



---

# Resilient Stormwater Solutions

Tailored, integrated solutions  
delivered by a comprehensive  
water resource management team



**BLACK & VEATCH**



# Tailored, Multi-Benefit Stormwater Solutions that Enable Community Resilience

**Black & Veatch's** comprehensive stormwater solutions team is nationally and internationally recognized for its ability to deliver cost-effective, integrated solutions for projects and programs large and small. Our continent-wide team successfully blends engineering and science in water resources management – as well as decades of experience solving communities' most complex stormwater challenges – to provide a full spectrum of expertise across the entire project lifecycle. We leverage our experience and lessons learned to tailor solutions

that simultaneously provide multiple complimentary benefits including flood protection, water quality improvement, water reuse, ecological benefits and recreational/educational opportunities while optimizing life-cycle costs and providing operational flexibility. Our vision is to provide comprehensive water resource capabilities and a collaborative approach for the planning, design and construction management of solutions that support our clients' missions and objectives.



## North American Stormwater Solution Experience

# Our Areas of Focus

## Resiliency

Black & Veatch has been a proponent and strong advocate for resilient and sustainable infrastructure for decades – long before “resiliency” became a catchword. We have completed vulnerability and risk adaptation studies on hundreds of facilities across the U.S., have recently developed a common framework to guide the planning and implementation of resilient water infrastructure via the Water Research Foundation (WRF), have completed AWIA risk assessments for dozens of clients, and continue to support this critically important area of focus across the full spectrum of our core services. The figure below emphasizes the complex interdependencies between sectors, threats, outcomes and available adaptation solutions.



## One Water

Creating sustainable One Water solutions is a long-term mission and passion of the Black & Veatch Water team. One Water is a collaborative, innovative, and integrated approach to optimize the sustainability of our essential water resources. Its outcome enhances our quality of life by promoting vibrant and engaged community participation while encouraging responsible stewardship of our social, economic and environmental resources.

## Implementation/Delivery

CBP, CM, CA, PDB, CMAR, PPP

## Funding/ Finance

SWU, HGMP,  
Grants, Cost  
Share, Etc.

## Planning/ Design

H&H, GIS,  
Design,  
Permitting,  
CDs

## Implementation Spectrum

The Black & Veatch Water team is uniquely qualified in all three of the principal pillars that encompass the comprehensive scope of stormwater management:

- **Funding & Finance** – Black & Veatch has the expertise and experience to identify and pursue various funding alternatives including the turnkey development of stormwater or resiliency utility programs. As the principal author of the biannual National Stormwater Utility Survey, we keep close tabs on how the market creatively funds their everchanging Stormwater needs.
- **Planning & Design** – Black & Veatch is well recognized for our ability to innovate and develop design concepts that incorporate state-of-the-art practices including smart infrastructure and dynamic/risk integrated asset management planning and capital improvement plan development. As a designer, builder and asset manager, we naturally understand the critical need to develop plans that are constructible, functional and easy to operate and maintain.
- **Infrastructure Delivery** – Black & Veatch has the unique ability and requisite relationships to bring low-risk, collaborative project/program delivery alternatives to bear to efficiently deliver distributed infrastructure over a regional-scale geography.

Each of these pillars is critical as it relates to initiating and driving progress around any stormwater management program. Whether the need is regulatory driven or community inspired, we can help.



## Our Services

Our services have included funding and financing, peer review, studies and planning, preliminary and final design, construction phase services, and/or collaborative delivery on a wide variety of stormwater projects undertaken across the U.S. and abroad. In addition, our offerings have spanned from localized projects to state- and regional-scale programs.



