



City elevation data still show the old Cooper River bridges.

This deep drainage line and pump combination has helped alleviate flooding in the area of Calhoun and East Bay streets.

Pump station: Its four punps can evacuate 480,000 gallons a minute. (An Olympic-size swimming pool holds roughly 660,000 gallons.)

The deep drainage system is to be extended to the Market Street area. Bidding on the tunnel should happen this year or early next year.

Older parts of town were built on the peninsula's original high ground.

Tide valves have helped reduce the flooding on the western end of The Battery.

1 Marsh filled in

Lower-elevation areas
Original high-ground area (approx.)
 Centuries ago, the area of the peninsula that was above sea level was much smaller; over time its marsh was filled in, often using debris, wood shavings — whatever was bulky and cheap — and often with little regard for letting water drain downhill from high land around King Street. Today these areas are often low-lying and prone to flooding.

Four reasons the city floods

A way to solve many of the problems isn't cheap

When the tide comes in and rain falls, large parts of the Charleston peninsula that once were marsh and tidal creeks can quickly flood. The water simply has nowhere to go.

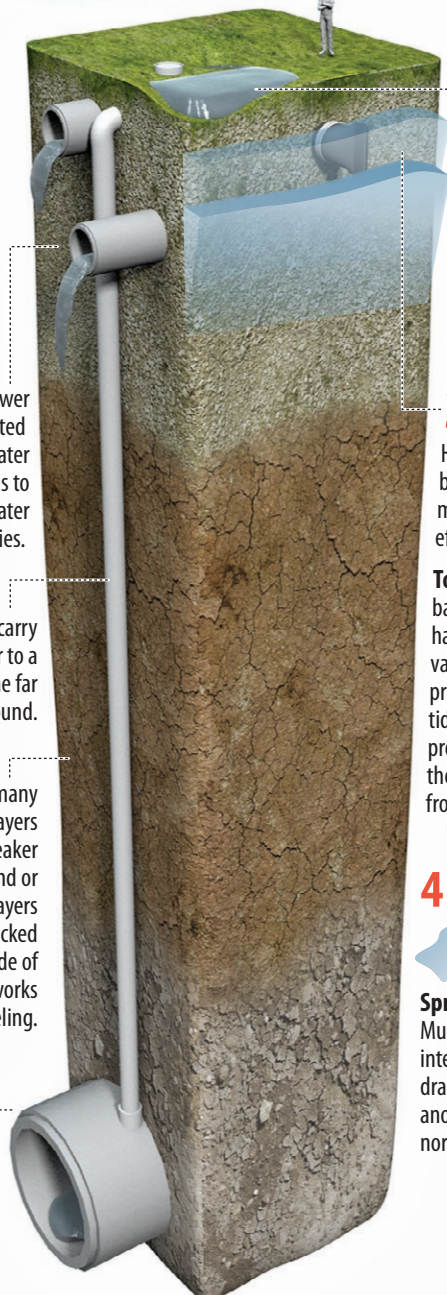
It's a long-standing problem compounded by rising sea levels, about 9 inches in the last century, and the settling of areas built on filled marsh, such as the area around Lockwood Drive.

The modern solution involves drainage pipes with valves that close at high tide, deep drainage shafts, tunnels 100 feet below the city and huge pumps that could empty an Olympic swimming pool in about a minute.

The costs are staggering. The city spent about \$15.5 million to address flooding around Calhoun Street in 2001 and expects to spend \$20 million on Market Street drainage in the next two years. Tackling the largest problem area, around the Crosstown Expressway, could cost as much as \$100 million.

The fix: Pumps and big pipes

A stormwater drain system under the Calhoun Street area runs more than 100 feet deep and up to 8 feet wide and ends at a pump complex off Calhoun and Concord streets. Plans call for this system to be expanded toward Market Street and for a similar system for the Crosstown Expressway area.



2 Landfill has settled

Landfill has settled irregularly, forming lower-lying pockets where water pools into lakes. These bodies of water often can reach only older drains that are often unlevel, and the water becomes trapped, unable to flow rapidly.

3 High tides, rising sea level

High tides and rising sea levels interfere with drainage by raising water levels above drainage pipes. Because much of Charleston's drainage is gravity-based, this effectively corks many pipes.

To help prevent tides from backing up into drains, the city has begun to install Tideflex valves (right). The water pressure created by a high tide pinches the valves shut, preventing backflow. At low tide, the valves open and water drains from the pipes.



4 Aging drain system

Spreading the problem
 Much of the drain system is interconnected. If a pipe cannot drain, its water might flow out another pipe to an area that normally would not flood.

Unlevel drains
 Many of Charleston's older drains do not flow evenly downhill.

Charleston's sewer system is separated from the stormwater system, which drains to surrounding water bodies.

Several lines carry stormwater to a larger drain line far underground.

Charleston's soil has many layers. Upper layers generally contain weaker soil made of fine sand or landfill. Lower layers contain densely packed pebble beds made of phosphate, which works well for tunneling.

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