Fiscal Year 2019 REDI Community & Innovative Projects Cost-Share Application

INSTRUCTIONS FOR USE OF THIS FORM:

This form is designed to assist in submitting a complete application for consideration by the St. Johns River Water Management District (SJRWMD) for the REDI Community & Innovative Projects Cost-Share Program. Detailed guidance on completing this application can be found in the Funding Guidance Document. All sections of the form must be completed to be considered a complete application. **Any information listed on the checklist that is not included in the application will result in an automatic deduction of 5 points in the evaluation.** If additional space is needed to fully complete a section, please attach separately.

PROJECT CATEGORY (select only one): ☐ **REDI** ☒ **Innovative**

A. BASIC INFORMATION

A-1	**NAME OF ENTITY / ORGANIZATION:** Clay County Utility Authority	
	PROJECT NAME: Stormwater Mining Pilot Project	
A-2	**Contact information of project manager or contact person:**	
	(District will send correspondence concerning this application ONLY to the below person)	
	Name/title: Leslie Buchanan / Administrative Assistant to the Chief Engineer	
	Email address: LBuchanan@ClayUtility.org	
	Mailing address: 3176 Old Jennings Road, Middleburg, Florida 32068	
	Office Phone: (904) 213-2445	Mobile Phone: (904) 237-1909
A-3	**Contact information of person with authority to enter into a contractual agreement, if other than project manager or contact person:**	
	If same as A-2 above, do not complete this section.	
	Name/title: Tom Morris, Executive Director	
	Email address: TMorris@ClayUtility.org	
	Mailing address: 3176 Old Jennings Road, Middleburg, Florida 32068	
	Office Phone: (904) 272-5999	Mobile Phone: (904) 213-2407

A-4 What County is this project located?

☐ Alachua	☐ Baker	☐ Bradford	☐ Brevard	☒ Clay	☐ Duval
☐ Flagler	☐ Indian River	☐ Lake	☐ Marion	☐ Nassau	☐ Orange
☐ Osceola	☐ Putnam	☐ Seminole	☐ St. Johns	☐ Okeechobee	☐ Volusia

A-5 What Water Supply Planning Region is this project located *(Refer to map at https://www.sjrwmd.com/water-supply/planning/)*

☒ North Florida (North Florida Regional Water Supply Partnership)
☐ Central Springs and East Coast
☐ Central Florida (Central Florida Water Initiative)

A-6	**a. Is the project located in an area that has an established Total Maximum Daily Load (TMDL) or Basin Management Action Plan (BMAP)?** *If the proposed project is listed within a BMAP, please provide the BMAP name and BMAP project number (e.g., VC-3 or LM-4) and ensure that the project name corresponds to the BMAP project name. If the project is part of a BMAP project but is not identical, please provide the BMAP name, project name, and BMAP project number that most closely corresponds to the project in the BMAP and explain the relationship of your proposed project to the project contained in the BMAP within section B-2 Project Description.* Indicate the FDEP Waterbody IDs (WBIDs) that the project benefits (http://www.dep.state.fl.us/water/tmdl/index.htm).

The Project is located in an area that has an established TMDL or BMAP: ☒ Yes ☐ No		
Name of TMDL. Waterbody: St. Johns River	Name of BMAP: Lower St. Johns River (LSJR) Mainstem	WBID: 2213G & 2213H
Is the project specifically named in the BMAP identified above? ☐ Yes ☒ No *BMAP project name, BMAP project number, and relationship to BMAP project if not identical*		

b. Does the project benefit a water body with an established Minimum Flows & Levels (MFL)?

Project benefits a waterbody that has established Minimum Flows & Levels (MFLs): ☐ Yes ☒ No
Name of MFL Waterbody:
Prevention/Recovery Strategy Implemented for the MFL Waterbody above? ☐ Yes ☒ No *Name of Prevention/Recovery Strategy*

A-7	**Is the Applicant a Rural Economic Development Initiative (REDI) Community?** ☐ Yes ☒ No If yes, please attach a signed Waiver of Matching Funds Letter on your letterhead. See format at https://www.sjrwmd.com/localgovernments/funding/#FY2018-2019-REDI.
A-8	**For County or Municipal applicants: Have you adopted the District's model Landscape Irrigation Ordinance? *(Scoring Criterion #5)*:** ☐ Yes ☒ No *If yes, attach copy of ordinance*
B. PROJECT INFORMATION	
B-1	**PROJECT TYPE** *Check the primary core mission and provide evidence in Section B-3.* ☒ **Water Supply** ☒ **Water Conservation** ☐ **Water Quality** ☐ **Flood Protection** ☒ **Natural Systems**

B-2 **PROJECT DESCRIPTION** *(Scoring Criterion #1)*

a. Short Description

Succinctly describe the project, e.g. what is being constructed or what is the program to be implemented (attach supporting documentation if necessary)?

The Clay County Utility Authority (CCUA) plans to construct and operate a stormwater harvesting pilot project for the supplementing of its public access reuse system with stormwater from an FDOT wet detention pond (Pond 6A) located along the first phase of the First Coast Outer Beltway/ SR-23 (FCOB). The project will involve the installation of 1,000 to 1,200 feet of horizontal well adjacent to FDOT's wet detention stormwater ponds, with a wetwell, and submersible pump for the augmentation into CCUA's nearby public access reclaimed water distribution system. During high demand periods in the public access reuse distribution system CCUA uses the high-quality Floridan aquifer water to supplement or augment its supply of reuse water. The objective of the pilot study consists of monitoring to validate the yield, water quality, horizontal well design, disinfection needs, and operational protocols to provide the data needed for full scale permitting and implementation for the use of stormwater as an augmentation source for public access reuse.

b. Innovative Potential *(N/A for REDI Projects)*

Describe why this project is innovative. Refer to the guidance document for further instruction. Attach separate pages if necessary.

The purpose of the pilot project is to harvest stormwater from the FCOB to supplement CCUA's public access reuse water system as an alternative water supply instead of using high quality potable sources. This will save the high quality potable sources by using an alternative supply, such as stormwater, to augment the public access reuse distribution system during periods of high demand. CCUA has an extensive public access reclaimed water reuse program, meeting the irrigation needs of golf courses, public areas, and 13,204 residential customers. The quality of stormwater runoff from roadways is highly variable. Several factors influence the quality of the stormwater including traffic, rainfall patterns, road maintenance, and stormwater system maintenance. The variable quality of the stormwater is difficult to characterize for design purposes. Our planning efforts indicate that stormwater harvesting projects typically use a horizontal well or withdrawals directly from the pond to harvest the stormwater. Horizontal wells are used to improve the quality of the stormwater using the soil as a filter, but traditional horizontal wells foul from fines migration and do not have long term life expectancy. Instead CCUA will use an underdrain type system, like what we have used under clarifiers for over 30 years, to collect the stormwater. This type of system collects subsurface water by gravity flow to the wetwell reducing the approach velocities and decreasing fines migration and will improve the quality of the water source for the public access reuse system over direct withdrawals from the pond. Our experience with this type of underdrain system shows a significantly longer life expectancy. The goal of the pilot study consists of monitoring to validate the yield, water quality, and underdrain design, and fill in the data gaps such as disinfection needs and operational protocols to provide the data needed for full scale permitting and implementation for the use of stormwater as an augmentation source for public access reuse. A report from Mittauer & Associates, Inc. is included with this submission providing additional technical information ***(Attachment "A")***.

c. Measures of Success

Describe how will you measure the effectiveness of your project?

The pilot project will be operated for at least six months to validate that the yield, water quality, horizontal well design, disinfection needs, and operational protocols of stormwater recovered by the horizontal well to provide the data needed for full scale permitting and implementation. The pilot project will answer if the water is capable of meeting the FDEP's public access reuse water criteria and yields sufficient to provide the augmentation water needed. Ultimately, success is measured in the data the pilot will provide. First obtaining sufficient data to refine the design and full-scale implementation, second to have the data to provide for regulatory permitting agencies for implementation, and then if the data shows that stormwater is a suitable public access reuse augmentation water source.

d. Is this project multi-phased or part of a larger overall effort? If so, describe the larger project.

The data from the pilot project will refine and complete the design of a stormwater harvesting system planning by CCUA for the remainder of the FCOB corridor. In addition to the FCOB right-of-way itself, a series of horizontal wells are proposed to capture stormwater from new developments planned near the FCOB, with the potential average water supply of approximately 7 MGD.

Clay County will double in population over the next 20 years. The FCOB will bring new development and increased water usage. As part of the solution to conserve the high quality Floridan aquifer and find alternative water sources, stormwater harvesting will aid with offsetting ground water withdrawals and help with Floridan aquifer and spring restoration.

e. Describe the location, include a map. The map should identify any potentially affected MFL, TMDL, BMAP, or impaired water bodies, or affected wetlands or springs.

A location map is included ***(Attachment "B").*** The project is located adjacent to one of the FDOT stormwater ponds ***(Attachment "C")*** on the east side of the First Coast Outer Beltway, just north of Oakleaf Plantation Parkway and south of the South Prong Double Branch.

	f. Coordinates for the project in decimal degrees to 6 places. Use centroid for a large project area: **Latitude:** 30.161986 **Longitude:** -81.829693
B-3	**BENEFITS TO DISTRICT MISSIONS** ***(Scoring Criterion #2)*** *Describe the benefit to one (or more) of the District's main missions (Water Supply/Conservation, Water Quality, Flood Protection and/or Natural Systems). Attach separate pages if necessary. Be sure to refer to the Funding Guidance Manual for additional pertinent information* Primary benefit: This project will benefit the District's water supply and natural systems mission by conserving higher quality Floridan aquifer water through harvesting of stormwater as an alternative water supply source for irrigation. Clay County will double in population over the next 20 years. The FCOB will bring new development and increased water usage. As part of the solution to conserve the high quality Floridan aquifer and find alternative water sources, stormwater harvesting will aid with offsetting ground water withdrawals and help with spring restoration. The CCUA Stormwater Harvesting project has been identified by the District, through the North Florida Water Initiative and its MFL Prevention Strategy Process, as one of several projects that will benefit the Keystone Heights MFL lakes, and the Floridan aquifer levels regionally. (see http://floridaswater.com/keystoneheights/projectstatus.html) The project is also listed in the District's North Florida Regional Water Supply Plan. (see https://northfloridawater.com/watersupplyplan/documents/final/NFRWSP_Appendices_01192017.pdf) Secondary benefit(s) (if applicable): The project will benefit the District's water quality by improving treatment efficiency for already permitted FDOT stormwater ponds. The pilot project will increase the treatment efficiency from wet detention ponds discharging to impaired waterbodies. This will likely be a strong incentive to implement stormwater harvesting on the large scale envisioned for the FCOB and the new developments planned near the FCOB. The stormwater harvesting pilot project will valve off the drawdown orifice on existing ponds to harvest the treatment volume from the wet detention ponds. This will reduce the discharge of pollutants from the treatment volume portion of the wet detention ponds.

B-4	**If the Project is for Water Resource Development or Alternative Water Supply Development identify the source water** *(check all that apply)*: ☐ **Fresh Groundwater** ☐ **Brackish Groundwater** ☒ **Stormwater** ☐ **Reclaimed Water** ☐ **Surface Water: Identify surface water body:** ________________ ☐ **Brackish Surface Water: Identify surface water body:** ____________ ☐ **Other: Identify Source:** _________________
B-5	**District Permit Information:** *If the applicant has an SJRWMD-issued Consumptive Use Permit and or an Environmental Resource Permit for the project site, provide the following:*

Permit Type:	Permit #	Expiration date/Compliant (yes / no)

B-6 **Project likelihood of successful completion:**
a. Project Readiness *(Scoring Criterion #3)*: *Check all that apply and supply requested dates (month/day/year) and attach a detailed project construction schedule.* ***(Attachment "D")***

		Current % Complete					
	Planning	40	%	Start Date:	2015	Completion Date:	January 2019
	Design	0	%	Start Date:	February 2019	Completion Date:	April 2019
	Permitting	0	%	Start Date:	March 2019	Completion Date:	July 2019
	Bidding	0	%	Start Date:	July 2019	Completion Date:	September 2019
	Construction			Start Date:	October 2019	Completion Date:	March 2020
	Future Phases			Start Date:		Completion Date:	
	Pilot Study - Other			Start Date:	April 2020	Completion Date:	November 2020

Include documentation that demonstrates that the construction start date is realistic (e.g. critical milestones, commission approval dates, procurement timeline, etc.).

Applicant has identified all required permits necessary for project construction and has indicated whether any property needed is under its ownership or control. Applicant initials ______
(Attachment "E")

b. Local Government / Public Support: *Describe the public support for your project (meetings attended, community workshops, presentations to councils, notification in newsletters, etc.). If your project requires participation from certain communities or homeowners, provide a description of methods used to ensure participation in your project. For Septic to Sewer Projects, provide the rate of participation that can be documented at the time of the application.*

There is consistent public support for this project. The Clay County Board of County Commissioners convened a Water Summit on May 27, 2015. At that meeting CCUA's Executive Director, Tom Morris, presented CCUA's plans for sustainable water supply development, including the FCOB Stormwater Harvesting Project. This was a public meeting. Comments from Commissioners and interested public attendees indicated that this project is supported by the public and viewed positively as a benefit to the Keystone Heights lakes. We have updated the Clay County Board of County Commissioners on the project as recently as May 1, 2018. The project concept was presented at several publicly attended CCUA Board of Supervisors meetings, going back to 2015, when the CCUA Board of Supervisors instituted an Alternative Water Supply Surcharge, dedicated only to help fund alternative water supply projects, such as the Stormwater Harvesting Project. CCUA Board of Supervisors includes an annual update around July of each year on the status and progress of Alternative Water Supply projects that includes this project. At this year's Legislative Delegation Meeting held in Clay County at the Board of County Commissioner's meeting room on October 18, 2017, attendees included Senator Bradley, Representative Cummings, and Representative Payne, CCUA discussed its Alternative Water Supply (AWS) initiative aimed at protecting the community's valuable water resources.

As part of the regional water supply planning process, the District has held many public meetings to plan alternative water supply projects and other actions to address the long-term sustainability, including protection of minimum flows and levels in North Florida. This process has been extensive and included numerous District meetings with interested persons to develop preliminary MFL protection strategies for several lakes in the Keystone Heights area. This stormwater harvesting project, initially proposed by CCUA, has been consistently supported by stakeholders in these District deliberations. The CCUA Stormwater Harvesting project has been identified by the District, through the North Florida Water Initiative and its MFL Prevention Strategy Process, as one of several projects that will benefit the Keystone Heights MFL lakes, and the Floridan aquifer levels regionally. (see http://floridaswater.com/keystoneheights/projectstatus.html)

The project is also listed in the District's North Florida Regional Water Supply Plan.
(see https://northfloridawater.com/watersupplyplan/documents/final/NFRWSP_Appendices_01192017.pdf)

C. PROJECT COST INFORMATION

C-1	**a. Breakdown of project cost** *(provide details in separate attachment)* *Attach a table or spreadsheet with detailed project costs for each task or segment of the project. The District will contribute only to the construction costs of the project. Indicate at the conclusion of the table/spreadsheet, a cost effectiveness evaluation as described below.* ***(Attachment "F")***

	b. Cost-share request funding table *The District's share (C) cannot exceed 50% of the total construction cost (B) except for REDI communities that have submitted a waiver, up to 100% of total construction cost can be reimbursed.*		
	1. Total estimated project cost: (includes capital, construction, land acquisition, planning, permitting & design costs)	$ 920,180	
	2. Construction costs:	Year 1 (FY2019) $ 456,900	Year 2 (FY2020) $ 152,280
	3. Cost-share amount requested:	$ 304,590	
	4. Estimated Applicant's Annual Operation & Maintenance Costs:	$ 12,400	
	5. Estimated Service life of components:	30 years	
	c. Funding Sources: *Identify any other outside sources of funding including State or Federal appropriations or grant monies, municipal bonds. Identify source and status of applicant funding. Applicants should include detail to demonstrate that funds are identified and available for the portion of the project cost that is not funded in this program (i.e. the funding match).* Failure to identify a committed funding source and meeting the requirements for release of the funding match will result in a lower score for project readiness. Clay County Utility Authority committed $1,232,150 in the 2017/2018 fiscal year budget that will roll over into fiscal year 2018/2019 for the this stormwater mining pilot project as part of its capital improvement projects. ***The District would like to recognize in-kind financial contributions for REDI communities requesting 100% funding of the construction costs. Describe your in-kind contribution and estimate the monetary value of that contribution. This will not affect your score or ranking***		
	d. Project partners: *Check one below and if multi-jurisdictional include the percent of funding to be contributed by each partner.* ☒ Single entity ☐ Multi-jurisdictional (attach copy of partnership agreement or memorandum of understanding, if available, and includes status of agreement). Identify other partners:		
C-2	**Quantification of Project Benefits: District staff will quantify benefits for Septic to Sewer projects, Flood Protection Projects and projects benefiting MFL water bodies using the information provided below and the map provided in B-2 e.**		
	For Water Supply/Conservation Projects: 0.7 MGD conserved/alternative water supplied	**For Natural Systems projects:** ____ Acres Wetlands Restored/Enhanced Acres Uplands Restored/Enhanced	

	For Water Quality Projects: _____ Lbs/year TN removed/reduced annually _____ Lbs/year TP removed/reduced annually **For Flood Protection projects:** _____ Acres protected from flooding Annual Exceedance Probability As is: 1/_____years After implementation: 1/_____years	_____Linear feet of shoreline Restored/Enhanced **For projects that MFL waterbodies:** _____MGD of water recharged _____MGD of alternative water source to offset withdrawals.
C-3	**Cost Effectiveness *(Scoring Criterion #4)*** *Complete all that apply. For Water Supply, Water Conservation, and Water Quality projects, please attach the Cost Effectiveness Calculator and supporting documentation. The calculator can be found at:* https://www.sjrwmd.com/localgovernments/funding/#FY2018-2019-REDI *Failure to use the cost effectiveness calculator may result in a zero score for cost effectiveness. For Water Quality, Flood Protection, and Natural Systems projects, please provide methodology used and additional supporting documentation, including, for Water Supply and Water Quality projects, the cost effectiveness calculator.* ***(Attachment "G")*** Water Supply: $0.226 cost per 1000 gallons made available Water Conservation: _____ cost per 1000 gallons conserved Water Quality (TN/ TP): _____ cost per lb TN _____ cost per lb TP Natural Systems: _____ cost per acre or linear feet shoreline ** District staff will calculate the benefits for Septic to Sewer, Flood Protection, and MFL projects based on the information provided in sections C-1 and C-2 of the application.	

Provide the required attachments: project map, construction schedule/timeline, project cost table or spreadsheet, and cost effectiveness calculator; plus, additional information required for your specific project type in accordance with the District's 2019 REDI Community& Innovative Projects Cost-Share (RCIPCS) Funding Program Guidance.

Application Checklist

- ☐ All sections of the application are filled in completely
- ☐ Dates are within timeframes prescribed in the Funding Guidance Document (construction/ program must begin by December 30, 2019 and be completed within 2 years)
- ☐ REDI Waiver of Matching Funds document is attached for REDI projects (if applicable)
- ☐ Detailed project construction schedule with backup
- ☐ Construction phasing information (if applicable)
- ☐ Detailed project cost breakdown
- ☐ Calculations for quantification of project benefits
- ☐ Cost effectiveness calculations and a copy of the cost effectiveness calculator for water supply/water conservation or water quality projects
- ☐ Applicant has identified all required permits necessary for project construction
- ☐ Application is signed and dated

I certify that all information on this form and the attached document(s), if applicable, is true and correct.

Name (print): ~~Tom Morris~~ Jeremy D. Johnston, P.E.
Chief Operations Officer

Signature: ____________________
Signature of the person with authority to enter into a contractual agreement.
SIGNING FOR THE EXECUTIVE DIRECTOR

Title: Executive Director

Date: October 18, 2018

Clay County Utility Authority
3176 Old Jennings Road
Middleburg, Florida 32068-3907
Telephone (904) 272-5999
Facsimile (904) 213-2498
www.clayutility.org

Working together to protect public health, conserve our natural resources, and create long-term value for our ratepayers.

