Appendix

A - Acronyms

CZA – Coastal Zone Act

DFS – Delaware Forestry Service

DNREC – Delaware Department of Natural Resources and Environmental Control

DCP – Delaware Coastal Programs

DelDOT – Delaware Department of Transportation

DRBC – Delaware River Basin Commission

DSWA – Delaware Solid Waste Authority

EPA – United States Environmental Protection Agency

FEMA – Federal Emergency Management Agency

GIS – Geographic Information Systems

HCC – Habitats of Conservation Concern

HSIP – Homeland Security Infrastructure Protection

IMPLAN – Impacts Analysis for Planning

IPCC – Intergovernmental Panel on Climate Change

LiDAR – Light Detection and Ranging

LMSL – Local Mean Sea Level

LUST – Leaking Underground Storage Tank

MHHW – Mean Higher High Water

NFIP – National Flood Insurance Program

NOAA – National Oceanic and Atmospheric Administration

NWR – National Wildlife Refuge

PDE – Partnership for the Delaware Estuary

SIRS – Site Investigation & Remediation Section

SLAMM – Sea Level Affecting Mashes Model

SLR – Sea Level Rise

SLRAC – Sea Level Rise Advisory Committee

SoVI – Social Vulnerability Index

UD – University of Delaware

USDA – United States Department of Agriculture

USFWS – United States Fish & Wildlife Service

USGS – United States Geologic Survey

UST – Underground Storage Tank

WILMAPCO – Wilmington Planning Area Council

B - Glossary

Adaptation – An action that can be taken to adjust to new or emerging conditions. With respect to sea level rise, adaptation can include a variety of actions including raising structures, building sea walls, restoring natural areas, relocating structures and avoiding investments in high risk areas.

Anadromous Fish – A fish species that is born in fresh water, spends most of its life in the ocean, and returns to fresh water to spawn. Examples would be salmon, striped bas, and sturgeon.

Bathtub Model – A water surface model that floods all land below a certain elevation, unless there is a structure that would block the tidal flow.

Biodiversity – The number and variety of organisms found within a specified geographic region.

Brownfield – Any vacant, abandoned, or underutilized real property the development or redevelopment of which is hindered by the reasonably held belief that the property may be environmentally contaminated.

Chronic – Persisting for a long time or constantly recurring.

Coastal Impoundment – A topographic depression, excavation, or diked area, primarily formed from earthen materials and designed to hold accumulated water and provide storm water control.

Conservation Easement – Legal agreement between a landowner and a land trust (or other organization) which places protective environmental restrictions on the property.

Corrosion – The gradual destruction of a material, usually metal, by a chemical reaction with the surrounding environment.

Domestic Well – A privately owned well that supplies groundwater for human consumption and other household uses.

Effluent – Liquid waste or sewage discharged into surface water or groundwater.

Environmental Justice – The fair treatment and meaningful involvement of people from all races, cultures, and incomes regarding the development of environmental laws, regulations, and policies.

Estuary – A partly enclosed coastal body of water with one or more rivers or streams flowing into it with a free connection to the open sea. Estuaries form a transition zone between river environments and ocean environments and are subject to both marine influences and riverine influences.

Eustatic Sea Level Rate – The worldwide change of sea level elevation with time. The changes are due to such causes as glacial melting or formation, thermal expansion or contraction of sea water, etc.

Exposure – Refers to the presence of people, livelihoods, environmental resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected by sea level rise and which, thereby, are subject to potential future harm, loss, or damage.

Farmland of Statewide Importance – Land other than prime farmland with a good combination of physical and chemical characteristics for crop production.

B - Glossary

Feeder Road – A secondary road used to bring traffic to a major road or highway.

Functionality – Determines whether a resource can continue to meet its intended purpose.

Future Development Areas – Lands within the long-term growth plans (greater than five years) of county and municipal governments and/or are adjacent to already developed or developing areas.

Geographic Information System – A system of hardware and software used for the storage, retrieval, mapping, and analysis of geographic data.

Geomorphology – The scientific study of landforms and the processes that shape them.

Groundwater Recharge Area – The area where an aquifer is replenished from natural processes, such as the infiltration of rainfall and snowmelt or from human interventions, such as the use of storm water management systems.

Habitats of Conservation Concern – Types of environments (habitats) identified in the Delaware Wildlife Action Plan that are rare, sensitive to disturbance, have a high density of rare plants, or have special significance to the state.

Hydraulic – denoting a liquid moving in a confined space under pressure.

Hydrogeology/ Hydrogeological – Branch of geology that deals with the occurrence, distribution, and effect of groundwater.

Hydrology/Hydrological – Properties, distribution, and effects of water on the earth's surface, in the soil, and the atmosphere.

Local Mean Sea Level – The height of the ocean relative to land, measured hourly and averaged over a nineteen year period known as the National Tidal Datum Epoch.

Intermittent – Occurring at irregular intervals.

Inundation – Movement of coastal water over land as a result of sea level rise.

LiDAR (Light Detection and Ranging) – An optical remote sensing technology that can measure the distance to, or other properties of a target by illuminating the target with light, often using pulses from a laser.

Land Subsidence – The lowering of a portion of the earth's crust.

Mean Higher High Water – The long-term average of the higher of the daily high tides.

Mean Sea Level – The average level of the sea observed over a period of time and referenced to a water or land elevation benchmark. Tide gauges are frequently used to measure sea level.

Non-point Source Pollution – Pollution source that is not fixed or specific. Instead the source is mobile or widely scattered.

Preservation District – A voluntary agreement to use land only for agricultural purposes for at least a ten year period.

Prime Farmland – Land with the optimal combination of physical and chemical characteristics for crop production.

Public Well – A privately or publicly owned well that provides water to a public water system including: (1) community water systems, such as municipalities, mobile home parks, or nursing homes; (2) transient non-community water systems, such as campgrounds, motels, and gasoline stations; and (3) non-transient, non-community systems, such as schools, factories, and hospitals.

Remediation - The removal of pollution or contaminants from environmental media such as soil, groundwater, sediment, or surface water for the general protection of human health and the environment.

Saltwater Intrusion – Occurs in coastal freshwater aquifers when the different densities of both the saltwater and freshwater allow the ocean water to intrude into the freshwater aquifer due to its greater density.

Sea Level – The level of the sea after averaging out short-term variations due to wind and waves.

Sea Level Rise – long-term increases of mean sea level. At a coastal site, sea level rise can occur both as a consequence of worldwide increases in sea level due to an increased volume of water in the oceans and due to local sinking of land surfaces.

Social Vulnerability – The inability of people, organizations, and societies to withstand adverse impacts from multiple stressors to which they are exposed. A person's vulnerability to environmental hazards is determined by access to resources, diversity of income sources, and by the economic status of the person or household.

Storm Surge – The local change in the elevation of the ocean along a shore due to high winds and low atmospheric pressure experienced during a storm. The storm surge is measured by subtracting the astronomic tidal elevation from the total elevation. Storm surge can be potentially catastrophic, especially on low lying coasts with gently sloping offshore topography.

Tidal Prism – The difference between the mean high water volume and the mean low water volume in an estuary.

Tide Gauge – A water measurement device used to continuously record coastal sea level and referenced to an elevation benchmark.

Vulnerability – Susceptibility of a resource to negative impacts from sea level rise.

Wellhead – The principal source of a well or stream.

Wellhead Protection Area – The surface and subsurface area surrounding a water well or well-field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water wells or well-fields.

