OFS 2004-14

From Missile Bases to Public Places: Conducting Environmental Assessments of City Parks

C. Brian Trask

Open File Series 2004-14

Illinois Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
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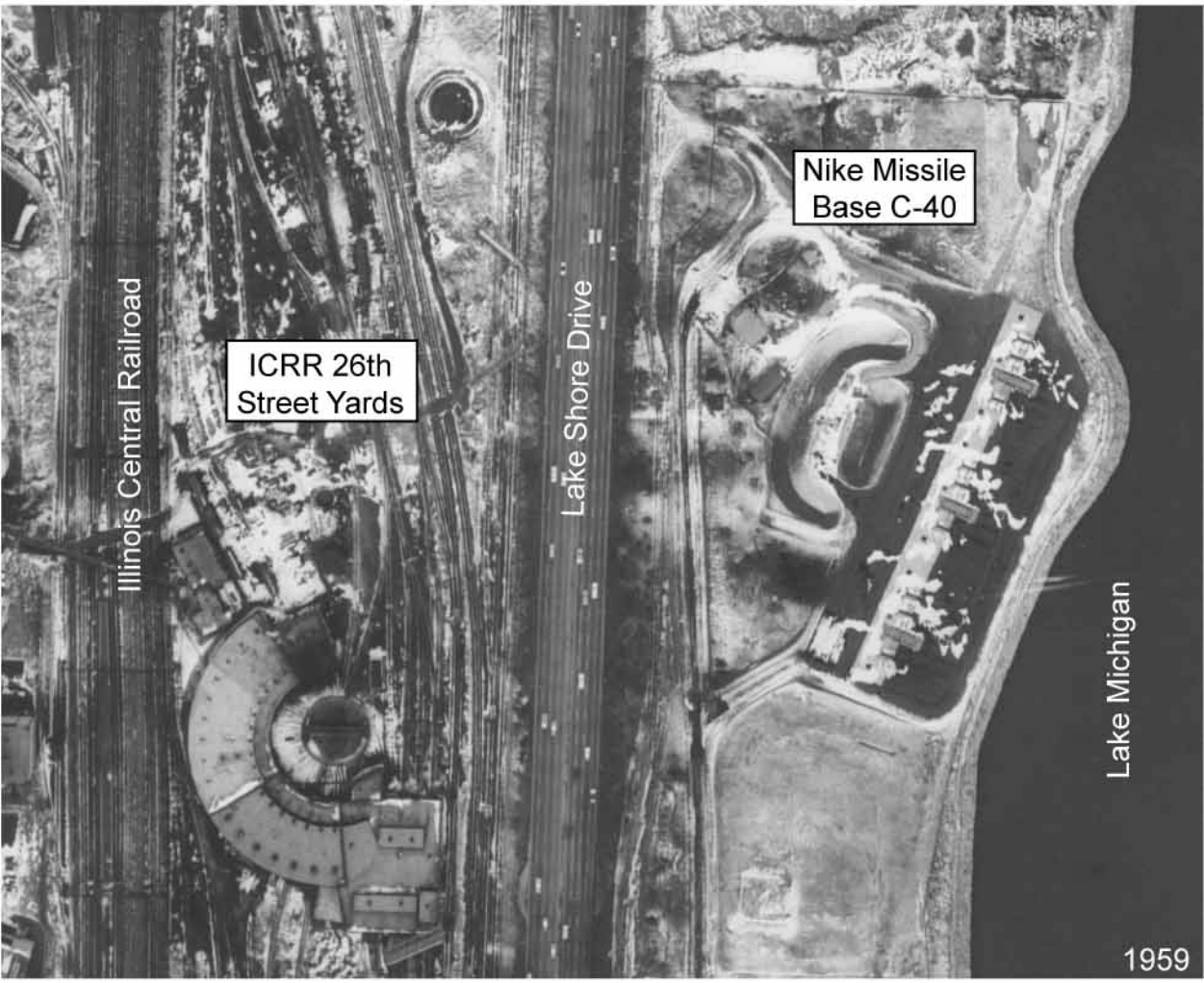

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Website addresses listed in this document were accurate and active at the time the document was published. However, websites change frequently and may be different in the future.

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INTRODUCTION

A preliminary environmental site assessment along a segment of U.S. Route 41 (US 41; also known as Lake Shore Drive) in Chicago was completed by the Illinois State Geological Survey (ISGS) for the Illinois Department of Transportation (IDOT) in late 1999. The purpose of the survey was to identify any environmental concerns, both natural and man-made, that IDOT might encounter during construction work to repave US 41 through Chicago's Burnham Park and Jackson Park (fig. 1), and to improve drainage along this part of the highway. The ISGS procedure for conducting such evaluations (Erdmann *et al.*, 1996) consists of gathering historical and scientific information from published and unpublished reports and from government lists, conducting a field investigation of the project area, and drilling boreholes to test soil gases for volatile organic compounds (VOCs) and to collect soil samples to analyze for various compounds of concern identified during the investigation.

Information concerning potential geological hazards was taken from publications of the ISGS (Willman, 1971; Hansel and Johnson, 1996) and the U.S. Geological Survey (Hopper, 1985). Information was also obtained from other U.S. Government sources concerning wetlands in the project area (U.S. Department of the Interior, Fish and Wildlife Service, 1985) and flood hazards along the lake shore (Federal Emergency Management Agency, National Flood Insurance Program, 1981). Historical documents included numerous aerial photographs available from IDOT and the Chicago Historical Society; Sanborn Fire Insurance maps; ground-level photography from the Historical Society and the Chicago Park District; and historical maps and documents from the Historical Society, the Park District, and the Chicago District of the U.S. Army Corps of Engineers. Government lists consulted during the course of this investigation included the list of registered underground storage tanks (USTs) maintained by the Illinois Office of the State Fire Marshal; the Illinois Environmental Protection Agency's list of leaking underground storage tanks (LUSTs), available on-line at http://epadata.epa.state.il.us/land/ust/index.asp, and other lists maintained by the agency; and the U.S. Environmental Protection Agency's Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) list, available on-line at http://www.epa.gov/superfund/.

