Peirce Island Wastewater Treatment Facility Upgrade
Value Engineering Study Report

August 2014

Designer

AECOM

Value Engineering Consultant

ARCADIS

Infrastructure · Water · Environment · Buildings

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Mr. Terry L. Desmarais, Jr., PE
City Engineer
City of Portsmouth, New Hampshire
Public Works Department
680 Peverly Hill Road
Portsmouth, NH 03801

Subject:
Peirce Island Wastewater Treatment Facility Upgrade
Value Engineering Study Report

Date:
August 25, 2014

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Our ref:
28650001.0000

Dear Mr. Desmarais:

ARCADIS is pleased to submit the subject value engineering (VE) study report documenting the results of the VE workshop conducted August 4-7, 2014. More than 45 alternatives and design suggestions for enhancing the project's functionality, reducing costs, enhancing safety, improving sustainability, and facilitating construction are included for your consideration.

Please do not hesitate to call if you or any of the reviewers have questions about the ideas presented. We appreciate the opportunity to participate with the City on this most important project.

Sincerely,

ARCADIS U.S., Inc.

Howard Greenfield

Howard Greenfield, CVS
Associate Vice President

Jennifer K Lachmayr

Jennifer Lachmayr, PE
Project Manager

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SECTION ONE EXECUTIVE SUMMARY

INTRODUCTION

This value engineering (VE) study report documents the events and results of the VE study conducted by ARCADIS U.S., Inc. for the City of Portsmouth, New Hampshire (the City). The subject of the study was the Peirce Island Wastewater Treatment Facility (WWTF) Upgrade 30% design submission, prepared for the City by AECOM Technical Services, Inc. The study was conducted August 4-7, 2014 at the City's Public Works Department Training Room.

Participating on the study were engineers, an architect and a construction specialist with experience in the design, construction and operations of wastewater treatment facilities and a Certified Value Specialist team leader. The team employed the following six-phase VE Job Plan to guide its discussions:

- Information Gathering Phase (including a site visit)
- Function Identification and Analysis Phase
- Creative Idea Generation Phase
- Evaluation/Judgment of Creative Ideas Phase
- Alternative Development Phase
- Presentation Phase

Details of phases one through four are provided in Section Four – Value Analysis and Conclusions and the fully developed alternatives are presented in Section Two – Study Results of the report.

PROJECT DESCRIPTION

The proposed project upgrades the existing WWTF from an enhanced primary treatment facility to a secondary treatment facility. The facility must be capable of treating 6.13 million gallons per day (mgd) of average daily flow and 9.06 mgd of peak daily flow and reduce the total nitrogen content of the effluent to 8 milligrams per liter (8 mg/L) (seasonal average) in accordance with a Consent Decree issued by the United States Environmental Protection Agency (EPA). There is also the potential that the plant will have to limit the effluent to a total nitrogen content of 3 mg/L in the future.

The facility must also accommodate a wet weather flow of 22 mgd. The design flow for the BAF system with all cells operating is 6.13 MGD average and 10.33 MGD peak (not including recycle flows). At times of high wet weather flow, all of the flow will undergo chemically enhanced primary treatment. A portion of this wet weather flow will bypass the BAF system directly to disinfection.

The following changes to the facility are being designed:

- Refurbish the existing Primary Clarifiers and construct a new Gravity Thickener under a separate contract currently in the bidding stages
- Provide new underground power to the facility from a power source located near the City's swimming pool complex

- Construct a new Headworks Building to include two fine screens in channels and a bar screen in a bypass channel, solids compactors and storage bin, electrical room for new incoming electrical service, standby generator, storage area, and truck wash bay
- Refurbish the existing grit removal system and provide new grit classifiers, ancillary equipment and a grit storage bin
- Demolish the existing Filter Building and construct a new Biological Activated Filter Building
- Add chemical facilities to provide enhanced primary treatment and disinfection for wet weather flows over 9.06 mgd
- Demolish the existing Administrative Building and construct a new Solids Building to house three screw presses, storage bins, polymer systems, caustic soda tanks and other support systems and a new Secondary Influent Pump Station in the basement using dry pit submersible pumps
- Demolish the former Administration Building that was converted to a solids processing facility and construct a new Operations/Laboratory Building with chemical pumps located in the basement of the building
- Provide biofilter odor control for the Headworks Building and carbon filter odor control for the Solids Building
- On the site, remove existing electrical ductbanks and wiring, install the required yard piping, electrical distribution ductbanks and wire, and provide new pavement for access to all the facilities

The estimated total cost for the project is approximately $92 million with the construction of the facilities studied being approximately $85.2 million, including construction administration and a provision for change orders. Work is scheduled to commence in September 2015.

CONCERNS AND OBJECTIVES

The cost of the project has escalated significantly over the time to develop it to this stage. In order to complete the work while maintaining current plant operations, it will be necessary to phase the work, which adds significant complexity to the contractor's job and costs. The project is located on an island with only one means of vehicular access that passes in front of the City's swimming pool complex and other recreation areas, providing a safety hazard during the construction period. There is also only one route through the City that has the ability to support construction traffic, which is a concern because of safety, noise and traffic issues. The City also desires to build a sustainable project that is environment-friendly and can be run efficiently.

The City engaged this VE study with the purpose of identifying alternatives that could alleviate their concerns, reduce project risks and reduce costs. The objective of the VE team was to identify specific changes to the current design concept that could be implemented separately or in unison that would address all or some of these issues.

RESULTS OF THE STUDY

After evaluating brainstorming options to enhance the project's functionality and reduce its cost, the VE team investigated more than 45 potential changes and eventually developed 28 alternatives with cost reduction opportunities and 19 design suggestions, detailed in Section Two, that will enhance the project's functionality, reduce project risks, enhance the safety of the construction or produce non-quantifiable cost savings. Each alternative or design suggestion has an Alternative Number (Alt. No.) consisting of letters to indicate the part of the project addressed and a number which indicates the order in which the idea emerged during the Creative Idea Generation Phase. The Alt. No. was used to identify an idea as it proceeded through the VE process. Note that some of the alternatives and design suggestions are mutually exclusive or interrelated so that the total potential cost savings will have to be determined once implementation decisions are enacted. The narrative below highlights the findings of the VE team.

As designed, the project meets all of the requirements of the consent decree, facility operations, and maintenance staff personnel, but at a cost significantly over the amount previously presented to the City Council. Construction of the new facilities will be extremely difficult due to the need to existing operations, and the single access route and road that must be used, and resulting safety issues associated with construction traffic through the downtown area and near the public pool.

To effectively provide significant cost and value improvements, the VE team will have to balance potentially excessive requirements guiding the design of the project. Alt. No. G-1 suggests reorganizing the site and using building structures specifically suited to house the functions contained within the structure. To accomplish this, the existing Solids Building is converted back to an Operations/Laboratory Building in lieu of demolishing it and constructing a new Operations/Laboratory Building. The Headworks Building is reduced in size to house the screens and storage bins with the wash bay and storage located in a pre-fabricated type of structure. The electrical gear and standby generated are moved closer to the BAF facility and placed in outdoor enclosures. All of these changes would produce a $4.6 million (M) savings as well as improving construction by moving the electrical work to the back of the site. The cost savings for some of the element of Alt. No. G-1 are incorporated in other alternatives.

Raising the elevation of the BAF structure to avoid additional rock excavation has the potential to save almost $1 M as presented in Alt. No. BAF-2 and if the existing Filter Building foundation is retained, the savings increase to $1.4 M. This will also reduce truck trips to and from the site improving safety and sustainability.

Another critical value alternative concerns the dry pit pump station. Although a dry pit pump station is preferred for maintenance, constructing a submersible pump station will save about $1 M in construction costs, as depicted in Alt. No. SB-6.

Several options for the buildings' exterior were explored by the VE team. Using single wythe concrete block construction reduces costs by about $1 .3 Mas described in Alt. No. G-4. With a minor change to the exterior of the buildings caused when using jumbo brick in lieu of regular sized brick, about $0.5 M can be saved as presented in Alt. No. G-3. Using insulated precast concrete sandwich panels as shown in Alt. No. G-2 saves about $0.6 M but also has the advantage of reducing truck trips to the site because the manufacture of the panels is completed off-site.

Addressing the use of labor, Alt. Nos. C-3 and C-7 offers opportunities to reduce the use of flagmen to control access to and from the site saving around nearly $0.6 M each.

If a judicious combination of alternatives are accepted for implementation, it is projected that the project's cost could be reduced by approximately $9 M.

CONSIDERATIONS AND ASSUMPTIONS

In the preparation of this report, and the alternatives and design suggestions that were developed, the VE team made some assumptions with respect to conditions that may occur in the future. In addition, the VE team reviewed the project documentation, relying solely upon the information provided by the design team and the City and relying on that information as being true, complete and accurate. This summary of considerations and assumptions should be read in connection with the report:

- The alternatives and design suggestions rendered herein are as of the date of this report. We assume no duty to monitor events after the date, or to advise or incorporate into the alternatives and design suggestions, any new, previously unknown technology.

- It is assumed that there are no material documents affecting the design or construction costs that the VE team has not seen. The existence of any such documents will necessarily alter the alternatives and design suggestions contained herein.

- We are not warranting the feasibility of these alternatives and design suggestions or the advisability of their implementation. It is solely the responsibility of the City and its design consultant team to explore their technical feasibility and make the determination of implementation.

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
CIVIL/SITE WORK						
CS-2	Use demolished concrete for rip rap to fill in eroded shoreline areas	DESIGN SUGGESTION				
CS-3	Reuse existing materials to be demolished such as brick, pipe, valves, pumps, etc. to the extent practical	DESIGN SUGGESTION				
CS-4	Require the contractor to develop a site waste management plan	DESIGN SUGGESTION				
CS-5	Reduce or eliminate the temporary influent bypass line at the Headworks Building	$354,000	$197,000	$157,000		$157,000
CS-6	Revise the plant loop road to allow tractor-trailer trucks to use the road	DESIGN SUGGESTION				
CS-7	Eliminate the granite curbs and use asphalt curbs	$66,000	$8,000	$58,000		$58,000
CS-8	Provide access to the Odor Control Facility near the Solids Building	DESIGN SUGGESTION				

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
HEADWORKS						
H-1	Use metal deck and steel bar joists in lieu of cast-in-place concrete for the roof structure of the Headworks Building	$293,000	$82,000	$211,000		$211,000
H-2	Construct the roof of the Headworks Building as one level surface in lieu of several separate heights	$512,000	$476,000	$36,000		$36,000
H-7	Use precast concrete decking in lieu of cast-in-place concrete for the roof structure for the Headworks Building	$293,000	$125,000	$168,000		$168,000
H-11	Provide portable gantry crane in lieu of monorail/ hoists for screen pivoting and lower building roof height	$1,031,000	$879,000	$152,000		$152,000
H-14	Center 42-in.-diameter RWW pipe between the influent screens	DESIGN SUGGESTION				
H-16	Move the generator outdoors in its own enclosure and reduce the size of the Headworks Building	$464,000	$210,000	$254,000		$254,000

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City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
BAF						
BAF-2	Raise the BAF structure and reduce the rock excavation	$1,199,000	$241,000	$958,000		$958,000
BAF-6	Reduce height in the BAF Stage 1 Mudwell by raising the floor level	$336,000	$0	$336,000		$336,000
BAF-9	Retain parts of the existing Filter Building structure for the BAF structure and raise elevation of building	$1,866,000	$436,000	$1,430,000		$1,430,000
BAF-10	Use a crystalline admixture in the concrete to improve water tightness	DESIGN SUGGESTION				
BAF-16	Use different piping material than 316L stainless steel	$638,000	$365,000	$273,000		$273,000
BAF-17	Revise the air release piping for the denitrification effluent piping	DESIGN SUGGESTION				
BAF-18	Eliminate the expansion joint in the BAF Building	DESIGN SUGGESTION				
BAF-19	Reevaluate wall and foundation thicknesses in the BAF Building	$631,000	$0	$631,000		$631,000
GRAVITY THICKENER						
GT-1	Use a flat cover system in lieu of a dome for the gravity thickener	$753,000	$647,000	$106,000	$67,000	$173,000
GT-2	Slope the foundation slab in lieu of using grout to create the sloped bottom	$93,000	$0	$93,000		$93,000
SOLIDS BUILDING						
SB-3	Use precast concrete roof plank in lieu of a cast-in-place concrete roof structure for the Solids Building	$513,000	$230,000	$283,000		$283,000
SB-6	Use submersible pump station in lieu of dry-pit station and relocate station between the existing Primary Clarifier Effluent Distribution Box and the proposed Solids Building	$2,059,000	$1,067,000	$992,000		$992,000

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
OPS/LAB BUILDING						
OL-5	Incorporate the wheelchair lift into the Ops/Lab Building envelope	DESIGN SUGGESTION				
OL-7	Reuse the existing Sludge Building encapsulating PCBs	$5,475,000	$3,534,000	$1,941,000		$1,941,000
OL-9	Reuse existing laboratory furniture and equipment to the extent practical	DESIGN SUGGESTION				
OL-10	Reuse the existing Sludge Building substructure by encapsulating the PCBs and reconstruct the area above the first floor for use as the operations/ laboratory space	$5,475,000	$3,739,000	$1,736,000		$1,736,000
ELECTRICAL						
E-2	Use a closed transition in lieu of an open transition automatic transfer switch	DESIGN SUGGESTION				
E-3	Use an above ground storage tank in lieu of an underground storage tank for the generator diesel fuel	DESIGN SUGGESTION				
E-4	Reduce size (rating) of the incoming power transformer, automatic transfer switch, generator and service entrance rated switchboard	$1,741,000	$1,389,000	$352,000		$352,000
E-5	Reuse existing transformer and use outdoor automatic transfer switch, switchboard and generator	$2,468,000	$1,414,000	$1,054,000		$1,054,000
E-6	Develop an electrical demand limiting procedure	DESIGN SUGGESTION				

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

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PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

				PRESENT WORTH OF COST SAVINGS		
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
GENERAL						
G-1	Reconfigure the site layout for the Operations/ Laboratory Building and Headworks Building	$9,816,000	$5,168,000	$4,648,000		$4,648,000
G-2	Use insulated precast concrete exterior walls for the new buildings in lieu of brick and block	$1,754,000	$1,127,000	$627,000		$627,000
G-3	Use jumbo brick in lieu of standard brick for the exterior walls of the new buildings	$1,465,000	$938,000	$527,000		$527,000
G-4	Use single wythe walls in lieu of brick and block cavity walls for the exterior walls of the new buildings	$1,754,000	$498,000	$1,256,000		$1,256,000
CONSTRUCTABILITY						
C-1	Run overhead electrical and other services from the swimming pool area to the fence line of the site and then go underground	$482,000	$0	$482,000		$482,000
C-2	Allow the contractor to use the pool parking lot during the off-season	DESIGN SUGGESTION				
C-3	Reduce the use of flagpersons when the swimming pool is closed	$666,000	$111,000	$555,000		$555,000
C-7	Straighten the access road east of the swimming pool house to eliminate the blind curve and delete the use of flagpersons at this location	$666,000	$144,000	$522,000		$522,000
C-8	Allow night work on site but limit the amount of truck traffic at night	DESIGN SUGGESTION				
C-9	Move temporary construction fence along the plant access road to behind the existing guardrail along the road	DESIGN SUGGESTION				
C-11	Allow use of a snow melt machine and allow contractor to use snow disposal area year-round	DESIGN SUGGESTION				

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

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PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
CONSTRUCTABILITY (cont'd)						
C-12	Allow the contractors to use barges to store construction material	DESIGN SUGGESTION				
C-14	Consolidate storage areas in process buildings into one commercial building	$5,124,000	$4,369,000	$755,000		$755,000

SECTION TWO STUDY RESULTS

INTRODUCTION

The following results highlight the major outcome of this value engineering (VE) study conducted on the City of Portsmouth, New Hampshire (the City) Peirce Island Wastewater Treatment Facility Upgrade Project. These results represent the benefits that can be realized by the City, the community, the plant operations and maintenance staff, and the designer, AECOM Technical Services, Inc. (AECOM). The results include worthy alternatives that can improve the project's design and will require coordination between the owner, plant staff and the design team to determine the disposition of each alternative.

During the VE workshop, many ideas for value enhancement were conceived and evaluated by the VE team for technical merit, applicability to the project, implementability considering the project's status, and the ability to meet the owner's project value objectives. Research performed on those ideas considered to have value-enhancing potential resulted in the development of individual alternatives. These alternatives identify specific changes to the project as a whole or to individual project elements. These solutions brought forth may be in the form of VE alternatives (accompanied by cost estimates) or design suggestions (typically without cost estimates). For each alternative developed, the following information is provided:

- A summary of the original design,
- A description of the proposed change to the project,
- Sketches and design calculations, if appropriate,
- A capital cost comparison and life cycle discounted present worth cost comparison of the alternative and original design, where appropriate,
- A descriptive evaluation of the advantages and disadvantages of selecting the alternative, and
- A brief narrative to compare the original design and the proposed change and provide a rationale for implementing the change into the project.

The capital cost comparisons used unit quantities contained in the project cost estimate prepared by AECOM whenever possible. If unit costs were not available, published databases, such as the one produced by the RS Means Company, or team member or owner databases were consulted. Direct quotes from vendors for equipment items were also obtained. A composite markup of 91.2%, as described in Section Four – Value Analysis and Conclusions section of the report, was used to generate an all-inclusive project cost for the construction items being compared.

Each design suggestion contains the same information as the VE alternatives, except that no cost information is included. Design suggestions are presented to bring attention to areas of the design that, in the opinion of the VE team, should be changed for reasons other than cost. Examples of these reasons include improved facility operation, ease of maintenance, ease of construction, safer working conditions, sustainability and reduced project risk. In addition, some ideas cannot be quantified in terms of cost with the design information provided; these are also presented as design suggestions and are intended to improve the quality of the project.

Each alternative or design suggestion developed is identified with an alternative number (Alt. No.) to track it through the value analysis process and facilitate referencing among the Creative Idea Listing and Evaluation worksheet, the alternatives, and the Summary of Value Engineering Alternatives table. The Alt. No. includes a letter prefix that refers to a major project element as listed below:

PROJECT ELEMENT	PREFIX
Civil/Site Work	CS
Headworks Building	H
BAF Building	BAF
Gravity Thickener	GT
Solids Building	SB
Operations/Laboratory Building	OL
Electrical	E
General	G
Constructability	C

Summaries of the alternatives and design suggestions are provided on the Summary of Value Engineering Alternatives table. The table is divided into design project elements for the convenience of the reviewer and are used to divide the results section. The complete documentation of the developed alternatives and design suggestions follows the table.

KEY ISSUES

This project has been under development for several years and over this period its scope and cost has escalated significantly from the approximately $65 million (M) previously reported to the City Council to about $92 M at the time of the VE study. Construction of the project is also fraught with risks because of its location on an island. There is only one access road into the facility, which passes by City recreation areas and its swimming pool complex. In addition, there is only one truck route through the City that construction vehicles use to reach the access road. These conditions will create safety issues and cause disruption to the community during the construction.

In order to maintain current operations during construction, the work must be carefully planned and phased resulting in schedule and cost penalties. There is also a desire to create a sustainable project that is aesthetically pleasing to the community.

STUDY OBJECTIVES

With a myriad of issues facing the City as it develops this project, this VE study was initiated to provide an independent review of the project and through the use of the VE Job plan generate alternatives that would address these issues. The objective of the VE team was to identify specific changes to the current design that will be evaluated by the City, its plant staff and its design consultant to determine their viability to enhance the value of the project and then implement those receiving a positive evaluation.

RESULTS OF THE STUDY

Research of the ideas identified as having value-enhancing potential resulted in the development of 28 alternatives with cost reduction opportunities and 19 design suggestions for consideration by the owner and designer. These alternatives and design suggestions address the key issues described above, specifically cost, safety, constructability, and sustainability. The following highlights the full complement of alternatives and design suggestions detailed in the remainder of this section of the report.

As designed, the project meets all of the requirements of the consent decree, facility operations, and maintenance staff personnel, but at a cost significantly over the amount previously presented to the City Council. Construction of the new facilities will be extremely difficult due to the need to existing operations, and the single access route and road that must be used, and resulting safety issues associated with construction traffic through the downtown area and near the public pool.

To effectively provide significant cost and value improvements, the VE team will have to balance potentially excessive requirements guiding the design of the project. Alt. No. G-1 suggests reorganizing the site and using building structures specifically suited to house the functions contained within the structure. To accomplish this, the existing Solids Building is converted back to an Operations/Laboratory Building in lieu of demolishing it and constructing a new Operations/Laboratory Building. The Headworks Building is reduced in size to house the screens and storage bins with the wash bay and storage located in a pre-fabricated type of structure. The electrical gear and standby generated are moved closer to the BAF facility and placed in outdoor enclosures. All of these changes would produce a $4.6 million (M) savings as well as improving construction by moving the electrical work to the back of the site. The cost savings for some of the element of Alt. No. G-1 are incorporated in other alternatives.

Raising the elevation of the BAF structure to avoid additional rock excavation has the potential to save almost $1 M as presented in Alt. No. BAF-2 and if the existing Filter Building foundation is retained, the savings increase to $1.4 M. This will also reduce truck trips to and from the site improving safety and sustainability.

Another critical value alternative concerns the dry pit pump station. Although a dry pit pump station is preferred for maintenance, constructing a submersible pump station will save about $1 M in construction costs, as depicted in Alt. No. SB-6.

Several options for the buildings' exterior were explored by the VE team. Using single wythe concrete block construction reduces costs by about $1 .3 Mas described in Alt. No. G-4. With a minor change to the exterior of the buildings caused when using jumbo brick in lieu of regular sized brick, about $0.5 M can be saved as presented in Alt. No. G-3. Using insulated precast concrete sandwich panels as shown in Alt. No. G-2 saves about $0.6 M but also has the advantage of reducing truck trips to the site because the manufacture of the panels is completed off-site.

Addressing the use of labor, Alt. Nos. C-3 and C-7 offers opportunities to reduce the use of flagmen to control access to and from the site saving around nearly $0.6 M each.

If a judicious combination of alternatives are accepted for implementation, it is projected that the project's cost could be reduced by approximately $9 M.

EVALUATION OF ALTERNATIVES AND DESIGN SUGGESTIONS

When reviewing the study results, the reader should consider each part of an alternative or design suggestion on its own merit. There may be a tendency to disregard an alternative because of a concern about one part of it. Each area within an alternative or design suggestion that is acceptable should be considered for use in the final design, even if the entire alternative or design suggestion is not implemented. Variations of these alternatives and design suggestions by the owner or designer are encouraged.

All alternatives and design suggestions were developed independently of each other to provide a broad range of options to consider for implementation. Therefore, some of them are mutually exclusive, so acceptance of one may preclude the acceptance of another. In addition, some of the alternatives may be interrelated, so acceptance of one or more may not yield the total of the cost savings shown for each alternative. Design suggestions could also be interrelated, thus precluding a part of one or more suggestions from being implemented if another design suggestion is also implemented.

The reader should evaluate all alternatives carefully in order to select the combination of ideas with the greatest beneficial impact to the project. Once this has been accomplished, the total cost savings resulting from the VE study can be calculated based on implementing revised, all-inclusive design solutions.

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
CIVIL/SITE WORK						
CS-2	Use demolished concrete for rip rap to fill in eroded shoreline areas	DESIGN SUGGESTION				
CS-3	Reuse existing materials to be demolished such as brick, pipe, valves, pumps, etc. to the extent practical	DESIGN SUGGESTION				
CS-4	Require the contractor to develop a site waste management plan	DESIGN SUGGESTION				
CS-5	Reduce or eliminate the temporary influent bypass line at the Headworks Building	$354,000	$197,000	$157,000		$157,000
CS-6	Revise the plant loop road to allow tractor-trailer trucks to use the road	DESIGN SUGGESTION				
CS-7	Eliminate the granite curbs and use asphalt curbs	$66,000	$8,000	$58,000		$58,000
CS-8	Provide access to the Odor Control Facility near the Solids Building	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **CS-2**
DESCRIPTION:	**USE DEMOLISHED CONCRETE AS RIP RAP TO FILL IN ERODED SHORELINE AREAS**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

There are two areas around the perimeter of the plant where the ground has been eroded away close to the fence line of the site. No method for filling in these areas has been determined.

ALTERNATIVE:

Use some of the concrete from the existing Filter Building that is going to be demolished for rip rap in the areas to be filled in.

ADVANTAGES:

- Avoids having to truck out the demolished material and truck in new material, which reduces the number of truck trips and the carbon footprint of the project
- Reduces cost of trucking and acquiring fill material

DISADVANTAGES:

- The reinforcing steel will have to be removed from the concrete before it can be used

DISCUSSION:

This alternative provides a sustainable solution for a problem that exists on the site as well as providing a reuse option for existing material to be demolished.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **CS-3**
DESCRIPTION:	**REUSE EXISTING MATERIALS TO BE DEMOLISHED SUCH AS BRICK, PIPE, VALVES, PUMPS, ETC. TO THE EXTENT PRACTICAL**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

The current design has extensive demolition of existing structures, piping, valves, equipment, fencing and other materials.

ALTERNATIVE:

Consideration should be given to reusing these materials to the extent practical.

ADVANTAGES:

- Improves sustainability
- Reduces waste materials
- Materials re-used on site will reduce/ minimize vehicle trips through the City

DISADVANTAGES:

- Potentially reduces longevity

DISCUSSION:

This option enhances the sustainability of the project.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **CS-4**
DESCRIPTION:	**REQUIRE THE CONTRACTOR TO DEVELOP A SITE WASTE MANAGEMENT PLAN**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

The current design has extensive demolition of existing structures, and delivery of materials and equipment will generate considerable construction waste.

ALTERNATIVE:

Require the contractor to develop and maintain a construction waste management plan.

ADVANTAGES:

- Improves sustainability
- Encourages reuse or recycling of materials
- Reduces waste materials
- Materials reused on site will reduce/minimize vehicle trips through the City

DISADVANTAGES:

- None apparent

DISCUSSION:

This alternative enhances the sustainability aspects of the project and reduces truck traffic through the City.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALTERNATIVE NO.: **CS-5**

DESCRIPTION: **REDUCE OR ELIMINATE THE TEMPORARY INFLUENT BYPASS LINE AT THE HEADWORKS BUILDING**

ORIGINAL DESIGN:

As shown on Dwg. 00 C-114, a 42-inch-diameter RWW temporary bypass line is to be routed around the footprint of the proposed Headworks Building to eliminate the conflict between the existing 30-inch-diameter pressure sewer and the foundation at the east end of the proposed Headworks Building.

ALTERNATIVE: (sketch attached)

Provide a temporary 30-inch-diameter bypass connection on the existing 30-inch-diameter force main/pressure sewer at the east side of the proposed Headworks Building.