C - Advisory Committee and Workgroup Members

Sea Level Rise Advisory Committee Members

Sarah Cooksey ..... Delaware Department of Natural Resources and Environmental Control
Richard Collins ..... Positive Growth Alliance
Gerard Esposito..... Tidewater Utilities, Inc.
Jim Ford III ..... Delaware League of Local Governments/City of Lewes
Alt: Victor Letonoff
Mark Davis ..... Delaware Department of Agriculture
Barbara DeHaven ..... Delaware Economic Development Office
Andrea Godfrey ..... Delaware Office of Management and Budget
Brenna Goggin ..... Delaware Nature Society
Alternate: Chris Bason Center for the Inland Bays
Mary Ellen Gray..... Kent County Department of Planning Services
Constance Holland ..... Delaware Office of the Governor
Quinton Johnson ..... Delaware Department of Health and Social Services
Roger Jones ..... The Nature Conservancy
Alternate: Jen Adkins Partnership for the Delaware Estuary
Karl Kalbacher ..... New Castle County
Michael Kirkpatrick ..... Delaware Department of Transportation
Alternate: Rob McCleary
Bill Lucks ..... Delaware Association of Realtors
Richard Perkins ..... Delaware Department of Health and Social Services
Gene Reed ..... Delaware Insurance Commissioner's Office
Keith Rudy ..... Home Builder's Association of Delaware
Kurt Reuther ..... Delaware Department of Safety and Homeland Security
Alternate: Don Knox
Jeff Shockley ..... Sussex County
Chris Sommerfield ..... University of Delaware College of Earth, Ocean and the Environment
John Taylor ..... Delaware State Chamber of Commerce
Pam Thornburg-Bakerian ..... Delaware Farm Bureau
Chad Tolman ..... Delaware League of Women Voters
Alternate: Peggy Schultz

Society & Economy Workgroup Members

David Ames ..... UD Center for Historic Architecture and Design
Rich Collins ..... Positive Growth Alliance
Mark Davis ..... Delaware Department of Agriculture Barbara DeHaven
Andrea Godfrey ..... Delaware Economic Development Office
Mary Ellen Gray ..... Delaware Office of Management and Budget
Alice Guerrant..... Delaware Division of Historic and Cultural Affairs
Connie Holland..... Delaware Office of State Planning Coordination
The Honorable Quinn Johnson ..... Delaware House of Representatives
Karl Kalbacher ..... New Castle County
Sarah Keifer ..... Kent County Department of Planning
Michael Kirkpatrick ..... Delaware Department of Transportation
John Laznik ..... UD Center for Applied Demography and Survey Research

Society & Economy Workgroup Members

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Rob McCleary ..... Delaware Department of Transportation
Richard Perkins ..... Delaware Department of Health and Social Services
Mike Powell ..... DNREC Division of Watershed Stewardship
Keith Rudy ..... Home Builders Association of Delaware
John Taylor ..... Delaware State Chamber of Commerce
Greg Williams ..... DNREC Division of Watershed Stewardship

Public Safety & Infrastructure

Dave Carlson ..... Delaware Emergency Management Agency
Greg DeCowsky ..... DNREC Div. of Waste & Hazardous Substances
Jerry Esposito ..... Tidewater Utilities
John Greer ..... Public
Karissa Hendershot ..... DNREC Div. of Waste & Hazardous Substances
Jim Kirkbride ..... Public
Michael Kirkpatrick ..... Delaware Department of Transportation
Don Knox ..... Delaware Emergency Management Agency
Nancy Lawson ..... Public
John Laznik ..... UD Center for Applied Demography & Survey Research
Victor Letonoff ..... City of Lewes Council
Robert McCleary ..... Delaware Department of Transportation
Cindy Miller ..... Public
Kurt Reuther ..... Delaware Department of Safety & Homeland Security
Peggy Schultz ..... League of Women Voters
Dr. Chad Tolman ..... League of Women Voters

Natural Resources

Jennifer Adkins ..... Partnership for the Delaware Estuary
Chris Bason ..... Center for the Inland Bays
Karen Bennett ..... Delaware Department of Natural Resources and Environmental Control
Robert Coxe ..... Delaware Department of Natural Resources and Environmental Control
Sarah Cooksey ..... Delaware Department of Natural Resources and Environmental Control
Morgan Ellis ..... Delaware Department of Natural Resources and Environmental Control
Brenna Goggin ..... Delaware Nature Society
Susan Guiteras ..... U.S. Fish and Wildlife Service
Roger Jones ..... The Nature Conservancy
Kevin Kalasz ..... Delaware Department of Natural Resources and Environmental Control
Andy Manus ..... The Nature Conservancy
Chris Sommerfield ..... University of Delaware
Hillary Stevens ..... University of Delaware
Michael Stroeh ..... U.S. fish and Wildlife Service
Pam Thornburg-Bakerian ..... Delaware Farm Bureau
Robin Tyler ..... Delaware Department of Natural Resources and Environmental Control

D - Data layers requested and used in the Vulnerability Assessment

Public Safety and Infrastructure Layers Used in Analysis	Workgroup Requesting Data			Source Notes
	PS&I	S&E	NR	
Schools (K-16)	X			Del. Dept. of Education, Delaware Public School Layer, 9-29-2010
Fire and Rescue stations	X	X		TechniGraphics, Inc., Delaware Fire Stations 2008 Q1, 2008-04-02
Police stations	X	X		Department of Homeland Security (Technigraphics), Delaware Law Enforcement 2009 Q4, 20091218
Communication/cell towers	X	X		FCC, Cellular Tower Locations , 20030427
Roads	X	X		Del. Dept. of Transportation, Road Centerline File, 2008-06-01
Bridges	X	X		Del. Dept. of Transportation, Road Centerline File, 2008-06-01
Bus Routes	X			Del. Dept. of Transportation - DART, DTC TRAPESE Routes and Stops, 20101001
Airports	X			HSIP Freedom (Department of Homeland Security); Del. Dept. of Transportation - Aviation
Railroads - Stations/Lines/Holding areas	X			USGS, 7.5 minute Digital Line Graphs - Rail, 20100930; HSIP Freedom (Department of Homeland Security)
Ports and Ferry Terminals	X	X		DNREC - Office of the Secretary, Coastal Zone Heavy Industries, unpublished.
Sewer pump stations	X	X	X	Kent County Engineering, New Castle County Special Services and Sussex County GIS
Sewer lines	X	X	X	Kent County Engineering, New Castle County Special Services and Sussex County GIS
Waste Water Facilities	X	X	X	DNREC - Financial Assistance Branch (TetraTech), POWWTP, 1/11/2010 Kent County Engineering, New Castle County Special Services and Sussex County GIS
Septic Systems	X	X	X	DNREC, Delaware Septic Systems (last update 20101123), unpublished
Hospitals and medical facilities	X	X		DE Div. of Public Health (UofD - CADSR), Delaware Hospitals, 2011-05-31
Emergency Operation Centers	X	X		Delaware Emergency Management Agency, EOC shapefile, 2011-04-03 [edit by Delaware Coastal Programs]

Public Safety and Infrastructure Layers Used in Analysis	Workgroup Requesting Data			Source Notes
	PS&I	S&E	NR	
Evacuation Routes	X			Del. Dept. of Transportation Traffic Management Team (Edwards and Kelcey), 2007 Evacuation Routes, 2010-15-04
Pipelines	X			DOT-PHMSA-National Pipeline management System
Wells - domestic, public, irrigation, industrial	X	X		DNREC-Water Resources-Doug Rambo
Navigation Aids	X			HSIP Freedom (Department of Homeland Security)
Correctional Facilities	X			TechniGraphics, Inc., Delaware Correctional Institutions 2007 Q4, 2007-11-05
Day Care centers	X			UofD - CADSR, Current Day Care Centers, unpublished.
Senior Centers	X			Del. Div. of Public Health (UofD - CADSR)
Nursing Homes	X			Del. Div. of Public Health (UofD - CADSR)
Refineries	X	X		DNREC - Office of the Secretary, Coastal Zone Heavy Industrial Facilities (20110321), unpublished.
Factories	X	X		EPA, EPA Facilities Toxics Release Inventory, 20080212
Site Investigation and Restoration Section (superfund, HSCA)	X	X		DNREC - SIRS, Site Investigation and Remediation Database, unpublished.
Leaking Underground Storage Tanks	X			DNREC, Leaking Underground Storage Tanks, 2010-11-15
Underground Storage Tanks	X			DNREC, Underground Storage Tanks, 2010-10-27
Brownfields	X			DNREC, Brownfields GIS Layer, 2010-10-27
Salvage Yards	X			DNREC, Salvage Yards GIS Layer, 2010-10-27
Hazardous Waste Generator	X			DNREC, Hazardous Waste Generator GIS layer, 2010-11-16

