Niantic Bay Overlook Project

Entry-way Project Monument and Storm Damage of 11/9&10, 12/16/2005 and 1/18/2006 and Initial Pathway Destabilization Caused by Rain Storms of 2005

Final Report

April 24, 2006

The purpose of this report is to document information gathered by the East Lyme Public Trust Foundation, Inc., concerning the Niantic Bay Overlook Project. In particular, this material relates directly to storm damage on the Overlook resulting from rain and storm waves that caused various degrees of washout to the walking surface and revetment structure of the western-most 2,739 feet of the 5,348 Overlook Public Park.

Both engineering and marine science analytical studies are being undertaken at the time of this printing. Their results will be added to future revisions of this report as new information becomes available to the Foundation.

The Overlook Project is a Public Park that cost $4,400,000 in 2005 and that has a present day value in use of $14,487, 868, as defined below.

After the Overlook Ribbon Cutting on July 15, 2005, the question arose of what was the overall project cost at that time – It was $2,300,000 (ISTEA DOT Grant) + $1,500,000 (State Open Space Bonds) + $500,000 State Small Community Grant) = $4,300,000. This cost is distinguished from Present Day Project Value, which is an estimate of project value in its use. That is, the value of this unique park is a reflection of it replacement dollar value in light of the use value of other comparable properties. It is, therefore, not a simple addition of project cash grants. In light of the difference between project value and project cost, the East Lyme Public Trust Foundation, Inc. has estimated project values by adding the dollar values of grants and gifts ($4,300,000) as well as estimates of In-Kind Services, and their associated values. These include value added added to the Overlook by professionals who donated their labor to ELPTF in the preparation and administration of grant applications, lobbying efforts, and the continual public relations efforts needed to bring such a large and complex project to fruition. A large part of this value added results from: (1) The Appreciation between 1995 and 2006 of the project Land Value ($3,268,800), and (2) the on-going fund raising value made through anticipated cash donations for inscriptions on benches and boards (estimated here at $313,900).

I. East Lyme Public Trust Foundation In-Kind Value Added

Starting even before its incorporation in 1994, Trust members performed many services and drew upon their own experience and talents and those of many other individual. This effort was required of professionals in order to obtain and coordinate various grants it won and donations of labor it solicited over eleven years that were dedicated to the sole support of the Overlook. The dollar estimates of these in-kind services reflect efforts by Trust members, councilors, and consultants. These estimates are based on the assumption that each major gift or grant resulted from, or subsequently required, the equivalent of 3% of its value for each of the eleven years (1994-2005) that the Trust dedicated to securing and managing these grants and gifts.

An example of one donation of labor and expertise was made by Rail Trac Associates in its preparation of an appraisal of Amtrak property in 1997 which it valued at $2,100.00. Another example is the effort of the Trust and its then President Jay Gionet to solicit and secure the ISTEA/BESTEA DOT Grant in 1998 for $2,300,000. That success required long, complicated, and demanding lobbying efforts of hundreds of hours of work, writing, travel, and argument, none of which were reimbursed to the Trust in any form. Those efforts won the grants that the Trust then donated directly and entirely to the Town of East Lyme.

Niantic Bay Overlook Project
Estimated Cost vs. Value as of March, 2006

Niantic Bay Overlook Project
Estimated Cost vs. Value as of March, 2006

ELPTF

	Dollar Value	Per Annum Value Added incl. Land Appreciation	Years of Effort or Duration of Land Holdings	ELPTF Costs Added**	Value Added***	Appreciated Project Value as of 3/2006
Amtrak Grant to ELPTF (1997)	$75,000	3%	4		$9,000	$84,000
EP OLSP Grant to ELPTF (1996)	$25,000	5%	2	$10,000	$1,000	$36,000
BESTEA/ISTEA Grant (1998)	$2,300,000	1%	4	$1,000	$93,000	$2,393,000
Open Space State Bond (1999)	$1,500,000	1%	5	$500	$75,500	$1,575,500
CT Small Town Economic Assistance Program Grant	$500,000	0%			$0	$500,000
Amtrak Beach Gift (1995)	$2,100,000	*12%	12			$5,124,000
Other Lands Gifts (1996)	$170,000	*12%	12			$414,800
Technical Reports/Permits (2006)			1		****$60,000	$60,000
Project Grants to East Lyme as of 7/2005	$4,300,000					
Project Grants to ELPTF	$100,000					
Total Grant Value uaed to Design and Build Overlook	**$4,400,000**				Appreciated Project Value as of 3/2006	**$10,187,300**
	Project COST					Project VALUE

* Average annual increase in land value in the coastal zone of Niantic. Land value calculated based on this non-compounded percent increase for the 12 years since the donation of the land to ELPTF in 1995.

** These are costs paid by ELPTF for services or travel and per diem expenses.

*** Efforts required of professionals in order to obtain/coordinate grants ELPTF won and donations of labor it solicited that were dedicated to the sole support of the Overlook. Dollar estimates of these in-kind services reflect labor donated by Trust members, councilors, and consultants.

**** Storm Damage assessment, repair efforts, and preparation for Standing before USCG, USACOE, and DEP environmental permit processes, required beginning in November 2005, and involving consultant services of donated labor (@ $200/hr.).

In this sense, in-kind services include all labor and expertise associated with: (1) conceptual and preliminary design, (2) coordination and project promotion, (3) preparation and submission of permit applications, (4) grant solicitation and preparation of applications, (5) grant administration, (6) contract administration, and (7) all associated administrative and reporting labor and expenses. The Trust received no payment for any of these in-kind services, yet they were all essential in that they collectively enabled implementation of the Overlook project. No other project benefited from Trust resources from 1994 through September, 2005.

The accompanying table assumes a 3% per annum In-Kind Services Value Added since 1994, the year of incorporation of the Trust. However, individual members of the Trust were working to develop the Overlook Project before the Trust was incorporated in 1994. No value is claimed here for that pre-1994 development work, although it was essential to the ultimate success of this project.

II. East Lyme Land Values

The appreciation of land value in Niantic, especially along its shoreline for the years 1997-2006, has been estimated by local real estate professionals to be an average of 13% a year. Using this estimate, the land value of the Overlook Project, which was originally valued in 1997 at approximately $2,270,000, is currently valued at $9,839,368 based on compounded increases in real estate values in the shoreline property of Niantic.

III. Fund-raising for Maintenance through Bench and Board Inscription Donations

Bench and Board Inscription Donations are an on-going activity that has so far been conducted solely by the Trust. The prices of bench and board inscriptions include the costs incurred by the Trust for the manufacture, delivery, assembly, inscription, and installation of each inscribed bench and board. The added cost to the Overlook is equivalent to present and projected donations of bench and board inscriptions that are summarized below:

1. Bench inscriptions donated before7/2005, 50 x $500
   = $ 25,000
2. Board inscriptions donated as of 10/2005, 844 x $75
   = $ 63,300
3. Additional Bench inscriptions offered, 50 x $600
   = $ 30,000
4. Additional Board inscriptions offered, 1,956 x $100
   = $ 195,600

Total = $ 313,900

The Ribbon Cutting commemoration of the Overlook took place on July 15, 2005, after approximately eleven years of development culminating in two years of construction activity. Soon after construction began, people began to trespass on it, although that was recognized as contrary to advertised regulations that were intended to protect those trespassers from accidents. Once opened, the Overlook became an immediate and popular park in which walkers, runners, and handicapped people found

a regular attraction to the Niantic Coast line, which was not previously available to them. The East Lyme Parks and Recreation Department, responsible for the operation of the Overlook as an open space park asset of East Lyme, provides staff attendants during the summer season of Memorial Day through Labor Day. Based on patronage surveys conducted by Parks and Recreation staff during the summer season after July 15, 2005, we estimate that at least 40,000 people were attracted to the Overlook, over and above those who used the adjacent McCook Point Park during that period.

In addition to the public use of the Overlook as a 1.1 mile coastal walk way for passive recreation, the Not-For-Profit, East Lyme Public Trust Foundation Inc., on behalf of the Town of East Lyme, offered the public opportunity to support the project through donation of inscribed benches placed on the walk way. One hundred and three such donations were made of tax-deductible contributions of $500 for each bench in the first phase and $600 in the second phase. All monies above the cost of bench construction and placement are donated to the Town of East Lyme dedicated for its maintenance of the Overlook.

The inscriptions on these benches are listed in the following table that includes the phase during which each donation was made between 1995 and 2006, the bench location in feet from the Hole in The Wall under-

Inscription	Phase	Location	Sequence
Carlos Lozada East Lyme Public Works 09-05-03	IIa	27	1
Gene Jones • Gone Fishing Noreen Jones	IIa	39	2
Nat Sschwarz 1959-94 M. Schwartz 1922-01	I	56	3
The Hennessey Family NIANTIC-GLASTONBURY	I	75	4
ECCO UNA PASSEGGIATA DI BELLEZZA; DOPPO A DORMIRE	IIa	96	5
In Loving Memory 1999 George and J.R. Ryalls	IIa	116	6
Hans "…to the sea again"	I	136	7
THE WIEDERMANN FAMILY	I	161	8
FOR OUR GRANDPARENTS SILAS & ERMA BRAILEY	IIa	187	9
John, Catherine, and Christopher Devine	IIa	207	10
To Honor My Parents Howard & Olivia Cary	I	277	11
In Memory of Stan Horner Gone, But Not Forgotten	I	366	12
In Memory of Ethel L. and Horace A. Burrowes	IIa	399	13
Wife Mother & Friend NOREEN LINDA MICALI	I	468	14
To Lloyd and Ruth Middleton David, Ruth, & Jeff, Williams	IIa	529	15
Josephine Shontell 11.28.29 3.10.02	I	565	16
Niantic Plumbing Cutillo Family	I	783	17
In Loving Memory of Katherine and Joseph Waldron	IIa	823	18
Elmer and Agnes Jones Irving and Mary Gaudet	IIa	838	19
The Bobinski Family Niantic Dairy Queen	I	905	20
The Wilkes Family 1955	IIa	918	21
Bob and Marie Pierce	IIa	974	22
Ma We Miss and Love You	IIa	996	23
In Memory of Gerald W. Purvis	I	1,008	24
Vincent "Jim" Barone Barber and Philosopher	IIa	1,045	25
In Memory of Anthony R. Sena	I	1,115	26
Bill and Connie Dwyer To Tomorrow's Dreams	IIa	1,123	27
BILL AND FLO MAHONEY - 2005 TO 30 YEARS! ♥ YOURS KIDS ♥	IIa	1,172	28
Fran and John Ghersi In Memory of our Parents	IIa	1,211	29
KTC Niantic LLC and Niantic Sun LLC	I	1,227	30

Inscription	Phase	Location	Sequence
Darrell McIntyre Love OF FAMILY, FRIENDS, & EL	I	1,271	31
James O. Stevens Christy S. Stevens	I	1,347	32
The Barrett Family & The Bridal Mall	I	1,427	33
In Memory of Edythe and Harold McNulty	I	1,538	34
IN MEMORY OF JOAN DENISON FROM FAMILY	IIa	1,590	35
For His Love of the Ocean Sal Mangiafico	IIa	1,608	36
In Memory of Bernie McGuinness	IIa	1,660	37
Pat McMahon Walsh	I	1,738	38
Edward & Arline Morris Love Ali, Brettini & Shawn	I	1,838	39
Lisa Marie DiMaggio The O'Donnell Family	IIa	1,928	40
"Enjoy Life" William T. Stadler, Jr.	IIa	2,036	41
Frank & Sue Ranelli	I	2,087	42
Mike & Kevin Jacobsen♥ ♥C.J. & Nicholas Simon♥	IIa	2,263	43
In Loving Memory of Leo J. McNamara	IIa	2,281	44
Richard L. North Husband-Dad-Teacher	I	2,408	45
In Loving Memory of Fletcher F. DonBrosky	IIa	2,434	46
IN LOVING MEMORY OF DONALD W. BENOIT "DB"	I	2,477	47
Enjoy The View From Wil-MaryEllen Gladue	I	2,566	48
George & Mary Hayden Daughters & Husbands	I	2,674	49
POWERS GOLDEN ANNIVERSARY	I	2,732	50
Flanders Fish Market & Restaurant THE FORMICA FAMILY	IIb	2,768	51
Mark, Maura, Katherine & Maggy Powers	I	2,783	52
THE MARRION FAMILY	IIb	2,798	53
Mario Orefice Lorraine Orefice	I	2,813	54
ELHS Class of 1987 Come, Sit, and Remember	IIb	2,833	55
IN LOVING MEMORY OF ELAINE McKIRDY	IIb	2,869	56
Dreams Do Come True Jack & Gay Supliki	I	2,899	57
CATHERINE L. RATHBUN She Loved Niantic	IIb	2,924	58
Loving Memory of John Rocco Marandino	IIb	2,949	59
In Memory of Leon J. RisCassi	IIb	2,969	60

