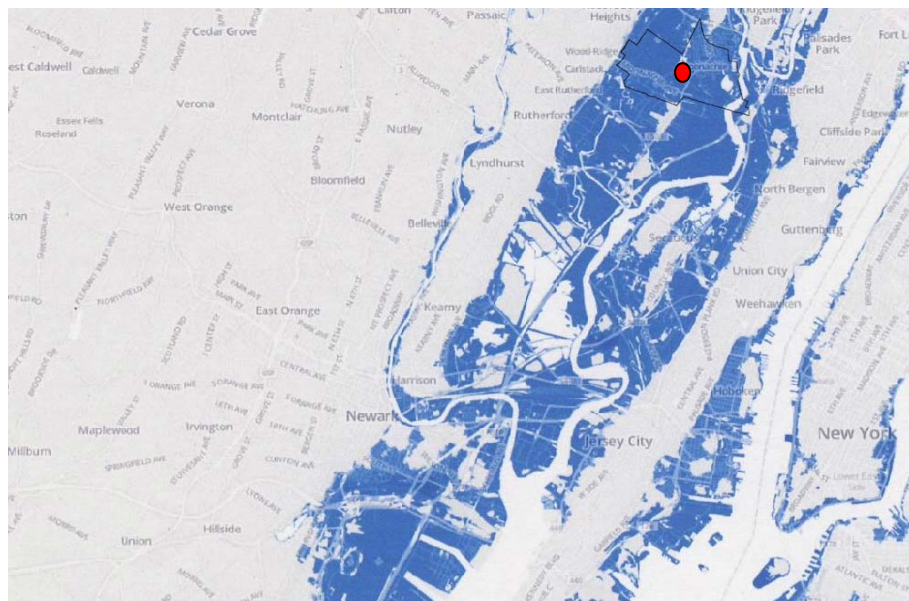
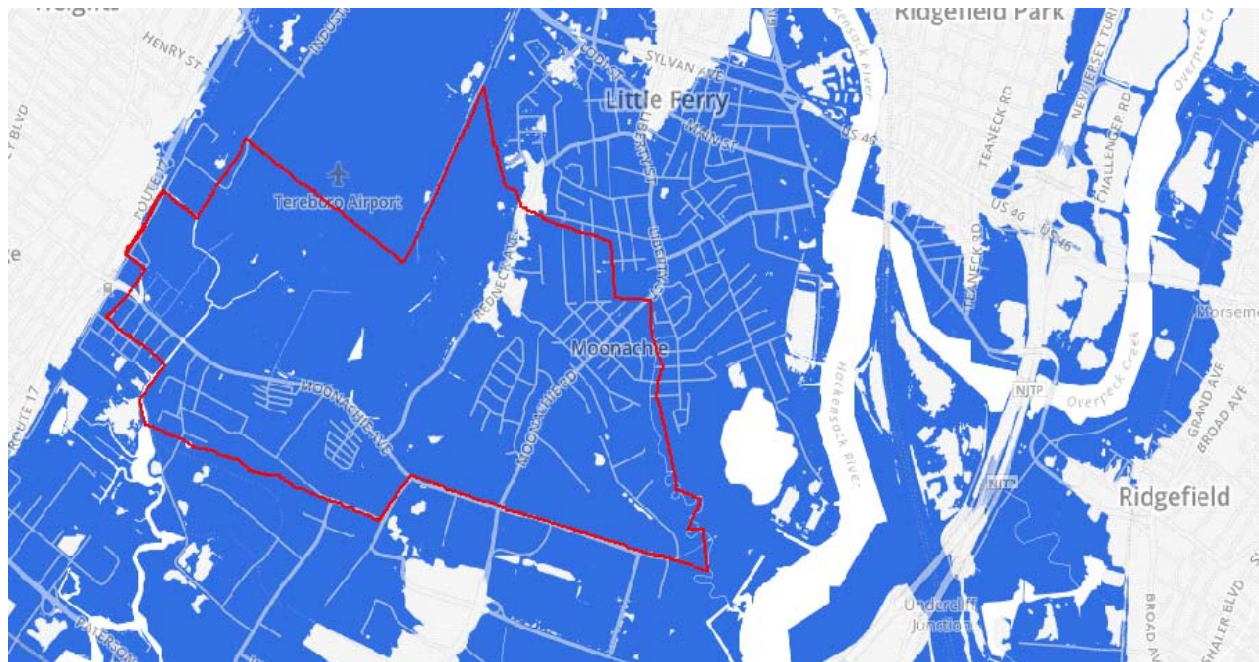


# BOROUGH OF MOONACHIE NEW JERSEY STRATEGIC RECOVERY PLANNING REPORT

Post Sandy Planning Assistance Grant Program

New Jersey Department of Community Affairs Office of Local Planning Services



L+C Design Consultants PA  
Architects Planners Engineers  
Jill A. Hartmann PP AICP

**PRELIMINARY DRAFT**  
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# BOROUGH OF MOONACHIE STRATEGIC RECOVERY PLANNING REPORT

The Borough of Moonachie  
Bergen County New Jersey

Mayor Dennis Vaccaro

Council President Robert Bauer

Council

Antonio Cirillo

Kathy Kinsella

Manuel Martinez

Lucille Millar

Bruce Surak

Superintendent of Department of Public Works MaryEllen Lyons

Chief of Police Michael J. McGuire

Construction Official/Flood Plain Manager Michael Sartori

Report prepared by

L+C Design Consultants PA

One Marine Plaza Suite 205

North Bergen New Jersey

Principal Planner Jill Hartmann PP AICP

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Jill A. Hartmann NJ Professional Planner No. 408800

Cover Images- Extent of Superstorm Sandy Flooding, 2012. Map Source: NY Times /WNYC

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## Executive Summary

Superstorm Sandy struck the coast of New Jersey on October 29th, 2012. The state sustained unparalleled damage to its housing, infrastructure and environment. The low-lying areas along the Hackensack and Passaic Rivers experienced massive flooding due to the combination of high winds and tidal surge. Within the Borough of Moonachie, roads were inundated with flood waters and almost every building was significantly affected by the storm surge. All of the Borough's public buildings sustained damage, rendering some totally unusable.

The devastation of an event like Superstorm Sandy, a weather event of a magnitude unknown previously to the region, has been well documented. First responders, civil servants, residents, neighbors and businesses, both local and regional, struggled in unison without reliable communication, equipment or other resources. Immediate needs for safe evacuation, shelter, food and water, debris removal and all of the challenges to recovery brought on by the storm could not be fully met. The tidal surge, which occurred at night, primarily affected borough residents. Had a catastrophic event, such as Sandy, occurred during the day the needs of some 20,000 individuals would not have been met. Borough administration and staff, residents and emergency services personnel bravely came together to assist each other in the face of an overwhelming crisis. While the full damages and aftereffects of this major event are not yet fully realized, the value of community resiliency and the critical need for planning is evident.

Moonachie has unique geography. Based on the most recent FEMA mapping, which will soon be adopted, almost 98% of the Borough is located in the 100-year flood zone. As a result, Moonachie and its adjacent neighbors Little Ferry and Carlstadt are often at the center of flood events in the Hackensack River watershed. Even a few concentrated inches of water may flood critical areas of the Borough and, dependent on subsequent weather, may not dissipate for days or weeks. Increased permeability, the enhancement of positive drainage and the application of mitigation and flood resistance strategies to create a more resilient community are critical, as is protecting persons, property, infrastructure and industry. Planning for events of varying magnitude and duration and protecting the nature and character of the community for the future when mitigation strategies are established must be the overarching goal.

Following Sandy, the importance of updating local and regional planning has become clear. To this end, grant programs set forth by the NJDCA Office of Local Planning have created opportunities not typically afforded to small communities such as Moonachie to pursue critical planning and planning grant opportunities. The ability to plan in a professional capacity will not only aid in prioritizing immediate needs of the Borough but also facilitate the development of long term strategies for sustainable resiliency.

## Introduction

The Borough of Moonachie is a community of approximately 2,700 residents with a large commuting work force, adding more than 20,000 to the daily local population during the work week. The Borough has a well-established and fully developed mix of small scale residential, service commercial, civic and industrial/back-office/warehouse uses. All major utilities and communications infrastructure, which serve the Borough, as well as lower Bergen County traverse the Borough along or under major local County roadways including Moonachie Road, a primary arterial road; Moonachie Avenue, a secondary, arterial road; and Redneck Road, a secondary road. Local economic vitality, which in turn has had a regional impact, depends on the continued stability of the Borough and the continued opportunity for businesses and residents to thrive.

As was common in many Bergen County and Hudson County communities during the 19th century, Moonachie was organized as a municipality when small family farming was the prevalent land use. Pressure to develop Moonachie, in order to meet the needs of an increasingly dense population in Bergen and Hudson counties, took precedence over environmental concerns. Over time, this regional change in use and permeability of the land in the Hackensack River watershed has directly affected the impact of storm events and, in current times, the ability of the Borough of Moonachie and other municipalities in the region to respond appropriately.



**Borough of Moonachie - Aerial View**

Accordingly, Moonachie and its adjacent neighbors Little Ferry and Carlstadt are often at the center of flood events in the Hackensack River watershed. Even a few concentrated inches of water may flood critical areas of the Borough and, dependent on subsequent weather, may not dissipate for days. Since the event, the devastation of Moonachie by Superstorm Sandy and its subsequent challenges has been reported on extensively. While residents, employees and public safety officials all worked closely together to have the best outcome during a terrible crisis, the immediate needs for safe evacuation, shelter, food and water, debris removal and all of the challenges to recovery brought on by the storm were not met. While the full damages and after effects of this major event are not yet fully realized, the value of community resiliency and the critical need for planning in Moonachie is evident.

The Borough of Moonachie Strategic Recovery Planning Report will assist the municipality with its recovery efforts and provide a framework within which to identify strategies as well as funding sources for planning related recovery efforts and urgently needed improvements.

This report includes the following:

- A Community Overview.
- A summary of Moonachie's vulnerability and conditions created or exacerbated by Superstorm Sandy.
- Recommendations and descriptions of proposed projects that will result in the Borough being more resistant to damage not only from future storm events, but any catastrophic event.

This report is intended as a guide for future planning efforts that may be eligible for grant funding under the Post Sandy Planning Assistance Grant Program, Rebuild by Design, Bergen County Open Space grants and other funding sources as they may become available. The Borough of Moonachie was awarded funds from the Post Sandy Planning Assistance Grant program to prepare this report.

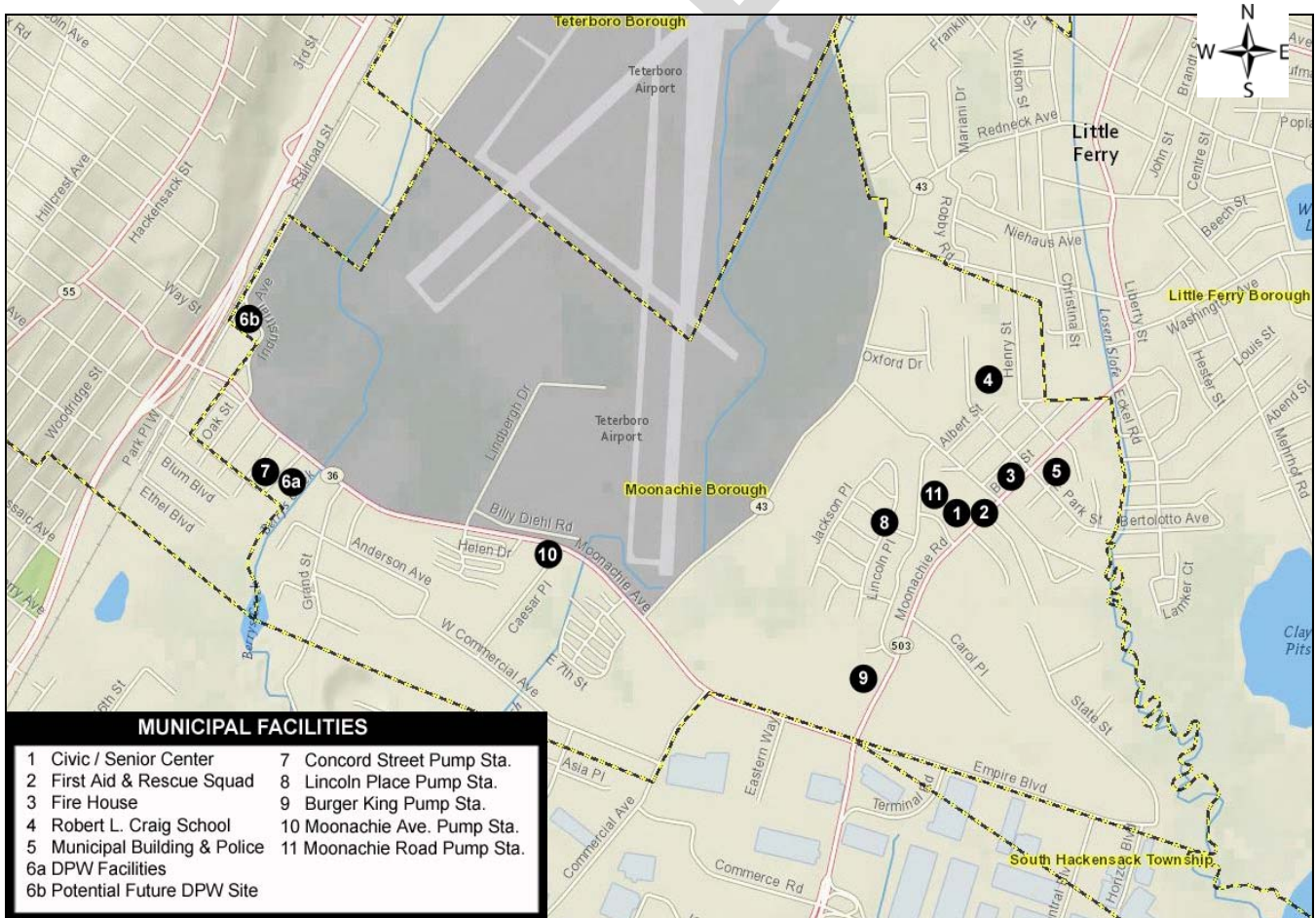
The purpose of the Post Sandy Planning Assistance Grant is to support short and long range planning for community development in municipalities and counties that sustained damage from Superstorm Sandy. The Department of Community Affairs (DCA) created this local planning assistance program in order to supplement ongoing efforts of storm impacted local and county governments to assist in the rebuilding and revitalization of affected locales. The Program is administered by the DCA's Office of Local Planning Services (LPS).



## Community Overview

Moonachie lies in the heart of the New Jersey Meadowlands. The Borough has an area of 1.678 square miles with an average elevation of just 3 feet above sea level. [Figure 1] The Borough offers quick access to highways which traverse the New York metropolitan region. Ease of access has attracted many businesses, typically located in planned industrial developments dating from the 1950s through the 1980s. Residential development is densest in the center of the Borough to the west and east of Moonachie Road. A small residential neighborhood is located near the Borough’s western border with Wood-Ridge and Carlstadt, with two mobile home communities of several hundred units located opposite Teterboro Airport on the south side of Moonachie Avenue.

Moonachie Road is the primary north/south route between Route 46 and the New Jersey Turnpike, while Moonachie Avenue connects to Route 17 to the west. Moonachie Borough Hall, otherwise known as the Municipal Building, is located at 70 Moonachie Road. The Moonachie Police Department is also located there. The Fire Department is located at 111A Moonachie Road. The Department of Public Works is located at 27 Willow Avenue. Moonachie First Aid & Rescue and the Volunteer Ambulance Corps are located at 121 Moonachie Road and the Civic/Senior Citizens Center is located at 125 Moonachie Road. The Robert L. Craig Elementary School, which has Pre-Kindergarten through 8th Grade, is located at 20 West Park Street.



**Borough of Moonachie - Municipal Services**

## Demographics

The population of Moonachie has remained fairly constant for the past two decades. In the 2000 census, there were 2,754 people living in Moonachie. By 2010, the population had dropped to 2,708. The 2013 estimated census counted 2,757 people living in the Borough in 1,011 households. The major demographic change from the 2000 to 2010 census has been the approximate doubling of those residents of Hispanic lineage - from 12.67% to 24.37% - and near doubling of the Asian American population - from 6.64% to 10.04% . Between 2000 and 2010 there was a corresponding decrease in the Non-Hispanic White population, from 73.0% to 52.22%. This corresponds with the general increase in the Hispanic and Asian population in Bergen County. <sup>1</sup>

## Income

Approximately 4.0% of families and 6.6% of the population were below the poverty level in 2010; the median household income in 2012 was \$48,306, the median family income was \$72,125 and per capita income was \$31,507. <sup>2</sup>

## Employment

The total resident labor force of Moonachie is 1,446 with the employed residents totaling 1,330. The unemployment rate in Moonachie in 2013 was 9.2% with the four preceding years having an average of 6.05%. <sup>3</sup>



**Most employment in Moonachie is either light industrial, back office, warehouse or local service retail in nature.**



## Planning Documents

As part of the information gathering process for this report, the Borough of Moonachie reached out to Borough representatives, as well as surrounding municipalities, Bergen County, the Bergen County Utilities Authority and the New Jersey Meadowlands Commission to inquire about present or future actions pertaining to the mitigation issues for future storm events or other natural disasters. Better coordination in planning as well as emergency response and readiness is a shared goal.