D - Data layers requested and used in the Vulnerability Assessment

Public Safety and Infrastructure Layers Requested but not Used in Analysis	Workgroup Requesting Data			Source Notes
	PS&I	S&E	NR	
Emergency Shelters	X			Data unavailable for Public Use
Public Utilities	X	X		Unspecific request. Several specific utility data layers collected and listed elsewhere
Private Utilities	X	X		Unspecific request. Several specific utility data layers collected and listed elsewhere
Wind Generation	X			Data unavailable for Public Use
Combined Sewer Overflows	X			Data Incomplete
Spray irrigation fields	X			Data Unavailable in GIS format
Community treatment facilities	X			Data unavailable for public use
Telephone switching stations	X			Data unavailable for public use
Water Supply Intakes	X			Data unavailable for public use
DelDOT Maintenance Yards	X			Data Incomplete
School Bus Storage	X			Data Unavailable in GIS format
Emergency Shelters	X			Data unavailable for Public Use
Public Utilities	X	X		Unspecific request. Several specific utility data layers collected and listed elsewhere
Private Utilities	X	X		Unspecific request. Several specific utility data layers collected and listed elsewhere
Wind Generation	X			Data unavailable for Public Use
Combined Sewer Overflows	X			Data Incomplete

Society & Economy Layers Used in Assessment	Workgroup Requesting Data			Source Notes
	PS&I	S&E	NR	
Social Vulnerability Index		X		NOAA Coastal Services Center (2000 Census)
Housing Units -Housing Units in mobile homes, trailers, others		X		UD CADSR - 911 Addressing
Income - Median Household and Per Capita		X		2010 Census (UofD - CADSR)
Delaware Environmental Justice Communities		X		WILMAPCO (2000 Census)
Heavy Industrial Sites		X		DNREC-Coastal Zone Act permitted sites; DNREC Toxic Release Inventory
Land use/land cover		X		datamil.delaware.gov
Agriculture Preservation/Easements		X	X	Del. Dept. of Agriculture, State Ag Easements, 2010-09-17
State Planning Investment Layers		X	X	Delaware OSPC, Investment Levels, Delaware State Strategies for State Policies and Spending (2010), 2010-10-01
Historic and Cultural resources			X	Delaware State Historic Preservation Office, CRS Inventory, unpublished, and National Register Properties, SHPO
Residential Addresses		X		UD CADSR - 911 Addressing
Inundated State Landmass		X		USGS and Delaware Geologic Survey, State Outline (Area), 2007-04-01
Tourist Destinations	X	X		DNREC Facilities-parks, beaches - DE Division of Parks and Recreation
Commercial Buildings		X		County 911 Databases [digitized by UofD - CADSR]
Agriculture Data - acreage and crop/animal types and economic impact		X	X	Del. Dept. of Agriculture, Ed Ratledge-UD, DEDO, Conservation districts Productive Soils data from USDA, LandUse/LandCover
Agriculture facilities/infrastructure		X	X	Delaware Geographic Data Committee, 2007 Delaware Land Use and Land Cover, 2008-05-19
Business Licenses		X		Delaware Division of Revenue, through University of Delaware CADSR

D - Data layers requested and used in the Vulnerability Assessment

Society & Economy Layers Requested but not Used in Assessment	Workgroup Requesting Data			Source Notes
	PS&I	S&E	NR	
Date structure was built		X		Data unavailable
Tax Ditches		X		Data available but later deemed not necessary for inclusion
Impermeable Surfaces		X	X	OSPC-OMB, 2007 Impervious Surface Data, 2008-05-18
Zoning		X		Statewide data not available.
Water Franchises		X		Data requested by later deemed not necessary for inclusion
Special Overlay Zones		X		Data requested by later deemed not necessary for inclusion
Floodplains		X		Not 'at-risk' per se. Information more suited to adaptation.
Maps where insurance is available		X		Data requested by later deemed not necessary for inclusion
Recurring Damage Claims		X		Data unavailable statewide
Rating Schedules		X		Data requested by later deemed not necessary for inclusion
"Pre-FIRM" maps		X		Data requested by later deemed not necessary for inclusion
Affordable Housing communities		X		Data unavailable statewide
Senior Housing		X		Data unavailable statewide
Manure Sheds		X		Data unavailable statewide
Buffer Regulations		X		Data unavailable statewide
Large Employers		X		Data requires analysis beyond scope of current project

Natural Resources Layers Used in Assessment	Workgroup Requesting Data			Source Notes
	PS&I	S&E	NR	
Wetlands			X	DNREC, De_Wetlands_20100901_PD6, 2010-09-01
State Protected Areas			X	DNREC - Parks and Recreation, Outdoor Recreation Inventory (2009), unpublished
Recharge Areas			X	DNREC, Recharge Areas, 2010-10-27
Wellhead Protection Areas			X	Sources: DNREC, Statewide WHPA 2009, 2009-09-29
Natural Areas			X	DNREC - Parks and Recreation, Outdoor Recreation Inventory (2009), unpublished
Habitats of Conservation Concern			X	DNREC - Natural Heritage Program, Habitats of Conservation Concern (2011), unpublished
Nature Preserves			X	DNREC Division of Parks and Recreation, Nature Preserves (2008), unpublished
Coastal Impoundments			X	Delaware Coastal Programs, Impoundments (2010), unpublished
Public Access Sites (ORI2009)			X	DNREC - Parks and Recreation, Outdoor Recreation Inventory (2009), unpublished
Conservation Easements			X	DNREC Division of Parks and Recreation, Conservation Easements (2010), unpublished
Forests			X	Delaware Geographic Data Committee, 2007 Delaware Land Use and Land Cover, 2008-05-19
DNERR			X	Delaware Coastal Programs, DNERR Boundary (2010), unpublished
Wetlands			X	DNREC, De_Wetlands_20100901_PD6, 2010-09-01
State Protected Areas			X	DNREC - Parks and Recreation, Outdoor Recreation Inventory (2009), unpublished
Recharge Areas			X	DNREC, Recharge Areas, 2010-10-27
Wellhead Protection Areas			X	Sources: DNREC, Statewide WHPA 2009, 2009-09-29

D - Data layers requested and used in the Vulnerability Assessment

Natural Resources Layers Requested but not Used in Assessment	Workgroup Requesting Data			Source Notes
	PS&I	S&E	NR	
Depth to Water Table			X	Data requires analysis beyond scope of current project
Stormwater Management Structures			X	Data unavailable in GIS format
Salt Line/Salt water intrusion		X	X	Data requires analysis beyond scope of current project
Turbidity, nutrient changes, salinity			X	Data requires analysis beyond scope of current project
Head of tide			X	Data unavailable
Increased Extent of storm surges and habitat changes			X	Data requires analysis beyond scope of current project
Fisheries, EFH, nursery habitat			X	Data not at scale suitable for vulnerability assessment
Shellfish maps			X	Data requires analysis beyond scope of current project
Freshwater mussels			X	Data unavailable in GIS format
Site Specific species migration studies			X	Data requires analysis beyond scope of current project
Map physical barriers to wetland migration			X	Data requires analysis beyond scope of current project
Marsh Vulnerability Index			X	Data requires analysis beyond scope of current project
Model marsh response to SLR			X	Data requires analysis beyond scope of current project
Wetland to Forest migration maps from The Nature Conservancy			X	Data requires analysis beyond scope of current project
Economic Value of hunting and fishing			X	Data requires analysis beyond scope of current project
Depth to Water Table			X	Data requires analysis beyond scope of current project

E - Sea Level Rise Public Engagement Session Comments Received

The Delaware Sea Level Rise Advisory Committee hosted a series of five public engagement sessions in November 2012, as described in the Public Engagement Section. All comments received in writing or by phone in response to these sessions are below:

Do you have concerns about sea level rise not mentioned today that you would like the sea level rise advisory committee to consider? Please describe.

