

# HURRICANE READY

By MARK MOORE

## NC TOWN HAS SEWERS THAT WITHSTAND STORMS



**H**urricanes are terrifying but not surprising in the Carolinas. Statistically, we can expect one to hit our shores every other year. Over the past two years we've met our quota.

In October 2016, Hurricane Matthew skirted the coast of North and South Carolina. It made landfall briefly at McClellanville, SC, before tracking north-east back into the Atlantic. Over a two-day period it brought high winds, heavy rains and a massive storm surge to our city, Oak Island, North Carolina.

Almost two years later, in September 2018, Hurricane Florence stormed the Carolina coast. It made landfall near Wrightsville Beach, NC, about 30 miles north of Oak Island. The slow-moving Category 1 hurricane pounded the area with record rainfall – more than 30 inches in a three-day period.

In both instances there was significant damage, much of it due to flooding. There were fatalities resulting from both events: 39 in North Carolina attributed to Florence, 26 deaths to Hurricane Matthew.

In spite of the massive devastation, our public works held up well during both storms, especially our sanitary sewers.

Oak Island was prepared for hurricanes and as a result, our systems weathered the storms. In neither storm did we ever lose electrical power. We also had no sewage overflows during or after the storms and sewer service was restored throughout our city within hours of the storms' passing. We

also kept our public works crews safe as they prepared for the onslaught.

