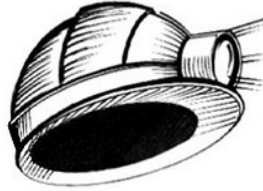


November 26, 2018



**Griggs-Lang Consulting
Geologists and Engineers, P.C.**

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**Lake Rescue
Town of Ludlow, Windsor County, Vermont**

BATHYMETRIC INVESTIGATION

November 26, 2018

This report was prepared at the request of the Lake Rescue Association by Krystyna Kornecki, Project Geologist at Griggs-Lang Consulting Geologists and Engineers, P.C.

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November 26, 2018

Background

On August 29, 2011 Tropical Storm Irene swept through Vermont causing flooding and damage throughout central Vermont. The Black River flooded the lakes region of Plymouth and Ludlow. The flood waters carried sediment from the Black River and its tributaries, Patch Brook, Buffalo Brook and Money Brook into the lakes, particularly Lake Rescue where large amounts of sediment were deposited in the lake. The sediment caused shallow areas that were hazardous to navigation near the mouth of the Black river, the northern end of the Narrows and an area east of Discovery Island.

In April 2012, Griggs-Lang Consulting Geologist and Engineers, P.C. (“Griggs-Lang”) performed a bathymetric analyses to measure the depth of the lake in certain areas and estimate the amount of material to be removed to provide a minimum 4 foot channel. Based on the analyses, the Lake Rescue Association (“LRA”) in conjunction with the Town of Ludlow submitted an application to dredge an area in Round Pond north of the Narrows near the mouth of the Black River (the “2012 Application”) to restore navigation from Round Pond into the Black River. The 2012 Application was approved on September 20, 2012 by the Vermont Agency for Natural Resources and on November 10, 2012 by the LRA membership. The approved 2012 Application permitted the restoration of the water level to a 4-foot depth and the removal of up to 1200 cubic yards at an estimated cost of \$70,000 to \$100,000.

On August 14, 2013 Griggs-Lang updated their bathymetric analyses of the permitted area as well as the sandbar in the area east of Discovery Island. The dredging contractor, Chris Sheldon worked from September 3 to October 1, 2013 to remove sediment in a cone shaped 30 feet wide channel near the mouth of the Black River fanning out to 130 feet wide.(Chart A). Although the permit allowed the removal of 1200 cubic yards after dewatering of the sediment approximately 600 cubic yards was removed.

Since the 2013 restoration more sediment has been carried into Lake Rescue and deposited in the 2012 Application area. It has been reported to LRA from time to time boats have recently hit bottom at lower lake levels. In 2018 the LRA decided to investigate the depth of the lake and engaged Griggs-Lang.

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Work Performed

Griggs-Lang was engaged to:

- Perform a bathymetric analysis to measure the depth of the lake in the same areas studied in 2012/2013,

- Compare the 2018 depths to the assumed 2013 post-restoration depths based on the maps from 2013,

- Estimate the amount of material that would be required to be removed to restore the lake depth to the assumed 2013 post restoration depths, and

- Provide a preventative plan to help alleviate the build up of sediment.

Bathymetric mapping was performed by Griggs-Lang on October 10 and 12, 2018.

Observations and actions to be considered

The bathymetric charts included herein reflect the actual depths on the date of the observations and do not consider the differences in lake levels at the time of observation. The difference in lake level must be considered when comparing the depths recorded on the charts. The lake level on October 10 and 12, 2018 was approximately 12 inches higher than the lake level of the 2012 and 2013 observations. Relative lake level (2013 vs. 2018) was determined by measuring the distance (height) to the surface of the water from a known elevation on land at the time of each survey.

2012 Application Area Observations

The mouth of the Black River and north of the Narrows has filled in between 6 and 18 inches since the restoration was performed in 2013. There are large areas that have a depth of less than 4 feet after adjusting for the differences in lake level at the time of observation. After considering the effect of differences in the lake levels on the observation dates, any area marked by a 2018 contour line of [5 feet or less] would have a depth less than 4 feet compared to the 2012/13 lake level. (See Chart B)

Since the lake levels are approximately 12 inches higher Griggs-Lang recommends dredging to the 5-foot contours *at a minimum* to restore navigation in the river and the Narrows. The estimate of material to be removed to restore the depth of the lake in the general area of the 2012 Application is 1,980 cubic yards. The area of the estimate includes all of the area in the 2012 Application and additional area south of the river channel and north of the Narrows. The restoration would remove between 6 to 12 inches of sediment from the bottom of the proposed area, which covers approximately 69,017 square feet. (See Chart C)