- Should have a chart that draws a month by month continuous curve of tide gauge data.
- Yes, the actual impacts on homes in the vulnerable areas. For instance, South Bethany is greatly affected by 0.5 meter SLR. Can we project when these areas are going to be impacted to the point that the homes will be unusable?
- This information needs to be shared with the local coastal communities in Sussex County so that they can plan their new construction projects with this information in mind. I believe that future construction should be severely restricted along the coast.
- It would be helpful to describe: (a) impacts of SLR on those living in high elevations (b) Delaware's SLR efforts vs. those of surrounding states, USA, global.
- Impacts on underground utilities and water supply.
- Require the deed or lease to describe possibility of flooding and make the realtor liable if they do not show it to the customer. Deny federal flood insurance to properties that flood repeatedly. Stop beach replenishment which is a waste of taxpayer money. At Fowlers Beach the replenished beach lasted only a month. Avoid waivers for waterfront lots. Bulkheads do not work well. Levees also have problems.
- More community outreach efforts – target city and town councils.
- No, DNREC is getting too powerful and is infringing on private citizens rights.
- I am not concerned at all about sea level rise.
- Impact of increased salinity on oysters?
- Impact at local levels/ municipalities
- No, covered well and everything was explained in detail. Everyone took time to answer questions about localized areas of concern. Good presentation and exhibits. Thank you.
- Pollutant transfer particularly from contaminated areas. This was alluded to in the presentation but should be addressed more specifically and would help underscore the public health impacts of SLR.
- I believe the projections concerning sea level rise may not be accurate. Temperatures have fluctuated over history. If the only reasonable action given the economy, is to move to higher ground. Humanity is not going to stop natural rhythms. Constructing dikes throughout the state is impractical. Regulations should prohibit development in at risk areas and all funding for stop gap measures, such as beach replenishment, should cease or be funded totally by the landowner.
- Not sure that there is a clear well articulated state policy or initiative.
- I am very concerned about (1) insuring the accuracy and integrity of the data upon which any SLR conclusions are based, and (2) the inevitable conflict between contemplated regulatory initiatives and existing property uses and private property rights.

E - Sea Level Rise Public Engagement Session Comments Received

- Please discuss in subsequent presentations the effects of the unexpected rapidly rising rate of the melting of surface ice in Greenland and Western Antarctica.
- You have a long awareness challenge! Look for ways to get more information to more people such as newspaper articles and community meetings.
- Recommendation for financial incentives to mitigate or abate impact of SLR from both the private property owner as well as municipalities. At the same time, do not mandate or intrude into personal property issues.
- Would like to see more of this information in the local newspapers.
- Please consider the fact that your committee may be being used to promote an agenda not known to the members, as a means to insure local compliance to the U.N. Convention on Biological Diversity, wetlands project, as a vital step in attaining sustainable development. This is set forth in the U.N. "Agenda 21" program. If you are not familiar with it, look it up!
- No, except possibly how will we deal with the impacts to sequestered toxins at existing landfills and disposal areas that will be inundated.
- The presentation needed, I think, 3 areas of more in-depth analysis:

  1) The potential economic/financial impact

  2) A 25 -50 year scenario in the presentation. It is truly hard for the public to grasp 100 years

  3) Impact of climate change: increased storm activity, storm surge, etc.
- I think the best and cheapest way to fix Primehook's problem is to dredge the beach and bay. The sand and filler could be dumped on the beach benefitting the citizens and commerce. Actually, it would help all of Delaware's beach area.
- No, you have a very dynamic and diverse background to consider the problem.

Did you find any inaccuracies or problems with the information displayed today? Please describe.

- What causes global temperatures to change?
- Poster: What causes Sea Levels to Change? The section dealing with global temperature change seems to indicate that most of climate change is resulting from natural forces and therefore there is little we can do to mitigate it.
- I struggled (as you did) with the maps. They do not readily convey the information. A possibility would be to start with what questions (5) the maps should answer and design the maps with that in mind.
- No – very well presented.
- No, I thought the computer models and available displays were accurate.
- We now know some information being presented is based on false science.
- I do not agree with your findings that the sea will rise and swallow us up!
- fire/Ems stations- seemed to be a lot of Ems stations. Need to distinguish between the two. Police station ids. Business impacts need to be more detailed.
- No, very informative.

- Did not review in enough detail, though the 2 computer stations were a great idea.
- No, but I have little or no ability to question the data or the conclusions drawn from the data. That is why I came, to learn more and educate myself.
- Display 4 contains the statement “approximately 3% of Delaware’s 411,000 homes could be inundated by 3.3 feet (1 meter) of SLR”. My comment is that SLR inundates land that is low, not homes. Codes exist along the coast which requires homes to be elevated more than 3.3 feet above sea level.
- I am not keen on the display that shows the reasons for SLR. The Milankovitch cycles and sunspot activity are relatively minor factors which take away from the main threat.
- Because the projections are on a gross scale, actual local elevations do not show.
- No, Committee seems to be using an even handed approach.
- No, but a cost study would have enhanced the presentation along with some short term analysis. You have bent over backwards to make a scientific presentation without using panic ideology.
- I found the presentation very professional. The DelDOT people were very friendly as were the volunteers. It was just a depressing subject.
- No, it was reflective of a balanced approached to addressing a complex problem.

Please tell us what aspects of sea level rise might impact you, your home, or your community.

- I’ll be gone by the time SLR gets really bad, but I worry about my grandchildren and their children.
- None to my home, at least for another 284 years according to my calculations however, it will have an impact on my community. Things will change the question is how well will we change with SLR?
- If Delaware makes taxpayers pay for risky investments, specifically homes that should not have been built so close to the water, I will have less money. Where is the County responsibility?
- Sea level rise will affect all of us living in areas adjacent to coastal Sussex County. It will affect tourism, agriculture, and real-estate.
- I live and work in a coastal town. SLR could affect my home, job, and recreational opportunities.
- flooding of our business community in Milton.
- 1.0 meter SLR, Delaware is sinking.
- Infrastructure availability.
- I live in Georgetown; your maps show that my house will stay high and dry no matter what.
- I live inland but my family has a beach house so I am concerned about storm surge. But I am also concerned about all regional impacts especially on natural resources and infrastructure.
- I am from Primehook, so the roadway for emergency need is impacted plus the loss of dunes and beach front.
- Habitat migration/ adaptation, impacts on drinking water, and impacts on wastewater treatment.
- Wells, septic, damage from storms pushing water further inland.
- No but the material presented is fairly dense.

E - Sea Level Rise Public Engagement Session Comments Received

- Loss of home very shortly.
- Not much, fortunately, as I live on relatively high ground.
- I till 3 farms in South Bowers. We used to see saltwater intrusion onto our land once every 5-6 years. Now it happens 3-5 times a year. Changes have been seen over the past 15 years. We have lost about 30 acres that are no longer tillable because the soil is too salty. flooding by saltwater is so frequent that salt never has a chance to be flushed out of the soil.
- I will probably have to pay taxes to make up for the stupid land use decisions county officials have made. They are so keen to get real-estate transfer taxes that they ignore SLR.
- I live in a relatively low lying area in Kent County. Concerned about community water and wastewater utilities.
- Loss of property, economic decline, loss of quality of life, environmental changes.
- A significant point of vulnerability in Lewes is the bridge over Canary Creek. It currently is too low! The bridge floods regularly and a strong northeast wind can keep water, from storms, in the creek for days. This bridge, when built, was not properly constructed and the approaches sink quickly after they are repaired by DELDOT. This bridge has served as a crabbing and fishing point for 75-100 years. Please do not eliminate this local feature of the bridge if you choose to rebuild a better bridge over the Canary Creek.
- I live in South Bethany on a canal!
- I live in South Bethany and my home is about 8 feet above sea level.
- I live in the back of Primehook Beach. That marsh and strip of land has been our barrier island but it is dissolving quickly. It is very frightening, as we have worked for 25 years for our home and property.
- Land value decrease as it will become less desirable to come to the beach areas.
- SLR will significantly reduce our opportunity for recreational benefits, damage the ecosystem, put our homes at risk for flooding, and cause economic hardship.
- My home may be completely destroyed. The value has declined drastically and it is scary. I see sale signs going up with asking prices cut to the bone. They are good people and deserve better. Our road to Primehook is really dangerous but we are thankful for it.
- Communities will need infrastructure for roads and schools. For me personally and for my family, we are outside of the impact zone.