Despite an initial expectation that the main environmental concerns in the area of this project would be erosion and flooding along the lake shore itself, along with minor commercial activity at 67th Street south of Jackson Park, an examination of the various sources of information made it apparent that previous land uses within the parks had created other potential man-made hazards. These included two railroad roundhouses, two Nike missile bases, and two world's fairs. It was also discovered that several USTs were, or had formerly been, located adjacent to the project alignment, not only at gasoline stations along 67th Street, but within the parks themselves. The results of this investigation have been presented at the Third International Symposium on Integrated Technical Approaches to Site Characterization at Argonne National Laboratory (Trask, 2000) and at the 20th meeting of the North Central Section of the Geological Society of America (Trask, 2001).

Project Location

The section of US 41 investigated is along Chicago's South Lake Shore Drive beginning at 23rd Street and passing through Burnham Park south of the McCormick Place convention center and through Jackson Park from the Museum of Science and Industry south to 67th Street (fig. 1). It is surrounded by parklands from McCormick Place to 67th Street, except for minor commercial development along the west side through sections of the Hyde Park neighborhood. At the south end, the project included the commercial development along 67th Street at its intersections with Lake Shore Drive and with Jeffery Boulevard.

Historical Documents

Aerial photographs dating back to 1936 were the most valuable historical documents available, because they showed parts of Burnham and Jackson Parks not covered by map documents. Sanborn Fire Insurance Maps from as early as 1895 showed commercial development near the north end of the project (the area currently containing McCormick Place), along the west side of the Illinois Central Railroad tracks throughout most of the project area, and along 67th Street at the south end of the project. Historical documents at the Chicago Historical Society, in addition to aerial photographs, included collections of surface photographs for various historical activities that have occurred in the parks and documents dealing with the parks' land-use planning, maintenance, and infrastructure. Surface photographs at the Chicago Park District covered numerous prior uses of the two parks. Using available government lists, discussions with an environmental engineer at the Chicago Park District, and field observations, the ISGS discovered USTs and LUST events at commercial facilities adjacent to the parks (particularly along 67th Street) and at Park District facilities. Aerial photographs from various sources, documents and ground-level photographs obtained from the Chicago Park District and the Chicago Historical Society, and reports reviewed at the Chicago District of the U.S. Army Corps of Engineers provided information that permitted identification of sites associated with railroads, military bases, and world's fairs formerly located within the parks.

GEOLOGY

Geomorphology

The project area consists of relatively level terrain encompassing areas of Burnham and Jackson Parks. These areas have undergone extensive modification and reflect little of their original appearance. Originally a series of beach ridges and intervening swales, the Jackson Park area was extensively modified under the direction of landscape architect, Frederick Law Olmsted (1822-1903), for the 1893 World's Columbian Exposition. Numerous lagoons were dredged and connected to Lake Michigan by inlets, and the excavated materials were used to construct upland surfaces for exposition buildings (Chrzastowski, 1991).

That portion of the Chicago lakeshore occupied by Burnham Park was formerly lake-bottom sediments. The area along the western margin of Burnham Park was primarily a beach with sand dunes at its western boundary that were constructed by winds blowing off the lake. During the 1800s, the Illinois Central Railroad built a railroad along the shore of Lake Michigan along what is now the west side of Burnham Park and into the downtown area across a trestle. Positioning of the railroad at this location offered protection of the Chicago shoreline from erosion by waves

generated by northeasterly winds blowing across the long fetch from the northeastern end of the lake.

In 1909, Daniel H. Burnham (1846-1912) presented a plan to create parkland along the lake shore, consisting of a series of bays, inlets, and headlands (Burnham and Bennett, 1909). Burnham's vision had to be created by filling, which began with the Illinois Central's creation of a two-block area near what is now Solidarity Drive where the Field Museum is currently located (Wille, 1972). During preparation for the Century of Progress world's fair of 1933, extensive fill was emplaced. The portion of the lake front encompassed by Burnham Park is located on this fill from Promontory Point on the south to the north end of the project at 23rd Street.

Unlithified Sediments

Surficial sediments in the project area are approximately 24-27 m (80-90 ft) in thickness (Piskin and Bergstrom, 1975). The uppermost unit from 23rd Street on the north to approximately 56th Street consists of more than 3.0 m (10 ft) of fill, which was placed over silt and clay of the Lake Michigan Formation. From 56th Street to the Jackson Park Yacht Harbor, the topmost unlithified sediments consist of fill to the east and sand forming the Dolton facies of the Henry Formation overlying the finer-grained facies of the Equality Formation to the west. From the Yacht Harbor south to the end of the project at 67th Street, the project is underlain by discontinuous Equality Formation. The Lake Michigan and Equality Formations overlie thick (more than 6 m [20 ft]) units of the Wedron Group, consisting of silty and clayey tills (Willman, 1971; Lineback, 1979; Hansel and Johnson, 1996).

Bedrock

The uppermost bedrock unit in the project area is the Silurian-age Racine Dolomite of the Niagaran Series. Rocks of the Racine Dolomite consist of relatively pure dolomite, formed in reef environments, surrounded by clayey to silty dolomite with lenses of shale. These rocks are exposed on the lake bottom at Morgan Shoals, located offshore from Burnham Park at 46th Street; at Stony Island, near the north end of Lake Calumet; and at the Thornton Quarry, where they have been mined since the early 1800s. Bedrock is not exposed in the project area.