ADVANTAGES:

- Eliminates the need for the 42-inch or 48-inch RWW Temporary Bypass piping and connections
- Simplifies tie-in and transition to the new Headworks (no need to disconnect 42-inch or 48-inch bypass)
- Minimizes potential for conflicts for buried piping around the Headworks Building

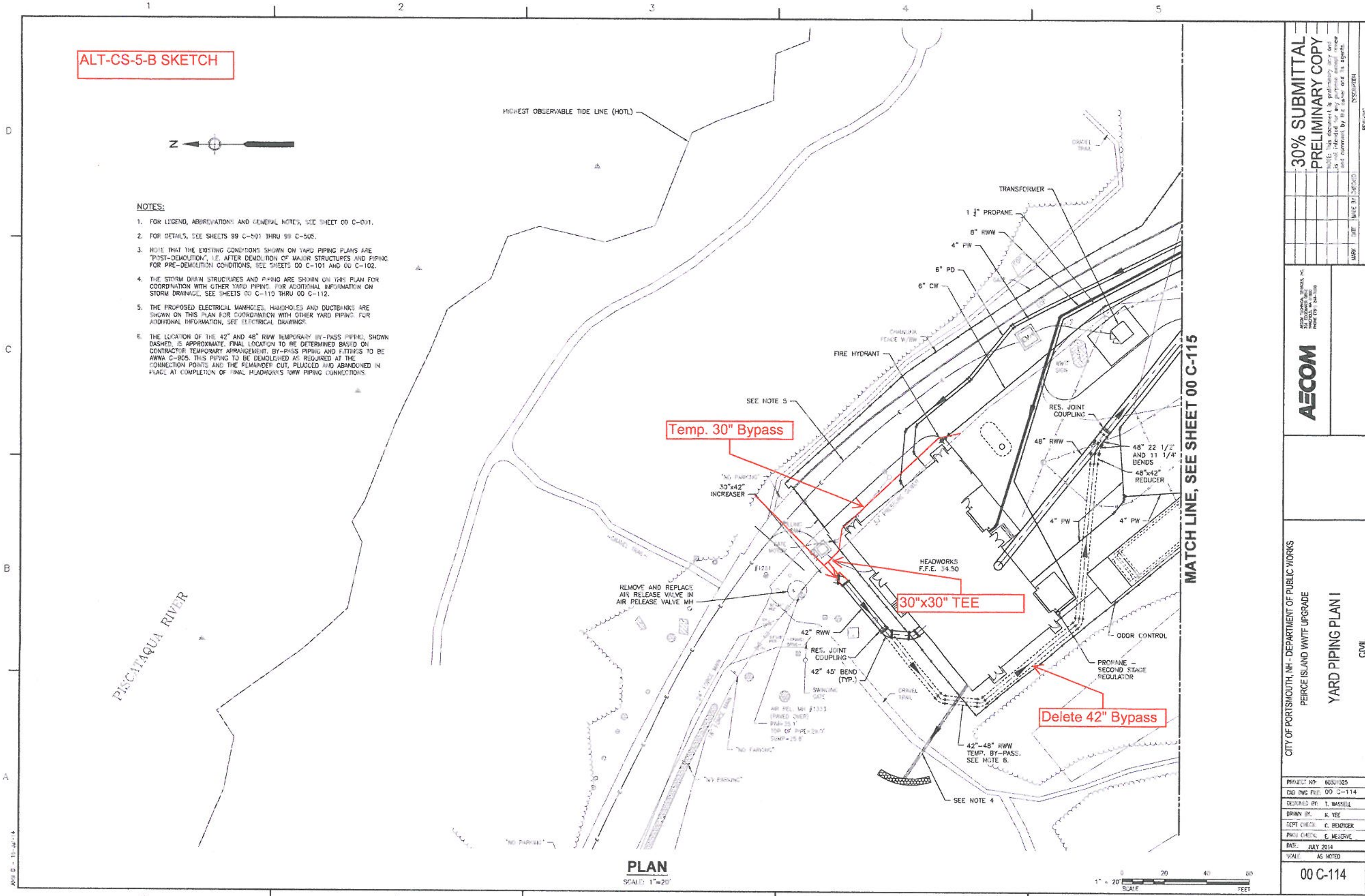
DISADVANTAGES:

- 30-inch Temporary Bypass is under the plant road
- Increases staging coordination with the new EHH to the north of the Headworks

DISCUSSION:

This alternative would eliminate the need for the 42-inch or 48-inch RWW Temporary Bypass shown on Dwg. 00 C-114, and will simplify staging for transitioning flow to/from the new Headworks once it is available for operation. With the elimination of the 42-inch or 48-inch RWW Temporary Bypass on the west side of the new Headworks, consideration should be given to shifting the building to the west which may eliminate the conflict with the existing 30 in. force main/pressure sewer altogether.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 354,000	—	$ 354,000
ALTERNATIVE	$ 197,000	—	$ 197,000
SAVINGS (Original minus Alternative)	$ 157,000	—	$ 157,000



ALT. NO. CS-5 Sht. 2 of 3

COST WORKSHEET

ARCADIS

PROJECT:	PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE *City of Portsmouth, NH*	ALTERNATIVE NO.: CS-5 SHEET NO.: 3 of 3

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Excavation for 42" Yard Pipe	CY	109	14.00	1,526			
Rock Excavation/Disposal (42")	CY	109	144.00	15,696			
Backfill for 42" Yard Pipe	CY	136	17.00	2,312			
Bedding for 42" Yard Pipe	CY	27	8.00	216			
42" DIP	LF	92	449.00	41,308			
42" 45 DEG	EA	4	17,017.00	68,068			
48"x42" RED	EA	1	17,181.00	17,181			
30" WYE	EA				2	13,818.00	27,636
30" 45 DEG	EA	1	7,624.00	7,624	2	7,624.00	15,248
Excavation for 30" Yard Pipe	CY				71	14.00	994
Rock Excavation/Disposal (30")	CY				71	144.00	10,224
Backfill for 30" Yard Pipe	CY				89	17.00	1,513
Bedding for 30" Yard Pipe	CY				15	8.00	120
30"x30" TEE	EA				1	12,000.00	12,000
30" DIP	LF				80	272.00	21,760
48" 45 DEG (22.5+11.25)	EA	1	23,431.00	23,431			
30" Restrained Coupling	EA	1	3,429.00	3,429	4	3,429.00	13,716
48" Restrained Coupling	EA	1	4,607.00	4,607			
Subtotal				185,398			103,211
Markup (%) at	**91.2%**			169,083			94,128
TOTAL				354,481			197,339
TOTAL (ROUNDED)				354,000			197,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **CS-6**
DESCRIPTION:	**REVISE THE PLANT LOOP ROAD TO ALLOW TRACTOR-TRAILER TRUCKS TO USE THE ROAD**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN: (sketch attached)

The current design of the access road around the treatment plant will not accommodate tractor-trailer traffic.

ALTERNATIVE: (sketch attached)

Reconfigure the access road by using larger radius curves to accommodate all trucks and delivery vehicles expected to service the facility after construction is completed.

ADVANTAGES:

- Improves access for deliveries and traffic flow

DISADVANTAGES:

- Some additional paving required
- May need to remove or relocate required small storage shed

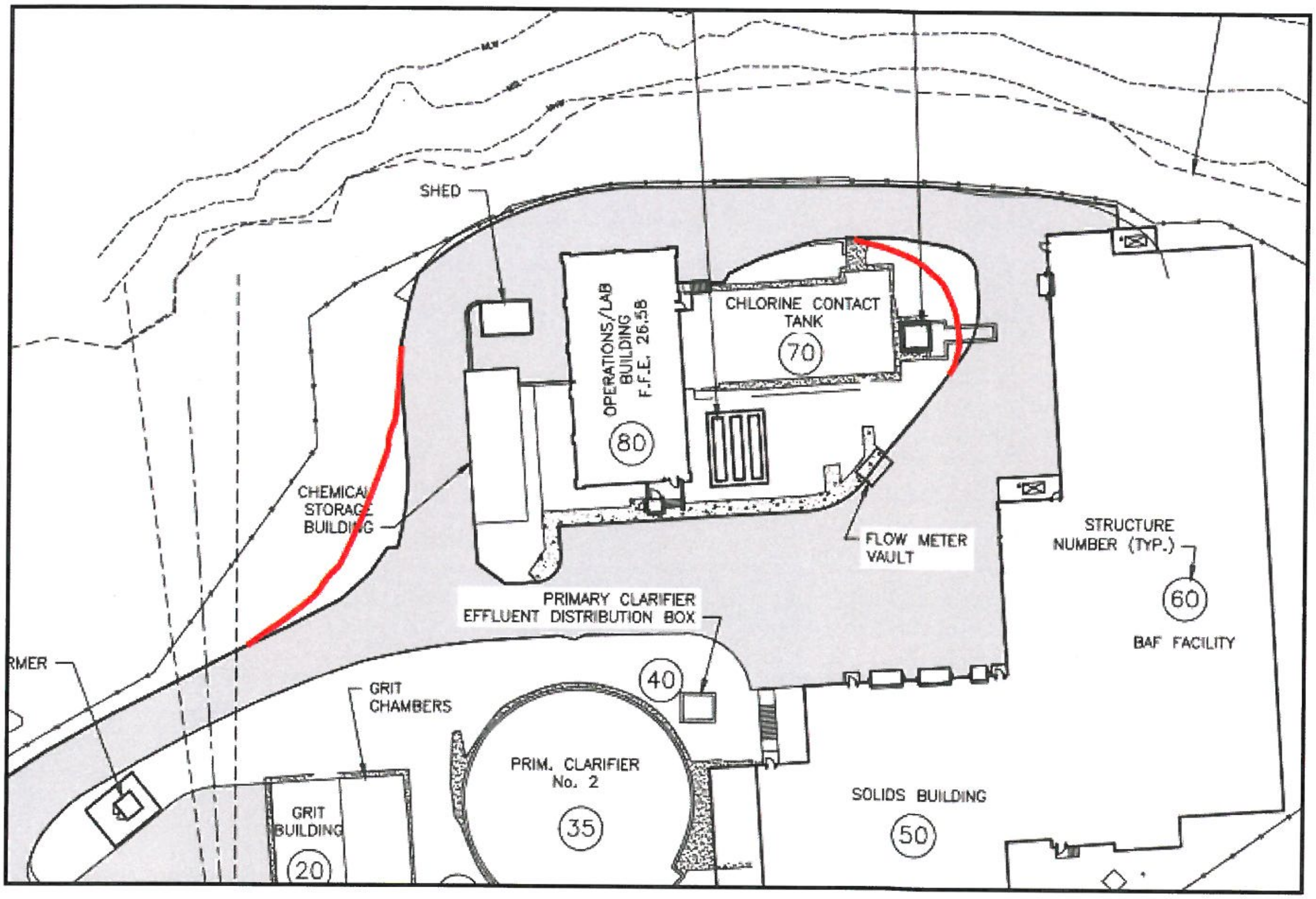
DISCUSSION:

By making the curves sufficient to accommodate a tractor-trailer, all vehicles can circulate around the site making operations more efficient.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			

SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **CS-6**
ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☐	BOTH ☒	SHEET NO.: **2 of 2**



VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **CS-7**
DESCRIPTION:	**ELIMINATE THE GRANITE CURBS AND USE ASPHALT CURBS**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN:

The original design shows granite curbs around most of the parking and roadway areas.

ALTERNATIVE:

Use asphalt curbs or change the grading and provide parking bumpers to eliminate the need for the curb.

ADVANTAGES:

- Cost savings

DISADVANTAGES:

- Reduces long term durability
- Reduces resistance to damage from snow plows
- Does not match existing curb

DISCUSSION:

Granite curbs currently define parking boundaries and create an edge along paved areas for stormwater conveyance. Using alternate curb materials or making changes to grading and providing parking bumpers would result in a cost savings.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 66,000	—	$ 66,000
ALTERNATIVE	$ 8,000	—	$ 8,000
SAVINGS (Original minus Alternative)	$ 58,000	—	$ 58,000

COST WORKSHEET

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**

City of Portsmouth, NH

ALTERNATIVE NO.: **CS-7**

SHEET NO.: **2 of 2**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Granite Curb	LF	1,050	33.00	34,650			
Asphalt Curb	LF				1,050	4.00	4,200
Subtotal				34,650			4,200
Markup (%) at	**91.2%**			31,601			3,830
TOTAL				66,251			8,030
TOTAL (ROUNDED)				66,000			8,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **CS-8**
DESCRIPTION:	**PROVIDE ACCESS TO THE ODOR CONTROL FACILITY NEAR THE SOLIDS BUILDING**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN: (sketch attached)

The current design shows an odor control facility on the southwest corner of the new Solids Building.

ALTERNATIVE:

Select a more accessible location or provide access to the current location.

ADVANTAGES:

- Enhances accessibility for maintenance

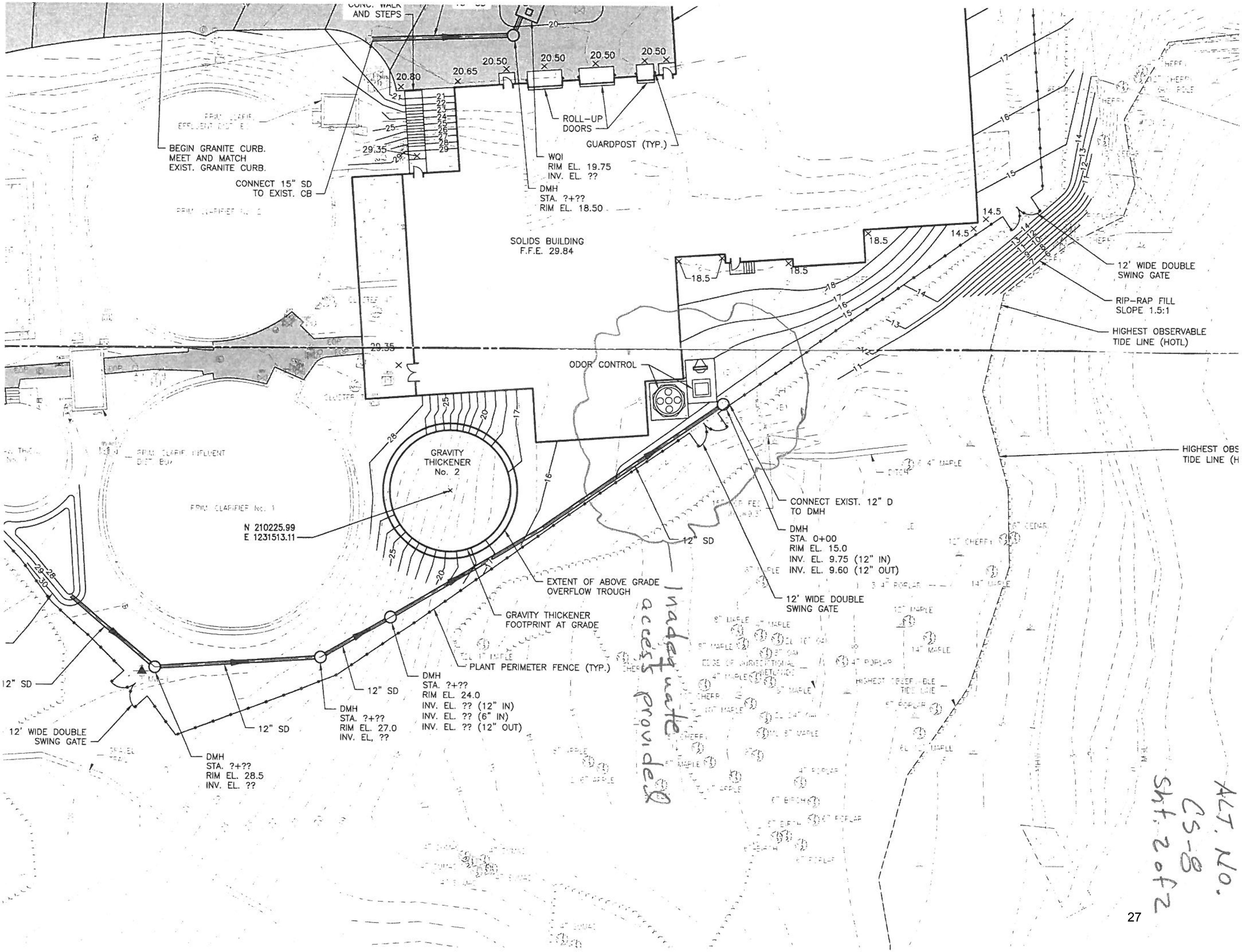
DISADVANTAGES:

- None apparent

DISCUSSION:

Adequate access is necessary in order to maintain this facility.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			


CONC. WALK AND STEPS
20.80
20.65
20.50
20.50
20.50
20.50
ROLL-UP DOORS
GUARDPOST (TYP.)
BEGIN GRANITE CURB. MEET AND MATCH EXIST. GRANITE CURB.
CONNECT 15" SD TO EXIST. CB
29.35
WQI
RIM EL. 19.75
INV. EL. ??
DMH
STA. ?+??
RIM EL. 18.50
SOLIDS BUILDING
F.F.E. 29.84
14.5
14.5
18.5
18.5
18.5
12' WIDE DOUBLE SWING GATE
RIP-RAP FILL SLOPE 1.5:1
HIGHEST OBSERVABLE TIDE LINE (HOTL)
29.35
ODOR CONTROL
HIGHEST OBS
TIDE LINE (H
GRAVITY THICKENER No. 2
N 210225.99
E 1231513.11
CONNECT EXIST. 12" D TO DMH
DMH
STA. 0+00
RIM EL. 15.0
INV. EL. 9.75 (12" IN)
INV. EL. 9.60 (12" OUT)
12" SD
EXTENT OF ABOVE GRADE OVERFLOW TROUGH
12' WIDE DOUBLE SWING GATE
GRAVITY THICKENER FOOTPRINT AT GRADE
PLANT PERIMETER FENCE (TYP.)
12" SD
DMH
STA. ?+??
RIM EL. 24.0
INV. EL. ?? (12" IN)
INV. EL. ?? (6" IN)
INV. EL. ?? (12" OUT)
12" SD
DMH
STA. ?+??
RIM EL. 27.0
INV. EL, ??
12" SD
12' WIDE DOUBLE SWING GATE
DMH
STA. ?+??
RIM EL. 28.5
INV. EL. ??
Inadequate access provided
ALT. NO. CS-8
Sht. 2 of 2

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
HEADWORKS						
H-1	Use metal deck and steel bar joists in lieu of cast-in-place concrete for the roof structure of the Headworks Building	$293,000	$82,000	$211,000		$211,000
H-2	Construct the roof of the Headworks Building as one level surface in lieu of several separate heights	$512,000	$476,000	$36,000		$36,000
H-7	Use precast concrete decking in lieu of cast-in-place concrete for the roof structure for the Headworks Building	$293,000	$125,000	$168,000		$168,000
H-11	Provide portable gantry crane in lieu of monorail/ hoists for screen pivoting and lower building roof height	$1,031,000	$879,000	$152,000		$152,000
H-14	Center 42-in.-diameter RWW pipe between the influent screens	DESIGN SUGGESTION				
H-16	Move the generator outdoors in its own enclosure and reduce the size of the Headworks Building	$464,000	$210,000	$254,000		$254,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **H-1**
DESCRIPTION:	**USE METAL DECK AND STEEL BAR JOISTS IN LIEU OF CAST-IN-PLACE CONCRETE FOR THE ROOF STRUCTURE OF THE HEADWORKS BUILDING**	SHEET NO.: **1 of 3**

ORIGINAL DESIGN:

A cast-in-place (CIP) concrete roof slab supported on CIP columns and beams is designed for the Headworks Building.

ALTERNATIVE: (sketch attached)

Use epoxy-coated metal deck and steel bar joists for the roof structure and support the bar joists on the masonry walls. Eliminate CIP concrete roof slab, beams and columns.

ADVANTAGES:

- Decreases construction cost
- Reduces construction traffic
- Reduces construction duration

DISADVANTAGES:

- Reduces durability
- Adds maintenance by requiring periodic painting of the steel

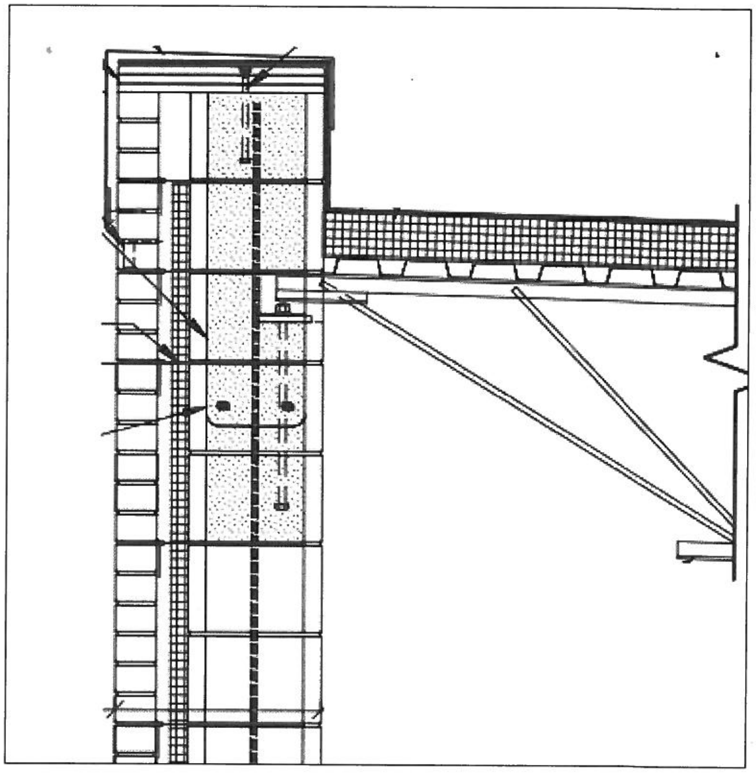
DISCUSSION:

The VE team believes that appropriately coated metal decking and bar joists would be a valid option for this project. Using metal deck and bar joists would reduce the construction duration and reduce the amount of construction traffic to and from the project site. During the VE team's site visit, metal decking and bar joists were observed in the existing Scum Building. The 30-year-old metal decking and bar joists appeared to be holding up very well to the exposure conditions.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 293,000	—	$ 293,000
ALTERNATIVE	$ 82,000	—	$ 82,000
SAVINGS (Original minus Alternative)	$ 211,000	—	$ 211,000

SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **H-1**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **2 of 3**



COST WORKSHEET

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**

City of Portsmouth, NH

ALTERNATIVE NO.: **H-1**

SHEET NO.: **3 of 3**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
CIP Concrete Roof Slab	CY	200	766.00	153,200			
Metal Decking	SF				5,100	3.30	16,830
Bar Joist	SF				5,100	3.00	15,300
Bar Joist Anchorage	EA				150	20.00	3,000
Misc Metals	LB				2,000	1.40	2,800
Painting	SF				5,100	1.00	5,100
Subtotal				153,200			43,030
Markup (%) at	**91.2%**			139,718			39,243
TOTAL				292,918			82,273
TOTAL (ROUNDED)				293,000			82,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **H-2**
DESCRIPTION:	**CONSTRUCT THE ROOF OF THE HEADWORKS BUILDING AS ONE LEVEL SURFACE IN LIEU OF SEVERAL SEPARATE HEIGHTS**	SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

The current Headworks Building design incorporates three different roof heights. Each of the roof heights seem to have been established to accommodate the process equipment housed within a respective area.

ALTERNATIVE: (sketch attached)

Establish one roof height for the entire building. The established roof height will take into consideration the worst case scenario as it relates to all process equipment within each space.

ADVANTAGES:

- Simplifies the construction process
- Decreases multiple roof levels
- Decreases the quantity of roof flashing, copings and transitioning roofs and potential leaks
- Simplifies roof access
- Minimizes the number of roof drains and overflow drains

DISADVANTAGES:

- Increases volume of space and odor control air volume minimally

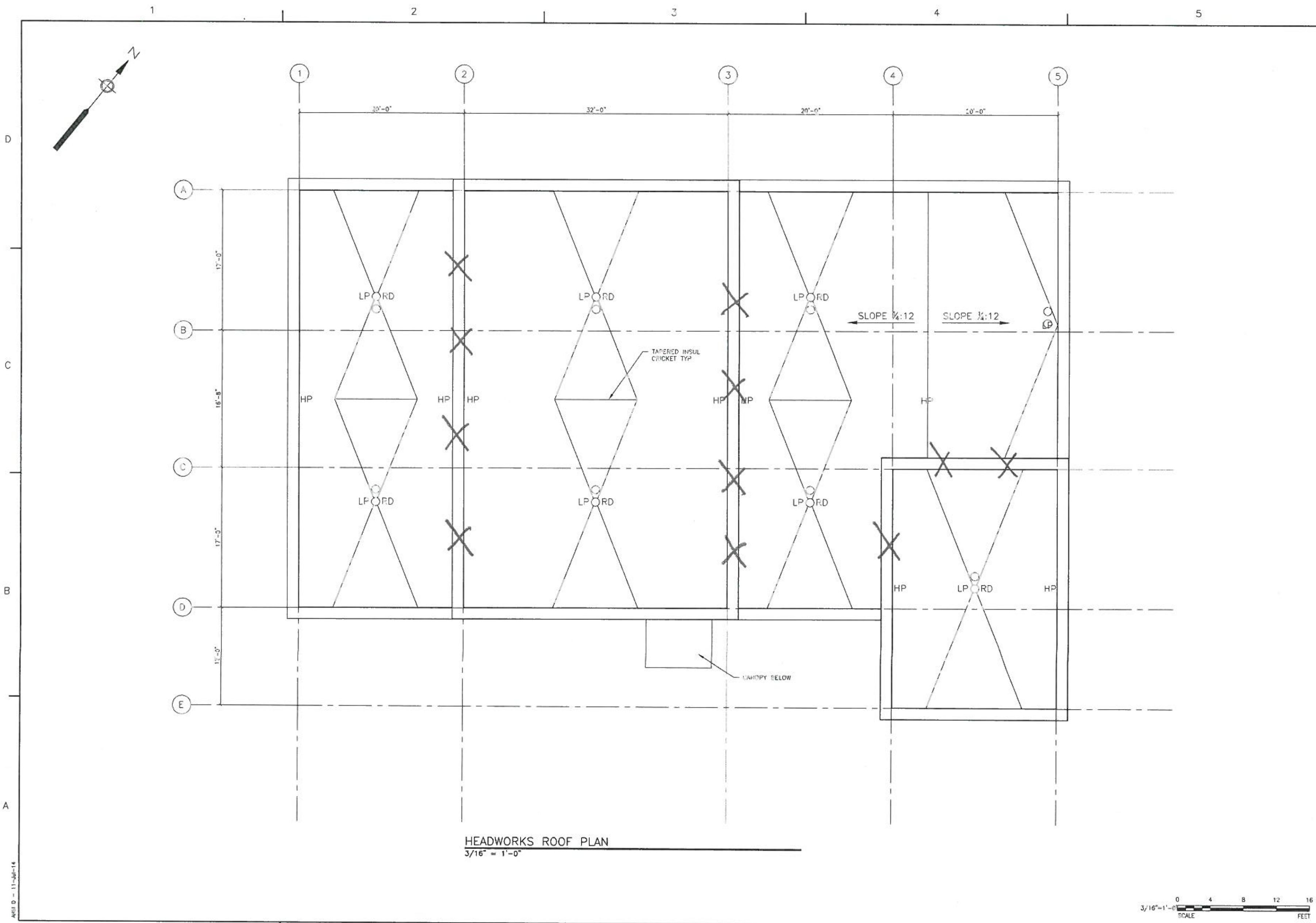
DISCUSSION:

Based on the VE team's assessment of the various spaces, the maximum height of the concrete roof slab for all areas could be set at El. 54.50 (which is the current height of the roof slab above the screen room). This benchmark height would require the roof above the Generator Room to decrease by 2 feet 8 inches and the roofs above the Mechanical Room, Wash Bay Garage, Shop/Storage Area, Screenings Garage and Electrical/ Switchgear Room to increase by 3 feet 4 inches.

The concrete beams of the building are currently varying in height to accommodate the change in the roof levels. The proposed one level roof concept will allow all the concrete beams to be constructed at one height, therefore simplifying and minimizing the construction of the concrete beams.

