"Central Florida's High Point"

REQUEST FOR QUALIFICATIONS

ENGINEERING DESIGN SERVICES
FOR THE MINNEOLA
WATER RECLAMATION FACILITY
EXPANSION

Mandatory Pre-Proposal Meeting: January 25, 2024 at 10:00 a.m.

Deadline for Written Questions: February 8, 2024 at 3:00 p.m.

Due Date: February 22, 2024 at 3:00 p.m.

Contact Information:
Fred Miller
Project Manager
FMiller@Minneola.us
(352) 394-3598, ext. 301

CALENDAR OF EVENTS / RFQ TIMELINE

Listed below are the important dates and times by which the actions noted must be completed. All dates are subject to change by the City of Mineola. If the City of Minneola finds it necessary to change any of these dates or times prior to the due date, the change will be posted on the City of Minneola's website: http://www.minneola.us.

ACTION	COMPLETION DATE
Issue RFQ	January 8, 2024
Mandatory Pre-Proposal Meeting	January 25, 2024 at 10:00 a.m.
Last Day for Written Questions	February 8, 2024 at 3:00 p.m.
Submission Deadline	February 22, 2024 at 3:00 p.m.
Selection Committee Meeting	February 29, 2024 at 1:00 p.m.
Vendor Presentations (If Necessary)	TBD
Award and Enter into Contract Negotiations	March 15, 2024

SECTION 1 – RESPONSE PROCEDURES

1.1 *Purpose*

The purpose of this solicitation is to receive responses from qualified professional engineering firms pursuant to Florida Statute 287.055 (the Consultant's Competitive Negotiation Act or CCNA) to provide design services to expand and improve the Water Reclamation Facility for the City of Minneola (hereinafter referred to as the City). Upon the completion of the response review process, the City intends to enter into direct negotiations with the most qualified respondent resulting in a single contract award for a single specific undertaking.

1.2 *Mandatory Pre-Proposal Meeting*

Thursday, January 25, 2024 at 10am

All potential respondents are required to attend this mandatory pre-proposal meeting.

The meeting will present an opportunity to ask questions and/or seek clarification regarding any and all aspects of this solicitation. The City will provide written responses in the form of addenda to formal and material questions received during this mandatory meeting.

Any verbal discussions at the meeting shall not be considered part of the solicitation unless incorporated into the solicitation through the formal written addenda process. Questions asked at the meeting that cannot be adequately answered during the meeting may be deferred until issuance of the addenda. A copy of the questions and the responses will be available to all potential respondents in the form of addenda.

Potential respondents are requested to bring this solicitation document to the pre-proposal meeting as additional copies may not be available.

Meeting Location:

Minneola City Hall Council Chambers (1st Floor)
800 North U.S Hwy 27, Minneola, Florida 34715
Meeting will begin promptly at the time specified above.

1.3 *Questions Deadline*

To ensure that all prospective respondents have accurately and completely understood the requirements, the City of Minneola will accept written questions up until 3:00 P.M. on Thursday February 8, 2024. Verbal inquiries will not be accepted, and potential respondents are instructed to only seek additional information or clarification or to communicate in writing with the Project Manager – Fred Miller.

The City of Minneola requires **all** questions relating to this solicitation be directed in writing by e-mail accepted until 3:00 P.M. on Thursday February 8, 2024 to:
Fred Miller
City of Minneola
P.O. Box 678
Minneola, FL 34755
Phone: (352) 394-3598, ext. 301
E-mail: FMiller@Minneola.us

- **ALL QUESTIONS MUST BE SUBMITTED PRIOR TO THE DEADLINE.**
- **QUESTIONS WILL NOT BE ANSWERED VIA TELEPHONE OR EMAIL.**

Failure by a potential respondent to ask questions or request changes by the date indicated above shall constitute the respondent's acceptance of the requirements set forth in this solicitation. No answers provided by any party given in response to questions submitted shall be binding upon this solicitation unless released in writing as an addendum.

1.4 Response Closing Location, Date, and Time

Responses to this solicitation are due on or before February 22, 2024 at 3:00 p.m. Any original response package received after the specified date and time will not be considered and will be returned unopened to the submitter. Please submit one (1) original, three (3) copies, and one (1) electronic version.

1.5 Delivery of Qualifications Packages

To be considered for award, a bid or proposal must be received and accepted prior to the date and time established within this solicitation. A response will not be considered for award, if received after the official due date and time, regardless of when or how it was received by the City of Minneola. Allow sufficient time for transportation and inspection.

Each package shall be clearly marked with the applicable title and company name. Ensure that your bid or proposal is securely sealed in an opaque envelope or other package to provide confidentiality of the bid or proposal prior to the due date for the solicitation.

If you plan on submitting your bid or proposal IN PERSON, by a THIRD-PARTY CARRIER (DHL, FedEx, UPS, etc.), or by a PRIVATE COURIER please deliver it/address it to:

City of Minneola
800 North U.S. Highway 27
Minneola, FL 34715

If you submit your bid or proposal by the UNITED STATES POSTAL SERVICE, (U.S.P.S.) please address it to:

City of Minneola
P.O. Box 678
Minneola, FL 34755

NOTE: Submissions through facsimile (fax) or email will not be accepted.

1.6 Public Opening

On February 22, 2024 at 3:05 p.m. proposals will be opened in the Council Chamber at Minneola City Hall located at 800 North US Hwy 27, Minneola, FL. 34715. All timely qualifications packages that have been accepted by the City will be formally opened and conditionally accepted for consideration. The names of the firms submitting packages will be read aloud and recorded. Individuals covered by the Americans with Disabilities Act of 1990 in need of accommodations to attend public openings or meetings should contact the City at least five (5) days prior to the scheduled opening date.

1.7 Questions Concerning This Solicitation

Questions concerning any portion of this RFQ shall be directed in writing by e-mail accepted until **February 8, 2024 at 3:00 p.m.** to:

Fred Miller
City of Minneola
P.O. Box 678
Minneola, FL 34755
Phone: (352) 394-3598, ext. 301
E-mail: FMiller@Minneola.us

Failure by a potential respondent to ask questions or request changes by the date indicated above shall constitute the respondent's acceptance of the requirements set forth in this RFQ. No answers provided by any party given in response to questions submitted shall be binding upon this RFQ unless released in writing as an addendum to the RFQ.

1.8 Respondents Responsibility/Clarification and Addenda

While the City has used considerable efforts to ensure an accurate representation of information in this RFQ, each prospective respondent is urged to conduct its own investigations into the material facts and the City shall not be held liable or accountable for any error or omission in any part of this RFQ. It is incumbent upon each prospective respondent to carefully examine these requirements, terms, and conditions. A respondent, by submitting a qualifications package, represents that the respondent has read and understands the request for qualifications requirements and its response is made in accordance therewith and that the respondent is familiar with the local conditions under which the awarded Respondent must perform. Any inquiries, suggestions, or requests concerning interpretation, clarification or additional information shall be made by email to Fred Miller, at FMiller@Minneola.us in accordance with procedures set forth herein. The City will not be responsible for any oral communication given by any employee, agent, or representative of the City. The issuance of a written addendum is the only official method by which interpretation, clarification, or additional information can be provided.

If the City revises or otherwise amends this RFQ, notice will be posted on the City of Minneola's website: http://www.minneola.us

You must acknowledge each addendum in your proposal. Failure to acknowledge each addendum may prevent your proposal from being considered for award. It is solely your responsibility to ensure that you have received all addenda to this RFQ before submitting your proposal.

Before submitting a qualifications package, each respondent shall make all investigations and examinations necessary to ascertain site conditions and requirements affecting the full performance of the contract and to verify any representations made by the City upon which the respondent will rely. If the respondent receives an award, failure to have made such investigations and examinations will in no way relieve the respondent from its obligations to comply in every detail with all provisions and requirements of the contract, nor will a plea of ignorance of such conditions and requirements be accepted as a basis for any claim by the respondent for additional compensation or relief.

1.9 Restricted Discussions

From the date of issuance of this solicitation until final City action, respondents should not discuss the solicitation or any part thereof with any employee, agent, or any other representative of the City except as expressly authorized by the designated procurement representative, as listed in Section 1. The only communications that shall be considered pertinent to this solicitation are appropriately signed written documents from the proposer to the designated procurement representative and any relevant written document promulgated by the designated procurement representative.

1.10 Specific Directions Regarding Format and Contents of Response

Firms, organizations, joint ventures, or individuals interested in submitting a qualifications package (offer) in response to this RFQ shall submit one (1) original, three (3) copies, and (1) electronic version of their qualifications package for review and evaluation by the City. Failure to provide the required copies and information may result in the qualifications package not being considered.

To facilitate analysis of its qualifications package, the respondent shall prepare its qualifications package in accordance with the instructions outlined in this RFQ. If the respondent's qualifications package deviates from these instructions, such response may, in the City's sole discretion, be rejected. The City emphasizes that the respondent concentrates on accuracy, completeness, and clarity of content.

SECTION 2 – SCOPE OF WORK

2.1 Scope of Work

The City of Minneola Water Reclamation Facility (MWRF) provides wastewater service to approximately 7,000 residential and commercial customers. The existing MWRF is designed and permitted for capacities of 1.2 million gallons per day (MGD), on an annual average daily flow (AADF) basis. The facility utilizes a phased isolation oxidation ditch process to provide secondary treatment and a moderate degree of nitrogen control. Treated effluent from the facility is discharged to on-site rapid infiltration basins (RIBs) or is used for irrigation. The City is seeking professional engineering services to provide planning, design, permitting, and development of construction plans and bid documents (100%), as well as construction administration support necessary for the construction of the project to expand the MWRF with an additional 2.0 MGD AADF. Other project considerations include Flow equalization, Biosolids improvements, Electrical & SCADA improvements, as well as potential site size limitations. **For the purposes of this solicitation, the City has established a performance period of twelve (12) months to be substantially complete with the design documents.**

2.2 General Project Information

See attached the City of Minneola Water Reclamation Facility Draft Capacity Rerating Study Dated December 2022 (Attachment A).

2.3 Professional Service to be Provided

The scope of services shall include the completion of permitting, 30%, 60%, 90% and 100% contract documents, bidding phase services and construction administration services for the construction of the Project to include, but not limited to, the following:

a. Conduct necessary surveys, geotechnical explorations, analysis and ecological assessments.
b. Survey of project areas indicating topography and fixed improvements.
c. Any Federal, State or Local permitting
d. Environmental services indicating the extent of wetlands and any threatened and/or endangered species.
e. A preliminary design report (PDR) including 30% drawings of all components listed below. At a minimum, the PDR will include the following: process flow diagram for all main process systems, site plan(s), preliminary equipment lists, and anticipated effluent nutrient target limits.
f. Expansion of the MWRF may include (but not limited to):

i. Flow equalization tank evaluation.
ii. New preliminary treatment structure, including a mechanical bar screen, grit removal, and odor control.
iii. New anoxic zone and aeration basin.
iv. Existing process evaluation for repairs, expansion and/or improvement.
v. New secondary clarifiers with RAS/WAS pumping.
vi. New chlorine contact tank, mixers and transfers pumping.
vii. Improvements to biosolids management facilities.
viii. Additional reclaimed ground storage tank.
ix. Additional rapid infiltration basin evaluation.
x. Replacement of generator.
xi. Miscellaneous improvements (i.e., site work, piping, grading, electrical, instrumentation and controls, etc.)
xii. Upgrade of existing SCADA system.
xiii. Offsite master repump lift station.

The engineering design plans shall include complete process and mechanical design plans, storm water design plans, yard piping plans, site civil grading and drainage, and roadway plans, as required for the project.

a. Electrical, lighting, and instrumentation and control design.
b. Structural design.
c. Heating, ventilation and air conditioning (HVAC) system design.
d. Noise abatement design, as necessary.
e. Architectural and landscape architectural design, as necessary.
f. Obtain all necessary regulatory approvals and permits for the completion of the project.
g. Preparation of Engineer's Opinion of Probable Construction Costs at 60%, 90% and 100% stages of design completion.
h. Assistance to the City with pre-qualification of contractors, bidding (including issuance of addenda and bid clarifications), bid evaluations and award of the construction contract.
i. Preparation of conformed documents for contracting purposes.
j. Monitoring project schedule and report on progress throughout the permitting and design phases.
k. Construction administration services, including:

i. Attendance at pre-construction meeting.
ii. Logging and processing of contractor's shop drawings and requests for information (RFIs), payment applications, owner's field directives and change orders, as necessary.
iii. Attendance at monthly progress meetings and verification of contractor's maintenance of record drawings.
iv. Intermittent site inspections to monitor progress of contractor's work and as necessary to fulfill the duties as engineer of record.
v. Inspections for determination and issuance of certifications of substantial and final completion of construction in accordance with the contract documents.
vi. Resident project representative services (as necessary).

l. Other services as required for project completion.

2.4 Minimum Requirements

Successful firm must have experience in providing design, permitting and construction administration services for at least five similar wastewater facility projects constructed within the last ten (10) years or currently under construction, for a public agency within the State of Florida, with a construction contract value of $10,000,000 or above. The construction value must be for construction of a single site and for a single phase of construction. Experience from respondent firms must be from serving as the prime engineering design consultant or, in the case of a design-build or CMAR delivery, serving as the lead engineering firm (i.e., not as a sub-consultant to another engineering firm).

2.5 Qualifying Standards

Pursuant to Chapters 471, 472, and/or 481, Florida Statutes, as applicable to this solicitation, firms or individuals shall be registered with the State of Florida and have obtained at least the minimum thresholds of education and experience required by the applicable statute(s).

Responding vendors must exhibit compliance with the qualification standards and evaluation factors stated in Section 287.055, Florida Statutes, to be considered for award under this solicitation.

SECTION 3 – RESPONSE FORMAT AND AWARD

3.1 *Proposal Requirements*

A response to this solicitation should address the requirements listed in this RFQ in a clear concise manner in the order stated herein. The response shall clearly detail how the services being proposed can best satisfy the City's needs. The submitted proposal must follow the rules and format outlined within this section. Adherence to the rules will ensure a fair and objective analysis of all proposals.

All responses must be submitted and received in accordance with this RFQ by the deadline specified in this solicitation or as otherwise amended. The responsibility for submitting the proposal on or before the stated date and time is solely that of the respondent. The City of Minneola will in no way be responsible for delays in transmittal or delays caused by any other occurrence. **LATE PROPOSALS WILL NOT BE ACCEPTED.**

3.2 *Specific Directions Regarding Format and Contents of Response*

Firms, organizations, joint ventures, or individuals interested in submitting a qualifications package (offer) in response to this RFQ shall submit one (1) original, three (3) copies, and (1) electronic version of their qualifications package for review and evaluation by the City. Failure to provide the required copies and information may result in the qualifications package not being considered.

To facilitate analysis of its qualifications package, the respondent shall prepare its qualifications package in accordance with the instructions outlined in this section. If the respondent's qualifications package deviates from these instructions, such response may, in the City's sole discretion, be rejected. The City emphasizes that the respondent concentrates on accuracy, completeness, and clarity of content.

3.3 *Economy of Presentation*

Each qualifications package shall be prepared simply and economically, providing a straightforward and concise description of the respondent's capabilities regarding the conditions and requirements of the specific work to be performed pursuant to this RFQ. Elaborate bindings, colored displays, and any superfluous promotional material are not desired, and at a level considered unwarranted by assigned evaluators, may serve as evidence of cost inefficiency supportive of a lower technical rating. Emphasis in each qualifications package must be on completeness and clarity of content. To expedite the evaluation of qualifications packages, it is mandatory that respondent follow the format and instructions contained herein. The City retains the prerogative to reject any response that does not essentially conform to the stated requirements.

3.4 Response Package Format

The respondent shall organize its qualifications package into the following major sections.

Table of Contents

Outline in sequential order (as stated below) the major areas of the response. All pages must be consecutively numbered. Respondents must respond to all minimum requirements listed below. Responses which do not contain such documentation may be deemed non-responsive.

TAB A – Introduction Letter

To be submitted on the firm's letterhead. Provide an introduction letter outlining the respondent's specialization, location of office that will be responsible for managing the project and a brief summary of past experience intended to support the qualifications of the respondent to perform required professional services. The introduction letter shall be signed by an officer of the Company submitting the response.

The introduction letter shall:

- Concisely state the firm's understanding of the services required by the City
- Include additional relevant information not requested elsewhere in the RFQ.
- The signature on the statement shall be that of a person authorized to bind the firm.

Tab A shall also contain a properly completed, signed, and notarized Form 1 - Lobby Prohibition and Form 2 - Conflict of Interest Disclosure Form.

TAB B – Firm Profile – Company Background

The respondent must have been in existence, under its current name, for at least five (5) years providing professional engineer services to government agencies, in good standing with a track record of performance and must provide evidence of such in this section. If name changes have occurred in the past twenty (20) years, provide these name changes in chronological order.

Provide a brief narrative of company history, including date the company was formed and/or incorporated, list the officers of the company submitting and its qualifying agents. In addition, include the firm's organizational chart including names, titles and positions of leadership staff.

The respondent must provide evidence that its company is currently registered with the State of Florida and holds an unexpired active license. Respondent shall provide photo copy of license indicating it is active in this section. In addition, if the respondent is a corporation, it must be properly chartered with the Florida Department of State and must submit evidence of such in this section. Include a copy of business W-9 certificate.

TAB C – Company Project Experience

Indicate the company's number of years of experience in providing the requested services stated in Section 2.

Provide a brief narrative of the company's most significant projects undertaken in the past ten (10) years; limit to no more than five (5). Describe the scope of each project in physical terms and by cost, dates of service, the respondent's responsibilities, and provide the name and contact telephone number of an individual in a position of responsibility who can attest to respondent's activities in relation to the project. Detail the original project cost, amount of change orders, and final project cost.

TAB D – Team Composition and Subcontractors

Provide the resume of the project manager and team members who will be assigned to this project. Resume shall include education, number of years of experience, relevant projects and any other pertinent information necessary to convey the quality of the individual(s) assigned to this project. Detail the Company's familiarity with the City of Minneola.

The Project Manager shall have a minimum of five (5) years of experience operating in the same capacity (position) working on projects of similar scope and size. The Project Manager must be an employee of the respondent for the last two (2) years.

If available, provide letters of recommendations from owners/customers that identify these individuals as being instrumental in the success of the project they were on. Provide resumes of key subcontractors.

List the key people proposed for the City 's project along with any proposed subcontractors. Include a copy of each person's current State of Florida Board of Professional Regulation License. Additional resumes and/or information about the individuals proposed on this team may be attached. Respondents are advised their location, and that their listing of subcontractors, to include location and respective percentage of use, are a listed evaluation factor under CCNA and that this information will be considered and documented throughout the evaluation and award process.

TAB E – Claims Disputes

In this section, list all respondent's projects that:

- Are currently in a claims dispute or have been in a claim dispute within the last ten (10) years and provide reasons for dispute. In addition, provide disposition (pending or settled), the amount of claim and brief description of the claim or dispute.
- List all projects that have been completed by respondent's surety in the last ten (10) years.
- List all liquidated damages have been assessed to respondent in the last five (5) years including a brief narrative of the circumstances and the amount accessed.

TAB F – Methodology and Approach

Proposer shall provide an explanation of how it typically manages its engagements to realize project budgetary goals, timetables and quality control objectives. Proposer shall explain, for this specific Scope of Work, how it intends to meet the budgetary goals, timetables and quality criteria established herein. Consideration shall be given for cost effectiveness of potential solution(s), creativity and innovation of proposed solutions and comprehensive utilization of proposed personnel to meet the deliverables**. Detail how the proposer will achieve the established performance period of twelve (12) months to be substantially complete with the design documents.**

Proposer shall also provide a project schedule indicating:

- All the activities envisioned to fulfill the requirements of the Work
- The estimated duration for each activity;
- The estimated man-hours for each activity; and
- The total estimated man-hours each primary Team Member, identified in the Tab D will devote to the Work through completion.
- Additionally, the project schedule must demonstrate the utilization of any

Subcontractors.

Identify suspect areas of difficulties and provide solutions through methods and approach. Identify all project milestones and discuss each phase of the project from inception to final completion of services. Provide a detailed description of the project approach to the required services. Information should include:

- Written description of the team organization/reporting responsibilities.
- Project specific approach.
- Value Engineering approach
- Errors and Omission prevention

3.5 *Withdrawal of Qualifications Package*

Respondents may withdraw the qualifications package or modify it at any time prior to February 1, 2024 at 3:00 p.m. The Proposer shall be required to produce photo identification that satisfies the City prior to withdrawal or modification of the qualifications package. Negligence upon the Proposer's part in preparing the qualifications package confers no right of withdrawal after the time fixed for the submission of qualifications packages.

3.6 *Qualifications Package Acceptance / Rejection*

The City reserves the right to accept or reject any or all qualifications packages received as a result of this RFQ, or to negotiate separately with competing Respondents. The City reserves the right to waive any informalities, defects, or irregularities in any qualifications package, or to accept that qualifications package, which in the judgment of the proper officials, is in the best interest of the City and the citizens of City of Minneola.

3.7 *Post-closing Discussions and/or Presentations*

The City, at its sole discretion, may conduct discussions with, and/or require formal presentations by, any respondent without charge to the City. The City reserves the right to require any respondent to demonstrate to the satisfaction of the City that the respondent has the fiscal and technical ability to furnish the service(s) and/or product(s) as proposed. The City shall be the sole judge of compliance in this regard. The City reserves the right to conduct discussions with any respondent(s) which has (have) been "shortlisted" as a most-qualified respondent.

Respondents are cautioned not to assume that they will be asked for discussions or a presentation and should include all pertinent and required information in their original qualifications package.

Discussions and/or presentations shall follow the spirit and intent of provision of this RFQ. Any formal presentations that are overly elaborate and appear to rely more on the technical manner of presentation rather than on the actual content of presentation will be subject to lesser technical ranking. The discussion and/or presentation shall be focused on the essentials of the project itself, and, unless requested by the respondent and approved by the City, shall include no more than three representatives from the respondent, one of whom shall be the respondent's proposed project manager for the project to be performed. Any additional attendees must have a documented direct function in the work to be performed.

Upon completion of discussions and/or presentations with short-listed respondents, the City will determine which one (or more in the case of a multiple award continuing contract) of those respondents is considered the best qualified for the specific work being solicited. Pricing negotiations will then ensue with the respondent(s) in the manner stated in Section 287.055, Florida Statutes.

3.8 Award of Contract(s)

The City reserves the right to reject any or all responses, to waive any minor informality or irregularity in any response, and to make award to the response deemed to be most advantageous to the City within the selection factors and process cited within Section 287.055, Florida Statutes, and the Qualifying Standards of this of this solicitation.

It is understood that the City is not obligated to make an award under or as a result of this RFQ or to award such contract, if any, on the basis of lowest cost or one factor alone. The City reserves the right to award such contract, if any, to the best qualified respondent(s).

The City has the sole discretion, and reserves the right, to cancel this RFQ or to re-advertise with either the identical or revised specifications, if it is deemed to be in the City's best interests to do so.

Any qualifications package that is contingent upon an award or a contract for any additional service shall be rejected and not considered for an award.

In the event of default by the awarded Respondent, the City reserves the right to negotiate and award the contract to the next best qualified Respondent without any further competition.

3.9 Time Limit To Submit Required Award or Initial Performance Related Documentation

Within ten (10) calendar days after City notification of intent to award, or subsequent intent to proceed, any successful respondent must furnish all deliverables or documentation required to specifically support the City intent. If any successful respondent fails to furnish the required deliverables within the required time frame, intent to award, or award to that respondent may be withdrawn and award made to the next highest rated respondent.

3.10 Disputes/Exceptions

Any prospective respondent who disputes the reasonableness or appropriateness of any item within this RFQ document, any addendum to this RFQ document, notice of award, or notice of rejection shall set forth the specific reason and facts concerning the dispute, in writing, within three (3) business days of the City's issuance of the qualifications package document or addenda, or notice of award or rejection. The written dispute shall be sent via certified mail or delivered in person to the City's Clerk. However, respondents are advised that any protest based exclusively on disagreement with the technical judgment of evaluators is subject to summary rejection and will be rejected unless there is any clear evidence of arbitrary or capricious action in that regard.

Any prospective respondent who may have any exceptions to any requirements set forth in this RFQ or the scope of work may identify the item(s) that exception is taken to, including the reason and include these item(s) in a separately marked section of their submitted qualifications package. All such exceptions shall be evaluated by the City personnel involved in the review and evaluation process. It is recommended that any such exception or deviation be addressed to the assigned contracting officer in writing during the solicitation period.

Respondents are advised that their proximity to the City, as well as their list of subcontractors, including location and respective percentage of use of such, are listed evaluation factors under CCNA.

3.11 Evaluation Process

All responses will be reviewed and evaluated by City staff. The City reserves the right to evaluate each response on a separate and individual basis or to invite selected firms to make personal presentations to staff. The City further reserves the right to reject any and all responses submitted, or accept a response deemed most advantageous to the City. The procedure for response evaluation and selection is as follows:

a. Solicitation issued.
b. Receipt of responses.
c. Opening of responses and determination if responses meet the minimum qualification standards.
d. An Evaluation Committee composed of City employees will meet to evaluate each response in accordance with the requirements of this solicitation.
e. The Evaluation Committee may shortlist the number of respondents to a minimum of three (3) for further discussions by using the following criteria for selection:
    i. Introduction letter identifying the respondent's professional specialization and other items requested in this section of the solicitation. [0 to 5 pts.]
    ii. Firm profile - Company background. [0 to 5 pts.]
    iii. Company project experience. [0 to 30 pts.]
    iv. Team Composition and Personnel experience (including Subcontractors). [0 to 25 pts.]
    v. Methodology and approach. Thorough understanding on the methodology and design approach to be used in this project. Ability to meet City timeframe. [0 to 30 pts.]
    vi. Quality of submittal – clarity, conciseness and compliance with the requirements of the solicitation. [0 to 5 pts.]

In addition to the requirements set forth by Florida Statute and the policies and procedures of the City of Minneola, the short listing and final selection criteria may include, but not be limited to, evaluation of:

a. The proximity of the Respondent and its subcontractors to the City.
b. The Respondent's experience with designing Water Resource Facilities in the State of Florida.
c. The Respondent's experience with providing innovative design, construction, and operational cost savings and efficiencies.
d. The Respondent's familiarity with the City, staff and related projects.

Evaluation Scoring Criteria

	Possible Points	Points Given
Introduction Letter	5	
Firm Profile - Company Background	5	
Company Project experience	30	
Team Composition and Personnel experience	25	
Methodology and Approach	30	
Quality of Submittal	5	
Total	100	

SECTION 4 – GENERAL TERMS AND CONDITIONS

4.1 Period of Performance & Term of Contract

The contract resulting from this solicitation is in support of a specific project. The period of performance shall commence upon formal notice to proceed or notice of award. For the purposes of this solicitation, the City has established a performance period of twelve (12) months to be substantially complete with the design documents. A firm completion period and term will be specified in the final resulting contract. Actual start of performance is contingent upon the completion and submittal of all required award-related documents.

4.2 Key Proposer Personnel

In submitting a qualifications package, the respondent is representing that each person listed or referenced in the qualifications package shall be available to perform the services described for the City, barring illness, accident, or other unforeseeable events of a similar nature in which case the respondent must be able to promptly provide a qualified replacement. In the event the Proposer wishes to substitute personnel, the Proposer shall propose a person with equal or higher qualifications. Each substitute or replacement must be approved by the City prior to their involvement with the project; and such approval may be withheld for any or no reason. In the event the requested substitute person is not satisfactory to the City and the matter cannot be resolved to the satisfaction of the City, the City reserves the right to cancel the contract for cause.

4.3 Prohibition Against Contingent Fees

Any contract entered into as a result of this request for response shall contain the following statement.

"I, as an authorized agent of ***[firm name]*** warrant that ***[firm name]*** has not employed or retained any company or person, other than a bona fide employee working solely for ***[firm name]*** to solicit or secure this agreement and that ***[firm name]*** has not paid or agreed to pay any person, company, corporation, individual, or firm, other than a bona fide employee working solely for ***[firm name]*** any fee, commission, percentage, gift, or other consideration contingent upon or resulting from the award or making of this agreement."

4.4 Truth In Negotiation Certificate

For each contract that exceeds one hundred fifty thousand dollars ($150,000.00), any organization awarded a contract must execute a truth-in-negotiation certificate stating that the wage rates and other factual unit costs are accurate, complete, and current, at the time of contracting. Any contract requiring this certificate shall contain a provision that the original contract price and any additions shall be adjusted to exclude any significant sums by which the City determines the contract price was increased due to inaccurate, incomplete, or non-current wage rates and other factual unit costs. All such contract adjustments shall be made within one (1) year following the end of the contract.

4.5 Insurance Requirements

Each Proposer shall include in its solicitation response package proof of the ability to obtain and pay for, at Proposer's sole expense, the policies provided in this section. Proposer does not need to have obtained such coverage at the time of submitting the solicitation response package, but rather that the coverage must be in effect prior to the contract being executed by the City.

- Workers Compensation: Florida Statutory coverage and Employer's Liability (including appropriate Federal Acts); Insurance Limits: Statutory Limits (Workers' Compensation) $500,000 each accident (Employer's Liability).

