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REPORT

December 2019

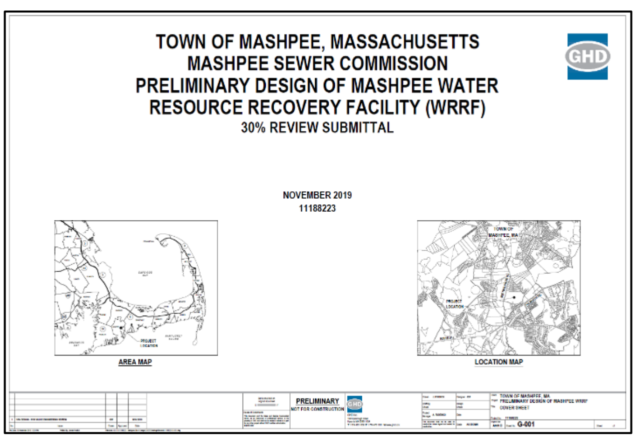
TOWN OF

Mashpee

MASSACHUSETTS

DRAFT

30% Preliminary Design
Value Engineering Report



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1.0 STUDY APPROACH AND OVERVIEW

The Town of Mashpee, Massachusetts initiated this Preliminary Design Value Engineering (VE) study of the 30% Design for the new Mashpee Wastewater Treatment Plant prepared by GHD to provide an independent review of the proposed project and identify and assess the potential benefits of design alternatives that could reduce project costs or otherwise add value, while maintaining the basic functional requirements, performance, and quality of the original design and meet the project intent.

The VE Team performed an initial review of the design documents to gain a preliminary understanding of the scope of the proposed project and developed a number of questions for GHD to help clarify the VE Team's understanding. The Design Team from GHD made a project presentation to the VE Team on the morning of December 3, 2019 that included an overview of the project's design progress at the time of the study, as well as project constraints, history, issues, goals, objectives, and discussion of the VE Team questions. The VE Team then conducted a separate session to review the information presented and brainstorm preliminary design alternatives. The VE Team then reconvened with GHD staff later that afternoon to ask more specific follow up questions relative to various alternatives identified to asses to what extent they had been considered and what the primary factors were that resulted in the proposed design elements. A site visit was subsequently conducted on December 13, 2019 by the VE Team to gather final site specific understanding and information before completing the study. The VE Study results and recommendations provided herein will be summarized in a presentation to the Town of Mashpee and GHD on January 23, 2020.

Value Engineering Study Premise and Objectives

For those unfamiliar with value engineering studies there are a few fundamental concepts of a VE study that are important to understand to avoid potential misunderstanding of the process or results. First, just because a value engineering study has been conducted and recommendations for changes to a given design have been made, one should not make the assumption that there is a problem with the existing design. It must be understood that a VE team works from a different perspective than does the design team. The VE Team's objective is to identify cost savings potential and value-enhancement opportunities by analyzing the function of a project in general and specific aspects and individual elements of the project. The VE team represents an independent opinion with the benefit of hindsight and with the ability to challenge given project scope requirements and even applicable codes and regulations or virtually any aspect of the proposed project basis. This freedom to initially "question anything and everything" is fundamental to a thorough unbiased study.

It should also be noted that VE studies can be performed on designs in various stages of development from preliminary (30 % design) as in this case, to near 100% design in some cases. For projects in the early stages some ideas will cover items that are in development and are subject to change as the design advances, thus causing the ideas developed in a VE of an early stage design in certain cases to be irrelevant. In addition, some ideas will be based on insufficient data, as the VE Team cannot be expected to know everything that the Design Team and project stakeholders know, partially due to limited time the VE Team has for its review. This in fact can in some ways be a benefit to the process as the VE Team is not encumbered by prior reasoning behind the design decisions that led to the proposed design and may revisit alternatives that were previously discussed from a new perspective.

VE studies are working sessions for the purpose of developing and recommending alternative approaches to a given project or project elements. As such, the results and recommendations presented are of a conceptual nature and are not intended as final design solutions. Detailed feasibility assessment and final design development of any of the ideas presented herein, should the project stakeholders accept them, remain the responsibility of the designer.

Project Summary Description

The purpose of the Wastewater Treatment Preliminary Design is to provide an environmentally and economically sound plan for wastewater treatment and nutrient management in the Town of Mashpee for the planning period 2016-2021. The project was developed based on assessment of the Town's wastewater management needs and desire to protect local environmental resources and included evaluation of appropriate mitigation measures to meet those needs to identify the current recommended plan for improved management systems.

The Town of Mashpee completed their Comprehensive Wastewater Management Plan (CWMP)/Watershed Nitrogen Management Plan (WNMP) in May 2015 and received their Massachusetts Environmental Policy Act (MEPA) compliance in July 2015. Significant portions of the Town currently rely on individual on site subsurface treatment systems for wastewater management. These systems provide limited attenuation of nutrients which are having a negative impact on local environmental resources. The Town is therefore proceeding with the preliminary design of a new wastewater collection and treatment system to convey and treat raw wastewater from parcels within the Mashpee River watershed currently served by on-site systems. The new treatment facility is to be located on land adjacent to the Town's landfill/transfer station.

The WNMP considers future growth through construction performed in 5 phases over a 25-year period to mitigate costs and disruption, allow for interim assessment and avoid overbuilding, and to allow time to assess the viability of adaptive management through shellfish propagation. Phase 1 is currently being analyzed at 30% preliminary design. Based upon the documents provided, it is understood that the major process components consist of preliminary treatment, secondary/tertiary treatment, ultraviolet effluent disinfection, sand beds for effluent recharge, and wet hauling of waste solid from the treatment process for disposal off-site. From the documents provided from the Design Team, both a preliminary treatment building and process building will be built to house all equipment and tanks. The preliminary treatment building will house all influent screening and grit removal equipment. All secondary treatment, effluent disinfection and related chemical systems and support equipment and process tankage will be housed inside a separate secondary treatment building. Both MBR and SBR based secondary treatment system technology were evaluated with the MBR being selected due to its smaller overall footprint and potential to remove a larger range of constituents. Odor control for the treatment building and process tanks will be provided by a biofilter. Four (4) sand beds will be constructed for effluent recharge. The

View of project site from the Mashpee Transfer Station.

biosolids will be stored in aerated, covered tanks and will be processed offsite. Based on the selection of the MBR based treatment approach the VE Team did not revisit an SBR based approach as part of this VE study, rather this study evaluated the MBR process as presented in the 30% design drawings and related basis of design memoranda.

Weston & Sampson conducted this VE study of the Mashpee WRRF from December 3, 2019 through December 20, 2019. On December 13, 2019, members of the VE Team and Design Team met to do a site visit. The 30% Phase I design plans and associated Basis of Design Memoranda formed the base design used by the VE Team in its study. These documents can be found in Appendix B.

Value Engineering Study Team and Design Team

Weston & Sampson's VE team for this review included the following individuals.

Name	Discipline/Role	Organization	Telephone
Kent, M. Nichols, Jr., P.E.	WWT Practice Leader	WSE	978-532-1900
Carl Stone, P.E.	Lead Process Engineer	WSE	978-587-1052
Corey Repucci, P.E.	Senior Project Manager	WSE	978-532-1900
Richard V. Peter	Regional Manager	WSS	508-945-5153
Graham Hines	Estimator	CMR	978-532-1900
Rebecca Mongada	Engineer	WSE	978-532-1900

GHD's design team involved in the review included the following individuals.

Name	Discipline/Role	Organization	Telephone
Anastasia Rudenko, PE	Project Engineer	GHD	774-470-1637
Lenna Quackenbush	Engineer	GHD	774-470-1654
Marc Drainville	Vice President	GHD	617-893-2484
Jeff Gregg		GHD	

2.0 ALTERNATIVES DEVELOPMENT AND EVALUATION

Creativity/Brainstorming

Subsequent to the initial summary presentation of the project by the Design Team and follow up discussions on December 3, 2019, the VE Team, reviewed the information further and as a group conducted a brainstorming session to identify any and all potential design alternatives, enhancements, suggestions and comments. The intent of the initial brainstorming was to generate as many ideas as possible across all aspects of the project without detailed evaluation or analysis unencumbered by any creativity-limiting conditions or boundaries. The VE Team generated 76 preliminary thoughts and ideas during from this brainstorming process that after further discussion and evaluation fell into the following "type" categories:

- Substantive design modifications/alternatives to existing design elements that could provide similar or improved functionality and performance at lower overall costs,
- Specific suggestions for additional design element not currently included in the design documents that could improve overall operability, and
- Observations relative to various Capital Cost estimate items based on our experience that may warrant review and revision of the current cost estimate.

The substantive design modifications became formal VE suggestions and are summarized in this section with detailed VE forms provided at part of the VE recommendations presented in Section 4. The specific additional design element suggestions are from an operator's perspective and generally are things that would not typically be reflected in documents at a 30% design level and therefore do not rise to the level of a VE Alternative to an existing design element. Nevertheless, these could add overall value and as such are presented as Design Suggestions in Section 5. Similarly, the observations related to the project capital cost estimate do not fall into the category of VE Alternatives but are nevertheless presented together with an overview of the project cost estimate in Section 3 for completeness of presentation and further consideration by the Design Team.

Evaluation

Following the brainstorming session and categorization of ideas, the team further developed the substantive design modification ideas into formal VE Alternatives which include summary descriptions of the current approach and proposed modifications, and qualitatively identified various pros and cons of each idea compared to its respective originally designed concept. The VE Team discussed the ideas and further defined each alternative concept and their associated advantages and disadvantages. As part of this evaluation process, some of the ideas in the initial brainstorming phase were withdrawn as the VE Team felt they did not meet the project function or provide significant added value. Of the 76 ideas originally generated, 69 ideas where thought to provide some value to the Design Team in one or more of 4 general categories: Capital Cost Savings, .

After further analysis of these, the VE Team concluded that some of the remaining ideas could potentially benefit the project design, but either could not be reasonably developed in the limited time with the information provided or the suggestion was more specific than could be expected to be included at a 30% design level. Consequently, these ideas have been described as Design Suggestions as they may be helpful when moving into final design. It was determined that 38 of the 69 ideas generated were Design Suggestions. These 38 design suggestions have no easily quantifiable cost implications but remain noteworthy to the results of the VE study and can be found in Section 5. Some of the design suggestions represent changes in design approach, re-consideration of criteria, and in some cases, modification of the project scope.

The remaining 31 ideas were evaluated and are being recommended by the VE Team. The detailed forms for the 31 recommendations can be found in Section 4.

Summary Tabulation of Recommended Alternatives & Associated Value Added Categories

The following table presents a tabulation of the ideas that developed into VE recommendations and identifies which of the 4 different value categories they provide benefit in.

Table 1. Recommendation Summary Table

No.	Description	Capital Cost Savings	O&M Cost Savings	Operational Improvement	Aesthetic Improvement
Ideas					
G-1	Flow Development			✓	
G-2	I/I Allowance			✓	
G-3	Private Property Connections		✓		
G-4	Groundwater Discharge Permit	✓			
S-1	Construction Access			✓	
S-2	Site Access			✓	
S-3	Routing CS Flows to the WWTF Site	✓			
S-4	Fencing Along Site Perimeter			✓	✓
S-5	Landscape Plantings				✓
S-6	Standby Generator Set(s)		✓		
PT-1	Screening Area	✓	✓		
P-1	Reducing Building Space	✓	✓		
P-2	Reduce Secondary Treatment Above Grade Building Footprint	✓			
P-3	Membrane Modules	✓		✓	
P-4	Shared Blowers	✓	✓		
P-5	Blower Monorail			✓	
P-6	Chemical Room			✓	
P-7	Chemical Feed			✓	
P-8	UV Disinfection	✓		✓	
B-1	Architectural – Duplicative Features	✓			✓
B-2	Control Room			✓	

No.	Description	Capital Cost Savings	O&M Cost Savings	Operational Improvement	Aesthetic Improvement
B-3	Restrooms			✓	
B-4	Building Architectural Finish (A Series Drawings)				✓
B-5	Architectural Roof Construction			✓	
B-6	Basement Height			✓	
T-1	Equalization Tanks			✓	
T-2	Combine EQ Tanks and Secondary Influent Splitter	✓		✓	
T-3	Distribution Structures - Grating	✓		✓	
T-4	Integrated WAS Sludge Holding Tanks	✓			
T-5	Sludge (MLSS) Storage	✓		✓	
T-6	Expanding Process Tankage	✓		✓	✓

VE Alternative Themes

Several of the ideas on a similar theme include deferring or postponing some proposed work to a later project phase. The phasing overall is a concept that can allow the town time to make better financial provisions for the long-term debt service to be incurred. As discussed, phasing can allow more time to plan needed capacity more closely, allow some additional communication on permit issues (including possible future limits), and to develop a better appreciation of the WWTF's likely long-term performance capabilities.

Another theme is to improve the combined use of tankage and spaces, such as combining the preliminary treatment effluent/secondary influent splitters and equalization tanks into a single structure. These types of examples can help to limit expenditures while not impacting overall process flexibility. Other themes include process idea modifications, suggested landscaping and site access.

We have also made a number of design suggestions – many of which can be moved directly into discussion with the Design Team, and offer opportunities for streamlining the project and some areas for needed review. These suggestions also offer some opportunities for interaction between the owner and Design Team on more detailed design issues.

Our Team hopes that our recommendation proves helpful to the Town of Mashpee and its Design Team in moving forward with a WWTF improvement project that emphasizes value for the costs expended and serves the phase I service area. As the design progresses, our team would be available to engage in a detailed VE effort for more fully developed design documents or to engage on issues of constructability and 'biddability' for the final project.

Presentation

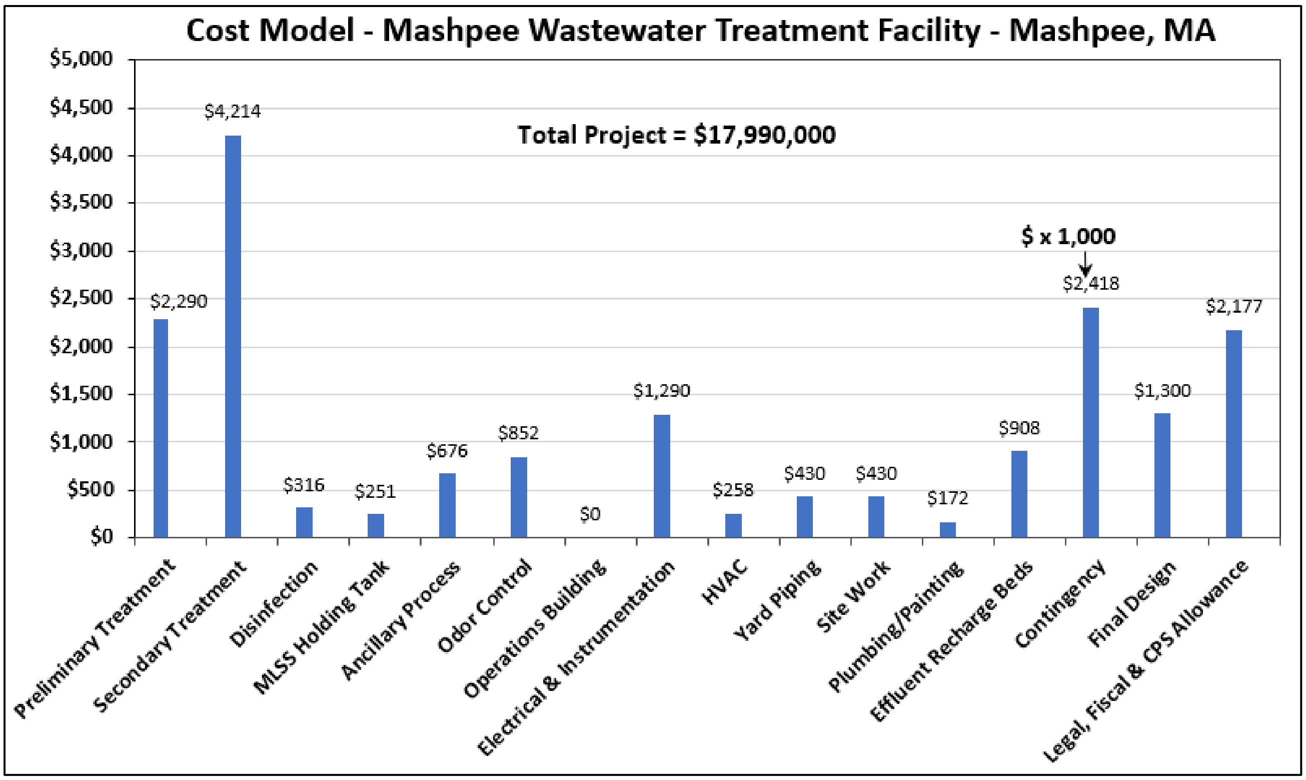
The VE Team will provide a final presentation to discuss the completed developed ideas and design suggestions. The presentation will include some sketches and cost discussion where appropriate to assist in explaining ideas in detail. This final presentation is scheduled for January 23, 2020 at the Sewer Commission Meeting.

3.0 PROJECT COST ESTIMATE REVIEW

Project Cost Estimate

As stated in Section 1.2, both MBR and SBR systems were analyzed and ultimately the Town selected the MBR process over the SBR process due to its lower costs, smaller overall footprint, and potential to remove a larger range of contaminants. As such the VE team has accepted the MBR based secondary process as the preferred approach and conducted the VE evaluations of the proposed MBR based system design.

The Engineer's Estimate of Probable Construction Cost prepared by the Design Team, dated November 2019, identified a total cost of $17,990,000 for a MBR system. The figure provides a summary of the cost model developed for the MBR process system.



The largest cost component identified by the VE Team in the cost model for the MBR process system was the secondary treatment at $4,214,000, which accounted for 23% of the total project costs. The other large cost items identified in the cost model are Preliminary Treatment, $2,290,000 (13%), Electrical & Instrumentation, $1,290,000 (7%), and the Effluent Recharge Beds, $908,000 (5%).

In general, the approximate $18 million appears to be a sufficient budget for the preliminary design projection. However, we have several questions and comments on various cost elements based on our experience with similar recent work that the Design Team may wish to consider further to determine if revisions to the costs are warranted. These are summarized below.

Preliminary Treatment

1. The earthwork quantity costs appear light.
2. The interior piping seems light given the need for spray water systems at multiple units and backflow preventers.
3. Further analysis of structural and architectural budget may be warranted as they appear to be light.

Secondary Treatment

1. What are the values for the covers? Are they walk on type?
2. Is there an install factor for the monorail and hoist?
3. Aeration system blower cost appears to be low.

UV Disinfection System

1. The concrete work given the channel design may be light.

Sludge Storage

1. This is based off a lump sum.
2. The covers are shown as $40/square foot. What type are they?

Ancillary Equipment

1. The Plant Water system price seems low and no capacity is noted.
2. Pricing for the 1,000-gallon Micro C and other 55-gallon and 100-gallon systems are priced similarly and may not accurately reflect system size differences.
3. $10,000 for lab equipment allowance was stated. What does this include?

Effluent Recharge

1. Piping price seems low at $80/ linear foot of 12-inch ductile iron piping.

Additionally, there are a few more items that could drive costs up but are recognized as difficult to quantify at this point. These include:

- Increased transportation costs due to location on the cape, both from the added time to get to site and seasonal traffic.
- Decreased bid competitiveness due to the very busy market.
- Increased labor costs due to the scarcity of skilled labor and the use of less skilled tradespeople.
- Increased material costs from tariffs and possible AIS requirements if SRF or other federal funds are used.
- Potential geotechnical issues as no geotechnical information is available.

4.0 VE RECOMMENDATIONS

Definition of VE Recommendations

Details of the identified VE Alternative recommendations for the 30% design identified through this study are provided in the individual forms at the end of this section. Value Engineering Recommendations, by definition, attempt to satisfy the function or purpose of a specific aspect of the project in an alternative manner. The goal is to accomplish the function without sacrificing the underlying purpose or basic function being provided by that aspect of the project.

Organization of VE Recommendations

Each recommendation is documented by a separate write-up that includes a description of the original design concept and the recommended change to be further evaluated, a list of advantages and disadvantages and preliminary range of potential economic impact of the recommendation is included where data allowed.

Acceptance of VE Recommendations

Each of the VE Alternatives presented here are recommended for further consideration by the Design Team and Town. The potential value and whether that value in light of any other specific significant factors that may exist but were not identified here warrants incorporation into and revision of the current design approach.

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Weston & Sampson

Process Area/Category: Flow Development	Idea No. G-1	Page No.
TITLE: Flow Development	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT:

Design flows for the facility are based on Phase 1 flows of 120,000 gpd Average Daily, 312,000 gpd Max Month, 360,000 gpd Max Day and 648,000 gpd Instantaneous Peak. A ratio of 2.6 is used to project the Max Month flow from the Max Day flow. Currently, Oak Bluffs is used as an example in estimating peaking due to its expected comparable seasonal peaks.

ALTERNATIVE CONCEPT:

The developed flow basis appears to be conservative. The use of Oak Bluffs for estimated peaking emphasizes seasonal peaks, which are common on the Vineyard, may be less intense in the Phase 1 service areas. We recommend checking against actual info on seasonality in the service area. Also, use of factors more akin to Chatham may be appropriate. While this conservatism does not necessarily present a design problem, conservatism will result in under-estimating the number of properties that could be served by the initial phase – ultimately making the project look less affordable to local voters. In any event, using the higher peaking factors must be adjusted as the facility grows (e.g. the 2.6 peak factor is less applicable for the much larger Stage 4 design flows).

ADVANTAGES:

- Use of the most appropriate flow development methods will best reflect the number of properties that can be served by each phase. When estimating costs to residents (e.g. user charges), these numbers will be important.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M. Nichols, P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Process Area/Category: Flow Development	Idea No. G-2	Page No.
TITLE: I/I Allowance	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Based on TM M-1, it appears that the 120,000 gpd includes an allowance for infiltration/inflow (I/I). This flow rate is then peaked to determine Max Month, Max Day and Peak flows.

ALTERNATIVE CONCEPT:

The flow numbers including I/I appear to have been peaked with sanitary flows. Traditionally, I/I allowances in newer pipelines should not be subjected to the larger peak factors used for sanitary flows. Check to ensure that the flow calculations are adjusted for appropriate I/I estimates.

ADVANTAGES:

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Weston & Sampson

Process Area/Category: Private Property Connections	Idea No. G-3	Page No.
TITLE: Private Property Connections	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The Town will need to coordinate property connections to the collection system. Inspection of these service connections on private property should be considered.

ALTERNATIVE CONCEPT:

The Town should consider who will be doing the inspection of private property connections, and will need to add provisions for inspections to the new sewer regulations.

ADVANTAGES:

- Improved quality control and coordination of service connections.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Process Area/Category: Groundwater Discharge	Idea No. G-4	Page No.
TITLE: Groundwater Discharge Permit	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The Town has not yet filed for their Groundwater Discharge Permit (GWDP). A load test has been completed and DEP has done a review. GHD has met with Brian Dudley of DEP, but have not gone back through design with DEP.

ALTERNATIVE CONCEPT:

The final design of the site and discharge sand beds is dependent on the final GWD Permit to be issued by DEP. The loading rate of 7 gpd/sf shown in TM SB1 requires DEP concurrence as it exceeds the guidelines for sand beds (5 gpd/sf). Any changes in the permitted loading rates will affect the site layout plan, and therefore need to be confirmed as soon as practicable.

The GWD Permit is a crucial step in assuring site suitability for the project. We strongly recommend that the design team obtain DEP approval of the Hydrogeological Report to be filed with the GWDP prior to significantly advancing project design. A failure to obtain the GWDP for the site may make the site less usable, so design steps should proceed only cautiously until the GWDP is issued by MA DEP.

ADVANTAGES:

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design	Weston & Sampson	
Process Area/Category: Site	Idea No. S-1	Page No.
TITLE: Construction Access	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY
Site access to the project site is limited to one entrance off of Carleton Drive for construction work.

ALTERNATIVE CONCEPT:
Site access should be further considered as Carleton Drive in the entrance/exit proposed for construction is a narrow, winding road. A detailed traffic management plan should be prepared, and potential traffic calming/controls may be useful (such as high level warning/construction access lights).

ADVANTAGES:
- Site access safety during construction should be improved.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design		Weston & Sampson	
Process Area/Category: Site Access		Idea No. S-2	Page No.
TITLE: Site Access		Weighted Total:	
		Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The permanent site access to the project site is planned to use the transfer station entrance off of Asher's Path East. This access will be shared with the transfer station operations, and includes a gate at the entrance on Asher's Path.

ALTERNATIVE CONCEPT:

Site access should be further considered. Coordinating access with the Transfer Station and contract operators may present challenges to the WWTF operations. Arrangements for deliveries and visitors on days when the transfer station is closed will need to be thought out. A remote access system may be required.

We suggest considering a separate access entrance off of Asher's Path closer to the fence line with the WWTF site. Traffic to the WWTF site will be significantly less than traffic to the transfer station. Keeping these accesses separate will simplify both operations.

ADVANTAGES:

- Avoid complications that may result from deliveries, personnel access and security.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design		
Process Area/Category: Collection System/WWTF Site	Idea No. S-3	Page No.
TITLE: Routing CS Flows to the WWTF Site	Weighted Total: Ranking:	

ORIGINAL CONCEPT:

The general concept allows for an influent pump station on the site of the WWTF. The general thought is to bring a gravity sewer into the WWTF site, and then lift at the proposed influent pump station.

ALTERNATIVE CONCEPT:

Consider locating the influent pump station remotely from the site to reduce the amount of gravity sewer line that needs to be constructed to reach the site. In general, gravity lines should only be built where they are needed for sewer services to abutting properties, and where excavation depths are not excessive.

ADVANTAGES:	**DISADVANTAGES:**

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: K. Nichols

Discipline: Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design		Weston & Sampson	
Process Area/Category: Site		Idea No. S-4	Page No.
TITLE: Fencing Along Site Perimeter		Weighted Total:	
		Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The current site drawings do not show a clear plan for fencing around the WWTF.

ALTERNATIVE CONCEPT:

Fencing should be provided along the perimeter of the site. To save on cost, the existing fence may be used where practical. A completely fenced, secure site is needed, with gate access that can be locked when the plant is not attended.

ADVANTAGES:	DISADVANTAGES:
• Provides required site security.	

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M. Nichols, Jr., P.E.	**Discipline:** Wastewater Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design		Weston & Sampson
Process Area/Category: Site	Idea No. S-5	Page No.
TITLE: Landscape Plantings		Weighted Total: Ranking:

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The current plans show landscape plantings intended to provide "low and dense" visual cover. These are planned to provide improved year-round screening of the WWTF from surrounding neighborhoods.

ALTERNATIVE CONCEPT:

In general, the concept of clearing then planting may not be the most appropriate in all places. This is particularly true for the first few years after construction, when new vegetation is growing in, and is less robust than existing growth. Plantings proposed along the tree line on the northwest side of the plant site may be better located on the inside (near the plant) than outside the 50 ft buffer. Also, verify the limit of clearing and intent in this area, as the drawings seem to conflict on what is to be cleared. We discourage 'cutting a swath' through existing trees just to do plantings. It may be best to spot locate these plantings based on actual sight lines to maximize the visual screening effect.

ADVANTAGES:	**DISADVANTAGES:**
• Less construction impacts to existing vegetation.	

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M. Nichols, Jr., P.E.	**Discipline:** Wastewater Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design	Weston & Sampson	
Process Area/Category: Site	Idea No. S-6	Page No.
TITLE: Standby Generator Set(s)	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The standby generator set is currently located by the biofilter and future pump station in drawings C-003 and C-004.

ALTERNATIVE CONCEPT:

Locate the standby generator set(s) in the area northwest of the Preliminary Treatment Building, closer to the electrical room (where we assume the main switchgear will be located). Also, identify plan location for the main service transformer to serve the site – this may need to be located along the road, Asher's Path, to provide required power utility access.

ADVANTAGES:

- Saves cost on conduit and heavy wire.
- Reduces susceptibility of these important power feeds to damage from work (e.g. repairs) on yard piping.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Carl Stone., P.E.

Discipline: Wastewater Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design	Weston & Sampson	
Process Area/Category: Preliminary Treatment	Idea No. PT-1	Page No.
TITLE: Screening Area	Weighted Total: Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Currently, the plans on drawing M-100 show two stage screening, with three micro strainer units for the preliminary screening process.

ALTERNATIVE CONCEPT:

Consider 2 larger fine screens as second stage screening, rather than three units. Initially, one larger screen (sized for Stage 1 and 2 flows) may be installed with spare parts and motors on the shelf.

Consider long term disposal of grit and screenings. Will the operators need to combine these into a dumpster for disposal hauling? If so, that dumpster needs to be protected against odor release. Consider a single commercial roll-off unit located in this building.

The design team should consider simplifying and compressing the channel layouts. Concretes channels and gratings are expensive to build. The design team should look into simple square channel pours to keep formwork and reinforcing cost-effective.

ADVANTAGES:

- Initially buying one unit and stocking spare rotating assemblies for quick repair would save cost in initial phase
- Greater savings would be realized with less concrete channel work, slide gates, gratings and ancillary systems, and a reduced building footprint

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design	Weston & Sampson	
Process Area/Category: Process Building	Idea No. P-1	Page No.
TITLE: Reducing Building Space	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Drawings M-200 through M-202 shows a building space over the anoxic and aeration process tanks, incorporated as part of the process building.

ALTERNATIVE CONCEPT:

We understand the town's goal is to enclose the plant as much as possible to improve aesthetics and odor control. It does appear that this goal can be achieved with some limited changes to the building as depicted. The process trains as planned can be turned perpendicular to the buildings, and the building only extended over the membrane segments and permeate pump room. The remaining tankage can be buried outside the building, with hatches for access. This will greatly reduce building footprint, save significant capital costs, and save in heating/ventilating costs. The building over these tanks offers limited advantages, and presents challenges. The outside aesthetics can be improved with good design and landscape approaches (e.g. gass or plantings over the tankage), and a smaller building will have a lower overall aesthetic impact on the area (especially for distant sightline neighbors).

ADVANTAGES:	**DISADVANTAGES:**

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M. Nichols, Jr., P.E.	**Discipline:** Wastewater Process

VE CONCEPT

Project: Mashpee WWTP 30% Design

Process Area/Category: Process Building	Idea No. P-2	Page No.
TITLE: Reduce Secondary Treatment Above Grade Building Footprint	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

All major wet stream processes and equipment are housed in buildings. One smaller for headworks and one larger for the secondary process tankage and equipment, including chemical systems. The proposed design encloses all headworks and secondary process tanks inside building reportedly to minimize visual impacts and odors. All Secondary process tanks are also equipped with covers to minimize odor control air handling. Secondary process buildings include significant vertical height to accommodate a mezzanine for additional future blowers.

ALTERNATIVE CONCEPT:

Alter secondary process tanks layout to include a “pipe/equipment” gallery between the MBR tanks and the Post Anoxic Tanks to house more equipment below grade and build a building over only the equipment gallery and MBR tanks with a single bridge crane and hatches to access all equipment. Also build out from the western most tank and progress the gallery and building with the phased expansion approach instead of building the whole building under the initial phase. Below grade gallery could include a tunnel to the waste sludge holding tanks and a below grade blower room for them.

ADVANTAGES:

- Significant Reduction in Building footprint and height reducing visual impact of building mass, HVAC, lighting and other associated building needs.
- Tank Covers will be low to the ground and less visible from surrounding residences.
- Single all purpose bridge crane in lieu of current multiple bridge crane approach.
- Take greater advantage of residual heat from blowers for mechanical equipment space heating.
- Provides protection from weather and more stable temperature for equipment.
- Spreads building costs more equitably across construction phases.
- Common wall construction and footprint could reduce overall concrete volumes and excavation.

DISADVANTAGES:

- Less favorable for winter access to aeration and anoxic tank equipment if needed.
- Exposed Tank covers may not be as aesthetically appealing as a building. More industrial.

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Carl Stone, P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Weston & Sampson

Process Area/Category: Process Building	Idea No. P-3	Page No.
TITLE: Membrane Modules	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The drawings M-200 and M300 show two membrane modules for each Stage, and we understand the assumption is one would not be out of service for "no more than a day" to meet the design conditions.

ALTERNATIVE CONCEPT:

We recommend reviewing this approach, as redundancy for membranes should generally provide for a longer "out of service" period. Using two larger membrane sets, or adding a third smaller cartridge should be considered in the initial stage. As stages progress, fewer additional "separate" membrane racks/cartridges may be used (for example using larger cartridges may be effective as the plant capacity is increased).

ADVANTAGES:

- Membranes designed for appropriate "out-of-service" periods will allow more effective operation.
- Initial membrane sizing should be selected to allow the best initial unit equipment pricing.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTP 30% Design

Weston & Sampson

Process Area/Category: Process Building	Idea No. P-4	Page No.
TITLE: Shared Blowers	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Current design in drawings M-400, M-401 and M-402 employs separate blower systems for Secondary process tanks, EQ tanks and WAS storage tanks.

ALTERNATIVE CONCEPT:

1. Provide fewer blowers with a shared distribution system and controls for different tanks. As a minimum, the standby duty blowers should be multi-purposed. The ultimate number of blowers should likewise be reduced. As process air needs grow, use of new appropriately-sized, and possibly larger, blowers should replace some of the duplication.

ADVANTAGES:

- Reduced number of blowers overall for maintenance.
- Potential smaller building footprint and or height to house blowers.

DISADVANTAGES:

- Possible need for additional control valves and DO or air flow meters for control.
- Larger blower elements require larger hoisting equipment.

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Carl Stone, P.E.

Discipline: Wastewater Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design		Weston & Sampson	
Process Area/Category: Process Building		Idea No. P-5	Page No.
TITLE: Blower Monorail		Weighted Total:	
		Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Drawing M-400 through M-402 provide information on the proposed monorail in the middle of the Blower Room.

ALTERNATIVE CONCEPT:

The monorail in this room seems to suggest limited functional use (it is shown to be located over the piping headers below, not the blowers). Ensure that the lifting system is suitable for the maintenance needs. If a monorail is not useful, consider alternatives. For example, the additional cost of a bridge crane may be justified, and should be reviewed.

ADVANTAGES:	**DISADVANTAGES:**

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Process Area/Category: Process Building | Idea No. P-6 | Page No.

TITLE: Chemical Room | Weighted Total: | Ranking:

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Drawing M-400 through M-402 provide information on the Chemical Room. The current plan includes a chemical fill station, citric acid storage tank, chemical pumps, sodium hydroxide storage tank and hypochlorite storage tank. Control panels line the opposite side of the wall for supplemental carbon, citric acid, sodium hydroxide and sodium hypochlorite.

ALTERNATIVE CONCEPT:

The chemical room should be rethought to allow for the use of totes and drums, with provision for bulk fill stations only where that is economically supported. Suggest a wider room with a garage door access for a fork truck to allow bringing totes and pallets into the areas. Also, plan for separate secondary containment for each chemical in their discrete areas. Ensure enhanced separation between reactive chemicals to improve operator safety.

ADVANTAGES:

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design		Weston & Sampson	
Process Area/Category: Process Building		Idea No. P-7	Page No.
TITLE: Chemical Feed		Weighted Total:	
		Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The systems called for in TM M10 suggest small storage amounts for hypochlorite, citric acid, and hydroxide. The preliminary plans show outside feed stations for bulk delivery for each chemical.

ALTERNATIVE CONCEPT:

The plans show a feed station for bulk delivery, but the likely chemical use volumes will likely make bulk delivery uneconomical. Suggest planning for a larger door (garage door type) and drum handling/storage space for these chemicals. Access for a fork lift or pallet jack system is recommended.

The Micro C storage suggest a likely tote delivery method. Consider a tote handling and storage area in place of bulk delivery. The design team should verify delivery options for Micro C and design accordingly.

ADVANTAGES:	**DISADVANTAGES:**

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M. Nichols, Jr., P.E. | **Discipline:** Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Weston & Sampson

Process Area/Category: Process Building	Idea No. P-8	Page No.
TITLE: UV Disinfection	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The plans currently show open channel for their UV disinfection on drawings M-600 and M-601.

ALTERNATIVE CONCEPT:

The open channel UV system is unnecessarily complex and costly for this plant. As all the effluent comes from the permeate pumps, use of a simplified pipe manifold and two (or more) enclosed pipe UV disinfection vessels is appropriate. With this approach, a separate room is not needed, and the UV units can be located in the lower level pump room.

ADVANTAGES:

- Reduce building footprint and space costs.
- Saves significant concrete work and costs.
- Improves operator safety (less opportunity for exposure to UV light).

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Carl Stone., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Process Area/Category: Process Building	Idea No. B-1	Page No.
TITLE: Architectural - Duplicative Features	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

In drawings M-200 and A-200, two long corridors and two large stairwells are shown inside the process building.

ALTERNATIVE CONCEPT:

The two long corridors do not serve as functional space. One can be deleted completely from the floor plan. Some of the building space assigned to corridor can possibly be repurposed.

One of the two large stairwells can be maintained, and on can be replaced with a simpler secondary egress stairs. The spaced allowed for one stairwell is likely sufficient for the two separated stairs.

ADVANTAGES:

- Building footprint can be reduced.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Weston & Sampson

Process Area/Category: Process Building | Idea No. B-2 | Page No.

TITLE: Control Room

Weighted Total:

Ranking:

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

In drawings M-200 and A-200, a room labeled "Office" is shown in the Process Building.

ALTERNATIVE CONCEPT:

Consider changing the "Office" shown in the Process Building to be a "Control Room". The plan does not otherwise provide a place for the head end SCADA to be viewed and operations manuals, records, etc. to be available for operator troubleshooting. A desk in this space and file storage may be supplemental uses for the space as well.

ADVANTAGES:

- Combine "Office" Space and SCADA system space into one room.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design		
Process Area/Category: Process Building	Idea No. B-3	Page No.
TITLE: Restrooms	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The drawings M-200 & A-200 show a single restroom with one access in the Process Building.

ALTERNATIVE CONCEPT:

We recommend consulting formally with the local Building Department as to requirements for separate men's and women's toilet facilities, and related code requirements. If two restrooms are needed in the initial building, then the plans should be adjusted for the required space. Provisions are needed for a shower area, and in a smaller facility this may be best set up as a separately accessed room.

ADVANTAGES:

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M. Nichols, Jr. P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design			
Process Area/Category: Architectural	Idea No. B-4	Page No.	
TITLE: Building Architectural Finish (A Series Drawings)		Weighted Total:	
		Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The preliminary design drawings include cedar shakes, horizontal cement board and many translucent panels to make the buildings appear more aesthetically pleasing to neighbors/residents.

ALTERNATIVE CONCEPT:

Consider siding and materials carefully during design. The combination of cedar shakes, horizontal cement board and many translucent panels may not result in the desired appearance - it may look more industrial than residential. As a minimum, reducing the enclosed tankage (as discussed elsewhere) should allow the elimination of a good number of the larger translucent panels. The overall aesthetic look of the building should be improved, and the smaller size have less total impact.

ADVANTAGES:

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design		Weston & Sampson
Process Area/Category: Architectural	Idea No. B-5	Page No.
TITLE: Architectural Roof Construction	Weighted Total:	Ranking:

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

The Cost Estimate notes buildings to be reinforced masonry structures with wood trusses. Current building costs are set at $195/square foot. Architectural finishes show cedar shake.

ALTERNATIVE CONCEPT:

The building materials cited in TM A1 should be evaluated for cost effectiveness. For roof construction, metal truss with pre-insulated panel decking should be considered in place of the wood construction. For walls, cedar shakes and masonry require significant on-site labor. Different alternatives should be considered. The current building costs seem reasonable, but the blower room has a “second level mezzanine” and is not a typical single-story structure. The extra wall height and vertical structure for this building may warrant higher cost for portions.

ADVANTAGES:

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M. Nichols, P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Weston & Sampson

Process Area/Category: Process Building	Idea No. B-6	Page No.

TITLE: Basement Height	Weighted Total:
	Ranking:

ORIGINAL CONCEPT:

The elevations shown on drawing M-202 shows a floor to floor elevation difference of 9'-6" for the lower level/pump room.

ALTERNATIVE CONCEPT:

Check with structural design group before planning the building elevations in this area. The floor under the blower room will need to be supported by significant beams to support the blower area dead and live loads. The floor and beams must be accounted for in allowing a ceiling height sufficient for portable lifting equipment in the basement pump room. It is likely this elevation will need to be greater – more likely 12' floor to floor.

ADVANTAGES:	DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M. Nichols, P.E. | **Discipline:** Wastewater Process

VE CONCEPT **Project:** Mashpee WWTF Preliminary Design		Weston & Sampson	
Process Area/Category: Process Tankage		Idea No. T-1	Page No.
TITLE: Equalization Tanks		Weighted Total:	
		Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Drawing M-001 through M-003 provides locational information on where the equalization (EQ) tankage will be placed.

ALTERNATIVE CONCEPT:

No detail is provided on the equalization tank. Please review to ensure that adequate (greater than minimum) equalization is provided in the equalization tank system. The equalization tank has functional importance and is significant in the hydraulic flow of the plant.

ADVANTAGES:

- Adequate EQ tankage will improve plant operability, and can mitigate sizing needs for peak daily flows.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Process Area/Category: Process Tankage	Idea No. T-2	Page No.
TITLE: Combine EQ Tanks and Secondary Influent Splitter	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Current design on drawings C-008 and M-850 includes one preliminary treatment splitter, to two separate secondary treatment influent splitters, and two separate equalization tanks.

ALTERNATIVE CONCEPT:

Combine preliminary treatment effluent/secondary influent splitters and equalization tanks into a single structure built in two phases. Build common wall tanks with a plan for EQ and secondary treatment splitting tanks, as needed.

ADVANTAGES:

- Some reduction in concrete work through common wall construction.
- Some reduction in piping and gates/valves.
- Reduced site footprint and less excavation.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Carl Stone., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Weston & Sampson

Process Area/Category: Process Tankage	Idea No. T-3	Page No.
TITLE: Distribution Structures - Grating	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Drawing M-850 shows that the current plan for covering the distribution structures is grating.

ALTERNATIVE CONCEPT:

The primary and secondary distribution structures appear to show grating. Consider solid covers to improve odor containment. Consider precast concrete for the smaller primary structure.

ADVANTAGES:

- Solid covers will improve odor containment.
- Precast structures will reduce cost and construction disturbance.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	$	$	$
Alternative Concept	$	$	$
Additional Savings	$	$	$

Team Member: Kent M. Nichols, Jr., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTP 30% Design

Weston & Sampson

Process Area/Category: Process Tankage	Idea No. T-4	Page No.
TITLE: Integrated WAS Sludge Holding Tanks	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Current layout includes WAS (MLSS) storage tanks constructed separately from secondary process tanks.

ALTERNATIVE CONCEPT:

Extend secondary process tanks to include WAS (MLSS) tanks, using common wall construction. Could employ air lift waste pumps or perhaps waste by gravity from MBR tanks using control valve and level sensor.

ADVANTAGES:

- Common wall construction will save construction disturbance and costs.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Carl Stone, P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design	Weston & Sampson
Process Area/Category: Process Tankage	Idea No. T-5 / Page No.
TITLE: Sludge (MLSS) Storage	Weighted Total: / Ranking:

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

Currently, the plans show two tanks that are sized for sludge (MLSS) storage from just Stage 1 flows on pages M-004 and M-800.

ALTERNATIVE CONCEPT:

The configuration of sludge (MLSS) holding tanks seems to differ on these sheets. Review the volume and tank configuration plan for efficiency.

Consider building two larger sludge storage tanks, sized for Stage 1 and 2 flows. As a minimum, if you build tanks 1.1 and 1.2 as separate, tank 2 can later be built without separation. It may be worth building tanks 1 and 2 initially, and not separating these tanks into halves. The result will increase volume and save concrete, piping, valves and instruments, without sacrificing functionality.

Also, TM M7 shows sludge blowers for Stage 1 with 2 in operation, and one backup. Consider one duty and one backup. Also consider possible shared backup blowers with alternate process.

ADVANTAGES:

- Save construction costs and allow more efficient mixing/aeration of MLSS storage.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Carl Stone., P.E.

Discipline: Wastewater Process

VE CONCEPT

Project: Mashpee WWTF Preliminary Design

Process Area/Category: Process Tankage	Idea No. T-6	Page No.
TITLE: Expanding Process Tankage	Weighted Total:	
	Ranking:	

ORIGINAL CONCEPT: PROCESS AREA/CATEGORY

It appears that the redundancy assumptions for Stage 1 (two trains, so one can be taken out of service) have been translated through each construction stage without considering the cumulative redundancy effect.

ALTERNATIVE CONCEPT:

The tankage/process sizing needs should be reviewed in detail. As shown, it appears that building all of the Stage 2 tanks can actually serve both Stage 2 and 3 flows. Ultimately, the plan showing two trains per stage (eventually 8 total stages) seems to assume half the tanks out of service – which is excessively conservative. This needs careful review, as an excess number of small tanks will not likely provide for the most efficient process operation.

ADVANTAGES:

- Possible significant reduction in ultimate tankage needed.
- Less construction disturbance, total plant footprint, and cost.
- Reduced aesthetic impact.

DISADVANTAGES:

COST SUMMARY	Initial Cost	O&M LCC	Net Present Value
Original Concept	**$**	**$**	**$**
Alternative Concept	**$**	**$**	**$**
Additional Savings	**$**	**$**	**$**

Team Member: Kent M Nichols, Jr., P.E.

Discipline: Wastewater Process

5.0 DESIGN SUGGESTIONS

The following are the various thoughts and suggestions for design elements that we believe warrant consideration to enhance long term operations and maintenance. Many of these are likely already anticipated by the design team but not typically sufficiently defined to be depicted in a 30% design level set of documents as provided for this VE review. We offer them only for design team consideration as they move forward with the detailed design process.

1. Access road curves and turns will need to be adequate for large vehicles (i.e. Vactor, 10 wheel and 18 wheeled vehicles).
2. The sand beds will need access ramps for maintenance vehicles (i.e. Tractor and York Rake).
3. Suggest adding flushing water connections to chemical feed piping header for maintenance/repairs and safety.
4. Drawing M-006 – A provision for a plant water flow meter may want to be considered.
5. Drawing M-100 – it is suggested that the screening room have a wash/yard hydrant.
6. Drawing M-200 – It is suggested that an office/lab building be constructed for the operators. Also, a parts storage and work area with bench is also highly recommended.
7. Drawing M-200 – To help with pump, blower, and mechanical equipment removal, ramps are suggested for outside of the double doors in the corridor.
8. Drawing M-200 – It is suggested that the chemical room have a dual entrance with glass windows in the doors.
9. Drawing M-201 – Is crane access to the lower level provided to allow pump removal/installation as opposed to carrying equipment up and down the stairs?
10. Drawing M-202 – It is suggested that a UV module storage/maintenance rack with wash water and drain availability.
11. Drawing M-300 – All submersible mixer/pump slide rails should be welded after installation into one continuous piece. We have experienced slide rail disassembly after installation. All slide rail systems should be constructed of stainless steel.
12. Drawing M-300 – Have the process tanks accessible for cleaning/maintenance with apparatus such as a Vactor or scavenger truck.
13. Drawing M-300 – Are the fine bubble diffusors removable from the tanks for cleaning and maintenance?
14. Drawing M-300 – A loading dock is suggested if possible.
15. Drawing M-400 – The plans show only one membrane air compressor. Is redundancy planned?
16. Drawing M-400 – Consider portable gantry vs the Monorail for potential cost savings and to avoid potential for misalignment. If monorails are not lined up properly, they can be more of a hinderance.
17. Drawing M-402 – Verify plant water system plumbing isolation for repairs etc.

18. Drawing M-500 – It is suggested to have water flushed mechanical seals. Use town water with BFP.
19. Drawing M-500 – Are MLSS flow meters to be provided?
20. Drawing M-500 – For UV bulb dip cleaning, Dry anhydrous citric acid will be needed.
21. Drawing M-600 – Electric crane is recommended for UV module removal.
22. Drawing M-600 – UV trough weir with gate valve to flush UV channel may want to be explored, as we have experienced problems with finger weirs.
23. Drawing M-600 – Explore the idea of potentially have the UV module cleaning tank drain back to the headworks.
24. Drawing M-700 – Specify proper PVC pipe/cleaner and adhesives matched to the chemical being used. Sodium Hypochlorite leaks are common due to improper glue/cleaner/primer being used.
25. Drawing M-700 – Spare chemical feed pumps are suggested. Plan currently show one each.
26. Drawing M-701 – Will chemical storage tanks have level indicators such as ultrasonic units? M-701 – MBK
27. Drawing M-701 – It is suggested to install floor drains in the chemical room for emergency shower drain and clean-up.
28. Drawing M-800 – MLSS tank diffusor header pipe supports are suggested to be stainless steel.
29. Drawing A-050 – it is suggested that all entrance doors be chemical resistant fiberglass as opposed to aluminum (Chem-Pruf or equal).
30. Drawing A-050 – Currently, the door awning material is wood. For longer life, consider Azek.
31. Drawing A-050 – Recommend operations building be in phase 1.
32. Drawing A-050 – Provide baffles for gable end louvers to protect from wind blow rain.
33. Drawing E-001 – A permanently installed natural gas or diesel emergency generator load bank is indicated. An option would be a receptacle on the generator main disconnect for ease of hooking up a portable load bank periodically (i.e. annually during generator PM work).
34. Drawing E-001 – Consider dual electric grid feeds.
35. Drawing E-001 – Consider bypass contactors for VFD's.
36. Drawing I-001 – Consider SCADA text capabilities as a back-up to the primary voice calls for alarms.
37. What are the hoists and lifting eyes attached to? Structural steel may be required.
38. Will a Gas Detection system be added?

APPENDIX A

Basis of Design Memo – Index of Memoranda

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
	Anastasia Rudenko PE, BCEE, ENV SP		774-470-1637
CC:	Mashpee Sewer Commission		

Subject: **Basis of Design Memo - Index of Memoranda**
Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design

1. Purpose of Memo

The purpose of this memo provides an Index of the Technical Memoranda for this project. These memoranda are intended to represent design basis and decisions, and are intended to be updated throughout the design project to reflect/document the current approach.

2. List of Memoranda

Table 2.1 Title

Index	Subject	Date
G-0	Index of Memoranda	11/19/2019
G-1	General Information	11/19/2019
M-1	Design Flows and Loads	11/19/2019
M-2	Treatment Goals	11/19/2019
M-3	Hydraulic Profile	11/19/2019
M-4	Preliminary Treatment	11/19/2019
M-5A	Secondary Treatment Technology Selection	11/19/2019
M-5B	Membrane Biological Reactor	11/19/2019
M-6	UV Disinfection	11/19/2019
M-7	MLSS Waste Storage	11/19/2019
M-8	Ancillary Equipment	11/19/2019
M-9	Odor Control	11/19/2019
M-10	Chemicals	11/19/2019
A-1	Architectural	11/19/2019
E-1	Electrical	11/19/2019

Table 2.1 Title

Index	Subject	Date
H-1	Heating, Ventilation, and Air Conditioning	11/19/2019
I-1	Instrumentation	11/19/2019
S-1	Structural	11/19/2019
SB-1	Sand Beds	11/19/2019
ENV-1	Environmental Design Criteria	11/19/2019
FP-1	Fire Protection	11/19/2019
PRM-1	Permitting	11/19/2019
SUS-1	Sustainability Design Features	11/19/2019
SW-1	Site Work	11/19/2019
CS-1	Cost Summary	11/19/2019
PSE-1	Preliminary Sequence of Expansion	11/19/2019

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
	Anastasia Rudenko PE, BCEE, ENV SP		774-470-1637
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo - G-1 General Information** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to summarize general information for the design of the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts. The memo contains the following information:

- Project Description
- Terminology
- Codes, Standards and References
- Room Names and Classifications
- List of Commonly Used Acronyms

2. Project Description

This project is the preliminary design of a new Water Resource Recovery Facility (WRRF) in Mashpee.

Construction of the proposed WRRF was recommended in the Mashpee Watershed Nutrient Management Plan (WNMP) to address the nitrogen impacts to the Town's two major coastal embayments primarily from existing individual septic systems and existing privately owned and operated wastewater treatment facilities. A phased approach is proposed for the facility, allowing future expansion to address the flows identified in the WNMP and the Flows and Loads Basis of Design Memorandum for this project.

The proposed collection system to serve this new facility will primarily convey raw wastewater flow from parcels within the Mashpee River watershed to the Mashpee WRRF. Following advanced treatment (including nitrogen removal), effluent will be recharged within the same watershed through open sand beds proposed at the site.

The location of the WRRF is off of Asher's Path in Mashpee next to the existing transfer station.

3. Terminology

The following are terminology that will be used for the Mashpee Site 4 project:

Mashpee Water Resource Recovery Facility: This will be the name used to refer to the facility on the site that was previously named Mashpee Site 4. This terminology will be used per the Water Environment Federation (WEF) adoption of the term in 2012.

Biosolids: This term will be used to refer to the nutrient-rich organic materials that result from the treatment of domestic waste at a water resource recovery facility. This terminology will be used per the WEF adoption of the term in 2011. The term “Waste MLSS” will also be used interchangeably with biosolids.

Microconstituents: The WEF defines microconstituents as “natural and manmade substances, including elements and inorganic and organic chemicals, detected within water and the environment for which continued assessment of the potential impact on human health and the environment is a prudent course of action.” This term will be used to replace previously used terms including, contaminants of emerging concerns (CECs) and micro-pollutants. This terminology will be used per the WEF adoption of the term in 2007. The term “contaminants of emerging concern” will be also used interchangeably with microconstituents.

4. Codes, Standards and References

The following Codes, Standards and references have been adopted for this project.

4.1 Building Code

- The Massachusetts State Building Code – 9th Edition, 2018
- The Architectural Access Code (521 CMR)
- Environmental Protection (310 CMR)
- Water Pollution Control (314 CMR)
- Massachusetts State Fuel Gas and Plumbing Code (248 CMR)
- Massachusetts State Fire Prevention Code (527 CMR)
- Massachusetts State Electrical Code (527 CMR 12.00)
- Massachusetts State Sanitary Code (105 CMR)
- International Mechanical Code (IMC-03)
- International Fire Code (IFC-03)
- International Energy Conservation Code (IECC-03)
- National Electrical Code – NFPA 70
- ICC/ANSI A117.1 – Accessible and Usable Buildings and Facilities

4.2 Fire Codes

- International Fire Code (IFC-03) - 2018 Edition
- NFPA 70 National Electric Code
- NFPA 72 National Fire Alarm Code
- NFPA 101 Life Safety Code
- NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities – 2020 Edition

4.3 References

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016
- Water Environment Federation; "Design of Municipal Wastewater Treatment Plants"; WEF Manual of Practice No 8; Fifth Edition; 2010
- Tchobanoglous, George; Burton, L. Franklin; Stensel, H. David; "Wastewater Engineering: Treatment and Reuse"; Metcalf and Eddy, Inc.; Fifth Edition; 2014
- Final Recommended Plan / Final Environmental Impact Report – Town of Mashpee Sewer Commission, prepared by GHD and dated May 2015
- Town of Mashpee Existing WWTF Evaluation – Final report, prepared by GHD and dated September 2017

5. Room Names and Classifications

5.1 Preliminary Treatment Building

Screening Room: Class 1 Group D Division 1

Electrical Room: Unclassified

5.2 Process Building

Chemical Room: Unclassified

Office: Unclassified

Restroom: Unclassified

Stair: Unclassified

Blower Room: Unclassified

UV Disinfection Room: Unclassified

Corridor: Unclassified

Mechanical Room: Unclassified

Pump Room: Class 1 Group D Division 2

Storage: Unclassified

5.2.1 Process Tanks

Under Process Tank Cover: Class 1 Group D Division 1

Above Process Tank Cover (Interior of Tank maintained at negative pressure): Unclassified

Permeate Pump Room: Unclassified

5.3 Operations Building (Future)

Office: Unclassified

Mechanical Room: Unclassified

Men's Room: Unclassified

Women's Room: Unclassified

Control/Files Room: Unclassified

Lab Room: Unclassified

Break Room: Unclassified

Conference Room: Unclassified

6. List of Commonly Used Acronyms

ACI	American Concrete Institute
ADAAG	Americans with Disabilities Act Accessibility Guidelines
ADF	Average Daily Flow
AOR	Actual Oxygen Requirement
BOD	Biological Oxygen Demand
CEC	Contaminants of Emerging Concern
cfm	cubic feet per minute
cfu	colony forming unit
CWMP	Comprehensive Wastewater Treatment Plan

EMT	Electrical Metallic Tubing
EQ	Equalization
ERV	Energy Recovery Ventilator
EV	Electric Vehicle
FRP	Fiberglass-Reinforced Plastic
GIS	Geographical Information System
gal	gallons
gpd	gallons per day
gpm	gallons per minute
HP	Horsepower
HRT	Hydraulic Retention Time
HVAC	Heating, Ventilating, and Air Conditioning
IBC	International Building Code
IECC	International Energy Conservation Code
IFC	International Fire Code
lb/day	pounds per day
lbs	pounds
JBCC	Joint Base Cape Cod
kW	Kilowatt
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
MassDEP	Massachusetts Department of Environmental Protection
MEP	Massachusetts Estuaries Project
MBH	Thousand British Thermal Units per Hour
MBR	Membrane Bioreactor
MBT	Membrane Thickener
mg/L	milligrams per liter

mgd	million gallons per day
MLSS	Mixed Liquor Suspended Solids
NACD	North American Vertical Datum
NaOH	Sodium Hydroxide
NEIWPCC	New England interstate Water Pollution Control Commission
NFPA	National Fire Protection Association
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OTE	Oxygen Transfer Efficiency
PA	Pre-aeration
PCB	Polychlorinated biphenyl
PLC	Programmable Logic Controller
PV	Photovoltaic
PVC	Polyvinylchloride
RAS	Return Activated Sludge
RFP	Request for Proposal
SBR	Sequencing Batch Reactor
SCADA	Supervisory Control and Data Acquisition
scfm	standard cubic feet per minute
SHT	Sludge Holding Tank
sq. ft.	square feet
SRT	Solids Retention Time
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
TSS	Total Suspended Solids

UF	Ultrafiltration
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
UVT	Ultraviolet Transmittance
VFD	Variable Frequency Drive
WAS	Waste Activated Sludge
WEF	Water Environment Federation
WNMP	Watershed Nitrogen Management Plan
WPCF	Water Pollution Control Facility
WRRF	Water Resource Recovery Facility
WWTF	Wastewater Treatment Facility

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
	Anastasia Rudenko PE, BCEE, ENV SP		774-470-1637
cc:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – M-1 Design Flows and Loads** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to summarize the methodology used to develop design influent flow and loading rates for the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016
- Water Environment Federation; “Design of Municipal Wastewater Treatment Plants”; WEF Manual of Practice No 8; Fifth Edition; 2010
- Tchobanoglous, George; Burton, L. Franklin; Stensel, H. David; “Wastewater Engineering: Treatment and Reuse”; Metcalf and Eddy, Inc.; Fifth Edition; 2014

2.1 References

The following references were used to develop this memorandum:

- ‘Final Recommended Plan / Final Environmental Impact Report – Town of Mashpee Sewer Commission’, prepared by GHD and dated May 2015
- ‘Town of Mashpee Existing WWTF Evaluation – Final report’, prepared by GHD and dated September 2017
- 2017 American Community Survey, United States Census Bureau. www.census.gov

3. Background

The Town of Mashpee has been involved in a watershed nitrogen management planning effort since the late 1990's. In 2015, the planning effort culminated in a Town-wide Watershed Nitrogen Management Plan (WMNP) for the watersheds of Popponesset Bay, Waquoit Bay East, and the remainder of the Town of Mashpee. The WMNP is built under the general approach that shellfish aquaculture will be used in conjunction with traditional wastewater infrastructure in order to meet the Town's Total Maximum Daily Loads (TMDLs) for nitrogen.

The WNMP implementation schedule is broken down into five phases and relies on an adaptive management approach (see attached figure). If shellfish aquaculture is unsuccessful in reducing its portion of the nitrogen load, a complete traditional infrastructure approach will be implemented to meet the TMDLs. Under the adaptive management approach additional flow will be conveyed to the WRRF during multiple phases if shellfish aquaculture is not advancing as fast or effectively as anticipated.

