Needs Work

Redo

VF 11/25/21

Maps used in Report VF

110

Alamoosook Lake Breach Study

02/06/2020

Breach Parameter Summary Sheet

Dam Number	**110**	
Dam Name	**Alamoosook Lake**	
Program Used	DSS-WISE Web	
Elevation Datum	NAVD 1988	
Max Pool/Top of Dam Elevation (ft)	25.70	
Max Pool Storage (ac-ft)	7,097	
Principle Spillway Freeboard (ft)	2.00	
Normal Pool Freeboard (ft)	2.00	
Normal Pool Elevation (ft)	23.70	
Normal Pool Storage (ac-ft)	6,105	
Height of Dam (ft)	15.00	
Toe Elevation (ft)	10.70	
Criterion	Fair Weather Breach	Stormy Day Breach
Failure Mode	Piping	Overtopping
Simulation Type	Reservoir	Reservior
Reservoir Elevation at Failure (ft)	23.70	25.70
Reservoir Storage at Failure (ac-ft)	6,105	7,097
Breach invert Elevation (ft)	10.70	10.70
Breach Width (ft)	70.00	70.00
Breach Formation Time (hrs)	0.000	0.000
Separate Breach Hydrograph (Y/N)*	N	N
Peak Breach Flow (cfs)	7,960	7,640

*If separate breach Hydrograph is used, attach it to this form

NO see Sec A

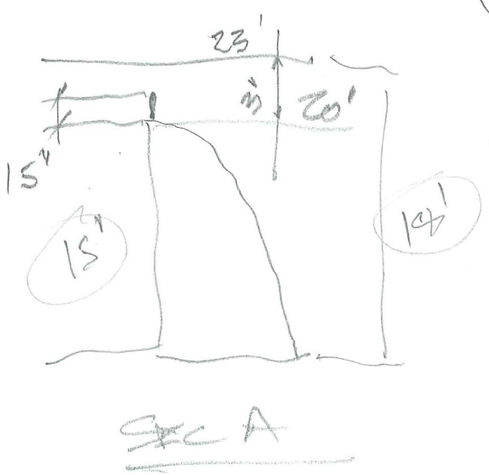
±6'

±6

Reasonable Estimate

Failure Mode Wrong. This is a Canoe Dam!

INSTABILITY



Sec A

520 cfs.