Drainage direction

Surficial drainage in the project area is generally toward the east, in the direction of Lake Michigan. In the southern part of the project area, south of 56th Street, surficial drainage is both to the east toward Lake Michigan and to the west toward harbors and lagoons in Jackson Park. The 59th Street Harbor at the north end of Jackson Park and the Jackson Park Yacht Harbor and South Lagoon at the south end of the park exchange water with Lake Michigan through inlets. However, storm water runoff in the project area is funneled into the tunnels and reservoirs constructed in bedrock by the TARP[1] program.

[1]Tunnel and Reservoir Plan. Extensive tunnels and underground reservoirs were constructed beginning in the 1970s to intercept and store sewage and storm-water runoff until it can be treated at sewage treatment plants following cessation of rainfall.

NATURAL HAZARDS

Throughout major portions of the project area, US 41 crosses fill emplaced along the lake shore. Fill material in the Chicago area has been determined to be contaminated with polycyclic aromatic hydrocarbons (Berggreen *et al.*, 1991). However, the samples collected for that study were from downtown locations and included materials from the Chicago Fire of 1871 and waste dumped during the late 1800s, including ash and cinders. Fill placed along the lakeshore to form Burnham Park consisted of relatively clean sand from the near-shore lake bottom and the sand dunes of northern Indiana. According to National Wetlands Inventory maps, several wetlands have been mapped in or adjacent to the project area. According to Flood Insurance Rate maps, the project route crosses the 100-year floodplain of Lake Michigan at the entrance to the 59th Street Harbor, at the passage between Jackson Park Yacht Harbor and South Lagoon, and at the crossing of a drainageway south of Marquette Drive and east of Jeffery Boulevard. Flooding, standing water, and saturated soils may be encountered in these areas, particularly during periods of heavy or extended rainfall or spring snowmelt and when the level of Lake Michigan is high.

MAN-MADE HAZARDS

Roundhouses

The former presence of two Illinois Central Railroad roundhouses, located in the area currently covered by pavement for parking and truck marshaling south of McCormick Place West, was discovered through examination of Sanborn Fire Insurance maps (fig. 2) and aerial photographs. The roundhouses were built prior to 1860 for steam-engine repair and maintenance (Anonymous, 1960). Activities at the roundhouses had included extensive servicing of steam and diesel locomotives (consuming as much as 3,028,320 liters [800,000 gallons] of petroleum products each month), electrical power generation, and metals handling.

Built in the 1800s, the two roundhouses are shown on Sanborn Fire Insurance maps from 1911 (fig. 2A). Located on what was at that time the shore of Lake Michigan, the roundhouses were situated between the main-line railroad tracks and the Lake Michigan shoreline and were part of the Illinois Central Railroad 26th Street Yards and Electric Power Plant. Between the two roundhouses were a machine shop, tin shop, blacksmith, and a generating facility powered by petroleum-fueled engines. The location of the fuel storage area is not shown on the Sanborn maps.

North Round House was demolished in the 1940s (Anonymous, 1960), and an above-ground storage tank (AST) for petroleum was installed at the site of the former turntable (fig. 2B). The electrical generating plant had been removed by 1950, according to Sanborn maps, and South Round House had been modified for servicing of diesel-powered locomotives, including addition of a diesel-engine servicing area and an oil-reclaiming facility at the south end of the roundhouse and installation of a larger blacksmith shop at the north end of the roundhouse. South Round House was demolished in the 1960s. The area is currently used for truck parking for McCormick Place.

Soils adjacent to this truck parking lot were tested for metals, PCBs (polychlorinated biphenyls), and VOCs. VOCs were detected near the former North Round House adjacent to the former location of the large petroleum AST. Arsenic and lead at concentrations above TACO Tier

I residential standards[2] were detected adjacent to the central area where metals had been worked for locomotive repair. PCBs were not detected adjacent to the former power house.

World's Fairs

Two world's fairs have taken place within the project area. In 1893, the World's Columbian Exposition occupied Jackson Park, and in 1933 and 1934, A Century of Progress International Exposition was held in what is now the northern part of Burnham Park. One aspect of the World's Columbian Exposition was development of electricity, marked by the large Electricity Building, numerous electrical fountains and displays, and electrical rides along Midway Plaisance, which connects Jackson Park with Washington Park to the west (Fig. 1). These rides included the large wheel invented by George W. Ferris of Pittsburgh (Appelbaum, 1980). Review of maps from the fair indicated that electrical generating capability was constructed on the fairgrounds. Using a map provided by the Chicago Park District (Chicago Department of Works, 1893), it was possible to identify a former oil-tank vault, a pump house, sewage cleaning works, and car shops for repair of railroad cars just north of 67th Street and west of Lake Shore Drive (fig. 3). Though these facilities were located at too great a distance from Lake Shore Drive to be of concern to the project, a power house near the oil-tank vault had been built in a position close to the current position of Lake Shore Drive. PCBs did not come into use until the 1900s, but oil from the oil-tank vault may have been used for power generation. VOCs were detected in soils at the location of this former power house. Similar oil-storage facilities were not identified in the part of Burnham Park that was the site of A Century of Progress in 1933-34.

Buildings at the World's Columbian Exposition were iron and timber sheds with an exterior surface constructed of staff, a mixture of plaster, cement, and jute fibers (Appelbaum, 1980). Construction materials used for A Century of Progress are unknown. After the World's Columbian Exposition closed, fires consumed several of the buildings, and all buildings were allowed to fall into a state of disrepair until they were finally demolished, except for the Palace of Fine Arts, which was restored and remains as the Museum of Science and Industry. It is possible that asbestos-containing materials (ACM) were used during construction of these two world's fairs, and fill dumped along the lake shore may include ACM. Thus, ACM may be present in soils throughout the project area.

Nike Missile Bases

Information concerning the Nike missile program was taken from Morgan and Berhow (2002) and Carlson and Lyon (1996). The internet site maintained by Donald E. Bender (http://alpha.fdu.edu/~bender/nike.html) contains excellent information concerning Nike missiles and links to numerous other sites with photographs and specific Nike missile base information. Ed Thelen's Nike Missile Web Site (http://www.ed-thelen.org/) is a very good source of Nike missile illustrations, data, and links.

