Tree Nurseries - May be container or green houses operations. Numerous varieties are grown in tightly spaced rows.
- 4100 Upland Coniferous Forests - These are not planted in rows.
- 4130 Sand Pine - Has a carpet-like appearance and even-toned signature.

- 4430 Forest Regeneration - Trees are seedlings or saplings and are barely visible on aerial photos.

## SPECIAL MAPPING CONVENTIONS

In order to be able to dual code hardwood plantations with wetlands, 4420 is considered a land use class, in contrast to the other forest types. Wetland sites that have been planted over with hardwood are considered both hardwood plantation (LUCODE = 4420 or 4430) and wetland (LCCODE = 6170).

## DUAL CODING CONVENTION

4420 is a **Land Use** class. A separate **Land Cover** code is not normally required. Exceptions are hardwoods planted over wetland sites, as noted above.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
03/17/07

**COORDINATES**
4510008.95 1464950.50

# 4430
# Forest Regeneration Areas

LEVEL 1: 4000 Upland Forests
LEVEL 2: 4400 Tree Plantations
**LEVEL 3: 4430 Forest Regeneration Areas**

## DESCRIPTION

These are areas in which it is clear that open areas will be reforested through prescribed silvicultural practices rather than take on another land use or be abandoned. The area may appear disturbed, thus producing a wide variety of photosignatures, depending on the stage of re-growth following timber harvest. The boundaries of this class are somewhat irregular and can meander through an area of existing pine flatwoods.

Windrows of brush may be piled up and visible on the photo, along with bare soil. The soil may show tones ranging from light greys and greens to black, representing standing water. Vehicle ruts and trails from equipment and dragging of trees may also be visible, along with the pink, red and magenta tones (on CIR returns) of herbaceous and shrub re-growth in recently cut over areas.

These areas may be replanted at a later time, but at the time of photography, no positive indication of the intended use of the land is apparent. Surrounding areas of existing plantations and the lack of surrounding development are indicators that forest regeneration is likely to continue, and the 4430 code should be assigned. Signs of site preparation following timber harvest indicate a change in land use to either improved or unimproved pasture. If intensive preparation has been performed and rows of seedlings are not visible, pasture land uses should be considered.

## KEYS TO PHOTOINTERPRETATION

- Saplings must be less than 20' tall and may or may not be visible.
- Understory vegetation or bare soils are visible.
- Signs of fire may be evident.
- Recently clear cut areas with lines of piled up slash and debris indicate regeneration.
- Clearing, site preparation and planting activities are usually done in parallel rows. However, sand pine plantations are aerially seeded, not in rows.
- Pines in wet areas may appear stressed but the rows are still evident.

## CONTEXT

- **Landscape Position** - Pine plantations occur most often on sites formerly occupied by former flatwoods communities.
- **Vegetation** - Species of pine and associates typically found in the flatwoods.
- **Soils** - Sandy, acidic soils typical of flatwoods sites.
- **Hydrology** - Often on mesic sites with moderate to poor drainage and high water table during the wet season.

## SIMILAR CLASSES

- 2210 Citrus Groves - Citrus plots exhibit a higher intensity management and a crop production context.

- 2410 Tree Nurseries - May be container or greenhouse operations. Numerous varieties are grown in tightly spaced rows.
- 4100 Upland Coniferous Forests -These are not planted in rows and are not uniform.
- 4410 Coniferous Plantations - Rows of trees are distinctly visible - trees are over 20 feet tall.

## SPECIAL MAPPING CONVENTIONS

Wetland sites that have been planted over with pine are considered both pine plantation (LUCODE = 4410 or 4430) and wetland (LCCODE = 6250 or 6300). Aids to delineation include 1999 LCLU, SSURGO soil data and NWI wetland maps.

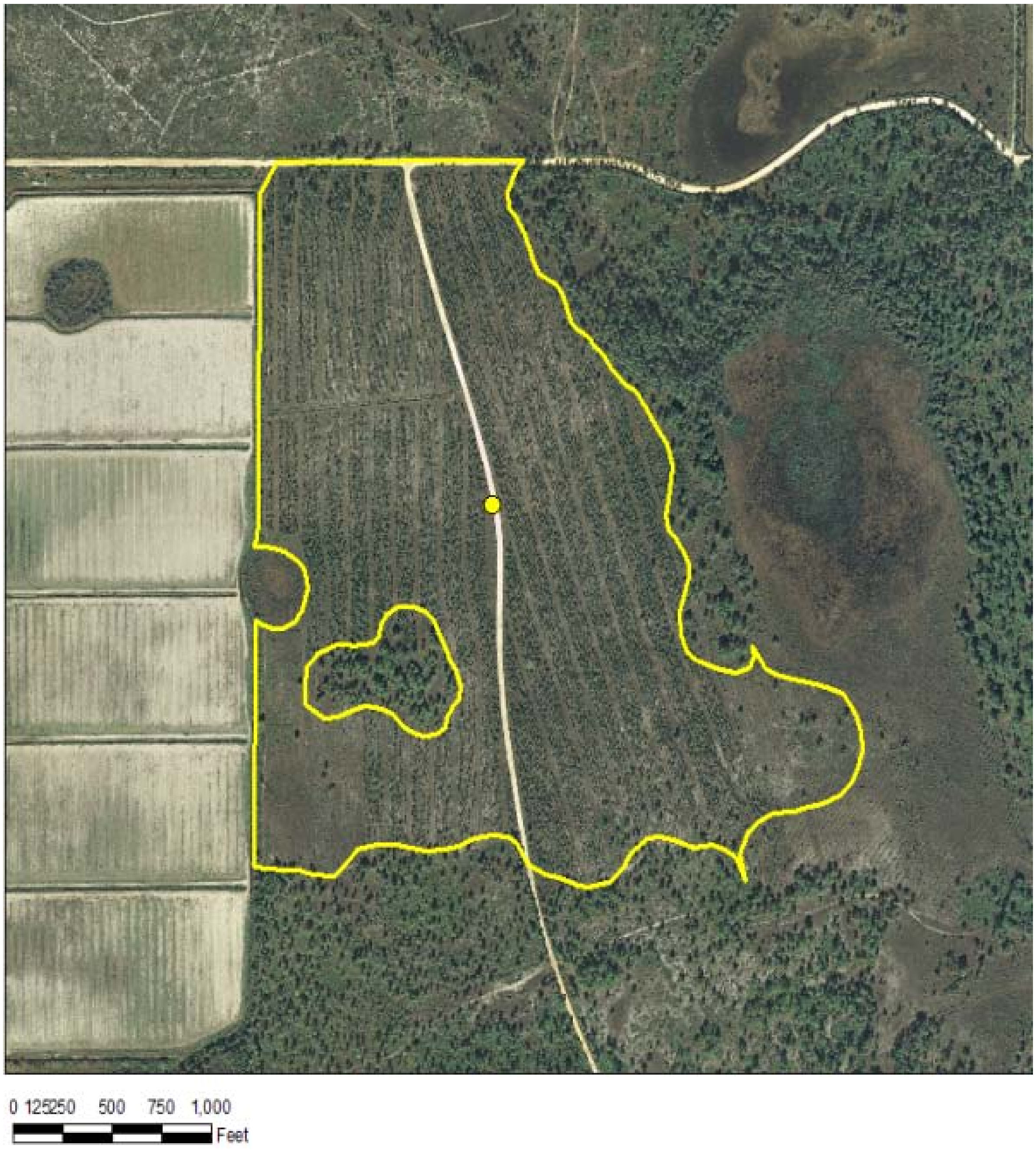
It is assumed that freshly cut over areas where pine has not yet been planted, in the vicinity of established pine plantations, should be coded with LUCODE = 4430 Forest regeneration.

## DUAL CODING CONVENTION

4430 is a **Land Use** class. It normally does not require separate **Land Cover** coding. Exceptions are pine planted over wetland sites, as noted above.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE




**COORDINATES**
466466.02 905472.35 (Images)

## FIELD PICTURE

**DATE**
10/04/07

**COORDINATES**
451769.22  1500910.21 (Field Picture)

# 5000
# Water

This Level 1 class is not active in the map itself - a more specific subclass must be selected. The Level 2 subclasses include:

5100 Streams and Waterways
5200 Lakes
5300 Reservoirs
5400 Bays and Estuaries
5600 Slough Waters
5700 Ocean and Gulf

For details on each subclass (both Level 2 and Level 3) see the respective PI Key pages.

## BACKGROUND

Water is the most important feature in the District's LCLU data layer. It is also one of the easiest to map, due to the almost uniformly deep black signature it presents on CIR photography. The District maps water features as small as 2 acres - the same MMU used for wetlands - and as narrow as 50 feet.

Water features can be problematic, especially between similar classes within the general 5000 category. The main problem is change, including slow changes that render lakes into prairies and vice-versa, and beaches into ocean. Seasonal changes may also turn water bodies into dry land or cause the emergence or disappearance of vegetation. On an hourly basis, the changes in tide can turn ocean into broad tidal flats or salt marsh. And human influence to manage water levels can change the boundaries of water features, causing reservoirs to fill or empty and canals to flow one way or the other. To summarize, water is a dynamic and often transient feature on the flat, wet surface of Florida. The standard solution is to delineate the water bodies as they appear at the time of photography.

## MAPPING CONVENTIONS

Some bodies of water are not classified in the 5000 class. These include: the portions of water bodies with emergent vegetation or floating islands, which are classified in the 6000 Wetlands class; 1660 Extractive Holding Ponds; shoreline areas obscured by 8150 Port Facilities; 2540 Aquaculture; and permanent bodies of water that are temporarily drained. On the other hand, areas that are only temporarily flooded may appear as water bodies due to recent flooding or other factors.

**Minimum mapping units:** The MMU for all 5000 Water classes is 2 acres. Waterways as narrow as 50 feet are included in the map and even narrower segments may be mapped to maintain connectivity.

In transitional areas where species-specific wetland (2acre MMU) and upland (5 acre MMU) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

**Differentiating subclasses:** See **Similar Classes** below and the respective 5000 subclass Key pages.

## DUAL CODING CONVENTION

All the subclasses in the 5000 category are **Land Cover** classes. They do not require a separate **Land Use** code. **Land Cover** and **Land Use** (LCCODE and LUCODE) are always the same.

## SIMILAR CLASSES

Some of the specific difficulties in mapping subclasses in the 5000 Water and 6000 Wetlands classes include the following:

- Reservoirs vs. lakes vs. lagoons and impoundments
- Transportation canals vs. streams and waterways
- Tidal flats vs. salt marsh vs. water
- Enclosed salt water ponds
- Mapping shorelines in coastal areas
- Wetlands vs. water
- Standing water on other land uses, such as agricultural fields
- Rivers vs. long linear bays and inland waterways

The PI Key pages for each of the water and wetlands subclasses indicate how the above issues are resolved. However, no set of decision rules can take all the subjectivity out of the map. As a result, water boundaries, just as with all other classes, do not agree precisely between one data layer and another.

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

Other data layers that delineate water bodies include NWI wetlands, USGS hydrology layers, the National Hydrography Data (NHD) layer, SFWMD Vegetation Data, NRCS soils maps and previous LCLU maps. Each of these has its particular strengths and weaknesses. Imagery and aerial photos can often provide the best confirmation for any given date.

# 5100
# Streams and Waterways

This general Level 2 class is not used in the map itself - a more specific subclass must be selected. The Level 3 subclasses are:

5110 Natural River, Stream, Waterway
5120 Channelized River, Stream, Waterway

## BACKGROUND

This category includes rivers, creeks, canals and other linear water bodies flowing across the landscape within defined channels. They are delineated where they average 50 feet or greater in width. Where the water course is interrupted by a control structure, the impounded water area will be classified as 5300 Reservoirs. The 5100 class includes both natural and modified waterways, as well as man made canals and channels.

## MAPPING CONVENTIONS

**Minimum mapping units:** Waterways are mapped if they are 50 feet or greater in width. Narrower segments are also mapped as needed in order to maintain connectivity. Marine waterways over one mile wide are classified as 5400 Bays and Estuaries.

Water lying under bridges, docks, piers, or other structures is mapped as water.

The boundary between streams and lakes, reservoirs or the ocean is the straight line across the mouth of the stream unless the mouth is more than one mile (1.85 kilometers) wide. In that case, the rule given under 5400 Bays and Estuaries is followed.

## DUAL CODING CONVENTION

All of the 5100 classes are **Land Cover** classes. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## SIMILAR CLASSES

- 5400 Bays and Estuaries - These are inlets of the sea greater than one mile in width. Marine waterways less than one mile in width are classified as 5100 Streams and Waterways.
- 5600 Slough Waters - These are blocked, stagnant, slow moving channels.

# 5110
# Natural River, Stream, Waterway

LEVEL 1: 5000 Water
LEVEL 2: 5100 Streams and Waterways
**LEVEL 3: 5110 Natural River, Stream, Waterway**

## DESCRIPTION

This class includes natural rivers, creeks and other linear water bodies flowing across the landscape within defined channels. They are delineated where they average 50 feet or greater in width. Where the water course is interrupted by a control structure, the impounded water area will be classified as 5300 Reservoirs.

This class includes only natural waterways and not man-made canals and channels.

There is not one conclusive feature separating natural from channelized waterways. The PI must determine whether a water body is **predominantly** natural or channelized.

## KEYS TO PHOTOINTERPRETATION

- Water will generally exhibit a color tone varying from dark blue or black to a medium gray.
- Natural waterways generally follow the landscape and have natural shapes with very few straight edges.

## CONTEXT

- **Landscape Position** - Natural streams and waterways may be found throughout the District draining the surrounding lands.

## SIMILAR CLASSES

- 5120 Channelized River, Stream, Waterway - These are entirely or substantially man made or substantially modified by man.
- 5410 Embayments Opening Directly to Gulf or Ocean - More than one nautical mile in width and have a direct connection to the open sea
- 5420 Embayments Not Opening Directly to Gulf or Ocean - More than one nautical mile in width
- 5600 Slough Waters - These are blocked, stagnant, slow moving channels.

## SPECIAL MAPPING CONVENTIONS

Natural Rivers, Streams and Waterways are mapped if they are 50 feet or greater in width. Narrower segments are also mapped as needed in order to maintain connectivity. Marine waterways over one mile wide are classified as 5400 Bays and Estuaries.

Natural waterways flowing under bridges, docks, piers, or other structures are mapped as water.

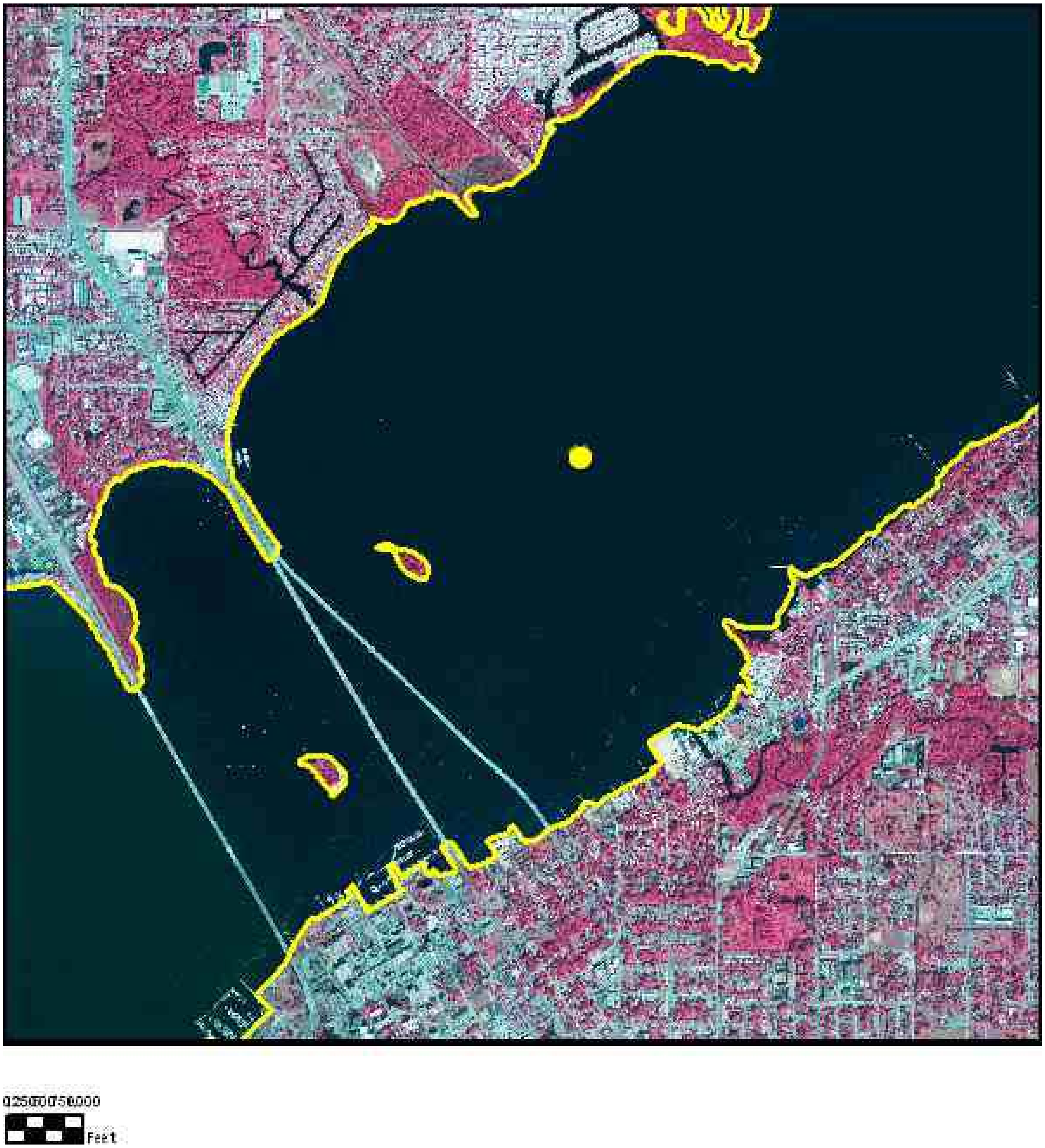
The continuity of roads, highways, and other transportation features that meet the criteria for delineation shall be maintained in cases where they actually bisect a water body. Where continuity of the water body is visible on the photo - such as a bridge over a river or canal - the water body will be delineated and the road or other transportation feature will be broken at the boundary of the water body.

The boundary between natural waterways and lakes, reservoirs or the ocean is the straight line across the mouth of the stream unless the mouth is more than one mile (1.85 kilometers) wide. In that case, the rule given under 5400 Bays and Estuaries is followed.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE


**DATE**
10/15/07

**COORDINATES**
374638.73 847526.77

# 5120
# Channelized River, Stream, Waterway

LEVEL 1: 5000 Water
LEVEL 2: 5100 Streams and Waterways
**LEVEL 3: 5120 Channelized River, Stream, Waterway**

## DESCRIPTION

This class includes artificially improved rivers, creeks, canals and other linear water bodies flowing across the landscape within man-made (or substantially man-made or altered) channels. They are delineated where they average 50 feet or greater in width. Where the water course is interrupted by a control structure, the impounded water area will be classified as 5300 Reservoirs.

This class includes only channelized waterways and not natural rivers, streams and waterways.

There is not one conclusive feature separating channelized from natural waterways. The PI must determine whether a water body is **predominantly** channelized or natural.

## KEYS TO PHOTOINTERPRETATION

- Water will generally exhibit a color tone varying from dark blue or black to a medium gray.
- Shorelines generally have straight or regular shapes for most of their length and may not appear to follow the surrounding topography.

## CONTEXT

- **Landscape Position** - Channelized streams and waterways may be found throughout the District, used for travel, shipping or irrigation.

## SIMILAR CLASSES

- 5110 Natural River, Stream, Waterway - These are entirely or substantially natural and generally follow the surrounding topography.
- 5410 Embayments Opening Directly to Gulf or Ocean - More than one nautical mile in width and have a direct connection to the open sea.
- 5420 Embayments Not Opening Directly to Gulf or Ocean - More than one nautical mile in width.
- 5600 Slough Waters - These are blocked, stagnant, slow moving channels.

## SPECIAL MAPPING CONVENTIONS

Channelized waterways and canals are mapped if they are 50 feet or greater in width. Narrower segments are also mapped as needed in order to maintain connectivity. Marine waterways over one mile wide are classified as 5400 Bays and Estuaries.

Channelized waterways and canals flowing under bridges, docks, piers, or other structures are mapped as water.

The continuity of roads, highways, and other transportation features that meet the criteria for delineation shall be maintained in cases where they actually bisect a water body. Where continuity of the water body is visible on the photo - such as a bridge over a river or canal - the water body will be delineated and the road or other transportation feature will be broken at the boundary of the water body.

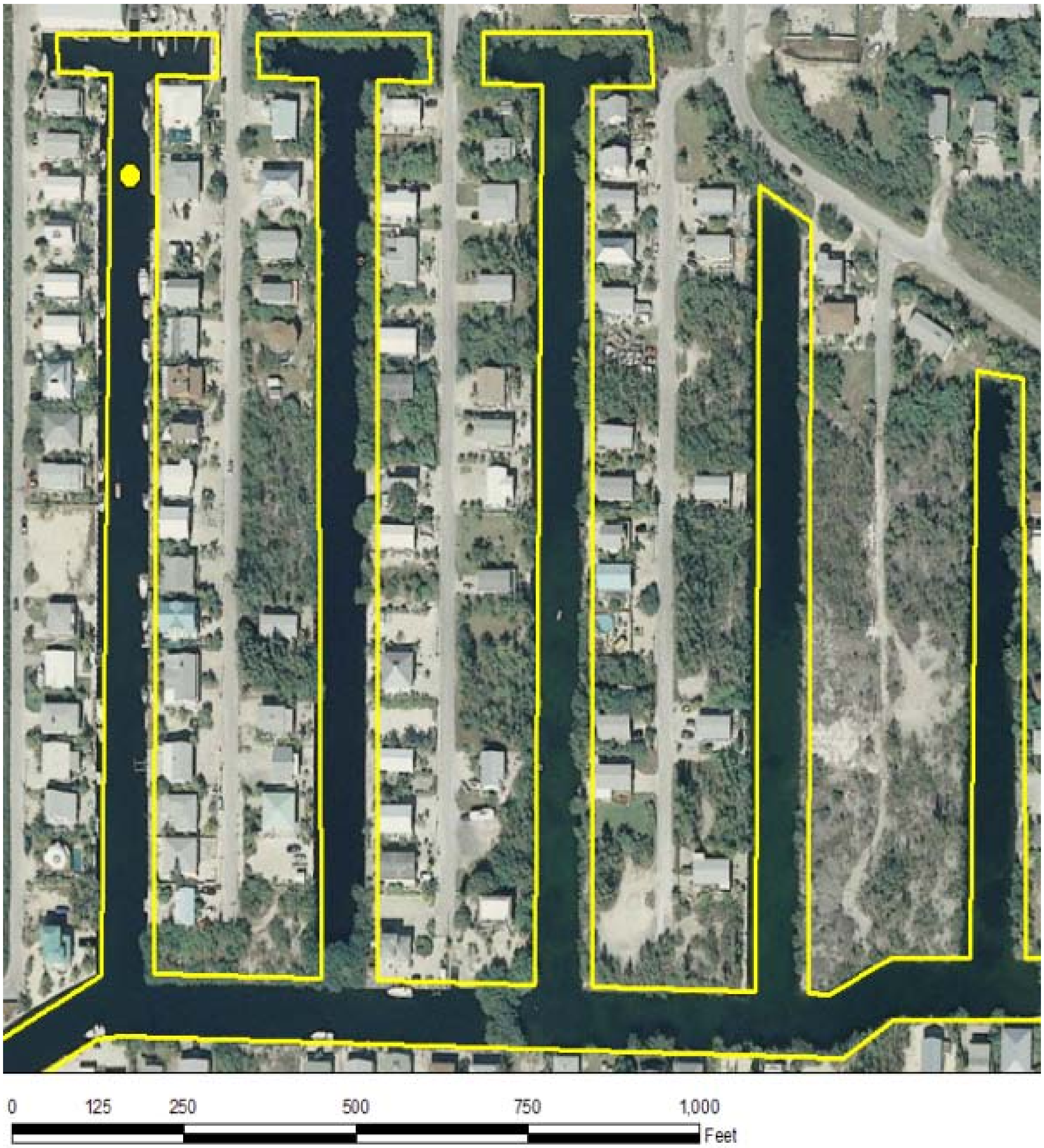
The boundary between this class and other water features such as lakes, reservoirs, or the ocean is the straight line across the mouth of the stream unless the mouth is more than one mile (1.85 kilometers) wide. In that case, the rule given under 5400 Bays and Estuaries is followed.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
05/07/07

**COORDINATES**
534047.84 122023.89

# 5200
# Lakes

LEVEL 1: 5000 Water
**LEVEL 2: 5200 Lakes**

## DESCRIPTION

This class includes freshwater bodies greater than 2 acres in size, that are predominantly natural in origin. It includes all natural bodies of water situated in a depression, excluding reservoirs.

It does not include water bodies that are man-made or extensively modified, which are classed as 5300 Reservoirs. This class also does not include major springs, holding ponds or treatment ponds.

In contrast with reservoirs, water bodies in this class have a natural appearance - curved shorelines, normal vegetation, healthy (black) water tones and few if any control structures. However, the presence of some of these indicators does not necessarily make it a reservoir, since most water bodies are subject to human influence and modification.

The PI must determine if the water body is predominantly natural or man-made, based on the water body's context, functions, indicators and general appearance. There is no precise dividing line, and error costs between 5200 and 5300 are not necessarily high. For larger lakes and those with apparent natural origins, 5200 is the more appropriate code.

The limits of the water are mapped to that shown on the aerial photo and only represent conditions on the date of photography.

## KEYS TO PHOTOINTERPRETATION

- Water will exhibit a varying tone from very dark to medium depending on the turbidity and sediment load of the water.
- Highly turbid waters have a light bluish, greenish or whitish signature due to the reflection from suspended solids in the water (on CIR).
- Shorelines will appear natural and follow the landscape. They may also show evidence of fluctuating water levels on shoreline.

## CONTEXT

- **Landscape Position** - Lakes occur throughout the District, in varying concentrations. Water bodies in highly developed areas are much more likely to be reservoirs. The PI should examine undeveloped areas of the surrounding landscape to see if water bodies are a common feature. Otherwise, they are likely to be man-made.

## SIMILAR CLASSES

- 5110 Natural River, Stream, Waterway - These are linear features.
- 5120 Channelized River, Stream, Waterway - These are linear features, either man-made or substantially altered by man.
- 5300 Reservoirs - These are man-made or significantly altered by man.
- 5430 Saltwater Ponds - Same signature-field verification and collateral data needed.

## SPECIAL MAPPING CONVENTIONS

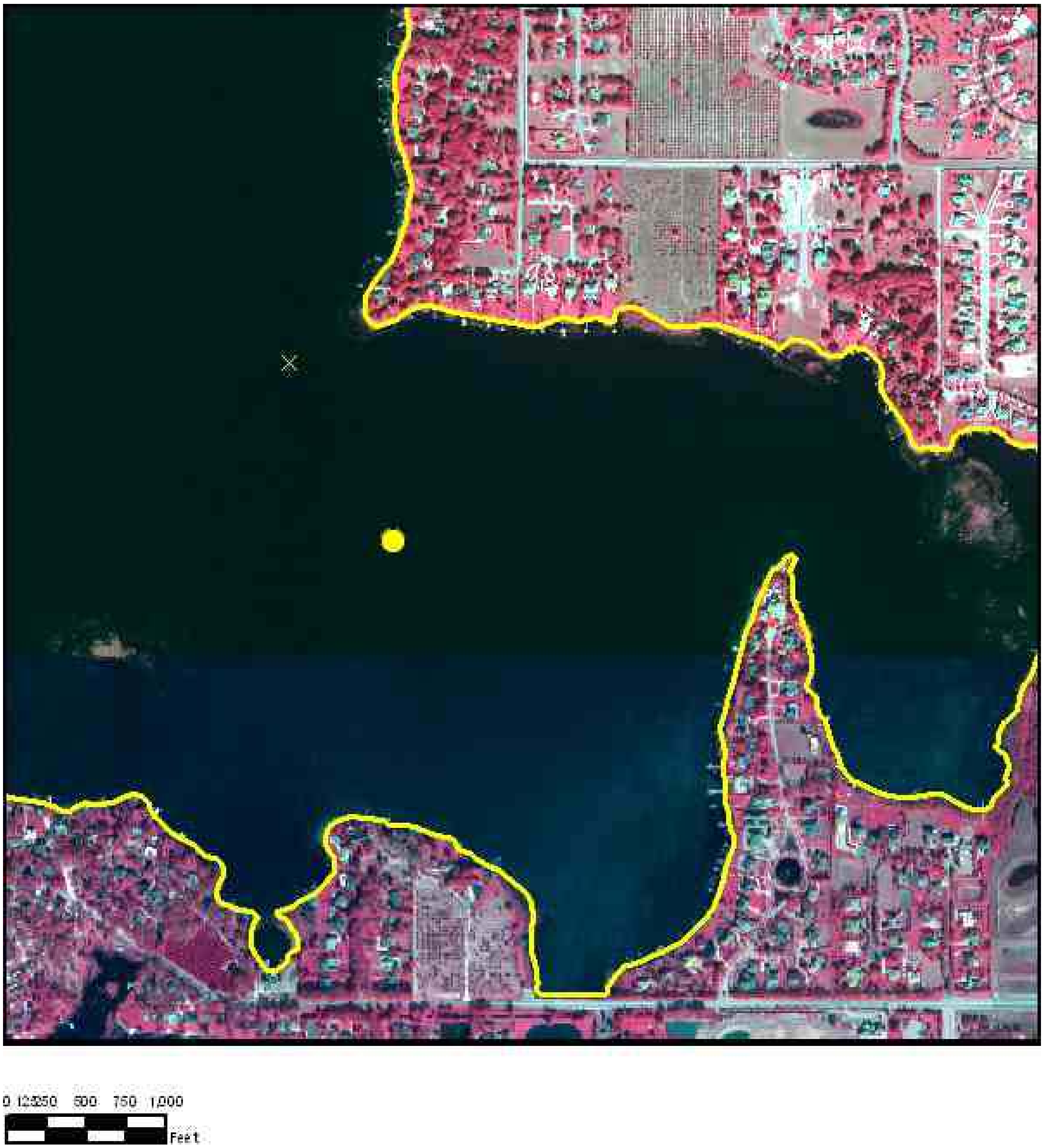
In urban areas, natural lakes may have water control structures to control lake level or discharge. These are still considered 5200 Lakes, rather than 5300 Reservoirs.

Active agricultural areas that are temporarily flooded should be classed as the appropriate agriculture class, not water bodies. The PI should check collateral data to see if these areas are public lands undergoing restoration. Other permanent **land uses** that are temporarily flooded should be given the appropriate land use class, not 5200. An example would be flooded parking lots in a mall or roadways under water. Land covers, in general, that are under water should be classed as open water. Some PI discretion is required to determine whether the flooded condition is typical or highly infrequent and whether it is an appropriate characterization of the mapping unit.

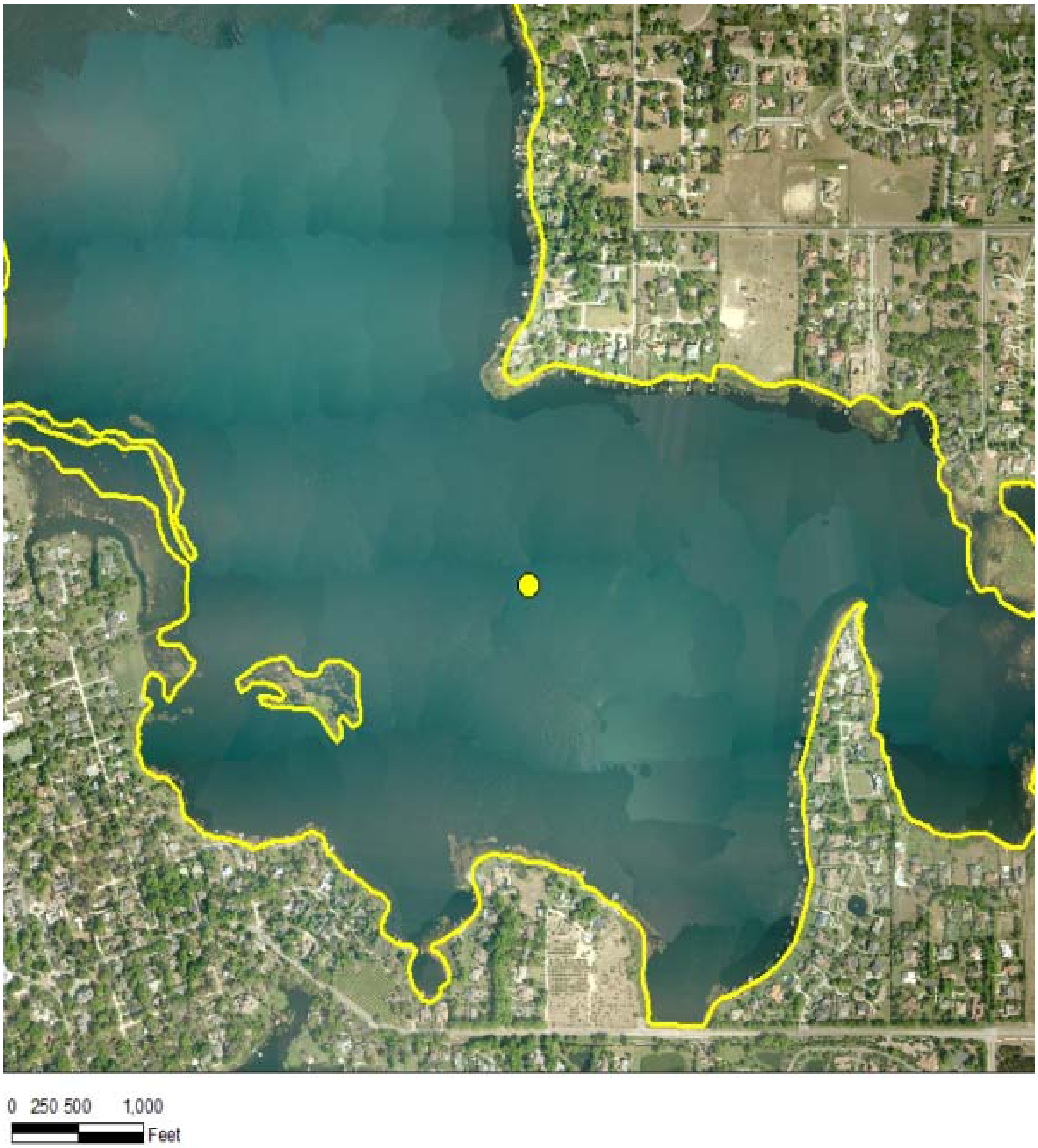
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
10/04/07

**COORDINATES**
488052.05 1515443.09

# 5300
# Reservoirs

LEVEL 1: 5000 Water
**LEVEL 2: 5300 Reservoirs**

## DESCRIPTION

Reservoirs are artificial impoundments of water or water bodies that have been significantly modified from their natural state. They are used for irrigation, flood control, municipal and rural water supplies, stormwater treatment, recreation and hydro-electric power generation. Dams, levees, other water control structures or the excavation itself usually will be evident to aid in the identification.

There is no fine dividing line or conclusive indicator feature to separate lakes and reservoirs. The PI must determine whether a water body is **predominantly** natural or man-made. In cases where a water body was historically present, the PI should classify the polygon as 5200 Lakes.

## KEYS TO PHOTOINTERPRETATION

- Reservoirs are artificial impoundments of water which will often contain a man-made structure on at least one side of the water body.
- Generally, all or part of the shorelines are straight or regular shapes and do not appear to follow the surrounding topography. Linear shapes are uncommon.
- Reservoirs are likely to diverge from the black signature of natural water bodies. Signature and tone of the water will be dependent on turbidity and sediments in the water body.

## CONTEXT

- **Landscape Position** - Reservoirs occur throughout the District, in varying concentrations. Water bodies in highly developed areas are much more likely to be reservoirs. The PI should examine undeveloped areas of the surrounding landscape to see if water bodies are a common feature. Otherwise, they are likely to be man made.

## SIMILAR CLASSES

- 1660 Holding Ponds - Associated with an active mining operation. Holding ponds at abandoned or reclaimed mining sites are considered reservoirs.
- 5200 Lakes - Natural water bodies; shorelines appear natural and tend to follow the landscape.

## SPECIAL MAPPING CONVENTIONS

USGS topographic maps can assist in the determination of whether or not a lake is artificial. New reservoirs, such as those created in subdivisions, may not be delineated on topographic maps, or may look radically different from water bodies on older maps.

This class does not include reservoirs that are part of either the 1600 Extractive or 8300 Utilities classes. These ancillary facilities, when clearly identified as belonging to another land use, should be mapped with that land use.

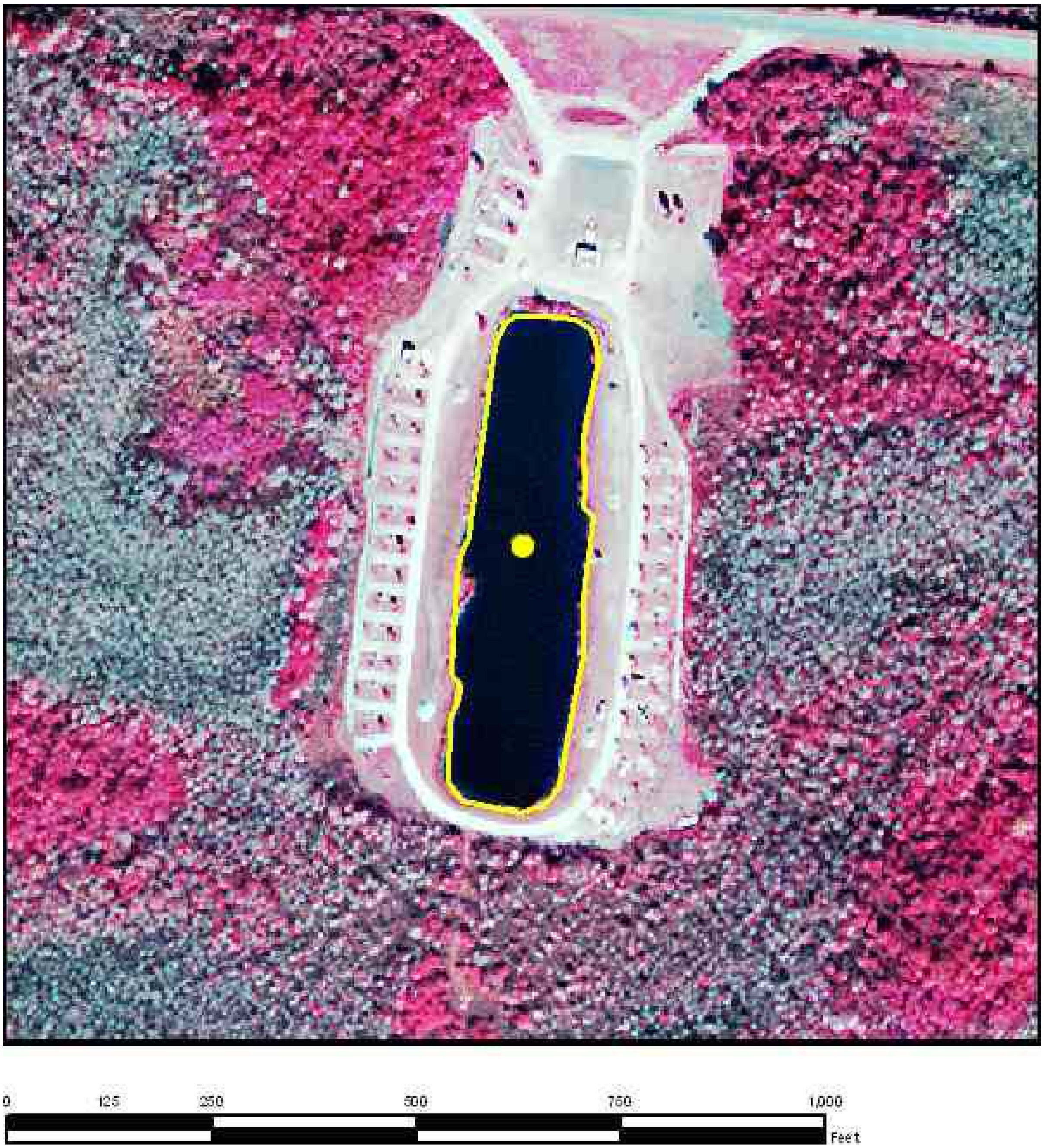
Several emergent marshes exhibit high water conditions at the time the aerial photography was taken. No emergent vegetation visible in these areas. Collateral data may identify these areas as

[6410 Freshwater Marshes]; however, they are coded as [5200 Lakes] or [5300 Reservoirs] due to their <u>open water signature</u>.

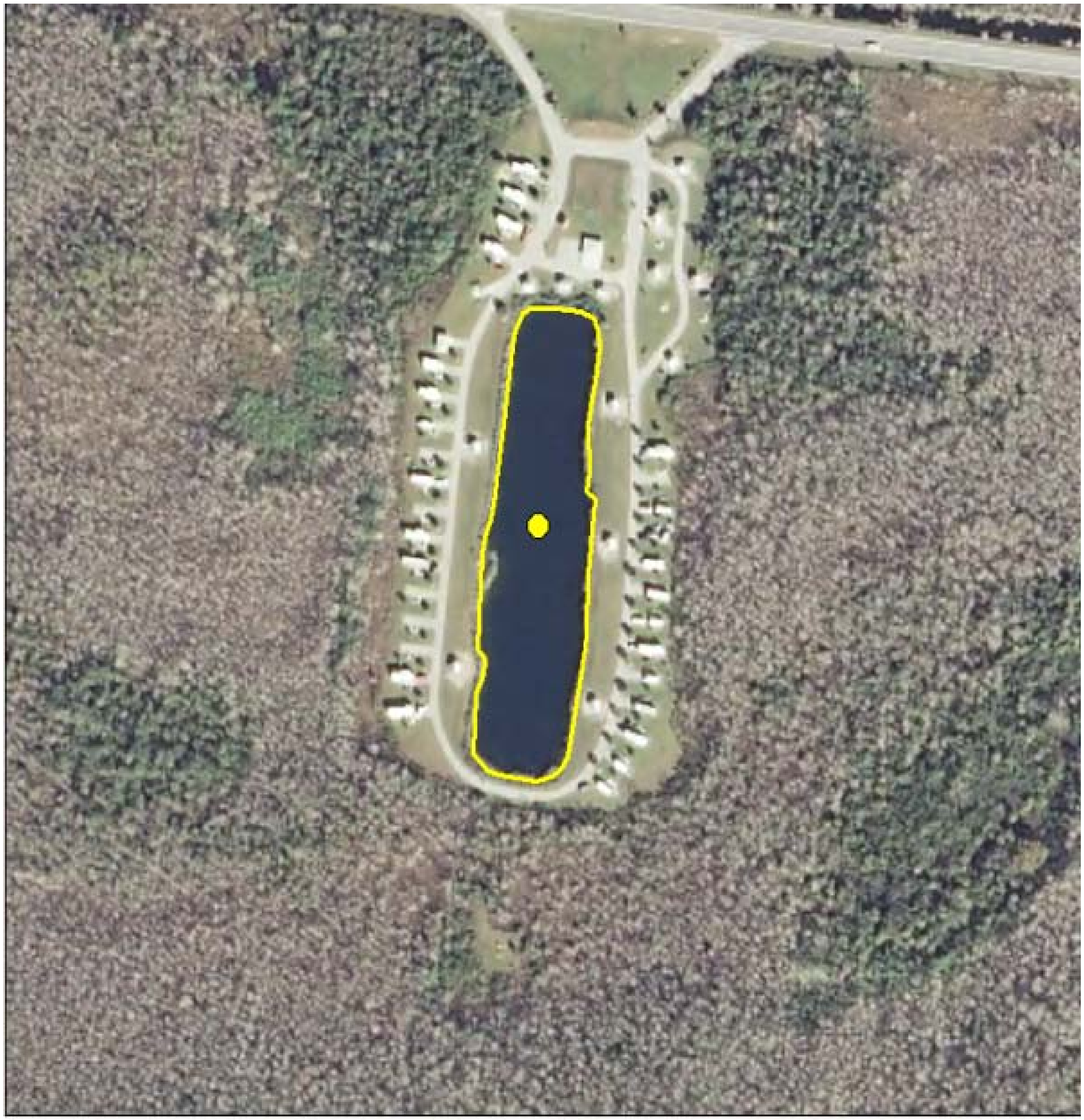
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## COLOR DOQQ IMAGE



## FIELD PICTURE

**DATE**
05/08/07

**COORDINATES**
659608.65 551380.51

# 5400
# Bays and Estuaries

This general Level 2 class is not used in the map itself - a more specific subclass must be selected. The Level 3 subclasses are:

5410 Embayments Opening Directly to Gulf or Ocean
5420 Embayments Not Opening Directly to Gulf or Ocean
5430 Saltwater Ponds

## BACKGROUND

This class is defined as inlets or arms of the sea that extend into the land and are between 1 and 10 nautical miles in width (1.85 to 18.5 kilometers). Embayments less than one nautical mile in width are classed as 5100 Streams and Waterways. Embayments or portions of embayments more than 10 nautical miles in width are not considered as included within the limits of the United States.

Isolated water bodies that have no visible surface connection to adjacent coastal waters are classified as 5200 Lakes. However saltwater ponds are classified as 5430.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit for 5400 classes is 2 acres, except 5430 Saltwater Ponds - the MMU for this class is 5 acres.

**Differentiating subclasses:** See the Level 3 key pages for guidance on how to distinguish these classes.

## DUAL CODING CONVENTION

All of the 5400 classes are **Land Cover** classes. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## SIMILAR CLASSES

- 5100 Streams and Waterways - Less than one nautical mile (1.85 km) in width
- 5200 Lakes - These are independent freshwater bodies
- 5430 Saltwater Ponds - Isolated estuarine water bodies that have no visible connection to adjacent coastal waters
- 5600 Slough Waters - Not connected via open water to any coastal waters
- 6420 Saltwater Marsh - Exhibits emergent estuarine vegetation
- 6510 Tidal Flats - White to whitish grey signature; typically sand or mud, with some scattered vegetation

# 5410
# Embayments Opening Directly to Gulf or Ocean

LEVEL 1: 5000 Water
LEVEL 2: 5400 Bays and Estuaries
**LEVEL 3: 5410 Embayments Opening Directly to Gulf or Ocean**

## DESCRIPTION

Embayments are inlets or arms of the sea that extend into the land.

Water bodies in this class are those which **have a direct connection to the open Gulf of Mexico or the Atlantic Ocean and do not meander great distances up or down the interior of the coast.** Where the feature does turn sharply north or south, and becomes narrow (less than one nautical mile in width) and travels a long way with a strip of land separating it from the open seas, other land cover codes will be used (such as 5420 Embayments Not Opening Directly to Gulf or Ocean, 5110 Natural River, Stream, Waterway or 5120 Channelized River, Stream, Waterway).

They produce a signature typical of water (blackish on CIR photography) unless they contain turbid water, in which case they may appear lighter in color.

The boundary between this class and the open sea will be a straight line connecting the waterward-most headlands drawn across the mouth of the opening, except as noted in Special Mapping Conventions below. In cases where the embayment is so shallowly indented into the land that the area of water enclosed in this manner would be less than that encompassed by a semicircle drawn with the boundary line as its radius, the coastline itself will be the boundary of the coastline and no Bays and Estuaries code will be used.

## KEYS TO PHOTOINTERPRETATION

- Located only in coastal areas.
- Levees may be present.
- Surrounding vegetation is characteristic of saltwater marshes and may include spartina, mangroves and borrichia. Levees may support Brazilian pepper.

## CONTEXT

- **Landscape Position** - This class is only found in coastal locations. Therefore it will only be used for waters directly along the Gulf of Mexico or Atlantic Ocean that are within the project area.

## SIMILAR CLASSES

- 5200 Lakes -These are independent freshwater bodies.
- 5420 Bays and Estuaries Not Opening Directly to Gulf or Ocean - No direct connection to the open Gulf of Mexico or the Atlantic Ocean.
- 5430 Saltwater Ponds - Isolated estuarine water bodies that have no visible connection to adjacent coastal waters.
- 5600 Slough Waters - Channels of slow-moving water in coastal marshland.

## SPECIAL MAPPING CONVENTIONS

In the southernmost part of the project area (the Florida Keys), the boundary between this class and the Gulf of Mexico is a straight line drawn from the southwestern corner of Cape Sable southwest through Mallory Square in Key West and extending to the western edge of the project area.

**The minimum mapping unit for this class is 2 acres.**

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
386334.84 707975.19

# 5420
# Embayments Not Opening Directly to Gulf or Ocean

LEVEL 1: 5000 Water
LEVEL 2: 5400 Bays and Estuaries
**LEVEL 3: 5420 Embayments Not Opening Directly to Gulf or Ocean**

## DESCRIPTION

Embayments are inlets or arms of the sea that extend into the land.

Water bodies in this class are those which **do not have a direct connection to the open Gulf of Mexico or the Atlantic Ocean and may meander up or down the interior of the coast with a strip of land separating the majority of their water surface from the open Gulf of Mexico or Atlantic Ocean.**

They exhibit a signature typical of water (blackish on CIR photography) unless they contain turbid water, in which case they may appear lighter in color.

Where this feature becomes narrow (less than 1 nautical mile) and travels for long distances with a strip of land separating it from the open seas, it should be classified as either 5110 Natural River, Stream, Waterway or 5120 Channelized River, Stream, Waterway.

## KEYS TO PHOTOINTERPRETATION

- Located only in coastal areas.
- Levees may be present.
- Surrounding vegetation is characteristic of saltwater marshes, and may include spartina, mangroves, borrichia. Levees may support Brazilian pepper.
- The flow to the natural seawater system is not impeded by surrounding vegetation.

## CONTEXT

- **Landscape Position** - This class is only found in coastal locations. Therefore it will only be used for waters directly along the Gulf of Mexico or Atlantic Ocean that are within the project area.

## SIMILAR CLASSES

- 5200 Lakes - These are independent freshwater bodies.
- 5410 Bays and Estuaries Opening Directly to Gulf or Ocean - Have a direct connection to the open Gulf of Mexico or the Atlantic Ocean
- 5430 Saltwater Ponds - Isolated estuarine water bodies that have no visible connection to adjacent coastal waters.
- 5600 Slough Waters - Channels of slow-moving water in coastal marshland.

## SPECIAL MAPPING CONVENTIONS

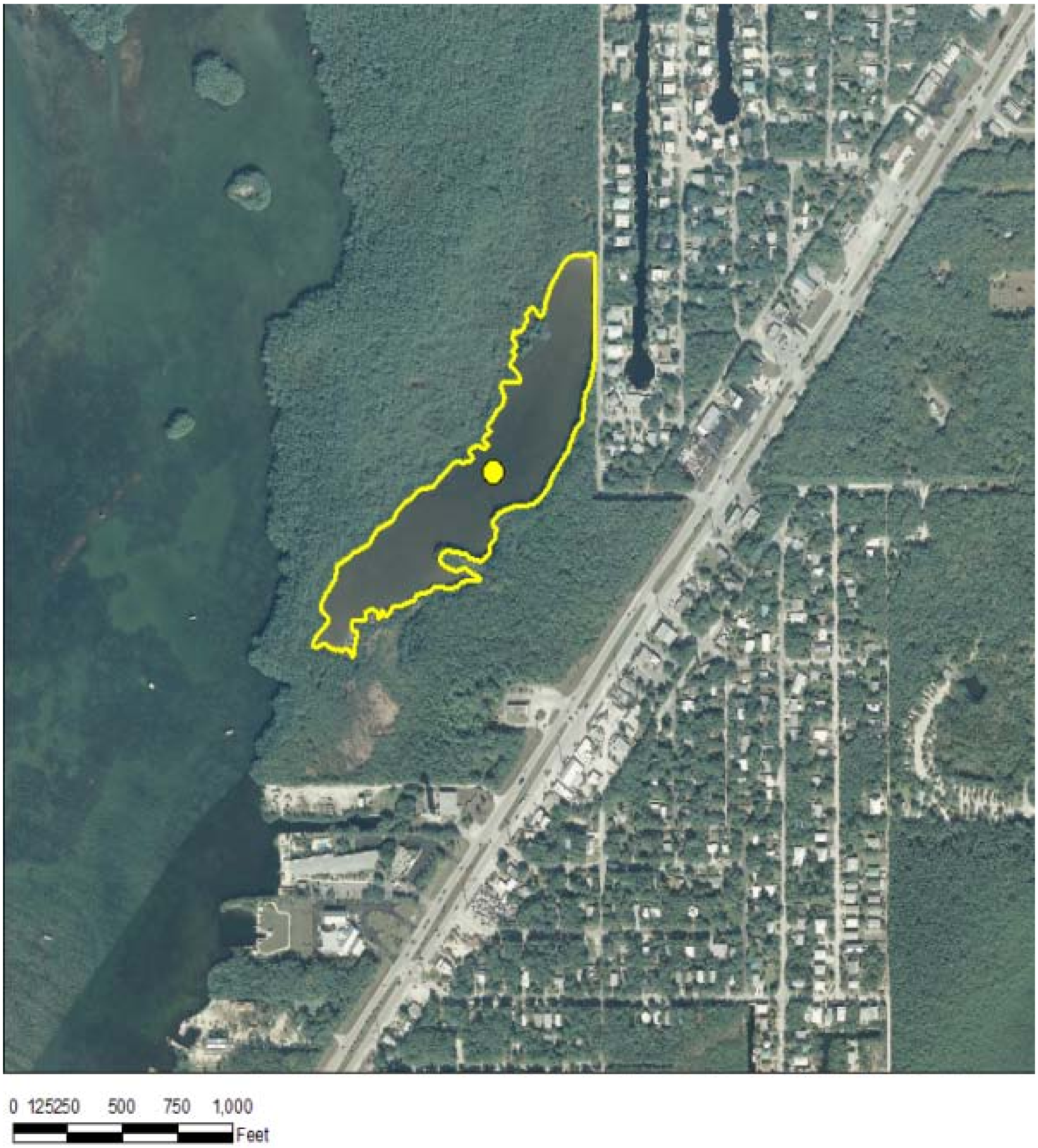
**The minimum mapping unit for this class is 2 acres.**

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
01/16/07

**COORDINATES**
849642.24 288590.37

# 5430
# Saltwater Ponds

LEVEL 1: 5000 Water
LEVEL 2: 5400 Bays and Estuaries
**LEVEL 3: 5430 Saltwater Ponds**

## DESCRIPTION

This code was created by SFWMD and is not part of FLUCCS. It includes natural or artificially enclosed areas of open water within estuarine areas. Groupings of closely-spaced, smaller ponds can be aggregated together to form one polygon five acres in size or greater.

Included are isolated open water areas within estuarine areas that have no visible connection to adjacent coastal waters.

## KEYS TO PHOTOINTERPRETATION

- Located in estuarine areas.
- Levees may be present.
- Surrounding area is dominated by saltwater marsh vegetation and tidal flats. Levees may support Brazilian pepper.

## CONTEXT

- **Landscape Position** - This class occurs only in estuarine areas.

## SIMILAR CLASSES

- 5200 Lakes - Independent freshwater bodies
- 5410 Embayments Opening Directly to Gulf or Ocean - Not impounded
- 5420 Embayments Not Opening Directly to Gulf or Ocean - Not impounded
- 5600 Slough Waters - Not connected via open water to any coastal waters
- 6420 Saltwater Marsh - Exhibits emergent estuarine vegetation

## SPECIAL MAPPING CONVENTIONS

The minimum mapping unit for this class is 2 acres**.**

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE


**COORDINATES**
340447.82 786046.09 (Images)

## FIELD PICTURE

**DATE**
05/08/07

**COORDINATES**
456127.88 602772.33 (Field Picture)

# 5600
# Slough Waters

LEVEL 1: 5000 Water
**LEVEL 2: 5600 Slough Waters**

## DESCRIPTION

Sloughs are generally channels of slow moving water in the coastal marshland. The term also refers to "backwater sloughs" - narrow, often stagnant bodies of water found near inland rivers. Slough waters are made up of extremely slow-moving or stagnant water at the time of photography and ancillary data does not indicate a substantial connection to the main hydrologic system.

Grasses are the most common vegetation in sloughs. Sedges and rushes also occur, with scattered shrubs in some locations.

This class is common in South Florida flatwoods.

## KEYS TO PHOTOINTERPRETATION

- Channels of slow-moving water found in coastal marshland
- Typically appears as dark black ribbons which meander through wetland areas
- Not connected via open water to the river system or estuary
- Water and vegetation may be intermixed in patchy patterns with indistinct boundaries that are difficult to delineate.

## CONTEXT

- **Landscape Position** - Slough waters are found in the context of a flowing system, as opposed to a closed basin. They have minimal elevation drop. They tend to be relatively long and narrow and slightly lower in elevation than surrounding flatwoods and hammocks.
- **Vegetation** - Grasses are the most common vegetation in sloughs. Sedges and rushes also occur.
- **Hydrology** - They are blocked by vegetation, control structures or deposition to the extent that the flow is stagnant. Most sloughs serve as drainageways for water during periods of heavy and prolonged rainfall.

