ATTACHMENT (1)

NINE MILE POINT FLOOD HAZARD REEVALUATION REPORT

Constellation Energy Nuclear Group, LLC
March 12, 2013

AREVA

AREVA NP Inc.

Engineering Information Record

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Constellation Energy Nuclear Group (CENG) Flood Hazard Reevaluation Report for Nine Mile Point (NMP) Nuclear Station

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Flood Hazard Reevaluation Report for Nine Mile Point (NMP) Nuclear Station

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000	All	Initial issue.

Overview

This report describes the approach, methods, and results from the reevaluation of flood hazards at the Nine Mile Point Nuclear Station (NMP) Unit 1 and Unit 2. It provides the information, in part, requested by the U.S. Nuclear Regulatory Commission (NRC) to support the evaluation of the NRC staff Recommendation 2.1 for the Near-Term Task Force (NTTF) review of the accident at the Fukushima Daiichi nuclear facility.

Section 1 provides information related to the flood hazard. The section begins with an introduction that includes background information, scope, general method used for the reevaluation, the vertical datum used throughout the report, and a conversion table to determine elevations in other common datums. The section continues by describing detailed NMP site information, including present-day site layout, topography, and current licensing basis flood protection and mitigation features. The section concludes by identifying relevant changes since license issuance to the local area and watershed as well as flood protections.

Section 2 presents the results of the flood hazard reevaluation. It addresses each of the eight flood-causing mechanisms required by the NRC as well as a combined effect flood. In cases where a mechanism does not apply to the NMP site, a justification is included. The section also provides a basis for inputs and assumptions, methods, and models used.

Section 3 compares the current and reevaluated flood-causing mechanisms. It provides an assessment of the current licensing and design basis flood elevation to the reevaluated flood elevation for each applicable flood-causing mechanism.

Section 4 presents an interim evaluation and actions taken, or planned, to address those higher flooding hazards identified in Section 3 relative to the current licensing and design basis.

The report also contains one appendix. Appendix A describes the software models used in the reevaluation, including the quality assurance criteria and a discussion of validation of model-derived results.

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Acronyms and Abbreviations

Acronym/Abbreviation	Description
AMC	Antecedent Moisture Condition
ANS	American Nuclear Society
ANSI	American National Standards Institute
ARC	Area Reduction Factor
ARF	Antecedent Rainfall Condition
CEDAS	Coastal Engineering and Design Analysis System
CEM	Coastal Engineering Manual
CFR	Code of Federal Regulations
CLB	Current Licensing Basis
CN	Curve Number
COLA	Combined Operating License Application
FEMA	Federal Emergency Management Agency
FFT	Fast Fourier Transform
GLERL	Great Lakes Environmental Research Laboratory
HEC-HMS	Hydrologic Engineering Center Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center River Analysis System
HHA	Hierarchical Hazard Assessment
HMR	Hydrometeorological Report
HURDAT	NOAA National Hurricane Center
IGLD	International Great Lakes Datum

Acronyms and Abbreviations
(continued)

Acronym/Abbreviation	Description
IJC	International Joint Commission
IPEEE	Individual Plant Examination for External Events
ISLRBC	International Saint Lawrence River Board of Control
LIP	Local Intense Precipitation
MSL	Mean Sea Level
NAVD	North American Vertical Datum
NCDC	National Climatic Data Center
NGDC	National Geophysical Data Center
NGVD	National Geodetic Vertical Datum
NMP	Nine Mile Nuclear Station
NMP3NPP	Nine Mile Point 3 Nuclear Power Plant
NOAA	National Oceanic And Atmospheric Administration
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NTTF	Near Term Task Force
PMF	Probable Maximum Flood
PMH	Probable Maximum Hurricane
PMP	Probable Maximum Precipitation
PMS	Probable Maximum Seiche
PMSS	Probable Maximum Storm Surge

Acronyms and Abbreviations
(continued)

Acronym/Abbreviation	Description
PMWS	Probable Maximum Wind Storm
ROC	Rochester Airport
SCS	Soil Conservation Service
SRP	Standard Review Plan
SSC	Structures, Systems and Components
SSPP	Great Lakes Storm Surge Planning Program
Tc	Time of Concentration
UFSAR	Updated Final Safety Analysis Report
UH	Unit Hydrograph
USAR	Updated Safety Analysis Report
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
USLS	United States Lake Survey
WIS	Wave Information Studies
WRF	Width Reduction Factor

1.0 INFORMATION RELATED TO THE FLOOD HAZARD

1.1 Introduction

Following the Fukushima Daiichi accident on March 11, 2011, which resulted from an earthquake and subsequent tsunami, the U.S. Nuclear Regulatory Commission (NRC) established the Near-Term Task Force (NTTF) to review the accident. The NTTF subsequently prepared a report with a comprehensive set of recommendations (NRC 2012).

In response to the NTTF recommendations, and pursuant to Title 10 of the Code of Federal Regulations, Section 50.54 (f), the NRC has requested information from all operating power licensees (NRC 2012). The purpose of the request is to gather information to re-evaluate seismic and flooding hazards at U.S. operating reactor sites.

The Nine Mile Point Nuclear Station (NMP), Units 1 and 2, located on Lake Ontario in Scriba, N.Y., is one of the sites required to submit information.

The NRC information request relating to flooding hazards requires licensees to re-evaluate their sites using updated flooding hazard information and present-day regulatory guidance and methodologies and then compare the results against the site's current licensing basis (CLB) for protection and mitigation from external flood events.

1.1.1 Purpose

This report provides, in part, the information requested by the NRC to support the evaluation of the NRC staff recommendations for the NTTF review of the accident at the Fukushima Daiichi nuclear facility.

The report describes the approach, methods, and results from the reevaluation of flood hazards at the NMP Unit 1 and Unit 2.

1.1.2 Scope

This report addresses the eight flood-causing mechanisms and a combined effect flood, identified in Attachment 1 to Enclosure 2 of the NRC information request (NRC 2012).

Each of these flood causing mechanisms and the potential effects on the NMP site is described in Section 2 and 3 of this report.

1.1.3 Method

This report follows the Hierarchical Hazard Assessment (HHA) approach, as described in NUREG/CR-7046, "Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States of America" (NRC 2011) and its supporting reference documents.

A HHA consists of a series of stepwise, progressively more refined analyses to evaluate the hazard resulting from phenomena at a given nuclear power plant site to structures, systems, and components

(SSC) important to safety with the most conservative plausible assumptions consistent with the available data. The HHA starts with the most conservative, simplifying assumptions that maximize the hazards from the maximum probable event. If the assessed hazards result in an adverse effect or exposure to any safety-related SSC, a more site-specific hazard assessment is performed for the probable maximum event.

The HHA approach was carried out for each flood-causing mechanism listed in Section 2 and 3, with the design-basis flood being the event that resulted in the most severe hazard to the safety-related SSC at NMP Unit 1 and Unit 2. The steps involved to estimate the design-basis flood typically included the following:

1. Identify flood-causing phenomena or mechanisms by reviewing historical data and assessing the geohydrological, geoseismic, and structural failure phenomena in the vicinity of the site and region.

2. For each flood-causing phenomenon, develop a conservative estimate of the flood from the corresponding probable maximum event using conservative simplifying assumptions.

3. If any safety-related SSC is adversely affected by flood hazards, use site-specific data and/or more refined analyses to provide a more realistic condition and flood analysis, while ensuring that these conditions are consistent with those used by Federal agencies in similar design considerations.

4. Repeat Step 2; if all safety-related SSCs are unaffected by the estimated flood, or if all site-specific data have been used, specify design bases for each using the most severe hazards from the set of floods corresponding to the flood-causing phenomena.

Section 2 of this report provides additional HHA detail for each of the flood-causing mechanisms evaluated.

1.1.4 Elevation Values

Reference to elevation values in this report are based on the United States Lake Survey (USLS) datum of 1935, unless otherwise stated. To determine elevations in other datums, use the conversion table below (AREVA 2012).

Table 1-1: Conversion Table for Oswego

		To:				
	Datum	USLS35 (ft)	IGLD55 (ft)	IGLD85 (ft)	NGVD29 (ft)	NAVD88 (ft)
From:	USLS35	0	-1.23	-0.73	-0.03	-0.68
	IGLD55	1.23	0	0.5	1.2	0.55
	IGLD85	0.73	-0.5	0	0.7	0.05
	NGVD29	0.03	-1.2	-0.7	0	-0.66
	NAVD88	0.68	-0.55	-0.05	0.66	0

Where:

USLS35 = U.S. Lake Survey Datum of 1935
IGLD55 = International Great Lakes Datum of 1955
IGLD85 = International Great Lakes Datum of 1985
NGVD29 = National Geodetic Vertical Datum of 1929
NAVD88 = North American Vertical Datum of 1988

1.2 Detailed Site Information

NMP Unit 1 and Unit 2 are located adjacent to one another on the southeast shore of Lake Ontario, in Oswego County, NY. The site property consists of approximately 900 acres of partially wooded land. The natural elevation of the site is between an elevation of 256 ft and 265 ft. The general site layout and topography is shown in Figure 1.2-1. A more detailed site layout is provided in Figure 1.2-2 (NMP 2011, Figure III-1).

1.2.1 Site Layout and Topography

The NMP site, in the immediate vicinity of the plant, is graded to carry onsite runoff to Lake Ontario. In addition, exterior barriers (e.g., berms) located on all three land sides of the immediate plant area divert offsite surface water flow from the watershed adjacent to the plant from reaching the plant site. The flood control berms also prevent onsite runoff from leaving the site in most directions. Surface water flow inside the flood control berms, and directly adjacent to plant facilities, are generally controlled by two outlets: a site drainage channel that discharges to Lake Ontario and overland flow to the north, next to the plant structures (NMP 2010).

The shoreline adjacent to NMP is protected by a 1,000 ft long rock dike adjacent to NMP Unit 1 transitioning to a revetment ditch adjacent to NMP Unit 2, both with a top elevation of 263 ft (USLS35). The lake shore is approximately 200 ft from the nearest safety-related or station blackout building. The intermediate area, starting from the shoreline, includes a shore protection dike adjacent to NMP Unit 1 constructed from rock with soil fill at an elevation of 263 ft and 50 ft wide, and a revetment and interior drainage ditch adjacent to NMP Unit 2 at an elevation of 263 ft and averaging 24 ft wide. The ditch, with an elevation ranging from 254 ft to 249 ft (USLS35), allows crashing waves to break and flow back to the lake to the southwest end of the dike (NMP 1995). Finally, the plant grade rises along the protected area security fence, 80 ft to 100 ft from the shoreline to at least elevation 260 ft (NMPC 1976).

Encompassing the NMP site are two watersheds as illustrated in Figure 1.2-4 . The berms located east, west and south of the plant physically separate these watersheds from the plant site. However, the Lake Road culvert as identified in Figure 1.2-5 connects the upgradient of Watershed 2 to the plant south side allowing a portion of drainage from the Watershed 2 upgradient to enter the plant inside the flood control berm. This culvert also connects to the plant main drainage located south of cooling tower which continues along the south side of the plant going west and then north into the lake. There are four culverts along the main drainage as shown in Figure 1.2-5.

1.2.2 Elevation of Safety Structures, Systems and Components

All personnel entrances to Category I structures for NMP Unit 1 and Unit 2 are at or above an elevation of 261 ft.

For NMP Unit 1, Figure 1.2-3 shows a detailed floor plan of NMP Unit 1 structures at 261 ft elevation (NMP 2011, Figure III-4).

For NMP Unit 2, the structures housing safety-related equipment and systems, such as the reactor building, diesel generator building, and control building are constructed with reinforced concrete walls below grade level. The personnel entrance and equipment access to these buildings are at or above el 261 ft. All penetrations through the exterior walls below grade level have watertight penetration sleeves. Underground cables are protected from wetting or flooding by being housed in watertight conduits which are enclosed in reinforced concrete encasements to form electrical ductlines. As electrical ductlines enter the structure, the joints are provided with waterstops to prevent in-leakage of the design basis groundwater or floodwater into the structures (NMP 2010).

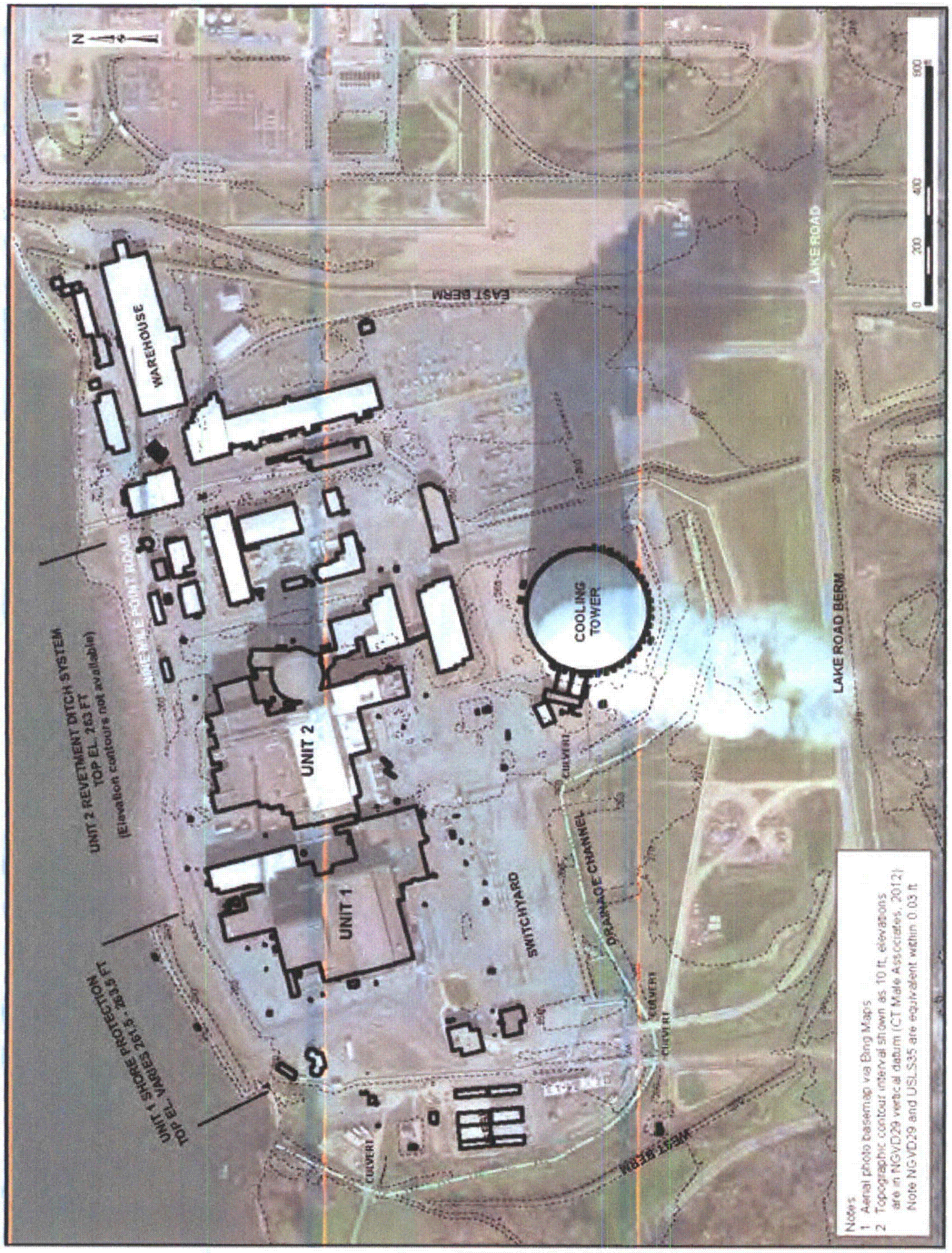
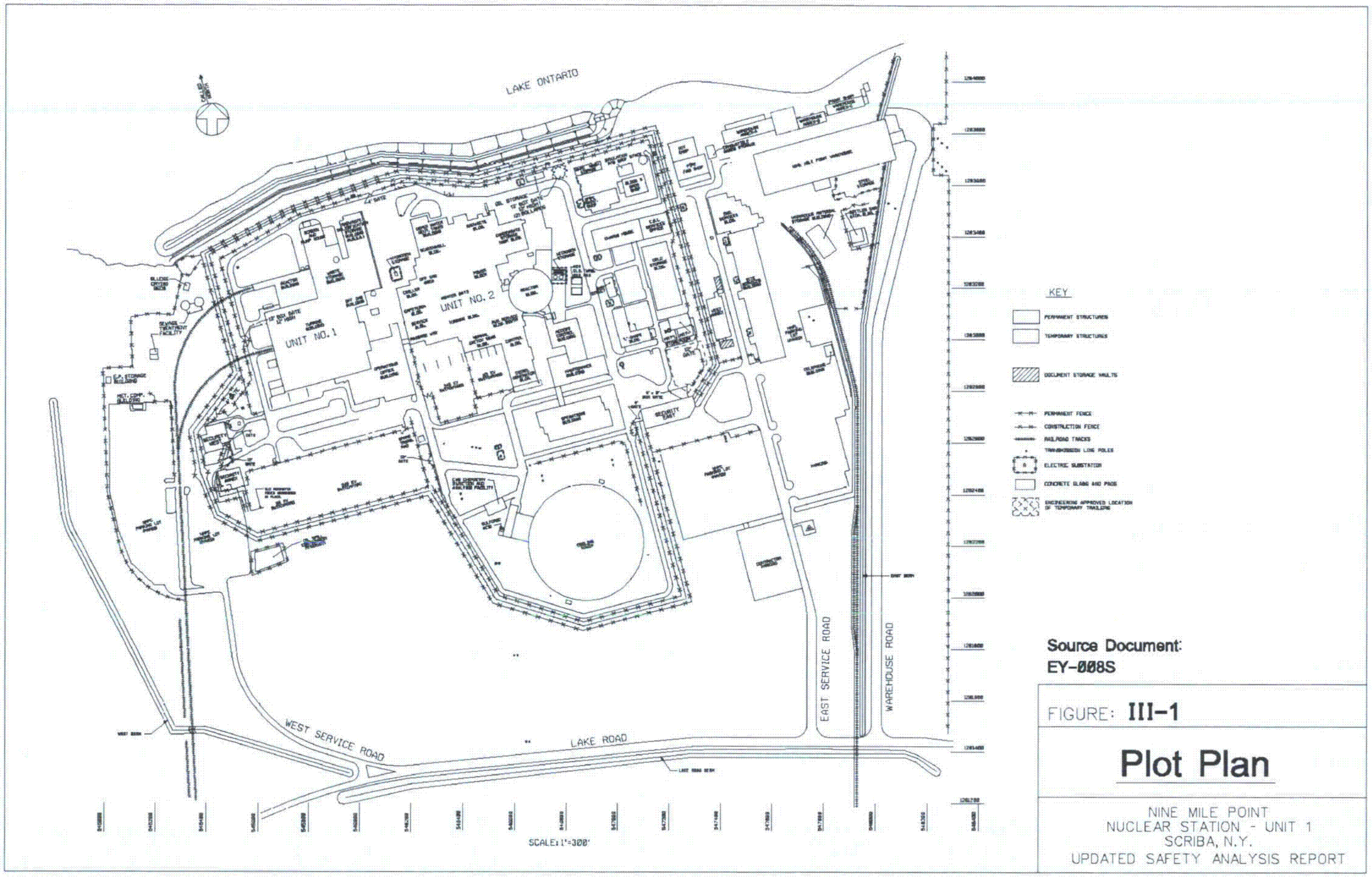


Figure 1.2-1: General Site Layout and Topography



UFSAR Rev. 22, October 2011

Figure 1.2-2: Detailed Site Layout

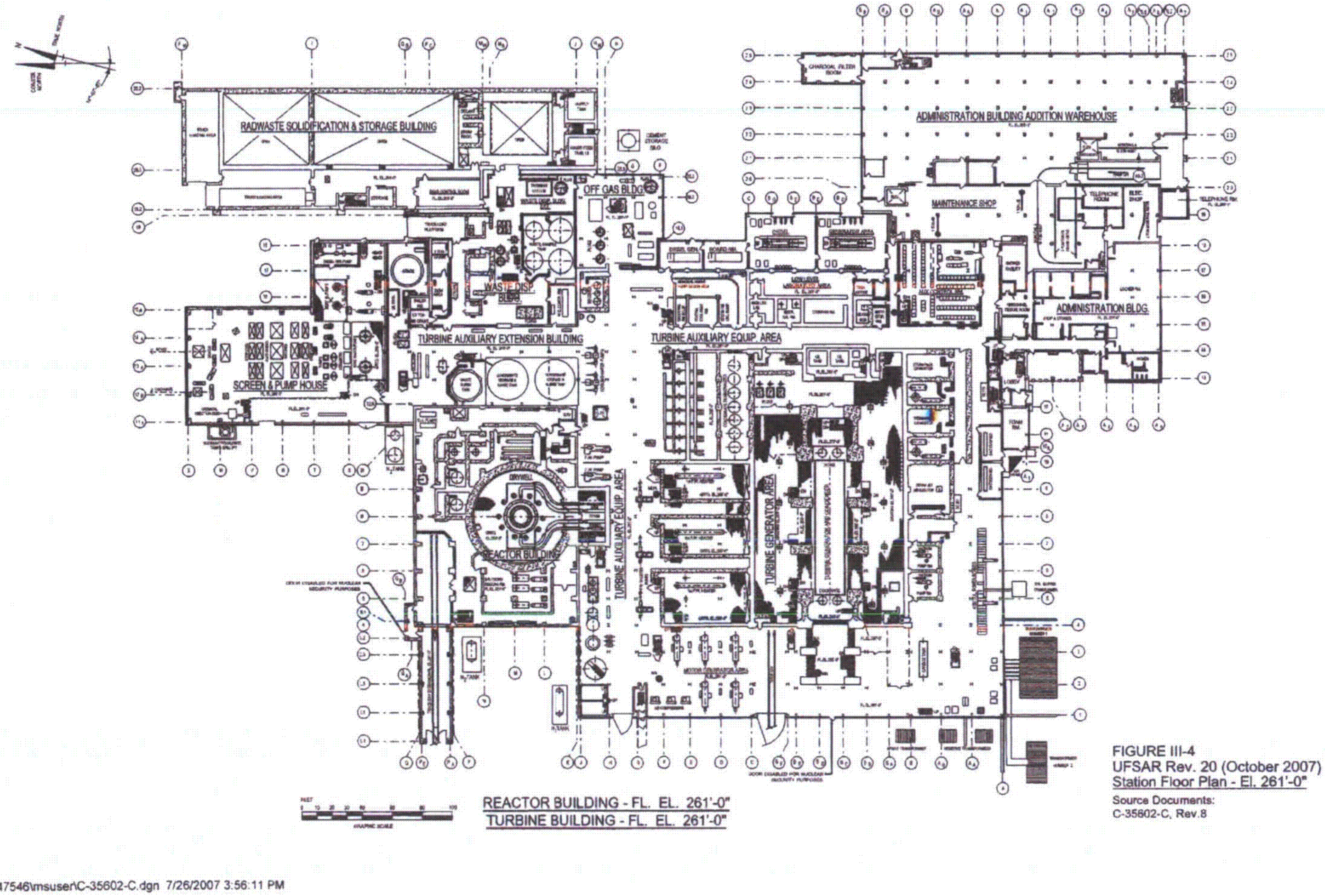


Figure 1.2-3: NMP Unit 1 Plan at 261 ft.