Every flashing transition and roof penetration is an opportunity for the roof to fail. Reconfiguring the roofs to one level will minimize the parapet/roof transitions by more than 50%. The single level roof will also minimize the number of roof drains and overflow drains by 50%.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 512,000	—	$ 512,000
ALTERNATIVE	$ 476,000	—	$ 476,000
SAVINGS (Original minus Alternative)	$ 36,000	—	$ 36,000



HEADWORKS ROOF PLAN

3/16" = 1'-0"

30% SUBMITTAL

PRELIMINARY COPY

AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS

PEIRCE ISLAND WWTF UPGRADE

HEADWORKS ROOF PLAN

ARCHITECTURAL

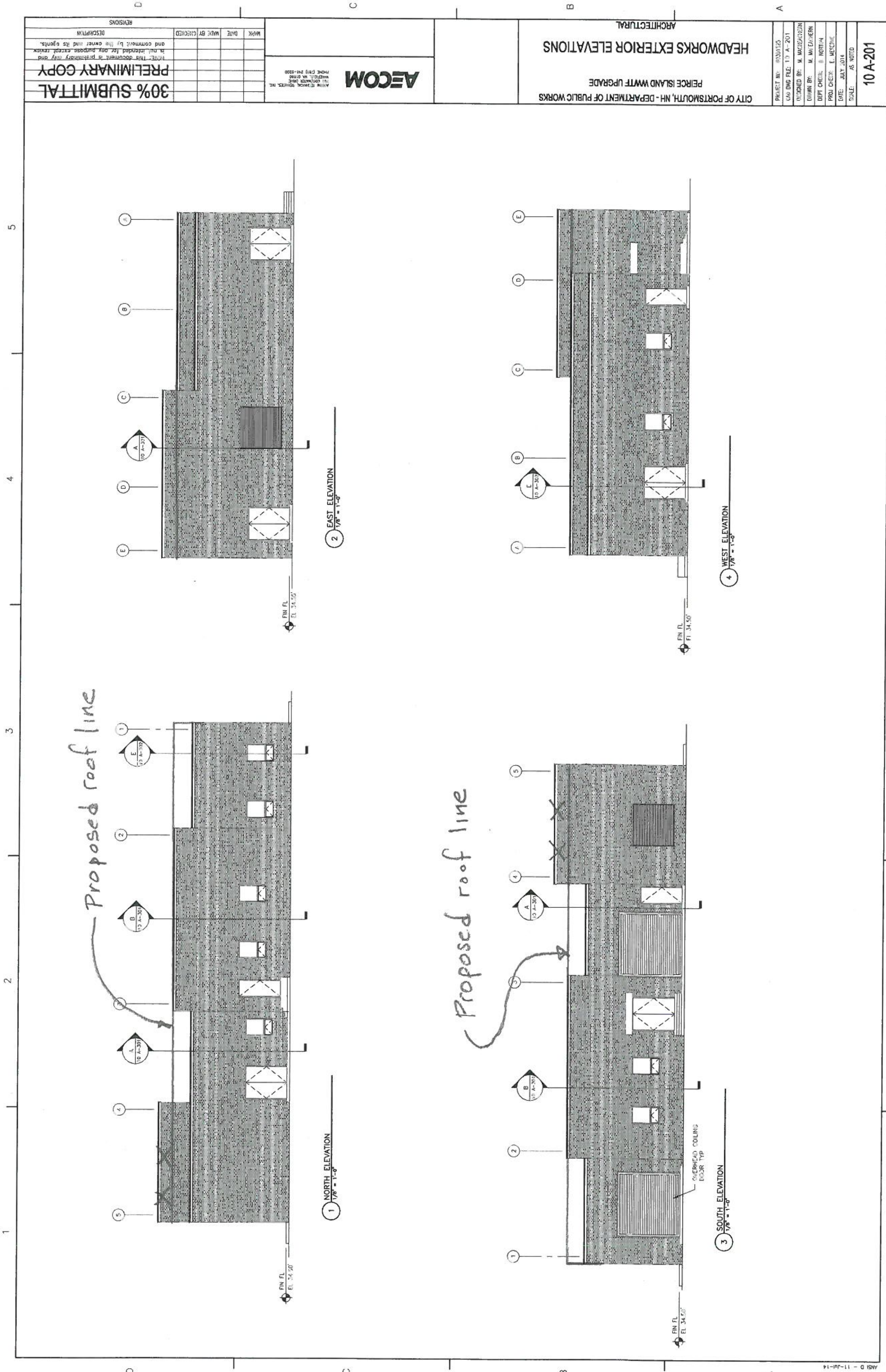
PROJECT NO:	60301325
CAD DWG FILE:	10 A-102
DESIGNED BY:	M. MACEACHERN
DRAWN BY:	M. MACEACHERN
DEPT CHECK:	S. NORTON
PROJ CHECK:	C. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

10 A-102

ALT. NO. H-2

Sht. 2 of 4

ALT. NO.
H-2
Sht. 3 of 4



COST WORKSHEET

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**

City of Portsmouth, NH

ALTERNATIVE NO.: **H-2**

SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Concrete Columns	CY	21	1,005.00	21,105	22	1,005.00	21,809
Concrete Beams	CY	87	766.00	66,336	73	766.00	55,688
Exterior Walls	SF	6,000	27.58	165,480	5,895	27.58	162,584
Roof Drains	EA	8	500.00	4,000	4	500.00	2,000
Overflow Drains	EA	8	500.00	4,000	4	500.00	2,000
Metal Coping	EA	460	15.00	6,900	318	15.00	4,770
Subtotal				267,821			248,851
Markup (%) at 91.2%				244,253			226,952
TOTAL				512,074			475,803
TOTAL (ROUNDED)				512,000			476,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **H-7**
DESCRIPTION:	**USE PRECAST CONCRETE DECKING IN LIEU OF CAST-IN-PLACE CONCRETE ROOF STRUCTURE FOR THE HEADWORKS BUILDING**	SHEET NO.: **1 of 3**

ORIGINAL DESIGN:

A cast-in-place concrete roof slab is designed for the Headworks Building.

ALTERNATIVE: (sketch attached)

Use precast concrete roof planks with a cast-in-place (CIP) concrete topping.

ADVANTAGES:

- Decreases construction cost
- Reduces construction traffic and carbon footprint of the project
- Reduces construction duration, less forming required

DISADVANTAGES:

- None apparent

DISCUSSION:

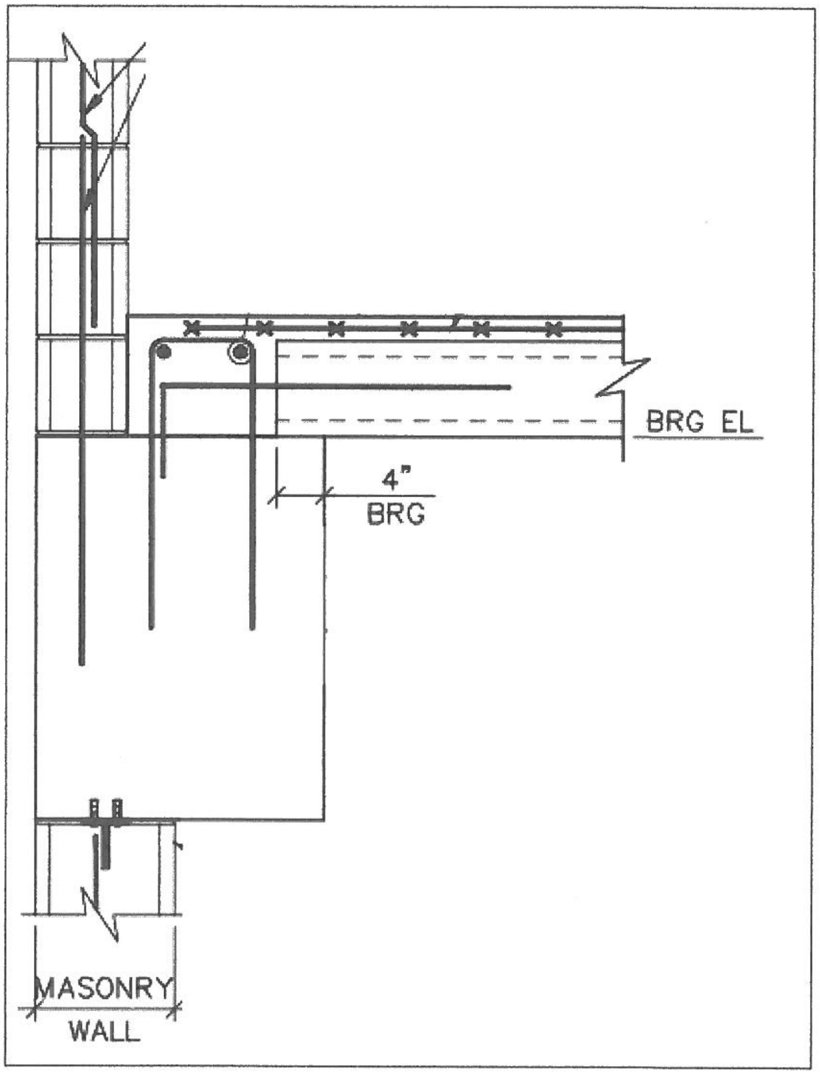
The VE team feels that precast roof plank would be a valid option for this project. Precast roof plank can provide equivalent strength and durability properties to CIP concrete. Using precast plank would reduce the construction duration and reduce the amount of construction traffic to and from the project site. The precast plank could be used in conjunction with the concrete moment frame and provide diaphragm action support.

If some of the other VE options are implemented and the size of the Headworks Building is reduced, the concrete frame could potentially be eliminated and the concrete masonry units could be made load bearing.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 293,000	—	$ 293,000
ALTERNATIVE	$ 125,000	—	$ 125,000
SAVINGS (Original minus Alternative)	$ 168,000	—	$ 168,000

SKETCH ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*		ALTERNATIVE NO.: **H-7**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **2 of 3**



COST WORKSHEET

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**

City of Portsmouth, NH

ALTERNATIVE NO.: **H-7**

SHEET NO.: **3 of 3**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
CIP Concrete Roof Slab	CY	200	766.00	153,200			
Precast Roof Plank	SF				5,100	11.00	56,100
2" Grout Topping	CY				31	300.00	9,444
- quantities for estimate are based on area of roof estimate							
Subtotal				153,200			65,544
Markup (%) at 91.2%				139,718			59,776
TOTAL				292,918			125,320
TOTAL (ROUNDED)				293,000			125,000

VALUE ENGINEERING ALTERNATIVE ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALTERNATIVE NO.: **H-11**

DESCRIPTION: **PROVIDE PORTABLE GANTRY CRANE IN LIEU OF MONORAIL WITH HOISTS FOR SCREEN PIVOTING AND LOWER BUILDING ROOF HEIGHT**

ORIGINAL DESIGN: (sketch attached)

The original design utilizes four monorail beams and four explosion proof hoists/trolleys for pivoting the influent screens out of the influent channels for maintenance.

ALTERNATIVE: (sketch attached)

Provide one portable gantry crane (A-frame) with one hoist for lifting (pivoting) each influent screen out of the influent channel for maintenance.

ADVANTAGES:

- Eliminates three explosion proof hoists/trolleys and four monorail beams
- Will make it easier to pivot the screens out of the channel
- Reduces electrical load
- Portable A-frame could be used at other buildings within the site as needed
- Reduces odor control air volume and system requirements

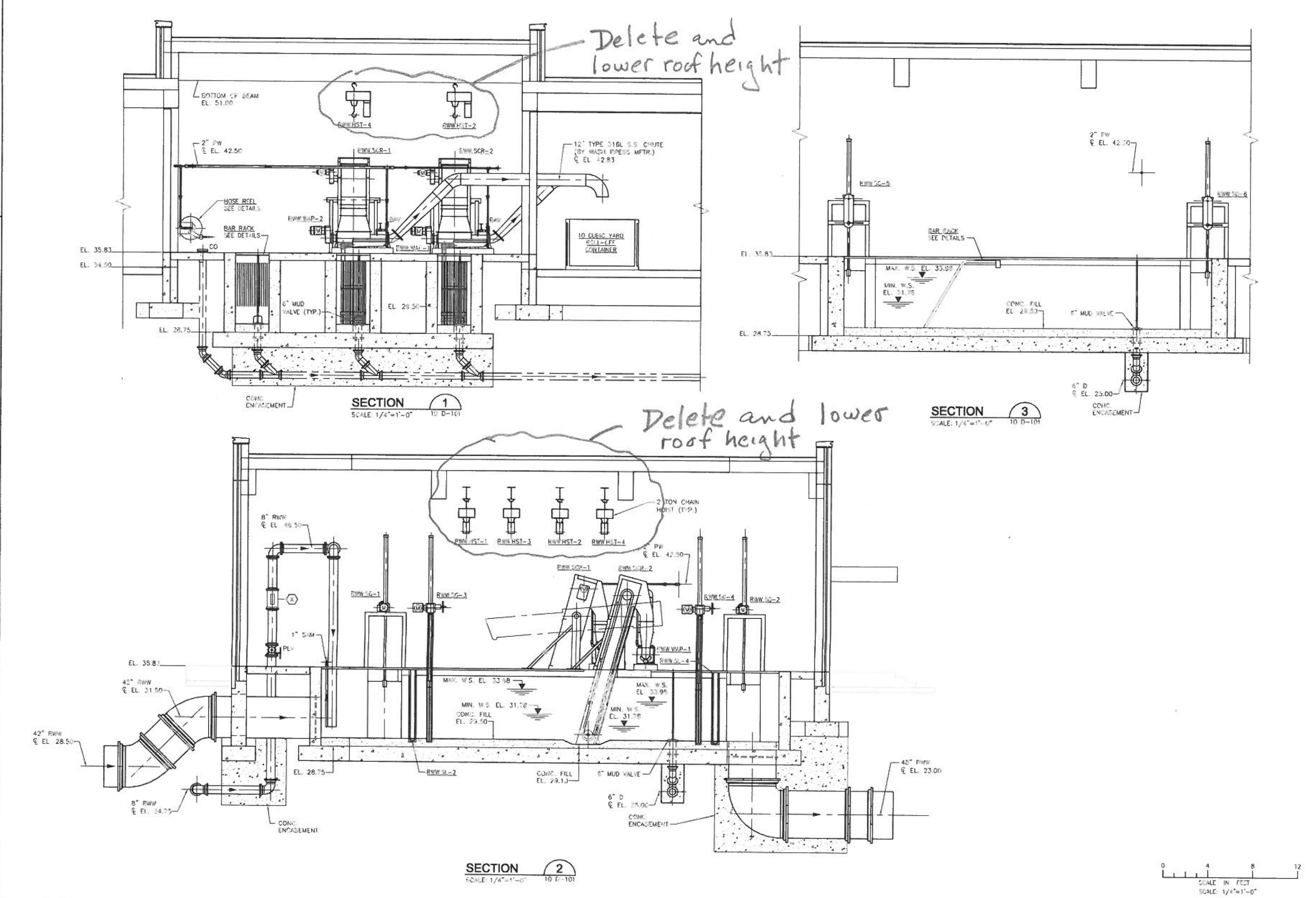
DISADVANTAGES:

- Requires at least two feet on either side of the screen to be able to roll the A-frame into place (space is available in the original design) vs. having an overhead monorail
- Grating/covers above the channels will need to be designed for the load imparted by the A-frame rolling over it (lightweight aluminum frame can be used)
- Lightweight aluminum frame may corrode faster than a coated steel monorail beam

DISCUSSION:

The original design appears to provide for four monorail beams and four explosion-proof hoists/trolleys (two per screen as shown on Dwg. 10 D-301) for pivoting the fine screens out of the influent channels. Under this arrangement, it appears that the first hoist lifts each screen from its initial upright position to a certain distance out of the channel, and the second hoist would then be connected to lift the screen to its final horizontal position for maintenance, and hold it in place above the channel. Providing a portable A-frame allows for one hoist/trolley for both screens. The A-frame can be wheeled around as necessary, and can be shifted away from the screen as it lifts to pivot the screen out of the channel. This eliminates the need to transfer the load between hoists. Note, the cost estimate only includes three hoists whereas the drawings appear to show four.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,031,000	—	$ 1,031,000
ALTERNATIVE	$ 879,000	—	$ 879,000
SAVINGS (Original minus Alternative)	$ 152,000	—	$ 152,000



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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

MARK	DATE	MADE BY	CHECKED	DESCRIPTION

REVISIONS

AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

HEADWORKS - SECTIONS
MECHANICAL PROCESS

PROJECT NO:	60301525
CAD DWG FILE:	10 D-301
DESIGNED BY:	D. YUHN
DRAWN BY:	S.A. COTE
DEPT CHECK:	C. GALLIGAN
PROJ CHECK:	E. MCERVE
DATE:	JULY 2014
SCALE:	AS NOTED

10 D-301

ALT. NO. H-11
Sht. 2 of 3

COST WORKSHEET

ARCADIS

PROJECT:	PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE *City of Portsmouth, NH*	ALTERNATIVE NO.: **H-11** SHEET NO.: **3 of 3**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bar Screen Chain Hoist/Trolley	EA	4	6,510.00	26,040	1	6,510.00	6,510
Monorail Beam	EA	4	6,508.00	26,032			
Portable Gantry Crane (A-Frame)	EA				1	4,500.00	4,500
Electrical for Hoist (40% of Mech)	LS	4	2,604.00	10,416	1	2,604.00	2,604
Roof & Flashing	LS	1	173,460.00	173,460	1	158,169.00	158,169
Odor Control System No. 1	LS	1	303,233.00	303,233	1	288,071.35	288,071
	Subtotal			539,181			459,854
Markup (%) at	**91.2%**			491,733			419,387
	TOTAL			1,030,914			879,241
	TOTAL (ROUNDED)			1,031,000			879,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **H-14**
DESCRIPTION:	**CENTER 42-IN.-DIAMETER RWW PIPE BETWEEN THE INFLUENT SCREENS**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN: (sketch attached)

The original design includes a 42-inch-diameter RWW pipe entering the Headworks Building through the north wall, directly in-line with Influent Screen No. 2 channel.

ALTERNATIVE: (sketch attached)

Relocate the 42-inch-diameter RWW pipe entering the Headworks such that it is in line with the space between the fine screens (i.e., end of pipe will discharge into the concrete channel wall).

ADVANTAGES:

- Reduces potential for hydraulic short circuiting and uneven distribution of flow to each influent screen

DISADVANTAGES:

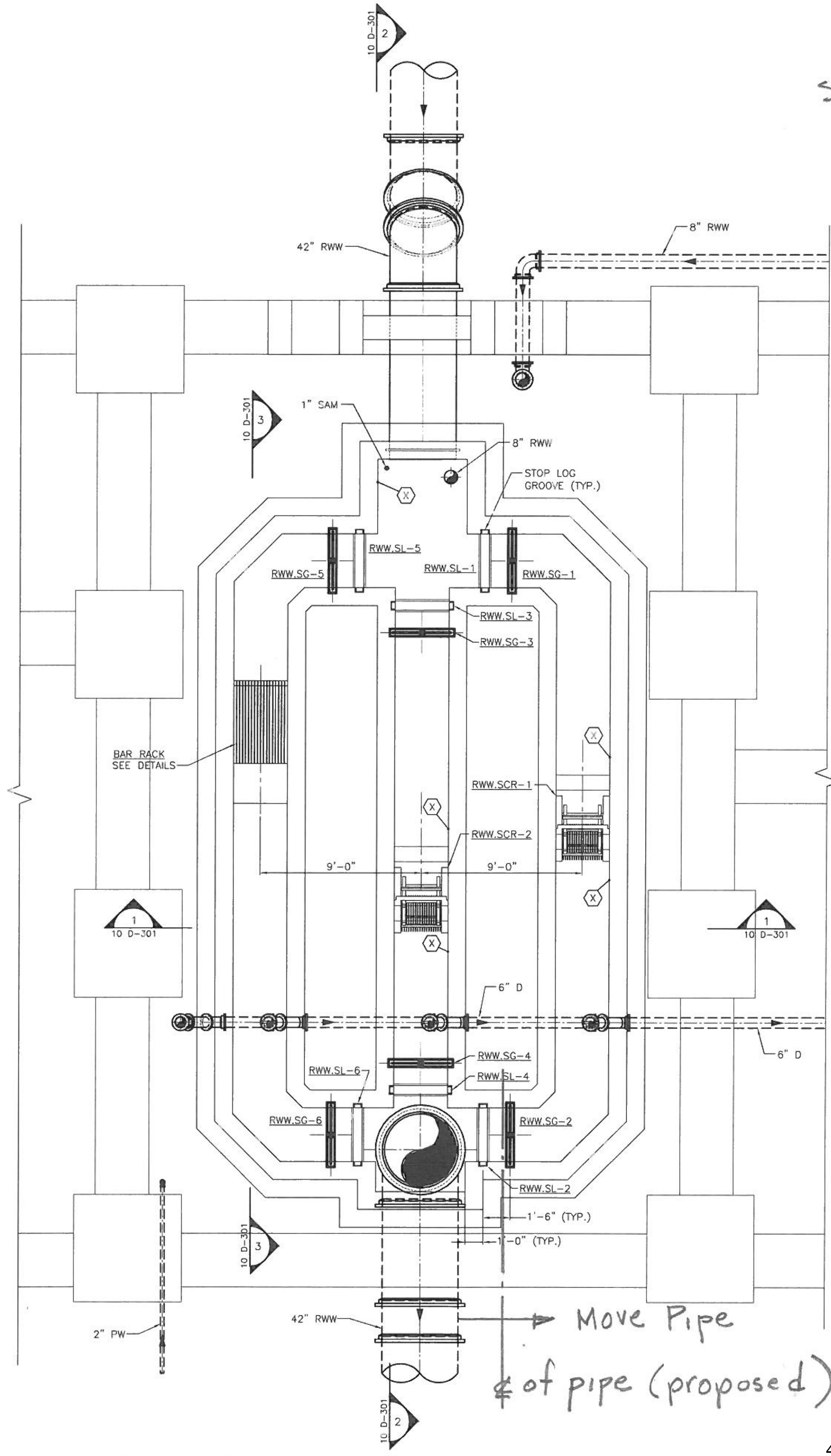
- If a third screen is added in the future, influent pipe may not be centered within the three influent channels

DISCUSSION:

By shifting the 42-inch-diameter RWW line so that it is not in line with Screen No. 2, it reduces the potential that flow will tend to go towards Screen No. 2 and mal-distribute flow to Screen No. 1. Shifting the pipe will require the channel isolation slide gates to be relocated in front of each screen, which would allow for the space between each screen to be reduced. If a third screen is added in the future, the influent pipe may not be centered on the three channels, however, by shifting the screen location within the channel, the upstream hydraulics can be matched to minimize headloss differential upstream of each screen. Under this design suggestion, consideration should be made to switching the location of Screen No. 2 and the manual bypass bar screen to facilitate an equal flow distribution. This would increase the length of the discharge tube from the Screen No. 2 Washpress, however, equal distribution of flow to each screen would be more beneficial.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS (Original minus Alternative)			

ACT. NO.
H-14
Sht. 2 of 2



VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **H-16**
DESCRIPTION:	**RELOCATE GENERATOR OUTSIDE IN ITS OWN ENCLOSURE AND REDUCE THE SIZE OF THE HEADWORKS BUILDING**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN:

The present design shows the 1500 kW standby generator housed in a room in the Headworks Building with a 5,000 gallon diesel underground fuel storage tank located south of the Headworks Building.

ALTERNATIVE:

Relocate the generator outside the Headworks Building and install it in its own walk-in enclosure with a 5,000 gallon sub-base diesel storage tank in lieu of the 5,000 gallon underground storage tank presently shown on the drawings. Reduce the size of the Headworks Building accordingly.

ADVANTAGES:

- Reduces capital cost
- Simplifies fuel delivery system
- If desired, the shop/storage areas for the facility can now be consolidated into this building saving additional costs
- Eliminates tallest element of building

DISADVANTAGES:

- Places the generator in a separate structure

DISCUSSION:

The present design shows the 1500 kW generator located in a room in the Headworks Building. Today, it is very common to install a generator outdoors in its own walk-in enclosure with a sub-base fuel tank ("belly tank"). There are several advantages to this outdoor configuration. First, the walk-in enclosure is considerably less expensive than a building constructed on site since the enclosure is built in a fabricating shop. The walk-in enclosure provides working space for maintenance and protection from the elements. Since the generator is located in its own enclosure, the designated room in the Headworks Building can be deleted.

Further, by using a sub-base fuel tank, the cost of the underground double-walled fuel tank, the necessary excavation, and the double-walled fuel piping from the tank to the building are eliminated, along with the fuel pump, the day tank, and the necessary controls. Last, the entire unit, including the sub-base fuel tank, the generator, and the housing can all be set in place with a crane in a very short period of time, saving installation costs.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 464,000	—	$ 464,000
ALTERNATIVE	$ 210,000	—	$ 210,000
SAVINGS (Original minus Alternative)	$ 254,000	—	$ 254,000

COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.: **H-16** SHEET NO.: **2 of 2**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Headworks Generator Room	SF	713	200.00	142,600			
Generator Room Ventilation	EA	1	47,000.00	47,000			
5000 Gallon UST, Installed with Piping, Day Tank, et al	EA	1	53,000.00	53,000			
Slab for Outdoor Generator	EA				1	10,000.00	10,000
Enclosure with Belly Tank	EA				1	100,000.00	100,000
Subtotal				242,600			110,000
Markup (%) at 91.2%				221,251			100,320
TOTAL				463,851			210,320
TOTAL (ROUNDED)				464,000			210,000

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
BAF						
BAF-2	Raise the BAF structure and reduce the rock excavation	$1,199,000	$241,000	$958,000		$958,000
BAF-6	Reduce height in the BAF Stage 1 Mudwell by raising the floor level	$336,000	$0	$336,000		$336,000
BAF-9	Retain parts of the existing Filter Building structure for the BAF structure and raise elevation of building	$1,866,000	$436,000	$1,430,000		$1,430,000
BAF-10	Use a crystalline admixture in the concrete to improve water tightness	DESIGN SUGGESTION				
BAF-16	Use different piping material than 316L stainless steel	$638,000	$365,000	$273,000		$273,000
BAF-17	Revise the air release piping for the denitrification effluent piping	DESIGN SUGGESTION				
BAF-18	Eliminate the expansion joint in the BAF Building	DESIGN SUGGESTION				
BAF-19	Reevaluate wall and foundation thicknesses in the BAF Building	$631,000	$0	$631,000		$631,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-2**
DESCRIPTION:	**RAISE THE BAF STRUCTURE AND REDUCE THE ROCK EXCAVATION**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN:

The top of the BAF foundation is set at El. -1.00 necessitating excavating rock below the existing Filter Building foundation which is to be demolished.

ALTERNATIVE:

Raise the top of foundation to El. 6.00 and eliminate the extra rock excavation.

ADVANTAGES:

- Reduces rock excavation and associated time to complete
- Reduces construction cost
- Reduces construction traffic from hauling rock spoils offsite

DISADVANTAGES:

- Increases the above grade height and slightly changes the aesthetics which could be mitigated by using creative building features and landscaping

DISCUSSION:

Although the VE team recognizes the aesthetic concerns of increasing the height of the BAF Building, a significant construction cost savings can be saved by raising the structure and reducing the amount of rock excavation. With the efforts of the landscaping provided by this project and additional architectural measures (if needed), the VE team feels the value/savings of raising the structure needs to be considered.

Please note, alternate exterior treatments may want to be considered. With structures of this size, a smaller brick can sometimes give the appearance of a larger structure. The VE team believes there are other treatment options available that would help break up the mass of the building.

