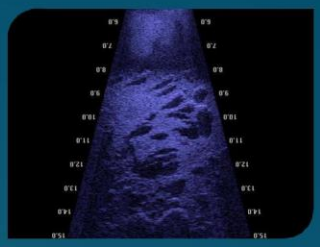
LAKE STURGEON STEWARDSHIP & ENHANCEMENT PROGRAM



Construction of Shoals to Enhance Lake Sturgeon Spawning Habitat in the Winnipeg River at Pointe du Bois: 2010 Monitoring Program

Report 10-01
April 2011

Manitoba Hydro

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Construction of Shoals to Enhance Lake Sturgeon Spawning Habitat in the Winnipeg River at Pointe du Bois:
2010 Monitoring Program

Report Prepared for

Manitoba Hydro

April 2011

By

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EXECUTIVE SUMMARY

The Lake Sturgeon Stewardship and Enhancement Program was developed by Manitoba Hydro in 2008 with the goal of maintaining and enhancing lake sturgeon populations in areas affected by Manitoba Hydro's developments and operations. As part of this initiative, a research study in the Winnipeg River downstream of the Pointe Du Bois GS was conducted to determine if spawning shoal areas could be constructed below an existing hydroelectric generating station, improving lake sturgeon spawning success. Previous lake sturgeon spawning studies conducted from 2006-2008 as part of the Pointe du Bois Spillway Replacement Project identified that sturgeon are abundant in the area and spawn downstream of the tailrace and spillway at specific locations that vary annually with powerhouse unit and spillway operation. Therefore, the primary objective of this study was to investigate methods of enhancing and/or creating lake sturgeon spawning habitat in the tailrace of an existing hydroelectric GS with a resident sturgeon population.

Based on results from a 2009 spawning shoal study, three additional spawning shoals were constructed in 2010. These shoals were constructed closer to the powerhouse, immediately downstream of units 1, 5 and 13 during April 2010. This report provides results of the program to monitor lake sturgeon use of the constructed shoals during spring 2010.

Egg mat and DIDSON camera data indicate that lake sturgeon spawning occurred in the powerhouse tailrace area in 2010, with the highest concentration of egg deposition occurring between units 2 and 4. Additional egg deposition was observed between units 11 and 12 and to a lesser extent from units 5 and 10. It appeared that sturgeon were attracted to the high flows exiting the turbines, particularly the current edges between operational and non-operational units. A total of three lake sturgeon eggs were collected on the constructed shoal near Unit 13 but not on any of the other constructed shoals. Large numbers of eggs were collected in close proximity to the shoals located downstream of units 5, 13, and 1, suggesting that spawning occurred near the shoals. In addition, the DIDSON acoustic camera showed increasingly large numbers of inactive sturgeon near Units 1 and 13 increased prior to the spawning period. Lake sturgeon were significantly less common on the shoal downstream of Unit 16 during the monitoring period compared to the other constructed shoals located nearer the GS.

STUDY TEAM - 2010

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ACKNOWLEDGMENTS

North/South Consultants would like to thank, Shelley Matkowski, Marilynn Kullman and Rob Tkach from Manitoba Hydro for their assistance with this project. We would also like to thank Garth Fergusson, Doug Krampetz, Jason Lamb, Scott Richards and the staff at the Pointe du Bois Generating Station for their assistance throughout the study.

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1.0 INTRODUCTION

The Lake Sturgeon Stewardship and Enhancement Program was developed by Manitoba Hydro in 2008 with the goal of maintaining and enhancing lake sturgeon populations in areas affected by Manitoba Hydro's developments and operations. In order to achieve this goal, several strategies have been adopted, one of which is to conduct research on questions relevant to lake sturgeon and hydroelectric development. Perhaps one of the most important ways that hydro developments affect lake sturgeon relates to the alteration and loss of spawning habitat. As such, Manitoba Hydro initiated a research study in the Winnipeg River downstream of the Pointe Du Bois GS to determine if spawning shoal areas could be constructed below an existing hydroelectric generating station that would improve lake sturgeon spawning success. Spawning shoals have been successfully developed downstream of the Rivière-des-Prairies hydroelectric station on the Des Prairie River, in Quebec (Dumont et al. 2009), however, similar attempts at improving or enhancing lake sturgeon habitat have not been attempted in Manitoba. Therefore, the primary objective of this study was to investigate methods of enhancing and/or creating lake sturgeon spawning habitat in the tailrace of an existing hydroelectric GS.

Lake sturgeon spawning investigations using egg mats and gill nets were conducted downstream of the Pointe du Bois GS from 2006-2008, as part of the Pointe du Bois Spillway Replacement Project (McDougall et al. 2008a, McDougall et al. 2008b, McDougall 2009). Results of these studies: a) indicated that lake sturgeon were abundant in the 10 km long reach of the Winnipeg River between the Pointe du Bois GS (upstream end) and the Slave Falls GS (downstream end); b) indicated that lake sturgeon spawn downstream of both the Pointe du Bois GS tailrace and spillway (Figure 1); c) identified specific lake sturgeon spawning sites; and d) determined that lake sturgeon spawning sites varied annually (as did both the powerhouse unit operation and spillway operation). Habitat surveys were also conducted in this area by scuba divers to characterize the existing habitat and develop a relationship between habitat use and habitat characteristics.

Based on the results of these studies, it was determined that the tailrace area of the Pointe du Bois GS would be an ideal location to construct spawning shoals. In addition the area offered several advantages including the abundance of spawning lake sturgeon in this area would increase the likelihood that spawning lake sturgeon would encounter the spawning shoal, studies conducted from 2006 – 2008 at this location would provide baseline information and valuable context to the results of this research study, and lastly, habitat surveys, identified areas downstream of the powerhouse that lacked suitable substrates (i.e., substrates that provides sufficient interstitial spaces for egg deposition and incubation), suggesting that these areas could be enhanced through the addition of substrates.

The first lake sturgeon spawning shoal in Manitoba was constructed downstream of Unit 16 of the Pointe du Bois GS during late April 2009. Subsequent monitoring of the shoal for use by spawning lake sturgeon began that spring (i.e., May 2009) over a three week period when water temperatures ranged from 9 – 17°C (Murray and MacDonell 2010). Although lake sturgeon were observed moving near the constructed shoal, results indicated that lake sturgeon did not spawn over the shoal, instead selecting for areas closer to the powerhouse where higher water velocities and more complex flows existed.

Based on the results of the 2009 monitoring studies, three additional spawning shoals were constructed. These shoals were constructed closer to the powerhouse, immediately downstream of units 1, 5 and 13 during April 2010 (Figure 2). This report provides results of the program to monitor lake sturgeon use of the constructed shoals during spring 2010.

2.0 CONSTRUCTED SPAWNING SHOAL DESIGN

2.1 Site Selection

As previously discussed, results of egg mat and habitat surveys conducted in 2007 and 2008 were used to identify an area downstream of Unit 16 that was suitable for shoal construction. This area was characterized by depths between 4.5 and 6.5 m, and maximum water velocities in the range of 0.7 - 0.8 m/sec, which fall within optimal velocities for lake sturgeon spawning. Substrates in the area consisted of small cobbles and gravel, providing few interstitial spaces for egg incubation and flow diversity.

Construction of the shoal took place in late April of 2009, just prior to the expected onset of lake sturgeon spawning. There was some evidence to suggest that spawning had occurred in close proximity to this area during a non-spill year in 2007 (Figure 3), but was not used by spawning sturgeon in 2008, which was characterized as a relatively high spill year (Figure 4). Based on these data, it was anticipated that construction of a shoal in this area comprised of large boulders and cobbles would increase the suitability of the habitat for egg deposition by spawning sturgeon. Additional advantages of this area for shoal placement included: the proximity to the dock, which would facilitate construction; and, the proximity to the edge of the GS, which would only require shutting down two generating units during the construction period

During spring 2009 (a high spill year), an egg mat survey and DIDSON Camera surveillance yielded no evidence that lake sturgeon used the constructed spawning shoal (Murray and MacDonell 2010). However, monitoring results did identify several areas located closer to the powerhouse, where water velocities were higher relative to those observed on the constructed spawning shoal, that were used by lake sturgeon for spawning.

Based on the 2009 monitoring results, additional shoal construction planned for 2010 was focused closer to the powerhouse. Construction of shoals in proximity to the generating units would also allow for increased opportunities for manipulating microhabitats near the shoals by changing unit operation. Three potential areas were identified as being suitable for shoal construction based on the uniformity and low suitability of substrates, as well as previous spawning location information (Figure 2). The locations included:

- The area below Unit 13 due to its proximity to Unit 12 where some evidence of spawning was collected in 2007 and 2008 (figures 3 and 4).
- The area below Unit 5 due to its proximity to the area below units 2-4 where suitable spawning substrates are located and evidence of spawning was collected from 2007 to 2009 (figures 3,4, and 5).
- The area below Unit 1 (the only Straflo Unit in the Powerhouse) because it was located immediately downstream of the highest water velocities recorded in the vicinity of the Pointe du Bois powerhouse (~1.8-2.6 m/sec).

2.2 Shoal Construction

Specifications for the spawning shoals were based on criteria developed for the Rivière-des-Prairies hydroelectric station on the Des Prairie River, in Quebec (Dumont et al. 2009). Dominion Divers Ltd. (Winnipeg, Manitoba) constructed the shoals by lowering boulders and cobble from a barge and using divers to position the material on the bottom according to provided specifications. The size distribution for the introduced substrates was as follows: 100% < 60 cm, 75% < 40cm, 100% > 20 cm. This combination of boulder and cobble was expected to provide interstitial spaces for protecting and incubating eggs. Cover,

turbulence and flow diversity were provided at each shoal by placing four large boulders with volumes of approximately 1-1.5 m^3 at the upstream end of the introduced substrate.