Figure 1.2-4: Watershed Delineation Map

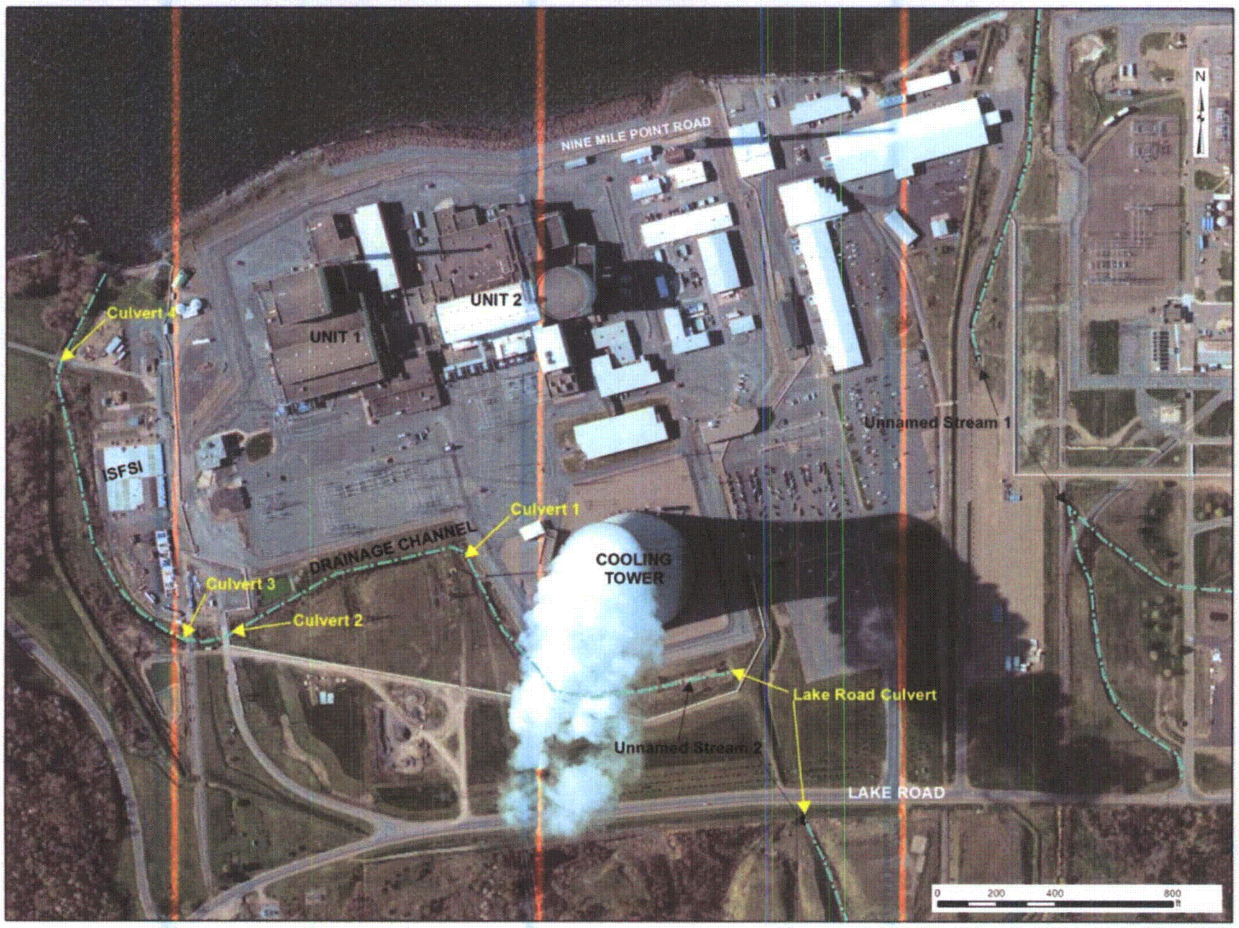


Figure 1.2-5 - Culvert Locations

1.3 Current Design Basis Flood Elevations

The current design basis and related flood elevations for NMP Unit 1 and Unit 2 are described in their respective UFSAR (NMP 2011) and USAR (NMP 2010) as well as the recent walkdown reports required as part of NRC's 10 CFR 50.54(f) letter (CENG 2012). The summary of the design basis below was prepared using these documents.

1.3.1 NMP Unit 1

NMP Unit 1 was designed and built prior to the requirements presented in the NRC Standard Review Plan (SRP) criteria for external floods (NUREG-75/087). Therefore, the evaluation and documentation to satisfy the SRP external flooding criteria was not required. However, the NMP Unit 1 Individual Plant Examinations for External Events (IPEEE) process (NMPC 1996) was used to find vulnerabilities with respect to the SRP external flooding criteria. Various possible flood scenarios were considered and information from calculations for NMP Unit 2 were used to show that the only flooding scenario of concern for the plant was one involving a probable maximum precipitation (PMP) event. See Section 1.3.2 below.

Based on the NMP Unit 2 flood analysis, the worst flood height for NMP Unit 1 resulting from the PMP is 261.75 ft. This value includes the conservative assumptions that the stormwater drainage system is inoperable and that the culverts located southwest of the NMP Unit 1 switchyard are not blocked.

1.3.2 NMP Unit 2

NMP Unit 2 was designed to satisfy the requirements stated in the NRC SRP criteria for external floods (NUREG-0800). In particular, the design basis floods for NMP Unit 2 are in accordance with NRC Regulatory Guide 1.59, Design Basis Floods, and the maximum flood level is based on the assumptions that the storm drains are inoperable and the culverts located southwest of the NMP Unit 1 switchyard are not blocked. The evaluation of the conditions resulting in the worst site-related flood probable at NMP Unit 2 has been made in conformance with ANSI N170-1976/ANS 2.8.

The PMP values were computed using publication of the NOAA, U.S. Department of Commerce: Hydrometeorological Report (HMR) No. 33 (HMR33 1956). This report determined a maximum PMP of 8.4 in/hr at the time of the site's construction permit and determined that the walls and foundations of all Category 1 structures should be designed for a flooding elevation of 261 ft. The maximum flood level is based on the assumptions that the storm drains are inoperable and the culverts located southwest of the NMP Unit 1 switchyard are not blocked.

Subsequently, the NMP Unit 2 maximum flood level was recalculated (NMPC 1995) to demonstrate that external flood protection is provided to prevent flood damage from the following combinations of events (NMP, 2010 Section 2.4.2.2):

1. Probable maximum precipitation (PMP) and historical maximum lake water level, 250.19 ft (USLS35);
2. Historical maximum precipitation and probable maximum lake stillwater level, 254 ft (USLS35); and

3. Surge with wind-wave action from probable maximum wind storm (PMWS), 261 ft (USLS35).

Based on the analyses performed, the probable maximum flood (PMF) level in the vicinity of the plant buildings is elevation 262.5 ft (NMP 2010) and was determined from the local probable PMP. The PMP analyses are based on inputs from NOAA HMR-51 and HMR-52 (HMR511978, HMR52 1982) and USACE HEC-1&2 (NRC 1999, NMP 2010) and a series of site-specific calculations (CENG 2012b).

The historical maximum precipitation, combined with the probable maximum storm surge lake level, including wave action, results in a constant water level of 259.7 ft in the ditch immediately south of the shore protection dike. This combination of events creates a maximum flood level north of the plant buildings of elevation 260.4 ft, which is less than the probable maximum flood level caused by the PMP.

1.4 Current Licensing Basis Flood Protection and Mitigation Features

The NMP Unit 1 licensing basis for flooding protection is provided by the Principal Design Criteria of the US Atomic Energy Commission (USAEC 1965) and did not contain any formal flooding analyses. NMP Unit 1 was licensed to standards prior to the issuance of the SRP (NUREG-0800), which provides the licensing criteria for NMP Unit 2.

Current licensing basis (CLB) for NMP Unit 1 is defined from the respective plant UFSAR documents (NMP 2011). NMP Unit 1 was not designed to satisfy the requirements stated in the NRC SRP and the NMP Unit 1 Individual Plant Examinations for External Events (IPEEE) (NMP 1996, NRC 1999) process was used to find vulnerabilities with respect to the SRP external flooding criteria.

1.4.1 Flooding Mechanisms

As a result, criteria for the CLB at NMP Unit 1 for the purposes of this evaluation, does not include an analysis for PMP. Criteria for NMP Unit 2 include a screening for all flood mechanisms cited in NUREG-0800 including site flooding due to flooding from:

1. Local Intense Precipitation (due to PMP)
2. Flooding in Streams and Rivers
3. Dam Breaches and Failures
4. Storm Surge
5. Seiche
6. Tsunami
7. Ice Induced Flooding
8. Channel Migration or Diversion
9. Cooling Water Structures, Canals, Reservoirs

The NMP Unit 2 licensing basis considers PMP/LIP and Storm Surge, but screens out all other processes as not applicable or not significant for the NMP site.

For the purposes of this evaluation, the Probable Maximum Flood at NMP Unit 1 and 2 results from PMP/LIP.

1.4.2 PMP Analysis

PMP analyses done for NMP Unit 1 and NMP Unit 2 are based on inputs from NOAA Hydrometeorological Reports HMR-51 and HMR-52 (HMR51 1978, HMR52 1982) and USACE HEC-1&2 (NRC 1999, NMP 2011) and a series of site-specific calculations.

1.4.3 Elevations (U.S. Lake Survey 1935 Datum: USLS35)

Plant grade for NMP Unit 1 is approximately elevation 261 ft (NMP 2011) and for NMP Unit 2 is approximately elevation 260 ft to 262 ft (NMP 2010). For NMP Unit 1 the PMP Flood elevation is 261.75ft (NRC 1999) used in the IPEEE PMP Flood elevation. A design basis flood is defined for NMP Unit 2 at elevation 262.5 ft (NMP 2011).

Lake storm protection elevation for NMP Unit 1 is the top of the rock dike, elevation 263 ft. Lake storm protection elevation for NMP Unit 2 is the top of the armor stone revetment ditch (breakwater), elevation 263 ft (NMP 2010).

The historic high Lake Ontario level forms the basis for shoreline flooding; for NMP Unit 1 the historic high level is elevation 249 ft; for NMP Unit 2 it is elevation 250.19 ft. A probable maximum lake level is specified for NMP Unit 2 at elevation 254 ft; a probable maximum lake surge level plus wave runup for NMP Unit 2 is specified as elevation 261 ft.

The maximum PMP flood level in the vicinity of NMP Unit 1 was elevation 261.75 ft (NRC 1999). The maximum PMP flood level for NMP Unit 1 is derived from the NMP Unit 2 analyses and is based on the assumptions that the storm sewers are inoperable and the culverts southwest of the NMP Unit 1 switchyard are not blocked. The maximum lake level stated in the NMP Unit 1 UFSAR is Elevation 249 ft (NMP 2011). Historical maximum lake level of 250.19 ft (NMP 2010, NMPC 1996) represents the assumed lake level for flood calculations.

1.4.4 Durations

A flood duration is not specified for either NMP Unit 1 or Unit 2. The rain event, or PMP duration, specified for NMP Unit 2 is 20 minutes with 9.9 inches of rainfall.

1.4.5 Flood Protection Components

NMP Unit 1 relies on exterior walls of the substructure and the base slab structures housing safety-related equipment designed to resist hydrostatic pressure and uplift due to exterior flooding to elevation 249 ft (Waste Disposal, Turbine and Reactor Buildings and Control Room Floor). NMP Unit 1 also has a rock dike 1000-ft long at the shoreline that protects the SSCs from lake wave action or possible ice accumulation (DCD 120). The dike is 2 ft higher than yard grade at elevation 263 ft and is constructed of rock. Large rocks face the lake side of the dike and have proven very effective in wave damping and as a barrier to floating ice.

NMP Unit 2 relies on exterior barriers (i.e., berms) located on all three land sides of plant site that divert PMF flow from the watershed adjacent to the plant to prevent the offsite surface water flow from reaching the plant site. Also, an armor stone revetment (breakwall) will protect the plant from lake wave action to elevation 263 ft.

In addition, NMP Unit 2 flood protection components include 1. Exterior doors listed in USAR Table 2.4-15 (NMP 2010); 2. Diesel Generator stop logs; 3. Railroad wooden logs; 4. Seals on exterior penetrations below grade.

Though not credited in CLB, the storm sewer system is designed to remove runoff from a locally intense precipitation rate of 6.5 inches per hour without ponding (CENG 2012).

1.4.6 Emergency/Plant Maintenance Procedure for Flood Occurrence

NMP Units 1 and 2 rely on flood response procedures in site administrative procedure EPIP-EPP-26. Unit 1 relies on procedure S-MRM-REL-0102 to monitor structures. NMP Unit 2 relies on procedures N2-MSP-GEN-V001, N2- MPM-GEN-A016, and N2-MPM-GEN-017 to provide periodic surveillance and maintenance of external flood barriers (CENG 2012c).

1.4.7 Consequences

The consequences of a PMF at the NMP site include the initiation of flooding into NMP Unit 1 buildings when flood water reaches elevation 261 ft. The Diesel Generator Building floods if water level reaches elevation 261.75 ft (CENG 2012). The Diesel Generator building flooding is of very short duration and so is determined to be inconsequential for safety (NRC 1999). The consequences of a PMF at the NMP site do not affect NMP Unit 2 SSCs.

1.5 Licensing Basis Flood-Related and Flood Protection Changes

No changes to the licensing basis flood elevations or flood protection have been made at Unit 1 or Unit 2. The NRC's Technical Evaluation Reports on the NMP Unit 1 and Unit 2 IPEEE submittals concluded that no vulnerabilities with respect to external flooding were present.

1.6 Watershed and Local Area Changes

1.6.1 General NMP Site Hydrological Description

The NMP site is located on the southeastern shore of Lake Ontario in the Lake Ontario watershed. That hydrologic setting generally provides an overland pathway for runoff directly into the lake with any streams mostly small and intermittent. The nearby Oswego River is one of only five major rivers that are exceptions to this condition for the entire lake. The NMP site, in the immediate vicinity of the plant, has its ground surface graded to carry the runoff of the PMP to the lake (CENG 2012) with minimal structures for surface water collection.

1.6.2 Watershed Changes

New hydrologic conditions were described in the NMP3NPP FSAR, 2009 and included:

- The average annual precipitation in the site area is about 42.9 inches (NOAA 2002).
- The maximum recorded hourly rainfall rate in the vicinity of the site is 1.4 inches/hour (3.6 cm/hour), based on 51 years of record (NOAA 2005).

Lake Ontario Conditions

Lake Ontario outflows have been regulated since 1960, primarily through the Moses-Saunders power dam near Cornwall and Massena, New York about 100 miles from the outlet of Lake Ontario (USACE 2007). Prior to the beginning of flow regulation, the elevation of the lake surface was controlled by a natural rock weir located about 4 mi downstream from Ogdensburg, NY, in the Galop Rapids reach of the St. Lawrence. Long Sault Dam, located near Long Sault, Ontario, acts as a spillway when outflows are larger than the capacity of the Moses-Saunders power dam. A third structure at Iroquois, Ontario, is principally used to help to form a stable ice cover and regulate water levels at the power dam. These facilities are under the authority of the International St. Lawrence River Board of Control (IJC 2006) and were designed to withstand seismic and flood events as per applicable federal standards as described in the Federal Energy Regulatory Commission FTS "Engineering Guidelines for the Evaluation of Hydropower Projects," revised 2002.

Prior to regulation, Lake Ontario levels ranged from a maximum of 249.3 ft (IGLD85) in June 1952 to a minimum of 242.6 ft (IGLD85) in November 1934, a range of 6.6 ft. Over the past three decades of regulation, that range has been reduced to 4.3 ft. If not regulated, projected lake levels would have reached approximately 250.2 ft (IGLD85) in July 1986 and 244.73 ft (IGLD85) in February 2000, a range of 5.5 ft. As currently regulated, the mean annual variability is 1.7 ft, with lake levels ranging from 245.0 ft (IGLD85) to 246.7 ft (IGLD85). (USGS 2007).

Regulation changes to be implemented by the IJC

Lake Ontario has been regulated by the International Joint Committee (IJC) (formerly the International St. Lawrence River Board of Control) under Plan 1958-D since 1960. The current regulated water level of Lake Ontario, defined as the regulated monthly mean level, is elevation 247.3 ft (IGLD85). Proposals (Plan Bv7 2011) to modify the regulated water levels are currently under study and review. Upon the completion of the works, the discharge of water from Lake Ontario and the flow of water through the International Rapids Section shall be regulated to meet the requirements of conditions (b), (c) and (d) hereof; shall be regulated within a range of stage from elevation 243.3 ft (IGLD85) (navigation season) to elevation 247.3 ft (IGLD85). Under regulation, the frequency of occurrences of monthly mean elevations of approximately 246.3 ft (IGLD85) and higher on Lake Ontario shall be less than would have occurred in the past.

1.6.3 Local Area Changes

Local area changes have been minimal since plant operation began at the plant site. NMP Unit 2 was under construction when NMP Unit 1 began to operate. The Fitzpatrick Nuclear plant to the east of the

NMP site began operation coincident with NMP Unit 1. Offsite areas to the south and west remain largely undeveloped.

Changes consistent with most nuclear plant sites have been made at NMP since operations began. A revised plant flood calculation (NMP2 2012) provides a summary of general changes to the NMP site, specifically involving addition of the following structures:

- Operations Building
- Site Services Building
- Site Support Building
- Swing/Outage Building
- Chemical Building
- Bottled Gas Building
- New York Telephone Switch Building
- Maintenance Building
- P-Building Annex
- Hazardous Materials Storage Warehouse
- Oil Spill Containment Reservoir
- Engineering Services Building
- Security Annex and Security West Buildings
- A new spare transformer foundation
- An ISFSI serving both NMP units

Addition of security barriers, relocation of the security fence and relocation and addition of trailers and a truck unloading area constructed with an inflatable berm were also provided. Several minor structures have been removed.

Location and configuration of all current structures were inputs for the Local Intense Precipitation (Section 2.1) calculations as related to the flooding impacts on SSCs.

1.7 Additional Site Details

There are no additional site details.

1.8 References

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2.0 FLOODING HAZARD REEVALUATION

The flooding hazard reevaluation for each of the eight flood causing mechanisms required in Attachment 1 to Enclosure 2 of NRC's March 2012 10 CFR 50.54(f) letter, as well as a combined effect flood, is described in the following subsections. Flooding due to LIP is the only scenario that results in standing water in the vicinity of SSCs at NMP Units 1 and 2. Debris loading and transportation during the LIP scenario is not a hazard for safety-related SSC at NMP Units 1 and 2.

2.1 Local Intense Precipitation

2.1.1 Methodology

The HHA approach described in NUREG/CR-7046 (NRC 2011) was used for Local Intense Precipitation (LIP) (AREVA 2013a) along with the analyses performed as part of the Combined License (COL) application for the formerly proposed NMP Unit 3 Nuclear Power Plant (NMP3NPP) (NMP3NPP 2009).

In particular, this calculation applied the assumptions of Case 3 in Appendix B of NUREG/CR-7046. Case 3 assumes that the design of the site grade and the passive drainage channels are incapable of routing any flow from the immediate plant site, and therefore, overland flow occurs over the entire plant site during the local intense precipitation event.

Rainfall inputs used were originally calculated as part of the NMP Unit 3 COLA (AREVA 2013b). The proposed NMP3NPP project is located adjacent to the NMP Unit 1 and Unit 2 site. As such, it represents the same hydrometeorological setting as NMP Unit 1 and Unit 2 and is characterized by the same flooding mechanisms. Therefore, the Probable Maximum Precipitation (PMP) event developed as part of the LIP flooding analysis performed in 2008 at NMP3NPP applies to NMP Unit 1 and Unit 2 as well.

Runoff losses were ignored during the LIP event to maximize runoff per NUREG/CR-7046. As a result, infiltration (i.e., constant loss) was not considered and initial abstraction was set to zero. Rainfall was transformed directly into runoff within the two-dimensional hydrodynamic computer model discussed below.

Due to the unconfined over-land flow conditions expected during the LIP flood, a two-dimensional hydrodynamic computer model, FLO-2D, was used for this calculation (FLO-2D 2009). FLO-2D is a physical process model that routes flood hydrographs and rainfall-runoff over unconfined flow surfaces or in channels using the dynamic wave approximation to the momentum equation. Overland flood routing in two-dimensions is accomplished through a numerical integration of the equations of motion and the conservation of fluid volume. FLO-2D also contains hydrologic routines to convert rainfall to runoff. The use of a two-dimensional computer model is expected to more realistically capture the unconfined runoff due to the LIP versus traditional one-dimensional computer models such as HEC-RAS. More information including model validation on the FLO-2D software is provided in Appendix A.

Note that the methodology used in this study differs from what was used in the calculations supporting NMP's Current Licensing Basis (CLB), primarily due to changes in regulatory guidelines since the CLB was developed. A summary of methodologies used is provided in Table 2.1-1. Three important contrasts between the CLB and re-evaluation methodologies include:

1. The CLB LIP evaluation assumes culverts to be 100 percent open during the PMF, corresponding to Case 1 in Appendix B of NUREG/CR-7046 (which is not recommended in NUREG/CR-7046). In this re-evaluation, culverts along the main drainage channel were assumed 100 percent blocked, which is equivalent to the recommended conceptual model used by Case 3 in Appendix B of NUREG/CR-7046, which is the most conservative model for site drainage.

2. The supporting calculation for the CLB concludes that the 20-minute, 9.9 inches PMP is the controlling LIP event for the site. In this re-evaluation, storm durations of up to the 72-hour PMP were applied per NUREG/CR-7046, Appendix C (i.e., the duration of PMP for estimating the PMF extends to 72 hours based on Hydrometeorological Report Nos. 51 and 52). The 6-hour PMP was also evaluated as per NUREG/CR-7046, Appendix B.

3. The CLB LIP evaluation uses Soil Conservation Service (SCS, now known as the Natural Resources Conservation Service, i.e., NRCS) curve numbers for Antecedent Moisture Condition (AMC) II. In this re-evaluation, runoff losses were ignored as per Section 3.2.1 of NUREG/CR-7046.

2.1.2 Results

2.1.2.1 Flood Sources and Drainage Area

Sources of potential flooding at the NMP site are Lake Ontario to the north, Lakeview Creek to the southwest, and LIP directly over the site. The LIP-induced flood is the result of the PMP centered over the site area and the local watershed. There are also two small unnamed drainage courses near and/or on the site (referred to and labeled as Stream 1 and Stream 2). Flooding of these small drainages is expected to occur coincident with the LIP; therefore, they are also included in this analysis.

The delineated watershed boundaries for NMP and the two unnamed drainage courses are shown in Figure 2.1-2. The calculated watershed areas are summarized in Table 2.1-2.

2.1.2.2 PMP and FLO-2D Model Inputs

The PMP event used is the same as developed for the LIP flooding analysis performed in 2008 at NMP3NPP. One-hour through 72-hour PMP values were computed using NOAA publications Hydrometeorological Report No. 51, Probable Maximum Precipitation - United States East of the 105th Meridian (NOAA 1978) and HMR No. 52, Application of Probable Maximum Precipitation - United States East of the 105th Meridian (NOAA 1982). Three PMP durations were selected for evaluation in the LIP calculation:

- The 1-hour 1-mi^2 (Point) PMP depth has a total rainfall depth of 16.0 inches as summarized in Table 2.1-3. The peak intensity is located at the beginning of the 1-hour event, with 5.4 inches occurring during the first 5 minutes and 8.6 inches occurring during the first 15 minutes.

- Total rainfall depth for the 6-Hour PMP was calculated to be 22.4 inches. The hyetograph was constructed using the 1-hour PMP of 16 inches for the first hour and equal increments for the remaining 5 hours. The 6-Hour PMP hyetograph is shown in Figure 2.1-3 (a).

- Total rainfall depth for the 72-hour PMP was calculated to be 33.0 inches. The peak intensity of the 72-hour PMP is at the 7th 6-Hour period of the total 72-hour duration. The 72-hour PMP hyetograph is shown in Figure 2.1-3 (b).

PMP values were then used as input into FLO-2D. Other inputs to the FLO-2D model included:

- Digital elevation data based on an existing site topographic survey drawing (NIMO 1999). A grid element elevation rendering (ft, USLS35) is shown in Figure 2.1-4.

- Manning's "n" roughness coefficients based on land cover information (NLCD 2006; FLO-2D 2009) and published guidance (FLO-2D 2009). The correlation between the input Manning's n-values and NLCD 2006 land use categories is presented in Table 2.1-4. Grid element Manning's n-values are shown in Figure 2.1-5. A Manning's n-value of 0.04 was assigned for channels.

- Levees were input into the model to represent the existing flood control berms. Portion of East Berm north of the warehouse building was not included because the east flood protection berm is not connected to the north and south side of the warehouse (NMPNS 2012).

- A hydraulic structure was included to represent the existing culvert that penetrates the southern Lake Road berm and conveys flow toward NMP. On-site channels and other culverts within the flood control berms were not considered.

- Area Reduction Factors (ARF) and Width Reduction Factors (WRF) were included to represent existing buildings and other features (e.g., security barriers) that may impede flow off the site. Features (e.g., security barriers) which are not designed specifically for flooding that may assist in re-directing flow away from NMP were not considered. Recent additions such as the ISFSI pad were included in the FLO-2D model. However, smaller-sized structures such as Dry Cask Storage and Security West Building were not modeled, because they were considered effectively "downstream" of the safety-related SSCs and judged to have inappreciable impact in the flood analysis results.

- Grid elements along the lakeshore were defined as outflow nodes. A constant lake level of 248 ft was assumed for the analysis.

An overview of the final FLO-2D model is shown in Figure 2.1-6.

2.1.2.3 LIP Effects

The calculated flood elevation varies spatially, depending upon location. Grid element locations are given in Figure 2.1-7. The maximum calculated flood elevation and flow depth at NMP occur during the 72-hour PMP. In general, the 72-hour PMP yields flood elevations up to approximately 0.6 ft higher than the results from the 6-Hour PMP simulation.

