

FIRM PROFILE

Freese and Nichols, Inc. (FNI) was founded in 1894. We are a privately owned, multidiscipline professional services firm.

We are a regionally based firm with 24 offices in Louisiana, Texas, Georgia, North Carolina, Oklahoma, New Mexico and Florida.



We hire locally and have access to 900+ staff across all our offices, spanning multiple disciplines giving our clients the benefit of multiservice integration with an approach that is as innovative as it is practical. During our 125-year history, FNI has gained extensive experience with the engineering services necessary to support planning and for utility master planning and community resiliency.

FIRM EXPERIENCE

FNI has completed water and wastewater (W/WW), hydraulic modeling, and master planning for more than 90 utilities in Texas with a combined population totaling 10 million people, which equates to providing optimized utility systems for over one-third of Texas' population. We have developed comprehensive solutions to issues facing many utilities, including low pressure, fire flow availability, water quality issues, funding challenges, sanitary sewer overflows, pump system upgrades, lift station elimination, high growth areas, limited available data and more.

Additional highlights of the FNI team include:

Depth of Technical Resources and National Expertise — We have the largest W/WW master planning staff in the region, with over 75 full-time water, wastewater and stormwater planning engineers and GIS analysts. FNI has three staff members serving on national boards of the American Water Works Association (AWWA) and Water Environment Federation (WEF). A majority of our team has presented regularly at national conferences, including WEFTEC and ACE, for more than 20 years. FNI is viewed as a national expert in W/WW and drainage master planning.

Successful History with Master Plans — FNI has completed more than 90 W/WW Master Plans, Capital Improvement Plans (CIPs), and funding programs in the last 10 years — more than any other consultant within the Gulf Coast region. We have also completed projects for clients similar in size such as Dallas Water Utilities, City of Houston Public Works, San Antonio Water System, Austin Water Utilities and Fort Worth Water. FNI will customize its proven CIP development process to address the unique needs and issues affecting the SWBNO.



In 2010, FNI was the recipient of the Malcolm Baldrige National Quality Award, the highest presidential honor given to U.S. organizations for performance excellence. FNI is the first engineering firm to receive this honor. To receive the award, an organization must have a management and quality control system that ensures continuous improvement. The FNI Team will adopt this approach of focusing on quality results, which encourages us to respond with creative and flexible approaches, resulting in constant improvement through innovation.

SERVICES OVERVIEW

- Water Resiliency
- Water and Wastewater (W/WW) Master Planning and Design
- W/WW Treatment
- Water Resources Planning and Facility Design
- Stormwater Master Planning and Design
- Facility Planning
- Funding/Grant Applications
- Growth Management and Development
- Civil Engineering
- Coastal and Navigation Services
- Construction Management/Services
- Environmental Assessments and Remediation
- Levee and Dam Evaluations and Design
- Mechanical, Electrical and Plumbing Engineering
- Program Management
- Transmission/Substation Engineering
- Environmental Compliance/Permitting
- Community Outreach
- Independent Design Reviews

PROJECT EXPERIENCE

The matrix below shows a sample of our relevant experience.

FNI Integrated Master Planning Experience															
Utility	Population Served	Year Completed (O/G = ongoing)	Water/Sewer	Asset Management	Data Integration	W/WW Projections	Treatment Plant Evaluation and/or Modeling	I/I Reduction	Water Quality Evaluation	Condition Assessment	Risk-Based Assessment	Long-Range Investment Strategies/CIP	Client Staff Training	Drainage & Stormwater	Resiliency
City of Houston	2,300,000	O/G	S	■	■		■	■				■	■		■
North Texas Municipal Water District	1,600,000	2017	W/S	■	■	■		■	■	■	■	■	■		■
San Antonio Water System	1,700,000	2019	W/S	■	■	■	■	■	■	■	■	■	■		■
Dallas Water Utilities	1,300,000	2019	S		■	■	■	■		■		■		■	■
City of Fort Worth	1,050,000	2018	W/S				■	■	■	■	■	■	■	■	■
City of Austin	932,000	2020	S	■	■			■		■	■	■		■	■
City of Arlington	396,400	2014	W/S	■	■	■	■	■	■	■	■	■	■	■	■
City of Corpus Christi	326,500	O/G	W/S		■	■	■		■			■		■	
City of Garland	237,000	2019	W/S	■	■	■		■	■	■	■	■	■	■	■
City of Lubbock	236,000	2019	W/S	■	■	■		■	■	■	■	■	■	■	
City of Irving	216,000	2017	W/S	■	■	■		■	■	■	■	■		■	■
City of Grand Prairie	187,000	2018	W/S	■	■	■			■	■	■	■		■	
City of McAllen	143,000	2009	W/S		■	■	■	■		■		■	■		
City of Killeen	130,000	2013	W/S	■	■	■	■	■	■	■	■	■	■	■	
City of Frisco	120,000	2014	W/S	■	■	■	■	■		■		■	■	■	■
City of Beaumont	119,000	2019	W/S				■		■	■					■
City of Sugar Land	118,600	O/G	W/S	■	■	■		■		■	■	■		■	■
The Woodlands	110,000	2017	S		■			■		■		■			
City of Richardson	106,000	O/G	W/S	■	■			■		■	■	■		■	
City of College Station	97,800	2015	W/S		■	■	■	■	■	■	■	■	■	■	■
City of San Angelo	94,600	2010	W/S			■	■		■	■	■	■	■	■	
City of Conroe	80,000	2016	S		■	■	■	■		■	■	■	■		



CHOOSING A PROJECT TEAM

FNI has a long-standing history of collaborating with small businesses and valuing our small and disadvantaged business partners.

FNI has a strong history with small businesses and always strives to exceed DBE and Small Business requirements, as we did for the Dillard Wetland Gentilly Resiliency District Project, where we have **Batture, LLC (DBE)** as a project partner and on our recent USACE contract wins, where **GreenPoint Engineering, LLC (DBE)** is a valued team member.

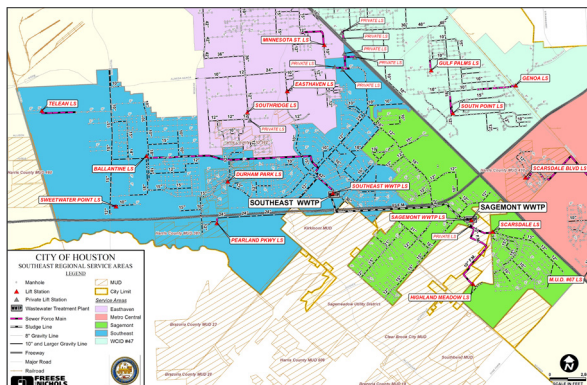
Valuing the local and specialized expertise that DBE's add and investing in mentorship is part of FNI's culture and our 125-year track record validates this approach!

PROJECT EXPERIENCE (CONTINUED)

FNI has a wide range of applicable experiences and project work.

CITY OF HOUSTON/HARRIS COUNTY FLOOD CONTROL DISTRICT WASTEWATER AND STORMWATER MASTER PLANNING AND CIP PRIORITIZATION | HOUSTON, TX

FNI has been actively involved in master planning for the City of Houston's Wastewater System and Harris County Flood Control District (HCFCD – entity responsible for major stormwater facilities in and around Houston) for the last eight years, conducting existing system evaluation, risk planning and developing prioritized CIPs. Detailed descriptions and innovative approaches for each of these efforts are described below.



Wastewater System

The City of Houston's wastewater system, like all major utilities in coastal areas, is facing a major challenge with only 25 feet of elevation drop across the City. FNI has been providing the City with on-site modeling and master planning staff augmentation for the past eight years. In this role, FNI staff has been responsible for building, calibrating and planning hydraulic models for all 40 wastewater treatment facilities service areas, which includes over 380 lift stations and approximately 6,000 miles of sewer lines. Since 2012, the FNI Houston team has acquired a detailed understanding of the unique issues facing a large coastal utility similar to New Orleans, including operational challenges, and the inter-connections of the various wastewater service areas.

Data analytics tools including PowerBI and ESRI GIS are extensively utilized by the FNI team for flow monitoring data and rainfall evaluation and analysis. InfoWorks ICM has been used for the hydraulics analysis and alternatives evaluation tool for the wastewater system. FNI is utilizing these tools for system capacity planning, support for the City of Houston as it prepares for a pending consent decree and assisting the City with post Harvey consolidation solutions to reduce the number of wastewater treatment facilities and lift stations.

Stormwater System

The City of Houston Stormwater System major facilities are served by the HCFCD. FNI has been providing stormwater planning services to this system for the last eight years. These services include performing flood risk analysis and mapping to produce new and updated flood hazard data and capital improvement planning for the three largest watersheds within the City encompassing over 500 square miles and nearly one third of the entire county. The stormwater planning and modeling is being performed using the latest Atlas 14 rainfall data for compliance with latest FEMA guidelines to produce the county's most comprehensive and complete set of flood hazard maps and analysis tools.

The FNI study area includes complex overflows which occur between watersheds, rapid development and one of the few areas in the county that is currently protected by a levee system. FNI is using advanced modeling techniques and methods to better identify and evaluate both riverine and overland flood risk coupled with potential coastal surge modeling impacts. These flood risk products will allow for improved management and regulation of floodplains, identification of mitigation strategies and capital improvement prioritization using 1D/2D unsteady state HEC-RAS modeling results.

LOCATION

Houston, TX

REFERENCE

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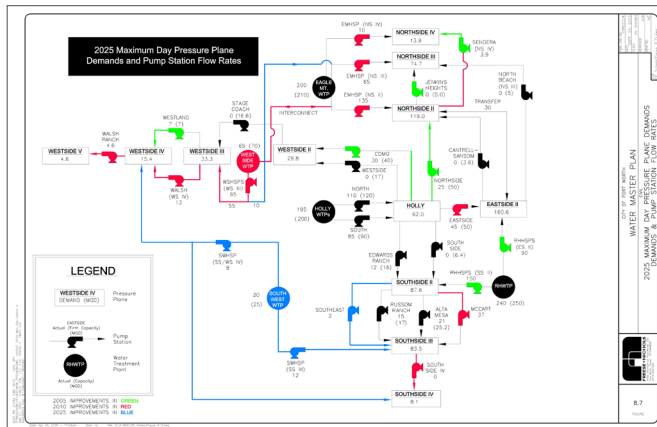
RELEVANCE TO SWBNO

- Similar Risk Planning Issues; Flooding, Coastal Surge, Subsidence
- Near Sea Level with Very Flat Topography Challenges and Issues
- Aging Infrastructure Issues and Need to Prioritize Renewal/Rehabilitation

CITY OF FORT WORTH WATER, WASTEWATER AND STORMWATER MASTER PLANNING AND CIP PRIORITIZATION | FORT WORTH, TX

FNI has been actively involved in master planning for the City of Fort Worth over the last decade developing prioritized CIPs to address growth, resiliency and asset renewal for their three primary infrastructure systems; Water, Wastewater and Stormwater.

