**Chapter 2**

**REVIEW OF RELATED LITERATURE**

## 2.1 Project NOAH (Nationwide Operational Assessment of Hazards)

Project NOAH is the Department of Science and Technology’s (DOST) response to the call of President Benigno S. Aquino III for a more accurate, integrated, and responsive disaster prevention and mitigation system, especially in high-risk areas throughout the Philippines.The Project will harness technologies and management services for disaster risk reduction activities offered by the DOST through PAGASA, PHIVOLCS, and the DOST-Advanced Science and Technology Institute (ASTI), in partnership with the UP National Institute of Geological Sciences and the UP College of Engineering.Automated rain gauges (ARG) and water level monitoring stations (WLMS) will be installed along the country’s major river basins (RBs) to provide a better picture of the country’s surface water in relation to flooding.The project shall use LIDAR technology and computer-assisted analyses to identify exact areas prone to landslides.Targeted to be completed by December 2013 is a flood center that will provide timely and accurate information for flood early warning systems. The FloodNET  Project will come up with computer models for the critical RBs, automate the process of data gathering, modeling and information output, and release flood forecasts. [13]

**2.2 A Coastal Flood Monitoring System for Delaware**

During the last two decades, storms such as Hurricanes Katrina and Ike along the Gulf of Mexico and Floyd and Hugo along the Atlantic Coast of the United States have resulted in significant loss of life, injuries, and property damages exceeding well over 100 billion dollars. Much of the damage associated with these and other tropical and extra-tropical weather systems is associated with severe coastal flooding. The Delaware coastline is extremely vulnerable to such events. A recent example of coastal flooding is the event of May 12, 2008, which left at least one person dead and many people homeless after ocean flood waters destroyed homes, especially along the Delaware Bay Coast of Kent County. The added concern of sea-level rise and its effect on the frequency and intensity of coastal flooding events, further emphasizes the need for a modern, dependable coastal flood monitoring system for Delaware’s coastal communities.

The purpose of this project is to develop a real-time coastal flood monitoring and warning system for the coastal communities in Delaware. A prototype system was built for selected coastal communities along the Delaware Bay coast in Kent County. Work has also begun to expand the system to other areas along the Delaware Bat coastaline (i.e., areas within the coastal plain of Delaware where coastal flood potential is dominated by tidal fluctuations).

The Coastal Flood Monitoring System is comprised of:

1. an early warning alert system (via emails and/or cell phone text messages that alerts subscribers of potential flood events,
2. flood inundation maps and elevation profiles along primary evacuation routes using the latest LiDAR data for Delaware,
3. predicted water level data from NOAA’s hydrodynamic model for up to 4 days in advance in graphical and tabular format, and
4. a website and user guide that combines all aspects of this system with links to more real-time information (e.g., NWS weather alerts) for planners and emergency managers to use in advance of and during coastal storm events.

The deliverables from this project are used by several state agencies including the Delaware Department of Natural Resources and Environmental Control (DNREC), the Delaware Emergency Management Agency (DEMA), the Delaware Department of Transportation (DelDOT), and the Delaware National Estuarine Research Reserve (DNERR). Moreover, the proposed system will have a direct impact upon the well-being of Delaware's coastal communities.

Development and operation of the system builds on the existing expertise of the staff of the Delaware Environmental Observing System (DEOS) and the Delaware Geological Survey and is being conducted in cooperation with Delaware Coastal Program Section, DNREC. [14]

**2.3 LiDAR Technology**

**Lidar** (also written **LIDAR** or **LiDAR**) is a [remote sensing](http://en.wikipedia.org/wiki/Remote_sensing) technology that measures distance by illuminating a target with a [laser](http://en.wikipedia.org/wiki/Laser) and analyzing the reflected light. The term lidar comes from combining the words [light](http://en.wikipedia.org/wiki/Light) and [radar](http://en.wikipedia.org/wiki/Radar).

Lidar is popularly known as a technology used to make high resolution maps, [geomatics](http://en.wikipedia.org/wiki/Geomatics), [archaeology](http://en.wikipedia.org/wiki/Archaeology), [geography](http://en.wikipedia.org/wiki/Geography), [geology](http://en.wikipedia.org/wiki/Geology),[geomorphology](http://en.wikipedia.org/wiki/Geomorphology), [seismology](http://en.wikipedia.org/wiki/Seismology), [forestry](http://en.wikipedia.org/wiki/Forestry), [remote sensing](http://en.wikipedia.org/wiki/Remote_sensing), [atmospheric physics](http://en.wikipedia.org/wiki/Atmospheric_physics), airborne laser swath mapping (ALSM), laser altimetry, and [contour mapping](http://en.wikipedia.org/wiki/Contour_map). [15]

**2.4 UrbanFlood (Europe)**

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|  | UrbanFlood is a European funded project\* investigating the xuse of sensors within flood embankments to support an online early warning system, real time emergency management and routine asset management. Application of the concepts to support routine asset management, which includes the regular inspection of dikes, will also be considered. Safer dikes are not only stronger but also smarter dikes.  **Early Warning System Framework for European Cities**  More than two thirds of European cities have to deal with flood risk management issues on a regular basis; these are issues which will worsen as climate change effects result in more extreme conditions. Early Warning Systems (EWS) can play a crucial role in mitigating flood risk by detecting conditions and predicting the onset of a catastrophe before the event occurs, and by providing real time information during an event. EWSs thus fulfil multiple roles as general information systems, decision support systems and alarm systems for multiple stakeholders including government, companies and the general public.  **The UrbanFlood approach**  The UrbanFlood project will create an EWS framework that can be used to link sensors via the Internet to predictive models and emergency warning systems. The data collected from the sensors will be interpreted to assess the condition and likelihood of failure; different models will be used to predict the failure mode and subsequent potential inundation in near real time. Through the Internet, additional computer resources required by the framework are made available on demand.  UrbanFlood will validate the EWS framework and method for implementation in the context of dike performance (failure) in an urban environment.  A number of live pilot sites will be used to prove the methodology. Dikes will be equipped with sensor systems and the EWS service built up from a series of dike failure and flooding specific modules which include dike breach evolution and flood-spreading models. UrbanFlood will investigate and show the feasibility to remotely monitor dikes and floods, whether from nearby offices or from other countries and continents through secure use of web based technologies.    For the development of flood mitigation scenarios and the training of personnel, the framework will also connect to a simulator that computes flood responses associated with failing dikes. UrbanFlood will make use of data from the induced failure of real dikes at the IJkdijk field laboratory to test and validate the overall EWS framework and individual modules. [16] |  |  |