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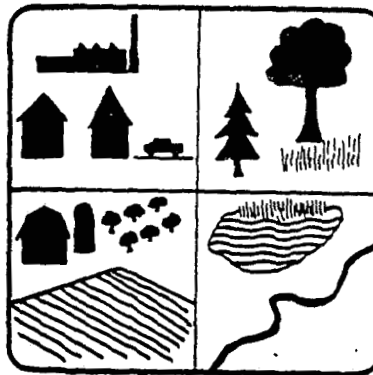
PHOTO INTERPRETATION KEY

TO E84-10048

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MICHIGAN LAND COVER/USE

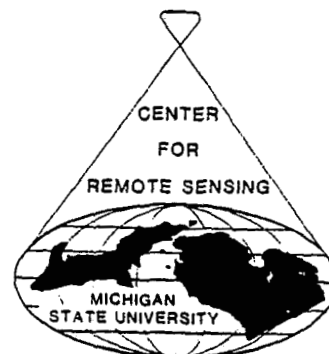
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PHOTO INTERPRETATION KEY

TO

MICHIGAN LAND COVER/USE

Introduction This set of photo interpretation keys is designed to provide a structured approach to the identification of Michigan land cover/use categories as specified in the Michigan Resource Inventory Act (Act No. 204, Public Acts of 1979). They were developed for use with medium-scale (1:20,000-1:24,000) color infrared aerial photography. Although each key is generalized in that it relies only upon the most distinguishing photo characteristics in separating the various land cover/use categories, additional interpretation characteristics, distinguishing features and background material are provided. Please keep in mind that these are general criteria only. The color, texture or other image properties of a feature as described in this guide may be different from those appearing in a given photograph due to variations in film characteristics, exposure and development, date of acquisition, atmospheric and other environmental conditions. Thus adjustments should be made based upon an evaluation of photo characteristics in conjunction with field observations.

A description of each land cover/use category is contained in the "Current Use Inventory Classification System Definitions"; more detailed definitions for each category are included in the "Michigan Land Cover/Use Classification System." Both publications are available from the Division of Land Resource Programs, Michigan Department of Natural Resources.

The classification system which the Inventory Advisory Committee (IAC) has established is based upon explicit identification criteria to maintain consistency among groups preparing current use inventories. These include:

1. It is comprehensive enough to allow for an appropriate category for identifying the existing use of every 2.5 to 5.0 acres of land in Michigan.
2. Every category has a unique description or set of characteristics to resolve questions of double or multiple category qualifications.
3. The classification system can be applied using aerial photography as the primary source of data for the inventory. Since aerial photography has certain limitations, the classification system recognizes those limitations and is designed to allow different interpreters using aeri- als to obtain the same results. Further, a minimum level of accuracy in the interpretations of different categories is obtainable using the system.
4. The current use classification system is part of a larger one which allows for the interpretation and mapping of subcategories when larger scale photography is available or where on-the-ground checking can occur.

The following list of land cover/use categories make up the current use classification system adopted by the IAC. The category names and the corresponding number should be placed on the map legend. The definitions provided should be used by the interpreter to distinguish between the categories. (NOTE: As the interpreter becomes familiar with the definitions, pay particular attention to the categories listed as potential interpretation problem areas. Tips for

delineating potential problem categories using aerials are provided. When in doubt, either field check the area or identify the cover/use at the more general level, i.e., use the two digit classification code versus the three digit code.)

(1) URBAN AND BUILT UP LANDS

These are areas of intensive land use in which much of the surface is covered by structures. Included are cities, towns, villages, strip developments, transportation systems, power and communication facilities, which are sometimes separated from urban centers, as well as areas such as mines and quarries, shopping centers, industrial or commercial complexes and institutional land uses.

As development progresses, some land of less intensive use may become isolated in the midst of the urban or built-up areas but will generally be included in this category. Agricultural land, forests, wetlands or water bodies located on the fringe of the urban areas, on the other hand, will not generally be included.

The urban or built-up category takes precedence over all others when the criteria for more than one category are met. For example, many residential areas have sufficient tree cover to meet the Forest Land criteria, but are classified in the Residential category.

11 Residential

Land use dominated primarily by dwelling units and their associated structures and areas.

111 Multi-family Residential--Medium to High Rise

Description

This category includes all multi-family and apartment structures having 4 or more stories. Included are apartments, condominiums and similar units, as well as any associated areas of lawns, parking lots or recreational facilities (e.g. basketball or tennis courts) built on the site.

Interpretive Characteristics

- Tone/Color:** Tone varies from white to dark gray; color varies from white to dark cyan.
- Texture:** When in groups or clusters, this category usually has an even texture.
- Pattern:** When in groups, this category usually has a regular, geometric pattern.
- Shape:** Individual structures vary from square or rectangular to complex geometries having many wings. Building codes require a specified number of windows per dwelling unit area which precludes very large square or rectangular structures. Some of the modern structures are circular, ovoid or polygonal in shape.
- Site:** Medium to high rise multi-family dwellings are often sited near the CBD but can also occur randomly within single-family residential areas. Recently constructed suburban areas also tend to have large numbers of these tall multi-family structures.

Associations: Open-lot or car port parking areas are usually associated with these structures. Underground parking garages are also possible, but rarely occur to the exclusion of surface parking facilities. Landscaped grounds with walkways are also common, as are in-ground swimming pools and tennis courts. The roofs are usually flat and have air conditioning units and elevator houses. Balconies are common.

Stereo Appearance: This category is restricted to structures having at least four stories so they are noticeably taller than other surrounding residential structures. They may be confused with tall commercial/governmental buildings but their associated grounds and parking areas are usually diagnostic.

112 Multi-family Residential--Low Rise

Description

This category includes multi-family and apartment structures having up to 3 stories. Duplexes are not included in this category (see 113), but condominiums and townhouses are.

Interpretive Characteristics

Tone/Color: Tone varies from white to dark grey; color varies from white to dark cyan.

Texture: An even texture is common for this category which usually contains multiple structures.

Pattern: Multiple structures are common for this category and are usually laid out in a regular, geometric pattern, often enclosing a central "quad" or green space.

Shape: Individual structures are usually rectangular, but complex plans including several wings are also possible.

Site: Tend to be randomly located throughout single family residential areas but are very common in newly settled suburban areas.

Associations: Open-lot or car port parking areas are usually associated with these structures. Parking facilities flanking the long axis of these structures on both sides are common and give the appearance of streets between the buildings. Landscaped grounds, including multiple entry-way walks are typical. Compared to condominiums and townhouses, the grounds of apartment buildings are small. Recreational facilities, including swimming pools, tennis courts and playground equipment, are also common. Ridge roofs are typical of this category, particularly for condominiums and townhouses. Flat roofs are more common for low-rise apartment buildings. Many condominium/townhouse complexes have complex roof structures with many ridge forms associated with the irregular facade plan. Balconies are common.

Stereo Appearance: These structures have three stories or less and are, therefore, shorter than the medium to high rise category or similar commercial buildings. The associated grounds and parking facilities are usually diagnostic relative to the confusion of this category with commercial structures.

113 Single Family/Duplexes

Description

This category includes areas dominated by detached single and two-family structures. Lawns, drive ways and associated buildings such as garages, tool or garden sheds, etc. are also included in this category.

Interpretive Characteristics

- Tone/Color:** Tone usually white to medium gray, sometimes dark gray; color varies from white to dark cyan.
- Texture:** Tends to be even in older residential neighborhoods, becoming uneven and irregular in recently developed, low-density subdivisions.
- Pattern:** Residences are typically uniformly set back from and parallel to the street. Backyards are obvious to the rear of the residences, usually with clearly defined boundaries. Older homes tend to have detached garages at or near the rear property line; newer homes tend to have attached garages. In both cases, driveways are obvious. Frequently, older neighborhoods are laid out with rectangular street patterns while newer subdivisions utilize curvilinear street patterns with cul-de-sacs.
- Shape:** Individual structures are square to rectangular in plan view. Detached garages are smaller than the residence and are also rectangular to square.
- Site:** Single family/duplex housing makes up the bulk of any urban area and usually surrounds the CBD and most older industrial sites as well.
- Associations:** Alleys, where present, tend to be associated with the older neighborhoods. Upper-income residences usually have large lots and may have curving driveways which enter the lot at any point along its frontage. These houses are large in size and tend to have complex ridgetop roofs. Large backyards, sometimes containing in-ground swimming pools and/or tennis courts, are also typical. Middle-income residences are smaller in size with less complex roof structures. The lots are smaller in size compared to the upper-income residences and the spatial arrangement of garages, driveways and entrance walks is fairly consistent over large areas. These residences occupy most of the width of their lots. Trees are much more common in residential neighborhoods than in commercial or industrial areas. A grass strip between the sidewalk and curb, often containing trees, is very common.

Above-ground swimming pools have become very common in single-family/duplex subdivisions built in the last 10-15 years. Neighborhood-schools and parks are distributed throughout this category as are strip commercial developments. Shopping centers or malls tend to be associated with more recently developed subdivisions.

Stereo Appearance: Single-family/duplex structures are rarely more than two stories high and tend, therefore, to be lower than most buildings in other categories.

115 Mobile Home Park

Description

Included in this category are groupings of 3 or more mobile homes and the associated service/storage structures and recreational facilities.

Interpretive Characteristics

- Tone/Color:** Typically appear white on both black-and-white and CIR photography.
- Texture:** Tends to be even and regular due to the standardized size and shape of the units and their lots.
- Pattern:** Most mobile home parks are laid out with a very rigid geometric pattern ranging from rectilinear to curvilinear or radial.
- Shape:** Typical units have length-width ratios of 5:1 or 6:1, i.e., elongated rectangles. The newer modular homes (two halves joined together on-site) are more nearly square. Most mobile homes have at least a front stoop at the entryway if not an enclosed entrance vestibule. These show up as small squares or rectangles protruding from the long axis side of the residence, usually near one end. Lots are small in size with little yard area. Dwelling density (units/acre) is high.
- Site:** Most mobile home parks are found in suburban or urban/rural fringe areas.
- Associations:** Garages or car ports are rare in mobile home parks but small, unattached storage sheds are common. Mature shade trees are rare. Community clubhouses and/or recreational facilities (swimming pool, tennis courts, etc.) are common.
- Stereo Appearance:** The low heights of mobile homes makes them appear nearly flat within the stereo image although their shadows provide some clue to their relief.

12 Commercial, Services and Institutional

This level-two category is used to classify areas used predominantly for the sale of

products and services that are not encompassed by the following level-three classes or to identify commercial land uses which cannot be accurately separated in these more-detailed categories.

121 Primary/Central Business District (CBD)

Description

This category is used to identify the main commercial service center in a community; it includes retail establishments as well as business, financial, professional and repair facilities. Although the CBD often contains institutional land uses (e.g., governmental offices, churches, schools, etc.), these are included in the 121 category unless they exceed about one-third of the total CBD area.

Interpretive Characteristics

- Tone/Color:** Tone varies from light gray to dark gray; color varies from white to dark cyan. These variations occur from one building to the next due to variations in roof types and differences of roofing materials.
- Texture:** For individual roofs, the texture is usually even and smooth. Contiguous groupings of commercial buildings exhibit a more uneven texture than contiguous residential structures.
- Pattern:** Downtown commercial cores vary in pattern according to the historical development of the city-center. Detroit, for instance, was laid out as a radial pattern with several major streets arranged like spokes in a wheel. This pattern is, of course, truncated by the riverfront, but is also complicated by the triangular overprint imposed by Judge Woodward's plan. Other cities, like Lansing, have a distinct rectangular plan to their CBD's, while still others, like East Lansing, are essentially linear.
- Shape:** Structures tend to be square or rectangular in plan view. Roofs are usually flat and have elevator houses, air conditioning units and/or advertising signs upon them. Some ridge or arch roof types may be present, associated with auditoriums, theaters, churches, etc.
- Site:** The CBD is at the principal focus of the main streets and extends outward along the major thoroughfares.
- Associations:** In most CBD's, parking space is at a premium. Most streets in the area will have parallel or angled curb-side parking. Parking structures and surface parking lots will be located throughout this category. Larger commercial/office complexes may have attached/adjacent parking facilities. Compared to residential areas, the CBD will have few trees. Green space, in general, is usually very limited except in the case of large public and/or governmental complexes (e.g. main library, state capitol, etc.). Most building fronts are close to the curb and little or no grass area will separate the sidewalk from the street. In the larger

cities, bus and rail depots are usually located in the CBD.

Stereo Appearance: The commercial core forms a clearly differentiated cluster of tall buildings. There is an abrupt change in roof heights from the surrounding, lower residential or industrial buildings. Shadows cast by the tall buildings are particularly noticeable and may obscure adjacent structures.

122 Shopping Center/Malls

Description

This is usually a single structure or a closely-spaced group of structures which provide a large amount of floor space and contain a variety of commercial and service establishments. These retail centers have large common parking lots which usually occupy several times the area of the structures.

Interpretive Characteristics

- Tone/Color:** Tone varies from light gray to dark gray; color varies from white to dark cyan.
- Texture:** Overall texture of building roof is smooth but may be variegated due to roof-top equipment and uneven drainage. Texture of adjacent parking lots is fine due to parked cars and/or painted lines.
- Pattern:** The larger shopping centers and malls tend to have the structures located centrally with respect to the surrounding parking lots. Smaller shopping centers may have parking on only one side of the buildings.
- Shape:** The buildings in this category tend to be rectangular in general plan view but can have a complex outline in detail due to additions and uneven store fronts. Overall, the centers or malls tend to square or ovoid in plan view when the parking areas are included.
- Site:** Most large shopping malls are located in suburban areas because of their large area requirements. Smaller shopping centers, however, can be found throughout the urban area, but are usually located along major thoroughfares or at the intersections of major streets.
- Associations:** Modern shopping centers typically provide open, surface parking areas which are at least two to three times the size of the associated retail sales area. The buildings, usually one or more stories high, have flat roofs with several air conditioning units on them. Outdoor advertising signs are also common, either on the roofs or at the mall perimeter, or both. Theaters are commonly located adjacent to or within shopping mall complexes and tend to be taller than the associated retail buildings. Trees and green space are rare within this category. Some light industry complexes could be confused with this category but can

usually be differentiated on the basis of rail transportation links, shipping/receiving docks, outdoor material storage and more complex roof-top equipment.

Stereo Appearance: The abrupt height difference between the retail buildings and the adjacent parking lots is usually obvious. These structures appear to be lower than buildings in other categories except for single-family/duplex residences which have about the same height.

124 Secondary/Neighborhood Business District

Description

These areas are composed of relatively compact groupings of retail sales, service or institutional structures which are located outside of the central business district. The 124 category is usually located along major streets and is typically surrounded by noncommercial uses. Small parking lots or parking structures are scattered throughout the area.

Interpretive Characteristics

- Tone/Color:** Tone varies from light to dark gray; color varies from white to dark cyan.
- Texture:** Roof texture is smooth, except for contrasting rooftop equipment. Due to their common walls but uneven heights, the overall texture of strip commercial developments tends to be coarse and blocky.
- Pattern:** Neighborhood commercial buildings are unevenly distributed throughout residential areas, but generally occur in small clusters or strips along prominent surface streets. Most of these structures are built close to the curb and curb-side grass or trees are usually lacking. Houses which have been converted to commercial uses tend to be set back from the curb farther and often still have a front lawn.
- Shape:** Individual stores tend to be square or rectangular with flat roofs and generally smooth, straight facades. Often these structures will be two or three stories high; the ground floor devoted to commercial uses, the upper stories to residential purposes. Houses which have been converted to commercial uses generally have gable roofs, but additions toward the sidewalk tend to have flat roofs, straight facades and are usually only one story high. In strip commercial developments, which may occupy entire city blocks, common parting walls are obvious although individual units within the block are often of varying heights.
- Site:** Neighborhood business districts are typically found along the principal thoroughfares within the residential category, particularly at the major intersections.
- Associations:** Strip commercial developments tend to be parking-space-poor compared to shopping centers or malls. Curb side parking predominates along the fronting streets, but small public parking lots

are frequently scattered throughout the area, usually behind the stores. Alleys are typical at the rear of strip commercial buildings and usually divide this category from the adjacent residences. Store-front advertising signs, often at right angles to the facade, project out over the sidewalks as do the less frequent awnings. Some establishments will be set back from the street and have small parking lots in the front.