### State/Regional Scale

- **Planning, technical support, facilitation**
- **Rule development/policy support**
- **Program delivery**

### Watershed Scale

- **Comprehensive management planning**
- **Watershed modeling**
- **FEMA Hazard Mitigation Grant Program**
- **TMDL/BMAP support**
- **MFL assessment and recovery strategies**
- **River/stream mechanics/geomorphology**
- **Water quality and sediment transport modeling**
- **Hydrogeological assessments**

### Community Scale

- **Stormwater master planning**
- **Asset management and risk-integrated CIP development**
- **Funding and financing**
- **Community-based partnerships**
- **One Water planning**
- **Resiliency master planning**
- **Smart infrastructure**

### Project Scale

- **Green and blue/green Infrastructure**
- **Retrofit design**
- **Alternative delivery**
- **Construction services**
- **Monitoring and instrumentation**
- **Computational fluid dynamic modeling**

## Industry Leadership

### About Black & Veatch's Stormwater Team

- Leveraging broad expertise in watershed-scale planning and strategic resource management in leading development of the first comprehensive One Water master plan in the Southeastern U.S.
- Was owner's engineer for the New Orleans Hurricane Protection project that involves the nation's largest stormwater pump stations.
- Completed the Sea Level Rise and Resilience Strategy for Charleston, SC, one of the oldest cities in the U.S.
- Participating in the first community-based partnership project in the U.S., aimed at turnkey implementation of dispersed stormwater best management practices on a regional scale.
- Has delivered significant national and global award-winning projects including Echo Park Lake, an international ASCE finalist for Outstanding Civil Engineering Achievement, and Lake Lenexa, an American Crown Community Award winner.

### In Addition, Black & Veatch Key Staff:

- Managed the first sub-tropical whole lake restoration project in the U.S.
- Participated in the development and verification testing of the first fully integrated ground and surface water model, linking Hydrological Simulation Program - Fortran with Modflow.
- Led engineering design of the first major wetland treatment system in Florida designed to treat wastewater effluent. The 1200-acre system was designed to provide advanced nitrogen removal and now provides a unique opportunity for public use, research and education.
- Led the planning and implementation of one of Florida's first potable reuse pilot projects, pureALTA, which uses a state-of-the-art treatment train designed to purify water beyond current drinking water standards.



# Complimentary Expertise Integration



## Dams

As a global leader in inspection/assessment, design and construction of major earthen and concrete dams and reservoirs for the purpose of water supply and environmental restoration, Black & Veatch has been involved in seven of the 10 largest dams in the U.S.



## Tunnels

**Black & Veatch** is a proven global leader in the design and construction of major tunnels for the purpose of conveying and storing water. We've been engaged on some of the largest tunneling programs in North America, from Charleston, SC to Las Vegas, NV and from Toronto, Ontario to Dallas, TX; delivering more than 300 miles of tunnels up to 38 feet in diameter.



## Pump Stations

Expertise in pump station systems of all types in all conditions, delivered more than 4,000 water facility pump stations with capacities up to 13,000 cubic feet per second.



## Pipelines

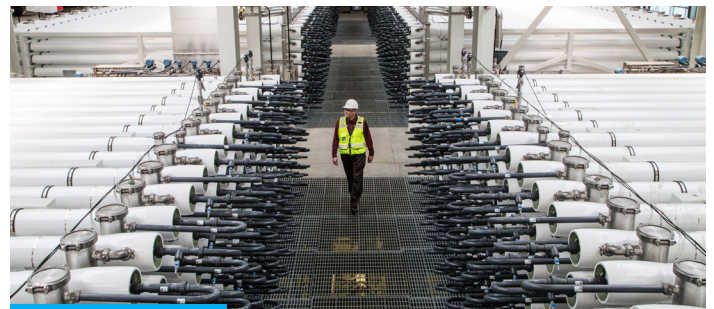
Through various implementation technologies, we've delivered nearly 10,000 miles of pipelines in the U.S. up to 108-inch diameter and 450 psi.

## Asset Management

A recognized demonstrated leader in asset management planning, we create and regularly apply a unique risk-integrated asset management strategy that facilitates dynamic, real-time plan updates as various capacity, management, operations and maintenance programs and capital improvement plans are implemented.

## Big Data

Through our collective expertise in power, water, telecommunications and smart, integrated infrastructure, Black & Veatch helps clients leverage big data coupled with smart technologies to manage and enhance performance of urban assets and services.



## Water Reuse

Black & Veatch has been involved in more than 2,200 MGD of installed reuse facilities for direct and indirect potable reuse, non-potable reuse, industrial, agricultural, groundwater recharge and sea water intrusion.