Inscription	Phase	Location	Sequence
In Memory of JAMES JOSEPH GLYNN	IIb	2,989	61
Tom and Helen Preston Thank you -- Love, S., J., & C.	IIb	3,014	62
In Memory of the Pignone Family JOHN, MILLIE, BETTI, & CARL, Jr.	IIb	3,055	63
IN MEMORY OF THE BUCKINGHAM - HARDING FAMILY	IIb	3,075	64
Camp Niantic Family Campground in Memory of Terrell A. Rice, Jr.	IIb	3,100	65
Frank & Antoinette Cascio Our Mom and Dad	IIb	3,120	66
In Memory of Peter E. Mitchell	I	3,140	67
PAUL G. JOHNSON Boat Beach Memories	IIb	3,170	68
In Memory of Lilly Bebe, Carrie & Kiley	I	3,200	69
DeSanto Grandchildren Gramma and Grampa	I	3,256	70
In Memory of Chris, Carl and Joyce Olsen	I	3,306	71
SAINT AGNES PARISH REST IS A GIFT OF GOD	IIb	3,336	72
GEORGE P. JANK ISOBEL C. JANK	IIb	3,366	73
Sean Lugano 9-11-01	I	3,397	74
The Rinoski Family Bill, Fran, Ty, Kyle	I	3,432	75
Cynthia J. Parisi Mother, Wife, and Friend	IIb	3,468	76
Loving Memory 9/10/03 Susanne Olson Libby	I	3,508	77
Stevens Five Generations Ireland to Niantic	IIa	3,558	78
Laugh Love Inspire James J. Brown, Jr.	I	3,608	79
WILLIAM and BESSIE MOUNTZOURES	IIb	3,664	80
May Peace Be With You in This Place	I	3,704	81
Remembering Leah Beyer ♥Your NCS Friends ♥	IIb	3,769	82
Live Your Dreams Adrea I Love You -- DAD	I	3,810	83
SHERWOOD LINCOLN A FSHNUT – A SHUR-BET	IIb	3,875	84
Matthew Michael Mark Ashley & Jesse Jones	I	3,906	85
In Loving Memory Of JESSE R. LONG, Jr.	IIb	3,926	86
THE REARDON FAMILY	IIb	3,962	87
The Silver Skate Christman Shop	I	4,011	88
Rose and Bob Sinagra	I	4,051	89
Mary and Arthur Glendhill	I	4,106	90

Inscription	Phase	Location	Sequence
In Memory of BEBE DANIELS CARRIE and KILEY	IIb	4,147	91
Tri Town Foods Flanders	I	4,213	92
In Memory of Alfred J. Brousseau	I	4,278	93
Connecticut Valley Homes	I	4,338	94
In Loving Memory of Our Mom April Lowell	I	4,414	95
IN LOVING MEMORY OF GEORGE H. GLENDENNING, Jr.	IIb	4,459	96
ANNE MALLEY Forever in Our Hearts -- M/R	IIb	4,500	97
John & Mary Kish Bill & Sue Ebersole	I	4,540	98
EVELYN D. JACKSON JACK and ANNE HALLISSEY	IIb	4,596	99
August-17-1957 John T. & June M.Hoye	I	4,858	100
CTE Engineers -- With Pride & Appreciation	I	5,008	101
James A. Greenleaf, Jr. 2/10/69 -- 9/11/01	I	5,083	102
In Loving Memory of David L. Cini	I	5,121	103

pass, and the consecutive numbering of the benches.

In addition to bench donations, boards are an equally important aspect of community donations made in support of the Overlook. Each such board donation provides the donor with a two line inscription that is inlaid on a plank along with six other donated inscriptions. Each plank carrying seven such inscriptions are permanently mounted on the fence that line the elevated boardwalk of the Overlook.

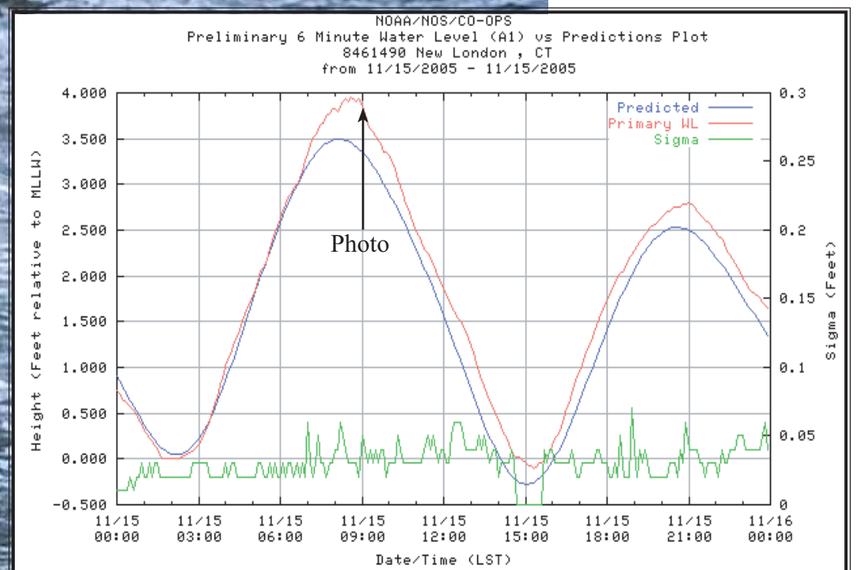
As of March 8, 2006, board donations appear on the boardwalk totaling 1,070 with an additional 1,500 or more expected to be added to the Overlook within the next two years.

Each bench and board inscription is a dedicated memorial of one kind or another and each contributes to the community nature of the park. In only one season of use, this public park commands a level of respect and caring that is unique and inspiring. Much more than a simple exercise path, albeit aesthetically pleasing, it is equally a commemoration of community spirit and a unique place where friends and memories converge. Niantic Bay Overlook opens 1.1 miles of Connecticut's unique vista of Long Island Sound to the public and adds 10% to the state's open space along its shore. By its nature as a memorial park and as a substantial source of year-round passive recreation*, the Overlook provides an unsurpassed opportunity for the public benefit in East Lyme, in the region, and in the State.

* *Passive Recreation: The non-consumptive use of natural resources that generally encompasses the less intensive range of outdoor activities compatible with preserving natural resource functions such as wildlife habitat and floodplain protection.*

The two views of the study area at the left and right were taken at 0900 hours on November 15, 2005, during High Tide as determined by the unverified tidal gauge readings at New London, CT (#8461490). Weather was solid overcast with variable light south south-west winds, Barometric Pressure was 30.94 inches.

Placement of the monument at the main entrance to the Overlook and off the walkway and drainage easement, places its seaward face in the wave field during onshore storms. Its foundation can be protected against erosion by rip rap to armor it against damage, but the present stone, <u>if not augmented</u>, will not provide that long term protection.

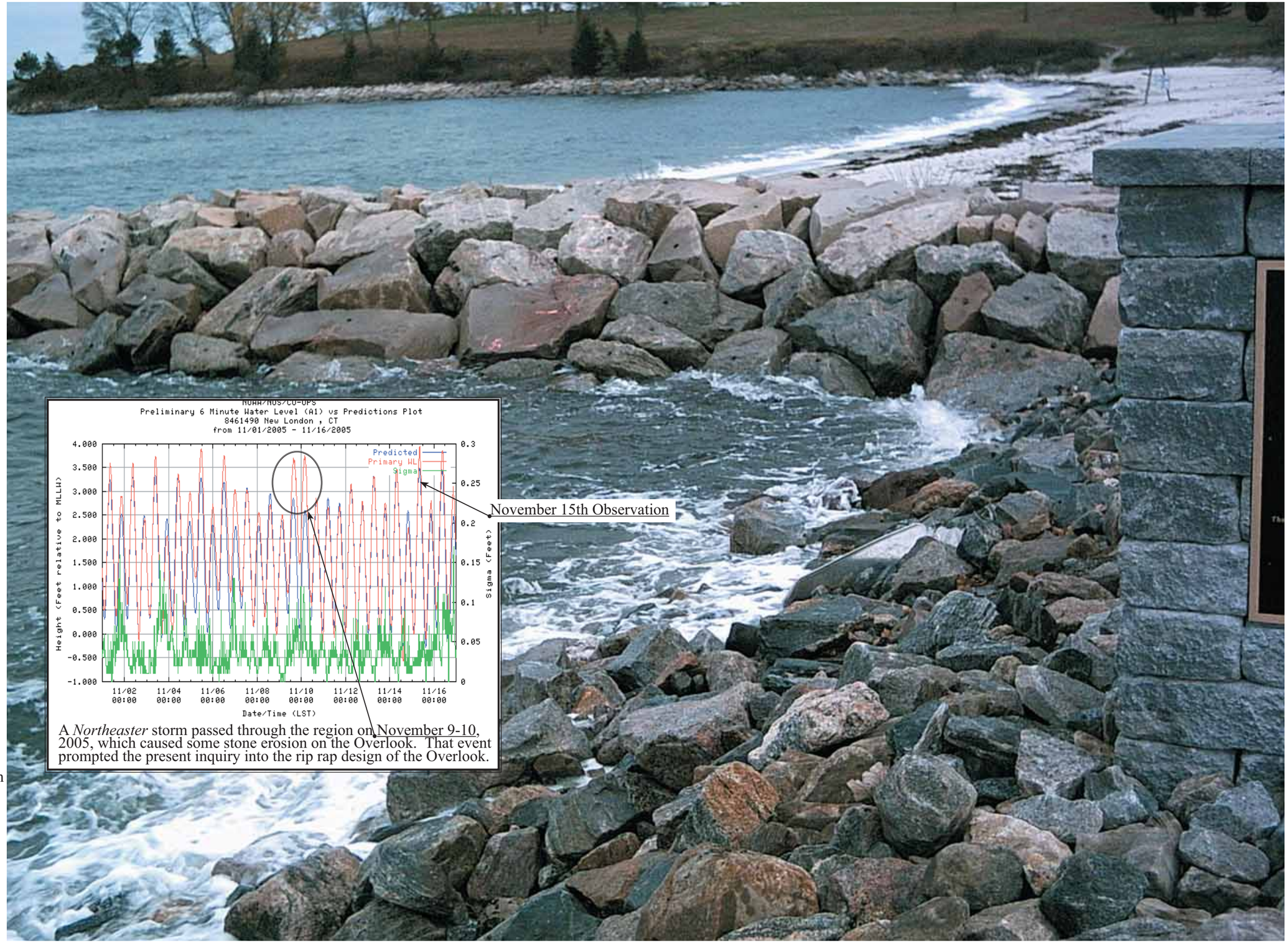


The tidal readings above at the New London Tidal Station (6.19 land and 9.70 water miles away from Hole In The Wall) are 1 minute behind equivalent readings at the Millstone Point (i.e. Niantic Bay). Therefore, the tidal reading at New London indicated here by the arrow is equivalent to the tidal state shown in the photographs.