1200 cfs

Gate Sill

Breach b=3h,

Storage Calculations

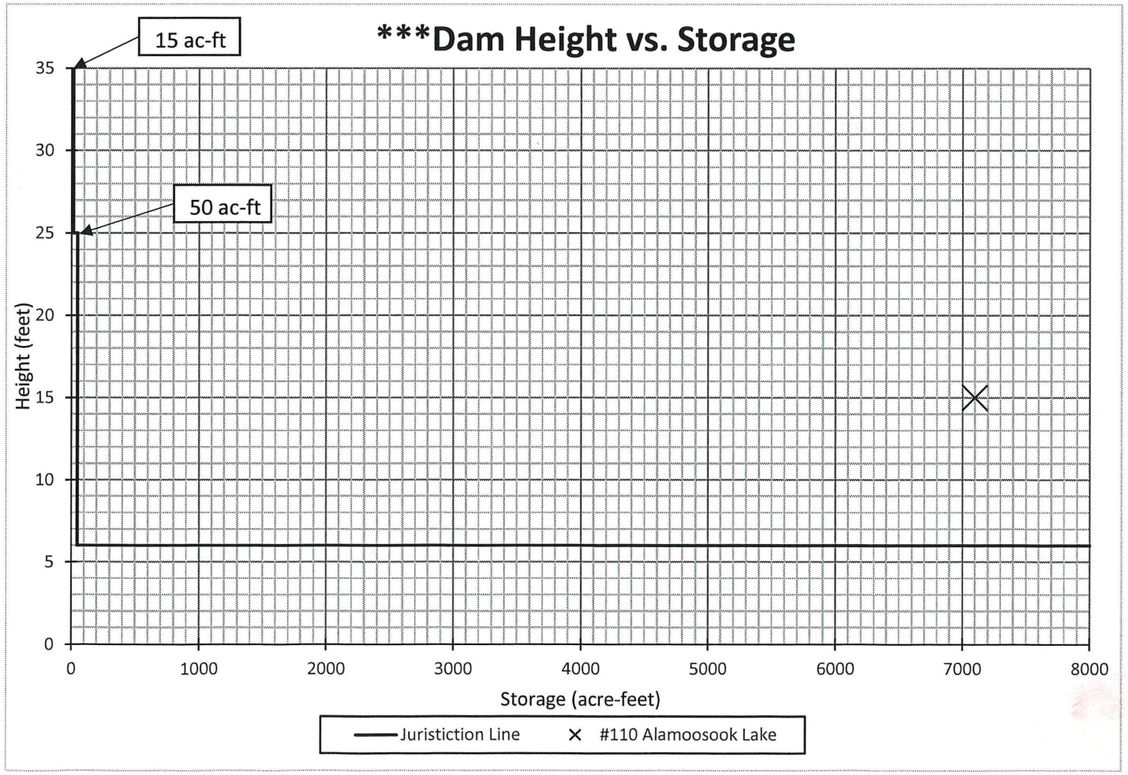
#110 Alamoosook Lake

Measurements (ft)		Elevations(ft)		Pond Characteristics		Pond Areas (acres)	Storages (ac-ft)
Dam Height (H)	15.00	Top of Dam	25.54	*Pond Slope (s)	34.75%	Normal Pool (Anp)	Normal Pool (S_{np}) $H_s*S_c*A_{np} = S_{np}$
Freeboard (H_f)	2.00	Principle Spillway				1,174	~~6,105~~ 6100
Spillway Height (H_s)	13.00	Normal Pool	13.00	**Storage Coefficient (Sc)	0.40	Top of Dam Area (Atod) $((H_f/s)*P)/43560 + A_{np} = A_{tod}$	Top of Dam (Stod) $H*S_c*A_{tod} = S_{tod}$
Pond Shoreline (P)	67,400	Toe	10.54			1,183	~~7,097~~ 7100 USED

*Using a contour map, take the slope of the ground around the pond in places that look typical for that particular pond. Alternatively, enter the mean basin slope cumputed by streamstats. Default value is 10% or 1/10

**Use 0.5 for the Storage Coefficient if the dam impounds a flat wetland or raised lake; use a coefficient of 1/3 for a v-shape valley

***The chart automatically plots height and storage of the dam. If the "X" falls below and to the left of the black line then the dam DOES NOT qualify for regulation by MEMA. If the "X" falls above and to the right the black line, or off the chart, then the dam DOES qualify for regulation by MEMA.



Storage Calculations

Slope Estimation		
Slopes	Value (degrees)	Value (% slope)
1	16.7369	37.19%
2	16.6459	36.99%
3	12.0998	26.89%
4	19.1589	42.58%
5	14.0863	31.30%
6	12.1023	26.89%
7	10.8786	24.17%
8	17.7021	39.34%
9	21.0377	46.75%
10	15.9355	35.41%
Average Slope:	**15.6384**	**34.75%**


Duck Cove Rd
Wights Rd
46
French Island
Loon Island
Alamoosook Lake
175
Orland
1
East Orland
#110 Alamoosook Lake
Shoreline = 67,400 ft
Area = 1,133 acres
Google Earth
2 mi
N

Addresses Impacted by Overtopping Breach

County	Zipcode	Place Type	Address	Latitude	Longitude
Hancock	4472		100 Lower Falls Rd	44.579	-68.742916
Hancock	4472		114 Narramissic Dr	44.579626	-68.74518
Hancock	4472		105 Castine Rd	44.571664	-68.743408
Hancock	4472	Residential	10 Fish Point Rd	44.571022	-68.744305
Hancock	4472		220 Lower Falls Rd	44.585792	-68.736694
Hancock	4472		6 Lower Falls Rd	44.572549	-68.74285
Hancock	4472		8 Fish Point Rd	44.571355	-68.744303
Hancock	4472		32 Lower Falls Rd	44.574386	-68.743005
Hancock	4472		36 Narramissic Dr	44.574237	-68.744801
Hancock	4472		52 Lower Falls Rd	44.575539	-68.742981
Hancock	4472		62 Lower Falls Rd	44.576349	-68.743192
Hancock	4472		66 Lower Falls Rd	44.576763	-68.743133
Hancock	4472		92 Castine Rd	44.571847	-68.744648
Hancock	4472		94 Castine Rd	44.571851	-68.744509
Hancock	4472		98 Castine Rd	44.571963	-68.744244
Hancock	4416		546 State Route 46	44.600817	-68.736733
Hancock	4472		5 Narramissic Dr	44.572355	-68.744274
Hancock	4472		7 Lower Falls Rd	44.572765	-68.74254
Hancock	4472		24 Narramissic Dr	44.573513	-68.744917
Hancock	4472	Other	91 Castine Rd	44.571554	-68.74468
Hancock	4472		95 Castine Rd	44.571526	-68.744133
Hancock	4472		116 Grant Ln	44.583814	-68.739915
Hancock	4472	Residential	106 Castine Rd	44.572145	-68.743318
Hancock	4416		329 Duck Cove Rd	44.593834	-68.730195
Hancock	4472		90 Lower Falls Rd	44.578393	-68.743026
Hancock	4472		104 Lower Falls Rd	44.579342	-68.742725
Hancock	4472		128 Lower Falls Rd	44.581077	-68.741634
Hancock	4472		150 Lower Falls Rd	44.582172	-68.740219
Hancock	4472		4 Narramissic Dr	44.572144	-68.744734
Hancock	4472		76 Lower Falls Rd	44.577466	-68.743313
Hancock	4472		31 Soper Rd	44.592518	-68.722207

All address points located inside, or within 75 feet of, the floodline were considered to be Impacted Addresses

Notes:

-Datum/Proj: NAD 83/UTM Zone 19N

-The areas depicted in the following maps can be found Maine Atlas and Gazetteer Map(s): 23

-All Flood data are estimates made using a FEMA sponsored program called DSS-WISE Lite

-Please note the assumptions and methods made and used while creating this inundation map are for guidance and evacuation purposes only.

