

Design Example B

The following example demonstrates the design of an armor stone revetment for erosion protection at a site with medium (20 to 30-foot high) bluffs along the shore. The project site is fictitious but similar to the coastal features common along the south coast of Lake Erie's central basin.

Project Purpose

The purpose of Example Project B is to protect the toe of the glacial till bluff from erosion due to wave action. An armor stone revetment is selected to best achieve the project purpose.

Site Description

The project site is located along the shore of Lake Erie in Vermilion, Erie County, approximately 3.5 miles west of the Vermilion River. The shore in this area is oriented from west to east. The predominant direction of sediment transport in the littoral zone is from east to west.

The shore at the project site is irregular in shape due to the installation of the shore perpendicular structures. The site property is oriented in a slight northwest to southeast direction. At the east end of the property there is a small embayment suggesting increased erosion in this area.

The bluffs at the project site are 15 to 20 feet in height and have been partially regraded to an approximately 1.7 horizontal to 1 vertical slope. The bluff extends from 575.1 feet at the toe to a top elevation of 589.1 feet as referenced to the International Great Lakes Datum of 1985 (IGLD 1985). A 15 to 20-foot wide sand and gravel beach is present at the project site.

The bluffs are composed primarily of till overlain with glaciolacustrine silts and clays. In the nearshore zone, shale makes up the bottom. Sand and a nearshore bar system are located as far as 700 feet offshore near the site location. Closer to shore, in the beach zone, sand beaches are trapped by the area's groin structures and range from 0.5 to 3-feet thick. The bottom slope from 100 to 1500 feet offshore is approximately 100 horizontal to 1 vertical.

The site is exposed to storm waves from all angles from west-southwest to east-northeast. A review of historic wave information results in a significant wave height of 2.3 feet at a period of 3.6 seconds. The most frequent wave direction was from 180 degrees (referenced to 0/360 degrees north). The largest wave recorded over the 32-year study was 11.8 feet with a 9.0 second period. The average direction of the largest waves was 11.0 degrees. Wave data was measured at WIS station E06 located approximately 4.5 miles north of the project site in 33-foot deep water.

The project site is not located in a designated Coastal Erosion Area based on the 2010 mapping, but has an expected erosion rate of 0.1 to 0.8 feet over 30 years. There are no existing drainage measures causing localized erosion at the project site.

The eastern and western adjoining properties are similar to the project site in bluff elevation and upland topography. The western adjoining property is undeveloped and includes no shore protection. A 15 to 20-foot wide sand and gravel beach is present at the toe of the bluff. The eastern adjoining property includes an existing structure for erosion protection in the form of a rubble mound revetment. The structure is in poor condition due to undersized concrete rubble being fractured and displaced by wave action.

Field Survey

The upland parcel is located within the Firelands portion of the Connecticut Western Reserve district of Ohio's Public Lands Survey System more specifically part of Original Lot (O.L.) 34, Town 13 North, Range 20 West. Being within the incorporated boundaries of the city of Vermilion, the parcel boundary extends to north right of way of the 60 foot dedicated right of way centered on said centerline.

Horizontal control was established for this site by evaluating the location of published monumentation through the National Geodetic Survey (NGS) website: www.ngs.noaa.gov. The closest station to this site was determined to be "A 319" (PID MC0927) which is approximately 2.5 kilometers east. Based upon the NGS datasheet the horizontal accuracy of the station is reported as a Cooperative Base Network Control Station with reports that attempts to recover the station were successful in 2003, 2004 and 2009. Therefore this station was used within the horizontal control network. An open traverse was performed between "A 319" and a Third Order station "Ceylon" (PID MC1118) with intermediate stations located close to the project site. No adjustment was made to the resultant coordinates based upon Ohio State Plane 3401(NAD 83).

Vertical control was established for this site by

evaluating the location of published monumentation through the NGS website. The closest station to this site was determined to be "Z 318" (PID MC0928) which is approximately 0.1 kilometers south. Based upon the NGS datasheet, the vertical accuracy of the station is First Order Class II with reports that an attempt to recover the station was successful in 2004. The NGS stainless steel rod, established in 1980, has a reported dynamic height of 597.99 feet at 45 degrees latitude. NGS Vertical Datum Transformation software (VDatum) was used to adjust for the hydraulic corrections for the project location based upon the latitude and longitude positions in the NGS datasheet for station "A 319." A closed level circuit was completed. Confirmation of the elevation, relative to IGLD 1985, of the control stations was performed by benching into the water level on a calm day with minimal wave activity and comparing that value to the water level station data retrieved from NOAA's Great Lakes Online website: www.glakesonline.nos.noaa.gov/monitor.html for station #9063063 (Cleveland).

With the horizontal and vertical control network established, recovery of boundary evidence was performed. Monumentation was found, and held as controlling stations included 5/8-inch iron pins at the southwest corner of Sub Lot 5 and the southeast corner of Sub Lot 6. Subsequent points were located along the north right of way of West Lake Road



within the Water's Edge Subdivision, and proration of any surplus was calculated and applied to the subject parcels in the final determination of the boundary lines. A topographic survey was performed that located the cultural (i.e. buildings, survey monuments, coastal structures) and natural (i.e. top and toe of bluff) features on the subject parcel and adjoiners. Notwithstanding the presence of random rubble along the shore on the east portion of the upland parcel, the natural shoreline appears to be unaltered by artificially placed fill material.

Analysis

Parcel data provided by the Erie County Auditor's Office was imported into the computer-aided design (CAD) drawing to establish a general orientation of the shoreline for a reach of approximately 1.5 kilometers. Methodology for partitioning the boundaries between the littoral adjoiners was examined including extending the upland parcel boundary lakeward without deflection and a radial projection from the general alignment of the 1.5 kilometer reach of shore from the intersection of the natural shoreline and the parcel sidelines. The radial projection method provided the most equitable distribution between the subject parcel and the east and west adjoiners.

A base map was provided to the engineering consultant that depicted the locations of the existing site improvements relative to the established parcel boundaries and littoral partitions. A general statement that the survey and plat were prepared in accordance with Ohio Administrative Code (OAC) Section 4733-37 was included and the Ohio registered professional surveyor's signature and seal were affixed to the survey plat (see Existing Site Plan "A").

Design

The maximum slope normally considered for the long-term stability of an armor stone revetment is 1.5 horizontal to 1 vertical. Based on the wave climate in the area of the project site, a slope of 2 horizontal to 1 vertical was selected for a conservative design. Placing a 2H:1V sloped revetment over the existing 1.7H:1V slope also offers the advantage of not having to excavate the existing slope while minimizing the amount of fill required. The toe of the structure is entrenched 2.5 feet into shale bedrock at an elevation of 567.5 feet IGLD 1985.

The project site is located in the Huron to Vermilion reach of the "Revised Report on Great Lakes Open Coast Flooding," (USACE 1988) and has a design water level of 575.5 feet IGLD 1985 for a 30-year return period.

A 5.5-foot structure depth was calculated based on the lake bottom elevation at the structure toe and the design water level. Using the breaking wave equation presented in Chapter 3, a design wave height of 4.3 feet was calculated for this case.

Since the toe of the structure was designed to be entrenched 2.5 feet into the shale bedrock, the depth of the structure at the base of the toe will be 8.0 feet. Future scouring at the toe of the structure due to the fractures and wear of the shale would result in an increase in water depth from 5.2 to 7.7 feet and a design wave height of 6.0 feet for this conservative case. The scour of shale bedrock may not always be a reasonable assumption, but for this example, it was assumed that the fractures caused during entrenchment would lead to scour.

Hudson's Equation was used to calculate the median armor stone size to resist displacement due to wave action. Using the unit weight for the specified limestone, the minimum median armor stone size is 0.4 tons for the non-scour case. The minimum median armor stone size was 1.1 ton per unit if the toe of the structure is scoured.

