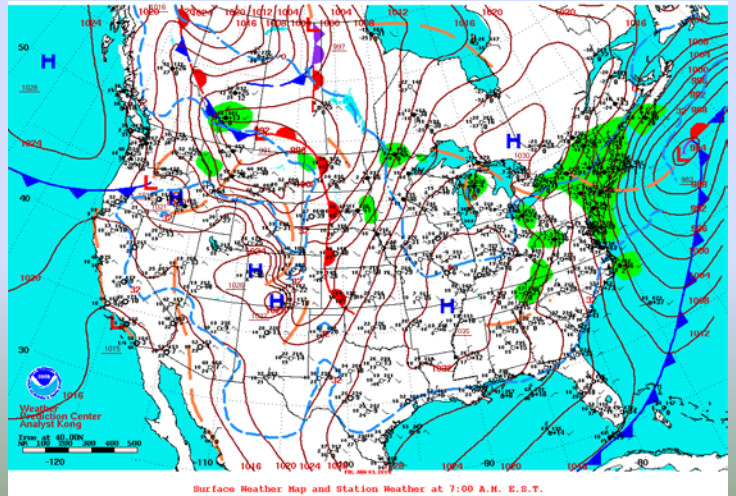
January 3, 2014 Coastal Flood Event

"Minor" to Locally "Moderate" Flooding

(Questions/Feedback: john.w.cannon@noaa.gov)

- Jan 3rd coastal event had much higher water and less wave action in most communities when compared to the December 15th storm
  - Nevertheless some splash-over was reported by the EMAs in all York County communities.
  - The exception was the NH Seacoast which reported more intense wave action with large, battering waves
- All Warnings verified with ample lead time due to the high water
  - In low end cases, "Coastal Flood Advisories" can be issued. However, this event was expected to be more significant over southernmost areas.



Storm begins to push offshore on the morning of January 3rd

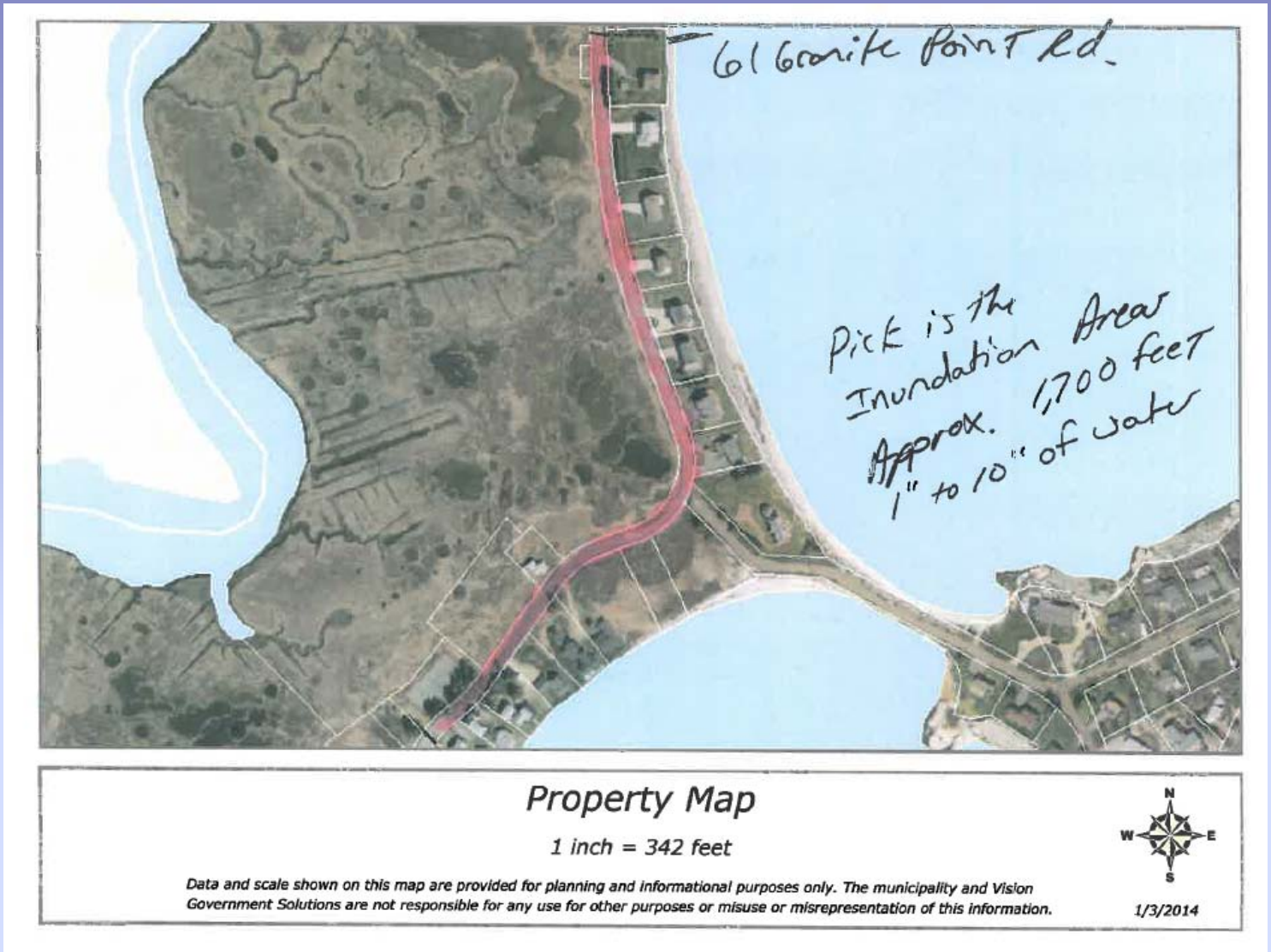
Examples of Inundation on January 3rd

Hobson Avenue

- Hampton Fire Chief reported (via text, email and telcons) up to a foot of water on the roads at high tide in real-time during the storm. The Chief took pictures and detailed records to better calibrate the new tide gage within the Hampton estuary.
- The onset of flooding matched up well with the newly developed flood stage of 11 feet (The tide topped out at 12.2 feet in Hampton with around a foot of water covering some of the roadways).

