

**Kingdom Dam Phase II Report – Vol. II
Hydraulic and Hydrologic Supplement**

for

Kingdom Dam on Lincoln Pond

**Town of Elizabethtown
Essex County, New York**

Prepared for:

State of New York Office of General Services
34th Floor, Corning Tower
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July 14, 2006
(Revised February 22, 2007)

CHA Project No. 15470

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February 22, 2007

Mr. Howard Hasenbein
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**Re: Kingdom Dam Phase 2 Report – Vol. 2: Hydrologic and Hydraulic Supplement, Lincoln Pond, Essex County, New York
CHA Project No.: 15470**

Dear Mr. Hasenbein,

Clough Harbour & Associates (CHA) is pleased to present this report documenting the hydrologic and hydraulic assessment of Kingdom Dam.

BACKGROUND

Kingdom Dam is located on Lincoln Pond in the Town of Elizabethtown, NY (See Figure 1 – Site Location Map). On June 18, 2004 representatives of the New York State Department of Environmental Conservation (DEC), the New York State Office of General Services (OGS), and CHA visited Kingdom Dam for the purposes of performing a reconnaissance of the general condition of the dam.

CHA was asked by OGS and DEC to provide a Phase 1 report of the general condition of the dam structure including structural, geotechnical and hydrological evaluations. CHA's Phase 1 report dated September 27, 2004 included the general condition of the structure and preliminary cost estimates for the rehabilitation of the dam.

Based on the Phase 1 report recommendations and the condition of the structure, OGS and DEC requested a more in depth Phase 2 analysis and report. This report summarizes the findings from the site investigation, the analysis of the Lincoln Pond Watershed, the evaluation of the hydraulic capacity of the spillway at Kingdom Dam and the preliminary dam hazard assessment.

PURPOSE

This portion of the engineering report was commissioned to determine the existing adequacy of the dam spillway, to provide a preliminary assessment of the impacts resulting from a sunny day dam breach, and to verify the current hazard classification of Kingdom Dam.

DESCRIPTION OF STRUCTURE

Kingdom Dam on Lincoln Pond is a buttressed concrete gravity dam built in 1911. The dam is approximately 255 feet long and 24 feet in height. According to the NYSDEC Dam Safety Database, the structure is currently rated as a large dam with a "B" hazard classification. The main section of the dam is approximately 178 feet long. The remainder of the structure consists of buried end dykes. The dam has received patching and overlay type repairs to the exposed concrete surfaces at unknown times in the past.

A 45 foot long fixed crest spillway works in conjunction with a three (3) foot gate valve to control the water level of Lincoln Pond. The outlet structure further consists of a three (3) foot diameter corrugated metal pipe which conveys flow from the valve to the channel of the Black River. The interior dimension of the outlet chamber is 6 feet wide by 26.5 feet long. The top of the outlet structure is covered with open steel grating. The outlet structure is accessed by a steel ladder fixed to the concrete wall of the chamber. Beneath the gate valve there is an abandoned two (2) foot diameter penstock. The upstream end of the penstock appears to be blocked by a metal gate valve.

A two (2) span steel foot bridge provides access to the gate valve. Each span of the foot bridge is approximately 23 feet long. There is a two (2) foot wide concrete pier supporting the bridge which is centered on the spillway. At each end of the dam there is a gate to restrict access to the top of the dam and spillway. The gate is made of a steel frame in-filled with timber planks.

FINDINGS

Hydrologic and Hydraulic Field Observations

During the weeks of April 11, May 3, and June 15, 2006, a CHA engineer made site visits in the vicinity of Kingdom Dam to quantify the hydrologic and hydraulic characteristics of Lincoln Pond, its upstream watershed, and its downstream channel. To maintain continuity throughout this report all elevations are referenced to NGVD 29.

Upstream Watershed

The 14.8± square-mile Kingdom Dam watershed is located within the Towns of Westport and Elizabethtown in Essex County, NY and is generally forested with hilly to mountainous terrain. Residential development within the drainage basin is limited to a narrow corridor along Lincoln Pond Road, as well as along the eastern shoreline of the pond. The only other significant source of impervious area is the Adirondack Northway (I-87) which passes through the western limits of the drainage area. Elevations within the watershed range from 1960 feet along its eastern boundary to 1031 feet at Lincoln Pond.

Lincoln Pond

Lincoln Pond is divided into two (2) separate basins by a causeway which carries Lincoln Pond Road over the waterway. The causeway is armored on both sides with riprap to protect against shore erosion. For the purposes of this report the southern basin will be referred to as the upper pond and the northern basin will be the lower pond. The upper and lower ponds are connected by a three (3) sided concrete box approximately ten (10) feet wide by eight (8) feet tall. The profile of the causeway has a low point on either side of the culvert; the first is located approximately 280 feet west of the culvert at an elevation of 1036.7 feet, and the second is located approximately 300 feet east of the culvert at elevation 1036.9 feet

(See Figure 2 – Lincoln Pond Causeway Elevation). Most of the volume of the upper pond is contained by the natural topography of the area while the lower pond was a stream corridor surrounded by shallow wetlands before the construction of Kingdom Dam. Although each basin is fed by a number of small streams, the main tributaries are Brandy Brook in the upper pond and Cold Brook in the lower pond.

The volume of the upper and lower ponds up to normal pool elevation (1031 feet) was generated using the bathymetric mapping provided in the NYSDEC Information Leaflet for Lincoln Pond. Volume above normal pool was computed through interpolation using the surface area from the 1978 USGS Elizabethtown Quadrangle at elevation 320 meters (1050 feet) as an upper boundary. A summary of the surface areas and volumes (at normal pool and top of dam) of Upper and Lower Lincoln Ponds is provided in Table 1 below.