## SIMILAR CLASSES

- 5100 Streams and Waterways - Part of a main hydrologic system
- 5410 Embayments Opening Directly to Gulf or Ocean - Have a direct hydrologic connection to the Gulf of Mexico or the Atlantic Ocean within the project area
- 5420 Embayments Not Opening Directly to Gulf or Ocean - Used only for waters directly along the Gulf of Mexico or Atlantic Ocean within the project area

## SPECIAL MAPPING CONVENTIONS

Large homogeneous inclusions of either water or emergent vegetation must be broken out separately if these features appear as **solid** inclusions with **distinct** boundaries.

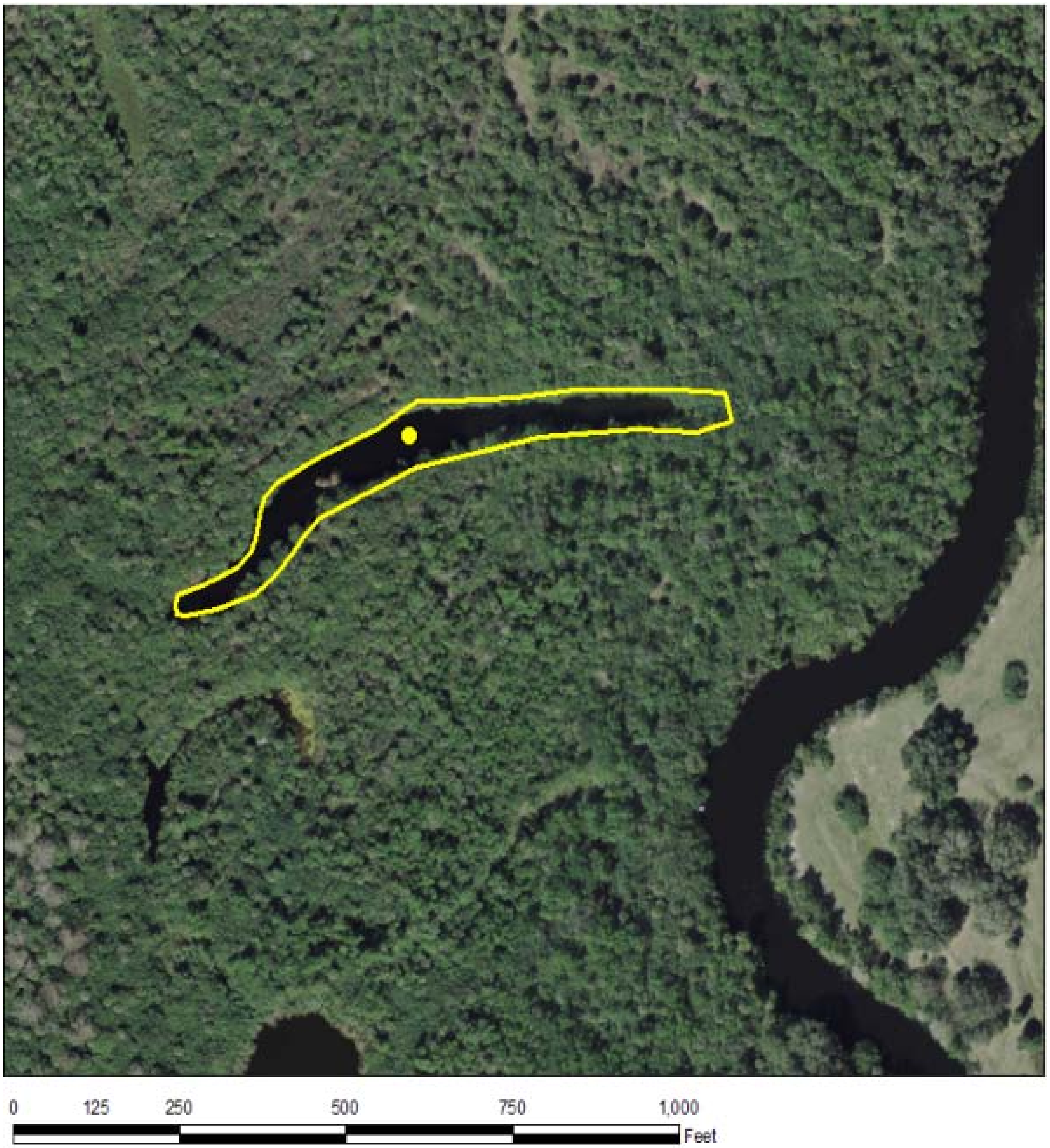
The classification is based on the water levels visible at the date of photography. Ancillary data may show other patterns of vegetation and water, due to changes in hydrology.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE




**COORDINATES**
656141.24 1075642.81 (Images)

## FIELD PICTURE

**DATE**
01/17/07

**COORDINATES**
449097.55  598681.38 (Field Picture)

# 5700
# Ocean and Gulf

This Level 2 class is not used in the map itself - a more specific subclass must be selected. The Level 3 subclasses are:

5710 Atlantic Ocean
5720 Gulf of Mexico

## BACKGROUND

This class is a SFWMD modification of the FLUCCS class 5700 Major Bodies of Water.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit for all water classes is 2 acres.

**Differentiating subclasses:** The Atlantic Ocean and the Gulf of Mexico are separated by Florida Bay.

## DUAL CODING CONVENTION

All of the 5700 classes are **Land Cover** classes. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## SIMILAR CLASSES

The Atlantic Ocean and Gulf of Mexico have the same open water signature as other water features. They are distinguished by their large size and position on the coastlines of the District.

**For more information:**

See the PI keys for each of the subclasses for more details and graphic examples.

# 5710
# Atlantic Ocean

LEVEL 1: 5000 Water
LEVEL 2: 5700 Ocean and Gulf
**LEVEL 3: 5710 Atlantic Ocean**

## DESCRIPTION

This code was created by SFWMD and is not part of FLUCCS.

The Atlantic Ocean is the second largest ocean in the world and it is adjacent to the east coast of the District. It covers the coastline from St. Lucie County in the north to Monroe County in the south.

## KEYS TO PHOTOINTERPRETATION

- The Atlantic Ocean has the typical open water signature.
- It is distinguished by its size and location off the east coast of the District

## CONTEXT

- **Landscape Position** - The Atlantic Ocean is located off the east coast of the District, ranging from St. Lucie County southward to Monroe County.

## SIMILAR CLASSES

- 5720 Gulf of Mexico - This is the only similar class, located off the west coast of the District.

## SPECIAL MAPPING CONVENTIONS

This is an SFWMD modification to the FLUCCS system.

The classification is based on the water levels visible at the date of photography. Ancillary data may show other patterns of vegetation and water, due to changes in hydrology.

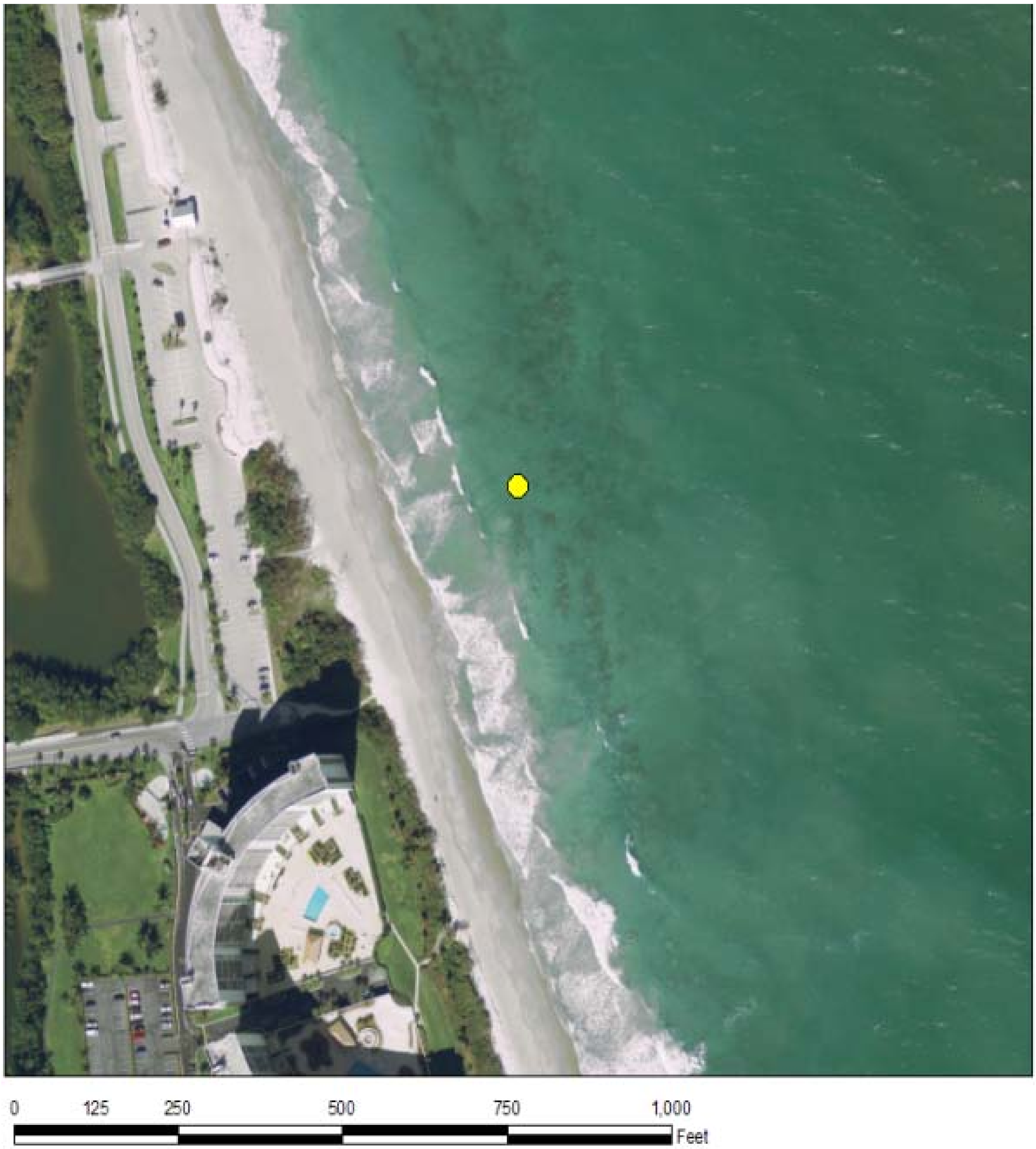
In the southernmost part of the project area (the Florida Keys), the boundary between this class and Florida Bay (classified as 5410 Embayments Opening Directly to Gulf or Ocean) is US 1.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
01/11/07

**COORDINATES**
959193.59 948278.56

# 5720
# Gulf of Mexico

LEVEL 1: 5000 Water
LEVEL 2: 5700 Ocean and Gulf
**LEVEL 3: 5720 Gulf of Mexico**

## DESCRIPTION

This code was created by SFWMD and is not part of FLUCCS.

The Gulf of Mexico is an arm of the Atlantic Ocean bordering on eastern Mexico, the southeast United States and Cuba. It connects with the Atlantic Ocean through the Straits of Florida.

## KEYS TO PHOTOINTERPRETATION

- The Gulf of Mexico has the typical open water signature.
- It is distinguished by its size and location off the west coast of the District.

## CONTEXT

- **Landscape Position** - The Gulf of Mexico is located off the west coast of the District, ranging from Monroe County northward to Lee County.

## SIMILAR CLASSES

- 5710 Atlantic Ocean - This is the only similar class, located off the east coast of the District.

## SPECIAL MAPPING CONVENTIONS

This is an SFWMD modification to the FLUCCS system.

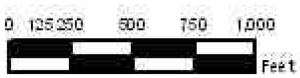
The classification is based on the water levels visible at the date of photography. Ancillary data may show other patterns of vegetation and water, due to changes in hydrology.

In the southernmost part of the project area (the Florida Keys), the boundary between this class and Florida Bay (classified as 5410 Embayments Opening Directly to Gulf or Ocean) is a straight line drawn from the southwestern corner of Cape Sable southwest through Mallory Square in Key West and extending to the western edge of the project area.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
382708.57 711553.34

# 6000
# Wetlands

This Level 1 class is not used in the map itself - a more specific subclass must be selected. The Level 2 subclasses are:

- 6100 Wetland Hardwood Forests
- 6200 Wetland Coniferous Forests
- 6300 Wetland Forested Mixed
- 6400 Vegetated Non-Forested Wetlands
- 6500 Non-Vegetated Wetlands

For details on each subclass (Level 2, Level 3, and Level 4) see the respective PI Key pages.

## BACKGROUND

Wetlands are a high priority feature to the District, as they perform so many critical functions related to water resources management. In particular, the wetlands/uplands boundary is critical to many types of decision making. The subclasses of wetlands are relatively general, representing broad vegetation communities. However, as with the other natural land cover classes, consistently high accuracy is often difficult to achieve due to the project imagery, time frame, budget and other constraints. For higher resolution maps of natural vegetation, users should obtain data layers scaled to smaller project areas, such as the major watershed basins of the District.

Wetlands are those areas where the water table is at, near or above the land surface for a significant portion of most years. The hydrologic regime is such that aquatic or hydrophytic vegetation usually is established, although alluvial and tidal flats may be non-vegetated. Examples of wetlands include marshes, mudflats, emergent vegetation areas and swamps. Shallow water areas with submerged aquatic vegetation are usually classed as water and not included in the Wetlands category.

Extensive parts of some river floodplains qualify as Wetlands. These do not include agricultural land where seasonal wetness or short term flooding may provide much of the soil moisture necessary for crop production. But uncultivated wetlands used as pine plantation or pastures are retained in the Wetlands category.

Wetlands that are currently drained for any purposes belong to other land use categories, such as Agriculture, Rangeland, Forested Uplands or Urban and Built-Up. When the drainage is discontinued and the pre-existing hydrologic regime re-established, the classification reverts to Wetlands. Wetlands managed for wildlife purposes may show short-term changes in vegetation and hydrology under different management practices, but they are still classified as Wetlands.

The above definitions are tailored to the limitations imposed by the project methodology, which relies primarily on aerial photography to delineate wetland communities. In absence of extensive fieldwork, imposing a more definitive description of wetlands is not feasible. The official definition of a wetland as adopted by the State of Florida is discussed in detail under Florida Session Law 84-79 (HB 1187). Strict adherence to this definition using remotely sensed images, however, cannot be achieved.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit (MMU) for all 6000 Wetlands classes is 2 acres.

Wetland systems can range from large monocultures to complex intermixtures of different classes. Individual plants or trees may be dispersed evenly throughout a matrix or grouped in patches. If distinct patches of any class are greater than 2 acres, they are broken out separately. In transitional areas where species-specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit. PIs must use discretion to avoid excessive line work while adding useful information.

Upland areas that occur as "islands" within wetlands systems are also broken out down to 2 acres. Adjacent uplands obey the standard MMU of 5 acres, unless otherwise defined.

**Differentiating subclasses:** See the PI keys for each of the subclasses for indicators that assist in differentiation.

Differentiating between natural communities requires expertise in photo interpretation. The communities are recognized by the signatures of individual species, rather than by the general color, texture and patterns of the mixture or community. It is generally accepted that PI's can not recognize these species unless they have extensive experience in the field comparing features on the ground against the exact same feature on recent photography. Also required is an understanding of the system's ecology. These skills are difficult to obtain, which accounts for the high levels of error sometimes found in mapping plant communities.

## DUAL CODING CONVENTION

All of the wetlands classes are **Land Cover** classes that do not normally require a separate dual code - LCCODE and LUCODE are normally the same. However, in rare cases, a separate **Land Use** code is required. The most common example is for pine plantations on hydric soils; reclaimed and abandoned mining areas may also require separate dual coding.

## SIMILAR CLASSES

The District places a high priority on establishing a wetland boundary, but it is sometimes easy to confuse upland and wetlands communities based on photosignature alone. Vegetation is usually the only visible indicator of the hydrologic boundary on aerial photography. Unfortunately, many species and communities stretch across this boundary, which ranges from being distinct to being virtually invisible.

Many of the wetland classes have similar upland counterparts that occur in wetland margins or in adjacent uplands. Notable examples are hardwood forests, flatwoods, cabbage palms, wet and dry prairies and pastures and even pine plantations. In addition, the hydrologic regimes can change due to unpredictable, long or short-term climatic fluctuations and human interventions. These factors often make the delineation of a wetland / upland boundary problematic. The problem is addressed with experience, ancillary data, magnified stereo viewing of imagery, field checking and tolerance of an acceptable level of error.

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

# 6100
# Wetland Hardwood Forests

LEVEL 1: 6000 Wetlands
**LEVEL 2: 6100 Wetland Hardwood Forests**

## DESCRIPTION

This is an active Level 2 class that should be applied only when one of the more specific Level 3 or Level 4 subclasses does not apply.

Wetland Hardwood Forests are wetlands whose canopy is at least 67% dominated by wetland hardwood species and are the result of natural generation.

## KEYS TO PHOTOINTERPRETATION

- Over 67% of the canopy is composed of hardwood species adapted to grow in hydric soils.
- NRCS soils maps indicate hydric soils.
- See the Level 3 and Level 4 class pages for keys to interpreting these classes.

## CONTEXT

- **Landscape Position** - Wetland hardwood forests can be found almost anywhere in the project area where hydric conditions exist and trees have not been cleared.
- **Vegetation** - See respective subclasses.
- **Soils** - See respective subclasses.
- **Hydrology** - See respective subclasses.

## SIMILAR CLASSES

Wetland hardwood forests can appear similar to many of the Level 3 and Level 4 subclasses, depending on the species composition. See the respective key pages for more information on how to differentiate these classes.

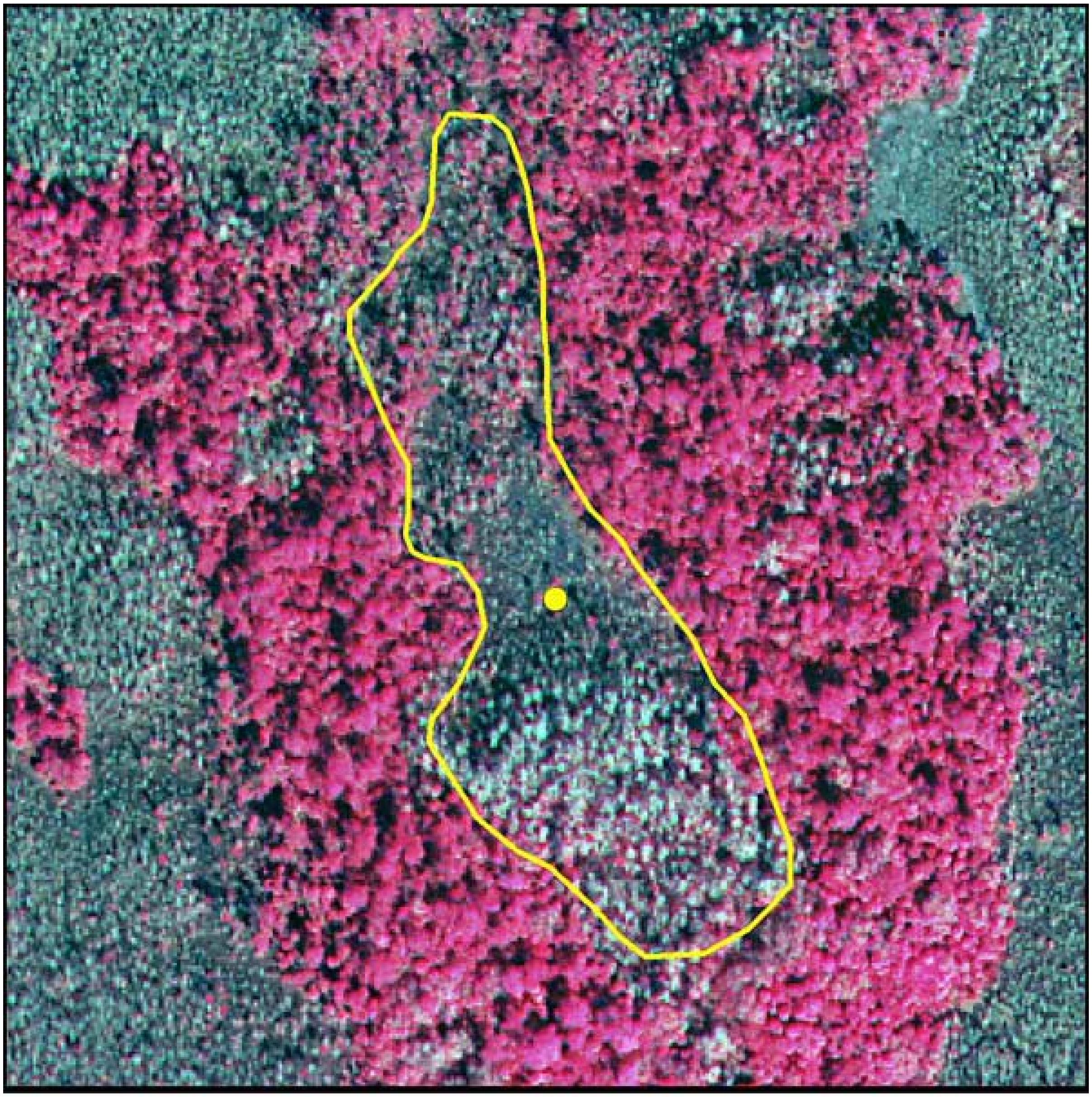
## SPECIAL MAPPING CONVENTIONS

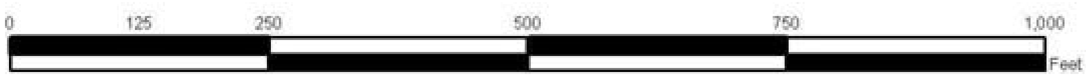
None

## DUAL CODING CONVENTION

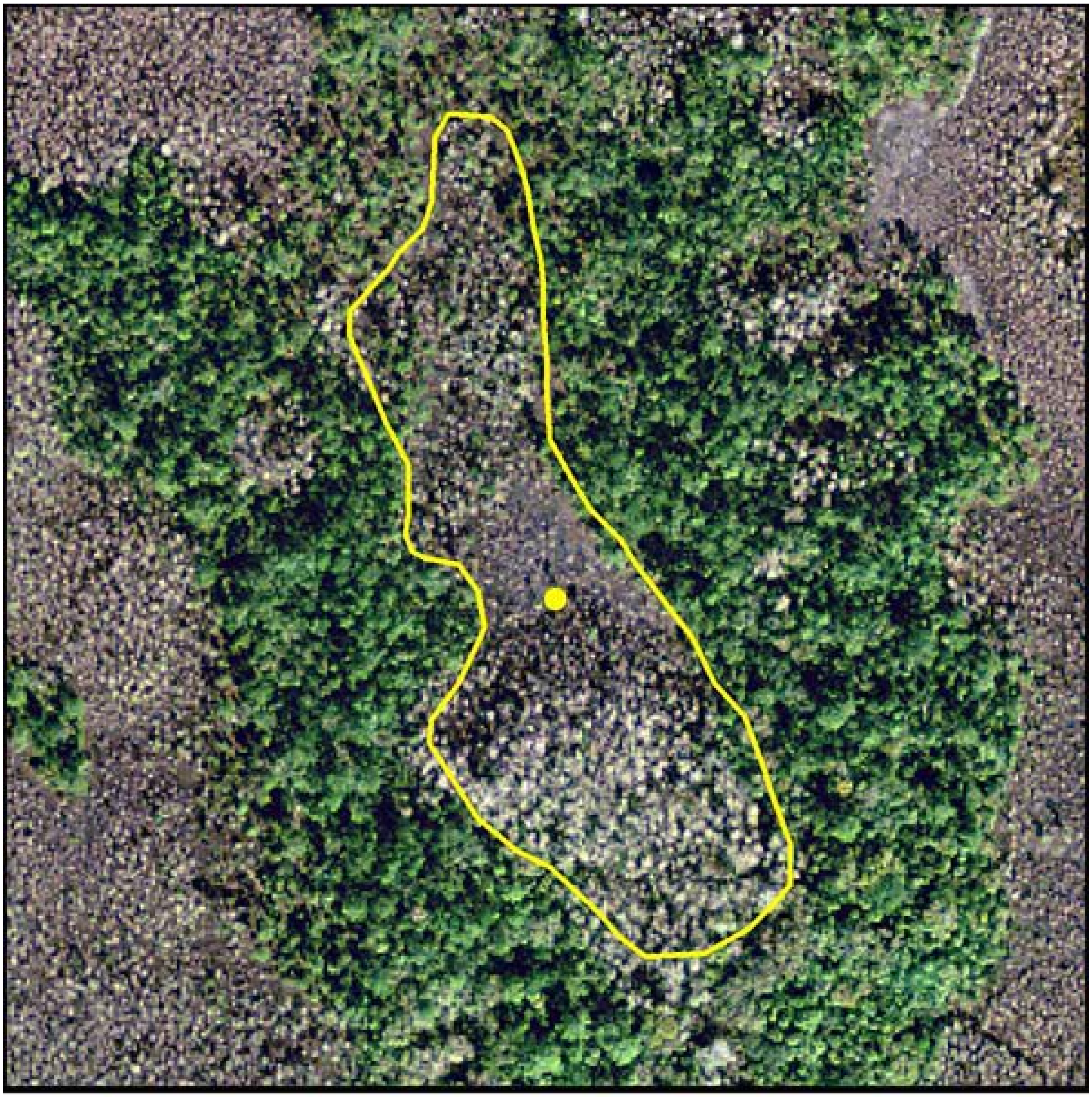
This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

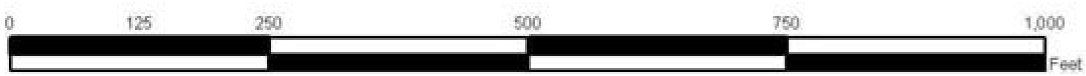
## CIR DOQQ IMAGE





## COLOR DOQQ IMAGE





## FIELD PICTURE

(Original 1999 field picture)

**DATE**
n/a

**COORDINATES**
n/a

# 6110
# Bay Swamps

LEVEL 1: 6000 Wetlands
LEVEL 2: 6100 Wetland Hardwood Forests
**LEVEL 3: 6110 Bay Swamps**

## DESCRIPTION

Bay Swamps occur throughout Florida as relatively small communities. This community can be found on hillsides, in depressions in pine flatwoods, in ravines or as strips along edges of creeks. These swamps are characterized by dense, low vegetation and are believed to be fed by groundwater and run-off from higher land.

A crown canopy closure of **at least 67% but less than 90%** evergreen bay species is required for inclusion in this class.

Dominant species include one or more species of broadleaved, evergreen bay trees, such as loblolly bay, sweet bay, red bay and swamp bay. The upper canopy of some sites may be dominated by pines, especially slash pine, but bays and other indicators will be prevalent in the subcanopy and understory. Understory species include large gallberry, fetterbush, wax myrtle and titi.

Round, oval or "teardrop" shaped bay swamps should be classified as 6111 Bayhead.

## KEYS TO PHOTOINTERPRETATION

- There is a stippled texture of medium to tall closely packed narrow tree canopies.
- Colors are usually bright scarlet red (CIR) or green (natural color) year round.

## CONTEXT

- **Landscape Position** - Occurs on hillsides, in depressions, in ravine areas and in poorly defined drainages.
- **Vegetation** - Dominant trees include loblolly bay, sweet bay, red bay or swamp bay. May have pines or other hardwoods intermixed as associates.
- **Soils** - Typically poorly to very poorly drained and usually high in organic matter content.
- **Hydrology** - Bay swamps are usually saturated or less often seasonally flooded.

## SIMILAR CLASSES

- 4200 Upland Hardwood Forests - Canopy signatures may be very similar if evergreens are dominant, but understories reflect drier conditions.
- 6111 Bayhead - Circular, oval, or teardrop-shaped areas of bay trees.
- 6170 Mixed Wetland Hardwoods - Evergreen bays and other associated species are not as prevalent and inundation is not sustained. Red maples and other deciduous species may be prominent.

## SPECIAL MAPPING CONVENTIONS

The canopy closure must be **25 percent or more** and the trees must average over 20 feet tall at the time of photography.

In transitional areas where species-specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
03/13/07

**COORDINATES**
753711.54 1093863.45

# 6111
# Bayhead

LEVEL 1: 6000 Wetlands
LEVEL 2: 6100 Wetland Hardwood Forests
LEVEL 3: 6110 Bay Swamps
**LEVEL 4: 6111 Bayhead**

## DESCRIPTION

Bayheads are dense evergreen forests found in peat-filled depressions or at the upstream ends of Everglades tree islands. They have distinct circular, oval or "teardrop" shapes.

They are scattered throughout the landscape, but are most abundant in areas with numerous cypress domes, where they represent an advanced stage of dome succession with peat accumulation in the absence of severe fire. They are also abundant in the Everglades, where they characteristically grow on organic soil built up upstream of limestone-based hardwood hammocks.

A crown canopy closure of **90% or more bay species** is required for inclusion in this class.

Bayheads are fed by groundwater and run-off from higher ground. They show very little evidence of other species within the bayhead itself, but frequently are surrounded by other species groups.

## KEYS TO PHOTOINTERPRETATION

- There is a stippled texture of medium to tall closely packed narrow tree canopies.
- Colors are usually bright scarlet red year round.

## CONTEXT

- **Landscape Position** - Typically found in depressions or at the upstream ends of Everglades "tree islands".
- **Vegetation** - Dominated by loblolly bay, sweet bay, red bay or swamp bay.
- **Soils** - Typically poorly to very poorly drained and usually high in organic matter content.
- **Hydrology** - Areas usually saturated or seasonally flooded.

## SIMILAR CLASSES

- 4200 Upland Hardwood Forests - Canopy signatures may be very similar if evergreens are dominant, but understories reflect drier conditions.
- 6110 Bay Swamps - Swamps do not show the typical circular, oval or "teardrop" shape of bayheads.
- 6170 Mixed Wetland Hardwoods - Evergreen bays are not as prevalent and inundation is not sustained. Red maples and other deciduous species may be prominent.

## SPECIAL MAPPING CONVENTIONS

The canopy composition must be **90 percent or more bay trees** and the trees must average over 20 feet tall at the time of photography for inclusion in this class.

In transitional areas where species-specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## COLOR DOQQ IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
485478.39 1338165.80

# 6120
# Mangrove Swamps

LEVEL 1: 6000 Wetlands
LEVEL 2: 6100 Wetland Hardwood Forests
**LEVEL 3: 6120 Mangrove Swamps**

## DESCRIPTION

This class is used for communities in which mangrove species are pure or predominant. Mangroves appear as a medium height (10 to 20 feet) thicket of fleshy leaved woody plants in coastal areas subject to periodic or continual inundation by salt or brackish water. In many sites, mangroves are prevented from reaching tree stature (20 feet) by natural processes, including climate, nutrients and wave action.

The communities are dominated by one or more mangrove species, including red, black and white mangroves (*Rhizophora mangle*, *Avicennia germinans*, or *Laguncularia racemosa*). Associate species that may also be present include buttonwood, cabbage palm and sea grape. Herbaceous associates include sea grape and sea oxeye (borrichia).

## KEYS TO PHOTOINTERPRETATION

- Primarily found in, but not limited to, coastal areas subject to periodic or continual inundation by salt or brackish water
- Plants may be shrubs or trees and occur in pure or predominant stands.
- Broad crowns and bright red color return (on CIR).
- In areas where water levels have been artificially altered (mosquito impoundments) and held too high for too long, plants (especially black mangroves) become stressed and may drop their leaves resulting in a bright greenish color (on CIR) and a rough or stippled texture.
- Red mangroves extend to the open water, with black mangroves towards the landward edge, and white mangrove in the most landward, least inundated.
- Available District vegetation maps should be consulted as collateral data, taking into account temporal changes.

## CONTEXT

- **Landscape Position** - Broad expanses of mangrove swamps are found on the west coast of South Florida. Back bays and estuaries with mild wave actions create favorable conditions for this community. Mangroves may extend well inland in the southern and southwestern Everglades.
- **Vegetation** - Dominant vegetation is red, white or black mangrove. Buttonwood may also be present or co-dominant. Sea grape and palms may occur, as well as Brazilian pepper on disturbed sites.
- **Soils** - Very poorly drained organics and/or marl or saline sands.
- **Hydrology** - Permanently flooded to regularly flooded by tidal waters.

## SIMILAR CLASSES

- 6110 Bay Swamps - Trees will be over 20' tall.
- 6170 Mixed Wetland Hardwoods - A wider range of signatures, including blue-grays and light pinks

## SPECIAL MAPPING CONVENTIONS

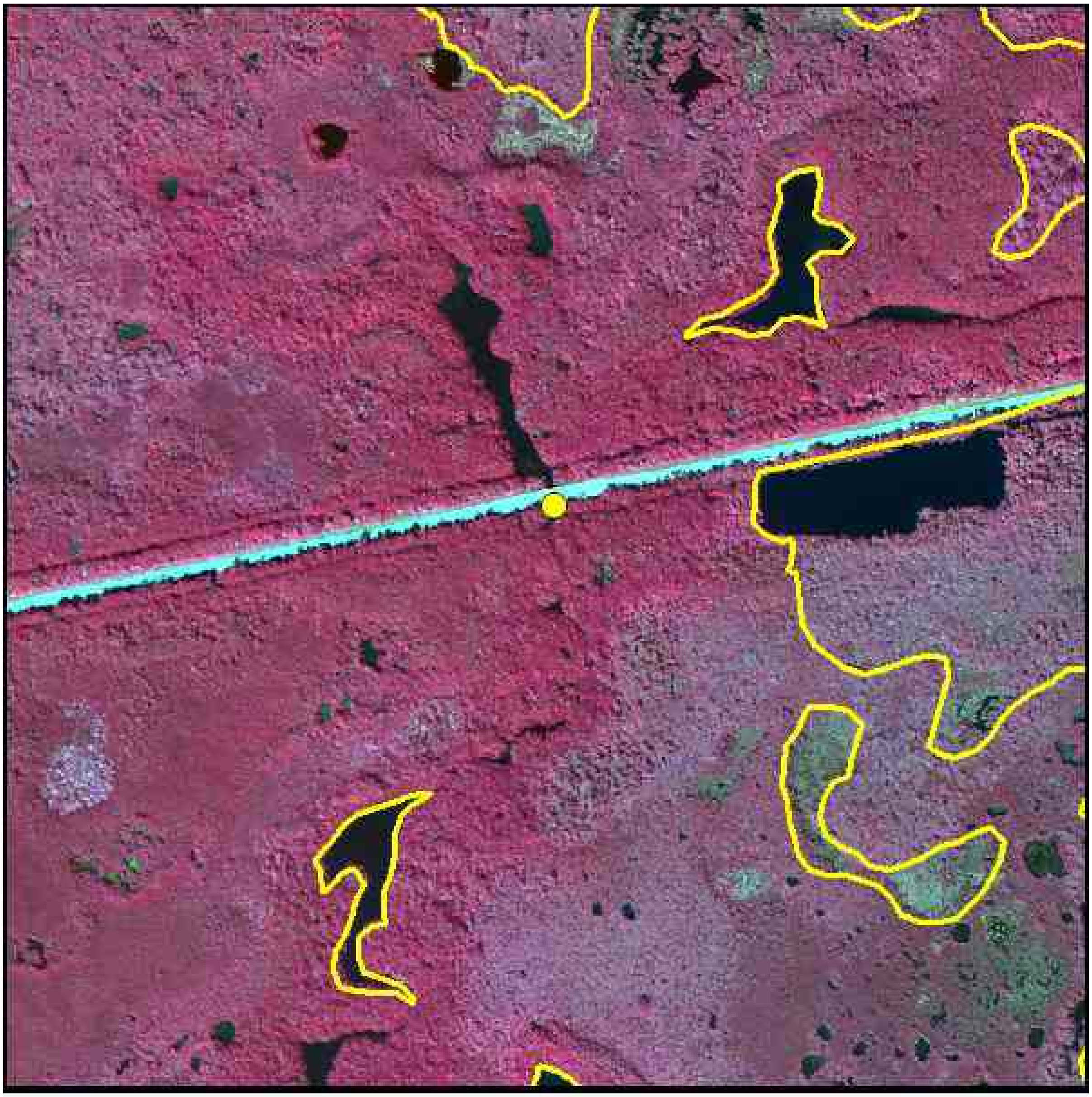
This is considered a forested class, even though it is found in shrub form, no taller than 20 feet.

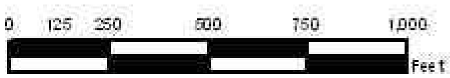
Fringes of mangrove community as narrow as 30 feet wide should be mapped. Mangrove species must be dominant in the species mixture.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
05/08/07

**COORDINATES**
455161.5 602633.23

# 6170
# Mixed Wetland Hardwoods

LEVEL 1: 6000 Wetlands
LEVEL 2: 6100 Wetland Hardwood Forests
**LEVEL 3: 6170 Mixed Wetland Hardwoods**

## DESCRIPTION

This class is a general class for any wetland hardwood forests that do not fall in to one of the other 6100 subclasses (bay swamps, mangroves, cabbage palms or exotic species). Examples of this class include bottomland and floodplain communities dominated by hardwoods, willow swamps and mixed hardwoods found in other landscape positions.

Defined as a very broad class, 6170 may have species mixtures ranging from relatively homogeneous stands, such as those dominated by red maple or willows, to a wide diversity of different species. Species in the mixtures may include red maple, black gum, water oak, sweet gum, willows, cabbage palm, water hickory, water tupelo, water ash and bays. Cypress is often present but not dominant (under 25%).

## KEYS TO PHOTOINTERPRETATION

- A number of different types of communities are included in this class, with a broad range of signatures depending on species composition.
- CIR signatures range from blue-gray, bright red to light pink, indicating a diversity of different species.
- Tree crowns are typically broad, except for inclusions of cypress, cabbage palms, and other narrower species.

## CONTEXT

- **Landscape Position** - Wetland hardwood forests can occur on a range of different landforms and hydrologic regimes, including floodplains and bottomlands, basins and depressions, lake and coastal fringes, and disturbed wet areas. Broad extents occur on wide floodplains along the Kissimmee River and other major drainageways.
- **Vegetation** - This community is comprised of a mixture of shrubs and trees which either do not fit within any other category due to species composition (i.e., either willow or titi) or else has an unidentifiable mix of species where none are predominant.
- **Soils** - These communities occur in depressions which collect silty sediments and are generally high in organics or on a variety of mineral soils. Some organic layers are thick enough to qualify as a histic epipedon.
- **Hydrology** - Wetness varies in these communities from temporary inundation through long-term semi-permanent to permanent flooding.

## SIMILAR CLASSES

- 6110 Bay Swamps - Scarlet red signature year round
- 6210 Cypress - Usually a grayish, or grayish-green CIR signature
- 6300 Wetland Forested Mixed - Pine species achieve at least 33% crown canopy cover.

## SPECIAL MAPPING CONVENTIONS

In transitional areas where species specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
396287.34 719546.10

# 6172
# Mixed Shrubs

LEVEL 1: 6000 Wetlands
LEVEL 2: 6100 Wetland Hardwood Forests
LEVEL 3: 6170 Mixed Wetland Hardwoods
**LEVEL 4: 6172 - Mixed Shrubs**

## DESCRIPTION

This class is used for wetland areas that are dominated by woody vegetation less than 20 feet in height.

Wetland shrub communities may proliferate when forested communities are regenerating after natural or induced die-offs; or they may form when water tables are lowered in marshes or swamps; or when upland or free flowing areas are flooded or impounded. Many types of disturbance or change can alter vegetation and result in a phase of shrubby growth.

## KEYS TO PHOTOINTERPRETATION

- Often associated with areas of transitional hydrology or regenerating swamps, but found in a wide variety of community types and locations.
- Small crowns, 20 feet or less in height, are visible. An understory of grasses may be visible.
- The CIR signatures are often bright, patchy, with a mottled texture. Shrubs tend to be bright compared to wet areas and understory herbs. Monocultures of willows may be smooth, bright and uniform.

## CONTEXT

- **Landscape Position** - Mixed wetland shrubs are typically found in shallow depressions and the upper edges of poorly defined drainages (sloughs), rivers, creeks or streams. They also occur in seasonally or temporarily wet situations near man-induced disturbances such as an impoundment, road, railroad or powerline/pipeline corridor.
- **Vegetation** - This community is comprised of a mixture of various shrubs, most commonly wax myrtle, saltbush, buttonbush and elderberry with some aquatic and herbaceous vegetation or primrose willows intermixed.
- **Soils** - Generally in mineral soils or in silty sediments, high in organics, accumulated over mineral soils.
- **Hydrology** - This land cover type frequently occurs in areas which do not remain wet for excessive lengths of time. Seasonal flooding or temporary inundation at regular intervals throughout the growing season typically provides the proper hydrologic regime for this community.

## SIMILAR CLASSES

- 3200 Upland Shrub and Brush Land - Signatures and even species may be very similar. Ancillary data may be required to differentiate.
- 4220 Brazilian Pepper - Upland Brazilian Pepper has same signature but is coded as 4220

## SPECIAL MAPPING CONVENTIONS

This is a SFWMD modification to the FLUCCS system, which assigns the FLUCCS code 6310 to Wetland Scrub. (Note: the SFWMD does not use 6310.)

**NOTE:** This code is an addition to identify scrub-shrub wetlands where shrub height does not exceed 20 feet. Although the code description is Mixed Shrubs, this class also includes shrub wetlands that do not have a mixture of species. For example, if cypress or bays are dominant, but they are of shrub height, they are coded as 6172 Mixed Shrubs.

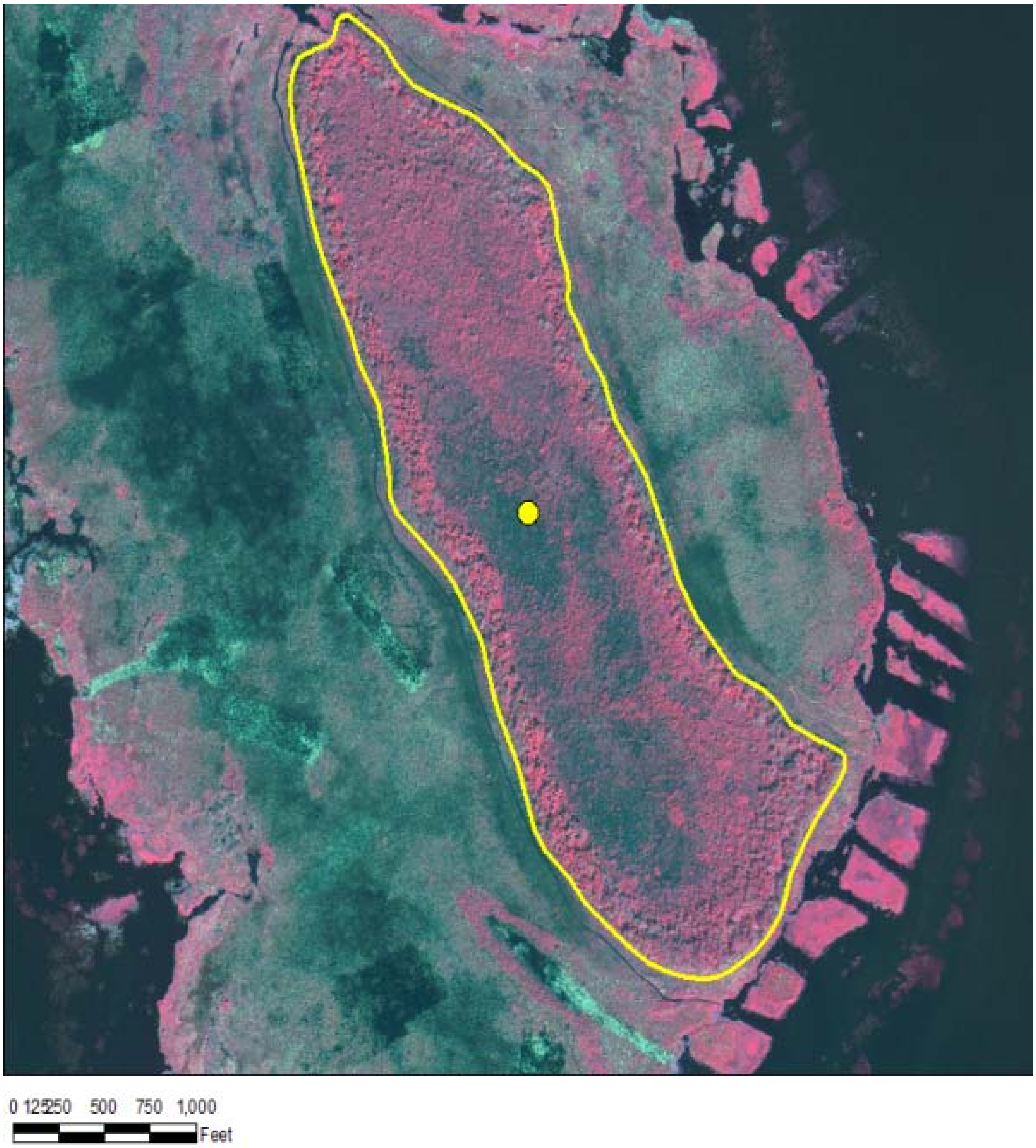
Brazilian Pepper upland communities are coded as 4220 Brazilian Pepper.

If shrubby vegetation is clearly part of a forested system in the process of regenerating, it may be so intermixed that precise delineation would result in overly complex linework or polygons that are below the MMU. Where shrubs are close to this size cutoff, PI's should avoid excessive line work and err on the side of identifying the community type rather than growth stage.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

0 125 250 500 750 1,000
Feet

**COORDINATES**
573204.58 1104058.29 (Images)

## FIELD PICTURE

**DATE**
03/16/07

**COORDINATES**
748389.46  867446.02 (Field Picture)

# 6180
# Cabbage Palm Wetland

LEVEL 1: 6000 Wetlands
LEVEL 2: 6100 Wetland Hardwood Forests
**LEVEL 3: 6180 Cabbage Palm Wetland**

## DESCRIPTION

Cabbage palm wetlands are found in varying habitats from the sparse canopy of a seasonally flooded "savannah" to the denser temporarily flooded hammocks containing a diverse mix of species.

## KEYS TO PHOTOINTERPRETATION

- Canopy composition is greater than 10% cabbage palm (sabal palmetto). See Special Mapping Conventions below.
- Signatures include uniformly round, compact, ball like tree crowns with a characteristic pinkish-red color on CIR film.
- A combination of the dull, medium red color of other species, with its predominantly fluffy and irregular crown texture in which individual crowns are discernible and the lollipop-shaped, pinkish-red to washed-out color of Cabbage Palms.
- In some examples of this community, bright reds from vines occurring on the tree crowns may be evident.

## CONTEXT

- **Landscape Position** - Usually found on relatively flat, poorly drained terrain. Cabbage palms are susceptible to fire and inundation and persist best where these are controlled.
- **Vegetation** - Consists of a sparse seasonally flooded understory of wetland grasses dominated by palms or a mix of palms, laurel oak, live oak, water oak, hackberry, red maple, other temperate hardwoods,vines and ferns. Saw palmetto is not typically present.
- **Soils** - Commonly circumneutral sands underlain by marl or shell beds.
- **Hydrology** - Cabbage Palm wetlands are situated where inundation and soil saturation are affected by seasonally high water tables. Some saturation may occur but inundation, other than for brief periods, is uncommon.

## SIMILAR CLASSES

- 4280 Cabbage Palm - Found in upland areas, they have a canopy closure of at least 25% cabbage palm with a 67% dominance. Signatures may appear similar-refer to soils data.
- 4271 Oak-Cabbage Palm Forest - Found in upland areas, signatures may appear similar-refer to soils data.

## SPECIAL MAPPING CONVENTIONS

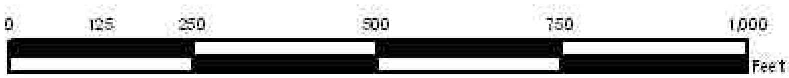
**NOTE:** This class is an exception to the general crown canopy requirements for Forest classes - (25% for inclusion in a Forest class, and 67% dominance of a particular species to be assigned to that species class).

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## COLOR DOQQ IMAGE



## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
443843.53 693574.59

# 6190
# Exotic Wetlands Hardwoods

This Level 3 class is not used in the map itself - the only exotic wetland hardwood species mapped in this data layer is classified at Level 4 as:

6191 Wet Melaleucas

## BACKGROUND

This Level 3 class consists of forested wetlands with a dominant exotic species such as Brazilian pepper, melaleuca or other exotic species.

As noted above, Wet Melaleuca is mapped at Level 4. Brazilian pepper found on wetland sites is mapped at Level 4 as 6172 Mixed Shrubs. Other exotic species will be mapped at Level 2 as 6100 Wetland Hardwood Forests.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit (MMU) for all 6190 Exotic Wetland Hardwoods classes is 2 acres.

**Differentiating subclasses:** The only subclass mapped in this data layer is 6191 Wet Melaleuca.

## DUAL CODING CONVENTION

All of the 6190 classes are **Land Cover** classes. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## SIMILAR CLASSES

**For more information:**

See the PI key page for 6191 Wet Melaleuca for more information.

# 6191
# Wet Melaleuca

LEVEL 1: 6000 Wetlands
LEVEL 2: 6100 Wetland Hardwood Forests
LEVEL 3: 6110 Bay Swamps
**LEVEL 4: 6191 Wet Melaleuca**

## DESCRIPTION

This class includes Melaleuca found growing in wetland environments such as marshes and wet savannahs. It is also found in low areas and also can invade cypress swamps.

Melaleuca is capable of invading the zone between pine and cypress forests in southern Florida and of displacing the cypress trees.

## KEYS TO PHOTOINTERPRETATION

- Melaleuca mainly invades sparsely-vegetated ecotones, prairies, marshes and fire-damaged forests.
- CIR signature is dark red, with narrow spike-like crowns, packed tightly together.
- Natural color is a dull grayish-green.
- Forms monotypic stands which are devoid of other vegetation and often impenetrable
- Context should be examined to distinguish this class from Melaleuca in upland situations.

## CONTEXT

- **Landscape Position** - Melaleuca tolerates most subtropical ecosystems, preferring wet to intermittently wet sites and can survive extended flooding, moderate drought and some salinity.
- **Vegetation** - Melaleuca is the only species, to the exclusion of virtually all other species.
- **Soils** - Can be found on any disturbed soil in southern Florida.
- **Hydrology** - Ranges from areas with a seasonally low ground water level to those subject to seasonal flooding.

## SIMILAR CLASSES

- 4110 Pine Flatwoods - Pines have more rounded, asymmetrical and "feathered" canopies.
- 4240 Melaleuca - Occurs in upland areas.
- 4370 Australian Pine - These have a fluffy, overlapping crown pattern; they overtower and crowd out other vegetation.

## SPECIAL MAPPING CONVENTIONS

None

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

0 125 250 500 750 1,000 Feet

## FIELD PICTURE

**DATE**
05/09/07

**COORDINATES**
403104.26 766365.55

# 6200
# Wetland Coniferous Forests

LEVEL 1: 6000 Wetlands
**LEVEL 2: 6200 Wetland Coniferous Forests**

## DESCRIPTION

This is an active Level 2 class that should be applied only when one of the more specific Level 3 or Level 4 subclasses does not apply.

Wetland Coniferous Forests are wetlands whose canopy is at least 67% dominated by wetland coniferous species and are the result of natural generation.

## KEYS TO PHOTOINTERPRETATION

- Over 67% of the canopy is composed of coniferous species adapted to grow in hydric soils.
- NRCS soils maps indicate hydric soils.
- See the Level 3 and Level 4 class pages for keys to interpreting these classes.

## CONTEXT

- **Landscape Position** - Wetland coniferous forests can be found almost anywhere in the project area where hydric conditions exist and trees have not been cleared.
- **Vegetation** - Cypress and pines (both longleaf and slash pine) are the dominant coniferous species. Slash pine is the dominant pine in the southern portion of the District, where it is the only common pine. Water-tolerant hardwoods such as black gum, swamp tupelo and red maple may be seen in association with cypress. Cabbage palm may also be included in some areas.
- **Soils** - Soils range from the semi-permanent to permanent hydroperiods of cypress swamps to the sandy and acidic soils of pine flatwoods, which are subject to brief seasonal inundation or saturation.
- **Hydrology** - Hydrology ranges from semi-permanent flooding to brief seasonal inundation.

## SIMILAR CLASSES

Wetland coniferous forests can appear similar to many of the Level 3 and Level 4 subclasses, depending on the species composition. See the respective key pages for more information on how to differentiate these classes.

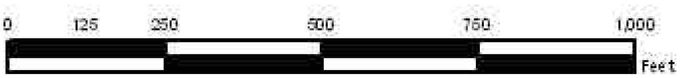
## SPECIAL MAPPING CONVENTIONS

Wetland sites that have been planted over with pine are considered both pine plantation (LUCODE = 4410 or 4430) and wetland (LCCODE = 6250 or 6300). The 1999 land cover maps, the District's wetlands vegetation maps and NRCS soils are useful as collateral data.

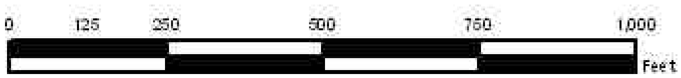
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are usually the same. A separate **Land Use** code is not generally required. However, if the community is also a pine plantation then the LUCODE may be separately coded as 4410 Coniferous Plantation or 4430 Forest Regeneration.

## CIR DOQQ IMAGE



## COLOR DOQQ IMAGE



## FIELD PICTURE

**DATE**
10/17/07

**COORDINATES**
631190.76 1381577.83

# 6210
# Cypress

LEVEL 1: 6000 Wetlands
LEVEL 2: 6200 Wetland Coniferous Forests
**LEVEL 3: 6210 Cypress**

## DESCRIPTION

This class is for forested wetland communities in which pond cypress or bald cypress comprises over 67% of the forest canopy. In the case of pond cypress, common associates are swamp tupelo, slash pine and black titi. In the case of bald cypress, common associates are water tupelo, swamp cottonwood, red maple, American elm, pumpkin ash, Carolina ash, overcup oak and water hickory. Bald cypress may be associated with laurel and water oaks, sweet gum and sweet bay on drier sites.

Cypress trees are deciduous conifers with a long leaf-off cold period, making them relatively easy to identify with winter photography. Crowns are densely packed and pin-like, although some larger, broader individuals may protrude above the rest or in isolation. In domes and heads, the larger trees are towards the center and the center itself may be open water.

## KEYS TO PHOTOINTERPRETATION

- Cypress species maintain at least a 67% dominance in the canopy. Tree crowns are usually tightly packed.
- Sites are flooded for long periods - typically 4 to 8 months in any given year.
- Usually grayish, or grayish-green (CIR), puffy signature - classic "Q-Tip" appearance.
- Spring CIR signature is often pink due to the regeneration of the cypress needles.
- Natural color is either green or brown depending on the season.
- Pine has a larger crown signature than cypress. Therefore, if an area appears to be evenly split between pine and cypress, there is actually more cypress than pine, and the polygon should be classified as 6210.

## CONTEXT

- **Landscape Position** - Cypress is found in a variety of situations, but typically requires prolonged inundation and periodic dry spells. It occurs as cypress "domes" in depressions or in long linear drainages as cypress "strands". It may be present as a distinct community along the fringes of lakes or in bottomlands and floodplains associated with rivers. Cypress "heads" may also occur at the beginning of drainage ways. It can also be part of the mix of hardwood swamps or bay swamps wherever they occur.
  Note: Cypress occurring in "domes" or "heads" is classified at Level 4 as 6215.
- **Vegetation** - Clearly dominated by cypress, either pond or bald. Other species (water tolerant hardwoods) such as black gum, swamp tupelo, red maple, American elm, pumpkin ash, Carolina ash, overcup oak and water hickory may be present as associates but these must not comprise more than 33% of the system. Drier sites may include laurel and water oaks, sweet gum and bays.
- **Soils** - Variable but generally poorly or very poorly drained. Soils are very poorly drained and high in organics with a peat layer of varying thickness on the surface.
- **Hydrology** - Hydroperiods are semi-permanent to permanent in the center of domes and swamps. There are also deep, prolonged seasonal hydro-periods (e.g. next to rivers).

## SIMILAR CLASSES

- 6170 Mixed Wetland Hardwoods - Signatures range from blue-gray to light pink with a variety of crown types.
- 6215 Cypress-Domes/Heads - Similar signatures but are isolated as round or 'teardrop' domes rather than part of a drainage.
- 6216 Cypress-Mixed hardwoods - Cypress comprises less than 33% pf the canopy.
- 6300 Wetland Forested Mixed - A wide variety of textures and crown types, depending on species.

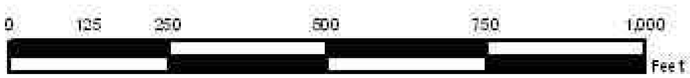
## SPECIAL MAPPING CONVENTIONS

Fringes of cypress community as narrow as 30 feet wide should be mapped, if they meet minimum mapping units.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

| DATE | COORDINATES |
| --- | --- |
| 10/15/07 | 452604.89 704694.40 |

# 6215
# Cypress - Domes/Heads

LEVEL 1: 6000 Wetlands
LEVEL 2: 6200 Wetland Coniferous Forests
LEVEL 3: 6210 Cypress
**LEVEL 4: 6215 Cypress - Domes/Heads**

## DESCRIPTION

Cypress Domes are circular cypress swamps that have developed around a sinkhole. Frequently situated in an open marsh or pineland, the characteristic dome-shaped appearance of this type of cypress swamp is apparent. These areas are generally small - about 2 to 10 acres.

Shape is very important in recognizing domes; they are oval-shaped in the Everglades and round on floodplains or in pinelands.