Stereo Appearance: Commercial strip buildings tend to appear taller than adjacent residential structures because of their two to three story height and expansive, flat roofs compared to gable roofed houses which attain similar heights at their ridge-lines only.

126 Institutional

Description

This category encompasses educational, governmental, religious, health, correctional and military facilities including all buildings, grounds and parking lots.

Interpretive Characteristics

- Tone/Color:** Tone varies from white to dark gray; color varies from white to dark cyan.
- Texture:** In general, the texture is uneven due to the abrupt juxtaposition of institutional structures and other land uses. Governmental and educational buildings tend to have smooth-textured flat roofs, broken only by air conditioning units and/or elevator houses. Hospitals, on the other hand, tend to have very complex roof textures due to the abundance of roof-top equipment and the variations in roof segment tone, shape, height, etc. associated with the many additions typical of these buildings.
- Pattern:** These structures, varied as they are in their uses, have no orderly pattern. They do tend to be set back from the street and often have landscaped grounds or at least lawns.
- Shape:** The buildings in this category vary widely in their shapes, although rectangular is common. Many structures in this category have several wings, particularly hospitals. Flat roofs are most common, except for churches which tend to have gable, gambrel or other ridged roof forms.
- Site:** Governmental buildings tend to be located near the CBD. Libraries, schools and churches are distributed throughout the urban area, usually within residential neighborhoods.
- Associations:** Governmental and hospital structures usually have moderate-size parking lots. Libraries, schools and churches tend to have small parking areas or curb-side parking only. Large suburban churches may have fairly large parking lots. Most churches have a steeple or belfry of some sort, often with a cross at the top, which cast distinctive shadows. Schools generally have a flag pole in the

front and almost always have playgrounds and/or athletic fields associated with them. Older schools tend to be more than two stories tall, newer ones are often one story and cover larger areas.

Stereo Appearance: Most structures in this category tend to be tall compared to the surrounding, usually residential, buildings.

13 Industrial

Description

Industrial areas include a wide array of uses from light manufacturing and industrial parks to heavy manufacturing plants. Identification of light industries--those focused on design, assembly, finishing, and packaging of products--can often be based on the type of building, parking, and shipping arrangements. Light industrial areas may be, but are not necessarily, directly in contact with urban areas; many are now found at airports or in relatively open country. Heavy industries use raw materials such as iron ore, lumber, or coal. Included are steel mills, pulp or lumber mills, oil refineries and tank farms, chemical plants and brick making plants. Stockpiles of raw materials, large power sources, and waste product disposal areas are usually visible, along with transportation facilities capable of handling heavy materials.

Interpretive Characteristics

- Tone/Color:** The roofs of industrial buildings vary in tone from light gray to black; color varies from white to dark cyan or black. Associated areas of stockpiles (e.g., limestone) and storage tanks tend to be light in tone or white to light cyan in color. Coal piles, of course, are dark toned or blue-black in color.
- Texture:** Industrial complexes usually have a rough texture due to the juxtaposition of varying roof types and heights, exposed conveying systems, pipelines, overhead cranes, etc.
- Pattern:** Industrial buildings are often clustered together in large complexes or are strung out along streets, railroads or waterways.
- Shape:** Most industrial buildings are rectangular in shape. Certain types of industrial activities require long, narrow buildings. Roof tops are usually flat or sawtoothed (due to skylights/ventilation equipment). Buildings associated with heavy industry are usually massive steel-frame, one story structures, while light industry tends to occupy light steel-frame, expansive, one-story buildings or sometimes multi-story structures.
- Site:** Heavy industry is typically located along railroads or waterways, or both. Light industry may fringe the heavy industrial areas or be found within the commercial core of the city.
- Associations:** Typical features associated with processing industries include: bulk material storage facilities (piles, ponds, silos, tanks, hoppers, bunkers, etc.); bulk material handling equipment

(conveyers, pipelines, cranes, etc.); exposed processing equipment (blast furnaces, cooling towers, kilns, cracking towers, etc.); evidence of high fuel/power consumption (boiler houses, oil tanks, coal piles, large and/or numerous smoke stacks or transformer yards); waste disposal facilities. Heavy fabrication industries are associated with outdoor storage yards and overhead cranes which enter the buildings as well as rail lines which enter or pass through the structures. Light fabrication industries usually lack the large, open storage areas and the heavy lifting equipment. Light industries are generally more dependent on truck transportation than on rail linkages.

Stereo Appearance: The low appearance of most industrial buildings is common, but smoke stacks, cracking towers, storage tanks, etc. can exhibit considerable height.

138 Industrial Parks

Description

These areas have been set aside by a community to support industrial growth and development. They are, therefore, not usually identifiable as such from airphoto interpretation. In some instances, however, large areas of cleared land, possibly with some industrial structures already in place, served by good roads, rail lines, power transmission lines, etc. may be indicative of this zoned land use.

14 Transportation, Communication and Utilities

141 Air Transportation

Description

This category includes all facilities directly connected with air transport, whether it be commercial, municipal, military or private. All runways, taxiways, terminals, service buildings, hangers, navigation aids, fuel storage areas, parking lots and a limited buffer zone should be delineated within this classification.

Interpretive Characteristics

- Tone/Color:** Most runways are white to light gray in tone and white to light cyan in color.
- Texture:** Runways exhibit a smooth, even texture in contrast to the velvety texture of adjacent grass areas.
- Pattern:** The abrupt linear pattern of airports is distinctive. Larger airports are characterized by several runways oriented in varying directions which cross each other to form open angles and/or enclosed triangles. The taxiways of major airports are parallel to the runways and connected to them at several places with short driveways.

- Shape:** Airport buildings are typically rectangular in shape. The terminal structures at larger airports usually have several long, narrow wings extending outward from the central structure along which numerous articulated passenger loading ramps protrude.
- Site:** Most airports are located in suburban or urban/rural fringe areas. Adjoining land uses are frequently agricultural, residential, light industrial and/or commercial.
- Associations:** Large airports are frequently located near major roads and attract commercial enterprises (hotels, motels, restaurants, etc.). Large parking areas or structures are common. In addition to passenger terminals, large airports tend to have cargo and maintenance hangars distributed around their perimeters and connected to the runways by taxiways. Obviously, numerous aircraft are usually apparent adjacent to the terminals and hangars.
- Stereo Appearance:** Terminal and hangar facilities are usually two or three stories high and stand in stark relief against the flat runway surfaces.

143 Water Transportation

Description

This category, which excludes the water, includes areas related to water transportation such as port facilities, docks, shipyards and locks. Note, however, that recreational marinas and yacht basins are not a part of this category and are classified under the 19 land use.

Interpretive Characteristics

- Tone/Color:** Tone varies from light to dark gray; color varies from white to dark cyan.
- Texture:** The port areas, terminals, shipyards, docks, etc. included in this category tend to have an overall rough texture due to the juxtaposition of structures of widely varying shape and height.
- Pattern:** The linear docks and slips often form a regular repetitive pattern of linear elements protruding perpendicularly from the coastline.
- Shape:** Docks and terminal buildings are often long and narrow. Warehouse structures may be more square, other storage facilities (tanks, silos, etc.) are round. Flat roofs are common, but dockside terminals often have gable roofs.
- Site:** Obviously, this category is located along the water's edge and usually at the focus of road and rail transportation.
- Associations:** Large parking facilities (particularly for trucks) and rail yards are commonly associated with this category as are various industrial land uses. Large cranes and other material handling systems are typical of port areas. Drydocks, large cranes and other

heavy equipment are associated with shipyards, as are outdoor storage areas.

Stereo Appearance: Many structures are several stories high in these port areas as are the large cranes and conveyors. Docks and wharves, on the other hand, are very low.

145 Communications

Description

Areas associated with radio, radar, television, telegraph, telephone, etc. are included in this category if they meet the minimum type-size requirement.

Interpretive Characteristics

This category includes many diverse structures which have little in common with one another.

Radio/Television: Usually small, low building(s) associated with one or more tall antennas. Because of the guy wire supports and the possibility of falling ice in winter, these antennae "farms" occupy large open fields usually with a herbaceous ground cover. These installations tend to be located in suburban or rural fringe areas.

Radar: Most frequently these are found at airports and are included in the air transportation category. They are rarely found in isolated locations. Small, low buildings are usually associated with the rotating antennae. Sometimes the antenna is covered with a protective white dome.

Telecommunications: Can be large, multi-story buildings when located within the urban areas. Oftentimes parabolic dish antennas (for satellite communications) and/or microwave antennas are located around or on top of these structures.

146 Utilities

Description

Those areas associated with the transport or storage of gas, oil, water or waste products, as well as electrical generation plants, are included in this category. Similar facilities directly associated with industrial, commercial or extractive land uses should be included in those categories.

Interpretive Characteristics

This category also includes many diverse structures which cannot be described in common.

Tank "Farms": Storage of oil or gas in broad, one- to two-story high tanks. These are usually arranged in a regular rectangular pattern and each tank is almost always surrounded by a square earthen berm 3'-5' high. Associated pipelines and truck, rail or water transportation are usually obvious.

- Electrical Generation:** Usually have numerous tall smoke stacks on top of or next to a rectangular, multi-story building. Coal piles and associated railroad sidings are usually obvious. Nuclear power plants tend to have several separate buildings of varying heights within their complex. They are often located near water bodies due to the cooling requirements of the reactor. One or more cylindrical, dome top structure(s) are common as containment buildings. Electrical generation plants within the urban area usually distribute their power via underground lines. Rural or suburban facilities typically have several high-voltage transmission lines emanating from them, often with associated transformer yards. Hydroelectric plants are usually obvious due to the dam site and reservoir. Transmission lines and transformer yards are typical of the larger installations.
- Solid Waste Disposal:** Landfills--These open-pit operations are characterized by their lack of vegetation. Typically, storage piles of overburden material are found around the area and several pieces of earth-moving equipment are present. Easy access for truck traffic is provided. Often the area is scattered with litter. These areas are usually fenced and have only one access point at which a small, low structure is located associated with the truck scale.
- Incineration plants--The square or rectangular, two- or three-story buildings usually have large, tall smoke stacks on top of or adjacent to them. Typically, the structure is designed to allow truck traffic to pass through it at or slightly above grade level (to dump the garbage) and provision is made for loading the ashes onto trucks either via conveyer systems or at a loading dock below grade.
- Waste water treatment facilities--These are characterized by their numerous outdoor settling/aeration ponds which are usually square, rectangular and/or circular. Associated buildings are usually square or rectangular, two-stories high and with a flat roof. Large, above-ground pumps and pipelines are sometimes obvious.

17 Extractive

Description

Extractive mineral land encompasses both surface and subsurface mining operations, such as sand and gravel pits, stone quarries, oil and gas wells, and metallic and nonmetallic mines. In size, these activities range from large open pit mines covering thousands of acres to oil and gas wells less than a foot square. Surface structures and equipment operations include large power shovels and production trucks, rock crushers, concentrating or processing plants, stockpiles, maintenance buildings, waste dumps, tailings basins and parking lots. Inactive pits or quarries that are flooded are placed in the water category if the water body is larger than 2.5 to 5.0 acres (1 to 2 hectares).

171 Extractive - Open PitInterpretive Characteristics

- Tone/Color:** Tone is usually white to light gray, color is usually white. Ponded water within the pit is usually medium to dark gray in tone or light blue to dark blue-black in color.
- Texture:** Varies from smooth in the flat areas to rough in the active/storage areas.
- Pattern:** Varies depending on the mining technique being used. Storage piles in a sand and gravel operation can exhibit a loose, regular geometric pattern. Trench-and-fill operations result in numerous semi-parallel linear elements. Deep quarries sometimes utilize spiral access roads.
- Shape:** No definitive shape is characteristic of this category.
- Associations:** Sand and gravel operations typically utilize floating dredges on barges with large, segmented pipelines moving the material to stockpiles. Various types of earthmoving equipment are common. Rock crushers, sieving hoppers, conveyer systems, truck and rail transportation facilities are typical.
- Stereo Appearance:** The relief of the pit itself is usually obvious. Tall processing equipment may exhibit a stereo height, but usually are detected by their shadows.

172 Extractive - UndergroundDescription

These underground mining activities are usually associated with tall, rectangular surface structures which house the personnel and raw material elevators as well as conveyer systems and ventilation equipment. Typically, concentration, beneficiation, agglomeration or smelting facilities are located near the mine shaft entrance(s) and are mapped within this category. Waste dumps, tailings ponds and water treatment facilities are also commonly associated with this activity. Without local knowledge, it is very difficult to interpret the specific mining activity from airphotos.

173 WellsDescription

This category includes the areas used for the extraction of oil and natural gas and other minerals from the subsurface. In the case of one individual well, the area immediately surrounding the well is all that is placed into this category. Care must be taken not to confuse these wells with water wells.

1731 Oil WellsInterpretive Characteristics

These wells are usually obvious when they are being drilled due to the large, unvegetated, square pads which are opened up to accommodate the drilling equipment. Once established, however, oil wells may be difficult to see on airphotos, particularly when located in forested areas. One clue to these wells is their profuse number within a relatively restricted area. Producing wells use electrically powered, rocker-arm pumps whose shadows may be diagnostic. Access roads and power lines to the well head are also clues. In southern Michigan, many oil wells are located on agricultural land but are too small to be mapped individually. Oftentimes these wells will have cylindrical storage tanks immediately adjacent to the pump. Within large oil fields, pipelines may convey the crude oil from several wells to one central collection point.

1732 Gas Wells

Interpretive Characteristics

During the drilling phase, these are undistinguishable from oil wells. Once established, gas wells are practically undetectable due to their small size, lack of large pump equipment and absence of short-term storage facilities. Networks of buried pipelines connect several wells together and their rights-of-way provide good interpretation clues. Frequently, "sweetening" plants, which remove the hydrogen sulfide commonly associated with natural gas, occur along these pipelines. These in-line processing facilities usually have one or two rectangular, one-story buildings, typically made of corrugated metal, with gable roofs which appear light in tone or white in color. Oftentimes, one or more pipelines will arch above the ground level as they enter and leave these structures. Buried pipelines crossing agricultural or open lands are often detected by their linear soil disturbance scar which typically brings the brighter subsoil to the surface.

19 Open and Other

Interpretive Characteristics

Open land includes those parcels used for outdoor cultural, public assembly and/or recreational purposes. These lands may be intensively or extensively used and the category includes structures incidental to these outdoor activities.

191 Outdoor Cultural

Interpretive Characteristics

Includes facilities such as zoos, arboretums, botanical gardens, etc. These may be difficult to interpret directly from airphotos, but are usually delimited on USGS topo maps if recently revised quadrangles are available.

192 Outdoor Public Assembly

Interpretive Characteristics

Includes facilities such as drive-in movies, large stadiums, racetracks, fairgrounds, amusement parks, etc. The unique shape and pattern of many of these facilities make them fairly obvious on airphotos. Fairgrounds may be difficult to interpret without local knowledge of the area, but they are usually noted on USGS topo quads.

193 Outdoor Recreation

Interpretive Characteristics

This is a broad category which includes a wide diversity of recreational land uses including:

 parks; playlots; playgrounds; athletic fields; golf courses and driving ranges; off-road vehicle trails, tracks and arenas; shooting ranges; swimming beaches and pools; marina and yacht basins and boating sites.