October 16, 2018

Re: Authorization for Jeremy Johnston, Chief Operations Officer/Assistant to the Executive Director, to act on behalf of Tom Morris, Executive Director of the Clay County Utility Authority, from Wednesday, October 17, 2018 through Friday, October 19, 2018.

To Whom It May Concern:

In accordance with the Clay County Utility Authority's Enabling Legislation, created by the Florida Legislation, Chapter 94-491, House Bill 2299, recorded in the Public Records of Clay County, Florida, in Official Records Book 1524, pages 1798-1836, as the acting Executive Director, I, Tom Morris, hereby confirm that Jeremy Johnston is hereby authorized to act on my behalf, with regard to signing any documents associated with the legal business of the Clay County Utility Authority, which I would otherwise be authorized to sign during the above-referenced period.

Very truly yours,
CLAY COUNTY UTILITY AUTHORITY

Tom Morris
Executive Director

WTM/sla

ATTACHMENT

"A"

Horizontal Well Feasibility Study

by

Mittauer & Associates, Inc.

April 2018

HORIZONTAL WELL FEASIBILITY STUDY

for

CLAY COUNTY UTILITY AUTHORITY

Prepared by:

MITTAUER & ASSOCIATES, INC.
CONSULTING ENGINEERS
Orange Park, Florida
Project No. 9204-52-1
April 2018

HORIZONTAL WELL FEASIBILITY STUDY

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CLAY COUNTY UTILITY AUTHORITY

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Orange Park, Florida

Project No. 9204-52-1
April 2018

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EXHIBITS

I. INTRODUCTION

A. PURPOSE

The purpose of this report is to evaluate the long-term feasibility of utilizing horizontal wells located next to stormwater retention ponds as an alternative water supply source for the Clay County Utility Authority's public access reuse system. The use of horizontal wells to withdraw water from adjacent stormwater ponds may also be considered as an alternative potable water supply source in the future.

B. SCOPE

The scope of this report will include the following: a literature review of horizontal wells for water supply; a review of the performance of existing horizontal wells and underdrains within CCUA's system; soil suitability of Clay County soils for horizontal wells; recommended horizontal well design, configuration, materials of construction, and means of control; estimation of horizontal well yields; potential for fouling; projected useful life of horizontal wells; projected capital and operational costs, and permitting aspects. The results of this desk top evaluation will determine whether horizontal wells are a feasible means of withdrawing water from adjacent stormwater ponds to supplement CCUA's public access reuse system. If it is determined that the horizontal well concept is feasible, pilot testing will be conducted to verify its real-world performance and applicability.

II. LITERATURE REVIEW

A. REVIEW OF CCUA HORIZONTAL WELL/UNDERDRAIN FACILITIES

The CCUA has underdrain systems at four (4) of its wastewater treatment facilities. These underdrain systems function similarly to a horizontal well in that surficial groundwater is withdrawn through perforated pipes in a sand/gravel bed with filter fabric in order to prevent buried process tanks from “floating” due to high groundwater conditions. A summary of these four systems is presented in the following:

1. **Miller Street WWTP**: An underdrain system was installed beneath the clarifiers and aeration basins in 1973. These systems have run continuously since that time. The underdrains under one of the clarifiers failed in 2009 when sand accumulated in the underdrain piping. The remaining three underdrain systems still function to this day. Service life for the failed underdrain system was 33 years. The remaining three underdrain systems continue to operate without incident after 45 years. The materials used in the underdrain system are not known. The predominant soil type at the Miller Street WWTP is Meggett Fine Sandy Loam. Meggett Fine Sandy Loam is considered an unsuitable soil for the construction of horizontal wells based on a low saturated hydraulic conductivity and a high fines content.

2. **Spencers WWTP:** Underdrains were installed beneath Clarifier Nos. 1 and 2 in 2005 and have operated continuously (13 years) without incident. Clarifier No. 3 was installed with an underdrain system in 2009 and experienced total failure which may be attributable to issues with its underdrain system, although that has not been conclusively proven at the time of this report writing. The underdrain system consisted of perforated pipe wrapped in filter fabric placed in a two foot layer of stone with filter fabric on top. The predominant soil type at Spencers WWTP is Leon Fine Sand. Leon Fine Sand is considered a marginal soil for the construction of a horizontal well system due to a relatively high fines content.

3. **Ridaught WWTP**: An underdrain system was installed under Clarifiers Nos. 1 and 2, Filter No. 1, and the chlorine contact chamber in 1996. Another underdrain system was installed beneath Clarifier No. 3 when it was constructed in 2008. The underdrain systems consisted of perforated PVC

pipe placed in a trench with 6" of stone and filter fabric surrounding it. There have been no failures or incidents with any of the underdrain systems after 22 years of operation. The predominant soil type at the Ridaught Landing WWTP is Quartzipsamments. Quartzipsamments is considered a suitable soil for horizontal well construction due to a relatively high saturated hydraulic conductivity and a low fines content.

4. **Fleming Island WWTP:** An underdrain system was installed beneath Clarifier No. 1, Digester No. 1, and Digester No. 2 in the mid -1990's. An underdrain system was installed with Clarifier No. 2 in 1998 and with Clarifier No. 3 in 2001. The underdrain systems consisted of perforated PVC pipe surrounded by stone with filter fabric. No failures or incidents with underdrain systems have been experienced after 17 to 23 years of operation. The predominant soil group at the Fleming Island WWTP is Meadowbrook Sand. Meadowbrook sand is considered a suitable soil for horizontal well construction due to a high saturated hydraulic conductivity and low fines content.

In summary, CCUA has experienced very few failures of its underdrain systems. Many of these underdrain systems have operated continuously in excess of 20 years without issue, some for over 40 years. The proposed horizontal wells being evaluated will operate very similarly to these underdrain systems. If properly designed and constructed, CCUA's experience has shown that these underdrain systems should have a useful life in excess of 20 years.

B. STATE GUIDELINES AND MANUALS REGARDING STORMWATER HARVESTING

1. **Florida:** The local water management districts within the state of Florida have collectively published the Applicants Handbook which includes the rules and guidelines administered by each district in evaluating and permitting any stormwater collection and harvesting system. Chapters 22 and 29 of the handbook specifically deal with stormwater harvesting and offer methodology and design examples for a range of possible collection systems. The manual limits extraction of stormwater from wet detention systems to the treatment volume of the pond and the designer must ensure that the permanent pool is not impacted. Additionally, the design must ensure that pond recovery and flood protection are not negatively impacted by the harvesting method.

2. **<u>Texas</u>:** The Texas Water Development Board publishes the Texas Manual on Rainwater Harvesting which is currently in its 3rd Edition. The state derives almost two thirds of its municipal water demands from surface water with the remainder from groundwater. Texas expects to double its year 2000 population by the year 2050 making the advancement and innovation of stormwater harvesting a high priority for the state. The manual largely focuses on collection of stormwater at the residential level and details the typical components of a homeowner type system. However, a companion document called "Stormwater Harvesting Guidance Document for Texas Water Development Board" focuses more on utility level collection and treatment systems. Whether due to soil types, groundwater tables or other limiting factors "horizontal well" systems are not specifically considered as a collection method. However, the manual does discuss dry retention ponds, wet detention ponds and infiltration trenches as possible collection methods all of which have components which are applicable to the system being considered in this report.

3. **<u>Virginia</u>:** The state of Virginia is also actively trying to provide guidance and design criteria for rainwater harvesting. The state has issued a guidance document that provides assistance, primarily to the end user, called Virginia Rainwater Harvesting Manual. The document is largely geared to residential and commercial rainwater collection facilities owned and maintained by the end user.

Florida and Texas would appear to be on the cutting edge of stormwater harvesting policy. Both states are actively moving towards meaningful regulations and criteria that will define acceptable practices for both utilities and end users. Of the two, Florida's published information is the most practical for the purposes of this report. The Applicant's Handbook is the best and most comprehensive manual governing design and methodology when considering large withdrawals of stormwater from pond systems.

III. SUITABILITY OF CLAY COUNTY SOILS FOR HORIZONTAL WELLS

The Natural Resource Conservation Service (NRCS) has identified 65 different soil types in Clay County. Of these 65 soil types, 43 soil types comprising approximately roughly 86% of total county area, are classified as “sands” or “fine sands.” The remaining soil types are classified as either loams, complexes, or mucks.

The two most import characteristics of a soil in regards to its suitability for horizontal wells are its “Saturated Hydraulic Conductivity and “Percent Fines.” A high saturated hydraulic conductivity (i.e., > 20 ft/day) is desirable to allow water to move easily and quickly through the soil matrix to the horizontal well. Soils having saturated hydraulic conductivities < 10 ft/day were deemed to be unsuitable. A low percent fines (i.e., < 8%) is desirable so that migrating fines do not plug the soil matrix over time and reduce the capacity of the horizontal well. Soils having percent fines greater than or equal to 15% were deemed to be unsuitable.

Table III-1 summarizes the 65 soil types in Clay County in regards to suitability for horizontal wells.

Of the 65 soil types, 20 are classified as “suitable” and these comprise roughly 45% of the total area in Clay County; 9 are classified as “marginal” and comprise roughly 23% of the total area in Clay County and; 36 are classified as “unsuitable” and comprise roughly 32% of the total area in Clay County. A map of Clay County Soils can be generated at the NRCS website (https://websoilsurvey.nrcs.usda.gov/app/HomePage.htm). This website is also a good way to perform a desktop evaluation of a proposed site. Maps can be created for 1 acre areas with reasonable accuracy.

It should be noted that the NCRS soil profiles are only taken to a depth of 80 inches (6'-8"). It is likely that the horizontal wells will be installed at depths ranging from 8' to 10' which means that additional soil data may be necessary before siting a well. Additional information that would be needed would include hydraulic conductivity and percent fines of the soils below 80 inches in depth.

TABLE III-1
CLAY COUNTY SOILS-SUITABILITY FOR HORIZONTAL WELLS

Unit Symbol	Soil Name	Hydrologic Group	Percent of Clay County Soils (%)	Depth (in.)		AASHTO Classification	Percent Fines (%)	Saturated Hydraulic Conductivity (ft/day)	Suitability for Horizontal Wells
				Low	High				
1	Albany Fine Sand	A/D	2.3	0	6	A-2	15	26.0	Unsuitable
				6	47	A-2	15	26.0	
				47	60	A-2	26	8.0	
				60	80	A-2, A-4, A-6	36	2.6	
2	Blanton Fine Sand	A	1.5	0	6	A-2-4, A-3	13	26.0	Unsuitable
				6	58	A-2-4, A-3	13	29.0	
				58	80	A-2-4, A-2-6, A-4	29	2.6	
3	Hurricane Fine Sand	A	7.4	0	5	A-3	6	26.0	Suitable
				5	56	A-3	6	26.0	
				56	80	A-2-4, A-3	10	22.0	
4	Ocilla Loamy Fine	B/D	1.0	0	6	A-2, A-3	22	22.0	Unsuitable
				6	27	A-2, A-3	22	22.0	
				27	80	A-2, A-4, A-6	38	2.6	
5	Penney Fine Sand	A	7.7	0	3	A-3	5	26.0	Suitable
				3	57	A-3	5	26.0	
				57	80	A-2-4, A-3	9	26.0	
6	Mandarin Fine Sand	A	5.4	0	7	A-3, A-2-4	11	25.8	Unsuitable
				7	13	A-2-4	13	25.8	
				13	18	A-2-4	16	21.8	
				18	62	A-2-4, A-3	14	25.8	
				62	80	A-2-4	18	21.8	
7	Centenary Fine Sand	A	2.2	0	5	A-3	7	26.0	Marginal
				5	54	A-3	12	26.0	
				54	80	A-3	12	8.0	
8	Sapelo Fine Sand	B/D	4.3	0	8	A-2, A-3	12	26.0	Unsuitable
				8	16	A-2, A-3	12	26.0	
				16	29	A-2, A-3	14	2.6	
				29	49	A-2, A-3	12	26.0	
				49	80	A-2, A-4, A-6	30	2.6	

TABLE III-1
CLAY COUNTY SOILS-SUITABILITY FOR HORIZONTAL WELLS

Unit Symbol	Soil Name	Hydrologic Group	Percent of Clay County Soils (%)	Depth (in.) Low	Depth (in.) High	AASHTO Classification	Percent Fines (%)	Saturated Hydraulic Conductivity (ft/day)	Suitability for Horizontal Wells
9	Leon Fine Sand	A/D	11.5	0	8	A-2-4, A-3	9	26.1	Marginal
				8	18	A-2-4, A-3	6	26.1	
				18	37	A-3, A-2-4	9	6.5	
				37	45	A-2-4, A-3	7	22.1	
				45	80	A-3, A-2-4	9	2.3	
10	Ortega Fine Sand	D	5.9	0	3	A-3	6	26.0	Suitable
				3	80	A-3	5	26.0	
11	Allanton and Rutledge Mucky Fine Sands	A/D	2.2	0	18	A-2-4, A-3	9	8.0	Unsuitable
				18	56	A-2-4, A-3	7	8.0	
				56	80	A-2-4, A-3	9	8.0	
12	Surrency Fine Sand	B/D	0.6	0	12	A-2	18	22.0	Unsuitable
				12	34	A-2	18	22.0	
				34	80	A-2	39	2.6	
13	Meggett Fine Sandy Loam	C/D	1.7	0	6	A-2, A-4	27	8.0	Unsuitable
				6	11	A-2, A-4	27	8.0	
				11	23	A-6, A-7	71	0.3	
				23	80	A-6, A-7	65	0.3	
14	Ortega-Urban Land Complex	A	0.7	0	5	A-3	6	26.0	Suitable
				5	80	A-3	5	26.0	
15	Quartzipsaments	A	0.4	0	80	A-3	6	26.1	Suitable
16	Hurricane-Urban Land Complex	A	0.6	0	7	A-3	6	26.0	Suitable
				7	52	A-3	6	26.0	
				52	80	A-2-4, A-3	10	22.0	
17	Plummer Fine Sand	A/D	0.6	0	7	A-2-4, A-3	13	22.0	Unsuitable
				7	52	A-2-4, A-3	13	22.0	
				52	80	A-2-4, A-4, A-2-6	34	2.6	
18	Ridgewood Fine Sand	A	3.5	0	5	A-2-4, A-3	9	26.0	Suitable
				5	80	A-2-4, A-3	7	26.0	
19	Osier Fine Sand	A/D	1.6	0	5	A-2, A-3	9	26.0	Suitable
				5	80	A-1, A-2-4, A-3	6	70.0	

TABLE III-1
CLAY COUNTY SOILS-SUITABILITY FOR HORIZONTAL WELLS

Unit Symbol	Soil Name	Hydrologic Group	Percent of Clay County Soils (%)	Depth (in.)		AASHTO Classification	Percent Fines (%)	Saturated Hydraulic Conductivity (ft/day)	Suitability for Horizontal Wells
				Low	High				
20	Scranton Fine Sand	A/D	0.4	0	9	A-1, A-2, A-3	13	26.0	Suitable
				9	80	A-1, A-2, A-3	8	26.0	
21	Goldhead Fine Sand	B/D	0.3	0	6	A-3	4	26.0	Marginal
				6	38	A-3	4	26.0	
				38	51	A-2-4, A-2-6	28	2.6	
				51	80	A-2-4, A-3	7	26.0	
22	Pelham Fine Sand	B/D	2.4	0	6	A-2-4	27	26.1	Unsuitable
				6	26	A-2-4	26	26.1	
				26	42	A-2 ,A-6	42	2.6	
				42	83	A-2, A-6	43	2.6	
23	Sapelo-Urban Land Complex	B/D	0.3	0	4	A-2, A-3	12	26.0	Unsuitable
				4	19	A-2, A-3	12	26.0	
				19	32	A-2, A-3	14	2.6	
				32	49	A-2, A-3	12	26.0	
				49	80	A-2, A-4, A-6	36	2.6	
25	Maurepas Muck, frequently flooded	A/D	1.6	0	66	A-8	100	22.0	Unsuitable
				66	75	A-2, A-3	14	26.0	
27	Pamlico Muck	A/D	0.9	0	38	A-8	100	6.6	Unsuitable
				38	75	A-2, A-3	13	26.0	
28	Santee Fine Sandy Loam	C/D	0.1	0	11	A-2, A-4	40	8.0	Unsuitable
				11	61	A-6, A-7	85	0.3	
				61	80	A-4	36	0.3	
29	Rutlege-Osier Complex	A/D	5.5	0	14	A-3, A-2	8	26.0	Suitable
				14	80	A-2, A-3	6	26.0	
30	Arents, Sandy		0.1	0	36	A-3	6	26.0	Suitable
				36	60	---	---	---	
31	Pottsburg Fine Sand	A/D	4.3	0	7	A-3, A-2-4	12	26.0	Marginal
				7	53	A-3, A-2-4	12	26.0	
				53	80	A-2-4, A-3	11	2.6	

TABLE III-1
CLAY COUNTY SOILS-SUITABILITY FOR HORIZONTAL WELLS

Unit Symbol	Soil Name	Hydrologic Group	Percent of Clay County Soils (%)	Depth (in.)		AASHTO Classification	Percent Fines (%)	Saturated Hydraulic Conductivity (ft/day)	Suitability for Horizontal Wells
				Low	High				
32	Blanton Fine Sand (5-8% slopes)	A	0.2	0	6	A-2, A-3	13	26.0	Unsuitable
				6	48	A-2, A-3	13	26.0	
				48	58	A-2	22	8.0	
				58	80	A-2, A-4, A-6, A-7	38	2.6	
34	Penney Fine Sand (5-8% slopes)	A	1.0	0	3	A-3	5	26.0	Suitable
				3	57	A-3	5	26.0	
				57	80	A-2-4, A-3	9	26.0	
36	Ortega Fine Sand (5-8% slopes)	A	0.4	0	5	A-3	6	26.0	Suitable
				5	80	A-3	5	26.0	
37	Ridgewood Fine Sand (5-8% slopes)	A	0.2	0	4	A-2-4, A-3	9	26.0	Suitable
				4	80	A-2-4, A-3	7	26.0	
38	Surrency Fine Sand, frequently flooded	B/D	0.6	0	13	A-2	18	26.0	Unsuitable
				13	24	A-2	18	26.0	
				24	80	A-2, A-4, A-6	37	2.6	
39	Meadowbrook Sand, frequently flooded	A/D	1.3	0	8	A-3	6	26.0	Unsuitable
				8	43	A-3	6	26.0	
				43	80	A-2-4, A-2-6	26	0.8	
40	Ousley Fine Sand, occasionally flooded	A	0.3	0	12	A-2, A-3	15	26.0	Suitable
				12	80	A-2, A-3	9	26.0	
41	Albany Fine Sand, occasionally flooded	A/D	0.2	0	6	A-2	15	26.0	Unsuitable
				6	47	A-2	15	26.0	
				47	60	A-2	36	8.0	
				60	80	A-2, A-4. A-6	35	2.6	
42	Osier Fine Sand, occasionally flooded	A/D	0.7	0	5	A-2, A-3	9	26.0	Suitable
				5	80	A-1, A-2-4, A-3	6	70.0	
43	Pamlico Muck, frequently flooded	A/D	0.9	0	38	A-8	100	6.6	Unsuitable
				38	75	A-2, A-3	13	26.0	
46	Plummer Fine Sand, depressional	A/D	0.3	0	7	A-2-4, A-3	16	26.0	Unsuitable
				7	46	A-2-4,A-3	16	26.0	
				46	80	A-2-4, A-4	34	2.6	

