REQUEST FOR QUALIFICATIONS

Orange Water and Sewer Authority
Off-site Biosolid Storage Tank #2 Cleaning and Condition Assessment
CIP Project No. 378-07
Issue Date: August 27, 2024

Submittal Deadline: October 2, 2024 at 2PM

1. INTRODUCTION

Your firm is hereby invited to submit a written statement of qualifications to provide professional engineering services for the cleanout, condition assessment, and rehabilitation of off-site biosolids mixing tank #2. OWASA will conduct a Qualification-Based Selection process to identify the best qualified firm with which to negotiate a contract. All firms submitting qualifications must have demonstrated experience and expertise in design and construction services for tank and mixing system rehabilitation similar in scope to this project RFQ.

To be considered by OWASA, responses to this RFQ must be received by 2:00 p.m. Eastern Time on Wednesday, October 2, 2024. Refer to Section 5 – Submittal Requirements for details.

2. OBJECTIVES

The primary objectives of the project are to:

a) Cleanout off-site biosolids tank #2 and perform comprehensive condition assessment to inform rehabilitation scope.
b) Perform rehabilitation of jet aeration mixing system.
c) Develop standard operating procedure (SOP) for emptying and filling the tanks to prevent clogging of aeration piping or other unwanted material from entering the air pipes.

3. BACKGROUND AND DESCRIPTION

OWASA has two off-site, glass-lined, bolted steel, open, flat-bottomed biosolids mixing storage tanks. Tank sizing can be found in Table 1 below. Both utilize a single duty pump per tank to power jet headers. These tanks serve as additional biosolids storage when land-application is not available, due to rainfall or seasonal needs. Due to previous intermittent mixing and varying biosolids levels, the headers have experienced clogging, and with no water at this location OWASA must utilize a nearby creek and water trucks to flush the system. The clogging issue motivated OWASA to hire Brown and Caldwell to perform a biosolids mixing system evaluation in 2022. The identified mixing system replacement options (see attachment 3) were deemed infeasible due to cost; thus, OWASA would like to rehabilitate the existing jet aeration system. The repeated mixing system failures have resulted in significant downtime and limited operability

of tank #2; thus, time is of the essence for the completion of both the cleanout/condition assessment and rehabilitation of tank #2. It is assumed this will be done in a phased approach, with an initial procurement for tank cleanout and comprehensive condition assessment that will inform a separate rehabilitation procurement.

	Tank 1	Tank 2
Installed	1997	2002
Diameter (ft)	70	90
Side Water Depth (ft)	30	30
Capacity (MG)	1.0	1.5

Table 1 - Off-site Tank Details

4. SCOPE OF SERVICES

The engineering services required for this project are expected to be completed to meet the objective outlined above and in general accordance with a scope of services as needed to accomplish the tasks listed below. **However, the final scope of services will be negotiated with the selected engineering firm and may include modified and/or additional tasks.**

1. Assessment services may include:
    a. Develop Condition Assessment Report
2. Design Services for two procurements (cleanout and rehabilitation) may include:
    a. Development of construction contract documents and technical specifications
    b. Bid phase services.
3. Construction Services for two procurements (cleanout and rehabilitation) may include:
    a. Construction inspection
    b. Construction administration
    c. Preparation of closeout information

The draft and final plans, reports, etc. will be provided in electronic and hard copy formats in a manner acceptable to and usable by OWASA. The actual list and format of deliverables will be negotiated with the selected firm.

5. SUBMITTAL REQUIREMENTS

There will be a non-mandatory pre-submittal meeting and site visit on September 10, 2024 1:30 – 2:30 pm at the Biosolids Storage Facility located at 4611 NC 54 W. Traveling west on NC 54, go 0.5 miles west of Orange Grove Rd and turn right onto gated gravel access drive.

Responses to this RFQ must be received by OWASA no later than 2:00 p.m. Eastern Time on Wednesday, October 2, 2024. To be considered, please submit four (4) hard copies and one (1) electronic copy in PDF format of the required qualifications to:

Mohisin Rasheed, P.E.
mrasheed@owasa.org

Utilities Engineer – Capital Projects
Orange Water and Sewer Authority
400 Jones Ferry Road
Carrboro, North Carolina 27510

The Statement of Qualifications (**including** resumes) shall be limited to a maximum of 10 double-sided pages (i.e., 20 pages printed double-sided onto 10 sheets of 8-1/2"x11" paper). Please note that all Submittals shall become public documents upon delivery to OWASA. If there is sensitive or confidential information that cannot be shared publicly, please include additional documentation along with your submittal.

Along with completed copies of forms in Attachment 1, each submittal must include the following in order to be considered:

a) ***Statement of Interest***: explaining your firm's interest in performing the work on this project, including how the project aligns with your firm's capabilities.
b) ***Project Team/Org Chart*** **[25 points]** showing the proposed project team members, including sub-consultants (if any), identifying their respective roles on the project, and indicating their availability to support this project. Each proposal shall include resumes of key team members. The primary contact shall be clearly identified.
c) ***Project Approach*** **[30 points]** describing your proposed approach to accomplish the work to meet the project objectives, identifying how you will manage any notable risks to meeting the schedule and maintenance of operations. Provide detailed information that will allow OWASA staff to distinguish your team from other firms that may be competing for this project.
d) ***Project Schedule*** **[25 points]** with sufficient delineation of phasing and tasks to demonstrate your understanding of the necessary project activities and reasonable durations, sequencing, risks, etc. for this type of project.
e) ***Past Experience and References*** **[20 points]** for the four most similar projects (i.e., tank cleanout and condition assessment) completed by your project team in the last (5) years for other clients. Identify who served as project manager and key lead technical roles in those projects.
f) ***Contract Objections:*** It is OWASA's intention to use a contract similar to the one included as Attachment 2. If your firm objects to any element of the contract, please state the objections in the submittal.
g) ***Completed Attachment 1 forms (does not count towards 20-page limit)***

6. TIMELINE AND SELECTION PROCESS

The timeline for this solicitation is as follows:

Advertisement	August 27, 2024
Non-Mandatory Pre-Submission Meeting and Site Visit	September 10, 2024 1:30 – 2:30 pm at the Biosolids Storage Facility (4611 NC 54 W)
Questions Close	September 27, 2024
Statement of Qualifications Due	October 2, 2024 at 2:00 PM
Anticipated Notice of Selection	October 17,2024

Anticipated Completion of Final Scoping and Contracting	November 2024

All dates in the above table are subject to change.

OWASA reserves the right to reject any and all proposals, to waive any minor formalities, and to disregard all nonconforming or conditional submittals.

OWASA may elect to conduct face-to-face interviews with two or more firms being evaluated prior to making a final selection.

If OWASA cannot reach an agreement with the initially selected firm, OWASA will then proceed to negotiate with the next best qualified firm, or will reissue the RFQ.

In accordance with North Carolina State law (NC GS 143-128.2(g)) regarding Minority/Women Business Enterprises (M/WBE), it is the policy of OWASA to encourage and promote the use of minority-owned businesses in the procurement of goods and services. Proposers are strongly encouraged to include minority and women-owned businesses to the fullest extent possible when assembling their teams.

7. OWASA POINT OF CONTACT

Mohisin Rasheed will be OWASA's primary point of contact for all consultant selection matters relating to this project. **All questions regarding this Request for Qualifications must be emailed on or before September 27, 2024** to Mr. Rasheed at mrasheed@owasa.org.

8. SUPPLEMENTAL INFORMATION

Attachment 1 – Procurement Forms
Attachment 2 – OWASA Standard Design Services Agreement
Attachment 3 – 278-04 OWASA Biosolids Mixing Evaluation Technical Memorandum
Attachment 4 – Brown and Caldwell – Biosolids Storage Mixing Evaluation – Abbreviated Meeting Minutes and Slides

ACKNOWLEDGEMENT OF ADDENDA

The undersigned hereby acknowledges that their submission is reflective of any addenda posted for this solicitation by checking the appropriate box(es) below:

☐ N/A – no Addenda issued

☐ Addendum 1
☐ Addendum 2
☐ Addendum 3
☐ Addendum 4
☐ Addendum 5

Signature Date

Printed Name Title

E-VERIFY AFFIDAVIT

I,_____(the individual attesting below), being duly authorized by and on behalf of

_____ (the entity identified as the "Employer") after first being duly sworn hereby swears or affirms as follows:

1. Employer understands that E-Verify is the federal E-Verify program operated by the United States Department of Homeland Security and other federal agencies, or any successor or equivalent program used to verify the work authorization of newly hired employees pursuant to federal law in accordance with Article 2 of Chapter 64 of the North Carolina General Statutes.

2. Employer understands that Employers Must Use E-Verify. Each employer, after hiring an employee to work in the United States, shall verify the work authorization of the employee through E-Verify in accordance with Article 2 of Chapter 64 of the North Carolina General Statutes.

3. Employer will ensure compliance with E-Verify by any subcontractors subsequently hired by Employer for specified contracts subject to E-Verify entered into with the Orange Water and Sewer Authority.

This_____day of_____,_____.

_____

Signature of Affiant

Print or Type Name: _____

State of_____County of _____

Signed and sworn to (or affirmed) before me, this the __

day of_____,_____.

My Commission Expires:

_____ _____

Notary Public

(Affix Official/Notarial Seal)

Name of Counterparty:

_____

IRAN DIVESTMENT ACT CERTIFICATION REQUIRED BY N.C.G.S. 143C-6A-5(a)

N.C.G.S. 143C-6A-5(a) requires this certification for bids or contracts with the State of North Carolina, a North Carolina local government, or any other political subdivision of the State of North Carolina.

N.C.G.S. 143C-6A-5(b) requires that contractors with the State, a North Carolina local government, or any other political subdivision of the State of North Carolina must not utilize any subcontractor found on the State Treasurer's Final Divestment List.

As of the date listed below, the vendor or bidder listed above is not listed on the Final Divestment List created by the State Treasurer pursuant to N.C.G.S. 143-6A-4.

The undersigned hereby certifies that he or she is authorized by the vendor or bidder listed above to make the foregoing statement.

Signature	Date
Printed Name	Title

Notes to persons signing this form:

The State Treasurer's Final Divestment List can be found on the State Treasurer's website at: https://www.nctreasurer.com/about/transparency/commitment-transparency/divestment-and-do-not-contract-rules
and will be updated every 180 days.

COMPANIES BOYCOTTING ISRAEL DIVESTMENT ACT CERTIFICATION REQUIRED BY N.C.G.S. §147-86.81*et seq*. *

Pursuant to N.C.G.S. §**147-86.81**, any company identified as engaging in a boycott of Israel, as defined by this Act, is ineligible to contract with the State of North Carolina or any political subdivision of the State. In addition, State agencies must divest from investments in such restricted companies, determined by appearing on the Final Divestment List created by the State Treasurer pursuant to G.S. 147-86.81.

As of the date listed below, the supplier or bidder listed above is not listed on the Final Divestment List created by the State Treasurer pursuant to N.C.G.S. §147-86.81.

The undersigned hereby certifies that he or she is authorized by the contracting party or bidder listed above to make the foregoing statement.

Signature Date

Printed Name Title

Notes to persons signing this form:

The State Treasurer's Final Divestment List can be found on the State Treasurer's website at: https://www.nctreasurer.com/about/transparency/commitment-transparency/divestment-and-do-not-contract-rules
and will be updated every 180 days.

NON-COLLUSION AFFIDAVIT

The submitter, being duly sworn, solemnly swears (or affirms) that neither he, nor any official, agent or employee has entered into any agreement, participated in any collusion, or otherwise taken any action which is in restraint of free competition in connection with any bid or contract, that the bidder has not been convicted of violating *N.C.G.S. § 133-24* within the last three years, and that the submitter intends to do the work with its own bona fide employees or subcontractors and will not submit for the benefit of another contractor.

By submitting this non-collusion affidavit, the Submitter certifies, under penalty of perjury according to North Carolina law, their compliance with non-collusion standards. This affidavit affirms the Submitter's adherence to the required non-collusion guidelines without any exceptions.

SIGNATURE OF BIDDER

Name of Submitter_____
Print or type name

Address _____

Signature of Submitter_____
Print or type Signer's Name

Signature of Witness_____
Print or type Signer's name

AFFIDAVIT MUST BE NOTARIZED
Subscribed and sworn to before me this the

_____ day of _____ 20__ .

Signature of Notary Public

of _____County

State of _____

My Commission Expires: _____ **NOTARY SEAL**

CERTIFICATION REGARDING CONFLICT OF INTEREST

All Vendors should be aware of OWASA'S Code of Ethics, which prohibits OWASA Employees and Board Members from having certain relationships with persons or entities conducting (or proposing to conduct) business with OWASA and which prohibits the acceptance of gifts from Vendors. If the Vendor has an actual or potential conflict, the Vendor shall disclose any Conflict of Interest that may exist.

Conflicts of Interest (potential or actual) will be evaluated by OWASA'S General Counsel to determine the proper course of action. Failure to comply with the provisions established above may render the vendor ineligible to participate in OWASA'S procurement process.

The Submitter is required to certify that performance of the work will not create any conflicts of interest or disclose any actual or potential conflicts of interest by completing and signing <u>one</u> of the following statements:

The Submitter hereby discloses no conflicts of interest.

DATE: _____

AUTHORIZED SIGNATURE: _____

TITLE: _____

SUBMITTER/COMPANY NAME: _____

OR

The Submitter hereby discloses the following circumstances that could give rise to a conflict of interest for the Submitter, any affiliates, any proposed subconsultants, and key personnel of any of these organizations. (Attach additional sheets as needed.)

Name of the Individual/Company to which potential conflict of interest might apply:

_____

Nature of potential conflict of interest:

_____

_____

Proposed Remedy:

_____

_____

_____

DATE: _____

AUTHORIZED SIGNATURE: _____

TITLE: _____

SUBMITTER/COMPANY NAME: _____

AGREEMENT
BETWEEN

ORANGE WATER AND SEWER AUTHORITY,

a political subdivision of the State of North Carolina, its successors and assigns, hereinafter referred to as "Owner" through its Board of Directors,

and

CONSULTANT NAME

its successors and assigns, hereinafter referred to as "Consultant"

IN ORANGE COUNTY NORTH CAROLINA

FOR
CONSULTING SERVICES

W I T N E S S E T H :

WHEREAS, Owner intends to conduct a study of the sanitary sewer system within its service area; and,

WHEREAS, Owner requires certain consulting services in connection with the project (the Services); and,

WHEREAS, Consultant is prepared to provide the Services;

NOW THEREFORE, in consideration of the mutual terms and conditions, promises and payments contained in this Agreement, Owner and Consultant agree as follows:

ARTICLE 1 - TIME FOR PERFORMANCE

1.1 The effective date of this Agreement is _____ and shall remain in effect until terminated. Consultant shall perform the services described in Attachment B (herein, the Project Scope of Services) to this Agreement. Owner will issue a separate Notice to Proceed for the work, and the work shall proceed according to the schedule as described in the Project Scope of Services. Any work initiated by Consultant prior to the Owner's written authorization of the Project will be at the Consultant's sole risk.

ARTICLE 2 - GOVERNING LAW

2.1 This Agreement shall be governed by the laws of the state of North Carolina. Any disputes which may arise out of this agreement shall be filed in the North Carolina Court of Justice, The Superior Court of Orange County NC.

ARTICLE 3 - SERVICES TO BE PERFORMED

3.1 Consultant shall perform the Services described in the Project Scope of Services as authorized

under this Agreement. Consultant shall provide all services as set forth in the Project Scope of Services, including the necessary, incidental and related activities and services required and contemplated in the Consultant's level of effort.

3.2 Consultant and Owner acknowledge that the Scope of Services described for the Project does not delineate every detail and minor work task required to be performed by Consultant to complete the work authorized by the Scope of Services. If during the course of the performance of the services authorized by this Agreement, Consultant determines that work should be performed to complete the Project which is in the Consultant's opinion outside the level of effort originally anticipated, whether or not the Project Scope of Services identifies the work items, Consultant shall notify Contract Administrator in writing within 30 days and wait for Owner approval before proceeding with the work. If Consultant proceeds with said work without notifying the Contract Administrator, said work shall be deemed to be within the original level of effort described in the Project Scope of Services. Notice to the Contract Administrator does not constitute authorization or approval by Owner to perform the work. Performance of work by Consultant outside the originally anticipated level of effort without prior written Owner approval is at the Consultant's sole risk.

3.3 Upon mutual written agreement, the Project Scope of Services may be modified. The Owner and the Consultant may negotiate additional scopes of services, compensation, time of performance and other matters related to the project. If the Owner and Consultant cannot contractually agree, Owner shall have the right to immediately terminate negotiations at no cost to the Owner and to procure services from another source.

ARTICLE 4 - OWNER'S RESPONSIBILITIES

4.1 Owner shall be responsible for all matters described in the Project Scope of Services (Attachment B).

ARTICLE 5 - COMPENSATION AND METHOD OF PAYMENT

5.1 Owner agrees to pay Consultant as compensation for performance of services as described in the Project Scope of Services. Compensation may be as a lump sum or as maximum amount not-to-exceed. The maximum amount not-to-exceed method of compensation will utilize hourly billing rates established as part of this Agreement.

5.2 Consultant shall separately invoice for services rendered each month. Each project invoice shall reflect percentage of work completed to date and for the invoiced month. Invoices shall provide a detailed breakdown of hours worked, hourly billing rates by each individual, and the expenses attributable to the project during the period.

5.3 The Owner shall assign a Project CIP Number, as well as a Purchase Order Number for the Project to facilitate internal contract administration. Each Project Invoice must reference the assigned CIP Number and the Purchase Order Number for the Project and be sent directly to the Owner’s Project Manager as assigned. Payment terms shall be the net invoice amount within 30 days.

5.4 The hourly billing rates for this agreement are set forth in Attachment A to this agreement and shall be used for maximum not-to-exceed compensation**.**

5.5 The reimbursable expenses for this agreement are set forth in Attachment A to this agreement and shall be used for maximum amount not-to-exceed compensation. Consultant shall be allowed to adjust expense items in accordance with changes in IRS criteria for deductible expenses.