The monument is placed immediately East of a drainage easement that contains the storm drain pipe from the Hole In The Wall Parking Lot on the north side of the railroad embankment. The foundation of the monument consists of stone dust on construction fabric protected from erosion by a subsurface concrete form. That is covered by about one foot of small rip rap.

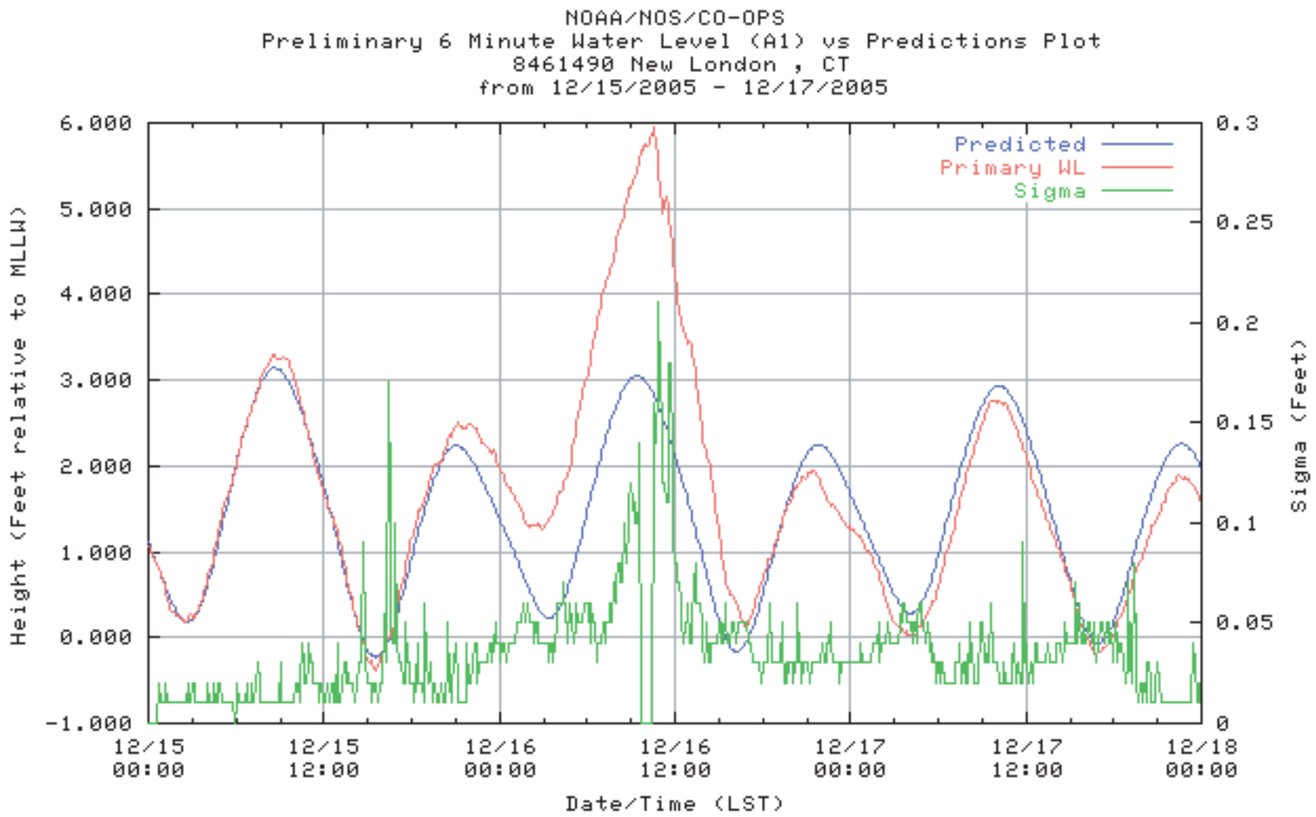
Conversation with the Town Engineer, Keith Heyden, resulted in agreement that stabilizing the monument by use of placed rip rap would be acceptable. Present plans are temporarily suspended until such time as a completed damage report is completed by East Lyme.

The Foundation is undertaking a study of storm damage relative to wave energy impacts and storm return frequencies, which began on 11/18/05 in meetings with Prof. W. Frank Bohlen in the Department of Marine Sciences, University of Connecticut. The results of ths study are expected in late March, 2006.



A *Northeaster* storm passed through the region on November 9-10, 2005, which caused some stone erosion on the Overlook. That event prompted the present inquiry into the rip rap design of the Overlook.

Tidal Cycle Recorded at the New London State Pier
Occurring 52 Minutes Before Niantic Bay *



* The nearest National Oceanic and Atmospheric Administration (NOAA) Tide Station is located 9.7 water miles away from Niantic Bay Overlook. As a result, the tidal cycle recorded at New London precedes the same tidal cycle at Millstone Point (i.e. Niantic Bay) by 1 minutes. It is virtually of the same magnitude. The plot above is taken from: NOAA/NOS/CO-OPS Water Level Station Data (http://140.90.121.76/cgi-bin/co-ops_qry_direct.cgi?stn=84611490+New+London+%2C+CT&dcp=1&ssid=A1+-+Acoutoc+WL...

During the morning of December 16th, winds from the South-East with sustained gusts of 40 mph, drove waves at the Overlook during an extreem high tide that was twice the height of the normal extreme high water for that date. Here, they are seen breaking over the Monument at 10:00 am ±.

Although the ELPTF Monument was not damaged, its surrounding rip rap was eroded leaving its foundation exposed as is shown here photographed at 2:30 pm, December 16, 2005. Note the stones cast onto the path.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration

UNEDITED LOCAL CLIMATOLOGICAL DATA HOURLY OBSERVATIONS TABLE GROTON-NEW LONDON AIRPORT (GON) GROTON NEW LONDON , CT (12/2005)

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801

Elevation: 21 ft. above sea level Legend: AO2 = Unattended; OVC007 = Overcast at 700 feet; 4SM = 4 Statute Miles; RA = Rain; BR = Mist

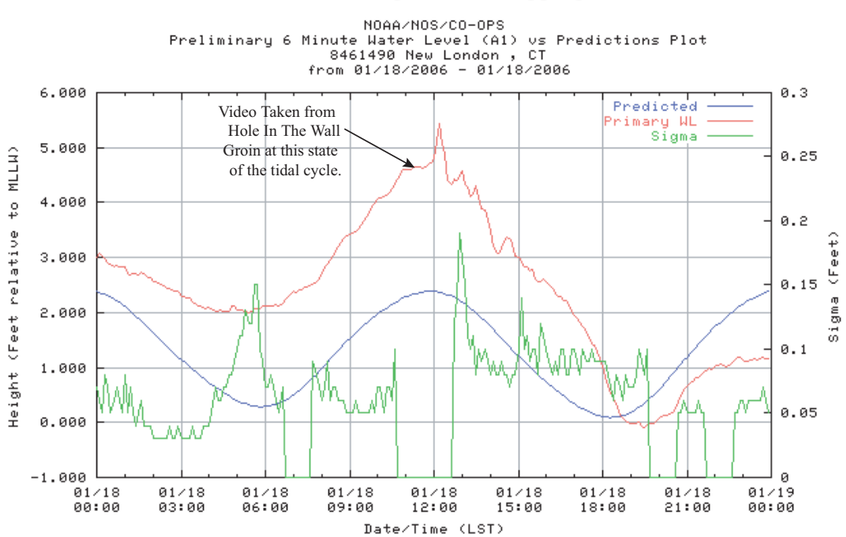
Latitude: 41°20'N Longitude: 72°03'W

Date	Time	Station Type	Maint Indic	Sky Conditions	Visibility	Weather Type	Dry Bulb Temp (F)	Dry Bulb Temp (C)	Wet Bulb Temp (F)	Wet Bulb Temp (C)	Dew Point Temp (F)	Dew Point Temp (C)	Rel Humd %	Wind Speed (KT)	Wind Dir	Wind Char. Gusts (KT)	Val. for Wind Char.	Station Pressure	Press Tend	Sea Level Pressure	Report Type	Precip. Total
16	0756	AO2	-	OVCOO7	4SM	-RA BR	48	8.9	47	8.4	46	7.8	93	25	110	G	32	29.67	-	055	AA	,07
16	1056	AO2	-	BKN007 OVC015	3SM	-RA BR	50	10.0	49	9.4	48	8.9	93	15	150	G	24	29.53	-	007	AA	.06
16	1356	AO2	-	OVC006	7SM	-	42	5.6	41	4.8	39	8.9	89	16	300	G	22	29.63	-	040	AA	-
16	2056	AO2	-	FEW110	10SM	-	37	2.8	35	1.4	31	-.6	79	9	300	-	0	30.02	-	172	AA	-

Shown above are a few hourly readings reported at the nearest weather station to Niantic Bay. These indicate the general nature of the storm of December 16, 2005 that was much stronger than the one of November 9-10, 2005, reported on pages 1 and 2. That earlier storm erosion prompted the East Lyme Public Trust Foundation, Inc. to initiate its contact with the University of Connecticut, Avery Point Branch, Department of Marine Science, Professor W. Frank Bohlen, Ph.D. The Foundation funded an analytical study by Dr. Bohlen to help define the actual nature of this damaging storm, its return frequency and to provide advice relative to minimizing such damage as might otherwise occur in the future. Our assessment will be shared with the public, when completed in March 2006.

In order to aid in storm wave analyses stricking the Overlook, a 22 minute video was made overlooking the Overlook revetment from the groin structure that extends into Niantic Bay opposite the Hole In The Wall underpass. The Compact Disk of that video accompanies the original copies of this report. Copies are available from the Foundation (860/444-8793) upon request.

The relative state of the tide during the vedio tapping is indicated below:



Prefabricated, concrete curbing (8 ft x 20 in. x 7 in.), were used to form the seaward edge of the western 2,743 foot long Overlook walk way. Forty-eight of these sections were removed from eroded por-

tions of that walk way following the coastal storms of December 16th and January 18th. Shown here in temporary storage in the parking lot adjacent to the Hole In The Wall underpass, the inset is a detailed view of the Re-Bar pin used to align curb units with one another when they are set end to end along the seaward endge of the walk way. Photographs A, B, and C on the following pages show the consequences of the erosion of fines, coupled with storm wave shifting of rip rap that caused collapse of the curbing. The locations along the Overlook from which these curb sections were removed are illustrated in the aerial photograph on page 9.

Niantic Bay Overlook Storm Damage Due to Pronounced Subaerial Erosion* of Foundation Fines from the Walkway Caused by Heavy Rains of October, 2005

LCD Form

Page 1 of 1

This form contains Quality Controlled data.