This class also includes cypress heads, which are those cypress ponds (or domes) that typically occur at the head of long linear drainages, sometimes referred to as "strands".

## KEYS TO PHOTOINTERPRETATION

- Cypress Domes have a distinct dome-shaped appearance.
- Cypress Heads are at the beginning or at the end of drainageways.
- Cypress species maintain at least a 67% dominance in the canopy. Crowns are not typically tight; their nature is to have dense stems and a loose canopy.
- Sites are often flooded for long periods.
- Usually grayish or grayish-green (CIR), puffy signature - classic "Q-Tip" appearance.
- Natural color either green or brown depending on the season.
- Spring CIR signature is often pink due to the regeneration of the cypress needles.

## CONTEXT

- **Landscape Position** - Cypress domes are generally isolated on the landscape, even if located inside a larger drainage system. Cypress heads occur at the beginning or end of drainage ways.
- **Vegetation** - Clearly dominated by cypress, either pond or bald. Other species (water tolerant hardwoods) such as black gum, swamp tupelo, red maple, American elm, pumpkin ash, Carolina ash, overcup oak and water hickory may be present as associates but these must not comprise more than 33% of the system. Drier sites may include laurel and water oaks, sweet gum and bays.
- **Soils** - Variable but generally poorly or very poorly drained. Soils are very poorly drained and high in organics with a peat layer of varying thickness on the surface.
- **Hydrology** - Hydroperiods are semi-permanent to permanent in the center of domes and swamps.

## SIMILAR CLASSES

- 6210 Cypress - Cypress swamps consist of a larger drainage system which may have cypress domes within its boundaries.

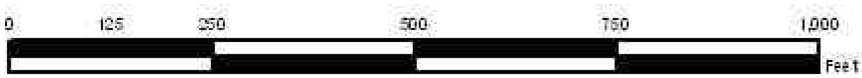
- 6250 Wet Pinelands-Hydric Pine - Generally brick-red signature; understory of grasses and at times, shrubs
- 6300 Wetland Forested Mixed - A wide variety of textures and crown types, depending on species

## SPECIAL MAPPING CONVENTIONS

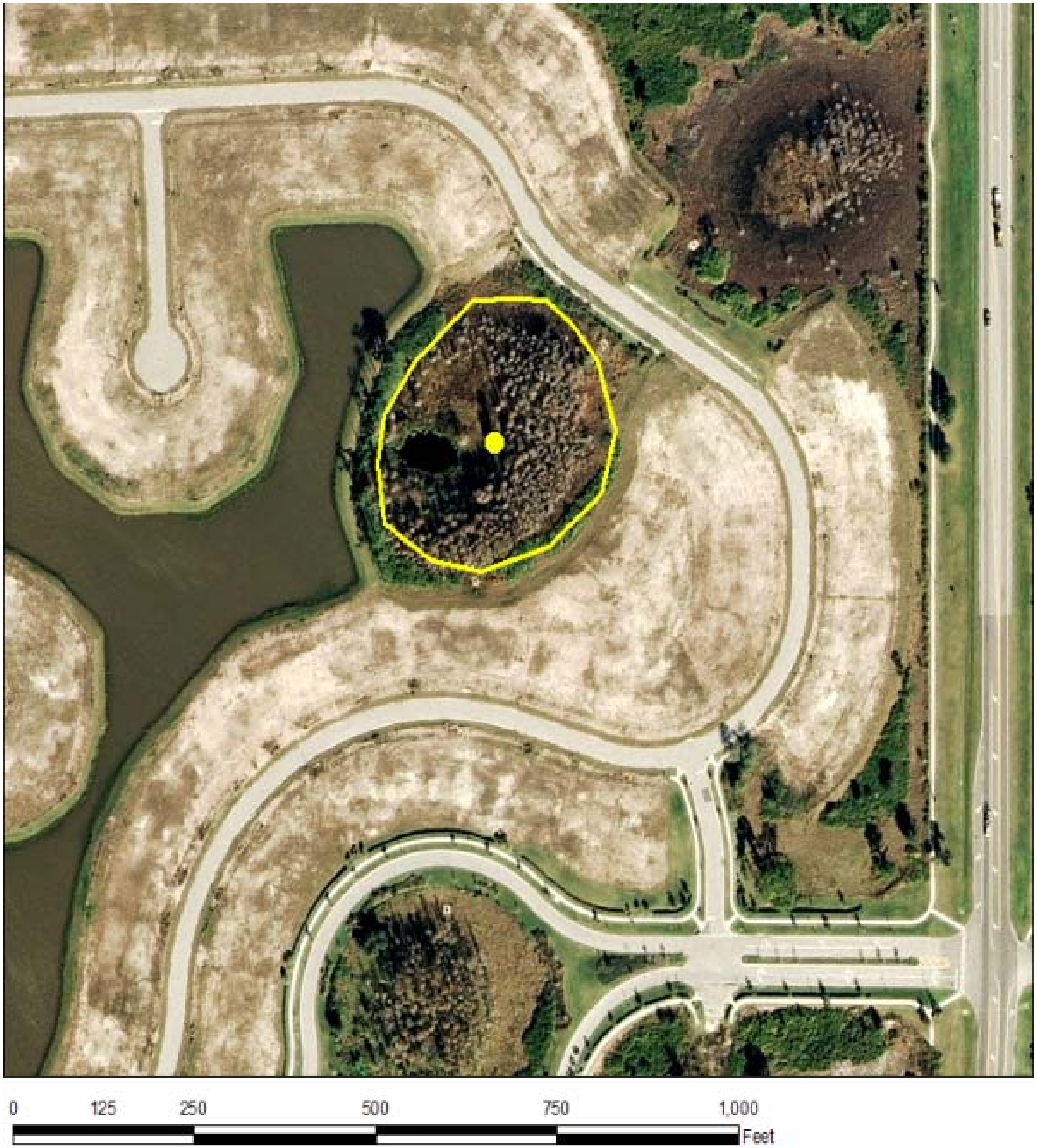
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE




NATURAL COLOR IMAGE


0
125
250
500
750
1,000
Feet

## FIELD PICTURE

**DATE**
10/07/07

**COORDINATES**
503759.08 1389524.56

# 6216
# Cypress - Mixed Hardwoods

LEVEL 1: 6000 Wetlands
LEVEL 2: 6200 Wetland Coniferous Forests
LEVEL 3: 6210 Cypress
**LEVEL 4: 6216 Cypress - Mixed Hardwoods**

## DESCRIPTION

This class is for forested wetland communities in which neither cypress nor hardwood species achieve a 67% dominance of the crown canopy composition.

**Cypress must comprise 25% or more of the crown canopy composition for use of this class.**

## KEYS TO PHOTOINTERPRETATION

- Cypress crowns are usually tightly packed.
- Cypress has grayish or grayish-green (CIR), puffy signature - classic "Q-Tip" appearance.
- Spring CIR signature is often pink due to the regeneration of the cypress needles.
- Cypress natural color is either green or brown depending on the season.
- Hardwood CIR signatures range from blue-gray, bright red to light pink, indicating a wide variety of species.
- A number of different hardwood types are included in this class, with a broad range of signatures depending on species composition.

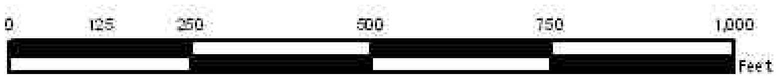
## CONTEXT

- **Landscape Position** - Cypress is found in a variety of situations, but typically requires prolonged inundation and periodic dry spells. It occurs as cypress "domes" in depressions or in long linear drainages as cypress "strands". It may be present as a distinct community along the fringes of lakes or in bottomlands and floodplains associated with rivers. Cypress "heads" may also occur at the beginning of drainage ways. It can also be part of the mix of hardwood swamps or bay swamps wherever they occur. **Note:** Cypress occurring in "domes" or "heads" is classified at Level 4 as 6215. Hardwood forests can occur on a range of different landforms, including floodplains, basins, depressions, lake and coastal fringes, and disturbed wet sites.
- **Vegetation** - A mixture of cypress, either pond or bald, and water tolerant hardwoods such as black gum, swamp tupelo, red maple, American elm, pumpkin ash, Carolina ash, overcup oak and water hickory. These hardwood species must not comprise more than 67% of the system. Drier sites may include laurel and water oaks, sweet gum and bays.
- **Soils** - Variable but generally poorly or very poorly drained. Soils are very poorly drained and high in organics with a peat layer of varying thickness on the surface.
- **Hydrology** - Wetness in these communities ranges from temporary inundation through long term semi-permanent to permanent flooding.

## SIMILAR CLASSES

- 6170 Mixed Wetland Hardwoods - Hardwoods are dominant and cypress comprises less than 25% of the canopy.
- 6210 Cypress - Cypress is dominant and hardwoods or other species comprise less than 33% of the canopy.

## CIR DOQQ IMAGE



## COLOR DOQQ IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
453867.53  699055.00

# 6240
# Cypress - Pine - Cabbage Palm

LEVEL 1: 6000 Wetlands
LEVEL 2: 6200 Wetland Coniferous Forests
**LEVEL 3: 6240 Cypress - Pine - Cabbage Palm**

## DESCRIPTION

This class includes cypress and/or pine found with cabbage palm in combinations where none of the three species achieves dominance.

Although not strictly a wetlands community, it forms a transition between moist upland and hydric sites.

**NOTE:** See Special Mapping Conventions for this class.

## KEYS TO PHOTOINTERPRETATION

- Cypress is characterized by narrow, densely-packed crowns producing a "pin like" look and grayish or grayish-green color (CIR) due to its deciduous nature.
- Pines are characterized by rounded asymmetrical and "feathered" brick-red canopies (CIR). Individual trees are visible.
- Cabbage Palm is characterized by "lollipop" shaped tree crowns of pinkish-red to washed-out red color (on CIR).

## CONTEXT

- **Landscape Position** - This class is transitional between pine flatwoods, marshes and cypress in the Big Cypress Area and between pine rocklands and marshes in the Everglades. It also occupies upper floodplains of South Florida rivers and streams.
- **Vegetation** - This community includes cypress, pine and/or cabbage palms in combinations in which neither species achieves dominance.
- **Soils** - These communities occur on poorly drained fine sands. Some have high amounts of organic material present in the surface layer.
- **Hydrology** - Although not strictly a wetland community, it forms a transition between moist upland and hydric sites.

## SIMILAR CLASSES

- 6300 Wetland Forest Mixed - Conifers are not predominant.

## SPECIAL MAPPING CONVENTIONS

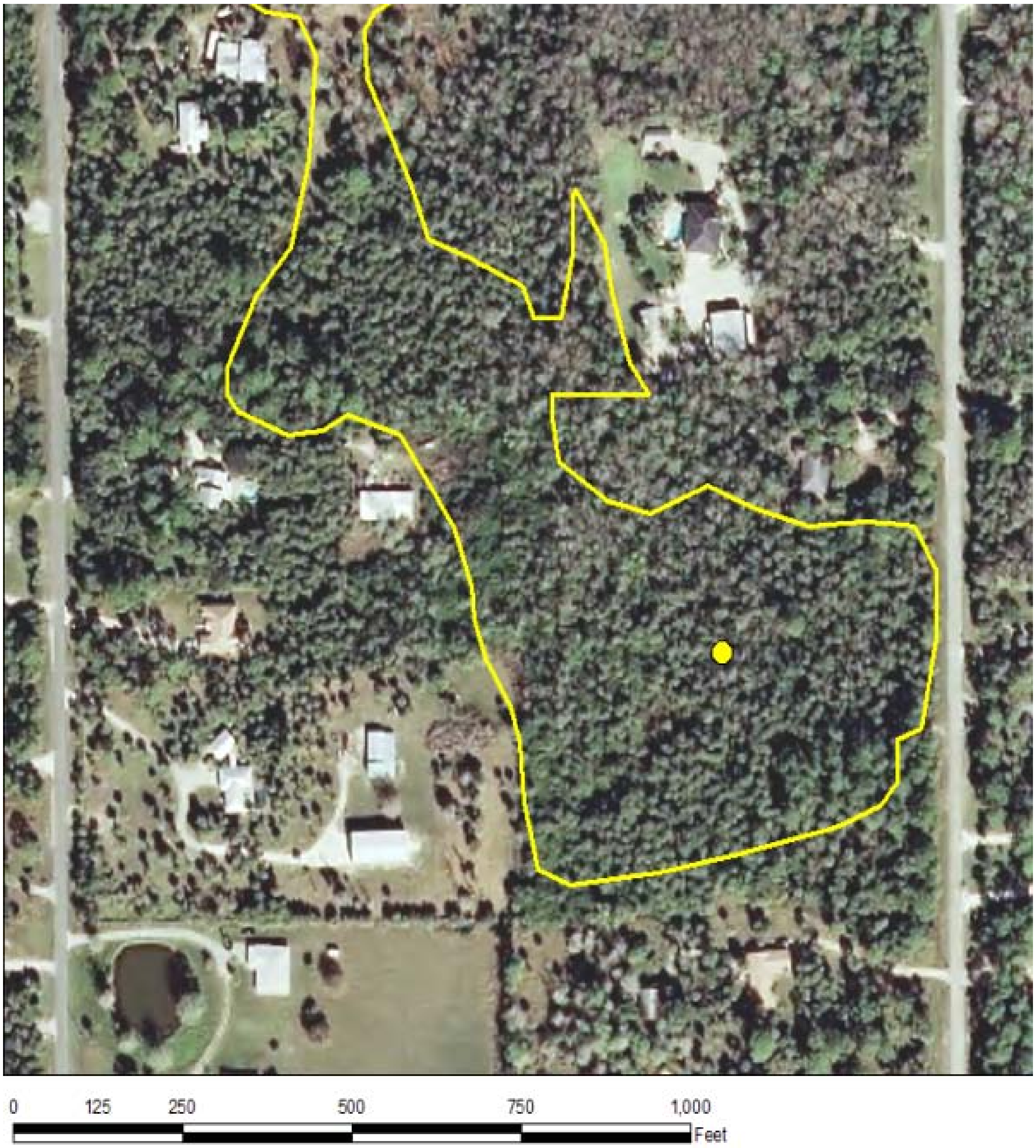
Cabbage palm is the indicator species for use of this class. All three species need not be present; however, Cabbage palm must be present for use of this class.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
450950.97 692976.77

# 6250
# Wet Pinelands - Hydric Pine

LEVEL 1: 6000 Wetlands
LEVEL 2: 6200 Wetland Coniferous Forests
**LEVEL 3: 6240 Wet Pinelands - Hydric Pine**

## DESCRIPTION

This class is for wetland coniferous forests with a **sparse to moderate** canopy of longleaf and/or slash pine.

The "sparse to moderate" tree canopy of this class is defined as a crown canopy closure of 25% or more.

It may be naturally generated or the result of pine plantations that are planted in rows through flatwoods depressions. The understory is grasses, wiregrass, forbs and sometimes sparse saw palmetto. If the wetland pine community is part of a pine plantation (with rows evident), a land use code of either 4410 Coniferous Plantation or 4430 Forest Regeneration is required, in addition to the 6250 land cover code.

Hydric pinelands appear similar to mesic pine communities, but on careful inspection show decreased vigor and height. The high water table favors hydrophytic shrubs, grasses and herbs, and inhibits the establishment of saw palmetto, gallberry and other typical upland species. Understories are comprised mostly of grasses, with subdued color tones and surface water is sometimes visible. In the absence of fire, species such as loblolly bay may be visible in the understory, imparting a bright reddish tone.

## KEYS TO PHOTOINTERPRETATION

- Over 67% of the canopy is composed of coniferous pine species adapted to grow in hydric soils.
- NRCS soils maps indicate hydric soils.
- Color tones on CIR are brick-red, similar to uplands pine, but lack brightness due to decreased vigor. In wetlands the trees tend to be more widely spaced and appear somewhat stunted or ragged.

## CONTEXT

- **Landscape Position** - This community can be found almost anywhere in the project area where hydric conditions exist and trees have not been cleared.
- **Vegetation** - Slash pine is the dominant tree species, especially in the southern part of the District, where it is the only common pine; understory consists of grasses, wiregrass, forbs and sometimes sparse saw palmetto.
- **Soils** - Soils are usually sandy and acidic, underlain by hardpan and subject to brief seasonal inundation or prolonged soil saturation.
- **Hydrology** - Surface water may be visible following heavy rains.

## SIMILAR CLASSES

- 4110 Pine Flatwoods - Usually a lighter understory with saw palmetto and other upland shrubs.

- 6260 Pine Savannah - The crown canopy closure is less than 25%.
- 6300 Wetland Forest Mixed - Conifers are not predominant.

## SPECIAL MAPPING CONVENTIONS

Wetland sites that have been planted over with pine are considered both pine plantation (LUCODE = 4410 or 4430) and wetland (LCCODE = 6250). The 1999 land cover maps and NRCS soils are useful as collateral data.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use c**ode is not required, except in the case of plantations, as noted above.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
450952.48 695326.70

# 6260
# Pine Savannah

LEVEL 1: 6000 Wetlands
LEVEL 2: 6200 Wetland Coniferous Forests
**LEVEL 3: 6260 Pine Savannah**

## DESCRIPTION

This class includes wetland coniferous forests with a **sparse** canopy of longleaf and/or slash pine. The understory is grasses, wiregrass, forbs and wetland shrubs.

Pine savannahs are a community intermediate between grassland and forest. They are used extensively for cattle grazing.

The "sparse" tree canopy of this class is defined as a crown canopy closure of 10% or more, but not more than 25%.

## KEYS TO PHOTOINTERPRETATION

- At least 10% (but less than 25%) of the canopy is composed of coniferous pine species adapted to grow in hydric soils.
- NRCS soils maps indicate hydric soils.
- Color tones on CIR are brick-red, similar to uplands pine, but lack brightness due to decreased vigor. In wetlands the trees tend to be more widely spaced and appear somewhat stunted or ragged.

## CONTEXT

- **Landscape Position** - This community can be found almost anywhere in the project area where hydric conditions exist and trees have not been cleared.
- **Vegetation** - Slash pine is the dominant tree species, especially in the southern portion of the District, where it is the only common pine; understory consists of grasses, wiregrass, forbs and sometimes sparse saw palmetto.
- **Soils** - Soils are usually sandy and acidic, underlain by hardpan and subject to brief seasonal inundation or prolonged soil saturation.
- **Hydrology** - Surface water may be visible following heavy rains.

## SIMILAR CLASSES

- 2130 Woodland Pasture - Evidence of cattle grazing within Pine Flatwoods.
- 4110 Pine Flatwoods - Usually a lighter understory with saw palmetto and other upland shrubs.
- 6250 Wet Pinelands - Hydric Pine - The crown canopy closure is greater than 25%.
- 6300 Wetland Forest Mixed - Neither hardwoods nor evergreen conifers achieve a 67% crown canopy dominance.

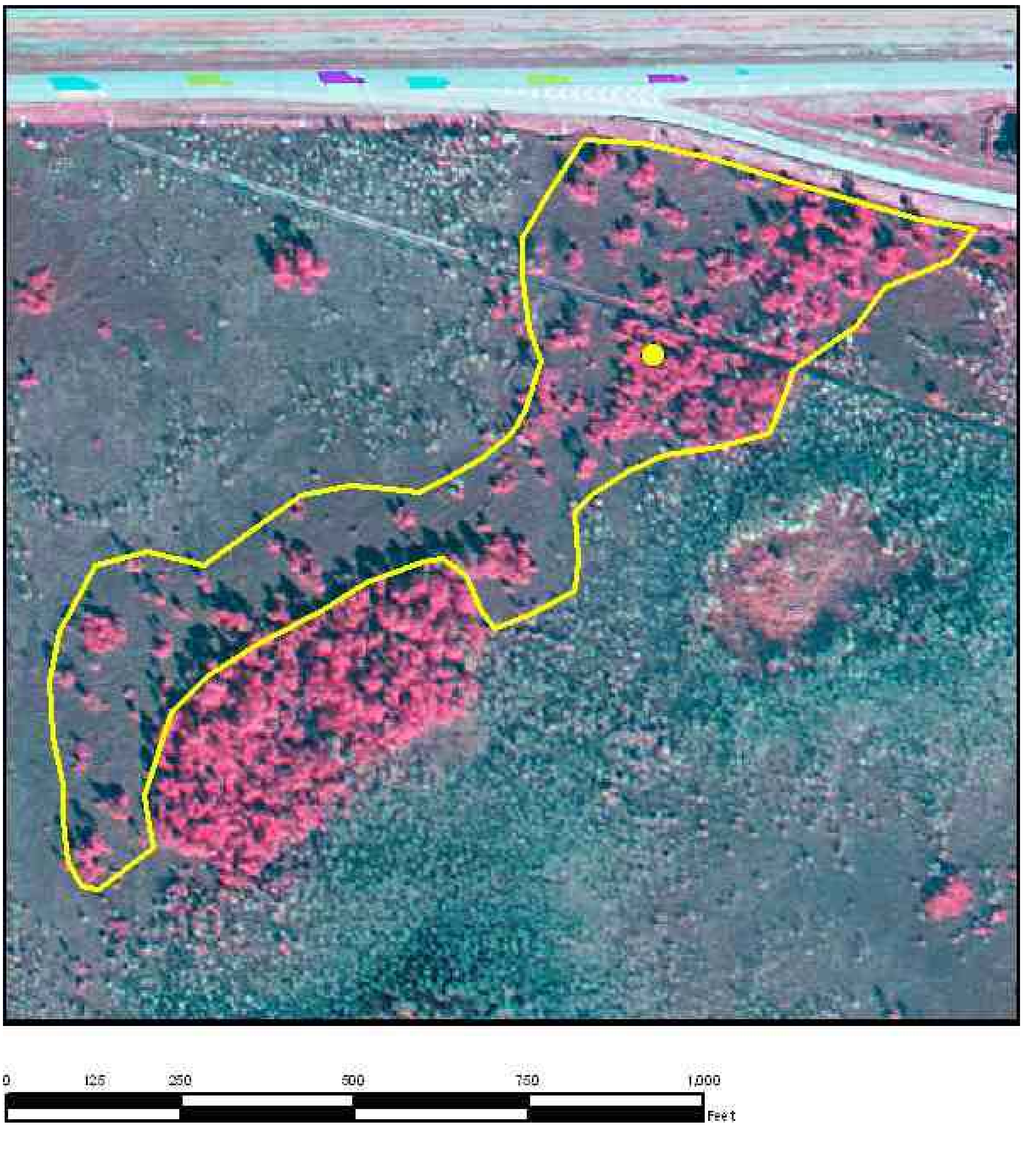
## SPECIAL MAPPING CONVENTIONS

**Note**: This class is an exception to the general crown canopy requirements for Forest classes - (25% for inclusion in a Forest class and 67% dominance of a particular species to be assigned to that species class). Only 10% crown canopy closure is required for inclusion in this class, since a sparse tree canopy is a defining feature of this class.

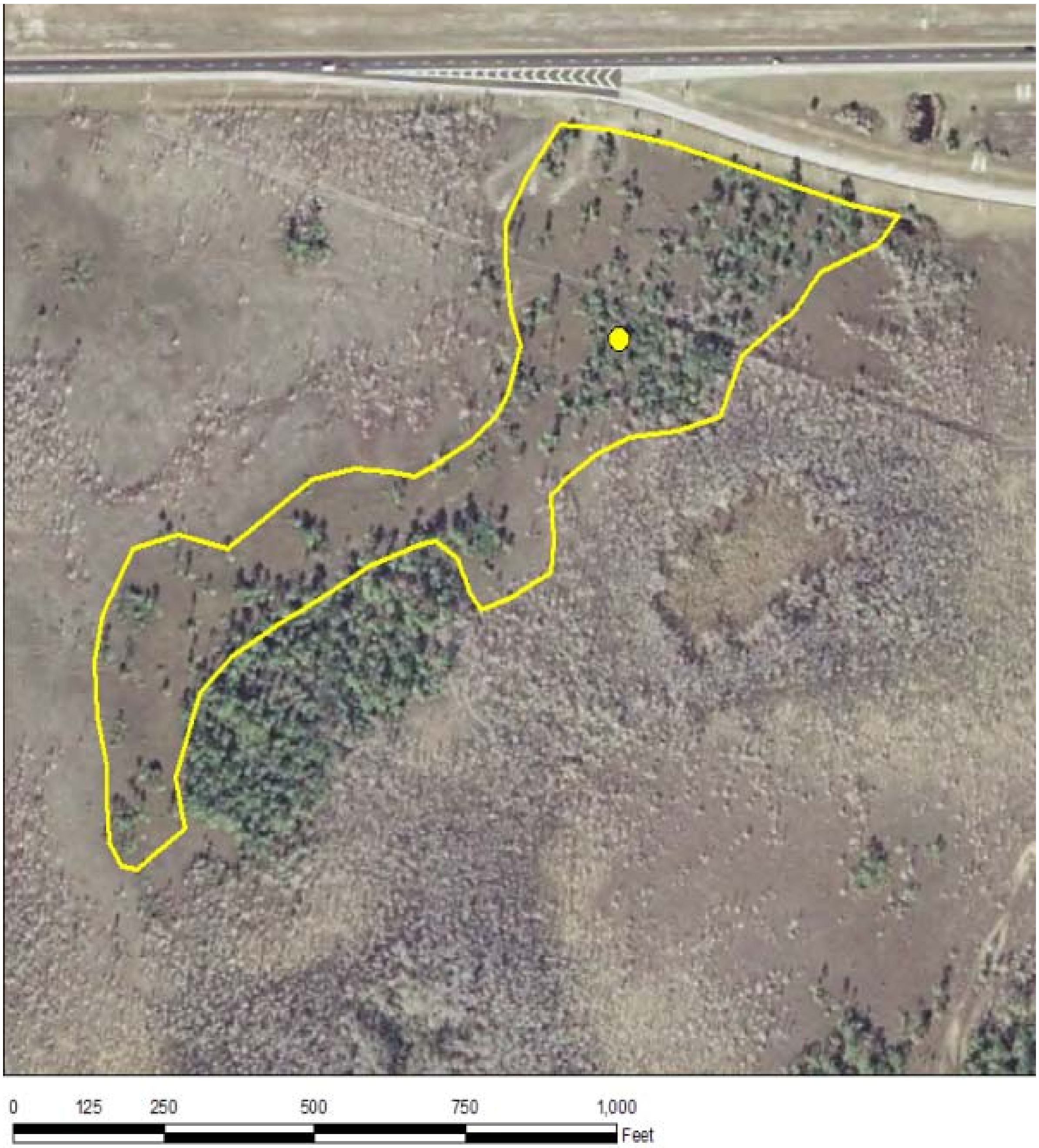
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use c**ode is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
591065.01  665993.95

# 6300
# Wetland Forested Mixed

LEVEL 1: 6000 Wetlands
**LEVEL 2: 6300 Wetland Forested Mixed**

## DESCRIPTION

This class is used for wetland forested communities in which neither hardwoods nor evergreen conifers achieve a 67% dominance of the crown canopy composition, and where no other more specific 6100 Wetland Hardwood Forests or 6200 Wetland Coniferous Forests class applies.

Mixed wetland forests occur on a wide variety of soil moisture conditions, from permanently wet to seasonally or infrequently wet.

A combination of hardwoods and evergreen conifers can occur in nearly all the foregoing forested wetlands communities, including cypress, bay swamps, hardwood swamps, hammocks, depressions, floodplains and bottomlands. It is not possible to describe a context that is representative.

The signatures will vary widely depending on which combination of trees and understory species make up the mixture.

## KEYS TO PHOTOINTERPRETATION

- Forested systems composed of a mixture of hardwoods and evergreen conifers in which neither species achieves greater than 67% dominance.
- Species may include a mixture of deciduous and evergreen tree species such as black gum, red maple, water oak, cabbage palm, bay trees and evergreen conifers adapted to wet environments.
- Will usually exhibit a variety of textures and crown types depending on species present.
- Open water or water staining may be evident where canopy is open.
- Seasonality is an influence on photo signature, as hardwoods reflect dormancy in winter months.

## CONTEXT

- **Landscape Position** - This community could occur in almost any slightly lowered position of the landscape where sufficient moisture exists to support hydrophytic vegetation.
- **Vegetation** - Dominated by an "even" mixture of hardwoods and cypress. Neither cypress nor the hardwoods achieve 67% cover.
- **Soils** - Generally found on mineral soils.
- **Hydrology** - Hydroperiod is variable in this type due to the wide range of species mixtures which can occur within this land cover type. Typical conditions will likely be temporary to seasonal inundation, however.

## SIMILAR CLASSES

- 4340 Upland Mixed Coniferous/Hardwood - These forests occur in upland environments, without the conditions to support wetland species.

- 6100 Wetland Hardwood Forests (except mangroves) - These forests are dominated by hardwood species and while conifers may be present, they do not achieve more than a 33% crown canopy closure.
- 6200 Wetland Coniferous Forests - These forests are dominated by coniferous species and while hardwoods may be present, they do not achieve more than a 33% crown canopy closure.

## SPECIAL MAPPING CONVENTIONS

These communities are likely to be complex mixtures of different species. Individual plants or trees may be dispersed in a matrix or grouped in patches. If distinct patches of any class are greater than 2 acres, they are broken out separately. In transitional areas where species-specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit. PI's must use discretion to accurately characterize the communities but avoid excessive linework.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
509824.85 1262507.15

# 6400
# Vegetated Non-Forested Wetlands

This Level 2 class is not used in the map itself - a more specific subclass must be selected. The Level 3 subclasses are:

6410 Freshwater Marshes/Graminoid Prairie-Marsh
6420 Saltwater Marshes/Halophytic Herbaceous Prairie
6440 Emergent Aquatic Vegetation

## BACKGROUND

Vegetated, non-forested wetlands include marshes and seasonably flooded basins and meadows. These communities usually occur on level, low-lying areas. Sawgrass and cattail are the predominant species in freshwater marshes while spartina and needlerush are the predominant species in the saltwater marsh communities.

To be non-forested, the tree canopy closure must be less than 25%. Trees are defined as woody plants that are over 20 feet in height.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit (MMU) for wetlands and water bodies is 2 acres. Upland areas that occur as "islands" within wetlands systems are broken out down to 2 acres. Adjacent uplands obey the standard MMU of 5 acres, unless otherwise defined.

**Differentiating subclasses:** The 4 subclasses are defined by their respective characteristic plant species. The communities can only be identified by the signatures of individual species, rather than by the general colors, textures and patterns. This generally requires extensive experience in the field comparing features against the photography. There is substantial room for confusion based on the similar signatures that these subclasses present. The problem is addressed with experience, ancillary data, magnified stereo viewing of imagery and field checking.

See the PI keys for each of the subclasses for indicators that assist in differentiation.

## DUAL CODING CONVENTION

All of the 6400 classes are **Land Cover** classes that do not normally require a separate dual code - LCCODE and LUCODE are normally the same. However, in rare cases, a separate **Land Use** code is required. Relevant examples are marshes on reclaimed and abandoned mining areas, which may require separate dual coding. Wetlands that are also pine plantations or forest regeneration areas are dual coded accordingly, with the wetland code always assigned to the LCCODE field.

## SIMILAR CLASSES

The most common source of confusion with this class is between non-forested wetlands and water bodies. In general, the PI is required to map the area as it appears on the source photography. If there is a black return without sign of emergent vegetation a water class would be applied. Since the conditions can change rapidly in flat terrains, this causes some inconsistencies between different maps and can only be considered a "snapshot" of the hydrologic regime in many cases.

In view of the ephemeral nature of water bodies and the complex intermixtures of signature, it is not always cost effective to delineate every minute boundary. Some aggregation often presents a more accurate and more useful model for users.

Another source of confusion is that between wet prairies and uplands pastures. These may be difficult to determine on photography and collateral data such as NRCS soils is likely to be helpful.

**For more information:**

See the PI keys for each of the subclasses for more details and graphic examples.

# 6410
# Freshwater Marshes/Graminoid Prairie-Marsh

LEVEL 1: 6000 Wetlands
LEVEL 2: 6400 Vegetated Non-Forested Wetlands
**LEVEL 3: 6410 Freshwater Marshes/Graminoid Prairie-Marsh**

## DESCRIPTION

This class is used for wetlands communities characterized by herbaceous plant species that occur on sites where surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years.

Freshwater marshes tend to be open expanses of grasses, sedges, rushes and other types of herbaceous plants. Periods of inundation are intermediate between deep marshes (6440 Emergent Aquatic Vegetation) and wet prairies - sites are usually covered with water at least two months of the year and undergo prolonged periods of soil saturation.

This category also includes marl prairies of the Everglades.

*Due to the scale of photography and similarity of code definitions, it has been determined that Wet Prairies (6430) and Freshwater Marshes / Graminoid Prairie-Marsh (6410) be combined into one class as 6410.*

## KEYS TO PHOTOINTERPRETATION

- Signatures are very diverse, as a result of the variety of plant assemblages and land forms that make up freshwater marshes. Mono-cultures of sawgrass or cattail have smooth, uniform signatures. More diverse, non-graminoid communities may have more patchy and irregular signatures with a variety of height, colors and textures.
- Scattered shrubs and trees may be present, especially on drier sites and in the absence of fires.
- The sites typically have a coarse textured organic surface soil over soft organic muck substrates. NRCS soils maps indicate muck soils.

## CONTEXT

- **Landscape Position** - Marshes are usually encountered along rivers, streams or lakes in floodplain situations. They also occur in depressional situations with water supplied by rainfall or groundwater. Basin marshes are often former lake or pond systems which are progressing along the ecological process to a drier community. Many of these communities are found within pasture settings. This category also includes marl prairies of the Everglades which are vegetated by beak rush, spike rush, periphytons and algal mats in shallow water.
- **Vegetation** - Dominated by herbaceous vegetation including pickerelweed, arrowhead, maidencane, common reed, arrowroot, switch grass, cordgrass and bulrush.
- **Soils** - Very poorly drained, mineral or organic.
- **Hydrology** - These communities are seasonally to permanently flooded and many only dry out during extended droughts.

## SIMILAR CLASSES

- 4430 Forest Regeneration - Wet areas with marsh-like signatures are often observed where land has been cleared for pine plantations. These areas are not identified as 6410 unless the natural vegetation is still present.
- 5000 Water - High water conditions at the time of photography may cover over the emergent vegetation in some marsh systems. These areas are coded as water bodies, even though collateral data may identify them as 6410 Freshwater Marshes, due to their open water signature at the time of photography.
- 6440 Emergent Aquatic Vegetation - Signatures are variable, including bright pinks or mottled reds and grays, depending on species

## SPECIAL MAPPING CONVENTIONS

Areas dominated by sawgrass are included in this class, unless they are 10 acres in size or greater, in which case they are mapped at Level 4 as 6411 Freshwater Marsh - Sawgrass.

Where other freshwater marsh species are observed in a larger sawgrass community, the freshwater marsh portion is not delineated separately unless it is greater than 10 acres.

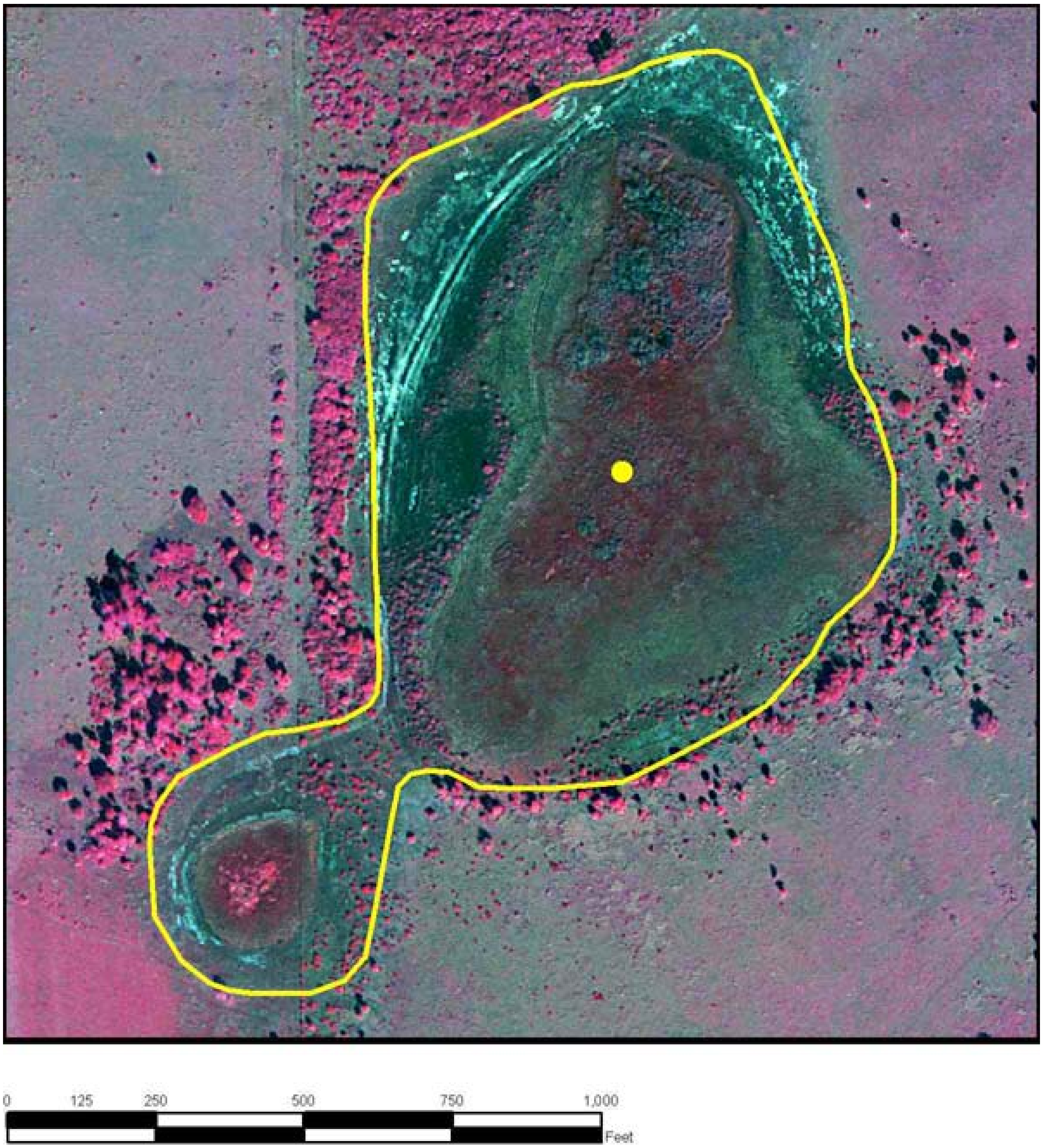
Marshes may have a complex, patchy distribution of different species groups, open water and other communities. In transitional areas where species-specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit. The map should accurately characterize the communities but avoid excessive linework.

To avoid excessively complex delineation where other freshwater marsh species are intermixed with sawgrass, specifically in the Everglades sawgrass and marl prairie communities, vegetation dominance for the area will be determined and the appropriate code applied. Where the sawgrass component of the mixed community is less than 67% cover, the polygon will be coded **6410 Freshwater Marshes/Graminoid Prairie Marsh.**

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
01/09/07

**COORDINATES**
561699.32  840197.79

# 6411
# Freshwater Marshes - Sawgrass

LEVEL 1: 6000 Wetlands
LEVEL 2: 6400 Vegetated Non-Forested Wetlands
LEVEL 3: 6410 - Freshwater Marshes/Graminoid Prairie - Marsh
**LEVEL 4: 6411 - Freshwater Marshes - Sawgrass**

## DESCRIPTION

Sawgrass marsh is widespread in Florida and is the predominant species in the Everglades, accounting for 70% of the landscape. The nearly total dominance of this species over such a large area is one of the distinguishing features of the Everglades.

It grows equally well in water several feet deep and on moist ground several feet above the water table.

Sawgrass may exceed 10 feet in height and form an impenetrable mass. Two categories of sawgrass are recognizable: dense and sparse. The dense type occurs on higher ground, and although it appears monotypic, it may include small areas of other tall emergents such as cattail, ferns, and small shrubs.

The transition between dense sawgrass and adjacent marsh communities is often sharply defined, probably owing to fire effects. Sparse sawgrass usually occurs at lower elevations.

## KEYS TO PHOTOINTERPRETATION

- Produces a smooth pinkish-beige CIR signature, often in a circular pattern with a whitish ring around the edges.
- In larger marshes the circular pattern is usually absent and patches of open water, floating aquatic vegetation or other marsh vegetation may be visible as white, whitish-pink, pinks and reds on CIR.
- The pinkish-beige sawgrass CIR signature must predominate for this code to be applied.

## CONTEXT

- **Landscape Position** - Sawgrass marshes may be found in either freshwater coastal or inland situations. Unlike cattail, sawgrass is seldom found in highly disturbed situations. More natural marshes and the centers of deeper wet prairies in more remote areas often contain sawgrass. Large expanses of sawgrass are found in the Everglades.
- **Vegetation** - Sawgrass is the dominant species in this community to the virtual exclusion of all other vegetation.
- **Soils** - Very poorly drained, mineral or organic; sometimes over limestone outcrops as in the Everglades.
- **Hydrology** - These communities are typically inundated on a seasonal basis, but may even be permanently flooded. Most examples will be either dry or saturated by the end of the growing season, but some only dry out during extended droughts. In larger marshes, slowly flowing water may be present over very large areas. The flow rate in such situations is usually so slow as to be imperceptible.

## SIMILAR CLASSES

- 6410 Freshwater Marshes/Graminoid Prairie-Marsh - Signatures are more diverse, reflecting a greater variety of species.
- 6440 Emergent Aquatic Vegetation - Bright pink or mottled red, gray or purple signatures, often with a "shiny" appearance on the photo.

## SPECIAL MAPPING CONVENTIONS

Areas dominated by other freshwater marsh species are included in this class, unless they are 10 acres in size or greater, in which case they are mapped at Level 3 as 6410 Freshwater Marshes/Graminoid Prairie.

Where sawgrass is observed in a larger freshwater marsh of mixed species, the sawgrass portion is not delineated separately **unless it is greater than 10 acres.**

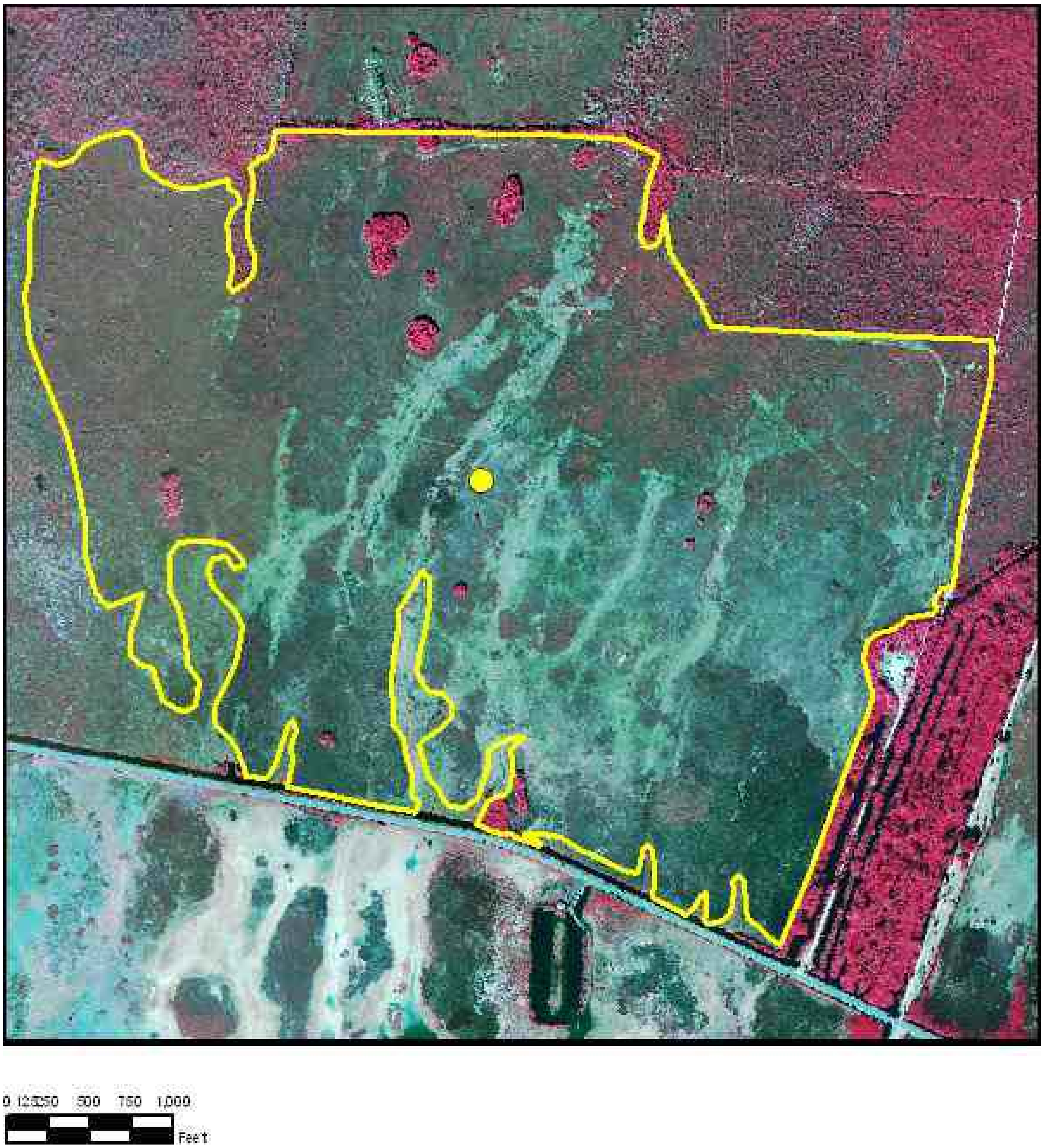
Sawgrass communities within the Everglades may be intermixed with marl prairie, which is addressed within the 6410 Freshwater Marshes/Graminoid Prairie-Marsh class. In transitional areas where species-specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases, intermixed community classes will be assigned and mapped at a larger unit. The map should accurately characterize the communities but avoid excessive linework.

To avoid excessively complex delineation where sawgrass is intermixed with other freshwater marsh species, specifically in the Everglades sawgrass and marl prairie communities, vegetation dominance for the area will be determined and the appropriate code applied. Sawgrass equal to 67% or greater cover will be coded 6411 Freshwater Marshes - Sawgrass.

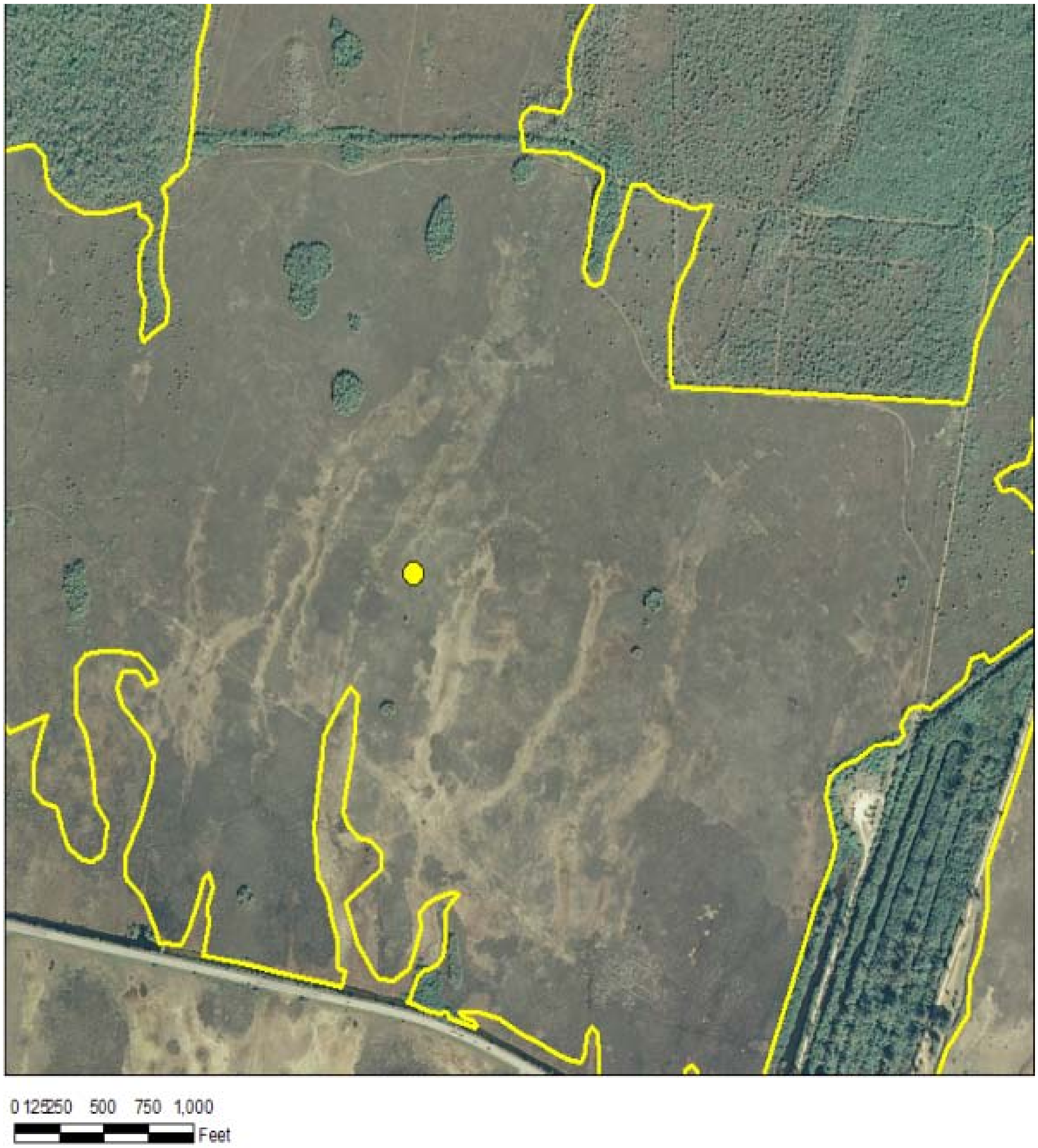
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
05/08/07

**COORDINATES**
531537.90 577786.99

# 6420
# Saltwater Marshes/Halophytic Herbaceous Prairie

LEVEL 1: 6000 Wetlands
LEVEL 2: 6400 Vegetated Non-Forested Wetlands
**LEVEL 3: 6420 Saltwater Marshes/Halophytic Herbaceous Prairie**

## DESCRIPTION

This class is used for wetlands communities of non-woody, salt-tolerant plants occupying intertidal zones that are at least occasionally inundated with salt water. They exist at the interface of land and marine waters, wherever wave energy is sufficiently low to allow their development and where mangrove trees are not dense enough to shade out the characteristic vegetation.

Within these constraints, the areal extent of saltwater marshes is determined in large part by the size of the intertidal zone. Regions of low relief and high tidal range are likely to have extensive salt marshes.

**Note:** The saltwater marsh is an early successional community in South Florida. These areas are generally taken over by mangroves, especially within mosquito impoundments.

## KEYS TO PHOTOINTERPRETATION

- Marshes present a smooth textured appearance with vegetation generally below 3 feet. Color tones are greenish to whitish-green (CIR), varying with predominant species.
- A distinct watershed and network of drainage creeks (tidal channels) is often present.
- A bare, whitish area, or "salt pan" may be visible in flatter areas near the landward limit of salt marshes.
- Some dikes may be visible. Large areas have been impounded for mosquito control.
- Vast expanses of vegetation are separated into distinctive zones, often with abrupt boundaries.
- Light pinkish-red CIR signature of young mangroves may be visible in these communities, but are not dominant.

## CONTEXT

- **Landscape Position** - This community occurs in low energy coastal and estuarine environments with sufficiently high salinities to support these salt community species. Generally found near the northern ends of the District (Atlantic Ocean side) in mosquito impoundments. Coastal areas of the Gulf of Mexico will have more extensive examples of this class.
- **Vegetation** - Dominant species include: cordgrasses, needlerush, seashore salt grass, saltwort, sea oxeye daisy, glassworts and fringerush. These species are generally short - less than three feet tall.
- **Soils** - Very poorly drained and usually mucky, sandy clay loams or saline sands.
- **Hydrology** - Tidal fluctuations directly influence the hydrology.

## SIMILAR CLASSES

- 5430 Saltwater Ponds - Isolated estuarine water bodies that have no visible connection to adjacent coastal waters

- 6500 Non-Vegetated Wetlands - See decision rules used to differentiate tidal flats. Tidal flats under 5 acres found within saltwater marshes are mapped as open water or saltwater marsh depending on context.
- 6510 Tidal Flats - These are non-vegetated, or with only sparse vegetation.

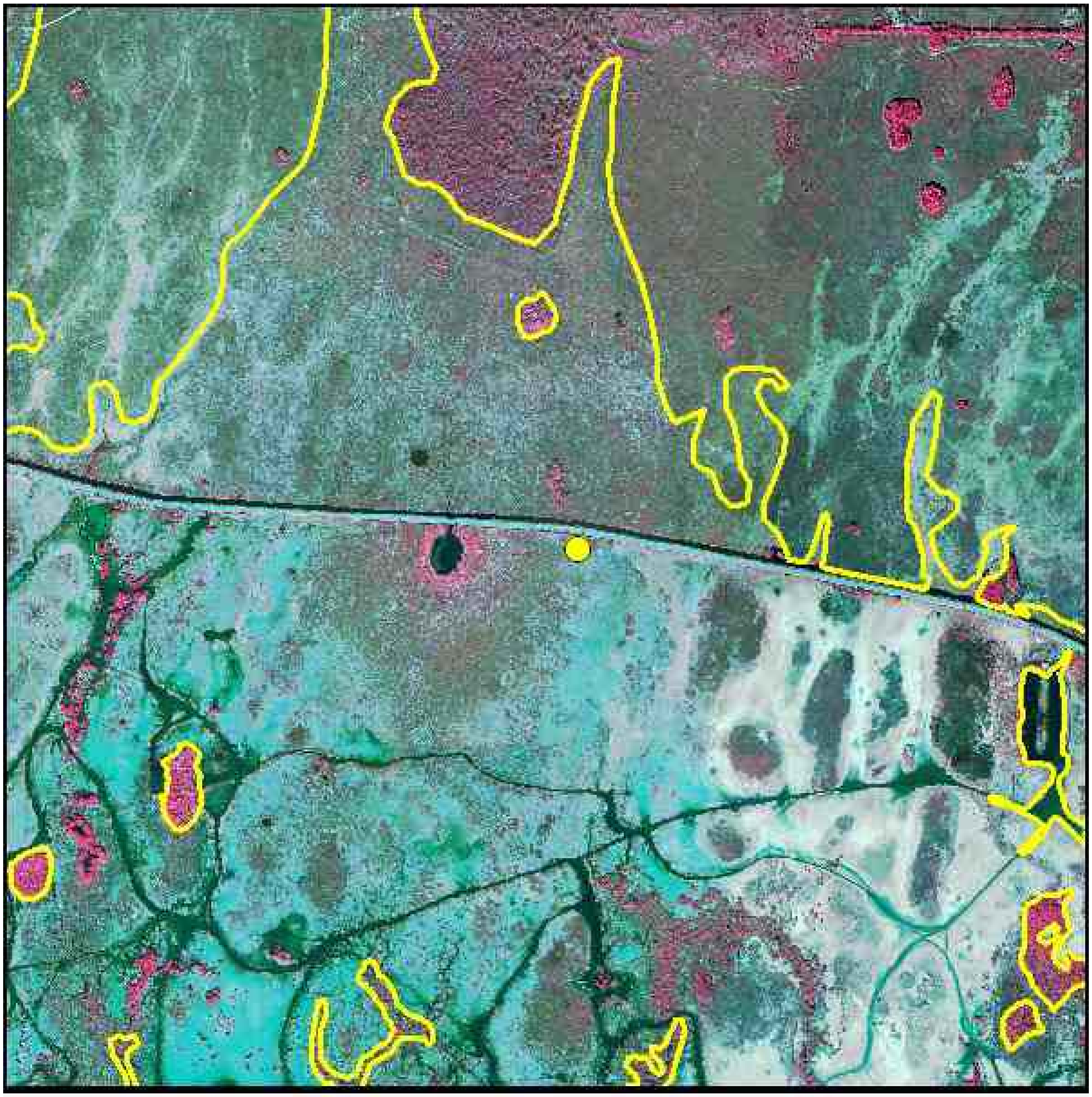
## SPECIAL MAPPING CONVENTIONS

Marshes may have a complex, patchy distribution of different species groups, open water and other communities. In transitional areas where species-specific wetland (2 acres) and upland (5 acres) polygons are below the appropriate MMU, some aggregation may be justified. In these cases intermixed community classes will be assigned and mapped at a larger unit.