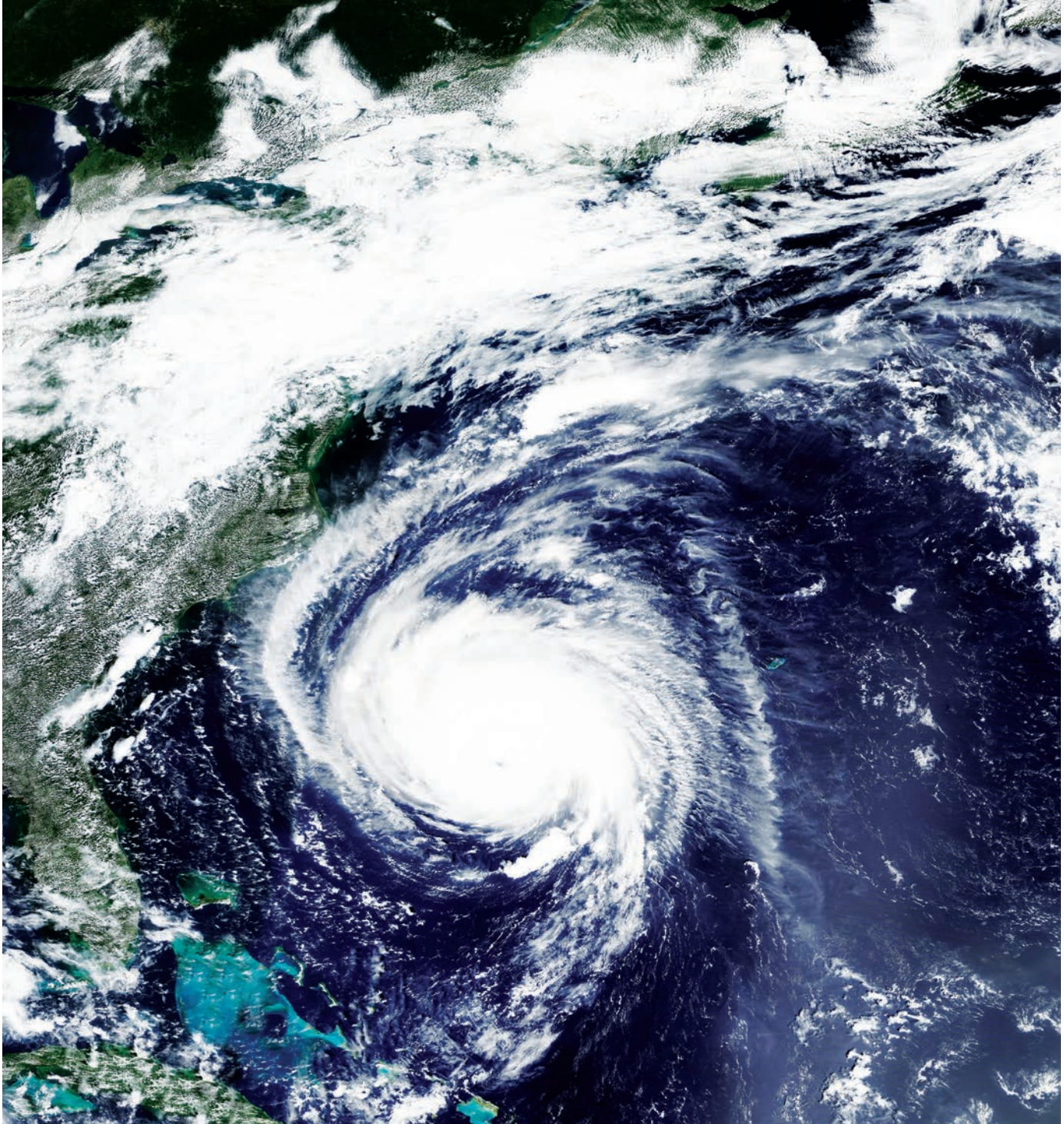
### Two Big Concerns

Oak Island is located on North Carolina's Atlantic shore about 40 miles northeast of Myrtle Beach, South Carolina. Our city is small, with a population of 6,800 in the off-season, but we grow substantially in the summer to approximately 30,000 or more. There are about 3,000 households and about 6,600 housing units in Oak Island.

We have two sewer systems; a gravity system with 1,000 connections and 32 lift stations, and a vacuum sewer system with 8,700 connections and nine vacuum stations. The gravity system was built in 1992, the vacuum system in 2007-10, so both are relatively new by public utilities standards.

Two of the biggest concerns for sewer operators facing a hurricane are the loss of electrical power and storm water infiltration/system overflow. The loss of electrical power at the vacuum and lift stations means the loss of sewer service in the community, while infiltration can overload the system and cause backups and overflows which contaminate groundwater and, potentially, potable water supplies. Excess infiltration also can overload the local treatment center. All of these are significant problems.

Losing electric power is not a big concern for us. Our power lines are buried so they are not exposed to the extreme winds caused by hurricanes. Plus, we have backup generators ready should the electric grid be shut down



A satellite photo shows Hurricane Florence just hours before it made landfall in September 2018. The slow-moving hurricane caused severe damage and was responsible for 26 deaths in North Carolina alone.

for any reason. Oak Island was one of the only towns in this area to maintain power during our most recent hurricanes.

Prior to a storm arriving, we shut down our vacuum stations near the beachfront and in low-lying areas. This added benefit of protecting our vacuum system infrastructure is something that is not possible with a gravity system as there really is no way to shut down a gravity system. With vacuum, this is

a precaution to prevent storm water or ocean surge from infiltrating and overwhelming the system and damaging the vacuum pumps. Although vacuum sewers are “closed systems” that prevent both infiltration and exfiltration, storm water will sometimes enter the system from man-made sources – homeowners have actually drilled holes in collection line cleanout caps to act as a drain. About 90 percent of infiltration after a

flooding event enters the system this way.

### **Pre-Storm Actions**

Shutting down the vacuum stations is a simple process, basically five steps:

- Fuel and check the generators.
- Check vacuum cleanout caps to ensure all are intact.
- Pick up around the vacuum

## Sewer & Collection Systems



**CONTROL CENTER** – One person can control most aspects of Oak Island’s vacuum sewer system from a central command center. Here, the operator can see the status of each of the city’s nine vacuum stations and make adjustments to any one of them.

- stations to prevent flying debris.
- Alert residents that the system will be shut down during the storm.
- Close specific isolation valves and mark them with a stake (if sand should wash in and obscure them).