Table 1 compares the flows as outlined in the WNMP with updated flows, which were derived from updated water use data.

Table 1 WNMP Outline of Future Phases for Site 4 WRRF

Phase	Original Schedule	Infrastructure Proposed in WNMP	Average Annual Flow from WNMP (gpd)[1,2]	Updated Average Annual Flow from Existing WWTF Evaluation (gpd)[3,4]
1	2017 to 2021	• Design and construction of Site 4 facility (Phase 1) to serve sections of Subarea S (within Mashpee River watershed) adjacent to Falmouth Road/Route 28. • Design and construction of related collection system to serve Site 4 WRRF.	80,000	120,000
2	2022 to 2026	• If Shellfish propagation is not advancing as fast as anticipated: - Site 4 expansion to serve additional Mashpee River and Popponesset Bay watershed properties south of Route 28 with new recharge facility at Willowbend Golf Course (off-site effluent recharge).	45,000	65,000
3	2027 to 2031	• If Shellfish propagation is not advancing as fast as anticipated: - Site 4 facility expansion with sewer extension to serve Mashpee River and Popponesset Bay watershed Mashpee (north of Route 28) with associated sewer extensions.	90,000	131,000

(continued)

Phase	Original Schedule	Infrastructure Proposed in WNMP	Average Annual Flow from WNMP (gpd)[1,2]	Updated Average Annual Flow from Existing WWTF Evaluation (gpd)[3,4]
4	2032 to 2036	• If Shellfish propagation is not advancing as fast as anticipated: - Collection system expansion (North of Falmouth Road) Subarea S to Site 4.	33,000	49,000
5	2037 to 2041	• If Shellfish propagation is not advancing as fast as anticipated: - Collection system expansion (Main Street/Route 130) Subarea T to Site 4.	110,000	110,000

Notes:

1. Future average annual flowrates as described in the 'Final Recommended Plan / Final Environmental Impact Report – Town of Mashpee Sewer Commission' (WNMP), prepared by GHD and dated May 2015.
2. Flows do not include inflow and infiltration (I/I).
3. Flows using phasing and area locations from the WNMP with updated parcel and flowrate information from 'Town of Mashpee Existing WWTF Evaluation – Final report', prepared by GHD and dated September 2017.
4. Flows include inflow and infiltration (I/I).
5. Figure of Implementation Phasing Plan is attached

4. Design Flows

In lieu of actual wastewater flow data, MassDEP guidelines allow WRRF design flows to be established through the following two methodologies:

1. Establishment of design flows using State Environmental Code (Title 5) flows.
2. Establishment of design flows using water use data from known similar establishments (metered flow).

Flows developed as part of the WNMP were established using Method 2, using three (3) years of existing water data from the late 1990's. This preliminary design looks to update that based on more recent water data available from regional planning efforts. Therefore, continuing with the second method of estimating flows, water usage data from 2009 through 2011, provided by the Cape Cod Commission, was used to develop estimated wastewater flows for the proposed Phase 1 sewershed (Attachment 1 - Proposed Phase 1 Sewershed). A 90% conversion factor (which is consistent with the water to wastewater conversion factor used in Massachusetts Estuaries Project (MEP) reports and the WNMP) was used to convert water usage to wastewater flow. A SewerCAD model of the proposed Phase 1 collection system was developed by GHD in 2017. An infiltration rate of 500 gallons per day/inch-diameter mile was applied to all gravity sewer pipe lengths in the proposed sewershed (TR-16 recommends applying an I/I rate of 250 – 500 gpd/in-dia mi). The high end of I/I flowrate range was chosen to help buffer for increased I/I rates due to climate change that have been witnessed in the area in the past years.

The future Mashpee collection system will be a new system. The new gravity PVC sewers and manhole joints and covers will be gasketed. All new connections will be wye-connections with new laterals to the house, and no roof leaders or sump pumps and/or foundation drain connections will be allowed under any condition. In addition, public education programs should be employed to prevent illegal connections. Because of these factors, inflow is expected to be negligible.

The proposed sewershed is primarily zoned as residential. An average wastewater flow for residential parcels was established based on "existing" data and applied to all parcels that are currently undeveloped but which are zoned as residential parcels in the sewershed to estimate future wastewater flow.

4.1 Population Growth

To assess anticipated future growth, population growth was evaluated using census data for the Study Area from 2010 to 2017. Census data was obtained from the United States Census Bureau. The collection system area was determined to include census track 150 and 151. No population increase or decrease trend was shown in the data, as shown in Figure 1. Based on historical population projections for the census tracks, a large population increase is not anticipated in the proposed sewershed and was not included in the design flows. Because there have been no sizeable changes in population the buildout analyses from the 2015 WNMP and 2017 WWTF evaluation were comparable to current conditions.

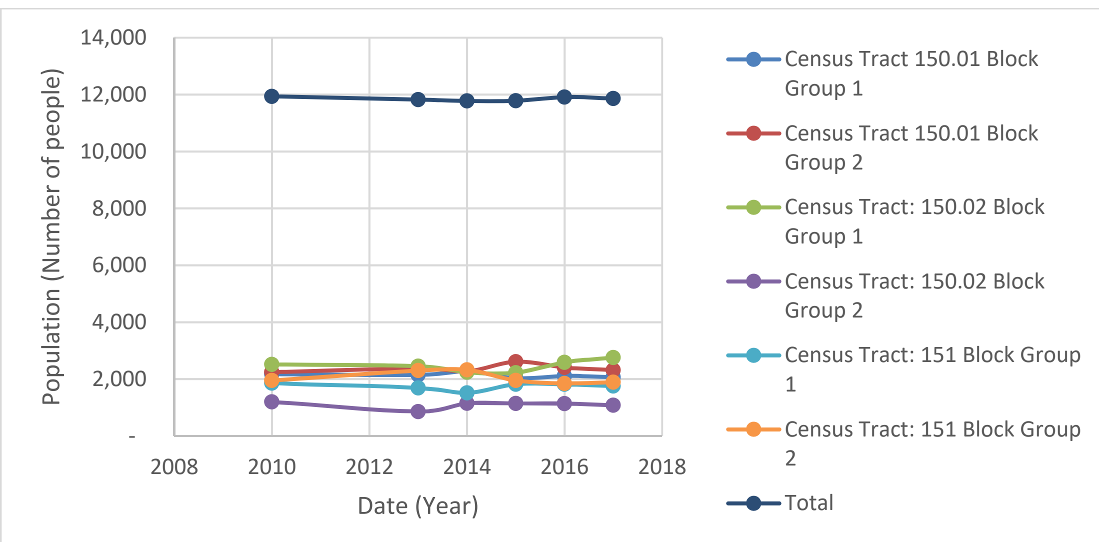


Figure 1 2010 – 2017 Population Trends in Proposed Mashpee WRRF Sewershed

5. Stage Flows

5.1 Average Flows

Using the methodology outlined above the average annual flow for Stage 1 was established as 120,000 gpd. The design of the WRRF was split into four equal stages which can meet the buildout of the five phases described in the WNMP. Each stage increases the average day flowrate by 120,000 gpd. The flowrate values for the four stages are shown in Table 2.

Table 2 Average Day Flowrate for Stages

Parameter	Average Day (gpd)
Stage 1 Design	120,000
Stage 2 Design	240,000
Stage 3 Design	360,000
Stage 4 Design	480,000

5.2 Flow Peaking Factors

Peaking factors were used to determine maximum day, peak hour, and maximum month flowrates. TR-16 and data from other nearby treatment facilities were used to establish the peaking factors. Changes in peaking factors and weather related flowrates have been observed at nearby treatment facilities in the last few years. In order to incorporate theses observed changes slightly more conservative peaking factors have been chosen for this design. The peaking factors used for the design of the Mashpee WRRF are in Table 3.

Table 3 Flow Peaking Factors

Parameter	Peaking Factor	Source
Maximum Day	3.0	TR-16 Merrick Curve
Peak Hour	5.4	TR-16 Merrick Curve
Maximum Month	2.6	Ratio of Similar Facilities to Flow

5.2.1 Maximum Day

To determine the maximum daily flow rate from the average daily flow rate, a peaking factor of three (3.0) was chosen. This was determined using the Ratio of Extreme Flow to Average Daily Flow figure from TR-16. The smallest average daily discharge rate of domestic sewage on the figure was 0.1 mgd. This value was used because the average wastewater flow (no I/I) estimated from water usage data is around 85,000 gpd.

5.2.2 Peak Hour

A peak hour factor of 5.4 was chosen using the Ratio of Extreme Flow to Average Daily Flow Figure from TR-16. An average daily discharge rate of domestic sewage of 0.1 mgd was used.

5.2.3 Maximum Month

A peaking factor of 2.6 was chosen to determine the maximum month flow rate. TR-16 does not include a methodology to establish the maximum month peaking factor. Therefore, peaking factors for nearby wastewater treatment facilities of a similar size to the proposed Mashpee WRRF were reviewed. Facilities included in the analysis are summarized in Table 4.

Table 4 Peaking Factors from Nearby WWTFs with Similar Characteristics to the Proposed Mashpee WRRF

Facility	Average Day Flow (gpd)	Maximum Month Flow (gpd)	Maximum Day Flow (gpd)
Southport WWTF, Mashpee MA	30,000 (design)	1.3	1.6
Falmouth WWTF	660,000[1]	1.8	1.9
Chatham WPCF	194,000[1]	1.4	2.1
Oak Bluffs WWTF	98,000[1]	2.5	2.8
1. Value from facility effluent data.			

The maximum month to maximum day ratio from Oak Bluffs WWTF data was used to estimate the peaking factor for the Mashpee WRRF. The Oak Bluffs WWTF has an average daily flow rate of 100,000 gpd and therefore is a similar size to the Mashpee WRRF. It also encounters a similar seasonal pattern as Mashpee with increased flow rates during the summer due to tourism. Oak Bluffs is a more seasonal community than Mashpee, therefore using data from Oak Bluffs provides some conservatism in the flow estimates. Flow data from Oak Bluffs indicates that the facility encounters a maximum month peaking factor of 2.5 and a maximum day peaking factor of 2.8. By applying the ratio of these two Oak Bluffs' peaking factors to the previously determined maximum day peaking factor for Mashpee (3.0) a maximum month peaking factor for Mashpee of 2.6 was estimated.

$$\frac{Oak\ Bluffs'Max\ Month}{Oak\ Bluffs'Max\ Day} * Mashpee\ Max\ Day = Mashpee\ Max\ Month$$

$$\frac{2.5}{2.8} * 3.0 = 2.6\ \ \text{(Values Rounded)}$$

5.3 Stage Flows

The design flowrates for each of the stages are shown below in Table 5.

Table 5 Stage Flowrates

Parameter	Stage 1 Design	Stage 2 Design	Stage 3 Design	Stage 4 Design
Average Day (gpd)	120,000	240,000	360,000	480,000
Maximum Month (gpd)	312,000	624,000	936,000	1,248,000
Maximum Day (gpd)	360,000	720,000	1,080,000	1,440,000
Peak Instantaneous (gpd)	648,000	1,296,000	1,944,000	2,592,000

6. Design Loads

Design loads were estimated based on TR-16 recommended values for domestic waste. As discussed in Section 5.1 the proposed sewershed is primarily residential.

TR-16 outlines average loads on a per capita basis. To determine the average number of people in each housing unit, 2017 population data and number of housing units for the census blocks around the area of WNMP Phase 1 were obtained from the 2017 American Community Survey. The census tracts do not coincide with the collection area so the population was estimated using the ratio of census population to census housing units. With a census population of 11,864 and the number of housing units for the same census year being 6,724, the ratio is 1.76 people per housing unit. The number of housing units in the proposed sewershed was obtained from GIS data.

The design concentration was then estimated using the TR-16 concentrations, ratio of people per housing unit, number of housing units in the proposed sewershed, and design flows. Average day concentrations for the Mashpee WRRF are outlined in Table 6.

Table 6 Average Design Loads and Concentrations

Parameter	Design Per Capita Load (lbs/capita/day)	Design Concentration (mg/L)
Total Suspended Solids	0.20	275
Carbonaceous BOD	0.17	238
Total Nitrogen	0.04	49
Total Phosphorus	0.006	7

The design load for average day conditions was estimated using the design concentration and flowrates for each of the four stages and is shown in Table 7.

Table 7 Design Average Day Load for Stages

Parameter	Stage 1 Design	Stage 2 Design	Stage 3 Design	Stage 4 Design
Average Day (mgd)	0.12	0.24	0.36	0.48
TSS (lb/day)	275	550	825	1,100
BOD (lb/day)	238	477	715	954
TN (lb/day)	49	98	147	196
TP (lb/day)	7	15	22	29

6.1 Load Peaking Factors

Load peaking factors were obtained for maximum month and maximum month from TR-16 and are shown below in Table 8.

Table 8 TR-16 Recommended Load Peaking Factors for Domestic Wastewater

Parameter	Maximum Month	Maximum Day
TSS	1.3	1.9
BOD	1.26	1.6
TKN	1.25	1.4
Total P	1.2	1.36

6.1.1 Load Maximum Month

Using the TR-16 peaking factors the loading rate (lbs/day) for maximum month conditions for each of the four stages are shown in Table 9.

Table 9 Load Maximum Day

Parameter	Stage 1 Design	Stage 2 Design	Stage 3 Design	Stage 4 Design
Average Day (mgd)	0.12	0.24	0.36	0.48
TSS (lb/day)	358	715	1073	1430
BOD (lb/day)	300	601	901	1202
TN (lb/day)	61	122	182	243
TP (lb/day)	9	18	26	35

6.1.2 Load Maximum Day

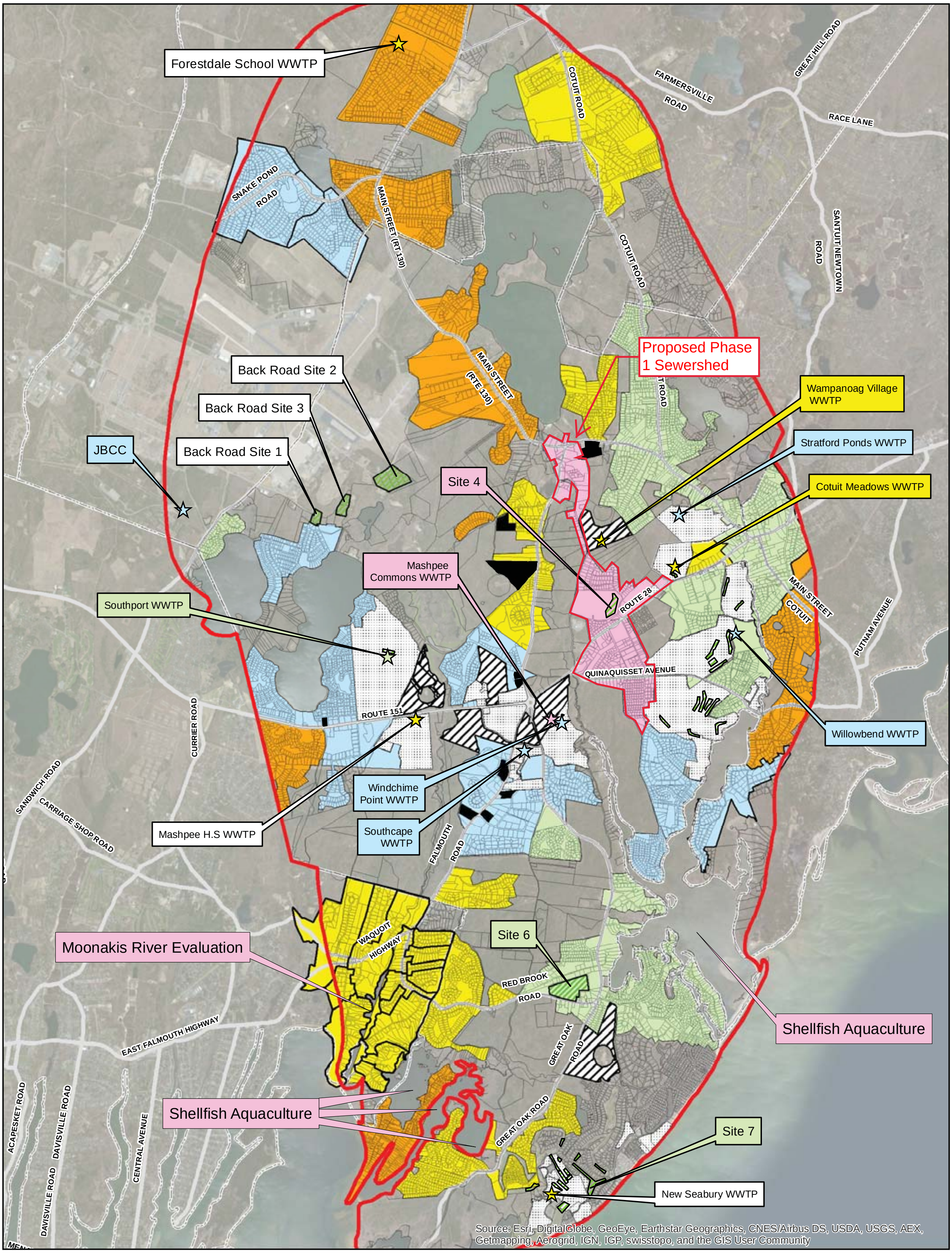
Using the TR-16 peaking factors the load rate (lbs/day) for maximum Day conditions for each of the four stages are shown in Table 10.

Table 10 Load Maximum Month

Parameter	Stage 1 Design	Stage 2 Design	Stage 3 Design	Stage 4 Design
Average Day (mgd)	0.12	0.24	0.36	0.48
TSS (lb/day)	523	1045	1568	2091
BOD (lb/day)	381	763	1144	1526
TN (lb/day)	68	136	204	272
TP (lb/day)	10	20	30	40

Proposed Treatment goals are discussed in Technical Memorandum M-2 "Treatment Goals."

Attachments



LEGEND

- I/A
- Planning Area Boundary
- Parcel Boundary
- Wastewater WWTP (Color per Phase)
- Existing Private Sewer
- Proposed Private Sewer
- Proposed Treatment/Discharge Site

Implementation Phase

- Phase 1
- Phase 2
- Phase 3
- Phase 4
- Phase 5

Paper Size ANSI B

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet

N

GHD

TOWN OF MASHPEE SEWER COMMISSION
Watershed Nitrogen Management Plan

Job Number	86-12001
Revision	A
Date	07 May 2015

Implementation Phasing Plan

Figure ES-2

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Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – M-2 Treatment Goals** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to summarize the treatment goals that will be used for the design of the Mashpee Water Resource Recovery Facility (WRRF). The proposed Mashpee WRRF will be developed on a greenfield site with effluent recharge to groundwater in a nitrogen sensitive watershed. This is a proposed facility, therefore a Massachusetts Department of Environmental Protection (MassDEP) issued groundwater discharge permit has not been issued or applied for yet

2. Codes and Standards

The following wastewater treatment design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016
- "Guidelines for the Design, Construction, Operation and Maintenance of Small Wastewater Treatment Facilities with Land Disposal", prepared by MassDEP, revised July 2018.
- 314 CMR 5.00: Ground water discharge permit program. Massachusetts Department of Environmental Protection. Dated: January 13, 2017.
- Ground Water Discharge General Permit for Discharges of Treated Effluent From Small Publicly Owned Wastewater Treatment Facilities. Massachusetts DEP January 10, 2019 – January 24, 2014.
- 40 CFR 133. Secondary Treatment Regulation. United States Environmental Protection Agency.

3. References

The following references were used to develop this memorandum:

- 'Final Recommended Plan / Final Environmental Impact Report – Town of Mashpee Sewer Commission', prepared by GHD and dated May 2015 (WNMP).

- 'Final Quashnet River, Hamblin Pond, Little River, Jehu Pond and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen (Report # 96-TMDL-5 Control #218.0)', prepared by the Commonwealth of Massachusetts Executive Office of Environmental Affairs, Massachusetts Department of Environmental Protection and Bureau of Resource Protection, dated January 31, 2006.
- Final Popponesset Total Maximum Daily Loads for Total Nitrogen (Report #96-TMDL-4 Control #217.0), prepared by the Commonwealth of Massachusetts Executive Office of Environmental Affairs, MassDEP, Bureau of Resource Protection. December 2006.

4. Background

The proposed collection system to serve the proposed Mashpee Water Resource Recovery Facility (WRRF) facility will primarily convey raw wastewater flow from parcels within the Mashpee River watershed (a subwatershed to Popponesset Bay) to the Mashpee WRRF. Following advanced treatment (including nitrogen removal), effluent will be recharged within the same watershed through open sand beds proposed at the site.

As outlined in the WNMP, the Mashpee WRRF will be designed for an effluent total nitrogen limit of 3 mg/L (limit of technology) to minimize the nitrogen load re-introduced to the Town's watersheds through effluent recharge.

5. Effluent Limits

Design effluent limit parameters for the Mashpee WRRF are shown in Table 1. The proposed effluent recharge location is outside of a Zone II or Interim Wellhead Protection Area. Due to the effluent recharge location in a nitrogen sensitive watershed, the WRRF will be designed to meet an effluent total nitrogen limit of 3 mg/L.

Table 1 Proposed Mashpee WRRF Effluent Limits

Parameter	Effluent Limit	Limit Type	Reference
Total Suspended Solids (TSS)	30 mg/L	Daily Maximum	314 CMR 5.00
Biological Oxygen Demand (BOD)	30 mg/L	Daily Maximum	314 CMR 5.00
Total Nitrogen (TN)	10 mg/L	Daily Maximum	314 CMR 5.00
Total Nitrogen (TN)	3 mg/L	Annual Average	WMNP
Oil and Grease	15 mg/L	Daily Maximum	314 CMR 5.00
Fecal Coliform	200 cfu / 100 mL	Daily Maximum	314 CMR 5
pH	6 - 9	Daily	314 CMR 5.00

The following parameters are not expected to have permitted discharge limits. However, to provide flexibility for future potential permit limits or potential remote effluent recharge options, the effluent concentrations for these parameters should be evaluated as part of the design of the WRRF. These parameters include:

- Total Phosphorus
- Turbidity
- Total Organic Carbon (TOC)
- Microconstituents (for example: pharmaceuticals, PFAS, microplastics)

6. Design Criteria for Requests for Proposals

Below is the design criteria requested in the requests for proposals.

6.1 Preliminary Treatment

Table 2 Preliminary Treatment Design Criteria

Parameter	Value
Screen Size	6 mm and 2 mm

6.2 Secondary Treatment

Table 3 MBR Design Criteria

Parameter	Value
Flow	Stage 1 Max Day
MLSS Concentration	10,000 mg/L
Fouling Factor	0.9
Alpha Factor	0.45
Beta Factor	0.95

6.3 UV Disinfection

Table 4 UV Disinfection Design Criteria

Parameter	Value
Design UV Transmittance(1)	65% (MBR system) / 55% (SBR system)
Treatment Capacity per Channel	100% of Peak Instantaneous Flow with one bank out of service
Design Peak Instantaneous Coliform Effluent Limit	200 cfu/ 100 mL

6.4 Odor Control

Table 5 Odor Control Design Criteria

Parameter	Value
Flow Rate	4,820 CFM

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Kayla Wirth	Tel:	717-585-6418
	Howard Butler, PE		717-541-0622
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design – M-3 Hydraulic Profile** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memorandum is to provide the Basis of Design for the hydraulic profile analysis for the preliminary design of the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts. For further details related to the development of design flows, refer to the "M-1 Flows and Loads Memorandum."

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016

3. Reference

- National Flood Insurance Program – Flood Insurance Rate Map, Barnstable County, Massachusetts, Map No. 25001C0538J, Effective Date July 16, 2014.

4. Summary of Proposed Facilities

4.1 Flood Elevations

In order to comply with TR-16 guidance, the 25-year flood elevation should be used to create a hydraulic profile, ensuring plant operations would function properly in such an event. The site is located outside both the 25-year and 100-year flood zone.

4.2 Stage 1 Hydraulic Profile

Currently, the proposed design hydraulics of the Mashpee WRRF is such that all the incoming water will be pumped via single force main to the beginning of the treatment process, then will flow by gravity through the 6 mm screen to the grit vortex unit. Flow will then continue to through two 2-mm screens. Since the 2-mm screening system has full redundancy, it is anticipated one screen will operate at a time during Stage 1. Flow from the screens will continue into a channel in the preliminary treatment building before being piped underground to distribution boxes that will distribute the flow to each secondary process train. Initially during Stage 1 there will be two distribution boxes the first the “Preliminary Treatment Effluent Distribution Box” will split flow from Stages 1 and 2 (in the future) from flow for Stages 3 and 4 (in the future). A “Secondary Treatment Influent Distribution Box” will split Stage 1 flows into two trains (1.1, 1.2).The Secondary Treatment Influent Distribution Box will also split flow to and from the equalization tank as needed in peak flow events.

In Stage 1, flow then enters one of two treatment trains, consisting of a pre anoxic, aerated, post anoxic, and membrane tanks by gravity. Then the flow will be pumped from the membranes (by the membrane permeate pumps) to the Ultraviolet (UV) disinfection system. The UV system requires a constant water level, with a tolerance of +/- 2 inches, so a weir is required to limit the water level elevation change during transitions between minimum and maximum flows. Following the UV weir, effluent is conveyed by gravity to the “Effluent Distribution Box” and piped by gravity to the sand beds where it is finally discharged.

There is a hydraulic break in the hydraulic profile of the facility at the membrane permeate pumps. The hydraulic profile for the first part of the facility is controlled by the elevation of the membrane tanks, the hydraulic profile for the second part of the facility is controlled by the elevation of the effluent sand beds.

4.3 Stage 4 Hydraulic Profile

In order to model Stage 4 (future) design hydraulics, the following assumptions were incorporated into the hydraulic profile:

- A third 2-mm screen is added following the grit vortex unit. This assumes that two 3-mm screens are operating at one time and all three fine screens have the same unit capacity.
- Flow is split from the Preliminary Treatment Effluent Distribution Box to two Secondary Treatment Influent Distribution Boxes.
- Each Secondary Treatment Influent Distribution Box splits flow into four equal trains for secondary treatment.
- All flow pumped to the UV system and combined in the UV channel.
- Effluent flows by gravity to the Effluent Sand Bed Distribution Box and is piped by gravity to the sand beds where it is discharged.

5. Process Description and Design Criteria

The hydraulic profile for the preliminary design of the Mashpee WRRF was created using Microsoft Excel and the Visual Hydraulics software package. The profile will continue to be refined and verified in further designs. The hydraulic profile is included in the drawings set and attached to this memorandum.

5.1 Flows Used for Hydraulic Profile

The hydraulic profile was developed for:

- Stage 1 Average Daily Flow with both Stage 1 trains in service,
- Stage 1 Peak Instantaneous Flow with both Stage 1 trains in service, and
- Stage 4 Peak Instantaneous Flow with all trains for all four stages in service.

The hydraulic design shows key process unit elevations under Stage 1 and Stage 4 conditions (see Drawing M-005 attached).

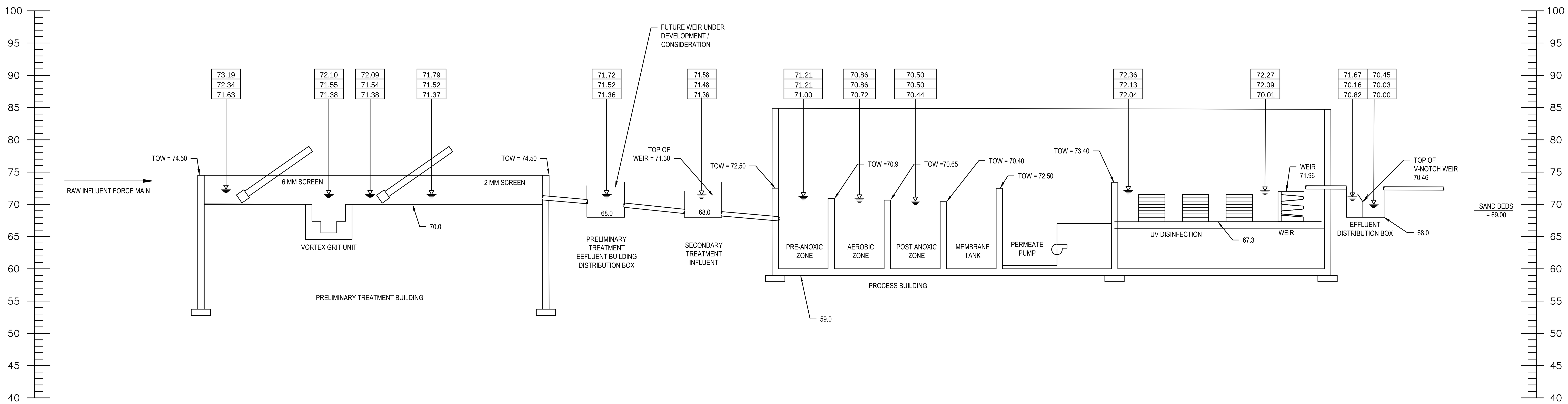
Table 1 Flows

Parameter	Stage 1 Design	Stage 4 Design
Average Day (gpd)	120,000	480,000
Maximum Month (gpd)	312,000	1,248,000
Maximum Day (gpd)	360,000	1,440,000
Peak Instantaneous (gpd)	648,000	2,592,000

Other considerations in the development of the hydraulic profile are as follows:

- TR-16 recommends plants should provide for uninterrupted operation of all units under flood conditions of a 25-year frequency, and should be placed above the 100-year flood level to protect all equipment and processes. The entire WRRF site is beyond the 100-year flood plain, so no special considerations are required.
- Pipes that follow secondary treatment will be sized to minimize headloss without consideration for maintaining specific velocities. The reasoning for this is that additional settling is unlikely in a pipe that follows membrane treatment.
- As a clarification, head over weirs will be no more than 6-inches unless site constraints control. Generally, 3 inches has been assumed for separation between weir crests and downstream water levels.
- Internal recirculation flows provided by the membrane manufacturer are included in the calculations for weir elevations within the process tanks.
- Individual membrane train recycle flows (1/2 stage) are estimated at 62.5 gpm for MLSS return and 455 gpm for the nitrate recycle.

Attachments



1 HYDRAULIC PROFILE

SCALE: NOT TO SCALE

LEGEND

WATER SURFACE ELEVATION AT STAGE 4 PEAK INSTANTANEOUS FLOW (2.6 MGD) WITH ALL UNITS IN SERVICE.	STAGE 4 PEAK
WATER SURFACE ELEVATION AT STAGE 1 AVERAGE DAY FLOW (0.12 MGD) WITH ALL UNITS IN SERVICE.	STAGE 1 PEAK
WATER SERVICE ELEVATION AT STAGE 1 PEAK INSTANTANEOUS FLOW (0.65 MGD) WITH ALL UNITS IN SERVICE.	STAGE 1 ADF
ELEVATION OF STAGE 1 PEAK.	▽

NOTES:

1. NITRATE RECYCLE FLOW IS 400% OF THE AVERAGE FLOW TO THE REACTORS AT AVERAGE DESIGN AND MAX MONTH FLOWS AND 400% OF THE MAX MONTH FLOW AT PEAK HOURLY CONDITIONS.
2. MIXED LIQUOR SUSPENDED SOLIDS (MLSS) FLOW IS 400% OF THE AVERAGE FLOW TO THE REACTORS AT AVERAGE DESIGN AND MAX MONTH FLOWS AND 400% OF THE MAX MONTH FLOWS AT PEAK HOURLY CONDITIONS.
3. MLSS RECYCLE FLOWS FROM MEMBRANE TANKS TO PRE-ANOXIC ZONE.
4. NITRATE RECYCLE FLOWS FROM AEROBIC ZONE TO PRE-ANOXIC ZONE.

No.	Issue	Drawn	Approved	Date
1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

Bar is one inch on original size sheet
0 1"

PRELIMINARY
NOT FOR CONSTRUCTION

GHD Inc.
1545 Iyannough Road
Hyannis MA 02601 USA
T 1 774 470 1630 F 1 774 470 1631 W www.ghd.com

Drawn	J. FOSDICK	Designer	LMQ
Drafting Check		Design Check	
Project Manager	A. RUDENKO	Date	
This document shall not be used for construction unless signed and sealed for construction.		Scale	AS SHOWN

Client **TOWN OF MASHPEE, MA**
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **HYDRAULIC PROFILE**

Project No. 11188223
Original Size Arch D
Sheet No. **M-002**
Sheet of

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
CC:	Mashpee Sewer Commission		

Subject: Basis of Design Memorandum – M-4 Preliminary Treatment

Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design

1. Purpose of Memo

The purpose of this memo is to provide a Basis of Design for Preliminary Treatment for the Mashpee WRRF.

The objectives of the preliminary treatment design at Mashpee WRRF are as follows:

- Design preliminary treatment to handle average flow and peak instantaneous flow for Stage 1, with channels and building designed to fit Stage 4 flow.
- Evaluate whether equipment should be initially sized to handle Stage 1, Stage 2, Stage 3 or Stage 4 flows.
- Provide 6mm screening for sequencing batch reactor (SBR) and 2mm minimum screening for membrane bioreactor (MBR) system.
- Evaluate screen equipment options based on cost, footprint and spatial requirements, headloss, efficacy, water requirements, energy use, and accessibility.
- Provide grit removal system that protects downstream pumps and equipment at the facility.
- Evaluate grit removal options based on cost, footprint and spatial requirements, headloss, efficacy, water requirements, energy use and accessibility.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016
- NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2020 Edition.

2.1 References

- Water Environment Federation; “Design of Municipal Wastewater Treatment Plants”; WEF Manual of Practice No 8; Fifth Edition; 2010
- Tchobanoglous, George; Burton, L. Franklin; Stensel, H. David; “Wastewater Engineering: Treatment and Reuse”; Metcalf and Eddy, Inc.; Fifth Edition; 2014

3. Design Criteria

3.1 Design Flows

The average day, maximum day, and peak instantaneous flows for Stage 1 through Stage 4 are outlined in Table 1.

Table 1 Design Flows

Parameter	Stage 1 Design	Stage 2 Design	Stage 3 Design	Stage 4 Design
Average Day (gpd)	120,000	240,000	360,000	480,000
Maximum Month (gpd)	312,000	624,000	936,000	1,248,000
Maximum Day (gpd)	360,000	720,000	1,080,000	1,440,000
Peak Instantaneous (gpd)	648,000	1,296,000	1,944,000	2,592,000

3.2 Hydraulics

Design hydraulic criteria is summarized below:

- Velocities through mechanically cleaned screens shall be 2-4 ft/sec (TR-16).
- Velocities through manually cleaned screens shall be 1-2 ft/sec (TR-16).
- Entrance channels shall provide equal and uniform flow distribution to screens (TR-16).
- Maximum headloss across either the 6 mm or 2 mm screens shall not exceed 24 inches for any flow condition (basis).
- Maximum headloss across the vortex grit removal unit shall not exceed 12 inches for any flow condition (basis).
- Minimum freeboard from maximum water surface elevation to top of channel elevation shall be 12 inches (basis).
- Slide gates will be used to enable screened flow to bypass the vortex grit unit directly to the fine screens.
- Grit pumps will be capable of passing a 3-inch diameter sphere (basis).
- Minimum diameter of suction piping and discharge piping for the grit pump will be 4-inches (TR-16).
- Velocity in suction and discharge piping for grit pumps shall be 3-6 ft/s (TR-16).

- Water flushing connections will be provided on suction and discharge manifold piping for grit pumps (TR-16).
- System curves for grit pumps will be developed based on a Hazen Williams coefficient of 100 and 140 to verify operating range and account for the aging condition of the pipe throughout the pumps design lift (basis).
- Overflow to the bypass screen shall be passive (TR-16).

4. Screening

Manufacturer recommended screening criteria for SBR and MBR systems differ and are shown in Table 2.

Table 2 Screen Size Requirements

System	Screen Size
MBR	2 mm (0.08 in)
SBR	6 mm (0.24 in)

For the MBR system (the Mashpee Sewer Commission's stated preference for secondary treatment), the following preliminary treatment equipment will be provided:

- A single 6 mm screening unit with bypass.
- A manual 25 mm bar rack screen.
- A single grit removal unit with bypass.
- A redundant grit pump.
- Two 2 mm screening units (full redundancy).

Based on GHD experience, it is recommended a 6 mm screen be provided to protect the grit removal unit for either manufacturer's configuration. The final fine screening size should be confirmed with the chosen MBR manufacturer to assure that the screening meets the MBR manufacturer's requirements.

If an SBR system were selected for secondary treatment, the following preliminary treatment equipment will be provided:

- A single 6 mm screening unit with bypass.
- A manual 25 mm bar rack screen.
- A single grit removal unit with bypass.
- A redundant grit pump

4.1 6 mm Screen

In either an SBR or MBR process one screen with 6 mm clear spacing between the bars will be provided to remove screenings from pumped flow from the collection system. The screen shall be designed with the following design criteria:

- 6 mm (1/4 inch) spacing between bars or perforations within perforated plate
- Maximum headloss across screen shall not exceed 24 inches when screen is 50% blinded.
- Screen shall be located indoors
- Option to use type 304 or 316 stainless steel shall be available for screen
- Screen shall be capable of pivoting out of channel for servicing
- Screen and screening products shall be able to be safely accessed

Multiple screen manufacturers were contacted for the 6mm coarse screen equipment. Based on the responses received, the preliminary design was based off of the most conservative sizing requirements. Further evaluation of or-equal manufacturers will be completed in later design.

The 6mm screen equipment information being used for the preliminary design is listed below in Table 3, the cutsheet figure for the Raptor® 16” Micro Strainer is attached.

Table 3 6mm Screen for Preliminary Design

Parameter	Description
Screen Type	RAPTOR® Micro Strainer Screen, Lakeside
Model	16MS-0.25-100
Opening Type	Perforated Plate
Washwater Requirements	5-15 gpm 60 psi
Headloss	7.3 in at 1.296 mgd, 10 in downsteam submergence
Channel Width	16 in
Maximum Flow	2.169 mgd

4.2 Bypass Screen

For both the SBR and MBR design there will be a manual bypass screen. The manual bypass screen will be design based on the following criteria.

- Manually cleaned bypass screen
- Bar rack with 25mm (1in) openings
- Screen positioned at an angle of 30-45 degrees from horizontal
- Passive overflow into the bypass channel when maximum design flow to coarse screen is reached.
- Velocity through screen should be designed to be 1-2 feet per second during average day conditions.

- Designed to be accessible from a platform from which the screen can be safely and easily cleaned.
- Material of construction shall have the option to use Type 316 stainless steel anchor bolts and fasteners.

4.3 2 mm Fine Screen

If a MBR secondary treatment system is chosen for the Mashpee facility a 2mm screen is expected to be required to protect the MBRs. Two screens, one duty and one redundant screen, will be required to provide the MBRs with protection when one screen is down or being serviced.

The fine screens shall be designed with the following design criteria:

- Two screens (1 duty and 1 stand-by) with 2mm openings
- Step-screen or perforated plate design shall be used.
- Maximum headloss across screen shall not exceed 24 inches when screen is 50% blinded.
- Screen shall be located indoors
- Option to use type 304 or 316 stainless steel shall be available for screen
- Screen shall be capable of pivoting out of channel for servicing
- Screen and screening products shall be able to be safely accessed

Multiple screen manufacturers were contacted for the 2mm coarse screen equipment. Based on the responses received the preliminary design was based off of the most conservative sizing requirements. Further evaluation of or-equal manufacturers will be completed in later design.

The 2mm screen equipment being used for preliminary design is listed in Table 4, the cutsheet figure for the Raptor® Rotating Drum Screen is attached..

Table 4 Fine Screen (2mm) for Preliminary Design

Parameter	Description
Screen Type	Raptor Rotating Drum, Lakeside
Model	30 RDS-0.080-106
Opening Type	Perforated Plate
Washwater Requirements	30 gpm 80 psig
Headloss	9 in at 1.296mgd, 4 in downstream submergence
Channel Width	30 in
Maximum Flow	1.38 mgd

5. Grit Removal

Once wastewater has passed through the coarse screen it will be conveyed to a free vortex grit removal unit by an interconnecting channel. Grit removed by the vortex grit unit will be continuously removed by one of two recessed impeller end suction direct drive centrifugal pumps. Pumped grit will be conveyed to a grit classifier.

The following design criteria have been established for the vortex grit system:

- One vortex grit system will be provided for a peak hydraulic flow of 1.296 mgd.
- The unit shall be based on the principle of secondary boundary layer velocities to separate and classify inorganic solids from organic solids and water.
- Vortex unit shall be provided with a fluidizing ring to avoid compaction of settled grit requiring subsequent removal.
- The unit shall be designed to remove 95% of the inorganic matter with a specific gravity of 2.6 or greater retained on a 150 mesh at the peak instantaneous flow of 1.296 mgd.
- The unit shall have sufficient turndown to address the flows expected at start-up to minimize excessive removal of organic matter present in the waste stream.
- Materials of construction shall be corrosion resistant with metal components constructed of Type 304 stainless steel.

The following design criteria has been established for the grit pumps:

- Two (1 duty + 1 stand-by) recessed impeller end centrifugal pumps shall be installed.
- Each pump will be direct drive unit equipped with an explosion proof motor.
- Each pump will be capable of passing a 3-inch diameter sphere.
- Minimum pump suction and discharge will be 4 inches.
- Pump parts exposed to the abrasive pumped fluid shall be designed for a minimum Brinell Hardness of 650.

Multiple manufacturers were contacted for grit removal systems. Based on the responses received, the preliminary design was based off of the most conservative sizing requirements. Further evaluation of or-equal manufacturers will be completed in later design.

The grit removal vortex equipment being evaluated in preliminary design is listed in Table 5, the cutsheet figure for the SpiraGrit is attached..

Table 5 Grit Removal Vortex Equipment for Preliminary Design

Parameter	Description
Name	RAPTOR® SpiraGrit, Lakeside
Model	SG7-2.5
Capacity	2.5 mgd
Diameter Vortex	7 ft
Mixer Drive Unit	0.75 Hp

Grit Pump	Gorman-Rupp Super T Series T4A71S-B self-priming grit pump
Grit Pump	up to 250 gpm, TDH 45 Feet

The grit removal classifier equipment being evaluated is listed in Table 6, the cutsheet figure for the Grit Classifier is attached.

Table 6 Grit Removal Classifier Equipment for Preliminary Design

Parameter	Description
Name	Type "W" Grit Cyclone-Classifier
Motor Size	1 Hp
Pump Capacity	250 gpm
Length	144.75 in
Incline	16 degrees
Width	16.5 inch

6. Combined System

A combined fine screen and grit removal system was initially considered for preliminary treatment due to the compact footprint of the equipment. However, since full redundancy in the fine screen system is required for an MBR system but not required for the grit removal system (this system can be bypassed in the event of equipment failure or maintenance), a combined system is not cost effective for this application.

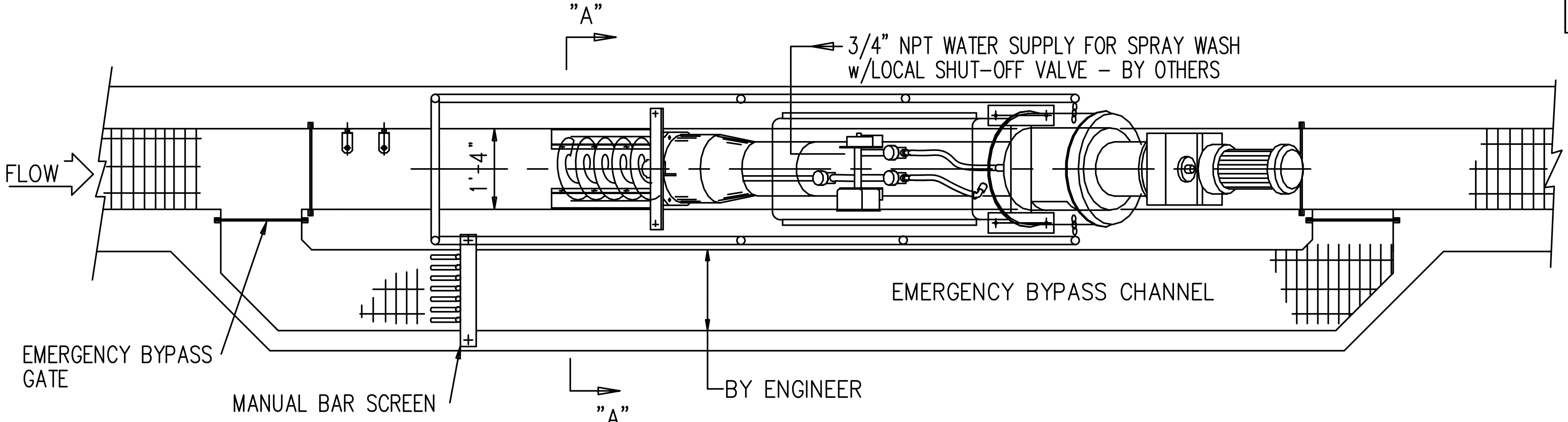
7. Screened Material Quantities

Collected material from screenings and grit removal will be disposed in waste containers. Screenings and grit will be fed into bags to limit the odor of the screenings and to keep the area clean and hygienic. Removed byproduct will then be transported offsite of the facility. Removed material quantities will be estimated based on manufacturer provided values and industry design standards.

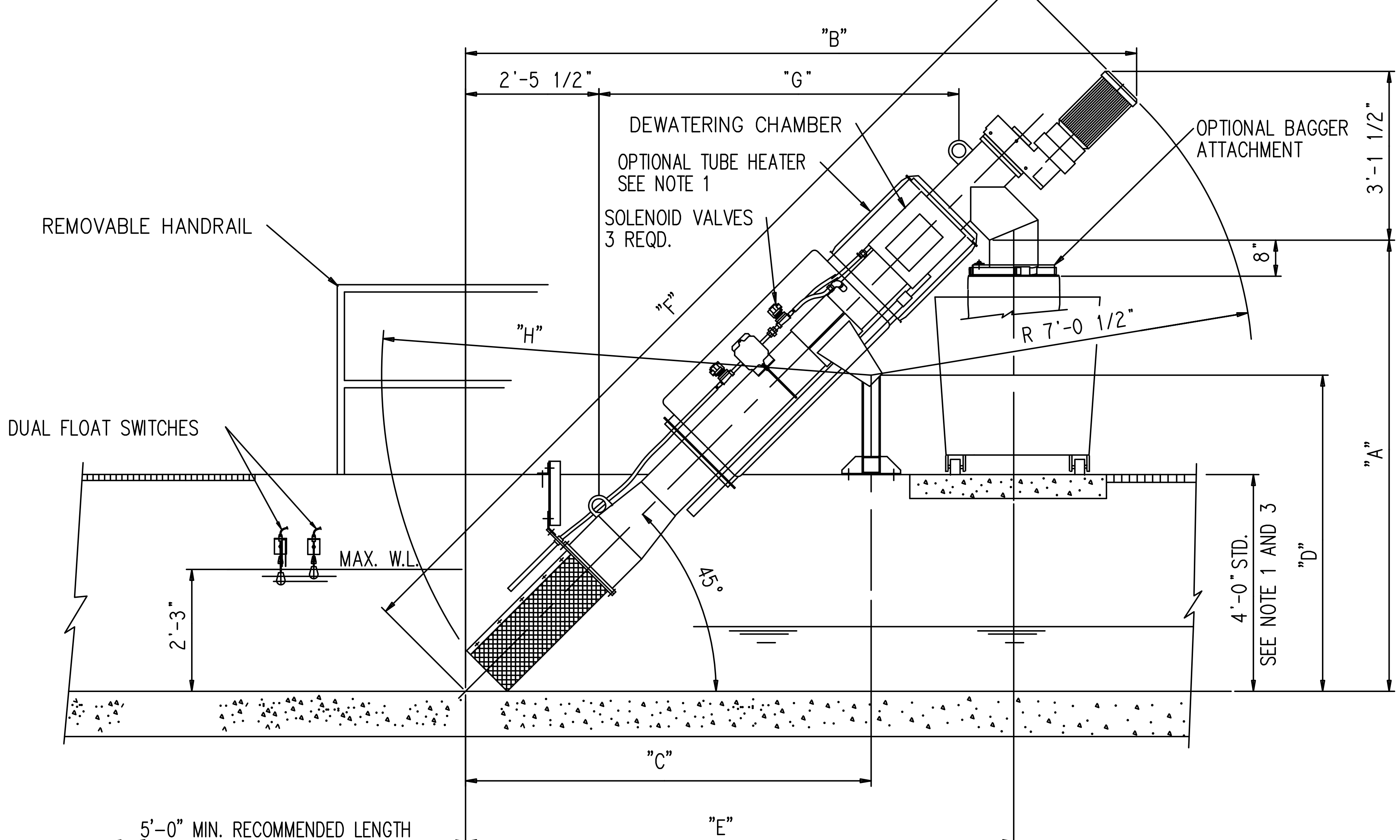
Attachments

8:38a 10/24/107 DXF

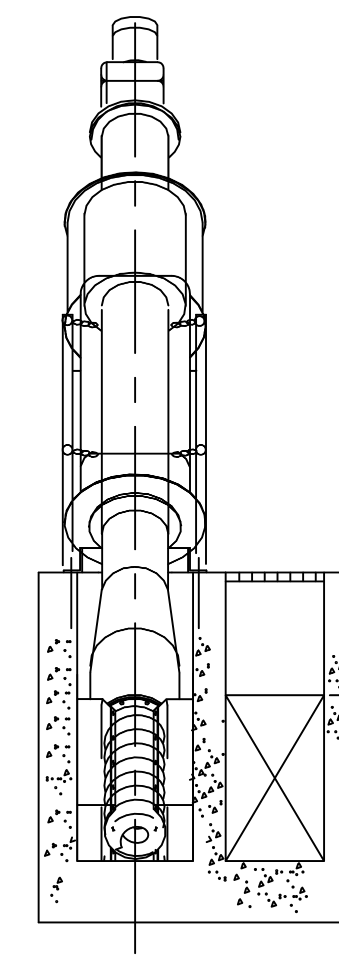
16MS	PART No	A	B	C	D	E	F	G	H
STD	-100	8'-4"	12'-2 3/4"	7'-5 3/4"	5'-10"	10'-1 1/2"	16'-5 1/2"	6'-7"	8'-11 1/2"



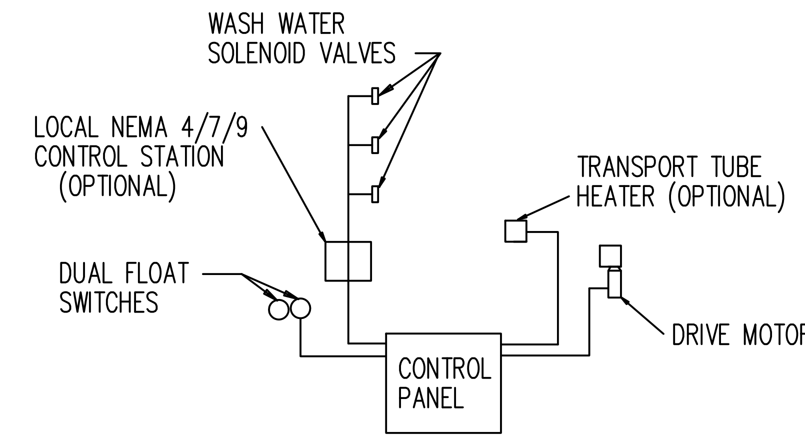
PLAN



ELEVATION



SECTION "A-A"



CONTROL INTERCONNECTION DIAGRAM

ALL CONDUIT AND WIRE CONNECTIONS BETWEEN CONTROL PANEL AND SCREEN COMPONENTS BY OTHERS.

EMERGENCY BYPASS GATE
TOP ELEV. 2" ABOVE MAX. W.L.

NOTES:

1) WHEN HEAT SYSTEM IS TO BE SUPPLIED, CHANNEL WIDTH TO BE 24" IF CHANNEL DEPTH IS GREATER THAN 4'-0".
2) CONTACT LAKESIDE FOR ANY ADDITIONAL REQUIREMENTS OR QUESTIONS.
3) KEEP TOP OF CENTER CHANNEL WALL AS LOW AS POSSIBLE TO ALLOW EASE OF CONSTRUCTION AND MAINTENANCE.
4) WATER SUPPLY LINES AND ELECTRICAL CONNECTIONS TO BE FLEXIBLE or QUICK DISCONNECT TYPE TO ALLOW UNIT TO PIVOT OUT OF CHANNEL.
5) BE SURE UPSTREAM PIPING IS NOT SURCHARGED AT MAX. W.L.
6) FOR PROPER APPLICATION OF THIS PRODUCT REFER TO RMI-95, LAKESIDE SCREEN GENERAL DESIGN NOTES.

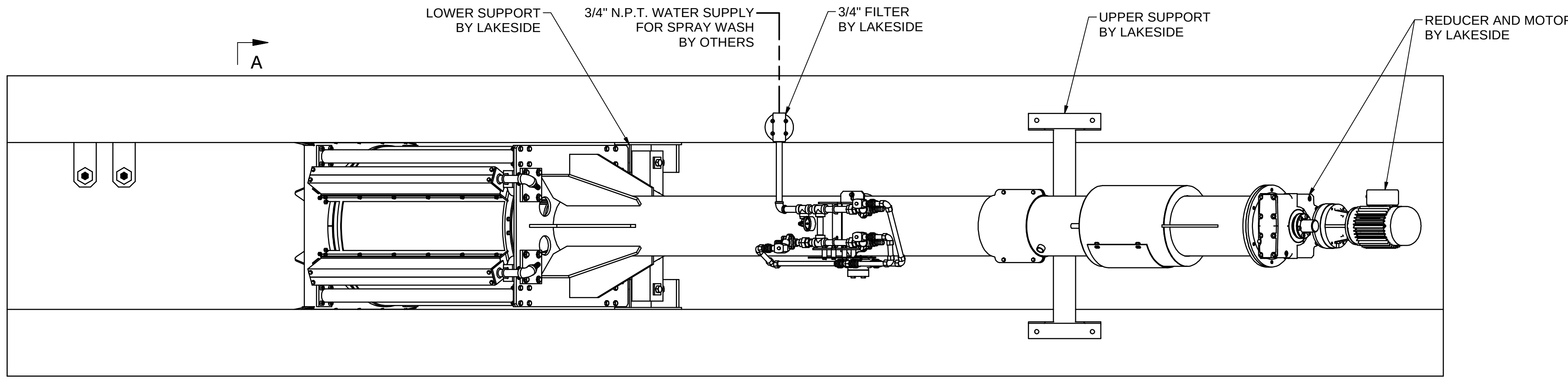
REVISIONS	DATE	DR.	CHKD.
M w/FLOAT SWITCH-REMOVED COARSE BAR RACK	9-27-07	GS/WK	
L REVISED TO CURRENT STANDARD	12-18-06	G.F.	

LAKESIDE EQUIPMENT CORPORATION

DR. R.D. DATE 2-20-95
CHKD. SNYDER 4-18-95 FILE NO. 250

RAPTOR®
16" MICRO STRAINER

DWG. NO. D -51153-S REV. M



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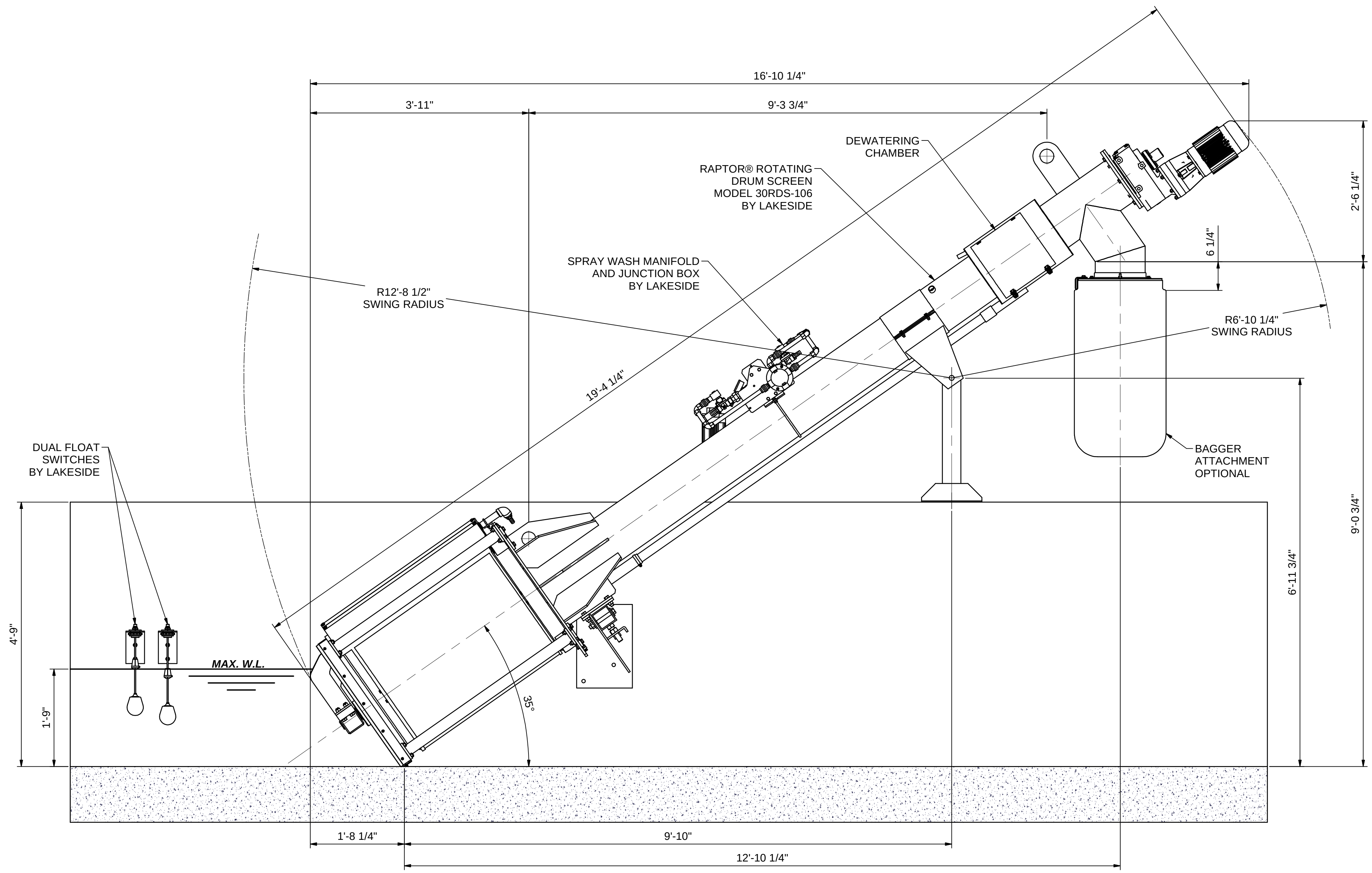
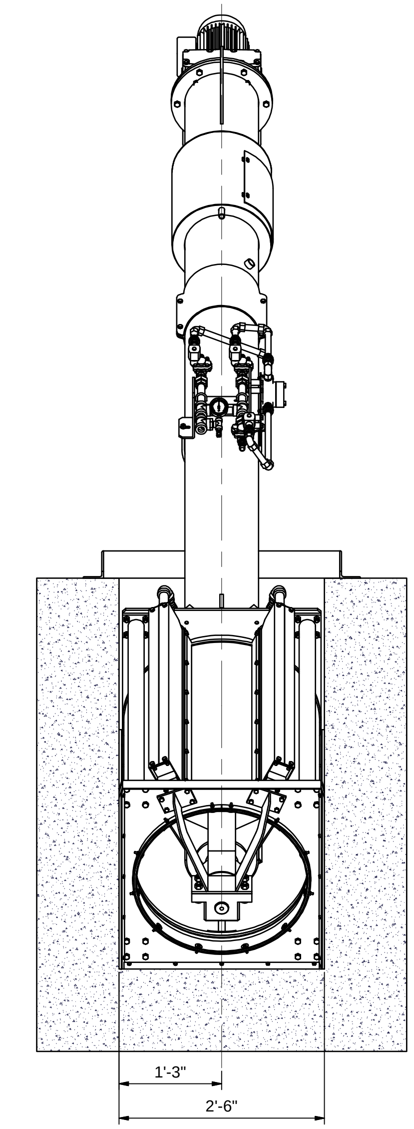


SECTIONAL ELEVATION



SECTION A-A

NOTES:

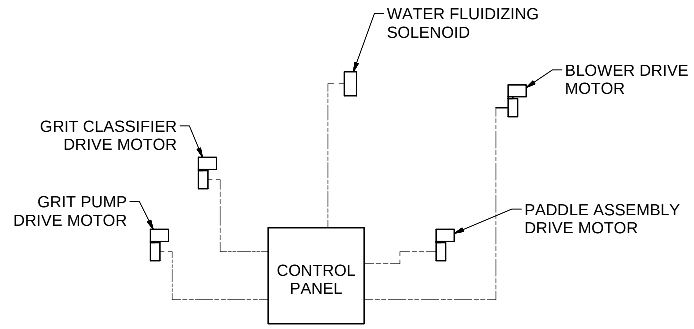
1) WATER SUPPLY LINES AND ELECTRICAL CONNECTIONS TO BE FLEXIBLE OR QUICK DISCONNECT TYPE TO ALLOW UNIT TO PIVOT OUT OF CHANNEL.

