Preparing for Tomorrow's High Tide

A Progress Report of the Delaware Sea Level Rise Advisory Committee

November 2011

Sea Level Rise Advisory Committee Goal Statement

The goal of the Sea Level Rise Advisory Committee is to assess Delaware's vulnerability to current and future inundation problems that may be exacerbated by sea level rise and to develop a set of recommendations for state agencies, local governments, businesses and citizens to enable them to adapt programs, policies, business practices and make informed decisions.

Tony Pratt

Homes and wildlife habitat at Broadkill Beach, along the Delaware Bay.

Peggy Schultz

The Delaware Sea Level Rise Advisory Committee discussing a presentation.

About this Document

This document was developed by the Delaware Sea Level Rise Advisory Committee to help engage Delaware's citizens in sea level rise planning. It contains information about sea level rise and the role of Delaware's Sea Level Rise Advisory Committee. It also contains preliminary findings concerning the potential impacts of sea level rise based upon scenarios developed by the Delaware Department of Natural Resources and Environmental Control.

More information about this document and the Delaware Sea Level Rise Advisory Committee can be found online and at the address below:

http://www.dnrec.delaware.gov/coastal/Pages/DESLRAdvisoryCommittee.aspx

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Delaware's Sea Level Rise Advisory Committee

Delaware's Sea Level Rise Advisory Committee was established to help the state plan for future sea level rise because it could affect everything ranging from infrastructure sustainability to crop yields to wildlife habitat. The committee was established by invitation of Collin O'Mara, Secretary of the Department of Natural Resources and Environmental Control (DNREC), to investigate Delaware's vulnerability to sea level rise and to provide recommendations about how to best prepare for higher sea levels. The committee is composed of members from a wide variety of interest groups, including State agencies, local governments, citizen organizations, business organizations and environmental organizations. The committee's work has been split into two phases, a Vulnerability Assessment Phase and an Adaptation Planning Phase.

The Sea Level Rise Advisory Committee is now soliciting feedback from the public to incorporate into its vulnerability assessment. During the Adaptation Planning phase, the Advisory Committee will identify ways that government, businesses and citizens can adapt their policies and business practices to reduce the impact of sea level rise on our state's citizens, economy and natural resources. The final report of the Sea Level Rise Advisory Committee will contain recommendations to help governments, businesses and citizens prepare for sea level rise.

It is the intent of the Sea Level Rise Advisory Committee to provide information and guidance to help people make informed decisions when considering activities and investments in areas that may be at risk from the effects of sea level rise. The Advisory Committee will not oversee implementation of protective measures. Any action that would require a change in legislation or regulations will go through the normal legislative and public processes.

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Riverfront Homes in the City of New Castle, Delaware.

Peggy Schultz

The Delaware Sea Level Rise Advisory Committee discusses the issues.

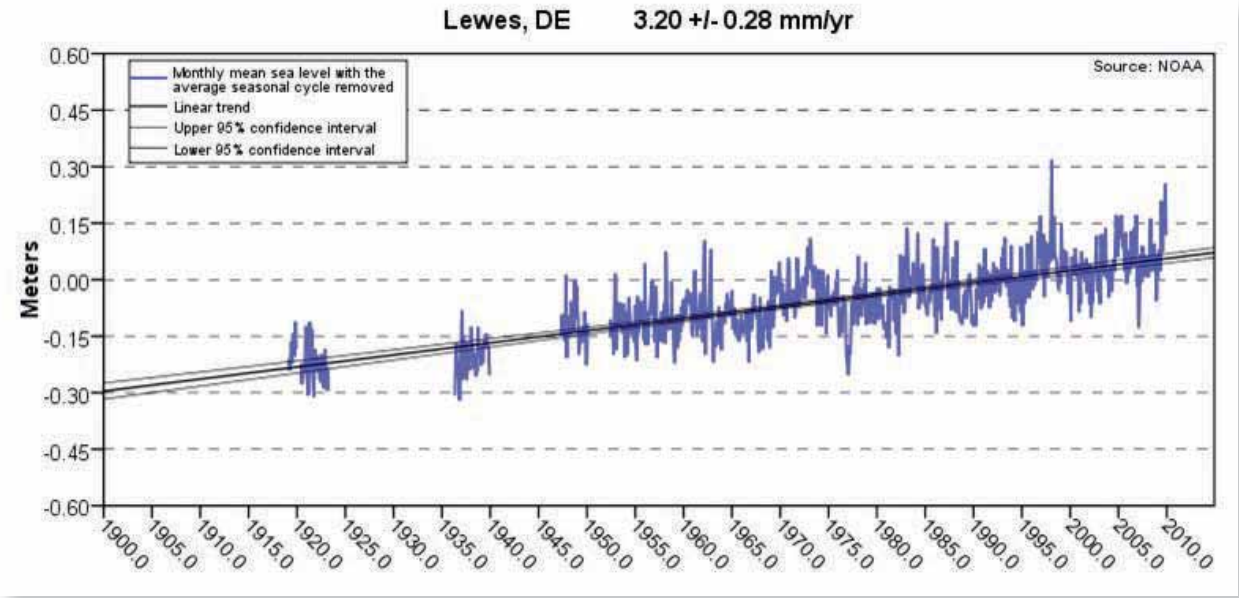
Sea Level Rise Advisory Committee Member Agencies