5.6 Consultant shall keep such records and accounts and require any and all consultants and sub-consultants to keep records and accounts as may be necessary in order to record complete and correct entries as to personnel hours charged to the project and any expenses for which Consultant expects to be reimbursed. All books and records relative to the project shall be available at all reasonable times for examination and audit by Owner and shall be kept for a period of three (3) years after completion of all work pursuant to this Agreement. Incomplete or incorrect entries in such books and records shall be grounds for Owner's disallowance of any fees or expenses based upon such entries.

ARTICLE 6 - STANDARD OF CARE

6.1 General: Consultant shall exercise the same degree of care and diligence in the performance of the Services as is ordinarily exercised by a professional serving under similar circumstances.

ARTICLE 7 - LIABILITY AND INDEMNIFICATION

7.1 General: Having considered the potential liabilities that may exist during the performance of the Scope of Services, the benefits of the project, and the Consultant's fee for the Services, and in consideration of the promises contained in this Agreement, Owner and Consultant agree to allocate and limit such liabilities in accordance with this Article.

7.2 Indemnification by Consultant: Consultant agrees to defend, indemnify, and hold harmless Owner, its agents, and its employees from and against legal liability for all claims, losses, damages, and expenses to the extent such claims, losses, damages, or expenses are caused by Consultant's negligent acts, errors, or omissions.

7.3 Employee Claims: Consultant shall indemnify Owner against legal liability for damages arising out of claims by Consultant's employees to the extent such claims arise out of Consultant's negligent acts, errors or omissions.

7.4 Survival: Upon completion of all Services, obligations, and duties provided for in this Agreement, or if this Agreement is terminated for any reason, the terms and conditions of this Article shall survive.

ARTICLE 8 - INSURANCE

8.1 During the performance of the Services under this Agreement, Consultant shall maintain the minimum levels of insurance shown below and provide certificates of such coverage to Owner prior to performance. All policies must provide ten (10) days advance written notice to Owner in the event of cancellation, expiration, or alteration.

8.1.1 General Liability Insurance, with a combined single limit of $1,000,000 for each occurrence and $1,000,000 in the aggregate.

8.1.2 Automobile Liability Insurance, with a combined single limit of $1,000,000 for each person and $1,000,000 for each accident.

8.1.3 Workers' Compensation Insurance in accordance with statutory requirements and Employers' Liability Insurance, with a limit of $500,000 for each occurrence.

8.1.4 Professional Liability Insurance, with a limit of $1,000,000 annual aggregate.

ARTICLE 9 - OWNERSHIP OF DOCUMENTS AND INTELLECTUAL PROPERTY

9.1 Except as otherwise provided herein, documents and reports prepared by Consultant as part of the Services shall become the property of Owner upon payment for same. All finished or unfinished documents, data studies, surveys, drawings, maps, models, photographs and reports prepared or provided by Consultant in connection with this Agreement become the property of the Owner, whether the projects are completed or not, and shall be delivered by Consultant to the Owner within ten (10) days after receipt of written notice and upon payment for same. Consultant shall retain its rights to its specifications, databases, computer software, and other proprietary property. Rights to intellectual property developed, utilized, or modified in the performance of the Services shall remain the property of Consultant. Any use by Consultant of intellectual property owned by Owner is authorized solely for the project.

ARTICLE 10 - TERMINATION

10.1 This Agreement may be terminated by either party upon written notice in the event of substantial failure by the other party to perform in accordance with the terms of this Agreement. The nonperforming party shall have fifteen calendar days from the date of the termination notice to cure or to submit a plan for cure acceptable to the other party.

10.2 Owner may terminate or suspend performance of this Agreement for Owner's convenience upon written notice to Consultant. Consultant shall terminate or suspend performance of the Services on a schedule acceptable to Owner. If termination or suspension is for Owner's convenience, Owner shall pay Consultant for all the Services performed and termination or suspension expenses. Upon restart, an equitable adjustment shall be made to Consultant's compensation.

ARTICLE 11 - DELAY IN PERFORMANCE

11.1 Neither Owner nor Consultant shall be considered in default of this Agreement for delays in performance caused by circumstances beyond the reasonable control of the nonperforming party. For purposes of this Agreement, such circumstances include: floods; earthquakes; fire; epidemics; war, riots, and other civil disturbances; strikes, lockouts, and other labor disturbances; sabotage; judicial restraint; and the inability to procure permits, licenses, or authorizations from any local, state, or federal agency for which such permits have been properly applied for in accordance with the specified Project Schedule for any of the supplies, materials, accesses, or services required to be provided by either Owner or Consultant under this Agreement.

11.2 Should such circumstances occur, the nonperforming party shall, within a reasonable time of being prevented from performing, give written notice to the other party describing the circumstances preventing continued performance and the efforts being made to resume performance of this Agreement. Consultant shall be entitled to an equitable adjustment in schedule and compensation in the event such circumstances occur.

ARTICLE 12 - COMMUNICATIONS

12.1 Any communication required by this Agreement shall be made in writing to the address specified in the Project Scope of Services. The Contract Administrator for the Owner shall be specified in the Project Scope of Services. Nothing contained in this Article or the Project Scope of Services shall be construed to restrict the transmission of routine communications between representatives of Owner and Consultant.

ARTICLE 13 - WAIVER

13.1 No waiver by either Owner or Consultant of any breach of this Agreement shall be of any effect unless it shall be written and signed by the waiving party. Such a waiver shall not affect the waiving party's rights with respect to any other or further breach.

ARTICLE 14 - SEVERABILITY

14.1 The invalidity, illegality, or unenforceability of any provision of this Agreement, or the occurrence of any event rendering any portion or provision of this Agreement void, shall in no way affect the validity or enforceability of any other portion or provision of this Agreement. Any void provision shall be deemed severed from this Agreement, and the balance of this Agreement shall be construed and enforced as if this Agreement did not contain the particular portion or provision held to be void. The parties further agree to amend this Agreement to replace any stricken provision with a valid provision that comes as close as possible to the intent of the stricken provision. The provisions of this Article shall not prevent this entire Agreement from being void should a provision which is of the essence of this Agreement be determined void.

ARTICLE 15 - SUCCESSORS AND ASSIGNS

15.1 Owner and Consultant each binds itself and its directors, officers, partners, successors, executors, administrators, assigns, and legal representatives to the other party to this Agreement and to the directors, officers, partners, successors, executors, administrators, assigns, and legal representatives of such other party in respect to all provisions of this Agreement.

ARTICLE 16 - ASSIGNMENT

16.1 Neither Owner nor Consultant shall assign any rights or duties under this Agreement without the prior written consent of the other party. Unless otherwise stated in the written consent to an assignment, no assignment will release or discharge the assignor from any obligation under this Agreement. Nothing contained in this Article shall prevent Consultant from employing independent consultants, associates, and subcontractors to assist in the performance of the Services. Consultant will not employ subcontractors for the performance of the Services without the prior written approval of Owner, which approval shall not be unreasonably withheld. Consultant shall have the right to assign duties to any of Consultant’s related or affiliated companies.

ARTICLE 17 - THIRD PARTY RIGHTS

17.1 Nothing in this Agreement shall be construed to give any rights or benefits to anyone other than Owner and Consultant.

ARTICLE 18 - MISCELLANEOUS

18.1 INTERPRETATION: The language of this Agreement has been agreed to by both parties to express their mutual intent and no rule of strict construction shall be applied against either party hereto. The headings contained in this Agreement are for reference purposes only and shall not affect in any way the meaning or interpretation of this Agreement. All personal pronouns used in this Agreement shall include the other gender, and the singular shall include the plural, and vice versa, unless the context otherwise requires. Terms such as "herein," "hereof," "hereunder," and "hereinafter" refer to this Agreement as a whole and not to any particular sentence, paragraph, or section where they appear, unless the context otherwise requires. Whenever reference is made to a Section or Article of this Agreement, such reference is to the Section or Article as a whole, including all of the subsections of such Section unless the reference is made to a particular subsection or subparagraph of such Section or Article.

18.2 CONSULTANT'S STAFF: Consultant shall provide the key staff identified in their proposal for the Project as long as said key staff are in Consultant's employment.

18.2.1 Consultant will obtain prior written approval of Contract Administrator to change key staff members. Consultant shall provide Contract Administrator with such information as necessary to determine the suitability of proposed new key staff. Contract Administrator shall be reasonable in evaluating key staff qualifications.

18.2.2 If Contract Administrator desires to request removal of any of Consultant's staff, Contract Administrator shall first meet with Consultant and provide reasonable justification for said removal.

18.3 ENTIRE AGREEMENT: This Agreement, including all documents identified below, represents the entire understanding between the Owner and the Consultant as to this particular scope of work and shall supersede all prior and contemporaneous communications, representations, understandings, and Agreements relating to the subject matter hereof and may be amended only by written mutual Agreement of the parties.

18.4 ATTACHMENTS: Current listing of Attachments includes:

- Attachment A – Hourly Billing Rates and Reimbursable Expenses.
- Attachment B – Project Scope of Services.

ARTICLE 19 – PRE-EXISTING CONTAMINATION

19.1 Anything herein to the contrary not withstanding, title to, ownership of, and legal responsibility and liability for any and all pre-existing contamination shall at all times remain with Owner. "Pre-existing contamination" is any hazardous or toxic substance, material, or condition present at the project site or sites concerned which was not brought onto such site or sites by Consultant.

ARTICLE 20 – LIMITATIONS OF RESPONSIBILITY

20.1 Consultant shall not be responsible for: (1) construction means, methods, techniques, sequences, procedures, or safety precautions and programs in connection with the Project; (2) the failure of any contractor, subcontractor, vendor, or other participant, not under contract to Consultant, to fulfill contractual responsibilities to Owner or to comply with federal, state, or local laws, regulations, and codes; or (3) procuring permits, certificates, and licenses required for any

construction unless such responsibilities are specifically assigned to Consultant in Scope of Services.

ARTICLE 21 – NON DISCRIMINATION CLAUSE

21.1 The Consultant shall not discriminate against any person on the grounds of race, color, national origin, sex, age, or handicap in administration of this Agreement. Nor shall any person be excluded from participation in, or be denied the benefits of any project designed under this Agreement on the grounds of race, color, national origin, sex, age, or handicap.

ARTICLE 22 – MINORITY BUSINESS PARTICIPATION

22.1 It is the policy of OWASA to provide minority businesses an equal opportunity to participate in all aspects of OWASA's contract activities. Consultant shall comply with OWASA's Minority Business Participation Outreach Plan and Guidelines.

ARTICLE 23 – E-VERIFY

23.1 Consultant shall comply with the requirements of Article 2 of Chapter 64 of the General Statutes. Further, if Consultant utilizes a subcontractor, Consultant shall require the subcontractor to comply with the requirements of Article 2 of Chapter 64 of the General Statutes.

IN WITNESS WHEREOF, Owner and Consultant have executed this Agreement.

OWNER:

ORANGE WATER AND SEWER AUTHORITY

BY: _____

TITLE:

DATE: _____

CONSULTANT:

CONSULTANT NAME

BY: _____

TITLE:

DATE: _____

APPROVED AS TO FORM AND LEGALITY:

_____ _____

Date Robert Epting, Esquire
Authority General Counsel

This instrument has been pre-audited in the manner required by the Local Government Budget and Fiscal Control Act:

_____ _____

Date Kelly Satterfield
Director of Finance

ATTACHMENT A

HOURLY BILLING RATES AND REIMBURSABLE EXPENSES

INTRODUCTION

The hourly billing rates are set forth below.

Billing Category	Individual Name and Title	Hourly Billing Rate for the Agreement
Principal		
Senior Project Manager		
Senior Discipline Engineer		
Project Manager		
Project Engineer		
Engineer		
Engineering Associate		
Senior Technician		
Technician		
Administrative Assistant		

BILLING CATEGORY DEFINITIONS

The following table provides broad definitions for various Billing Categories. As a guideline, expected experience and duties for each of the categories have been included in the Billing Category Definitions. It is expected that in some instances the actual experience of an individual may be different than what is required for the corresponding Billing Category. In all such cases, Consultant will provide appropriate justification and seek approval from the Owner.

Principal	This is the firm's corporate officer. In some cases "Principal" may be the owner or one of the partners of the firm, and is generally in a position to make all the corporate level decision for the firm as it pertains to this Agreement.
Senior Project Manager	Person in this position provides senior level project management, provides high level of professional input for the project and is generally responsible for conducting high level project review. This person has a Professional Engineering license in North Carolina and professional-level experience of over 15 years.

Senior Discipline Engineer	Person in this position is considered the firm's expert for a particular discipline. This person will oversee Engineering work of particular discipline at the highest level for the firm. This person has a Professional Engineering license in North Carolina and professional-level experience of over 18 years. Engineering Disciplines may include, but are not limited to: Structural Engineering, Water Resources, Environmental Engineering, Transportation, Electrical Engineering, Mechanical Engineering, Pump Station Design, Instrumentation and Control, Construction Management, Power Generation, etc.
Project Manager	Person in this position provides day-to-day Project Management for the Project and acts as the key client contact. This person has a professional license in North Carolina and professional-level experience of over 8 years.
Project Engineer	Person in this position provides day-to-day engineering work for various disciplines as required by individual projects. This person has a professional license in North Carolina and professional-level experience of over 8 years.
Engineer	Person in this position provides day-to-day engineering support to the Project Manager, Project Engineer and other team members as required for their respective projects. This person has a professional license in North Carolina and professional-level experience of over 3 years.
Engineering Associate	Person in this position provides day-to-day engineering support to the Project Manager, Project Engineer, Engineer and other team members as required for their respective projects. This person is an Engineering Intern or has an Engineering Associates degree with appropriate technical experience.
Senior Technician	Person in this position provides senior technical-level support to the Project Team. Support may include CAD services, GIS, or other technical-level work. This person has 10 years of experience providing technical-level work.
Technician	Person in this position provides technical-level support to the Project Team. Support may include CAD services, GIS, or other technical-level work. This person has 4 years of experience providing technical-level work.
Registered Land Surveyor	This person is a North Carolina Board of Engineers and Land Surveyors certified Land Surveyor and has 4 years of professional-level experience.
2 Person Survey Crew	These individuals form a surveying team, acting as an Instrument Person and Rod-Person.
Administrative Assistant	This person performs administrative and clerical-level work for the Project Team, including data entry, word processing, and other non-technical support work as needed for the Project.

REIMBURSABLE EXPENSES

Reimbursable expenses for each individual project shall be clearly itemized by the Consultant. The following guidelines shall be used to develop these expenses:

1. Overtime at straight time rates shall apply for exempt employees to the extent the employee works more than 40 hours per week on Owner's project.
2. Subcontracted services shall be based on Cost Plus 5%. Consultant shall obtain Owner's approval before authorizing such services.
3. Cost of printing and reproducing drawings and bid documents, except for those included in the lump sum cost.
4. Cost for use of field equipment, safety equipment and field sampling equipment.
5. Cost of courier and express mail services.
6. Living and traveling expenses when Consultant's employees are away from home on Owner's project assignments. The following limitations shall apply:
   - Base room charges (excluding taxes and other fees) shall not exceed $119 per night.
   - Base rental car charges (excluding taxes and other fees) shall not exceed $60 per day.
   - Meal charges per individual shall not exceed $51 per day.
7. Automobile mileage to be reimbursed at rate established and updated by Internal Revenue Service.

ATTACHMENT B

PROJECT SCOPE OF SERVICES

Project Title: …

OWASA's CIP #: …

Project Contract Administrators:

OWASA	**Consultant**
...	**...**
Utilities Engineer	…
Orange Water and Sewer Authority	…
400 Jones Ferry Road	…
Carrboro, NC 27510	
Office: (919) 537-4248	

Project Background:

…
…

Project Scope:

Task 1 – Kickoff Meeting, Flow Monitoring and Data Collection
…
Task 2 - … …
…

Deliverables:

Specify deliverables, number of copies, and format.

Project Team:

…

Key Team Members:
…
The OWNER will be notified in writing of changes to the project team members. Other staff may participate in the project in a minor role at Consultant's discretion.

Project Schedule:

….

List durations for interim milestones and final completion in total number of days from Notice to Proceed.

Compensation:

…

Provide compensation basis (lump sum, cost ceiling) and subtotals by task.
Provide separate subtask breakdowns for projects above exemption limit, or as warranted.

Owner Responsibilities

…

Scope Exceptions, Additional Services, etc

223 S. West St., Suite 900
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Technical Memorandum

Prepared for: Orange and Water Sewer Authority (OWASA)

Project Title: Biosolids Storage Mixing Evaluation

Project No.: 158870

Technical Memorandum

Subject: Evaluation Summary and Capital Improvements Plan (CIP) Recommendation

Date: January 24, 2023

To: Andre Miller, PE

From: Tom Nangle, PE

Copy to: Peter Schuler, PE

Prepared by: _____
Emma Guertin

Prepared by: _____
Tom Nangle, License No. 042096, Expiration 12/31/2023

Reviewed by: _____
Peter Schuler, PE

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Executive Summary

Brown and Caldwell (BC) evaluated mixing technologies to replace existing ineffective mixing systems at the on-site and off-site biosolid storage tanks for the Orange and Water Sewer Authority (OWASA). BC performed a cost and non-cost evaluation of the different mixing technologies to recommend the best suited technologies based on key considerations for both facilities. Energy consumption, maintenance efforts and capital costs were included in the economic analysis. Non-cost factors such as maintenance schedules, technology maturity, site space availability and additional system requirements (water access, shelter, power, and HVAC) were also evaluated for each technology. A planning level cost estimate was developed for the selected technologies, which helped inform budgets to be included in OWASA's Capital Improvements Plan (CIP).

Coarse bubble mixing had previously been used to mix the on-site tanks but was stopped due to operational challenges. These tanks are used to store digested biosolids before being transferred to either dewatering or truck loading and have historically been mixed only prior to transfer. Therefore, a key consideration for the on-site tanks is a system that can effectively resuspend solids after long periods without mixing. OWASA requested large bubble mixing to be evaluated and compared to a previous study that evaluated hyperbolic mixers for the on-site tanks.

The off-site tanks are currently mixed with a single duty pump per tank that provides mixing through jet headers. The volume in these tanks varies significantly throughout the year due to OWASA's biosolid storage strategy. With the current mixing system, this results in clogging issues caused from intermittent operations and settling in headers when the system is pumped down. This key consideration, in addition to other considerations, helped screen out all mixing technologies except for large bubble mixing, pumped nozzle mixing and impeller mixing.

