
# Infrastructure Task Force Meeting

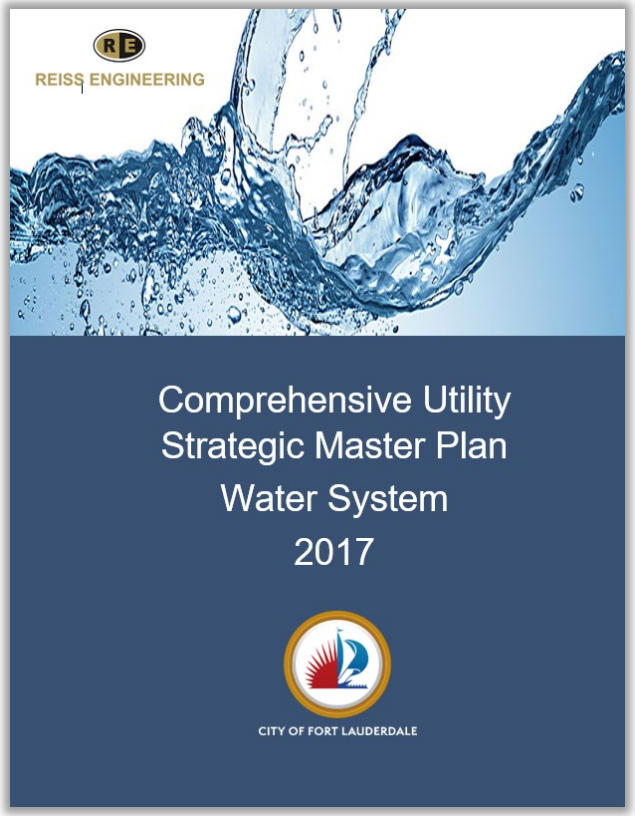
## Fiveash Water Treatment Plant Replacement

February 1, 2023

# Agenda

1. Key Findings of 2017 Reiss Master Plan
2. Key Findings of 2019 Carollo Report
3. Key Findings of 2021 Reiss Tech Memo
4. Broad Conclusions

# 1 Key Findings of 2017 Reiss Master Plan

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### 8.2 Treatment R&R Needs

#### 8.2.1 Fiveash WTP

The City's largest water treatment plant is the Charles W. Fiveash WTP, with a design capacity of 70 million gallons per day (MGD). However, City operations staff have noted that treating more than 55 MGD through the lime softening process shows a significant increase in finished water turbidity and decreased color removal. Therefore, the Fiveash WTP currently has a reduced, effective capacity of approximately 55 MGD. The Fiveash WTP is located in northwest Fort Lauderdale and draws its raw water from the Prospect Wellfield, which is fed from the surficial Biscayne Aquifer. The Fiveash WTP processes include the following:

a. Pretreatment Aeration
b. Lime Softening Total Organic Carbon (TOC) Removal
c. Chemical Treatment and Filtration
d. Clearwell and Transfer Pumps
e. Ground Storage Tanks and High Service Pumping
f. Lime Sludge Management

Many of the equipment and mechanical items for the lime softening system are at the end of their useful life. Additionally, the majority of the electrical power distribution system is out of date and is in need of replacement. More than half of the equipment is not in a conditioned environment and is subject to humidity, heat, and a corrosive atmosphere, causing the equipment to deteriorate faster. For specific electrical R&R needs, please refer to **Section UW3**. A Fiveash WTP "Reliability Upgrades Project" is on-going to replace several key mechanical items and automate the controls of key plant processes. Phases II and III of the Reliability Upgrades are under design and will be distributed for bid in the near future.

The CUS Master Plan Team met with key City water treatment plant operations and maintenance staff to jointly update and prioritize R&R improvements for the Fiveash WTP. **Table WA8-4** illustrates the updated 2015 Renewal and Replacement requirement analysis and the anticipated schedule expenditures.