Overland flow generally occurs from south to north, ultimately flowing into Lake Ontario. Buildings block flow paths in certain areas, resulting in a more west-to-east flow along existing roadways and other open areas.

2.1.2.3.1 6-Hour PMP

In the immediate vicinity of Unit 1 and Unit 2 SSCs (labeled A through K), maximum water surface elevations were calculated to range from elevation 260.3 ft to elevation 261.8 ft (USLS35) (Figure 2.1-8). In the immediate vicinity of Unit 1 and Unit 2, the calculated maximum flow depth ranged from 0.2 ft to 2.1 ft (Figure 2.1-9). In the immediate vicinity of Unit 1 and Unit 2, the calculated maximum flow velocity reached up to approximately 2.0 ft/sec (Figure 2.1-10).

SSCs of Units 1 and 2 are clustered in the main building complex labeled A through K.

Unit 1: Maximum flood elevations along the south / west perimeter ranged from 261.1 ft to 261.7 ft (USLS 35), in the immediate vicinity of Reactor Building (A) and Turbine Building (B). Maximum flood elevations along the north / east perimeter of Screenwell Building (E) and Radwaste Building (C) ranged from 260.8 ft to 261.7 ft (USLS35), with lower water surface elevations along the northern perimeter and higher elevations along the eastern perimeter outside Radwaste Building. Maximum flood elevations along the south / east perimeter of Administration Building (J) were nearly constant and around 261.8 ft (USLS35). Flow depths were up to 2.1 ft around the southeast corner of the administration building (J) and as low as a few inches on the northern perimeter outside Screenwell Building and Radwaste Building (Figure 2.1-9). In general, the water surface elevation (Figure 2.1-8) and the flow depths (Figure 2.1-9) sloped down toward the lakeshore north of the SSCs, which was consistent with the velocity vectors shown in Figure 2.1-10. The highest water surface elevation occurred at the southeast corner of Unit 1, outside Administration Building (J) and the constricted flow area between Unit 1 and Unit 2, approaching elevation 261.8 ft (USLS35).

Unit 2: Maximum flood elevation along the eastern perimeter of Unit 2, immediately outside Reactor Building (A), ranged from 261.5 ft to 261.8 ft (USLS35). Maximum flood elevation around Turbine Building (B) and Switchgear Building (H) reached up to 261.8 ft (USLS35) along the south side of the buildings. Maximum flood elevations along the northern perimeter, immediately outside Screenwell Building (E) and Radwaste Building (C) ranged from 260.3 ft to 261.6 ft (USLS35). Around the northeast corner of Condensate Storage Building (F), maximum water surface elevations ranged from 261.1ft to 261.6 ft (USLS35). The water level was nearly constant and around elevation 261.8 ft (USLS35) outside Control Building (G) and Diesel Generator Building (K) located on the southeast corner of Unit 2. Similar to the calculated flow depths around Unit 1, maximum water depths were generally greater along the southern perimeter than those predicted along the northern perimeter of Unit 2. The absolute maximum water depth of 2.2 ft occurred immediately outside Reactor Building (A), where flow velocities were also the highest, up to around 2 ft/sec.

East of Unit 2: The FLO-2D model predicted higher flood elevations, greater flow depths, and higher flow velocities between the SSCs east of Unit 2 (labeled L through R), as shown in Figures 2.1-11 through 2.1-13. This was mainly caused by the reduced flow width/area due to the presence of the closely spaced buildings in this area. For the buildings close to the Unit 1 and Unit 2 complex, Access Control Building (N), Maintenance Building (O) and Operations Building (P), the calculated water elevation ranged from 261.8 ft to 263 ft (USLS35). In the vicinity of Change house / Service office Building (M), flood elevations ranged from 261.4 ft to 261.9 ft (USLS35). The maximum water surface elevation for this area occurred along the eastern perimeter of Site Services Building (L), up to elevation 262.8 ft (USLS35) (Figure 2.1-11). Maximum flow depths immediately east of Site Services Building (labeled as L) reached up to around 3.7 ft (Figure 2.1-12). Maximum flow velocities reached up to approximately 2.5 ft/sec between Site Services Building (L) and NMP Warehouse (R) (Figure 2.1-13).

A summary of the FLO-2D simulated results on the SSCs (grouped based on their layout locations) is presented in Table 2.1-5.

Time series of flood elevations at Grid Element No. 8156 near the Unit 1 Diesel Generator Building are shown in Figure 2.1-14. Time series of flood elevations at Grid Element No. 10043, southeast corner of Diesel Generator Building Unit 2, is shown in Figure 2.1-15. The flood elevation at both locations remains higher than the building floor elevation 261.0 ft (USLS35) for approximately 14.5 hours.

2.1.2.3.2 72-hour PMP

In the immediate vicinity of Unit 1 and Unit 2 SSCs (labeled A through K), maximum water surface elevations were calculated to range from elevation 260.6 ft to elevation 262.4 ft (USLS35) (Figure 2.1-16). In the immediate vicinity of Unit 1 and Unit 2, the calculated maximum flow depth ranged from 0.3 ft to 2.8 ft (Figure 2.1-17). In the immediate vicinity of Unit 1 and Unit 2, the calculated maximum flow velocity reached up to approximately 2.0 ft/sec (Figure 2.1-18).

SSCs of Units 1 and 2 are clustered in the main building complex labeled A through K.

Unit 1: Maximum flood elevations along the south / west perimeter ranged from 261.1 ft to 262.1 ft (USLS35), in the immediate vicinity of Reactor Building (A) and Turbine Building (B). Maximum flood elevations along the north / east perimeter of Screenwell Building (E) and Radwaste Building (C) ranged from 260.8 ft to 262.3 ft (USLS35), with lower water surface elevations along the northern perimeter and higher elevations along the eastern perimeter outside Radwaste Building. Maximum flood elevations along the south / east perimeter of Administration Building (J) were nearly constant and around 262.2 ft (USLS35). Flow depths were up to 2.4 ft around the southeast corner of the administration building (J) and as low as a few inches on the northern perimeter outside Screenwell Building and Radwaste Building (Figure 2.1-19). In general, the water surface elevation (Figure 2.1-16) and the flow depths (Figure 2.1-17) sloped down toward the lakeshore north of the SSCs, which was consistent with the velocity vectors shown in Figure 2.1-18. The highest water surface elevation near an SSC occurred at the southeast corner of Unit 1, outside Administration Building (J) and the constricted flow area between Unit 1 and Unit 2, approaching elevation 262.2 ft (USLS35).

Unit 2: Maximum flood elevation along the eastern perimeter of Unit 2, immediately outside Reactor Building (A), ranged from 262.1 ft to 262.4 ft (USLS35), which was the highest for both Unit 1 and Unit 2. Maximum flood elevation around Turbine Building (B) and Switchgear Building (H) reached up to 262.2 ft (USLS35) along the south side of the buildings. Maximum flood elevations along the northern perimeter, immediately outside Screenwell Building (E) and Radwaste Building (C) ranged from 260.6 ft to 261.9 ft (USLS35). Around the northeast corner of Condensate Storage Building (F), maximum water surface elevations ranged from 261.4 ft to 262.1 ft (USLS35). The water level was nearly constant and around elevation 262.3 ft (USLS35) outside Control Building (G) and Diesel Generator Building (K) located on the southeast corner of Unit 2. Similar to the calculated flow depths around Unit 1, maximum water depths were generally greater along the southern perimeter than those predicted along the northern perimeter of Unit 2. The absolute maximum water depth of 2.8 ft occurred immediately outside Reactor Building (A), where flow velocities were also the highest, up to around 2 ft/sec.

East of Unit 2: The FLO-2D model predicted higher flood elevations, greater flow depths, and higher flow velocities between the SSCs east of Unit 2 (labeled L through R), as shown in Figures 2.1-19 through 2.1-21. This was mainly caused by the reduced flow width/area due to the presence of the closely spaced buildings in this area. For the buildings close to the Unit 1 and Unit 2 complex, Access Control Building (N), Maintenance Building (O) and Operations Building (P), the calculated water elevation ranged from 262.3 ft to 263.0 ft (USLS35). In the vicinity of Change house / Service office Building (M), flood elevations ranged from 262 ft to 262.5 ft (USLS35). The maximum water surface elevation for this area occurred along the eastern perimeter of Site Services Building (L), up to elevation 263.7 ft (USLS35) (Figure 2.1-19). Maximum flow depths immediately east of Site Services Building (labeled as L) reached up to around 4.3 ft (Figure 2.1-20). Maximum flow velocities reached up to approximately 3 ft/sec between Site Services Building (L) and NMP Warehouse (R) (Figure 2.1-21).

A summary of the FLO-2D simulated results on the SSCs (grouped based on their layout locations) is presented in Table 2.1-6.

Time series of flood elevations at Grid Element No. 8156 near the Unit 1 Diesel Generator Building are shown in Figure 2.1-22. Time series of flood elevations at Grid Element No. 10043, southeast corner of Unit 2 Diesel Generator Building, are shown in Figure 2.1-23. The flood elevation at both locations remains higher than the building floor elevation 261.0 ft (USLS35) for approximately 19 to 20 hours.

2.1.3 Conclusions

Based on the LIP calculation for the NMP Unit 1 and Unit 2, the following conclusions are reached:

- The maximum LIP flood elevation at NMP is caused by the 72-hour PMP.
- In the immediate vicinity of Unit 1 Administration Building (J) (near an SSC), the maximum water surface elevations predicted by the FLO-2D model are up to elevation 262.2 ft (USLS35) which is slightly higher than the CLB LIP-PMP elevation of 261.75 ft for Unit 1. In the immediate vicinity of Unit 2, the maximum water surface elevations are up to elevation 262.4 ft (USLS35) which is similar to the previously calculated CLB LIP-PMP elevation of 262.5 ft presented in the Unit 2 USAR (USAR 2010).
- Results indicate higher water elevations up to elevation 263.7 ft (USLS35) between the non-safety-related structures east of Unit 2 (between buildings such as NMP Warehouse, Site Services Building and Change House).
- Building entrance elevations for all Category I Structures are 261 ft (USLS35) as per the Unit 2 USAR (USAR 2010). The calculated maximum flood elevation 262.2 ft (USLS35) for Unit 1 exceeds elevation 261 ft (USLS35) for approximately 19 hours during the 72-hour PMP. The calculated maximum flood elevation 262.4 ft (USLS35) for Unit 2 exceeds elevation 261 ft (USLS35) for approximately 20 hours during the 72-hour PMP. Therefore, additional calculations on inflows to the SSCs may be needed.

- The opening between the Warehouse Building and the East Berm does not adversely impact flood analysis results.

Table 2.1-7 summarizes the difference in calculated results on LIP-induced flooding at NMP between the CLB and this flood margin re-evaluation study.

Significant debris loading/transportation is not a safety hazard due to the relatively low velocity and depth of LIP flood waters in the vicinity of SSCs at NMP, in addition to the lack of natural debris sources on site.

Regarding uncertainty as per NUREG/CR-7046, note that the LIP methodology herein incorporates conservatism which is anticipated to bound potential uncertainties in the analysis. Specifically:

- Use of HMR-51 and HMR-52 PMP values is by definition conservative since the PMP represents the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location. (NRC 2011).
- Rainfall loss rates (i.e., infiltration, evaporation) were conservatively not considered as per NUREG/CR-7046.
- Rainfall was directly translated to runoff within the FLO-2D computer program, without use of unit hydrograph transformations.
- Roughness coefficients used in the FLO-2D hydraulic simulation are conservative, selected in accordance with manufacturer guidance, and typically higher than traditional 1-dimensional calculation procedures (FLO-2D 2009). Higher roughness coefficients result in higher water surface elevations (FLO-2D 2009).

2.1.4 References

NOTE: Refer to the Project Manager's approval (on the signature page of this report) verifying that the Constellation Nuclear Energy Group (CENG) references are valid sources of design input created in accordance with the CENG's QA program.

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Table 2.1-1: Comparison of Methodology used in Current Licensing Basis and Flood Re-evaluation

Calculation	Current Licensing Basis	Re-evaluation	Remarks
PMP	10-min, 15-min, 20-min, 30-min, 1-hr through 6-hr using HMR-51 and 52 (for Unit 2)	1-hr, 6-hr and 72-hr using HMR-51 and 52 and NUREG/CR-7046	FLO-2D model boundary includes the overall watershed area of the two unnamed drainages. The PMP duration extends to 72 hours as per HMR-51 and 52.
Runoff Curve Number	72 (south of Lake Road) and 82 (north of Lake Road) for antecedent moisture condition II (AMCII)	No runoff losses per NUREG/CR-7046	AMC II is not conservative. NUREG/CR-7046 recommends runoff losses be ignored for LIP flooding events.
LIP Flood Development	Rainfall – runoff from local watershed computed with HEC-1 and the SCS runoff curve numbers above Runoff from impervious site area computed by the Rational Method (i.e., Q= C*I*A) Elevations computed using HEC-2 along two selected routes: (1) main ditch s/w of Unit 1; (2) drainage ditch east of Unit 2	Runoff flow rates / volumes and water surface elevations computed using 2-dimensional computer model, FLO-2D	FLO-2D is a 2-dimensional flow routing software, including overland flow and 1-D channel flow. FLO-2D translates rainfall into overland flow internally. Flood control berms were included with the exception of the east berm, north of the warehouse, which has an identified opening which may convey flow through the berm. Flow through the east berm near the warehouse does not adversely affect LIP flood elevations.
Blockage of culverts along Main Channel	Case A: 100% open culverts Case B: 25% blocked Case C: 50% blocked culverts (under railroad and access road)	Per NUREG/CR-7046, used the conceptual model of Case 3 with no functional stormwater system (i.e., catch basins and storm drains), channel or culverts (i.e., drainage channel being completely blocked)	Case 3: most conservative; CLB used Case 1: least conservative which is not recommended in NUREG/CR-7046.

Table 2.1-2: Watershed Delineation

Stream Name	Watershed Area (sq. mi.)	Delineation Point at Confluence with Lake Ontario
Unnamed Stream 1	0.62	Discharge point (Lat.43°31'27.3"; Long. 76°24'3.7")
Unnamed Stream 2	0.68	Discharge point (Lat.43°31'19.2"; Long. 76°24'47.6")

Table 2.1-3: Point (1 mi^2) Probable Maximum Precipitation Depths

Time (min)	PMP Depth (in)
60	16.0
30	12.3
15	8.6
5	5.4

Table 2.1-4: Manning's n-Values and NLCD2006 Land Use Classes

NLCD2006 Code	NLCD Definition	Manning's n
21	Developed, open space	0.1
22	Developed, low intensity residential	0.08
23	Developed, medium intensity	0.06
24	Developed, high intensity	0.05
31	Barren land	0.1
41	Deciduous forest	0.4
42	Evergreen forest	0.4
43	Mixed forest	0.4
52	Shrub/scrub	0.35
71	Grassland/Herbaceous	0.3
81	Pasture	0.3
82	Cultivated crop	0.4
90	Woody wetlands	0.1
95	Emergent herbaceous wetlands	0.09

Table 2.1-5: 6-Hour LIP Impact on SSCs

Block	Building Identification	Label	Maximum Water Elevation (ft, USLS35)	Maximum Flow Depth (ft)	Maximum Velocity (ft/sec)
Unit 1	Reactor Building & Turbine Building	A & B	261.1 to 261.7	0.6 to 1.2	1 ±
	Radwaste Building, Screenwell Building & Offgas Stack Building	C, E & I	260.8 to 261.7	0.2 to 1	1 ±
	Administration Building	J	261.8 ±	1.4 to 2.1	1 ±
Unit 2	Reactor Building	A	261.5 to 261.8	1 to 2.1	1.5 ±
	Turbine Building & Switchgear Building	B & H	261.8 ±	1.7 to 2.2	1 ±
	Radwaste Building, Screenwell Building & Offgas Stack Building	C, E & I	260.3 to 261.6	0.4 to 1.6	2 ±
	Condensate Storage Building	F	261.1 to 261.6	0.5 to 1.2	1.5 ±
	Control Building & Diesel Generator Building	G & K	261.8 ±	1.2 to 2.1	1.5 ±
East of Unit 2	Access Building & Maintenance Building	N & O	261.9 ±	0.2 to 2.1	1.5 ±
	Operations Building	P	261.8 to 263	0.1 to 2.5	1 ±
	Change House	M	261.4 to 261.9	0.6 to 2.2	1.5 ±
	Site Services Building	L	261.8 to 262.8	1.7 to 3.7	2.5 ±
	NMP Warehouse	R	261.4 to 262.7	0.4 to 1.6	2.5 ±
	East Security Building	Q	262.3 ±	0.1 to 2.3	3 ±

Table 2.1-6: 72-hour LIP Impact on SSCs

Block	Building Identification	Label	Maximum Water Elevation (ft, USLS35)	Maximum Flow Depth (ft)	Maximum Velocity (ft/sec)
Unit 1	Reactor Building & Turbine Building	A & B	261.1 to 262.1	0.6 to 1.5	2 ±
	Radwaste Building, Screenwell Building & Offgas Stack Building	C, E & I	260.8 to 262.3	0.2 to 1.3	2 ±
	Administration Building	J	262.2 ±	1.7 to 2.4	1.5 ±
Unit 2	Reactor Building	A	262.1 to 262.4	1.6 to 2.8	2 ±
	Turbine Building & Switchgear Building	B & H	262.2 ±	2.5 ±	1.5 ±
	Radwaste Building, Screenwell Building & Offgas Stack Building	C, E & I	260.6 to 261.9	0.6 to 1.8	2 ±
	Condensate Storage Building	F	261.4 to 262.1	1 to 1.5	2 ±
	Control Building & Diesel Generator Building	G & K	262.3 ±	1.6 to 2.6	2 ±
East of Unit 2	Access Building & Maintenance Building	N & O	262.6 ±	0.6 to 2	2 ±
	Operations Building	P	262.3 to 263	0.4 to 2.8	1.5 ±
	Change House	M	262 to 262.5	1.3 to 2.7	3 ±
	Site Services Building	L	262.4 to 263.7	2.7 to 4.3	3 ±
	NMP Warehouse	R	262 to 263.3	1 to 2.5	3 ±
	East Security Building	Q	263.2 ±	0.5 to 2.7	3 ±

Table 2.1-7: Comparison of Results by Current Licensing Basis and Flood Re-evaluation

Results	Current Licensing Basis	Re-evaluation
Most Critical LIP (PMP) Event	20-minute duration 9.9 inches (for Unit 2)	72-hr, 33 inches (16 inches in one hour, 12.3 inches in 30 min)
LIP Flood Elevation	Elevation 261.75 for Unit 1; Elevation 262.5 for Unit 2	Elevation 262.2 for Unit 1; Elevation 262.4 for Unit 2
Duration of PMF Elevation Above 261.0	20 minutes	Up to 20 hours by the 72-hr PMP

