A Strategic Approach to Planning a New Reclaimed Water System

2014 Rocky Mountain Water Reuse Workshop

Imagine the result

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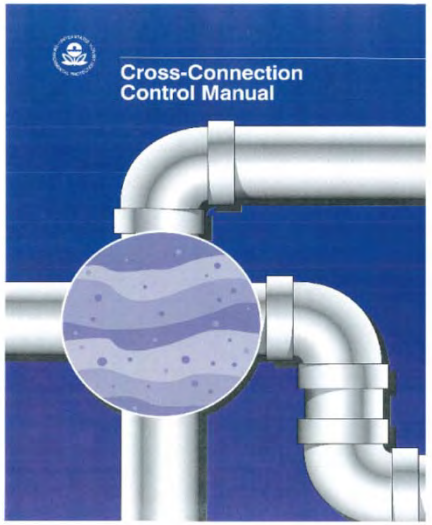
AGENDA

- Health and Safety Moment
- Presentation Outcomes
- Case Study Background
- Reclaimed Water System Justification
- Regulatory Compliance
- System Demand and End User Identification
- Reclaimed Water System Modeling and Masterplan
- Rate Study and Financial Reviews
- Treatment Facility Improvements
- Business Plan, Marketing, and Operational Plan Development
- Conclusions

Health and Safety Moment

- Reclaimed Water has potential for regrowth within the Distribution System
- Standards for Reclaimed Water Quality is often lower than Potable Water
  - No virus, giardia log removal as with Potable Water
- Utilities need to ensure they have a strong compliance program
  - Test reclaimed water throughout the Distribution System
- Public Outreach to provide Purple Pipe Education
- Detailed Cross Connection Plan
- Detailed Signage
- Detailed Utility Health and Safety = Safe Reclaimed Water and Beneficial Public Perception and Awareness



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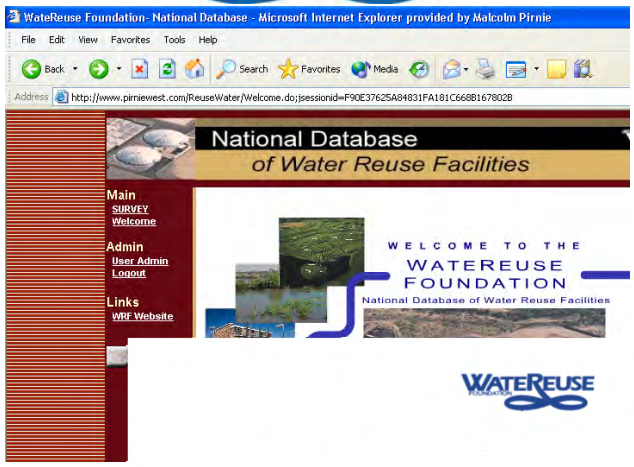
Reclaimed Water Strategic Planning Presentation Outcomes

- Learn Basic Concepts to Planning a Reclaimed Water System
- Basic Understanding of State Regulations
- Confidential Approach to Understanding Potential Reclaimed Water Demand
- Why a Distribution System Model and Master Plan is Necessary at the Beginning of the Process
- How to approach Financing your System
- Reclaimed Water Assets
- Business and Administrative Considerations



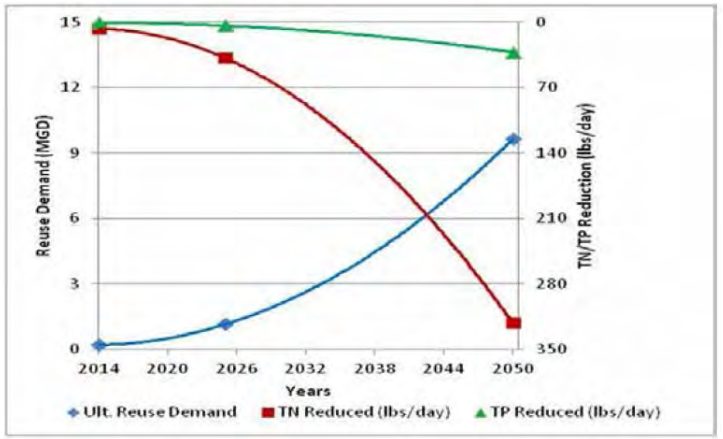
AlexRenew Case Study Background

- Alexandria Renew is a 56 MGD Advanced Resource Recovery Facility located in Alexandria, VA
- Approximate Population of 150,000 in 15.4 mi^2
- Landlocked Site surrounded by High Dollar real estate.
- ARCADIS was engaged to provide a review of Sustainability Initiative
- To divert nutrients (N,P) regulated by the Chesapeake Bay Initiatives away from the Potomac River, a Reclaimed Water System was elected for further investigation
- Other Improvements to Reduce N,P included advanced nutrient removal secondary treatment process and a nutrient management facility (effectively an Equalization Tank at the front of the facility

Reclaimed Water System Justification

Important to understand WHY you are implementing a Reclaimed Water System

- Water Demand exceeds Supply
- Water Conservation to limit future WTP and Distribution System Expansion
- Sustainability
- Regulatory Drivers
- Internal Financial Drivers
- Regional Economic Development
  - Ex: Loudoun County has seen large expansion of Data Centers in Part because of lower cost Reclaimed Water used for large cooling requirements.