November 26, 2018

In addition to the restoration plan to the 2012 Application area, Grigg-Lang also prepared a preventative plan that would help disperse future sediment and extend the period of time before a subsequent restoration would be required. This preventative plan is north of the existing 2012 Application area. It would remove 6 to 12 inches of existing sediment over a 54,430 square foot area or approximately 3,800 cubic yards. (see Chart D)

Sandbar east of Discovery Island Observations

The Sandbar east of Discovery Island shows very little change after adjusting for the 12 inch difference in lake level. Observed bathymetry of the “sandbar” adjacent to Discovery Island was consistently one foot deeper than measured in 2013. See charts E and F

Dredging Plan Maps

Charts G and H are the Dredging Plan maps assuming the restoration of the 2012 Application Area and the preventative dredging suggested above were implemented.

Volumes Report:

Dredge a conically shaped channel as shown below to 4.0' below lake surface - 1200+/- C.Y.



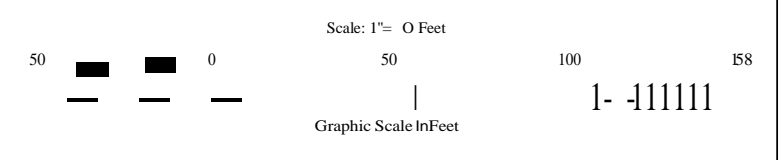
LAKE RESCUE ASSOCIATION
 LAKE RESCUE DREDGING PROJECT
 Town of Ludlow, Windsor County, Vermont

2013 DREDGING PLAN

DETAILS
 Scale: 1" = 50 Feet
 Contour Interval: 0.5'
 Datum: MLLW
 Project: MLLW
 Date: 9/2/13

LEGEND
 --- Extents of Dredging
 --- Dredging Contours
 --- Lake Bottom Contours

NOTES
 1) Depth to lake bottom contours based on Lake Levels as observed on 8/14/13.



Grigg-Lang Consulting



CONTINUATION	DETAILS	LEGEND	NOTES	GRAPHIC SCALE

CHART C



LAKE RESCUE DREDGING PROJECT
 Town of Ludlow, Windsor County, Vermont
 2018 MATERIAL THICKNESS TO
 BE REMOVED - Restorative

Bose Mop(s):
 Ve Aerial Photography
 Revisions:
 1) Review Dredging Plan,
 2) 2018 Survey Update,
 3) Review Dredging Plan, WTS,
 9/2/13

Thickness of Material to
 be Removed
 Lake Bottom Contours

1) Depth to lake bottom contours based on Lake Levels as observed on 10/12/18. Lake level is 12" higher than in 2013.



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DETAILS

LEGEND

NOTES

CHART D



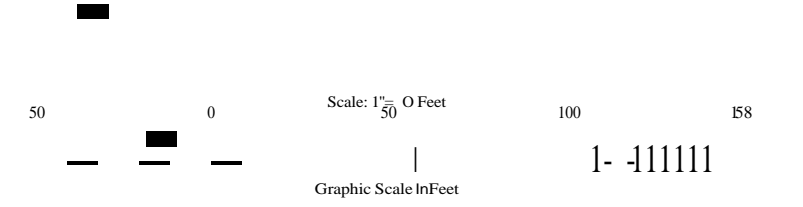
LAKE RESCUE DREDGING PROJECT
 Town of Ludlow, Windsor County, Vermont
**2018 MATERIAL THICKNESS TO
 BE REMOVED - Preventative**

Base Map(s):
 tm2Vc A11rra1 Photography
 Revisions:
 1) Review Dredging Plan.
 WTS, 5/20/12
 2) Review Dredging Plan.
 WTS, 8/13/13
 3) Review Dredging Plan.
 WTS, 9/2/13

Thickness of Material to
 be Removed
 Lake Bottom Contours

1) Depth to lake bottom contours based on Lake Levels as observed on 10/12/18. Lake level is 12" higher than in 2013.