2) KEEP AREA UNDER SCREENINGS TRANSPORT SCREW FREE FROM FIXED OBSTRUCTIONS SUCH AS ELECTRICAL CONDUIT, PIPING, ETC. TO PERMIT ROTATION OF THE SCREEN OF THE CHANNEL FOR SERVICE.

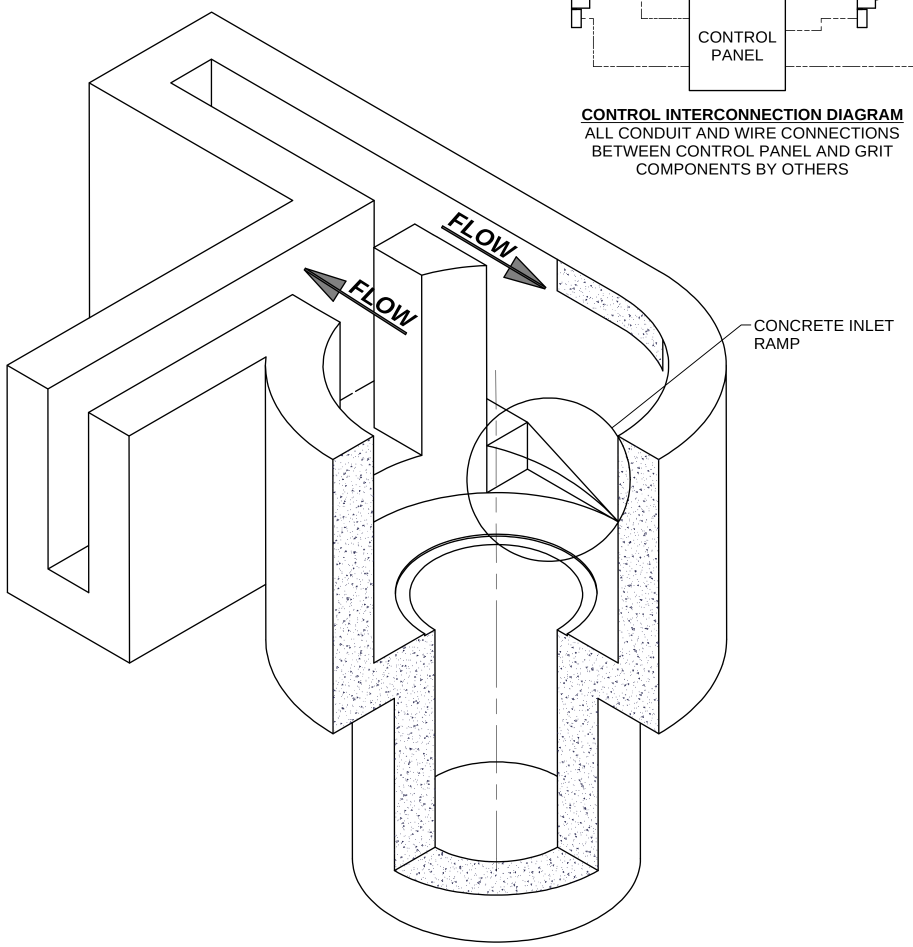
SAFETY WARNING:
THERE ARE INHERENT DANGERS WHILE INSTALLING OR OPERATING ELECTRICALLY POWERED MECHANICAL EQUIPMENT. CONSULT AND WORK WITH YOUR PROJECT SAFETY COORDINATOR TO DETERMINE ALL NECESSARY CAUTION IS EXERCISED AND GUARDING IS BEING PROVIDED TO PREVENT ACCIDENTS.

LAKESIDE EQUIPMENT CORPORATION
Water Purification Since 1928

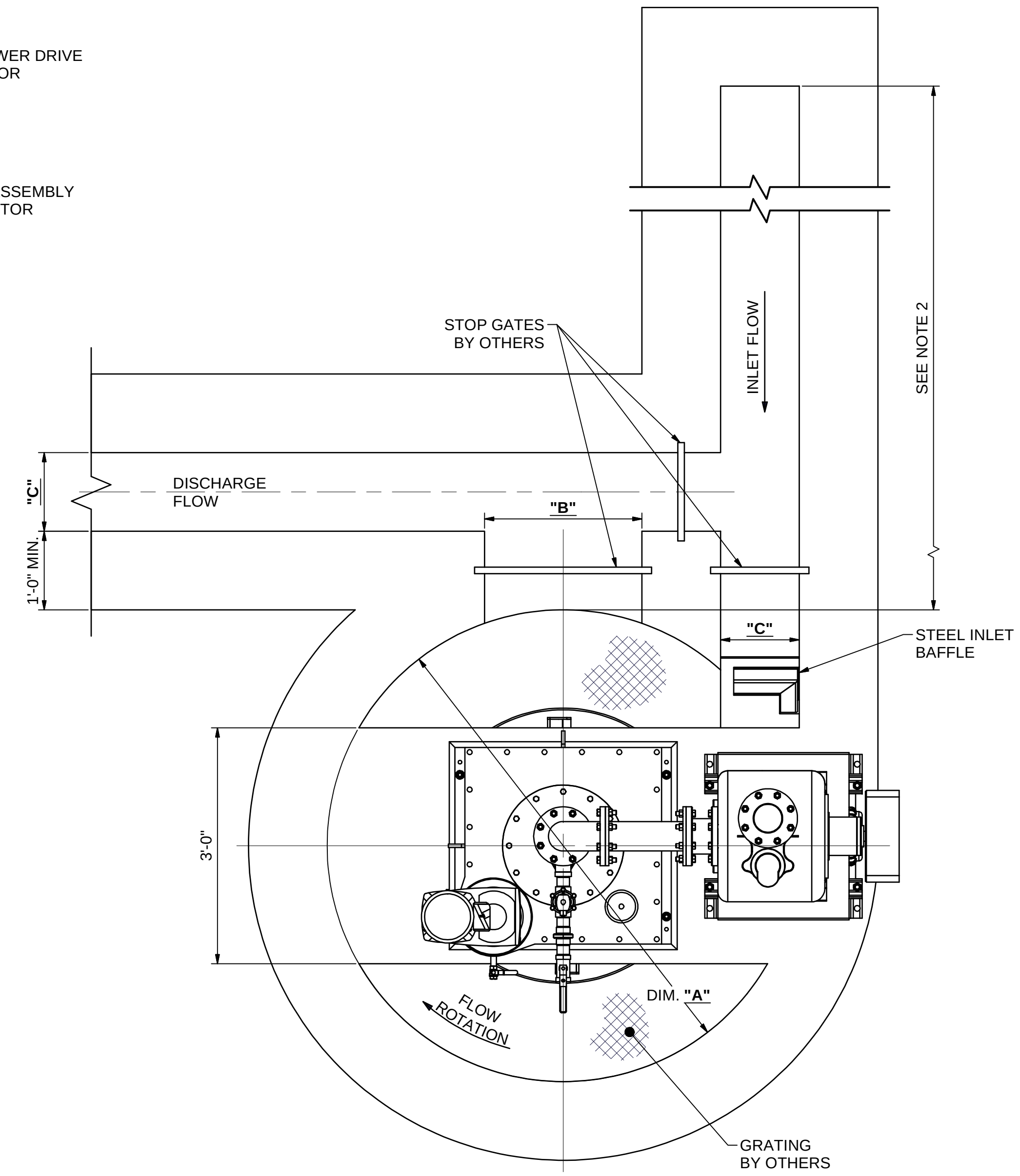
PROJECT					
TITLE MODEL 30RDS-0.250-106 PROPOSAL RAPTOR® ROTATING DRUM SCREEN					
DRAWN KH	DATE 3/15/2019	SIZE	S.O. #	DWG NO	REV
CHECKED JS	DATE 3/19/2019	D		D106669-S	
		SCALE		FILE NO. 250	



CONTROL INTERCONNECTION DIAGRAM
ALL CONDUIT AND WIRE CONNECTIONS BETWEEN CONTROL PANEL AND GRIT COMPONENTS BY OTHERS



ISOMETRIC



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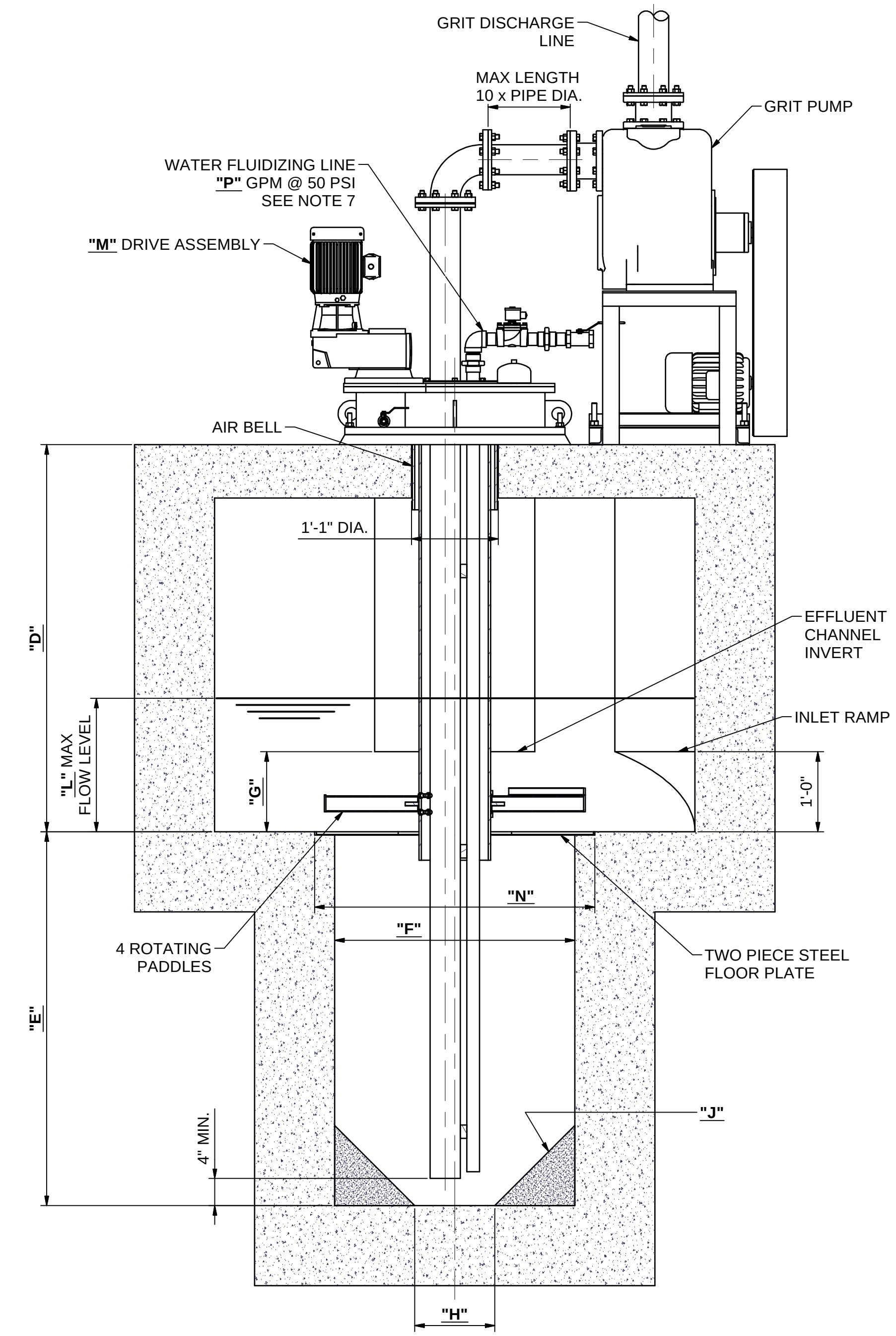


SECTIONAL ELEVATION
(STEEL INLET BAFFLE NOT SHOWN FOR CLARITY)

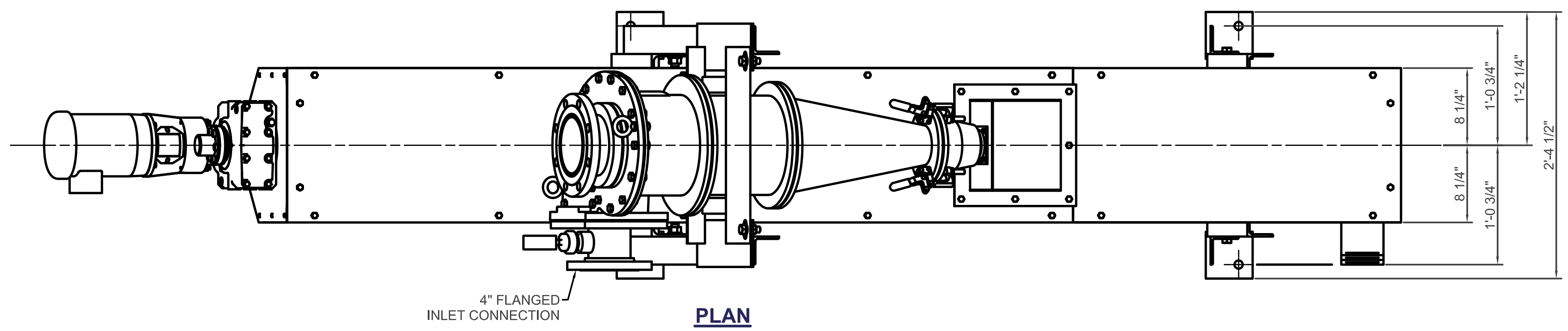
MODEL	INFLUENT M.G.D.	DIA. A	DIM. B	DIM. C	DIM. D	DIM. E	DIA. F	G1	G2	DIA. H	ANG. J	L1	L2	PADDLE DRIVE H.P. M	DIA. N	"P" GPM	EQUIPMENT WEIGHT (LBS)
SG-6-1.0	1.0	6'-0"	2'-0"	1'-0"	3'-8"	5'-0"	3'-0"	1'-0"	1'-0"	1'-0"	45°	1'-5"	1'-8"	3/4	3'-6"	15 TO 20	3,900
SG-7-2.5	2.5	7'-0"	2'-6"	1'-3"	3'-8"	5'-0"	3'-0"	1'-3"	1'-0"	1'-0"	45°	1'-11"	2'-2"	3/4	3'-6"	15 TO 20	3,900
SG-8-4.0	4.0	8'-0"	3'-0"	1'-6"	4'-0"	5'-0"	3'-0"	1'-4"	1'-0"	1'-0"	45°	2'-2"	2'-4"	3/4	3'-6"	15 TO 20	3,900
SG-9-5.5	5.5	9'-0"	3'-6"	1'-9"	4'-4"	5'-0"	3'-0"	1'-5"	1'-0"	1'-0"	45°	2'-4"	2'-4"	3/4	3'-6"	15 TO 20	3,900
SG-10-7.0	7.0	10'-0"	4'-0"	2'-0"	4'-9"	5'-6"	5'-0"	1'-6"	1'-0"	1'-6"	45°	2'-6"	2'-6"	1	5'-6"	50	4,200
SG-11-9.5	9.5	11'-0"	4'-6"	2'-3"	5'-0"	6'-0"	5'-0"	1'-9"	1'-5"	1'-6"	45°	2'-10"	2'-10"	1	5'-6"	50	4,200
SG-12-12.0	12.0	12'-0"	5'-0"	2'-6"	5'-0"	6'-8"	5'-0"	1'-11"	1'-9"	1'-6"	60°	3'-1"	3'-1"	1	5'-6"	50	4,250
SG-14-16.0	16.0	14'-0"	6'-0"	3'-0"	5'-3"	6'-9"	5'-0"	2'-1"	1'-11"	1'-6"	60°	3'-4"	3'-4"	2	5'-6"	50	4,300
SG-16-20.0	20.0	16'-0"	7'-0"	3'-6"	5'-6"	6'-10"	5'-0"	2'-2"	2'-0"	1'-6"	60°	3'-6"	3'-6"	2	5'-6"	50	4,300
SG-18-30.0	30.0	18'-0"	8'-0"	4'-0"	6'-6"	7'-0"	5'-0"	2'-8"	2'-3"	1'-6"	60°	4'-3"	4'-3"	2	5'-6"	50	4,400
SG-20-50.0	50.0	20'-0"	9'-0"	4'-6"	7'-0"	8'-0"	5'-0"	3'-9"	3'-5"	1'-6"	60°	5'-10"	5'-10"	2	5'-6"	50	4,400
SG-24-70.0	70.0	24'-0"	11'-0"	5'-6"	7'-0"	8'-0"	6'-0"	3'-9"	3'-9"	1'-6"	60°	5'-11"	5'-11"	2	6'-6"	70	4,600

NOTES:
1) DIMENSIONS "G" AND "L" CHANGE ACCORDING TO TYPE OF SYSTEM:
DIMS. G1 AND L1 ARE USED FOR FREE FLOWING FLUME SYSTEM.
DIMS. G2 AND L2 ARE USED FOR PARSHAL FLUME SYSTEM.
REFER TO DRAWING D66918S FOR DIMENSIONS OF THE PARSHAL FLUME.
2) RECOMMENDED INLET STRAIGHT CHANNEL LENGTH IS 7 TIMES CHANNEL WIDTH ("C" DIMENSION) OR 15 FT, WHICHEVER IS GREATER.
3) ALL CONCRETE, GROUT, HANDRAIL AND GRATING BY OTHERS.
4) ALL DIMENSIONS ARE PRELIMINARY AND SHOULD NOT BE USED FOR CONSTRUCTION.
5) STEEL BAFFLE IS NOT REQUIRED FOR UNITS 30 MGD AND LARGER.
6) GRIT CLASSIFIER DRAIN SHOULD BE PIPED UPSTREAM OF THE GRIT CHAMBER OR TO FLOOR DRAIN.
7) WATER FLUIDIZING LINE IS TO ENTER GRIT TANK SIDE WALL NEAR BOTTOM OF LOWER HOPPER FOR UNITS 30 MGD AND LARGER.

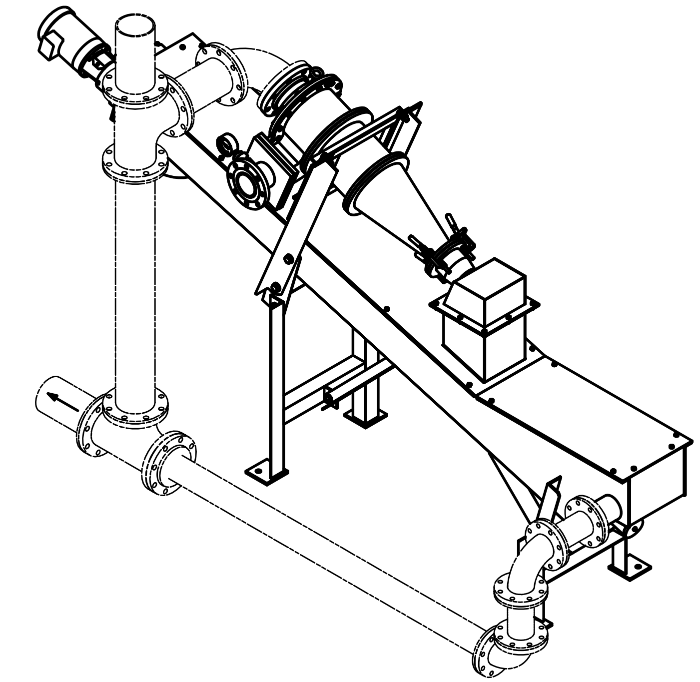
REVISION	DATE	DR	CHKD
G REVISED	4/4/18	MM	JS

LAKESIDE EQUIPMENT CORPORATION
Water Purification Since 1928

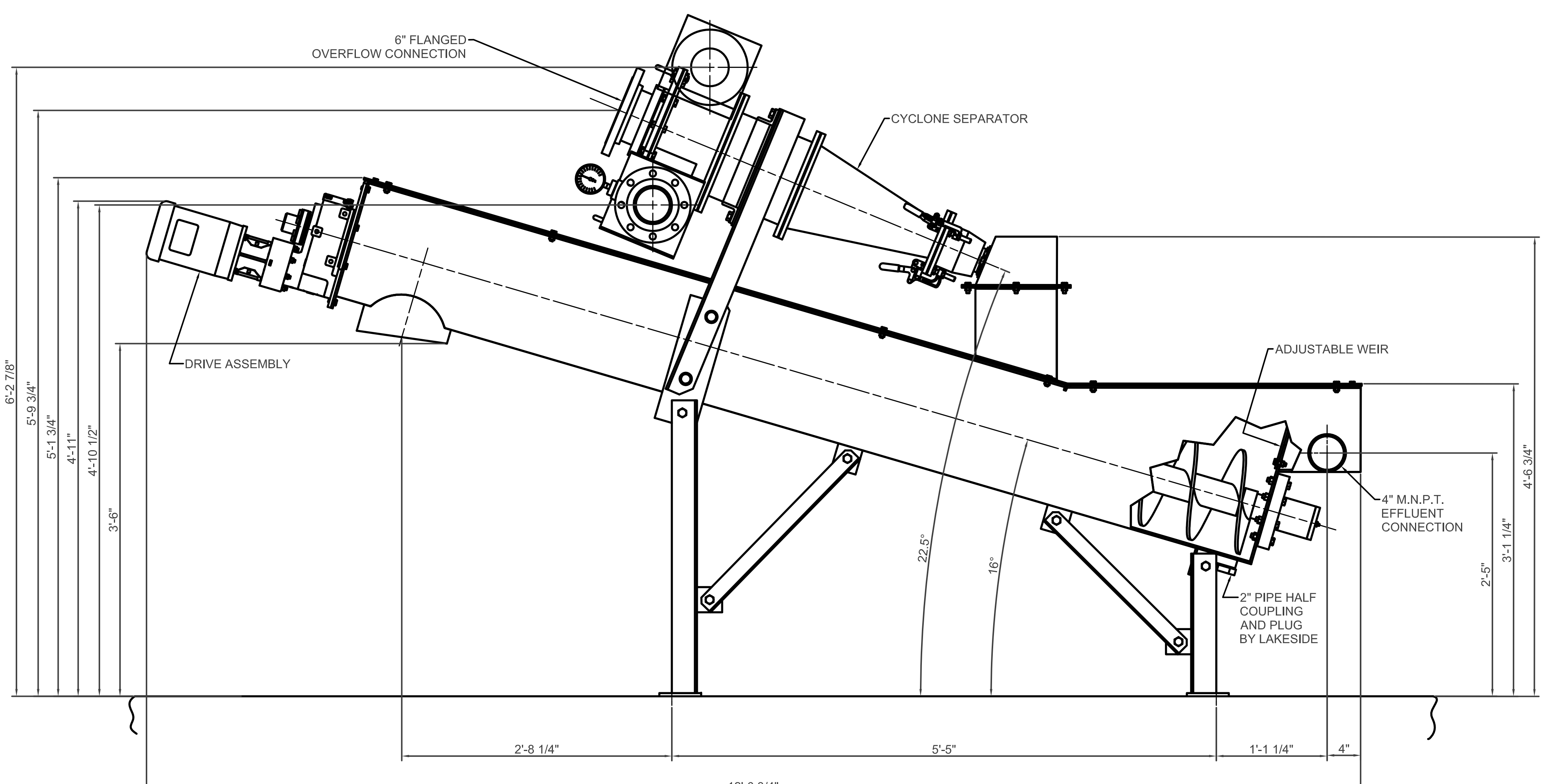
PROJECT
TITLE SPIRAGRIT w/ PUMP
DRAWN SNYDER DATE 12/17/2004
CHECKED DATE
SIZE D S.O. # DWG NO D70850-S REV G
SCALE FILE NO. 250



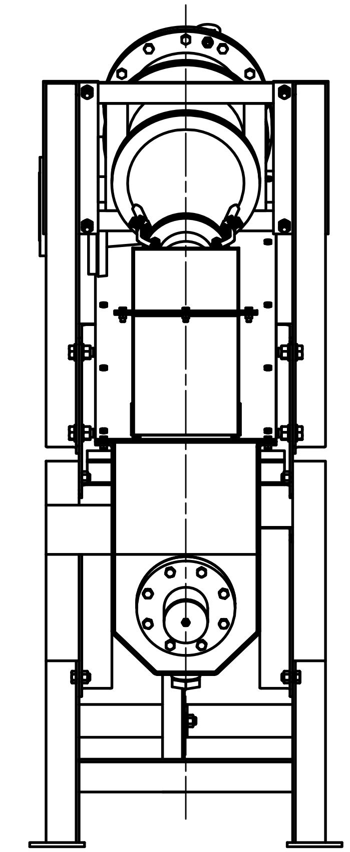
PLAN



TYPICAL EFFLUENT PIPING SCHEMATIC



ELEVATION



END VIEW

B REVISED	10-24-07	J.M.S.		
REVISION	DATE	DR.	CHKD	

LAKESIDE
EQUIPMENT CORPORATION

PROJECT: w/ CYCLONE SEPARATOR

TITLE: TYPE "W" GRIT CLASSIFIER

DRAWN S.Sosa	DATE 9/8/2005	SIZE D	S.O. #	DWG NO D72973-S	REV B
CHECKED		SCALE	SHEET 1 OF 1	FILE NO. 65	

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Howard Butler, PE (PA) Amanda Craver, EIT	Tel:	717-541-0622
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo M-5A Secondary Treatment Technology Selection** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memorandum is to present the reasoning for the secondary treatment technology selection and to narrow down the manufactures' proposals for design. This memo specifically addresses the selection criteria used to short list secondary treatment processes and manufacturers.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- 'TR-16 Guides for the Design of Wastewater Treatment Works', prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition revised in 2016
- 'Sequencing Batch Reactor Design and Operational Considerations', prepared by the New England Interstate Water Pollution Control Commission, dated September 2005 (NEIWPCC SBR Guidelines)
- NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2020 Edition.

3. Background

The Town of Mashpee is investigating building a new water resource recovery facility (WRRF). The WRRF will be built on a greenfield site directly east of the Mashpee Transfer Station (380 Ashers Path East, Mashpee, MA 02649).

The design average daily flow for the WRRF is 120,000 gpd and the design maximum monthly flow is 312,000 gpd; however, future expansions to the plant are expected (refer to Flows and Loads Basis of Design memo [M-1]). The Stage 2 design average daily flow is 240,000 gpd, and the Stage 2 design maximum monthly flow is 620,000 gpd. Therefore the design needs to maximize the scalability of the secondary treatment process and to design the overall plant with future expansions in mind.

The WRRF is expected to have effluent requirements of 3 mg/L of nitrogen, 30 mg/L TSS, 30 mg/L BOD, 15 mg/L oil and grease, and a coliform count below 200 cfu per 100 mL (as identified in TM M-2). While there are no expected limits for phosphorous, turbidity, or contaminants of emerging concern, information was requested from the manufacturers regarding performance for these parameters as there may be limits imposed in the future.

In addition to the secondary treatment system, the design of the WRRF includes a primary treatment system including screening and grit removal, a UV disinfection system, odor control and sludge handling. The limited site footprint precluded conventional activated sludge processes and the associated additional footprint required for separate tanks for each process stage.

4. Treatment Technology Alternatives

Two secondary treatment alternatives were identified in the Town's approved Watershed Nitrogen Management Plan (WNMP) for in-depth evaluation: Membrane Bio-Reactors (MBRs) and Sequencing Batch Reactors (SBRs). The treatment technologies are evaluated in this document based upon footprint, capital cost, energy requirements, treatability, and future growth potential. Table 1 below shows the advantages and disadvantages of both treatment technologies, irrespective of the other.

Table 1 Treatment Technologies Comparison

	Membrane Batch Reactor (MBR)	Sequencing Batch Reactor (SBR)
Advantages	• High quality effluent produced to achieve low nutrient limits • Small footprint requirement • Eliminates need for secondary clarifiers and tertiary filters • Independent HRT and SRT – Sludge Retention Time (SRT) and Hydraulic Retention Time (HRT) are completely independent since sludge solids are completely retained in the bioreactor • Can operate at a higher mixed liquor suspended solids (MLSS) concentration, reducing tank size.	• Potential capital cost savings by eliminating clarifiers and other equipment • Operating flexibility and control • Biological treatment, and secondary clarification can be achieved in a single reactor vessel
Disadvantages	• Potentially higher capital and operating costs • Higher pretreatment requirements (i.e. fine screenings) • Higher level of sophistication and maintenance (compared to conventional systems) • Peak flow limitations; may require equalization basins prior to the secondary process	• Higher level of sophistication and maintenance (compared to conventional systems) • Limited redundant tankage. • Potential effluent quality limitations without tertiary treatment. Denitrification filter required following SBR tankage to consistently meet effluent TN limit of 3 mg/L.
Disadvantages (continued)		• Surge in the effluent flow when the system decants; potential requirement

	Membrane Batch Reactor (MBR)	Sequencing Batch Reactor (SBR)
		for equalization after the SBR, depending on the downstream processes • NEIWPCC design guidelines recommend influent equalization basins for systems designed for nitrification /denitrification

The two secondary treatment technologies will be evaluated based on the above criteria and presented to the Town. Additionally, the cost comparison will be in a forthcoming document that will be presented to the Town for secondary treatment selection.

5. MBR Manufacturers' Proposal Review

MBR manufacturers were requested to submit proposals that adequately matched the requirements outlined in the RFP (RFP- MBR Rev 2). The submittal MBR proposals included:

1. Dynatec MBR
2. Kubota MBR
3. Kubota Membrane Thickener (MBT) Option
4. Suez ZeeWeed MBR

The proposals were reviewed based upon the requested criteria, and the following matrix outlines the findings.

Table 2 Manufacturers' Proposal Review Matrix

Criteria	Dynatec MBR	Kubota MBR	Kubota MBT Opt	Suez ZeeWeed
# of Tanks/Trains	In vessel	2 trains / 1 tank per train	2 MBR tanks; 1 MBT tank	2 trains
Maximum Month Flow	180,000 gpd	180,000 gpd	180,000 gpd	318,000 gpd[1]
Maximum Influent Month TSS Concentration	Not identified	170 mg/L	170 mg/L	135 mg/L
Maximum Influent Month BOD Concentration	169 mg/L	142 mg/L	142 mg/L	113 mg/L
No. of Blowers #	2 Units	2 PA / 3 MBR	2 PA / 3 MBR / 2 MBT	2 PA / 3 MBR
Blower horsepower	10 HP each	HP not provided	HP not provided	PA – 10 hp MBR -15hp
Blower Airflow	Not Provided	50 scfm / 380 scfm	70 scfm / 380 scfm / 106 scfm	PA - 150 SCFM MBR - 205 SCFM
Note: 1. Suez ZeeWeed proposal updated to reflect updated Maximum Month Flow				

The membrane bioreactor (MBR) process consists of a suspended growth biological reactor integrated with a membrane filtration system, using a hollow fiber ultrafiltration membrane. The membrane filtration system essentially replaces the solids separation function of secondary clarifiers and tertiary sand filters used in a conventional activated sludge process.

After the proposals were evaluated, the Dynatec and the Kubota MBT Option proposals were eliminated. The Dynatec MBR uses external tubular membranes that are skid mounted, located outside of the process tank. The external membranes would be housed inside a building. The Dynatec MBR design is not ideal for the Mashpee MBR design. Given how dissimilar it was from the other processes it was not a fair comparison with the other processes, and would have required a vastly different layout, precluding selection of alternates at the bid phase.

The Kubota MBT Option proposal includes, in Stage1, one of the two pre-aeration (PA) tanks and one of the three MBR tanks will be utilized as a Sludge Holding Tank (SHT) and Membrane Thickener (MBT) tank, respectively. To better handle higher flows, in Stage 2 the SHT will be used as a second PA tank, and MBT tank will turn into the third MBR tank with extra membrane cassettes employed. Due to the higher initial cost, and the complexity of the Stage 2 buildout modifications, the Kubota MBT Proposal was eliminated from consideration.

The Kubota MBR requires two trains with one tank per train. The Kubota Stage 2 expansion does not require any increases to the MBR footprint. The water surface elevations will increase in the anoxic tank and the MBR tanks to achieve the capacity to handle Stage 2 flows. The Kubota Stage 2 approach is a stackable approach requiring slightly taller tank wall heights (approximately 3-4' taller than the Suez design),

The Mashpee MBR preliminary basis of design will be based upon the Suez ZeeWeed MBR. The Suez ZeeWeed MBR requires 2-mm fine screening as a pre-treatment to the MBR, and recommends grit removal. The Suez layout was chosen for the preliminary design based on the ability to easily twin the layout for future stages, its more conservative future sizing requirements, and the very close cost estimates provided by the respective vendors. The Suez MBR processes consists of a suspended growth biological reactor integrated with a membrane filtration system with hollow fiber ultrafiltration membrane. The membrane filtration system essentially replaces the solids separation function of secondary clarifiers and tertiary sand filters used in a conventional activated sludge process. The membranes are immersed in mixed liquor. Using gravity or a permeate pump, a vacuum is applied to a header pipe connected to the membranes. The vacuum draws the treated water through the hollow fiber membranes. Permeate is then directed to downstream disinfection and discharge facilities. Air, in the form of large bubbles, is introduced below the bottom of the membrane modules, producing turbulence that scours the outer surface of the hollow fibers to keep them clean.

The Suez Stage 2 expansion requires an additional train be added in parallel to the two trains proposed for Phase 1. Each train includes a pre-anoxic tank, aerobic tank, post anoxic tank, ultrafiltration tank, supporting blowers, mixers, and a process equipment skid.

The Suez and Kubota MBR have similar footprint (during Stage 1), cost, energy requirements, achieve similar treatability, and both allow for the addition of Stage 2 flows with limited modifications or downtime. A second round of questions following the RFP was conducted with the manufacturers to request additional information to allow the design team to more uniformly compare options, and evaluate component equipment suppliers. The Seuz ZeeWeed technology was chosen to use for the preliminary design because it had a larger full buildout footprint and is considered more conservative for layout sizing. A detailed analysis of or-equal manufacturers will be conducted in the next stage of design.

6. SBR Manufacturers' Proposal Review

SBR manufacturers were requested to submit proposals that adequately matched the requirements outlined in the RFP (SBR RFP). The submitted SBR manufacturer's proposals included:

1. AquaAerobics SBR
2. Evoqua Omniflo SBR
3. Sanitaire SBR

The proposals were reviewed based upon the requested criteria, and the following matrix outlines the findings.

Table 3 Manufacturer Comparison

Criteria	AquaAerobics[1]	Evoqua Omniflo[2]	Sanitaire[3]
# of Basins/Tanks	2 rectangular basins / 2 tanks per basin	1 rectangular basin / 1 tank	2 rectangular basins / 1 tank per basin
Design Flow	260,000 gpd	260,000 gpd	260,000 gpd
Design TSS – Influent to SBR	117 mg/L	117 mg/L	117 mg/L
Design BOD – Influent to SBR	98 mg/L	98 mg/L	98 mg/L
Number of Pumps	3 submersible pumps	2 submersible pumps	not provided
Aeration Basin Blower # horsepower scfm	3 blowers 10 HP motor 189 scfm per basin	3 blowers 7.5 HP motor 103 scfm	2 Blowers 15 HP motor 220 scfm
# of Installations	31 – of similar size in New England region	21 – of similar size in New England region	not provided
HRT	0.672 days or 16 hours	0.829 days or 19.9 hours	1.11 days or 26.6 hours
SRT	17.7 days	25 days	38.1 days
Warranty	not provided	not provided	not provided
Equipment Cost	$408,880	$337,000	$464,600
Notes: 1. Based on AquaAerobics proposal April 29, 2019 2. Based on Evoqua proposal dated May 5, 2019 3. Based on Sanitaire proposal dated May 21, 2019			

After the proposals were evaluated, the Evoqua Omniflo and the Sanitare SBR proposals were eliminated. All of the manufacturers were able to treat the design flow and load to the same effluent standards. Based upon the footprint, tank arrangement, capital cost, energy requirements, treatability, and future growth potential criteria, the AquaAerobics SBR was selected for the SBR conceptual design. The AquaAerobics proposal was selected due to its compact layout, Stage 2 expandability, and the conventional SBR design. The advantages of the AquaAerobics SBR design include internal process piping in the SBR tanks and a lower hydraulic and solids retention time. AquaAerobics utilizes deeper tanks with greater variation in the internal water level to accommodate higher flows, reducing the footprint required. The two-basin setup provides more redundancy than the Omniflow system, despite having similar internal component layouts.

7. Recommendations

Based upon the evaluation criteria, the MBR was chosen due to the smaller footprint, higher effluent quality, and the future growth capacity. The Mashpee Sewer Commission also voiced a strong preference for the MBR technology. The MBR technology also has the benefit of being able to remove some microconstituents that a traditional SBR is unable to remove. The MBR can be constructed to accommodate the increase in flows anticipated in the expansion phase, but will not drastically increase the treatment footprint. Based on the overall analysis of the two alternatives, the MBR option was selected for conceptual design. The Suez ZeeWeed MBR technology was used for the preliminary design of the WRRF.

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Amanda Craver, EIT Howard Butler, PE (PA)	Tel:	717-541-0622
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – M-5B Membrane Biological Reactor** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memorandum is to establish the basis of design for the secondary treatment system. Major process components of the secondary treatment system include:

- Membrane Bioreactor (MBR) (including ancillary equipment)

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- 'TR-16 Guides for the Design of Wastewater Treatment Works', prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition revised in 2016
- NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2020 Edition.

3. Background

3.1 Alternatives Selection Memo

The Secondary Treatment Technology Selection Memo (M5-A) was previously created to evaluate the following secondary treatment designs:

- Membrane Bioreactor (MBR)
- Sequencing Batch Reactor (SBR)

The treatment technologies were evaluated based upon footprint, capital cost, energy requirements, treatability, and future growth potential. Advantages and disadvantages of both treatment technologies were evaluated in the Secondary Treatment Alternative Selection Memo. Based upon the evaluation criteria, the MBR was chosen due to the smaller footprint, higher effluent quality, and the future growth capacity. The Mashpee Sewer Commission also expressed a strong preference for MBR technology. The Suez ZeeWeed

MBR technology was chosen to use for the preliminary design, a cutsheet figure for the Suez ZeeWeed technology is attached to this memo. Further evaluation of or-equal manufacturers will be completed in later design.

3.2 Basis of Design

The basis of design lays out the secondary treatment process components and requirements at the Mashpee Site 4 WRRF. It will also evaluate the improvements necessary to meet the project's probable nitrogen removal goals. The secondary treatment basis of design features the following:

- Construction of a new membrane bioreactor (MBR) with an ultrafiltration (UF) membrane system and the following ancillary equipment:
  - Process pump equipment
  - Membrane scour aeration system
  - MLSS wasting system
  - Process aeration system
  - Fine bubble diffuser aeration
  - Process mixers
  - Mixed liquor recirculation equipment
  - Nitrogen recirculation equipment
  - Sodium hypochlorite cleaning system
  - Citric acid cleaning system
  - Supplemental carbon feed system
  - Compressed air system
  - Backpulse tank

4. MBR Design Criteria

The design criteria information for influent flow into the plant is presented in Table 2. An additional five percent loading above the base value is assumed for side stream load from the sludge handling processes.

Table 2 Stage 1 Design Influent Flow Rates

Parameter	Design Influent Flow (gpd)
Average Day	126,000*
Maximum Month	312,000
Maximum Day	360,000
Peak Instantaneous	648,000
* Includes 5% of base flow as an internal recycle per day.	

The MBR design is based on the wastewater characteristics form maximum month flows. The design influent loading conditions are summarized in Table 3.

Table 3 Design Influent Loads

Parameter	Max Month (lb/day)
TSS	358
BOD	300
TN	61
Total Phosphorus	9

The estimated mixed liquor suspended solids concentration is shown in Table 4.

Table 4 Design MLSS Concentration

Parameter	Value
MLSS Concentration	8,000 - 10,000 mg/L

In plants designed for nitrogen removal using the nitrification–denitrification process, the mixed liquor recirculation also serves to bring nitrate-nitrogen from the membrane tanks back to the anoxic zone of the bioreactors for denitrification. However, the range of MLSS concentration allowed in the bioreactor must still be 8,000 – 10,000 mg/L.

The year-round effluent performance requirements are summarized in Table 5.

Table 5 Performance Requirements

Parameter	Effluent Concentration (mg/L)	Expected Performance Limit Type
TSS	30 mg/L	Daily Maximum
BOD	30 mg/L	Daily Maximum
TN	3 mg/L	Annual Average
TN	10 mg/L	Daily Maximum
Oil and Grease	15 mg/L	Daily Maximum
Fecal Coliform	200 cfu / 100 mL	Daily Maximum
pH	6 - 9	Daily

The design influent temperatures are summarized in Table 6.

Table 6 Design Temperatures

Condition	Temperature (°C)
Winter	10
Summer	20

5. MBR Equipment Design

5.1 Biological System Design

The MBR biological system will be designed for Stage 1 flows. The proposed biological system consists of pre-anoxic, aerobic and post anoxic zones. The biological tank volumes and design characteristics are shown in Table 7 below.

Table 7 Biological System Design

Parameter	Value
Flow basis for biological design (Max Month Flow (MMF))	318,000 gpd
Total pre-anoxic working volume	10,000 gal
Total aerobic working volume (excluding membranes)	45,000 gal
Total post-anoxic working volume	13,000 gal
Total bioreactor working volume (excluding membranes)	68,000 gal
Total design Hydraulic Retention Time (HRT)	5.9 days
Total design Solids Retention Time (SRT)	21.5 days
Actual Oxygen Requirement (AOR) (based on Average Daily Flow (ADF))	410 lb O_2/day
Waste sludge removal (based on ADF)	1,200 gpd
Notes: Total design HRT and SRT includes pre-anoxic, post-anoxic, aerobic, and membrane tanks.	

Table 8 provides a summary of the components and equipment included in the MBR design.

Table 8 MBR Process Equipment Summary

Equipment	Quantity	Capacity/Size
Fine bubble diffuser system for process aeration	2	
Process aeration blower	2 duty, 1 spare	150 SCFM / 10 HP
Process mixers	4 (1 each per pre-anoxic and post-anoxic zones)	2.4 HP
Membrane scour blower	2 duty, 1 installed spare	205 SCFM / 15 HP
Membrane permeate pump	2 duty, 1 shelf spare	340 gpm / 10 HP
Nitrate recirculation pump	2 duty, 1 installed spare	455 gpm / 5.7 HP
RAS pump	2 duty, 1 installed spare	630 gpm / 10 HP

5.2 Ultrafiltration System Design

The MBR is a type of conventional activated sludge process that utilizes membranes instead of a secondary clarifier to separate biomass from secondary wastewater. The MBR system utilizes immersed hollow-fiber membranes located in the process tanks. The individual membranes are connected together into modules. The membrane modules are assembled into cassettes and the cassettes are installed in concrete process tanks. Using a permeate pump, a vacuum is applied to a header pipe connected to the membranes. The vacuum draws the treated water through the hollow fiber membranes. Permeate is then directed downstream to disinfection and discharge. Diffusers introduce air below the membrane modules to scour membrane surfaces for cleaning, facilitate mixing, and to contribute oxygen to the biological process. The UF system designed is summarized in Table 9 below.

Table 9 Ultrafiltration System Design

Parameter	Value
Type of membrane	ZeeWeed 500D
Number of Trains	2
Number of process pump skids	2
Type of cassette (52 module)	52
Number of cassette spaces per train	1
Number of cassettes installed per train	1
Module design per train	48
Total number of modules installed per train	48
Membrane tank internal dimensions (L x W x H)	8' x 9' x 13'

5.3 MBR Design Summary

A membrane bioreactor (MBR) that consists of a suspended growth bioreactor integrated with a hollow-fiber ultrafiltration (UF) membrane system is recommended for the Mashpee WRRF. The biological system for this project consists of pre-anoxic, aerobic, and post-anoxic zones. The UF membranes are directly immersed in mixed liquor. Using gravity or a permeate pump, a vacuum is applied to a header pipe connected to the membranes. The vacuum draws the treated water through the hollow fiber membranes. Permeate is then directed to downstream disinfection and discharge facilities. Air, in the form of large bubbles, is introduced below the bottom of the membrane modules, producing turbulence that scours the outer surface of the hollow fibers to keep them clean. The MBR system will include the following ancillary equipment:

- Process pump equipment
  - One reversible process pump per train is used to draw water through the membranes. The process pump, associated valves, and piping for the train are mounted on a factory assembled, epoxy-coated carbon steel skid.
  - One automatic ejector system per train to prime process pumps for permeation.
- Membrane scour aeration system
  - One duty membrane blower per train with one common standby blower is to be shared by all trains. The blowers are required to have isolation valves, check valves, pressure relief valve, pressure indicators, and flow indicators.
- MLSS wasting system
  - MLSS wasting is accomplished by periodically diverting mixed liquor from the recirculation return line, via manual control or by pulling directly from the bioreactor. The frequency of wasting is a function of influent characteristics, reactor design and operator preference. Wasting has the potential to be run at periodic increments or at a continuous 24-hour bleeding at a fixed flow rate.
- Process aeration system

  - The process aeration blowers provide air for the biological tank and ensure that sufficient oxygen is available to maintain the biological processes in the tank. Each train is supported by a duty blower, with a common spare blower shared between the two trains. Dissolved Oxygen control is provide to optimize efficiency of the aeration system.
- Fine bubble air diffusers
  - A fine bubble diffused aeration system delivers air from the process aeration blowers to the aerobic zone of the biological process tank.
- Process mixers
  - Process mixers are used to mix the pre-anoxic and post-anoxic zones to provide a completely mixed reactor zone.
- Mixed liquor recirculation equipment
  - Mixed liquor flows by gravity from the bioreactor to the membrane tank. Recirculation pumps are used to transfer mixed liquor from the membrane tanks back to the influent end of the bioreactor at a rate of 4 times influent flows, variable with the average daily flow rates.
- Nitrogen recycle equipment
  - Nitrogen recycle is necessary in cases where low effluent concentrations of TN are required. The mixed liquor recirculation system transfers mixed liquor from the end of the aerobic chamber to the beginning of the pre-anoxic chamber of the process tank. The nitrogen recycle pumps are designed for 2.5 times the maximum month flow.
- Sodium hypochlorite cleaning system
  - The sodium hypochlorite cleaning system is used for membrane cleaning to remove organic foulants from the membrane surface. The sodium hypochlorite solution is used for two types of cleaning: maintenance cleaning and recovery cleaning. Maintenance cleaning occurs two times per week at a sodium hypochlorite concentration of 200 mg/L. Recovery cleaning occurs two times per year at a sodium hypochlorite concentration of 1,000 mg/L. Both maintenance and recovery cleaning are estimated to consume approximately 420 gallons of sodium hypochlorite per year. Space will be provided for a 55-gallon drum for active use and spare drum storage.
- Citric acid dosing system
  - The citric acid dosing system is used for membrane cleaning to remove inorganic scaling from the membrane surface. The MBR uses citric acid for recovery cleaning two times per year at 2,000 mg/L concentrations. Space will be provided for a 55-gallon drum for active use and spare drum storage.
- Supplemental carbon feed system
  - The supplemental carbon dosing system is used to feed a carbon substrate into the biological tanks to assist in the conversion of nitrates to nitrogen gas.

5.4 System Redundancy

The MBR system, provided by Suez (ZeeWeed), is intended to be fully redundant at the maximum daily flow – that is one train can handle the peak daily flow for 24 hours. Additional redundancy beyond this max day condition is not recommended, as the increased flow capacity is proportional to the membrane surface area, resulting in significantly increased costs. Influent equalization tanks will be provided in the design to shave peak flows to the secondary treatment system. Should the Town wish to increase the internal redundancy, physical space is available to accommodate a longer duration of the established peak daily flow. Space is available on the cassettes for additional membrane modules - by increasing the number of modules in the future additional capacity could be gained – currently the cassettes have 7% open space available.

Attachments

TOP VIEW

TANK COVER NOT SHOWN FOR CLARITY

NOTES:
1. THIS DRAWING IS NOT TO SCALE.
2. TANKS GEOMETRY AND DEPTH, ALONG WITH EQUIPMENT/PIPING LAYOUT AND POSITIONING ARE PRELIMINARY AND CAN BE FURTHER OPTIMIZED TO BEST SUIT THE SITE CONDITIONS.

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A1	PRELIMINARY - NOT FOR CONSTRUCTION					

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SUEZ

CUSTOMER INFORMATION
MBR SYSTEM FOR PORT DEPOSIT WWTP

PLOT PLAN LAYOUT

DRAWING NUMBER				REVISION
344633-PC-01				A1
REF.:	DOC. OWNER:			
PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
344633	344633-PC-01	1:32	D	1 OF 3

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SECTION A-A

NOTES:
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A1	PRELIMINARY - NOT FOR CONSTRUCTION					

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CUSTOMER INFORMATION
MBR SYSTEM FOR PORT DEPOSIT WWTP

PLOT PLAN LAYOUT

DRAWING NUMBER	REVISION
344633-PC-01	A1

REF.:
DOC. OWNER:

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
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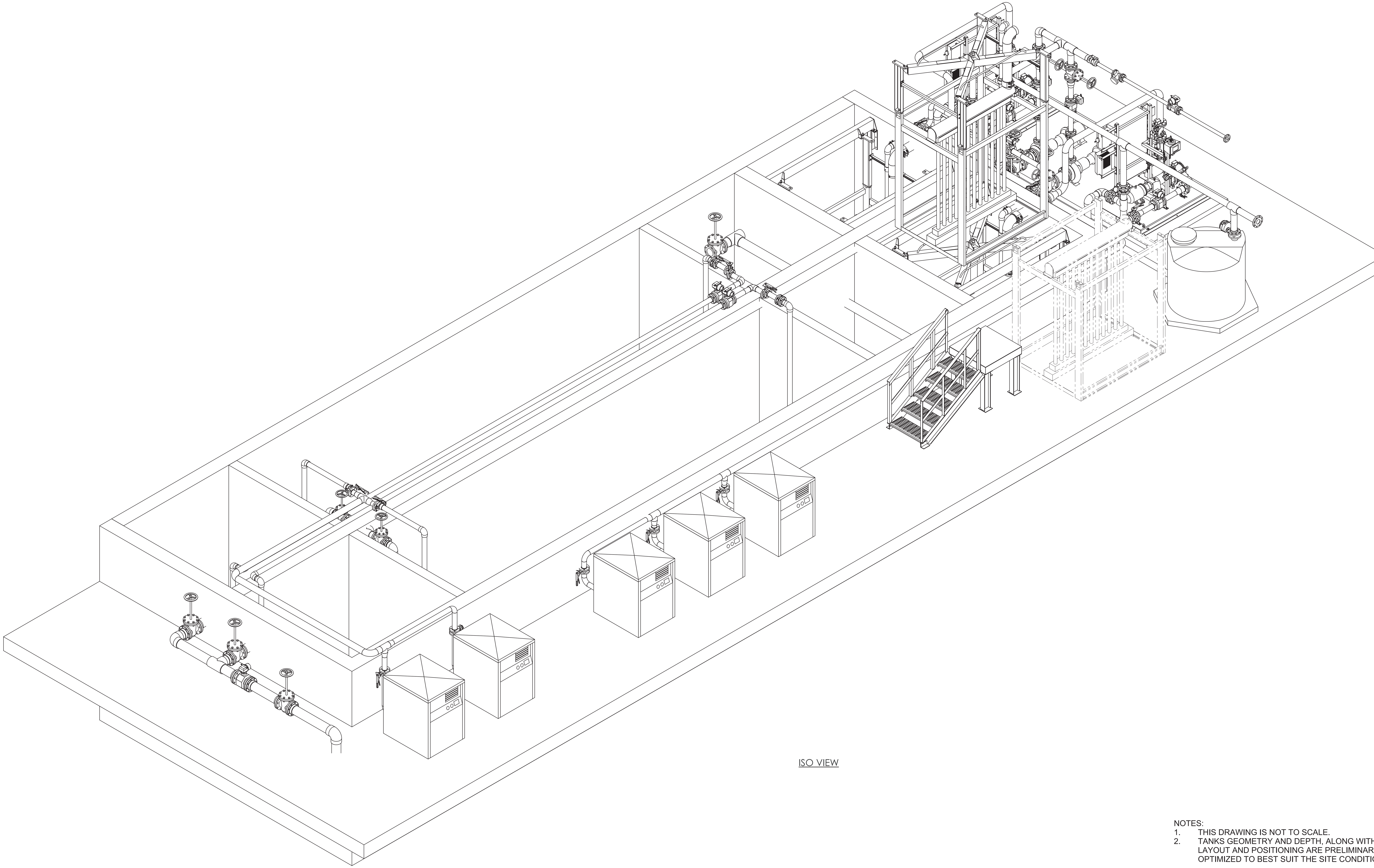
LAST SAVED: Wednesday, July 17, 2019 2:30:54 PM



ISO VIEW

NOTES:
1. THIS DRAWING IS NOT TO SCALE.
2. TANKS GEOMETRY AND DEPTH, ALONG WITH EQUIPMENT/PIPING LAYOUT AND POSITIONING ARE PRELIMINARY AND CAN BE FURTHER OPTIMIZED TO BEST SUIT THE SITE CONDITIONS.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A1	PRELIMINARY - NOT FOR CONSTRUCTION					

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CUSTOMER INFORMATION
MBR SYSTEM FOR PORT DEPOSIT WWTP

PLOT PLAN LAYOUT

DRAWING NUMBER				REVISION
344633-PC-01				A1
REF.:	DOC. OWNER:			
PROJECT NO. 344633	PART/MATERIAL NO. 344633-PC-01	SCALE 1:32	SIZE D	SHEET 3 OF 3

LAST SAVED: Wednesday, July 17, 2019 2:30:54 PM

FILE LOCATION: C:\GEWaterVault\NAM-ITO\344633 - MBR SYSTEM FOR PORT DEPOSIT WWTP\2. Mechanical Drawings\

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – M-6 UV Disinfection** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to provide a Basis of Design for wastewater disinfection for the Mashpee Water Resource Recovery Facility (WRRF).

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016

2.1 References

- Water Environment Federation; "Design of Municipal Wastewater Treatment Plants"; WEF Manual of Practice No 8; Fifth Edition; 2010
- Tchobanoglous, George; Burton, L. Franklin; Stensel, H. David; "Wastewater Engineering: Treatment and Reuse"; Metcalf and Eddy, Inc.; Fifth Edition; 2014

3. UV Disinfection

Regulatory limits and disinfection systems are usually designed based on one of the following indicator species: total coliform, fecal coliform, Escherichia coli (E. Coli) or Enterococci. Chlorination or Ultraviolet (UV) light radiation are the two most common types of disinfection at wastewater treatment facilities. Ultraviolet disinfection was selected as the disinfection method at Mashpee WRRF over other disinfection methods as identified in the Mashpee approved WNMP. UV disinfection was chosen due to its small footprint, limited need for chemical storage and ability to disinfect a variety of flow rates.

4. Design Requirements

4.1 Design Flows

The Design flows that will be required to be disinfected by the UV disinfection are shown in Table 1. UV equipment will be sized to handle peak instantaneous flow.

Table 1 Design Flows

Parameter	Stage 1 Design	Stage 2 Design	Stage 3 Design	Stage 4 Design
Average Day (gpd)	120,000	240,000	360,000	480,000
Maximum Month (gpd)	312,000	624,000	936,000	1,248,000
Maximum Day (gpd)	360,000	720,000	1,080,000	1,440,000
Peak Instantaneous (gpd)	648,000	1,296,000	1,944,000	2,592,000

4.2 Effluent Limits

Expected design effluent limit parameters for the Mashpee WRRF are shown below in Table 2. The proposed effluent recharge location is located outside of a Zone II or Interim Wellhead Protection Area.

Table 2 Proposed Mashpee WRRF Effluent Limits

Parameter	Effluent Limit	Limit Type
Total Suspended Solids (TSS)	30 mg/L	Daily Maximum
Biological Oxygen Demand (BOD)	30 mg/L	Daily Maximum
Total Nitrogen (TN)	10 mg/L	Daily Maximum
Total Nitrogen (TN)	3 mg/L	Annual Average
Oil and Grease	15 mg/L	Daily Maximum
Fecal Coliform	200 cfu / 100 mL	Daily Maximum
pH	6 - 9	Daily

5. Design Criteria

The basis of design for the UV disinfection system is for a vertical open-channel system. The system will consist of one UV channel and be able to disinfect peak instantaneous flow with one module out of service, per TR-16 guidelines. The design criteria for the UV disinfection is shown below in Table 4.

Table 4 Design Criteria

Parameter	Value
Design UV Transmittance	65%
Minimum No. of Channels	1
Number of Redundant Modules	1
Treatment Capacity per Channel	100% of Peak Hour Flow
Design Peak Instantaneous Coliform Effluent Limit	200 cfu/ 100 mL
Note: 1. UV Dose at Peak flow, determined by bioassay	

The system must maintain the minimum design dose under the following conditions, including but not limited to:

- Inclusion of a lamp aging factor of 0.80.
- Inclusion of a lamp fouling factor of 0.88 (based on clean sleeves).
- Peak hour flow with one module out of service.

The efficiency of the lamps shall be calculated in terms of emissions at 253.7 nanometres wavelength per TR-16 recommendations.

Type 316 Stainless steel shall be available for all metal components of equipment design

6. Concept of Operation

6.1 UV Disinfection

The UV system will dose based on flow and a UV transmittance (UVT) or intensity monitoring signal to control turndown of the system. Fixed weirs, motorized automatic level controllers, or hydraulic controls can be used to keep water level constant at the lamps.

Each module may include a mechanical cleaning component (i.e. wipers) for in-situ cleaning. This is not required in high-quality filtered effluent but is strongly suggested as per TR-16 guidelines. Provisions should be made to allow for removal of each module from the channel for chemical cleaning.

The UV disinfection system shall have a control system and PLC to monitor and control the UV lamps. Lifting devices or davit cranes will be required to lift the modules in a safe and accessible manner.

6.2 Emergency Power

In accordance with TR-16, a backup electrical supply capable of powering the entire system will be provided.

6.3 Equipment Comparison

Multiple manufacturers were contacted for the UV disinfection equipment. Based on the responses received the preliminary design was based off of the most conservative sizing requirements. An evaluation of or-equal manufacturers will be completed in later design.

The equipment information that the preliminary design was based off of is listed in Table 5, the cutsheet figure for the Ultratech UV Disinfection system is attached.

Table 5 Stage 1 Equipment Comparison

Description	Values
Design UV Transmission	65%
Design TSS	10 mg/L
Number of Channels	1
Number of UV Modules	2 (1 Duty, 1 Spare)

Description	Values
Number of UV Lamps per Module	40
Maximum Water Elevation in Channel	62 in
Minimum Water Elevation in Channel	58 in
Headloss at Peak Flow	<1 in
Cost For Stage 1	$159,000
Additional Cost for Stage 2	$0
Main Cleaning Operation	Air scour
Main Cleaning Chemicals	Food grade Citric Acid
Main Cleaning Position	In-line

The number of modules expected for each flowrate is shown below in Table 6.