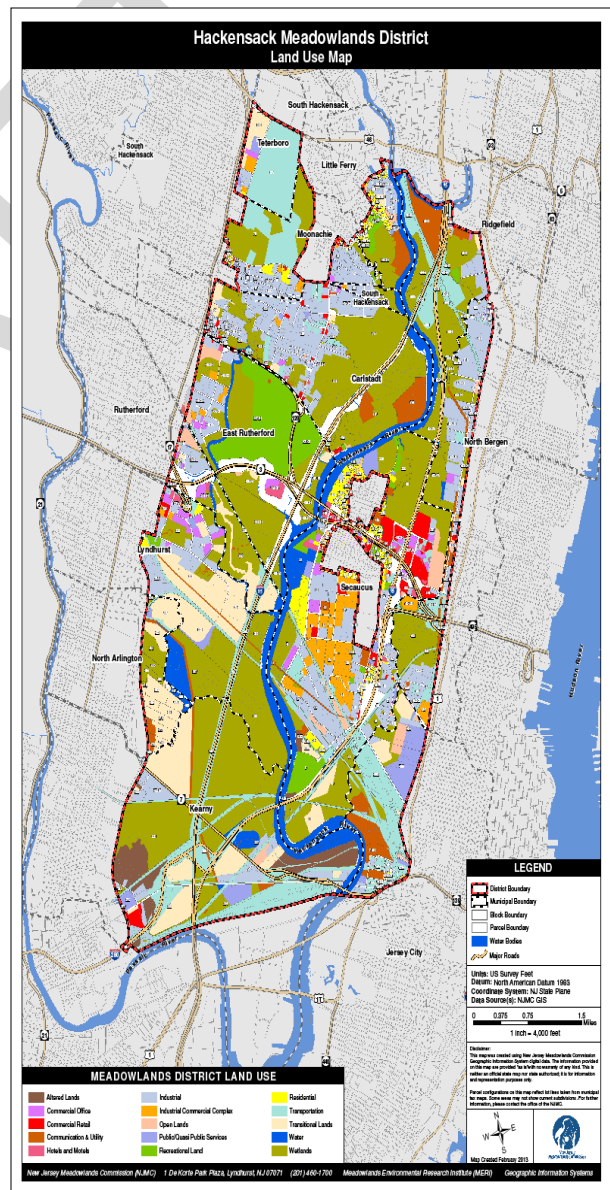
- The Bergen County Multi-Jurisdictional Hazard Mitigation Plan was prepared as a comprehensive natural hazard mitigation plan by the New Jersey Meadowlands Commission (NJMC) (recently renamed the New Jersey Sports and Exposition Authority (NJSEA) and approved by FEMA on November 7, 2008. Bergen County is presently updating its Multi-Jurisdictional All-Hazards Mitigation Plan to meet the requirements of the Disaster Mitigation Act of 2000. The 2014 Natural Hazard Mitigation Plan update continues to identify potential natural hazards and associated risks across jurisdictions and to develop an integrated mitigation strategy. The Plan update address the mitigation of potential damage to public, quasi-public and private entities, facilities and infrastructure. The noted goals of the Plan are as follows:
  - Protect and promote public health and safety.
  - Safeguard critical public facilities and infrastructure.
  - Protect public and private property.
  - Promote economic vitality in Bergen county and its 70 constituent municipalities.
  - Preserve the natural environment and promote human health.
- The Borough of Little Ferry adopted its most recent Master Plan Reexamination Report in 2014. The Reexamination Report recommended that the Borough evaluate how future development can be more resilient to super storm events and identify how its infrastructure can be less vulnerable to disruption. Little Ferry completed its Strategic Recovery Planning Report draft, dated March 21, 2014.
- The South Hackensack Office of Emergency Management has taken the lead in advancing resiliency in the Township. The Township is in the process of purchasing and installing a new pump station generator. Significant concerns surround cleaning and restoring the many drainage ditches under its jurisdiction. As a result, South Hackensack is investigating other mitigation strategies including the construction of more substantial berms throughout the municipality.

- Though flooded, Teterboro sustained less damages than nearby Meadowland communities. As a result, in the aftermath of Superstorm Sandy, the Borough of Moonachie utilized Teterboro's facilities for the staging emergency services. Local improvements include the dredging and rebuilding of West Riser from Route 46 to the Teterboro pumping station. Teterboro is covered by Bergen County and Moonachie police forces that includes emergency planning and response.. Airport expansion tied to a new air traffic control tower proposes filling in wetlands, rerouting waterways, elevating and expanding roadways, constructing new parking areas and new buildings near its eastern border with Moonachie.

The New Jersey Sports and Exposition Authority (NJSEA), formerly known as the New Jersey Meadowlands Commission, continues to have a primary role in planning and zoning regulatory actions throughout its jurisdiction, which includes more than three-quarters of the Borough of Moonachie. The Commission's last master plan update was completed in 2005. Though the NJMC has been referenced as the most appropriate party for regional watershed planning and supervision of implementation of improvement, the NJMC has had a limited role in flood control in recent years. In 2004, a flood control management program was initiated by NJMC in consultation with local municipalities but ultimately no regional programs, regulations, enforcement policies, or funding sources for implementation were set in place. In February of 2015, the NJMC was restructured and merged with the New Jersey Sports and Exposition Authority <sup>4</sup> with proposed changes to regulatory powers and responsibilities. These changes can potentially have an effect on flood control and land use policy in Moonachie and other Meadowlands communities. <sup>5</sup>

The Borough of Moonachie's last Master Plan was authored in 1978, with a re-examination report completed in 2000. Consistent with the NJMC master plan, part of the Borough's plan specifically cites the need for preservation of the last remnants of healthy forested wetlands located in Moonachie, primarily in the lands of Teterboro Airport, for both environmental and flood control purposes.

The Port Authority, which has jurisdiction over all of the Teterboro Airport (both in Moonachie and Teterboro) has a long term capital plan to provide assistance to ensure that water flows through both boroughs. Unfortunately, the Port Authority has recently removed many trees and topped hundreds of trees throughout remaining forested and wetlands areas under their jurisdiction. This may complicate and diminish groundwater absorption rates in a future flooding



## NJMC - Land Use Map

Event. Additionally, a portion of these forested wetlands are scheduled to be filled in and developed for new airport facilities, as noted above.

The Bergen County Utilities Authority, in its report regarding proposed flood mitigation for its Little Ferry Pollution Control Facility, notes that serious compromise of the facility and the aversion of total disaster was prevented only by dedicated human intervention. In light of this critical facility, the BCUA has set forth proposals to elevate and improve the physical plant and equipment consistent with FEMA policy and floodplain standards.

## New Jersey Sports and Exposition Authority (NJSEA)

Approximately three-quarters of the land area of the Borough of Moonachie lies within the jurisdiction of the The New Jersey Sports and Exposition Authority (NJSEA) planning area. Most of the Borough within the NJSEA District is zoned for industrial use. Several small residential developments as well as park and conservation land are included in the NJSEA planning area. Approximately one half of Teterboro Airport is also located within the NJSEA jurisdiction.

While the NJSEA plans for the Hackensack River watershed, the responsibility for flood control strategies and enforcement is unclear. Although directly impacted by the condition of the Hackensack River watershed, the Borough has little control over the larger watershed area and flood control. Much of the stormwater runoff has point source origins emanating from the surrounding municipalities and upstream water flow. Redneck Avenue (County Road S 43), Moonachie Avenue (County Road 36) and Moonachie Road (County Route 503) and their drainage systems are designed and controlled by Bergen County. Reportedly waters from the Oradell reservoir contributed to Moonachie's inundation during Sandy. All improvements, such as the recent reconstruction of tide gates on the West Riser ditch, may impact the Borough. <sup>6</sup>

**These multiple layers of jurisdiction, combined with the movement of stormwater from one jurisdiction to another, create response challenges, to a significant flooding event. Much of the responsibility for control of flooding lies outside of Moonachie's. In addition, numerous public and private utilities, such as Verizon, New Jersey Transit and PSE&G, have easements, right of ways and other agreements with private property owners further complicating drainage/flood storage issues. <sup>7</sup> An example of problematic jurisdictional impacts is the ditch controlled by New Jersey Transit. The Moonachie DPW does not have access to this ditch, along Industrial Avenue and therefore cannot maintain it.**

## Borough of Moonachie Flood Conditions and Risks



### **Water and sewer lines, gas mains and communications arrays and cables for much of Bergen County crisscross Moonachie, posing potential challenges during major weather and flooding events like Superstorm**

Presently, the Borough is comprised of a mix of scattered low-density residential development with a small downtown commercial area, heavy and light industry and conservation land. As noted, the majority of Teterboro Airport's land area is located in Moonachie; while this property incorporates most of the remaining forests and wetlands left in the Borough, Moonachie has no control over its development. The Borough is unique in its location among Meadowlands communities in that it lies in a natural bowl with no upland areas.

As Moonachie transformed from a farming community to a fully developed mixed-use community, the physical environment was altered dramatically.

Over the past 50 years, Moonachie has seen most of its historic ponds and wetlands filled in and waterways rerouted, ostensibly for flood control purposes. Over the decades, many of these drainage ditches and channels have been filled with sediment. Moonachie is traversed by a series of earthen berms created nearly a century ago and related to historic flow of surface water, some reportedly for the purposes of mosquito control. The berms are typically no more than five to seven feet above present mean sea level. They are piled earth with no structural reinforcement and in their current condition many earthen walls have been compromised. Presently, the Borough is comprised of a mix of scattered, but compact, low-density residential development with a small downtown commercial area. With a significant amount of area devoted to heavy and light industrial uses. As noted,

the majority of Teterboro Airport's land area is located in Moonachie which includes most of Moonachie's remaining forests and wetlands. Moonachie has no jurisdictional control over the airport's development and expansion yet it lies in a natural bowl with no upland area.

Consequently, externalities including land use, site configuration, and environmental practices of its neighbors have had a significant impact on the Borough. This includes its many vulnerabilities to major rain and storm events, with Superstorm Sandy as the most intense storm to impact the Meadowlands in modern history, and regular flooding that occurs, in certain areas, during average rainfall events.

More than 80% of the Borough of Moonachie is located within boundaries defined in 2005 by FEMA as the 100-Year Special Flood Hazard Area [Figure 2]. The preliminary FEMA maps released in 2014 show that the 100-Year Special Flood Hazard Area has increased to include 98% of the Borough [Figure 3]. Moonachie is integrated and connected to the stormwater control areas at both Losen Slote Creek, which is shared with Little Ferry, South Hackensack and Carlstadt, and Berry's Creek, which is shared with South Hackensack and Carlstadt. In addition, the East and West Riser ditches traverse the Borough.

A recent autumn rainfall of two inches flooded critical areas of the Borough. Events which vary in magnitude and duration will continue to occur, causing interim flooding and related damage. Sandy's sea surge averaged between 8.5 and 9.5 feet above mean sea level in the Meadowlands, overwhelming the existing network of earthen berms and other flood controls. [Figures 4-9] Tide gates designed by the Army Corp of Engineers at 7.5 feet above mean sea level were breached by more than two feet of water.

With an estimated 18"-20" increase in sea level rise projected to occur, along the mid-Atlantic coastline by the year 2100<sup>8</sup>, portions of the Meadowlands will be at or below sea level. Moonachie will be increasingly prone to extraordinary flood events. Infrastructure maintenance and structural solutions, flood resistant treatments for buildings, and technological upgrades for flood control must be paired with a careful reexamination of land use throughout the Meadowlands with an eye towards buffering existing vulnerable residential development.

## Climate Change and Sea Level Rise

The Meadowlands have seen numerous habitat and vegetation shifts based upon climate change since the ending of the last great Wisconsinian glaciation, including a giant glacial lake, significant forests of black spruce and American larch and numerous freshwater streams and rivers. At the time of Dutch and English colonization, much of the Meadowlands was covered in Atlantic white cedar forests, which were completely destroyed by the mid-19th

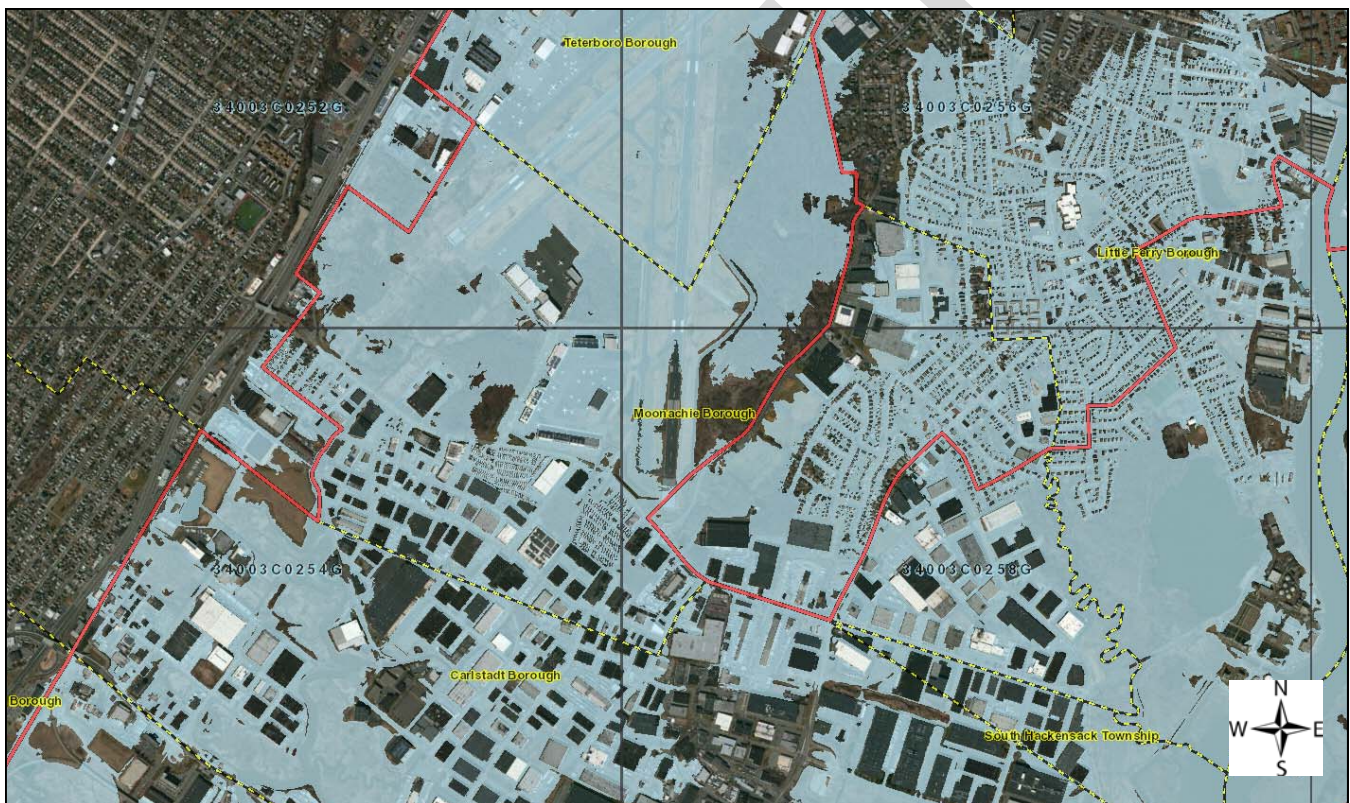


**Brackish wetlands near Losen Slote Creek are a relatively new ecosystem in Moonachie - and one severely threatened with climate change.**

century. Scientific studies have demonstrated that the modern native marsh grasses - not to mention invasive species, such as phragmites - which we think of as being typical of the Meadowlands have only been extant for a few hundred years and do not offer the level of absorption which existed historically. <sup>9</sup>

An examination of Moonachie from 1930 to the present reveals major manmade landscape changes to the Borough. In 1930, more than 60% of Moonachie's land mass was used for agriculture; 15% for forested land; 10% active freshwater/brackish wetlands; 10% undeveloped (former farmland) [Figure 10]; and 5% for residential development. In 1958, approximately 45% was used for agriculture; 20% for forested land; 10% active freshwater/brackish wetlands; 5% undeveloped (former farmland); 15% for residential development; and 5% for industrial uses. [Figure 11] By 1969, agriculture had ceased in Moonachie beyond a few small truck farms, with most former farmland laying fallow or beginning to be replaced by light industrial and commercial uses. [Figure 12]

Within ten years, a significant amount of the former farmland was developed with corporate park-type buildings. This was also true of some of the marshland and forested areas. By 2014,



**Extent of Tidal Flooding from Superstorm Sandy in Moonachie, New Jersey and Surrounding Communities (shown in light blue)**

more than 70% of Moonachie is classified as intensively developed, mostly with industrial development. [Figure 13] Hardscape, or impermeable surfaces, constitutes over 50% of the overall land mass accompanying this intense development, resulting in substantial increases in stormwater runoff into storm control systems already overburdened.