Delaware Department of Agriculture, Delaware Department of Health and Social Services, Delaware Department of Natural Resources and Environmental Control, Delaware Department of Safety and Homeland Security, Delaware Department of Transportation, Delaware Economic Development Office, Delaware Farm Bureau, Delaware League of Women Voters, Delaware Insurance Commissioner's Office, Delaware League of Local Governments, Delaware Legislature, Delaware Nature Society, Delaware Office of the Governor, Delaware Office of Management and Budget, Delaware Realtor's Association, Delaware State Chamber of Commerce, Home Builder's Association of Delaware, Kent County, The Nature Conservancy, New Castle County, Positive Growth Alliance, Tidewater Utilities, Inc., University of Delaware.

Delaware is a coastal state; its economy and quality of life have historically been linked to its shores, its vast expanses of protected tidal wetlands and its fertile farm fields. Because of its location and dependence on the coast, Delaware is particularly vulnerable to the effects of rising sea levels.

The line between land and sea along Delaware's coast is constantly on the move. It is obvious to those who live near or spend time on the water that the high tide line along Delaware's shorelines fluctuates daily depending on local weather and the cycle of the moon. Less obvious is the fact that the high tide line is slowly and steadily moving landward and upward[1].

Tide data has been collected at Lewes for ninety years and at Reedy Point (located near the C&D Canal) for fifty years. These data sets have given scientists consistent long-term tidal records to track tidal fluctuation and sea level changes in the ocean and bays. The tide data show that the mean sea level in Delaware has risen about a foot over the last century. Other long-term tide stations within the Mid-Atlantic region show similar trends[2].



Tide gauge data from Lewes, Delaware from 1900 – 2010

Globally, sea level rises for two main reasons: warming water and loss of ice on land. As the ocean absorbs solar radiation, the water warms. When water warms, it expands and causes the mean level of the water to rise. In addition, as the Earth becomes warmer, land-based glaciers and ice-caps melt. This melt-water empties into oceans and increases mean sea levels worldwide. The worldwide average rate of sea level rise during the twentieth century, as determined by tide gauge measurements, was about 0.07 inches per year (or about 7 inches over 100 years)[3].

[1]CCSP, 2009: Sea Level Rise and its effects on the coast. In: Coastal Sensitivity to Sea Level Rise: A Focus on the Mid-Atlantic Region. A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. J.G. Titus et al. U.S. Environmental Protection Agency, Washington D.C., USA, pp 11-24. Available online: http://www.climatescience.gov/Library/sap/sap4-1/final-report/

[2]Tide gauge information is available from the National Oceanic and Atmospheric Administration: http://tidesandcurrents.noaa.gov/sltrends/sltrends.shtml

[3]IPCC (Intergovernmental Panel on Climate Change), 2001. Observations: Oceanic Climate Change and Sea Level. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report of the IPCC [S. Solomon et al (eds)]. Cambridge University Press, Cambridge, UK, and New York, pp. 387 – 432. Available online: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html

[4]Tide gauge information is available from the National Oceanic and Atmospheric Administration: http://tidesandcurrents.noaa.gov/sltrends/sltrends.shtml.

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House raised above coastal flood zone in Slaughter Beach, Delaware.