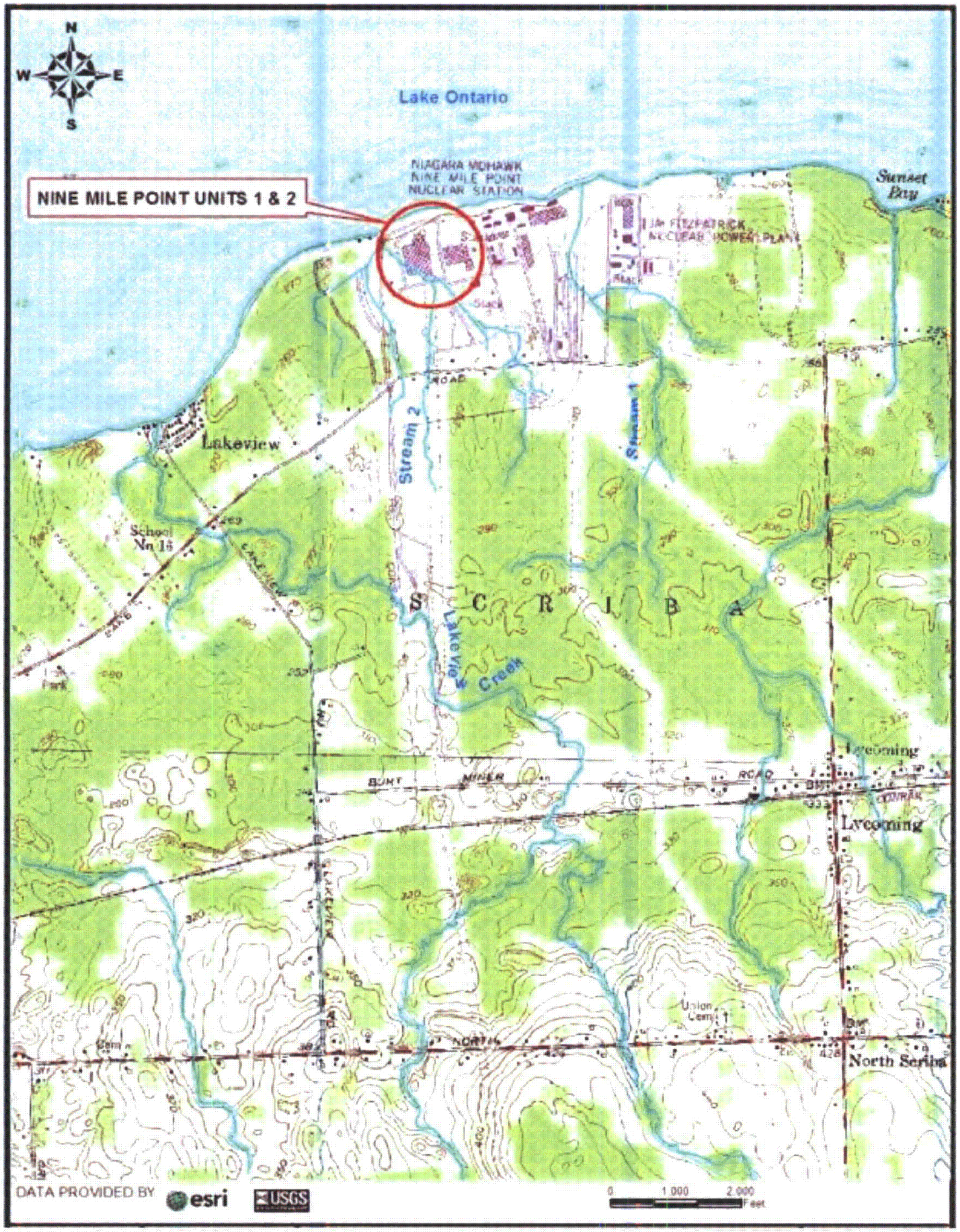


Figure 2.1-1: Site Locus Map

Figure 2.1-2: Watershed Delineation Map

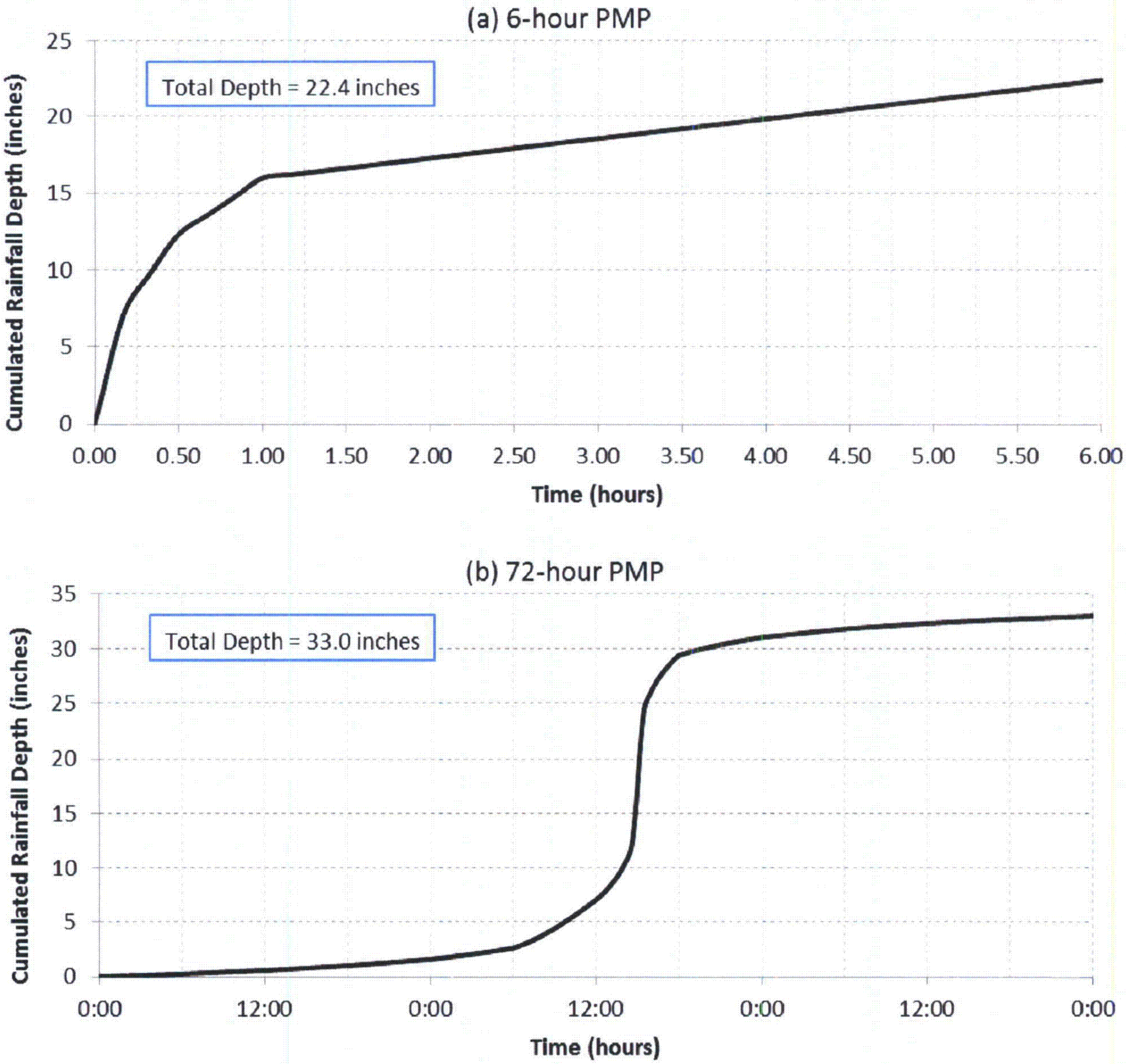


Figure 2.1-3: Cumulative Hyetographs for 6-Hour and 72-hour PMPs

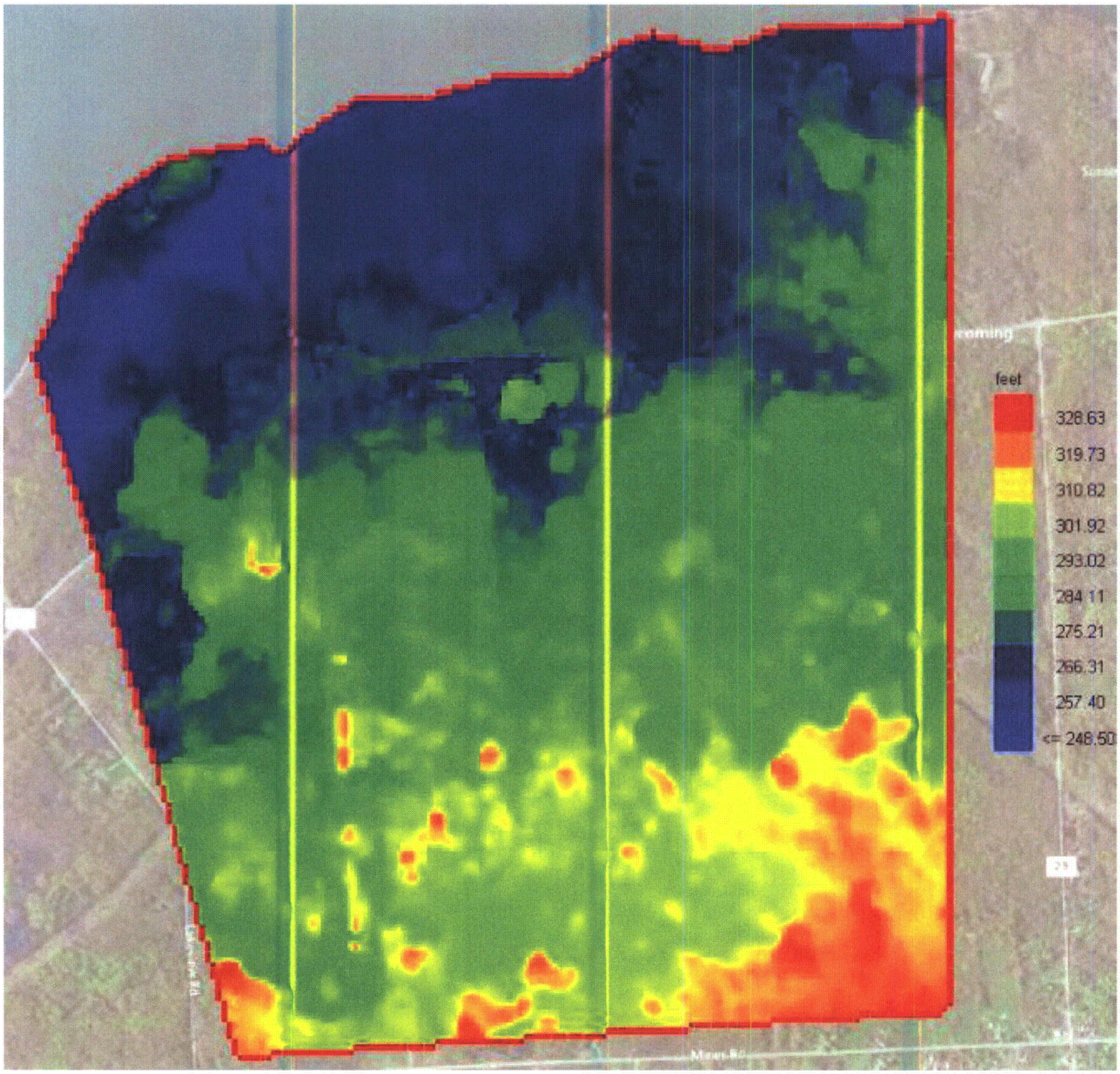


Figure 2.1-4: Grid Element Elevation Rendering (USLS35)

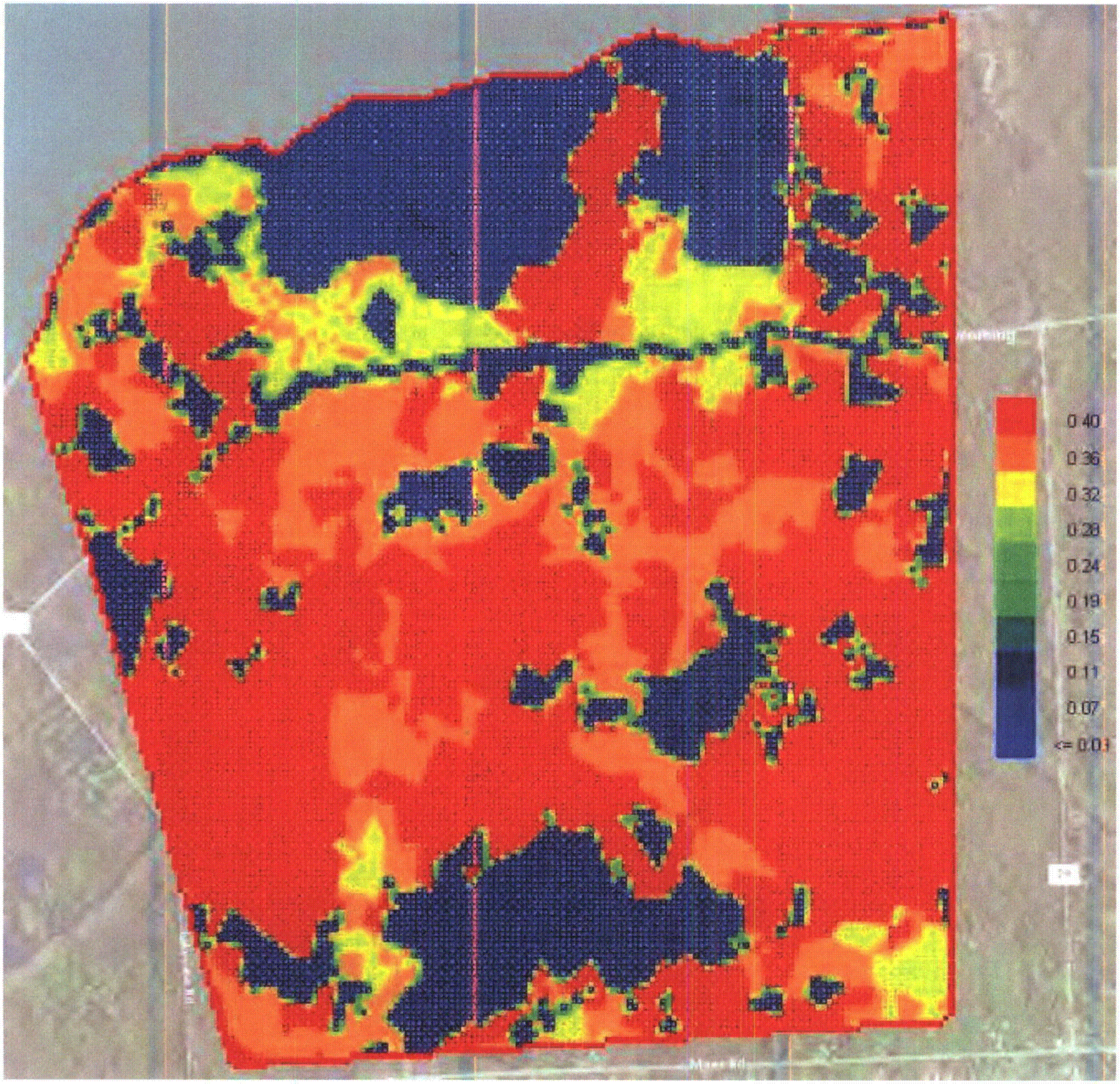


Figure 2.1-5: Manning's n-Values

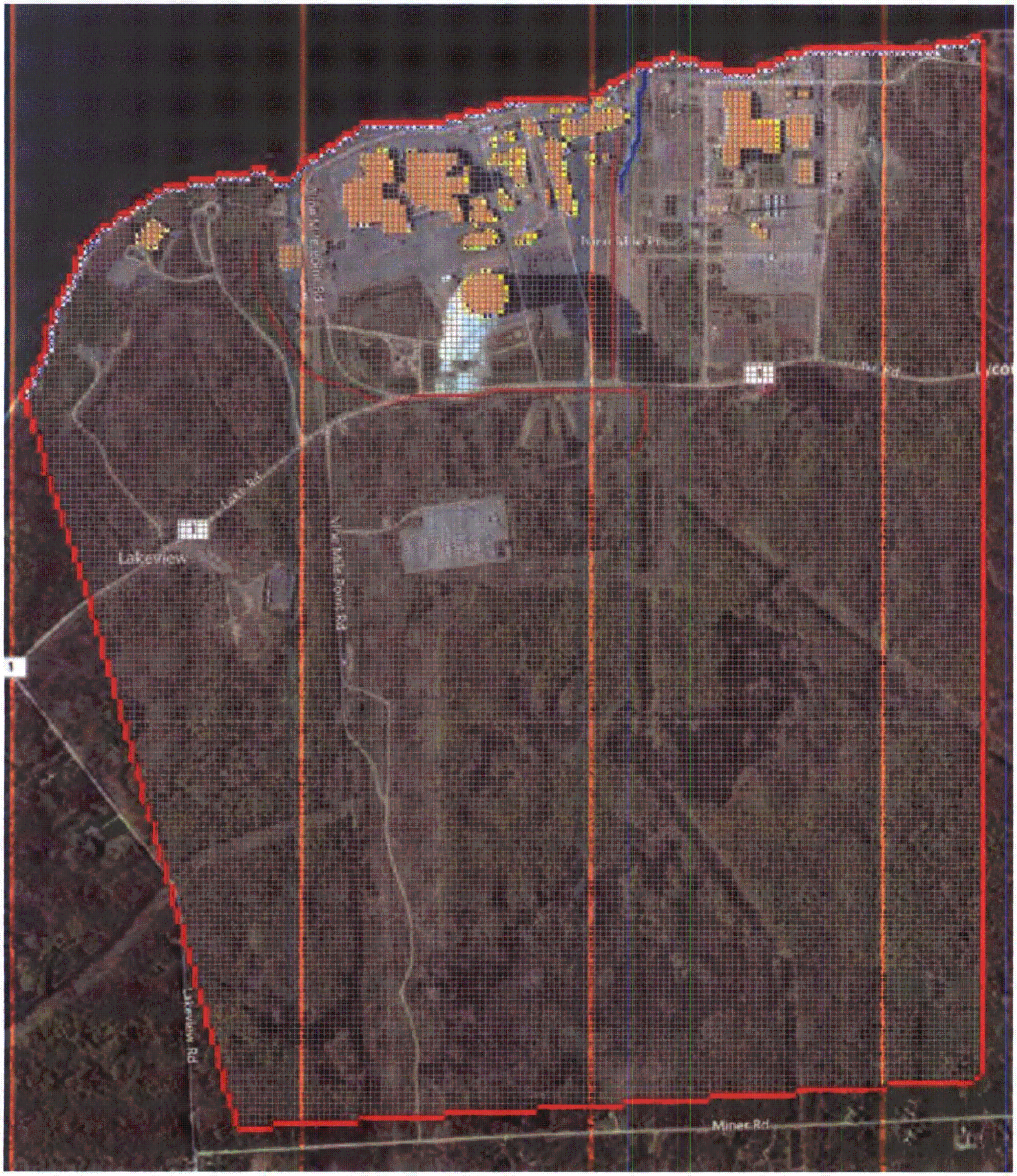
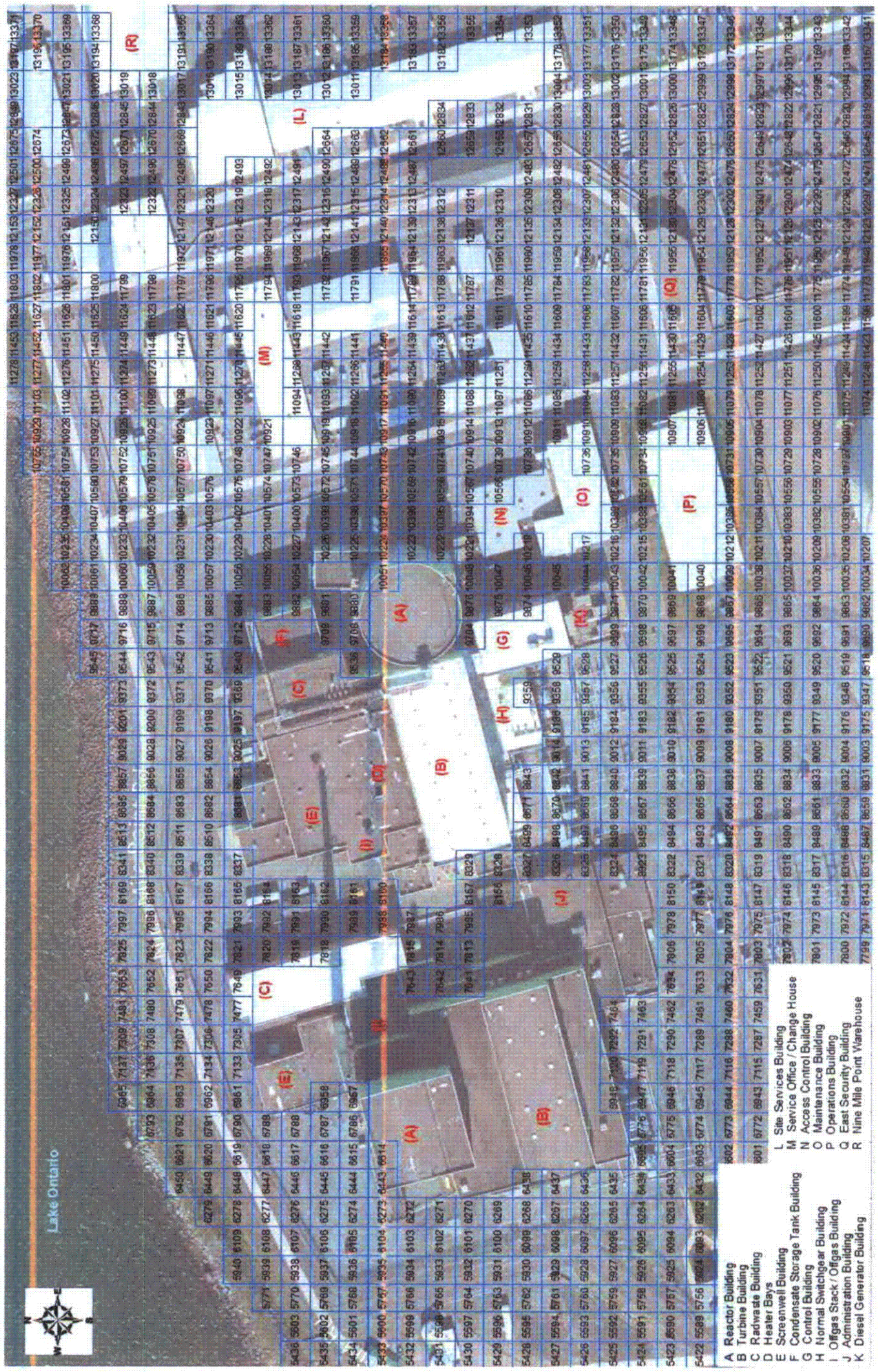


Figure 2.1-6: Components in FLO-2D for LIP Simulations



Note: Aerial photo basemap is shown to provide an approximate geographic point of reference for the reader, for information purposes only. FLO-2D grid elements represent site ground elevations and the FLO-2D grid alignment represents the layout of building locations. The FLO-2D grid shown is not intended to exactly match the aerial photo basemap

Figure 2.1-7: Grid Element Identification

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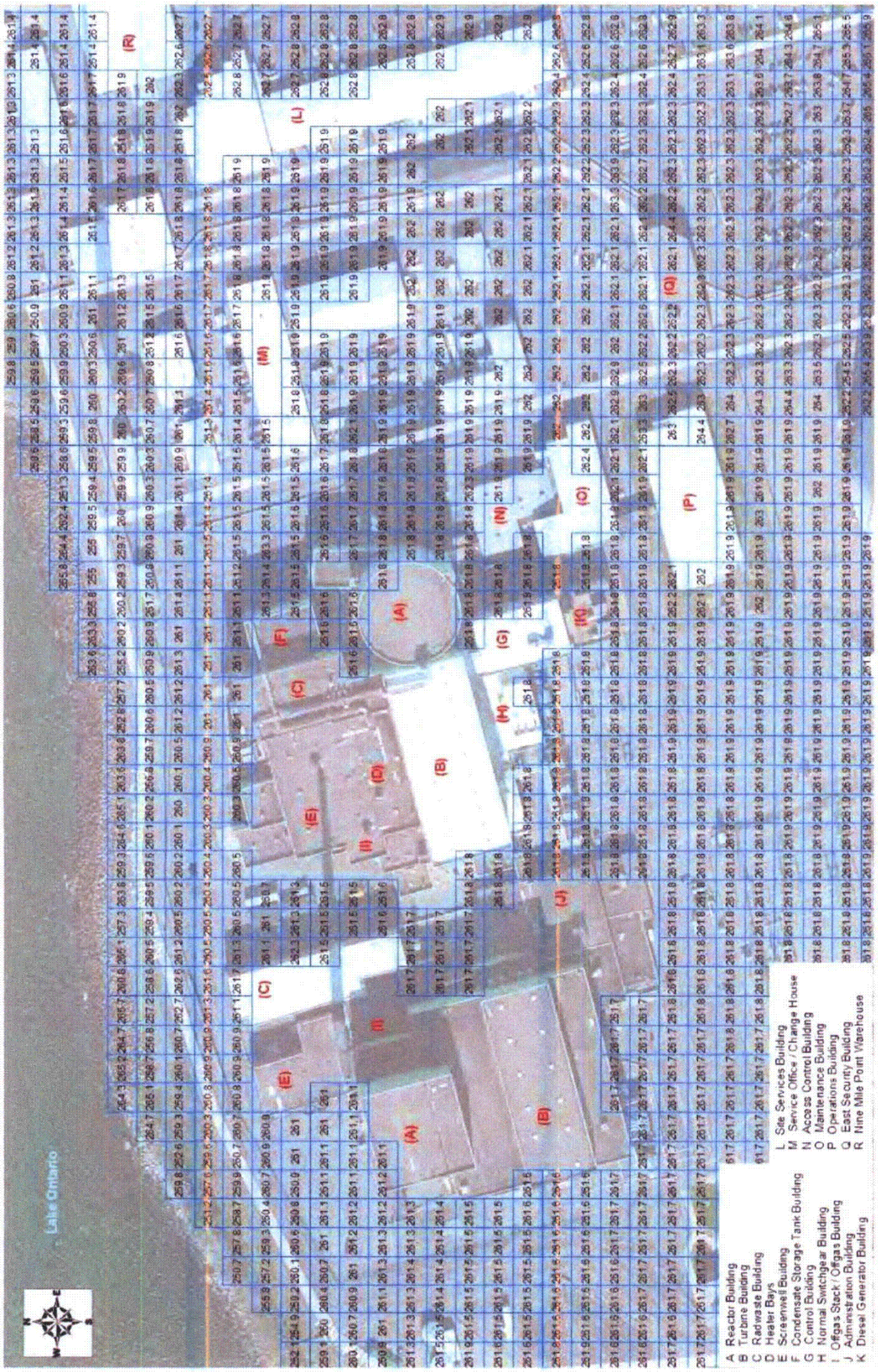

Figure 2.1-8: Grid Element Maximum Water Elevation (ft, USLS35) around Units 1&2-6-Hour PMP

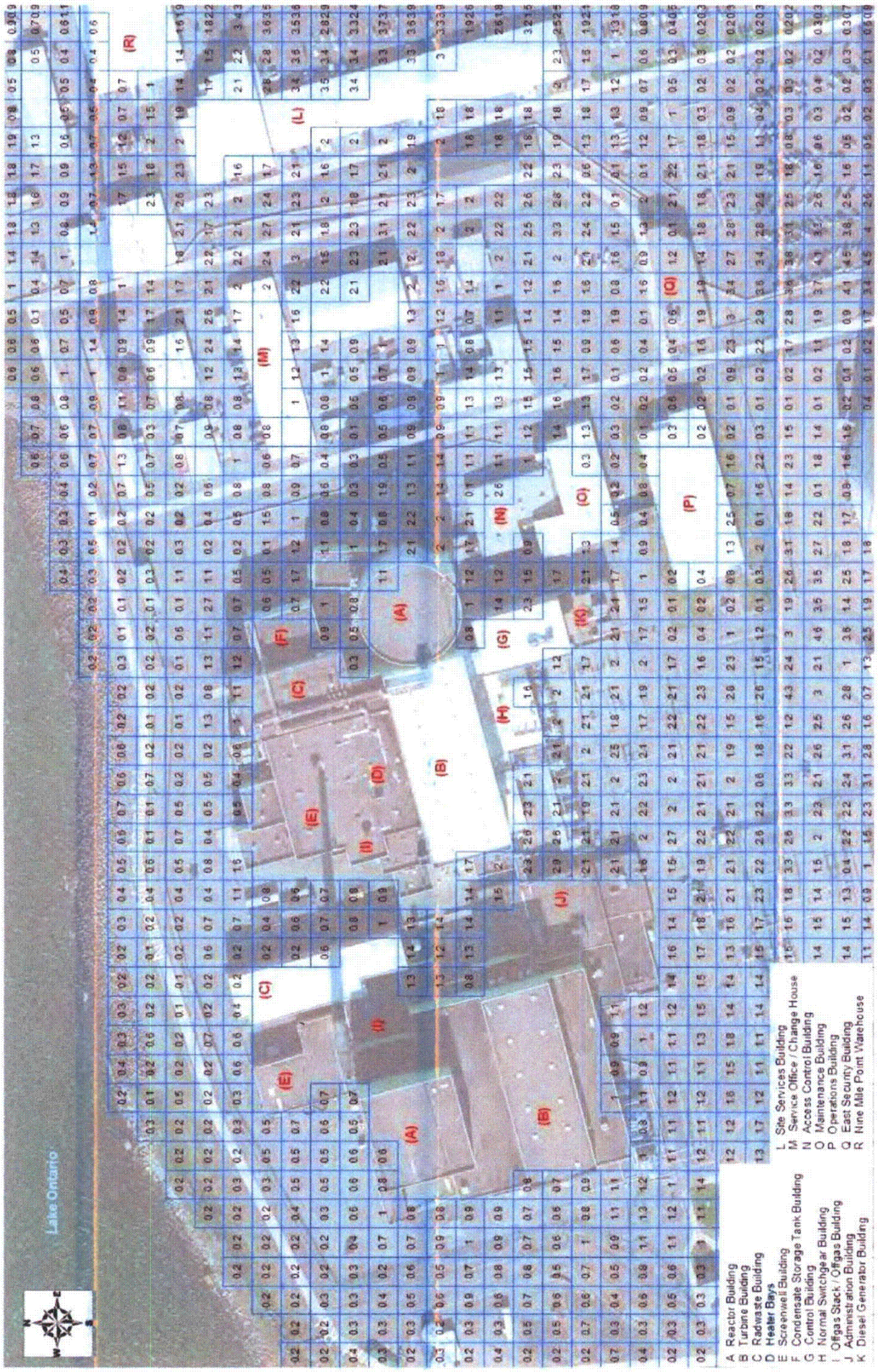

Figure 2.1-9: Grid Element Maximum Flow Depth (ft) around Units 1 & 2 – 6-Hour PMP