Source: Reiss, 2017 p. WA8-7

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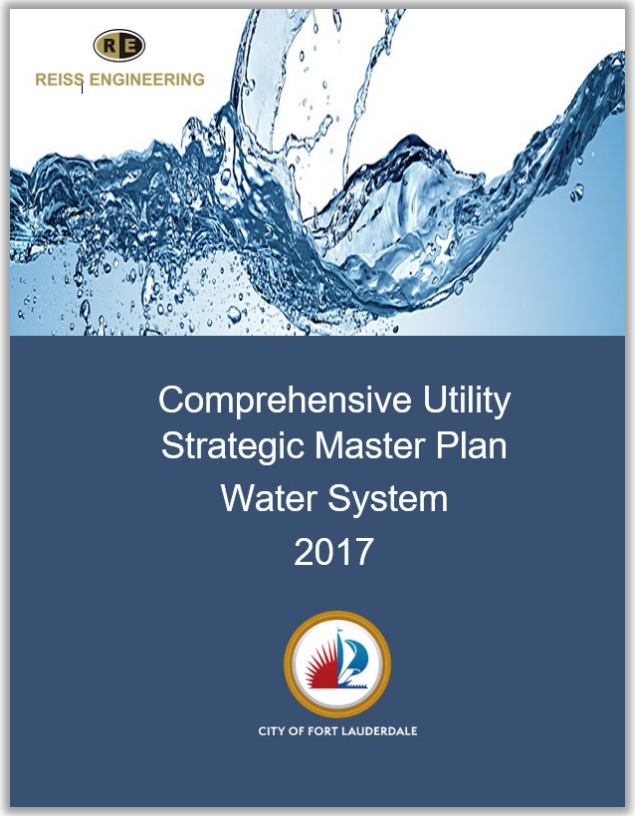


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**Option 2: Implement Color Removal Process to Existing Fiveash WTP**

Option 2 for the Fiveash WTP involves upgrading the existing plant to include an efficient color removal process. Based on **Section WA5.B**, the CUS Master Plan Team recommends conducting a GAC pilot study to gather the appropriate effectiveness/efficiency and design criteria. The GAC treatment strategy (Option 2A) provides the desired benefit at the lowest potential cost, and could potentially be incorporated into the existing treatment process. This treatment alternative will allow the Fiveash WTP to produce finished water with a color quality parameter 8 Pt-Co or less. The feasibility of GAC is recommended to be confirmed by pilot testing. Options 2B (new ozone + softening + GAC) is included in case the GAC process alone is infeasible due to rapid consumption by the raw water total organic carbon concentrations.

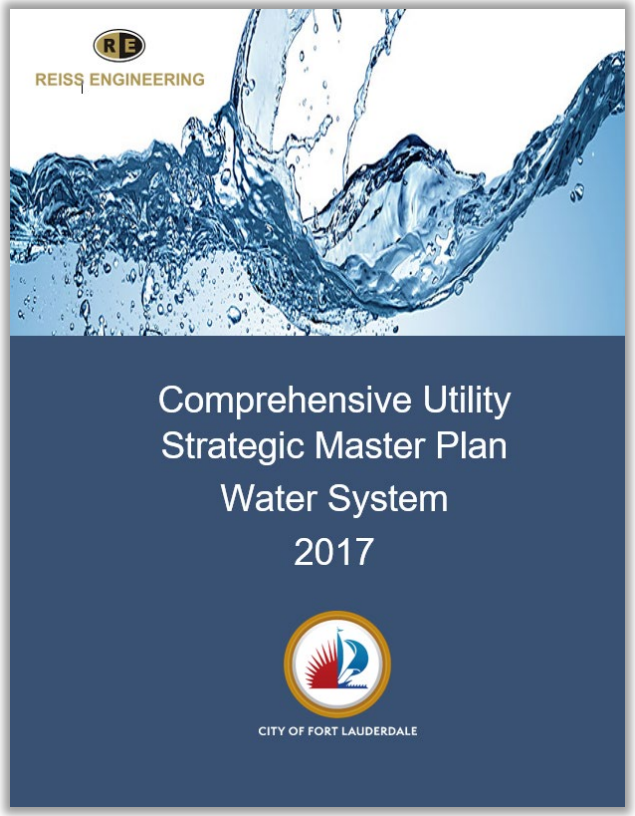
Source: Reiss, 2017 p. WA5.A-6

The CUS Master Plan Team recommends:

- Pilot testing ozone and GAC as the preferred color removal process to confirm cost viability. This treatment strategy potentially provides the greatest benefit at the lowest potential cost, and can be incorporated into the existing treatment process.