Presently, more than 50% of the Borough of Moonachie is developed with industrial and corporate uses and/or covered in impermeable paving, including Teterbor Airport.

Due to anticipated sea level rise, the ability of the Borough to adapt to flood events will be increasingly difficult, making the regional importance of planning for resiliency critically important to Moonachie. Since 1870, global sea levels have risen approximately 8 inches, with an annual rate above one-tenth of one inch since the 1990s. Along the Mid-Atlantic coast of the United States from Virginia to New York, the sea level rise has been nearly double the global average. It is expected that the sea level rise along the mid-Atlantic will be more than a foot higher than comparable coastal areas in the United States. Sea level is expected to rise an additional eighteen to twenty inches by the end of the 21st century, which will be catastrophic to Moonachie should no preventive actions be taken.<sup>4</sup> As a result, storm surges from the Atlantic will have a greater effect on low-lying communities in the Meadowlands catchment area, including Moonachie. As the sea level rises, areas that are currently marshland may well transform into arms of the Hackensack River and its tributaries, further endangering property. [Figures 14-18]

Issues related to flooding include the threat to infrastructure, undermining of structures throughout the Borough and, in particular, further dispersal of hazardous materials. This is of significant concern, as there are 73 active, pending and remediated contaminated sites in Moonachie as identified by the EPA and the NJ DEP. Flooding events pose a hazard through potential dispersal of contamination.<sup>10</sup>

## Drainage

Three main drainage systems, Losen Slote Creek (shared with Little Ferry), East Riser Ditch and West Riser Ditch (both shared with Teterboro), drain into Berry's Creek. The Teterboro Tide Gate and Pump Station lies directly adjacent to the Borough's northwest boundary, while the West Riser Tide Gate is on Berry's Creek, shared with Wood-Ridge. While none of these waterways terminate in Moonachie, their conveyance of water through the borough is critical during flood events. Water flowing from Teterboro Airport, in particular, is pumped through Moonachie during flood events, exacerbating downstream flooding for the borough. The extant drainage system is deficient in terms of both maintenance of the canals, ditches and streambeds and the continued filling in and development of open space. This decreases permeable surfaces which previously absorbed a considerable amount of surface water.

Drainage and water retention in Moonachie, and the immediate surrounding area, is impacted by a convergence of four indices: climate change/sea level rise; hardscaping/impermeability of the landscape; historically high water tables; and upstream conditions and waterways that contribute to local flooding. Any one of these indices can create issues in moving floodwaters away from vulnerable areas in Moonachie, but all four together may create conditions which can significantly exacerbate flooding events.

Based on historical aerial maps from 1930 to the present, the transformation of Moonachie from a low-impact agricultural area to an industrial suburb of New York City radically altered the hydrology of the borough. In 1930, more than 95% of the borough was open land, with over 60% used for cropland and agriculture, 15% forested 10% open space and another 10% active marshland. By 1958, Moonachie was still primarily agricultural, with approximately 45% being used for cropland and agriculture, 20% forested, 5% open space and 10% marshland. However, by 1969, all active farmland had disappeared; while two-thirds of the borough was still undeveloped at this time, by 1980 large swaths of former farm fields and forest had been developed with industrial and corporate parks, leading to increased impermeability. [Figure 19] Some of the remaining marshland was filled in or degraded.

[Appendix X, Figure 20] This does not include Moonachie's street and roadway network which adds additional impermeable paving. Less than 30% of the municipal land has remained forested, marshland or open, with much of the remaining open lands located in isolated parcels. [Figure 21]

The two largest contiguous areas of open space— essentially east and west of the Teterboro Airport runways— remain potentially vulnerable to the planned expansion of the airport.

Concerns regarding the Airport expansion are reflected in the Moonachie Master Plans and New Jersey Meadowlands Commission Master Plans for more than thirty years.



**Mature trees were recently “topped” on land controlled by the Port Authority of New York and New Jersey in Moonachie.**

In fact, conserving these forested tracts of land at Teterboro Airport are supposed to be a top priority. The New Jersey Meadowlands Master Plan states on Page 5-17 that the forested wetlands around Teterboro Airport and Losen Slote Creek - both primarily in Moonachie - are remnant and unique habitats, which “provide a local diversity of plants and animals which may supply the stock to recolonize other areas of the Meadowlands at some future time.” Protecting the remaining acreage from degradation and development will both meet this stated goal and retain natural permeability and water retention for flood control purposes.

Unfortunately, continued development, expansion of Teterboro Airport and related drainage patterns and increased impermeability, within Moonachie, has increased runoff as well as decreased biological water absorption. There are three large-scale impermeable areas in Moonachie: south of Moonachie Avenue; portions of Teterboro Airport; and the triangle north of Empire Boulevard and west of Losen Slote. A smaller area of impermeability is directly east of Redneck Avenue north of Moonachie Road. These largely impermeable areas of



Moonachie directly contribute to the general inability of drainage ditches and creeks - West Riser, East Riser, Losen Slote and Berry Creek - in removing excess water from the Borough during a major flooding event.

There are several vacant marshland parcels along Losen Slote Creek (Block 31, Lots 1, 2 and 3) which could be acquired for stormwater control use. Block 45, Lot 1, on the south side of Redneck Avenue, is adjacent to East Riser ditch and Teterboro Airport and is currently used for ball fields and passive use. It is possible that this parcel can be used for 100-Year event flood storage. Portions of Teterboro Airport adjacent to West Riser Ditch has the potential to be re-engineered to better retain water and limit storm runoff from the airport itself. Other smaller vacant or partially vacant parcels of land may also be appropriate for stormwater diversion.

## Importance of Moonachie Infrastructure

The Borough of Moonachie is one of the primary conduits for almost every power, energy and communications array as well as water/sewer lines in Bergen County. These include major data lines and fiber optic cable; natural gas and pipelines along Moonachie Avenue; major electrical transmission lines which run between the Clifton substation and Ridgefield Park; the main water trunk line running from Oradell to Moonachie feeding much of southern Bergen County; National Gas pipeline and the main sewer line running along Moonachie Avenue to the Bergen County Municipal Utilities Authority.

PSE&G and United Gas have gas pipelines that run beneath many residential properties and electrical wires underground at Moonachie Avenue, Moonachie Road, Redneck Avenue, Empire Boulevard and State Street. Verizon has fiber optic cables under Moonachie Avenue, Empire Boulevard, and State Street.

Moonachie Avenue and Moonachie Road have underground and exposed power lines which are critical for transmission both within Moonachie and to surrounding municipalities. All of these critical utility lines were vulnerable during Superstorm Sandy and all failed or had to be shut down for safety at the time of the storm surge. A significant number of critical transmission lines remained out of commission for weeks afterwards. In addition to utility, data and communication lines fiber optics were recently installed at West commercial Avenue.

## Damage after Hurricane Sandy

During Superstorm Sandy, all three sanitary stations experienced significant damage and pump stations failed. The earthen berms, located in the borough, while averaging 6 feet above the mean elevation of Moonachie, were immediately breached and overtopped, dissolving portions of the berms. The highest sea surge reached 9.5 feet above mean level and remained over seven feet for six hours. Total power outages and pump station failure, along with the failure of the drainage system caused the water in Moonachie to remain stagnant and standing for days after. This compounded the already significant water damage to the majority of buildings in the borough.

Drainage and limited water retention systems, already extant, were easily overwhelmed by Superstorm Sandy. All publicly-owned marshland and open space bordering Losen Slote Creek and the West and East Riser ditches, used for water retention, were beyond maximum capacity.

All roadways, including the Bergen County roads of Moonachie Avenue, Moonachie Road and Redneck Road were unprepared for Superstorm Sandy. With the exception of the northerly portion of Redneck Avenue, all of these roadways were under several feet of water during the event and all but impassable without boats. This significantly contributed to the lack of escape routes for residents and workers in Moonachie. All freight railways are located near or on the border of Carlstadt and run east-west, crossing Berry's Creek into Wood-Ridge. The entire network of creeks and ditches which run through Moonachie flooded during Superstorm Sandy. This network included the West and East Riser ditches, Losen Slote Creek and Berry's Creek; the West Riser Tide Gate, located at Berry's Creek within Moonachie; and other tidal gates located nearby (including Losen Slote and Teterboro).

All municipal buildings in the Borough flooded during Superstorm Sandy. Many sustained extensive damage, including the Moonachie Borough Hall, which must be replaced. Direct storm damage from Superstorm Sandy was compounded by overwhelmed drainage and pump systems, power outages and impaired community services. All municipal facilities were rendered inoperable by flood waters and damaged services left first responders without access to reliable communication or necessary equipment, and town residents without means for safe evacuation, shelter, and safe food or water.

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In response to questionnaires, homeowners noted that the ground floor levels of their properties took the most damage, with destruction ranging from mild flooding to the entire destruction of the ground floor level or garage including all belongings within. Many respondents noted that repairs to properties were still ongoing. Business owners reported damages ranging in cost from minimal expense to multi-million dollar expense. Losses largely included inventory, equipment or computers. In some cases, business owners had advanced notice of the oncoming storm, but could not move heavy machinery. Several local businesses have closed in the aftermath of the storm.

## Outreach



**Mobile home parks in Moonachie south of Teterboro Airport were devastated after the Superstorm Sandy tidal surge.**

Outreach relative to recommendations for future disaster response included gathering information from municipal responders and the public, particularly those affected in the borough, including residents and businesses.

### First Responders Outreach

The first responders in the Borough of Moonachie include the police, the DPW, the volunteer fire department and the volunteer First Aid and Rescue Squad. General consensus among first responders was that there was no advanced local or state-wide disaster coordination or planning, as described below:

- No pre-determined rally point for first responder coordination.
- Mutual Aid Agreements between Moonachie, South Hackensack, Carlstadt, Little Ferry Wood-Ridge and Wallington, in place to assist each other in case of emergency, were ineffective because all member municipalities were severely impacted by the storm.
- There was no advanced coordination between the Police, DPW, volunteer Fire Department and volunteer First Aid and Rescue Squad. Each department met individually to coordinate internally with police staff staying at police headquarters and fire department members securing food, shelter items and fuel in order to remain at the fire house for the duration of the storm.

- There was no coordination for moving equipment, vehicles, etc. ahead of the storm. No upland storage area was pre-planned for vehicles and equipment. As a result, the police, DPW, fire department and First Aid Squad vehicles and equipment suffered significant damage and contamination from the flooding of the municipal building/police headquarters, fire house and EMS building. The ability to fight fires was severely impacted as the fire department equipment was damaged and contaminated.
- The borough had only two small boats as part of the EMS squad equipment. Requests for additional boats were sent by the Fire Department through shared interagency radio channels. Boats from Wallington responded the same night and the State police responded the next day.
- No opportunity existed for sheltering residents as the Borough Hall and Civic/Senior Center were unavailable due to flooding. The current emergency shelter for Moonachie is shared with Little Ferry at the Memorial School on Liberty Street, but was inaccessible to all Moonachie residents without a boat to ferry them to that location.
- Overall borough-wide power outages occurred. The fire house did not have a generator and the municipal building/police headquarters generator was damaged by the flood. Phone and emergency communications were damaged with all communications lost during critical hours. Police dispatch and the reverse 911 system was ineffective for the duration of the power outages.

### First Responder Recommendations

The first responders had the following recommendations: Local Office of Emergency Management (OEM) needs to coordinate with local police, fire and First Aid and Rescue Squad volunteers, as well as the county and State. There is a need to prepare a long term plan that identifies, among other items, a back up command center, if the fire house must be abandoned; that provides a communication system that can be shared among the police, fire, DPW and EMS; that updates the Standard Operating Procedure (SOP) that identifies the chain of command; and that re-examines the existing Mutual Agreement between the surrounding municipalities to ensure it meets the needs of the Borough of Moonachie.

- Purchase high water amphibious vehicles and rescue boats.
- Purchase generators and install them above the flood elevation to ensure the viability of power to the municipal building and fire house.
- Purchase low tech public address system(s), including supplemental megaphones and satellite radios, as back-up communication between the borough and its residents.
- Conduct outreach and preparedness classes with Borough residents.

The needs communicated by First Responders in Moonachie should be advanced, and planning efforts should be initiated and regularly updated. Citizen volunteers assisted the community and many businesses volunteered staff, funding and countless resources.

### Homeowner/Property Owner Questionnaire

As part of the Strategic Recovery Planning Report process, the Borough of Moonachie created a questionnaire. 13 questionnaire hard copies were delivered to Borough Hall in

Moonachie, while more were responded to on the website (we are still waiting to access them). We expect these percentages and details to change once this new information is assessed.

Most respondents had their house and property seriously damaged, with a typical repair time of 6 months to 1.5 years. One respondent stated he had no damage, while several others only had light damage that was quickly repaired (within one week to one month). Several respondents stated that they were still repairing their property and houses. These responses also closely correspond with the reported statistics that 62% of property and houses were damaged in Superstorm Sandy.

According to the respondents, much of the damage was limited to the basement and first floor. However, the scope of damage varied widely, from minor flooding to complete damage of garages and cars to total destruction of entire first floors and all of the contents therein.

One of the questions that generated the most interest was Question #28, which stated "Would you support these actions [new tide gates, higher berms and storm barriers, other improved emergency equipment] if it meant additional tax dollars were necessary in order to implement them?" Nine respondents stated yes; one respondent stated "Probably"; and three respondents stated no. However, many of the "yes" respondents qualified their support for new taxes, only supporting a small increase, as they felt that A) they are paying too much in taxes already and B) some of the flooding was due to human error that was not the fault of the Borough of Moonachie.

While most of the respondents were aware of the impending storm, five out of thirteen respondents stated that they had no knowledge as to emergency evacuation procedures. Of the eight who had emergency communications, most were on the telephone as recorded messages or from the police calling for an immediate evacuation of their house to higher ground.



**The residential sections of Moonachie are primarily made up of detached single and two-family houses. Throughout the Borough, the worst damage caused by Superstorm Sandy was generally confined to the first floor.**

Funding and reimbursement for homeowner repairs to damage came mostly from FEMA, Private Insurance, a New Jersey Homeowner Assessment Grant or a New Jersey Resettlement Grant. This funding/reimbursement varied significantly from respondent to respondent but many respondents stated that it did not amount to very much, leaving little option but to utilize personal savings.

## Business Questionnaire

Random samples of businesses were contacted directly by phone during the questionnaire process. The responses were varied with some businesses stating they were not affected by the storm due to careful planning, slightly higher elevation or sheer luck, while others stated they experienced significant damage.

All businesses contacted were aware of the impending storm and had ample time to contact their onsite employees, which ranged from 5 to 170 persons. Most businesses stated that they had water issues in the past with large storms such as Hurricane Irene but nothing of the magnitude of Superstorm Sandy. Most had also taken preventive measures, such as resealing the building, and installing generators and sump pumps. In general, such measures did not make any difference during Sandy. Damage from Sandy ranged from negligible to over \$3 million - mostly in inventory, computers and electronic equipment and office furniture.

Many businesses were able to get up and running within a week of the storm - when power was restored throughout the Borough - even with limited facilities. More typically, it took four to six months for businesses to get back to pre-storm operations. After Superstorm Sandy, all businesses that were surveyed stated that they had made changes to where their critical infrastructure and inventory was located in order to make them more stormproof. However, there were cases where large machinery was impossible to relocate, making those businesses vulnerable to the next large storm event.

Overall, most businesses understood the difficulties face by the Borough and the response from the Borough of Moonachie and its emergency services during the storm. They were, however, critical about the failing infrastructure, including pump stations, poorly maintained ditches and overall drainage which exacerbated flooding. Many of the businesses stated that their neighbors and, in some cases, nearby residents banded together to help each other.

Reportedly, in the two years since Superstorm Sandy, a number of local businesses have closed their doors due to financial ruin and others have relocated out of Moonachie. Other businesses and residents have filed tax appeals based on their damages and the Borough's damages.

It is the Borough's intention to pursue critical planning grants through the Landmark Planning Assistance Program to act on behalf of this community.

The Borough of Moonachie has many challenges ahead in order to best prepare for the next Superstorm Sandy including the allocation of funding streams for critical improvements. While funding can be raised from local, state and federal sources several have been created specifically for Sandy-impacted communities in New Jersey.

## Recovery and Mitigation Steps to Date

To date, improvements have occurred throughout the Borough to the limited requirements of continual operation of said facilities. Through great public and private effort, the Borough has:

- Removed debris from homes, businesses, parks and municipal properties; roads were cleared.
- Conducted search and rescue, traffic control, street barricading and closures, and sand bags, food and shelter were made available for flooded residents and rescuers. [SEE LOCATION MAP]
- Cleaned and made minor improvements for continued access and operation to the Redneck Avenue ball fields and local parks. [SEE LOCATION MAP]
- Cooperated with utilities to repair power lines
- Coordinated with Bergen County to initiate a project for check valves on storm outflows and upgrading of the pressurized gas lines. Ten locations were proposed in Moonachie, primarily along Losen Slote. The project is in design phase.