The shape or pattern of many of these facilities is quite distinctive and serve as good interpretive clues to the land use.

194 Cemeteries

Interpretive Characteristics

Within the urban setting, cemeteries are one of several types of open green-spaces. They are characterized by a rectilinear road system, presence of trees and shrubbery and the orderly row pattern of tombstones. In the older cemeteries which allowed large, vertical grave monuments, these markers and associated shrubs make the row pattern more obvious. Newer establishments tend to restrict grave monuments to those which are installed flush to the ground surface making the row pattern less obvious on airphotos.

(2) AGRICULTURAL LANDS

Areas where the production of food and fiber is the dominant land use.

21 Cropland

Land used to produce small grains, row crops, hay or vegetables.

211 Cultivated Crop

Description

Consists of row and interplanted crops such as corn, soybeans, dry beans and sugar beets that are planted in rows at specific intervals. Also in this category are a number of small grains such as wheat, oats, rye and barley which have been included even though, strictly speaking, they are not considered cultivated crops. Speciality vegetable crops like tomatoes, peppers, asparagus, onions and cucumbers are also included.

Corn

Description

A cereal crop which ranges in height at maturity between 10-15 feet and takes approximately 3-5 months to mature. The plant consists of a central stalk with 10 to 15 nodes per stalk with alternate borne leaves. The male flowers are borne on the ears located further down the stalk. Corn is surface planted in rows 40 inches or closer; however, row widths between 20 to 30 inches are most common. Planting rates usually range between 12,000 to 24,000 plants per acre with 17,000 being the average. Corn can be harvested in several different ways by row combine, row picker or by picking and shelling for storage. In dairying areas, though, a significant amount of corn acreage is cut for silage while it is still green and contains a relatively high moisture content. Usual planting and harvesting dates for corn, as well as for all crops, naturally varies from year to year. However, there is a range of dates in which these procedures are carried out. Planting dates usually extend from May 5 to June 10, with most planting being done during the middle of May. Harvesting for grain feed begins in late September and is most active from mid-October to mid-November with completion around December 1. Harvesting of corn for silage begins in late August and ends before November.

Interpretation Characteristics

Initially a corn crop is very difficult to differentiate from other row crops which have similar colors and patterns. Identification of corn in the early stage, though, might possibly be made by size or texture differences if there was a sufficient variance in planting dates between the corn and other row crops, for corn should be approximately 12 to 18 inches tall by July 4 while other row crops will probably not have attained such a height this early in the year. A mature corn crop can be easily recognized on aerial photography by shadows at the edges of the field because of its height and it has a definite "corduroy" appearance because the leaves have branched out enough to obscure the specific row pattern on aerial photography.

- Shape:** Rectangular or square fields, though can be found in irregularly shaped fields conforming to various topographic features.
- Size:** Field size varies, representative size approximately 40-80 acres.
- Tone:** Initially appears on color infrared photography in light pink to red color. When the crop reaches maturity it produces a yellow tassel flower which produces a reddish brown color in the CIR imagery.
- Shadow:** Because of its height of 10 to 15 feet, mature corn fields exhibit a definite shadow effect on the edges of the field.
- Texture:** Initially corn fields have a rather coarse texture because of the small plants in widely spaced rows. As the plant matures and the leaf structure spreads out, the corn field assumes a corduroy-like texture.
- Pattern:** Typical row crop pattern of regularly spaced linear lines throughout the field. In some instances, legumes like alfalfa or clover may be intertilled in alternating rows with the corn when planted along the contour.
- Site:** Most often found on level to gently undulating topography of well-drained soils.
- Association:** Usually associated with small grains, pasture or soybeans.

Soybeans

Description

An upright, branching herbaceous annual belonging to the pea family which ranges from 1 to 6 feet, though 2 to 3 feet is the average height in Michigan. Soybeans are planted in rows from 18 to 24 inches apart with 20 inches being the average. Usual planting dates vary from May 20 to June 20. To facilitate weed control, a rotary hoe is used about every five days following the emergence of the plant and continuing until the beans have grown to a height of around 6 inches. In addition to this cultivation practice, a variety of herbicides are used for weed control. Soybeans are harvested by a combine which cuts the plants in the rows and threshes and separates the bean pods from the rest of the plant. Harvesting begins around September 25, is most active between October 5 to 25 and ends around November 15.

Interpretive Characteristics

Initially soybeans are very difficult to differentiate from other emerging row crops, especially other dry beans. It might be possible to distinguish young soybeans from corn by examining the narrower row spacing and smaller plant size of the soybeans. As the soybean matures, its leaf structure becomes huskier and spreads out horizontally which tends to obscure the bare soil between rows, giving the field a uniform appearance. Sugar beets, on the other hand, exhibit a more upright leaf structure which is not as bushy and, therefore, does not obscure the inter-row areas. Because of this difference, sugar beet fields tend to have bare soil apparent between rows, whereas mature soybeans do not. On CIR imagery, soybeans will appear in pink to bright reddish colors with a "corduroy" texture at maturity. The plant is harvested

relatively late in the season, usually after most specialty row crops have been harvested.

- Shape: Usually square or rectangular.
- Size: 40-80 acres or larger.
- Tone: Pinkish to light red in young stage; a brighter red as plant approaches maturity.
- Shadows: Slight shadow at field edge may be apparent depending on the plant size.
- Texture: Typical coarse row texture initially; more of a corduroy texture at maturity as plant spreads out.
- Pattern: Regularly spaced rows of linear lines throughout the field.

Sugar Beets

Description

A biennial related to the goosefoot or beet family which produces a cluster of spreading or radiating basal leaves and a large white root during the first year. Planting is done as early in the season as possible to insure maximum sugar content. Sugar beets are planted in either single or double rows on beds which are 4 to 6 inches high. The normal width between single rows varies from 14 to 30 inches. If double rows are planted side by side on the same bed there is usually 40 to 42 inches between bed centers. There must be at least 14 inches between the rows on top of the bed for harvesting purposes. Usual planting dates range between April 15 and June 1. In the cultivation of sugar beets, the crop is thinned out resulting in a 4 to 12 inch spacing between individual plants. Before harvesting can take place, the plant tops must be removed; these can be used as livestock feed. Harvest of the sugar beets is usually delayed as long as possible to increase the sugar content as much as possible in the root stalk. A mechanical harvester plows up the rows, removes the beet roots and deposits them directly into following trucks. Harvesting usually starts around October 5, is most active from October 15 to November 1 and ends November 15.

Interpretive Characteristics

There are some unique features in sugar beet cultivation that might differentiate them from other row crops on airphotos. Sugar beets have a distinctive pattern and texture when planted in double rows with a wide space between beds. A field of sugar beets planted this way should appear on the imagery as thick, widely spaced rows with bare soil showing between rows. Because the leaf structure of sugar beets is rather upright and does not spread horizontally as much as other row crops, the bare soil signature is usually not obscured. Prior to topping, sugar beets appear in a pinkish light red to red color.

- Shape: Regular shaped fields.
- Size: 40-80 acres or larger.

Tone: Pinkish red to red prior to topping.

Shadow: Probably no visible shadows.

Texture: Coarse row texture.

Pattern: Planted in straight, linear rows.

Site: Majority of the acreage is on the lake plains of the Saginaw lowland.

Association: Sugar processing plants with large, outdoor storage piles of beets during harvest.

Winter Wheat

Description

Belonging to the grass family, wheat is an annual herb with many varieties like: 1) hard red spring, 2) hard red winter, 3) durum, 4) red durum, 5) soft red winter, 6) soft white and 7) mixed wheat. Most of these varieties have minor physiological differences but none that are distinguishable on medium-scale imagery. The plant grows to a height of 2 to 4 feet and produces several long, thin stems with spiked shaped inflorescences (the flowering region of a plant) at the tips. Most wheat grown in southern Michigan is the white wheat variety which is usually planted in the fall between September 15 and October 15. The seeds are planted with a crop drill, an implement which digs small furrows a few inches apart, deposits the seeds in dribbles and covers and lightly compacts the soil over them. Winter wheat must be planted at the proper date so that it will emerge and grow several inches before its dormant period to insure proper root development. The growth cycle starts again in early spring with the plant ripening in late June and early July. A color change from green to a yellowish brown is associated with this ripening process. Harvesting begins around July 15, is most active between July 20 and August 1 and usually ends around August 20. This crop is harvested by a combine which cuts, threshes and cleans it in one operation, leaving a short stubble in the field.

Interpretive Characteristics

Initially the winter wheat crop should appear in light pink tones in the fall with faint line patterns perhaps being present. At this time, wheat fields will have a definite bare soil reflectance in conjunction with the light pink toned reflectance of the newly emergent plants. As the crop matures in the early spring it becomes a bright reddish color on CIR imagery. When the wheat ripens and the color shift takes place, it will appear in a light yellowish color on the film. After the crop has been harvested, the stubble left in the field will appear as faint, light tan or brown line patterns.

Shape: Square or rectangular fields are typical, but irregularly shaped plots conforming to the topography also occur.

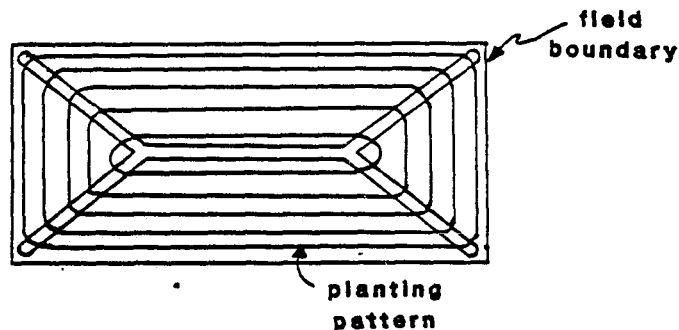
Size: 40-80 acres, but usually larger.

Tone: Initially light pink, changing to bright red as plant matures, then to light yellow as senescence occurs.

Shadow: Not evident.

Texture: Initially medium changing to a fine texture as the field "fills out" with a maturing crop. After harvest, the field will assume a medium texture again resulting from the stubble left on the field. In some cases, a definite mottling will be present because of variations in soil properties throughout a field or because of disease.

Pattern: The planting pattern of most drilled crops is distinctive. As illustrated, the planting is done concentrically parallel to the field boundaries and then the missed "corners" in the turns are seeded, producing the characteristic "open X" pattern in a rectangular field.



Oats

Description

A cereal grass which grows to a height of 2 to 5 feet. Unlike other temperate cereal grasses, the flowers and resulting seeds of oats are borne on panicles. Oats are usually planted between April 10 and May 15. Initially oat fields have a dark green color, much more so than any other cereal crop. Like the other cereals, though, the oat plant changes color from green to a yellowish brown when it ripens beginning in middle to late July. Oats are usually combine harvested, however, they may first be cut and windrowed (a long, relatively low ridge of grain made for drying) and then threshed a few days afterwards with a pick-up combine. Harvesting usually begins around July 20, is most active between July 25 and August 20 and ends by September 15.

Interpretive Characteristics

Initially, an oat field should appear in rather light pink tones with no particular pattern evident. This pink tone will change rather rapidly to more brilliant red colors on CIR imagery as the crop matures. When the oats ripen and the color shift takes place, the tonal signature on the photography will change from red to a light yellow. Besides some spring-sown barley, the vast majority of spring-sown grain in Michigan is oats. While oats are ripening, most fall-sown grain (i.e., wheat) should already have been harvested. After the oats have been cut, certain patterns may be present on the field. If the crops have been windrowed, the field will appear on the imagery as light yellow stripes or lines of cut grain a few feet apart with a somewhat darker yellow or perhaps even bare soil apparent between windrows.

Shape: Regularly shaped fields, square or rectangular; some irregular.

Size: 20-80 acres or larger.

Tone: Initially pink changing to bright red or magenta. When the crop ripens, color shifts to a light yellow on CIR imagery.

Shadow: Rarely evident.

Texture: Initially a medium texture which rapidly changes to a fine texture as the field fills out. After harvest there may be a return to a medium texture with the stubble residue; a coarse texture is associated with grain that has been windrowed.

Pattern: The typical drill planting pattern is often evident and after harvesting a linear pattern may be present because of windrowing.

Rye and Barley

Description

Both are cereal grasses; barley attains heights of 3 to 4 feet while rye grows to heights of between 4 to 5 feet. There are two main varieties of barley--the 2 and 6 row types (referring to the number of rows of kernels on the spike head), however, these differences are not discernible on airphotos. Barley is usually seeded by drilling the crop in a prepared seedbed; a legume grass is interseeded with the crop in some cases. Barley can be sown in either the fall or spring. If fall sowing is practiced, the planting usually takes place between September 5 and 15. Spring planting is usually done between April 10 and May 10. Like most cereal grains, as barley ripens it turns from green to a yellowish-brown color. Barley is combine harvested and the kernels threshed, leaving a stalk stubble on the field. Harvesting of fall-sown barley usually begins around June 25, is most active between July 1 and 10 and typically ends by August 1. Harvesting of spring-sown barley usually begins around July 15, is most active between July 20 and August 1 and ends around August 5. It should be noted that most barley which is grown in Michigan is sown in the fall.

Rye is another fall-sown cereal grain which is similar to barley but has rather narrow one-leaved glumes with drooping spikes and shorter awn structures. Like other cereal crops, rye is planted by drilling the seed in a prepared seedbed. Planting is usually done between August 15 and October 15 depending on whether or not the crop is to be grown for grain, it can be seeded in August; however, if grain production is desired then a late September, early October seeding is favored. Rye is also combine harvested beginning around July 15. Harvesting is most active between July 20 and August 1 and usually ends around August 10.

Interpretive Characteristics

Initially both barley and rye will appear on CIR images in pinkish tones which will change to reddish colors as these crops mature and the fields fill out. A faint line pattern may initially be present because of the drill planting though such a pattern will probably diminish as the field fills out. In the case of barley, if a legume grass is interseeded, no crop pattern will be evident. Because both of these grains turn yellow when they ripen, a color shift will appear on CIR photography; these grain crops appearing in light yellowish colors as senescence develops. After harvest both crop fields will have the characteristic residue stubble appearance.

Shape: Regularly shaped fields.

Size: 40 acres or more.

Tone: Initially both barley and rye will appear in pinkish colors and later in reddish ones as the crop matures. When these cereals ripen, they will appear in light yellowish tones. However, if a legume grass has been interseeded, then the field may have a deeper yellowish color, or perhaps even a reddish-brown appearance.

Shadow: Some on edge of field, especially with rye.

Texture: Initially a medium texture, changing to a fine one as the field fills out prior to harvesting.

Pattern: Faint line pattern resulting from drilled seeding may be apparent, though no discernible pattern will probably be evident if interseeding has taken place.

NOTE: It is very difficult and almost impossible on most imagery to differentiate between various types of cereal grasses because of physiological similarities. Planting dates and harvesting practices may be a key to identification, particularly between fall-sown and spring-sown grains. Except for oats, most grains grown in Michigan are fall-sown which means winter barley, winter wheat and rye are the fall-sown cereals, barley ripens the quickest and is usually harvested before rye and winter wheat.

212 Hay, Rotation and Permanent Pasture

Land which produces grasses for animal consumption.

Hay

Description

Any leafy plant material, fine-stemmed grasses and sedges and other legumes that are cut, dried and fed to livestock. A variety of grasses are utilized in hay production, the most common being alfalfa, clover and timothy, as well as mixtures of these grasses. Alfalfa is probably the most important of these hay crops in Michigan. Alfalfa grows to a height of 2 to 3 feet and may have anywhere from five to twenty stems with new stems growing at the crown as old ones either mature or are harvested. Alfalfa is a perennial, leguminous herb which continues for a number of years and usually has a purple flower, although some varieties have yellow flowers. The alfalfa is usually drilled seeded. As the crop matures, a more or less continuous mat is formed, having a bright green color. Alfalfa is usually cut 2 to 3 times during the summer between June 10 and September 1.