- Public Liability and Property Damage Insurance: Proposer shall provide and maintain, during the life of the contract, at Proposer's expense, such public liability and property damage insurance as shall protect Proposer, as well as any employees, agents, or subcontractors performing work covered by the contract from claims for property damage which may arise from operations under this contract, whether such claims arise from the actions or failures to act of Proposer, subcontractor, or anyone directly employed by the Proposer or any subcontractor, and the amount of such insurance shall be as follows:

- Comprehensive General Liability Insurance: The Proposer shall provide and maintain during the life of the contract, at his or her own expense, comprehensive general liability insurance. Coverage must afford on a form no more restrictive than the latest edition of the Occurrence Form Commercial General Liability Policy (C.G. 00 01) of the Insurance Services Office and must include without restrictive endorsements, the following minimum limits and coverage:

    - One million dollars ($1,000,000) per occurrence combined single limit for bodily injury liability, and property damage liability; premises and/or operations coverage; independent contractor's coverage; and products and/or completed operations coverage
    - Two million dollars ($2,000,000) aggregate
    - Two million dollars ($2,000,000) products-completed operations
    - One million dollars ($1,000,000) personal and advanced injury
    - Fifty thousand ($50,000) fire damage
    - Five thousand ($5,000) medical expense

  Note: The contractual coverage must specify that it covers the Hold Harmless Agreement, which will be part of the contract.

- Business Automobile Policy: The Proposer shall provide and maintain, during the life of the contract, at Proposer's expense, comprehensive automobile liability insurance. Coverage must be afforded on a form no more restrictive than the latest edition of the Business Auto Policy filed by the Insurance Services Office and must include, without restrictive endorsements, the following minimum limits and coverage:

- One million dollars ($1,000,000) per occurrence combined single limit for bodily injury liability and property damage liability; owned vehicles coverage; hired and non-owned vehicles coverage; and coverage for employer's non-ownership.

Note: The contractual coverage must specify that it covers the Hold Harmless Agreement, which will be part of the contract.

- Umbrella Liability: In addition to the above limits, the Proposer shall provide the following minimum limit and coverage:

  - Five million dollar ($5,000,000) umbrella or excess liability insurance policy

Note: The contractual coverage must specify that it covers the Hold Harmless Agreement, which will be part of the contract.

- Additionally Insured: The City of Minneola shall be named additional insured on all of the above-named insurance policies and the City of Minneola's interest shall appear on all applicable liability insurance policies.

- Deductibles: Any and all deductibles to the above referenced policies are to be fully and faithfully paid by Proposer.

- Indemnification: The Proposer shall at all times defend, indemnify, protect, save harmless, and exempt the City, its officers, agents, servants, employees, representatives, contractors, and subcontractors, from and against any and all penalties, damages, or other charges, claims, suits, demands, actions, causes of action, awards of damages whether compensatory or punitive, injuries, liabilities, losses, or expenses, including attorney's fees and costs, at law or in equity, which might be claimed now or in the future, including any payments required by worker's compensation laws or any amounts for infringement of patent, trademark or copyright, which may arise out of or be caused by the operation of the business or the performance of operations under this Agreement, and which is caused by a negligent or intentional act or omission of the Proposer, its officers, agents, servants, employees, representatives, contractors, or subcontractors, and which is not caused solely by a negligent or intentional act or omission of the City.

- Notification and Certificates of Insurance: The certificate(s) of insurance shall provide for a minimum of sixty (60) days prior written notice to the City of any change, cancellation, or nonrenewal of the provided insurance. It is the Proposer's specific responsibility to ensure that any such notice is provided within the stated timeframe to the certificate holder. An original certificate of insurance, indicating that the awarded Proposer has coverage in accordance with the requirements of this section, shall be furnished by the Proposer to the contracting officer within five (5) working days of such request and must be received and accepted by the City prior to contract execution and before any work begins.

  Certificate holder shall be:

  City of Minneola
  P.O. Box 678
  Minneola, FL 34755

  Certificates of insurance shall evidence a waiver of subrogation in favor of the City, that coverage shall be primary and noncontributory, and that each evidenced policy includes a cross liability or severability of interests provision, with no requirement of premium payment by the City.

  The Proposer shall be responsible for subcontractors and their insurance. Subcontractors are to provide certificates of insurance to the prime vendor evidencing coverage and terms in accordance with the Proposer's requirements.

  All self-insured retentions shall appear on the certificate(s) and shall be subject to approval by the City. At the option of the City, the insurer shall reduce or eliminate such self-insured retentions, or the Proposer or subcontractor shall be required to procure a bond guaranteeing payment of losses and related claims expenses.

  The City shall be exempt from, and in no way liable for, any sums of money, which may represent a deductible or self-insured retention in any insurance policy. The payment of such deductible or self-insured retention shall be the sole responsibility of the Proposer and/or subcontractor providing such insurance.

  Failure to obtain and maintain such insurance as set out above will be considered a breach of contract and may result in termination of the contract for default.

  Neither approval by the City of any insurance supplied by the Proposer or subcontractor(s), nor a failure to disapprove that insurance, shall relieve the Proposer or subcontractor(s) of full responsibility for liability, damages, and accidents as set forth herein.

4.6 General Qualification Guidance

Receipt of this document does not indicate that the City has pre-determined any company's qualifications to receive a contract award. Such determination will be made after the opening and will be based upon City's evaluation of each qualifications package compared to the specific requirements and qualifications contained in this document.

Section 287.055, Florida Statutes, "The Consultants' Competitive Negotiation Act" will be followed to secure the required firm. The contact person listed on the face page will be the sole point of contact for all respondents. In addition to the materials provided in the written responses to this RFQ, the City may utilize site visits or may request additional material, information, presentations or references from the respondent(s) that submitted qualifications packages.

4.7 Incurred Expenses

This RFQ does not commit the City to make an award nor shall the City be responsible for any cost or expense which may be incurred by any respondent in preparing and submitting a qualifications package or offer, or any cost or expense incurred by any respondent prior to the execution of a purchase order or contract agreement. By submitting a qualifications package, the respondent agrees that all costs associated with the preparation of the qualifications package will be solely the respondent's responsibility. The respondent also agrees that the City bears no responsibility for any costs associated with the preparation of the qualifications package, preparing and delivering presentations, and/or any administrative or judicial proceedings resulting from this solicitation process.

4.8 Minor Irregularities

The City reserves the right to waive minor irregularities in submitted qualifications packages when such action is in the best interest of the City. Minor irregularities are defined as those that have no adverse effect on the City's best interests and will not affect the outcome of the selection process by giving the respondent an advantage or benefit not enjoyed by other respondents.

4.9 Collusive Responses

The respondent certifies, by submission of a response, that its response is made without any previous understanding, agreement or connection with any person, firm, or corporation making a response for the same service with prior knowledge of competitive prices, and is in all respects fair, without outside control, collusion, fraud or otherwise illegal action. Any evidence of collusion among respondents and prospective respondents acting to illegally restrain freedom of competition by agreement to offer a fixed price, or otherwise, will render the responses of such responders void.

4.10 Conflict of Interest

If any officer, director, or agent of the Proposer's organization is also an employee of the City of Minneola, then the Proposer shall clearly identify the name of the individual(s) and the position he or she holds in the Proposer's organization within the response. Further, Proposer shall disclose the name(s) of any city employee(s) who owns, directly or indirectly, any interest in the Proposer's organization or any of its branches. This does not include stock in a publicly traded organization unless the individual holds more than a five percent (5%) stake. Contactor shall complete and have notarized a conflict of interest form and include it in the qualifications package.

If there is a conflict of interest as defined above and by Chapter 112, Part III, Florida Statutes, Code of Ethics for Public Officers and Employees, the issue will be addressed to the City Attorney's Office for review and opinion whether or not the respondent can be considered for award.

4.11 Public Entity Crimes

Pursuant to Section 287.132 and 287.133, Florida Statutes, the City, as a public entity, may not consider a qualifications package from, award any contract to, or transact any business in excess of the threshold amount set forth in Section 287.017, Florida Statutes, with any person or affiliate on the convicted contractor list for the time periods specified unless such person has been removed from the list pursuant to law. By submitting a qualifications package in response to this RFQ, the respondent is certifying that it is eligible for award under this solicitation pursuant to Section 287.132 and 287.133, Florida Statutes.

4.12 No Confidentiality of Information

When the qualifications package is opened, it becomes a public record, except as listed below. All material submitted becomes the property of the City and may be returned only at the City's option. The City has the right to use any or all ideas presented in any reply to this RFQ. Selection or rejection of a qualifications package does not affect this right.

The City is governed by the Public Records Law, Chapter 119, Florida Statutes (F.S.). Only trade secrets as defined in Section 812.081, F.S., will be exempt from disclosure. If a respondent submits trade secret information, the information must be segregated and each pertinent page must be clearly labeled "trade secret." The City will maintain the confidentiality of such trade secrets to the extent provided by law. If a respondent labels all or most pages "trade secret," the Respondent may not be considered for award.

Also pursuant to Section 119.071 (c), F.S., financial statements will be exempt from examination by anyone other than legally authorized City employees or agents. The City will maintain the confidentiality of such financial data to the extent provided by law.

4.13 Public Records/Copyrights

All electronic files, audio and/or video recordings, and all papers pertaining to any activity performed by the Proposer for or on behalf of the City shall be the sole property of the City and will be turned over to the City upon request. In accordance with Chapter 119, Florida Statutes, each file and all papers pertaining to any activities performed for or on behalf of the City are public records available for inspection by any person even if the file or paper resides in the Proposer's office or facility. The Proposer shall maintain the files and papers for not less than three (3) complete calendar years after the project has been completed or terminated, or in accordance with any grant requirements, whichever is longer. Prior to the close out of the contract, the Proposer shall appoint a records custodian to handle any records request and provide the custodian's name and telephone number(s) to the Contracting Officer.

During the term of the Contract, the Contractor shall comply with the Florida Public Records Law, to the extent such law is applicable to the Contractor. If Section 119.0701 of the Florida Statutes is applicable, the Contractor shall do the following: (1) keep and maintain public records required by the City in order to perform this service; (2) upon request from the City's custodian of public records, provide the City with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost allowed by law; (3) ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the contract term and following completion of the contract if the Contractor does not transfer the records to the public agency; (4) upon completion of the Contract, transfer, at no cost, to the City all public records in possession of the Contractor or keep and maintain public records required by the City to perform the service. If the Contractor transfers all public records to the City upon completion of the Contract, the Contractor shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If the Contractor keeps and maintains public records upon completion of the Contract, the Contractor shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the City, upon request from the City's custodian of public records, in a format that is compatible with the information technology systems of the City.

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTACT THE CITY CLERK AT(352) 3598 x 2100; PUBLICRECORDSREQUEST@MINNEOLA.US; CITY HALL, 800 NORTH U.S. HIGHWAY 27, MINNEOLA, FL 34715.

The Contractor shall keep and make available to the City for inspection and copying, upon written request by the City all records in the Contractor's possession relating to the Contract. Any document submitted to the City may be a public record and is open for inspection or copying by any person or entity unless considered confidential and exempt. Public records are defined as all documents, papers, letters, maps, books, tapes, photographs, films, sound recordings, data processing software, or other material, regardless of physical form, characteristics, or means of transmission, made or received pursuant to law or ordinance or in connection with the transaction of official business by an agency. Any document in the Contractor's possession is subject to inspection and copying unless exempted under Chapter 119 of the Florida Statutes.

If the Contractor fails to comply with the Public Records Law, the Contractor shall be deemed to have breached a material provision of the Contract.

Any copyright derived from any agreement derived from this solicitation shall belong to the author. The author and the Proposer shall expressly assign to the City nonexclusive, royalty free, rights to use any and all information provided by the Proposer in any deliverable and/or report for the City's use which may include publishing in City documents and distribution as the City deems to be in the City's best interests. If anything included in any deliverable limits the rights of the City to use the information, the deliverable shall be considered defective and not acceptable and the Proposer will not be eligible for any compensation.

4.14 Special Notice to Contractors Regarding Federal and/or State Requirements

Upon award of a contract resulting from this solicitation, the Contractor shall utilize the U.S. Department of Homeland Security's E-Verify system in accordance with the terms governing use of the system to confirm the employment eligibility of:

- All persons employed by the Contractor during the term of the contract; and,
- All persons, including subcontractors, assigned by the Contractor to perform work pursuant to the contract.

4.15 Lobbying Prohibited

Upon the issuance of this RFQ, all prospective applicants, and any agent, representative or person acting at the request of such prospective applicant, shall be prohibited from discussing any matters related in any way to this RFQ with any officer, agent, employee, or Council member of the City, other than the individual identified in Section 1.0. Such prohibition applies to any and all communications regarding this RFQ with the City, with the sole exception of the mandatory pre-proposal meeting referenced in Section 1.2 above, at which all interested parties will have an equal opportunity to pose questions and receive answers. See Form 1.

FORM 1

LOBBYING PROHIBITION FORM

Upon the issuance of this RFQ, all prospective applicants, and any agent, representative or person acting at the request of such prospective applicant, shall be prohibited from discussing any matters related in any way to this RFQ with any officer, agent, employee, or Council member of the City, other than the individual(s) identified in Section 1.

Discussions during the mandatory pre-bid meeting between participants present at the mandatory pre- bid meeting is not subject to this prohibition.

I (printed name) ____________________________being the (title) _________________________

of (firm name) ____ certify that I, or any other member of the Firm or its affiliates, have not discussed any matters related to this RFQ, outside of the mandatory pre-bid meeting, with any officer, agent, employee, or council member of the City, other than the individual(s) identified in Section 1.

Signature ____________________________ Date _______________________

FORM 2

CONFLICT OF INTEREST DISCLOSURE FORM

I HEREBY CERTIFY that

1. I (printed name) ____am the (title)

   ____________________________and the duly authorized representative of the firm of

   (Firm Name) _____________________________________whose address is

   ____

   ____, and that I possess the legal authority to make this affidavit on behalf of myself and the firm for which I am acting; and,

2. Except as listed below, no employee, officer, or agent of the firm have any conflicts of interest, real or apparent, due to ownership, other clients, contracts, or interests associated with this project; and,

3. This proposal is made without prior understanding, agreement, or connection with any corporation, firm, or person submitting a proposal for the same services, and is in all respects fair and without collusion or fraud.

Signature:____

Printed Name:____

Firm Name:____

Date: _________________

Sworn to before me this __________day of _____________________20__.

Personally known __________________

OR Produced identification _______________________Notary Public - State of _______________

________________________________My Commission expires _________________________

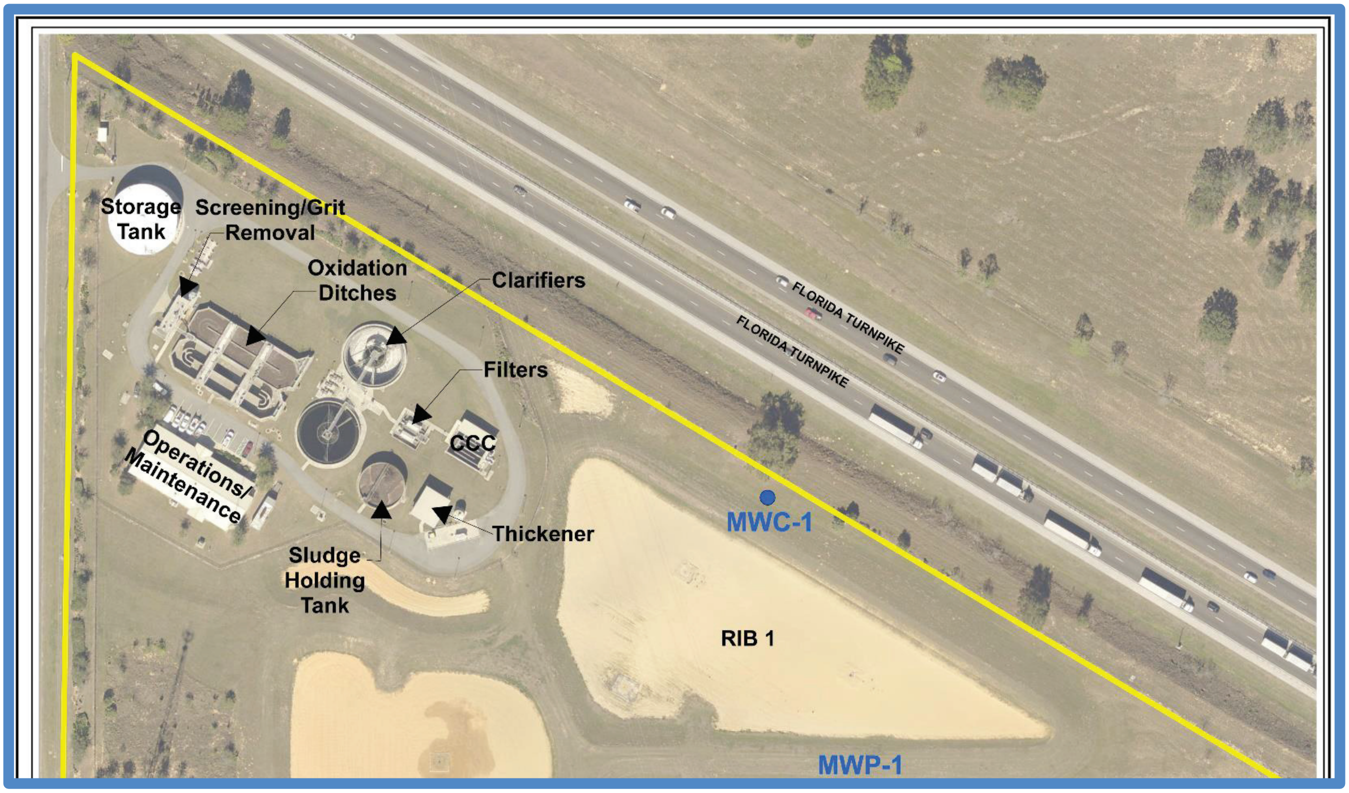
(Type of Identification)

____

(Printed, typed or stamped commissioned name of Notary Public)

City of Minneola Water Reclamation Facility Draft Capacity Rerating Study

December 2022



PRESENTED TO	PREPARED BY
Mark Johnson, City Manager **City of Minneola** 800 N. U.S. Hwy. 27 Minneola, FL 34715 **P** +1-352-394-3598 www.minneola.us	**Tetra Tech** 201 East Pine Street, Suite 1000 Orlando, FL 32801 **P** +1-407-839-3955 www.tetratech.com

JOHN TOOMEY, PE – This item has been electronically signed and sealed by John Toomey using a Digital Signature. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

JOHN PETER TOOMEY LICENSE No. 40264 STATE OF FLORIDA PROFESSIONAL ENGINEER

Digitally signed by John P Toomey
Date: 2022.12.05 15:13:58 -05'00'

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1.0 INTRODUCTION

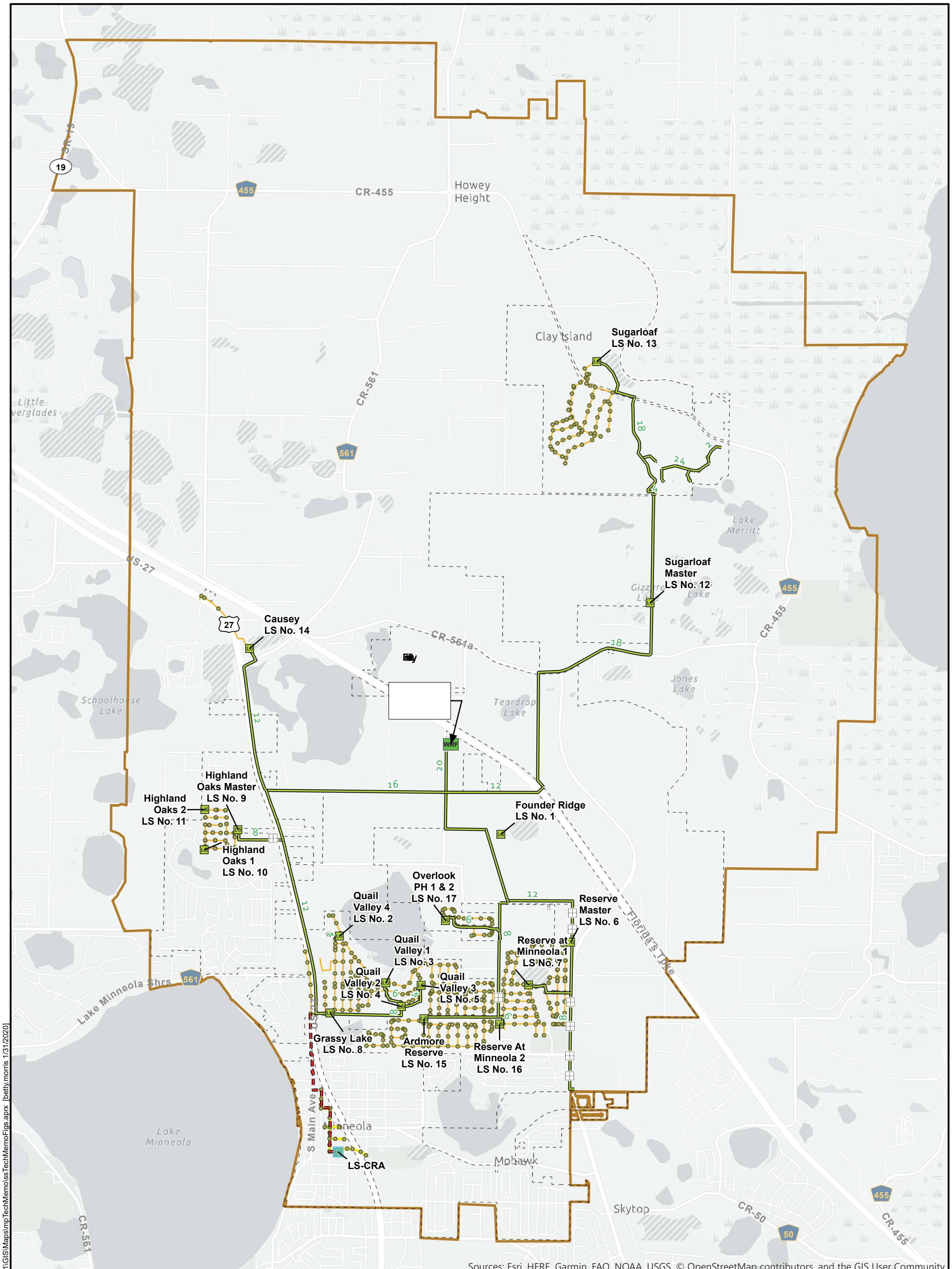
1.1 BACKGROUND AND PURPOSE

The City of Minneola in Lake County, Florida owns and operates the Minneola Water Reclamation Facility (WRF) which is located near Sugarloaf Mountain, approximately 8 miles northeast of Clermont. **Figure 1-1** presents the City's Wastewater Service Area the location of the WRF and the associated rapid infiltration basins (RIBs).

The existing WRF is designed and permitted for capacities of 1.000 and 0.999 million gallons per day (MGD), respectively, on an annual average daily flow (AADF) basis. The facility utilizes a phased isolation oxidation ditch process to provide secondary treatment and a moderate degree of nitrogen control. Treated effluent from the facility is discharged to on-site rapid infiltration basins (RIBs) or is used for irrigation.

The primary purpose of this report is to present preliminary engineering information related to a proposed capacity increase to 1.200 MGD on AADF basis and it is intended for this report to support an application for a "Wastewater Permit" pursuant to Florida Administrative Code (FAC) Chapter 62-620. The objective of this project is to increase the permitted capacity from 0.999 MGD to 1.200 MGD with only minimal physical improvements.

A detailed evaluation of the individual treatment components supports the proposed increase in capacity to 1.200 MGD. Similarly, an evaluation of the existing RIBs indicates that they will provide adequate effluent disposal capacity.



Source: City of Minneola, FL

LEGEND

City Limits	Manhole	Lift Station	Air Release Valve
Wastwater Service Area	Gravity Main	Force Main	
Water Reclamation Facility	Future Gravity	Future Force Main	

TETRA TECH

0 0.6 Miles N

WASTEWATER SERVICE AREA & FACILITY LOCATION MAP

FIGURE 1-1

1.2 SCOPE

In general, the scope of this report includes the following:

- Analysis of existing flows and influent characteristics
- Assessment of WRF performance
- Presentation of pertinent regulatory criteria
- Process modelling and assessment of unit operations and processes with respect to generally accepted design criteria
- Documentation supporting the process rerating concept with only minor improvements
- Hydrogeological evaluation and modelling to support an increase in the permitted capacity of the RIBs.
- Conceptual opinions of cost for identified minor improvements

2.0 FLOWS AND INFLUENT CHARACTERISTICS

2.1 DEFINITIONS

To provide a clear, concise discussion of wastewater flows and influent characteristics, brief definitions of various terms are presented below.

Annual Average Daily Flow (AADF): The total volume of wastewater flowing to a facility during a year divided by 365 and expressed in units of million gallons per day (MGD).

Maximum Monthly Average Daily Flow (MMADF): The largest volume of wastewater flowing to a facility during one month of a year divided by the number of days in that month and expressed in units of MGD.

Maximum Daily Flow (MDF): The maximum wastewater flow to a facility in one day during a year expressed in units of MGD.

Peak Hourly Flow (PHF): The maximum average flow rate to a facility during a one-hour period for a year expressed in units of MGD.

Three-Month Average Daily Flow (TMADF): The average amount of wastewater flowing to a facility during three consecutive months expressed in units of MGD.

Carbonaceous 5-Day Biochemical Oxygen Demand ($CBOD_5$): The quantity of oxygen utilized in the carbonaceous biochemical oxidation of organic matter under standard laboratory procedures in 5 days at 20º C expressed in milligrams per liter (mg/L).

Rapid Infiltration Basin (RIB): A permeable basin designed and operated to treat and disperse treated effluent from municipal wastewater treatment facilities.

Total Suspended Solids (TSS): Solids that either float on the surface of or are suspended in water or wastewater which are removed from a sample by a filter in a standard laboratory procedure and expressed in mg/L.

Total Kjeldahl Nitrogen (TKN): The sum of free ammonia and organic nitrogen compounds in water or wastewater expressed as elemental nitrogen in mg/L.

Total Phosphorous (TP): The total phosphorus content of water or wastewater including all of the orthophosphates and condensed phosphates, both soluble and insoluble, and organic or inorganic species, expressed as elemental phosphorus in mg/L.

2.2 EXISTING AND PROJECTED WASTEWATER FLOWS AND INFLUENT CHARACTERISTICS

To evaluate the existing components and identify needed improvements, it is necessary to consider flow patterns and influent characteristics. To develop various peaking factors and to establish influent characteristics, monthly operating records for the existing plant have been reviewed and evaluated. A summary of the results from the data analysis is presented in **Table 2-1**. A summary of the design peaking factors, and influent characteristics used in the design of the proposed WRF expansion is presented in **Table 2-2.**

Table 2-1 Summary of Historical Flows & Influent Characteristics

Parameter	2019	2020	2021
AADF (MGD)	0.305	0.340	0.368
MMF (MGD)	0.355	0.389	0.431
MMF/AADF Ratio	1.16	1.14	1.17
MDF (MGD)	0.401	0.401	0.575
MDF/AADF Ratio	1.31	1.18	1.56
Influent $CBOD_5$ (mg/L)	244	358	294
Influent TSS (mg/L)	293	227	173
Effluent Nitrate (mg/L)	3.0	2.6	3.3
Effluent Total Nitrogen	3.1	4.3	4.7

Table 2-2 Summary of Design Flows & Influent Characteristics

Parameter	Value
Annual Average Daily Flow	1.20 MGD
MMADF:AADF Ratio	1.20
Maximum Monthly Average Daily Flow	1.44 MGD
MDF:AADF Ratio	1.40
Maximum Daily Flow	1.68
PHF:AADF Ratio	2.90
Peak Hourly Flow[1]	3.48
Influent $CBOD_5$	300 mg/L
Influent TSS	240 mg/L
Influent TKN[2]	60 mg/L
Influent TP	6 mg/L

Notes:

1. The operating data for the WRF does not include data for PHF. For PHF, a peaking factor can be reasonably assumed pursuant to Ten State Standards.
2. Typical influent sampling does not include TKN analyses; however, sporadic sampling indicates the influent TKN averages approximately 60 mg/L.

3.0 BASIS OF DESIGN AND SUMMARY OF PROPOSED FACILITIES

3.1 EFFLUENT LIMITS AND RELIABILITY REQUIREMENTS

As previously stated, the Minneola WRF is proposed to have a permitted design capacity of 1.200 MGD on an AADF basis. This section addresses some of the key regulatory requirements that must be considered as part of the expansion of the WRF.

The level of treatment to be provided is dependent upon the effluent disposal option that will be used. The primary method of disposal for the Minneola WRF will be discharge to the existing RIBs. The City of Minneola WRF lies within the Upper Ocklawaha Basin Action Management Plan (BMAP). Currently, this BMAP does not establish any applicable effluent limit requirements for permitted domestic wastewater facilities.

As the Upper Ocklawaha BMAP does not have TN and TP effluent limit requirement; therefore, the current effluent limits at Minneola WRF are set forth by the existing FDEP Permit. **Table 3-1** summarizes the effluent limits applicable to the following methods of effluent reuse: discharge to reuse system (R-001) and effluent discharge to existing on-site RIBs (R-002).

