

A Year After the August 5 Flood, a Look Back at New Orleans' 300-Year-Long Drainage Drama

Richard Campanella
rcampane@tulane.edu

Published in the *New Orleans Times-Picayune*, Sunday August 19, 2018, page 1.

This month marks a year since the Aug. 5, 2017 flash flood and subsequent investigations in New Orleans. The product of extremely intense and concentrated rainfall vis-à-vis aging infrastructure, off-line pumps, clogged storm drains and bowl-shaped topography, the costly deluge made drainage in general, and the management of the Sewerage & Water Board in particular, a top municipal priority.

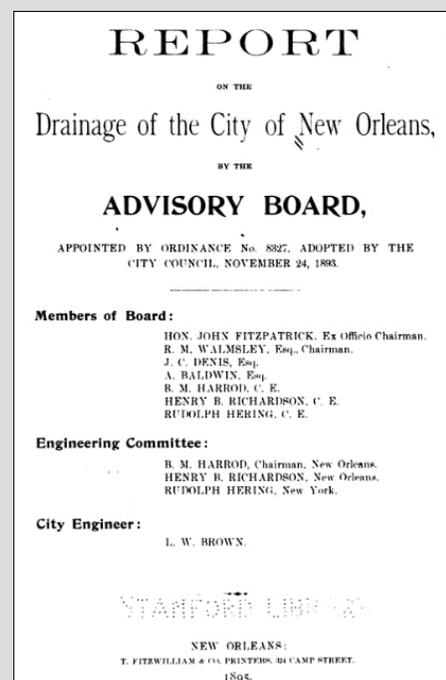
Together with prior deluges, the Aug. 5 inundation of Mid-City, Lakeview, Treme, the 7th Ward and other neighborhoods also led to a Louisiana legislative resolution creating a [task force](#) to study drainage in New Orleans and recommend improvements.

It so happens that this state task force, which convened for the first time in late July this year, formed on the 125th anniversary of the original advisory board that first brought modern engineering know-how to New Orleans' drainage challenge.

That effort, starting in 1893, deserves credit for the design and construction of what would become one of the world's most remarkable urban drainage systems. But it was a long time in coming. Engineers have grappled with how to dry this wet delta since the city was founded in the spring of 1718.

New Orleans originally was shaped not as a bowl, as it is today, but as a gradual slope of fine alluvium ranging from higher banks (natural levees) along the Mississippi River to lower cypress swamps (*cipriere*) and grassy marshes (*prairies tremblantes*) by the brackish bay known as Lake Pontchartrain. A secondary ridge, paralleling the abandoned distributary known as [Bayou Metairie](#) and Bayou Gentilly, split the lowlands into a series of hydrological sub-basins.

This was not the sort of terrain to which French colonists were accustomed. "The land is of *peculiar* formation,"



Title page of the influential 1895 Drainage Advisory Board report leading to the design of New Orleans' drainage system.

wrote a Jesuit priest in 1750. Whereas “the bank of a river is (usually) the lowest spot; here, on the contrary, it is the *highest*.”

Our topography is indeed peculiar. Moving waters usually erode soil downward and flow beneath its surroundings; only in flat alluvial valleys and deltaic plains do they amass sediment, build up their banks and rise above their landscape. New Orleans sits upon one of the world’s biggest, best examples of a fluvial (river-dominated) delta, and that setting has made geography a constant factor in the city’s history.

Upon that higher river-hugging natural levee, urbanization in New Orleans would expand, during the 1700s and 1800s, into the shape of a crescent, its rear flanks circumscribed by the backswamp.

The technology needed to drain the swamp was not available at the time, though the will certainly was. Residents universally disdained the soggy lowlands, viewing them as a useless and foreboding source of disease. They had no choice but to tolerate what one anonymous critic described in 1850 as a “boiling fountain of death(,) one of the most dismal, low and horrid places, on which the light of the sun ever shone.”