A factor of safety of 2.0 was selected for the armor stone size to account for potential effects of ice forces and long-term fracturing of the stone. Using the conservative 1.1 ton per unit value from Hudson's Equation, the safety factor results in a lower limit

for the armor stone of 2.2 tons per unit and a range of 1.6 to 2.7 tons per unit. The selected design specification of a 2 to 4-ton range for the armor stone layer also provides additional mass that improves the long-term ability of the revetment to resist earth forces from the upland. A double layer of 2 to 4-ton limestone will be stacked in a 6-foot thick armor layer.

The filter layer was specified as stone or clean concrete rubble about 1/3 of the diameter of the armor stone. For economy of design, the existing concrete modules and concrete rubble at the toe of the bluff will be relocated to form the filter layer for the revetment. Due to the variability of the filter layer material and the fine-grained till composition of the bluff, a geotextile filter fabric is specified.

Wave run-up on the structure was calculated using the empirical formula introduced in Chapters 3. Wave run-up of 5.7 feet to an elevation of 581.2 feet IGLD 1985 was calculated for the initial design case. If the toe of the structure is scoured, the wave run-up increases to 7.6 feet, to an elevation of 583.1 feet IGLD 1985. For an economical design, the crest of the revetment is set to 582.0 feet IGLD 1985 and a splash apron is specified to 585.0 feet IGLD 1985. The splash apron is specified as a double layer of new ODOT 601 Type "B" stone. The upper bluff will be stabilized by re-grading a gentle slope from the top of the splash apron at 585.0 feet IGLD 1985 to the top of the bluff at 589.1 feet IGLD 1985. A thin layer of ODOT 601 Type 56 stone will be used as a base for the re-graded slope in the area of the 12 to 24-inch filter layer stone.

To prevent sliding failure along the slope of the revetment, 4 to 5-ton armor stones are to be entrenched 2.5 feet into the shale bedrock. Toe stones are typically specified to be 1 to 2 tons heavier than stones used for the armor layer.

To mitigate end effects, the west end of revetment will be curved back into the bluff face with a radius approximately equal to the plan view width of the armor layer. The east end of the structure is extended to the property line to be continuous with the existing revetment on the eastern adjacent property. This should sufficiently reduce the risk to adjacent properties and prevent potential upland slope failure at the ends of structure.

Discussion

In this example, the revetment has been designed to closely follow the shape of the shore. The revetment will extend a maximum of 29.2 feet from the toe of the existing bluff. This distance is determined by the required crest elevation and revetment slope and cannot be reduced without compromising the functionality or stability of the structure. Therefore this structure has been appropriately designed to minimize effects on lake processes and adjacent properties.

The revetment is intended to prevent erosion of the existing bluff and will decrease the amount of material added to the littoral system. Any sand or gravel in the footprint of the revetment must be excavated and sidecast into the lake prior to construction to prevent sediment from being permanently removed from the littoral system.

As the structure will extend approximately 29 feet lakeward of the bluff toe, it will affect the littoral transport of material along the shore. In this case, the impact is expected to be minimal due to the existing rubble mound revetment on the eastern adjacent property. It is unlikely that this structure will trap sediment. The structure may cause changes in wave energy that could adversely affect adjacent properties. This risk has been addressed with the use of rough, angular limestone placed at a slope of 2H:1V. Much of the wave energy will be absorbed and dissipated by the revetment, minimizing the wave energy reflected in the nearshore zone.

Final Survey Products

Based upon the design from the Ohio registered professional engineer, a plat that depicted the boundaries of the submerged lands lease has been prepared. The project site includes two separate parcels, and a lot consolidation has not been planned by the parcel owner. Therefore two separate lease parcels are depicted using the location of the water's edge on the date of the field survey as the natural shoreline. (see Submerged Lands Plat "B").

Two metes and bounds descriptions have been written for the areas depicted on the plat of survey with direct relationship to the upland parcel boundaries as required in Ohio Revised Code Section 1506.11(B). (See Submerged Lands Lease descriptions for Parcel "A" and "B.")

SAMPLE ENGINEERING AND SURVEYING INC.
STREET ADDRESS

JOB EXAMPLE B - MEDIUM BLUFF
 SHEET NO. 1 OF 3
 CALCULATED BY MPC DATE 02/01/11
 CHECKED BY DLB DATE 02/01/11
 SCALE _____

REVETMENT DESIGN

A. DESIGN WATER LEVEL

30 YEAR DESIGN WATER LEVEL = 575.5 FT IGLD 1985
 REFERENCE: "REVISED REPORT ON GREAT LAKES OPEN COAST FLOODING" USACE, 1988.

B. DESIGN WAVE HEIGHT

INITIAL DESIGN CASE
 LAKE BOTTOM ELEVATION = 570.0 FEET IGLD 1985
 STRUCTURE DEPTH = $d_s = 575.5 \text{ FT} - 570.0 \text{ FT} = 5.5 \text{ FT IGLD 1985}$
 BREAKING WAVE HEIGHT = $H_b = 0.78 \times d_s = 0.78 \times 5.5 \text{ FT} = 4.3 \text{ FT}$
 REFERENCE: "COASTAL ENGINEERING MANUAL" USACE, 2006, PAGE II-4-3.

CONSERVATIVE CASE, IF TOE OF STRUCTURE IS SCoured
 TOE OF STRUCTURE = 567.5 FEET IGLD 1985
 STRUCTURE DEPTH = $d_s = 575.5 \text{ FT} - 567.5 \text{ FT} = 8.0 \text{ FT IGLD 1985}$
 BREAKING WAVE HEIGHT = $H_b = 0.78 \times d_s = 0.78 \times 8.0 \text{ FT} = 6.2 \text{ FT}$
 REFERENCE: "COASTAL ENGINEERING MANUAL" USACE, 2006, PAGE II-4-3.

C. ARMOR STONE SIZE

USE HUDSON'S EQUATION:

$$\text{MEDIAN ARMOR STONE SIZE} = W_{50} = \frac{\omega_r H^3}{K_d (S_r - 1)^3 \text{COT } \theta}$$

REFERENCE: "COASTAL ENGINEERING MANUAL" USACE, 2006, TABLE VI-5-22

$\omega_r = \text{UNIT WEIGHT OF ARMOR STONE} = 165 \text{ LB/FT}^3$
 ASSUME $H = \text{BREAKING WAVE HEIGHT} = H_b$
 $K_d = 2.0 \text{ FOR ROUGH ANGULAR QUARRY STONES}$
 REFERENCE: "COASTAL ENGINEERING MANUAL" USACE, 2006, TABLE VI-5-22
 $\text{COT } \theta = \text{STRUCTURE SLOPE} = 2.0$

$$S_r = \frac{\omega_r}{\omega_w} \quad \omega_r = \text{SPECIFIC WEIGHT OF STONE} = 165 \text{ LB/FT}^3$$

$$\omega_w = \text{SPECIFIC WEIGHT OF WATER} = 62.4 \text{ LB/FT}^3$$

INITIAL DESIGN CASE

BREAKING WAVE HEIGHT = $H_b = 4.3 \text{ FT}$

$$W_{50} = \frac{(165 \text{ LB/FT}^3) (4.3 \text{ FT})^3}{2.0 (165/62.4 - 1)^3 (2.0)} = 738 \text{ LB} = 0.4 \text{ TON}$$

MEDIAN STONE SIZE = $W_{50} \times FS = 0.4 \text{ TON} \times 2.0 = 0.8 \text{ TON}$



Engineer Signature
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SAMPLE ENGINEERING AND SURVEYING INC.
STREET ADDRESS

JOB EXAMPLE B - MEDIUM BLUFF
 SHEET NO. 2 OF 3
 CALCULATED BY MPC DATE 02/01/11
 CHECKED BY DLB DATE 02/01/11
 SCALE _____

REVTMENT DESIGN (CONT.)