## Finance & Rate Development

A demonstrated leader in financial and rate development services, for two decades Black & Veatch has published its Stormwater Utility Report and for more than a decade has published a report assessing water and wastewater rates among the 50 largest cities in the U.S.

# Project Highlights

## U.S. Army Corps of Engineers, New Orleans District

### Outfalls Canals, Permanent Flood Gates, Pump Stations and Outfall Canal Feasibility Study



Three main canals drain stormwater from New Orleans. The emergency response following Hurricane Katrina installed interim control structures to protect the drainage system from future storm surge and flooding. Serving the U.S. Army Corps of Engineers (USACE) New Orleans District and State of Louisiana, Black & Veatch evaluated the system and provided solutions to strengthen the resilience of the pumping stations, surge gates, floodwall, levees and other components. Black & Veatch performed a complete condition assessment of the interim control structures, including site assessments. Based on the results, three new pump stations and surge gates were selected to replace the interim control structures. Pump station capacities are 12,500 CFS (8,080 MGD), 3,390 CFS (2,190 MGD) and 8,980 CFS (5,805 MGD), respectively. Black & Veatch provided the conceptual design of new pump station and gate structures to increase surge protection and reduce the potential of hurricane-driven flooding in the Orleans and Jefferson parishes.

## South Florida Water Management District, Everglades, Florida

### Everglades Agricultural Reservoir and Pump Station, Phase 1



**Black & Veatch** provided design for an above-ground water-storage reservoir with a capacity of 190,000 acre-feet and maximum depth of 12 feet. The project included the design of a new pump station with a capacity of up to 3,000 CFS (1,940 MGD) and of modifications to existing pump stations and canals. Completed as the first phase of the Everglades Agricultural Area (EAA) reservoir project, the work supported flood control and water quality protection in the Everglades and coastal estuaries while also creating a supply to meet agricultural demands and lessen the area's dependence on water from Lake Okeechobee.

**"We found Black & Veatch to be committed to our success, and they remain a valuable resource for Johnson County. They have consistently exceeded our expectations, and I sincerely look forward to working with them in the future."**

- Lee Kellenberger,  
Johnson County Stormwater Program Manager





# Matrix of Stormwater Experience

[illegible]

# Representative Proofs

## Federal

### 8.5 Square Mile Area Flood Damage Reduction Project, Everglades Restoration, Miami-Dade County, FL



The intent of this project is to protect a residential area in Miami-Dade County from increased water elevations that will result from the Everglades National Park Water Deliveries and Restoration Project. The project also involves freshwater diversion into a stormwater treatment area. The main protection system will be a perimeter levee. Significant seepage is expected through the bedrock into the protected area. An interior canal will collect the seepage. The water will be pumped through a 500 cfs pump station into a stormwater treatment area and ultimately travel back into the Everglades. The Stormwater Treatment Area (STA) is approximately 400 acres in size, surrounded by a perimeter levee about 3.25 miles long. The perimeter levee is a minimum height of 7 feet high to allow for 4 feet of storage and 3 feet of freeboard with a crest elevation of about 12.5 feet, NGVD. The perimeter levee minimum crest width is 12 feet, and side slopes are no steeper than 3:1.

## State Scale

### Florida Fish and Wildlife Conservation Commission

Black & Veatch performed assessment, data collection, preliminary design, and final design services for hydrologic restoration elements and culvert system replacement.

## State Scale (continued)

### Florida Department of Environmental Protection's Total Maximum Daily Load Program

As a sub to Janicki Environmental, Black & Veatch is providing statewide technical support to the Florida Department of Environmental Protection's Total Maximum Daily Load (TMDL) program. Duties include data collection and analysis, document development, mechanistic modeling, engineering assessments and coordination with local governments and stakeholders for tasks associated with the technical aspects of developing, implementing and tracking:

- Total Maximum Daily Loads (TMDLs)
- Basin Management Action Plans (BMAPs)
- Reasonable Assurance and Pollutant Reduction Plans
- Class III-Limited Petitions
- Site Specific Alternative Criteria (SSACs) Petitions
- Human Health Criteria (HHC) public outreach