Table 3-1 Effluent Limits

	R-001		R-002	
Parameter	**Limit**	**Statistical Basis**	**Limit**	**Statistical Basis**
Max. $CBOD_5$ (mg/L)	20 30 60	Annual Average Monthly Average Single Sample	20 30 60	Annual Average Monthly Average Single Sample
Max. TSS (mg/L)	5.0	Single Sample	20 30 60	Annual Average Monthly Average Single Sample
Max. Fecal Coliform (#/100ml)	Non-Detectable in 75% of Daily Sample/Less than 25/100 mL at all Times		200 200 800	Annual Average Monthly Geo Mean Single Sample
Min. Chlorine Residual (mg/L)	1.0	Single Sample	0.5	Single Sample
Max. Nitrogen, Nitrate, Total as N (mg/L)	-	-	12.0	Single Sample

Various “classes” of reliability are defined by EPA, and FDEP has established reliability requirements for WRFs depending upon the method of effluent disposal. For discharge to a RIBs, the facility must provide Class III reliability as defined by EPA MCD-05. Class I Reliability must be provided for public access reuse systems unless alternative means of disposal are provided. In the case of the Minneola WRF, the RIBs have sufficient capacity to accommodate all effluent produced by the facility. This results in the need for Class III Reliability rather than Class I. **Tables 3-2 and 3-3** present detailed summaries of treatment process and standby power requirements for Class III Reliability.

Table 3-2 Wastewater Treatment Component Reliability Requirements
For Class III Reliability

General Requirements:
1. Trash removal or comminution is required.
2. Grit removal is generally required; however, it is not necessary for treatment works which do not pump or dewater sludge (e.g., stabilization ponds).
3. Provisions for removal of settled solids is required for channels, pump wells, and piping upstream of degritting or primary sedimentation.
4. Unit operation bypass is generally required; however, it is not applicable where two or more units are provided, and operating unit can handle peak flows. Unit operation bypass is applicable to comminution regardless of the number of units.

Component/Backup Feature	Class III Reliability Requirement
Backup Bar Screen for Mechanically Cleaned Bar Screen or Comminutor	Yes
Backup Pumps	Yes[1]
Primary and Final Sedimentation Basins	Multiple Basins[2]
Aeration Basins	Single Basin
Aeration Blowers or Mechanical Aerators	Multiple Units[3], one of the units may be uninstalled.
Sedimentation Basins	Multiple Basins
Trickling Filter	Backup component(s) not required
Chemical Flash Mixers	Backup component(s) not required
Chemical Sedimentation Basins	Backup component(s) not required
Filters	Backup component(s) not required
Flocculation Basins	Backup component(s) not required
Activated Carbon Column	Backup component(s) not required
Disinfectant Contact Basin	Multiple Basins[4]

Notes:
1. Sufficient capacity of remaining pumps to handle peak flow with one pump out of service.
2. Minimum two (2) basins.
3. With largest unit out of service remaining units must be able to maintain design oxygen transfer.
4. Minimum of two (2) basins, equal volume.

Table 3-3 Electric Power System Reliability Requirements for Class III Reliability

General Requirements:
Power Sources: Two separate and independent electric power sources from either two separate utility substations or one substation and one standby generator. As a minimum, the capacity of the back-up power source shall be sufficient to operate the screening or communition facilities, the main wastewater pumps, the primary sedimentation basins, and the disinfection facility during peak wastewater flow condition, together with critical lighting and ventilation.

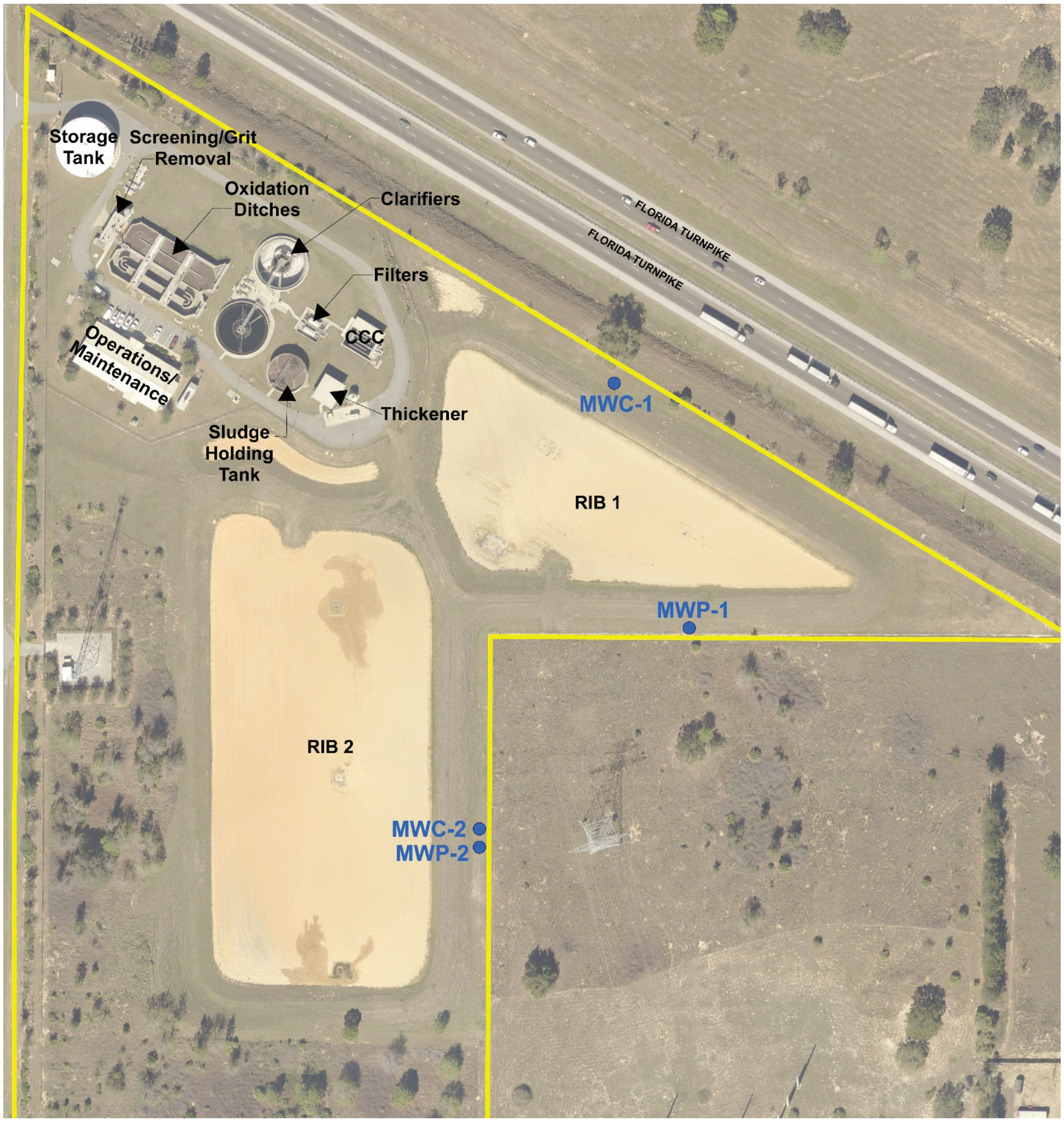
Capacity of Backup Power Source	Class III Reliability Requirement
Mechanical Bar Screens or Comminutors	Yes
Main Pumps	Yes
Degritting	Optional
Primary Sedimentation	Yes
Secondary Treatment	Optional
Final Sedimentation	Optional
Advanced Waste Treatment	Optional
Disinfection	Yes
Sludge Handling and Treatment	Optional
Critical Lighting and Ventilation	Yes

3.2 RESIDUALS STABILIZATION REQUIREMENTS

Residuals from the biological treatment process will continue to be hauled by a private company to a remote location for stabilization and subsequent disposal. Since stabilization will be provided off-site, design and operational criteria for residuals stabilization are not applicable to the rerate WRF.

3.3 SUMMARY OF WASTEWATER TREATMENT, EFFLUENT REUSE AND RESIDUALS HANDLING FACILITIES

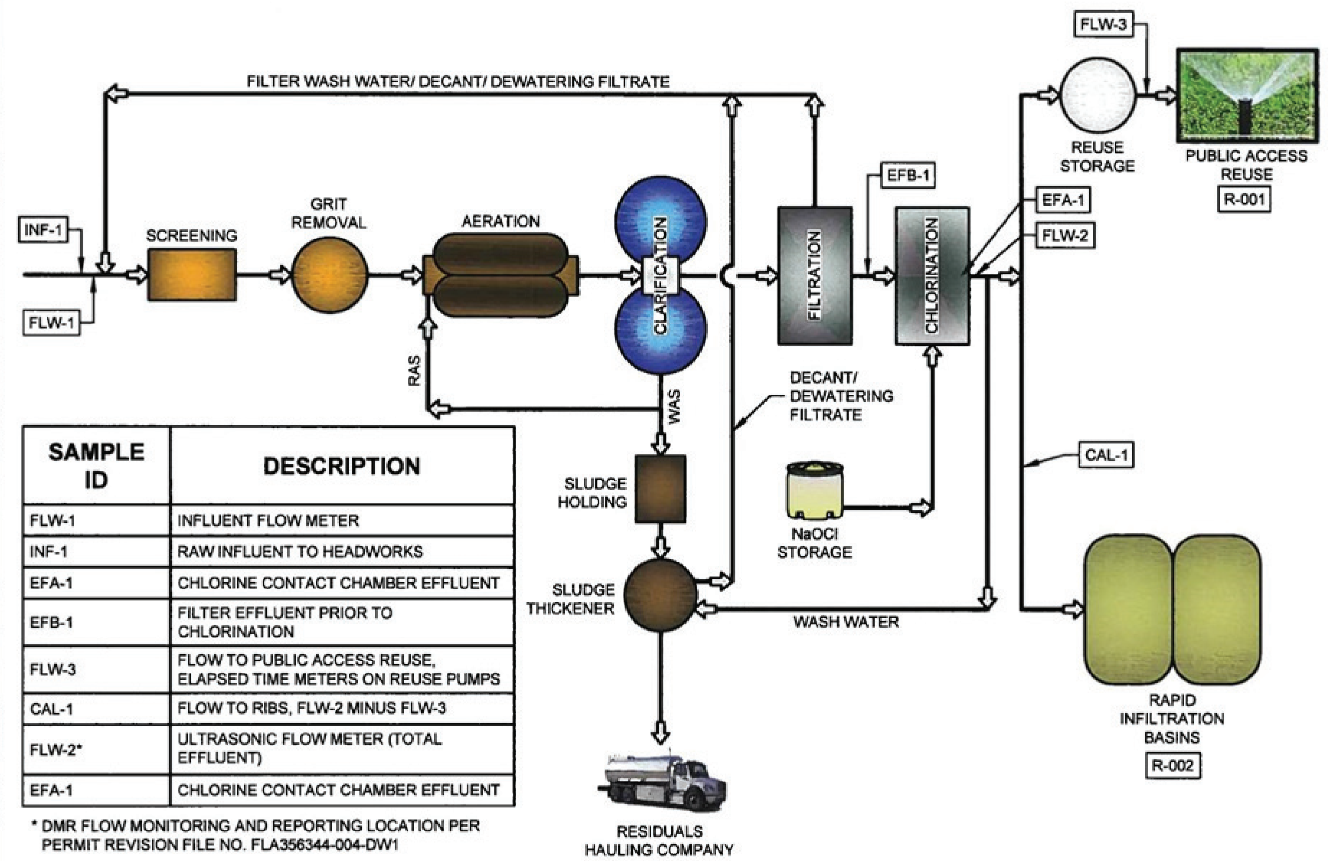
As stated in Section 1.0, rerating and minor improvement are being proposed to increase the permitted treatment capacity to 1.200 MGD The following provides a more detailed description of each proposed plant process improvement. **Figure 3-1** presents an overall site plan for the expanded WRF, **Figure 3-2** presents a process flow diagram, and **Figure 3-3** presents the hydraulic profile. **Appendix A** presents process modeling results. **Appendix B** presents a hydrogeologic report pertaining to the RIBs. **Table 3-4** presents a detailed preliminary design summary.



TETRA TECH

CITY OF MINNEOLA WRF

FIGURE 3-1: SITE PLAN



SAMPLE ID	DESCRIPTION
FLW-1	INFLUENT FLOW METER
INF-1	RAW INFLUENT TO HEADWORKS
EFA-1	CHLORINE CONTACT CHAMBER EFFLUENT
EFB-1	FILTER EFFLUENT PRIOR TO CHLORINATION
FLW-3	FLOW TO PUBLIC ACCESS REUSE, ELAPSED TIME METERS ON REUSE PUMPS
CAL-1	FLOW TO RIBS, FLW-2 MINUS FLW-3
FLW-2*	ULTRASONIC FLOW METER (TOTAL EFFLUENT)
EFA-1	CHLORINE CONTACT CHAMBER EFFLUENT

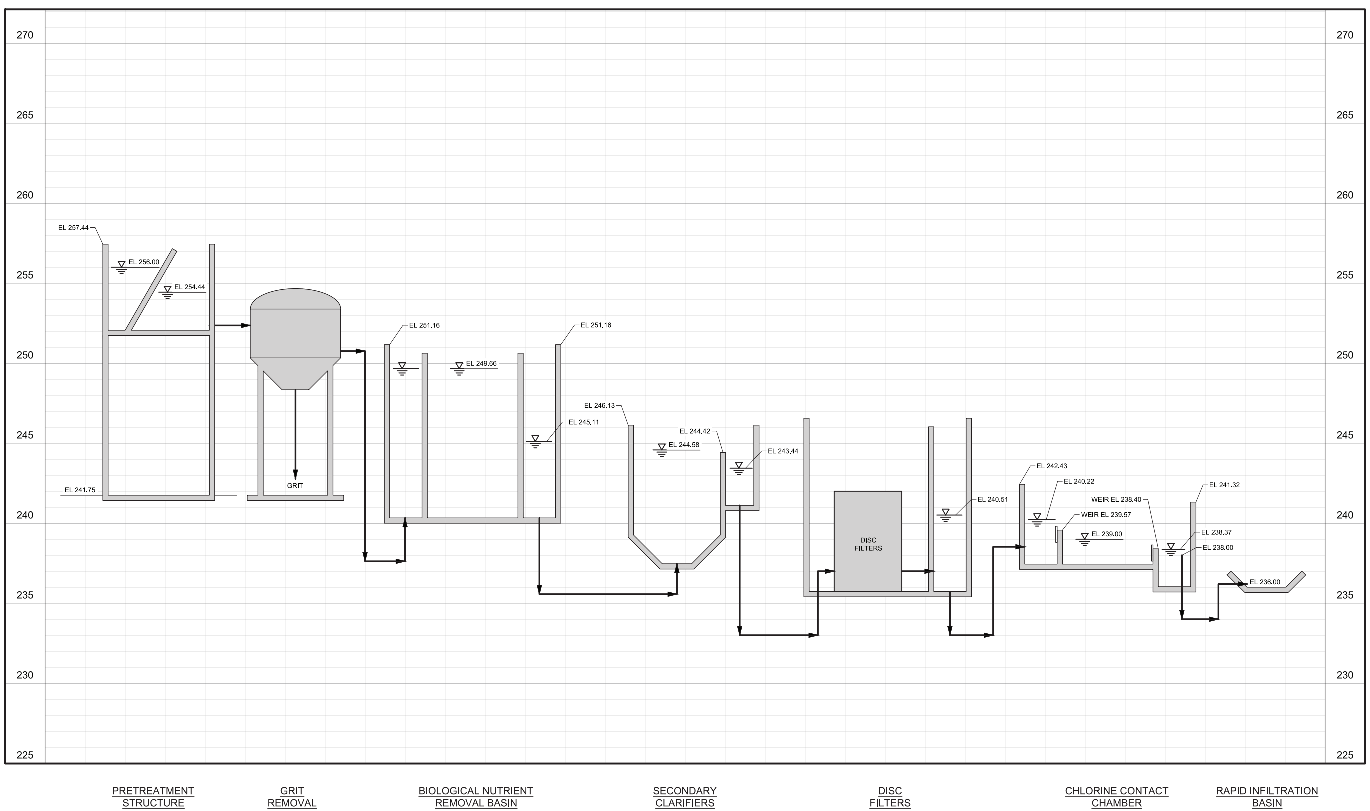
* DMR FLOW MONITORING AND REPORTING LOCATION PER PERMIT REVISION FILE NO. FLA356344-004-DW1

CITY OF MINNEOLA

WRF OPERATING PERMIT RENEWAL
OPERATION AND MAINTENANCE PERFORMANCE REPORT

PROCESS FLOW DIAGRAM

FIGURE 3



TETRA TECH
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PRELIMINARY
NOT FOR CONSTRUCTION

MARK	DATE	DESCRIPTION	BY

CITY OF MINNEOLA
WATER RECLAIMATION FACILITY RERATE

HYDRAULIC PROFILE

PROJ: 200-08520-22003
DESN: JT
DRWN: CS
CHKD: JT

FIG 3-3

Bar Measures 1 inch, otherwise drawing not to scale

10/11/2022 9:49:21 AM • O:\PROJECTS\ORLANDO\ER\08520\200-08520-22003\CAD\CONCEPTUAL\HYDRAULIC PROFILE.DWG • SANFORD, CHADWICK

Table 3-4 Minneola WRF Expansion Preliminary Design Summary

Parameter/Unit Operation or Process			Description
I.	**Flows and Influent Characteristics**		
	Flow Rates, MGD		
		Average Day	1.20
		Maximum Month	1.44
		Maximum Day	1.68
		Peak Hour	3.48
	Influent $CBOD_5$ Concentration, mg/L		300
	Mass Loading, lbs./day		
		Average Day	3,004
		Maximum Month	3,605
		Maximum Day	4,206
	Influent TSS Concentration, mg/L		240
	Mass Loading, lbs./day		
		Average Day	2,403
		Maximum Month	2,884
		Maximum Day	3,365
	Influent TKN Concentration, mg/L		60
	Mass Loading, lbs./day		
		Average Day	601
		Maximum Month	721
		Maximum Day	841
	Influent TP Concentration, mg/L		6
	Mass Loading, lbs./day		
		Average Day	60
		Maximum Month	72
		Maximum Day	84
II.	**Screening (Existing, No Modifications)**		
	Inclined Rotary Drum Bar Screen		
		Number of Units	1
		Channel Width, feet	1.67
		Channel Depth, feet	4.00
		Opening Size, inches	0.25
		Peak Design Capacity, MGD	3.50

Table 3-4 Minneola WRF Expansion Preliminary Design Summary (cont'd)

Parameter/Unit Operation or Process	Description
Manual Bypass Screen	
Number of Units	1
Channel Width, feet	2.00
Channel Depth, feet	4.00
Opening Size, inches	0.25
III. Grit Removal (Existing - No Modifications)	
Type	Vortex
Number of Units	1
Peak Design Capacity, MGD	3.50
IV. Process Basins (Existing - Add One (1) Aerator	
Type	Phased Isolation Oxidation Ditch
Number of Units	2
Volume, gallons	
Each	0.341
Total	0.682
SWD, feet	10.00
Design MLSS, mg/l	4,000
SRT, days	
Average Day	7.1
Maximum Month	6.3
Hydraulic Detention Time, hours	
Average Day	13.6
Maximum Month	11.4
Solids Production, lbs./day	
Average Day	3,204
Maximum Month	3,611
Oxygen Demand, lbs./day	
Average Day	4,210
Maximum Month	4,940
Maximum Day	5,758

Table 3-4 Minneola WRF Expansion Preliminary Design Summary (cont'd)

Parameter/Unit Operation or Process	Description
Aeration System	
Aeration Method	Horizontal Rotors
Clean Water Oxygen Transfer Efficiency,	3.10
Design Dissolved Oxygen Concentration,	
Average Day	2.00
Maximum Month	1.00
Maximum Day	0.50
Aeration Rotors	
Existing	6 @ 20 HP Each
Proposed	2 @ 20 HP Each
Total	8 @ 20 HP Each
Total Installed Horsepower	160
Process Cycles Times	
Anoxic	33% (8 hours/day)
Aerobic	67% (16 hours/day)
Power Requirements (Based on Aerators	
Average Day	131
Maximum Month	131
Maximum Day	143
Mixers	
Number of Units	4
Type	Submersible
Horsepower, Each	7.5
V. Secondary Clarifiers (Existing – No Modifications)	
Number of Units	2
Sludge Removal Method	Spiral Scraper
Diameter, feet	70.00
Sidewater Depth, feet	14.00
Surface Area, sq. ft	
Each	3,848
Total	7,696
Volume, gallons	
Each	431,000
Total	862,000

Table 3-4 Minneola WRF Expansion Preliminary Design Summary (cont'd)

Parameter/Unit Operation or Process	Description
Surface Loading Rate, GPD/sq. ft.	
Average Day	156
Peak Hour	452
Effluent Weirs	
Weir Diameter, feet	64.67
Weir Length Per Clarifier, feet	203
Total Weir Length, feet	406
Weir Loadings, GPD/lineal foot	
Average Day	2,956
Peak Hour	8,571
Design RAS Flow Ratio, RAS:Influent Flow	0.67
Solids Loading Rate, lbs./day/sq. ft.	
Average Day	8.7
Maximum Day	12.2
Hydraulic Retention Time (Excluding RAS), hrs.	
Average Day	17.2
Peak Hour	5.9
Return Activated Sludge Pumps	
Number of Units	3
Type	Non-Clog, Centrifugal
Horsepower, Each	15
Capacity, Each, Flow-GPM	700
WAS Pumps	
Number of Units	2
Type	Non-Clog, Centrifugal
Horsepower, Each	3
Capacity, Each, Flow-GPM	180
Scum Pumps	
Number of Units	2
Type	Torque Flow

Table 3-4 Minneola WRF Expansion Preliminary Design Summary (cont'd)

Parameter/Unit Operation or Process	Description
Horsepower, Each	3
Capacity, Each, Flow-GPM	150
VI. Filters (Existing – No Modifications)	
Filter Type	Kruger Disk Filter
Number of Units	2
Disks per Unit	14
Area per Disk, sq. ft.	39.21
Total Area, sq. ft.	
Each Filter Unit	549
Total	1,098
Loading Rate, GPM/sq. ft.	
Average Day	0.76
Peak Hour	2.20
Filter Drive Horsepower, Each	1.5
Backwash System	
Number of Pumps	2
Type	Centrifugal
Horsepower, Each	10
VII. Disinfection Facilities (Existing – No	
Chlorination System	
Type	Sodium Hypochlorite
Disinfectant Storage, Gallons	3,000
Design Chlorine Dosage for Disinfection,	6.0
Sodium Hypochlorite Usage, GPD	
Average Day	60
Maximum Month	72
Peak Hour	174
Days of Storage @ Average Day	50

Table 3-4 Minneola WRF Expansion Preliminary Design Summary (cont'd)

Parameter/Unit Operation or Process	Description
Design Chlorine Residual, mg/L	
Average Day	2.0
Peak Hour	2.0
Sodium Hypochlorite Feed Rates, GPH	
Average Day	2.5
Peak Hour	7.3
No. of Metering Pumps	2
Metering Pump Capacity, Each, GPH	20
Hypochlorite Application Point	Chlorine Contact Tank
Metering Pump Feed Rate Control	Flow Proportional
Chlorine Contact Chamber	
Number of Tanks	1
Number of Contact Chambers per Tank	2
Basin Volume, gallons	
Each Basin	27,545
Total	55,090
Detention Time, minutes	
Average Day	66.1
Peak Hour	22.8
CT for Disinfection, mg-minutes/L	
Average Day	132.2
Peak Hour	45.6
VIII. Effluent Transfer Pumps (Existing – No	
Number of Units	2
Type	Vertical Turbine
Horsepower, Each	35
Capacity, each, Flow – GPM	2,100
IX. Effluent Reuse Storage & Pumping (Existing – No	
Storage Type	Concrete Tank
Total Storage Volume, MG	1.0
Pumping Facilities	
Type	Vertical Turbine
Number of Units	3
Horsepower, Each	50
Capacity, GPM, Each	1,500

Table 3-4 Minneola WRF Expansion Preliminary Design Summary (cont'd)

Parameter/Unit Operation or Process	Description
X. Solids Handling (Existing – No Modifications)	
Sludge Production @ 1.0% DS, GPD	
Average Day	38,400
Maximum Month	43,300
Thickening (Intermittent Use)	
Method	Gravity Belt
Thickened Sludge Solids Content, Percent	4.00
Thickened Sludge Production, GPD	
Average Day	9,600
Maximum Month	10,800
Aerated Holding Tanks	
Number of Units	1
Volume, gal.	198,000
Decanting	**Adjustable Pipe**
Aeration System	
Type	Mechanical
Number of Units	2
Horsepower, Each	15

Notes:

1. The oxygen transfer capacities for the process aeration system are based on WPCF MOP FD-13 models with the following values:
   - α= 0.70
   - β = 0.96
   - Temp. = 30° C
2. In lieu of installation additional 20 horsepower rotors, floating mechanical aerators will provide comparable oxygen transfer capacity at a lower capital investment. This option is preferable to installing additional rotors.

3.4 SUMMARY OF ELECTRICAL, INSTRUMENTATION, AND STANDBY POWER FACILITIES

Electric power service to the WRF is 480 volt, 3 phase, 60 hertz provided by the local electric utility. A pad mounted on-site transformer is provided near the operations building and distribution and motor control components are located within the building. The service is backed up with a single 1,250 kW diesel generator and automatic transfer switch. Control panels and loads at the MCC's have time delay relays to prevent the simultaneous starting of motors, which might overload the generator. A turbidimeter continuously monitors turbidity prior to disinfection and continuous monitoring of pH and chlorine residual is performed following disinfection. A supervisory control and data acquisition (SCADA) system is provided in the operations building The system automatically notifies the WRF superintendent of alarm conditions when the facility is unattended.

3.5 CLASS III RELIABILITY EVALUATION

As previously stated, the WWTP improvements will need to meet Class III Reliability Criteria pursuant to FAC Chapter 62-610. The criteria vary depending upon the unit operation or process under consideration as shown in **Tables 3-2** and **3-3**. In some cases, spare units are required to maintain full operation when a unit is out of service, while in other cases, multiple units with a minor degree of "oversizing" will suffice. For some unit operations that are extremely reliable, such as chlorine contact tanks, it is only necessary to have multiple basins, without any redundancy. Clearly, each unit operation and process must be evaluated on an individual basis to ascertain compliance with appropriate criteria. Accordingly, **Table 3-5** presents the various unit operations and processes within the WRF, appropriate Class III Reliability Criteria, and a description of the method of complying with the requirements.

Table 3-5 Class III Reliability Documentation

Item	Class III Reliability Requirement	Method of Providing Class III Reliability
Mechanical Bar Screen	Backup screen for mechanically cleaned bar screen	A manually cleaned bar screen is provided as a back-up to the mechanically cleaned bar screen.
Aeration Basins	A single basin is permissible.	Multiple basins are provided
Aeration Equipment	There shall be at least two blowers or mechanical aerators available for service. One may be uninstalled, provided that the installed unit can be easily removed and replaced.	With the addition of two additional mechanical aeration units, maximum day oxygen demand can be satisfied with one unit out of service at a slightly lower operating dissolved oxygen concentration.
Clarifiers	Multiple basins	Two equally sized clarifiers are provided.
Filters	No backup required	Two equally sized filters are provided.
Chlorine Contact Basins	With largest unit out of service remaining units must have capacity for 50% of design flow	Two equally sized contact chambers are provided
Effluent Transfer Pumps	With largest unit out of service, remaining units must maintain design flow	Effluent can flow by gravity to the on-site RIBs at the proposed PHF
Polymer Metering Pumps	With largest unit out of service, remaining units must maintain design flow	A backup metering pump is provided
Hypochlorite Metering Pumps	With largest unit out of service, remaining units must maintain design flow	A backup metering pump is provided

4.0 PROJECT EVALUATION

4.1 ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

Short-term environmental impacts of the proposed project are not expected to be significant. Also, it is anticipated that the proposed project will not adversely impact unique, endangered, or threatened species, agricultural lands, or significant historical or archeological resources. Also, the project will not result in land uses that are inconsistent with the approved "Comprehensive Plan" for the City of Minneola.

The proposed project will not result in any significant adverse impacts on any potable groundwater resources due to effluent quality, application rates, and regulatory agency setback distances between the application areas and public potable water supply wells. Due to the proposed wastewater treatment, residuals handling, and effluent reuse methods, it is anticipated that ambient air quality will not be compromised. Noise resulting from normal operation of the treatment equipment is not expected to cause complaints by adjacent landowners due to the locations of the treatment units.

5.0 IMPLEMENTATION

5.1 IMPLEMENTATION SCHEDULE

It is expected that construction of the proposed improvements will be completed by September 2023.

5.2 ESTIMATED CONSTRUCTION COST

Table 5-1 presents the estimated cost to implement the improvements described herein.