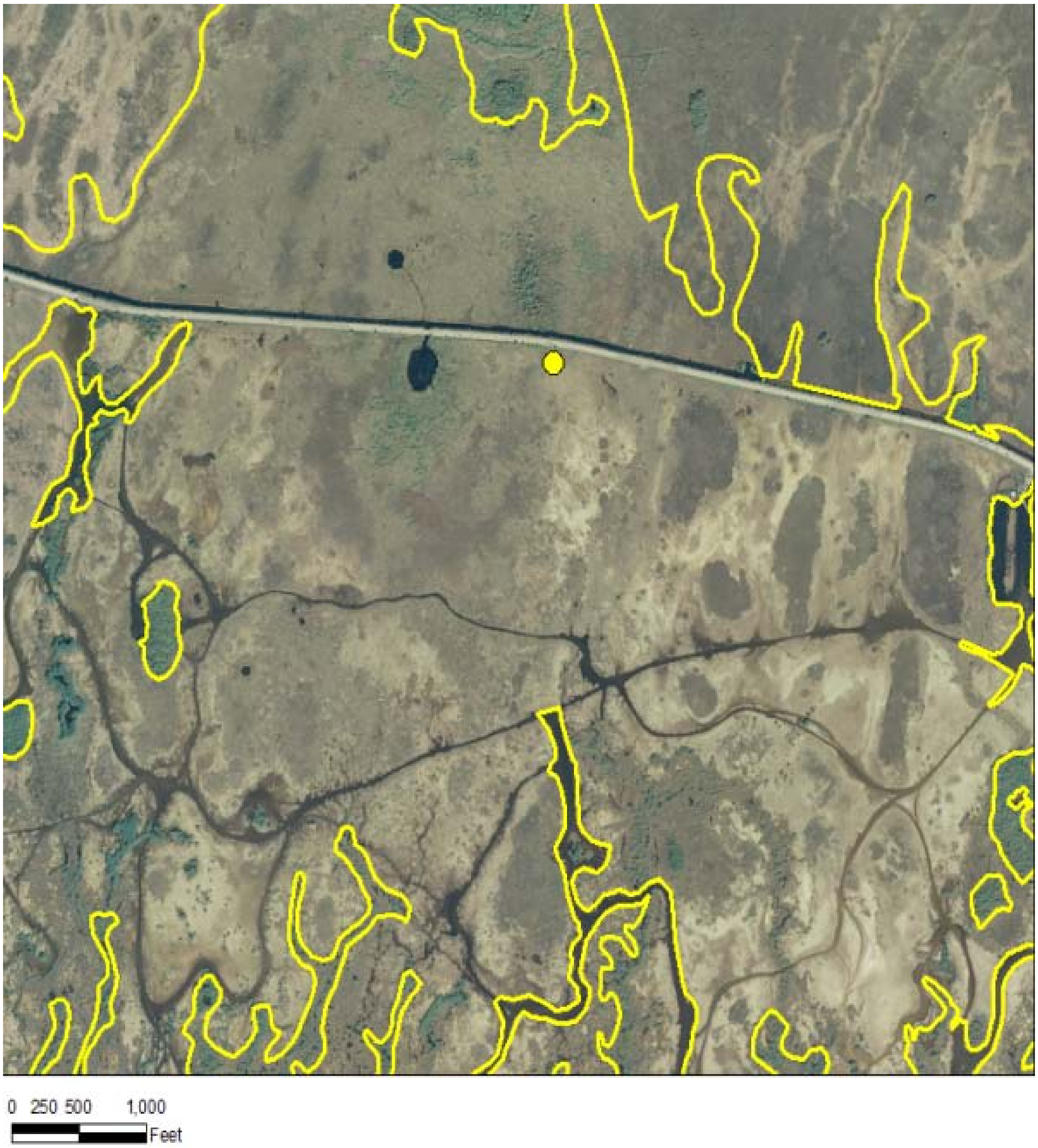
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
05/08/07

**COORDINATES**
528578.09  576074.78

# 6440
# Emergent Aquatic Vegetation

LEVEL 1: 6000 Wetlands
LEVEL 2: 6400 Vegetated Non-Forested Wetlands
**LEVEL 3: 6440 Emergent Aquatic Vegetation**

## DESCRIPTION

This class is for flooded (aquatic) areas with emergent or floating vegetation. It includes communities otherwise known as deep marsh or floating marsh. In the absence of vegetation these areas would be classed as water bodies, which indeed they are. Submerged aquatic vegetation (SAV) is not included in this class or in the land cover data layer. It is generally included with open water.

Four of the most common emergent aquatic communities are described below:

**Deep Marsh** - Deep water wetlands dominated by a mixture of water lilies and deep water emergent species. Semi-permanently to permanently flooded.

**Lakeshore Emergents** - Emergent vegetation growing along lake shores and usually semi-permanently flooded. *Panicum hemitomon* and species of *Scirpus* are most common.

**Water Lilies** - Floating-leaved species in the genera *Nymphaea*, *Nuphar*, *Nelumbo*, *Brasenia* and *Nymphoides*. Usually semi-permanently to permanently flooded.

**Floating Marshes** - Communities of free-floating plants (such as water hyacinth, water lettuce, or *Lemna*) or floating mats of rhizomatous species (such as alligator weed or various grasses and sedges).

The FLUCCS system includes five subclasses of emergent aquatic species: Water lettuce, Spatterdock, Water hyacinth, duck weed and water lily. These subclasses are not active in this data layer.

## KEYS TO PHOTOINTERPRETATION

- Deep water wetlands dominated by free-floating plants, such as water lilies, water hyacinth, water lettuce, or lemna, or floating mats of rhizomatous species, such as alligator weed or various grasses and sedges.
- Signatures are variable, including bright pinks or mottled reds and grays on CIR, depending on species. Distinct smooth bright green signatures on natural color, or bright red CIR signatures caused by floating plants are strong indicators of deep marsh.

## CONTEXT

- **Landscape Position** - Emergent aquatics are found in depressed areas, solution holes, ponds, lakes, canals, rivers, streams and other areas where persistent water prevents the growth of other plants. These areas are permanently inundated and only dry out during extended droughts or artificial drawdowns.
- **Vegetation** - Community dominated by floating or emersed aquatic plants including spatterdock, water lily, water lettuce, water hyacinth, duckweed and salvinia.
- **Soils** - Substrates for this community will be highly organic silts accumulated over otherwise sandy or sandy loam soils which are very poorly drained.

- **Hydrology** - These areas are permanently inundated and only dry up during extended droughts.

## SIMILAR CLASSES

- 5000 Water - Including areas of submergent aquatic vegetation
- 6410 Freshwater Marshes - The context is not aquatic. Plants are typically taller and less open water is visible.

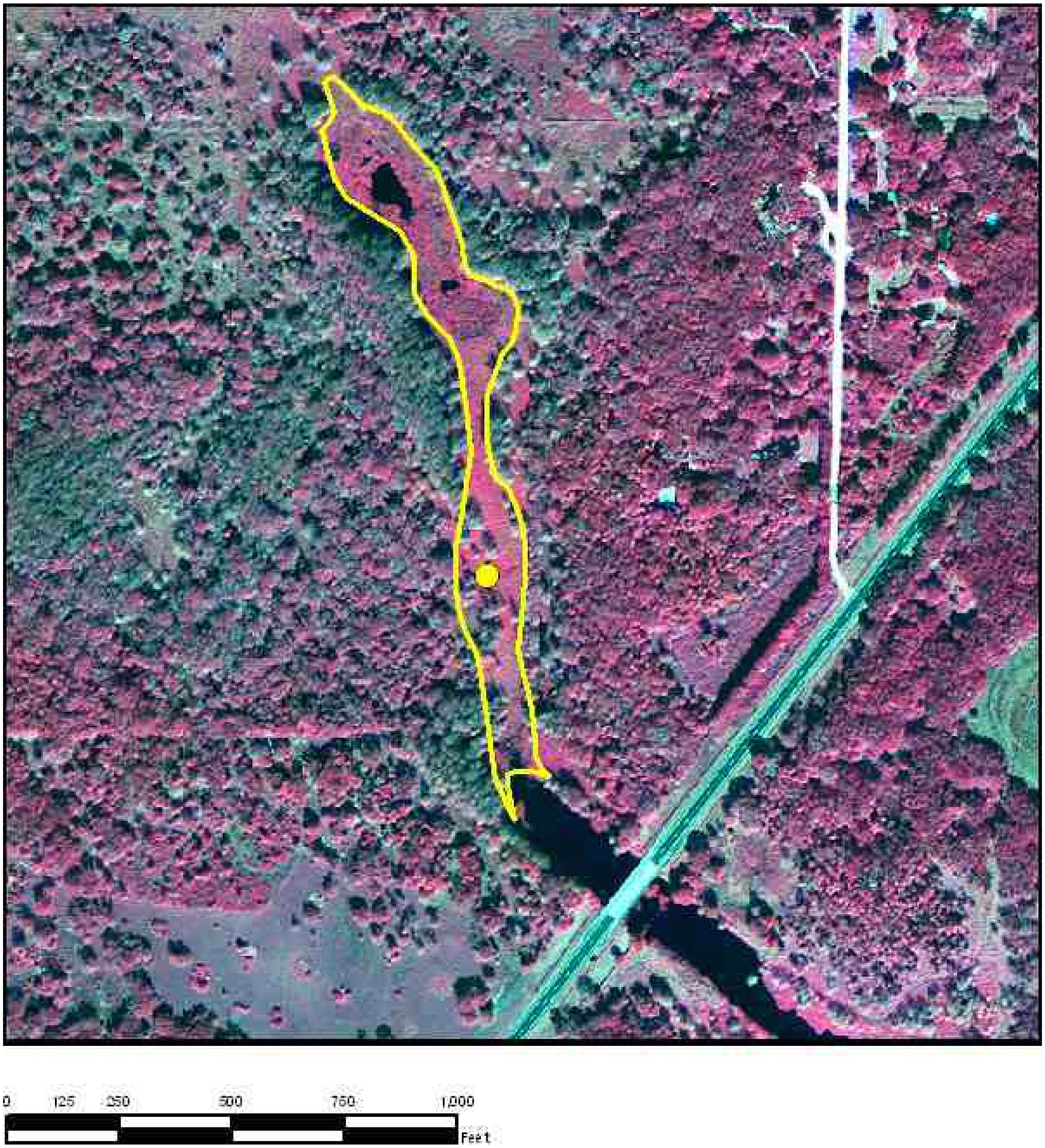
## SPECIAL MAPPING CONVENTIONS

Where emergent aquatic vegetation is observed in a larger freshwater marsh of mixed species, the emergent aquatic portion is not delineated separately **unless it is greater than 10 acres.**

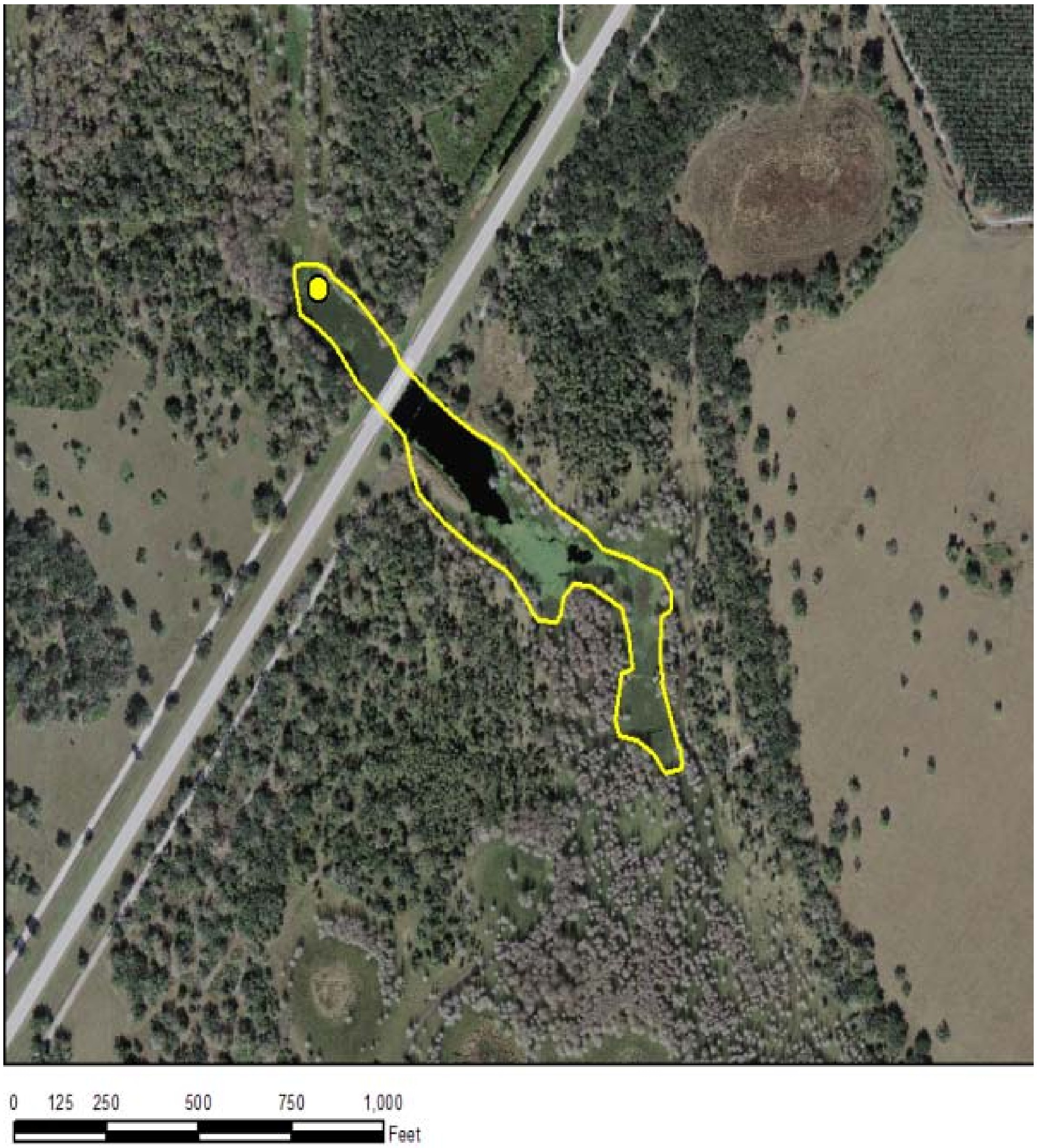
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
01/09/07

**COORDINATES**
535405.02 920108.03

# 6500
# Non-Vegetated Wetlands

LEVEL 1: 6000 Wetlands
**LEVEL 2: 6500 Non-Vegetated Wetlands**

## DESCRIPTION

Non-Vegetated Wetlands are hydric surfaces that lack vegetation due to reasons such as those below:

- The erosional effects of wind and water may transport surface materials so rapidly that the establishment of plant communities is hindered.
- The fluctuation of the water surface level is such that vegetation cannot become established.
- Submerged or saturated substrates may develop toxic conditions of extreme acidity or salinity.

Tidal flats, shorelines and intermittent ponds are the most common examples of this class. Also included are barren salt flats on higher grounds resulting from surface evaporation.

**NOTE:** Tidal Flats are classified at Level 3 as 6510 Tidal Flats.

## KEYS TO PHOTOINTERPRETATION

- Hydrologic changes or toxic conditions (salinity, acidity, chemical or thermal pollution) prevent plant growth.
- White signatures are characteristic of dry or sandy areas.
- Examples are tidal mud flats, tidal sand flats, shorelines, intermittent ponds, salt flats.

## CONTEXT

- **Landscape Position** - This class usually occurs on areas where water fluctuations are too rapid to permit establishment of plant communities.
- **Vegetation** - These areas are generally unvegetated.
- **Soils** - Substrate can range from mud and sand to rocks.
- **Hydrology** - Water fluctuation is a distinguishing characteristic.

## SIMILAR CLASSES

- 6420 Saltwater Marshes - These have at least 25% vegetative cover.
- 7200 Sand Other Than Beaches - These have no influence by fluctuating water levels.

## SPECIAL MAPPING CONVENTIONS

This class is one of the most problematic of the FLUCCS land cover classes to map, for the following reasons:

- The ability to recognize tidal flats depends on tide stage - during high tides this feature is submerged. Therefore the resulting maps may only provide a "snapshot" varying with tidal stage.

- Tidal channels occurring within salt marshes are often too narrow and complex to allow complete delineation within this project's scope. For this reason a 5 acre MMU is used.
- The actual coastline should technically be drawn at the mid point of tidal stage. That requires information resources beyond the scope of the mapping project. For more accurate coastlines other maps, such as those of USGS or NOAA, should be consulted.
- Barren salt flats may pop up in surprising locations and look like dry, sandy areas. Collateral data is required.

The minimum mapping unit for this class is 2 acres.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE


**COORDINATES**
886587.87 1131936.13 (Images)

## FIELD PICTURE

**DATE**
03/16/07

**COORDINATES**
745674.80 865379.79 (Field Picture)

# 6510
# Tidal Flats

LEVEL 1: 6000 Wetlands
LEVEL 2: 6500 Non-Vegetated Wetlands
**LEVEL 3: 6510 Tidal Flats**

## DESCRIPTION

Tidal Flats are non-vegetated, shallow-water habitats situated between the low and high tide limits. Their substrate is soft to semi-soft sand or mud. They are found where sediments accumulate and are usually bordered landward by *Spartina alterniflora* marshes and seaward by tidal channels or sub-tidal seagrass beds.

An important characteristic of this class is its alternating tidal cycle of submergence and exposure to the atmosphere.

## KEYS TO PHOTOINTERPRETATION

- Signatures are very wet sand or mud with a dark gray or greenish-gray CIR tone, whitish natural color and very smooth texture.
- If the tide is not completely out and substrates are somewhat sandy, the return may be a light or whitish blue on CIR.
- Examples are tidal mud flats, tidal sand flats, shorelines, intermittent ponds, salt flats.

## CONTEXT

- **Landscape Position** - Tidal flats occur in the shallower portions of estuaries and bays which are protected from intense wave action. They are found along the shorelines and in tidal channels or openings in the salt marsh and mangrove communities.
- **Vegetation** - This category is unvegetated by definition. Tidal marl flats of the southeastern Everglades may be vegetated by sparse and stunted red mangroves and sawgrass.
- **Soils** - Substrates are saline sands and muds.
- **Hydrology** - Intermittently exposed or regularly flooded (and exposed) by daily tidal action.

## SIMILAR CLASSES

- 5100 Streams and Waterways - Dark blue or black signature, indicating deeper water
- 5410 Embayments Opening Directly to Gulf or Ocean - Will have a more open water signature than tidal flats
- 5420 Embayments Not Opening Directly to Gulf or Ocean - Will have a more open water signature than tidal flats
- 5430 Saltwater Ponds - Isolated estuarine water bodies that have no visible connection to adjacent coastal water
- 6420 Saltwater Marshes - Characterized by expanses of grasses, sedges, rushes, and other herbaceous plants
- 7200 Sand Other Than Beaches - Not associated with water; usually wind deposited

## SPECIAL MAPPING CONVENTIONS

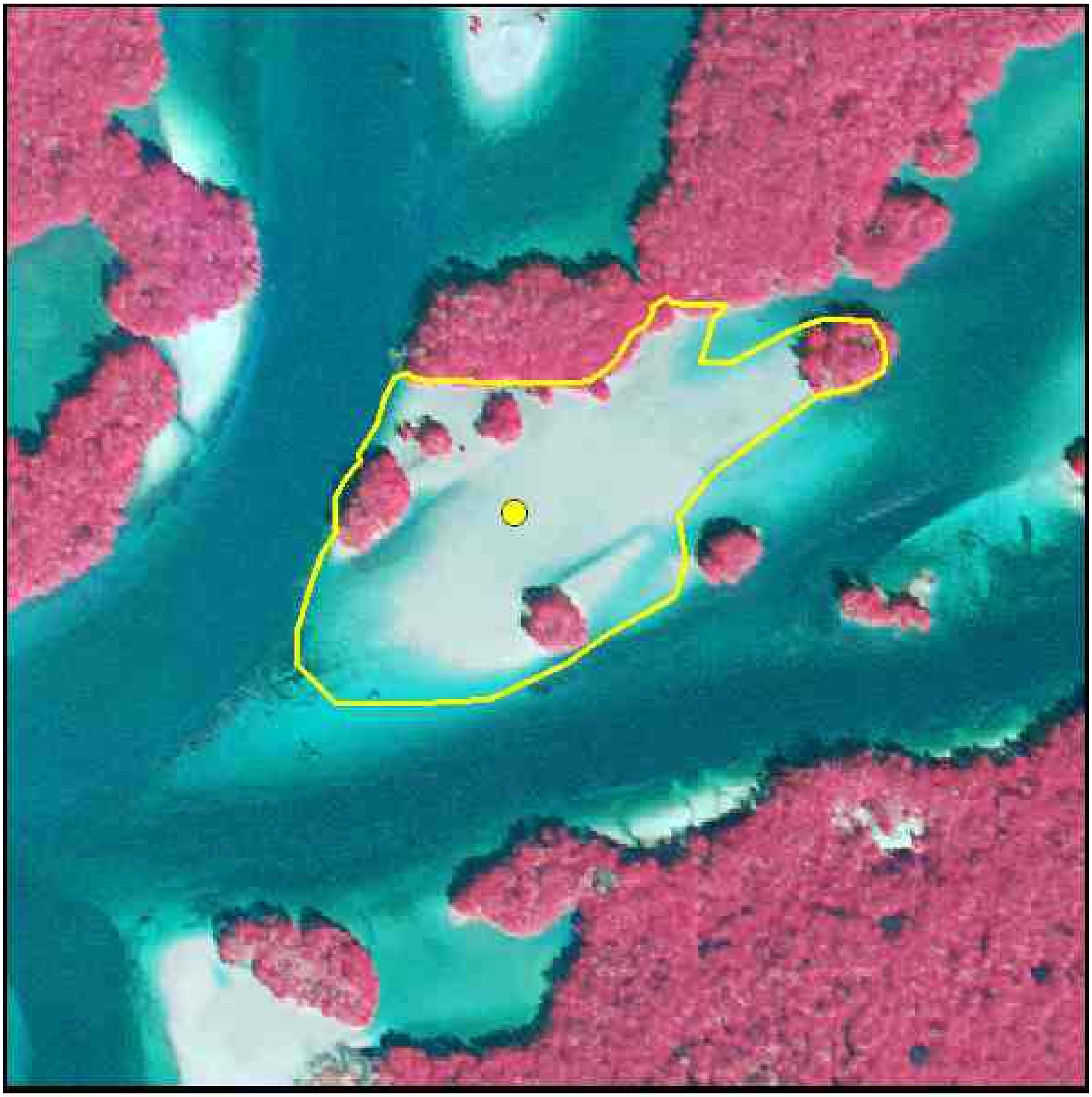
This class is one of the most problematic of the FLUCCS land cover classes to map, for the following reasons:

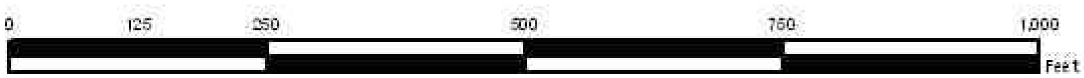
- The ability to recognize tidal flats depends on tide stage - during high tides this feature is submerged. Therefore the resulting maps may only provide a "snapshot" which will vary depending on tidal stage.
- Tidal channels occurring within salt marshes are often too narrow and complex to allow complete delineation. For this reason, they may sometimes be aggregated into the surrounding marsh in order to avoid overly complex linework.
- The actual coastline should technically be drawn at the mid point of tidal stage. This requires information resources beyond the scope of the mapping project. For more accurate coastline determination other maps, such as those of USGS or NOAA, should be consulted.
- Barren salt flats may appear in locations which can be mistaken for dry, sandy areas. Collateral data is required.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
385667.90 712293.22

# 7000
# Barren Land

This Level 1 class is not used in the map itself - a more specific subclass must be selected. The Level2 subclasses include:

7200 Sand Other Than Beaches
7300 Exposed Rock
7400 Disturbed Land

For details on each subclass (both Level 2 and Level 3) see the respective PI Key pages.

## BACKGROUND

Barren land has very little or no vegetation and limited potential to support vegetative communities. In general, it is an area of bare soil or rock. Vegetation, when present, is very sparse and scrubby. Not all barren areas will be coded as such - barren land may temporarily exist due to human activity. In such cases the mapping unit may be coded with the specific land use or dual coded with both the land cover and a separate land use code.

Barren land classes are all **Land Cover** classes, except 7470 Dikes and Levees, that are frequently used together with a Land Use code, such as 1180 Rural Residential or 1670 Abandoned Mining Land. Possible dual coding combinations are listed below under Dual Coding Conventions. However, in most cases of disturbed areas, the land cover type is not required - examples are industrial areas, land fills, active mining operations and others listed below under Similar Classes.

The Barren classes apply only to upland areas. Non-vegetated wetlands, such as tidal flats and salt flats, are assigned the appropriate 6500 code. Borrow areas that are saturated or inundated are mapped as either Wetlands or Water.

## MAPPING CONVENTIONS

**Minimum mapping units:** The minimum mapping unit for all 7000 Barren Land classes is 5 acres.

**Differentiating subclasses:** Subclasses are not difficult to differentiate. Note that the class 7200 Sand Other Than Beaches applies to undisturbed areas, in contrast with the 7400 classes.

## DUAL CODING CONVENTION

All of the 7000 classes are **Land Cover** classes. The LCCODE and LUCODE are usually the same. However some subclasses may be used to describe the **Land Cove**r for various **Land Use** classes such as 1180 Rural Residential, 1650 Reclaimed Mine Land, 1670 Abandoned Mine Land, 1900 Open Land, 1920 Inactive Land With Street Pattern, 7470 Dikes and Levees, and others.

## SIMILAR CLASSES

- 1190, 1290, 1390, etc. - Any of the 'Residential Under Construction' classes can be disturbed, but are not dual coded with 7000s.
- 1500 Industrial - Industrial areas, particularly heavy industry, are often disturbed and unvegetated.

- 1600 Extractive - Active mining areas will appear disturbed, but are not classed as 7000. Use a 7000 class only for reclaimed or abandoned areas, with dual coding to show both land cover and land use.
- 2000 Agriculture - Fields that are unvegetated because they are fallow or under preparation and cultivation may be confused with Barren Land. The context should be considered.
- 3000 Upland Non-Forested - These areas will have vegetation.; There may be inclusions of Barren Land, which should be broken out if large and distinct.
- 4430 Forest Regeneration - These may appear unvegetated when trees are small. PIs should look carefully at the forestry context.
- 6500 Non-Vegetated Wetlands - These will be in areas where water levels fluctuate.

**For more information:**

See the PI keys for each of the subclasses for more details and graphic examples.

# 7200
# Sand Other Than Beaches

LEVEL 1: 7000 Barren Land
**LEVEL 2: 7200 Sand Other Than Beaches**

## DESCRIPTION

Sand Other Than Beaches refers to natural, sandy, unvegetated areas - usually dune sands. Dunes are of aeolian (wind transported) origin and are composed of sand grains deposited downwind from a natural source of sand. Dune sizes vary greatly with diameters ranging from a few feet to more than several hundred feet. Their heights also vary and their shapes display considerable variety. Where the dunes are the major feature, shore and strand lines, coastal plains, river flood plains and deltas are secondary.

This class is not restricted to dune sands as bare sands exist in other forms, such as other unvegetated areas of open sand, which do not fit within the other land use categories of "Under Construction".

Use of this class requires presence of less than 10 percent vegetative cover within the polygon.

## KEYS TO PHOTOINTERPRETATION

- Characteristic bright white outcropping occurring in areas of sand deposition or historic dunes
- May be of various sizes and often occur as ridges or on slopes where vegetation cannot grow due to lack of soil accumulation
- Not associated with water (at present time); may be wind deposited

## CONTEXT

- **Landscape Position** - This land use may occur anywhere within the project area. Where it occurs away from the coast or a water body, it generally is the result of some form of disturbance. The interpreter is therefore cautioned to look for other land use activities occurring in the area to determine if this code is correct or if another code should be applied.
- **Vegetation** - Dune features in inland areas are usually vegetated, not barren.
- **Soils** - Sand is generally the only soil type present.

## SIMILAR CLASSES

- 1810 Swimming Beach - Generally linear features accessible for recreation; parking lots may be visible.
- 6500 Non-Vegetated Wetland - Influenced by water level fluctuations

Also, see "Similar Classes" in the 7000 General Description

## SPECIAL MAPPING CONVENTIONS

The minimum mapping unit for this class is 5 acres. Linear features as narrow as 30 feet are mapped.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LUCODE and LCCODE are generally the same. A separate **Land Use** code may be required in rare exceptions - for instance, if dunes occur in conjunction with uses such as 1180 Rural Residential or 1920 Inactive Land With Street Patterns.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
11/20/07

**COORDINATES**
666988.75  151771.20

# 7300
# Exposed Rock

LEVEL 1: 7000 Barren Land
**LEVEL 2: 7300 Exposed Rock**

## DESCRIPTION

This class consists of exposed bedrock and other accumulations of rock materials lacking vegetative cover. Exposed bedrock, when weathered, may be lacking vegetation due to the fine soil materials being removed by the actions of wind and water.

Use of this category requires presence of less than 10 percent vegetative cover within the polygon.

## KEYS TO PHOTOINTERPRETATION

- Rough textured, light colored appearance
- A sprinkling of magenta or reddish tones on CIR indicating scattered vegetation

## CONTEXT

- **Landscape Position** - It may be found anywhere in the District, and also in abandoned quarry areas which have reverted to native vegetative types. (Also see Special Mapping Conventions)

## SIMILAR CLASSES

- 1500 Industrial - Some Industrial operations are often disturbed and unvegetated.
- 1600 Extractive - Parts of some of the Extractive classes may appear as rock, but are included in their Extractive class.
- 7400 Disturbed Land - The soil or substrate has been altered by human activity.

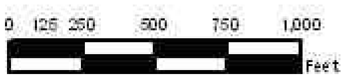
## SPECIAL MAPPING CONVENTIONS

This class is found interspersed with marsh grass in the Everglades area.

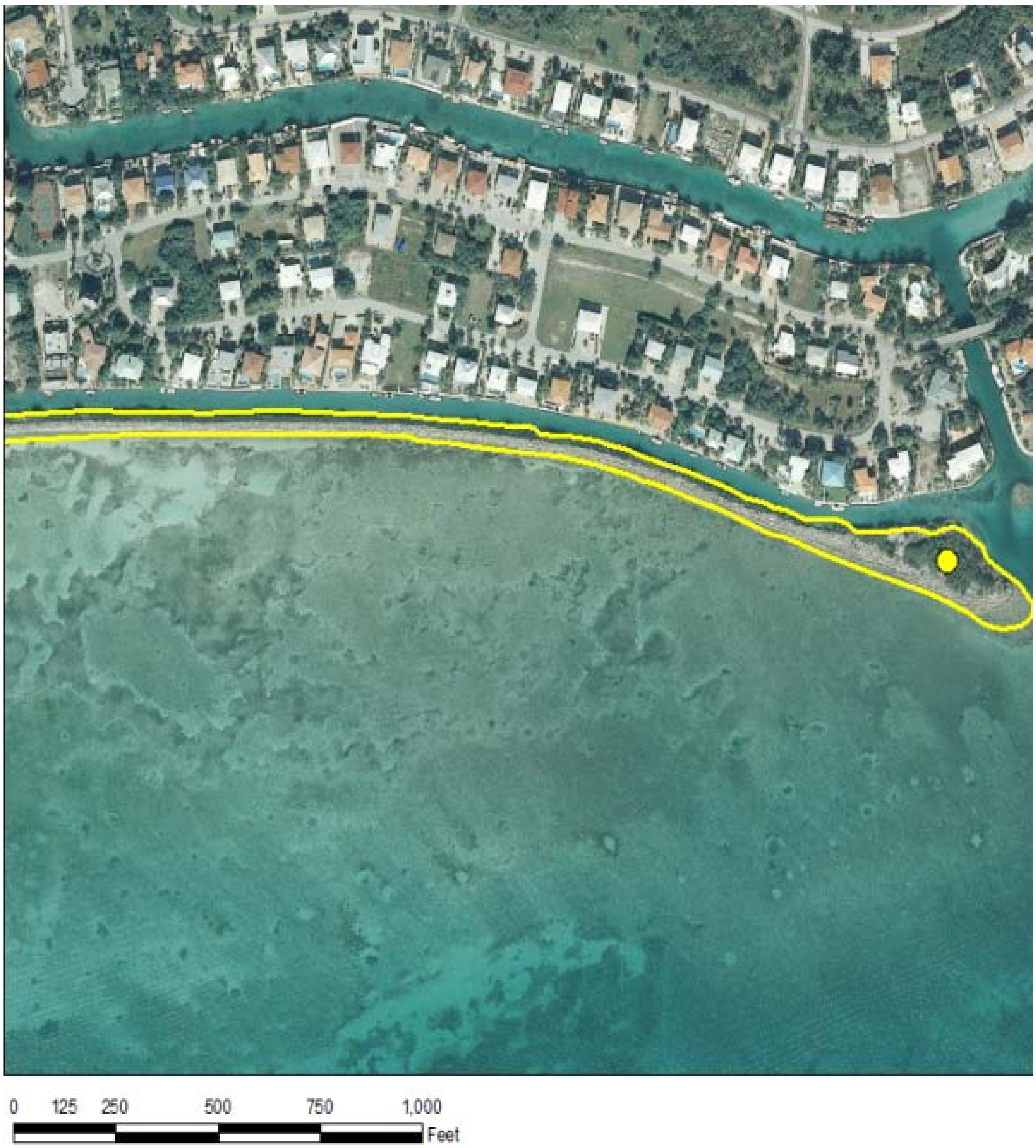
## DUAL CODING CONVENTION

This is a **Land Cover** class. The LUCODE and LCCODE are the same. A separate **Land Use** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
Original 1999 field picture

**COORDINATES**
685250.77 157072.51

# 7400
# Disturbed Land

LEVEL 1: 7000 Barren Land
**LEVEL 2: 7400 Disturbed Land**

## DESCRIPTION

This is the general Level 2 class for barren and/or disturbed lands. **It is only used where the more specific Level 3 classes (7420, 7430 or 7470) do not apply**.

These are areas where soil and/or substrate has been altered or removed by human activity. The cause of disturbance is not always known - for example, this code may be used with the land use class 1900 Open Land, which may be land in transition and without a recognizable intended use.

The barren classes apply only to upland areas. Non-vegetated wetlands, such as tidal flats and salt flats, are classified in the appropriate wetlands class. Borrow areas that are saturated or inundated are mapped as wetlands or water.

## KEYS TO PHOTOINTERPRETATION

- Soil and/or substrate has been altered or removed by human activity.
- Signatures are typically white or white with mottling due to regenerating vegetation.
- The ground may appear scraped and worked, usually with angular or geometric boundaries.
- There may be evidence of old machinery, possibly abandoned without visible cause.
- The lack of vegetation cannot be attributed simply to fire damage.

## CONTEXT

- **Landscape Position** - These areas can be found in any part of the District, and may be extensive in size. They are more common in former mining areas and in transitional urban areas.
- **Vegetation** - Barren land has very little or no vegetation and limited potential to support vegetative communities. In general, it is an area dominated by bare soil, but may have some very sparse vegetation.
- **Soils** - A variety of soil types may be found in this class.

## SIMILAR CLASSES

- 1190, 1290, 1390, etc. - Any of the Residential Under Construction classes can be disturbed, but are not dual coded with 7400 as a land cover code.
- 1500 Industrial - Industrial areas, particularly heavy industrial, are often disturbed and unvegetated.
- 1600 Extractive - Active mining areas will appear disturbed, but are not classed as 7000s. Use 7000s only for reclaimed or abandoned areas.
- 2000 Agriculture - Fields that are unvegetated because they are fallow or under preparation and cultivation may be confused with Barren Land. The context should be examined to properly classify these areas.
- 3000 Upland Non-Forested - These areas will have vegetation. There may be inclusions of barren land, which should be broken out if large and distinct.

- 4430 Forest Regeneration - These may appear unvegetated when trees are small.
- 6500 Non-Vegetated Wetlands - These are influenced by water fluctuations.

## SPECIAL MAPPING CONVENTIONS

This code should be used very sparingly and only when other classes are not applicable.

The standard 5 acre MMU applies without exception.

Do not use this code for burned areas if the permanent land cover can be identified. For example, pine flatwoods where the underbrush has been cleared by a controlled burn but the pines remain should be coded as 4110 Pine Flatwoods.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are usually the same, but often 7400 is used as the **Land Cover** code for land uses such as 1180 Rural Residential, 1650 Reclaimed Lands, 1670 Abandoned Lands, 1900 Open land, 1920 Inactive Land with Street Pattern and others.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE


**COORDINATES**
945034.39  617663.75 (Images)

## FIELD PICTURE


**DATE**
07/21/06

**COORDINATES**
953416.75 964410.69 (Field Picture)

# 7420
# Borrow Areas

LEVEL 1: 7000 Barren Land
LEVEL 2: 7400 Disturbed Land
**LEVEL 3: 7420 Borrow Areas**

## DESCRIPTION

Borrow areas are depressions caused by the removal of earth that is intended to be used as fill material. The types of material include top soil, clean fill and other mixed substrates that can be used to raise the grade at construction sites, road projects or for landscaping. It does not include commercial grade sand, clay, limestone, peat or other mining materials, which are classified in the 1600 Extractive classes.

After the disturbance is over, these sites may fill with water or start to re-vegetate, in which cases other codes will apply. Active sites will show signs of heavy machinery traffic and earth moving equipment is usually present.

These areas may not be reliably identifiable from aerial photography and collateral data is typically not available. Active sites will show obvious signs of vehicular use and earth moving equipment should be present along with an office type trailer.

## KEYS TO PHOTOINTERPRETATION

- There is evidence of excavation such as pits, trenches, etc.
- Excavation equipment and transportation access may be visible.
- Using stereo photography, PIs can identify depressions with regular, often rectangular shapes. Depressions may be large or small in extent.
- Some parts of the depressions tend to fill with water. The water signature is often an unusual tone (blues, greens on CIR photos, rather than the typical black tone) due to turbidity.
- Varying amounts of magenta and greenish tones on CIR will be present within the pit as vegetation returns to the site.

## CONTEXT

- **Landscape Position** - Borrow areas are often located near highways, railroads, and other major projects. They also support urban construction by being located at the fringes of developing areas.

## SIMILAR CLASSES

- 1190, 1290, 1390, etc. - Residential Under Construction - These classes are not dual coded with 7000 codes. Borrow areas are depressional and usually off-site from the construction.
- 1500 Industrial - Industrial areas, particularly heavy industrial, are often disturbed and unvegetated.
- 1600 Extractive - Active mining areas will appear disturbed, but are not given 7000 codes. Use 7000s only for reclaimed or abandoned areas. Borrow areas may look very similar to strip mines, sand and gravel pits, and quarries.
- 3000 Upland Non-Forested, and 4430 Forest Regeneration - There may be inclusions of barren land, but they will not appear as depressions on aerial photography.

- 5300 Reservoirs - Borrow pits or other artificial depressions that contain water should be classed as reservoirs. See the 5300 key page for exceptions.
- 7430 Spoil Areas - These may look the same initially. Stereo viewing will show that they are mounds rather than depressions.

## SPECIAL MAPPING CONVENTIONS

The standard 5 acre minimum mapping unit applies without exception.

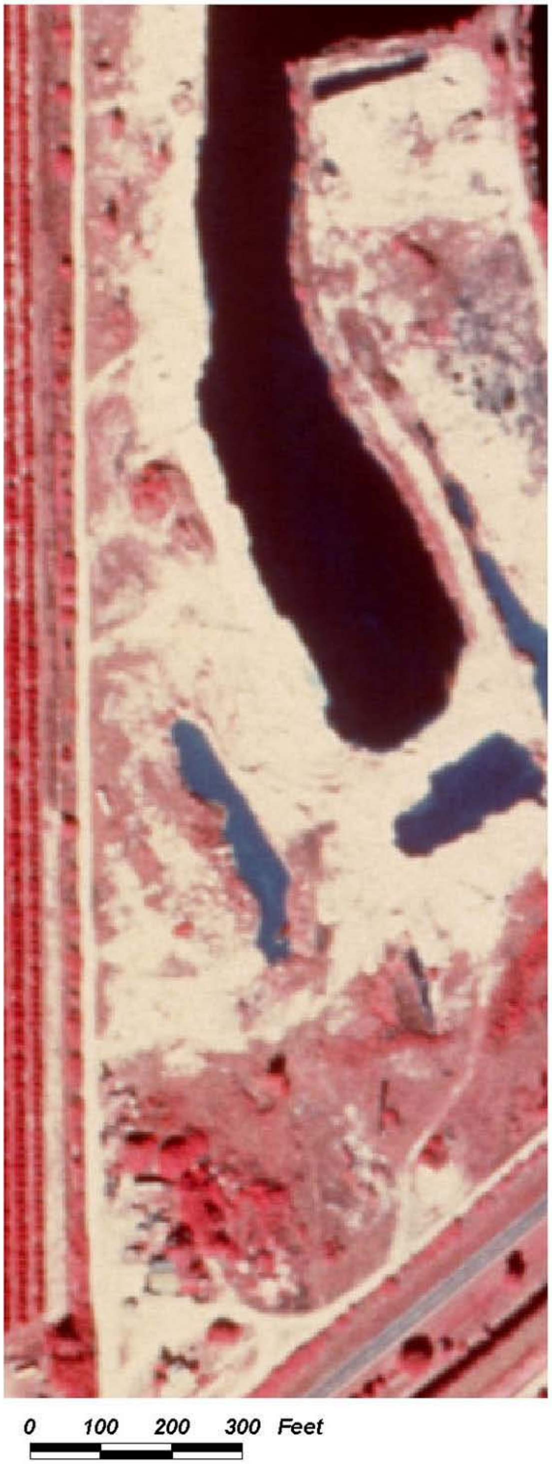
If there are a number of smaller (< 5 acre MMU) borrow pits in the same area they should be aggregated together into a single mapping unit. More than 50% of the total area should be barren and/or excavated in this case.

Borrow pits that contain water should be classed as 5300 Reservoirs, with a 2 acre MMU.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are usually the same, but in rare cases, 7420 could be used as the **Land Cover** for land uses such as 1650 Reclaimed Mine Lands or 1670 Abandoned Mine Lands.

## CIR DOQQ IMAGE



## FIELD PICTURE

**DATE**
Original 1999 field picture

**COORDINATES**
n/a

# 7430
# Spoil Areas

LEVEL 1: 7000 Barren Land
LEVEL 2: 7400 Disturbed Land
**LEVEL 3: 7430 Spoil Areas**

## DESCRIPTION

Spoil areas are elevated mounds created by artificial deposition of excavated or dredged materials. The material is natural soils, sediments and rocks.

Spoil islands are created from sediments dredged out of bays and estuaries.

The mounds appear as elevated areas when viewed in stereo. Compared to borrow areas, mounds tend to have regular shapes due to the way they were created. The most common shape is circular. The mounds also tend to appear in regular patterns on the landscape.

This class does not include spoil areas at active mining operations composed of overburden, waste or processed sediments. A number of other exceptions are listed below under "Similar Classes".

Spoil mounds are included in this class as long as they remain barren. Once vegetated or developed, they are treated like any other area and the appropriate land cover/land use codes apply.

The flat topography of the project area will aid in the identification of this land use type as any mound or regular raised feature should be suspect as spoil if of substantial size.

## KEYS TO PHOTOINTERPRETATION

- The mounds show up as elevated areas when viewed in stereo.
- Mounds tend to have regular shapes, usually circular or linear.
- On former mining sites, spoil areas are usually large mounds with artificial shapes (symmetrical shapes, straight edges, sharp angles, etc).
- The movements of mining or dredging machines may create a series of mounds in regular, straight or curved patterns, or a series of wavy hills.

## CONTEXT

- **Landscape Position** - Spoil areas may be encountered throughout the project area outside urban centers.

## SIMILAR CLASSES

- 1190, 1290, 1390 - Residential Under Construction - These classes are not dual coded with 7430. Spoil areas are elevated and usually detached from the construction.
- 1500 Industrial - Industrial areas may have spoil mounds, but they are not coded 7430
- 1600 Extractive - Active mining areas have spoil mounds, but they are not classed as 7430. Use 7430 only for reclaimed or abandoned areas.
- 7420 Borrow Areas - These may look the same initially. Stereo viewing will show that they are depressions rather than mounds.
- 7470 Dikes and Levees - These are linear in shape as opposed to circular or irregular.

## SPECIAL MAPPING CONVENTIONS

If there are a number of smaller (< 5 acre MMU) spoil mounds in the same area they should be aggregated together into a single mapping unit. More than 50% of the total area should be barren and/or mounded in this case.

## DUAL CODING CONVENTION

This is a **Land Cover** class. The LCCODE and LUCODE are usually the same, but in rare cases, 7430 could be used as the **Land Cover** for land uses such as 1650 Reclaimed Mine Lands and 1670 Abandoned Mine Land.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
01/12/07

**COORDINATES**
482291.23 105129.03

# 7470
# Dikes and Levees

LEVEL 1: 7000 Barren Land
LEVEL 2: 7400 Disturbed Land
**LEVEL 3: 7470 Dikes and Levees**

## DESCRIPTION

Levees are natural or artificial embankments or dikes, usually earthen, which parallel the course of a river or canal. The main purpose of an artificial levee is to prevent flooding of the adjoining areas; however, they also confine the flow of the river resulting in higher and faster water flow.

Levees, or spoil areas functioning as levees, are classified as 7470. In the SFWMD, Levees are frequently seen formed along canals used for drainage or transportation.

## KEYS TO PHOTOINTERPRETATION

- Levees show up as elevated areas when viewed in stereo.

## CONTEXT

- **Landscape Position** - Levees occur in strips along the sides of man-made canals, channels, lakes and streams. In this context, levees may be encountered throughout the project area outside urban centers.

## SIMILAR CLASSES

- 7430 Spoil Areas - These may look circular or irregular in shape as opposed to linear

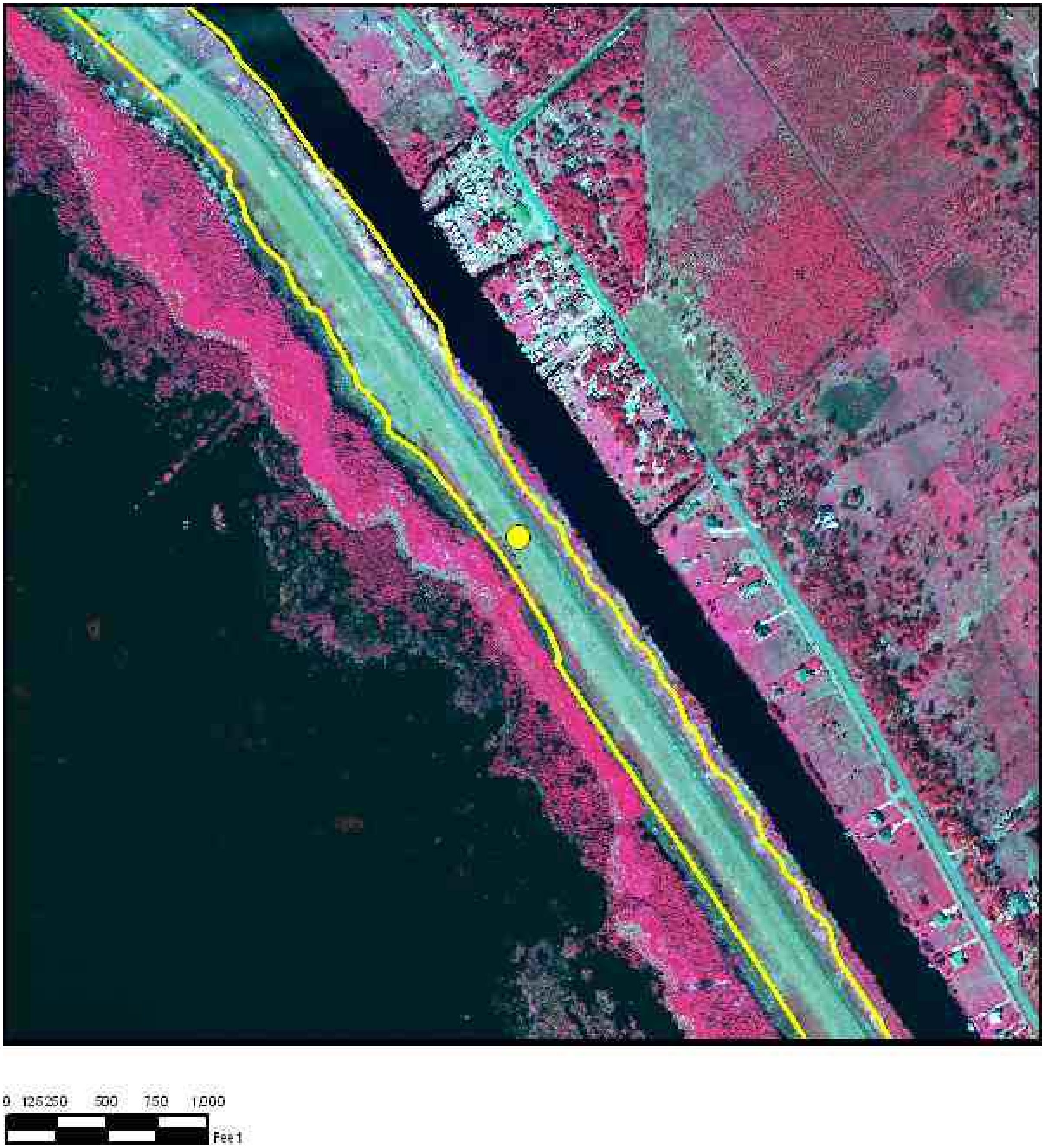
## SPECIAL MAPPING CONVENTIONS

Levees are mapped if they average 40 feet wide or greater.

## DUAL CODING CONVENTION

This is a **Land Cover** class. It does not normally require a separate **Land Use** code. However, where this class occurs in association with a mapped land use, a separate **Land Use** code may be required. Examples: 8140 Roads and Levees.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
n/a

**COORDINATES**
755074.78 1021139.96

# 8000
# Transportation, Communications and Utilities

This Level 1 class is not used in the map itself - a more specific subclass must be selected. The Level 2 subclasses include:

8100 Transportation
8200 Communications
8300 Utilities

For details on each subclass (both Level 2 and Level 3) see the respective PI Key pages.

## BACKGROUND

This broad class includes not only Transportation classes, but also Communications and Utilities.

Transportation facilities are used for the movement of people and goods; therefore, they are major influences on land and many land use boundaries are outlined by them.

Highways are easily identifiable on medium altitude photography. Highways include areas used for interchanges, limited access rights-of-way and service facilities. The center median, pavement and sizable buffer zone should be included even if exact boundaries cannot be detected.

The Transportation category includes rail-oriented facilities including stations, round-houses, repair and switching yards and related areas. It also includes airport facilities such as runways, intervening land, terminals, service buildings, navigational aids, fuel storage, parking lots and a limited buffer zone.

Transportation areas also include ports, docks, shipyards, dry docks, locks and water course control structures designed for transportation purposes. The docks and ports include buildings, piers, parking lots and adjacent water utilized by ships in the loading and unloading of cargo or passengers. Locks, in addition to the actual structures, include the control buildings, power supply buildings, docks and surrounding supporting land use (i.e., parking lots and vegetated areas).

Communications classes include airwave communications, radar and television antennas with associated structures. When stations are associated with a commercial or governmental facility, they will be included in those specific categories (1400 Commercial and Services or 1700 Institutional) rather than 8200 Communication.

Utilities include power generating facilities and water treatment plants and related facilities such as transmission lines for electric generation plants and aeration fields for sewage treatment sites. Small facilities or those associated with an industrial, commercial or extractive land use are included within these larger respective categories.

## MAPPING CONVENTIONS

**Minimum mapping units:** There is a minimum width criteria for linear features in the 8000 classes. Non-linear features have a minimum area criteria. They will be mapped as generally indicated below. Individual key pages will describe these criteria in more detail:

- 8120 Railroads and Railyards - Must exceed an average width of 100 feet over long segments.
- 8140 Roads and Highways - Must exceed 100 feet in width over long segments and have four lanes and a substantial median.

- 8320 Electrical Power Transmission Lines - Must be at least 150 feet in width and have a different land cover than the surrounding landscape.
- 8340 Wastewater Treatment Facilities - Must be 5 acres or more.
- 8350 Solid Waste Disposal - Must be 5 acres or more.

**Differentiating subclasses:** Some of the subclasses may be difficult to differentiate without ancillary data. Electrical power transmission lines may look very similar to other utility corridors and may in fact occur together. Communications facilities are difficult to identify.

## DUAL CODING CONVENTION

The 8000 classes are **Land Use** classes that do not normally require a separate **Land Cover** class. Some exceptions are noted above. Additional exceptions include 8340 Sewage Treatment and 8350 Solid Waste Disposal, which require dual coding under certain defined situations. For more details see each subclass PI key.

## SIMILAR CLASSES

With minor exceptions, the 8000 classes are relatively distinctive and are readily differentiated from other categories. For details and exceptions see the PI keys for each subclass.

### For more information:

See the PI keys for each of the subclasses for more details and graphic examples.

# 8100
# Transportation

LEVEL 1: 8000 Transportation, Communications and Utilities
**LEVEL 2: 8100 Transportation**

## DESCRIPTION

This general Level 2 class is used where more specific Level 3 classes do not apply.

It is also used where roads and railroads are directly adjacent to each other where one or both individually does not meet the minimum width criteria, but their **combined** width is greater than 100 feet. They are delineated as one polygon and coded 8100 Transportation.

Transportation facilities are used for the movement of people and goods; therefore, they are major influences on the land and many land use boundaries are outlined by them.

Highways include areas used for interchanges, limited access right-of-ways and service facilities. The center median, pavement and a sizable buffer zone are included even if exact boundaries cannot be determined. Highways are easily identified on project photography.

Rail-oriented facilities include stations, round-houses, repair and switching yards, and related areas.

Airport facilities include runways, intervening land, terminals, service buildings, navigational aids, fuel storage, parking lots and a limited buffer zone.

Transportation areas also include ports, docks, shipyards, dry docks, locks and water course control structures designed for transportation purposes. The docks and ports include buildings, piers, parking lots and adjacent waters utilized by ships in the loading and unloading of cargo or passengers. Locks, in addition to the actual structure, include the control buildings, power supply buildings, docks and surrounding supporting land uses (i.e. parking lots and green areas).

## KEYS TO PHOTOINTERPRETATION

- See the respective Level 3 key pages for more details.

## CONTEXT

- **Landscape Position** - Transportation features can be found throughout the District.

## SIMILAR CLASSES

The Transportation classes are distinctive and are readily differentiated from other classes. For details and exceptions, see the PI keys for each of the Level 3 subclasses.

## SPECIAL MAPPING CONVENTIONS

There are minimum width criteria for linear features in the 8100 class. The following criteria apply:

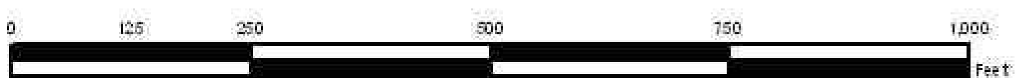
- 8120 Railroads - These must be multi-track railroads to be delineated and must exceed 100 feet in width over long segments.

- 8140 Roads and Highways - They must have 4 lanes and a median and must exceed 100 feet in width over long segments. (See the 8140 key page for more details.)
- 8320 Electrical Power Transmission Lines - These must exceed 150 feet in width and have a different land cover than the surrounding landscape.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## COLOR DOQQ IMAGE

## FIELD PICTURE

**DATE**
10/16/07

**COORDINATES**
379458.31 834061.88

# 8110
# Airports

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8100 Transportation
**LEVEL 3: 8110 Airports**

## DESCRIPTION

This class includes airports and airfields of various sizes, along with their associated facilities. It includes fixed-base commercial, and major airline operations. Heliports and seaplane bases are included if they meet size criteria (5 acres). It does not include single owner private air strips, nor does it include aviation facilities on military bases where the aviation is clearly subsidiary to the other functions of the base.

Included within the mapping unit are all buildings, grounds, parking lots, hangers, passenger terminals, fuel storage, control towers, maintenance areas and other features that are involved in the operation.

Private airports and grass airports are classified at Level 4 and not included in this class.

## KEYS TO PHOTOINTERPRETATION

- Aircraft are usually recognizable on the aerial photos.
- There is a distinctive pattern of runways, taxiways and terminal buildings with associated markings.
- Commercial airfields and buildings are usually identified on topographic maps.
- At abandoned airfields, the runways and aprons may show deterioration and/or obstructions. The ends of abandoned runways are painted with a large white "X".
- Helipads have white circles painted on the landing pads, often marked with the letter "H".

## CONTEXT

- **Landscape Position** - Aviation facilities are found throughout the District. Major airports are along transportation corridors and usually do not abut residential neighborhoods.

## SIMILAR CLASSES

Airports have a unique appearance on aerial photos. Military airports may look similar to commercial airports - in these cases, where aviation is the predominant use, the 8110 coding is appropriate.

## SPECIAL MAPPING CONVENTIONS

Included within the mapping unit are all buildings, grounds, parking lots, hangers, passenger terminals, fuel storage, control towers and other features that are involved in the operation.

Those areas that are not clearly related to the functions of the facility or inside the operational boundaries are not included. Adjacent open areas are assigned the appropriate land cover value.

Priority classes such as water bodies, wetlands, land fills or waste treatment sites are exceptions to the above. If these features meet their minimum size criteria they are always broken out.

Off-site parking areas are coded 8100 Transportation, unless they are adjacent to the airport and exclusively used for airport parking.

Airports under construction are classified as if the construction were complete.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
n/a

**COORDINATES**
639089.59  142630.49

# 8113
# Private Airports

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8100 Transportation
LEVEL 3: 8110 Airports
**LEVEL 4: 8113 Private Airports**

## DESCRIPTION

This class includes private paved airstrips. They are not always immediately evident; they may not be marked on aeronautical charts or topographic maps. They may be detected by the presence of light aircraft near the airstrip. The paved airstrip is typically 1000 to 1500 feet in length with a smoother texture than the surrounding land cover.