Tide gauges indicate that Delaware's local sea level is rising faster than the worldwide average. The rate of sea level rise recorded at the tide gauge in Lewes is 0.13 inches per year (or 13 inches over 100 years)[4], as compared to the worldwide average rate of 0.07 inches per year. The difference between the local rate and the global rate is due to the vertical movement of the Earth's crust, which is causing the land in Delaware to slowly sink. Tide gauges used to track sea level record the combined motion of the land and the sea.

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[5]. If this occurs, it will affect homes, businesses, roads, natural areas and other important resources. Many federal, state and local officials have decided that it is prudent to begin planning now for the effects of rising sea levels[6]. A survey of Delaware citizens showed that they believe government, businesses and others should be doing more to prepare for sea level rise[7]. As a result, Delaware's Sea Level Rise Committee was formed to investigate the potential impacts that it could have on our state and recommend ways to adapt.

Delaware is just one of many states that is currently investigating and planning for the potential impacts of sea level rise. Maryland published an assessment and state policy recommendations in 2008; New York published their assessment and recommendations in 2010[8]. Massachusetts recently completed a climate change adaptation report which included considerations for sea level rise and North Carolina is currently studying potential impacts of sea level rise and storm surge in their state.

Tony Pratt

Low-lying homes along Delaware's Inland Bays

[5]IPCC (Intergovernmental Panel on Climate Change), 2001. Global Climate Projections. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report of the IPCC [S. Solomon et al (eds)]. Cambridge University Press, Cambridge, UK, and New York, pp 749 - 845. Available online: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html

[6]DNREC Sea Level Rise Technical Workgroup, 2009. Recommended Sea Level Rise Scenarios for Delaware. Available online: http://www.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/Final%20and%20Signed%20DNREC%20SLR%20scenarios.pdf

[7]Responsive Management, 2010. Delaware Residents' Opinions on Climate Change and Sea Level Rise, Report to the DNREC Delaware Coastal Programs. Available online: http://www.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/SLRSurveyReport.pdf

[8]A recent survey of Mid-Atlantic states highlights some of these initiatives: http://www.midatlanticocean.org/MARCOwhite%20paper_FINAL.pdf

Future Sea Levels

In 2009, the Delaware Department of Natural Resources and Environmental Control (DNREC) formed a Sea Level Rise Technical Workgroup to provide planning scenarios for sea level rise up to the year 2100. This workgroup, composed of scientists from the University of Delaware, Delaware Geological Survey, Center for the Inland Bays, Partnership for the Delaware Estuary and DNREC, reviewed historical data for local sea level rise and reviewed the findings of international and national expert panels. Based on this information, the Sea Level Rise Technical Workgroup recommended three planning scenarios. The conclusions of the workgroup were then reviewed by several national experts. The Committee chose to recommend a range of scenarios because it is not possible to precisely predict future rates of sea level rise[9]. These scenarios can be used for understanding and planning for sea level rise.

The Technical Workgroup's lowest scenario was a sea level rise of 1.6 feet (0.5 meters) between now and the year 2100. This scenario is slightly higher than the current rate of sea level rise in Delaware and is partially based on low estimates for future global warming. Their highest scenario was a sea level rise of 4.9 feet (1.5 meters) between now and the year 2100. This scenario is based on higher estimates of future global warming. Their middle scenario was 3.3 feet (1.0 meter) between now and the year 2100, and is based on moderate estimates of future global warming. From these planning scenarios, a series of maps was developed using very accurate elevation data. These maps show the areas that could be flooded (or inundated) for each planning scenario. The areas shown as inundated on these maps were used by the Sea Level Rise Advisory Committee to assess Delaware's vulnerability to future sea level rise. The maps are available through an on-line viewer at: http://www.dnrec.delaware.gov/Pages/SLRMaps.aspx

It is important to note that scientists are continually working to increase their knowledge about sea level rise and to provide better predictions of future sea levels. As new data and information become available, the planning scenarios and maps will be revised in order to reevaluate potential impacts.

These maps show the level of high tide in Bowers Beach, Delaware under three different planning scenarios, which were developed using local data coupled with scenarios generated by several federal agencies.

Bowers Beach at high tide, 2011.

Bowers Beach at high tide with 1.6 feet of sea level rise.

[9]DNREC Sea Level Rise Technical Workgroup, 2009. Recommended Sea Level Rise Scenarios for Delaware. Available online: http://www.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/Final%20and%20Signed%20DNREC%20SLR%20scenarios.pdf

Planning for the long-term effects of sea level rise may also help us better prepare in the short-term for flooding from coastal storms.