Even on higher ground, watery soils frustrated development. Persistently muddy streets and dank puddles exasperated ordinary folks and building experts alike, among them Benjamin Latrobe, the first formally trained American architect and designer of the U.S. Capitol. “Mud, mud, mud,” Latrobe sighed in 1819. “This is a floating city, floating below the surface of the water on a bed of mud.”

Like today, New Orleanians wanted to get water out of their way, despite the fact that water was intrinsic to deltaic soils, and that wetlands stored excess water and kept it from flooding streets and houses.

Understandably, citizens called for drainage improvements, and authorities pursued various strategies to accomplish them.

Attempts at draining New Orleans may be broken into two eras: one in which gravity was the main removal agent, followed by one deploying mechanized pumps.

The “gravity era” began with the founding of the city. A French colonist named Dumont recalled how settlers petitioning for parcels in 1722 were “ordained (to) leave all around a strip at least three feet wide, at the foot of which a ditch was to be dug, to serve as a drain.”

Three years later, another colonist noted that there were “little ditches in front of (people’s) houses, one or two feet in width by a foot or (so) in depth, to drain off the water.” Pedestrians avoided the mess by traversing *banquettes* (“little benches,” or raised wooden sidewalks) over the ditches.

In the Spanish era, ditches were deepened into gutters, lined with planks or bricks, and covered with wooden boards called *puentes* (“bridges”), which widened the *banquettes* and aided foot traffic over muddy intersections.

In both the French and Spanish colonial eras, drainage was viewed as a localized task for which property owners, and later private contractors, were chiefly responsible. This began to change under the administration of Spanish Gov. Hector de Carondelet, who in 1794 had a canal dug to speed the flow of runoff into Bayou St. John and out Lake Pontchartrain. Also used for navigation, the Carondelet Canal was New Orleans' first major city-sponsored outfall channel; later called the Old Basin Canal, its footprint today is the Lafitte Greenway.

Just outside the city, plantation owners also manipulated the flow of water. They used enslaved labor or low-paid contractors to excavate ditches through their fields to flood rice fields or to dry out sugar cane fields. Other land owners channeled water to power saw mills, irrigate food crops, [access swamp resources](#), or manipulate salinity regimes to benefit desired shellfish or finfish.

In every case, gravity was the sole source of energy — and for urban drainage, it just wasn't enough. Slopes were too weak, water too voluminous and ditch networks too piecemeal to befit a major metropolis.

Mechanized pumps would be needed to give gravity a boost, and steam engines would be the technology to do it. The task of drainage in this era also shifted from the responsibility of residents and contractors to city-administered public-private partnerships.

In 1835, the city granted a 20-year charter to the New Orleans Drainage Co. to devise a system with steam pumps. After delays related to the Panic of 1837, the company implemented a modest network of curbside ditches connecting with the Girod and Orleans canals and, with a boost from a steam-driven pump, draining out Bayou St. John. The company went bankrupt within a few years, illustrating the problem with outsourcing public works to private firms.