Please tell us what aspects of sea level rise you are most concerned about.

- Port Mahon – roadway is problem already; Bombay Hook NWR.
- Dealing with SLR is going to cost a lot of money. The Committee needs to hold more discussions about the value of vulnerable assets.
- Being smart about our adaptation methods. Who is responsible? If I buy a home that in 100 years will be under water and I am ok with that because it is on the beach and I am only looking 10-15 years ahead, then So What! The problem is 40 years from now, the owner of that home is screaming for a buyout at top dollar. Personal responsibility has to play into the strategy.
- Loss of wetlands!
- Be able to adjust in the future as new info about SLR becomes available.

- According to the models the community where I work is in big trouble.
- What can we do as individuals beyond AWARENESS?
- Economic impacts
- Little
- I have no concerns about sea level rise.
- All of them!
- Road inundation and critical infrastructure inundation.
- Engulfing our cottage with no option of relocation. Loss of property will impact us financially and our family sentiment since we built the cottage ourselves.
- Habitat migration and affects on surface water and groundwater resources.
- I would like to thank you for the information. Everyone involved is doing a good job and the State of Delaware should be proud to have people who are industriously applying themselves to their jobs.
- How will adaptation be paid for? Will emerging solutions be considered.
- Revert back to a beach replenishment agreement in exchange for public assistance. Then go for long range solutions.
- Why are we spending millions of dollars on Indian River Inlet Bridge when the roads to and from it will be under water?
- Future regulatory initiatives.
- Spending taxpayer money to benefit a small portion of people who live along the coast.
- I am most concerned about economically disadvantaged people who are without choices in dealing with SLR.
- flooding/inundation and salt water intrusion.
- Loss of property and the ability to provide health and safety services for the community.
- The government, through regulation and restriction of personal property use and denying citizens their right to private property i.e. the 4th Amendment the U.S. Constitution.
- Inundation of wetlands and existing infrastructure. Will the taxpayers have to bail out flooded homeowners in the coastal zone? Example: Primehook Beach?
- Impact on beach communities. When preparing public information after the recommendation phase, be mindful of how such information may impact property value and tourism in Delaware which is a substantial revenue source for the State.
- Should I move? Should we build dikes? Should we bring in a lot of sand? I could still get around in my boat.
- It is clear that our town will be inundated due to sea level rise. Our issue will be how do we plan for SLR now and not later. (Mayor of South Bethany)
- flooding. May allow for the distribution and spreading of toxic and carcinogenic chemicals.
- The increasing impact on groundwater and the drinking water around my house and the flooding potential.
- That people can ignore this issue. SLR is happening whether you believe it or ignore it!
- Risk of damage and flooding to property, degradation of the community from economic hardship,

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infrastructure damage, and potential danger to evacuation routes and possibly even to overall evacuation.

- Complete flooding in the area which will happen and to a degree has happened several times recently.
- Cost to me and the community.

Please tell us if you feel that the Delaware Sea Level Rise Advisory Committee is on the right track or on the wrong track with its approach to planning for sea level rise.

- Right track x 12
- Right track. I will be interested to hear the solutions now that I know the issues.
- Right track with proper government representation.
- Wrong track. Reduce DNREC budget or eliminate department, it is getting too political.
- Wrong track. I think we are wasting a lot of money on studying sea level rise.
- Right track. Hope for rapid answers but know that research must be done.
- Right track. Bravo for taking this issue on and focusing the public's attention.
- Right track for the long range. Wrong direction for the short range.
- Do not know enough yet to say for sure. It appears that the Committee is doing a good job of studying the issue.
- Right track. There is a need to reassess what is going on along the coast and change what we are doing.
- Right track. Could be less conservative
- You did not make any suggestions for solutions. Should we move or spend a lot of money?
- Right track. Thank you for the great presentation and displays.
- This is a great track. You are carefully building the case for adaptation.
- Right track. This is going to be of upmost importance to all of Delaware in time, not just the coastal areas. All options should be investigated and evaluated.
- You are on a good track. I encourage you to continue to maintain your diverse group.

What information presented today was most useful to you?

- TV info and the SLR map viewer.
- The ability to see the areas that will be potentially affected.
- Rate and extent of change.
- Computer availability
- Knowing your direction so citizens can resist.
- I enjoy looking at maps.
- It's very useful to listen to simple explanations of sea level rise. It's helpful for explaining to friends and family without putting them to sleep.

- All. Nice job by the presenter and facilitators.
- Scenarios/mapping
- All of it.
- The GIS maps and infrastructure display
- Maps
- Very good. The information was well presented.
- Include below-water-level sewer outlets for the Wilmington sewer system.
- Information on mapping
- Computer map overlay showing flooding at various elevations of SLR.
- Local information about my community provided by the computer maps.
- The website that allows us to look at the SLR maps on our home computer.
- Visuals showing potential inundation.
- Both the presentation and the displays.
- The data presented has been around for some time. I am waiting for the strategies and recommendations.
- Seeing what the Committee is doing.
- Computer maps that show the potential effects on our property.
- Everything. It was great to see that people are actually trying to address this issue.
- Computer maps and scenarios, well done.
- The information simply confirmed my thoughts.
- Social and economic impacts.

Do you have additional information or concerns you would like to share?

- The general public needs to understand SLR and be challenged to live more efficiently and use less energy. Please offer a plan to educate the public on what they can do and what we all must do to lower the impacts over time. We need our government to be proactive on this as well. Thanks for your efforts.
- Need to add wastewater plant in Milton.
- I am wondering why you are scaring people with this stuff when the sea is barely rising at all if at all. I do not believe in global warming which has now been renamed climate change. It is a hoax. I am sorry we are wasting so much time and money on this.
- Keep up the good work.
- Integration between the State and County governments regarding hazard mitigation plans.
- Perhaps your group could come to our Primehook Beach organization meetings with your exhibits on SLR or contact the Board chair, she is great at dispensing information to us non-residents by email.
- Many questions about how this research/data will be used. Could have been addressed during the presentation.
- You should have been more forceful with this information years ago to advise other agencies to pass zoning

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and building codes to stop people from building in areas that will be under water. Laws could have been made to say if you build you cannot be bailed out by taxpayers.

- Support not allowing people to build in certain areas. Want the amount of sand on the beach to be reduced so that the shoreline can change naturally.
- Availability of GIS layers for 3rd party users to evaluate.
- Sussex County Government should participate.
- Why is Sussex County not listed as a member of the Advisory Committee?
- If the plan is that I should move then I should do it soon so that I can sell my property. I am 68 so I probably do not need to do anything but my children will have to worry about it.
- What should towns in the impact zone do? As more and more information about SLR “gets out”, town officials will be asked to provide what we have in place to combat SLR. So the sooner the better in getting out the recommended solutions. Thank you for holding these public engagement sessions. I believe SLR is happening and I came tonight with the hope that the Committee would provide solutions with how to handle the impacts of SLR. (Mayor of South Bethany)
- The town oflewes would like the SLR maps to download.
- Your maps should show:

  A) the range of static sea level rise

  B) the range of storm surge

  C) the combination of A + B, which would be the real world worst case scenario
- Why are the Sussex County municipalities and Sussex County not represented on the Advisory Committee? Most of the ocean shoreline is in Sussex County! It is very disconcerting that many DNREC employees do not know the municipalities in Delaware, such as Henlopen Acres. What procedures are being developed to keep all municipalities involved and informed?
- Why is Sussex County not directly represented on the Advisory Committee? We should stop wasting time with determining why SLR is happening. It is happening and we need to keep moving forward.
- The public will have difficulty attempting to mitigate risk, increasing protection, or taking on other costly measures without a cost/benefit analysis. The Committee must continue to build the scientific argument that SLR is real and then add in the cost of adaptation options. Also we probably need to emphasize the rapidly changing trends - this is so important- since the situation is accelerating and we do not want the maps to lead to panic. We need to build this into our UD campus tours. Can we build in the ecosystem changes that are likely to occur?

