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Identifying Groundwater Drainage: A Case Study in New Orleans

Introduction

Within the Greater New Orleans, Louisiana, three parishes can be identified: Orleans Parish, Jefferson Parish, and St. Bernard Parish. These are almost completely surrounded by water: Lake Pontchartrain to the north, the Mississippi River to the south, Lake Borgne to the east, and wetlands to both the east and west. The wet borders, along with the fact that half of the land between these water bodies is below sea level, create major flooding and drainage concerns. Due to the bowl like shape of these parishes, virtually all rainfall that falls within this region can only be removed through pumping or evaporation. These pumping systems, as well as the wastewater system and drinking water system, have been found to play a crucial role on groundwater drainage and recharge.

Water infrastructure interaction

Storm drainage system

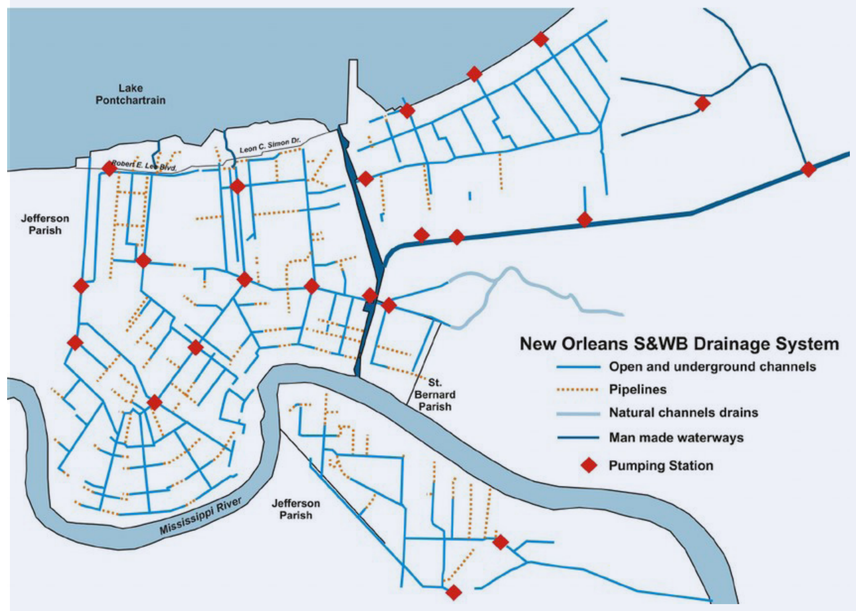
New Orleans is equipped with a dense network of pumping stations. Due to the age of the storm drainage network and damage caused during hurricane Katrina, this system is damaged and full of cracks at the pipe connections, meaning stations unintentionally drain groundwater through the storm drainage pipes during both wet and dry periods. Data gathered from the Sewerage & Water Board of New Orleans (SWBNO) was used to quantify the volume of groundwater drained through this system. An impulse-response analysis done during the study revealed that a significant part of the drained water could not be explained by precipitation, indicating the presence of groundwater in the pumping station discharges.

Wastewater system

The wastewater system is a gravity collection system with various wastewater pumping stations that lift the sewage back up to a higher level for continued gravity flow towards the wastewater treatment plants (WWTP's). Ideally, the wastewater system only transports industry and household wastewater and not rainwater or groundwater. However, the New Orleans system is in poor condition and so the WWTP's receive much more influent than can be related to household and industry discharges. For the sanitary sewer system, an existing QGIS model and daily WWTP influent time series were used to quantify the amount of groundwater drained through the sewer system.

Drinking water network

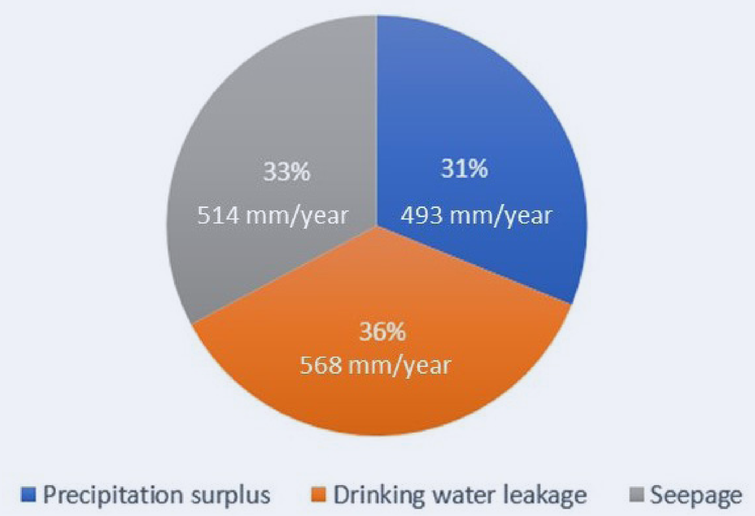
The current drinking water infrastructure in New Orleans has segments which are over 100 years old, and so, similarly to the other two systems, suffers from leaking pipes. Here however, drinking water leaks into the ground, wasting a portion of the produced drinking water. To quantify the drinking water losses, a Water Audit written up by Freeman LLC was used.

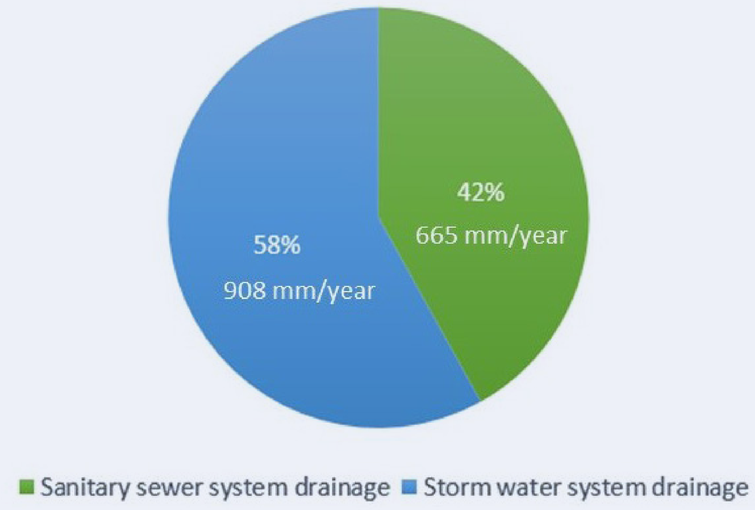


Water balance conclusions

The following conclusions were drawn in the desk study:

1. the stormwater drainage system is the largest groundwater drainage component, contributing to 58% of the total groundwater drainage,





2. 50% of the total water treated in the WWTP is groundwater, adding a large amount of unnecessary stress to the treatment process and
3. 55% of the produced drinking water infiltrates into the ground during distribution, meaning the drinking water losses are a larger groundwater recharge than the annual precipitation surplus.

Consequences

These interactions have crucial consequences. Excessive groundwater drainage leads to land subsidence and in turn groundwater flooding vulnerability and cracks in roads and patios that must be repaired. It greatly burdens WWTPs, so much so that during large storms, contaminated wastewater is directly discharged into the Mississippi and money is wasted by all the produced drinking water that is lost during transportation.

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