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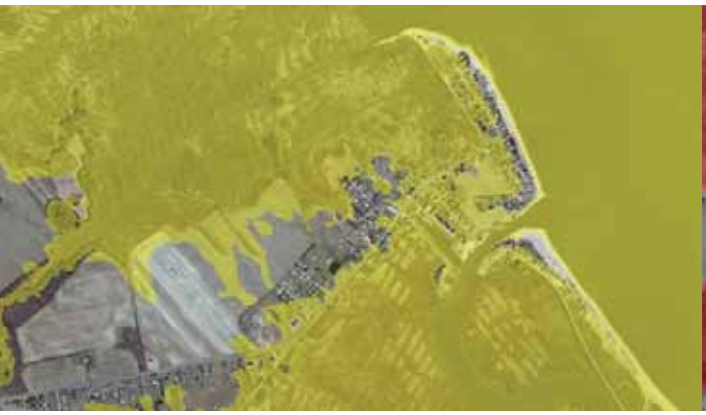
Dockside parking lot at Bowers Beach in May 2009 after a nor'easter.



Bowers Beach at high tide with 3.3 feet of sea level rise

Bowers Beach at high tide with 4.9 feet of sea level rise

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Impacts of Sea Level Rise

Rising sea levels can cause several major problems: loss of low-lying land and structures; saltwater intrusion into ground and surface waters; and increased coastal flooding from storm events.

Inundation of low-lying land and structures can occur when the sea level rises faster than natural forces can build land or where shoreline protection structures are not constructed. This can cause dry land to become flooded and can cause wetlands to convert into open water[10]. Structures, including homes, roads and utilities that have been built in low-lying areas can become difficult to access, suffer structural instability or become unusable. The sea level rise inundation maps show the areas where this might occur if we do not act.

Saltwater intrusion of ground water and streams can also occur as sea levels increase. In rivers and streams, sea level rise may cause the "salt-line" to move further inland, changing the types of vegetation in and around the stream and impacting fish spawning areas. It also may affect intake structures for drinking water and industry. In certain areas, water from the ocean and bay may turn groundwater supplies salty, affecting water used for drinking and irrigation[11].

As sea level rises, flooding from coastal storm events may also become more widespread as storm surges reach areas that are not normally prone to flooding. This can occur due to the higher mean sea level, combined with increased coastal erosion as well as loss of tidal wetlands that provide natural flood protection[10]. Storm flooding can cut off evacuation routes and cause damage to homes and infrastructure. While increased storm flooding is a very important consideration, understanding storm surge impacts statewide is a complicated undertaking and will require additional resources and time. Because of this, the maps that the Sea Level Rise Advisory Committee is using to determine potential future effects of sea level rise are based on a "bathtub model," showing all land below a certain elevation as flooded at each scenario. The maps do not yet include future storm surges, which could be higher than they have been in the past[10]. They also do not account for changes in topography that may occur in our coastal areas as a result of sea level rise and coastal storms.

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A driver navigates across a flooded road during a nor'easter in October 2009.

[10]CCSP, 2009. Sea Level Rise and its effects on the coast. In: Coastal Sensitivity to Sea Level Rise: A Focus on the Mid-Atlantic Region. A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. J.G. Titus et al. U.S. Environmental Protection Agency, Washington D.C., USA, pp 11-24. Available online: http://www.climatescience.gov/Library/sap/sap4-1/final-report/

[11]United States Environmental Protection Agency and the Delaware River Basin Commission, 1986. Greenhouse Effect, Sea Level Rise and Salinity in the Delaware Estuary. EPA-230-05-86-010. Available online: http://www.epa.gov/climatechange/effects/downloads/delaware.pdf

A flooded business in Little Creek, Delaware during a November 2009 nor'easter.

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Many people are surprised to learn that sea level rise effects may be seen throughout each of Delaware's three counties, not just at the ocean beach communities.

Eric Crossan

The St. Jones River meeting the Delaware Bay, southeast of Dover, Delaware.

Tony Pratt

Homes in Bethany Beach, Delaware during a coastal storm.