A side street in Hampton near high tide. Photo taken by Chief Silver.

This is our “new” coastal inundation “hot spot” on Granite Point Road as reported by Biddeford EMA Roby Fecteau in Real-time during the storm



- Roby provided this map showing up to 10” of water covering the road which was flooded for 1700’.
- For every inch of water the tide rises above its 12 foot flood stage in Portland…roughly almost an inch of water will inundate Granite Point Road in Biddeford.
- In Portland, people drove through a foot of rising waters in some cases.

Splash-over

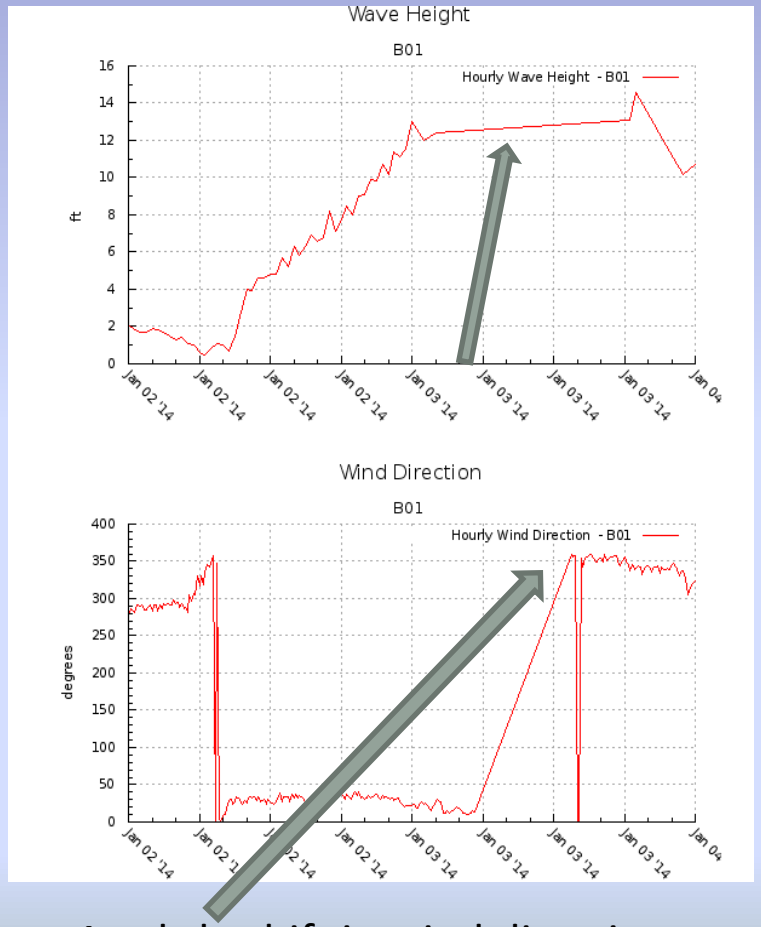
Heavy surf breaks over the seawall after a winter storm, Friday, Jan. 3, 2014, in Hampton, N.H.

Photograph by: Jim Cole, AP Photo

- This is the “infamous” Hampton Seawall designed to protest the community from large, battering waves. Waves splashed over the wall in this case leading to flooding of the main thoroughfare in town, Route 1A (Asheworth Avenue).
- Fire Chief Silver reported flooding waters surrounding local businesses up to a foot deep on Route 1A solely from the wave action (not from typical inundation).
- The location in this photo is one of the “Stockdon” splash-over and inundation prototype sites that were surveying last year (more information on “Stockdon” wave run-up will be provided in the future).