Unit 16

The area below Unit 16 was enhanced in late April 2009 by introducing substrates consisting of boulders and cobbles. The enhanced area that was created was approximately 3.5 m x 6 m and was located approximately 25 m from the face of the GS and 40 m from the shore (Figure 6).

Unit 13

The area below Unit 13 was enhanced in early April 2010 by introducing substrates consisting of boulders and cobbles. Cover and turbulence were provided on the constructed shoal by placing four larger boulders diagonally across the upstream end (Figure 7). The shoal was approximately 7.9 m wide, which encompassed the width of the unit from pier to pier, and 7.9 m long. It was located approximately 1.8 m from the face of the GS immediately downstream of a 1.8 m deep trench running along the front of the GS (Figure 7). Existing boulders were incorporated into the southwestern section of the shoal.

Unit 5

The area below Unit 5 was enhanced in early April 2010 by introducing substrates consisting of boulders and cobbles. Cover and turbulence were provided on the constructed shoal by placing four larger boulders diagonally across the upstream end (Figure 8). The shoal was approximately 7.9 m wide, covering the width of the generating unit from pier to pier, but only 5.2 m long as a 1 m high bedrock ledge limited its length. The shoal was located approximately 2.4 m from the face of the GS immediately downstream of a 1.8 m long trench running along the front of the GS (Figure 8).

Unit 1

The area below Unit 1 was enhanced in early April 2010 by introducing substrates consisting of boulders and cobbles. Cover and turbulence were provided on the constructed shoal by placing four larger boulders horizontally across the upstream end (Figure 9). The shoal was constructed on top of a bedrock ledge approximately 3.7 m from the GS and immediately downstream of a trench extending from Unit 1. The shoal was approximately 7.9 m long and 7.9 m wide, extending east from the center of Unit 1.

3.0 CONSTRUCTED SPAWNING SHOAL MONITORING METHODS

The constructed shoals were monitored by two methods during the lake sturgeon spawning period in spring 2010; egg collection mats were deployed throughout the tailrace and spillway areas and a DIDSON (Dual Identification Sonar) acoustic camera (Soundmetrics Corp., Lake Forest Park, Washington, USA) was used to observe fish presence on the constructed shoals and in surrounding areas. The shoal monitoring was conducted in concert with investigations of lake sturgeon spawning activity and habitat use conducted as part of the Pointe du Bois Spillway Replacement Project.

Egg Collection Mats

Egg collection mats were placed on and around the constructed shoals to search for direct evidence of spawning. Egg mats consisted of a 30 x 90 cm portion of furnace filter material wrapped around a 39 x 19 x 9 cm cinder block and held in place with bungee cords (Figure 10). Lake sturgeon eggs readily adhere to

furnace filter material and the presence of eggs on the mats provides an indication that spawning has occurred in close proximity.

The mats were either deployed as transects running parallel to the river flow, with mats located at approximate 20 m intervals, or as individual mats. The majority of transects consisted of four to five egg collection mats, with some transects consisting of only two mats. A large anchor was attached to the upstream end of most transects and a float was attached to the downstream end to facilitate retrieval. The egg collection mats were lifted every two to three days to inspect the filter material for eggs and subsequently replaced. GPS coordinates, depth, and velocity were recorded at each mat location. The objective was to deploy a similar number of egg mats on each of the shoals, however, approximate UTM coordinates and high water velocities precluded exact placement.

DIDSON Acoustic Camera

A DIDSON sonar camera was used to monitor the constructed shoals and surrounding areas during the spawning period to determine if lake sturgeon were utilizing and/or spawning in the vicinity of the constructed spawning shoals. The setup consisted of a DIDSON camera unit attached to a pan & tilt rotator (PT-25) that was mounted on a swiveling Viper Fish Pole (Rented from Ocean Marine Industries Inc., Virginia, USA) (Figure 11). A custom built mounting bracket was bolted to the seat of the boat (constructed by Anything Custom Ltd. Winnipeg, Manitoba) and the pole, rotator, and camera were attached to it. The setup allowed the camera to be lowered approximately 1 m below the surface for monitoring, raised for travel. The boat was moored differently at each of the constructed shoal locations for optimal camera operation. To monitor the constructed shoal downstream of Unit 16, the boat was moored immediately downstream of the shoal and the camera was pointed upstream. At the Unit 13 shoal, the boat was tied directly to the station and the camera was pointed downstream at the shoal. Attempts were made to moor near the Unit 5 shoal, but flow conditions prevented the capture of steady images. The constructed shoal downstream of Unit 1 was monitored by mooring the boat in the calmer water east of the shoal. Each constructed shoal was monitored throughout the spawning period for approximately 2 hours each day, and the time of day that each shoal was monitored was changed daily. Digital images were recorded whenever there was evidence of fish use. The digital data were reviewed and summarized at a later date to describe the frequency of lake sturgeon observations and spawning behaviour.

4.0 RESULTS

4.1 Egg Mat Monitoring Results

Egg mat results suggest that lake sturgeon spawning commenced on 17 May, and peaked from 17 to 20 May in 2010 (Figure 12). Discharge rates for the Winnipeg River were low during spring 2010 and no spill occurred during the spawning period. Evidence of lake sturgeon spawning was only found in the powerhouse tailrace area and was primarily concentrated downstream of units 2 – 5 with some evidence of spawning occurring downstream of units 11 – 12 and to a lesser extent downstream of units 5 and 10 (Figure 13).

A total of 12 egg mats were located on or immediately adjacent to the constructed shoals: one on the Unit 1 shoal, none on the Unit 5 shoal, ten on the Unit 13 shoal, and one on the Unit 16 shoal (Table 1 and Figure 14). Only one egg mat, which was located on the downstream end of the shoal below Unit 13, yielded lake sturgeon eggs (n=3). Large numbers of eggs were found immediately adjacent (within 10 m) to all the

shoals, with the exception of the shoal downstream of Unit 16 (Table 1). Nearly 1200 eggs were collected adjacent to the Unit 5 shoal suggesting that the area between units 4 and 5 was a spawning location in 2010 (Table 1). Due to safety concerns associated with high water velocities, egg mats could not be located directly on the shoal; however, the presence of eggs downstream of the shoal (Figure 14) likely indicates that spawning occurred within the area of the shoal. Egg mats in close proximity to the shoals downstream of units 1 and 13 captured a smaller number of eggs, likely indicating that sturgeon eggs were deposited just upstream and then drifted onto the egg mats (Table 1 and Figure 14). The egg mat results did not definitively confirm that lake sturgeon spawned on any of the shoals in 2010; however, there was strong evidence that spawning occurred very close to the constructed shoals.

4.2 DIDSON Acoustic Camera Monitoring Results

The DIDSON acoustic camera was used to monitor the constructed shoals from 13 to 29 May. Several attempts were made to monitor the shoal downstream of Unit 5; however, extremely turbulent conditions prevented effective deployment of the camera. Lake sturgeon were observed on and just adjacent to the constructed shoals just prior to the beginning of the spawning period (May 17). The lake sturgeon appeared to be fairly inactive during this time and multiple sturgeon were observed lying parallel to each other along the bottom for extended periods of time - a behaviour likely attributable to mature males waiting for females to arrive at the spawning area (Figure 15). As water temperature increased, the number, and activity level of sturgeon increased, peaking from May 17-20 (Figure 16). Although very high numbers of lake sturgeon were observed swimming on and near the constructed shoals, and spawning activity was observed adjacent to the Unit 13 shoal, there were no conclusive observations of lake sturgeon spawning on the shoals.

Unit 1 Shoal

Large numbers of adult lake sturgeon (< 800 mm fork length) were observed lined up along the bottom adjacent to the shoal. Prior to the spawning period the sturgeon were relatively inactive, with activity progressively increasing on a daily basis as water temperatures increased. Very few lake sturgeon were observed actually on the shoal. Lake sturgeon were first observed on the shoal on 15 May with the highest number of observations occurring on 18 May (n=14) (Figure 16). Following the spawning period, the number of sturgeon observed on or near the shoal decreased. None were observed on the shoal on 21 May and only a few individuals were observed thereafter (Figure 16).

Unit 13 Shoal

Initially, few lake sturgeon were observed on or near the Unit 13 shoal. As water temperatures increased, the number and activity level of sturgeon observed on the shoal also increased, with the highest number of observations occurring on 16 and 17 May (n=63 and n=52 respectively, Figure 16). During this time sturgeon were frequently observed swimming around the boulders at the upstream end of the shoal, the unit openings (units not in operation), as well as a bedrock outcrop surrounded by boulders (Figure 15). Although no direct evidence of spawning activity was observed on the shoal, there did appear to be spawning activity adjacent to the shoal, including the bedrock outcrop pictured in Figure 15. Sturgeon were also frequently observed swimming around an egg mat placed upstream of the shoal near the wall of the GS, however, no eggs were collected at this location (Figure 15). Following the peak spawning period, the number of lake sturgeon observations on the shoal steadily decreased (Figure 16). It should be noted that the units in closest proximity to this constructed shoal (i.e., units 12, 13, and 14) were not in operation during the peak spawning period.

Unit 16 Shoal

The shoal downstream of Unit 16 had the lowest frequency of lake sturgeon observations of all constructed shoals monitored. As water temperatures increased, the number of observations remained very infrequent (Figure 16). No visible evidence of spawning activity was observed on or near the shoal throughout the monitoring period. There was an increase in the number of sturgeon observations toward the end of the monitoring period.