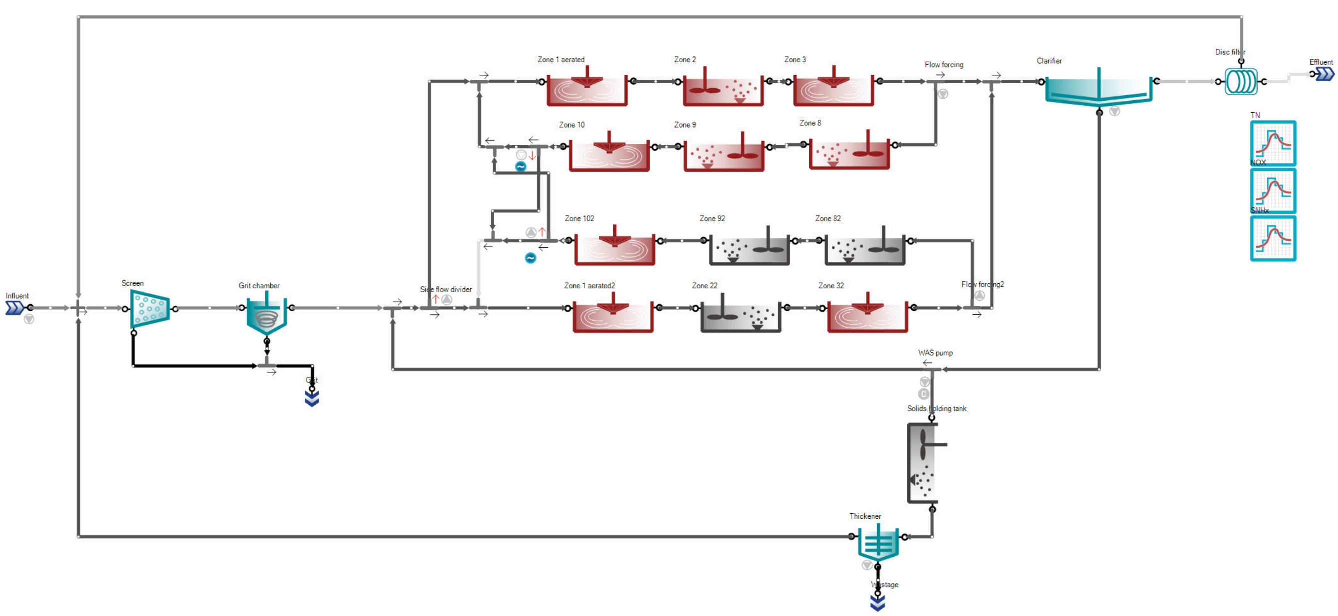
Table 5-1 Estimated Construction Costs

Item	Estimated Cost
Mobilization Bonds, Permits, & General Conditions	$40,000
Two 20 Horsepower Floating Mechanical Aerators	$210,000
Ovivo Enhance Controls (Optional)	$100,000
Electrical	$80,000
Sub-Total	$430,000
Contingency	$86,000
Total Estimated Construction Cost	**$516,000**

APPENDIX A
PROCESS MODELING

Project overview

File name:	P:\IER\08520\200-08520-22003\SupportDocs\Calcs\Sumo Model\Calibrated\Minneola WWTP full plant low load 08_02_AADF_MMMDF.sumo	
Report date:	Friday, August 5, 2022 10:07:26 AM	
Sumo version:	21.0.2	
Model:	Sumo1	
Scenario:	AADF	
Model Options:	1-step nitrification/denitrification Input gas phase concentrations Skip pH calculations	
Simulation from:	Hot start	
Stop time:	10	days
Data interval:	5	minutes



Frequently used variables

Symbol	Influent	Zone 1 aerated	Zone 2	Zone 3	Zone 8	Zone 9	Zone 10	Effluent	Plant	RAS	Pipe17	Unit
Flow rate	1.2	141.7290605	141.7290605	141.7291	139.6044	139.6044	139.6044	1.192574		0.7625	0.0375	MGD
Total chemical oxygen demar	660	4189.071246	4189.102537	4189.134	4189.167	4189.2	4189.234	21.96991		11050.89	11050.89	mg COD/L
Total suspended solids (TSS)	240.1748194	3754.061379	3754.082233	3754.101	3754.123	3754.147	3754.166	4.165339		9928.843	9928.843	mg TSS/L
Volatile suspended solids (VS	204.1485965	3056.375112	3056.395004	3056.413	3056.434	3056.457	3056.476	3.391224		8083.599	8083.599	mg VSS/L
Total biochemical oxygen der	308.6721	893.5578279	893.5742414	893.5918	893.6088	893.6249	893.6441	1.709797		2362.188	2362.188	mg O2/L
Dissolved oxygen (O2)	1E-40	1	0.771682843	1	0.769153	0.551814	1	1		1	1	mg O2/L
Oxygen uptake rate (OUR)		25.05265187	23.98916886	24.95351	23.88662	22.29814	24.85318					mg O2/L/h
Total nitrogen	60	178.4523897	178.4627628	178.4751	178.4857	178.4933	178.5059	7.445348		460.097	460.097	mg N/L
Total ammonia (NHx)	39	0.24002444	0.238776845	0.236309	0.235314	0.236528	0.23436	0.236309		0.236309	0.236309	mg N/L
Nitrate and nitrite (NOx)	1E-40	6.095182048	6.105408136	6.118456	6.128662	6.134261	6.147319	6.118456		6.118456	6.118456	mg N/L
Total phosphorus	6	90.24496399	90.24493068	90.24489	90.24486	90.24481	90.24477	0.294097		238.3602	238.3602	mg P/L
Orthophosphate (PO4)	2.502	0.142949543	0.142725972	0.142455	0.142279	0.142218	0.141977	0.142455		0.142455	0.142455	mg P/L
Oxygen gas (O2) off-gas concentration in v/v%		18.84	1E-40	18.84	1E-40	1E-40	18.84					%
Total SRT									6.746327			d
VSS/TSS ratio	0.85	0.814151609	0.814152385	0.814153	0.814154	0.814155	0.814156	0.814153		0.814153	0.814153	g VSS.g TSS-1
Yield TSS									94.39235			%

State variables

Symbol	Influent	Unit
Volatile fatty acids (VFA)	20.13	mg COD/L
Readily biodegradable substra	163.35	mg COD/L
Methanol (MEOL)	1E-40	mg COD/L
Colloidal biodegradable substr	65.01	mg COD/L
Slowly biodegradable substrat	227.66	mg COD/L
Soluble unbiodegradable orga	16.5	mg COD/L
Colloidal unbiodegradable org	65.01	mg COD/L
Particulate unbiodegradable o	85.8	mg COD/L
Stored polyhydroxyalkanoates	0.1	mg COD/L
Stored glycogen (GLY)	0.1	mg COD/L
Endogenous decay products	2.64	mg COD/L
Anaerobic endogenous decay	1E-40	mg COD/L
Ordinary heterotrophic organi	13.2	mg COD/L
Carbon storing organisms (CAS	0.1	mg COD/L
Anoxic methanol utilizers (ME	0.1	mg COD/L
Aerobic nitrifying organisms (I	0.1	mg COD/L
Acidoclastic methanogens (AN	0.1	mg COD/L
Hydrogenotrophic methanoge	0.1	mg COD/L
Total ammonia (NHx)	39	mg N/L
Nitrate and nitrite (NOx)	1E-40	mg N/L
Dissolved nitrogen (N2)	16	mg N/L
Soluble biodegradable organic	6.534	mg N/L
Particulate biodegradable orga	11.0254	mg N/L
Particulate unbiodegradable o	0.858	mg N/L
Orthophosphate (PO4)	2.502	mg P/L
Stored polyphosphate (PP)	0.1	mg P/L
Soluble biodegradable organic	1.6335	mg P/L
Particulate biodegradable orga	1.05886	mg P/L
Particulate unbiodegradable o	0.0858	mg P/L
Dissolved oxygen (O2)	1E-40	mg O2/L
Dissolved methane (CH4)	1E-40	mg COD/L
Dissolved hydrogen (H2)	1E-40	mg COD/L
Total inorganic carbon (CO2)	90	mg TIC/L
Inorganics in influent and bion	35.63315772	mg TSS/L
Other strong cations (as Na+)	109.9	mg Na/L
Other strong anions (as Cl-)	300	mg Cl/L
Calcium	150	mg Ca/L
Magnesium	15	mg Mg/L
Potassium	16	mg K/L
Ferrous ion (Fe2)	1E-40	mg Fe/L
Active hydrous ferric oxide, hi	9.04255E-41	mg Fe/L
Active hydrous ferric oxide, lo	9.57447E-42	mg Fe/L
Aged unused hydrous ferric ox	0.01	mg Fe/L

P-bound hydrous ferric oxide,	1E-40	mg Fe/L
P-bound hydrous ferric oxide,	1E-40	mg Fe/L
Aged used hydrous ferric oxid	1E-40	mg Fe/L
Aged used hydrous ferric oxid	1E-40	mg Fe/L
Active hydrous aluminium oxi	9.77011E-41	mg Al/L
Active hydrous aluminium oxi	2.29885E-42	mg Al/L
Aged unused hydrous alumini	0.01	mg Al/L
P-bound hydrous aluminium o	1E-40	mg Al/L
P-bound hydrous aluminium o	1E-40	mg Al/L
Aged P-bound hydrous alumin	1E-40	mg Al/L
Aged P-bound hydrous alumin	1E-40	mg Al/L
Calcium carbonate (CaCO3)	1E-40	mg TSS/L
Amorphous calcium phosphat	1E-40	mg TSS/L
Brushite (BSH)	1E-40	mg TSS/L
Struvite (STR)	1E-40	mg TSS/L
Vivianite (Vivi)	1E-40	mg TSS/L
Enthalpy	83626	kJ.m-3
Alpha indicator	5.1192E-08	

Model overview

Name: Sumo1

Settings

Key parameters

Symbol	Name	Value	Unit	Comment
iCV,XB	COD of biodegradable substrate in volatile solids	1.8	g COD.g VSS-1	
iCV,XU	COD of particulate unbiodegradable organics in volat	1.3	g COD.g VSS-1	
iCV,BIO	COD of biomass in volatile solids	1.42	g COD.g VSS-1	
iCV,XE	COD of endogenous products in volatile solids	1.42	g COD.g VSS-1	
µNITO	Maximum specific growth rate of NITOs	0.9	1/d	
KO2,NITO,AS	Half-saturation of O2 for NITOs (AS)	0.25	mg O2/L	
KNHx,NITO,AS	Half-saturation of NHx for NITOs (AS)	0.7	mg N/L	
µOHO	Maximum specific growth rate of OHOs	4	1/d	
KSB,AS	Half-saturation of readily biodegradable substrate for	5	mg COD/L	
KO2,OHO,AS	Half-saturation of O2 for OHOs (AS)	0.15	mg O2/L	
µCASTO	Maximum specific growth rate of CASTOs	1	1/d	
qPAO,PP	Maximum polyphosphate uptake rate of PAOs	0.1	1/d	
KPO4,PAO,AS	Half-saturation of PO4 for PAOs (AS)	0.3	mg P/L	
qHYD	Rate of hydrolysis	2	1/d	

Ordinary heterotrophic organism kinetics (OHO)

Symbol	Name	Value	Unit	Comment
µOHO	Maximum specific growth rate of OHOs	4	1/d	
µFERM,OHO	Fermentation growth rate of OHOs	0.3	1/d	
bOHO	Decay rate of OHOs	0.62	1/d	
ηOHO,anox	Reduction factor for anoxic growth of OHOs	0.6		
KSB,AS	Half-saturation of readily biodegradable substrate for	5	mg COD/L	
KO2,OHO,AS	Half-saturation of O2 for OHOs (AS)	0.15	mg O2/L	
KVFA,AS	Half-saturation of VFA for OHOs (AS)	0.5	mg COD/L	
KMEOL,OHO,AS	Half-saturation of methanol for OHOs (AS)	0.1	mg COD/L	
KNOx,OHO,AS	Half-saturation of NOx for OHOs (AS)	0.03	mg N/L	
KVFA,FERM,AS	Half-saturation of VFA in fermentation of OHOs (AS)	50	mg COD/L	
LograngeVFA,F	Effective range of logistic switch for VFA fermentation	1.2	%	define range in percentage of half-saturation value
KSB,ana,AS	Half-saturation of readily biodegradable substrate in	5	mg COD/L	
KSB,ana,DIG	Half-saturation of readily biodegradable substrate in	350	mg COD/L	

Anoxic methanol utilizer kinetics (MEOLO)

Symbol	Name	Value	Unit	Comment
µMEOLO	Maximum specific growth rate of MEOLOs	1.3	1/d	
bMEOLO	Decay rate of MEOLOs	0.05	1/d	
qMEOL	Rate of methanol degradation by MEOLOs under ana	10	1/d	to clean up any remaining methanol in digesters without having to ferment mechanistically
KMEOL,AS	Half-saturation of methanol for MEOLOs (AS)	0.5	mg COD/L	
KiO2,MEOLO,A	Half-inhibition of O2 for MEOLOs (AS)	0.05	mg O2/L	
KNOx,MEOLO,A	Half-saturation of NOx for MEOLOs (AS)	0.03	mg N/L	

Carbon storing organism kinetics (CASTO)

Symbol	Name	Value	Unit	Comment
µCASTO	Maximum specific growth rate of CASTOs	1	1/d	
qPAO,PP	Maximum polyphosphate uptake rate of PAOs	0.1	1/d	

µFERM,PAO	Fermentation growth rate of PAOs	0.45	1/d	
µPAO,lim	Maximum specific growth rate of PAOs under P limite	0.49	1/d	
bCASTO	Decay rate of CASTOs	0.08	1/d	previously 0.05 (0.15 for Lopez et al. 2006; Hao et al., 2010)
bSTC	Rate of CASTOs maintenance on PHA and GLY	0.07	1/d	
bPP,ana	Rate of PAOs maintenance under anaerobic condition	0.005	1/d	
qPAO,PHA	Rate of VFA storage into PHA for PAOs	7	1/d	
qGAO,GLY	Rate of VFA storage into glycogen for GAOs	4	1/d	
ηCASTO,anox	Reduction factor for anoxic growth of CASTOs	0.66		
ηbCASTO,anox	Reduction factor for anoxic decay of CASTOs	0.5		
ηbCASTO,ana	Reduction factor for anaerobic decay of CASTOs	0.25		
ηbSTC,anox	Reduction factor for anoxic maintenance of CASTOs o	0.66		
ηbPP,aer	Reduction factor for aerobic maintenance of PAOs on	0.25		
ηbPP,anox	Reduction factor for anoxic maintenance of PAOs on	0.5		
KPO4,PAO,AS	Half-saturation of PO4 for PAOs (AS)	0.3	mg P/L	
LograngePO4,P	Effective range of logistic switch for PO4 uptake by P/	80	%	define range in percentage of half-saturation value
LograngePP,PA	Effective range of logistic switch for PP cleavage by P/	40	%	define range in percentage of half-saturation value
KPHA,cle	Half-saturation of PHA for PAOs at PP cleavage	0.1	g COD.g COD-1	
KPHA	Half-saturation of PHA for PAOs	0.01	g COD.g COD-1	
KSTC	Half-saturation of PHA and GLY for PAOs	0.1	g COD.g COD-1	
KO2,CASTO,AS	Half-saturation of O2 for CASTOs (AS)	0.05	mg O2/L	
KNOx,CASTO,A	Half-saturation of NOx for CASTOs (AS)	0.03	mg N/L	
KVFA,CASTO,A	Half-saturation of VFA storage for CASTOs (AS)	5	mg COD/L	
KPP	Half-saturation of PP for PAOs	0.01	g COD.g COD-1	
KiPP,PAO,max	Half-inhibition of maximum PP content of PAOs	0.35	g P.g COD-1	
LograngePP,PA	Effective range of logistic switch for PP/PAO inhibitio	17	%	define range in percentage of half-inhibition value
XPP,PAO,min	PAO PP uptake booster denominator limiting term	0.1	mg COD/L	
KiPHA,PAO,ma	Half-inhibition of maximum PHA content of PAOs	0.6	g COD.g COD-1	
LograngePHA,P	Effective range of logistic switch for PHA/PAO inhibiti	10	%	define range in percentage of half-inhibition value
KMg,PAO,AS	Half-saturation of Mg (counter-ion in PP storage) for	0.001	mg Mg/L	
KK,PAO,AS	Half-saturation of K (counter-ion in PP storage) for PA	0.001	mg K/L	
KCa,PAO,AS	Half-saturation of Ca (counter-ion in PP storage) for P	0.001	mg Ca/L	
KPP,lim	Half-saturation of PP (nutrient) for PAOs under PO4 li	0.002	mg P/L	
KiPO4,lim,AS	Half-inhibition of PO4 for PAOs under PO4 limitation	0.005	mg P/L	
LogsatORP,PAO	Logistic half-saturation of ORP switching in fermentat	-170	mV	previously -100
LogsatORP,PAO	Logistic slope of ORP switching in fermentation of PA	0.1	mV-1	
ηbGLY,ana	Reduction factor for anaerobic maintenance of GAOs	0.1		
KGLY	Half-saturation of glycogen for GAOs (AS)	0.05	g COD.g COD-1	
KiGLY,GAO,ma	Half-inhibition of maximum glycogen content of GAO	0.5	g COD.g COD-1	
LograngeGLY,G	Effective range of logistic switch for GLY/GAO inhibiti	12	%	define range in percentage of half-inhibition value
LogsatORP,GAO	Half-value of ORP switch of glycogen storage by GAO	-30	mV	
LogsatORP,GAO	Half-value of ORP switch of glycogen storage by GAO	-110	mV	
LogsatORP,GAO	Logistic slope of ORP switching of GAOs	0.035	mV-1	

Aerobic nitrifying organism kinetics (NITO)

Symbol	Name	Value	Unit	Comment
µNITO	Maximum specific growth rate of NITOs	0.9	1/d	
bNITO	Decay rate of NITOs	0.17	1/d	
KNHx,NITO,AS	Half-saturation of NHx for NITOs (AS)	0.7	mg N/L	
KCO2,NITO,AS	Half-saturation of CO2 for NITOs (AS)	12	mg TIC/L	if pH is not calculated
LograngeCO2,N	Effective range of CO2 logistic switch for NITOs (AS)	200	%	define range in percentage of half-saturation value
KCO2,NITO,side	Half-saturation of CO2 for NITOs (Sidestream)	48	mg TIC/L	if pH is not calculated
LograngeCO2,N	Effective range of CO2 logistic switch for NITOs (Sides	100	%	define range in percentage of half-saturation value
KCO2,NITO,pH,	Half-saturation of bicarbonate for NITOs (AS)	1	mmol [HC	if pH is calculated
LograngeCO2,N	Effective range of bicarbonate logistic switch for NITO	100	%	define range in percentage of half-saturation value

KCO2,NITO,pH,	Half-saturation of bicarbonate for NITOs (Sidestream)	4	mmol [HCO	if pH is calculated
LograngeCO2,N	Effective range of bicarbonate logistic switch for NITO	30	%	define range in percentage of half-saturation value
KO2,NITO,AS	Half-saturation of O2 for NITOs (AS)	0.25	mg O2/L	
KO2,NITO,sides	Half-saturation of O2 for NITOs (Sidestream)	0.5	mg O2/L	
KNOx,NITO,AS	Half-saturation of NOx for NITOs (AS)	0.03	mg N/L	
KiNH3,NITO,pH	Half-inhibition of NH3 for NITOs (AS)	9999	mol [NH3].	if pH is calculated

Acidoclastic methanogen kinetics (AMETO)

Symbol	Name	Value	Unit	Comment
µAMETO	Maximum specific growth rate of AMETO	0.3	1/d	
bAMETO	Decay rate of AMETOs	0.03	1/d	
KVFA,AMETO,A	Half-saturation of VFA for AMETOs (AS)	400	mg COD/L	
KiVFA,AMETO,A	Haldane inhibition of VFA for AMETOs (AS)	99999	mg COD/L	
KiNHx,AMETO,A	Half-inhibition of SNHx for AMETOs (AS)	9999	mg N/L	if pH is not calculated
KiNH3,AMETO,	Half-inhibition of NH3 for AMETOs (AS)	999	mmol/L	if pH is calculated
LograngeNH3,A	Effective range of NH3 logistic switch for AMETOs	10	%	define range in percentage of half-saturation value
KiO2,AMETO,A	Half-inhibition of O2 for AMETOs (AS)	0.05	mg O2/L	
KNOx,AMETO,A	Half-saturation of NOx for AMETOs (AS)	0.05	mg N/L	
pHlow,AMETO	pH inhibition low value for AMETOs	4.5	pHunit	
pHhigh,AMETO	pH inhibition high value for AMETOs	9.5	pHunit	

Hydrogenotrophic methanogen kinetics (HMETO)

Symbol	Name	Value	Unit	Comment
µHMETO	Maximum specific growth rate of HMETO	1.3	1/d	
bHMETO	Decay rate of HMETOs	0.13	1/d	
KH2,HMETO,AS	Half-saturation of H2 for HMETOs (AS)	0.1	mg COD/L	
KiO2,HMETO,A	Half-inhibition of O2 for HMETOs (AS)	0.05	mg O2/L	
KNOx,HMETO,A	Half-saturation of NOx for HMETOs (AS)	0.05	mg N/L	
pHlow,HMETO	pH inhibition low value for HMETOs	4.5	pHunit	
pHhigh,HMETO	pH inhibition high value for HMETOs	9.5	pHunit	

Precipitation kinetics

Symbol	Name	Value	Unit	Comment
qCaCO3,PREC	Rate of CaCO3 precipitation	0.1	mg/L/d	
qCaCO3,DISS	Rate of CaCO3 dissolution	0.1	mg/L/d	
qSTR,PREC	Rate of struvite precipitation	10	mg/L/d	
qSTR,DISS	Rate of struvite dissolution	10	mg/L/d	
qACP,PREC	Rate of ACP precipitation	5	mg/L/d	
qACP,DISS	Rate of ACP dissolution	5	mg/L/d	
qBSH,PREC	Rate of brushite precipitation	500	mg/L/d	
qBSH,DISS	Rate of brushite dissolution	500	mg/L/d	
qVivi,PREC	Rate of vivianite precipitation	0.01	mg/L/d	
qVivi,DISS	Rate of vivianite dissolution	0.01	mg/L/d	
KSTR,DISS	Half-saturation of struvite redissolution	0.01	mg TSS/L	
KACP,DISS	Half-saturation of ACP redissolution	0.01	mg TSS/L	
KBSH,DISS	Half-saturation of brushite redissolution	0.01	mg TSS/L	
KCaCO3,DISS	Half-saturation of CaCO3 redissolution	0.01	mg TSS/L	
KVivi,DISS	Half-saturation of vivianite redissolution	0.01	mg TSS/L	

HFO kinetics

Symbol	Name	Value	Unit	Comment
qHFOH,AGING	Rate of XHFO,H aging	250	1/d	
qHFOL,AGING	Rate of XHFO,L aging	1	1/d	
qP,HFO,COPRE	Rate of P binding and coprecipitation on XHFO,H	150	1/d	

qP,HFO,BIND	Rate of P binding on XHFO,L	1	1/d	
qHFOH,DESORP	Rate of XHFO,H,P desorption	100	1/d	
qHFOL,DESORP	Rate of XHFO,L,P desorption	10	1/d	
qHFO,DISS	Rate of XHFO,H,P,old and XHFO,L,P,old redissolution	100	1/d	
qHFO,RED	Rate of HFO reduction with organics	2	1/d	
LogsatORP,HFO	Logistic half-saturation of ORP switching in HFO reduc	-100	mV	
LogsatORP,HFO	Logistic slope of ORP switching in HFO reduction	0.1		
qFe2,OX	Rate of Fe2 oxidation	1	1/d	
KiP,HFO,DISS	Half-inhibition of PO4 in HFO redissolution	0.01	mg P/L	
LograngeP,HFO	Effective range of logistic switch for HFO redissolution	100	%	define range in percentage of half-inhibition value
KiP,HFO,DESOR	Half-inhibition of PO4 in HFO desorption	0.1	mg P/L	
KP,HFO,BIND	Half-saturation of PO4 in binding on HFO	0.1	mg P/L	

HAO kinetics

Symbol	Name	Value	Unit	Comment
qHAOH,AGING	Rate of XHAO,H aging	75	1/d	
qHAOL,AGING	Rate of XHAO,L aging	1	1/d	
qP,HAO,COPRE	Rate of P binding and coprecipitation on XHAO,H	175	1/d	
qP,HAO,BIND	Rate of P binding on XHAO,L	1	1/d	
qHAOH,DESORP	Rate of XHAO,H,P desorption	100	1/d	
qHAOL,DESORP	Rate of XHAO,L,P desorption	10	1/d	
qHAO,DISS	Rate of XHAO,H,P,old and XHAO,L,P,old redissolution	100	1/d	
KP,HAO,BIND	Half-saturation of PO4 for binding on HAO	0.1	mg P/L	
KiP,HAO,DISS	Half-inhibition of PO4 in HAO redissolution	0.001	mg P/L	
LograngeP,HAO	Effective range of logistic switch for HAO redissolutio	200	%	define range in percentage of half-inhibition value
KiP,HAO,DESOR	Half-inhibition of PO4 in HAO desorption	0.1	mg P/L	

Common switches

Symbol	Name	Value	Unit	Comment
KNHx,BIO,AS	Half-saturation of NHx as nutrient for biomasses (AS)	0.005	mg N/L	
KPO4,BIO,AS	Half-saturation of PO4 as nutrient for biomasses (AS)	0.002	mg P/L	
KCO2,BIO,AS	Half-saturation of CO2 for biomasses (except NITOs)	1.2	mg TIC/L	
KCAT,AS	Half-saturation of strong cations (as Na+)	0.1	mg Na/L	
KAN,AS	Half-saturation of strong anions (as Cl-)	0.1	mg Cl/L	
KMg,BIO,AS	Half-saturation of Mg for biomasses (AS)	0.0001	mg Mg/L	
KCa,BIO,AS	Half-saturation of Ca for biomasses (AS)	0.0001	mg Ca/L	
ηb,anox	Reduction factor for anoxic decay	0.5		
ηb,ana	Reduction factor for anaerobic decay	0.25		
mtox,anox	Toxicity factor of anaerobes under anoxic conditions	5		
mtox,aer	Toxicity factor of anaerobes under aerobic conditions	10		
mtox,ana,max	Toxicity factor of aerobes under anaerobic conditions	10		
pHlow	pH inhibition low value	3	pHunit	
pHhigh	pH inhibition high value	11	pHunit	

Conversion kinetics

Symbol	Name	Value	Unit	Comment
qHYD	Rate of hydrolysis	2	1/d	
ηHYD,anox	Reduction factor for anoxic hydrolysis	0.5		
ηHYD,ana	Reduction factor for anaerobic hydrolysis	0.5		
qFLOC	Rate of flocculation	50	1/d	
KFLOC,AS	Half-saturation of colloids in flocculation (AS)	0.001	g COD.g COD-1	
KHYD,AS	Half-saturation of particulates in hydrolysis (AS)	0.05	g COD.g COD-1	
qAMMON	Rate of ammonification	0.05	1/d	
qSPB	Rate of soluble biodegradable organic P conversion	0.5	1/d	

qXE	Rate of endogenous decay products conversion	0.007	1/d	
qASSIM	Rate of assimilative nutrient production	1	1/d	
KiNHx,ASSIM,A	Half-inhibition of NHx in NOx assimilative reduction	0.0005	mg N/L	
KNOx,ASSIM,AS	Half-saturation of NOx in NOx assimilative reduction (	0.001	mg N/L	

Parameters for half saturation coefficients in biofilms

Symbol	Name	Value	Unit	Comment
fKS,biofilm	Diffusion factor for half-saturation coefficients	0.4		

Temperature dependency

Symbol	Name	Value	Unit	Comment
θμ,OHO	Arrhenius coefficient for OHO growth	1.04		
θFERM,OHO	Arrhenius coefficient for fermentation (OHO)	1.04		
θb,OHO	Arrhenius coefficient for OHO decay	1.03		
θμ,MEOLO	Arrhenius coefficient for MEOLO growth	1.06		
θb,MEOLO	Arrhenius coefficient for MEOLO decay	1.03		
θμ,CASTO	Arrhenius coefficient for CASTO growth	1.04		
θμ,PAO,lim	Arrhenius coefficient for PAO growth (P limited)	1.04		
θFERM,PAO	Arrhenius coefficient for fermentation (PAO)	1.04		
θq,PAO,PP	Arrhenius coefficient for PP storage	1.04		
θq,PAO,PHA	Arrhenius coefficient for PHA storage	1.04		
θb,CASTO	Arrhenius coefficient for CASTO decay	1.03		
θb,STC	Arrhenius coefficient for PHA and GLY storage use for	1.064		based on Lopez Vazquez et al., 2009
θb,PP,ana	Arrhenius coefficient for anaerobic PP storage	1.03		
θq,GAO,GLY	Arrhenius coefficient for GLY storage	1.072		
θμ,NITO	Arrhenius coefficient for NITO growth	1.072		
θb,NITO	Arrhenius coefficient for NITO decay	1.03		
θμ,AMETO	Arrhenius coefficient for AMETO growth	1.03		
θb,AMETO	Arrhenius coefficient for AMETO decay	1.03		
θμ,HMETO	Arrhenius coefficient for HMETO growth	1.03		
θb,HMETO	Arrhenius coefficient for HMETO decay	1.03		
θq,FLOC	Arrhenius coefficient for flocculation	1.03		
θq,HYD	Arrhenius coefficient for hydrolysis	1.03		
θq,AMMON	Arrhenius coefficient for ammonification	1.03		
θq,SPB	Arrhenius coefficient for PO4 conversion	1.03		
θq,XE	Arrhenius coefficient endogenous residual conversion	1.03		
θq,ASSIM	Arrhenius coefficient assimilative kinetics	1.03		
θq,Fe2,OX	Arrhenius coefficient for ferrous iron oxidation kineti	1.04		
θq,HFO,RED	Arrhenius coefficient for ferric iron reduction kinetics	1.04		
Tbase	Arrhenius base temperature	20	Co	