Source: Reiss, 2017 p. WA5.B-25

# 1 Key Findings of 2017 Reiss Master Plan

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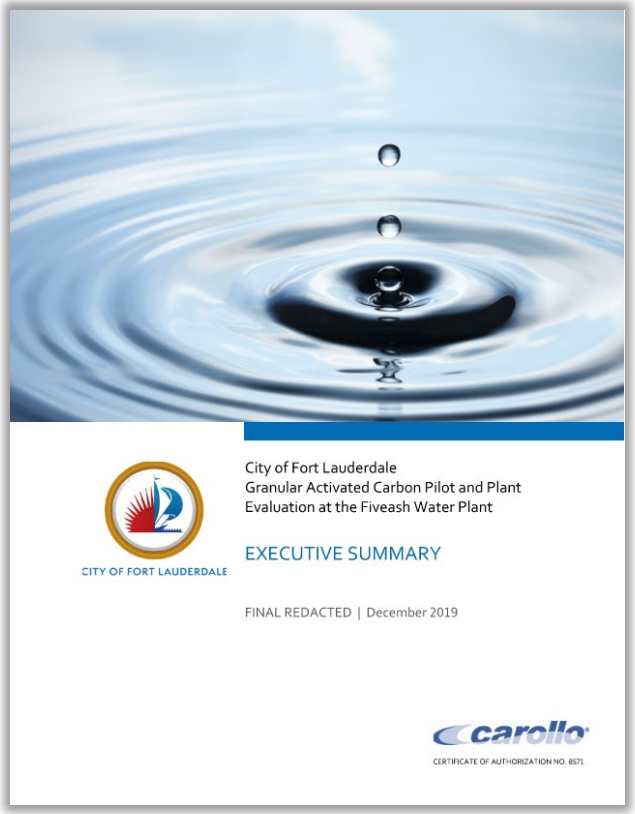
**Option 3: Implement New WTP at Fiveash**

Based on **Section WA5.B.5**, the cost to improve the current Fiveash WTP system exceeds $75,000,000. With an additional $30,000,000 being spent on the Reliability Upgrade Project, the Fiveash WTP will require approximately $100,000,000 to maintain over the next five years. With the current Fiveash WTP being over 60 years old, building a new, innovative water treatment plant may be the best option for the City. Once an ideal treatment method is determined based on the recommended pilot testing, costs for a new WTP can be refined and compared to the $100,000,000 renovation costs. The advantages of building a new water treatment plant are significant versus renovating the old Fiveash WTP. A new, innovative and robust water treatment plant will produce improved water quality, greater reliability, easier operation, and lower maintenance costs. Option 3A and 3B are brand new WTPs with varying processes, Option 3C includes partial use of the existing Fiveash WTP lime softening facilities coupled with a smaller, new membrane WTP to blend finished water and minimize cost.

A life cycle cost analysis is summarized in **Table WA5.A-3**.

Source: Reiss, 2017 p. WA5.A-6

# 2 Key Findings of 2019 Carollo Report




facility expansions over the years have occurred since that time. Much of the existing wellfield has wells and well equipment is at the end of the predicted useful life, with primary and backup electrical systems old and vulnerable to future failure. The primary WTP processes have also exceeded the predicted useful life. Much of the WTP equipment is old and antiquated technology, including the electrical equipment.

There are several additional major operational and maintenance issues at the WTP such as leaking aeration and filtration structures; single point of failure due to lack of isolation, insufficient interconnectivity and redundancy; lack of access for maintenance; lack of spare part access due to outdated/antiquated equipment and so forth. A quantification in terms of correction is difficult to assess. It was determined that continuing re-investment of significant funds for the long-term use of existing facility originally constructed in 1950's, while possible, is not be prudent nor recommended. This alternative was not investigated further.

Source: Carollo Tech Memo 9, 2019 p. 9-2.