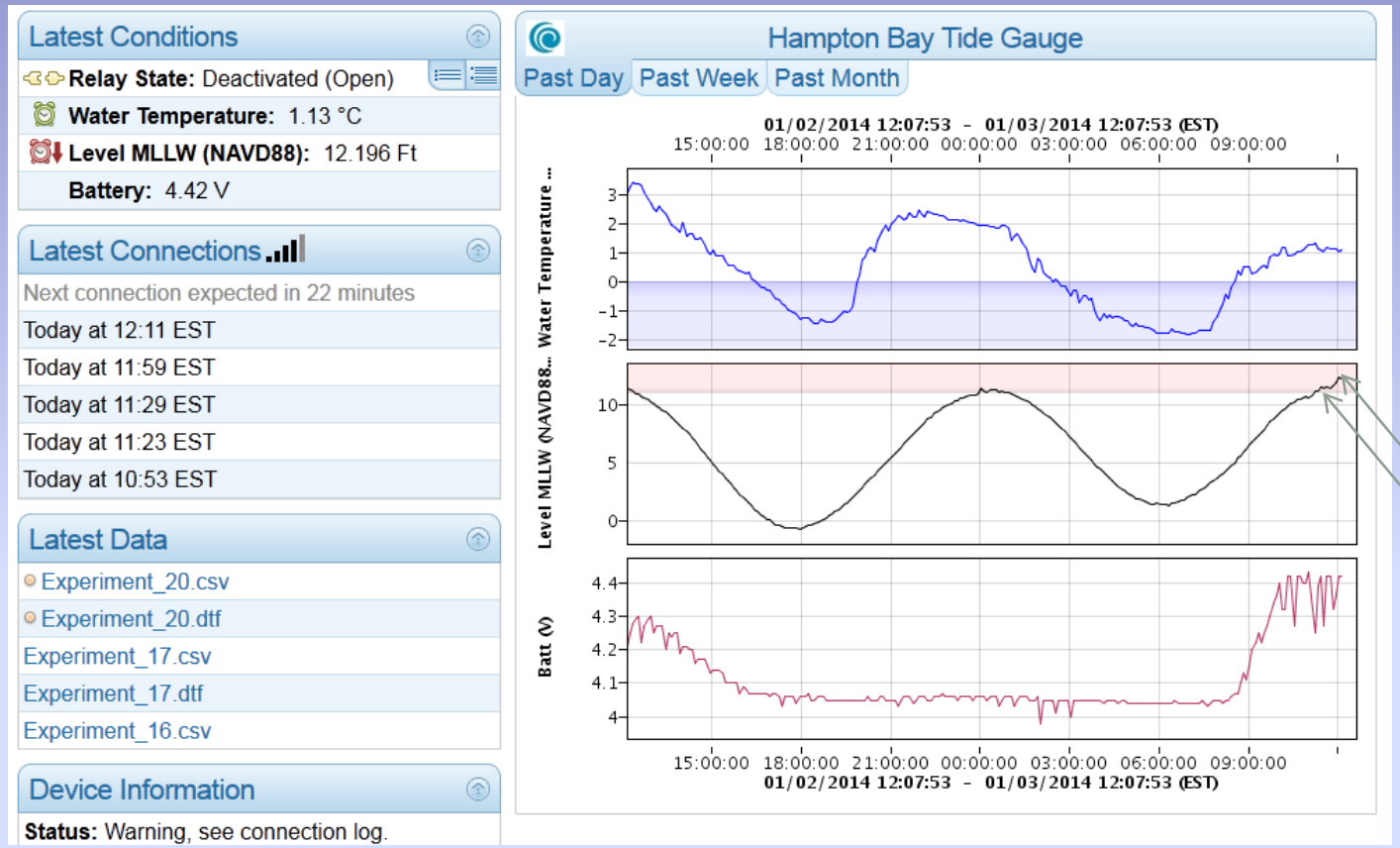
Waves and Wind Direction (Courtesy NERACOOS)

- Winds backed a little to the north prior to high tide
- Buoy data along the York County coastline will not be as useful when determining impact along the coast in this case as some of the wave energy is deflected further south toward WFO BOXs area
  - Again, the exception in this type of flow (due to the orientation of the shoreline) was the NH Seacoast
  - EMs stated “This would have been a particularly bad event if the winds had been onshore”.