CONSERVATIVE CASE, IF TOE OF STRUCTURE IS SCOURED

BREAKING WAVE HEIGHT = $H_b = 6.2$ FT

$$W_{50} = \frac{(1.65 \text{ LB/FT}^3) (6.2 \text{ FT})^3}{2.0 (1.65/62.4 - 1)^3 (2.0)} = 2212 \text{ LB} = 1.1 \text{ TON}$$

MEDIAN STONE SIZE = $W_{50} \times F_5 = 1.1 \text{ TON} \times 2.0 = 2.2 \text{ TON}$

TO BE CONSERVATIVE USE 2 TO 4 TON ARMOR STONE

*NOTE: ACES CALCULATIONS SUPPORT RESULTS

INITIAL DESIGN CASE

$W_{50} = 1399 \text{ LB} = 0.7 \text{ TON}$

ARMOR LAYER THICKNESS = 4.1 FEET

CONSERVATIVE DESIGN CASE

$W_{50} = 3717 \text{ LB} = 1.9 \text{ TON}$

ARMOR LAYER THICKNESS = 5.6 FEET

C. WAVE RUNUP AND OVERTOPPING

EMPIRICAL FORMULA: $R = \frac{H_b (a \times \xi)}{1 + (b \times \xi)}$

REFERENCE: "WAVE PERIOD EFFECT ON THE STABILITY OF RIPRAP" ASCE, 1975, P 1019- 1034.

$a = 0.775$ FOR DOUBLE LAYER WITH CORE OR FILTER LAYER

$b = 0.361$ FOR DOUBLE LAYER WITH CORE OR FILTER LAYER

REFERENCE: "COST-EFFECTIVE OPTIMIZATION OF RUBBLE-MOUND BREAKWATER CROSS SECTIONS" USACE, 1986, P 45-53.

IRIBARREN NO. = $\xi = \frac{\tan \theta}{\sqrt{(2\pi H_b / g T^2)}}$

REFERENCE: "COASTAL ENGINEERING MANUAL" USACE, 2006, PAGE VI-5-6.

θ = ANGLE OF STRUCTURE FACE

$g = 32.2 \text{ FT/SEC}^2$

T = WAVE PERIOD = 8 SECOND PERIOD ASSUMED*

*AN 8 SECOND PERIOD IS A CONSERVATIVE ESTIMATE BASED ON WIS DATA. THE LARGEST WAVE RECORDED AT WIS STATION E06 OVER A 32 YEAR STUDY (1956-1987) HAD A PERIOD OF 9.0 SECONDS. - REFERENCE: "WIS REPORT 22, HINDCAST WAVE INFORMATION FOR THE GREAT LAKES: LAKE ERIE" USACE, 1991, P A86.



Engineer Signature
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SAMPLE ENGINEERING AND SURVEYING INC.
STREET ADDRESS

JOB EXAMPLE B - MEDIUM BLUFF
SHEET NO. 3 OF 3
CALCULATED BY MPC DATE 02/01/11
CHECKED BY DLB DATE 02/01/11
SCALE _____

REVETMENT DESIGN (CONT.)

INITIAL CASE

$$\text{IRIBARREN NO.} = \xi = \frac{(1/2.0)}{\sqrt{2\pi (4.3 \text{ FT}) / (32.2 \text{ FT/SEC}^2) (8 \text{ SEC})^2}} \quad \xi = 4.4$$

$$\text{WAVE RUNUP: } R = \frac{(4.3 \text{ FT}) (0.775 \times 4.4)}{1 + (0.361 \times 4.4)}$$

R = 5.7 FT (FOR INITIAL CASE)

RUNUP ELEVATION = 575.5 FT IGLD 1985 + 5.7 FT = 581.2 FT IGLD 1985

CONSERVATIVE CASE, IF TOE OF STRUCTURE IS SCoured

$$\text{IRIBARREN NO.} = \xi = \frac{(1/2.0)}{\sqrt{2\pi (6.2 \text{ FT}) / (32.2 \text{ FT/SEC}^2) (8 \text{ SEC})^2}} \quad \xi = 3.6$$

$$\text{WAVE RUNUP: } R = \frac{(6.2 \text{ FT}) (0.775 \times 3.6)}{1 + (0.361 \times 3.6)}$$

R = 7.6 FT (FOR CONSERVATIVE CASE)

RUNUP ELEVATION = 575.5 FT IGLD 1985 + 7.6 FT = 583.1 FT IGLD 1985

CONSERVATIVE DESIGN: SET TOP OF ARMOR STONE AT 582.0 FT IGLD 1985
SET TOP OF SPLASH APRON AT 585.0 FT IGLD 1985

*NOTE: ACES CALCULATIONS SUPPORT RESULTS

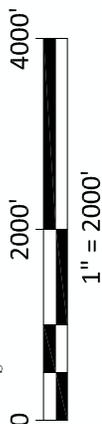
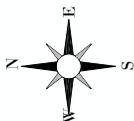
INITIAL: RUNUP = 5.6 FT TO AN ELEVATION OF 581.1 FT IGLD 1985

CONSERVATIVE: RUNUP = 7.6 FT TO AN ELEVATION OF 583.1 FT IGLD 1985

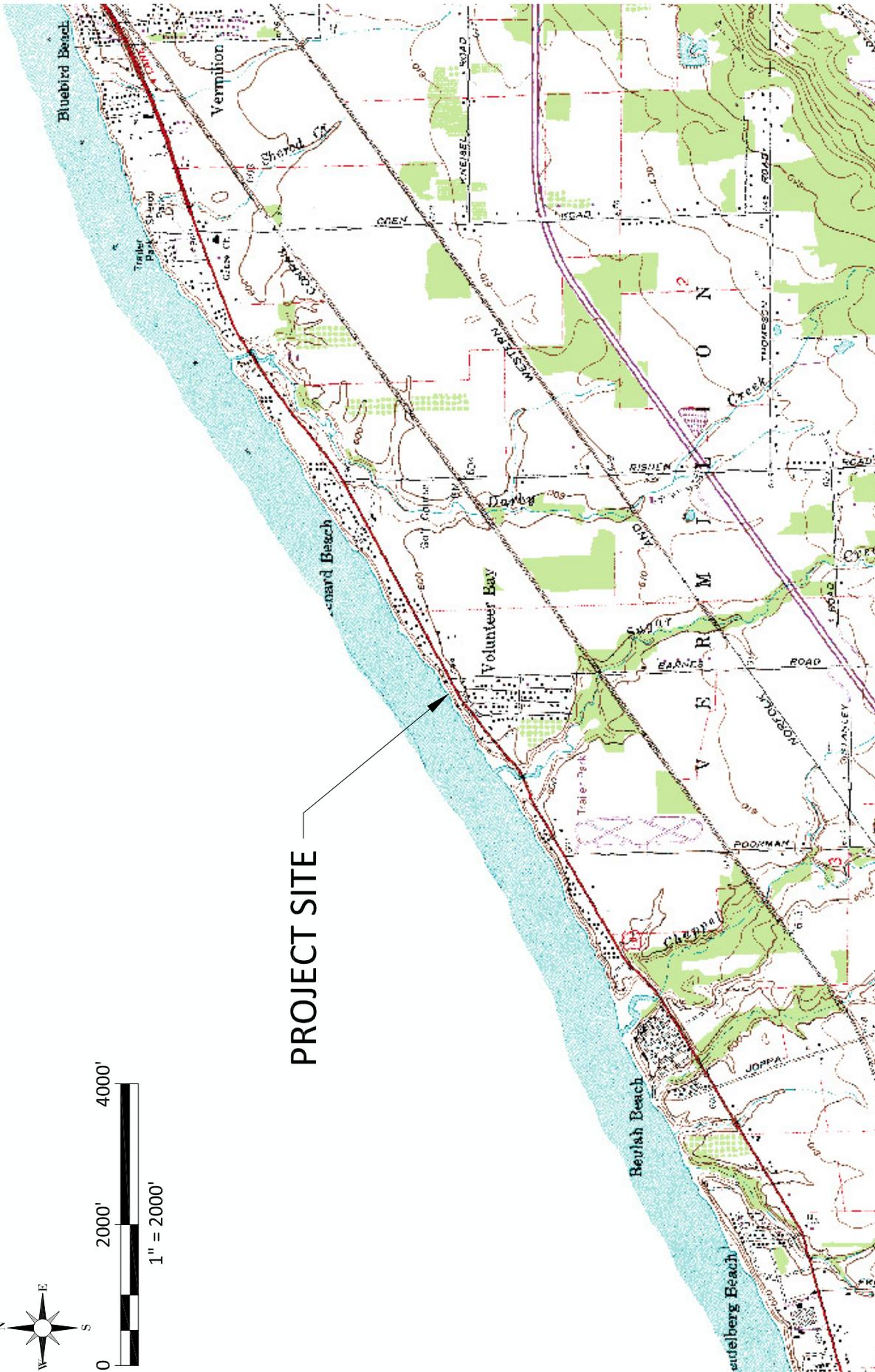
*NOTE: THE CALCULATIONS INCLUDED IN THIS EXAMPLE WERE ORIGINALLY COMPUTED USING EXCEL SPREADSHEETS. THE SOFTWARE DISPLAYS A SPECIFIED NUMBER OF SIGNIFICANT FIGURES BUT RETAINS THE ORIGINAL NUMBER FOR OPERATIONS. AS A RESULT SMALL ROUNDING ERRORS ARE INTRODUCED IN TRANSCRIBING THE STEP-BY-STEP CALCULATIONS. THESE ERRORS ARE ACCEPTABLE CONSIDERING THE OVERALL ACCURACY OF THE CALCULATION METHODS AND THE PURPOSE OF THIS DESIGN MANUAL.