Also, the perspective of the new building is shown against the existing building. However, the existing building will be demolished and there will be several months before the new building takes shape. Thus people looking into the site will have no reference line to compare the new building with the old building and therefore the change in height will most likely not be recognized.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,199,000	—	$ 1,199,000
ALTERNATIVE	$ 241,000	—	$ 241,000
SAVINGS (Original minus Alternative)	$ 958,000	—	$ 958,000

COST WORKSHEET

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**

City of Portsmouth, NH

ALTERNATIVE NO.: **BAF-2**

SHEET NO.: **2 of 2**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Rock Excavation/Disposal	CY	4,563	121.13	552,712			
- assumed surface area of BAF Building = 20,400 sq.ft.							
- assumed surface area of rock already excavated with Existing Filter Building = 2,800 sq.ft.							
- assumed surface area of rock to be excavated = 17,600 sq.ft.							
Removal of Lower Foundation of Filter Building	CY	310	240.00	74,400			
Fill in Lower Area of Filter Building	CY				700	30.00	21,000
Additional Masonry	SF				4,200	25.00	105,000
Subtotal				627,112			126,000
Markup (%) at	**91.2%**			571,926			114,912
TOTAL				1,199,038			240,912
TOTAL (ROUNDED)				1,199,000			241,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-6**
DESCRIPTION:	**REDUCE HEIGHT IN THE BAF STAGE 1 MUDWELL BY RAISING THE FLOOR LEVEL**	SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

The BAF Stage 1 Mudwell has a clear height of 11.75 ft. with a maximum water depth of 8.25 ft. equating to a 3.5 ft. freeboard.

ALTERNATIVE: (sketch attached)

Reduce the amount of freeboard in the Stage 1 Mudwell to 1 ft. by raising the foundation slab (only in the Stage 1 Mudwell area) by 2.5 ft.

ADVANTAGES:

- Reduces rock excavation
- Reduces construction cost
- Reduces construction traffic by approximately 60-65 round trips from hauling rock spoils offsite and bringing in concrete

DISADVANTAGES:

- None apparent

DISCUSSION:

It appears that the top of foundation within the Stage 1 Mudwell was based on the requirements within the Stage 2 Mudwell. Since the mudwells are separate and have no need for commonality, it is suggested to step up the foundation within the Stage 1 Mudwell. This will reduce the amount of rock excavation required without raising the overall height of the building.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 336,000	—	$ 336,000
ALTERNATIVE	$ 0	—	$ 0
SAVINGS (Original minus Alternative)	$ 336,000	—	$ 336,000

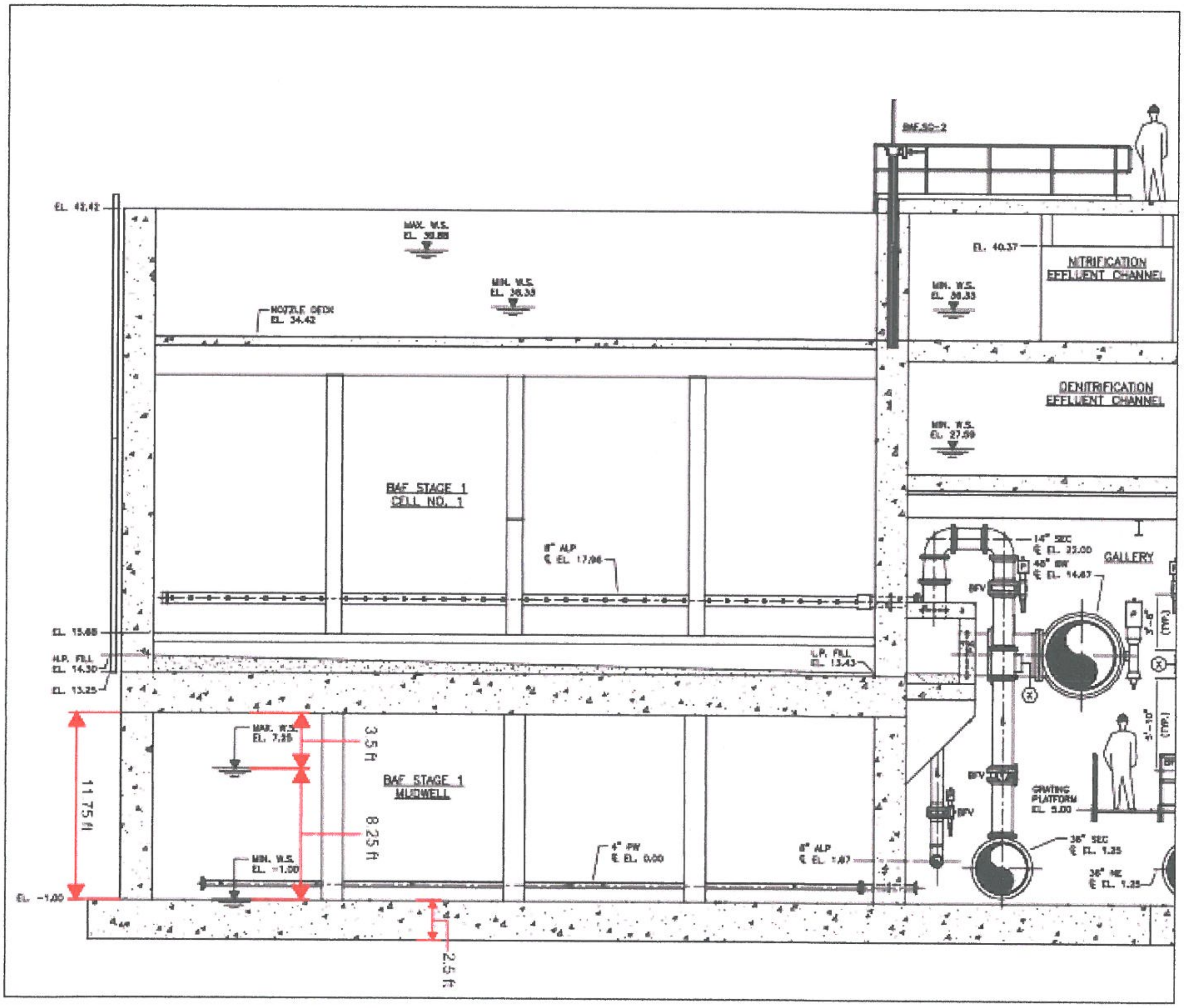
SKETCH ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALTERNATIVE NO.: **BAF-6**

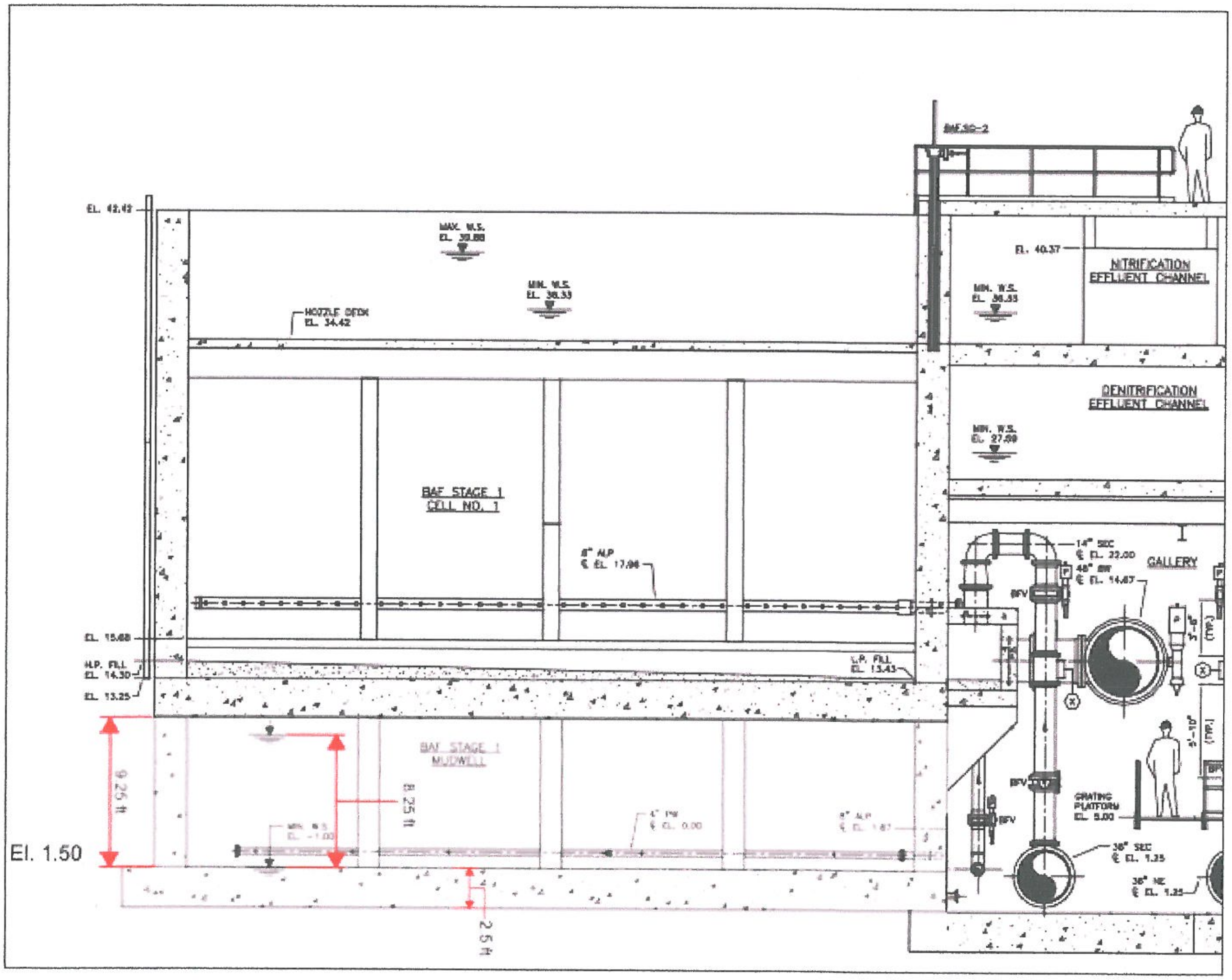
ORIGINAL DESIGN ☒ ALTERNATIVE DESIGN ☐ BOTH ☐

SHEET NO.: 2 of 4



SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-6**
ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒	BOTH ☐	SHEET NO.: 3 of 4



COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
	City of Portsmouth, NH
ALTERNATIVE NO.:	**BAF-6**
SHEET NO.:	**4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Rock Excavation/Disposal	CY	981	121.13	118,887			
- assume area of Stage 1 Mudwell is 10,600 sq.ft.							
Concrete Walls	CY	56	756.00	42,000			
- assume 300 ft. of linear wall							
Concrete Columns	CY	10	1,478.00	14,780			
Subtotal				175,667			
Markup (%) at	**91%**			160,208			
TOTAL				335,875			
TOTAL (ROUNDED)				336,000			

VALUE ENGINEERING ALTERNATIVE ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-9**
DESCRIPTION:	**RETAIN PARTS OF THE EXISTING FILTER BUILDING STRUCTURE FOR THE BAF STRUCTURE AND RAISE ELEVATION OF BUILDING**	SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

Demolish all of the existing Filter Building and construct a new BAF structure with its base at a lower elevation.

ALTERNATIVE: (sketch attached)

Preserve parts of the existing structure and reuse them for the new structure. This alternate is in combination with Alt. No. BAF-2 – Raise the BAF Structure and Reduce Rock Excavation.

ADVANTAGES:

- Reduces rock excavation
- Reduces construction cost
- Reduces construction traffic by approximately 220-260 round trips from hauling rock spoils offsite and bringing concrete onto the site

DISADVANTAGES:

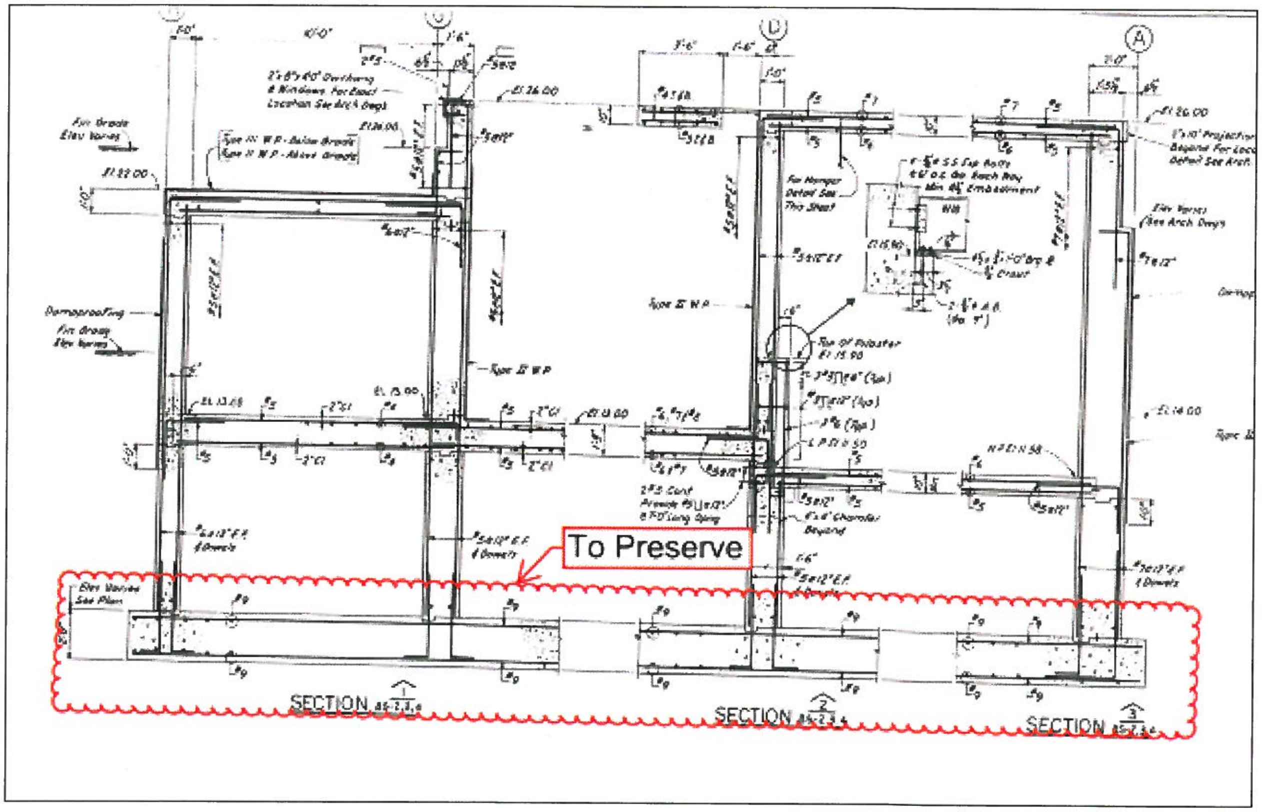
- Increases the above grade height of the building affecting its aesthetics which could be mitigated with creative architecture on the building's façade and landscaping
- Requires careful demolition of the existing building structure

DISCUSSION:

It is the opinion of the VE team that the existing Filter Building foundation is reinforced sufficiently to serve as part of the foundation for the new BAF Foundation. This option would require the BAF Building to be raised so that the new foundation is at the same height as the existing foundation height. To incorporate this alternative, one option would be to perform hydro-demolition in the areas where the connections with walls and foundations would occur to allow for new steel reinforcement to tie in with the existing foundation.

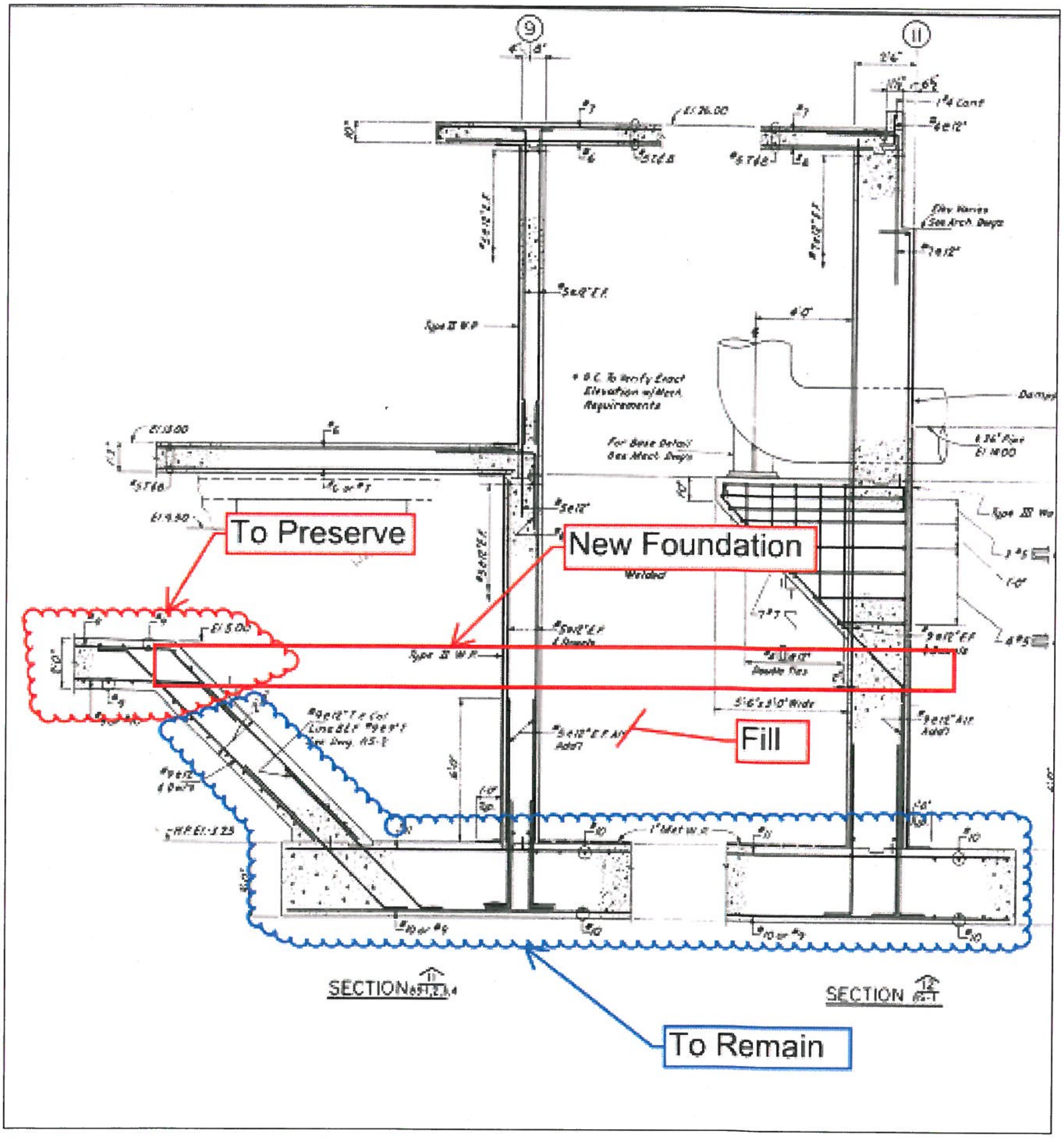
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,866,000	—	$ 1,866,000
ALTERNATIVE	$ 436,000	—	$ 436,000
SAVINGS (Original minus Alternative)	$ 1,430,000	—	$ 1,430,000

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-9**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☐ BOTH ☒	SHEET NO.: **2 of 4**



SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-9**
ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☐	BOTH ☒	SHEET NO.: **3 of 4**



COST WORKSHEET

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**

City of Portsmouth, NH

ALTERNATIVE NO.: **BAF-9**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Rock Excavation/Disposal	CY	4,563	121.13	552,712			
- assumed surface area of BAF Building = 20,400 sq.ft.							
- assumed surface area of rock already excavated with Existing Filter Building = 2,800 sq.ft.							
- assumed surface area of rock to be excavated = 17,600 sq.ft.							
Removal of Lower Foundation of Filter Building	CY	310	240.00	74,400			
Fill in Lower Area of Filter Building	CY				700	30.00	21,000
Additional Masonry	SF				4,200	25.00	105,000
Foundation Removal	CY						
Removal of Upper Foundation of Filter Building	CY	330	240.00	79,200			
New Foundations	CY	389	693.00	269,500			
Hydro Demolition	CY				140	300.00	42,000
Concrete Resloping Topping	CY				150	400.00	60,000
Subtotal				975,812			228,000
Markup (%) at 91.2%				889,941			207,936
TOTAL				1,865,753			435,936
TOTAL (ROUNDED)				1,866,000			436,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-10**
DESCRIPTION:	**USE A CRYSTALLINE ADMIXTURE IN THE CONCRETE TO IMPROVE WATER TIGHTNESS**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

Concrete for liquid containment structures shall have a minimum 28-day compressive strength of 4,500 psi [31 MPa] and a maximum water-cement ratio of 0.42.

ALTERNATIVE:

Along with the original design, include a crystalline admixture for the concrete.

ADVANTAGES:

- Increases water tightness
- Increases concrete durability
- Increases life span of structure

DISADVANTAGES:

- Increases cost of concrete

DISCUSSION:

Since the BAF pipe gallery is surrounded by liquid retaining walls and a roof slab, the VE team suggests providing additional measures to ensure water tightness of the retaining concrete and a dry gallery. By incorporating a crystalline admixture into the concrete, a non-soluble crystalline formation will generate through the entire concrete section and seal the pores and capillary tracts of the concrete. Thus, the concrete becomes sealed against the penetration of water.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-16**
DESCRIPTION:	**USE DIFFERENT PIPING MATERIAL THAN 316L STAINLESS STEEL**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN:

The air low pressure pipe is specified to be Type 316L stainless steel (SS).

ALTERNATIVE:

For air low pressure pipe, use carbon steel (CS) for exposed or buried pipe and Type 304 SS for submerged pipe.

ADVANTAGES:

- Reduces piping cost
- Reduces thermal expansion/contraction which reduces impact on pipe support design
- CS pipe requires less supports (can span longer)

DISADVANTAGES:

- CS pipe requires painting

DISCUSSION:

Providing carbon steel piping in lieu of Type 316L SS piping for all exposed piping in the BAF Facility will reduce the piping cost and thermal expansion/contraction impacts associated with SS piping. CS piping is typically heavier walled as compared to SS which can span longer distances unsupported, thus reducing the quantity of pipe supports required. Carbon steel piping will require painting, however, the majority of the piping is insulated so it will be protected during its service life. For submerged piping connected to the diffuser systems, assuming chloride concentrations do not exceed 2,000 mg/L, Type 304 SS pipe can be used in lieu of Type 316 SS.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 638,000	—	$ 638,000
ALTERNATIVE	$ 365,000	—	$ 365,000
SAVINGS (Original minus Alternative)	$ 273,000	—	$ 273,000

COST WORKSHEET

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**

City of Portsmouth, NH

ALTERNATIVE NO.: **BAF-16**

SHEET NO.: **2 of 2**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
BAF Foundation Level ALP							
20 inch Butt Welded - Straight Tee	EA	1	9,988.00	9,988	1	4,850.00	4,850
20" Butt Welded - LR 90.0 Deg Elbow	EA	1	4,797.00	4,797	1	2,495.00	2,495
20" x 12" Butt Welded - Ecc Red	EA	1	3,042.00	3,042	1	2,281.50	2,282
20"x 8" Butt Welded -Conc Red	EA	1	2,494.00	2,494	1	1,870.50	1,871
20 Inch Commercial Pipe	LF	155	383.00	59,365	155	243.00	37,665
BAF Backflow Loop							
20" Commercial Pipe	LF	15	383.00	5,745	15	243.00	3,645
20" Butt Welded - LR 90.0 Deg Elbow	EA	2	4,797.00	9,594	2	2,495.00	4,990
12" x 6" Butt Welded - Ecc Red	EA	1	1,666.00	1,666	1	1,013.00	1,013
12" Commercial Pipe	LF	6	246.00	1,476	6	154.98	930
BAF Lower Level ALP							
20" Butt Welded - Straight Tee	EA	1	9,988.00	9,988	1	4,850.00	4,850
20" Butt Welded - LR 90.0 Deg Elbow	EA	1	4,794.00	4,794	1	2,495.00	2,495
20"x20"x12" BW Red Tee	EA	4	8,683.00	34,732	4	4,986.01	19,944
12" BW LR 90 Deg elbow	EA	20	4,794.00	95,880	20	692.67	13,853
20" Commercial Pipe	LF	60	383.00	22,980	60	243.00	14,580
12" Commercial Pipe	LF	80	246.00	19,680	80	154.98	12,398
Aerated Grit ALP	LS	1	47,635.00	47,635	1	42,871.50	42,872
Carbon Steel Pipe Painting	LS				1	20,000.00	20,000
Subtotal				333,856			190,733
Markup (%) at	**91.2%**			304,477			173,948
TOTAL				638,333			364,681
TOTAL (ROUNDED)				638,000			365,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-17**
DESCRIPTION:	**REVISE AIR RELEASE PIPING FOR THE DENITRIFICATION EFFLUENT PIPING**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN: (sketch attached)

On the denitrification effluent piping, the design calls for a 48 in. x 30 in. tee with a flange and 6 in. ductile iron vent located upstream of the flow meter.

ALTERNATIVE: (sketch attached)

Consider adding a spool piece extending approximately 3 ft. above the 48 in. tee to avoid gas bubbles sweeping past the vent.