Clover, another common grass grown for hay, grows anywhere between 1 to 3 feet tall. Clover, particularly the common red clover variety, is broadcast sown on the surface with some small grains early in the spring. Though it is a perennial, it usually functions as a biennial, dying after two years. The crop is usually cut by the time it reaches full bloom, sometime between June 15 and July 10.

Another common hay grass is timothy, a perennial bunch grass which can grow to a height of between 20 to 46 inches. Like clover, timothy is cut between June 15 and July 10.

Interpretive Characteristics

Most hay fields will be in bright red colors throughout the growing season on CIR photography. Slight color shifts may take place as the plant's flowers bloom. Such shifts may be from red to pink in the case of white clover or from red to magenta in the case of red clover. The most distinctive feature in identifying hay fields is the field-border-concentric harvesting pattern.

Hay is cut with a mowing machine which either bales the hay and leaves them on the field or leaves the hay in windrows to be picked up later. Initially, hay windrows will appear as thin red or pink lines on CIR imagery, however, as the hay dries out and changes to a brown color, a color shift will occur on CIR photography; the windrowed hay appearing in yellowish-brown lines on a more pinkish colored grass stubble. Because of its fine texture and bright red color, hay fields are often hard to differentiate from cereal grain crops. As an aid in identification, patterns within the fields should be examined, looking for the distinctive planting patterns of drilled grains already mentioned. The faint corduroy texture of the grains contrast with the very fine texture of hay fields.

Shape: Regular shaped fields, square or rectangular.

Size: 10-20 acres or more.

Tone: Bright red color on CIR imagery throughout the growing season.

Shadow: None apparent.

Texture: Fine to very fine texture throughout growing season. A coarser texture is evident after cutting, especially if hay is left in windrows.

Pattern: No visible pattern, though the cutting technique leaves a distinctive pattern on the field.

Rotation Pasture

This is land sown to some sort of grass (such as alfalfa and clover mixture) for livestock grazing. The practice of rotational pasture is part of a crop rotation technique designed to preserve the productivity of the land. Fields are usually kept in pasture for 2 or 3 years and then plowed for crop production. To prevent overgrazing on good crop producing land, a technique known as rotational grazing is sometimes practiced wherein the pasture is divided into segments and the livestock are grazed on one segment for a period of time and then moved to another.

Interpretive Characteristics

Similar to hay fields, rotational pastures are a bright red color on CIR photography throughout the growing season. Usually little texture or pattern is evident, except if the pasture is rotationally grazed, in which case the fenced-in segments might be

discernible on larger scale imagery. If the field has been in pasture long enough, "cow trails" and other evidence of livestock grazing may be evident on larger scale imagery.

Shape: Regularly shaped fields.

Size: 5-40 acres.

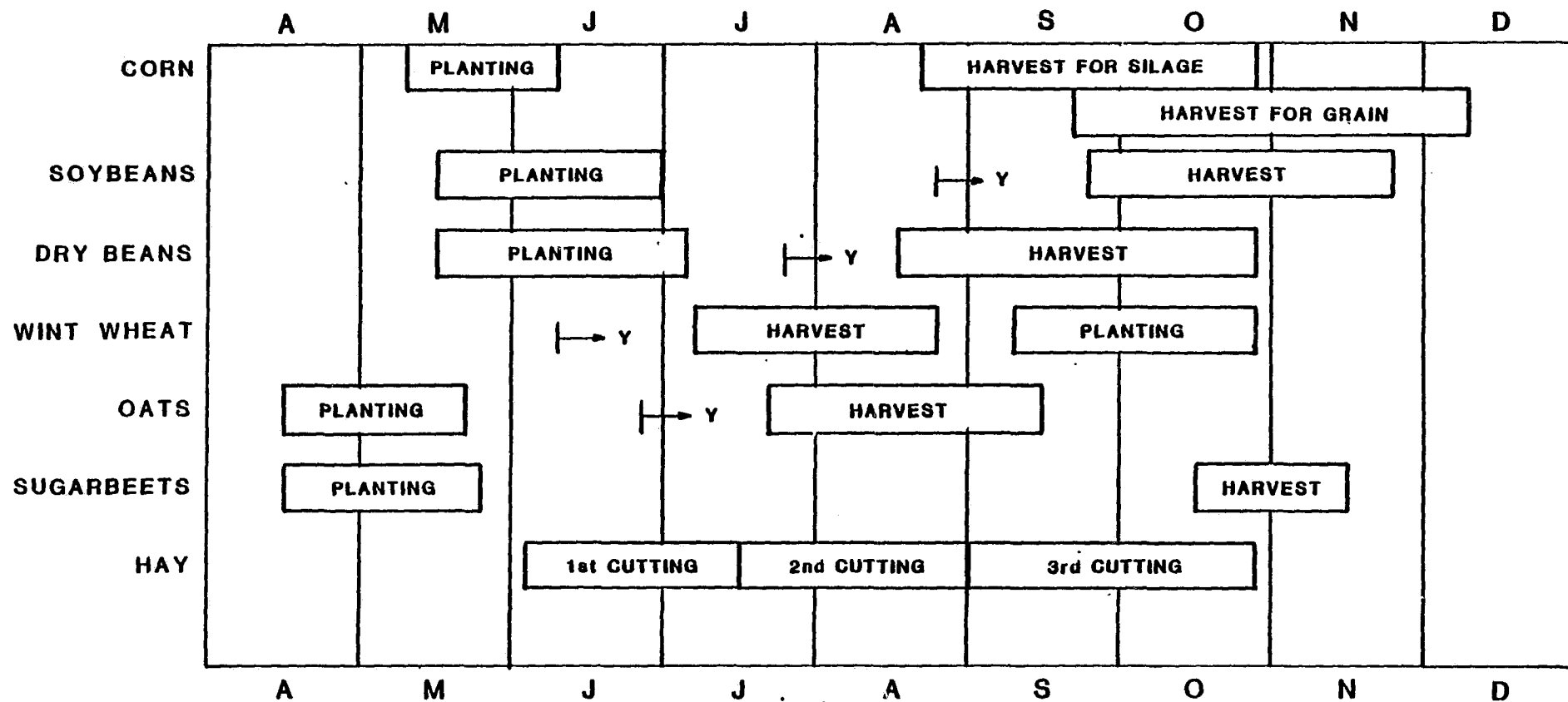
Tone: Usually red to bright red throughout the growing season, though a slight color shift to darker colors may take place in late summer as the grass dries out.

Shadow: None.

Texture: Fine to very fine texture.

Pattern: No readily discernible pattern in the field unless the field has been segmented for rotational grazing.

CROP CALENDAR FOR MICHIGAN



source: MICHIGAN PLANTING AND HARVESTING DATA. Michigan Dept. Ag., 1980

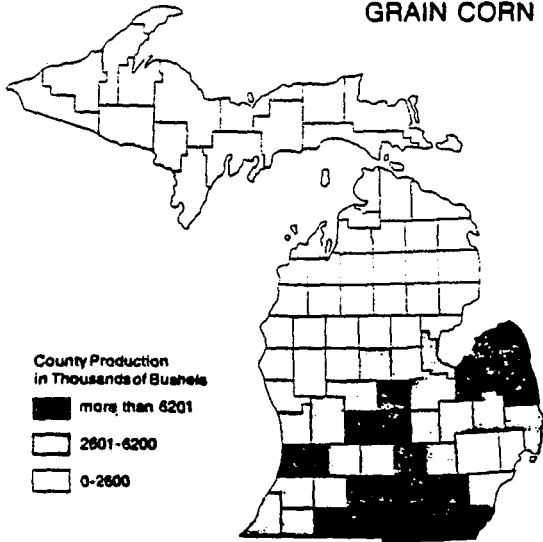
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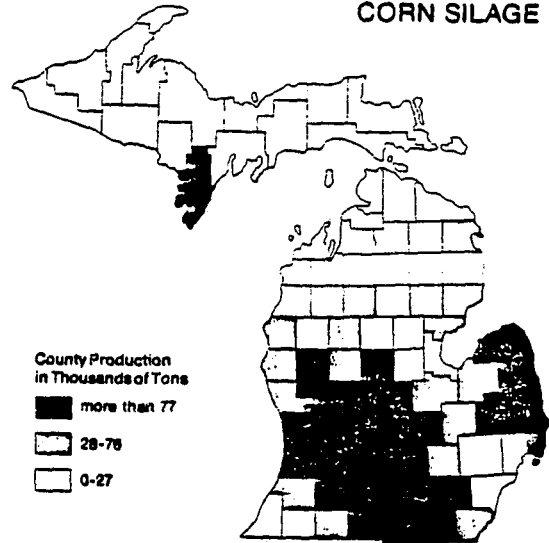
CROPLAND

CORN

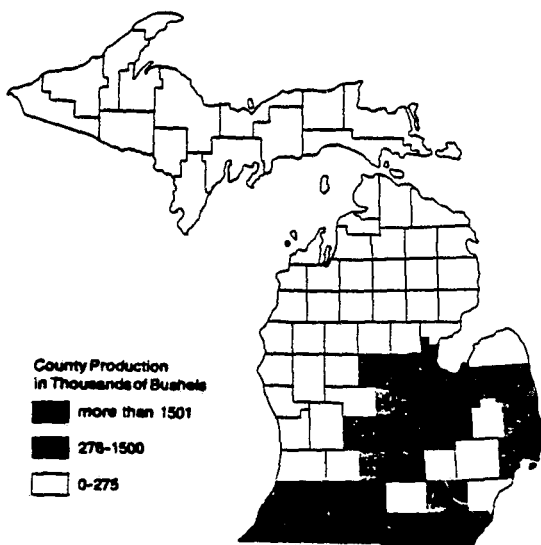
GRAIN CORN



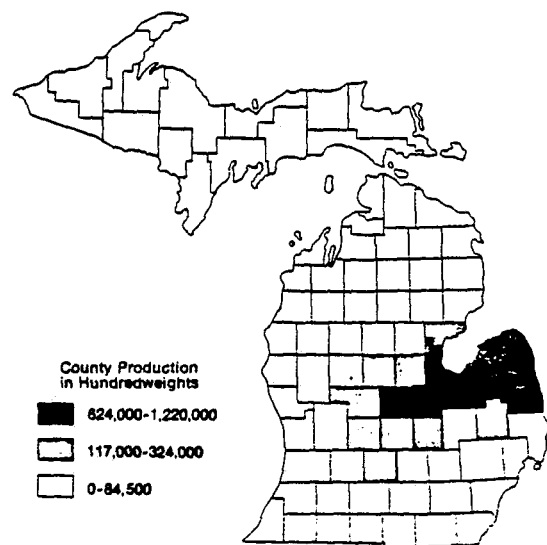
CORN SILAGE



SOYBEANS



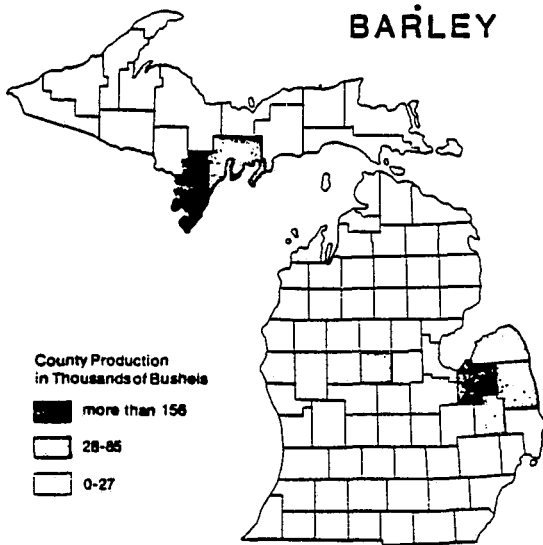
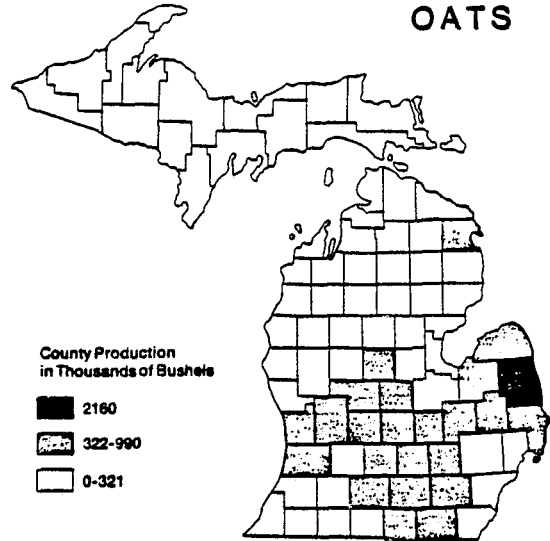
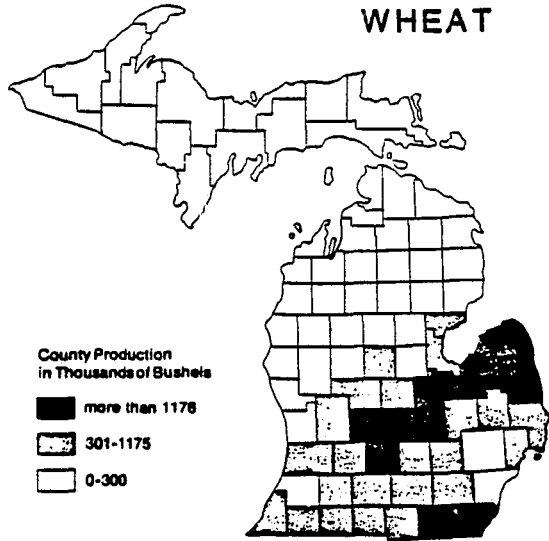
DRY BEANS



source: Michigan Agricultural Statistics, July 1981. Mich. Dept. Ag.

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21 CROPLAND (cont'd.)

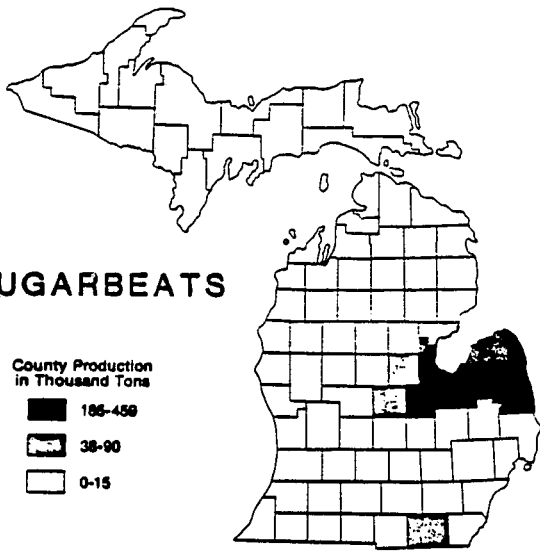
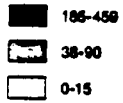


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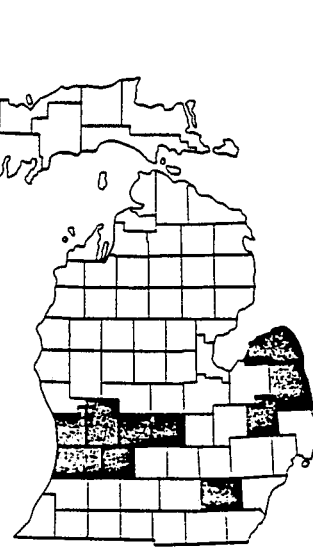
21 CROPLAND (cont'd.)