For AlexRenew the main drivers were to divert N,P from the Potomac River, reduce treatment costs associated lower total N,P discharged (total lbs/year), and provide a sustainable resource to the community

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Regulatory Compliance

Reclaimed Water Category	E-Coli/100 ml	TSS	Notes
1	126 monthly Mean and 235 single sample Max	30 mg/l daily maximum	Treatment and Disinfection
2	126 Monthly Mean and 235 Single Sample Max	3 NTU monthly Average and no more than 5 NTU in 5% of samples per month	Treatment, Filtration, and Disinfection
3	Non Detect in 75% of Samples and 126 single sample max	3 NTU monthly Average and no more than 5 NTU in 5% of samples per month	Treatment, Filtration, and Disinfection

Regulatory Compliance

Approved Uses	Category 1	Category 2	Category 3	Additional Conditions
Industrial				
Evaporative Industrial Process	Allowed	Allowed	Allowed	1
Washwater Applications	Not Allowed	Allowed	Allowed	2,3,7
Non-Discharging Construction and Road Maintenance	Allowed	Allowed	Allowed	3,7
Non-Evaporative Industrial Processes	Allowed	Allowed	Allowed	7
Landscape Irrigation				
Restricted Access	Allowed	Allowed	Allowed	
Unrestricted Access	Not Allowed	Allowed	Allowed	3,4
Resident Controlled	Not Allowed	Not Allowed	Allowed	3,4,5
Commercial				
Zoo Operations	Allowed	Allowed	Allowed	
Commercial Laundries	Not Allowed	Allowed	Allowed	7
Automated Vehicle Washing	Not Allowed	Allowed	Allowed	3,8
Manual Non-Public Vehicle Washing	Not Allowed	Allowed	Allowed	3,8
Fire Protection				
Nonresidential Fire Protection	Not Allowed	Allowed	Allowed	6
Residential Fire Protection	Not Allowed	Not Allowed	Not Allowed	6
Agricultural Irrigation				
Non-Food Crop Irrigation and Silviculture	Allowed	Allowed	Allowed	3

Regulatory Compliance

- Contact CDPHE Early and Often!
- Determine if upcoming regulatory changes are expected
- Discuss best practices as determined by CDPHE
- Review Conditions for Use of Reclaimed Water
  - Information required by CDPHE to permit the Reclaimed Water System
  - User Plan Information
- Discuss Monitoring and Record Keeping Requirements at the Beginning Stages of the Planning Process
  - Location of Points of Compliance Important!

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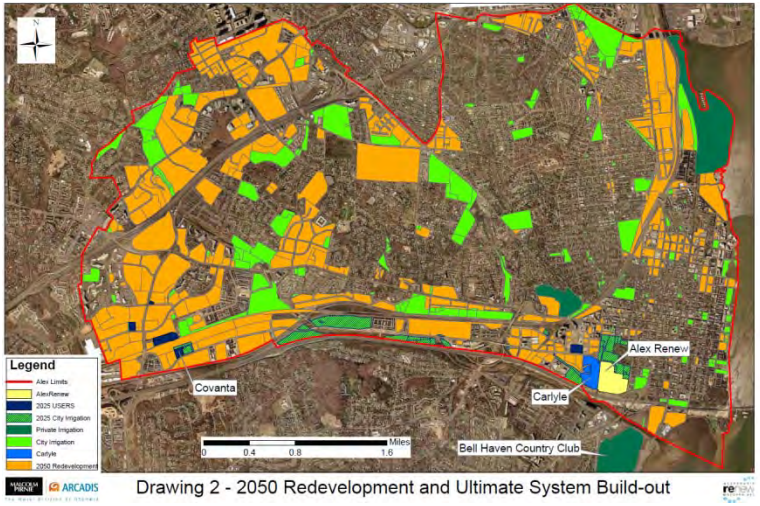
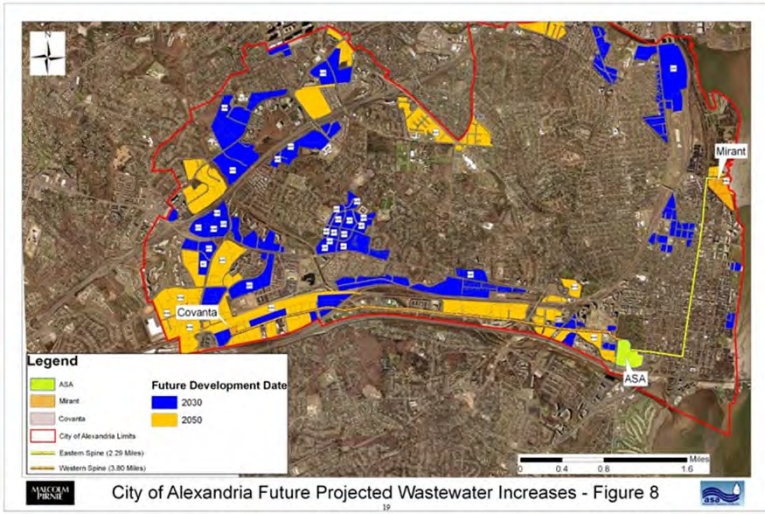
Reclaimed Water Demand and End User Identification

- Low Profile Review of Potential Reclaimed Water Demands
- Review Land Use Maps, Zoning, and Available GIS Information
- Able to identify industrial and commercial properties, power plants, large open spaces, areas for planned redevelopment
  - Unlikely to installed dual plumbing systems in existing buildings, but it is feasible to service large Evap. Coolers and other HVAC Systems.
- For Industrial Systems, Identify largest water users onsite, cooling loads, green spaces, etc.