ADVANTAGES:

- Assures a location to collect air outside the flow stream

DISADVANTAGES:

- Small additional cost for spool piece

DISCUSSION:

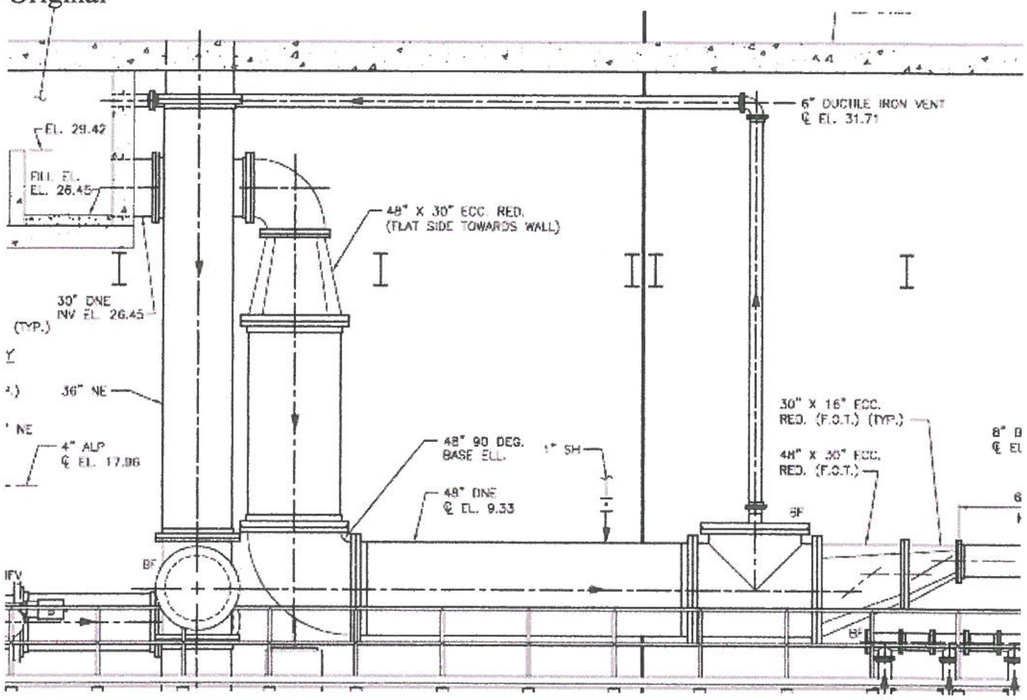
This option will ensure a location to collect air outside the flow stream.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			

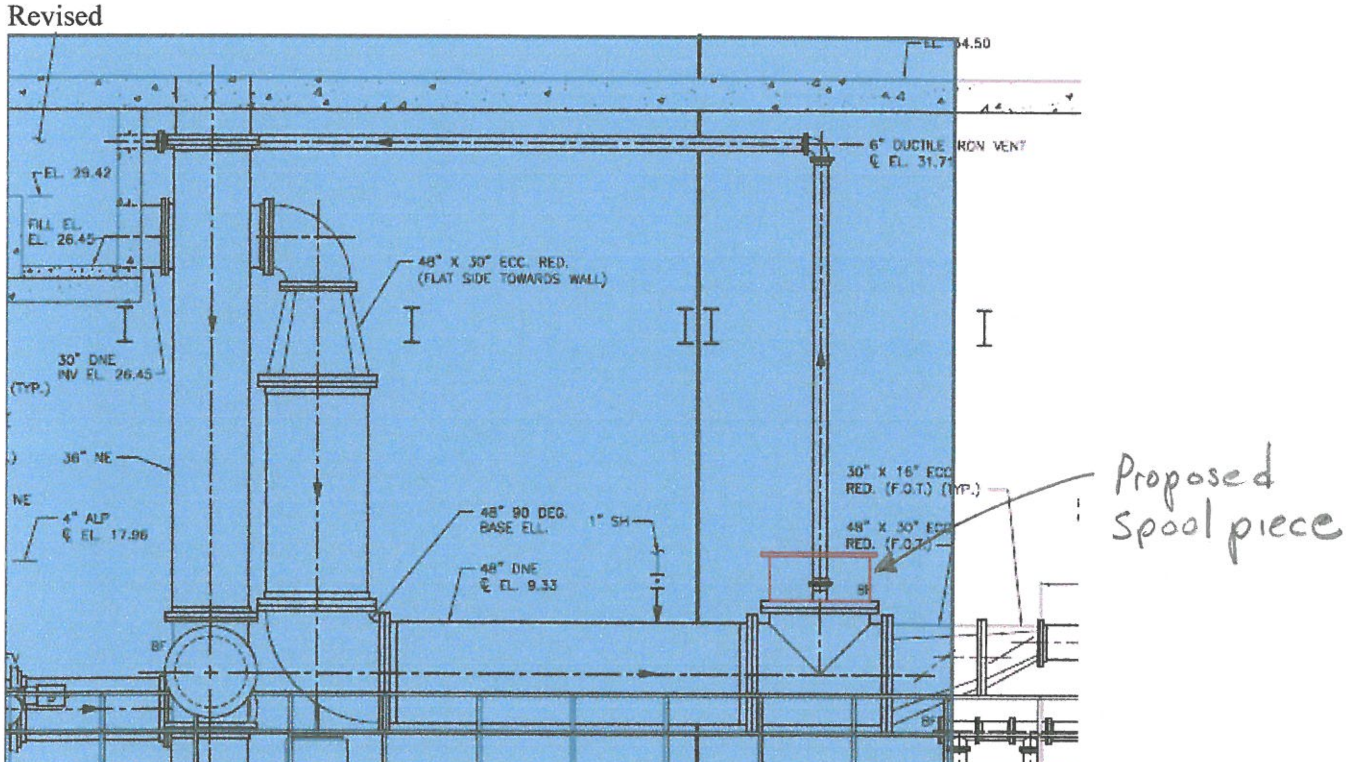
SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-17**
ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☐	BOTH ☒	SHEET NO.: **2 of 2**

Original



Revised



VALUE ENGINEERING ALTERNATIVE ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-18**
DESCRIPTION:	**ELIMINATE EXPANSION JOINT WITHIN THE BAF STRUCTURE**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN:

The BAF structure is designed with an expansion joint. The expansion joint runs north to south and divides the BAF Stage 1 Mudwell, BAF Stage 2 Mudwell, Denitrification Effluent Channel, and Nitrification Effluent Chanel.

ALTERNATIVE: (sketch attached)

Eliminate the expansion joint within structure.

ADVANTAGES:

- Decreases construction cost
- Reduces potential future maintenance on expansion joint
- Increases assurance of pipe gallery being dry
- Eliminates double wall construction between BAF Stage 1, Cell 4 and 5
- Eliminates need for expansion joints in piping

DISADVANTAGES:

- Increases potential for cracking

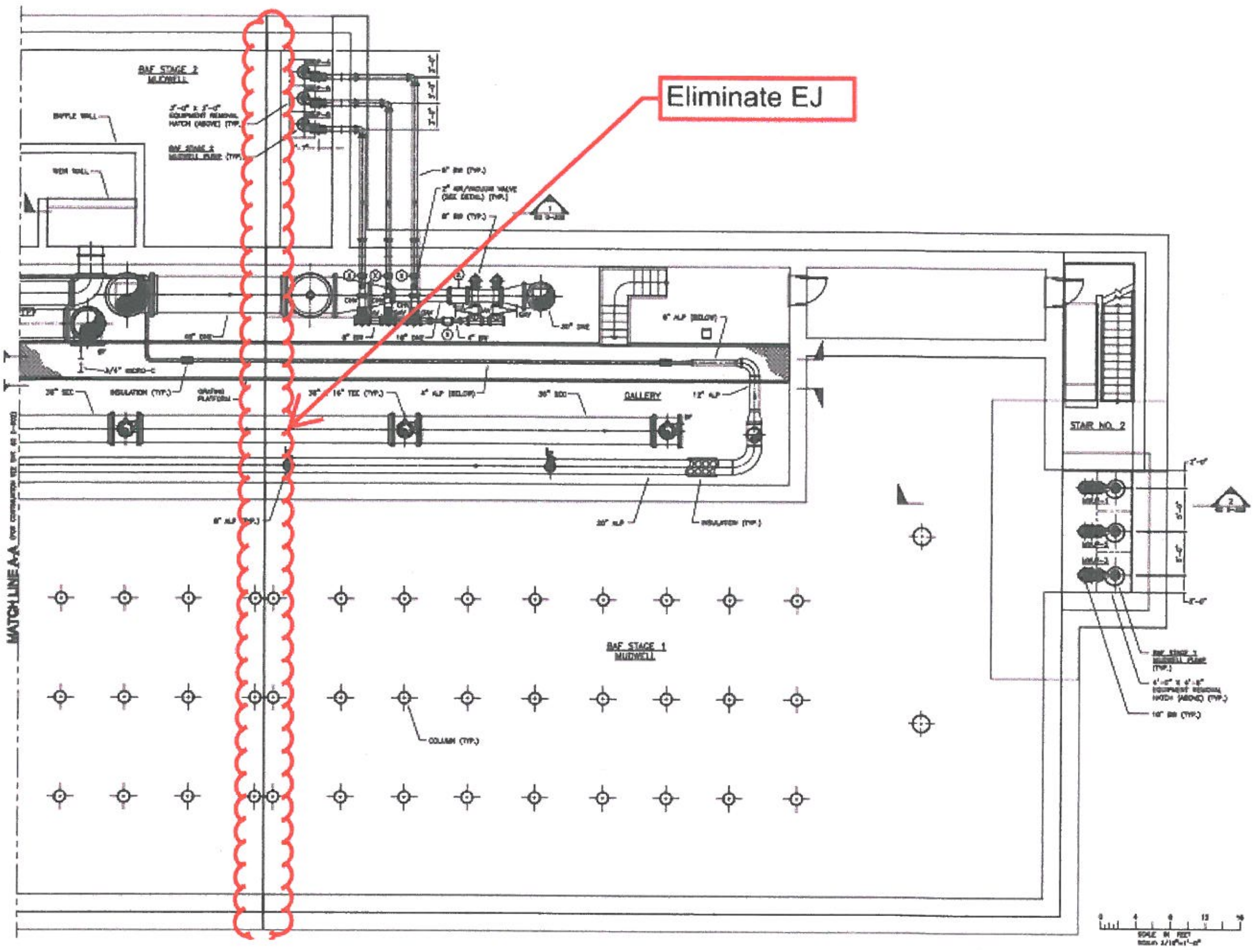
DISCUSSION:

It has been the VE team's experience that expansion joints within water retaining structures can be very problematic and often require maintenance to mitigate leaking. Although the footprint of the structure could justify an expansion joint, the VE team believes that with this type of structure where the pipe gallery has liquid retaining walls and roof slab on all sides of the gallery, an expansion joint could be very problematic. In most cases, it is easier to mitigate a leaking crack than a leaking expansion joint.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS (Original minus Alternative)			

SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-18**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **2 of 2**



VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-19**
DESCRIPTION:	**REEVALUATE WALL AND FOUNDATION THICKNESSES IN THE BAF BUILDING**	SHEET NO.: **1 of 3**

ORIGINAL DESIGN:

Based on scaling the 30% Design Drawings and a review of the Construction Cost Estimate, the foundation and wall thicknesses are estimated to be:

- Foundation = 30 inches
- Exterior Walls = 24 inches
- Pipe Gallery Walls = 24 inches
- BAF Stage 1 Support Slab = 30 inches
- BAF Stage 2 Support Slab = 30 inches
- BAF Stage 1 Cell Divider Walls = 24 inches
- BAF Stage 2 Cell Divider Walls = 24 inches

ALTERNATIVE:

Based on VE team's experience, preliminary structural member thickness could potentially be:

- Foundation = 20 inches
- Exterior Walls = 20 inches
- Pipe Gallery Walls = 20 inches
- BAF Stage 1 Support Slab = 20 inches
- BAF Stage 2 Support Slab = 18 inches
- BAF Stage 1 Cell Divider Walls = 20 inches
- BAF Stage 2 Cell Divider Walls = 18 inches

ADVANTAGES:

- Reduces construction cost
- Reduces construction traffic by approximately 230 round trips

DISADVANTAGES:

- None apparent

DISCUSSION:

Since the structural drawings were not provided as part of this submittal, it was difficult for the VE team to evaluate the structural approach proposed for the BAF structure. Based on scaling the drawings and a review of the Construction Cost Estimate, this is the VE team's best assumption on the proposed structural elements.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 631,000	—	$ 631,000
ALTERNATIVE	$ 0	—	$ 0
SAVINGS (Original minus Alternative)	$ 631,000	—	$ 631,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **BAF-19**
DESCRIPTION:	**REEVALUATE WALL AND FOUNDATION THICKNESSES IN THE BAF BUILDING**	SHEET NO.: **2 of 3**

DISCUSSION: (continued)

Although the VE team realizes that as the design progresses the design team will provide a design that meets the requirements of the Building Codes, we feel it is important to as accurately as possible estimate/determine the thicknesses of each structural member so that an accurate Construction Cost Estimate can be generated. Based on the assumed member thicknesses, the VE team feels there is a potential that the concrete cost for the BAF structure may be high at this time.

The VE team recognizes the value of an efficient design (and even more so on this project because of the difficult site access and realizing the value in limiting as much construction traffic as possible). The VE team suggests reevaluating the design and providing the most efficient structural system as possible.

COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
	City of Portsmouth, NH
ALTERNATIVE NO.:	**BAF-19**
SHEET NO.:	**3 of 3**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Potential Concrete Savings							
Foundation	CY	725	150.00	108,750			
Exterior Wall	CY	300	150.00	45,000			
Pipe Gallery Walls	CY	175	150.00	26,250			
BAF Stage 1 Support Slab	CY	150	150.00	22,500			
BAF Stage 2 Support Slab	CY	75	150.00	11,250			
BAF Stage 1 Cell Divider Walls	CY	115	150.00	17,250			
BAF Stage 2 Cell Divider Walls	CY	75	150.00	11,250			
Reduced Rock Excavation w/ Thinner Foundation Slab	CY	725	121.13	87,819			
Subtotal				330,069			
Markup (%) at 91.2%				301,023			
TOTAL				631,092			
TOTAL (ROUNDED)				631,000			

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
GRAVITY THICKENER						
GT-1	Use a flat cover system in lieu of a dome for the gravity thickener	$753,000	$647,000	$106,000	$67,000	$173,000
GT-2	Slope the foundation slab in lieu of using grout to create the sloped bottom	$93,000	$0	$93,000		$93,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **GT-1**
DESCRIPTION:	**USE A FLAT COVER SYSTEM IN LIEU OF A DOME FOR THE GRAVITY THICKENER**	SHEET NO.: **1 of 5**

ORIGINAL DESIGN:

The original design utilizes a dome cover system over the gravity thickener tank with odor control for the space above the tank water surface.

ALTERNATIVE:

Provide a flat cover system over the tank in lieu of dome cover system.

ADVANTAGES:

- Eliminates confined space entry under the cover system
- Eliminates hazardous area classification of enclosed space
- Reduces volume of air to be odor controlled, thus reducing size of odor control system
- Improves accessibility to top of the tank for maintenance/inspection
- Eliminates need for walkway, railing and grating associated with tank access
- Minimizes visual impact

DISADVANTAGES:

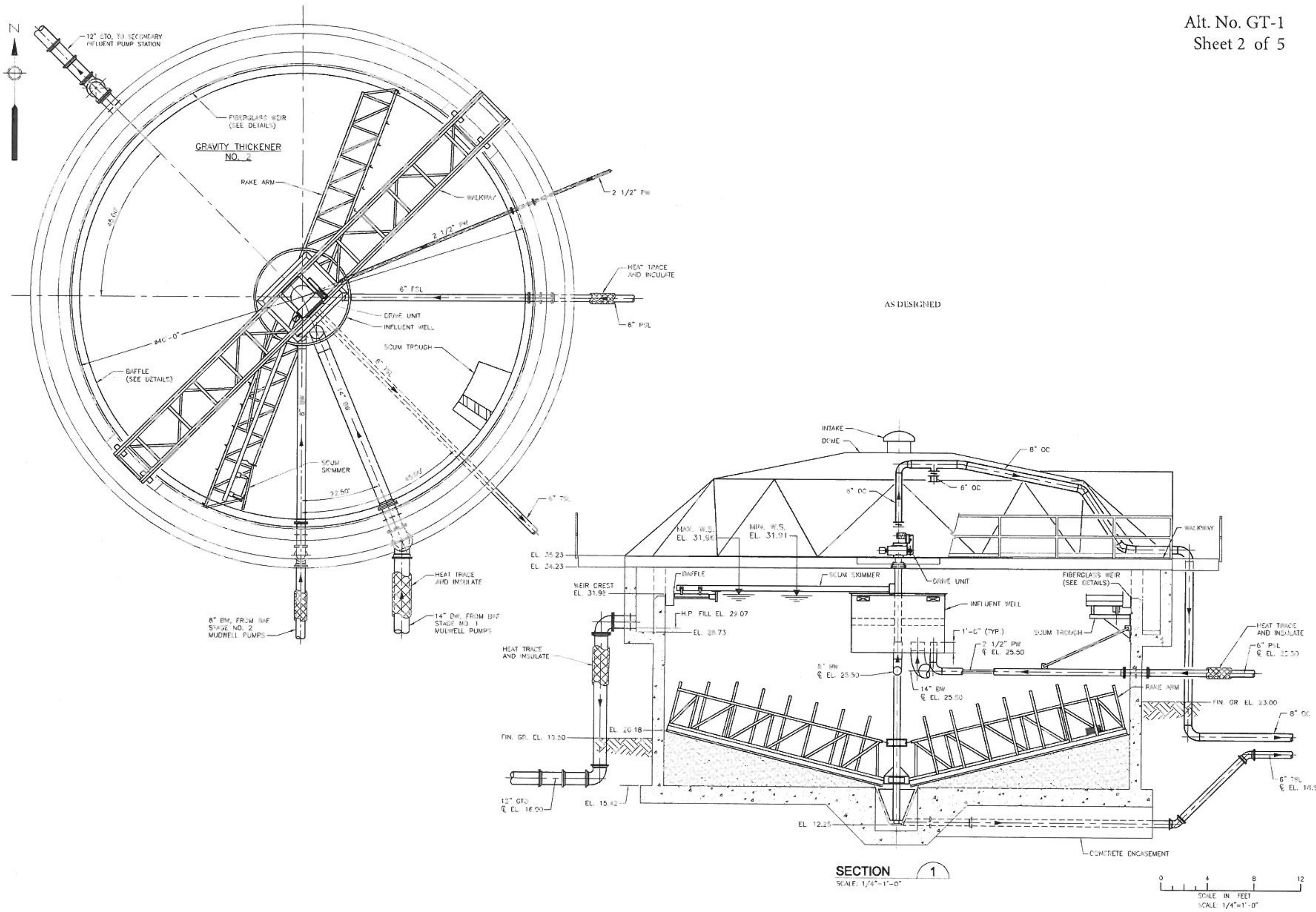
- May require additional supports for cover system

DISCUSSION:

Providing a flat cover system supported off of the tank walls reduces the need to odor control the space enclosed by the original dome cover, and eliminates the need for plant staff to enter a hazardous area to perform maintenance and inspections. Elimination of the dome reduces the visual impact of the structure especially when viewed from the west (the top of dome is at approximately El. 44.23 vs. top of concrete at El. 34.23 on the existing thickener and top of concrete at El. 30.23 on the existing primary clarifiers). The flat cover system reduces the volume of air to be odor controlled from 2500 scfm down to 1600 scfm. Thus, the total airflow for Odor Control System No. 2 can be reduced from 9,300 scfm to 8,400 scfm (approximately 10% lower). This reduction may allow for a reduction in the size of the odor control vessel, and it is assumed the size of the odor control fan can be reduced from 25 HP to 20 HP, yielding an annual operating cost and 20-yr. present worth cost savings.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 753,000	$ 334,000	$ 1,087,000
ALTERNATIVE	$ 647,000	$ 267,000	$ 914,000
SAVINGS (Original minus Alternative)	$ 106,000	$ 67,000	$ 173,000

Alt. No. GT-1
Sheet 2 of 5



30% SUBMITTAL
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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

MARK	DATE	MADE BY	CHECKED	DESCRIPTION
REVISIONS				

AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

GRAVITY THICKENER NO. 2 - PLAN AND SECTION
MECHANICAL PROCESS

PROJECT NO:	60301335
CAD DWG FILE:	53 D-101
DESIGNED BY:	D. YURK
DRAWN BY:	S.A. COTE
DEPT CHECK:	C. GRUDEN
PROJ CHECK:	E. MCSERVE
DATE:	JULY 2014
SCALE:	AS NOTED

53 D-101

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **GT-1** SHEET NO.: **3 of 5**

FLAT COVER SYSTEM VENTILATION CALCULATIONS:

GT TANK DIAMETER INCL. LAUNDER WIDTH = 45'-0" DIA.

AREA OF TANK = $pi(r)^2$

$A = pi*(22.5\ ft)^2$

A = 1589.9 sf => Say 1600 sf

From 30% Final Design Report, flat cover systems provide 1 cfm air/sq. ft. of covered area to maintain a slightly negative pressure.

Therefore, 1600 sf x 1 cfm/sf = 1600 scfm of air under the flat cover system.

Original Design for Odor Control System No. 2 included 2500 scfm of air under dome.

Therefore, flat cover system reduces required volume by 2500-1600 scfm = 900 scfm.

Total Odor Control System No. 2 airflow can be reduced from 9,300 scfm to 8,400 scfm.

ODOR CONTROL FAN 30 YR PRESENT WORTH COST REDUCTION:

Original Design Fan Size: 25HP
W/ 10% Reduction in Total Airflow, Assume a 20 HP fan can be used.

20 HP = 14.9 kW
25 HP = 18.6 kW

25 HP Annual Electrical Cost: 8760 hrs/yr x 18.6 kW x $0.13/kWhr = $21,181.68/yr => $21,200/yr
20 HP Annual Electrical Cost: 8760 hrs/yr x 14.9 kW x $0.13/kWhr = $16,968/yr => $17,000/yr

Annual Operating Cost Savings = $4,200/yr

Assume 20 year life on fan, 20 yr present worth cost analysis (see attached for backup):
25 HP Fan - $333,985.14
20 HP Fan - $267,188.11

Savings = $66,797.03

Portsmouth, NH VE
Odor Control System No. 2 Fan

CALCULATION OF ELECTRICAL PRESENT WORTH COSTS

Cost of Electricity:	$0.130 /kWh
	$0.130 /kWh
Service Life:	30 years
Interest Rate (i):	6.50%
Inflation Rate (I):	4.00%
Operation:	Fan operating 24 hrs/d, 365 days/yr

EQUATIONS FROM HYDRAULIC INSTITUTE STANDARDS:

$KW = P_{mot} \times 0.7457$

P_{mot} = power input to driver in HP

KW = power input to driver in kilowatts

No. of Operational Blowers	1	1	0
BHP (P_{mot}) per Blower	20.00	25.00	0.00
KW	14.91	18.64	0.00
Value, One Year (2014)	$16,984.06	$21,230.08	$0.00

* BHP and quantity of operational blowers estimated for operating point stated above; manufacturer did not provide information

	Odor control System No. 2 Fan			
Year (n)	Total Annual Electrical Cost	PW Cost	Total Annual Electrical Cost	PW Cost
0				
1	$17,663.43	$16,585.38	$22,079.28	$20,731.72
2	$18,369.96	$16,196.05	$22,962.45	$20,245.06
3	$19,104.76	$15,815.86	$23,880.95	$19,769.82
4	$19,868.95	$15,444.59	$24,836.19	$19,305.74
5	$20,663.71	$15,082.05	$25,829.64	$18,852.56
6	$21,490.26	$14,728.01	$26,862.82	$18,410.01
7	$22,349.87	$14,382.28	$27,937.34	$17,977.85
8	$23,243.86	$14,044.67	$29,054.83	$17,555.83
9	$24,173.62	$13,714.98	$30,217.02	$17,143.73
10	$25,140.56	$13,393.03	$31,425.70	$16,741.29
11	$26,146.18	$13,078.64	$32,682.73	$16,348.30
12	$27,192.03	$12,771.63	$33,990.04	$15,964.54
13	$28,279.71	$12,471.83	$35,349.64	$15,589.78
14	$29,410.90	$12,179.06	$36,763.63	$15,223.83
15	$30,587.34	$11,893.17	$38,234.17	$14,866.46
16	$31,810.83	$11,613.99	$39,763.54	$14,517.48
17	$33,083.27	$11,341.36	$41,354.08	$14,176.70
18	$34,406.60	$11,075.13	$43,008.24	$13,843.91
19	$35,782.86	$10,815.15	$44,728.57	$13,518.94
20	$37,214.17	$10,561.27	$46,517.72	$13,201.59
21	$38,702.74	$10,313.35	$48,378.43	$12,891.69
22	$40,250.85	$10,071.26	$50,313.56	$12,589.07
23	$41,860.88	$9,834.84	$52,326.11	$12,293.55
24	$43,535.32	$9,603.98	$54,419.15	$12,004.97
25	$45,276.73	$9,378.53	$56,595.92	$11,723.17
26	$47,087.80	$9,158.38	$58,859.75	$11,447.97
27	$48,971.31	$8,943.39	$61,214.14	$11,179.24
28	$50,930.17	$8,733.45	$63,662.71	$10,916.82
29	$52,967.37	$8,528.44	$66,209.22	$10,660.56
30	$55,086.07	$8,328.25	$68,857.59	$10,410.31
		$267,188.11		**$333,985.14**

Total Annual Electric Cost = Current Annual Electrical Cost x (1 + Inflation Rate)^{Year} = $A_o(1+I)^n$
PW Cost = Total Annual Electric Cost / (1 + Interest Rate)^{Year} = $F / (1 + i)^n$

Values indicated are 20 year net present values

COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.: **GT-1** SHEET NO.: **5 of 5**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Solids Complex Odor Ctrl Sys. No.2	LS	1	179,917.00	179,917	1	161,925.30	161,925
Alum. Dome Cover for Tank	SF	1,256	49.00	61,544			
Alum. Flat Cover for Tank	SF				1,600	55.00	88,000
Alum. Railing	LF	170	59.00	10,030			
Alum. ST (4x4x1/2)	LF	310	96.00	29,760			
Alum. Grating (Tank)	SF	582	19.00	11,058			
New GT Odor Control Connection	LS	1	5,516.00	5,516	1	2,206.40	2,206
New Electrical (40% of Mech)	LS	1	71,967.00	71,967	1	64,770.30	64,770
Sys. No. 2 24" Ductwork	LF	200	101.00	20,200			
Sys No. 2 24" Fittings	EA	4	937.00	3,748			
Sys. No. 2 20" Ductwork	LF				200	90.00	18,000
Sys No. 2 20" Fittings	EA				4	843.30	3,373
Subtotal				393,740			338,274
Markup (%) at 91.2%				359,091			308,506
TOTAL				752,831			646,780
TOTAL (ROUNDED)				753,000			647,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **GT-2**
DESCRIPTION:	**SLOPE THE FOUNDATION SLAB IN LIEU OF USING GROUT TO CREATE THE SLOPED BOTTOM**	SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

A flat foundation slab with grout fill is used to form the sloped bottom of the new Gravity Thickener.

ALTERNATIVE: (sketch attached)

Use a sloped foundation slab with 2-in.-thick grout topping.

ADVANTAGES:

- Reduces construction cost
- Reduces the amount of construction traffic
- Reduces construction duration
- Reduces excavation

DISADVANTAGES:

- When used to house sludge pumps during construction, temporary flat platforms will have to be installed in the tank

DISCUSSION:

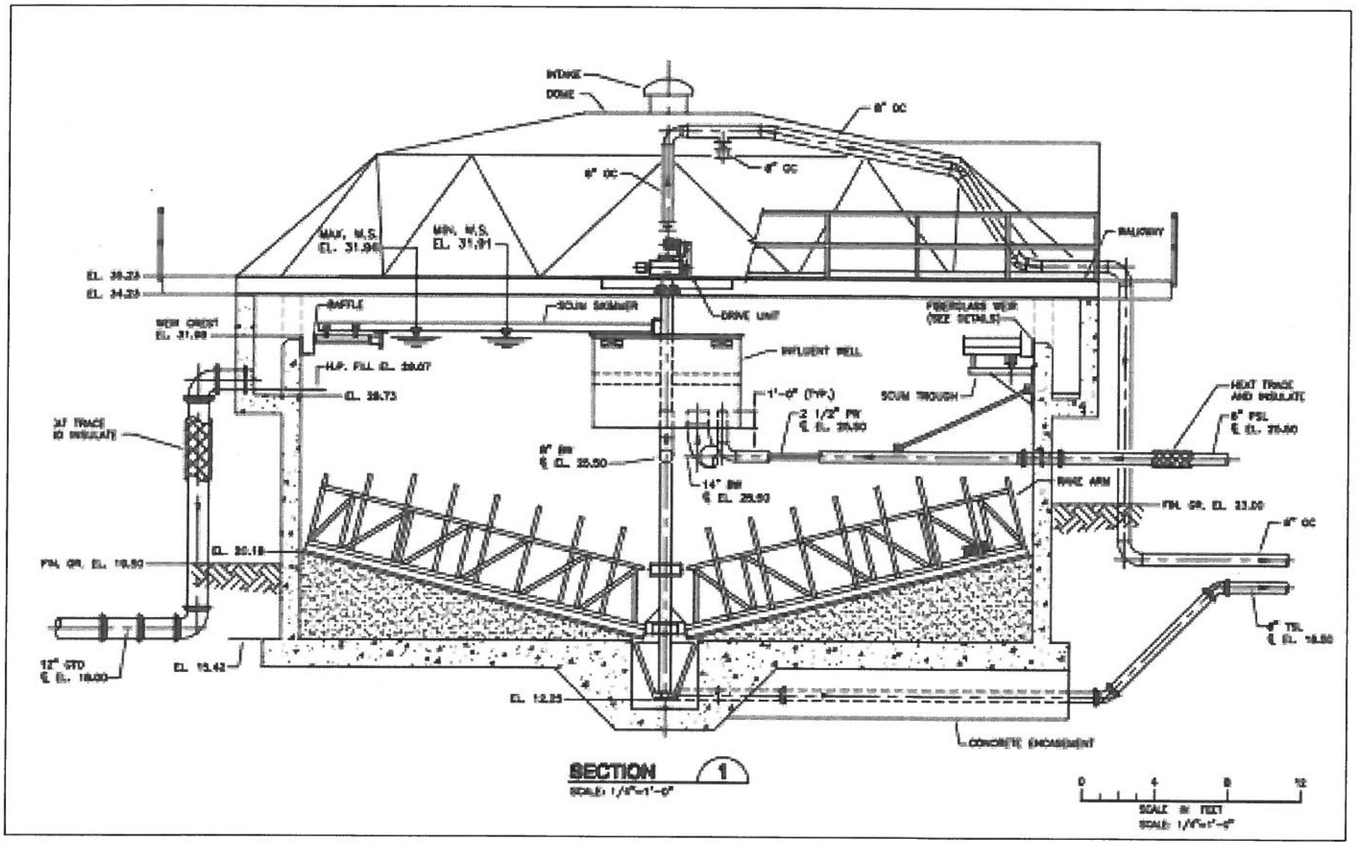
Sloping foundation slabs are very common and the current existing Gravity Thickener foundation is sloped. Since access to the site requires traveling through the downtown area, the VE team believes there is a benefit, whenever possible, to reduce the amount of construction traffic required. Reducing the amount of excavation, concrete and grout fill required will reduce the number of concrete trucks required.

