

TOWN OF KILLINGWORTH NATURAL HAZARDS MITIGATION PLAN



**Prepared by the Connecticut River Estuary Regional Planning
Agency**

For the Town of Killingworth, Connecticut

Adopted by the Town of Killingworth, Connecticut

October _____, 2007

KILLINGWORTH NATURAL HAZARDS MITIGATION PLAN

TABLE OF CONTENTS

PREFACE

1.	Introduction and Instructions for NHMP	I-1-2
2.	Estuary Regional Risk and Vulnerability Assessment	R1-98
3.	Natural Hazards Mitigation Regional Overview Plan	RO1-37

SECTION I – Introduction

TP-4

A.	Plan Development	TP-4
B.	Town Description	TP-4
1.	Geography	TP-4
2.	Demographics	TP-5
3.	Geology	TP-5
4.	Land Use	TP-5

SECTION II - Evaluation and Proposals for Hazard Mitigation

A.	Flood Hazards	TP-5
1.	Current Regulatory Guidelines	TP-5
a.	Flooding	TP-7
b.	Stormwater Guidelines	TP-8
c.	Open Space Guidelines	TP-9
B.	Mitigation of Flood Hazards & Affected Properties	TP-9
1.	Historical Perspective	TP-9
2.	Existing Infrastructure	TP-11
3.	Floodproofing Existing Structures	TP-11
a.	Residential Property Owners	TP-11
b.	Business Owners	TP-13
c.	Repetitive Loss Property	TP-13
d.	Floodproofing Dams	TP-14
C.	Additional Natural Hazards	TP-16
1.	Wind & Tornadoes	TP-16
2.	Wildfires	TP-17
3.	Winter Storms	TP-17
4.	Earthquakes	TP-18
5.	Hurricanes	TP-19

FIGURES AND MAPS

Map 1 – Killingworth Relative Location	TP-6
Map 2 – Open Space and Flood Zones	TP-10
Map 3 - Killingworth Infrastructure Hazard Areas	TP-12
Map 4 - Dam Hazard Categories	TP-15

APPENDICES

Appendix I – Repetitive Loss Properties	
Appendix II – Recommendations for Implementation	
Appendix III – HAZUS MH Hurricane Report – Town of Chester	
Appendix IV – Public Outreach Bulletins and Notices <i>(Regional and Town Specific)</i>	
Appendix V - References and Literature	

KILLINGWORTH HAZARD MITIGATION PLAN



I. INTRODUCTION

A. PLAN DEVELOPMENT

The Killingworth Natural Hazards Mitigation Plan has been developed to identify hazards or risks and the town's existing capabilities and activities for hazard mitigation. There are numerous tasks which can be undertaken by the town which will prevent loss of life, and reduce property damages associated with natural hazards. The full Natural Hazards Mitigation Plan for Killingworth includes: the Risk and Vulnerability Assessment , the Natural Hazards Regional Mitigation Overview Plan, this town specific plan and attached appendices.

Within Killingworth, there are mitigation strategies that are unique to the town. Recommendations that require regional or inter-town cooperation are included in the Natural Hazards Regional Mitigation Overview Plan. The property specific addendum attached to this document outlines repetitive loss properties that will need assistance to mitigate future losses. Another example of individual town mitigation efforts includes bridge replacement or relocation/improvement of utilities or important buildings. Addendum II identifies the implementation strategies listed in the document by board or committee

B. GENERAL TOWN DESCRIPTION

1. GEOGRAPHY

Killingworth is located in the northwestern section of the region, bounded on the east by Chester and Deep River, to the south by Clinton and on the north by Durham and Haddam, and to the west by Madison. The total area in Killingworth is 36.0 square miles of which 35.4 square miles is land area. Killingworth is geographically the largest town in the Region. It is the only town without a coastal area. Less than 2% of total town area is occupied by water bodies. Larger open water areas include the Killingworth Reservoir and a portion of the Hammonasett Reservoir. Killingworth historically has been a rural community without much industry or commercialism. The town dates from 1663 and has primarily developed as a farming community with some industry in the form of water-powered mills. The town is drained by three river basins running directly into Long Island Sound. Most of the town lies within the Hammonasett River Basin. Map Ch-1 depicts the relative location of Killingworth to its neighboring towns in the Estuary region.

2. DEMOGRAPHICS

Today, Killingworth is primarily rural and, to a lesser degree, ex-urban in character along town roads. In the year 2000, Killingworth's population was 6018. This number represents a 25.01% increase over the 1990 population count of 4814.

3. GEOLOGY

The topography of Killingworth ranges from gently rolling terrain in the valleys to steep hilly terrain in several upland areas. The land area of Killingworth consists of mainly soil developed on well drained, glacial, stratified drift in the valleys and glacial till and bedrock in the uplands. Killingworth is almost entirely underlain by Monson Gneiss, a light –gray rock consisting of biotitic quartz plagioclase gneiss which forms a mass known as the Killingworth dome. Bedrock is close to the surface in this area and large scale housing development is not suitable for this area.