SUGARBEATS

County Production
in Thousand Tons



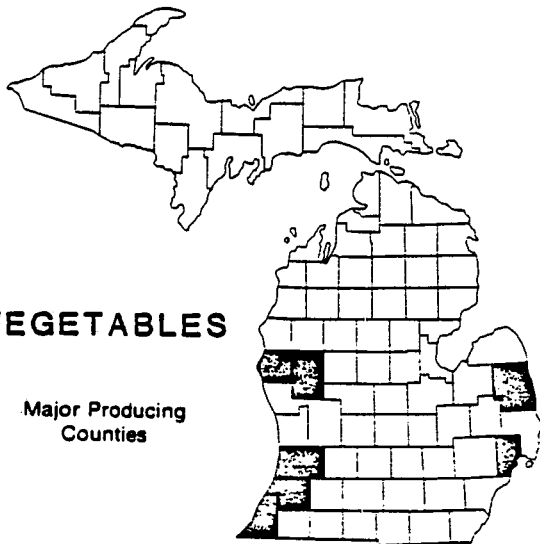
HAY
grown in all
areas of the state
Major Producing
Counties



Source: 1978 Census of Agriculture

VEGETABLES

Major Producing
Counties



Source: 1974 Census of Agriculture

22 Orchards, Bush Fruits, Vineyards and Ornamental Horticultural Areas

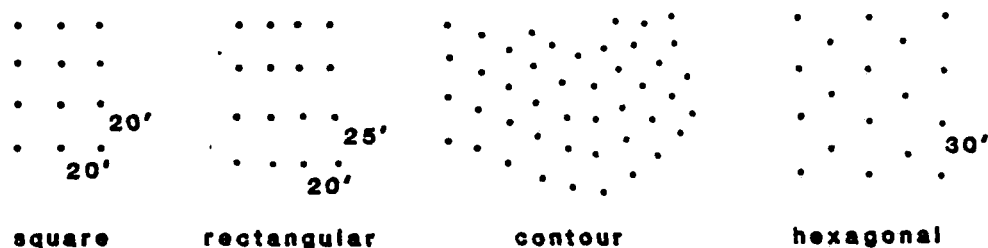
This category includes land used for fruit or berry production, as well as nurseries, floricultural areas and sod farms.

221 Tree FriutsDescription

This category includes fruit-bearing trees like apple, cherry, peach, pear and prune which range in height anywhere between 2 or 3 feet in new orchards to around 25 feet in mature fields. Orchards are usually planted in a systematic pattern of evenly spaced trees including square, rectangular, curvilinear or hexagonal systems. Spacing between individual trees differs according to the system used, varying between 15 feet and 35 feet. Bloom dates vary among the different species of fruit trees, occurring sometime during early to middle spring. Harvesting of tree fruits usually begins sometime in July or August and continues throughout the fall season. The accompanying table lists these bloom and harvest dates for the common Michigan fruits.

Interpretive Characteristics

Fruit trees have the same appearance on CIR imagery as deciduous trees, appearing in red to magenta colors. The most distinguishing feature of orchards, which makes them very easy to identify on aerial photography, is their planting pattern. As illustrated, orchards are planted in either square, rectangular, contour or hexagonal patterns of widely spaced rows.



The image characteristics of orchards are:

- Shape:** Regularly shaped fields or conforming to the contour of the land. Individual tree shapes should be readily apparent on larger scale imagery.
- Size:** 2.5-10 acres; usually larger.
- Tone:** Red or magenta after leafout and prior to leaf-fall.
- Shadow:** Individual tree shadow should be easily identified.

Texture: Stippled texture resulting from wide spacing of individual trees.

Pattern: Most orchards display either a square, rectangular, contour or hexagonal pattern.

Site: Many times located on moderate hill slopes to take advantage of favorable air drainage to prevent frost damage.

Association: Often occur in association with other fields of small fruits like strawberries.

222 Bush Fruits and Vineyards

Description

Includes fruits such as strawberries, raspberries, blueberries and grapes. Both raspberries and blueberries are bush fruits which are usually planted 2 to 3 feet apart in rows 6 to 10 feet apart. The crowns of individual blueberry bushes usually coalesce within the rows, forming long hedgerows about 4 feet wide.

Grapes are grown on wires supported by posts along the rows. The rows are 4 to 6 feet apart and the row canopy is about 3 feet wide. Early in the season, the shadow cast by the support posts may be obvious on airphotos.

Interpretive Characteristics

Shape: Regular field shapes, sometimes conforming to the contour of the land.

Size: 5-10 acres or larger.

Tone: Blueberry bushes appear red or magenta; inter-row areas appear white or light cyan if kept bare, dark to purple if kept in grass. Grapes are also red in color, but the narrow row width and bare ground usually gives the field an overall light cyan color.

Shadow: High bush blueberries will cast definite shadows; grapes usually have smaller shadows due to their smaller size. The support posts used in viticulture often cast distinctive shadows, particularly early in the season.

Texture: Coarse texture due to the relatively wide row spacing.

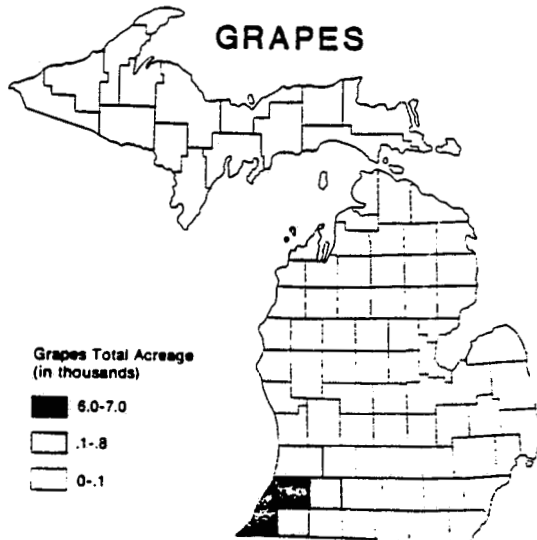
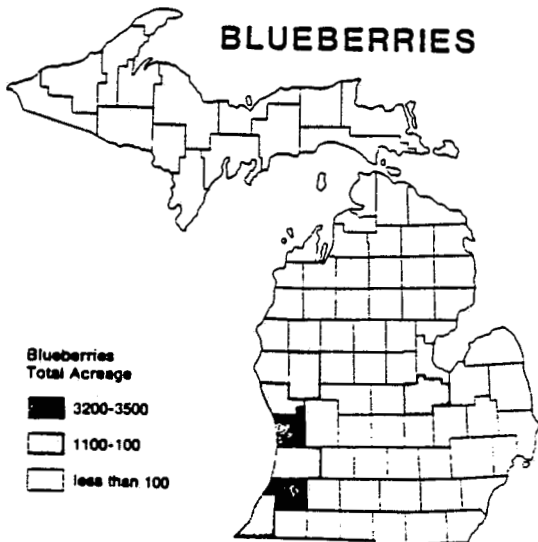
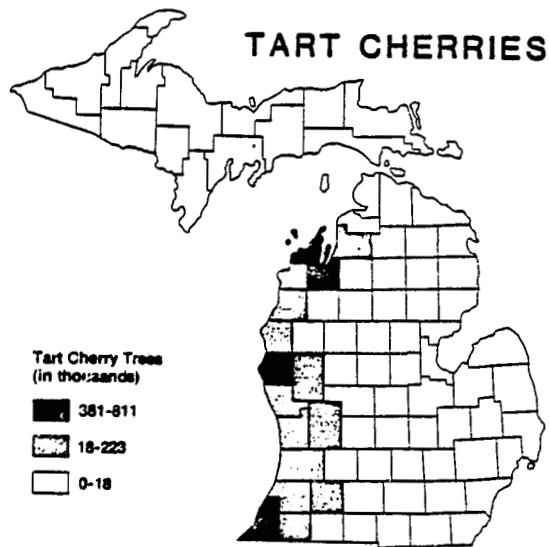
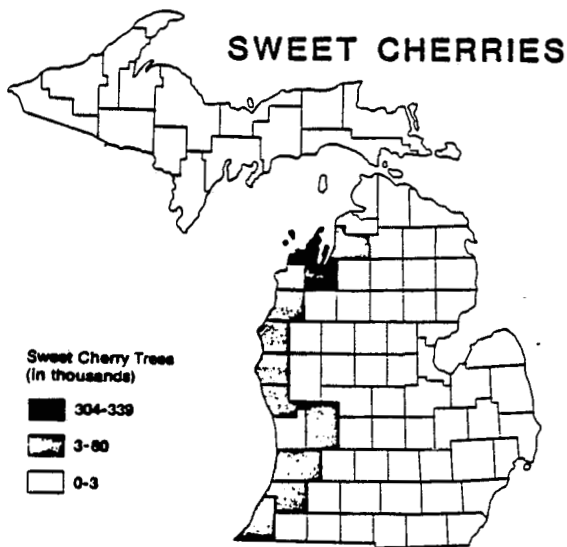
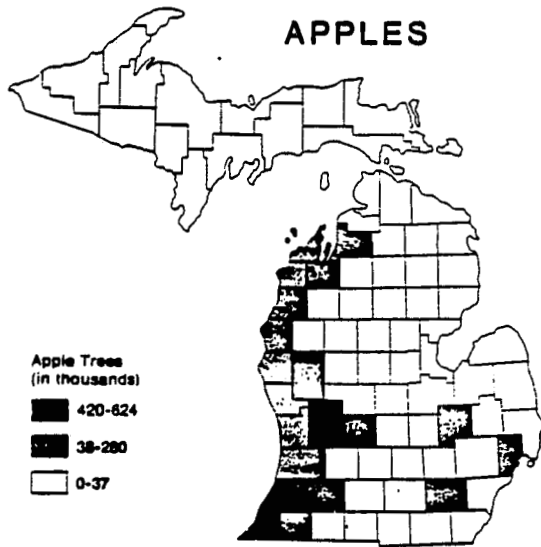
Patterns: Raspberries, blueberries and grapes all have a distinctive straight-line row pattern.

Site: Raspberries and blueberries are usually grown on relatively flat, sandy loam soils. Grapes may be located in moderately rolling terrain to promote air drainage.

Association: Orchards, blueberries, raspberries and grapes often occur in close proximity to one another. Processing facilities for these crops may be obvious on the air photos and typically have large

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22 ORCHARDS, BUSH FRUITS, VINEYARDS, & ORNAMENTAL HORTICULTURE AREAS



stacks of pallets stored outdoors.

NOTE: Sod farms appear as smooth, bright red rectangular areas on CIR imagery and are typically associated with organic soils. Drainage ditches and brush hedgerows or tree windbreaks are common.

23 Confined Feeding Operations

These land uses are large, specialized, livestock-production enterprises, chiefly beef cattle feedlots and large poultry farms, but also including large hog, dairy and fur-bearing animal farms. Clues to beef cattle operations include several large barns, several long pole barns, groups of silos, small rectangular fenced areas and extensive pasture fields nearby. Hog farms are similar, but have fewer barns and usually have numerous small "hog houses" arranged in geometric patterns near to the barns. Poultry farms utilize long, rectangular, one-story sheds to house the poultry, each of which usually has a small, cylindrical grain silo attached at one end.

24 Permanent Pasture

Description

This category includes land used to produce grasses and certain types of legumes which are grazed by animals. The land is continuously used for pasture and is tilled only to reestablish the grasses or legumes.

This land is permanently left in pasture grasses for livestock grazing. Permanent pasture land usually has limited capabilities for profitable crop production because of such factors as poor drainage, low fertility, encroachment of weeds and brush or too steep a slope. Many permanent pastures are periodically renovated by tearing up the sod, applying fertilizers and reseeding the field with pasture legumes.

Interpretive Characteristics

It may be difficult to distinguish between permanent pasture, rotational pasture and hay fields, and some small grains early in the growing season. Permanent pasture will probably appear in reddish or greenish-brown color with a rather rough texture in comparison with hay or small grain fields and usually show signs of disturbance by the grazing livestock. Cattle trails or paths may also be evident on larger-scale imagery as well as trough feeders, drinking tanks and salt licks. The ground around such areas is usually well trampled, giving it a light cyan color on the imagery.

Shape:	Can either be regularly or irregularly shaped depending on location.
Size:	10 acres or more.
Tone:	Reddish or greenish-brown color.
Shadow:	None.
Texture:	Can have a smooth to coarse texture depending on length and type of grazing practices.

Pattern: No discernible pattern, though livestock trails may be present.

Site: Usually located on poor producing land which is either poorly drained or too steep for cultivation.

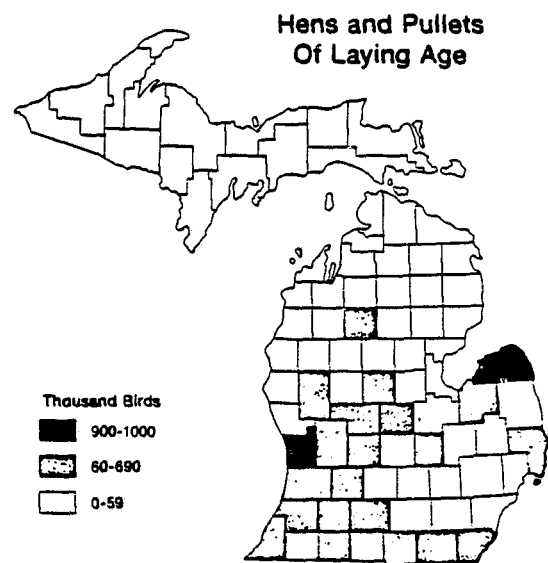
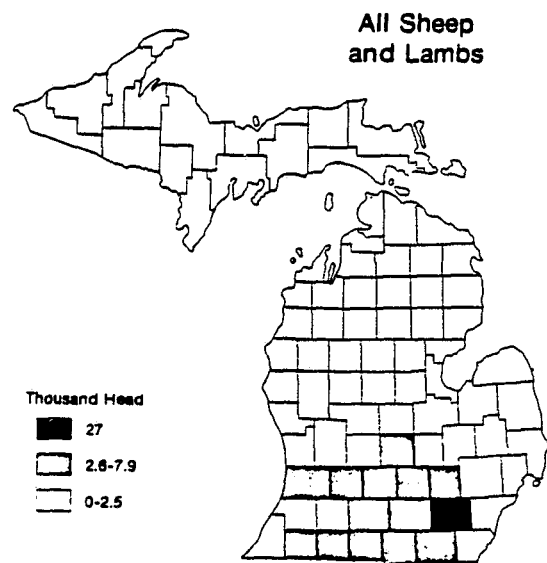
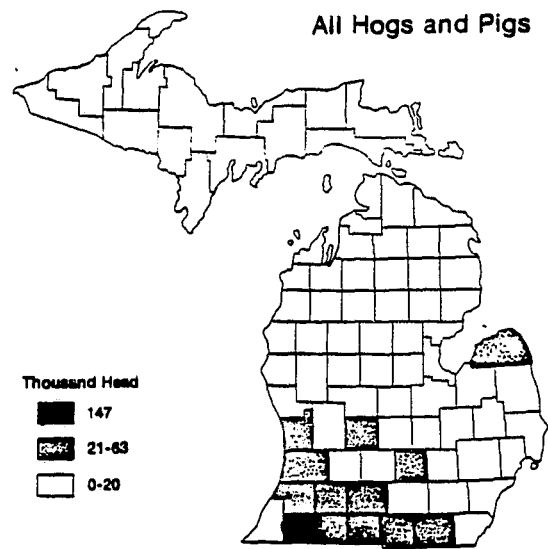
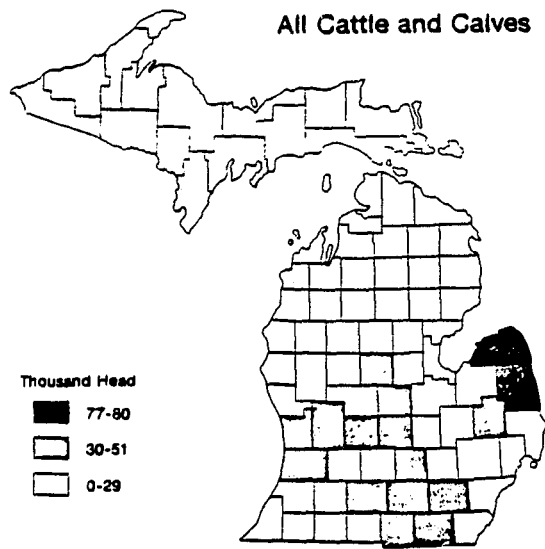
Association: May be in association with wetland areas and woodlots.