Large bubble mixing was recommended for both the on-site and off-site tanks as it offered the lowest capital and operating costs, superior mixing of thickened biosolids, ease of maintenance, and OWASA's familiarity and preference for this technology. BC's estimating group developed an AACE (Association for the Advancement of Cost Engineering) Class 4 estimate for the selected mixing technologies for the on-site and off-site biosolids storage tanks. This estimate is used as the basis for recommended fiscal year budgets for these improvements, which is summarized below.

Table ES-1. Biosolids Storage Mixing Improvements Budgeting for CIP

OWASA Fiscal Year	On-Site	Off-Site	Total	Includes
2024 (7/2023 – 6/2024)	$195,000	$220,000	$415,000	60% of Legal, Administration and Engineering
2025 (7/2024 – 6/2025)	$2,130,000	$3,305,000	$5,435,000	40% of Legal, Administration and Engineering + Upper Range of OPCC

Next steps include refining the conceptual designs developed in this study into bid documents. Key considerations for each application are detailed in Section 4.2 and summarized below.

Conduct a preliminary engineering evaluation that will include:

- Condition assessment of the existing aluminum cover and concrete walls of the on-site storage tanks.
- Evaluation of the on-site biosolids loadout pump station.
- Refine details of the compressor building and mixing system for both on-site and off-site applications.

- Determine whether pre-selection or pre-procurement of the large bubble mixing system is advantageous.
- Develop an automation plan to reduce frequency of maintenance visits for the off-site system.

It is anticipated that an accelerated final design (one deliverable at 90%) would be achievable after completion of the preliminary engineering evaluation.

Section 1: Project Background & Scope

The Orange and Water Sewer Authority (OWASA) desires a holistic approach to evaluate different mixing technologies for their on-site (Mason Farm WWTP) and off-site biosolids storage facilities. The goal is to identify the mixing systems that best meet OWASA's operational, maintenance, and energy efficiency goals for each location, and to develop a planning level estimate for the selected solutions to be included in OWASA's Capital Improvements Plan (CIP).

The scope included:

- A kickoff workshop and site visits to identify key considerations and come to a consensus on which technologies to evaluate for each application.
- A cost and non-cost evaluation of the mixing systems, including meetings as needed with OWASA to get buy-in on site layouts and other considerations.
- Recommendation Workshop, where Brown and Caldwell (BC) presented the findings of the evaluation and recommend improvements.
- Class 4 Opinion of Probable Construction Cost for the recommended improvements.
- A technical memorandum documenting the evaluation and summarizing budgets to be included in OWASA's CIP.

This technical memorandum satisfies the final scope item for this project. The evaluations and CIP budgetary costs are separated into on-site and off-site improvements to provide OWASA with flexibility in how to implement these improvements.

Section 2: On-site Storage Tanks Evaluation

2.1 Background

In 1991, OWASA had two 53' x 53' x 15' side water depth (SWD) square reinforced concrete basins installed that are still in use today as the on-site biosolid storage tanks. Each tank has a volume of 330,00-gallons, 360,000 gallons if including the bottom cone. The odor control aluminum truss-supported covers were installed in 2004. The current conditions of these covers and the interior concrete walls are unknown. The tanks store digested sludge at 2-3% solids concentration. Sludge is either transferred from these storage tanks to:

- Dewatering (single rotary press in adjacent building at Mason Farm WWTP)
- Truck loading for either liquid land application or to be transferred to the off-site storage tanks.

2.1.1 Historic and Current Mixing System

The on-site tanks previously had been mixed with a diffused air mixing system using fixed coarse bubble diffusers mounted to the tank floors powered by the aeration basin blowers. The mixing system was operated

intermittently, only in preparation for biosolids transfer. This system is no longer used due to O&M challenges, instead OWASA uses two 7.5 HP transfer pumps (one per basin) to continuously recirculate the tank contents. Multiple challenges have resulted from inadequate mixing, including solids settling and stratification in the tank, foaming, loss of active tank volume and inconsistent biosolids feeding into the rotary press (resulting in poor dewatering performance).

2.1.2 On-site Tank Considerations

The technology selection included the following considerations:

- There is limited space around the tanks for externally mounting mixing systems.
- The tank cover conditions are unknown but are not designed to support cover mounted equipment, so potential modification to odor covers may be required, which can be costly.
- Square, variable level tanks can be a difficult application for some mixing technologies.
- The tank covers also limit access to the interior of tanks without removing them (each tank cover has a 3'x3' manway access hatch)

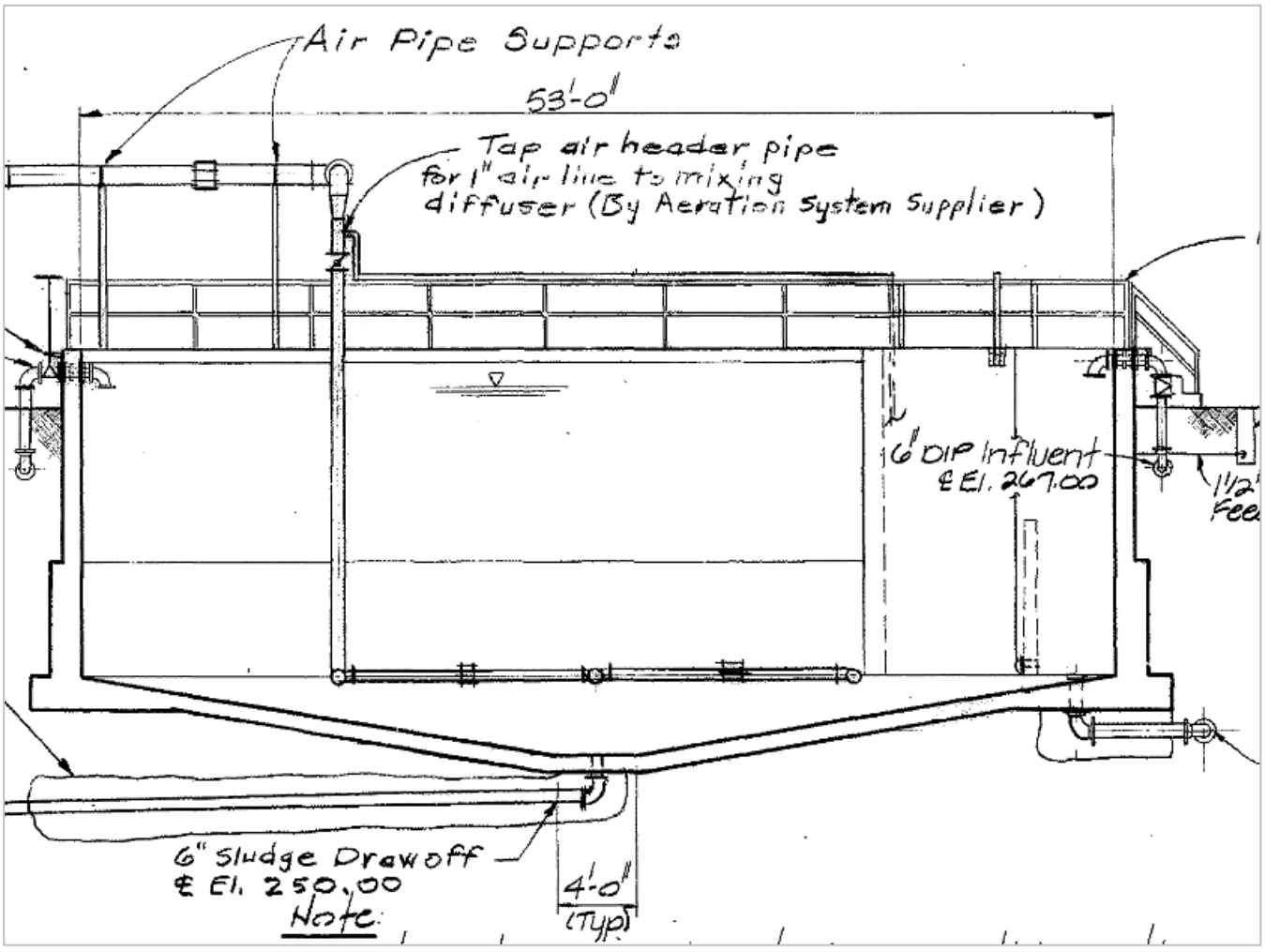


Figure 1. Section View of Existing Mixing System in On-site Tanks

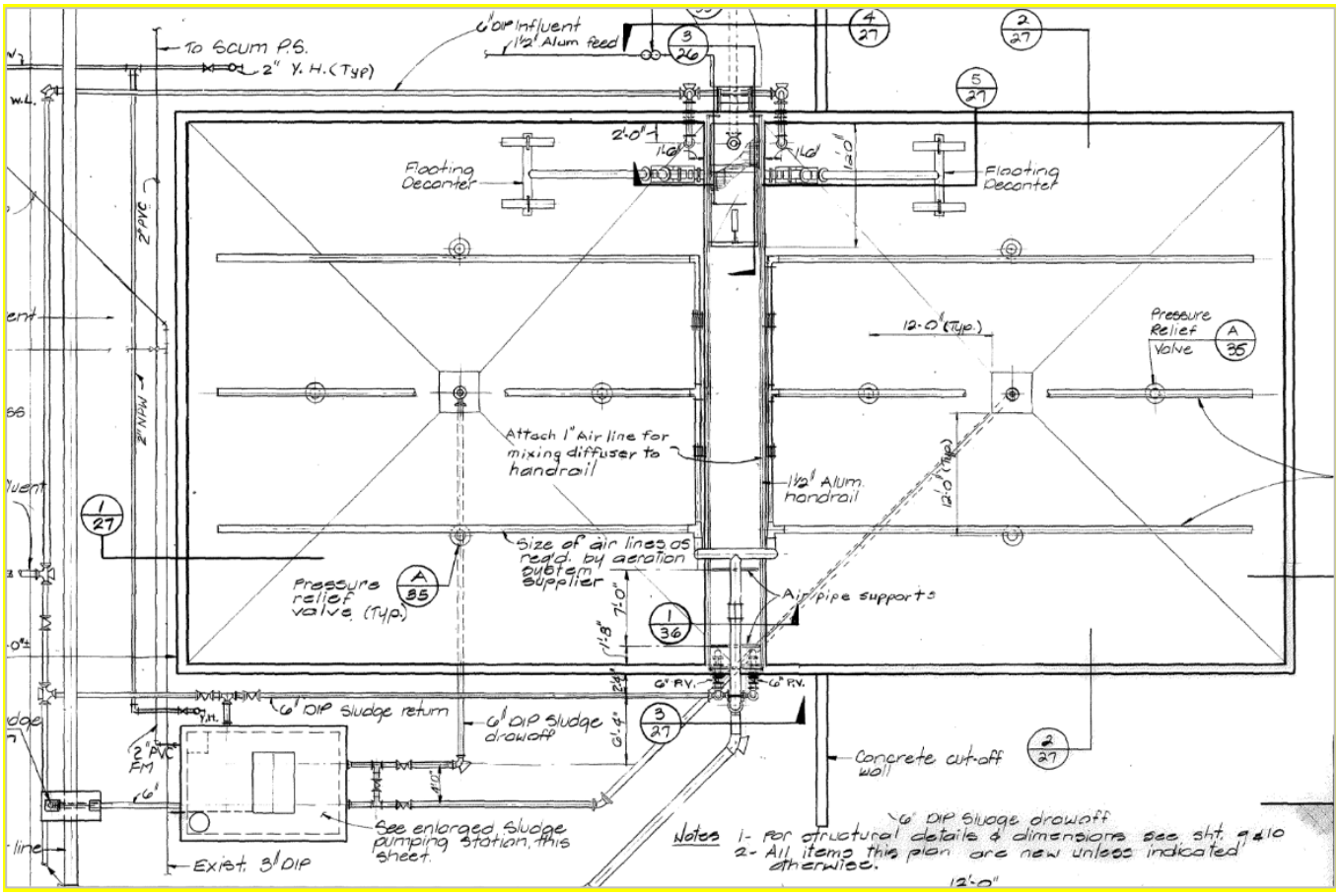


Figure 2. Plan View of Existing Mixing System in On-site Tanks

2.2 Hyperbolic Mixing Evaluation

2.2.1 Design Overview

In 2018, CDM evaluated hyperbolic mixers for the on-site tanks. The hyperbolic mixer generates a swirling mixing pattern with bottom to top movement at the walls of the tank. These mixers are capable of effectively resuspending solids with low energy consumption. Although, past installations have shown this system is not as effective in square tanks due to build up in the corners. A previous mixing evaluation conducted by CDM Smith assumed a conceptual design where the mixer platforms were tower supported from the floor of the tank as shown in Figure 3. This design impedes mixing conditions and would require cover replacement.

Figure 3. Hyperbolic Mixing with Tower Supported Platform (Basis of CDM Smith Conceptual Design)

BC revised the design to utilize a bridge support platform (Figure 4) spanning the length of the tanks to improve mixing conditions and not require cover replacement.

Figure 4. Hyperbolic Mixing with Bridge Supported Platform (Basis of Brown and Caldwell Conceptual Design)

2.2.2 Energy and Capital Cost

Capital costs for the alternative's evaluation were estimated based on vendor quotes and pulling construction data from recent BC projects.

- In 2018, the two hyperbolic mixers with a self-supported platform structure were estimated to have an uninstalled cost of $422,000, before markups. This design can only be implemented with cover removal.
- In 2022, the uninstalled cost for two hyperbolic mixers with a bridge supported platform is estimated to be $485,000. For this design, the bridge can be installed above the existing covers. This would only require shaft penetration through the covers instead of replacement.

It was assumed that the on-site storage tanks would only be mixed intermittently, specifically when biosolids were being transferred out of the tanks. Typically, OWASA loads liquid biosolids into its tanker trucks up to 12 hours a day, five days a week. Dewatering operations follow a similar schedule if liquid land application isn't available. It is assumed that OWASA would turn on the mixing system 30 to 60 minutes before biosolids would be pumped to dewatering or onto tanker trucks and would be turned off when dewatering or truck loading ends for the day. For power consumption purposes, it is assumed that the system would only operate 12 hours a day, five days a week (3,120 hours per year). Invent's power consumption is 140,000 kilowatt hours per year for a 30 HP mixer for each tank.

2.3 Large Bubble Mixing Evaluation

2.3.1 Design Overview

Large bubble mixing was the other technology that passed pre-screening for the on-site tanks. Large bubble mixing technology delivers compressed air to an air receiver tank, which then delivers air to a valve module. The valve module controls the bubble burst timing and sequence of the short-duration bursts of compressed air from nozzles on the tank floor. The conceptual design for the on-site tanks included 7 headers in the tank with 64 nozzles per tank. The vendor package includes a 400-gallon air receiving tank and a 30 HP compressor. The air receiver tank will be located on a new pad and under a canopy adjacent to the tanks. OWASA decided to include a standby compressor for redundancy. The compressors will be in a new prefabricated fiber-reinforced plastic (FRP) climate-controlled building. Feedback from installation reference checks and BC's previous designs called for the compressors to be located indoors in a climate-controlled building. The building will require an 8-ton AC unit to offset the heat output from the compressor. As shown in Figure 5, OWASA decided to put the compressor building in between the chemical building and the dewatering building.