### Pump Stations - Repairs and Upgrades

Flood waters overwhelmed and damaged many of the Borough storm and sanitary pump stations. Damage continues to accrue due to the corrosive flood waters of Superstorm Sandy. To date, the following repairs and improvements have been made:

Lincoln Street Pump Station	New raised electric service installed New generator Pumps have been replaced
Moonachie Road Pump Station	New raised electric service installed
Burger King (Moonachie Road) Pump Station	New raised electric service installed Power Box placed above flood elevation
Moonachie Ave- nue Pump Station	New pumps installed Electrical Repairs Roof repaired
Concord Street Pump Station	Corroded connections and pods replaced

### Moonachie Public Buildings

The **Borough Hall** is a critical municipal facility which also houses the police station. The building was substantially damaged. To meet storm resiliency for the future, elevating the building is the only available remedy. The cost of elevating the building and bringing all elements up to code compliance and floodplain compliance exceeds the cost of new

construction.

As such, the Borough is pursuing an improved project and expanding be used for access, parking and non-essential storage only. The Borough has been engaged in a lengthy process of review with FEMA relative to repair/replacement. This project is in the design stage; architectural plans will be completed and submitted in the Spring of 2015.

The **Firehouse** had its garage floor renovated by the Borough. The cascade system has not yet been replaced although a grant has been procured by the Fire Department, with replacement anticipated soon. They have received foundation, private and other funds for the replacement of personal and firefighting equipment. In conjunction with bid jobs for improvements, private donations may subsidize the all volunteer organization's efforts to make their building as flood resilient as possible.



**The Fire Department building has been partially renovated since flood damage during Sandy.**

The **EMS** building has been repaired only to the limit of private donation dollars. Improvements are still required. The ambulance service, however, lost all equipment, vehicles, computers, communications, office supplies and records in the storm. All repair work has been completed solely by volunteer organizations, as has the donated equipment and materials. While the EMS has a number of vehicles, only two are semi-operational; the rest are being stored for spare parts.

The two vehicles are barely working, with broken handles on the doors and no siren. One military grade amphibious vehicle has been purchased. This vehicle, which can operate in water up to 4' deep, is the only one currently capable of operating during a significant storm event. Other donations include two flat-bottomed boats (without engines) and a single inflatable raft, which has been damaged. A 4 x 4 was donated for difficult access areas.

The **DPW** building and facilities were also flooded by Superstorm Sandy, and suffered damages which have yet to be repaired. In addition, 7 vehicles were damaged beyond repair and only 3 have been replaced.

The **Robert L. Craig Elementary School** was seriously flooded and damaged. A single-story building, it requires extensive renovations. Classes were held in Wood-Ridge for two months and students returned to modular classrooms. The estimated cost of busing, modular classrooms and repair to the building is between \$6 and \$8 million. A long-term strategy to construct an elevated school, possibly with the added goal of creating a local community shelter for future emergencies, should be considered as part of a long term plan. <sup>11</sup>



The **Civic/Senior Center**, while flooded, was not substantially damaged and was repaired. Interior finishes and casework were replaced. Damage to the roof and siding were addressed. Minor strategies of mitigation which were realized include raising outlets and equipment, curbs and drainage. However, the building was not replaced and/or elevated. The Borough is pursuing door and hardware replacement.

**Parks** in Moonachie were damaged by the storm. A neighborhood park was renovated using volunteer help and donated equipment and materials under the KABOOM program, a working example of public/private partnership which mobilized the community into action. The Joseph Street Park was also repaired through volunteers and foundation funding from the Rebuilding Together Foundation and Community Funding of Morristown, NJ donated \$25,000, which helped to renovate the basketball courts.<sup>12</sup>

## Borough Waterways

The Tide Gate at Berry's Creek at the West Riser Ditch was repaired and upgraded for the stated purpose, in the New Jersey Meadowlands Commission Plan, of better protecting Teterboro Airport from daily tidal flooding. Concerns remain relative to the vulnerability of downstream areas.

At East Riser Ditch, a trash rack has been installed to keep refuse from clogging the waterway. This equipment must be constantly monitored and cleaned. And the maintenance responsibility remains undetermined.

Tide Gates have been installed at Moonachie Creek and Bashes Creek in Carlstadt which may help Participate in the National Flood Insurance Program's (NFIP) Community Rating System (CRS). This is a voluntary incentive program that recognizes and encourages community floodplain management activities. Flood insurance premium rates are discounted to reflect the reduced flood risk that results from community actions that meet the following three goals: reducing flood damage to insurable property; strengthening and supporting the insurance aspects of NFIP; and encouraging a comprehensive approach to floodplain management.



**The Berry's Creek Tidal Gate has been repaired and upgraded to protect Teterboro Airport from daily tidal flood-**

Proposed Action	Relevance to Superstorm Sandy's Effects	Resiliency / Recovery Response Application	Project Timetable
Create an Open Space Plan as part of the Borough's comprehensive Master Plan.	Flooding is commonplace in the Borough even during minor storm events. Comprehensive waterway and open space inventory, mapping and planning is critical.	Documenting and proposing uses for existing open space to help mitigate flooding and support water retention will benefit the Borough in future recovery efforts, including identifying critical parcels for storm surge retention/absorption.	Short-term (within 1 year of grant acquisition)
Create an Economic Plan as part of the Borough's comprehensive Master Plan..	Flood damage to businesses in Moonachie was devastating, and post-Sandy recovery was slow for many.	Businesses account for ten times the resident population on a daily basis in the Borough and have an outsized role in Bergen County. Protecting them from future events is critical to the future economic health of Moonachie and the region.	Short-term (within 1 year of grant acquisition)
Create a Design Standards ordinance for the treatment of flood resiliency means and methods.	Create design standards to reflect the needs of new development and additions to all structures.	New design standards compelled by ordinance will insure increased resiliency in future catastrophic storm events.	Short-term (within 1 year of grant acquisition)
Create and install a town-wide Supervisory Control and Data Acquisition (SCADA) system in conjunction with the Borough's owned and operated facilities.	During Superstorm Sandy, information services and communications were brought to a standstill, with no coordination between first responders and other personnel. Most services and facilities were destroyed or heavily damaged.	Gathering and sharing of data amongst all local departments is critical in the case of emergency, particularly if floodwaters threaten critical infrastructure, including pump stations, and provide system-wide alarm capability. The SCADA will monitor fire, security, power failures and generator operations for the Borough.	Short-term (within 1 year of grant acquisition)

Proposed Action	Relevance to Super-storm Sandy's Effects	Resiliency / Recovery / Response Application	Project Timetable
Update the Borough's Floodplain Management Plan as a part of the comprehensive Master Plan.	All planning documents will reflect contemporary and best management practices in land use and environmental design.	Onsite water retention, wetlands restoration, new construction techniques and engineering are critical to preventing or mitigating future storm events in the Borough.	Short-term (within 1 year of grant acquisition)
Update the Borough's Stormwater Management Ordinance to meet contemporary stormwater management best practices.	Lack of appropriate ordinances have created gaps in planning structures and execution in terms of future storm events. The ordinance will reflect best management practices.	Adoption of ordinance establishes clear rules and regulations which will assist any response and recovery to future storm events.	Short-term (within 1 year of grant acquisition)
Create a Hazards Mitigation and Emergency Operating Plan.	The planning document will reflect best management practices.	This type of document assists in preserving life and property during catastrophic events, applying specific approaches to mitigation, preparation, response and recovery efforts by coordinating first responders and all volunteer emergency entities.	Short-term (within 1 year of grant acquisition)
Create a Borough-wide Emergency Debris Management Plan .	In the aftermath of Super-storm Sandy, the Borough was littered with natural and man-made debris, creating challenges in clean-up and disposal services.	Debris removal is essential for critical infrastructure (stormwater management, emergency services, etc.) to function properly in the aftermath of a catastrophic event.	Short-term (within 1 year of grant acquisition)

Proposed Action	Relevance to Superstorm Sandy's Effects	Resiliency / Recovery / Response Application	Project Timetable
Create a GIS database of all public and private critical infrastructure in the Borough and environs.	Most services and facilities were destroyed or heavily damaged during Superstorm Sandy, and some critical infrastructure has yet to be repaired or upgraded	Creating a database and mapping system will allow the Borough to better respond to future catastrophic events and aid recovery efforts.	Long-term (within 3 years of grant acquisition)

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Proposed Action	Relevance to Superstorm Sandy's Effects	Resiliency / Recovery / Response Application	Project Timetable
Upgrade, digitize and place building application process online to provide enhanced access for applications and inquiries to the Borough.	Most services and facilities were destroyed or heavily damaged during Superstorm Sandy, and some critical infrastructure has yet to be repaired or upgraded, including filing systems.	Recovery efforts will be increased due to technological upgrades leading to expedited restoration and reconstruction of the Borough after a future catastrophic storm event.	Mid-term (within 2 years of grant acquisition)
Create a PILOT program to study the commercial areas of the Borough, including mobile home parks, and implement new strategies for resiliency.	Many of the commercial areas, along with the mobile home parks, were among the worst hit by Superstorm Sandy.	This type of program will outline and implement mitigation strategies and sustainability practices which can be created and maintained.	Mid-term (within 2 year of grant acquisition)
Create a PILOT program to increase permeability throughout the Borough,	Flooding during Superstorm Sandy was exacerbated by a lack of permeable surfaces in the Borough, creating additional water issues.	Adequate water retention and stormwater control is critical for future resiliency and recovery in the Borough after a catastrophic storm event.	Mid-term (within 2 year of grant acquisition)
Prepare a Capital Improvement Plan using data in part collected from GIS database in order to improve Borough-wide resiliency and response efficacy.	Most services and facilities were destroyed or heavily damaged during Superstorm Sandy, and some critical infrastructure has yet to be repaired or upgraded.	Infrastructure owned and operated by the Borough should be correctly accounted for in order to repair and rebuild post-Storm events.	Mid-term (within 2 years of grant acquisition)
Initiate Borough participation in FEMA's Community Rating System (CRS) including a resiliency survey or assessment.	FEMA's CRS promotes recovery from the effects of future catastrophic storm events.	Benefits from entering a CRS program include discounted flood insurance premium rates, reduced property damage from catastrophic storm events and increased public safety, among others.	Long-term (within 3 years of grant acquisition)

## Development of Codes, Ordinances, Standards and Regulations

Bergen County, Meadowlands, State of New Jersey, FEMA, NFIP and all regulatory agencies are undertaking revisions and modifications to planning documents as well as policy, standards and codes post-Sandy. The Borough of Moonachie had in place, prior to Sandy, a Flood Damage Prevention Ordinance. This document and all other municipal planning and development ordinances now require review and revision to address long-term resiliency and incorporate revised regulatory documents by others which are pertinent to the Borough.

## Funding Sources

In addition to FEMA and insurance funding which is being pursued for damaged municipal properties, one funding stream, *Rebuild By Design*, was created by the Department of Housing and Urban Development (HUD) as a response to Superstorm Sandy's affect on the northeastern United States. Started as a design competition for the creation of environmentally- and economically-healthier ways to rebuild Sandy-affected communities, more than \$150 million has been committed to jump-start resiliency-based development strategies in the Meadowlands communities since June of 2014. The adjacent borough of Little Ferry was included in September 2014 as one of five Meadowlands communities slated to receive a protective berm as part of *Rebuild By Design's* "coastal fortification plan." Additional municipalities are slated for funding, which must be spent on capital projects by 2019; Moonachie would benefit from this type of funded implementation of resiliency planning.

The Borough will pursue all grant opportunities, importantly additional planning assistance through the Department of Community Affairs Post-Sandy Planning Assistance Grant Program to address serious and varied issues which face the Borough to successfully plan for the future.

## Post-Sandy Recovery Recommendations for Future Response

### Emergency Response

During Superstorm Sandy, emergency procedures relied on telephone calls, bullhorns and door to door evacuations based on current policies and procedures in the Borough of Moonachie. The Borough believes that an early warning system for floods and tides is essential for a faster and more thorough response from public safety and emergency services. While removing Moonachie's residents to an emergency shelter or higher ground is essential in a tidal storm surge of Sandy's magnitude, the over 17,000 employees who work in Moonachie on a daily basis must also be evacuated quickly. There are inadequate controls in place for any sort of weather emergency, whether it be a blizzard, tidal storm surge, torrential rain or the like. There are also few public transit options. A large-scale emergency transportation solution should be considered. Additionally, public safety in Moonachie is shared with Teterboro; the Police Department has jurisdiction over Teterboro Airport, and volunteers are the back-up for the Fire Department as well.



**The Robert L. Craig Elementary School was closed for months after extensive flooding and damage from Superstorm Sandy. Future proposals call for an elevated structure which can also be used as emergency shelter.**

Currently, the Little Ferry Memorial School on Liberty Street is the primary emergency shelter for Moonachie, but as noted, residents could not access the building due to flood waters, nor was the school equipped with emergency provisions, such as a generator. Moonachie's population of residents and employees far outnumber available shelter space should a catastrophic event reoccur. The Moonachie Municipal Building, due to substantial damage from the storm surge, has submitted to FEMA for review as an elevated reconstructed improved project, the Municipal Court within will be able to hold up to 100 persons only, and only as a supplemental refuge.

### Purchase, Reclamation and Restoration

Throughout Sandy-affected communities, many properties and buildings were severely damaged or totally destroyed. In some cases, decades of development in inappropriate locations have exacerbated flooding problems. In the months after Sandy, state governments in New York and New Jersey committed financial resources - \$300 million in New Jersey and \$600 million in New York - to create buyout incentives in certain locales where future catastrophic flooding is likely. As of April 2014, New Jersey has identified 695 homes throughout the state for potential purchase and demolition. While business properties have not been included in the program and scope has been limited to buying out properties already identified, additional sensitive and vulnerable parcels should be considered.

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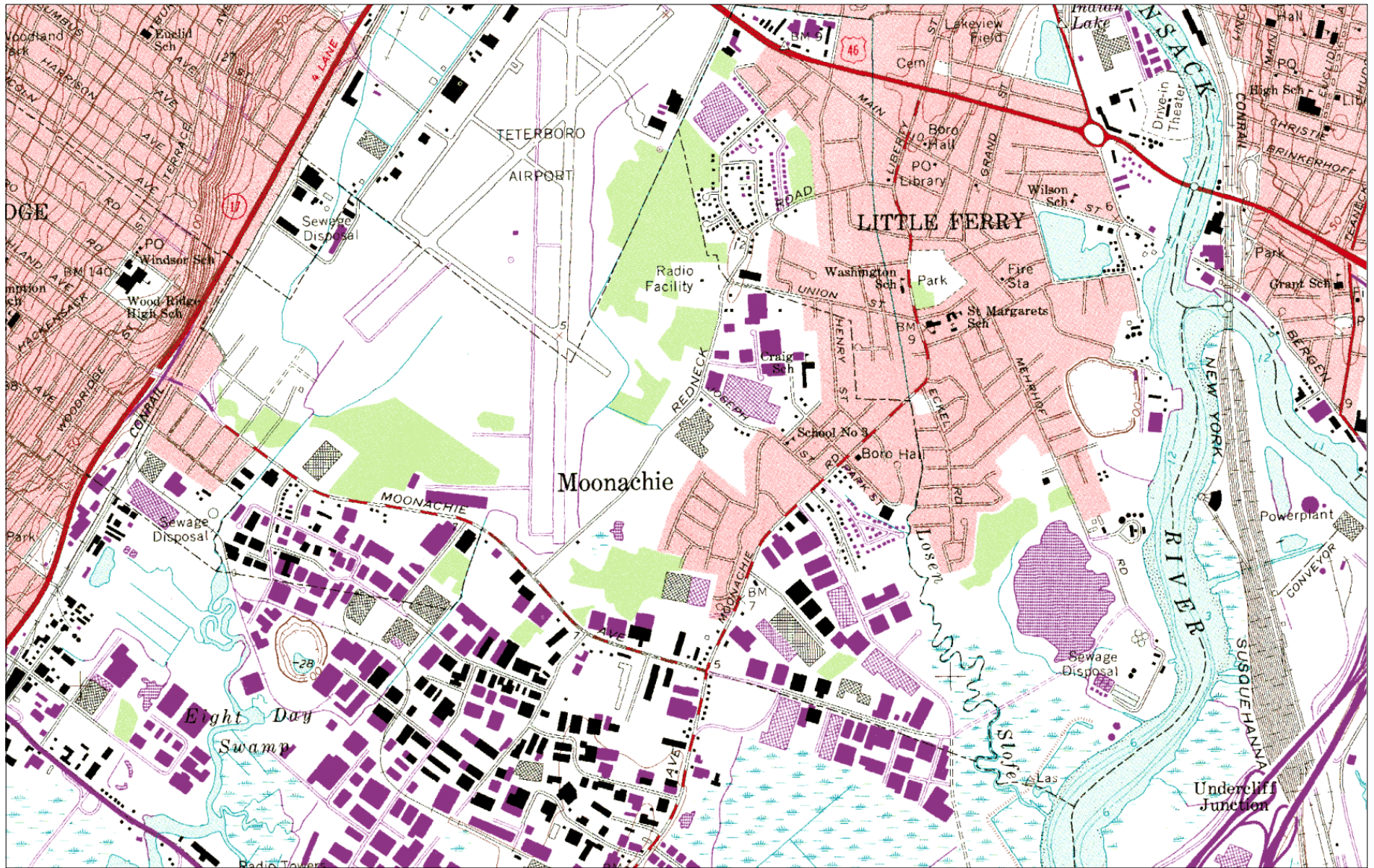