A subtle shift in wind direction occurred near high tide

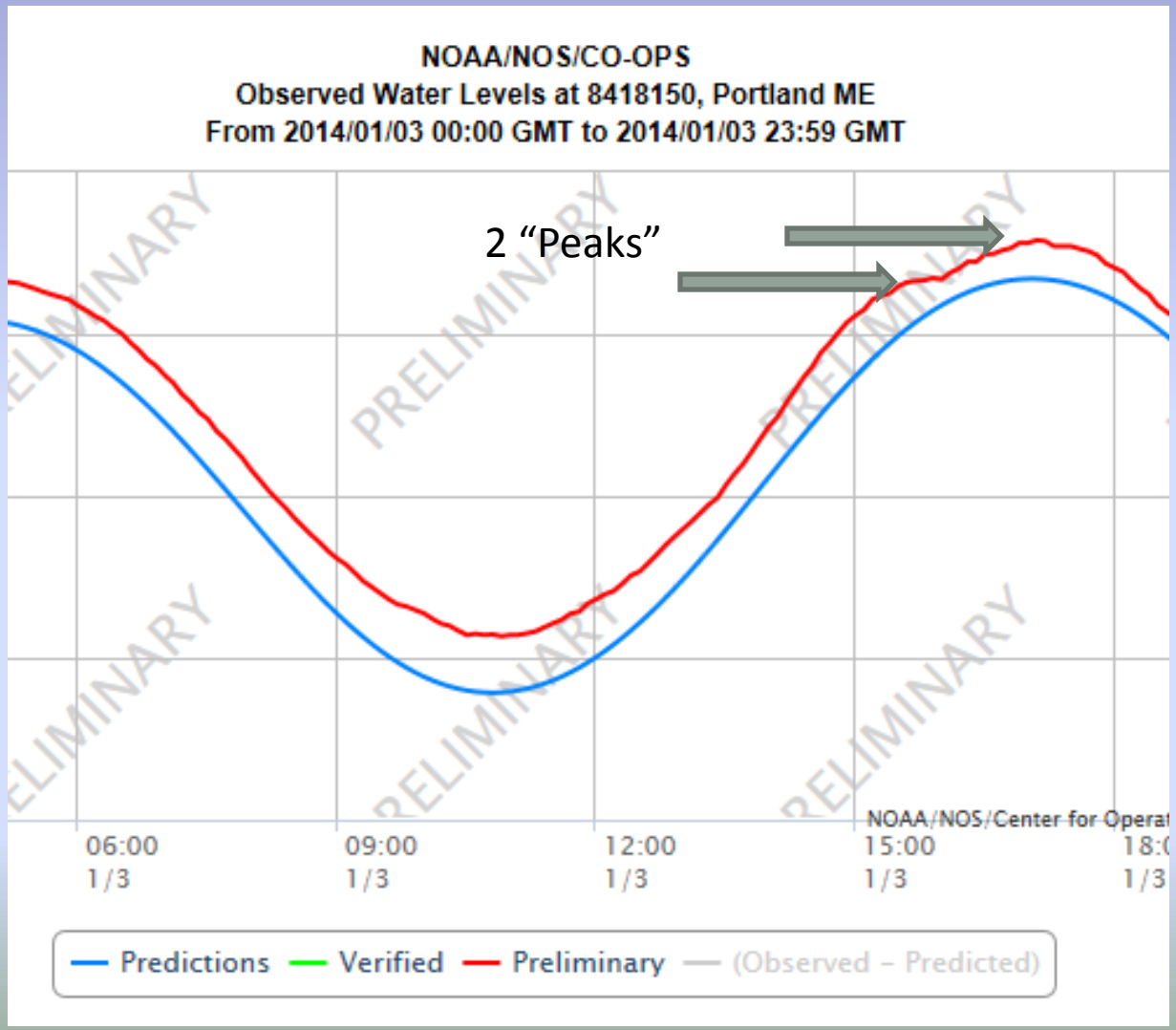
Hampton Tide Gage



Water level "Peaks" twice

- Fire Chief Silver (Hampton) reported the tide was "coming in…then going out". Then switched direction and began coming in for a second time causing "moderate" flooding in the region.
- This strange phenomenon was witnessed and confirmed through follow up correspondence with many other EMs along the coast.

A similar leveling off of the tide…then a second “surge” occurred in Portland



Ice Accretion Due to Splash-over (Saco)

- This is what happens when it is zero degrees and splash-over is occurring. Shown above are boulders covered in ice.

Structures were covered in ice throughout York County. In the background, an arctic looking gray slush covered the first hundred yards of the ocean

A home in Saco showing the artificial berm (Geotube) in front, designed to “protect” the property. Access to this (and other closed roads) courtesy Saco EMA.

2013 MAINE HARBOR MASTER'S ASSOCIATION CONTACT LIST updated April 3, 2013

Town Employed	Psn	Name	Mailing Address Town Office			Town Clerk	Work P	Cell P	Fax	e-mail
OFFICERS & BOARD MEMBERS 2013-14:										
Freeport - President	HM	Jay Pinkham	30 Main St.	Freeport	04032	865-4743	865-4546	751-4691	865-0929	frprthmstr@gmail.com
Bar Harbor-Vice Pres	HM	Charlie Phippen	1 Town Pier	Bar Harbor	04609	288-4098	288-5571	266-2110	288-1034	bhhmaster@barharbormaine.gov
Scarborough-Treasurer	HM	Dave Corbeau	246 US Rt 1	Scarborough	04074	883-4301	883-6361	671-2821	730-4251	dcorbe@ci.scarborough.me.us
Belfast - Secretary	HM	Katherine Pickering	131 Church St.	Belfast	04915	338-3370	338-1142		338-6222	harbormaster@cityofbelfast.org
Harpswell	HM	Jim Hays	PO Box 39	Harpswell	04079	833-5771	833-5771 x 105	751-9298		jhays@town.harpswell.me.us harbormaster@town.harpswell.me.us
Mount Desert	HM	Shawn Murphy	PO Box 237	NE Harbor	04662	276-5531	276-5737		276-5741	harbormaster@mtdesert.org
Rockland	HM	Ed Glaser	270 Pleasant St.	Rockland	04841	594-0312	594-0312	691-1952		eglaser@ci.rockland.me.us
Searsport	HM	Wayne Hamilton	PO Box 62	Searsport	04974	548-2300	548-2722	323-0895	548-0483	cilow ay@aol.com whamilton@hamiltonmarine.com
St George/Port Clyde	HM	Dave Schmanska	PO Box 131	Tenants Harbor	04860	372-6363	372-6363			hbrmstr@stgeorgemaine.com
Portland	HM	Jeff Lilick	2 Portland Fish Pier, Suite 102	Portland	04101		772-8121	807-7156	772-2367	phm@maine.rr.com
Wells	HM	Chris Mayo	PO Box 398	Wells	04090	646-2882	646-3236	251-1987		cmayo@wellstown.org
Naples	AHM	Shawn R Hebert	PO Box 1757		04055			615-8445		shebert@ci.scarborough.me.us
MEMBERS:										
Addison	HM	Irvin Pinkham	PO Box 142	Addison	04606		483-4678	598-8068		butch6167@yahoo.com
Addison	HM	Oscar Look	PO Box 142	Addison	04606					
Addison	HM	Tony Graham	PO Box 142	Addison	04606					
Addison	HM	Ty Batson	PO Box 142	Addison	04606					
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Bangor	HM	Gerald Ledwith	73 Harlow St.	Bangor	04401	992-4490	947-5251			hmaster1@msn.com
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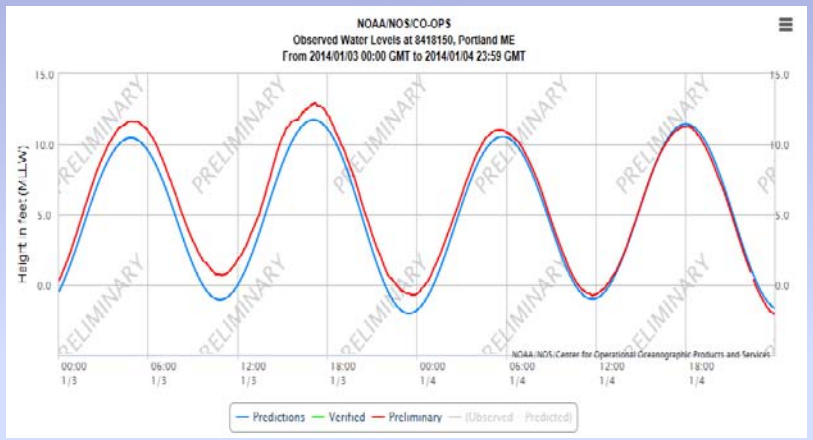
Bath	HM	Nathan Gould	250 Water St.	Bath	04530		443-5563	751-5071	443-8343	ngould@cityofbath.com
Bath	HM	Jeff Shiers	250 Water St.	Bath	04530	443-5563		837-8048		jshiers@cityofbath.com
Bath	AHM	Dan Couture	250 Water St.	Bath	04530			522-2027		dcouture@cityofbath.com
Beals	HM	Eugene Smith	PO Box 189	Beals	04611					
Belfast	HM	Katherine Pickering	131 Church St.	Belfast	04915	338-3370	338-1142		338-6222	harbormaster@cityofbelfast.org
Belfast	AHM	Howard Whitcomb	131 Church St.	Belfast	04915		338-1142		338-6222	
Biddeford	HM	Marshall Alexander	205 Main St.	Biddeford	04005	284-9307	282-3479	467-5137	284-4337	
Biddeford	AHM	Paul Lariviere	205 Main St.	Biddeford	04005		283-1099	468-1865	284-8703	paul@southernmainemarine.com