The contour would need to be regraded along the south of the tank to keep the foundation from being exposed. It appears there is enough spoils from the site that could be used to fill this area, thus requiring even less traffic to and from the site.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 93,000	—	$ 93,000
ALTERNATIVE	$ 0	—	$ 0
SAVINGS (Original minus Alternative)	$ 93,000	—	$ 93,000

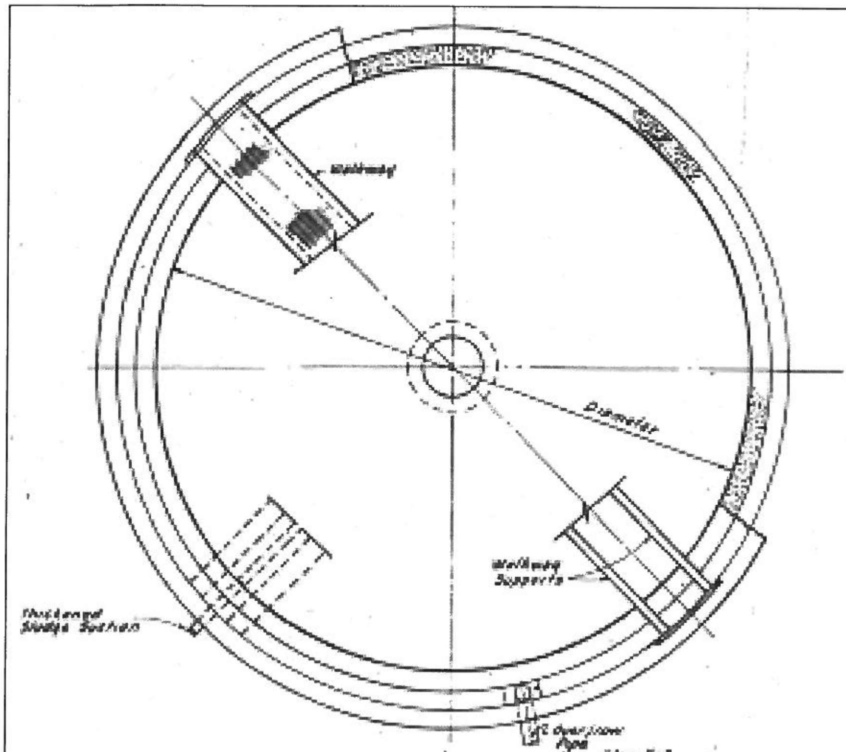
SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **GT-2**
ORIGINAL DESIGN ☒	ALTERNATIVE DESIGN ☐ BOTH ☐	SHEET NO.: **2 of 4**

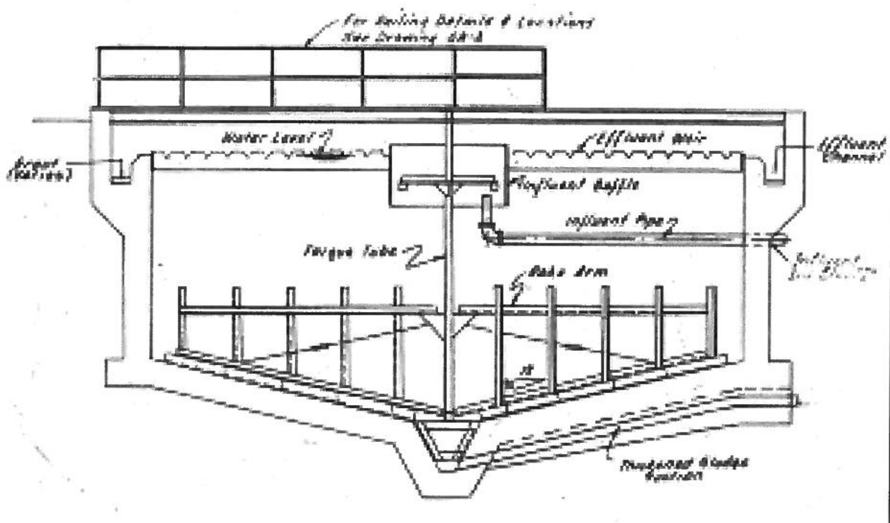


SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **GT-2**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **3 of 4**



PLAN
Not To Scale



SECTIONAL ELEVATION
Not To Scale

COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.:	**GT-2**
		SHEET NO.:	**4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Grout Fill	CY	143	341.63	48,854			
- Backfill not considered in estimate							
Subtotal				48,854			
Markup (%) at 91.2%				44,555			
TOTAL				93,409			
TOTAL (ROUNDED)				93,000			

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
SOLIDS BUILDING						
SB-3	Use precast concrete roof plank in lieu of a cast-in-place concrete roof structure for the Solids Building	$513,000	$230,000	$283,000		$283,000
SB-6	Use submersible pump station in lieu of dry-pit station and relocate station between the existing Primary Clarifier Effluent Distribution Box and the proposed Solids Building	$2,059,000	$1,067,000	$992,000		$992,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **SB-3**
DESCRIPTION:	**USE PRECAST CONCRETE ROOF PLANK IN LIEU OF A CAST-IN-PLACE CONCRETE ROOF STRUCTURE FOR THE SOLIDS BUILDING**	

ORIGINAL DESIGN:

A cast-in-place (CIP) concrete roof slab is designed for the Solids Building.

ALTERNATIVE: (sketch attached)

Use precast concrete roof plank with a 2-inch-thick CIP concrete topping.

ADVANTAGES:

- Decreases construction cost
- Reduces construction traffic by eliminating round trips of concrete trucks, trucks loaded with formwork and trucks loaded with reinforcing steel
- Reduces construction duration, less forming required

DISADVANTAGES:

- None apparent

DISCUSSION:

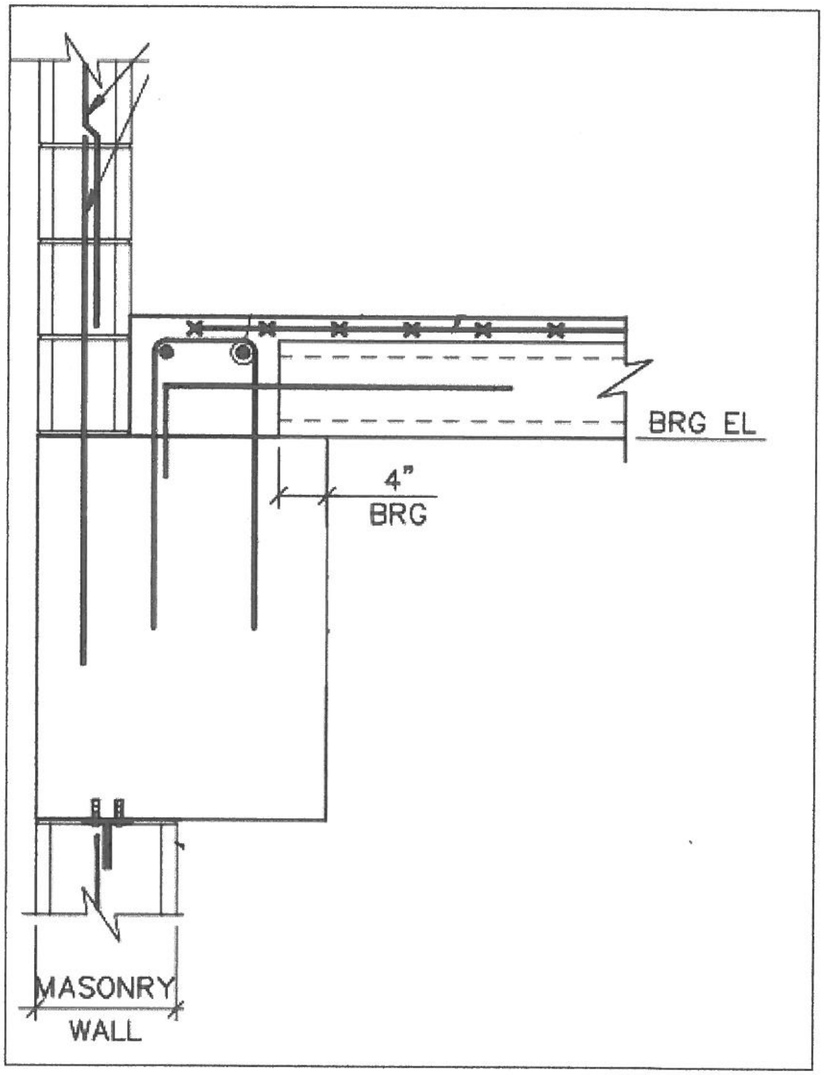
The VE team believes that precast roof plank would be a valid option for this project. Precast roof plank can provide equivalent strength and durability properties to CIP concrete. Using precast plank would reduce the construction duration and reduce the amount of construction traffic to and from the project site. The precast plank could be used in conjunction with the concrete moment frame and provide diaphragm action support.

If some of the other VE options are implemented, the concrete frame could potentially be eliminated and the concrete masonry units could be made load bearing.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 513,000	—	$ 513,000
ALTERNATIVE	$ 230,000	—	$ 230,000
SAVINGS (Original minus Alternative)	$ 283,000	—	$ 283,000

SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **SB-3**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **2 of 3**



COST WORKSHEET

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**

City of Portsmouth, NH

ALTERNATIVE NO.: **SB-3**

SHEET NO.: **3 of 3**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
CIP Concrete Roof Slab	CY	350	766.00	268,100			
Precast Roof Plank	SF				9,350	11.00	102,850
2" Grout Topping	CY				58	300.00	17,315
- quantities for estimate are based on area of roof estimate							
Subtotal				268,100			120,165
Markup (%) at 91.2%				244,507			109,590
TOTAL				512,607			229,755
TOTAL (ROUNDED)				513,000			230,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **SB-6**
DESCRIPTION:	**USE SUBMERSIBLE PUMP STATION IN LIEU OF DRY-PIT STATION AND RELOCATE PUMP STATION BETWEEN THE EXISTING PRIMARY CLARIFIER EFFLUENT DISTRIBUTION BOX AND THE PROPOSED SOLIDS BUILDING**	SHEET NO.: **1 of 8**

ORIGINAL DESIGN: (sketch attached)

The original design includes a dry-pit, submersible pump station situated in the southwest corner of the proposed Solids Building for pumping of the secondary influent. The proposed facility includes a partially below grade wet well structure (Invert El. 12.23) attached to the Solids Building, a pump gallery in the lower level of the Solids Building, and a room above on the upper level of the Solids Building to house the discharge piping, valves and common header. The upper level also contains four (4), 48-in. x 48-in. pump removal hatches and a dedicated overhead monorail and hoist. The common 24-inch-diameter SEC discharge header exits the Solids Building in the southeast corner and appears to run overhead on supports approximately 14 to 17 feet above grade (Cl El. 32.08), and then enters the west side of the BAF Facility approximately 16 to 17 feet below grade (Cl El. 1.25).

ALTERNATIVE: (sketch attached)

Provide a submersible pump station and locate it between the existing Primary Clarifier Effluent Distribution Box and the proposed Solids Building adjacent to the plant road. Add a valve vault and route the 24-inch-diameter SEC line below grade under the plant road to the east end of the BAF Facility. Shift the new exterior stair on the east side of the building to make room for the wet well.

ADVANTAGES:

- Reduces footprint of pump station
- Reduces size of Solids Building by eliminating pump gallery and valve room
- Moves pump station closer to the primary clarifiers
- Eliminates above ground piping and supports on southwest corner of site
- Eliminates potentially objectionable overhead pipe and supports from views from the southwest

DISADVANTAGES:

- May be less preferable for pump maintenance vs. a dry-pit arrangement
- A separate valve vault is required
- Requires longer length of buried 24-inch SEC under the plant road
- Increases potential for conflicts with other buried piping and utilities under the plant road
- Increases length of GTO piping

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 2,059,000	—	$ 2,059,000
ALTERNATIVE	$ 1,067,000	—	$ 1,067,000
SAVINGS (Original minus Alternative)	$ 992,000	—	$ 992,000

VALUE ENGINEERING ALTERNATIVE ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALTERNATIVE NO.: **SB-6**

DESCRIPTION: **USE SUBMERSIBLE PUMP STATION IN LIEU OF DRY-PIT STATION AND RELOCATE PUMP STATION BETWEEN THE EXISTING PRIMARY CLARIFIER EFFLUENT DISTRIBUTION BOX AND THE PROPOSED SOLIDS BUILDING**

ADVANTAGES: (continued)

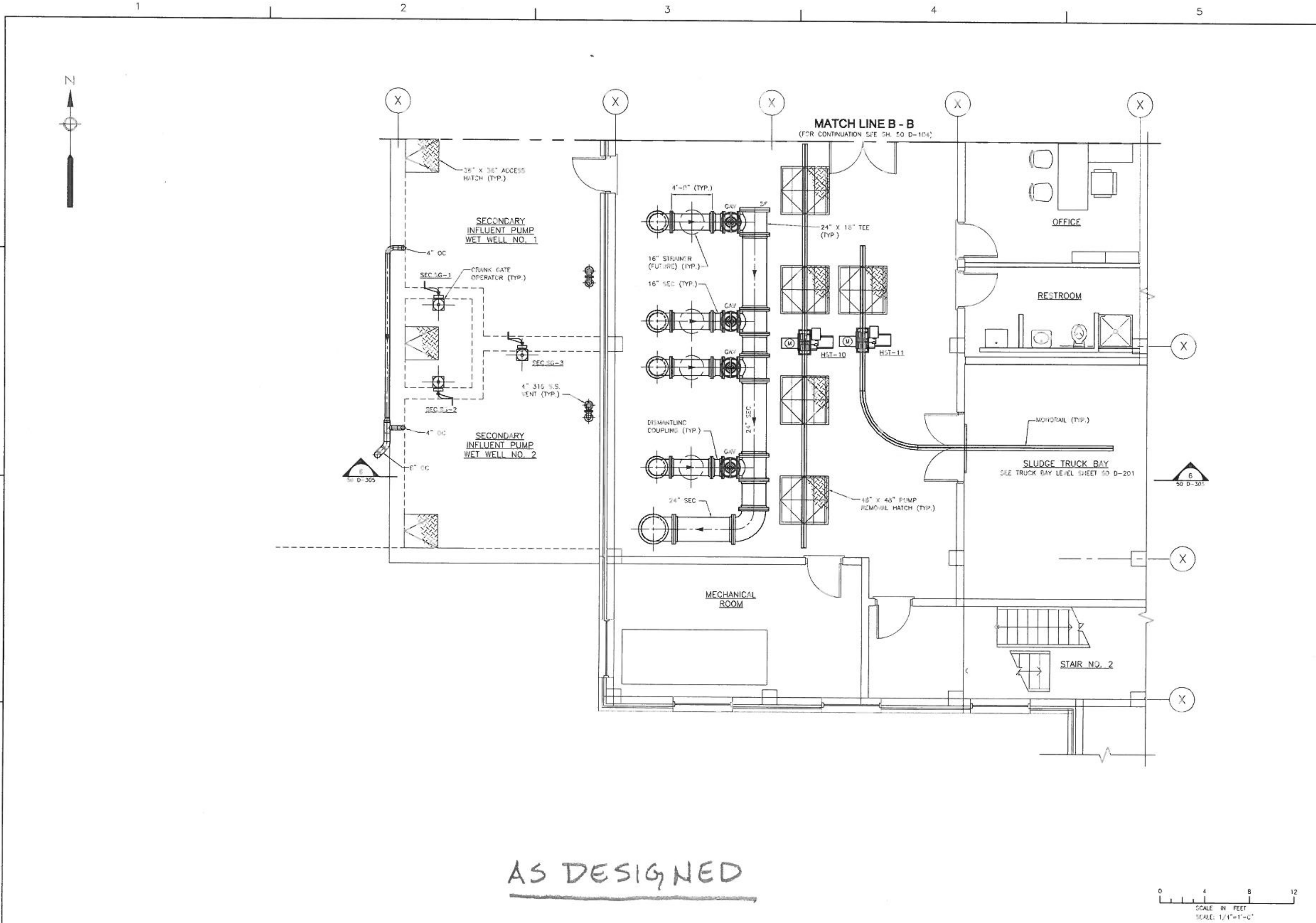
- Improves accessibility to the wet well from the main plant road for maintenance/ cleaning
- Improves accessibility to the carbon adsorber and fan on west side of Solids Building – can locate it closer to the plant road
- Reduces length of 36-inch PCE pipe required and avoids installing it beneath the Solids Building
- Would potentially allow truck bay area to be shifted to the west to provide more room in the plant road area for sludge truck maneuvering and accessibility
- Eliminates two access hatches
- Eliminates pump suction piping, fittings and valves

DISCUSSION:

The original Secondary Influent Pump Station is located remotely from the source of primary effluent on the west side of the Solids Building. This alternative moves the pump station closer to the primary clarifiers, increases accessibility from the plant road for maintenance, reduces the amount of 36-inch PCE pipe originally required, and eliminates the need to install the 36-in. PCE pipe below the building. By converting to a submersible pump station, the area within the Solids Building for the pump gallery and valve area can be eliminated or re-purposed/reconfigured for other needs within the Solids Building such as shifting the truck bays to the west to improve truck/accessibility to the building. The overall footprint of the Solids Building can likely be reduced.

A valve vault will be required adjacent to the pump station wet well, and a monorail with trolley/hoist would be required above the wet well for pump removal. While the 24-inch SEC line to the BAF Facility will now need to be buried and routed under the plant road, it eliminates the overhead pipe on supports (approximately 14 to 17 feet above grade) on the west side of the building that may have been objectionable to neighbors viewing the facility from the southwest. The odor control equipment for the Solids Building can also be shifted to the north and get it closer to the plant road to improve accessibility. When reducing the length of 36 in. PCE, consideration can be given to using a different pipe material than ductile iron.

ALT. NO.
SB-6
Sht. 3 of 8



AS DESIGNED

30% SUBMITTAL
PRELIMINARY COPY
NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

MARK	DATE	MADE BY	CHECKED	DESCRIPTION

REVISIONS

AECOM

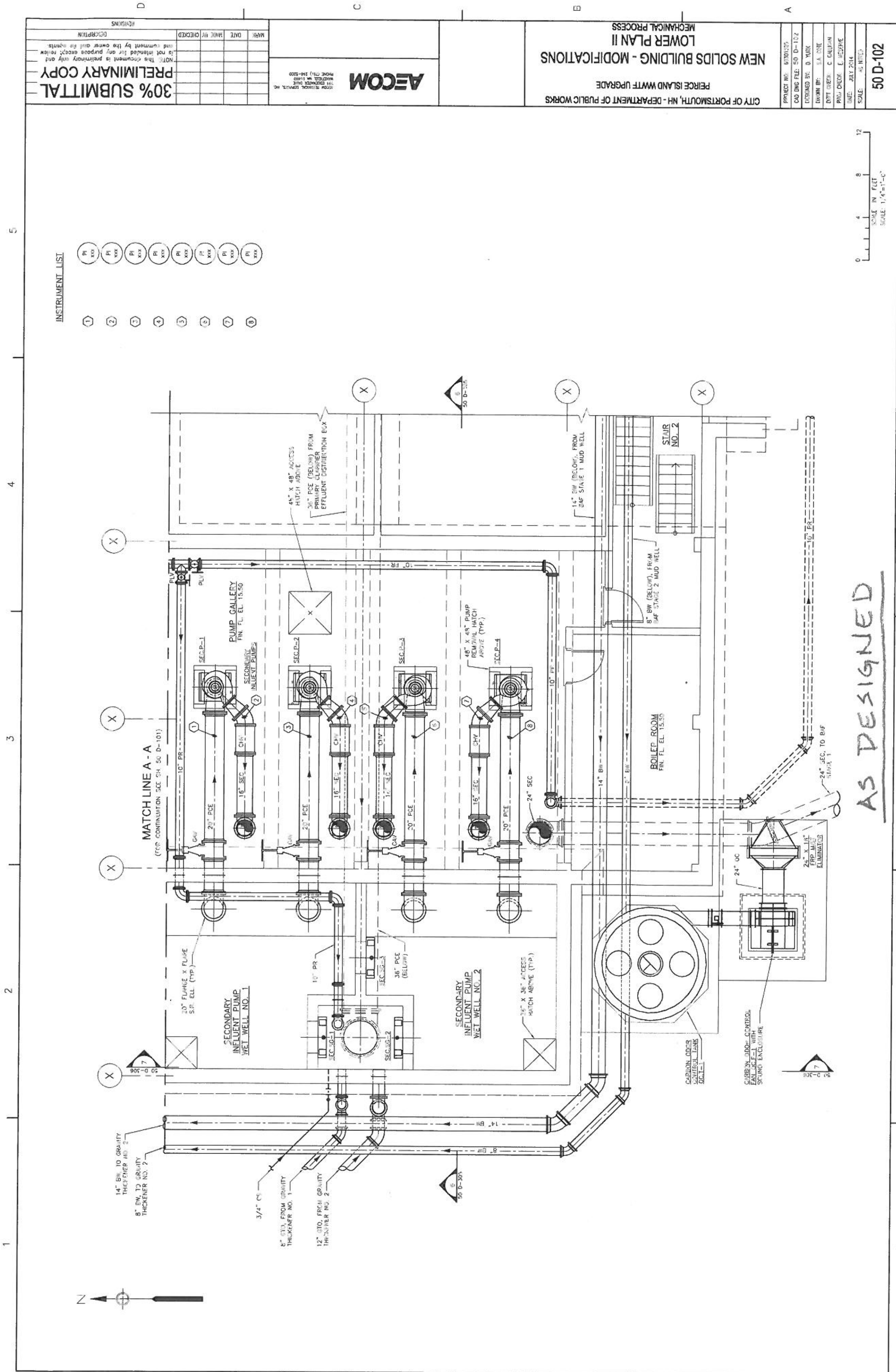
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE
NEW SOLIDS BUILDING - MODIFICATIONS
UPPER PLAN II
MECHANICAL PROCESS

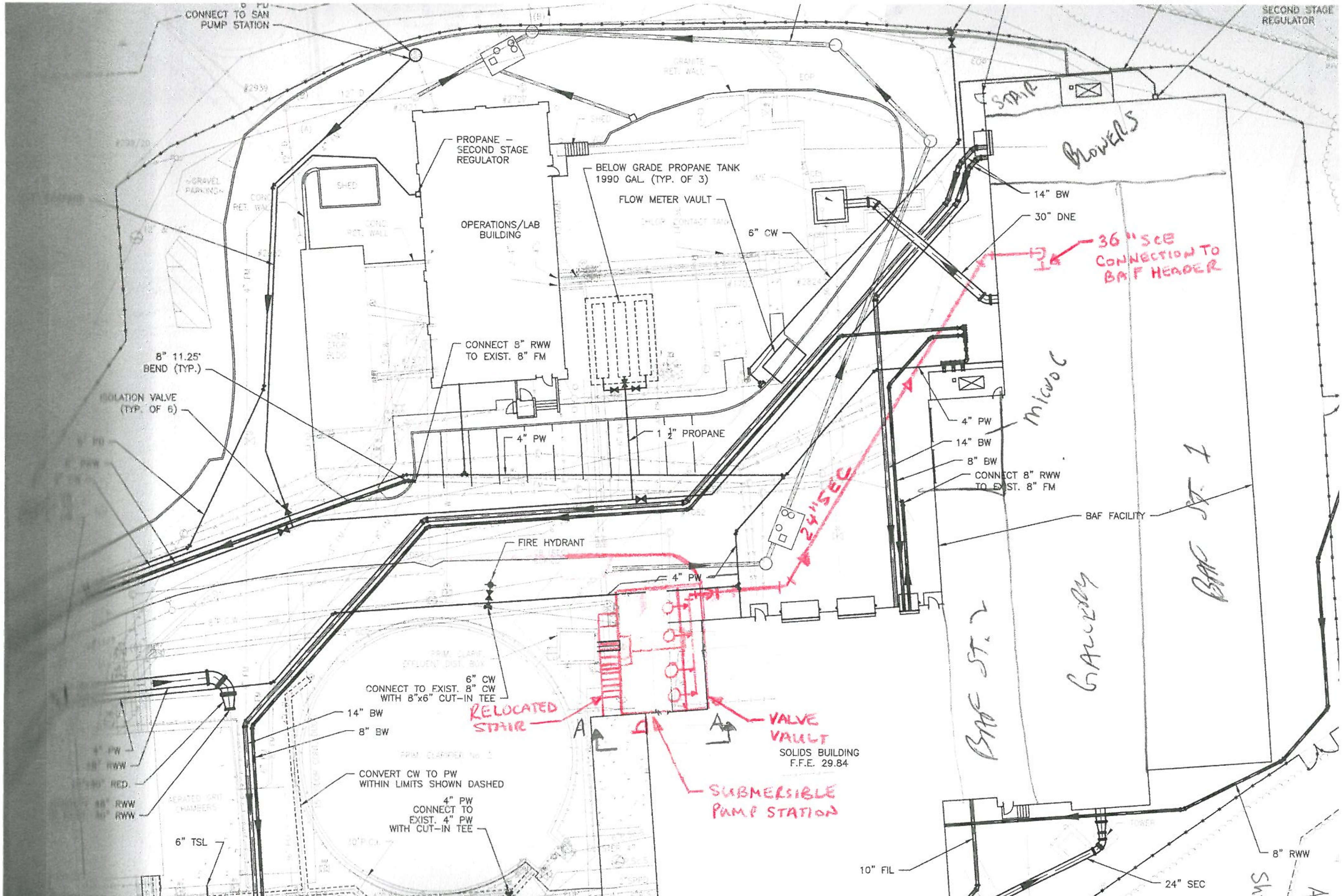
PROJECT NO:	60301525
CAD DWG FILE:	50 D-105
DESIGNED BY:	S. YURK
DRAWN BY:	S.A. COTE
DEPT CHECK:	D. GALLIGAN
PROJ CHECK:	E. WILCRIVE
DATE:	JULY 2014
SCALE:	AS NOTED

50 D-105

ANSI D - 15-Jul-14
LAST UPDATE: Tuesday, July 15, 2014 11:14:02 PM
PLOT DATE: Tuesday, July 15, 2014 2:35:50 PM