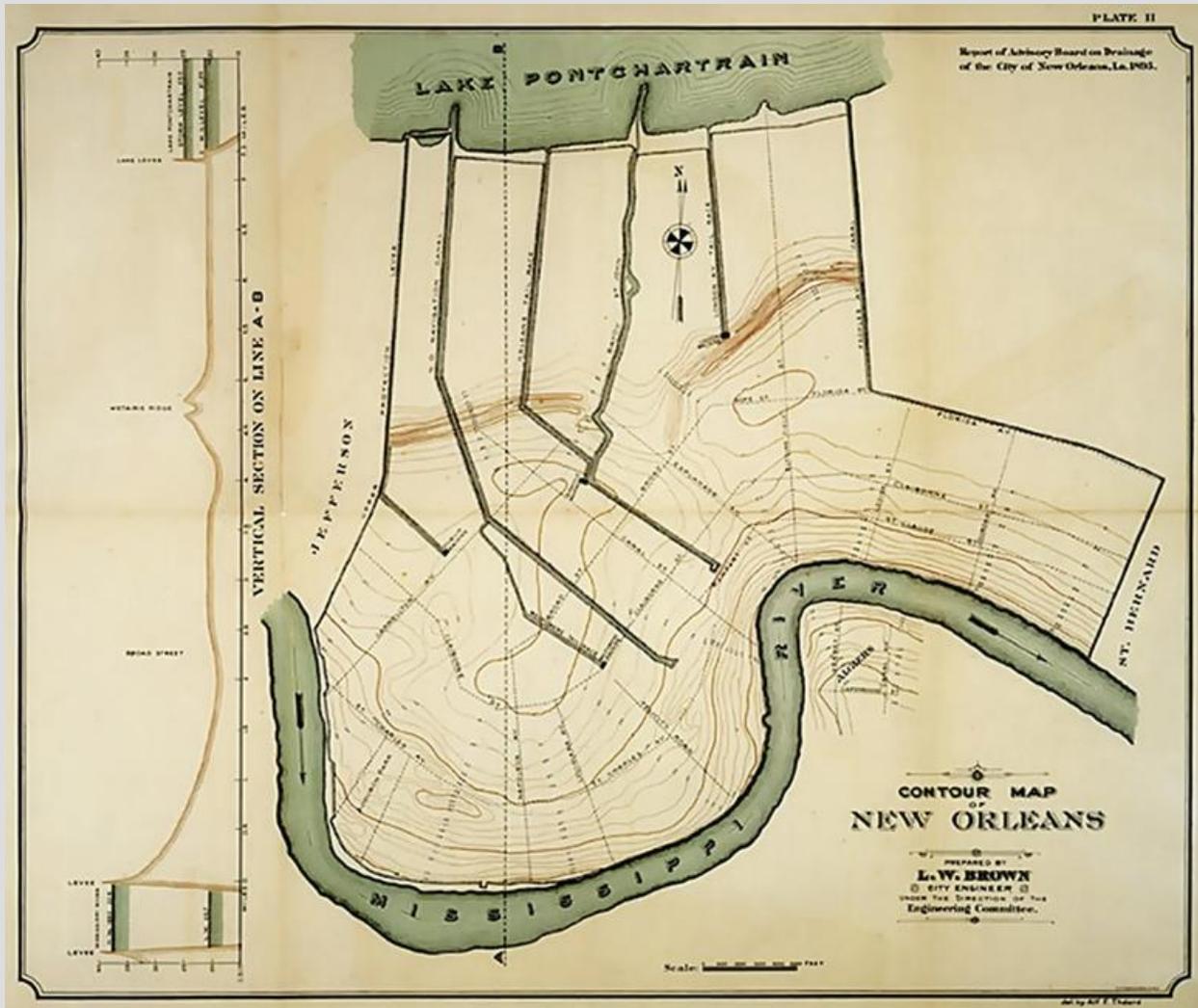
In 1857, in response to recent yellow fever epidemics, city surveyor Louis H. Pilie sketched a system of ditches feeding four steam-powered paddle wheels pushing the water to the backswamp. It was built in 1859, but the Civil War brought the effort to an end.

In 1871, the Mississippi and Mexican Gulf Ship Canal Co. excavated 36 miles of drainage ditches, including the 17th Street, Orleans Avenue and London Avenue Outfall Canals, and linked them with the existing drainage ditches. The costs of the undertaking exceeded their revenue, and the company soon went out of business.

By the 1880s, authorities began to realize that a complex engineering service like drainage was best managed by the municipality and not private firms. City engineers made do with the extant hodgepodge of drainage apparatus, whose removal capacity was at most 1.5 inches of rainfall over an entire day — barely a sustained drizzle. And it did nothing to dry out the swamps.