Table 6 Number of Modules needed to meet Stage Flowrates

Stage	Number of Modules
Stage 1	2 (1 use, 1 spare)
Stage 2	2 (1 use, 1 spare)
Stage 3	3 (2 use, 1 spare)
Stage 4	3 (2 use, 1 spare)

6.4 Cleaning of Systems

The cleaning system used for the preliminary design is that of the Ultratech Terminator which is described below.

6.4.1 Ultratech Cleaning System

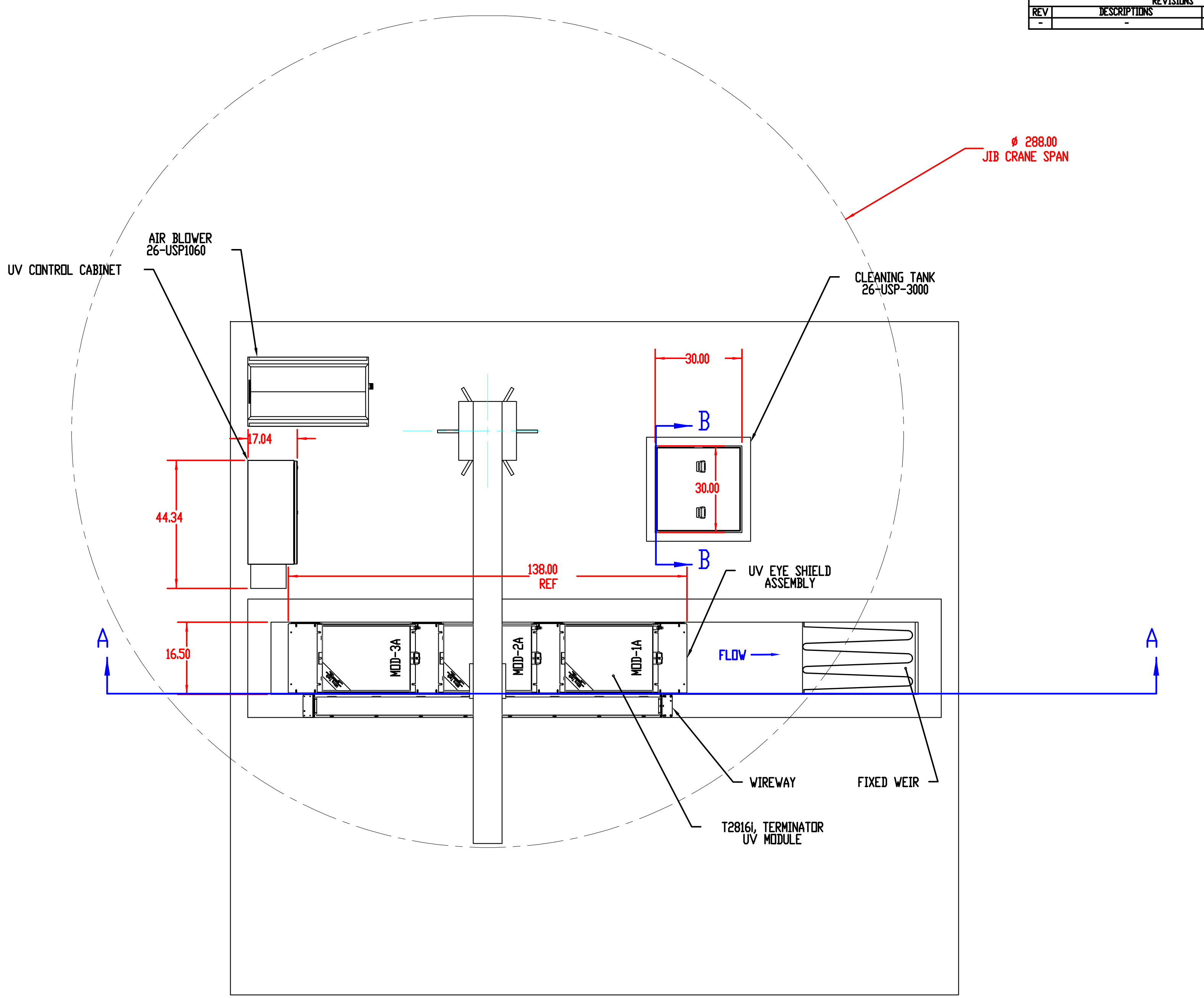
The Ultratech Terminator™ uses an in-channel air scrub that is scheduled to run automatically for 15 minutes every other day. Additionally a deeper cleaning of the Terminator™ system can happen infrequently (usually four times a year) through one of the three following means:

- In-channel air scour and simultaneous treatment with food grade citric acid for 15 minutes while model is out of service.
- Rinsing of modules lifted above channel with water for 5 minutes.
- Removal of module, to be placed into cleaning tank with air scouring and food grade citric acid for 15 minutes.

7. Design

The preliminary design of the Mashpee facility uses the sizing and layout of the Ultratech system due to its scalability for future stages of expansion and more conservative sizing due to the requirement for chemical cleaning tank and air scour equipment.

Attachments



REVISIONS			
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UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/32
ANGULAR: MACH ± 1°
TWO PLACE DECIMAL ± .05
THREE PLACE DECIMAL ± .005

	NAME	DATE
DRAWN	J.K.LEVIS	3/13/17
CHECKED		
ENG APPR.	G.P.	3/13/17

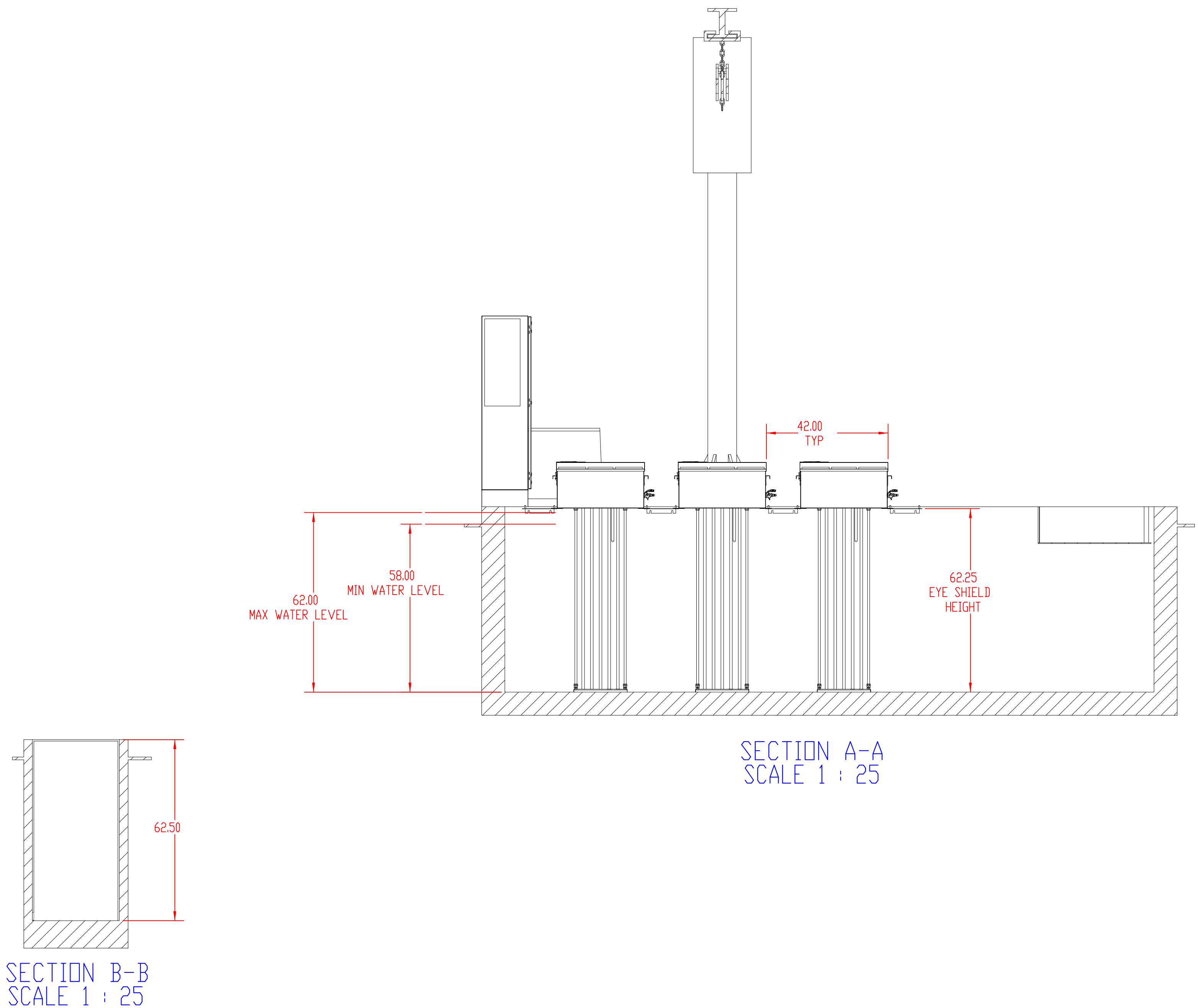
MATERIAL
,
FINISH
FREE OF BURRS & SHARP EDGES

ULTRATECH SYSTEMS, INC.

TITLE: FACILITIES, UV DISINFECTION SYSTEM, 3 MODULE SYSTEM T2816I

SIZE C | DWG. NO. GID 3X1 T28 | REV -

SCALE: 1:25 | WEIGHT: | SHEET 1 OF 2



ULTRATECH SYSTEMS, INC.

TITLE: FACILITIES, UV DISINFECTION SYSTEM, 3 MODULE SYSTEM T2816I

SIZE	DWG. NO.	REV
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SCALE: 1:35 WEIGHT: SHEET 2 OF 2

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
	Lenna Quackenbush		774-470-1654
From:	Anastasia Rudenko PE, BCEE, ENV SP	Tel:	774-470-1637
CC:			
Subject:	**Basis of Design Memo – M-7 MLSS Waste Storage** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to develop a MLSS waste storage and disposal plan for the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016
- NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2020 Edition.

3. References

The following references were used to develop this memorandum:

- 'Final Recommended Plan / Final Environmental Impact Report – Town of Mashpee Sewer Commission', prepared by GHD and dated May 2015 (WNMP)

4. Design Criteria

Preliminary information from MBR manufacturers indicate the MBR process will produce about 2,600 gpd of MLSS waste based on Stage 1 average daily flow conditions. This value will be used for preliminary design sizing and will be confirmed in a later phase through BioWIN modeling.

MLSS waste will be pumped from the MBR to the holding tanks which will be aerated to prevent septic conditions. The biosolids holding tank is sized for a 10 day at average annual conditions. Table 1 shows the design parameters for the MLSS waste/biosolids holding tank.

Table 1 Stage 1 MLSS Waste Holding Tank Design Parameters

Parameter	Value
Number of Units	1 (divided)
Tank Dimensions	20 ft Diameter x 15 ft (height) [13 ft (SWD)]
Unit Volume	30,500 gallons
Number of Days Storage Time – average annual flow	10 days

There are several options for the disposal of biosolids once it is in storage. The first option is to haul liquid biosolids (<2% solids) from the MLSS holding tanks offsite to a facility designed to manage liquid.

The second option is to add biosolids thickening equipment and to haul thickened biosolids (<6% solids) offsite. This would require another building to store the thickening equipment, and a thickened biosolids storage tank and truck fill facilities.

The third option is to dewater the WAS and to haul the dewatered biosolids (15 to 20% solids) offsite for processing. This approach would also require a building to store the dewatering equipment, biosolids conveyors, and a truck/trailer loading area for dewatered solids.

Based on a preliminary cost estimate, the most cost-effective option at this site is storage in a biosolids holding tank and disposal of dilute liquid biosolids. Any extra equipment would require a building to house it in, which increases capital costs for the site. Additionally, biosolids processing on site is not being recommended so as to avoid odor generation through the solids handling process.

Several regional biosolids disposal contractors were contacted to evaluate the viability of hauling liquid biosolids. Waste Water Services Inc, in Bridgewater Massachusetts indicated that the company provides biosolids hauling services for several private wastewater treatment facilities in Mashpee. The Joint Base Cape Cod (JBCC) WWTF, which is located in a neighboring town, also hauls liquids biosolids. Market viability and hauling costs for liquid biosolids disposal will need to continue to be re-assessed as design proceeds.

Aerobic biosolids holding is a commonly used method for biosolids storage before it is transported to be further treated or disposed of. The aerobic biosolids holding will provide limited volatile solids reduction; it is basically a holding/storage tank for biosolids until it is ready to be transported to another facility for further treatment.

Advantages of aerobic biosolids holding include the following:

- Operation, maintenance, and control of aerobic biosolids holding is simple; less training may be required as contract operations staff are already familiar with major system components (blowers, pumps, diffusers, etc.).
- Safer to operate – does not generate combustible biogas.
- Less prone to process upsets, less demanding of operator process control input.

- Open tanks (typical) without confined space entry requirements, important when cleaning and repairing tank and equipment. Cover removal will be required, but once covers are removed the tanks are fully open to atmosphere.

The proposed aerobic biosolids holding system will consist of the following:

- Aerobic biosolids holding tank.
- Positive Displacement Blowers.
- Stainless steel air piping.
- Coarse bubble diffusers.

The aerobic biosolids holding has the potential to generate odors. Therefore, these tanks will be covered and piped to the odor control system.

The conceptual design parameters of the aerobic digestion system are summarized in Table 5.2.

Table 2 Aerobic Digester Basis of Design

	Basis of Design
No. of units	1 (divided)
Digester dimensions	16.5 ft. L x 16.5 ft. W x 13 ft. side water depth (total depth 15 ft.)
Design solids retention time (SRT)	10 days @ Stage 1
Diffuser type	Coarse Bubble
Oxygen transfer efficiency (OTE)	7.8%
No. of blowers (Stage 1)	3 (2 in Operation and 1 backup)
Blower type	Positive Displacement
Blower capacity	125 scfm at 5.2 psig
Blower motor size	6 horsepower

The holding tank design parameters are based off the following assumptions:

- MBR vendor estimates 2,600 gpd biosolids per stage at the prescribed flow and load.
- Assume 66% volatile solids removal during the treatment process to obtain a reasonable biosolids yield.

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Anastasia Rudenko PE, BCEE, ENV SP	Tel:	774-470-1637
	Lenna Quackenbush		774-470-1654
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – M-8 Ancillary Equipment** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to summarize the ancillary processes for the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts.

2. Codes and Standards

- TR-16 Guides for the Design of Wastewater Treatment Works; New England Interstate Water Pollution Control Commission, 2011 Edition as revised in 2016.
- NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

2.1 References

- Water Environment Federation; "Design of Municipal Wastewater Treatment Plants"; WEF Manual of Practice No 8; Fifth Edition; 2010.
- Tchobanoglous, George; Burton, L. Franklin; Stensel, H. David; "Wastewater Engineering: Treatment and Reuse"; Metcalf and Eddy, Inc.; Fourth Edition; 2003.

3. Plant Water

A plant water system will be provided using a pre-fabricated skid mounted system, located in the Process Building Pump Room. The skid system will be preceded by a strainer. The system will provide flow to maintain the pressurized distribution network. Provisions will be made to add sodium hypochlorite to the plant water system to prevent filamentous growth.

The plant water system sizing will be based off of the minimum, average, and peak demands for Stage 1 operation. The following assumptions will be used to establish the three design flow conditions:

- Minimum Demand – Any process that requires a continuous supply of plant water.

- Average Demand – Any process equipment that requires a continuous supply of plant water plus consistent intermittent needs.
- Peak Demand – Any process equipment that requires continuous supply of plant water, intermittent needs, and 25% of all yard hydrant and host bibs.

The proposed plant water system is a triplex system, with one pump running during minimum and average demands and two pumps running to meet the peak demand. The system will be designed to maintain a designated pressure within the piping network. A hydro-pneumatic tank will serve as a buffer to maintain the system pressure during times of minimum demand.

4. Distribution Boxes

Three new distribution boxes will be constructed at the following locations:

1. Preliminary Treatment Effluent Distribution Box – distributes flow from preliminary treatment to the Secondary Influent Distribution Box.
2. Secondary Treatment Influent Distribution Box – distributes flow to secondary treatment trains.
3. Effluent Distribution Box – distributes flow from UV disinfection to each sand bed.

5. Flow Measurement

Influent flow will be measured through influent pump station run times.

Effluent flow will be measured by an effluent weir in the Effluent Recharge Distribution Box using an ultrasonic level sensor to record water level readings at the weir. This flow rate will be reported to the SCADA system for process control, monitoring, and reporting.

6. Flow Equalization (EQ) Basins

Two offline flow equalization basins will be provided to enhance the overall process performance of the WRRF. The basins will allow the plant to attenuate extreme diurnal variations in the incoming pumped flow from the wastewater collection system, thereby enhancing the treatment efficiency of the downstream unit processes.

Space has been reserved in the site layout for additional future underground EQ basins for future stages.

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Anastasia Rudenko PE, BCEE, ENV SP Lenna Quackenbush	Tel:	774-470-1634
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – M-9 Odor Control Processes** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to provide and compare options for odor control for the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016
- NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2020 Edition.

2.1 References

The following references were used to develop this memorandum:

- 'Final Recommended Plan / Final Environmental Impact Report – Town of Mashpee Sewer Commission', prepared by GHD and dated May 2015 (WNMP)

3. Background

Construction of the proposed Mashpee WRRF was recommended in the Mashpee Watershed Nutrient Management Plan (WNMP) to address nitrogen impacts to coastal embayment's from existing septic systems.

The proposed location of the WWRF is a greenfield municipal property, bordered on the west by a municipal covered landfill and active transfer station. The site is bordered by residential neighborhoods on the remaining three sides. Due to its proximity to residential neighborhoods, a robust odor control system is considered a critical success factor for this project. In order to control odors all preliminary treatment equipment will be enclosed in the Preliminary Treatment Building and all secondary treatment equipment and tankage will be enclosed in the Process Building, in addition the secondary process tanks within the Process Building will also be covered.

3.1 Potential Sources of Odors

Odors emanate from various parts of a typical wastewater treatment facility. Some treatment processes have a greater potential for producing odors. Hydrogen sulfide is the most commonly known and prevalent odorous gas associated with wastewater treatment and collection systems. It has a characteristic rotten egg odor, and is corrosive to metals. It is also a precursor to the formation of sulfuric acid, which corrodes concrete, metals, and other materials. Hydrogen sulfide is formed when dissolved oxygen has been depleted from wastewater and it has become anaerobic or septic. Under these conditions, anaerobic bacteria metabolize elemental sulfur and sulfates to create hydrogen sulfide and mercaptans.

Typically the preliminary treatment process and biosolids holding tanks/processing have the highest potential for odors. In order to minimize the potential for odors it is recommended that biosolids are not processed on-site. Processes with low odor-producing potential include the activated sludge process aeration tanks, and effluent disinfection.

Sulfide concentrations in wastewater and resulting hydrogen sulfide concentrations in the air can be highly variable. Sulfide concentrations at a wastewater treatment facility can range from negligible quantities (less than 1 ppm) in dilute wastewater to 20 to 30 ppm or higher in some cases. Because there is no plant data available to determine the quantities of odorous compounds at the proposed Mashpee WRRF, estimated quantities of odorous compounds will be based on GHD’s experience with odor control systems.

4. Odor Control Basis of Design

Odor control will be accomplished through containment, collection, conveyance, and treatment of odorous air produced by the wastewater treatment process. The components of the proposed odor control system are described below.

4.1 Containment, Collection, and Conveyance

4.1.1 Containment

Enclosures and covers are used to contain odors. Dumpsters, hoppers, and certain types of equipment can be enclosed, while tanks and channels are typically covered to contain odorous air. Potential enclosure materials include lightweight fiberglass or non-corrosive metals. Cover materials that have been used include coated concrete, polyvinyl chloride lined concrete, coated steel, stainless steel, aluminum, plastic, fiberglass, and fabric. Aluminum, fiberglass, and fabric covers are widely used in both tank and channel covers. Aluminum covers are lightweight, UV- and weather-resistant, and durable (expected to last at least 20 years). Fiberglass covers are also lightweight, UV- and weather-resistant, but they are more expensive and may be less durable than aluminum covers.

An alternative to covering and collecting the odorous air is to cover the tanks and provide as tight a seal as possible. This will contain most odors, until the cover is removed for inspection or maintenance, then the build-up of odors will be released. Covering without collecting/removing the foul air can cause corrosion problems for metals and concrete due to the high concentrations of hydrogen sulfide gas that will accumulate. Thus, special coatings would be required to protect these materials. Covering tankage without collecting/removing the foul air is not recommended for this project due to the potential of strong odor releases during tank inspection and maintenance, and the potential for severe corrosion problems.

4.1.2 Collection and Conveyance

Ducts are used to convey odorous air from the source to the treatment unit. Materials used for ducts, which are large diameter pipes, include stainless steel, fiberglass reinforced plastic (FRP), and plastic. These ducts can be buried or elevated through supports. Due to the proximity of residential neighborhoods to the site, it is recommended that the ducts be buried for this project to minimize the visual impact of the site.

4.2 Odor Control Treatment

Multiple options for odorous air treatment were evaluated as part of this project, and are listed and compared in Table 1.

Table 1 Odor Treatment Options

Odor Control Method	Advantages	Disadvantages
Chemical Treatment	Can be a relatively cheap form of odor control (hydrogen peroxide, iron salts).	Iron salts can adversely affect UV disinfection equipment.
	Iron sludges can enhance settling properties of existing sludges.	Requires chemical tankage and storage.
		Depending on chemical, results are local and do not help downstream.
Packed Tower Scrubbers	Relatively small footprint.	Not effective on low-strength odors.
	Typically more space-efficient than soil compost filters or tankage for liquid chemical feed.	Requires heated area for chemical storage and sump.
	Does not need to be taken down for periodic regeneration or element replacement.	Not effective on odorous compounds which are not water-soluble.
	Able to treat stronger odors.	May cause a chlorine smell.
Activated Carbon Filters	Very effective on low strength odors.	May not be effective on large-chain odor molecules.
	No chemical storage feed required (except regeneration).	Requires periodic regeneration or replacement of activated carbon charge.
	Small footprint.	High-strength odors may shorten life of the carbon.
		Rapid loss of effectiveness once activated carbon reaches breakthrough.
Bioflters	Very effective on low strength odors.	Not suitable for very strong odors.
		May need supplemental nutrients at low flow.
	Very simple technology and low maintenance.	Large surface area required (except pre-engineered units).

It was determined that chemical treatment and packed tower scrubbers are not suitable for the Mashpee WRRF. Chemical treatment would require extra tanks for storage, and iron salts could harm UV disinfection units. Packed tower scrubbers are used to treat strong odors and can produce a chlorine smell at low strength odors. Packed tower scrubbers are typically not effective on low-strength odors.

Activated carbon filters are very effective on low-strength odors and do not require chemical storage. However, activated carbon must be periodically regenerated or replaced, which can be expensive. Typical lifespan ranges from six months to a year while particularly strong odors may shorten its lifespan. Additionally, the risk of odor complaints increases as the media approaches breakthrough.

Biofilters treat odorous air passes through a media that supports biologically active organisms. Organism's specific for the degradation of the specific odorous compounds accumulate on the media and multiply. The biofilter can either be made of soil amended with compost to remove odors or a manufactured system that utilizes an inorganic media. To maintain the biological process, several parameters such as moisture content, pH, and bed density must be maintained within relatively narrow ranges. Moisture content is a critical parameter because if the bed is too dry, adsorption will not be possible and the biota will not survive. Conversely, if the bed is too wet, anaerobic conditions may be present in the bottom of the filter and it may become a source of odors itself. Biofilter leachate is collected and sent to the head of the plant for treatment.

Biofilters are very effective on low-strength odors and are a simple technology. Due to it's relatively simplicity a biofilter is being proposed for odor control as part of the Mashpee WRRF preliminary design.

There are two basic types of biofilter: soil compost units and pre-engineered units. A soil compost unit consists of a header and distribution ducts surrounded by crushed stone with approximately three feet of soil amended with compost, covered with chipped wood or bark to retard moisture escape. The lifespan of a soil compost biofilter is approximately three to five years, after which the soil-compost amendment needs to be replaced. The ultimate determination of replacement time is made either by increased headloss through the filter or reduced effectiveness of the filter. Additionally, soil compost units typically require large footprints.

A pre-engineered unit can be designed in a smaller footprint. Pre-engineered units typically use an inorganic media that has a 20-year design life. Due to the smaller footprint and lower maintenance requirement for media replacement, a pre-engineered odor control unit is included in the preliminary design of the proposed Mashpee WRRF.

4.3 Odor Control Treatment Sizing Criteria

Odor control treatment sizing criteria for each process is outlined below.

4.3.1 Influent Pumping Station

Raw wastewater pumping stations can be a significant source of odors when turbulence in the wet well allows odorous gas to escape from the water to the air. The wet well will be covered. Potentially odorous air from the headspace between the cover and water surface will be conveyed by ductwork to an odor control unit. To be conservative, preliminary odor control sizing was based on an airflow rate of 12 air changes per hour from the influent pumping station. The air flow rate will be refined in final design once NFPA classifications for each structure have been finalized.

4.3.2 Preliminary Treatment

Preliminary treatment can be a significant source of odors because the processes create turbulence, which allows odorous gas to escape from the water to the air. Potential odors will be managed by locating all preliminary treatment equipment within an enclosed building. Air from the Preliminary Treatment Building will be conveyed by ductwork to an odor control unit. To be conservative, preliminary odor control sizing was based on an airflow rate of 12 air changes per hour from the Preliminary Treatment Building. The air flow rate will be refined in final design once NFPA classifications for each structure have been finalized.

4.3.3 Secondary Treatment

Odors from the activated sludge processes are generally described as “musty” or “earthy” and are generally not strong odors. However, to minimize the potential for odors from these processes, all secondary treatment and disinfection equipment will be located within an enclosed building.

Three design options for the process tank room are currently being investigated, which effect the odor control system:

Alternative 1: Open Tanks Inside the Room

Tanks: Division 1 (9.a1)

Room: Division 1 (9.a1)

The ventilation required for the space based on building and fire code would first have to be determined. Then working with the odor control representatives the airflow required to properly control odor in the building would have to be determined. The larger of the two airflow rates would be used to design the odor control system.

Alternative 2: Covered Tanks with Less than 12 Air Changes per Hour

Tanks: Division 1 (9.a1)

Room: Division 2 (9.a2)

The airflow being pulled from under the tanks would be considered unoccupied and therefore would not have to meet higher air change rates proscribed by NFPA or other Codes. The airflow rate for under the tank covers would be determined from the odor control representative and similar past data.

Alternative 3: Covered Tank with 12 Air Changes per Hour Underneath the Covers

Tanks: Division 2 (9.b1)

Room: Unclassified (9.b2)

A negative pressure would be kept under the tank covers. The odor control would be based on the air flowrate under the tanks. The rest of the room would then be unclassified based on NFPA 820 guidelines and airflow in the area would be dictated by HVAC and applicable codes and standards.

The advantages and disadvantages of the three alternatives are shown below in Table 2.

Table 2 Secondary Treatment Odor Control Options

Alternative	Advantages	Disadvantages
1	• Simplify odor control system. • Removes cost and complexity of covers.	• Oversize odor control system. • Increase electrical cost in the room. • Room will smell for operators. • Nutrient levels in treated air may be too low to maintain bacteria growth.
2	• No special monitoring of odor control ventilation system. • Odor control system sized efficiently. • Reduce odors in room for operators.	• Increase electrical cost in the rest of the room as Div. 2.
3	• Decrease electrical cost in the rest of the room. • Reduce odors in room for operators.	• Complex monitoring of odor control HVAC system. • Over size odor control system.

Alternative 3 was selected to size the odor control unit at this stage of design. A cost-effectiveness analysis will be conducted in final design to determine the most cost-effective alternative.

4.3.4 MLSS/Biosolids Holding

Biosolids generated by the secondary treatment process will be conveyed to covered biosolids holding tanks. The biosolids holding tanks will be aerated and mixed to prevent anaerobic conditions. Air from the headspace between the water level and cover will be conveyed by ductwork to an odor control unit. In order to eliminate potential odor generation from the process, a decant valve will not be installed in the tanks. Biosolids will not be processed at the site. It will be pumped out by tanker trucks, to be processed offsite, through a cam-lock connection between the covered tank and truck. To be conservative, preliminary odor control sizing was based on an airflow rate of 12 air changes per hour from the Biosolids Holding Tanks. The air flow rate will be refined in final design once NFPA classifications for each structure have been finalized.

4.3.5 Odor Control Sizing Summary

The design criteria used to size the proposed Mashpee WRRF odor control system is summarized below.

Table 3 Preliminary Odor Control Sizing Criteria

Process	Air Changes Per Hour	Air Flow Rate (cfm)
Influent Pumping Station	12	38
Preliminary Treatment Building	12	6,122
MRB Tanks	12	10,219
Biosolids Holding Tanks	12	126
Total	**N/A**	**16,505**

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – M-10 Chemicals** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to list and describe expected chemicals that will be used at the Mashpee Water Resource Recovery Facility (WRRF) in the Town of Mashpee, Massachusetts.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016
- NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2020 Edition.

2.1 References

The following references were used to develop this memorandum:

- 'Final Recommended Plan / Final Environmental Impact Report – Town of Mashpee Sewer Commission', prepared by GHD and dated May 2015 (WNMP)

3. Chemicals

Below is a list of the chemicals that may be used at the plant

Sodium Hypochlorite
Related Names: bleach
Uses: cleaning, odor control
Treatment Use Locations: Membranes, UV Disinfection
Storage amount (Stage 1): 55 gallons

Citric Acid
Related Names: citrus fruit juice
Uses: Cleaning
Processes: Membranes, UV Disinfection
Storage amount (Stage 1): 100 gallons

Supplemental Carbon
Related Names: MicroC®
Uses: additional carbon source for secondary treatment process
Treatment Use Locations: Process tanks
Storage amount (Stage 1): 1000 gallons

Sodium Hydroxide
Related Names: Lye
Uses: pH adjustment
Treatment Use Locations: Secondary Treatment Influent Distribution Box
Storage amount (Stage 1): 100 gallons

4. Chemical Feed Systems

Proposed chemicals are outlined below. All chemicals will be stored in the Chemical Room in the Process Building. In accordance with TR-16 all chemical tanks will be enclosed by a secondary containment dike with a containment volume of 125 percent of the storage tank's volume. Eyewash stations and overhead showers that utilize potable, tempered water will be provided in the vicinity of the Chemical Room.

4.1 Supplemental Carbon

Supplemental carbon is necessary to achieve complete denitrification. Supplemental carbon at wastewater treatment facilities is commonly provided by the addition of methanol or glycerin. Due to the flammability and hazardous handling issues associated with methanol, the use of glycerin (MicroC) is being proposed. The proposed MicroC storage and feed system is located in the Process Building Chemical Room. The supplemental carbon addition system, dosing pump, and associated valving will be provided by the membrane manufacturer. Process modeling will be conducted during final design to confirm the preliminary chemical feed rates.

4.2 Sodium Hydroxide

Raw wastewater will be dosed with sodium hydroxide (NaOH / caustic soda) to maintain adequate alkalinity through the treatment process. The additional alkalinity is required because the nitrification process consumes alkalinity. Sodium hydroxide is typically dosed to plant flows as an aqueous solution. The solution is available in different concentrations, such as 50-percent and 25-percent. Although the 50-percent solution requires less storage volume, the concentration is susceptible to a crystallization at around 53 degrees F. Once the solution is crystalized, it is very difficult to clear the piping and equipment. Although more dilute, 25-percent solution has a lower crystalizing temperature of approximately zero degrees F, and is recommended for this application. The shelf life for caustic soda ranges from a year to nearly unlimited if stored under proper conditions.

4.3 Sodium Hypochlorite

Sodium hypochlorite will be used for membrane cleaning to remove organic foulants from the membrane surface. A sodium hypochlorite chemical feed system, dosing pump, and associated valving will be provided by the membrane manufacturer. Sodium hypochlorite will also be used for disinfection of plant water.

4.4 Citric Acid

Citric acid will be used for membrane cleaning to remove inorganic scaling from the membrane surface. A citric acid chemical feed system, dosing pump, and associated valving will be provided by the membrane manufacturer. Citric acid will also be used to clean the UV bulbs. The bulk storage for both systems will be stored in the chemical room.

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Esten V. Rusten, AIA, NCARB, LEED AP BD+C	Tel:	(717) 585-6409
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – A-1 Architectural** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to provide a summary of the Building Design Criteria for the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- Massachusetts State Building Code (780 CMR) – Ninth Edition, Base Volume (2015 International Building Code (IBC) with amendments) and all other referenced codes and standards.
- Title III Regulation 28 CFR Part 36, Appendix A: ADA Accessibility Guidelines for Buildings.
- NFPA 101 – Life Safety Code.

3. Preliminary Design

3.1 Preliminary Treatment Building

A new preliminary treatment building is proposed for the Mashpee WRRF. The building includes a screening room and an electrical room. The roof will consist of asphalt shingles and the southern face be kept clear of equipment and penetrations for future solar capabilities. The building will be designed to match the architectural character of the neighborhood

3.2 Process Building

A new process building is proposed for the Mashpee WRRF. The building includes chemical storage, blower room, and UV disinfection areas on the main level, and a pump room, mechanical room, and storage in the basement. The building's proposed construction is to be similar to the Preliminary Treatment Building and match the architectural character of the neighborhood.

3.3 (Future) Operations Building

A new operations building is proposed for future stages at the southwest end of the site layout. The building's proposed construction is to be masonry, clad with cedar shake siding to match the other major structures. The building will include a laboratory, control room with file and storage, office, conference room, break room, mechanical room, and locker rooms. The more heavily occupied areas are to be located on the southwest side of the building to maximize opportunity for daylighting.

4. Exterior Design and Materials

4.1 Roofs

We are proposing the construction for the roofs to be wood truss, asphalt shingle, with batt or cellulose insulation. South-facing roofs will be kept clear for future solar panels (PV).

4.2 Exterior Walls

We are proposing masonry exterior walls with cedar shake siding. Other siding materials were considered during the preliminary design and may continue to be considered in further designs. The space between siding and concrete masonry units on the upper portion of the wall would include a vapor retarder and rigid board insulation.

4.3 Exterior Doors

Fiberglass-reinforced plastic (FRP) doors should be considered for process buildings due to the material's ability to resist degradation from moisture or chemical exposure. Aluminum exterior doors may be suitable for areas that are not particularly humid or corrosive.

5. Sustainability

The sustainability measures that are being considered for the buildings at the Mashpee WRRF are discussed in the Sustainability Design Features Basis of Design (SUS-1). Specific sustainability measures will be determined in further designs.

6. Accessibility

The Massachusetts State Building Code references Massachusetts Architectural Access Board's Rules and Regulations (521 CMR). The facilities at the WRRF, although publicly funded, are not "open to public use", and are therefore not regulated by 521 CMR. In our opinion this fact, however, does not exempt these facilities from the accessibility requirements of the Americans with Disabilities Act.

ADAAG (Title III Regulation 28 CFR Part 36, Appendix A: ADA Accessibility Guidelines for Buildings) requires accessible routes into work places, and requires that many features such as toilet rooms, signs, door hardware, etc., be designed to be accessible and usable to the extent defined by the Guidelines. Therefore, accessibility features should be incorporated into the designs except where explicitly exempt (below-grade pump rooms, equipment access platforms, and certain other locations are usually interpreted as exempt).

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Matthew Moore	Tel:	717-541-0622
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – E-1 Electrical** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memorandum is to describe the required new facilities for both the electric service and standby emergency power for the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts.

2. Codes and Standards

The following Codes and Standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016
- NFPA 70 National Electric Code
- NFPA 72 National Fire Alarm Code
- Massachusetts Electrical Codes Changes
- NFPA 101 Life Safety Code
- NFPA 820 Fire Protection in Wastewater Treatment and Collection Facilities
- Illuminating Engineering Society

3. Electric Supply

The electrical supplier for the Mashpee WRRF will be Eversource. Since the wastewater treatment plant is a new installation, there is no current electrical service. However, according to the information that has been received from the design team thus far on the equipment that will be required, the facility will require 277/480 volts, three-phase, four-wire, and it will most likely be brought underground from the utility transformer to a distribution switchboard located in the preliminary treatment building. From this switchboard, power is to be distributed to the various MCCs and power panels to service the facility. At this time, the facility demands have not be finalized and the transformer has not been sized. This will be done as part of final design.

A preliminary service sizing calculation was completed using the loads identified based on the 30% design, which conservatively indicate the peak service to be about 700 amperes. This includes:

1) motors running for more than three hours being considered at 125% of their full load,
2) all remaining motor loads are taken at 100%,
3) motors are taken at their full horsepower, when in fact they usually run at a lesser amperage, and
4) loads are taken as though they all will be running at one time.

These result in a very conservative estimate of the plant's connected peak load. Experience has shown Utilities typically use a "load service factor" of anywhere from 0.4 to 0.6 when determining the size service to be provided, based upon engineer's estimated loads. Using a factor of 0.5, the calculated real peak load would be around 350 amps. The proposed 1200-ampere service should be able to handle the plant electrical load, in addition to allowing for future electrical capacity. Attached to this memo is a preliminary Power One-Line Diagram showing the anticipated service size along with various pieces of electrical equipment throughout the facility.

4. Standby Power

Preliminary standby power demand was calculated using a commercially available manufacturers sizing program. Table 1 loads were used to calculate a generator size. Based on the loads shown in that table, the calculated generator size is 300 kW and it is loaded to 93% of its capacity. A 300 kW generator should adequately run the plant when utility power is unavailable. If expansion of the facility beyond Stage 1 within the first 10-15 years of operation, the generator sizing will need to be reevaluated. Preliminarily program parameters have been reviewed to identify any obvious issues, however the generator manufacturer will be consulted to review and provide comment on the initial sizing as the project moves into detail design.

In an effort to minimize the generator size, the plant loads were stepped to spread out demand upon generator startup. As part of preliminary design, five steps have been identified. Generally, our approach to step loads is as follows:

- Step 1 power all life safety equipment, lighting transformers; ventilation systems; both screening systems and grit equipment, in addition to all other resistive loads.
- Step 2 and beyond, start bringing the major pumps and aeration equipment up to speed after a specified time delay until all of the required units are started.

For the Table 1, the "Load" column refers to the equipment that is being powered. The "HP/(kW)" column refers to the type of load and whether it is a motor or resistive load. The "Starting Type" column refers to the type of starter for each motor, all are started with a VFD, which stands for Variable Frequency Drive. The "Stage Demand" column refers to the stage of construction when that particular set of equipment will be installed. It is assumed and possible that all of the equipment shown in the table could be running at the same time.

Table 1 Mashpee WRRF Generator Load List

Load	HP/(kW)	Starting Type	Stage Demand
Step No. 1			
Miscellaneous Loads, including Life Safety equipment	(30)		1
Bar Screen 1	(5)		1
Bar Screen 2	(5)		1
Grit System	(20)		1
UV System	(12)		1
Step No. 2			
Anoxic Mixer 1	2.4	VFD	1
Post Anoxic Mixer 1	2.4	VFD	1
Process Aeration Blower 1	15	VFD	1
Membrane Scour Blower 1	20	VFD	1
Nitrate Recycle Pump 1	2.7	VFD	1
Membrane Permeate Pump 1	10	VFD	1
RAS Pump 1	10	VFD	1
Step No. 3			
Anoxic Mixer 2	2.4	VFD	1
Post Anoxic Mixer 2	2.4	VFD	1
Process Aeration Blower 2	15	VFD	1
Membrane Scour Blower 2	20	VFD	1
Nitrate Recycle Pump 2	2.7	VFD	1
Membrane Permeate Pump 2	10	VFD	1
RAS Pump 2	10	VFD	1
Step No. 4			
Anoxic Mixer 3	2.4	VFD	2
Post Anoxic Mixer 2	2.4	VFD	2
Process Aeration Blower 3	15	VFD	2
Membrane Scour Blower 3	20	VFD	2
Nitrate Recycle Pump 3	2.7	VFD	2
Membrane Permeate Pump 3	10	VFD	2
RAS Pump 3	10	VFD	2
Step No. 5			
Anoxic Mixer 4	2.4	VFD	2
Post Anoxic Mixer 4	2.4	VFD	2
Process Aeration Blower 4	15	VFD	2
Membrane Scour Blower 4	20	VFD	2
Nitrate Recycle Pump 4	2.7	VFD	2
Membrane Permeate Pump 4	10	VFD	2
RAS Pump 4	10	VFD	2

5. Distribution

Conduit will be installed surface-mounted in all process areas and generally concealed in the Operations Building, if constructed in the future. The conduit types used will depend on the area of installation but will generally be as follows:

Table 2 Conduit Location and Type

Area	Conduit Types
Interior non-classified	Rigid galvanized steel (except in the Administration Area of the Process Building where EMT will be used)
Interior corrosive	PVC Schedule 40 and 80
Interior wet	PVC-coated rigid galvanized steel
Hazardous	PVC-coated rigid galvanized steel or aluminum
Exterior above grade	PVC-coated rigid galvanized steel or aluminum
Exterior below grade (power)	PVC Schedule 40
Exterior below grade (signal)	Rigid galvanized steel except in manholes, where PVC-coated rigid is used

All wiring will be stranded copper. All conductor insulation will be Type THWN/THHN with the exception of the major feeder conductors, which will be Type RHW/USE or Type XHHW and shielded instrumentation conductor with PVC insulation and nylon jacketing.

6. Motors

Motor sizes are selected based on the individual process equipment requirements. All motors will be required to be premium efficiency meeting the standards set forth in the applicable requirements of the U.S. Energy Policy Act. Although rebates may be available for the use of high-energy motors and VFDs, it has been our past experience that the cost to submit for the rebates is more than the rebates themselves. Therefore, most of our clients have not pursued the rebates, satisfied with the assurance they have the most efficient motors and drives available.

Minimum motor power factor is specified at 85%. Motors 7-½ HP and larger not meeting this minimum are required to have their power factor corrected to 90%. Where applicable, adjustable speed drives, typically variable frequency drives, are provided to vary the speed of motors as the driven load characteristics vary. Presently, VFDs are proposed for the following: Anoxic Mixers, Post Anoxic Mixers, Process Aeration Blowers, Membrane Scour Blowers, Nitrate Recycle Pumps, Membrane Permeate Pumps, RAS Pumps, and Digester Blowers.

7. Lighting

Generally, lighting for all areas, both inside and outside, will be LED. See the following tabulation for fixture (luminaire) usage.

Table 3 Fixture Usage

Room or Area Designation	Approximate Design basis		Volts/Phase	Luminaire Type
	Foot-Candles	Watts/ft^2		
Headworks Building	30	1.0	120	LED
Process Building	30	1.0	120	LED
Building Entry Areas	5	--	120	LED (photocell controlled)
General Site Lighting	0.5-1	--	120	LED (cut-off type)
(Future) Operations Building				
Entries/Corridors	15	0.5	120	LED
Offices/Process Control	30-60-90	1.0-3.0	120	LED
Laboratory[1]	75	2.7	120	LED
Locker and Toilet Rooms	20	0.8	120	LED
Storage Areas	30	1.0	120	LED
Utility Areas				
Garage Areas				

Notes:

1. Task lighting to be provided as applicable.

8. Area and Room Classifications

For electrical work, we use the following classifications:

Exterior.......................... Generally all non-hazardous areas outside

Interior, Wet .... All interior wet, hose-down, and damp areas

Interior, Corrosive .... All interior chemical storage and feed areas

Hazardous..................... Areas where explosive vapors may be present, i.e., headworks or influent areas

Non-classified .... Interior dry areas not falling under any of the above areas

9. Miscellaneous Systems

9.1. Emergency Lighting

Emergency lighting will be designed via either emergency battery packs in certain fixtures or via individual battery operated units.

9.2. Telephone Service

The Town's telephone system will be extended into the new facility as required by the Owner and all applicable codes. We will include conduit and wiring for the telephone system as directed by the Owner. No separate paging system is being proposed.

9.3. Lightning Protection

Lightning protection is not required by Code, but if desired, we can provide the appropriate design as an additional service. Proper grounding will be designed for at all structures as required by Code.

9.4. Fire Alarm System

A fire alarm and detection system will be included in the design. A system of smoke, thermal, and special detectors will report to a single alarm panel which shall be connected into the applicable Town facilities either via SCADA, or directly via a dialer or Gamewell-type box.

9.5. Exit Signs

Illuminated and non-illuminated exit signs (depending on the environment) will be designed at exits and as required by the Town of Mashpee Fire Marshall.

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Sean Patrick, P.E.	Tel:	(315) 679-5781
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – H-1 Heating, Ventilation, and Air Conditioning** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memorandum is to provide an overview of the proposed HVAC design and approach for buildings on the site of the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts, and to summarize preliminary HVAC equipment types and heating source.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016
- Massachusetts State Building Code (780 CMR) – Ninth Edition including the following codes by reference:
  - International Mechanical Code (IBC) with amendments (2015 edition)
  - International Energy Conservation Code (IECC) with amendments (2015 edition)
- SMACNA – HVAC Duct Construction Standards
- NFPA 90A – Installation of Air Conditioning and Ventilating Systems
- ASHRAE 62.1 - 2013 Ventilation for Acceptable Indoor Air Quality
- NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2020 Edition

3. Design Conditions

The design conditions given in Tables 1 and 2 will be used for this project:

Table 1 Outside Design Parameters

Design	Temperature
Winter design dry-bulb temperature	10.3°F
Summer design dry-bulb temperature	84.2°F
Summer design wet-bulb temperature	72.9°F

Note:
ASHRAE Fundamentals 2017; Barnstable Municipal, MA; 99.6% heating and cooling

Table 2 Inside Design Conditions

Space Description	Winter Inside Design Temperatures	Summer Inside Design Temperatures	Total Ventilation Rate(1) (CFM)
Screenings room	50°F	Ambient	6 ACPH
Electrical rooms (fan cooled)	60°F	100°F	0.06 cfm/ft²
Electrical rooms (air conditioned)	72°F	78°F	ASHRAE 62.1
Chemical room	50ºF	Ambient	1.5 cfm/ft²
Office, lab, lavatories, locker rooms, control rooms	72° F	75ºF	0.75 cfm/sq ft
Blower room	50ºF	100ºF	0.06 cfm/ft²
UV disinfection room	50ºF	100ºF	0.06 cfm/ft²
Storage	50° F	Ambient	0.06 cfm/ft²
Pump room	50ºF	Ambient	6 ACPH
MBR room	50ºF	Ambient	6 ACPH

Notes:
(1) Total ventilation rate is the total outside air required unless noted otherwise.

4. HVAC Design

4.1 General

HVAC design concepts have been developed based on current information. As the design progresses and heating/cooling loads change and building layouts are adjusted, it will be necessary to modify the HVAC design concepts such that the Owner is provided with the most suitable and energy efficient design.

The HVAC systems will be designed to provide Code-required ventilation rates, occupant thermal comfort, and safe working atmosphere for the operators. Control strategies will incorporate energy savings where practical.

There is no known natural gas service near the site. Electric, propane, or fuel oil shall be evaluated as potential heat sources.

In areas where equipment will emit large quantities of heat, air conditioning or other ventilation equipment will be provided to assist in maintaining room temperatures under 100°F. By Code, electrical equipment in these areas must be derated if it is to operate at elevated temperatures for long durations of time. Experience on past projects has proven it is more cost-effective to provide cooling equipment than to derate the equipment.

Process areas classified as hazardous will have both supply and exhaust fans when providing continuous ventilation and will be constructed of corrosion-resistant materials. HVAC construction in wet, corrosive areas will specify corrosion-resistant materials such as fiberglass reinforced plastic (FRP), Type 316 stainless steel, or aluminum. Other areas such as Mechanical and Electrical Rooms will be specified with "industry accepted standard" materials of construction for similar areas.

4.2 Preliminary Treatment Building

The Preliminary Treatment Building shall contain wastewater grit and screening equipment. Exhaust air shall be routed to a centralized odor control fan sized for 6 air changes per hour (2,000 cfm). Exhaust air grilles shall be located at 12-inches above finished floor. The building shall have a 100% outdoor air unit sized for 2,000 cfm and 200 MBH of heat. Supply air shall be delivered high in the space. HVAC equipment shall be explosion-proof. The space shall be rated for class 1 division 1 group D and ventilated at less than 12 air changes per hour.

The electrical room shall be ventilated or cooled based on electrical equipment temperature requirements.

4.3 Process Building

The Process Building shall contain blowers, pumps, and MBR tanks. The secondary treatment process tanks and membrane tanks are to be covered inside of the process tank room. The tanks will be kept under negative pressure by using exhaust fans. The space surrounding the tanks shall be considered unclassified.

4.4 (Future) Operations Building

The future Operations Building proposed for later stages of the facility consists of an office, lab, mechanical space, bathrooms, conference room, break room, and control/file storage room. The proposed HVAC system would be a cold weather air source heat pump system. The system would consist of a single outdoor condensing unit piped to multiple indoor evaporator units. Outdoor air shall be provided to each space by a central energy recovery ventilator (ERV). The ERV would capture waste energy from the toilet exhaust air. The lab space would have a dedicated 100% outdoor air unit and a dedicated exhaust fan.

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Dustin Sedlack	Tel:	315-679-5734
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo I-1 Instrumentation** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memorandum is to outline the overall design for implementing a Supervisory Control and Data Acquisition (SCADA) system at the proposed Mashpee Water Resource Recovery Facility (WRRF).

2. Background

The automation system will be designed to address several unique design considerations for the proposed Mashpee WRRF:

- Advanced automation to minimize operations costs.
- Advanced automation to accommodate a wide range of influent flows.
- Advanced automation to support single shift operation.
- Phased connection to wastewater supplies (future phases of collection system extension).
- Multiple Original Equipment Manufacturer (OEM)-supplied, packaged equipment that need to interoperate.

To accommodate these needs the design criteria for the treatment plant's network and control system will include:

- Scalable network design to accommodate current and future needs.
- Ethernet connected OEM control panels to facilitate detailed monitoring and manufacturer service.
- Secure remote access to the SCADA system to reduce Operations and Maintenance (O&M) costs.
- Intelligent remote alarm notification.
- Advance SCADA/HMI (Human Machine Interface) development to integrate the many disparate control panels into a cohesive and intuitive SCADA system.

3. SCADA Structure

The SCADA system requires an Ethernet network that spans the Preliminary Treatment Building, Process Building, and possible future Operations Building. The network will be designed to accommodate the current needs of the SCADA system as well as needs for business computing (operator email, ordering supplies), a maintenance management system, building management system, site security systems (access control), and should not preclude a future video surveillance system or asset management. A fault-tolerant, multimode fiberoptic ring architecture is recommended to interconnect the networks within each building. Additional fibers will be included to accommodate network segmentation, if desired, and possible fiber optic damage. The fiberoptic network will have the bandwidth to accommodate all the different systems that may be interconnected in a facility of this size. Fiberoptic cabling will be terminated in 19-inch rack mounted network cabinets to support the location of IT equipment, spare capacity, and to simplify network expansion. Ethernet networks internal to these buildings will utilize gigabit-capable Category 6 Ethernet cabling in a star configuration, whereby individual network connections are connected back to the nearest network cabinet.

The SCADA system will be comprised of a redundant pair of SCADA computers equipped with HMI software, SCADA reporting software, and a software-based alarm notification program capable of notifying operations staff of critical alarms via SMS/text messaging and/or voice calls. A firewall between the plant's internet service and the control system network will enable secure remote access to the HMI application for select operators and the Town's SCADA system consultant. The HMI application will facilitate real-time monitoring and historization of key operational data collected from individual Programmable Logic Controller (PLC)-based control panels throughout the facility. SCADA reporting software will create Microsoft Excel-based reports that assist the operations staff in reporting to MassDEP.

The majority of OEM-based control panels will be PLC-based and communicate to the SCADA local area network (SCADA LAN) via Ethernet. The buildings will likely be equipped with an additional PLC-based control panel to accommodate instrumentation and equipment not already incorporated in OEM-based control panels. With careful selection of compatible PLCs, individual control panels will be capable of exchanging key data effectively to support a fully-integrated control system. In so far as possible, the same PLC hardware and associated appurtenances will be utilized to reduce spare parts inventory and maximize supportability.

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Michael S Dickun II, PE (DC, MD, PA, VA)	Tel:	717-585-6351
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – S-1 Structural** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to provide a summary of the structural design criteria for the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- 780 CMR: Massachusetts State Building Code – Ninth Edition, Base Volume (2015 International Building Code (IBC) with amendments) and all other referenced codes and standards. All structures will take into consideration hurricane forces along with the potential for other natural disaster events.
- ACI 350-06: Code Requirements for Environmental Engineering Concrete Structures.
- 2015 Aluminum Design Manual.

3. Preliminary Design

3.1 Operations Building (future)

The new Operations Building proposed will consist of construction utilizing a reinforced masonry superstructure with a cast-in-place concrete foundation and concrete slab on grade. The roof will consist of wood trusses. Cast-in-place concrete foundations will utilize conventional spread footings. It should be known that future soil borings are to be performed on site in order to confirm that the use of conventional spread footings is acceptable. If it is determined that deep foundations are required, the foundations will be modified accordingly. During preliminary site layout review it was decided that an Operations Building would be constructed in a future phase of the project.

3.2 Preliminary Treatment Building

The new Preliminary Treatment Building will consist of construction utilizing a reinforced masonry superstructure. The foundation will consist of the cast-in-place concrete structure for the new Headworks facility. The roof will consist of wood trusses. It should be known that future soil borings are to be performed on site in order to confirm that the use of conventional spread footings is acceptable. If it is determined that deep foundations are required, the foundations will be modified accordingly.

3.3 Headworks Structure

The new Headworks structure will consist of cast-in-place concrete construction utilizing a reinforced structural base slab in conjunction with reinforced structural walls and will serve as the foundation for the new Preliminary Treatment Building. All concrete utilized will be specified as Type I/II (Sulfate Resistant) and follow the code requirements of ACI 350-06 to ensure a sustainable structure for many years. All access stairs and platforms associated with the structure will utilize aluminum framing and handrail along with FRP grating and/or stair treads. It should be known that future soil borings are to be performed on site in order to confirm that the use of conventional spread footings is acceptable. If it is determined that deep foundations are required, the foundations will be modified accordingly.

3.4 Process Building

The new Process Building will consist of construction utilizing a reinforced masonry superstructure. The foundation will consist of the cast-in-place concrete tanks for the MBR/SBR and Denitrification Filter Tanks (if the SBR process is utilized). The roof will consist of wood trusses. It should be known that future soil borings are to be performed on site in order to confirm that the use of conventional spread footings is acceptable. If it is determined that deep foundations are required, the foundations will be modified accordingly.

3.5 MBR/SBR Structure

The new MBR/SBR structure will consist of common wall cast-in-place concrete construction utilizing reinforced structural base slabs in conjunction with reinforced structural walls and will serve as the foundation for the new Process Building. The tank will be analyzed and designed so that there is flexibility for the tank to be emptied for maintenance or so that other future modifications or excavation on the exterior can occur while the tanks are still in operation. All concrete utilized will be specified as Type I/II (Sulfate Resistant) and follow the code requirements of ACI 350-06 to ensure a sustainable structure for many years. All access stairs and platforms associated with the structure will utilize aluminum framing and handrail along with FRP grating and/or stair treads. It should be known that future soil borings are to be performed on site in order to confirm that the use of conventional spread footings is acceptable. If it is determined that deep foundations are required, the foundations will be modified accordingly.

3.6 Denitrification Filter

The new Denitrification Filter Tank (if the SBR process is utilized) will consist of common wall cast-in-place concrete construction utilizing reinforced structural base slabs in conjunction with reinforced structural walls and will serve as the foundation for the new Process Building. The tank will be analyzed and designed so that there is flexibility for the tank to be emptied for maintenance or so that other future modifications or excavation on the exterior can occur while the tanks are still in operation. All concrete utilized will be specified as Type I/II (Sulfate Resistant) and follow the code requirements of ACI 350-06 to ensure a sustainable structure for many years. All access stairs and platforms associated with the structure will utilize aluminum framing and handrail along with FRP grating and/or stair treads. It should be known that future soil borings are to be performed on site in order to confirm that the use of conventional spread footings is acceptable. If it is determined that deep foundations are required, the foundations will be modified accordingly.

3.7 MLSS Waste Holding Tanks

The new MLSS Waste Holding Tanks will consist of cast-in-place concrete construction utilizing a reinforced structural base slab in conjunction with reinforced structural walls. The tank will be analyzed and designed so that there is flexibility for the tank to be emptied for maintenance or so that other future modifications or excavation on the exterior can occur while the tanks are still in operation. All concrete utilized will be specified as Type I/II (Sulfate Resistant) and follow the code requirements of ACI 350-06 to ensure a sustainable structure for many years. Access hatches with fall protection will be utilized on the top of the tanks. It should be known that future soil borings are to be performed on site in order to confirm that the use of conventional spread footings is acceptable. If it is determined that deep foundations are required, the foundations will be modified accordingly.

3.8 Biofilter

The new Biofilter structure will consist of cast-in-place concrete construction utilizing a reinforced structural base slab in conjunction with reinforced structural walls. The tank will be analyzed and designed so that there is flexibility for the tank to be emptied for maintenance or so that other future modifications or excavation on the exterior can occur while the tanks are still in operation. All concrete utilized will be specified as Type I/II (Sulfate Resistant) and follow the code requirements of ACI 350-06 to ensure a sustainable structure for many years. All access stairs and platforms associated with the structure will utilize aluminum framing and handrail along with FRP grating and/or stair treads. It should be known that future soil borings are to be performed on site in order to confirm that the use of conventional spread footings is acceptable. If it is determined that deep foundations are required, the foundations will be modified accordingly.

3.9 UV Disinfection (Located in the Process Building)

The new UV Disinfection structure will consist of cast-in-place concrete construction utilizing a reinforced structural base slab in conjunction with reinforced structural walls. The tank will be analyzed and designed so that there is flexibility for the tank to be emptied for maintenance or so that other future modifications or excavation on the exterior can occur while the tanks are still in operation. All concrete utilized will be specified as Type I/II (Sulfate Resistant) and follow the code requirements of ACI 350-06 to ensure a sustainable structure for many years. All access stairs and platforms associated with the structure will utilize aluminum framing and handrail along with FRP grating and/or stair treads. It should be known that future soil borings are to be performed on site in order to confirm that the use of conventional spread footings is acceptable. If it is determined that deep foundations are required, the foundations will be modified accordingly.

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Anastasia Rudenko PE, BCEE, ENV SP	Tel:	774-470-1637
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design SB-1 Sand Beds** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memorandum is to establish the basis of design for the effluent recharge sand beds for Stage 1 flows at the proposed Mashpee WRRF.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition Revised in 2016
- 'Guidelines for the Design, Construction, Operation and Maintenance of Small Wastewater Treatment Facilities with Land Disposal', prepared by MassDEP, revised July 2018.

3. References

The following references were used to develop this memorandum:

- 'Final Recommended Plan / Final Environmental Impact – Town of Mashpee Sewer Commission', prepared by GHD and dated May 2015 (WNMP)
- 'Hydraulic Load Test – Site 4 (Transfer Station)' memorandum, prepared by GHD, updated March 19, 2014.

4. Effluent Sand Beds

As evaluated as part of the WNMP, open sand beds are recommended for effluent recharge due to their relatively high hydraulic loading capacity, which requires less land area than other land-based options. Hydraulic load testing results, obtained in 2011, indicate that an average infiltration rate of up to 70 gpd/sf could potentially be recharged at the site (based on the USEPA design factor of 10% of observed infiltration rates, which are approximately 700 gpd/sf).

A hydraulic loading rate of 7 gallons per day / square foot was selected for sizing the sand beds in the preliminary design. In previous projects MassDEP has indicated that they would allow a sand bed design loading rate of 7 gpd/sf for hydraulic loading results similar to those observed during the Mashpee testing, until performance testing (after implementation with actual treated water from a WRRF) proved that a higher rate was warranted.

The effluent sand bed system is designed to recharge maximum month flow with the largest bed out of service. The maximum month flow for Stage 1 is 312,000 gpd. The design criteria for the beds is summarized in Table 1.