29 Other Agricultural Lands

Farmsteads, greenhouses and noncommercial training areas primarily for race horses should be placed in this category.

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23 CONFINED FEEDING OPERATIONS



(3) NONFORESTED LANDS

Nonforested land (open land, rangeland) is defined as areas supporting early stages of plant succession consisting of plant communities characterized by grasses or shrubs. In cases where there is obvious evidence of seeding, fertilizing or other cultural practices, these areas should be mapped as cropland or permanent pasture. Areas dominated by grasses or shrubs, but which occur in marshes, flooded basins or bogs, should be mapped under the appropriate wetland category.

31 Herbaceous Openland

Herbaceous openlands (prairies, grassland, rangeland) are dominated by grasses and forbs. Such areas are often subjected to continuous disturbance such as mowing, grazing or burning to maintain the herbaceous character. Typical plant species are quack grass, clovers, blueberry and ferns.

Marshland meadow areas are classified under the herbaceous openland category. Fresh meadows are found on sites which experience seasonal fluctuations in water level. Meadows may be flooded periodically due to fluctuations in the water table.

Meadows are usually found in connection with agricultural land (farmland topographic depressions) or bordering shallow marshes and overflow bottom lands or in sloughways and usually no standing water is evident. When located in cultivated fields, meadows may interrupt the cultivated pattern. Livestock paths usually avoid wet meadows located in pastures. Meadows are generally darker in tone than nearby cultivated fields or pastures due to damp soils. The flora of seasonally flooded areas is highly variable and may be composed primarily of non-wetland species or aquatic vegetation including hydrophytic grasses (often growing in clumps), sedges, rushes and various broadleafed plants.

32 Shrubland

Shrublands are dominated by native shrubs and low woody plants. If left undisturbed, such areas are soon dominated by young tree growth. Typical shrub species include briars, dogwood, hazel and sumac.

33 Pine or Oak Opening (Savannah)

This category should be used to classify those openings in oak or pine forestland where grass cover is so thick that seeds cannot germinate. Oak savannahs primarily occur in the sandy plains through Muskegon, Oceana, Newaygo and Mecosta Counties, although some may exist in some of the more southern counties. The pine savannahs can be found in the jack pine forest land between Gaylord and Grayling.

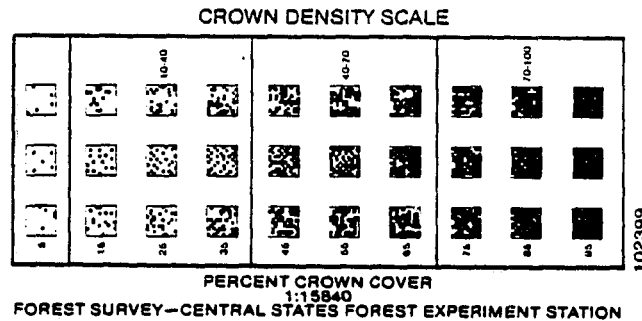
The following table summarizes the significant features for separating the non-forested lands categories.

NONFORESTED LANDS			
Comparison of Categories			
	HERBACEOUS OPENLAND	SHRUBLAND	PINE OR OAK OPENING
SITE	upland, mesic to dry	upland, mesic to dry	sandy plains
COLOR	light magenta to cyan	light pink to dark blue magenta	light magenta to cyan
TEXTURE	smooth	moderately rough	smooth
SHADOW	none	slight	none
PATTERN	irregular	irregular	small openings in otherwise continuous forest cover

(4) FOREST LAND

Forest lands are lands that are at least 10 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest use.

Tree crown closure is used as a measure of stocking since neither basal area nor number of trees per acre are readily obtainable from aerial photographs. Percent crown closure, or crown density, refers to the percent of area under consideration which is covered by tree crowns. Crown closure estimates are subjectively made by comparison of the stand with a printed density scale.



Comparisons should be made by viewing the stand in the space between the rows of different percentages of simulated crown areas. This procedure should be accomplished while viewing the photos in stereo. Lands which do not meet the minimum 10 percent stocking requirements should be mapped under the appropriate nonforested lands or wetlands category.

Lands from which trees have been removed to less than 10 percent stocking but which have not been developed for other uses are included in the Forest Land category. For example, lands on which there is forest rotation, involving clear cutting and regeneration, should be classified as Forest Land, even if there are currently no trees on the site. Unless there is evidence of other use, such areas of little or no forest growth should be included in the Forest Land category.

Lands that meet the criteria for Forest Land and also are being used for a higher category (Urban and Built Up or Agricultural) should be placed in the higher category. Plant communities dominated by herbs or shrubs should be mapped under Nonforested (upland) or Wetland (lowland).

The interpretation of forest land from other land categories is relatively easy on aerial photography. Forest Lands will appear dark blue magenta to red and have one of the roughest textures of any feature on the photo. The shape is normally irregular, often following topographic features, except where a linear boundary exists between it and another category (for example, a road or an agricultural field).

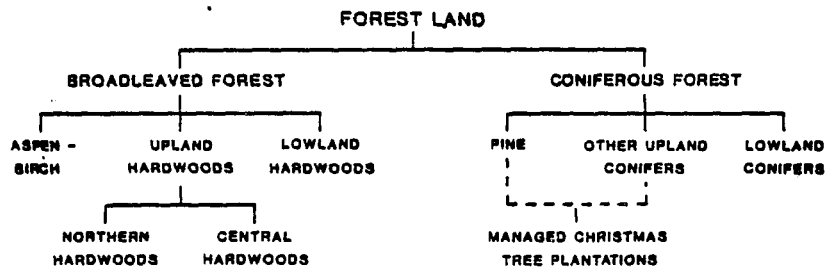
Forest plantations will normally have a rectangular pattern, follow a hillside or "fill in" a previously open area in the forest. The distinguishing characteristics of forest land are summarized in the following table:

FOREST LAND

Distinguishing Characteristics

COLOR	dark blue magenta to red
TEXTURE	moderately rough to very rough
SHAPE	Irregular, canopy composed of many rounded, broadly conical or pointed crowns
PATTERN	heterogeneous mixture of shapes and tones

The Forest Land category is further subdivided into the following groupings:



Forest Land is divided into two major categories, Broadleaved Forest and Coniferous Forest. Broadleaved forest, also called deciduous or hardwoods, includes species such as oak, maple, beech, birch, ash, hickory, aspen, cottonwood and yellow poplar. Coniferous forest, also called evergreens or softwoods, includes species such as pine, spruce, balsam, larch, hemlock and cedar. Broadleaved Forest is differentiated from Coniferous Forest by its brighter red or magenta colors and predominantly rounded crowns.



Coniferous



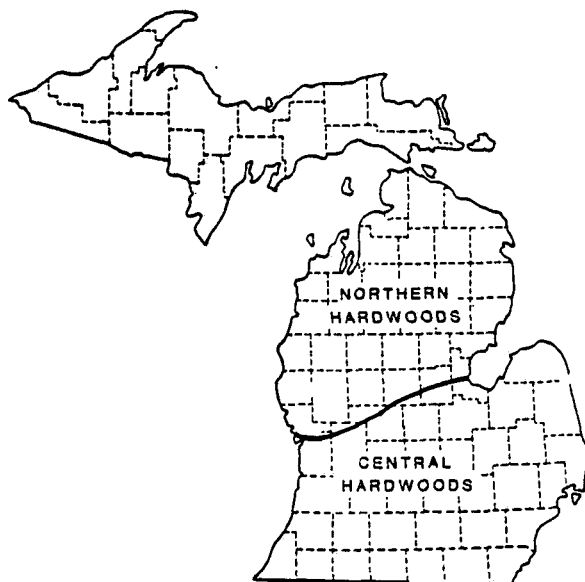
Broadleaved

Both have irregular shapes, except for plantations (which are virtually all coniferous species) which are rectangular. The following table summarizes the significant features for separating broadleaved from coniferous forests:

BROADLEAVED AND CONIFEROUS FOREST

Table of Comparison

	BROADLEAVED	CONIFEROUS
COLOR	red to magenta, occasionally pink to white	dark blue magenta to reddish brown
TEXTURE	billowy to moderately rough	rough, occasionally fuzzy
SHAPE	Irregular	Irregular or rectangular
CROWNS	predominantly rounded	broadly conical to pointed
PATTERN	Irregular	Irregular or distinct rows



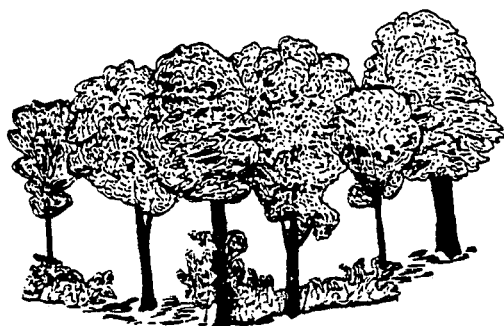
411/412 Upland-Mixed HardwoodsDescription

Upland hardwood forests are widespread throughout the Central Forest Region, south of the tension zone (the line between Bay City-Muskegon where soil types and plant species are different) where they are known as central hardwoods, and the Northern Forest Region, north of the tension zone where they are known as northern hardwoods.

This type is generally found on loamy soils with good fertility and moisture conditions but also extends into quite sandy soils in places. It covers extensive areas, except where the forest is broken by settlement. Old-growth stands are typically uneven-aged, whereas many second-growth stands are even-aged. Composition varies widely, with complex tree associations being common. Principal species include sugar and red maple, elm, beech, yellow birch, cherry and red and white oaks.

Interpretive Characteristics

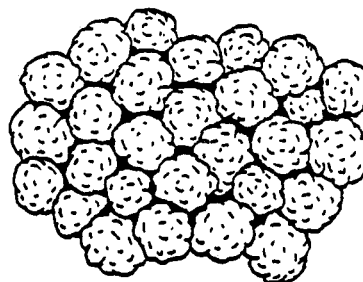
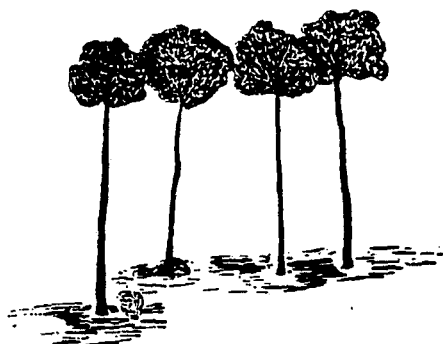
Upland hardwood forests generally occupy upland sites with mesic to dry conditions. Young stands will display a very solid and even canopy formed by very dense, coarse and irregularly rounded crowns. Mature hardwoods, especially in under-stocked stands, may appear broad and round-topped creating a rounded or billowy texture. The crowns will often cast a hard, but distinct, shadow pattern, resulting in a characteristic crown relief. These forests display variable colors within the same stand, the colors ranging from shades of pink to dark red and creating a mottled effect (maples may produce an especially distinctive pink color).

413 Aspen-BirchDescription

The aspen-birch forest type is very widespread, occurring throughout the Northern Forest Region and less frequently in the Central Forest Region. It is a ubiquitous type found on all kinds of soils except the very driest sands and wettest swamps. This type occurs chiefly on burns, clear-cut areas and, less frequently, on abandoned fields, pastures and other disturbed sites. Aspen and white birch, both intolerant species, grow in even-aged stands. Both species will reproduce by sprouting, thus creating heavily stocked stands.

Interpretive Characteristics

The aspen-birch forest type can be found on most sites except the driest sands and wettest swamps. Stands generally appear uniform in height with a regular stand pattern and an even, systematic spatial arrangement. Typically, all crowns are of about the same size, are irregularly rounded and small in relation to tree size. A high density of stocking and the presence of multiple stems often creates stands with an unbroken, grainy texture. The tendency to form clones may result in a stand pattern which appears patchy or "clumpy". Aspen-birch will normally appear bright red; fall coloration produces pink and, eventually, white colors.

414 Lowland HardwoodsDescription

Lowland hardwoods occur throughout the Northern Forest Region and into portions of the Central Forest Region. The type occupies moist or wet mineral and muck or shallow peat soils. It is found in swamps or in elongated areas along small sluggish streams, occasionally covering extensive areas. This type frequently grades into northern white-cedar on the wetter sites (in the Northern Forest Region). Composition is highly variable but black ash, elm, red maple and cottonwood are the principal species.

Interpretive Characteristics

Lowland hardwoods are found predominately along stream and river banks but also occur over extensive areas of low topography and drainage. This type may be separated from aspen by its medium to large crowns and more broken and staggered stand pattern, and from swamp conifers by the characteristically large, ascending branches and the more billowy crowns of the hardwoods. The ground often appears as very dark colors beneath this type due to the open nature of the stands and the associated soil moisture and under-story vegetation. Lowland hardwoods display a moderately rough, uneven

texture and vary in color from dark pink to purple. Because of their topographic location, lowland hardwoods are some of the first trees to show fall coloration. Bright shades of yellow, pink and greens are common of this type.



The following table summarizes the significant features for separating the broadleaved forest categories.

BROADLEAVED FOREST

Comparison of Categories

	UPLAND - MIXED HARDWOODS	ASPEN - BIRCH	LOWLAND HARDWOODS
SITE	upland, mesic to dry	dry to moist	lowland, moist to wet
COLOR	mottled, pink to dark red	bright red, turning to pink and eventually white	dark pink to purple
TEXTURE	smooth to billowy	unbroken, grainy	moderately rough, uneven
PATTERN	irregular with a distinct relief	even, systematic spatial arrangement, may form 'patches'	broken and staggered
CROWNS	variable, broad and round-topped	small, irregularly rounded	medium to large, ascending or upward spreading branches

421 Pine

Description

Stands of white, red and jack pine are found throughout the Northern Forest Region in

Michigan. Naturally occurring stands are found in sand and gravelly locations or on dry, sandy soils; often they are found on shallow-soiled rocky knolls and lake shores. Most forest plantations in Michigan are pine and may be located on a variety of sites in both the Northern and Central Forest Regions. The majority of the plantations are either red or jack pine with lesser amounts of white and scotch pine.

Interpretive Characteristics

The pine forest type is usually found on dry, sandy or rocky, upland soils with low fertility. Plantations are easily recognized by their regular, usually rectangular, shape and uniform spacing of trees. Pine forests present a rough texture (jack pine stands often appear to have a "fuzzy" texture). Crowns vary from irregularly rounded, narrowly conical to star-shaped. The pine type will appear a dark blue magenta to reddish brown, the color changes being associated with species composition, stand density and ground vegetation.

422 Other Upland Conifers

Description

Balsam fir and white spruce are the two most common conifers, besides the pine species, occurring on upland sites. They are more restricted to mesic sites and are commonly found in association with northern hardwoods. These species have occasionally been used for reforestation and may be found in plantations.

Interpretive Characteristics

Upland spruce-fir occurs sporadically on mesic sites, commonly in association with northern hardwoods. This type has a rough texture and irregular stand profile, except for plantations which have a rectangular pattern with distinct rows. The single most distinguishing characteristic of spruce fir are their conical, somewhat pointed (often spine-like), very symmetrical crowns. The type has a light to dark blue magenta color.

423 Lowland Conifers

Description

Lowland conifers, also known as swamp conifers, occupy wet lowlands and drainage ways throughout the Northern Forest Region. It is often found on seepage areas and occasionally on limestone uplands adjacent to the Great Lakes. The type is restricted to small, isolated (relic), bog-type environments in the Central Forest Region. Through natural plant succession, there is a strong tendency for hardwoods to invade conifer swamps. Stands may contain only one or two species or display considerable species mixture. Principal species include black spruce, tamarack, northern white cedar and balsam fir.