Comment Letter from Steve Callanen
Chair, Southern Delaware Group, Sierra Club

38986 Bayfront Drive
Ocean View, DE 19970
December 2, 2011

Susan E. Love, Resource Planner, Delaware Coastal Programs
DNREC, Division of Soil & Water Conservation
5 E. Reed Street, Suite 201
Dover, Delaware 19901

Subj: Reduction of Indian River Inlet Depth Needed to Curtail Bay flooding

Attachments:
a) Tidal Prism Graph, CCMP, Appendix F, p. 2-1, June 1995.
b) Tidal Prism Graph, 2011 State of the Delaware Inland Bays, 23 Sep. 2011.
c) Indian River Bay Shoreline flooding, Callanen Photo 5109, 5-12-08.
d) Indian River Bay Shoreline flooding, Callanen Photo 5115, 5-12-08.
e) Indian River Bay Shoreline flooding, Callanen Photo 5125, 5-12-08.
f) Indian River Bay Shoreline flooding, Callanen Photo 5130, 5-12-08.
g) Indian River Inlet - ACOE Multi-beam survey data - Mar 1999 Slide42
h) IR Inlet Cross Section, figure 3.14
i) IR Inlet Cross Section, figure 3.15
j) USGS 01484540 Indian River at Rosedale Beach, DE, Tide height, Sep. - Oct. 2008.
k) USGS 01484540 Indian River at Rosedale Beach, DE, Tide height, Oct. 2009.
l) USGS 01484540 Indian River at Rosedale Beach, DE, Tide height, May - Aug. 2011.
m) USGS 01484540 Indian River at Rosedale Beach, DE, Tide height, Aug. - Nov. 2011.
n) USGS 01484540 Indian River at Rosedale Beach, DE, Location Data & Photo.

Dear Ms. Love,

I enjoyed talking with you after your Sea Level Rise Engagement Session presentation on November 29th in Lewes. Please consider the comments in this letter as my “Comment Form” reply.

My primary concern, which has not been addressed by the Sea Level Rise Advisory Committee, which astonishingly has no representative from Sussex County, is the rise in water levels around the shores of Delaware’s Inland Bays due to self-scouring of Indian River Inlet. According to Robert Scarborough, DNREC Research Coordinator & Environmental Scientist, whom I also spoke to on Tuesday evening, it is unlikely that this problem will be addressed for at least two years. This delay in taking action on this serious problem is inappropriate and downright foolish.

It is submitted that tidal-prism data (Attachments (a) & (b)) indicates that the rate of water level rise on the shorelines of the Inland Bays exceeds future flooding rate increase estimates attributed strictly to global warming.

The 320-square-mile Inland Bays watershed has experienced well documented severe flooding on numerous occasions, including in November 2009 during tropical storm Ida and in May 2008 (Attachments (c), (d), (e) & (f)). Bay flooding is adversely impacted not only by major storms and sea-level rise, but also by the extreme self-scouring of Indian River Inlet, which provides the primary connection between Delaware’s Inland Bays and the Atlantic Ocean.

A greater volume of water exchange between the ocean and the Bays now occurs on each tide cycle, due to extreme self-scouring of the Inlet (Attachments (g), (h) & (i). The cross-sectional area of Indian River Inlet, 500-feet east of the bridge, increased from approximately 800 square feet in 1936 to nearly 22,000 square feet in 1991. The cross-

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sectional area of the channel, 600-feet west of the bridge, increased from approximately 900 square feet to over 31,000 square feet during this same time period.[11] The volume of water flowing through the Inlet on each tide cycle roughly tripled from 1939 to 1969, then almost doubled from 1969 to 1988. The depth of the Inlet has dramatically increased from 15-feet to over 100-feet in some places; and as a result, high tides in the bays are higher and low tides are lower. Low tide water levels in Indian River Bay are 12-inches lower than they were 50 years ago. (Delaware Inland Bays Comprehensive Conservation and Management Plan (CCMP), Appendix F, p. 7, June 1995.) As the Inlet's cross-sectional area has increased, it has become less effective as a deterrent of excessively high water levels in the Bays.

The attached Indian River Bay and Rehoboth Bay "tidal prism" graphs illustrate the increasing tidal action, and hence the corresponding higher high tide and lower low tide water levels. (Delaware Inland Bays Comprehensive Conservation and Management Plan (CCMP), Appendix F, p. 2-1, June 1995.) This same "tidal prism" data was recently published in the 2011 State of the Delaware Inland Bays.

Because of the significant progress made over the past decade in eliminating large point sources of pollution around the Bays, it seems highly doubtful that significantly reducing, or halting, further scouring of the Inlet will detrimentally impact adequate flushing action, which transports excess harmful nitrogen and phosphorus nutrients from the Bays to the ocean.

Sea-level rise and typical nor'easter storms increase flooding impacts, not only on private property and public roads surrounding the Bays, but also on the leaching of toxic heavy metals into Bay waters from the unlined 144-acre Burton Island coal ash landfill adjacent to the Indian River Power Plant.

The Burton Island site is now mostly surrounded by riprap; however, U. S. Geological Survey tide height measurements taken at Rosedale Beach, almost directly across Indian River from the power plant, show that on numerous occasions in 2008, 2009 and 2011, for which data is available (Attachments (j), (k), (l) & (m)), water levels have exceeded the top of the pier on which the USGS water height gage is located. In October 2009 and August 2011 the excessively high water levels caused the water height gage to malfunction, thereby preventing accurate recording of these events. The USGS indicates that a maximum water elevation of 6.99 feet occurred at this site on Feb. 5, 1998, (Attachment (n)).

It was shocking and disturbing to learn at a 2008 DNREC public hearing that 26 years after Delmarva Power and Light ceased dumping coal ash from the Indian River Power Plant onto Burton Island, 26 of 26 offshore sediment samples were discovered to contain seven heavy metal pollutants identified as "Constituents of Potential Concern for either human or ecological receptors."

These metals include aluminum, arsenic, barium, cobalt, copper, mercury and nickel. Delaware Toxic Release Inventory Reports identify compounds of arsenic, cobalt and nickel as carcinogens.

An ecological risk assessment published by Shaw Environmental Inc. in March 2008 states, "There is a potential for adverse affects to benthic invertebrates in the sediment along the shoreline of Burton Island due to arsenic and barium."

NRG's remediation plan for Burton Island has thus far consisted of leaving contaminated offshore sediment in place and adding riprap along the shoreline. Although this riprap helps inhibit erosion of shoreline embankments, the synthetic fabric underlay is permeable, and therefore does not prevent leaching of the landfill pollutants into bay waters. The riprap fails to eliminate the long-term pollution problem, which is exacerbated by high water levels and wave action, especially during typical Nor'easter storms.

To the best of my knowledge, the impact of sea level rise has not even been considered in the ongoing Burton Island remediation analysis or discussed in the reports developed to date. The Sea Level Rise Advisory

Committee should focus attention on this omission.

To prevent long-term worsening of Inland Bay flooding impacts, it is necessary for DNREC and/or the Army Corps of Engineers to reduce the volume of water entering the Bays on each tide cycle by reducing the Inlet's depth and hence its cross-sectional area.

According to an ACOE report, "inlet scour continues and presently poses what may prove to be the most difficult and costly of the coastal engineering challenges presented in the 100 plus years since locals first petitioned the Government for a jettied inlet." Assuming this statement to be correct, it is respectively submitted that the time to start working on remediation of this worsening problem is NOW.