Single owner private strips (such as on large ranches) are to be included in the surrounding land use and not mapped under this class.

## KEYS TO PHOTOINTERPRETATION

- Aircraft may be recognizable on the aerial photos.
- The landing strip will appear as a long rectangular strip.

## CONTEXT

- **Landscape Position** - Private airports may be found throughout the District, in almost any context.

## SIMILAR CLASSES

- 8115 Grass Airports - These will have a grass landing strip, as opposed to a paved one.

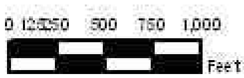
## SPECIAL MAPPING CONVENTIONS

Single owner private strips (such as on large ranches) are to be included in the surrounding land use and not mapped under this class.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/16/07

**COORDINATES**
362009.59  873452.45

# 8115
# Grass Airports

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8100 Transportation
LEVEL 3: 8110 Airports
**LEVEL 4: 8115 Grass Airports**

## DESCRIPTION

This class includes private grass airstrips. These tend to be smaller and not immediately evident; they may not be marked on aeronautical charts or topographic maps. They may be detected by the presence of light aircraft near the airstrip. The grass airstrip is typically about 1000 to 1500 feet in length with a smoother texture than the surrounding land cover.

Single owner private strips (such as on large ranches) are to be included in the surrounding land use and not mapped under this class.

## KEYS TO PHOTOINTERPRETATION

- Aircraft may be recognizable on the aerial photos.
- The landing strip will appear as a long rectangular strip.

## CONTEXT

- **Landscape Position** - Grass airports may be found throughout the District, in almost any context.

## SIMILAR CLASSES

- 8113 Private Airports - These will have a paved landing strip.

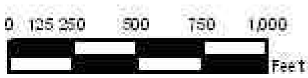
## SPECIAL MAPPING CONVENTIONS

Single owner private strips (such as on large ranches) are to be included in the surrounding land use and not mapped under this class.

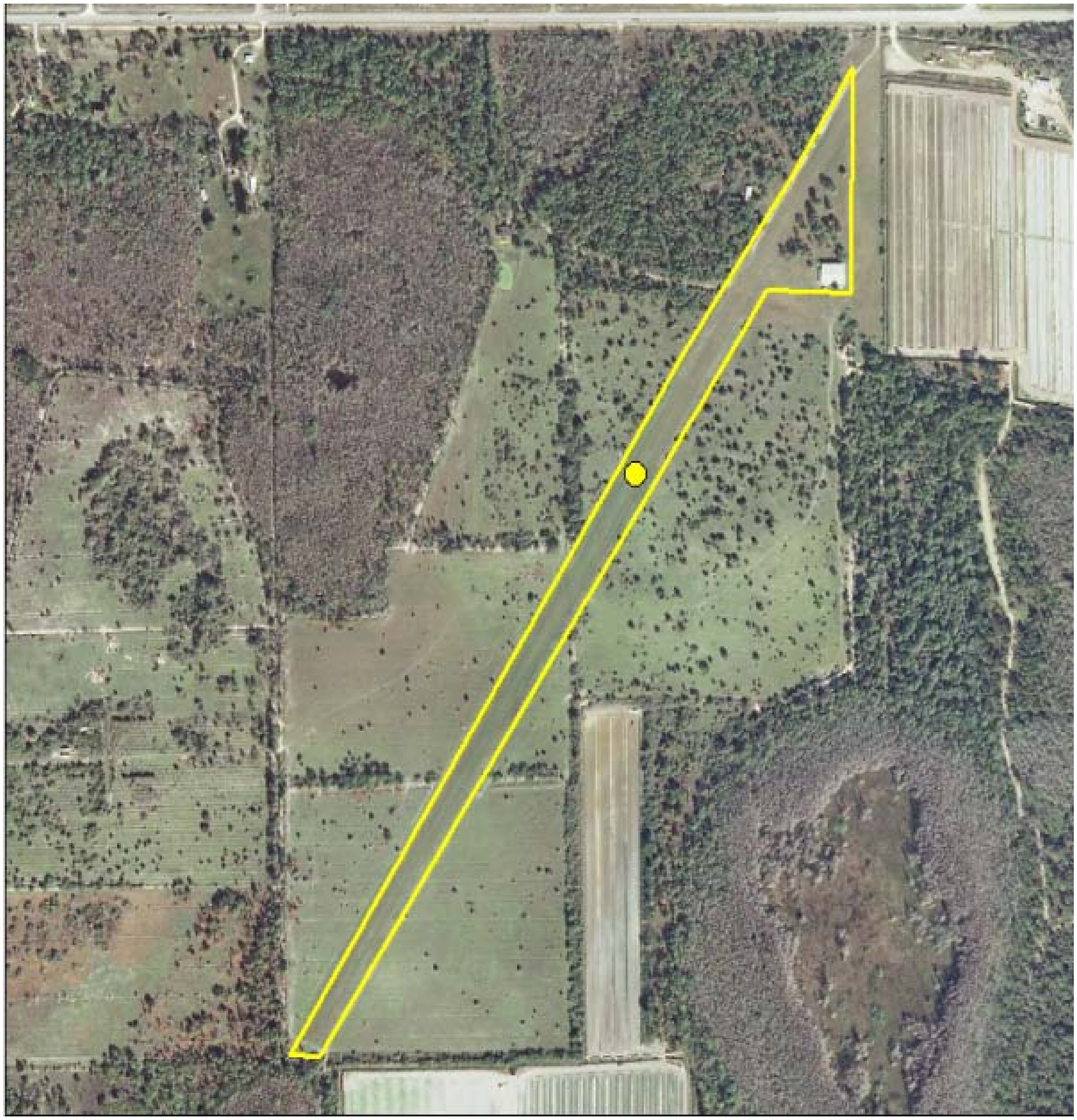
## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



0 125 250 500 750 1,000

Feet

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
457684.45 768273.82

# 8120
# Railroads and Railyards

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8100 Transportation
**LEVEL 3: 8120 Railroads and Railyards**

## DESCRIPTION

This includes all railroad tracks greater than 100 feet wide and all facilities related to the rail operations. Only multi-track railroads are included. Related facilities include:

- **Classification yards** (marshaling yards) are used to sort freight cars and are identified by a large group of parallel tracks with a restricted (one or two track) entrance and exit called a chokepoint. In an active yard, numerous freight cars and small switch engines will be found.
- **Servicing yards** are normally found in or near marshaling yards and are identified by the presence of roundhouses (for light repair and storage of locomotives) and turntables for turning the engines around.
- **Car repair shops** appear as long, low buildings straddling one or more tracks, with cars awaiting repairs on sidings adjacent to the buildings.
- **Freight or loading yards** are identified by loading platforms, freight stations, warehouses and access to other means of transportation. Special loading stations are identified by grain elevators, coal and ore bins, oil storage tanks and livestock pens with loading ramps.
- **Storage yards**, used to store rolling stock, are recognized by dead end trackage not adjacent to any loading facility.
- **Station yards** are for storage of passenger cars, are found near passenger terminals and are identified by the presence of a variety of passenger cars not connected to a train.

Freight stations may be identified by loading docks along railroad tracks on one side of a building and loading docks along a road or street on the opposite side. Freight stations are smaller than warehouses and are designed only for the temporary storage of goods received. Freight stations usually occur as single structures near passenger stations.

Passenger stations vary in size from the small rural depot or suburban station to the large stations and terminals of major cities. Small stations usually do not have loading docks and may not have parking areas for vehicles in the vicinity. The large stations located in cities are identified by a large number of tracks leading into or past a large building which houses the waiting rooms, ticket offices and other passenger facilities. The track or boarding area is normally covered.

Railroads that are abandoned or inactive are included, unless the tracks have been removed. Abandoned rail facilities may be identified by adding the "abandoned" modifier to the land use code.

## KEYS TO PHOTOINTERPRETATION

- Tracks are generally straight linear features of varying width. They most often appear as a thin, straight line.
- Freight stations appear as long, small warehouses with loading docks on both sides. One side is along the railroad tracks, and the other is along a roadway, pier, or other form of transportation.
- Passenger stations may be small rural depots or large city terminals, characterized by auto parking, buildings and covered tracks and boarding areas.

## CONTEXT

- **Landscape Position** - Rail facilities are located throughout the District. Railroad tracks are always present or nearby.

## SIMILAR CLASSES

- 8140 Roads and Highways - Road surface and traffic lane markings visible

## SPECIAL MAPPING CONVENTIONS

Included within the mapping unit are all buildings, grounds, parking lots, passenger terminals, fuel storage, and other related features. Those areas that are not clearly related to the railroad or inside the operational boundaries are not included.

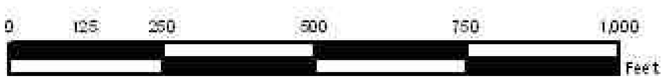
Priority classes such as water bodies, wetlands, land fills or waste treatment sites are always broken out if they meet minimum size criteria.

Railroads under construction are classified as if the construction were complete.

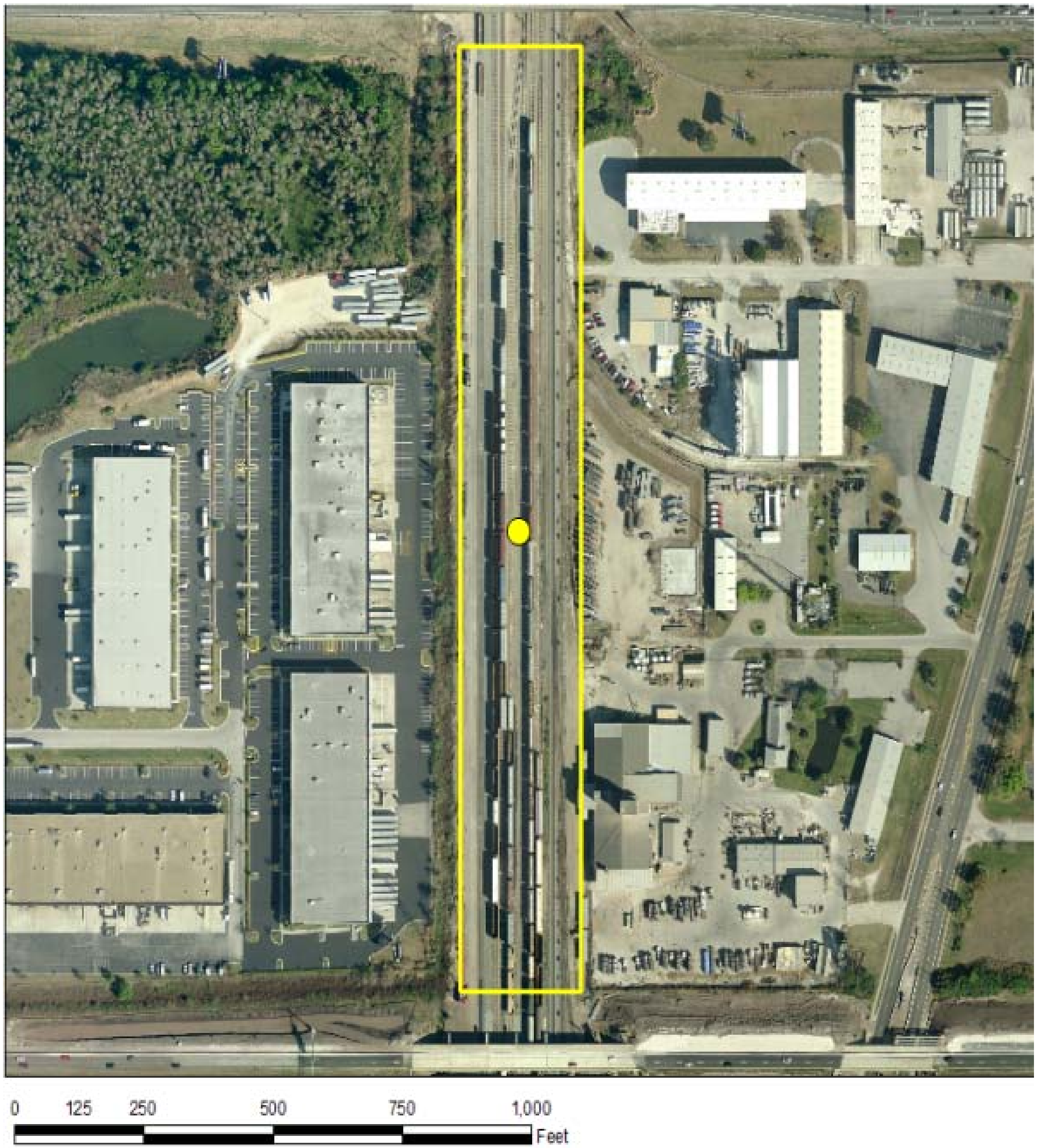
## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
538163.56 1495911.12

# 8140
# Roads and Highways

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8100 Transportation
**LEVEL 3: 8140 Roads and Highways**

## DESCRIPTION

This class includes those highways exceeding 100 ft. in width, with 4 or more lanes and median strips. The intent of this data layer is to include only the major transportation corridors.

Roads and highways will be delineated where they meet **ALL** of the following conditions:

- They exceed 100 feet in width.
- They are a **divided highway** and possess a median along most segments.
- They possess at least 4 lanes (two lanes in each direction).

Also included in the mapping unit are all interchanges, right-of-ways, highway patrol facilities, maintenance and service facilities and associated parking areas. Highway maintenance facilities may include local highway departments and roadside depots - these may not be located along major routes and may require supplemental data to identify.

However, parking lots along transportation routes that are used only for parking are not included in this class and are classified as 8100 Transportation.

## KEYS TO PHOTOINTERPRETATION

- The right-of-way boundary forms the edge of the mapping unit. It is usually fenced, and the boundary is usually distinct from adjacent land use. The ROW usually follows along the top of a highway cut or the along the base of a highway fill area.

## CONTEXT

- **Landscape Position** - Major highways are located throughout the District.

## SIMILAR CLASSES

- 8120 Railroads - Railroads tend to be straight or have long, smooth curves. They also have few houses or commercial establishments along them.

## SPECIAL MAPPING CONVENTIONS

Any median strips exceeding 150 ft. in width will be delineated and classified with the appropriate land cover class.

Priority classes such as water bodies and wetlands are always broken out if they meet minimum size criteria.

The continuity of roads, highways, and other transportation features that meet the criteria for delineation shall be maintained in cases where they actually bisect a water body. Where continuity of the water body is visible on the photo - such as a bridge over a river or canal - the water body will be delineated and the road or other transportation feature will be broken at the boundary of the water body.

Highways under construction are classified as if the construction were complete.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE values are the same, except in the case of medians, as noted in Special Mapping Conventions.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
388246.91 868948.65

# 8150
# Port Facilities

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8100 Transportation
**LEVEL 3: 8150 Port Facilities**

## DESCRIPTION

This class is used for marine freight and passenger terminals and ferry slips. It is for dockside facilities that are directly related to transportation, including structures, subsidiary parking areas, docks and mooring areas, warehouses and open storage areas, port administration and passenger terminals, and on-site roads, rail spurs and other conveyance facilities.

This class does not include other commercial and industrial activities present at ports, including those that provide supporting services to the port facilities. Also not included are shipyards employed in ship building and repair. Only uses that are directly involved in transportation are included.

Marine freight terminals are identified by characteristic long loading/off-loading piers with associated warehouses and open storage areas. Open storage may range from rows of automobiles to stacked containers. Cargo vessels and lighters tied to the docks or moored nearby confirm commercial freight activities.

Modern marine terminals have heavy cranes for loading and unloading container ships, similar to the portal and hammerhead cranes used for fitting out floating hulls at a shipyard; their presence requires a detailed examination of the surrounding area for shipyard facilities, which are classified as 1560 Heavy Industrial.

## KEYS TO PHOTOINTERPRETATION

- Heavy cranes for loading and unloading container ships may be present.
- Ships will usually be visible alongside docks, not blocking each other.
- Ferry slips are identified by tall pilings that enclose the slip. Ferry routes are often shown on highway maps as dashed lines.
- Roads and rail spurs serve the terminal.
- Open storage may include uniform rows of automobiles or stacked containers.

## CONTEXT

- **Landscape Position** - Port facilities can be found in any shoreline area. The boundaries with adjacent commercial and industrial land uses may be poorly defined.

## SIMILAR CLASSES

- 1560 Other Heavy Industrial - Shipyards have heavy cranes similar to port facilities. Careful inspection or supplemental data is needed to differentiate them.

## SPECIAL MAPPING CONVENTIONS

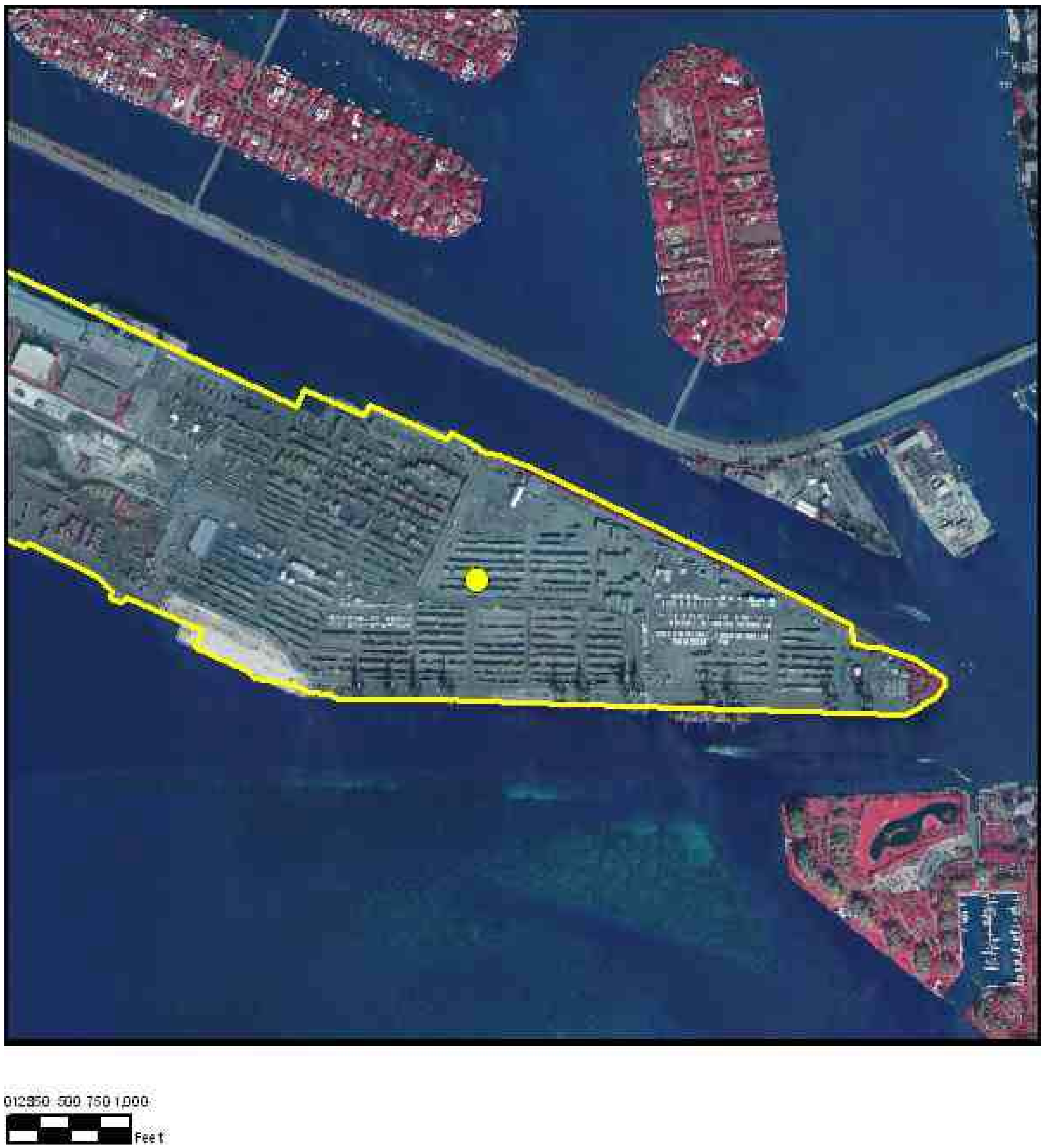
Included within the mapping unit are all structures, parking areas, docks and mooring areas, warehouses and open storage areas, port administration and passenger terminals, and on-site roads, rail spurs and other conveyance facilities. Those areas that are not directly related to transportation functions are not included.

Port Facilities under construction are classified as if the construction were complete.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
n/a

**COORDINATES**
933746.13 522660.87

# 8200
# Communications

LEVEL 1: 8000 Transportation, Communications and Utilities
**LEVEL 2: 8200 Communications**

## DESCRIPTION

This class refers to communications facilities larger than 5 acres that are not attached to another land use. When the stations are part of a commercial or governmental facility, they will be included in those categories rather than classified separately.

This class is predominantly for airwave communications facilities composed of antennae or transmission towers and all associated structures. It includes transmission towers and antenna for radio transmission or for microwave transmission of television and telephone communications.

Transmission towers may be detectable, but antenna are difficult to see on photography except perhaps by their shadows.

Communications facilities are not a high priority class to the District. They are often below minimum size criteria (5 acres). The primary reason to map them is their distinct appearance in rural areas and to avoid confusing them with more important classes, such as treatment facilities.

## KEYS TO PHOTOINTERPRETATION

- Usually small facilities with towers, radars and antenna present
- These often occur as small open spaces in isolated rural areas - usually fenced and with a small building. The boundaries with adjacent land cover are usually distinct.
- In urban areas the antennas and towers may be roof mounted.
- Stereo enlargement is often necessary for proper identification. Long, thin shadows may be present.
- These structures are usually very tall and are sometimes placed on the tops of tall buildings.

## CONTEXT

- **Landscape Position** - They can be located anywhere, including rural areas, but are preferably sited at high points in the landscape.

## SIMILAR CLASSES

- 1900 Open Land - may appear heavily vegetated or have a disturbed, scoured, white appearance
- 3100 Herbaceous (Dry Prairie) - vegetation is diverse in type, texture, and pattern
- 8320 Electrical Power Transmission Lines - appear as long, linear strips that transect the landscape

## SPECIAL MAPPING CONVENTIONS

When Communications facilities are subsidiary to another mapped land use, they will be included in that land use rather than classified separately. Included within the mapping unit are any buildings, grounds, parking lots, storage and other related features. Those areas that are not inside the operational boundaries are not included.

## DUAL CODING CONVENTION

This is a **Land Use** class.; The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
03/13/07

**COORDINATES**
713292.56 1089321.85

# 8300
# Utilities

LEVEL 1: 8000 Transportation, Communications and Utilities
**LEVEL 2: 8300 Utilities**

## DESCRIPTION

This general Level 2 class is only to be used where more specific Level 3 classes do not apply.

Utilities include power generating facilities and water treatment plants and their related facilities such as transmission lines for electric generation plants and aeration fields for sewage treatment sites.

Utilities associated with an Industrial, Commercial or Extractive land use are included within those other classes and are not classified as 8300 Utilities.

Many of the Utilities are priority classes, in view of their importance to water resources.

## KEYS TO PHOTOINTERPRETATION

- See the respective Level 3 key pages for more details.

## CONTEXT

- **Landscape Position** - Utility features can be found throughout the District.

## SIMILAR CLASSES

The Utilities classes are distinctive and are readily differentiated from other classes. For details and exceptions, see the PI keys for each of the Level 3 subclasses.

## SPECIAL MAPPING CONVENTIONS

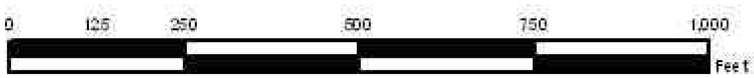
There are Minimum Mapping Units for the 8300 Utilities classes as outlined below. The following criteria apply:

- 8310 Electrical Power Facilities - These must be 5 acres or more.
- 8320 Electrical Power Transmission Lines - These must exceed 150 feet in width and have a different land cover than the surrounding landscape.
- 8330 Water Supply Plants - These must be 5 acres or more.
- 8340 Sewage Treatment - These must be 5 acres or more.
- 8350 Solid Waste Disposal - These must be 5 acres or more.
- 8360 Other Treatment Ponds - These must be 5 acres or more.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
510029.04 1485385.11

# 8310
# Electrical Power Facilities

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8300 Utilities
**LEVEL 3: 8310 Electrical Power Facilities**

## DESCRIPTION

Electric power plants include fossil fuel and nuclear plants. Subsidiary facilities included are cooling ponds or towers, canals and facilities for receiving and storing fuel (coal, oil), parking areas and transformer yards.

Electricity generating plants are indicated by transformer yards, which look like intricate wire cages supported by a heavier open steel frame; they are often easier identified by their shadows. High-voltage lines often can be seen running from the transformer yards. Fossil fuel plants and nuclear plants use water for cooling the condensers (which condense the steam used to drive the turbines connected to the generators).

Intake and discharge canals, and cooling ponds or cooling towers are evident. The nuclear plant at Turkey Point is conspicuous by having six square miles of linear, parallel cooling ponds. The fossil plant at Barley Barber Swamp in western Martin County is easily identified by the plant facilities adjacent to a very large cooling pond system. These cooling ponds should be mapped as part of the Electrical Power Facilities when directly adjacent to the plant and identifiable as part of the facility.

Fossil fueled plants are common in Florida. They are distinguished from nuclear plants by the lack of a large monolithic reactor building, the presence of two or more tall chimney stacks, and the presence of either coal stockpiles or oil storage tanks.

The presence of the large boiler house and large transformer yards next to the relatively small main building (the generator hall) distinguishes the thermal power plant from a heavy manufacturing or processing plant, which would not require two large sources of power for the same building.

Substations, which have transformer yards with the same complex appearance as those at power plants, occur at the ends of high-voltage transmission lines near built-up areas.

## KEYS TO PHOTOINTERPRETATION

- The power plants require water for cooling and are always located next to natural or artificial water bodies. Intake and discharge canals are present.
- Cooling towers or chimney stacks are present and steam may be visible.
- Transformer yards look like intricate wire cages supported by a heavy open steel frame. They are present at the power plants and at substations at the ends of the transmission lines near built-up areas.
- Fossil fueled plants have piles of coal and/or large oil storage tank farms. Rail spurs, pipe lines or dock facilities are needed to deliver the fuels.

## CONTEXT

- **Landscape Position** - Power plants are located next to water bodies used for cooling, often near other industrial areas. Transformer yards and substations are found throughout the District, usually adjacent to built-up areas.

## SIMILAR CLASSES

- 1560 Other Heavy Industry - These have large manufacturing facilities and do not require extensive transformer yards, cooling towers, etc.

## SPECIAL MAPPING CONVENTIONS

Only those features that are inside the facility boundaries and involved in its operation are included in the 8310 mapping unit. These may include parking and transportation areas, treatment facilities, fuel storage, office buildings and open areas within the operational boundary.

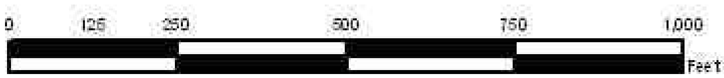
Priority classes such as water bodies and wetlands are exceptions to the above. If these features meet their minimum size criteria they are always broken out.

All utilities under construction are classified as if the construction were complete.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
03/17/07

**COORDINATES**
402140.51 867841.14

# 8320
# Electrical Power Transmission Lines

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8300 Utilities
**LEVEL 3: 8320 Electrical Power Transmission Lines**

## DESCRIPTION

This class includes only high-voltage power transmission lines. The right-of-ways (ROWs) are not usually shared with any other utilities and have a distinct appearance due to design considerations. The ROWs appear as long, linear strips that transect the landscape.

High-voltage lines must be at least 30 feet above the ground or vegetation, so they are carried on high insulated towers above cleared swaths of land. The cleared swaths may be over 500 feet wide and may be used for other purposes, including agricultural and recreational uses.

## KEYS TO PHOTOINTERPRETATION

- The (ROWs) are not shared with other utilities, due to the corrosive effects of the electrical currents and other factors.
- The lines and ROWs are typically very straight. Bends in the lines are sharp, not gradual or curved. The lines do not need to conform to topography, as do most other utilities.
- Vegetation in the strip is usually cleared of trees and shrubs and maintained as an open, accessible area.
- Support towers and their shadows are often visible. They are spaced at an even distance apart in a generally straight line.
- Actual transmission lines are sometimes visible, if over a dark background such as water.
- Trails usually wind along the ROWs, from tower to tower.

## CONTEXT

- **Landscape Position** - Electrical Power Transmission Lines can occur anywhere within the project area, in any context. The transmission line ROWs begin in transformer yards at power generating stations and end at transformer yards at substations in built-up areas.

## SIMILAR CLASSES

- 8120 Railroads - Tracks are visible, ROWs have gradual curves, and the lines follow topography.

## SPECIAL MAPPING CONVENTIONS

Utility corridors are delineated only where they are 150 feet or greater in width and their land cover is different from the surrounding landscape.

In those corridor segments where the land cover is identical to adjacent areas, such as through pastures or rangeland, the utility feature will not be mapped.

The above applies as follows:

- LU=8320/LC=8320 where they are 150 to 300 feet in width.
- LU=8320 **and dual coded with the appropriate Land Cover code** where they exceed 300 feet in width.

Continuity of the strip across the landscape is not required.

Transmission lines under construction are classified as if the construction were complete.

## DUAL CODING CONVENTION

This is a **Land Use** class. **A separate Land Cover code is only required as indicated above.**

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
03/14/07

**COORDINATES**
808944.62 1018654.60

# 8330
# Water Supply Plants - Including Pumping Stations

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8300 Utilities
**LEVEL 3: 8330 Water Supply Plants - Including Pumping Stations**

## DESCRIPTION

This class includes water treatment plants, settling basins, water storage towers, wells and pumping facilities that serve municipalities or residential subdivisions. It does not include water treatment facilities attached to 1400 Commercial, 1500 Industrial, 1600 Extractive or 1700 Institutional classes. It does not include water transmission pipelines, which are classified as 8100 Transportation.

Nearly all water supply plants in the District use ground water. Well fields are not mapped unless the boundaries of the well field are distinct on the photography. Wells, pipelines and storage towers often do not meet minimum size criteria.

The treatment plants are identified by a number of low, open sedimentation tanks. The tanks are circular or rectangular and about 100 to 200 feet across. The plants vary greatly in size. Each plant may contain buildings, storage areas, sludge disposal sites, pumping facilities, parking and other features.

## KEYS TO PHOTOINTERPRETATION

- Mixing tanks and settling basins are rectangular and contain a series of baffles or mechanical agitators.
- "Dorr" clarifiers are circular settling tanks that may have rotating scrapers and a single narrow walkway running from the rim to the center of the tank.
- Ground water wells can be at varying distances and elevations from the plant and each other and may not be identifiable without ancillary data.

## CONTEXT

- **Landscape Position** - Water treatment plants are located in or near built-up areas. The plants may be separate from well fields and storage towers.  Plants that use surface water are usually located near the water body.

## SIMILAR CLASSES

Water treatment plants may appear similar to treatment facilities that use similar equipment at industrial sites, or with water treatment operations at commercial or institutional facilities.

- 8340 Sewage Treatment - Sewage treatment plants (STPs) use much of the same equipment. STP trickling filters look like Dorr clarifiers - low circular tanks. But they are distinguished by having four narrow booms that revolve around the center of the tank, sprinkling effluent over the filter bed. STPs may also have sludge digestion tanks and large sand filter beds (see 8360 Other Treatment Ponds).

## SPECIAL MAPPING CONVENTIONS

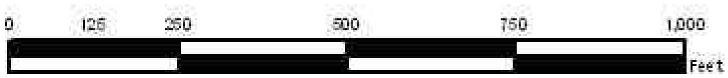
Well fields are not mapped unless the boundaries are distinct on the photography. Wells, pipelines and storage towers often do not meet minimum size criteria. If well fields are mapped, a separate land cover code is required for the well field polygon.

Treatment plants under construction are classified as if the construction were complete.

## DUAL CODING CONVENTION

This is a **Land Use** class. The LUCODE and LCCODE are the same. A separate **Land Cover** code is not required.

## CIR DOQQ IMAGE



## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
425944.19  774623.77

# 8340
# Sewage Treatment

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8300 Utilities
**LEVEL 3: 8340 Sewage Treatment**

## DESCRIPTION

There are at least three different types of facilities included in this class and they have nothing in common except wastewater. In order to tell them apart, 8340 is designated a land use class and a separate land cover class is assigned to LCCODE. The land cover code identifies what kind of sewage treatment facility it is. Typical land **cover** codes associated with wastewater treatment plants (WTPs) include 2150 Field Crops (hay), 3100 Herbaceous - Dry Prairie, 6000 Wetlands or 8360 Other Treatment Ponds, as described below.

The three types of facilities (and there may be more) are:

- Wastewater Treatment Plants
- Spray Fields
- Percolation Beds - also known as rapid infiltration basins (RIBs)
- Wetlands used for wastewater treatment and discharge

The treatment plants themselves are characterized by round digesters, about 100 to 200 feet in diameter. Aerobic digesters are open on top and have visible booms that pivot from the center and spray the effluent on the digester beds. Anaerobic digesters are smaller in size and covered. Treatment plants may also have settling basins, drying beds, settling ponds or lagoons and enclosed buildings. They tend to be near (but not too near) urban areas and may also be located near discharge features (such as streams, wetlands or the coast). WTPs are coded 8340/8340, for LCCODE/LUCODE.

Spray fields tend to be hay fields located near the WTP. They are associated with the WTPs rather than private farm operations, so typical farming features (barns, homesteads, etc.) may be absent. Since spray fields get a large dose of nutrient and water, they tend to have an exaggerated red or pink CIR signature, indicating vegetative growth. Patterns of fertilization may be uneven, since disposal is the main objective, not crops. *Land cover code is from 2000s and 3000s.*

Wetlands used for wastewater treatment may be hard to identify. Ancillary data such as District or DEP maps are the best source. Also, look for conveyance systems (pipes, pump houses, canals) or other artificial features, such as dikes, levies, straight edges and partitioning of the wetlands. Accelerated growth may result in exaggerated reddish CIR tones. *Land cover code is from the 6000s.*

Percolation beds are also called rapid infiltration beds (RIBs). The appearance of these basins suggests aquaculture, except they are larger and may be spaced farther apart (spacing allows more infiltration without raising the water table). They are located in rural areas separated from development, for obvious reasons. Look for road access and some minor utilities (sheds, fences, gates, valves); there may be few other features to assist interpretation. *Land cover code for RIBs is 8360 (Other Treatment Ponds).* The basins and connecting uplands are delineated together as a single polygon.

## KEYS TO PHOTOINTERPRETATION

**Treatment Plants:**

- Primary, secondary and tertiary cylindrical treatment tanks appearing as small circles (round from above).
- Large processing/office buildings and smaller structures for storing equipment, supplies.
- Visible settling ponds, often have aquatic vegetation in them with a bright pink signature.

**Spray Fields:**

- Lack of typical agricultural indicators (barns, homesteads).
- Reddish CIR tones due to increased fertilizer and water.
- Irregular growth patterns.

**Treatment Wetlands:**

- Conveyance systems, such as pipes, pumping facilities, canals may be visible.
- Artificial features, such as dikes, levies, partitioning into sub-areas.
- Reddish CIR tones from increased nutrient.

**Percolation Beds:**

- Large, rectangular-shaped basins, uniformly spaced, sometimes far apart.
- Located in rural areas away from development.
- Beds are mostly dry, but some show standing or surface moisture.

## CONTEXT

- **Landscape Position** - Sewage treatment plants are located near municipalities (often near large water bodies) throughout the project area. Boundaries with adjacent land uses are regular and well defined.

## SIMILAR CLASSES

- 2540 Aquaculture - May look like percolation beds, or RIB's. Aquaculture ponds tend to be smaller, closer together, in farming context. Also, RIBs are mostly dry.
- 8330 Water Supply Plants - Have fewer treatment structures and are usually closer to residential areas

## SPECIAL MAPPING CONVENTIONS

Priority classes such as water bodies and wetlands are always broken out if they meet minimum size criteria.

All utilities under construction are classified as if they were complete.

## DUAL CODING CONVENTION

The **Land Cover** code for each 8340 variant is as follows:

- For Treatment Facilities, the land cover code defaults to 8340
- For Spray Fields, use 2150 or 3100 for land cover
- For Treatment Wetlands, use appropriate wetlands class

- For Percolation Beds, use 8360 - Other Treatment Ponds

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
495949.14 1449405.22

# 8350
# Solid Waste Disposal

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8300 Utilities
**LEVEL 3: 8350 Solid Waste Disposal**

## DESCRIPTION

This class includes sanitary landfills, dumps and other waste disposal areas. The sites may be publicly or privately operated, and may or may not be permitted. It does include dumps and landfills that are found at private operations such as farms, institutions, industrial and commercial sites, if they meet size criteria. However, it does not include storage of uniform wastes and residuals that are part of a normal process stream, such as mine tailings and treatment plant sludges. These are treated as subsidiary to the operation and included with the applicable land use.

Sanitary landfill operations are identified by supervisor's buildings, bulldozer and truck tracks, and a small white fringe of debris that has not been covered by the fill. Despite buffer zone requirements for wetlands and water bodies, landfills may still be seen adjacent to wetlands and water bodies. This is partly because so many parts of the project area have a very high water table. The high water table (and thin soils) interfere with the proper operation of sanitary landfills and often results in above ground mounded disposal appearing as a truncated pyramid.

Incinerators are often present, either rough conical structures with ground entrances or structures having elevated loading, platforms and truck ramps. These features, and the tracks made by trucks removing the remaining material, may be visible if the incinerator is active.

Landfills and dumps may be fenced. A junk yard may also be fenced and contain a small building. It is distinguished from a dump only by the arrangement of the junked equipment, emphasized by patterns of vegetation and trails around the equipment. Mine dumps and ore dressing tailings areas may also be mistaken for solid waste dumps. They are often depicted on topographic maps.

## KEYS TO PHOTOINTERPRETATION

- Landfills are characterized by large elevated mounds. Leachate seeps may be visible at the base of the mounds. At legal sites only the small active areas are not covered with a uniform fill material.
- Heavy equipment, treatment ponds, offices and warehouses, storage bins and other facilities may be present.
- The appearance of landfills can vary from very regular and organized to very messy and disordered. Boundaries with adjacent land uses can be distinct or irregular.
- Large parts of the site have little or no vegetation. The sites tend to be heavily modified by earth moving activities, with or without a clear pattern or intent.
- Un-permitted dumps lack the regular shapes and smooth textured earth fill of sanitary landfills. Open pits, trash and junked vehicles and appliances are often visible.

## CONTEXT

- **Landscape Position** - Found throughout the project area, in any context except for densely built-up areas. Solid waste disposal sites are often adjacent to an Open Land class. Boundaries with adjacent land uses are usually not well defined.

  Land fills are located at the closest acceptable distance from the built-up areas that generate the solid wastes. Disposal sites are difficult to approve in urban areas due to public reaction. Un-permitted dumps are often located in the least conspicuous locations, such as a remote back corner of a property or at the end of a remote dirt road in a forested area.

## SIMILAR CLASSES

- 1500 Industrial - Areas that are disturbed, under construction, or used for storage of raw or residual materials may look like dumps. Sites that store uniform wastes and residuals as part of a normal process stream are subsidiary to the industrial site and not included in this class.
- 1600 Extractive - Excavating equipment such as bulldozers, shovels, dredges and drag lines are visible.
- 7400 Disturbed Land - Soil and/or substrate has been altered by human activity; white or whitish, mottled signature due to regenerating vegetation.
- 7420 Borrow Areas - Excavation equipment may be visible; appear as depressions with regular, often rectangular shapes.
- 7430 Spoil Areas - These will lack many of the above 8350 indicators, but may otherwise look like dumps.

## SPECIAL MAPPING CONVENTIONS

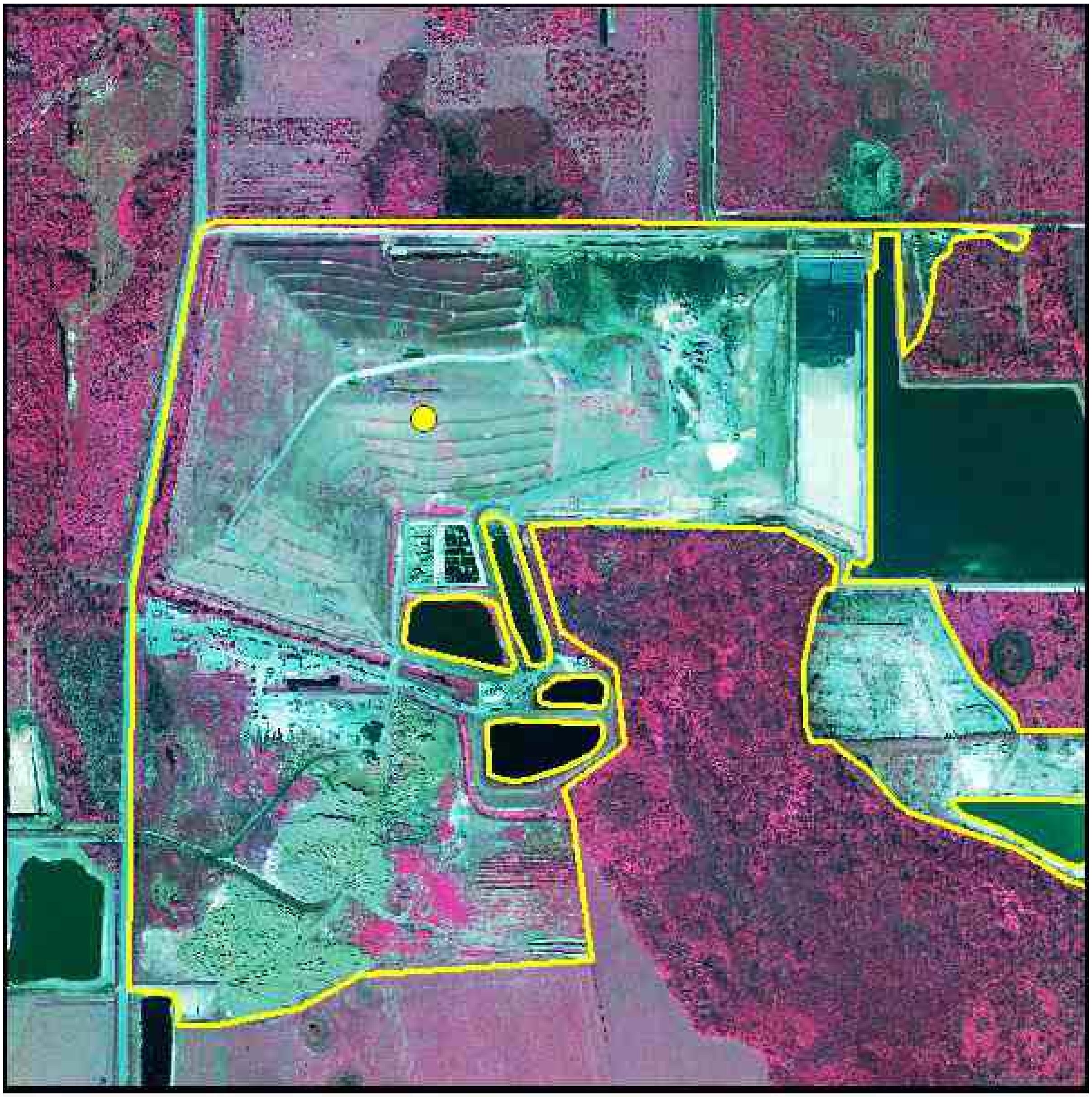
The minimum mapping unit (MMU) for this class is 5 acres. Landfills are considered a very high priority feature in water resource management.

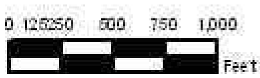
Landfills under construction are classified as if the construction were complete.

## DUAL CODING CONVENTION

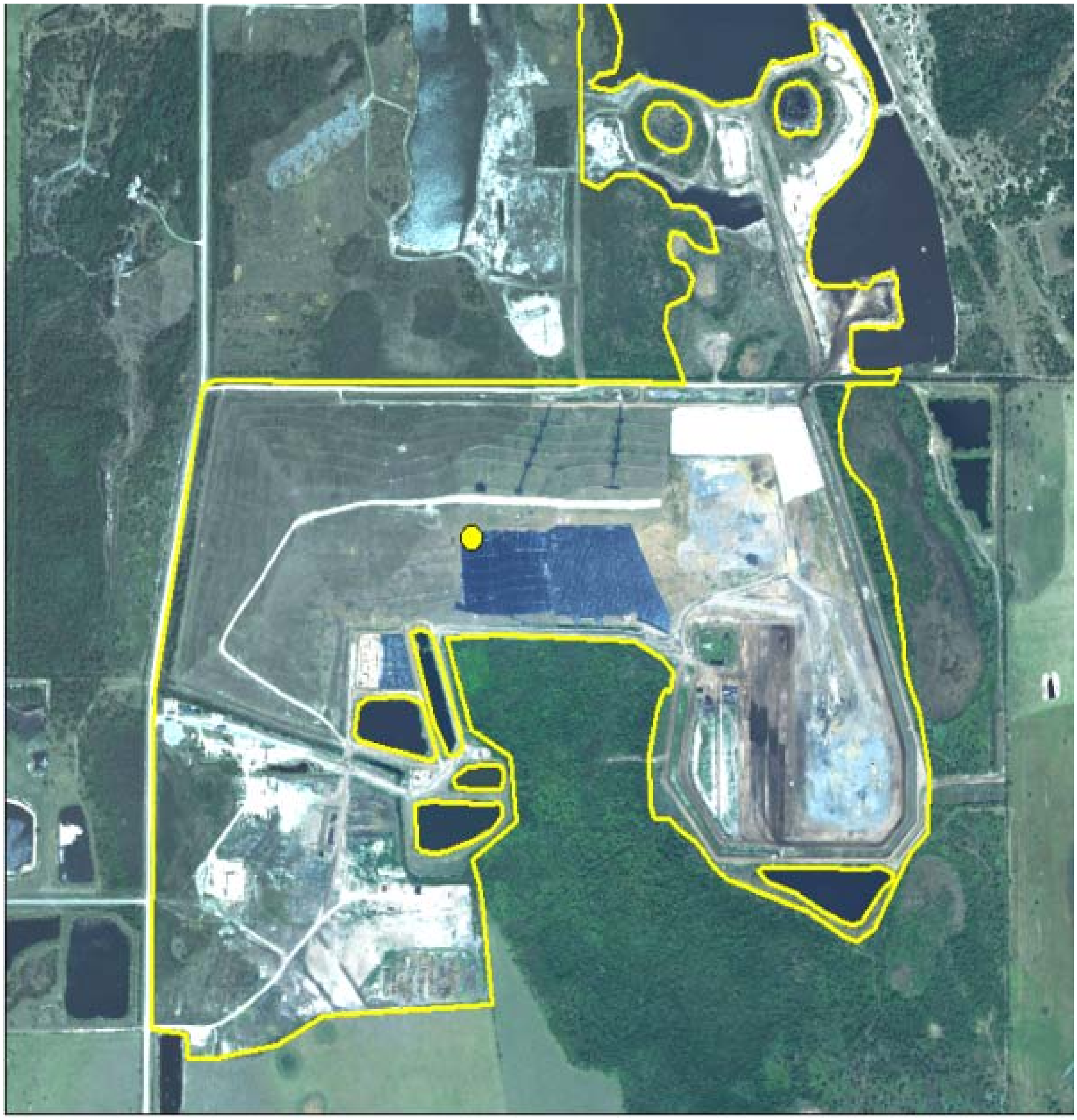
This is a **Land Use** class. The LUCODE and LCCODE are generally the same. However, treatment ponds at a landfill are dual coded with 8360 Other Treatment Ponds as the LCCODE along with 8350 as the LUCODE.

## CIR DOQQ IMAGE





## NATURAL COLOR IMAGE



## FIELD PICTURE

**DATE**
03/13/07

**COORDINATES**
756890.39  1093873.57

# 8360
# Other Treatment Ponds

LEVEL 1: 8000 Transportation, Communication, and Utilities
LEVEL 2: 8300 Utilities
**LEVEL 3: 8360 Other Treatment Ponds**

## DESCRIPTION

This code was created by the SFWMD to classify those lagoons, holding ponds, impoundments and infiltration ponds which are utilized for agricultural or industrial treatment purposes.

This 8360 code is used for facilities that are **designed and utilized for specific treatment or infiltration functions,** including percolation beds used for sewage treatment/disposal.

**It is not used for typical farm ponds, stormwater treatment ponds and other "reservoirs"** that generally function as normal water bodies. It is not used for holding ponds in mining applications, which are classified as 1660 Holding Ponds.

## KEYS TO PHOTOINTERPRETATION

- The interpreter needs to recognize the type of facility that the impoundment is associated with and, if possible, its function.
- It is generally located in or adjacent to the operation it serves. Percolation beds (RIBs) may be isolated in rural areas.
- Inflow/outflow structures, plumes or aerial spray, pumps and other buildings or equipment are often visible.
- Levees and access roads are generally present.
- The water color may deviate from the typical black color seen on CIR photography, due to altered chemistry or biota. Colors may be blues or greens, and contrast distinctly with surrounding natural water bodies.
- Shape of the impoundment appears artificial, with straight lines, angles, geometric curves or symmetrical shapes.

## CONTEXT

- **Landscape Position** - Treatment ponds can be associated with industrial, agricultural and municipal facilities. They are not associated with mining operations or with residential areas.

## SIMILAR CLASSES

- 1660 Holding Ponds- associated with extraction (mining)
- 5300 Reservoirs - Reservoirs do not have a treatment or infiltration function.
- 6000 Wetlands and 7000 Barren Land - Treatment ponds may be confused with wetlands or barren categories if vegetated or in a dry state.

## SPECIAL MAPPING CONVENTIONS

This is a SFWMD modification to the FLUCCS system, which does not have this class.

**Treatment Ponds in this class are given the Land Cover code 8360 whether they are vegetated or empty.**

Priority classes such as water bodies, wetlands, golf courses, land fills or waste treatment site are always broken out if they meet minimum size criteria.

Treatment facilities under construction are classified as if the construction were complete.

## DUAL CODING CONVENTION

This is a **Land Cover** class. **Dual coding is always required. A Land Use class must always be assigned** in addition to the 8360 code. The **Land Use** code is determined by the type of facility the treatment pond is associated with, if identifiable. An example is 2520 Dairies. If the type of facility is unidentifiable, the PI should use his best judgment based on context, ancillary data or field checking.

## CIR DOQQ IMAGE

## NATURAL COLOR IMAGE

## FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
457645.18 1473901.21

# MODIFIERS

Modifiers are used in this dataset to denote conditions which are not described by a Land Cover or Land Use code, or to add more descriptive detail for polygons which are already classified by a Land Cover or Land Use code.

They are divided into the three classes below:

IMPACT
VEGETATION
SPECIES

## DESCRIPTION

See the respective Modifier Key pages for descriptions of these modifiers and information on their use in this data layer.

## MAPPING CONVENTIONS

**Minimum Mapping Units:** There is no minimum mapping unit for the application of these modifiers.

# Impact Modifiers

The impact modifiers used in this map are the following:

- Burned
- Off-Road Vehicles (ORV)

## DESCRIPTION

These modifiers are added to land cover or land use codes to indicate the presence of these two conditions wherever they are identified on the aerial photograph.

- **Burned** - Burned areas are those affected by fire, either through natural means such as wildfire, or through the controlled use of fire to achieve land management goals. Fire is used to achieve a variety of objectives, such as enhancing forage for cattle, restoring a fire-dependent ecosystem, improving wildlife habitat or preparing sites for reforestation. Burned areas usually appear as a flat, bluish, or blue-green signature on the aerial photo.
- **Off-Road Vehicles** - Off-Road Vehicles (ORV) include a variety of land and water craft, ranging from all-terrain vehicles such as four-wheel motorbikes, swamp and dune buggies, and motorcycles, to personal watercraft such as jet and air boats. Evidence of ORV use usually appears as irregular, random trails through areas not accessible by roads. They can be found either on upland areas or through wetland areas such as prairies and marshes. They are particularly evident in the Big Cypress National Preserve in Collier County.

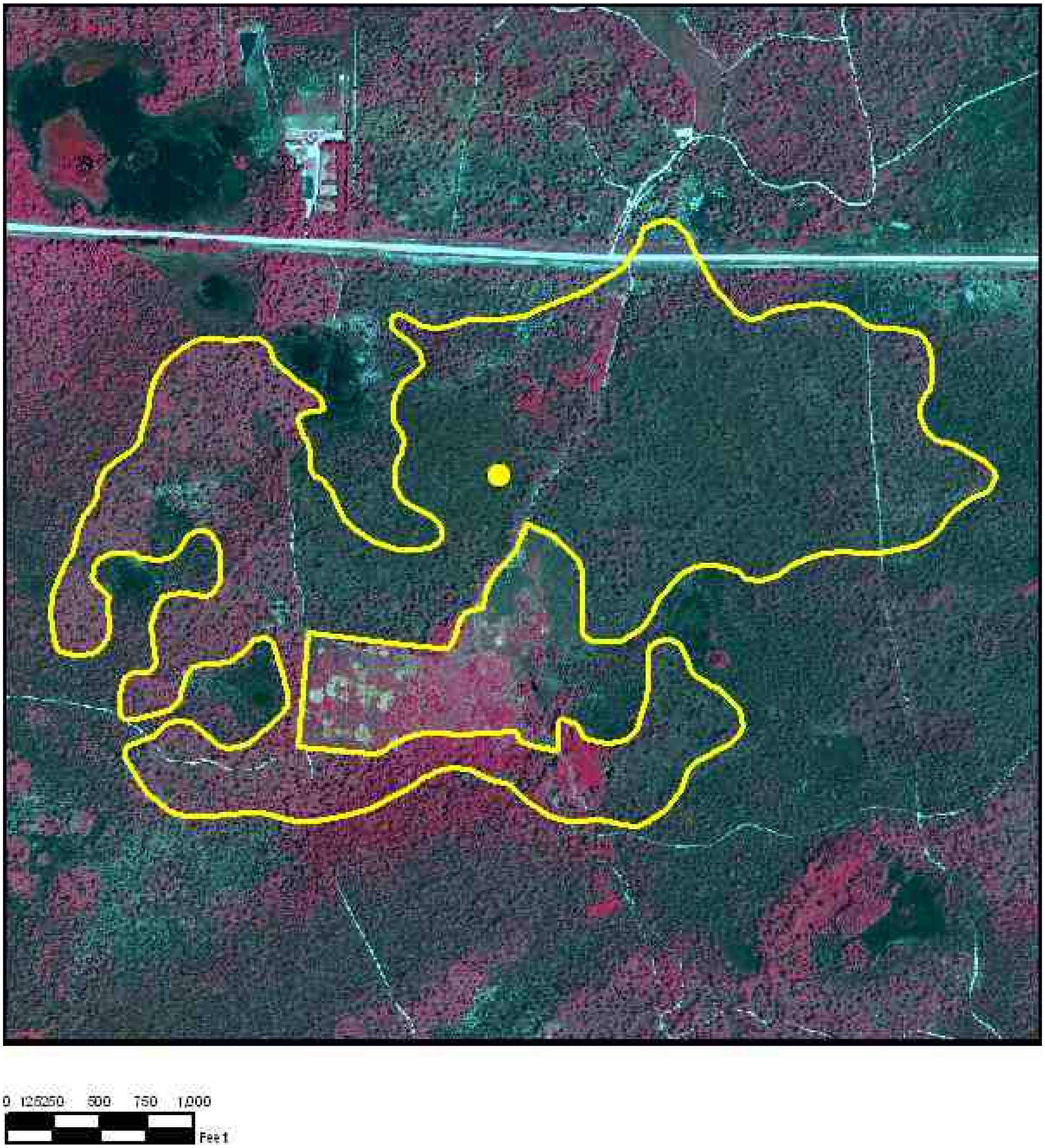
## MAPPING CONVENTIONS

### Minimum Mapping Units:

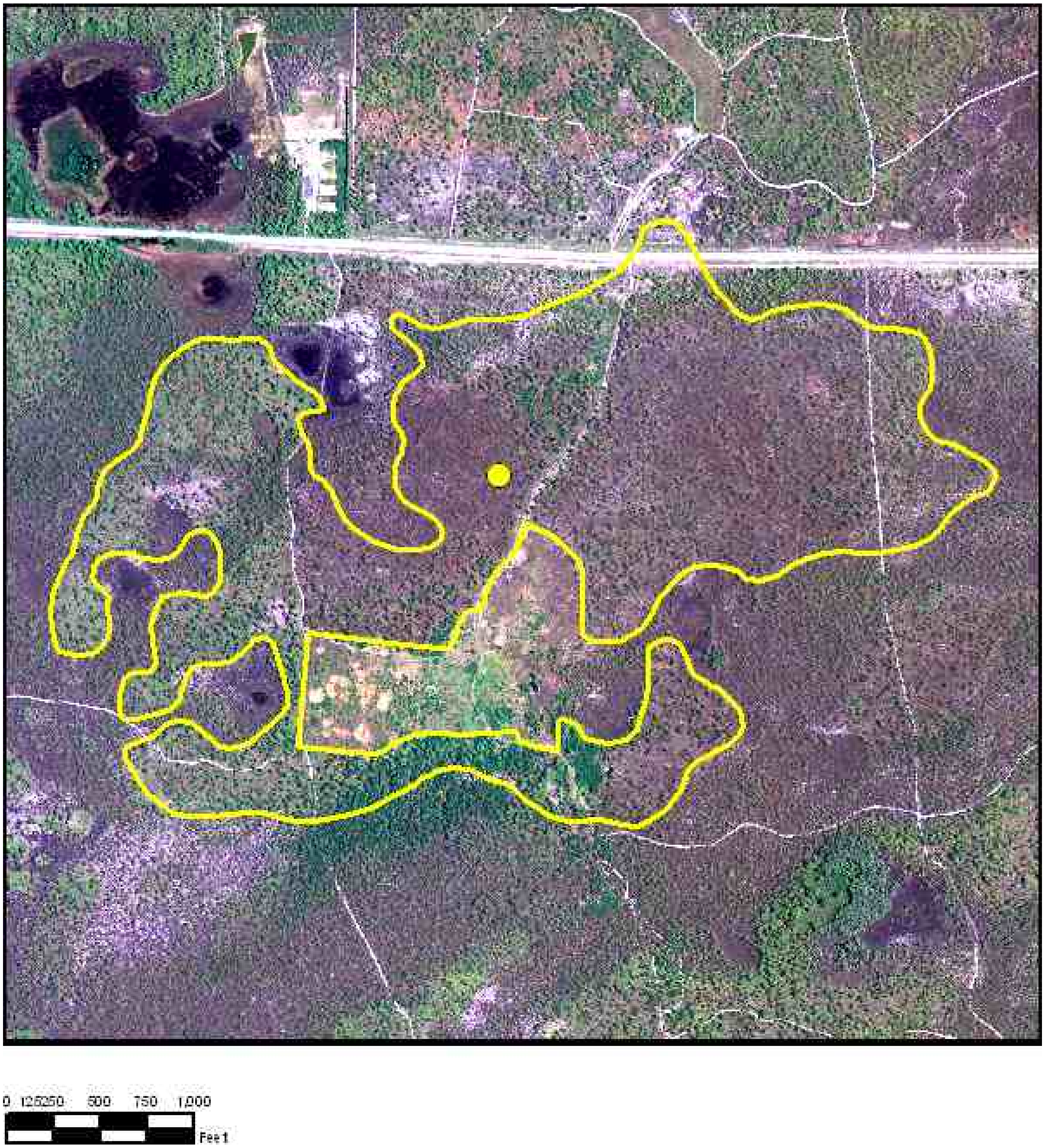
There is no minimum mapping unit for the application of these modifiers.