Citizen-led activism in the 1890s called for more than just “making do.” New Orleanians pressed their elected officials to finally, fully solve the drainage problem, as well as sanitary sewerage and potable water service. Historians call this period the Progressive Era, for the widespread engagement of ordinary Americans toward improving conditions, and New Orleans exemplified the spirit of the times.

The City Council responded in February 1893 by forming the Drainage Advisory Board to design an integrated citywide drainage solution. Funded with \$700,000, the board brought together the city's best and brightest, "successful engineers (and) international experts," according to environmental historian Ari Kelman, "who believed New Orleans's history of inconclusive skirmishes with ... the forces of nature could end in a rousing victory." Members included Mayor John Fitzpatrick, three esquires including Chairman R.M. Walmsley, and three civil engineers, B.M. Harrod, Henry B. Richardson, and Rudolph Hering, who comprised the Engineering Committee and worked directly with City Engineer L.W. Brown.



Contour Map of New Orleans, 1895, based on field surveys conducted by the DAB starting in 1893. Courtesy NOPL.

Over the next two years, the Drainage Advisory Board set out to bring science and engineering to the geography of New Orleans. Maps of existing infrastructure were made; data on rainfall were collected and runoff volumes computed; and elevation measurements were collecting along 49 base lines spanning 150 linear miles on both banks, from which cartographers compiled one-foot elevation contours. The resulting "Topographical Map of New Orleans" (1895), which, at a scale of one inch to 600 feet covered ten linen sheets large enough to fill an entire wall, represented

American civil engineering at its best, conducted by native New Orleanians. The data informed the Drainage Advisory Board's design, which was finalized and presented to the city in January 1895. The plan was to use natural topography to drain water via street gutters, which flowed down storm drains and into main drains, then through branch canals and finally into a central main canal, where pumps would propel the water and eject it into a surrounding waterbody.

But where — northward into Lake Pontchartrain, or eastward out Bayou Bienvenue into Lake Borgne?

Drainage Advisory Board members debated this key matter and ultimately selected the latter. The flanks of Bayou Bienvenue and Lake Borgne, they explained in their report, “are mostly uninhabited and a slight pollution of the (runoff) has no disadvantages. It is open to the Gulf, and the tides rise and fall more rapidly, (causing) a more complete dispersion and a more rapid removal of the drainage water. The mean level is several inches lower than Lake Pontchartrain. ... Bayou Bienvenu, (with) dredging(,) can readily be made of sufficient size to convey the drainage water. ... It is, also, the natural outfall for (much) of the city. In our opinion, the proper place therefore to discharge the daily drainage from the City of New Orleans ... is Lake Borgne. Although farther from the city, it possesses (many) material advantages ... as a drainage receptacle.”

The Bayou Bienvenue/Lake Borgne decision made the eastward-running Broad Street/Florida Avenue corridor the logical choice to place the central main canal and its pumps. This pathway ran along what was, at the time, the edge of the backswamp, behind where most New Orleanians lived.

Years later, in 1918, when the [Industrial Canal](#) was excavated across this eastward pathway, a complex underground siphon was installed to pass the runoff beneath the shipping channel and expel it through Bayou Bienvenue and into Lake Borgne. But when the siphon proved inadequate as a bypass, engineers changed their larger drainage strategy and shifted instead to a northward ejection route into Lake Pontchartrain, using the 17th Street, Orleans Avenue and London Avenue Outfall Canals, dug back in the 1870s. By then, however, the massive pumps could not be moved from their interior positions on Broad Street to the lakefront perimeter — which is where the Drainage Advisory Board probably would have placed the pumps had they selected Lake Pontchartrain as the drainage receptacle back in 1895.

This would prove to be a costly mistake.

Another later-regretted decision arose from the “heroic” engineering philosophy of the day, which valorized man's control of nature and eschewed environmental accommodation. The Drainage Advisory Board tended to view every drop of water as a problem to be solved, rather than a condition to be managed.