-Areas inundated will depend on the actual flood/failure conditions, and the resulting inundated areas may be different than what is shown on the map

Peak Breach Flow Estimates:

(Times measured from the moment the breach begins forming)

Overtopping

-Peak Flow: 7,640 cfs

-Occurs at: 0 hours

-Volume Released: 5,047/7,097 acre-feet

Sources:

Maine OGIS, and MEMA

Legend

Floodlines
- Overtopping Breach
- Observation Line

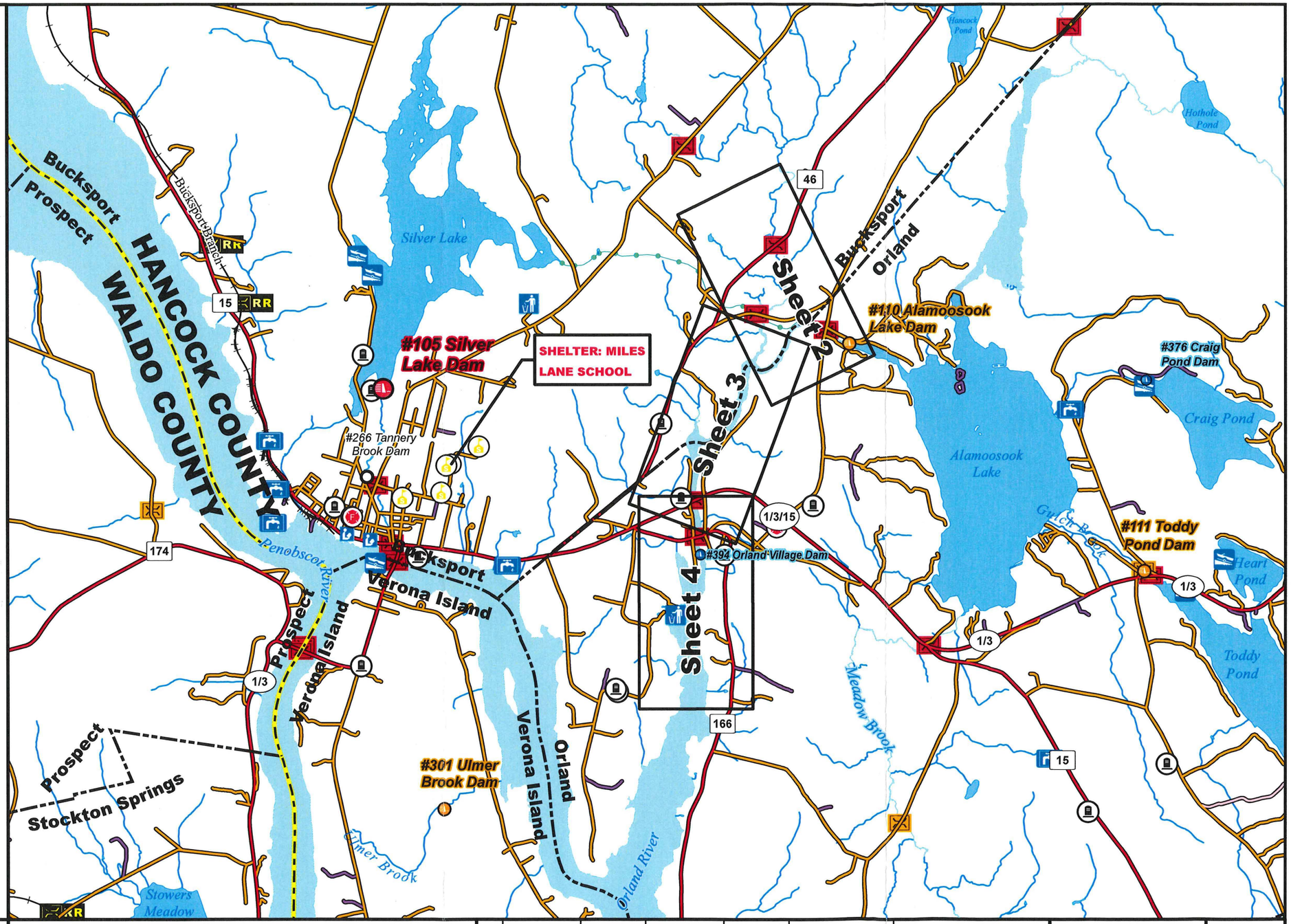
Boundaries
- County Line
- Town Line
- Map Outline

Locations
- Water Treatment Facility
- School
- Fire/EMS Station
- Police Station
- Red Cross Shelter
- Municipal Landfill
- Boat Launch
- Library
- Cemetery
- Impacted Address