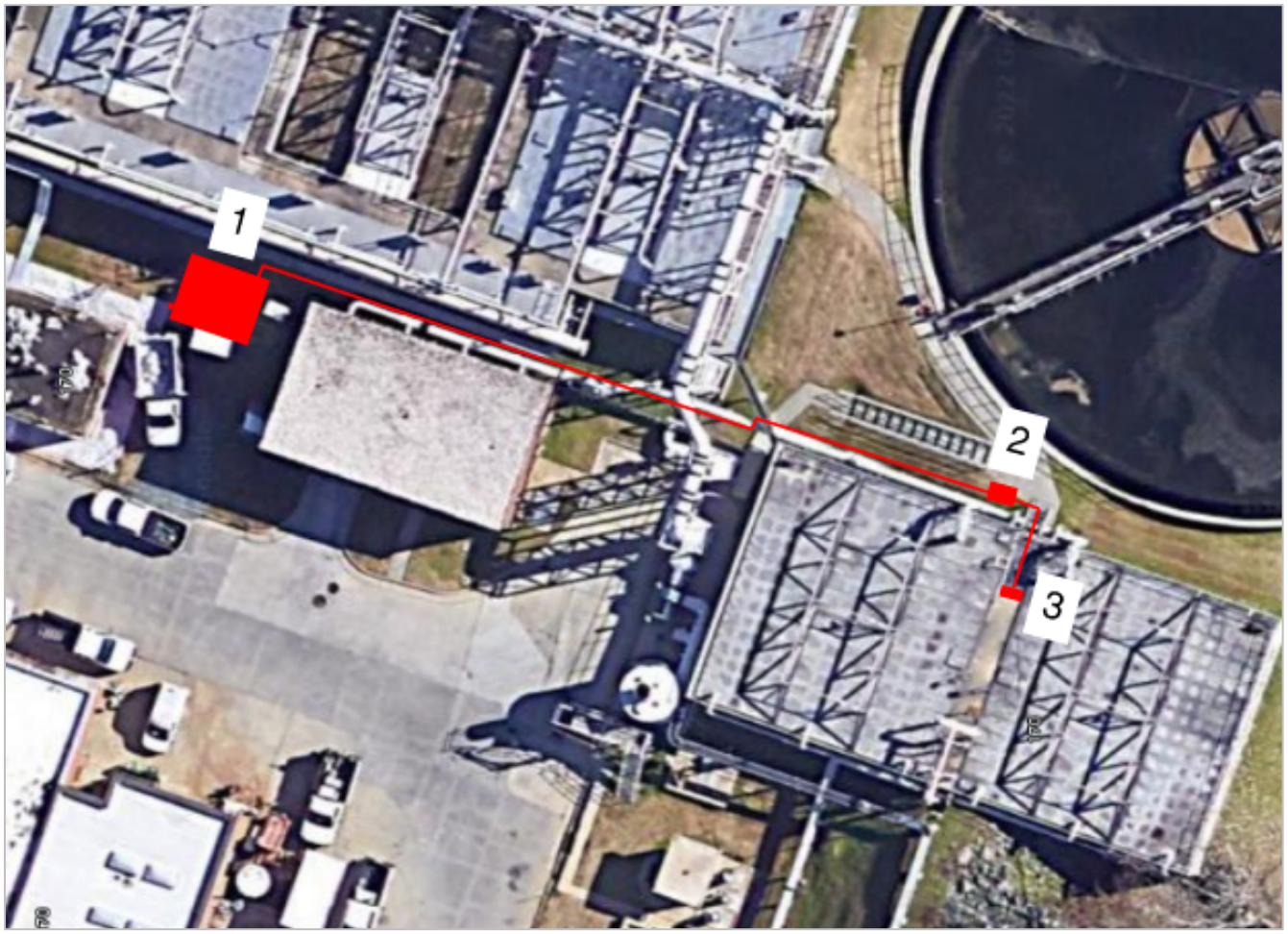


Figure 5. Large Bubble Mixing Conceptual Design - Equipment Layout

(1) Compressor Building (2) Air Receiver Pad and Canopy (3) Valve Module

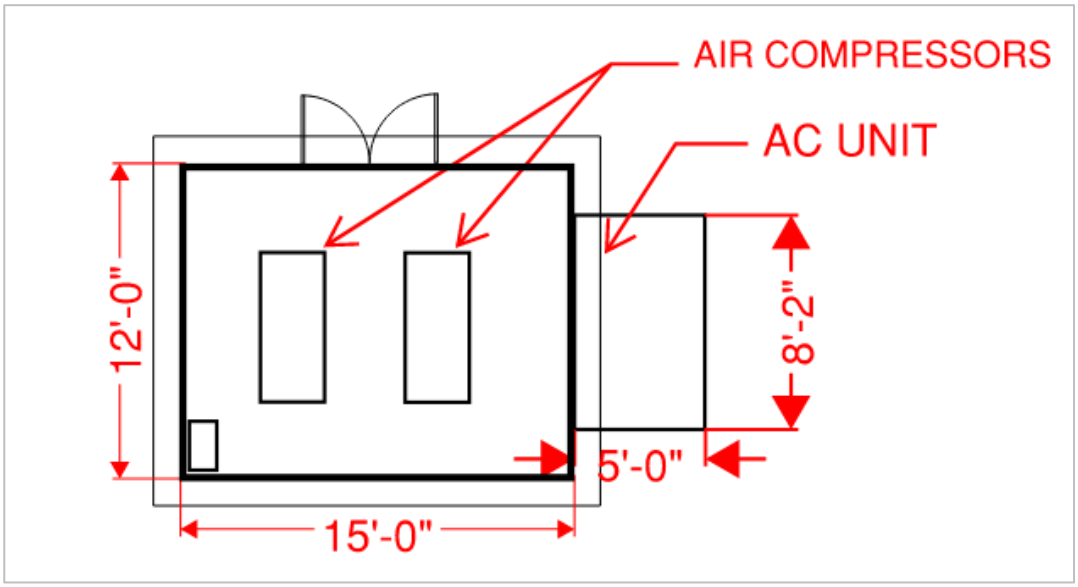


Figure 6. Compressor Building Layout and Footprint with Redundant Compressors

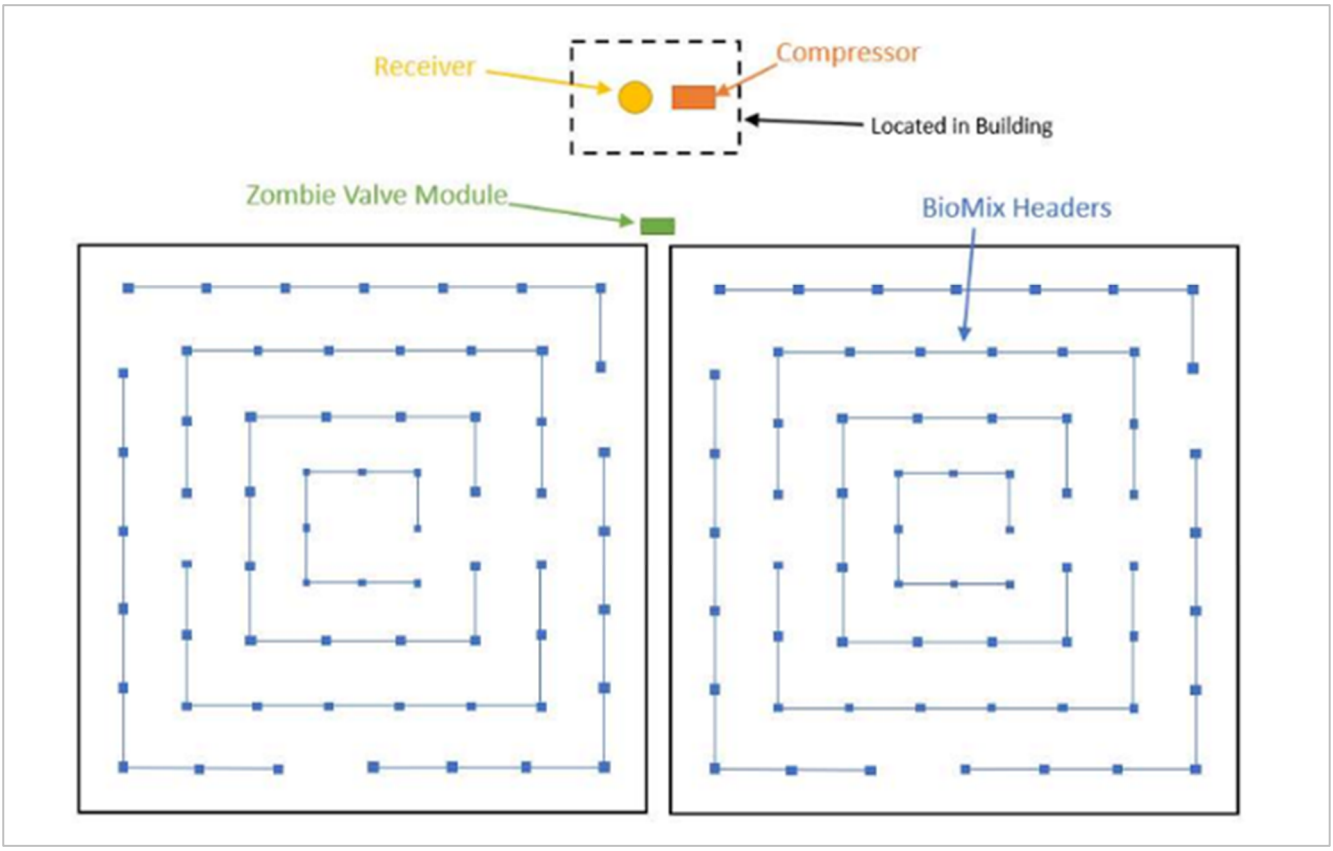


Figure 7. Large Bubble Mixing Nozzle Layout in Tanks

2.3.2 Energy and Capital Costs

Capital costs for the alternative's evaluation were estimated based on vendor quotes and pulling construction data from recent BC projects. The vendor package for the large bubble mixing technology is quoted to be $285k. Additional costs driving the estimated capital cost include the compressor building ($70k), electrical instruments ($45k), yard piping ($20k), and the pad and canopy for the air receiver tank ($20K).

The 30 HP compressor operates continuously but averages a lower power consumption because it has a loaded and unloaded (motor and screw still spinning, but not pushing air though) mode. The estimated daily energy use is 367 kWh/day.

It was assumed that the on-site storage tanks would only be mixed intermittently, specifically when biosolids were being transferred out of the tanks. Typically, OWASA loads liquid biosolids into its tanker trucks up to 12 hours a day, five days a week. Dewatering operations follow a similar schedule if liquid land application isn't available. It is assumed that OWASA would turn on the mixing system 30 to 60 minutes before biosolids would be pumped to dewatering or loaded onto tanker trucks and would be turned off when dewatering or truck loading ends for the day. For power consumption purposes, it is assumed that the system would only operate 12 hours a day, five days a week (3,120 hours per year); see section 2.4.1 for operation and maintenance details. The large bubble mixing power consumption is 66,000 kilowatt hours per year, which is less than half of the hyperbolic mixer energy demand.

2.4 Technology Comparison

2.4.1 Non-Cost Factors

The compressor in the large bubble mixing system will require daily preventative maintenance checks as shown in Figure 8, but there are no in-tank maintenance requirements. The hyperbolic mixer requires monthly preventative maintenance checks, as noted in Figure 9. Large bubble mixing also offers full redundancy by including a standby compressor. There is no redundancy offered with hyperbolic mixing. OWASA staff does have experience with both hyperbolic mixers and large bubble mixing.

BC conducted informational interviews with WWTPs that have past experiences with large bubble mixing, specifically the EnviroMix system Bio-Mix. The focus was on systems comparable to OWASA (high solids concentration). Constructive feedback from the plants highlighted the operational issues with the compressor if exposed to corrosive gasses or weather impacts. Placing the compressors in a building addresses these issues and helps with dampening the noise pollution from the compressor.

Atlas Copco Recommended Preventative Maintenance	
4,000 hours	Change oil and filter
Or yearly	Replace air filter element
	Replace filter element of electric cabinet
	Check pressure and temperature readings
	Check condition of air intake hose
	Test temperature shutdown function
In air cooled compressors:	
	Clean coolers
	Clean cooling fans of converter
	Check operations of cooling fan
	Check blow-off solenoid valve
	Inspect restriction nozzle in scavenging line
In water-cooled compressors:	
	Check for water leaks
8,000 hours	Replace oil separator element
Or every 2 years	Inspect oil separator vessel for damage and corrosion

Enviro-Mix Recommended Preventative Maintenance	
Daily	Check oil level
	Check readings on display
	Check air filter service indicator
	Check condensate is discharged
	Drain condensate
	Water- Cooled units: check cooling water flow
Monthly	Check condensate is discharged
	Vacuum condenser inlet
	Clean air jet in dryer
	Vacuum dust from inside dryer
3-Monthly	Check coolers for cleanliness
	Remove air filter and inspect
	Check filter element of electric cabinet
Yearly	Replace wearing parts of electric water drain
5-years	Replace all rubber hoses

Figure 8. Large Bubble Mixing Preventative Maintenance per O&M Manuals

Preventative Maintenance	
Daily	Check for obvious noises, vibrations and changes
Monthly	Check ventilation valve for contamination
	Check alignment of bottom guide unit
	Check bearing journal for wear
Annually	Clean the drive unit and mounting plate
	Check the alignment of the drive unit
	Check all bolt connections above waterline
	Check terminal box leak tightness
	Check conditions of safety and monitoring equipment
	Check condition of rubber buffers
	Renew grease packing under hollow shaft cover
	Clean the drive unit pressure relief valve
	Check insulation resistance against earthing
	Complete inspection of drive unit
	Clean ventilation holes in shaft
3-5 Years	Clean mixer body and shaft
	Visual check on mixer body and shaft

Figure 9. Invent Mixing Preventative Maintenance per O&M Manuals

2.4.2 Life Cycle Cost Analysis (LCA)

Table 1 summarizes the capital cost and 20 year NPV per the conceptual designs for the two technologies.

Table 1. Capital Cost Comparison for On-site Mixing Technologies

	Large Bubble Mixing	Hyperbolic Mixing
Capital Cost	$1.4M	$1.8M
20 yr NPV	$1.49M	$1.91M

The inclusion of a new cover for the tanks drives the hyperbolic capital cost to $3.5M and 20-year NPV to $3.61M. The conceptual design offers a potential way to install the new hyperbolic mixing system without demolishing the covers. However, once installed it would make replacing the covers more difficult. It is possible the condition assessment of the 20-year-old covers will determine that they may need replacement over the next 20 years, which would push OWASA to consider replacing them during the mixing improvements regardless.

2.5 Final Recommendation

Final recommendation for the on-site tanks is the large bubble mixing system. The system has lower capital and operating cost, half the energy consumption of hyperbolic mixers and the ability to install the system with the existing cover.

Additionally, large bubble mixing will achieve more effective mixing in the tanks. There is more control over mixing intensity with the ability to program bubble burst frequency and sequence. There is also more confidence that this system can resuspend thickened solids to facilitate intermittent mixing if desired.

While there is required daily maintenance checks, this can easily be added to Mason Farm's daily rounds. The compressor will be in a climate-controlled atmosphere, and the system doesn't require draining tanks and confined space entry for maintenance checks.

For these reasons, BC recommends OWASA install the large bubble mixing for the on-site biosolid storage tanks.

Section 3: Off-site Storage Tanks Evaluation

3.1 Background

OWASA has two off-site storage tanks for temporary storage when land application cannot occur. The tanks are circular glass-lined bolted steel tanks with open tops and flat floors; details are outlined in Table 2.

Table 2. Off-site Tank Details

	Tank 1	Tank 2
Tag	SST1	SST2
Installed	1997	2002
Diameter (ft)	70	90
SWD (ft)	30	30
Capacity (MG)	1.0	1.5

The suction line from the center sump of the tanks is encased in concrete below grade. The tanks are visibly in good condition, though significant effort was needed to clean Tank 1 in the Fall of 2021, which is the first time either tank has been cleaned in over 20 years.

OWASA's biosolids handling strategy is as follows:

- During the summer months, biosolids are pumped from the on-site storage tanks into tankers and are land applied. If land application can't occur temporarily due to wet weather or equipment downtime, the tankers will deliver the biosolids to the off-site storage tanks until land application can be resumed. At which time biosolids will be pumped from the tanks into tanker trucks and brought to land application sites.
- During the winter months, when land application isn't frequently practiced, liquid biosolids are pumped from the on-site storage tank to the Dewatering Facility, and dewatered biosolids are hauled to McGill for off-site composting. If the dewatering is unavailable (only one rotary press with no redundancy) and on-site storage is being depleted, liquid biosolids will be trucked to the off-site storage tanks.

Normally biosolids will need to be transferred to the off-site storage tanks during the winter and will have to be stored there until the spring when land application can resume. BC assumed (and OWASA confirmed) that a good assumption is that the mixing system for the off-site storage tanks would be operated on average 25% of the time (3 months per year). This duration will be used to determine the energy demand of the mixing system for the off-site storage tanks.

To calculate energy costs, BC took into account the free energy associated with OWASA's 150 kW solar photovoltaic farm that is adjacent to the off-site storage tanks. In 2021, the solar farm produced 176,390 kWh of renewable energy. The lowest generation month was December at 10,876 kWh, and the highest was July with 20,763 kWh. Biosolids will typically be stored at the off-site tanks during the winter months, so the energy demand was subtracted by the lowest solar generation time (December) to determine the amount of energy that would have to be purchased for the off-site mixing system.

3.1.1 Current Mixing System

Both tanks are mixed with a single duty pump per tank that provides mixing through jet headers. OWASA has experienced clogging of the headers due to intermittent operation or settling of solids in the header after the tank is pumped down. There is no water at the off-site location, so to flush out the pipes to unclog the system OWASA must bring water up from a nearby creek via water trucks. OWASA must do this several times a year.

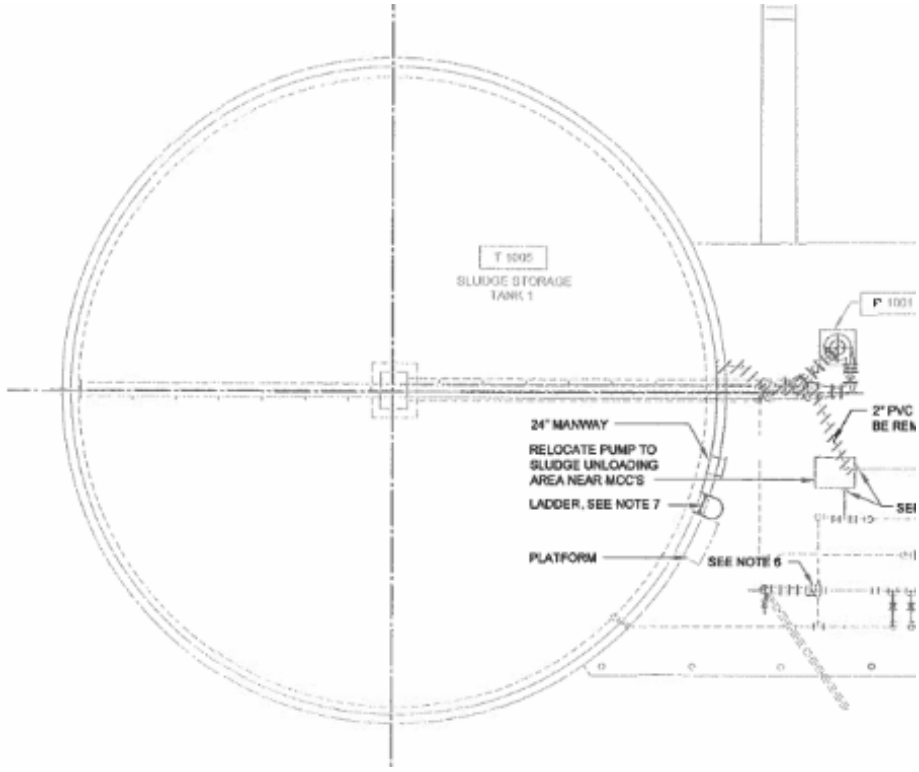


Figure 10. Plan View of Off-site Storage Tank 1

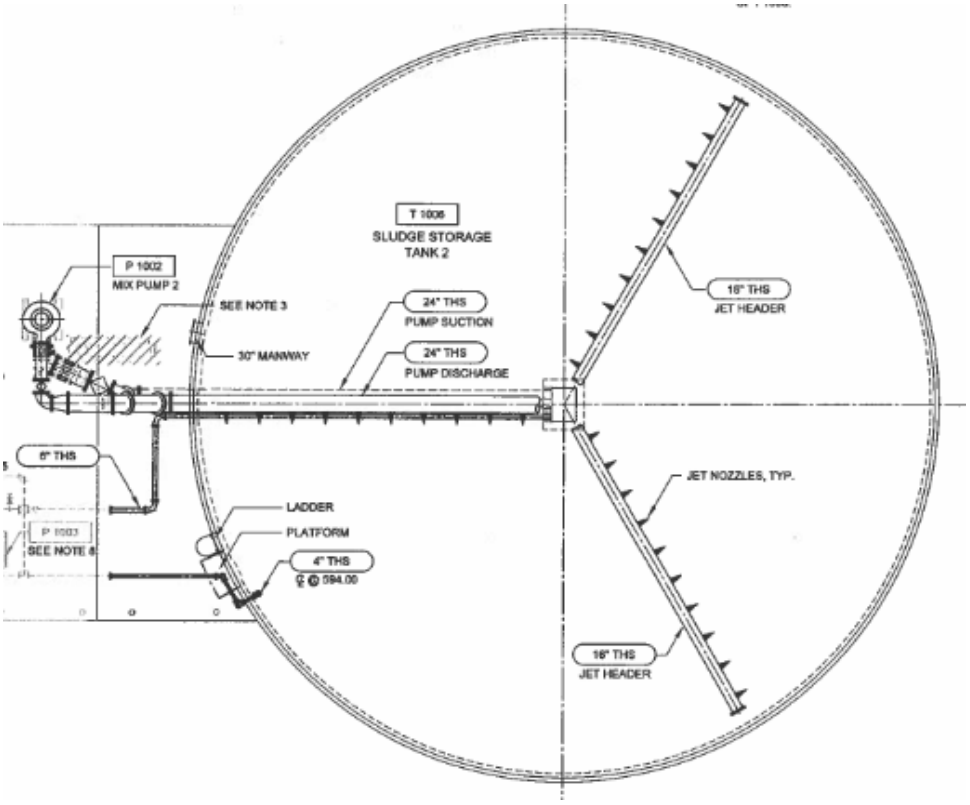


Figure 11. Plan View of Off-site Storage Tank 2

3.1.2 Off-site Tank Considerations

The off-site storage has very tall open top tanks, limiting the technology applications. The chosen technology also needs to avoid structural modifications or penetrations to the tank walls. There is no water source at the site, also limiting available technologies. There are solar panels at the off-site location that provides "free'" energy at site. This was used in the design to reduce the impact of higher horsepower technologies.