Table 1 – Lincoln Pond Surface Area and Volume Summary

Basin	Water Level Description	Elevation (feet -NGVD 29)	Surface Area (acres) / Volume (acre-feet)
Upper Lincoln Pond	Normal Pool	1031.0 ±	268 / 3348
	Spillway	1032.7 ±	274 / 3829
	Top of Dam	1035.7 ±	284 / 4678
Lower Lincoln Pond	Normal Pool	1031.0 ±	384 / 3021
	Spillway	1032.7 ±	402 / 3750
	Top of Dam	1035.7 ±	432 / 5037

As shown in Table 1 above, there is a significant amount of storage available in each pond between normal pool elevation and the top of dam. As a result, Lincoln Pond has the potential to attenuate the peak flows generated by its watershed.

Kingdom Dam Elevations

Data in Table 2 on the following page was gathered during a CHA survey of Kingdom Dam in April, 2006. For the purposes of the assessment, Kingdom Dam is assumed to have a single spillway which operates in conjunction with a three (3) foot gate valve to maintain water levels in Lincoln Pond. This spillway is composed of two (2) 21.5 foot long sections which are approximately two and a half (2.5) feet wide at their crest and have a slightly rounded profile. The spillway sections are divided by a central pier approximately two (2) feet wide, which supports an access walkway. The top of dam is defined as the average top of the concrete on either side of the spillway and is located approximately three (3) feet above its crest (See Figure 3 – Kingdom Dam Elevation). In addition, the invert of the three (3) foot diameter gate valve mentioned above is located approximately 11 feet below the spillway crest. This valve is generally used to maintain water surface elevations during the drier months of the year, and also represents the primary method of drawdown for Lincoln Pond.

Table 2 - Kingdom Dam Survey Data Summary

Dam Component	Elevation (feet – NGVD 29)
Downstream Toe of Slope	1015.0 ±
Maintenance Gate Valve	1021.4 ±
Spillway Crest	1032.7 ±
Top of Dam	1035.7 ±

Downstream Study Reach (Black River)

For the purposes of this analysis, the limits of the preliminary dam hazard assessment extend along the Black River approximately 4.1 miles downstream of Kingdom Dam to the Route 9N crossing. The study reach can be further divided into three (3) typical sections, Kingdom Dam to Megsville Road, Megsville Road to Goff Road, and Goff Road to the downstream limits. From Kingdom Dam to Megsville Road (12,800± feet) the channel has an average slope approaching 3.5% and is located in a moderate relief valley with a narrow floodplain. From Megsville Road to Goff Road (3,800± feet) the channel has an average slope of 2.2% and is located in a moderate relief valley with a narrow floodplain. From Goff Road to the downstream study limits (5,200± feet) the channel has an average slope of 0.5% and is located in a low relief valley with a wide floodplain. Photographs were taken at each of the channel sections and are included in Appendix A

Based on the field investigation of the downstream reach, two (2) areas were identified which contained residential structures that may fall within the potential inundation limits of a sunny day break of Kingdom Dam (See Figure 1 – Site Location Map).

The first area of interest involves a hunting camp owned by the Miegsville Fish and Game Club, which is located approximately 1.1 miles downstream of the dam. It is classified as a temporary structure and was built on property leased from International Paper. According to club members it is used infrequently throughout the year and is only occupied for continuous periods during the big game hunting season (Late September through early December). Based on survey data, the camp is situated 325± feet from the Black River at an approximate elevation of 775.5 feet (11± feet above the channel bed). Photographs were taken at the camp location and are included in Appendix A.

The second area of interest includes several residential properties located near the intersection of Goff and Megsville Road (See Figure 1 – Site Location Map). The Black River crosses under Goff Road near this intersection, with the channel bed situated approximately eight to ten (8-10) feet below the surrounding topography. Most of the houses in this area are situated several hundred feet from the river and as a result are not likely to be impacted by a breach event; however there is one (1) within a 100 foot radius. The residence appears to be vacant and is found along the eastern stream bank below the Goff Road crossing. According to survey data this structure is located 100± feet from the Black River at an approximate elevation of 510 feet (8± feet above the channel bed). Photographs were taken to document this residence and are included in Appendix A.

METHODS AND TECHNIQUES

Hydrologic Analysis

A hydrologic analysis was performed for the 14.8± square-mile Kingdom Dam watershed to determine peak flows for various design storms at the outlet of Lincoln Pond. Based on the Soil Survey of Essex County, New York (USDA, 2003) soils in the watershed consist primarily of Group C (sandy clay loams). The Natural Resources Conservation Service (NRCS) assigns each soil series to a hydrologic soil group (HSG) as part of their soil classification system. The HSG is a four-letter index that is intended to indicate the minimum rate of infiltration experienced by each soil type after prolonged wetting, and also indicates the relative potential for a soil type to generate runoff. The infiltration rate is the rate at which water enters the soil at the soil surface. The HSG also indicates the transmission rate – the rate at which water moves within the soil. Soil scientists define the four groups as follows:

- a. Group A (sand, loamy sand, or sandy loam): Soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission (greater than 0.30 inches/hour).
- b. Group B (silt loam or loam): Soils have moderate infiltration rates when thoroughly wetted, and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to fine texture. These soils have a moderate rate of water transmission (0.15 – 0.30 inches/hour).
- c. Group C (sandy clay loam): Soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water, and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05 – 0.15 inches/hour).
- d. Group D (clay loam, silty clay loam, sandy clay, silty clay, or clay): Soils have high runoff potential. They have very low infiltration rates when thoroughly wetted, and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (< 0.05 inches/hour).