PRELIMINARY LOCAL CLIMATOLOGICAL DATA

NOAA, National Climatic Data Center

Month: 10/2005

October 2005

Station Location: GROTON-NEW LONDON AIRPORTT (14707)
GROTON NEW LONDON , CT

Lat. 41.328 Lon. -72.049

Elevation(Ground): 21 ft. above sea level

Date	Temperature (Fahrenheit) Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Degree Days Base 65 Degrees Heating	Cooling	Significant Weather	Snow/Ice on Ground(In) 0600 LST Depth	1200 LST Water Equiv	Precipitation (In) 2400 LST Snow Fall	2400 LST Water Equiv	Pressure(inches of Hg) Avg. Station	Avg. Sea Level	Wind: Speed=mph Dir=tens of degrees Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	Dir	max 2-minute Speed	Dir	Date
1	66	43	55	M	49	52	10	0	-	M	M	M	0.00	30.29	30.32	2.6	20	5.5	14	200	12	200	1
2	69	45	57	M	54	56	8	0	BR	M	M	M	0.01S	30.35	30.37	1.9	20	3.6	10	190	10	200	2
3	71	51	61	M	57	58	4	0	BR HZ	M	M	M	0.00	30.40	30.41	2.3	08	4.3	13	140	10	140	3
4	69	55	62	M	59	61	3	0	FG+ BR	M	M	M	0.00	30.35	30.36	1.6	15	3.1	12	160	10	180	4
5	73	57	65	M	62	63	0	0	FG+ FG BR HZ	M	M	M	0.00	30.29	30.30	1.0	09	3.6	10	130	9	130	5
6	71	66	69	M	66	66	0	4	RA FG+ FG BR	M	M	M	0.01	30.19	30.20	4.3	19	4.6	14	180	13	180	6
7	75*	66	71*	M	68	68	0	6	RA FG+ FG BR	M	M	M	0.11	30.06	30.05	7.0	16	7.3	25	180	22	170	7
8	72	68	70	M	69	69	0	5	RA BR	M	M	M	1.39	29.82	29.80	14.5	17	15.1	36	170	30	170	8
9	72	53	63	M	56	56	2	0	RA BR	M	M	M	0.17	29.84	29.90	5.4	02	11.5	39	170	31	170	9
10	58	54	56	M	54	55	9	0	RA BR	M	M	M	0.13	30.04	30.06	8.2	03	8.4	17	060	14	050	10
11	63	55	59	M	55	56	6	0	RA BR	M	M	M	1.00	30.03	30.05	12.6	04	13.0	31	040	25	040	11
12	57	53	55	M	52	53	10	0	RA BR	M	M	M	0.37	30.14	30.16	21.4	05	21.5	41	070	32	060	12
13	61	55	58	M	55		7	0	RA BR	M	M	M	0.74	30.13	M	M	M	19.2	36	050	25	050	13
14	66	59	63	M	61		2	0	RA BR	M	M	M	4.65	29.88	M	M	M	14.3	33	090	26	090	14
15	66	53	60	M	54	57	5	0	RA BR	M	M	M	2.16	29.49	29.49	11.3	34	14.1	30	360	25	320	15
16	65	51	58	M	42	49	7	0	-	M	M	M	0.00	29.46	29.48	15.8	28	16.3	36	270	28	300	16
17	63	49	56	M	42	49	9	0	-	M	M	M	0.00	29.59	29.63	11.5	30	12.4	35	320	25	320	17
18	69	46	58	M	45	51	7	0	-	M	M	M	0.04	29.65	29.66	8.4	28	9.2	31	290	22	260	18
19	63	44	54	M	48	52	11	0	-	M	M	M	0.00	29.81	29.81	8.4	24	9.1	23	240	20	240	19
20	59	41	50	M	36	44	15	0	-	M	M	M	0.00	29.93	29.97	7.6	34	8.1	26	340	18	340	20
21	57	38	48	M	38	43	17	0	-	M	M	M	0.00	30.03	30.03	3.2	36	3.8	13	330	10	330	21
22	49	39	44	M	43	45	21	0	RA BR	M	M	M	0.47	29.83	29.78	12.1	05	12.8	33	070	26	060	22
23	54	39	47	M	41	44	18	0	-	M	M	M	0.05	29.62	29.67	9.6	32	10.6	29	050	26	060	23
24	51	35	43	M	40	43	22	0	RA	M	M	M	0.21	29.96	29.95	10.2	05	10.6	31	070	24	060	24
25	52	39	46	M	44	46	19	0	RA BR	M	M	M	1.18	29.41	29.39	17.8	03	19.5	48	040	35	050	25
26	51	38	45	M	34	39	20	0	-	M	M	M	0.00	29.60	29.67	13.1	30	13.4	37	300	30	300	26
27	51	33*	42	M	31	37	23	0	-	M	M	M	0.00	30.09	30.13	5.5	31	6.3	18	320	16	320	27
28	45	34	40*	M	29	36	25	0	-	M	M	M	0.00	30.28	30.29	7.9	01	8.1	18	360	15	360	28
29	48	37	43	M	29	36	22	0	RA	M	M	M	0.07	30.14	30.12	8.8	34	9.7	25	340	20	320	29
30	68	40	54	M	37	45	11	0	-	M	M	M	0.00	30.04	30.07	9.7	31	10.0	24	330	20	330	30
31	M	M	M	M			M	M	BR	M	M	M	M	M	M	M	M	M	M	M	M	M	31
	M	M	M	-------	48.3	51.0	10.4	0.5	<Monthly Averages	Totals>			M	M	M	3.7	35	10.3	<Monthly Average				
	M	M	M	-------	<----------Departure From Normal---------->								M										

Legend:
BR = Mist
M = Missing
RA = Rain

Degree Days	Monthly Total	Monthly Departure	Season to Date Total	Season to Date Departure
Heating	313	M	M	M
Cooling	15	M		

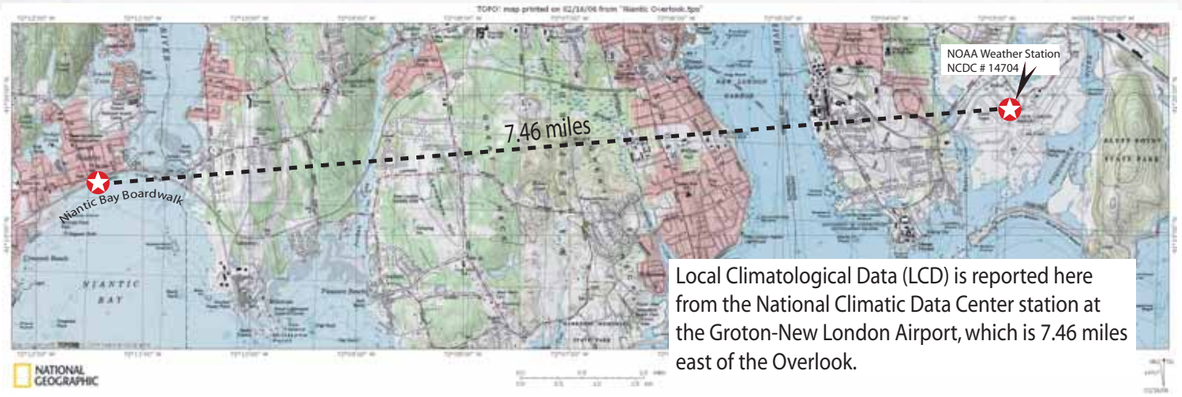
Greatest 24-hr Precipitation: M Date: M
Greatest 24-hr Snowfall: M Date: M
Greatest Snow Depth: M Date: M

Sea Level	Pressure	Date	Time
Maximum	M	M	M
Minimum	M	M	M

Number of Days with -------->
Max Temp >=90: M
Max Temp <=32:
Thunderstorms : 0
Min Temp <=32: M
Min Temp <=0 : M
Heavy Fog : 4
Precipitation >=.01 inch: M
Precipitation >=.10 inch: M
Snowfall >=1.0 inch : M

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.

Data Version: V020



Local Climatological Data (LCD) is reported here from the National Climatic Data Center station at the Groton-New London Airport, which is 7.46 miles east of the Overlook.

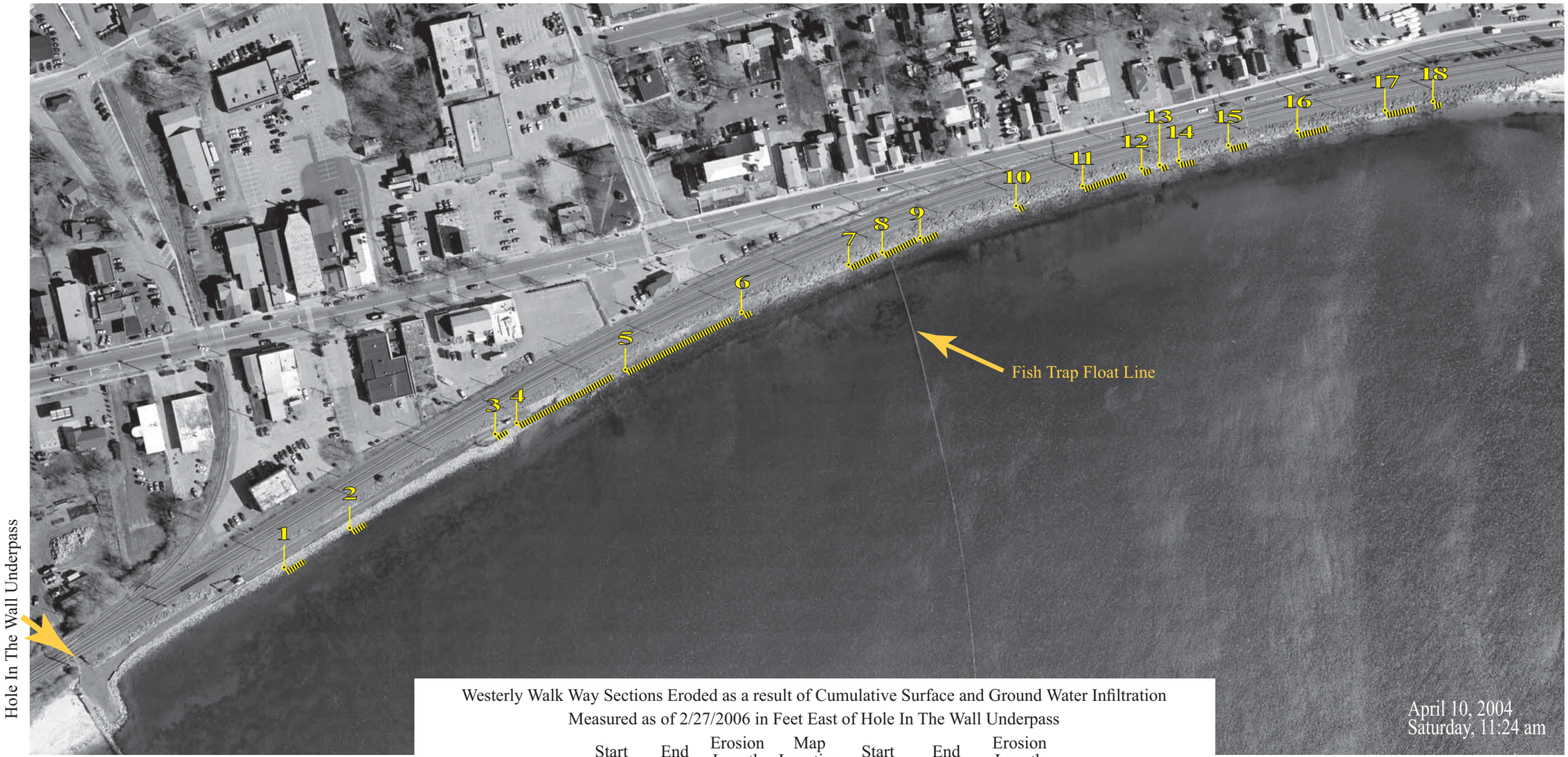
Independent observations at various time in July 2005 through February 2006, made by a Professional Planner (AICP) and by a Certified Environmental Professional (ABCEP #02010409), reported sediment laden waters at the toe-of-slope along portions of the westerly revetment of the Niantic Bay Overlook. The independent conclusions of both observers were that heavy rains, and particularly those during the storm of October 14, 2005, significantly eroded fine sediments contained in the Overlook structure, thus undermining that structure. The erosion of these fines culminated in further surface damage, as illustrated below in photographs 1 and 2. Revetment failures appear scattered along portions of the westerly Overlook and resulted directly from the "Nor'easter" coastal storms of November 9-10, December 16, and January 18. The impacts of these storms on the walking surfaces of the Overlook were greatly exacerbated by destabilization of the fill caused by rain erosion described above and resulting in such damage as illustrated in photographs A and B, below and in photograph C on page 10.

Precipitation data was recorded at the Groton-New London Airport (NOAA Station #14707), which is 7.46 miles east of the Overlook. A total of 10.38 " of rain fell as a result of five separate storms of 1" to 4.65" during that month. Mean rain fall of those five storms was 2.08±1.5".