Although OWASA prefers to minimize the time biosolids are held in tanks, the tanks will be continuously mixed if solids are being stored. A key consideration in choosing mixing technologies is how to empty the tank without letting residual biosolids settle in pipes and on the floor.

3.2 Pumped-Nozzle Mixing

Pumped-nozzle mixing was one of the pre-screened options selected for detailed analysis for the off-site tanks. Pumped nozzle mixing recirculates solids through nozzles strategically located in the tank. The nozzles are low profile to help the tank stay well mixed at low liquid depths; however, even with the low-profile nozzles, mixing is lost once the depth drops below 7 feet above finished floor.

Figure 12. Example Installation of Pumped-Nozzle Mixing

3.2.1 Design Overview

The conceptual design, which includes duty/standby pumps (with "flushless" mechanical seals due to lack of water at the site) for each tank, was based on Vaughan's Rotamix system. Tank 1 was quoted for two (one duty, one standby) 60 HP mixing chopper pumps, creating a mixing flow of 3,600 GPM. Tank 2 was quoted for two (one duty, one standby) 75 HP mixing chopper pumps resulting in a mixing flow of 5,400 GPM. Figure 13 illustrates the optimal layout for pump performance and maintenance access. The pumps are in a vertical configuration.

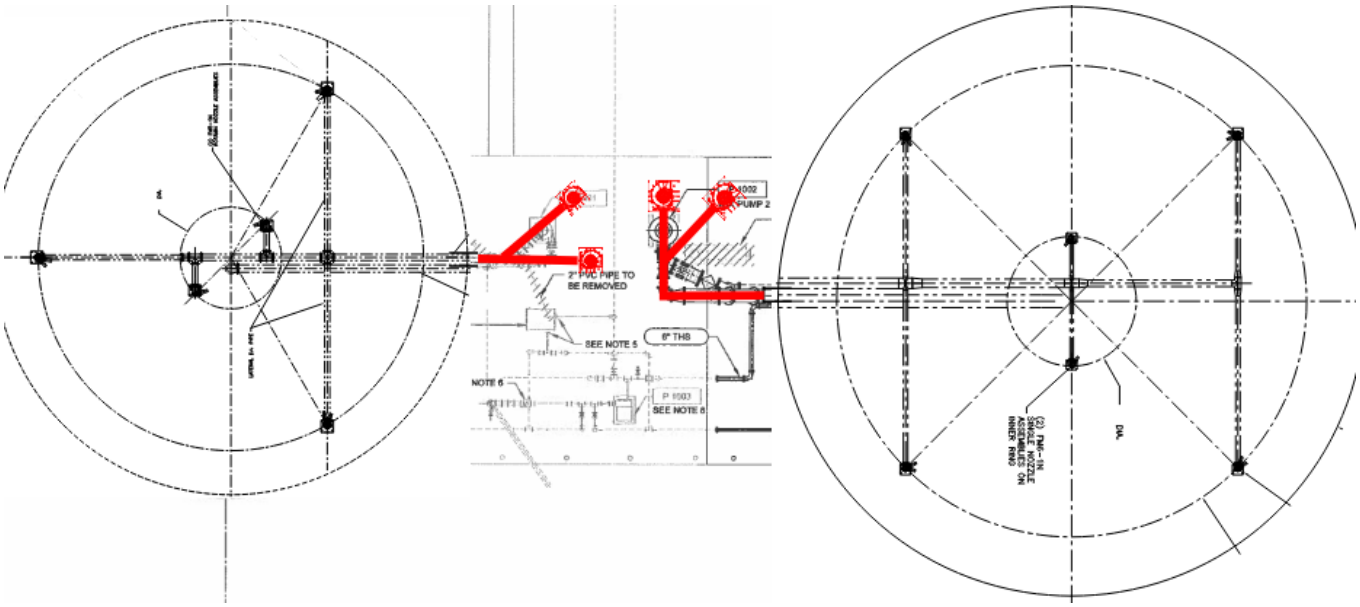


Figure 13. Pumped-Nozzle Mixing Conceptual Design-Equipment Layout

3.2.2 Energy and Capital Cost

The total system daily energy usage would be 2400 kWh/day. The total connected load at both tanks would increase significantly from the existing system but only one pump would operate at a time. Therefore, the total operating load will decrease as shown in Table 3.

Table 3. Operating Loads Comparison of Existing and Rotamix System

	Tank 1	Tank 2	Total
Existing Pump HP	50 HP	125 HP	175 HP
Rotamix Pump HP	60 HP	75 HP	135 HP

Capital costs for the alternative's evaluation were estimated based on vendor quotes and pulling construction data from recent BC projects. The capital cost of installing the pumped nozzle technology was $2.2M with a 20 yr NPV of $2.34M. With no standby pumps, the capital cost decreases to $1.8M and the 20 yr NPV to $1.94M.

3.3 Submersible Impeller Mixing

Submersible impeller mixing was the other technology that passed pre-screening for the off-site tanks. The submersible impeller vendor used for this evaluation was Anaergia. The Anaergia mixer (example installation shown in Figure 14) is a three-blade impeller attached to a steel post that allows for variable mixing direction, height, and speed.

3.3.1 Design Overview

The smaller impeller option was utilized for this design to allow effective mixing down to 7 feet of liquid level. An electrical winch was included in the analysis to allow for easy removal for maintenance. Per the conceptual design provided by Anaergia, there are two mixers in tank 1 and three in tank 2. During an interim meeting with OWASA, BC presented multiple options to provide maintenance access to the impellers. The lowest cost option is improving the current ladders to be able to support maintenance access. However, since all the maintenance must happen at the top of the tank, OWASA required a stair tower at each impeller to improve access and safety. Each stair tower (Figure 15) would support a davit crane that would facilitate lowering an impeller out of the tank for replacement. The five stair towers would require grading improvements due to the limited space between the tanks and the berm (Figure 16).

Figure 14. Example Installation of Anaergia Impeller Mixer

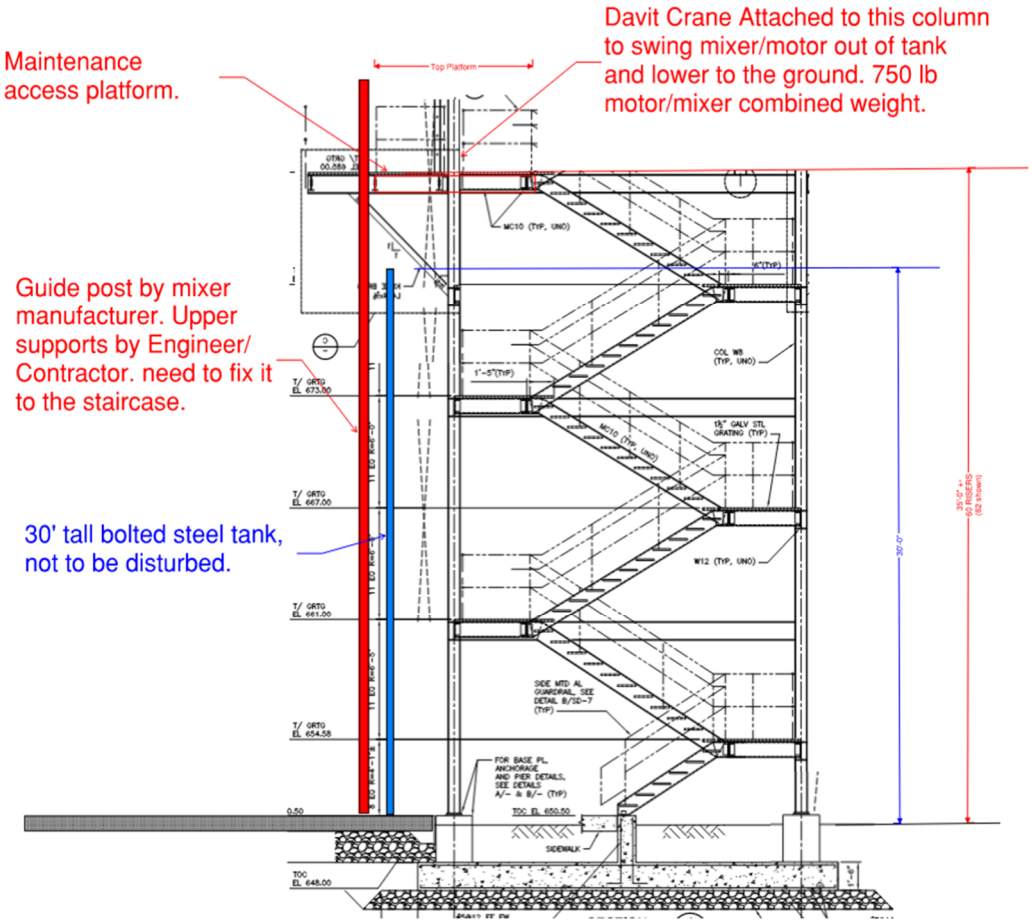


Figure 15. Conceptual Design of Maintenance Access Stair Tower

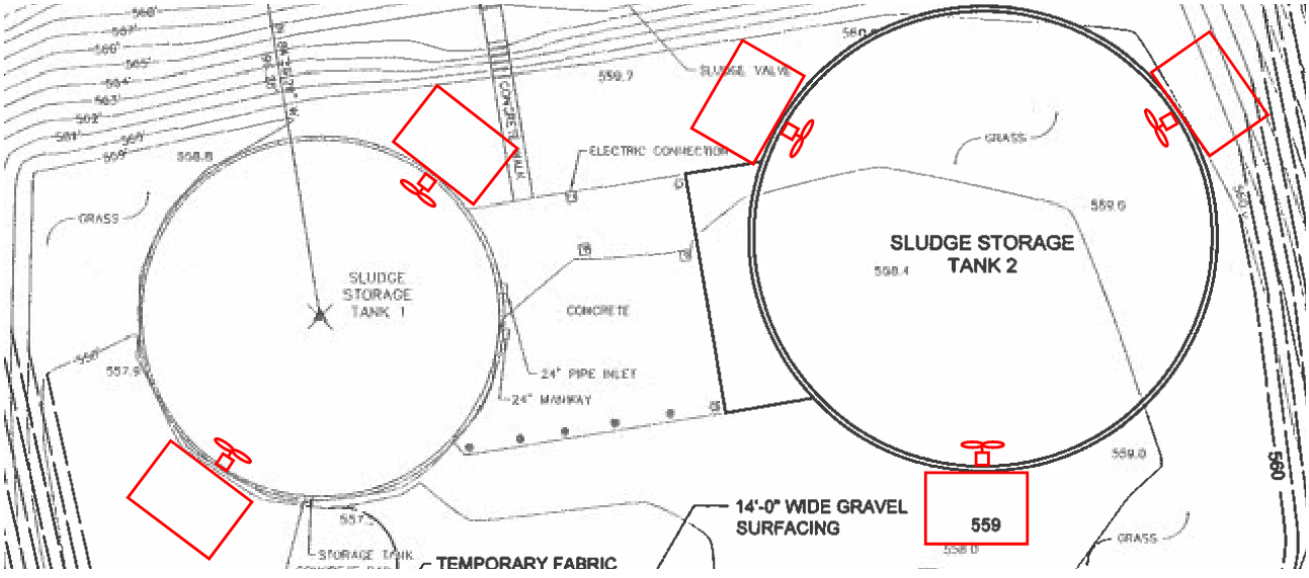


Figure 16. Anaergia Impeller Mixing Conceptual Design

3.3.2 Energy and Capital Cost

The connected load for each mixer is 12.5 kW, but the average operating load provided by Anaergia is 6.4 kW per mixer. The total loads for each tank are summarized in Table 4.

Table 4. Anaergia Energy Consumption

	Tank 1	Tank 2
Connected Load	25 kW	37.5 kW
Operating Load	13 kW	19.5 kW

Capital costs for the alternative's evaluation were estimated based on vendor quotes and pulling construction data from recent BC projects. The capital cost of installing the mixers would be $3.0M with a 20 yr NPV of 3.01M. A significant portion of this cost is driven by the stair tower installation. The capital cost with minimal maintenance access instead is $2.0M and the 20 yr NPV decreases to 2.01M.

3.4 Large Bubble Mixing

After the initial kickoff workshop and multiple conversations, OWASA decided to eliminate large bubble mixing from the off-site evaluation due to concerns with the daily maintenance checks. OWASA does not have staff out at the off-site location daily, so this challenge initially was identified as a fatal flaw. However, the evaluation of pumped nozzle mixing and submersible impeller mixing clarified that these technologies did not fully solve OWASA's current issues. Therefore, it was recommended to reconsider large bubble mixing, but with the inclusion of instrumentation provisions to allow the daily maintenance checks on the compressor to be performed virtually. OWASA decided to move forward with re-evaluating large bubble mixing.

3.4.1 Design Overview

The conceptual design provided by EnviroMix at the off-site tanks included duty and standby 50 HP compressors in a climate-controlled prefabricated FRP building, a 400-gal air receiving tank, two valve modules (one for each tank), and 86 nozzles in Tank 1 and 136 nozzles in Tank 2 (Figure 18). The 50 HP compressor is only slightly larger than the 30 HP compressor for the on-site system, so the FRP prefabricated, and climate-controlled building will be of similar size. The building will require a larger AC unit (12 tons) to properly mitigate heat output from the compressor. Figure 17 displays the location for the building, air receiver and valve modules used in the conceptual design. The air receiver tank will be on a pad and under a canopy like the on-site configuration. The building is preliminarily placed along the access road on top of the berm, which would require grading and retaining wall.

3.4.2 Energy and Capital Cost

As mentioned in the on-site analysis for large bubble mixing, the compressor operates continuously, but averages a lower power consumption due to two different modes. The daily energy consumption of the compressor is approximately 620 kWh/day.

The vendor package from EnviroMix at the off-site is $495K. The other drivers of the capital cost for large bubble mixing at the off-site location include the compressor building (70k), retaining wall ($70k) and the electrical and instruments needed to perform the remote daily maintenance checks on the compressor ($100k).