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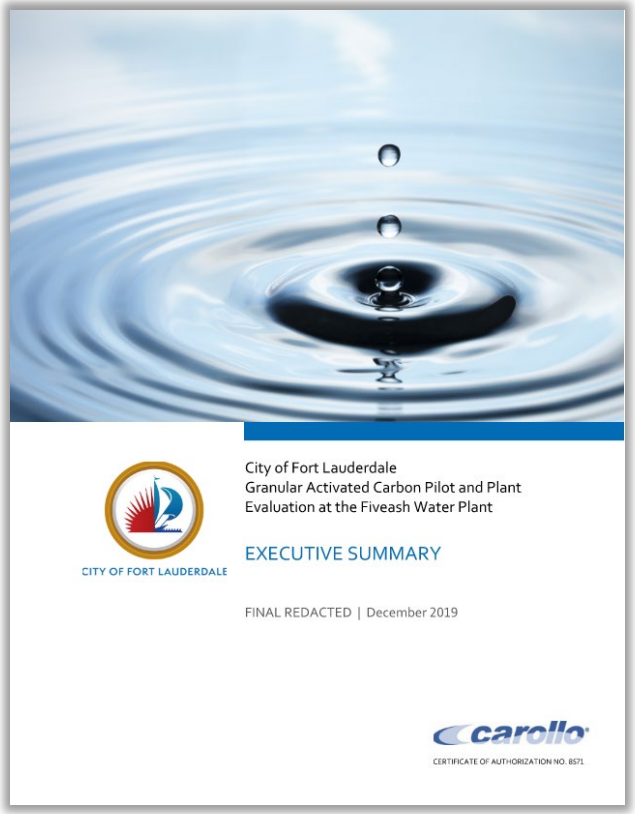
# 2 Key Findings of 2019 Carollo Report

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A small scale research trial was conducted at a remote laboratory facility utilizing water from the Fiveash facility to determine the viability of GAC as a treatment option. In addition, an in-depth investigation into how best to develop a future treatment system which meets the goals and objectives of the City for the Fiveash water service system. A description of the technical tasks performed and a summary of findings with recommendations is included below.

## Summary of Study and Findings

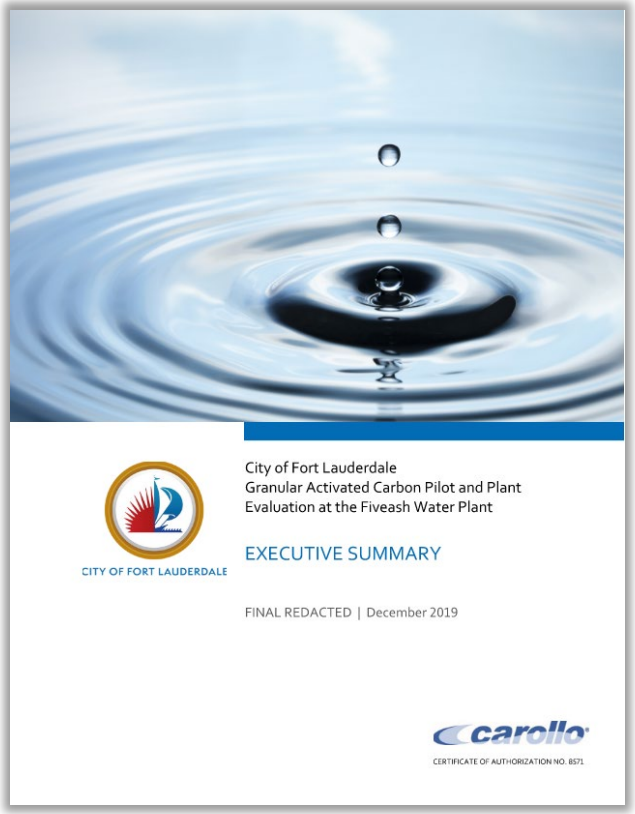
### GAC Evaluation

The raw water source that feeds the Fiveash WTP is from the Biscayne Aquifer, which is a shallow aquifer that exists throughout southeast Florida. A characteristic of this aquifer water is an extremely high organic content that imparts significant water coloration. This water color cannot be removed to desired levels by the existing treatment processes.