They will be applied to LCLU polygons as observed to reflect their influence on the landscape.

## BURNED - CIR DOQQ IMAGE




BURNED - COLOR DOQQ IMAGE

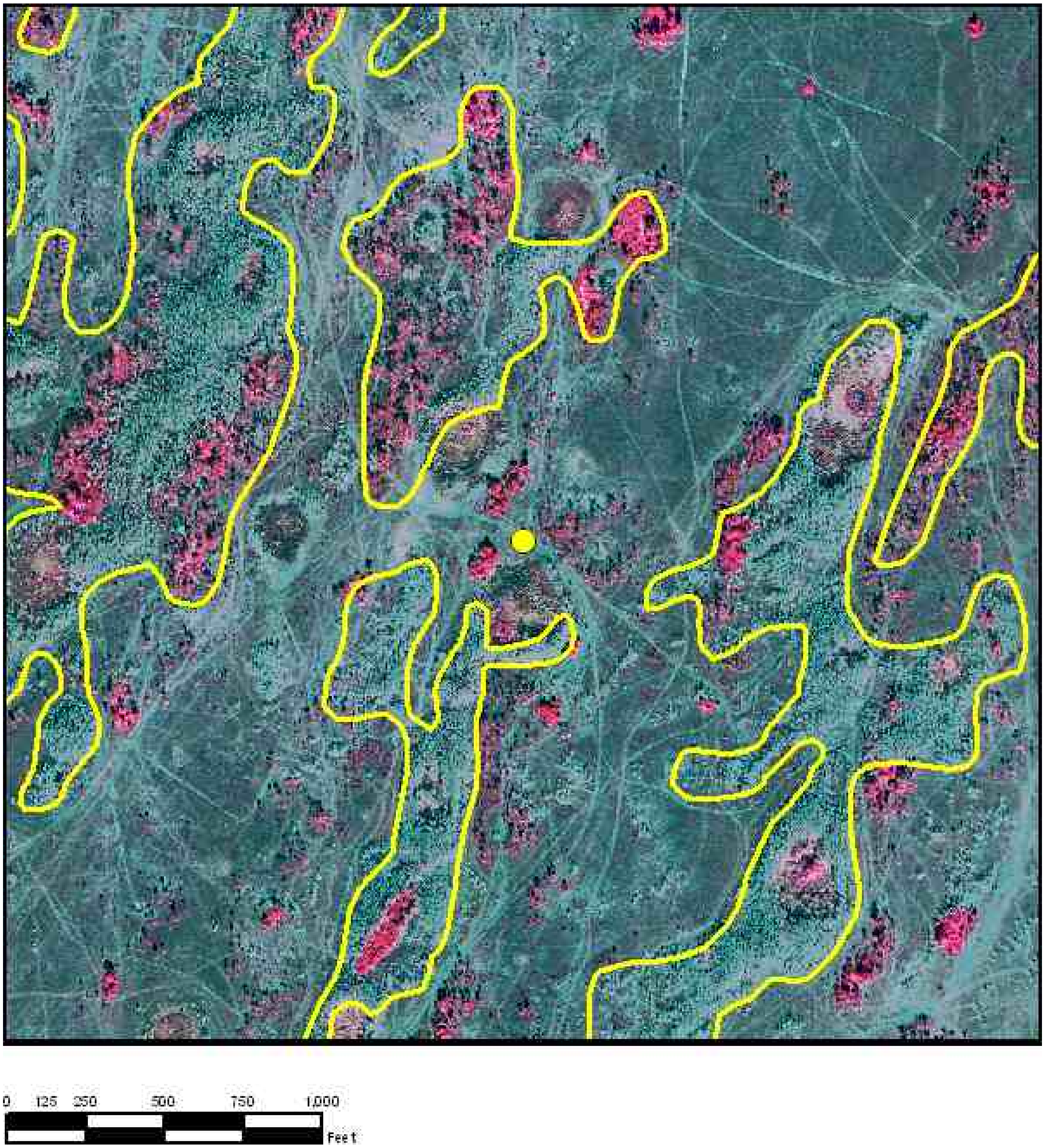



## BURNED - FIELD PICTURE

**DATE**
10/15/07

**COORDINATES**
333197.49 896343.43

**ORV - CIR DOQQ IMAGE**




## ORV - COLOR DOQQ IMAGE


**DATE**
n/a

**COORDINATES**
591964.66 585630.80

# Species Modifiers

The species modifiers used in this map are the following:

- Brazilian pepper
- Melaleuca

## DESCRIPTION

These modifiers are added to all LCLU polygons to indicate the presence of these conditions or species as identifiable on the aerial photograph to a degree that does not meet the criteria for classification as the dominant land cover.

- **Brazilian pepper** - See the PI Key page for 4220 Brazilian pepper for a description of this species and its typical photo-signature and habitat.
- **Melaleuca** - See the PI Key page for 4240 Melaleuca for a description of this species and its typical photo-signature and habitat.
- Domain=Present conditions of Melaleuca:

| Code | Description |
|---|---|
| 0 | No |
| 1 | Yes |
| 2 | Dead |
| 3 | Cleared |
| 4 | Multiple |

- **Dead Melaleuca** - Dead Melaleuca are normally found in areas where they have been treated for eradication mainly within the Everglades. They usually have a sparse, whitish gray signature.
- **Cleared Melaleuca** - Collateral data such as the previous studies will be needed. These areas may be seen adjacent to dead Melaleuca within the Everglades.

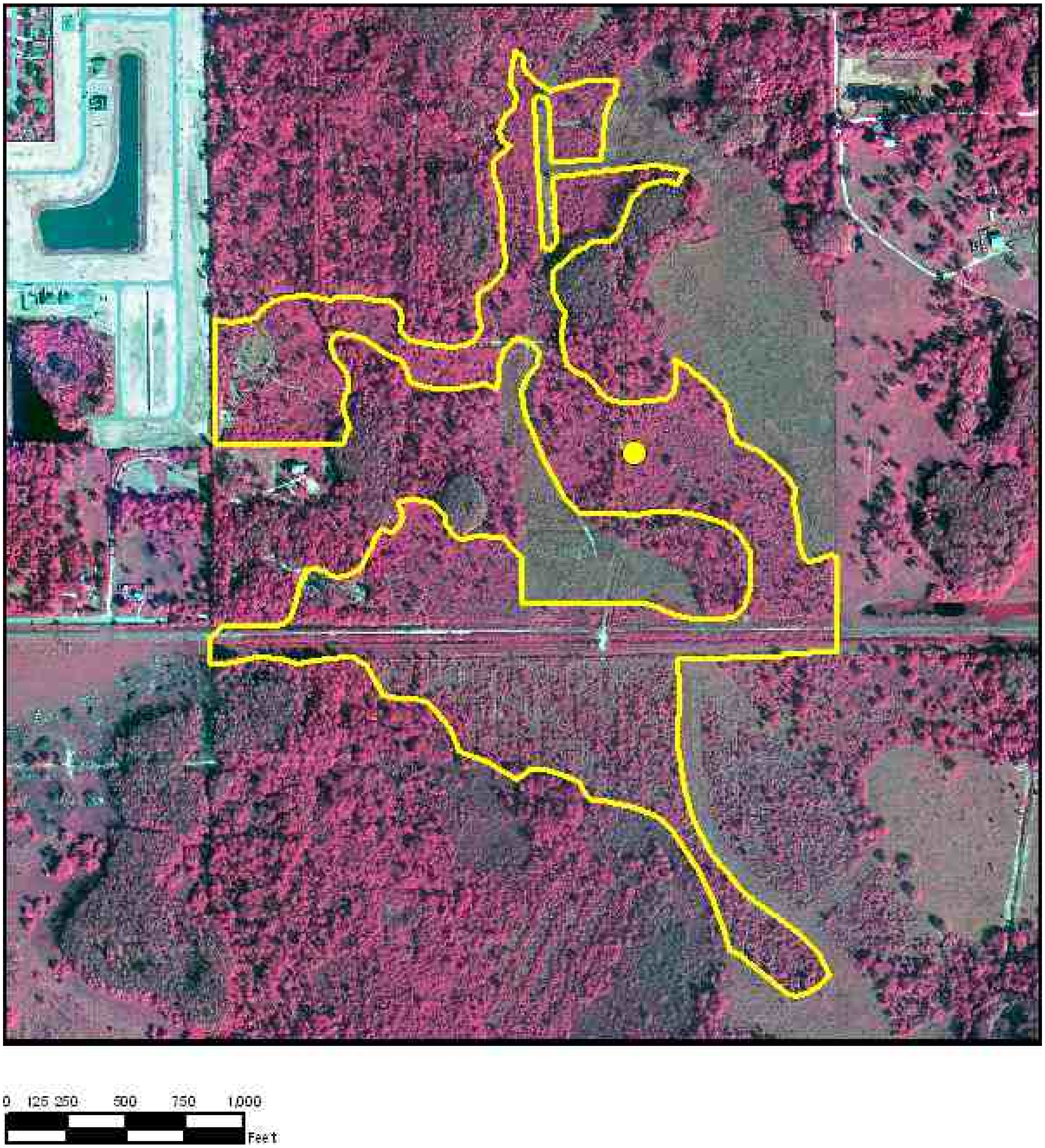
## MAPPING CONVENTIONS

**Minimum Mapping Units:**

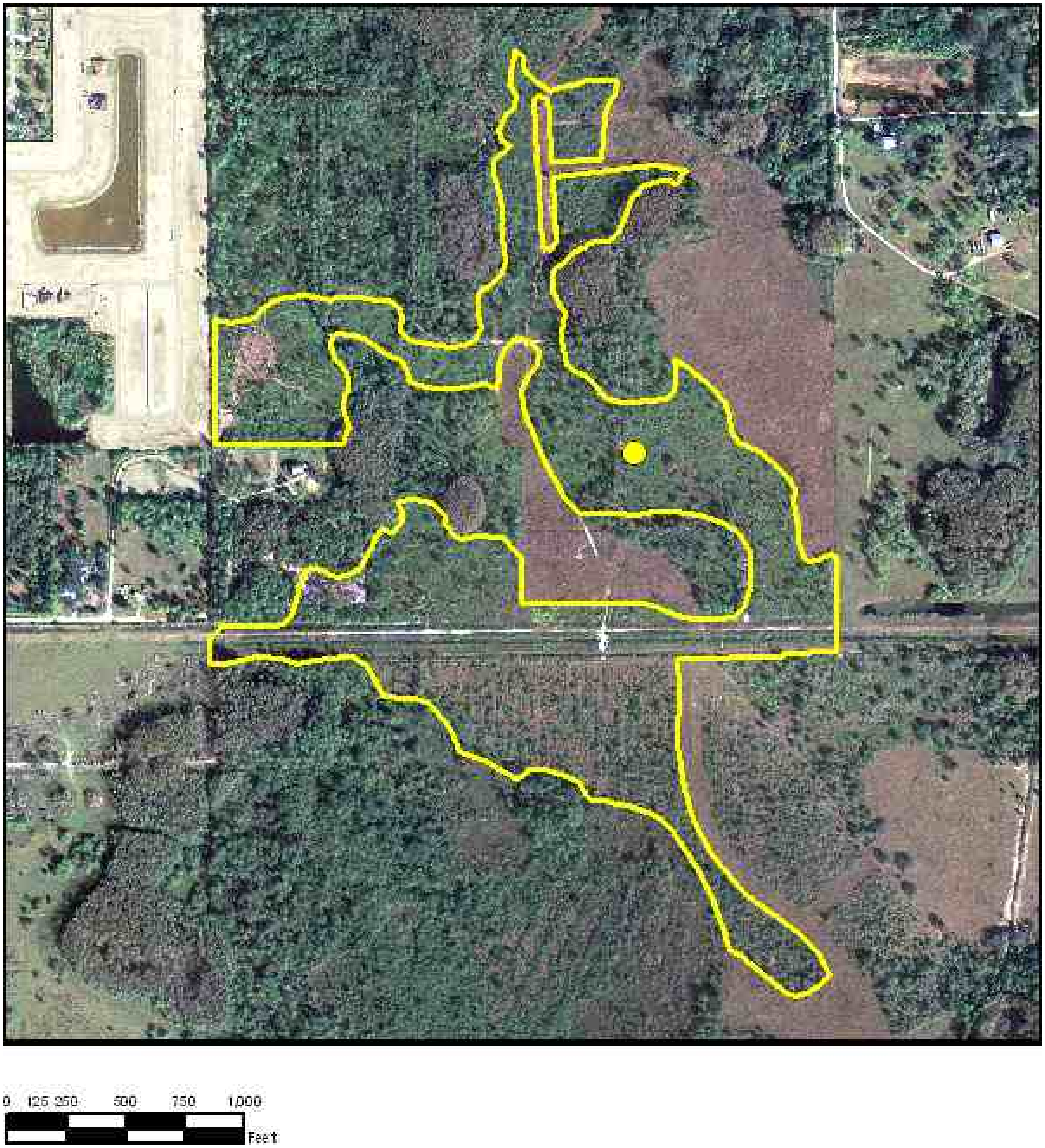
There is no minimum mapping unit for the application of these modifiers.

They will be applied to all LCLU polygons as observed on the aerial photograph.

## BRAZILIAN PEPPER - CIR DOQQ IMAGE




**BRAZILIAN PEPPER - COLOR DOQQ IMAGE**



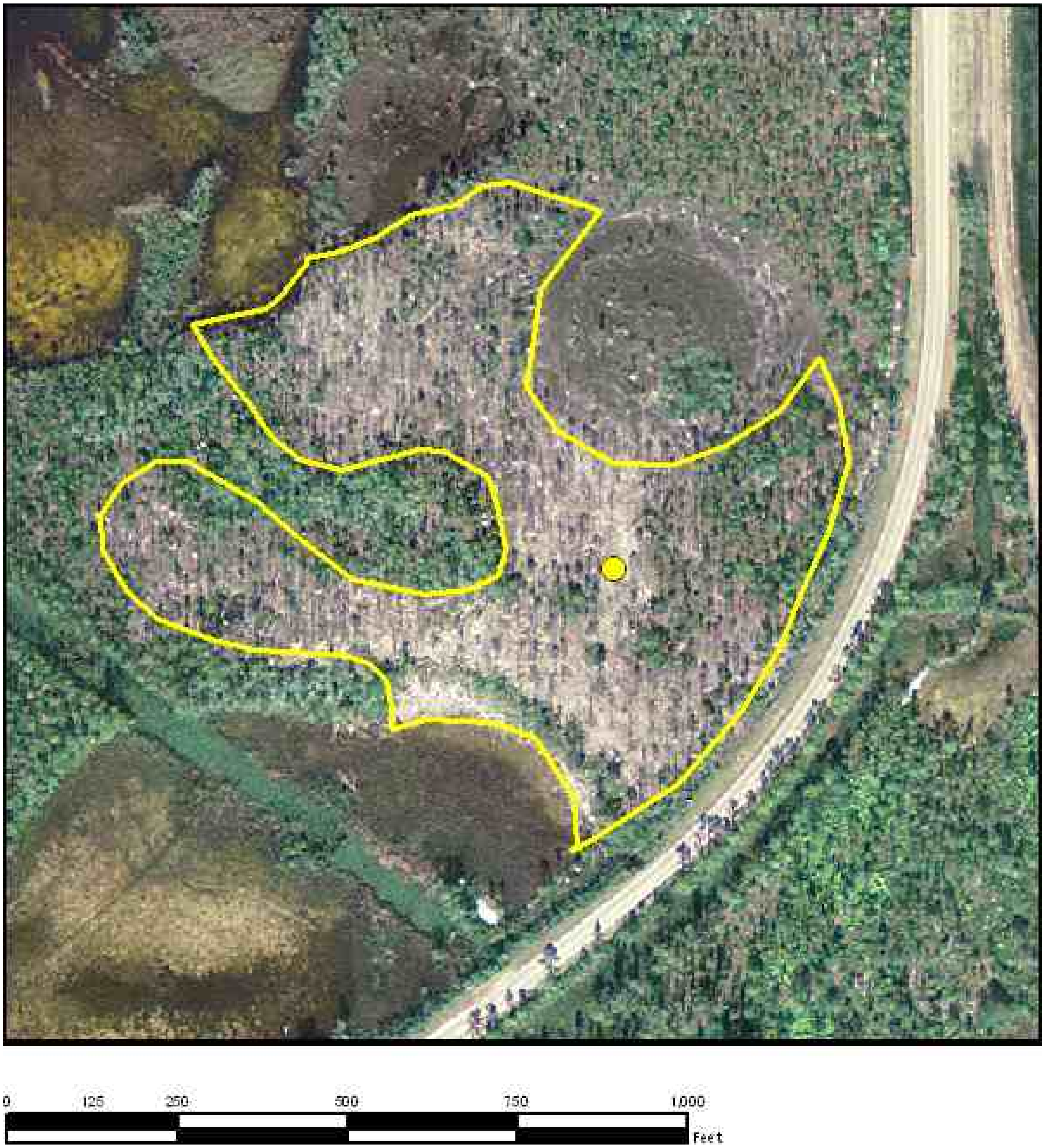

## BRAZILIAN PEPPER - FIELD PICTURE

**DATE**
10/16/07

**COORDINATES**
425429.15 862247.00

**MELALEUCA (DEAD) - CIR DOQQ IMAGE**


MELALEUCA (DEAD) - COLOR DOQQ IMAGE




MELALEUCA (DEAD) - FIELD PICTURE

**DATE**
01/15/07

**COORDINATES**
887853.09 935561.79

# Vegetation Modifiers

The vegetation modifiers used in this map are the following:

- Dead Trees
- Exotics
- Tree Islands

## DESCRIPTION

These modifiers are added to all LCLU polygons to indicate the presence of these conditions or species as identifiable on the aerial photograph.

- **Dead Trees** - Dead trees, also known as "snags", can be found in areas where normal water flow has been impounded, either naturally or through the building of dams. Trees killed by these methods commonly appear denuded, with whitish or grayish signatures.
- **Exotics** - Exotics are species introduced to Florida, either purposefully or by accident, from a natural range outside Florida. This modifier will be used for species such as Australian pine, kudzu and Old World climbing fern *(Lygodium microphyllum).*
- **Tree Islands** - Tree islands are the most distinct plant communities in the Everglades. In general, they consist of low trees, which are situated on slight elevations above the surrounding marsh areas. They range in size from small circular islands of one half to 5 or 6 acres, to larger, tear-drop shaped "strands", which can grow to over 300 acres in size. These are wetland communities in which species composition varies, and they may be classified variously as bay heads, hammocks, willows or cypress islands.

## MAPPING CONVENTIONS

- **Tree Islands** - The "tree islands" modifier is applied to both the forested and shrub portions of tree islands that contain both, and also to tree islands that are made up of only forest or only shrubs. The modifier is not applied to any surrounding marsh areas.

### Minimum Mapping Units:

There is no minimum mapping unit for the application of these modifiers.

They will be applied to all LCLU polygons as observed on the aerial photograph.

## DEAD TREES - CIR DOQQ IMAGE

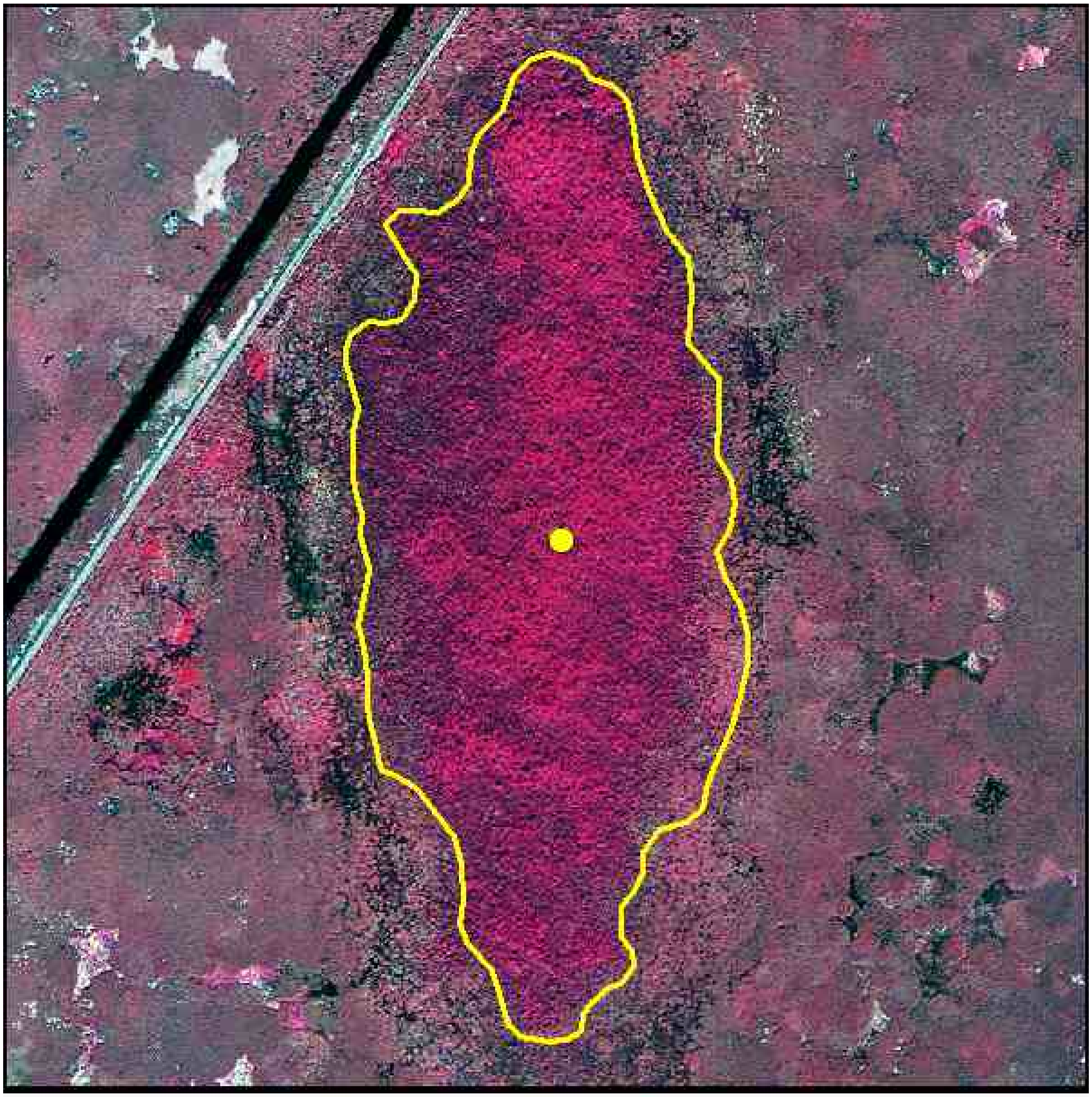

DEAD TREES - COLOR DOQQ IMAGE

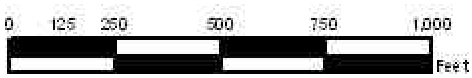

## DEAD TREES - FIELD PICTURE

**DATE**
03/13/07

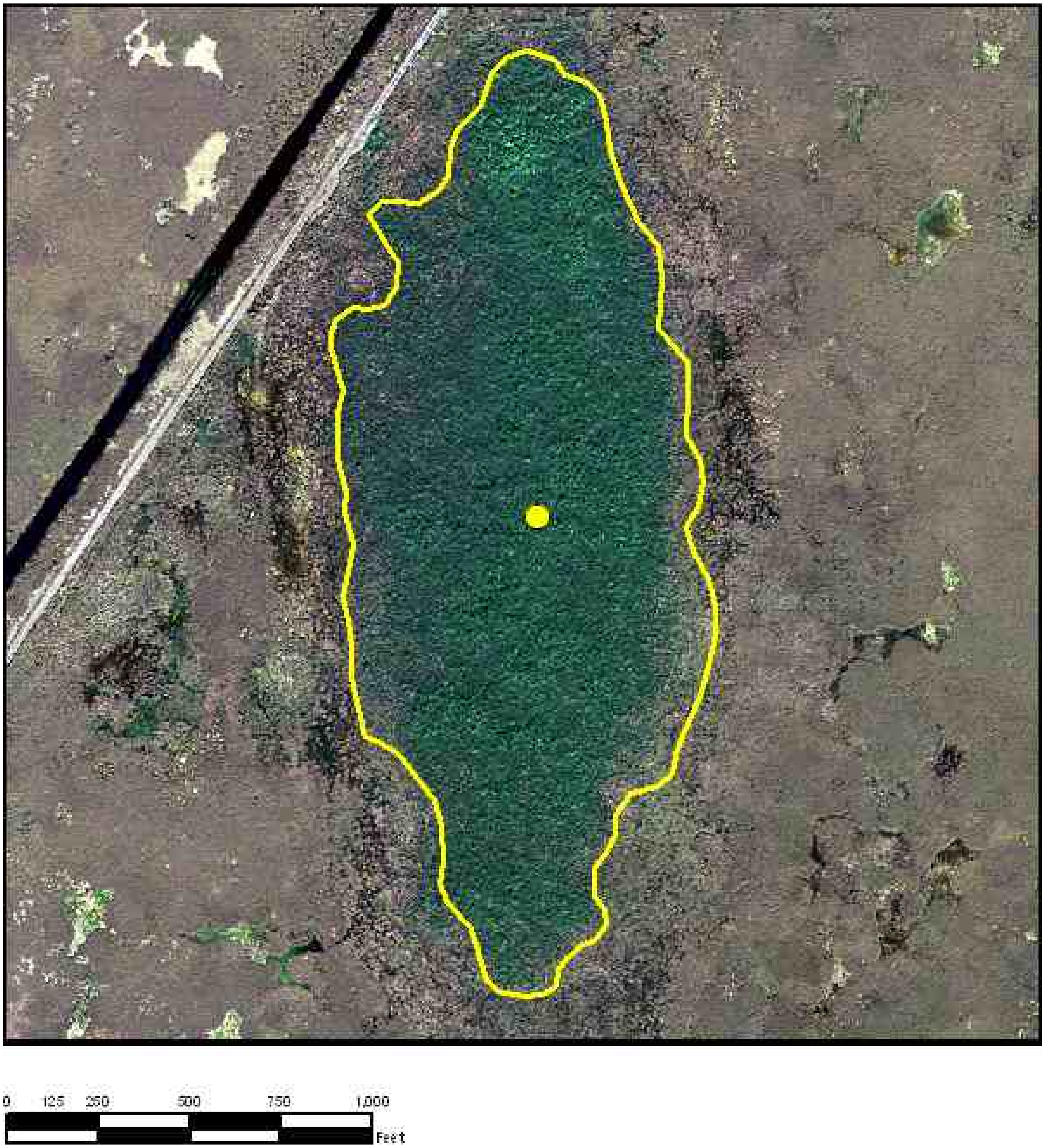
**COORDINATES**
754414.65 1092262.61

## EXOTICS - CIR DOQQ IMAGE






## EXOTICS - COLOR DOQQ IMAGE





## EXOTICS - FIELD PICTURE

**DATE**
n/a

**COORDINATES**
788177.41 554605.32

## TREE ISLANDS - CIR DOQQ IMAGE


**TREE ISLANDS - COLOR DOQQ IMAGE**


## TREE ISLANDS - FIELD PICTURE

**DATE**
05/13/04

**COORDINATES**
744154.41 508080.41

# High-Density Residential Modification

## Review of Residential Density for LUCODE

Some of the high-density residential land use codes in the 2004 - 05 dataset may have been attributed improperly based on the empirical experience of LCLU Subject Matter Exports (SME). Since the 2008-09 dataset is being updated, based on the 2004-05, the assigned residential LU codes needed to be re-evaluated based on the acreage of each parcel property within a 1310 polygon (i.e., High-Density Residential, Fixed Single Family Unit). In other words, some of the high-density residential polygons need to be re-classed to medium-density residential as shown in the table below.

## Adjustments of Residential Classes

| 2004-05 | 2008-09 | LU Description |
|---|---|---|
| 0.00 – 0.20 | 0.00 – 0.15 | High |
| > 0.20 – 0.50 | >0.15 - 0.50 | Medium |
| > 0.50 - 2.00 | >0.50 - 2.00 | Low |

Unit: Acres/Parcel

## LU Code adjustment for LUCODE = 1310

The process workflow is described below:

1. **Query** polygon attribute records with LUCODE = 1310 (High Density Residential)
2. **Export** the selected features to a new featureclass
3. **Create** a new field called ***iAcres*** (floating)
4. **Populate** the polygon area (acres) in ***iAcres*** using the syntax

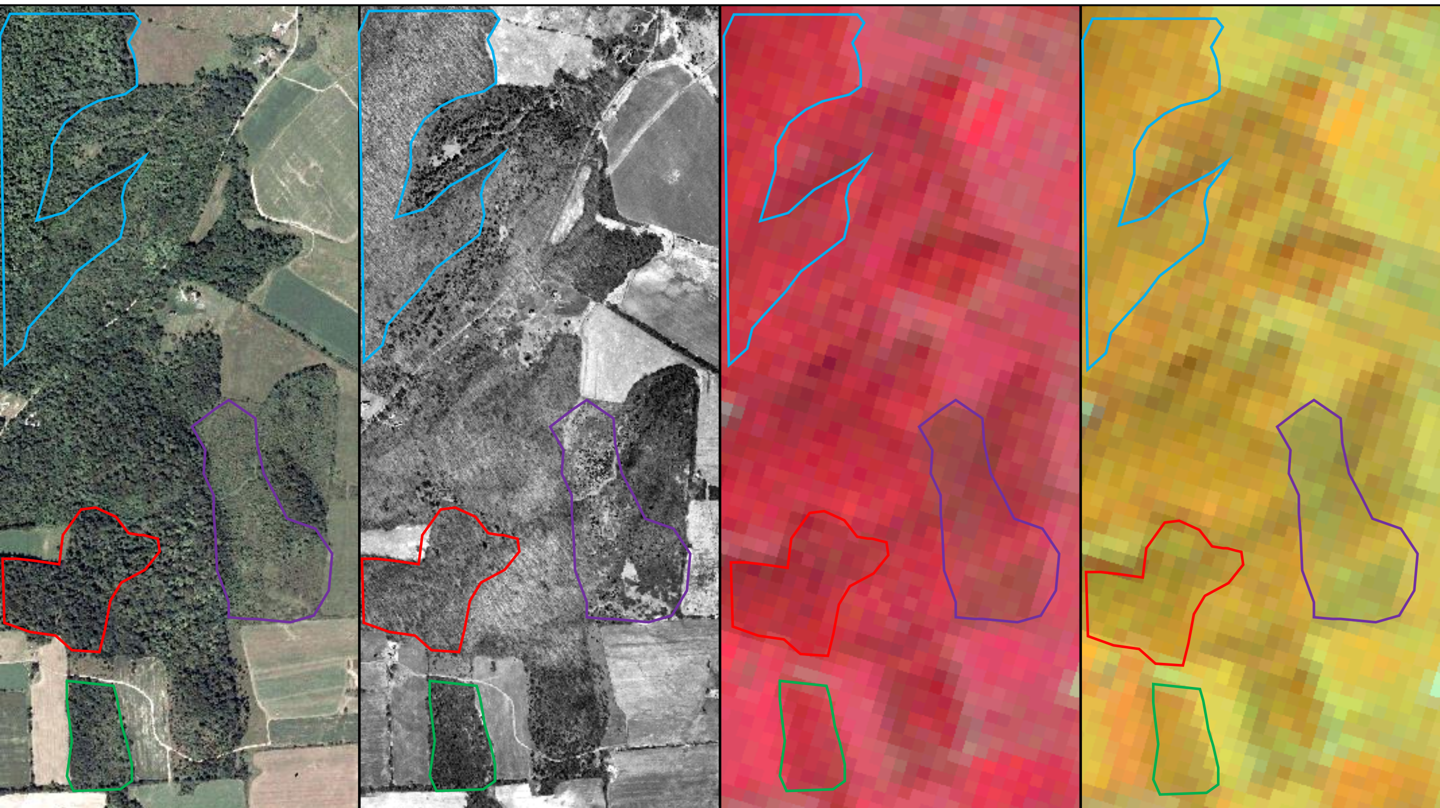
   ***iAcres*** = SHAPE_Area (sq. $ft^2$) * 43560 (Acres * sq.$ft^{-2}$)
5. **Clip** the parcel data for the area of interest using the boundary of the Priority Area to reduce process time
6. **Create** a point featureclass of parcel centroids from step #5
7. **Intersect** the featureclass from step#2 with point centroids (step #6) with “Join Attribute”, which results in a point featureclass
8. **Create** a frequency table based on FID
9. **Join** the frequency table with the featureclass from step #2
10. **Create** a table field called ***iDensity***
11. **Populate** iDensity with iAcres / [frequency field]
12. **Select** records that are attributed with 0.15 < ***iDensity*** <=0.5
13. **Reassign** LUCODE to 1210 of LCLU dataset[1]
14. **Save** the dataset and complete the edits

[1] In the event that the parcel data for a specific polygon is incomplete, a representative area within the polygon is measured and the houses are counted by hand.

# Deciduous Forests

Deciduous forests in Vermont are comprised of species who go through a cycle of their leaves changing color then falling off in the autumn followed by new growth in the spring. Deciduous forests are most easily identified using a combination of leaf-off (late fall or early spring) and leaf-on (summer) imagery. They are most often confused with coniferous forests or mixed forests and shrubs.

Deciduous Forest
Shrub
Coniferous Forest
Mixed Forest



| NAIP | Vermont Orthophoto Program | Landsat-5 | Landsat-5 |
|---|---|---|---|
| Sensor: Visible true color film | Sensor: Visible panchromatic film | Sensor: Thematic Mapper | Sensor: Thematic Mapper |
| Resolution: 1-meter | Resolution: 0.5-meter | Resolution: 30-meter | Resolution: 30-meter |
| Bands: True Color (1-2-3) | Bands: Panchromatic | Bands: CIR (4-3-2) | Bands: Pseudo Color (4-5-3) |
| Date: Leaf-on (mid-August) | Date: Leaf-off (late March) | Date: Leaf-on (early September) | Date: Leaf-on (early September) |

Deciduous forests in leaf-on, high-resolution true-color imagery, such as NAIP, are green, but the actual tone will vary. They will typically be a brighter green than mixed or coniferous forests, but this is not always the case. Furthermore the tone of deciduous forests can be influenced by topographic shadows. The texture will appear rough due to the presence of shadows. There is no standard pattern, although patterns due to environmental conditions, such as soil type, may emerge. Shrubby areas will lack dark textured appearance of deciduous forests.

Deciduous forests in leaf-off, high-resolution visible wavelength panchromatic imagery typically will appear bright. The leaf off conditions expose the forest floor, which void of photosynthetic vegetation, creates the bright tone. They will be highly textured with a noticeable pattern similar to that of matchsticks lying on the ground. This pattern is result of the shadows thrown by the trees, the trees themselves are rarely visible. Deciduous forests can be distinguished from coniferous forests as the latter are much darker due to the presence of needles. In addition, coniferous trees produce cylindrical shadows. Deciduous forests are most easily confused with shrubby areas, but shrubby areas typically lack the matchstick pattern.

In moderate resolution leaf-on color-infrared imagery deciduous forests typically appear as a moderately toned magenta color. They are darker than lawns, agricultural fields, and shrubs, but brighter than coniferous and mixed forests. Topographic shadows can influence the tone, causing confusion with deciduous forests. There is often a noticeable texture, resulting from canopy shadows, causing a mix of brighter and darker pixels.

In a Landsat 4-5-3 composite image deciduous forests typically appear as a moderately toned yellow to orange color. They are darker than lawns, agricultural fields, and shrubs, but brighter than coniferous and mixed forests. Topographic shadows can influence the tone, causing confusion with deciduous forests. There is often a noticeable texture, resulting from canopy shadows, causing a mix of brighter and darker pixels.

# SECTION 1
# INTRODUCTION

In addition to those airfield facilities and features discussed in the preceding sections, the following are frequently present:

1. Compass-aligning bases
2. Aircraft-gun testing ranges
3. Drainage patterns
4. Aircraft crates
5. Jet blast marks
6. Security fences
7. Firebreaks
8. Airfield construction
9. Transformer stations
10. Water storage tanks

These features should be relatively easy to identify on aerial photography of suitable scale. Their importance lies in frequent association with certain airfield activities, types of aircraft or countries. For example, the Soviets commonly plow firebreaks around airfield storage areas.

## COMPASS-ALIGNING BASES

Bases for aligning aircraft compasses are found on some airfields. They are circular, often hard-surfaced stands with compass points marked on the circumference. When an aircraft is in aligning position on this stand, its compass may be brought into adjustment with the points on the base.

FIG. 10.01 Two compass-aligning bases on airfield in former East Prussia. Aircraft on base to left is in aligning position. Scale 1:12,000

FIG. 10.02 Two compass-aligning bases on airfield in Sovzone, Germany.

FIG. 10.03 Compass bases shown in Fig. 10.02. Scale 1:7,200

## AIRCRAFT-GUN TESTING RANGES

Ranges for testing and adjusting aircraft machine guns and other weapons are most commonly found on airfields having major repair facilities or on those associated with aircraft factories. On aerial photography they appear as long trough-like installations with an opening at one end, where aircraft are positioned for target fire. This open end may or may not have a hardstand. Walls are of extremely heavy construction, generally earth banked. As a rule, the range is uncovered, though some are entirely roofed and others may have a shelter only over the aircraft position.

Ranges are often in groups of two or more and may differ in length to permit varying adjustments of guns. Occasionally, small arms and aircraft-gun testing ranges appear side by side. When occurring together they are similar in construction. The small arms ranges are generally the narrower of the two and lack stands for positioning of aircraft.


FIG. 10.04 Group of three aircraft-gun testing ranges and a small arms range in Sovzone, Germany. Shelters appear over aircraft positions. See Fig. 10.18 for similar ranges appearing at reduced scale. Scale 1:6,300

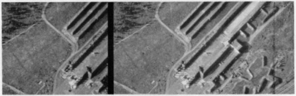


FIG. 10.05 Ranges for aircraft-gun testing and for small arms firing. Note aircraft in firing position. Sovzone, Germany. Scale 1:3,300

FIG. 10.06 Covered aircraft-gun testing range in Sovzone, Germany. Scale 1:10,000

# SECTION 2
# LANDING AREA SURFACES

## LANDING AREA SURFACES
### Identification of Type

Positive identification of the type of landing surface is important in assessing the full capabilities of an air installation. The kind of surfacing is one of the major factors determining not only the types of aircraft that can operate from a field, but also the field's capability for supporting sustained operations.

The type of surface material on an airfield landing and take-off area often is difficult to determine from aerial photographs. However, photography of proper exposure, taken at scales of approximately 1:15,000 or larger, usually will reveal enough of the recognition features outlined in the table below to permit adequate photo interpretation of the landing surfaces.

Identification of types of landing surfaces just on the basis of tone is difficult. Many times, the various surfacing materials give the same general appearance on photographs with scales as large as 1:2,000. Graded earth, gravel, coral, sand, clay, closely cropped grass, and concrete usually reflect much more light than the features surrounding them. Most operational photography is exposed for the overall airfield and not the landing surfaces. As a result, these surfaces are overexposed and appear very light in tone. Also, the overexposure results in loss of pattern and texture details. Photography using panchromatic film with the exposure calculated to reveal the details of the surface of the landing area, should give the following average relative tone values for the various surfacing materials:

| Type Surface Material | Average Relative Munsell Value (Tone) |
|---|---|
| Graded earth, gravel, coral, clay(dry) | 6 - 7 |
| Concrete | 5 - 6 |
| Pierced steel plank | 5 - 7 |
| Sod | 4 - 5 |
| Asphalt | 2 - 4 |

The Munsell (1947) gray-scale number or value describes the degree of lightness or darkness of tone. This scale extends from black at 0 to white at 10. A shade of gray having a tone halfway between black and white has a notation of 5. Light grays range from 5 to 10, while dark grays range from 5 down to 0.

Relative tone values are helpful in identifying surface materials, but it is most important to remember that there are many factors which affect tone on a photograph, e.g., moisture content of surface material, texture of surface, angle of light incidence, printing and developing processes, etc. Therefore, the recognition features listed in the table below must be given primary consideration when identifying landing surfaces.

### RECOGNITION FEATURES OF LANDING SURFACES

| TYPE OF SURFACE | PATTERN | | | TONE | WIDTH OF LANDING AREA OR RUNWAY | TYPE OF AIRFIELD | AIRCRAFT SERVICING FACILITIES | TAXIWAYS | OTHER |
|---|---|---|---|---|---|---|---|---|---|
| | EDGES | CORNERS | SURFACE | | | | | | |
| Sod (Page 2.03) | Irregular line | Jagged or irregularly curved | Irregular | Dark gray to white-mottled | Variable | Usually auxiliary, small civil or emergency | Usually limited | None | Tire tracks |
| Graded earth; Gravel; Coral; Sand; Clay (Pages 2.04 - 2.05) | Irregular line | Jagged or irregularly curved | May have grader marks | Medium gray to white-often mottled | Variable | Usually auxiliary, small civil or emergency | Usually limited | May be present | May be pit nearby where surface material obtained |
| Pierced Steel Plank (page 2.06) | Irregular ends of plank may be visible | Stepped | Parallel planks with holes | Dark gray to white-often mottled | Variable | Military-usually new construction | None to complete | Usually present | Often piles of steel plank in area |
| Asphalt; Brick (Page 2.07) | Straight line | Right angle or smoothly curved | None visible | Very dark to light gray-usually uniform | Uniform | Usually major military or civil | Usually complete | Usually present | Surface may be patched or painted |
| *Concrete (Pages 2.08 - 2.09) | Straight line | Right angle or smoothly curved | Block | Medium gray to white-uniform | Uniform | Major military or civil | Usually complete | Usually present | Surface may be patched or painted |

*Surface of rolled earth and crushed rock gives the appearance of concrete but shows no block pattern; tone often mottled. This type of surface common in the Far East. (Fig. 11.07).


FIG. 2.01 Sod landing area having no defined runways (Sovzone, Austria). Presence of wheel tracks, together with tone characteristics, indicate sod surface. Outlined area is shown in Fig. 2.02. Scale 1:15,000

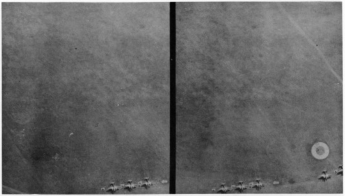


FIG. 2.02 Part of sod landing area shown in Fig. 2.01. Note mottled tone and wheel tracks. Scale 1:2,500


FIG. 2.03 Sod landing strip. Areas with light tone are bare earth or very thin sod. Dark areas are heavy sod. Cut in bank on right, which shows light, is gravel. See Fig. 2.04 for ground view. Scale 1:16,000

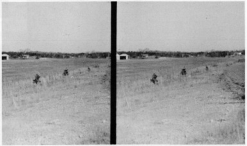


FIG. 2.04 View of airfield from top of gravel bank toward hangar. (See camera station in Fig. 2.03). Note coarse gravel in foreground which has a very light tone on the vertical photo. Ground stereopair

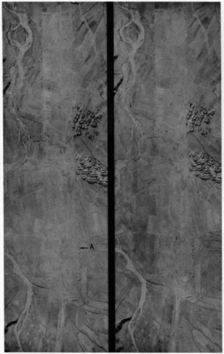



FIG. 2.05 Recently constructed, graded earth landing strip in Korea. Note that agricultural patterns and old roads are still visible. Such fields are for limited or emergency use. They are unserviceable in wet weather. Observe similarity of tone between earth fill (A) and runway surface, indicating that both are of the same material. Scale 1:10,000

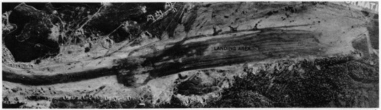



FIG. 2.06 Graded earth landing strip in European U.S.S.R. Crude oil or some other material has been sprinkled on the surface to keep down dust. Scale 1:12,000

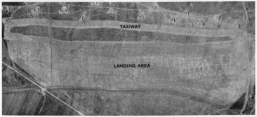



FIG. 2.07 Graded earth landing strip in European U.S.S.R. Note grader marks running lengthwise of strip. Scale 1:12,000

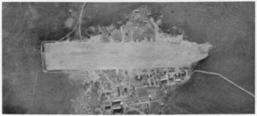


FIG. 2.08 Graded earth landing strip in European U.S.S.R. Note tone variation from medium gray to white and irregular boundary of strip. Scale 1:14,500

FIG. 2.09 Graded earth strip in U.S.S.R. Note grader marks running length of strip. Scale 1:7,000

FIG. 2.10 Graded earth runways on a small airfield in U.S.A. Note pit in lower left hand corner from which surfacing material was obtained.


FIG. 2.11 Gravel and sod landing area on small airfield in U.S.A. Note that gravel area appears very light in tone.


FIG. 2.12 Graded earth landing area in permafrost zone (area of permanently frozen ground) in U.S.S.R. Grader marks form pattern running lengthwise of strip. Polygonal pattern on surface around landing area indicates permafrost. Scale 1:8,000


FIG. 2.13 Graded earth landing area in Korea. White spots on the runway are filled-in bomb craters. Scale 1:48,000

FIG. 2.14 Large-scale photograph of landing area shown in Fig. 2.13. Scale 1:9,000

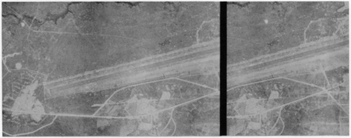


FIG. 2.15 Pierced steel plank runway. At regular intervals sections of steel planking extend beyond the edges of the runway. French Indochina. Scale 1:8,000

FIG. 2.18 Grass and seeds growing through holes in pierced steel plank runway. On small-scale photography such surfaces are easily confused with sod. U.S.A.


FIG. 2.16 Pierced steel plank runway, taxiway and parking area. USAF, Korea. See Fig. 2.19 for large scale of blocked-out area. Scale 1:10,000

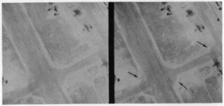


FIG. 2.19 Part of runway and taxiway shown in Fig. 2.16. Note step pattern of corners and irregular edges. Scale 1:4,300

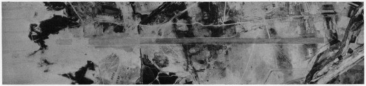


FIG. 2.17 Pierced steel plank runway in Korea. Left side of photograph shows new construction on a runway extension. Old part of runway resembles an asphalt surface except for irregular edges. USAF. Scale 1:10,000

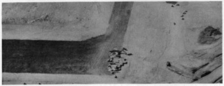


FIG. 2.20 Part of pierced steel plank runway. Note irregular edge of runway and step pattern in corner.

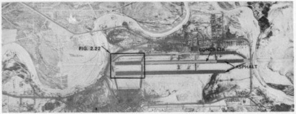



FIG. 2.21 Asphalt and concrete runways. Asphalt surface very dark, uniform tone; concrete at ends of runways and center section of upper runway light in tone with parts of block pattern barely visible. This exposure under snow conditions makes the asphalt surfaces appear almost black. See Fig. 2.22 for summer exposure. Alaska. Scale 1:38,000

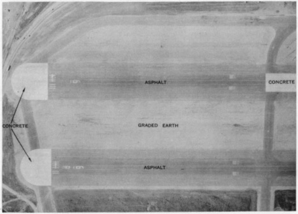



FIG. 2.22 Part of asphalt and concrete runways shown in Fig. 2.21. Asphalt surfaces are darker in tone than the concrete or graded earth, but considerably lighter than in Fig. 2.21. Note that edges are straight and corners make sharp angles or smooth curves. Painting on runways indicates hard surface. Scale 1:4,700


FIG. 2.23 Asphalt runways. Note that asphalt surface is lighter in tone than the sod and much darker than the gravel road or bare earth. U.S.A.

FIG. 2.24 Asphalt runways. In contrast, graded earth on edges of runway is very light. U.S.A. Scale 1:25,000

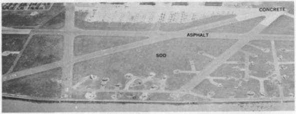



FIG. 2.25 Asphalt runways with concrete extensions and parking apron. Runway edges form a straight line and corners are smoothly curved. Asphalt surface has lighter tone than sod surface and darker than the concrete. Painting on runways indicates hard surface. U.S.A.

## Concrete

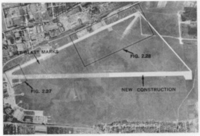



FIG. 2.26 Concrete runway on airfield in Sovzone, Germany. Note that new construction on right appears very light. Corners of runway and taxiways are sharply defined angles or smooth curves (See Figs. 2.27 and 2.28). Scale 1:25,000

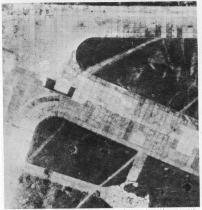


FIG. 2.27 Part of runway shown in Fig. 2.26. Expansion joints in concrete form a block pattern. Note repair patches in old runway. Scale 1:2,000

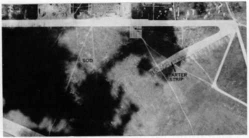



FIG. 2.28 Part of taxiway and starter strip shown in Fig. 2.26. Block pattern of concrete is clearly visible in the cloud shadow but lost elsewhere due to overexposure. Scale 1:8,300


FIG. 2.29 Very light tone, sharply defined corner angles and straight-lined edges indicate that runway is concrete. Due to overexposure the block pattern is not discernible. Sovzone, Germany. Scale 1:22,000

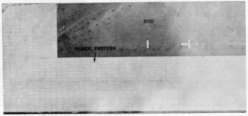



FIG. 2.30 Part of runway shown in Fig. 2.29. Block pattern of concrete visible in cloud shadow. Scale 1:2,100

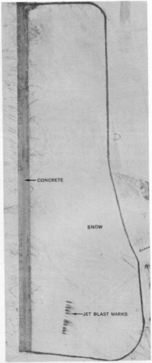



FIG. 2.31 Runway shown in Fig. 2.29. The runway, which was very light in tone on summer photography, is dark in contrast to snow. Note that block pattern is visible. Scale 1:10,000

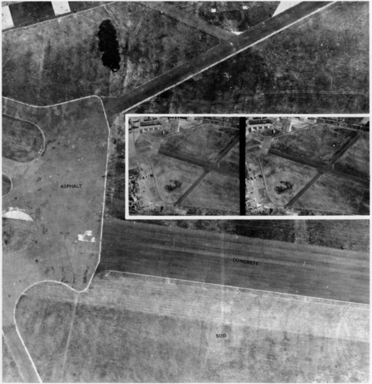



FIG. 2.32 Part of toned down concrete runway and taxiway and an asphalt assembly apron on airfield in Sovzone, Germany. Surface toned down to blend in with surrounding area. Inset is a stereopair of the airfield at a scale of 1:20,000. Scale 1:2,000

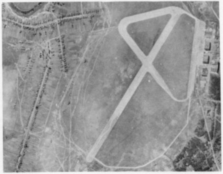


FIG. 2.33 Concrete runway and parking apron on airfield in European U.S.S.R. Note straight edges and smooth curved corners of runway. Scale 1:20,000

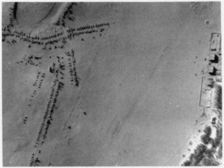


FIG. 2.34 Airfield shown in Fig. 2.33 with runway covered with snow. Summer photography is needed to determine the exact location and composition of surface here obscured by snow. Scale 1:23,000

# SECTION 3
# PARKING FACILITIES

Special facilities, other than hangars, are usually provided for parking of aircraft on airfields. The facilities may be widely varied in types and in degree of improvement, depending upon the functions, capabilities and vulnerability of the fields on which they are located. A recognizable parking facility may be a hard surface with or without blast walls to accommodate one or several planes. It also may be nothing more than a mark on a natural surface to indicate a parking position. Individual facilities are identified and described on pages 3.02 through 3.08.

The location of special parking facilities in relation to significant parts of the airfield is important in PI reporting. These locations are described on pages 3.09 through 3.13.

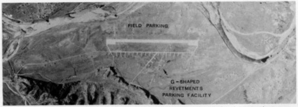



FIG. 3.01 Parking areas with facilities at airfield in North Korea. Scale 1:45,000

DICHOTOMOUS KEY FOR THE IDENTIFICATION OF PARKING FACILITIES

- Blast walls present. (Fig. 3.02) → REVETMENTS (Pages 3.04-3.06)
- Blast walls absent.
  - Natural surface.
    - With marks to indicate aircraft parking position. (Fig. 3.03) → PARKING LINE (Page 3.07)
    - Without marks to indicate aircraft parking position. (Fig. 3.04) → GENERAL FIELD PARKING (Page 3.07)
  - Artificial surface.
    - For single aircraft. (Fig. 3.05) → HARDSTANDS (Page 3.07)
    - For several aircraft.
      - On taxiway. (Fig. 3.06) → TAXIWAY PARKING (Page 3.08)
      - On large paved surface.
        - At end of runway. (Fig. 3.07) → ASSEMBLY APRON (Page 3.08)
        - Not at end of runway; usually near hangar.
          - In front of hangar. (Fig. 3.08) → HANGAR APRON (Page 3.08)
          - Not in front of hangar. (Fig. 3.09) → PARKING APRON (Page 3.08)

FIG. 3.02 Aircraft revetments. North Korea. Scale 1:10,000

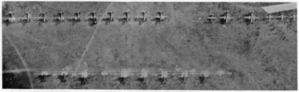


FIG. 3.03 Parking line. Sovzone, Austria. Scale 1:2,500

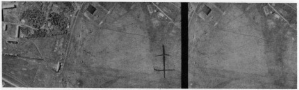


FIG. 3.04 General airfield parking. U.S.S.R. Scale 1:9,500

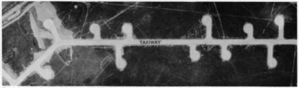



FIG. 3.05 Hardstands. Sovzone, Germany. Scale 1:9,000


FIG. 3.06 Taxiway parking. Sovzone, Germany. Scale 1:2,000

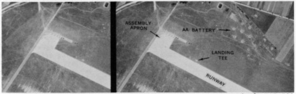



FIG. 3.07 Assembly apron. Sovzone, Germany. Scale 1:9,500

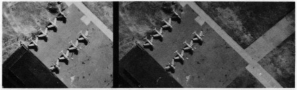


FIG. 3.08 Hangar apron. Sovzone, Germany. Scale 1:1,600

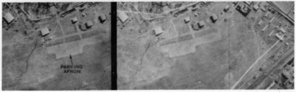



FIG. 3.09 Parking apron. U.S.S.R. Scale 1:13,000

## AIRCRAFT REVETMENTS

An aircraft revetment is a blast shelter built to protect aircraft against concussion and flying bomb or shell fragments. The blast or retaining walls are most commonly constructed of earth. Other construction materials include sand bags, wood, or prefabricated concrete slabs with earth filler.

Revetments may be roofed with wood, sheet metal or concrete for added protection against blast and weather. Roofs also serve to conceal the aircraft parked within, but, if protection against observation is the sole consideration, camouflage netting is apt to be the only covering.

Many of the recently constructed Soviet revetments for jet aircraft have a vent in the rear. This provides an outlet for hot exhaust gases as well as a personnel exit.

Width of the mouth of the revetment determines the largest type of aircraft that can be accommodated. For example, an opening of forty feet will admit no aircraft larger than fighters. Generally, revetments are built to shelter single aircraft of a particular type, but in some instances they are built for more than one aircraft.