Early Planning for Sea Level Rise

Delawareans are always planning for the future, whether it is for retirement, a business expansion, a park, a school or a new highway. Many of these plans look forward only 20 to 30 years, but new amenities like a park or a new bridge have lifespans of 50 to 100 years. The rate of sea level rise is rarely considered in such plans. Accounting for changes in sea level that may be expected to occur over the lifetime of these projects will help us make informed decisions for public and private investments by minimizing risk and minimizing potential for damage. For example, expensive retrofits or replacements of roads and buildings could be avoided by building structures that are designed to withstand a certain rise in sea level. Proactive planning may also ensure that funding and resources are available for projects like shoreline stabilization, wetland restoration and infrastructure improvements that may be necessary to help Delaware's economy and natural resources continue to flourish even with the challenges of sea level rise.

Planning for the long-term effects of sea level rise may also help us better prepare in the short-term for flooding from coastal storms. Storm surges of between two and four feet frequently occur along the Delaware Bay and Atlantic coast from tropical storms and nor'easters. Delaware's largest storm on record, a nor'easter that occurred in 1962, caused a storm surge of 4.5 feet (1.4 meters) in Lewes; a nor'easter that occurred on Mother's Day in 2008 produced a storm surge of 4.0 feet (1.2 meters) in Bowers Beach. These storm surges are comparable to our highest sea level rise planning scenario; any actions taken to reduce the effects of sea level rise will also have the added benefit of increased protection from storm surge flooding.

The impacts of storm surge from Hurricane Irene in August 2011 take a toll on State Highway Route 9 over Augustine Creek near Port Penn, Delaware.

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Broad Dike tide gate in New Castle, DE.

Delaware's Vulnerability to Sea Level Rise

Many people are surprised to learn that sea level rise effects may be seen throughout each of Delaware's three counties, not just at the ocean beach communities. The Sea Level Rise Advisory Committee has found that some of our most vulnerable areas are located in Kent and New Castle Counties. In Kent County, vast stretches of protected tidal marshes that are home to a wide array of wildlife species are at particular risk from increasing sea levels, but fewer homes and businesses are impacted because coastal Kent County remains relatively rural. In New Castle County, developed areas like Delaware City, the Town of New Castle and low-lying areas in Wilmington are at risk, as are job centers like the Port of Wilmington and Wilmington's Riverfront. In Sussex County, residential areas along the Delaware Bay and Inland Bays are at risk, as are developed areas on the barrier island between Dewey Beach and Fenwick Island.

The Sea Level Rise Advisory Committee formed three workgroups to investigate potential impacts of sea level rise: Natural Resources, Public Safety & Infrastructure, and Society & Economy. Each workgroup used existing data and the sea level rise inundation maps to determine what important resources, amenities and structures are within areas that might become inundated as a result of sea level rise. They also documented potential effects to Delaware's residents, economy, and natural resources.

The community of Kitts Hummock next to the Delaware Bay.

Eric Crossan

An oil recycling facility sits directly next to the Christina River in Wilmington, Delaware

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Natural Resources

The Natural Resources Workgroup focused on assessing impacts that might occur in Delaware's important wildlife habitats, preserved land, nature preserves and agricultural areas. The workgroup's major findings include:

- Sea level rise is predicted to affect up to 99 percent of Delaware's tidal wetlands. These wetlands protect communities from floods and storms and serve as critical habitat for fish, shellfish, birds, waterfowl and wetland plants. If tidal wetlands are not able to move landward or accumulate sediment to keep pace with rising waters, these areas will revert to open water. The inundation of tidal wetlands could create major environmental changes including increased storm surge susceptibility, fewer fish and poorer water quality for our bays and beaches. These impacts may also affect Delaware's commercial and recreational fishing industries.

- The number and variety of species present (biodiversity) within Delaware may be negatively affected as different habitat types are impaired or eliminated by rising water. Some unique environments, such as freshwater tidal wetlands, are becoming increasingly rare not only in Delaware but in the Mid-Atlantic and globally. Sea level rise will further stress these distinctive environments and the plant and animal species that inhabit them.

- The beaches along the Atlantic Coast and Delaware Bay provide recreational opportunities, bring in tourism dollars, provide storm surge protection for coastal communities and are important habitat for key species like horseshoe crabs and migrating shorebirds. Beach nourishment projects offer short term protection from rising waters but the cost effectiveness and sustainability of these efforts are often debated. An increased rate of sea level rise may make it more difficult and costly to maintain beaches

- Agriculture is integral not only to Delaware's economy, but to the social, environmental and cultural heritage of our state. Impacts from sea level rise (and associated effects from salt water intrusion) include decreased crop yield, inability to grow salt-intolerant crops, and impacts to the health of domestic livestock. Additionally, shallow irrigation wells in coastal areas may become contaminated with salt water. Two percent of the almost 500,000 acres of actively farmed land in the state is within an area that could be inundated by 3.3 feet (1.0 meter) of sea level rise.