ALT. NO. SB-6
Sht. 4 of 8





MATCH LINE, SEE SHEET 00 C-116

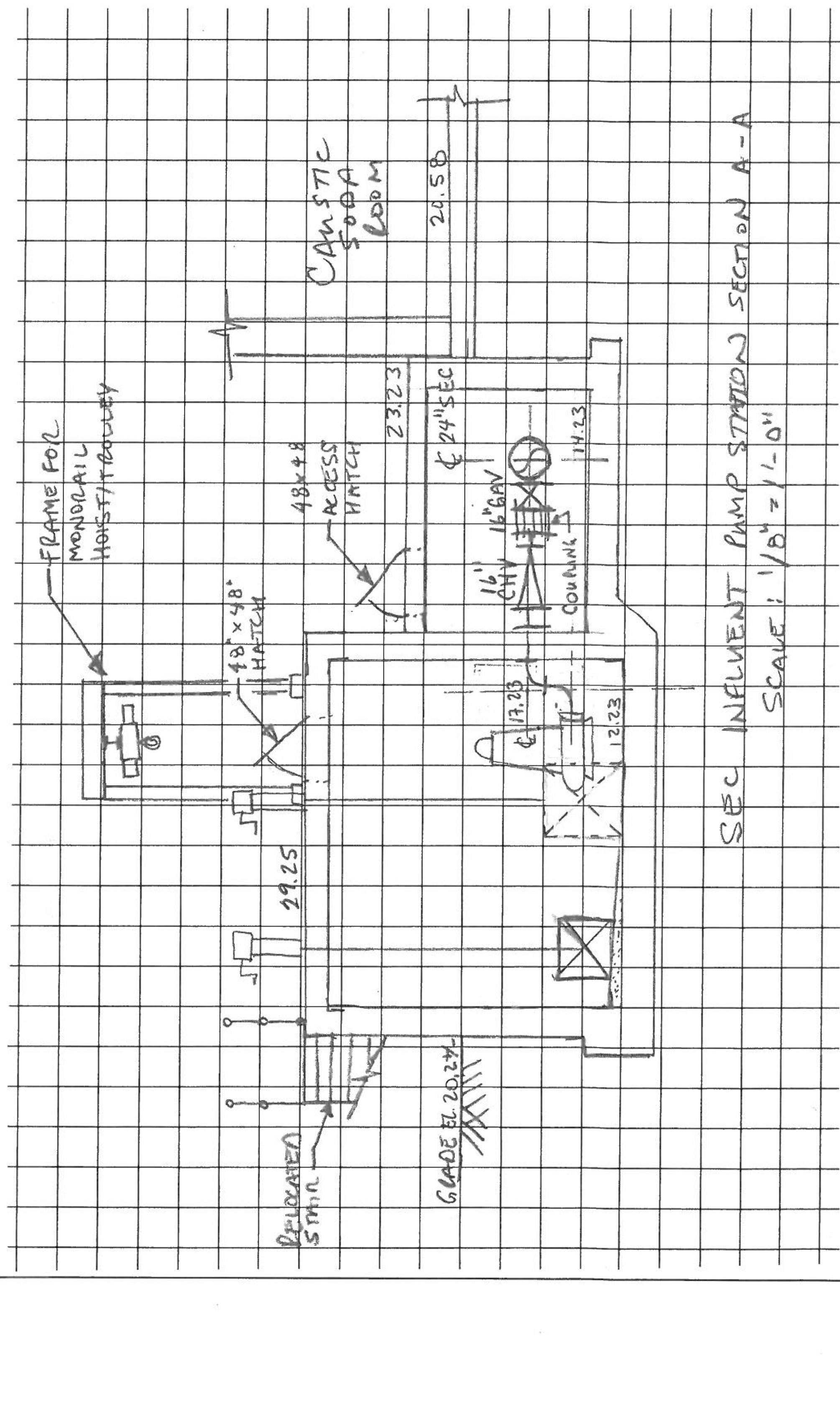
PLAN

SCALE: 1"=20'

ALT. NO. 5B-6
Sh. 5 of 8

SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **SB-6**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **6 of 8**



COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.:	**SB-6**
		SHEET NO.:	**7 of 8**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
36" PCE (Buried)	LF	34	330.63	11,241	10	330.63	3,306
36" PCE (Encased Under Bldg)	LF	150	430.00	64,500			
36" 90 MJ Elbow	EA	3	10,500.00	31,500	2	10,500.00	21,000
24" SEC (above grade)	LF	50	5.70	285			
24" SEC (buried)	LF	10	139.66	1,397	135	139.66	18,854
24" SEC Trenching & Hauling (Rock)	CY	25	131.51	3,288	150	131.51	19,727
24"45 MJ Elbow	EA	3	4,780.00	14,340	4	4,780.00	19,120
24" SEC OH Pipe Supports/Foundation	EA	4	10,000.00	40,000			
Valve Vault (12'x30'x8')							
Foundation Concrete	CY				20	693.00	13,860
Elevation Slab/Beam	CY				20	819.00	16,380
Walls	CY				25	756.00	18,900
Pump Gallery and Valve Room							
Foundation Concrete	CY	72	693.00	49,896			
Elevation Slab/Beam	CY	82	819.00	67,158			
Walls	CY	288	756.00	217,728	144	756.00	108,486
Pump Pads	CY	2	756.00	1,512			
Roof	SF	23	1,292.00	29,716			
Int. Double Door	EA	1	1,829.00	1,829			
Interior CMU (8")	SF	1,368	18.00	24,624			
Pump Suction Piping							
20" 90 Flare Elbows	EA	4	5,800.00	23,200			
20" Gate Valves	EA	4	11,125.00	44,500			
20" SEC (12ft L Flanged)	EA	4	3,800.00	15,200			
20"x12" Reducing Elbows	EA	4	6,000.00	24,000			
Access Hatches	SF	82	163.00	13,366	80	163.00	13,040
Subtotal				679,280			252,673
Markup (%) at							
TOTAL				679,280			252,673
TOTAL (ROUNDED)				679,000			253,000

COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.: **SB-6** SHEET NO.: **8 of 8**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Subtotal from Previous Page				679,280			252,673
12" GTO Pipe	LF	80	66.00	5,280	160	66.00	10,560
12" GTO Excav/Backfill/Bed	CY	80	43.00	3,440	160	43.00	6,880
Pump Gallery and Valve Rm Lighting	SF	1,300	15.00	19,500			
Steel Frame for Monorail Support	LS				1	10,500.00	10,500
Building HVAC	LS	1	369,600.00	369,600	1	277,200.00	277,200
Subtotal				1,077,100			557,813
Markup (%) at	**91.2%**			982,315			508,725
TOTAL				2,059,415			1,066,538
TOTAL (ROUNDED)				2,059,000			1,067,000

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
OPS/LAB BUILDING						
OL-5	Incorporate the wheelchair lift into the Ops/Lab Building envelope	DESIGN SUGGESTION				
OL-7	Reuse the existing Sludge Building encapsulating PCBs	$5,475,000	$3,534,000	$1,941,000		$1,941,000
OL-9	Reuse existing laboratory furniture and equipment to the extent practical	DESIGN SUGGESTION				
OL-10	Reuse the existing Sludge Building substructure by encapsulating the PCBs and reconstruct the area above the first floor for use as the operations/ laboratory space	$5,475,000	$3,739,000	$1,736,000		$1,736,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **OL-5**
DESCRIPTION:	**INCORPORATE THE WHEELCHAIR LIFT INTO THE OPERATIONS AND LABORATORY BUILDING ENVELOPE**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN: (sketch attached)

The current design includes an exterior wheelchair lift on the west side of the upper level plan of the Operations and Laboratory Building contiguous with the stair landing.

ALTERNATIVE:

Redesign the vestibule of the building to include an interior accessed wheelchair lift.

ADVANTAGES:

- Relocates the lift to a protected environment
- Minimizes maintenance
- Extends the life of the lift
- Visually more aesthetically pleasing if the lift is designed as part of the building

DISADVANTAGES:

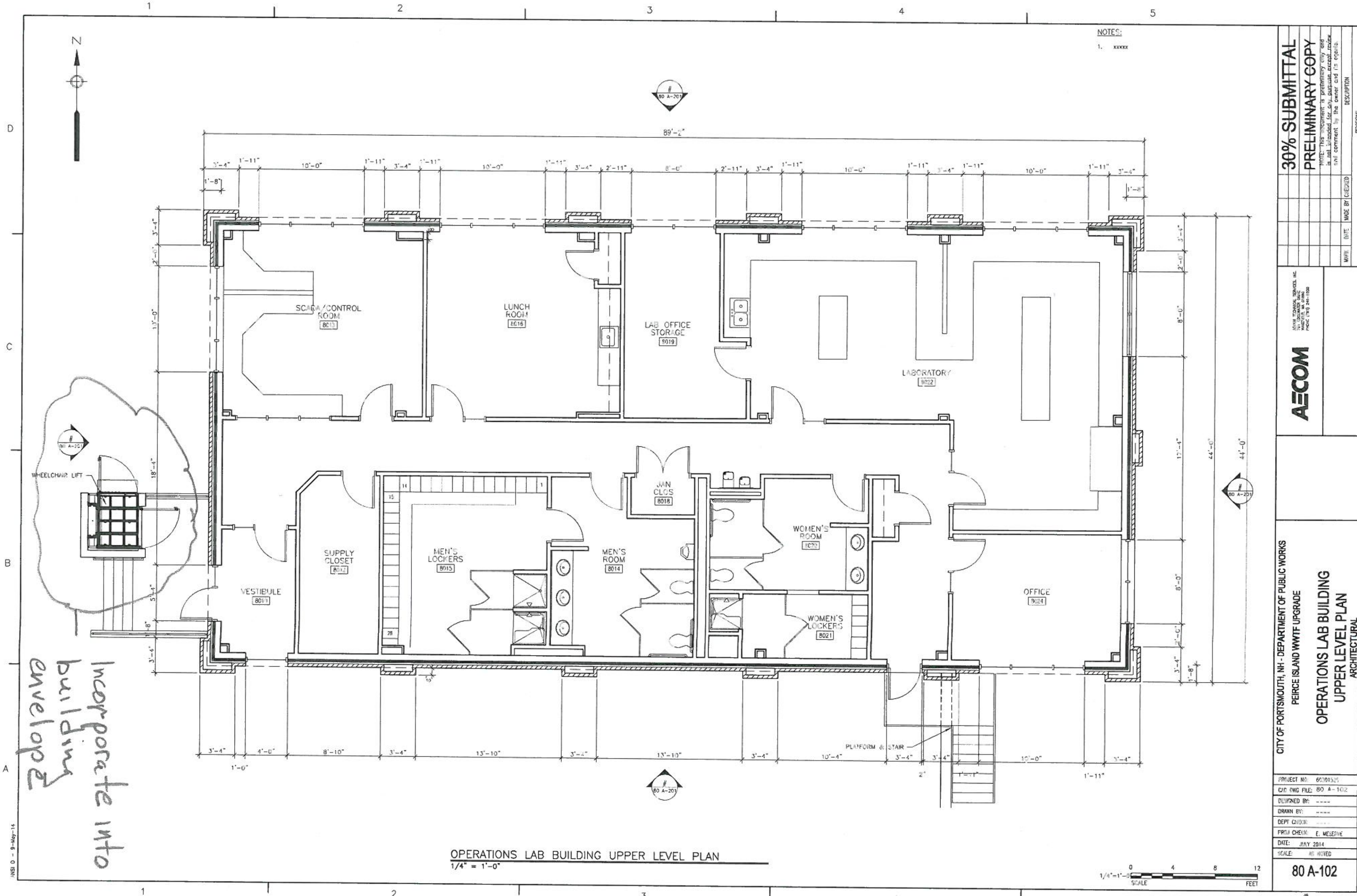
- Reduces the interior square footage of the building
- Additional cost associated with an interior installation
- Reconfiguration of the entry vestibule is required

DISCUSSION:

The current proposed location of the wheelchair lift is on the exterior of the building. This location is not protected from the environment. Over the life of the lift, it will incur additional maintenance and will need to be replaced sooner than later.

There will be an additional cost and a reduction of square footage associated with installing the lift in the interior, but these minor disadvantages far outweigh the multiple maintenance needs that will be required and the reduction in the operating life of the lift.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS (Original minus Alternative)			



Incorporate into building envelope

ALT. NO OL-5
Sht. 2 of 2

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **OL-7**
DESCRIPTION:	**REUSE THE EXISTING SLUDGE BUILDING BY ENCAPSULATING PCBs**	SHEET NO.: **1 of 3**

ORIGINAL DESIGN:

The original design calls for the entire existing Sludge Processing Building to be demolished and construct a new Operations and Laboratory Building in the same location.

ALTERNATIVE: (sketch attached)

Reuse the existing Sludge Building substructure and superstructure for the Operations and Laboratory Building. To address the PCBs in the lower level, encapsulate all exposed concrete containing PCBs with a 6-inch-thick concrete layer.

ADVANTAGES:

- Reduces construction cost
- Reduces construction traffic by eliminating vehicle trips by trucks carrying demolished material, concrete trucks, trucks carrying formwork and reinforcing steel and vehicles carrying workers
- Will not expose workers to PCBs
- Improves sustainability

DISADVANTAGES:

- Results in a 5% reduction in building size

DISCUSSION:

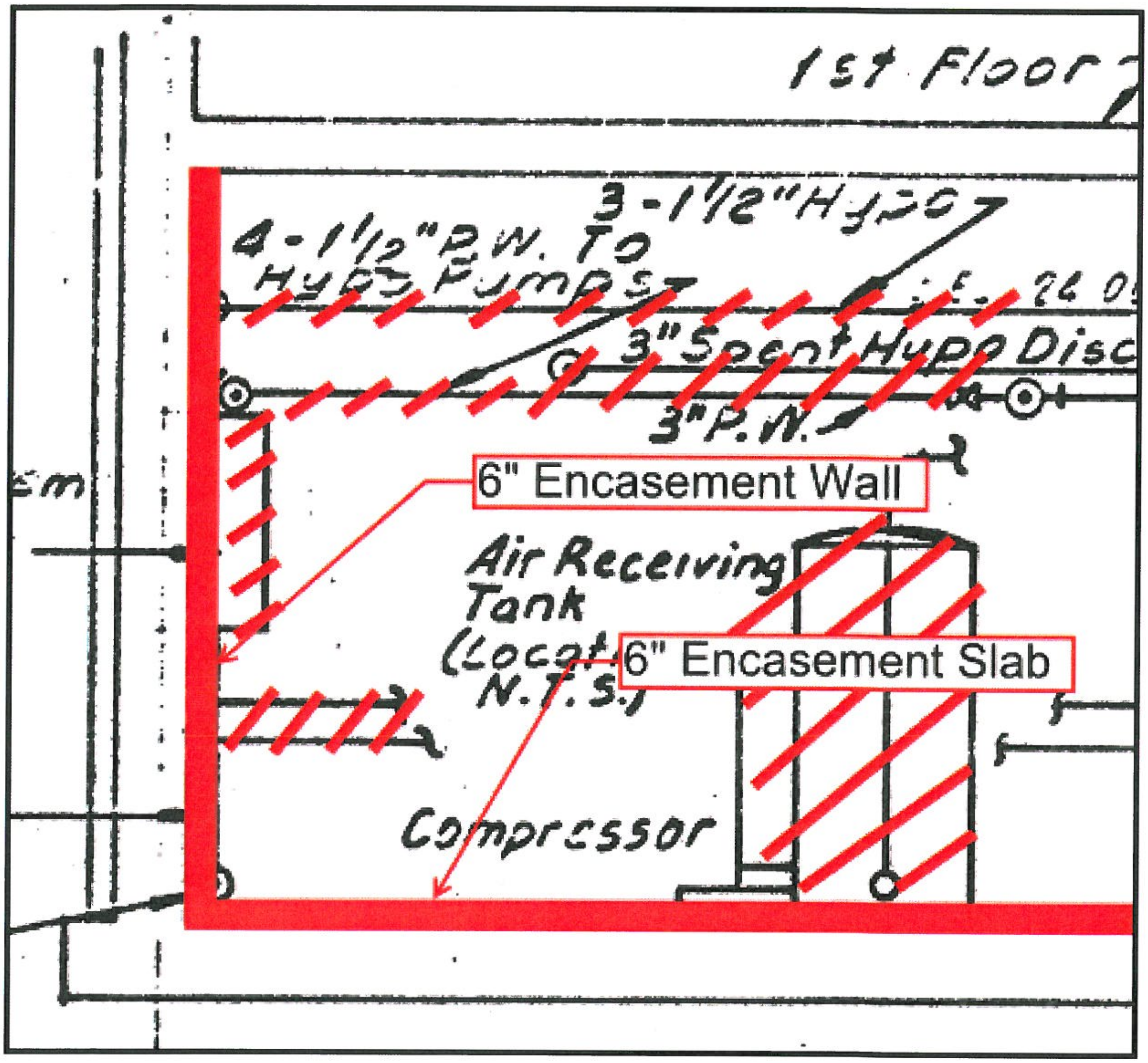
With one of the goals of the project being to improve sustainability, one opportunity to achieve this goal is to reuse the existing Sludge Building for the Operations and Laboratory Building. Since the proposed Operations and Laboratory Building is similar in size to the existing Sludge Building (only 5% smaller in footprint), it provides an excellent opportunity to improve sustainability.

To address the PCBs, the VE team proposes encapsulating the PCBs with concrete. Encapsulating with concrete would be more economical than removing and replacing. The proposed alternate is to fully clear out the first floor and basement, and then provide similar finishes as currently proposed in the 30% design. Based on the VE team's site visit, the substructure was in good condition (other than the PCBs) and would be a good candidate for repurposing. With the right finishes/treatments, the VE team is not concerned with odors.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 5,475,000	—	$ 5,475,000
ALTERNATIVE	$ 3,534,000	—	$ 3,534,000
SAVINGS (Original minus Alternative)	$ 1,941,000	—	$ 1,941,000

SKETCH ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*		ALTERNATIVE NO.: **OL-7**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **2 of 3**



COST WORKSHEET

ARCADIS

PROJECT:	PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE *City of Portsmouth, NH*	ALTERNATIVE NO.: **OL-7** SHEET NO.: **3 of 3**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Current O / L Building Cost	LS	1	2,863,503.37	2,863,503			
Clean Up and Remove Debris Lower Level	LS				1	27,000.00	27,000
Clean Up and Remove Debris Upper Level	LS				1	35,000.00	35,000
6" Thick Concrete to Contain PCBs in Wall	CY				80	800.00	64,000
6" Thick Concrete to Contain PCBs on Foundation	CY				65	350.00	22,750
New Lower Level Work	LS				1	310,000.00	310,000
New 1st Floor Interior Construction	LS				1	225,000.00	225,000
New Roof Membrane	SF				3,500	25.00	87,500
HVAC	LS				1	285,000.00	285,000
Plumbing	LS				1	42,000.00	42,000
SCADA	LS				1	750,000.00	750,000
Laboratory Equipment (did not appear to be in 30% construction cost estimate, so was not included in this comparsion)							
Subtotal				2,863,503			1,848,250
Markup (%) at 91.2%				2,611,515			1,685,604
TOTAL				5,475,018			3,533,854
TOTAL (ROUNDED)				5,475,000			3,534,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **OL-9**
DESCRIPTION:	**REUSE EXISTING LABORATORY FURNITURE AND EQUIPMENT TO THE EXTENT PRACTICAL**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

It is unclear in the 30% design documents whether the new laboratory in the Operations and Laboratory Building will be equipped with new equipment or make use of existing laboratory furniture and equipment.

ALTERNATIVE:

Consider reusing laboratory furniture and equipment to the extent practical.

ADVANTAGES:

- Potential cost savings
- Improves sustainability
- Reduces waste materials
- Materials reused on site will reduce/minimize vehicle trips through the City

DISADVANTAGES:

- Potentially reduces longevity of equipment
- Equipment will have to be stored once the existing laboratory is demolished and reinstalled when the new facility is ready for it based on the current sequence of construction

DISCUSSION:

This alternative offers an opportunity to reuse existing equipment and furniture and enhance the sustainability aspects of the project.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **OL-10**
DESCRIPTION:	**REUSE THE EXISTING SLUDGE BUILDING SUBSTRUCTURE BY ENCAPSULATING PCBs AND RECONSTRUCT THE AREA ABOVE THE FIRST FLOOR FOR USE AS OPERATIONS AND LABORATORY SPACE**	SHEET NO.: **1 of 3**

ORIGINAL DESIGN:

The original design calls for the entire Sludge Processing Building to be demolished and construction of a new Operations and Laboratory Building in the same location.

ALTERNATIVE: (sketch attached)

Reuse the existing Sludge Building basement, demolish the building above the first floor and reconstruct it for reuse as the operations and laboratory area. To address the PCBs in the lower level, encapsulate all exposed concrete containing PCBs with 6-inch-thick concrete.

ADVANTAGES:

- Reduces construction cost
- Reduces construction traffic by eliminating removal of debris and bringing in new concrete and forms for installing the concrete
- Will not expose workers to PCBs
- Improves sustainability

DISADVANTAGES:

- Results in a 5% reduction in building size

DISCUSSION:

With one of the goals of the project being to improve sustainability, one opportunity to achieve this goal would be to reuse the existing Sludge Building Substructure and repurpose it for the Operations and Laboratory Building. Since the proposed Operations and Laboratory Building is similar in size to the existing Sludge Building (only 5% smaller in footprint), it is an excellent opportunity to improve sustainability.

To address the PCBs, the VE team proposes to encapsulate the PCBs with concrete. Encapsulating with concrete would be more economical than removing and replacing. The proposed alternate is to demolish the superstructure, fully clear out the basement, and then provide similar finishes and superstructure as currently proposed in the 30% design. Based on the VE team's site visit, the substructure was in good condition (other than the PCBs) and would be a good candidate for repurposing. With the right finishes/treatments, the VE team is not concerned about odors.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 5,475,000	—	$ 5,475,000
ALTERNATIVE	$ 3,739,000	—	$ 3,739,000
SAVINGS (Original minus Alternative)	$ 1,736,000	—	$ 1,736,000

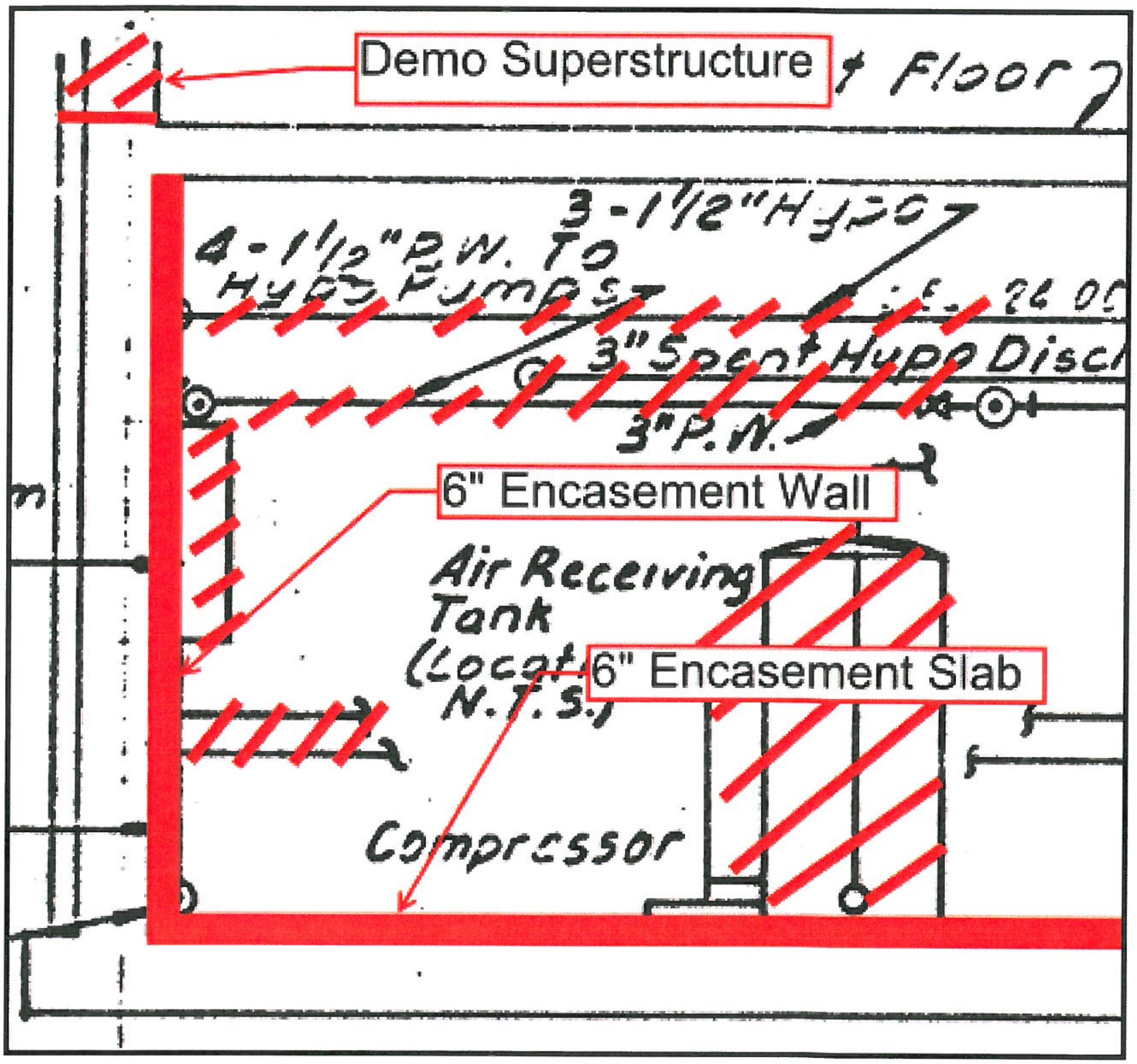
SKETCH ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALTERNATIVE NO.: **OL-10**

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒ BOTH ☐

SHEET NO.: **2 of 3**



COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
	City of Portsmouth, NH
ALTERNATIVE NO.:	**OL-10**
SHEET NO.:	**3 of 3**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Current O / L Building Cost	LS	1	2,863,503.37	2,863,503			
Clean Up and Remove Debris Lower Level	LS				1	27,000.00	27,000
Clean Up and Remove Debris Upper Level	LS				1	35,000.00	35,000
Demo of Superstructure	LS				1	35,000.00	35,000
6" Thick Concrete to Contain PCBs in Wall	CY				80	800.00	64,000
6" Thick Concrete to Contain PCBs on Foundation	CY				65	350.00	22,750
New Lower Level Work	LS				1	310,000.00	310,000
New 1st Floor Interior Construction	LS				1	235,000.00	235,000
New 1st Floor Exterior Construction	LS				1	150,000.00	150,000
HVAC	LS				1	285,000.00	285,000
Plumbing	LS				1	42,000.00	42,000
SCADA	LS				1	750,000.00	750,000
Laboratory Equipment (did not appear to be in 30% construction cost estimate, so was not included in this comparsion)							
Subtotal				2,863,503			1,955,750
Markup (%) at	**91.2%**			2,611,515			1,783,644
TOTAL				5,475,018			3,739,394
TOTAL (ROUNDED)				5,475,000			3,739,000

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

				PRESENT WORTH OF COST SAVINGS		
ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
ELECTRICAL						
E-2	Use a closed transition in lieu of an open transition automatic transfer switch	DESIGN SUGGESTION				
E-3	Use an above ground storage tank in lieu of an underground storage tank for the generator diesel fuel	DESIGN SUGGESTION				
E-4	Reduce size (rating) of the incoming power transformer, automatic transfer switch, generator and service entrance rated switchboard	$1,741,000	$1,389,000	$352,000		$352,000
E-5	Reuse existing transformer and use outdoor automatic transfer switch, switchboard and generator	$2,468,000	$1,414,000	$1,054,000		$1,054,000
E-6	Develop an electrical demand limiting procedure	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **E-2**
DESCRIPTION:	**USE A CLOSED TRANSITION IN LIEU OF AN OPEN TRANSITION AUTOMATIC TRANSFER SWITCH**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

Per the 30% Final Design Report, an open transition 3000 amp automatic transfer switch (ATS) is being specified in the electrical distribution system.

ALTERNATIVE:

Use a 3000 amp, 100 millisecond closed transition ATS in lieu of the open transition ATS.

