Final report

Bathymetry and sediment characterization of Lake Manor
City of Naples, FL

Research Proposal submitted to:
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Introduction

Lake Manor is a narrow "L" shaped 4.3 acres (1.7 ha) detention pond located in the city of Naples within 7th Avenue North, 10th Street North and 6th avenue North (UTM 17R 420805 E 2893062 N; Fig.1). The perimeter as determined by aerial photographs from Google Earth is 1,205m for a resulting shoreline development index (SDI) of 1.56. This pond was sampled previously by Johnson Engineering, Tim Denison on 05/29/2008. Mid-depth water samples and what to appear to be dredged sediment samples (grab) were collected at three locations in the pond. Water was analyzed for chlorides and for the following nutrients: total Kjeldahl Nitrogen (TKN), total nitrogen (TN), Nitrates + nitrites (NOx), ammonia nitrogen, orthophosphate (Soluble Reactive Phosphorus SRP) and total phosphorus (TP). Sediment was analyzed for the same aforementioned nutrients conducted for the water with the addition of total organic carbon and heavy metals (Al, As, Cd, Cu, Pb, Hg and Zn).

Johnson Engineering interpreted the results using the "Typical Water Quality Values for Florida's Lakes, Streams and Estuaries" (FDEP, 1989) to assess the water quality and the resulting sediment analyses were plotted again the concentration of Al to determine metal enrichment using the standard curves with confidence interval developed by Florida DEP. Lake Manor water had high chloride levels but nitrogen and phosphorus concentrations were lower than average in most FL Lakes. Sediment samples however showed high levels for all metal tested and were higher than in nearby Forest Lake.

Our group conducted a more involved analysis with the nutrients to determine that this pond was mesotrophic (medium enriched) for both phosphorus (TSI=40 ± S.D. 14) and nitrogen (TSI= 50 ± S.D. 3). Furthermore, by looking at the atomic TN:TP ratio (80.8 ± S.D. 40.7), the pond water was strongly phosphorus limited for the phytoplankton. As such, small amounts of phosphorus could trigger algae blooms in this pond. However, the sediment TN:TP ratio (7 ± S.D. 4) indicated that Lake Manor was limited in nitrogen and this figure should be retained as the sediment is a better long term estimate of nutrient limitation. When salinity was computed from the chlorides concentration, it was found to be 1.8 ± S.D. 0.0 ppt, which is above normal range (0.001 to 0.5 ppt) for a freshwater pond. By looking at the sediment metal concentration, it appears that As, Cu and Pb were above the soil cleanup target levels (SCTLs) for residential soil. Arsenic was 15 times above SCTLs while results were 5 times above SCTL for Cu and Pb.

On 06/10/2008, the pond water depth to the top of the muck layer and to its bottom was also determined at 38 locations and along 7 transects crossing the lake at its width. The sediment thickness exhibited a lot of variability and averaged 34.0 ± S.D. 26.2 and a maximum of 88.7cm of sediment accumulation. Most of the sediment seemed to be localized in the southwest end of the pond (Fig. 2). The sediment data were interpolated but it was not possible to estimate the amount of sediment in the pond with accuracy because transects are positioned too far from one another. With such a low number of transects, an interpolation would necessitate to make the assumptions that data located as far as 200 meters away and at the same depth would have the same value. The interpolation would also need to be repeated for the East-West portion of the pond and for the North-South portion of the pond. Additionally, a sediment grab is an inaccurate method to account for nutrients or metals in the sediment. The dredge indeed samples superficial sediment some of which washes away as it was pulled up to the surface.

Lastly, the number of soundings was insufficient to generate an accurate bathymetry of Lake Manor for the aforementioned reasons that too few transects were used.

Objectives

This comprehensive, but snapshot in the time investigation had several objectives:

1. Build an accurate bathymetry of Lake Manor which would help managing the pond and study its ecology
2. Assess the health and trophic status of the pond through its water characteristics
3. Assess the health and trophic status of the pond based upon its sediment characteristics for organic content and nutrients
4. Assess how much sediment and floc has accumulated on the pond bed since its inception
5. Assess how much metals (Al, Cr, Ni, Cu, Zn, As, Se, Ag, Cd, Ba, Hg and Pb) have accumulated since the inception of the pond and compare the concentration to the Soil Cleanup Target Levels (SCTL)
6. Provide the sponsor with a comprehensive set of interpretations
7. Provide the sponsor with a comprehensive set of recommendations

Methods

Bathymetry data acquisition– The bathymetry of the deepest portion of the pond >0.7m) was initiated in November 2012 with the use of a Garmin GPSMAP 531S sonar/GPS. The GPS was equipped with the Wide Area Augmentation System (WAAS) giving an accuracy of often 3m. Sonar soundings and GPS coordinates were taken at every 3 seconds intervals from a kayak which zigzagged over the pond (Fig. 3). A few sonar soundings were also correlated to actual depths measured by lowering a Secchi disk to the pond's bed. The resulting regression was used to correct the depth given by the sonar. Shallow soundings were made from a kayak using a meter stick which were georeferenced with a WAAS enhanced Garmin Etrex Vista handheld GPS. The shoreline of the pond was walked with the handheld GPS which logged the track and thus delineated the actual perimeter.

Bathymetry interpolation and surface and volume computations – Discrete depth soundings were transformed in feet and referenced against the NGVD elevation found at the weir. The resulting elevations were then interpolated with Surfer 8 (www.goldensoftware.com) using the inverse to distance power method on a square tight grid (1.5x1.5m). A "breakline" delineating the perimeter prevented the interpolations from being made outside the perimeter of the pond. Volumes, pond surface area and bed surface area were then calculated by Surfer 8 at every ½ a foot intervals from the highest to the lowest elevation equivalent to an empty pond. The mean depth defined as the "volume/pond surface area" was also computed every ½ foot. The resulting data was graphed on MS Excel 2010 and each scattergram was fitted a polynomial order 2 or 3. Non-linear regressions were not conducted as, from previous experience, the coefficient of correlation is generally very high and the data is well distributed over its range.

Water column physical characterization –Water profiles were conducted on 11/3/12 around noon in the median portion of the 90º bend of Lake Manor (17R 420805E, 2893069N, Fig. 4). Temperature, conductivity, dissolved oxygen (DO), pH and ORP were measured every 0.25m until the pond's bed was reached with an YSI (www.YSI.com) multi-parameters 600 XL sonde equipped with the 6560 temperature/conductivity, 6562 Rapid Pulse polarographic DO and the 6565 pH/ORP sensors. Photosynthetically Active Radiation (PAR) was measured with a LI193 4Pi underwater sensor coupled with a LI-1400 meter (www.licor.com) every 0.25m under constant atmospheric lighting and away from the boat's shading. Light decreases exponentially with depth as $I_z=I_0$ exp(-kz), where I_z is the light at depth z, I_0 is the light just below the surface and k is the light extinction coefficient (Kirk, 2011). By plotting $Ln(I_0/I_z)=kz$, it was thus possible to determine k graphically and to assess the depth to which algal photosynthesis was possible, z_{eu} and defined as $I_0/100$ (i.e. $z_{eu}=Ln(100)/k$). Light transparency was also determined with a Secchi disk (SD) which was lowered in the water column around noon until it was no longer seen. Secchi disk depth was measured to the nearest cm.

Water nutrients – The water column was sampled in subsurface and 0.5 m above the pond's bed using a vertical 2.2L Beta™ Van Dorn bottle sampler. Once sampled, water was kept in an opaque 1.5L Nalgene bottle which was kept in the dark in a cooler with no ice. Within 4 hours, water for the analysis of total phosphorus (TP, EPA365.1) was transferred to a 125ml Nalgene bottle which was kept refrigerated until being analyzed. A 60ml subsample was then filtered on a Nucleopore 0.22µm pore size filter into an 80ml Nalgene bottle which was immediately frozen until being analyzed for dissolved nutrients: NO_x (EPA353.2), NO_2^- (EPA353.2), NH_4^+ (EPA350.1) and soluble reactive phosphorus (SRP, EPA365.1). NO_3^- was computed as NO_x- NO_2^- . Nutrients were analyzed by the NELAC laboratory of the Southeast Environmental Research Center (SERC) at Florida International University (FIU), Miami, FL on a Technicon Autoanalyzer II System (Pulse Instrument Ltd.).

Total chlorophyll of the various algal groups, photosynthesis capabilities - Three dark adapted 3ml water subsamples were then run through a Phyto-PAM (www.walz.com; Schreiber et al. 1986) to determine the total chlorophyll of the three major algal groups: Chlorophyceae (greens), Bacillaryophyceae (brown diatoms) and Cyanophyceae (blue green or cyanobacteria). The Phyto-PAM used the factory calibrated standard reference spectra. The photosynthetic capabilities of the three algal groups were also measured using the Pulse Amplitude Modulation method (Schreiber et al. 1986).

Sediment coring – Coring were performed from a 13' aluminum Jon boat. A total of 32 sediment cores instead of the 21 initially proposed were pulled from the pond. All 32 cores had their sediment and flocculent layers thicknesses assessed. The initially proposed 21 cores had their sediment layer (and sometimes their floc layer) sampled for further analyses in the laboratory (cf. sediment analyses section below). Sediment cores were sampled using a handheld push corer made of interlocking 2" PVC sections which held a clear acrylic tube of inner diameter 6.35cm on top of which a one-way valve was mounted. The one-way valve allowed the water to flow one way as the corer was lowered to the water column and the acrylic core pushed through the sediment. The acrylic core was pushed in the pond's bed until rebuttal and then brought to the surface. The one way valve would hold the sediment material in the acrylic tube until the surface where its bottom was capped with a rubber stopper #13 to create a good seal. Once on the boat deck, the corer was uncoupled from the acrylic tube and the tube's apex was capped with a second rubber #13 stopper. A 10MP picture of the core was then taken against a white erase board after the total sediment core was recorded. The sediment material was then extruded upward by pushing upward a piston inserted at the bottom of the tube (in lieu of the rubber stopper). Once the lake bed material was flushed to the opening of the acrylic tube, the depth of the floc layer was measured to the nearest ½ cm by letting a plastic ruler sink through it under its own weight. The flocculent layer was then sampled and kept in a ziplock bag chilled in a cooler packed with crushed ice. The sediment was then pushed upward and its thickness measured to the nearest ½ cm until either sand, peat, clay or limestone was reached. The sediment was collected in a bucket then mixed and stored in a ziplock bag chilled in the cooler. All of the other layers underneath the sediment were characterized and measured to the nearest cm then discarded.

Sediment analyzes – Once in the laboratory, part of the sediment or floc was dried until constant weight in a drying oven set at 80 ºC (DW) and then combusted at 550ºC for one hour. The ash weight was then determined (AW) and the ash free dry weight deducted (AFDW). The organic content was finally computed as AFDW/DW (ASTM D2974-87). About 100ml of the sediment was frozen in a plastic cup and sent to the NELAC certified Bioinorganic and Environmental Analytical Facility (BEAF) at FIU, Miami for the analyses with an ICP-MS of Ag, Al, As, Ba, Cd, Cr, Cu, Hg, Ni, Pb, Se and Zn.

For Hg analysis, the preparation of the sediment samples was done outside the mercury-free room, due to their relative high Hg concentrations. The sediment was homogenized, and 1 ml of the homogenate was transferred to a 10 ml ampoule with 2 ml of concentrated nitric acid (total volume in the ampoule was 3 ml) and left to sit for 20 minutes. The ampoule was sealed and autoclaved for 1 hour at 105ºC. The ampoules were allowed to cool completely to room temperature, and then an aliquot of the ampoule solution was diluted with 1% HCl to 40 ml in a polypropylene centrifuge tube for CV-AFS analysis of Hg.

For the rest of the metal analysis, sediment samples (about 10 g wet weight) were placed in digestion vessels. After adding 10mL of concentrated HNO_3, the vessels were placed onto a hot plate and the samples were digested for 1h at 95ºC following the standard operating procedure (EPA-6020). After cooling off the samples to room temperature, 1mL of hydrogen peroxide was added to each sample. The samples were then re-digested for 20min at 95 ºC. After digestion, the samples were diluted to 50mL with deionized water and left decanted. After the particulates settled, an aliquot of the supernatant was placed in a 10-ml plastic test tube and diluted to 10mL with water or 2% nitric acid. After running standards, the samples were analyzed on ICP-MS for metals which concentrations were reported in mg/kg DW.

Another fraction of the sediment or floc was dried in the oven until constant weight, then grinded to a fine powder with a Belart MICRO-MILL® grinder. A few grams of powdered sample were then sent to the SERC laboratory for the analyses of total phosphorus (TP), total carbon (TC) and total nitrogen (TN, ASTM D5176) which were reported in g/g DW or % DW. Total phosphorus in sediments was determined using the ashing/acid hydrolysis method of Solorzano and Sharp (1980) with the resulting soluble reactive phosphorus (SRP) being measured SRP in water (EPA365.1). Sediment TC and TN were analyzed using Perkin Elmer Series II 2400 CHNS/O Analyzer (Nelson and Sommers 1996).

Sediment size analysis – Sediment grain size analysis was determined via laser particle size diffraction with a MALVERN Mastersizer 2000e (Malvern, UK). Such a method allows determining the grain size distribution of sediment in the 0.02-2000 µm range. The sample was wet sieved through a 2mm mesh screen and the filtrate was sonicated to separate each sediment grain. The filtrate was then homogenized and an aliquot pipetted from the created vortex was placed in the Malvern closed circulation loop until the instrument obscuration was optimized. Sediment grain sizes were reported in a $\log_{10}$ scale of the diameter of each particle expressed in µm. We found this method of representation more friendly and intuitive than reporting the grain size analysis on a phi scale (i.e. $-\log_2$(particle diameter in mm)). Data generated by the MALVERN Masterizer however were transformed as phi equivalent and volumetric cumulative curves were made to assess the average, the standard deviation and the skewness of the grain size distribution using Folk and Ward method (1957). These calculations are not presented in this report.

Pond trophic status index (TSI) and determination of the limiting macro-nutrient for phytoplankton growth- The index developed by Brezonik (1984) using the TP, TN, Chlorophyll *a* concentrations and the Secchi disk depths data from 313 Florida lakes was used to assess the pond's trophic status. Three formulas are available depending on the limiting nutrient in the pond water. This limiting nutrient was determined subsequent to the calculation of the water TN/TP concentrations ratio.

- Phosphorus-Limited (mass TN/TP>30): TSI=1/3 [TSI(chla)+TSI(SD)+TSI(TP)]

where TSI(chl *a*)= 16.8+14.4 Ln(chl *a*), TSI(SD)= 60.0-30.0 Ln(SD), TSI(TP) = 23.6 Ln(TP)-23.8

- Nitrogen-Limited (mass TN/TP<10): TSI= 1/3 [TSI(chl*a*)+TSI(SD)+TSI(TN)]

where TSI(chl*a*)= 16.8+14.4 Ln(chl*a*), TSI(SD)= 60.0-30.0 Ln(SD), TSI(TN)= 59.6+21.5 Ln(TN)

- Nutrient-balanced (10 <mass TN/TP <30): TSI = 1/3 [TSI(chl*a*)+TSI(SD)+0.5 (TSI (TP) + TSI (TN))]

where TSI(chl*a*) = 16.8+14.4 Ln(chl*a*), TSI(TN) = 56+19.8 Ln(TN), TSI(TP) = 18.6 Ln(TP)-18.4 and
TSI (SD) = 60.0-30.0 Ln(SD)

Statistics - T tests and regressions were computed with SPSS 20 after the data were checked for normality and homoscedasticity. All graphs presented in this report were constructed with MS Excel. All averages are expressed along with their standard deviation (±S.D.).

Sediment characteristics Interpolations – Interpolations were conducted with Surfer 8 (www.goldensoftware.com) using the inverse distance to power method. Interpolations outside the data were limited by the use of a "fault" file which avoid making assumptions outsides the grid.

Google Earth core ID file creation – In addition of adding all the pictures of the cores and their characteristics to this report's appendix, pictures were also compiled in a kml file which opens in Google Earth and which, upon clicking on each core location, pops up a window depicting the picture(s) of the core along with its characteristics.

Results

Bathymetry -The bathymetry is presented in Fig. 5. At the moment of the investigation the water was overflowing the weir and the pond level was at an NGVD elevation of 2.66'. There was 29,749m^3 (7,858,767 US gallons) of water in the pond for a lake surface area of 18,683 m^2 (201097 ft^2, 4.6 acres) and roughly about the same pond bed area (Fig. 5). The mean depth was then 1.6m (5.2ft, Fig. 6, 7, 8). The bathymetry depicted a "U" cut pond with very minimal shelf for the major part. Shallows were mainly present in the north and southwestern ends of the pond.

The pond volume as a function of NGVD elevation could be determined using a simple 2nd order polynomial function (Fig. 9, 10, 11):
Volume (m^3)= 392.16 x [NGVD elevation]^2 + 4838.6 x [NGVD elevation] + 14649, with the NGVD elevation expressed in feet.

The pond surface area (and the lake bed area, Fig. 15, 16, 17) could be determined using a 3rd power polynomial function (Fig. 12, 13, 14):
Surface (m^2)= -51.331 x [NGVD elevation]^3 - 414.8 x [NGVD elevation]^2 + 2055 x [NGVD elevation] + 16571, with the NGVD elevation expressed in feet.

The pond surface area could also adequately be determined using a linear function with a good coefficient of correlation (r^2= 0.97): 2292.6 x [NGVD elevation] + 14881, with the NGVD elevation expressed in feet.

The pond mean depth could be modeled as (Fig. 6, 7, 8) as:
Mean depth (m)= 0.0119 x [NGVD elevation] + 0.2167 x [NGVD elevation] + 0.9269

Water column characteristics – Temperature profile showed a weak but conspicuous water column stratification with warmer water within the top 0.5m (epilimnion, 22.8ºC) followed by a drop in temperature (metalimnion or thermocline) the subsequent 0.25m to reach a cooler constant temperature of 22.5 ºC in the hypolimnion (Fig. 18). Dissolved oxygen followed the same stratification with ~4mg O_2/L and ~3.3mg O_2/L in the epilimnion and hypolimnion respectively (Fig 18). The conductivity typical of freshwater systems (~546 µS/cm) was nearly the same in the entire water column but at higher resolution it was possible to notice a lower conductivity in the epilimnion and higher in the hypolimnion (Fig. 18). The pH and the ORP decreased with depth from 7.7 to 7.5 and 179 to 75 mV respectively and showed slightly basic conditions and oxidative conditions throughout the water column (Fig. 18).

Because of low differences between the nutrient levels in subsurface and above the pond's bed, water nutrients were averaged. TON 0.452±S.D.0.004mg/L largely dominated the TN pool (0.466±S.D.0.012 mg/L) since TIN accounted only for 0.015±S.D.0.008 mg/L which could be broken down into NO_2^- and NO_3^- (0.001±S.D.0.001 mg/L each) and 0.013±S.D.0.007 mg/L for NH_4^+. Phosphorus was mostly particulate with TP averaging 86±S.D.6 µg/L and SRP was 12±S.D.1 µg/L. The TN/TP ratio was 5.4±S.D.0.2 thus resulting in a strongly nitrogen limited pond. The resulting TSI(N) was thus 43.2.

Water clarity as assessed with the Secchi disk was 1.27m and the light extinction coefficient "k" was 2.2m^{-1} thus resulting in a euphotic zone where photosynthesis can happen of z_{eu}= 2.1m (6.9'; Fig. 18). The calculated TSI(SD) using the Secchi disk depth was thus 52.8.

Large amounts of solely green algae were found in the water samples and their total chlorophyll concentrations were not significantly different in subsurface and above the lake bed (T test P=0.6, average 124.8±S.D.11.1 µg/L). These green algae had good photosynthetic capabilities with an average photosynthetic yield of 53±S.D.3% and they were adapted to a fairly high light regime (I_K of 644 and 505 µmol.photons.m^2.s^{-1} in surface and above the lake bed, Fig. 19). By using total chlorophyll as a substitute to chlorophyll *a* concentrations, the calculated TSI(Chl tot) was thus 86.3.

Based on the water characteristics, the average aforementioned compounded TSIs was thus 60.8 and is typical of a eutrophic pond.

Sediment thickness – Based on the interpolation of the sediment thickness, the total volume of sediment was 4,515 m^3 (159,446 ft^3) of combined sediment and floc on the pond's bed for an average of 24.2cm of sediment + floc (Fig. 20). When all the coring data were averaged, the average sediment+floc thickness was 25.5±S.D.14.1cm for a corresponding volume of sediment over the lake bed of 4,764 m^3 (168,245 ft^3). This average thickness is less than the one reported in 2008, likely because no distinction between the various sediment types was made in 2008.

Using the same two computational method, it was found that the interpolated sediment volume was 2,881 m^3 (101,742 ft^3) for an average thickness over the lake bed of 15.4cm vs. 16.3±S.D.10.8cm in average for a volume of sediment of 3,054 m^3 (107,834 ft^3, Fig. 21).

The interpolated floc volume was 1,588 m3 (56,080 ft3) for a sediment thickness of 8.5cm vs. 9.2±S.D.7.4cm for a total volume of 1,718 m^3 (60,700 ft^3, Fig. 22).

Sediment + floc thickness was higher in the southwest corner of the pond with the exception of this extreme same corner which has been recently dredged (Fig. 20). This same pattern was also noticeable when considering the sediment only (Fig. 21). The floc thickness seemed to show no clear spatial distribution patterns (Fig. 22).

Sediment organic content – The combined sediment+floc organic content was 22.4±S.D.11.1% (Fig. 23) with a more organic floc fraction (47.2±S.D.7. 6%, Fig. 24) and a less organic sediment fraction (31.2±S.D.9.2%, Fig. 25 T test with P=0.008). Overall, the sediment, floc or the combined floc + sediment organic content was higher in the north and southwest ends of the pond.

Sediment nutrient content – Sediment carbon, nitrogen and phosphorus contents were 13.5±S.D.5.4% (Fig. 26), 0.6±S.D.0.3% (Fig. 27) and 0.12±S.D.0.06% (Fig. 28) respectively. For the 5 floc samples which were analyzed (not in the scope of work), TC, TN and TP accounted for 30.7±S.D.3.3%, 1.8±S.D.0.3% and 0.27±S.D.0.22% respectively. The carbon, nitrogen and phosphorus contents were higher in the north and southwestern parts of the pond and correlated significantly with the amount of organic content in the sediment (Fig. 29). The TC/TN, TC/TP, TN/TP ratio were very constant across the sediment samples ($p<<0.05$) and were 23.6±S.D.6.0, 127.4±S.D.64.1, 5.5±S.D.2.5 respectively. These ratios assert nitrogen limitation at the sediment level.

Sediment metal contents – Ag concentration in the sediment was low at 0.15±S.D.0.10 mg/kg and was higher in the southwestern corner of the pond (Fig. 30). Al was mostly below SCTL 38313±S.D.31537 mg/kg with the exception of two samples located at station 23 and 28 located in the northern end of the pond (Fig. 31, Table 1). Arsenic was very to extremely high in all sediment samples (10.0±S.D.5.5 mg/kg) and, in average, 4.8 times higher than SCTL (Fig. 32, Table 1). Ba was low with 17.4±S.D.10.2 mg/kg and seems higher in the northern end of the pond (Fig. 33). Cd was very low with 1.2±S.D.0.9 mg/kg and was higher in the southwest end of the pond (Fig. 34). Cr was moderate with 69.2±S.D.28.7 mg/kg without distinctive spatial distribution patterns (Fig. 35). Cu was moderate to high (69.4±S.D.44.5 mg/kg) especially in the north and southwest corners of the pond where SCTL level was reached for station 5 (Fig. 36. Table 1). Hg (Fig. 37) and Ni (Fig. 38) were low with no clear distribution patterns with 0.2±S.D.0.1 mg/kg and 11.5±S.D.4.3 mg/kg. Pb was high 502±S.D.416 mg/kg especially in the south part of the pond and at a couple of locations (stations 26 and 32, Fig. 39) in the north portion of the pond. In average, Pb content was 1.3 higher than SCTL. Se was low 0.5±S.D.0.2 mg/kg and slightly higher in the east portion of the pond (Fig. 40). Zn was very low 251.8±S.D.186.7 and higher in the south portion of the pond (Fig. 41).

Sediment grain size distribution- The average sediment grain size ranged from 41 to 131µm and appeared to be coarser (loamy fine sand to fine sandy loam) around the overflow box and in the southwestern and northern end of the pond (figs. 42, 43). The ends of the ponds have higher velocity and thus only coarser sediment can deposit there. This same assertion can be made around the overflow box. The rest of the pond has finer sediment grain size (silt loam to very fine sandy loam, Figs. 42, 43). Grain size distributions were slightly fine tailed skewed with a slight excess of finer material when compared to the mean grain size. The standard deviation was within 1-2ϕ thus characterizing poorly sorted sediments (i.e. quite widespread grain size distribution, Fig. 43).

Discussion

Bathymetry – Based upon the mean depth when full, Lake Manor is a shallow pond with a shoreline development index of 2.6 which increases the susceptibility of getting pollutants in the pond. The narrowness of the pond and the fact that it is surrounded by large amount of riparian trees and bushes makes it less prone to sediment resuspension subsequent to wind events. Wind driven sediment resuspension is indeed detrimental for ponds having a lot of floc and sediment since this allows nutrient and other pollutants to reenter the water column which could trigger algae blooms. Further, if the pond is overflowing, these pollutants can be exported outside the pond and reach the natural downstream hydrosystems. The narrowness of the pond does not allow for an extensive shelf to be present and thus limits the potential for rooted aquatic plants (emerged or submerged) which would limit bank erosion and pollutants from reaching the pond. On the other hand, an extensive shelf can be colonized by benthic algae which would thrive and eventual slough off it and float on the surface. Such scenario is often encountered when the aquatic plants established on the shelf are removed mechanically or chemically thus leaving room for benthic algae to establish. Because of the narrowness of the pond and of the long shoreline development index, benthic algae sloughing and coming to the surface can fill the open water and thus create a thick algal mat on its surface.

Thus, ponds with low shoreline development index (i.e. having a round shape) should be favored over narrow, highly convoluted ponds. In all cases, abrupt shorelines/banks with limited shelf area should be avoided to allow the growth of rooted emerged/submerged aquatic plants which would control shoreline erosion, capture pollutants before they enter the pond and prevent light from reaching the shelf bed thus limiting benthic algal growth. The sedge *Cyperacea Eleocharis* spp. is often a plant of choice to be planted on the shelf because it grows thick enough to block light, creates a strong filtration barrier and resists fairly well to lake level variations which, on steep banks, is accentuated. The drawback of such a rooted emerged aquatic plant is that it can turn brown during the dry season.

The bathymetry and the resulting volume to elevation and surface area to elevation models shall prove useful to dose adequately the amount of chemicals used to treat this pond. Further, the use of dyes concentrated adequately could be used to reduce water clarity in this pond and thus limit algal and plant growth on its deepest portions.

Water quality – Based on our findings, Lake Manor is a fresh eutrophic nitrogen limited pond with high concentrations of green micro algae and tremendous amounts of floating vegetation such as *Azolla* spp. It was actually surprising that the TSI was not higher when one looks at the nutrients found in the organic rich sediment (cf. subsequent paragraph).

When investigated, the pond was normally at its lowest possible trophic status. The end of the rainy season indeed brings nutrients poor runoffs to tropical hydrosystems (e.g. Thomas et al. 2000) which further dilute the nutrients in the ponds. When overflowing, the pond water turnover rate is high (typically less than a week) and thus allows the export of nutrients through the overflow box, a phenomenon designated as “flushing”. Finally, the presence of aerators which were well functioning and positioned every 50 m helped reducing the sediment organic amount via oxidation (i.e bacterial respiration) and create a vertical water circulation which could prevent algae (and especially blue green algae) from establishing because of the fast ever changing light conditions.

However, Lake Manor had moderate water clarity with light attenuation mainly linked to the green phytoplankton suspended in the water column. Most of the water column of the pond was potentially useful for algal growth because the euphotic zone was ~2.1m and the maximum depth when full is about 2.4m. As such 95% of the pond water when full is available for algal photosynthesis and this volume increases as pond water recedes during the dry down period. Further, attached algae can colonize 75% of the pond when full and this figure increases also during the dry down. The green phytoplankton collected demonstrated good photosynthetic capabilities at high light regime thus showing that the thick mat of floating vegetation did not mask light much. The high photosynthetic capabilities of the phytoplankton also showed that no algaecide was recently added in the pond.

The nitrogen limitation of Lake Manor contradicts the phosphorus limitation found in 2008 pond water. This finding asserts that water turnover is very high and as such, can change characteristics periodically. Nitrogen limitation was also found the sediment and this can lead to potential problems.

First, small nitrogen amounts can easily trigger algae blooms and can select certain types of algae which can gather their nitrogen from the atmospheric nitrogen gas (nitrogen fixation). Some blue green algae are indeed able to fix nitrogen e.g. *Cylindrospermpsis* spp. and are given a competitive advantage over the other green and brown algae. Such blue green algae can also be toxic for the fauna and humans (e.g. Carmichael 2001). However, paradoxically, only green algae were found in the Lake Manor and this could be linked to the presence of aerators. The presence of the floating plant *Azolla* spp. is logical because this floating plant has a mutualistic relationship with nitrogen fixing organisms which help the plant gather its nitrogen and thus thrive in open water.

Despite the presence of aerators and a clear water column, a weak thermal stratification could paradoxically be found. The only explanation could be that the floating plants of green color absorbed enough solar radiation to warm the surface water. It is however unknown whether this could attenuate or even negate the function of the aerators in the pond.

Even with aeration, it is noteworthy to assert that the water column had low dissolved oxygen contents not prone to the establishment of healthy fish populations. This low oxygen level was very likely linked to the high sediment oxygen demand (SOD) of the very organic, nutrient rich, sediment. This relatively low oxygen level still was high enough to create oxidative conditions (positive ORP) and reactions to happen. Hypoxia near the sediment was indeed not observed so that low redox potential reactions e.g. H_2S reduction could happen.

Sediment thickness and organic content – In comparison to other eutrophic and hypereutrophic ponds in Florida, it was found that Lake Manor sediment had organic contents much higher than the high eutrophic Lake Jesup in Central Florida (21.7%, Anderson et al. 2011) and slightly lower organic content than the extremely hypereutrophic Lake Apopka (62%, Thomas, 2009). The floc had higher organic content than the sediment since it had yet to undergo through the dewatering and oxidation processes. Lake Manor floc organic content was typically in the high range when compared to the floc of Lake Jesup and Lake Apopka. Lake Manor TN in the sediment and in the floc were slightly lower or equivalent to the ones found in Lake Jesup with 1.8% and 0.9% for TN in the floc and the sediment respectively. Lake Manor TN was however ½ less than Lake Apopka with 3.2% TN. Lake Manor sediment and floc TP were twice higher than in Lake Jesup (0.13% and 0.07% for floc and sediment TP respectively). Lake Manor sediment TP was however in par with Lake Apopka (0.15%).

Subsequent to the above comparisons, it strongly appears that Lake Manor exhibits all signs of a hypereutrophic pond even though the water, at the time of sampling, suggests a eutrophic pond. Further, the TN:TP ratio pointed out nitrogen limitation and thus corroborates with the investigation conducted in 2008. Because of the longer residence time of the sediment in a pond, sediment characteristics are better proxies to assess the trophic status than the short residence time water characteristics (Thomas, *in progress*).

Because of the high sediment thickness to mean water depth ratio of 0.16 m/m when the pond is full (this number is most of the year much less as water recedes during the dry season), it is asserted that the sediment oxygen demand was mainly responsible for the low pond water dissolved oxygen.

It is felt that the aerators placed in Lake Manor are fulfilling their role of oxidizing the organic layer but such an oxidization creates nutrient release which subsequently will create algae blooms or will be exported through the overflow box and thus pollute the bay. Floating islands placed on the pond would capture some of the nutrients, but, from a current literature review lead by our group (Thomas and Dettmar, *to be submitted*), it does not appear that the nutrient removal rate is high. Current ongoing research about alternative collateral beneficial functions of the floating islands is currently under research investigation (Thomas, *pers. comm*.).

Since Lake Manor can be compared as a narrow ½ enclosed canal system, it would be better to dredge from the banks the sediment materials accumulated over the years. Further, because most of the sediment and floc had very high leaf litter content from the riparian trees, it is advised that these be removed and eventually replaced by low leaf litter producing trees or plants.

Metal contents in the sediment –When compared to the Soil Cleanup Target Levels for residential published by the Department State of Florida in 2005, two metals posed a major problem and two others were occasionally higher. As was found to be very high in all our sediment samples and it is expected that these number were high also in the floc. Pb was also high in nearly ½ of the sediment samples. Al was only higher than SCTL in two samples and Cu was higher in one sample. Pb might be coming from the flushing of the adjacent roads while Cu was obviously linked to copper sulfate applications which were made in the past as an algaecide especially in the north and southwest ends of the pond. Cu accumulates in the sediment and sometimes the sulfate delivered with the Cu enhances Hg sequestration (Dr. D. Rumbold, *pers. comm*.) but Hg was below SCTL in Lake Manor. It is not known what is the source of As in Lake Manor sediment but it is commonly used in pesticides and it would be valuable to find out what As based pesticides were/are used to treat Lake Manor animal and vegetal pests.