Table 1 Stage 1 Effluent Sand Bed Sizing

	Proposed Active Surface Area (SF)[1]	Design Hydraulic Loading Rate (gpd/sf)	Approximate Design Capacity (gpd)[1]
Effluent Sand Bed 1	14,800	7	104,000
Effluent Sand Bed 2	14,800	7	104,000
Effluent Sand Bed 3	14,800	7	104,000
Effluent Sand Bed 4	14,800	7	104,000
Total – All Beds	**59,400**	**7**	**416,000**
Total – Largest Bed Out of Service (Design Condition)	**44,600**	**7**	**312,000**
Note: 1. Areas rounded to three values			

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – ENV-1 Environmental Design Criteria** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- Massachusetts Department of Environmental Protection, Air Quality Permits (as applicable), BWP AQ 04 - Asbestos Removal Notification that may be required for Asbestos Pipe removal and BWP AQ 06 Construction/Demolition Notification.
- Massachusetts Department of Environmental Protection, Emergency Engine and Emergency Turbine Compliance. The program applies to all new emergency or standby engines with a rated power output equal to or greater than 37 kW or emergency turbines with a rated power output less than one megawatt constructed, substantially reconstructed, or altered after March 23, 2006.
- Massachusetts Department of Environmental Protection, Air Quality Permit BWP AQ 14, 15, 16, 17 Operating Permits. These are mandated for major sources of air pollution by the Clean Air Act Amendments of 1990. Massachusetts has incorporated this program in 310 CMR 7.00 Appendix D of its Air Pollution Control Regulations. In some cases, emissions from Wastewater Treatment Facilities (WWTFs) or odor control systems trigger this requirement.
- Massachusetts Department of Environmental Protection Bureau of Waste Site Cleanup, Filing of Utility Release Abatement Plan (as applicable), for excavation within known contaminated sites.

2. Environmental Design Criteria

Environmental considerations that may need to be managed for the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts

2.1 Lead, PCB, and Asbestos

This is a greenfield site, therefore lead, PCB, and asbestos contamination or materials are not anticipated.

Any work related to this facility as it is adjacent to the existing capped landfill and transfer station (entrance roadway) will need to be considered during final design. All utilities are anticipated to come into the site from the main roads and not through the landfill site, therefore minimal deep excavations are anticipated (where potential for encountering trash is greater at depth).

2.2 Air Quality Permitting

The Mashpee WRRF project includes the installation of the following equipment that generates air emissions potentially requiring permitting with the Massachusetts Department of Environmental Protection (MassDEP):

- Emergency backup generator
- Chemical tanks and ancillary equipment

These are discussed further in the Permitting Basis of Design Memo (PRM-1).

2.2.1 Emergency Backup Generator

The Environmental Results Program of MassDEP requires new emergency engines with a rated power output equal to or greater than 37 kW, or new emergency turbines with a rated power output less than one megawatt constructed, substantially reconstructed, or altered after March 23, 2006 to be certified with them. As discussed in the Electrical Basis of Design Memorandum (E-1), the emergency generator is anticipated to be approximately 300kW and therefore will require permitting and certification.

2.2.2 Sodium Hypochlorite Tanks

The amount of sodium hypochlorite stored at the facility is under the threshold for sodium hypochlorite air permitting requirements of 40,000 gallons. The product shall be stored with a vapor pressure of less than 1.5 psi; therefore it should be exempt from plan approval (air permitting requirements) per 310 CMR 7.02 (2)(b)(11).

2.3 Noise and Dust

2.3.1 Construction Mitigation

Construction noise from heavy equipment will normally be limited to within normal operating hours of 7:00 a.m. to 5:00 p.m. No construction work will normally be performed during evening, holiday, or weekend hours.

Dust controls, including the use of street sweepers and/or watering trucks, will be used to minimize air-borne dust as necessary. Debris will not be burned as a means of disposal. The contractor will be required to thoroughly clean up the site before the contract is considered complete.

2.3.2 Operational Mitigation

Sound attenuation and other mitigation measures will be incorporated into the design to minimize noise impacts.

Dust impacts are not anticipated during normal operations. Paved surfaces shall remain clear, in accordance with normal Town operations of similar municipal facilities.

2.4 Chemicals

The following is a list of chemicals that may be at the Mashpee WRRF:

- Sodium Hypochlorite (Bleach)
- MicroC®
- Citric Acid
- Sodium hydroxide

These are discussed in more detail in the Chemical Memorandum (M-10).

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush Anastasia Rudenko, PE, BCEE, ENV SP	Tel:	774-470-1654
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – FP-1 Fire Protection** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memorandum is to provide the Basis of Design for the proposed fire protection systems for the design of the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works, prepared by the New England Interstate Water Pollution Control Commission, 2011 Edition, Revised in 2016
- NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2020 Edition.
- "International Building Code." International Code Council, 2018 Edition
- The Massachusetts State Building Code, 9th Edition, 2018
- Massachusetts State Fire Prevention Code (527 CMR)
- International Fire Code, 2018 Edition

3. Design Criteria

3.1. Fire Protection Detection & Suppression Systems

Fire Protection detection and suppression systems will be designed at the Mashpee WRRF during final design of the facility.

3.2. Fire Extinguishers

Fire extinguishers shall be provided at multiple locations throughout the facility. All shall be 4A rated units unless noted. Possible locations of fire extinguishers are:

- Preliminary Treatment Building
- Process Building
- (Future) Operations Building

3.3. Hydrants

Hydrants shall be provided at the facility. The location of hydrants will be determined in final design.

3.4. Combustible Gas Detectors

Combustible gas detectors shall be provided at multiple locations throughout the facility. Possible locations of combustible gas detectors are:

- Preliminary Treatment Building
- Process Building
- MLSS storage Tanks

3.5. Other Requirements of NFPA 820

This memo does not encompass all fire protection measures or requirements, project team shall refer to NFPA 820 during final design.

Technical Memorandum PRM-1

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
	Anastasia Rudenko PE, BCEE, ENV SP		774-470-1634
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo PRM-1 – Permitting** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memorandum

The purpose of this memo is to provide the Basis of Design for possible permitting that may be required for the construction of the Mashpee Water Reclamation and Recovery Facility (WRRF).

2. Required Permits

A preliminary list of permits for the project are outlined below. This list will continue to be expanded and refined throughout the design process.

2.1 Effluent Disposal

2.1.1 Groundwater Discharge Permit (GWDP)

WRRF's that are permitted to discharge over 10,000 gpd to a groundwater discharge are governed by the MassDEP Groundwater Discharge Permit (GWDP) Program (314 CMR 5.00). Application for a GWDP requires a hydro-geologic evaluation, as well as an engineered design for the treatment and discharge facility.

2.2 Air Quality Permitting

The Mashpee WRRF project includes the installation of the following equipment that generates air emissions potentially requiring permitting with the Massachusetts Department of Environmental Protection (MassDEP):

- Back-up/emergency generator – following construction the Town will be required to complete the MassDEP "Installation Compliance Certification-For New Emergency Engines and Emergency Turbines" for any emergency generator larger than 37kW.

Per Technical Memorandum E-1, the emergency generator is anticipated to be approximately 300kW and therefore will require permitting and certification.

2.3 Chemicals

2.3.1 Sodium Hypocholorite

The amount of sodium hypochlorite stored at the facility is under the threshold for sodium hypochlorite air permitting requirements of 40,000 gallons. The product shall be stored with a vapor pressure of less than 1.5 psi; therefore it should be exempt from plan approval (air permitting requirements) per 310 CMR 7.02 (2)(b)(11).

2.4 Site Permits

2.4.1 Natural Heritage - NHESP Tracking No. 08-25582

The Massachusetts Natural Heritage and Endangered Species Program (NHESP) maintains an atlas of estimated habitats and priority sites for rare plants and wildlife in Massachusetts. A request to NHESP for a list of state-listed species for the site was initially requested in 2008. The response letter from NHESP noted that portions of the site are loved within Priority Habitat 15 and Estimated Habitat 70 in the Massachusetts Natural Heritage Atlas (13th Edition). The letter recommended that rare species habitat concerns be addressed during the project design phase prior to submission of a formal Massachusetts Endangered Species Act (MESA) filing). Due to the time that has lapsed since this letter was filed, updated NHESP mapping should be reviewed to assess whether there have been any changes in habitats related to Site 4.

As part of the design process a permit will be filed with NHESP in order to obtain a site-specific determination for the project, with respect to estimated habitats and priority sites on the site.

2.4.2 Massachusetts Historical Commission (MHC) - MHC #RC.29581; EEA #12615

During the CWMP process the Town filed a Project Notification Form to MHC. The response letter, dated September 17, 2008 requested that an intensive (locational) archeological survey be conducted in accordance with 950 CMR 70 to locate and identify any significant historical or archaeological resources that may be affected by the project. An Intensive (Locational) Archaeological Survey was performed by Public Archaeological Laboratory (PAL) in 2010 and submitted to MHC on October 12, 2010. The report concluded that no documented pre-contact or post-contact period resources or archeological deposits were located within Site 4. Therefore no further archeological investigations were recommended.

During the design process coordination will be needed with MHC and other historic boards to insure that final design plans for proposed new infrastructure avoid impacts to historic or archaeological resources.

2.4.3 Wetlands (NOI) – Not required

The Wetland Protection Act (M.G.L. ch. 131, s. 40) and parallel State Regulations (310 CMR 10.00) were enacted to safeguard wetlands, associated resource areas, and floodplains from over-development.

The Wetland Protection Act covers any wet area where the groundwater level is at or near the surface of the ground for a long enough period during the year to support a community of wetland-type vegetation. Wet areas may include salt or fresh-water marshes, meadow, swamp, or bog.

Areas subject to protection under the Wetland Protection Act includes banks, dunes, beaches, and flats. All of these protected areas are referred to as resource areas. Resource areas are protected by a surrounding 100-foot buffer zone in which landscape alterations are regulated. The Wetlands Protection Act also covers construction on land subject to flooding as well as land subject to coastal storm inundation. Generally, the regulations apply to two types of floodplains; those lands directly bordering on bodies of water, and those lands subject to flooding (called “Isolated Land Subject to Flooding”) which do not border bodies of water.

The State regulates activities that involve filling, dredging, or excavating in or near a wetland or water body. The regulations govern additional construction activities including site preparation, the removal of trees or bushes, vista pruning, and the changing of land contours.

A Notice of Intent (NOI) must be filed for work in a resource area. This Notice requires a detailed description of the planned activity, and the application must show that if the resource area will be altered, the benefits will out-weight the damage. For work outside the resource areas but within a 100-foot buffer zone are a bordering vegetated wetland, bank, dune or beach, the owner has the option of filing a “request for Determination” in order to show that the work will not alter a resource area. If the Conservation Commission agrees, it will issue a “Negative Determination” permitting the work as presented. If the Conservation decides that the work will alter a resource area, it will issue a “Positive Determination” and require a full hearing and the filing of a Notice of Intent.

The proposed Mashpee WRRF site is not located in an area subject to an NOI.

2.4.4 Stormwater Pollution Prevention Plan (SWPPP)

Massachusetts administers stormwater standards through the Wetlands Protection Act (310 CMR 10.00). A draft Stormwater Pollution Prevention Plan (SWPPP) will need to be developed for the project. The SWPPP will be included in the bidding documents for the project. The General Contractor selected for the construction project will be responsible for completing the document and filing with USEPA after contract award.

2.4.5 National Pollutant Discharge Elimination System (NPDES) General Construction Permit

The NPDES stormwater program requires permits for stormwater discharges from construction activities that disturb at least one acre of land and discharges stormwater to waters of the United States or to a storm sewer. In Massachusetts, the Commonwealth of Massachusetts is the permitting authority for construction activities. If the stormwater management plan meets the thresholds listed above, a NPDES permit will be developed during design and implemented during construction.

Technical Memorandum SUS 1

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo SUS-1 – Sustainability Design Features** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memorandum

The Commonwealth of Massachusetts has developed several guidance documents outlining sustainability features that should be considered during design, including the Commonwealth's Sustainable Development Principles, Water Policy, Water Conservation Standards, and Greenhouse Reduction Policy. Sustainability considerations are also incorporated into industry design guidance documents, including TR-16.

The purpose of this memorandum is to outline the Basis of Design for sustainability design features that will be considered for the Mashpee WRRF.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16 Guides for the Design of Wastewater Treatment Works; New England Interstate Water Pollution Control Commission, 2016 Edition
- Envision Rating System for Sustainable Infrastructure v3
- LEED v4

3. Design Criteria

Sustainable design opportunities are listed below and will be evaluated during design to determine if they can be cost-effectively incorporated into the project. The items listed below have been identified through review of LEED and Envision guidance documents. Each opportunity is grouped into one of the four sustainability consideration topics discussed in TR-16:

- Water Conservation
- Energy Conservation
- Site Considerations

- Design Considerations for Non-Process Buildings

3.1 HVAC

- High efficiency HVAC system (Energy Conservation).

3.2 Electrical

- Dark Sky, High Efficiency Site Lighting—Place exterior lighting fixtures only where needed for safety and specific operations. Use high-efficiency LED fixtures. Select fixtures with controlled light patterns to reduce impact of lighting on adjacent properties and night sky visibility (Site Consideration).
- Use of premium motors for blowers and pumps (Energy Conservation).
- Installation of a low-polluting generator (Site Consideration).
- Installations of VFDs on the following process equipment (Energy Conservation):
  - Sewage pumping station pumps (where appropriate)
- Energy Management System—Lock out specified process operations during periods of peak energy demand in order to minimize demand charges from the local utility (Energy Conservation).

3.3 Site/Civil

- Stormwater management that is compliant with state and local regulations (Site Consideration).
- Manage Heat Island Effect—Reduce impermeable pavement area through permeable pavers (Site Consideration).
- Install rain gardens for stormwater management (Site Consideration).
- Low-Maintenance Landscaping—Reduce lawn mower fuel, fertilizer, and potable water use by converting selected mowed grass areas of the site to native and adapted vegetation that requires only occasional, seasonal maintenance (Site Consideration).

3.4 Architectural

- High Insulation Levels—Installation of insulation levels greater than the minimum required by the Energy Code (Energy Conservation).
- Increased Daylighting—Where room configurations and building orientations permit, provide additional windows or translucent insulating panels to furnish daylight at useful levels. Combine with light level sensors to automatically turn off unnecessary electric lights (Energy Conservation).
- Reduced Flow Plumbing—Installation of water-efficient fixtures and fittings including water-saving toilets, reduced flush devices, and restricted flow shower head (Water Conservation).
- Reuse of existing building and structure (Site Consideration).
- Preserve local character through exterior design (Site Consideration)

3.5 Instrumentation

- Supervisory Control and Data Acquisition (SCADA) System Upgrade—Utilize SCADA software to monitor and control portions of the facility and to remotely adjust the system to current conditions through the measurement of process variables such as liquid and gas flow rates, chemical residual, and dissolved oxygen concentration (Energy Conservation).
- Installation of dissolved oxygen monitoring and automated control (Energy Conservation).
- Installation of energy meters (Energy Consideration).

3.6 Other

- Consideration for solar installation (Site Consideration).
    - Solar installations on the Mashpee WRRF site were discussed with the Mashpee DPW director. There is currently a solar array on the landfill site. Further discussions on solar will take place in further designs.
- Installation of EV Charging Stations—Reduces the overall energy footprint of the site and promotes the use of alternative transportation (Site Consideration).
- Encourage alternative transportation through installation of bike racks and showering facilities (Site Consideration).
- Utilize regional materials, when possible (Site Consideration).
- Utilize recycled materials, when possible (Site Consideration).
- Divert waste from landfills (Site Consideration).
- Reduce excavated materials taken off site (Site Consideration).
- Specify minimum energy performance standards for equipment (Energy Consideration).
- Provide recycling facilities (Site Consideration).
- Minimize noise and vibration (Site Consideration).
- Preserve prime habitats, wetland, and floodplain functions (Site Consideration).
- Prevent surface and groundwater contamination (Site Consideration).
- Control invasive species/avoid introducing invasive species (Site Consideration).
- Restore disturbed soils (Site Consideration).
- Assess climate threat including anticipated sea level rise (Site Consideration). – Not applicable for this site
- Manage heat island effects (Site Consideration).

Technical Memorandum

November 19, 2019

To:	Town of Mashpee	Ref. No.:	11188223
From:	Anastasia Rudenko PE, BCEE, ENV SP	Tel:	774-470-1637
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – SW-1 Site Work** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memorandum is to establish the basis of design for site work at the proposed the Water Resource Recovery Facility (WRRF) site for the Town of Mashpee, Massachusetts.

2. Codes and Standards

The following design guidelines and standards have been adopted for this project:

- Town of Mashpee General Bylaws, updated October 16, 2017
- Town of Mashpee Zoning Bylaws, updated October 16, 2017
- FEMA FIRM Map Number 25001C0548J, effective date July 16, 2014
- Massachusetts Stormwater Management Standards (MSMS).
- Massachusetts Stormwater Handbook (all volumes)

3. Design Criteria

- Project Datum: Horizontal orientation is based on the Massachusetts State Coordinate System, NAD 83 feet; vertical datum is based on the North American Vertical Datum of 1988 (NACD 88) in feet.
- Building / Structure setbacks: as requested at the Sewer Commissioner Meeting dated 7/18/19, a minimum setback of 150 feet will be maintained from property boundaries bordering residential neighborhoods, increased to a 200 foot buffer to Asher's Path. A vegetative buffer will be installed around the WRRF to provide a visual barrier for residential neighborhoods.
- Wetland: There are no inland wetlands and tidal wetlands onsite.
- Flood zones: The site is outside of the Special Flood Hazard Area for the 100-year flood.
- Traffic: The site design will allow sufficient room for delivery and fire trucks maneuverability.

- Sediment and Erosion Control: The site design will provide adequate space for sedimentation and erosion control structures as needed during construction.
- Zoning bylaws limit structure height to 35 feet.
- The goal of the proposed site plan is to consolidate facilities, minimize site disturbance, maximize the buffer to residential neighborhoods, and minimize the visual impact of the site.

4. Stormwater

During final design, the site will require proper grading and stormwater facilities to manage runoff from impervious surfaces and maintain all stormwater within the site and in accordance with the Town's regulations regarding stormwater management and use of Best Management Practices (BMPs). The site will be designed for no increase in peak run-off discharge rate for 25-year storm.

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Lenna Quackenbush	Tel:	774-470-1654
	Anastasia Rudenko PE, BCEE, ENV SP		774-470-1637
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – CS-1 Summary of Costs** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to display the preliminary design engineer's opinion of probable costs for the Mashpee Water Resource Recovery Facility (WRRF) Project.

2. Preliminary Cost Estimates

Preliminary level capital costs were developed for the preliminary Design. The Engineer's opinion of probable costs (in 2019 dollars) is outlined in Table 1.

Because of the conceptual nature of this design, a 20 percent construction contingency is carried to cover the details of design not completed at 20 percent and bidding variability. During final design a reduced contingency will be carried, as more design details will be addressed. The final design contingency is primarily for variability in the bidding climate, project changes before bidding, residential property restoration, and change orders due to unforeseen conditions. Easements are not anticipated for Site 4, as the site is currently owned by the Town. However, for collection systems and pumping station sites, easements are also often needed but not typically carried beyond a reasonable allowance. These are typically identified as a separate line item because these are negotiated values and they are typically addressed as an additional cost with direct input from the Town/Owner. Project costs are presented in 2019 dollars. Once the construction timeframe is finalized, project costs should be adjusted to the mid-point of construction.

Table 1 Preliminary Engineer's Opinion of Probable Capital Costs - WWTF

Components	Probable Costs
Preliminary Treatment	$2,290,000
Secondary Treatment	$4,214,000
Disinfection	$316,000
MLSS Holding Tank	$251,000
Ancillary Processes	$676,000
Odor Control	$852,000

Components	Probable Costs
Electrical & Instrumentation	$1,290,000
HVAC	$258,000
Yard Piping	$430,000
Site Work	$430,000
Plumbing, Painting	$172,000
Effluent Recharge Beds	$908,000
Subtotal of Construction Costs	**$12,090,000**
Contingency (20%)	$2,418,000
TOTAL CONSTRUCTION	**$14,510,000**
Final Design	$1,300,000
Legal, Fiscal & CPS Allowance	$2,177,000
TOTAL CAPITAL COSTS	**$17,990,000**

Notes:
1. Values rounded to the hundreds.
2. ENR Index for October 2019 = 11326

Engineer's Opinion of Probable Capital Costs for infrastructure recommended as part of a multi-year planning project are typically initially developed as part of the planning process. As the project progresses, it is critical that these costs are updated and refined at each stage of the planning and design process to accurately reflect items that may affect them. Items that may affect cost may include, but are not limited to:

- Changes in bidding climate and tariffs.
- Design changes resulting from future law, regulation, or code changes.
- Design changes resulting from industry or manufacturer advances, updates, or changes.
- Owner-driven decisions and changes.
- Unknown conditions discovered through field investigations during design (borings, surveys, etc.).
- Design decisions regarding proprietary equipment/sole sourcing of equipment.

The Engineer's Opinion of Probable Capital Costs presented in this memorandum will continue to be refined and updated at each major stage of the design process and prior to construction financing.

Attachments

Mashpee WRRF - Stage 1 Preliminary Design	10/7/2019	11188223
Project	Date	Job No.
Engineers Estimate of Probable Construction Cost	LMQ	AR (11/15/19)
Subject	Comp. By	Checked By

ENGINEERS ESTIMATE OF PROBABLE CONSTRUCTION COST
MASHPEE WATER RESOURCE RECOVERY FACILITY - STAGE 1 PRELIMINARY DESIGN
DESIGN STATUS: 30%

	MBR Alternative	SBR Alternative
Preliminary Treatment	$2,290,000	$1,832,000
Secondary Treatment	$4,214,000	$4,742,000
Disinfection	$316,000	$358,000
MLSS Holding Tank	$251,000	$251,000
Ancillary Processes	$676,000	$676,000
Odor Control	$852,000	$852,000
Operations Building	$0	$0
Electrical & Instrumentation	$1,290,000	$1,307,000
HVAC	$258,000	$261,000
Yard Piping	$430,000	$436,000
Site Work	$430,000	$436,000
Plumbing, Painting	$172,000	$174,000
Effluent Recharge Beds	$908,000	$908,000
Subtotal of Construction Costs	**$12,090,000**	**$12,230,000**
Contingency	$2,418,000	$2,446,000
TOTAL CONSTRUCTION (ENR - October 2019 = 11326)	**$14,510,000**	**$14,680,000**
Final Design	$1,300,000	$1,300,000
Legal, Fiscal & CPS Allowance	$2,177,000	$2,202,000
TOTAL CAPITAL COSTS (ENR - OCTOBER 2019 = 11326)	**$17,990,000**	**$18,182,000**
TOTAL CAPITAL COSTS TO MIDPOINT OF CONSTRUCTION	**TBD**	**TBD**

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST

Project:	Mashpee WRRF - Stage 1 Preliminary Design	**Computed By:**	LMQ
Location:	Mashpee, MA	**Checked By (Checked By Date):**	AR (11/15/19)
Owner:	Town of Mashpee, MA	**Design Status of Estimate:**	30%
Description:	**Preliminary Treatment - MBR Alternative**	**Project Number:**	11188223

Description	Quantity		Material			Installation			Total Cost
	No. Units	Basis		Per Unit	Total	%	each	Total	
Preliminary Treatment Equipment (Manufacturer)									
Raptor Micro Stainer Screen (6mm)	1	EA	$	113,400	$113,400	30%	$34,020	$34,020	$147,420
Raptor SpiraGrit Vortex Grit System (Vorte	1	EA	$	162,300	$162,300	30%	$48,690	$48,690	$210,990
Raptor Rotating Drum Screen (2mm)	2	EA	$	151,300	$302,600	30%	$45,390	$90,780	$393,380
ByPass Screen	1	EA	$	10,000	$10,000	30%	$3,000	$3,000	$13,000
Spare Grit Pump	1	EA	$	16,800	$16,800	30%	$5,040	$5,040	$21,840
Preliminary Treatment Equipment (Miscellaneous)									
Slidegate	13	EA	$	5,600	$72,800	30%	$1,680	$21,840	$94,640
Dumpsters	4	EA	$	6,000	$24,000				$24,000
pH and Temp. Analyzer and Transmitter	1	EA	$	6,000	$6,000	30%	$1,800	$1,800	$7,800
Hoists and Lifting Eyes	4	EA	$	1,500	$6,000	30%	$450	$1,800	$7,800
Interior Piping	1	LS	$	20,000	$20,000	30%	$6,000	$6,000	$26,000
Distribution Box									
Weir gate	1	EA	$	20,000	$20,000	30%	$6,000	$6,000	$26,000
Structural									
Conctrete Floor and Channel	200	CY	$	1,200	$240,000				$240,000
Grating over Channels	225	SF	$	80	$18,000				$18,000
Overhead Coiling Doors w/operator	1	EA	$	15,000	$15,000				$15,000
Architectural									
Building Cost	2515	SF	$	195	$490,425				$490,430
Slab on Grade	31	CY	$	900	$27,900				$27,900
Footing	23	CY	$	1,000	$23,000				$23,000
Architectural Finish Allowance	1	LS	$	98,000	$98,000				$98,000
Civil/Earthwork									
Excavation	35	CY	$	70	$2,450				$2,450
Backfill - off Site	12	CY	$	40	$467				$470
Piping Allowance	1	LS	$	20,000	$20,000				$20,000
	General Conditions								
		Subtotal			$1,689,100			$219,000	**$1,908,000**
		Taxes	**Tax-Exempt**					$0	
		Overhead						**10%**	**$190,800**
		Profit						**10%**	**$190,800**
	TOTAL								**$2,289,600**

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST

Project:	Mashpee WRRF - Stage 1 Preliminary Design	**Computed By:**	LMQ
Location:	Mashpee, MA	**Checked By (Checked By Date):**	AR (11/15/19)
Owner:	Town of Mashpee, MA	**Design Status of Estimate:**	30%
Description:	**Preliminary Treatment - SBR Alternative**	**Project Number:**	11188223

Description	Quantity No. Units	Quantity Basis	Material Per Unit	Material Total	Installation %	Installation each	Installation Total	Total Cost
Preliminary Treatment Equipment (Manufacturer)								
Raptor Micro Stainer Screen (6mm)	1	EA	$ 113,370	$113,370	30%	$34,011	$34,011	$147,380
Raptor SpiraGrit Vortex Grit System (Vorte	1	EA	$ 162,310	$162,310	30%	$48,693	$48,693	$211,000
ByPass Screen	1	EA	$ 10,000	$10,000	30%	$3,000	$3,000	$13,000
Spare Grit Pump	1	EA	$ 16,780	$16,780	30%	$5,034	$5,034	$21,810
Preliminary Treatment Equipment (Miscellaneous)								
Slidegate	7	EA	$ 5,600	$39,200	30%	$1,680	$11,760	$50,960
Dumpsters	3	EA	$ 6,000	$18,000				$18,000
pH and Temp. Analyzer and Transmitter	1	EA	$ 6,000	$6,000	30%	$1,800	$1,800	$7,800
Hoists and Lifting Eyes	4	EA	$ 1,500	$6,000	30%	$450	$1,800	$7,800
Interior Piping	1	LS	$ 20,000	$20,000	30%	$6,000	$6,000	$26,000
Distribution Box								
Weir gate	4	EA	$ 21,000	$84,000	30%	$6,300	$25,200	$109,200
Structural								
Conctrete Floor and Channel	200	CY	$ 1,200	$240,000				$240,000
Grating over Channels	150	SF	$ 80	$12,000				$12,000
Overhead Coiling Doors w/operator	1	EA	$ 15,000					$15,000
Architectural								
Building	2515	SF	$ 195	$490,425				$490,430
Slab on Grade	31	CY	$ 900	$27,900				$27,900
Footing	23	CY	$ 1,000	$23,000				$23,000
Architectural Finish Allowance	1	LS	$ 98,000	$98,000				$98,000
Civil/Earthwork								
Excavation	35	CY	$ 50	$1,750				$1,750
Backfill - off Site	12	CY	$ 40	$467				$470
Piping Allowance	1	LS	$ 20,000	$20,000				$20,000
	General Conditions							
		Subtotal		$1,389,200			$137,300	**$1,527,000**
		Taxes	**Tax-Exempt**					
		Overhead					**10%**	**$152,700**
		Profit					**10%**	**$152,700**
	TOTAL							**$1,832,400**

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST

Project:	Mashpee WRRF - Stage 1 Preliminary Design	**Computed By:**	HGB
Location:	Mashpee, MA	**Checked By (Checked By Date):**	AR (11/15/19)
Owner:	Town of Mashpee, MA	**Design Status of Estimate:**	30%
Description:	**Secondary Treatment - MBR Alternative**	**Project Number:**	11188223

Description	Quantity		Material/Equipment		Installation			Total
	No. Units	Basis	Per Unit	Total	%	each	Total	Total Cost
Tank Structure								
Excavation	1600	CY	$50	$80,000				$80,000
Backfill	550	CY	$50	$27,500				$27,500
Concrete Walls	240	CY	$1,500	$360,000				$360,000
Concrete Slab	105	CY	$1,200	$126,000				$126,000
Covers	1050	SF	$40	$42,000				$42,000
Monorail and Hoist	1	EA	$31,500	$31,500				$31,500
Architectural								
Building Cost	6000	SF	$195	$1,170,000				$1,170,000
Slab on Grade	75	CY	$900	$67,500				$67,500
Footing	55	CY	$1,000	$55,000				$55,000
Architectural Finish Allowance	1	LS	$250,000	$250,000				$250,000
Bioreactor Equipment								
Pre and Post Anoxic Mixers	4	EA	$5,000	$20,000	30%		$6,000	$26,000
Aeration system blowers	3	EA	$10,000	$30,000	30%		$9,000	$39,000
IR pumps	2	EA	$7,500	$15,000	30%		$4,500	$19,500
Membrane Equipment								
Process Skids & instrumentation	2	EA	$152,000	$304,000	30%		$91,200	$395,200
Process Tank Cassettes	2	EA	$162,000	$324,000	30%		$97,200	$421,200
Air Scour Blowers	3	EA	$22,000	$66,000	30%		$19,800	$85,800
RAS/WAS pumps	3	EA	$18,000	$54,000	30%		$16,200	$70,200
Spare Parts Allowance	1	LS	$20,000	$20,000				$20,000
Air Ejector System	1	EA	$16,000	$16,000	30%		$4,800	$20,800
Chemical Feed Skids & piping	3	EA	$8,500	$25,500	30%		$7,650	$33,150
Backpulse Tanks	1	EA	$5,000	$5,000	30%		$1,500	$6,500
Process Air Piping, 8" SS	139	LF	$130	$18,070	40%		$7,228	$25,300
Permeate piping 6" DIP	326	LF	$65	$21,190	40%		$8,476	$29,670
MLSS & NR piping 6" DIP	240	LF	$65	$15,600	40%		$6,240	$21,840
Micellaneous Process Piping and Parts	1	LS	$88,000	$88,000				$88,000
	General Conditions							
		Subtotal						$3,511,700
		Taxes	**Tax-Exempt**					
		Overhead					10%	$351,200
		Profit					10%	$351,200
		TOTAL						**$4,214,100**

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST

Project:	Mashpee WRRF - Stage 1 Preliminary Design	**Computed By:**	HGB
Location:	Mashpee, MA	**Checked By (Checked By Date):**	AR (11/15/19)
Owner:	Town of Mashpee, MA	**Design Status of Estimate:**	30%
Description:	**Secondary Treatment - SBR Alternative**	**Project Number:**	11188223

	Quantity		Material		Installation			
Description	No. Units	Basis	Per Unit	Total	%	each	Total	Total Cost
Tank Structure								
Excavation	2789	CY	$50	$139,450				$139,500
Backfill	1000	CY	$50	$50,000				$50,000
Concrete Walls	286	CY	$1,500	$429,000				$429,000
Concrete Slab	117	CY	$1,200	$140,400				$140,400
Tank Cover	1480	SF	$60	$88,800				$88,800
Architectural								
Building Cost	6000	SF	$195	$1,170,000				$1,170,000
Slab on Grade	75	CY	$900	$67,500				$67,500
Footing	55	CY	$1,000	$55,000				$55,000
SBR Equipment								
SBR Equipment	1	LS	$349,180	$349,180	30%	$104,754	$104,754	$453,900
Spare parts	1	LS	$6,180	$6,180				$6,200
Process Air Piping, 8" SS	150	LF	$130	$19,500	40%	$52	$7,800	$27,300
Decant piping 6" DIP	200	LF	$65	$13,000	40%	$26	$5,200	$18,200
Denite Filters								
Fitler Equipment and controls	1	LS	$800,000	$800,000	30%	$240,000	$240,000	$1,040,000
Excavation	104	CY	$50	$5,200				$5,200
Backfill	35	CY	$50	$1,733				$1,700
Concrete Walls	47	CY	$1,500	$70,778				$70,800
Concrete Slab	40	CY	$1,200	$47,667				$47,700
Tank Cover	144	SF	$60	$8,640				$8,600
Micellaneous Process Piping and P	1	LS	$132,000	$132,000				$132,000
	General Conditions							
		Subtotal						$3,951,800
		Taxes	**Tax-Exempt**					
		Overhead					10%	$395,200
		Profit					10%	$395,200
	TOTAL							**$4,742,200**

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST

Project:	Mashpee WRRF - Stage 1 Preliminary Design	**Computed By:**	LMQ
Location:	Mashpee, MA	**Checked By (Checked By Date):**	AR (11/15/19)
Owner:	Town of Mashpee, MA	**Design Status of Estimate:**	30%
Description:	**Disinfection - SBR Alternative**	**Project Number:**	11188223

Description	Quantity		Material		Installation			Total
	No. Units	Basis	Per Unit	Total	%	each	Total	Total Cost
UV Disinfection Equipment System								
UV module	2	EA	$66,000	$132,000	30%	$19,800	$39,600	$171,600
Mechanical wipers	2	EA	$8,000	$16,000	30%	$2,400	$4,800	$20,800
Power Distribution Pre-wired for Stage 4	1	LS	$18,000	$18,000	30%	$5,400	$5,400	$23,400
Effluent Sampling Unit	1	LS	$6,000	$6,000	30%	$1,800	$1,800	$7,800
Finger Weir	10	LF	$160	$1,600	30%	$48	$480	$2,080
Davit Crane	1	EA	$10,000	$10,000	30%	$3,000	$3,000	$13,000
Blower	1	EA	$5,000	$5,000	30%	$1,500	$1,500	$6,500
Concrete								
Channel	16	CY	$1,500	$24,000				$24,000
Base Slab	12	CY	$1,000	$12,000				$12,000
Channel Inlet/weir	6	CY	$1,500	$8,333				$8,330
Cleaning Tank	3	CY	$1,200	$3,430				$3,430
Structural								
Channel Grating	60	SF	$80	$4,800				$4,800
	General Conditions							
		Subtotal		$241,200			$56,600	**$298,000**
		Taxes	**Tax-Exempt**	$0		**0%**	$0	
		Overhead					**10%**	**$29,800**
		Profit					**10%**	**$29,800**
	TOTAL							**$357,600**

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST

Project:	Mashpee WRRF - Stage 1 Preliminary Design	**Computed By:**	LMQ
Location:	Mashpee, MA	**Checked By (Checked By Date):**	AR (11/15/19)
Owner:	Town of Mashpee, MA	**Design Status of Estimate:**	30%
Description:	**Disinfection - MBR Alternative**	**Project Number:**	11188223

Description	Quantity		Material		Installation			Total Cost
	No. Units	Basis	Per Unit	Total	%	each	Total	
UV Disinfection Equipment System								
UV module	2	EA	$53,000	$106,000	30%	$15,900	$31,800	$137,800
Mechanical wipers	2	EA	$8,000	$16,000	30%	$2,400	$4,800	$20,800
Power Distribution Pre-wired for Stage 4	1	LS	$18,000	$18,000	30%	$5,400	$5,400	$23,400
Effluent Sampling Unit	1	LS	$6,000	$6,000	30%	$1,800	$540	$6,540
Finger Weir	10	LF	$160	$1,600	30%	$48	$480	$2,080
Davit Crane	1	EA	$10,000	$10,000	30%	$3,000	$3,000	$13,000
Blower	1	EA	$5,000	$5,000	30%	$1,500	$1,500	$6,500
Concrete								
Channel	16	CY	$1,500	$24,000				$24,000
Base Slab	12	CY	$1,000	$12,000				$12,000
Channel Inlet/weir	6	CY	$1,500	$8,333				$8,330
Cleaning Tank	3	CY	$1,200	$3,430				$3,430
Structural								
Channel Grating	60	SF	$80	$4,800				$4,800
	General Conditions							
		Subtotal		$215,200			$47,500	**$263,000**
		Taxes	**Tax-Exempt**					
		Overhead					**10%**	**$26,300**
		Profit					**10%**	**$26,300**
	TOTAL							**$315,600**

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST

Project:	Mashpee WRRF - Stage 1 Preliminary Design	**Computed By:**	MD
Location:	Mashpee, MA	**Checked By (Checked By Date):**	AR (11/15/19)
Owner:	Town of Mashpee, MA	**Design Status of Estimate:**	30%
Description:	**Sludge Storage - All Alternatives**	**Project Number:**	11188223

	Quantity		Material		Installation			
Description	No. Units	Basis	Per Unit	Total	%	each	Total	Total Cost
Tanks								
Concrete Walls	1	LS	$70,000	$70,000				$70,000
Concrete Base Slab	1	LS	$33,000	$33,000				$33,000
Excavation/Backfill	1	LS	$25,000	$25,000				$25,000
Cover	272	SF	$40	$10,890				$10,890
Slide Gate	1	LS	$5,583	$5,583				$5,580
Access Hatches	4	LS	$5,000	$20,000				$20,000
Sump Pumps	2	LS	$5,000	$10,000				$10,000
Misc. Metals								
Equipment								
PD Blowers	3	EA	$16,130	$48,390	30%	$14,517	$13,065.30	$61,460
Coarse Bubble Aeration System	1	LS	$34,940	$34,940	30%	$10,482	$3,144.60	$38,080
Davit Cranes & Bases	1	EA	$4,700	$4,700	30%	$1,410	$423.00	$5,120
	General Conditions							
		Subtotal		$192,500			$16,600	**$209,000**
		Taxes	**Tax Exempt**					
		Overhead					**10%**	**$20,900**
		Profit					**10%**	**$20,900**
	TOTAL							**$250,800**

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST

Project:	Mashpee WRRF - Stage 1 Preliminary Design	**Computed By:**	LQ
Location:	Mashpee, MA	**Checked By (Checked By Date):**	AR (11/15/19)
Owner:	Town of Mashpee, MA	**Design Status of Estimate:**	30%
Description:	**Ancillary Equipment - All Alternatives**	**Project Number:**	11188223

Description	Quantity		Material		Installation			Total Cost
	No. Units	Basis	Per Unit	Total	%	each	Total	
Generator	1	LS	Inc. in E&I					
Plant Water System								
Plant Water Packaged System	1	LS	$50,000	$50,000	30%		$15,000	$65,000
Hydro-pneumatic tank	1	LS	$3,900	$3,900	30%		$1,170	$5,070
Chemical Feed Systems								
Sodium hydroxide system	1	LS	$25,000	$25,000				$25,000
Sodium hypochlorite system	1	LS	$20,000	$20,000				$20,000
Supplemental carbon system	1	LS	$25,000	$25,000				$25,000
Citric acid system	1	LS	$20,000	$20,000				$20,000
Piping / drip trays /supports	1	LS	$5,000	$5,000				$5,000
Emergency Shower / Eye Wash	2	LS	$7,100	$14,200				$14,200
Equalization Tank								
Precast Concrete Tank	2	EA	$25,928	$51,856				$51,860
EQ Pumps	2	EA	$50,000	$100,000				$100,000
Excavation	150	CY	$50	$7,500				$7,500
Valve Allowance	1	LS	$10,000	$10,000				$10,000
Access Hatches	2	LS	$5,000	$10,000				$10,000
Distribution Boxes								
Preliminary Effluent D-Box	1	LS	$30,000	$30,000				$30,000
PE D-Box Slide Gates	2	EA	$5,583	$11,166				$11,170
Secondary Influent D-Box	1	LS	$30,000	$30,000				$30,000
SI D-Box Slide Gates	6	EA	$5,583	$33,498				$33,500
Sand Beds D-Box	1	LS	$30,000	$30,000				$30,000
SB Box Slide Gates	8	EA	$5,583	$44,664				$44,660
Weirs								
Effluent Sand Bed Box	24	LF	$158	$3,800				$3,800
Secondary Influent D-Box	24	LF	$158	$3,800				$3,800
Preliminary Effluent D-Box	10	LF	$158	$1,583				$1,580
Level Sensors	2	EA	$3,000	$6,000				$6,000
Lab Equiment Allowance	1	LS	$10,000	$10,000				$10,000
	General Conditions							
		Subtotal		$547,000			$16,200	**$563,000**
		Taxes	**Tax-Exempt**					
		Overhead					**10%**	**$56,300**
		Profit					**10%**	**$56,300**
		Subtotal						
		TOTAL						**$675,600**

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST

Project:	Mashpee WRRF - Stage 1 Preliminary Design	**Computed By:**	LQ
Location:	Mashpee, MA	**Checked By (Checked By Date):**	AR (11/15/19)
Owner:	Town of Mashpee, MA	**Design Status of Estimate:**	30%
Description:	**Effluent Recharge - All Alternatives**	**Project Number:**	11188223

	Quantity		Material		Installation			
Description	No. Units	Basis	Per Unit	Total	%	each	Total	Total Cost
Demolition								
Topsoil Stockpiling	84400	SY	$1	$50,640				$50,640
Site Cut	3126	CY	$10	$31,259				$31,259
Site Fill	3126	CY	$5	$14,067				$14,067
Hauling	3126	CY	$11	$34,385				$34,385
Distribution Piping								
Trench Excavation	1000	CY	$59	$59,496				$59,496
Backfill	500	CY	$30	$15,000				$15,000
Hauling	500	CY	$20	$10,000				$10,000
Pipe Bedding	456	CY	$70	$31,946				$31,946
12" DI Pipe	1500	LF	$80	$120,000				$120,000
12" DI Gate Valve	4	EA	$5,810	$23,240				$23,240
DI Valve Box	4	EA	$480	$1,920				$1,920
Effluent Sand Bed Discharge Pipe								
8' Diameter Pad Concrete	7	SY	$40	$299				$299
24" CI Frame & Grate	2	EA	$660	$1,320				$1,320
Filter Fabric	100	SF	$3	$270				$270
Meter Vault								
Electrical connection and communication to V		LS	$5,250					
Perimeter Berm	1800	LF						
Type D-1	2000	SY	$16	$32,000				$32,000
Filtration Geotextile	90000	SF	$3	$243,000				$243,000
1-1/2" to 2" Double-Washed Crushed Stone	800	CY	$41	$32,800				$32,800
Interior Walking Dike								
Type D-1	150	SY	$16	$2,400				$2,400
Filtration Geotextile	16000	SF	$3	$43,200				$43,200
1-1/2" to 2" Double-Washed Crushed Stone	150	CY	$41	$6,150				$6,150
Filtration Geotextile (Vehicle Crossover)	350	SF	$3	$945				$945
4" to 8" Rip Rap (Vehicle Crossover)	40	SY	$70	$2,800				$2,800
	General Conditions							
		Subtotal		$757,100				**$757,000**
		Taxes	**Tax-Exempt**					
		Overhead					**10%**	**$75,700**
		Profit					**10%**	**$75,700**
		Subtotal						
		TOTAL						**$908,400**

ENGINEER'S ESTIMATE OF PROBABLE CONSTRUCTION COST

Project:	Mashpee WRRF - Stage 1 Preliminary Design	**Computed By:**	LQ
Location:	Mashpee, MA	**Checked By (Checked By Date):**	AR (11/15/19)
Owner:	Town of Mashpee, MA	**Design Status of Estimate:**	30%
Description:	**Odor Control - All Alternatives**	**Project Number:**	11188223

Description	Quantity		Material		Installation			
	No. Units	Basis	Per Unit	Total	%	each	Total	Total Cost
Biofilter Cells (1)	1	LS	$465,000	$465,000	30%	$139,500	$41,850	$506,850
Humidifier vessel		incl.						
Engineered biofilter meda		incl.						
Butterfly dampers (2)		incl.						
5 HP recirculation pump		incl.						
15 FRP exhaust fan (2)		incl.						
Sch 80 PVC manufolds		incl.						
Control Panel		incl.						
Waterbox		incl.						
Dual-bed carbon polisher		LS	$55,000					
Hollow core roof panels	1	LS	$49,000	$49,000	30%	$14,700	$4,410	$53,410
Odor Control Piping Contingency	1	LS	$100,000	$100,000				$100,000
Underground Concrete Vault	1	LS	$50,000	$50,000				$50,000
	General Conditions							
		Subtotal		$664,000			$46,300	**$710,000**
		Taxes	**Tax-Exempt**					
		Overhead					**10%**	**$71,000**
		Profit					**10%**	**$71,000**
		Subtotal						
	TOTAL							**$852,000**

Technical Memorandum

November 19, 2019

To:	Town of Mashpee, MA	Ref. No.:	11188223
From:	Anastasia Rudenko PE, BCEE, ENV SP	Tel:	774-470-1637
CC:	Mashpee Sewer Commission		
Subject:	**Basis of Design Memo – PSE-1 Preliminary Sequence of Expansion** **Mashpee Water Resource Recovery Facility – Stage 1 Preliminary Design**		

1. Purpose of Memo

The purpose of this memo is to summarize the methodology used to develop the preliminary sequence of expansion for Planning Phases 1 through 5 outlined in the Mashpee Watershed Nutrient Management Plan for the Water Resource Recovery Facility (WRRF) Project for the Town of Mashpee, Massachusetts.

2. References

The following references were used to develop this memorandum:

- 'Final Recommended Plan / Final Environmental Impact Report – Town of Mashpee Sewer Commission', prepared by GHD and dated May 2015

3. Background

The Town of Mashpee has been involved in a watershed nitrogen management planning effort since the late 1990's. In 2015, the planning effort culminated in a Town-wide Watershed Nitrogen Management Plan (WNMP) for the watersheds of Popponesset Bay, Waquoit Bay East, and the remainder of the Town of Mashpee. The WNMP is built under the general approach that shellfish aquaculture will be used in conjunction with traditional wastewater infrastructure in order to meet the Town's Total Maximum Daily Loads (TMDLs) for nitrogen.

The WNMP implementation schedule is broken down into five phases and relies on an adaptive management approach. If shellfish aquaculture is unsuccessful in reducing its portion of the nitrogen load, a completely traditional infrastructure approach will be implemented to meet the TMDLs. Under the adaptive management approach, additional flow will be conveyed to the WRRF during multiple phases if shellfish aquaculture is not advancing as fast or effectively as anticipated.

A primary goal of the project is to maintain flexibility within the site layout for treatment of flow from future phases. Anticipated average annual flows for each phase, based on water usage data, are outlined in TM M-1. It is anticipated that the five phases will be constructed in four “Stages”. Each stage is anticipated to handle the same flow rate, which is equivalent to anticipated flows from Planning Phase 1.

The preliminary sequence of expansion was developed to:

- Minimize the amount of equipment replacement/upsizing that will be required for future phases.
- Minimize the amount of infrastructure installed for future phases that may not be required, if shellfish provide adequate nitrogen removal in later phases.
- Maintain flexibility in the site layout for future phases.

Table 1 Preliminary Sequence of Expansion

Process	Stage 1 Construction	Accommodation for Future Phases
Preliminary Treatment	• 6mm screen sized for anticipated flow from Stages 1 through 4. • Grit vortex system sized for handling anticipated flow from Stages 1 through 4. • 2 mm screens sized for anticipated Stage 1 flow only.	• Space allocated for future 2 mm screen. It is anticipated one additional 2 mm screen is required for anticipated flow from Stages 1 through 4.
Secondary Treatment	• Tankage and equipment constructed for Stage 1 flow. • Process Building is sized for Stage 1 with accommodations for future equipment in the building layout.	• Space allocated for Process Building expansion footprint for Stages 2 through 4.
Disinfection	• UV channel sized to accommodate modules for Stages 1 through 4. • UV modules installed for Stage 1 only.	• UV modules for Stages 2 through 4 will be installed in the future.
MLSS Waste Storage	• MLSS Waste Storage Tank sized for anticipated sludge generated in Stage 1.	• Space allocated for future MLSS Waste Storage Tanks for Stages 2 through 4.
Effluent Recharge	• Construction of effluent recharge for Stage 1 maximum month conditions with one open sand bed out of service.	• Space allocated on site layout for future open sand beds. • It is recommended that once Stage 1 open sand beds are operational, hydrologic load testing be conducted with WRRF effluent to evaluate the ability to request an increase in the rated capacity of the open sand beds.
Odor Control	• Odor control sized for Stage 1.	• Space allocated on site layout for odor control expansion for Stages 2 through 4.
Ancillary Processes	• Plant water system sized for Stage 1. • Generator sized for Stage 1.	• Space allocated in the Process Building for plant water system expansion for Stages 2 through 4. • Space allocated on site layout for additional generator for Stages 2 through 4.

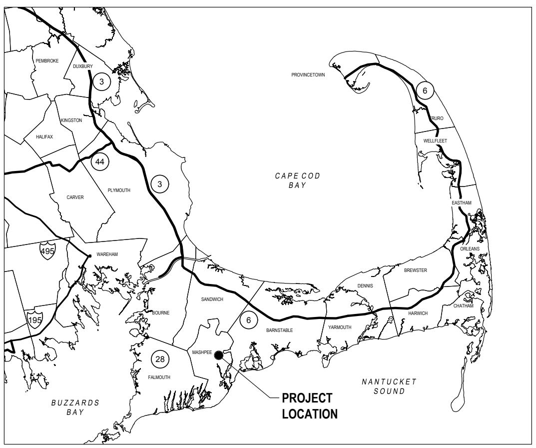
APPENDIX B

30% Preliminary Drawings

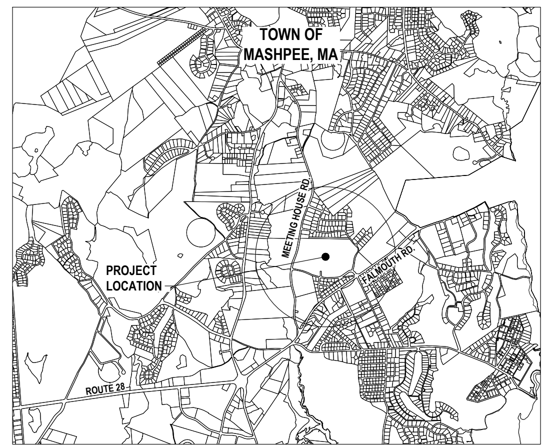
TOWN OF MASHPEE, MASSACHUSETTS
MASHPEE SEWER COMMISSION
PRELIMINARY DESIGN OF MASHPEE WATER RESOURCE RECOVERY FACILITY (WRRF)
30% REVIEW SUBMITTAL

NOVEMBER 2019

11188223



AREA MAP



LOCATION MAP

No.	Issue	Drawn	Approved	Date
1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

Bar is one inch on original size sheet
0 1"

Reuse of Documents
This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of GHD and shall not be reused in whole or in part for any other project without GHD's written authorization.

PRELIMINARY
NOT FOR CONSTRUCTION

GHD Inc.
1545 Iyannough Road
Hyannis MA 02601 USA
T 1 774 470 1630 F 1 774 470 1631 W www.ghd.com

Drawn J. FOSDICK	Designer JDF
Drafting Check	Design Check
Project Manager A. RUDENKO	Date
This document shall not be used for construction unless signed and sealed for construction.	Scale AS SHOWN

Client **TOWN OF MASHPEE, MA**
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **COVER SHEET**
Project No. **11188223**
Original Size **Arch D** Sheet No. **G-001** Sheet of

Plot Date: 19 November 2019 - 6:29 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\General\11188223-G-001.dwg

ABBREVIATIONS

AB	ANCHOR BOLT
AC	ASBESTOS CEMENT
ADD'L	ADDITIONAL
AFF	ABOVE FINISHED FLOOR
AST	ASPHALT TILE
ACTL	ACOUSTIC TILE
ADJ	ADJUSTABLE
AGGR	AGGREGATE
ALLOW	ALLOWANCE
ALT	ALTERNATE
ALUM	ALUMINUM
ARCH	ARCHITECT OR ARCHITECTURAL
ASB	ASBESTOS
ASPH	ASPHALT
ASSY	ASSEMBLY
ACOUS	ACOUSTICAL (SOUND DEADENING)
APPROX	APPROXIMATE
ATAD	AUTOTHERMAL AEROBIC DIGESTION
BASP	BALLASTED ACTIVATED SLUDGE PROCESS
BET	BETWEEN
BF	BLIND FLANGE
BFV	BUTTERFLY VALVE
BL or ♇	BUILDING LINE
BM	BENCH MARK\ BEAM
BOF	BOTTOM OF FOOTING
BU	BUILT UP
BV	BALL VALVE
BO	BOARD
BIT	BITUMINOUS
BLDG	BUILDING
BLK	BLOCK
BP	BASE PLATE
BRG	BEARING
BRK	BRICK
BRZ	BRONZE
BOT or B	BOTTOM
CB	CATCH BASIN
CC	CENTER TO CENTER
CF	CUBIC FEET
CFM	CUBIC FEET PER MINUTE
CI	CAST IRON
CIP	CAST IRON PIPE
CJ	CONSTRUCTION JOINT
CMP	CORRUGATED METAL PIPE
CO	CLEANOUT
CONN	CONNECTION
CP	CONCRETE PLANK
CRS	COURSE
CT	CERAMIC TILE
CV	CHECK VALVE
CW	COLD WATER/ CIRCULAR WASHER
CY	CUBIC YARD
CABN	CABINET
CEM	CEMENT
CER	CERAMIC
CL2	CHLORINE
CL	CLEAR
℄	CENTER LINE
CLG	CEILING
CLKG	CAULKING
CLF	CHAIN LINK FENCE
COL	COLUMN, COLOR
COMBN	COMBINATION
CONC	CONCRETE
CON	CONCENTRIC
CONST	CONSTRUCTION
CONT	CONTINUOUS
CONTR	CONTRACTOR
COND	CONDUIT
COR	CORRIDOR
CPLG	COUPLING
CPVC	CHLORINATED POLYVINYL CHLORIDE
CRF	CHEMICAL RESISTANT FINISH
CL JT	CONTROL JOINT
CTR	CONTRACT
CU	COPPER
CU IN	CUBIC INCH
D	DISCHARGE
DB	DISTRIBUTION BOX
DF	DRINKING FOUNTAIN
DJ	DOUBLE JOINT
DL	DEAD LOAD
DET	DETAIL
DIA, Ø	DIAMETER
DIAG	DIAGONAL
DEFL	DEFLECTION
DIM	DIMENSION
DIST	DISTRIBUTION, DISTANCE
DI / DIP	DUCTILE IRON
DOZ	DOZEN
DN	DOWN
DR	DOOR
DWG	DRAWING
DWL	DOWEL
DH	DECK HYDRANT
E	EAST
EF	EACH FACE
EJ	EXPANSION JOINT
EW	EACH WAY
EA	EACH
ECC	ECCENTRIC
EFF	EFFLUENT
EL or ELEV	ELEVATION
ELB	ELBOW
ELEC	ELECTRIC
ENAM	ENAMEL
ENG	ENGINE
ENGR	ENGINEER
ENT	ENTRANCE
ENR	ENHANCED NUTRIENT REMOVAL
EQUIP	EQUIPMENT
EX, EXIST	EXISTING
EXC	EXCAVATE
EXH	EXHAUST
EXP	EXPANSION
EXT	EXTERIOR
EXTEND OPER	EXTENDED OPERATOR
EXTR	EXTRUDE
FC	FOOT CANDLE/ FLUSHING CONNECTION
FCV	FLOW CONTROL VALVE
FD	FLOOR DRAIN/ FIRE DOOR
FE	FIRE EXTINGUISHER
FF	FAR FACE/ FINISHED FLOOR
FG	FIBERGLASS
FM	FORCE MAIN
FAB	FABRICATE
FDN	FOUNDATION
FIN	FINISH
FIN RAD	FIN RADIATOR
FITG	FITTING
FIX	FIXTURE
FL	FLASHING/ FLANGE
FLX CON	FLEXIBLE CONTAINMENT TUBE
FLG	FLOORING
FLR	FLOOR
FLOUR	FLUORESCENT
FOC	FACE OR COLUMN
FPRF	FIREPROOF
FRP	FIBERGLASS REINFORCED PLASTIC
FS	FOOTING STEP
FST	FINAL SETTLING TANK
FT	FEET
FTG	FOOTING
FURR	FURRING/ FURRED
F&C	FRAME AND COVER
F&G	FRAME AND GRATING
G	NATURAL GAS
GC	GENERAL CONTRACTOR
GI	GALVANIZED IRON
GPM	GALLONS PER MINUTE
GV	GATE VALVE
GWF	GLAZED WALL FINISH
GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GEN	GENERATOR
GL	GLASS
GR	GRADE
GRAN	GRANITE
GYP	GYPSUM
GYP BD	GYPSUM BOARD
GMU	GLAZED MASONRY UNIT
H&V	HEATING and VENTILATING
HD	HEAVY DUTY
HDPE	HIGH DENSITY POLYETHYLENE
HDBD	HARDBOARD
H EXCH	HEAT EXCHANGER
HWL	HIGH WATER LEVEL
HDWR	HARDWARE
HGT or HT	HEIGHT
HM	HOLLOW METAL
HOR or H	HORIZONTAL
HP	HORSEPOWER
HPT	HIGH POINT
HTR	HEATER
HYD	HYDRANT
I	IRON
'I'	INLET
IN FC	INSIDE FACE
ID	INSIDE DIAMETER
INCIN	INCINERATOR
INCL	INCLUDE
INF	INFLUENT
INSUL	INSULATION
INT	INTERIOR
INV	INVERT
IPS	INTERNAL PIPE SIZE
I/O	INPUT/ OUTPUT
JCT	JUNCTION
JST	JOIST
JT	JOINT
JAN CLO	JANITOR'S CLOSET
KC	KEENE'S CEMENT
LE	LEFT END
LL	LIVE LOAD
LLV/ (H)	LONG LEG VERT./ (HOR.)
LWL	LOW WATER LEVEL
LAM	LAMINATE
LAV	LAVATORY
LT WT	LIGHTWEIGHT
LG	LENGTH/ LONG
L PT	LOW POINT
LT	LIGHT
LV	LOUVER
M	MOTOR
MCC	MOTOR CONTROL CENTER
MBAS	MAGNETITE-BALLASTED ACTIVATED SLUDGE
MGD	MILLION GALLONS PER DAY
MH	MANHOLE
MJ	MECHANICAL JOINT
MO	MASONRY OPENING
MAS	MASONRY
MATR	MATERIAL
MAX	MAXIMUM
MBR	MEMBRANE BIOLOGICAL REACTOR
MECH	MECHANICAL
MEMB	MEMBRANE
MET	METAL
MEZZ	MEZZANINE
MFR	MANUFACTURER
MIN	MINIMUM
MIR	MIRROR
MISC	MISCELLANEOUS
MLSS	MIXED LIQUOR SUSPENDED SOLIDS
MTD	MOUNTING
MULT	MULTIPLE
N	NORTH
NF	NEAR FACE
NIC	NOT IN CONTRACT
NPT	NATIONAL PIPE THREAD
NPW	NON POTABLE WATER
NTS	NOT TO SCALE
No. or #	NUMBER
NOM	NOMINAL
NAT	NATURAL
NS	NO SMOKING
OF	OVERFLOW STRUCTURE
OC	ON CENTER
OD	OUTSIDE DIAMETER
O FC	OUTSIDE FACE
OT	OPEN TRUSS
OPNG	OPENING
OPP	OPPOSITE
ORIG	ORIGINAL
OPER	OPERABLE
P&ID	PROCESS AND INSTRUMENTATION DIAGRAM
PARB	POST-ANOXIC & RE-AERATION BASINS
PCF	POUNDS PER CUBIC FOOT
PD	POSITIVE DISPLACEMENT
PRV	PRESSURE RELIEF VALVE
PSF	POUNDS PER SQUARE FOOT
PV	PLUG VALVE
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
POLY, PE	POLYETHYLENE
PAR	PARALLEL
PARTN	PARTITION
PAT	PATTERN
PAVT	PAVEMENT
PC	PIECE
PERF	PERFORATED
PERP	PERPENDICULAR
♇	PLATE/ PROPERTY LINE
PLAST	PLASTER
PLAS LAM	PLASTIC LAMINATE
PLBG	PLUMBING
PLR	PILASTER
PLWD	PLYWOOD
PNL	PANEL
PW	POTABLE WATER
POR	PORCELAIN
PR	PAIR
PREFAB	PREFABRICATED
PROP	PROPOSED
PT	POINT/ PAINT
PVC	POLYVINYL CHLORIDE
PAC	POLYALUMINUM CHLORIDE
PS	PUMP STATION
QT	QUARRY TILE
QUAN	QUANTITY
R	RISER, REACTION, RADIUS
RD	ROOF DRAIN\ ROAD
RO	ROUGH OPENING
ROB	RUN OF BANK
RAD	RADIUS/ RADIATOR
RE	RIGHT END
REC	RECESS/ RECORD
RECIR	RECIRCULATION
RED	REDUCER
REF	REFERENCE/ REFRIGERATOR
RCP	REINFORCED CONCRETE PIPE
REG	REGISTER
REINF	REINFORCING
REM	REMOVE
REP	REPAIR
REQ'D	REQUIRED
REV	REVISE
RF	ROOF
RFG	ROOFING
RL	ROOF LEADER
RM	ROOM
RUBB	RUBBER
RES FLR	RESILIENT FLOORING
S	SOUTH
'S'	SUCTION
SF	SQUARE FOOR
SLDG	SLIDE GATE
SLCG	SLUICE GATE
SJ	STEEL JOINT
SP	STOP PLATE
SS	STAINLESS STEEL
SWD	SIDE WATER DEPTH
SADL	SADDLE
SAN	SANITARY
SCH	SCHEDULE
SECT	SECTION
SEL	SELECTION
SEW	SEWER
SH	SHEET
SIM	SIMILAR
SOI	SPRAYED ON INSULATION
SPEC	SPECIFICATION
SQ	SQUARE
ST	STREET
STAT	STATION
STL	STEEL
STOR	STORAGE
STD	STANDARD
STIRR	STIRRUPS
STRUC	STRUCTURAL or STRUCTURE
SUR	SURFACE
SUS	SUSPENDED/ SUSPENSION
SYM	SYMMETRICAL
SCP	STRUCTURAL CLAY PIPE
T	TILE, TREAD or TOP
TDH	TOTAL DYNAMIC HEAD
T/D	TOP OF DECK
T/F	TOP OF FOOTING
T/G	TOP OF GROUT
T/M	TOP OF MASONARY
T/S	TOP OF SLAB
T/W	TOP OF WALL
THK	THICK
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
TEL	TELEPHONE
TEMP	TEMPERATURE
TR	TOILET ROOM
TOL	TOLERANCE
TRANS	TRANSFORMER
TK	TANK
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE
UR	URINAL
UV	ULTRAVIOLET
V	VINYL or VERTICAL
VAT	VINYL ASBESTOS TILE
VT	VITRIFIED TILE
VERT	VERTICAL
W	WATER
W/	WITH
WI	WROUGHT IRON
WG	WEIR GATE
WL	WATER LEVEL
WO	WINDOW OPENING
W/O	WITHOUT
WS	WATER SURFACE
WWF	WELDED WIRE FABRIC
WC	WATER CLOSET
WD	WOOD
W PT	WORKING POINT
WS	WATERSTOP
WT	WEIGHT
W ST	WELDED STEEL PIPE
WV	WATER VALVE
WH	WALL HYDRANT
WP	WHITE PINE

GENERAL NOTES (APPLY TO ALL DRAWINGS):

1. EXISTING CONDITIONS SHOWN LIGHT. PROPOSED FACILITIES AND PIPING SHOWN DARK.
2. CONTRACTOR SHALL FIELD VERIFY AND COORDINATE ALL EXISTING PIPING ELEVATIONS, LOCATIONS, SIZE AND TYPE OF MATERIAL WITH NEW PIPING PRIOR TO CONSTRUCTION.
3. CONTRACTOR SHALL COORDINATE ALL PIPING AND OTHER CONNECTIONS WITH THE APPROVED EQUIPMENT SHOP DRAWINGS.
4. CONTRACTOR SHALL SUPPLY ALL BENDS REQUIRED TO MAINTAIN SMOOTH FLOW LINES, CHANGES IN ELEVATION, AND TO MEET ALL TRANSITIONS
5. ALL PIPES ENTERING OR LEAVING A STRUCTURE SHALL HAVE (2) TWO JOINTS WITHIN 4'-0" OF PIPE LENGTH FROM OFF THE WALL OF THE STRUCTURE.
6. UNDERGROUND FACILITIES, STRUCTURES AND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE SURVEYS AND RECORDS AND THEREFORE THEIR LOCATIONS MUST BE CONSIDERED APPROXIMATE ONLY. THERE MAY BE OTHERS . THERE MAY BE ADDITIONAL FACILITIES IN EXISTENCE OF WHICH THEIR LOCATION IS PRESENTLY NOT KNOWN. ANYONE USING UTILITY INFORMATION AND DATA PROVIDED HERE IN SHALL CALL DIG SAFE AT 811 SEVENTY (72) HOURS, 3 BUSINESS DAYS IN ADVANCE TO VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO THE START OF CONSTRUCTION.