- One of the outcomes from this storm came from correspondence with the Knox County EMA Director (Ray Sisk). Ray sent a spread sheet with about 200 Harbormasters in Maine for future coastal inundation/splash-over reports. I'll create an email distribution list in gmail for future verification purposes.

Verification By the numbers

- 3 Warnings Issued (Cumberland, York and Rockingham)
- POD = 1.00
- FAR = 0.00
- CSI = 1.00
- ALT = 1339 minutes (~22hours)



* Portland Harbor Storm surge = 1.20' + ***a very high astronomical tide*** 11.71' at 1206 pm yielded a Storm Tide = 12.91', Seas only 8' every 9 sec at high tide at buoy "B" off York County, however seas ran 18 feet every 11 sec at 44098. Time above flood stage (in PWM) 108 mins, warnings issued 140 pm Jan 2nd for Cumberland County and points south]

* Coastal Flood Watches were issued two days in advance.

Hindcast for Hampton

- Seas were about 18 feet at the time of high tide at NERACOOS Buoy "B" (Best buoy to use in a NE flow for coastal York County)
- Water level in Hampton reached ~ 12.2 feet (NAVD88)
- Matrix below would imply a "moderate" impact event in Hampton in terms of "Splash-over" and/or "Inundation"
- Moderate impact was highlighted in our warnings

"Output" Assuming a 12.2' (Hampton) tide and 18' waves "upstream" at Buoy "B"

Hampton Coastal Flooding and Splash-over Forecast Matrix

Forecast Wave Height (Ft) (Buoy "B")

Forecast Storm Tide (Ft) (NAVD88, Hampton, NH)

FS ~ 10.75+ ft

	0	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0	27.5	30.0	32.5
14.25	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj
14.00	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj
13.75	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj
13.50	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj
13.25	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj	Mj
13.00	Md	Md	Md	Md	Md	Md	Md	Md	Mj	Mj	Mj	Mj	Mj	Mj
12.75	Md	Md	Md	Md	Md	Md	Md	Md	Md	Mj	Mj	Mj	Mj	Mj
12.50	Md	Md	Md	Md	Md	Md	Md	Md	Md	Md	Mj	Mj	Mj	Mj
								Md	Md	Md	Md	Mj	Mj	Mj
12.00	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Md	Md	Md	Md	Mj	Mj	Mj
11.75	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Md	Md	Md	Md	Md	Mj
11.50	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Md	Md	Md	Md	Md	Mj
11.25	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Md	Md	Md	Md	Md
11.00	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Md	Md	Md	Md	Md
10.75	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Mi	Md	Md	Md	Md
10.50	Ac	Ac	Ac	Ac	Ac	Ac	Ac	Mi	Mi	Mi	Mi	Md	Md	Md
10.25	Ac	Ac	Ac	Ac	Ac	Ac	Ac	Ac	Mi	Mi	Mi	Mi	Md	Md
10.00	-	-	-	-	-	-	-	Ac	Ac	Mi	Mi	Mi	Mi	Md
9.75	-	-	-	-	-	-	-	-	Ac	Ac	Mi	Mi	Mi	Mi
9.50	-	-	-	-	-	-	-	-	-	Ac	Ac	Mi	Mi	Mi
9.25	-	-	-	-	-	-	-	-	-	-	Ac	Ac	Mi	Mi
9.00	-	-	-	-	-	-	-	-	-	-	-	Ac	Ac	Mi
8.75	-	-	-	-	-	-	-	-	-	-	-	-	Ac	Ac
8.50	-	-	-	-	-	-	-	-	-	-	-	-	-	Ac
8.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Statement Not Req/Optional
Issue Coastal Flood Advisory
Issue Coastal Flood Warning

Ac = Action stage. High water levels or wave action with limited or unknown impact.
Mi = Minor coastal flooding or splash-over along several roads and basements
Md = Moderate coastal flooding or significant splash-over along numerous roadways. Isolated structural damage.
Mj = Major coastal flooding with widespread flooding of vulnerable roadways. A few homes severely damaged

How do we define minor versus. moderate flooding (or impact)??