HSG types A, B, C and D compose approximately 3.5%, 22%, 74% and 0.5% of the watershed, respectively (See Figure 4 – USDA Soils Classification).

For the purposes of this hydrologic analysis, the watershed was divided into three (3) subareas ranging from 1350± to 4420± acres (See Figure 5 – Kingdom Dam Watershed). Each subarea represents the runoff directly tributary to one of three (3) principal ponds located within the watershed. The upper most drainage area flows into Tanaher, Mill, Murray and Russett Ponds in the southeastern corner of the watershed (these four interconnected ponds were modeled as a single storage area encircled by the 460 meter (1509 foot) contour with a single outlet to Brandy Brook). The remaining two (2) subareas flow into Upper Lincoln Pond and Lower Lincoln Pond, respectively.

Runoff curve numbers (CN) and times of concentration (T_c) were developed using standard NRCS methodology. Curve numbers were generated based upon land use designated on USGS quadrangle mapping and verified using aerial photos from 2003. The sheet flow component of the T_c was limited to 150 feet for each of the subareas and the channel flow components were computed using typical stream sections as measured in the field (Manning's n values were developed using Jarrett's Equation for steep mountain streams). T_c segments through Mill Pond, Russett Pond, Nichols Pond and Lincoln Pond were determined using the Soil Conservation Service (SCS) National Engineering Handbook Methodology as presented in Section 4, Hydrology, Equation 15.5. Table 3 on the following page provides a summary of the hydrologic input data.

Table 3 – Summary of Hydrologic Data

Watershed	Area (ac)	T_c (hrs)	Curve Number
Russett Pond	1353.1	1.5	63
Upper Lincoln Pond	3715.8	1.7	67
Lower Lincoln Pond	4417.5	2.1	71

Spillway Evaluation

CHA developed a hydrologic and hydraulic model (using Haestad Methods Pondpack Version 10.0) to evaluate various storm events including the 2-year, 10-year, 50-year, 100-year and 150% of the 100-year. The last storm event represents the spillway design flood (SDF) for Kingdom Dam and is based on the current hazard classification of the structure. Runoff hydrographs for the contributing watershed were developed using a type II distribution and rainfall amounts were referenced from Section 4 of the New York State Stormwater Management Design Manual. The 24-hour totals for the 2-, 10-, 50- and 100-year storms are 2.5, 3.6, 4.6 and 5.0 inches, respectively.

As mentioned above, the Kingdom Dam watershed was divided into three (3) subareas, each representing runoff directly tributary to one of three (3) principal ponds. In order to generate the peak flows for the SDF at Kingdom Dam, each of the input hydrographs to Upper and Lower Lincoln Ponds were multiplied by 150%. A summary of the peak flows for each subarea is provided in Table 4 below and detailed computations are included in Appendix B.

Table 4 – Unrouted Peak Flow Summary

Storm Event	24-hour Rainfall Amounts (inches)	Peak Flow Rate (cfs)		
		Russett Pond	Upper Lincoln Pond	Lower Lincoln Pond
2-year	2.5	73	325	515
10-year	3.6	295	1025	1358
50-year	4.6	595	1880	2313
100-year	5.0	733	2258	2725
150% 100-year ¹	N/A	N/A	3387	4088

¹The peak flow for the SDF was not generated at the outlet of Russett Pond, it was only required at the inlets of Upper and Lower Lincoln Pond.

For the purposes of the hydraulic model, normal pool depths were established for each of the ponds to be routed. Russett Pond is the uppermost water feature and represents four interconnected ponds in the southeastern corner of the watershed. These ponds were modeled as single storage area (encircled by the

460 meter (1509 foot) contour) with an outlet to Brandy Brook. Normal pool elevation was referenced from NYSDEC bathymetric mapping as 1490 feet. As mentioned previously, the normal pool elevation for Upper and Lower Lincoln Ponds is 1031 feet and was referenced from the bathymetric mapping provided in the NYSDEC Information Leaflet. For the purposes of this model, the starting water surface elevations in the upper and lower ponds were taken at the crest of the spillway at Kingdom Dam (1032.7 feet). This elevation was used for the initial conditions because the three (3) foot gate valve at the dam was assumed to be closed.

As discussed earlier, Kingdom Dam has a single spillway composed of two (2) 21.5 foot long sections at elevation 1032.7 feet, with the average top of the concrete on either side of the spillway approximately three (3) feet above its crest. In addition, the upper and lower ponds are separated by a causeway with a hydraulic connection provided by a three (3) sided concrete box approximately ten (10) feet wide by eight (8) feet tall. A summary of the routings at the causeway and Kingdom Dam is provided in Table 5 below and detailed computations are included in Appendix B.

Table 5 – Upper and Lower Lincoln Ponds Routing Summary

Storm Event	Peak Flow Rate ¹ (cfs)		Water Surface Elevation (feet – NGVD 29)	
	Upper Pond (Causeway)	Lower Pond (Kingdom Dam)	Upper Pond (Causeway)	Lower Pond (Kingdom Dam)
2-year	19	27	1033.2	1033.1
10-year	54	91	1033.8	1033.6
50-year	108	185	1034.4	1034.1
100-year	126	231	1034.7	1034.3
150% 100-year	229	415	1035.6	1035.0

¹Flows are based on routing through the upper pond (Causeway Results) and both ponds (Kingdom Dam Results) with the three (3) foot diameter gate valve (invert 1021.4) at Kingdom Dam closed.