DATUM AND REFERENCE NOTES:

1. ALL SITE PLANS ARE BASED ON A SURVEY PERFORMED BY JC ENGINEERING DATED APRIL 26, 2019. HORIZONTAL DATUM IS BASED ON MASSACHUSETTS STATE COORDINATE SYSTEM, NAD83. VERTICAL DATUM IS BASED ON NAVD88.
2. CONDITIONS IN THE FIELD MAY VARY FROM THOSE SHOWN HEREIN. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL EXISTING FIELD CONDITIONS THAT MAY AFFECT HIS WORK.
3. ANY UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE.
4. BACKGROUND DRAWINGS SUPPLEMENTED WITH DATA DOWNLOADED FROM THE MASS GIS WEBSITE. DATUMS FOR THE GIS VECTOR DATABASE INFORMATION IS AS FOLLOWS:
   - 4.1. HORIZONTAL - NORTH AMERICAN DATUM 1983 (NAD83) MA STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE FEET
   - 4.2. VERTICAL - NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88).

GENERAL NOTES:

1. TOPOGRAPHIC INFORMATION SHOWN HEREON ON CIVIL DRAWINGS IS BASED ON ACTUAL FIELD SURVEY COMPLETED IN APRIL 2019 BY J.C. ENGINEERING INC.; BOUNDARY INFORMATION SHOWN IS BASED ON AN ACTUAL FIELD SURVEY MADE DURING MARCH-APRIL, 2011.

DESIGNATION INDEX (EXAMPLE)

C001 — DRAWING NO; DISCIPLINE

DISCIPLINE DESIGNATION

G	GENERAL
C	CIVIL
D	DEMOLITION
A	ARCHITECTURAL
S	STRUCTURAL
M	PROCESS MECHANICAL
E	ELECTRICAL
I	INSTRUMENTATION
H	HVAC
P	PLUMBING
F	FIRE PROTECTION

PROCESS CODE

000	GENERAL
050	CIVIL
100	PRETREATMENT BUILDING
200	PROCESS BUILDING
300	PROCESS TANKS AND MBR
400	BLOWER ROOM
500	PUMP ROOMS
600	UV DISINFECTION ROOM
700	CHEMICAL ROOM
800	MLSS HOLDING TANKS
850	MISCELLANEOUS DISTRIBUTION STRUCTURES
900	MISCELLANEOUS DETAILS

SHEET INDEX

No.	Issue	Drawn	Approved	Date
1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

Bar is one inch on original size sheet
0 1"

PRELIMINARY
NOT FOR CONSTRUCTION

GHD Inc.
1545 Iyannough Road
Hyannis MA 02601 USA
T 1 774 470 1630 F 1 774 470 1631 W www.ghd.com

Drawn J. FOSDICK	Designer JDF
Drafting Check	Design Check
Project Manager A. RUDENKO	Date
This document shall not be used for construction unless signed and sealed for construction.	Scale AS SHOWN

Client **TOWN OF MASHPEE, MA**
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **LIST OF DRAWINGS, ABBREVIATIONS & GENERAL NOTES**
Project No. **11188223**
Original Size **Arch D** Sheet No. **G-002** Sheet of

LEGEND - EXISTING CONDITIONS

LINETYPES

- WATER LINE
- COMMUNICATION LINE
- EDGE OF ASPHALT
- EDGE OF GRAVEL
- ELECTRIC LINE
- GAS LINE
- SEWER LINE
- TREE LINE
- DRAIN LINE
- OVERHEAD WIRES (OHW)
- 228 MINOR CONTOURS
- 230 MAJOR CONTOURS
- UPLP UTILITY POLE WITH LIGHT
- GUARD RAIL
- CONCRETE / STL GRATING / RIP RAP
- EDGE OF WETLAND
- 100 YR FL 100' FLOOD ZONE
- 200 200' RIVERFRONT BUFFER ZONE
- 100 100' WETLAND SETBACK
- 50 50' WETLAND SETBACK
- 25 25' WETLAND SETBACK
- NATIONAL HERITAGE ENDANGERED SPECIES BOUNDARY

SYMBOLS

- ELECTRIC MANHOLE
- WV WATER VALVE
- SIGN
- SEWER MANHOLE
- SV SEWER VALVE
- GUY POLE
- UTILITY POLE
- CATCH BASIN (CBN)
- DRAIN MANHOLE
- YARD HYDRANT
- SPECIMEN TREE
- SHRUB
- DROP INLET
- 10" GATE WHEEL
- 24" GATE WHEEL
- TRANSFORMER
- ETW EDGE OF TRAVELED WAY
- WELL
- GRANITE BOUND
- BENCHMARK
- BOLLARD
- WF-A-28 WETLAND FLAG (WETLAND AREA 'A' FLAG NO.28)

LEGEND - PROPOSED CONDITIONS

- LP-1 / LP-2 LEACHING PITS (LP-1 WITH ACCESS MANHOLE AND LP-2 WITHOUT) SURROUNDED BY CRUSHED STONE
- ST-1 SETTLING TANK (ST-1)
- CB-100 CATCH BASIN NO 100
- IB-10 INLET BASIN NO 10
- DMH-100 DRAIN MANHOLE NO 100
- SMH-500 SANITARY MANHOLE NO 500
- CLEANOUT
- GATE VALVE
- END CAP
- PROCESS OR PROCESS DRAIN PIPING
- B-1 SOIL BORING 1
- TEST PIT #1 TEST PIT 1
- CAPE COD BERM (UNLESS OTHERWISE NOTED ON PLANS)
- PERFORATED HDPE STORMWATER PIPING
- D STORMWATER PIPING
- LOS LIMIT OF STAGING
- LOW LIMIT OF WORK
- EC EROSION CONTROL
- X CHAIN LINK FENCE
- LIMIT OF CLEAR & GRUB
- 1+00 ROADWAY BASELINE
- 235 CONTOUR INTERVAL
- EDGE OF STRUCTURE
- BOTTOM OF SLOPE
- EROSION CONTROL CATCH BASIN
- CONCRETE SIDEWALKS OR PADS
- ASPHALT SIDEWALKS
- ASPHALT PAVEMENT
- STAGING 1
- RESERVED FOR FUTURE STAGES
- STAGE 1 INFRASTRUCTURE - AT GRADE
- GRASS
- LANDSCAPED AREA SHRUB
- YARD HYDRANT

VALVE SYMBOLS

SCHEMATIC/1 LINE | 3 LINE

- PLUG VALVE
- 3-WAY PLUG VALVE
- PINCH VALVE
- GATE VALVE
- CHECK VALVE
- BALL VALVE
- GLOBE VALVE
- BUTTERFLY VALVE
- KNIFE GATE VALVE
- PRESSURE REDUCING VALVE
- DIAPHRAGM VALVE
- M MOTOR-OPERATED BUTTERFLY VALVE
- M MOTOR-OPERATED BALL VALVE
- S SOLENOID VALVE

MISCELLANEOUS SYMBOLS

- FLANGED JOINT
- WELDED JOINT
- SCREWED JOINT
- MECHANICAL JOINT
- STANCHION SADDLE PIPE SUPPORT
- SPLIT PIPE CLAMP PIPE SUPPORT
- STRAP W/S.S. BOLTS AND INSERTS PIPE SUPPORT
- IN TRENCH PIPE SUPPORT
- CONCRETE BASE FITTING PIPE SUPPORT
- CONCRETE PIPE SUPPORT
- WELDED BRACKET PIPE SUPPORT
- PIPE CHANNEL SUPPORT PIPE SUPPORT
- DUAL BRACKET VERTICAL PIPE SUPPORT (SHOWN IN PLAN VIEW)
- WALL SLEEVE
- HEAT TRACED AND INSULATED PIPING (FOR INSULATION LIMITS AND REQUIREMENTS REFER TO INDIVIDUAL DRAWINGS)
- PIPE COUPLING
- THERMAL EXPANSION JOINT
- EXPANSION COUPLING
- FLANGE ADAPTER
- FLUSHING CONNECTION

GENERAL LEGEND

NEW GRAPHICS; EQUIPMENT, STRUCTURES, ETC., ARE SHOWN AS BOLD LINEWORK AND IN THIS TEXT FORMAT.

EXISTING GRAPHICS; EQUIPMENT, CONDITIONS STRUCTURES, ETC. ARE SHOWN AS LIGHT LINEWORK AND IN THIS TEXT FORMAT. FUTURE GRAPHICS ARE SHOWN WITH A DASHED LINE.

TYPICAL SECTION MARKS (FOR PLANS)

- A / X-301
- SECTION LETTER
- SECTION INDICATOR
- SHEET WHERE SECTION IS SHOWN (IF SHOWN ON DIFFERENT SHEET)

SECTION (A / D-101)

SCALE: 1/4" = 1'-0" (0, 2', 4', 8')

- SECTION LETTER (ALPHABETICAL FOR EACH STRUCTURE)
- SHEET WHERE SECTION IS REFERENCED

TYPICAL DETAIL TITLE

DETAIL NAME (1 / D-101)

NO SCALE

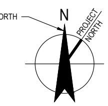
- DETAIL NUMBER (NUMERICAL ON EACH SHEET BEGINNING WITH DETAIL 1)
- SHEET WHERE DETAIL IS REFERENCED

TYPICAL DETAIL CALLOUT

1 / A-501 OR 1 / A-501

- DETAIL NUMBER
- SHEET WHERE DETAIL IS SHOWN (IF ON DIFFERENT SHEET)
- DEPICTION BOUNDARY

NORTH INDICATOR



No.	Issue	Drawn	Approved	Date
1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

Bar is one inch on original size sheet 0 1"

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Drawn J. FOSDICK | Designer JDF
Drafting Check | Design Check
Project Manager A. RUDENKO | Date

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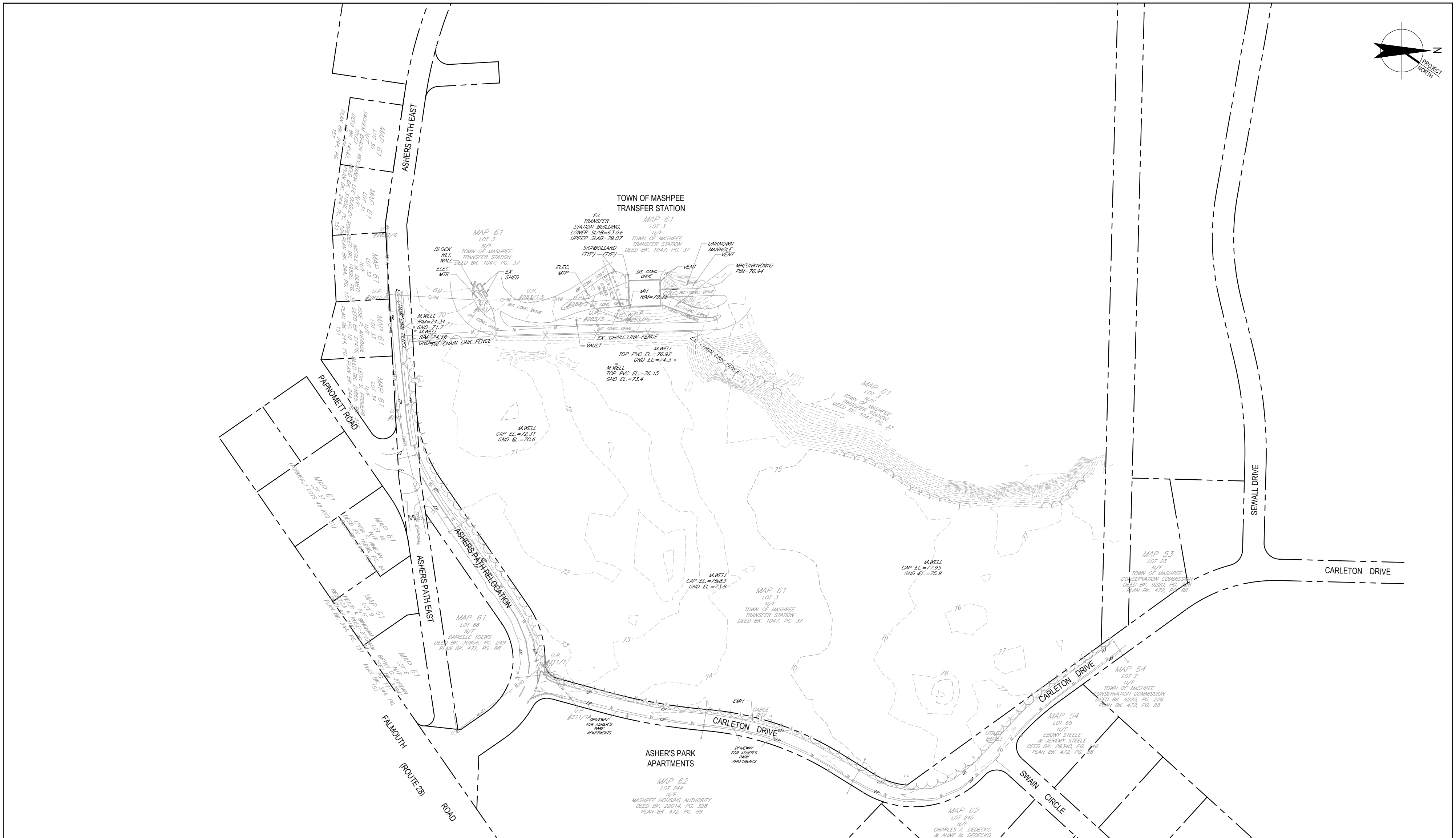
Client **TOWN OF MASHPEE, MA**
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **LEGEND AND SYMBOLS**

Project No. 11188223
Original Size Arch D
Sheet No. **G-003**
Sheet of

Plot Date: 19 November 2019 - 6:30 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\General\11188223-G-003.dwg



EXISTING SITE PLAN - OVERALL 80 SCALE

SCALE 1" = 80'

0 40 80 120 160'

SCALE 1"=80' AT ORIGINAL SIZE

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Project **PRELIMINARY DESIGN OF MASHPEE WRRF**

Title **EXISTING SITE PLAN - OVERALL 80 SCALE**

Project No. 11188223

Original Size Arch D

Sheet No. **C-001**

Sheet of

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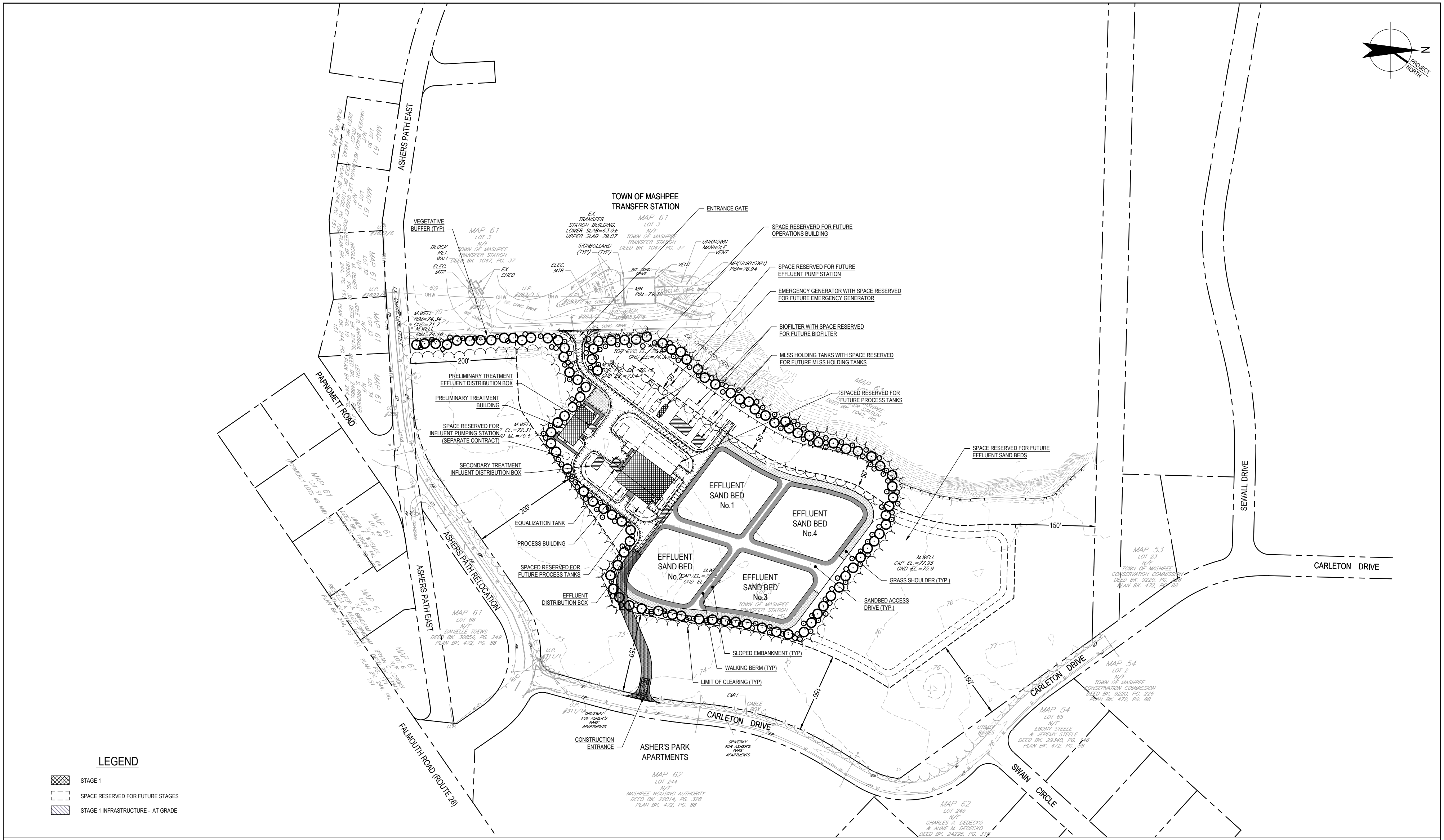

PROPOSED SITE PLAN - OVERALL

SCALE 1" = 80'

0 80' 160'

No.	Issue	Drawn	Approved	Date
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0 1"

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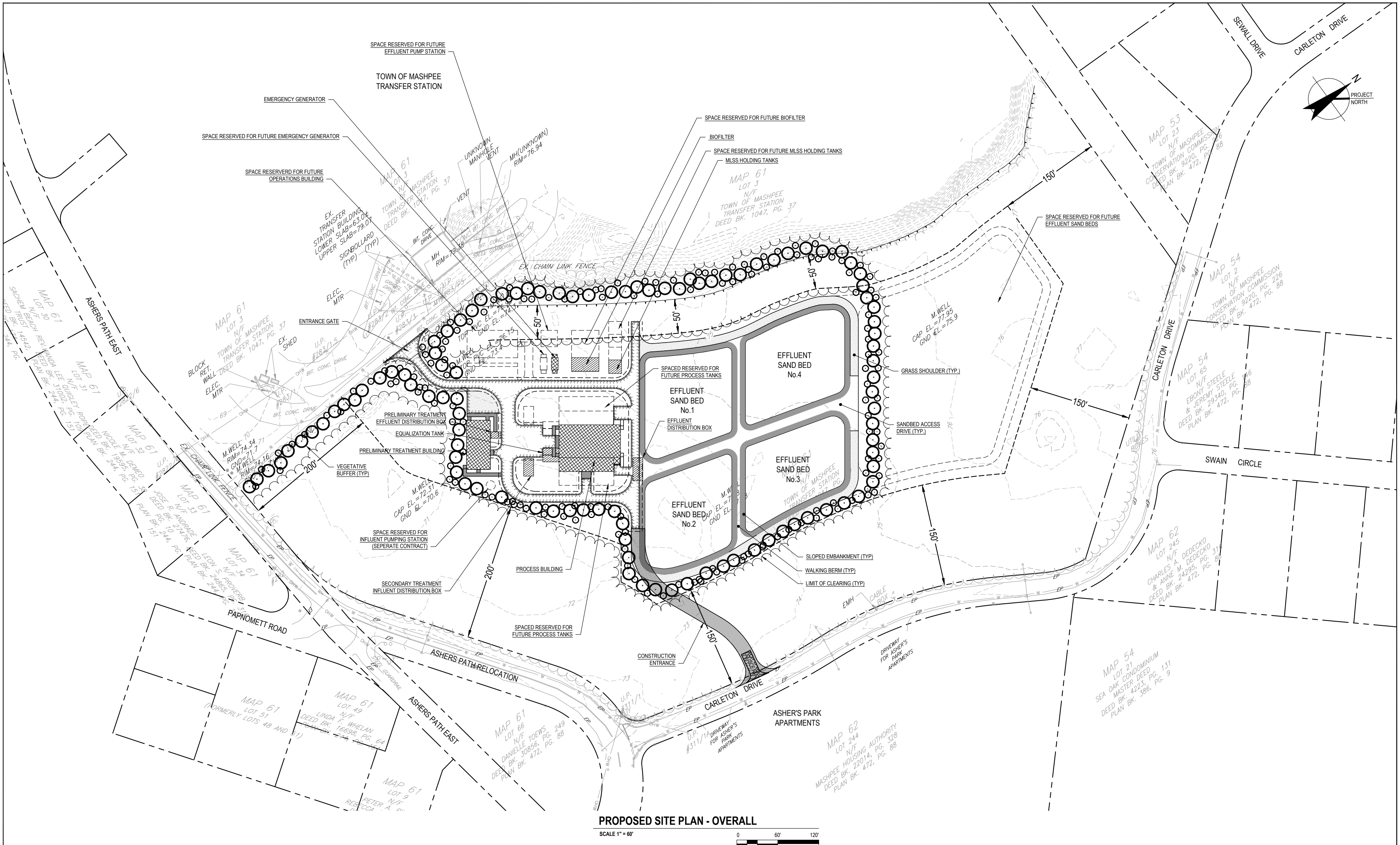
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROPOSED SITE PLAN - OVERALL 80 SCALE**

Project No. 11188223
Original Size Arch D
Sheet No. **C-002**
Sheet of

Plot Date: 19 November 2019 - 6:30 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\Civil\11188223-C101-C107.dwg



No.	Issue	Drawn	Approved	Date
1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

LEGEND

- STAGE 1
- SPACE RESERVED FOR FUTURE STAGES
- STAGE 1 INFRASTRUCTURE - AT GRADE

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0 1"

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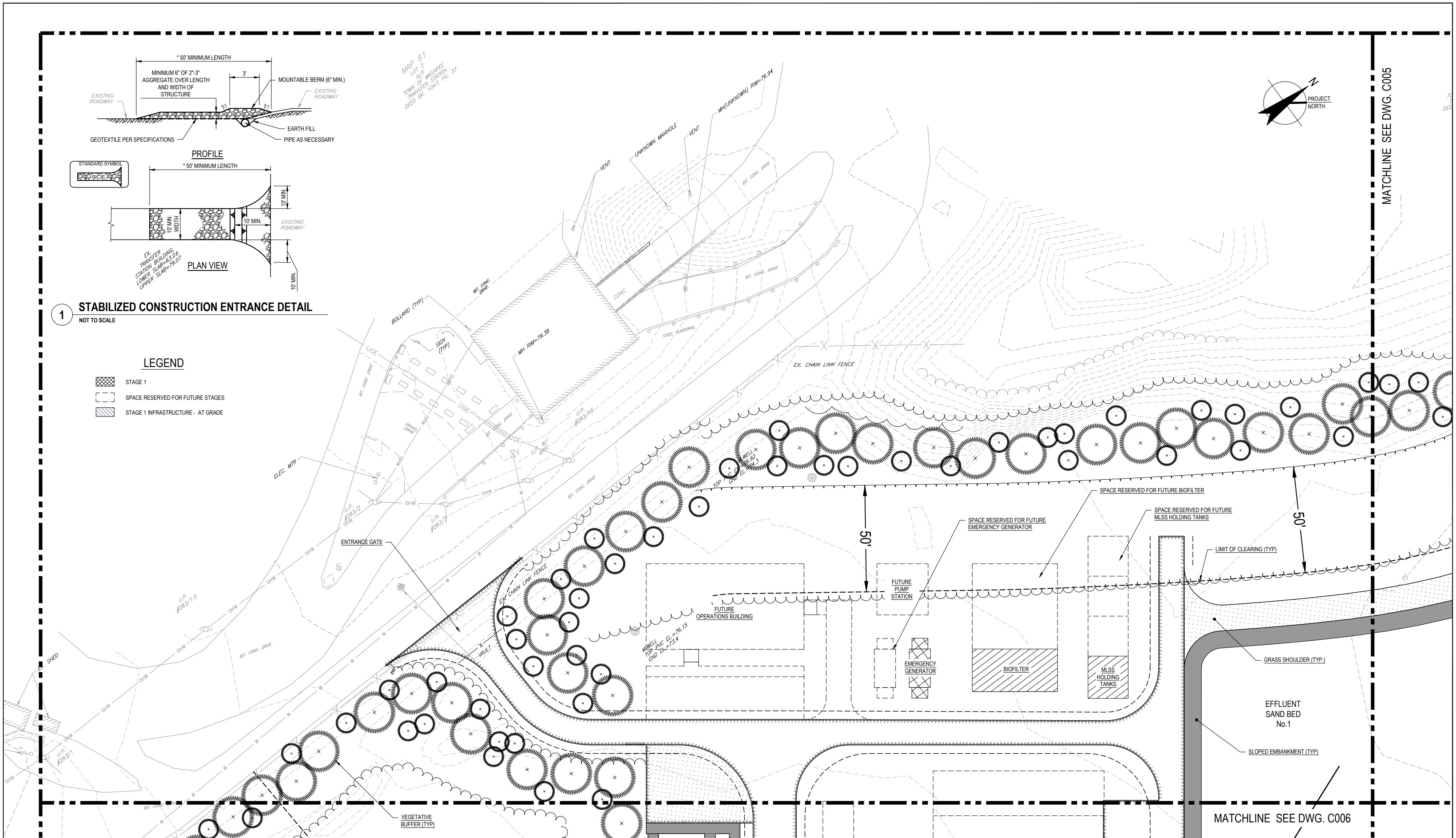
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROPOSED SITE PLAN - OVERALL 40 SCALE**
Project No. 11188223
Original Size Arch D
Sheet No. C-003
Sheet of

Plot Date: 19 November 2019 - 6:30 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\Civil\11188223-C101-C107.dwg



PARTIAL SITE PLAN - 1

SCALE 1" = 20'

0 10' 20' 40'

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Title **PARTIAL SITE PLAN - 1**

Project No. 11188223
Original Size Arch D
Sheet No. **C-004**
Sheet of

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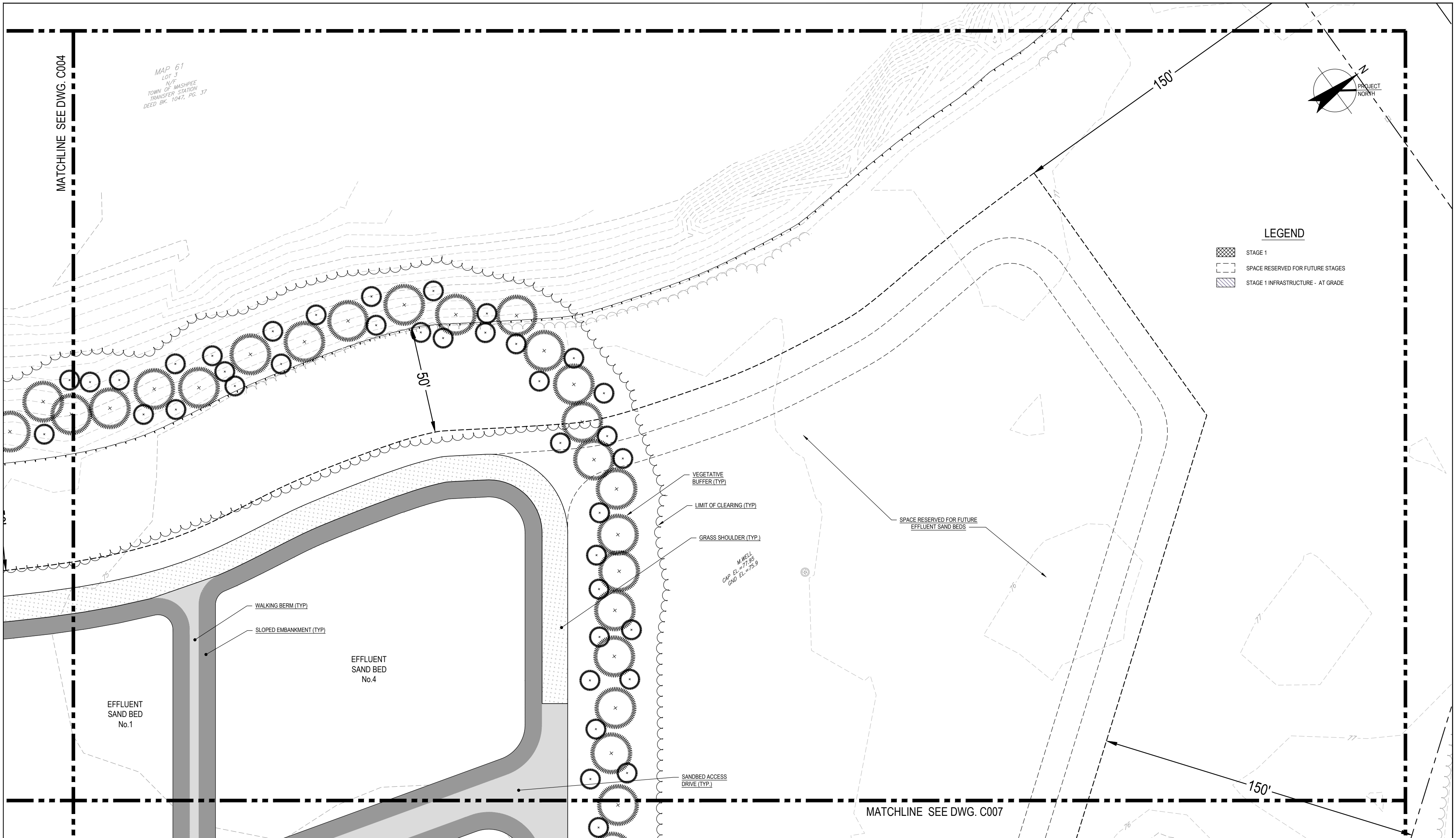

PARTIAL SITE PLAN - 2

SCALE 1" = 20'

0 10' 20' 40'

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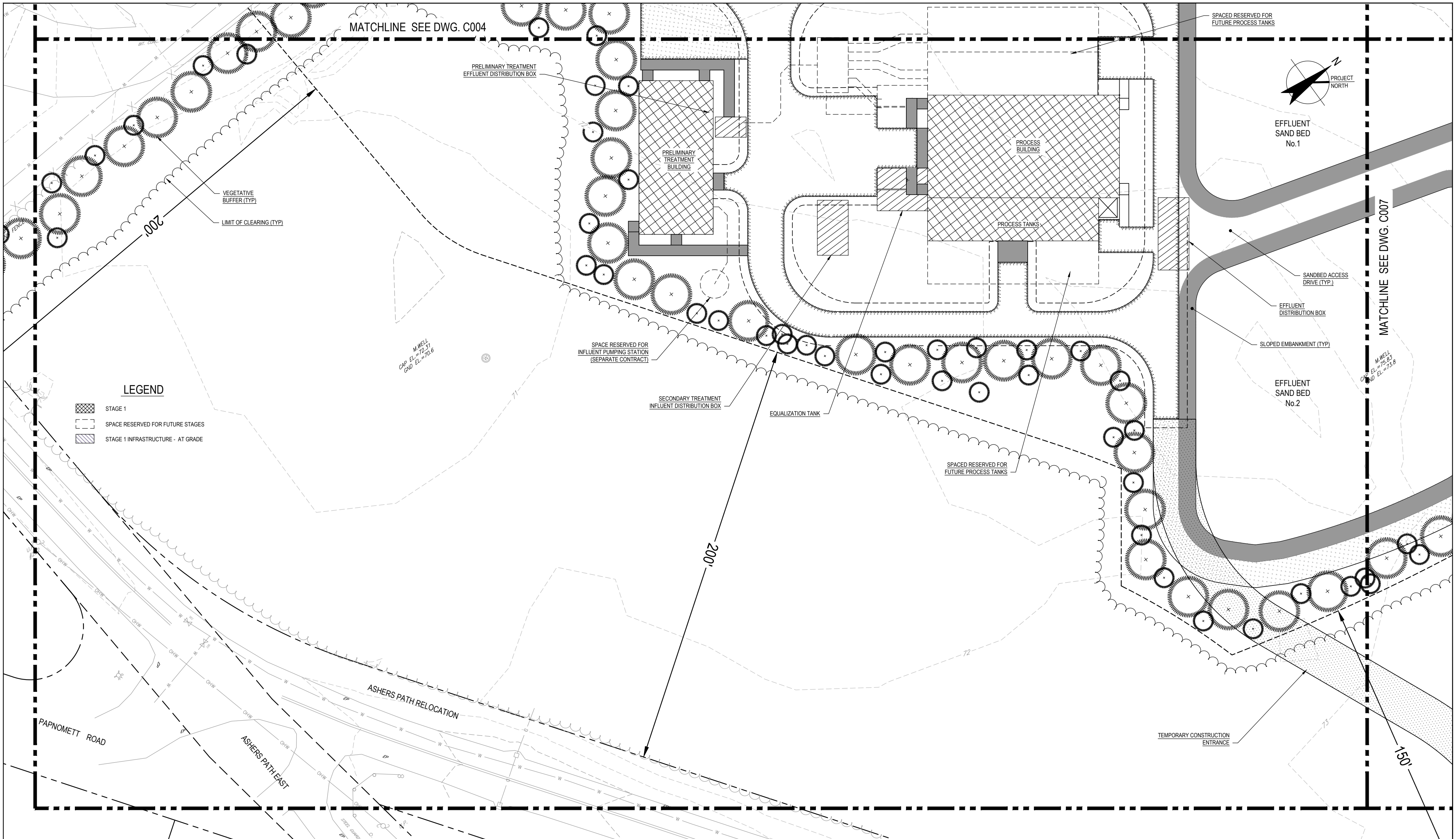
Title **PARTIAL SITE PLAN - 2**
Project No. **11188223**
Original Size **Arch D**
Sheet No. **C-005**
Sheet of

Plot Date: 19 November 2019 - 6:30 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\Civil\11188223-C101-C107.dwg



PARTIAL SITE PLAN - 3

SCALE 1" = 20'

0 10' 20' 40'

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1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

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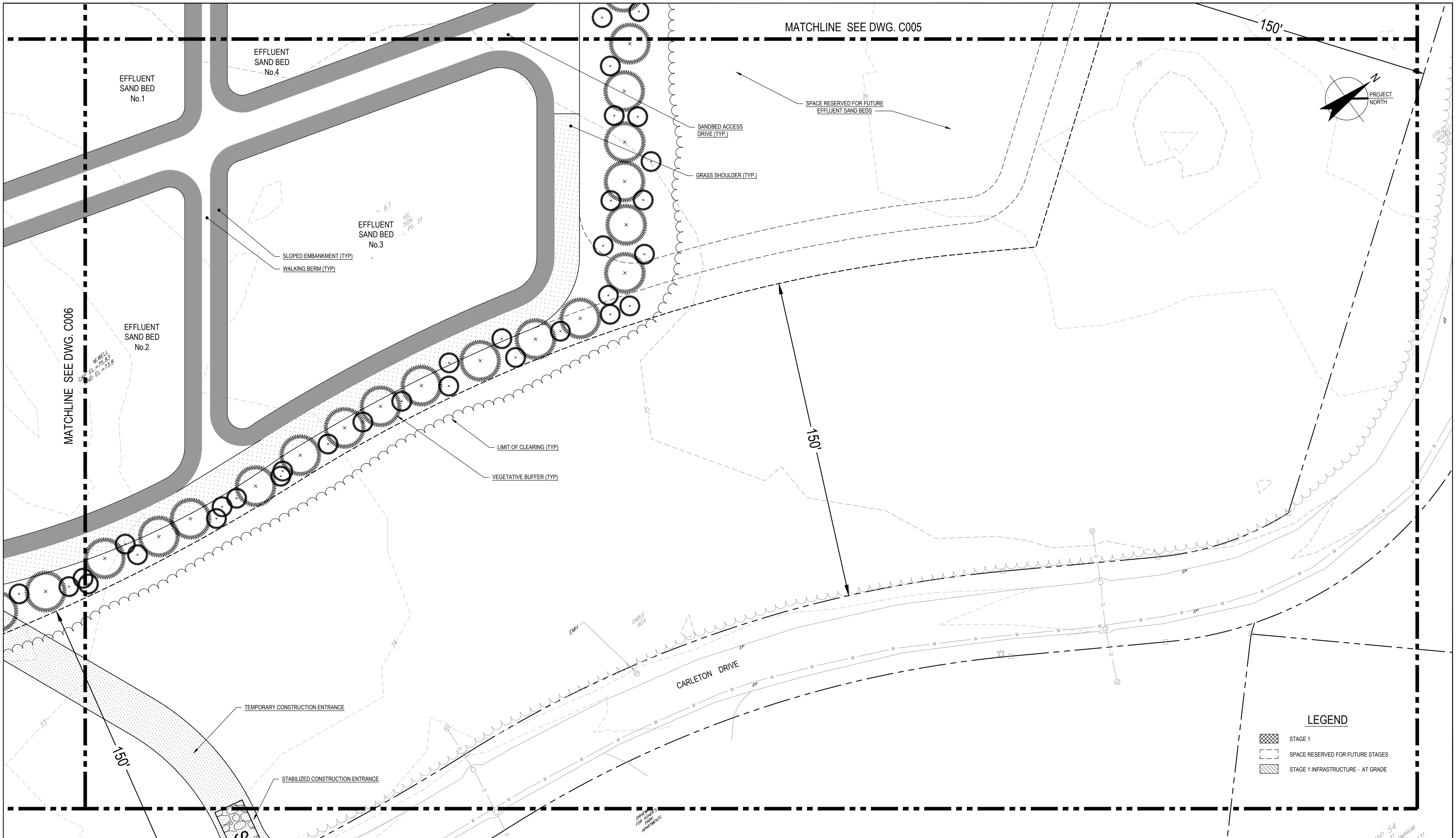
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PARTIAL SITE PLAN - 3**

Project No. 11188223
Original Size Arch D
Sheet No. **C-006**
Sheet of

Plot Date: 19 November 2019 - 6:30 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\Civil\11188223-C101-C107.dwg



PARTIAL SITE PLAN - 4

SCALE 1" = 20'

0 10' 20' 40'

No.	Issue	Drawn	Approved	Date
1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

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0 1"

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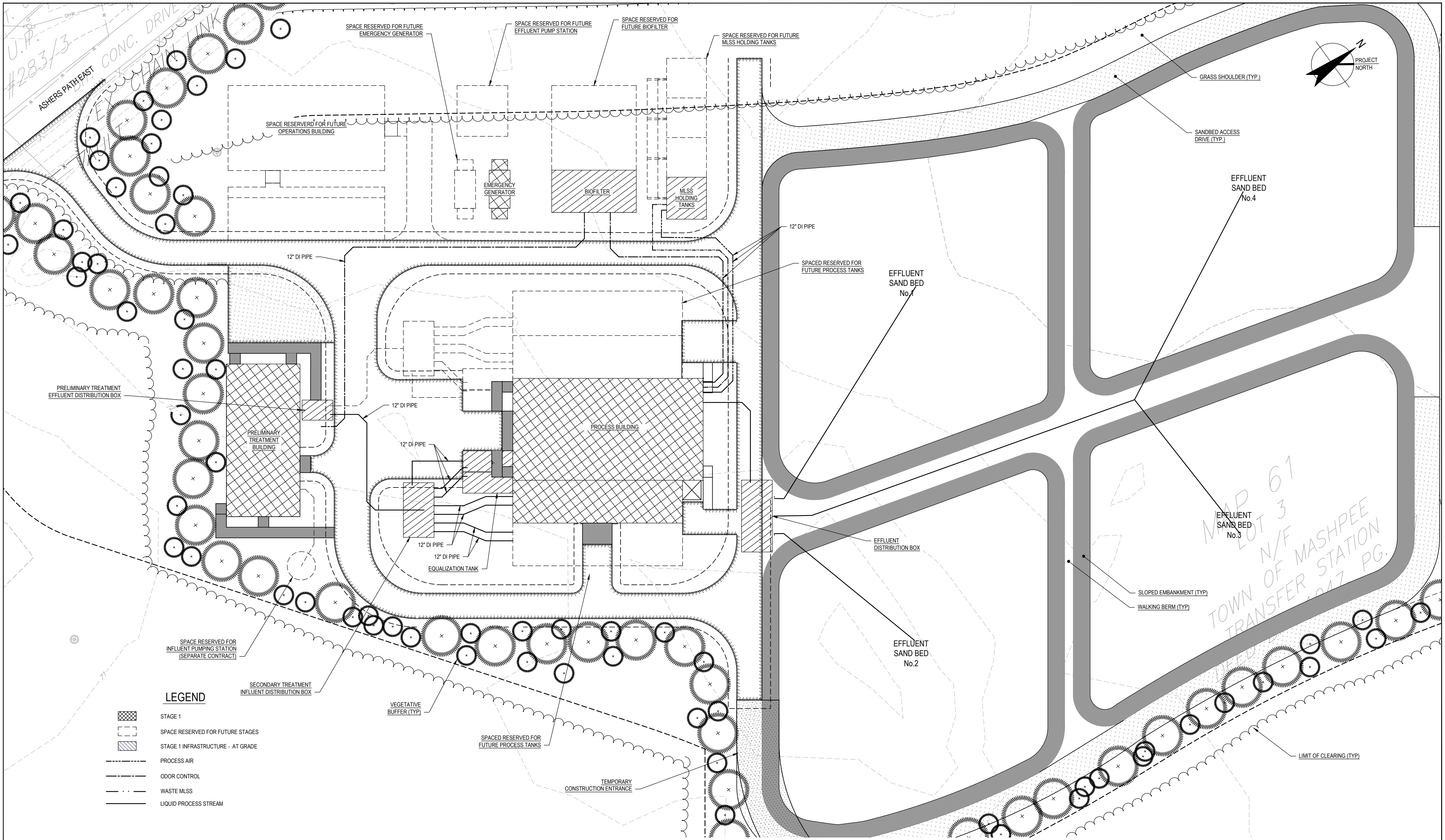
Title PARTIAL SITE PLAN - 4
Project No. 11188223
Original Size Arch D | Sheet No. C-007 | Sheet of

Plot Date: 19 November 2019 - 6:30 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\Civil\11188223-C101-C107.dwg



PROPOSED YARD PIPING PLAN

SCALE 1" = 60'

0 60' 120'

No.	Issue	Drawn	Approved	Date
1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

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0 1"

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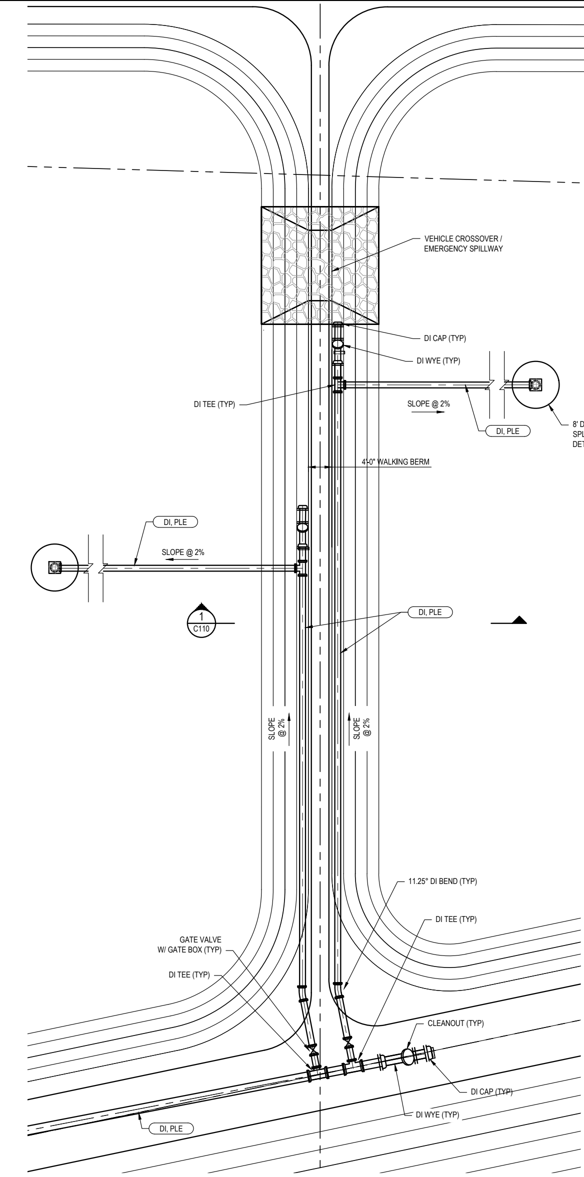
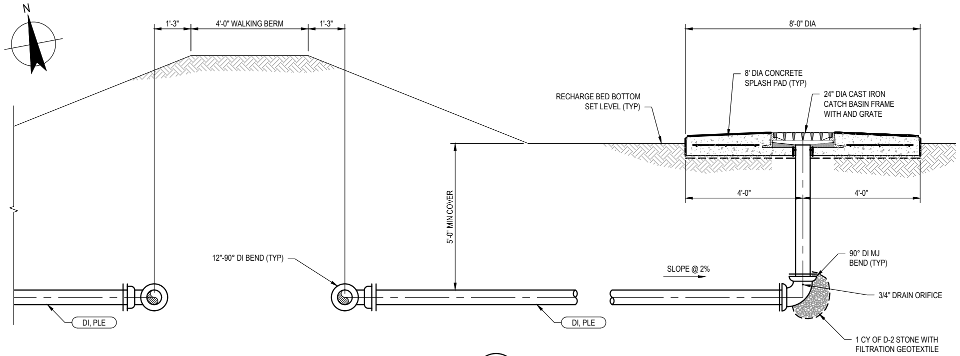
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROPOSED YARD PIPING PLAN**
Project No. 11188223
Original Size Arch D | Sheet No. **C-008** | Sheet of

Plot Date: 19 November 2019 - 6:31 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\Civil\11188223-C008.dwg



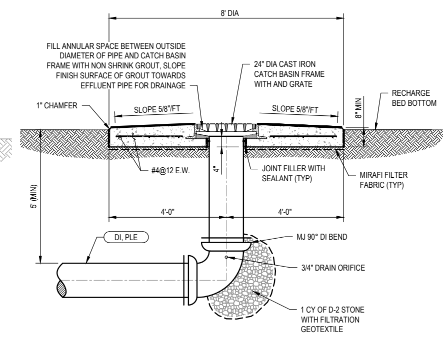
HEADER PIPING PLAN

NOT TO SCALE



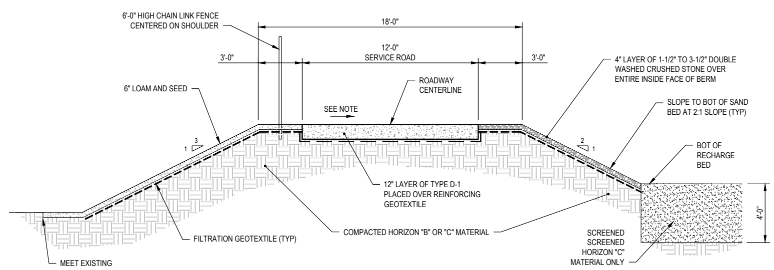
1 SECTION
C110 NOT TO SCALE

NOTE:
1. REINFORCED JOINT SYSTEM SHALL BE INSTALLED AT EACH END OF A FITTED JOINT.



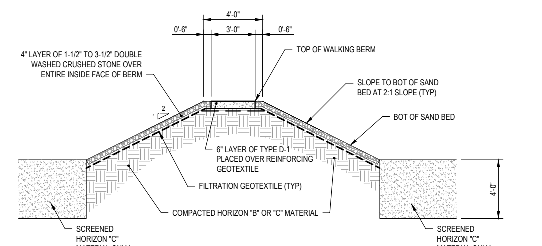
SAND BED DISCHARGE PIPE DETAIL

SCALE 1/2" = 1'-0"



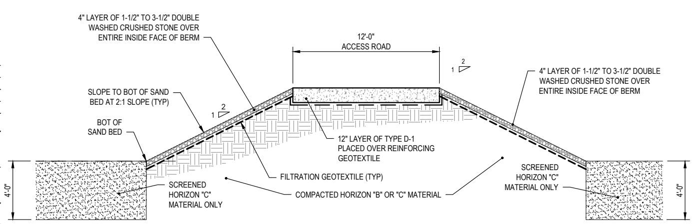
PERIMETER BERM WITH SERVICE ROAD-IN FILL DETAIL

SCALE 1/4" = 1'-0"



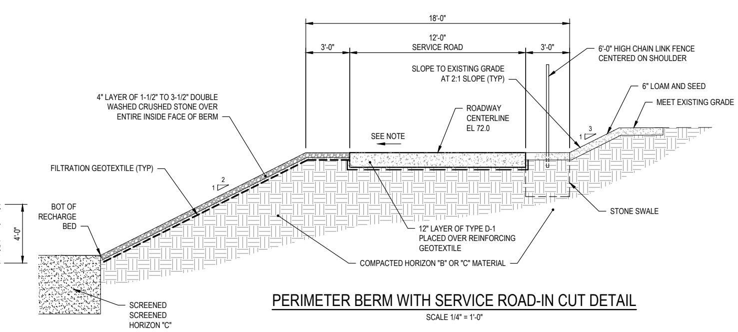
SAND BED INTERIOR WALKING DIKE DETAIL

SCALE 1/4" = 1'-0"



TYPICAL SERVICE RAMP DETAIL

SCALE 1/4" = 1'-0"



PERIMETER BERM WITH SERVICE ROAD-IN CUT DETAIL

SCALE 1/4" = 1'-0"

No.	Issue	Drawn	Approved	Date
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0 5 10 15 20'
SCALE 1"=10' AT ORIGINAL SIZE

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0 1"

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Client **TOWN OF MASHPEE, MA**
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **EFFLUENT SAND BEDS - PARTIAL PLAN, SECTION, & DETAILS**
Project No. 11188223
Original Size Arch D
Sheet No. **C-009**
Sheet of

Plot Date: 19 November 2019 - 6:31 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\Civil\11188223-C009.dwg

FLOW	STAGE 1	STAGE 2	STAGE 3	STAGE 4
DESIGN AVERAGE (MGD)	0.12	0.24	0.36	0.48
MAX MONTH (MGD)	0.31	0.62	0.93	1.24
MAX DAY (MGD)	0.36	0.72	1.08	1.44
PEAK INSTANTANEOUS (MGD)	0.65	1.3	1.95	2.6

DESIGN EFFLUENT PARAMETERS (MONTHLY AVERAGE)

BIOLOGICAL OXYGEN DEMAND (MG/L)	30
TOTAL SUSPENDED SOLIDS (MG/L)	30
TOTAL NITROGEN (MG/L)	3
FECAL COLIFORM (MPN/100 ML)	200
PH (MAX/MIN)	6-9

STAGE 1 RAW INFLUENT CHARACTERISTICS	AVERAGE (LBS/D)	AVERAGE (MG/L)	MAX MONTH (LBS/D)	MAX MONTH (MG/L)
BOD 5	238	238	300	300
TSS	275	275	358	357
TKN	49	49	61	61
NH3-N	36	36	45	45

STAGE 1 ZONE	PRE-ANOXIC	AEROBIC	POST-ANOXIC	TOTAL
VOLUME/REACTOR (GAL)	6500	22500	5000	34000
VOLUME/STAGE (GAL)	13000	45000	10000	68000
HRT @ ADF /REACTOR (HRS)	1.3	4.5	1.0	6.8
TOTAL HRT @ ADF (HRS)	2.6	9.0	2.0	13.6
VOLUME DISTRIBUTION (%)	19%	66%	15%	100%
SRT (DAYS)	4.6	15.9	3.5	24.0

PRELIMINARY TREATMENT BUILDING - 6 MM SCREEN	STAGE 1
TYPE	FINE SCREEN
NO. OF UNITS	1
OPENING SPACING (MM)	6

PRELIMINARY TREATMENT BUILDING - BAR RACK

TYPE	MANUAL BAR RACK
NO. OF UNITS	1
OPENING SPACING (MM)	25

PRELIMINARY TREATMENT BUILDING - 2 MM SCREEN

TYPE	FINE SCREEN
NO. OF UNITS	2
OPENING SPACING (MM)	2

PRELIMINARY TREATMENT BUILDING - VORTEX GRIT REMOVAL SYSTEM

NO. OF UNITS	1
DIAMETER (FT)	7
FLOW CAPACITY (MGD)	3

PRELIMINARY TREATMENT BUILDING - GRIT PUMPS

TYPE	SELF-PRIMING
NO. OF UNITS	2
CAPACITY (GPM)	250

PRELIMINARY TREATMENT BUILDING - GRIT CLASSIFIER

NO. OF UNITS	1
CLASSIFIER DIAMETER (INCH)	12
CLASSIFIER MAXIMUM CAPACITY (GPM)	250

BIOLOGICAL REACTORS	STAGE 1
PROCESS TYPE	MBR
NO. OF UNITS	2
AVERAGE MLSS (MG/L)	8000
MAX MONTH MLSS (MG/L)	10000
MIN TEMP (C)	10
MAX TEMP (C)	20

BIOLOGICAL REACTOR BLOWERS

TYPE	PD
NO. OF UNITS	3 (2 DUTY)
RANGE, EACH (SCFM)	200
DISCHARGE PRESSURE (PSIG)	6

NITRATE RECYCLE PUMPS

TYPE	SUBMERSIBLE
NO. OF UNITS	2
CAPACITY, EACH @ ADF (GPM)	455
TOTAL DYNAMIC HEAD @ ADF (FT)	10

MLSS RECYCLE / WAS PUMPS

TYPE	SUBMERSIBLE
NO. OF UNITS	3 (2 DUTY)
CAPACITY, EACH @ ADF (GPM)	630
TOTAL DYNAMIC HEAD @ ADF (FT)	10

PERMEATE PUMPS

TYPE	ROTARY LOBE
NO. OF UNITS	2
CAPACITY, EACH @ ADF (GPM)	44
TOTAL DYNAMIC HEAD @ ADF (FT)	45
PUMPING RANGE (GPM)	340
TOTAL DYNAMIC HEAD RANGE (FT)	45
MOTOR SIZE (HP)	10

MEMBRANE TANKS

NO. OF UNITS	2
CAPACITY, EACH (NO OF CASSETTES)	2
NO. OF MODULES PER CASSETTE	42

AIR SCOUR BLOWERS

TYPE	PD
NO. OF UNITS	3 (2 DUTY)
DESIGN CAPACITY, EACH (SCFM)	400
DISCHARGE PRESSURE (PSIG)	8

UV DISINFECTION	STAGE 1
NUMBER OF CHANNELS	1
NUMBER OF BANKS	2
UV OUTPUT (MJ/CM^2)	40000

SAND BEDS

ACTIVE SURFACE AREA, TOTAL (SF)	68571
HYDRAULIC LOADING RATE (GPD/SF)	7
DESIGN CONDITION	MAXIMUM MONTH FLOW WITH ONE BED OUT OF SERVICE

SUPPLEMENTAL CARBON

NO. OF STORAGE TANKS	1
STORAGE TANK CAPACITY (GAL)	1000

SODIUM HYPOCHLORITE

NO. OF STORAGE TANKS	1
STORAGE TANK CAPACITY (GAL)	55

CITRIC ACID

NO. OF STORAGE TANKS	1
STORAGE TANK CAPACITY (GAL)	100

SODIUM HYDROXIDE

NO. OF STORAGE TANKS	1
STORAGE TANK CAPACITY (GAL)	100

WASTE MLSS PRODUCTION

DESIGN AVERAGE (GPD)	2600

** BASED ON WAS CONCENTRATION OF 7,000 MG/L

WASTE MLSS HOLDING TANK

NO. OF TANKS	2
TOTAL VOLUME (GAL)	26474
SIDEWATER DEPTH (FT)	13
AERATION SYSTEM	COARSE BUBBLE DIFFUSER

WASTE MLSS STORAGE TIME

DESIGN AVERAGE (DAYS)	10

1 DESIGN CRITERIA
NOT TO SCALE

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1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

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Drawn J. FOSDICK | Designer LMQ
Drafting Check | Design Check
Project Manager A. RUDENKO | Date
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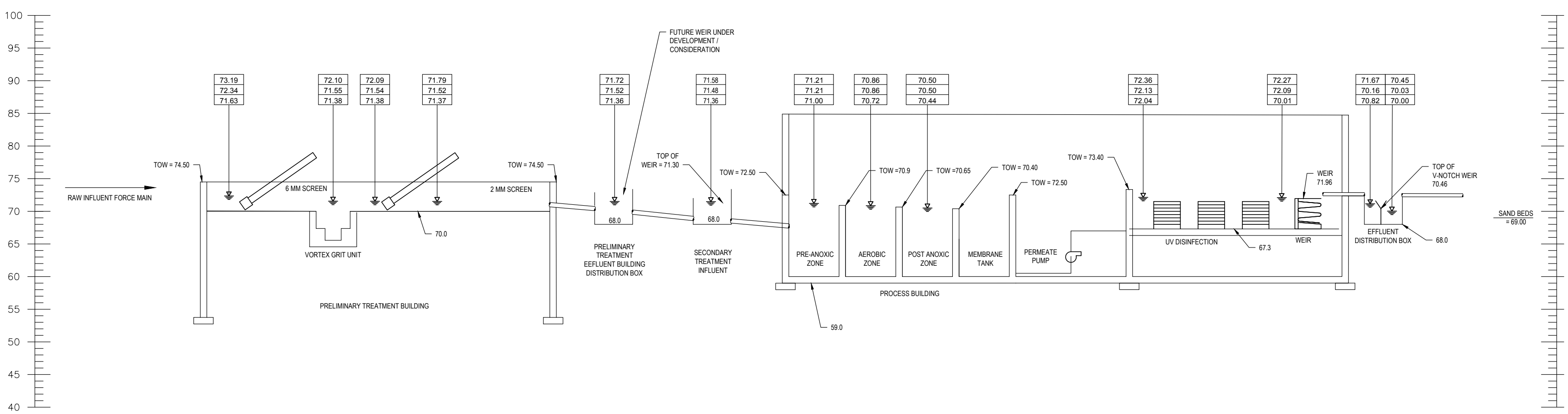
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **DESIGN CRITERIA**
Project No. **11188223**
Original Size **Arch D** | Sheet No. **M-001** | Sheet of



1 HYDRAULIC PROFILE

SCALE: NOT TO SCALE

LEGEND

WATER SURFACE ELEVATION AT STAGE 4 PEAK INSTANTANEOUS FLOW (2.6 MGD) WITH ALL UNITS IN SERVICE.	STAGE 4 PEAK
WATER SERVICE ELEVATION AT STAGE 1 PEAK INSTANTANEOUS FLOW (0.65 MGD) WITH ALL UNITS IN SERVICE.	STAGE 1 PEAK
WATER SURFACE ELEVATION AT STAGE 1 AVERAGE DAY FLOW (0.12 MGD) WITH ALL UNITS IN SERVICE.	STAGE 1 ADF
ELEVATION OF STAGE 1 PEAK.	▽

NOTES:

1. NITRATE RECYCLE FLOW IS 400% OF THE AVERAGE FLOW TO THE REACTORS AT AVERAGE DESIGN AND MAX MONTH FLOWS AND 400% OF THE MAX MONTH FLOW AT PEAK HOURLY CONDITIONS.
2. MIXED LIQUOR SUSPENDED SOLIDS (MLSS) FLOW IS 400% OF THE AVERAGE FLOW TO THE REACTORS AT AVERAGE DESIGN AND MAX MONTH FLOWS AND 400% OF THE MAX MONTH FLOWS AT PEAK HOURLY CONDITIONS.
3. MLSS RECYCLE FLOWS FROM MEMBRANE TANKS TO PRE-ANOXIC ZONE.
4. NITRATE RECYCLE FLOWS FROM AEROBIC ZONE TO PRE-ANOXIC ZONE.