In order to determine GAC viability, water from the Fiveash WTP was delivered to a research facility which specializes in performing water testing. At this facility a number of experiments were conducted with multiple GAC's that are commercially available. The results of all of the carbon removal experiments indicated that GAC was not a viable treatment alternative. Although the GAC was able to remove the carbon, it was exhausted to the point where regeneration or replacement was required every few days. The associated cost to regenerate or replace the GAC at this frequency was determined to be impractical as a long term solution to water coloration.

Source: Carollo Executive Summary, 2019 p. 1.

# 2 Key Findings of 2019 Carollo Report

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## Recommendation

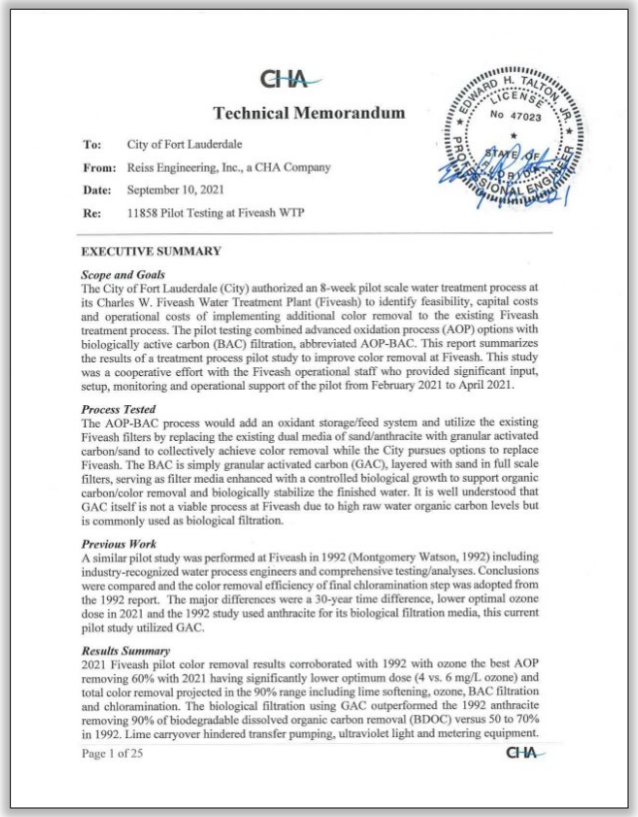
In summary, all the shortlisted treatments schemes are effective at achieving project goals associated with capacity, water quality, and infrastructure sustainability. The level of each technology to meet the operation and maintenance goals varies due to chemical and power usage, labor requirement, and byproducts disposal.

A key objective of the Utility Vision as noted in the CUSMP 2017 is for "..., all of our water treatment facilities will be state of the art by 2035, ..." State of art implies the most recent stage in development of a product incorporating the newest ideas, etc. Of the three short-listed technologies the most state of the art technologies are included in Scheme 11. These technologies of nanofiltration and ion exchange are tried and true over decades of utilization. In addition to a solid performance track record, the industry continues to support significant research and development (R&D) to address existing and potential future challenges.

Based on the analysis and evaluation described herein, it is recommended that the City proceed with design and construction of a new state-of-the-art water treatment facility at the Prospect Wellfield site with a proposed treatment process consisting of a combination of nanofiltration and ion exchange (Treatment Scheme 11). The City could minimize capital costs in the short term by utilizing existing infrastructure at Fiveash Water Treatment Plant (WTP) including the high service pump station, generators, storage tanks, etc. as defined in "Capital Cost Estimate 1." The conceptual cost estimate for this alternative is approximately $350 million.

Source: Carollo Executive Summary, 2019 p. 4.

# 3 Key Findings of 2021 Reiss Tech Memo



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**Technical Memorandum**

**To:** City of Fort Lauderdale

**From:** Reiss Engineering, Inc., a CHA Company

**Date:** September 10, 2021

**Re:** 11858 Pilot Testing at Fiveash WTP

**EXECUTIVE SUMMARY**

***Scope and Goals***

The City of Fort Lauderdale (City) authorized an 8-week pilot scale water treatment process at its Charles W. Fiveash Water Treatment Plant (Fiveash) to identify feasibility, capital costs and operational costs of implementing additional color removal to the existing Fiveash treatment process. The pilot testing combined advanced oxidation process (AOP) options with biologically active carbon (BAC) filtration, abbreviated AOP-BAC. This report summarizes the results of a treatment process pilot study to improve color removal at Fiveash. This study was a cooperative effort with the Fiveash operational staff who provided significant input, setup, monitoring and operational support of the pilot from February 2021 to April 2021.