Infrastructure

Roads
- Secondary
- Local/Town
- Private
- Paper Street

Bridges
- MEDOT
- Municipal
- RR Railroad Bridge



#110 Alamoosook Lake Dam Dam Breach Inundation Map

Project Location: **Orland, Hancock County, ME**

Owner: **Bucksport Generation LLC**

0 2,000 4,000 8,000 12,000 16,000

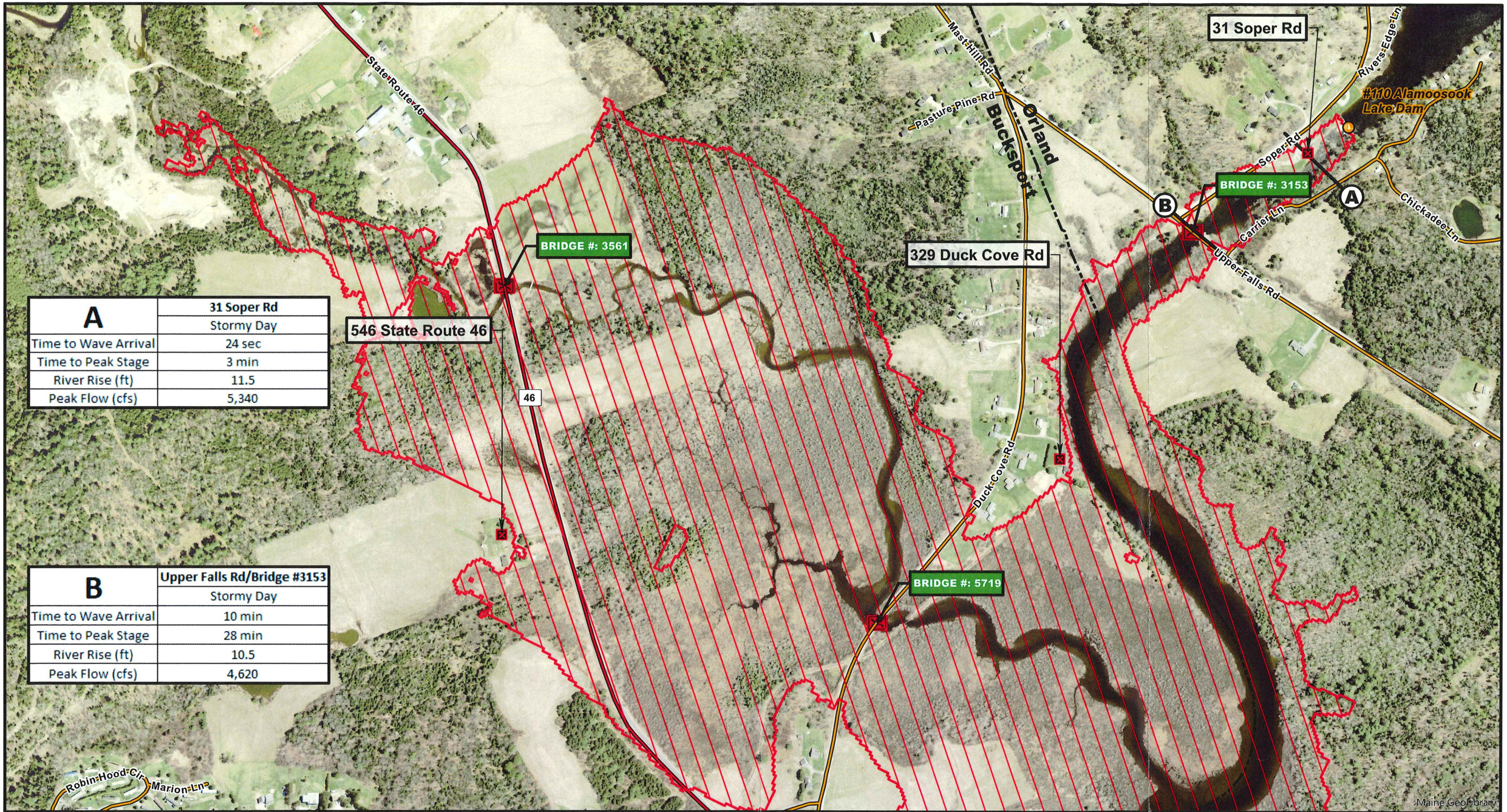
Map Scale: 1 inch = 4,000 feet

**Please note the assumptions and methods made and used while creating this inundation map are for guidance and evacuation purposes only. The information shown is approximate, and actual areas inundated will depend on failure conditions and may differ than what is shown.*

Rev	Drawn By:	Drawn On:	CHK'd By:	CHK'd On:	Rev. Made:
1.0	Andrew Manzi	07/26/2017			Initial Draft
2.0	Andrew Manzi	02/06/2020	John Skelley	02/06/2020	Floodlines, Titleblock

Office of Dam Safety at Maine Emergency Management Agency
(207) 624-4400
45 Commerce Dr.
Suite #2
Augusta, ME 04330
STATE OF MAINE

Sheet: **1** of 4



A	31 Soper Rd
	Stormy Day
Time to Wave Arrival	24 sec
Time to Peak Stage	3 min
River Rise (ft)	11.5
Peak Flow (cfs)	5,340

B	Upper Falls Rd/Bridge #3153
	Stormy Day
Time to Wave Arrival	10 min
Time to Peak Stage	28 min
River Rise (ft)	10.5
Peak Flow (cfs)	4,620