5.0 SUMMARY

In 2010, there was no spill during the lake sturgeon spawning period. Lake sturgeon spawning occurred in the powerhouse tailrace area, with the highest concentration of egg deposition occurring between units 2 and 4. Additional egg deposition was observed between units 11 and 12 and to a lesser extent from units 5 and 10. It appeared that sturgeon were attracted to the high flows exiting the turbines, and were keying in on the current edges adjacent to the main flow between the units that were in operation and those that were not in operation. A total of three lake sturgeon eggs were collected on the constructed shoal near Unit 13 but not on any of the other constructed shoals. Large numbers of eggs were collected in close proximity to the shoals located downstream of units 5, 13, and 1, suggesting that spawning occurred near the shoals. The DIDSON acoustic camera showed large numbers of inactive sturgeon present near the Unit 1 shoal prior to the spawning period. As peak spawning approached, the number of sturgeon present near Unit 13 increased rapidly. The shoal near Unit 5 could not be observed with the DIDSON camera, but egg mat results suggested that this area may have been an important location for spawning within the tailrace. The shoal downstream of Unit 16 attracted substantially fewer lake sturgeon during the monitoring period compared to the other constructed shoals located in closer proximity to the GS.

Lake sturgeon larvae were captured in drift traps set downstream from the powerhouse during 2010 lake sturgeon spawning studies conducted below the Pointe du Bois GS (Koga and MacDonell 2011). Although it cannot be confirmed that the drifting larvae originated from eggs deposited on the spawning shoals, these captures confirm that successful spawning occurred within the tailrace in 2010.

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Table 1. Summary of the number of egg mats and eggs located on or within 10 meters of the constructed shoals located downstream of the Pointe du Bois GS, spring 2010.

Constructed Shoal Area	Number of Egg Mats Present	Number of Eggs Collected Within Area
Unit 1 SS	1	0
Unit 5 SS	0	0
Unit 13 SS	10	3
Unit 16 SS	1	0
<10 m from Unit 1 SS	18	240
<10 m from Unit 5 SS	15	1194
<10 m from Unit 13 SS	34	151
<10 m from Unit 16 SS	44	0
Grand Total	**123**	**1588**

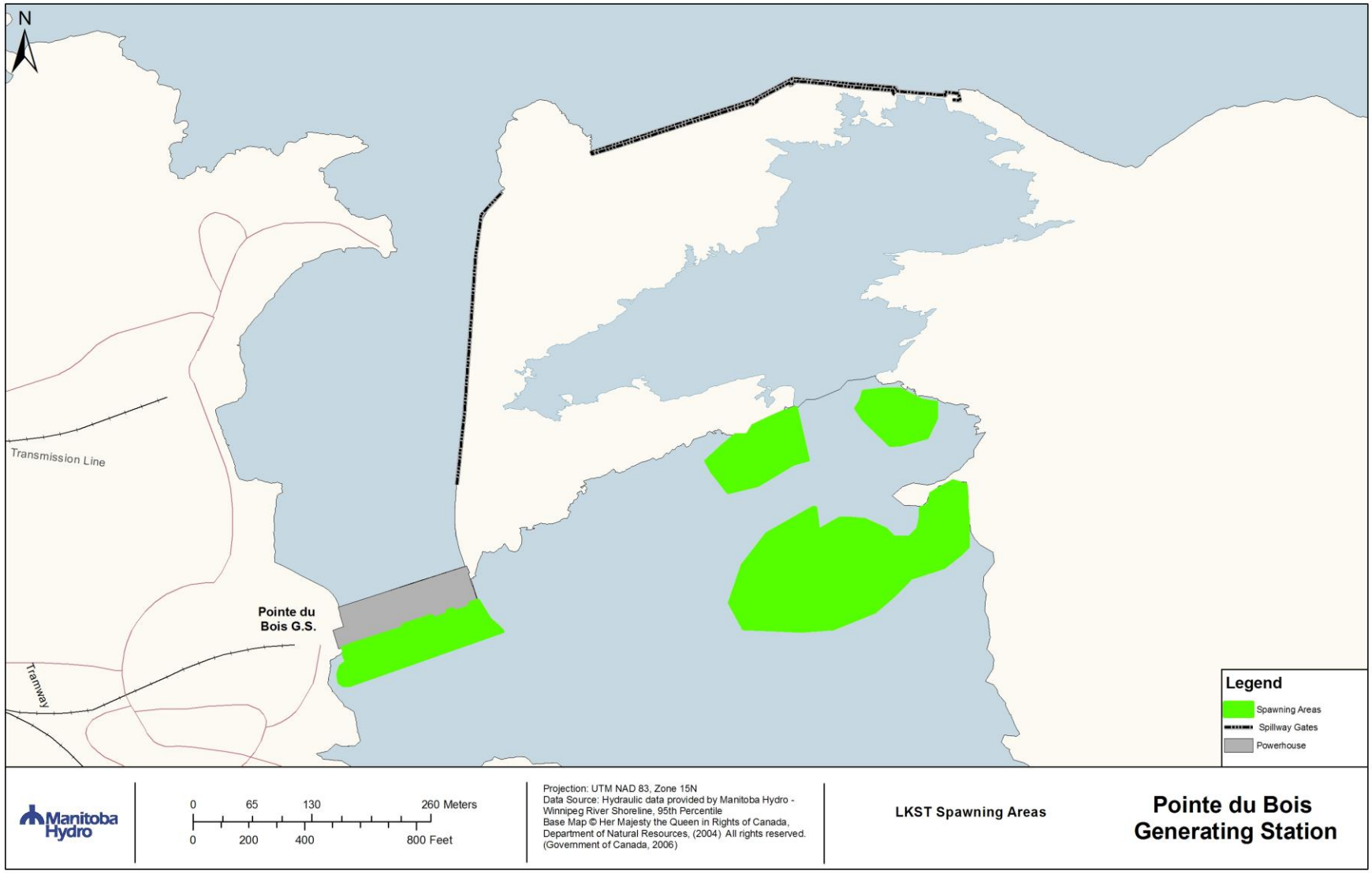


Figure 1. Lake sturgeon spawning areas identified below the Pointe du Bois Generating Station and spillway.

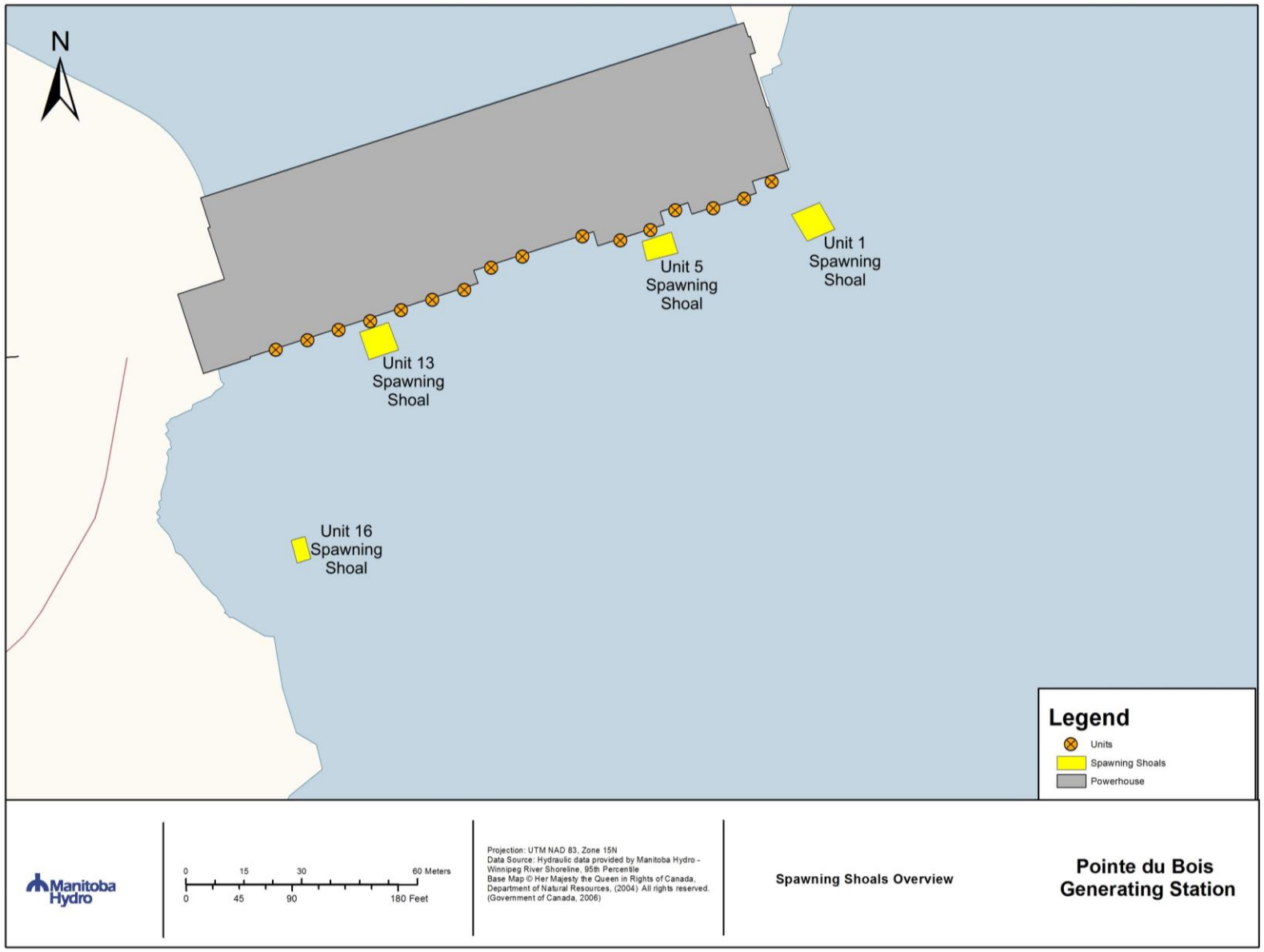


Figure 2. Location of spawning shoals constructed in 2009 (Unit 16) and 2010 (units 1, 5, and 13) downstream of the Pointe du Bois GS.