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Title **HYDRAULIC PROFILE**

Project No. 11188223
Original Size Arch D
Sheet No. **M-002**
Sheet of

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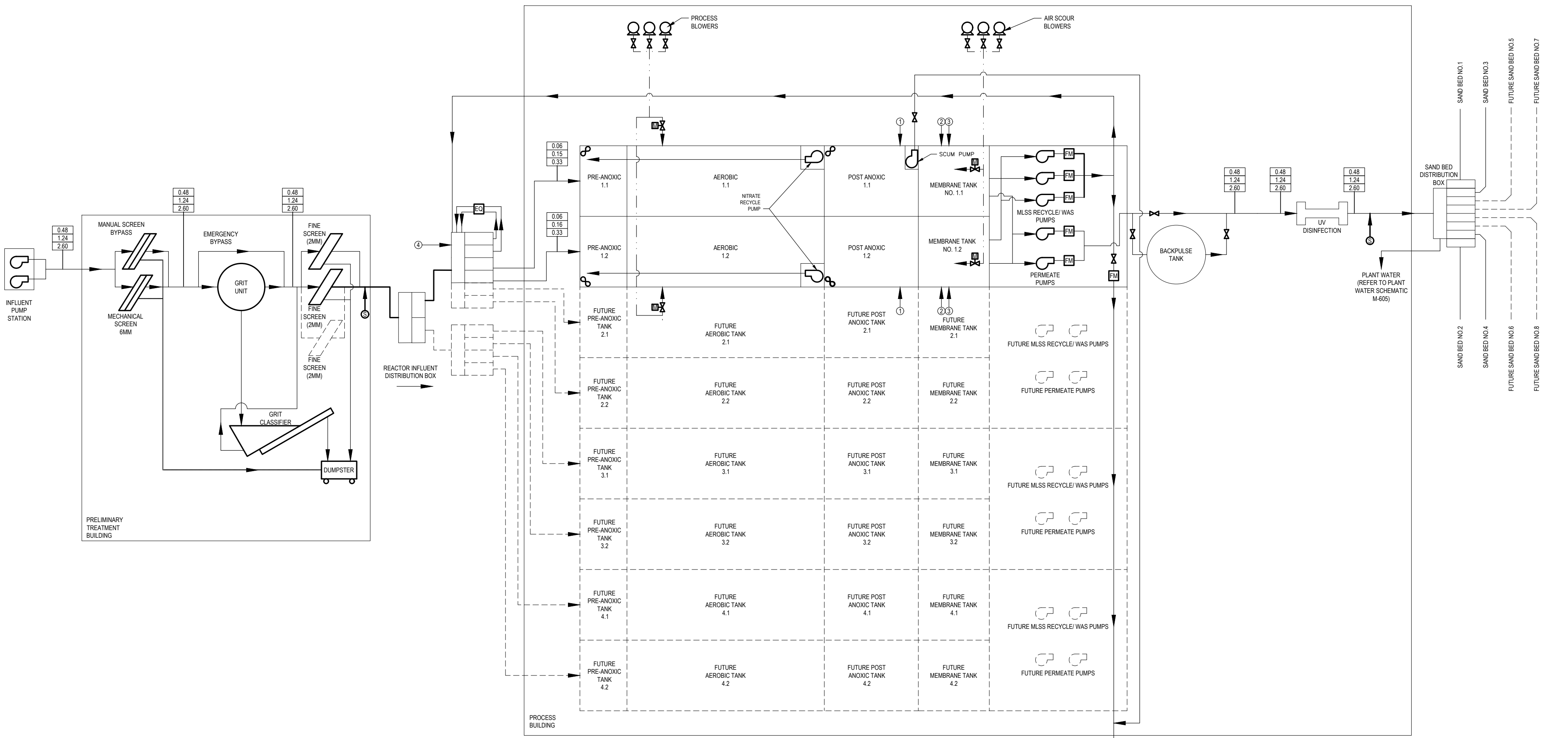

1 PROCESS FLOW DIAGRAM

NOT TO SCALE

NOTES:

1. DIAGRAM DOES NOT INCLUDE RECYCLE FLOWS.

LEGEND

PROCESS FLOW	MOTORIZED VALVE
PROCESS AIR	VALVE
NEW	PUMP
FUTURE	BLOWER
	SAMPLE POINT
	MIXER
	FLOWMETER

CHEMICAL FEED KEY

1. SUPPLEMENTAL CARBON
2. SODIUM HYPOCHLORITE
3. CITRIC ACID
4. SODIUM HYDROXIDE

FLOW KEY (MGD)

X.XX	AVERAGE DAILY FLOW
X.XX	MAX MONTH FLOW
X.XX	PEAK INSTANTANEOUS FLOW

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Drafting Check	Design Check	Project	PRELIMINARY DESIGN OF MASHPEE WRRF
Project Manager A. RUDENKO	Date	Title	PROCESS FLOW DIAGRAM - LIQUIDS TRAIN
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		Original Size Arch D	Sheet No. M-003

Sheet of

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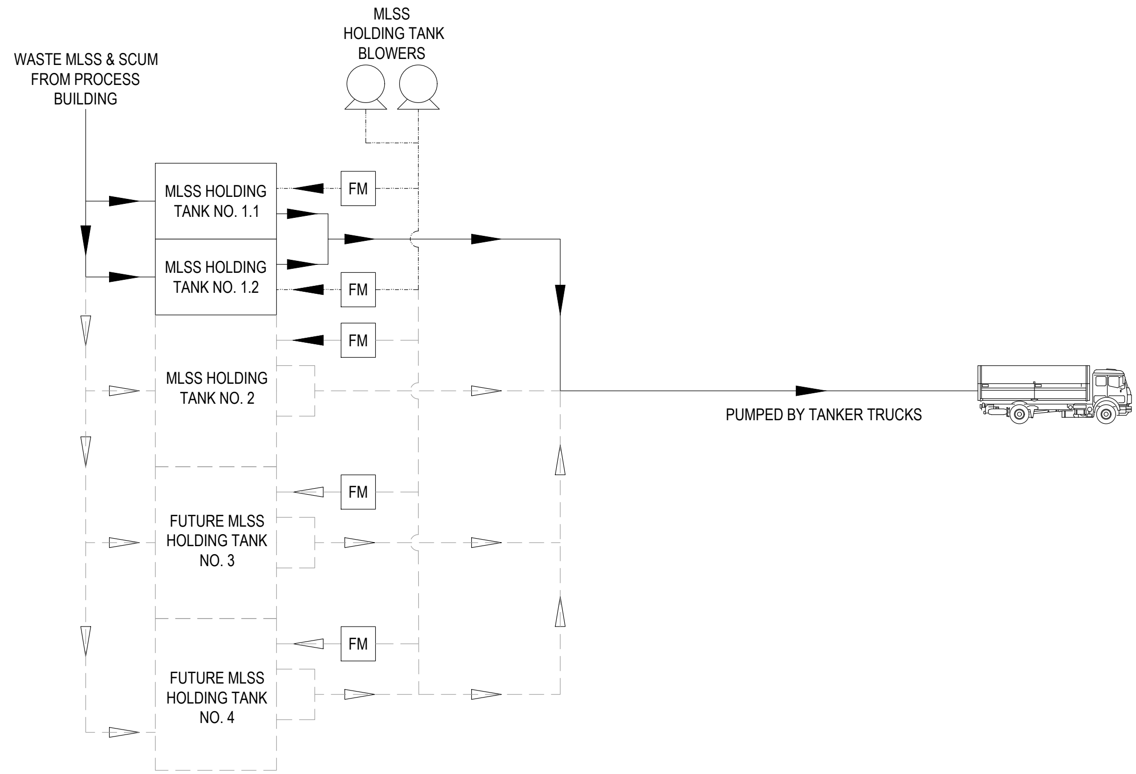

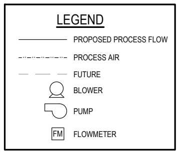

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Title **PROCESS FLOW DIAGRAM - SOLIDS TRAIN**
Project No. 11188223
Original Size Arch D
Sheet No. **M-004**
Sheet of

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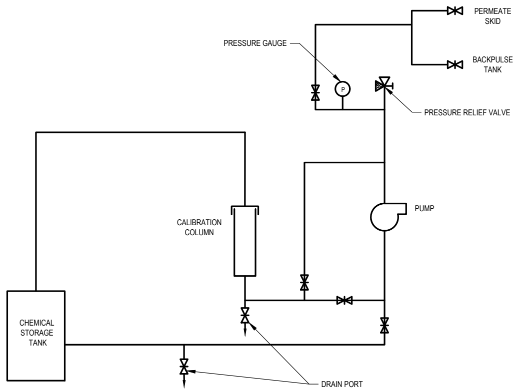
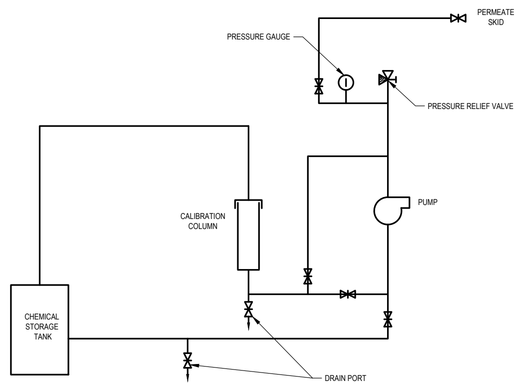


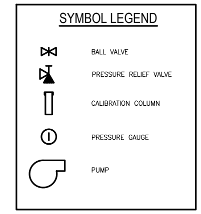
1 **SODIUM HYPOCHLORITE FEED SCHEMATIC**
NOT TO SCALE

NOTES:

1. SODIUM HYPOCHLORITE FEED FOR PLANT WATER SYSTEM NOT SHOWN IN SCHEMATIC.
2. ANY EXTERIOR ABOVE GRADE SODIUM HYPOCHLORITE PIPING SHALL BE HEAT TRACED AND INSULATED.

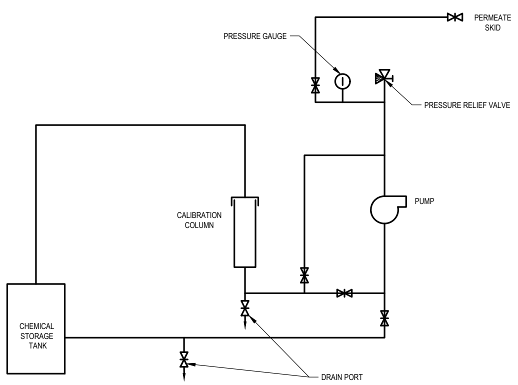


2 **CITRIC ACID FEED SCHEMATIC**
NOT TO SCALE

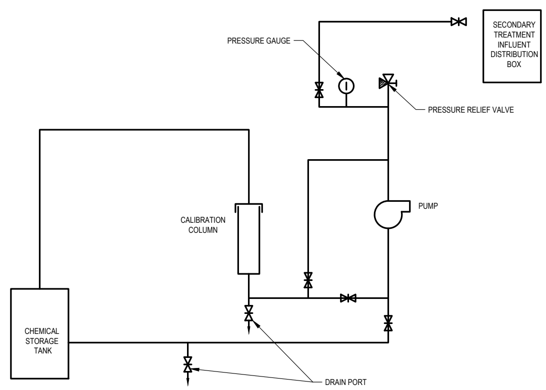


GENERAL NOTES:
(FOR ALL SYSTEMS UNLESS OTHERWISE NOTED)

1. VERIFY PIPE SIZES WITH MANUFACTURER.
2. CHEMICAL SUPPLY PIPING SHALL SLOPE (MIN 1/8" PER FOOT) FROM TANKS DOWN TO DRAIN ON SUCTION SIDE OF PUMP.
3. SUPPLY REDUCERS AT PUMP AND TANK AS REQUIRED. UNIONS SHALL BE LOCATED ON THE PUMP SIDE OF THE REDUCER.
4. THE HIGHEST POINT ON THE SUCTION PIPING SHALL BE AT THE PUMP OR DOSING UNIT THERE SHALL BE NO LOOPS OR HIGH SPOTS ON THE SUCTION PIPING.
5. SUPPLY SPRAY SHIELDS ON ALL UNIONS.
6. ALL VALVES ON DISTRIBUTION PANELS SHALL BE MAXIMUM OF 4' ABOVE OPERATING PLATFORM.
7. ALL CARRIER PIPE ELBOWS SHALL BE LONG RADIUS.
8. ALL HOSE BARBS AND OTHER FITTINGS HARDWARE SHALL BE CHEMICALLY RESISTANCE.
9. CARRIER PIPE TERMINATION ASSEMBLY SHALL BE BY FLO-SAFE, OR EQUAL.



3 **SUPPLEMENTAL CARBON FEED SCHEMATIC**
NOT TO SCALE



4 **SODIUM HYDROXIDE FEED SCHEMATIC**
NOT TO SCALE

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Project No. 11188223
Original Size Arch D
Sheet No. **M-005**
Sheet of

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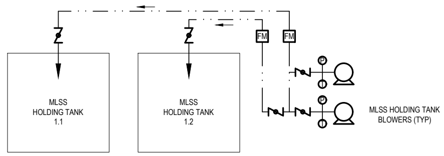
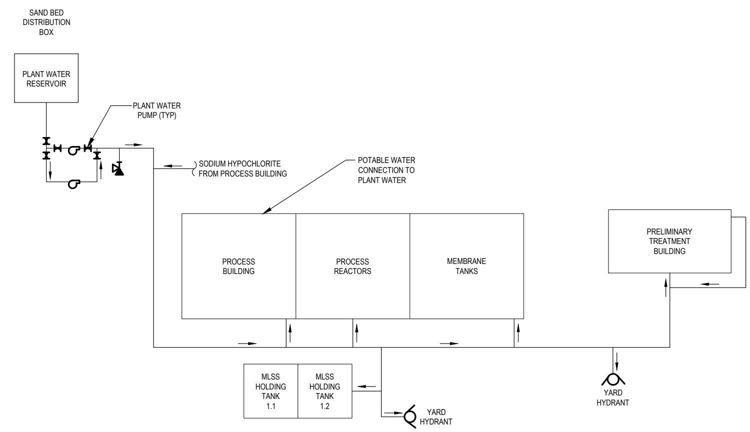


NOTE:

1. STAGE 1 SHOWN.

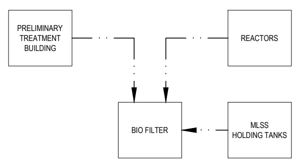
1 MLSS HOLDING TANKS AIR SCHEMATIC

NOT TO SCALE



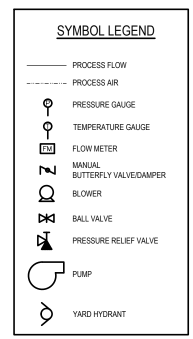
2 PLANT WATER SCHEMATIC

NOT TO SCALE



3 ODOR CONTROL SCHEMATIC

NOT TO SCALE



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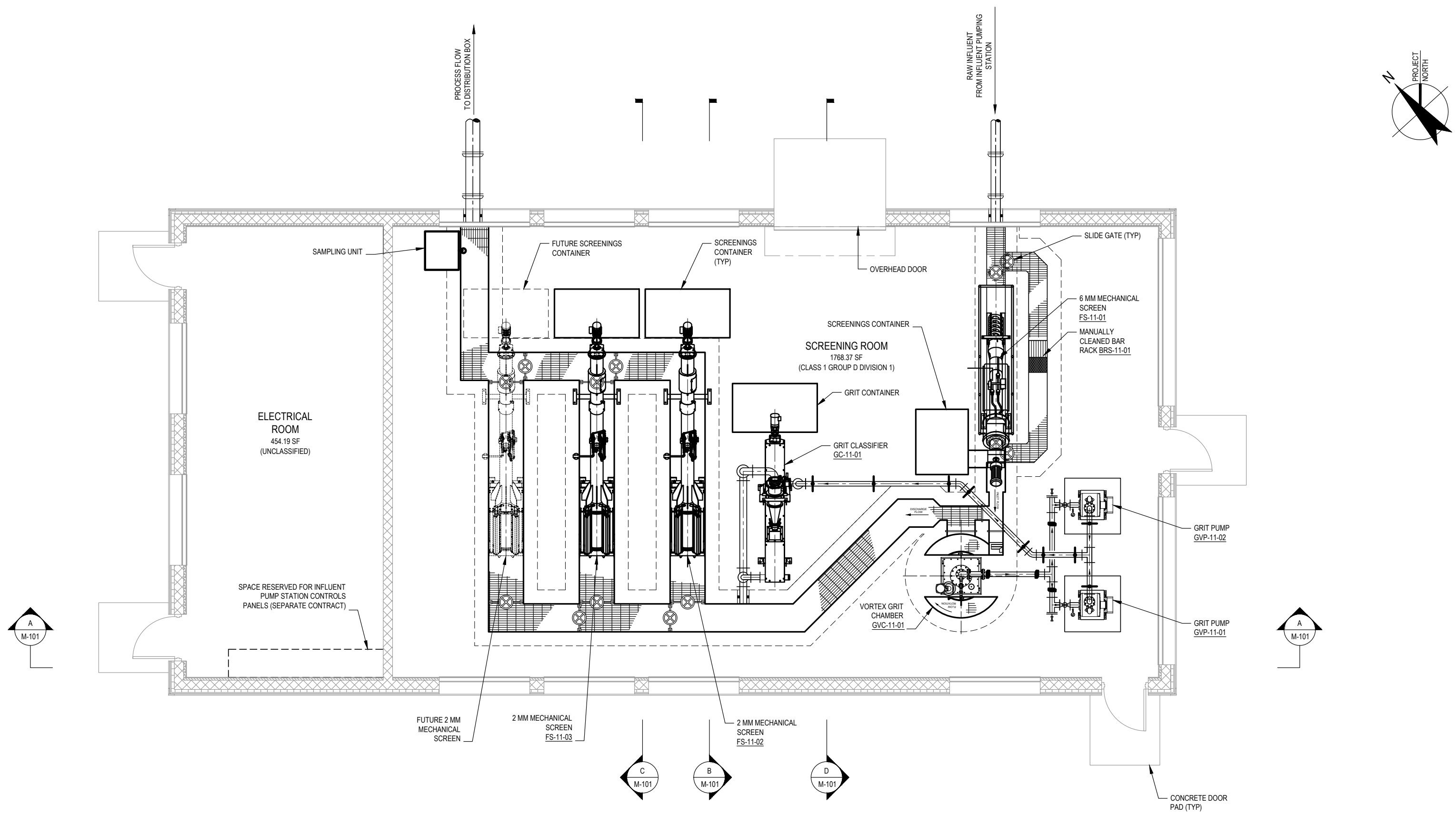
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **MISCELLANEOUS SCHEMATICS**

Project No. 11188223
Original Size Arch D
Sheet No. **M-006**
Sheet of



PRELIMINARY TREATMENT BUILDING - PLAN

SCALE 1/4" = 1'-0"

0 2' 4' 8'

No.	Issue	Drawn	Approved	Date
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Title **PRELIMINARY TREATMENT BUILDING - PLAN**
Project No. 11188223
Original Size Arch D | Sheet No. **M-100** | Sheet of

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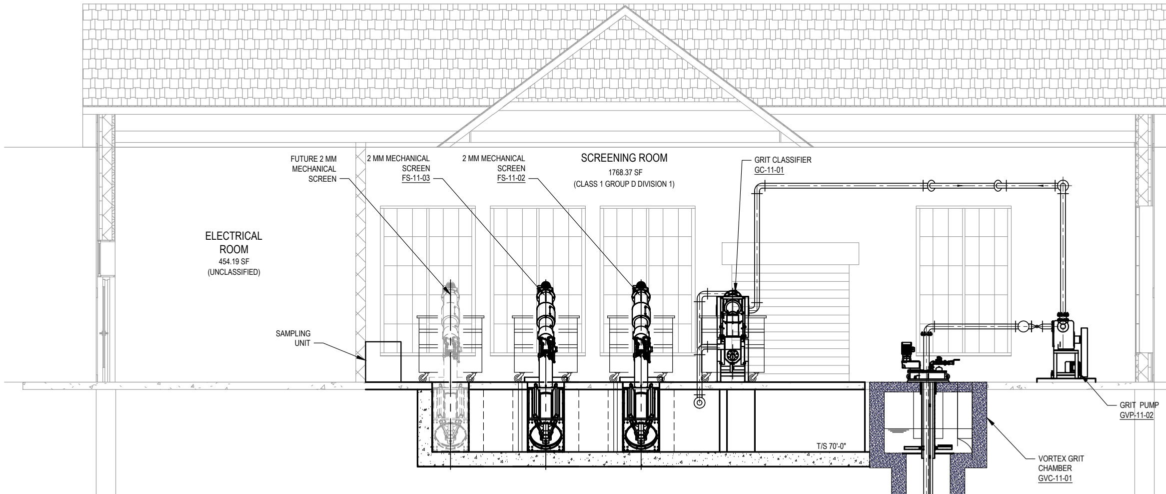
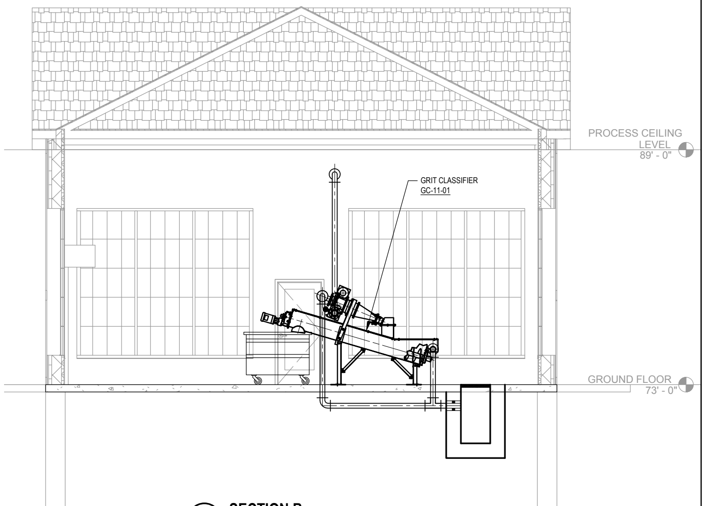
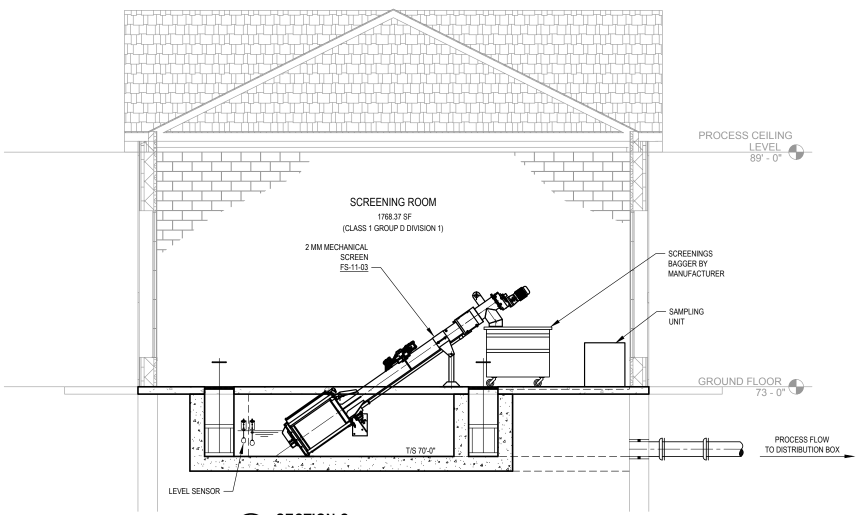


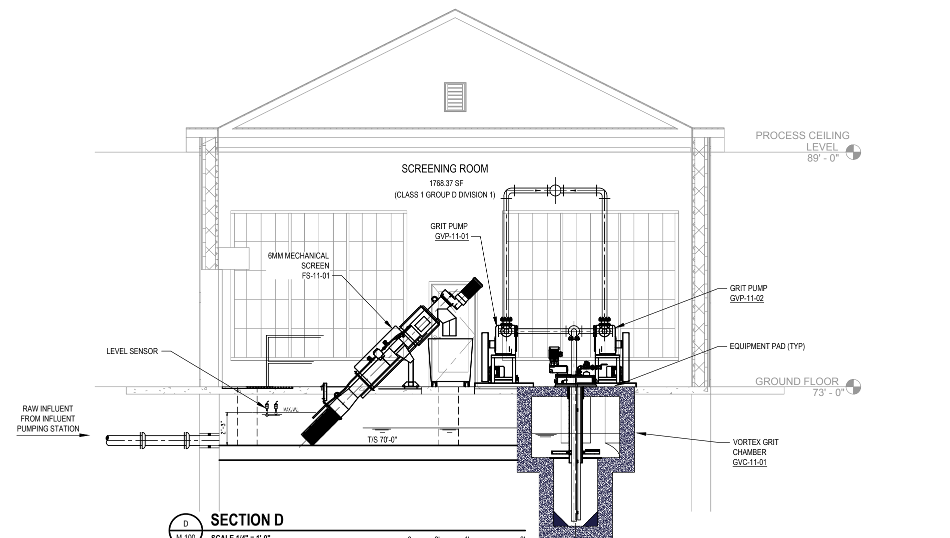
SECTION A
A M-100
SCALE 1/4" = 1'-0"
0 2' 4' 8'



SECTION B
B M-100
SCALE 1/4" = 1'-0"
0 2' 4' 8'



SECTION C
C M-100
SCALE 1/4" = 1'-0"
0 2' 4' 8'



SECTION D
D M-100
SCALE 1/4" = 1'-0"
0 2' 4' 8'

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Project No. 11188223
Original Size Arch D
Sheet No. **M-101**
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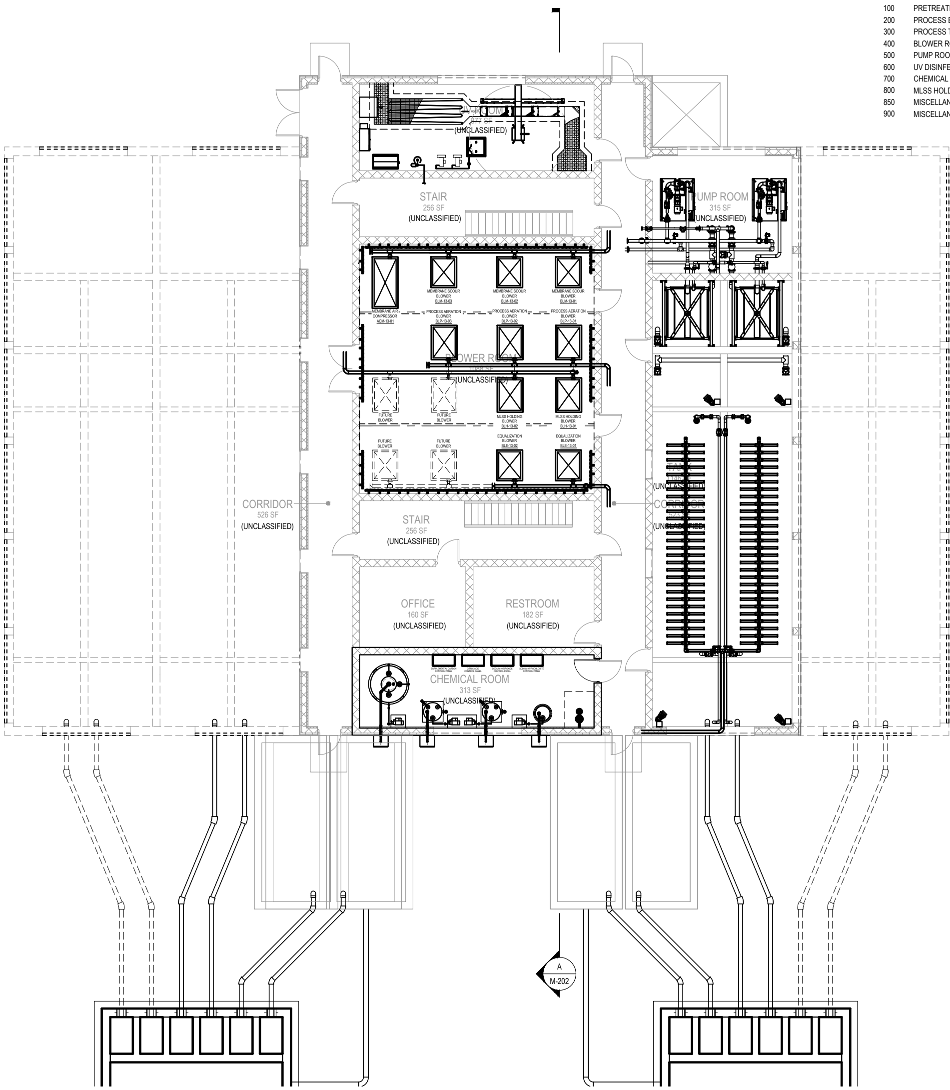
PROCESS CODE

000	GENERAL
050	CIVIL
100	PRETREATMENT BUILDING
200	PROCESS BUILDING
300	PROCESS TANKS AND MBR
400	BLOWER ROOM
500	PUMP ROOMS
600	UV DISINFECTION ROOM
700	CHEMICAL ROOM
800	MLSS HOLDING TANKS
850	MISCELLANEOUS DISTRIBUTION STRUCTURES
900	MISCELLANEOUS DETAILS

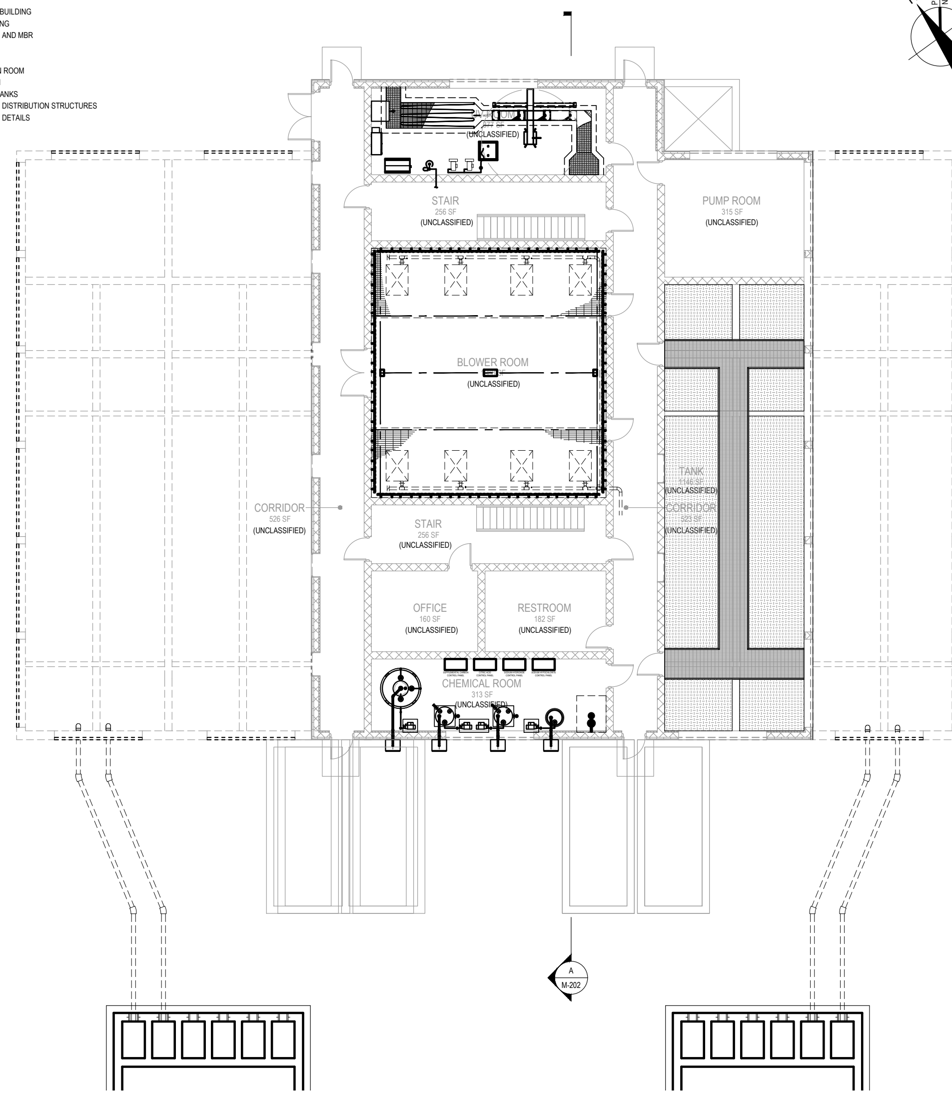
PROJECT NORTH



PROCESS BUILDING - FIRST FLOOR PLAN

SCALE: 1/8" = 1'-0"

0 4' 8' 16'



PROCESS BUILDING - FIRST FLOOR PLAN - FUTURE MEZZANINE

SCALE: 1/8" = 1'-0"

0 4' 8' 16'

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Project No. 11188223
Original Size Arch D
Sheet No. **M-200**
Sheet of

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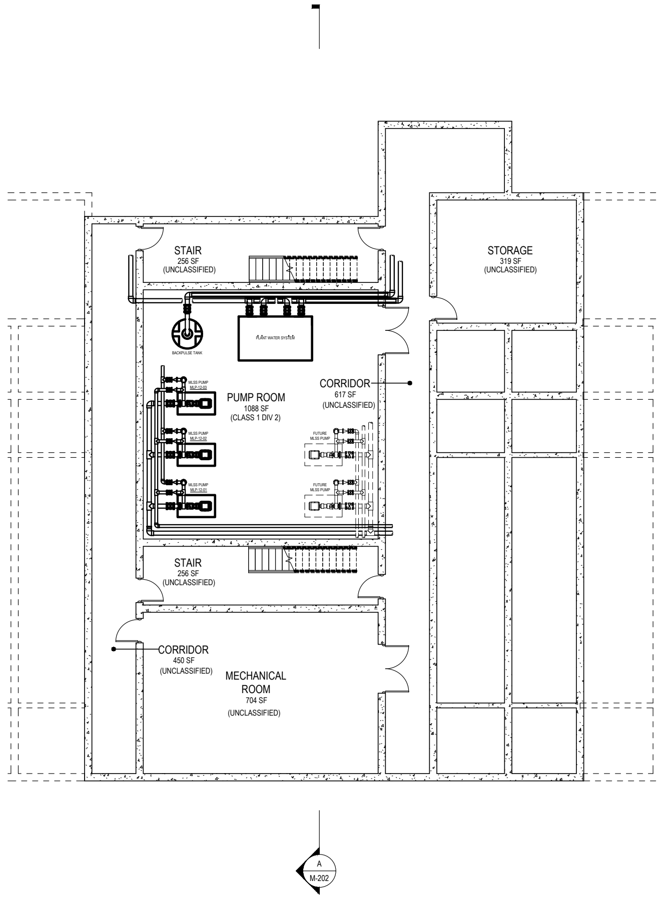

PROCESS BUILDING - LOWER LEVEL PLAN

SCALE: 1/8" = 1'-0"

0 4' 8' 16'

No.	Issue	Drawn	Approved	Date
1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

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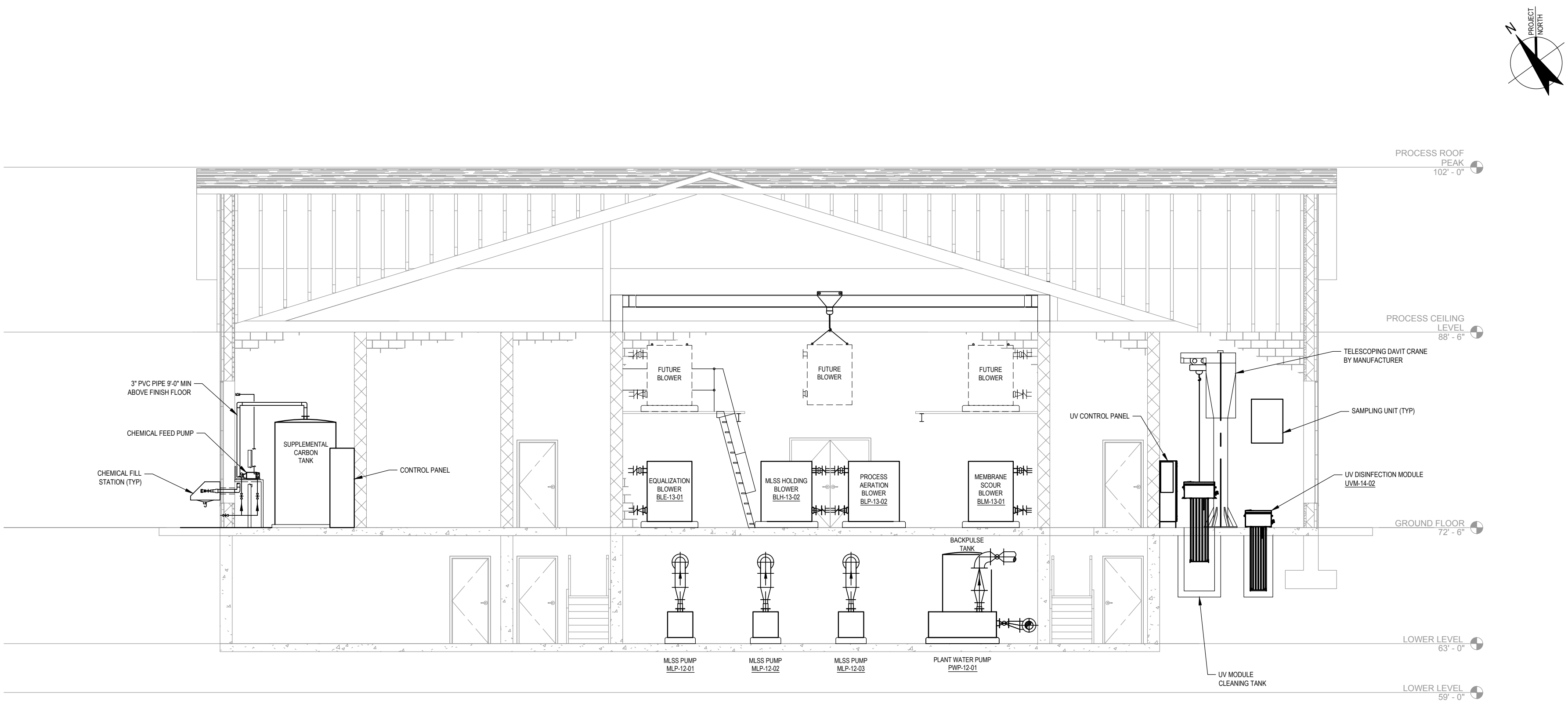
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROCESS BUILDING - LOWER LEVEL PLAN**

Project No. 11188223
Original Size Arch D
Sheet No. **M-201**
Sheet of

Plot Date: 19 November 2019 - 6:33 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M201.dwg



A
M200

PROCESS BUILDING - SECTION

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

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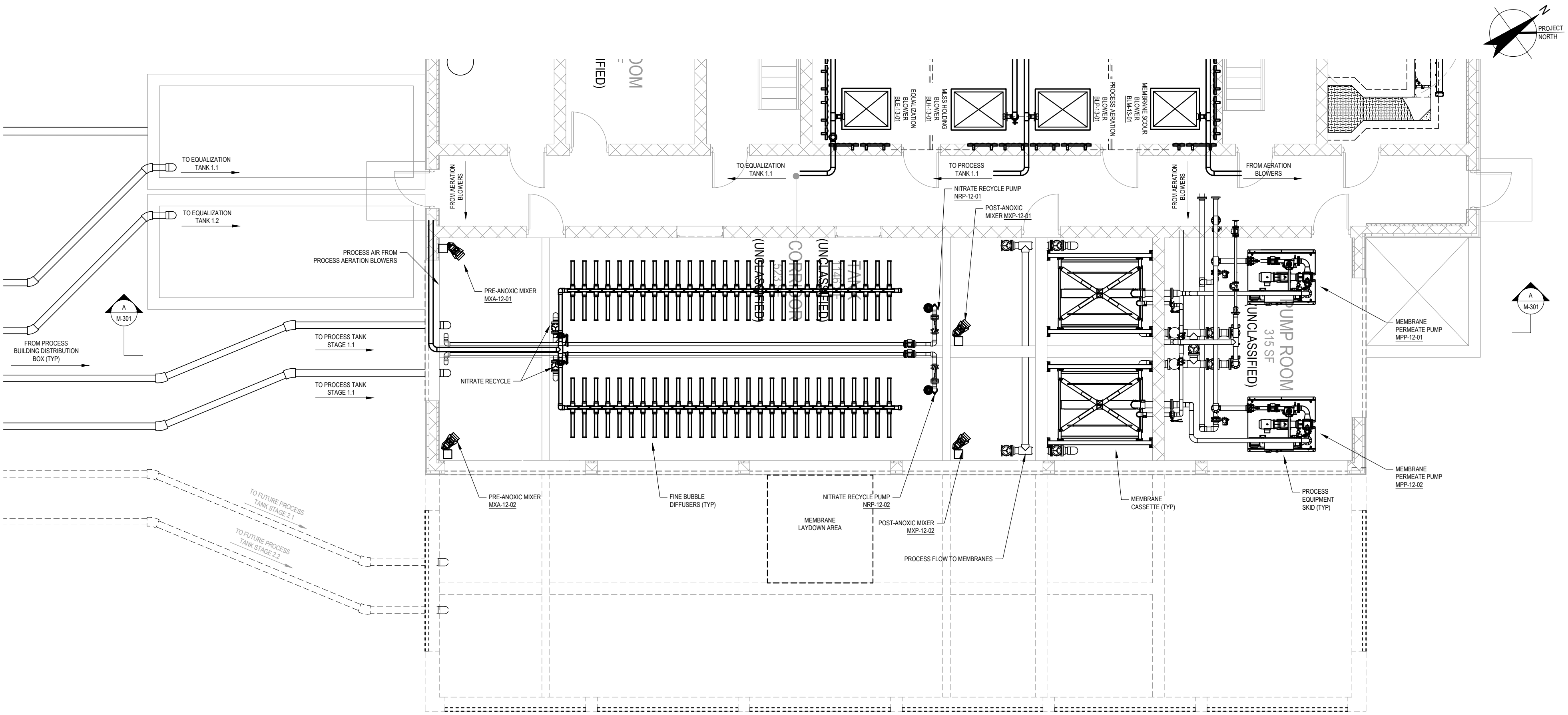
Title **PROCESS BUILDING - SECTION**

Project No. 11188223
Original Size Arch D
Sheet No. **M-202**
Sheet of

Plot Date: 19 November 2019 - 6:33 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M202.dwg



PROCESS BUILDING PARTIAL PLAN - PROCESS TANKS AND MBR

SCALE: 1/4" = 1'-0" 0 2' 4' 8'

No.	Issue	Drawn	Approved	Date
1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JDF		NOV 2019

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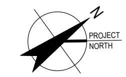
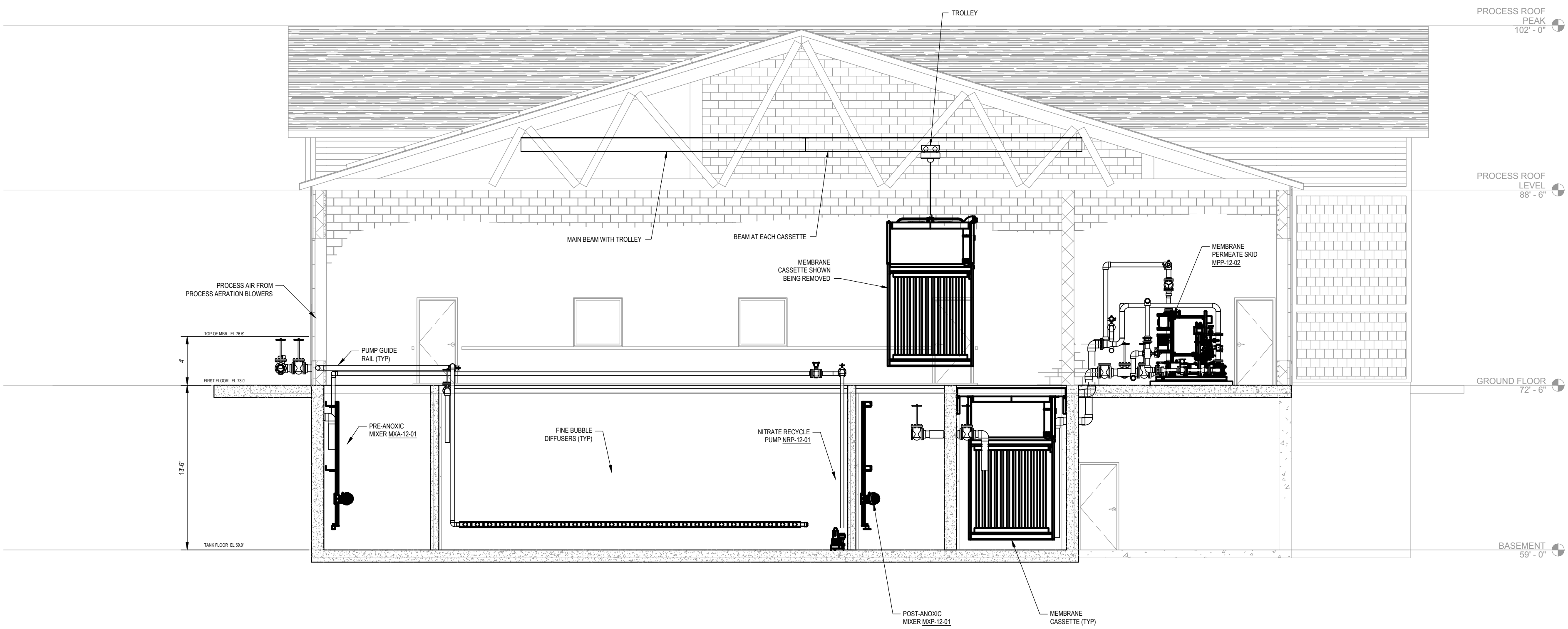
Client **TOWN OF MASHPEE, MA**
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROCESS BUILDING - PARTIAL LOWER LEVEL PLAN - PROCESS TANKS AND MBR**
Project No. 11188223
Original Size Arch D Sheet No. **M-300** Sheet of

Plot Date: 19 November 2019 - 6:34 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M300.dwg





A
M-300

PROCESS BUILDING SECTION -
PROCESS TANKS AND MBR

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

No.	Issue	Drawn	Approved	Date
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Title **PROCESS BUILDING SECTION - PROCESS TANKS AND MBR**
Project No. **11188223**
Original Size **Arch D**
Sheet No. **M-301**
Sheet of

Plot Date: 19 November 2019 - 6:34 PM
Plotted By: James Fosdick
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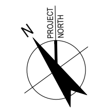

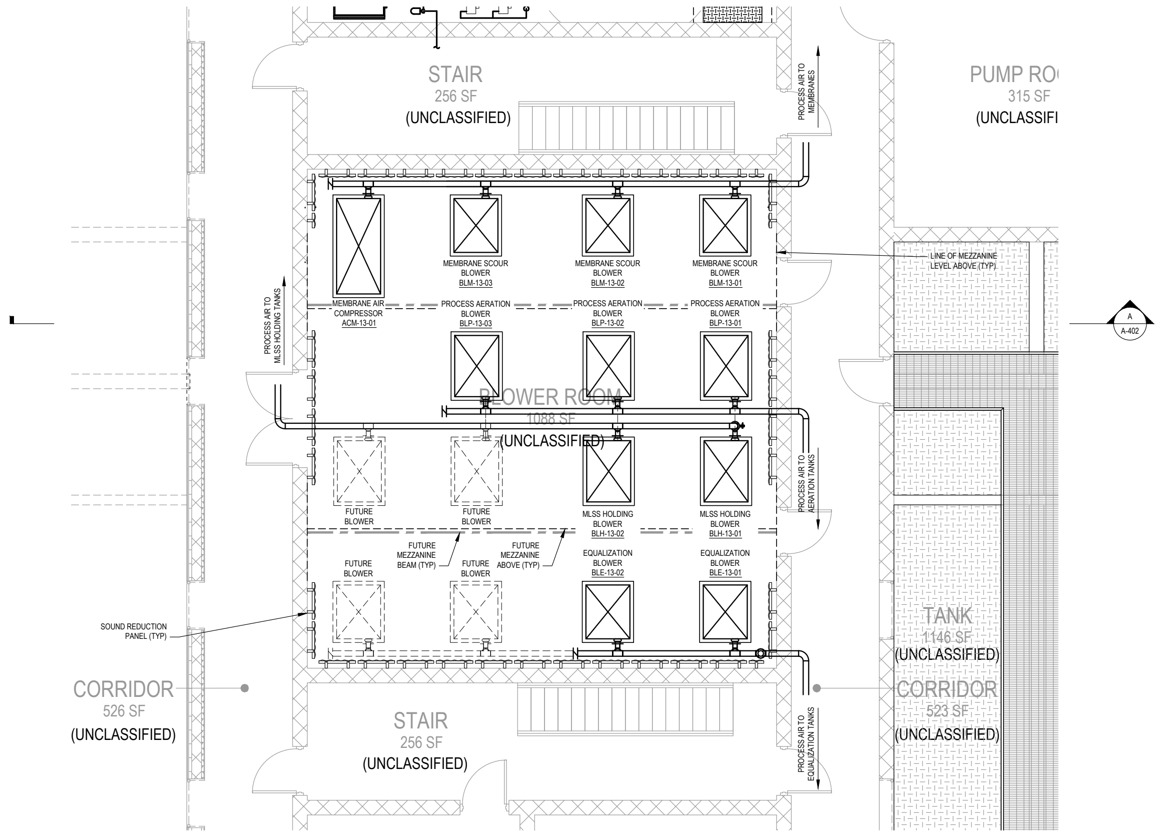

PROCESS BUILDING PARTIAL PLAN - BLOWER ROOM

SCALE: 1/4" = 1'-0" 0 2' 4' 8'

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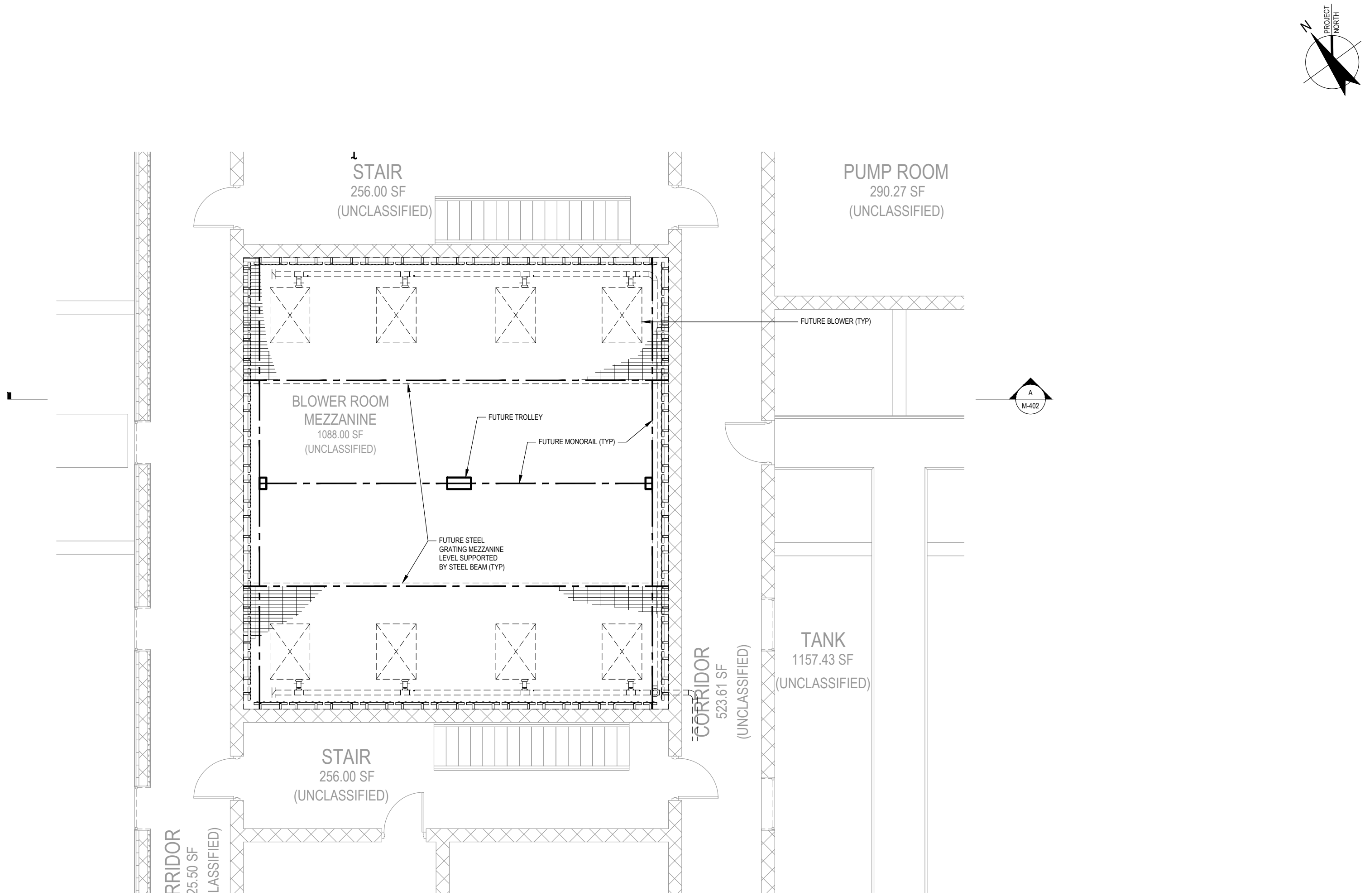
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROCESS BUILDING PARTIAL PLAN - BLOWER ROOM**
Project No. 11188223
Original Size Arch D | Sheet No. **M-400** | Sheet of

Plot Date: 19 November 2019 - 6:35 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M400.dwg



PROCESS BUILDING PARTIAL PLAN - BLOWER ROOM - FUTURE MEZZANINE

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

No.	Issue	Drawn	Approved	Date
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Title **PROCESS BUILDING PARTIAL PLAN - BLOWER ROOM - FUTURE MEZZANINE**