Nike missiles resulted from a research program initiated by a memorandum written by Army Lieutenant Jacob W. Schaefer in 1944, which culminated in the Bell Telephone Laboratories report, A Study of an Antiaircraft Guided Missile Systemm, in 1945 (Carlson and Lyon, 1996). The

[2]Tiered Approach to Corrective Action Objectives. Risk-based and site-specific standards established by the Illinois Pollution Control Board for remediation of soil and groundwater.

memorandum and the Bell Labs report described a concept of supersonic missiles, guided to a target by computer-controlled ground-based radar, which permitted the missiles to intercept the target aircraft in spite of any evasive actions the pilot might take. Following the Soviet Union's development of long-range bomber aircraft (first observed in 1947), closing of land approaches to Allied sectors of Berlin in 1948, detonation of the USSR's first atomic bomb in 1949, and initiation of the Korean War in 1950, the United States rapidly developed and deployed the Nike missile system. The first Nike missile base was operational by 1953.

Nike missile sites were constructed in rings surrounding major urban and industrial areas and key Strategic Air Command (SAC) bases and other sensitive installations. Though they were built on government-owned property where available (such as military bases and former artillery bases), much real estate was acquired specifically for missile-base construction, including two portions of Chicago's Burnham and Jackson Parks. Approximately 250 sites were constructed in the U.S. between 1953 and 1958.

The first deployed missile system, Nike "Ajax," consisted of a two-stage guided missile powered by a solid-fueled booster engine and a liquid-fueled sustainer engine. The sustainer engine was fueled by JP-4 jet petroleum with an inhibited red fuming nitric acid oxidizer and a catalyst consisting of unsymmetrical dimethylhydrazine. This missile had a range of 48 km (30 mi) and carried a conventional warhead. The first Ajax base was operational by 1954 at Fort George C. Meade, MD, and several antiaircraft artillery bases in the Chicago area had been converted to Nike missile bases by 1957. A total of 24 bases were constructed in the ring surrounding Chicago and Gary, IN.

The Nike "Hercules" missile, developed as the Nike "Ajax" bases were being constructed, contained a solid-fuel motor and could carry nuclear or conventional warheads. With a range of 145 km (90 mi) and able to reach altitudes in excess of 30,480 m (100,000 ft), this missile system replaced the Nike "Ajax" system. Only half as many Hercules sites were needed. Conversion of the Ajax bases occurred over the period 1958 to 1962. The first Ajax site converted to Hercules was Site C-03 Montrose/Belmont in 1958 (Morgan and Berhow, 2002).

Soviet military strategy changed following development of the Nike system. Fearing that manned aircraft were vulnerable to attack, the Soviet Union began development of intercontinental ballistic missiles and never deployed a strategic bomber force equivalent to SAC. Because Nike Hercules missiles were not a defense against nuclear-tipped ICBMs, closing of Nike bases began in the middle 1960s. All sites within the nationwide Nike air defense system had been deactivated by 1974, though they remained operational in Florida and Alaska into the late 1970s. Deactivation occurred rapidly, commonly leaving facilities such as USTs present on site. Bases may have been sold to the private sector for other uses (such as the paint-ball camp located at the Integrated Fire Control Area of Nike missile base C-47, Wheeler/Hobart, IN), may remain as closed installations under General Services Administration control (such as the Launch Area of Nike missile base C-47), or may have been demolished (such as both Nike bases C-40 and C-41 in Burnham and Jackson Parks). Commonly, when facilities were demolished, the demolition debris was placed in the underground missile storage areas and the elevators were left in place due to their great mass and expense of removal (John C. Kannaby, Corps of Engineers, Chicago District, personal communication, September 30, 1999).

A typical Nike base consisted of three components. The Integrated Fire Control Area (IFC; fig. 4) contained the ground-based radar and computer systems that permitted the facility to detect

and track hostile aircraft and to guide missiles to the targets. In Illinois, radar antennas were typically installed on towers built out of a metal framework and topped by a hexagonal or octagonal platform on which the antenna was situated (figs. 4 and 5A). However, conversations with Dr. J. Kent Mitchell, Professor Emeritus of Agricultural Engineering at the University of Illinois at Urbana-Champaign, revealed that this type of installation likely resulted from the need to elevate the antennas above ground clutter in the flat terrain of Illinois. Dr. Mitchell stated that at the Pittsburgh, PA, missile base where he was stationed in the late 1950s, the antennas sat on ground-level platforms, which were elevated above surrounding ground clutter by the natural topography of the Pittsburgh area.

The Launch Area (figs. 5B and 6) was where missiles were assembled and fueled, and if conditions necessitated, launched. During the Nike Ajax era, the Launch Area contained USTs for the three components of the Ajax fuel. Missiles were stored in underground missile magazines and brought to the surface by elevators, which remain at many sites as voids with large masses of concrete and metal. Launch area facilities also contained electrical power-generating plants, which permitted the base to continue operations in the event that utility lines were severed by hostile activities during a military confrontation.

The Administration Area (figs. 4 and 6) contained administrative offices and berthing and dining facilities for base personnel. USTs for heating oil and vehicle fuel were present in this area, though the motor pool commonly was located in the Launch Area.

A typical Nike missile site occupied two separate parcels of land separated by 914 to 5,486 m (1,000 to 6,000 yds), because technology of the period required a minimum of 914 m (3,000 ft) between radar and launch areas to allow radar units to lock onto missiles being launched. Commonly the IFC and Administration Areas were co-located on one of the parcels (figs. 4 and 6).