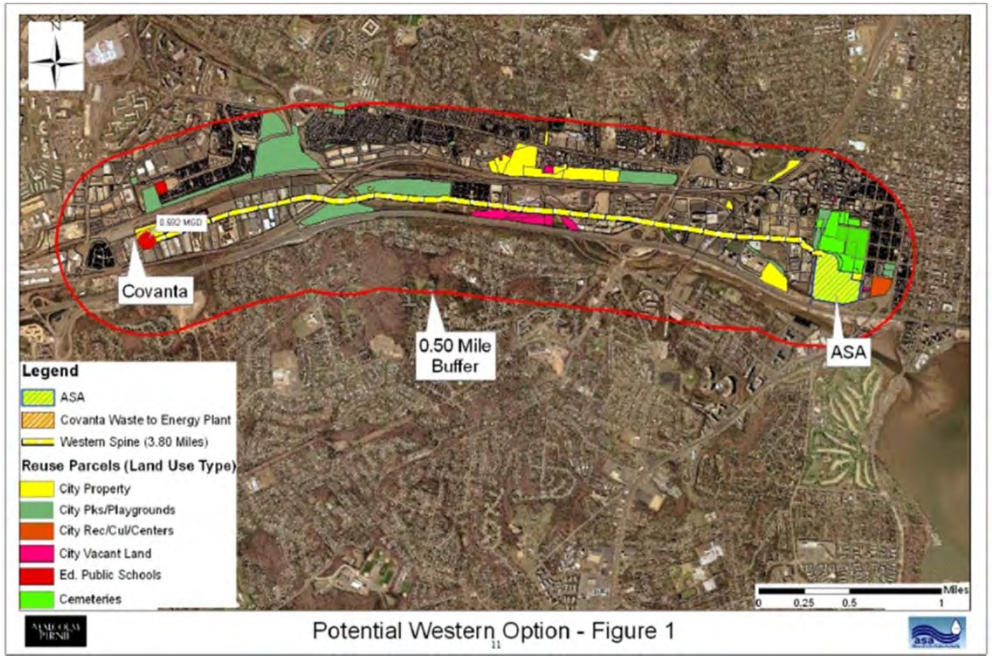
Drawing 2 - 2050 Redevelopment and Ultimate System Build-out



City of Alexandria Future Projected Wastewater Increases - Figure 8

Reclaimed Water Demand and End User Identification

- Identify Potential Corridors that may provide highest potential Reclaimed Water Flows, highest probability of use, and highest ROI.
- Need to Focus on Large Users if Possible

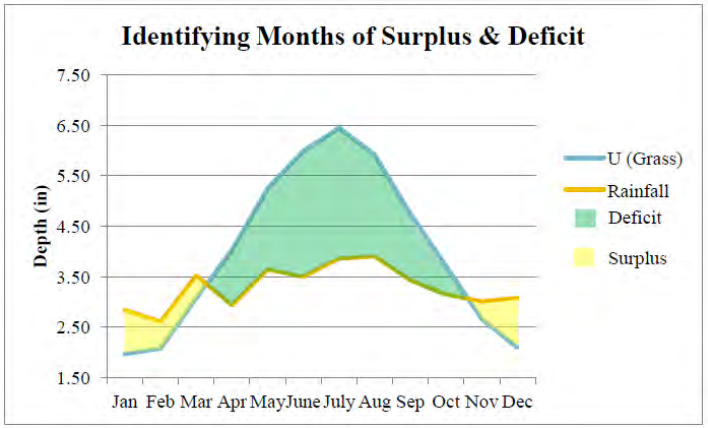


Potential Western Option - Figure 1

Potential Eastern Option - Figure 2

System Demand and End User Identification

- Need to engage in projected heavy users or base load Early and Often
  - Determine interest and Specific Water Demands and Patterns
  - End Users will want to discuss costs e.g. Rates and Connection Fees
- With General Land Use Information, Specific End User Information, and Strategic Reclaimed Water pipeline routing, Preliminary Reclaimed Water System Demands can be ***Estimated***
- Seasonal Demands, Daily Usage Patterns, and Preliminary System Sizing



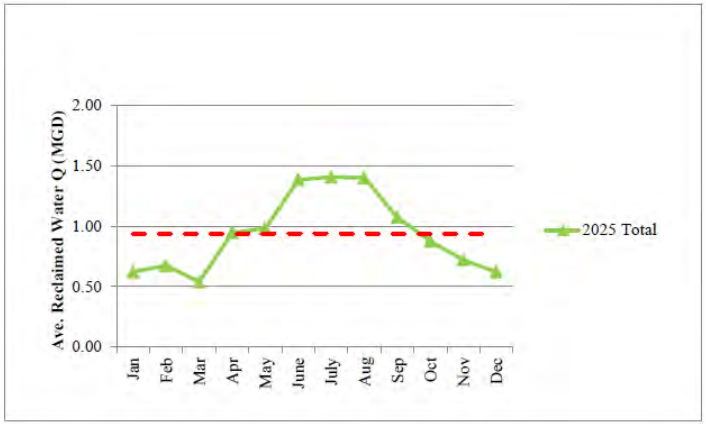


Table 3-1: Summary of 2025 Demands

Users	*Average Demand (MGD)*	*Peak Demand (MGD)*
ALSCO, Mr. Wash, Covanta, Lane Construction, US Patent and Trade	0.71	3.2
Carlyle Development	0.21	0.95
City Irrigation[1]	0.17	0.77
Total (MGD)	**1.1**	**4.9**

Note: [1]Irrigation demands are a 7-month average.

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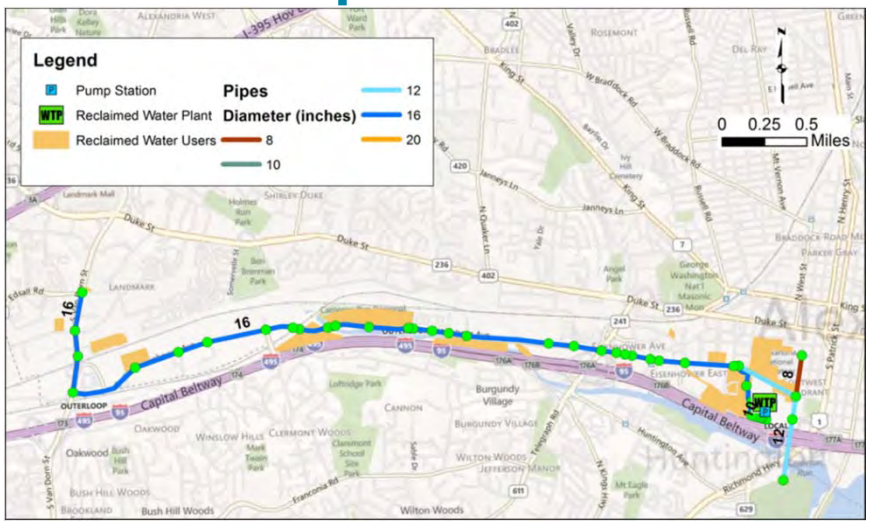
Reclaimed Water System Modeling and Masterplan