***Process Tested***

The AOP-BAC process would add an oxidant storage/feed system and utilize the existing Fiveash filters by replacing the existing dual media of sand/anthracite with granular activated carbon/sand to collectively achieve color removal while the City pursues options to replace Fiveash. The BAC is simply granular activated carbon (GAC), layered with sand in full scale filters, serving as filter media enhanced with a controlled biological growth to support organic carbon/color removal and biologically stabilize the finished water. It is well understood that GAC itself is not a viable process at Fiveash due to high raw water organic carbon levels but is commonly used as biological filtration.

***Previous Work***

A similar pilot study was performed at Fiveash in 1992 (Montgomery Watson, 1992) including industry-recognized water process engineers and comprehensive testing/analyses. Conclusions were compared and the color removal efficiency of final chloramination step was adopted from the 1992 report. The major differences were a 30-year time difference, lower optimal ozone dose in 2021 and the 1992 study used anthracite for its biological filtration media, this current pilot study utilized GAC.

***Results Summary***

2021 Fiveash pilot color removal results corroborated with 1992 with ozone the best AOP removing 60% with 2021 having significantly lower optimum dose (4 vs. 6 mg/L ozone) and total color removal projected in the 90% range including lime softening, ozone, BAC filtration and chloramination. The biological filtration using GAC outperformed the 1992 anthracite removing 90% of biodegradable dissolved organic carbon removal (BDOC) versus 50 to 70% in 1992. Lime carryover hindered transfer pumping, ultraviolet light and metering equipment.

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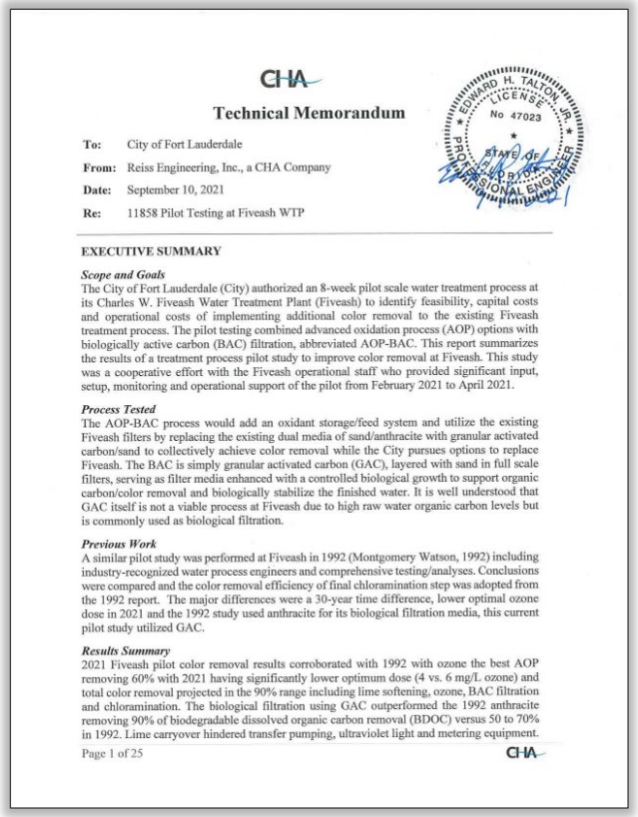

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A pilot scale water treatment process was mobilized and operated from February to April 2021 at Fiveash to identify feasibility and operational and capital costs associated with implementing an advanced oxidation process (AOP) combined with biologically active carbon (BAC) treatment, abbreviated AOP-BAC, to replace the existing dual media in the filters and provide short term color removal while City pursues options to replace the WTP. The BAC is simply granular activated carbon (GAC) that is allowed to have controlled biological growth to support organic carbon/color removal and biologically stabilize the finished water.

Source: Reiss, 2021 p. 5.