## Regional Scale

### Florida Water Management Districts

Black & Veatch has performed numerous assignments for Florida's water management districts, from planning to large infrastructure projects design and construction phase. Our relevant water management district experience includes projects such as:

- C-43 Reservoir – Engineer during construction for a 10,000-acre reservoir and ancillary infrastructure
- EAA Reservoir and Pump Station – Design of a major reservoir and pump station to support Everglades restoration
- Wysong Water Conservation Structure rehabilitation – alternatives analysis, data collection, and design of rehabilitation concepts for a water control structure
- Medard Reservoir Dam Rehabilitation – Assessment and design of a system to rehabilitate the toe drain system
- Risk-based Replacement Planning Model – Application of asset management to flood control structures to prioritize renewal and replacement of system components
- Emergency Action Plan updates for earthen levee systems



# Watershed Scale

## Harris County (Houston) Flood Control



The Harris County Flood Control District (Flood Control District) is implementing studies to identify and evaluate new technologies that can readily be integrated into its existing flood control system. Black & Veatch completed a planning level assessment of tunnel conveyance concepts and their ability to provide cost-effective flood reduction benefits. Study work elements include hydrologic and hydraulic modeling, development of tunnel and traditional flood control concepts, geotechnical and environmental evaluations, stakeholder and public involvement services, alternatives analysis, construction cost and schedule estimating, development of a Tunnel Implementation Plan (TIP) and a Basis of Design Report.

## Blue River Watershed Integrated Plan

### Johnson County KS, Kansas City MO and Mid-America Regional Council

The city of Kansas City, MO and Johnson County, KS, are exploring the feasibility of developing an integrated plan for the Blue River Watershed according to the six step process developed by EPA. The Black & Veatch team is assisting this effort by developing the first phase of the Blue River Watershed Integrated Plan (BRWIP) with an ultimate goal of providing the Blue River

Partners an approach that allows them to effectively prioritize and affordably implement wastewater and stormwater programs to comply with evolving Clean Water Act (CWA) regulations and improve water quality throughout the watershed.

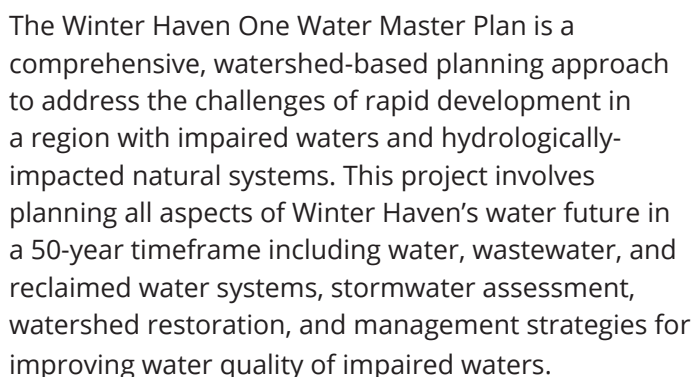


**"The UG has been greatly pleased with the partnership with Black & Veatch on the Stormwater Master Plan. Black & Veatch has gone above and beyond the requirements of providing watershed based solutions for our stormwater needs in Kansas City, KS. We had presented them with a unique request for a parallel project with the Impervious Rate Transition Plan, and they were able to implement their study to compliment the efforts of the rate study. We feel that Black & Veatch has provided us with a superb product and that they are invested in the future of KCK."**

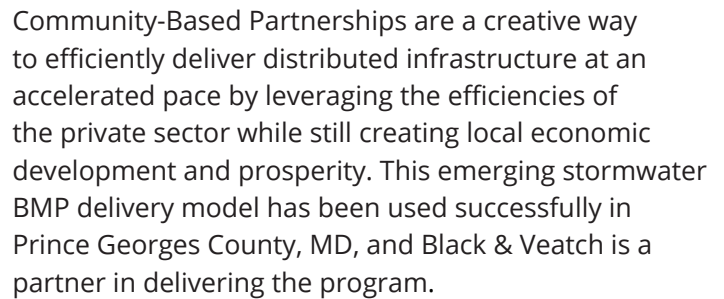
- Sarah White,  
Stormwater Engineer, Unified Government