TABLE III-1
CLAY COUNTY SOILS-SUITABILITY FOR HORIZONTAL WELLS

Unit Symbol	Soil Name	Hydrologic Group	Percent of Clay County Soils (%)	Depth (in.)		AASHTO Classification	Percent Fines (%)	Saturated Hydraulic Conductivity (ft/day)	Suitability for Horizontal Wells
				Low	High				
47	Newman Fine Sand	A	1.3	0	5	A-2-4, A-3	8	26.0	Unsuitable
				5	19	A-2-4, A-3	8	26.0	
				19	29	A-2-4, A-3	11	22.0	
				29	51	A-2-4, A-3	11	26.0	
				51	80	A-2-4, A-2-6, A-4, A-6	29	0.7	
49	Sapelo-Meadowbrook, frequently flooded, complex	B/D	0.3	0	4	A-2, A-3	12	26.0	Unsuitable
				4	18	A-2, A-3	12	26.0	
				18	30	A-2, A-3	14	2.6	
				30	60	A-2, A-3	12	26.0	
				60	80	A-2, A-4, A-6	35	2.6	
50	Leon Fine Sand, frequently flooded	A/D	0.5	0	4	A-2-4, A-3	90	26.0	Unsuitable
				4	16	A-2-4, A-3	90	26.0	
				16	26	A-2-4, A-3	90	6.6	
				26	54	A-2-4, A-3	90	6.6	
				54	80	A-2-4, A-3	90	6.6	
51	Pottsburg Fine Sand, occasionally flooded	A/D	0.4	0	4	A-3	95	26.0	Unsuitable
				4	65	A-3	95	26.0	
				65	80	A-2-4, A-3	95	2.6	
52	Meggett Fine Sandy Loam, frequently flooded	C/D	0.4	0	5	A-2, A-4	27	8.0	Unsuitable
				5	12	A-2, A-4	27	8.0	
				12	59	A-6, A-7	71	0.3	
				59	80	A-6, A-7	71	0.3	
54	Troup Sand	A	0.3	0	4	A-2	20	26.0	Unsuitable
				4	64	A-2	20	26.0	
				64	80	A-2, A-4, A-6	34	2.6	
56	Kershaw Sand	A	3.4	0	4	A-2, A-3	4	70.0	Suitable
				4	80	A-2, A-3	4	70.0	
58	Allanton Fine Sand, frequently flooded	A/D	1.9	0	18	A-2-4, A-3	9	8.0	Marginal
				18	56	A-3	6	8.0	
				56	80	A-3	6	8.0	
59	Lynn Haven Fine Sand	A/D	0.8	0	19	A-2-4, A-3	8	26.0	Marginal
				19	26	A-2-4, A-3	12	26.0	
				26	80	A-2-4, A-3	13	6.6	

TABLE III-1
CLAY COUNTY SOILS-SUITABILITY FOR HORIZONTAL WELLS

Unit Symbol	Soil Name	Hydrologic Group	Percent of Clay County Soils (%)	Depth (in.)		AASHTO Classification	Percent Fines (%)	Saturated Hydraulic Conductivity (ft/day)	Suitability for Horizontal Wells
				Low	High				
60	Ridgeland Fine Sand	B	0.4	0	8	A-2, A-3	13	26.0	Marginal
				8	18	A-2, A-3	11	6.6	
				18	65	A-2, A-3	9	26.0	
				65	80	A-2, A-3	9	6.6	
61	Wesconnett Fine Sand, frequently flooded	A/D	0.4	0	12	A-2-4, A-3	9	26.0	Marginal
				12	51	A-2-4, A-3	10	6.6	
				51	65	A-2-4, A-3	9	26.0	
				65	80	A-2-4, A-3	10	6.6	
62	Neilhurst Fine Sand, undulating	A	1.5	0	3	A-2-4, A-3	4	70.0	Suitable
				3	80	A-2-4, A-3	4	70.0	
63	Solite Fine Sand	A/D	1.4	0	5	A-2-4, A-3	7	26.0	Suitable
				5	80	A-2-4, A-3	7	26.0	
64	Ona Fine Sand	B/D	0.7	0	5	A-3	7	26.0	Marginal
				5	15	A-2-4, A-3	13	2.6	
				15	41	A-3	7	26.0	
				41	60	A-2-4, A-3	13	2.6	
				60	80	A-3	7	26.0	
65	Meadowbrook Sand	A/D	2.1	0	7	A-3	6	26.0	Suitable
				7	42	A-3	6	26.0	
				42	70	A-2-4	24	2.2	
				70	80	A-2-4	24	2.2	

IV. RECOMMENDED HORIZONTAL WELL DESIGN

A. EXPECTED PUMPING RATES FROM STORMWATER PONDS

Mittauer & Associates, Inc. prepared a report entitled “Stormwater Capture Analysis Along First Coast Outer Beltway for Reclaimed Water Augmentation” for CCUA in June 2017. Table V-3 of that report (included as Appendix A) determined the required pumping rate for each of the various stormwater ponds along Segments 2 and 3 of the First Coast Outer Beltway (FCOB) to be able to capture 90% of the rainfall/runoff discharging into each pond in a 12 hour period. Required pumping rates for the ponds range from a low of 98 gpm to a high of 504 gpm. These pumping rates will be utilized in selecting the design pump capacity at each pond location. **Table IV-1** provides a summary of the required pumping rates and yields from each pond along the FCOB. Ponds generating less than 18 MGY were deemed to be non-cost effective due to their small projected yield.

B. DETERMINATION OF POTENTIAL WELL YIELDS

In the GAI report entitled “Technical Memorandum 1 - Review of Hydrology Within FDOT Corridor and Environmental Conditions” dated February 2014, aquifer performance tests were conducted at eight (8) locations along the FCOB. The results of these aquifer performance tests showed horizontal well yield rates ranging from a low of 0.264 gpm/LF to a high of 0.875 gpm/LF. As expected, the sandy soils with minimal fines had the highest yield while the soils with the most fines had the lowest yield. For preliminary design purposes, it is reasonable to expect that horizontal wells installed in soils identified as “suitable” in **Table III-1** will have yields of approximately 0.6 gpm/LF while those soils identified as “marginal” will have yields of 0.3 gpm/LF. Horizontal wells should not be installed in areas of “unsuitable” soils.

To estimate the required length of horizontal well for a particular pond location, divide the “Required Pumping Rate” from **Table IV-1** by the appropriate well yield (depending on soil type suitability from **Table III-1**). For example, if Pond 1B-G has soils classified as “marginal”, the required length of horizontal well would be estimated by dividing its pumping rate (i.e., 372 gpm) by the “marginal” well yield factor of (i.e., 0.3 gpm/LF), resulting in an estimated 1,240 LF of horizontal well being required. It is recommended that actual horizontal well yields be determined by performing pilot testing using a full scale horizontal well installation prior to moving forward with the full scale project.

TABLE IV-1
STORMWATER POND REQUIRED PUMPING RATES AND HARVEST POTENTIAL FOR AVERAGE YEAR AND 10-YEAR DROUGHT OCCURRENCES

Segment	Pond	Stormwater Harvested for Average Rainfall Year with 90% Capture (MGY)	Stormwater Harvested for Drought Rainfall Year with 90% Capture (MGY)	Required Pumping Rate (gpm)
SEGMENT 2 SOUTH OF MID-CLAY	PS-C01	39	31	271
	PS-C02	6	5	55
	PS-C6-1	39	31	266
	PS-C6-2	39	31	266
	PS-C07	31	24	390
	PS-C08	37	29	277
	PS-C09	12	10	118
	PS-C10	84	66	504
	PS-C10-1	84	66	504
	PS-C15	19	15	98
	PS-C18	37	29	251
	PS-C19	25	20	154
	PS-C20	37	29	303
	PS-C21	34	27	209
	PS-C22	30	24	242
	PS-C24	38	30	248
	PS-C25	26	20	197
	PS-C26	29	23	215
	PS-C27	31	25	238
	PS-C28	20	15	138
	PS-C29	25	19	149
	PS-C30	24	19	162
	PS-C31	19	15	144
	PS-C32	22	17	161
	PS-C33	15	12	108
	PS-C34	17	14	117
	PS-C35	17	14	129
	PS-C36	56	44	387
	PS-C37	37	29	279
	PS-C38	57	45	422
	PS-C39	34	26	257
	SUBTOTAL	***954***	***748***	***6,732***
SEGMENT 2 NORTH OF MID-CLAY	PS-C40	35	27	254
	PS-C41	14	11	96
	PS-C42	23	18	170
	PS-C43	42	33	357
	PS-C44A	24	19	162
	PS-C44B	21	16	142
	PS-C45	36	29	318
	PS-C46	39	30	271
	SUBTOTAL	***220***	***172***	***1,674***
SEGMENT 3	Pond C50	17	13	130
	Pond 1A	44	34	342
	Pond 1B-G	50	39	372
	Pond DR-2	24	19	159
	Pond DR-3C01	3	3	19
	Pond DR-3C02	7	6	60
	Pond DR-3D0	5	4	42
	Pond 4A	20	15	110
	Pond 6A/6B	24	19	194
	Pond PS-63A	12	9	98
	Pond PS-64A	15	12	119
	Pond PS-65A	12	9	95
	SUBTOTAL	***161***	***126***	***1,177***
	TOTAL	***1,335***	***1,047***	***9,583***

Note: Ponds in red are excludeed from total because they generate less than 18 MGY of stormwater.

C. GENERAL HORIZONTAL WELL CONFIGURATION

1. **<u>Review of GAI Recommended Horizontal Well Configuration</u>:** In the GAI reports entitled “Technical Memorandum 1 - Review of Hydrology Within FDOT Corridor and Environmental Conditions” dated February 2014, and “Technical Memorandum 2 - Review of Predicted Yield and Conclusions on the Environmental Impact of the Project” dated February 2014, GAI proposed horizontal wells using 8" perforated HDPE pipe wrapped with filter fabric installed at a 20' depth with a vertical turbine type pump directly connected to the 8" HDPE riser pipe. Although economical to construct, this arrangement can create a negative pressure in the horizontal well pipe and higher than desired velocities in the soils surrounding the horizontal well. Both of these will likely encourage the migration of fines into the horizontal well. Also, with the vertical turbine pump connected directly to the horizontal well riser pipe, there is no way to see if sand/fines are migrating into the horizontal well without removing the vertical turbine pump. Trench width is shown as only 18" wide which will be very difficult to maintain with their proposed 20' pipe depth.

2. **<u>Horizontal Well Construction Techniques</u>:** There are three (3) basic horizontal well construction techniques available. The include conventional trench excavation, directional drill, and gravelless drainage pipe.

   a. **Conventional Trench Excavation:** This technique uses conventional trench excavation to install perforated PVC pipe surrounded by a gravel bed with filter fabric and coarse sand placed between the native soils and the gravel bed. While this technique is the most difficult and costly construction technique, it is the least prone to fouling. Dewatering during installation can be difficult due to the fact that the horizontal well will be placed next to a stormwater pond.

   b. **Directional Drill:** Directional drilling, while the simplest and most economical construction technique for horizontal wells, is not well suited because there is no means to install the needed gravel bed, filter fabric, and coarse sand which prevent fines from getting into the perforated pipe. Also, the drilling mud surrounding the perforated pipe would initially be pulled into the pipe leaving a void. Horizontal wells installed by directional drilling are typically used to remove contamination from an area without having to excavate or dewater.

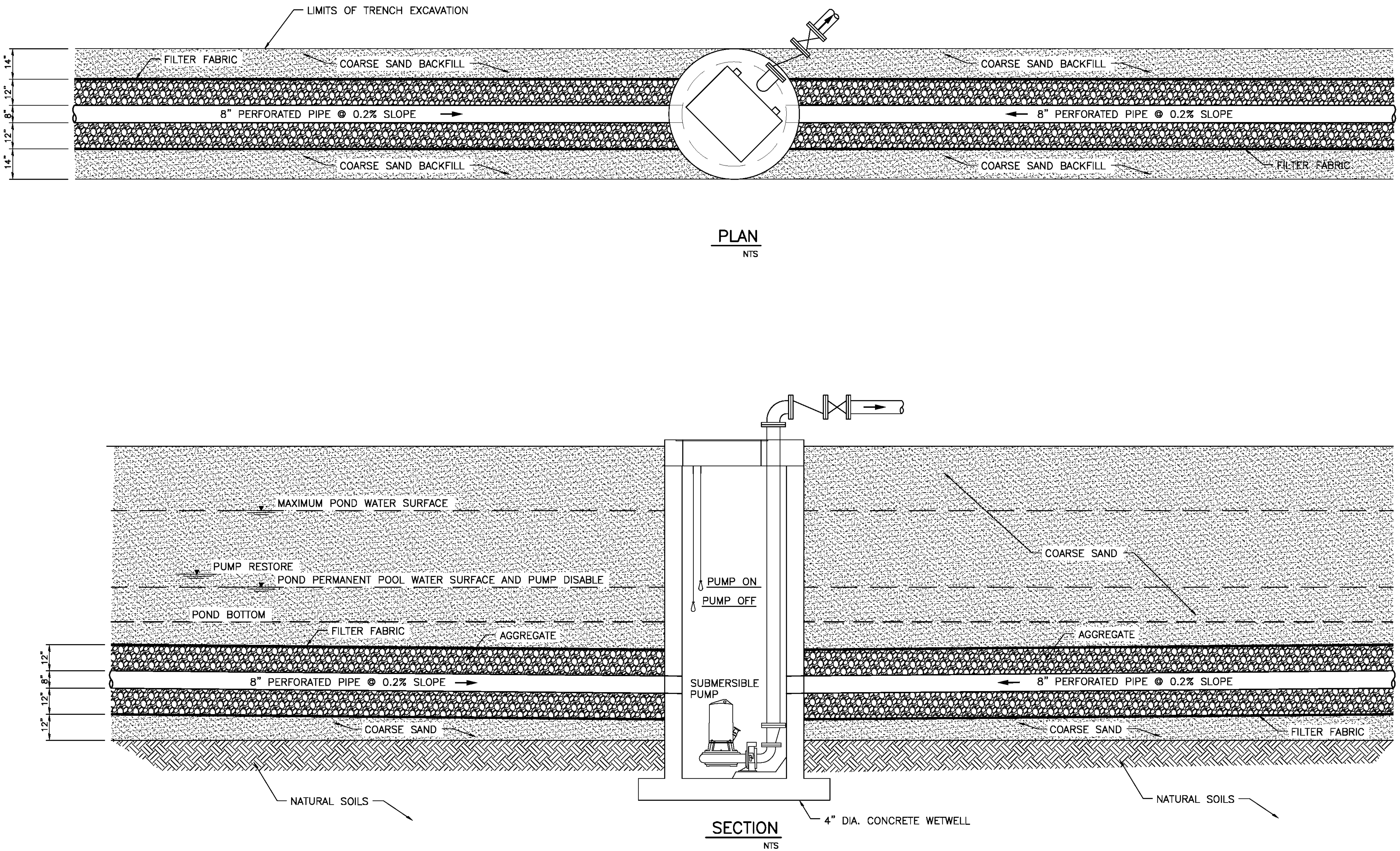
c. **Gravelless Drainage Pipe:** Utilizes sock drain pipe installed using a trenching machine. Depths up to 20 feet are possible. Installation is very easy and does not require dewatering. It is limited to sandy soils that have good hydraulic conductivity. These type systems are typically for short term dewatering applications (i.e., several months) and are prone to fouling with extended use.

The most suitable horizontal well construction technique for a long term horizontal well is conventional trench excavation. A conceptual layout of the proposed horizontal well system is presented in **Exhibit IV-A**. Although it is the most difficult and costly construction technique, it will result in a horizontal well that should have a useful life in excess of 20 years with minimal operating issues.

3. **Horizontal Well Components:** Each horizontal well will consist of the following basic components: perforated PVC pipe; gravel bed; coarse sand; filter fabric; wetwell for submersible pump; simplex submersible pump with float controls; and a pump control panel. Depending on whether the water from the horizontal well will be pumped directly into the public access reuse transmission/distribution or sent to an offsite treatment or storage facility, other components such a hypochlorite injection system and hydropneumatic tank may be required. A description of each of the horizontal well components is presented in the following:

   a. **Perforated Pipe:** The most commonly used perforated pipe is bell & spigot PVC pipe meeting ASTM 3034 and ASTM F758. This pipe is economical, readily available and does not require any special installation techniques. It is available in sizes ranging from 4" to 10". This pipe will not degrade and should have a useful life in excess of 50 years.

   b. **Gravel:** Gravel (or aggregate) to be installed around the perforated pipe will be washed 57 stone as per FDOT underdrain details. Overall dimensions of the gravel bed will be 32" x 32".



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MITTAUER & ASSOCIATES, INC.
CONSULTING ENGINEERS
580-1 Wells Road, Orange Park, Florida 32073
Tel. (904) 278-0030 Fax. (904) 278-0840 Florida CA No. 6569

CLAY COUNTY UTILITY AUTHORITY
Horizontal Well Feasibility Study
Pump Station & Horizontal Well
Clay County, Florida

EXHIBIT
IV–A
March 22, 2018
Project No.
9204–52–1

c. **Coarse Sand:** Coarse sand (or fine aggregate) to be installed around the gravel bed will consist of quartz sand meeting the requirements of Section 902-4 of the FDOT Standard Specifications. Minimum thickness of the coarse sand between the gravel bed and native soils on all sides will be 12". Coarse sand will be utilized as backfill from the top of the gravel bed to existing grade to allow the easy vertical movement of surficial groundwater to reach the underdrain pipe in case there are impermeable or semi-impermeable native soil layers.

d. **Filter Fabric:** Filter fabric shall meet the requirements of FDOT Type D-3. Filter fabric will be placed around the entire gravel bed and will overlap a minimum of one foot.

e. **Wetwell:** The wetwell for the pump will consist of a four (4) foot diameter precast manhole with aluminum access hatch. The top of the wetwell will be placed above the maximum water level of the pond. The bottom of the wetwell will be placed approximately three (3) foot below the invert of the perforated pipe.

f. **Pumping System:** The pumping system will be comprised of a simplex submersible pump meeting CCUA design standards. Pump will be installed on guiderails for easy removal and maintenance. Pumping system will be equipped with a swing check valve and isolation valve.

g. **Pumping System Controls:** The submersible pump will be controlled using floats in the wetwell. If the water level in the wetwell is above the “PUMP ON”, pump will be called to run unless the water level in the stormwater pond is below the “permanent pool” level (as sensed by floats in the pond) and/or the pressure in the reuse transmission/distribution (as sensed by a pressure transducer on the discharge pipe of pump) is above a preset pressure indicating no demand for reuse. The ability to operate the pump using a VFD could also be provided to allow variance of flow and pressure. The ability to control the pump remotely could also be provided.

V. POTENTIAL FOR FOULING

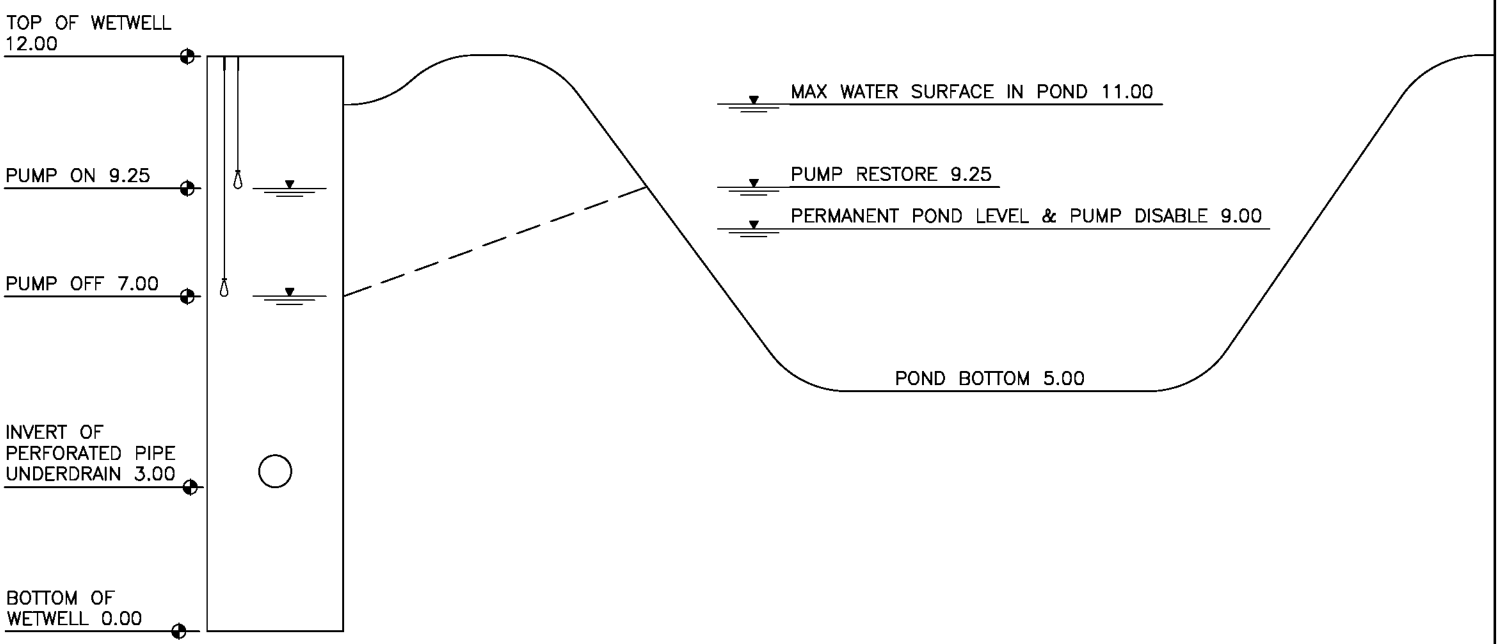
A. GENERAL

The potential for fouling of a horizontal well is a function of the hydraulic conductivity of the surrounding soils, the percent fines of the surrounding soils, the approach velocity of the groundwater to the horizontal well, and the design characteristics of the horizontal well. Ideally, the surrounding soils should have a high hydraulic conductivity and a low percentage of fines. The approach velocity to the horizontal well can be minimized by providing a sufficient length of horizontal well while also maintaining a reasonable water column depth (e.g., 4'-0") at the horizontal well.