Figure 1: Borough of Moonachie - USGS Topographical Map

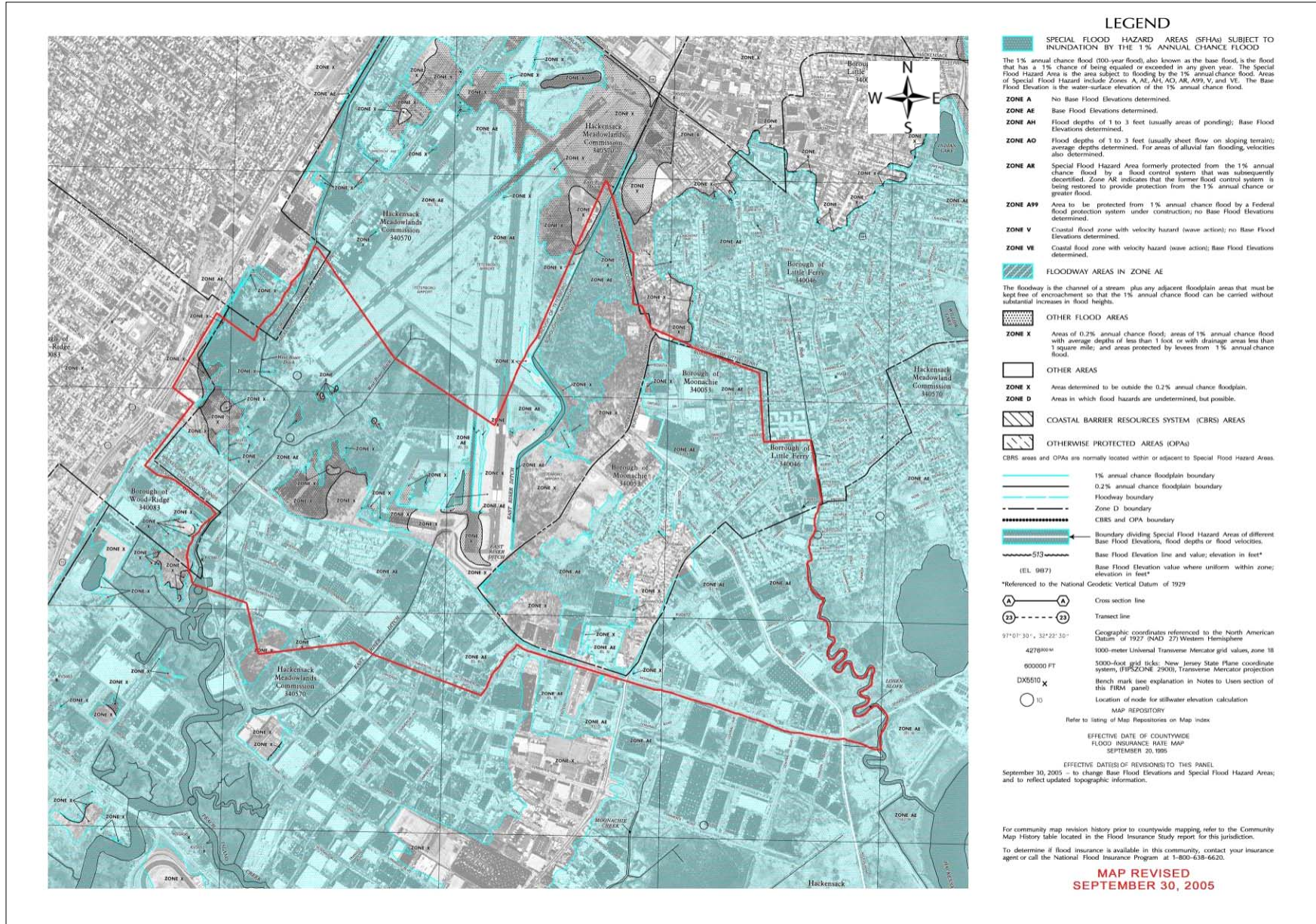
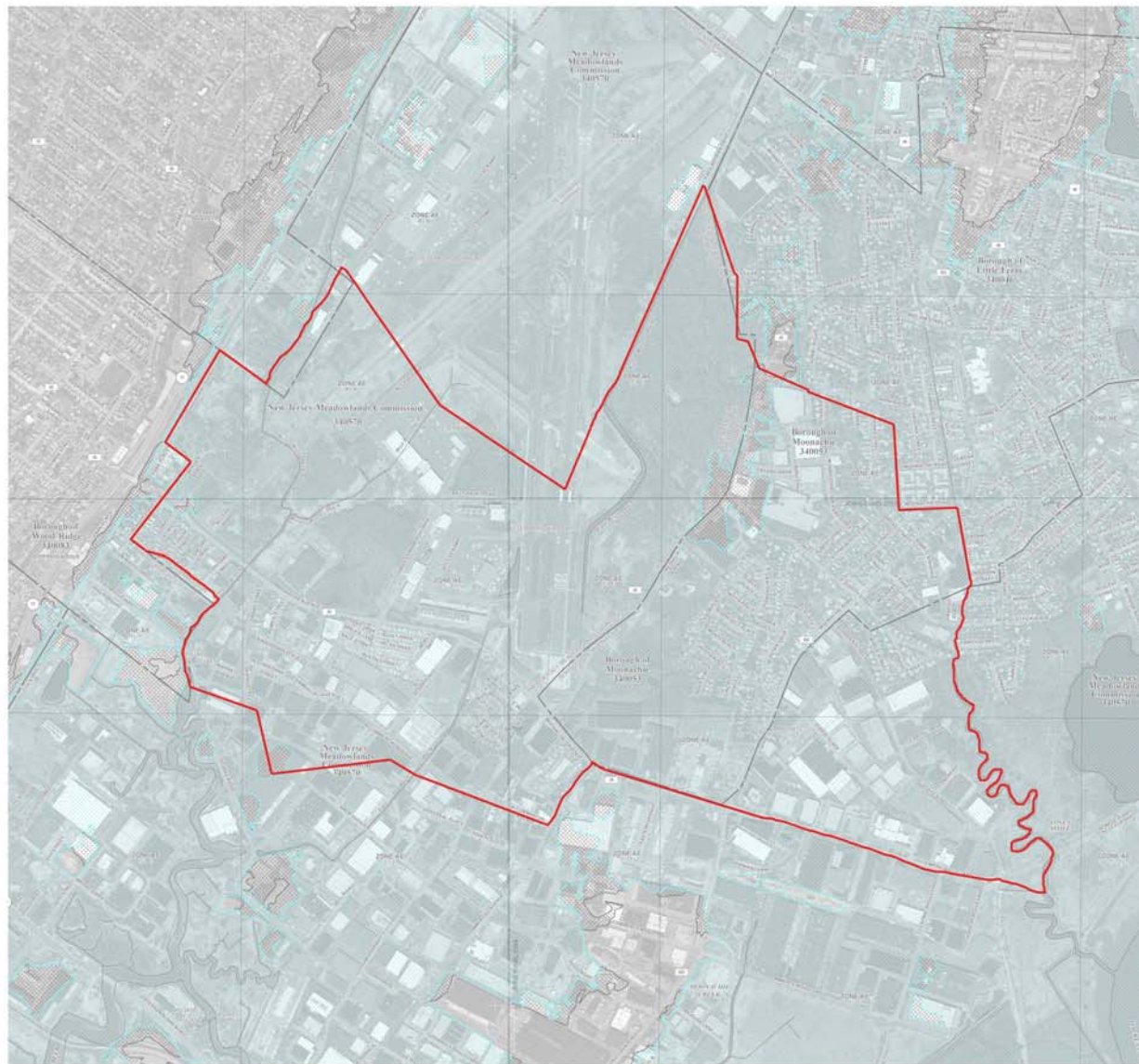


Figure 2: Borough of Moonachie - FEMA 100-Year Flood Maps, 2005



### LEGEND

**SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equalled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

**ZONE A** No Base Flood Elevations determined.

**ZONE AE** Base Flood Elevations determined.

**ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

**ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

**ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently deserted. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

**ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

**ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

**ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

**FLOODWAY AREAS IN ZONE AE**  
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

**OTHER FLOOD AREAS**

**ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

**OTHER AREAS**

**ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.

**ZONE D** Areas in which flood hazards are undetermined, but possible.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- New Jersey Flood Hazard Area Design Flood (NJFHDF)
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Limit of Moderate Wave Action
- Base Flood Elevation line and value; elevation in feet\* (EL. 987)
- Base Flood Elevation value where uniform within zone; elevation in feet\*

\* Referenced to the North American Vertical Datum of 1988

- Cross section line
- Limited detail cross section line
- Transect line

87°07'45", 32°22'30"  
Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

76°N  
1000-meter Universal Transverse Mercator grid values, zone 18

600000 FT  
5000-foot grid values; New Jersey State Plane coordinate system (TPSZONE 2900), Transverse Mercator projection

DX5510 X  
Bench mark (see explanation in Notes to Users section of this FEMA panel)

M1.5  
River Mile

MAP REPOSITORY  
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP  
September 20, 1995

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL  
September 30, 2005 - See Notice to Users in Flood Insurance Study Report

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6625.

**PRELIMINARY**  
**AUGUST 29, 2014**

Figure 3: Borough of Moonachie - FEMA 100-Year Flood Maps, 2014



Figure 4: Borough of Moonachie - Surface Water Levels from Sandy, 7:14pm



Figure 5: Borough of Moonachie - Surface Water Levels from Sandy, 8:14pm



Figure 6: Borough of Moonachie - Surface Water Levels from Sandy, 9:14pm



Figure 7: Borough of Moonachie - Surface Water Levels from Sandy, 10:14pm



Figure 8: Borough of Moonachie - Surface Water Levels from Sandy, 11:14pm





Figure 9: Borough of Moonachie - Surface Water Levels from Sandy, 12:14am

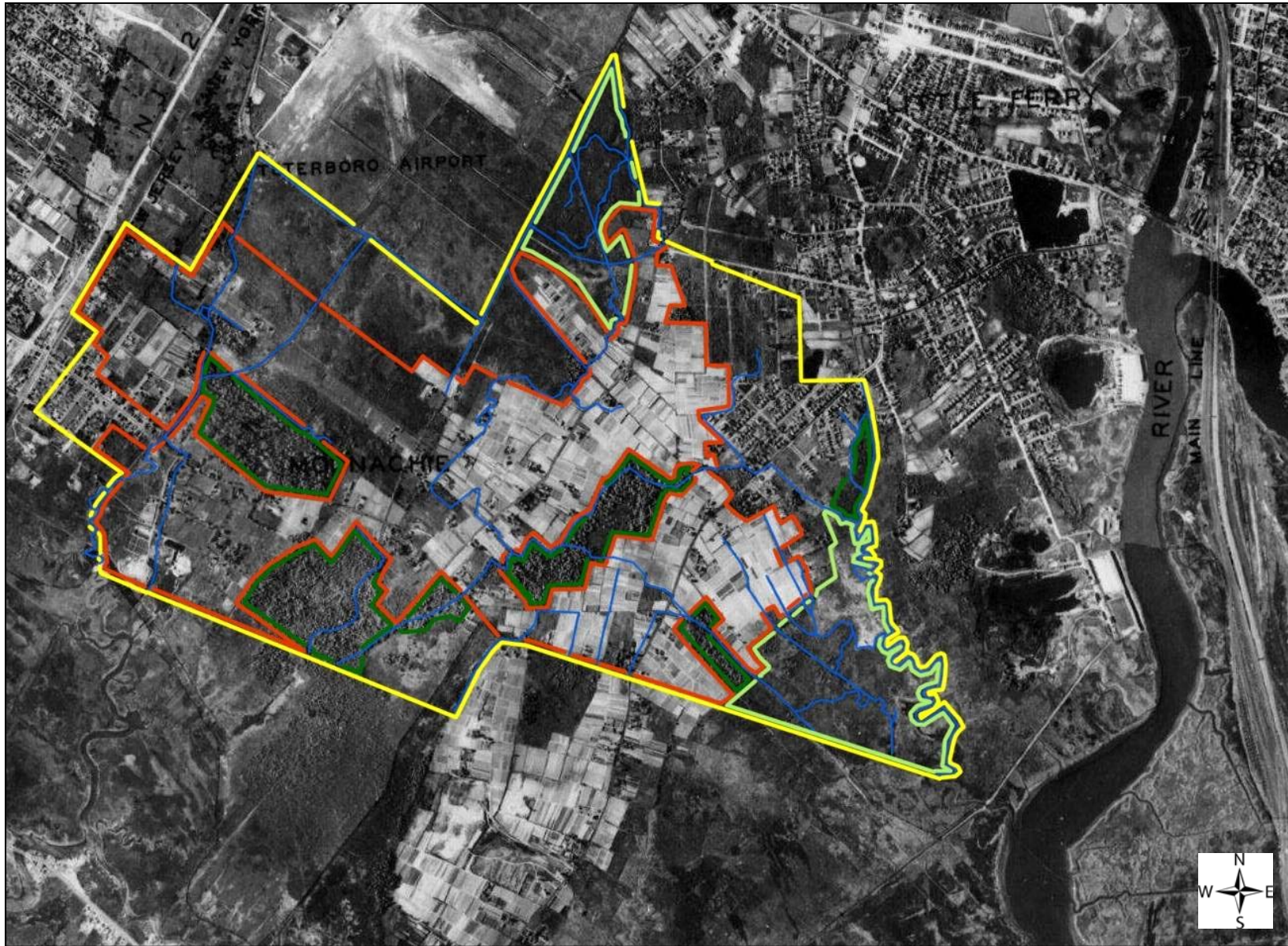
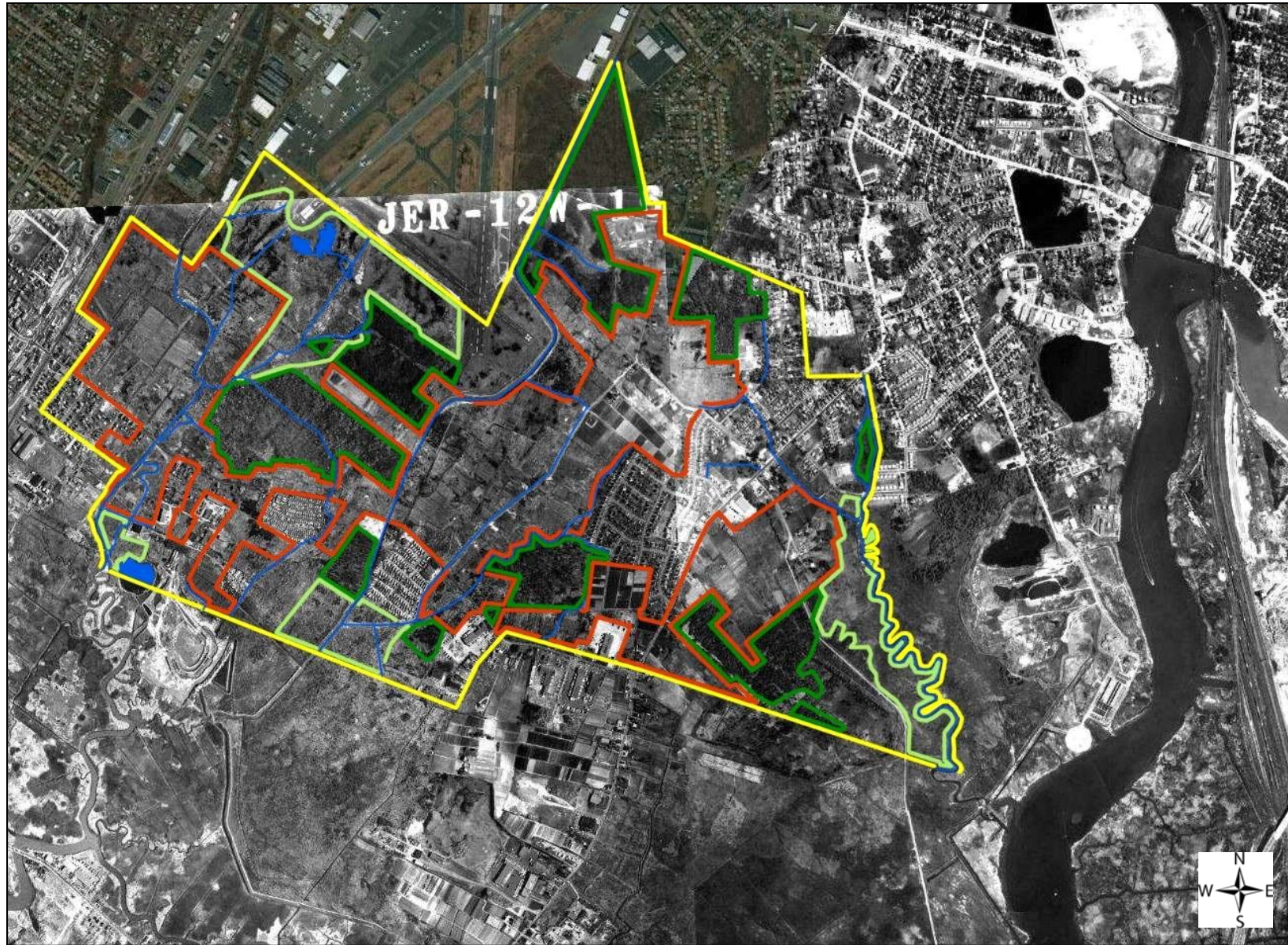
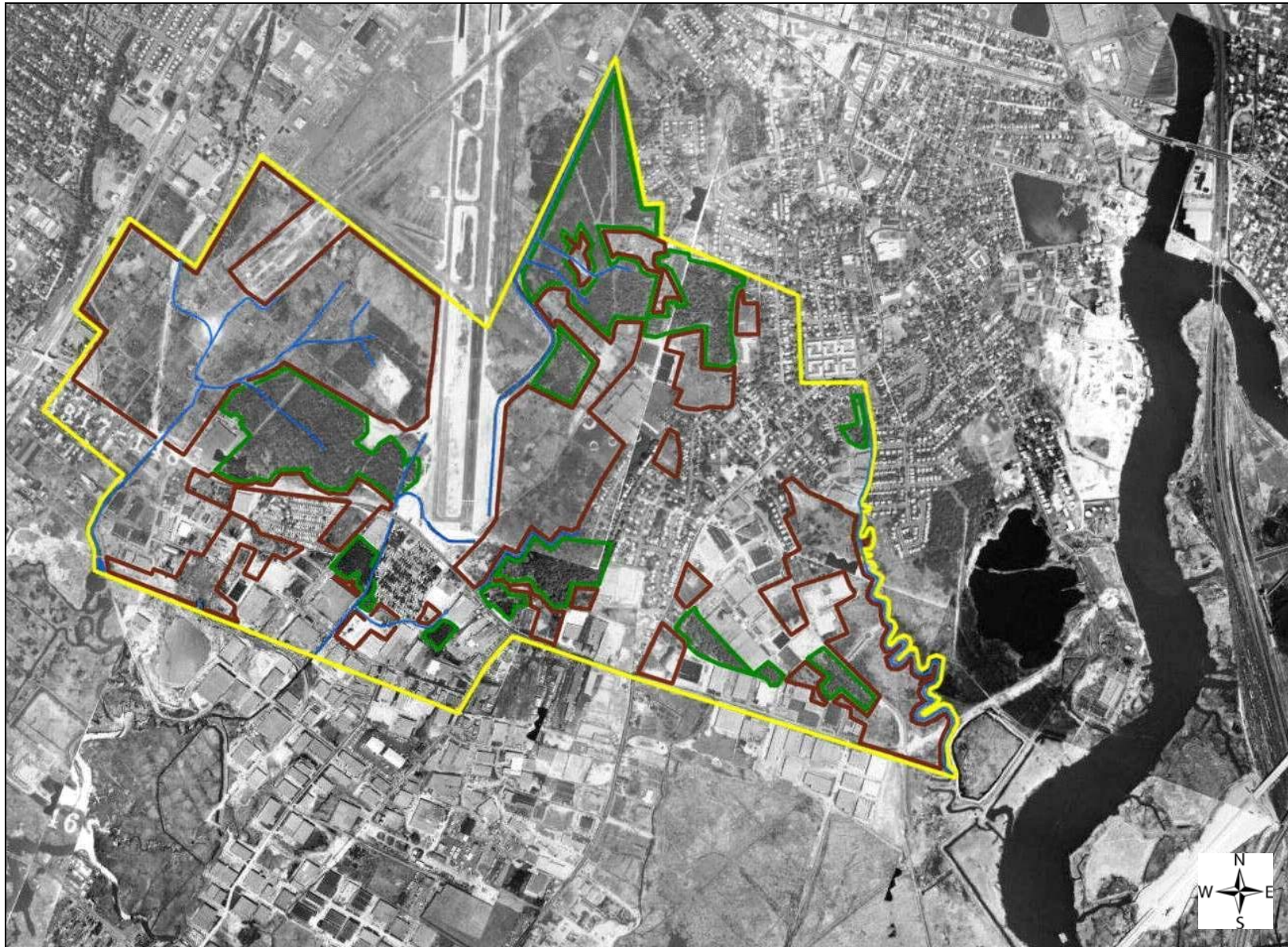