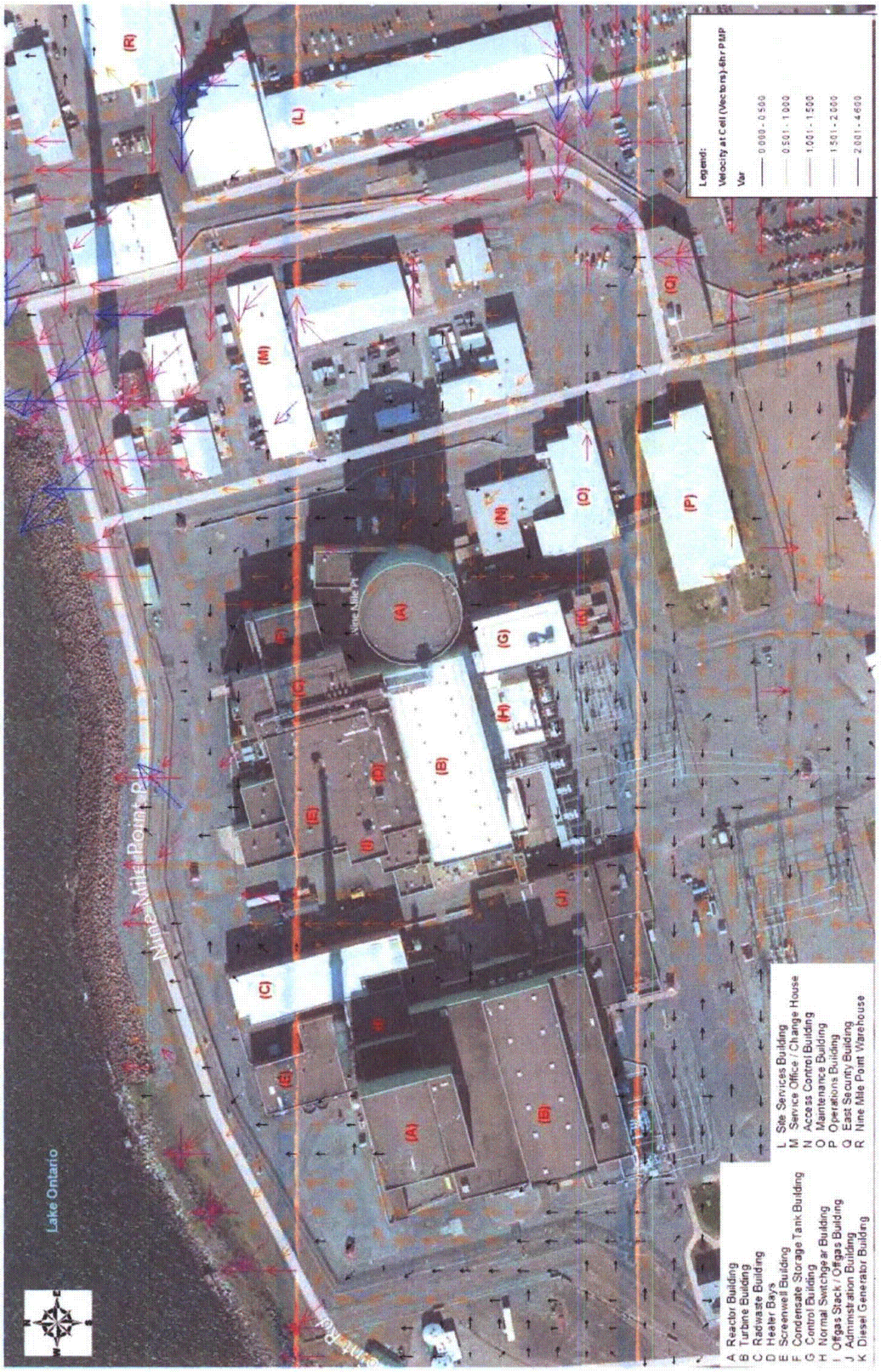

Figure 2.1-10: Grid Element Maximum Flow Velocity (ft/sec) around Units 1 & 2 – 6-Hour PMP

Figure 2.1-11: Grid Element Maximum Water Elevation (ft, USLS35) East of Units 1 & 2 – 6-Hour PMP

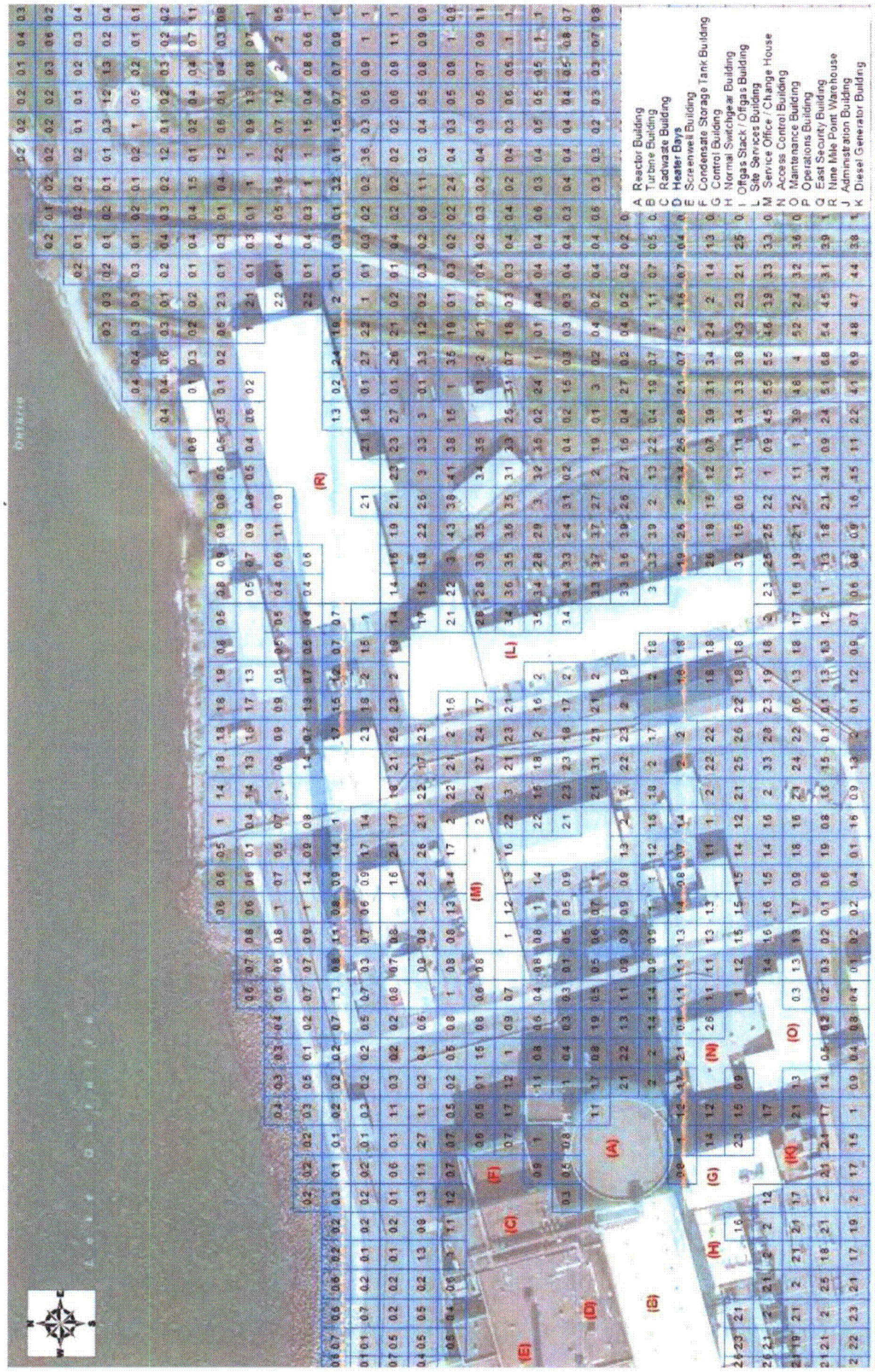

Figure 2.1-12: Grid Element Maximum Flow Depth (ft) East of Units 1 & 2 – 6-hour PMP

Figure 2.1-13: Grid Element Maximum Flow Velocity (ft/sec) East of Units 1 & 2 – 6-hour PMP

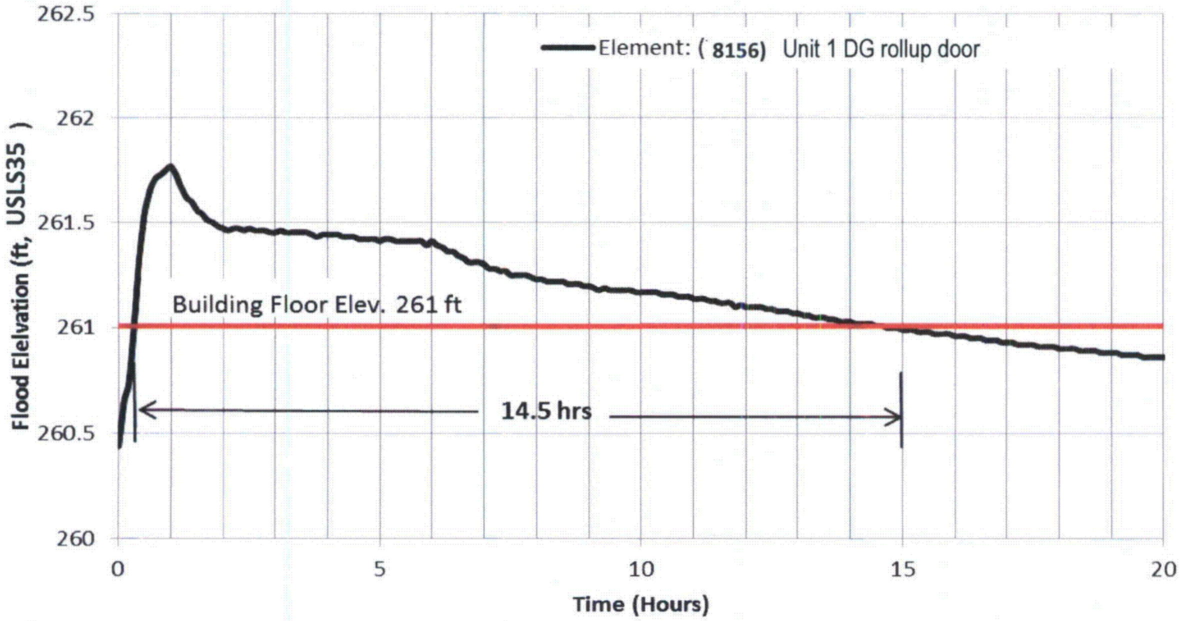

Figure 2.1-14: Time Series of Water Surface Elevation at Element 8156 Unit 1 – 6-hour PMP

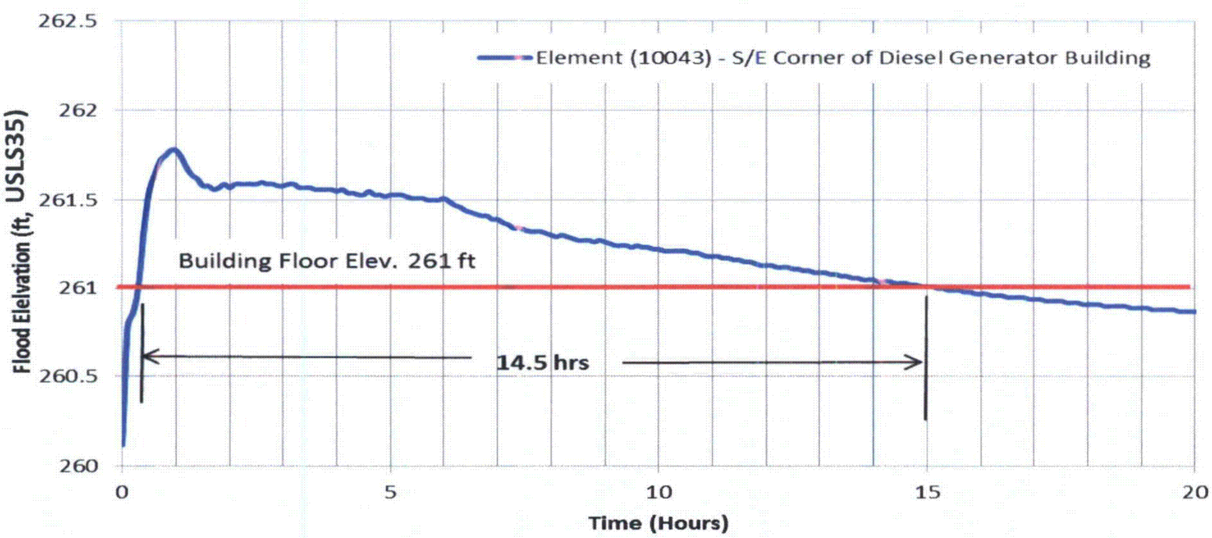

Figure 2.1-15: Time Series of Water Surface Elevation at Element 10043 Unit 2 – 6-hour PMP

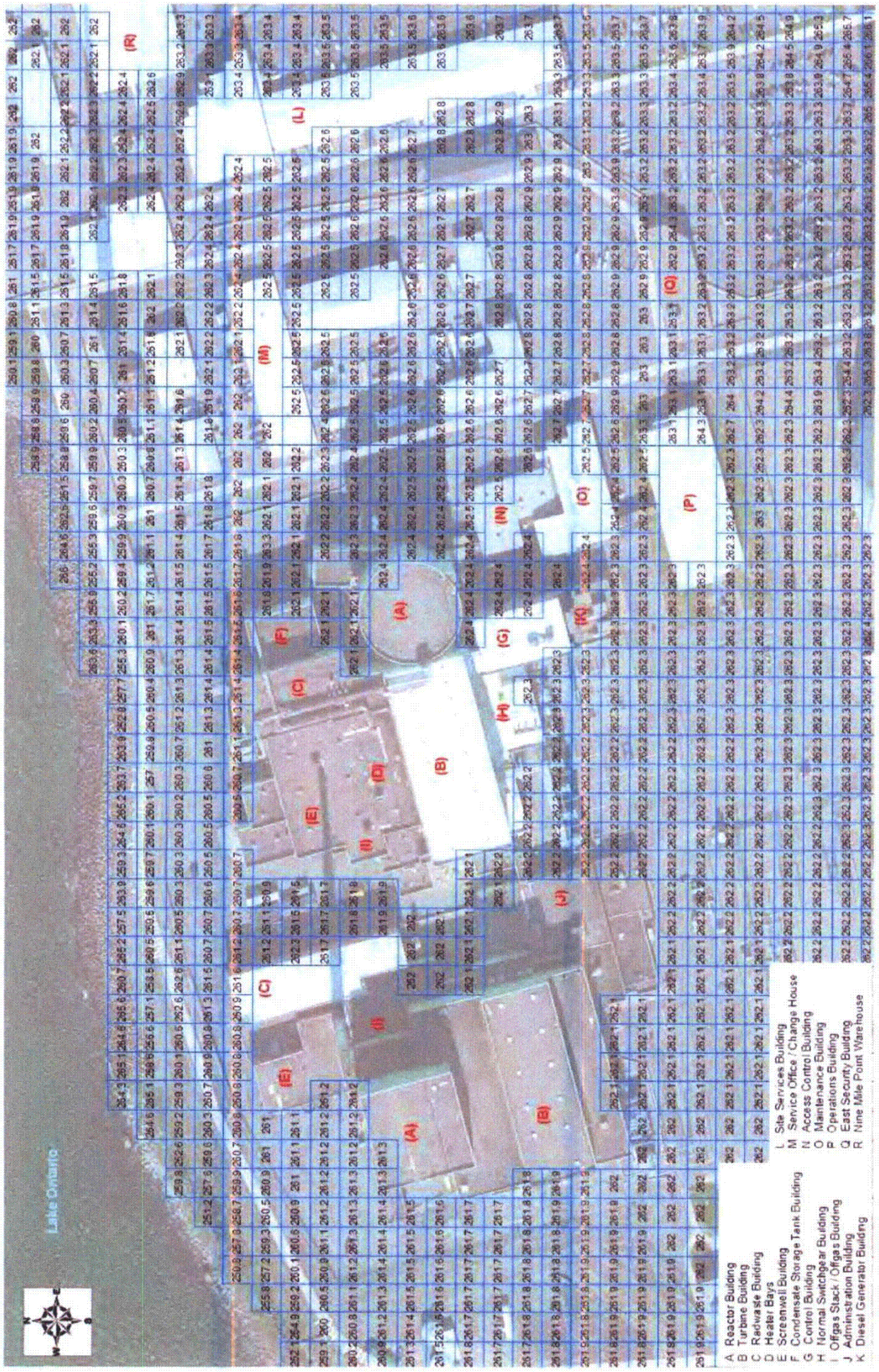

Figure 2.1-16: Grid Element Maximum Water Elevation (ft, USLS35) around Units 1 & 2 – 72-hour PMP

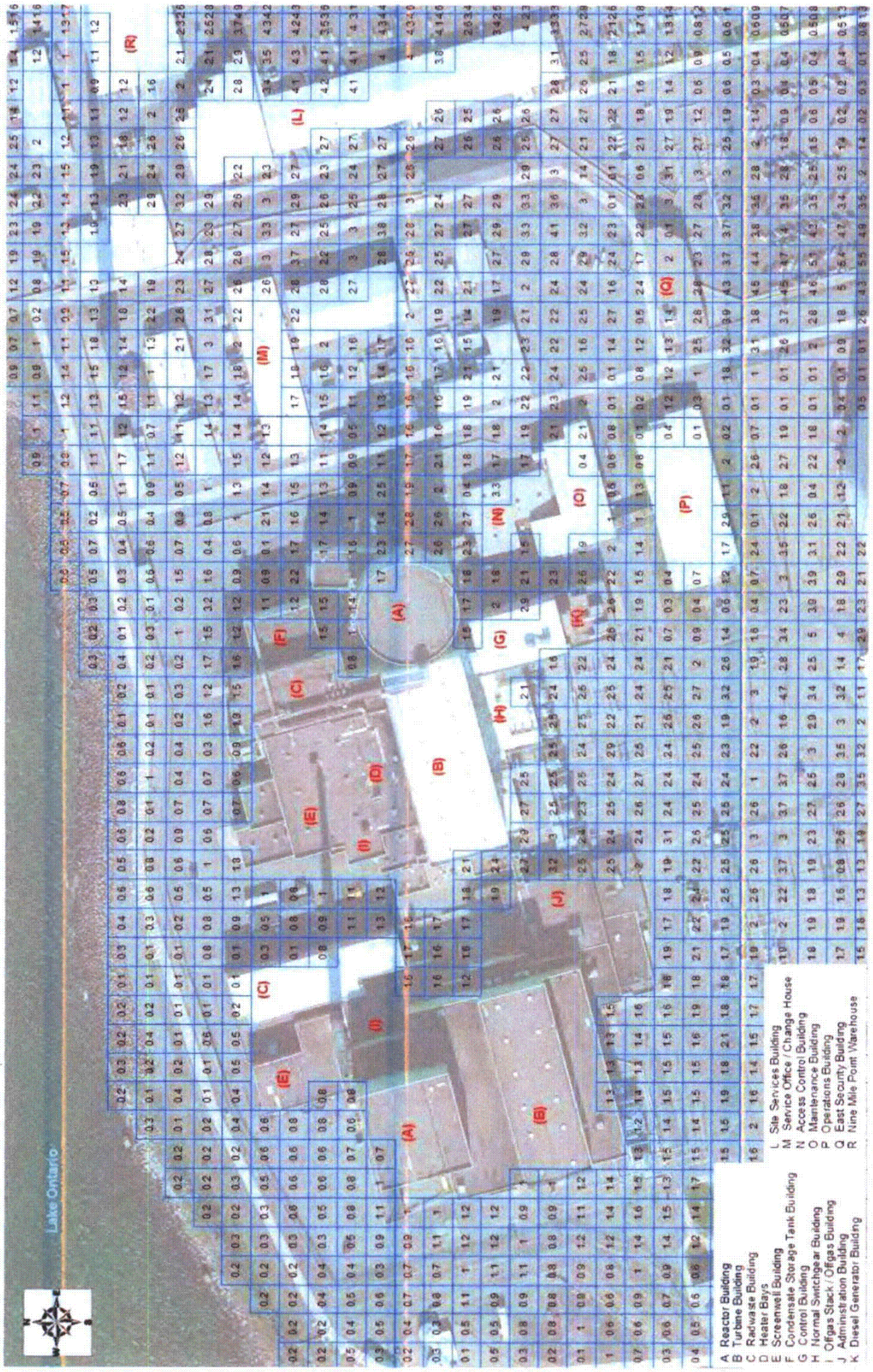

Figure 2.1-17: Grid Element Maximum Flow Depth (ft) around Units 1 & 2 – 72-hour PMP

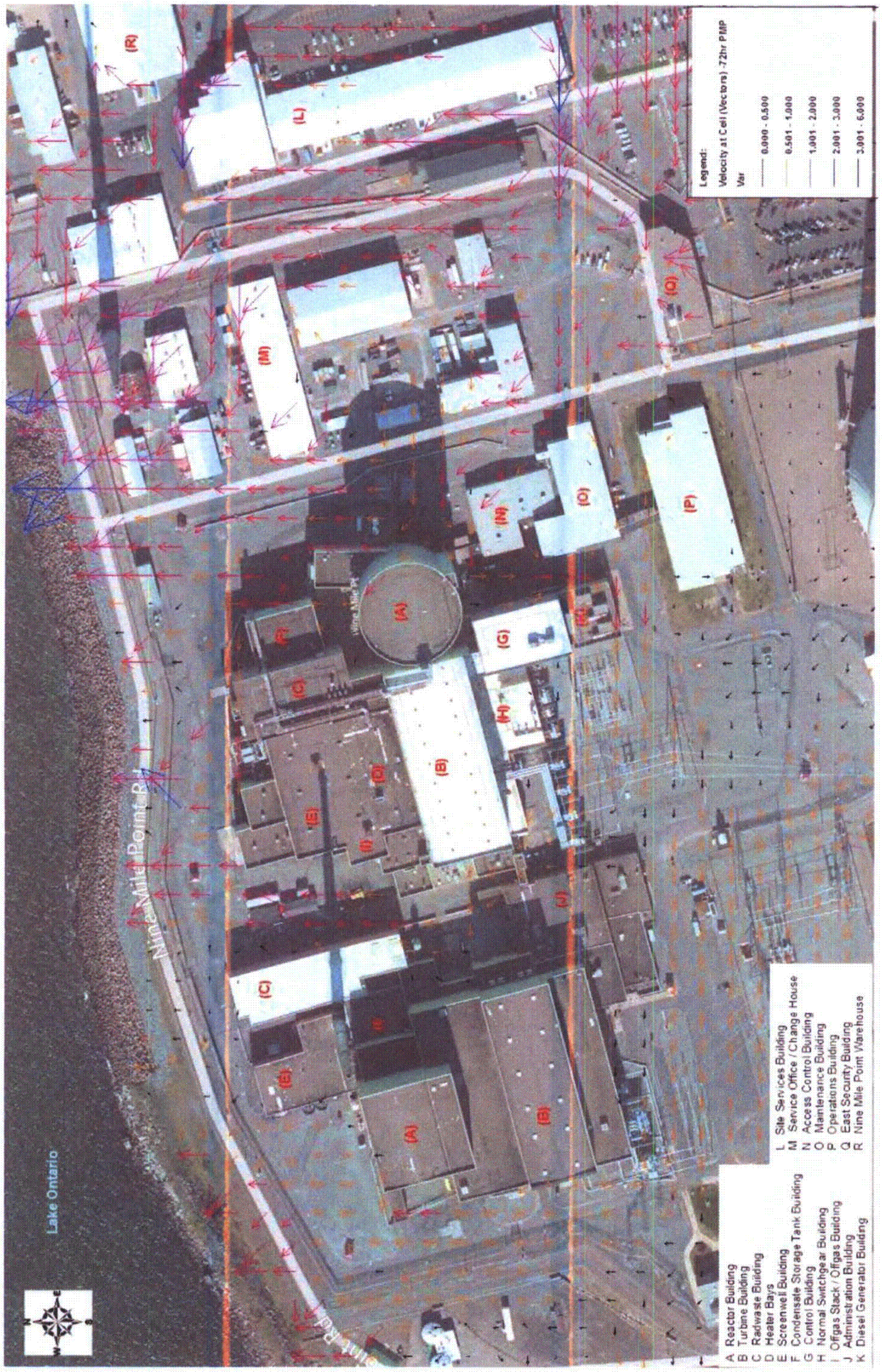

Figure 2.1-18: Grid Element Maximum Flow Velocity (ft/sec) around Units 1 & 2 – 72-hour PMP