Stoichiometric yields

Symbol	Name	Value	Unit	Comment
YOHO,VFA,ox	Yield of OHOs on VFA under aerobic conditions	0.6	g XOHO.g SVFA-1	
YOHO,VFA,ano	Yield of OHOs on VFA under anoxic conditions	0.45	g XOHO.g SVFA-1	
YOHO,SB,ox	Yield of OHOs on readily biodegradable substrate und	0.67	g XOHO.g SB-1	
YOHO,SB,anox	Yield of OHOs on readily biodegradable substrate und	0.54	g XOHO.g SB-1	
YOHO,SB,ana	Yield of OHOs on readily biodegradable substrate und	0.1	g XOHO.g SB-1	
YOHO,H2,ana,h	Yield of H2 production in fermentation with high VFA	0.35	g SH2.g SB-1	
YOHO,H2,ana,l	Yield of H2 production in fermentation with low VFA (	0.1	g SH2.g SB-1	
YOHO,SMEOL,o	Yield of OHOs on methanol under aerobic conditions	0.4	g XOHO.g SMEOL-1	
YMEOLO	Yield of MEOLOs on methanol	0.4	g XMEOLO.g SMEOL-1	
YCASTO,PHA,ox	Yield of CASTOs on PHA under aerobic conditions	0.639	g XCASTO.g XPHA-1	
YCASTO,PHA,an	Yield of CASTOs on PHA under anoxic conditions	0.52	g XCASTO.g XPHA-1	

YCASTO,SB,ana	Yield of CASTOs on readily biodegradable substrate u	0.1	g XCASTO.g SB-1	
YCASTO,H2,ana	Yield of H2 production in fermentation with high VFA	0.35	g SH2.g SB-1	
YCASTO,H2,ana	Yield of H2 production in fermentation with low VFA	0.1	g SH2.g SB-1	
YPP,CASTO,ox	Yield of CASTOs consumed per PP uptake under aerob	0.33	g XCASTO.g XPP-1	
YPP,CASTO,ano	Yield of CASTOs consumed per PP uptake under anoxi	0.23	g XCASTO.g XPP-1	
fP,VFA	Ratio of P released per VFA stored	0.65	g XPP.g SVFA-1	
iTSS,PP	TSS content of PP	3.516129032	g XTSS.g XPP-1	
YCASTO,GLY,ox	Yield of CASTOs on glycogen under aerobic condition	0.6	g XCASTO.g XGLY-1	
YCASTO,GLY,an	Yield of CASTOs on glycogen under anoxic conditions	0.5	g XCASTO.g XGLY-1	
YNITO	Yield of NITOs on NHx	0.24	g XNITO.g SNHx-1	
YAMETO	Yield of AMETOs on VFA	0.1	g XAMETO.g SVFA-1	
YHMETO	Yield of HMETOs on H2	0.1	g XHMETO.g SH2-1	

General stoichiometry

Symbol	Name	Value	Unit	Comment
fE	Fraction of endogenous products produced in biomas	0.08	g XE.g XBIO-1	
iN,BIO	N content of biomasses	0.07	g N.g COD-1	
iN,XE	N content of endogenous products	0.06	g N.g COD-1	
iN,CB	N content of colloidal biodegradable substrate	0.01	g N.g COD-	previously 0.03
iN,CU	N content of colloidal unbiodegradable organics	0.01	g N.g COD-1	
iN,SU	N content of soluble unbiodegradable organics	0.01	g N.g COD-	previously 0.05
iN,XSTR	N content of struvite	0.057075505	g N.g TSS-1	A_MN/M_MSTR
iP,BIO	P content of biomasses	0.02	g P.g COD-1	
iP,CB	P content of colloidal biodegradable substrate	0.002	g P.g COD-	previously 0.005
iP,CU	P content of colloidal unbiodegradable organics	0.002	g P.g COD-	previously 0.005
iP,SU	P content of soluble unbiodegradable organics	0.002	g P.g COD-1	
iP,XSTR	P content of struvite	0.126214106	g P.g TSS-1	A_MP/M_MSTR
iP,XACP	P content of ACP	0.162065388	g P.g TSS-1	2*A_MP/M_MACP
iP,XBSH	P content of BSH	0.17998807	g P.g TSS-1	A_MP/M_MBSH
iP,XVivi	P content of vivianite	0.123499858	g P.g TSS-1	2*A_MP/M_MVivi
iCV,XB	COD of biodegradable substrate in volatile solids	1.8	g COD.g VSS-1	
iCV,XU	COD of particulate unbiodegradable organics in volat	1.3	g COD.g VSS-1	
iCV,BIO	COD of biomass in volatile solids	1.42	g COD.g VSS-1	
iCV,XE	COD of endogenous products in volatile solids	1.42	g COD.g VSS-1	
iCV,VFA	COD of VFA in volatile solids	1.066	g COD.g VS-1	
iCV,SB	COD of readily biodegradable substrate in volatile sol	1.066	g COD.g VS-1	
iCV,MEOL	COD of methanol in volatile solids	1.5	g COD.g VS-1	
iCV,SU	COD of soluble unbiodegradable organics in volatile s	0.926	g COD.g VS-1	
iCV,CB	COD of colloidal biodegradable substrate in volatile s	1.8	g COD.g VS-1	
iCV,CU	COD of colloidal unbiodegradable organics in volatile	1.3	g COD.g VS-1	
iCV,PHA	COD of PHA in volatile solids	1.67	g COD.g VSS-1	
iCV,GLY	COD of glycogen in volatile solids	1.19	g COD.g VSS-1	
iCIT,BIO	Inorganic carbon content of biomass	0.352	g TIC.g COD	C5H7O2N: 32 g COD/mol C
iCIT,SB	Inorganic carbon content of SB and SU	0.286	g TIC.g COD	C5H7O2N: 32 g COD/mol C
iCIT,MEOL	Inorganic carbon content of methanol	0.25	g TIC.g COD	CH4O: 48 g COD/mol C
iCIT,CH4	Inorganic carbon content of CH4	0.188	g TIC.g COD	CH4: 64 g COD/mol C
iCIT,VFA	Inorganic carbon content of VFA	0.375	g TIC.g COD	C2H4O2: 32 g COD/mol C
iCIT,PHA	Inorganic carbon content of PHA	0.333	g TIC.g COD	H[C4H6O2]nOH: 36 g COD/mol C
iCIT,GLY	Inorganic carbon content of glycogen	0.375	g TIC.g COD	[C6H10O5]n: 32 g COD/mol C
iINORG	Inorganic content of biomass	0.11	g TSS.g COD	15% of VSS - Ekama
iCa,PP	Calcium content of PP	0.1	mol Ca.mo	sum of the charges of Ca, Mg and K content of PP...
iMg,PP	Magnesium content of PP	0.35	mol Mg.mo	...should be equal to 1...
iK,PP	Potassium content of PP	0.1	mol K.mol	...e.g.: 2*0.1 + 2*0.35 + 1*0.1=1
fNa	Fraction of Na in NaCl	0.393372343	g Na.g NaCl-1	

iCa,INORG	Ca content of XINORG	0.05	g Ca.g TSS-1	
iMg,INORG	Mg content of XINORG	0.05	g Mg.g TSS-1	
fVFA,DM	fraction of SVFA not volatilized in Dry Matter analysis	50	%	

BOD stoichiometry

Symbol	Name	Value	Unit	Comment
YBOD,ult	Yield on ultimate BOD	0.95	g O2.g COD-1	
fS,BOD5,BODul	Fraction of BOD5 to ultimate BOD in soluble biodegra	0.9		
fC,BOD5,BODul	Fraction of BOD5 to ultimate BOD in colloidal biodegr	0.6		
fX,BOD5,BODul	Fraction of BOD5 to ultimate BOD in particulate biode	0.5		

HFO stoichiometry

Symbol	Name	Value	Unit	Comment
ASFHFO,H	Active site factor for HFO,H	1.2	mol P.mol Fe-1	
ASFHFO,L	Active site factor for HFO,L	0.2	mol P.mol Fe-1	
fH2O,HFO,TSS	Fraction of H2O loss in TSS test for HFO	0.0829	g H2O.g FeOH-1	
fH2O,HFO,VSS	Fraction of H2O loss in VSS test for HFO	0.17	g H2O.g Fe	Fe(OH)3 -> Fe2O3 + 3H2O

HAO stoichiometry

Symbol	Name	Value	Unit	Comment
ASFHAO,H	Active site factor for HAO,H	1	mol P.mol Al-1	
ASFHAO,L	Active site factor for HAO,L	0.1	mol P.mol Al-1	
fH2O,HAO,TSS	Fraction of H2O loss in TSS test for HAO	0.173216029	g H2O.g AlOH3-1	
fH2O,HAO,VSS	Fraction of H2O loss in VSS test for HAO	0.346432058	g H2O.g Al	2Al(OH)3 -> Al2O3 + 3H2O

Parameters for gas transfer

Symbol	Name	Value	Unit	Comment
kL,GO2,bub	Liquid-side mass transfer coefficient of O2 for gas bub	319.0510073	gpd/ft2	
kL,GO2,sur	Liquid-side mass transfer coefficient of O2 at liquid su	186.5221273	gpd/ft2	
fkL,GN2	Correction factor for mass transfer of N2	100	%	
fkL,GCO2	Correction factor for mass transfer of CO2	100	%	
fkL,GCH4	Correction factor for mass transfer of CH4	100	%	
fkL,GH2	Correction factor for mass transfer of H2	100	%	
fkL,GNH3	Correction factor for mass transfer of NH3	5	%	Used to compensate for the high solubility of NH3 gas
qALPHA	Sludge retention-based alpha improvement rate com	0.0017	m3.g-1.d-1	
SALPHA,sat	Alpha indicator saturation value	1		
KSO2,ALPHA	Half-saturation of dissolved oxygen for anoxic/anaero	0.05	mg O2/L	
fSO2,max,ALPH	Maximum anaerobic/anoxic alpha enhancement fact	2.5		
coeffdamp,ALP	Coefficient of alpha first order limitation damping ter	3		
powdamp,ALPH	Power of alpha first order limitation damping term	9		
slTSS,α,def	Slope of solids-related alpha correction, default	-0.0711	m3.kg-1	
slTSS,α,coarse	Slope of solids-related alpha correction, coarse bubbl	-0.0474	m3.kg-1	
coefflead,TSS,α	Leading coefficient of solids-related alpha correction,	-0.000787	(kg.m-3)-2	
coefflin,TSS,α,n	Linear coefficient of solids-related alpha correction, n	0.0232	m3.kg-1	
constTSS,α,mec	Constant of solids-related alpha correction, mechanic	0.877		

Oxidation-reduction potential constants

Symbol	Name	Value	Unit	Comment
ORPbase	Base ORP value	-300	mV	
ORPmax,SO2	ORP max for dissolved oxygen	300	mV	
ORPmax,SNOx	ORP max for dissolved nitrate	70	mV	
KORP,SO2	Half-saturation of dissolved oxygen for ORP	0.05	mg O2/L	
KORP,SNOx	Half-saturation of NOx for anoxic ORP	0.1	mg N/L	

KORP,H2,CH4	Half-saturation of dissolved hydrogen and methane fo	5	mg COD/L	

IS calculation

Symbol	Name	Value	Unit	Comment
ISlim	IS cut-off threshold for Davies activity coefficient corr	0.2	ISunit	The fmono/fdi/ftri curves have minima at 0.3 and literally couldn't be used above that
SlopeIS,corr	Slope of correction	-0.001		
ISinput,AS	Ionic strength input for activated sludge	0.02	ISunit	
ISinput,DIG	Ionic strength input for digesters	0.1	ISunit	
ISinput,sidestre	Ionic strength input for sidestream	0.1	ISunit	

TOC calculation coefficients

Symbol	Name	Value	Unit	Comment
fTOC,1	fTOC,1	0.334448	g C.g COD-1	
fTOC,2	fTOC,2	2.42475	g C.m-3	

Interstitial water content

Symbol	Name	Value	Unit	Comment
iiw,BIO	Interstitial water of biomass in volatile solids	2.33	g H2O.g VS	Assuming 70% of biomass cytoplasm is water

Vicinal water content

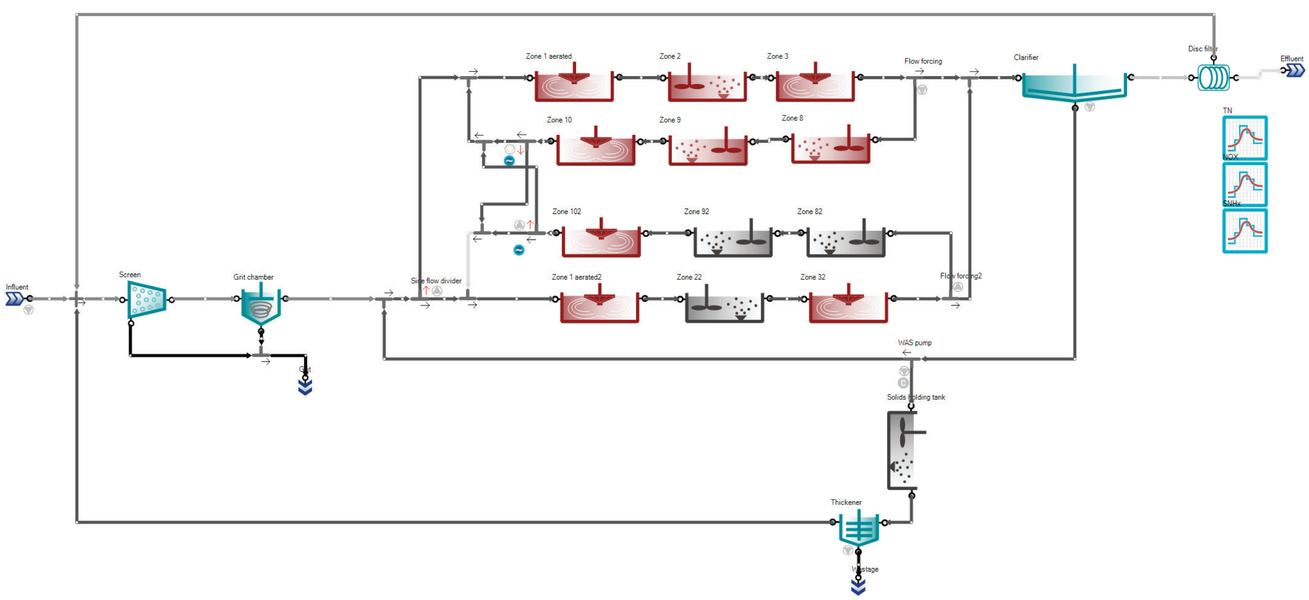
Symbol	Name	Value	Unit	Comment
ivw,XB	Vicinal water of biodegradable substrate in volatile so	0.052	g H2O.g VS	Assuming 5% of H2O is associated with vicinal water for these organics
ivw,XU	Vicinal water of particulate unbiodegradable organics	0.052	g H2O.g VS-1	
ivw,BIO	Vicinal water of biomass in volatile solids	0.052	g H2O.g VS-1	
ivw,XE	Vicinal water of endogenous products in volatile solid	0.052	g H2O.g VS-1	
ivw,CB	Vicinal water of colloidal biodegradable substrate in v	0.052	g H2O.g VS-1	
ivw,CU	Vicinal water of colloidal unbiodegradable organics in	0.052	g H2O.g VS-1	
ivw,PHA	Vicinal water of PHA in volatile solids	0.052	g H2O.g VS-1	
ivw,GLY	Vicinal water of glycogen in volatile solids	0.052	g H2O.g VS-1	
ivw,EPS	Vicinal water correction of EPS in volatile solids	0.052	g H2O.g VS-1	

Water of Hydration content

Symbol	Name	Value	Unit	Comment
iwh,XB	Water of hydration of biodegradable substrate in vola	0.11	g H2O.g VS	Assuming 10% of H2O is associated with water of hydration
iwh,XU	Water of hydration of particulate unbiodegradable or	0.11	g H2O.g VS-1	
iwh,BIO	Water of hydration of biomass in volatile solids	0.11	g H2O.g VS-1	
iwh,XE	Water of hydration of endogenous products in volatil	0.11	g H2O.g VS-1	
iwh,PHA	Water of hydration of PHA in volatile solids	0.17	g H2O.g VS	Assuming 15% of H2O is associated with water of hydration
iwh,GLY	Water of hydration of glycogen in volatile solids	0.17	g H2O.g VS-1	
iwh,EPS	Water of hydration correction of EPS in volatile solids	0.33	g H2O.g VS	Assuming 25% of H2O is associated with water of hydration

Project overview

File name:	P:\IER\08520\200-08520-22003\SupportDocs\Calcs\Sumo Model\Calibrated\Minneola WWTP full plant low load 08_02_AADF_MMMDF.sumo	
Report date:	Friday, August 5, 2022 7:51:50 AM	
Sumo version:	21.0.2	
Model:	Sumo1	
Scenario:	MMADF	
Model Options:	1-step nitrification/denitrification Input gas phase concentrations Skip pH calculations	
Simulation from:	Hot start	
Stop time:	10	days
Data interval:	15	minutes



Frequently used variables

Symbol	Influent	Zone 1 aerated	Zone 2	Zone 3	Zone 8	Zone 9	Zone 10	Effluent	Plant	RAS	Pipe17	Unit
Flow rate	1.44	142.3672813	142.3672813	142.3673	139.6044	139.6044	139.6044	1.430795		1.1515	0.0485	MGD
Total chemical oxygen demar	660	4570.081574	4570.10961	4570.139	4570.17	4570.201	4570.236	21.92477		10463.35	10463.35	mg COD/L
Total suspended solids (TSS)	240.1748194	4078.47453	4078.497041	4078.517	4078.541	4078.57	4078.59	4.096187		9357.823	9357.823	mg TSS/L
Volatile suspended solids (VS	204.1485965	3331.646023	3331.664492	3331.681	3331.701	3331.726	3331.744	3.346115		7644.268	7644.268	mg VSS/L
Total biochemical oxygen der	308.6721	1018.549345	1018.563666	1018.58	1018.596	1018.61	1018.63	1.750895		2336.105	2336.105	mg O2/L
Dissolved oxygen (O2)	1E-40	1	0.696289103	1	0.692323	0.419104	1	1		1	1	mg O2/L
Oxygen uptake rate (OUR)		34.10194278	31.94139458	33.89243	31.71832	28.01116	33.65142					mg O2/L/h
Total nitrogen	60	197.5168806	197.5296771	197.5458	197.5592	197.567	197.5838	7.893412		443.2819	443.2819	mg N/L
Total ammonia (NHx)	39	0.481448269	0.477652602	0.471099	0.46791	0.470551	0.464846	0.471099		0.471099	0.471099	mg N/L
Nitrate and nitrite (NOx)	1E-40	6.314196934	6.329098212	6.349507	6.364424	6.369011	6.389491	6.349507		6.349507	6.349507	mg N/L
Total phosphorus	6	95.16882794	95.16903426	95.16923	95.16943	95.16962	95.16981	0.262111		218.1422	218.1422	mg P/L
Orthophosphate (PO4)	2.502	0.117202893	0.116373881	0.115476	0.114739	0.114235	0.113399	0.115476		0.115476	0.115476	mg P/L
Oxygen gas (O2) off-gas concentration in v/v%		18.84	1E-40	18.84	1E-40	1E-40	18.84					%
Total SRT									6.012785			d
VSS/TSS ratio	0.85	0.816885333	0.816885352	0.816885	0.816886	0.816886	0.816886	0.816885		0.816885	0.816885	g VSS.g TSS-1
Yield TSS									96.14463			%

State variables

Symbol	Influent	Unit
Volatile fatty acids (VFA)	20.13	mg COD/L
Readily biodegradable substra	163.35	mg COD/L
Methanol (MEOL)	1E-40	mg COD/L
Colloidal biodegradable substr	65.01	mg COD/L
Slowly biodegradable substrat	227.66	mg COD/L
Soluble unbiodegradable orga	16.5	mg COD/L
Colloidal unbiodegradable org	65.01	mg COD/L
Particulate unbiodegradable o	85.8	mg COD/L
Stored polyhydroxyalkanoates	0.1	mg COD/L
Stored glycogen (GLY)	0.1	mg COD/L
Endogenous decay products	2.64	mg COD/L
Anaerobic endogenous decay	1E-40	mg COD/L
Ordinary heterotrophic organi	13.2	mg COD/L
Carbon storing organisms (CAS	0.1	mg COD/L
Anoxic methanol utilizers (ME	0.1	mg COD/L
Aerobic nitrifying organisms (N	0.1	mg COD/L
Acidoclastic methanogens (AM	0.1	mg COD/L
Hydrogenotrophic methanoge	0.1	mg COD/L
Total ammonia (NHx)	39	mg N/L
Nitrate and nitrite (NOx)	1E-40	mg N/L
Dissolved nitrogen (N2)	16	mg N/L
Soluble biodegradable organic	6.534	mg N/L
Particulate biodegradable orga	11.0254	mg N/L
Particulate unbiodegradable o	0.858	mg N/L
Orthophosphate (PO4)	2.502	mg P/L
Stored polyphosphate (PP)	0.1	mg P/L
Soluble biodegradable organic	1.6335	mg P/L
Particulate biodegradable orga	1.05886	mg P/L
Particulate unbiodegradable o	0.0858	mg P/L
Dissolved oxygen (O2)	1E-40	mg O2/L
Dissolved methane (CH4)	1E-40	mg COD/L
Dissolved hydrogen (H2)	1E-40	mg COD/L
Total inorganic carbon (CO2)	90	mg TIC/L
Inorganics in influent and bion	35.63315772	mg TSS/L
Other strong cations (as Na+)	109.9	mg Na/L
Other strong anions (as Cl-)	300	mg Cl/L
Calcium	150	mg Ca/L
Magnesium	15	mg Mg/L
Potassium	16	mg K/L
Ferrous ion (Fe2)	1E-40	mg Fe/L
Active hydrous ferric oxide, hi	9.04255E-41	mg Fe/L
Active hydrous ferric oxide, lo	9.57447E-42	mg Fe/L
Aged unused hydrous ferric ox	0.01	mg Fe/L

P-bound hydrous ferric oxide,	1E-40	mg Fe/L
P-bound hydrous ferric oxide,	1E-40	mg Fe/L
Aged used hydrous ferric oxid	1E-40	mg Fe/L
Aged used hydrous ferric oxid	1E-40	mg Fe/L
Active hydrous aluminium oxi	9.77011E-41	mg Al/L
Active hydrous aluminium oxi	2.29885E-42	mg Al/L
Aged unused hydrous alumini	0.01	mg Al/L
P-bound hydrous aluminium o	1E-40	mg Al/L
P-bound hydrous aluminium o	1E-40	mg Al/L
Aged P-bound hydrous alumin	1E-40	mg Al/L
Aged P-bound hydrous alumin	1E-40	mg Al/L
Calcium carbonate (CaCO3)	1E-40	mg TSS/L
Amorphous calcium phosphat	1E-40	mg TSS/L
Brushite (BSH)	1E-40	mg TSS/L
Struvite (STR)	1E-40	mg TSS/L
Vivianite (Vivi)	1E-40	mg TSS/L
Enthalpy	83626	kJ.m-3
Alpha indicator	5.1192E-08	

Model overview

Name: Sumo1

Settings

Key parameters

Symbol	Name	Value	Unit	Comment
iCV,XB	COD of biodegradable substrate in volatile solids	1.8	g COD.g VSS-1	
iCV,XU	COD of particulate unbiodegradable organics in volat	1.3	g COD.g VSS-1	
iCV,BIO	COD of biomass in volatile solids	1.42	g COD.g VSS-1	
iCV,XE	COD of endogenous products in volatile solids	1.42	g COD.g VSS-1	
µNITO	Maximum specific growth rate of NITOs	0.9	1/d	
KO2,NITO,AS	Half-saturation of O2 for NITOs (AS)	0.25	mg O2/L	
KNHx,NITO,AS	Half-saturation of NHx for NITOs (AS)	0.7	mg N/L	
µOHO	Maximum specific growth rate of OHOs	4	1/d	
KSB,AS	Half-saturation of readily biodegradable substrate for	5	mg COD/L	
KO2,OHO,AS	Half-saturation of O2 for OHOs (AS)	0.15	mg O2/L	
µCASTO	Maximum specific growth rate of CASTOs	1	1/d	
qPAO,PP	Maximum polyphosphate uptake rate of PAOs	0.1	1/d	
KPO4,PAO,AS	Half-saturation of PO4 for PAOs (AS)	0.3	mg P/L	
qHYD	Rate of hydrolysis	2	1/d	

Ordinary heterotrophic organism kinetics (OHO)

Symbol	Name	Value	Unit	Comment
µOHO	Maximum specific growth rate of OHOs	4	1/d	
µFERM,OHO	Fermentation growth rate of OHOs	0.3	1/d	
bOHO	Decay rate of OHOs	0.62	1/d	
ηOHO,anox	Reduction factor for anoxic growth of OHOs	0.6		
KSB,AS	Half-saturation of readily biodegradable substrate for	5	mg COD/L	
KO2,OHO,AS	Half-saturation of O2 for OHOs (AS)	0.15	mg O2/L	
KVFA,AS	Half-saturation of VFA for OHOs (AS)	0.5	mg COD/L	
KMEOL,OHO,AS	Half-saturation of methanol for OHOs (AS)	0.1	mg COD/L	
KNOx,OHO,AS	Half-saturation of NOx for OHOs (AS)	0.03	mg N/L	
KVFA,FERM,AS	Half-saturation of VFA in fermentation of OHOs (AS)	50	mg COD/L	
LograngeVFA,F	Effective range of logistic switch for VFA fermentatio	1.2	%	define range in percentage of half-saturation value
KSB,ana,AS	Half-saturation of readily biodegradable substrate in	5	mg COD/L	
KSB,ana,DIG	Half-saturation of readily biodegradable substrate in	350	mg COD/L	

Anoxic methanol utilizer kinetics (MEOLO)

Symbol	Name	Value	Unit	Comment
µMEOLO	Maximum specific growth rate of MEOLOs	1.3	1/d	
bMEOLO	Decay rate of MEOLOs	0.05	1/d	
qMEOL	Rate of methanol degradation by MEOLOs under ana	10	1/d	to clean up any remaining methanol in digesters without having to ferment mechanistically
KMEOL,AS	Half-saturation of methanol for MEOLOs (AS)	0.5	mg COD/L	
KiO2,MEOLO,A	Half-inhibition of O2 for MEOLOs (AS)	0.05	mg O2/L	
KNOx,MEOLO,A	Half-saturation of NOx for MEOLOs (AS)	0.03	mg N/L	

Carbon storing organism kinetics (CASTO)

Symbol	Name	Value	Unit	Comment
µCASTO	Maximum specific growth rate of CASTOs	1	1/d	
qPAO,PP	Maximum polyphosphate uptake rate of PAOs	0.1	1/d	

µFERM,PAO	Fermentation growth rate of PAOs	0.45	1/d	
µPAO,lim	Maximum specific growth rate of PAOs under P limite	0.49	1/d	
bCASTO	Decay rate of CASTOs	0.08	1/d	previously 0.05 (0.15 for Lopez et al. 2006; Hao et al., 2010)
bSTC	Rate of CASTOs maintenance on PHA and GLY	0.07	1/d	
bPP,ana	Rate of PAOs maintenance under anaerobic conditior	0.005	1/d	
qPAO,PHA	Rate of VFA storage into PHA for PAOs	7	1/d	
qGAO,GLY	Rate of VFA storage into glycogen for GAOs	4	1/d	
ηCASTO,anox	Reduction factor for anoxic growth of CASTOs	0.66		
ηbCASTO,anox	Reduction factor for anoxic decay of CASTOs	0.5		
ηbCASTO,ana	Reduction factor for anaerobic decay of CASTOs	0.25		
ηbSTC,anox	Reduction factor for anoxic maintenance of CASTOs o	0.66		
ηbPP,aer	Reduction factor for aerobic maintenance of PAOs on	0.25		
ηbPP,anox	Reduction factor for anoxic maintenance of PAOs on	0.5		
KPO4,PAO,AS	Half-saturation of PO4 for PAOs (AS)	0.3	mg P/L	
LograngePO4,P	Effective range of logistic switch for PO4 uptake by P/	80	%	define range in percentage of half-saturation value
LograngePP,PA	Effective range of logistic switch for PP cleavage by P/	40	%	define range in percentage of half-saturation value
KPHA,cle	Half-saturation of PHA for PAOs at PP cleavage	0.1	g COD.g COD-1	
KPHA	Half-saturation of PHA for PAOs	0.01	g COD.g COD-1	
KSTC	Half-saturation of PHA and GLY for PAOs	0.1	g COD.g COD-1	
KO2,CASTO,AS	Half-saturation of O2 for CASTOs (AS)	0.05	mg O2/L	
KNOx,CASTO,A	Half-saturation of NOx for CASTOs (AS)	0.03	mg N/L	
KVFA,CASTO,AS	Half-saturation of VFA storage for CASTOs (AS)	5	mg COD/L	
KPP	Half-saturation of PP for PAOs	0.01	g COD.g COD-1	
KiPP,PAO,max	Half-inhibition of maximum PP content of PAOs	0.35	g P.g COD-1	
LograngePP,PA	Effective range of logistic switch for PP/PAO inhibitio	17	%	define range in percentage of half-inhibition value
XPP,PAO,min	PAO PP uptake booster denominator limiting term	0.1	mg COD/L	
KiPHA,PAO,ma	Half-inhibition of maximum PHA content of PAOs	0.6	g COD.g COD-1	
LograngePHA,P	Effective range of logistic switch for PHA/PAO inhibiti	10	%	define range in percentage of half-inhibition value
KMg,PAO,AS	Half-saturation of Mg (counter-ion in PP storage) for	0.001	mg Mg/L	
KK,PAO,AS	Half-saturation of K (counter-ion in PP storage) for PA	0.001	mg K/L	
KCa,PAO,AS	Half-saturation of Ca (counter-ion in PP storage) for P	0.001	mg Ca/L	
KPP,lim	Half-saturation of PP (nutrient) for PAOs under PO4 li	0.002	mg P/L	
KiPO4,lim,AS	Half-inhibition of PO4 for PAOs under PO4 limitation	0.005	mg P/L	
LogsatORP,PAO	Logistic half-saturation of ORP switching in fermentat	-170	mV	previously -100
LogsatORP,PAO	Logistic slope of ORP switching in fermentation of PA	0.1	mV-1	
ηbGLY,ana	Reduction factor for anaerobic maintenance of GAOs	0.1		
KGLY	Half-saturation of glycogen for GAOs (AS)	0.05	g COD.g COD-1	
KiGLY,GAO,ma	Half-inhibition of maximum glycogen content of GAO	0.5	g COD.g COD-1	
LograngeGLY,G	Effective range of logistic switch for GLY/GAO inhibiti	12	%	define range in percentage of half-inhibition value
LogsatORP,GAO	Half-value of ORP switch of glycogen storage by GAO	-30	mV	
LogsatORP,GAO	Half-value of ORP switch of glycogen storage by GAO	-110	mV	
LogsatORP,GAO	Logistic slope of ORP switching of GAOs	0.035	mV-1	