4. LAND USE

About 49% of the town's land area is committed to a specific use. More than 4,400 acres, almost half of the committed land is in open space use, including state forest and water company land. Killingworth has more land in committed open space than any other town in the Region. Residential uses occupies about 20% of the land area. Single family houses are located principally as strip development on large lots along existing roads, especially Route 80 and Route 148.

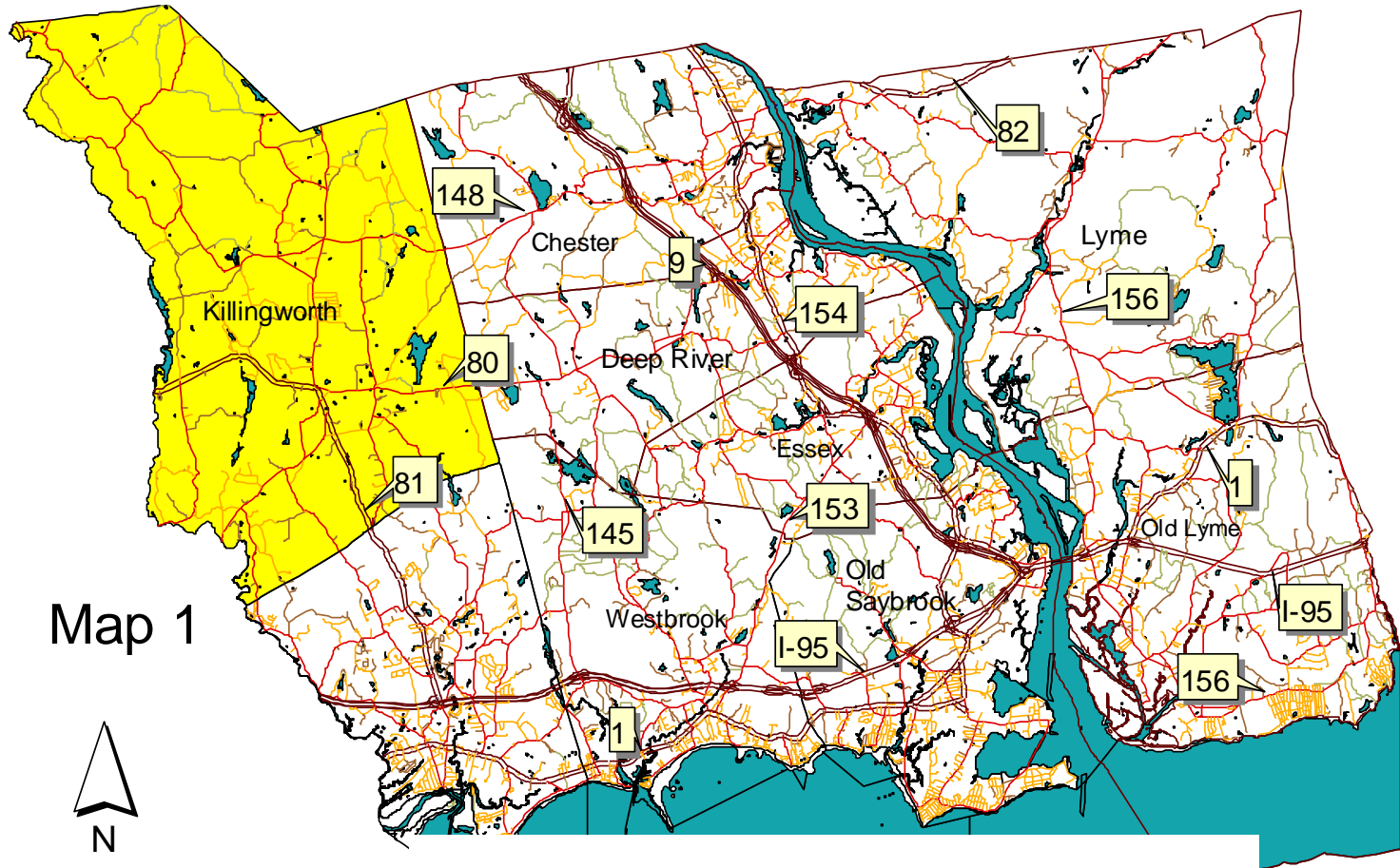
Killingworth has about 50 acres in commercial use, and about 55 acres in industrial use. Institutional uses occupy about 6% of the land area, or 1401 acres. Transportation uses occupy 2.2% of the land area, or 499 acres. The topography of Killingworth ranges from gently rolling terrain in the valleys to steep hilly terrain in several upland areas. The land area of Killingworth consists of mainly soil developed on well drained, glacial, stratified drift in the valleys and glacial till and bedrock in the uplands.