- Protected lands in coastal areas, such as state forests and wildlife areas, federal wildlife refuges, parks, conservation lands and nature preserves, could be affected by sea level rise. Forty-two percent of the state's 168,000 acres of protected lands are within areas that could be inundated by 3.3 feet (1.0 meter) of sea level rise. Impacts from this could include loss of wildlife habitat and open space in addition to reduced recreational opportunities for hunting, fishing, and bird watching.

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Rob Robinson

Resources Analyzed

Highly Productive Soils, Agricultural Land Preservation Districts, Agricultural Conservation Easements, Protected Lands, Undeveloped Groundwater Recharge Areas, Tidal Wetlands, Non-Tidal Wetlands, Impoundments, Habitats of Conservation Concern, Shellfish Areas, Upland Forest, Natural Heritage Program Native Vegetation.

Workgroup members

Partnership for the Delaware Estuary, The Nature Conservancy, Center for the Inland Bays, Department of Natural Resources and Environmental Control, Department of Agriculture, Delaware Nature Society, Delaware Farm Bureau, Coastal Delaware National Wildlife Refuge Complex, University of Delaware.

Society and Economy

The Society and Economy Workgroup focused on assessing impacts from rising seas that might be felt by citizens, businesses, agriculture and vulnerable populations. Existing information was used to begin assessing these impacts, but additional studies and research will be necessary to fully understand and quantify the economic and social impacts of sea level rise. Some of the workgroup's major findings include:

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- Homes within low-lying areas along the Delaware River and Bay and Delaware's Inland Bays could be subject to repetitive flooding as a result of sea level rise. Of the approximately 411,000 homes in Delaware, three percent are within areas that could be inundated by 3.3 feet (1.0 meter) of sea level rise. Although the total percentage is small, the individual impact to families and communities within these areas could be significant. Manufactured home communities in Sussex County are particularly at risk; over thirty percent of the county's 10,000 manufactured homes are potentially inundated by 4.9 feet (1.5 meters) of sea level rise.
- For many businesses, sea level rise could result in reduced accessibility to customers and added expenses for flood protection and repairs. Commercial and recreational fishing operations and water-based tourism businesses could be particularly affected, as they are by necessity, located in waterfront areas. Of the 51,000 commercial business licenses in Delaware, two percent have addresses located within areas that could be inundated by 3.3 feet (1.0 meter) of sea level rise.
- Industrial and manufacturing facilities provide goods and materials to the region, and also provide jobs and tax revenues. An increase in sea level at these facilities may lead to costly repairs and upgrades, loss of production or eventual abandonment of some sites. Twelve of Delaware's industrial and manufacturing facilities are within areas that could be inundated by 4.9 feet (1.5 meters) of sea level rise, but the operations of many other facilities may be affected by the impact of rising water on their associated structures including wastewater treatment lagoons, intake pipes and docks.
- Archeological and historical sites are important cultural resources and key to understanding Delaware's past. These sites could be permanently impacted due to inundation, but rising water tables damage archeological sites well before they are lost to permanent flooding. Three percent of the over 14,000 historical sites catalogued by the Delaware State Historic Preservation Office are within areas that could be inundated by 3.3 feet (1.0 meter) of sea level rise.
- Outdoor recreational opportunities abound in Delaware, but could be significantly impacted by sea level rise. Twenty-two percent of the State's 24,000 acres of parkland is within areas that could be inundated by 3.3 feet (1.0 meter) of sea level rise. Inundation of parkland could result in fewer outdoor recreational opportunities for citizens, loss of coastal access points and potential loss of tourism revenue.

Resources Analyzed

Commercial Addresses, Business Licenses, Facilities permitted under the Coastal Zone Act, Toxic Release Inventory Sites, Residential Addresses, Future Development Areas, Acreage of Actively Farmed Lands, Acreage of Confined Feeding Operations (CAFO), Acreages of Farmsteads and Related Buildings, US Census, Active Recreational Areas, Open Space Areas, Boat Ramps, State Historic Sites, National Register Sites.