Closing thoughts

As a detention pond, Lake Manor fulfilled its role as a trap for sediment and heavy metals. It also responded to nutrient loading through a logical eutrophication process. Because of its shape and because of the way it was dug out and maintained, this pond also seems to have aged prematurely. The long shoreline to open water ratio and the lack of shelf combined with steep banks made this pond particularly susceptible to accelerated eutrophication and inorganic sediment as well as metal filling. Additionally, the tremendous amount of riparian vegetation producing leaf litter added tremendously to the eutrophication process as this pond is not surrounded by manicured fertilized lawns. The drainage of the paved roads to the pond also added to the pond filling problem.

It is advised to dredge the entire pond to its original bed rock and to preferably use a dredge equipped with a sucking head to vacuum the sediment and highly organic and nutrient rich floc. Regular dredging will create sediment resuspension and will not capture the floc layer which, by definition, flows like water. A site to dewater the sucked material would then have to be implemented unless the sediment and floc are sucked into geotextile or other geotubes (although tube rupture does happen). The high As and Pb content of the sediment will likely increase dredging cost and since As is high all across the pond, one cannot rely on dilution to hope meeting SCTL for As. Because of the narrowness of the pond and of the quite large surface area of flat lawns surrounding it, the logistic of dredging seems simplified. Dredging will induce a shock to the pond and will reset the pond to some extent. It is central that the riparian vegetation surrounding the pond will be removed and replaced by low leaf litter producing plants. The implementation of a new shelf should be implemented after dredging to reduce bank steepness. All efforts leading to bank consolidation and steepness reduction shall be taken. The planting of rooted vegetation on the newly established shelf should be implemented to have some control on the establishing pioneer plants. However, models and experiments seem to predict that, over the long term, the plant biomass and diversity will be similar to planting: the community taxonomic composition will however be different. If floating islands have to be installed, Lake Manor canal like configuration is prone to a special arrangement of the floating islands which would force the flow to move in a zig zag motion and thus increase detention rate of pollutants and nutrients uptake (cf. Naples airport project). All of these implementations should post-pone the next dredging and protect the natural downstream hydrosystems into which the pond's water overflows during the rainy season.

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Appendix 1. Tables

Station #	Ag	Al	As	Ba	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
1	OK	OK	**819%**	OK	OK	OK	OK	OK	OK	**352%**	OK	OK
4	OK	OK	**287%**	OK	OK	OK	OK	OK	OK	**234%**	OK	OK
5	OK	OK	**481%**	OK	OK	OK	**103%**	OK	OK	**128%**	OK	OK
8	OK	OK	**444%**	OK	OK	OK	OK	OK	OK	**192%**	OK	OK
10	OK	OK	**372%**	OK	OK	OK	OK	OK	OK	**144%**	OK	OK
11	OK	OK	**657%**	OK	OK	OK	OK	OK	OK	**225%**	OK	OK
12	OK	OK	**1090%**	OK	OK	OK	OK	OK	OK	**272%**	OK	OK
14	OK	OK	**135%**	OK	OK	OK	OK	OK	OK	OK	OK	OK
16	OK	OK	**473%**	OK	OK	OK	OK	OK	OK	**143%**	OK	OK
17	OK	OK	**220%**	OK	OK	OK	OK	OK	OK	OK	OK	OK
18	OK	OK	**971%**	OK	OK	OK	OK	OK	OK	**288%**	OK	OK
20	OK	OK	**481%**	OK	OK	OK	OK	OK	OK	OK	OK	OK
22	OK	OK	**255%**	OK	OK	OK	OK	OK	OK	OK	OK	OK
23	OK	**154%**	**548%**	OK	OK	OK	OK	OK	OK	OK	OK	OK
24	OK	OK	**150%**	OK	OK	OK	OK	OK	OK	OK	OK	OK
26	OK	OK	**648%**	OK	OK	OK	OK	OK	OK	**123%**	OK	OK
28	OK	**119%**	**369%**	OK	OK	OK	OK	OK	OK	OK	OK	OK
29	OK	OK	**256%**	OK	OK	OK	OK	OK	OK	OK	OK	OK
30	OK	OK	**270%**	OK	OK	OK	OK	OK	OK	OK	OK	OK
32	OK	OK	**610%**	OK	OK	OK	OK	OK	OK	**118%**	OK	OK

Table 1. Table showing when metal contents were higher than SCTL and to which extent.

Appendix 2 – Figures

Fig. 1. Aerial photograph depicting Lake Manor (courtesy of Google Earth)

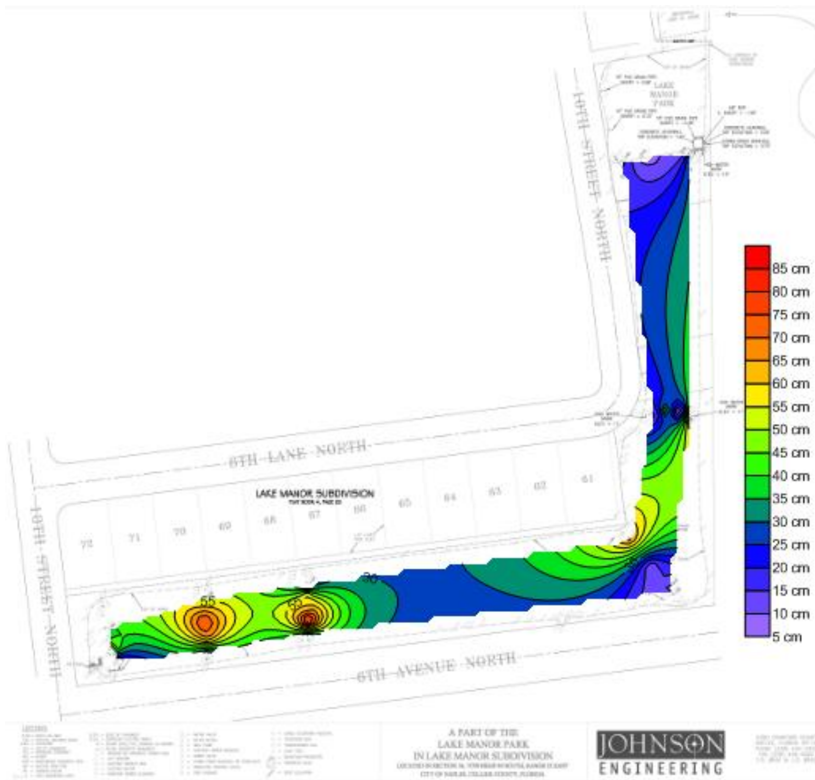


Fig.2. Sediment thickness (cm) in Lake Manor. Note the bull eye pattern linked to the lack of data. More sediment seems to be localized in the southwest end of the pond. More transects are needed to accurately assess the amount of the sediment present in the pond.

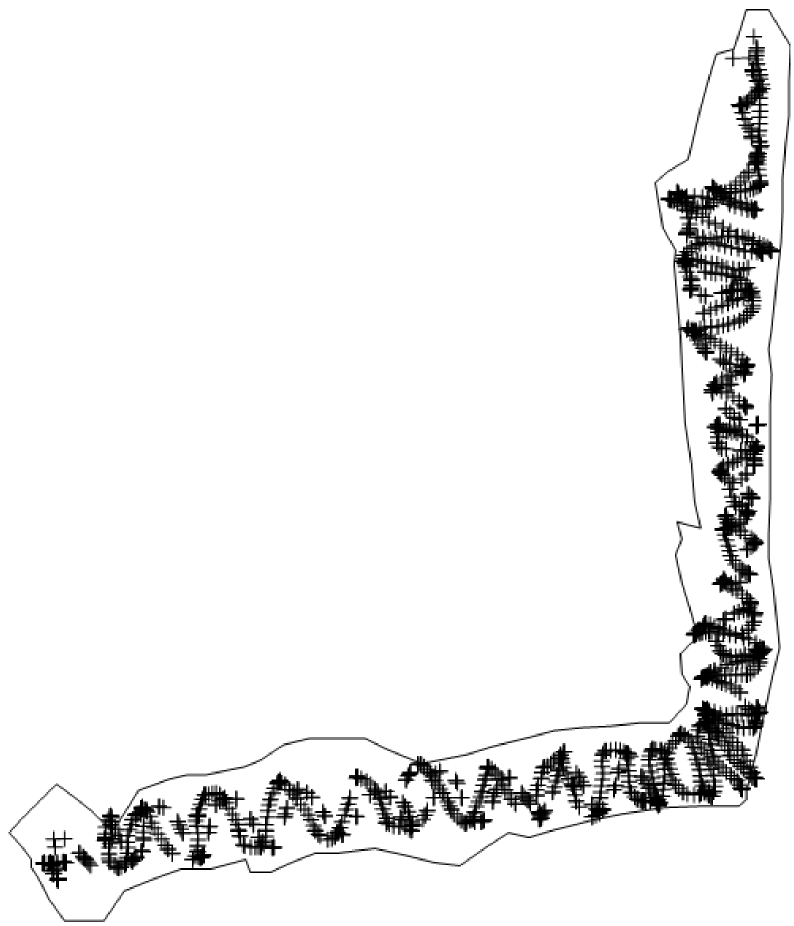


Fig.3. Sonar depth soundings (cross symbols) within the perimeter determined by walking the shoreline with a Garmin Etrex GPS.

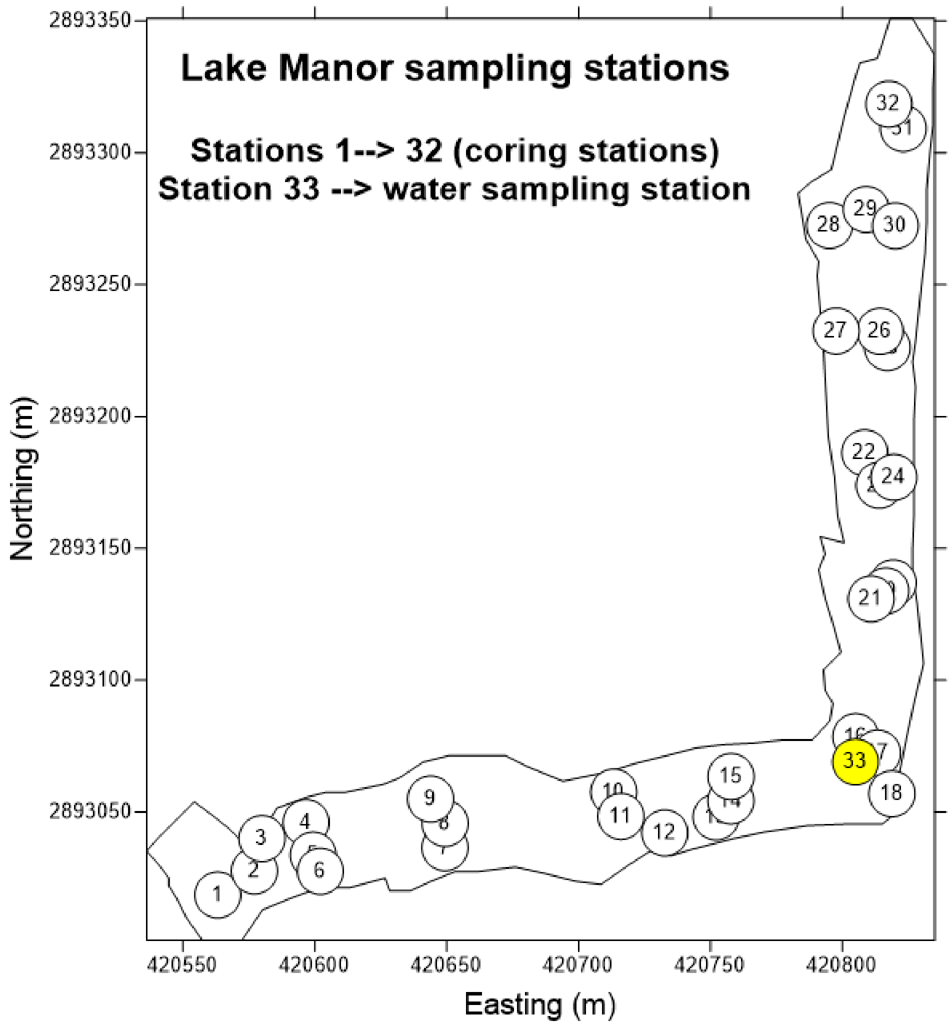


Fig.4. Sampling locations

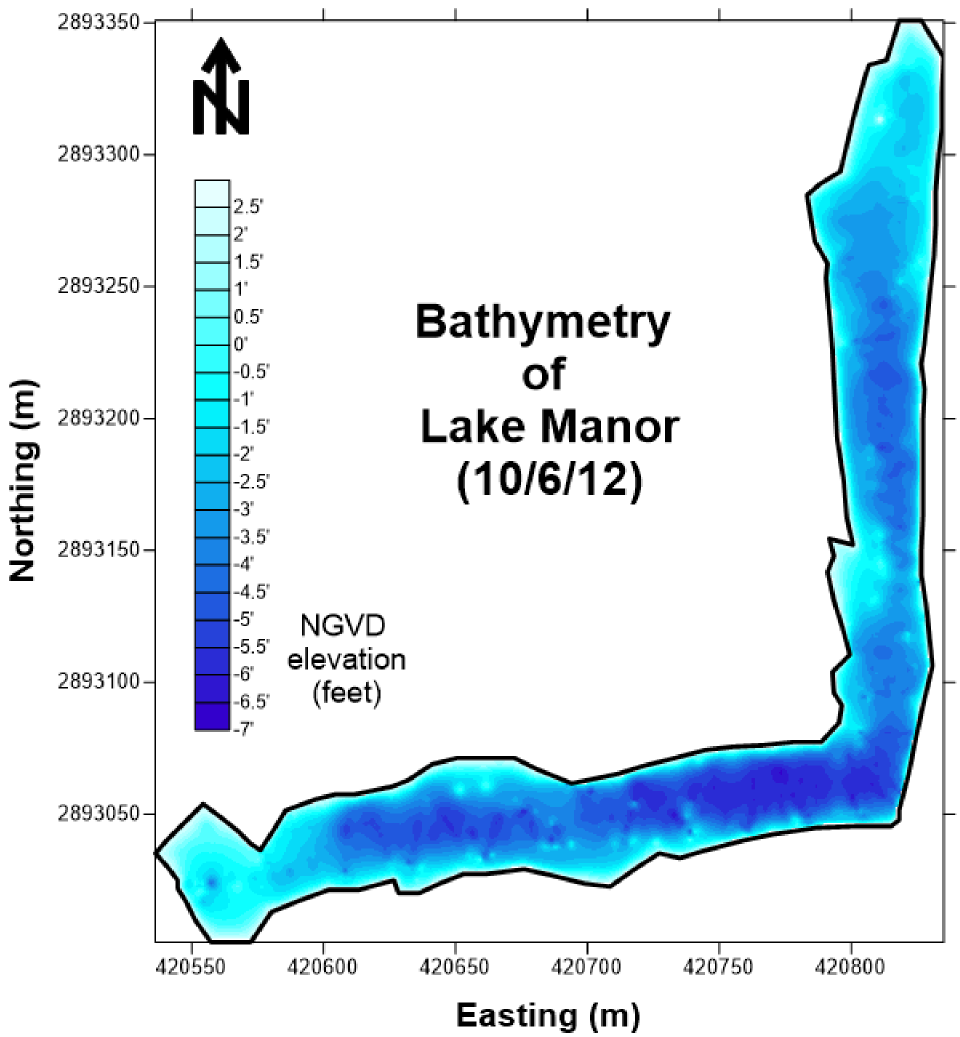


Fig.5. Bathymetry of Lake Manor

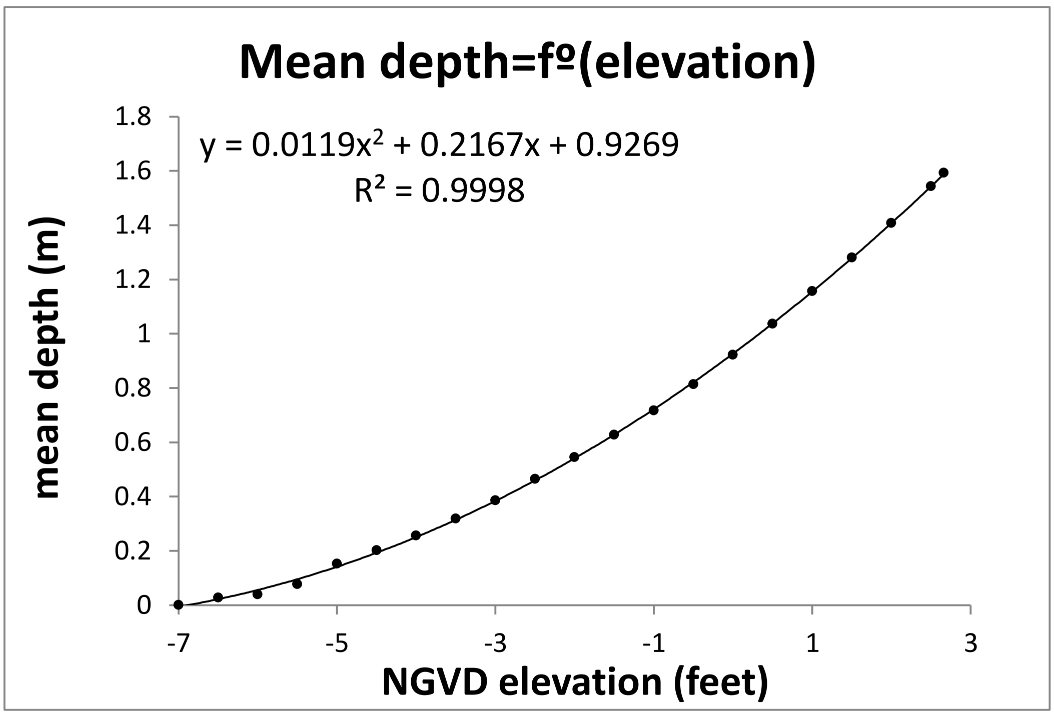


Fig.6. Mean depth=fº(elevation)

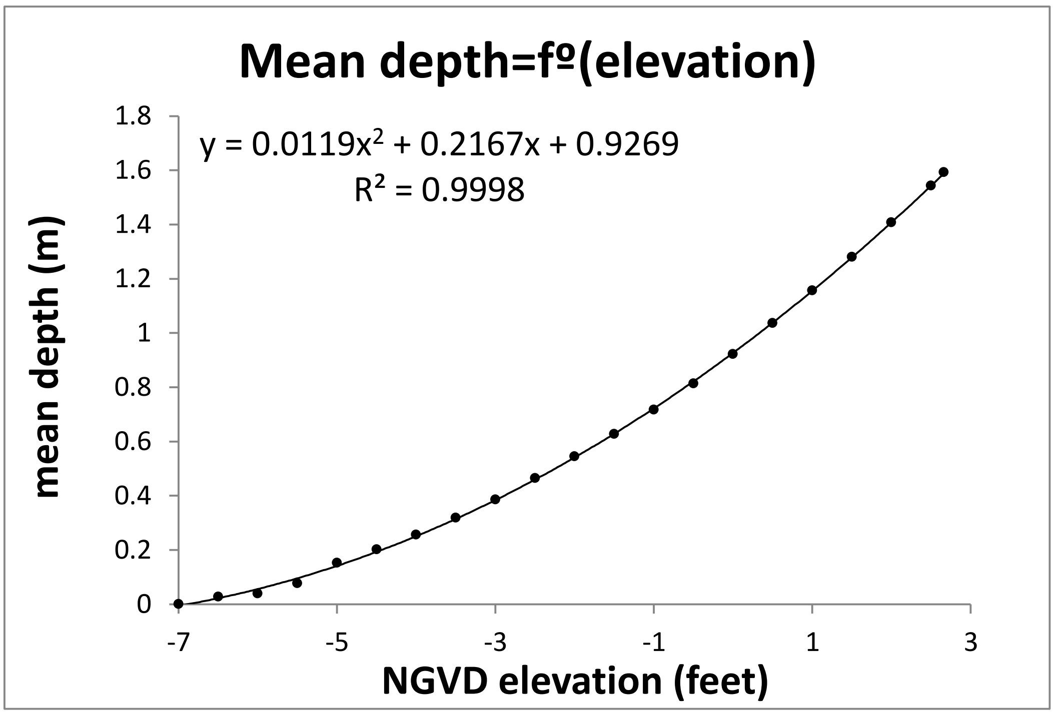


Fig.7. Mean depth=fº(elevation)

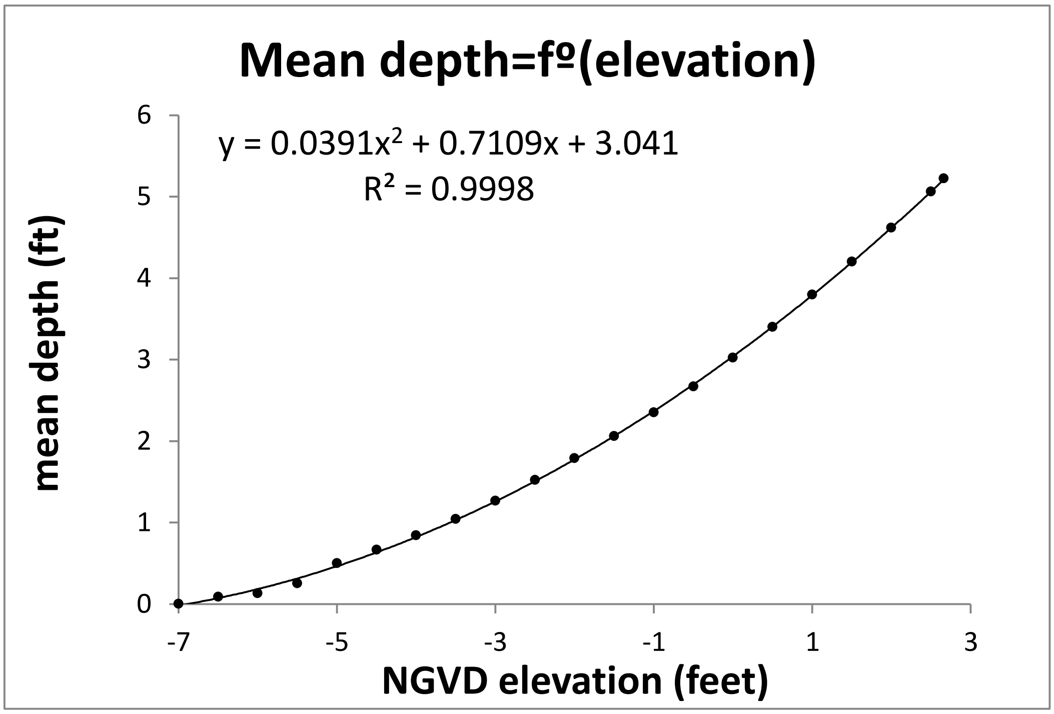


Fig.8. Mean depth=fº(elevation)

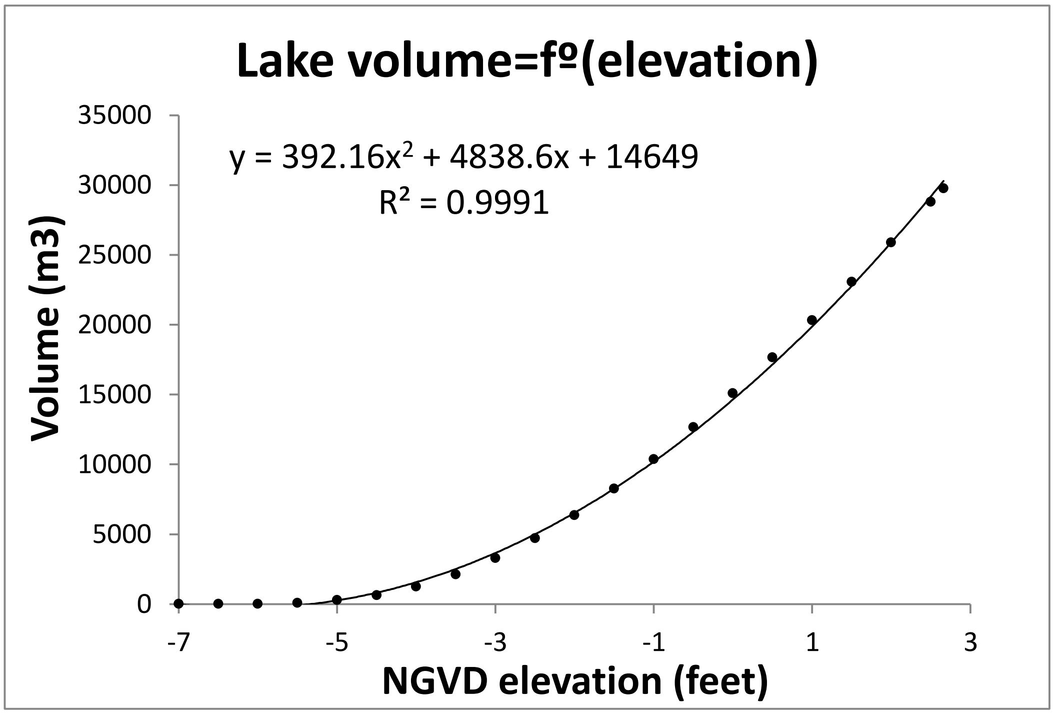


Fig.9. Lake volume=fº(elevation)

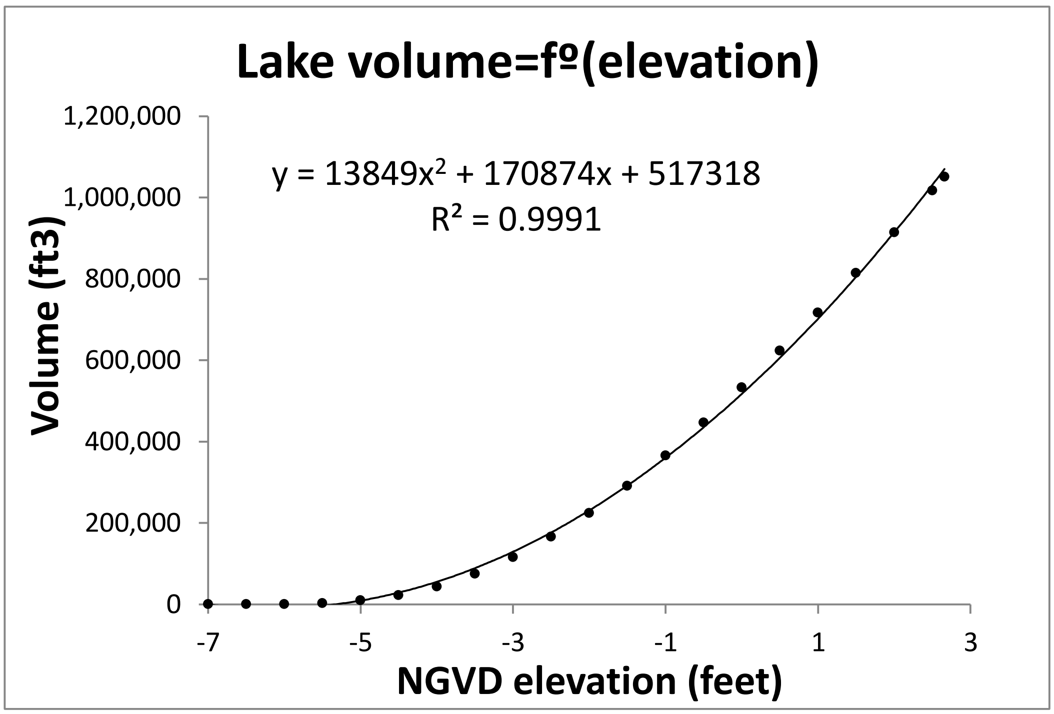


Fig.10. Lake volume=fº(elevation)

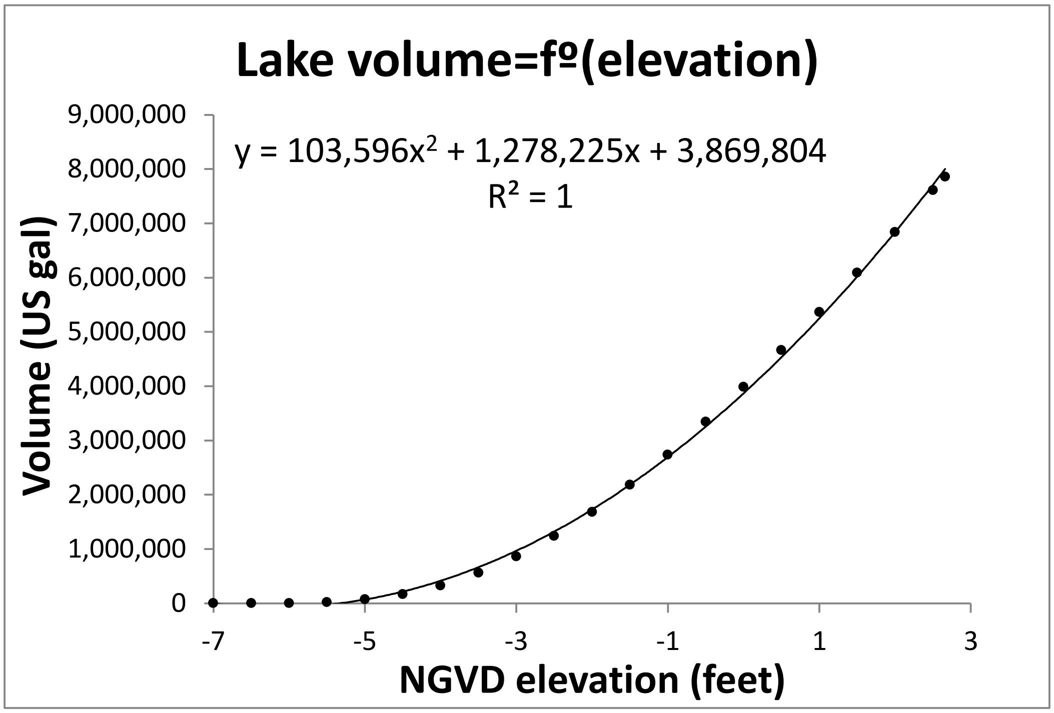


Fig.11. Lake volume=fº(elevation)

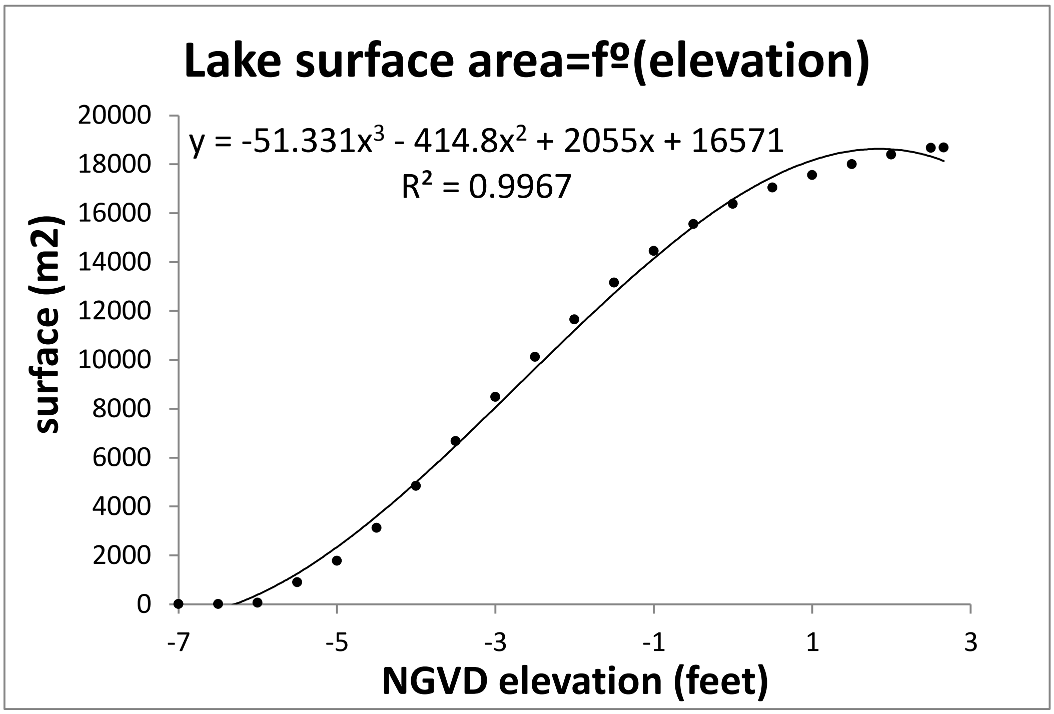


Fig.12. Lake surface=fº(elevation)