#110 Alamoosook Lake Dam Dam Breach Inundation Map

Project Location: **Orland, Hancock County, ME**

Owner: **Bucksport Generation LLC**

0 250 500 1,000 1,500 2,000

Map Scale: 1 inch = 500 feet

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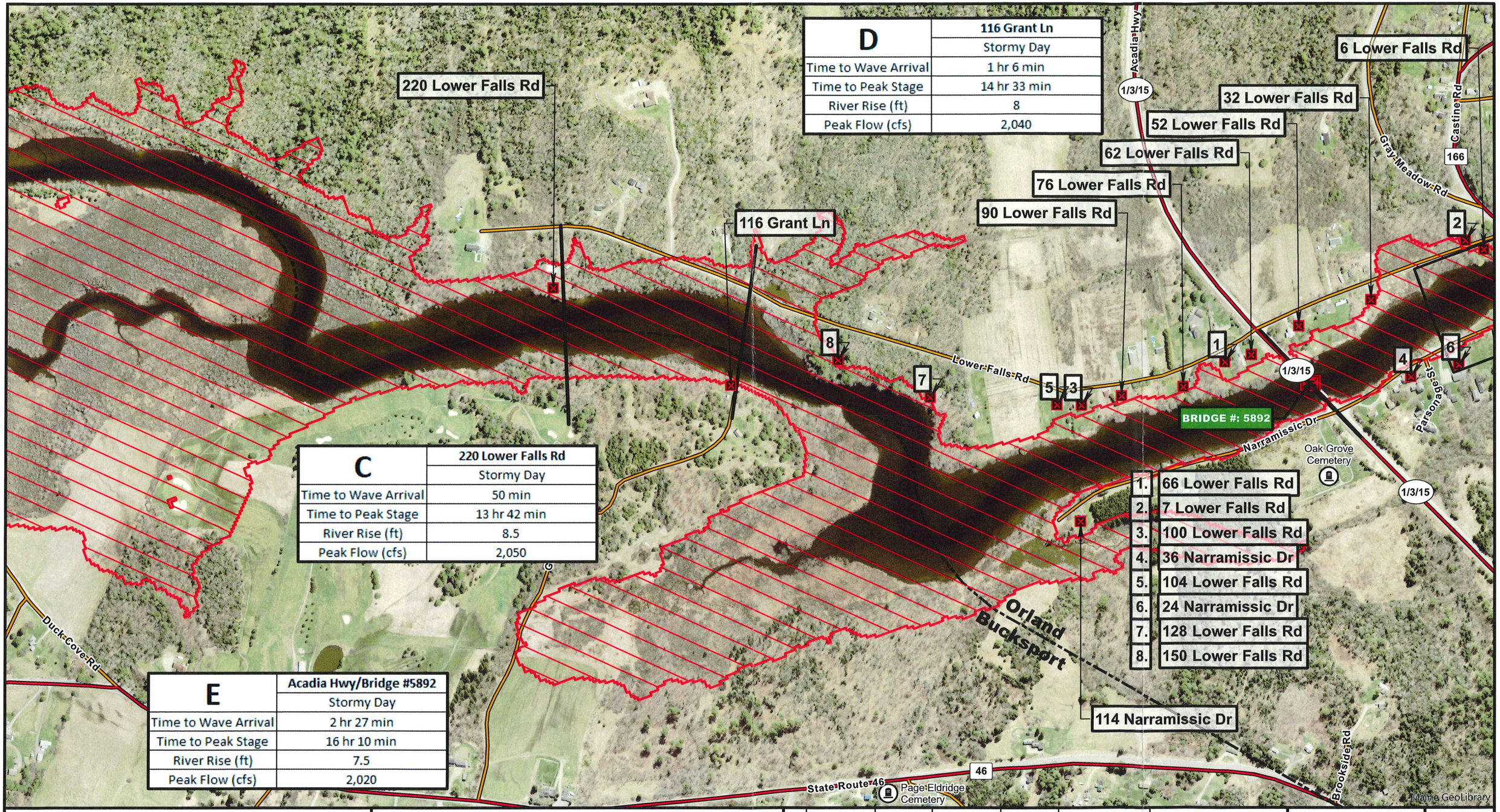
Sheet: **2** of 4



D	116 Grant Ln
	Stormy Day
Time to Wave Arrival	1 hr 6 min
Time to Peak Stage	14 hr 33 min
River Rise (ft)	8
Peak Flow (cfs)	2,040

C	220 Lower Falls Rd
	Stormy Day
Time to Wave Arrival	50 min
Time to Peak Stage	13 hr 42 min
River Rise (ft)	8.5
Peak Flow (cfs)	2,050

E	Acadia Hwy/Bridge #5892
	Stormy Day
Time to Wave Arrival	2 hr 27 min
Time to Peak Stage	16 hr 10 min
River Rise (ft)	7.5
Peak Flow (cfs)	2,020

#110 Alamoosook Lake Dam Dam Breach Inundation Map

Project Location: **Orland, Hancock County, ME**

Owner: **Bucksport Generation LLC**

0 250 500 1,000 1,500 2,000

Map Scale: 1 inch = 500 feet

**Please note the assumptions and methods made and used while creating this inundation map are for guidance and evacuation purposes only. The information shown is approximate, and actual areas inundated will depend on failure conditions and may differ than what is shown.*