Figure 2.1-19: Grid Element Maximum Water Elevation (ft, USLS35) East of Units 1 & 2 – 72-hour PMP

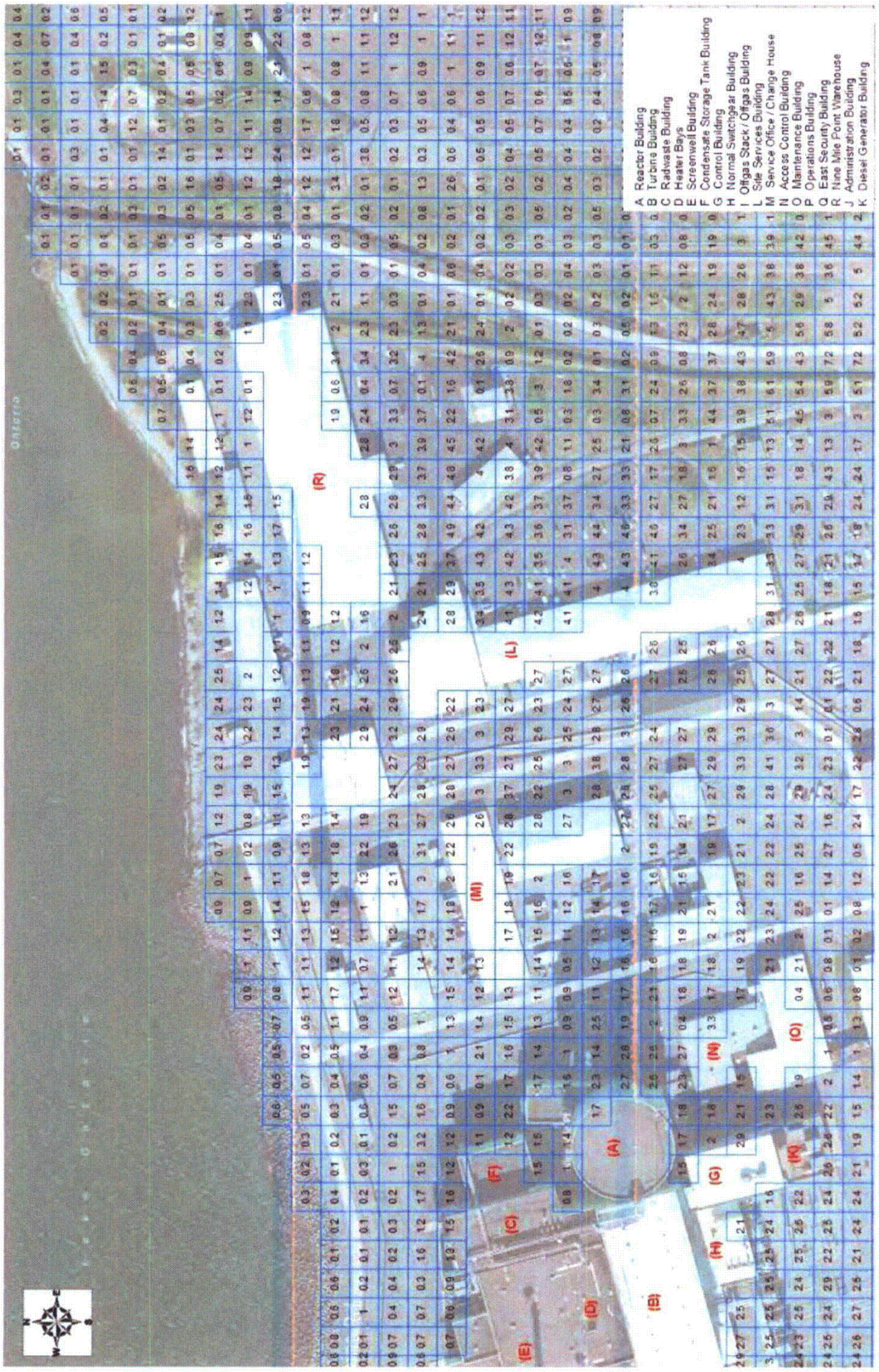

Figure 2.1-20: Grid Element Maximum Flow Depth (ft) East of Units 1 & 2 – 72-hour PMP

Figure 2.1-21: Grid Element Maximum Flow Velocity (ft/sec) East of Units 1 & 2 – 72-hour PMP

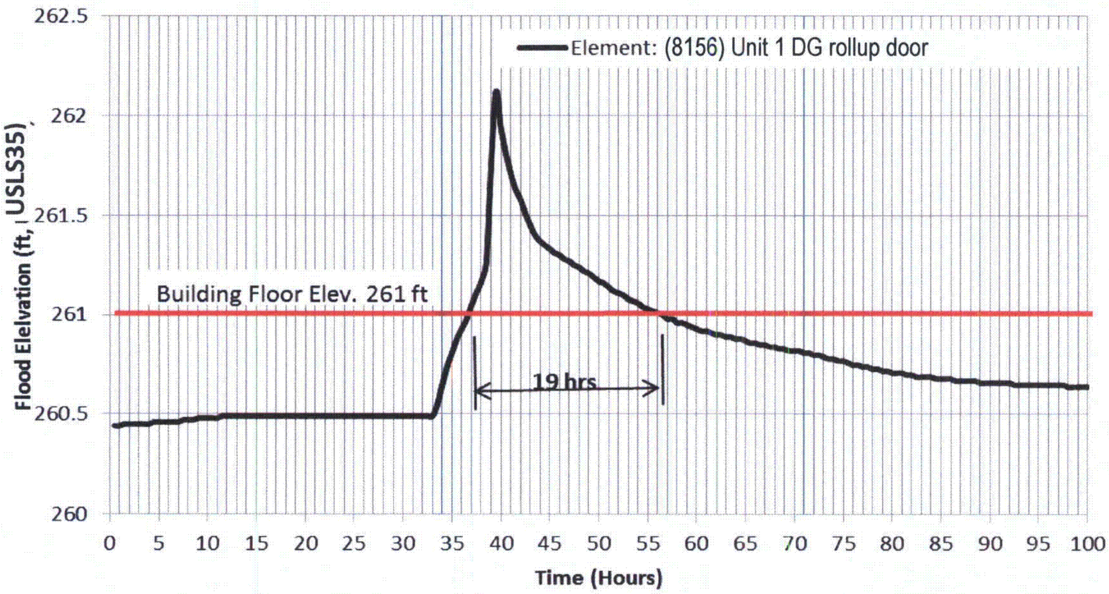

Figure 2.1-22: Time Series of Water Surface Elevation at Element 8156 Unit 1 – 72-hour PMP

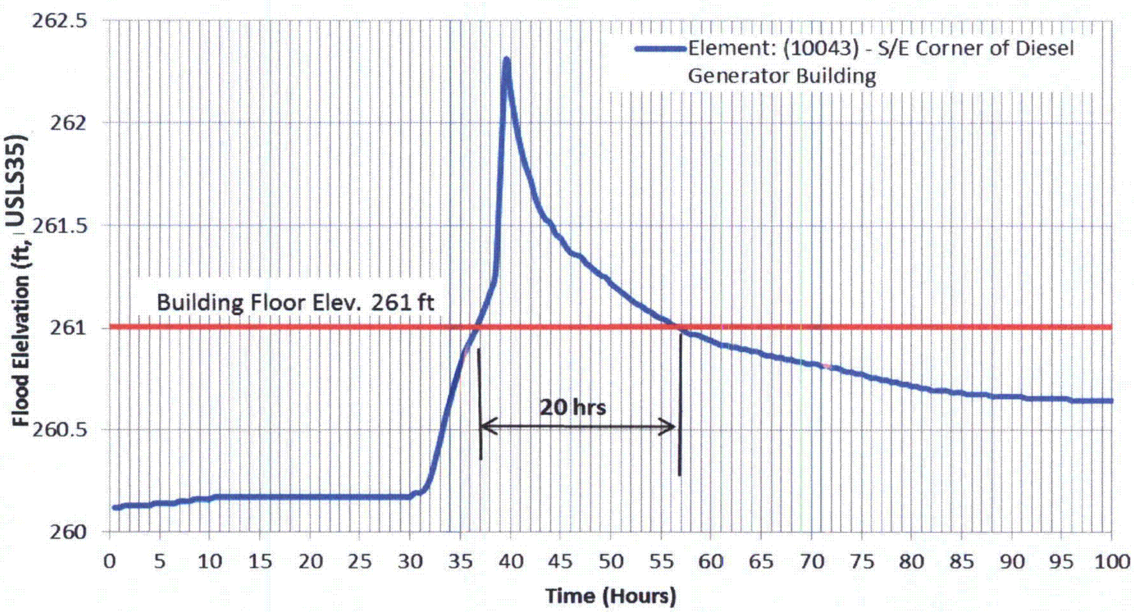

Figure 2.1-23: Time Series of Water Surface Elevation at Element 10043 Unit 2 – 72-hour PMP

2.2 Flooding in Streams and Rivers

This section is to address the potential of flooding at NMP due to the Maximum Probable Flood (PMF) on Lakeview Creek. Lakeview Creek is the nearest perennial, named stream to NMP, which lies outside of the NMP site. The discharge point of Lakeview Creek to Lake Ontario is located approximately 1.0 mile west of the NMP Units 1 and 2. The two small, unnamed streams are addressed in Section 2.1.

2.2.1 Methodology

The HHA approach described in NUREG/CR-7046 (NRC 2011) was used for evaluation of the PMF flow (AREVA 2012b) and elevations (AREVA 2012c) along with the analyses performed as part of the NMP Unit 3 Nuclear Power Plant (NMP3NPP) Combined License (COL) application (NMP3NPP 2009).

In particular, the HHA assumptions adopted by the example calculation in Appendix C of NUREG/CR-7046 (NRC 2011) are: (1) use of conservative Soil Conservation Service (SCS, now known as the Natural Resources Conservation Service, i.e., NRCS) curve numbers for Antecedent Rainfall Condition (ARC) III; (2) incorporation of an antecedent storm prior to the full PMF; and (3) application of nonlinearity adjustments to SCS Unit Hydrograph (UH).

Rainfall inputs were originally calculated as part of the NMP Unit 3 COLA (AREVA 2012a). PMP values were computed using two publications of the NOAA, U.S. Department of Commerce: Hydrometeorological Report No. 51, Probable Maximum Precipitation - United States East of the 105th Meridian (NOAA 1978) and HMR No. 52, Application of Probable Maximum Precipitation - United States East of the 105th Meridian (NOAA 1982). The PMP with duration of 72 hours was selected for evaluation of the PMF for Lakeview Creek. An antecedent storm, 40% of the full 72-hour PMP, was modeled. Seasonal variation of the PMP was evaluated based on HMR No. 53, combined with conservative, potential snowmelt contribution using the energy budget method to rule out the cool-season PMP as a controlling event.

The SCS unit hydrograph method incorporated in the U.S. Army Corps of Engineers HEC-HMS computer model was used to calculate watershed runoff in this calculation. SCS rainfall-runoff translation parameters, Curve Number (CN) and Lag Time, were calculated. HEC-HMS was used for evaluation of the maximum flood flow induced by the 72-hour PMP over the Lakeview Creek watershed (USACE 2000). As recommended by NUREG/CR-7046 (NRC 2011), adjustments were made to SCS Unit Hydrograph (UH) to account for nonlinearity runoff response under such a rare and extreme rainfall event. The calculated UH was used by HEC-HMS in place of lag time to compute the PMF on Lakeview Creek.

The HEC-HMS calculated PMF peak discharge from Lakeview Creek was used to estimate the flood elevations in the vicinity of Lakeview Creek. Due to anticipated significant overbank (floodplain) flow during the PMF flood from Lakeview Creek (i.e., to affect flooding at NMP, the PMF in Lakeview Creek would need to overflow its watershed drainage divide), a two-dimensional hydrodynamic computer model, FLO-2D, was used for this calculation (FLO-2D 2009) in lieu of one-dimensional computer models such as HEC-RAS. FLO-2D is a physical process model that routes flood hydrographs and rainfall-runoff over unconfined flow surfaces or in channels using the dynamic wave approximation to the momentum equation. Overland flood routing in two-dimensions is accomplished through a numerical integration of the equations of motion and the conservation of fluid volume. More information including model validation on the FLO-2D software is provided in Appendix A.

2.2.2 Results

2.2.2.1 PMF on Lakeview Creek

2.2.2.1.1 Rainfall-Runoff Translation Parameters

Lakeview Creek is located southwest of the NMP Unit 1 and Unit 2 and reaches its confluence with Lake Ontario about 1.0 mile west of NMP. The Lakeview Creek watershed was delineated at its discharge point to Lake Ontario. There are no existing stream gages, dams, reservoirs or other types of water control structures in the area of interest, therefore no sub-watersheds were delineated. The delineated watershed boundary for Lakeview Creek is shown in Figure 2.2-1. The calculated watershed area is presented in Table 2.2-1.

SCS rainfall-runoff CNs were calculated based on:

1. Hydrologic soil groups for Lakeview Creek watershed (NRCS 2011) as shown in Figure 2.2-2, where Type A indicates the lower runoff potential and Type D indicates the highest runoff potential;

2. Current land use data for the area (NLCD 2006) as shown in Figure 2.2-3.

Brief NLCD2006 code definitions are presented in Table 2.1-4. Area-weighed composite CNs were calculated. Two antecedent rainfall conditions (ARC) were considered, ARC II (normal conditions) and ARC III (wet conditions). The calculated CNs are summarized in Table 2.2-2.

Lag time was defined as 60 percent of Time of Concentration (Tc). Tc was calculated as the sum of three components: (1) travel time of sheet flow (2) travel time of shallow concentrated flow (3) travel time of open channel flow (NRCS 2010). The estimated flow path for calculation of Tc is shown in Figure 2.2-4. Calculated Tc and lag time are presented in Table 2.2-3.

2.2.2.1.2 PMP Inputs

The 72-hour PMP calculation was performed in accordance with HMR-51 and HMR-52 (AREVA 2012a). The 72-hour PMP used for this calculation is the same as that used in the LIP calculation. Total rainfall depth for the 72-hour PMP was 33.0 inches. The peak intensity is at the 7th 6-hour period of the total 72-hour duration. An antecedent storm, which is 40% of the 72-hour PMP, followed by 3 dry days, was simulated prior to the start of the full PMP. The final PMP input hyetograph for HEC-HMS simulations is shown in Figure 2.2-5.

Seasonal variation of the PMP was evaluated in combination with snowmelt. It was concluded that the all-season PMP discussed above is the controlling event, as the cool-season PMP plus maximum daily snowmelt is significantly less than 33.0 inches in 72 hours.

2.2.2.1.3 Nonlinearity Adjustments to UH

The nonlinearity adjustments made to the HEC-HMS calculated SCS UH (NRCS NEH 2007) include 20% increase in Unit Hydrograph peak discharge and 33% reduction in time to peak as recommended by NUREG/CR-7046 (NRC 2011). Comparison of the original SCS UH and the nonlinearity-adjusted UH is presented in Figure 2.2-6.

2.2.2.1.4 Lakeview Creek PMF Flow

The calculated PMF discharge rates from Lakeview Creek for ARC II and ARC III are summarized in Table 2.2-4. The outflow hydrographs from the Lakeview Creek watershed are shown in Figure 2.2-7 (with nonlinear adjustments). The PMF from Lakeview Creek under the 72-hour PMP was therefore determined to be 17,290 cfs, which incorporates ARC III CN and nonlinearity adjustments.

2.2.2.2 PMF Elevations on Lakeview Creek

2.2.2.2.1 FLO-2D Model Inputs

The calculated PMF peak discharge of 17,290 cfs from Lakeview Creek was used as the inflow into the FLO-2D model. The HEC-HMS calculated hydrograph was applied on the basis of drainage area proportion at two separate inflow nodes in FLO-2D (Figures 2.2-8 and 2.2-9). Other inputs to the FLO-2D model were similar to those used for the LIP calculation in Section 2.1.2:

1. Digital elevation data based on an existing site topographic survey drawing (NIMO 1999). A grid element elevation rendering (ft, USLS35) is shown in Figure 2.2-10.

2. Manning's "n" roughness coefficients based on land cover information (NLCD 2006; FLO-2D 2009). The correlation between the input Manning's n-values and NLCD 2006 land use categories is presented in Table 2.1-4. Manning's n-values are shown in Figure 2.2-11. A Manning's n-value of 0.04 was used for channels.

3. Levees were input into the model to represent the existing flood control berms around NMP.

4. A hydraulic structure was included to represent the existing culvert that penetrates the southern Lake Road berm and conveys flow toward NMP. On-site channels and other culverts within the flood control berms were not considered. However, the Lakeview Creek channel was incorporated into the FLO-2D model as a representative rectangular section. The geometry of the rectangular section was 40-ft wide by 6-ft deep based on visual observation and engineering judgment.

5. Area Reduction Factors (ARF) and Width Reduction Factors (WRF) were included to represent existing buildings and other features (e.g., security barriers) that may impede flow off the site. Features (e.g., security barriers) which are not designed specifically for flooding that may assist in re-directing flow away from NMP were not considered.

6. Grid elements along the lakeshore were defined as outflow nodes.

An overview of the final FLO-2D model is shown in Figure 2.2-12.

2.2.2.2.2 Lakeview Creek PMF Effects

The FLO-2D calculated maximum flood elevations due to the 72-hour PMF from Lakeview Creek are shown in Figure 2.2-13. The maximum flow depths are shown in Figure 2.2-14. These results indicate that the PMF on Lakeview Creek does not affect the NMP site. The inundated area does not extend into NMP's site boundary.

2.2.3 Conclusions

Based on the PMF calculation for Lakeview Creek, the following conclusions can be reached:

- The PMF on Lakeview Creek induced by the 72-hour PMP is calculated to be 17,290 cfs, using ARCIII CN and applying nonlinearity adjustments to UH.
- The PMF from Lakeview Creek alone does not cause flooding at NMP.

2.2.4 References

NOTE: Refer to the Project Manager's approval (on the signature page of this report) verifying that the Constellation Nuclear Energy Group (CENG) references are valid sources of design input created in accordance with the CENG's QA program.

AREVA 2012a. AREVA Document No. 32-9190263-000, Probable Maximum Precipitation at Nine Mile Point, 2012.

AREVA 2012b. AREVA Document No. 32-9190264-000, Probable Maximum Flood (Flow) on Lakeview Creek near Nine Mile Point, 2012.

AREVA 2012c. AREVA Document No. 32-9190265-000, Probable Maximum Flood Elevations on Lakeview Creek near Nine Mile Point, 2012.

FLO-2D 2009. FLO-2D® v.2009 Reference Manual, FLO-2D Software, Inc., Nutrioso, Arizona.

NIMO 1999. NIMO TOPO sheet blocks.dwg and Read Me.doc, C.T. Male, August 2012.

NLCD 2006. The National Land Cover Database (NLCD) 2006, U.S. Geological Survey, February 2011 (http://www.mrlc.gov/nlcd06_data.php).

NMP3NPP 2009. Final Safety Analysis Report for a Combined License Application for the Nine Mile Point 3 Nuclear Power Plant, Revision 1, UniStar Nuclear Energy, 2009 (Accession Number: ML090970448).

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NOAA 1982. Application of Probable Maximum Precipitation Estimates – United States East of the 105th Meridian, NOAA Hydrometeorological Report No.52 (HMR-52), US Department of Commerce & USACE, August 1982.

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NRCS 2007. Chapter 16 – Hydrographs, Part 630 Hydrology, National Engineering Handbook, U.S. Department of Agriculture Natural Resources Conservation Service, March 2007.

NRCS 2010. Chapter 15 - Time of Concentration, Part 630 Hydrology, National Engineering Handbook, U.S. Department of Agriculture Natural Resource Conservation Service, May 2010.

NRCS 2011. Soil Survey Geographic (SSURGO) Database for Oswego County, New York, Natural Resources Conservation Services (NRCS), December 2011 (http://soils.usda.gov/survey/geography/ssurgo/).

USACE, 2000. HEC-HMS, Hydrologic Modeling System Technical Reference Manual, CPD-74B, March, 2000.

Table 2.2-1: Lakeview Creek Watershed Area

Stream Name	Watershed Area (sq. mi.)	Delineation Point at Confluence with Lake Ontario
Lakeview Creek	4.91	Discharge point (Lat.43°30'49.9"; Long. 76°25'31.4")

Table 2.2-2: Summary of SCS Curve Numbers

Watershed Name	ARC II (normal)	ARC III (wet)
Lakeview Creek	83	89

Table 2.2-3: Time of Concentration and Lag

Watershed Name	T_c (hr)	L (hr)	L (min)
Lakeview Creek	4.6	2.8	165

Table 2.2-4: HEC-HMS Calculated Lakeview Creek Peak Discharge (cfs) by 72-Hour PMP

Watershed	ARC	SCS Method w/o Nonlinearity Adjustments	User Specified UHs w/ Nonlinearity Adjustments	Increase (%)
Lakeview Creek	II (normal)	15,440	17,240	12%
	III (wet)	15,480	17,290	12%