II. EVALUATION AND PROPOSALS FOR HAZARD MITIGATION

A. FLOOD HAZARDS

Killingworth has numerous small and large streams, ponds, and reservoirs. As evidenced from the damage in a 1982 flood event, flooding is an important hazard for mitigation planning within Killingworth. The Federal Emergency Management Agency (FEMA) has provided baseline information to identify areas within Killingworth that are vulnerable to flooding. In 1981, the Federal

Killingworth and Neighboring Towns



Emergency Management Agency (FEMA) updated the Flood Insurance Study for the Town. This report notes that Pond Meadow Brook from Kroopa Dam to Schnoor Road, Lane District Brook from the confluence with Pond Meadow Brook to a point approximately 7,400 feet upstream, and the Hammonasset River between State Route 80 and Chestnut Hill Road were studied by detailed methods. Areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through 1985. Pond Meadow Stream and Lane District Brook are the major streams in the developed portion of Killingworth. Continuing economic development in the basins of those streams is expected and pressures leading to intensified flood plain use will undoubtedly accompany such development.

Flooding in Killingworth occurs in every season of the year. Spring floods are common and are caused by rainfall in combination with snowmelt. Floods in late summer and fall are usually the result of hurricanes or other storms moving northeast along the Atlantic coast. Winter floods result from occasional thaws, particularly in years of heavy snowfall. In some areas of town, roads are periodically closed due to flooding or winter storms and access become an important issue for residents. The severity of the floods depends on the type of rain event, duration, and ground conditions.

Major floods of the past 50 years occurred in Killingworth in March, 1936, September, 1938, and August, 1955. Of these, the flood of September, 1938, which was caused by a hurricane, was by far the most severe. In 1982, damages to public property were all to roads, bridges, and culverts. Jensen's Mobile Home Park is particularly susceptible to stream flooding. In 1982, the State bridge on Route 80 over the Menunketesuck River was completely washed out as were two town bridges on Birch Mill and Paper Mill Roads. The Bunnell Bridge over the Hammonasset River was also damaged.

1. CURRENT REGULATORY GUIDELINES

a. FLOODING

Killingworth Subdivision and Zoning Regulations are the regulatory documents which provide oversight within floodways and zone. The current regulations are written to minimize building within the flood zones. Similar to other CRERPA communities, these regulations require that development provide for protection of the floodplain. In the Killingworth Subdivision Regulations, there are provisions for non-encroachment into the floodplain and that no building shall be erected or depicted on the plan on any site within the encroachment line unless the lowest point of any part of the leaching field is a least one foot above the "100" year predicted flood elevation. Also if any part of the subdivision areas is located within the special flood hazard area, the plan of subdivision shall conform to the

requirements that include that design shall minimize flood damage, utilities and drainage shall be located and constructed to minimize or eliminate flood damage.

The Zoning Regulations are more specific with regard to the creation of a floodplain district which incorporates the special flood hazard areas as designated on the Flood Insurance Study and Flood Insurance Rate Map. No changes can occur on the land until a permit can be obtained from the town. The conditions are standard format to the protocols provided by FEMA for anchoring structures, utilities, and measurement of the lowest floor level. Killingworth is unique in their requirement for comprehensive records and presentation of evidence on the application.

The Plan of Conservation and Development describes the floodplain requirements, but does not offer recommendation for future improvements for mitigation or study of flood prone areas.

b. STORM WATER

Storm water from municipal and private outflows has the potential for significantly exacerbating flooding within the town. Therefore, enforcement of no-net runoff for storm-water is a priority mitigation measure for subdivisions at higher elevations. This aspect is particularly true for drainage basins within the town which cross town boundaries. Excessive diversion of stormwater to drainage basins within the town can affect Clinton and Westbrook. This is particularly true of the drainage basin for the Menunketesuck River

Killingworth is currently exempt from filing under the federal NPDES [National Pollutant Discharge Elimination System] requirements for municipal storm water inventory. Currently, the road regulations which are an appendix to the subdivision regulations provide the construction standards for storm water facilities, but neither the zoning regulations nor the subdivision regulations provide design standards for comprehensive management of storm water on site.

As several drainage basins within Killingworth cross into other town boundaries, it is recommended that the town participate in with the other eight towns within the region by reviewing and adopt a plan for municipal storm water management. As part of this effort, mitigation should include:

- GIS mapping and monitoring of stormwater outlets and infrastructure
- Yearly maintenance programs for storm water facilities
- Most importantly, update the regulations to provide for no-net runoff from development on a site through the development of best management practices for storm water management. Regulations should also include newer measures

c. OPEN SPACE GUIDELINES

Currently, almost one third of the land area within Killingworth is dedicated to some category of open space of which about one fifth is committed open space. The uncommitted open space areas are owned by water companies and fish and game associations. The large percentage of committed open space is owned by the State of Connecticut. There is a significant uncommitted open space area near the Hammonsett River. Other uncommitted open space areas border the public reservoirs, Hammonsett Lake and Killingworth Reservoir. (See Map 2)

The Subdivision Regulations provide for 15% of total land area within a subdivision for open space dedication. These regulations are an excellent way to promote open space and storm water infiltration. Open Space within a project can be used for storm water management and the lots, roads, and structures can be designed for to minimize disturbance to soils and to resources which also promotes water retention on site. Storm water absorption techniques such as rain gardens, creative use of wetlands, and gallery systems can retain water on site and recharge aquifers in the area.