B. DESIGN CHARACTERISTICS TO MINIMIZE FOULING POTENTIAL

One of the most important design considerations to minimize fouling of a horizontal well is to locate it in an area whose soils have a high hydraulic conductivity and a low percentage of fines. This aspect cannot be overstated. Locating a horizontal well in an area with unsuitable soils will almost certainly result in fouling problems within the first few years of operation.

Another important design aspect for horizontal wells is the selection of the appropriate length of horizontal well. As discussed in the Section IV. B., the required length of horizontal well is a function of required pumping rate from the pond in question coupled with the characteristics of the surrounding soils. Longer horizontal well lengths result in lower approach velocities which minimizes the potential movement of fines through the soil matrix and hence, reduces fouling potential. Maintaining a reasonable saturated soil depth at the horizontal well also results in lower approach velocities by providing a larger cross sectional area for the groundwater to reach the horizontal well. Saturated soil depth at the horizontal well will be maintained at a minimum of 4.0 feet and could be significantly greater if the pond were at its maximum water depth. See **Exhibit V-A** for typical pond and pump station water levels.



SECTION
NTS

MITTAUER
& ASSOCIATES, INC.
CONSULTING ENGINEERS
580-1 WELLS ROAD, ORANGE PARK, FLORIDA 32073
TEL. (904) 278-0030 FAX. (904) 278-0840 FLORIDA CA NO. 6569

CLAY COUNTY UTILITY AUTHORITY
Horizontal Well Feasibility Study
Typical Pond & Pump Station Water Levels
Clay County, Florida

EXHIBIT
V-A
March 22, 2018
Project No.
9204-52-1

Using Pond 1B-G from the previous example, the approach velocity to the horizontal well is estimated as follows:

Design Pond Pumping Rate = 372 gpm
Length of Horizontal Well = 1,240 LF
Minimum Water Column Depth At Horizontal Well = 4.0 feet

$$\text{Approach Velocity} = \frac{(372\ \text{gal/min})(1{,}440\ \text{min/day})}{(7.48\ \text{gal/ft}^3)(1{,}240\ \text{ft})(4.0\ \text{ft})} = 14\ \text{ft/day}$$

From the GAI studies, the eight aquifer performance tests along the FCOB showed hydraulic conductivities ranging from 1.3 to 28 ft/day. The design approach velocity is in this range so the migration of fines should not be an issue, although there is a lack of published information on this topic. Lowering the approach velocity to the horizontal well should decrease its potential for fouling.

By constructing the horizontal well similar to an underdrain system with perforated pipe, coarse aggregate, filter fabric, and coarse sand, (essentially in accordance with FDOT underdrain standards), the likelihood of fouling is reduced. CCUA's previous experience with underdrains at its WWTPs using this configuration has been excellent with most of the underdrain systems operating successfully for over 20 years.

C. POTENTIAL FOR RESTORATION OF FOULED HORIZONTAL WELLS

If a horizontal well were to become fouled as a result of the migration of fines, there is very little that can be done to correct the problem, short of constructing a new horizontal well, preferably along a different side of the pond. Backwashing is not an option because there would be no ability to expand the media to remove accumulated fines as is normally done with a conventional sand filter. Chemical treatment would also not be effective because the accumulated fines are largely inert and would not be dissolved as a result of adding chemical.

D. PROJECTED USEFUL LIFE OF HORIZONTAL WELLS

The projected useful life of a horizontal well is dependent on the native surrounding soils, frequency of use, flow rates/velocities to the well, and design of the well components. Locating horizontal wells in soils having high hydraulic conductivity and low percent fines will extend the useful life of the well. Likewise, if the well is only used for several months out of a year (i.e. wet season), its life will be increased. Utilizing the design concepts presented herein, it is our opinion that the expected life of a horizontal well located in “suitable” soils is 20-30 years while a horizontal well located in “marginal” soils would have an expected life of 7-15 years.

VI. PROJECTED COSTS

A. CAPITAL COSTS

A conceptual capital cost estimate to construct a typical horizontal well with a simplex submersible pump station, discharge piping, hydrotank, hypochlorite disinfection facilities, and associated instrumentation and electrical is presented in **Table VI-1**.

TABLE VI-1
CONCEPTUAL CAPITAL COST ESTIMATE FOR HORIZONTAL WELL AND RELATED COMPONENTS

Description	Unit	Est. Qty	Unit Price	Estimated Cost
1. Mobilization & General Conditions	LS	1	$50,000	$50,000
2. Horizontal Well	LF	1,000	$150	$150,000
3. Simplex Self-Priming Pump Station	LS	1	$75,000	$75,000
4. Discharge Piping, Valves & Flowmeter	LS	1	$50,000	$50,000
5. Hydrotank & Air Compressor (5,000 gal)	LS	1	$75,000	$75,000
6. Hypochlorite Disinfection Facilities	LS	1	$50,000	$50,000
7. Instrumentation/Telemetry	LS	1	$50,000	$50,000
8. Electrical	LS	1	$50,000	$50,000
ESTIMATED CONSTRUCTION COST				$550,000
CONSTRUCTION CONTINGENCY (20%)				$110,000
TOTAL ESTIMATED CONSTRUCTION COST				**$660,000**
TOTAL ESTIMATED NON-CONSTRUCTION (15%)				$99,000
TOTAL ESTIMATED CAPITAL COST				**$759,000**

Estimated costs will vary for each horizontal well location depending on length of horizontal well required, required capacity of pump, hydrotank size, proximity of available electrical service, etc. Expected capital costs for each pond location will likely range from a low of $500,000 to a high of $1,000,000, excluding the cost of any required offsite reuse mains.

B. OPERATING & MAINTENANCE COSTS

Operating and maintenance costs for each horizontal well will include power, chemical, equipment maintenance/repair, and labor costs. Power costs will include the power to run the pump, air compressor, and disinfection facilities. Chemical costs include sodium hypochlorite for disinfection prior to pumping to the public access reuse transmission/distribution system. Equipment costs include maintenance/repair of the submersible pump, air compressor, and chemical feed system. Labor costs are assumed to be one person for an average of one (1) hour per week. A conceptual cost estimate for the expected operating and maintenance costs associated with each horizontal well installation is presented in **Table VI-2**.

TABLE VI-2 CONCEPTUAL O&M COST ESTIMATE FOR EACH HORIZONTAL WELL	
1. Power Cost	$1,500/yr to $7,000/yr
2. Equipment Maintenance/Repair	$3,000/yr to $6,000/yr
3. Chemical Cost	$1,000/yr to $6,000/yr
4, Labor Cost	$2,000/yr to $4,000/yr
TOTAL ANNUAL O&M COST	**$7,500/yr to $23,000/yr**

VII. PERMITTING

Stormwater harvesting is an activity regulated in State of Florida by the local Water Management District and the Florida Department of Environmental Protection (FDEP). For north east Florida, most projects will fall under the St. Johns River Water Management District (SJRWMD). The SJRMWD will oversee the construction of the horizontal well and any modifications to the stormwater system from which it extracts water and will also oversee the quantity of water harvested by the system. FDEP will oversee the quality of the water removed and pumped into any active reuse system.

For the scenario contemplated in this report, where the harvesting entity will be selectively targeting specific and existing stormwater ponds, the anticipated permits are listed as follows:

1. SJRWMD Environmental Resource Permit (ERP)
2. SJRWMD Consumptive Use Permit (CUP)
3. FDEP Application for Permission To Place a Public Access Reuse System in Operation.
4. FDEP Wastewater Facility or Activity Permit

The ERP application will be filed to allow modification of an existing pond system. The extraction method proposed in this report will likely require modification of the bleed down orifice (either blinding or partial restriction) so that the treatment volume can be extracted by the well instead of the bleed down orifice. The ERP has two forms of permit that are pertinent to the projects being considered in this report. First is the General Permit, which is a prescriptive permit of which there are over 50 variations. The applicant must achieve the specific conditions of each permit variation in order to qualify. Each variation of the permit allows a very narrow range of activities with very little flexibility. The intent behind this program is to expedite the permitting of ordinary activities and avoid the more extensive information and study required by the individual permit. Because it is likely that in most cases we will be modifying the control structure of each pond targeted by the project, this type of permit may have limited application. The second type of ERP is the Individual Permit which has broad scope and can be used to permit any type of stormwater project regardless of the activity. By their very nature, ERP's are a far more elaborate and extensive permitting process requiring significantly more effort and resources in order to prove the permitting standards have been met.

ERP's will typically require that the following permitting elements be evaluated and satisfied before permit issuance:

1. Maintain pond recovery characteristics. For a typical wet detention system the treatment volume must recover between 24 and 72 hours.

2. Ensure no reduction in the permanent pool volume of the pond.

3. Ensure no reduction in treatment or flood storage volumes.

4. Maintain the hydroperiod of surrounding wetlands or other sensitive ecosystems. Wet detention systems are typically selected as a treatment system because a high water table precludes the use of a dry system. Often the high water table will also support a wetland or surface water body. The permitting process will require assurance that the harvesting activity will not negatively impact the hydroperiod of the adjacent ecosystems causing stress in the fauna and flora associated with the environment.

In addition to the ERP, the SJRWMD will also oversee and permit the quantity of water harvested by the well system via it's Consumptive Use Permit (CUP) program. A well of any kind must receive a CUP if it trips any of the thresholds below:

1. Greater than 100,000 gallons per day AADF.
2. Equipment capable of greater than 1,000,000 gallons per day of extraction.
3. Greater than 6 inch diameter intake diameter measured at the end of the pipe.

Other thresholds exist, but the above summarize the most likely parameters to be tripped by a horizontal well project. The activities contemplated in this report will likely qualify for a general permit under the program. The rules (40C-2) for the program specifically mention extraction of water from wet detention ponds for the specific purpose of recycling water.

FDEP will oversee any modification of the reuse/reclaim water system and the associated treatment plant. In order to connect to an existing reuse water system, the water extracted will need to meet the treatment and water quality standards of the reuse water rule 62-610. FDEP may require a modification to the existing operating permit of the treatment plant. Additionally, an FDEP pilot program will need to be established for stormwater harvesting.

Additional permits that may be required due to the location or ownership of the pond system being targeted are as follows:

1. FDOT Utility Permit
2. FDOT Drainage Permit.
3. City or County permitting as determined by the local authority having jurisdiction

FDOT has an extensive stormwater system serving the federal and state highway system throughout Florida and CCUA has already implemented a pilot study for the potential reuse of stormwater collected as part of the proposed outer beltway encircling the greater Jacksonville area. FDOT requires utility owner to file a request for permission to use state right of ways prior to any construction. Because it is likely that we bill modify the response of any given pond system we extract water from, the FDOT also has its own stormwater permitting program and any modification will need to be approved by that program. The FDOT's design criteria focuses primarily on managing the quantity of water received from the roadways and is less concerned with treatment. Consequently, the FDOT has a battery of storm events that range in length from 1 hour to 10 days and with return periods of 1 year to 100 years. In terms of the volume of water that must accounted for the design process is generally more extensive than seen in other permitting agencies.

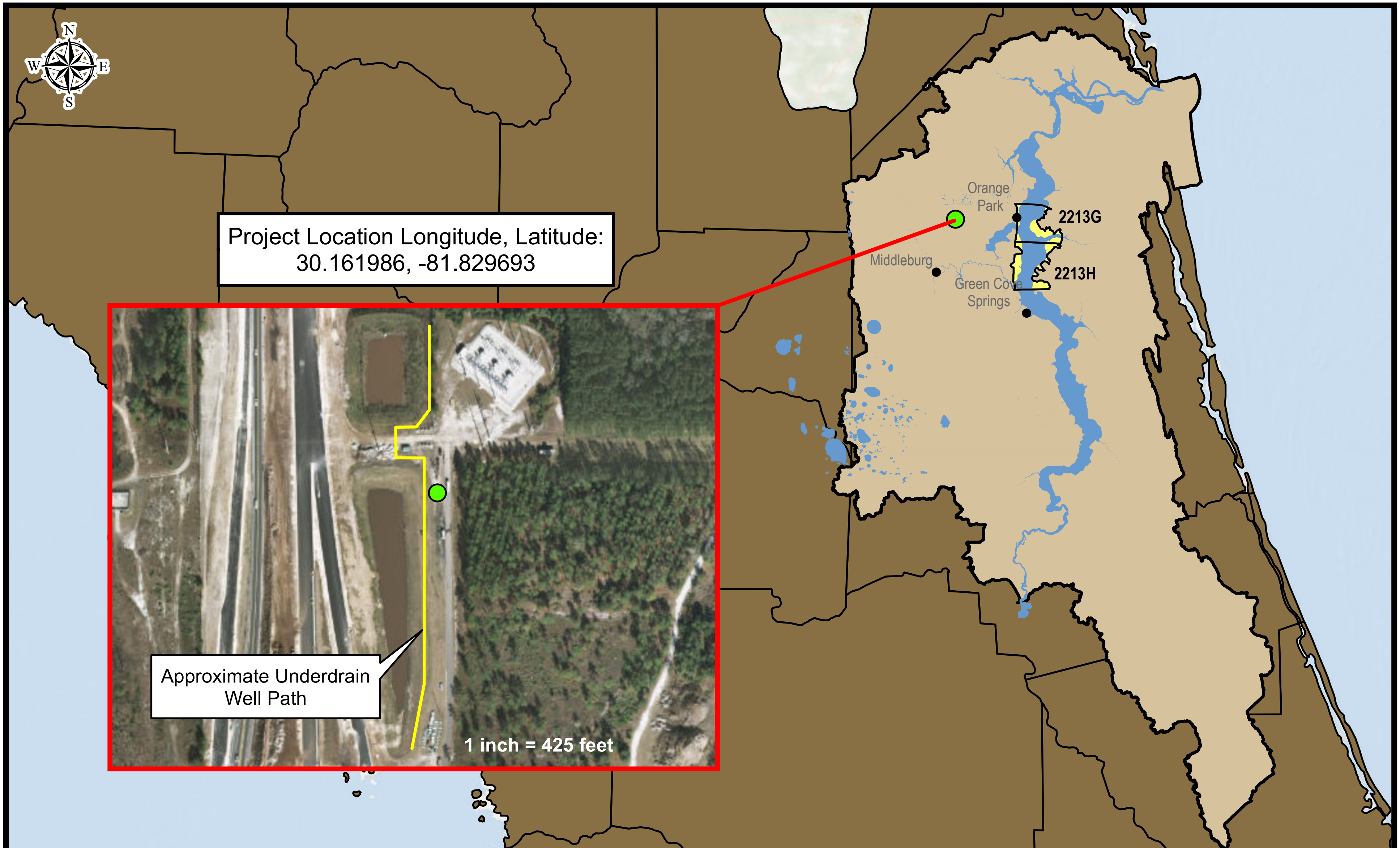
VIII. SUMMARY AND CONCLUSIONS

Horizontal wells are technically feasible for extracting excess stormwater from retention ponds along the FCOB to supplement CCUA's public access reuse system. If properly designed and constructed in suitable soils, they should have a useful life in excess of 20 years. CCUA has similar underdrain systems which have operated continuously for over 30 years without issue. Estimated capital costs for each horizontal well site range from $500,000 to $1,000,000 depending on the length of the horizontal well required and the capacity of the corresponding pumping system. Operating costs for each horizontal well site are anticipated to range from $7,500/yr to $23,000/yr, depending on the stormwater yield from that particular pond site. Recommend that CCUA move forward with pilot testing a horizontal well at one of the FCOB pond sites. Permission from the Florida Department of Environmental Protection (FDEP) would be required for any pilot testing. Funding for the pilot testing may be available from the St. Johns Water Management District (SJRWMD).

ATTACHMENT

"B"

Location Map #1



Clay County Utility Authority
3176 Old Jennings Road
Middleburg, Florida 32068-3907
Phone (904) 272-5999

Project:

Stormwater Maining Pilot Project

Info:

Attachment: B
Department: GIS
Prepared by: Sarah Grimsley, GIS Analyst II
Date: 10/18/2018
Scale: 1 inch = 92,000 feet

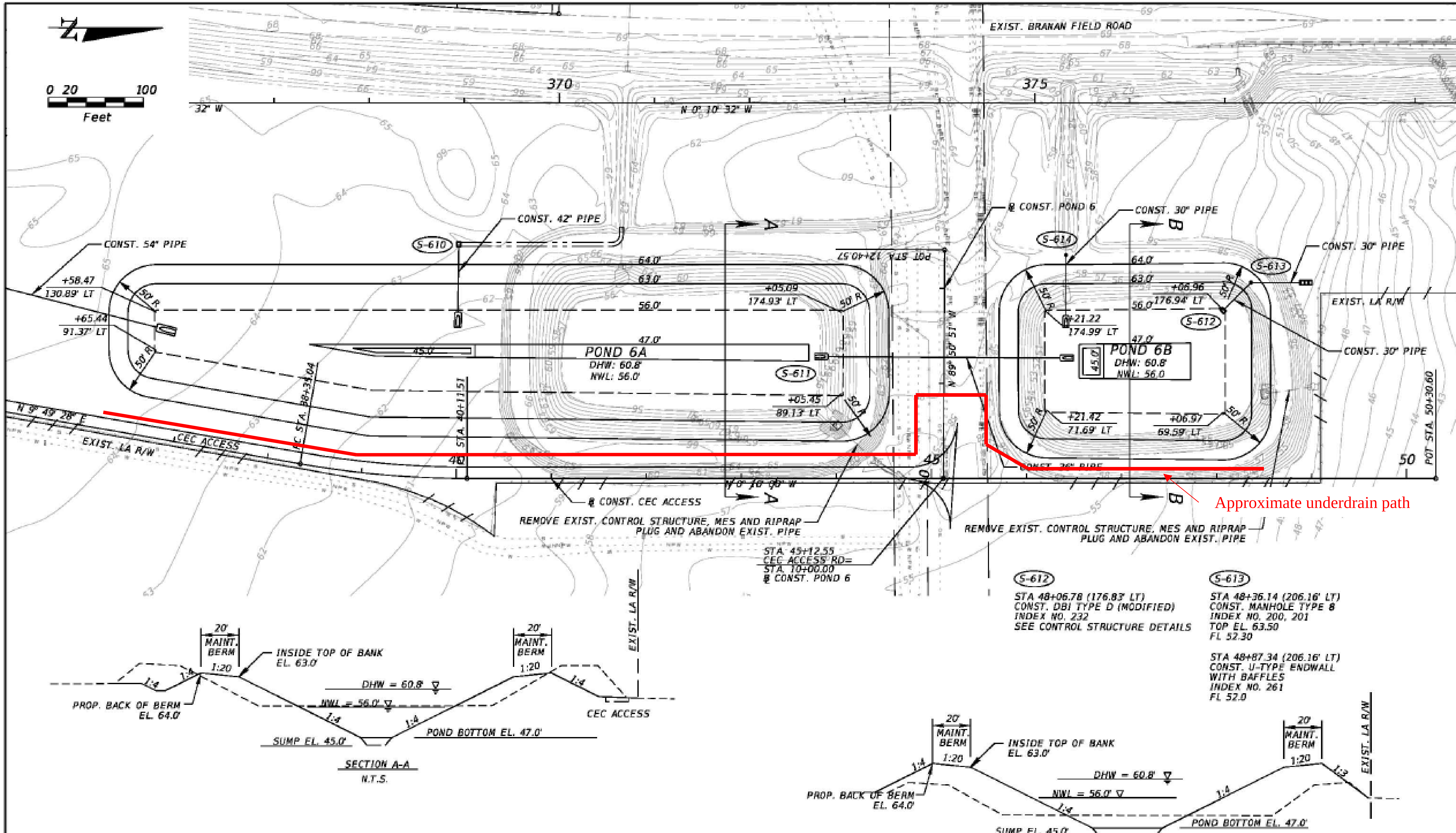
Legend

- Local Cities
- Project Location
- Underdrain Well Path
- WBIDs
- Lower St. Johns Watershed Basin
- Florida Counties

ATTACHMENT

“C”

Location Map #2



NOTES:

1) PONDS 6A AND 6B ARE INTERCONNECTED AND EQUALIZED. THE OUTFALL DISCHARGES TO SOUTH PRONG DOUBLE BRANCH.