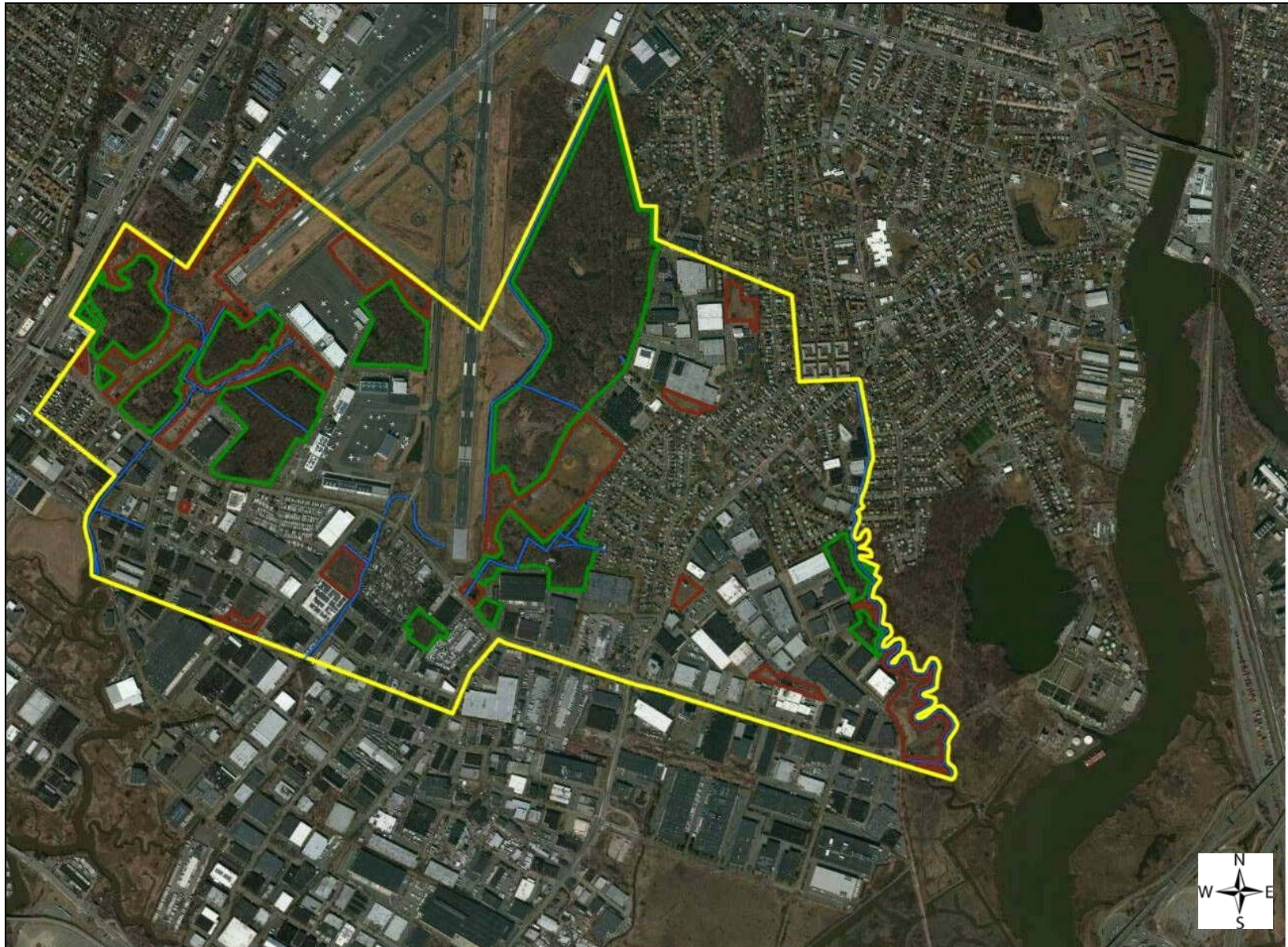
Figure 10: Borough of Moonachie - Land Use in 1930