We wait until the last possible moment before the storm arrives, factoring in a safety margin for our staff, to shut down the vacuum stations. Residents who have not evacuated (most seaside residents do evacuate) can still use their toilets and run water on a limited basis as the vacuum pits and the laterals that connect the house to the pit have some capacity to hold a limited amount of sewage. Once the storm has passed, our crews can reopen the isolation valves and vacuum stations within a couple of days.

Gravity lift stations typically remain online during storms, but overflowing the system is always a concern as collection lines and manholes always allow some infiltration. During Hurricane Florence we were very close to breaching the lift stations, within a foot or so at some locations, but it never happened. We were

fortunate given the size of the storm surge during that event.

### Plan, Learn, Maintain

Hurricane preparedness is a matter of planning, learning from past experiences and on-going maintenance.

Part of our preparedness lies in the fact that we have vacuum sewers that prevent the threat of infiltration and exfiltration. Unless a component is damaged, such as a cleanout cap or valve pit, there is no threat of sewage contaminating the environment or storm water overwhelming the system and treatment plant.

Past experience, along with advice from our vacuum technology provider Airvac, has taught us how to prepare for a hurricane. With a few simple steps we are ready for the storm, no matter how severe.

We conduct ongoing rehabilitation and maintenance programs on our gravity sewer collection lines and manholes to help reduce infiltration during storm events. Some storm water inevitably enters the system, but we’ve managed to keep it at a manageable amount.

The benefits of sewer preparedness are significant; protection of our

environment from sewage, the ability to have full sewer service quickly after a storm, and the safety of our staff are all priorities for us. We can expect hurricane to come through on a regular basis, so it is vital for public works officials to do everything within their control to prepare for storms and keep the sewers functional. Our residents depend on our service.

Mark Moore is the Wastewater Superintendent for the Town of Oak Island, North Carolina. He has been on the job there for 19 years and formerly served in the U.S. Coast Guard.



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**VACUUM STATION** – This is one of Oak Island’s nine vacuum sewer stations. In the event of a power outage, the stations can be powered by a portable generator (shown here).

# THE COASTAL-VACUUM CONNECTION

By **RICH NARET, P.E.**  
**Airvac Technical Director**

Why do so many coastal communities install vacuum sewers? There are 71 Airvac systems in Florida, 29 in North and South Carolina, 27 in Virginia and 13 in Texas. What’s the connection?

There are several benefits of vacuum technology, but for coastal cities one of the most important is the environment. Vacuum sewers are sealed systems, there is no infiltration or exfiltration. Sewage stays in the system and storm water stays out, so the local environment is safe.

The environmental benefits of vacuum sewers are extremely helpful when communities face severe storms. Public works officials know the consequences of sewer overflows and massive storm water infiltration. They rely on the protection inherent in vacuum sewer design and the expertise provided by Airvac experts to keep sewers operational before and after storms.

In the past 15 years, all of the 140 Airvac coastal systems have been exposed to hurricanes, some several times. In that time there have been no significant problems and all of them emerged operational with little or no damage. Bottom line: vacuum sewers can weather the storm.



## Advantages of Vacuum Systems in Hurricane Prone Areas

ADVANTAGE	WHY?
<b>Treatment Plant Not Affected</b>	Vacuum systems are sealed, so massive amounts of I & I cannot enter the system and overwhelm the treatment plant.
<b>Uninterrupted Service</b>	All vacuum stations have either a fixed or portable standby generator, which ensures uninterrupted service to customers.
<b>Less Hurricane Preparation is Required</b>	Vacuum systems eliminate the threat of massive I & I and sewage spills. In coastal areas one vacuum station typically replaces 7-8 lift stations – less storm prep work for your staff.
<b>Safer Working Conditions for the Maintenance Staff</b>	Most vacuum stations have the fixed generators that automatically start during a power outage. A vital safety feature – no need to expose your maintenance staff to the severe weather.
<b>As Last Resort, a Vacuum System Can Be Shut-off</b>	If water levels rise to the point where the air-intakes are in danger of flooding, the entire vacuum system can easily be turned off, thus preventing damage to the system.