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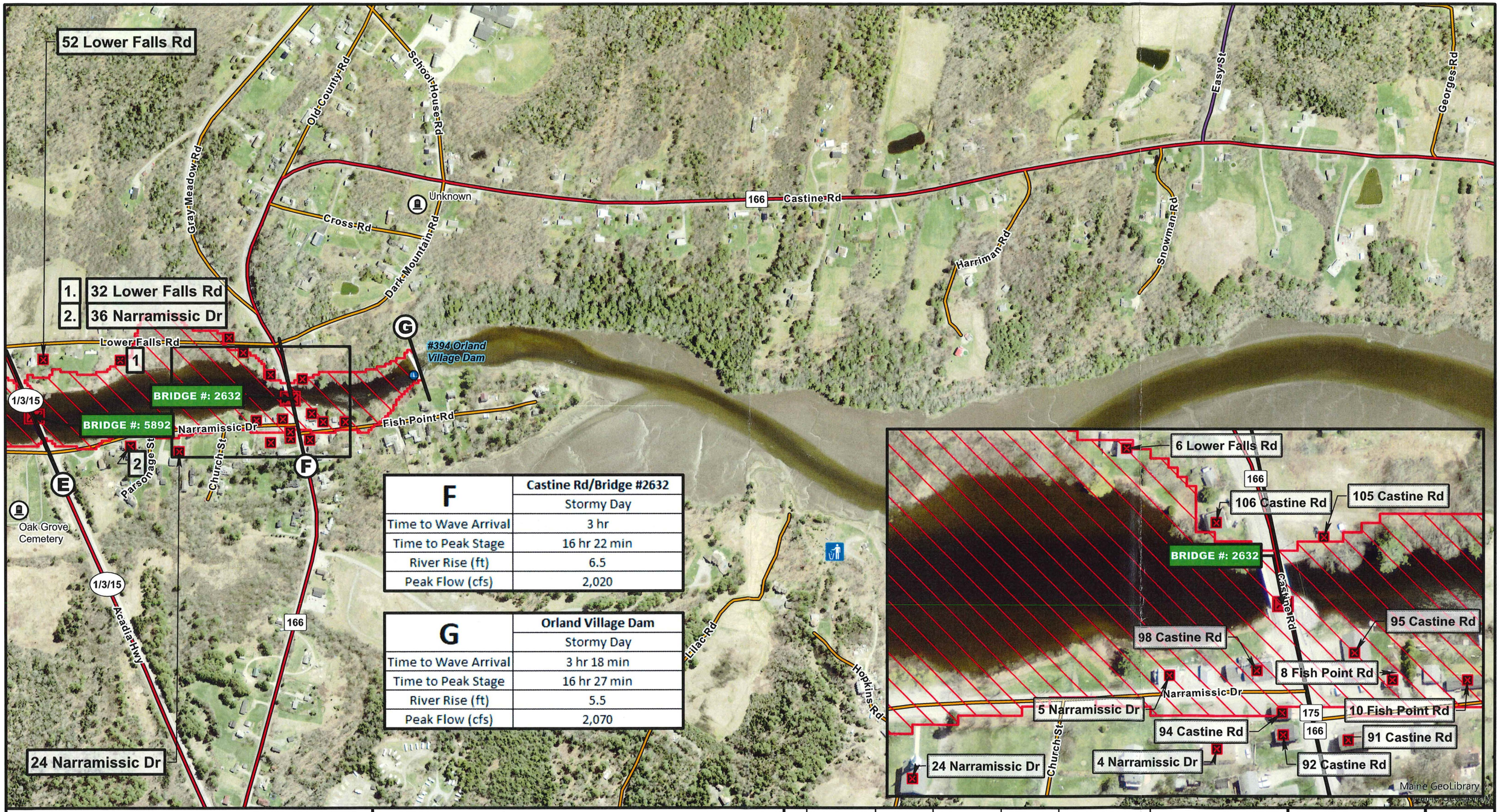

F	Castine Rd/Bridge #2632
	Stormy Day
Time to Wave Arrival	3 hr
Time to Peak Stage	16 hr 22 min
River Rise (ft)	6.5
Peak Flow (cfs)	2,020

G	Orland Village Dam
	Stormy Day
Time to Wave Arrival	3 hr 18 min
Time to Peak Stage	16 hr 27 min
River Rise (ft)	5.5
Peak Flow (cfs)	2,070

#110 Alamoosook Lake Dam Dam Breach Inundation Map

Project Location: **Orland, Hancock County, ME**

Owner: **Bucksport Generation LLC**

0 250 500 1,000 1,500 2,000

Map Scale: 1 inch = 500 feet

**Please note the assumptions and methods made and used while creating this inundation map are for guidance and evacuation purposes only. The information shown is approximate, and actual areas inundated will depend on failure conditions and may differ than what is shown.*