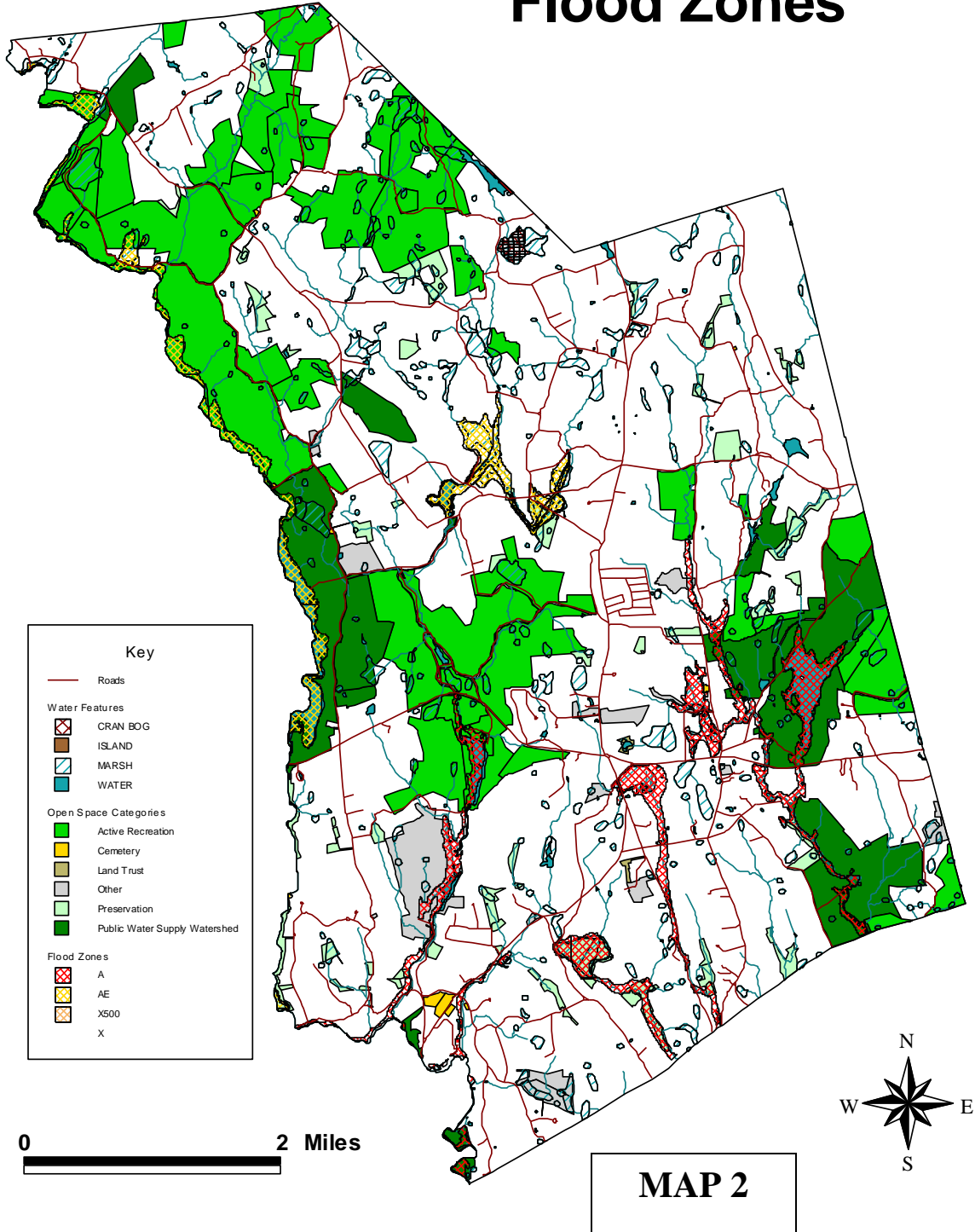
B. MITIGATION OF FLOOD HAZARDS AND AFFECTED PROPERTIES

1. Historical Perspective

Historically, Killingworth developed as primarily a farming community with water power from streams and rivers dedicated to a limited mill industry. For this reason, Killingworth has remained relatively rural in comparison to neighboring towns. Development pressures continue to occur within Killingworth as property values increase. Additionally, Killingworth is located on the primary transportation corridor of Route 80 which links the CRERPA region with the City of New Haven.

In reviewing the flood prone areas for mitigation, there is only one property on Reservoir Rd which is classified as a repetitive loss property. It appears that the most appropriate solution is to flood-proof existing infrastructure within the town using the 1982 flood as a benchmark for the potential extent of damage.