Drivers for each of these efforts, tools and process development steps and innovative approaches to identify CIPs priorities are described below. The City of Fort Worth serves approximately 1.2 million people including 900,000 retail customers and 300,000 wholesale customers.



Water System

Master planning and CIP development efforts focused on addressing the following three (3) drivers. 1) Provide infrastructure to meet the rapid growth. 2) Improve the resiliency and interconnection of its 13 pressure zones and 5 water treatment plants to leverage existing system capacity. 3) Development of a prioritization process to initiate Fort Worth Water asset management program for vertical and linear asset infrastructure renewal.

FNI utilized InfoWater for water system model development and future scenario planning with a one to one GIS to Model. FNI utilized InfoAsset Planner for water system risk based assessment planning. Fort Worth's water system asset management program was initiated with parallel planning efforts including the development of a) WECAP (Water Efficiency Condition Assessment Program) that prioritized water line replacements based on condition, criticality and coordination with transportation needs and b) Development of an Asset Management Policy and AMMA (asset management maturity assessment) to identify gaps in processes, tools and data capture.

Wastewater System

Master planning and CIP development efforts focused on addressing the following three (3) drivers. 1) Develop a capacity plan to avoid building new interceptors through the downtown area. 2) Reduce major sewer interceptor outages resulting in loss of public confidence, expensive reactive emergency repairs and risk of future consent decrees. 3) Systematically develop an asset management program to prioritize overall system renewal.

FNI utilized InfoSewer for wastewater system model development and future scenario planning with a one to one GIS to Model all pipes model. FNI utilized InfoAsset Planner for wastewater system risk based assessment planning. Fort Worth's wastewater system asset management program was initiated with the development of an ICAP (Interceptor Condition Assessment Program) that conducted a multi-sensor analysis (laser, sonar and HDTV field inspection) of all large interceptors to identify focused cleaning and remaining useful life of each pipe segment.

Stormwater System

Master planning and CIP development efforts focused on addressing the following three (3) drivers. 1) Leverage the existing stormwater utility fees and bond programs to maximize highest value stormwater capacity improvements. 2) Assist the City in transitioning to a pay-as-you-go system with reduced stormwater expenditures. 3) Assist the City in a risk based prioritization system to guide Fort Worth's stormwater planning team in selecting areas to future study and mitigation alternatives to move into CIP development.

FNI developed a needs based prioritization system in GIS to rank the City's 300 storm drain mapsheds based the following factors: structure flooding, road flooding, pipe capacity, infrastructure criticality, and drainage complaints. This information was incorporated into a risk-based ranking of mitigation alternatives tracked in an Access database.

LOCATION

Fort Worth, TX

REFERENCE

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Greg Simmons, PE
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RELEVANCE TO SWBNO

- Complex Multi-Pressure Zone Water System
- Resiliency Planning to Reduce Emergency Outages/Failures
- Aging Infrastructure Competing with Growth for CIP \$\$\$

WATER PLANNING AND SYSTEMS ANALYSIS | CITY OF BEAUMONT

At the end of August 2017, flooding from Tropical Storm Harvey severely affected the City of Beaumont's water system. Flooding impacted the City's raw water Lawson's pump station, canal and 48-inch water transmission line that feeds into the Beaumont Surface Water Treatment Plant. This event put unnecessary strain on the system that relies on this source of raw water to feed the Water Treatment plant and subsequently its customers. In order to plan recovery efforts, the City hired FNI to perform the following:

- Develop and utilize a calibrated hydraulic model in order to understand and improve water system performance and quality
- Evaluate improvement alternatives for building a more storm resilient raw water system to the existing surface water treatment plant
- Evaluate long term plans for a new surface water treatment plant outside of the T.S. Harvey flood zone
- Assist with Disaster Recovery funding and communication efforts

Over the past 10 years, FNI has played a significant role in the development of the City of Beaumont water system and during this important recovery effort, FNI was able to use its engineering and technical knowledge in determining the most cost-effective engineering and technical solutions to restore and build long term sustainable infrastructure systems.

LOCATION
Beaumont, TX

REFERENCE
Kyle Hayes
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RELEVANCE TO SWBNO

- Resiliency Protection from Coastal Surge & Flooding
- Aging Infrastructure and Funding Support
- Leveraging Multiple Sources for Capacity Needs and Regulatory Compliance




Thomas Haster, PE
30 years' experience

WATER/WASTEWATER

Thomas Haster, PE, is an FNI Vice President/Principal. A key leader in the firm's delivery of master planning and modeling services to municipal clients, He has led more than 60 water/wastewater master plans, condition assessment/asset management programs and impact fee studies. Thomas plays a pivotal role in assisting municipalities with addressing their water and wastewater planning needs. He has extensive experience in the design and rehabilitation of water and wastewater pumping facilities (up to 560 MGD capacity) and major water transmission lines (up to 96 inches in diameter). He is a member of the AWWA National Water Quality Committee and co-author of the AWWA M-32 Manual on Water System Planning.



Jessica Brown, PE
23 years' experience

WATER/WASTEWATER

Jessica Brown, PE, is an FNI Vice President/Principal and Practice Leader of FNI's Water/ Wastewater Master Planning Practice. Her background provides her clients with the confidence that they are making fully informed investments in their infrastructure. Jessica's experience involves setting the course for a municipality with an asset management plan and integrating GIS and work-order systems to comprehensive CIP planning. She played an integral role in offering the Institute of Asset Management (IAM) certification training to municipalities and is also IAM certified. Jessica has managed more than 60 W/WW master plans, asset management programs, condition assessment programs and infiltration/ inflow studies, as well as client workshops.



Jim Keith, PE, CFM
19 years' experience

STORMWATER AND DRAINAGE

Jim Keith, PE, CFM, is an Associate at FNI with two decades of technical and managerial experience in water resources planning and design, leading large-scale stormwater modeling and planning projects in Louisiana including the Interior Drainage Analysis for Orleans Parish. Jim was responsible for overseeing all modeling aspects of the interior drainage analysis, working closely with SWBNO to incorporate SELA projects into highly complex unsteady HEC-RAS models. Based on his focus on community-based approaches and resilient solutions, he was selected to serve as PM for an \$18M modeling effort in Region 2 supporting the Louisiana Watershed Initiative. He performed various individual watershed analyses in northern, central and southeastern Louisiana

WRITTEN RESPONSES



QUESTION A: WHAT WILL BE NEW ORLEANS' BIGGEST STORMWATER/ DRAINAGE CHALLENGES IN 50 YEARS AND WHAT IS THE BEST APPROACH TO INTEGRATED, LONG-RANGE PLANNING TO ADDRESS THOSE CHALLENGES?

Location

To understand the challenges facing New Orleans, one must understand its history and geographic location. The city has prospered due to its location on the Mississippi River and proximity to the Gulf of Mexico, driving national and international commerce. Being located on the Gulf Coast has always made New Orleans susceptible to impacts from tropical storms and hurricanes, which can cause severe impacts to the SWBNO infrastructure. The Mississippi River is an integral part of the city and its prosperity, providing not only a lifeline for maritime commerce, but also freshwater supply for the SWBNO as well as drainage relief. Incorporating local lessons learned will be a key element.

Severity of Tropical Storms

Increasing size and severity of tropical storms have resulted in increased risk of both storm surge and rainfall intensity. While damage from large tropical storms such as Katrina are well-documented, it is important to also note the damage resulting from smaller tropical storms like Isaac in 2012, which resulted in higher than anticipated storm surge elevations. SWBNO must continue to work as a local sponsor with USACE to maintain the Hurricane and Storm Damage Risk Reduction System (HSDRRS) including the multitude of interior drainage pump stations and canals.

Climate Variability

Over the past 10 years, the Mississippi River has experienced record-breaking flood events in 2011 and 2019, along with record low levels in 2012. The 2011 event marked the first time since 1973 that the Morganza Spillway was operated, and the 2019 flood

broke records for duration and total volume. The Bonnet Carre Spillway was operated twice just in 2019 – the most in its history. SWBNO must be prepared to operate all their water infrastructure in both extreme high and low river levels, with flood operations continuing for longer durations, placing additional stress on aging equipment.

Immense Funding Needs

The Stormwater Strategic Pathways document developed in 2018 identified nearly \$1B in immediate stormwater funding needs, with over \$8B needed to optimize and expand SWBNO's drainage infrastructure over the next 50 to 100 years. While much of this funding may come from Federal sources, ultimately the long-term operation and maintenance of the SWBNO drainage system must be generated from local revenue sources. This will require a stakeholder outreach and engagement program to garner public support for increased millages or other stormwater drainage fees.

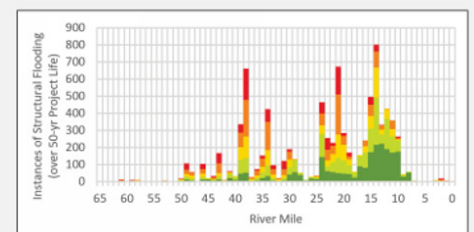
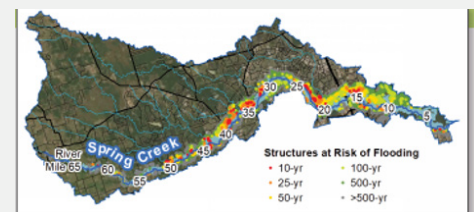
SPOTLIGHT | Compound Flooding

FNI'S PROJECT SPOTLIGHT

Identifying Flood-Risk Vulnerabilities and Evaluating Mitigation Solutions

The San Jacinto flood mitigation master plan is identifying vulnerability to flooding hazards, developing approaches to enhance public information and flood level assessment capabilities during a disaster, and evaluating mitigation strategies. The FNI team prepared a large-scale 2-D rain-on-grid model to set the course for the 254-mile 1-D effort. The models were calibrated to the Hurricane Harvey and Memorial Day 2016 storm events, validated against the October 1994 and Tropical Storm Imelda storm events, and updated based on 50-year population projections and development trends.