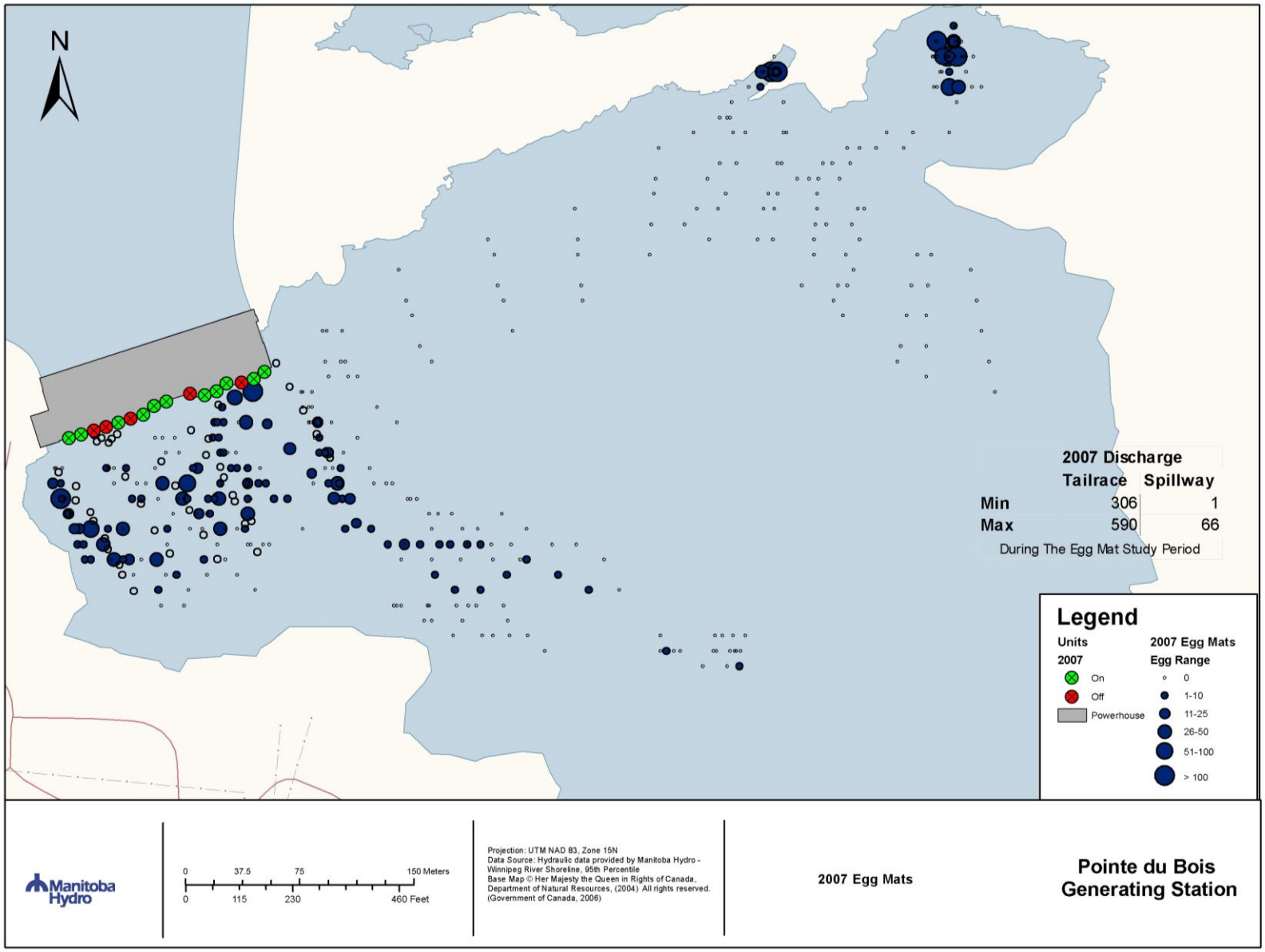


Figure 3. Lake sturgeon egg mat locations from 2007 indicating presence, absence, and abundance of eggs along with unit operation status (on/off) during peak spawning.

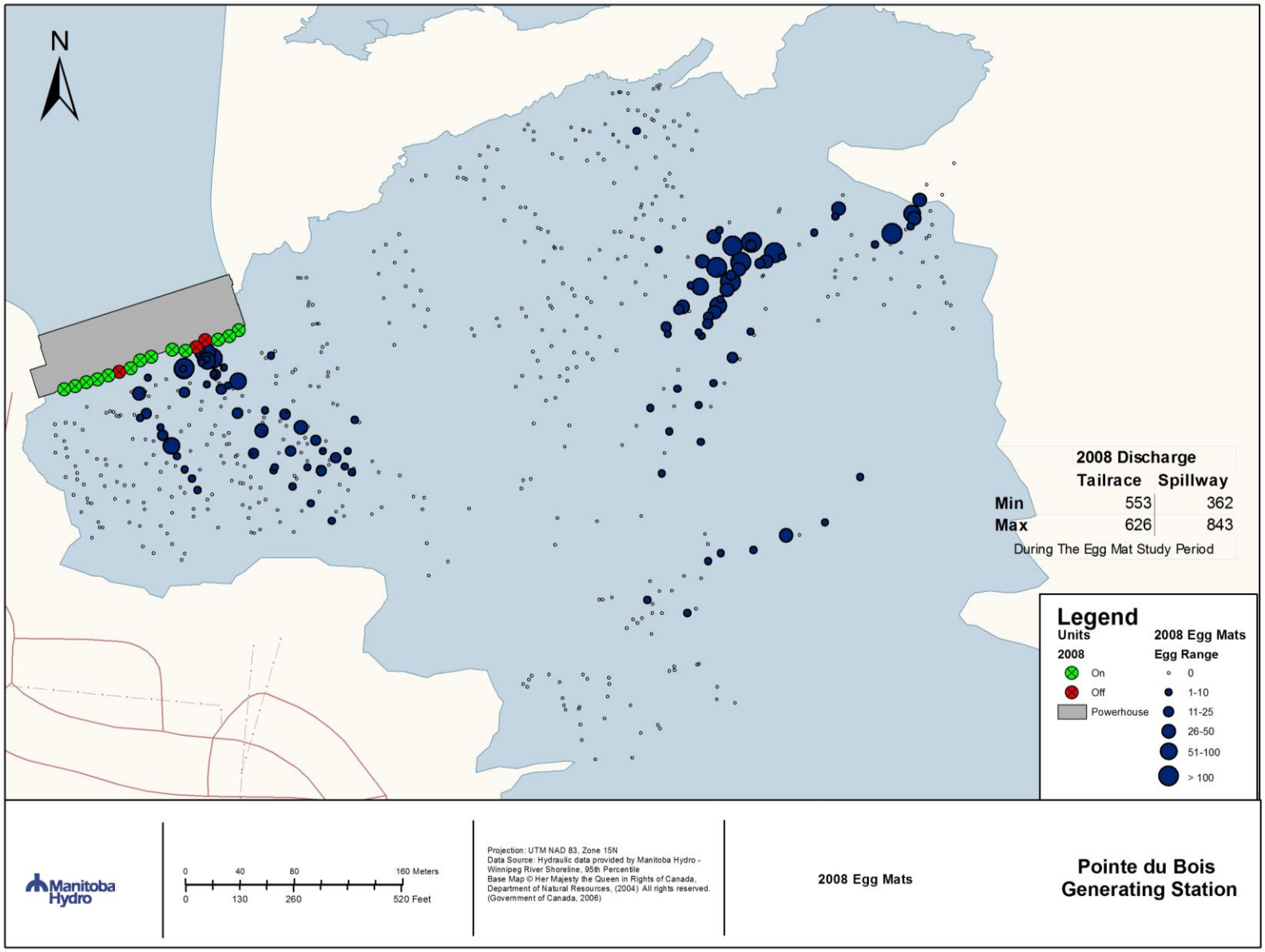


Figure 4. Lake sturgeon egg mat locations from 2008 indicating presence, absence, and abundance of eggs along with unit operation status (on/off) during peak spawning.