2) POND LOCATION CALLOUTS BASED ON ℄ CONST. CEC ACCESS.

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

RS&H
Reynolds, Smith and Hills, Inc.
10748 Deerwood Park Blvd. South
Jacksonville, Florida 32256
904-256-2500
Fl Cert. No. EB0005620
Engineer of Record: Will Stewart, P.E. No.: 42764

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
23	CLAY	429304-2-52-01

POND DETAILS
PONDS 6A & 6B

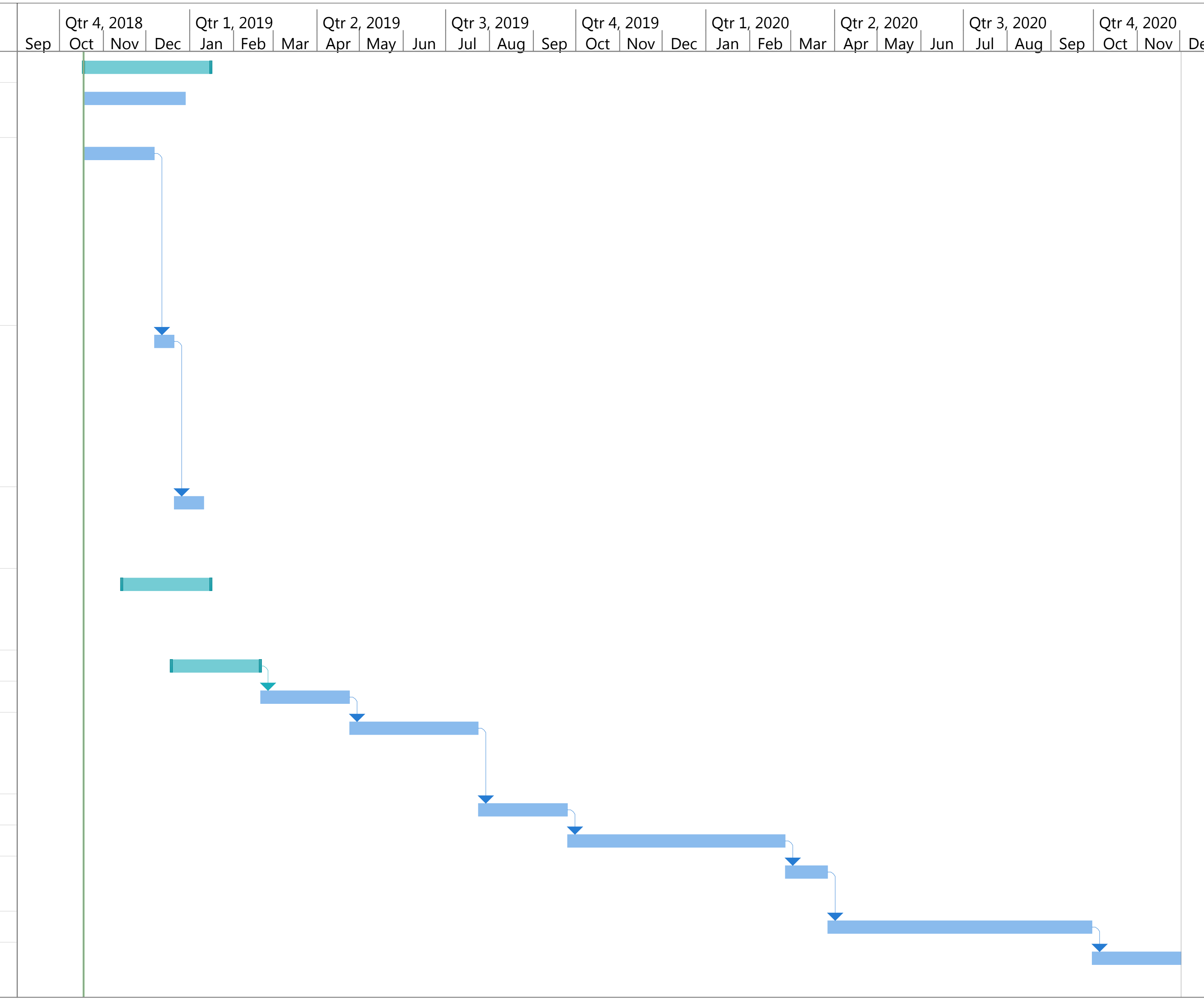
SHEET NO. 109

ATTACHMENT

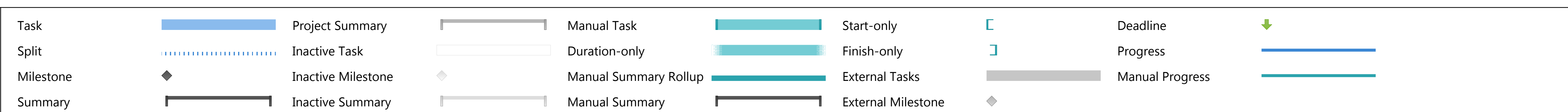
“D”

Project Schedule

ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1			Planning	64 days	Thu 10/18/18	Tue 1/15/19		
2			SJRWMD Grant Application	52 days	Thu 10/18/18	Fri 12/28/18		
3			Stakeholder engagement with FDOT, FDEP, and SJRWMD: Determine permitting requirements	36 days	Thu 10/18/18	Thu 12/6/18		
4			Refine scope requirements based on stakeholder engagement for design	10 days	Fri 12/7/18	Thu 12/20/18	3	
5			Scope and fee negotations for engineering design	15 days	Fri 12/21/18	Thu 1/10/19	4	
6			Geotechnical Engineering & Testing	45 days	Wed 11/14/18	Tue 1/15/19		
7			Site Surveying	45 days	Wed 12/19/1	Tue 2/19/19		
8			Engineering Design	45 days	Wed 2/20/19	Tue 4/23/19	7	
9			Permitting: FDEP, SJRWMD, and FDOT	65 days	Wed 4/24/19	Tue 7/23/19	8	
10			Bidding	45 days	Wed 7/24/19	Tue 9/24/19	9	
11			Construction	110 days	Wed 9/25/19	Tue 2/25/20	10	
12			Construction final completion	22 days	Wed 2/26/20	Thu 3/26/20	11	
13			Pilot testing	133 days	Fri 3/27/20	Tue 9/29/20	12	
14			Pilot data analysis, testing, and report	45 days	Wed 9/30/20	Tue 12/1/20	13	



Project: Project Schedule
Date: Thu 10/18/18



ATTACHMENT

“E”

Property Easement

CFN # 2004094733, OR BK 2469 Pages 1274 - 1277, Recorded 12/28/2004 at 03:30 PM, James B. Jett Clerk Circuit Court, Clay County, Doc. D $0.70 Deputy Clerk RICKSD

Prepared under the direction of,
Record and return to:
Grady H. Williams, Jr., Esq.
c/o Clay County Utility Authority
3176 Old Jennings Road
Middleburg, Florida 32068-3907

GRANT OF EASEMENT

(Individual)

Parcel No.: 17-04-25-007947-000-00
Project Name: Brannan Field/Chaffee Road Utility Extensions

THIS INDENTURE, made this 21st day of December, A.D. **2004**, BETWEEN **FRANK SPENCER, LTD.,** a Florida limited partnership, hereinafter called **GRANTOR**, whose mailing address is 3681 Kindlewood Drive, Middleburg, Florida 32068, and **CLAY COUNTY UTILITY AUTHORITY**, hereinafter called **GRANTEE**, whose business address is 3176 Old Jennings Road, Middleburg, Florida 32068-3907.

WITNESSETH: That GRANTOR, for and in consideration of the sum of Ten Dollars ($10.00) and other good and valuable consideration to them in hand paid by GRANTEE, the receipt whereof is hereby acknowledged, has granted, bargained, sold and conveyed to the GRANTEE, its successors and assigns forever an unobstructed right-of-way and easement with the right, privilege and authority to said GRANTEE, its successors and assigns, to construct, operate, lay, maintain, improve and/or repair associated equipment for water, wastewater, and/or reclaimed water utilities, any or all, on, along, over, through, across or under the following described land, situate in Clay County, Florida, to-wit:

See Exhibit "A" attached hereto and by reference made a part hereof.

TOGETHER, with the right of said GRANTEE, its successors and assigns, of ingress and egress, to and over said above described premises, and for doing anything necessary or useful or convenient or removing at any time any and all of said improvements upon, over, under or in said lands, together also with the right and easements, privileges and appurtenances in and to said land which may be required for the enjoyment of the rights herein granted. GRANTOR does hereby fully warrant the title to the Grant of Easement described herein, and will defend the same against the lawful claims of all persons whomsoever.

IN WITNESS WHEREOF, the said GRANTOR has hereto set hand and seal the day and year first above written.

Signed and sealed in our presence:

WITNESSES:

Melody Turner
Print Name: Melody Turner

Ly O. Valentin
Print Name: Lynn O. Valentin

FRANK SPENCER, LTD.,
a Florida limited partnership

By: FRANK SPENCER, INC.,
a Florida corporation, its general partner:

By: (Seal)
Frank T. Spencer, Sr., President

STATE OF FLORIDA
COUNTY OF CLAY

The foregoing instrument was acknowledged before me this 21st day of December, **2004**, by **FRANK T. SPENCER, SR.,** as **PRESIDENT** of **Frank Spencer, Inc., a Florida corporation, the general partner of FRANK SPENCER, LTD.,** a Florida limited partnership, on behalf of the partnership, who is personally known to me or has produced ______________________________, as identification.

Lyn O Valentin
Print Name: **Lynn O. Valentin**
Notary Public in and for the
County and State Aforesaid
My Commission Expires:

Lynn O Valentin
My Commission DD361204
Expires July 31, 2007

Accepted on behalf of the Clay County Utility Authority.

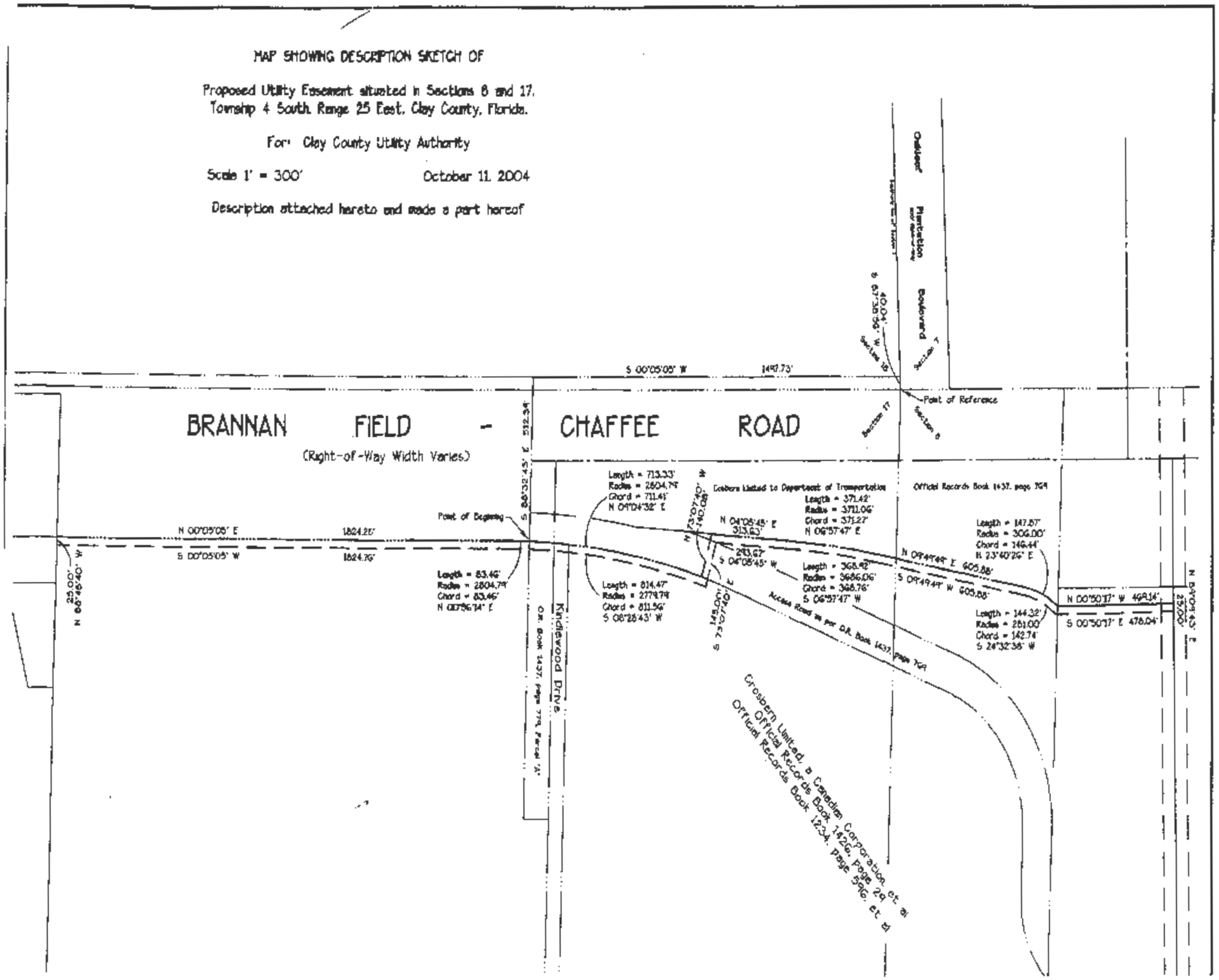
By: Ray Avery
Ray O. Avery, Executive Director

EXHIBIT "A"

Eiland & Associates, Inc.
PROFESSIONAL SURVEYORS and MAPPERS
615 Blanding Blvd. Orange Park, FL 32073
PHONE (904) 272-1000 FAX (904) 272-5443
www.eilandsurveyors.com

October 18, 2004
Job 27930
For: Clay County Utility Authority

An easement for utilities, situated partly in Section 8 and partly in Section 17, Township 4 South, Range 25 East, Clay County, Florida, said easement being more particularly described as follows:
For a Point of Reference, commence at the northwest corner of said Section 17; thence South 87 degrees 38 minutes 56 seconds West, 40.04 feet; thence South 00 degrees 05 minutes 05 seconds West, 1497.73 feet to the westerly prolongation of the southerly line of lands described in Official Records Book 1437, page 779 (Parcel "A") of the public records of said county; thence on said westerly prolongation, run South 88 degrees 32 minutes 43 seconds East, 512.39 feet to the Point of Beginning; thence on the arc of a curve concave easterly and having a radius of 2804.79 feet, an arc length of 713.33 feet, said arc being subtended by a chord bearing and distance of North 09 degrees 04 minutes 32 seconds East, 711.41 feet; thence North 73 degrees 07 minutes 40 seconds West, 140.08 feet; thence North 04 degrees 05 minutes 45 seconds East, 313.63 feet; thence on the arc of a curve concave easterly and having a radius of 3711.06 feet, an arc length of 371.42 feet, said arc being subtended by a chord bearing and distance of North 06 degrees 57 minutes 47 seconds East, 371.27 feet; thence North 09 degrees 49 minutes 49 seconds East, 605.88 feet; thence on the arc of a curve concave southeasterly and having a radius of 306.00 feet, an arc length of 147.87 feet, said arc being subtended by a chord bearing and distance of North 23 degrees 40 minutes 26 seconds East, 146.44 feet; thence North 00 degrees 50 minutes 17 seconds West, 469.14 feet to the centerline of that particular easement to Clay Cooperative, Inc., as described in Official Records Book 241, page 481 of said public records; thence on said centerline, run North 89 degrees 09 minutes 43 seconds East, 25.00 feet; thence South 00 degrees 50 minutes 17 seconds East, 478.04 feet; thence on the arc of a curve concave southeasterly and having a radius of 281.00 feet, an arc length of 144.32 feet, said arc being subtended by a chord bearing and distance of South 24 degrees 32 minutes 38 seconds West, 142.74 feet; thence South 09 degrees 49 minutes 49 seconds West, 605.88 feet; thence on the arc of a curve concave easterly and having a radius of 3686.06 feet, an arc length of 368.92 feet, said arc being subtended by a chord bearing and distance of South 06 degrees 57 minutes 47 seconds West, 368.76 feet; thence South 04 degrees 05 minutes 45 seconds West, 293.67 feet; thence South 73 degrees 07 minutes 40 seconds East, 145.00 feet; thence on the arc of a curve concave southeasterly and having a radius of 2779.79 feet, an arc length of 814.47 feet, said arc being subtended by a chord bearing and distance of South 08 degrees 28 minutes 43 seconds West, 811.56 feet; thence South 00 degrees 05 minutes 05 seconds West, 1824.76 feet; thence North 88 degrees 48 minutes 40 seconds West, 25.00 feet; thence North 00 degrees 05 minutes 05 seconds East, 1824.28 feet; thence on the arc of a curve concave easterly and having a radius of 2804.79 feet, an arc length of 83.46 feet to the Point of Beginning, said arc being subtended by a chord bearing and distance of North 00 degrees 56 minutes 14 seconds East, 83.46 feet. Containing 2.68 acres, more or less, in area. Less and Except any portion thereof lying within those lands described in Official Records Book 1437, page 769, Part "B" of said public records.