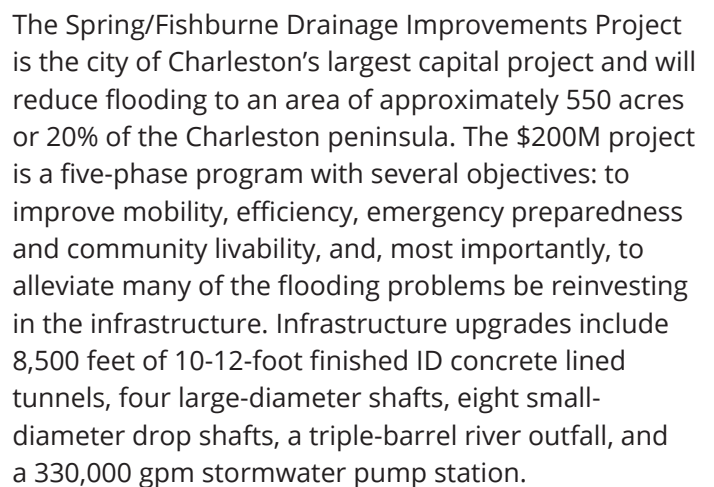
## Winter Haven One Water



## Community-Based Partnerships



## Charleston Stormwater Tunneling





## Project Scale - Minor

### City of Columbia Stormwater and Stream Restoration GEC



**Black & Veatch** has provided comprehensive stormwater services to the city of Columbia for the last five years. One of our assignments, the Upper Wildcat Creek Tributary Project, included geopolymer rehabilitation and design of a new stormwater conveyance. Another assignment, the Queen Street Stormwater Improvements Project, provided a myriad of stormwater structures including detention basin retrofits to provide flood relief and improve water quality. Black & Veatch has been responsible for all aspects of the projects including concept development, design, permitting, plans and bid docs, and construction administrative services.

## Resiliency

### Charleston SLR Study

In December 2015, Black & Veatch partnered with the city of Charleston to write its first Sea Level Rise Strategy. This document was meant to inform and provide a guiding framework to protect lives and property, maintain a thriving economy and improve quality of life by making the city more resilient to sea level rise and recurrent flooding.

The team consulted with local representatives from the National Oceanic and Atmospheric Administration to compile data and projections related to annual average sea level rise in the Charleston Harbor as well as tidal flooding. This information was used as a reporting mechanism in the strategy and was also the basis for revised planning standards. For instance, new freeboard elevations were recommended based on the 50-year flooding projections.

To frame the next steps for resilience planning and building in the city of Charleston, the strategy recognizes five categories through which effective change is supported: infrastructure, governance, resources, land use and outreach. Black & Veatch met regularly with department representatives from the city to draft, make recommendations and refine actionable initiatives within each of the five categories. The development of these initiatives was supported by Black & Veatch's knowledge on local challenges, involvement in ongoing flood mitigation projects with the city of Charleston and expertise on green infrastructure solutions. These initiatives were then organized in a dashboard, prioritized and individually assigned to city departments for execution. The final document was published in February 2019 and serves as the city's framework for one of its most pressing issues.



**"Black & Veatch are adept at listening to the needs of the County, communicating well and providing high-quality deliverables. They have worked across departments and disciplines to provide the County holistic system recommendations. As a result, the County has gained increased confidence in implementing projects without the fear of negative unintended consequences from evaluating systems in silos."**

- Becky Cook,  
Senior Engineer, Pinellas County, FL

# Modeling Capabilities

## Modeling and Analysis

Team personnel have combined scientific research and applied engineering concepts to develop models that address the effects of both simple as well as complex environmental processes. Our experience is inclusive of fundamental tasks such as monitoring, data research and interpretation, field reconnaissance, surveying, and interviews with local citizens. We have studied and analyzed a wide variety of system types, from small stormwater management systems to large-scale regional watershed and lake diagnostic/restoration projects. We maintain a comprehensive library of hydrologic/hydraulic computer software that our experts use routinely to solve a variety of water related problems. Some of the models our team uses on a routine basis include:

### Surface Water - Event and Continuous Simulation

- HSPF
- ICPR4
- SWMM
- EFDC
- CE-QUAL-W2
- QUAL2K
- WASP
- BathTub
- XPSWMM
- HEC-HMS
- SWMM
- QUAL2KW
- QUAL2E
- LAKE2K
- LoadEst

### Water Quality Modeling

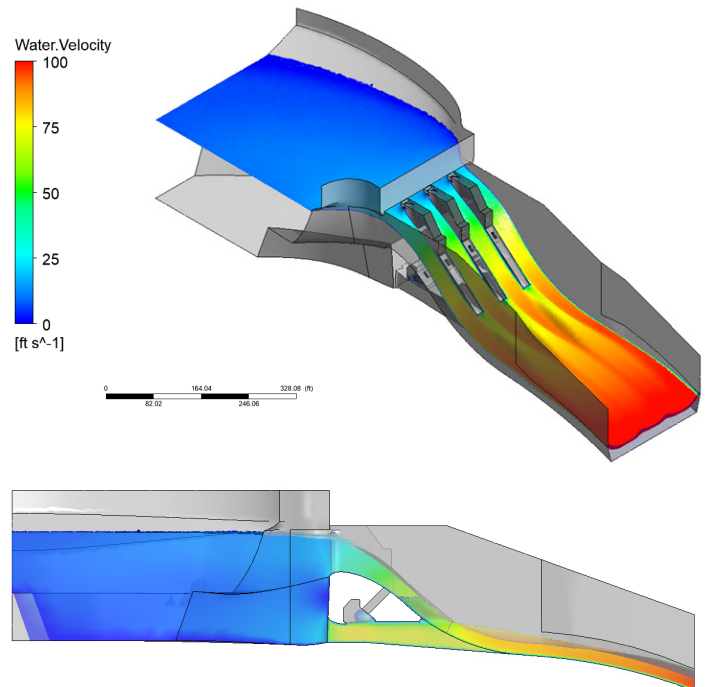
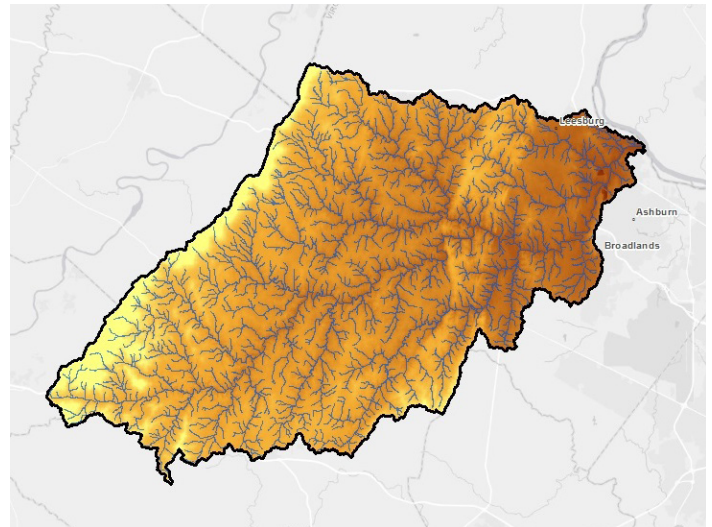
- HSPF
- WASP
- CEQUAL
- QUAL2EU
- PRZM
- EXAMS
- BASINS
- SWMM
- WAM

### Groundwater Only

- GMS MODFLOW
- AQTESOLV
- GFLOW
- Groundwater Vistas
- Visual MODFLOW

### Hydraulic/Water Surface Profile

- EXTRAN
- HEC-RAS
- FLOW2D
- STWAVE
- ACES
- TUFLOW
- EFDC
- CE-QUAL-W2
- ANSYS CFD
- VisualPlumes
- CORMIX



### Integrated Modeling

- MikeSHE and Proprietary spreadsheet models

### Watershed

- LSPC
- HSPF
- WAM
- GWLFe
- MapShed
- STEPL
- ICPRv4
- BASINS
- P8
- PCSWMM
- EPASWMM
- InfoSWMM
- Mike Urban
- Infoworks ICM