- Why Model?
  - Further Refine Water Demands through the planning process
  - Size Distribution System Pipelines for Initial and Future Demands
  - Establish Design Criteria for the Reclaimed Water System
  - Establish Pressure Zones
  - Balance Pumping System Capacity vs. Storage
  - Determine Water Age; Reclaimed Water Distribution System Quality
  - Easily identify asset quantities and refine Order of Magnitude Costs
  - Easy Method of Scenario Modeling for Future Demands

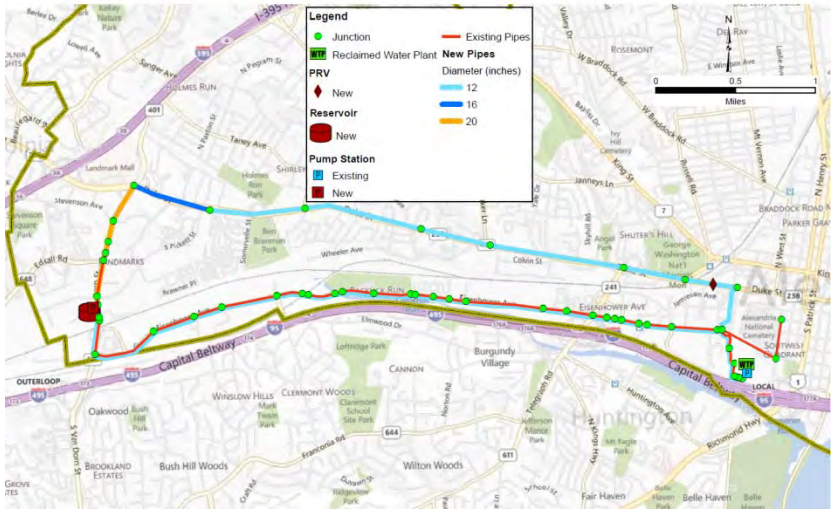
Table 2-1: System Performance and Design Criteria

Design Parameters		*Criteria*
Peaking Factors	Maximum Day Demand/ Average Day Demand (MPF)	3
	Peak Hour Demand/ Average Day Demand (PPF)	4.5
Storage	Elevated	Equalization Volume
	Ground	2 x Average Day
Production / Supply		Maximum Day Demand
Distribution Pipes	Velocity	< 5 ft/s (<8ft/s at Peak Hour)
	Headloss	<10 ft/ 1,000 ft for less than 16-inch < 4 ft/1,000 ft for greater than or equal to 16-inch
	Design Criteria	Peak hour of maximum day
	Minimum Pipe Size	6-inch
	Looping	All lines shall be looped where possible
System Pressure	Maximum Pressure	120 psi
	Minimum Pressure (Peak Hour Conditions)	30 psi
Booster Station	Without Elevated Storage	Peak Hour Demand with largest pump out of service
	With Elevated Storage	Maximum Day Demand with largest pump out of service

Reclaimed Water System Modeling and Masterplan



Initial System Model

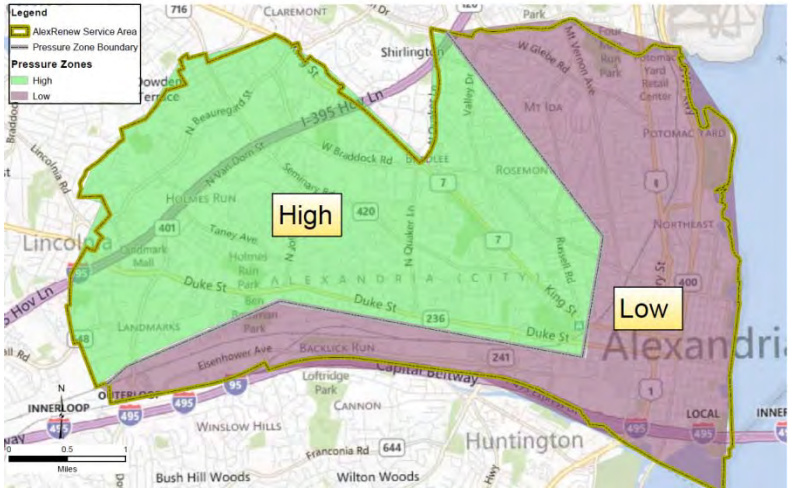


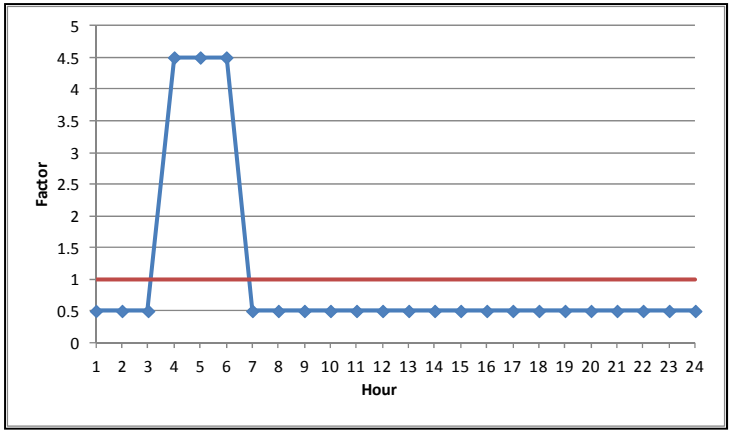
Intermediate System Build Out Conceptual Model