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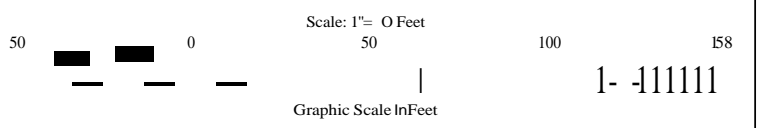


LAKE RESCUE ASSOCIATION
 LAKE RESCUE DREDGING PROJECT
 Town of Ludlow, Windsor County, Vermont
2013 EXISTING CONDITIONS
 -Discovery Island

DETAILS
 Date: 4/12/12
 Scale: 1" = 50'
 Contour Interval: 0.5'
 Datum: MLLW
 Project Manager: JTL
 Drafted by: WTS

LEGEND
 — Lake Bottom Contour

NOTES
 1) Depth to lake bottom contours based on Lake Levels as observed on 10/12/18. Lake level is 12 in higher than in 2013.



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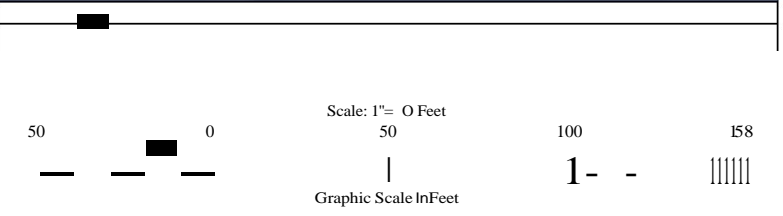
LAKE RESCUE ASSOCIATION
 LAKE RESCUE DREDGING PROJECT
 Town of Ludlow, Windsor County, Vermont
 2018 EXISTING CONDITIONS
 -Discovery Island

DETAILS
 Date: 10/12/18
 Scale: 1" = 50'
 Job No.: 18-05
 Drawn: MHL
 Project Manager: PTL
 Revision 1: KMK

LEGEND
 — Lake Bottom Contours

NOTES
 1) Depth to lake bottom contours based on Lake Levels as observed on 10/12/18. Lake level is 12 in higher than in 2013.

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LAKE RESCUE ASSOCIATION
 LAKE RESCUE DREDGING PROJECT
 Town of Ludlow, Windsor County, Vermont

LAKE RESCUE ASSOCIATION DREDGING PLAN

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 Phone: (518) 270-5920
 Fax: (518) 270-15122

DATE: 10/12/18
SCALE: 1" = 100 Feet
CAD/DESIGNER: O.S.
PROJECT MANAGER: JTL
DRAWN BY: KMK

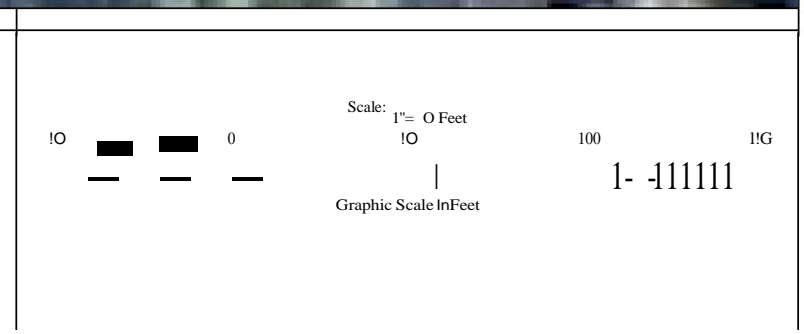
DETAILS
 Base Map(s):
 1) 2010 Aerial Photography
DATE: 10/12/18

LEGEND

- Extents of Dredging
- Dredging Contour
- Lake Bottom Contours

NOTES

1) Depth to lake bottom contours based on Lake Levels as observed on 10/12/18. Lake level is 12 in higher than in 2013.





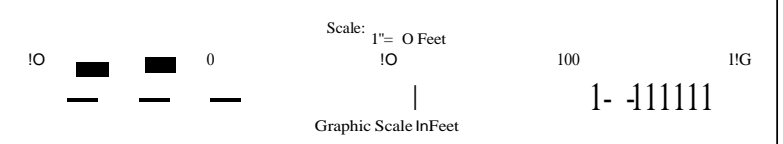
LAKE RESCUE ASSOCIATION
 LAKE RESCUE DREDGING PROJECT
 Town of Ludlow, Windsor County, Vermont

DETAILS
 Date: 10/12/18
 Scale: 1" = 100 Feet
 Contour Interval: 0.5'
 Datum: MLLW
 Project Manager: JTL
 KMK

LEGEND
 Extents of Dredging
 Dredging Contour
 Lake Bottom Contours

NOTES
 1) Depth to lake bottom contours based on Lake Levels as observed on 10/12/18. Lake level is 12 in higher than in 2013.

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