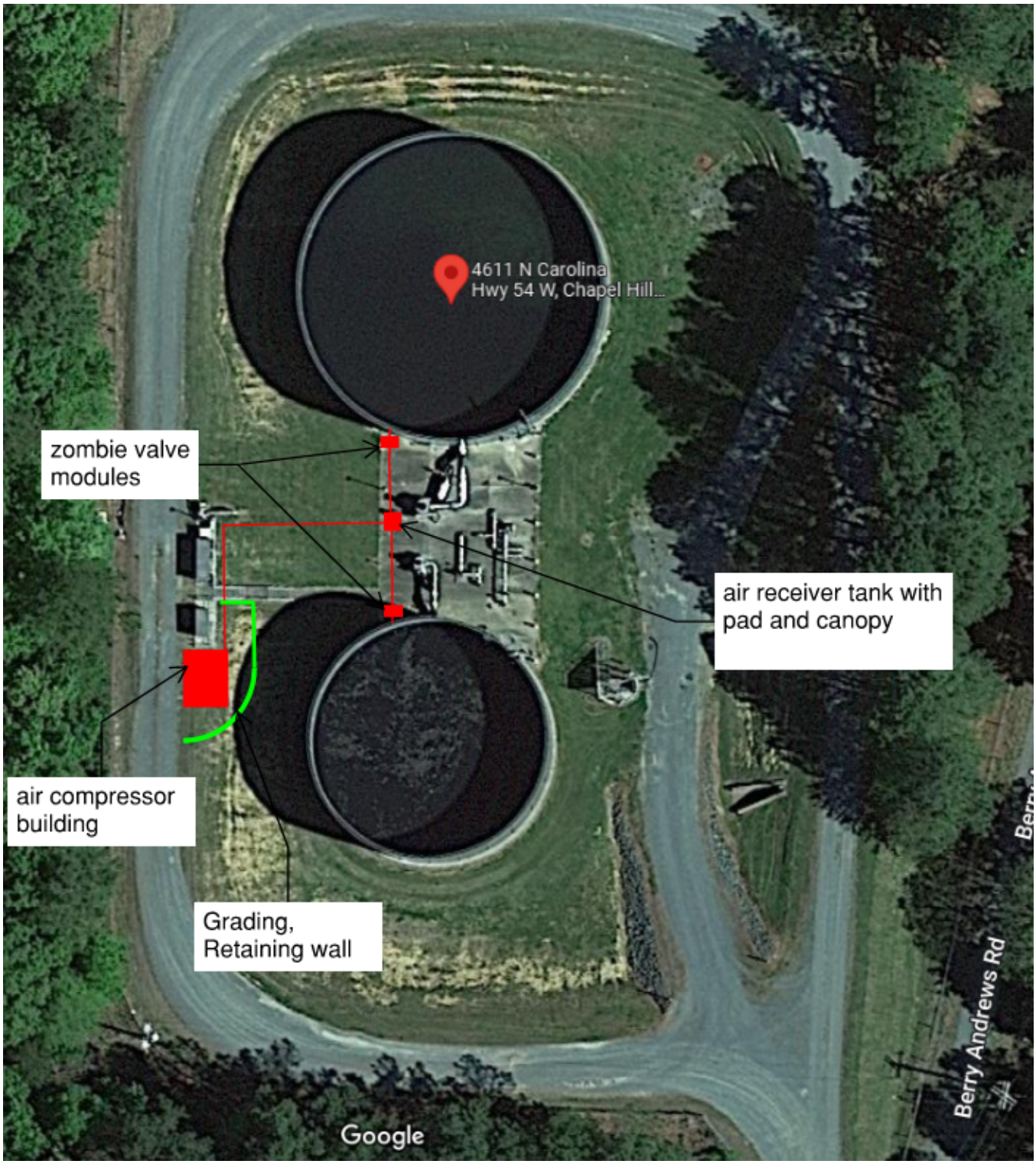
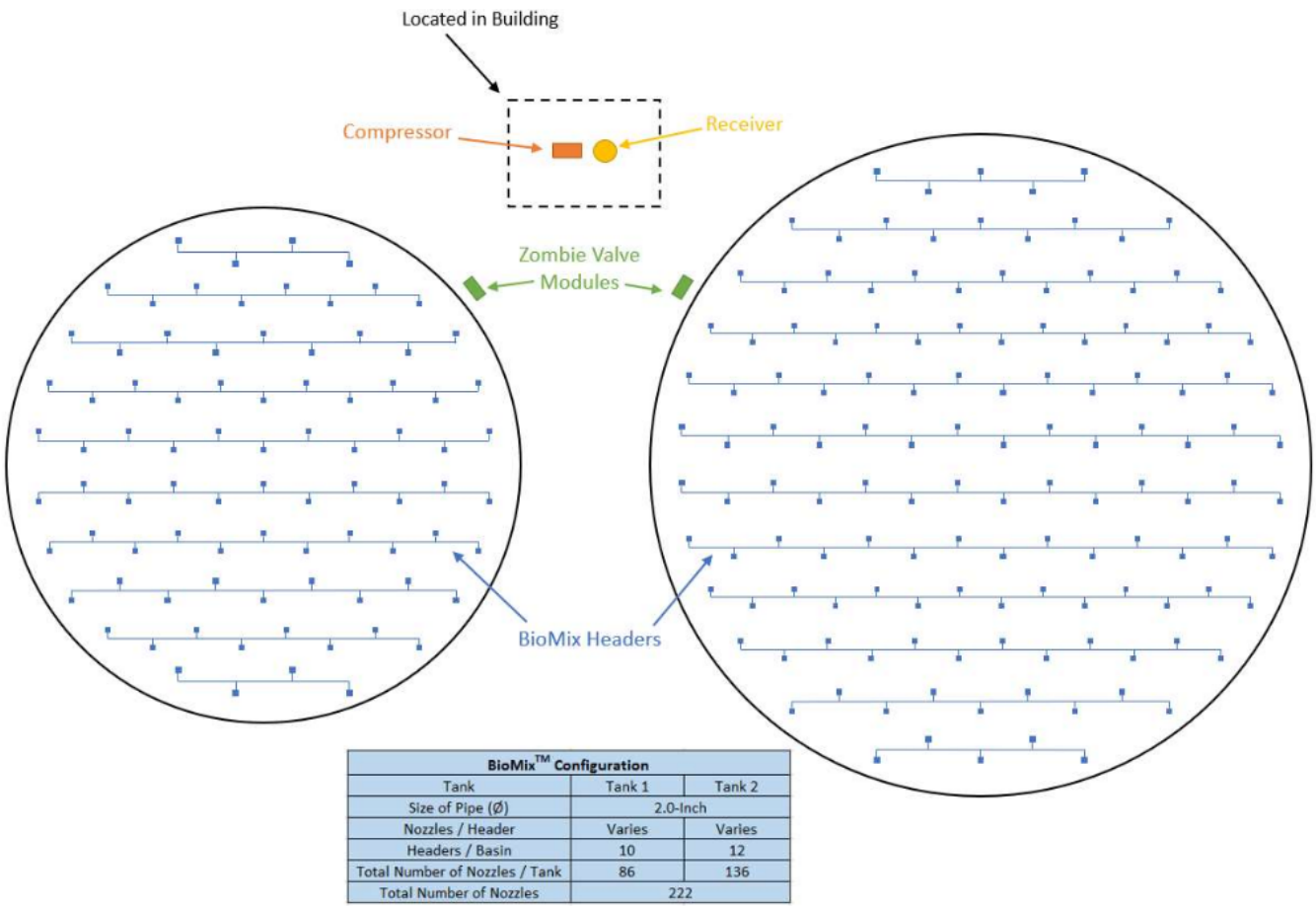


Figure 17. Large Bubble Mixing Conceptual Design- Equipment Layout at Off-site



BioMix™ Configuration		
Tank	Tank 1	Tank 2
Size of Pipe (Ø)	2.0-Inch	
Nozzles / Header	Varies	Varies
Headers / Basin	10	12
Total Number of Nozzles / Tank	86	136
Total Number of Nozzles	222	

Figure 18. Large Bubble Mixing Nozzle Layout

3.5 Technology Comparison

3.5.1 Non cost Factors

Pumped-nozzle mixing requires monthly preventative maintenance (PM) checks, while submersible impeller requires 6-month PM checks. However, PM for the pumps is easier because they are at grade, while the impellers require staff to climb several flights of stairs and operate a winch to remove the impellers for PM. Submersible impeller mixing requires daily maintenance checks that cannot utilize SCADA, unlike the large bubble mixing and pumped-nozzle mixing. Figures 19 and 20 summarize the maintenance schedules for the impeller and pumped nozzle mixing systems, respectively. Both mixing technologies require a minimum depth of seven feet to properly mix. Impeller mixing doesn't have redundancy with the design but can provide suboptimal mixing with a unit out of service. Pumped nozzle mixing offers full redundancy if OWASA decides to have duty/standby pumps for each tank.

BC conducted informational interviews of Anaergia impeller mixing installations at comparable applications. Both facilities mentioned Anaergia's technical department was not always helpful in answering their questions, concerns, and challenges with the system. One facility also mentioned the O&M manual was vague and lacking detail. Both installations were younger than two years, so they did not have experience with system failures or part replacement.

Task	Frequency
Check for unnatural operating behavior (noises, vibration, etc.)	Daily
Check cable for defects (chafing, stretch marks, kinks)	6 months
Check pull rope for wear, contamination, corrosion	
Check threaded connections are tight	
Check submersible mixer for corrosion and leaks	
Motor bracket for wear	
Check power consumption damage to motor	
Check motor housing for contamination	
Check roller bearings for generation of noise	
Check rope for contamination and damage	
Check mixer blade for deformation, damage, wear	
Replace shaft seal and slip ring seal.	

Figure 19. Anaergia Preventative Maintenance Schedule per O&M Manuals

Operation	Frequency	Lubricant	Comments
1) Check amperage draw to motor. Compare to amperage measured at start-up.	Monthly		Make sure amp draw does not exceed full load amps on nameplate.
2) Motor Greasing	6 months.	Polyrex EM Grease	Do not mix greases unless compatibility has been checked and verified.
3) Add oil to pump bearing housing	Only as needed.	ISO 46 hydraulic oil	
4) Check oil in Vaughan Seal	Monthly	ISO 46 hydraulic oil	If leakage is observed at the pressure relief valve change the oil. Replace seal if new oil is quickly contaminated.
5) Check cutter clearance	Annually		

Figure 20. Vaughan Rotamix Preventative Maintenance Schedule per O&M Manuals

Of the original two off-site technologies, pumped-nozzle and submersible impeller, pumped-nozzle was preferred because it offered higher intensity mixing and redundancy. However, pumped nozzle mixing was not recommended because cleaning out the discharge piping as a tank was emptied would be a very labor-intensive task (involving hauling water up from the creek in water trucks). Additionally, both technologies have a minimum mixing level of 7 feet; this is a fatal flaw since the off-site tanks are frequently emptied and require

continuous mixing to avoid solid settlement since a washdown system is not practical. These considerations drove OWASA to reconsider large bubble mixing.

Large bubble mixing provides redundancy and ease of maintenance access outside of the tanks, doesn't require washdown water when the tank is emptied, and most importantly provides the best means of keeping solids from settling on the large flat tank bottom. This is because large bubble mixing allows the tank to be continuously mixed down to less than 1 foot of depth, compared to 7 feet minimum mixing depth required of the other systems. The downside to large bubble mixing is the daily maintenance checks, which will be addressed with additional SCADA monitoring to reduce the frequency of trips to the off-site tanks.

3.5.2 Life Cycle Cost Analysis (LCA)

As described in Section 3.11, the off-site storage tanks are assumed to operate 3 months of the year, and the subtraction of the minimal monthly solar photovoltaic power generation are included in the energy cost analysis.

The capital costs were the driver of the cost analysis for the off-site system due to reduced operating time and availability of free energy from on-site power generation. All options assumed electrical and instrumentation costs were 15% of equipment costs, except for large bubble mixing, which was increased to 20% (additional $44k) to account for the additional electrical and instrumentation needed to reduce maintenance visits. Large bubble mixing has the lowest capital and life cycle costs of the three technologies.

Table 5. Capital Cost Comparison of Off-site Mixing Technologies

	Impeller	Pumped Nozzle	Large Bubble
Capital Costs	$3.0M	$2.2M	$2.1M
20 yr NPV	$3.0M	$2.3M	$2.1M

3.6 Final Recommendation

Large bubble mixing is recommended for the off-site tanks because it is best suited to address the current challenges OWASA faces. The system provides redundancy, avoids tank impacts, is resistant to clogging, and is capable of mixing when draining tanks. Due to the storage strategy at these off-site tanks, mixing while the tank is drained is a critical requirement. Additionally, this technology offers the lowest capital and life cycle cost. Utilizing instrumentation to reduce maintenance site visits will address the main concern OWASA originally had about large bubble mixing at the off-site storage tanks.

Section 4: Capital Improvements Plan and Next Steps

BC's estimating group developed an AACE Class 4 estimate for the selected mixing technologies for the on-site and off-site biosolids storage tanks. This estimate is used as the basis for recommended fiscal year budgets for these improvements, which are summarized in Section 4.1. Section 4.2 outlines the recommended next steps to proceed with these improvements.

4.1 Capital Improvements Plan

BC's estimating group developed a AACE Class 4 opinion of probable construction cost (OPCC) for the selected mixing technologies for the on-site and off-site biosolids storage tanks. This estimate is included in Attachment A and summarized in Table 6.

Table 6. Biosolids Storage Mixing Improvements Class 4 OPCC Summary

	Upper Range (+50%)	Estimated Construction Cost	Lower Range (-30%)
On-Site Improvements	$2,020,000	$1,340,000	$940,000
Off-Site Improvements	$3,140,000	$2,100,000	$1,470,000
Total Improvements	$5,160,000	$3,440,000	$2,410,000

Total construction costs could range from $2.4M to $5.2M. These costs don't include the potential replacement of the on-site storage tanks' aluminum odor control covers, which would cost approximately $800,000. This OPCC also assumes that all the storage tanks can be completely drained before turning over to the Contractor. This is likely not the case for the large off-site storage tank. If OWASA will rely on the Contractor to clean that tank, we estimate that could be a $500,000 effort given the size of the tank, flat floors, access constraints, and lack of a water source on site. Adding cleaning of the large off-site storage tank and replacement of the on-site tanks' odor control covers would bring the estimated construction cost of $3.4M closer to the upper range of the OPCC (150% of estimate). To be conservative and provide budget for contingency planning, the upper range of the OPCC (150% of estimate) is used to summarize fiscal year budgets for these improvements (Table 7).

Table 7. Biosolids Storage Mixing Improvements Budgeting for CIP

OWASA Fiscal Year	On-Site	Off-Site	Total	Notes
2024 (7/2023 – 6/2024)	$195,000	$220,000	$415,000	60% of Legal, Administration and Engineering
2025 (7/2024 – 6/2025)	$2,130,000	$3,305,000	$5,435,000	40% of Legal, Administration and Engineering + Upper Range of OPCC

The following assumptions are included in the budgeting outlined in Table 7:

- Upper range of the Class 4 OPCC was used to provide contingency.
- $690,000 (20% of the actual OPCC of $3.4M) was assumed for legal, administration and engineering services. Approximately 60% of this is scheduled to occur in FY 2024, which includes $40,000 for condition assessment of the concrete walls and aluminum covers for the on-site storage tanks. The remaining 40% would occur in FY 2025.

4.2 Next Steps

This study identified the preferred mixing system technology for the on-site and off-site biosolids storage tanks. The next step in this project is to refine the conceptual designs developed in this study. Key considerations for each application are summarized below.

4.2.1 Considerations common for both On-Site and Off-Site Applications

Conduct a preliminary engineering evaluation that will include:

- Confirm pipe sizing, routing and layout of air receiver and valve module near the storage tanks.
- Confirm source and routing of power and controls for the mixing system.
- Update mixing system lead times and recommend whether a pre-selection or pre-procurement of the large bubble mixing system is beneficial for OWASA. This includes obtaining quotes from the two other proven suppliers of large bubble mixing systems.
- Sequence of construction that will provide OWASA with the required storage capacity to maintain operations during construction. This will likely include:
    - Only working on one tank at a time for each facility
    - Starting off-site work in spring or early summer when OWASA has both land application and dewatering available.
    - Coordination with OWASA to ensure preventative maintenance is done on the rotary press and on land application equipment to reduce the risk of downtime when upgrades to the storage tanks are occurring.
- Recommendations for regular post-construction tank inspections by OWASA.
    - Off-site tanks to be inspected near the end of land application season when the tanks are empty. This will allow OWASA to document interior condition of the glass lined bolted steel tank as well as confirming the in-tank nozzles are not damaged or have any debris built up around them.
    - On-site tanks to be inspected the end of the first year, and then every 3-4 years afterward (timed to coincide with OWASA's concrete condition assessment asset management plan). Only one tank can be drained at a time. Inspection will allow for the condition of the concrete tank walls and aluminum covers to be evaluated, as well as confirming the in-tank nozzles are not damaged or have any debris built up around them.

It is anticipated that an accelerated final design (one deliverable at 90%) would be achievable after completion of the preliminary engineering evaluation.

4.2.2 On-Site Biosolids Storage Specific Considerations

Conduct a preliminary engineering evaluation that will include:

- Condition assessment of the existing aluminum cover and concrete walls of the storage tanks. The condition assessment will recommend any repairs or replacement that should be included with the mixing improvements.
- Evaluation of potential improvements or replacement of the two 7.5HP storage tank pumps and pump vault. The vault is over 30 years old and represents a confined space hazard which makes it difficult to maintain. The evaluation should develop conceptual designs for improvements, which OWASA can consider including with the detailed design of these improvements or into a separate project.
- Refine details of the compressor building, including method of cooling the compressors (air or water), coordinating with the vendor to provide controls for the duty/standby compressor configuration, and initiating a subsurface utility exploration (SUE) to confirm location of underground utilities to inform final location of compressor building and any associated site work.
    - A SUE was conducted on this area during the 14.5 mgd upgrade that identified several small pipes (water, drain, chemical) that run along the front the aeration tanks, some in service and some likely abandoned. BC to search for those SUE files during preliminary design.

  - OWASA to verify the location of air pipes behind the chemical building to finalize location of compressor building.
- Develop standard operation procedures (SOP) based on the vendor operation and maintenance requirements.

4.2.3 Off-Site Biosolids Storage Specific Considerations

Conduct a preliminary engineering evaluation that will include:

- Refine details of the compressor building, including coordinating with the vendor to provide controls for the duty/standby compressor configuration, and structural geotechnical considerations to confirm final location of compressor building and any associated site work required.
  - The current conceptual design includes a retaining wall to support the foundation of the compressor building that will be built into the containment berm's slope. This will reduce the secondary containment volume of the berm but was used to provide a worst-case budget for CIP planning. The PER should evaluate other potential locations for the compressor building and compare that to a more detailed design effort around the retaining wall to determine details and potential impact on the small storage tank's foundation. For example, the Contractor may have to drive sheeting in lieu of excavation to provide formwork for the concrete wall to avoid compromising the foundation of the small storage tank.
  - A SUE may be warranted to confirm viability of potential locations for the compressor building.
- Develop automation plan to allow daily maintenance checks to be performed remotely. Confirm the daily maintenance requirements associated with alternative large bubble mixing suppliers.
- Develop standard operating procedure (SOP) based on the vendor operation and maintenance requirements for emptying and filling the tanks that avoids sludge or other unwanted material from entering the air pipes.
  - Large bubble mixing prevents clogging of diffusers and entry of sludge into air headers by having the diffuser pointed down toward the floor. The standing pressure from the compressed air in the headers prevents sludge from entering the headers when it isn't mixing. However, when the tank is empty the compressed air in the headers will exit the pipe. BC should coordinate with the large bubble mixing vendors on the optimal SOP for this application. This likely requires the mixing system to be turned on just prior to introducing sludge into an empty tank.

Attachment A: Opinion of Probable Construction Cost

AACE Class 4 Estimate for Selected On-Site and Off-Site Mixing Technologies

Memorandum

Date: November 28, 2022

To: Thomas Nangle, Raleigh

From: Catherine Dummer, Portland

Reviewed by: William Agster, Denver

Copy to: Emma Guertin, Raleigh

Project No.: 155870.400.401

Subject: OWASA Biosolids Storage Mixing Evaluation
Planning Level Design Completion
Basis of Estimate of Probable Construction Cost

The Basis of Estimate Report and supporting estimate reports for the subject project are attached. Please call me if you have questions or need additional information.

Enclosures (2):

1. Basis of Estimate Report
2. Summary Estimate

Basis of Estimate Report

OWASA Biosolids Storage Mixing Evaluation

Introduction

Brown and Caldwell (BC) is pleased to present this opinion of probable construction cost (estimate) prepared for the OWASA Biosolids Storage Mixing Evaluation, Chapel Hill, NC.