FNI also developed a new method to quickly quantify and map flood reduction benefits for 100,000+ structures for any given mitigation alternative – **fully automating the benefit-cost analysis effort and providing a simple, more effective way to communicate mitigation benefits to the public.** This custom rapid benefit-cost analysis (BCA) tool combines building footprints and hydraulic results to instantly estimate a benefit-cost ration of any given modeled alternative following FEMA BCA methodology.



Hurricane Barry showcased the risk associated with tropical storm and riverine flooding occurring at the same time. High water levels in the river, which have been at flood stages for longer durations, coupled with a tropical storm/hurricane or high intensity rain event can have significant impacts to the City. Levee overtopping could be coupled with heavy rainfall inundating the City and overwhelming the available capacity of the drainage system.

FNI Approach:

Long-range planning will need to include an assessment of compounded risks of failure, including joint probability analysis of storm surge, river flooding, and interior rainfall.

SPOTLIGHT: Subsidence & Maintenance

There has been a shift in recent years to focus planning efforts on the City's long-term resiliency. As part of achieving resiliency the learning how to "live with water" approach has been tackled by many organizations. There are small efforts that focus on water retention in rain barrels at individual homes and there are larger coupled approaches as implemented through the Gentilly Resiliency District, whose overarching goal is to reduce flood risk, slow land subsidence, improve energy reliability, and encourage neighborhood revitalization. Utilities have been severely impacted by subsidence, which is accelerated by the soft soil conditions and drainage patterns that create significant variations in ground water elevations. Maintenance of water, sewer and drainage infrastructure are costly on their own, but coupled with severe subsidence the required maintenance cycles are even shorter and costs increase. If maintenance has been deferred, it becomes even harder to get back on track for maintaining a desired level of service.

FNI Approach:

Comprehensive planning of SWBNO's water, sewer, and drainage systems using a programmatic "One Water" approach will lead to optimized maintenance costs and reduced subsidence impacts. FNI has successfully utilized this approach for the City of Houston which faces similar subsidence issues.

"Shifting from Reactive to Proactive will have to be a Priority!"

SPOTLIGHT: Funding and Prioritization

Shifting to a maintainable level of service requires a certain funding commitment, that can be adjusted annually as cost increase. In addition, funding sources need to allow for flexibility to react to unforeseen emergencies and incorporate planning ahead for high-cost improvements that can be anticipated within the planning horizon. The current CASSWORKS system is a great resource, but the data needs to be transferred to a more sophisticated database and asset-management tool that can not only fulfill the tasks currently covered by CASSWORKS, but also help to tie the data to an assessment and prioritization tool, funding management tool and a geospatial visualization tool, real-time synergies between historic

EXAMPLE PROJECT MANAGEMENT APPROACH FOR GLO RESILIENCY STUDY



Initiate: Develop scope and fee, negotiate contract, conduct training. *Ready resources by identifying up to six study teams assigned to specific watersheds that will work in parallel to streamline analysis and delivery.*



Plan: Develop Project Management Plan, risk register, schedule and project baseline, assign roles/responsibilities, develop Quality Management Plan, Communication Plan, conduct kickoff meeting. *Technical and Coordination Leads will work with their Key Staff and Technical Advisors to develop an initial framework and technical methodology (to include recommendations for potential pilot studies) across geographic areas – in coordination with the GLO and its Program Manager and Study Teams.*



Execute: Mobilize watershed study teams. These teams will work in parallel to streamline Phases 2 and 3. Coordinate project activities with the team, including subconsultants. *Management Team and Key Staff will provide technical direction and quality control. Technical advisors will provide as-needed technical guidance to the team. Coordinate with GLO and Program Manager.*



Monitor and Control: Monitor schedule, budget, and scope using earned value principles. Report CPI, SPI, schedule and cost variances (within approved thresholds). *Manage risk, monitor effectiveness of mitigation strategies/adjust as needed.*



Close: Conduct project close meeting to verify contract requirements were met and the project met stated objectives and expectations. *Document lessons learned for future projects.*

data, operational data and forecasting data as well as report generation and updates on publicly accessible platforms.

SPOTLIGHT: SWBNO Proud & Public Trust

The SWBNO will only be successful in the long-term if the agency staff is collaborative and proud to be part of the agency and the services it provides to the residents of New Orleans. Therefore, the internal branding and team-building will need to be an important piece of the planning. Generating an atmosphere, and physical workspace, that can motivate existing employees and attract new talent to join the agency will be important. In the past, the agency's pay structure has created hurdles to a cohesive work-environment and the attraction of new talent. Any long-term planning will need to include an employment strategy to build the workforce needed to endure and prosper.

Obtaining the necessary funding long-term maintenance of acceptable levels of service will require the public to vote for financial support mechanisms. In order to be successful, the public needs to trust the agency and its commitment to serve and protect the community. To regain the trust, communication with the public will need to improve together with the responsiveness of the agency when issues are observed and reported.

An integral part of regaining public trust will be improving the relationship and collaboration between the SWBNO and DPW, especially as it relates to drainage work. The two agencies are in a unique situation, since the SWBNO maintains drainage lines 36" and greater, whereas the DPW maintains smaller lines and catch basins. The public does not always understand which agency is in charge as they observe leaks, damages or collapses, which is causing further public frustration when calling the wrong agency.

The Task Force on New Orleans Sewerage, Water, and Drainage Utilities in their final January 2019 report recommended a "one-call" system for drainage where operations, management, and customer service are handled by a single entity, which could be a co-operational group with representatives from DPW and the SWBNO. Having one database of complaints/comments and damage reports and their resolution status would not only improve public communication and response coordination but also reduce the public's frustration on where to report issues and therefore improve public satisfaction.

In addition, it should be a long-term goal for the SWBNO to expand and centralize their various interactive maps to one location that is linked to community outreach, community events and other stakeholder engagement and communication tools.

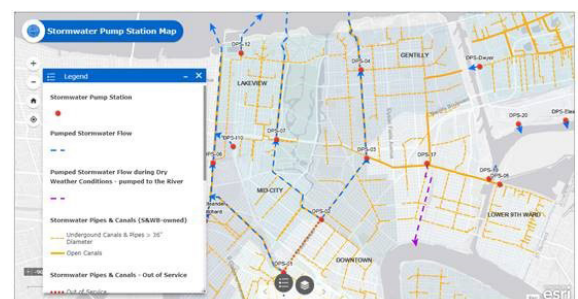
TRAINING

Creating a work environment that allows for personnel growth and accountability will help to create a workforce that will enhance the external messaging of the SWBNO. Also, training that includes staff and community members will create touch-points between staff and the SWBNO's customers, which in turn will improve knowledge about the agency and increase its approachability.

In addition to co-training of staff and community members, a robust community communication plan strategy will need to be developed as part of a long-term planning effort and the facilitators of this communication need to be trained in how to interact with the public and how to best communicate the information at hand, which will vary by stakeholder group.

A PROGRAMMATIC APPROACH ADDRESSES

- Business operations
- Levels of service
- Corresponding staffing requirements
- Processes and procedures
- System inventories
- Condition assessments
- Modeling
- Data management
- Decision support
- Capital needs identification
- CIP development
- Revenue requirements
- Financing recommendations



Source: <https://www.swbno.org/About/DrainageSystemFactsAndMap>



The SBNO will be able to lean upon FNI to assist with Training Plan development and implementation. **Freese and Nichols University (FNU)** is the culmination of more than a century of emphasizing education.

Our founder, Major John B. Hawley, believed that continuing education was essential, and today, this belief is an integral part of Freese and Nichols' culture.

The quality of education offered through FNU is a matter of pride within Freese and Nichols. Clients and employees, regardless of location, can attend seminars taught by Freese and Nichols' technical experts who hold advanced degrees and certifications in their respective disciplines. Freese and Nichols is pleased to offer free or nominally priced professional development opportunities to clients.

FNU 2019 NUMBERS

- Classes offered: 403
- Attendees: 4,573
- PDH Credits Issued: 11,759
- Average Course Satisfaction Rating: 4.86 out of 5



TRAINING AND PROFESSIONAL DEVELOPMENT

Stephanie Buckingham, CPLP, PHR, is an Associate Professional in Talent Development and is part of Freese and Nichols' Organizational Development team. She is FNI's Training and Professional Development Manager and develops customized training plans for municipalities nationwide.

Award-Winning Programs Available to Clients:

Engineering Ethics: Ethics is a key component of FNI's history and one of our core values and number one guiding principle. Developing an ethics class that would meet the LAPELS requirements as well as offer SWBNO specific ethics training should be part of a long-term training portfolio.

Individual Development: FNU offers classes to aid in personal development. Examples of these classes include: Crucial Conversations®, Personal Accountability, Listening Skills, Communication for Success, Management, Negotiation Skills and Presentation Skills. It will be important to the SWBNO's long-term success to focus on establishing opportunities for their individual staff members and develop customized training plans to foster an environment of continued learning and excellence.

Technical Seminars: Technical seminars are taught by technical professionals, who hold advanced degrees and certifications in their respective disciplines. The technical education needs at the SWBNO cover a very wide range and assuring that each employee group has appropriate technical learning goals identified and appropriate training available is key in keeping staff engaged and allow them to excel at their job.

Continuing Education Courses: FNU offers more than 200 classes in approximately 30 different subject areas each year. Classes in this category should count toward professional engineer re-licensing requirements or other professional development requirements. As part of a long-term vision development it would be advised to revisit training already supported and identify if any additional or not previously considered classes or training would qualify for continuing education credits while widening the opportunity of learning.

Mentor Programs: FNI participates in several mentor-protégé programs in which we provide business development guidance as an established firm to emerging historically underutilized businesses. The SWBNO's approved DBE's could be trained by the SWBNO on new processes or to allow them to participate in workshops with SWBNO staff of various departments to build relationships between the DBE community and the agency.