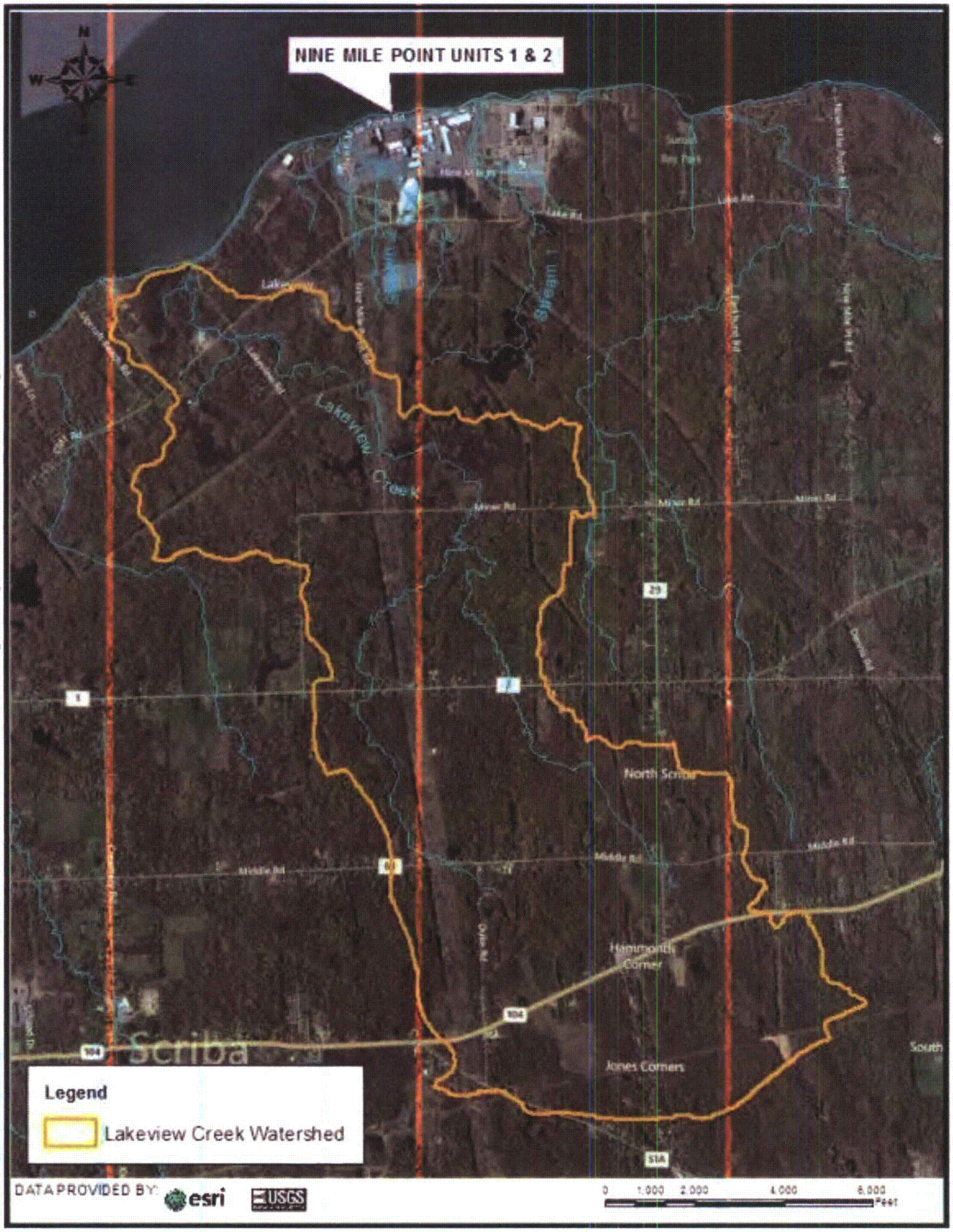

Figure 2.2-1: Lakeview Creek Watershed Delineation Map

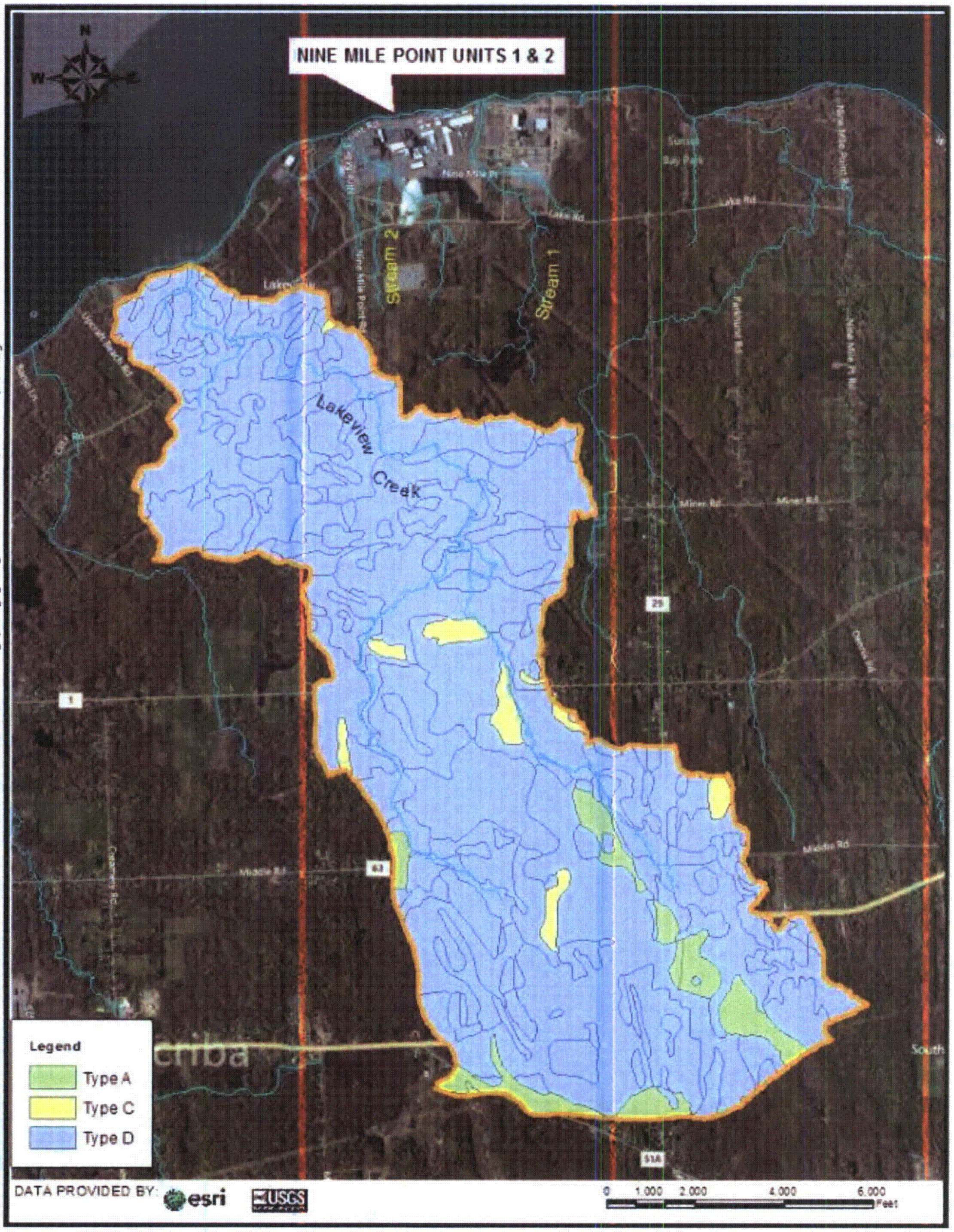

Figure 2.2-2: Hydrologic Soil Groups Map for Lakeview Creek Watershed

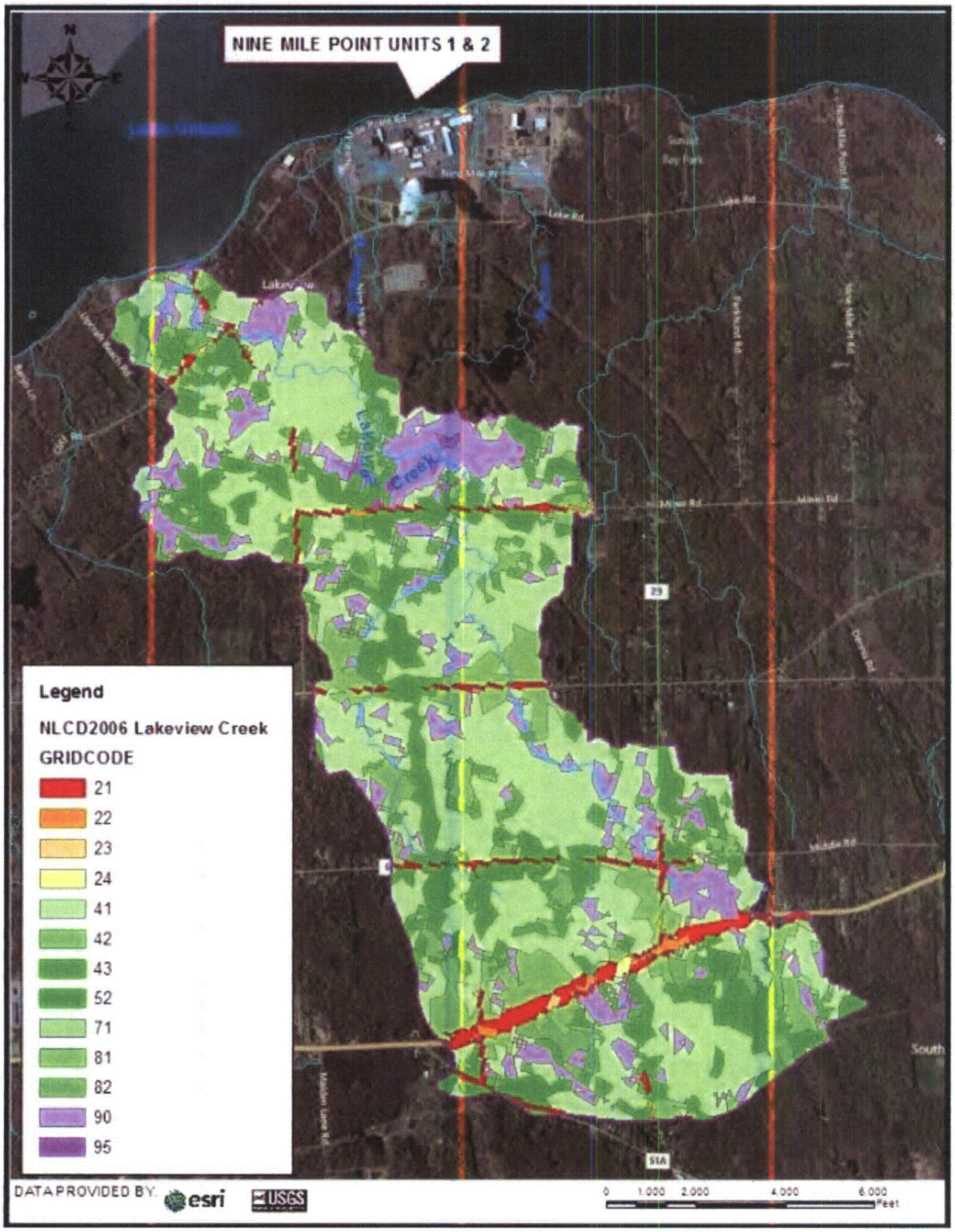

Figure 2.2-3: NLCD 2006 Land Cover Land Use Map for Lakeview Creek Watershed

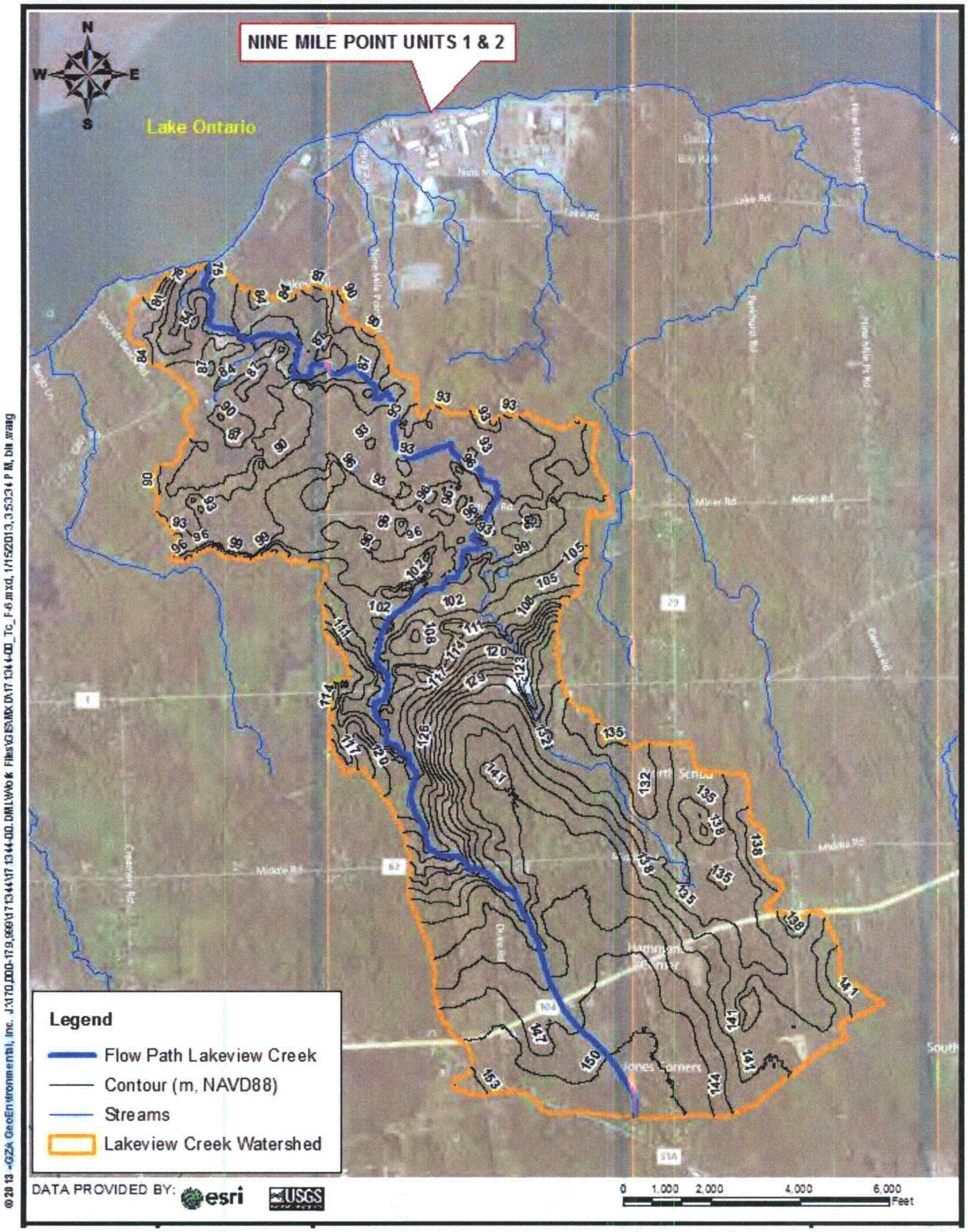

Figure 2.2-4: Flow Path for Time of Concentration for Lakeview Creek Watershed

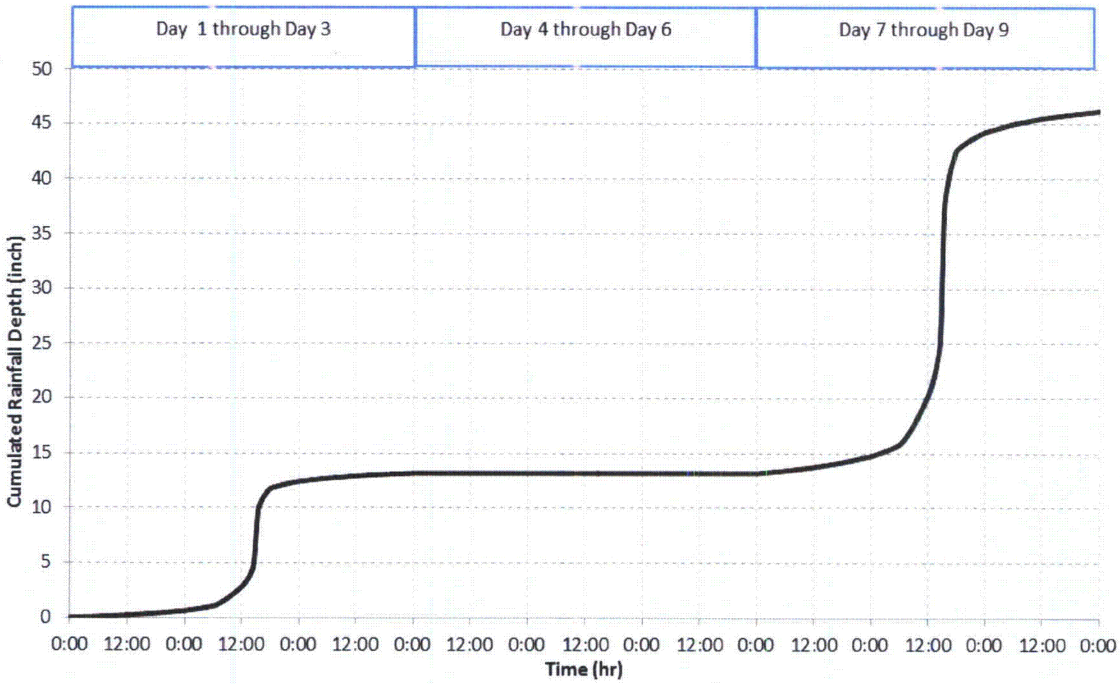

Figure 2.2-5: Input Hyetograph for 72-Hour PMP

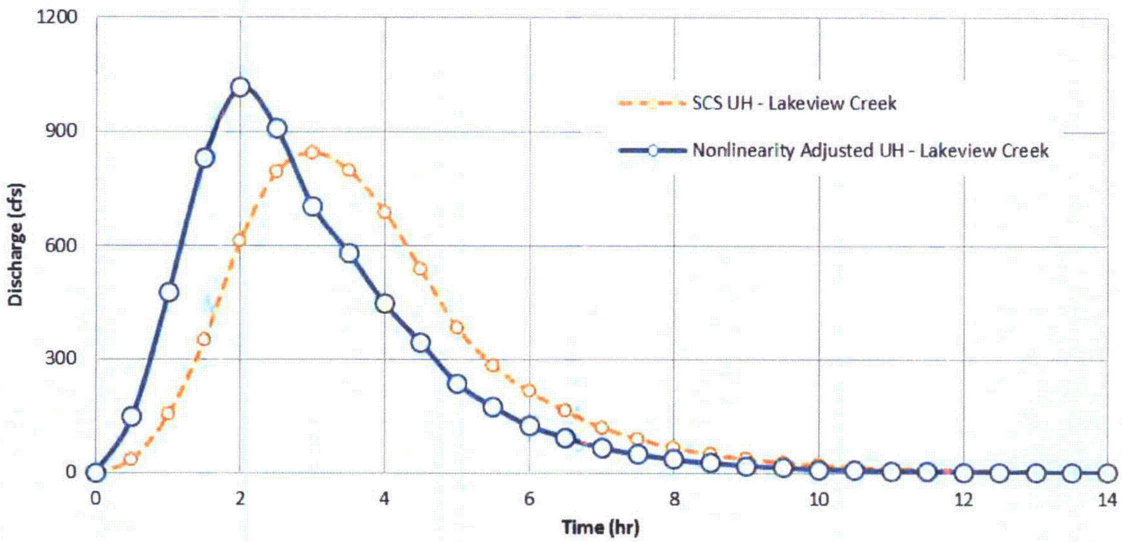

Figure 2.2-6: Unit Hydrograph with Nonlinearity Adjustments

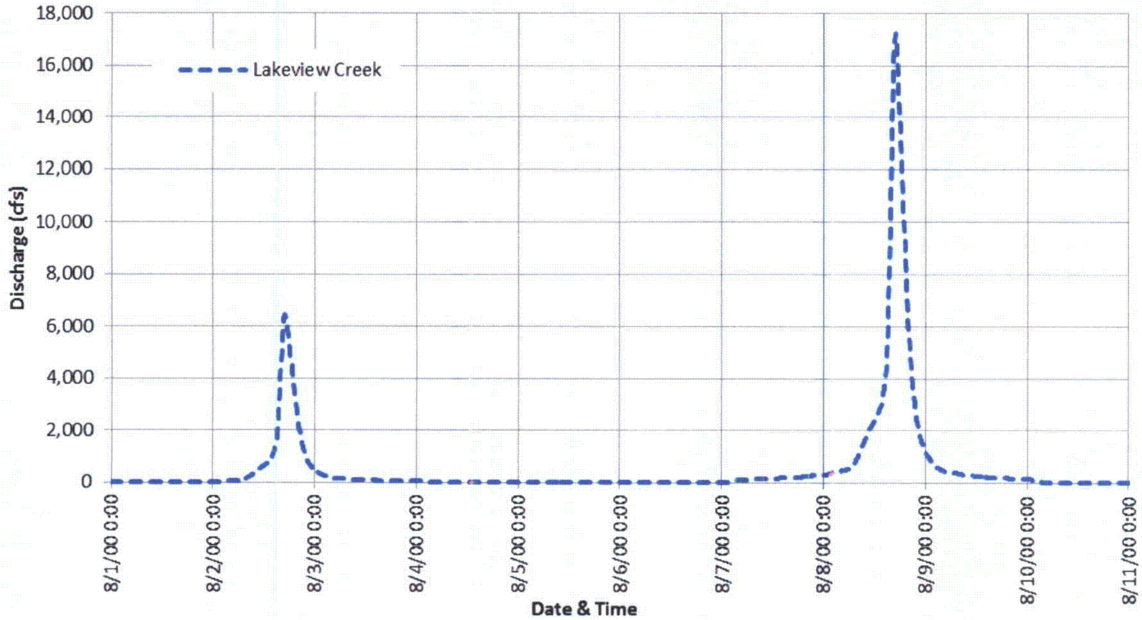

Figure 2.2-7a: Outflow Hydrographs for 72-Hour PMP w/ Nonlinearity Adjustments (a) Using ARC II CN

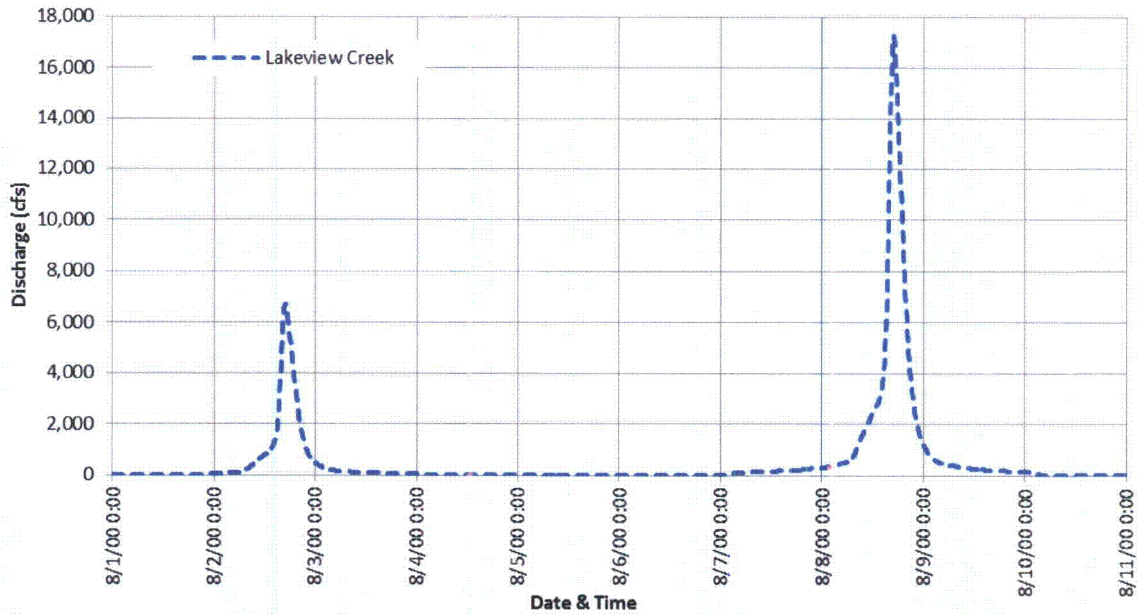

Figure 2.2-7b: Outflow Hydrographs for 72-Hour PMP w/ Nonlinearity Adjustments (b) Using ARC III CN