Interpretive Characteristics

The lowland conifer forest is found in wet lowlands and drainage ways. Stand appearances vary considerably but will normally have a rough to very rough texture with a ragged, uneven stand profile. Crown shapes vary from pointed-cylindrical to broadly conical or round-topped. Colors will range from light purplish magenta to bluish black, changes being associated with differences in soil moisture, stand density and stand composition.

The following table summarizes the significant features for separating the coniferous forest categories:

CONIFEROUS FOREST			
Comparison of Categories			
	PINE	OTHER UPLAND CONIFERS	LOWLAND CONIFERS
SITE	wetland, especially sandy and dry	mesic, commonly in association with hardwoods	lowland, moist to wet
COLOR	dark blue magenta to reddish brown	light to dark blue magenta	light purplish magenta to blueish black
TEXTURE	rough	very rough	rough to very rough
PATTERN	irregular or rectangular with distinct rows	irregular, occasionally rectangular with distinct rows	irregular
CROWNS	irregularly rounded to star-shaped	pointed, often spire-like, symmetrical	variable, pointed-cylindrical to broadly conical or round-topped

429 Managed Christmas Tree Plantations

These are forest lands specifically managed for the short term growth and harvesting of Christmas trees. Plantings are normally in a regular shape, usually rectangular blocks, with rows displaying a low, linear pattern. Spacing of trees within and between rows is close (approximately 10 ft. x 10 ft.), although the canopy is not closed and trees seldom exceed 9 feet in height. The plantations appear very systematic since after every 14 to 20 rows of trees a 16 to 18 foot strip is left for the passage of machinery. These access lanes are also placed at irregular intervals crossing the rows of trees forming a grid of access lanes. Species are similar to those found in the pine and other upland conifer categories, principally scotch pine, white spruce or balsam fir. Interpretive characteristics of managed Christmas tree plantations are summarized in the following table:

MANAGED CHRISTMAS TREE PLANTATIONS

Distinguishing Characteristics

SHAPE	regular, usually rectangular blocks
PATTERN	systematic, grid of access lanes left at regular intervals
CROWNS	small, close spacing but canopy is not closed, seldom exceed nine feet in height
SITE	frequently on previously farmed land

The most important image characteristics for forest land categories have been abstracted and arranged into a dichotomous key:

KEY TO FOREST LAND CATEGORIES

(1:24,000 Color-Infrared Imagery)

- I. Color- red to magenta, Crowns- predominately rounded . . . BROADLEAVED
 - A. Upland site, mesic to dry
 1. Crowns- broad and round-topped . . . UPLAND - MIXED HARDWOODS
 - a. North of tension zone . . . NORTHERN HARDWOODS
 - b. South of tension zone . . . CENTRAL HARDWOODS
 2. Crowns- small, irregularly rounded . . . ASPEN - BIRCH
 - B. Lowland site, moist to wet
 1. Crowns, medium to large, upward spreading branches . . . LOWLAND HARDWOODS
 2. Crowns- small, irregularly rounded . . . ASPEN - BIRCH
- II. Color- dark blue magenta to reddish brown, Crowns- broadly conical to pointed . . . CONIFEROUS
 - A. Upland site, mesic to dry
 1. Crowns- irregularly rounded to star-shaped
 - a. Pattern- irregular or rectangular . . . PINE
 - b. Pattern- systematic grid of access lanes . . . MANAGED CHRISTMAS TREE PLANTATION
 2. Crowns- pointed, spire-like, symmetrical
 - a. Pattern- irregular or rectangular . . . OTHER UPLAND CONIFERS
 - b. Pattern- systematic grid of access lanes . . . MANAGED CHRISTMAS TREE PLANTATION
 - B. Lowland site, moist to wet . . . LOWLAND CONIFERS

(5) WATER BODIES

Description

The water category includes all areas which are predominately or permanently water covered. This category is subdivided into streams and waterways, lakes, reservoirs and the Great Lakes. It is probably the easiest category to identify and delineate from aerial photographs.

Water bodies that are vegetated are placed in the Wetland category. Sewage treatment or water supply facilities are a basic part of the urban pattern and should be included in the Urban and Built Up category even where the unit is large enough to be separately identified.

51 Streams and Waterways

Description

This category includes rivers, streams, creeks, canals, drains, and other linear bodies of water. Intermittent streams which flow in wet seasons but are dry during dry seasons should be classified as streams if they are water covered the majority of the time. Ephemeral streams which carry surface runoff during and immediately after periods of precipitation or snow melt should not be classified as streams. These areas generally have no permanent or well-defined channels but follow slight depressions in the natural contour of the ground surface. Where the water course is interrupted by a control structure which creates an impoundment, the impounded area should be classified as a reservoir. The boundary between streams and lakes, or reservoirs, is the straight line across the mouth of the stream. The St. Mary's, St. Clair, and Detroit Rivers, are classified as Great Lakes connecting waterways.

52 Lakes

Description

Lakes are nonlinear water bodies, excluding reservoirs. A water body should be classified as a lake if a structure has been installed primarily to regulate or stabilize lake levels without significantly increasing the water area. The delineation of a lake will be based on the areal extent of water at the time the data is collected. Islands within lakes which are too small to delineate will be included in the water area.

53 Reservoirs

Description

Reservoirs are artificial impoundments of water, whether for irrigation, flood control, municipal and/or industrial water supply, hydroelectric power, or recreation. The reservoir category should not include lakes which have had control structures built to stabilize lake levels without significantly increasing the water area. Reservoirs can usually be identified by the presence of dams, levees, or other water control structures.

54 Great LakesDescription

The Great Lakes are the waters of Lake Superior, Lake Michigan, Lake Huron, Lake St. Clair, and Lake Erie. Connecting waterways are the St. Clair, St. Mary's and Detroit Rivers. Bays and estuaries of these lakes and waterways should be included under this heading.

Interpretive Characteristics

- Color:** Light blue, deep or dark blue to black or white depending on turbidity, depth of water and substrate and whether sunlight is present, light turquoise (shallow water marl).
- Texture:** Smooth to very smooth, uniform although ripples may be seen.
- Shape:** No specific shape. Generally conforming to contours of land. Rivers and streams are banded, linear.
- Pattern:** No specific pattern. Rivers and streams are winding.
- Site:** Occupying lowlands, depressions and kettle holes. Reservoirs may be located anywhere, usually in connection with a source of sand or gravel.

(6) WETLANDS

Description

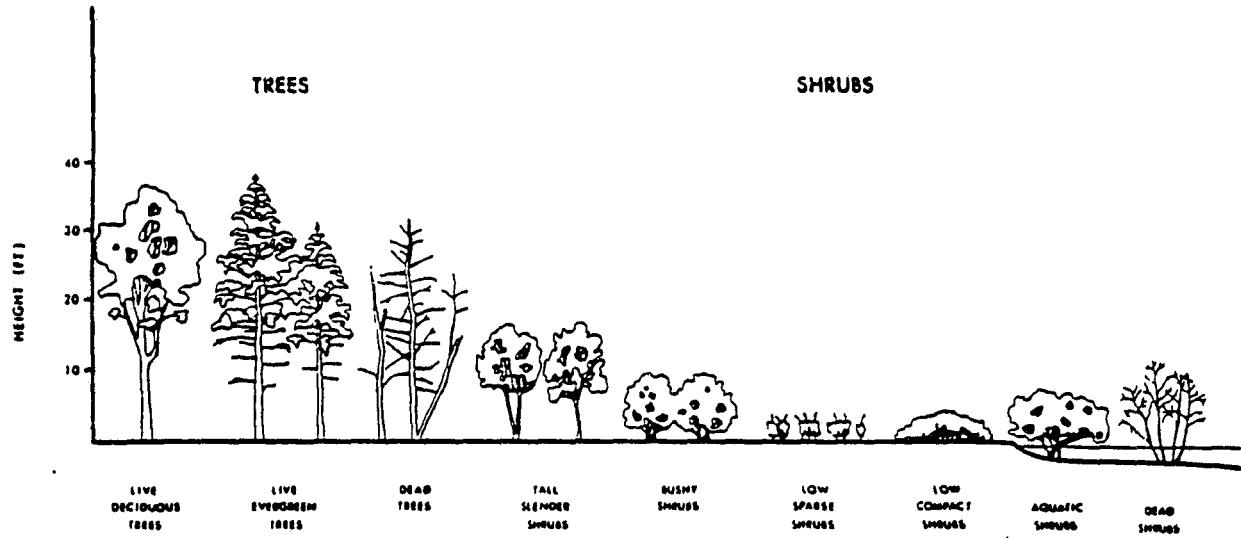
In the Michigan Land Cover/Use Classification System wetlands are defined as areas where the water table is at, near or above the land surface for a significant part of most years. The hydrologic regime is such that aquatic or hydrophytic vegetation usually is established. This general category includes marshes, swamps, bogs, potholes, wet meadows and river overflow land and shallow lakes and ponds with emergent vegetation. At the Level II classification level, there are two categories of wetlands (Forested Wetlands and Non-Forested Wetlands). At Level III there are seven categories: wooded swamp and shrub swamp are classified under Forested Wetlands whereas marshland, meadows, mudflats, shallow marshes, deep marshes and open water are classified under Non-Forested Wetlands. However, only five types of wetlands are recognized in the Michigan Current Use Inventory Classification System, which is being used in the statewide inventory.

Life forms and subforms of wetland vegetation are the foundation for this classification. Life-form or physiognomy is the physical structure or growth habit of a plant. The major factors contributing to form are plant height, branching pattern and leaf shape. Five life-forms and 18 subforms are identified in the following figures. The major life-forms represent obvious divisions of vegetation: trees, shrubs, emergents, surface plants and submergents. Subforms are divided based on differences in structure, leaf shape, ecology or stand density.

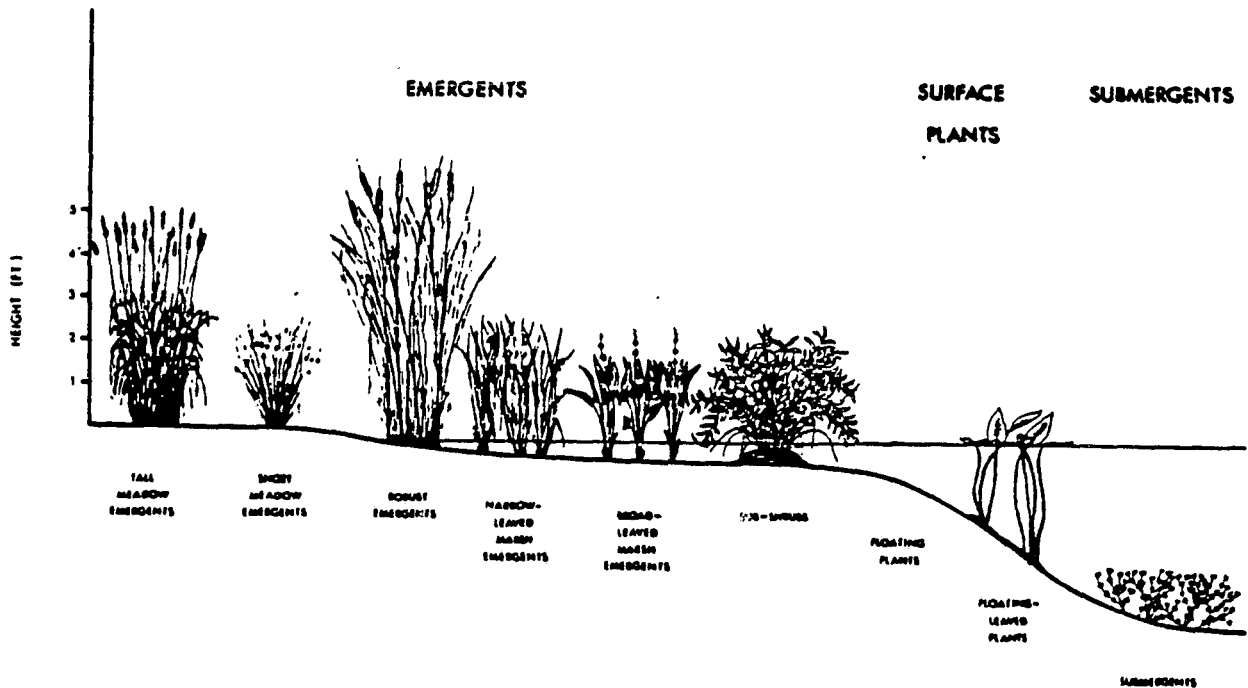
In order to accurately identify wetlands from aerial photographs, an interpreter must have detailed definitions for each type of wetland. Wetlands, however, are difficult to define and photo interpret for several reasons.

1. Wetlands may have indistinct boundaries, i.e., a gradation or continuum between wetland and dry land or wetland and water. The boundaries are dynamic.
2. Vegetation cover types may change with season or over years by progression and ecological succession.
3. Areal extent may change in response to weather, climate and man's activity.
4. The amount and duration of wetness may fluctuate (seasonally flooded areas vs. permanent water).
5. Water depth and transparency influence the interpretability of plant communities.
6. People are less familiar with wetlands due to their nature and inaccessibility.

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Subforms of wetland trees and shrubs.



Subforms of wetland emergents, surface plants and submergents.

Golet, F.C. and J.S. Larson. 1974. Classification of Freshwater Wetlands in the Glaciated Northeast, Bureau of Sport Fisheries and Wildlife, Resource Publication 116, U.S. Fish and Wildlife Service, Washington, D.C. 56p.

A wetland is a dynamic system. It responds to changes according to the time of the year, precipitation, ecological succession, beaver activity, human activity, etc. Air photos can only indicate the situation at the time of sensing. For example, spring is the time when soils are most saturated so spring photography will normally show the maximum extent of wetlands, particularly seasonally flooded areas. Leaf-off photos would also facilitate the interpretation of flooded deciduous trees. However, late summer/early fall would be the best time for mapping the maximum development of wetland vegetation types since one could identify late-blooming species. August or September would also be the best time of the year to detect floating-leaved vegetation. It is important to remember that the dominance of various wetland species may change throughout the growing season. What's dominant in June may be different from what's dominant in September or October.

Topographic maps and soil survey information are an aid in the correct identification of wetlands. Wetlands are situated usually in topographic lows and, in some cases, will be indicated on USGS topographic quadrangles. Since many wetland types are on organic soils, either muck or peat, a modern soil survey of the area to be inventoried is truly an asset. The water-holding capacity of muck soil is several times more than that of sand. It is, thus, an ideal environment for the development of aquatic water-loving plants. Different types of muck materials have been formed under four types of vegetative conditions: aquatic (deep water), marsh, swamp and bog. Caution must be exercised when using the delineation of muck and peat areas on soil maps as a key to wetland conditions since such areas may not now support aquatic vegetation. They may have been drained for agricultural purposes or the delineation of areal extent may not directly correspond to the configuration of the present wetland. Nonetheless, soil surveys are a vital data source in wetland mapping.

Interpretive Characteristics

Basic criteria for the identification of each wetland type are presented below, as well as problems encountered when attempting to differentiate them from other land uses. A general key is presented which lists the basic criteria for photo-identifying each wetland type based on specific image properties.

One of the most basic and obvious clues to the identification of wetlands is their location with respect to topographic contours in that they fill upland depressions, shallow lake basins, sloughs and overflow bottom lands. The shape of wetlands may be circular, oval, trough-like or irregular yet conforming to the contour of the land. Tone often varies within a short distance, ranging from black (indicative of water) through pink to the characteristic magenta appearance of highly infrared reflective vegetation. Texture may vary from smooth to coarse.

Wetlands are also frequently found in association with sluggish streams, seepage areas, lakes and other types of surface water features. Another key to their identification is a concentric or banded pattern caused by life form dominance and depth of water (See Figure following).