INTERNAL LEARNING: For any organization to develop and grow it must become a learning organization. Learning organizations facilitate the learning of its members and work to continually improve and transform into a better organization.

EXAMPLE TRAINING MATRIX - CONSTRUCTION MANAGEMENT PROGRAM

Communication and Collaboration Skills Training (3-4 Classes)

- Question Behind the Question - Practicing Personal Accountability
- Crucial Conversations
- Meeting Facilitation
- Communication for Success

Technical Skills Training (3-4 Classes)

- Bluebeam Basics
- Advanced Bluebeam Applications
- eBuilder Basics
- Advanced eBuilder Applications

Specialty Construction (3-4 Classes)

- The Art of Managing Construction
- NACE Certification Preparation
- ACI Certification Preparation
- Electrical Specialty Observation Training

Training, to be effective, must include more than sitting in a classroom. Therefore, a long-term approach to the agency's resiliency needs to integrate individual development, technical advancement, mentoring as well as team-building activities. It is important that the staff is an integral part in developing the portfolio and/or training matrix, and it has to be integrated in the agency's processes to establish mentoring opportunities and development of individual training goals.

FNI brings a wealth of local drainage and large-scale USACE civil works flood risk reduction expertise to SWBNO. Our team members are focused on reducing flood damages for the public through innovative and cost-effective approaches, and our clients include municipalities, regional drainage and levee boards, and State and Federal agencies. Scott Hubley and Barry Fehl are just two of our many experts who will assist SWBNO in addressing long-term challenges related to drainage and stormwater.



Scott Hubley, PE, CFM, is an FNI Vice President/Principal and North Texas Stormwater Group Manager. He provides clients with a comprehensive approach to stormwater solutions. He has experience in the planning and design of municipal stormwater infrastructure, including closed systems, open channels and detention facilities. His background in hydrologic and hydraulic modeling, including open-channel studies, closed-system analyses, flood damage analyses, FEMA map revisions and watershed studies, offers clients a technically sound, on-target look at their existing and future stormwater systems. He has been involved in design and construction of \$100 million in stormwater improvements.



Barry Fehl, DSC, PE, recently joined FNI and is a structural engineer and engineering manager with over 39 years of experience, especially with USACE projects. His expertise is related to the design and analysis of large, civil works projects, including flood protection and navigation. This includes working on pumping stations, floodwalls, levees, diversions, locks, and dams for projects throughout the U.S. Locally he has served as Principal-In-Charge on the Southeast Louisiana Urban Flood Control Project, performed structural analysis of the existing East of Harvey Floodwall (WBV-1), and performed as the PM for the Algiers Floodwall & Floodgates Project, all for the USACE New Orleans District.

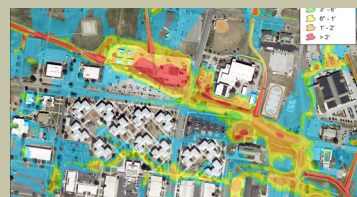
We understand the need of having resources that cover the multidisciplinary needs of solving long-term drainage issues and **understand how individual, smaller projects are key for developing a resilient long-term system and increase community understanding** and participation in issue resolution. The SWBNO will need to incorporate all facets of urban planning into their drainage considerations for long-term success!



George Fowler, PE, currently the Technical Lead on the Dillard Wetland Resiliency Project for the City of New Orleans is well versed in projects that mitigate flood hazards, erosion hazards and water quality pollution sources. His approach focuses on mirroring natural processes to solve complex surface water problems by incorporating geomorphology, and bioengineering into design where appropriate.



Wendy Shabay, AICP, is an award winning urban planner and has 26-years of experience in leading charrettes give her an exceptional ability for work with community groups in building consensus. She is currently assisting St. Tammany in updating the Parish’s development regulations in a streamlined Land Development Code. She offers extensive experience in the fields of planning and urban design, public participation and funding development.



Fort Hood Drainage Master Plan | Bell County, Texas | USACE | Fee: \$1.4 Million |

FNI was tasked to prepare a stormwater master plan for the entirety of Fort Hood. Proposed alternatives were developed to alleviate existing and future conditions flooding. The proposed improvements are designed to prevent the 25-year storm event from overtopping the roads and improvements are sized to prevent the 100-year storm event from inundating existing structures.



Rodney Cook Sr. Park | City of Atlanta, Georgia | Fee: \$0.9 Million |

FNI provided master planning and design services to add open community space to the surrounding neighborhood, alleviate localized flooding, increase stormwater capacity, separate combined sewers in the vicinity, improve water quality and provide educational opportunities, while honoring the neighborhood’s legacy by including historic leaders tributes.



QUESTION B: WHAT WILL BE NEW ORLEANS' BIGGEST WASTEWATER/ SEWERAGE CHALLENGES IN 50 YEARS AND WHAT IS THE BEST APPROACH TO INTEGRATED, LONG-RANGE PLANNING TO ADDRESS THOSE CHALLENGES?

Availability of Data and Integration for Decision-Making

Some of the specific locational and climate related challenges were initially discussed in Question A; however, one key consideration before embarking on any master planning effort is to do a comprehensive review of all available data compared to the data needed and perform a gap analysis and closure plan. The right decisions can't be made if the right data is not available. Some data challenges that SWBNO faces are:

- Data resides in separate systems, some of which are based on software that is not supported and can't be updated,
- Data sources are not tied together by common identifiers and can't be integrated
- Accuracy of some data hasn't been verified, resulting in lower confidence of the data.

Examples of these issues were raised in the Water Audit Update FY2008 – FY2017 published in March 2019 which showed non-revenue water to be nearly 20% of the operating costs; however, it is unknown at this time how much of that is truly attributable to water loss versus not being able to be quantified due to the unavailability of data. This causes an issue in that it appears that there is significant waste which may be overexaggerated by the lack of data.

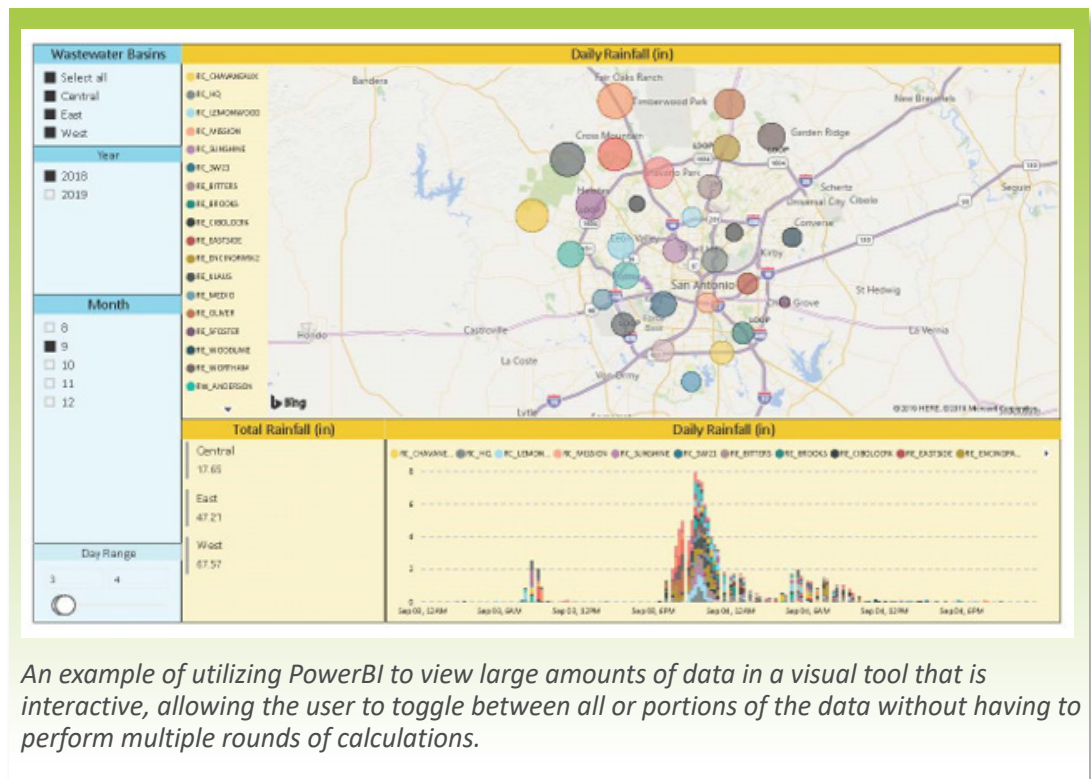
FNI Approach:

FNI would conduct a data evaluation process covering utility billing systems, GIS, CMMS, fieldwork databases and software, water quality databases, inspection

systems, SCADA, etc. The evaluation should consider:

- What information is being collected and how is it being used? Does process for flexible adaptability?
- Is the software or application currently supported?
- Does the software have additional functionality that isn't being used, and does that functionality overlap with other software or applications?
- Does the data being collected have a common identifier that allows integration with other systems?
- Is the data maintained on a regular basis, and has the accuracy been verified?
- Is the entry of data standardized with well-defined fields and allowed values?

The result of this exercise would be recommendations on data collection and software. FNI can also assist the SWBNO in developing dashboards in programs, such as PowerBI for powerful data visualization.



An example of utilizing PowerBI to view large amounts of data in a visual tool that is interactive, allowing the user to toggle between all or portions of the data without having to perform multiple rounds of calculations.

Accuracy of Mapping Data

The SWBNO has undergone significant GIS mapping efforts and has been prioritizing digitizing its system components as improvements are made. The SSERP Program has generated a mapping tool that facilitates construction inspections by depicting crew locations, while also providing info on completed and remaining repairs. The legacy data for existing lines however may not be as accurate as is required for daily maintenance or emergency repair needs in terms of alignment, depth, connectivity or attribute data. Because of topography changes over time, just georeferencing in plans and drawing may not result in an accurate integration.

FNI Approach:

FNI can work with SWBNO to develop a robust plan for data collection, including incorporating certain steps into the field inspection process to streamline the capture of necessary data and save time on gathering data on an asset. Tracking source and date of utilized and updated data will be key in generating a fully geo-referenced system grid in the long-term.