The Soviets constructed a wide variety of revetments on their airfields during World War II. It is quite likely that many of these have been rebuilt to accommodate modern aircraft.

Illustrations in this section cover recent trends in revetment construction in the Soviet Zone of Germany and in Communist-controlled North Korea. World War II revetments in U.S.S.R. are also included.

### REVETMENTS CONSTRUCTED IN THE SOVIET ZONE OF GERMANY.

FIG. 3.10 Earthen revetments with blastwall protecting vents. Openings 60 feet. Sovzone, Germany. Scale 1:10,000

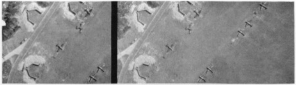


FIG. 3.11 Revetments under construction. Wooden walls are being reinforced with earth. Openings 60 feet. Sovzone, Germany. Scale 1:2,800

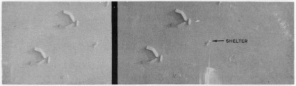



FIG. 3.12 Revetments, of the type shown in Fig. 3.11, under snow cover. Note personnel shelters in rear. Scale 1:3,000

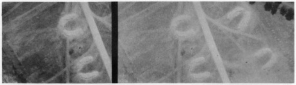


FIG. 3.13 Earthen fighter revetments under construction at Soviet field in Germany. Openings 40 feet. Scale 1:2,000

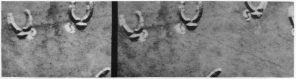


FIG. 3.14 Completed fighter revetments of type shown in Fig. 3.13. Personnel slit trench near vent. Scale 1:2,000

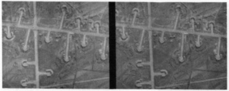


FIG. 3.15 Scale 1:8,000

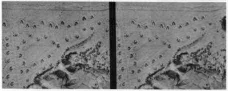


FIG. 3.16 Scale 1:20,000

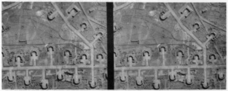


FIG. 3.17 Scale 1:8,000


FIG. 3.18 Scale 1:10,000

## REVETMENTS - KOREA

FIG. 3.15 U-shaped fighter revetments. Vents in rear, some with small vehicle revetments at entrance. Excavations around revetments indicate source of building material. North Korea.

FIG. 3.16 Revetments shown in Fig. 3.15 at a smaller scale and under snow conditions. Note bomb craters in upper part of photo.

FIG. 3.17 U-shaped fighter revetments. Observe rectangular revetment at upper right. No vents or personnel shelters. Area peppered with real and dummy bomb craters. North Korea.

FIG. 3.18 U-shaped revetments with vent leading into small shelter. North Korea.

FIG. 3.19 G-shaped fighter revetments with camouflage netting. North Korea.

FIG. 3.20 G-shaped fighter revetments. Note roofed revetment near center of photo. North Korea.

FIG. 3.21 Covered and open revetments constructed by the Japanese during World War II. North Korea.

FIG. 3.22 Sand bag revetments at USAF base in Korea.

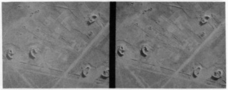


FIG. 3.19 Scale 1:8,300

FIG. 3.20 Scale 1:8,300

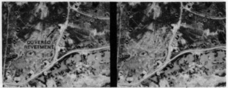



FIG. 3.21 Scale 1:9,000

FIG. 3.22 Scale 1:5,000

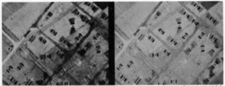


FIG. 3.23 Scale 1:7,500

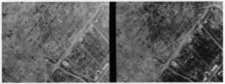


FIG. 3.24 Scale 1:10,000

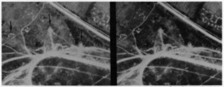


FIG. 3.25 Scale 1:9,500

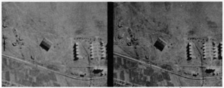


FIG. 3.26 Scale 1:10,000

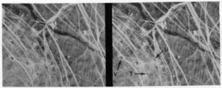


FIG. 3.27 Scale 1:13,000

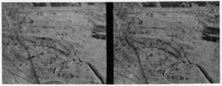


FIG. 3.28 Scale 1:12,000

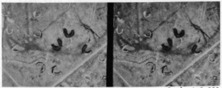


FIG. 3.29 Scale 1:8,000

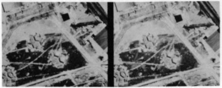


FIG. 3.30 Scale 1:5,000

## REVETMENTS-U.S.S.R.-WORLD WAR II

FIG. 3.23 Aircraft revetments consisting of two parallel walls which offer only partial protection from blast. Note excavation of building material from around revetments. U.S.S.R.

FIG. 3.24 Revetments consisting of two parallel earthen blastwalls. U.S.S.R.

FIG. 3.25 U-shaped bomber revetments. U.S.S.R.

FIG. 3.26 U-shaped revetments with vent in rear. U.S.S.R.

FIG. 3.27 U-, V- and T-shaped earthen revetments. U.S.S.R.

FIG. 3.28 Simple revetments with blastwall for protecting only the forward part of the aircraft. U.S.S.R.

FIG. 3.29 U-shaped revetments with vent in rear. Observe that three revetments have been reinforced with earth. U.S.S.R.

FIG. 3.30 Multiple-bay earthen revetments. Three revetments use the same center blastwalls. U.S.S.R.

## PARKING LINES

A parking line is a marker on the natural surface of an airfield used to indicate line-up and individual positions of planes. Some parking lines have a storage box for each plane and small paved areas which mark each engine position.

When a single line is used, aircraft usually are parked facing the landing area. When placed on a double line, aircraft generally face each other.

## GENERAL FIELD PARKING

A general field parking facility is nothing more than a natural surface on an airfield where planes are parked. The surface is usually sod, and there are no improvements to indicate aircraft positions. This type of facility can be recognized only when aircraft are present. (See Fig. 3.04)

## HARDSTANDS

A hardstand is a hard-surfaced area built to accommodate a single parked plane. A number of such stands may be placed at regular intervals along a hard-surfaced taxiway leading to the airstrip. Occasionally, a revetment is built on or immediately behind a hardstand.

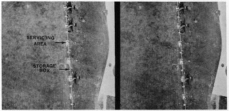



FIG. 3.31 Parking line for twin-engined aircraft. Observe small, paved servicing area under engine positions and storage box at each position.
Sovzone, Germany Scale 1:2,700

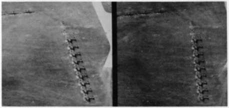


FIG. 3.32 Parking line shown in Fig. 3.31.
Oblique stereopair

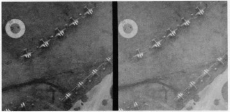


FIG. 3.33 Double parking line with storage box at each position. Note that aircraft face each other.
Sovzone, Austria Scale 1:2,300

FIG. 3.34 Parking line with wheel position indicators.
Sovzone, Germany Scale 1:2,300

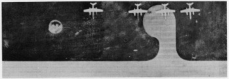


FIG. 3.35 Concrete hardstand branching from taxiway.
Sovzone, Germany Scale 1:1,900

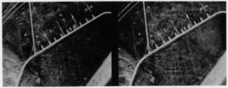



FIG. 3.36 Hardstands along taxiway. General field parking in area between taxiway and runway. U.S.S.R.
Scale 1:12,500

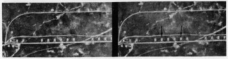


FIG. 3.37 Hardstand positions on airfield in U.S.S.R. Connections to taxiway are unpaved. Scale 1:15,000

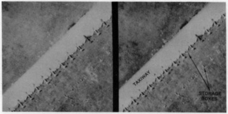


FIG. 3.38 Taxiway parking. Note storage boxes alongside and behind parked aircraft. Sovzone, Germany. Scale 1:2,000


FIG. 3.39 Assembly apron at end of runway with aircraft preparing for take-off. North Korea. Scale 1:11,000

FIG. 3.40 Hangar apron with lines to indicate parking positions and taxi lane. Parking aprons lie in front of and adjacent to the airfield administration building. U.S.A.

FIG. 3.41 Hangar apron and large parking apron. Parking aprons are not usually located so near runways. Japan. Scale 1:15,500

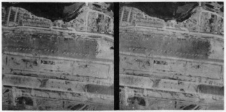


FIG. 3.42 Parking apron at USAF field in Korea. Scale 1:10,500

FIG. 3.43 Parking apron in hangar area. U.S.A. Scale 1:5,000

## TAXIWAY PARKING

Aircraft are occasionally parked along the edges of hard-surfaced taxiways. Frequently, marks are painted on these edges to indicate the position of each plane. Such parking has the advantage of keeping aircraft in a convenient location for servicing.

## ASSEMBLY APRON

Many military airfields have a large paved assembly apron at one or both ends of a runway, which is used only by aircraft preparing for take-off.

## HANGAR APRON

The hangar apron is a hard surface situated immediately in front of the hangar. It is used for aircraft servicing, minor repair and parking. Occasionally, lines are painted on the surface to indicate parking positions.

## PARKING APRON

A parking apron is a large hard surface which may or may not be located in the hangar area. It is used for aircraft servicing, minor repair, and parking and for loading and unloading of passengers and cargo. Lines may be painted on the surface to indicate parking positions and taxi lanes.

## LOCATIONS

The location of a parking area is readily identified on aerial photography, since parking facilities, parked planes, taxiway systems, and track activity between parking and landing areas are all distinctly conspicuous.

On civil airfields the parking area is in some convenient location such as the hangar area. Generally the aircraft are lined up in an orderly fashion to admit a maximum number of planes into the available space and to insure efficient handling.

At military airfields parking areas normally are located on outlying parts of or adjoining the airfield. Aircraft parked in such areas often are dispersed in an irregular manner or are sheltered by blastwalls for protection against attack. In such cases, parking areas often are referred to as dispersal areas.

### On-field Parking Areas

An on-field parking area may be in any convenient location on the field, other than the landing and take-off lanes. The following classification, based on location, is applied to the various on-field parking areas:

1. General airfield area.
2. Hangar area.
3. Airfield perimeter.
4. Taxiway.

### Off-field Parking Areas

An off-field parking area may be any suitable location closely accessible to the field. Such an area is usually located to take advantage of natural or cultural features that offer protection or concealment to parked aircraft. The following classification, based on location is applied to off-field parking areas:

1. Wooded area.
2. Field area.
3. Base of hills.
4. Urban area.


FIG. 3.44 Airfield in North Korea built by the Japanese. Scale 1:11,000


FIG. 3.45 On-field dispersal in hangar area, general airfield area and off taxiway. U.S.A. Scale 1:5,000


FIG. 3.46 On-field parking in hangar area. U.S.A. Scale 1:12,500

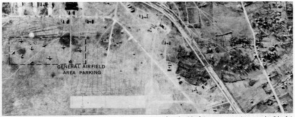



FIG. 3.47 On-field dispersal in general airfield area and on airfield perimeter. U.S.S.R. Scale 1:12,500

FIG. 3.48 Aircraft dispersed in general field area and on airfield perimeter. U.S.S.R. Scale 1:8,500

FIG. 3.49 Dispersal area on airfield perimeter. U.S.S.R. Scale 1:15,000

FIG. 3.50 Dispersal area on airfield perimeter. Sovzone, Germany. Scale 1:11,000

FIG. 3.51 Taxiway dispersal area with G-type revetments. North Korea. Scale 1:34,000

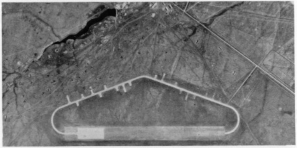


FIG. 3.52 Perimeter dispersal area and loop taxiway with hardstands. U.S.S.R. Scale 1:17,000

FIG. 3.53 Extensive taxiway dispersal area. U.S.S.R. Scale 1:13,000

FIG. 3.54 Taxiway dispersal with hardstands. Sovzone, Germany.

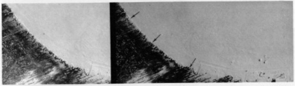


FIG. 3.55 Perimeter dispersal area with scattered revetments. U.S.S.R. Scale 1:15,000

FIG. 3.56 Perimeter dispersal area with scattered revetments. U.S.S.R. Scale 1:17,500

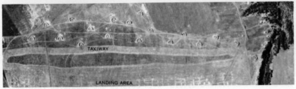



FIG. 3.57 Perimeter dispersal area with scattered revetments. U.S.S.R. Scale 1:12,000

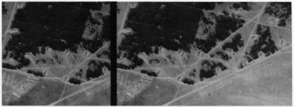


FIG. 3.58 Off-field dispersal area with revetments in wooded area adjoining airfield. Sovzone, Austria. Scale 1:10,000

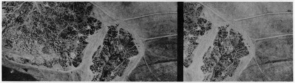


FIG. 3.59 Dispersal area in wooded area on the edge of an airfield. Note track activity. U.S.S.R. Scale 1:12,500

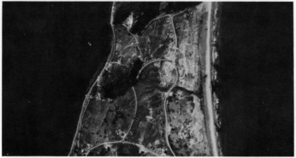


FIG. 3.60 Off-field dispersal with covered and uncovered revetments in wooded and field areas adjacent to Japanese airfield. North Korea. Scale 1:9,500

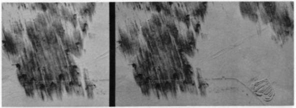


FIG. 3.61 Dispersal area with revetments in wooded area adjoining airfield. U.S.S.R. Scale 1:7,000

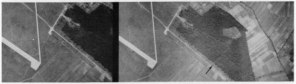


FIG. 3.62 Dispersal area along edge of wooded area contiguous to airfield. Sovzone, Germany. Scale 1:27,000

FIG. 3.63 Dispersal in wooded area bordering German airfield (World War II). Note camouflage netting covering revetments. Scale 1:15,000

# SECTION 4

# FUEL, AMMUNITION AND BOMB STORAGE

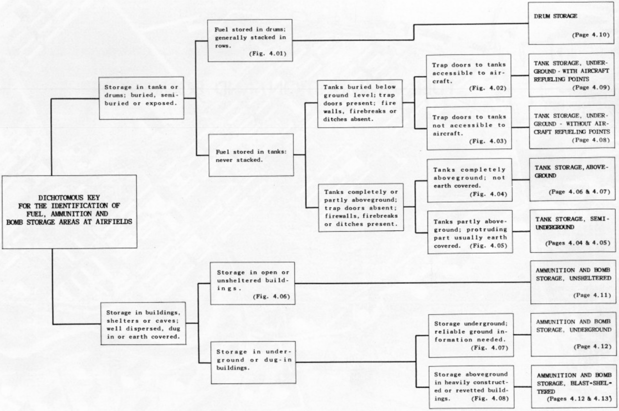

DICHOTOMOUS KEY FOR THE IDENTIFICATION OF FUEL, AMMUNITION AND BOMB STORAGE AREAS AT AIRFIELDS
Storage in tanks or drums; buried, semi-buried or exposed.
Fuel stored in drums; generally stacked in rows. (Fig. 4.01)
DRUM STORAGE (Page 4.10)
Fuel stored in tanks: never stacked.
Tanks buried below ground level; trap doors present; fire walls, firebreaks or ditches absent.
Trap doors to tanks accessible to aircraft. (Fig. 4.02)
TANK STORAGE, UNDERGROUND - WITH AIRCRAFT REFUELING POINTS (Page 4.09)
Trap doors to tanks not accessible to aircraft. (Fig. 4.03)
TANK STORAGE, UNDERGROUND - WITHOUT AIRCRAFT REFUELING POINTS (Page 4.08)
Tanks completely or partly aboveground; trap doors absent; firewalls, firebreaks or ditches present.
Tanks completely aboveground; not earth covered. (Fig. 4.04)
TANK STORAGE, ABOVEGROUND (Page 4.06 & 4.07)
Tanks partly aboveground; protruding part usually earth covered. (Fig. 4.05)
TANK STORAGE, SEMI-UNDERGROUND (Pages 4.04 & 4.05)
Storage in buildings, shelters or caves; well dispersed, dug in or earth covered.
Storage in open or unsheltered buildings. (Fig. 4.06)
AMMUNITION AND BOMB STORAGE, UNSHELTERED (Page 4.11)
Storage in underground or dug-in buildings.
Storage underground; reliable ground information needed. (Fig. 4.07)
AMMUNITION AND BOMB STORAGE, UNDERGROUND (Page 4.12)
Storage aboveground in heavily constructed or revetted buildings. (Fig. 4.08)
AMMUNITION AND BOMB STORAGE, BLAST-SHELTERED (Pages 4.12 & 4.13)


FIG. 4.01 Drum storage. Scale 1:1,750

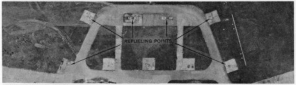
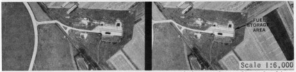



FIG. 4.02 Tank storage, underground — with aircraft refueling points. Scale 1:2,300




Scale 1:6,000

FIG. 4.03 Tank storage, underground — without aircraft refueling.

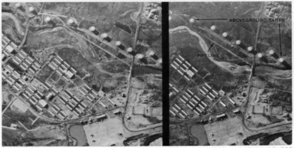



FIG. 4.04 Tank storage, aboveground. Scale 1:10,000

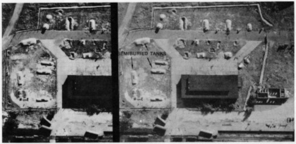



FIG. 4.05 Tank storage, semiunderground. Scale 1:1,600

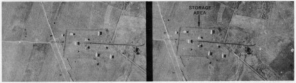



FIG. 4.06 Ammunition and bomb storage, unsheltered. Scale 1:8,200


FIG. 4.07 Ammunition and bomb storage, underground. Scale 1:7,100

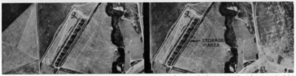



FIG. 4.08 Ammunition and bomb storage, blast-sheltered. Scale 1:12,000

## Tank Storage, Semiunderground

In 1952 fuel dumps of semiburied tanks were in general use at the important Soviet airfields in Europe. This fuel storage was a reserve supply to be used in case of delay in normal delivery by railroad tank car. The tanks were a part of the organizational equipment belonging to a particular flight unit. Should a flight unit move from one airfield to another, fuel storage tanks from the old dump would be moved to the new location. This fact made it possible to detect the moves of flight units into and out of airfields. Also, the number and size of tanks gave a clue to the size of the unit. It appeared that each fighter or light bomber "regiment" (approximately 30 planes) required storage for roughly 150,000 gallons of fuel.

### RECOGNITION FEATURES

Always present:
1. Located on perimeter or adjacent to airfield.
2. Tanks partially buried.
3. Tanks in horizontal position.
4. Service road to storage area.
5. Service openings on top of tanks.

Usually present.
6. Earth covering on tanks.
7. Ditch surrounding area.
8. Fence surrounding area.
9. Plowed firebreak surrounding area.
10. Railroad siding nearby.
11. Overhead pipe lines.
12. Storage-type building in area.
13. Fuel trucks and fuel drums in area.

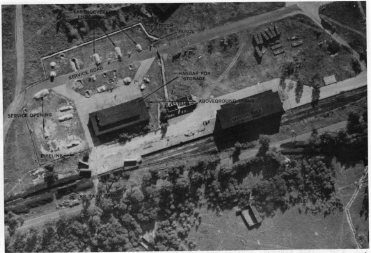



FIG. 4.09 Soviet semiunderground tank storage area. (See Figs. 4.10 - 4.12) Germany. Scale 1:1,600

FIG. 4.10 Fuel storage area shown in Fig. 4.09. Ditch and earth-covered tanks are distinctive at this scale. Scale 1:19,500

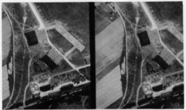


FIG. 4.11 Fuel storage area shown in Fig. 4.09. Scale 1:9,700

FIG. 4.12 Fuel storage area shown in Fig. 4.09. Scale 1:3,200


FIG. 4.13 Scale 1:9,000

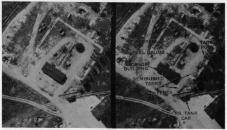



FIG. 4.14 Scale 1:1,600

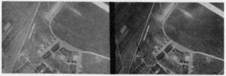


FIG. 4.15 Scale 1:22,000

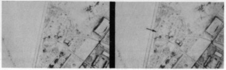


FIG. 4.16 Scale 1:10,000

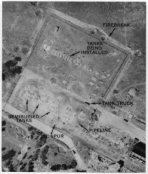



FIG. 4.17 Scale 1:2,300

Soviet semiunderground tank storage areas in Germany.

Note:

FIG. 4.13 Firebreak and loop road.

FIG. 4.14 R.R. tank car. Service openings are visible on tops of storage tanks.

FIG. 4.15 Storage area shown in preceding photo. Positive identification impossible at this scale.

FIG. 4.16 Storage area shown in preceding photo. Note snow cover.

FIG. 4.17 Small tanks being installed.

FIG. 4.18, 4.19 and 4.20 Most recognition features listed on page 4.04 can be easily recognized.

FIG. 4.21 Pipelines from R.R. siding to tops of tanks.

FIG. 4.18 Oblique stereopair

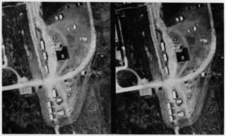


FIG. 4.19 Scale 1:2,300

FIG. 4.20 Scale 1:12,000


FIG. 4.21 Oblique stereopair

Aboveground tank storage systems are found on many airfields throughout the world. The installations may vary from large tank farms to nothing more than one or two exposed tanks.

(a) Installations with a large storage capacity are generally located near the airfield. These large fuel dumps have a piping system to bring the fuel to the airfield.

(b) Small installations of several storage tanks are located on the airfield. These simple storage systems seldom have elaborate piping facilities. Usually, fuel is pumped directly from the tanks into tank trucks.

In most cases, the exposed fuel storage tanks are easily identified on operational-scale photography. Small tanks located in the airfield building complex or camouflaged tanks are sometimes difficult to detect. Photographic cover showing refueling of tank trucks or filling of storage tanks is helpful in locating these storage areas.

RECOGNITION FEATURES

1. Tanks above ground in vertical or horizontal position.
2. Firebreak or firewall usually surrounds each tank.
3. Railroad or water transportation facilities nearby.
4. Service road to storage area.
5. Pipelines often present in storage area.
6. Tank trucks frequently in area.

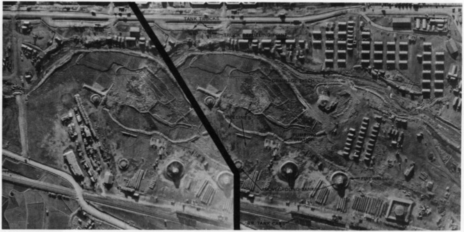



FIG. 4.22 Aboveground tank storage system in South Korea. Tanks camouflaged with netting. Scale 1:4,600


FIG. 4.23 Aboveground tank storage system in U.S.S.R. (False stereo from duplicate vertical photographs used for added clarity) Scale 1:12,000

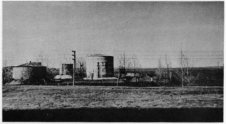


FIG. 4.24 Aboveground tank storage installation adjacent to airfield in U.S.S.R.

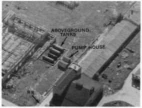



FIG. 4.25 Aboveground tank storage installation. (See Fig. 4.28) Oblique

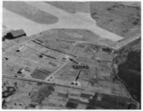



FIG. 4.26 Aboveground fuel storage tanks. (See Fig. 4.29)

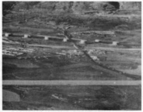


FIG. 4.27 Fuel storage tanks. (See Fig. 4.30) Oblique

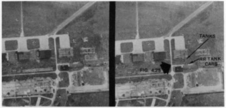



FIG. 4.28 Tank storage installation shown in Fig. 4.25. Austria. Scale 1:10,000

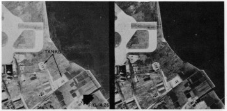



FIG. 4.29 Fuel tanks shown in Fig. 4.26. Japan. Scale 1:15,000


FIG. 4.30 Tank farm shown in Fig. 4.27. Pipeline to airfield. Greenland. Scale 1:10,000

FIG. 4.31 Aboveground tank storage system adjacent to airfield in South Korea. Scale 1:10,000


FIG. 4.32 Two aboveground fuel storage tanks at edge of airfield in U.S.S.R. False stereo. Scale 1:14,000

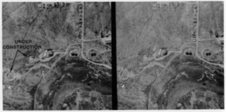



FIG. 4.33 Aboveground fuel tanks adjacent to airfield. Tank foundations and firebreaks under construction. Alaska. Scale 1:10,000

## Tank Storage, Underground - without aircraft refueling points

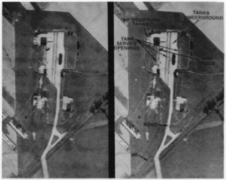



FIG. 4.34 Elaborate underground tank storage area in Sovzone, Germany. Scale 1:3,500


FIG. 4.35 Storage area shown in Fig. 4.34. Two railroad tank cars are on spur track. Oblique stereopair

FIG. 4.36 Storage area shown in Fig. 4.34. Scale 1:20,000


FIG. 4.37 Underground tank storage area adjacent to hangar area. Six tank cars on railroad siding. Scale 1:9,700


FIG. 4.38 Underground tank storage area shown in Fig. 4.37. Note tank trucks in the area. Scale 1:10,700

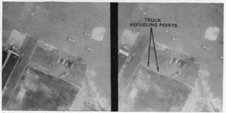



FIG. 4.39 Tank truck refueling points for storage area shown in Fig. 4.37 are visible on this scale of photography. Scale 1:2,600

An underground tank storage installation may be a complex system of buried tanks, pipes, and pumps or nothing more than several buried tanks. The more elaborate installations are usually located on important, permanent civil or military airfields. Less complex installations have been reported on some of the North Korean airfields.

Underground fuel storage systems are difficult to detect, since the identifying features that appear on air photographs are inconspicuous. Many times, photographic cover which shows refueling of tank trucks or filling of storage tanks furnishes the only clues to the location of the storage area.

### RECOGNITION FEATURES

1. Storage area located near hangars or adjacent to airfield.
2. Frequently concrete, asphalt or gravel surface above tanks.
3. Access road to storage area.
4. Tank-truck refueling points and tank-filler openings.
5. Railroad or water transportation facilities nearby.
6. Tank trucks frequently in the area.
7. Railroad tank cars, oil barge or tanker often nearby.

Underground tank storage installations with aircraft refueling points are generally located at the more important civil and military airfields. This type of fuel storage system was used at many of the German airfields during World War II. It is likely that the Soviets are using these fuel storage facilities on the German airfields which they occupy.

The refueling points are pits which house a pump and hose. Hinged covers over the pits are flush with ground level when closed. Usually, fuel storage tanks are buried beneath these pits. Refueling installations may be an elaborate "ladder type" servicing area (Fig. 4.41), a "refueling loop" (Fig. 4.42), or isolated refueling points (Figs. 4.43 and 4.44).

Photographic cover showing refueling of aircraft or filling of tanks is helpful in locating such storage areas, which, by their inconspicuous nature, are difficult to detect.

RECOGNITION FEATURES

1. Located on perimeter of landing area or on servicing apron.
2. Refueling points at ground level.
3. Frequently, railroad serves the area.
4. Tone of ground surface above tanks often differs from surrounding area.
5. Tank trucks frequently in area.
6. Aircraft being refueled.

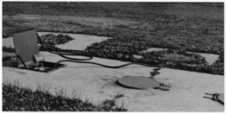


FIG. 4.40 Aircraft refueling point. Trap door on pit is open. U.S.A.

FIG. 4.43 Isolated aircraft refueling points. Trap door open on one pit and tank truck parked alongside another. Sovzone, Germany. Oblique

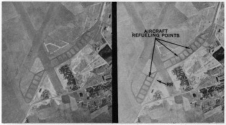



FIG. 4.41 "Ladder type" refueling installation in Germany. Railroad spur services the area. Scale 1:12,000

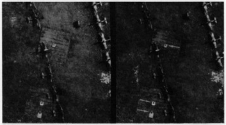


FIG. 4.44 Isolated aircraft refueling points. Note photographic tone and texture over buried tanks. Sovzone, Germany. Scale 1:1,600

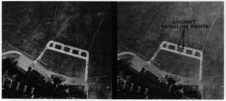



FIG. 4.42 "Loop type" refueling installation. Sovzone Germany. Scale 1:10,000

FIG. 4.45 Aircraft refueling points on servicing apron. Sovzone, Germany. Scale 1:2,000

FIG. 4.46 Fuel drums stored in revetments. USAF, Korea. Oblique

FIG. 4.50 Drum storage shown in Fig. 4.46 taken from the opposite direction. Oblique

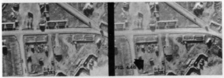



FIG. 4.47 Drum storage shown in Fig. 4.46. Scale 1:3,200


FIG. 4.51 Drum storage shown in Fig. 4.46. Scale 1:6,000


FIG. 4.48 Fuel drums in a Soviet fuel storage area. Sovzone, Germany. Oblique stereopair


FIG. 4.49 Fuel drums shown in Fig. 4.48. Scale 1:1,800

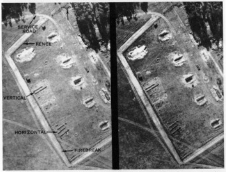



FIG. 4.52 Fuel drums stacked in vertical and horizontal positions. Sovzone, Germany. Scale 1:2,300

Generally, drums are used for oil storage and may be found in most fuel storage areas. They are also used for storage of aviation fuel at temporary or emergency airfields, whereas those fields capable of supporting more sustained flight operations are provided with the systems previously considered.

Fuel drums are difficult to detect on air photographs with scales of 1:5,000 or smaller. The drums may be stored in the open, in revetments, in buildings or in caves. In North Korea fuel drums have been stored in caves adjacent to airfields. Positive identification of drums stored under cover is impossible without reliable ground information or photographs showing fuel drums being moved into or out of such storage areas.

## RECOGNITION FEATURES

1. Fuel drums usually stacked horizontally.
2. Storage area located on perimeter of or adjacent to airfield.
3. Service road to area.
4. Fence and firebreak often surround area.

Ammunition and bomb-storage installations unsheltered from blast may be well-developed areas with one or several warehouse-type storage units served by good roads, or nothing more than an isolated area where ammunition and bombs are stored in the open. The more elaborate installations are located at permanent, well-equipped military airfields. Generally these storage areas are easily identified on operational-scale air photographs. Undeveloped storage areas are found at temporary or more advanced military airfields not having complete aircraft servicing facilities. Areas where ammunition and bombs are stored in the open are difficult to detect on air photographs.

Unsheltered buildings are used for storing unfused bombs and ammunition. Fuses, initiators or sensitive explosives are usually stored in blast shelters or small isolated sheds.

RECOGNITION FEATURES

1. Located in isolated areas adjacent to airfield (often wooded areas).
2. Open storage indicated by widely spaced stacks of bombs or ammunition cases.
3. Low, single-storied buildings of uniform appearance.
4. Buildings usually evenly spaced and well separated.
5. Firebreak and fence usually surround the area.
6. Service road from storage area to airfield.
7. Often one or more blast shelters or small, isolated sheds in area.

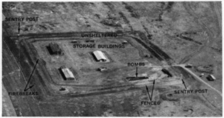



FIG. 4.53 Soviet ammunition and bomb storage area adjacent to airfield in Austria. Oblique

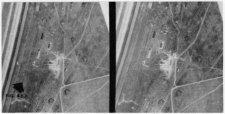



FIG. 4.54 Ammunition and bomb storage area shown in the preceding photo. Scale 1:10,500


FIG. 4.55 Ammunition and bomb storage at a Soviet airfield. Scale 1:22,000

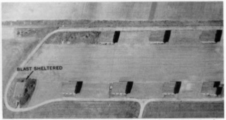



FIG. 4.56 Ammunition and bomb storage area at airfield in Austria. Note blast-sheltered storage unit on left. Oblique

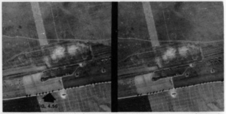



FIG. 4.57 Ammunition and bomb storage area shown in the preceding photo. Scale 1:10,000

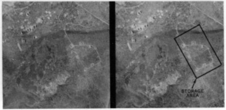



FIG. 4.58 Ammunition and bomb storage at a Soviet airfield. Scale 1:13,000

## Ammunition and Bomb Storage, Underground

FIG. 4.59 Cave entrances in hills adjacent to airfield in North Korea. Scale 1:9,500

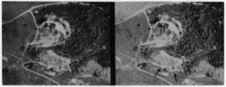


FIG. 4.60 Cave entrances to underground storage at airfield in North Korea. Scale 1:6,000


FIG. 4.61 Same area shown in Fig. 4.60 at a time when the caves were under construction. Note spoil bank in front of entrances and tracks in snow. Scale 1:13,000

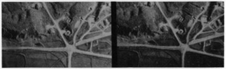


FIG. 4.62 Cave entrances, aircraft revetments, and revetted building in hills adjacent to airfield in North Korea. Scale 1:5,000

Ammunition and bombs are occasionally stored in complex underground installations or in simple caves. Positive identification of this type of storage is impossible without reliable ground information or photographic cover showing ammunition or bombs being moved into or out of the underground structures.

It is reported that the Communist forces in North Korea frequently store ammunition and bombs in caves adjacent to the airfields.

### RECOGNITION FEATURES

1. Located in isolated areas adjacent to airfield.
2. Entrance to caves or underground structures.
3. Service road from entrances to airfield.
4. Ammunition and bombs being moved into or out of underground entrances.

## Ammunition and Bomb Storage, Blast-Sheltered

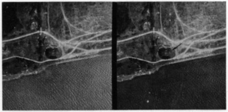


FIG. 4.63 Large, earth-covered, reinforced concrete, ammunition and bomb storage unit on perimeter of North Korean airfield. Scale 1:6,000

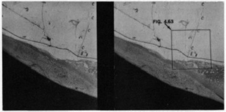
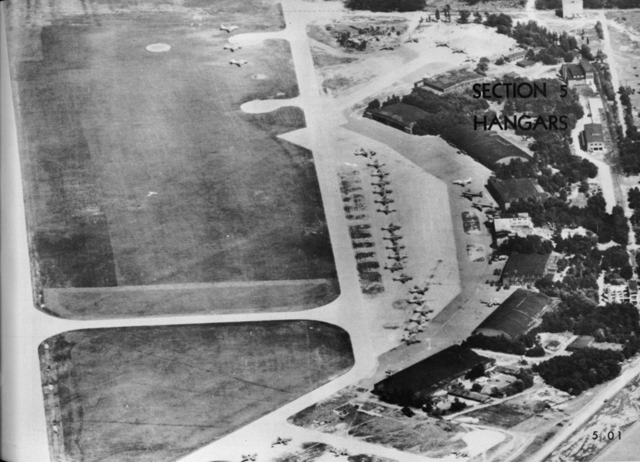



FIG. 4.64 Ammunition and bomb storage unit shown in preceding photo. Note snow conditions. Scale 1:13,500

FIG. 4.65 Earth-covered, reinforced concrete, ammunition and bomb storage units in aircraft dispersal area at North Korean airfield. Scale 1:6,000


SECTION 5
HANGARS

Hangars are usually found on permanent civil or military airfields. Auxiliary or emergency airfields seldom have them, but, if present, they are used chiefly for aircraft maintenance and repair and occasionally for storage of supplies or aircraft.

Normally, hangars can be recognized on photographs as the largest buildings located in close proximity to the landing area. In most cases they face an apron. There is a wide variety of sizes and types, but in general they all have a large barn-like appearance. The multiple-bay type, although distinctive in shape, is nothing more than a series of connected hangars. Often, wings and lean-to sheds are attached to the main structure.

Hangars are classified according to the length of the side with doors:

| | |
|---|---|
| Small | - under 100 ft. |
| Medium | - 100 to 200 ft. |
| Large | - 200 to 300 ft. |
| Very large | - over 300 ft. |

Any building wings attached to the front of the hangar are included in the measurement. Classification of a multiple-bay hangar is not determined by over-all length but by the length of the individual bay.

## RECOGNITION FEATURES

Primary:
1. Large buildings, usually of sufficient size to accommodate the type of aircraft commonly using the field.
2. Located on perimeter of landing area.
3. Frequently has hard-surfaced hangar apron in front.

Secondary:
4. Usually a part of or near the airfield building complex.
5. Entrance facing or easily accessible to landing area.
6. Doors usually located on longer side.
7. Sliding, folding or overhead doors are at ground level.
8. Aircraft often parked in doorway or on hangar apron.
9. Buildings usually grouped together in some orderly arrangement.
10. Hangar design often repeated on a given field.

## HANGARS IN SOVZONE, GERMANY

Many airfields of German construction now occupied by the Soviets are equipped with complete hangar facilities. Generally, there are two or three sizes on each field. Within each size class those on individual fields are usually of the same type. The only uniform design common to numerous fields is the standard repair hangar which measures 420 by 164 feet and has a large wing projecting from either side (See Fig. 5.01). The Soviets have repaired some of the German hangars, but up to 1952 no new hangar construction was reported in this Zone.

## HANGARS IN U.S.S.R.

During World War II there was a wide variety of hangar sizes and designs in the U.S.S.R. However, the facilities at individual fields were much less complete than those found on fields of German construction. The Soviets had several types in the small and medium classes that were of standard design. (See pages 5.07 and 5.08)

A variety of construction materials was used by the Soviets. In the northern forest regions many of the smaller hangars were built of wood. In the treeless steepes, steel and concrete or brick construction was more common. Only occasionally was a concrete apron laid in front of the hangar.

The Soviets often used hangars for storage of supplies as well as for maintenance and repair, but seldom for storage of aircraft.

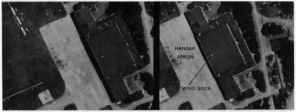



FIG. 5.01 German standard repair hangar of the "very large" class (420' x 164') of World War II construction. Scale 1:2,500

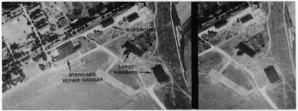



FIG. 5.02 German standard repair hangar and other "large" repair hangars. Scale 1:8,400


FIG. 5.03 Hangars shown in Fig. 5.02. Note that hangars are easily recognized on this scale of photography. Scale 1:21,000


FIG. 5.04 "Very large" hangars (650' x 155' and 740' x 110'). "Large" hangar (285' x 100'). Scale 1:11,000


FIG. 5.05 Two "very large" hangars (350' x 130'); three "large" hangars (270' x 70'). Scale 1:10,000

FIG. 5.06 Hangars shown in Fig. 5.05. Note lean-to extension for work benches and tools on back of the "very large" hangar.

FIG. 5.07 "Very large" German hangars. Note that sliding doors are built to open at ground level.

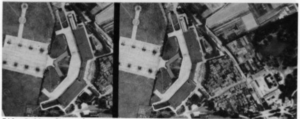


FIG. 5.08 "Very large" hangars (440' x 135') shown in Fig. 5.07. Scale 1:8,000


FIG. 5.09 Hangars shown in Fig. 5.08 are easily recognized at considerably reduced scale. Scale 1:24,000

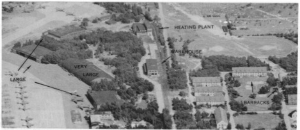



FIG. 5.10 "Very large" and "large" hangars. Observe small wings on sides for sliding doors.


FIG. 5.11 "Very large (360' x 135') and "large" (210' x 135') hangars shown in Fig. 5.10. Scale 1:10,500


FIG. 5.12 Hangars shown in Fig. 5.10 Note that those in same size group have identical design. Scale 1:19,000


FIG. 5.13 "Large" German hangars (290' x 165'). Hangar at upper right is totally destroyed. Scale 1:10,000


FIG. 5.14 Hangars shown in Fig. 5.13 are recognizable at greatly reduced scale. Scale 1:25,000

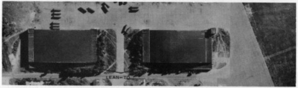



FIG. 5.15 Hangars shown in Fig. 5.13. Note lean-to on rear of each hangar for work benches and tools. Scale 1:2,500


FIG. 5.16 "Small" (90' x 70'), "medium" (160' x 140') and "very large" (640' x 160') hangars. Germany. Scale 1:20,000

FIG. 5.17 "Medium" German hangar (170' x 105'). Scale 1:2,100

FIG. 5.18 Hangar shown in Fig. 5.17. Scale 1:10,000

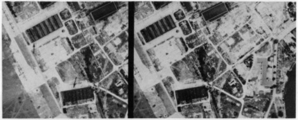


FIG. 5.19 "Very large" German hangars (380' x 175' and 420' x 180') with monitor-type roof. Such types are frequently used for aircraft assembly. Scale 1:7,400

FIG. 5.20 Hangars shown in Fig. 5.19. Scale 1:20,000

FIGS. 5.21 and 5.22
Two "large" hangars (280' x 170') on an important airfield in U.S.S.R. Note space in side wings for work shops and offices.

FIG. 5.23
Two of the "medium" size hangars shown in Fig. 5.24.

FIG. 5.24
One "large" and 5 "medium" hangars on a military airfield in U.S.S.R. Note that hangar at lower right has a large wing projecting from one side.

FIG. 5.25
Three of the "medium" size hangars shown in Fig. 5.24).

FIG. 5.26
"Large" hangar of steel and concrete construction on civilian airfield in U.S.S.R.

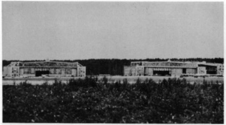


FIG. 5.21

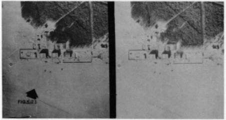



FIG. 5.22 Scale 1:22,000

FIG. 5.23

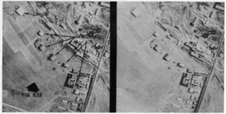



FIG. 5.24 Scale 1:18,000

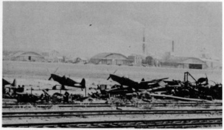


FIG. 5.25

FIG. 5.26

Hangars shown in Figs. 5.27 - 5.30 were commonly found on Soviet military fields during World War II. Size and construction details are somewhat varied, but general design is the same. Distinctive features are the flat gambrel roof, doors at both ends and small projections at each corner to accommodate sliding doors.

Multiple-bay hangars shown in Figs. 5.30 and 5.31 were also a standard design found on many military airfields. The individual bays, as a rule, are 110 by 180 feet and usually are built in multiples of two or three. They have an arched roof and doors at both ends.

Hangarettes shown in Figs. 5.32 and 5.33 are similar to the multiple-bay hangars but are much smaller. Usually they are found in multiples of five. Six of these units housed a Soviet fighter "regiment" of 30 planes. It has been reported that this type is becoming obsolete. For an additional illustration of hangarettes see Fig. 3.66.

FIG. 5.27 "Medium" military hangar having doors at both ends and a flat gambrel roof.

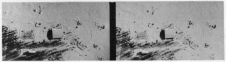


FIG. 5.28 "Medium" military hangar (185' x 185') similar to that in Fig. 5.27. Scale 1:11,500

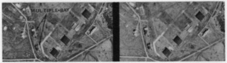



FIG. 5.29 "Medium" military (175' x 140') and "small" multiple-bay hangars. Scale 1:12,500

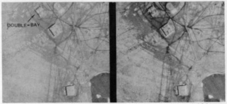



FIG. 5.30 "Medium" double-bay and "medium" military hangars (195' x 240'). The latter, though larger in size, have the same design as those shown in Fig. 5.29. Scale 1:15,000

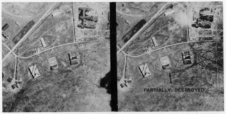



FIG. 5.31 "Medium" triple-bay hangars. Scale 1:15,000

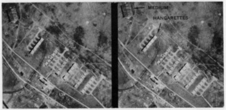



FIG. 5.32 Group of 30 hangarettes partially destroyed. Such a group accommodated one Soviet fighter "regiment". Scale 1:12,000

FIG. 5.33 Destroyed hangarette units being converted to aircraft revetments. Scale 1:9,300

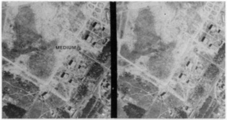



FIG. 5.34 Scale 1:20,000


FIG. 5.35 Scale 1:17,000

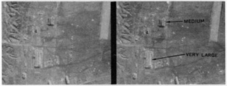



FIG. 5.36 Scale 1:15,000

FIG. 5.37 Scale 1:42,000

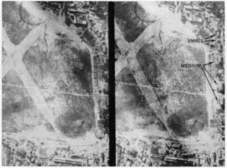



FIG. 5.38 Scale 1:19,000


FIG. 5.39 Scale 1:8,000

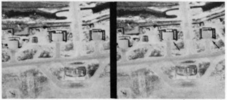


FIG. 5.40 Scale 1:5,000

FIG. 5.34 Standard-type hangars occasionally observed on Soviet fields. They are approximately 200' x 130', have a shed-type roof and are usually arranged in regular groups.

FIG. 5.35 A dirigible hangar. Although seldom found, these are used primarily to house captive balloons used at parachute jump training and barrage balloon training centers.

FIG. 5.36 The "very large" (400' x 180') and "medium" (180' x 110') hangars are located at an aircraft test field. The monitor-type roofs are not common.

FIG. 5.37 On exceptionally small scale photography, hangars can be easily distinguished in the airfield complex even under snow conditions.

FIG. 5.38 A variety of hangars can be seen on this large Soviet field which was built primarily for civil use.

FIG. 5.39 Hangars on a civil field in one of the former Baltic States. Construction differs noticeably from that of Soviet types.

FIG. 5.40 "Small" revetted hangars (80' x 65' and 90' x 70') located on a civilian field (Baltic area).

# SECTION 6
# OTHER BUILDINGS

# OTHER BUILDINGS

Airfields vary in their building developments from fields with no buildings to those with large and complex establishments. In general, all airfield building developments are characterized by the presence of certain functional-type structures of more or less standard design which follow such basic patterns of arrangement as the nature of airfield operations may require. The permanency and capabilities of an airfield are deducible in large measure from the number, size, types and construction of the buildings.

A field equipped with a limited number of structures and few, if any, hangars would indicate that use is limited to refueling and emergency repair. Many such fields without any buildings. were typical of Communist operations both in World War II and in the Korean conflict.

At the other extreme is the extensively developed airfield which usually can be considered a permanent major air facility. Such fields generally are equipped to handle not only the routine servicing of heavy air traffic but also extensive repairs.

The extent and nature of airfield building developments are determined by a number of factors such as:

1. Size of airfield.
2. Number and type of aircraft to be accommodated.
3. Extent of aircraft services — fuel and repair.
4. Extent of personnel services — billeting, recreation etc.
5. Type of use — civilian, military, training etc.
6. Protection from hostile action.
7. Permanence of field.
8. State of completion.
9. Proximity to community facilities — housing, messing, storage etc.
10. Availability of construction materials.
11. Climate.
12. Architectural and other cultural customs of the country.

Although some buildings are difficult to identify on aerial photography, several types have relatively well-defined recognition features. In addition to hangars (covered in Section 5), the types of buildings most commonly encountered on airfields are those used for headquarters, barracks, warehouses and motor vehicle storage. This section covers recognition of these four main types and other buildings of diverse but identifiable uses.

## HEADQUARTERS BUILDINGS

Headquarters buildings provide working space and facilities for personnel engaged in two major airfield functions — administration and air operations. Administration is responsible for management and logistics. Air operations handles air traffic and safety control and makes use of such facilities as radio, navigational aids and weather stations.

The two functions, administration and air operations, may be handled in one or several buildings. On lesser fields both functions frequently are carried on in the same building.

The operations headquarters is usually a permanent building, although on some fields mobile stations are used. Permanent buildings are relatively easy to identify because of prominent location and distinctive features, while mobile stations, due to insignificant size and changing position, are difficult to detect.

Buildings used specifically for administration have no design indicative of function. The features listed below should assist in identification.

### RECOGNITION FEATURES

#### ADMINISTRATION BUILDING

Primary:
1. Always is part of airfield building complex.
2. Building is often the most elaborate on the field.
3. Building may differ in construction from other buildings; is frequently of multistory and multiwing design.
4. Surrounding grounds are generally the best or only landscaped area on the field.

Secondary:
5. Location is ordinarily along the main road within the field.
6. Loop-driveway approach may be used.
7. Hard-surfaced motor vehicle parking area is often nearby.

#### AIR OPERATIONS BUILDING

Primary:
1. Generally is on perimeter of landing area.
2. Usually is part of airfield building complex.
3. A control tower having full view of landing area is usually in evidence.
4. Control tower frequently is located on corner of a hangar.

Secondary:
5. Radio masts and windsocks are commonly on the roof or nearby.
6. Weather instrument enclosure may be near by.
7. A cabin-top tower is often used.
8. Building area may be landscaped.


FIG. 6.01 Air operations building and facilities on perimeter of landing area at large well-developed airfield in Sovzone, Germany. Oblique stereopair


FIG. 6.02 Building and facilities shown in Fig. 6.01. Scale 1:6,300


FIG. 6.03 Administration building on large airfield in Sovzone, Germany. Note multistoried building, elaborate landscaping and loop driveway with parking area. Oblique stereopair

FIG. 6.04 Administration building shown in Fig. 6.03. Scale 1:10,000

FIG. 6.05

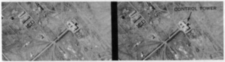


FIG. 6.06 Scale 1:18,000

FIG. 6.07 Scale 1:15,000

FIG. 6.08 Scale 4,800

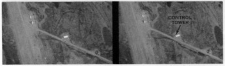


FIG. 6.09 Scale 1:7,500

FIG. 6.10

FIG. 6.11 Scale 1:8,500

FIG. 6.12 Oblique stereopair

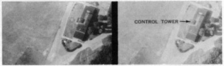


FIG. 6.13 Scale 1:2,500

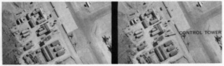


FIG. 6.14 Feb. 1952 Scale 1:4,400

FIG. 6.05 Headquarters building with control tower at large well-established Soviet airfield.
FIG. 6.06 Large Soviet headquarters building and control tower overlooking field. Note multiwing design, landscaping, location at end of main road and vehicle parking space.
FIG. 6.07 Soviet operations building and control tower on perimeter of landing area.
FIG. 6.08 Control tower on large hangar. Alaska.
FIG. 6.09 Control tower may be set back from landing area when there is nothing to obstruct view. Alaska.
FIG. 6.10 Operations shack with control tower constructed on large and important German airfield by the Soviets to replace bombed-out facilities.
FIG. 6.11 Facilities shown in Fig. 6.10.
FIG. 6.12 Control tower on corner of hangar. Note radio masts. Sovzone, Germany.
FIG. 6.13 Control tower on headquarters building. Note wind sock on roof. Sovzone, Germany.
FIG. 6.14 Control tower independent of buildings. Checkered roof shows pilots the location of tower. Shadows are frequently useful as an indication of tower height and shape. USAF, Korea.
FIG. 6.15 Operations building of post-war construction. U.S.S.R.

FIG. 6.15 U.S.S.R. April 1952

## PERSONNEL QUARTERS

Airfield personnel are housed either on airfields in specially constructed facilities or in nearby communities.

Quarters provided on airfields are usually barracks-type buildings. Such barracks on the large, well-developed fields, especially near urban areas, are frequently permanent, 2- or 3-storied masonry buildings with a central heating system and extensively landscaped surroundings. Those on the smaller, more remote fields are generally single-storied buildings of light construction, without central heating and with little evidence of landscaping.

Tents are often used as temporary housing, particularly on new airfields where barracks have not been constructed. It has been noted that the Soviets make extensive use of tents to house antiaircraft crews in the vicinity of their emplacements.

Prior to 1952 no conventional barracks-type buildings were observed on Korean fields constructed by Communist forces. Apparently, airfield personnel were housed in nearby towns or farm dwellings.

## RECOGNITION FEATURES

Primary:

1. Usually part of airfield building complex.
2. Barracks-type buildings most common.
3. Barracks grouped in systematic order rather than interspersed among other airfield buildings.
4. Usually not more than one or two building designs found in any barracks area.
5. Length of barracks or wings usually from two to five times the width.
6. Buildings seldom more than 50 feet wide.

Secondary:

7. Individual barracks having wings may be H-shaped, L-shaped, or T-shaped.
8. Barracks may be single or multistoried but seldom exceed three stories.
9. Roofs gabled, hipped, arched or shed types; sometimes dormered.
10. Sidewalks often present.
11. Some landscaping may be evident.
12. Outdoor recreation facilities such as volleyball courts, soccer fields or swimming pools may be in or near barracks area.

FIGS. 6.16 - 6.19 Substantial multistoried barracks on important and well-developed airfields in the U.S.S.R.


FIG. 6.16 Scale 1:19,000


FIG. 6.17 Scale 1:15,000


FIG. 6.18 Scale 1:12,300

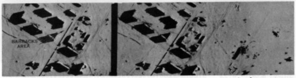



FIG. 6.19 Scale 1:12,500

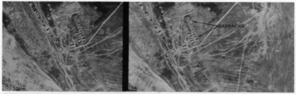



FIG. 6.20 Scale 1:13,000


FIG. 6.21 Scale 1:13,000

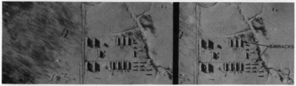



FIG. 6.22 Scale 1:15,000

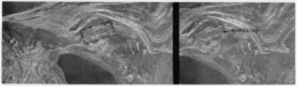



FIG. 6.23 Scale 1:12,500

FIGS. 6.20 - 6.23 Single-storied barracks of relatively light construction on less important and more remote airfields in the U.S.S.R.

FIG. 6.24 Single-storied T-shaped barracks and other buildings for enlisted personnel at large airfield in Alaska. Two front wings of each barracks are of Quonset-type construction. Scale 1:4,800

FIG. 6.25 Multiwing personnel quarters at airfield in Newfoundland. Scale 1:6,000

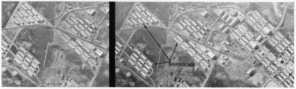



FIG. 6.26 Barracks without wings. Greenland. Scale 1:10,000


FIG. 6.27 Quonset barracks at airfield in Alaska. Scale 1:10,000

FIG. 6.28 Buildings shown in Fig. 6.27. Smaller Quonset huts are barracks, the larger huts serve as mess hall, PX, etc.


Stereogram insert. Scale 1:20,000

FIG. 6.29 Annotations show features which are fairly typical of personnel facilities in the Soviet zone of Germany. Buildings are commonly multi-storied, of brick or stone construction and have dormered roofs. The area is well landscaped and has a neat, orderly appearance. Scale 1:1,600

FIG. 6.30 1951

FIG. 6.31 Scale 1:6,000

FIG. 6.32 Scale 1:4800

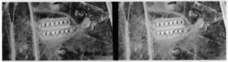


FIG. 6.33 Scale 1:2,900

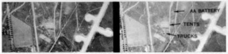



FIG. 6.34 Scale 1:10,000

FIG. 6.35


FIG. 6.36 Scale 1:7,500

FIG. 6.37 Oblique stereopair

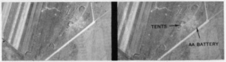



FIG. 6.38 Scale 1:10,500

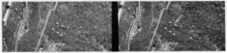



FIG. 6.39 Scale 1:12,500

FIG. 6.30 USAF personnel tents (approximately 12-man capacity) on airfield under construction.

FIG. 6.31 Tents similar to those shown in Fig. 6.30

FIG. 6.32 Square pyramidal tents and small barracks at airfield in Alaska.

FIG. 6.33 Square pyramidal tents (about 17' x 17') of the type most commonly used by Soviet AA crews. Each tent houses about four men.

FIG. 6.34 Tents shown in Fig. 6.33. Note trucks parked nearby. An AA position can be seen at top of photo.

FIG. 6.35 Large rectangular tent and three smaller square tents near a medium AA battery (see Fig. 6.36). Sovzone, Germany

FIG. 6.36 Tents shown in Fig. 6.35. Observe six-gun AA battery.

FIG. 6.37 Tents of the type illustrated in Fig. 6.33. Note six-gun AA position between groups of tents. Sovzone, Austria.

FIG. 6.38 Three of the tents shown in Fig. 6.37.

FIG. 6.39 Large tents probably used by airfield construction crew. U.S.S.R.

## STORAGE FACILITIES

Methods of storing supplies and materials (except fuel and ammunition, which are covered in Section 4), range from temporary open storage to use of permanent, specially constructed warehouses.

Temporary storage in unsheltered piles or in tents is usually found on fields under construction and where existing permanent storage facilities are insufficient. Well-established fields generally have adequate warehousing.

The extent of warehouse space necessary for a given airfield is determined in large measure by its accessibility. At airfields in large urban areas where supplies are readily obtainable, reserve stocks do not need to be held in the quantity required by those more remotely situated. For example, at Arctic fields, which depend on one or two boatloads of supplies in the short ice-free season, extensive storage facilities must be maintained.

## RECOGNITION FEATURES

### WAREHOUSES

Primary:

1. Usually part of airfield building complex.
2. Generally situated along a railroad spur if rail facilities serve airfield.
3. Buildings usually rectangular with length 2 to 5 times width.
4. Roads generally present for trucking materials to and from warehouses.
5. Evidence of considerable track activity in area.
6. Ramps frequently used for loading rail cars or trucks.

Secondary:

7. Loading ramp often has overhanging roof.
8. An apron may be in front of ramp or building entrance to permit turning and backing of trucks.
9. Piles of supplies may be found on ramp or on ground nearby.
10. Seldom landscaped.