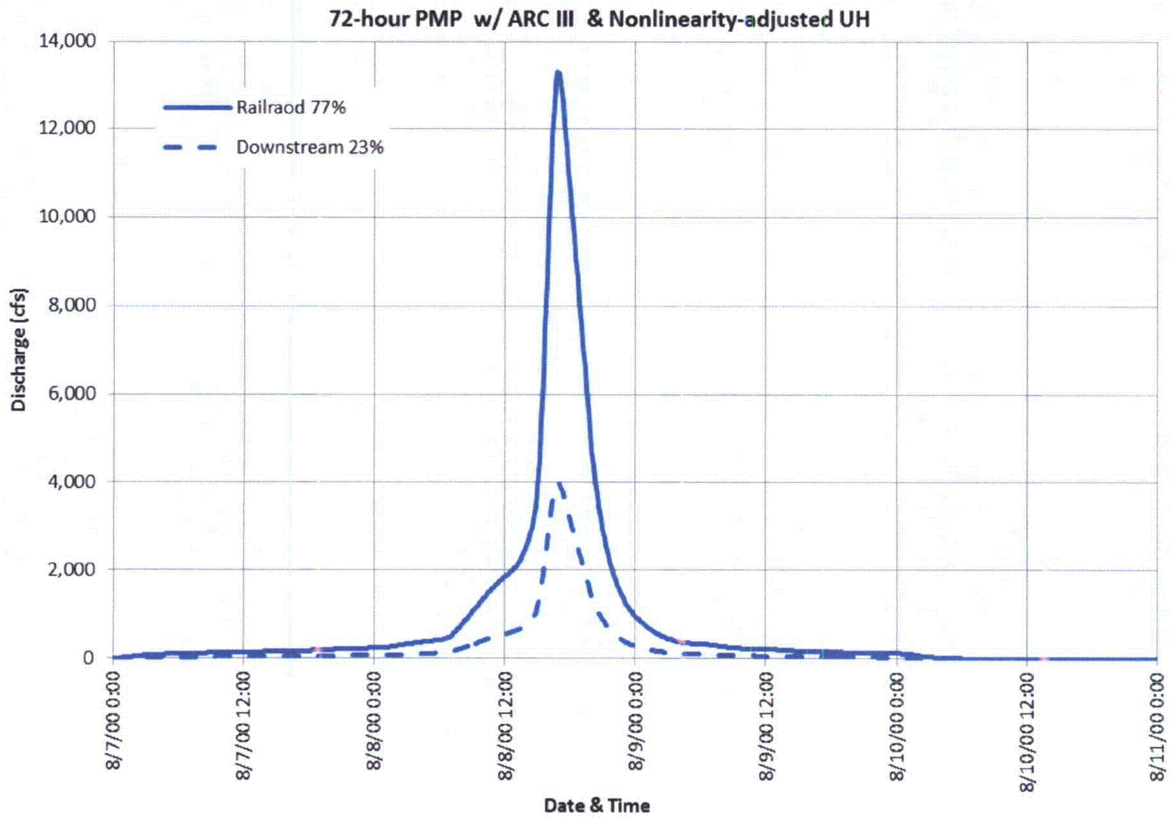

Figure 2.2-8: Inflow Hydrographs for FLO-2D Model

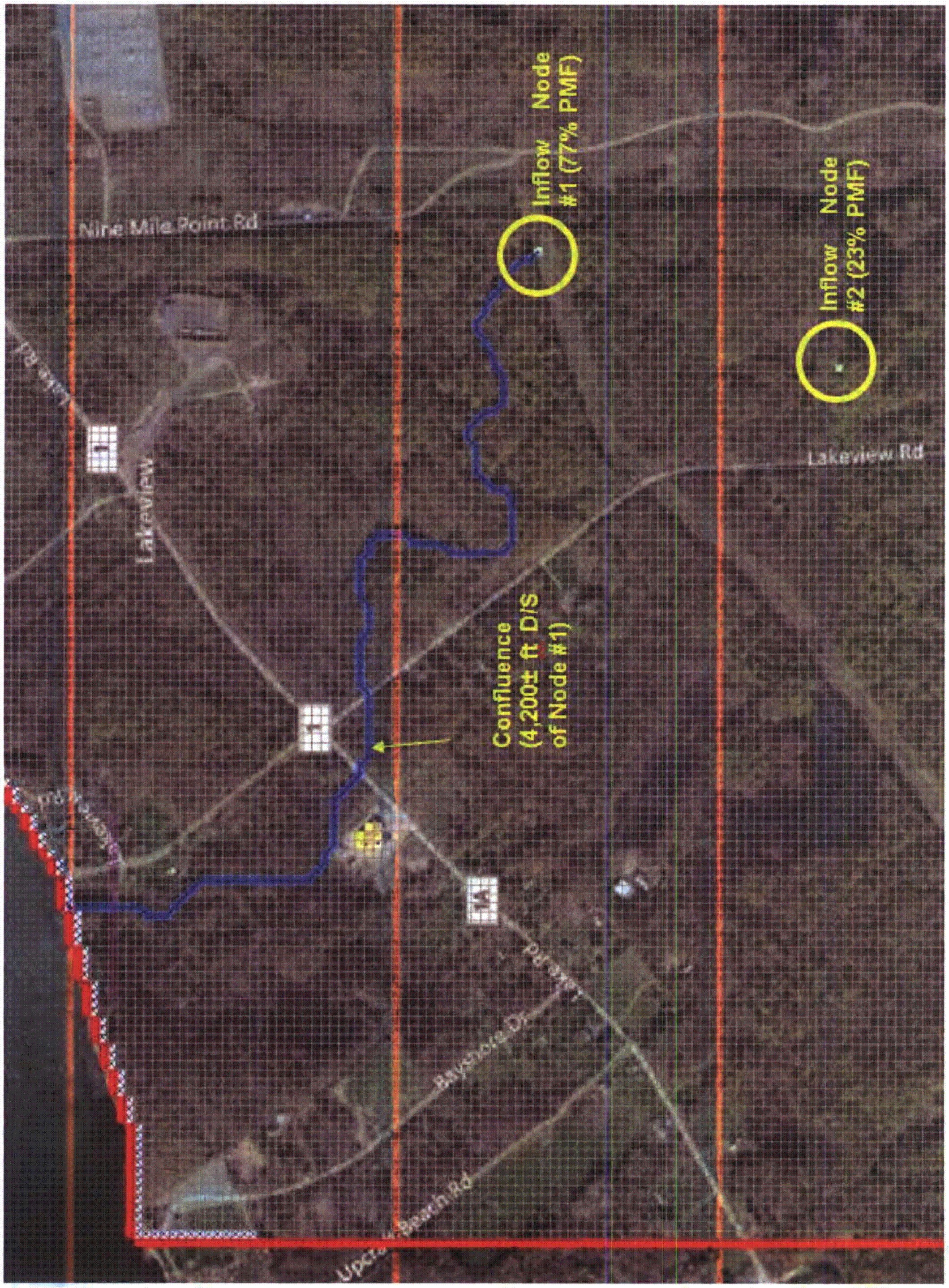

Figure 2.2-9: Inflow Elements in FLO-2D

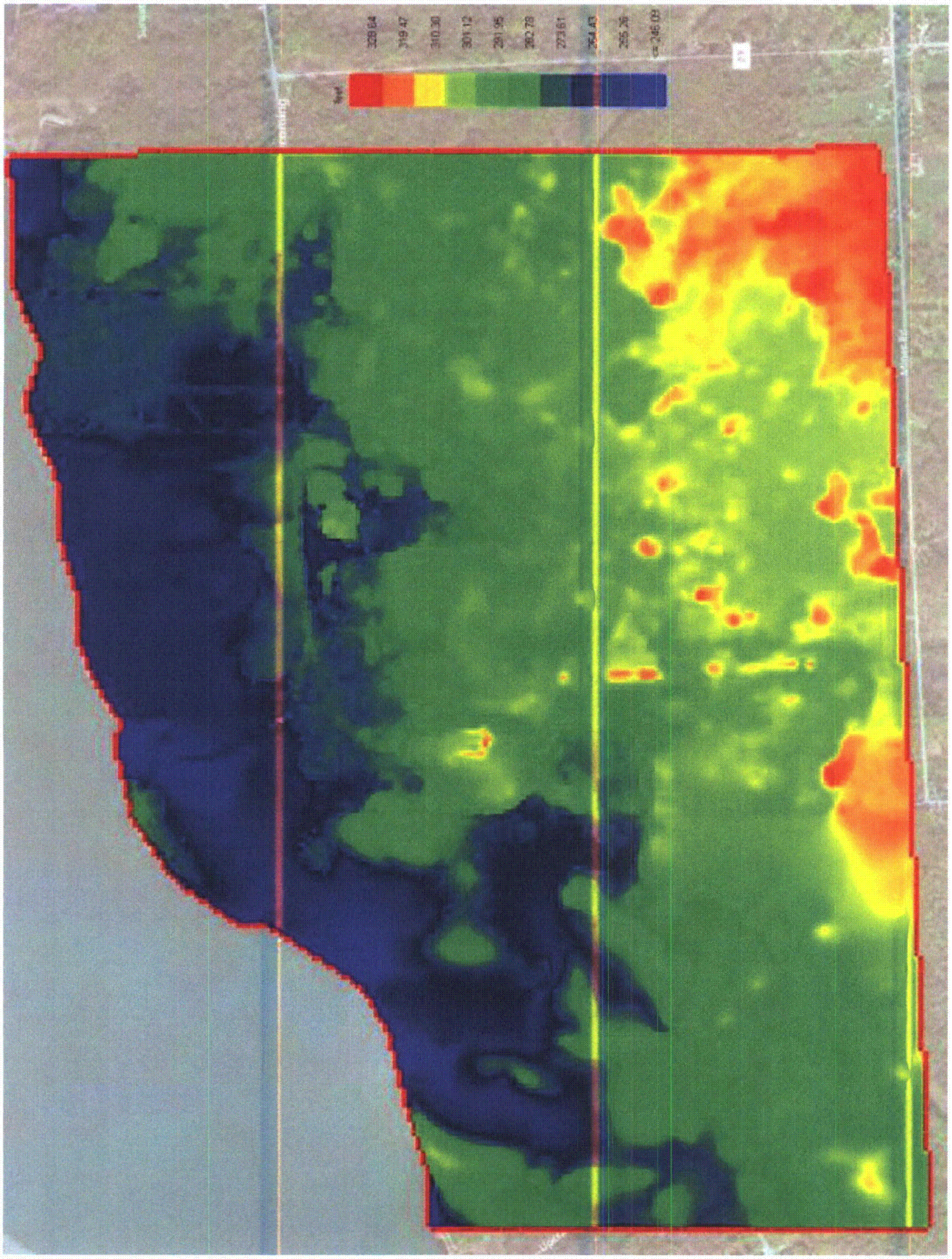

Figure 2.2-10: Grid Element Elevation Rendering (USLS35)

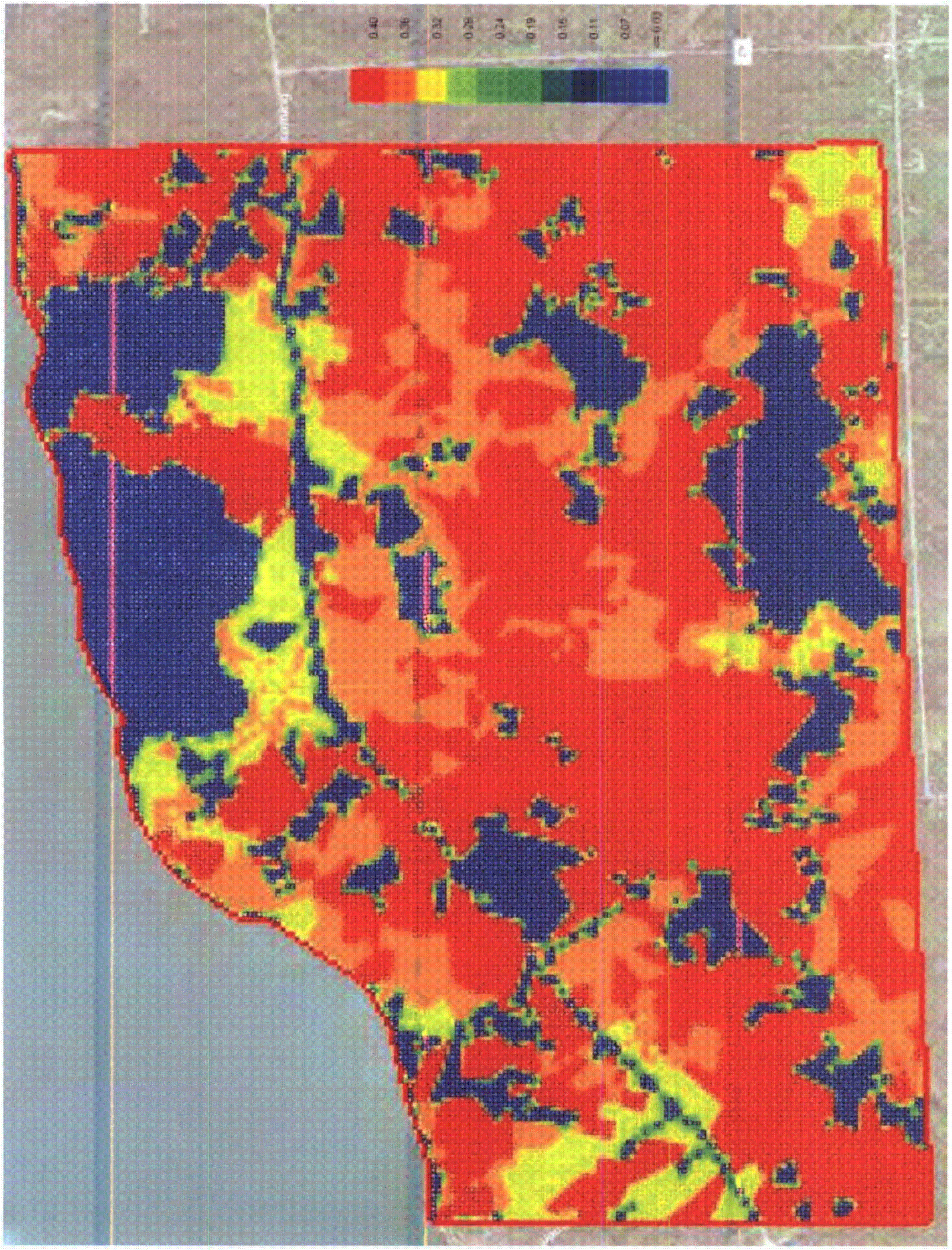

Figure 2.2-11: Grid Element Manning's n-Values

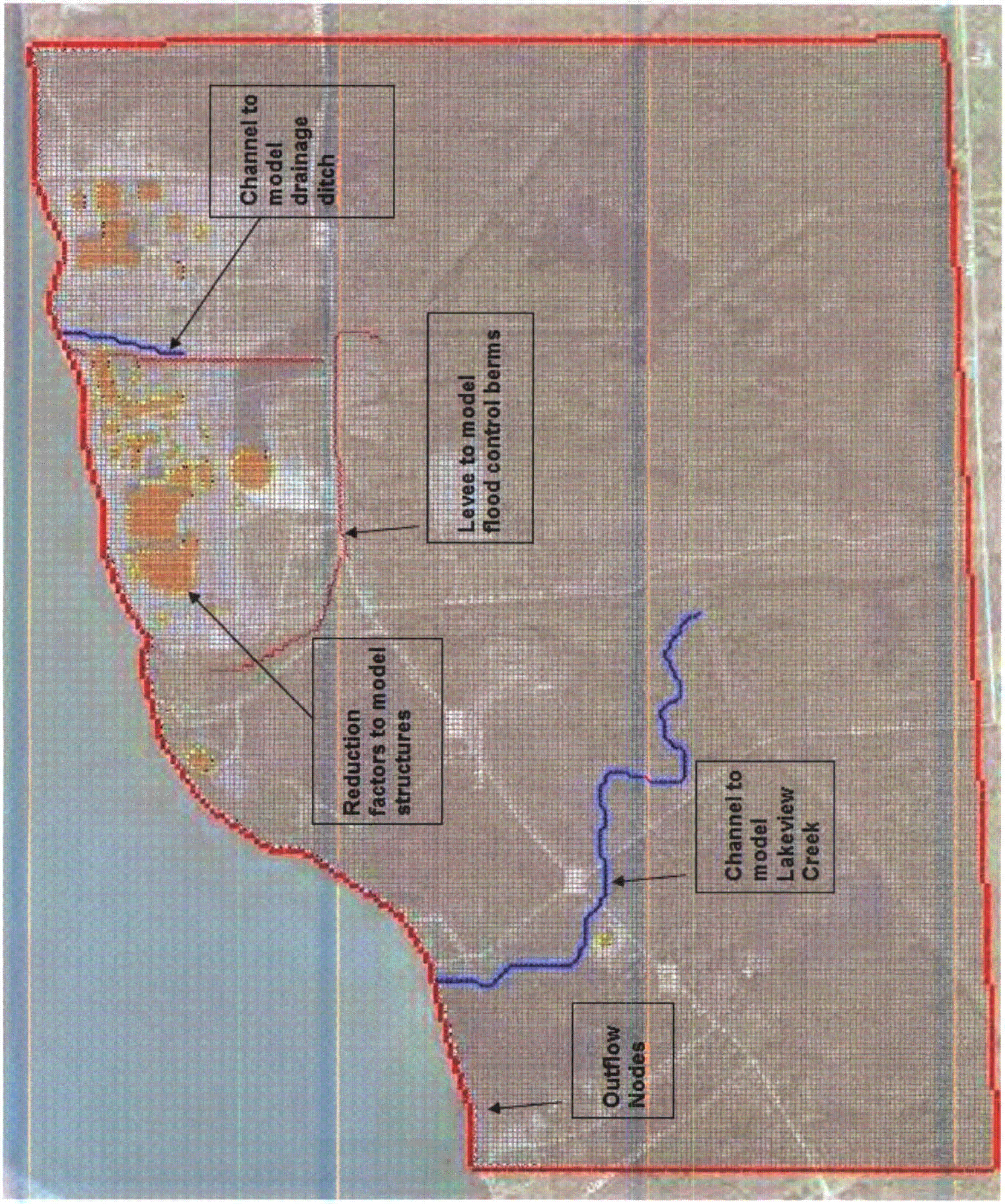

Figure 2.2-12: Components in FLO-2D for Lakeview Creek PMF Simulation

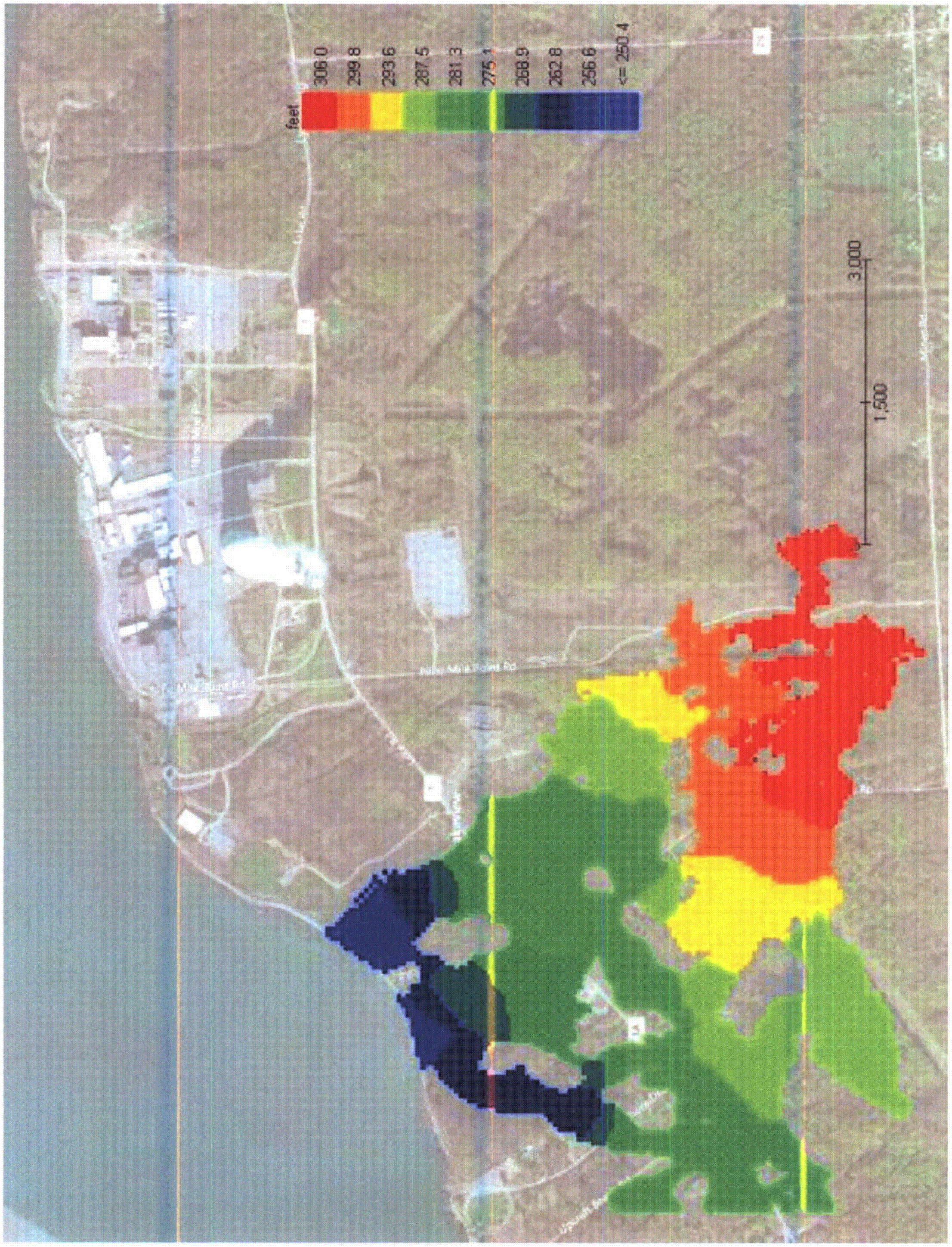

Figure 2.2-13: Grid Element Maximum Water Surface Elevation (USLS35)

Figure 2.2-14: Grid Element Maximum Flow Depth

2.3 Dam Breaches and Failures

Flood waves resulting from severe breaches of upstream dams, including domino-type or cascading dam failures, should be evaluated for the site. Water-storage or water-control structures (such as onsite cooling or auxiliary water reservoirs and onsite levees) that may be located at or above the safety-related site grade should also be evaluated (NRC 2011, Section 3.4).

2.3.1 Methodology

The HHA approach described in NUREGCR-7046 (NRC 2011) was used for Dam Breaches and Failures (AREVA 2013) along with the analyses performed as part of the NMP Unit 3 Nuclear Power Plant (NMP3NPP) Combined License (COL) application (NMP3NPP 2009).

The proposed NMP3NPP project is located adjacent to the NMP Unit 1 and Unit 2 site. As such, it represents the same hydrological setting as NMP Unit 1 and Unit 2 and is characterized by the same flooding mechanisms. Therefore, the potential dam failure flooding analysis performed in 2008 at NMP3NPP applies to NMP Unit 1 and Unit 2 as well.

2.3.2 Dam Breaches and Failures Results

The nearest dams to the NMP site that may affect Lake Ontario are

1. a series of six dams/locks on the Oswego River, and
2. three dams on the Saint Lawrence River.

The Oswego River is used for navigational purposes and carries the Oswego Canal its entire length. It drains 5,100 mi^2 into Lake Ontario, but the drainage area does not include any portion of the drainage area of the NMP site, which is 6.5 mi to the closest point of the river mouth.

The Saint Lawrence River is used in conjunction with three dams to control the level of Lake Ontario. Since 1960, Lake Ontario outflows have been regulated, primarily through the Moses-Saunders power dam near Cornwall and Massena, New York, about 100 mi from the outlet of Lake Ontario. Long Sault Dam, located near Long Sault, Ontario, acts as a spillway when outflows are larger than the capacity of the Moses-Saunders power dam. A third structure at Iroquois, Ontario, is used principally to help form a stable ice cover and regulate water levels at the power dam. These facilities are under the authority of the International St. Lawrence River Board of Control. The NMP site is greater than 50 mi to the closest point of the river mouth.

Failure of the six dams/locks on the Oswego River simultaneously would increase the water level on Lake Ontario and potentially affect the NMP site through flooding. However, if the total volume of the six reservoirs were to be instantly added to the lake without consideration of flow attenuation, the water level increase in the lake would be approximately 0.2 inches (NMP3NPP 2009). This insignificant increase in the water level on Lake Ontario would not affect the NMP site.

Failure of the dams at the outlet of Lake Ontario in the St. Lawrence River, on the other hand, would result in lower than normal water levels on Lake Ontario and potentially affect the NMP site through lake level draw down. The effects resulting from failure of the dams was analyzed in 1968 by the St. Lawrence Study Office of the Canadian Department of Energy, Mines and Resources and showed that the lake level would decline gradually to elevation 240.6 ft. (NMP3NPP 2009) approximately one year following the assumed failure.

The lower lake water level, however, has been considered in plant design for both NMP Unit 1 and Unit 2. The top of the NMP Unit 1 intake, for example, is at elevation 228.0 ft. (NMP1 1965). The margin, therefore, between the top of the intake and the lowest lake elevation following dam failure is 12.6 ft. (240.6 - 228.0). Similarly, the top of each of the two intakes for NMP Unit 2 is at elevation 232.5 ft. (NMP2 2004). Thus, the resulting margin between the top of the Unit 2 intakes and the lowest lake elevation of following dam failure is 8.1 ft. (240.6 - 232.5).

In addition, there are no on-site basins that could contribute to flooding of SSCs important to safety via a breach or failure (NMP1 1992 and NMP2 2010).

2.3.3 Conclusions

Based on the previous analyses performed at NMP3NPP, potential dam breaches and failures in the region would not affect the SSCs important to safety at either NMP Unit 1 or Unit 2 because:

- The effects resulting from the hypothetical failure of the six dams/locks simultaneously in the Oswego River would produce an insignificant increase in the water level on Lake Ontario of approximately 0.2 inches (NMP3NPP 2009).
- The effects of lower than normal Lake Ontario water levels due to the failure of the dams at the outlet of Lake Ontario in the St. Lawrence River have been considered in plant design. A margin of 12.6 ft. and 8.1 ft. exists above the tops of the NMP Unit 1 and Unit 2 intakes, respectively, to account for the lowest water level projected.
- There are no on-site basins that would contribute to the potential flooding.

2.3.4 References

NOTE: Refer to the Project Manager's approval (on the signature page of this report) verifying that the Constellation Nuclear Energy Group (CENG) references are valid sources of design input created in accordance with the CENG's QA program.

AREVA 2013. AREVA Document No. 51-9190301-000, Flooding from Upstream Dam Breaches or Failures at the Nine Mile Point Nuclear Station Units 1 and 2 Site.

NMP1 1965. Nine Mile Point Nuclear Station Unit 1, Dwg. No. C-15451-C, Rev. 1, Lake Intake Structure.

NMP1 1992. Nine Mile Point Unit 1 Safety Evaluation Report, Flooding Potential and Protection, Niagara Mohawk, Report No. NER-IS-001, Rev. 0, October 1992.

NMP2 2004. Nine Mile Point Nuclear Station, Unit 2, Dwg. No. EC-015G, Sheet 1, Rev. 9, Plans, Sections & Details Intake Structure.

NMP2 2010. Nine Mile Point Nuclear Station Unit 2, Updated Final Safety Analysis Report, Revision 19, October 2010.

NMP3NPP 2009. Nine Mile Point 3 Nuclear Power Plant, Final Safety Analysis Report, Rev. 1, Section 2.4, Hydrologic Engineering (ADAMS Accession No. ML090970448).

NRC 2011. NUREG/CR-7046, Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States of America, U.S. Nuclear Regulatory Commission, November 2011 (ADAMS Accession No. ML11321A195).