Completing FEMA Funded & Consent Decree Work

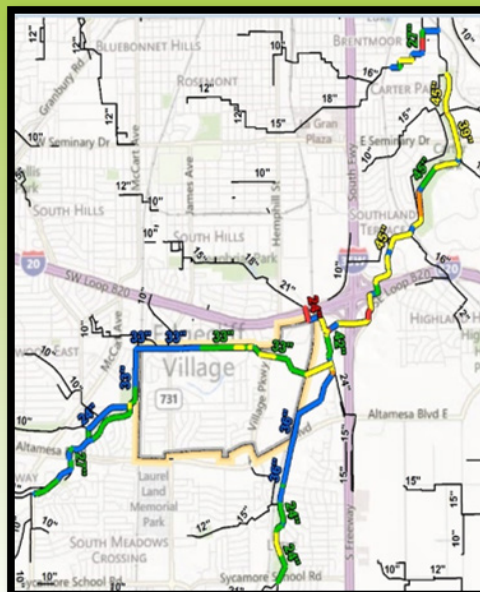
In 1998, the SWBNO entered a Consent Decree with the U.S. EPA and the U.S. DOJ, among other parties. The original version was modified in 2010, 2013 and 2014, and work is currently scheduled to be completed by 2025. The consent decree work was disrupted by Hurricane Katrina, and a force majeure was issued, resulting in extending the consent decree completion date, to allow coordination of the consent decree sewer work with FEMA authorized utility and street work to be executed by the SWBNO and the DPW. Any long-term planning will need to include critical deadlines and requirements set by FEMA and the EPA, as well as incorporating lessons learned, and to continue inspection cycles currently mandated by the EPA, which include manhole inspections, valve exercising, main line cleaning, CCTV and other activities.

FNI Approach:

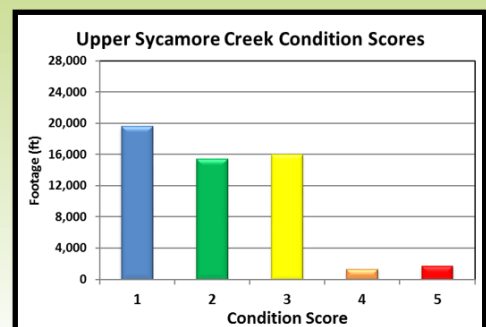
The SWBNO has been collecting a lot of valuable data, and we need to ensure that it's being stored in a system where it can be recalled later or updated with more recent data. For example, the CCTV and manhole inspection efforts capture valuable asset condition data that needs to be stored in a system that allow the user to easily visualize defects and other condition issues, plus tie into the GIS and CMMS systems. In addition to address significant condition issues, this data should be utilized to plan maintenance activities to extend the life of existing infrastructure or head off potential System Sewer Overflow (SSO) issues in the future.

Maximizing Use of Rehab Dollars

Due to the age of the sewer infrastructure in New Orleans, the budget needed for system upgrades and maintenance is much greater than available funding, and spending rehab dollars on the right asset at the right time becomes critical. Overall renewal planning is discussed below, but FNI has implemented programs that have allowed other utilities to stretch their rehab dollars through targeted inspection and



Through multi-sensor inspection of all large diameter pipe, Fort Worth has discovered that only portions of pipe (that was installed at the same time) is in need of replacement instead of full replacement, saving millions of dollars in their CIP.



identifying which portions of an asset have the greatest need.

FNI Approach:

Over the past 10+ years, FNI has been an industry leader as a program manager of multi-sensor inspection, developing a methodical approach where we prioritize inspection, analyze the data, assign remaining useful life and a failure year, and calculate rehab costs. This approach targets rehab dollars where they are needed most at the right time and has saved our clients millions of dollars by changing from a mentality of full manhole-to-manhole rehab.

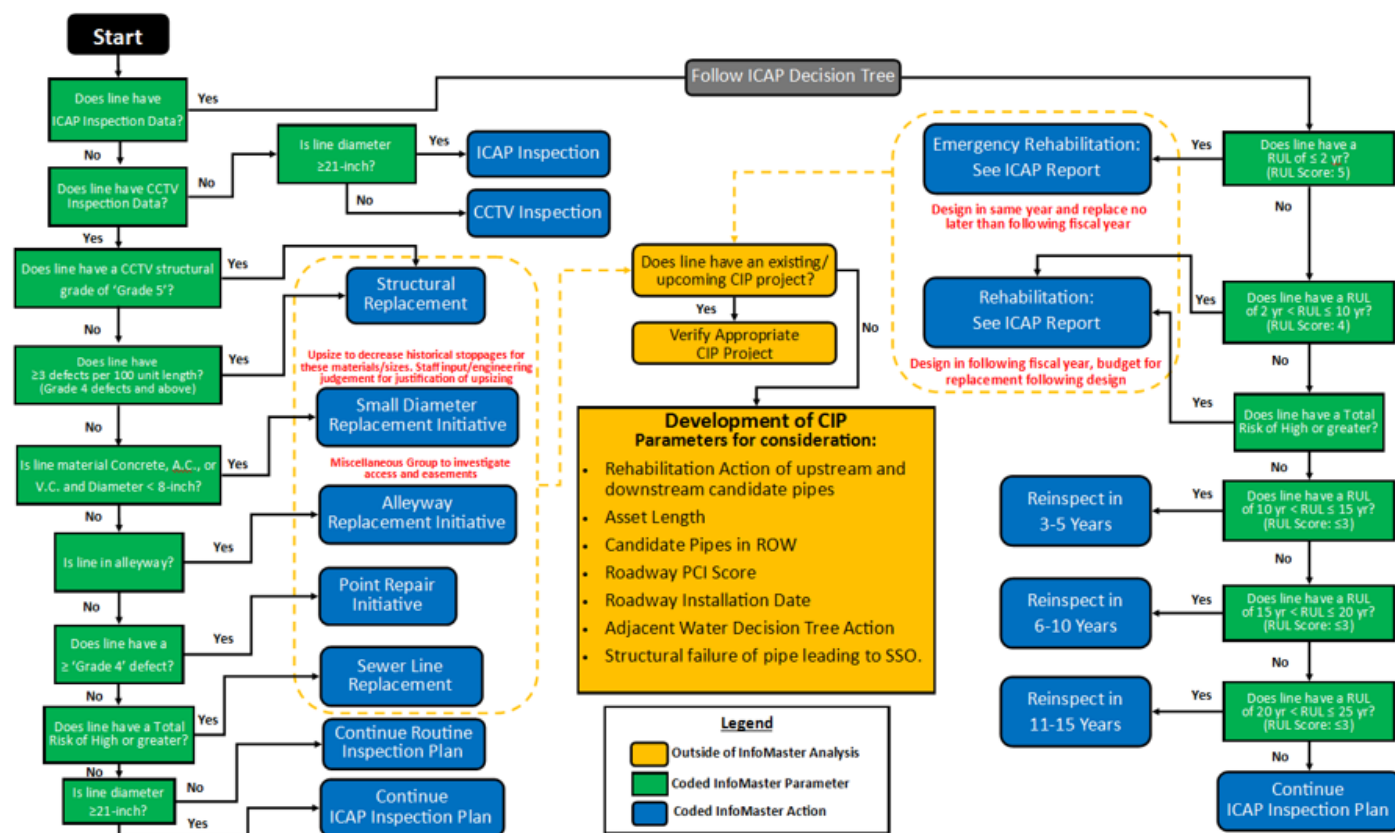
Battling I&I and Proactive System Renewal Planning

New Orleans was strategically built in the location it is in due to the benefits the Mississippi River Delta offered. It was not chosen for settlement for its excellent soil conditions. Having underground utilities in our current environment, which added excessive pumping and groundwater fluctuations to the poor soil conditions, has resulted in extensive subsidence issues and is creating unique infrastructure challenges and maintenance issues.

Sewer lines, just like other underground utility lines, are more likely to crack, break, collapse or disjoint due to the settlement and subsidence issues. The connection between individual services and main lines are particularly susceptible to displacement. Similarly, repair locations are usually exposed to differential settlement causing many repairs to not have the same life cycle as in other communities.

Finding the proper balance between rehabilitation and replacement is therefore critical. Although rehabilitation via CIPP lining has proven to be a good application locally, especially when coupled with lining the house connections and discontinuing abandoned connections, it can be costly. Long-term planning will have to include an evaluation of the entire system, which needs to include the identification of lines that could and/or should be abandoned or replaced by a new route as well as maintenance/replacement and inspection strategies. Also, an example of a small, but necessary improvements that can be made, is moving from hard-copy house connection cards to database-housed wye information.

FNI Approach:



With a decision tree approach, every pipe has an action based on inspection or other data whether it be replacement, rehab, inspect on a specific interval or monitor.

Some cities have found significant low hanging fruit from a focus on manhole rehabilitation after addressing pipes with major defects; however, FNI would recommend as a first step to perform follow-up flow monitoring in some of the first rehab basins to determine the amount of I/I removal from those efforts to best focus efforts in the latter basins. FNI has worked with SAWS the last several years on their Consent Decree program in a process that included flow monitoring, modeling, identification of improvements, running the identified improvements through a decision tree process, testing of some defects (particularly manholes) and then design work to address deficiencies. This next phase will involve follow-up flow monitoring to evaluate the level of I/I removed, and FNI can bring that data to SWBNO for consideration in its program.

There are many considerations and requirements that feed into maintaining an acceptable level of service that minimizes I&I, and the long-term planning will need to move to streamlining processes and evaluations, while continuing day to day operations. SWBNO has been conducting flow monitoring and field reconnaissance a basin at a time; however, only the most immediate needs are being addressed based on budget constraints. For the assets that have not been targeted for immediate rehabilitation or renewal, a system needs to be in place to prioritize renewal of that asset and assign an action to every pipe using a decision tree methodology.

FNI Approach:

An example is shown here, and FNI has assisted utilities such as Fort Worth Water Department, Austin Water Utility and San Antonio Water System (as part of their Consent Decree) in assigning an action and cost to every pipe with actions ranging from inspecting the asset again at a set time to full replacement.

