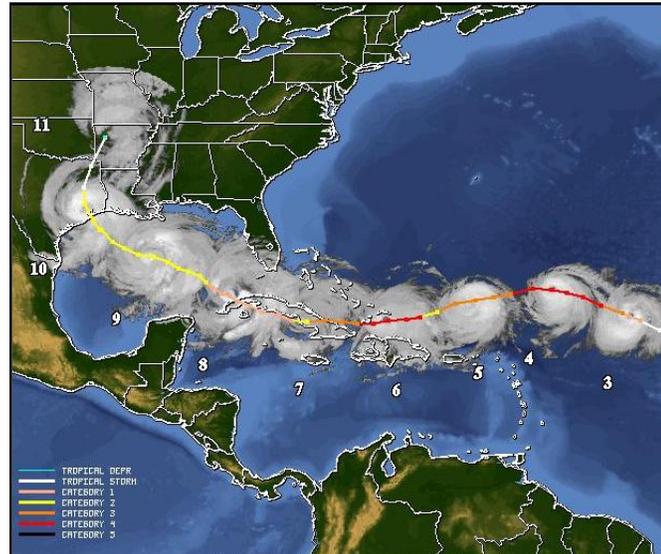


HURRICANE IKE, POWER SUPPLY AND HOUSTON'S WASTEWATER SYSTEM

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Ike, a 500-mile wide category 2 hurricane, made landfall on the Southeast coast of Texas and Southwest Coast of Louisiana on September 13, 2008. The eye of the hurricane passed over the City of Houston causing extensive damage to properties and lives. Although Ike was category 2, the destruction cause was equivalent to a category 4 hurricane. Houston experienced sustained winds of up to 60 mph and wind gusts up to 110 mph. The storm surge along the coast ranged from 8 feet to 21 feet high resulting in water several miles inland.



Approximately 180 million dollars were approved by the Federal Emergency Management Agency (FEMA) to aid recovery efforts. American Red Cross spent over 45 million dollars; Small Business Administration was issued disaster loans totaling to 30 million dollars and approximately 35 million dollars were received by Houston Independent School District. Approximately 750,000 residents were seeking assistance. United States Army Corps of Engineers distributed over 11,000 blue tarps and over 7 million cubic yards of debris were on the streets. 36 lives were lost in the Greater Houston–Galveston area.

City of Houston's public infrastructure also experienced losses including traffic signals, water supply and wastewater facilities. Power supply was lost for extended periods resulting in public services being affected.

The City of Houston's wastewater infrastructure consists of 39 Wastewater Treatment Plants (WWTP), 420 Lift Stations, 3 Wet Weather Facilities, 33 million linear feet of gravity sewers, 1.5 million linear feet of force mains and approximately 130,000 manholes. The service area includes 625 square miles and serves a population of approximately 2.9 million people.

Due to the proximity to the Gulf Coast, the City of Houston has a plan for hurricanes. A Standard Operating Procedure for emergencies is in place for the Public Works and Engineering Department (PW&E) including Wastewater Operations Branch (WOB). The WOB emergency response plan includes strategic placement of critical employees, a detailed database of back up power requirements for facilities, and portable generators deployment plan. Preparation for hurricane Ike included performing preventive maintenance of all generators and vehicles,

strategic placement of resources, reviewing of emergency procedures with employees and maximizing chemical storage.

Power supply was affected as soon as Hurricane Ike approached the Greater Houston area. Outages were experienced Citywide including at all the wastewater treatment facilities and lift stations. Damages to the power supply were experienced at every level including major transmission lines, distribution lines and individual lines. Multiple level of system component including transformers and panels were affected. The outage time varied from 3 days to 24 days.

A dramatic increase (approximately 30%) in the Sanitary Sewer Overflows (SSOs) occurred as a result of power outages at the lift stations and treatment plants. Sewage in the collection system turned septic resulting in increased odor complaints. Equipment damages at several facilities were noted. Communication systems such as Supervisory Control and Data Acquisition (SCADA), phone and email services were also affected. Numerous fences and gates were damaged compromising security of the facilities.



Facilities that experienced major damages were Sims Bayou WWTP (permitted capacity of 25 mgd) and Clinton Drive lift station (firm capacity 400 mgd). Minor damages were experienced throughout the system including several gravity main breaks.

Recovery efforts began immediately after the storm passed and winds subsided. The efforts were initially hampered by disruption to communication systems, debris on streets and flooding due to storm surges. Damage assessment teams were dispatched to every facility.



The deployment, fueling and maintaining of generators was meticulously planned and was a coordinated effort between City personnel, FEMA and City contracted companies. Factors considered during deployment were commercial power restoration schedule, facility size, population served, downstream to upstream approach and SSOs in the area. A total of 93 generators were utilized.

Recovery efforts included performing repairs, starting up of the facilities and cleaning up of SSOs.

Communications was a key component of recovery efforts and included updating the PWE Director's Office, Mayor's Office, Council Member's Offices, media, customers, state and federal agencies and regulators. Successful recovery was possible due to the dedication and team effort of the entire WOB and PWE personnel.

WOB learned several lessons from responding to Hurricane Ike. A high quality damage assessment must be performed in a timely manner. The assessment should include site accessibility, structural damage, equipment malfunctions, power supply, and resources needed to restore the facilities. Generator deployment should be a very well coordinated and the facilities should be equipped with quick connects for generators. If other utilities in the area also are affected, then resource availability becomes a challenge. The feasibility of an on-call contract with generator vendors, pump suppliers, technicians, electricians, CDL drivers should be investigated. Staff should also be well trained in FEMA procedures, policies and paper work. Commercial power suppliers should work closely with public utilities during recovery efforts. To be very successful, a public utility should have a well thought out plan to provide power to all its facilities within a 24 to 48 hour time frame after a disaster.