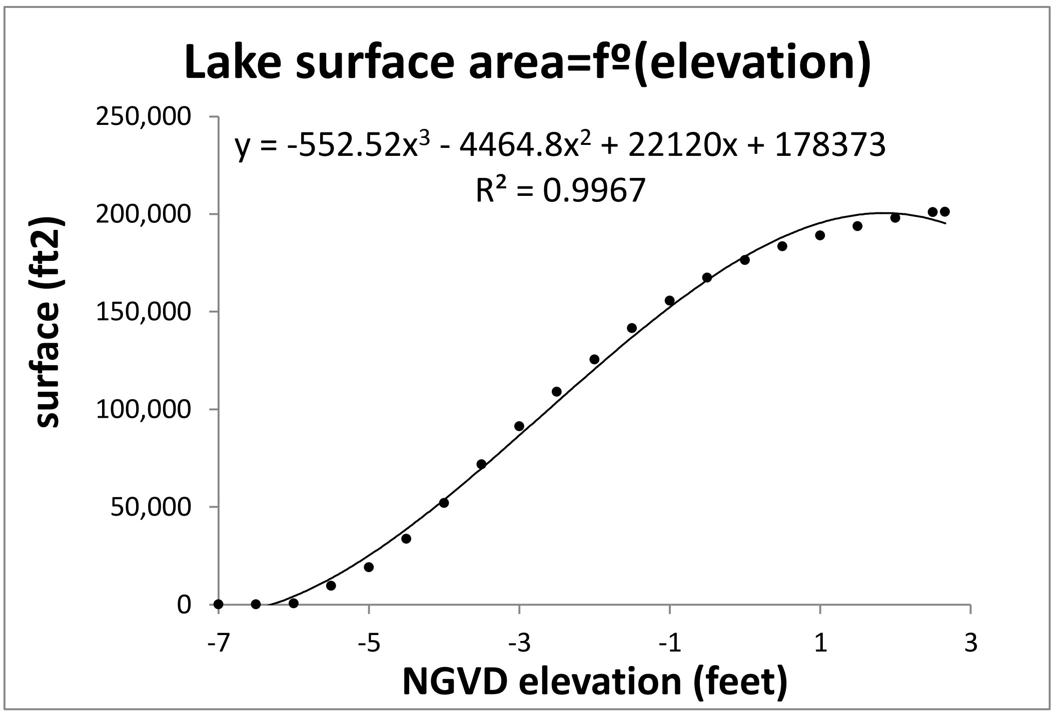


Fig.13. Lake surface=fº(elevation)

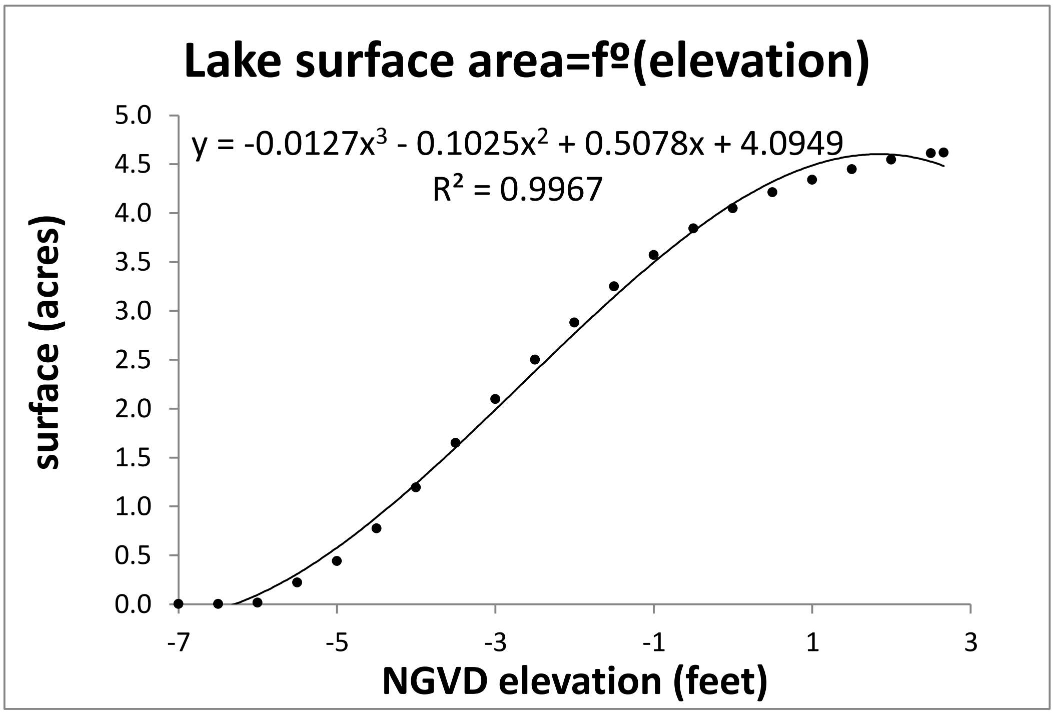


Fig.14. Lake surface=fº(elevation)

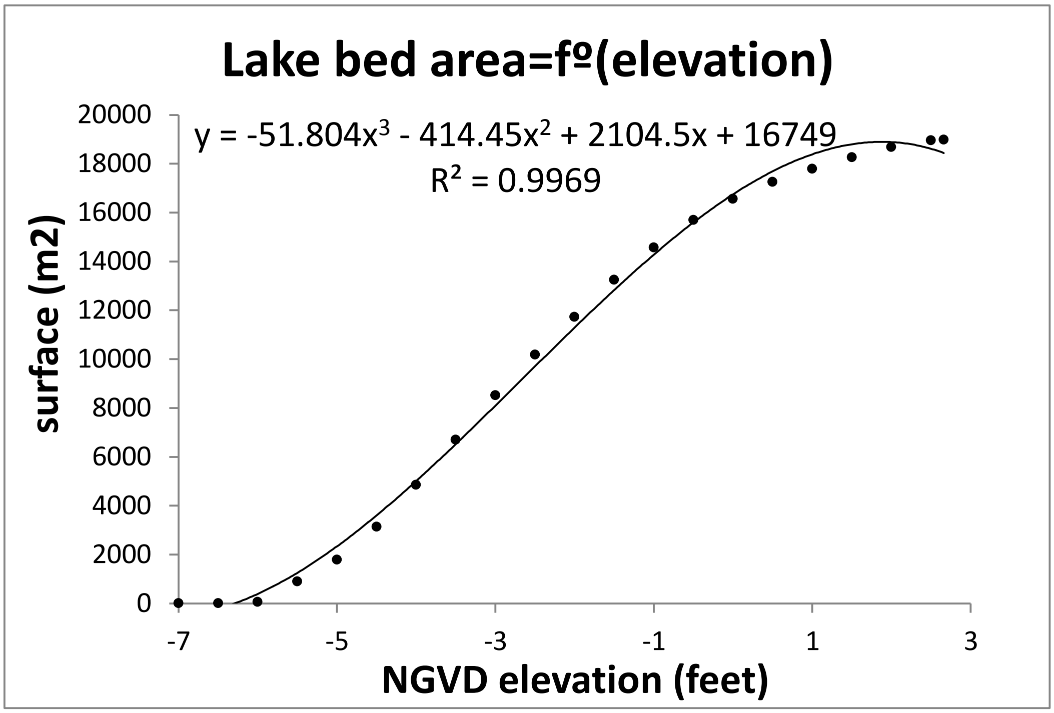


Fig.15. Lake bed=fº(elevation)

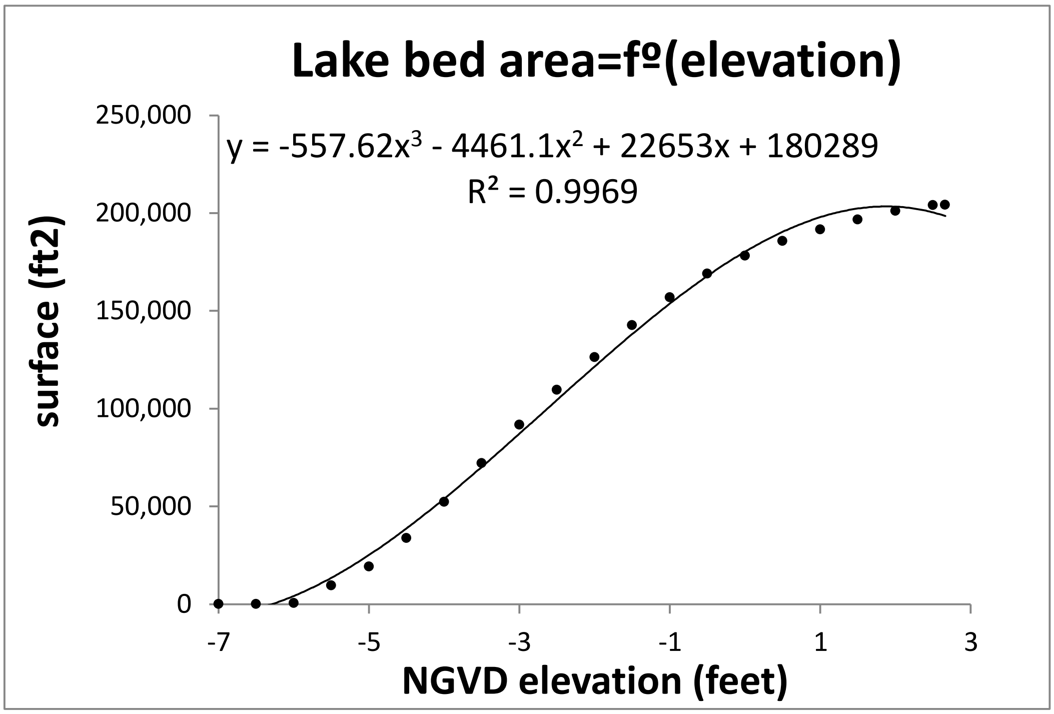


Fig.16. Lake bed=fº(elevation)

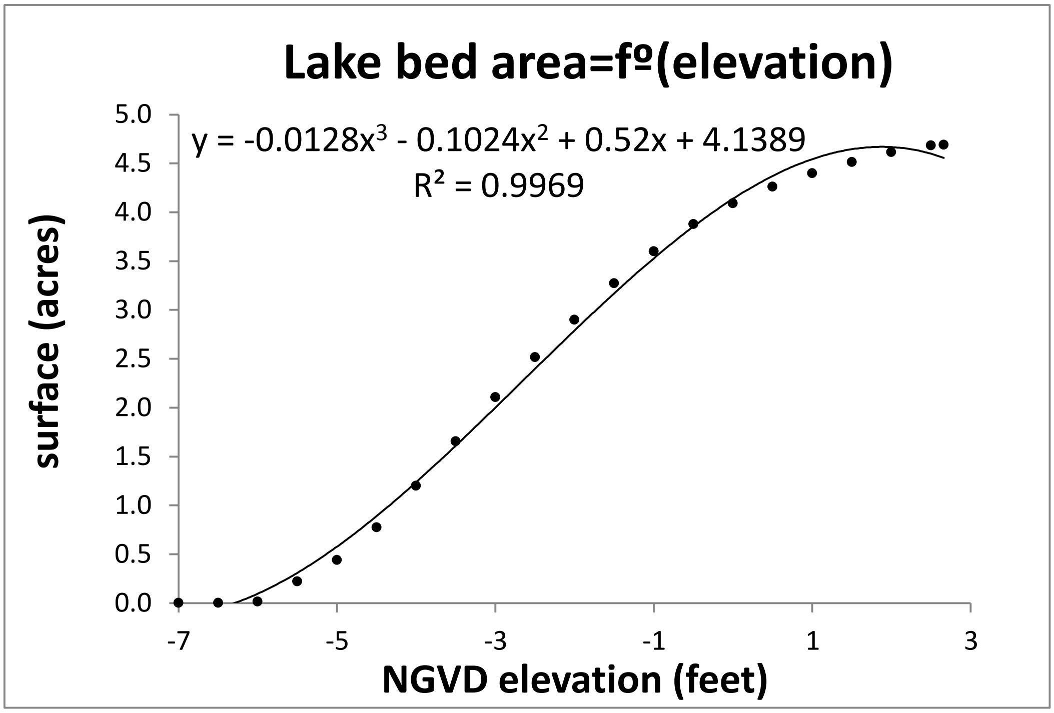


Fig.17. Lake bed=fº(elevation)

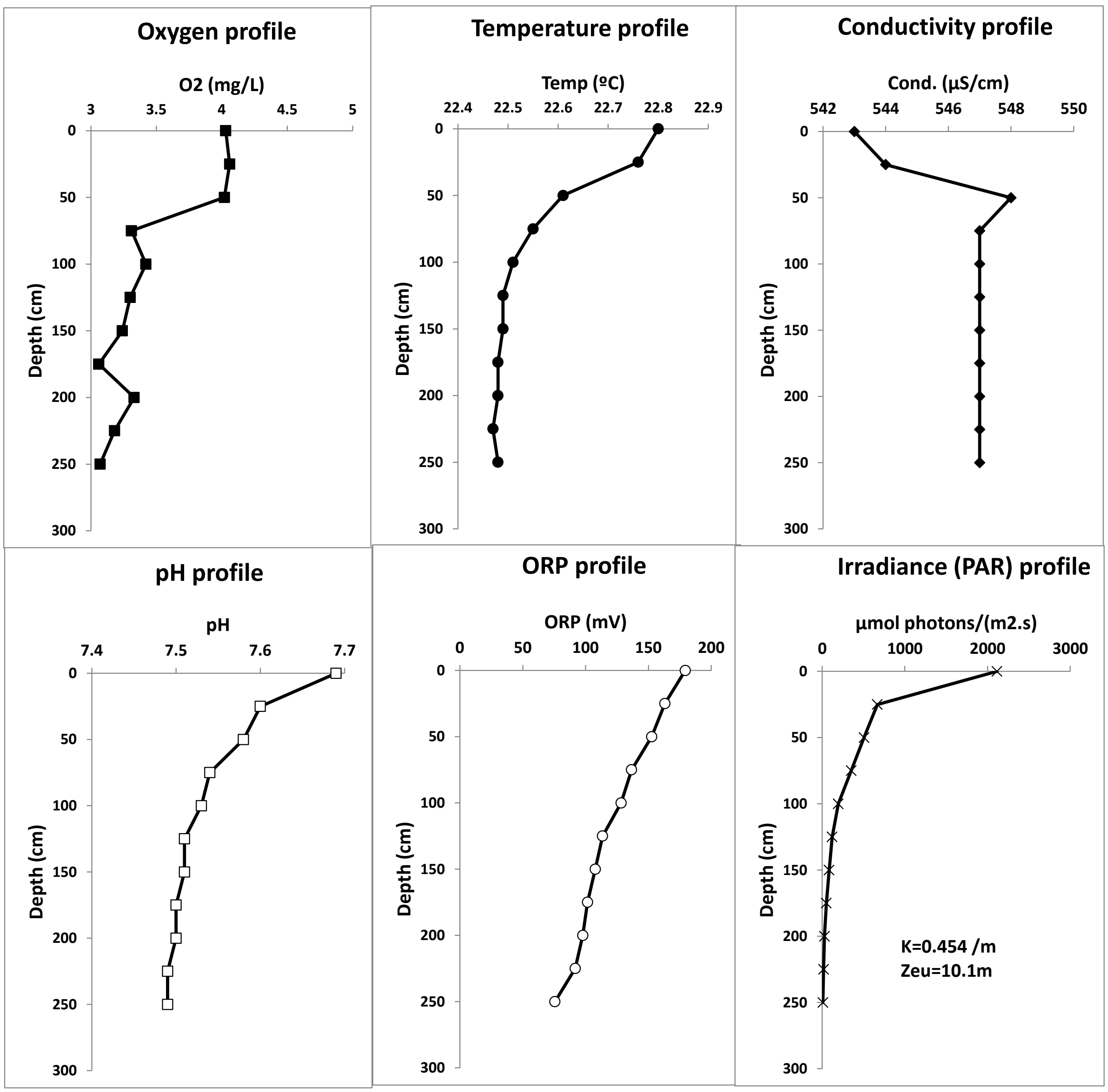


Fig.18 Profiles of dissolved oxygen, temperature, conductivity, pH, ORP and irradiance (light)

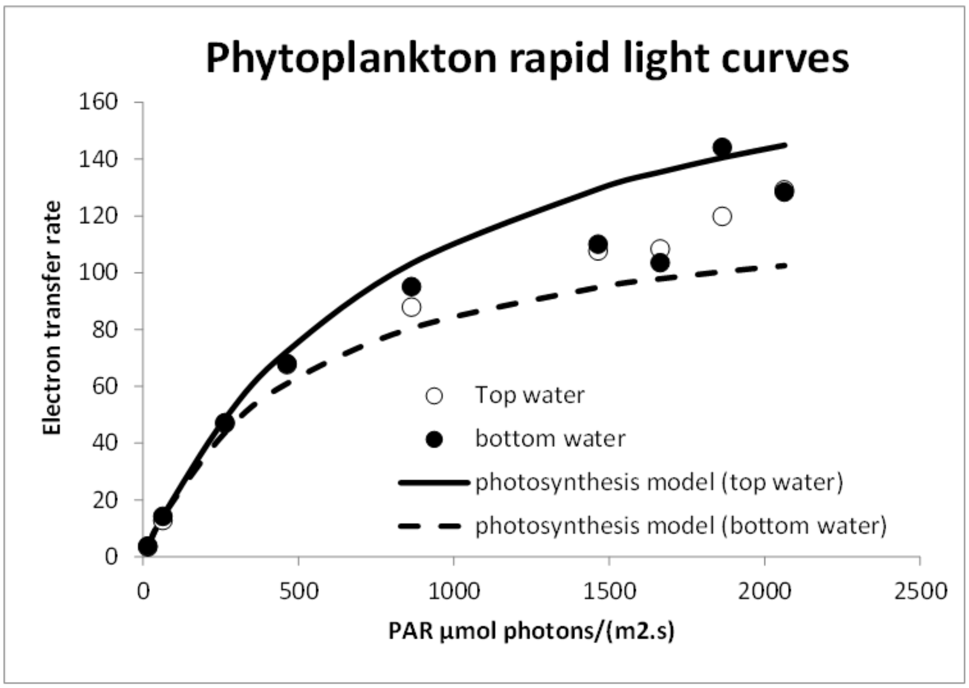


Fig.19. Phytoplankton rapid light curves.