MAP SHOWING DESCRIPTION SKETCH OF
Proposed Utility Easement situated in Sections 8 and 17, Township 4 South, Range 25 East, Clay County, Florida.
For: Clay County Utility Authority
Scale 1" = 300'
October 11, 2004
Description attached hereto and made a part hereof
BRANNAN FIELD - CHAFFEE ROAD
(Right-of-Way Width Varies)
S 00°05'05" W 1497.73'
Point of Reference
Section 17
Section 8
S 88°32'43" E 512.34'
Point of Beginning
N 00°05'05" E 1824.20'
S 00°05'05" W 1824.70'
25.00'
Length = 83.46'
Radius = 2804.79'
Chord = 83.46'
Length = 713.33'
Radius = 2804.79'
Chord = 711.41'
N 04°04'32" E
N 04°05'45" E 313.63'
293.67'
S 04°05'45" W
Length = 814.47'
Radius = 2779.79'
Chord = 811.56'
S 08°28'43" W
Length = 371.42'
Radius = 3711.06'
Chord = 371.27'
N 06°57'47" E
Length = 368.92'
Radius = 3686.06'
Chord = 368.76'
S 06°57'47" W
Official Records Book 1437, page 769
N 09°49'49" E 605.88'
S 09°49'49" W 605.88'
Length = 147.87'
Radius = 306.00'
Chord = 146.44'
N 23°40'26" E
Length = 144.32'
Radius = 281.00'
Chord = 142.74'
S 24°32'38" W
N 00°50'37" W 499.14'
S 00°50'37" E 478.04'
25.00'
Kindlewood Drive
O.R. Book 1437, page 779, Parcel "A"
Access Road as per O.R. Book 1437, page 769
Crosbern Limited, a Canadian Corporation et al
Official Records Book 1426, page 29
Official Records Book 1234, page 546, et al
Oakleaf Plantation Boulevard
Section 18
Section 7

ATTACHMENT

"F"

Breakdown of Project Cost

PLANNING AND DESIGN COST ESTIMATE FOR STORMWATER MINING PILOT

Description	Unit	Estimated Quantity	Unit Price	Estimated Cost
1. 50 ft x 50 ft Land Aqusition	LS	1	60000	$60,000
2. Design	LS	1	150000	$150,000
3. Permitting	LS	1	15000	$15,000
4. Construction Administration	LS0	1	23000	$23,000
5. Testing	LS	12	$ 1,000	$12,000
6. Laboratory Cost	LS	60	$ 500	$30,000
7. O&M Manual	LS	1	$ 6,000	$6,000
8. Summary Data Report	LS	1	$ 15,000	$15,000
				$311,000

CONCEPTUAL CAPITAL COST ESTIMATE FOR HORIZONTAL WELL AND RELATED COMPONENTS

Description	Unit	Estimated Quantity	Unit Price	Estimated Cost
1. Mobilization & General Conditions	LS	1	$50,000	$50,000
2. Horizontal Well	LF	1,200	$150	$180,000
3. Simplex Self-Priming Pump Station	LS	1	$75,000	$75,000
4. Discharge Piping, Valves & Flowmeter	LS	1	$50,000	$50,000
5. Instrumentation	LS	1	$50,000	$50,000
6. Electrical	LS	1	$50,000	$50,000
7. As-built	LS	1	$6,500	$6,500
Sub-total				$461,500
8. Sitework (grading, drainage, fill, grassing, etc.) (15%)				$46,150
Contingency (20%)				$101,530
TOTAL ESTIMATED OPINION OF CONSTRUCTION COST				**$609,180**

CONCEPTUAL O&M ANNUAL COST ESTIMATE FOR EACH HORIZONTAL WELL

Description	Unit	Estimated Quantity	Unit Price	Estimated Cost
1. Power Cost	LS	1	$ 4,400	$4,400
2. Equipment Maintenance/Repair	LF	1	$ 2,400	$2,400
3. Chemical Cost	LS	1	$ 4,000	$4,000
4. Labor Cost	LS	1	$ 1,600	$1,600
TOTAL ESTIMATED OPINION OF 1st YEAR ANNUAL O&M COST				$12,400

ATTACHMENT

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Cost Effectiveness Calculations

Cost Share Program Cost Effectiveness Calculator

Total Project Costs, (sum of components cost) Fill in total component cost and O&M costs for each component within the project, as applicable. Fill in MGD below for total project.

Q (MGD) = Amount of water conserved or made available by the total project

Interest rate (annual %) = **2.750%** **FY2018 Federal Water Resource Planning Disco**

Project / components	Q(MGD)	Total Project Cost*	O&M ($/year)	Service Life	$/kgal
Example Treatment Project	**1.000**	**$ 2,000,000**	**$ 2,000**	**20**	0.365
Stormwater Mining Pilot Project	0.700	$ 920,180	$ 12,400	30	0.226
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
				Total:	**0.226**

* Total Project Cost - include capital , total construction, land acquisition, planning, permitting and design costs

Service Life for system components (years)

Component type	Years
Water conveyance structures: (pipelines, collection & transmission systems)	40
Other Structures: (buildings, tankage, site improvements, etc.)	35
Wells	30
Process & Auxilliary Equipment: (treatment equipment, pumps, motors, mechanical equipment, etc.)	20
Reverse Osmosis Membrances	5
Advanced ET Controller	10
Faucet Aerator	10
Cooling Tower	10
Faucets	5
Irrigation system	5
Line looping	30
Major appliances: dishwasher, clothes washer	15
Plant materials	5
Rain sensors	5
Showerheads	8
Smart Controllers	10
Toilets / Urinals	30
Waterwise Florida Landscape	20

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Additional Information

Initial Assessment of Alternative Water Supply Options for Clay County Utility Authority

by

Taylor Engineering, Inc.

January 2016

TAYLOR ENGINEERING, INC.

Initial Assessment of Alternative Water Supply Options for Clay County Utility Authority

FINAL REPORT

January 2016

10151 Deerwood Park Blvd., Building 300, Suite 300
Jacksonville, Florida 32256
904-731-7040 | www.taylorengineering.com

Initial Assessment of Alternative Water Supply Options for Clay County Utility Authority

Final Report

Prepared for

Ken Fraser, Chief Engineer
Clay County Utility Authority

by

Taylor Engineering, Inc.
10151 Deerwood Park Boulevard
Building 300, Suite 300
Jacksonville, FL 32256
(904) 731-7040

January 2016

C2015-057

8/30/16

Harold A. Wilkening III, P.E. #37391

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INTRODUCTION

Clay County Utility Authority (CCUA) tasked Taylor Engineering with providing an initial assessment of potential alternative water supply (AWS) options that can be used to supplement CCUA's fresh groundwater and reclaimed water supplies currently used to meet its customers' water supply needs.
This initial assessment provides, for review and further consideration by CCUA, the following: (1) framework for AWS development; (2) identification of water supply options with planning level cost estimates; (3) a comparison of options; and (4) recommended next steps in developing long-term sustainable AWS options.

1.0 FRAMEWORK FOR SUSTAINABLE WATER SUPPLIES/AWS DEVELOPMENT

CCUA is committed to sustainable water supplies for the future. In October 2015, CCUA's Board of Supervisors approved an AWS surcharge expressly for the purpose of developing and implementing AWS to supplement the current fresh groundwater supplies and reclaimed water supplies available to CCUA. A framework for sustainable water supplies is proposed as follows:

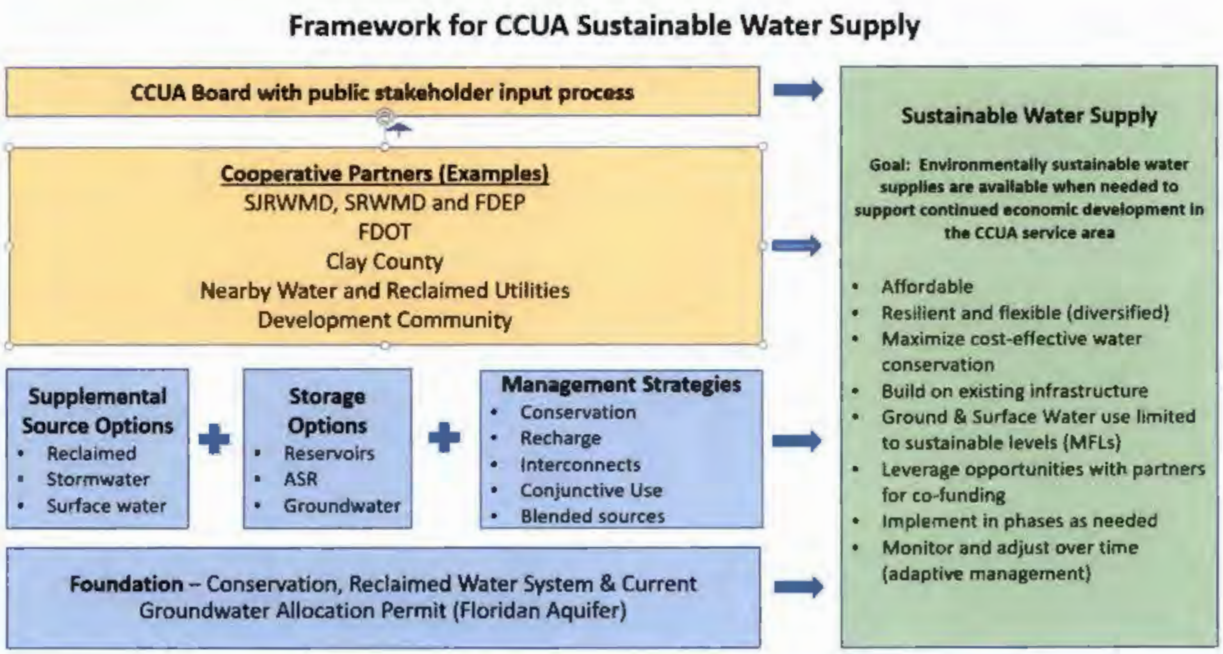

Figure 1. Framework for Sustainable Water Supplies/AWS Development

This framework recognizes the solid foundation that CCUA has already developed with groundwater and the use of reclaimed water resources. These sources will continue to be the foundation for the future. Various AWS options will be explored, recognizing that most of these options require aspects of short-term or seasonal storage, along with management strategies such as water conservation, interconnections, and conjunctive use of multiple sources. It should be acknowledged that AWS options are expensive and CCUA will likely have to partner with other entities to successfully fund projects. Co-funding is a viable option when project benefits are shared by multiple parties. The St. Johns River Water Management District (SJRWMD) and Florida Department of Environmental Protection (FDEP) encourage AWS development through various cost-sharing programs. The CCUA Board of Supervisors, considering input from customers

in their ongoing public process (bi-monthly public meetings), establishes the overall goal of the program, along with objectives and expenditures for development of specific water supply projects.
A program goal for consideration by the CCUA Board of Supervisors is….

> ***"…environmentally sustainable supplies are available when needed to support continued economic development in the CCUA's service areas…"***

Captured in this goal are attributes such as affordable water supply, resilient and flexible (diversified) supplies, maximum cost-effective water conservation, building on existing infrastructure, water use limited to sustainable levels defined by minimum flows and levels (MFLs), leveraging opportunities for collaboration and cooperative funding, timely implementation of AWS projects in phases only when needed, and adaptive management to make adjustments in plans and operations.
Planning for sustainable supplies requires careful consideration of the need for water in CCUA's existing and proposed service areas. Key utility water data is provided in Table 1 below, reported as average annual daily flow (AADF).

Table 1. Water and Reclaimed Water Supply and Demand Projections (AADF in MGD)

CATEGORY	2015	2025	2040
AVERAGE ANNUAL DAILY FLOW	MGD	MGD	MGD
POTABLE WATER USE DEMAND	11.355	14.128	17.78
CONSUMPTIVE USE PERMIT (CUP) ALLOCATION	23.911	34.073 (Last year of current permit)	No allocation - permit expires 2025
RECLAIMED WATER DEMAND	3.885	6.538	10.032
RECLAIMED WATER FLOW	6.995	8.672	10.912

Source: (Ken Fraser, Personal Communication, December 18, 2015)

1.1 Potable Water Supply

CCUA is planning for a significant increase in potable water use demand by 2040, approximately a 32% increase in the projected 2015 potable water use. This is due in large part to completion of the First Coast Expressway through Clay County within the next 10 years, with the resulting large scale development of lands in proximity to the expressway in numerous approved developments of regional impact (DRIs). The expressway is a driver for anticipated growth, but also provides opportunity for new water supply (stormwater harvesting).

CCUA has a consumptive use permit (CUP) from SJRWMD that expires in 2025. The current allocation for groundwater use is more than adequate through the remainder of the permit duration (2025). However, there is considerable uncertainty about future CUP allocations. The ongoing North Florida Water Initiative is likely to include MFL prevention and recovery strategies for the Keystone Heights lakes and Santa Fe River. In addition, SJRWMD indicates it will revise MFLs on lakes Brooklyn and Geneva in 2017. **The primary constraint to groundwater use in the North Florida Water Initiative region is likely to be MFLs on the lakes in the Keystone Heights area and on the Santa Fe River.**

Thus, it is prudent to plan for sufficient AWS options to cover the most conservative scenario with respect to yet to be permitted groundwater allocations through the 2040 timeframe, with an expectation that significant AWS implementation may be needed sometime in the 2025 to 2040 timeframe. A reasonable conservative scenario is to assume that future allocations may not exceed current levels of groundwater pumping. Based on Table 1, that scenario would result in the use of 7 MGD of AWS to meet potable water supply needs by 2040. Of course, actual AWS development by 2040 will ultimately depend on yet to be revised MFLs and water supply plans (SJRWMD and Suwannee River Water Management District regional water supply plans and Clay County's water supply facilities work plan). **Therefore, this assessment attempts to identify AWS options more than sufficient to provide 10 MGD by 2040.**

1.2 Reclaimed Water

CCUA has a long history, dating back to 1995, of implementing AWS through its reclaimed water system which currently serves approximately 11,000 active customers (residences, businesses, and golf courses) with reclaimed water for landscape irrigation.

There are two goals for CCUA's reuse program. The first is to maximize the use of lower quality reclaimed water for irrigation to preserve higher quality groundwater for potable water supply. To date, the reclaimed water system along with water conservation, have resulted in a remarkable decline in groundwater use on a per capita basis, from nearly 160 GPCD (gallons per person per day) in 2002, to around 100 GPCD in 2014.

The second goal is to fully eliminate the discharge of treated wastewater to the St. Johns River and its tributaries. This goal is a priority to ensure that CCUA can avoid having to meet the FDEP chronic testing requirement for wastewater influent discharges to the marine portions of the St. Johns River.

Meeting both of these goals is challenging, given the very seasonal nature of reclaimed water, which can be seen in Figure 2 for 2014. Average daily demand is significantly less than reclaimed flows most of the year, but during the late spring and summer, demands meet or exceed supply in many cases. In order to balance supply and demand, a combination of storage and supplemental supply is necessary. CCUA has already taken steps to increase seasonal storage with the interconnection of its reclaimed water facilities to the new Mid-Clay Land Application and Recovery Facility. In order to fully use all of the reclaimed water produced throughout the year, continued expansion of the customer base will be needed, along with a combination of storage and feasible supplemental sources to address the peak seasonal demand periods. **As a result, a goal is to development AWS sources to supplement the reclaimed water sources as well. CCUA has estimated the deficit in meeting the peak reclaimed water demand to be 3 MGD by 2040 (CCUA, 2014).**

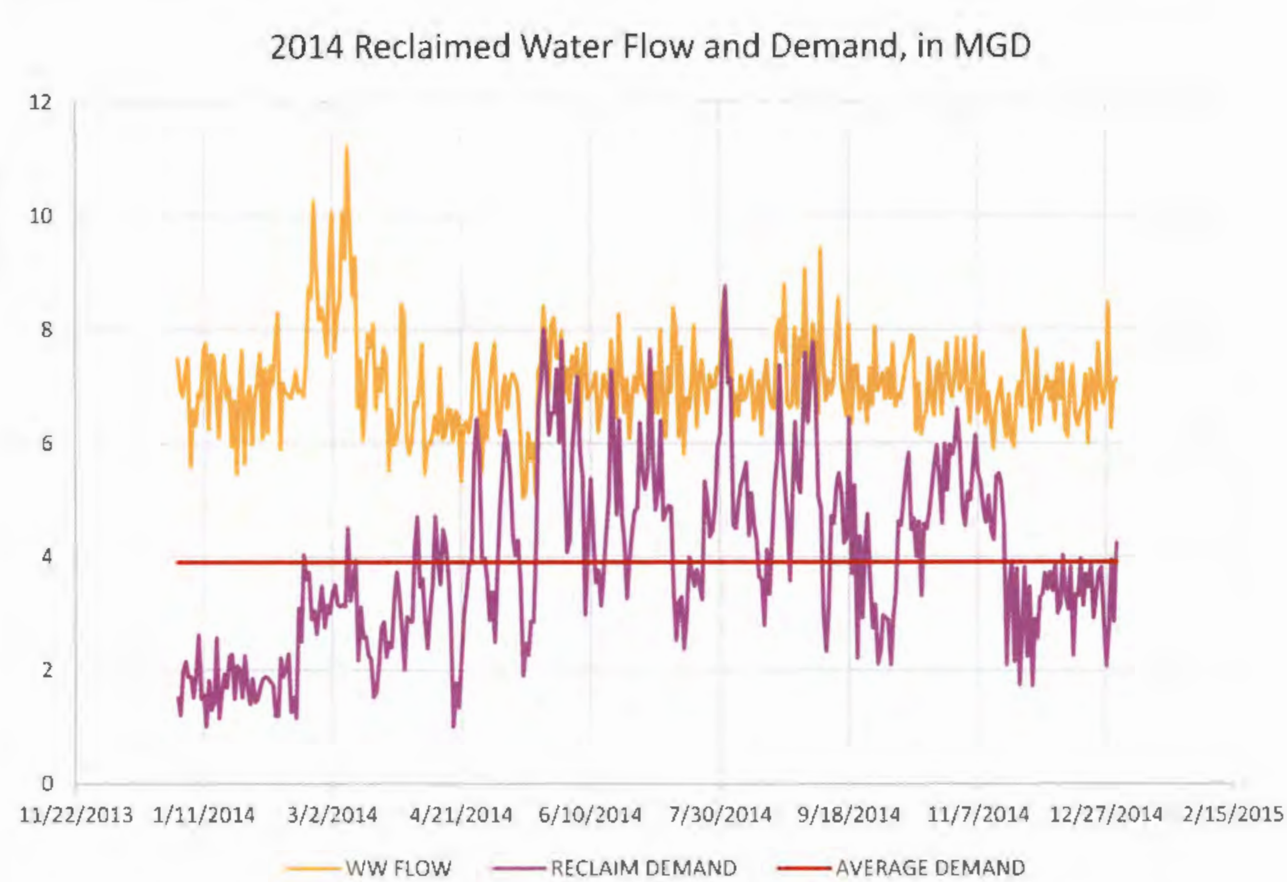

Figure 2. CCUA 2014 Reclaimed Water Flows Compared to Reclaimed Water Demand

2.0 WATER SUPPLY SOURCE OPTIONS

In addition to CCUA's current Floridan aquifer wells and reclaimed water production, potential additional AWS sources include stormwater harvesting, fresh surface water from Black Creek, additional reclaimed water transferred from other utility reclaimed water facilities, and brackish surface water from the St. Johns River. Options for using each of these sources is discussed below.

Seasonable storage is needed for many of these options to be successfully implemented. Storage options include reservoirs, aquifer storage and recovery wells, and aquifer replenishment through rapid infiltration basins or aquifer injections wells.

As a frame of reference, typical costs for common traditional and AWS water supply sources are shown in Table 2. These costs do not include transmission cost from source to use area. However, general implications can be drawn from the data in Table 2:

- Fresh groundwater is clearly the least expensive, and is preferable when available and sustainable
- Brackish and surface sources are generally more expensive than fresh water sources, primarily due to higher treatment costs
- Seawater is the most expensive by a significant amount, owing to higher capital and operating costs for membrane treatment and byproduct disposal.

Table 2. Comparison of Typical Costs for AWS in 10 and 20 MGD Increments (FDEP, 2015)

Water Supply Source	Avg. Daily Flow (MGD)	Unit Cost ($/1000 gal)	Type of Source
Upper Floridan Aquifer	10	$0.27	Traditional
Upper Floridan Aquifer	20	$0.25	Traditional
Seawater	10	$8.51	Alternative
Seawater	20	$7.21	Alternative
Brackish Ground Water	10	$2.55	Alternative
Brackish Ground Water	20	$2.05	Alternative
Surface Water	10	$2.43	Alternative
Surface Water	20	$1.74	Alternative

Source: (SJRWMD, 2014)

For this assessment, planning level cost estimates are provided for potential CCUA-specific options. Taylor Engineering developed these estimates upon consideration of estimates in existing recent reports, and also using SJRWMD's publication, "Engineering Assistance on Updating Information on Water Supply and Reuse System Component Costs" published in 2008 (Black & Veatch, 2008), and supplemented with additional commentary in 2010 (Wycoff, 2010). As part of the publication, SJRWMD has an estimating tool in a spreadsheet format. This estimating tool was successfully used by SJRWMD, South Florida Water Management District (SFWMD), Southwest Florida Water Management District (SWFWMD), and stakeholders as part of the Central Florida Water Initiative (CFWI). Further, SJRWMD's 2008 publication provides conceptual level costs for common water supply components and is assumed to be a reasonable reference for unit costs to apply to AWS options being considered in this assessment. It is intended to provide a Class 4 cost estimate as defined by the Association for the Advancement of Cost Engineering. Class 4 estimates are based on a 1 to 5 percent complete level of design and an expected accuracy range of -15 to -30 percent on the low side and +20 to +50 percent on the high side (Black & Veatch, 2008). Key metrics in the cost estimating tool are:

- Capital cost is the sum of construction cost, land cost, and non-construction costs (planning, engineering design, permitting, land, and construction management).
- Annual operating and maintenance cost is the estimated annual cost of operating and maintaining the facility when operated at average day capacity.
- Equivalent annual cost is the total annual life cycle cost of the project based on service life and time value of money.
- Unit production cost is the equivalent annual cost divided by total annual water production, and expressed as dollars per 1,000 gallons produced.