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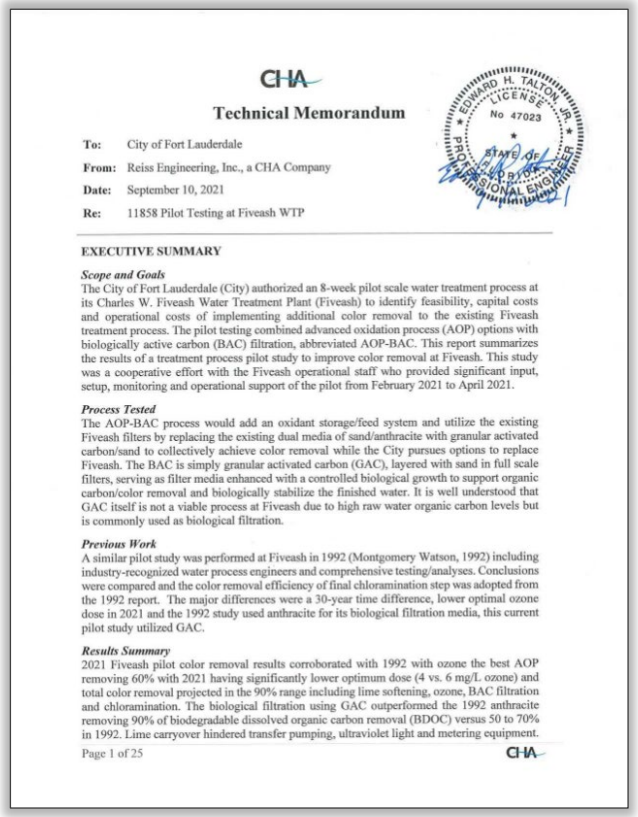

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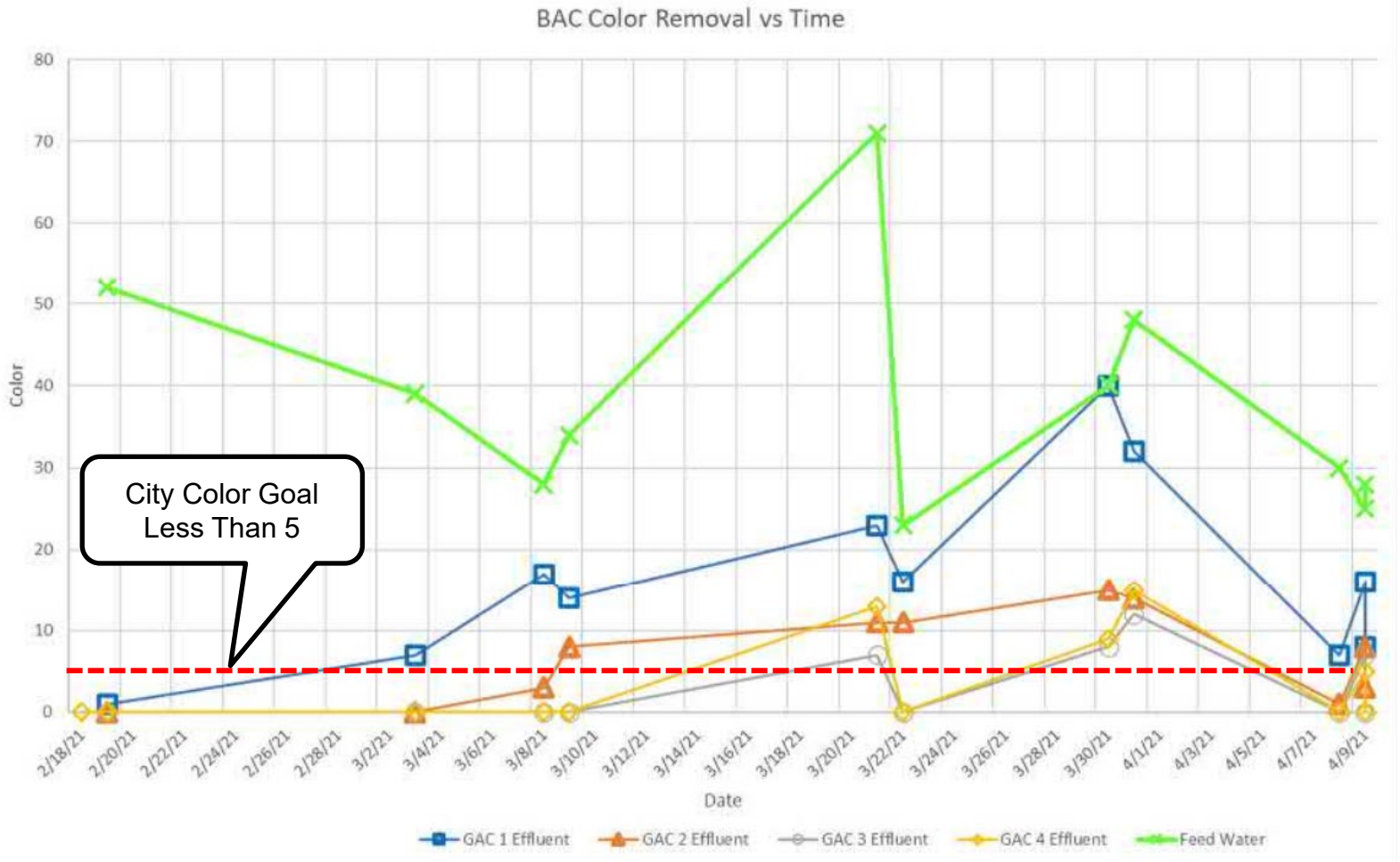