Engineer Signature
mm/dd/yyyy



PROJECT SITE



PREPARED BY:
SAMPLE ENGINEERING AND SURVEYING INC.
 STREET ADDRESS

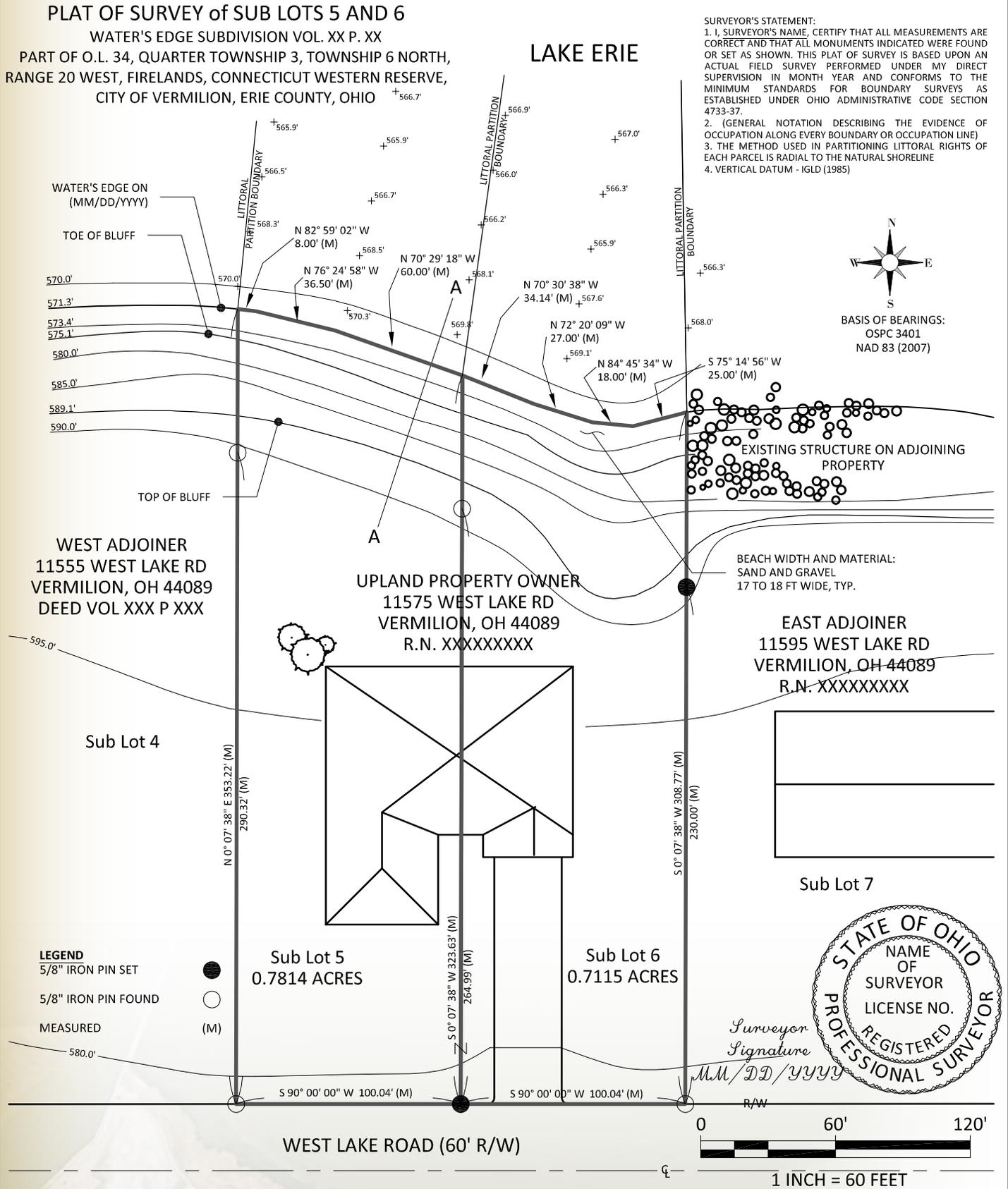
TITLE:
VICINITY MAP

APPLICANT:
SAMPLE PROPERTY OWNER
 11575 WEST LAKE RD,
 VERMILION, OH 44089

PROJECT:
ARMOR STONE REVETMENT

ADJACENT PROPERTY OWNERS:
 WESTERN ADJACENT PROPERTY OWNER
 11555 WEST LAKE RD, VERMILION, OH 44089
 EASTERN ADJACENT PROPERTY OWNER
 11595 WEST LAKE RD, VERMILION, OH 44089

SHEET: 1 OF 6
 DATE: 02/01/11



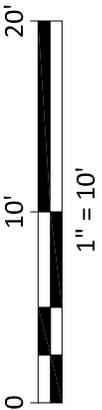
SURVEYOR'S STATEMENT:
 1. I, SURVEYOR'S NAME, CERTIFY THAT ALL MEASUREMENTS ARE CORRECT AND THAT ALL MONUMENTS INDICATED WERE FOUND OR SET AS SHOWN. THIS PLAT OF SURVEY IS BASED UPON AN ACTUAL FIELD SURVEY PERFORMED UNDER MY DIRECT SUPERVISION IN MONTH YEAR AND CONFORMS TO THE MINIMUM STANDARDS FOR BOUNDARY SURVEYS AS ESTABLISHED UNDER OHIO ADMINISTRATIVE CODE SECTION 4733-37.
 2. (GENERAL NOTATION DESCRIBING THE EVIDENCE OF OCCUPATION ALONG EVERY BOUNDARY OR OCCUPATION LINE)
 3. THE METHOD USED IN PARTITIONING LITTORAL RIGHTS OF EACH PARCEL IS RADIAL TO THE NATURAL SHORELINE
 4. VERTICAL DATUM - IGLD (1985)