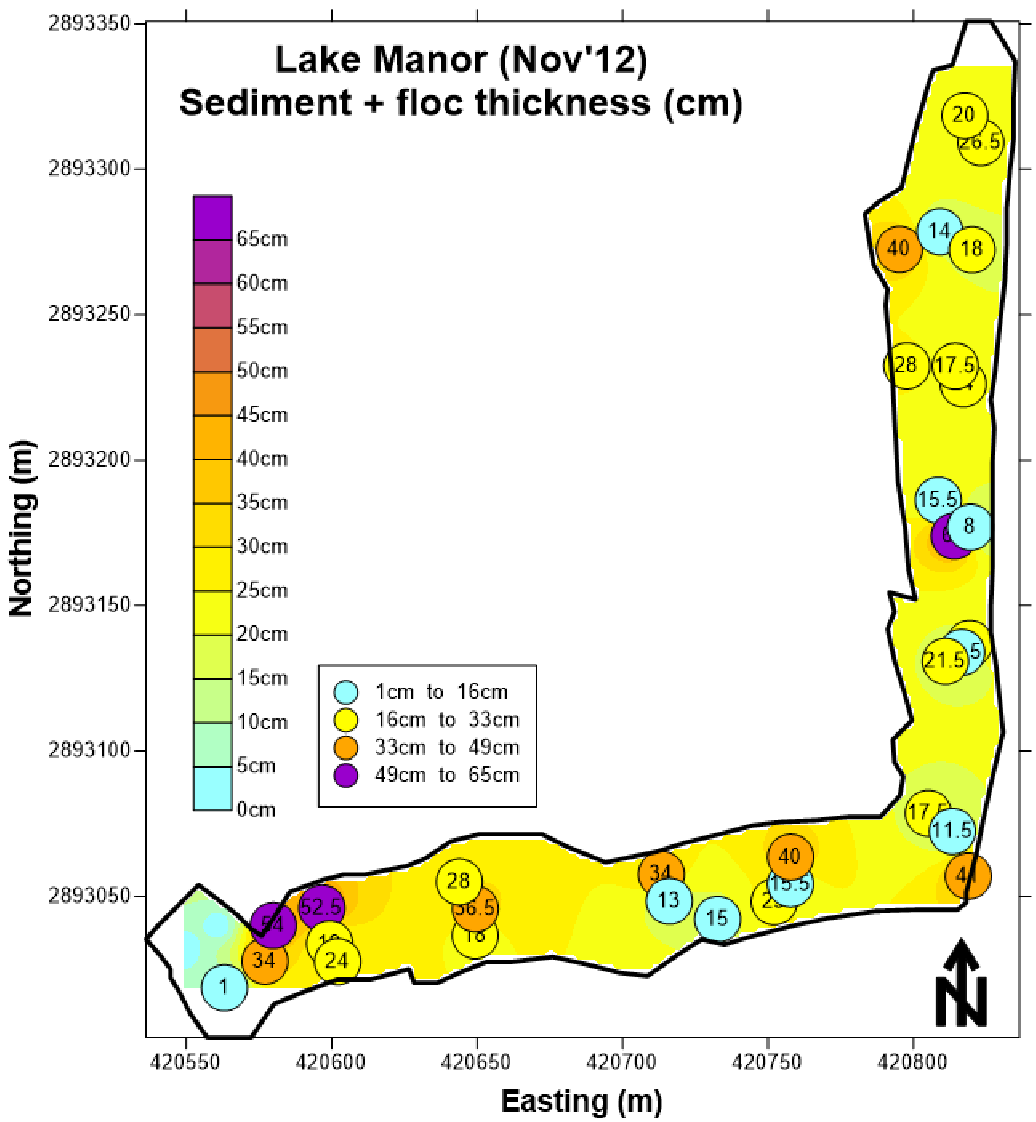


Fig.20. Spatial distribution of sediment + floc thickness

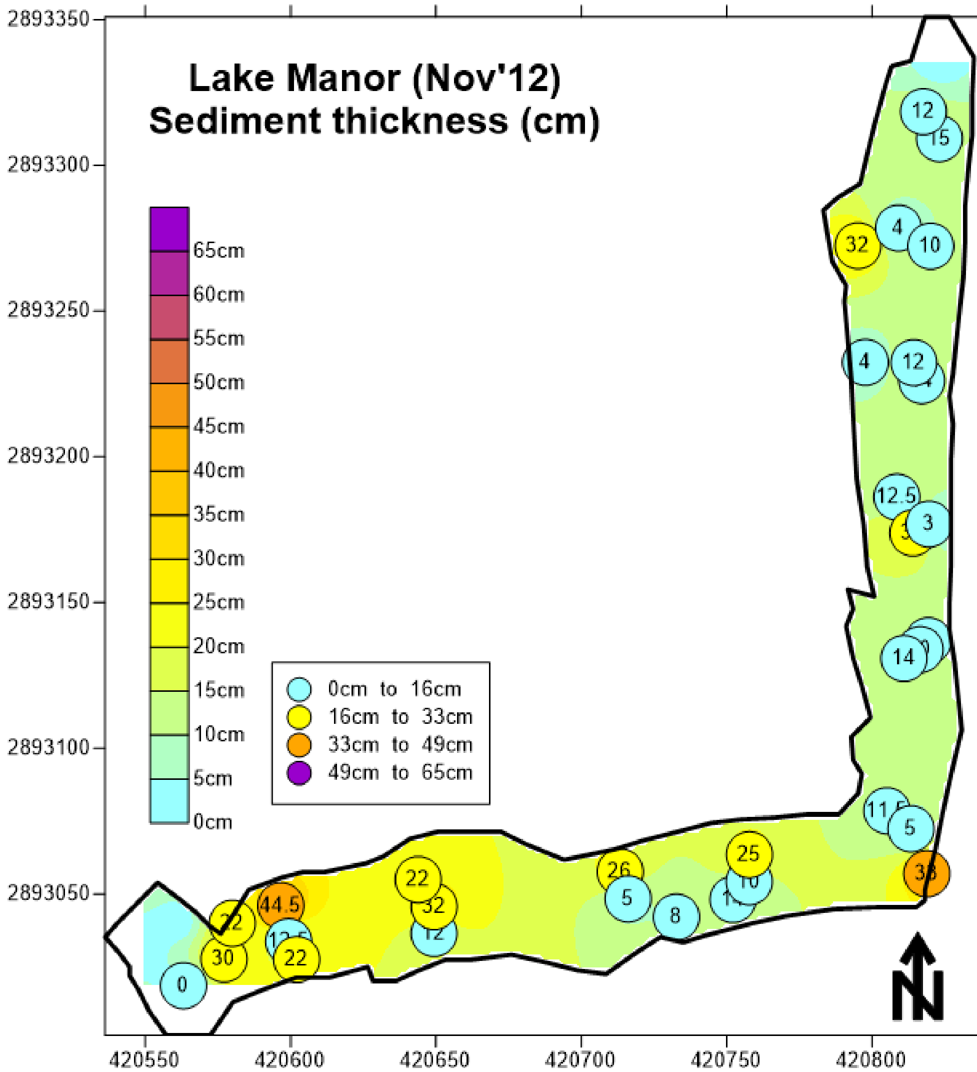


Fig.21. Spatial distribution of sediment thickness

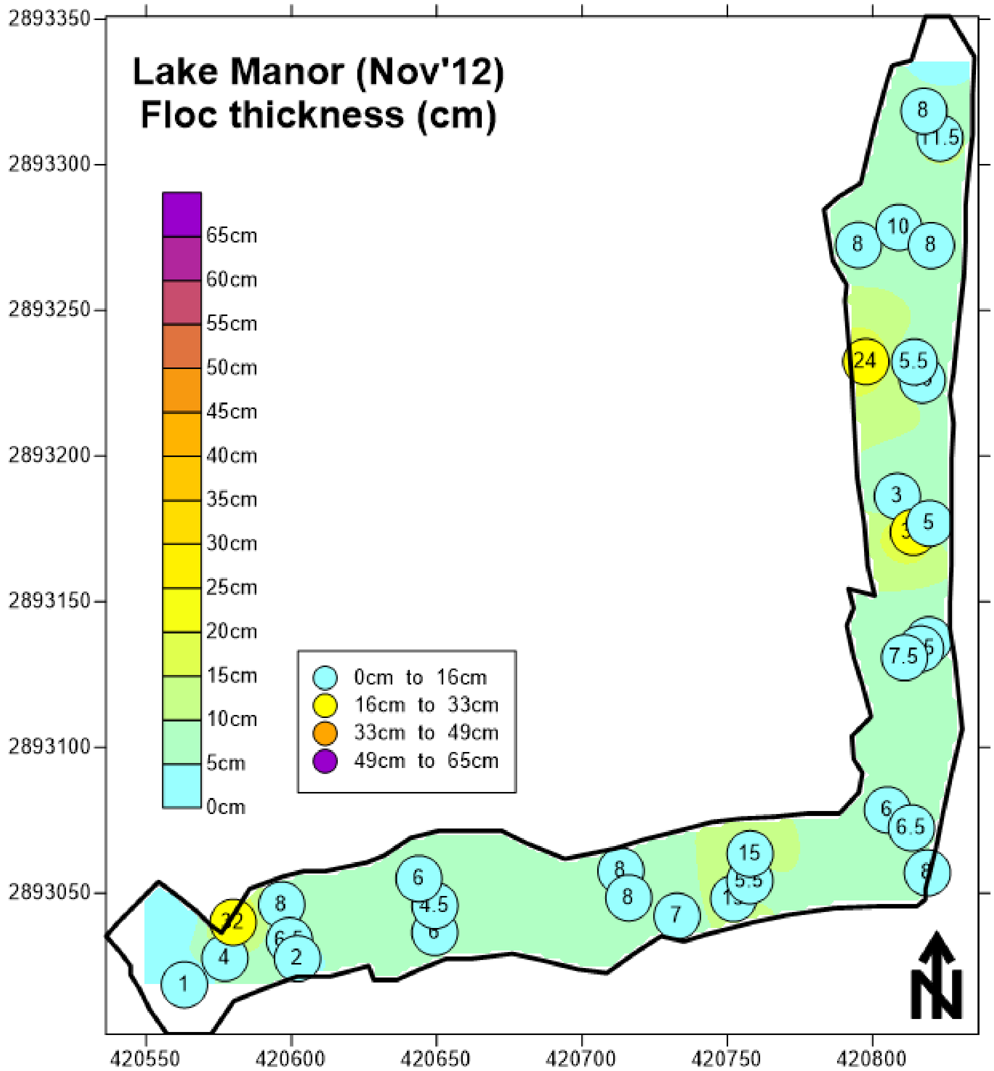


Fig.22. Spatial distribution of floc thickness

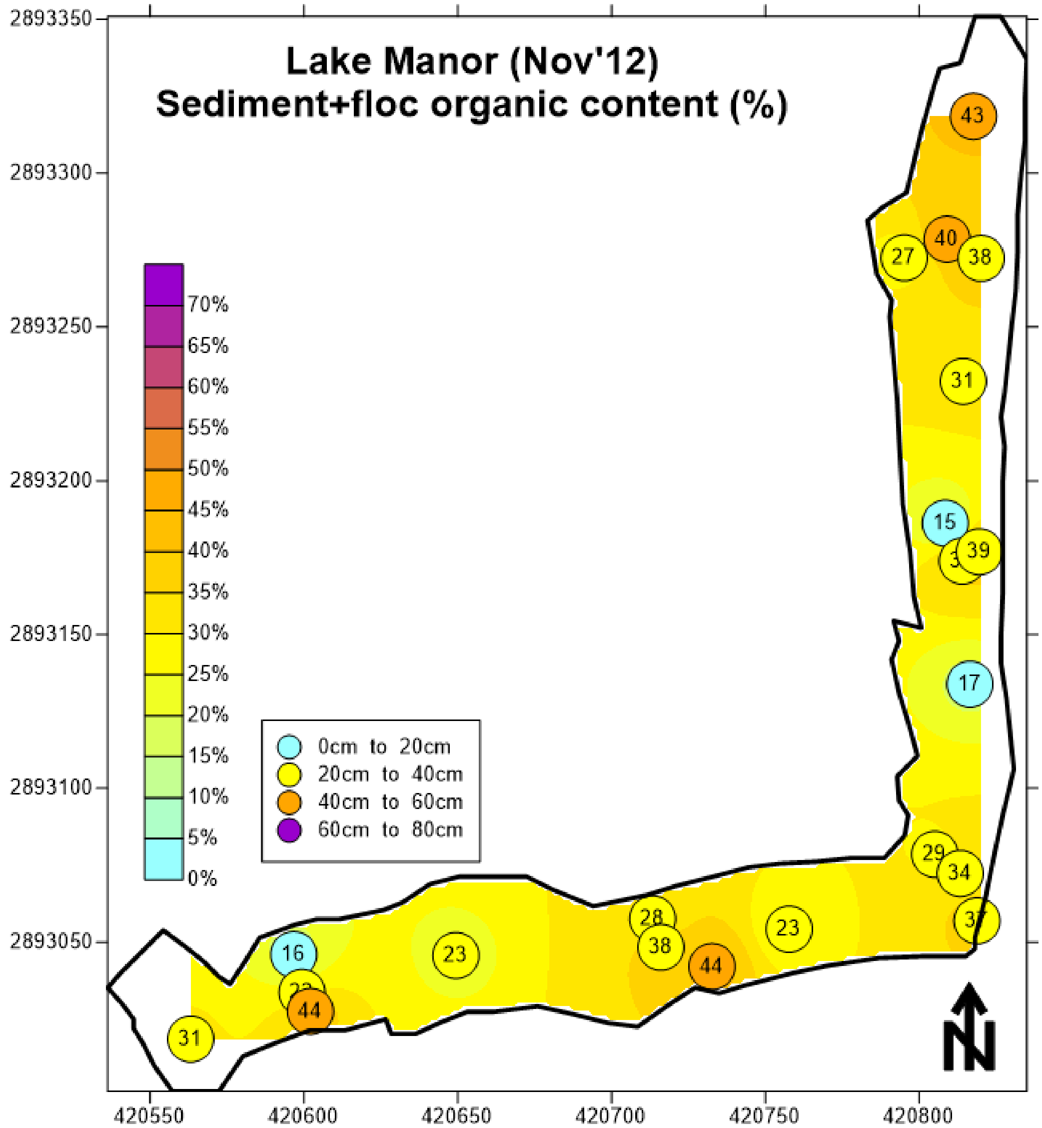


Fig.23. Spatial distribution of sediment + floc organic content

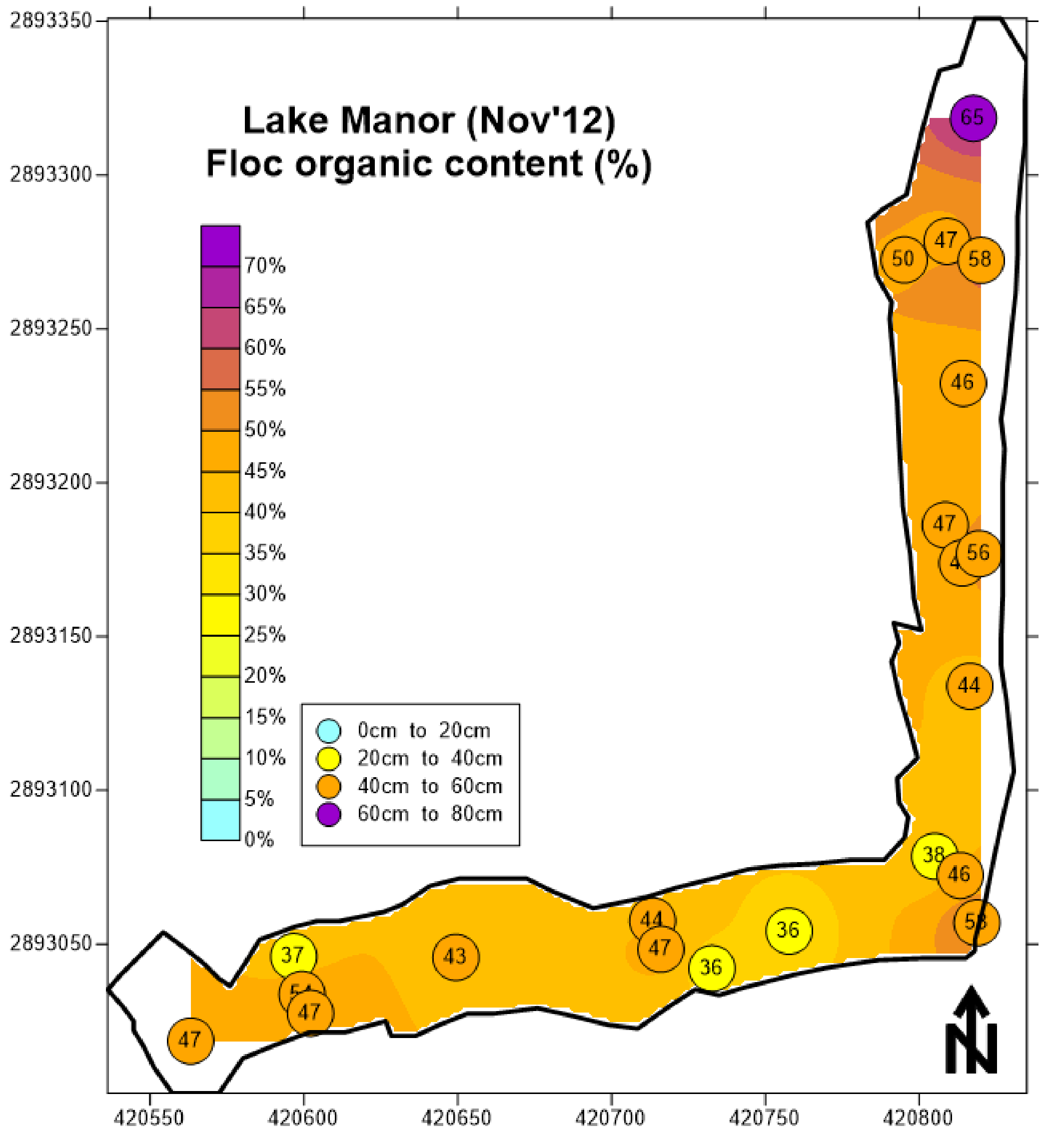


Fig.24. Spatial distribution of floc organic content

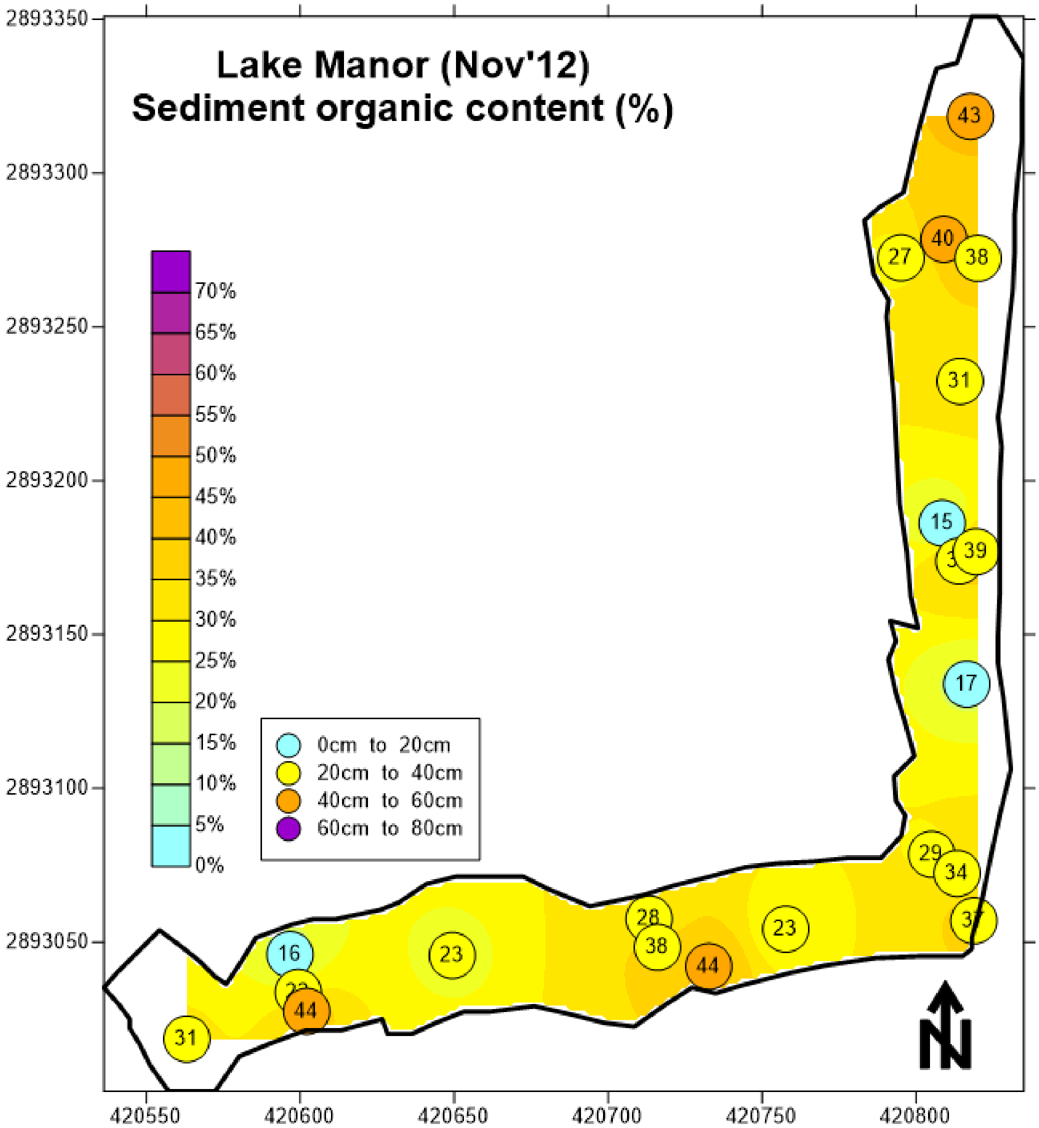


Fig.25. Spatial distribution of sediment organic content

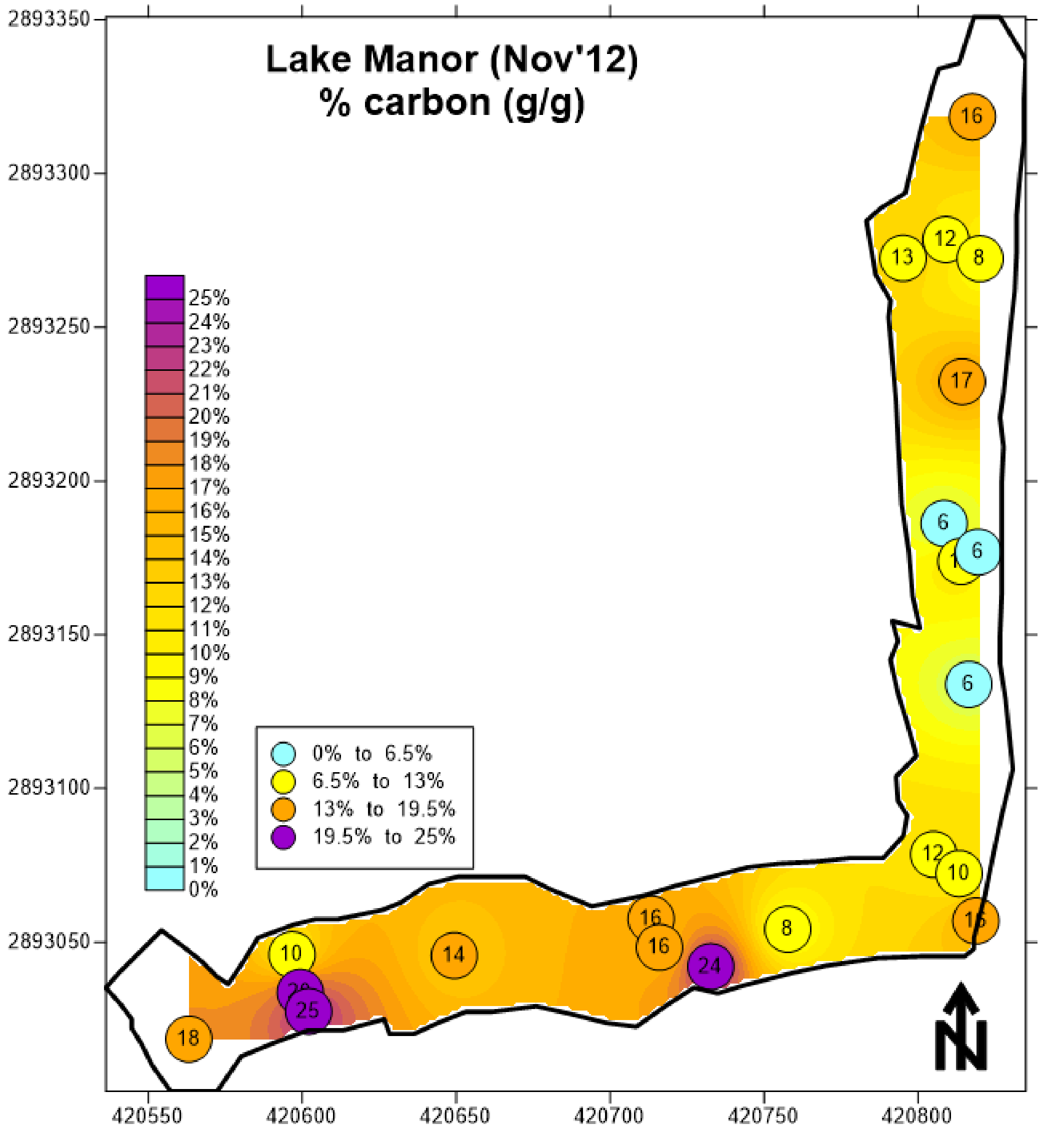


Fig.26. Spatial distribution of sediment TC content

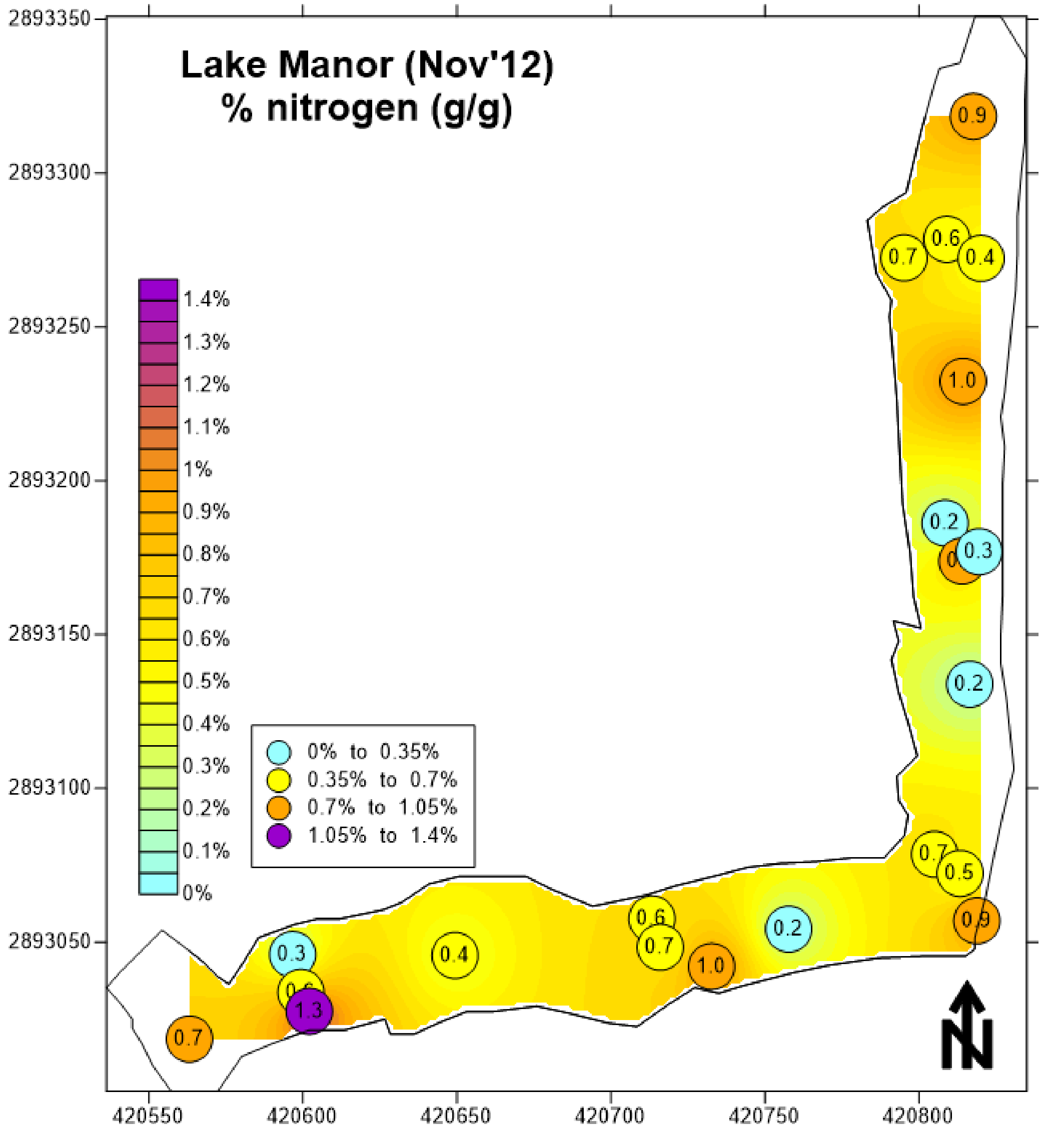


Fig.27. Spatial distribution of sediment TN content

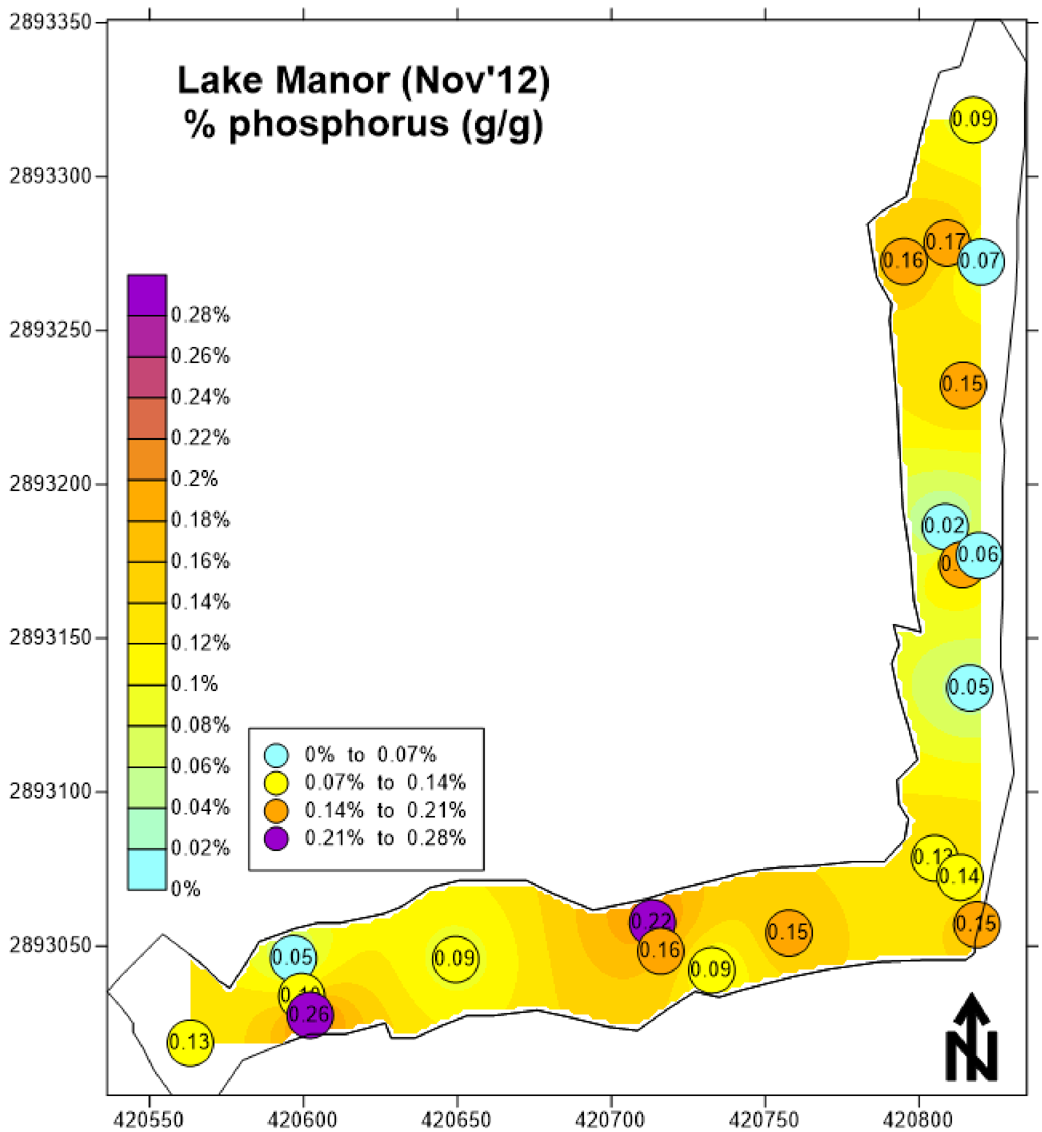


Fig.28. Spatial distribution of sediment TP content

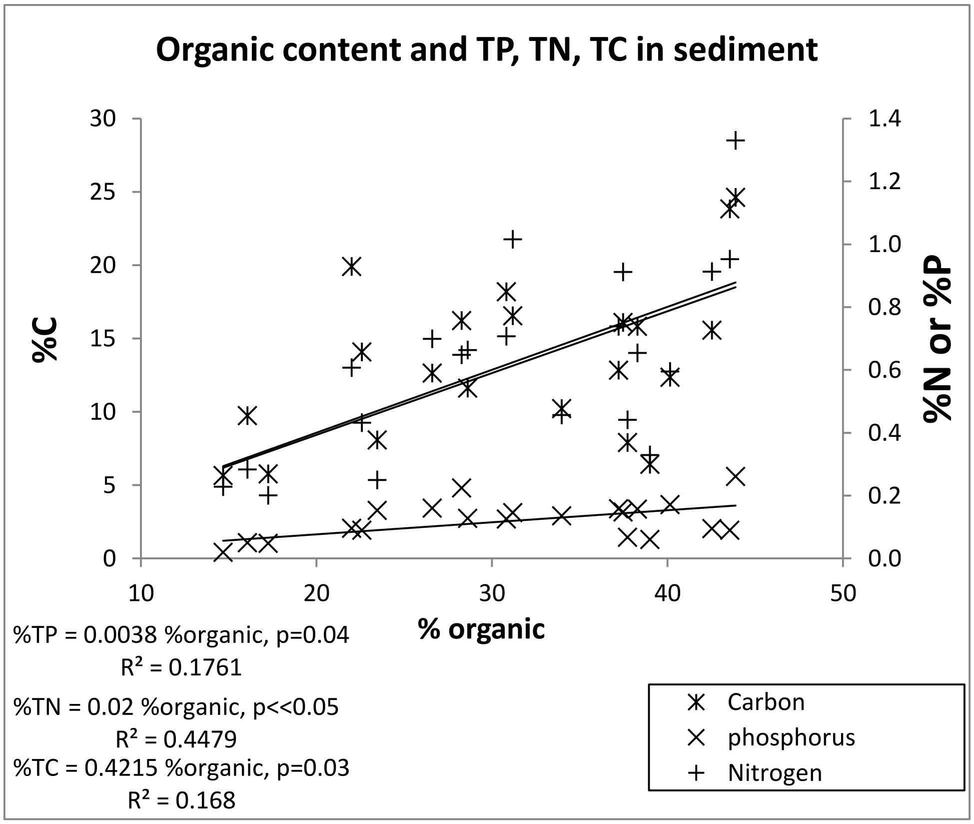


Fig.29. Regressions between the organic content of the sediment and the TC, TN and TP.