**Figure 11: Borough of Moonachie - Land Use in 1958**



**Figure 12: Borough of Moonachie - Land Use in 1969**



**Figure 13: Borough of Moonachie - Land Use in 2014**

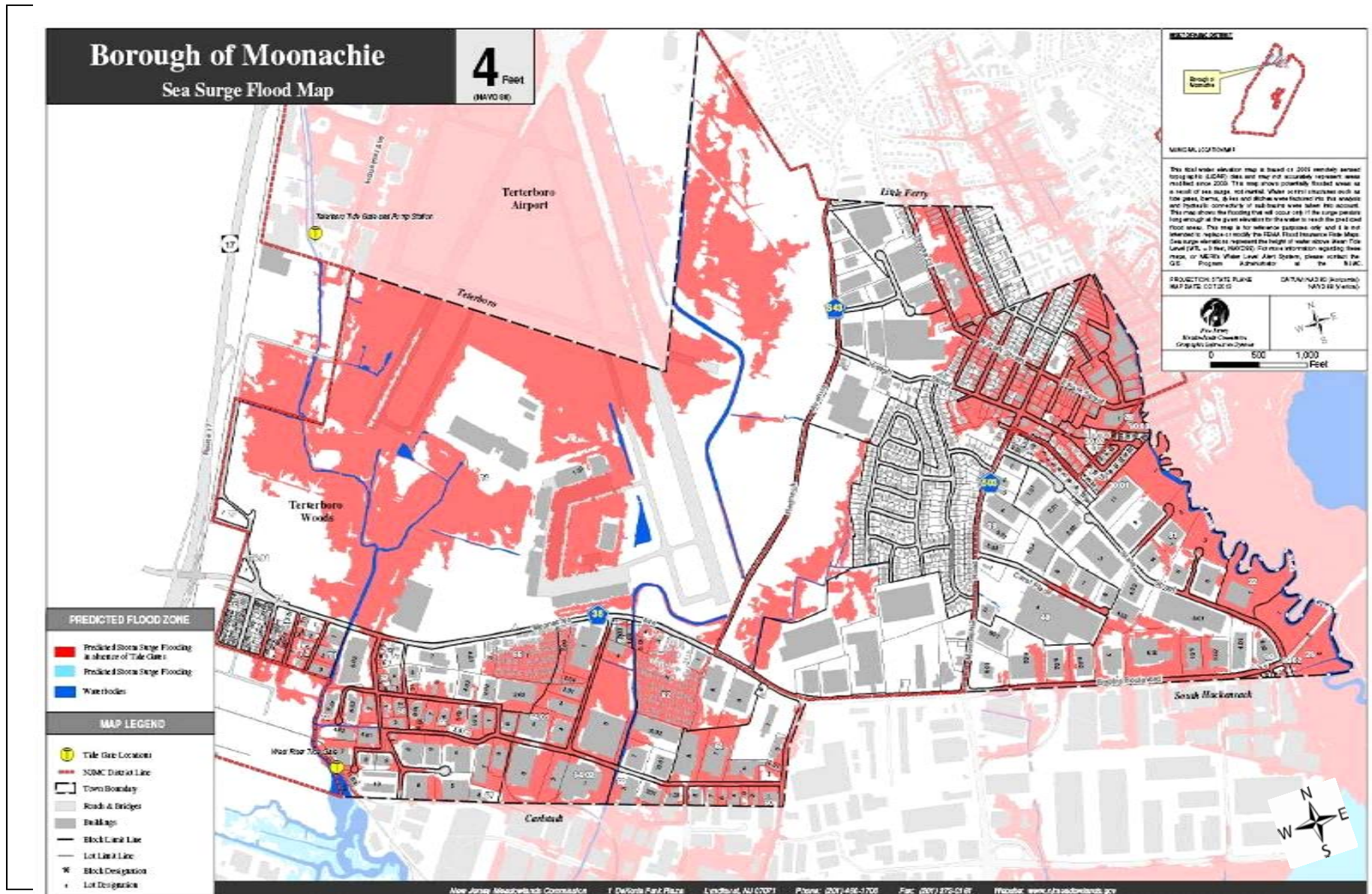


Figure 14: Borough of Moonachie - Sea Surge Flood Maps, 4 Feet

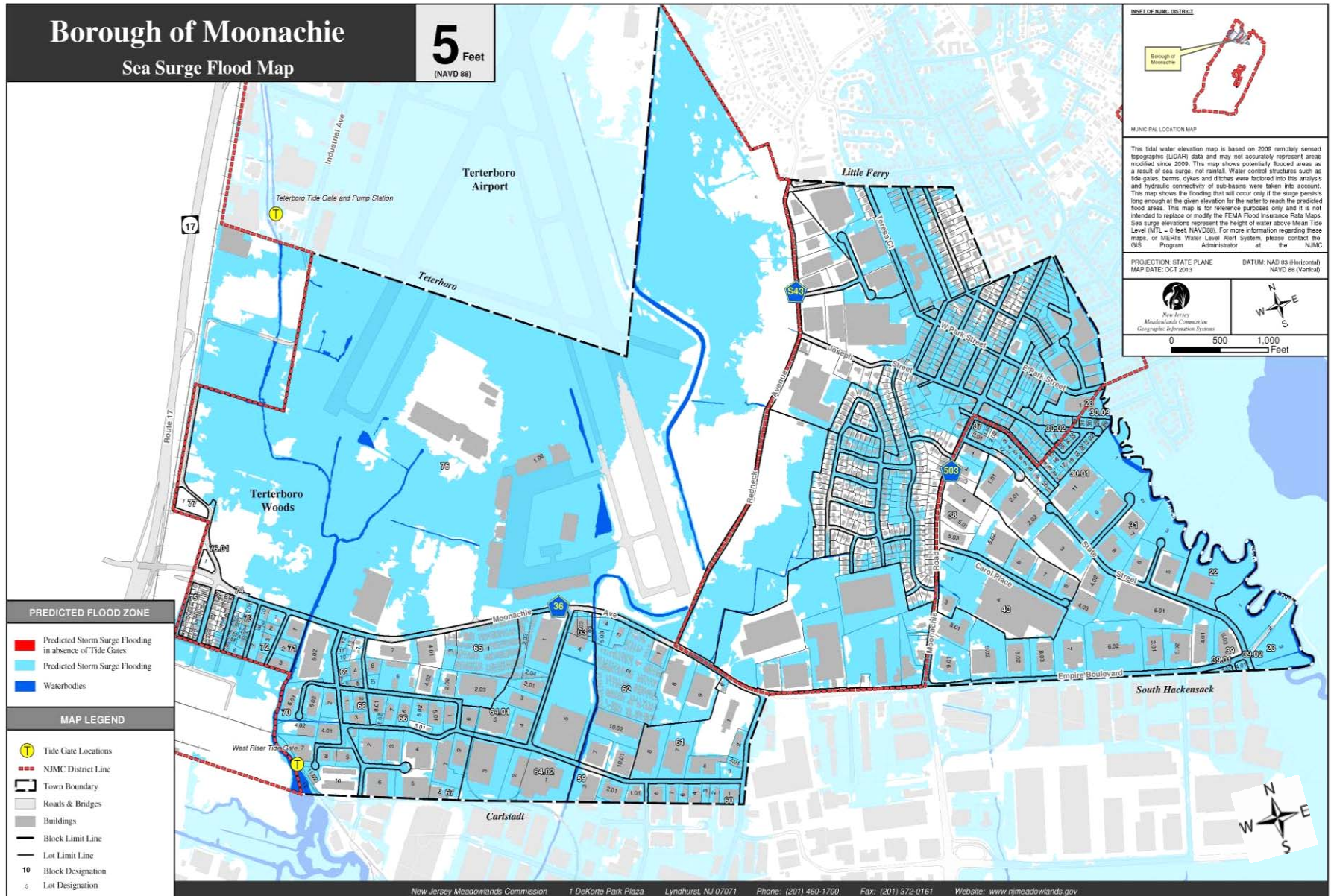


Figure 15: Borough of Moonachie - Sea Surge Flood Maps, 5 Feet

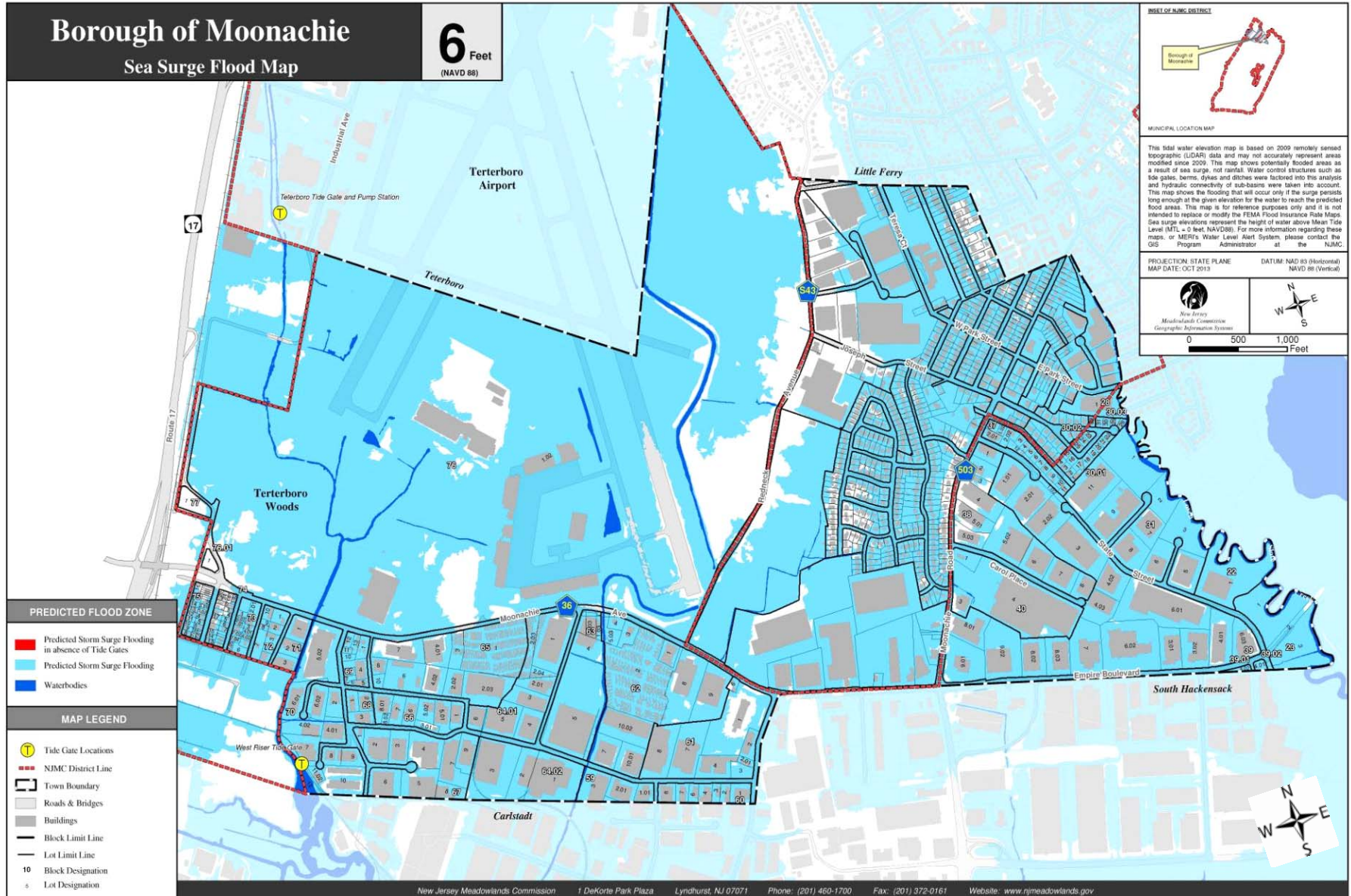


Figure 16: Borough of Moonachie - Sea Surge Flood Maps, 6 Feet





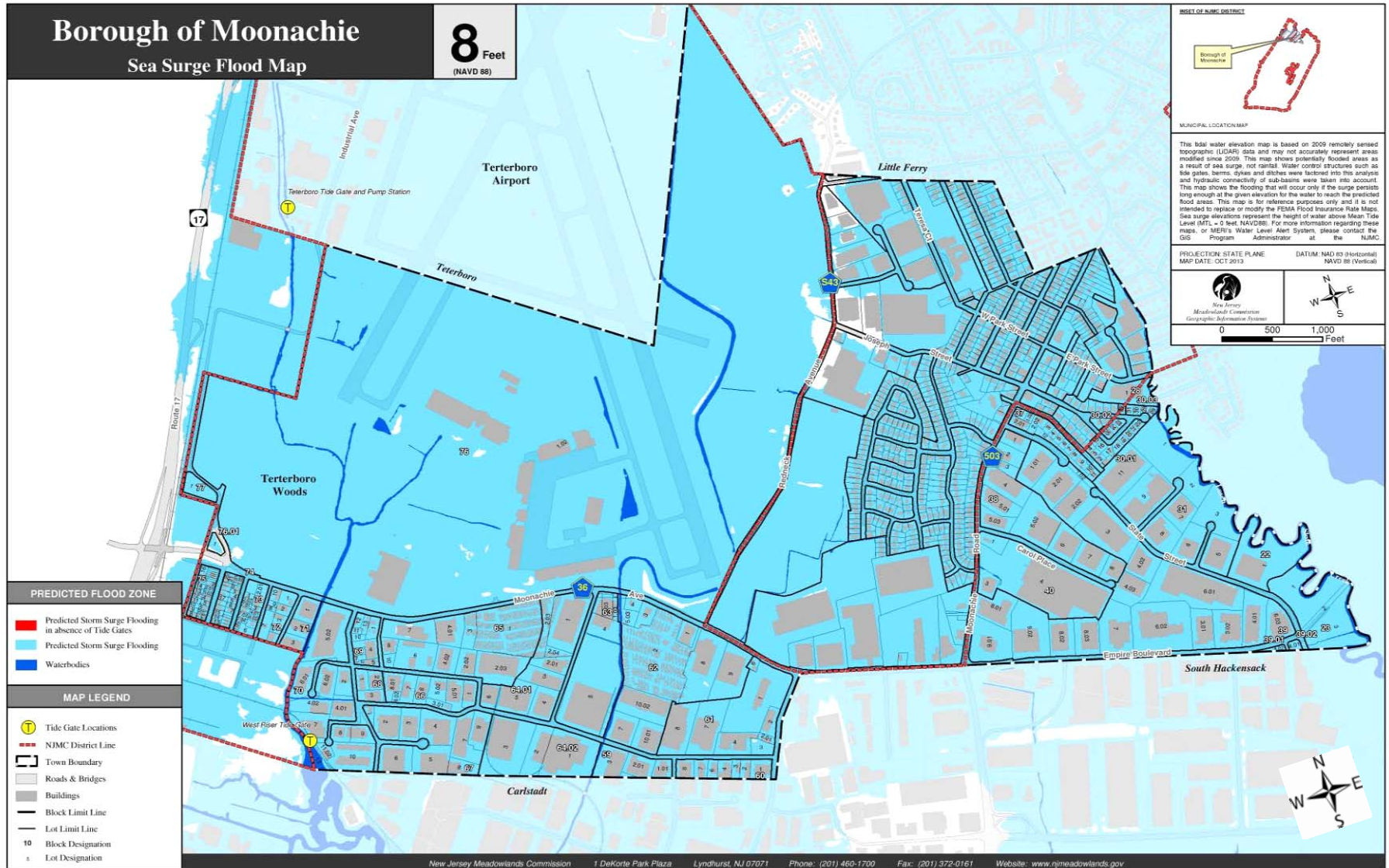
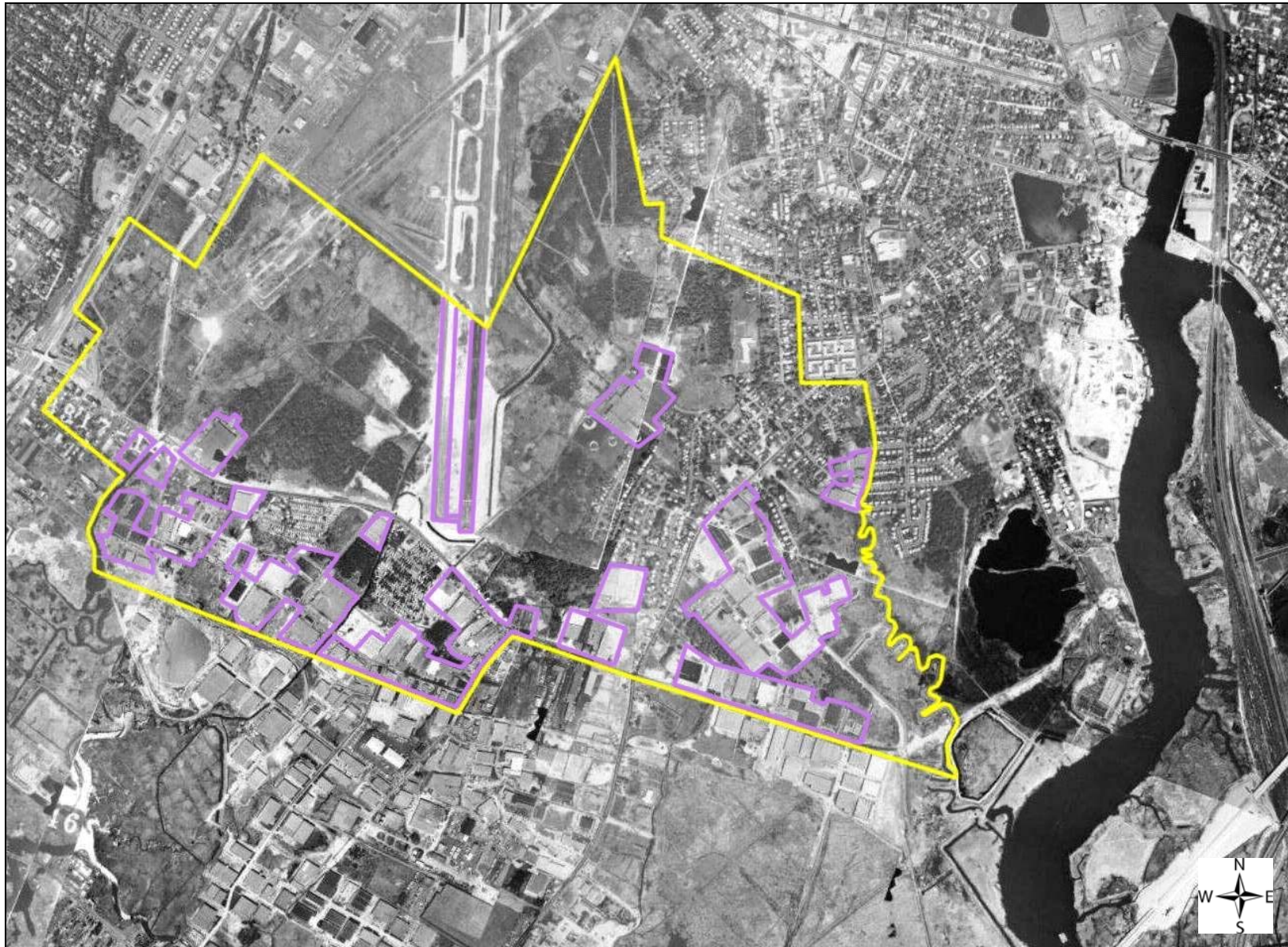