Workgroup Members

Delaware Department of Natural Resources and Environmental Control, Delaware Department of Health and Social Services, Delaware Economic Development Office, Delaware Association of Realtors, University of Delaware, Delaware Department of Agriculture, Delaware Office of Management and Budget, Delaware Chamber of Commerce, Delaware House of Representatives, New Castle County, Delaware Homebuilders Association, Kent County, Delaware Department of Transportation, Delaware Insurance Commissioner's Office, Positive Growth Alliance.

Public Safety and Infrastructure

The Public Safety and Infrastructure Workgroup focused on assessing impacts that might be felt by public safety providers, transportation, utilities, public services, and industrial services. The workgroup gathered data from a wide range of sources to assess the impacts sea level rise will have on Delaware's infrastructure. Some of the workgroup's major findings include:

- Over 150 police, fire and rescue stations and emergency medical service (EMS) stations ensure public safety across Delaware. Of these, five police stations, eight fire and rescue stations and two EMS stations are within areas that could be inundated by 4.9 feet (1.5 meters) of sea level rise. While the physical number of stations impacted is small, citizens living within their service areas could be significantly impacted by reductions in service or longer travel times for emergency calls.

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- Many of Delaware's roadways, including important evacuation routes like Route 13 and Route 9, already experience chronic flooding during storm events and extreme high tides. Statewide, four percent of the State's nearly 9,000 miles of road are within areas that could be inundated by 3.3 feet (1.0 meters) of sea level rise. Inundation of even a small segment of a roadway can cause detours and increase congestion problems miles from the flooded area.


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- A system of dams, dikes, and levees provides flood protection for roads, homes, businesses and wildlife areas throughout the state. Several important dikes that protect developed areas from tidal flooding are in poor condition as a result of erosion, animal burrows and overgrowth. In their current condition, almost three-quarters of the dikes in Delaware could be overtopped by sea level rise of 3.3 feet (1.0 meter).

- Central sewer systems provide wastewater disposal for suburban and urban homes and businesses. Four of Delaware's waste-water treatment facilities are within areas that could be inundated by 4.9 feet (1.5 meters) of sea level rise. Inundation of these facilities could result in reduced treatment capacity, sewer line overflows, sewer backups into homes, increased operating costs and impaired water quality.

- The Port of Wilmington, a major economic and transportation hub could be significantly impacted by sea level rise. At 1.6 feet (0.5 meters) of sea level rise, over thirty percent of its docks, cargo transfer areas and warehouses could be inundated. Transport of cargo from the port could also be affected by inundation of several local roads which connect the port to interstate highways. Without action, these impacts could mean reduction in port traffic and cargo, along with reductions to the job force and the overall economy of the region.

Resources Analyzed

Ambulance & Paramedic Stations, Fire & Rescue Stations, Police Stations, Evacuation Routes & Emergency Shelters, Emergency Operations Centers, Roads and Railroads, Public Transportation, Ports, Utilities, Wastewater Facilities, Drinking Water, Adult & Child Care Facilities, Correctional facilities, Cemeteries, Hospitals, Government Buildings, Schools, Hazardous Waste Sites, Manufacturing and Industrial Sites, Salvage Yards & Landfills, Dams, Dikes and Tide Gates.

Workgroup Members

Delaware Department of Homeland Security, Delaware Department of Transportation, Delaware Department of Natural Resources and Environmental Control, Delaware League of Women Voters, Tidewater Utilities, City of Lewes, University of Delaware.

Next Steps

The Sea Level Rise Advisory Committee will be sharing the preliminary results of the vulnerability assessment at a series of public engagement sessions in November of 2011. Information from the public will be collected and incorporated into the vulnerability assessment before it is finalized.

The vulnerability assessment will then be used by the Sea Level Rise Advisory Committee to develop a Sea Level Rise Adaptation Plan that will contain guidance and, in some cases, recommendations for adapting to the changes that future sea levels might bring to the coastline of Delaware. The Adaptation Plan can be used for a variety of purposes: state and local agencies may use it to do more detailed studies of their assets and operations to develop detailed adaptation plans; businesses may use it to plan for future changes to their operations and customer-base and individuals may use it to plan for improvements to their homes and communities.

Tony Pratt

The City of Lewes, Delaware and vicinity.

Blackbird Creek in Townsend, Delaware

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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.

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.

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.

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

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

Storm Surge - A large increase in sea level generated by extreme weather conditions.

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

Delaware Sea Level Rise Advisory Committee

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