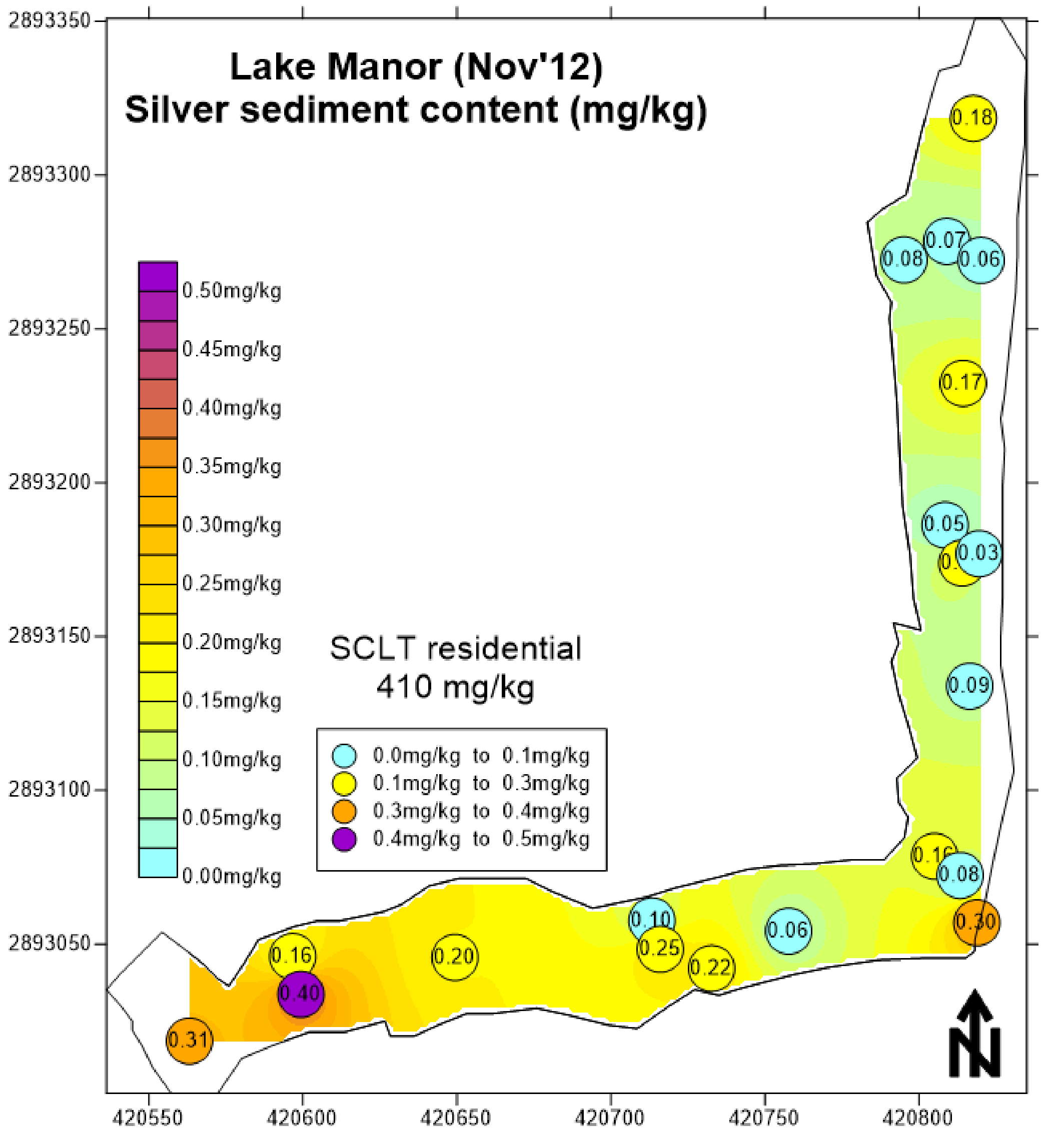


Fig.30. Spatial distribution of sediment Ag content

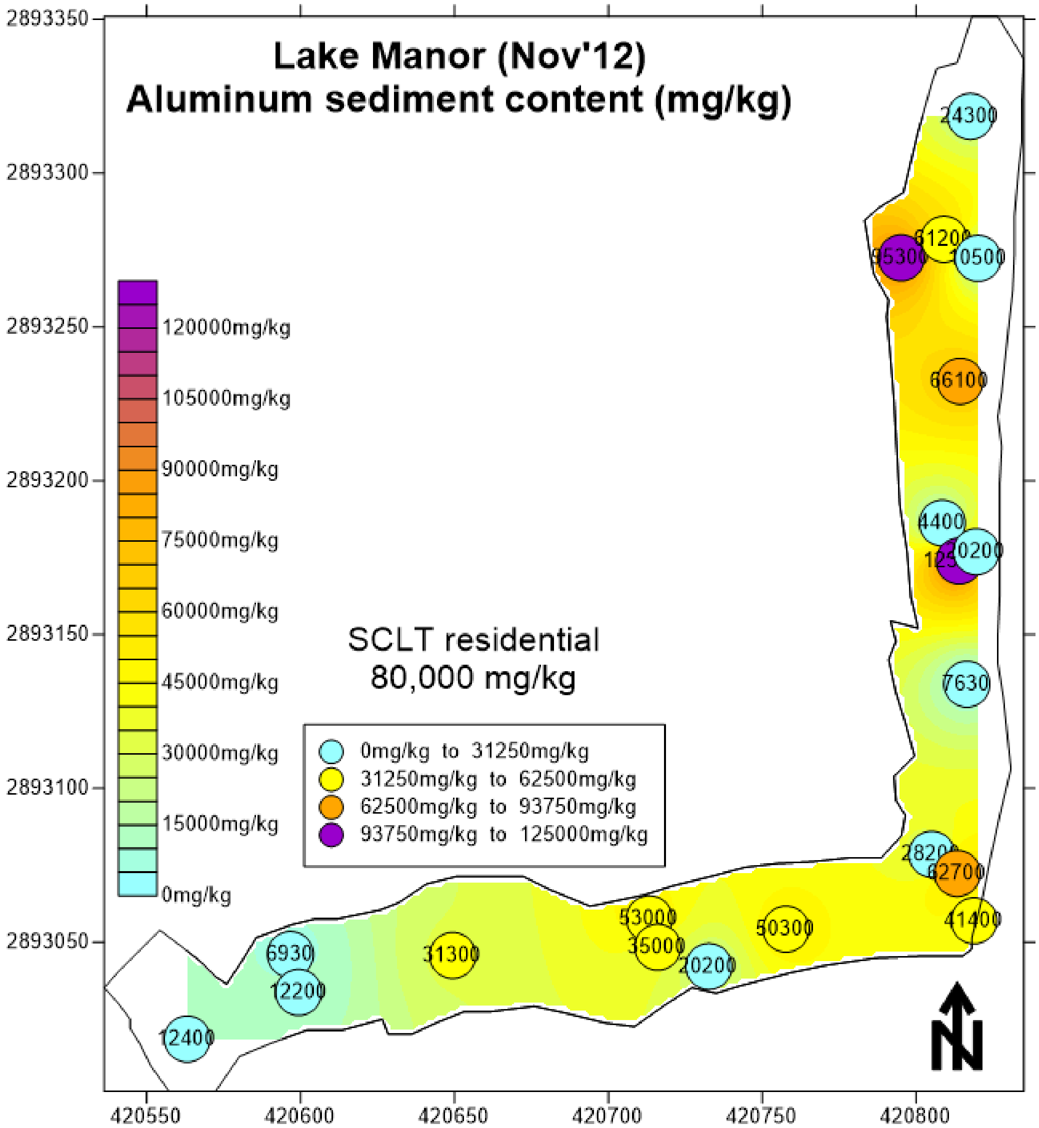


Fig.31. Spatial distribution of Al content

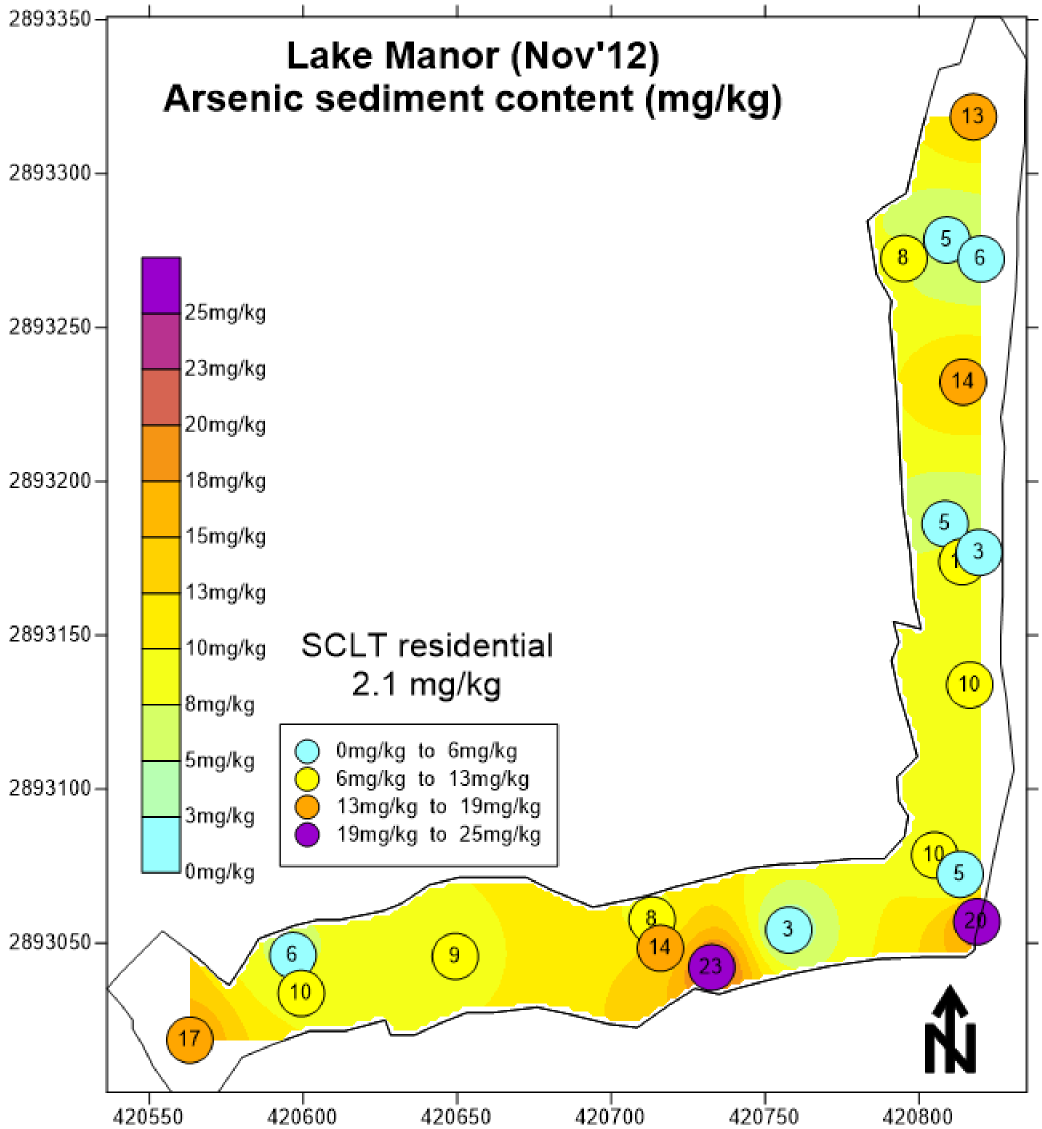


Fig.32. Spatial distribution of sediment As content

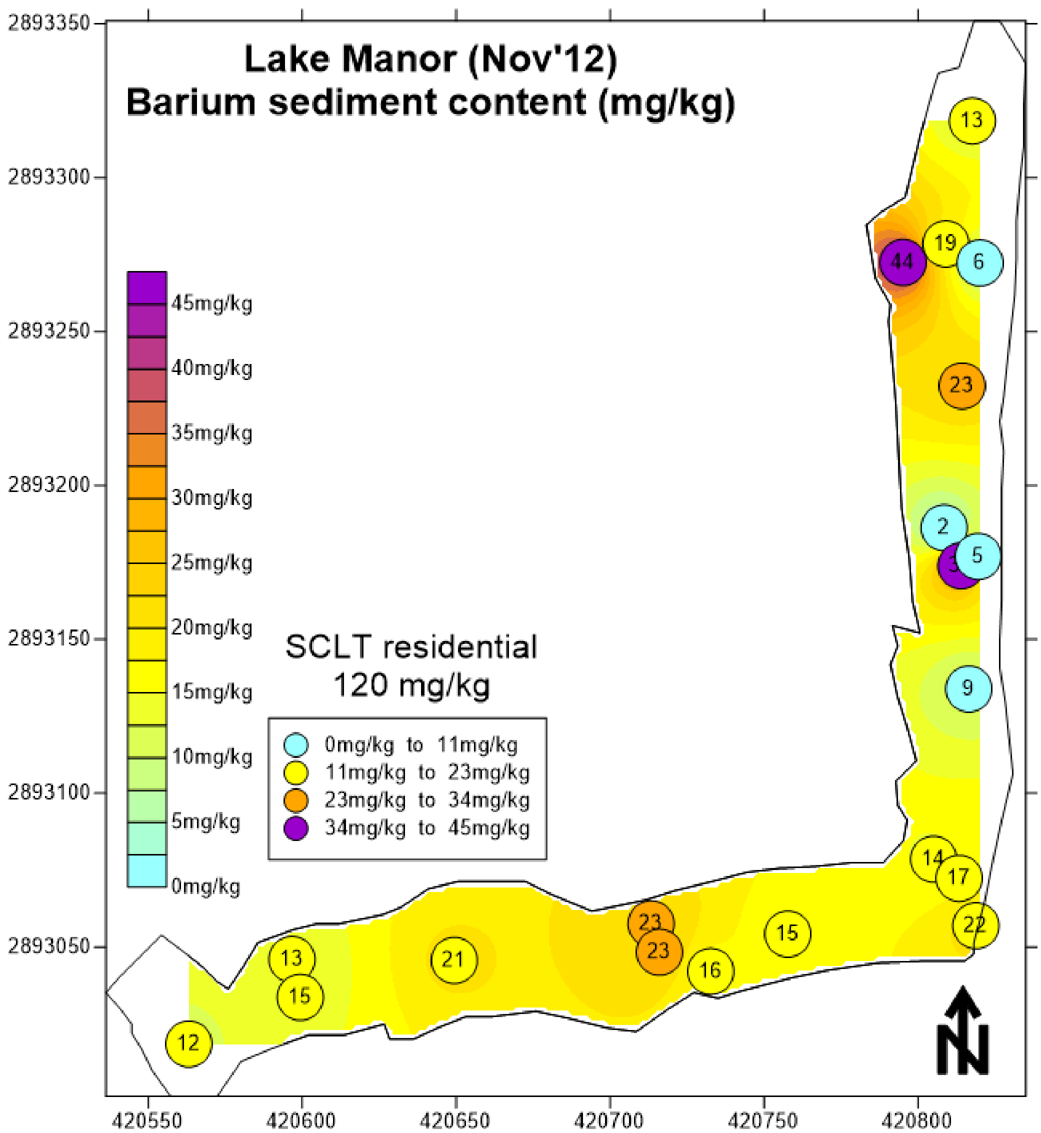


Fig.33. Spatial distribution of sediment Ba content

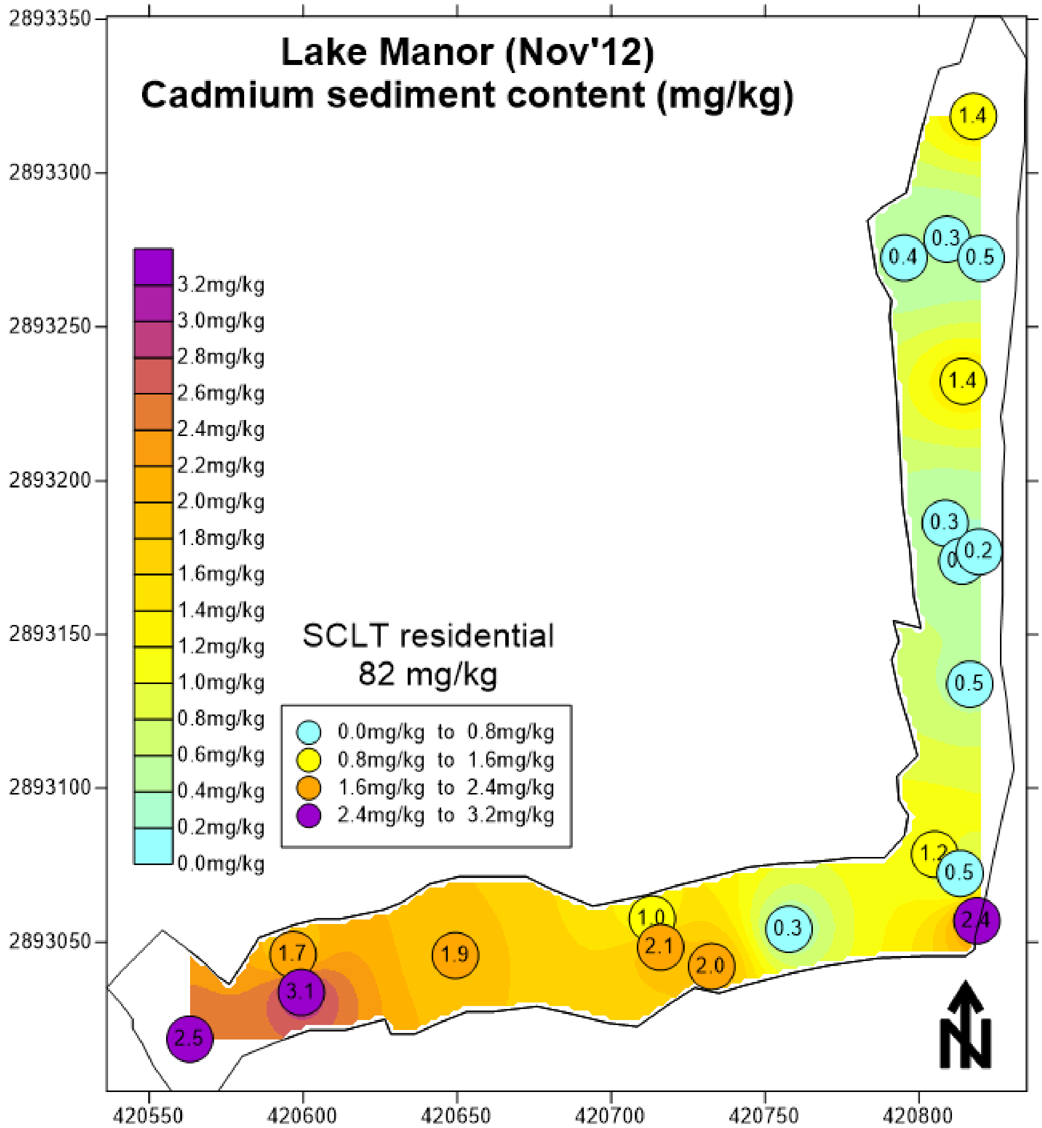


Fig.34. Spatial distribution of sediment Cd content

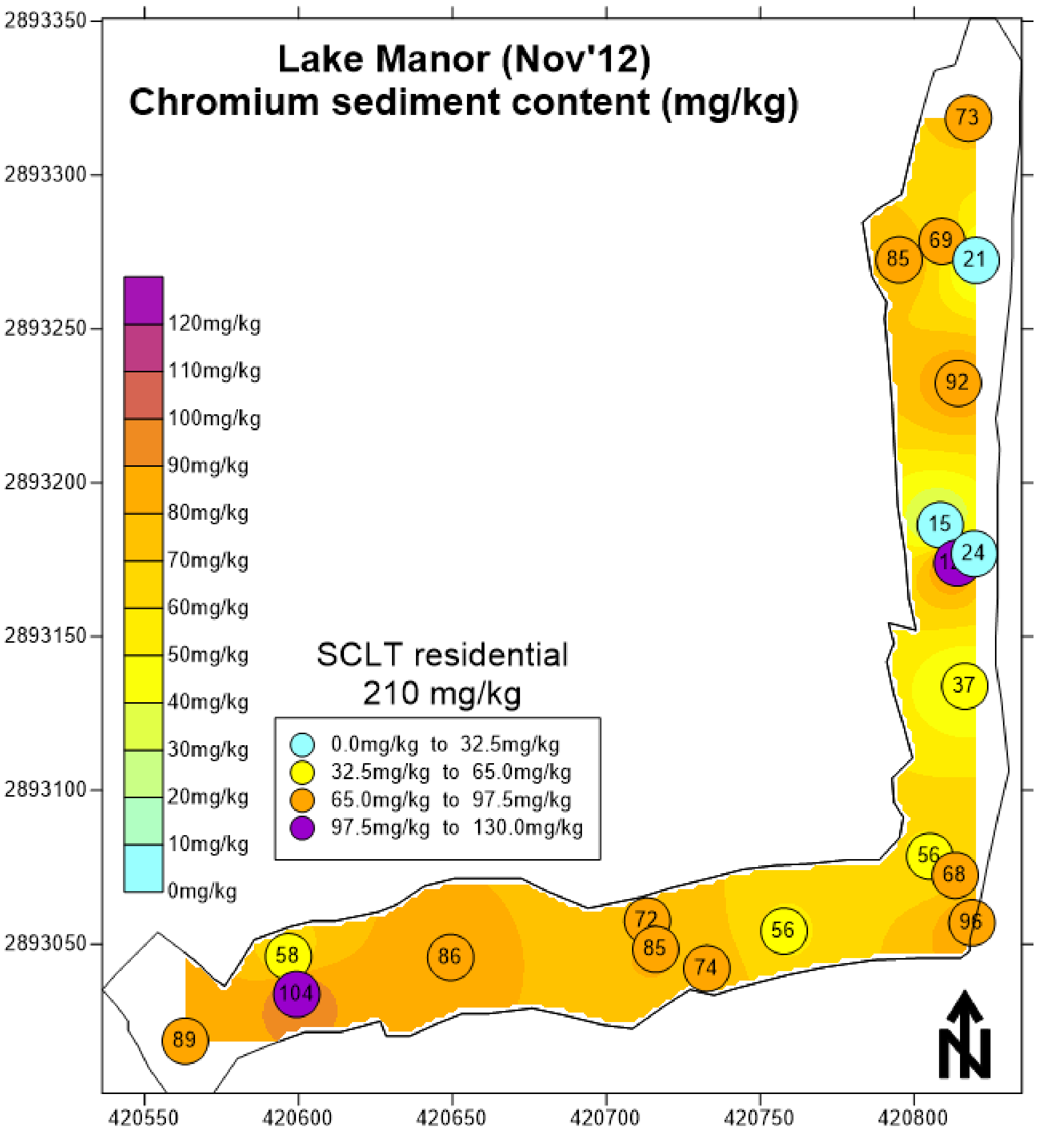


Fig.35. Spatial distribution of sediment Crcontent

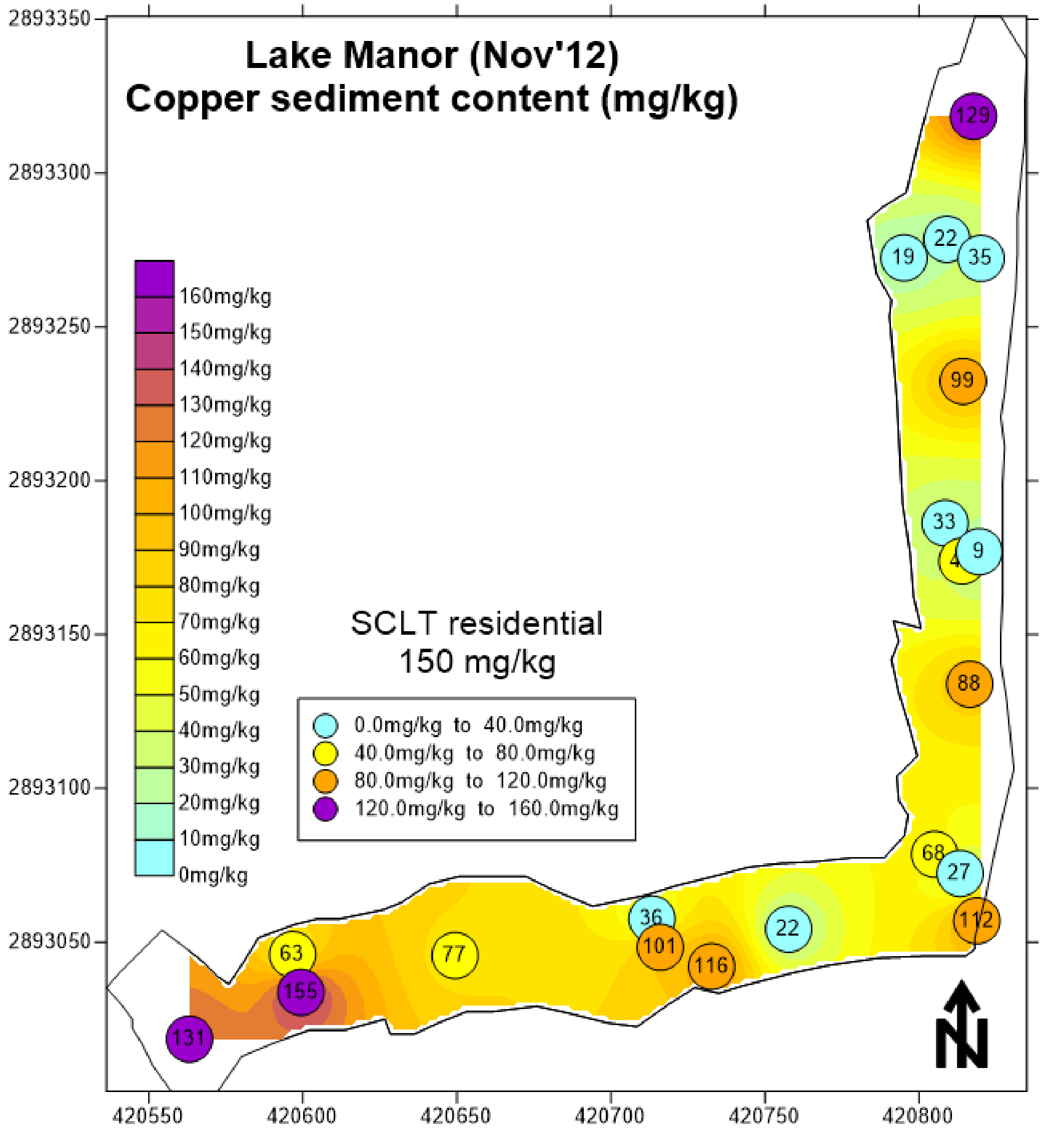


Fig.36. Spatial distribution of sediment Cu content

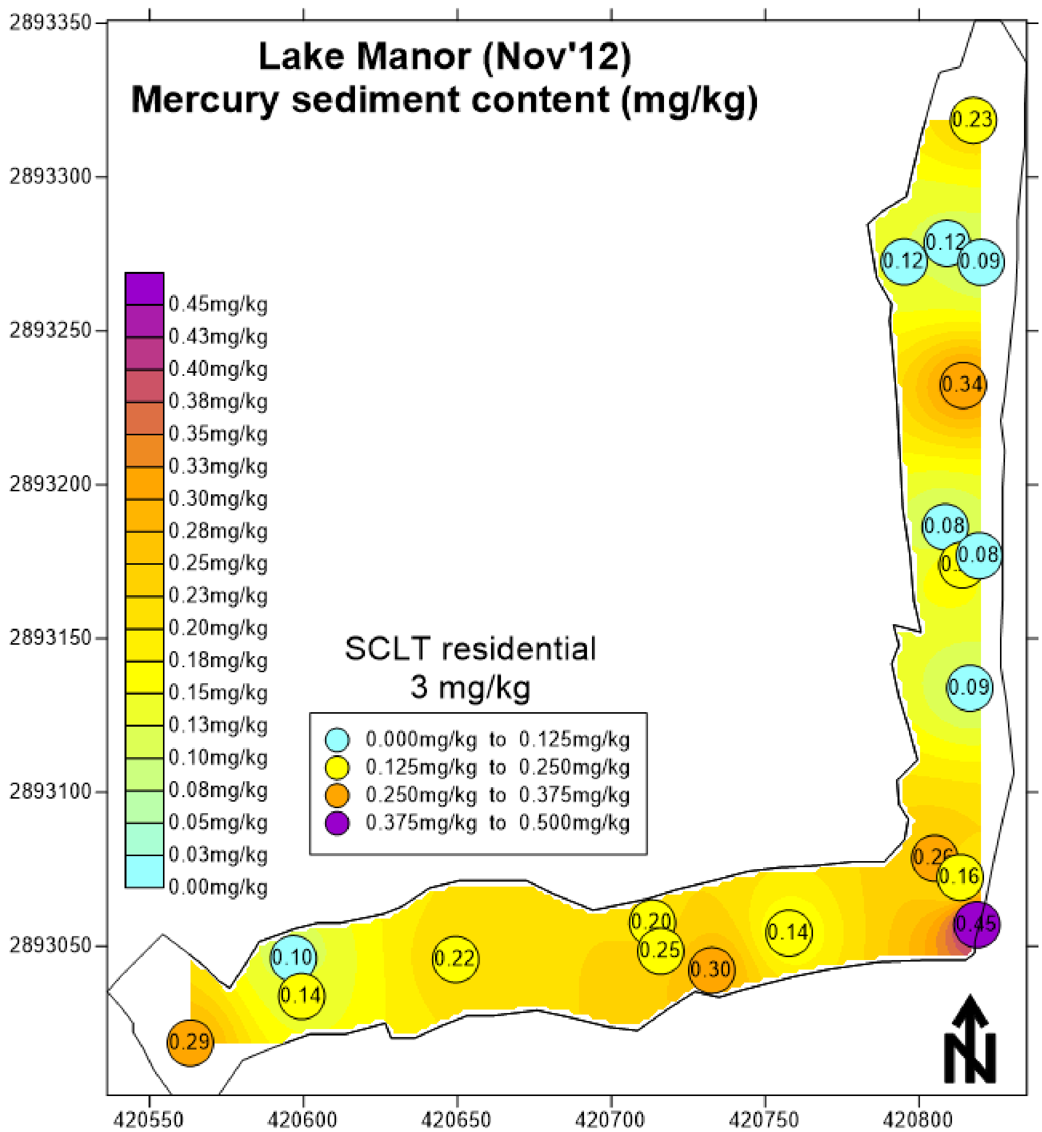


Fig.37. Spatial distribution of sediment Hg content

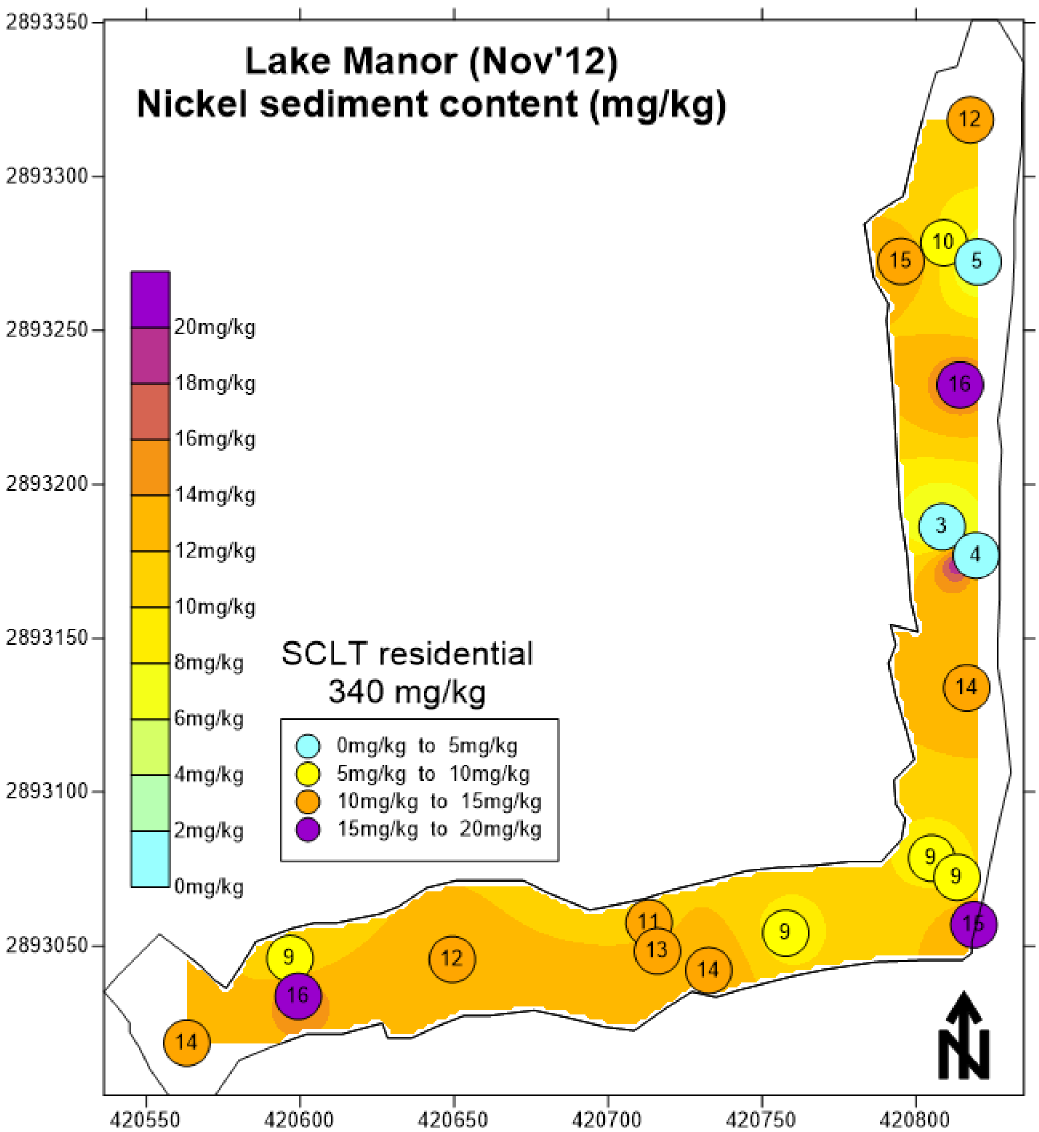


Fig.38. Spatial distribution of sediment Ni content

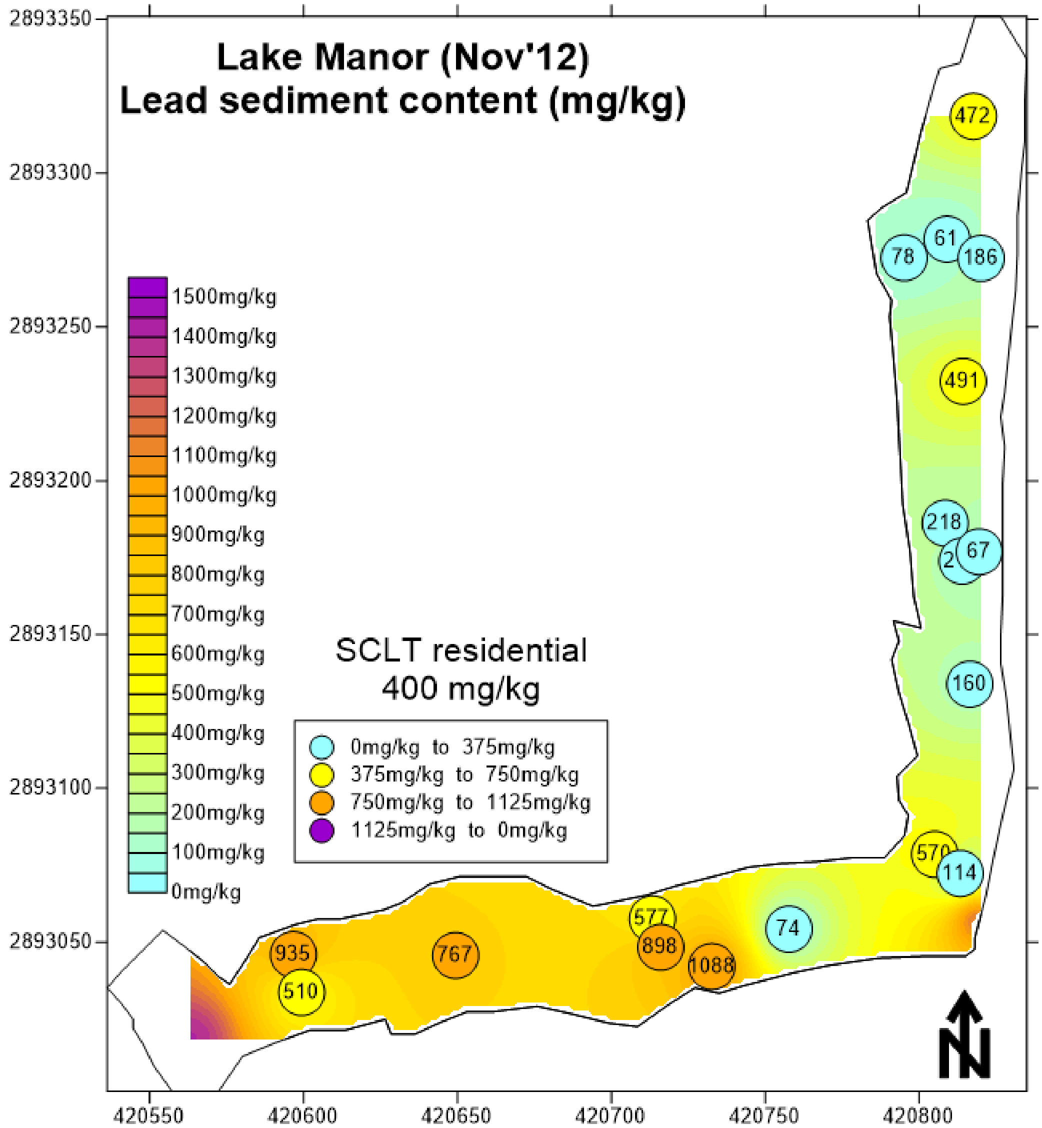


Fig.39. Spatial distribution of sediment Pb content

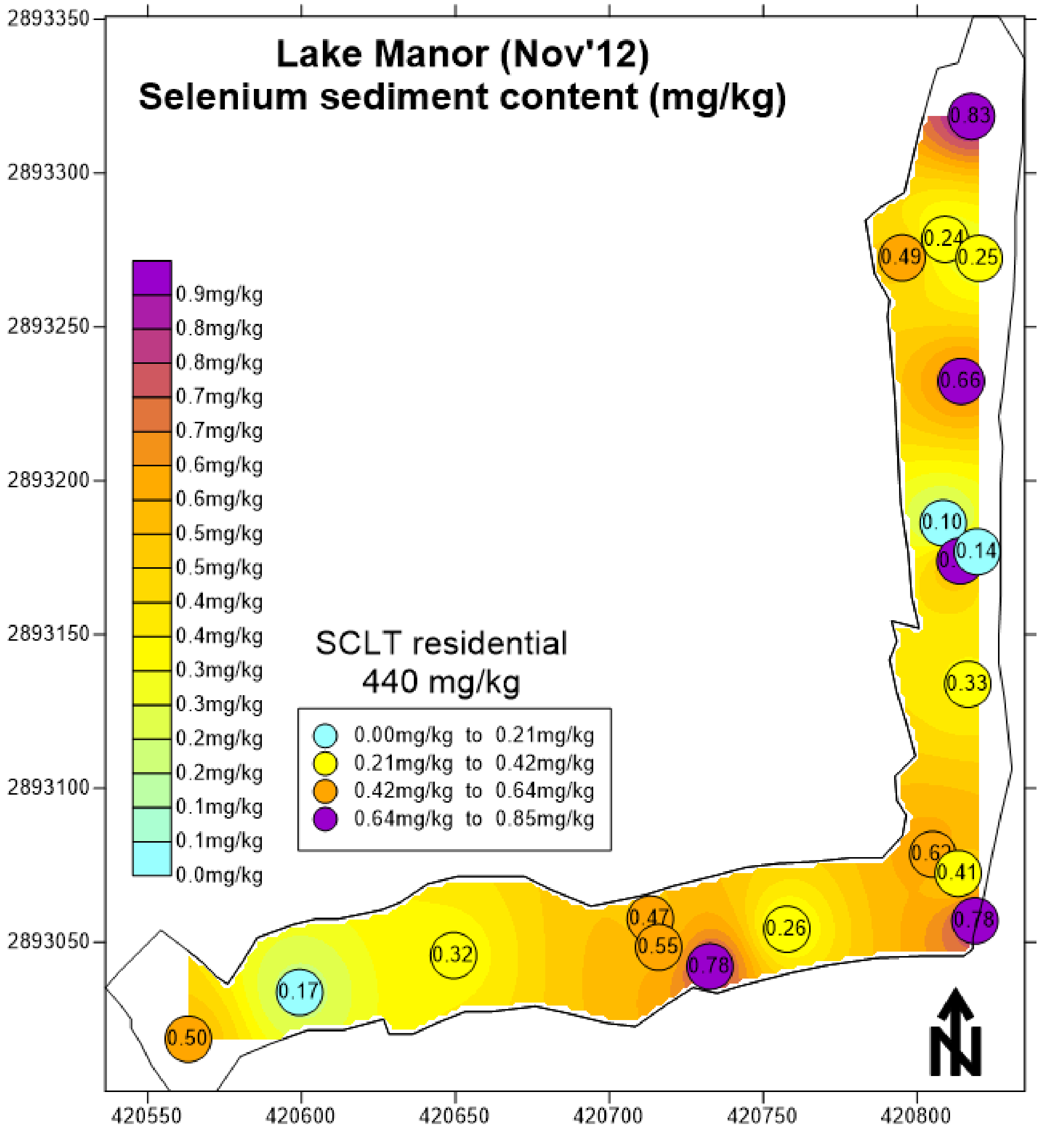


Fig.40. Spatial distribution of sediment Se content

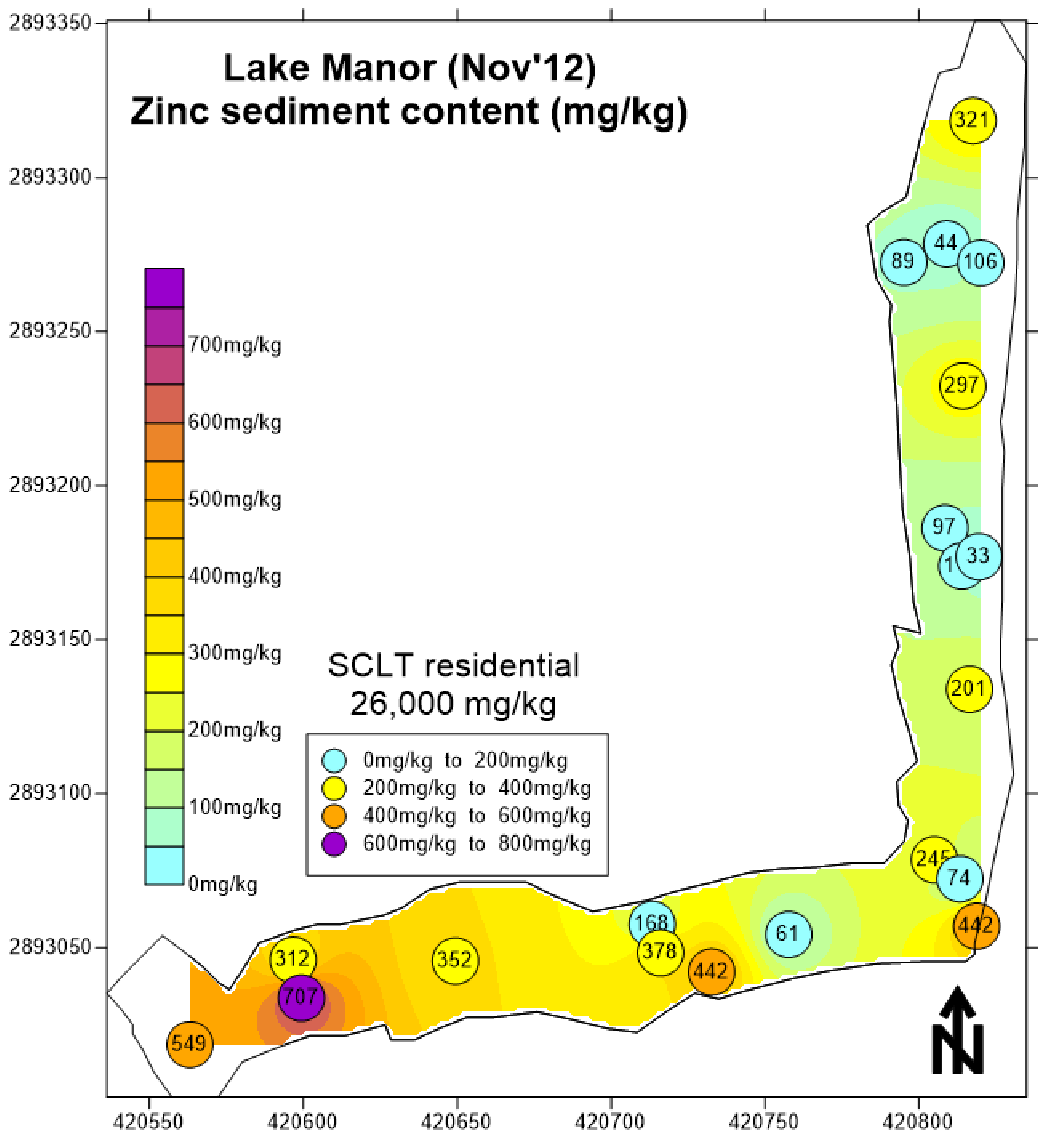


Fig.41. Spatial distribution of sediment Zn content

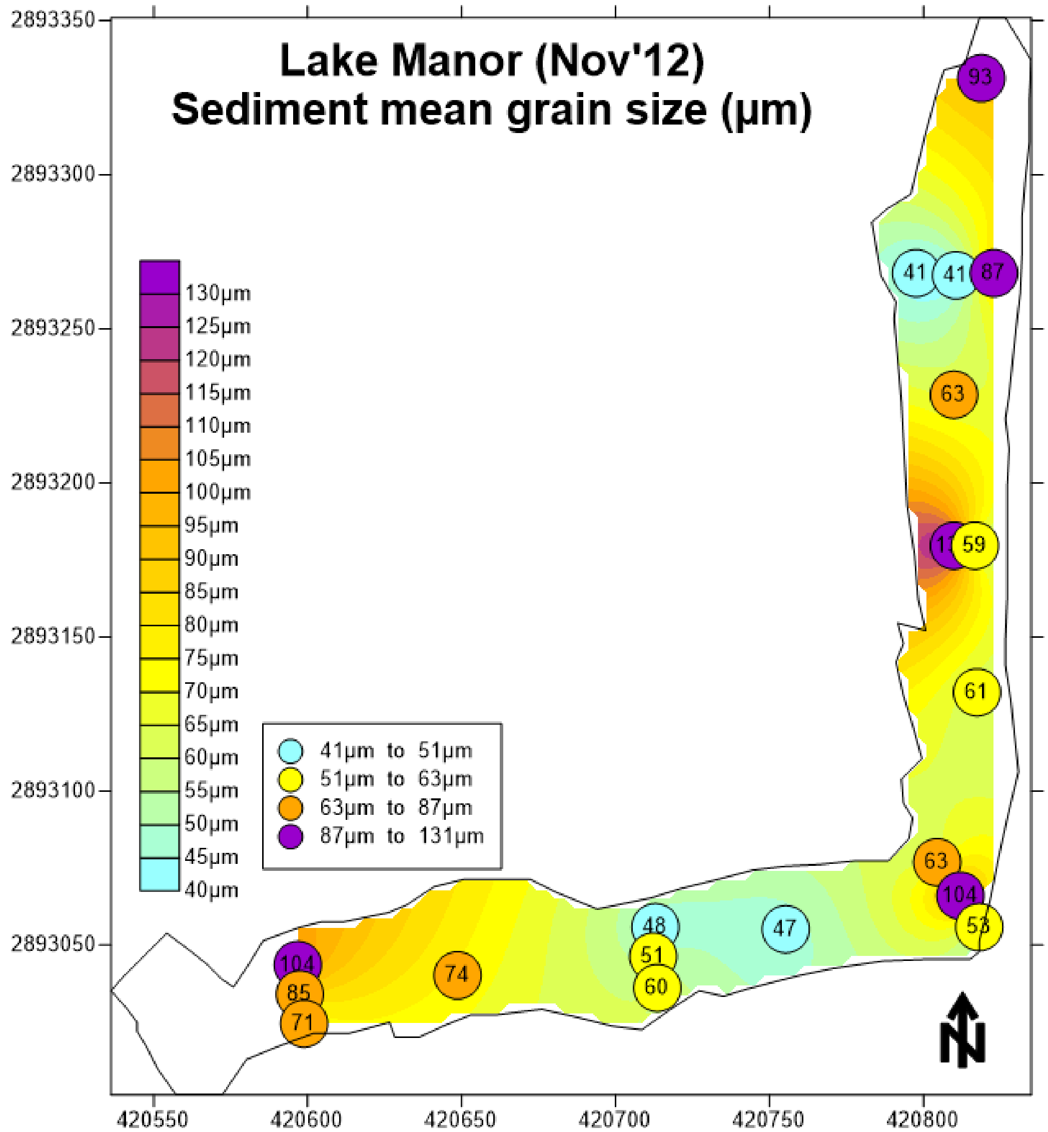
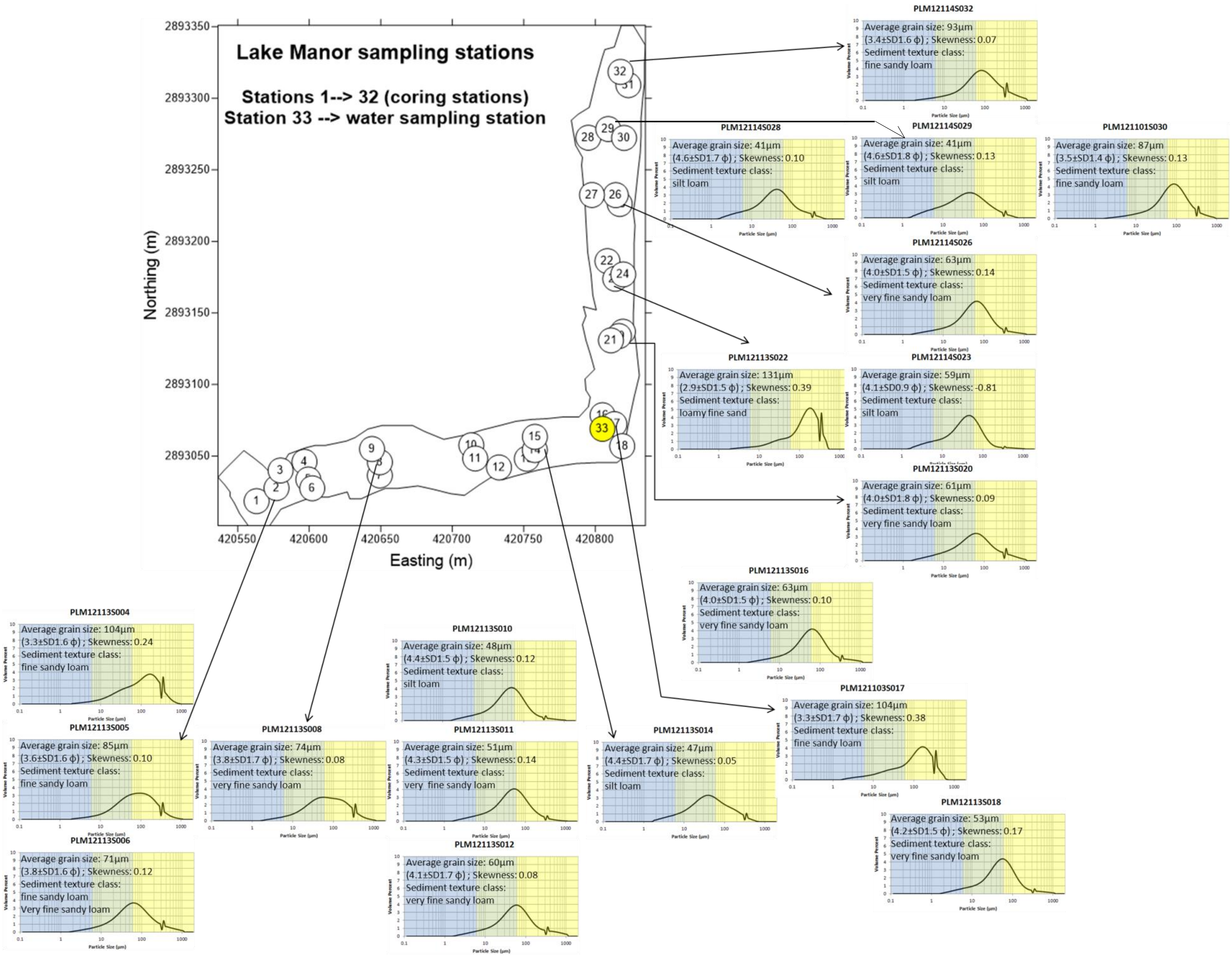


Fig.42. Spatial distribution of the average sediment grain size (µm)


Lake Manor sampling stations
Stations 1--> 32 (coring stations)
Station 33 --> water sampling station
Northing (m)
Easting (m)
PLM12114S032
Average grain size: 93µm
(3.4±SD1.6 ϕ) ; Skewness: 0.07
Sediment texture class:
fine sandy loam
PLM12114S028
Average grain size: 41µm
(4.6±SD1.7 ϕ) ; Skewness: 0.10
Sediment texture class:
silt loam
PLM12114S029
Average grain size: 41µm
(4.6±SD1.8 ϕ) ; Skewness: 0.13
Sediment texture class:
silt loam
PLM121101S030
Average grain size: 87µm
(3.5±SD1.4 ϕ) ; Skewness: 0.13
Sediment texture class:
fine sandy loam
PLM12114S026
Average grain size: 63µm
(4.0±SD1.5 ϕ) ; Skewness: 0.14
Sediment texture class:
very fine sandy loam
PLM12113S022
Average grain size: 131µm
(2.9±SD1.5 ϕ) ; Skewness: 0.39
Sediment texture class:
loamy fine sand
PLM12114S023
Average grain size: 59µm
(4.1±SD0.9 ϕ) ; Skewness: -0.81
Sediment texture class:
silt loam
PLM12113S020
Average grain size: 61µm
(4.0±SD1.8 ϕ) ; Skewness: 0.09
Sediment texture class:
very fine sandy loam
PLM12113S016
Average grain size: 63µm
(4.0±SD1.5 ϕ) ; Skewness: 0.10
Sediment texture class:
very fine sandy loam
PLM121103S017
Average grain size: 104µm
(3.3±SD1.7 ϕ) ; Skewness: 0.38
Sediment texture class:
fine sandy loam
PLM12113S018
Average grain size: 53µm
(4.2±SD1.5 ϕ) ; Skewness: 0.17
Sediment texture class:
very fine sandy loam
PLM12113S004
Average grain size: 104µm
(3.3±SD1.6 ϕ) ; Skewness: 0.24
Sediment texture class:
fine sandy loam
PLM12113S005
Average grain size: 85µm
(3.6±SD1.6 ϕ) ; Skewness: 0.10
Sediment texture class:
fine sandy loam
PLM12113S006
Average grain size: 71µm
(3.8±SD1.6 ϕ) ; Skewness: 0.12
Sediment texture class:
fine sandy loam
Very fine sandy loam
PLM12113S008
Average grain size: 74µm