Nike missile bases were discovered during the initial investigation of this project through a map that appeared in a report on redevelopment of the Burnham Park/Jackson Park area (Chicago Department of Development and Planning, 1969), obtained from the Chicago Historical Society. The map contained two notes concerning “open discussions relating to relocation of Army installation.” Further information concerning these two facilities was obtained from reports in the files of the Chicago District of the Corps of Engineers through the efforts of John Kannaby and Timothy Kelleher of that office. That information provided possible locations of USTs at the facilities, while aerial photographs and maps in Corps of Engineers files allowed the location of the various components of each base to be identified. Knowledge of the former presence and character of Nike missile bases permitted identification of the missile sites by the characteristic launch pads and elevator covers, by the berms surrounding the warheading building, and by the presence of hexagonal platforms on radar antenna supports (see figs. 4, 5A, 5B, and 6).

Two Nike missile bases had formerly been located in the parks along Lake Shore Drive—one south of McCormick Place East (designated C-40) and the other adjacent to the East Lagoon in Jackson Park (designated C-41). The site in Jackson Park was built on a former artillery range. Large underground voids for missile storage at these former missile bases were distant from the project and considered to be of no concern to the highway. However, numerous USTs had been installed to store fuel for space heating and for fueling of both missiles and vehicles. Not all were removed prior to closing of the missile bases (Chicago Park District, 1962; U.S. Army Corps of Engineers, 1995; IT corporation, 1998). The areas of these missile bases adjacent to US 41 were screened for USTs using magnetometer, ground-penetrating radar, and

electromagnetic surveys. Possible USTs were detected at both sites. At Nike base C-40, VOCs were detected adjacent to the former housing area, and lead and arsenic were measured at levels above TACO Tier I residential standards in soil samples obtained from near the IFC area. No PCBs were detected in the power generating area.

Underground Storage Tanks

The Chicago Park District currently has USTs installed at several locations for fueling park vehicles. A marina building that was formerly a Coast Guard station also contained USTs (fig. 7). Two gasoline stations along 67th Street at the south end of the project, one condominium adjacent to the west side of the project, and one Park District maintenance garage are LUST sites. An area of dead vegetation at the north end of the maintenance garage (fig. 8) suggested that environmental contaminants may have flowed into this area from the adjacent enclosure where park vehicles and street salt were stored. Testing at the gasoline stations revealed soils heavily contaminated with petroleum products. Though no VOCs were detected in right-of-way adjacent to the marina or near the USTs on the south side of the Park District maintenance facility, VOCs and petroleum-impacted soil were detected at shallow depths adjacent to the north side of the Park District maintenance facility where stressed vegetation was observed (fig. 8).

Electrical Transformers

Transformers at 22 sites along the highway provided power for traffic and street lights. These transformers ranged from ground-mounted green boxes (fig. 9A) to older brick enclosures (fig. 9B). No information was available from the Chicago Park District or the electrical company concerning the history of these transformers. Because of the apparent range in ages of these transformers, a soil sample was collected adjacent to each transformer to test for PCBs. No PCBs were detected at any of the transformer sites.

CONCLUSIONS

Examination of sites contained in parkland initially might suggest a lack of man-made hazards. Without a full understanding of the history of such sites, one might conclude that they are not worth the cost of a detailed investigation. However, review of historical documents may reveal past uses of those parcels for other than parkland. An investigation of two major parks along the Lake Michigan shoreline in Chicago revealed past industrial and national-defense uses as well as the presence of active USTs within and adjacent to the parks. Testing of soils and soil gas adjacent to Lake Shore Drive and to these facilities revealed the presence of soils impacted by petroleum compounds and metals.