Existing Open Space and Flood Zones



2. Existing Infrastructure

In addition to managing the floodproofing for the identified roads and bridges, efforts should be made to review changing land use conditions and identify other properties and utilities that may be subject to flooding in the future. (See Map 3) Also, the following efforts should be completed as part of the mitigation process in Killingworth:

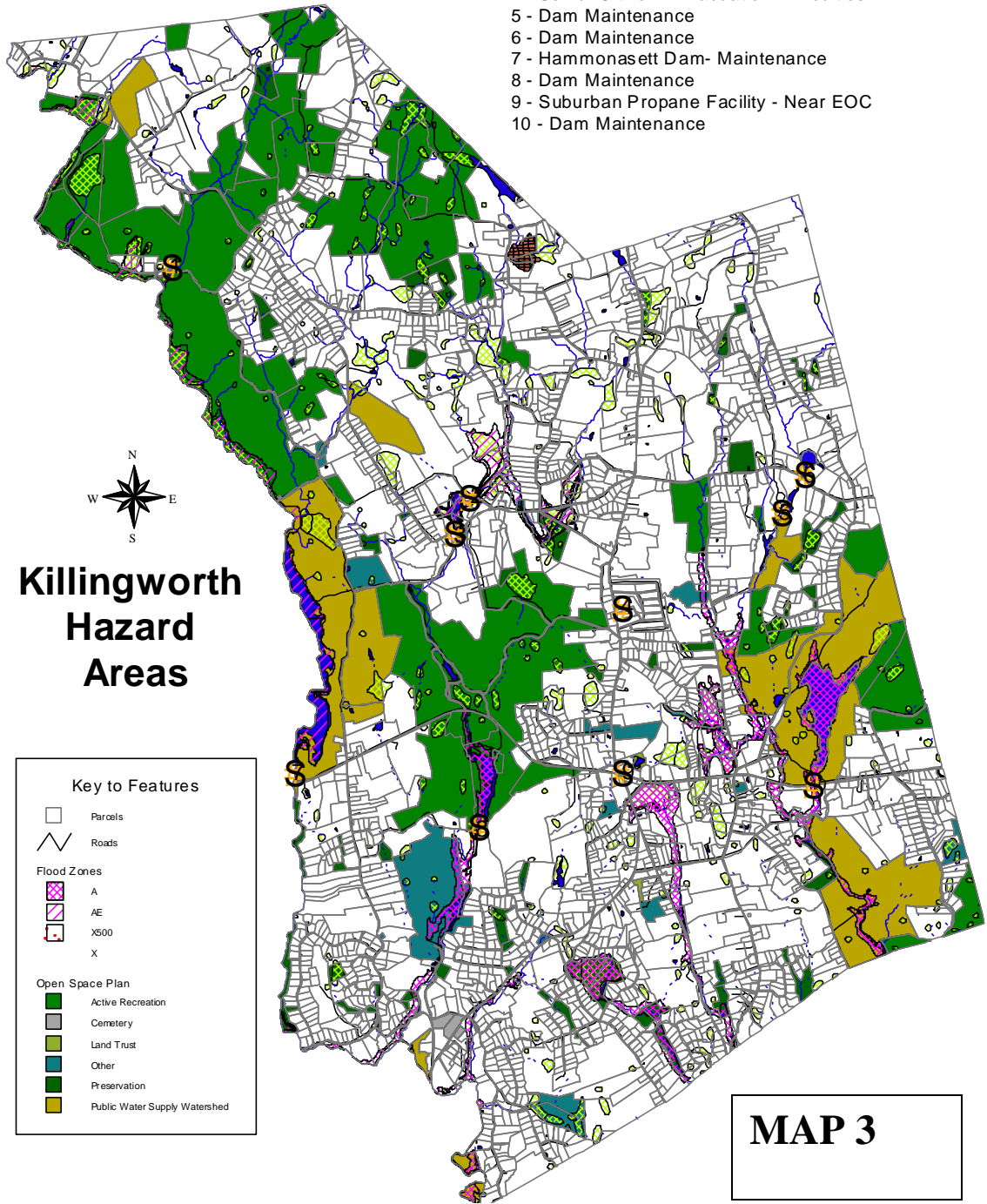
- Enforcement of the floodplain regulations should be increased to prevent any road or house construction within the floodplain.
 - A. Updated floodzone study for the Menunketesuck River and the Hammonasett River
Given changing conditions upland and within the floodplain, topographic changes as a result of the 1982 flood, along with sea level rise, a full update of the flood zone limits and study of critical areas and flows is warranted.
 - B. Full evaluation of dams in conjunction with state review and timeline and allocation of funding for repairs. (See Section 4)
 - C. Implement strategic enforcement actions to include: engineering reports for structural alterations or structural expansion of infrastructure within the 100 flood zone. This includes updating the regional Geographic Information System (GIS) mapping for accuracy with FEMA layers and location of buildings across town boundaries.

Based on interviews with Zoning Officials and Buildings Officials in CRERPA towns, there is limited opportunities to fully evaluate mitigation alternatives within flood zones. Due to town budgets, lack of staff, and a defined protocol for accepting engineering reports, plans and assurances for structural integrity in flood zones are not always present in the building files. GIS is an indispensable tool for tracking land use changes and mapping flooding events as they occur.