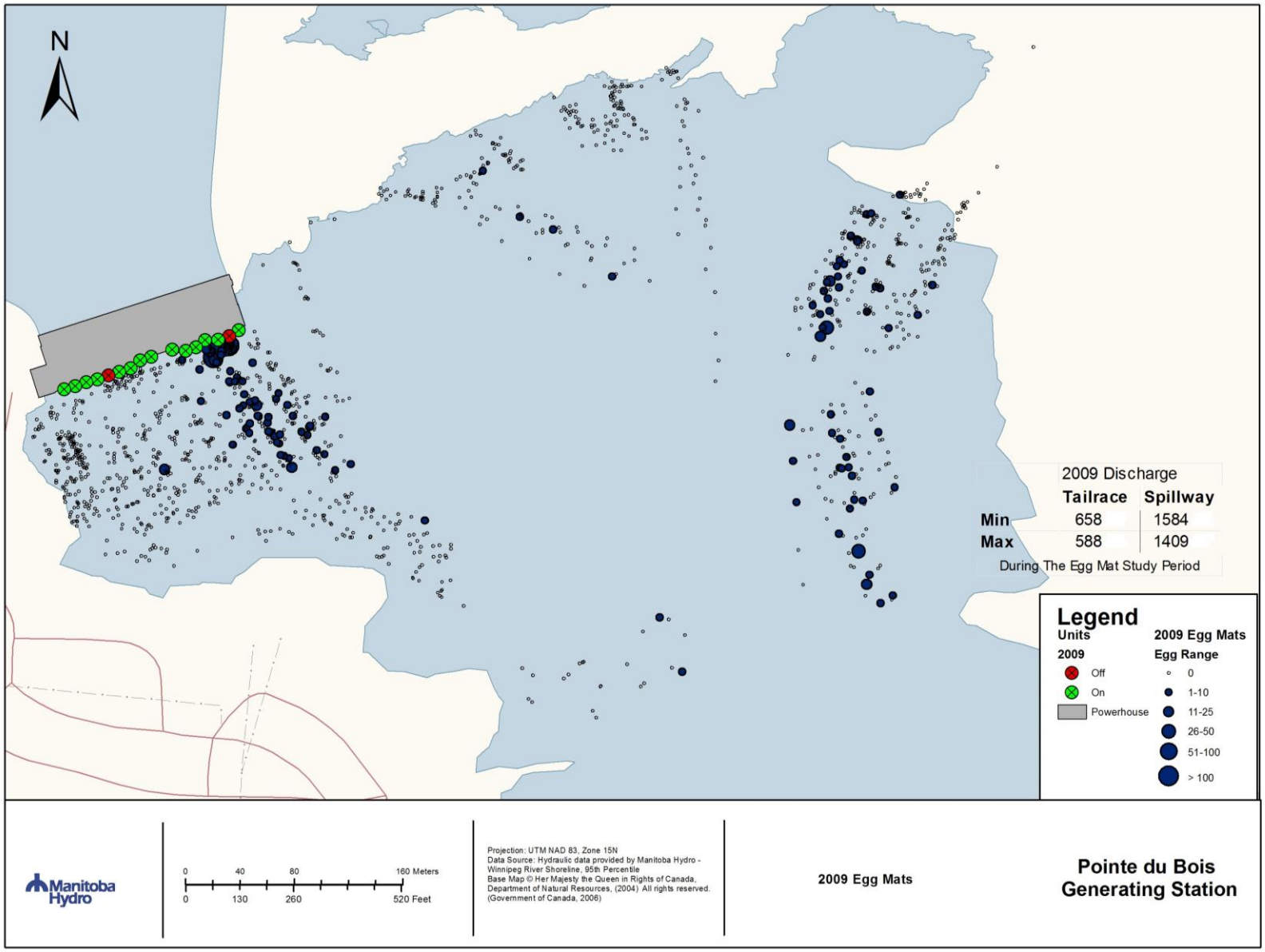


Figure 5. Lake sturgeon egg mat locations from 2009 indicating presence, absence, and abundance of eggs along with unit operation status (on/off) during peak spawning.

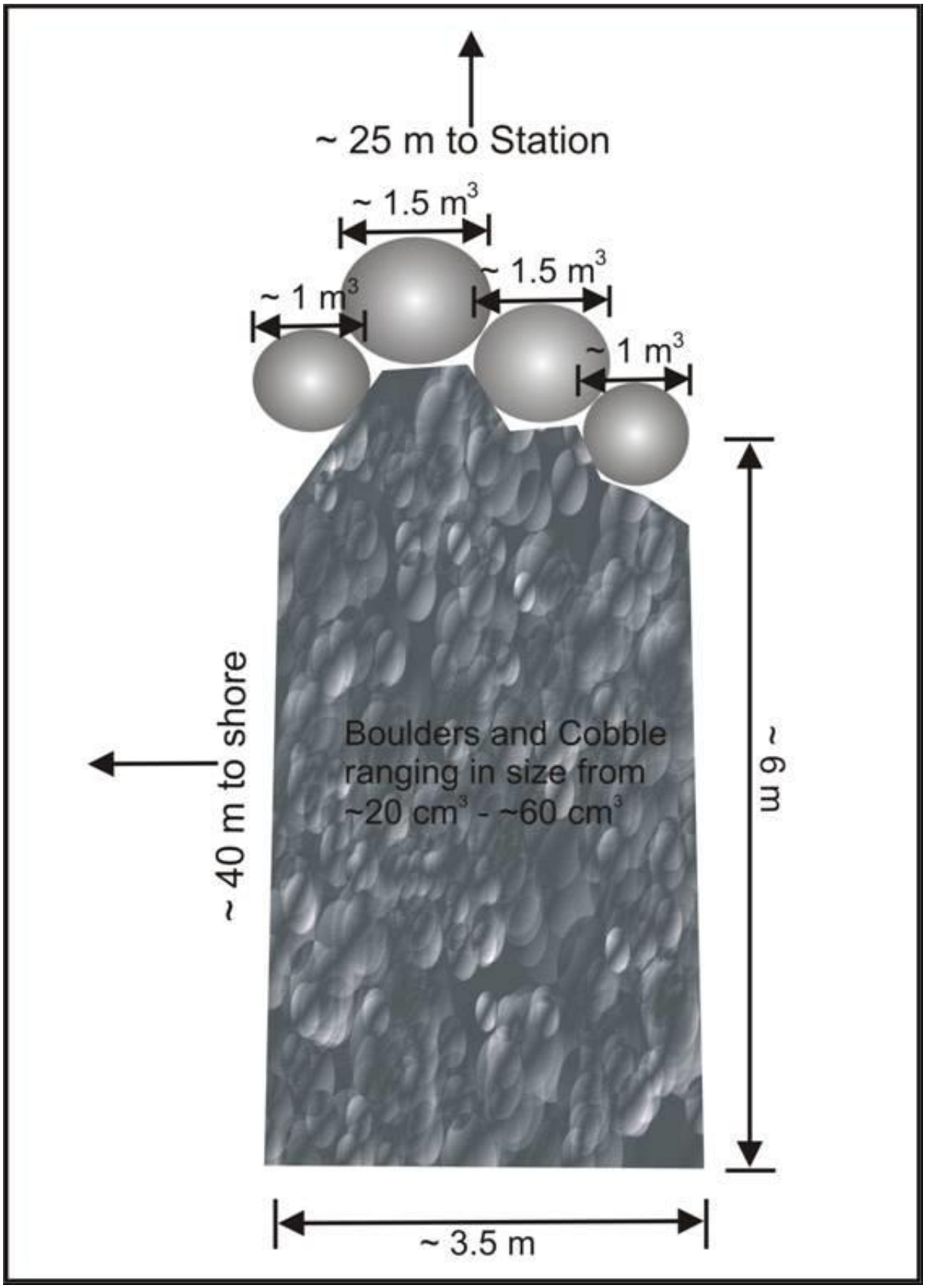


Figure 6. Plan view sketch of shoal constructed below Unit 16 (not to scale).

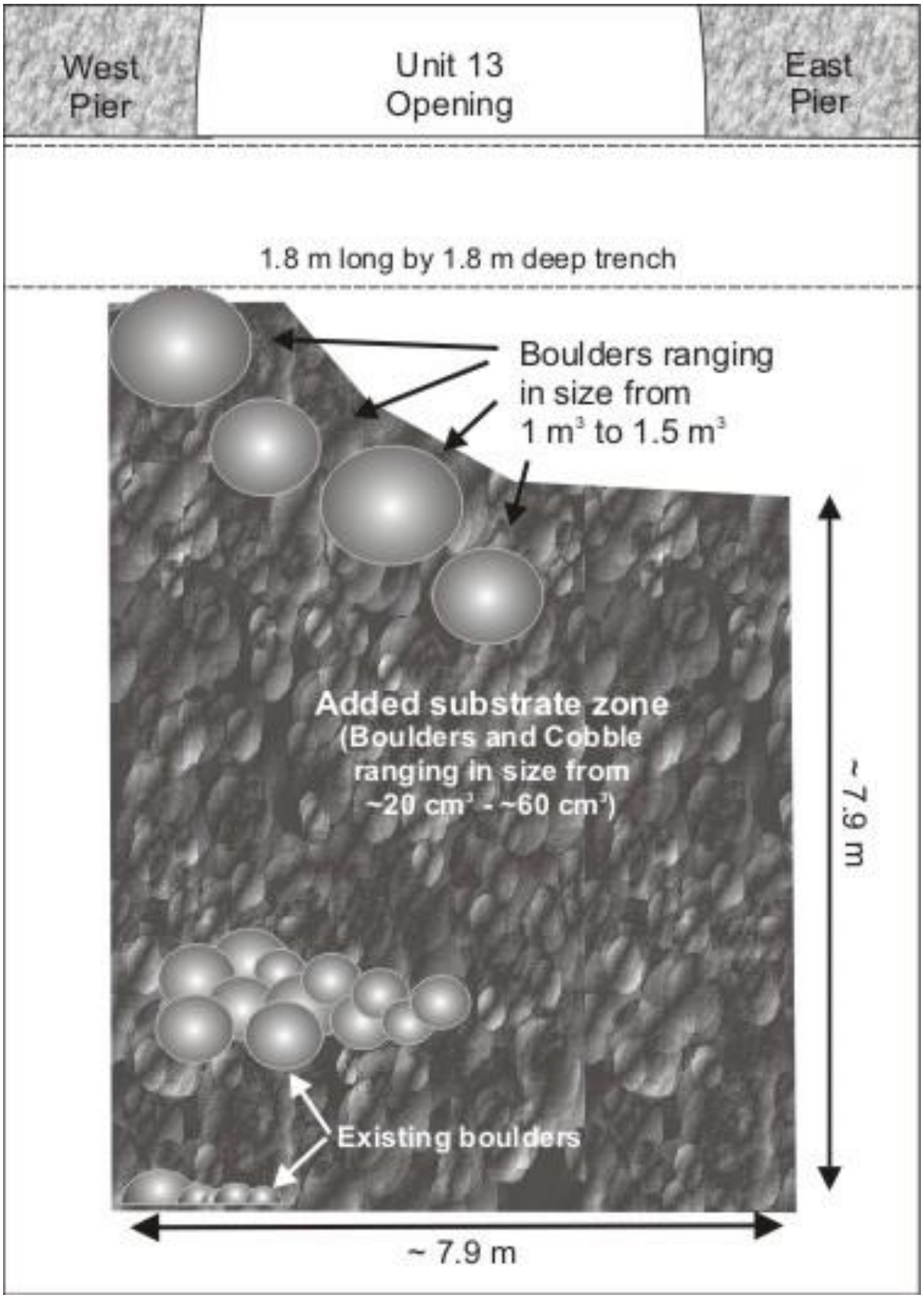


Figure 7. Plan view sketch of shoal constructed below Unit 13 (not to scale).