Sincerely,

Steve Callanen, Chair, Southern Delaware Group, Sierra Club

302-539-0635 (h)

Copy to: Senator George H. Bunting, Jr., 20th Senatorial District, Senator F. Gary Simpson, 18th Senatorial District, Joan R. Deaver, Sussex County Council, District 3, Collin O'Mara, DNREC Secretary, Sarah W. Cooksey, DNREC Administrator, Delaware Coastal Programs, Robert W. Scarborough, Ph.D., DNREC, Research Coordinator & Environmental Scientist, Kelly Valencik, DNREC, Coastal Programs, Chris Bason, Acting Director, the Delaware Center for the Inland Bays, Doug Parham, Chair, CIB, Citizens Advisory Committee

[11]"Delaware Inland Bays Comprehensive Conservation and Management Plan," Appendix F, figure 3.16, p. 3-130, Jun 1995.

[12]The DE Center for the Inland Bays, '2011 State of the DE Inland Bays,' p. 15, September 23, 2011.

[13]http://waterdata.usgs.gov/de/nwis/uv?cb_00065=on&format=gif_default&period=21&site_no=01484540

[14]The USGS tide gage was not installed until April 1991.

[15]"57 YEARS OF COASTAL ENGINEERING PRACTICE AT A PROBLEM INLET: INDIAN RIVER INLET, DELAWARE," by Jeffrey A. Gebert, Keith D. Watson, A. M., ASCE and Augustus T. Rambo.

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Responses to Steve Callanen Letter

Point of Clarification,

The item that I referred to that would not happen for probably two years is the expansion of the DEOS (Delaware Environmental Observing System) Coastal Storm Early Warning System. The system is now in place for Kent County (http://www.deos.udel.edu/coastal_flood) and researchers from the University of Delaware are currently expanding the coverage to go from Lewes to the City of New Castle. The next phase if funded will include the piedmont area of northern New Castle County and the Inland Bays. These two areas are last because of the complications and extra research required due to increased surface runoff in the piedmont region and difficulty in predicting flooding in the Inland Bays due to restricted tidal flows through the Inlet combined with runoff.

Thank you,

Robert W. Scarborough, Ph.D.DNREC//Delaware Coastal Programs/DNERR

Steve,

Thank you for your comments – we will include them for consideration by the sea level rise advisory committee.

You already received and email from Dr. Scarborough regarding the expansion of the Delaware Environmental Observing System Coastal Storm Early Warning System into the Inland Bays area, if funded.

I also wanted to let you know that modeling of the impact of sea level rise on the NRG ash disposal area was conducted as part of the recent remedial investigation by DNREC Site Investigation and Restoration Section. The reports are available here:

http://www.dnrec.delaware.gov/whs/awm/Info/Pages/NRGIndianRiver.aspx

The impacts of sea level rise are specifically addressed in the third document listed – NRG's Response to DNREC's comments. If you have questions about the results, please call Greg DeCowsky at SIRS who will be able to explain the technical details much better than I can.

Again, thanks for your comments.

Regards,

Susan E. Love

Delaware Coastal Programs

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Comment Letter from Claudine Bodin

Wednesday, November 16, 2011 - 12:20 PM

Subject: Government Inaction or Sea Level Rise?

From: Claudine Bodin

To: Valencik Kelly J. (DNREC); Senator Simpson; Kenton Harvey (LegHall); Hill Jennifer A. (Governor); Dan ASHE; Glen Robert A (DOS)

Cc: brenda.l.schillaci@mssb.com; Ron; Tena Alexander; Devores; trainster@aol.com; Diane McConnell

Sent: Monday, November 14, 2011 8:18 PM

Government Inaction or Sea Level Rise?

Because of an injunction brought forth by PEER, there has been massive, destructive flooding at Primehook Beach. Is this a case of “sea level rise” or “deferred maintenance”? The only reason this sort of flooding is not a current crisis at Rehoboth or Dewey Beach is because those communities can count on dune and beach replenishment done paid for by the state of Delaware, whenever needed. I clearly remember the Rehoboth boardwalk being destroyed by a storm . . . and then fixed. If those repairs had been neglected where would Rehoboth Beach be now?

What we are witnessing and experiencing at Primehook is a breach of duty by the state and federal governments -a matter of neglect and deferred maintenance in a National Wildlife Refuge abutting a great community. Primehook tax payers are in a constant crisis of being flooded, stranded, and their very lives left in peril. They must deal with this crisis mostly on their own. Some government agencies and representatives have helped and are currently seeking justice for the community. But the crux of the problem, the breached dunes, is not being addressed. I believe this has more to do with breach of duty, exacerbated by the PEER lawsuit (that was finally defeated late this summer) than a matter of sea level rise.

Primehook property owners have been left with properties that cannot be sold. Even if someone wanted to buy one of the houses currently for sale, mortgage lenders would require flood insurance; but that is no longer available at Primehook because of the neglect –not neglect by the Primehook property owners --they have been fighting to fix this problem for years!

At this point one of two things should happen:

1) The breached dunes should be fixed and consistently maintained, or;

2) The government must accept their breach of duty and buy the land from the owners who have been left to confront flooding as no other property owners in Delaware have had to.

What is Happening at Primehook is an Out-of-Control Short-Term Problem that has Left Residents in a Horrible Quandary

I have faith that what is happening at Primehook can be resolved. The former fresh water refuge is at a fragile, irreparable tipping point. I hope that the state of Delaware and the National Wildlife Refuge system (Department of the Interior) can appreciate that and take swift action for both the migratory birds and other wildlife dependent on that habitat as well as the property owners on beautiful Primehook Beach.

Sincerely,

Claudine Bodin

F - Dissenting Opinion Statements

Expertise, opinions and advice from members of the Sea Level Rise Advisory Committee was essential to the development of this sea level rise vulnerability assessment. Advisory Committee members outlined desired information, helped obtain datasets, drafted individual sections of the document, and reviewed draft and final products. Committee members also voted to finalize and publish the document.

Voting procedures approved by the Sea Level Rise Advisory Committee require the affirmative vote of 2/3 of the total committee membership to pass any motion. Committee members also recognize that dissenting opinions add context to a discussion and should be documented for consideration in future work. As a result, the voting procedures also outlined a process to allow Advisory Committee members who do not agree with a recommendation to have their opinions included in committee products as a dissenting opinion.

Two Advisory Committee member organizations have submitted dissenting opinion statements for inclusion in this vulnerability assessment, the Home Builders Association of Delaware and the League of Women Voters of Delaware. The Home Builders Association of Delaware registered the sole “no” vote for the finalization and publication of the Vulnerability Assessment. The League of Women Voters of Delaware voted to approve this document with the inclusion of the additional information contained within their dissenting opinion.

The two dissenting opinions are presented on the following pages.

MINORITY STATEMENT BY THE HOME BUILDERS ASSOCIATION OF DELAWARE

The Home Builders Association of Delaware (HBADE) appreciates the work effort of the Sea Level Rise Advisory Committee toward addressing the potentials of sea level rise. Our Board of Directors has approved the following position statement, and have asked our representative Keith Rudy to submit this on the behalf of HBADE.

Over the last 110, the rate of Sea Level Rise and Subsidence in Delaware has averaged about 3.35 mm per year. Over the next 100 years, at this rate, we expect that an addition 0.34 meters of rise. Accounting for an increased rate of sea level rise that some feel may occur over the next 100 years and in order to plan conservatively, the Home Builders Association of Delaware supports the planning for 0.5 meters of sea level rise over the next 88 years at the current time.

One half meter is consistent with the conservative estimates by the International Panel on Climate Change (IPCC) and NOAA for global sea level rise over the next 100 years. Additionally, the HBADE supports a close monitoring of the actual sea level rise over the next twenty years in order to determine if the 100 years trend will exceed 0.5 meters of rise. Even at the most catastrophic estimates of sea level rise being considered by DNREC, we would not exceed 0.5 meters in 30 years and we would still have adequate time to plan for this level if it appears that the trend is towards more than 0.5 meters of rise in the next 100 years.