The results shown in the table above indicate that the dam safely conveys each of the storm events investigated. The freeboard (from the top of dam, 1035.7 feet) at Kingdom Dam varies from 2.6 feet during a 2-year storm to 0.7 feet during the spillway design flood (SDF). As such, the structure is in compliance with the hydrologic criteria presented in the NYSDEC Guidelines for Design of Dams (January 1989). In addition, the causeway between the upper and lower ponds conveys each of the design storms without overtopping, with the available freeboard (from the roadway low point, 1036.7 feet) varying from 3.5 feet during a 2-year storm to 1.1 feet during the SDF.

Preliminary Dam Hazard Assessment

CHA developed the following process to evaluate the potential impact of a sunny-day breach at Kingdom Dam.

1. Field investigation - An engineer, specializing in the fields of hydrology and hydraulics, identified areas of potential impact along the Black River Corridor downstream of Kingdom

Dam. In particular, the engineer documented any residential structures which may fall within the potential inundation limits and which could lead to a reclassification of the dam.

2. Survey - Once a structure has been identified as at risk, the engineer worked with a survey crew to determine its elevation relative to the streambed and surrounding floodplain.
3. Analysis - CHA developed an estimate for the peak flow associated with a sunny-day dam failure. This estimate was then used in conjunction with the survey data to develop a steady-state HEC-RAS model in order to determine an approximate water surface elevation at each location.
4. Recommendation - Based on the results of the preliminary determination, CHA will recommend whether the current hazard classification is adequate, or whether a more detailed analysis is warranted.

The field investigation and survey components of the process have been addressed previously in this report while the analysis and recommendation components are described below.

Analysis

A sunny-day dam failure refers to a breach which occurs during fair weather or non-flood conditions. For the purposes of the preliminary hazard assessment, CHA assumed a water surface elevation of 1032.7 feet, which is equal to the crest of the spillway at Kingdom Dam. This elevation was used for the sunny-day evaluation because the three (3) foot gate valve (low-level outlet) at the dam was assumed to be closed. In order to develop a peak flow estimate for the sunny day failure, CHA used an equation developed by Froehlich (1995). The input variables for this equation consist of the volume and depth of water associated with the dam breach. As mentioned previously, the upper and lower ponds are separated by a causeway with a hydraulic connection provided by a three (3) sided concrete box approximately ten (10) feet wide by eight (8) feet tall. If Kingdom Dam were to fail, there would be a controlled release of water from the upper pond which would not impact the magnitude of the flood wave, as a result only the volume in Lower Lincoln Pond was accounted for in the development of a peak flow estimate. A summary of the input variables and the resulting peak flow estimate is provided in Table 6 below and detailed computations are included in Appendix C.

Table 6 – Kingdom Dam Sunny-Day Breach Peak Flow Estimate

Water surface Elevation (feet -NGVD 29)	Depth of Water (feet)	Volume of Breach (acre-feet)	Peak Flow Estimate (cfs)
1032.7 ±	20 ±	3750 ±	18634 ±

Once a peak flow was established, a water surface profile was generated using the U.S. Army Corps of Engineers' River Analysis System (HEC-RAS, Version 3.1.3). A steady-state model was developed to compute the hydraulic parameters needed to evaluate the potential impacts associated with a sunny-day breach of Kingdom Dam. It should be noted that the steady-state analysis produces a conservative result, as it does not take into account the attenuation of the floodwave, which will occur as the result of channel and floodplain storage.

The channel and bridge geometry necessary for the creation of the model was obtained from a field survey conducted in May 2006. Manning's "n" values and the contraction and expansion coefficients for each cross-section were based on field conditions documented during the site visit. A mixed flow scenario was modeled for the sunny-day breach event and starting water surface elevations were based on normal depth in the downstream reach.

HEC-RAS models were developed for each of the areas of interest identified earlier in the report. The results of these models indicate that both the hunting camp and residential structure (currently vacant) at 7 Goff Road are located within the inundation limits of the sunny-day break. In addition, although Goff Road is inundated, the Adirondack Northway (I-87) is not directly impacted by the dam breach, as it is located approximately 45 ft above the peak flood elevation. Furthermore, it would appear that the substructures of the I-87 Bridge would remain stable, due to the brief duration of flow and the moderate velocities (6-9 feet/second) estimated near the piers. A summary of the estimated impacts are provided in Table 7 and detailed computations are included in Appendix D. The hydraulic results presented in the table below are based on the assumption of unobstructed flow through the modeled cross-sections.

Table 7 – Kingdom Dam Sunny-Day Breach Impact Summary

Area of Interest	Structure Elevation (feet -NGVD 29)	Estimated Depth of Flooding at Structure (feet)	Estimated Velocity at Structure (feet/second)
1 – Hunting Camp (1.1± mile downstream of dam)	775.5 ±	9 ±	4 ±
2- Residential Structure (7 Goff Road)	510.0 ±	5 ±	8 ±

In addition to the impacts quantified in the above table, CHA performed a qualitative assessment of the two (2) remaining crossings of the Black River within the study reach.

The first crossing is located at Megsville Road approximately 12,800 feet downstream of the dam and is composed of a corrugated metal arch culvert extending through a 10-12 feet high earthen embankment. As mentioned previously, the reach of the Black River from the dam to Megsville Road has an average slope approaching 3.5% with a narrow floodplain. Due to these characteristics, CHA would expect only a minimal attenuation of the floodwave through this reach, which would result in a failure of the Megsville/Ledge Road crossing if a sunny-day breach were to occur at Kingdom Dam.