The relationship of topographic location or local relief to the location of the water table is a major factor affecting site moisture conditions. Topography and soil conditions affect how long a specific site will be covered by water (and at what depth) in the spring and during the growing season, how far above the water table it will be

and how frequently it will be flooded. How frequently a site is inundated with water is called its water regime, which may be described as ephemeral, temporary, seasonal, semi-permanent or permanent.

A site's water regime affects plant vigor and productivity. A photo interpreter should recognize the influence of higher moisture regimes on the tonal signature of similar plant associations. Variations in soil moisture definitely affect plant vigor. However, keep in mind that it can increase plant productivity or stunt growth, depending on the type of vegetation and specific site conditions.

The color and texture of wetland communities are also influenced by plant density and composition or the purity of the stand. The interpretation keys that follow are based mainly on pure stands or representative associations with uniform distribution of plant types. Many subtle shade differences may be evident within an area of mixed vegetation due to changes in species composition. This can be a major clue in identifying wetlands since many inland marshes are vegetatively diverse environments. The signature designation is also relative because seasonal changes in the reflectance of plant species and their distribution, as well as shifts in plant orientation and site conditions, can alter the photo image of a plant community. Scale changes and variations in atmospheric conditions will also affect tonal signature.

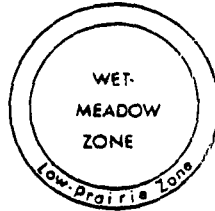
The following is a general description of key image-identification criteria:

- Color:** Often a large variation with a short distance. Ranges from black (indicative of water) through pink to the characteristic magenta appearance of highly IR reflective vegetation. May either be darker than other vegetation due to presence of water or lighter and more brilliant due to broadleaves (lilies) or abundant soil moisture (grasses and sedges).
- Texture:** Smooth to coarse.
- Shape:** Circular, oval, trough-like or irregular; conforming to the contour of the land.
- Pattern:** May be concentric or banded, high vegetation interspersion.
- Site:** May partly or completely fill upland depressions, shallow lake basins, sloughs or overflow bottom lands; frequently associated with sluggish streams, seepage areas, lakes and other types of surface water.

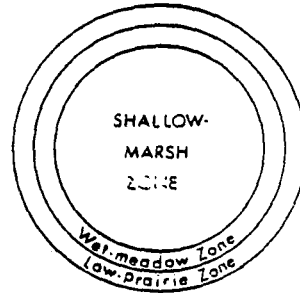
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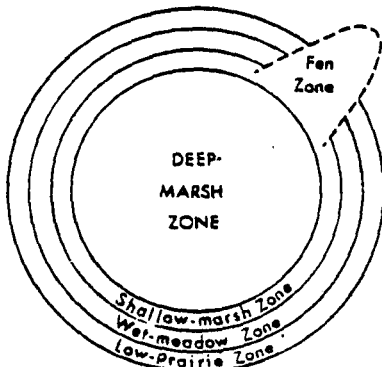
Class I
Ephemeral
Pond



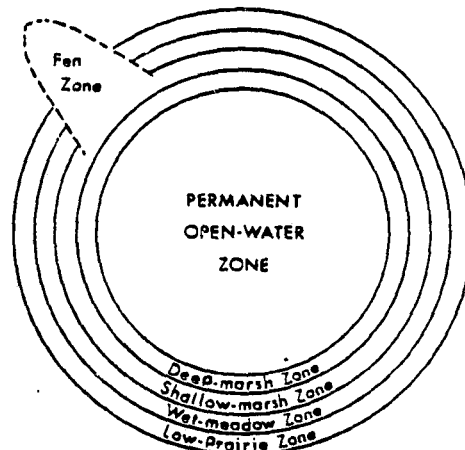
Class II
Temporary
Pond



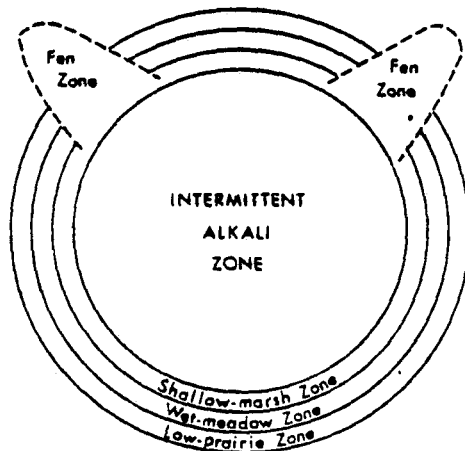
Class III
Seasonal
Pond or Lake



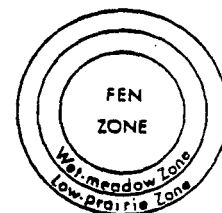
Class IV
Semi-permanent
Pond or Lake



Class V
Permanent
Pond or Lake



Class VI
Alkali
Pond or Lake



Class VII
Fen
Pond

Spatial relation of vegetational zones in major classes of natural ponds and lakes.

Stewart, Robert E. and Harold A. Kantrud. 1971. Classification of Natural Ponds and Lakes in the Glaciated Prairie Region. U.S. Fish and Wildlife Service Resource Publication 92. 57p.

61 Forested (wooded) Wetlands

611 Wooded Wetlands

Description

This class applies to wetlands dominated by trees more than 20 feet tall. The soil surface is seasonally flooded with up to one foot of water. Several levels of vegetation are usually present, including trees, shrubs and herbaceous plants. Wooded swamps may be located along streams or near marshes. Wooded or treed bogs are included in this category. Successional bogs may be identified by a concentric or banded pattern, however, bogs and swamps do intergrade and no hard and fast line can be drawn between them in all situations. Bogs may be identified by dominant bog indicator species such as sphagnum, Leather-leaf and Labrador-tea, bog rosemary, tamarack, black spruce or northern white cedar. In lieu of vegetation indicators, bogs are identified on the basis of substrate (organic soils or peat) and water chemistry (extreme pH value, normally acid in our area, and nutrient poor conditions). Bogs which do not contain trees would be classified under the shrub swamp category. Patterns and shapes are important and notable features characteristic of peatlands, i.e., the inter-associational pattern of concentricity:

Sphagnum Peatlands are surrounded by red maple-alder swamp and the shape of the peatlands are outlined by a narrow band of red maple swamp.

Leatherleaf-Sphagnum Peatlands are bordered by a Leatherleaf-cattail association.

These patterns and shapes are probably due to plant responses to gradients in environmental conditions, such as pH. Concentricity is a key factor in identification of peatlands.

Generally, the trees in wooded wetlands will vary in height and the tops are usually lower than surrounding upland trees. Flooded deciduous trees are often stunted. If an area can be identified as Lowland Hardwoods (414) or Lowland Conifers (423), it should be classified as such under the forest category.

Interpretive Characteristics

- Color:** Light purplish magenta, reddish brown to blueish black (conifers), deep mauve tone (tamarack, white cedar), dark pink to purple or white (deciduous), red-magenta-violet (alder and maple). The tone will be darker if there is water underneath or lighter if there are duckweed or emergents in the understory or if there is specular reflectance from the water.
- Texture:** Course, rough to very rough, uneven. May be mottled (red maple, alder, willow swamp).
- Shape:** Irregular.
- Pattern:** Irregular, broken and staggered; may be uniform when isolated and concentric when associated with other wetland types.

- Site:** Occurs in lowland areas and depressions; moist to wet sites, sluggish streams, flood plains, shallow basins; association with shrub swamps, streams.
- Crowns:** Variable, pointed-cylindrical to broadly conical (coniferous) or round topped (broadleaved); Ascending or upward spreading branches.

612 Shrub/Scrub Wetland

Description

Shrub wetlands contain woody vegetation less than 20 feet tall, mainly shrubs and small or stunted trees. The shrub vegetation may be stable or in a successional stage leading to a wooded wetland. Ericaceous bogs and areas of dead flooded trees are also placed in this category. Flooded sites are normally associated with man-made or natural impoundments (roads, pipelines, dams, beaver ponds). The individual trees are light in tone and there is a tweed-type texture due to arrangement (juxtaposition) of fallen limbs and trunks which is distinctively like broken matchsticks. Shrub swamps tend to have a random pattern, whereas bogs often exhibit a concentric or banded pattern due to plant succession. Shrub swamps as opposed to marshes are typically rougher in texture and often the presence of individual shrub crowns is quite evident. Shrubs typically have multiple stems. Viewing a questionable area stereoscopically often results in a quick and accurate identification because of vegetative height differences and topographic location (even at scales of 1:60,000 - 1:120,000).

Interpretive Characteristics

- Color:** Intense magenta to brown; usually darker than wooded swamps and emergents; dull magenta to dull green magenta (leatherleaf); green, orange (sphagnum).
- Texture:** Coarse, but not as coarse as wooded swamps; typically diverse stands of uneven height; grainy.
- Shape:** Irregular.
- Pattern:** Uniform when isolated and concentric when associated with other wetlands; random appearance of individual shrubs may be evident.
- Site:** Along sluggish streams, in small pockets and depressions, adjacent to shallow and deep marshes and occasionally on flood plains, often with streams or channels leading in and out of the area.

62 Non-Forested Wetlands

621 Aquatic Bed Wetland

Description

Aquatic beds are submerged, floating leaved or floating plants covering more than 30

percent of a water surface. Typical plants are yellow water lily, duckweed and pond weeds. This wetland type is basically a transition zone (dominated by submergents) between open water lacking macrophyte plant growth and the emergent taxa of the more landward communities.

The delineation of aquatic beds is particularly dependent upon film type, scale and date of the imagery as well as water transparency and the amount of atmospheric attenuation. These factors, in conjunction with the depth of the water above the submergents, determine whether submergents will be images.

The tonal signature of submergent vegetation on CIR photography is typically lighter than the surrounding water (which may contain submergents at depths beyond the water penetration capabilities of the film) yet it's darker than other types of aquatic vegetation. In sandy shoal areas, however, the water signature tends to be towards a light blue and the submergent vegetation is normally darker. Floating and floating-leaved plants (duckweed and water lily) are usually light in tone due to the high reflectivity of the leaves, its broad-leaved structure and its horizontal orientation on the water surface.

If the aquatic beds cover all of the surface of the water (e.g., a pond covered with duckweed), the texture will be very smooth and uniform. However, if vegetation cover is intermixed with open water (e.g., sparse growth of water lilies), texture will appear mottled or blotchy.

Aquatic beds do not extend much above the water surface although they may appear to be below the surface. Rooted floating-leaved vegetation appears in small mats scattered over the water or in narrow strips at the edges or fringe of a water body. Free floating plants are often blown to the leeward (usually east) side of a water body. Both types are normally found only in calm, protected water.

Interpretive Characteristics

Color:	Bright pink to medium pink (water lilies, pondweed), deep orange to dark green, blue green (water milfoil), deep red (coontail), light pink (duckweed), cream, white or gray blue very light tan (green algae mat), lighter than water or darker than very shallow waters underlain by sand.
Texture:	Fine, very smooth, uniform or grainy (duckweed), or coarser (pondweed, coontail).
Shape:	Round to elongated (water lily), round (pondweed), very distinct boundaries (water milfoil), amorphous or indistinct boundaries (green algae mat).
Pattern:	Uniform, mottled, blotchy.
Site:	In the water, near shore, wave-protected areas, ponds, water-filled drainage areas, storm sewer outfalls, woodland pools.

622 Emergent Wetland

Description

These are areas dominated (30 percent or more cover) by erect, rooted herbaceous hydrophytic plants which are growing out of standing water or waterlogged soils. Typical emergent plants are cattails, bulrushes, rushes, reed grass, bur reed, arrow arum, arrowhead, pickerelweed and sedges.

Marsh areas containing emergent types of aquatic plants can be differentiated from aquatic beds and open water by the magenta hues indicative of denser vegetative cover and by a coarser texture. Separating emergent marshes from shrub swamps usually poses little problem because of differences in texture and pattern, and when viewed stereoscopically, height.

Emergents with a persistent detritus which remains above the water (e.g., cattails) show very light tones on spring photography due to bleached dead vegetation (stems).

Some classification systems distinguish between shallow and deep marshes on the basis of a water depth of 6 inches and a plant-water ratio (cover) of 50%. Image discrimination between deep and shallow marshes is often difficult because water depth determination is not directly obtainable from aerial imagery. It is possible to identify and delineate discrete shallow marshes that nearly fill shallow lake basins or sloughs. However, in areas where deep and shallow marshes border each other it is difficult to precisely locate the deep-shallow boundary (approximately where 6 inches of water depth occurs).

Some emergent types have very distinctive signature characteristics. For example, hybrid cattail (*typha glauca*), when canopy is homogeneous and completely pure, it has a bright green hue on CIR photography. A midseason shift from crimson or magenta to green for non-hybrid cattails indicates a decrease in IR reflectance associated with dehydration of mesophyll degeneration accompanying early senescence.

Muskrat houses may be detectable in emergent wetlands as small, distinctive white dots. Some may be ringed by a narrow dark band of water. Since cattails and bulrushes are the principal vegetation comprising muskrat habitats, the photo interpreter can be certain that one or both plants are present.

Reed grass varies in color from greens to reds to pinks, depending indirectly upon water quality and soil moisture. However, it has a characteristically smooth, velvety texture due to lack of leaf bending and large distinct heads. It is often found in disturbance areas (e.g., dredge spoil deposits).

Interpretive Characteristics

Color: Red, deep red-brown, blue green, dull green or mottled white patches of bleached stalks (cattail, bur reed), medium red-brown, dark gray red-brown, browns, olive drabs, dark greens (bulrush, rush), strong pink, purplish pink (pigweed, smartweed), pinks (sedges), light pink, gray pink, gray, blue gray, gray blue (grasses), brilliant green blue, dark green blue, white (dead vegetation).

Texture: Normally medium but may be smoother or fine if stands are pure, emergents may have a slightly granular texture.

Shape: Irregular.

Pattern: May be concentric or banded around lake.

Site: Occurs in depressions in moraine, till plain and outwash and frequently borders open water in such depressions, shallow shoreline areas of lakes.

623 Wetland Flats

Description

These are level or nearly level deposits of unconsolidated sand, mud or organic sediments with less than 75% aerial coverage of stones, boulders or bedrock and less than 30 percent vegetative cover. Wetland flats support little or no vegetation and are exposed during periods of low water. Sites next to water typically appear in mid- to late-summer. They are, for the most part, temporary features.

Interpretive Characteristics

Color: Usually dark brown to black. Not as dark as open water (black); gray, gray/green or may be white, cream if sandy.

Texture: Smooth to fine.

Shape: Usually an irregular band, linear, patchy.

Pattern: Narrow, irregular band.

Site: Usually found next to rivers or streams, occasionally at water interface of lake or pond, drained muckland (drainage ditches always present), very level surface.

(7) BARREN LAND

Description

Barren land is land of limited ability to support life and little or no vegetation. Land temporarily barren owing to man's activities and where it may be reasonably inferred that the land will be returned to its former use, is included in one of the other categories. Agricultural land temporarily without vegetation because of tillage practices is still classified as agricultural land. Sites for urban development stripped of cover before construction begins should be classified as urban and built up. Areas of extractive and industrial land having waste and tailings dumps should be placed in the respective extractive and industrial category. In the Michigan Current Use Inventory the three main categories of barren lands are (72) beaches and riverbanks of exposed sand and ground, (73) unvegetated sand dunes and (74) areas of bare exposed rocks. An additional type, transitional areas, is included in this category under the Michigan Land Cover/Use Classification System. Transitional areas are sites of exposed earth which an image interpreter cannot reliably predict the future use of or discern the past use of. Most barren lands have very bright white and smooth tonal signatures, particularly on color infrared photography.

Interpretive Characteristics

Color:	Very bright white.
Texture:	Often very smooth.
Shape:	May conform to configuration of a water body.
Pattern:	Often linear or curvilinear.
Site:	May be close or adjacent to water bodies.