System Build Out Conceptual Model

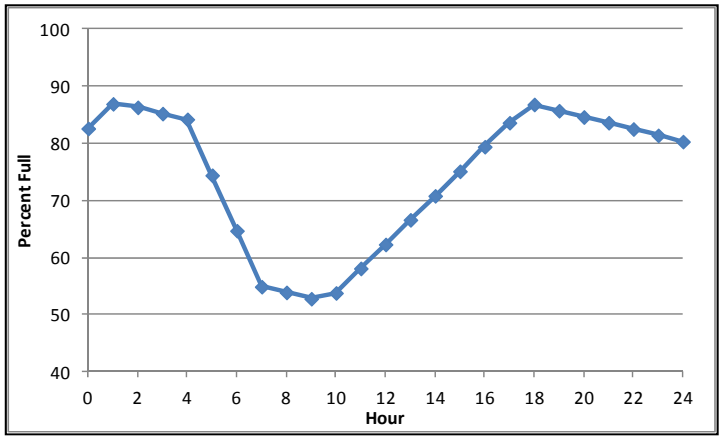
Reclaimed Water System Master Plan and Modeling

- Set System Pressure ~ 60 Psi if Fire Flows are Not Required
- System Pressure and Zone
- Peak Demand Factors and Hourly Profiles
- Tank/Reservoir Water Elevations
- Tank Sizing





Applied Peak Demand Factor



Tank Levels

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AlexRenew MasterPlan Lessons Learned

- Begin this process prior to Developing Infrastructure Improvement Planning
- Need to be Realistic About Future Flows
- Consider Redevelopment and New Development as a primary source for future demands
- Future Demands will change in your next model (5 years increments); Focus on Immediate and Near Future Scenarios.
- If Possible Obtain Water Use Records for Large Users that are not easily quantifiable e.x. commercial buildings, industry, etc.
- Proactively consider ways to manage peaking factors
  - Discuss if it is possible to distribute user demands

Commercial Building Evaporative Cooling Units

Rate Study and Financial Reviews

- Need to consider a Financial Model based on realistic customer usage
- Consider:
  - Cost of Service
    - Administrative
    - Capital Expenditures
    - Electrical (Pumping, etc.)
    - Chemical
    - O&M
  - Capital Funding Sources
    - Grants
    - Reclaimed Water Rates and/or Supplemental Income (i.e. established Sewer or Water Fees)
    - Agreements between Members of Water/Wastewater Authority
    - Bonding / Debt Funding (and Interest Rate Assumptions)
    - Cash Funding

Table 7: O&M Costs: 1.02 MGD by 2025

	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Energy / Pumping	$ -	$ 4,644	$ 5,518	$ 6,555	$ 7,788	$ 48,173
Bulk Chlorine	$ -	$ 249	$ 282	$ 320	$ 363	$ 2,141
UV Disinfection	$ -	$ 2,219	$ 2,517	$ 2,854	$ 3,237	$ 19,111
Personnel / Maintenance	$ 383	$ 400	$ 418	$ 4,352	$ 11,636	$ 19,331
Total	$ 383	$ 7,512	$ 8,734	$ 14,081	$ 23,024	$ 88,756

	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025
Energy / Pumping	$ 53,805	$ 60,153	$ 67,319	$ 75,417	$ 106,380
Bulk Chlorine	$ 2,283	$ 2,436	$ 2,603	$ 2,783	$ 3,747
UV Disinfection	$ 20,375	$ 21,744	$ 23,228	$ 24,840	$ 33,445
Personnel / Maintenance	$ 20,201	$ 21,110	$ 22,060	$ 23,053	$ 30,488
Total	$ 96,664	$ 105,444	$ 115,210	$ 126,093	$ 174,061

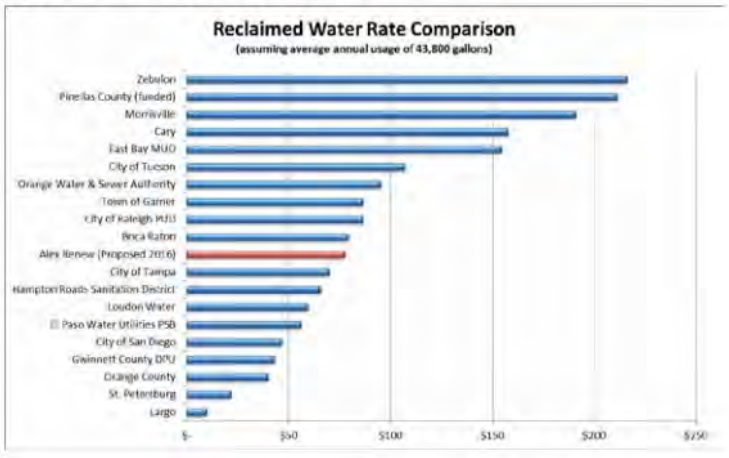
Rate Study and Financial Reviews

- Rate Designs:
  - Full Cost Recovery (Often More Expensive than Potable Water Rates)
  - Market Rate Method (Willingness to Pay)
    - Water Reuse Foundation Report
    - Regional Reclaimed Water Costs
    - Approximately 80% of Potable Water Costs Used for ARenew
  - Different Rates for Bulk Sale vs. Distribution System Customers
- Future Rate Projections
- Cash Flow Projections, Rate Scenario Modeling

Table 13: Full Cost Rates: 1.02 MGD by 2025

Line No.	Description	Fiscal Year Ending September 31 FY2016	FY2017	FY2018	FY2019	FY2025
1	Operation and Maintenance Expense	$ 7,512	$ 8,734	$ 14,081	$ 23,024	$ 174,061
	Capital Expenditures					
2	Cash Funded Capital	466,800	1,090,205	1,945,745	1,940,134	599,985
3	Transfers to JIRR Account	25,628	28,681	34,129	39,561	45,750
4	Total Capital Expenditures	$ 492,429	$ 1,118,886	$ 1,979,874	$ 1,979,695	$ 645,735
5	Total O&M and Capital Requirements	$ 499,941	$ 1,127,620	$ 1,993,955	$ 2,002,719	$ 819,796
6	Total Billable Demand (MGD)	0.105	0.113	0.122	0.132	1.020
7	**Full Cost Rate per 1,000 gallons**	**$ 13.04**	**$ 27.24**	**$ 44.60**	**$ 41.48**	**$ 2.20**

Figure 4: Reclaimed Water Rate Comparison



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Rate Study and Financial Reviews