Figure 18: Borough of Moonachie - Sea Surge Flood Maps, 8 Feet



**Figure 19: Borough of Moonachie - Impermeability in 1969**

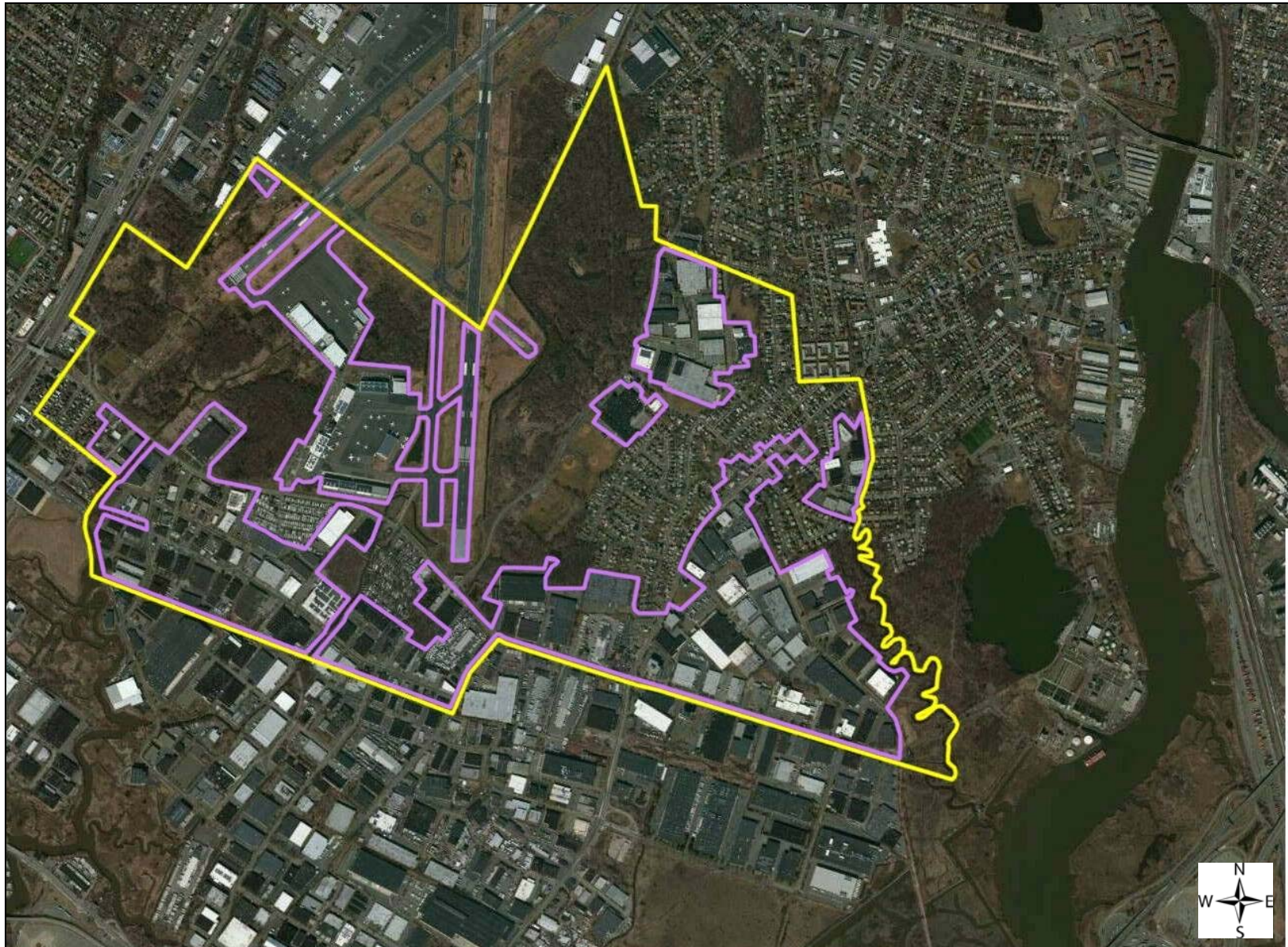


Figure 20: Borough of Moonachie - Impermeability in 2014

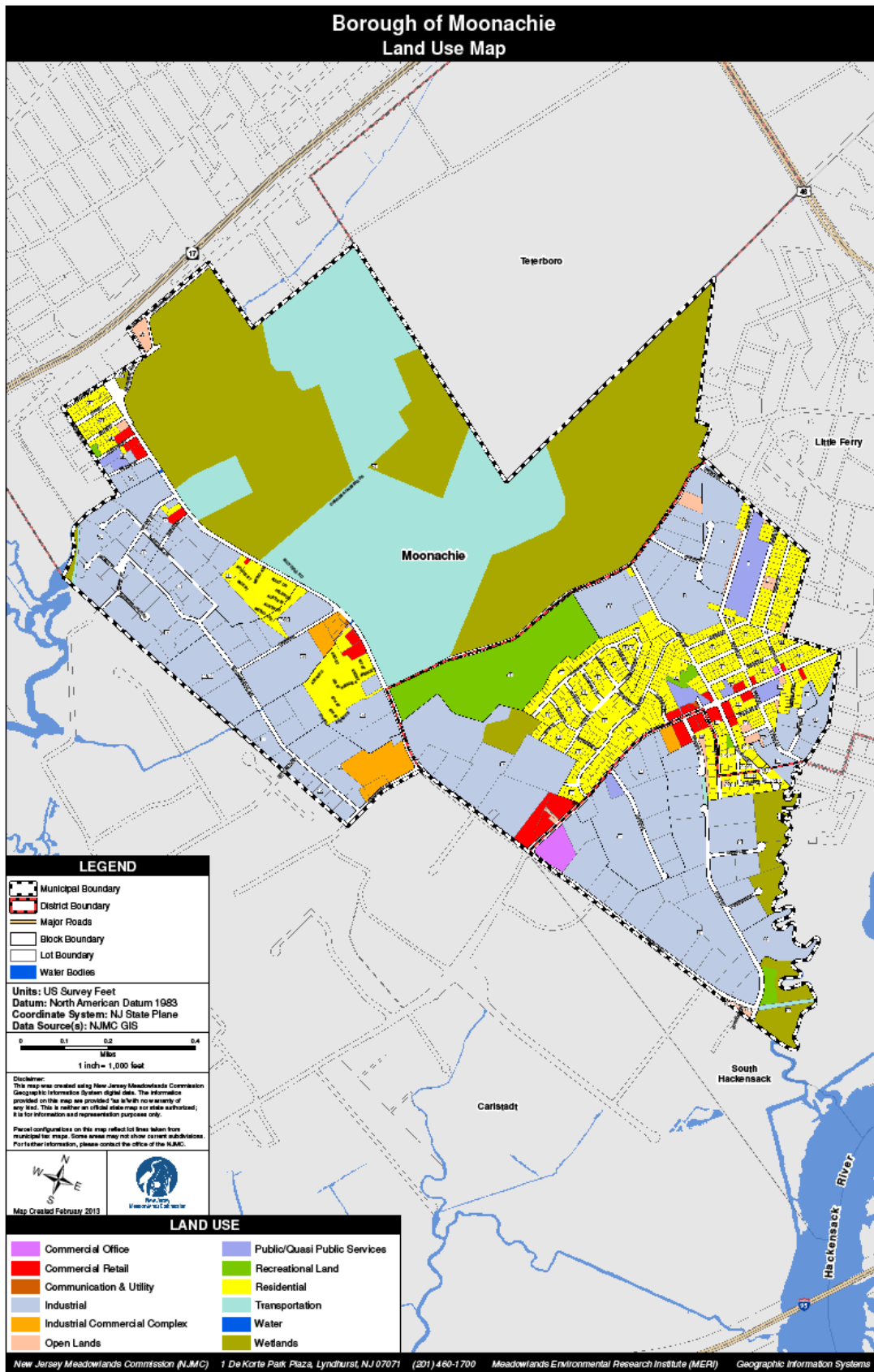


Figure 21: Borough of Moonachie - Land Use Map

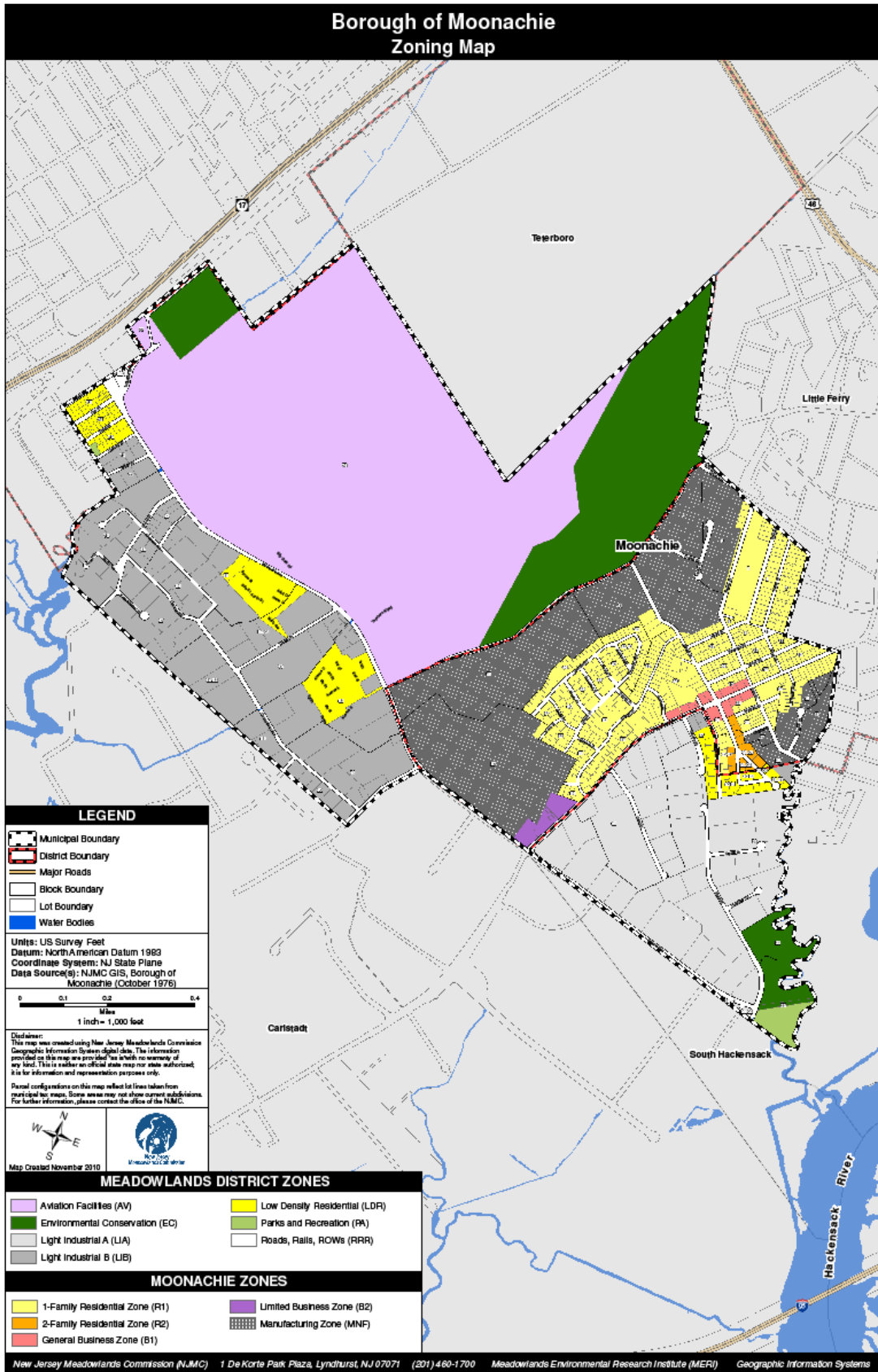


Figure 22: Borough of Moonachie - Zoning Map

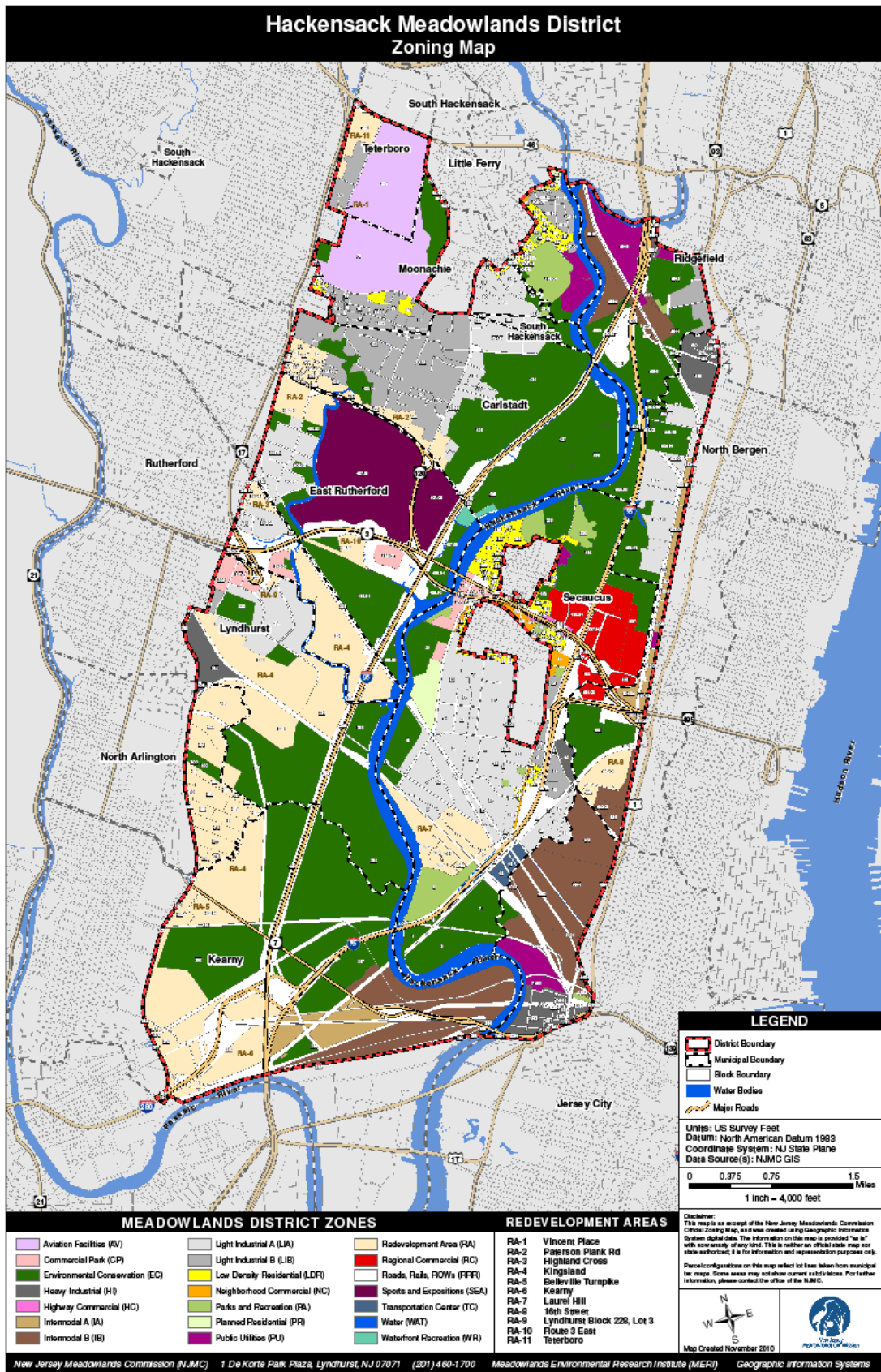


Figure 23: NJMC District - Zoning Map

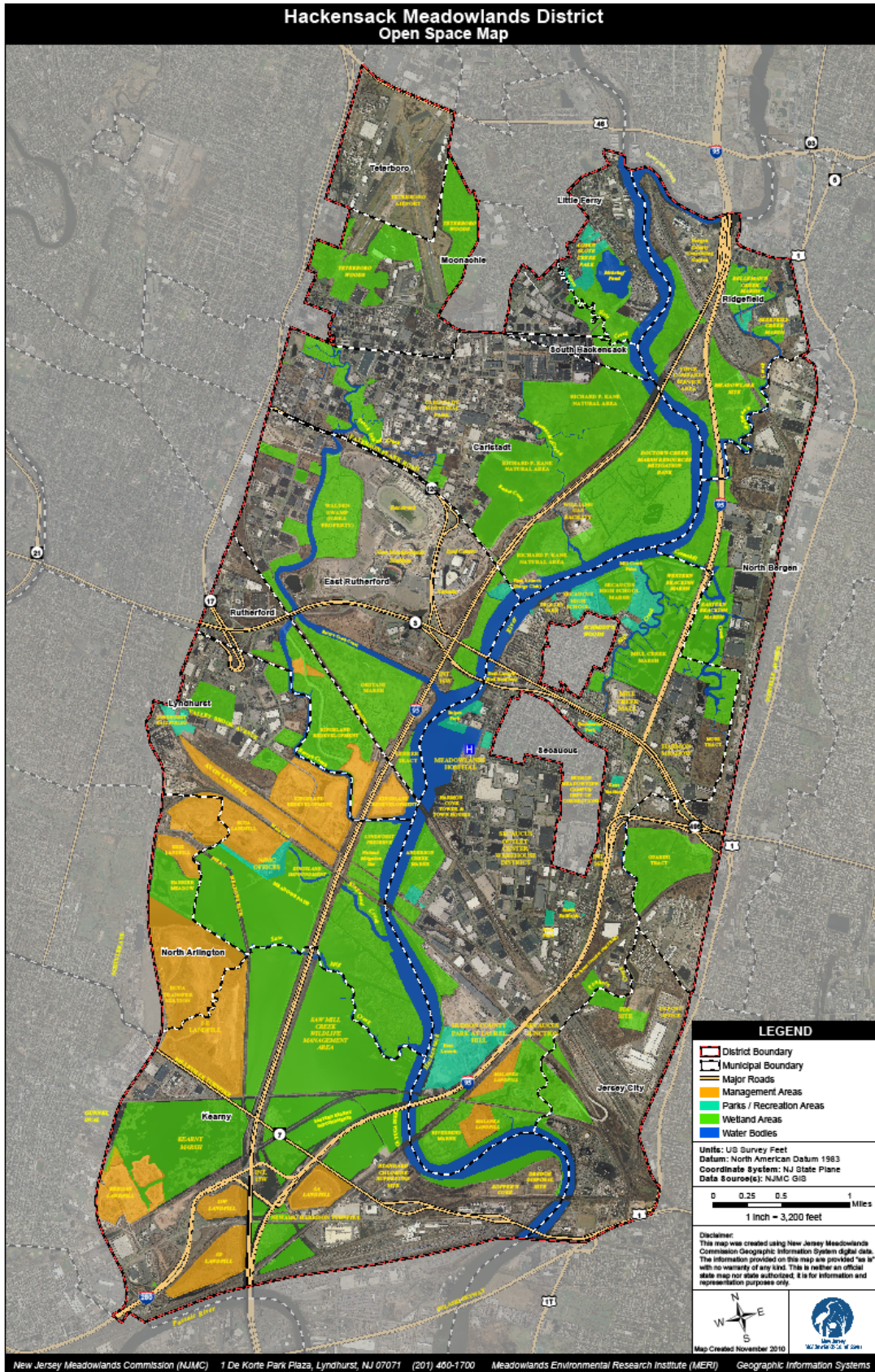


Figure 24: NJMC District - Open Space Map



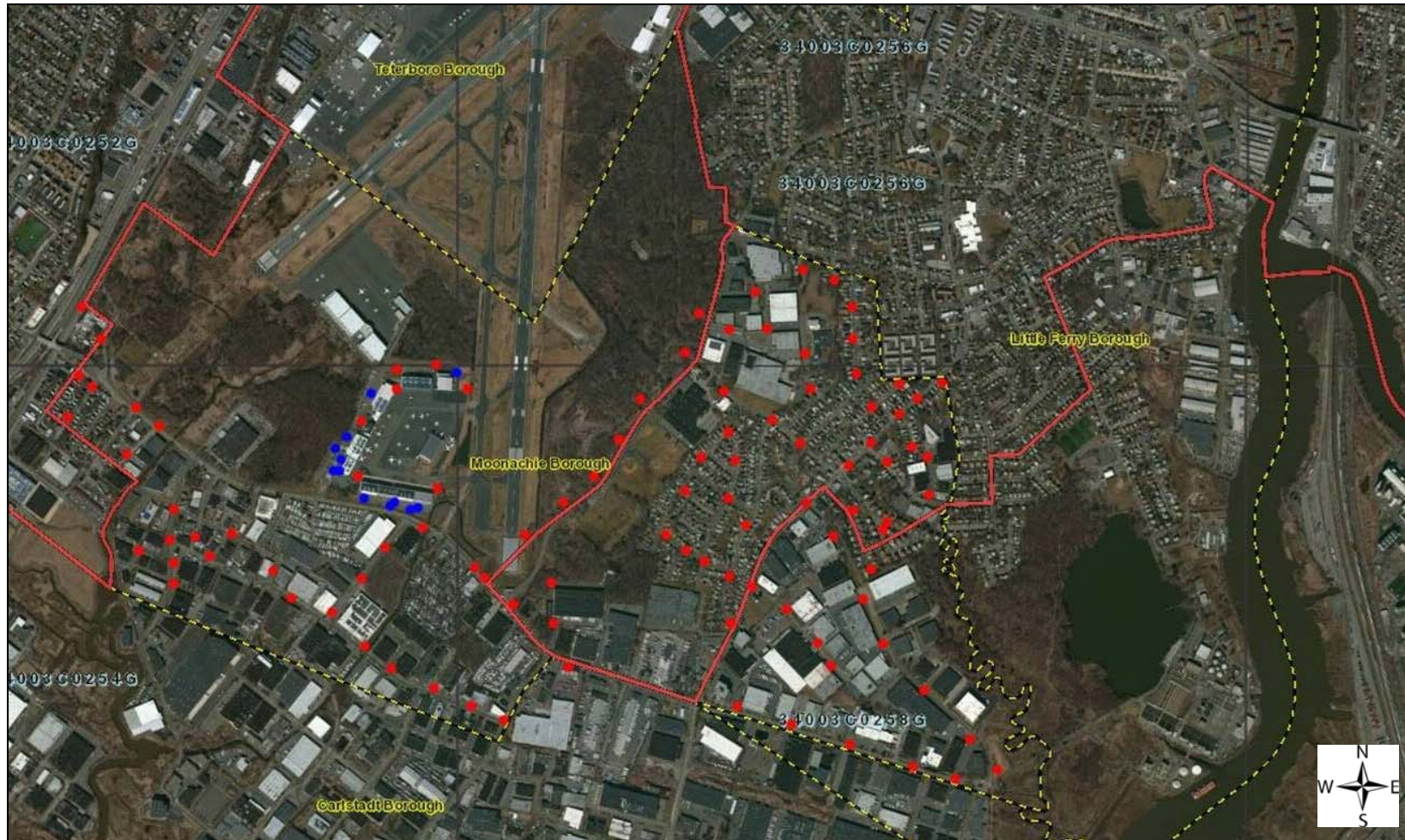


Figure 25: Borough of Moonachie - Standpipes and Hydrants