As part of this assessment, the spreadsheet cost estimate tabulations are provided to CCUA in electronic format, so that further refinements such as estimating costs on various modifications to these AWS options can easily be made by CCUA as part of the ongoing planning for new alternative water supplies.

2.1 Option 1 – Stormwater Harvesting

The stormwater harvesting option has been fully described in a previous CCUA document (CCUA, 2014). It is an ambitious proposal to harvest stormwater runoff from the First Coast Expressway and new land development projects that are planned along the expressway over the next 20 years. The first project phase is to install a series of horizontal wells adjacent to the Florida Department of Transportation (FDOT) storm ponds along the expressway, harvest stormwater that is naturally filtered through the natural soil matrix, and then disinfected prior to being pumped to supplemental reclaimed water facilities in proximity, including Oakleaf, Old Jennings, Mid-Clay and two future reclaimed water plants that would serve Governors Creek, Saratoga Springs, and Reinhold DRIs. Horizontal wells would ideally be co-located as part of FDOT Phase III (Blanding Blvd to S.R. 17) construction, and remaining pump, disinfection, and transmission piping could be deferred until the stormwater supply is needed to augment the reclaimed water system for new customers as new residential developments are completed. Wells would also be installed at selected locations along Phase I of the expressway, after construction is complete.

A second phase is proposed to include similar types of collection facilities adjacent to stormwater management systems that serve land developments. This phase will require coordination with developers and is expected to offer benefits in terms of increasing stormwater treatment efficiencies from traditional stormwater management systems, thus reducing the land areas otherwise needed for stormwater management, particularly when discharging to impaired water bodies with more stringent nutrient reduction requirements.

CCUA is proposing a pilot project at an existing stormwater pond in Phase I, but FDOT has only permitted the project to begin after their contractor completes construction in the immediate area. Unfortunately, current FDOT estimates are that the completion date will be delayed significantly– until mid-2017. This pilot project will provide useful operating and performance data, serving to verify if the proposed system meets FDEP's rules standards for filtration and disinfection of stormwater prior to addition to public access reclaimed water system. Alternative pilot project sites are being investigated by CCUA.

For the entire project concept, the total capital cost estimate is $26.8 million, annual operation and maintenance costs of about $920,000, yielding a unit production cost of about $0.82/1,000 gallons (see Table 6 for a summary of estimated costs of all AWS options). The pilot project will cost about $1 million, and a cost-share application for 50% of funding from SJRWMD is under review with a decision expected in February 2016.

Stormwater harvesting is an option that is being encouraged throughout the state by SJRWMD and FDEP. As such, there should be opportunities to obtain cost-share funding. Recently, the City of Altamonte Springs' new stormwater harvesting project became operational, where stormwater from the improved Interstate 4 within the city is treated and combined with unused reclaimed water flows during wet periods, and pumped to the City of Apopka for reuse and recharge. Altamonte Springs obtained cost-share funding from FDEP, FDOT, and SJRWMD.

The project offers many excellent opportunities, including the following:

- Very cost-effective to supplement reclaimed water supplies in CCUA's higher growth areas
- Flexibility to implement incrementally as needed
- Could help developers meet stormwater permitting requirements more cost-effectively, and also potentially result in nutrient credits for use in Clay County's MS-4 stormwater permit
- Since this source when fully implemented is likely to far exceed supplemental needs for the reclaimed water system, this water could also be a source for an aquifer replenishment project

Challenges faced in this option:

- Delays in moving forward due to FDOT construction delays on Phase I and an uncertain timeframe on Phase III
- Horizontal wells may be subject to clogging and operational performance will need to be carefully evaluated in the pilot project for long-term performance. Other options for collection and treatment may be needed, such as a more conventional water diversion at the stormwater pond outlet with transmission to an engineered stormwater filtration and disinfection module at each reclaimed water plant.
- Water yield may be less than estimated due to system performance and the degree to which the plan is ultimately fully implemented at all locations.
- Ensuring that these systems are implemented in a manner also beneficial to FDOT and land developers, thus requiring careful ongoing collaboration
- Challenge of utilizing the source during dry periods, when demand may be high, and availability of stormwater is low. The use of horizontal wells is expected to extend the period of water availability longer following storm events; however, this benefit will need to be verified during the pilot project.

2.2 Option 2 – Surface Water from Black Creek (Options 2a, 2b, and 2c)

Black Creek is a significant natural fresh surface water resource, in addition to fresh groundwater, available in the CCUA area. Since it is anticipated that fresh groundwater will be limited at some point, and the cost of developing brackish surface water is significantly more expensive, it is prudent to consider options for developing the fresh surface water supply in Black Creek. SJRWMD, CCUA, and other stakeholders have been discussing, as part of ongoing MFL prevention and recovery strategies, the potential environmental benefits from using water from Black Creek for new potable supplies, aquifer recharge, or direct lake augmentation in the Keystone Heights area.

Although no specific project proposals have moved forward, SJRWMD recently completed the "Black Creek Yield Assessment and Conceptual Design Project Technical Memorandum" (Liquid Solutions, 2014). The memorandum provides useful information directly applicable to this broader AWS assessment. Relevant information from that memorandum is used as the basis for describing this AWS option.

In the memorandum, SJRWMD considered three potential intake locations (Figure 3) and simulated a synthetic flow data set, based on the recorded flow data available, for each location for the period of 1940 to 2013. The resulting streamflow hydrographs are shown in Figure 4. Key flow statistics are provided in Table 3, expressed in units of MGD for easy comparison to potential water supply yields.

Black Creek streamflow is highly variable, with a significant portion of flow coming in high pulses in response to rapid runoff from the watershed, with extended periods of low flow conditions. These characteristics present challenges in developing a water supply.

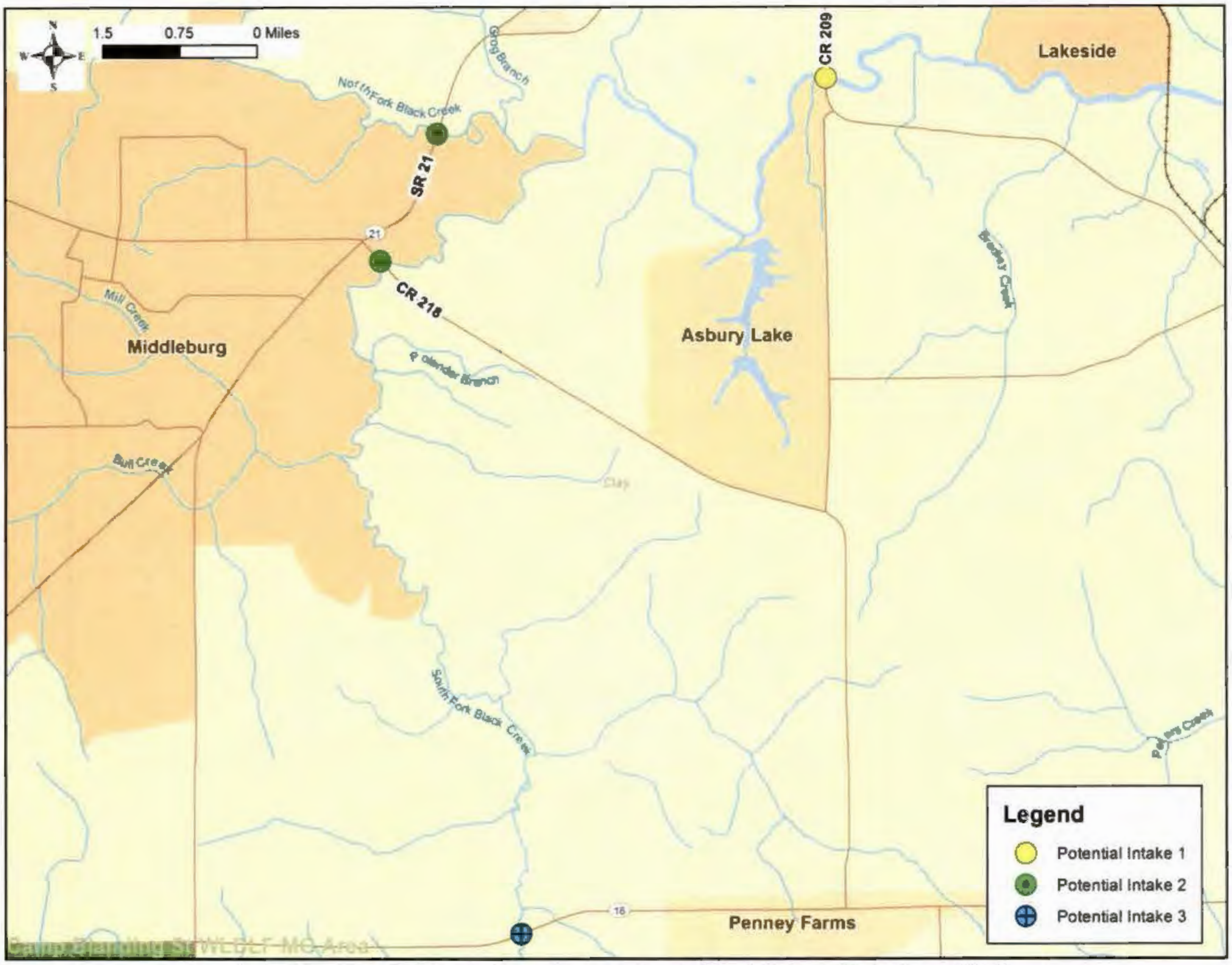

Figure 3. Potential Intake Locations on Black Creek (Liquid Solutions, 2014)

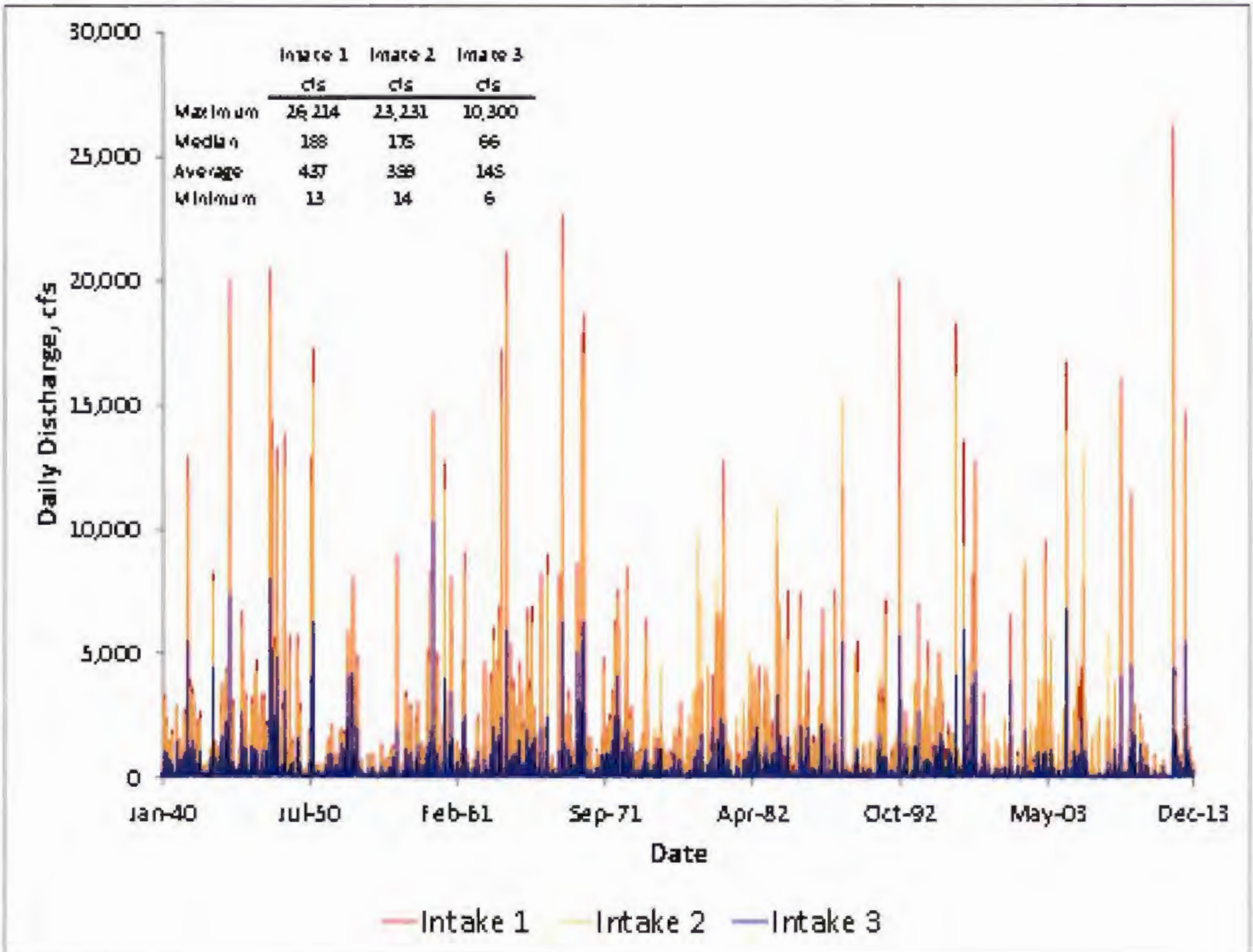

Figure 4. Black Creek Simulated Discharge at Three Potential Intake Locations (Liquid Solutions, 2014)

Table 3. Flow Characteristics at Potential Intake Locations on Black Creek (Liquid Solutions, 2014)

FLOW STATISTIC	INTAKE 1 MGD	INTAKE 2 MGD	INTAKE 3 MGD
MAXIMUM	16,942	15,014	6,656
MEDIAN	121	113	43
AVERAGE	282	258	94
MINIMUM	8	9	4

For the purposes of this assessment, Taylor Engineering selected the intake at S.R. 209 (Intake 1) as the potential AWS project. We chose this location due to its proximity to CCUA Mid-Clay facilities, ease of access, and providing the largest potential yield. Other intake locations, particularly Intake 3, may be preferable for an aquifer recharge or lake augmentation project; however, the focus here is a potential AWS source for CCUA.

The memorandum points out that based on water quality data available from SJRWMD for the period-of-record from 1984 through 2013, observed Cl and TDS concentrations in Black Creek at the C.R. 209 bridge are above state drinking water standards (250 milligrams per liter [mg/L] and 500 mg/L, respectively) approximately 29% of the time, with peak concentrations in excess of 2,500 mg/L and 4,000 mg/L, respectively. Water quality appears to continue to degrade downstream of the C.R. 209 bridge, but also appears to notably improve upstream of the bridge. Thus, it is likely that withdrawals could not occur during these low flow periods in order to avoid more expensive treatment. However, it is also likely that environmental constraints would also limit withdrawals during these low flow periods.

It is important to note that SJRWMD has not established MFLs for Black Creek. There are numerous important water-dependent environmental resources on Black Creek that must be protected, and would be considered if an MFL is established. In the interim, the memorandum uses a "Minimum Flow Threshold (MFT)" concept as a surrogate for MFLs. The MFT is a user-specified flow rate below which withdrawals are not allowed, ensuring that withdrawals do not occur below certain flowrates that could be related to environmental considerations and/or poor water quality. For the Black Creek yield model, MFTs were evaluated at the 85th, 90th, and 95th percentiles on the flow duration curve of the creek at each location. This range of percentages represents a potential environmental limitation associated with MFLs and is an approximation based on previous SJRWMD work on hydrologic systems that do not have adopted MFLs. This previous SJRWMD work indicates the Frequent Low MFL tends to occur between the 85th and 95th percentiles on the flow duration curve for a surface water system. For the purposes of this assessment, the most conservative MFT (85%) was selected and used in evaluating the yield and reliability of various project options.

Option 2a: 10-MGD water intake structure, with transmission to a 10 MGD conventional surface water treatment plant at or near the Mid-Clay facility site. This option envisions a conventional surface water treatment plant (coagulation, flocculation and sedimentation) that is capable of feasibly treating water from Black Creek during moderate to higher flow periods. This is typical water treatment process employed by water utilities using surface water for potable water supply in Florida, but is a more complex process than CCUA currently uses for its fresh groundwater supply.

Planning level opinion of cost for this option is provided in Table 6; estimated yield and reliability are provided in Table 4. Reliability is expressed as the percent of time, over the simulated period-of-record (1940 to 2014) that the system would provide water. The reliability (approximately 80%) is less than suitable for a potable water supply source. For that reason, two additional options with seasonal storage are also considered.

Table 4. Estimated Yield and Reliability of Black Creek Options with 10 MGD Withdrawal (Liquid Solutions, 2014)

BLACK CREEK WITHDRAWAL SCENARIO WHEN FLOW IS ABOVE MFT	MAX WITHDRAWAL RATE, MGD	AVERAGE YIELD, MGD	RELIABILITY (%)
NO STORAGE (OPTION 2A)	10	7.7	79.4%
200 MG RESERVOIR (OPTION 2B)	15	8.6	89.4%
3000 MG ASR WELL SYSTEM (OPTION 2C)	15	9.7	97.9%

Option 2b: 15 MGD water intake structure, with transmission to a 200 MG reservoir and a 10 MGD conventional surface water treatment plant at the Mid-Clay facility site. Because of the inherent unreliability of Black Creek flow conditions, a reservoir option can be considered to provide seasonable storage for period when flow conditions are too low to allow for water withdrawal. The concept for reservoir storage would consist of a diked area where water is pumped for storage above-ground. The SJRWMD memorandum concluded that an upper limit for a reservoir, considering the potential availability of land in the area, is probably about 200 million gallons (MG).

The potential feasibility of a reservoir is highly dependent on a number of factors, including: the availability of sufficient land acreage; location of available land; surrounding property ownership and land use considerations; potential impacts on environmental, cultural, archeological and historic resources; geotechnical investigations to ensure suitable site conditions for a safe and water-tight structure; topographic, surface water and groundwater evaluations to assess site suitability and to minimize impacts to surrounding areas; evaporative losses; sufficient land area for construction, maintenance and, expansion; access for power, personnel, equipment and chemical deliveries; and compliance with pertinent regulatory requirements.

The costs to construct surface reservoirs vary considerably with the required capacity, associated land costs, and the other considerations. Based on recent examples of large seasonal reservoirs, unit construction costs were found to range from less than $10,000 to greater than $80,000 per million gallons of capacity, with an average of about $27,000 per million gallons of storage capacity. The substantial range in unit costs for reservoir construction reinforces the need to closely evaluate specific project conditions before attempting to establish a reservoir project budget.

Planning level opinion of cost for this option is provided in Table 6 based on generalized assumptions; estimated yield and reliability are provided in Table 4. This option improves both yield and reliability, but reliability is still less than typically required for a potable supply system.

Option 2c: 15 MGD water intake structure, with transmission to a 300 MG Aquifer Storage and Recovery (ASR) system and a 10 MGD conventional surface water treatment plant at the Mid-Clay facility site. This option is similar to option 2b, except using ASR. ASR systems offer great potential for cost-effective storage by injecting treated water into the aquifer to create a "water storage bubble" (area of higher aquifer level or pressure) for later recovery when needed (Figure 5). However, considerable time and expense goes into initial hydrogeologic testing, followed by sometimes lengthy cycle testing needed to arrive at a suitable water quality pre-treatment regime to address potential leaching of arsenic from the limestone formation, and confirm aquifer confinement and recovery volumes (which is typically less than injection volumes). Based on recent case studies in central Florida, in which SJRWMD and several utilities conducted a cooperative ASR construction and testing program, the period of time for initial desktop evaluation through the final construction and cycle testing programs needed for operational permits can be expected to take five to 10 years. However, as part of the directive to promote greater use of alternative water supplies (Senate Bill 536), FDEP proposes regulatory changes that would likely help to reduce this implementation period (FDEP, 2015).