Asset Management & Prioritization Tool

FNI understands that the SWBNO has utilized a decision support system for identifying previous rehab priorities and has developed decision support systems for clients and utilized off-the-shelf software packages that are specifically designed to develop risk based assessments and a decision tree based outcome. Based on recent significant failures at sewer pump stations, we would recommend a full condition assessment of all wastewater facilities and identifying any additional testing needed. This would allow the City to determine if only individual components need to be replaced or if larger scale replacements (i.e., replacement of a full pump and motor unit vs. rehab of the motor) and better plan for these large expenditures, potentially avoiding significant emergency fund expenditures or the risk of backing up sewage into homes or discharging raw sewage into the Mississippi River.

Program Collaboration (DPW & Other Utilities)

“They just fixed that street & now they are cutting it again”

Since many utilities are co-located within street right-of-way (ROW) and any repairs require SWBNO to rehabilitate streets, sidewalks, driveways or sod areas within the ROW impacted by the dig repair, the SWBNO and DPW are required to constantly collaborate and maximize the positive impacts of each. The DPW maintains a GIS layer of pavement condition data that can continue to be coordinated with the renewal of the water and sewer systems; however, the condition of the DPW and SWBNO stormwater infrastructure should also be incorporated into the decision making.

FNI Approach:

On similar renewal/rehab programs, FNI has worked with multiple city departments to develop business processes that are specific to the entity and allow for collaboration between the departments and a more efficient expenditure of a City’s CIP funds.

City of Huntsville Water and Wastewater Condition and Capacity Assessment Studies Draft Lift Station Risk Based Assessment																									
Tanyard Creek A.J. Brown WWTP Service Area																									
<table border="1"> <tr> <td>Inspection Date:</td> <td>4/8/2021</td> </tr> <tr> <td colspan="2">Facility Information</td> </tr> <tr> <td>Address:</td> <td>1400 Fish Hatchery Rd</td> </tr> <tr> <td>Map to Station:</td> <td></td> </tr> <tr> <td>Type of Facility:</td> <td>Submersible</td> </tr> <tr> <td>Number of Pumps:</td> <td>2</td> </tr> <tr> <td>Pump Capacity:</td> <td>2 x 50 MGD @ 90' TDH</td> </tr> <tr> <td>Inspection:</td> <td>60 Min</td> </tr> <tr> <td>Monitoring:</td> <td></td> </tr> <tr> <td>Inspector:</td> <td>JTS/WR</td> </tr> </table>						Inspection Date:	4/8/2021	Facility Information		Address:	1400 Fish Hatchery Rd	Map to Station:		Type of Facility:	Submersible	Number of Pumps:	2	Pump Capacity:	2 x 50 MGD @ 90' TDH	Inspection:	60 Min	Monitoring:		Inspector:	JTS/WR
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CONDITION ASSESSMENT																									
Component Group	Component Condition Rating	Weight Factor	Weighted Component Rating	Comments																					
Electrical - MCC, Back-up Power, Cables	2	20%	0.40																						
Pumps and Motors	2	20%	0.40	Pump 2 observed 20% efficiency compared to Pump 1. One pump is down and the other is noisy.																					
Instrumentation - SCADA, Alarms	2	15%	0.30																						
Structure - Hatches, Corrosion, Cracks, Leaking, Ventilators, Odor Control	2	20%	0.40	Structure in good condition overall.																					
Piping and Valves	2	15%	0.30	Minor leaks in wet well.																					
Site - Drainage, Access Erosion, Security, Fencing	2	10%	0.20	Drainage needs touch up. No fence around.																					
Total Inspection Score	-	100%	2.00																						
Impact of Work Order Data	-	-	0.25	Above average number of work orders.																					
Condition Rating	-	-	2.25																						
CRITICALITY ASSESSMENT																									
Component Group	Component Criticality Rating	Weight Factor	Weighted Component Rating	Comments																					
Environmentally Sensitive Areas	5	50%	2.50																						
Population Served	2	25%	0.50																						
High Impact Areas	2	25%	0.50																						
Criticality Rating	-	100%	3.50																						
RISK BASED ASSESSMENT																									
Lift Station Risk Rating	Condition Rating	Criticality Rating	Overall Risk Rating	Risk Category																					
	2.25	3.50	5.75	Moderate Risk																					

Condition assessment of facilities with a framework similar to this helps identify key rehab or replacement needs and address issues before run to failure, particularly at key facilities.

Managing Capacity at WWTP

With high infiltration rates comes that the treatment plant is receiving very high flows during extreme rain events. While Veolia has performed well in managing the SWBNO Wastewater Treatment Plants, there may be additional opportunities to manage the required capacities between the two plants, and their input in required upgrades and maintenance recommendations will be highly valuable.

Standard Operating Procedures (SOPs)

Standard operating procedures provide consistency in operation of facilities and can result in operational savings.

FNI Approach:

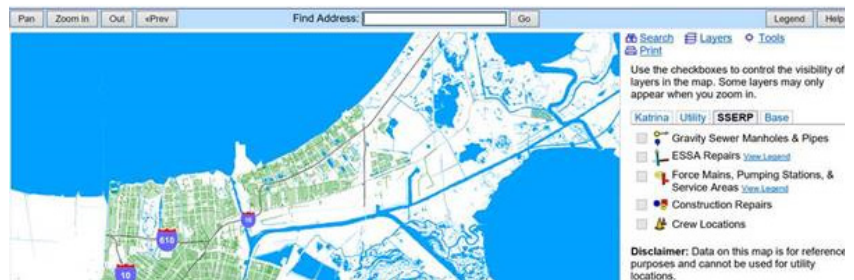
As part of the master plan effort, FNI recommends conducting an updated CMOM self-audit to determine any current gaps the SWBNO has and then developing a gap closure plan to address critical items identified in the audit. Part of the audit includes a review of existing SOPs and documentation, so a result of the audit may include updating or developing SOPs for the sewer system. Although there is not a self-audit for the water system that is comparable, there are some similar components that could be documented for the water system as part of that process. FNI's familiarity with EPA Region 6 staff is an asset as we have assisted other municipalities on similar efforts, and we met specifically with EPA staff on the CMOM framework after it was published. FNI's approach on the CMOM self-audit has an asset to municipalities with recent EPA site visits.

Funding

The cost of sewer service in New Orleans is economical compared to other cities, even with the annual rate increases that were enacted from 2013 through 2019; however, the revenues will fall short of the current projected needs and will require additional increases. Over half of the combined current capital funding is through EPA loans and grants from FEMA and the Corps of Engineers, meaning a heavy reliance on federal funding. A challenge going forward will be the availability of this funding and providing data-based decisions to justify needed expenditures.

FNI Approach:

FNI maintains funding experts, such as Mark Evans, who are available to assist in evaluating the variety of grants, loans and other funding mechanisms for a long term sustainable plan. Mark previously served as Team Lead of the Statewide Outreach initiative for the Texas Water Development Board (TWDB). In his nine years with the TWDB, Mark became a subject matter expert of both state and federal loan programs, including EPA's State Revolving Fund programs, as well as application processes.



Source: <http://www.gosserp.com/info/maps/>

SWBNO PROGRAM MANAGEMENT EXPERIENCE



Nina Reins, PhD, PE, PMP, is a Senior Environmental Engineer and Project Manager with 19 years' experience who has worked in New Orleans over 16 years. She is currently the Location Manager for FNI's New Orleans office on 900 Camp Street, which is located around the corner from the SWBNO's main office. Between 2008 to 2018, she supported all aspects of the SWBNO Sewer System Evaluation & Rehabilitation (SSERP) program, for which she became the Deputy Program Manager, and supported FEMA negotiations, funding associated reporting and audit compliance.

Post Katrina, she also supported City of New Orleans Recovery Work for the DPW and USACE Task Force work, performing water utility rehabilitation in Jefferson Parish. She has a unique background in coastal resiliency design and environmental compliance and has a broad experience through the full life-cycle of projects from conceptual planning to construction and maintenance.





QUESTION C: WHAT WILL BE NEW ORLEANS' BIGGEST DRINKING WATER CHALLENGES IN 50 YEARS AND WHAT IS THE BEST APPROACH TO INTEGRATED, LONG-RANGE PLANNING TO ADDRESS THOSE CHALLENGES?

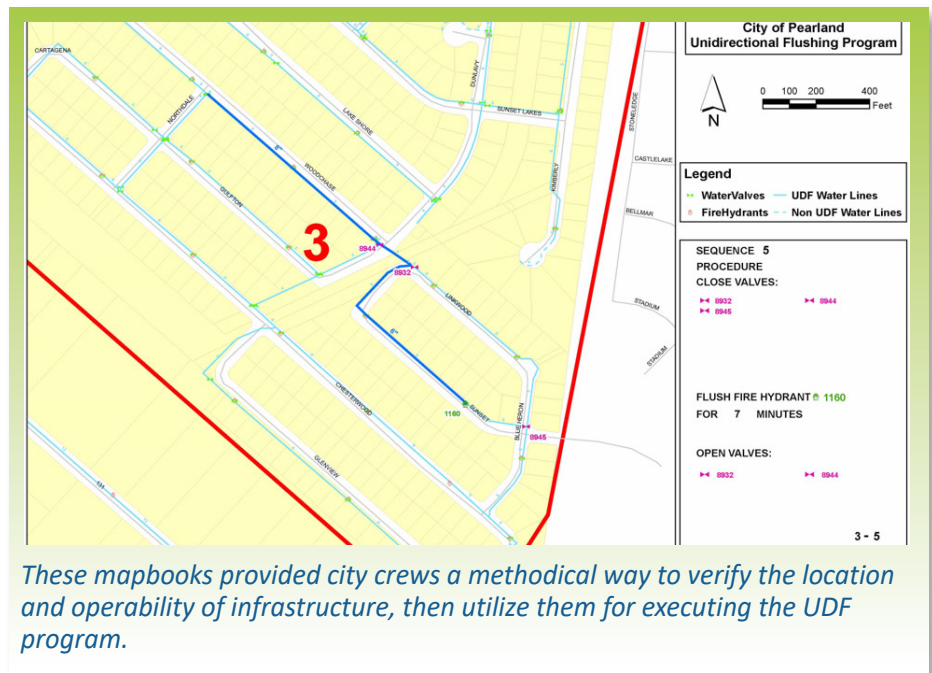
Each system (water, sewer and drainage) have similar challenges, and many are interrelated. A failure in the storm drain system can result in a roadway collapse plus significant damage to the water and sewer infrastructure. Integrated planning has a large impact on all three systems.