Minor Coastal Flooding – Flooding of the most vulnerable shore roads and/or basements due to height of storm tide or wave splash-over. Majority of roads remain passable with only isolated closures. There is no significant threat to life and any impact on property is minimal. This type of event is covered by a **Coastal Flood Advisory.**

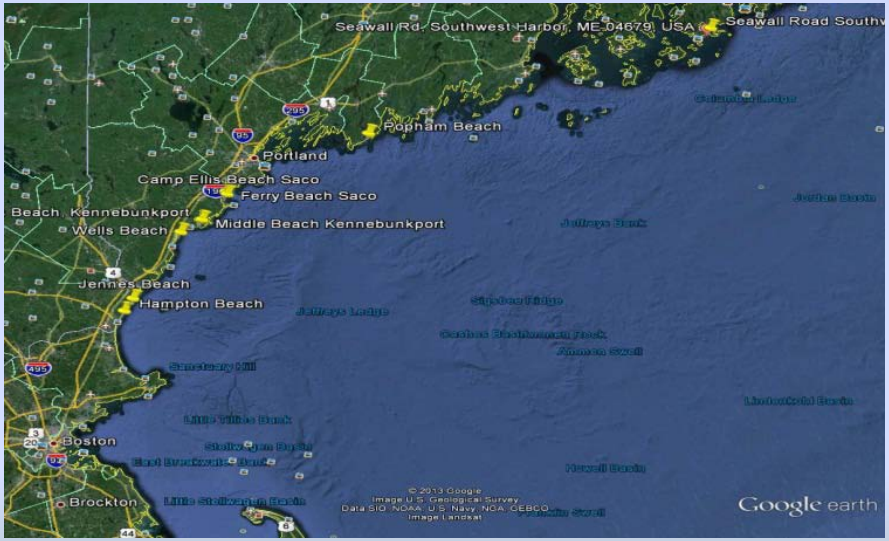
Moderate Coastal Flooding – Widespread flooding of vulnerable shore roads and/or basements due to height of storm tide and/or wave action. Numerous road closures are needed. Lives may be at risk for people who put themselves in harm's way. Isolated damage of very vulnerable structures such as docks or house decks/porches near the high tide line may be observed. This type of event is covered by a **Coastal Flood Warning.**

Major Coastal Flooding – Coastal flooding severe enough to cause *at least* scattered structural damage along with widespread flooding of vulnerable shore roads and/or basements. Some vulnerable homes or businesses are severely damaged or destroyed. Numerous roads are impassable, some with washouts severe enough to be life threatening if one attempted to cross on foot or by vehicle. Some neighborhoods are isolated. Evacuation of some neighborhoods is necessary. This type of event is covered by a **Coastal Flood Warning** with additional language to indicate that the flooding will be major, severe, destructive, damaging, etc.

(B. Thompson ERTA 2011-02)

Stockdon Equation Output for Hard Hit NH Seacoast (Jennes Beach)

- We are still testing empirical equations which forecast whether you will have erosion, overwash or inundation within a storm at many “hot spot” locations
- The technique forecasted erosion, Overwash and flooding for Jennes Beach which is near Hampton



Stockdon Survey Locations

Output

Stockdon_Runup_for_Jennes_Beach.xlsx

	A	B	C	D	E	F	G
1							
2		Input parameters (green only)			Feet	Meters	
3		Beach Slope			0.03		
4		Deep water wave height			13.00	3.96	
5		Deep water wave length			414.70	126.40	
6		Deep water wave period			9.00		
7		Tide			11.71	3.57	
8		Storm Surge			1.20	0.00	
9		Dune Base Elevation			11.10	3.38	
10		Dune Crest Elevation			13.57	4.14	
11							
12		These are the individual output parameters		$R_{2\%}$	3.56	1.08	
13				Swash	2.71	0.83	
14				Setup	0.85	0.26	
15							
16							
17					Include Tide + Surge		
18				R_{low}	12.56	3.83	
19				R_{high}	15.27	4.65	
20				$R_{2\%}$	3.559	1.08	
21				Erosion	Expected		
22				Overwash	Expected		
23				Inundation	Not Expect		
24							
25							

Stockdon Wave Run-up

Stockdon_Runup_for_Jennes_Beach.xlsx

Input parameters (green only)	Feet	Meters
Beach Slope	0.03	
Deep water wave height	13.00	3.96
Deep water wave length	414.70	126.40
Deep water wave period	9.00	
Tide	11.71	3.57
Storm Surge	1.20	0.00
Dune Base Elevation	11.10	3.38
Dune Crest Elevation	13.57	4.14

These are the individual output parameters	$R_{2\%}$	3.56	1.08
	Swash	2.71	0.83
	Setup	0.85	0.26

Include Tide + Surge		
R_{low}	12.56	3.83
R_{high}	15.27	4.65
$R_{2\%}$	3.559	1.08
Erosion	Expected	
Overwash	Expected	
Inundation	Not Expect	

Stockdon_Runup_for_Ferry_Beach.xlsx

Input parameters (green only)	Feet	Meters
Beach Slope	0.08	
Deep water wave height	9.00	2.74
Deep water wave length	414.70	126.40
Deep water wave period	9.00	
Tide	11.71	3.57
Storm Surge	1.3	0.40
Dune Base Elevation	11.50	3.51
Dune Crest Elevation	18.05	5.50

These are the individual output parameters	$R_{2\%}$	4.81	1.47
	Swash	2.93	0.89
	Setup	1.88	0.57

Include Tide + Surge		
R_{low}	14.89	4.54
R_{high}	17.82	5.43
$R_{2\%}$	4.812	1.47
Erosion	Expected	
Overwash	Not Expect	
Inundation	Not Expect	

Stockdon_Runup_for_Camp_Ellis_Beach.xlsx

Input parameters (green only)	Feet	Meters
Beach Slope	0.11	
Deep water wave height	9.00	2.74
Deep water wave length	414.70	126.40
Deep water wave period	9.00	
Tide	11.71	3.57
Storm Surge	1.3	0.00
Dune Base Elevation	12.00	3.66
Dune Crest Elevation	17.03	5.19