- For AlexRenew, 3 Scenarios reviewed potential Reclaimed Water Facility and Pipeline costs in comparison to potential revenues up 2025
  - One User Adjacent to the Treatment Plant
  - Two Main Users including a Power Plant
  - 1 MGD Average Day Demand
- Results:
  - Market Rate Rates Selected
  - $1.77 /1000 gallons

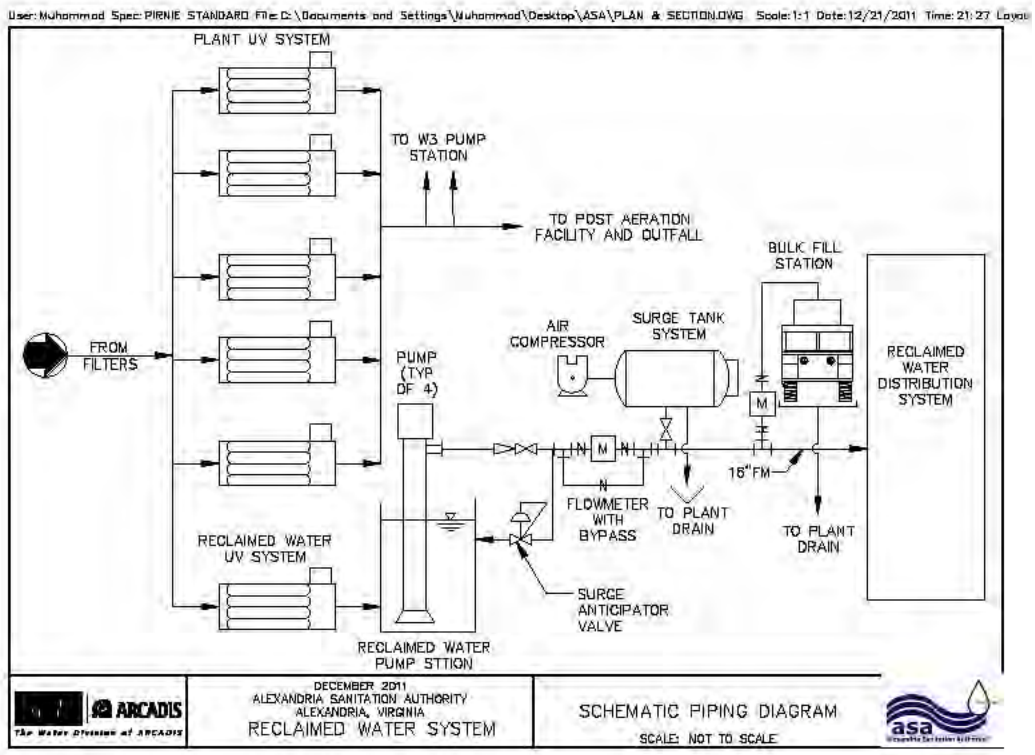
Figure 3: Capital Improvement Plan: 1.02 MGD by 2025

Table 4: Annual Capital Costs: 1.02 MGD by 2025

Description	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020 – FY 2023	FY 2024	FY 2025
Reclaimed Water System (including Bulk Fill, Switchgear C, MCC Upgrade and 500 LF piping)	$3.0M	$5.5M	--	$.41M	--	--	--	--	--	--
Distribution Piping	--	--	--	--	$.94M	$1.6M	$1.6M	--	$1.1M	$.40M
Total	$3.0M	$5.5M	--	$.41M	$.94M	$1.6M	$1.6M	--	$1.1M	$.40M

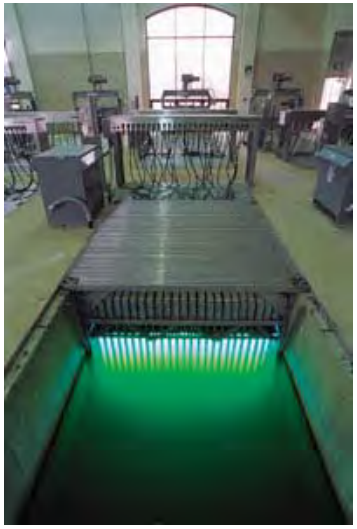
Treatment Facility Improvements

- Treatment Upgrades Depend Upon Reclaimed Water Category Produced and Existing Facility
- Updated Treatment Requirements
- Filtration Needed
- Modified Disinfection System
- New Reclaimed Water Booster Station
- Hydropnuematic Tank / Surge Vessel
- Bulk Fill Facility



Treatment Facility Improvements

- Consider UV dose required to meet the Category Biological Requirements. Increased dose may be required
- NaOCl or other residual disinfectant required to maintain Reclaimed Water Quality throughout the Distribution System
- AlexRenew Example:
  - Utilizing Low Pressure High Output Lamps
  - Current Dose at 32,000 mWsec/cm2
  - Anticipated Regulatory Change to require 100,000 mWsec/cm2
  - Consideration to convert a single existing channel to higher UV dose
  - Repurposing under utilized NaOCl facility to maintain residual of 1 ppm
  - Additional I&C required



Treatment Facility Improvements

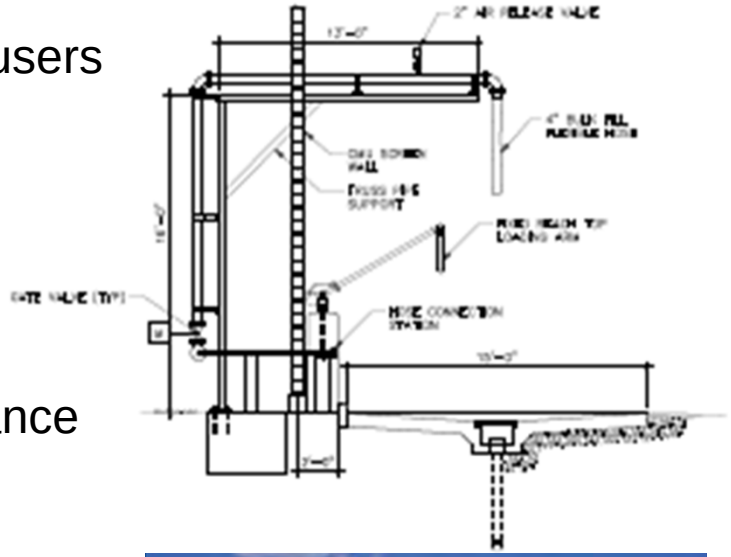
Booster Facility:

- Surge Protection Required especially during infancy of the system
- Many starts and stops of demands due to lower number of users
- Pump Control Valves Require Special Attention
- Consider smaller pumps in the line up to handle smaller flows
- Hydropnuematic tanks should be designed to provide both pressurized storage as well as surge protection.
- Reduce the number of pump start/stop cycles

Treatment Facility Improvements

Bulk Fill Station

- Consider Filling Methods for large and small users
  - 4-inch Overhead Flexible Fill Pipe
  - Loading Arm
  - 2-inch Hose Connection
- Need to monitor filling for billing
- All End Users Must Be Registered in Compliance with Regulations
- Fill Control Panel
  - Card Reader and Keypad
  - Flowmeter
  - Pressure Reducing Valve
  - PLC
  - Alarm and Status Indication
- Site Security – Place Fill Station Outside the fence or near the front of the facility
- Truck Containment/Splash Pad



Neuse River WWTP, North Carolina

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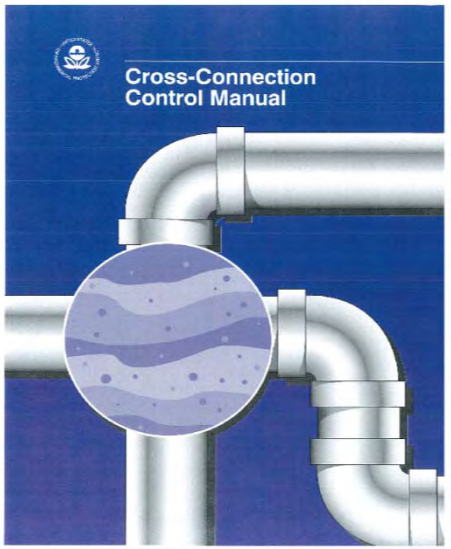
Outside the Fence Facility Improvements

- Water Quality / Point of Compliance Testing Locations
- System Flushing Points
- Cl2 Monitoring and Residual Management
- Distribution System Pipelines, Pump Stations, PRVs, and Storage Tanks
- Consideration for “Smart Distribution Systems” i.e flow monitoring, pressure monitoring, valve position indication, etc.
- Signage



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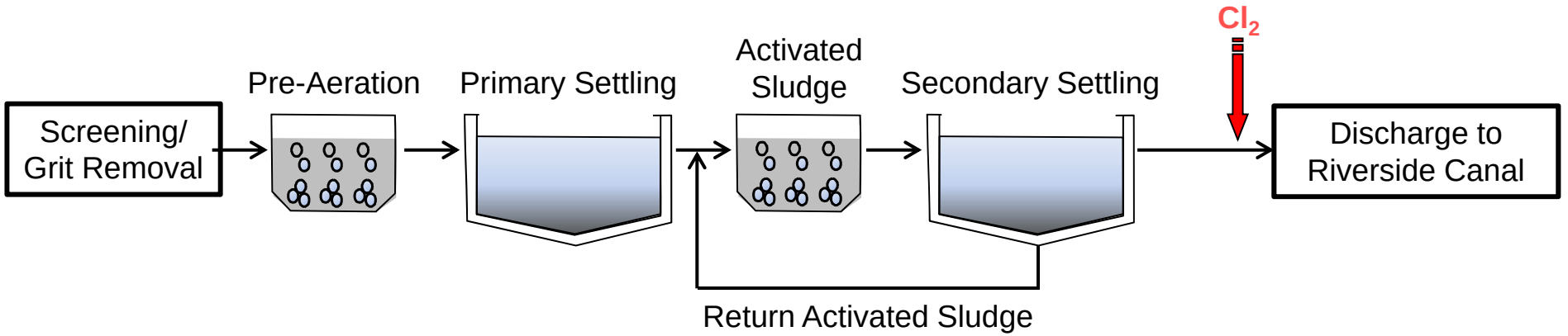
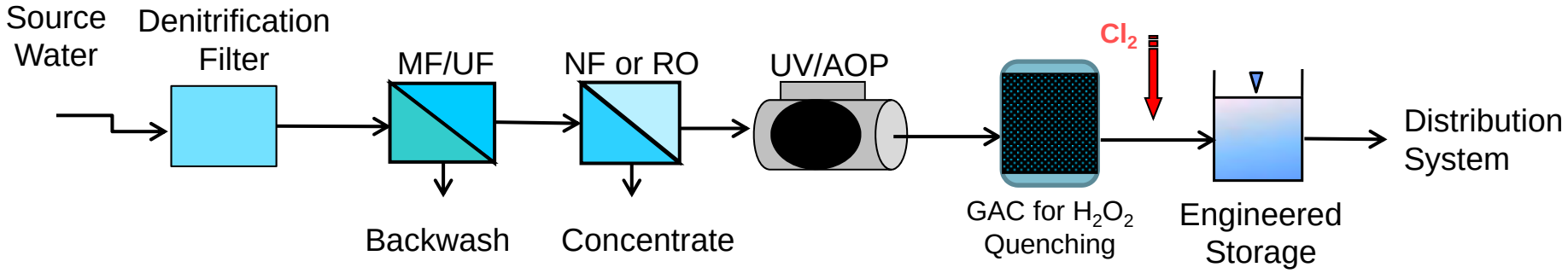
Treatment Facility Improvements
"Toilet to Tap"