Aerobic nitrifying organism kinetics (NITO)

Symbol	Name	Value	Unit	Comment
µNITO	Maximum specific growth rate of NITOs	0.9	1/d	
bNITO	Decay rate of NITOs	0.17	1/d	
KNHx,NITO,AS	Half-saturation of NHx for NITOs (AS)	0.7	mg N/L	
KCO2,NITO,AS	Half-saturation of CO2 for NITOs (AS)	12	mg TIC/L	if pH is not calculated
LograngeCO2,N	Effective range of CO2 logistic switch for NITOs (AS)	200	%	define range in percentage of half-saturation value
KCO2,NITO,side	Half-saturation of CO2 for NITOs (Sidestream)	48	mg TIC/L	if pH is not calculated
LograngeCO2,N	Effective range of CO2 logistic switch for NITOs (Sides	100	%	define range in percentage of half-saturation value
KCO2,NITO,pH,	Half-saturation of bicarbonate for NITOs (AS)	1	mmol [HCO	if pH is calculated
LograngeCO2,N	Effective range of bicarbonate logistic switch for NITO	100	%	define range in percentage of half-saturation value

KCO2,NITO,pH,	Half-saturation of bicarbonate for NITOs (Sidestream)	4	mmol [HCO	if pH is calculated
LograngeCO2,N	Effective range of bicarbonate logistic switch for NITO	30	%	define range in percentage of half-saturation value
KO2,NITO,AS	Half-saturation of O2 for NITOs (AS)	0.25	mg O2/L	
KO2,NITO,sides	Half-saturation of O2 for NITOs (Sidestream)	0.5	mg O2/L	
KNOx,NITO,AS	Half-saturation of NOx for NITOs (AS)	0.03	mg N/L	
KiNH3,NITO,pH	Half-inhibition of NH3 for NITOs (AS)	9999	mol [NH3].	if pH is calculated

Acidoclastic methanogen kinetics (AMETO)

Symbol	Name	Value	Unit	Comment
µAMETO	Maximum specific growth rate of AMETO	0.3	1/d	
bAMETO	Decay rate of AMETOs	0.03	1/d	
KVFA,AMETO,A	Half-saturation of VFA for AMETOs (AS)	400	mg COD/L	
KiVFA,AMETO,A	Haldane inhibition of VFA for AMETOs (AS)	99999	mg COD/L	
KiNHx,AMETO,A	Half-inhibition of SNHx for AMETOs (AS)	9999	mg N/L	if pH is not calculated
KiNH3,AMETO,	Half-inhibition of NH3 for AMETOs (AS)	999	mmol/L	if pH is calculated
LograngeNH3,A	Effective range of NH3 logistic switch for AMETOs	10	%	define range in percentage of half-saturation value
KiO2,AMETO,A	Half-inhibition of O2 for AMETOs (AS)	0.05	mg O2/L	
KNOx,AMETO,A	Half-saturation of NOx for AMETOs (AS)	0.05	mg N/L	
pHlow,AMETO	pH inhibition low value for AMETOs	4.5	pHunit	
pHhigh,AMETO	pH inhibition high value for AMETOs	9.5	pHunit	

Hydrogenotrophic methanogen kinetics (HMETO)

Symbol	Name	Value	Unit	Comment
µHMETO	Maximum specific growth rate of HMETO	1.3	1/d	
bHMETO	Decay rate of HMETOs	0.13	1/d	
KH2,HMETO,AS	Half-saturation of H2 for HMETOs (AS)	0.1	mg COD/L	
KiO2,HMETO,A	Half-inhibition of O2 for HMETOs (AS)	0.05	mg O2/L	
KNOx,HMETO,A	Half-saturation of NOx for HMETOs (AS)	0.05	mg N/L	
pHlow,HMETO	pH inhibition low value for HMETOs	4.5	pHunit	
pHhigh,HMETO	pH inhibition high value for HMETOs	9.5	pHunit	

Precipitation kinetics

Symbol	Name	Value	Unit	Comment
qCaCO3,PREC	Rate of CaCO3 precipitation	0.1	mg/L/d	
qCaCO3,DISS	Rate of CaCO3 dissolution	0.1	mg/L/d	
qSTR,PREC	Rate of struvite precipitation	10	mg/L/d	
qSTR,DISS	Rate of struvite dissolution	10	mg/L/d	
qACP,PREC	Rate of ACP precipitation	5	mg/L/d	
qACP,DISS	Rate of ACP dissolution	5	mg/L/d	
qBSH,PREC	Rate of brushite precipitation	500	mg/L/d	
qBSH,DISS	Rate of brushite dissolution	500	mg/L/d	
qVivi,PREC	Rate of vivianite precipitation	0.01	mg/L/d	
qVivi,DISS	Rate of vivianite dissolution	0.01	mg/L/d	
KSTR,DISS	Half-saturation of struvite redissolution	0.01	mg TSS/L	
KACP,DISS	Half-saturation of ACP redissolution	0.01	mg TSS/L	
KBSH,DISS	Half-saturation of brushite redissolution	0.01	mg TSS/L	
KCaCO3,DISS	Half-saturation of CaCO3 redissolution	0.01	mg TSS/L	
KVivi,DISS	Half-saturation of vivianite redissolution	0.01	mg TSS/L	

HFO kinetics

Symbol	Name	Value	Unit	Comment
qHFOH,AGING	Rate of XHFO,H aging	250	1/d	
qHFOL,AGING	Rate of XHFO,L aging	1	1/d	
qP,HFO,COPRE(	Rate of P binding and coprecipitation on XHFO,H	150	1/d	

qP,HFO,BIND	Rate of P binding on XHFO,L	1	1/d	
qHFOH,DESORP	Rate of XHFO,H,P desorption	100	1/d	
qHFOL,DESORP	Rate of XHFO,L,P desorption	10	1/d	
qHFO,DISS	Rate of XHFO,H,P,old and XHFO,L,P,old redissolution	100	1/d	
qHFO,RED	Rate of HFO reduction with organics	2	1/d	
LogsatORP,HFO	Logistic half-saturation of ORP switching in HFO redu	-100	mV	
LogsatORP,HFO	Logistic slope of ORP switching in HFO reduction	0.1		
qFe2,OX	Rate of Fe2 oxidation	1	1/d	
KiP,HFO,DISS	Half-inhibition of PO4 in HFO redissolution	0.01	mg P/L	
LograngeP,HFO	Effective range of logistic switch for HFO redissolutio	100	%	define range in percentage of half-inhibition value
KiP,HFO,DESOR	Half-inhibition of PO4 in HFO desorption	0.1	mg P/L	
KP,HFO,BIND	Half-saturation of PO4 in binding on HFO	0.1	mg P/L	

HAO kinetics

Symbol	Name	Value	Unit	Comment
qHAOH,AGING	Rate of XHAO,H aging	75	1/d	
qHAOL,AGING	Rate of XHAO,L aging	1	1/d	
qP,HAO,COPRE	Rate of P binding and coprecipitation on XHAO,H	175	1/d	
qP,HAO,BIND	Rate of P binding on XHAO,L	1	1/d	
qHAOH,DESOR	Rate of XHAO,H,P desorption	100	1/d	
qHAOL,DESORP	Rate of XHAO,L,P desorption	10	1/d	
qHAO,DISS	Rate of XHAO,H,P,old and XHAO,L,P,old redissolution	100	1/d	
KP,HAO,BIND	Half-saturation of PO4 for binding on HAO	0.1	mg P/L	
KiP,HAO,DISS	Half-inhibition of PO4 in HAO redissolution	0.001	mg P/L	
LograngeP,HAO	Effective range of logistic switch for HAO redissolutio	200	%	define range in percentage of half-inhibition value
KiP,HAO,DESOF	Half-inhibition of PO4 in HAO desorption	0.1	mg P/L	

Common switches

Symbol	Name	Value	Unit	Comment
KNHx,BIO,AS	Half-saturation of NHx as nutrient for biomasses (AS)	0.005	mg N/L	
KPO4,BIO,AS	Half-saturation of PO4 as nutrient for biomasses (AS)	0.002	mg P/L	
KCO2,BIO,AS	Half-saturation of CO2 for biomasses (except NITOs)	1.2	mg TIC/L	
KCAT,AS	Half-saturation of strong cations (as Na+)	0.1	mg Na/L	
KAN,AS	Half-saturation of strong anions (as Cl-)	0.1	mg Cl/L	
KMg,BIO,AS	Half-saturation of Mg for biomasses (AS)	0.0001	mg Mg/L	
KCa,BIO,AS	Half-saturation of Ca for biomasses (AS)	0.0001	mg Ca/L	
ηb,anox	Reduction factor for anoxic decay	0.5		
ηb,ana	Reduction factor for anaerobic decay	0.25		
mtox,anox	Toxicity factor of anaerobes under anoxic conditions	5		
mtox,aer	Toxicity factor of anaerobes under aerobic conditions	10		
mtox,ana,max	Toxicity factor of aerobes under anaerobic conditions	10		
pHlow	pH inhibition low value	3	pHunit	
pHhigh	pH inhibition high value	11	pHunit	

Conversion kinetics

Symbol	Name	Value	Unit	Comment
qHYD	Rate of hydrolysis	2	1/d	
ηHYD,anox	Reduction factor for anoxic hydrolysis	0.5		
ηHYD,ana	Reduction factor for anaerobic hydrolysis	0.5		
qFLOC	Rate of flocculation	50	1/d	
KFLOC,AS	Half-saturation of colloids in flocculation (AS)	0.001	g COD.g COD-1	
KHYD,AS	Half-saturation of particulates in hydrolysis (AS)	0.05	g COD.g COD-1	
qAMMON	Rate of ammonification	0.05	1/d	
qSPB	Rate of soluble biodegradable organic P conversion	0.5	1/d	

qXE	Rate of endogenous decay products conversion	0.007	1/d	
qASSIM	Rate of assimilative nutrient production	1	1/d	
KiNHx,ASSIM,A	Half-inhibition of NHx in NOx assimilative reduction	0.0005	mg N/L	
KNOx,ASSIM,AS	Half-saturation of NOx in NOx assimilative reduction (	0.001	mg N/L	

Parameters for half saturation coefficients in biofilms

Symbol	Name	Value	Unit	Comment
fKS,biofilm	Diffusion factor for half-saturation coefficients	0.4		

Temperature dependency

Symbol	Name	Value	Unit	Comment
θµ,OHO	Arrhenius coefficient for OHO growth	1.04		
θFERM,OHO	Arrhenius coefficient for fermentation (OHO)	1.04		
θb,OHO	Arrhenius coefficient for OHO decay	1.03		
θµ,MEOLO	Arrhenius coefficient for MEOLO growth	1.06		
θb,MEOLO	Arrhenius coefficient for MEOLO decay	1.03		
θµ,CASTO	Arrhenius coefficient for CASTO growth	1.04		
θµ,PAO,lim	Arrhenius coefficient for PAO growth (P limited)	1.04		
θFERM,PAO	Arrhenius coefficient for fermentation (PAO)	1.04		
θq,PAO,PP	Arrhenius coefficient for PP storage	1.04		
θq,PAO,PHA	Arrhenius coefficient for PHA storage	1.04		
θb,CASTO	Arrhenius coefficient for CASTO decay	1.03		
θb,STC	Arrhenius coefficient for PHA and GLY storage use for	1.064		based on Lopez Vazquez et al., 2009
θb,PP,ana	Arrhenius coefficient for anaerobic PP storage	1.03		
θq,GAO,GLY	Arrhenius coefficient for GLY storage	1.072		
θµ,NITO	Arrhenius coefficient for NITO growth	1.072		
θb,NITO	Arrhenius coefficient for NITO decay	1.03		
θµ,AMETO	Arrhenius coefficient for AMETO growth	1.03		
θb,AMETO	Arrhenius coefficient for AMETO decay	1.03		
θµ,HMETO	Arrhenius coefficient for HMETO growth	1.03		
θb,HMETO	Arrhenius coefficient for HMETO decay	1.03		
θq,FLOC	Arrhenius coefficient for flocculation	1.03		
θq,HYD	Arrhenius coefficient for hydrolysis	1.03		
θq,AMMON	Arrhenius coefficient for ammonification	1.03		
θq,SPB	Arrhenius coefficient for PO4 conversion	1.03		
θq,XE	Arrhenius coefficient endogenous residual conversion	1.03		
θq,ASSIM	Arrhenius coefficient assimilative kinetics	1.03		
θq,Fe2,OX	Arrhenius coefficient for ferrous iron oxidation kineti	1.04		
θq,HFO,RED	Arrhenius coefficient for ferric iron reduction kinetics	1.04		
Tbase	Arrhenius base temperature	20	Co	

Stoichiometric yields

Symbol	Name	Value	Unit	Comment
YOHO,VFA,ox	Yield of OHOs on VFA under aerobic conditions	0.6	g XOHO.g SVFA-1	
YOHO,VFA,ano	Yield of OHOs on VFA under anoxic conditions	0.45	g XOHO.g SVFA-1	
YOHO,SB,ox	Yield of OHOs on readily biodegradable substrate und	0.67	g XOHO.g SB-1	
YOHO,SB,anox	Yield of OHOs on readily biodegradable substrate und	0.54	g XOHO.g SB-1	
YOHO,SB,ana	Yield of OHOs on readily biodegradable substrate und	0.1	g XOHO.g SB-1	
YOHO,H2,ana,h	Yield of H2 production in fermentation with high VFA	0.35	g SH2.g SB-1	
YOHO,H2,ana,l	Yield of H2 production in fermentation with low VFA (	0.1	g SH2.g SB-1	
YOHO,SMEOL,o	Yield of OHOs on methanol under aerobic conditions	0.4	g XOHO.g SMEOL-1	
YMEOLO	Yield of MEOLOs on methanol	0.4	g XMEOLO.g SMEOL-1	
YCASTO,PHA,ox	Yield of CASTOs on PHA under aerobic conditions	0.639	g XCASTO.g XPHA-1	
YCASTO,PHA,ar	Yield of CASTOs on PHA under anoxic conditions	0.52	g XCASTO.g XPHA-1	

YCASTO,SB,ana	Yield of CASTOs on readily biodegradable substrate u	0.1	g XCASTO.g SB-1
YCASTO,H2,ana	Yield of H2 production in fermentation with high VFA	0.35	g SH2.g SB-1
YCASTO,H2,ana	Yield of H2 production in fermentation with low VFA	0.1	g SH2.g SB-1
YPP,CASTO,ox	Yield of CASTOs consumed per PP uptake under aerob	0.33	g XCASTO.g XPP-1
YPP,CASTO,ano	Yield of CASTOs consumed per PP uptake under anoxi	0.23	g XCASTO.g XPP-1
fP,VFA	Ratio of P released per VFA stored	0.65	g XPP.g SVFA-1
iTSS,PP	TSS content of PP	3.516129032	g XTSS.g XPP-1
YCASTO,GLY,ox	Yield of CASTOs on glycogen under aerobic conditions	0.6	g XCASTO.g XGLY-1
YCASTO,GLY,an	Yield of CASTOs on glycogen under anoxic conditions	0.5	g XCASTO.g XGLY-1
YNITO	Yield of NITOs on NHx	0.24	g XNITO.g SNHx-1
YAMETO	Yield of AMETOs on VFA	0.1	g XAMETO.g SVFA-1
YHMETO	Yield of HMETOs on H2	0.1	g XHMETO.g SH2-1

General stoichiometry

Symbol	Name	Value	Unit	Comment
fE	Fraction of endogenous products produced in biomas	0.08	g XE.g XBIO-1	
iN,BIO	N content of biomasses	0.07	g N.g COD-1	
iN,XE	N content of endogenous products	0.06	g N.g COD-1	
iN,CB	N content of colloidal biodegradable substrate	0.01	g N.g COD-	previously 0.03
iN,CU	N content of colloidal unbiodegradable organics	0.01	g N.g COD-1	
iN,SU	N content of soluble unbiodegradable organics	0.01	g N.g COD-	previously 0.05
iN,XSTR	N content of struvite	0.057075505	g N.g TSS-1	A_MN/M_MSTR
iP,BIO	P content of biomasses	0.02	g P.g COD-1	
iP,CB	P content of colloidal biodegradable substrate	0.002	g P.g COD-	previously 0.005
iP,CU	P content of colloidal unbiodegradable organics	0.002	g P.g COD-	previously 0.005
iP,SU	P content of soluble unbiodegradable organics	0.002	g P.g COD-1	
iP,XSTR	P content of struvite	0.126214106	g P.g TSS-1	A_MP/M_MSTR
iP,XACP	P content of ACP	0.162065388	g P.g TSS-1	2*A_MP/M_MACP
iP,XBSH	P content of BSH	0.17998807	g P.g TSS-1	A_MP/M_MBSH
iP,XVivi	P content of vivianite	0.123499858	g P.g TSS-1	2*A_MP/M_MVivi
iCV,XB	COD of biodegradable substrate in volatile solids	1.8	g COD.g VSS-1	
iCV,XU	COD of particulate unbiodegradable organics in volat	1.3	g COD.g VSS-1	
iCV,BIO	COD of biomass in volatile solids	1.42	g COD.g VSS-1	
iCV,XE	COD of endogenous products in volatile solids	1.42	g COD.g VSS-1	
iCV,VFA	COD of VFA in volatile solids	1.066	g COD.g VS-1	
iCV,SB	COD of readily biodegradable substrate in volatile sol	1.066	g COD.g VS-1	
iCV,MEOL	COD of methanol in volatile solids	1.5	g COD.g VS-1	
iCV,SU	COD of soluble unbiodegradable organics in volatile s	0.926	g COD.g VS-1	
iCV,CB	COD of colloidal biodegradable substrate in volatile s	1.8	g COD.g VS-1	
iCV,CU	COD of colloidal unbiodegradable organics in volatile	1.3	g COD.g VS-1	
iCV,PHA	COD of PHA in volatile solids	1.67	g COD.g VSS-1	
iCV,GLY	COD of glycogen in volatile solids	1.19	g COD.g VSS-1	
iCIT,BIO	Inorganic carbon content of biomass	0.352	g TIC.g COD	C5H7O2N: 32 g COD/mol C
iCIT,SB	Inorganic carbon content of SB and SU	0.286	g TIC.g COD	C5H7O2N: 32 g COD/mol C
iCIT,MEOL	Inorganic carbon content of methanol	0.25	g TIC.g COD	CH4O: 48 g COD/mol C
iCIT,CH4	Inorganic carbon content of CH4	0.188	g TIC.g COD	CH4: 64 g COD/mol C
iCIT,VFA	Inorganic carbon content of VFA	0.375	g TIC.g COD	C2H4O2: 32 g COD/mol C
iCIT,PHA	Inorganic carbon content of PHA	0.333	g TIC.g COD	H[C4H6O2]nOH: 36 g COD/mol C
iCIT,GLY	Inorganic carbon content of glycogen	0.375	g TIC.g COD	[C6H10O5]n: 32 g COD/mol C
iINORG	Inorganic content of biomass	0.11	g TSS.g COD	15% of VSS - Ekama
iCa,PP	Calcium content of PP	0.1	mol Ca.mo	sum of the charges of Ca, Mg and K content of PP...
iMg,PP	Magnesium content of PP	0.35	mol Mg.mo	...should be equal to 1...
iK,PP	Potassium content of PP	0.1	mol K.mol	...e.g.: 2*0.1 + 2*0.35 + 1*0.1=1
fNa	Fraction of Na in NaCl	0.393372343	g Na.g NaCl-1	

iCa,INORG	Ca content of XINORG	0.05	g Ca.g TSS-1	
iMg,INORG	Mg content of XINORG	0.05	g Mg.g TSS-1	
fVFA,DM	fraction of SVFA not volatilized in Dry Matter analysis	50	%	

BOD stoichiometry

Symbol	Name	Value	Unit	Comment
YBOD,ult	Yield on ultimate BOD	0.95	g O2.g COD-1	
fS,BOD5,BODul	Fraction of BOD5 to ultimate BOD in soluble biodegra	0.9		
fC,BOD5,BODul	Fraction of BOD5 to ultimate BOD in colloidal biodegr	0.6		
fX,BOD5,BODul	Fraction of BOD5 to ultimate BOD in particulate biod	0.5		

HFO stoichiometry

Symbol	Name	Value	Unit	Comment
ASFHFO,H	Active site factor for HFO,H	1.2	mol P.mol Fe-1	
ASFHFO,L	Active site factor for HFO,L	0.2	mol P.mol Fe-1	
fH2O,HFO,TSS	Fraction of H2O loss in TSS test for HFO	0.0829	g H2O.g FeOH-1	
fH2O,HFO,VSS	Fraction of H2O loss in VSS test for HFO	0.17	g H2O.g Fe	Fe(OH)3 -> Fe2O3 + 3H2O

HAO stoichiometry

Symbol	Name	Value	Unit	Comment
ASFHAO,H	Active site factor for HAO,H	1	mol P.mol Al-1	
ASFHAO,L	Active site factor for HAO,L	0.1	mol P.mol Al-1	
fH2O,HAO,TSS	Fraction of H2O loss in TSS test for HAO	0.173216029	g H2O.g AlOH3-1	
fH2O,HAO,VSS	Fraction of H2O loss in VSS test for HAO	0.346432058	g H2O.g Al	2Al(OH)3 -> Al2O3 + 3H2O

Parameters for gas transfer

Symbol	Name	Value	Unit	Comment
kL,GO2,bub	Liquid-side mass transfer coefficient of O2 for gas bu	319.0510073	gpd/ft2	
kL,GO2,sur	Liquid-side mass transfer coefficient of O2 at liquid s	186.5221273	gpd/ft2	
fkL,GN2	Correction factor for mass transfer of N2	100	%	
fkL,GCO2	Correction factor for mass transfer of CO2	100	%	
fkL,GCH4	Correction factor for mass transfer of CH4	100	%	
fkL,GH2	Correction factor for mass transfer of H2	100	%	
fkL,GNH3	Correction factor for mass transfer of NH3	5	%	Used to compensate for the high solubility of NH3 gas
qALPHA	Sludge retention-based alpha improvement rate com	0.0017	m3.g-1.d-1	
SALPHA,sat	Alpha indicator saturation value	1		
KSO2,ALPHA	Half-saturation of dissolved oxygen for anoxic/anaer	0.05	mg O2/L	
fSO2,max,ALPH	Maximum anaerobic/anoxic alpha enhancement fact	2.5		
coeffdamp,ALP	Coefficient of alpha first order limitation damping ter	3		
powdamp,ALPH	Power of alpha first order limitation damping term	9		
slTSS,α,def	Slope of solids-related alpha correction, default	-0.0711	m3.kg-1	
slTSS,α,coarse	Slope of solids-related alpha correction, coarse bubb	-0.0474	m3.kg-1	
coefflead,TSS,α	Leading coefficient of solids-related alpha correction,	-0.000787	(kg.m-3)-2	
coefflin,TSS,α,r	Linear coefficient of solids-related alpha correction, r	0.0232	m3.kg-1	
constTSS,α,me	Constant of solids-related alpha correction, mechanic	0.877		

Oxidation-reduction potential constants

Symbol	Name	Value	Unit	Comment
ORPbase	Base ORP value	-300	mV	
ORPmax,SO2	ORP max for dissolved oxygen	300	mV	
ORPmax,SNOx	ORP max for dissolved nitrate	70	mV	
KORP,SO2	Half-saturation of dissolved oxygen for ORP	0.05	mg O2/L	
KORP,SNOx	Half-saturation of NOx for anoxic ORP	0.1	mg N/L	

KORP,H2,CH4	Half-saturation of dissolved hydrogen and methane fo	5	mg COD/L	

IS calculation

Symbol	Name	Value	Unit	Comment
ISlim	IS cut-off threshold for Davies activity coefficient corr	0.2	ISunit	The fmono/fdi/ftri curves have minima at 0.3 and literally couldn't be used above that
SlopeIS,corr	Slope of correction	-0.001		
ISinput,AS	Ionic strength input for activated sludge	0.02	ISunit	
ISinput,DIG	Ionic strength input for digesters	0.1	ISunit	
ISinput,sidestre	Ionic strength input for sidestream	0.1	ISunit	

TOC calculation coefficients

Symbol	Name	Value	Unit	Comment
fTOC,1	fTOC,1	0.334448	g C.g COD-1	
fTOC,2	fTOC,2	2.42475	g C.m-3	

Interstitial water content

Symbol	Name	Value	Unit	Comment
iiw,BIO	Interstitial water of biomass in volatile solids	2.33	g H2O.g VS	Assuming 70% of biomass cytoplasm is water

Vicinal water content

Symbol	Name	Value	Unit	Comment
ivw,XB	Vicinal water of biodegradable substrate in volatile so	0.052	g H2O.g VS	Assuming 5% of H2O is associated with vicinal water for these organics
ivw,XU	Vicinal water of particulate unbiodegradable organics	0.052	g H2O.g VS-1	
ivw,BIO	Vicinal water of biomass in volatile solids	0.052	g H2O.g VS-1	
ivw,XE	Vicinal water of endogenous products in volatile solid	0.052	g H2O.g VS-1	
ivw,CB	Vicinal water of colloidal biodegradable substrate in v	0.052	g H2O.g VS-1	
ivw,CU	Vicinal water of colloidal unbiodegradable organics in	0.052	g H2O.g VS-1	
ivw,PHA	Vicinal water of PHA in volatile solids	0.052	g H2O.g VS-1	
ivw,GLY	Vicinal water of glycogen in volatile solids	0.052	g H2O.g VS-1	
ivw,EPS	Vicinal water correction of EPS in volatile solids	0.052	g H2O.g VS-1	

Water of Hydration content

Symbol	Name	Value	Unit	Comment
iwh,XB	Water of hydration of biodegradable substrate in vola	0.11	g H2O.g VS	Assuming 10% of H2O is associated with water of hydration
iwh,XU	Water of hydration of particulate unbiodegradable or	0.11	g H2O.g VS-1	
iwh,BIO	Water of hydration of biomass in volatile solids	0.11	g H2O.g VS-1	
iwh,XE	Water of hydration of endogenous products in volatil	0.11	g H2O.g VS-1	
iwh,PHA	Water of hydration of PHA in volatile solids	0.17	g H2O.g VS	Assuming 15% of H2O is associated with water of hydration
iwh,GLY	Water of hydration of glycogen in volatile solids	0.17	g H2O.g VS-1	
iwh,EPS	Water of hydration correction of EPS in volatile solids	0.33	g H2O.g VS	Assuming 25% of H2O is associated with water of hydration

APPENDIX B
HYDROGEOLOGIC EVALUATION

Andreyev Engineering, Inc.

▼ Groundwater ▼ Environmental ▼ Geotechnical ▼ Construction Materials Testing

SANFORD OFFICE
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June 13, 2022
GPGW-22-030

To: **TetraTech**
200 East Pine Street, Suite # 100
Orlando, FL 32804

Attention: **John Toomey, P.E.**

Subject: **Hydrogeologic Investigation and Groundwater Modeling Services, Re-Rate and Re-Permitting Existing RIBs, City of Minneola Water Reclaim Facility, Minneola, Lake County, Florida**

Dear Mr. Toomey:

As requested, Andreyev Engineering, Inc. (AEI) has completed hydrogeologic investigations and groundwater modeling for the existing City of Minneola effluent re-use/disposal site, located at 18340 Scrub Jay Lane, Minneola, Florida. The purpose of this study was to provide supplemental soil and groundwater investigations, then refine and calibrate the previously created model to assist the City's desire to re-rate and re-permit the existing rapid infiltration basin (RIBs) for a maximum disposal capacity of the RIBs. The modeling also includes estimation of 14 days and 30 days of short term wet weather storage and disposal capacity of the RIBs.

This hydrogeologic analysis provides an estimate for the optimum long term disposal capacity of the RIBs and a short term wet weather storage and disposal capacity for potential future use of the RIBs as a backup system for reclaimed water uses. The following report presents the results of the hydrogeologic investigation and groundwater modeling studies.

1.0 SITE LOCATION AND DESCRIPTION

The subject site is located along Scrub Jay Lane in Section 32, Township 21 South, and Range 26 East, in the City of Minneola, Lake County, Florida. We have included the U.S.G.S. Topographic Map, which depicts the location of the site, on the attached **Figure 1**. In addition, the Natural Resources Conservation Service (NRCS) Soil Map which depicts the location and general soil types of the subject site is presented on the attached **Figure 2**.

2.0 PURPOSE AND SCOPE OF GEOTECHNICAL SERVICES

The purpose of this supplemental soil and groundwater study was to provide additional data to assist in evaluating the disposal capacity of the site.