These are the individual output parameters	$R_{2\%}$	6.12	1.87
	Swash	3.51	1.07
	Setup	2.61	0.80

Include Tide + Surge		
R_{low}	14.32	4.36
R_{high}	17.83	5.44
$R_{2\%}$	6.125	1.87
Erosion	Expected	
Overwash	Expected	
Inundation	Not Expect	

Stockdon_Runup_for_Popham_Beach.xlsx

Input parameters (green only)	Feet	Meters
Beach Slope	0.07	
Deep water wave height	7.00	2.13
Deep water wave length	414.70	126.40
Deep water wave period	9.00	
Tide	11.71	3.57
Storm Surge	1.2	0.37
Dune Base Elevation	15.09	4.60
Dune Crest Elevation	22.69	6.92

These are the individual output parameters	$R_{2\%}$	3.89	1.19
	Swash	2.44	0.74
	Setup	1.45	0.44

Include Tide + Surge		
R_{low}	14.36	4.38
R_{high}	16.80	5.12
$R_{2\%}$	3.888	1.19
Erosion	Expected	
Overwash	Not Expect	
Inundation	Not Expect	

Stockdon Equations…

- Accurately predicted Erosion and Overwash at Several Locations!!!!
- Had issues with over-forecasting inundation at Wells and Middle Beach
- Did not forecast “overwash” in Hampton

Stockdon_Runup_for_Fortunes_Rocks_Beach.xlsx

Input parameters (green only)	Feet	Meters
Beach Slope	0.06	
Deep water wave height	9.00	2.74
Deep water wave length	414.70	126.40
Deep water wave period	9.00	
Tide	11.71	3.57
Storm Surge	1.3	0.00
Dune Base Elevation	15.31	4.67
Dune Crest Elevation	20.36	6.21

These are the individual output parameters			
	$R_{2\%}$	3.83	1.17
	Swash	2.54	0.77
	Setup	1.29	0.39

Include Tide + Surge		
R_{low}	13.00	3.96
R_{high}	15.54	4.74
$R_{2\%}$	3.831	1.17
Erosion	Expected	
Overwash	Not Expect	
Inundation	Not Expect	

Stockdon_Runup_for_Long_Beach.xlsx

Input parameters (green only)	Feet	Meters
Beach Slope	0.06	
Deep water wave height	10.00	3.05
Deep water wave length	414.70	126.40
Deep water wave period	9.00	
Tide	11.71	3.57
Storm Surge	1.4	0.00
Dune Base Elevation	13.32	4.06
Dune Crest Elevation	18.91	5.76

These are the individual output parameters			
	$R_{2\%}$	4.24	1.29
	Swash	2.75	0.84
	Setup	1.49	0.45

Include Tide + Surge		
R_{low}	13.20	4.02
R_{high}	15.95	4.86
$R_{2\%}$	4.237	1.29
Erosion	Expected	
Overwash	Not Expect	
Inundation	Not Expect	

Stockdon_Runup_for_Wells_Beach.xlsx

Input parameters (green only)	Feet	Meters
Beach Slope	0.38	
Deep water wave height	10.00	3.05
Deep water wave length	414.70	126.40
Deep water wave period	9.00	
Tide	11.71	3.57
Storm Surge	1.4	0.00
Dune Base Elevation	6.71	2.05
Dune Crest Elevation	18.81	5.73

These are the individual output parameters			
	$R_{2\%}$	19.77	6.02
	Swash	10.34	3.15
	Setup	9.42	2.87

Include Tide + Surge		
R_{low}	21.13	6.44
R_{high}	31.48	9.59
$R_{2\%}$	19.766	6.02
Erosion	Expected	
Overwash	Expected	
Inundation	Expected	

Overforecast

Stockdon_Runup_for_Middle_Beach.xlsx

Input parameters (green only)	Feet	Meters
Beach Slope	0.50	
Deep water wave height	9.00	2.74
Deep water wave length	414.70	126.40
Deep water wave period	9.00	
Tide	11.71	3.57
Storm Surge	1.4	0.00
Dune Base Elevation	5.55	1.69
Dune Crest Elevation	18.64	5.68

These are the individual output parameters			
	$R_{2\%}$	24.54	7.48
	Swash	12.78	3.90
	Setup	11.76	3.58

Include Tide + Surge		
R_{low}	23.47	7.15
R_{high}	36.25	11.05
$R_{2\%}$	24.544	7.48
Erosion	Expected	
Overwash	Expected	
Inundation	Expected	

Overforecast

Stockdon_Runup_for_Gooches_Beach.xlsx

Input parameters (green only)	Feet	Meters
Beach Slope	0.05	
Deep water wave height	9.00	2.74
Deep water wave length	414.70	126.40
Deep water wave period	9.00	
Tide	11.71	3.57
Storm Surge	1.4	0.00
Dune Base Elevation	13.61	4.15
Dune Crest Elevation	15.90	4.85

These are the individual output parameters			
	$R_{2\%}$	3.65	1.11
	Swash	2.47	0.75
	Setup	1.18	0.36

Include Tide + Surge		
R_{low}	12.89	3.93
R_{high}	15.36	4.68
$R_{2\%}$	3.647	1.11
Erosion	Expected	
Overwash	Not Expect	
Inundation	Not Expect	