(3.8±SD1.7 ϕ) ; Skewness: 0.08
Sediment texture class:
very fine sandy loam
PLM12113S010
Average grain size: 48µm
(4.4±SD1.5 ϕ) ; Skewness: 0.12
Sediment texture class:
silt loam
PLM12113S011
Average grain size: 51µm
(4.3±SD1.5 ϕ) ; Skewness: 0.14
Sediment texture class:
very fine sandy loam
PLM12113S012
Average grain size: 60µm
(4.1±SD1.7 ϕ) ; Skewness: 0.08
Sediment texture class:
very fine sandy loam
PLM12113S014
Average grain size: 47µm
(4.4±SD1.7 ϕ) ; Skewness: 0.05
Sediment texture class:
silt loam

Appendix 3 – core pictures

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	1	PLM121103S001	17	2893018	420563	42	28

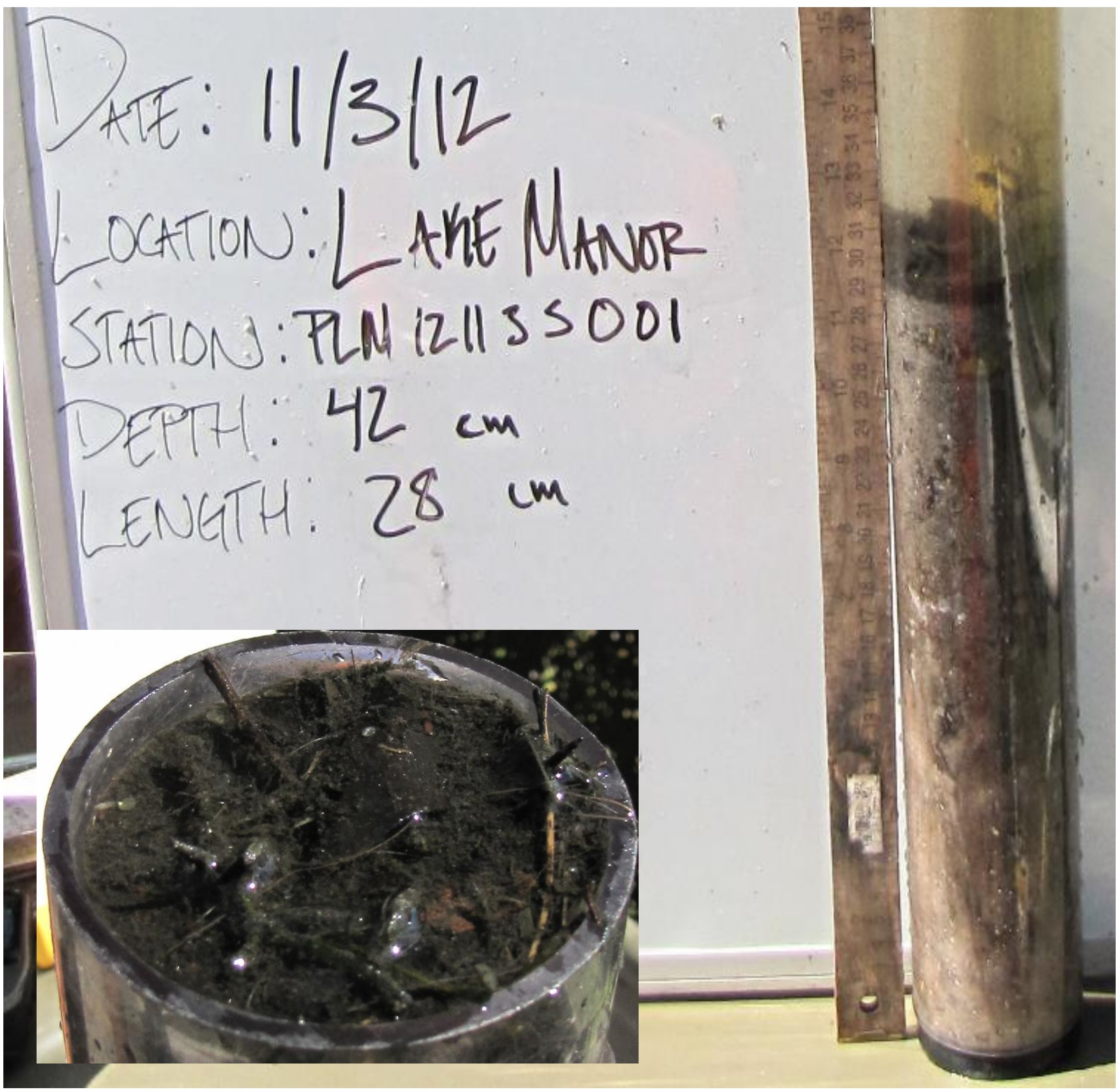
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	0	0.99	0.17	69.2%	30.8%	18.2%	0.71%	0.13%
floc	1							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.306	12400	17.2	11.7	2.53	88.8	131	0.288	13.6	1407	0.497	549

material type sed./floc	Sediment type desc.
sediment	no material
floc	black organic

bottom core desc.
26.5 cm white sand with peat

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	2	PLM121101S002	17	2893028	420577	186	47

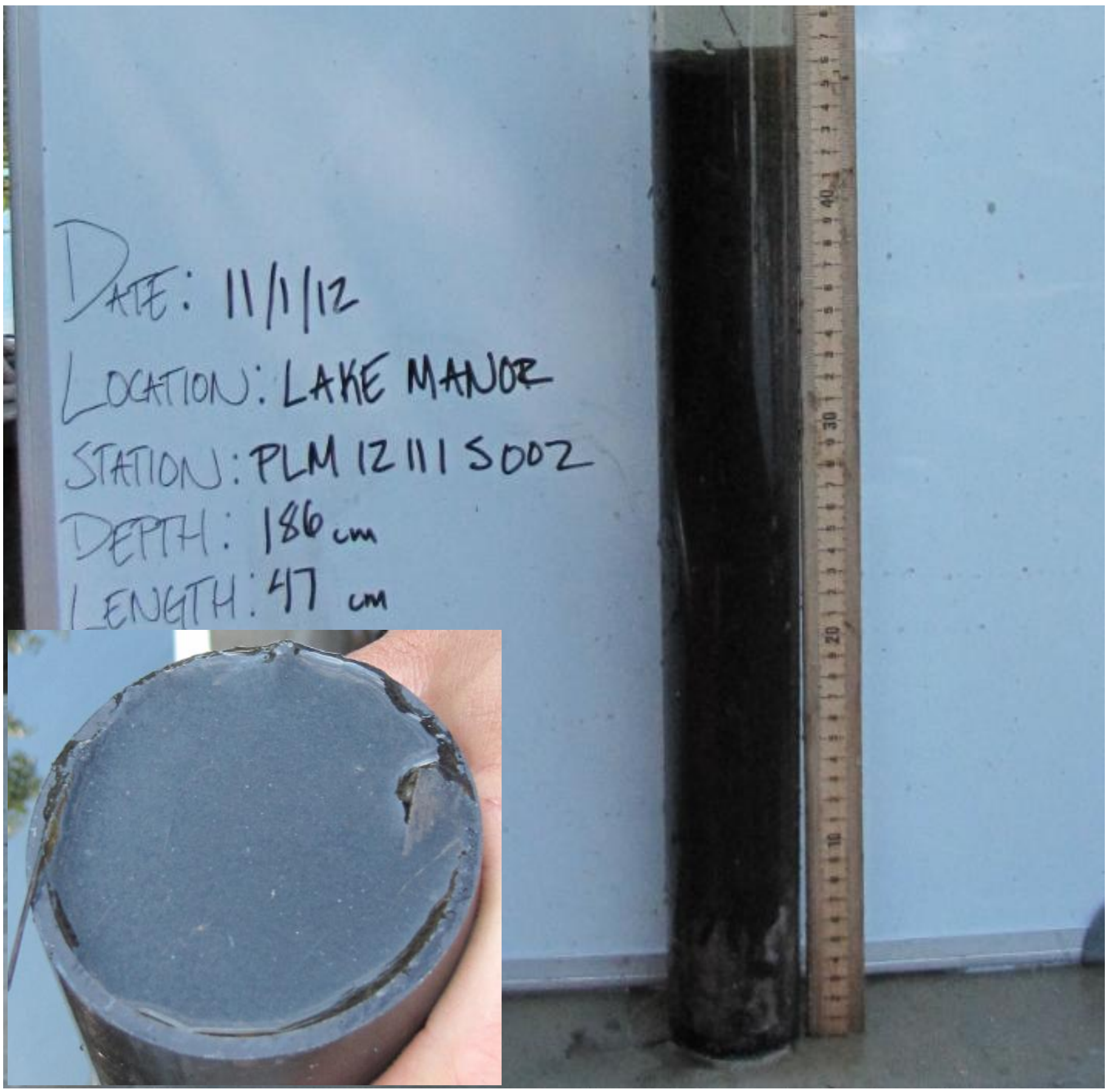
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	30							
floc	4							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
10 cm white sand muck mix

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	3	PLM121101S003	17	2893040	420580	137	71

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	22							
floc	32							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
7 cm sand then another layer of peat (12 cm)

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	4	PLM121103S004	17	2893046	420597	215	51

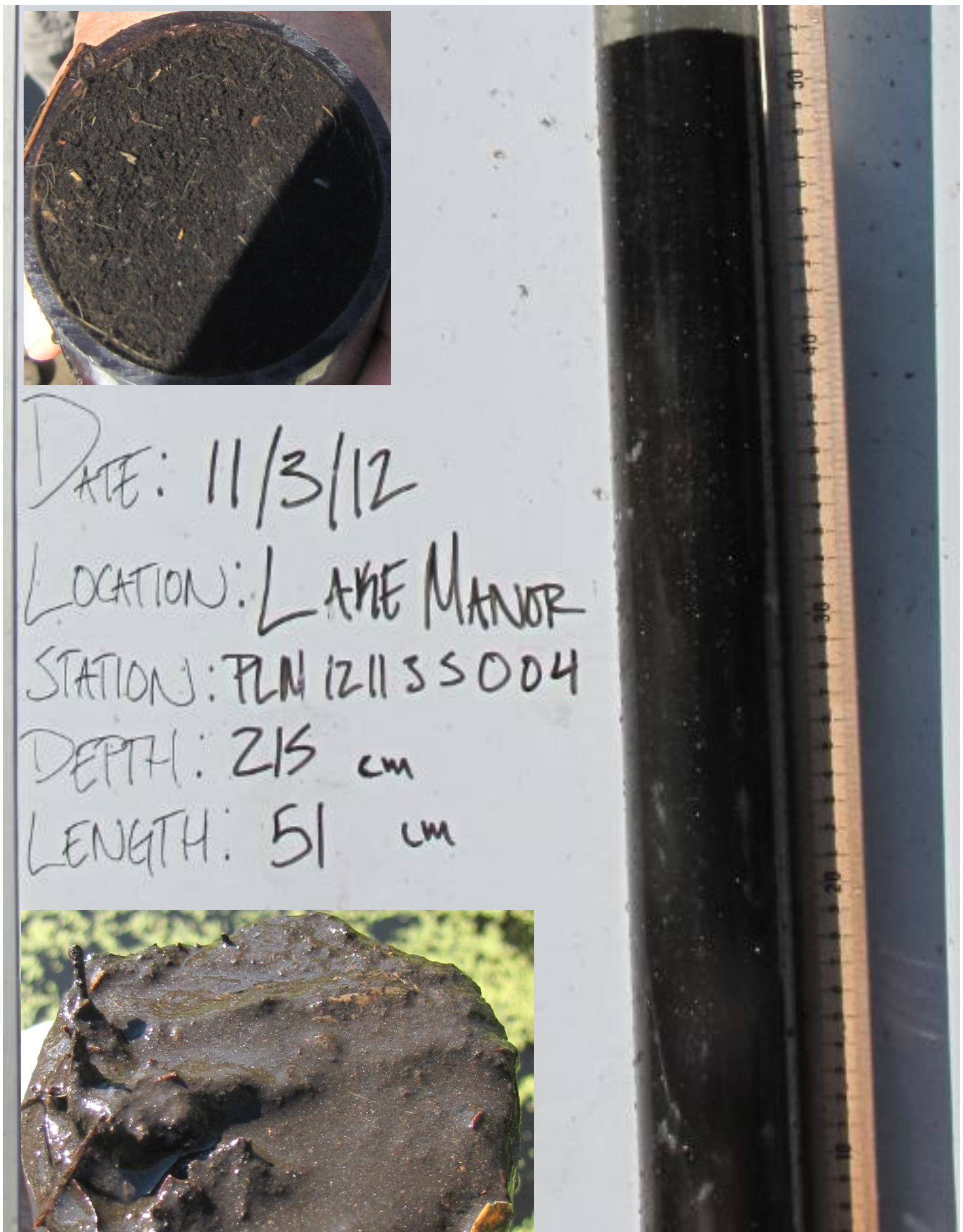
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	44.5	1.15	0.48	87.6%	12.4%	9.7%	0.28%	0.05%
floc	8	0.99	0.11	63.2%	36.8%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.162	6930	6.02	13	1.7	57.7	62.7	0.101	8.91	935	ND	312

material type sed./floc	Sediment type desc.
sediment	Black smooth organic; very little peat
floc	black organic

bottom core desc.
5 cm white sand mixed with muck

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	5	PLM121103S005	17	2893034	420599	193	30

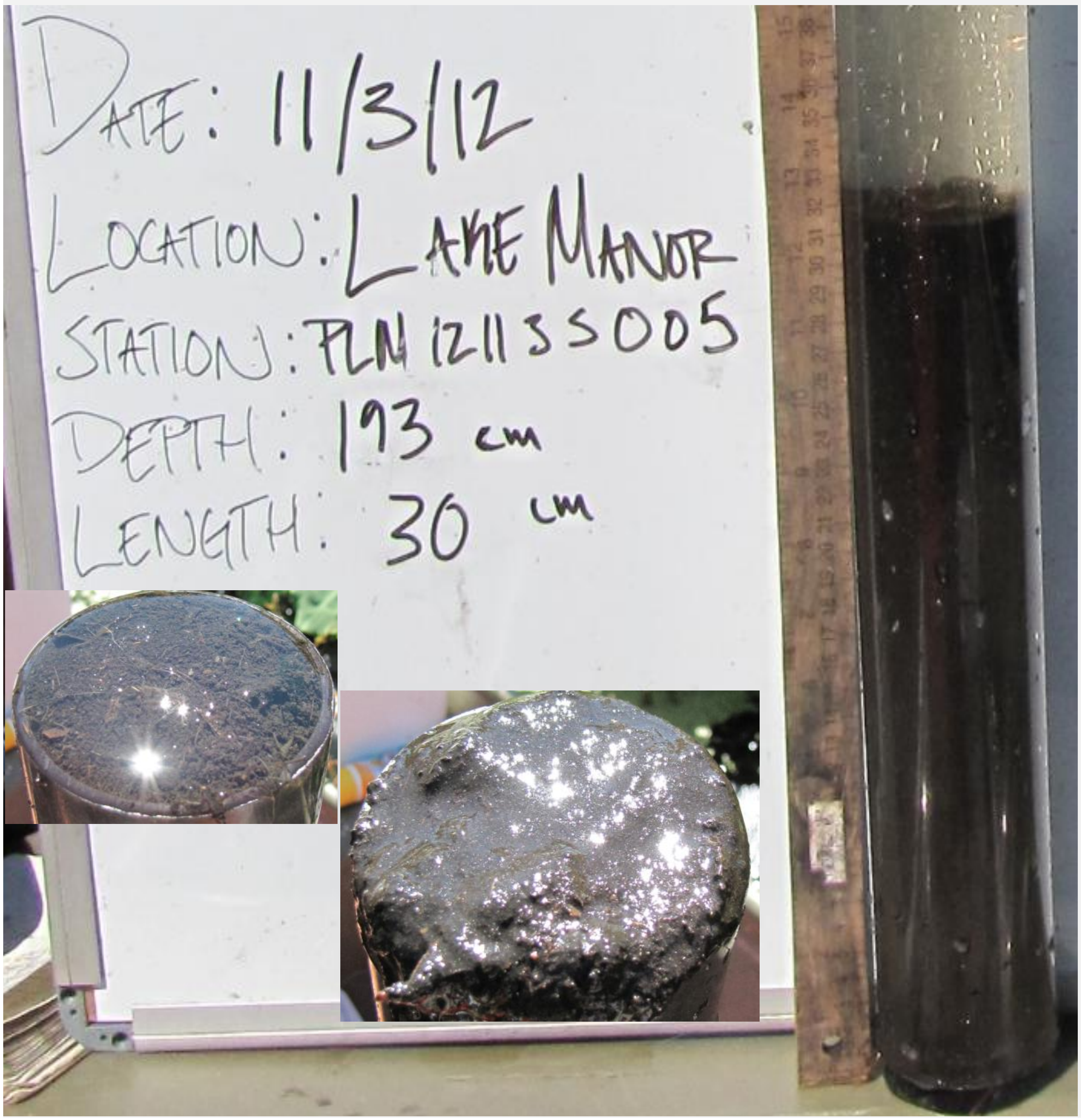
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	12.5	1.06	0.27	94.5%	5.5%	19.9%	0.61%	0.10%
floc	6.5	1.01	0.06	46.2%	53.8%	30.3%	2.09%	0.22%

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.404	12200	10.1	14.6	3.08	104	155	0.14	15.7	510	0.171	707

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
10.5 cm white sand mixed with muck

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	6	PLM121103S006	17	2893027	420602	177	32

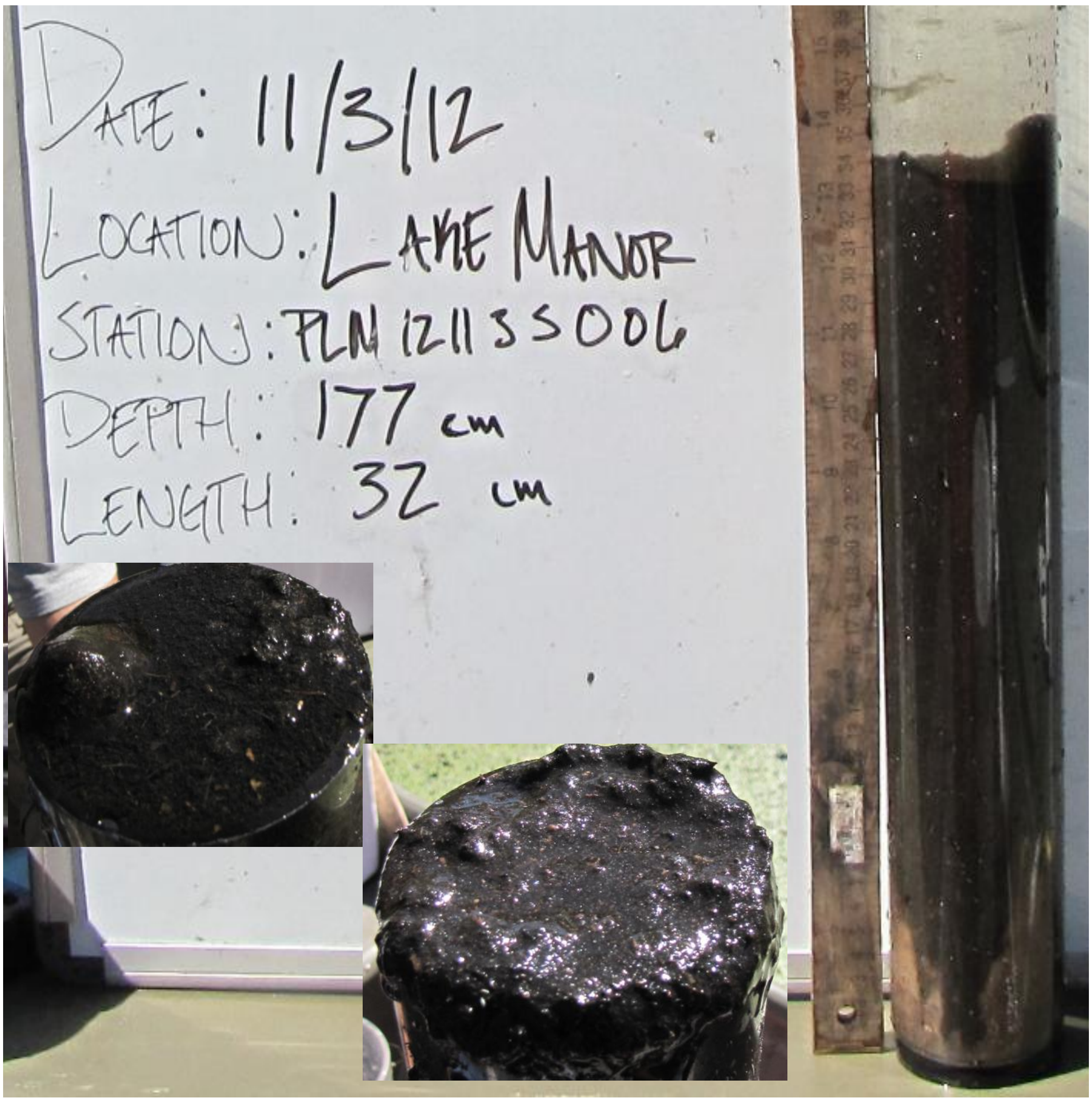
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	22	0.98	0.05	56.4%	43.6%	24.6%	1.33%	0.26%
floc	2							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
6 cm brown sand

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	7	PLM121101S007	17	2893036	420649	223	33.5