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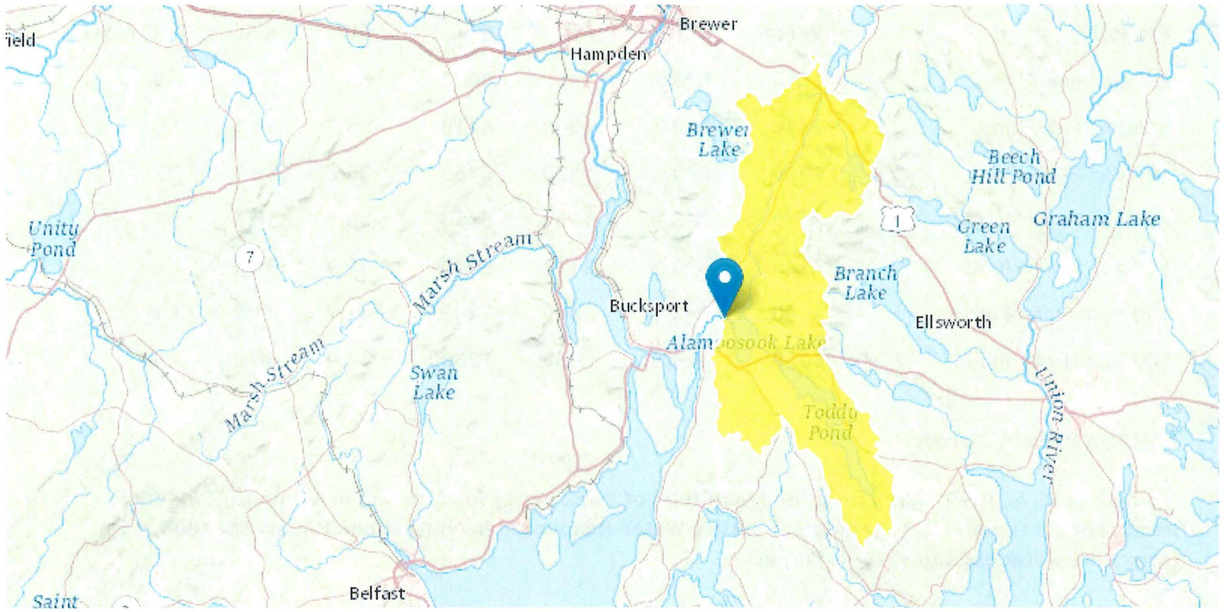
STATE OF MAINE

#110 Alamoosook Lake Dam

Region ID: ME
Workspace ID: ME20200206210135432000
Clicked Point (Latitude, Longitude): 44.59219, -68.72145
Time: 2020-02-06 16:01:53 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	94.8	square miles
STORNWI	Percentage of storage (combined water bodies and wetlands) from the National Wetlands Inventory	14.24	percent
BSLDEM10M	Mean basin slope computed from 10 m DEM	9.27	percent
ELEVMAX	Maximum basin elevation	1252	feet
LC06WATER	Percent of open water, class 11, from NLCD 2006	8.64	percent
PRECIP	Mean Annual Precipitation	44.3	inches

Peak-Flow Statistics Parameters[Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	94.8	square miles	0.93	1653
STORNWI	Percentage of Storage from NWI	14.24	percent	0.7	26.7

Peak-Flow Statistics Flow Report[Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SE	SEp	Equiv. Yrs.
2 Year Peak Flood	1690	ft^3/s	945	3020	35.1	35.1	1.8
5 Year Peak Flood	2440	ft^3/s	1360	4410	36.1	36.1	2.5
10 Year Peak Flood	2980	ft^3/s	1630	5450	36.8	36.8	3.2
25 Year Peak Flood	3670	ft^3/s	1960	6880	38.6	38.6	4.1
50 Year Peak Flood	4200	ft^3/s	2190	8020	39.9	39.9	4.8
100 Year Peak Flood	4750	ft^3/s	2430	9280	41.2	41.2	5.4
500 Year Peak Flood	6080	ft^3/s	2950	12600	44.9	44.9	6.4

Peak-Flow Statistics Citations

Hodgkins, G. A.,1999, Estimating the Magnitude of Peak Flows for Streams in Maine for Selected Recurrence Intervals: U.S. Geological Survey Water-Resources Investigations Report 99-4008, 45 p. (http://me.water.usgs.gov/99-4008.pdf)

Application Version: 4.3.11

/

floodplain area off the Mast Hill Road. Flood Insurance Rate mapping for the town of Bucksport (November 4, 1988) indicates that the structure is within the 100-year floodplain. Further downstream, approximately 1.2 miles downstream of the dam on the east side of the river, is a house located just off the Lower Falls Road. Flood Insurance Rate mapping for the Town of Orland indicates that this structure is also within the 100-year floodplain. Approximately 1.4 miles downstream of the dam, on the west side of the river, is another house within the 100-year floodplain. Closer to the Orland Village Dam, nearly 2.5 miles downstream of the Alamoosook dam, sits one house on the east side of the river (Lower Falls Road) and a house and one business on the west side of the river (Narramissic Road). The town of Orland Flood Insurance Rate mapping indicates that these structures may be within the 100-year floodplain. A mobile home on the Fish Point Road, on the west side of the river, lies within the 100-year floodplain indicated on the Town of Orland Flood Insurance Rate Map.

Bridges spanning the Narramissic River include the Upper Falls Road bridge, which includes four culverts approximately 12.5' in diameter, the Route 1 bridge and the Rt. 175 bridge.

Little information exists about watershed hydrology, lake levels and historic flows at the Alamoosook dam. From lake level records provided by Champion Paper for the period January 1960 through August 1998, a peak lake level of 25.0' (estimated USGS datum) occurred in December 1969. The flow in the Narramissic River was unknown. For the present dam configuration, a lake level of 25.0' would result in a calculated 3,089 cfs of overtopping flow (5.0' over the permanent crest of the spillway and 2.0' over the north abutment) with an unknown amount of gate flow. Assuming a maximum gate opening of 8', the gate could contribute as much as 580 cfs additional flow. Typically, Alamoosook Lake levels are between elevations 20' and 22', with the lowest levels occurring during September and October.