We appreciate the opportunity to submit our position and hope that it is helpful to the Advisory Committee.

Submitted by Howard Fortunato, Executive Vice President, HBADE on April 26, 2012

MINORITY STATEMENT BY THE LEAGUE OF WOMEN VOTERS OF DELAWARE ON THE SEA LEVEL ADVISORY COMMITTEE VULNERABILITY ASSESSMENT REPORT

1 The DNREC Coastal Programs Staff did a good job of writing the first draft of the 244-page Vulnerability Assessment Report and of including most of the suggestions made by Advisory Committee members, including a number made by the League, in the second draft. There are however three important issues that should be addressed on which we were unable to reach a consensus with the staff and Advisory Committee to include. We describe them, with references to our information sources, in this Minority Statement. The first set of three summarizes the issues; the second set gives more detail with references. The page numbers in parentheses refer to the Coastal Programs' second pdf draft of the report.

1. Delaware has the lowest average elevation of any state in the U.S., so that it is especially vulnerable to sea level rise.

2. The evidence that the rate of sea level rise is increasing and is very likely to keep increasing for many decades to come was downplayed in the report as adopted by the Committee, in spite of evidence that the rate of ice loss from both Greenland and Antarctica is increasing and that the loss of ice from these two huge ice sheets will dominate the future rate and extent of sea level rise.

3. The report fails to mention that Delaware's vulnerability to climate change is caused not only by sea level rise using the "bathtub model" adopted by the Committee, but by storm surges and wave heights that are likely to increase in a warming world.

1. Delaware is particularly vulnerable to the effects of SLR not only because of its location and dependence on the coast, but also because it has the lowest average elevation of any state in the U.S., only about 60 ft or 18 m.[1] (Pages xi and 3)

We suggested inserting on Page 3 right after the sentence starting with "Delaware is particularly vulnerable …"Delaware has the lowest average elevation of any state in the U.S., only about 60 ft or 18 m."

2. We strongly dislike the sentence on Page 7, "While it cannot be proven with certainty, climatologists have predicted that the rate of sea level rise occurring today will likely become greater in the decades to come." (emphasis added) We can't understand the reasons for not simply replacing it with, "Climatologists have predicted that the rate of sea level rise will likely become greater in the decades to come." The new wording provides the reader with the idea of uncertainty with the words, „predict" and „likely.„ We object to the phrase, "While it cannot be proven with certainty, ..." because it may give the lay reader the mistaken impression that the expectation of increasing rates of future sea level rise is quite uncertain, and that therefore adaptive action can be put off.

The U.S. Army Corps of Engineers (USACE) issued a circular in October 2011 providing guidance for incorporating the direct and indirect physical effects of projected future sea-level rise across the life cycle of USACE projects and systems.[2] The USACE guidance predicts an accelerating rise at least until 2100. The form of an equation describing the acceleration was taken from a 1987 NRC report.[3] At that time (25 years ago) it was not known whether the mass of ice on Antarctica was increasing or decreasing; it was thought that the snow and ice added by more annual snowfall in a warming world might exceed ice loss due to melting and calving.

A recent paper published in 2011 by research scientists E. Rignot et al.[4] - including two from the Cal Tech Jet Propulsion Laboratory and one from the National Center for Atmospheric Research - who have studied the ice sheet mass balance for Greenland and Antarctica over the last two decades, reports that both Greenland and Antarctic ice sheets are losing mass at accelerating rates,[5] and that the combined acceleration is 3 times larger than that of other glaciers. They write: "If this trend continues, ice sheets will be the dominant contributor to

sea level rise in the 21st century." The acceleration of ice loss from Greenland, which is caused in part by the increased rates of sliding and calving of glaciers, is supported by earlier papers from NASA.[6]

3. The report focuses too narrowly on its "bathtub" model of sea level rise and fails to point out that the vulnerability of some resources - like people's homes - depends not only on the gradual increase in the mean higher high water (MHHW) of high tides, but also on episodic storm surges and waves that are likely to increase in height with global warming and that need to be added to relative sea level rise to assess vulnerability along the coast. The U.S. Global Change Research Program states: "There is observational evidence for an increase of intense tropical cyclone activity in the North Atlantic since about 1970, correlated with increases of tropical sea surface temperatures."[7] We would like to have seen a figure in the report, similar to the one defining MHHW (Page 10), showing tide gauge measurements on the Delaware coast covering a number of days that include a period of storm activity. One example would be the passage of Hurricane Irene up the Delaware coast last year. In that case the damage was much less than feared because the highest storm surge was short-lived and came at an especially low tide (new moon).[8] Another possibility would be the nor"easter of 1962, which lasted through five high tides, produced waves 20-40 feet high, and devastated the Delaware coast.[9]

A study of the intensity of wave action in the northeast Atlantic, using microseismometers to measure the shaking of the coast, indicates that wave action has been increasing as the water temperature has been increasing.10 The same may be true of our Mid-Atlantic coast. More energetic wave action is expected to increase the rate of coastal erosion and make it harder to protect coastal resources like marshes.

Submitted by Chad Tolman on June 4, 2012 for the LWV of Delaware

[1] U.S. Census Bureau, Statistical Abstract of the United States, Chapter 6, Geography and Environment, p. 216, 2004-2005.
At: http://www.census.gov/prod/2004pubs/04statab/geo.pdf

[2] SEA-LEVEL CHANGE CONSIDERATIONS FOR CIVIL WORKS PROGRAMS, U.S Army Corps of Engineers, Circular No. 1165-2-212, Oct. 1, 2011.
At: http://planning.usace.army.mil/toolbox/library/ECs/EC11652212Nov2011.pdf

[3] Responding to Changes in Sea Level: Engineering Implications, NRC, 1987. At: http://www.nap.edu/openbook.php?record_id=1006&page=30

[4] E. Rignot, I. Velicogna, M. R. van den Broeke, A. Monaghan and J. Lenaerts, Acceleration of the contribution of the Greenland and Antarctic ice sheets to sea level rise, Geophysical Research Letters, Vol. 308, 2011. At: http://www.agu.org/pubs/crossref/2011/2011GL046583.shtml

[5] The measured combined acceleration from Greenland and Antarctica corresponds to an annual increase in the rate of global sea level rise of 0.10 mm/yr, so that in 2100, if the trend continues, these ice sheets by themselves will contribute 10.7 mm to the sea level rise that year. This can be compared with the average annual global rate of 1.7 mm during the last century from both water warming and ice on land melting.

[6] Greenland Ice Loss Doubles in Past Decade, Raising Sea Level Faster, NASA Jet Propulsion Laboratory, Feb, 16, 2006. At: http://www.jpl.nasa.gov/news/news.cfm?release=2006-023
Jacobshavn Glacier Retreat, NASA Earth Observatory, July 15, 2010. At: http://earthobservatory.nasa.gov/IOTD/view.php?id=44625

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For a good book on hurricane history and science by an MIT professor see Kerry Immanuel, Divine Wind – The History and Science of Hurricanes, Oxford University Press, New York, 2005.

[8] Hurricane Irene "Looking Bad" for U.S.—Moon May Make It Worse, National Geographic Daily News, Aug. 25, 2011.
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[9] The Great Nor'easter of 1962 - Delaware's Storm of the Century, published by the UD Sea Grant College Program in cooperation with DNREC.
At: http://www.deseagrant.org/sites/deseagrant.org/files/product-docs/1962_storm_of_the_century.pdf

[10] Grovmeyer, R. Herber and H.H. Essen, Microseismological evidence of a changing wave climate in the northeast Atlantic Ocean, Nature, Vol. 408, 16 November 2000, pages 349-352.
At: http://www.geo.uni-bremen.de/sensorik/publikationen/nature408_349.pdf

Delaware Sea Level Rise Advisory Committee

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