The second crossing is located at Route 9N, which represents the downstream limits of the study reach. There are approximately 5,200 feet of low gradient channel along the Black River from I-87 to the Route 9N crossing. This reach of the stream flows through a remote area (there are no additional structures located along this reach of stream) and is surrounded by a wide floodplain. Based on these characteristics, it is believed that the floodwave would be adequately attenuated before the Route 9N crossing and as such, it would not be adversely impacted by a sunny-day breach at Kingdom Dam.

Recommendation

The results from the sunny-day breach estimates were evaluated using the U.S. Department of the Interior Bureau of Reclamation (USBR) document entitled "Downstream Hazard Classification Guidelines". The reference document was consulted to quantify whether the increases in velocity and elevation associated with the failure of Kingdom Dam would result in the possible loss of life at a given structure. For the purposes of this assessment, the hunting camp was evaluated using the standards for mobile homes because of its lack of a foundation. Based on these criteria the hunting camp falls in the high danger zone (occupants of almost any size mobile home are in danger from flood water) due to the estimated flooding depth and velocity. The residential structure (currently vacant) located near the intersection of Goff and Megsville Roads was evaluated using the standards for houses built on foundations. Based on this criteria, the structure falls on the line between the judgement zone (danger level is based on engineering judgement) and the high danger zone (occupants of most houses are in danger from flood water) due to the combination of flooding depth and velocity.

Based on the evaluation presented above, each of the structures identified has a potential for loss of life during a sunny-day breach of Kingdom Dam. However, neither structure is considered a permanent residence, as the hunting camp is occupied only occasionally throughout the year and the home on Goff Road is currently vacant. As a result, CHA believes that the current classification for Kingdom Dam (Class "B") accurately represents the potential downstream hazards associated with a breach of the structure.

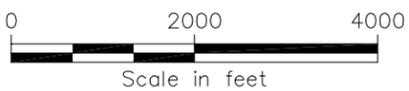
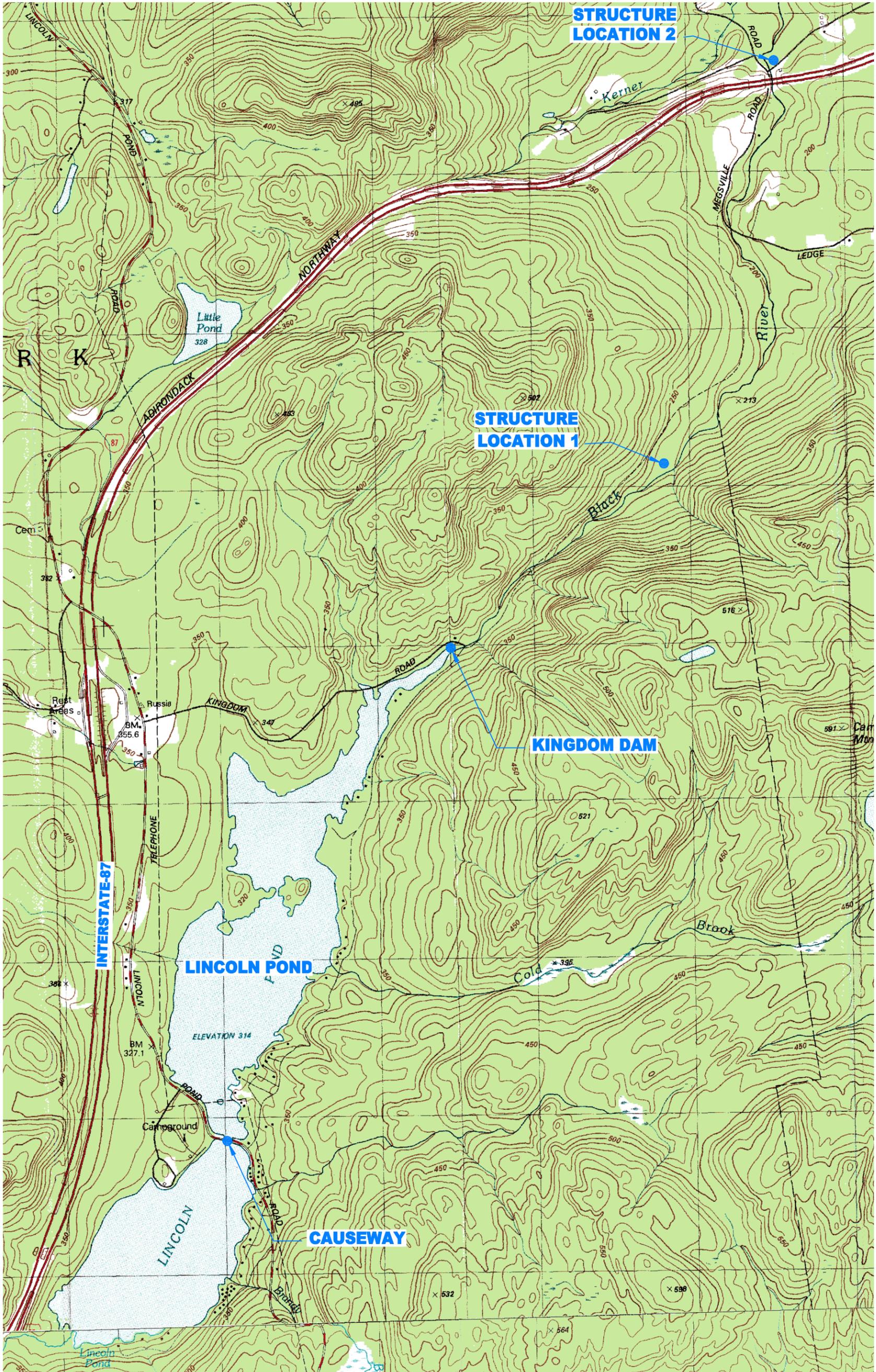
CONCLUSION

Kingdom Dam is currently rated as a "B" hazard classification by the NYSDEC. A written description of this hazard classification is presented below.