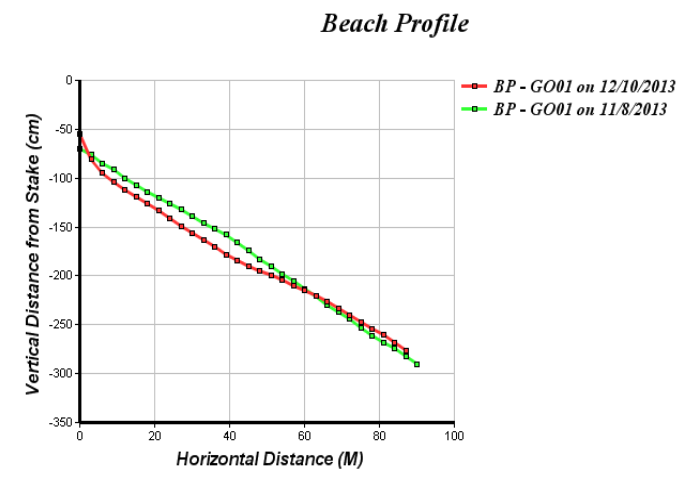
Stockdon_Runup_for_Hampton_Beach.xlsx

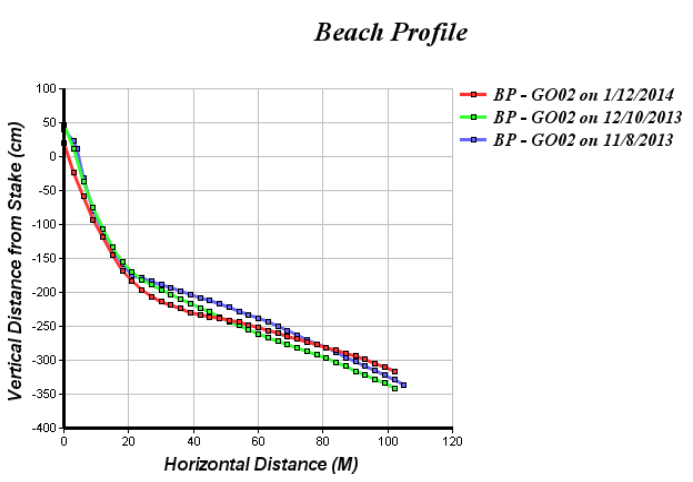
Input parameters (green only)	Feet	Meters
Beach Slope	0.08	
Deep water wave height	12.00	3.66
Deep water wave length	414.70	126.40
Deep water wave period	9.00	
Tide	11.71	3.57
Storm Surge	1.7	0.00
Dune Base Elevation	12.77	3.89
Dune Crest Elevation	20.77	6.33

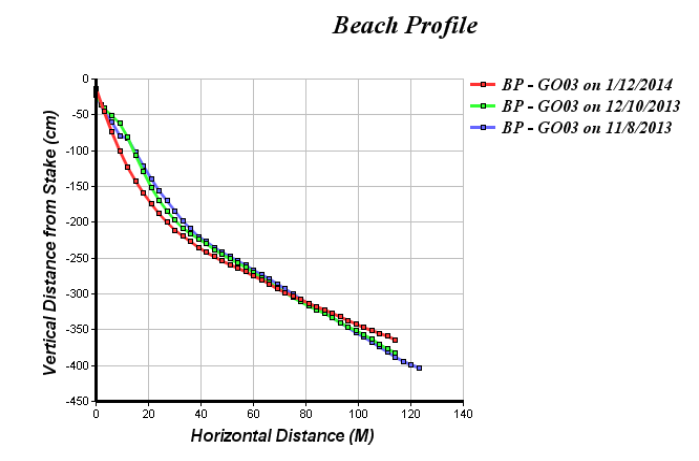
These are the individual output parameters			
	$R_{2\%}$	5.56	1.69
	Swash	3.38	1.03
	Setup	2.17	0.66

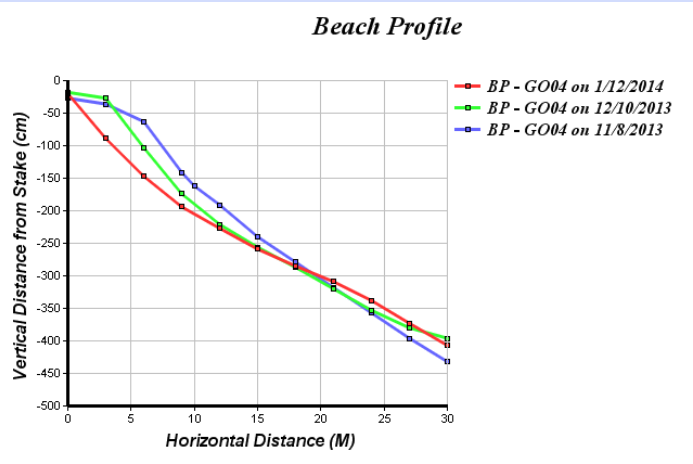
Include Tide + Surge		
R_{low}	13.88	4.23
R_{high}	17.27	5.26
$R_{2\%}$	5.556	1.69
Erosion	Expected	
Overwash	Not Expect	
Inundation	Not Expect	

“Verifying” Stockdon Erosion Forecasts in York County with Actual Dune Measurements (Beach Profiles)









* Some beach erosion and splash-over was reported by the EMs (and the Stockdon Wave Runup Equations) throughout Coastal York County. Minor erosion was confirmed using the longer temporal monthly beach profiles from Gooches Beach.

Thanks again to all the reports from the EMs, Beach Profilers, Police and Fire/Rescue in ME

January 4th, 2014

Hobson Ave on a Sunny Day

December 3rd, 2009

NWS Gray

- Operations: 207-688-3216
- Send Reports to: gyx.skywarn@noaa.gov
- WEB site: http://www.erh.noaa.gov/gyx/
- Facebook: http://www.facebook.com/US.NationalWeatherService.Gray.gov
- Twitter: @nwsgray