Subaerial erosion* of the Overlook path is seen in photograph 1 (2/16/06) as it appears between 2,088 and 2,100 feet east of Hole In The Wall underpass. The undercutting of the curbing, resulting from surface water eroding fines in the unconsolidated fill material. is clearly shown here to sink under the curbing and flow into the revetment face and then into the Bay, leaving the Overlook unstable and vulnerable to coastal storms which move the undersized rip rap and further erode the structure of the Overlook walk way.

Subaerial erosion of the Overlook path is seen here between 826 and 842 feet east of Hole In The Wall underpass as it appeared on February 16, 2006. The destabilization caused by leaching of heavy rainfall leading from the adjacent railroad embankment and the Overlook walking surface, undermined the Overlook fill by removing fines from both the foundation of the walk way as well as from the revetment slope. Erosion of the walking surface was not pronounced and the most prominent signs of cumulative problems, unrecognized in their significance at first, was the regular appearance of muddy waters at the toe-of-slope of the revetment along the westerly 2,743 feet of the dirt Overlook between Hole In The Wall underpass and the elevated boardwalk.

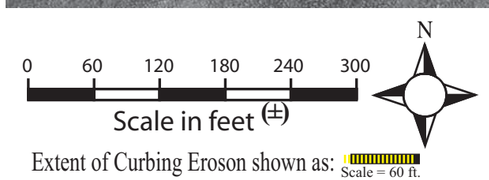
**Subaerial -- Taking place, existing, operating, or formed in the open air or on the earth's surface, as opposed to subaqueous, submarine, or subterranean.*



Westerly Walk Way Sections Eroded as a result of Cumulative Surface and Ground Water Infiltration
Measured as of 2/27/2006 in Feet East of Hole In The Wall Underpass

	Start	End	Erosion Length	Map Location		Start	End	Erosion Length	
	389	414	25	1	10	1,849	1,858	9	
	529	551	21	2	11	1,981	2,037	56	Photo 2
Photo 1	825	842	16	3	12	2,084	2,095	11	
	861	992	131	4	13	2,127	2,137	11	
	1,086	1,229	143	5	14	2,155	2,173	18	
	1,322	1,332	10	6	15	2,240	2,262	18	
Photo 3	1,545	1,582	37	7	16	2,379	2,417	41	
	1,596	1,643	47	8	17	2,538	2,575	40	
	1,665	1,687	22	9	18	2,611	2,621	10	

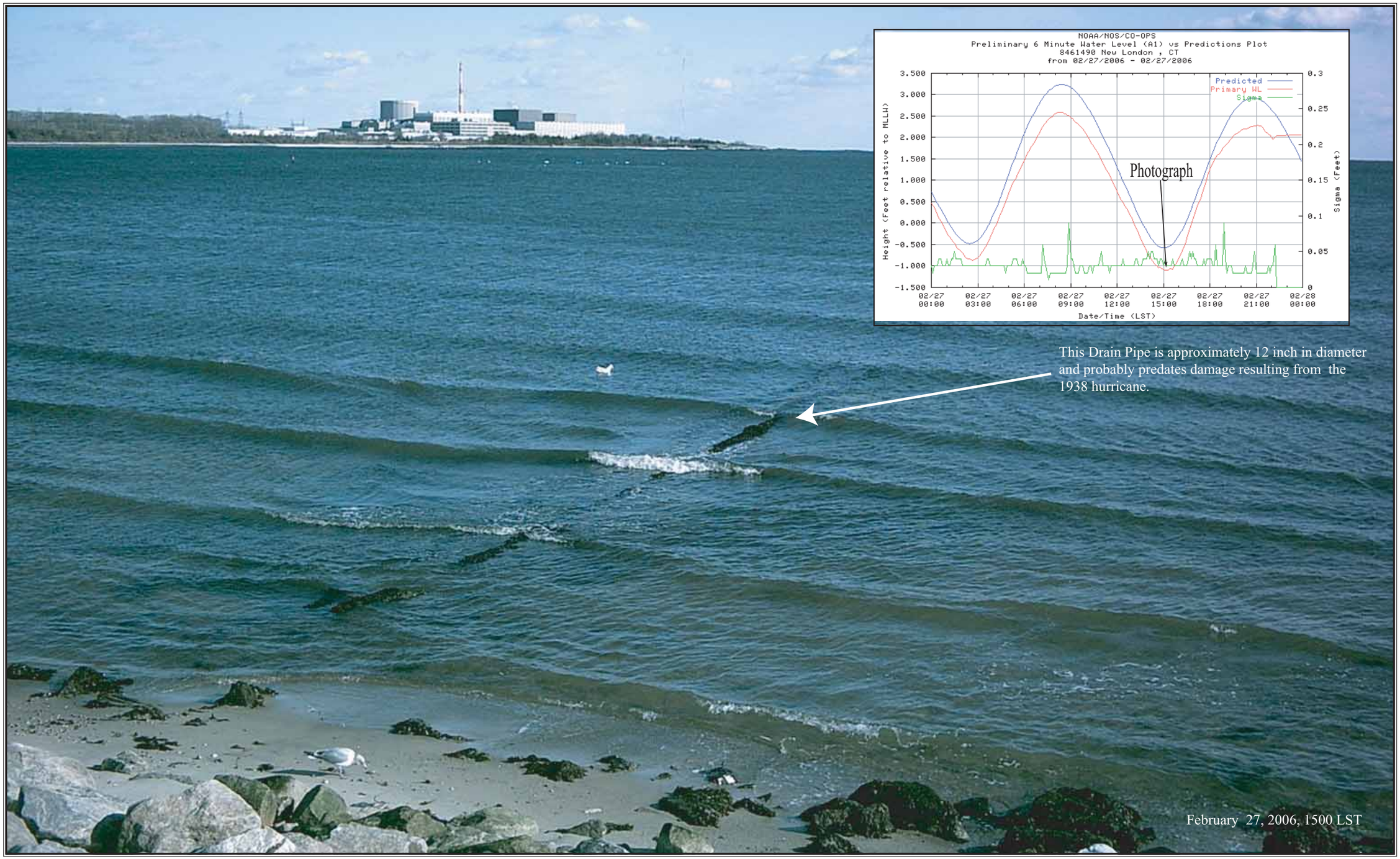
Total Length of Overlook Curbing Damage = 665 = $\frac{665}{2739}$ = 24%



Subaerial erosion due to rain, coupled with coastal erosion due to waves, resulted in undercutting curbing,as seen in Figure 3, which is bsed on observations made on February 16, 2006, 1,549 feet east of Hole In The Wall underpass. Note how the 8 foot section of curbing (marked with a ✓) has fallen onto the revetment rip rap. Sand bags were placed after the December 16th storm as an emergency repair to protect the walkway from further erosion.

Looking easterly in Figure D toward the beginning of the elevated Boardwalk, this photograph was taken on April 8, 2005. Note the relatively even surface texture of the revetment in the foreground. This appearance results from the use of graded stone of relatively small size.That sloped fill material seen here still contains brown soil sediments.

The photograph to the right was taken on February 27, 2006, approximately eleven months after the Figure D photograph to the left. Note the absence of brown soil and the absence of small stones that results in the rougher appearance of the slope. The slope at this location along the Overlook has increased by 5º. The soil and smaller stones have been eroded out of the revetment, casuing the slope to increase and making the walking surface of the Overlook less stable and more prone to futire washouts due to storm waves and/or
rain infiltration. Such infiltratioin may cause further removal of fines from the walking surace foundation material, undercutting the curbing that would result in further collapse of the revetment and curb-



This photograph of Niantic Bay was taken from the Niantic Bay Overlook at a point on its westerly walkway approximately opposite the Morton House. The tidal plot inset above is from the New London NOAA station, which records the tidal range. This tidal cycle reaches Millstone Point (i.e. Niantic Bay) one minute later, according to NOAA predictions. On February 27, 2006, at 3:02 pm, the low tide in Niantic Bay was extremely low due to atmosphric conditions. The tide seen here was 0.55 feet lower than was predicted by NOAA. Obvservations made possible because of this extremely low tide, indicate that a sandy bottom exists along the length of the abandoned drain pipe.

Coastal Storm Characteristics and Their Return Frequency with Respect to Niantic Bay and Overlook Damage

The following pages document the scientific report that was commissioned by the East Lyme Public Trust Foundation, Inc. with W. Frank Bohlen, Ph.D., Professor at the University of Connecticut, Marine Sciences Department, Avery Point, Groton, Connecticut.

Based on this report, our most important conclusions are that:

1. The two primary storms that damaged the western pathway of the Overlook were similar to one another, including their wind speeds, direction, and duration.
2. Neither storm was unusual and, can be expected to recur every one or two years.
3. Winds from the south and southeasterly direction produce waves that are most damaging to the Overlook revetments.
4. Refraction of waves due to topographic conditions of the Bay bottom do not appear to play any significant role in focusing or forming waves in the Bay.

April 11, 2006

Dr. Robert S. De Santo
President
East Lyme Public Trust Foundation Inc.
16B Center Street
Waterford, Connecticut 06385-1804

Dear Dr. De Santo:

As authorized in your letter of February 3, 2006 I have examined the characteristics of the storms which occurred on December 16, 2005 and January 18, 2006 to assist in your analysis of associated damage to the Niantic Bay Overlook (aka The Niantic Bay Boardwalk). The following represents a summary of my findings.

1. **Storm of December 16, 2005** - This event was the result of the passage of an area of low barometric pressure over a period extending from noon on the 15th of December to noon on the 17th of December. As this low passed, barometric pressures at the New London Ledge meteorological station, maintained by the University of Connecticut Department of Marine Sciences, progressively fell from a high of 1028 mb at noon on the 15th to a low of approximately 999 mb at noon on the 16th. During the next 24 hours pressures rose, returning to pre-storm levels of approximately 1030 mb by noon on the 17th (Fig. 1a).

As pressures dropped after noon on the 15th ,winds at New London Ledge progressively increased in speed from near calm to a high of approximately 45 mph (15 min average wind speed) at 0930 est on the 16th (Fig. 1b). Following this relatively monotonic increase maximum speeds decreased irregularly to approximately 10 mph by noon on the 17th. Wind directions through this event displayed a progressive clockwise rotation with winds first coming from the northeast (Fig.1c). After a period of approximately 5 hours falling barometric pressure resulted in an increase in wind speed to approximately 20 mph and a shift in wind direction to the southeast. This direction was maintained for a period of approximately 12 hours during which time speeds increased to the maximum of 45 mph with gusts to 55 mph. On approach to the barometric pressure minimum, wind speeds decreased slightly and directions slowly shifted through the south to the southwest over a period of several hours. The subsequent increase in barometric pressure favored a further shift in wind direction with winds coming primarily from the west to northwest and speeds falling to pre-storm levels over the next twenty four hours.

Extreme value analysis of the time series meteorological data for New London Ledge for the period 1994 to 2005 indicates that events similar in character to that of the December 16, 2005 storm can be expected to occur annually to every two years (Fig.2). Examination of the meteorological record for the month of December (Fig.1) shows several events with wind speeds higher than and directions similar to the event of December 16th. Note particularly the event of December 9th which produced wind speeds approaching 50 mph (gusts to 60 mph) from the

northeast before shifting to the northwest. This event differed from that of the 16th however in duration and directional characteristics. The combination effectively limited the time during which winds came from the southeast through south significantly reducing the influence of the wind field on the wave climate within the south facing Niantic Bay. (Fig.3)

In addition to affecting the regional wind field, the passage of the low pressure system on December 16th served to modify tidal elevations resulting in extensive flooding of low lying coastal lands. This was a spring tidal period with full moon on the 15th. High water levels on the 16th were predicted to approach 3.4 ft (above MLLW). Measured values showed significantly higher elevations with a maximum of 5.94 ft above MLLW at New London or approximately 5.06 ft above NGVD (National Geodetic Vertical Datum 1929 = Reference Mean Sea Level) (Fig. 4). Statistical analyses of the tidal records for New London over the period 1635 to 1974 (USACE, 1973) updated recently by analysis of the 1938 to1993 record indicate that tidal events with elevations similar in magnitude to that observed on the 16th might be expected to recur once every three to four years (Fig.5).