3. Floodproofing Existing Structures

Within Killingworth, there are approximately six structures near or within the existing headwaters of the Indian River flood zone. There are approximately ten houses and commercial structures within the 100 year flood zone of the and ten houses near or within the 100 year flood zone of the Menunketesuck River. The Hammonasett River which flows from Lake Hammonasett does not indicate the location of significant residential or commercial structures within the flood plain

- 1 - Dam Maintenance
- 2 - Road Flooding - Lover's Lane
- 3 - Dam Maintenance
- 4 - Mobile Home Park - Susceptible for Flooding
Senior Citizen - Evacuation Difficulties
- 5 - Dam Maintenance
- 6 - Dam Maintenance
- 7 - Hammonasett Dam- Maintenance
- 8 - Dam Maintenance
- 9 - Suburban Propane Facility - Near EOC
- 10 - Dam Maintenance



There are mitigation measures that would be appropriate for both business and home owners. They include structural alterations and hazard planning.

a. Residential Property Owners

Residential property owners within the flood districts have various options available for floodproofing. Give the limited number of homes within the floodzones and the low vulnerability for flooding for these homes, the primary recommendation is to provide information materials and sources of funding to homeowners for structures that may need retrofitting to sustain floodwaters. The primary concern for flood damage in interviews with the Emergency Management Director for the town is from dam failure (See Section on Dams)

b. Business Properties

Killingworth does not have a significant business district area or industrial areas. Small areas are located sporadically throughout the town. The primary business district is located at the intersection of Route 80 and Route 81. Within that area, there are approximately seven properties within the flood zone that could be affected by stream flooding. Of other business properties within Killingworth, the major factor affecting these businesses is the potential flooding of Route 80 south of its intersection with Route 81.

Mitigation for businesses within Killingworth would be to keep track of all expenses, including the hours worked, because the insurance company normally will reimburse you. Run a list of clients and inform them that the business will be closed for a while due to storm damage. Contact construction vendors, get estimates and write down everything. The insurance company will work with you and accurate records make a difference. Another important aspect of business preparation is coordination with the other towns in the region as an upland staging area for supplies and services in the event of a major hurricane or flood event. Killingworth as the single inland town within the region is less likely to sustain severe damage other than wind damage and therefore should be considered as a regional center for emergency operations and an outlet for services and supplies from existing businesses.

c. Repetitive Loss Properties

There is one repetitive loss property in Killingworth. Recommendations for this property include floodproofing to the event which flood as cause damage in the past.

d. Flood Proofing Dams

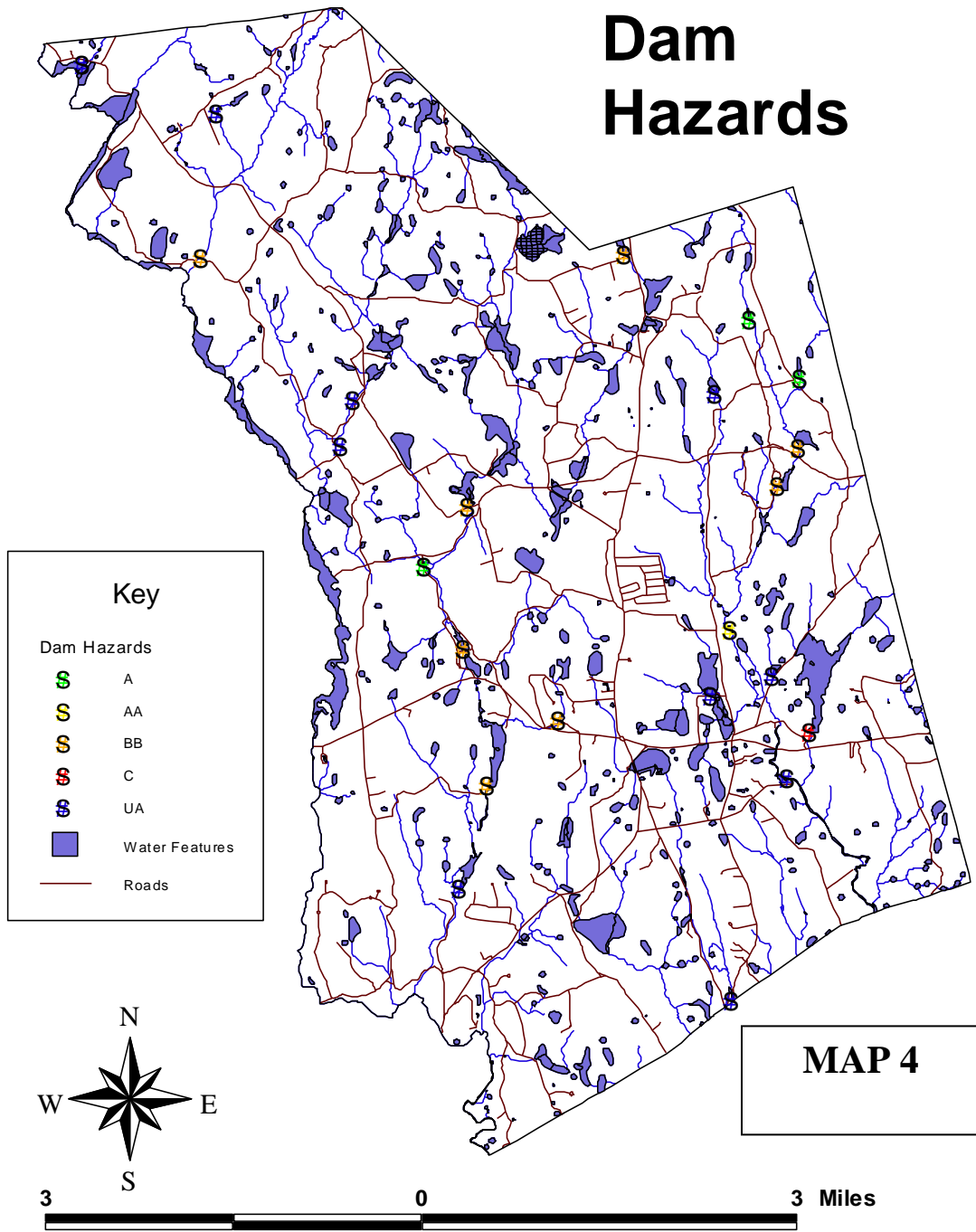
There are twenty nine dams in Killingworth. Four are owned by the Connecticut water companies, three are owned by the Connecticut Department of Environmental Protection, eighteen are privately owned, and two are owned by associations. In the attached map, seven dams are not depicted. Data for those dams is incomplete. Ten dams are unassigned, two dams are rated as Hazard Type C, seven dams are rated Hazard Type BB, one is rated Hazard Type AA, and three are rated Hazard Type A. (See Map 4)