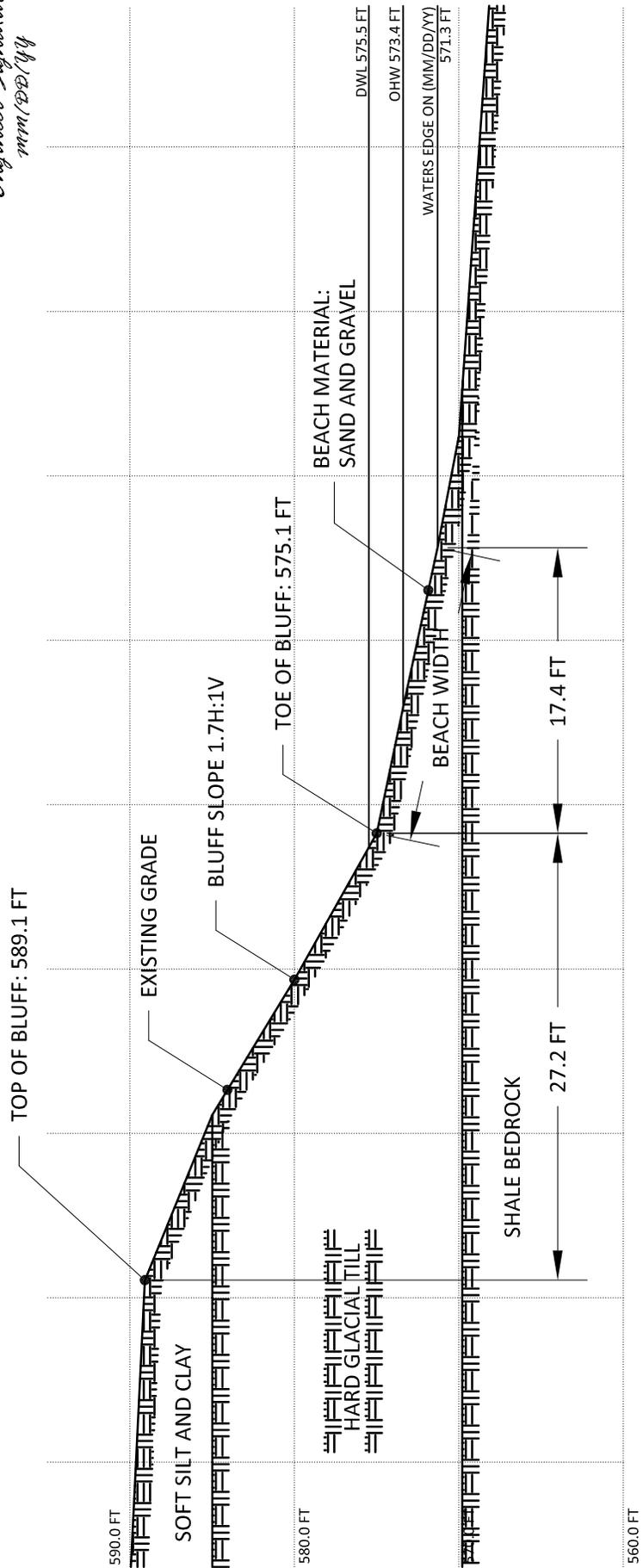
BASIS OF BEARINGS:
 OSCP 3401
 NAD 83 (2007)

PROJECT: ARMOR STONE REVETMENT	TITLE: EXISTING SITE PLAN	PREPARED BY: SAMPLE SURVEYING AND ENGINEERING INC. STREET ADDRESS	
ADJACENT PROPERTY OWNERS: WEST ADJOINER 11555 WEST LAKE RD, VERMILION, OH 44089 EAST ADJOINER 11595 WEST LAKE RD, VERMILION, OH 44089	APPLICANT: APPLICANT 11575 WEST LAKE RD, VERMILION, OH 44089	SHEET: 2 OF 6	DATE: 02/01/2011

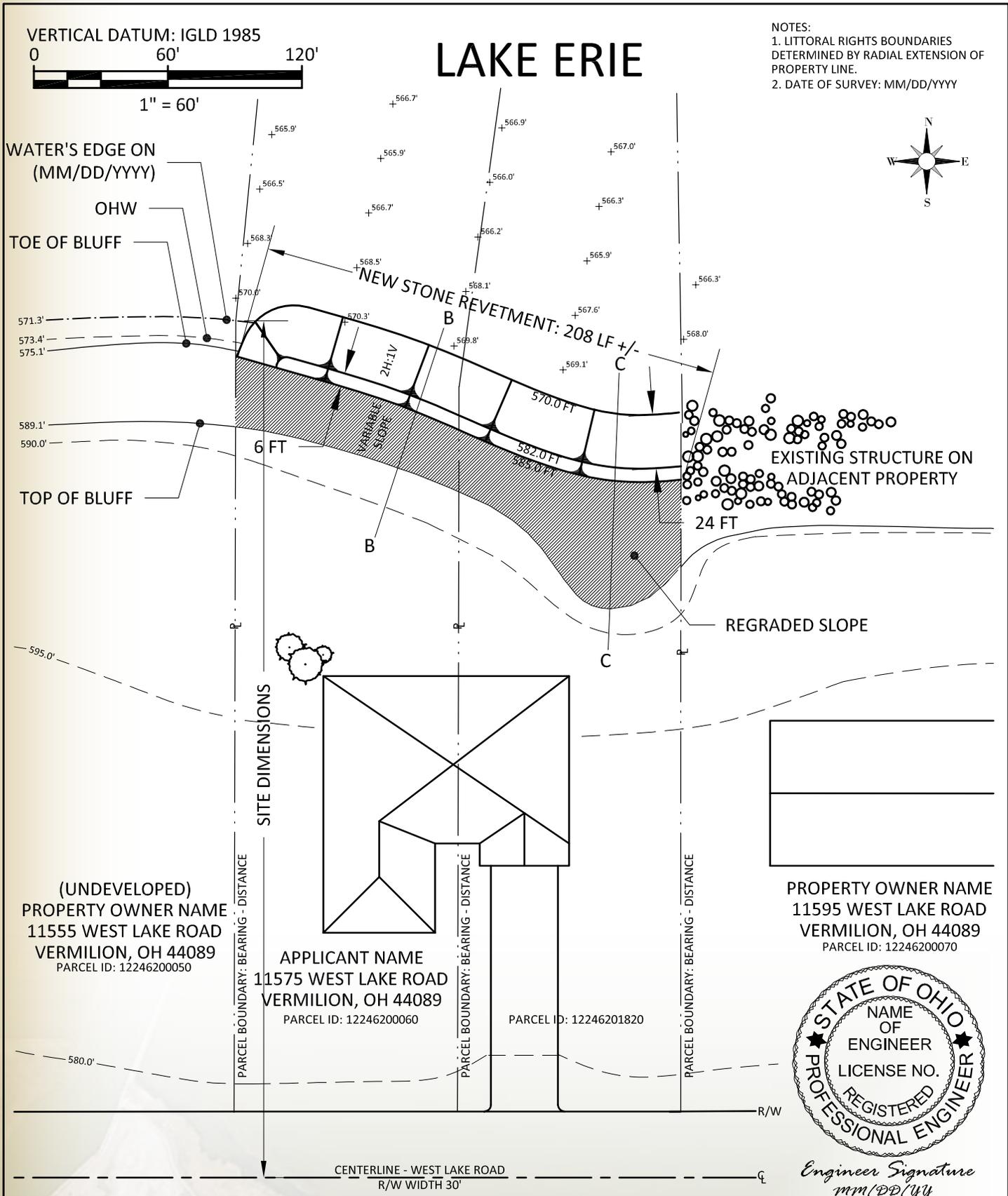
VERTICAL DATUM: IGLD 1985



Engineer Signature
mm/DD/YY



PROJECT:		TITLE:	
ARMOR STONE REVETMENT		SECTION A-A: EXISTING SITE	
ADJACENT PROPERTY OWNERS: WESTERN ADJACENT PROPERTY OWNER 11555 WEST LAKE RD, VERMILION, OH 44089 EASTERN ADJACENT PROPERTY OWNER 11595 WEST LAKE RD, VERMILION, OH 44089		APPLICANT: SAMPLE PROPERTY OWNER 11575 WEST LAKE RD, VERMILION, OH 44089	
PREPARED BY:		STREET ADDRESS	
SAMPLE ENGINEERING AND SURVEYING INC.		3 OF 6	
DATE:		DATE:	
02/01/11		02/01/11	