The scope of the field investigation included:

- Drilled three (3) Standard Penetration Test (SPT) borings, designated as TB-1 thru TB-3 to a depth of 150 feet below ground surface, for general deep soil data.

- Install one (1) temporary piezometer to a depth of 150 feet, for stabilized groundwater measurements.

Samples were recovered from the borings and returned to AEI's laboratory for visual classification and stratification. Soil strata were classified according to the Unified Soil Classification System (USCS). Approximate boring locations are shown on **Figure 3**, results of the Standard Penetration Test (SPT) borings, in profile form, are presented on **Figure 4**. On the profiles, horizontal lines designating the interface between differing materials represent approximate boundaries. The actual transition between layers is typically gradual.

3.0 NATURAL RESOURCES CONSERVATION SERVICE SOIL SURVEY

The publication titled "Soil Survey of Lake County, Florida" published by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) was reviewed. For your reference, we have included a portion of the NRCS Soil Map which depicts the location of the subject site on the attached **Figure 2**. The three soil map units for the subject project location are identified as:

<u>*Soil Map Unit 9:</u> **Candler Sand, 5 to 12 Percent Slopes**

<u>*Brief Description:*</u> *"This soil is a sloping to strongly sloping, excessively drained soil found on rolling uplands of the central ridge. Typically, the surface layer of this soil type consists of sand about 5 inches thick. The next layer is sand about 62 inches thick followed by a layer of sand about 13 inches thick. The water table for this soil type is at a depth of more than 80 inches. Available water capacity is very low and permeability is considered to be rapid to very rapid throughout the profile of this soil type."*

<u>Soil Map Unit 21:</u> **Lake Sand, 0 to 5 Percent Slopes**

<u>*Brief Description:*</u> *"This soil is a nearly level to gently sloping, well-drained to excessively drained soil. It has the profile described as representative for the series. In a representative profile, the surface layer is dark brown sand about 7 inches thick. It is underlain by a layer of brown loose sand about 11 inches thick. The next layer is strong brown loose sand about 15 inches thick. Below this, and extending to a depth of 98 inches, is yellowish-red loose sand. The water table is at a depth of more than 120 inches. Lake sand is very rapidly permeable and has very low available water capacity, low organic matter content, and low natural fertility."*

<u>Soil Map Unit 22:</u> **Lake Sand, 5 to 12 Percent Slopes**

<u>*Brief Description:*</u> *"This is a sloping and strongly sloping, well-drained to excessively drained soil. It has a profile similar to that described as representative for the series, but it is steeper and in some unprotected areas, it is eroded and the surface layer is only about 4 to 5 inches thick. In a representative profile, the surface layer is dark drown sand about 7 inches thick. It is underlain by a layer of brown loose sand about 11 inches thick. The next layer is strong brown loose sand about 15 inches thick. Below this, and extending to a depth of 98 inches, is yellowish-red loose sand. The water table is at a depth of more than 120 inches. This soil is very rapidly permeable. It has very low available water capacity, low organic matter content, and low natural fertility."*

* This soil map unit description is not presented in the 1975 NRCS "Soil Survey of Lake County, Florida" publication including revisions made to soil descriptions in 2004. These soil descriptions are interpreted from corresponding soil survey map units published for nearby counties.

4.0 SOIL AND GROUNDWATER CONDITIONS

The site-specific investigation and piezometer installation was completed March 17, 2022. The soil types encountered at the boring locations are presented in the form of soil profiles on the attached **Figure 4.** The stratification presented is based on visual examination of the recovered soil samples and the interpretation of the field logs by a geotechnical engineer.

4.1 Soil Conditions

In general, the borings encountered the following soil Strata:

- Brown to orangish brown to reddish brown fine sand (Stratum 1)
- Orangish brown to reddish brown fine sand to slightly clayey fine sand (Stratum 2)
- Light brown to light orangish brown to yellowish brown to light gray fine sand (Stratum 3)
- Brown to yellowish brown to gray to light gray to pink silty fine sand (Stratum 4)
- Orangish brown to yellowish brown silty clay (Stratum 5)

Standard Penetration Test (SPT) borings measure soil density using a split spoon sampler advanced by a 140-pound hammer dropped repeatedly a distance of 30 inches. The N-value, which is shown next to the corresponding depths of the boring profile, is the number of blows by the hammer required to advance the split spoon sampler one (1) foot. Split spoon sampling was conducted continuously in the upper 10 feet and at 5-foot intervals thereafter. Also included, adjacent to the SPT borings, are the blow counts or “N” values. The “N” values have been empirically correlated with various soil properties and are considered to be indicative of the relative density of cohesionless soils and the consistency of cohesive material.

Correlation of the SPT-N values with relative density, unconfined compressive strength and consistency are provided in the following table:

Coarse-Grained Soils		Fine Grained Soils		
Penetration Resistance N (blows/ft)	Relative Density of Sand	Penetration Resistance N (blows/ft)	Unconfined Compressive Strength of Clay (tons/ft^2)	Consistency of Clay
0-4	Very Loose	<2	<0.25	Very Soft
4-10	Loose	2-4	0.25-0.50	Soft
10-30	Medium-Dense	4-8	0.50-1.00	Medium
30-50	Dense	8-15	1.00-2.00	Stiff
>50	Very Dense	15-30	2.00-4.00	Very Stiff
		>30	>4.00	Hard

Please refer to **Figure 3 and 4** for boring locations, strata depths, and encountered soil conditions. The stratification lines represent the approximate boundaries between soil types. The actual transition may be gradual. Minor variations not considered important to our engineering evaluations may have been abbreviated or omitted for clarity.

4.2 Groundwater Conditions

At boring locations TB-1 thru TB-3, groundwater levels were not encountered in the upper 10 feet of drilling and could not be measured below 10 feet in depth, due to the introduction of a bentonite slurry used to maintain on open borehole during the mud rotary drilling process. However, at boring location TB-2, a 1-inch temporary piezometer was installed in the open borehole annulus to the boring termination depth of 150 feet below the existing ground surface elevation. A stabilized groundwater level was measured after a 24hr stabilization period, at TB-2, which occurred at elevation 122.1 feet NAVD. Two deep monitoring wells exist at the RIBs site as part of the permitted monitoring program. The groundwater elevations at the two deep wells, MW-1 and MW-2, were measured at 120.8 and 124.1 feet NAVD, respectively.

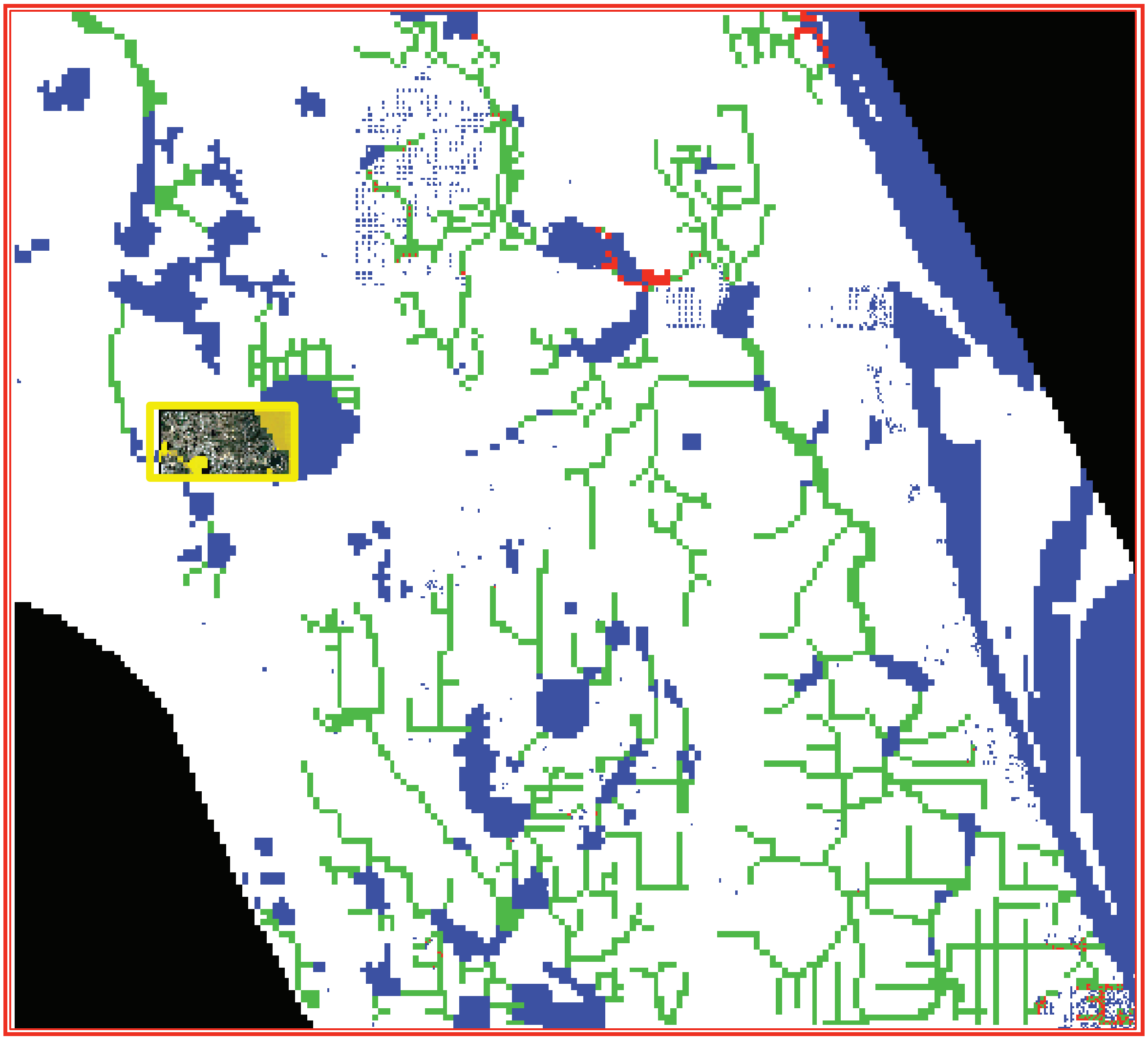
Based on the encountered subsurface conditions and the effects of effluent loading at the RIBs, the current groundwater elevations below the RIBs occur at 120 to 124 feet NAVD.

In addition, AEI reviewed the maps of the Potentiometric Surface of the Upper Floridan aquifer in the Southwest Florida Water Management District and Vicinity. The potentiometric surface contour maps of the Upper Floridan aquifer indicate that the potentiometric levels in the vicinity of this site occur at approximate elevations of 74 to 75 ft NAVD in the site vicinity. The potentiometric surface contours of the upper Floridan aquifer are presented on **Figure 5**. Based on the potentiometric contour maps, the direction of flow in the Upper Floridan aquifer is in a northeasterly direction across the site.

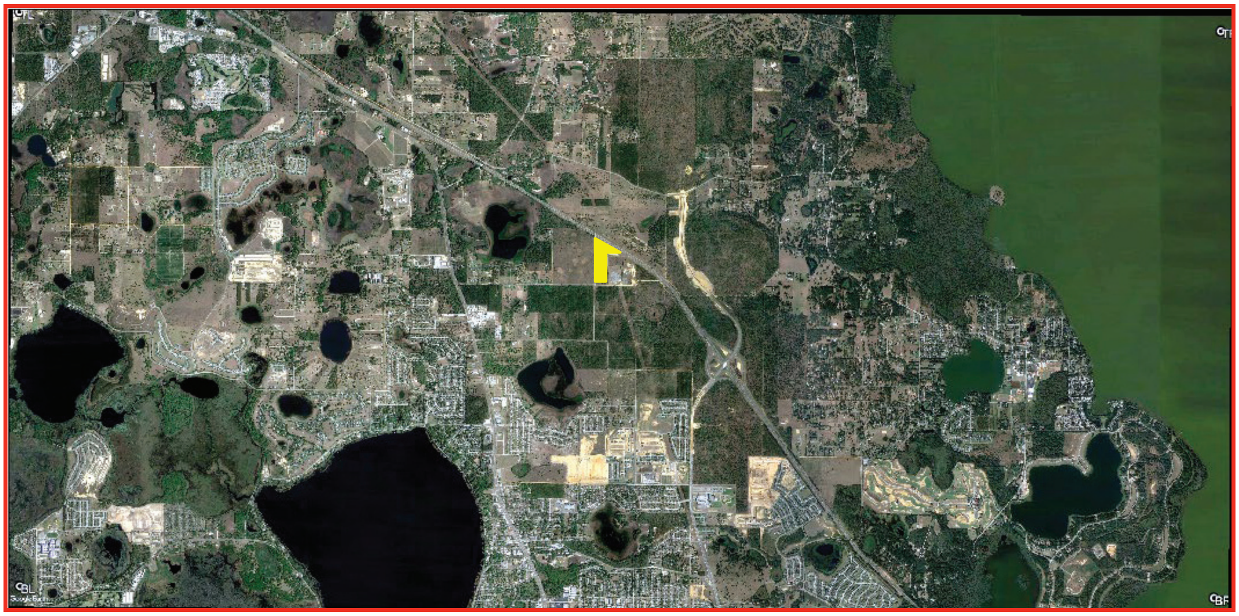
5.0 MODEL SET UP AND DESCRIPTION

To simulate the existing groundwater conditions and to allow modeling for long term disposal capacity and for wet weather storage and disposal of effluent at the City of Minneola's Rapid Infiltration Basins (RIBs) site, a numerical analysis consisting of a transient groundwater flow model (MODFLOW) was set up for the project and surrounding areas.

The initial set up of this model consisted of starting with the latest East Central Florida (ECF) regional groundwater flow model developed by the SJRWMD by zooming in on the project site and refining the model grid. The approximate ECF model boundaries (red) and the zoomed in area of the refined model grid (yellow) are shown below:



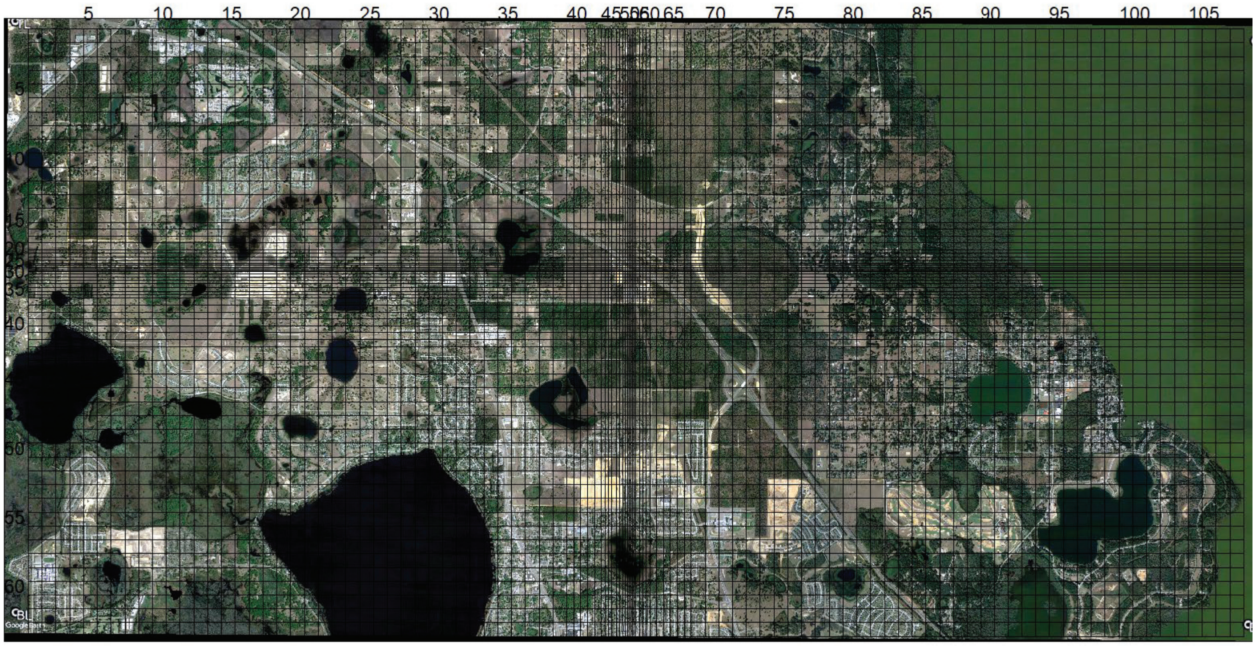
The effective area of the ECF model that was selected to model the effects of mounding at the RIB site was based on potential hydraulic influence of the RIBs and the surrounding hydraulic control features, such as lakes, depressions, drainageways, rivers. The following aerial map presents the boundaries of the model grid selected for this modeling effort, with the project area outlined in yellow:



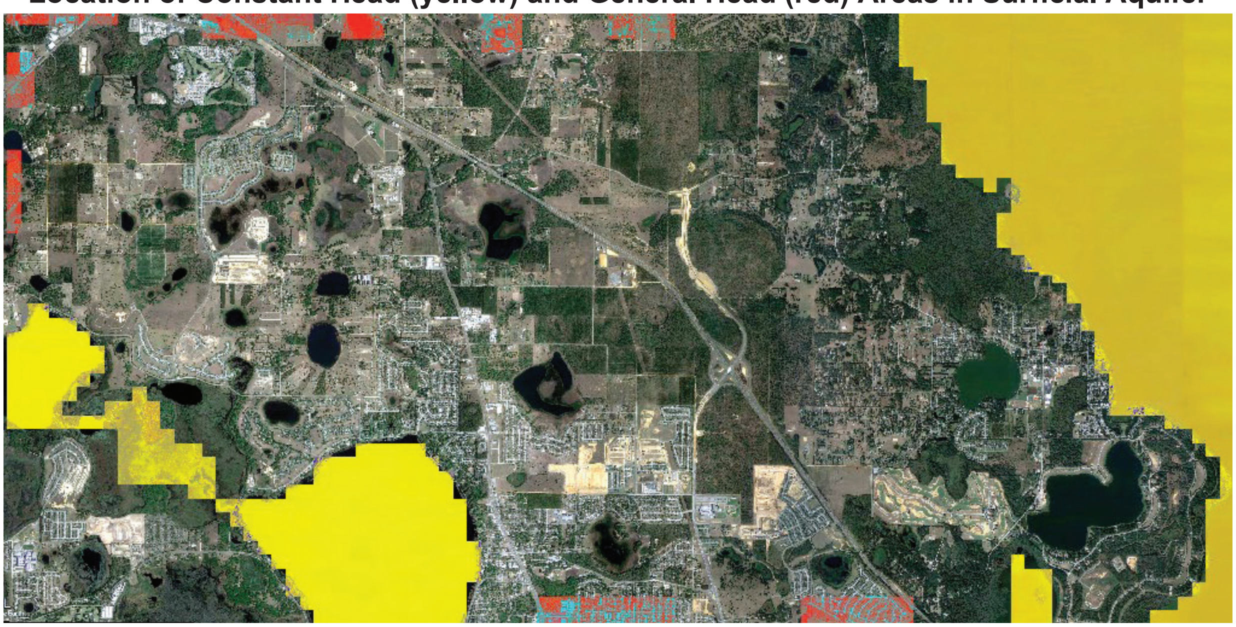
All 4 model layers of the ECF model were used in the zoomed in model and all model cells for all layers beyond the boundaries of this site were removed. Then the perimeter cells of the zoomed in model grid area were set to General Head Boundary (GHB) cells to allow calibration of the model with variable head conditions at the boundaries.

For the effective model area and specific needs to refine hydraulic features, the model area was divided into 63 rows and 104 columns. The model grid refinement within the model area was made to fit the various hydraulic features and the layout of the RIBs. The model cell widths varied from 625 feet along the perimeter and reducing down to 150 to 32 feet in the project area of the RIBs. The model grid area overlaid over the surrounding land features (lakes, wetlands, depressions and development area) are illustrated in the following screen capture from the model:

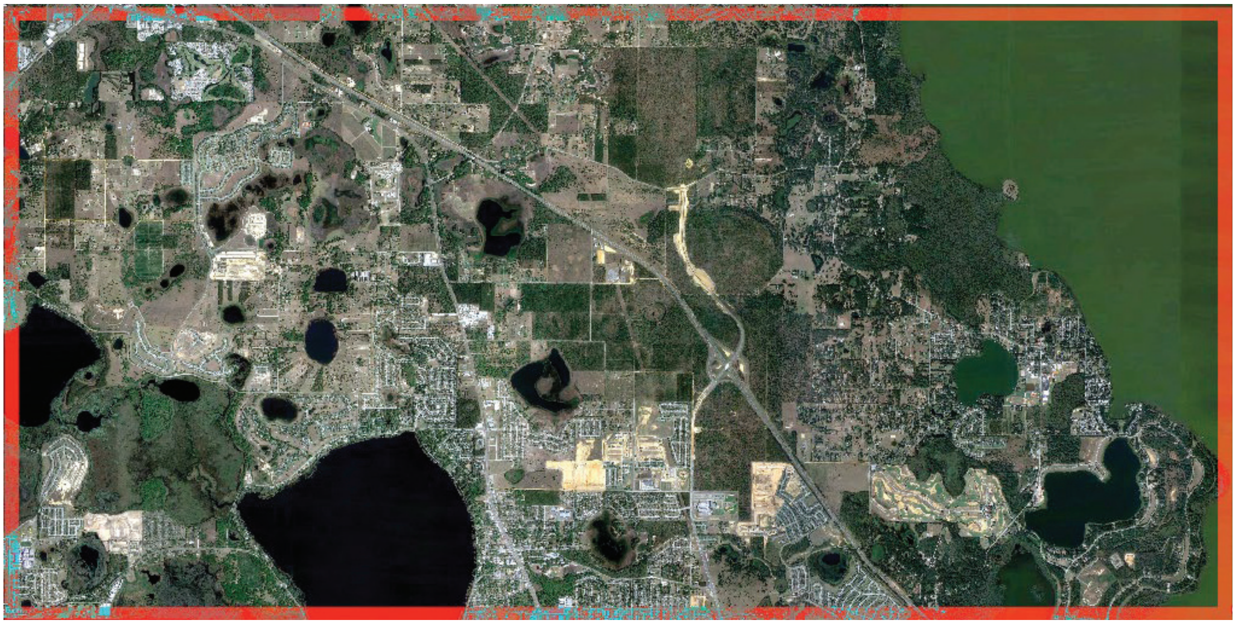
Effective Model Area and Variable Grid



Location of Constant Head (yellow) and General Head (red) Areas in Surficial Aquifer



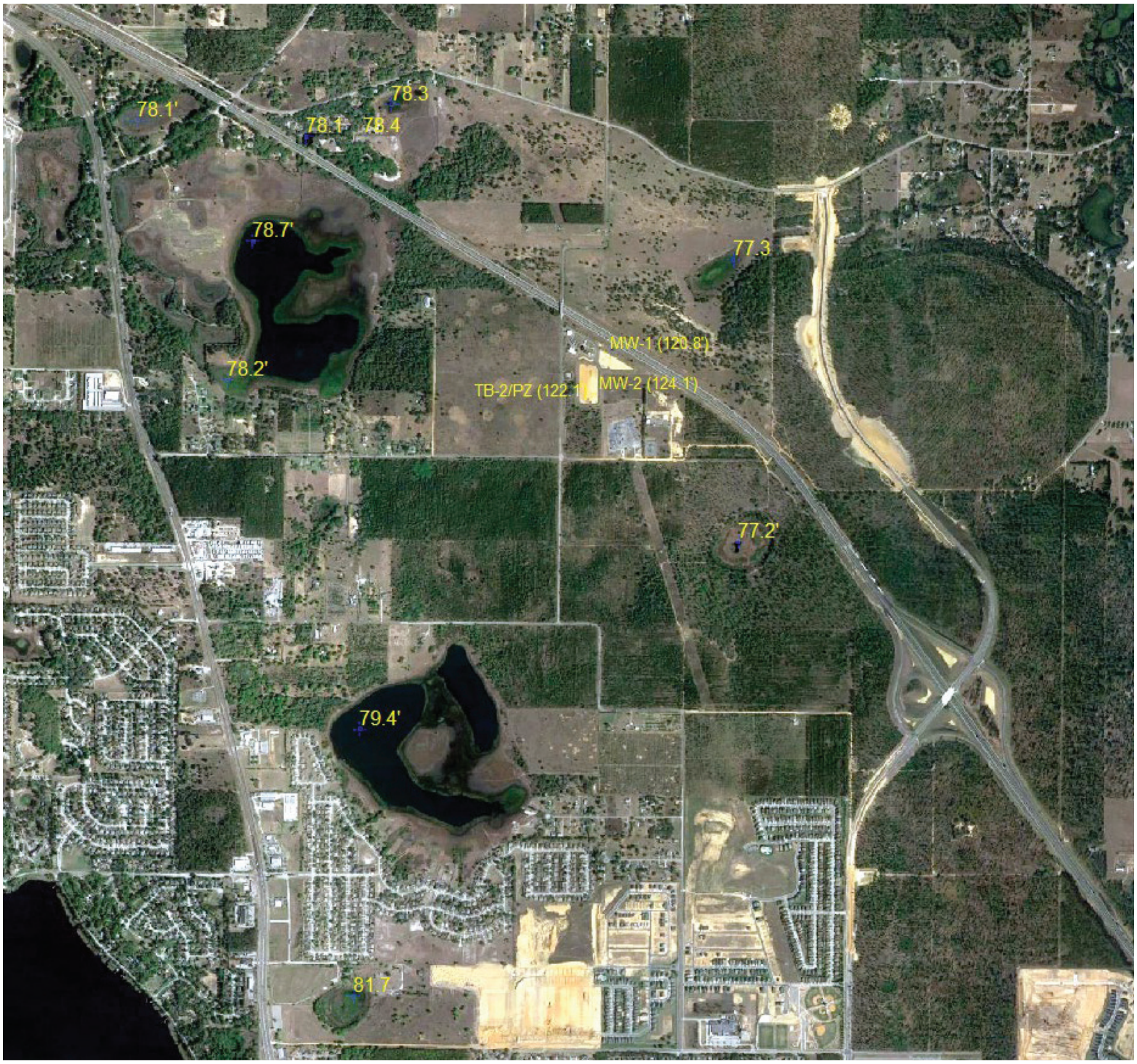
Location of General Head Boundary Areas in Upper Floridan Aquifer



Model Calibration to Site Specific Conditions

For this modeling effort we have reviewed the available site-specific data for the Minneola RIBs site. As part of the existing permit monitoring plan, two water quality monitoring wells were installed at the RIBs site to a depth of 150 feet below ground surface. In addition, two piezometers were installed to a depth of 50 feet below ground surface. Based on available of monitoring data, the two shallow monitoring wells remained dry throughout the monitoring period. Recorded groundwater levels in the deeper surficial aquifer monitoring wells (including mounding effects) were recorded at elevations 120.8 to 124.1 ft NAVD and are 107 to 110 feet below ground surface. Based on the flow records provided to us by the plant operators, the RIBs currently being loaded at an average long term (3-year average) rate of **0.341 MGD**.