This mindset paved the way, almost literally, for the design of a closed, “dry” system aimed at removing as much water as possible through mechanization, as opposed to an open, “wet” plan designed to meet nature halfway, by storing runoff in retention ponds or wetlands, and letting it percolate naturally into the groundwater or evaporation into the air.

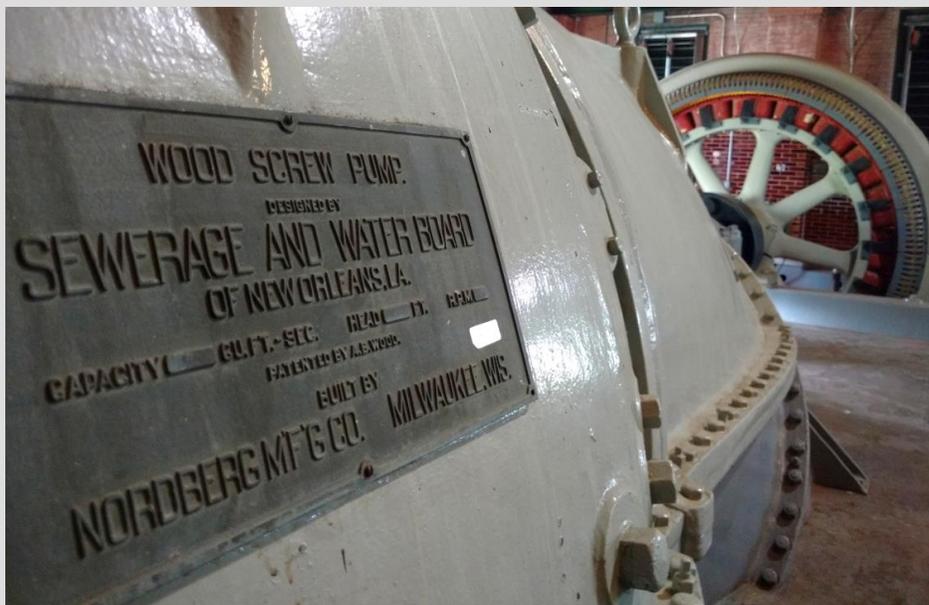
Construction, begun in 1896, received an additional impetus in 1899 when voters — including white women, who had suffrage in this special referendum — overwhelmingly approved a two-mill property tax to fund the Sewerage & Water Board of New Orleans. This state-legislated agency would be responsible not just for all aspects of municipal drainage, but also sewerage, water treatment and distribution — a herculean charge.

The S&WB promptly got to work, and throughout the opening years of the 20th century, New Orleans proliferated in torn-up streets, steam shovels, mule carts and dirt heaps. It was one of the largest manipulations of urban topography and hydrology ever seen in the nation. By 1905, workers completed 40 miles of open and underground canals, hundreds of miles drains and pipes, and six pumps draining 22,000 acres at 5,000 cubic feet per second.

The work was not yet half done, but the effects were already apparent. Muddy streets dried. Swampwater disappeared. Soils got paved. California-style bungalows starting appearing on streets designed for automobiles in areas that were previously marsh. Impervious surfaces expanded, which increased runoff, which forced an expansion of the system in 1910.

By this time, the S&WB employed a quiet, young Tulane University engineer named Albert Baldwin Wood. In 1913, Wood presented his design for a screw pump, an enormous impeller which would draw water out of the suction basin and into the discharge basin with incredible speed. Eleven “Wood pumps” were installed by 1915, and many are still in use today. Wood’s pumps and other inventions dramatically improved system efficiency, and his dedicated public service made his host agency a worldwide exporter of home-grown drainage technology.

Wood is often credited with draining New Orleans, but it is more accurate to say his pump design made an existing system that much more effective. It was the Drainage Advisory Board engineers who designed the underlying system; Wood was all of 14 years old when the board first convened.