A planning level opinion of cost for this option is provided in Table 6; estimated yield and reliability are provided in Table 4. Yield and reliability are further improved, and represent a reliability appropriate for a potable water supply system.

Figure 5. Schematic of an ASR Well (from Cocoawaterworks.com)

Comparison of Black Creek Project Options. Even with significant costs for reservoir storage, the reliability does not appear sufficient for a public water supply. With ASR storage, a suitable reliability can be achieved. Capital costs are lower for ASR than a reservoir, but annual operating and maintenance are higher for ASR. Overall, the use of ASR appears to be more cost-effective, but a more detailed investigation would be needed to verify costs and benefits.

An additional option worth consideration is a "conjunctive use" of groundwater from CCUA's existing permitted wells along with surface water when available from Black Creek. Conjunctive use projects, where excess surface waters are utilized seasonally and traditional groundwater supplies are used during drier periods, represent an important strategy for the development of surface water supplies. WMDs should encourage the development of conjunctive use systems through their regional water supply plans and cooperative funding programs (FDEP, 2015).

Conjunctive use appears to be one way to implement option 2a in a manner that would meet reliability standards. Under this kind of operation, CCUA would obtain an allocation for a maximum groundwater use rate for periods when Black Creek is not available, and then reduce pumping during periods when water is available from Black Creek. The concept of conjunctive use has been discussed among water utilities and SJRWMD, but more definition is needed regarding the permitting process. Also, there are technical issues that need further investigation concerning the intermittent operation of a treatment plant and the mixing of groundwater and surface water to produce a final potable water product.

Another possible implementation for Option 2a (no storage) would be to use Black Creek supplies, when available, as part of an aquifer recharge project (see discussion at section 2.4).

Opportunities for the Black Creek options include:

- Availability of a freshwater source in close proximity to areas of CCUA service area with projected growth
- Potential partnership with SJRWMD in developing this as a potential source for both CCUA water supply and as water resource development project with regional environmental benefits

Challenges with these options:

- Establishing environmental constraints, including MFLs and suitable water quality
- Dealing with the highly variable flow conditions and extensive storage needed for a reliable supply if this source is used as a reliable component of the potable water supply
- Solving technical and permitting issues with conjunctive use of this source and groundwater well production
- Blending treated water sources (surface and groundwater) for finished potable water supply
- Likely opposition from environmental advocacy groups of any proposed use of water from any surface water source, including Black Creek

2.3 Option 3 – Brackish Surface Water from the St. Johns River

Surface water from the St. Johns River is also a potential option for future potable water supply. A potential location for a water intake facility would be along the St. Johns River between Black Creek and the Shands Bridge, or on the lower portion of Black Creek near the St. Johns River. This general location would be closest to the portion of the CCUA service area subject to highest projected growth in demand. We did not specify a location in this assessment.

This AWS option includes the following major components: 10 MGD water intake structure (to produce approximately 8 MGD finished supply), booster pump, and approximately five miles of transmission line to a 10 MGD AADF membrane treatment plant located at or near the Mid-Clay facility.

A relevant case study is the Seminole County Yankee Lake Regional Wastewater Treatment Facility. Seminole County proposed a 50 MGD AADF public water supply to serve multiple utilities in the central Florida area. The 50 MGD AADF water intake and raw water transmission line have already been constructed, but only 5 MGD is currently permitted for use. The project also includes 90 miles of large diameter transmission line to several utilities, and a Lower Floridan well for reverse osmosis (RO) concentrate disposal. The estimated cost, as reported in the Central Florida Water Initiative Water Supply Plan is $565.8 million total capital cost, $18.5 million for annual operation and maintenance, and a unit production cost of $4.01/1,000 gallons.

Estimated planning level costs for this option, provided in Table 6, assume that RO concentrate could be managed by sending it to CCUA's reclaimed water plant. However, that assumption will need further review and if not feasible, additional costs would be required for concentrate disposal. The unit cost estimate is comparable with the Seminole County project.

The opportunity for this option:

- Potential future source of water when no additional freshwater sources are available to meet additional water demands

Challenges with this option:

- Operation of a RO membrane plant and disposal of RO concentrate
- Likely opposition from environmental advocacy groups to any proposed use of water from the St. Johns River
- Need for a St. Johns River MFL to be set to verify availability of water
- Blending treated water sources (surface and groundwater) for finished potable water supply

2.4 Option 4 – Aquifer Replenishment (Options 4a and 4b)

Aquifer replenishment is a potential AWS project option that can be used to increase CCUA's Floridan aquifer (groundwater) water supply yield by raising aquifer pressure (or water level in unconfined portions) of the Floridan aquifer. Replenishment can be accomplished with rapid infiltration basins (RIBs) in the surficial aquifer that indirectly leak into the Floridan aquifer, or more directly by recharging the Floridan aquifer through injection wells. These types of aquifer replenishment strategies are considered to be indirect potable reuse, with purified water introduced into the aquifer system by recharge, and later withdrawn at water production wells in the same aquifer zone (in this case in the upper and lower zones of the Floridan aquifer). Direct potable reuse, on the other hand, would directly use the purified water product as part of the potable water supply system.

CCUA's Mid-Clay Land Application and Recovery System (LARS) represents an important first step in providing indirect aquifer recharge, in addition to recapturing stored reclaimed water through a horizontal well when needed to meet peak reuse demand periods. However, confining layers between the surficial aquifer and the Upper Floridan aquifer are prevalent throughout most of Clay County which limit the potential to recharge significant quantities for water supply benefits.

Examples of successful aquifer recharge projects include those operated by the Orange County (California) Water District; Central Arizona Groundwater Replenishment District; the Peace River- Manasota Regional Water Supply Authority (Florida); United Water Resources (Idaho); Rio Rancho, New Mexico; and Dayton, Ohio. There are hundreds of such projects in place across the nation (NGWI, 2015).

The City of Clearwater (similar size as CCUA with 11 MGD water delivery and 7 MGD reclaimed water delivery) is in the final phases of planning and design to move forward with an indirect potable reuse project using groundwater replenishment technology. The project will include an advanced purification plant (filtration and membranes), an aquifer injection system, and all of the monitoring infrastructure necessary to recharge the Floridan aquifer with 2.4 MGD of purified effluent from the city's Northeast Water Reclamation Facility. Beneath the city, the fresh water from the Upper Floridan aquifer used for drinking water sits on top of a layer of brackish, or somewhat salty, water. The Floridan aquifer can be protected by balancing the recharge from this project and the withdrawals from the potable water supply wells. Design, permitting, and construction of the indirect potable reuse project is estimated to cost $28.5 million. The co-funded project is under construction in central Pinellas County in the Northern Tampa Bay Water Use Caution Area of SWFWMD (FDEP, 2015).

Aquifer recharge options for the north Florida area were investigated by SJRWMD and SRWMD as part of the North Florida Water Initiative (Atkins, 2013). This study concluded that aquifer recharge is generally feasible and beneficial, and investigated direct and indirect project options, including 30 MGD aquifer recharge at JEA's Southwest and Buckman Wastewater Treatment Plants (WWTPs).

A project concept for a 10 MGD aquifer recharge facility was recently investigated by SJRWMD and JEA for JEA's Southwest Wastewater Treatment Plant (SWTP) (CDM, 2015). The study provided a desktop analysis of treatment technologies appropriate for treating reclaimed water from a typical domestic wastewater treatment plant that could then be injected into a potable aquifer. Taylor Engineering used this information to estimate the range of potential treatment costs, which are the primary costs associated with this option

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The study found that while the effluent from the SWTP would likely meet all primary and secondary drinking water criteria, additional total organic carbon (TOC) removal would be required for injection into a potable aquifer. In addition, the study considered the additional public interest that JEA (and CCUA in this case) would have in understanding how to control currently unregulated compounds such as pharmaceuticals, personal care products, and endocrine disrupting compounds. Protection of the Floridan aquifer water quality is of paramount importance.

Two different treatment processes were investigated. The first was full advanced treatment (FAT), which is the most widely used treatment process for potable aquifer recharge in the U.S. This process includes micro-filtration, reverse osmosis, and UV-advanced oxidation processes, often abbreviated as MF/RO/UV-AOP. The FAT process, while clearly technical feasible, has high capital and operating costs. An alternative advanced treatment process competitive with FAT was also considered, involving a combination of filtration, ozonation, and biologically activate carbon (BAC). This process, denoted as "ozone-BAC," has significantly lower capital and operating costs, and does not produce a concentrate waste stream to be handled. The initial assessment was promising, and the study recommends that pilot testing be commenced to verify the ozone-BAC process is technically feasible.

Taylor Engineering applied cost data from the CDM study to prepare planning level cost estimates for the CCUA 10 MGD aquifer recharge option discussed below, with options for both treatment processes (Options 4a and 4b), summarized in Table 6. As a frame of reference, generalized cost data recently developed by FDEP and SJRWMD are provided in Table 5 for various potable reuse options. The data in Table 4 reflects different efficiencies for the various recharge options, considering the resulting benefit in terms of water supply yield. The actual benefit of the recharge options for water supply can only be determined after more detailed analysis using regional groundwater modeling analysis. It should be noted that estimated cost for the two treatment options varied significantly - \$10.97/1000 gal. for FAT (Option 4a) versus \$2.97/1000 gal. for the ozone-BAC process (Option 4b). The generalized cost data for direct potable recharge (from Table 4) lies in between the estimates for Options 4a and 4b. Economic feasibility of the recharge option will largely depend on whether the ozone-BAC process is determined to be feasible.

Table 5. Comparative Costs of Potable Reuse within SJRWMD (SJRWMD, 2014)

POTABLE REUSE WATER SUPPLY SOURCE	AVG. DAILY FLOW MGD	UNIT COST $/1000 GAL	UNIT COST TO TREAT FOR GW INJECTION $/1000 GAL	UNIT COST TO RECOVER AND TREAT INJECTED GW $/1000	% COST ADJUSTMENT FOR LOSSES AND NET WATER SUPPLY BENEFIT	ADJUSTED YIELD MGD	TOTAL UNIT COST $/1000 GAL
RAPID INFILTRATION BASIN	10	$0.60	NA	$0.27	20%	8	$1.04
RAPID INFILTRATION BASIN	20	$0.59	NA	$0.27	20%	16	$1.01
DIRECT POTABLE AQUIFER RECHARGE	10	$0.17	$2.94	$0.27	15%	8.5	$3.69
DIRECT POTABLE AQUIFER RECHARGE	20	$0.16	$2.45	$0.25	15%	17	$3.11
AQUIFER STORAGE AND RECOVERY	10	$0.29	$2.94	$0.27	5%	9.5	$3.68
AQUIFER STORAGE AND RECOVERY	20	$0.29	$2.45	$0.25	5%	19	$3.14
DIRECT REUSE	10	$3.91	NA	NA	NA	10	$3.91
DIRECT REUSE	20	$3.85	NA	NA	NA	20	$3.85

(Source: SJRWMD, 2014)

Options 4a and 4b include the following major components:

- Collection of water supplies, including reclaimed water and stormwater at a central location for treatment. CCUA already has infrastructure in place to collect unused reclaimed water at the Mid-Clay LARS site. Stormwater harvesting would add stormwater flows into the reclaimed system.
- 10 MGD treatment plant to provide supplemental treatment of reclaimed water flows, to meet all primary and secondary drinking water standards.
- A Floridan aquifer recharge well in the vicinity of Mid-Clay LARS site. If other locations provide significant improvement in benefits, an additional transmission component would be needed.
- Comprehensive monitoring well system to meet regulatory requirements and ensure that the Floridan aquifer is protected.

Aquifer replenishment provides the following opportunities:

- Potential to use the natural aquifer system for storage of purified water derived from multiple CCUA water sources, including unused reclaimed water, stormwater harvesting, and fresh surface water when available from Black Creek
- By raising aquifer levels in proximity to CCUA's Floridan aquifer production wells, potential to offset increases in well production in existing facilities that would not otherwise be permittable.
- Potential to also provide environmental benefits by improving aquifer levels as part of an MFL prevention or recovery strategy for lakes in the Keystone Heights area
- By providing a use for reclaimed water supplies not needed during non-peak demand periods, this option will meet CCUA's goals to eliminate all surface discharge.

Challenges for aquifer replenishment include:

- Verifying that a cost-effective treatment process such as ozone-BAC is technically feasible to produce purified water, ensuring protection of the Floridan aquifer as CCUA's primary water supply, and meeting all state and federal regulatory requirements
- Balancing multiple raw water sources (stormwater, reclaimed water, and surface water), and determining optimal location of treatment plant(s), Floridan aquifer injection wells, and Floridan aquifer injection zones
- Blending treated water sources (surface and groundwater) for finished potable water supply

3.0 COMPARISON OF OPTIONS AND POTENTIAL SCENARIOS FOR FURTHER INVESTIGATION

A comparison of AWS project options is provided in Table 6. In addition, a proposed screening tool is provided in Table 7 which provides a visual representation of how various options compare to potential criteria of importance. One note with regard to the permitting criteria is that the green designation for an option does not necessarily mean the process of obtaining the permit is simple and quick. For instance, permitting an aquifer replenishment project will be complex and take a significant amount of time; however, it should be fundamentally achievable. This screening tool could be further developed to consider other CCUA priorities.

Table 6. Comparison of Planning-level Opinion of Cost Estimates for AWS Options

OPTION	NAME	CONCEPTUAL PLANNING LEVEL COST ESTIMATE			SOURCES OF COST ESTIMATE
		CAPITAL COST IN $M	ANNUAL O & M, $M	UNIT PRODUCTION $/1000 GALLONS	
1	Stormwater Harvesting, 8 MGD AADF	$27	$0.90	$0.81	CCUA Report, 2014 and Pilot Project Design Information
2a	Black Creek with 15 MGD withdrawal, with no storage (7.7 AADF)	$67	$2.28	$1.70	For intake, pumps, transmission - Liquid Solutions 2014, and 10 MGD WTP - Planning level cost estimating tool (Black and Veatch, 2008 and Wycoff, 2010)
2b	Black Creek 15 MGD withdrawal, with 200 MG reservoir (8.6 mgd AADF)	$145	$2.80	$3.36	For intake, pumps, transmission, reservoir - Liquid Solutions 2014, and 10 MGD WTP - Planning level cost estimating tool (Black and Veatch, 2008 and Wycoff, 2010)
2c	Black Creek 15 MGD withdrawal, with ASR (9.8 AADF)	$99	$3.80	$2.53	For intake, pumps, transmission, ASR - Liquid Solutions 2014, and10 MGD WTP - Planning level cost estimating tool (Black and Veatch, 2008 and Wycoff, 2010)
3	St Johns River Brackish Water, 10 mgd withdrawal, 8 MGD AADF	$153	$5.80	$4.56	Planning level cost estimating tool (Black and Veatch, 2008 and Wycoff, 2010)
4a	Aquifer Replenishment with Purified Water (indirect Potable Reuse) using Full Advanced Treatment (FAT) - 10 MGD AADF	$149	$30.00	$10.97	CDM,2015 and Planning level cost estimating tool (Black and Veatch, 2008 and Wycoff, 2010)
4b	Aquifer Replenishment with Purified Water (indirect Potable Reuse) MGD using ozone-BAC treatment, 10 MGD AADF	$32	$6.00	$2.37	CDM,2015 and Planning level cost estimating tool (Black and Veatch, 2008 and Wycoff, 2010)

Table 7. Screening Tool for Comparison of AWS Options

		Screening Criteria				
Option No.	Option	Technical feasibility	Regulatory Feasibility	Public acceptance	Reliability	Economic feasibility
1	Stormwater harvesting from First Coast Expressway	Pilot project being implemented to validate technical feasibility of horizontal well capture	Feasible	Feasible	Feasible	Feasible
2a	Surface water from Black creek (fresh) with no storage	Feasibility of capturing large flows from the creek over short periods, MFLs need to be set to define availability	Feasible	Possible public concern about environmental impacts	Source is inherently unreliable and would require either significant storage or conjunctive use	As an intermittent source, could be used in conjunction with groundwater without seasonal storage
2b	Black Creek with 200 MG reservoir	Feasibility of capturing large flows from the creek over short periods, MFLs need to be set to define availability	Feasible	Possible public concern about environmental impacts	Source is inherently unreliable and would require either significant storage or conjunctive use	Highly intermittent, will require significant reservoir storage to create reliable source
2c	Black Creek with 3000 MG ASR storage	Significant hydrogeologic testing to design ASR, followed by pilot testing before permitting	Feasible	Possible public concern about environmental impacts	Source is inherently unreliable and would require either significant storage or conjunctive use	Highly intermittent, will require significant storage
3	Surface water from the St. Johns River (brackish)	Treatment process would need to be investigated further to address daily fluctuations in Chlorides and disposal of RO concentrate	Feasible	Based on Central Florida proposals, likely to be public concerns about possible negative impacts to the river	Feasible	Found to be feasible in Central Florida, more expensive treatment likely here
4	Florida Aquifer Replenishment with purified water	Proposed hydrogeologic testing would provide data needed for technically feasible design, also pilot testing of treatment needed	Feasible	Public education process required to address concern about recharging the Floridan Aquifer. Implemented in California and other locations, now in Clearwater	Feasible	Will depend on treatment costs - further feasibility testing on whether ozone-BAC alternative can be used instead of more expensive Full advanced treatment (FAT)

Key to rating criteria		
Sufficient information exists to conclude option likely scores high on this criteria	Insufficient data to make determination - additional investigations needed	Sufficient information to conclude option likely scores low on this criteria

In summary, CCUA has several AWS options to meet 2040 potable and peak reclaimed water demands if groundwater allocations are constrained at or below currently permitted levels. Each option is worthy of continued consideration; however, it needs to be kept in mind that each option has opportunities as well as challenges to be overcome through continued data collection, planning, and pilot testing. In consideration of the above planning level cost estimates and screening tool, the options that appear most promising are:

- **Option 1 - Stormwater Harvesting** – First for use to supplement reclaimed water supplies and then as a potential source to create purified water for aquifer replenishment or potable water supply
- **Options 4a and 4b** – Aquifer replenishment with purified sources developed from reclaimed water and stormwater available from CCUA and reclaimed flows potentially from the JEA Southwest Plant WWTP (assuming that a more cost-effective treatment process other than full advanced treatment is ultimately demonstrated to be feasible)
- **Options 2a and 2c** – Potential use of Black Creek for supplemental water supply, either with ASR seasonal storage (option 2c), or used without seasonal storage (option 2a) conjunctively with CCUA wellfield production or as a source in for a future aquifer replenishment project

4.0 RECOMMENDATIONS FOR NEXT STEPS

4.1 Stormwater Harvesting (Option 1)

- Complete pilot project to confirm the feasibility of horizontal well capture of stormwater
- Coordinate closely with FDOT and SJRWMD on the permitting of Phase III of the expressway to best incorporate CCUA's system for stormwater harvesting
- Propose this project in the "project identification" phase of the North Florida Water Initiative

4.2 Aquifer Replenishment (Options 4a and 4b)

- Conduct pilot testing of ozone-BAC treatment compared to FAT
- Investigate interconnection with JEA and potential transfer of reclaimed water from the SWTP to supplement
- Engage SJRWMD and other utilities to partner with CCUA, as part of the North Florida Water Initiative, in collecting needed Floridan aquifer hydrogeologic and geochemical data to fully evaluate and design aquifer recharge project(s)
- Conduct modeling scenarios of the aquifer replenishment using the North Florida/South Georgia Regional Groundwater Flow Model when available from SJRWMD
- Propose this project in the "project identification" phase of the North Florida Water Initiative
- Implement a public education process using resources available from the Water Reuse association

4.3 Black Creek as Supplemental Water Source (Options 2a, 2b, and 2c)

- Continue discussions with SJRWMD about the potential for a water resource development project involving the use of flow from Black Creek, when available, for aquifer recharge and supplemental water supply
- Consider proposing this project in the "project identification" process of the North Florida Water Initiative

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