NOTES:
 1. LITTORAL RIGHTS BOUNDARIES DETERMINED BY RADIAL EXTENSION OF PROPERTY LINE.
 2. DATE OF SURVEY: MM/DD/YYYY

(UNDEVELOPED)
 PROPERTY OWNER NAME
 11555 WEST LAKE ROAD
 VERMILION, OH 44089
 PARCEL ID: 12246200050

APPLICANT NAME
 11575 WEST LAKE ROAD
 VERMILION, OH 44089
 PARCEL ID: 12246200060

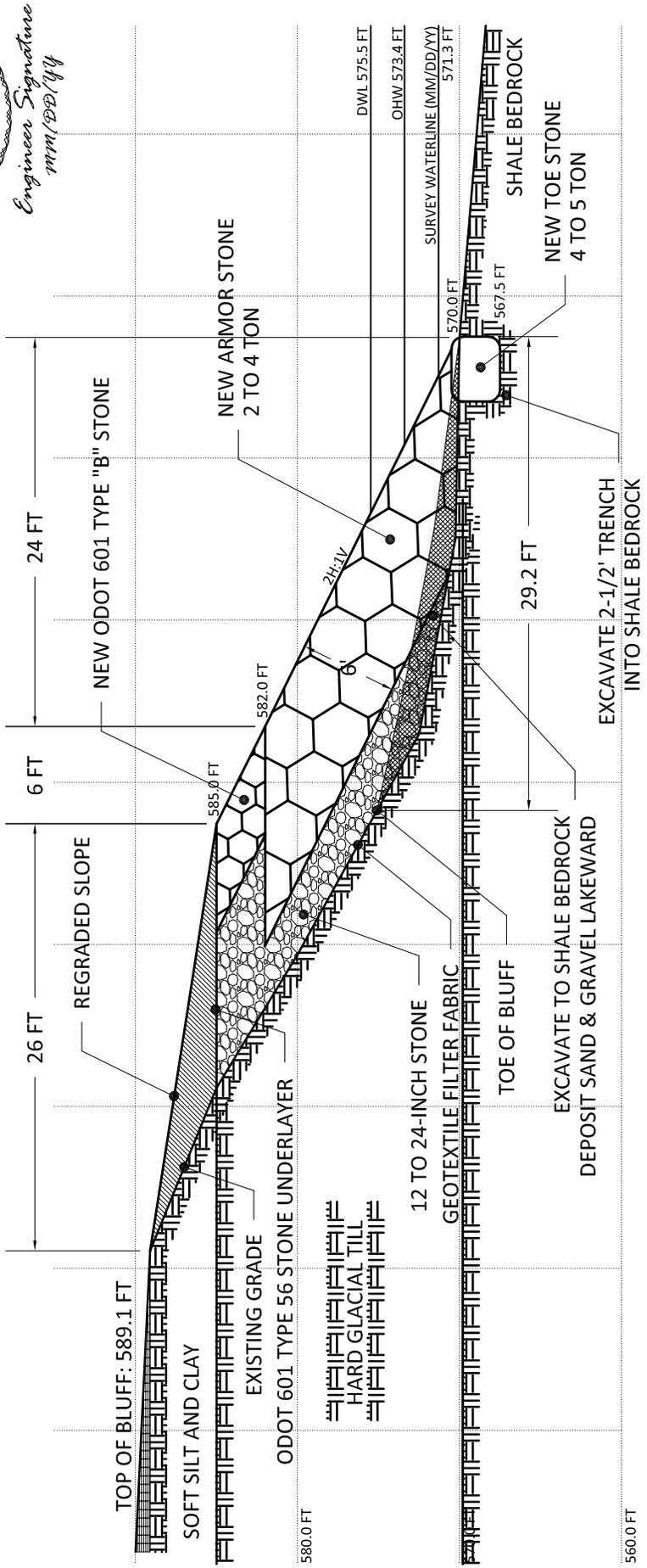
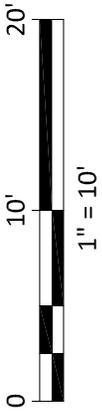
PROPERTY OWNER NAME
 11595 WEST LAKE ROAD
 VERMILION, OH 44089
 PARCEL ID: 12246200070



Engineer Signature
 mm/dd/yy

PROJECT: ARMOR STONE REVETMENT	TITLE: PROPOSED SITE PLAN	PREPARED BY: SAMPLE ENGINEERING AND SURVEYING INC.
ADJACENT PROPERTY OWNERS: WESTERN ADJACENT PROPERTY OWNER 11555 WEST LAKE RD, VERMILION, OH 44089 EASTERN ADJACENT PROPERTY OWNER 11595 WEST LAKE RD, VERMILION, OH 44089	APPLICANT: SAMPLE PROPERTY OWNER 11575 WEST LAKE RD, VERMILION, OH 44089	STREET ADDRESS
SHEET: 4 OF 6		DATE: 02/01/11

VERTICAL DATUM: IGLD 1985



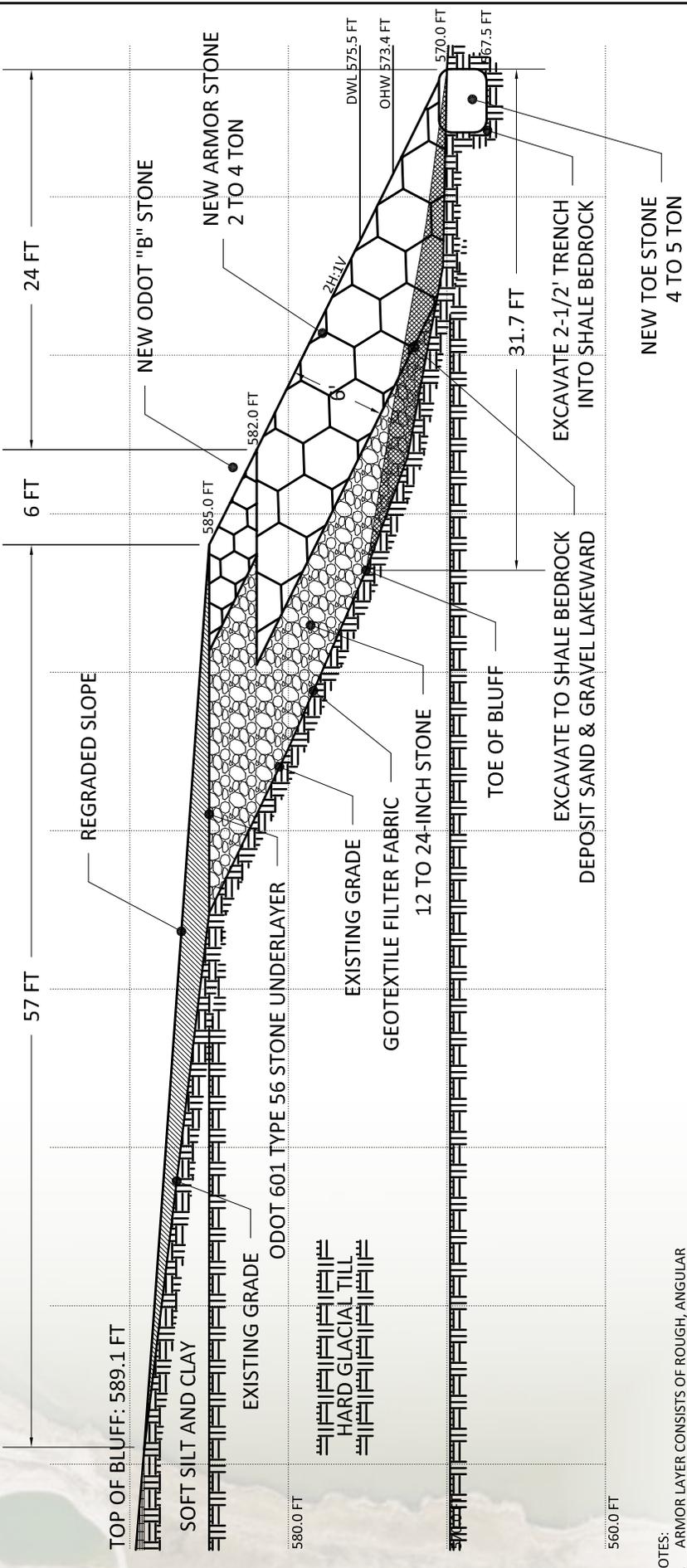
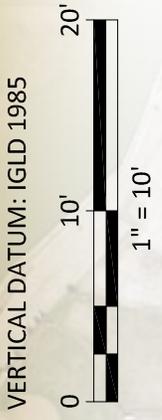
- NOTES:
1. ARMOR LAYER CONSISTS OF ROUGH, ANGULAR QUARRY STONE (LIMESTONE).
 2. STONES SHALL BE PLACED INDIVIDUALLY TO MAXIMIZE CONTACT AREA BETWEEN STONES AND MINIMIZE Voids. STONES SHOULD NOT BE DROPPED.
 3. FILTER LAYER CONSISTS OF 12 INCH TO 24 INCH STONE. EXCAVATE EXISTING BEACH TO SHALE BEDROCK.
 4. DEPOSIT EXCAVATED SAND & GRAVEL LAKEWARD OF PROJECT. NO SAND OR GRAVEL SHOULD BE TRAPPED UNDER REVETMENT.
 5. EXCAVATE TOE TRENCH 2-1/2 FT (MINIMUM) INTO SHALE BEDROCK.