Of these dams, the Killingworth Reservoir Dam is the one dam that is rated as Hazard Type C. It is an earthen dam on the south side of the Killingworth Reservoir which has a significant impoundment area. A dam failure would seriously exacerbate flooding on the Menunketesuck River. The impact on the Kelsey Town Reservoir and properties in Clinton would need to be further evaluated in the Hazard Mitigation Report. Areas to be reviewed would include residential areas around Bushy Hill Pond and property south of the reservoir in Clinton.

In the 1982 flood, the Deer Lake Dam failed and people on River Road just south of the dam had to be evacuated. Another dam not shown on the map and significant is the Hammonasset Dam. This dam impounds Lake Hammonasset. This lake has an impoundment area of 8330 acft. The dam is concrete and is maintained by the Connecticut Water Company. It is also classified as Hazard Type C.

Mitigation for dams within Killingworth include monitoring, inspection, and structural repairs or modifications where necessary. Of the 23 dams in Killingworth, there are 7 dams with unassigned hazard ratings, 1 with a hazard ratings of C which is severe and 8 with a hazard rating of BB. The ones that possess the highest hazard rating are also owned by the Connecticut Water Company and by the State of Connecticut. These dams are routinely inspected and repaired as necessary by both the Connecticut Water Company and the State of Connecticut. Of the remaining dams, one is state owned. Mitigation for the remaining dams that are not owned by the Connecticut Water Company would include: maintaining open yearly communications with property owners on the status of dams, and researching options for funding to repair dams as needed.

Killingworth Dam Hazards



C. MITIGATING FOR ADDITION NATURAL HAZARDS

1. HIGH WINDS AND TORNADO

a. Overview

While, Connecticut, ranked 42 out of 50, is an unlikely area for dangerous tornadoes, there have been instances where tornadoes have developed in conjunction with high wind events and storms. Tornadoes are produced inside powerful thunderstorms, which, in turn, are created near the junction between warm, moist air and cold, dry air. The conditions that produce a "tornadic thunderstorm" exist when warm, moist air gets trapped beneath a stable layer of cold, dry air. The primary difficulty with tornadoes in Connecticut is the relative density of population and structures to the potential for damage.

b. Mitigation Measures for Tornadoes and High Wind

While historically tornado damage is minimal in Middlesex County, there are several logical measures to protect for high wind damage and cyclonic events such as small tornadoes in Killingworth.

Killingworth is unique in the region for having an inland mobile home park. Owners of older mobile homes should be particular aware of mitigation measures to protect their homes from damage. Business owners should follow the same mitigation plan as they would for those listed under mitigation measures for flood damage.

Specific mitigation measures for wind damage include:

- enforcement and update for building code standards for light frame construction, especially wind resistant roofs. This is particularly important in small towns such as Killingworth which have limited building code and inspection personnel. FEMA articles on bracing for gable trussed roofs and bracing for door and windows are available for review. There are also articles on placement of HVAC systems and electrical utilities to resist both wind damage as well as flood damage. This would be applicable in coastal areas.
- pamphlets and web-based information for property owners on structural alterations to protect against wind damage.

2. WILDFIRE

a. Overview

There are a few areas within the Killingworth that have the potential for wildfires when drought conditions become extreme. Large expanses of deciduous forest are located in the western and northeast areas of town on water company lands. At times of severe drought, communities face growing danger from forest fires. As recent as April 2006, high hazard alerts for forest fires were issued by the NOAA within Connecticut. Effective land-use planning techniques can be applied to existing, new, and redeveloping areas alike.

b. Mitigation for Wildfires

Mitigation for wildfires in Killingworth would include:

- Land-use and natural resource planning which encourages groundwater retention within existing, new, and redeveloping areas.
- Work with region EMD group to develop a wildfire management plan and protocol, in conjunction with neighboring towns to ensure that outside fire-fighting resources, such as the National Guard are available.
- Recommendations for future land use patterns including recharge into existing aquifers, including site design to encourage water conservation through such techniques as: strict regulation of vegetative buffers for stream and river corridors, rain gardens for site drainage, and prohibition of wetlands alteration.
- Where water supplies are insufficient, new development should include dry hydrants.
- During vulnerable periods, a system of warnings about campfires and open fires should be posted in public locations.
- Training and education of new firefighters should include brush and forest fires

3. WINTER STORMS

a. Overview

Winter storms are a sporadic but recurrent event in New England. Winter storms within the region can be characterized by severe coastal storms, ice storms, or snow storms. Winter storms, blizzards and ice storms can cause significant damage to power lines resulting in power outages. The U.S. Weather Bureau definition of a blizzard is a snowstorm with winds of at least 35 mph, temperatures 20 degrees Fahrenheit or lower over the period of the storm. A

severe blizzard has 45 mph or greater winds, blowing snow and temperatures at 10 degrees F or below. The winter of 2005- 2006 produced a blizzard within Connecticut that required emergency assistance funding for affected towns.

All of the towns interviewed rated winterstorms as natural hazards of concern for emergency management. The key risks are the relative isolation of houses within the rural communities from emergency services, loss of electrical power to large areas within the region from ice accumulation or high winds associated with a blizzard, coastal flooding as a result of nor'easters, fire from improper use of alternative heating sources, candles, and gas stoves, and cost of cleanup. Property damage can also occur from frozen water pipes and falling trees or branches from ice accumulation and/ or wind.

b. Mitigation for Winter Storms

Mitigation for hazards associated with winter storms is similar to methods use for flooding and high wind. The unique hazard from winter storms is the time of year and the damage that can occur from loss of electrical power, snow loads and icing. The primary tool for mitigating damage from winter storms is advance preparation for the public. This includes information on methods for reducing damage from loss of electrical power and snow loads and icing.

As with many of the other hazards listed in this report, information on reducing damage from winter storms could be promoted through town hall and regional agencies. It is recommended that this be accomplished through web site links to town, regional, state and federal sites for information on reducing damage from natural hazards. Information for winter storms would include:

- Evaluating dangers of being outside or traveling, the danger of carbon monoxide poisoning in motor vehicles and from portable heaters and power generators in homes, the danger of house fires.
- Evaluating danger of hypothermia from prolonged exposure to cold weather.
- Landscaping practices that encourage the planting of species that are less susceptible to damage from ice storms to reduce to probability of damage structures

4. EARTHQUAKES

a. Overview

Connecticut has a population density that is 3.5 times greater than California's and has a hard base rock that transmits seismic waves over an area from 4-40 times more efficiently. These facts place more people at greater risk since the built environment in this region is predominantly old, non-reinforced masonry or

is not seismically designed. The majority of these mill structures are amazingly strong and stiff for the normal vertical loads.

There is also vulnerability associated with the numerous dams within the region. Many of these dams are older masonry/earth dams in need of repair. While they have sustained their integrity with earthquakes of less than 4.0 in magnitude, the vulnerability of these dams in the event of a larger earthquake would need to be explored in more depth as part of the “Mitigation Report”.

The most vulnerable aspect for the region from earthquakes in Connecticut is the lack of preparedness for such an event. The state and local building codes do not require new single-family structures to meet seismic standards and there is also no requirement for retrofitting an existing structure. Building code standards are invoked on commercial, industrial, or public buildings depending on the hazard classification and occupancy. For instance, construction of a hospital or an emergency center would require building design for seismic events. Also, earthquakes are not a hazard for which the public is psychologically prepared, so advance planning with respect to mitigation is generally absent.

b. Mitigation for Earthquakes

Mitigation would include retrofitting houses to sustained horizontal force, and securing large heavy items such as bookcases, refrigerators, stoves, water heaters, and furnaces. The most important mitigation item would include increase of public awareness that earthquakes could happen within the region and how to be prepared with a go-kit and how to respond in an earthquake in New England.

5. HURRICANE

a. Overview

There have been 35 tropical storms/hurricanes since the 1938 hurricanes over 63 years. Of those tropical storms/ hurricanes, 6 have caused serious damage in the United States eastern seaboard. New England and specifically the Connecticut coastline have recently experienced several near misses of destructive hurricanes.

The primary concern for the Estuary region is mitigate complacency about the potential for the deadly storm surges, winds, and flooding associated with a strong hurricane. As evidenced by the tropical storms/ hurricanes over the past 63 years, wind damage and flooding can affect interior communities as well as coastal communities. Complacency can lead to loss of life and catastrophic property damage.

b. Mitigation for Hurricanes

The primary risk for Killingworth in the event of a hurricane is high wind and localized flooding on rivers and streams from abundant rainfall. Mitigation efforts would mirror those used for high wind events and for flooding. A primary mitigation effort for Killingworth includes preparation as a receiving town for Clinton and Westbrook from hurricane evacuations implemented in those towns. Killingworth is relatively protected as an upland town and could serve as a regional coordination center in the event of a Cat 3-5 hurricane arriving on the region's shoreline and riverine towns.