Availability of Data and Integration for Decision-Making

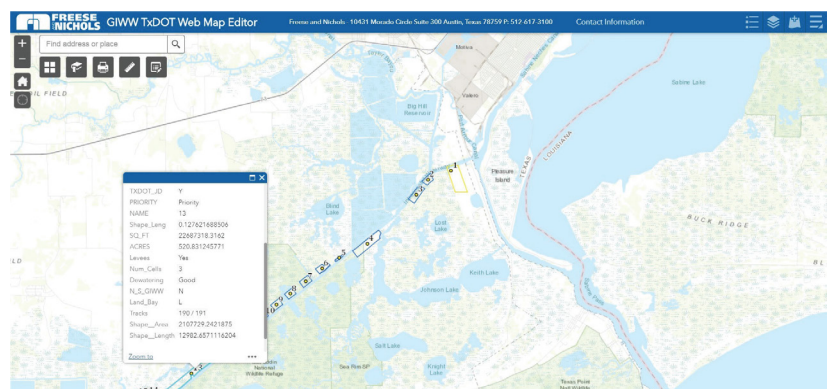
Availability of data and integrity of the data is just as critical for the water infrastructure, and many times is more difficult to obtain without significant field efforts.

FNI Approach:

Low hanging fruit for the water system would be GPS of valve and fire hydrants and testing the operability of both, as they are critical to emergency operations, whether that be a fire or a line break. Capturing all this data in a CMMS and GIS is important for the overall operation of the system and maintaining accurate records. For over 15 years, FNI has assisted cities, like the Cities of Grand Prairie and Pearland, in developing unidirectional flushing programs that confirm the operability of key infrastructure, improve water quality and utilize drastically less water, reducing nonrevenue water. In addition, Web-based data availability will be key for integrated decision making and transparency of decision factors. The FNI team also has experiences linking our spatial expertise with web-based applications. FNI's GIS staff creates custom GIS applications based on client needs. Our GIS professionals have decades of experience in developing needs assessments, implementation plans, databases, internet technologies, and system integration and architecture. FNI develops GIS/web applications using the ArcGIS PRO, ArcGIS Desktop, the ArcGIS Server, ArcGIS Online, ArcGIS Data Collector, and the ERDAS suite. These applications use both desktop databases, such as Access, and Enterprise databases, such as SQL Server and Oracle. We also use Python, .NET, Java™, Visual Basic Script, Java Script, Visual Basic, C#, .Net, Microsoft IIS™ and Silverlight™. The databases and GIS platform can be made accessible through web-based platforms to allow for access by



These mapbooks provided city crews a methodical way to verify the location and operability of infrastructure, then utilize them for executing the UDF program.



the project team and other stakeholders. The SWBNO will be able to direct the permissions when the web-based platforms are established and can change the permissions if needed throughout the project lifecycle. The benefits of integrating the data into a GIS platform are significant for the SWBNO and third-party agencies or stakeholders. The data management services will be wrapped into the needs of all the scope of services categories. The requirements of the data management will be part of initial master plan scoping and will be developed with the implementation plan to ensure the data acquisition, assessment, conclusions/recommendations and ultimately presentation to meet the master plans objectives.

Decision Support Analytical Framework

Integrated resource management is the new paradigm for decision making in relation to water resources. A decision support analytical approach is a vision to **merge adaptive management, integrative modeling, and stakeholder/decision-maker participation for successful management of the entire system portfolio**. For efficient management of an entire portfolio, it is important to account for the system constraints, environmental factors, cost components, legal, regulatory and institutional policy implications. For good decision making, understanding how systems work and how implications of decisions ripple through the operational framework of the entity is necessary.

The SWBNO's water, sewer, drainage and power portfolio is governed by a multitude of factors, but the end goal for any long-term decision support would be to optimize the reliability of each system component, while factoring in their interdependencies and the associated cost to maintain acceptable levels of reliability. However, no single tool exists which can simulate the complete interconnected systems (existing and improved) and screen potential strategies, and develop a viable operational policy for the SWBNO. As part of the SWBNO's long term planning we recommend a decision support interface that helps establish the operational policies and simulate various "what if" type scenario analyses. The decision support tool (DST) helps deal with the constantly changing decision criterion and provides the flexibility of keeping most of the potential sources still handy for future consideration.

FNI has served other clients in developing a decision support tools to optimize the operation of individual systems and/or system portfolio, which integrate information from the existing operation, the evaluation of sources, the infrastructure constraints identified in the conveyance evaluation, as well as financial evaluation. **The decision support tool incorporates a user interface with a comprehensive list of decision variables and displays relevant data for comparing alternatives.** All tools sequence and rank alternatives based on user-selected scenarios for key future variables (e.g. cost/funding uncertainties, supply availabilities, demand growth, etc.) and weighted values (e.g. impacts to rate payers, environmental consequences, etc.). The DST is always designed to be **easily adapted to changing assumptions and constraints** and can be easily updated with improved data. DST's are developed using Commercial Off-the-Shelf software and consist of all software, licenses, and data needed to compare and portray alternatives in accordance with the functionality and rules developed above.



Spandana Tummuri, PhD, PE, is an experienced Project Manager with doctorate in water resources and 14 years of experience in completing water supply planning studies, decision support system modeling, water quality studies, hydrologic and hydraulic models, and collection systems studies for state, municipal, and private sectors. Specific technical expertise in climate change adaptation and integrated resource planning. Dr. Tummuri is currently working on various regional and long range water supply planning projects and helping Tarrant Regional Water District, City of Dallas, and other clients identify potential water supply alternatives. Dr. Tummuri worked on decision support modeling applications for North Texas Municipal District's raw water supply system and TRWD's Integrated Water Supply Plan.

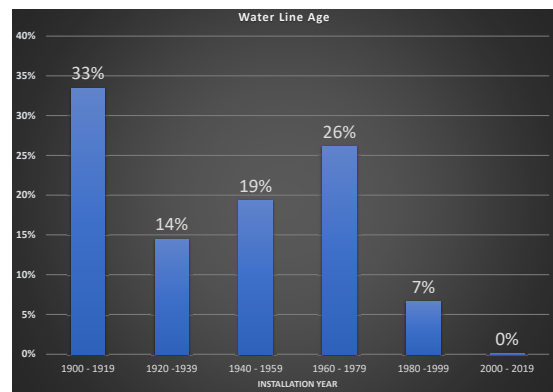
Aging Infrastructure and System Renewal

Out of the 1,530 miles of water pipe, over one-third of the system is over 100 years old, and two-thirds of the system is over 60 years old. Age isn't always an indicator of condition or pipe performance, but it is one factor to consider; however, the City's soils and pumping conditions appear to be a major contributor to the deterioration of SWBNO's pipelines. This coupled with the fact that over half of the lines are asbestos cement, and one-quarter of the lines are cast iron results in a high potential for line failures.

FNI Approach:

FNI typically utilizes a Risk-Based Assessment (RBA) methodology for prioritizing system asset renewal needs. The methodology incorporates the criticality of each asset in addition to the asset condition. The asset condition describes the likelihood of the asset failing to provide its required level of service. Asset criticality defines the consequence that the asset failure has on the system and its customers. The overall risk value of the asset is simply the product of its condition and criticality.

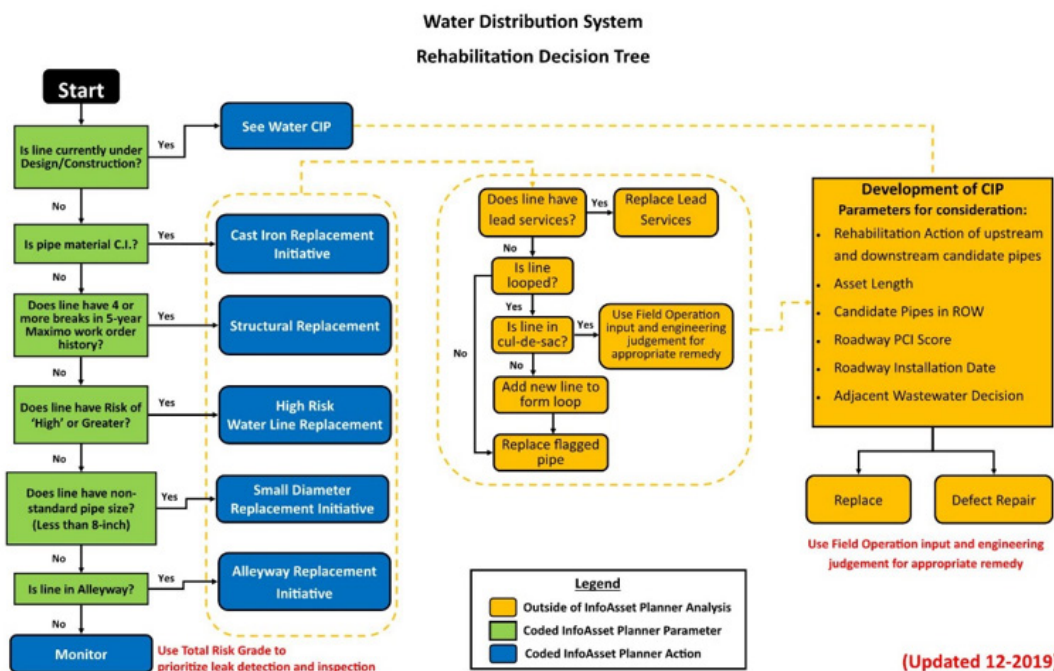
After risk is assigned, and a decision tree is developed, an action can be assigned to every pipeline. The decision tree graphic shown below is from the City of Fort Worth, who had several initiatives that were funded separately, and FNI helped the City develop a methodology that assigned risk scores to every pipe, which identified the highest risk pipes in each of these funding categories, allowing them to be grouped into CIP projects.



With such a high percentage of SWBNO's pipelines falling in the range of typical replacement, developing an approach that prioritizes the highest needs in the water system is key.