To allow re-calibration of the regional model around the RIBs area, we have collected the recent groundwater elevations at the monitoring wells and piezometers and surveyed the water surface elevations of numerous lakes, ditches and depressions. The following map and table summarize the elevations of groundwater and surface water for model calibration:



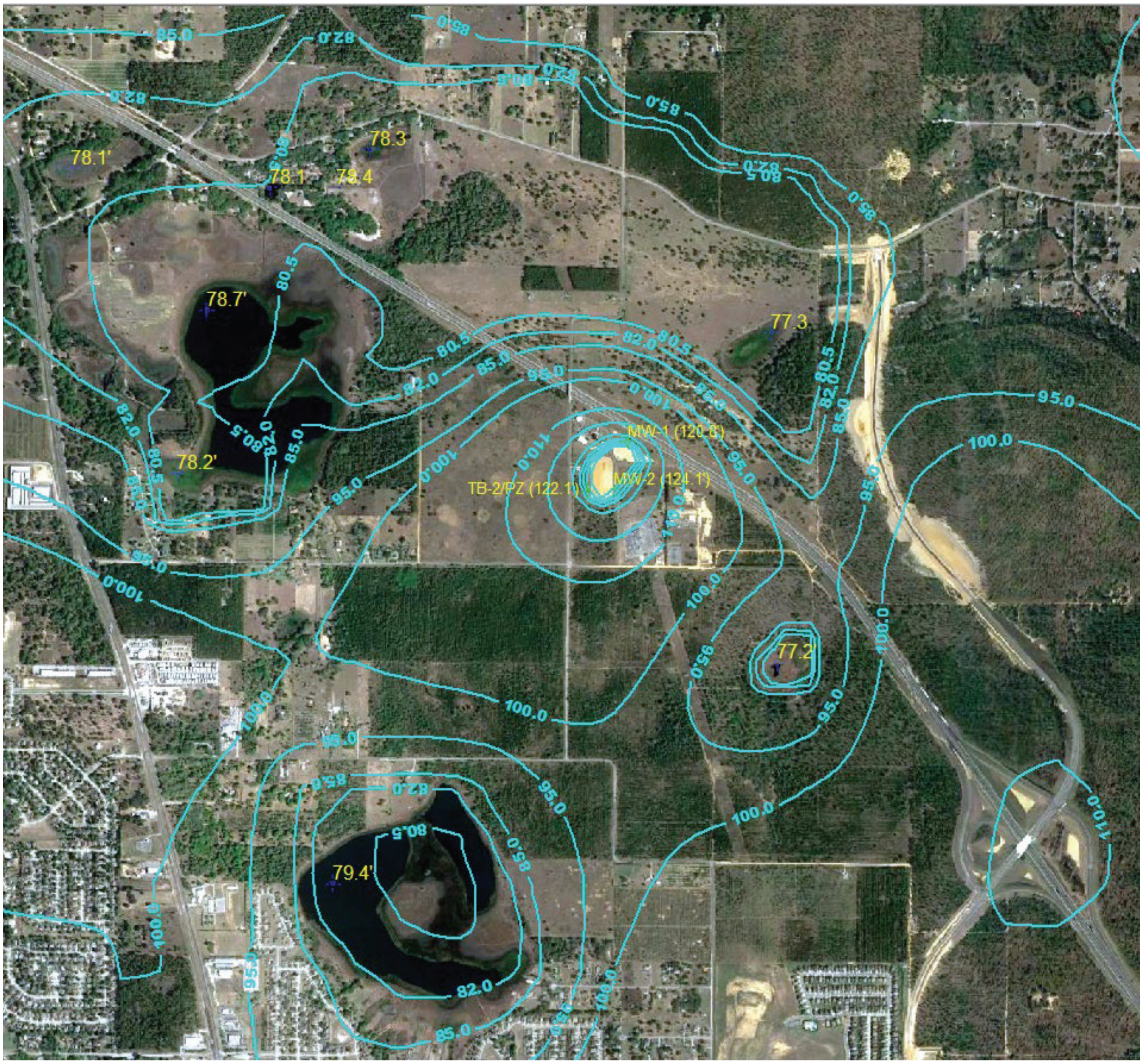
Surveyed Elevation of Surface Water and Groundwater			
Surface Water Locations	**Northing**	**Easting**	**Surface Water Elev. (NAVD88)**
Shepard Lake (SW) WL	1555804.184	414136.569	78.23
Camp Lake WL	1553678.425	422317.435	77.21
Teardrop Lake WL	1557958.842	422458.285	77.29
N of CR561 WL	1559901.491	413282.994	78.10
Lake View Drive WL	1559928.029	416742.391	78.34
Turnpike Pond WL	1559771.845	415578.826	78.41
Lake View Drive DITCH WL	1559750.68	416401.494	78.44
Shepard Lake (NW) WL	1559422.131	414558.823	78.74
Grassey Lake WL	1549630.037	416223.403	79.41
Little Grassey Lake WL	1546567.262	416498.466	81.68

Groundwater Point	Northing	Easting	Groundwater Elev. (NAVD 88)
MW-1 (4" well)	1556310.386	420354.407	120.77
MW-2 (4" well)	1555723.525	420173.97	124.10
TB2/PZ (1" PZ)	1555674.649	419763.292	122.06
MW-1A (2" well)	1555990.067	420452.835	dry
MW-2A (2" well)	1555700.299	420172.456	dry

The model calibration was based on approximate matching the groundwater elevations at the existing RIBs (loaded at 0.341 MGD for 3 years) and the surface water elevations around the project area, as surveyed and presented in the tables above. The calibration was set up with 2 stress period. Stress period 1 was set to steady state conditions to allow stabilization of the model. Stress period 2 was set to transient simulation to match the last 3 years (1,095 days) of RIBs loading at 0.341 MGD. The calibration approach was to simulate the site specific groundwater elevations as close to the observed levels as possible and to simulate the off-site surface water levels of lakes and depressions to conservative elevations, slightly above the recorded levels, to allow for potential rise of these levels due to long term fluctuations and wet weather conditions.

Numerous model runs were executed during the trial and error model calibration. The model was considered to be adequately calibrated when the on-site groundwater elevations were closely matched, and the off-site surface water levels were at 2 to 3 feet above the recorded levels. The following screen capture graphic presents the calibrated model groundwater contours in feet NAVD:

Regional Calibration Contours



Site Specific Calibration Contours

The following is a summary of the calibrated model parameters of horizontal hydraulic conductivity, K_h, leakance and storage coefficient:

Layer	Layer Description	K_h (ft/day)	Leakance (day^{-1})	Storage Coefficient
1	Surfical Aquifer	12.0 to 18.0	$5.4x10^{-5}$ to $1.0x10^{-2}$	0.15
2	Top of Upper Floridan Aquifer	500 to 750	$2.6x10^{-2}$ to $3.5x10^{-2}$	0.001
3	Bottom of Upper Floridan Aquifer	7,50 to 1,000	$5.7x10^{-5}$ to $2.7x10^{-4}$	0.001
4	Lower Floridan Aquifer	250	NA	0.0001

Modeling of Disposal Capacity and Wet Weather Storage Capacity of RIBs

Once the refined grid model was re-calibrated, it was used to evaluate the disposal capacity of the existing 2-RIB system for long-term loading (20 years) and short-term loading (14 and 30 day of wet weather storage and disposal).

For the long term annual average daily flow (AADF) simulation we modeled the two RIBs at the maximum loading rate of 5.6 gpd/ft^2. The model results indicate that the 2 RIBs will be capable of disposing effluent at the maximum rate of 5.6 gpd/ft^2, which translates to a total disposal capacity of the RIBs of **1.5 MGD AADF**.

The selected short-term loading scenarios were modeled for wet weather storage for 14 days and 30 days. The modeling results indicate that the existing 2-RIB-system at this site will be capable of storage and disposal of wet weather flows of **2.0 MGD and 1.75 MGD** for 14 days and 30 days, respectively. Due to the extremely deep groundwater conditions at this site and clean fine sand materials the groundwater mound will remain below the ground surface for all modelled scenarios. The model predicted groundwater elevations for the short term (14 days and 30 days) and long term (steady state) loading conditions are presented in a form of groundwater elevation contours in **Figures 5 through 7**.

The following table summarizes the long-term disposal capacity and the short-term storage and disposal of wet weather flows for the existing 2-RIBs system. Note that the direct storage of existing RIBs was estimated from project record drawings/as-built data and has not been surveyed for field verification:

Model Summary for Existing City of Minneola RIBs

Model Scenario	Infiltration & Storage (CFD)	Infiltration & Storage (MGD)	Maximum No. of days per year
Long Term Average Capacity	**202,165**	**1.51**	**365**
14 day Infiltration	202,165	1.51	
Direct Storage	67,225	0.50	
Total 14 day Capacity	**269,390**	**2.02**	**274**
30 day Infiltration	202,165	1.51	
Direct Storage	31,372	0.23	
Total 30 day Capacity	**233,537**	**1.75**	**316**

The modeling was conducted for continuous loading of the combined maximum effluent flows as presented in the table above. Although the actual loading for 14 days and 30 days may not occur consecutively during any one year, the modeling conservatively assumed that the wet weather storage will be continuously loaded for the full 14 days and 30 days. All GWV and MODFLOW files can be downloaded from the following Dropbox link:

https://www.dropbox.com/s/l1f5rv6ap4gs9xo/City%20of%20Minneola%20RIBs%20GWV%20%26%20MODFLOW%20Model%20Files.zip?dl=0

LIMITATIONS

This report has been prepared for the exclusive use of TetraTech, the City of Minneola, and their designers, based on our understanding of the project as stated in this report. This study was performed to assess the potential of the site for effluent disposal, to support a future proposed wastewater treatment facility at the site, which is only in preliminary planning stages. The explorations and evaluations for this study were performed in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made as to the professional advice presented herein.

CLOSURE

AEI appreciates the opportunity to participate in this project, and we trust that the information herein is sufficient for your immediate needs. If you have any questions or comments concerning the contents of this report, please do not hesitate to contact the undersigned.

Sincerely,

ANDREYEV ENGINEERING, INC.

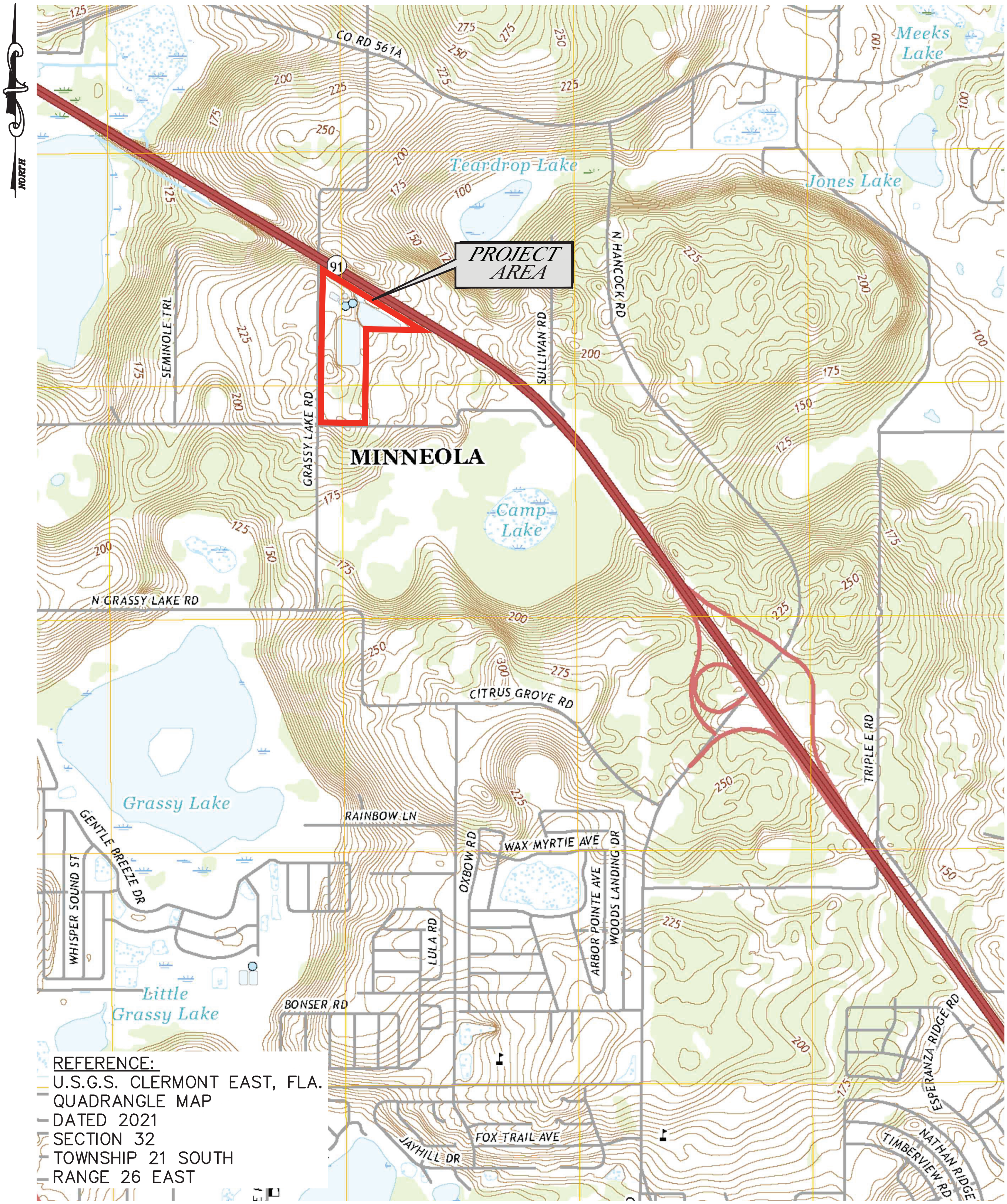
RAYMOND W. JONES
LICENSE
NO. 58079
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

Mark Livingston
Project Manager

Raymond W. Jones, P.E.
Vice President
Florida Registration No.58079

FIGURES

FIGURES



0 1000 2000 4000

GRAPHIC SCALE: 1"=2000'

Andreyev Engineering, Inc.

HYDROGEOLOGIC INVESTIGATION & GROUNDWATER MODELING SERVICES
RE-RATING & RE-PERMITTING
EXISTING RIBs
CITY OF MINNEOLA
MINNEOLA, LAKE COUNTY, FL

APPROXIMATE SCALE:	DATE: 03/31/22	ENGINEER: RJ	U.S.G.S. TOPOGRAPHIC MAP
1"=2000'	PN: GPGW-22-030	DRAWN BY: DLS	FIGURE 1

LEGEND:

9 CANDLER SAND, 5 TO 12% SLOPES
21 LAKE SAND, 0 TO 5% SLOPES
22 LAKE SAND, 5 TO 12% SLOPES

Andreyev Engineering, Inc.			HYDROGEOLOGIC INVESTIGATION & GROUNDWATER MODELING SERVICES RE-RATING & RE-PERMITTING **EXISTING RIBs** CITY OF MINNEOLA MINNEOLA, LAKE COUNTY, FL
APPROXIMATE SCALE:	DATE: 03/31/22	ENGINEER: RJ	N.R.C.S. SOIL SURVEY MAP
1"=300'	PN: GPGW-22-030	DRAWN BY: DLS	FIGURE 2

LEGEND:

⌖ APPROXIMATE LOCATION OF SPT BORING

0 150 300 600

GRAPHIC SCALE: 1"=300'

Andreyev Engineering, Inc.

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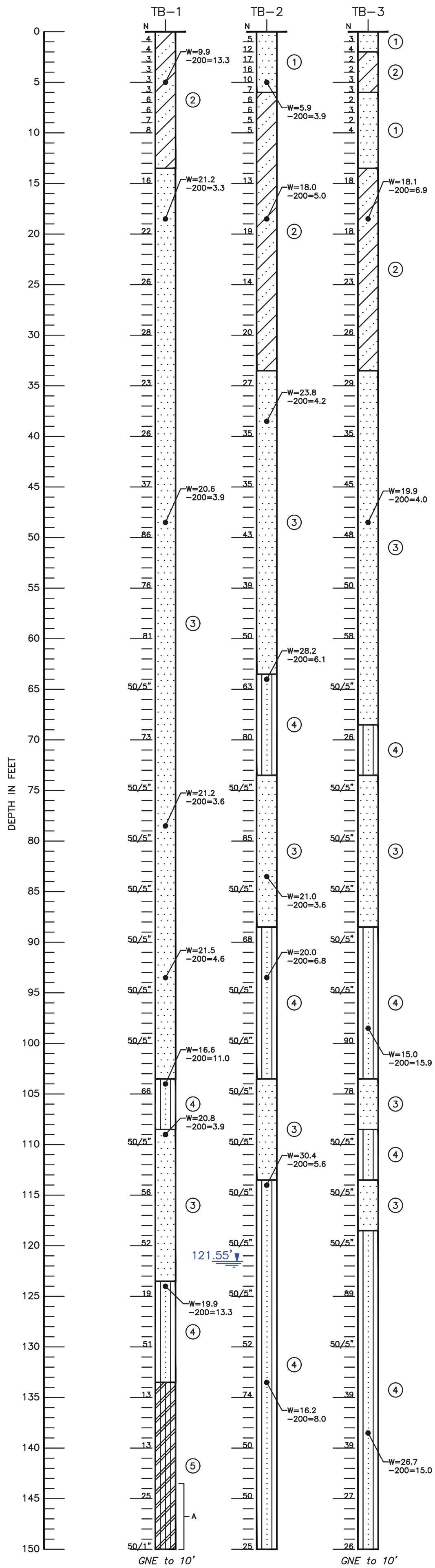
RE–RATING & RE–PERMITTING
EXISTING RIBs
CITY OF MINNEOLA
MINNEOLA, LAKE COUNTY, FL

APPROXIMATE SCALE:	DATE: 03/31/22	ENGINEER: RJ	BORING LOCATION PLAN
1"=300'	PN: GPGW–22–030	DRAWN BY: DLS	FIGURE 3



LEGEND:

(1) BROWN TO ORANGISH BROWN TO REDDISH BROWN FINE SAND (SP)

(2) ORANGISH BROWN TO REDDISH BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND (SP–SC)(SC)

(3) LIGHT BROWN TO LIGHT ORANGISH BROWN TO YELLOWISH BROWN TO LIGHT GRAY FINE SAND (SP)

(4) BROWN TO YELLOWISH BROWN TO GRAY TO LIGHT GRAY TO PINK SLIGHTLY SILTY TO SILTY FINE SAND (SP–SM)(SM)

(5) ORANGISH BROWN TO YELLOWISH BROWN SILTY CLAY (SM)(CL)

A WITH GRAVEL

(SP) UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL

GNE GROUNDWATER NOT ENCOUNTERED

N STANDARD PENETRATION RESISTANCE, IN BLOWS PER FOOT

50/1" 50 HAMMER BLOWS TO ADVANCE SAMPLING TOOL ONE INCH

1.0' DEPTH TO GROUNDWATER

W MOISTURE CONTENT, IN PERCENT

–200 PERCENT OF FINES PASSING THE U.S. No. 200 SIEVE

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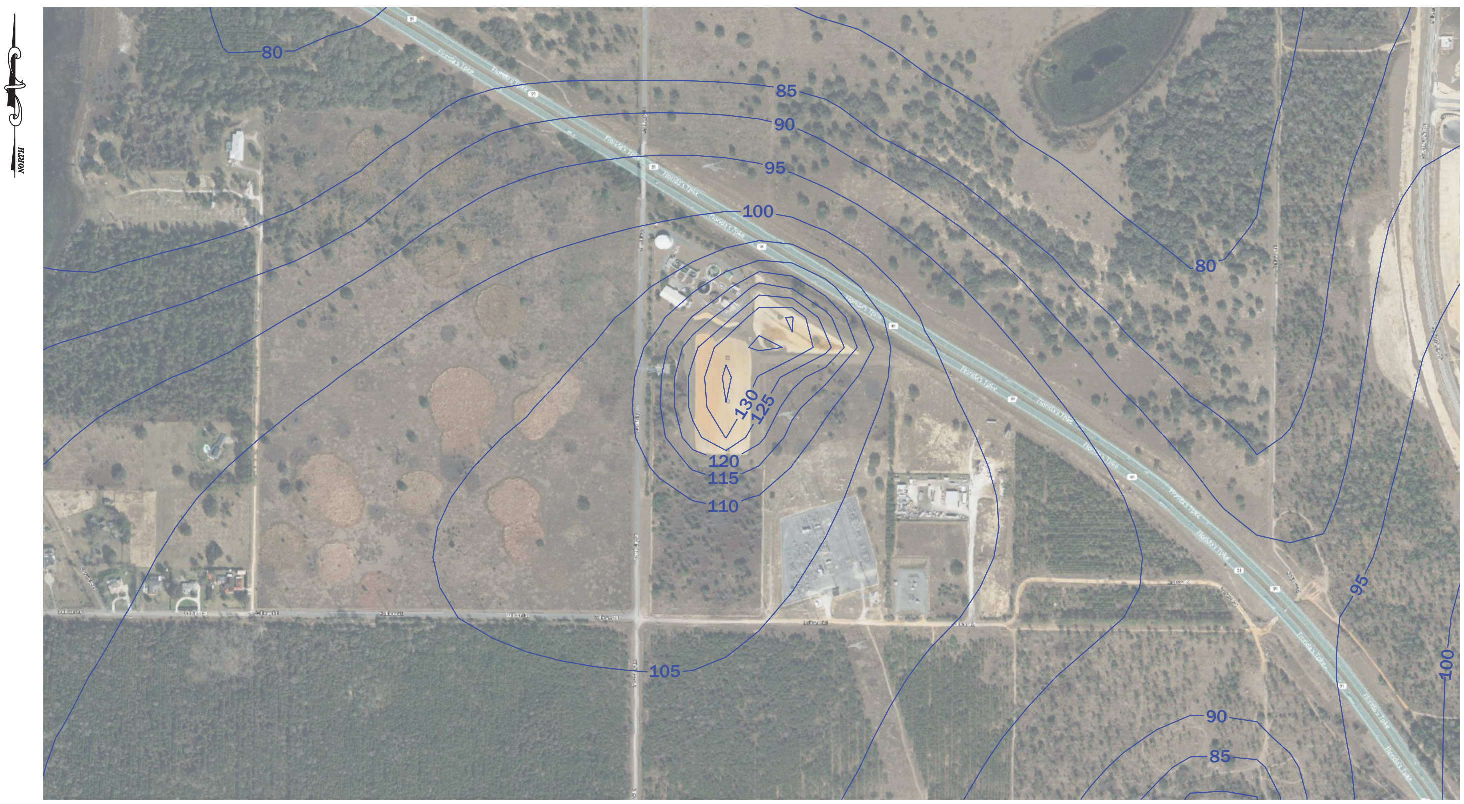
MINNEOLA, LAKE COUNTY, FL

APPROXIMATE SCALE: 1"=10'	DATE: 04/13/22	ENGINEER: RJ	SOIL PROFILES
	PN: GPGW–22–030	DRAWN BY: DLS	FIGURE 4



0 250 500 1000

GRAPHIC SCALE: 1"=500'

LEGEND:

GROUNDWATER ELEVATION CONTOURS (FT–NAVD) FOR EXISTING RIBS LOADING AT 2.00 MGD FOR 14 DAYS

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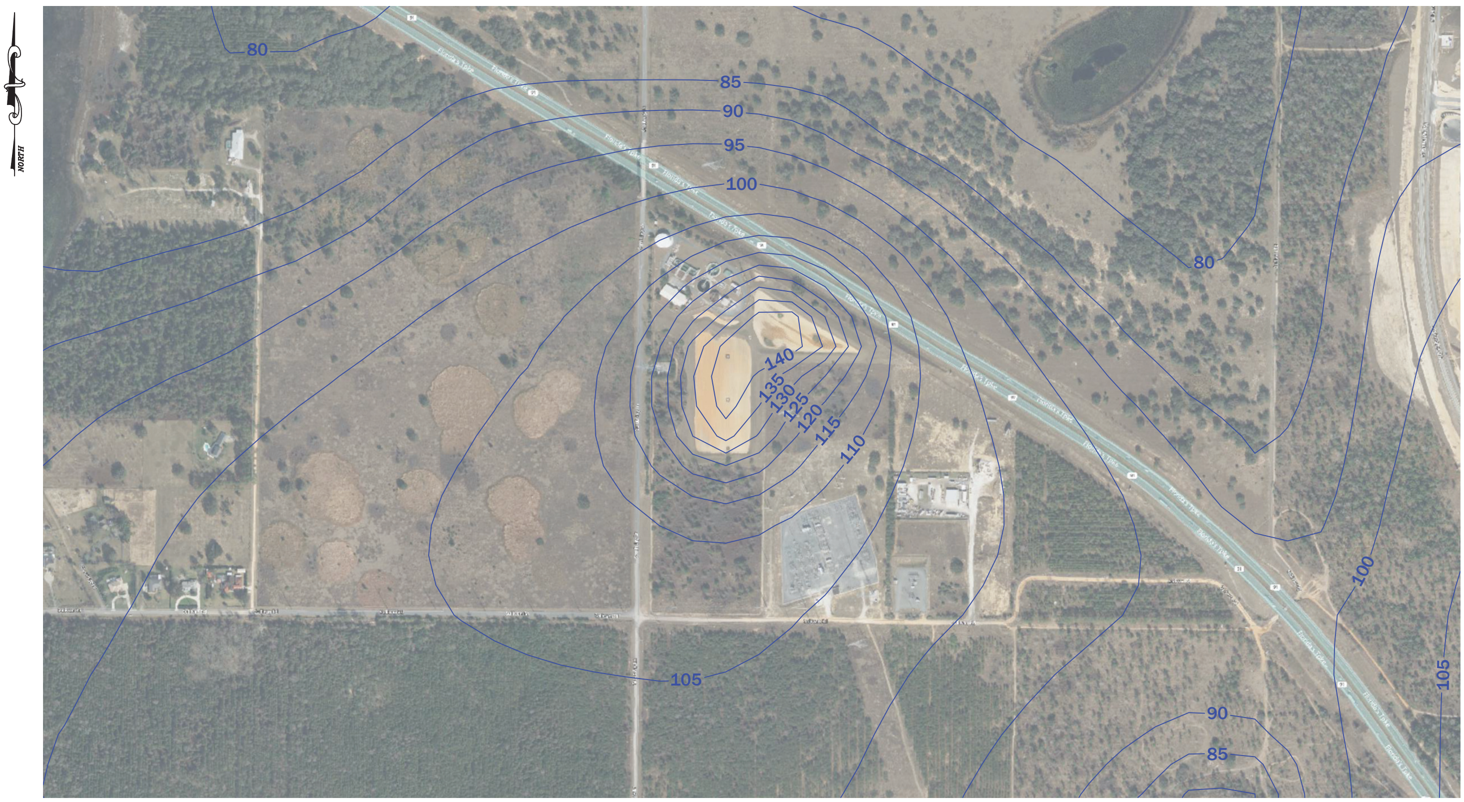
MINNEOLA, LAKE COUNTY, FL

APPROXIMATE SCALE: 1"=500'	DATE: 06/13/22	ENGINEER: RJ	GROUNDWATER ELEVATION CONTOUR MAP
	PN: GPGW–22–030	DRAWN BY: DLS	FIGURE 5



0 250 500 1000

GRAPHIC SCALE: 1"=500'

LEGEND:

GROUNDWATER ELEVATION CONTOURS (FT–NAVD) FOR EXISTING RIBS LOADING AT 1.75 MGD FOR 30 DAYS

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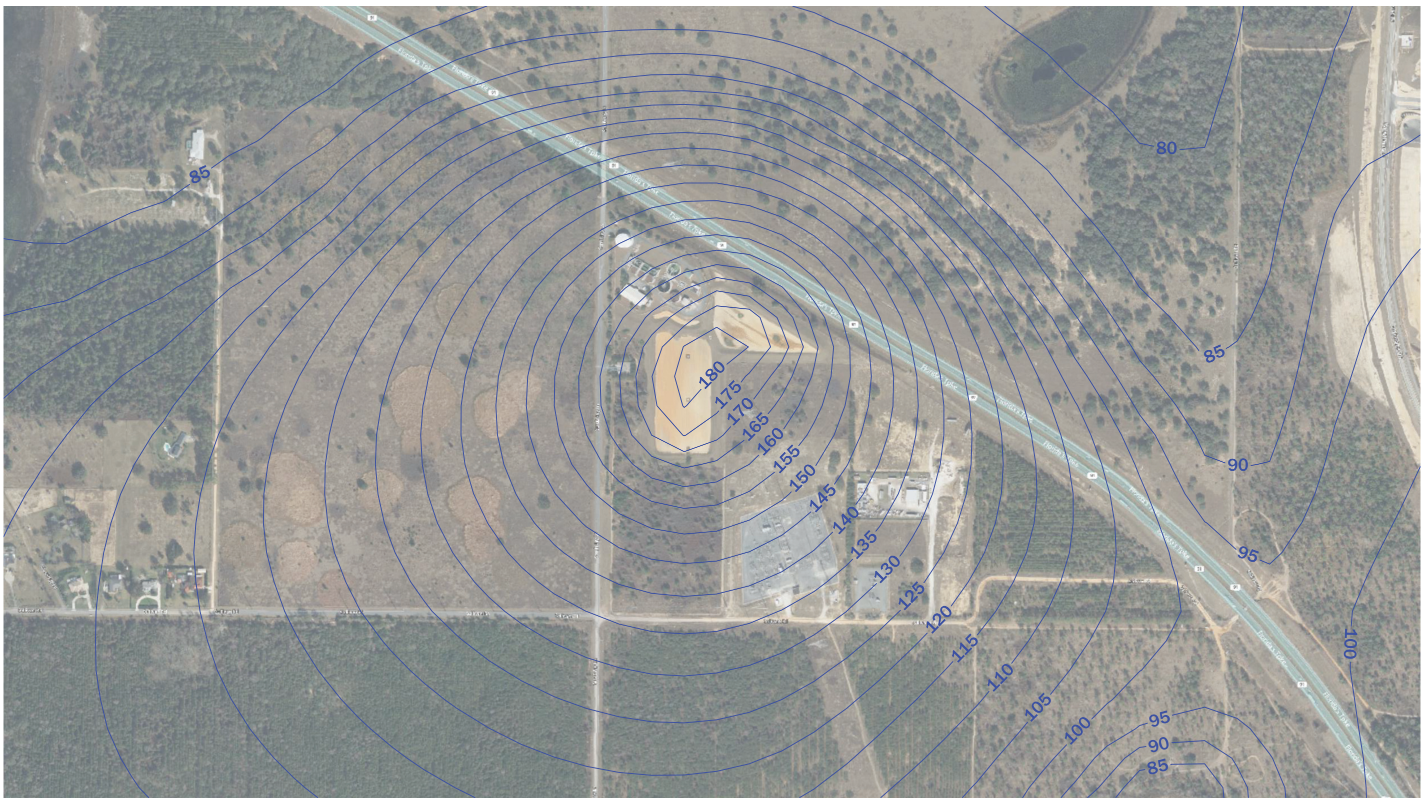
RE–RATING & RE–PERMITTING
EXISTING RIBs
CITY OF MINNEOLA
MINNEOLA, LAKE COUNTY, FL

APPROXIMATE SCALE:	DATE: 06/13/22	ENGINEER: RJ	GROUNDWATER ELEVATION CONTOUR MAP
1"=500'	PN: GPGW–22–030	DRAWN BY: DLS	FIGURE 6



NORTH

0 250 500 1000

GRAPHIC SCALE: 1"=500'

LEGEND:

GROUNDWATER ELEVATION CONTOURS (FT–NAVD) FOR EXISTING RIBS LONG TERM LOADING AT 1.50 MGD

Andreyev Engineering, Inc.

APPROXIMATE SCALE: 1"=500'	DATE: 06/13/22	ENGINEER: RJ
	PN: GPGW–22–030	DRAWN BY: DLS

HYDROGEOLOGIC INVESTIGATION & GROUNDWATER MODELING SERVICES
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EXISTING RIBs
CITY OF MINNEOLA
MINNEOLA, LAKE COUNTY, FL

GROUNDWATER ELEVATION CONTOUR MAP

FIGURE 7