The combination of high water levels and strong winds from the southerly directions can be expected to produce an energetic surface wave field in Niantic Bay. Although there have been no direct measurements of surface wave conditions within the Bay visual observations obtained during the December 16th (provided by East Lyme Public Trust Foundation Inc.) event show near shore wave heights of approximately 3ft immediately prior to breaking. This value is consistent with time series data obtained within other similar embayments along the Connecticut shoreline during events with similar wind speed and direction characteristics. For example, examination of data obtained in 2002 at a nearshore station in approximately 30 ft of water just west of the Thimble Islands Branford, Connecticut shows waves generated by a system similar in character to the December 16, 2005 storm having significant heights (average of the highest 1/3 of the waves observed) in excess of 3.6 ft and periods of six to seven seconds (Fig. 6). This consistency suggests that the storm of December 16th produced similar waves at the outer margin of Niantic Bay. Proceeding shoreward such waves will shoal significantly as a function of water depths in the Bay (see Fig.3) resulting in steepening and ultimately breaking. The increased depths associated with the storm induced tidal perturbation will tend to move the point of breaking shorewards resulting in conditions that will on occasion cause high velocity waters to overtop the Overlook walkway particularly near its western end where surface elevations are approximately 8 ft above NGVD (1929). The visual observations show this aperiodic inundation.

2. **Storm of January 18, 2006** - The storm of January 18, 2006 was the result of the passage of a low pressure system that caused barometric pressure at New London Ledge to fall from a high of approximately 1020 mb at 2000 est on the 17th to a minimum of 995 mb just after noon on the 18th (Fig. 7a). Pressures then rapidly increased returning to pre-storm levels by 1000 est on the 19th. This pressure signal was essentially identical to that associated with the December 16th event with the 16th data displaying a slightly greater total change in pressure.

in wind speeds at New London Ledge from approximately 10 mph at the onset of the fall to a maximum of approximately 50 mph (15 minute average) with gusts approaching 60 mph as pressures approached minimum on the 18th. Wind direction again displayed a clockwise trend with winds initially coming from the southeast. The southeasterlies prevailed until early on the morning of the 18th, or a period of approximately 6 hours, before giving way to southerlies and ultimately southwesterlies by approximately noon on the 18th. The maximum winds coincident with the barometric pressure minimum were rich in westerly components (Fig. 7b&c).

Again using the New London Ledge meteorological data for the period 1994 to 2005 (Fig. 2), extreme value analysis indicates that wind events similar in magnitude to the storm of January 18, 2006 can be expected to recur every year to two years. In fact, examination of the meteorological record for January, 2006 (Fig.7) indicates that an event with winds similar in magnitude to the January 18 storm occurred several days earlier on the 15th. Despite the magnitude of the change in barometric pressure associated with this event its track and rate of advance favored the generation of westerly to northwesterly winds with only a short period of low speed easterly winds. The combination resulted in a relatively small tidal perturbation and, due to land mass sheltering, a lower energy surface wave field within Niantic Bay. The response provides clear indication of the sensitivity of the area to wind direction.

In contrast to the storm of January 15th the passage of the low on January 18th significantly perturbed the local tidal regime. The timing of this event occurring 4 days after the spring tide favored a slight reduction in maximum water level elevations relative to those observed on December 16, 2005. The event of January 18th produced a maxima of 5.43 ft above MLLW or approximately 2.93ft above predicted high water levels. This high was followed by a period of extreme lows eliminating high water stands until mid-day on the 20th (Fig. 8). Statistical analysis of this event using the data provided by the U.S. Army Corps of Engineers (Fig.9) indicates that tidal flooding of this magnitude (~4.55ft above NGVD 1929) can be expected to recur approximately once every 1.6 years.

The similarities in wind speed, direction and duration between those associated with the December 16, 2005 event and those found during the January 18, 2006 storm suggest that the surface wave fields associated with each event will be essentially identical. The visual observations indicate that this was the case. This suggests that any differences in Overlook impact produced by each event were primarily the result of differences in mean water level elevations. The lower extreme tidal elevations associated with the January 18th event reducing the frequency and intensity of overtopping and the extent of drainage associated erosion and/or rubble displacement.

Summary - Analysis of the storms of December 16, 2005 and January 18, 2006 indicates that these events were similar in origin and fundamental characteristics, including wind speeds, directions and duration, and as a result produced essentially similar tidal perturbations and surface wave conditions. Comparisons to previous events indicates that these events were not

particularly unusual and could be expected to recur every year to two years. The fact that these storms caused measurable structural damage to the Overlook while other events with similar wind speeds observed during both December, 2005 and January, 2006 did not provides clear indication of the sensitivity of the Niantic Bay system to wind direction. Events producing winds rich in southerly to southeasterly components will tend to produce the highest energy surface waves. Northeasterly or westerly winds do not appear to be as effective. This response indicates that wave generation in this embayment is a simple function of fetch , or the overwater distance on which the wind acts. Refraction associated with the distribution of water depths does not appear to play a significant role in focusing and the formation of an energetic wave field in the Bay. As a result the area is effectively sheltered from the effect(s) of waves generated by winds oblique to the south facing offshore axis of the Bay. These factors should be considered within future designs of drainage and armoring intended to complement the longterm maintenance of the Overlook

References

USACE, 1973 Tidal Hydrology Interim Memo No. COE 2 . Prepared for the New England River Basins Commission. Long Island Sound Regional Study. By the Department of the Army. New England Division, corps of Engineers. Waltham, Ma. 15 pps + Plates.

If you have any questions concerning the above analysis please don't hesitate to call.

Sincerely,

Signed in the original

W.Frank Bohlen PhD

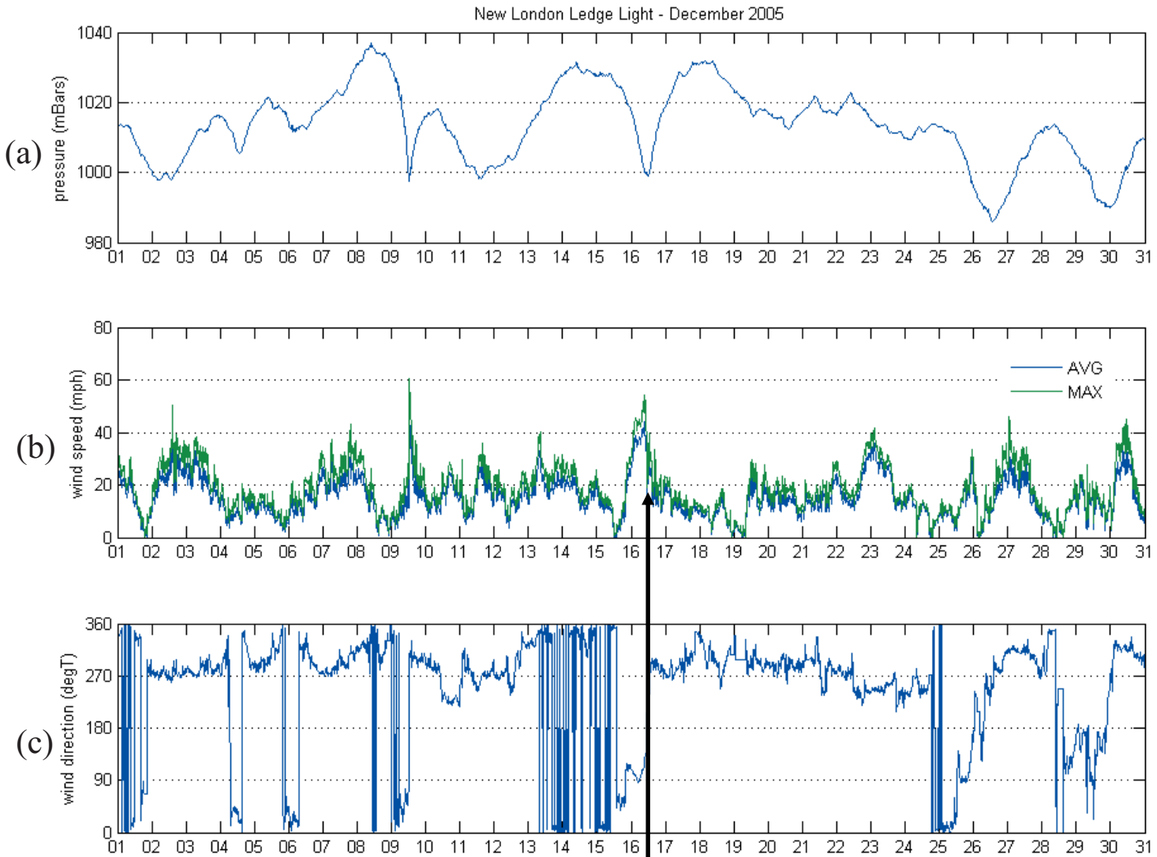


Figure 1 Meteorological Data – New London Ledge Station - December, 2005

(a) Barometric Pressure (b) Wind Speed (c) Wind Direction

Arrow Designates the Event of December 16, 2005

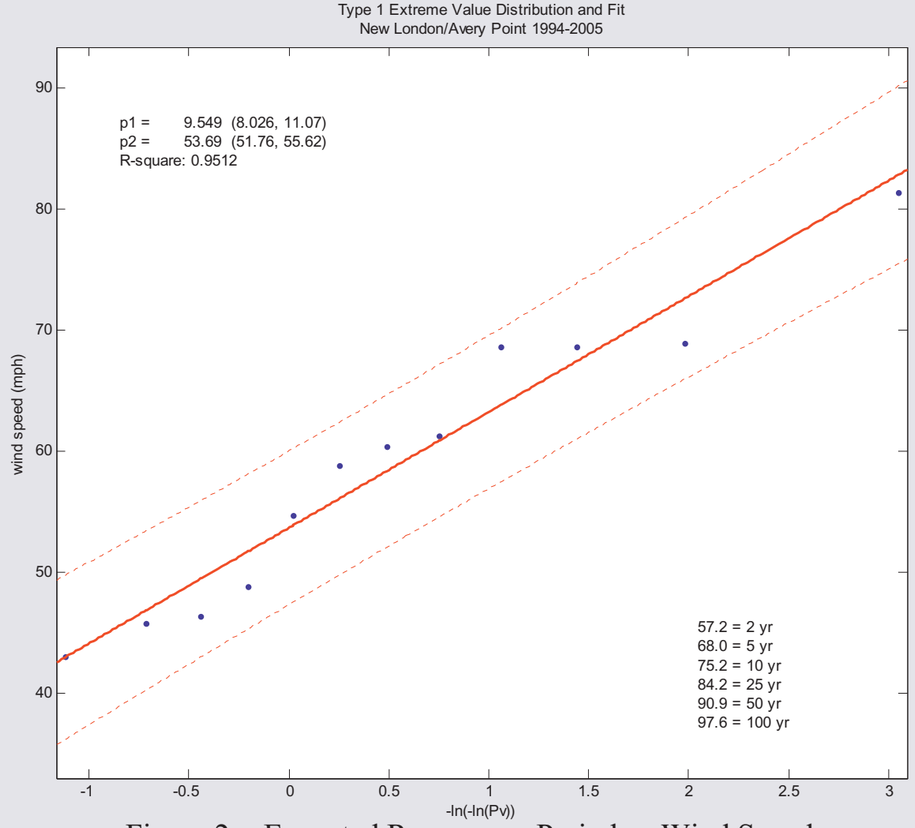


Figure 2 - Expected Recurrence Periods – Wind Speed
New London Ledge and Avery Point Stations