Class "B": dam failure can damage homes, main highways and minor railroads or interrupt service of relatively important public utilities.

Based on the results of the preliminary dam hazard assessment, in conjunction with input from the NYSDEC Dam Safety Division, CHA recommends that the hazard classification for Kingdom Dam remain a "B". The principal reason behind this recommendation is that neither of the impacted properties identified by the preliminary dam hazard assessment is classified as a permanent residence. However, CHA recommends that the NYSDEC continue to monitor the status of the residence located at 7 Goff Road (owned by Daniel Fields). If this residence becomes inhabited in the future, a full dam break analysis may be required, due to a possible change in the hazard classification for Kingdom Dam.

Given that Kingdom Dam is an existing structure with a "B" hazard classification, the spillway is required to convey 150% of the 100-year storm without overtopping the dam. The results of the hydrologic and hydraulic evaluation indicate the single spillway outlet at Kingdom Dam currently passes the SDF with approximately 0.7 feet of freeboard. As a result, the structure is in compliance with the hydrologic design criteria presented in the NYSDEC Guidelines for Design of Dams (January 1989).



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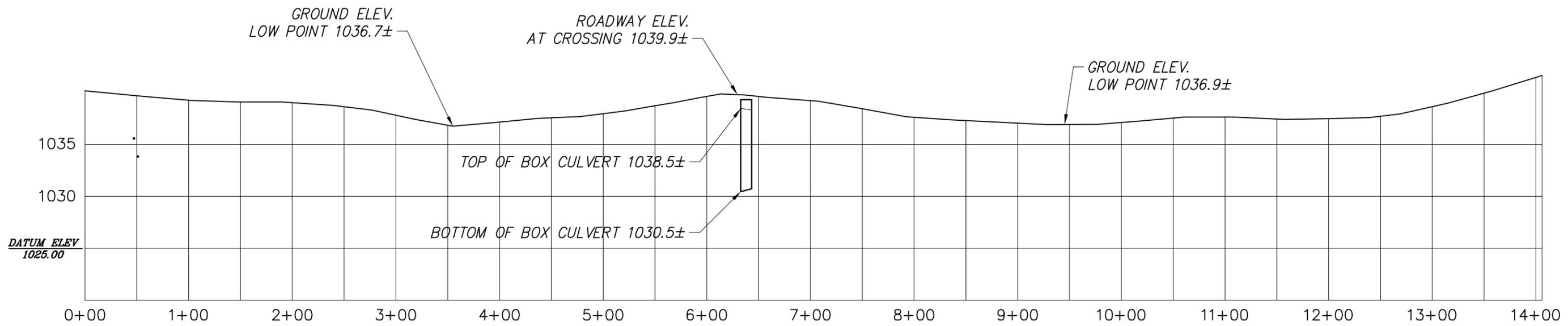
SITE LOCATION MAP
KINGDOM DAM PHASE II REPORT
LINCOLN POND
ESSEX COUNTY, NEW YORK

PROJECT NO.
15470

DATE: 02/22/07

FIGURE 1

File: M:\15470\ACAD\FIGURE 2 - CAUSEWAY.DWG Saved: 3/2/2007 11:05:08 AM Plotted: 7/18/2007 3:06:28 PM User: O'Connor, Neil



UPSTREAM FACE OF CAUSEWAY

SCALE:
1" = 100' (H)
1" = 10' (V)

ELEVATIONS REFERENCED TO NGVD 29

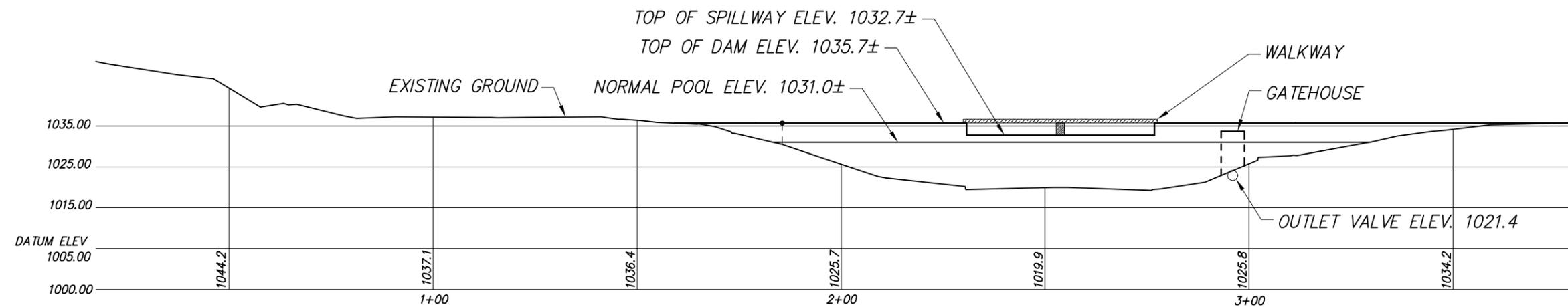
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LINCOLN POND CAUSEWAY ELEVATION
KINGDOM DAM PHASE II REPORT
LINCOLN POND
ESSEX COUNTY, NEW YORK

PROJECT NO. 15470
DATE: 02/22/07
FIGURE 2

File: M:\15470\ACAD\FIGURE 3 - KINGDOM DAM.DWG Saved: 2/28/2007 4:58:18 PM Plotted: 7/18/2007 3:06:46 PM User: O'Connor, Neil



UPSTREAM FACE OF DAM

SCALE:

1" = 30' (H)

1" = 30' (V)

ELEVATIONS REFERENCED TO NGVD 29

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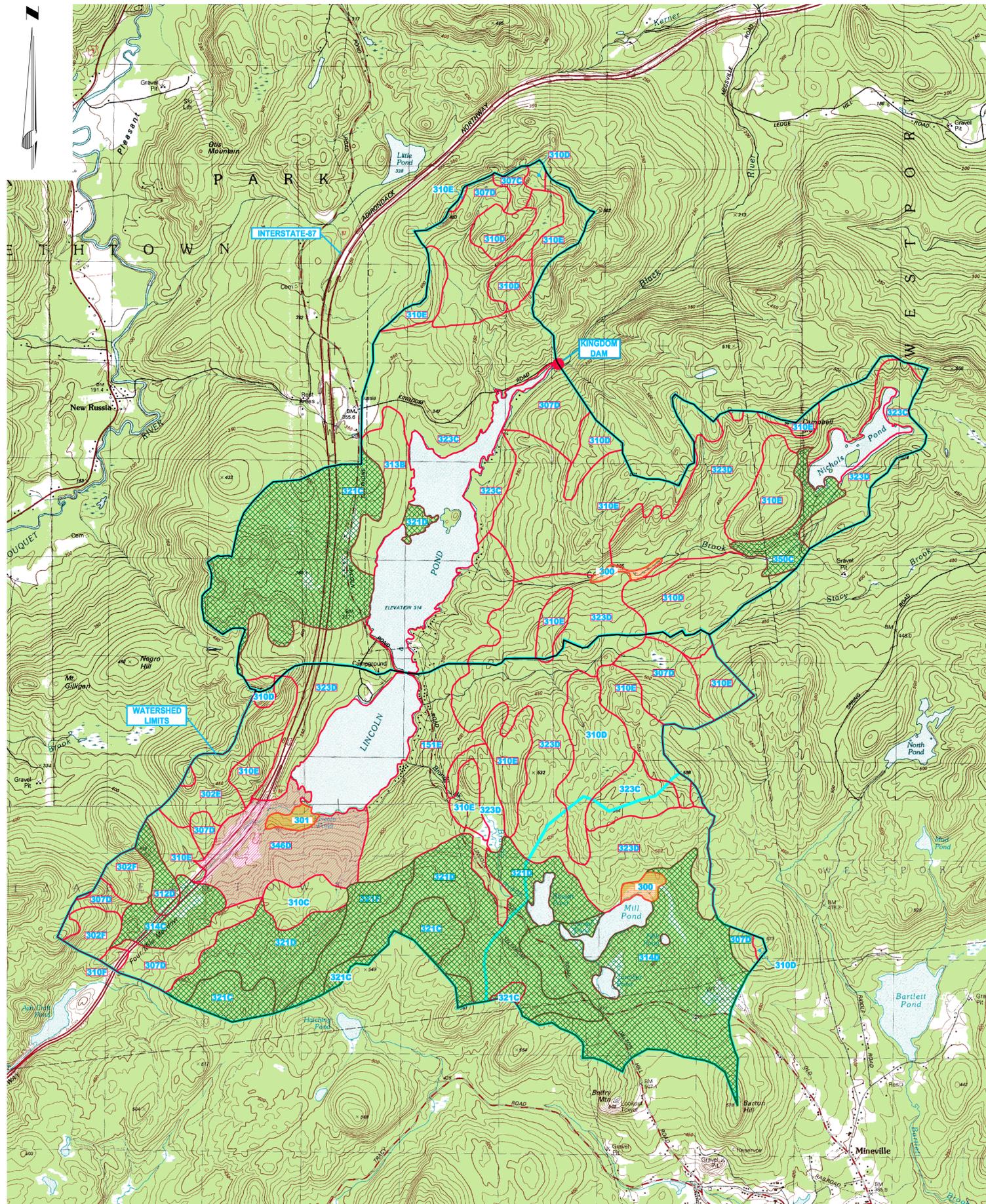
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KINGDOM DAM ELEVATION
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FIGURE 3



SOIL LEGEND

SOIL GROUP	SYMBOL	NAME	SLOPE
A	346D	Hermon Gravelly Loamy Sand	15-35%
B	314C	Monadnock-Tahawus Complex	3-15%
B	314D	Monadnock-Tahawus Complex	15-35%
B	321C	Monadnock Fine Sandy Loam	3-15%
B	321D	Monadnock Fine Sandy Loam	15-35%
B	321F	Monadnock Fine Sandy Loam	35-60%
B	350C	Monadnock-Adams-Colton Complex	3-15%
C	151E	Turnbridge-Lyman Complex	35-60%
C	302E	Lyman-Ricker Complex	35-60%
C	302F	Lyman-Ricker Complex	35-60%
C	307C	Becket-Turnbridge-Skerry Complex	3-15%
C	307D	Becket-Turnbridge Complex	15-35%
C	310C	Turnbridge-Lyman Complex	3-15%
C	310D	Turnbridge-Lyman Complex	3-15%
C	310E	Turnbridge-Lyman Complex	35-60%
C	310F	Turnbridge-Lyman Complex	30-60%
C	312D	Becket Fine Sandy Loam	15-35%
C	313B	Skerry-Becket Complex	3-15%
C	323C	Monadnock-Turnbridge-Tahawus Complex	3-15%
C	323D	Monadnock-Turnbridge Complex	15-35%
D	300	Loxley-Dawson Complex	0-2%
D	301	Dawson-Rumney-Loxley Complex	0-2%