PREPARED BY:	SAMPLE ENGINEERING AND SURVEYING INC. STREET ADDRESS
SHEET:	5 OF 6
DATE:	02/01/11

PROJECT:	ARMOR STONE REVETMENT
ADJACENT PROPERTY OWNERS:	WESTERN ADJACENT PROPERTY OWNER 11555 WEST LAKE RD, VERMILION, OH 44089 EASTERN ADJACENT PROPERTY OWNER 11595 WEST LAKE RD, VERMILION, OH 44089
TITLE:	SECTION B-B: PROPOSED SITE
APPLICANT:	SAMPLE PROPERTY OWNER 11575 WEST LAKE RD, VERMILION, OH 44089



Engineer Signature
mm/DD/YY



- NOTES:
1. ARMOR LAYER CONSISTS OF ROUGH, ANGULAR QUARRY STONE (LIMESTONE).
 2. STONES SHALL BE PLACED INDIVIDUALLY TO MAXIMIZE CONTACT AREA BETWEEN STONES AND MINIMIZE VOIDS. STONES SHOULD NOT BE DROPPED.
 3. FILTER LAYER CONSISTS OF 12 INCH TO 24 INCH STONE. EXCAVATE EXISTING BEACH TO SHALE BEDROCK.
 4. DEPOSIT EXCAVATED SAND & GRAVEL LAKEWARD OF UNDER RETEMENT.
 5. EXCAVATE TOE TRENCH 2-1/2 FT (MINIMUM) INTO SHALE BEDROCK.

PREPARED BY:	SAMPLE ENGINEERING AND SURVEYING INC. STREET ADDRESS
SHEET:	6 OF 6
DATE:	02/01/11

TITLE:	SECTION C-C: PROPOSED SITE
APPLICANT:	SAMPLE PROPERTY OWNER 11575 WEST LAKE RD, VERMILION, OH 44089

PROJECT:	ARMOR STONE RETEMENT
ADJACENT PROPERTY OWNERS:	WESTERN ADJACENT PROPERTY OWNER 11555 WEST LAKE RD, VERMILION, OH 44089 EASTERN ADJACENT PROPERTY OWNER 11595 WEST LAKE RD, VERMILION, OH 44089

Lake Erie Submerged Lands Legal Description Parcel "A"
Adjacent to 11575 West Lake Road, Vermilion

Situate in the State of Ohio and located within the waters of Lake Erie, County of Erie, City of Vermilion, part of Original Lot 34, Quarter Township 3, Township 6 North, Range 20 West of the Firelands portion of the Connecticut Western Reserve, adjacent to the Water's Edge Subdivision, Sub Lot 5 as recorded in Plat Volume (XX), Page (XX) of said county records and being adjacent to a parcel of land conveyed to (NAME OF UPLAND OWNER) by Record Number (XXXXXXXXXX) of said county and being more particularly described as follows:

Commencing at a 5/8 inch solid iron pin set at the southeast corner of Sub Lot 5 of Water's Edge Subdivision, said point also being the southwest corner of Sub Lot 6 conveyed to (NAME OF EAST ADJOINER) by Record Number (XXXXXXXXXX);

Thence along the east line of said Sub Lot 5, also being the west line of Sub Lot 6, North 00 degrees, 07 minutes, 38 seconds East, 323.63 feet to a point on the natural shoreline as determined by a field survey on (DATE) not monumented due to the location on the submerged lands of Lake Erie, and passing for reference a 5/8 inch solid iron pin found at 264.99 feet, also being the northeast corner of said Sub Lot 5 and the northwest corner of said Sub Lot 6, said point being the True Point of Beginning of the Lease Property described;

Thence departing the north line of said Sub Lot 5, across the open waters of Lake Erie, along the littoral partition boundary between said Sub Lot 5 and said Sub Lot 6 as determined by radial means, North 07 degrees, 57 minutes, 10 seconds East, 12.50 feet to a point not monumented due to location on submerged lands of Lake Erie;

Thence across the open waters of Lake Erie, North 70 degrees, 32 minutes, 59 seconds West, 79.34 feet to a point not monumented due to location on submerged lands of Lake Erie;

Thence continuing across the open waters of Lake Erie, South 69 degrees, 03 minutes, 43 seconds West, 16.00 feet to a point not monumented due to location on submerged lands of Lake Erie;

Thence continuing across the open waters of Lake Erie, South 41 degrees, 49 minutes, 55 seconds West, 6.00 feet to a point not monumented due to location on submerged lands of Lake Erie, also being the location of said natural shoreline;

Thence along said natural shoreline, South 76 degrees, 24 minutes, 58 seconds East, 36.50 feet to a point not monumented due to location on submerged lands of Lake Erie;

Thence continuing along said natural shoreline, South 70 degrees, 29 minutes, 18 seconds East, 60.00 feet to the True Point of Beginning of the submerged parcel herein described. Said parcel contains 1135 square feet (0.0260 acres) more or less and subject to all legal highways, easements, restrictions, and covenants of records. Based on a field survey performed by (NAME OF SURVEYOR), P.S. (#XXXX State of Ohio) performed in (MONTH, YEAR).

Basis of Bearings: The alignment of the 60' north right of way of West Lake Road (North 90 degrees, 00 minutes, 00 seconds East) as determined by the Ohio State Plane Coordinate System North Zone (3401) NAD 83 (2007).

SEAL

(Name of Surveyor)
Registered Surveyor (#XXXX)

Lake Erie Submerged Lands Legal Description Parcel "B"
Adjacent to 11575 West Lake Road, Vermilion

Situate in the State of Ohio and located within the waters of Lake Erie, County of Erie, City of Vermilion, part of Original Lot 34, Quarter Township 3, Township 6 North, Range 20 West of the Firelands portion of the Connecticut Western Reserve, adjacent to the Water's Edge Subdivision, Sub Lot 6 as recorded in Plat Volume (XX), Page (XX) of said county records and being adjacent to a parcel of land conveyed to (NAME OF UPLAND OWNER) by Record Number (XXXXXXXXXX) of said county and being more particularly described as follows:

Commencing at a 5/8 inch solid iron pin set at the southwest corner of Sub Lot 6 of Water's Edge Subdivision, said point also being the southeast corner of Sub Lot 5 conveyed to (NAME OF WEST ADJOINER) by Record Number (XXXXXXXXXX);

Thence along the west line of said Sub Lot 6, also being the east line of said Sub Lot 5, North 00 degrees, 07 minutes, 38 seconds East, 323.63 feet to a point on the natural shoreline of Lake Erie as determined by a field survey on (DATE) not monumented due to location on submerged lands of Lake Erie, and passing for reference a 5/8 inch solid iron pin found at 264.99 feet, also being the northwest corner of said Sub Lot 6 and the northeast corner of said Sub Lot 5, said point being the True Point of Beginning of the Lease Property described;

Thence departing the north line of said Sub Lot 6, across the open waters of Lake Erie, along the littoral partition boundary between said Sub Lot 5 and said Sub Lot 6 as determined by radial means, North 07 degrees, 57 minutes, 10 seconds East, 12.50 feet to a point not monumented due to the location on submerged lands of Lake Erie;

Thence across the open waters of Lake Erie, South 68 degrees, 06 minutes, 27 seconds East, 52.00 feet to a point not monumented due to the location on submerged lands of Lake Erie;

Thence continuing across the open waters of Lake Erie, South 77 degrees, 36 minutes, 38 seconds East, 25.00 feet to a point not monumented due to the location on submerged lands of Lake Erie;