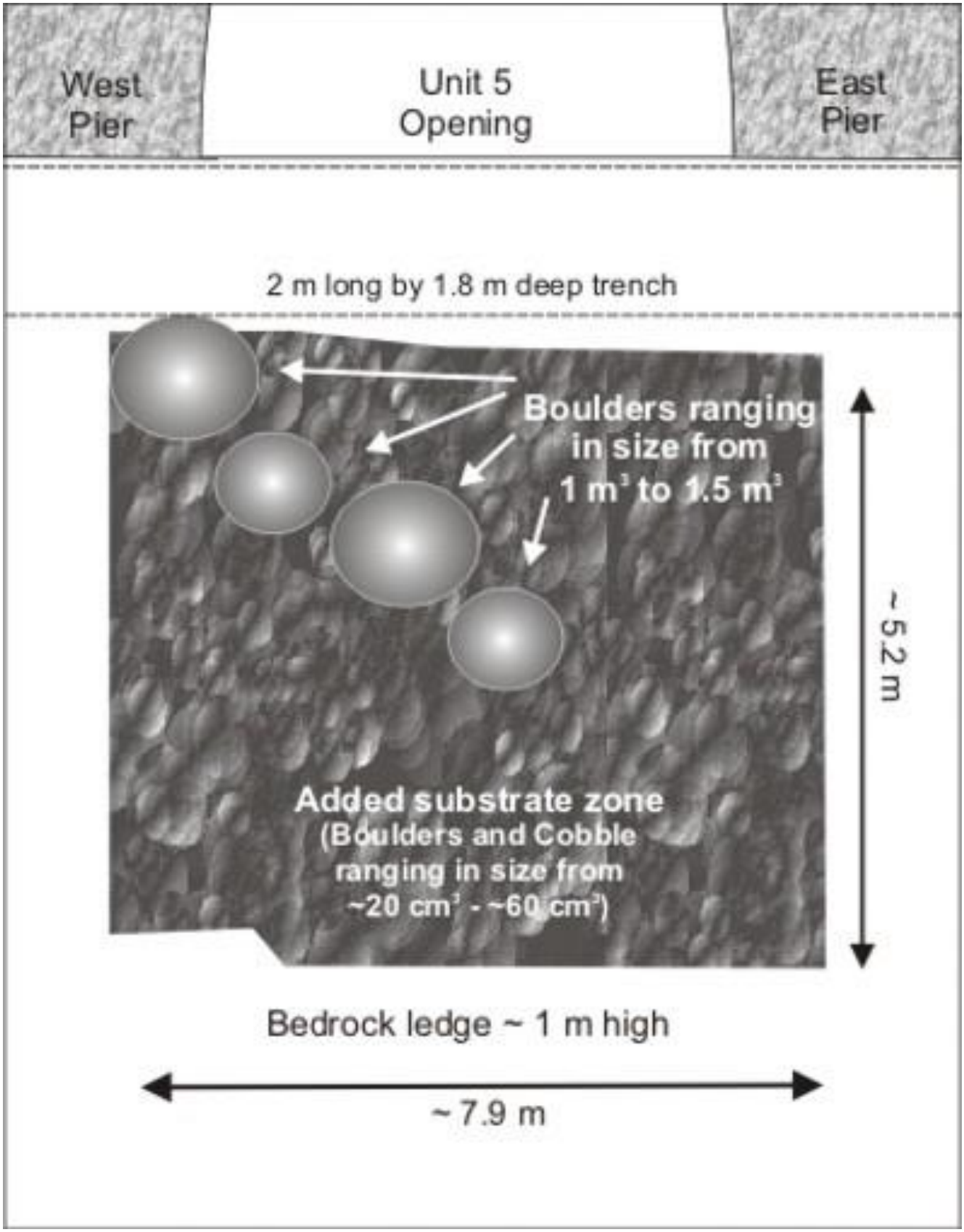


Figure 8. Plan view sketch of shoal constructed below Unit 5 (not to scale).

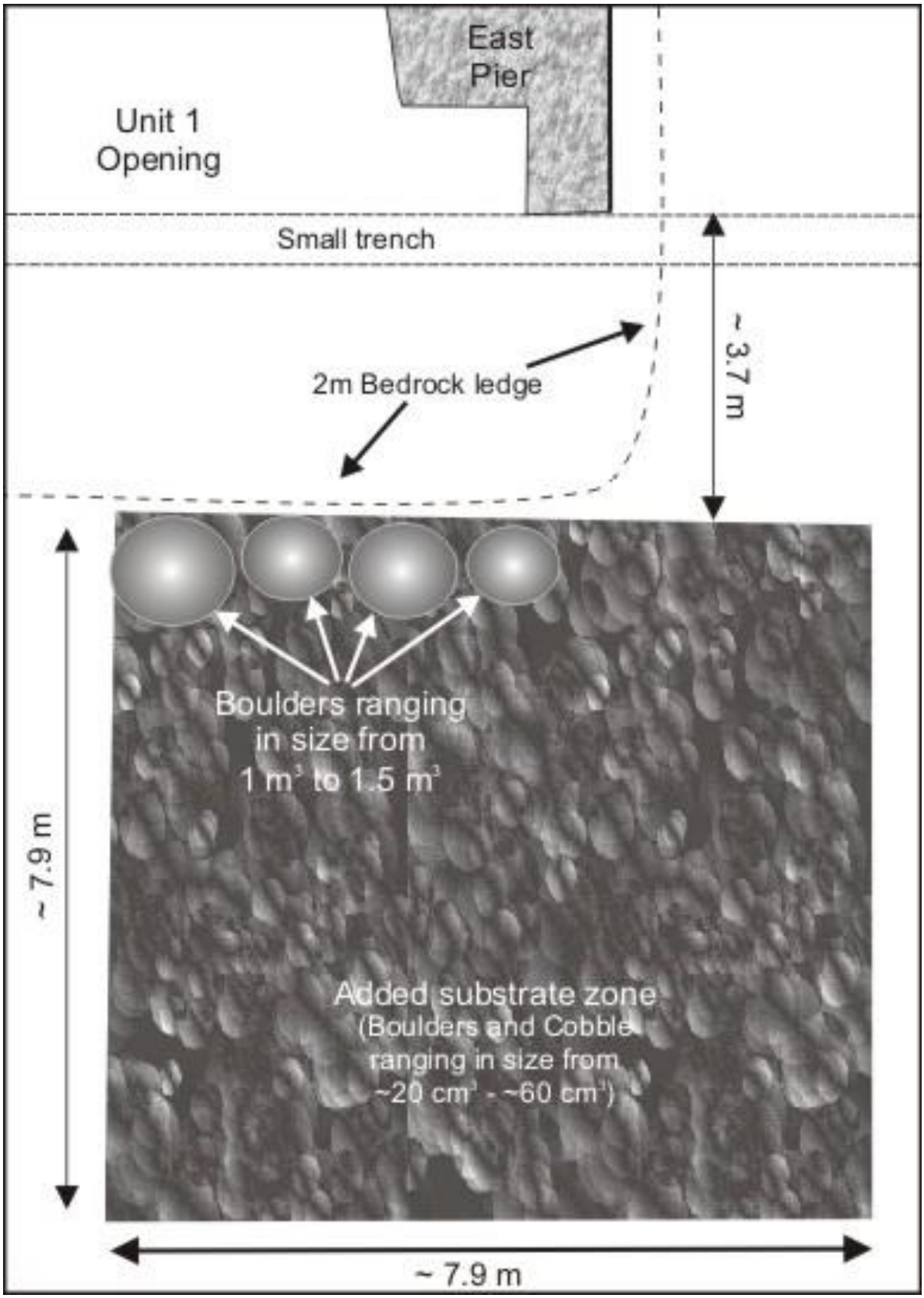


Figure 9. Plan view sketch of shoal constructed below Unit 1 (not to scale).

Figure 10. Egg collection mat used to monitor spawning on and near the constructed shoals.

Figure 11. DIDSON acoustic camera and pole mount used to monitor the constructed shoals.