HATCH LEGEND

-  - HSG A
-  - HSG B
-  - HSG C
-  - HSG D
-  - WATER



REFERENCE: USDA SOIL SURVEY
 ESSEX COUNTY, NEW YORK
 PUBLICATION DATE 2002

USGS QUAD MAPS: ELIZABETHTOWN
 AND WITHERBEE, NEW YORK
 PUBLICATION DATE 1978

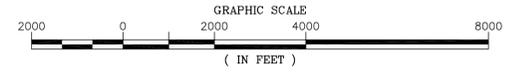
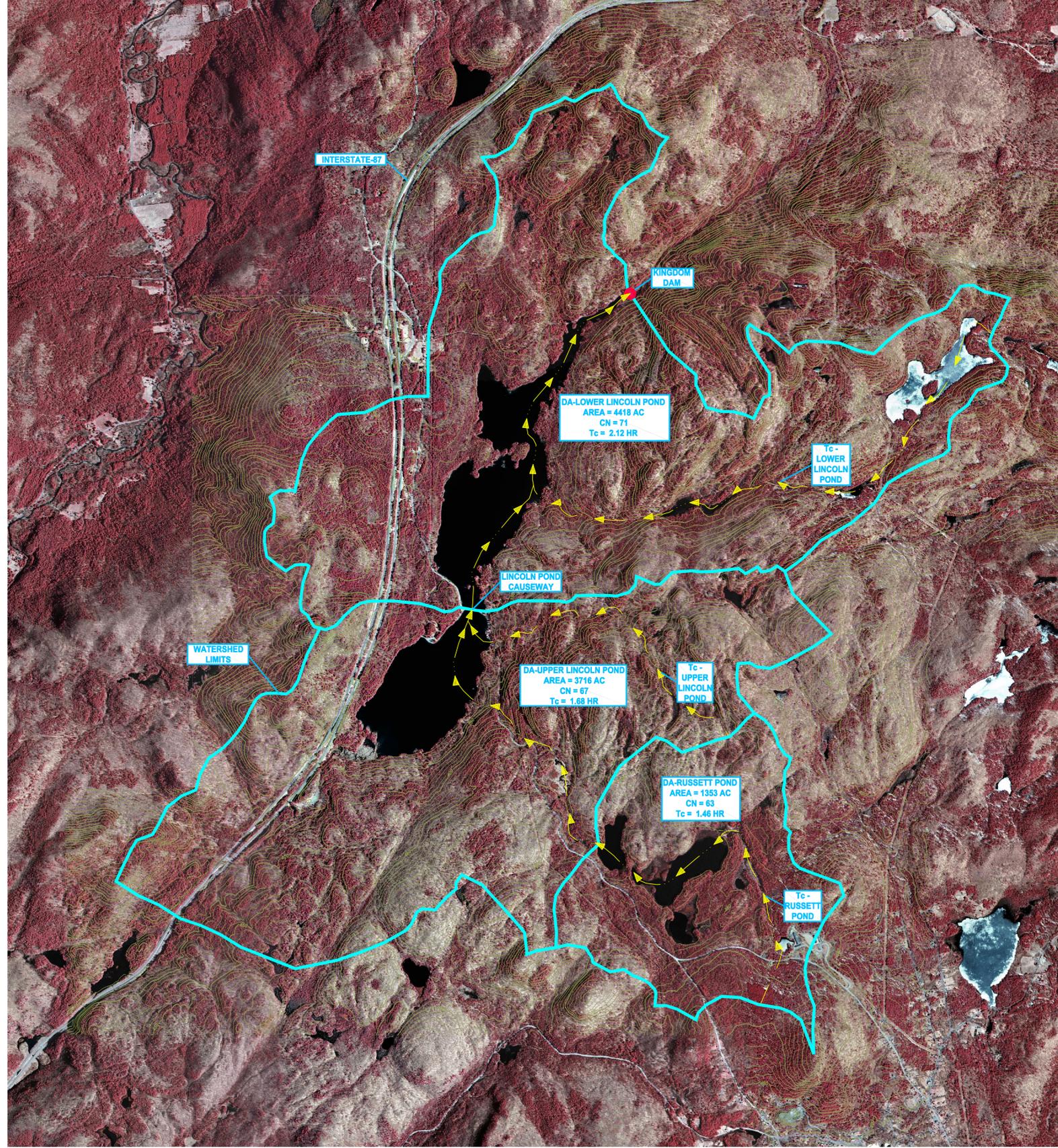
No.	Submitted / Revision	App'd By	Date
1	Revised Soil Hatch	KZD	12/15

NEW YORK STATE
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KINGDOM DAM PHASE II REPORT
LINCOLN POND, ESSEX COUNTY, NY
USDA SOILS CLASSIFICATION
 Issue Date: 02/22/07 Project No.: 15470 Scale: 1"=2000'

FIG. 4

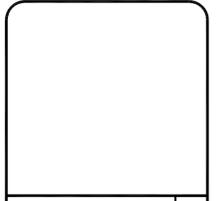


DRAINAGE BASIN: BLACK RIVER
 FLOWS INTO THE BOQUET RIVER
 AND EMPTIES INTO LAKE
 CHAMPLAIN

REFERENCE: ORTHOMAGERY
 ESSEX COUNTY, NEW YORK
 PUBLICATION DATE 2003

No.	Submittal / Revision	App'd By	Date

NEW YORK STATE
 OFFICE OF GENERAL SERVICES



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KINGDOM DAM PHASE II REPORT
 LINCOLN POND, ESSEX COUNTY, NY
 KINGDOM DAM WATERSHED
 Issue Date: 02/22/07 Project No.: 15470 Scale: 1"=2000'

FIG. 5