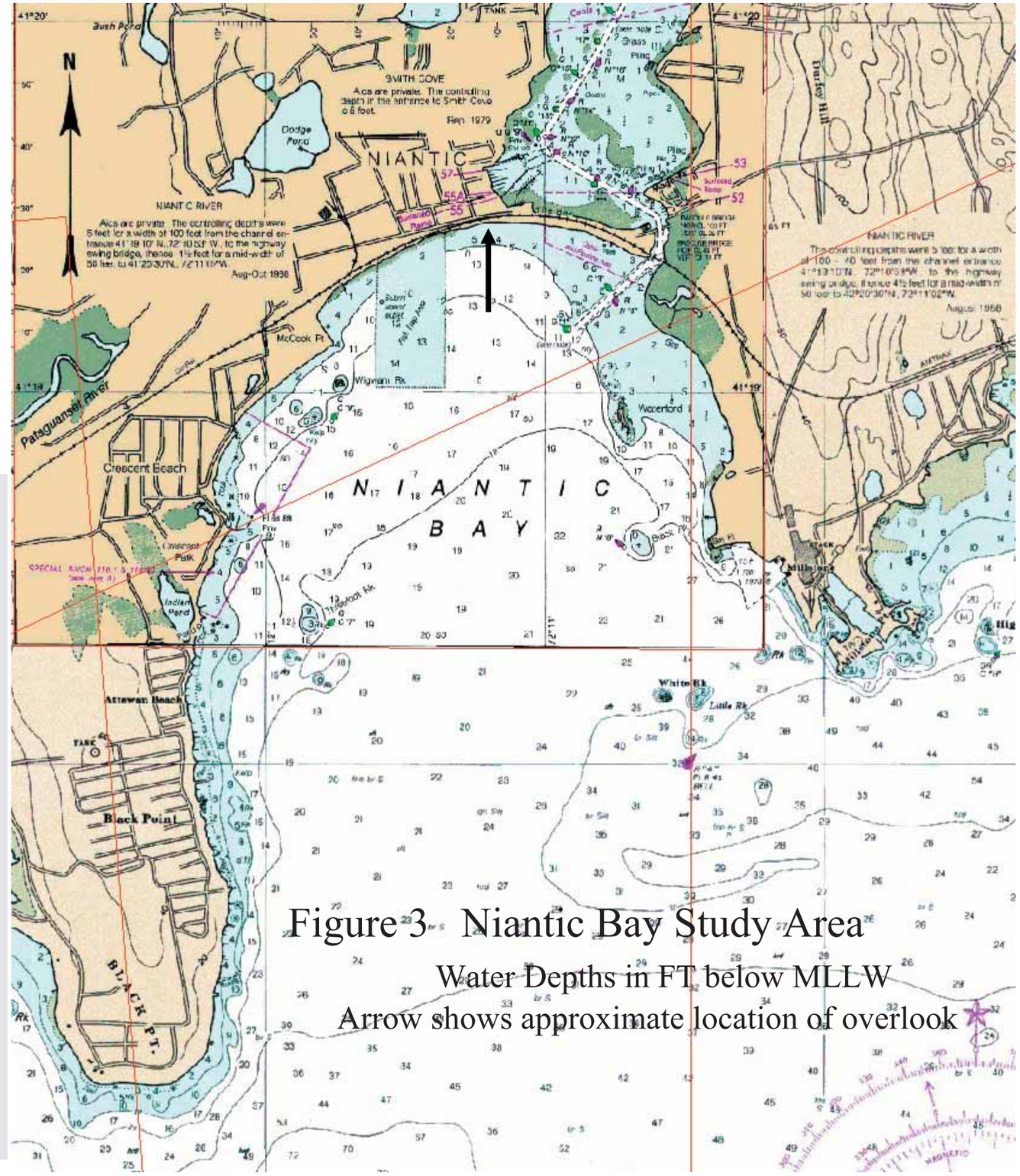


Figure 3 Niantic Bay Study Area
Water Depths in FT below MLLW
Arrow shows approximate location of overlook

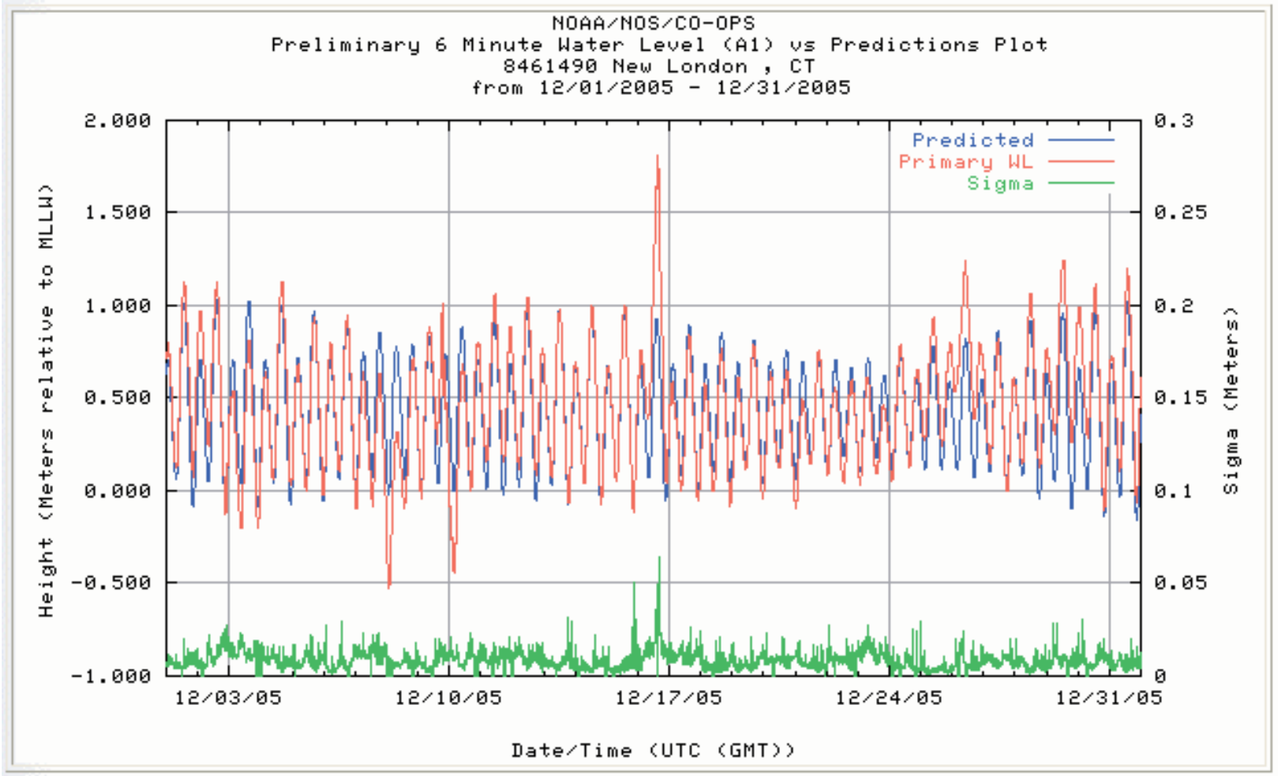


Figure 4 Tidal Elevations Predicted and Observed – New London Station – December, 2005
Note: Height in meters Time GMT

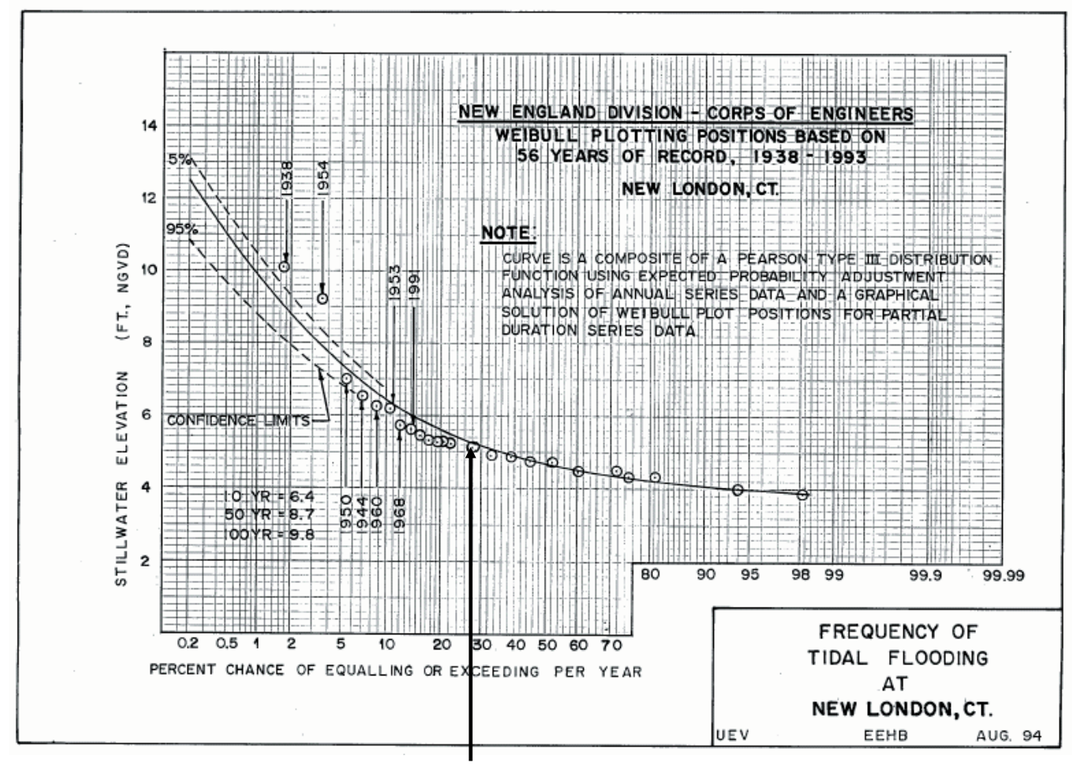


Figure 5 - Expected Recurrence Frequency – Tidal Heights – New London, Ct.
U.S. Army Corps of Engineers – Concord, Ma - File Data
Arrow indicates conditions associated with the event of December 16, 2005