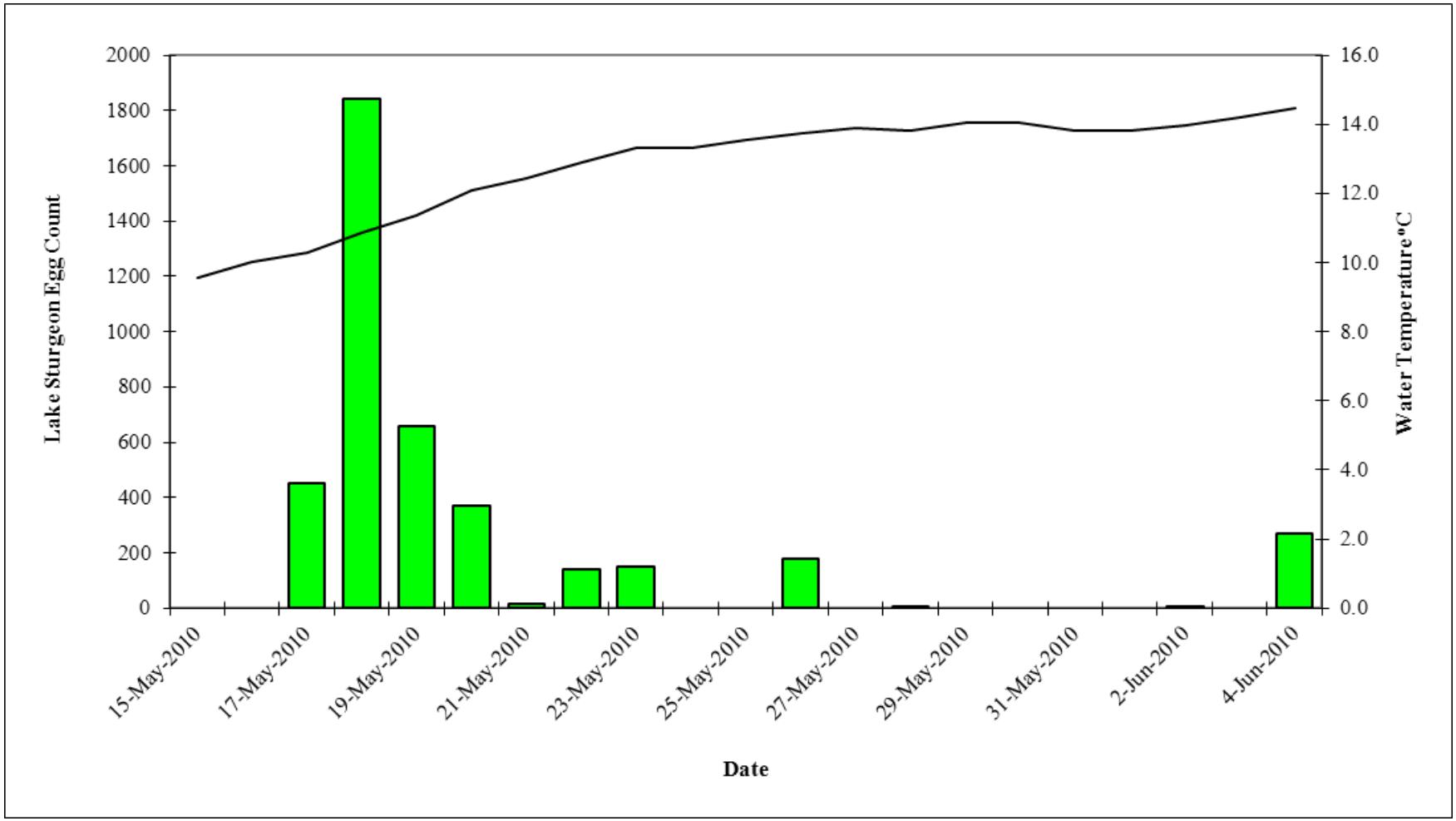


Figure 12. Summary of lake sturgeon egg collection mat results from below Pointe du Bois Generating Station for spring 2010 with daily water temperature indicated.

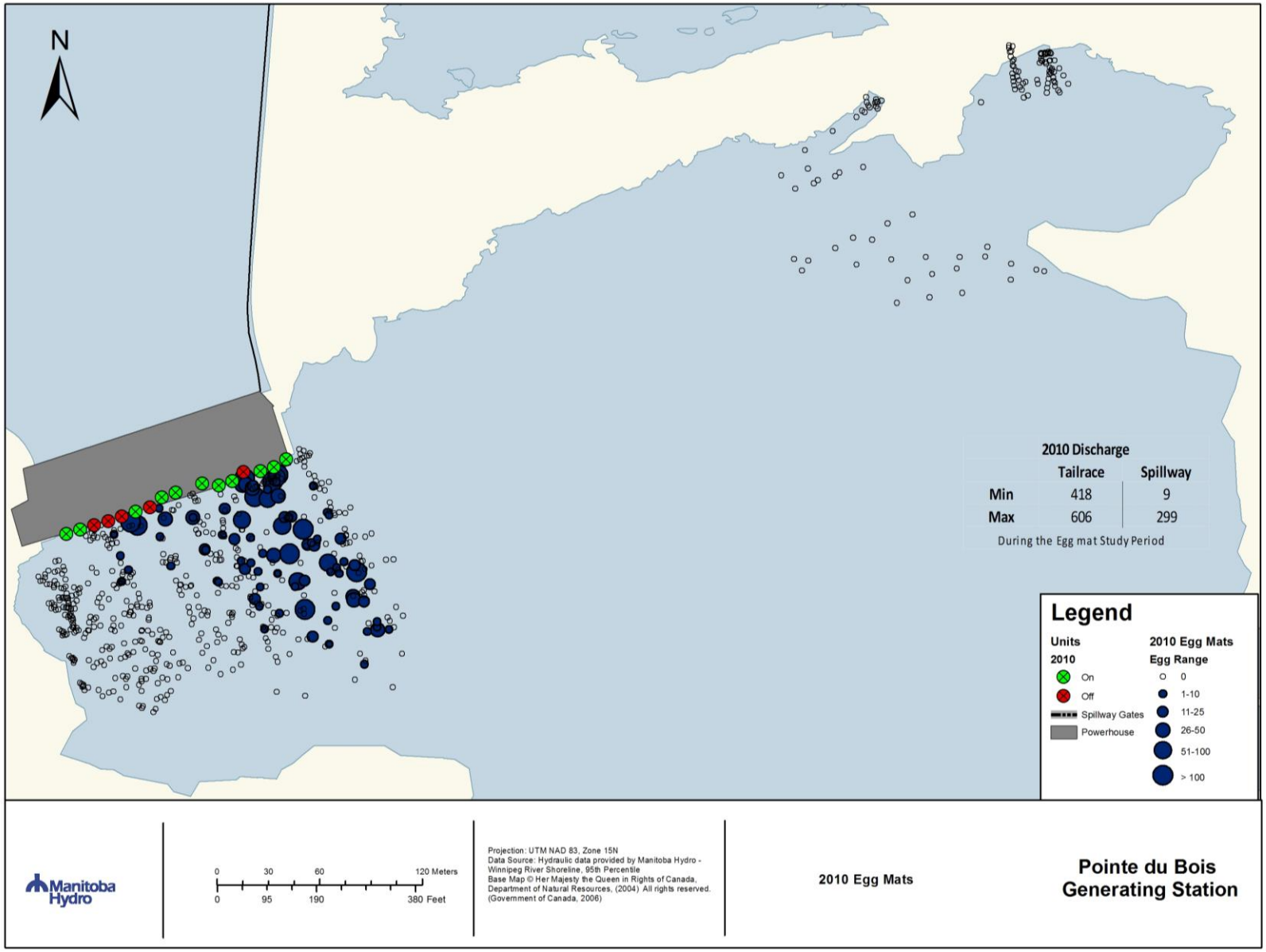


Figure 13. Egg collection mat results from below Pointe du Bois for spring 2010.

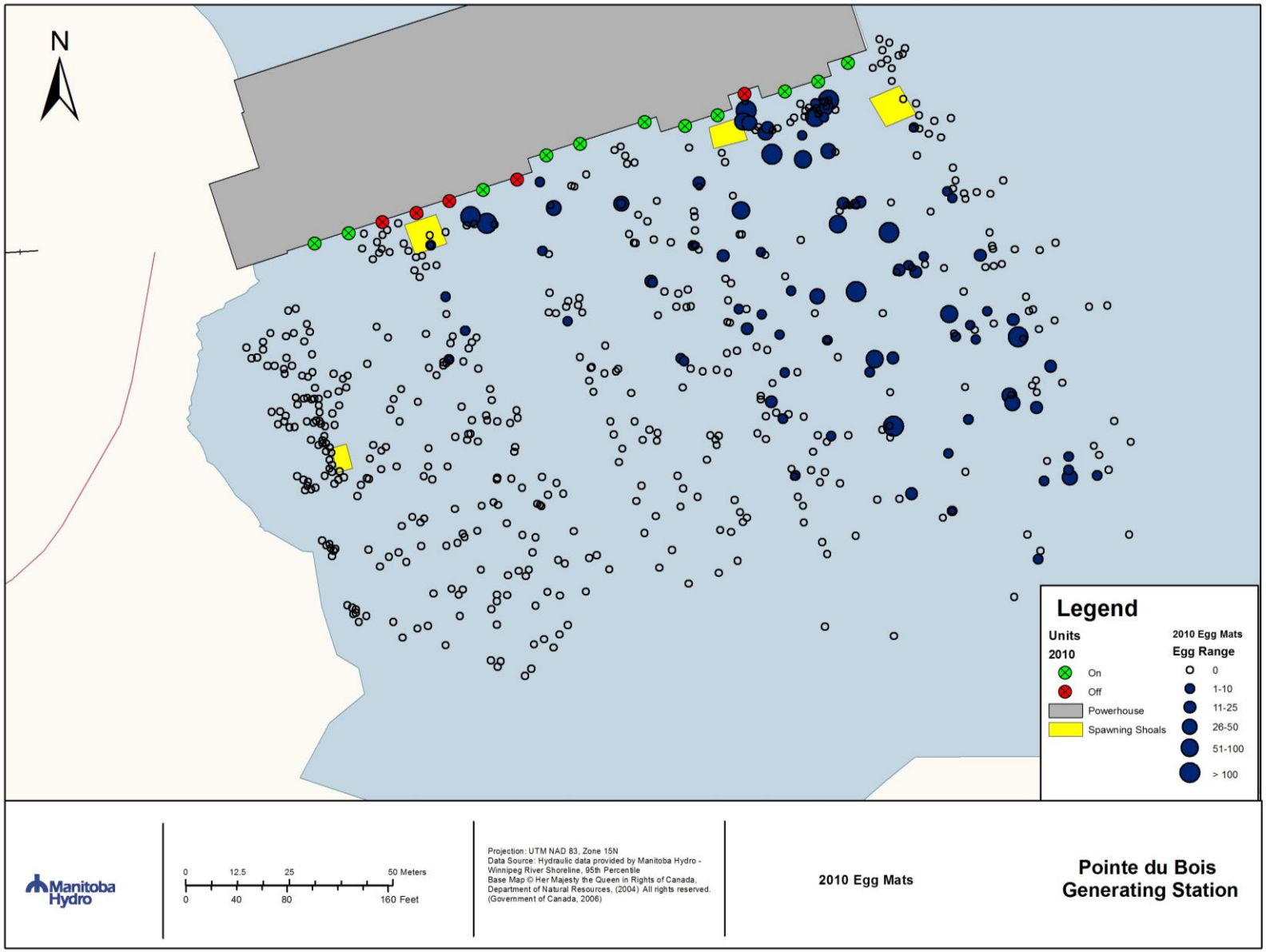


Figure 14. Egg collection mat results from tailrace area including constructed shoals for spring 2010.