Estimated Project Costs

Based on the typical accuracy of a Class 4 estimate, the expected range of costs is:

Upper Range	Estimated Cost	Lower Range
+50%		-30%
$5,164,650	$3,443,100	$2,410,170

Summary

This Basis of Estimate contains the following information:

- Scope of work
- Background of this estimate
- Class of estimate
- Estimating methodology
- Direct cost development
- Indirect cost development
- Bidding assumptions
- Estimating assumptions
- Estimating exclusions
- Allowances for known but undefined work
- Contractor and other estimate markups

Scope of Work

The work consists of installing the proposed compressed gas mixing system in two existing on-site storage tanks and in two off-site storage tanks. The work includes demolition of the existing mixing and aeration systems.

Background of this Estimate

The attached estimate of probable construction cost is based on documents dated November 16, 2022, received by the Estimating and Scheduling Group (ESG). These documents are described as planning level documents and include as-built drawings, site layouts, equipment quotes, and building quotes.

Class of Estimate

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, this is a Class 4 estimate. A Class 4 estimate is defined as a Planning Level or Design Technical Feasibility Estimate. Typically, engineering is from 1 to 15 percent complete. Class 4 estimates are used to prepare planning level cost scopes or to evaluate alternatives in design conditions and form the base work for the Class 3 Project Budget or Funding Estimate.

Expected accuracy for Class 4 estimates typically range from -30 to +50 percent, depending on the technological complexity of the project, appropriate reference information and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

Estimating Methodology

This estimate was prepared using quantity take-offs, vendor quotes and equipment pricing furnished either by the project team or by the estimator. The estimate includes direct labor costs and anticipated productivity adjustments to labor and equipment. Where possible, estimates for work anticipated to be performed by specialty subcontractors have been identified.

Construction labor crew and equipment hours were calculated from production rates contained in documents and electronic databases published by R.S. Means, Mechanical Contractors Association (MCA), National Electrical Contractors Association (NECA), and Rental Rate Blue Book for Construction Equipment (Blue Book).

This estimate was prepared using BC's estimating system, which consists of Sage Construction and Real Estate 300 estimating software engine (formerly Timberline) using RS Means database, historical project data, the latest vendor and material cost information, and other costs specific to the project location.

Direct Cost Development

Costs associated with the General Provisions and the Special Provisions of the construction documents, which are collectively referred to as Contractor General Conditions (CGC), were based on the estimator's interpretation of the contract documents. The estimates for CGCs are divided into two groups: a time-related group (e.g., field personnel) and non-time-related group (e.g., bonds and insurance). Labor burdens such as health and welfare, vacation, union benefits, payroll taxes, and worker's compensation insurance are included in the labor rates. No trade discounts were considered.

Indirect Cost Development

Local sales tax has been applied to material and equipment rentals.. A percentage allowance for contractor's home office expense has been included in the overall rate markups. The rate is standard for this type of heavy construction and is based on typical percentages outlined in Means Heavy Construction Cost Data.

The contractor's cost for builder's risk, general liability and vehicle insurance has been included in this estimate. Based on historical data, this is typically two to four percent of the overall construction contract amount. These indirect costs have been included in this estimate as a percentage of the gross cost and are added after the net markups have been applied to the appropriate items.

Bidding Assumptions

The following bidding assumptions were considered in the development of this estimate.

1. Bidders must hold a valid, current Contractor's credentials, applicable to the type of project.
2. Bidders will develop estimates with a competitive approach to material pricing and labor productivity, and will not include allowances for changes, extra work, unforeseen conditions or any other unplanned costs.
3. Estimated costs are based on a minimum of four bidders. Actual bid prices may increase for fewer bidders or decrease for a greater number of bidders.
4. Bidders will account for General Provisions and Special Provisions of the contract documents and will perform all work except that which will be performed by traditional specialty subcontractors as identified here: Electrical.

Estimating Assumptions

As the design progresses through different completion stages, it is customary for the estimator to make assumptions to account for details that may not be evident from the documents. The following assumptions were used in the development of this estimate.

1. Contractor performs the work during normal daylight hours, nominally 7 a.m. to 5 p.m., Monday through Friday, in an 8-hour shift. No allowance has been made for additional shift work or weekend work.
2. Contractor has complete access for lay-down areas and mobile equipment.
3. Equipment rental rates are based on verifiable pricing from the local project area rental yards, Blue Book rates, and/or rates contained in the estimating database.
4. Contractor markup is based on conventionally accepted values that have been adjusted for project-area economic factors.
5. Major equipment costs are based on vendor supplied price quotes obtained by the project design team and/or estimators and on historical pricing of like equipment.
6. Process equipment vendor training using vendors' standard Operations and Maintenance (O&M) material is included in the purchase price of major equipment items where so stated in that quotation.
7. Bulk material quantities are based on manual quantity take-offs.
8. There is enough electrical power to feed the specified equipment.
9. Soils are of adequate nature to support the structures. No piles have been included in this estimate.

Estimating Exclusions

The following estimating exclusions were assumed in the development of this estimate.

1. Hazardous materials remediation and/or disposal.
2. O&M costs for the project except for the vendor supplied O&M manuals.
3. Utility agency costs for incoming power modifications.
4. Permits beyond those normally needed for the type of project and project conditions.
5. Impacts from COVID-19 including additional labor and management hours required to meet social distancing, personal protection, and cleaning routines, additional costs of protective equipment, supply chain impacts, and material shortages.

Allowances for Known but Undefined Work

The following allowances were made in the development of this estimate.

1. Electrical, Instrumentation and Controls – 20% of all other work

Contractor and Other Estimate Markups

Contractor markup is based on conventionally accepted values which have been adjusted for project-area economic factors. Estimate markups are shown in Table 1.

Table 1. Estimate Markups

Item	Rate (%)
Net Cost Markups	
Labor markup	15
Materials and process equipment	10
Equipment (construction-related)	10
2022 Diesel Fuel Adjustment	6
Subcontractor	10
Other – Process Equipment	8
Sales Tax	Not Applied
Material Shipping and Handling	2
Gross Cost Markups	
Contractor General Conditions	15
Start-up, Training and O&M	2
Construction Contingency	35
Builders Risk, Liability and Auto Insurance	2
Performance and Payment Bonds	1.5
Escalation to Midpoint of Construction	6.3

Labor Markup

The labor rates used in the estimate were derived from RS Means latest national average wage rate tables and city cost indexes. These include base rate paid to the laborer plus fringes. A labor burden factor is applied to these such that the final rates include all employer paid taxes. These taxes are FICA (which covers social security plus Medicare), Workers Comp (which varies based on state, employer experience and history) and unemployment insurance. The result is fully loaded labor rates. In addition to the fully loaded labor rate, an overhead and profit markup is applied at the back end of the estimate. This covers payroll and accounting, estimator's wages, home office rent, advertising and owner profit.

These fully loaded national labor rates were then adjusted for local conditions using the RS Means City Cost Index for Durham, North Carolina.

Materials and Process Equipment Markup

This markup consists of the additional cost to the contractor beyond the raw dollar amount for material and process equipment. This includes shop drawing preparation, submittal and/or re-submittal cost, purchasing and scheduling materials and equipment, accounting charges including invoicing and payment, inspection of received goods, receiving, storage, overhead and profit.

Equipment (Construction) Markup

This markup consists of the costs associated with operating the construction equipment used in the project. Most GCs will rent rather than own the equipment and then charge each project for its equipment cost. The equipment rental cost does not include fuel, delivery and pick-up charges, additional insurance requirements on rental equipment, accounting costs related to home office receiving invoices and payment. However, the crew rates used in the estimate do account for the equipment rental cost. Occasionally, larger contractors will have some or all the equipment needed for the job, but to recoup their initial purchasing cost they will charge the project an internal rate for equipment use which is like the rental cost of equipment. The GC will apply an overhead and profit percentage to each individual piece of equipment whether rented or owned.

To address the significant increase in fuel pricing from early 2022 to the date of this estimate, a 6% Diesel Fuel Adjustment markup is applied in addition to the standard equipment markup.

Subcontractor Markup

This markup consists of the GC's costs for subcontractors who perform work on the site. This includes costs associated with shop drawings, review of subcontractor's submittals, scheduling of subcontractor work, inspections, processing of payment requests, home office accounting, and overhead and profit on subcontracts.

Sales Tax

No sales tax is applied. Typically on public works projects in North Carolina the General Contractor does not include sales tax in the construction bid price.

Contractor Startup, Training, and O&M Manuals

This cost markup is often confused with either vendor startup or owner startup. It is the cost the GC incurs on the project beyond the vendor startup and owner startup costs. The GC generally will have project personnel assigned to facilitate the installation, testing, startup and O&M manual preparation for equipment that is put into operation by either the vendor or owner. These project personnel often include an electrician, pipe fitter or millwright, and/or I&E technician. These personnel are not included in the basic crew makeup to install the equipment but are there to assist and troubleshoot the startup and proper running of the equipment. The GC also incurs a cost for startup for such things as consumables (oil, fuel, filters, etc.), startup drawings and schedules, startup meetings and coordination with the plant personnel in other areas of the plant operation.

Builders Risk, Liability, and Vehicle Insurance

This percentage comprises all three items. There are many factors which make up this percentage, including the contractor's track record for claims in each of the categories. Another factor affecting insurance rates has been a dramatic price increase across the country over the past several years due to domestic and foreign influences. Consequently, in the construction industry we have observed a range of 0.5 to 1 percent for Builders Risk Insurance, 1 to 1.25 percent for General Liability Insurance, and 0.85 to 1 percent for Vehicle Insurance. Many factors affect each area of insurance, including project complexity

and contractor's requirements and history. Instead of using numbers from a select few contractors, we believe it is more prudent to use a combined 2 percent to better reflect the general costs across the country. Consequently, the actual cost could be higher or lower based on the bidder, region, insurance climate, and the contractor's insurability at the time the project is bid.

Material Shipping and Handling

This can range from 2 to 6 percent, and is based on the type of project, material makeup of the project, and the region and location of the project. Material shipping and handling covers delivery costs from vendors, unloading costs (and in some instances loading and shipment back to vendors for rebuilt equipment), site paperwork, and inspection of materials prior to unloading at the project site. BC typically adjusts this percentage by the amount of materials and whether vendors have included shipping costs in the quotes that were used to prepare the estimate. This cost also includes the GC's cost to obtain local supplies, e.g., oil, gaskets and bolts that may be missing from the equipment or materials shipped.

Escalation to Midpoint for Labor, Materials and Subcontractors

In addition to contingency, it is customary for projects that will be built over several years to include an escalation to midpoint of anticipated construction to account for the future escalation of labor, material and equipment costs beyond values at the time the estimate is prepared. For this project, the anticipated rate of escalation is 4 percent per annum.

The estimated construction time for this project is 4 months, exclusive of unusual weather or site conditions delays. Construction is anticipated to start April 2024 and be completed by August 2024. The escalation factors used in this estimate are calculated from the date of this estimate to the anticipated midpoint of construction which is approximately 18.3 months from the date of this estimate.

Undesigned/Undeveloped Contingency

The contingency factor covers unforeseen conditions, area economic factors, and general project complexity. This contingency is used to account for those factors that cannot be addressed in each of the labor and/or material installation costs. Based on industry standards, completeness of the project documents, project complexity, the current design stage and area factors, construction contingency can range from 10 to 50 percent.

Performance and Payment Bonds

Based on historical and industry data, this can range from 0.75 to 3 percent of the project total. There are several contributing factors including such items as size of the project, regional costs, contractor's historical record on similar projects, complexity and current bonding limits. BC uses 1.5 percent for bonds, which we have determined to be reasonable for most heavy construction projects.

Estimate Summary Report

11/28/2022 4:59 PM

BC Project Number: 158870.400.401
Estimate Version Number: 2
Estimate Date: 11/28/2022
Lead Estimator: Catherine Dummer

BIOSOLIDS STORAGE MIXING EVALUATION

ORANGE WATER & SEWER AUTHORITY
BIOSOLIDS STORAGE MIXING EVALUATION
CLASS 4 ESTIMATE

Estimator	Catherine Dummer
BC Project Manager	Thomas Nangle
BC Office	Raleigh, NC
Est Version Number	2
QA/QC Reviewer	William Agster
QA/QC Review Date	11/28/2022
BC Project Number	158870.400.401

BIOSOLIDS STORAGE MIXING EVALUATION

Phase	Description	Takeoff Quantity	Grand Total Price	Gross Total Cost with Markups
01 TOTAL ESTIMATE				
01 On Site Storage Tanks				
01543	Working Lights	18.00 day	243.77 /day	4,388
01590	Crane Rental, demo and equipment install	15.00 day	3,281.69 /day	49,225
01999	Clean tanks, floor and walls to 8' above floor, confined space	1.00 ls	34,512.56 /ls	34,513
02301	Demo Coarse Bubble Aeration System, confined space	410.00 ft	103.74 /ft	42,534
03330	Building Slab, 13' x 16' x 12" th with thickened edge	10.93 cy	694.44 /cy	7,587
13999	Fiberglass Building, 12' x 15' x 10' tall, prefabricated	1.00 ea	152,263.56 /ea	152,264
23001	Building HVAC, 8 ton cooling	1.00 ls	32,254.36 /ls	32,254
26002	Electrical, Instrumentation, and Controls, Allowance 20% of all other work	1.00 ls	223,690.18 /ls	223,690
31290	Building Site Prep	35.88 cy	157.45 /cy	5,649
33490	Trench for 4" D	100.00 lf	78.77 /lf	7,877
33531	4" D, PVC Pipe, C900, buried, allowance	100.00 lf	18.08 /lf	1,808
40310	12" AIR, cap existing in field	1.00 ea	653.15 /ea	653
40310	2" AIR, 304SS, Sch5S, valve modules to receiver	50.00 lf	114.82 /lf	5,741
40310	1.5" AIR, 304SS, Sch5S, receiver to compressor	200.00 lf	39.60 /lf	7,919
46075	Digester Mixing System	1.00 ls	770,141.36 /ls	770,141
	01 On Site Storage Tanks			1,346,243
02 Off Site Storage Tanks				
01543	Working Lights	24.00 day	243.77 /day	5,850
01590	Crane Rental, demo and equipment install	20.00 day	3,265.70 /day	65,314
01999	Clean tanks, floor and walls to 8' above floor, confined space	1.00 ls	61,881.25 /ls	61,881
02301	Demo Jet Mixing System	240.00 ft	121.96 /ft	29,271
02999	Grout Fill Pipes	260.00 cf	19.24 /cf	5,001
03330	Building Slab, 13' x 16' x 12" th with thickened edge	10.93 cy	694.44 /cy	7,587
13999	Fiberglass Building, 12' x 15' x 10' tall, prefabricated	1.00 ea	152,263.55 /ea	152,264
23001	Building HVAC, 12.5 ton cooling	1.00 ls	42,817.83 /ls	42,818
26002	Electrical, Instrumentation, and Controls, Allowance 20% of all other work	1.00 ls	245,157.04 /ls	245,157
31290	Building Site Prep and Fill	1.00 ls	13,662.69 /ls	13,663
32999	Retaining Wall, 70 lf x 10' tall avg	70.00 lf	1,633.08 /lf	114,316
33490	Trench for 4" D	100.00 lf	78.77 /lf	7,877
33531	4" D, PVC Pipe, C900, buried, allowance	100.00 lf	18.08 /lf	1,808

BIOSOLIDS STORAGE MIXING EVALUATION

Phase	Description	Takeoff Quantity	Grand Total Price	Gross Total Cost with Markups
40310	2" AIR, 304SS, Sch5S, valve modules to receiver	50.00 lf	114.82 /lf	5,741
40310	1.5" AIR, 304SS, Sch5S, receiver to compressor	100.00 lf	59.63 /lf	5,963
46075	Digester Mixing System	1.00 ls	1,332,311.55 /ls	1,332,312
	02 Off Site Storage Tanks			2,096,823
	01 TOTAL ESTIMATE			3,443,066

Brown AND Caldwell

Biosolids Storage Mixing Evaluation

August 24, 2022

Meeting Minutes

Prepared for: Orange Water and Sewer Authority (OWASA)
Project Title: On-site and Off-site Biosolids Storage Mixing Evaluation
Project No.: 158870

Purpose of Meeting: Kickoff Meeting and Site Visits **Date:** August 22 & 24, 2022
Meeting Location: Mason Farm WWTP **Time:** 10:00 a.m.
Minutes Prepared by: Emma Guertin, Brown and Caldwell (BC)

Attendees:
Thomas Nangle, BC
Emma Guertin, BC
Dylan Bowers, OWASA
Marcus Hill, OWASA
Wil Lawson, OWASA
Allison Spinelli, OWASA

cc: Brenan Buckley, BC

Summary

The BC team toured the on-site biosolids storage tanks on August 22nd before meeting the OWASA team at the off-site biosolids storage tanks later that afternoon. The BC/OWASA team held a project kickoff meeting on Wednesday August 24th, 2022. The kickoff meeting included a review of findings of the site visits, and these minutes capture the notes from the site visit and the kickoff meeting. A PowerPoint presentation was utilized to aid in the discussion during the kickoff meeting, and is attached. These minutes supplement the slides to capture discussions that occurred during the kickoff meeting.

The driver for this project is that inadequate mixing of both on-site and off-site biosolids storage tanks are causing operational and maintenance challenges, increasing costs and risks to OWASA's biosolids program. The scope of this study is limited to analyzing mixing technologies best suited for OWASA onsite and offsite storage tanks. The study will evaluate life cycle costs and non-cost factors of different technology options for each application that will be based off conceptual designs which include layout of critical equipment. Deliverables will be a review workshop and meeting minutes, where the team will come to a consensus on recommended improvements. BC will then develop a Class 5 opinion of probable construction costs for the selected improvements, and provide a letter report outlining the next steps and costs to be factored into OWASA's CIP budget. To facilitate OWASA's budget planning schedule, this project will aim to be completed by December 2022.

Background (Slides 3-11)

- Confirmed storage strategy for onsite and offsite tanks
- Current conditions: Onsite Storage tanks, discussed dimensions/construction
    - Comments from Wil: Originally only mixing when about to haul, then started mixing 1-2 hours per shift (started about 2 yrs ago) to get more consistency for rotary press: press didn't like air mixing, so started recirculating with the transfer pumps (500 gpm with both pumps running, 300 gpm with one pump, flow split between two tanks).

They've had to replace transfer pump motors 3 times due to overheating since this pumped mixing started.