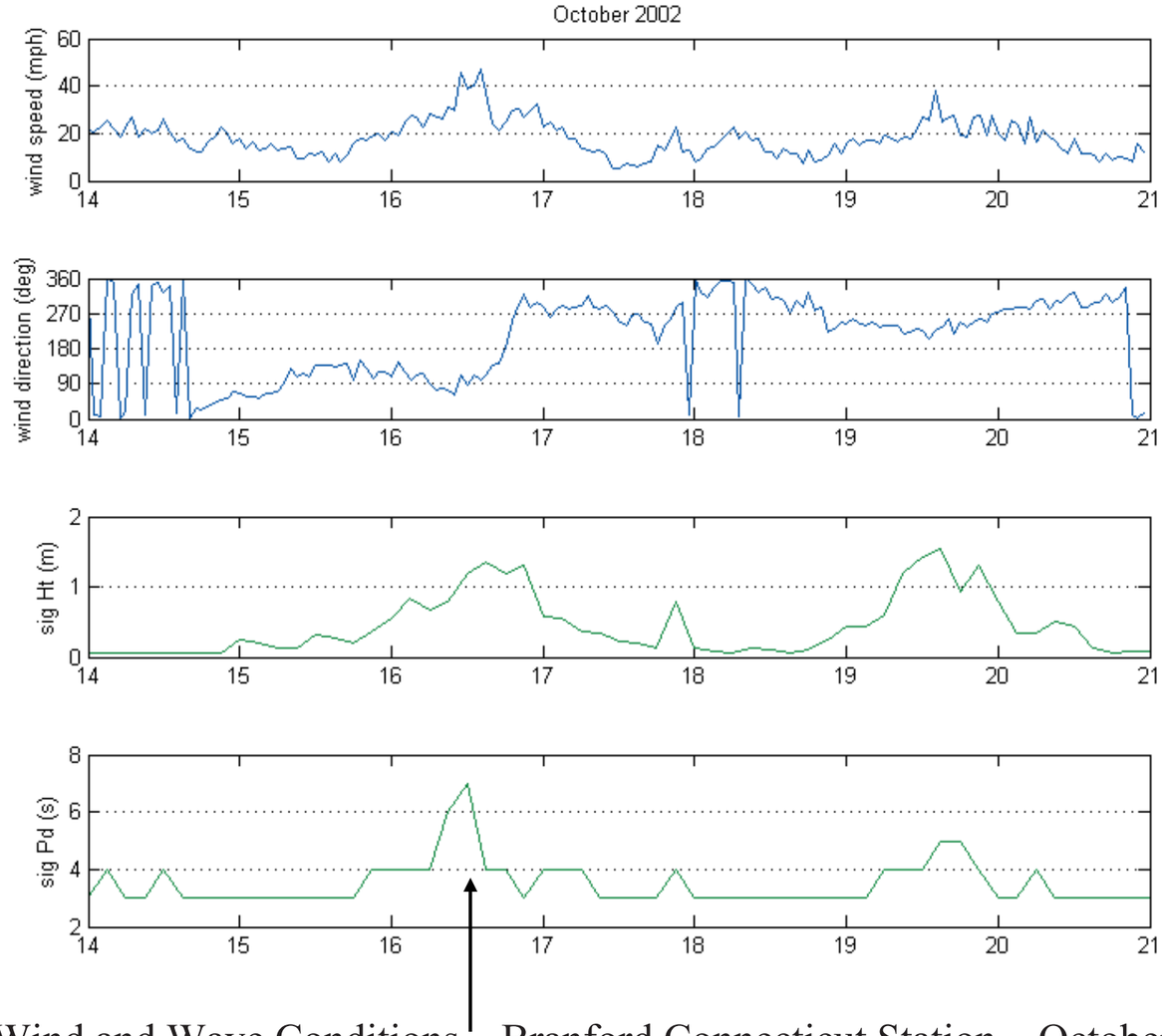


Figure 6 Wind and Wave Conditions – Branford Connecticut Station – October, 2002

Arrow shows waves produced by a system similar to the event of December 16, 2005

Meteorological Data from Central Long Island Sound Buoy – MYSOUND – Wave Height in Meters

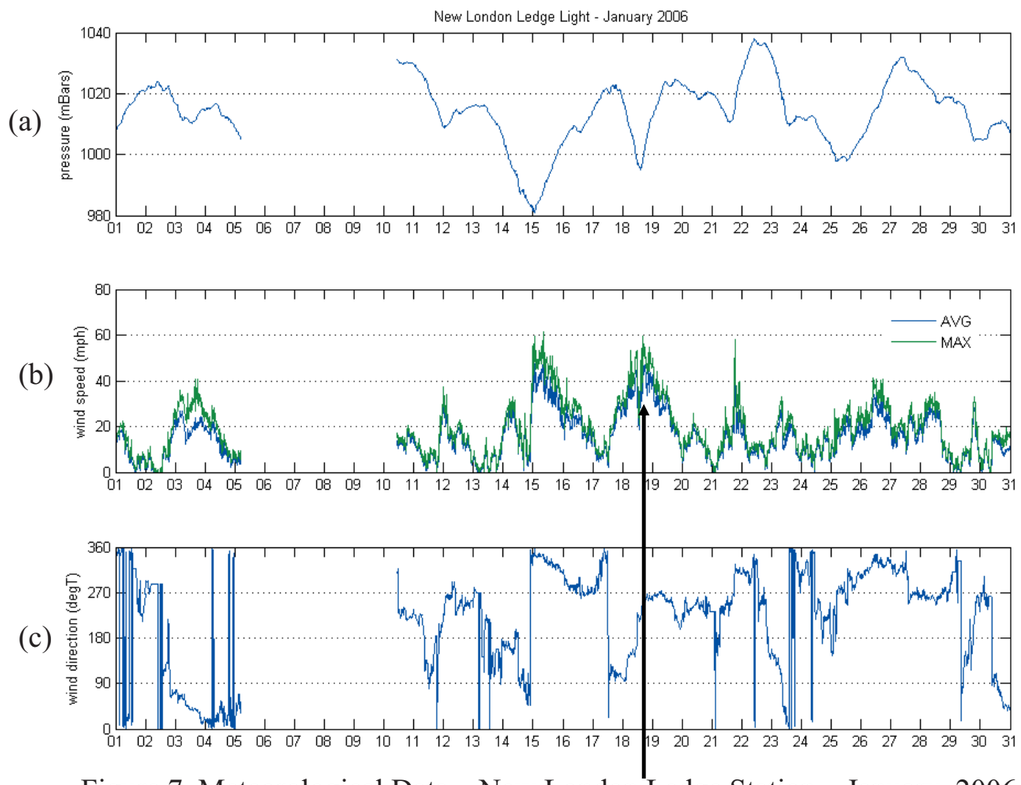


Figure 7 Meteorological Data – New London Ledge Station – January, 2006

(a) Barometric Pressure (b) Wind Speed (c) Wind Direction

Arrow Designates the Event of January 18, 2006

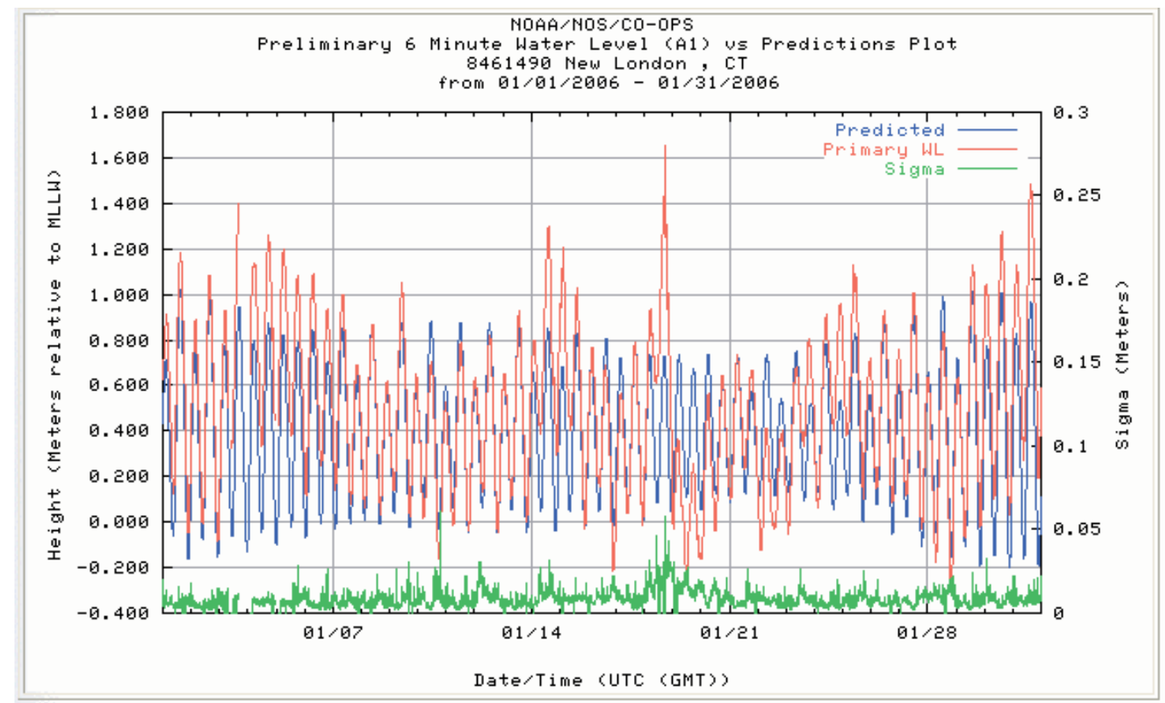


Figure 8 Tidal Elevations predicted and observed – New London Station – January, 2006

Note: Height in meters

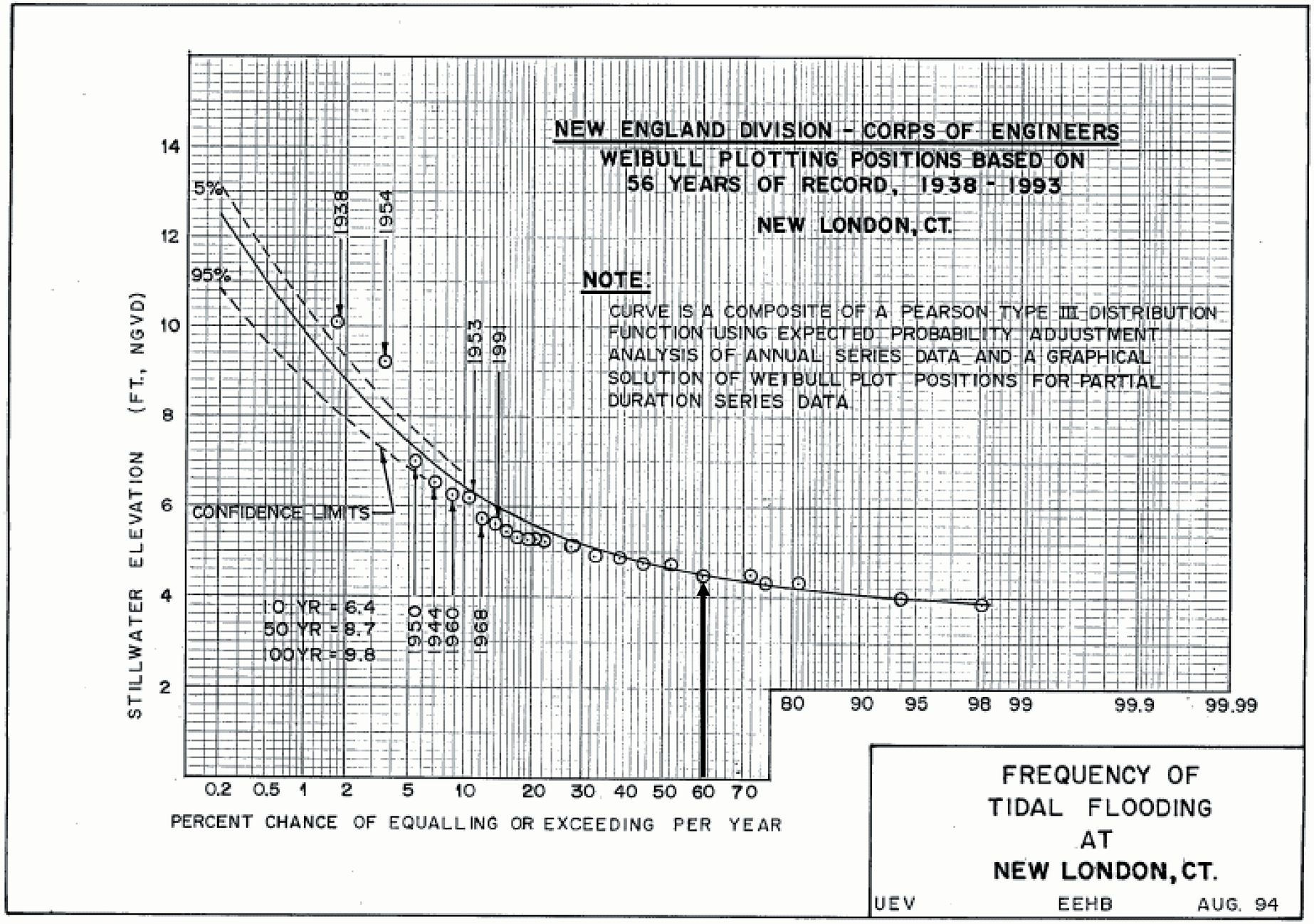


Figure 9 Expected Recurrence Frequency – Tidal Heights – New London, Ct.
U.S. Army Corps of Engineers – Concord, Ma. – File Data
Arrow indicates conditions associated with the event of January 18, 2006

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