El Paso Roberto R. Bustamante WWTP



Advanced Purified WTP



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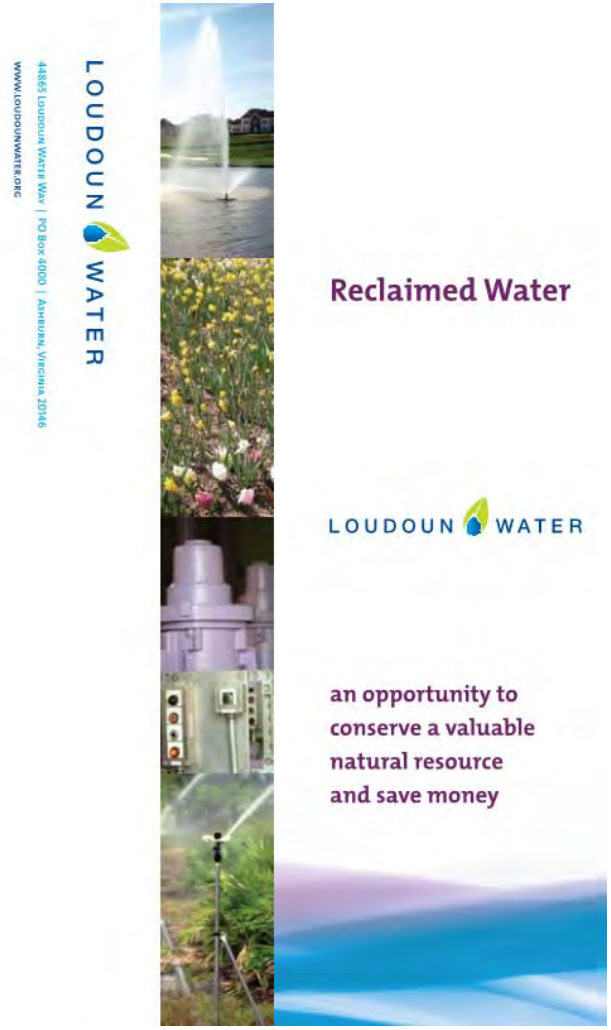
Business, Marketing and Operational Plans

- Summary Document from Previous Efforts
- Brand New System Requires New Staff / Organizational Roles
  - O&M of System
  - Billing
  - Marketing / Public Outreach, Customer Management
- Consider drafting a Business Plan
  - Who / How Will the System Run
  - Customer Profiles
  - System Financing / Accounting
  - Expansion and Marketing
  - Public Outreach and Education
  - Permitting and Compliance



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Business, Marketing, and Operational Plans

What is Reclaimed Water?

Reclaimed water is wastewater that has been thoroughly treated to remove harmful organisms and substances, such as bacteria, viruses, and heavy metals, so that it can be reused. Once treated, it has a clear appearance, is non-staining and odorless, and is bacteriologically safe. Reclaimed water is always carefully monitored so that it meets Virginia Department of Environmental Quality regulations and is safe for our customers. To distinguish drinking water and wastewater piping from this new reuse water piping, Virginia uses the color "purple" for all pipes, hydrants, and signs wherever reuse water is used.

Being Environmentally Responsible

With an increasing demand for water, it is wasteful to water lawns with drinking-quality water. Each person in the Loudoun Water service area who waters their lawn twice a week and washes their vehicle once a week can use more than 12,000 gallons of drinking water each year.

Reclaimed water can replace quality drinking-quality water for lawn watering and many other activities, which in turn, helps to conserve a valuable resource.

Reclaimed water contains low levels of nutrients (primarily nitrogen and phosphorous), can be beneficial to plant and turf growth, and may reduce the need for fertilizers that are normally applied.

Using reclaimed water is an important way to manage Loudoun Water's resources in an environmentally responsible manner

"Water reclamation and reuse helps conserve potable water for the highest quality uses." – Rick Weeks, Chief Deputy, Virginia Department of Environmental Quality

Cost Savings

Water used to supply Loudoun Water's growing population and economy has increased significantly over the last decade. Increasing water use has made naturally occurring high quality water more and more costly to treat. Using reclaimed water for irrigation reduces drinking water demands, in turn reducing the cost of building more drinking water facilities. When watering a lawn, using reclaimed water can substantially reduce a customer's water bill because it costs less to use treated water than drinking water.

Water Reuse Area

By using reclaimed water, we can reduce future costs of creating new drinking-quality water sources and treatment plants. These cost savings eventually can be passed on to our customers.

"By providing this resource, Loudoun Water gives our county another tool to attract more of the hi-tech businesses that will form the backbone of our economy throughout the 21st Century." – Loudoun County Supervisor Lori Waters (Broad Run)

Learn more about how you can benefit. Visit www.loudounwater.org and click on "Reuse Opportunities".

Sustainable Irrigation Supply

Loudoun Water's reclaimed water supply saves drinking water resources during drought conditions. It provides our customers with a sustainable irrigation supply that reduces the likelihood of outdoor watering restrictions.

Uses of Reclaimed Water

- Irrigation of grassed and landscaped areas, common areas, road right-of-ways, and medians
- Washing of vehicles and the outside of buildings
- Control of dust at construction sites
- Filling of fountains, ponds, and lagoons used for aesthetic and cooling purposes
- Chilling/cooling water
- Toilet flushing for non-residential buildings

"There are a lot of benefits to using reclaimed water... availability, the amount of available nutrients in there, and it's less expensive than potable water." – Steve Schwab, Water Conserv II, citrus irrigation supplier, Florida

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AlexRenew Update

- First Customer in the Adjacent Development is under Construction
- AlexRenew has begun construction of the Reclaimed Water Pump Station and Bulk Fill Station
- Other users including a power generation facility have expressed interest
- ARCADIS is currently studying pipeline routing
- Business, Marketing, and Operations Planning is underway.

Conclusions

- Overview of a Long but Rewarding Process
- Consider End Users and Realistic Goals
- Revisit System Demand and Capacity Throughout the Process
- Frequently Additional Revenue sources is required to complement User Fees
- Your Starting a “New Utility” ensure you have the business and administrative support

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Imagine the result

Questions

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