Source: Reiss, 2021 p. 7.

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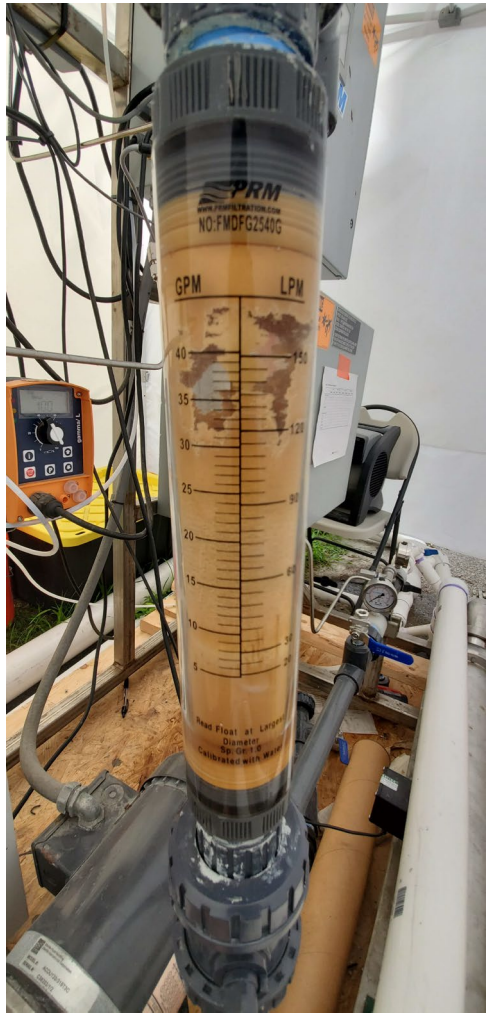


Source: Photos of lime carryover provided by the City of Fort Lauderdale

# 4 Broad Conclusions

1. Replacement of the Fiveash Technology has been consistently recommended.
2. Replacement of the Fiveash Infrastructure has also been recommended by Reiss (2017) and Carollo (2019). While a later Reiss pilot test of a new treatment option included capital costs for refurbishment of Fiveash, there was no testing of the condition of assets mentioned, and a definition of the resultant useful life of the refurbished plant was not offered. It appears probable that the study considered refurbishment in the context of short term.
3. Regardless, the later Reiss pilot study demonstrated an inability to meet the City's color goal with the ozone-BAC technology.
4. Hence, prior studies and planning could support a decision to construct a new WTP (regardless of implementation method or vendor) and to utilize significant nanofiltration technology. There are no competent scientific/engineering documents to support an alternative decision at this time. Should such an alternative be desirable to the City of Fort Lauderdale, it would be incumbent upon the decision makers to commission a study and document the reasonableness of such an approach.