Alamoosook Lake has drainage area of approximately 94 square miles. In watersheds in Maine, average annual flows are approximately 2 cfs/mi^2 according to records from gaged basins. The average annual flow for the Alamoosook Lake drainage is therefore estimated to be 188 cfs.

5.2 Recommendations

The breach analysis indicated that a failure of one half of the spillway at the Alamoosook Dam would result in a breach outflow that may reach a few houses along the Narramissic River. Although the extent of inundation is unknown, it is recommended that an Emergency Action Plan (EAP) be enacted to assist homeowners in the event of a breach or warn them of an impending failure condition at the dam. The EAP should also include provisions for monitoring the Upper Falls Road bridge in the event of a breach and closing it to through traffic if scouring or erosion occurs.

5.0 SUMMARY AND RECOMMENDATIONS

5.1 Summary

A breach analysis was prepared for the Alamoosook Dam in Orland, Maine. The dam is located at the outlet of Alamoosook Lake, approximately 2.5 miles upstream of the Orland River which is tidal. The dam has a concrete spillway, a gate structure with 5.5' wide sluice gate, fish ladder and abutments. The height of the spillway is 14.8', including 1.3' of flashboards, with a length of approximately 70'. The breach analysis was conducted using the DAMBRK program. The model assumed a rectangular breach of one half of the concrete spillway. The breach development time was assumed to be 0.2 hour. The impounded volume of the dam is 6,973 acre-feet at the normal pond elevation of 21.3', with a surface area of approximately 1,180 acres.

Three flow conditions were analyzed. They were "sunny day" (with a normal pond elevation of 21.3' and an outflow of 20 cfs), "lake level of record" (elevation 25.0', occurring in December 1969, with an assumed overtopping and gate outflow of 3,669 cfs), and "top of abutments" (elevation 26.0' with an assumed overtopping and gate outflow of 4,805 cfs). Peak breach outflows for the three conditions are 3,252 cfs, 5,495 cfs and 6,150 cfs respectively. The breach wave would travel rapidly down the Narramissic River, with significant attenuation occurring due to the backwater influence of the Orland Village Dam. Due to the large volume of water within Alamoosook Lake, breach outflows would be sustained for several days.

A few houses along the Narramissic River may be inundated above sill levels in the event of a spillway failure during flood conditions. Most of these structures are within the 100-year floodplain designated on the Flood Insurance Rate Maps for the towns of Orland and Bucksport. While the Upper Falls Road bridge may adequately pass breach flows from Alamoosook Lake, the bridge should be monitored for erosion in the event of a breach and closed to traffic if scouring, or erosion occurs.

APPENDIX A

DESCRIPTION OF PROJECT

Alamoosook Dam

The Alamoosook Dam is located at the outlet of Alamoosook Lake in the town of Orland, Maine at the head of the Narramissic River. The structure is primarily used to regulate the level of Alamoosook Lake and withdraw water to pump to Silver Lake, which serves as the water supply reservoir for the town of Bucksport and Champion International. Approximately 250' downstream of the Alamoosook dam is a pump station which pumps flow from Alamoosook Lake overland through a pipeline to Silver Lake in the town of Bucksport. A fish ladder in the dam provides passage for the seasonal migration of alewives.

The dam is a concrete gravity structure with sluice gate, pump intake, spillway, fish ladder and abutment sections. All elevations are approximate USGS datum, as converted from site datum which is an estimated 100 feet higher than USGS datum.

In the center of the structure is a 5.5' wide wooden sluice gate with a sill elevation of 13.5' (USGS), approximately 7.8' below the normal lake elevation of 21.3'. The concrete gate structure is abutted to the north by the concrete intake structure, which has an overtopping elevation of 25.0'. A concrete ogee spillway approximately 70' long abuts the gate structure on its south side and has a permanent crest elevation of 20.0'. Flashboards 1.3' high bring the normal pond elevation to 21.3'. The bottom of the spillway is at elevation 6.5'. The south abutment of the dam is 2' thick and has an elevation of 23.0'. This abutment is approximately 15' long and is tied into bedrock. North of the intake is a fish ladder and concrete abutment. The north abutment, at elevation 26.0', is approximately 30' long with a thickness of 2'.

The Alamoosook Dam impounds approximately 6,973 acre-feet of water at the normal pond elevation of 21.3', with a surface area of 1,180 acres. The drainage area contributing to the site is 94 square miles. When the lake elevation is below elevation 21.3' (20.0' when the flashboards are out), the principal means of passing flow is through the sluice gate. A small amount of flow is contributed by the fish ladder.

Narramissic River

The Narramissic River flows from Alamoosook Lake to the Orland Village Dam, a distance of approximately 2.5 miles. The Orland Village Dam, with a crest elevation of 7.8' (USGS), backwaters the Narramissic River to within several hundred feet of the Alamoosook Dam. The Orland Village Dam separates the Narramissic River from the Orland River, which is estuarine.

Due to the backwater influence of the Orland Village Dam, the Narramissic River is wide and sluggish. A single small tributary, Whites Brook, enters the river about a mile downstream of Alamoosook Lake. A site visit by KA engineers determined that development adjacent to the Narramissic River is limited to a few residences. On the west side of the Narramissic River, approximately 0.5 mile downstream of the Alamoosook Dam and just upstream of the confluence of Whites Brook with the river, a mobile home is situated in a