Efficient Water Use

The needs of SWBNO are centered on addressing condition issues, as there is significant capacity available. The recent water audit revealed that approximately 70% of the volume of water produced is non-revenue water, and at this time, it is unknown what portion of the 70% is lost through leaks. Two components will be key to increasing the efficiency of the water system – better quantifying the non-revenue water through better data collection and analysis and leak detection combined with system renewal. A number of recommendations were made regarding this in the most recent water audit.



The decision tree approach can also be utilized for the water system, allowing a utility to assign rehab lines even to specific buckets of money for budgeting.

FNI Approach:

FNI has conducted water audits for many utilities and can work with SWBNO staff on implementation from the water audit.

More Efficient Water System Operation

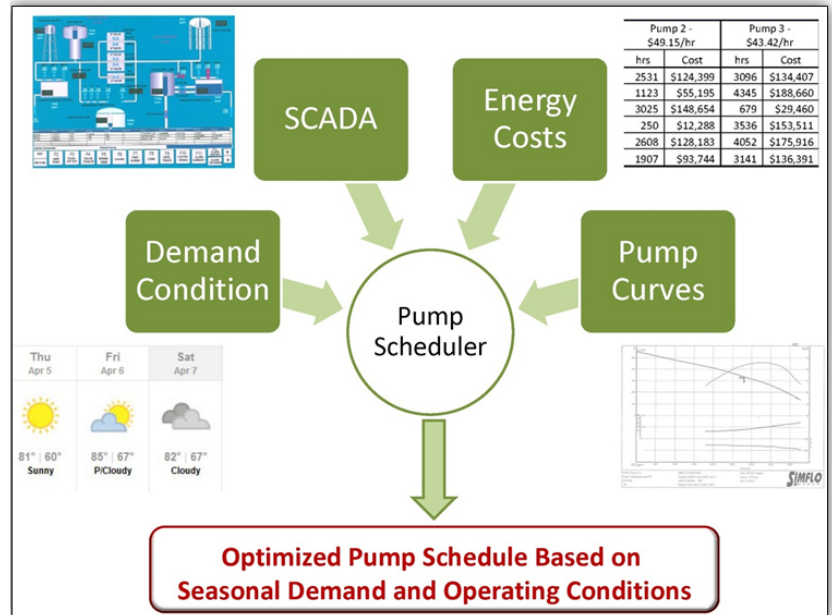
The water system has very little elevated storage for a city of its size (4 MG), and the current water system operation is very energy intensive with multiple pumps running continuously, and the water level in the elevated tanks changing very little according to the 2003 Water Master Plan. With a majority of the infrastructure sized for a much larger population, it is challenging to maintain efficient operations. An increase in the use of higher efficiency plumbing in houses and the initial significant decrease in population after Hurricane Katrina had an impact on water demands,

and even with the rebound in population, it remains quite a bit lower than before 2005. Pumps can typically be sized for larger flows, meaning they are operating inefficiently under current conditions. Piping in some areas can be oversized, and the mode of operation may not have been changed to accommodate the smaller population that the City experienced post-Hurricane Katrina.

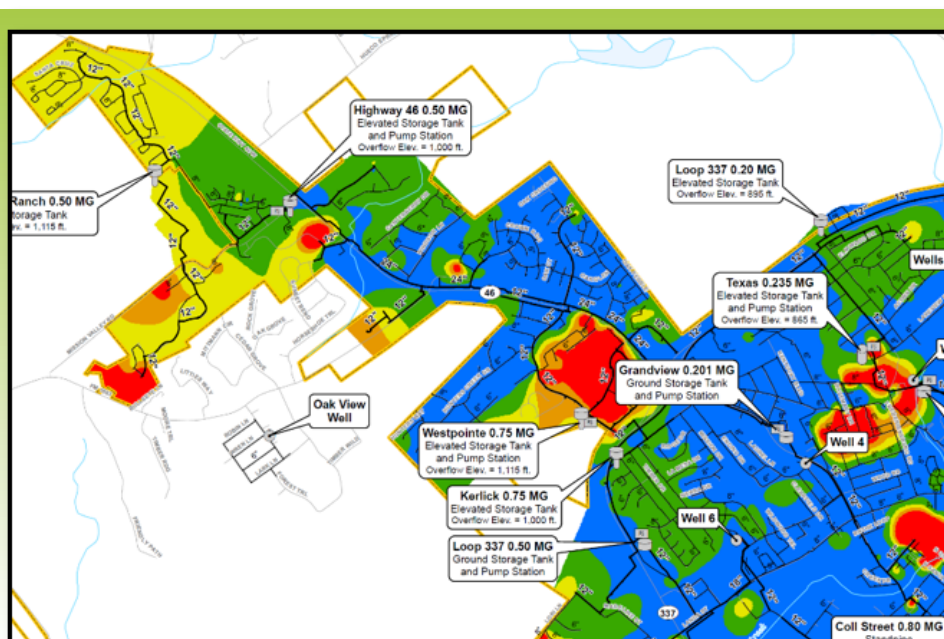
FNI Approach:

FNI views all problems as being data driven, with database management and spatial information being necessary for overall solution provision. Increased utilization of ARC GIS and Work Order Systems data coupled with our analytic tools provide the platforms needed to communicate inefficient water metering/tracking issues effectively to stakeholders and provide visual alternatives to identify and prioritize sustainable solutions for SWBNO staff. FNI has successfully leveraged these tools with other large Utilities to achieve increased efficiencies in water production tracking and metering and will leverage this experience to assist SWBNO in successfully addressing the findings from the water audit. Some of the approaches could include:

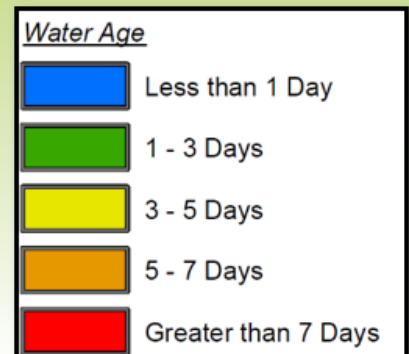
- Evaluation of water age in the hydraulic model allows the City to determine areas of higher water age that may contribute to water quality issues. Solutions that can be evaluated include changes in system operation and locations for autoflushers. FNI assisted the City of Fort Worth in evaluating water age under different demand conditions and operating parameters to evaluate modifications to operations to optimize water quality. We also included all of the City’s existing autoflushers and evaluated where others may be needed.



Multiple inputs to the model can be made to develop an operational scheme for different scenarios that reduce overall energy costs.



Water age can be a significant contributor to water quality issues and require large volumes of water when flushing the system to eliminate issues. A hydraulic model can be utilized to determine water age and evaluate scenarios to improve it.



- The water model can also be utilized to evaluate energy costs by inputting pump efficiency curves and power costs. As part of the Water Master Plan for the City of Lubbock, FNI determined that replacing the City's existing elevated tanks in a pressure plane with tanks that were at a 15' higher overflow level would save the City enough money in energy costs to pay for the capital costs of the tanks within 10 years because the City was continuously pumping over the tanks to prevent parts of the system from experiencing low pressures. This does not include cost savings from reduced flushing of the system and elevated tank due to low turnover in the elevated tanks.

System Resiliency

Water system resiliency is a multi-faceted issue. As outlined in our City of Beaumont project description, operational risk induced by storm and/or high intensity rain events are one component to consider when planning for long term resiliency, but similarly the water distribution system is exposed to higher risk of being compromised in environments of high water tables and subsidence. Even though the SWBNO has received FEMA compensation for water utility line repairs and replacements, many water lines have additional rehabilitation needs. While the water storage tanks have added value to water pressure reliability, other factors play a role in achieving long-term water system reliability, such as power reliability including, water system looping of transmission lines, interconnections between pump stations, redundancy of critical equipment for long delivery items such as critical valves and motors, cross training of key staff and enhancements to the Utility's overall power reliability. FNI has a long standing history in providing utility providers with solutions for water treatment, water distribution, asset management and water system resiliency planning. All aspects of the system need to be considered for a system to be resilient, since it can only be as reliable as the weakest link.

Mapping & Visualization

We understand that the SWBNO has undergone many different efforts to enhance its public outreach and public data viewing with tools such as the Interactive Drainage System Map (<https://www.swbno.org/About/DrainageSystemFactsAndMap>) and the GOSSERP Mapping Tool with various utility and repair layers (<http://www.gosserp.com/info/maps/>). Data management and visualization is a critical piece of asset management, stakeholder communication, public engagement and planning of long-term improvements. We have a robust Data Analysis and Management Group, which is led by Brian King. Most efforts **include obtaining, assembling, and organizing data from a variety of sources; reviewing data, quality assurance/quality control; analyzing data; designing and managing databases and web-based data visualization applications;** developing conclusions and making recommendations based on analyses; performing spatial analysis, operating geographic information systems, and remote sensing activities applicable to the protection and restoration program.



Brian King, GISP, RPA, CFM, has 19 years' experience and is proficient in ArcGIS Desktop 10.2.2, ArcSDE, ArcCatalog, ArcScene, ArcGlobe, ArcPad, Trimble Geomatics RTK Software, Trimble Pathfinder Software, ERDAS MAGINE, ENVI, HEC-RAS, HEC-HMS, Geo-RAS, AutoCAD 2015 and 3-D modeling. Brian is trained in photogrammetry, specifically LIDAR applications using Merrick's MARS software, USDA Fusion, GIS Terrain Modeler, Lidar GEOEYE software, and the LP360 extension software for ArcGIS. He is well trained in cloud web mapping design using ESRI ArcGIS for Server, ArcGIS Viewer for Silverlight, ArcGIS Viewer for Flex, the Amazon EC2 cloud environment, Open Geo Suite, Google Fusion Tables, and ArcGIS Online.

FNI views all problems and solutions as being data driven, with database management and spatial information being necessary for solution provision. Our team includes a variety of scientists with skills in GIS, asset management and geodatabase management. We use GIS on projects ranging from asset management and database design and planning, to development of custom ArcGIS Online web maps and mobile ArcGIS Data Collector apps to digitally record a client's asset inventory. Any master planning efforts and its implementation will require significant data compilation and analysis for each of the service areas outlined in the RFI. For its master planning efforts the SWBNO needs to convert all applicable data into useful master planning information to facilitate to make the best decisions possible for the path forward. FNI has the capabilities to provide a smooth transition from current data platforms and to perform data transition, organization and quality assurance/quality control.