In three theaters of Communist operations, differences have been noted in warehouse methods and facilities:

1. Soviet Germany

Many large airfields of German construction have warehousing facilities of fairly standard type. As illustrated in Fig. 6.40, these facilities are distingusihed by the following features:

a. Dimensions of approximately 180 by 55 feet.
b. Two-storied construction.
c. Very low-pitched ridge or hip roof.
d. Elevator penthouse extending a few feet above roof.
e. Location on railroad siding.
f. Arrangement for unloading rail cars directly into one side of building and for loading trucks from opposite side.
g. Overhanging roofs on each side of building to shelter loading and unloading operations.
h. Long loading ramp for trucks extends from one end of building along rail tracks.
i. Framework supporting block and tackle extends from unloading ramp across rail tracks and is used to unload flat cars.

2. U.S.S.R.

During World War II there was no apparent standardization of warehouse design within the U.S.S.R. Size of buildings and type of loading facilities varied from field to field and generally were less complete than in Germany. On aerial photographs they often resembled barracks.

3. North Korea

No conventional types of warehouses have been constructed by the North Korean forces. It appears that storage has been kept to a minimum and that use has been made of such facilities as native dwellings, revetments and caves.

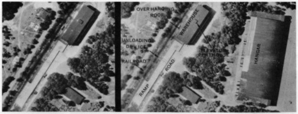



FIG. 6.40 German World War II warehouse and related facilities. Scale 1:2,600


FIG. 6.41 Warehouse facilities shown in Fig. 6.40. Sovzone, Germany. Oblique stereopair


FIG. 6.42 Warehouse facilities shown in Fig. 6.40. Sovzone, Germany. Scale 1:9,500

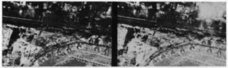


FIG. 6.43 Scale 1:12,000


FIG. 6.44 Scale 1:15,000


FIG. 6.45 Scale 1:5,000

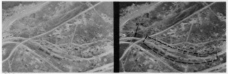



FIG. 6.46 Scale 1:13,000

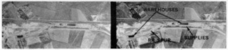



FIG. 6.47 Scale 1:15,000


FIG. 6.48 Scale 1:13,000

FIG. 6.49 Scale 1:20,000

FIG. 6.50 Scale 1:4,800

FIG. 6.51 Scale 1:6,500


FIG. 6.52 Scale 1:6,000

FIG. 6.43 Warehouse and facilities in Sovzone, Germany. Observe well-marked pattern of truck tracks in snow.

FIG. 6.44 Soviet warehouses. Presence of trucks and evidence of track activity are clues to warehouse identification.

FIG. 6.45 Four large Soviet warehouses in U.S.S.R. Fairly complete facilities include railroad, unloading platform, and hard-surfaced truck roads and aprons.

FIG. 6.46 A number of airfield warehouses along rail spur. U.S.S.R.

FIG. 6.47 Warehouses along railroad. Note supplies piled nearby. Germany.

FIG. 6.48 Warehouses on both sides of rail spur. U.S.S.R.

FIG. 6.49 Soviet storage area with four warehouses. Materials stacked in open.

FIG. 6.50 Storage and supply area showing warehouses of various sizes, unsheltered piles of supplies, rail spurs, truck roads and unloading platform. Alaska.

FIG. 6.51 Storage area with supplies deposited in the open, in aircraft revetments and in tents. South Korea.

FIG. 6.52 Unsheltered materials piled along rail spur. U.S.S.R.

## MOTOR VEHICLE STORAGE

Available information for the years up to 1948 indicates that storage facilities for motor vehicles were seldom provided on airfields in the U.S.S.R.

On fields of German construction in Sovzone, Germany, garages of more or less standard size and arrangement are generally provided for vehicle storage.

In North Korea vehicles are frequently parked in special motor vehicle revetments or aircraft revetments.

## RECOGNITION FEATURES MOTOR VEHICLE REVETMENTS NORTH KOREA

1. Measure approximately 25 by 11 feet.
2. Rectangular shape.
3. Earth-mounded walls.
4. Usually scattered singly within dispersal areas.
5. Rows of 5 to 15 revetments, spaced about 10 feet apart, may be found near AA batteries.

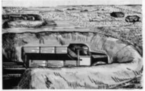


FIG. 6.53 Typical motor vehicle revetment. North Korea.


FIG. 6.54 Motor vehicle revetments near heavy AA battery in North Korea. Covering has been removed from two trucks in revetments at right.


FIG. 6.55 Motor vehicle revetments shown in Fig. 6.54. Scale 1:10,000

FIG. 6.56 Motor vehicle storage in aircraft revetments. North Korea. Scale 1:4,000


FIG. 6.57 Two motor vehicle revetments adjoining taxiway on North Korean airfield. 1:7,500

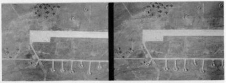


FIG. 6.58 Motor vehicle revetments shown in Fig. 6.57. Scale 1:16,500

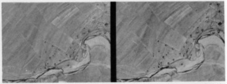


FIG. 6.59 Motor vehicle revetments, most of which are occupied. North Korea. Scale 1:10,000

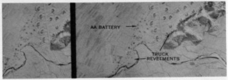



FIG. 6.60 Revetments shown in Fig. 6.59. Others may be seen at base of hill. Observe heavy AA battery. Scale 1:18,500


FIG. 6.61 Stereo-triplet of garages in Sovzone, Germany. Scale 1:2,250

FIG. 6.62 Garage (300' x 34') shown in Fig. 6.61.


FIG. 6.63 Garages shown in Fig. 6.61. Scale 1:9,000

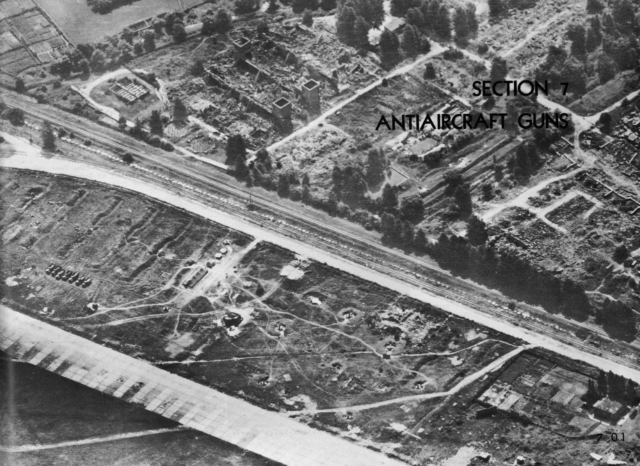
FIG. 6.64 Garages shown in Fig. 6.61. Scale 1:20,000

RECOGNITION FEATURES
GARAGES
SOVIET ZONE OF GERMANY

Primary:
1. Part of airfield building complex.
2. Generally single-storied.
3. Individual buildings are long and narrow.
4. Each garage generally has a width approximating either 35 or 50 feet.
5. Usually a U-shaped arrangement of three buildings with a fourth sometimes placed to form a quadrangle.
6. Repair shop with monitor roof frequently forms one end of a quadrangular building arrangement or is close by.

Secondary:
7. Occasionally an open shed-type building within the garage area is used for additional storage.
8. Courtyard formed by buildings may be hard-surfaced; frequently has landscaped islands.
9. Refueling facilities generally present.
10. Grease pit or ramp sometimes present.
11. Gate often at entrance to courtyard.
12. Occasionally a hard-surfaced apron is present.
13. Doors at courtyard or apron level.
14. "Doorstops" sometimes visible.
15. Well-developed track pattern may be evident.
16. Motor vehicles may be seen moving in or out of buildings or parked close by.

# SECTION 7
# ANTIAIRCRAFT GUNS



## General Features

Conventional antiaircraft artillery is divided into two basic categories:

Heavy guns - antiaircraft of 75-mm. or heavier.

Automatic weapons - antiaircraft less than 75-mm.

Heavy guns are designed primarily for defense against high level bombardment, while automatic weapons are designed to combat high speed, low level aerial operations. Both classes of antiaircraft are highly mobile and are deployed to meet the requirements of the battle situation.

Photo interpreters seldom have trouble locating antiaircraft batteries because of their characteristic layout when emplaced for firing. The heavy antiaircraft battery normally consists of 4, 6, or 8 guns in circular revetments with a fire control station nearby. Automatic weapons generally are emplaced in circular or diamond-shaped revetments and may occur singly or in groups of four or more. This type of antiaircraft seldom uses a separated fire control station.

Antiaircraft guns are usually located on or near the airfield in a commanding position, affording an all-around field of fire. Heavy guns are frequently located on or in close proximity to the probable bomb release line. Location of automatic weapons varies from placement on or immediately adjacent to the object defended to a widely dispersed pattern around the airfield.

In 1952 the following guns formed the foundation of the Soviet antiaircraft defenses:
85-mm. heavy antiaircraft gun
37-mm. automatic antiaircraft gun
12.7-mm. antiaircraft machine gun
These guns are standard in the Soviet antiaircraft divisions and have been supplied in quantity to virtually all Satellite Nations.

The standard Soviet antiaircraft fire control unit consists of a PUAZO-3-type electro-mechanical gun director, a DYA-type height-range finder, a gun-laying radar which is a modification of the U.S. SCR-584, and a portable power plant.

For more details see "The Photographic Interpretation Manual on Soviet Weapons and Vehicles" (USAF 1952).

FIG. 7.01 Soviet 85-mm. heavy AA gun.

FIG. 7.02 AA PUAZO-3 gun director.

FIG. 7.03 Soviet 37-mm. automatic AA gun.

FIG. 7.04 AA DYA height-range finder.

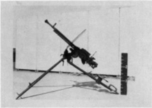


FIG. 7.05 Soviet 12.7-mm. heavy machine gun.

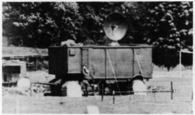


FIG. 7.06 AA gun-laying radar.

## 85-mm. HEAVY ANTIAIRCRAFT BATTERY

### RECOGNITION FEATURES

Primary:

1. Group of 4-, 8- or 12-gun revetments.
2. Gun revetments form a distinctive pattern.
3. Revetments circular; about 20 feet in diameter.
4. Entrance into revetment at least 7 feet wide.
5. Fire control unit in center or immediately adjacent to gun revetments.

Secondary:

6. Buildings or tents for gun crew may be in close vicinity.
7. Trucks usually nearby.
8. Cable junction box or boxes in center of battery.
9. Cable lines from junction box to guns.
10. Track activity around battery.

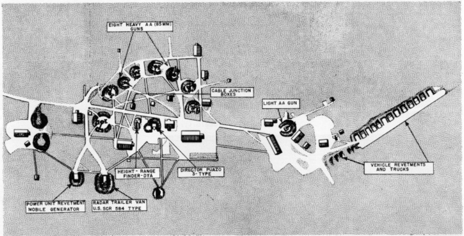



FIG. 7.07 Sketch of 85-mm. AA gun battery with fire control unit. See Figs. 7.08 and 7.09 for photographs.

FIG. 7.08 Eight-gun 85-mm. AA gun battery in North Korea. See Fig. 7.07 for sketch. Scale 1:7,000

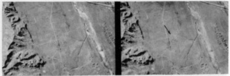


FIG. 7.09 Gun battery shown in sketch and Fig. 7.08. The characteristic battery layout is distinctive at this small scale on original photos. Scale 1:44,000

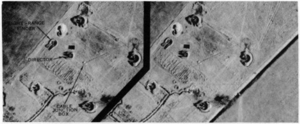



FIG. 7.10 Four-gun 85-mm.AA battery at a Soviet airfield in Germany. Scale 1:1,600


FIG. 7.11 Occupied eight-gun 85-mm.AA battery in North Korea. Observe track activity. Scale 1:10,000

FIG. 7.12 Eight-gun heavy AA battery at an airfield in North Korea. Note blast walls constructed across entrances to gun revetments. Scale 1:6,000

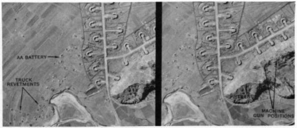



FIG. 7.13 Eight-gun heavy AA battery in North Korea. Scale 1:10,000

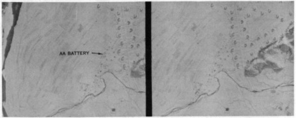



FIG. 7.14 Heavy AA Battery (shown in Fig. 7.13) under snow conditions. Not occupied. Scale 1:20,000

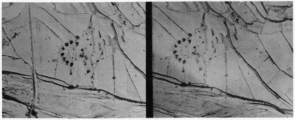


FIG. 7.15 Eight-gun heavy AA battery at a North Korean airfield. Note track activity in snow. Scale 1:6,800

## 37-MM. AUTOMATIC ANTIAIRCRAFT GUNS

### RECOGNITION FEATURES

1. One-to eight-gun batteries.
2. Revetments circular or diamond shaped; 9 to 15 feet in diameter.
3. Entrance to gun revetments approximately 7½ feet wide.
4. Seldom have a separate fire control unit.
5. Often a small revetment for command post near guns.

For other illustrations of 37-mm. automatic antiaircraft batteries see Figs. 6.36 and 6.37.

FIG. 7.16 Soviet four-gun 37-mm. automatic AA battery. Scale 1:1,100

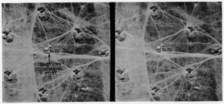



FIG. 7.17 Six-gun 37-mm. automatic AA battery at a Soviet airfield in Germany. Scale 1:2,200

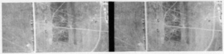


FIG. 7.18 Automatic AA battery shown in Fig. 7.17 Scale 1:9,600

## 12.7-MM. ANTIAIRCRAFT MACHINE GUNS

### RECOGNITION FEATURES

1. Gun pit about 10 feet in diameter.
2. Gun pits may be single or in groups.
2. No fire control unit associated with guns.
4. Trench often connects gun pits.

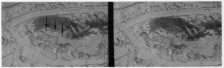


FIG. 7.19 AA machine gun pits on hill overlooking an airfield in North Korea. Scale 1:6,000

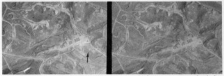


FIG. 7.20 AA machine gun positions connected by trenches at airfield in North Korea. Scale 1:17,000

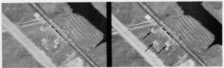


FIG. 7.21 Elevated machine gun positions on edge of airfield in U.S.S.R. Scale 1:5,000

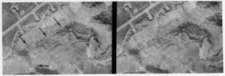


FIG. 7.22 Machine gun positions in hills above airfield in North Korea. Scale 1:6,500

# SECTION 8

# NAVIGATION FACILITIES

Airfield facilities for regulating air traffic and aiding pilots in all-weather flying, fall into two general categories:

A. Visual navigation aids

B. Radio and radar navigation aids

Minor airfields with limited air traffic generally have nothing more than a few field markers to designate landing and take-off areas and to indicate wind direction. Large airfields usually have complete facilities for controlling and regulating air traffic.

Identification of navigational facilities at airfields may determine the presence of such features as an air raid warning system and whether night and blind-flying operations are possible.

## VISUAL NAVIGATION AIDS

Visual navigation aids consist of markers and lights on the airfield, which indicate to the pilot the field boundary, landing area, direction of landing or take-off, wind direction, etc. Field markers are designed to be easily recognized by pilots when circling the field and can be identified on most aerial photography at scales of 1:10,000 or larger. Most lighting installations, except those for approach lighting, are so small and inconspicuous that they are difficult to locate on aerial photographs with scales smaller than 1:2,000. Although the light emplacements for approach lighting systems are small, they form a distinctly identifiable pattern off the end of the runway.


FIG. 8.01 Wind sock indicates wind direction, and is usually mounted on hangar roof or control tower. Sovzone, Germany. Scale 1:2,500

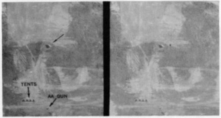



FIG. 8.02 Tetrahedron indicates wind direction. U.S.A. Scale 1:4,000

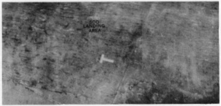



FIG. 8.03 Landing tee indicates direction of landing and take-off. These are found on most Soviet airfields. Sovzone, Germany. Scale 1:2,500

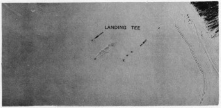



FIG. 8.04 Black landing tee used on top of snow. Note aircraft taking off. U.S.S.R. Scale 1:11,500

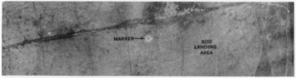



FIG. 8.05 Type of marker used on many Soviet airfields during World War II. Small line projecting from circle indicates north.
U.S.S.R. Scale 1:9,000

FIG. 8.06 Runway markers. Figure 6 indicates azimuth of 60 degrees, letter R indicates right hand runway, and seven tallies indicate runway to be 7,000 feet long. Code system may vary from country to country.
Alaska. Scale 1:4,700


FIG. 8.07 White markers delimit edges of sod runway.
Austria. Oblique

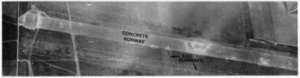



FIG. 8.08 Dotted white line marks center line of concrete runway and edges of sod runways. Austria. Scale 1:10,000

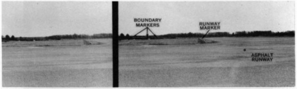



FIG. 8.09 Boundary and runway markers with lights outline perimeter of field and edge of runways. U.S.A.

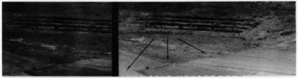



FIG. 8.10 Boundary lights along fence.
Sovzone, Germany. Oblique stereopair

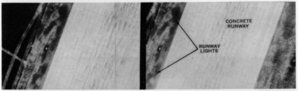



FIG. 8.11 Runway lights. Dark line between lights is buried wire.
Sovzone, Germany. Scale 1:1,900

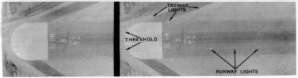



FIG. 8.12 Threshold lights indicate end of runway.
Alaska. Scale 1:4,700

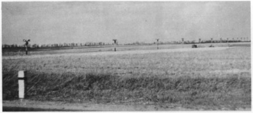


FIG. 8.13 Approach lighting system. Lights extend out from landing area. Pilot follows lights in to touchdown point. Sovzone, Germany.

FIG. 8.14 Approach lighting system shown in Fig. 8.13.
Oblique stereopair

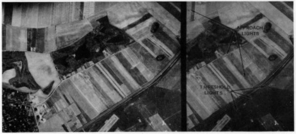



FIG. 8.15 Approach lighting system shown in Fig. 8.13 with threshold lights at end of runway.
Scale 1:9,500

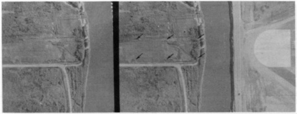


FIG. 8.16 Approach lighting system with double line of light poles. Alaska.
Scale 1:4,700

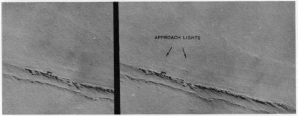



FIG. 8.17 Approach lighting system using single line of light poles. Shadows of poles are visible on snow. Alaska.
Scale 1:10,000

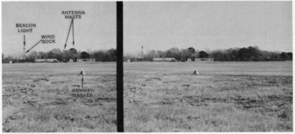



FIG. 8.18 Beacon light and wind sock on tower. Note runway marker with light. U.S.A.

Radio and radar navigation aids are electronic installations that transmit voice or code signals to direct pilots in landing and taking-off and in flying in the vicinity of an airfield. The most general types of installations are: ground-air communications, radio homing beacons, marker beacons, beam approach systems, instrument landing systems, ground control approach systems and air-traffic surveillance radars. There are many other types of radio and radar installations such as early warning radar, interceptor control, etc., but airfield traffic control is not their primary use.

## GROUND-AIR COMMUNICATION SYSTEM

The airfield ground-air communication system consists of a simple voice-transmitting and receiving station. Such an installation normally is found at all airfields having considerable air traffic. The antennae generally are on or near the control tower. This type of system is practically impossible to locate on aerial photography, but its existence may be deduced from the presence of antennae masts, which are discernible only on large-scale or close-range oblique photography. (See Figs. 8.19 - 8.21)

## RADIO HOMING BEACON

A radio homing beacon is an electronic airfield installation which transmits signals to aircraft primarily for homing and position-finding purposes. This beacon is usually low powered. It is used to direct the pilot to the field and may also be used to aid him in descending through cloud cover to an altitude safe for contact landing. Ordinarily, it is located within three miles of the airfield and is in line with the center of the runway. The radio homing beacon is difficult to identify on aerial photographs, since it has no readily recognizable features. (See Figs. 8.22 - 8.24)

## BEAM APPROACH SYSTEM

A beam approach system is an electronic installation similar to the radio homing beacon and furnishes the pilot a single beam for azimuth guidance to the landing area. The beacon which transmits the azimuth path is located at the downwind end of the runway. An inner marker beacon (about 1000 feet from the end of the runway) and an outer marker beacon (about 2 miles from the end of the runway) signal the pilot his distance from the touchdown point. The pilot must use his altimeter for elevation control. Beam approach landing equipment is usually portable and may be carried in a truck and trailer. When the system is in operation, its layout forms a small but distinctive pattern, which can be recognized on most aerial photography at scales of 1:8,000 or larger. (See Figs. 8.25 and 8.26)

## INSTRUMENT LANDING SYSTEM

An instrument landing system provides both lateral and vertical beam signals which give the pilot a glide path to the end of the runway. The electronic equipment for the system is easily portable and usually is in place only for immediate use. When in operation, its arrangement follows a standard pattern similar to the beam approach system. A beacon, which transmits the azimuth path, is located at the upwind end of the runway centerline. A second beacon, which transmits the glide path, is located just off the runway and opposite the touchdown point. Three marker beacons (inner, middle and outer) are located out from the downwind end of the runway about 500 feet, 3500 feet and 4.5 miles, respectively. These signal the pilot his distance from the end of the runway. Identification of this installation is difficult on aerial photography having scales smaller than 1:8,000.

## GROUND-CONTROL APPROACH SYSTEM

The ground-control approach system uses precision radar beams to guide the pilot to the airfield. Radar operators watch the course of the aircraft and radio exact landing instructions to guide the pilot to the touchdown point. The equipment is mounted on a truck and trailer. When the system is in operation, equipment normally is located about 500 feet from the side of and 2000 feet from the end of the runway and is on the left side of the pilot when he is landing. Photo recognition features are truck, trailer and radar antennae, which are difficult to identify on photography at scales of 1:10,000 or smaller. (See Figs. 8.27 - 8.29)

## AIR-TRAFFIC SURVEILLANCE RADAR

An air-traffic surveillance radar is used as an aid in regulating air traffic around a field. The radar operators watch the course of each aircraft flying in the region of the field and radio instructions to the pilot. The only recognition feature is the radar antennae system which usually is located in a position high enough to command an unobstructed view of the area around the field. The air-traffic surveillance radar is difficult to recognize on photography with scales smaller than 1:8,000. (See Figs. 8.30 - 8.32)


FIG. 8.19 Antenna masts indicate location of control tower. (See Fig. 8.20 for vertical view.) On the hangar roof are three structures without masts, which are machine gun emplacements.
Sovzone, Germany. Oblique Stereopair

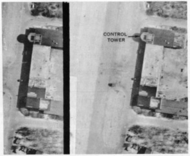



FIG. 8.20 Control tower shown in Fig. 8.19. Note that in large-scale photography only the shadows of the antenna masts are visible. Scale 1:1,500

FIG. 8.21 Control tower with ground-air radio antenna masts. Ordinarily only the shadows of masts can be recognized on vertical photography. Details of the antenna arrangement are sometimes discernible on large-scale low-oblique photographs. U.S.A.

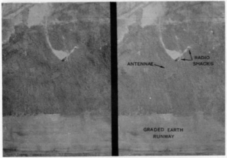



FIG. 8.22 Direction-finder and homing beacon station at airfield in U.S.A. Supports for antenna masts and shadows of the masts are barely discernible at this scale. Note that masts are not located around radio shack. Scale 1:4,000

FIG. 8.23 Direction-finder and homing beacon station at airfield in U.S.S.R. Station similar to the one shown in Fig. 8.24

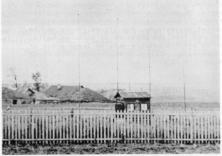


FIG. 8.24 Direction-finder station used for position finding lies adjacent to airfield in U.S.S.R.

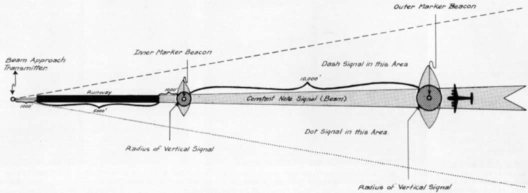



FIG. 8.25 Sketch of typical beam approach landing system. Beam approach transmitter furnishes the signal for azimuth guidance. Inner and outer marker beacons signal the distance from end of runway.

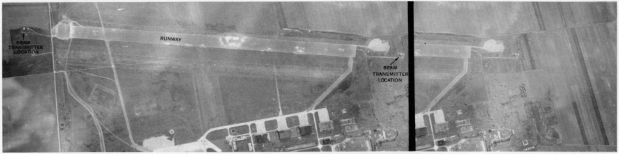



FIG. 8.26 Part of beam approach landing system showing locations for beam transmitter. Notice that they are in line with center of runway. The beam transmitter is portable and can be moved to either end of the runway. Austria. Scale 1:9,500

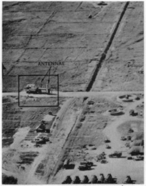



FIG. 8.27 Ground-control approach equipment on USAF field in Korea. Note two radar antennae systems on trailer. See Fig. 8.28 for vertical view. Low Oblique

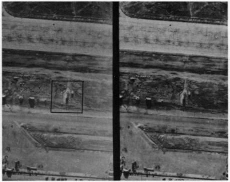


FIG. 8.28 Ground-control approach equipment shown in Fig. 8.27. Shadow of antennae systems is visible. Scale 1:3,000

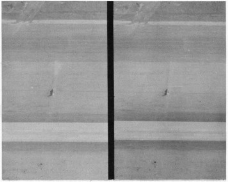


FIG. 8.29 Ground-control approach system on USAF Field in Alaska. Scale 1:3,500

FIG. 8.30 Antennae system for air-traffic surveillance radar at large airfield in the U.S.A.

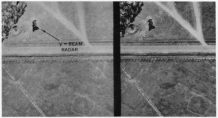



FIG. 8.31 Soviet V-beam radar equipment at airfield in Germany. This equipment may be used for air-traffic surveillance. Scale 1:2,400

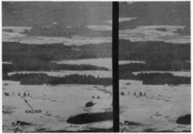
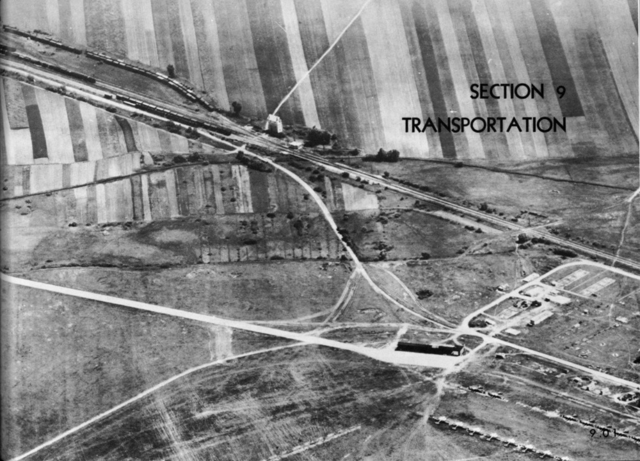



FIG. 8.32 Soviet V-beam radar equipment. Germany. Oblique Stereopair

# SECTION 9
# TRANSPORTATION



# TRANSPORTATION

The most common means of moving supplies and personnel to or from an airfield are by motor transport, water transport, railroads and aircraft. In some parts of the world and in certain situations where these means are infeasible, the use of animal and human transport may predominate.

When relying on photo interpretation alone, a certain amount of inference may be necessary in assessing transportation facilities. In the case of a field entirely lacking in motor roads, railroads or waterways, transfer of supplies must be assumed to be through use of aircraft or animals and, perhaps, human porters.

Following are discussions of the various types of transportation and the outstanding recognition features of each:

## 1. RAILROADS

Railroads associated with airfields may be built for permanent service or merely for temporary use during construction or improvement of the fields. Permanent railroad installations generally have spur tracks or sidings serving such facilities as fuel storage tanks, warehouses and heating plants.

It is frequently difficult for the photo interpreter to differentiate between railroads and highways. When presence of rail tracks cannot be determined and rolling stock is not in evidence, the following features may aid in distinguishing rail lines from motor roads:

a. Horizontal alignment without sharp twists and turns — curves gradual.

b. Vertical alignment without sharp dips and rises - grades gradual.

c. Spurs and sidings fork at relatively slight angles.

d. Beam-type bridges commonly used.

e. Rights-of-way clear of trees.

f. Tone on aerial photographs usually dark gray.

## 2. MOTOR TRANSPORT

Except in remote and isolated regions, most airfields are accessible by motor vehicle. Even where supplies are moved almost entirely by rail or water, roads are usually present. Those serving airfields vary from wide, hard-surfaced highways to rutted byroads.

In contrast to rail lines, motor roads tolerate much sharper curves and steeper grades (except those of very high construction standards); make right-angle turns; infrequently utilize beam-type bridges; and commonly have trees within rights-of-way. Tone of roads on aerial photographs is usually light gray to white except for asphalt which varies from dark to light gray.

## 3. WATER TRANSPORT

An airfield, though favorably located with respect to water transportation, may be supplied largely by other means. In evaluating waterways for transport suitability and extent of use, it is important that the photo interpreter consider the following:

a. Presence of cargo ships, barges, tugs etc.

b. Presence of piers, wharves and unloading facilities.

c. Navigability of waterway — width, depth, obstructions etc.

d. Rail or truck transshipment points located along waterway.

e. Pipelines from shore to fuel storage tanks.

f. Warehouses located along waterway.

g. Motor vehicle track activity along shore.

h. Supplies piled near shore.

## 4. AIR TRANSPORT

Primary dependence on air supply is limited ordinarily to very remote airfields and to times of emergency. Although the photo interpreter may surmise use of air transport, due to lack of other accessible facilities, his only conclusive proof of such use is the presence of cargo planes. Such evidence is difficult to gather from aerial photography.

## 5. ANIMAL AND HUMAN TRANSPORT

In North Korea and similar areas, the Soviets have made considerable use of humans and animals for transporting supplies. The detection of humans and animals on aerial photographs is also difficult, since lines of transport do not necessarily follow roads, and because their images are generally too hard to identify on operational photography.


FIG. 9.01 Spur to hangar area. Scale 1:3,500

FIG. 9.02 Siding at unloading platform near administration building. Oblique Stereopair


FIG. 9.03 End of spur used for coal delivery. Note coal supply along tracks. Oblique Stereopair


FIG. 9.04 Railroad system serving large important airfield in Sovzone, Germany. Scale 1:20,000

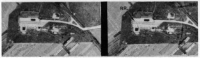
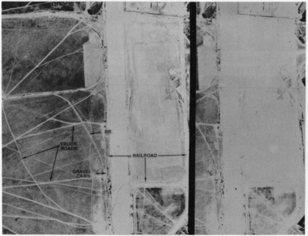



FIG. 9.05 Double-track spur at underground fuel storage area. Scale 1:9,500


FIG. 9.06 Rail fork from main line to airfield. Oblique Stereopair

FIG. 9.07 Cars on spur line to main building area. These cars do not appear in Fig. 9.04



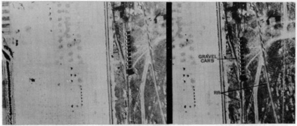




FIG. 9.09 Temporary rail facilities and truck roads in Fig. 9.08. At this scale, ties and rails are more easily identified. Scale 1:1,600

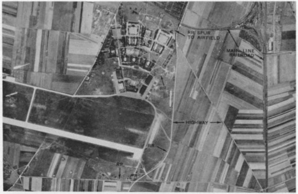



FIG. 9.10 Motor roads and railroad serving large airfield shown on upper single photo and lower stereopair. Scale 1:22,000

At this scale the most distinguishable features for railroads are the gradual curves, relatively acute angles of forking, and darker tone. Note that main line railroad has wide right-of-way clear of fringing trees. Spur rail line, though difficult to detect, will not be confused with motor road because of regular alignment—a motor road of this width generally would be quite irregular.

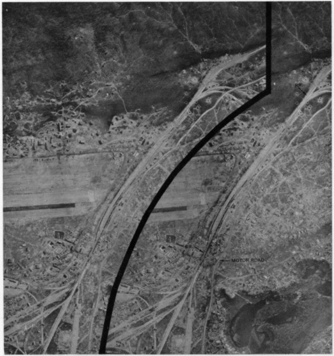



FIG. 9.11 Transportation system at airfield in north European Russia. The rail pattern of long regular curves is sharply contrasted with that of meandering motor roads. Field construction and improvement, rather than normal operating requirements, account for much of the relatively extensive railroad layout. Scale 1:13,000


FIG. 9.12 Transportation facilities for airfield in central European Russia. Primary motor roads to this field are distinguished from the railroad by their right-angle turns. Russian airfields characteristically have a maze of secondary roads and tracks among various facilities on the fields. Scale 1:18,000

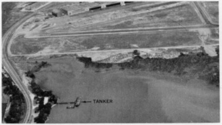



FIG. 9.13

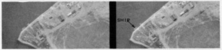



FIG. 9.14 Scale 1:13,000

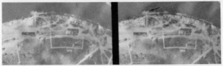


FIG. 9.15 Scale 1:15,000

FIG. 9.13 Tanker unloading fuel for large airfield in U.S.A.
FIG. 9.14 Ship and smaller craft anchored offshore at airfield in U.S.S.R.
FIG. 9.15 T-head pier at airfield in U.S.S.R.
FIG. 9.16 T-head pier facilities used for ocean transport at airfield in Aleutian Islands.
FIG. 9.17 Port facilities used for ocean transport at large airfield in Greenland. Note landing craft along shore, piers, and pipe lines for moving fuel from tankers to storage tanks. Water standing on ice gives mottled appearance to bay.
FIG. 9.18 Winter scene of barges pulled up on shore at airfield in Alaska. Barges are used for moving supplies from ship to shore when beach conditions preclude use of docks.
FIG. 9.19 Ocean-going supply ship beached on shore of airfield in Alaska.
FIG. 9.20 Unloading facilities for handling water transport at airfield in Germany. Facilities include railroad spur, motor roads and warehouse.

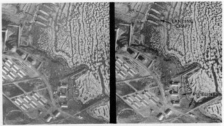



FIG. 9.17 Scale 1:10,000

FIG. 9.18 Scale 1:10,000

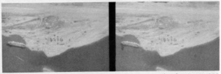


FIG. 9.19 Scale 1:15,000

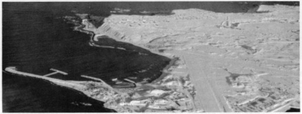


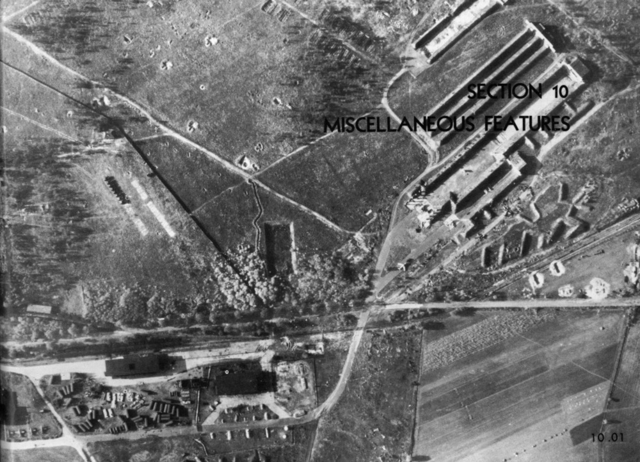
FIG. 9.16


FIG. 9.20 Scale 1:17,000


FIG. 9.21 Isolated landing strip in Arctic U.S.S.R. Since there are no railroads, motor roads or water transport facilities, supply is by aircraft and animal or human transport. Although some food and other light supplies may be brought in by wagons or pack animals along the rut road indicated, heavy equipment and fuel supplies undoubtedly are furnished by air. Scale 1:8,000


FIG. 9.22 Remote airfield in Arctic USSR. There are neither railroads nor motor roads and no evidence of use of water transport. Lack of these facilities, remoteness of the field and the extreme difficulty in moving supplies by animals or humans during most of the year, point to reliance on air supply. Scale 1:13,000

# SECTION 10
# MISCELLANEOUS FEATURES



## BASIC CONSIDERATIONS

An airfield is essentially an area prepared for the accommodation, landing and take-off of aircraft. Among the terms often used synonymously with airfield are those which apply to fields of various sizes and purposes such as: air base, airdrome, airport, airstrip, emergency landing ground, landing strip, auxiliary airfield and air depot.

The size and complexity of an airfield depend upon the purpose for which it was constructed and upon its stage of development. A most rudimentary type of construction is a sod or earth surface for emergency landings. At the other extreme are large airfields with long, hard-surfaced runways and complete facilities for refueling, repair, navigation, storage, supply, billeting and defense.

Airfield capability is determined by the number, size and type of aircraft which can be supported under sustained operations. The size and type of aircraft which can operate from a field depend primarily upon the length and weight-bearing capacity of the runway. Therefore, in judging the strategic importance of an airfield, primary consideration is given to the runway, the other facilities being of lesser importance in this evaluation. There is, however, a fairly close correlation between runway capability and the other services provided on a field. Airfields with long, heavy-duty runways commonly have extensive facilities for servicing many large aircraft.

### Type of Photography

Vertical aerial photographs at scales of 1:10,000 to 1:15,000 have been found to be satisfactory for interpretation of airfields. At times, photographs at scales of 1:5,000 or larger or close-range obliques are needed to clarify individual details and to identify small installations such as navigation aids. In this publication, vertical photographs at varying scales, high-altitude and close-range obliques, and ground photographs are used to illustrate airfield features and facilities to the best advantage possible.

Aerial photographs taken on panchromatic film with a minus-blue filter are adequate for airfield photo interpretation. This film is usually given an exposure time which is adjusted to the average light reflectance of the general area being photographed, but this exposure time does not always bring out needed details of specific objects. For example, runway surfaces often appear very light in tone and show no pattern or texture details. With film exposed for light reflectance of the runway, it is likely that pattern and texture will be clearly apparent on the photo. In many instances, photography with the exposure time adjusted to the light reflectance of a specific object will be particularly helpful in clarifying individual details.

In temperate zones, seasonal changes may affect the appearance of certain airfield features and facilities. For example, a semiunderground fuel storage area may have snow cover which obscures both the firebreak surrounding the area and the openings on top of fuel tanks. Even though these two photo recognition features cannot be identified, other features not affected by snow cover can be recognized and used for proper identification of the area. A few winter photographs are included in this publication to illustrate the effect of snow on the appearance of certain installations.

### Scope

The keys in this volume are intended to assist the photo interpreter and the photo reader in analysing and evaluating aerial photos of any airfield. No attempt has been made to classify airfields by the region or country in which they occur, although each photo caption gives a general location, which should aid the interpreter who is studying the characteristics of airfields in a particular region. It will be noted that emphasis has been placed upon airfields in Europe and Asia.

Deceptive measures such as concealment, camouflage and decoys, which are sometimes used at military airfields, are not included in this publication. These measures are covered in *Photographic Interpretation Manual on Deception: Concealment, Camouflage and Decoys*, Directorate of Intelligence, Headquarters USAF, which is now in preparation.

The bibliography appended to this publication lists reference material which may be useful in airfield photo interpretation.

## METHOD OF PRESENTATION

Important airfield features and facilities have been classified into several broad groups such as antiaircraft defenses, hangars, transportation, etc., which are readily identifiable on aerial photographs. The illustrated table of contents will assist in determining the group classification of a specific feature or facility. Each section of the volume is devoted to a single broad group.

Material is presented in the form of keys, of which three types are utilized:

(1) **Integrated-selective** - lists and illustrates the photo recognition features identifying an object or condition. In using this type of key, the photo interpreter determines whether the object or condition being studied has the recognition features listed, and whether its image is comparable to the images in the key.

(2) **Essay** - describes objects and conditions by means of text and illustrations. When using an essay type of key, the photo interpreter decides whether the object or condition under study is the same as that which is described.

(3) Dichotomous - systematically lists photo recognition features of objects or conditions by means of a graphic series of paired and contrasting recognition characteristics. To make the dichotomous type of key more effective, an illustration of each identifiable object is included. This type of key requires that the photo interpreter examine and identify the recognition features of an object or installation in *a prescribed sequence* and that each step in the sequence be *correctly interpreted*, if positive and final interpretation is to result.

## DRAINAGE PATTERNS

Most airfields have drainage systems of some type. Although these facilities are generally too deeply buried or are confined within areas too small to leave any identifying features, there are cases where drainage patterns are evident on aerial photography. The usual systems are open ditches, underground tile and a combination of the two.

Open-ditch drainage is confined to the area outside the landing strip and ordinarily is discernible as a network of open trenches.

Where underground drainage is not deeply buried under natural surface, a regular pattern of light-gray or white earth scars may outline the arrangement of the system. On vertical photos this pattern appears as parallel, regularly spaced lines, commonly rectangular or herringbone in arrangement. Where drainage systems have been recently installed under natural surfaces, scars are usually quite noticeable. With passage of time their prominence may or may not diminish.

FIG. 10.07 Open-ditch drainage between taxiways and revetments on Communist-constructed field in North Korea. Scale 1:10,000

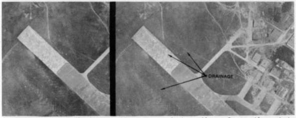



FIG. 10.08 Herringbone pattern on packed earth surface adjacent to both sides of runway indicates underground tile drainage. North Korea. Scale 1:11,000

## AIRCRAFT CRATES

Crates for shipping aircraft wings, fuselages and other components may be seen occasionally on airfields. They are roughly the same size and shape as the aircraft parts which they are designed to carry. Crates are most likely to be seen near railroad unloading platforms or around hangar and workshop areas. Aircraft in various stages of assembly are often nearby.

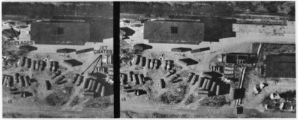



FIG. 10.09 Several types of crates containing jet aircraft components lie near railroad unloading point at a Soviet airfield in Germany. Two crates alongside railroad and to left of warehouse have been opened, exposing fuselages. Scale 1:1,750

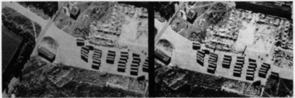


FIG. 10.10 Two types of crates for jet aircraft at airfield in Sovzone, Germany. Scale 1:2,600

FIG. 10.11 A later view of the airfield shown in Fig. 10.10 with more crates in evidence. Scale 1:23,000

## JET BLAST MARKS

Use of an airfield by jet aircraft frequently can be deduced when engine blast marks appear as burned-off patches on grass or as blackened patches on snow. The marks are roughly elliptical to elongate in shape and are from 75 to 150 feet long. On sod surfaces they are light gray or white in tone; on snow they are black. Blast marks are commonly found as a row of parallel 'scars' conforming to aircraft line-up.

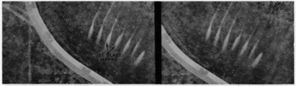



FIG. 10.12 Jet blast marks on sod surfaces appear very light in tone. Sovzone, Germany. Scale 1:2,600

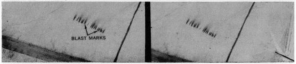



FIG. 10.13 Jet blasts marks in snow appear dark. Sovzone, Germany Scale 1:10,000

## SECURITY FENCES

The Soviets have constructed board fences on many of their airfields in Germany. These fences hide construction activities and new types of aircraft. They also aid in controlling the movement of personnel to and from restricted areas. Fences may be located to obstruct view of an airfield from nearby highways or railroads.

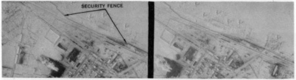



FIG. 10.14 Security fence erected between airfield and railroad to hide airfield activities and restrict access. Sovzone, Germany Scale 1:11,000

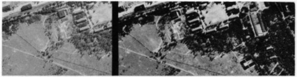


FIG. 10.15 Security fence along airfield boundary near building area. Sovzone, Germany. Scale 1:10,300

## FIREBREAKS

Storage areas on Soviet airfields frequently are protected from grass fires by plowed firebreaks, 25 to 100 feet wide. Although most common around fuel and ammunition storage (see Section 4.00), they are also used to protect other supplies stored in the open or in buildings. On aerial photographs they appear as closely spaced, roughly parallel lines and are considerably lighter in tone than the adjoining sod.

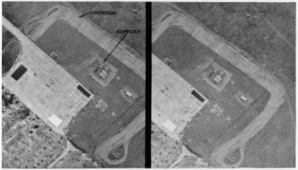



FIG. 10.16 Plowed firebreak protecting storage area. Sovzone, Germany. Scale 1:3,000

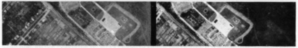


FIG. 10.17 Smaller scale view of firebreak in Fig. 10.16. Scale 1:11,000

## AIRFIELD CONSTRUCTION

As a rule, airfield construction and improvement activity are easily recognized on aerial photographs. Since most construction of this type requires grading, freshly exposed earth is usually in evidence and will appear very light in tone on photographs taken on panchromatic film. Other clues to such activity are the presence of construction equipment and extensive vehicle tracks.


FIG. 10.18 Concrete runway under construction at a World War II German airfield in the Sovzone, Germany. Scale 1:21,000

## TRANSFORMER STATIONS

Transformer stations at airfields are usually small sub-stations. Ordinarily they cannot be seen on photography of scales smaller than 1:5,000. The sub-station may be recognized as an open cage-like structure with a power line leading to the transformers. The station is generally located in the building complex and surrounded by a fence.

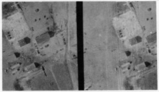


FIG. 10.19 Transformer station at an airfield in the U.S.A. Scale 1:4,800

## WATER STORAGE TANKS

An aboveground water storage tank or standpipe may be found on some airfields. It appears as a tower-like structure, taller than surrounding buildings, and casts a conspicuously heavy shadow. Such tanks are located in or near the building complex.


FIG. 10.20 Standpipe adjacent to administration building at airfield in the U.S.S.R. Scale 1:16,000

# SECTION 11
# OPERATIONAL CAPABILITIES

## OPERATIONAL CAPABILITIES

The most important criterion of the operational capability of an airfield is the type of aircraft which can operate from it over sustained periods. This in turn is determined principally by the length and type of surface of the runway.

The length and type of runway surfaces have been correlated with types of aircraft in developing an airfield classification system. The specifications and explanation of this classification prepared jointly by the Directorate of Intelligence, Headquarters USAF and the Office of Naval Intelligence, Navy Department (USAF and USN, 1952), are as follows:

### CLASSIFICATION OF AIRFIELDS

| CLASS | OPERATION CAPABILITY | MINIMUM RUNWAY LENGTH | RUNWAY SURFACE |
|---|---|---|---|
| 1 | Sustained operation of HB-MB* and Jet Light Bombers. Weight bearing capacity 120,000 pounds or more. | 7000′ | Permanent |
| 2 | Limited operations of HB-MB and sustained operations of Jet Tactical Support Fighters. | 6000′ | Permanent<br>Temporary |
| 3 | Potential HB-MB operations, presently capable of sustained operations of Jet Interceptor Fighters; easily improvable to Class 1. | 5000′ | Permanent<br>Temporary |
| 4 | Light Transports, Reciprocating Engine Fighters and limited Jet Fighters. | 4000′ | Permanent<br>Temporary<br>Natural |
| 5 | Other operational airfields, or potentially important airfields. | 2000′ | Permanent<br>Temporary<br>Natural |

RUNWAY SURFACES:

Permanent - Asphalt, brick, concrete, tar macadam, maintained coral, etc.
Temporary - Steel matting or metal planking, graded earth, gravel, laterite, etc.
Natural - Grass, earth or sand and clay, etc.

* HB - Heavy Bombers
MB - Medium Bombers

| CLASS | EXPLANATION OF CLASSIFICATION |
|---|---|
| 1 | **Heavy Bombers - Medium Bombers and Jet Light Bombers.** Airfields with runways of 7,000 feet or more in length with permanent surface and currently capable of sustained operation of aircraft weighing 120,000 pounds or more. In the absence of specific information on weight-bearing capacity, classification is determined by length and type of surface and other contributory information such as the type of aircraft using the field and aircraft revetment size. |
| 2 | **Limited Heavy Bombers - Medium Bombers and sustained Jet Tactical Support Fighters.** Airfields from which medium bombers have operated or airfields that possess some of the characteristics required in Category 1 above, but which by virtue of length, designed bearing capacity, and/or present condition, do not meet all the standards prescribed for Category 1. Airfields with runways less than 6,000 feet in length are not included in this category. |
| 3 | **Potential Heavy Bombers - Medium Bombers and sustained Jet Interceptor Fighters.** Airfields which do not meet the standards for Categories 1 and 2 above, but which are easily improvable to support operations of medium bomber or heavy bomber aircraft. Factors given primary consideration in selecting these fields are: length and weight-bearing capacity of the existing runway(s), the nature of the subgrade, field extensibility, obstructions and accessibility to transportation facilities. Airfields with runways of less than 5,000 feet in length are not included in this category. |
| 4 | **Light Transports, Reciprocating Engine Fighters and Limited Jet Fighters.** Those airfields with runways of 4,000 feet in length or greater, with either permanent, temporary, or natural surfaces, that do not meet the standards of Categories 1, 2 and 3 above. |
| 5 | Other operational or potentially important airfields or those airfields of 2,000 feet in length or over which do not meet the standards prescribed for Categories 1, 2, 3 and 4. |

Classification of airfields suitable for transport aircraft is made in accordance with the type of runway required for bomber aircraft of equivalent weight and characteristics.

In using this system to classify an airfield, reliance is not placed entirely on appearance of the runway. Though runway length and surface conditions may appear to meet the specifications of a class, there may be other *known* characteristics of an air facility which require that it be placed in a lower class. Reasons for this may include: obstructions, deteriorating or sub-standard runway surface, extreme elevation, or specific information on weight bearing capacity.

## SOVIET AIRFIELDS

Soviet specifications on runway lengths and surfaces in relation to types of aircraft are not known. However, photography of newly constructed airfields in the Soviet Zones of Europe and in North Korea, combined with other intelligence, indicates fairly definite patterns of airfield design and capabilities. Trends observed in these theaters are thought to reflect practices within the U.S.S.R. The Soviets are constructing many new airfields and are improving facilities on existing fields by laying new runways or extending old ones. In practically all cases, runway lengths indicate suitability for use by jet aircraft. The pattern of new construction is usually one of a single concrete runway with a loop taxiway. In the Eastern European States, major Soviet airfields are divided into two general categories (USAFE, 1951): one category has "heavy" runways suitable for medium and heavy bombers and the other category has "light" runways suitable for fighter-type aircraft. The heavy runways, usually 260 feet wide, have 10 to 12 inches of concrete on top of 16 inches of compacted stone and gravel. The light runways, usually 200 feet wide, generally have 8 inches of concrete on top of 16 inches of compacted stone and gravel. Diagrams in Figs. 11.01 and 11.03 illustrate these two types.

While the Soviets will most certainly use hard-surfaced runways to the fullest extent available, it is believed that for jet fighters they would not hesitate to use natural-surface runways when necessary (USAFE 1952). Their willingness to use airfields considered inadequate by Western standards is borne out by their operation of jet aircraft from natural-surface fields (See Fig. 11.11). However, it is estimated that of the many natural surface airfields available to the Soviets and potentially suitable for jet aircraft, a very high percentage would require extensive logistical and communications improvement to be serviceable. The Soviets are believed capable of providing the necessary equipment, manpower and communications to utilize a great many of these fields, and it is estimated that they would do so if it should be considered necessary.

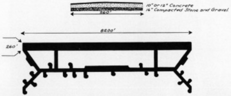



FIG. 11.01 Diagram of a typical Soviet bomber base and cross section of its "heavy" runway. This is a Class I airfield.

FIG. 11.02 Class I airfield in Sovzone, Germany. Runway length of 8,200 feet and reported capacity of 180,000 pounds per wheel meet Class I standards. Note how closely this field conforms to typical bomber base in Fig. 11.01. Oblique stereopair

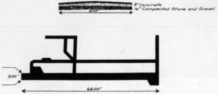



FIG. 11.03 Diagram of a typical Soviet fighter base and cross section of its "light" runway. This is a Class 2 airfield.

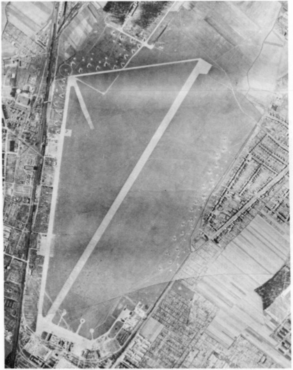


FIG. II.04 Class I airfield in Sovzone, Germany. The 7600' concrete runway is estimated to be suitable for sustained operations of Heavy and Medium Bombers and Jet Light Bombers. It should be noted that lack of major repair facilities, hangars, and other buildings does not lower the classification. Scale 1:14,000

FIG. II.05 This Class 2 airfield in the Sovzone of Germany meets the minimum requirements of a 6000' runway. Surface is concrete, estimated to be capable of sustaining operations of Jet Tactical Support Fighters and for limited use of Heavy and Medium Bombers. Scale 1:9,500

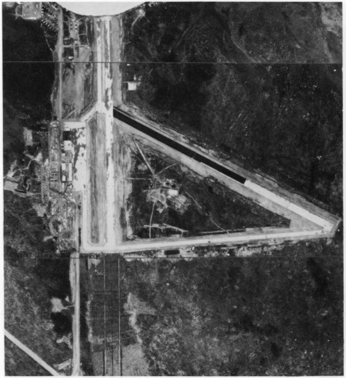


FIG. 11.06 Class 3 airfield in Alaska with asphalt runways 5,100' and 5,000' long. This field meets the Class 3 standards for runway length and weight-bearing capacity, field extensibility, obstructions and transportation facilities.

Scale 1:12,000


FIG. 11.07 Scale 1:15,000


FIG. 11.08 Scale 1:17,600

FIGS. 11.07 and 11.08 Class 3 airfields constructed by the Communists in North Korea. Photographically, these fields appear to meet Class 2 standards, however, presence of fighter revetments in an area of tactical operations and the fact that ground information indicates the runways will not support Heavy or Medium Bombers require that these fields be placed in Class 3.


FIG. 11.09 Class 4 airfield in U.S.S.R. with 4,900' graded earth runway. Scale 1:12,000

FIG. 11.10 Class 4 airfield of Japanese construction in North Korea. Runways are asphalt over concrete and are 4,140' and 3,200' long. Scale 1:10,000

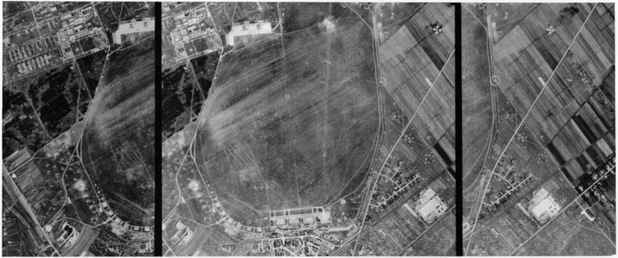


FIG. 11.11 Class 4 airfield in Sovzone, Germany. This natural-surface field with a 7,300' landing surface is used by jet fighter aircraft as indicated by MIG 15s lined up on apron and by jet blast marks on field. Scale 1:19,000

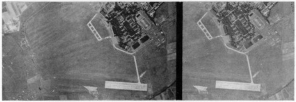


FIG. 11.12 Class 5 airfield in Sovzone, Germany with 3,450' asphalt and concrete runway. Although this is a very well-laid-out and well-equipped airfield, the short runway limits the types of aircraft that can be handled. Scale 1:21,000

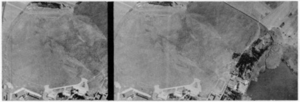


FIG. 11.13 Class 5 airfield in Sovzone, Germany. This airfield has a sod surface with a maximum run of about 5,000'. There are no designated runways. Nature of the landing surface will not support the sustained operations required for Class 4. Scale 1:20,500

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*In preparation*
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USAF [no date] *Development of photographic intelligence, vol. VIII: Interpretation of aircraft and airfields*. Directorate of Intelligence, Headquarters USAF, 88 p., illus. (CONFIDENTIAL)
Valuable for general characteristics of various types of German air installations constructed during World War II.

USAF (1952) *Photo interpretation manual: Identification of Soviet aircraft*. Directorate of Intelligence, Headquarters USAF, 76 p.; Appendix 1., 15 p., illus. (SECRET)
A loose-leaf guide to selected types of Soviet and Satellite aircraft. Includes ground and air-to-air photos, scaled diagrams with brief descriptions, annotated vertical aerial stereopairs, and oblique stereopairs. Appendix (UNCLASSIFIED) covers photo interpretation methods for use in aircraft interpretation. Reprinted as AFM 200-41.

USAF (1953) *Air Force Manual 200-50: Photographic interpretation handbook*. Headquarters USAF, illus., maps, glossary, appendices. (UNCLASSIFIED)
Current reference material basic to all types of military photo interpretation. Covers the nature of photographic interpretation, reconnaissance photography, techniques, maps, photo interpretation reports, copy preparation, and reproduction.

USAF and USN (1951 et seq.) *Airfields and seaplane stations of the world*. Directorate of Intelligence, Headquarters USAF, and Office of Naval Intelligence, Navy Department, vols. 1-39, illus. (SECRET)
Current intelligence on airfields throughout the world, excluding the United States. Gives a recent evaluation of each airfield. Each volume contains an index to the series.




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