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	12							
floc	6							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
12 cm brown sand; peat mixed at top; small organic layer at bottom (1 cm)

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	8	PLM121103S008	17	2893046	420649	281	44.5

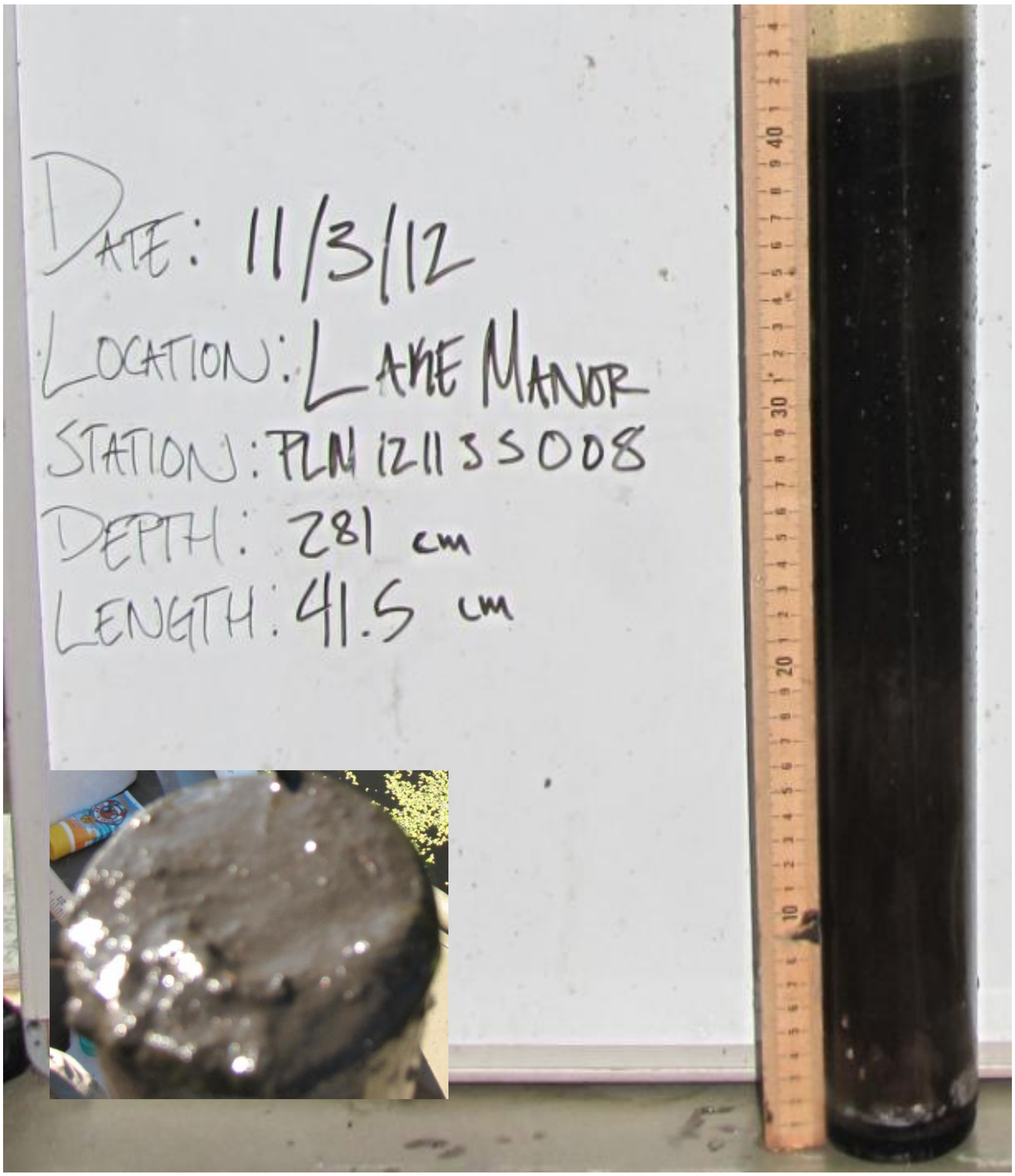
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	32	0.91	0.17	80.2%	19.8%	14.1%	0.43%	0.09%
floc	4.5	0.94	0.06	57.3%	42.7%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.198	31300	9.33	20.7	1.87	85.7	76.8	0.216	12	767	0.322	352

material type sed./floc	Sediment type desc.
sediment	Black smooth organic
floc	black organic

bottom core desc.
3.5 cm brown sand

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	9	PLM121101S009	17	2893055	420644	246	39

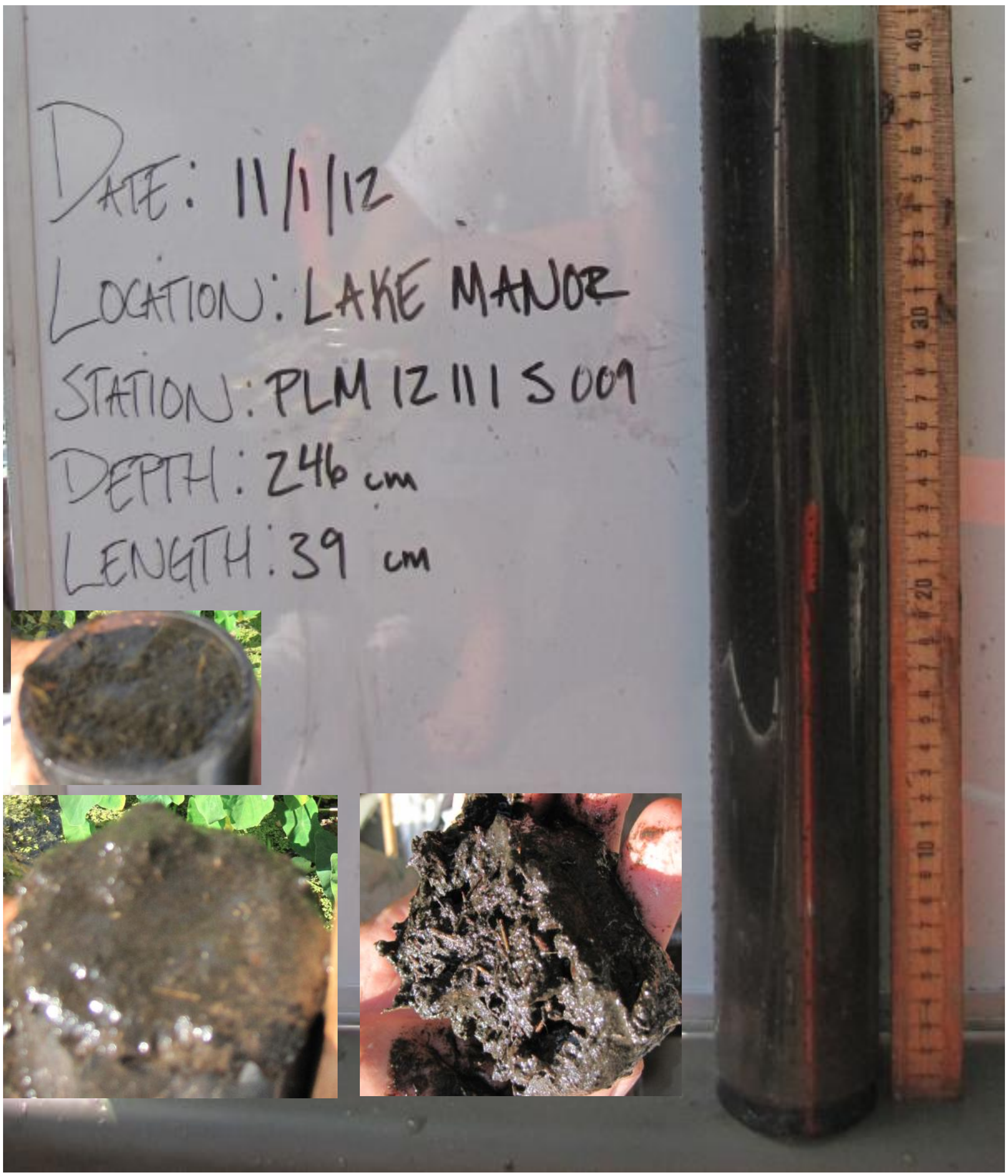
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	22							
floc	6							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
10 cm brown sand

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	10	PLM121103S010	17	2893058	420713	259	45.5

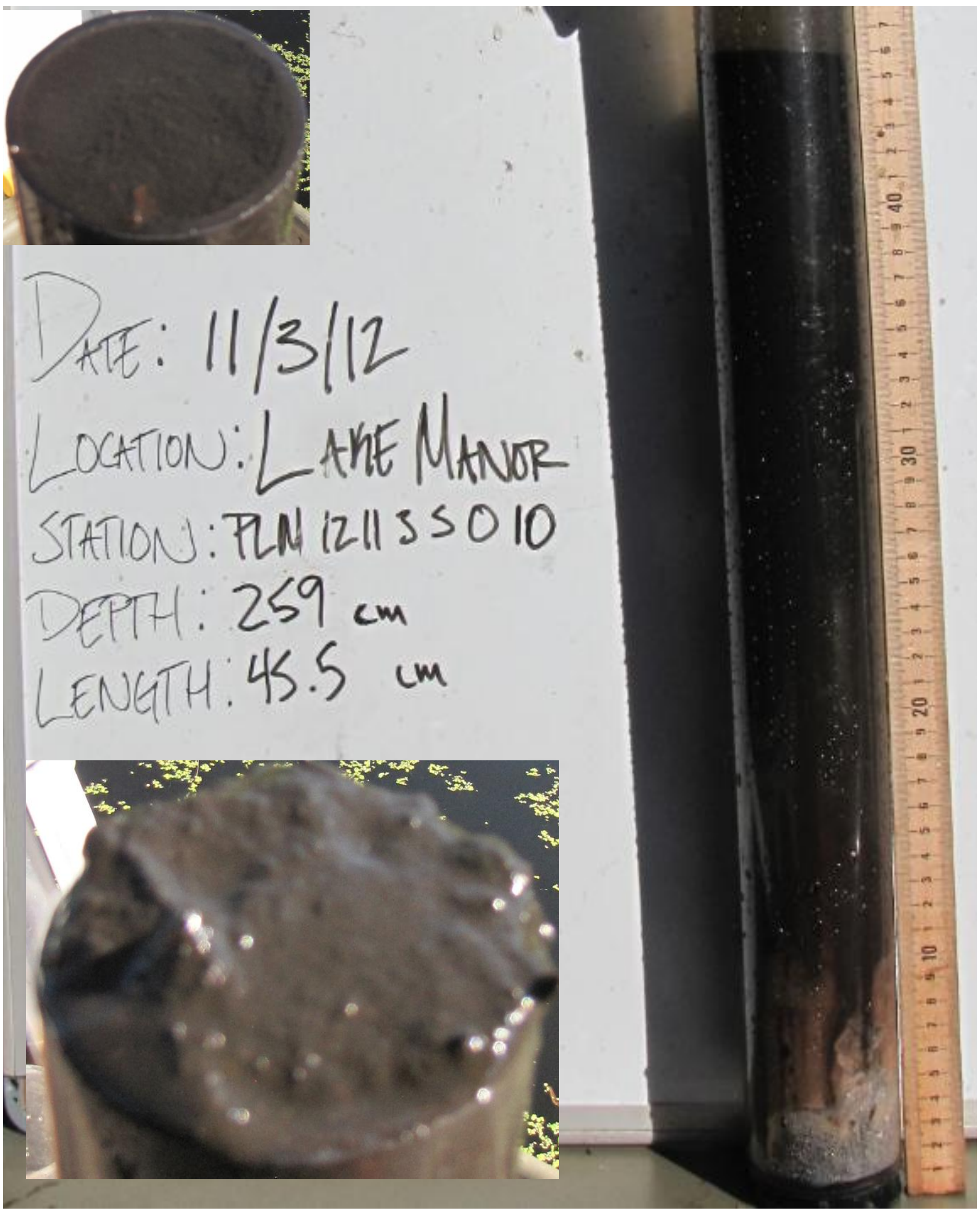
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	26	0.92	0.20	76.7%	23.3%	16.2%	0.65%	0.22%
floc	8	0.97	0.06	55.6%	44.4%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.098	53000	7.82	23	1.02	71.7	35.7	0.204	10.9	577	0.469	168

material type sed./floc	Sediment type desc.
sediment	Black smooth organic
floc	black organic

bottom core desc.
7 cm brown sand

NM= NO MATERIAL NR= NOT RECORDED



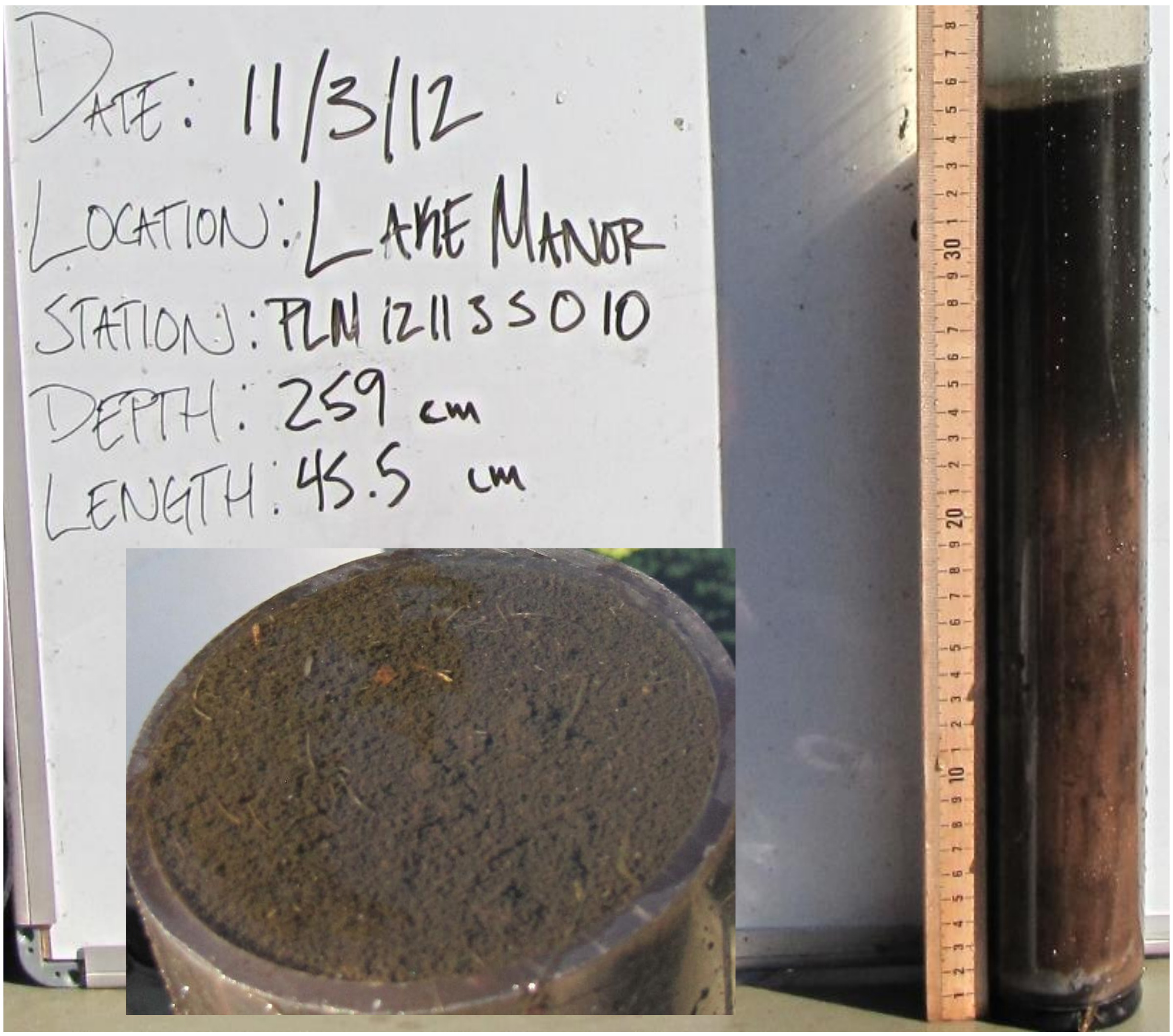
date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	11	PLM121103S011	17	2893048	420716	265	34

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	5	0.97	0.19	76.0%	24.0%	15.8%	0.65%	0.16%
floc	8	0.95	0.07	52.8%	47.2%	29.4%	1.41%	0.15%

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.246	35000	13.8	22.9	2.14	85.1	101	0.247	13	898	0.545	378

material type sed./floc	Sediment type desc.	bottom core desc.
sediment	Black smooth organic	21 cm brown sand
floc	black organic	

NM= NO MATERIAL NR= NOT RECORDED



Note : numbers on the board we not refreshed

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	12	PLM121103S012	17	2893042	420733	197	27

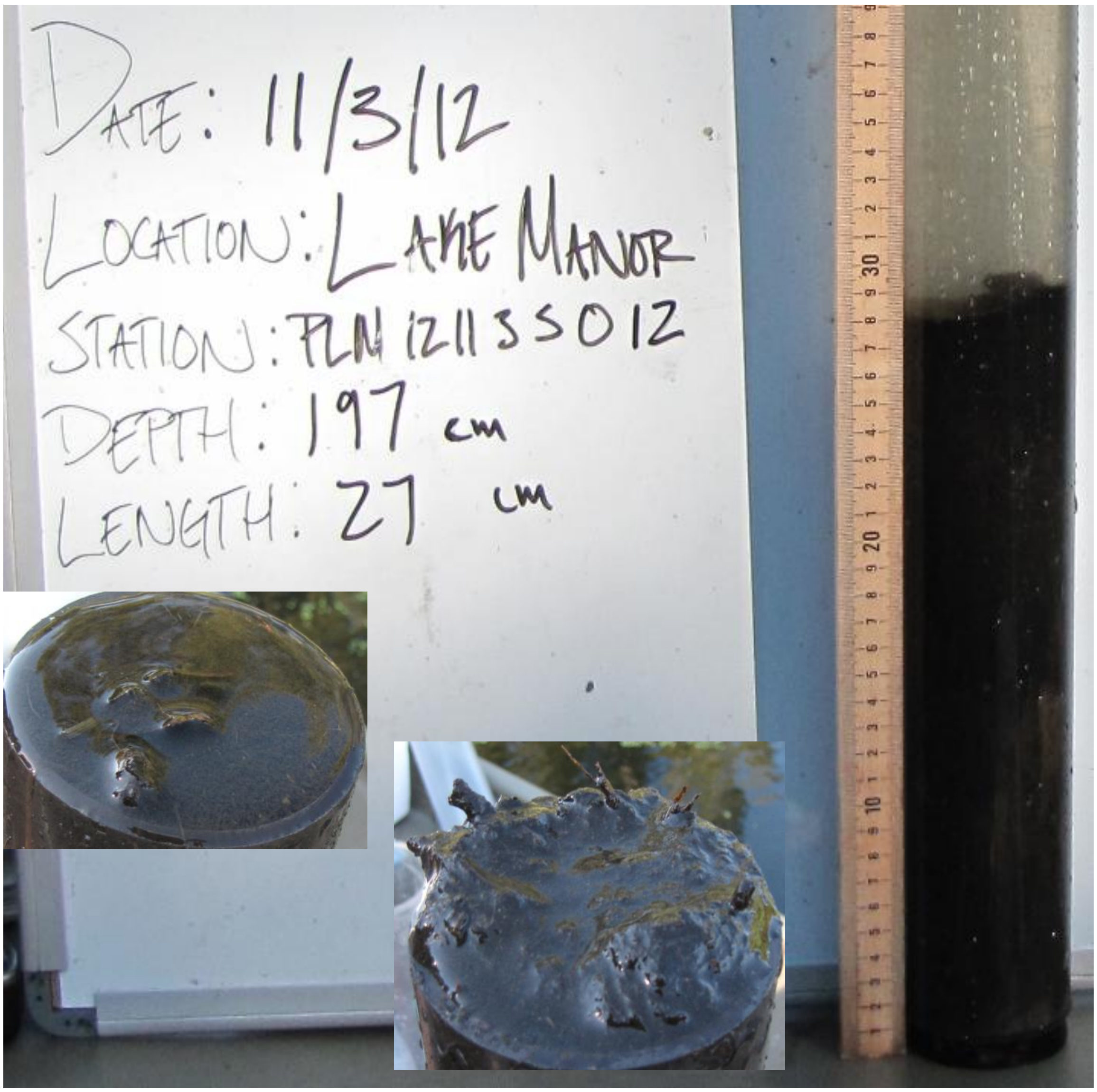
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	8	1.00	0.15	50.1%	49.9%	23.8%	0.95%	0.09%
floc	7	0.99	0.12	63.6%	36.4%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.222	20200	22.9	15.8	2.03	74	116	0.3	14.3	1088	0.78	442

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat; Large chunks of wood
floc	black organic

bottom core desc.
12.5 brown sand mixed with muck

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	13	PLM121101S013	17	2893048	420752	261	43

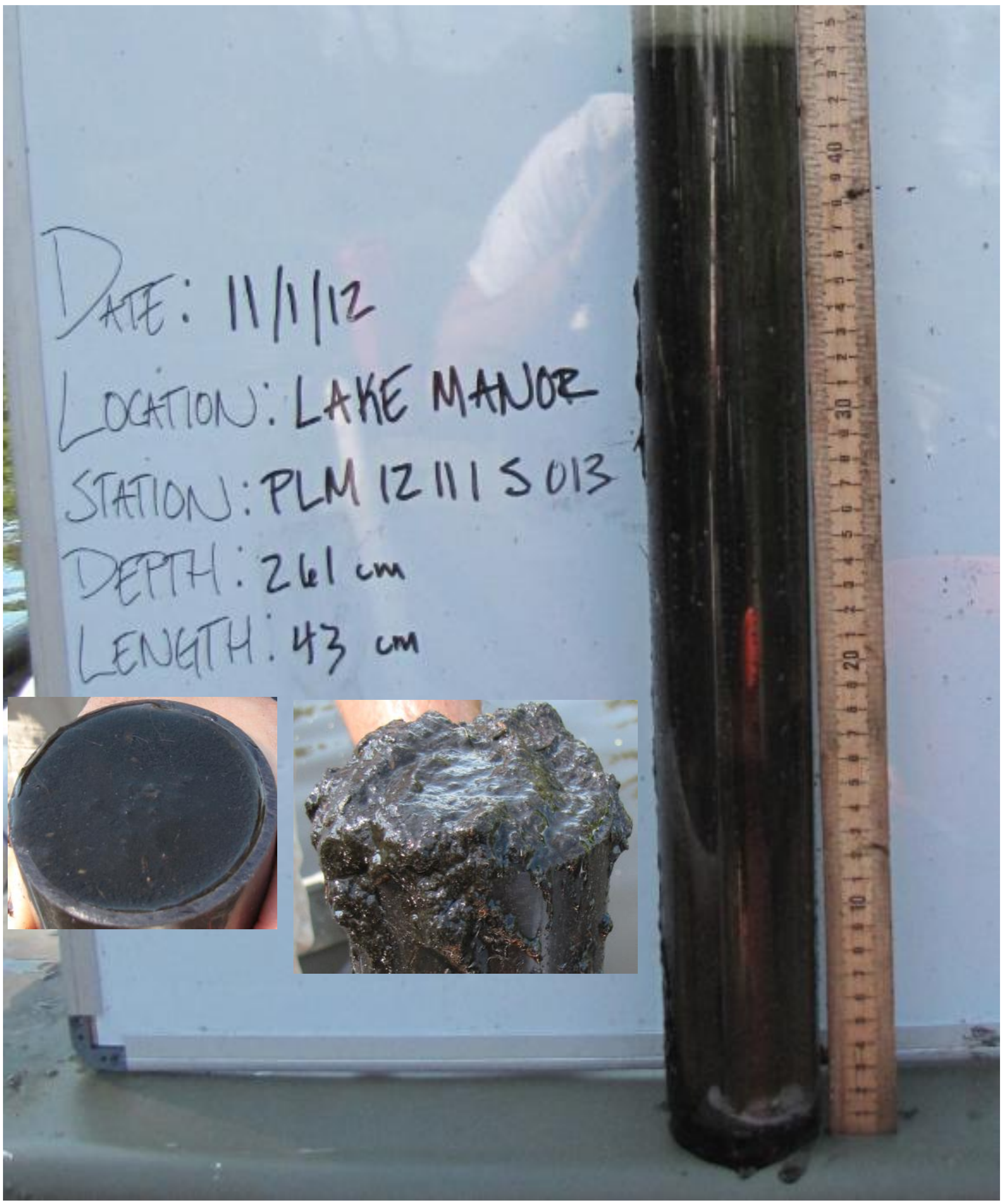
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	14							
floc	15							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
13 cm brown sand; top half mixed with peat

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	14	PLM121103S014	17	2893054	420758	278	23.5

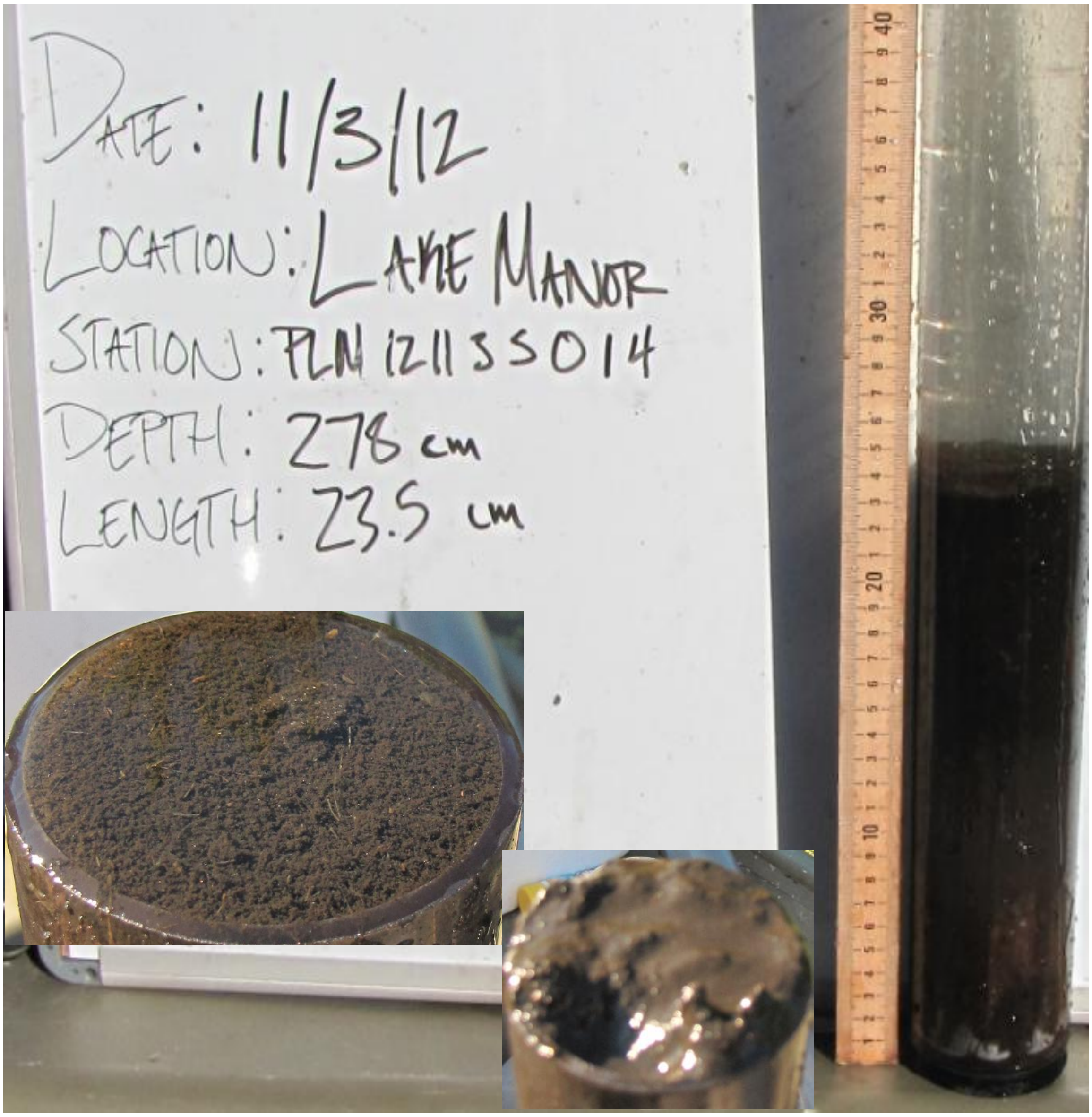
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	10	1.15	0.42	83.2%	16.8%	8.1%	0.25%	0.15%
floc	5.5	0.89	0.06	64.3%	35.7%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.062	50300	2.84	15.4	0.32	56.4	21.7	0.141	8.93	74.1	0.262	60.8

material type sed./floc	Sediment type desc.
sediment	Black smooth organic
floc	black organic

bottom core desc.
7.5 cm brown sand

NM= NO MATERIAL NR= NOT RECORDED



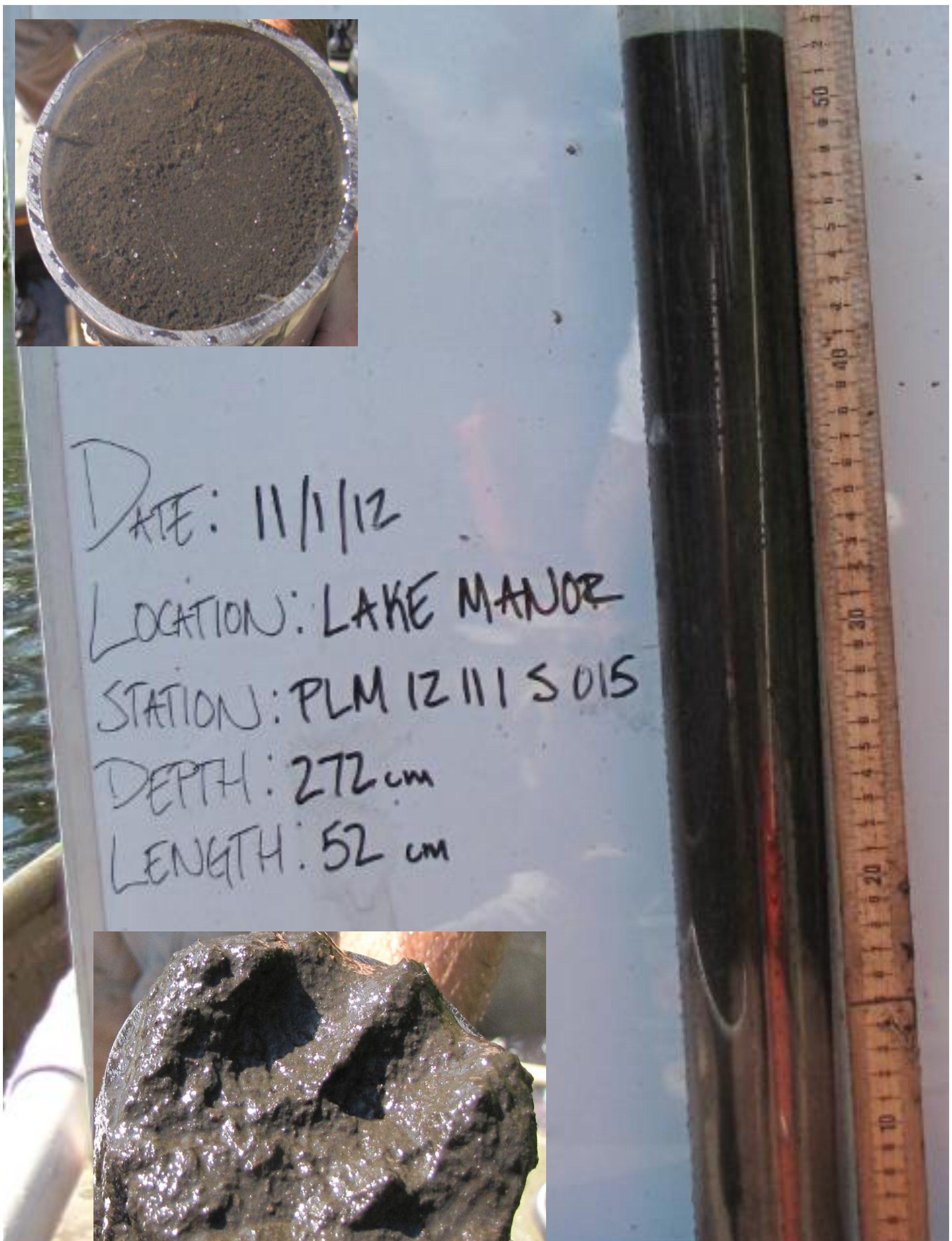
date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	15	PLM121101S015	17	2893063	420758	272	52

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	25							
floc	15							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.	bottom core desc.
sediment	Black smooth organic	14 cm brown sand
floc	black organic	

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	16	PLM121103S016	17	2893079	420805	240	33