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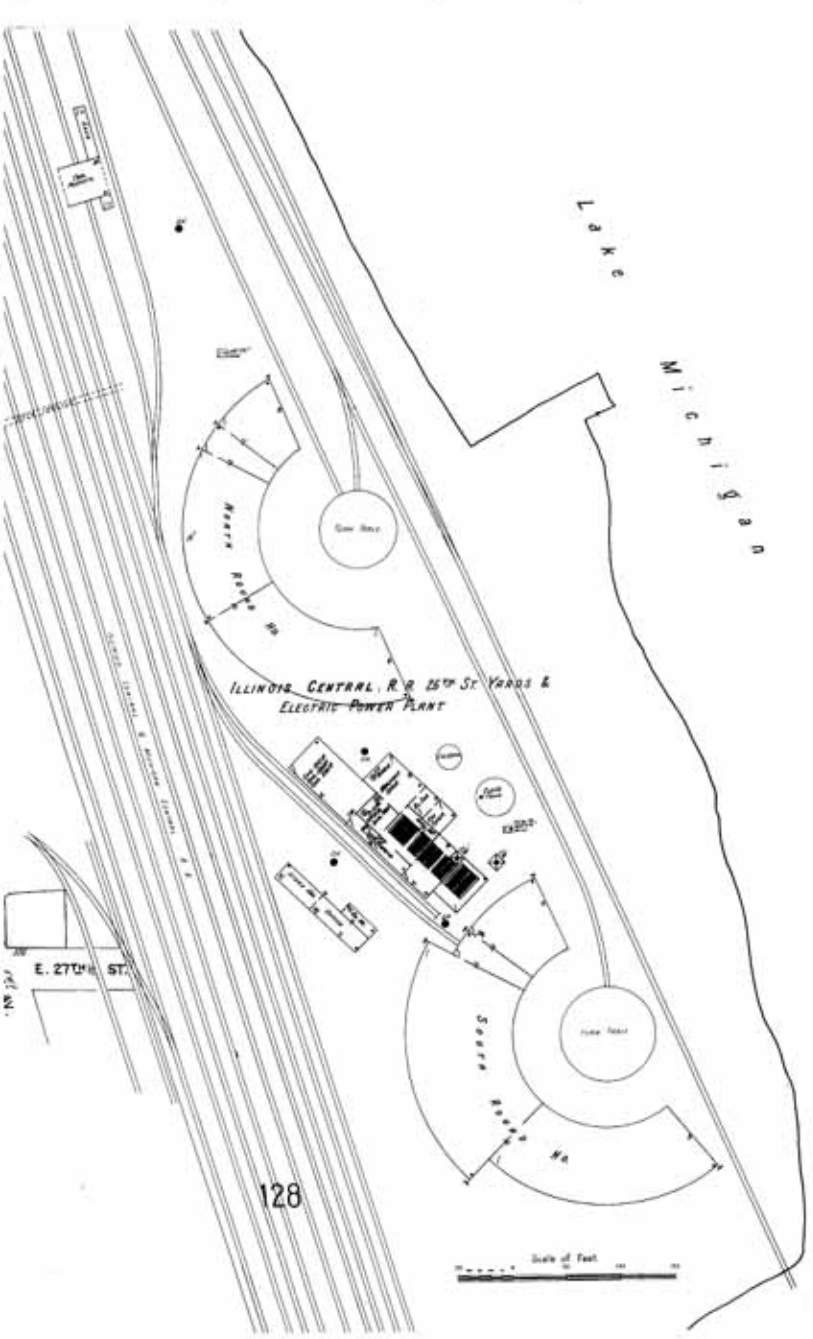
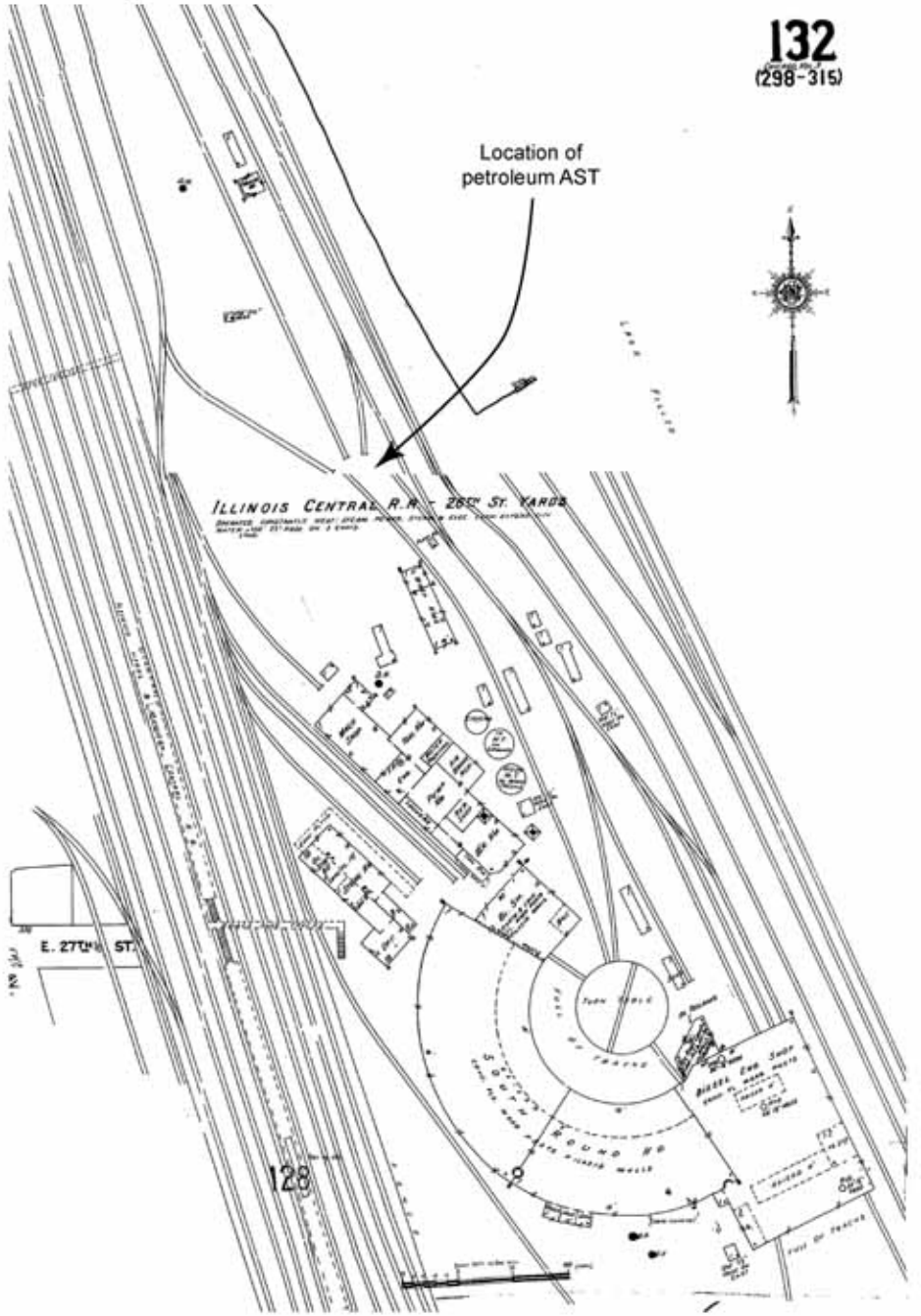
U.S. Environmental Protection Agency, Superfund home page, http://www.epa.gov/superfund/.

Figure 1. Project location map.

Figure 2. Sanborn maps of Illinois Central Railroad 26th Street Yards. Copyright (1911 [left] and 1950 [right]) Sanborn Map Company, The Sanborn Library, LLC. All Rights Reserved. These Sanborn maps have been reproduced with written permission from The Sanborn Library, LLC. All further reproductions are prohibited without prior written permission from The Sanborn Library, LLC.



A. 1911.



B. 1950.

Figure 3. Columbian Exposition sites.