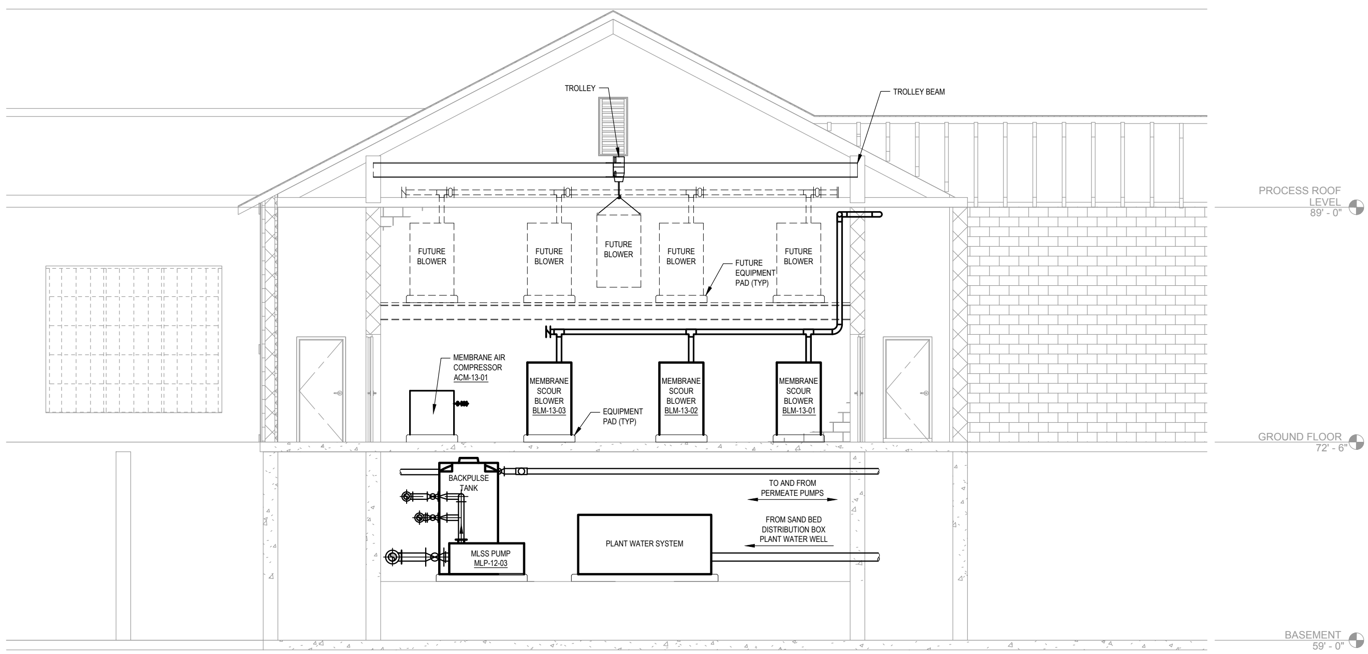
Project No. 11188223

Original Size Arch D

Sheet No. **M-401**

Sheet of

Plot Date: 19 November 2019 - 6:35 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M401.dwg



PROCESS BUILDING SECTION - BLOWER ROOM

A M-400 A M-401

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

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Project **PRELIMINARY DESIGN OF MASHPEE WRRF**

Title **PROCESS BUILDING SECTION - BLOWER ROOM**

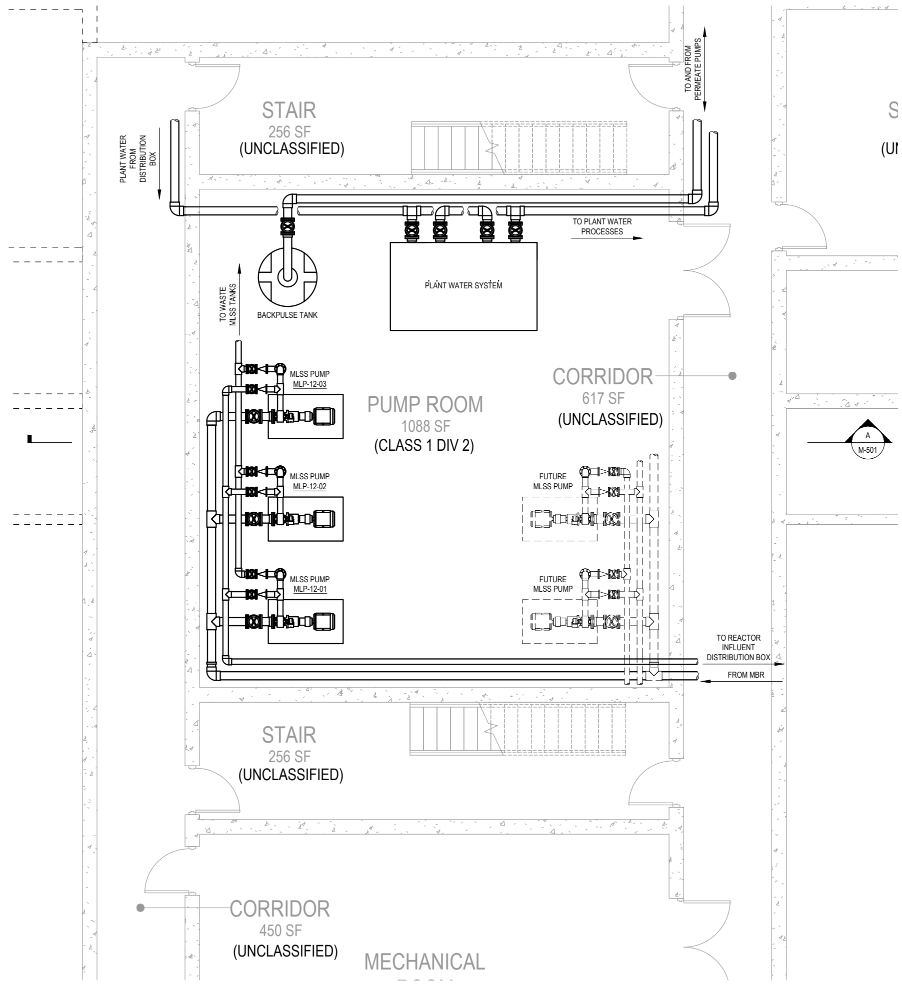
Project No. 11188223

Original Size Arch D

Sheet No. **M-402**

Sheet of

Plot Date: 19 November 2019 - 6:35 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M402.dwg



PROCESS BUILDING PARTIAL PLAN - PUMP ROOM

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

No.	Issue	Drawn	Approved	Date
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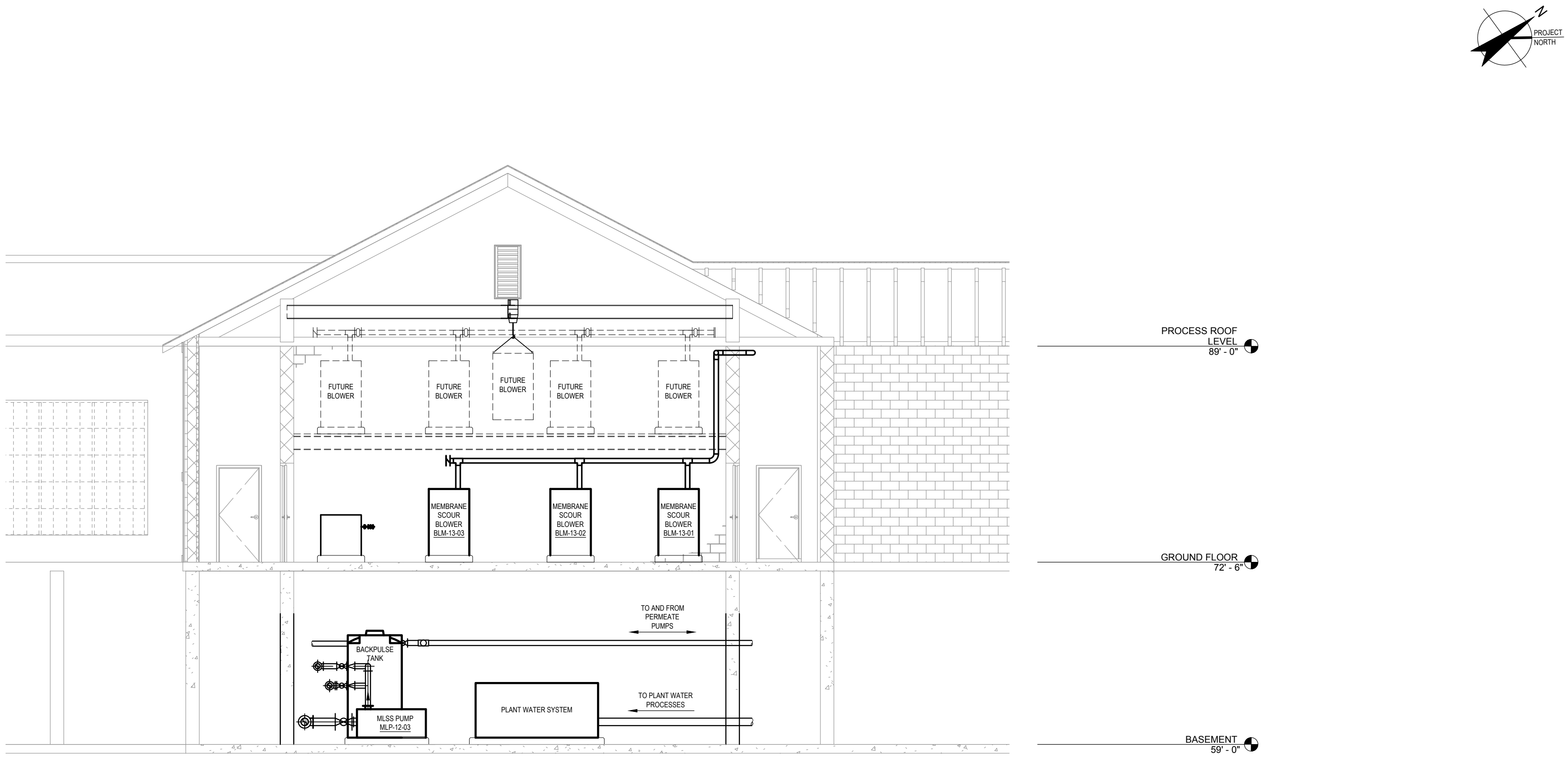
Title **PROCESS BUILDING PARTIAL PLAN - PUMP ROOM**

Project No. 11188223
Original Size Arch D
Sheet No. **M-500**
Sheet of

Plot Date: 19 November 2019 - 6:35 PM Plotted By: James Fosdick Filename: G:\11\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M500.dwg



1 M600 **PROCESS BUILDING SECTION - PUMP ROOM**
SCALE: 1/4" = 1'-0"
0 2' 4' 8'

No.	Issue	Drawn	Approved	Date
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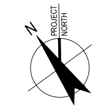
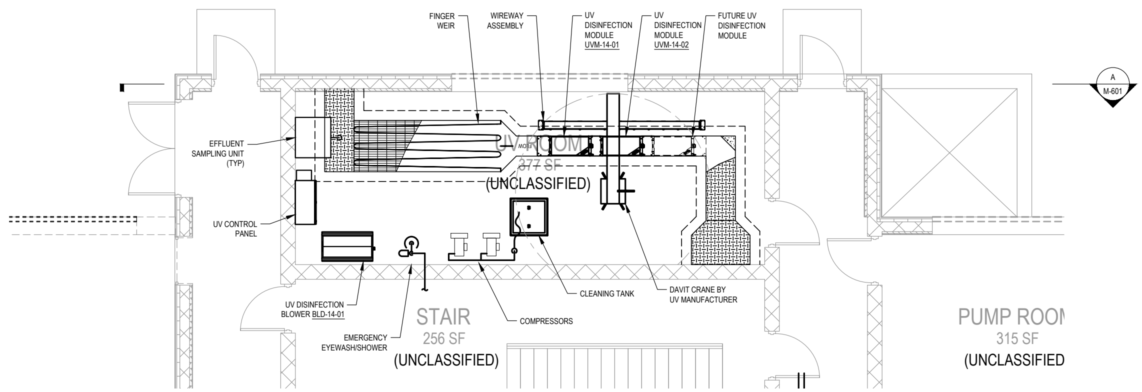
Title **PROCESS BUILDING SECTION - PUMP ROOM**
Project No. 11188223
Original Size Arch D
Sheet No. **M-501**
Sheet of





PROCESS BUILDING PARTIAL PLAN - UV DISINFECTION ROOM

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

No.	Issue	Drawn	Approved	Date
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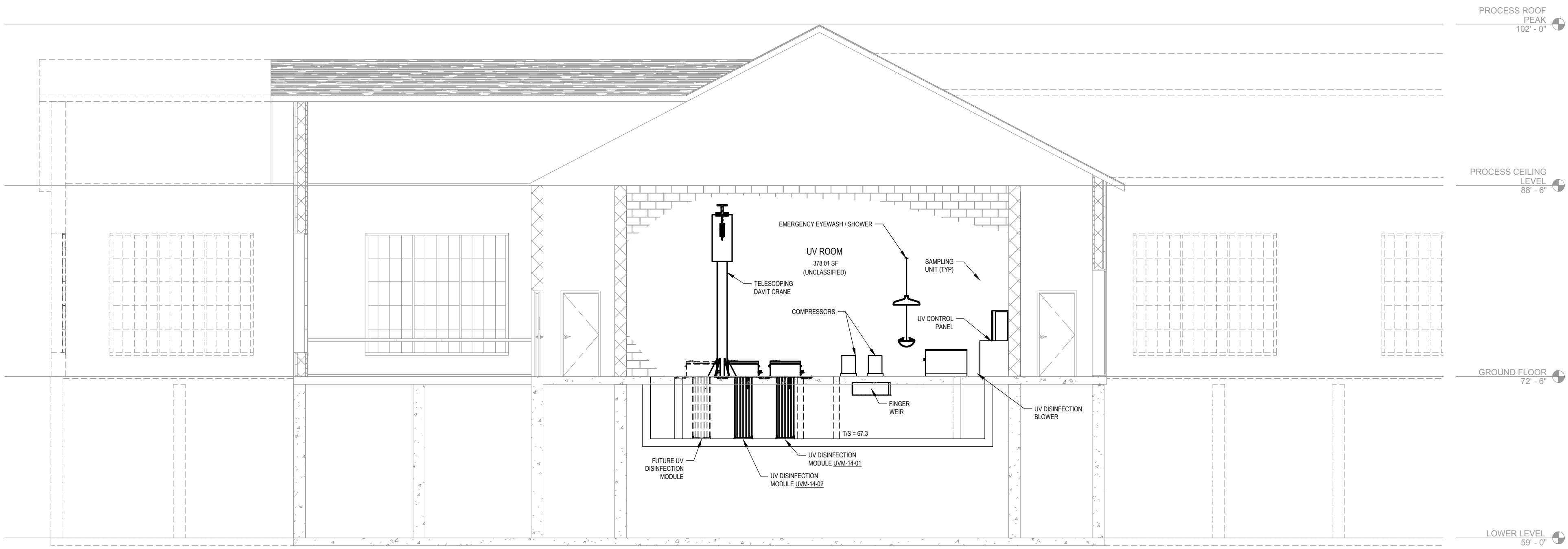
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROCESS BUILDING PARTIAL PLAN - UV DISINFECTION ROOM**
Project No. 11188223
Original Size Arch D
Sheet No. **M-600**
Sheet of



PROCESS BUILDING SECTION - UV DISINFECTION ROOM

A / M-600

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

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Title **PROCESS BUILDING SECTION - UV DISINFECTION ROOM**

Project No. 11188223

Original Size Arch D

Sheet No. **M-601**

Sheet of

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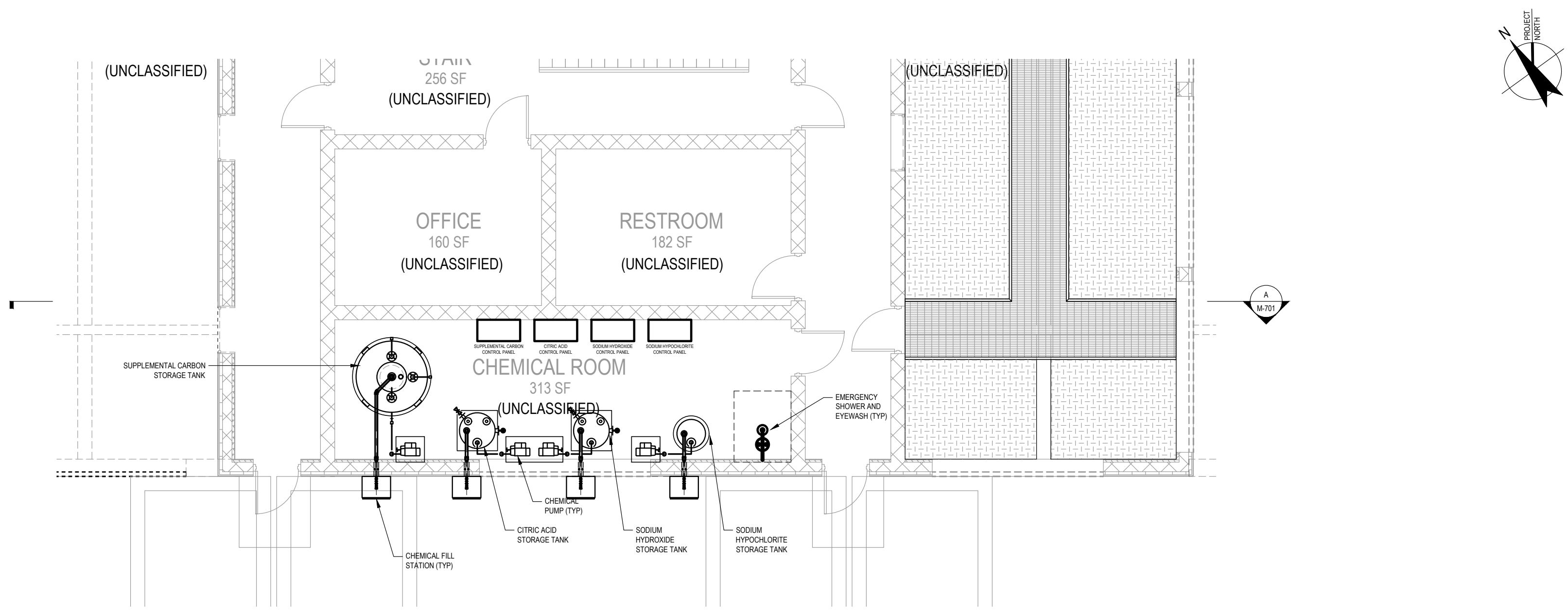

PROCESS BUILDING PARTIAL PLAN - CHEMICAL ROOM

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

No.	Issue	Drawn	Approved	Date
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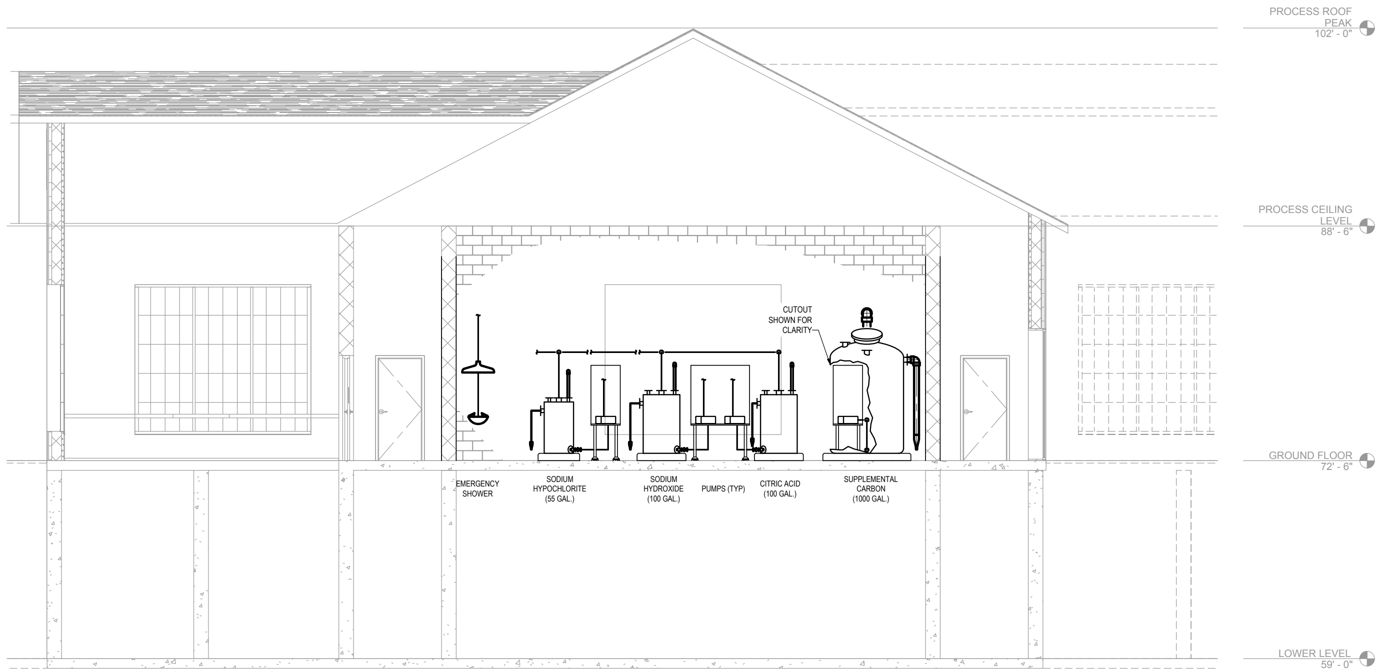
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROCESS BUILDING PARTIAL PLAN - CHEMICAL ROOM**
Project No. **11188223**
Original Size **Arch D**
Sheet No. **M-700**
Sheet of

Plot Date: 19 November 2019 - 6:36 PM
Plotted By: James Fosdick
Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M700.dwg



PROCESS BUILDING SECTION - CHEMICAL ROOM

A / M-700

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

No.	Issue	Drawn	Approved	Date
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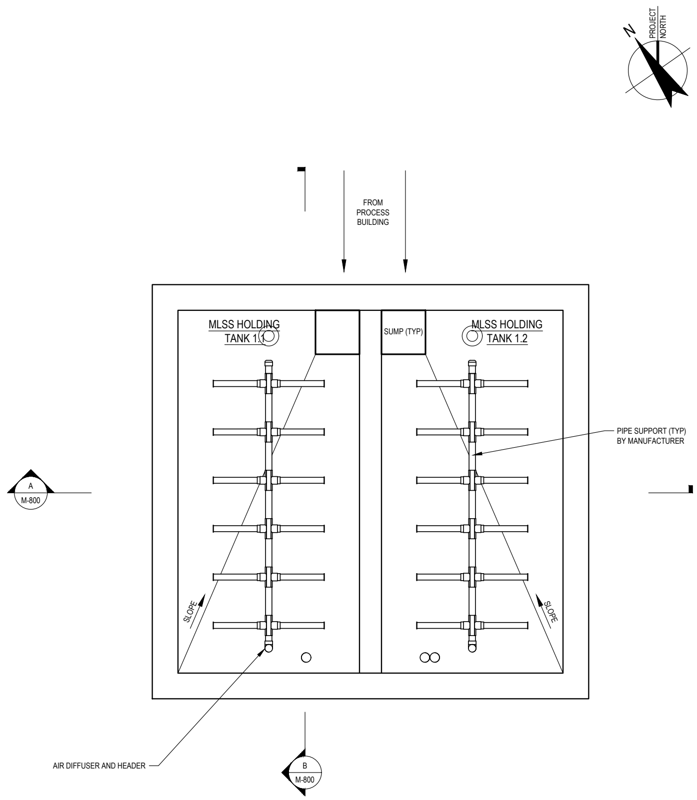
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROCESS BUILDING SECTION - CHEMICAL ROOM**
Project No. 11188223
Original Size Arch D
Sheet No. **M-701**
Sheet of

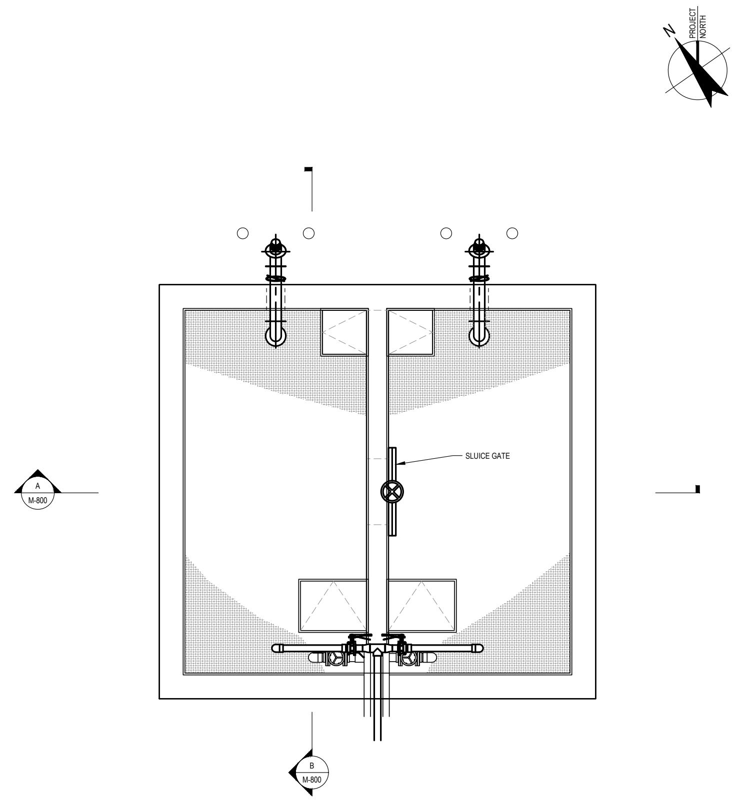
Plot Date: 19 November 2019 - 6:36 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M701.dwg



MLSS HOLDING TANK - LOWER PLAN

SCALE: 3/8" = 1'-0"

0 2' 4' 6'



MLSS HOLDING TANK - UPPER PLAN

SCALE: 3/8" = 1'-0"

0 2' 4' 6'

NOTES:

1. DIFFUSERS, PIPING, SUPPORTS AND ASSOCIATED ACCESSORIES DOWNSTREAM OF THE TRANSITION COUPLING SHALL BE PROVIDED AS A SYSTEM BY THE DIFFUSER MANUFACTURER.

No.	Issue	Drawn	Approved	Date
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Project **PRELIMINARY DESIGN OF MASHPEE WRRF**

Title **MLSS HOLDING TANK - PLAN AND SECTION**

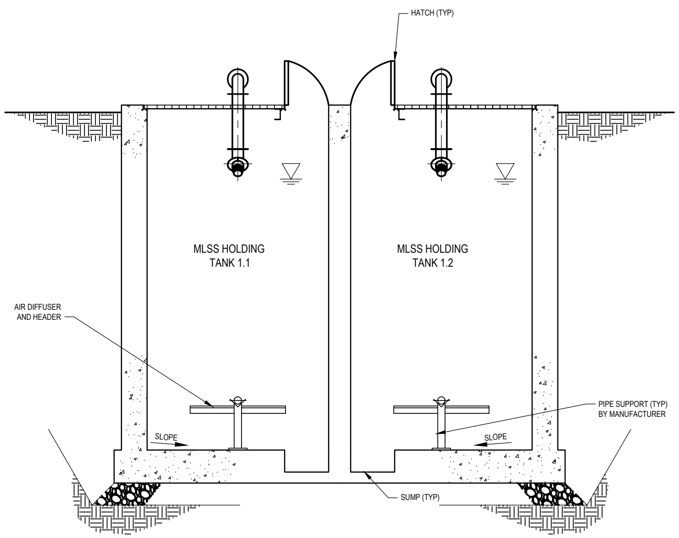
Project No. 11188223

Original Size Arch D

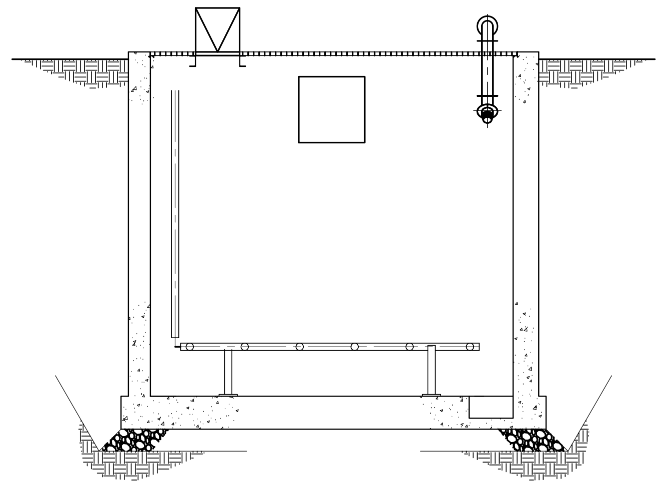
Sheet No. **M-800**

Sheet of

Plot Date: 19 November 2019 - 6:36 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M800.dwg



A M-800 **MLSS HOLDING TANK - SECTION**
SCALE: 3/8" = 1'-0"   0 2' 4' 6'



A M-800 **MLSS HOLDING TANK - SECTION**
SCALE: 3/8" = 1'-0"   0 2' 4' 6'

NOTES:

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No.	Issue	Drawn	Approved	Date
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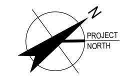
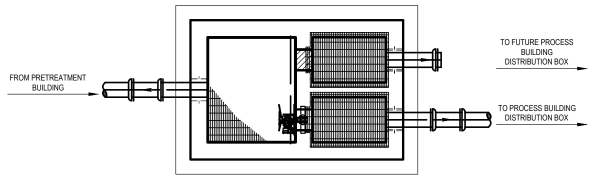
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **MLSS HOLDING TANK - SECTIONS**
Project No. **11188223**
Original Size **Arch D**
Sheet No. **M-801**
Sheet of

Plot Date: 19 November 2019 - 6:36 PM
Plotted By: James Fosdick
Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M801.dwg

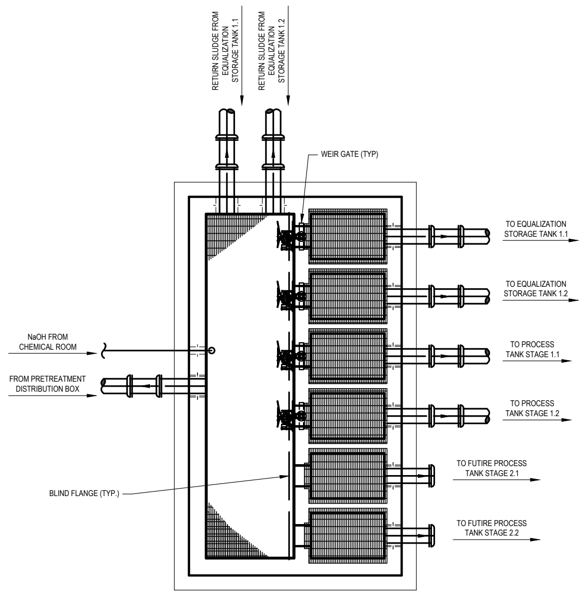




PRELIMINARY TREATMENT EFFLUENT DISTRIBUTION BOX PLAN

SCALE: 1/4" = 1'-0"

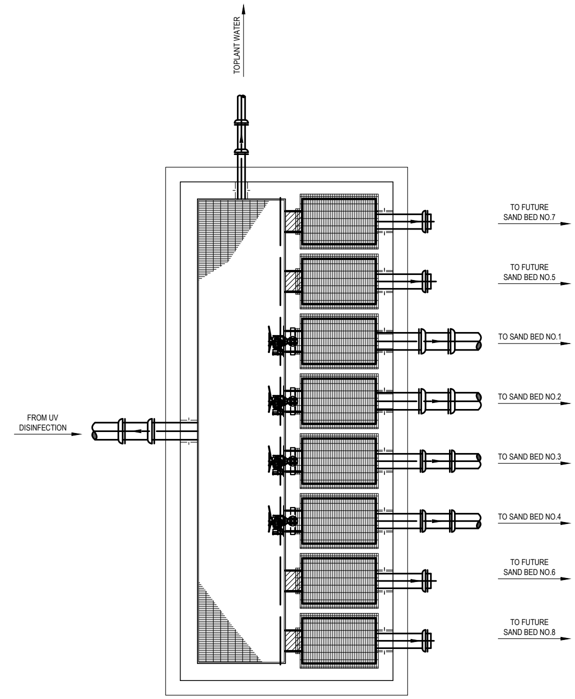
0 2' 4' 8'



SECONDARY TREATMENT INFLUENT DISTRIBUTION BOX PLAN

SCALE: 1/4" = 1'-0"

0 2' 4' 8'



EFFLUENT DISTRIBUTION BOX PLAN

SCALE: 1/4" = 1'-0"

0 2' 4' 8'

No.	Issue	Drawn	Approved	Date
1	30% DESIGN REVIEW VALUE ENGINEERING REVIEW			NOV 2019

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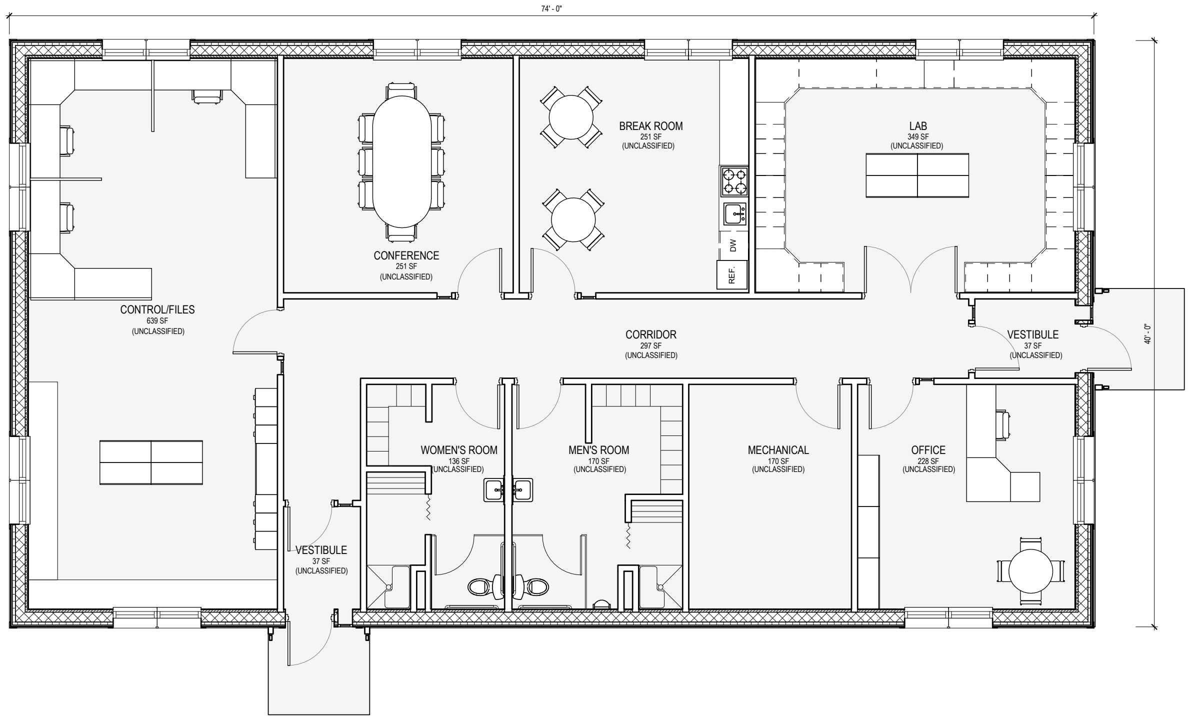
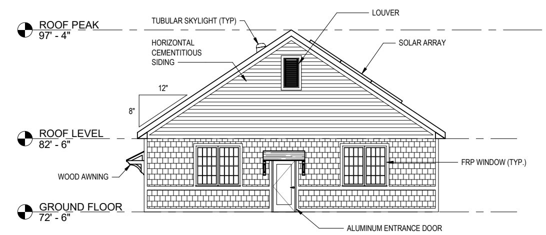
Title **DISTRIBUTION STRUCTURES - PLANS**

Project No. 11188223
Original Size Arch D
Sheet No. **M-850**
Sheet of

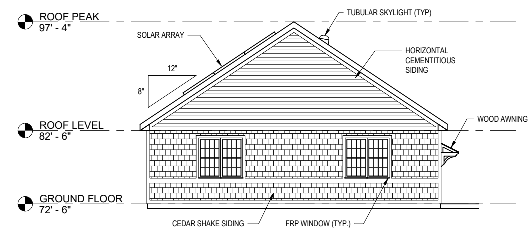
Plot Date: 19 November 2019 - 6:36 PM Plotted By: James Fosdick Filename: G:\11\11188223 - Mashpee Site 4 Design\CADD\Drawings\PROCESS MECHANICAL\11188223-M850.dwg



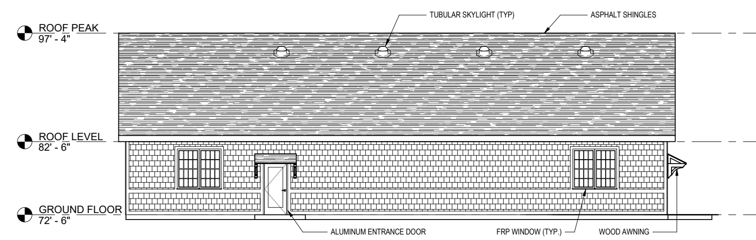
GROUND FLOOR PLAN
SCALE 1/4" = 1'-0"



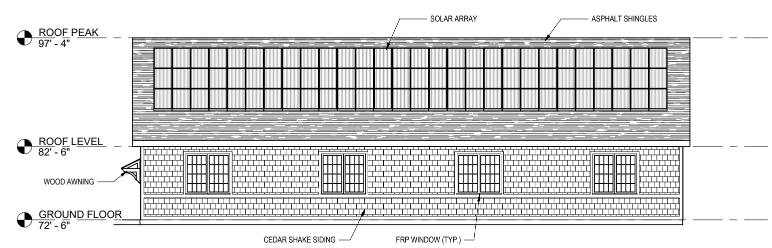
NORTH ELEVATION
SCALE 1/8" = 1'-0"



SOUTH ELEVATION
SCALE 1/8" = 1'-0"



EAST ELEVATION
SCALE 1/8" = 1'-0"



WEST ELEVATION
SCALE 1/8" = 1'-0"

No.	Issue	Drawn	Approved	Date
A	30% DESIGN REVIEW	KNH	RCF	05/18

0 4' 8' 16'
SCALE: 1/8"=1'-0"

0 2' 4' 8'
SCALE: 1/4" = 1'-0"

Bar is one inch on original size sheet
0 1"

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Drafting Check E. RUSTEN | Design Check
Project Manager A. RUDENKO | Date
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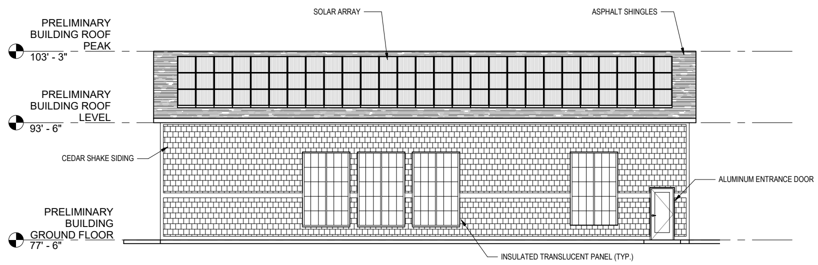
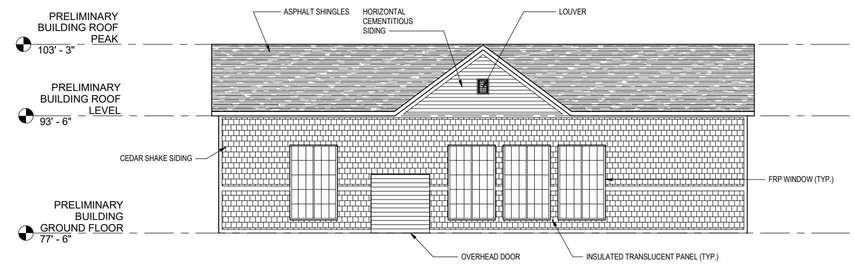
Client **TOWN OF MASHPEE, MA**
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **OPERATIONS BUILDING**
FUTURE PLAN AND ELEVATIONS
Project No. 11188223
Original Size Arch D
Sheet No. **A-050**
Sheet of 30

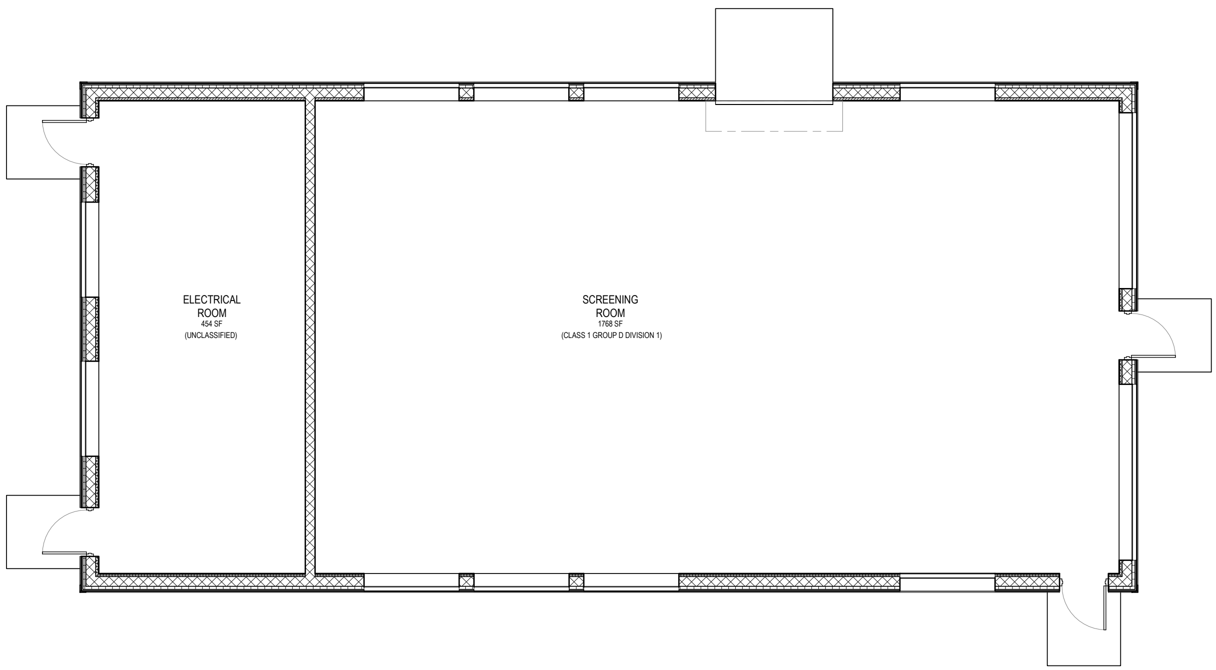
Plot Date: 11/11/2019 3:21:39 PM Plotted By: Curt Smith Filename: C:\Users\khanlin\Documents\Revit 2019 Local Files\11188223-Operations Building CM_Kaila.Hanlin.rvt

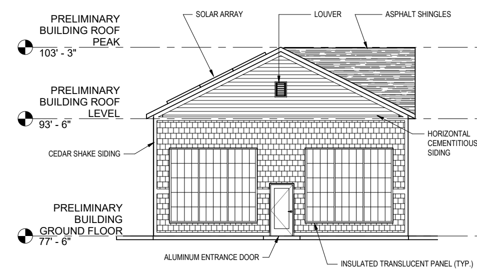


SOUTH ELEVATION
SCALE 1/8" = 1'-0"

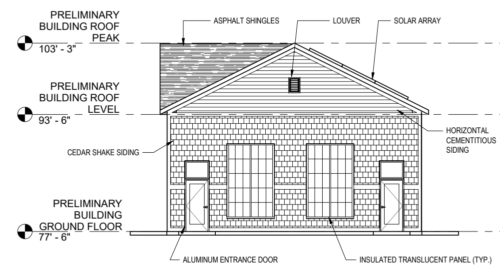


NORTH ELEVATION
SCALE 1/8" = 1'-0"





EAST ELEVATION
SCALE 1/8" = 1'-0"



WEST ELEVATION
SCALE 1/8" = 1'-0"

PRELIMINARY BUILDING GROUND FLOOR
SCALE 1/4" = 1'-0"

No.	Issue	Drawn	Approved	Date
A	30% DESIGN REVIEW		RCF	05/18

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0 1"

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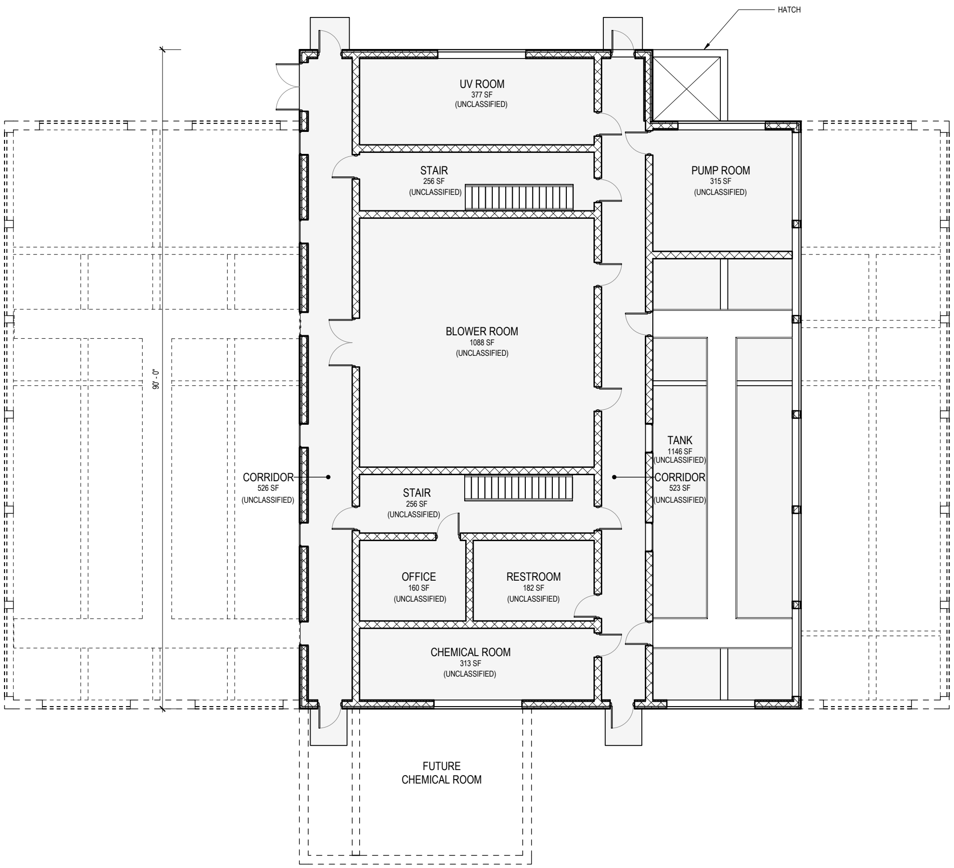
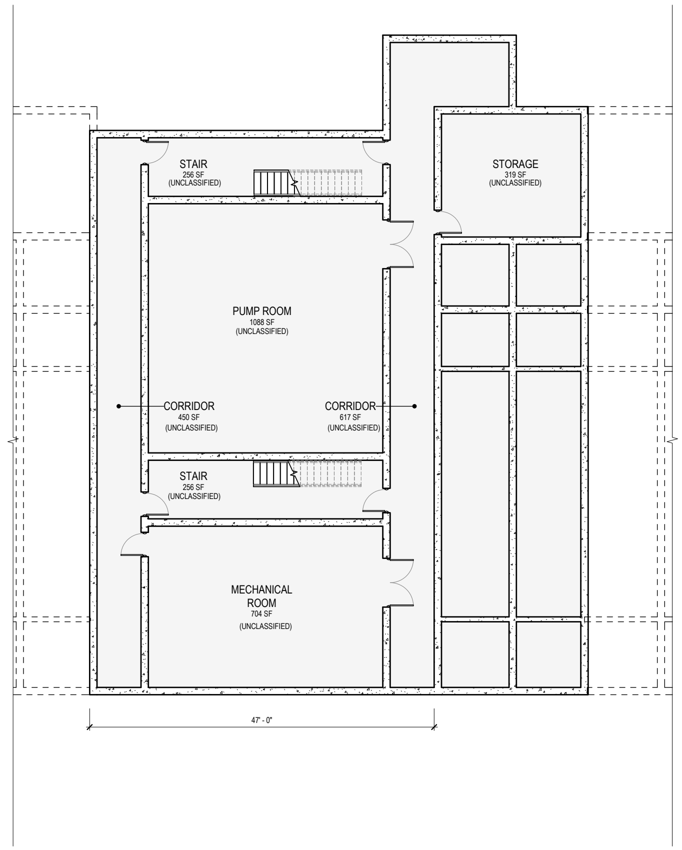
Project PRELIMINARY DESIGN OF MASHPEE WRRF
Title PRELIMINARY TREATMENT BUILDING PLAN AND ELEVATIONS
Project No. 11188223
Original Size Arch D
Sheet No. A-100
Sheet of 30

Plot Date: 11/11/2019 3:21:45 PM Plotted By: Curt Smith Filename: C:\Users\khanlin\Documents\Revit 2019 Local Files\11188223-Operations Building CM_Kaila.Hanlin.rvt



GROUND FLOOR PLAN
SCALE 1/8" = 1'-0"



BASEMENT PLAN
SCALE 1/8" = 1'-0"

No.	Issue	Drawn	Approved	Date
A	30% DESIGN REVIEW	KNH	RCF	05/18

0 4' 8' 16'
SCALE: 1/8"=1'-0"

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0 1"

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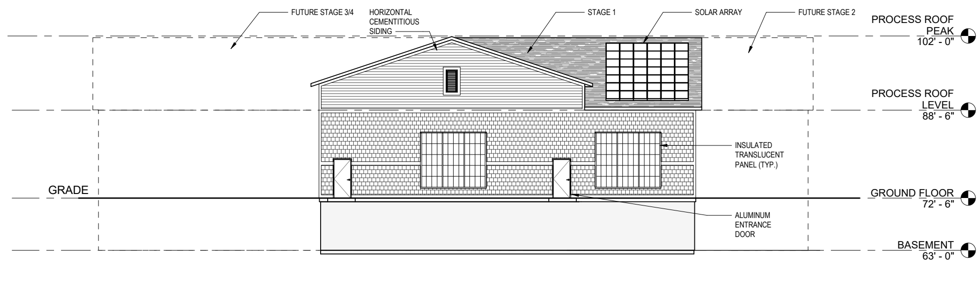
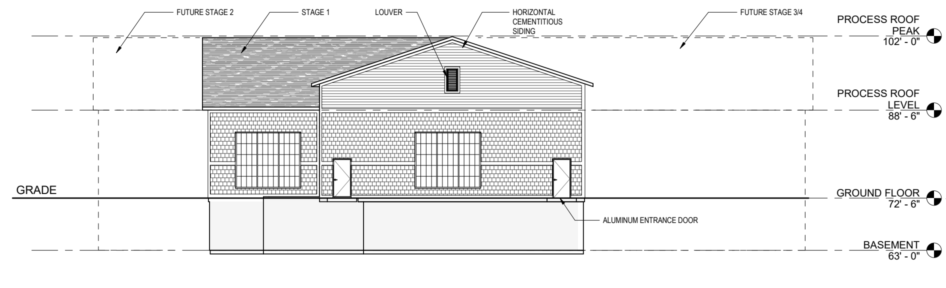
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROCESS BUILDING PLANS**
Project No. 11188223
Original Size Arch D | Sheet No. **A-200** | Sheet of 30

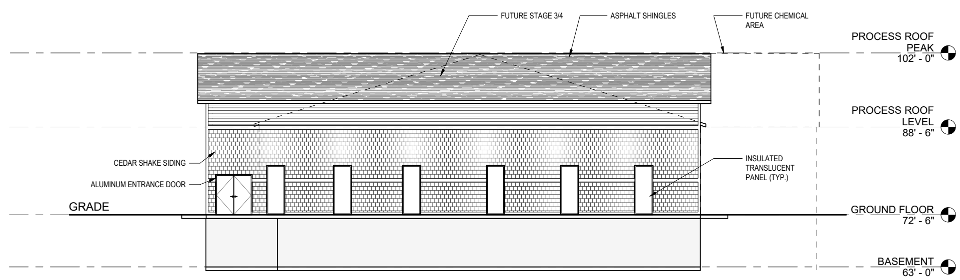
Plot Date: 11/11/2019 3:21:49 PM Plotted By: Curt Smith Filename: C:\Users\khanlin\Documents\Revit 2019 Local Files\11188223-Operations Building CM_Kaila.Hanlin.rvt



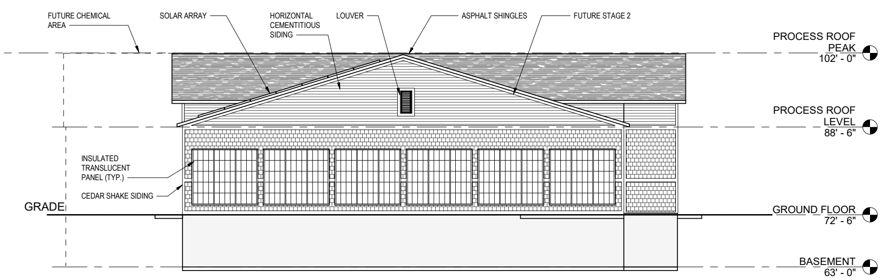
SOUTH ELEVATION
SCALE 3/32" = 1'-0"



NORTH ELEVATION
SCALE 3/32" = 1'-0"



WEST ELEVATION
SCALE 3/32" = 1'-0"



EAST ELEVATION
SCALE 3/32" = 1'-0"

No.	Issue	Drawn	Approved	Date
A	30% DESIGN REVIEW		RCF	05/18

0 8' 16' 24'
SCALE: 3/32" = 1'-0"

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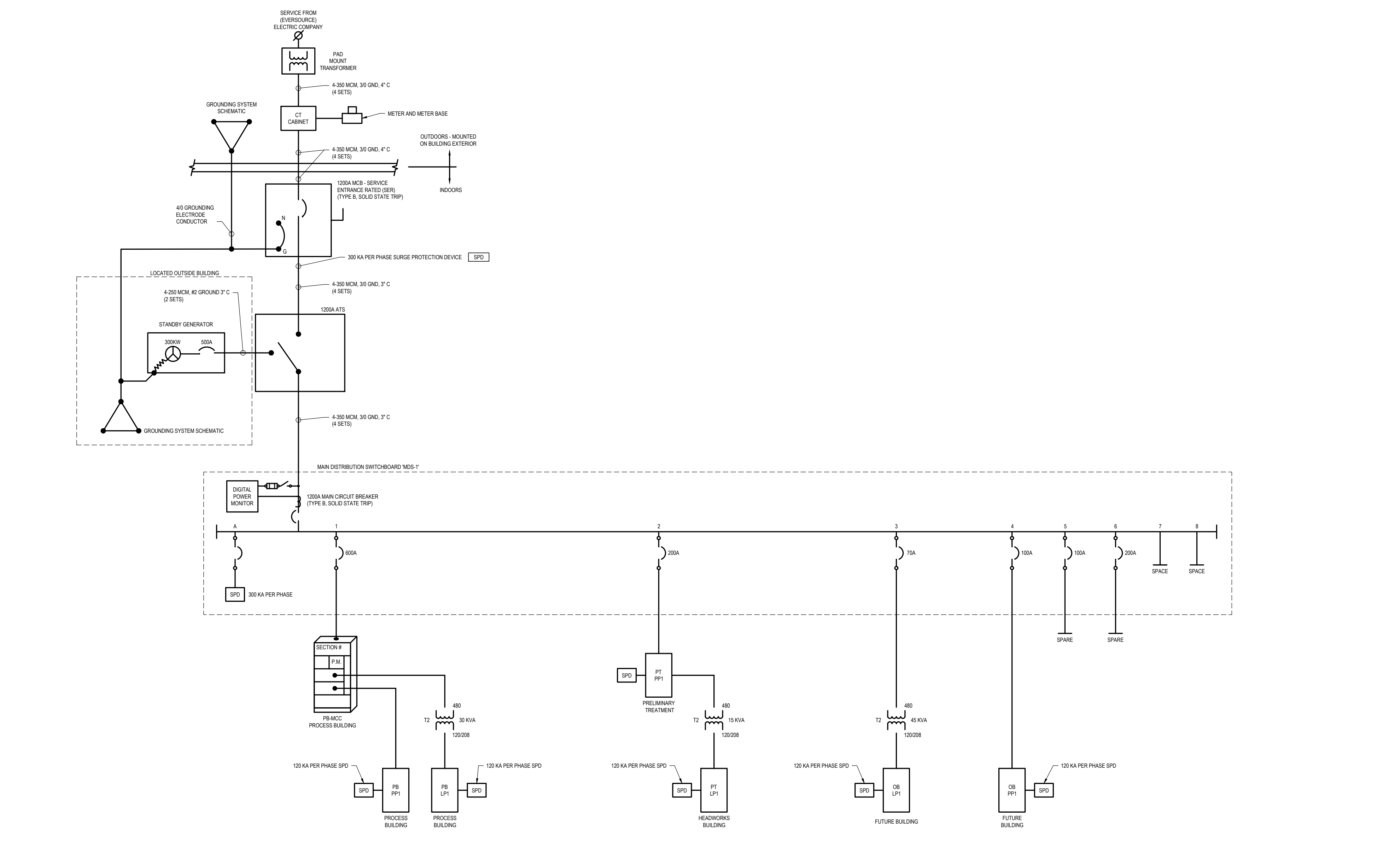
Client **TOWN OF MASHPEE, MA**
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **PROCESS BUILDING ELEVATIONS**
Project No. 11188223
Original Size Arch D
Sheet No. **A-201**
Sheet of 30

Plot Date: 11/11/2019 3:09:40 PM Plotted By: Curt Smith Filename: C:\Users\khanlin\Documents\Revit 2019 Local Files\11188223-Operations Building CM_Kaila.Hanlin.rvt



No.	Issue	Drawn	Approved	Date
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Design Check
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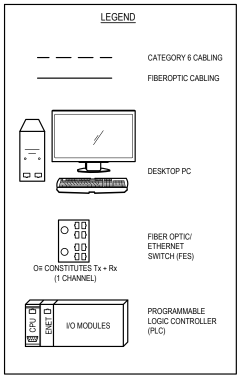
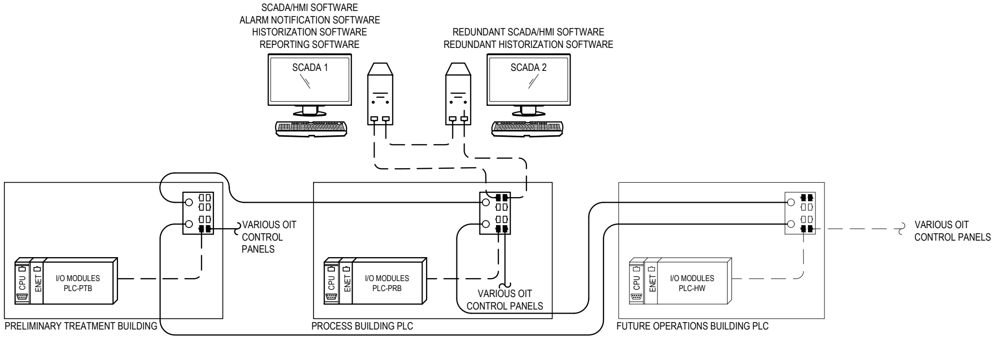
Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **ELECTRICAL DIAGRAM**
Project No. 11188223
Original Size Arch D
Sheet No. **E-001**
Sheet of

Plot Date: 19 November 2019 - 6:37 PM Plotted By: James Fosdick Filename: G:\11\11188223 - Mashpee Site 4 Design\CADD\Drawings\Electrical\11188223-E101.dwg





1 INSTRUMENTATION DIAGRAM

NOT TO SCALE

No.	Issue	Drawn	Approved	Date
1	30% DESIGN - FOR VALUE ENGINEERING REVIEW	JAD		NOV 2019

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Project **PRELIMINARY DESIGN OF MASHPEE WRRF**
Title **INSTRUMENTATION DIAGRAM**
Project No. 11188223
Original Size Arch D
Sheet No. **I-001**
Sheet of

Plot Date: 19 November 2019 - 6:37 PM Plotted By: James Fosdick Filename: G:\111\11188223 - Mashpee Site 4 Design\CADD\Drawings\Instrumentation\11188223-I001.dwg

APPENDIX C

Presentation Slides