- Transfer pumps used for onsite: younger than 6 months, still doing recirc. With two 7.5 HP pumps. Might be putting in new 10 HP pumps, would be an interim fix until this study is done, The motors are getting overheated, not designed to run continuously, pumps might not have the right ventilation. Pump vault is over 30 yrs old. Marcus: if we can engineer out confined spaces and still allow transfer, would want to include the pump vault in the upgrades. Wil: would be nice to also simplify pipes in the vault. BC will include recommendation that an evaluation of pump vault upgrades be included in a follow up detailed design.
- Early last year, on-site tank was low (radar level read down to 1') so they emptied one and only fed into one until it got wet again. They didn't inspect the interior of the tank while it was empty.
    - Concrete and cover condition assessment will be recommended regardless of mixing technology selected; these inspections are not in this scope.
- Solids Concentration Discussion: BC assumed 3-4% total solids based on known thickened sludge feed to the digesters and average volatile solids reduction. However, Wil believes they are seeing closer to 2-3% biosolids concentration in the storage tanks. Wil is currently feeding the digesters at 6-8%TS (high as they can go before the thickened sludge pumps trip), coming out 2-2.5%. Tom said assuming 70% of total solids are volatile (Wil agreed), and good VSR (65%), would result in about 50% reduction in solids concentration (3-4% TS range). The difference could be due to grit settling out in the digester, which could be simultaneously throwing off VSR calculations and reducing the concentration of the biosolids. During Digester 3 cleaning, that digesters had grit up to 6 feet high on the side wall.
    - OWASA to provide BC with updated data for BC to dig into. Tom indicated there would be a difference in what the mixing vendors would propose for a 2-3% TS vs a 3-4% TS biosolids.

- Conditions of offsite Storage Tanks
    - Tom discusses condition of off-site tanks/valves/pumps
    - Explains current mixing system (single duty pump per tank providing mixing through jet headers)
    - Marcus: Two pumps would be great, BC to consider a stand-by or swing pump at offsite for pumped mixing solutions.
    - Allison: Solar panel: 150kW system, generated 176,000 kWh last year, only mixed one tank through the year, so had excess credits: solar panels originally based on tanks being full and requiring more mixing.

- Offsite Challenges
    - Correction to clogging statement in PPT (slide 11): not occurring multiple times a year, not used often enough

Onsite Considerations (Slides 21-25)

- Main Takeaway: going to look at Biomix system and compare it to CDM's Invent Evaluation
    - Limited space for valve box and compressor, no room in nearby buildings for it
    - BC will plan an interim call with Wil and Marcus for location of valve box and compressor for Biomix system
    - Pumps would require wall penetrations, and there is not place for the pumps to be mounted close to the tanks.
    - Assume that the vertical shaft mixers would require replacing the existing odor control covers.
- Reviewed CDM evaluation (costs, energy use)

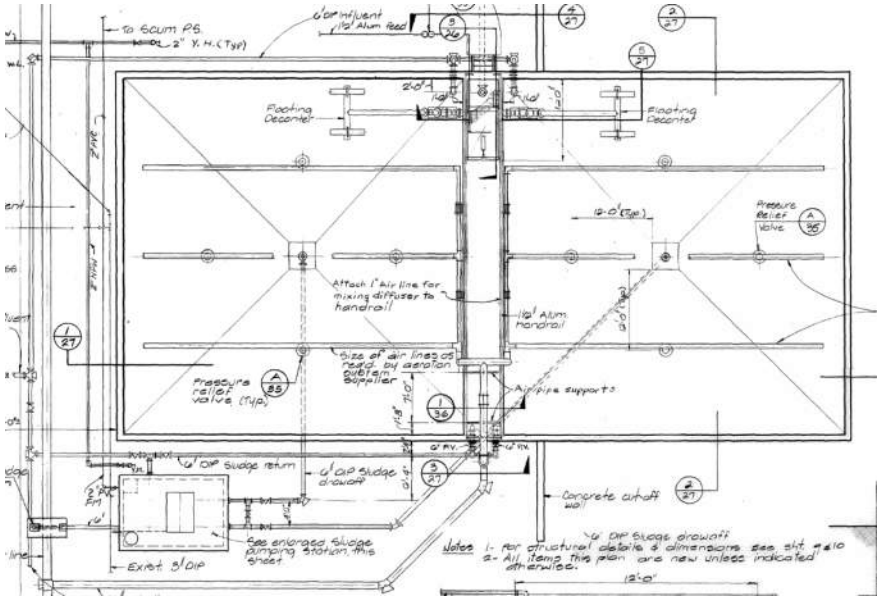
Offsite Considerations (Slides 26-38)

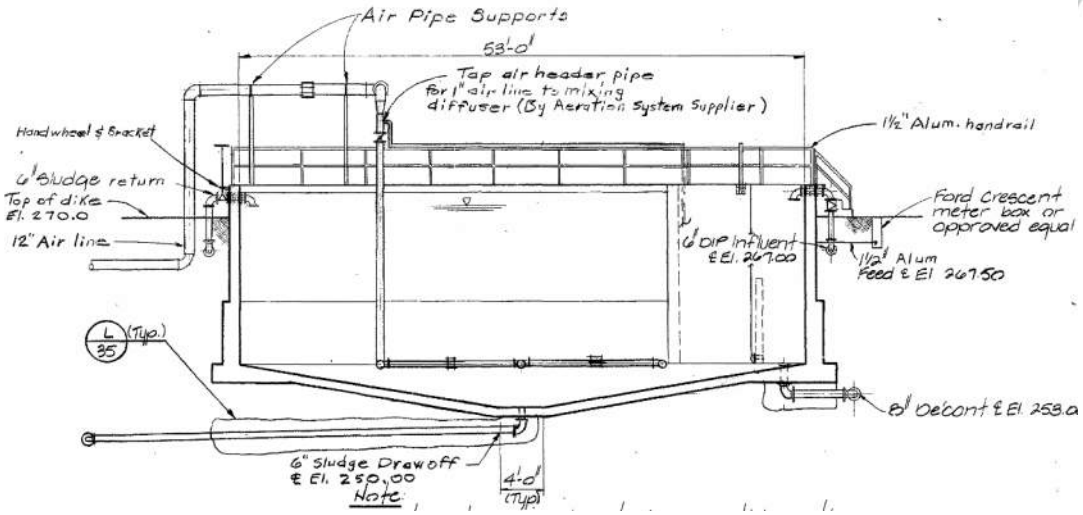
- Discussed limitations of off-site tanks (avoiding structural modifications, very tall, no water source)
- Discussion of possible technologies: Initial thoughts that large Bubble and pumped nozzle as more appropriate?
    - Dylan most interested in the impeller: would require structural work, must change access to the top (platform and a staircase); potential issues with power cord getting caught up around it
        - Concerns about getting impeller in and out of tank if needed
- From mechanical issue mindset: Easier to address impeller and large bubble than pumped-nozzle. have to address issues much faster, but system would work really well
    - Tom challenged that assumption. We know having the pumped system turn off for one to several days in a full tank can results in serious clogging. We don't know how well large bubble or the impeller would do in a similar situation. They may require significant manual maintenance as well. BC to investigate this.
- Most of the group was leaning towards impeller and large bubble (due to ease of maintenance)
    - Marcus: from maintenance, large bubble ranked last as anticipates more day to day work, want to see the overall recommended maintenance schedule for large bubble
    - What else would you need: BC Reach out to Enviro-mix to see if they would support the installation at off-site storage tanks
- BC to investigate question: One compressor for system or one per tank?
- Marcus concerned about effect of standing water in between two tanks from rainfall on compressor

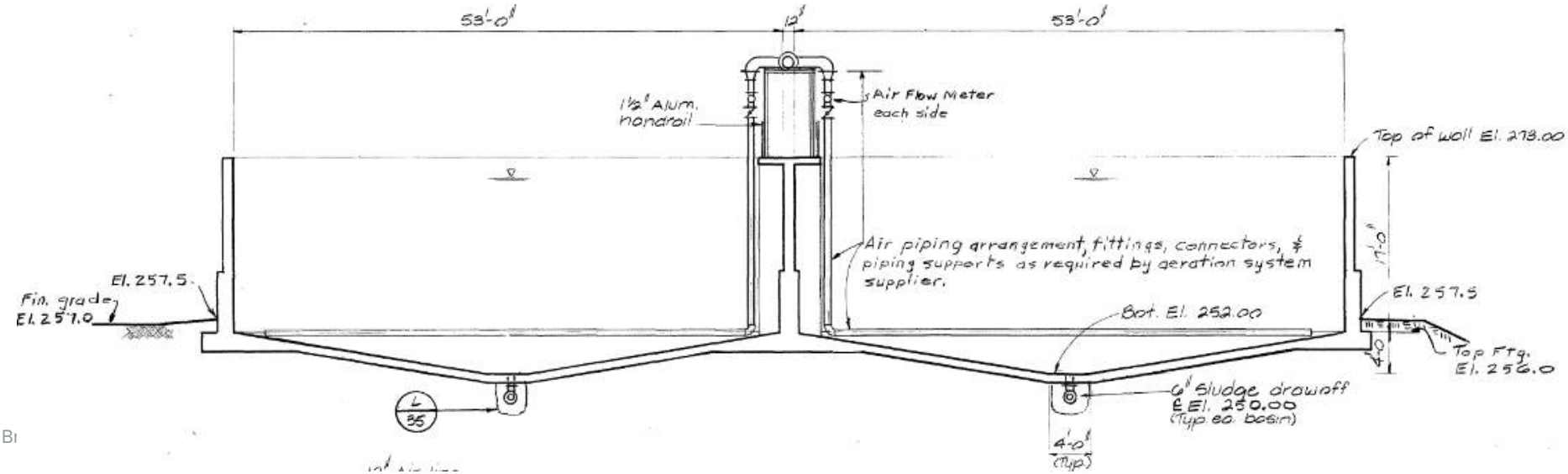
Noncost Drivers (Slides 39-40)

- OWASA had nothing to add to the drivers BC listed in the PPT.

On-site Storage Tanks

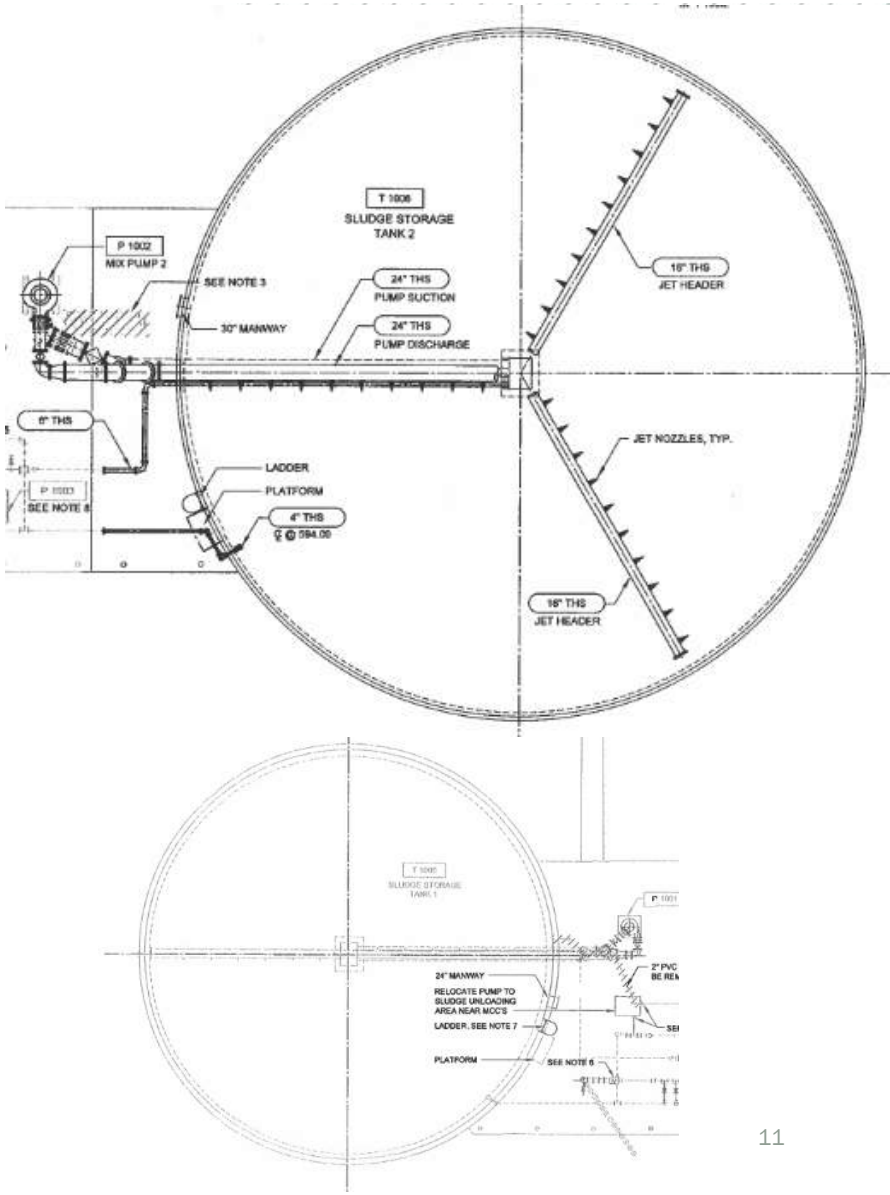






Off-site Mixing Approach

- **Current Mixing System:** Single duty pump per tank providing mixing through jet headers.
- System brought down and cleaned for the first time in Fall of 2021
- Tanks are loaded through bottom connection
- Unused energy from solar panels



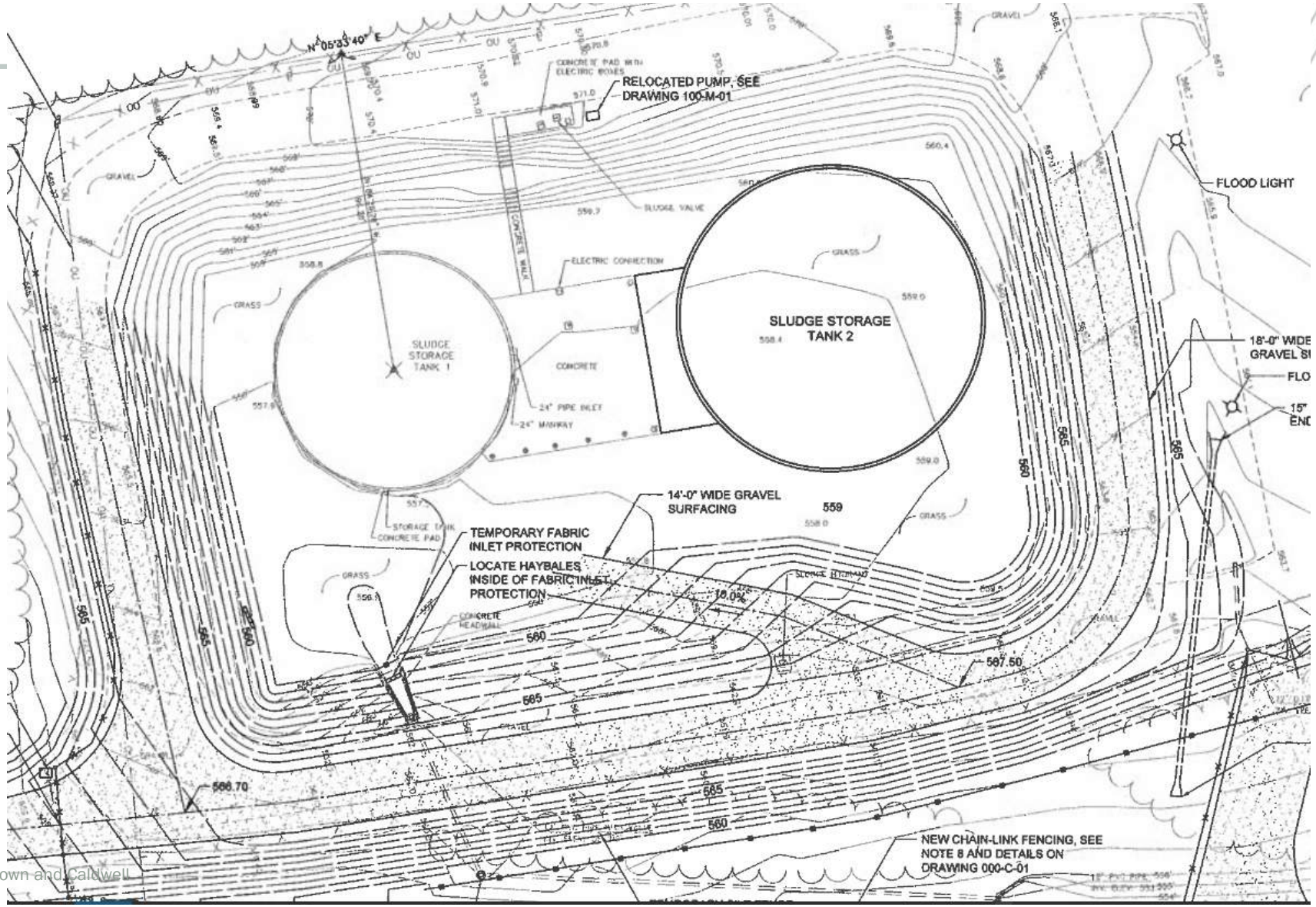
Off-Site Tank Challenges

- Jet header nozzles clogging, either due to intermittent operation or settling of solids in header after tank is pumped down.
  - OWASA must flush out pipes to unclog the system. Brings water up from creek via water truck.
  - Occurs several times a year
- Lost capacity in tank volume
- Unloading truck takes longer than expected (> 20 mins), loading takes about 8 minutes.

Off-Site Storage Considerations

- Avoid structural modifications or penetrations to tanks
- Very tall tanks, which limits technologies
- No water source at site
- “Free” energy at site, would reduce impact on higher HP technologies
- OWASA prefers to minimize the time biosolids are held in tanks, but as long as they are there, it will be mixed (no intermittent mixing strategy)
- Key consideration is how to empty the tank without letting residual biosolids set in pipes and on the floor.

Off-Site Storage Considerations



Smaller Tank

Loading/Unloading Connections

Larger Tank

Loading/Unloading Connections

Unloading Truck Connections

Loading Truck Connections

Big Tank (SST2)

Little Tank (SST1)