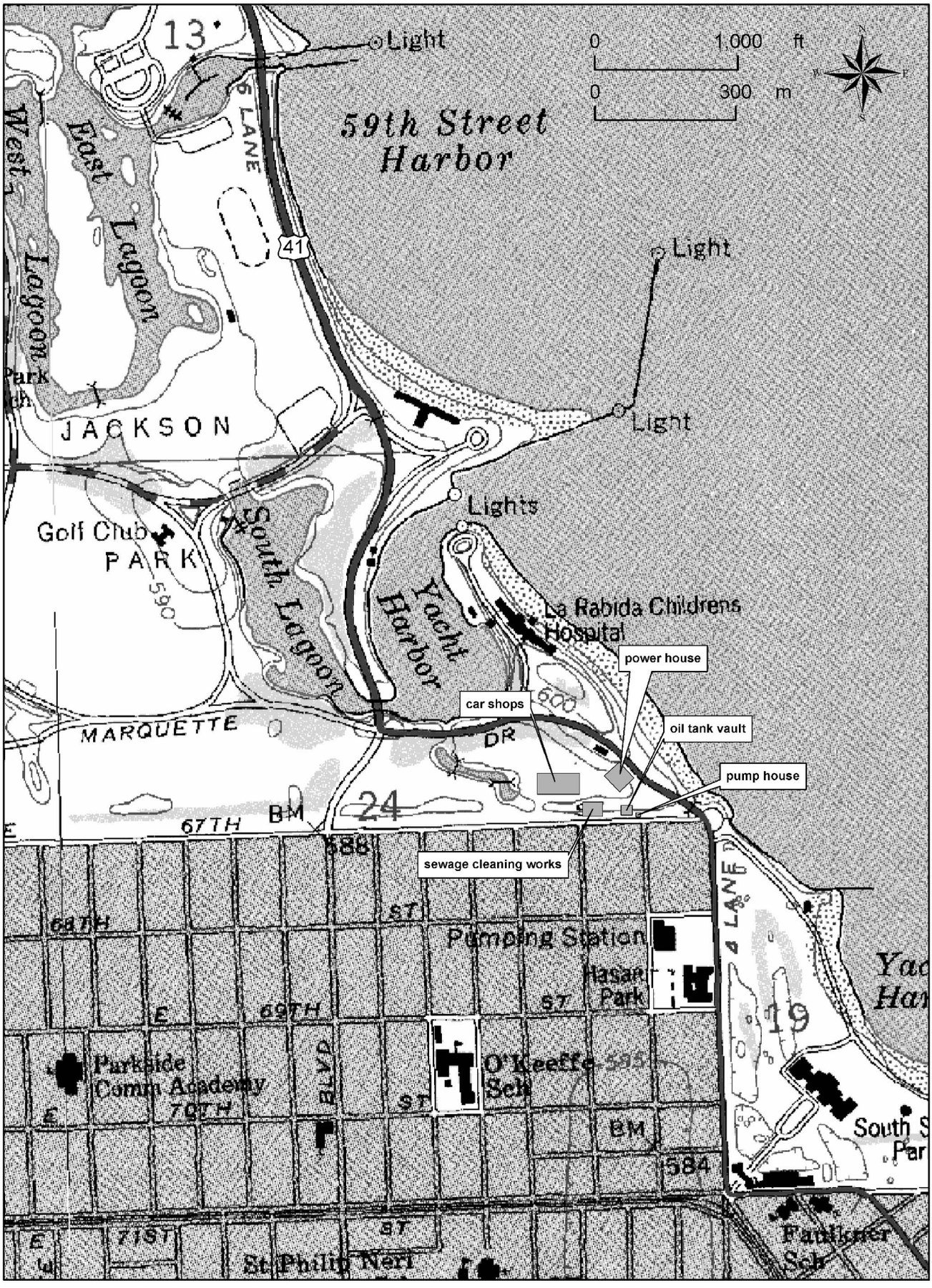


Figure 4. Aerial photograph of Integrated Fire Control and Administration areas for Nike Missile Base SL-10 in Madison County west of Marine, Illinois (photograph taken 8/25/68 by Department of Agriculture, Soil Conservation Service).