Thence continuing across the open waters of Lake Erie, North 84 degrees, 22 minutes, 58 seconds East, 25.65 feet to a point not monumented due to the location on submerged lands of Lake Erie on the littoral partition boundary as determined by radial means of said Sub Lot 6 and Sub Lot 7 as conveyed to (NAME OF EAST ADJOINER) by Record Number (XXXXXXXXXX);

Thence along the littoral partition boundary between said Sub Lot 6 and said Sub Lot 7 as determined by radial means, South 00 degrees, 59 minutes, 40 seconds East, 5.00 feet to a point not monumented due to location on submerged lands of Lake Erie, also being the location of said natural shoreline and the northeast corner of said Sub Lot 6;

Thence along said natural shoreline, South 75 degrees, 14 minutes, 56 seconds West, 25.00 feet to a point not monumented due to the location on submerged lands of Lake Erie;

Thence continuing along said natural shoreline, North 84 degrees, 45 minutes, 34 seconds West, 18.00 feet to a point not monumented due to the location on submerged lands of Lake Erie;

Thence continuing along said natural shoreline, North 72 degrees, 20 minutes, 09 seconds West, 27.00 feet to a point not monumented due to the location on submerged lands of Lake Erie;

Thence continuing along said natural shoreline, North 70 degrees, 30 minutes, 38 seconds West, 34.14 feet to the True Point of Beginning of the submerged parcel herein described. Said parcel contains 1002 square feet (0.0230 acres) more or less and subject to all legal highways, easements, restrictions, and covenants of records. Based on a field survey performed by (NAME OF SURVEYOR), P.S. (#XXXX State of Ohio) performed in (MONTH, YEAR).

Basis of Bearings: Basis of Bearings: The alignment of the 60' north right of way of West Lake Road (North 90 degrees, 00 minutes, 00 seconds East) as determined by the Ohio State Plane Coordinate System North Zone (3401) NAD 83 (2007).

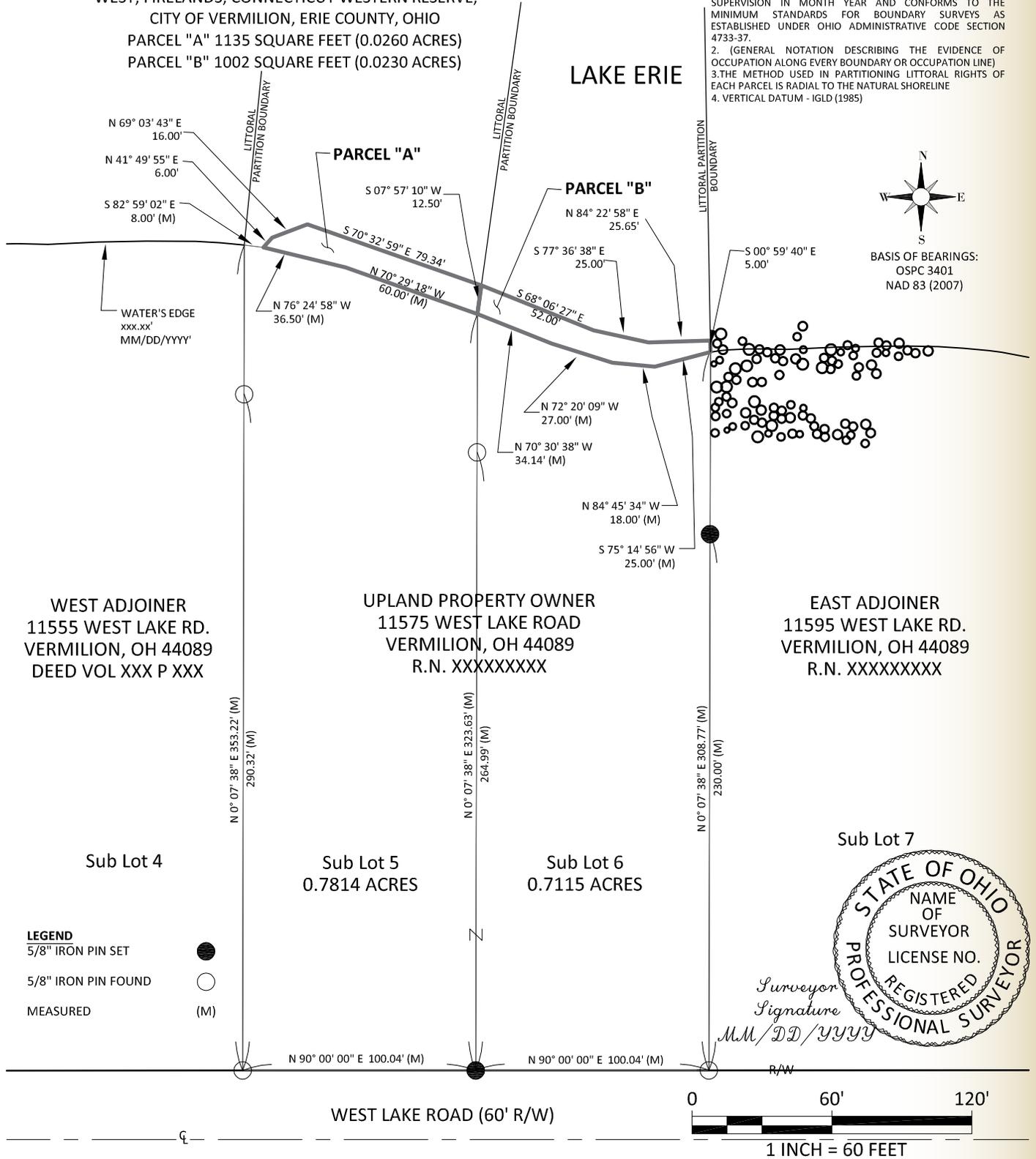
SEAL

(Name of Surveyor)
Registered Surveyor (#XXXX)

SUBMERGED LANDS LEASE PLAT OF SURVEY

SUBMERGED LANDS ADJACENT TO WATER'S EDGE SUBDIVISION VOL. XX P. XX
 PART OF O.L. 34, QUARTER TOWNSHIP 3, TOWNSHIP 6 NORTH, RANGE 20
 WEST, FIRELANDS, CONNECTICUT WESTERN RESERVE,
 CITY OF VERMILION, ERIE COUNTY, OHIO
 PARCEL "A" 1135 SQUARE FEET (0.0260 ACRES)
 PARCEL "B" 1002 SQUARE FEET (0.0230 ACRES)

SURVEYOR'S STATEMENT:
 1. I, SURVEYOR'S NAME, CERTIFY THAT ALL MEASUREMENTS ARE CORRECT AND THAT ALL MONUMENTS INDICATED WERE FOUND OR SET AS SHOWN. THIS PLAT OF SURVEY IS BASED UPON AN ACTUAL FIELD SURVEY PERFORMED UNDER MY DIRECT SUPERVISION IN MONTH YEAR AND CONFORMS TO THE MINIMUM STANDARDS FOR BOUNDARY SURVEYS AS ESTABLISHED UNDER OHIO ADMINISTRATIVE CODE SECTION 4733-37.
 2. (GENERAL NOTATION DESCRIBING THE EVIDENCE OF OCCUPATION ALONG EVERY BOUNDARY OR OCCUPATION LINE)
 3. THE METHOD USED IN PARTITIONING LITTORAL RIGHTS OF EACH PARCEL IS RADIAL TO THE NATURAL SHORELINE
 4. VERTICAL DATUM - IGLD (1985)



Surveyor
 Signature
 MM/DD/YYYY

PROJECT: ARMOR STONE REVETMENT	TITLE: SUBMERGED LANDS PLAT	PREPARED BY: SAMPLE SURVEYING AND ENGINEERING INC. STREET ADDRESS
ADJACENT PROPERTY OWNERS: WEST ADJOINER 11555 OAK ST, VERMILION, OH 44089 EAST ADJOINER 11595 OAK ST, VERMILION, OH 44089	APPLICANT: APPLICANT 11575 WEST LAKE RD, VERMILION, OH 44089	SHEET: 1 OF 1 DATE: 02/01/2011