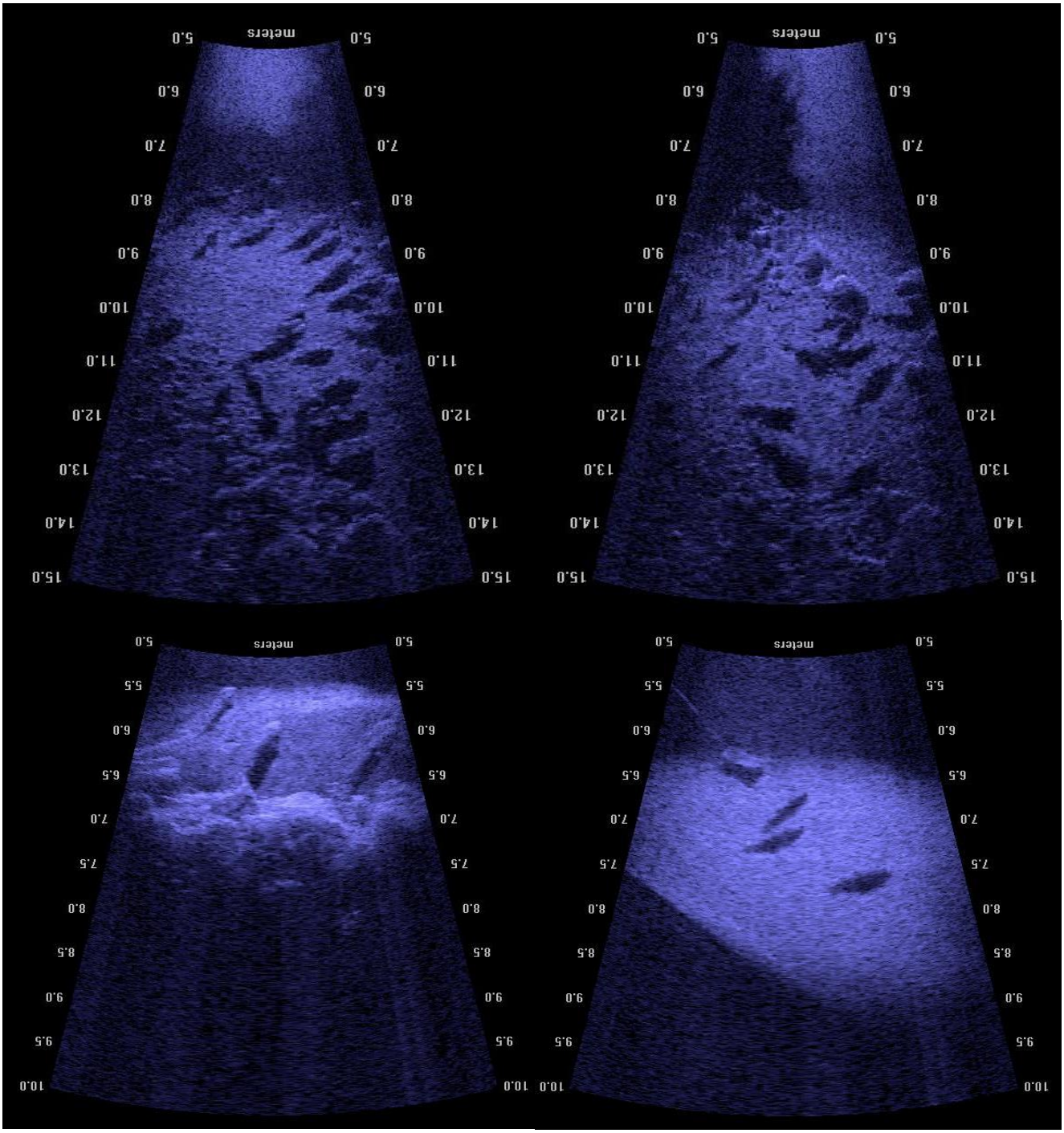
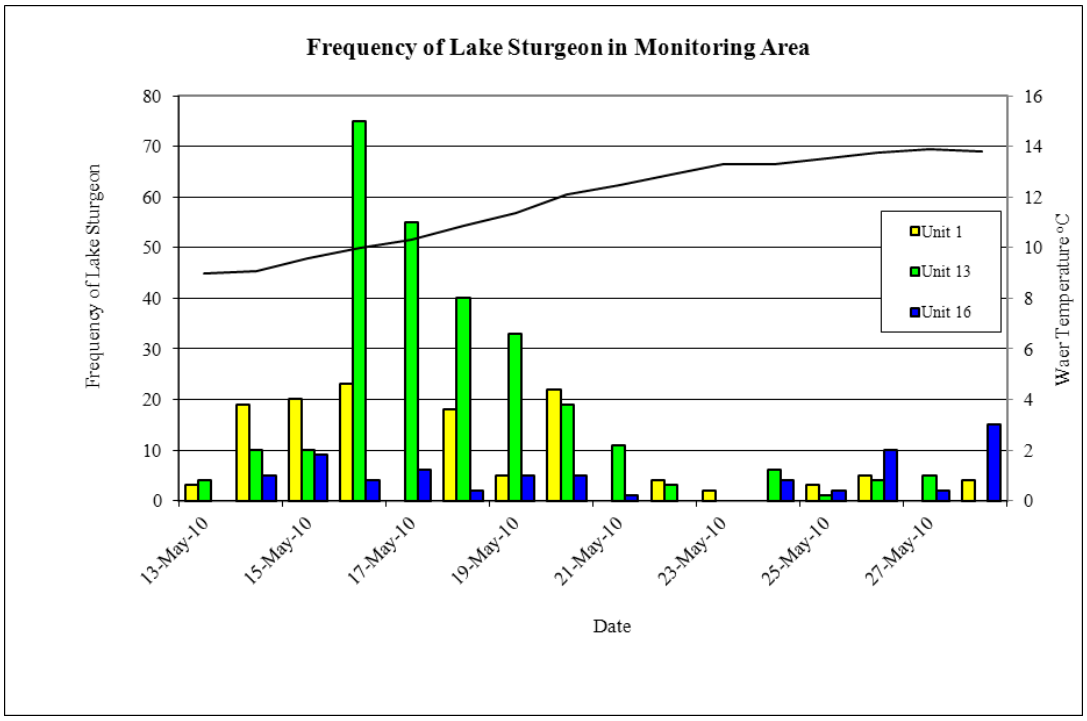


Figure 15. Screen captures from DIDSON camera footage. Top Left – multiple inactive lake sturgeon (15+) near Unit 1 shoal on 13 May; Top Right – same location on 14 May with noted increase in activity; Bottom Left – three adult lake sturgeon where spawning activity was observed adjacent to Unit 13 shoal; Bottom Right – three lake sturgeon swimming around egg mat located within trench upstream of Unit 13 shoal.



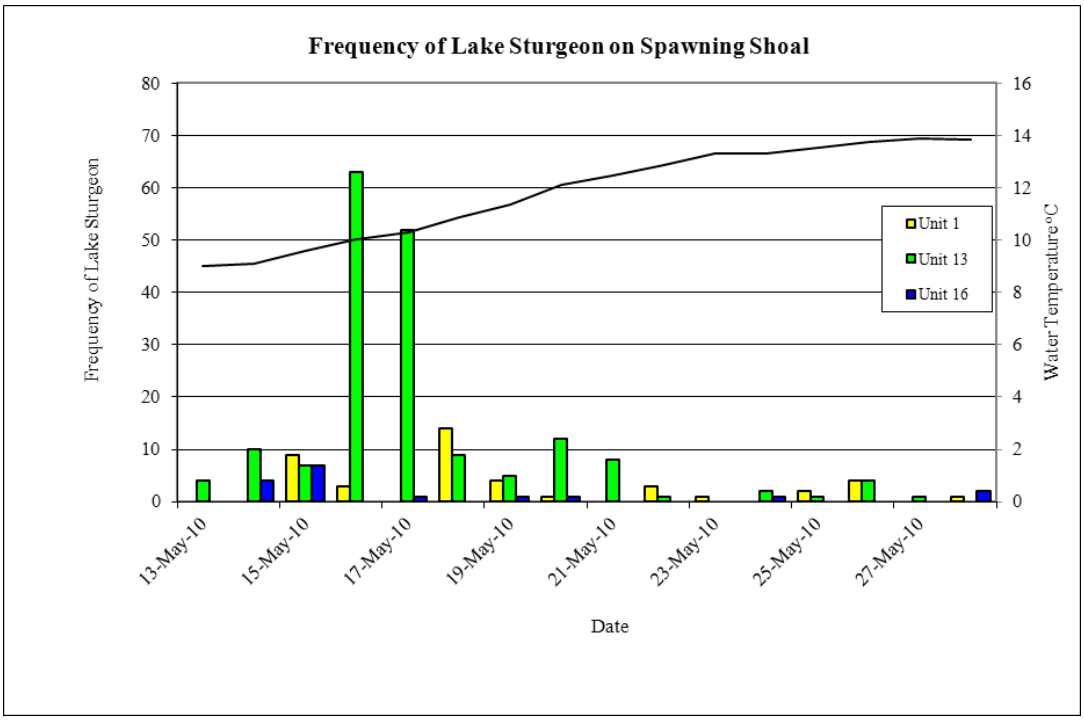


Figure 16. Frequency of lake sturgeon observed within the monitoring areas including constructed shoals (top) and within the constructed shoals (bottom). Water temperature during the monitoring period is indicated on the secondary vertical axis.