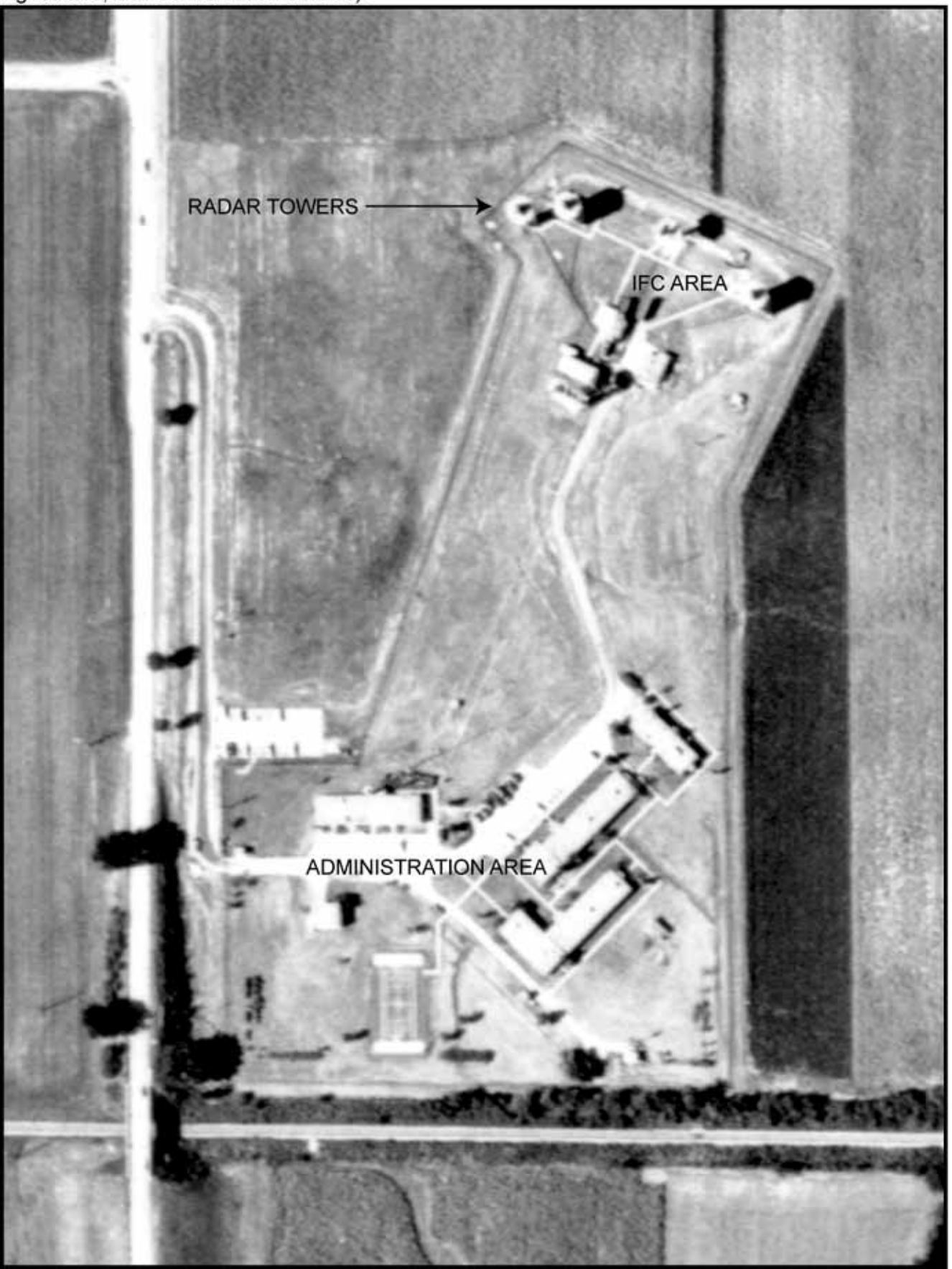
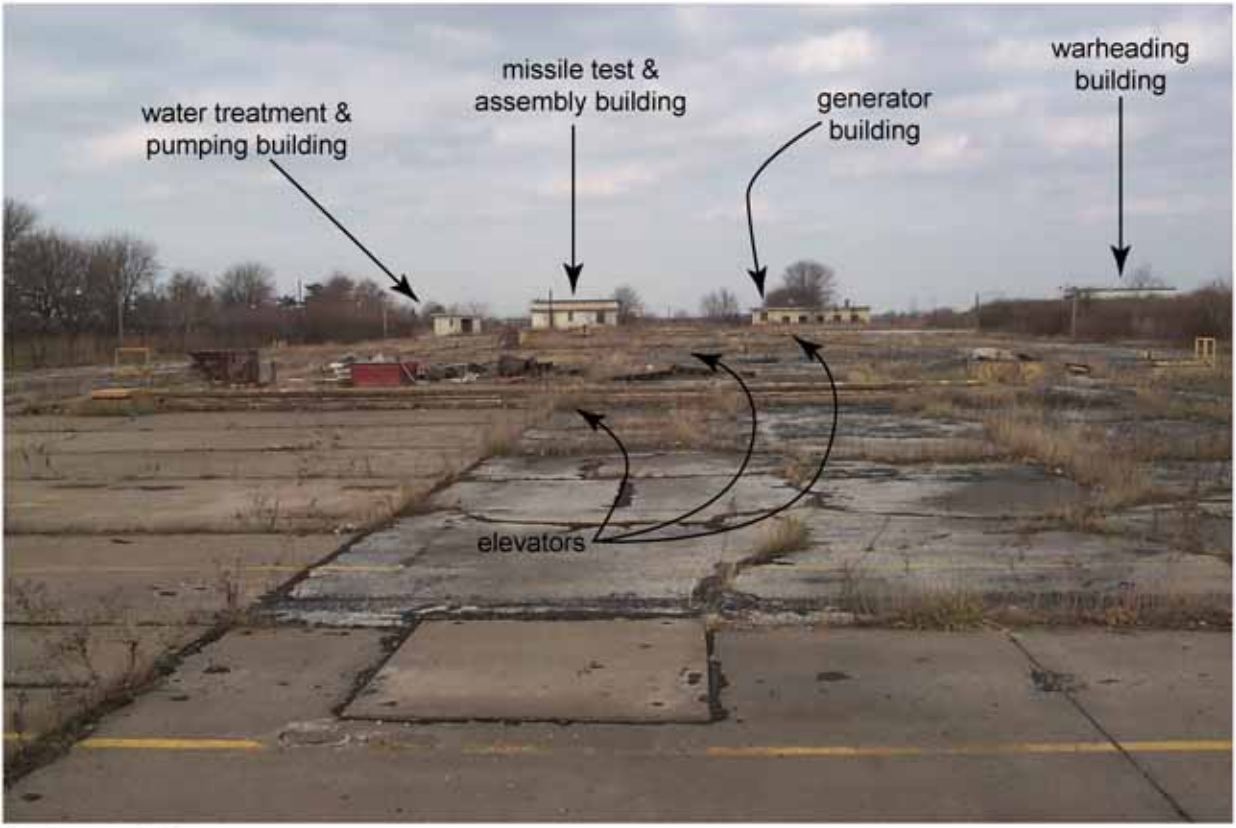


Figure 5. Nike missile base C-47, Wheeler/Hobart, IN.

A. Integrated Fire Control Area. Note hexagonal platforms that formerly supported radar antennas.



B. Launch Area.

Figure 6. Aerial photograph of Nike Missile Base C-40 (photograph taken 11/30/59 by Illinois Department of Transportation).

Figure 7. Former Jackson Harbor Coast Guard Station.

Figure 8. Chicago Park District Maintenance Facility. Note dead vegetation extending from brick wall.

Figure 9. Electrical transformer sites.

A. Green ground-mounted transformer, Museum of Science and Industry.

B. Brick building containing transformer, northeast quadrant of 67th Street and Jeffery Drive.