Wood Screw Pump, inside the A. Baldwin Wood Melpomene Pump Station No. 1 on South Broad. _Photo by Richard Campanella

By 1925, the system drained 30,000 acres with 560 linear miles of canals and pipes with a total capacity of 13,000 cubic feet per second. The results were astonishing. Property values and tax coffers skyrocketed as swamps became subdivisions; malaria and typhoid cases decreased tenfold, and death rates plunged with improved sanitation. “The entire institutional structure of the city” reveled in the ensuing urbanization of the former swamps, wrote local historian John Magill. “Developers promoted expansion, newspapers heralded it, the City Planning Commission encouraged it, the city built streetcars to service it, (and) the banks and insurance companies underwrote the financing.”

Citizens too cheered, and beautiful neighborhoods like Lakeview and Gentilly came to life. Later, eastern New Orleans, Metairie and Kenner, the urbanized West Bank and St. Bernard Parish would all replicate the basic concept of the 1895 New Orleans plan — only in their cases, pumps would be placed at the perimeter, and not the interior, of the basin being drained.

Modern drainage thus enabled the crescent-shaped city of the 1800s to expand into the spread-eagle-shaped metropolis it is today. But it all came at a cost.

The removal of groundwater opened cavities in the soil body, into which fine sediment particles settled and consolidated. Half of greater New Orleans would subside below the level of the sea, into a series of bowls — even as they were paved, further reducing the soil’s absorption capacity and increasing runoff.



LIDAR elevation model of New Orleans, showing areas above sea level in red tones and below sea level in yellow-to-blueish tones_Graphic by Richard Campanella

Each paved bowl required that the pumps do more and more lifting of more and more water. Worse yet, the interior locations of the pumps necessitated that the lifting be done early in the removal route to the lake, raising water levels in the outfall canals above the surrounding subsiding neighborhoods, rather than at the end of the route, just before ejection into the lake. All that stood between high water and low neighborhoods were thin floodwalls.

Other problems would materialize by century's end, by which time the S&WB drained over 61,000 acres of nearly 13 billion cubic feet of water annually — “the world's toughest drainage problem,” as the agency rightfully calls it. Specialized 25-cycle electrical turbines had become antiquated; aging pumps required constant repair; staffing and budgets could not keep up with needs; technology did not keep up with changing times; maintenance could not keep up with deterioration; and system capacity was all too often overwhelmed by intense rainfalls.

And then there was Hurricane Katrina, whose surge ruptured two outfall-canal floodwalls in three locations, not to mention numerous other federal levees and floodwalls, and whose waters got impounded within the bowl-shaped terrain created by the very system designed to keep it dry.

Had the Drainage Advisory Board in 1895 opted to expel runoff into Lake Pontchartrain rather than Lake Borgne, the pumps likely would have been positioned along the lakeshore heads of the outfall canals. The pump themselves would have acted as gates, and the canals would have been below grade, dug deep enough to let gravity draw the runoff toward the pumps. During Katrina, there would have been no surge in the outfall canals, no floodwalls to breach, and no serious flooding in Lakeview and Gentilly.

With the “gravity era” beginning in 1718, the “steam pump era” in 1835 and our current system dating to 1893, what sort of future drainage should we, and the current task force, create?

The consensus is for a greater use of gravity, less dependence on pumps, and a whole lot more runoff storage in ponds, trees, plants, bioswales, rain gardens, house-side barrels and cisterns, and in ground soil with permeable surfaces.

All are strategies for accommodating nature through an open, “wet” urban water management system, rather than controlling nature through a closed system.

That “dry” approach made sense in 1893. It no longer makes sense now, 125 years later.

Richard Campanella, a geographer with the Tulane School of Architecture, is the author of “Cityscapes of New Orleans,” “Bourbon Street: A History,” “Bienville’s Dilemma,” and “Time and Place in New Orleans,” from which this research was drawn. He may be reached through <http://richcampanella.com>, rcampane@tulane.edu, or @nolacampanella on Twitter.