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	11.5	0.99	0.18	76.2%	23.8%	11.6%	0.66%	0.13%
floc	6	0.95	0.09	62.1%	37.9%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.157	28200	9.93	14	1.23	56.1	67.7	0.261	9.02	570	0.617	245

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
14 cm brown sand

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	17	PLM121103S017	17	2893072	420813	265	39.5

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	5	1.01	0.27	82.3%	17.7%	10.2%	0.46%	0.14%
floc	6.5	0.96	0.06	53.5%	46.5%	27.8%	1.59%	0.17%

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.082	62700	4.61	17	0.48	67.5	27.2	0.158	9.41	114	0.412	73.7

material type sed./floc	Sediment type desc.
sediment	Black smooth organic
floc	black organic

bottom core desc.
18 cm white sand

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	18	PLM121103S018	17	2893057	420819	215	42

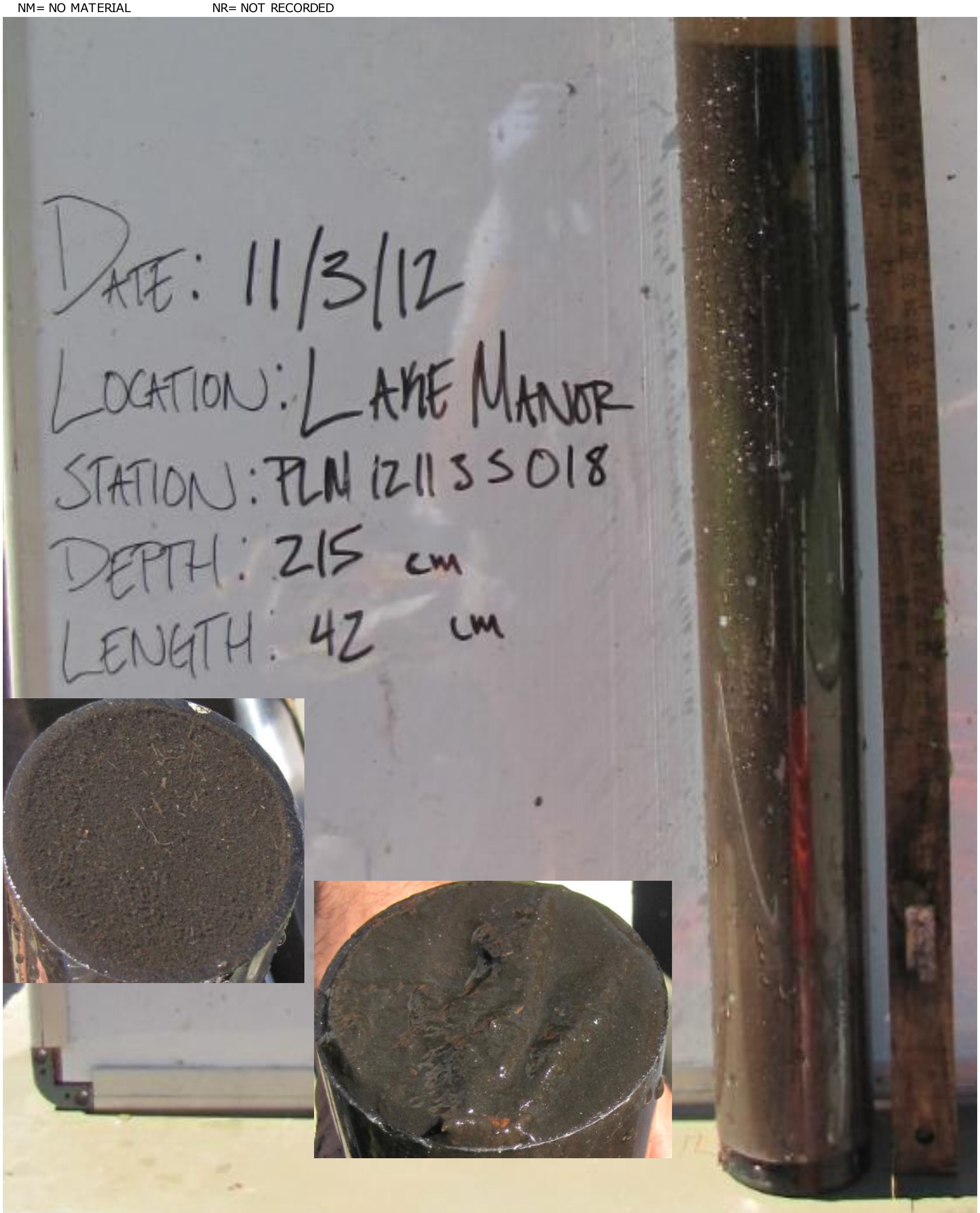
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	33	0.90	0.14	67.4%	32.6%	16.1%	0.91%	0.15%
floc	8	0.99	0.05	42.4%	57.6%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.3	41400	20.4	21.7	2.44	95.9	112	0.453	15.1	1150	0.775	442

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
1 cm brown sand

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	19	PLM121101S019	17	2893137	420819	221	25

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	14							
floc	8							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.	bottom core desc.
sediment	Black organic mixed with peat	3 cm brown sand
floc	black organic	

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	20	PLM121103S020	17	2893134	420817	225	33

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	10	1.19	0.42	92.0%	8.0%	5.8%	0.20%	0.05%
floc	3.5	0.97	0.06	56.4%	43.6%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.09	7630	10.1	8.77	0.53	36.7	88.2	0.086	14.4	160	0.333	201

material type sed./floc	Sediment type desc.
sediment	Black smooth organic with shells
floc	black organic

bottom core desc.
15 cm brown sand mixed with muck

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	21	PLM121101S021	17	2893131	420811	155	34

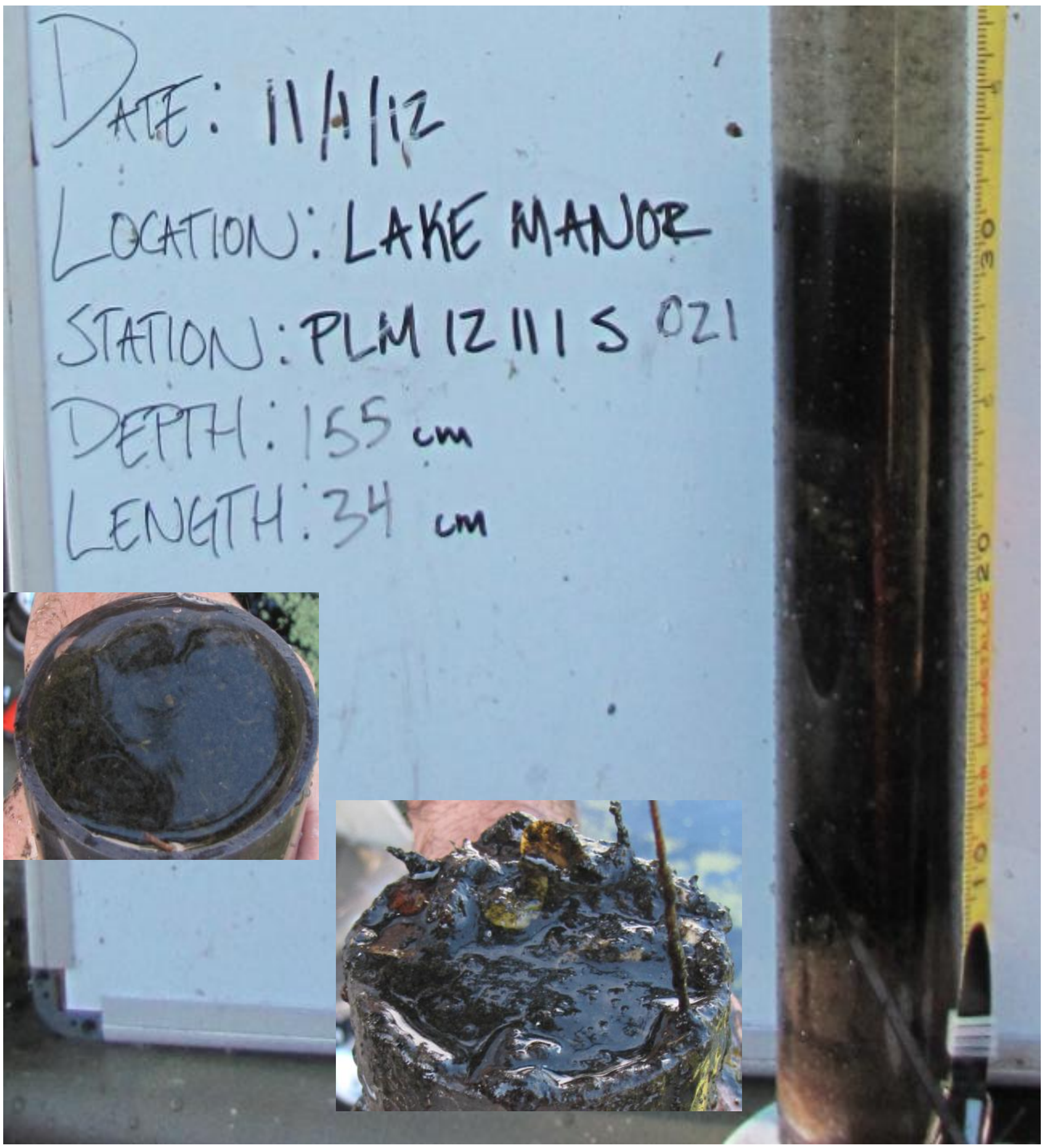
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	14							
floc	7.5							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic,lots of peat in the floc

bottom core desc.
10 cm white sand/peat transition then white sand

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/3/2012	22	PLM121103S022	17	2893186	420809	192	25

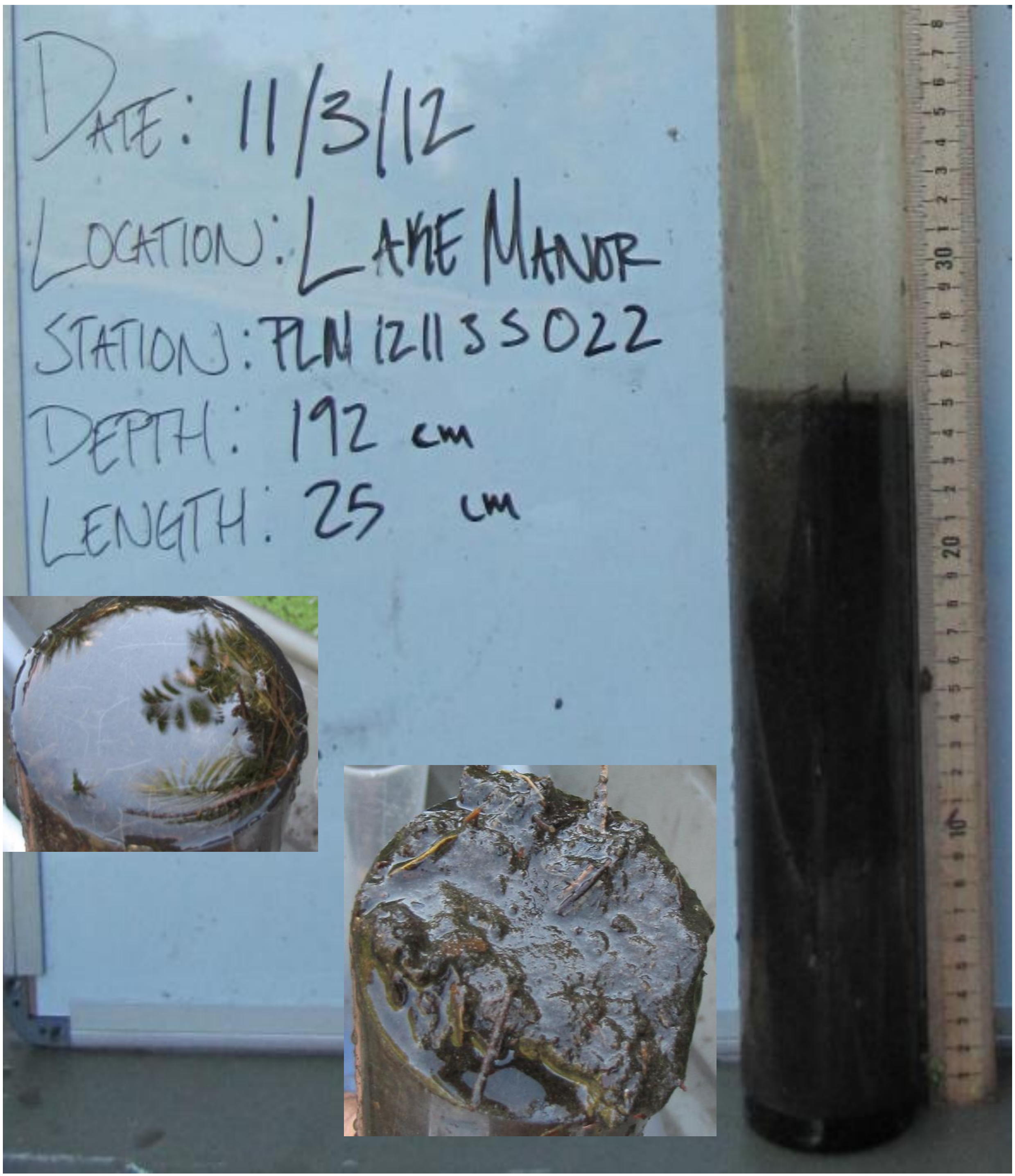
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	12.5	1.15	0.48	93.1%	6.9%	5.7%	0.23%	0.02%
floc	3							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.048	4400	5.35	1.98	0.34	14.7	32.9	0.081	3.48	218	0.103	97.3

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
7 cm brown sand mixed with muck

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/4/2012	23	PLM121104S023	17	2893174	420814	243	46

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	32	0.96	0.20	72.6%	27.4%	12.8%	0.74%	0.16%
floc	32	0.93	0.05					

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.143	123000	11.5	38.5	0.74	126	46.9	0.211	20.8	218	0.662	118

material type sed./floc	Sediment type desc.
sediment	Black smooth organic
floc	black organic

bottom core desc.
16.5 cm brown sand mixed with muck

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/4/2012	24	PLM121104S024	17	2893177	420820	244	21

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	3	1.13	0.40	89.1%	10.9%	6.4%	0.33%	0.06%
floc	5	0.96	0.07	44.1%	55.9%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.032	20200	3.14	4.81	0.17	24.2	9.05	0.077	3.71	67.4	0.143	33.2

material type sed./floc	Sediment type desc.
sediment	Black smooth organic
floc	black organic

bottom core desc.
10.5 cm brown sand mixed with muck

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	25	PLM121101S025	17	2893226	420817	254	45

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	14							
floc	10							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.
sediment	Black smooth organic
floc	black organic

bottom core desc.
20 cm white sand

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/4/2012	26	PLM121104S026	17	2893232	420814	234	30

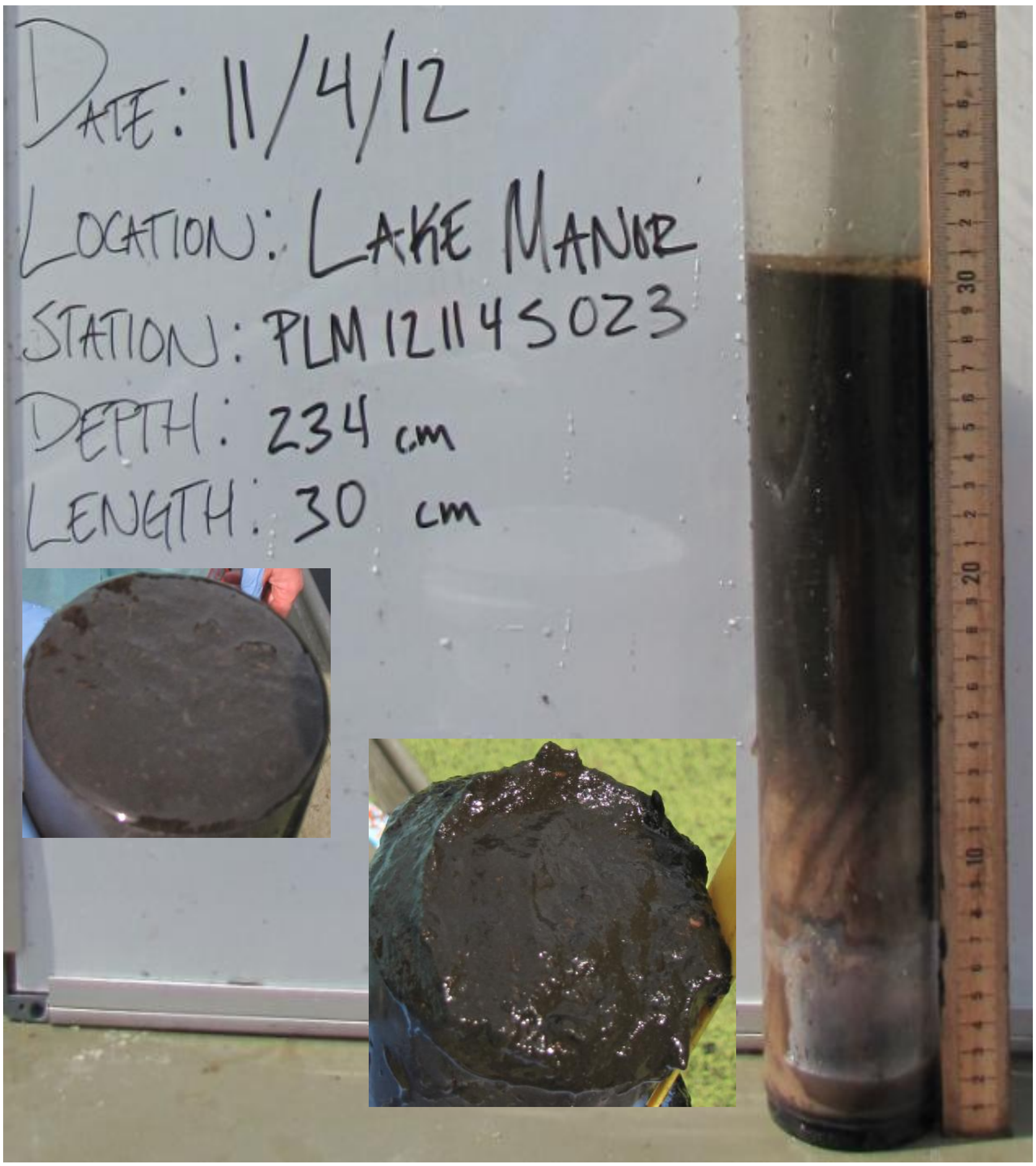
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	12	0.95	0.16	75.4%	24.6%	16.5%	1.01%	0.15%
floc	5.5	0.92	0.03	54.3%	45.7%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.172	66100	13.6	22.7	1.44	91.5	98.7	0.338	15.5	491	0.657	297

material type sed./floc	Sediment type desc.
sediment	Black smooth organic
floc	black organic

bottom core desc.
9 cm brown sand

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	27	PLM121101S027	17	2893232	420798	186	83

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	4							
floc	24							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
1 cm white sand; then brown sand on bottom

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/4/2012	28	PLM121104S028	17	2893272	420795	204	50

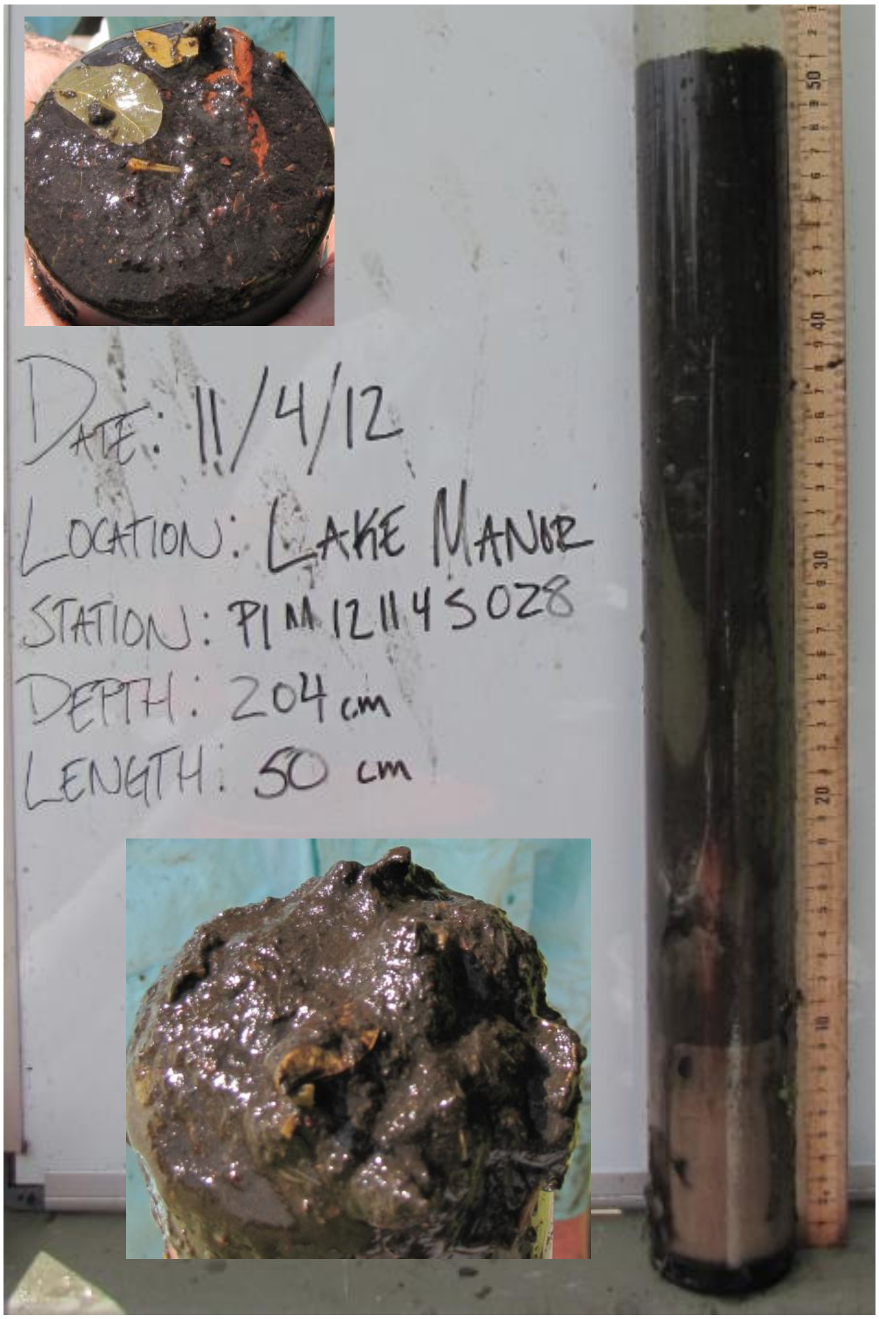
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	32	1.02	0.25	79.1%	20.9%	12.6%	0.70%	0.16%
floc	8	0.90	0.07	50.4%	49.6%	29.6%	1.95%	0.66%

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.08	95300	7.75	43.9	0.37	85.2	18.9	0.123	14.6	77.5	0.488	88.6

material type sed./floc	Sediment type desc.
sediment	Black smooth organic
floc	black organic

bottom core desc.
4 cm brown sand mixed with muck

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/4/2012	29	PLM121104S029	17	2893278	420809	202	23.5

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	4	0.95	0.22	76.9%	23.1%	12.4%	0.59%	0.17%
floc	10	0.97	0.05					

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.067	61200	5.37	18.6	0.35	69.2	21.5	0.116	9.9	60.9	0.242	44.4

material type sed./floc	Sediment type desc.	bottom core desc.
sediment	Black smooth organic	12 cm brown sand
floc	black organic	

NM= NO MATERIAL NR= NOT RECORDED

date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/4/2012	30	PLM121104S030	17	2893272	420820	175	39.5

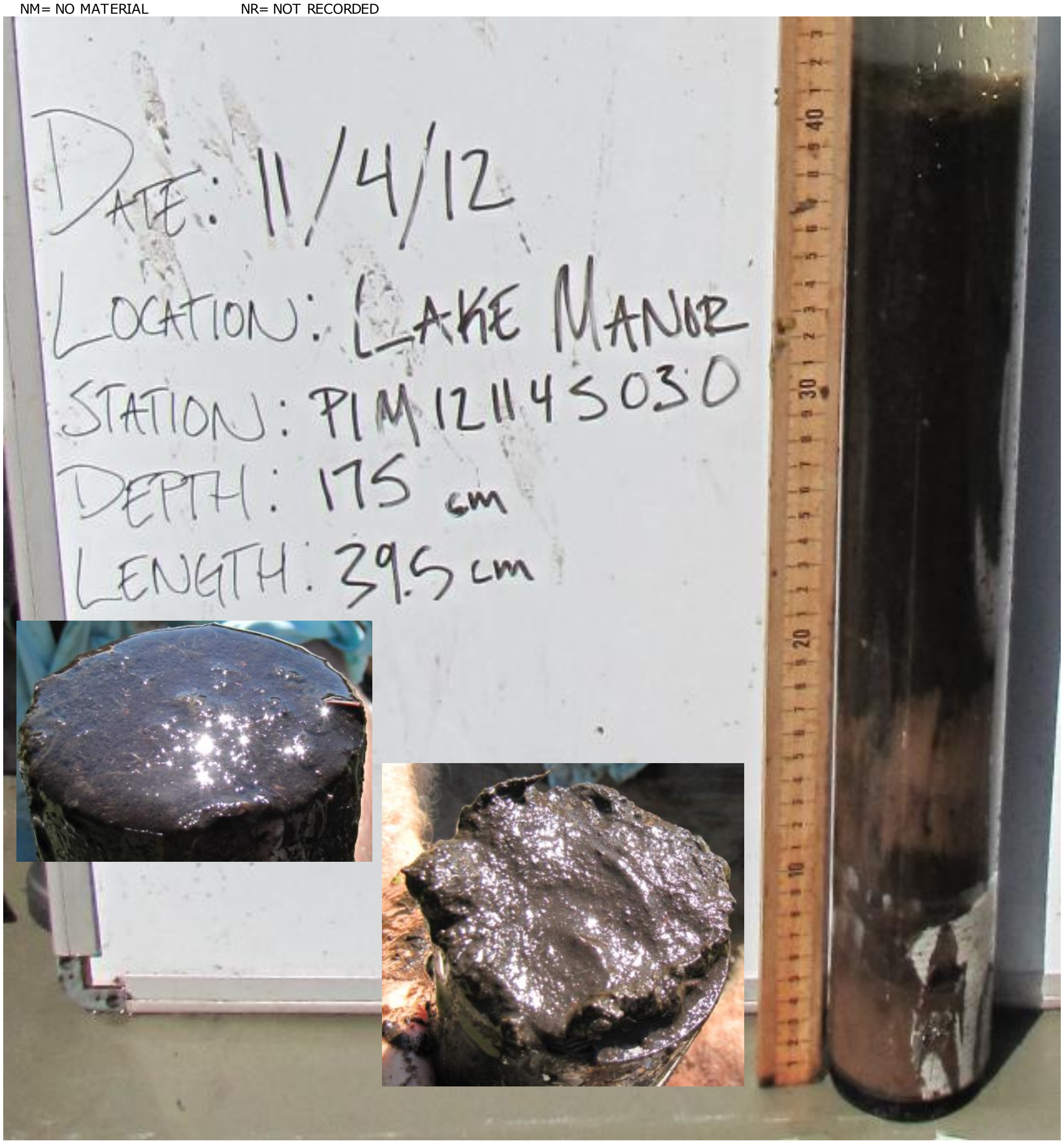
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	10	1.01	0.23	78.7%	21.3%	7.9%	0.44%	0.07%
floc	8	0.92	0.05	41.7%	58.3%			

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.059	10500	5.67	5.94	0.48	21.1	35.2	0.088	4.59	186	0.246	106

material type sed./floc	Sediment type desc.
sediment	Black smooth organic; some peat
floc	black organic

bottom core desc.
14.5 cm brown sand

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/1/2012	31	PLM121101S031	17	2893309	420823	183	29

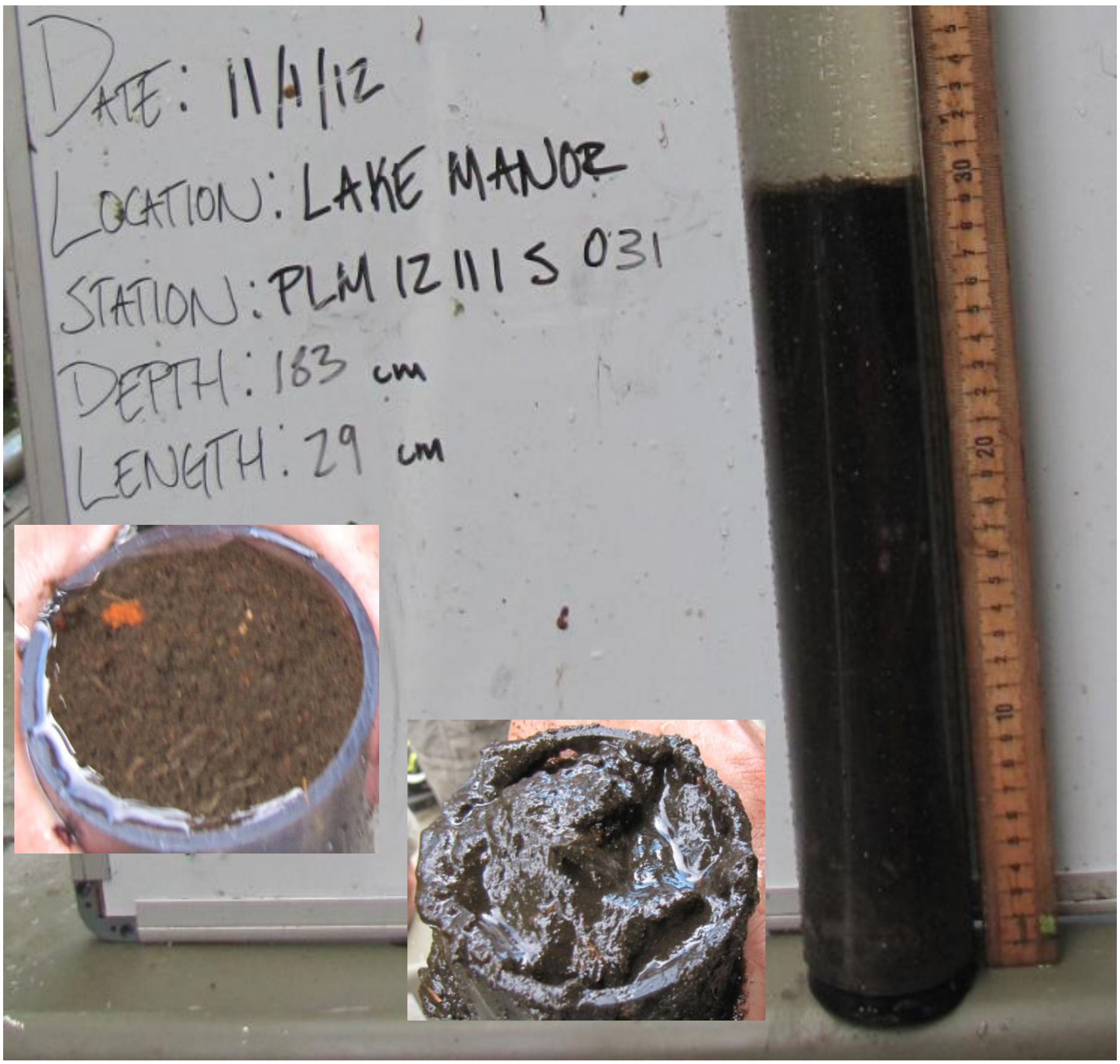
material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	15							
floc	11.5							

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment												

material type sed./floc	Sediment type desc.
sediment	Black organic mixed with peat
floc	black organic

bottom core desc.
4 cm white sand

NM= NO MATERIAL NR= NOT RECORDED



date sampled mm/dd/yy	station #	Station desc	Region ##	Easting m	Northing m	water depth cm	total core length cm
11/4/2012	32	PLM121104S032	17	2893318	420818	175	40

material type sed./floc	thick cm	bulk density g FW/ml	bulk density g DW/ml	inorg cont. %	org. cont. %	C %	N %	P %
sediment	12	0.90	0.12	72.1%	27.9%	15.6%	0.91%	0.09%
floc	8	0.89	0.04	35.4%	64.6%	36.5%	2.17%	0.16%

material type sed./floc	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cr mg/kg	Cu mg/kg	Hg mg/kg	Ni mg/kg	Pb mg/kg	Se mg/kg	Zn mg/kg
sediment	0.181	24300	12.8	12.6	1.38	73.1	129	0.227	12	472	0.83	321

material type sed./floc	Sediment type desc.
sediment	Black smooth organic
floc	black organic

bottom core desc.
17.5 cm brown sand

NM= NO MATERIAL NR= NOT RECORDED