ADVANTAGES:

- Plant will continue to operate without interruption when exercising the generator and ATS

DISADVANTAGES:

- Closed transition ATS is slightly more expensive

DISCUSSION:

Presently, an open transition ATS is prescribed in the electrical design. As a result, when switching from utility power to generator power while exercising the generator and ATS or when transferring from generator to utility power after exercising the generator, power will be lost to every load in the plant, meaning that every piece of equipment will have to be restarted. Since it is recommended by manufacturers and NFPA 110 that generators be tested under load every month and that the ATS be exercised regularly, this frequent restarting of the plant twice for the monthly generator exercising (once when going from utility to generator and once when transferring from generator back to utility) can cause process upsets and unnecessary work for the operators.

A 100 millisecond (ms) closed transition ATS simply ties the utility and the generator sources together for 100 ms or less so that the plant receives continuous power and does not experience the power outage during generator exercising. Almost without exception, this is permitted by utility companies without additional provisions being required by the utility.

At least one vendor has indicated that their ATS controller can be programmed for either open transition or 100 ms closed transition at no additional cost.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **E-3**
DESCRIPTION:	**USE AN ABOVE GROUND STORAGE TANK RATHER THAN AN UNDERGROUND STORAGE TANK FOR THE GENERATOR DIESEL FUEL**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

The present design includes a 5,000 gallon underground fuel storage tank (UST) for the generator.

ALTERNATIVE:

Use an above ground storage tank (AST) rather than a UST.

ADVANTAGES:

- On-going testing and reporting effort and costs are typically less with an AST

DISADVANTAGES:

- AST will take up space on this very tight plant site

DISCUSSION:

In the present design, a 5,000 gallon UST is shown to store the diesel fuel for the standby generator. As with all USTs, EPA regulations require regular testing of USTs to insure integrity, similar to the testing we all often see at gasoline fueling stations. This is true even with double-walled tanks equipped with interstitial monitoring. The test results then have to be recorded and tracked. A different set of regulations, typically less stringent and costly, cover ASTs.

Due to the difference between both initial installation costs and the ongoing compliance costs, aboveground storage tanks (ASTs) are said to have grown in popularity by 100 percent in the last five years.

Since the decision between ASTs and USTs is dependent upon Federal, State and local regulations, each installation must be evaluated on a case-by-case basis, and is outside the scope of this Value Engineering (VE) analysis. But this VE suggestion recommends evaluating not only the initial installation costs, but also the on-going cost of each alternative to determine the best option for this facility.

A guide to help in this decision, developed by the Steel Tank Institute, can be found at http://waste360.com/mag/waste_equipment_ust_ast as well as at the Institute itself.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **E-4**
DESCRIPTION:	**REDUCE THE SIZE (RATING) OF THE INCOMING POWER TRANSFORMER, AUTOMATIC TRANSFER SWITCH, GENERATOR AND SERVICE ENTRANCE RATED SWITCHBOARD**	SHEET NO.: **1 of 3**

ORIGINAL DESIGN:

The present design prescribes a 1500 kVA transformer, a 1500 kW generator, a 3000 amp automatic transfer switch, and a 3000 amp service entrance rated switchboard.

ALTERNATIVE:

Resize these components to a 1000 kVA transformer, a 1250 kW generator, a 2000 amp automatic transfer switch (ATS), a 2000 amp service entrance rated switchboard, and the ampacity of the cables interconnecting this equipment.

ADVANTAGES:

- Reduces capital cost without compromising reliability or functionality

DISADVANTAGES:

- None apparent

DISCUSSION:

While it is recognized that the project design is at only 30%, it appears there is an opportunity to reduce the rating and cost of the major electrical distribution equipment.

There are two pieces of information that suggest this may be possible. First, the 30% Final Design Report, paragraph 17.8.5 notes that the peak power demand for the existing facility in August 2013 was 116 kVA. Second, the Portsmouth, NH, Peirce Island WWTF PRELIMINARY Yearly Energy Calculation dated August 5, 2014, indicates a projected 644 kW loading plus plant wide HVAC load. This number assumes three 200 HP blowers running at 50% output. Even if these three blowers were to run at 100% output (a highly unlikely situation), this would result in 944 kW. Historically, this author has found that actual power bill demand has been between 30% and 70% of the calculated demand. Note that the electrical demand power on the August power bill was only 116KVA/1000 KVA = 12% of the existing transformer rating.

Electric utility companies often operate their transformers at or over their rating for extended periods of time, knowing that the life of the transformer will be slightly reduced through operating above their rating, but also know that this makes the most economic sense for them.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,741,000	—	$ 1,741,000
ALTERNATIVE	$ 1,389,000	—	$ 1,389,000
SAVINGS (Original minus Alternative)	$ 352,000	—	$ 352,000

DISCUSSION: (continued)

Assuming the worst case of 1000 kW demand (944 kW as suggested above plus 30kW for HVAC loads) (1333 amps at 90% power factor) as calculated above, a 1000 kW (1250 amps) transformer with a 2000 amp transfer switch and service entrance rated switchboard, and a 1250 kW (1875 amps) generator will be more than amply rated. Further analysis as the design develops could dictate a 1000 kW generator would be sufficient, which would save even more capital cost.

A reduced size generator would also require less diesel fuel stored on site to power the generator for 48 hours as well as perhaps a smaller fuel storage tank.

COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.:	**E-4**
		SHEET NO.:	**3 of 3**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
3000 amp ATS (no $ in estimate)	EA	1	41,000.00	41,000			
2000 amp ATS	EA				1	30,000.00	30,000
3000 amp Switchboard	EA	1	58,200.00	58,200			
2000 amp Switchboard	EA				1	34,200.00	34,200
1500 kW Generator	EA	1	500,000.00	500,000			
1250 kW Generator	EA				1	450,000.00	450,000
Interconnecting Cables & Conduits	LOT	1	291,000.00	291,000	1	194,970.00	194,970
Diesel Fuel	GALLONS	5,000	4.08	20,400	4,200	4.08	17,136
Subtotal				910,600			726,306
Markup (%) at	**91.2%**			830,467			662,391
TOTAL				1,741,067			1,388,697
TOTAL (ROUNDED)				1,741,000			1,389,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALTERNATIVE NO.: **E-5**

DESCRIPTION: **REUSE THE EXISTING TRANSFORMER AND USE OUTDOOR AUTOMATIC TRANSFER SWITCH, SWITCHBOARD, AND GENERATOR**

ORIGINAL DESIGN:

Install a new 1500 kVA transformer south of the new Headworks Building, and install the automatic transfer switch (ATS), main switchboard, and generator in the new Headworks Building with a 5000 gallon underground diesel fuel storage tank located in the parking lot. Run electrical feeders to other buildings from the Headworks Building switchboard.

ALTERNATIVE: (sketch attached)

Reuse the existing 1000 kVA transformer (see rational in Alt. No. E-4). Install the ATS and main electrical distribution switchboard in a factory fabricated outdoor enclosure located near the existing chlorine contact tank. Run all new building cables radially from the new switchboard. Locate the 1250 kW generator (see Alt. No. E-4) in an outdoor enclosure near the new outdoor switchgear.

ADVANTAGES:

- Reduces capital cost
- Main electrical distribution is more central to the plant electrical load
- Installing the new electrical distribution system does not depend on constructing the new Headworks Building before starting demolition of the Filter Building, thus shortening the construction schedule

DISADVANTAGES:

- Electrical switchgear and generator are in outdoor enclosures instead of housed in the Headworks Building

DISCUSSION:

From the electrical load analysis (Alt. No. E-4), the entire plant will be able to be fed from a 1000 kVA transformer. The existing transformer is a 1000 kVA.

The most cost effective electrical design is accomplished when the main electrical distribution point is located closest to the largest electrical loads. For this facility, the largest loads are the four 200 HP BAF blowers. All other building electrical loads are nominal in comparison. Therefore the optimum location for the main electrical distribution equipment for this site is close to the BAF building.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 2,468,000	—	$ 2,468,000
ALTERNATIVE	$ 1,414,000	—	$ 1,414,000
SAVINGS (Original minus Alternative)	$ 1,054,000	—	$ 1,054,000

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **E-5**
DESCRIPTION:	**REUSE EXISTING TRANSFORMER, USE OUTDOOR ATS, SWITCHBOARD, AND GENERATOR**	SHEET NO.: **2 of 4**

DISCUSSION:

As designed, due to scheduling constraints, the ATS, the main distribution switchboard, and the generator are shown located in the Headworks Building. The schedule prescribes that the Headworks Building is to be constructed early in the project so that the Filter Building, where the existing electrical distribution switchgear is now located, can be demolished. However, this means that the main electrical distribution equipment is located about as far from the largest plant electrical loads as possible. Due to the large power cable duct banks that must be run to power the largest loads, this configuration becomes costly to construct. Further, the sequence of construction requires that the new Headworks Building be built and the main electrical system be operational before the existing Filter Building demolition can start.

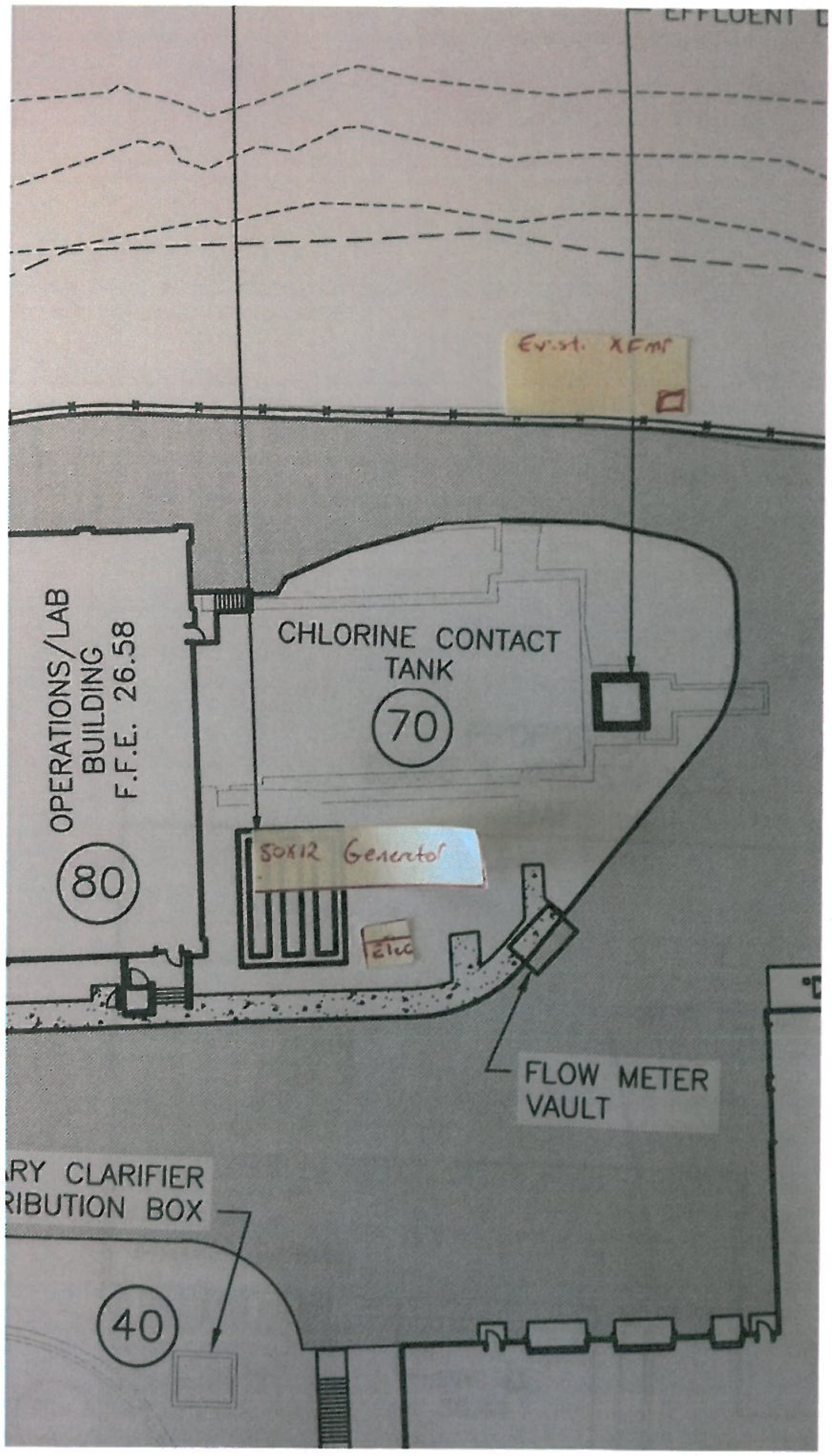
Under this alternative, a new ATS and switchboard would be installed in an outdoor, factory fabricated enclosure located near the existing chlorine contact tank. The generator would be installed in its own outdoor enclosure, complete with sub-base ("belly") fuel tank. This configuration will locate the main electrical equipment very close to the large BAF electrical load, and would allow radial feeders to the other buildings.

Since the new ATS, main electrical switchgear, and generator will be installed in an area where minimal demolition will be required, and since this electrical gear can be installed and operational concurrently with the new Headworks Building construction, demolition of the existing Filter Building can be moved forward on the schedule, thus potentially shorting the overall construction schedule. Further, moving the ATS, main switchgear, and generator into their own enclosures allows the size of the Headworks Building to be reduced. See Alt. No. H-16 for more details.

Given that the existing transformer is fed by an overhead pole line from across the water that can no longer be used, a new overhead pole line from the swimming pool area to the existing transformer will be required. It is assumed in this alternative that PSNH will provide this overhead pole line.

SKETCH ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*		ALTERNATIVE NO.: **E-5**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **3 of 4**



COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.: **E-5** SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Locate generator outdoors (from Alt. No. H-16)	LOT	1	349,000.00	349,000	1	210,000.00	210,000
Add outdoor enclosure for ATS, switchgear	EA				1	70,000.00	70,000
Reduced electrical feeder cable and ductbank costs within the fence	LOT	1	689,592.00	689,592	1	459,728.00	459,728
Delete the underground duct bank from the pool to the plant fence line (See Alt. No. C-1). Use overhead pole line instead.	LOT	1	252,000.00	252,000	1	Installed by PSNH	
Subtotal				1,290,592			739,728
Markup (%) at	**91.2%**			1,177,020			674,632
TOTAL				2,467,612			1,414,360
TOTAL (ROUNDED)				2,468,000			1,414,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **E-6**
DESCRIPTION:	**DEVELOP AN ELECTRICAL DEMAND LIMITING PROCEDURE**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

Provide an electrical distribution system that allows all equipment to operate at any and all times as designated by the plant operating staff.

ALTERNATIVE:

Develop an electrical demand limiting procedure that would including running solids handling processes during nighttime hours to reduce electrical demand costs.

ADVANTAGES:

- Reduces operating cost

DISADVANTAGES:

- Requires a conscious decision as to when to operate the solids processing equipment
- Requires staffing when flows are lower (nighttime)

DISCUSSION:

Power bills are comprised primarily of two components – the total amount of energy used for the month (kWH) and the maximum amount of energy used in any 15 or 30 minute demand interval (i.e. maximum rate of usage during the month). PSNH electrical demand rates are substantial at $12 per kVA. (For reference, one KVA is roughly equal to a 1 HP operating at full load). Since electrical demand is normally based on either 15 or 30 minute demand intervals, the highest amount of electrical demand (i.e. HP running) in any one demand interval dictates the electrical demand cost for the entire month's bill. Therefore, it is extremely important to limit the electrical demand as much as is consistent with viable plant operation in order to reduce electrical costs.

With four 200 HP BAF blowers (three duty, one standby), plus other new equipment requiring power, the electrical usage has been calculated as almost seven times the present energy usage per month. Electrical demand charges for future operation will also be much greater than present. Therefore, elimination or postponement of the operation of any loads when the plant is operating near peak electrical load can save substantial money in each electrical bill. Since the liquid flow processes must be continuous to handle incoming flow, equipment required to process liquid flow cannot be postponed. However, since solids processing is only operated eight hours per day, this processing could be postponed until the nighttime hours when the liquids flows are lower and thus are requiring less energy. From a preliminary analysis, it appears that the operation of approximately 60 HP of equipment could be delayed until the nighttime. By operating solids equipment at night, electrical demand charges could be reduced by $700/month or $8400 per year (60 HP X .9 demand X $12/kVA demand cost/month).

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS (Original minus Alternative)			

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
GENERAL						
G-1	Reconfigure the site layout for the Operations/ Laboratory Building and Headworks Building	$9,816,000	$5,168,000	$4,648,000		$4,648,000
G-2	Use insulated precast concrete exterior walls for the new buildings in lieu of brick and block	$1,754,000	$1,127,000	$627,000		$627,000
G-3	Use jumbo brick in lieu of standard brick for the exterior walls of the new buildings	$1,465,000	$938,000	$527,000		$527,000
G-4	Use single wythe walls in lieu of brick and block cavity walls for the exterior walls of the new buildings	$1,754,000	$498,000	$1,256,000		$1,256,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **G-1**
DESCRIPTION:	**RECONFIGURE THE SITE LAYOUT FOR THE OPERATIONS AND LABORATORY BUILDING AND HEADWORKS BUILDING**	SHEET NO.: **1 of 5**

ORIGINAL DESIGN:

The current design has positioned the Headworks Building at the north side of the plant (main entrance) and the Operations/Laboratory Building (OLB) on the east side of the site in the location of the existing Sludge Processing Building (SPB) that is scheduled to be demolished.

ALTERNATIVE: (sketch attached)

Relocate the OLB to the north end of the site and minimize and relocate the Headworks Building to near the Grit Building. Demolish the upper level of the existing SPB and repurpose the lower level to accommodate the proposed program spaces as detailed in Alt. No. OL-10. Reuse the existing transformer and use an outdoor automatic transfer switch, switchboard and generator as described in Alt. No. E-5.

ADVANTAGES:

- Cost savings
- Sustainability is enhanced by:
  - Minimizing the extent of the demolition at the SPB
  - Utilizing the existing lower level of the SPB
  - Reducing construction vehicle traffic
  - Making use of the existing transformer
- Schedule is enhanced by:
  - Eliminating the need to complete the Headworks Building first
  - Allowing earlier start of the OLB, and demolition of the existing Filter Building to start BAF construction
- Reduces the size of the Headworks Building
- Locates primary power supply closer to the electrical load
- Consolidates the shop / storage areas to the SPB

DISADVANTAGES:

- Requires encapsulating the lower level walls and slab of the Sludge Processing Building
- Restricts accessibility for deliveries to the Grit Building
- Redesign is required which may impact the start of construction but not necessarily the completion date based on the revised scope of work

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 9,816,000	—	$ 9,816,000
ALTERNATIVE	$ 5,168,000	—	$ 5,168,000
SAVINGS (Original minus Alternative)	$ 4,648,000	—	$ 4,648,000

ADVANTAGES: (continued)

- Places the OLB at the front entry of the plant
- Relocates personnel parking to the front of the plant
- Makes more space available to the contractor by eliminating the need for temporary operations staff trailers
- Reduces impact on operations by minimizing the number of moves for operations staff and equipment
- Minimizes visual impacts

DISCUSSION:

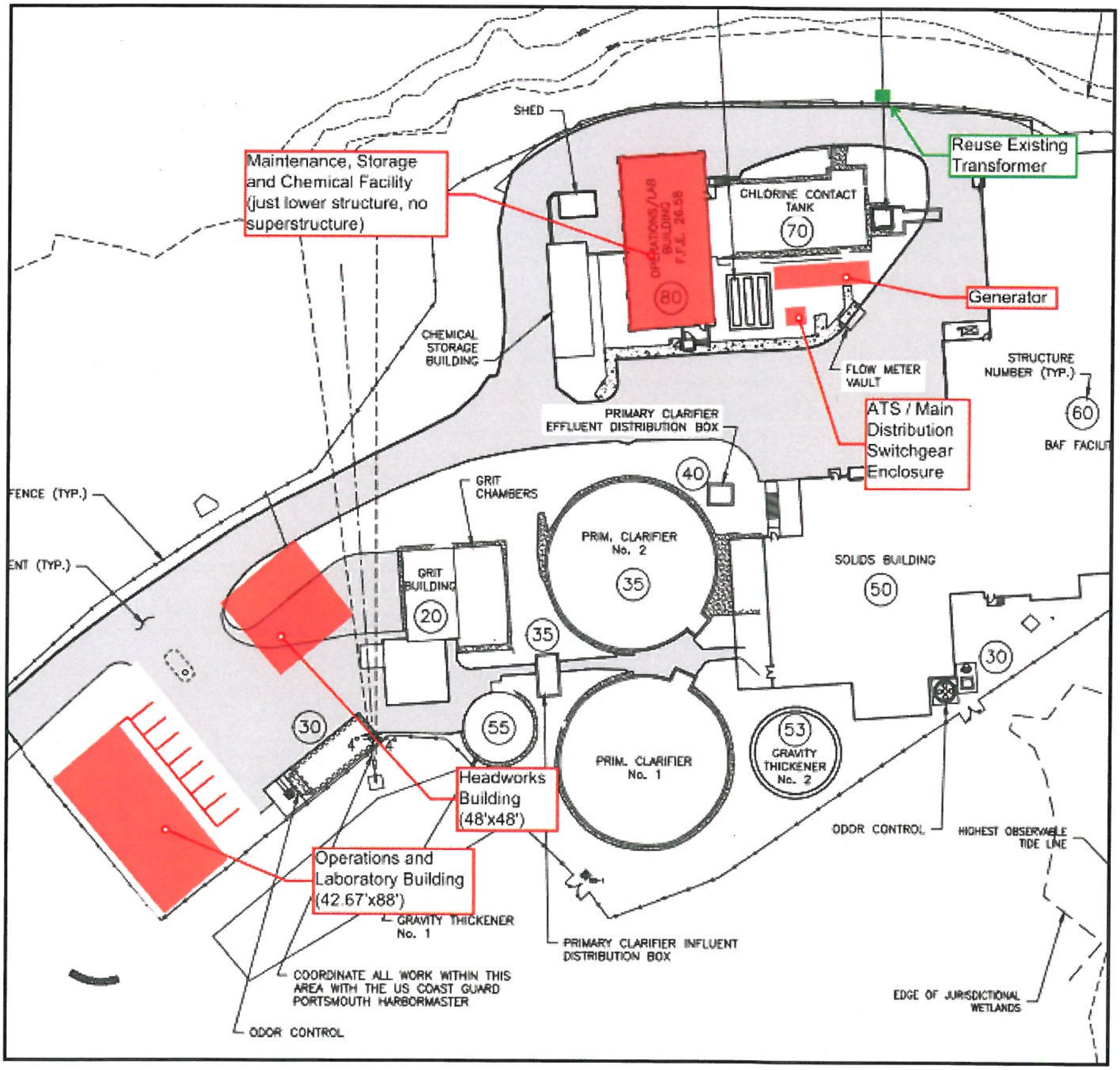
This alternative is based on the following:

- A single story OLB at the entrance to the facility.
- Utility electrical service installed overhead to the existing transformer
- Back-up generator, automatic transfer switch and main distribution switchgear installed in separate outdoor enclosures near the Chlorine Contact Tank.
- Re-use of the existing SPB foundation for sodium hypochlorite and sodium bisulfite pumping. The remainder of this foundation would be used for centralized maintenance and storage. Existing walls and floor will be encapsulated with 6-in.-thick concrete walls and a 6-in.-thick concrete slab.

It results in a significant cost reduction for a project whose costs have escalated substantially. Although redesign is required numerous benefits to the overall project schedule and site layout will accrue.

SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **G-1**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **3 of 5**



SKETCH

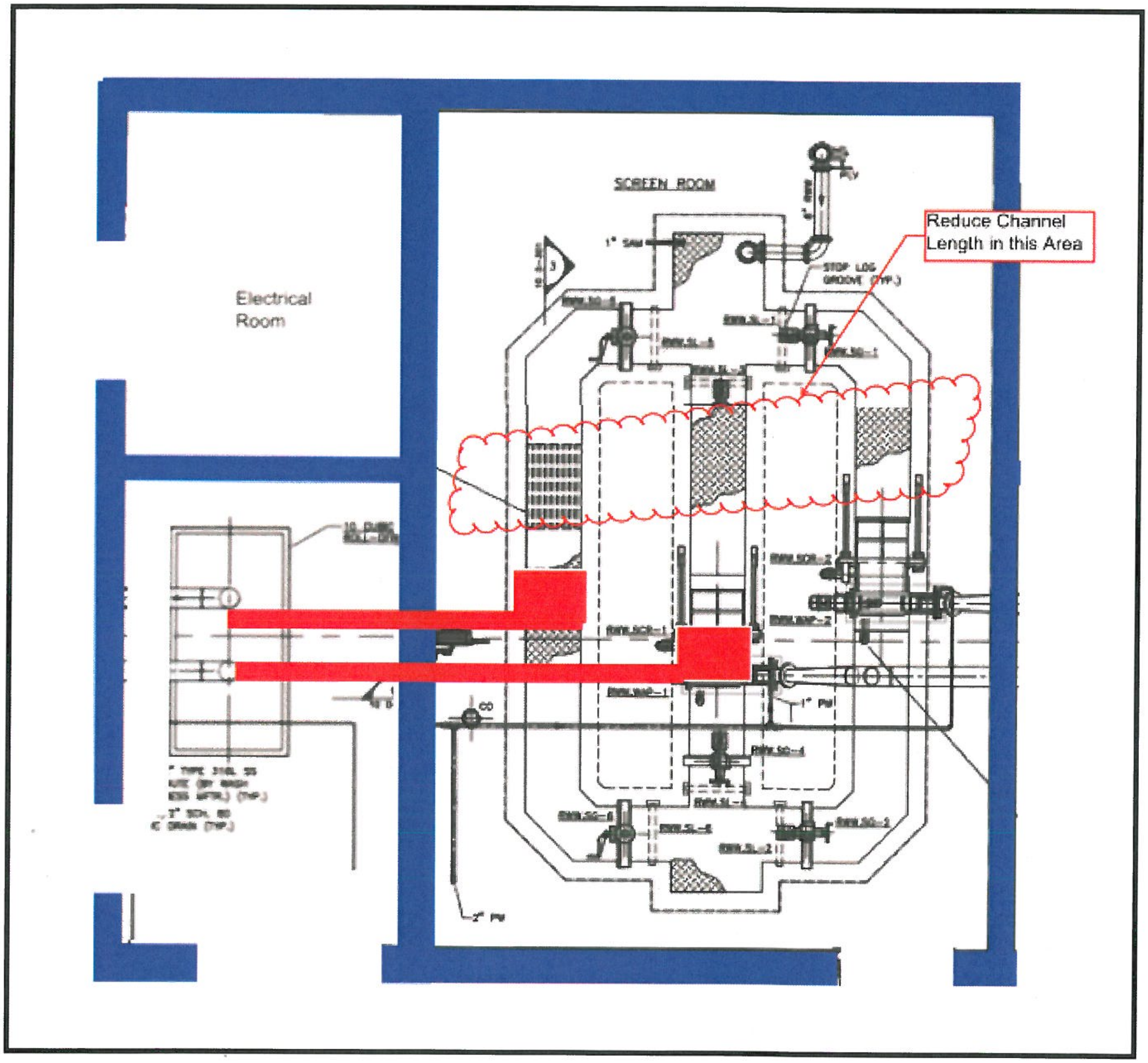
ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALTERNATIVE NO.: **G-1**

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒ BOTH ☐

SHEET NO.: **4 of 5**



Alternative Headworks Building

COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**	ALTERNATIVE NO.:	**G-1**
	City of Portsmouth, NH	SHEET NO.:	**5 of 5**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
30% Design							
Headworks Building (Architectural, Structural, HVAC and Plumbing)							
	LS	1	1,363,000.00	1,363,000			
Operations and Laboratory Building (Architectural, Structural, HVAC and Plumbing)							
	LS	1	2,020,000.00	2,020,000			
Temporary Facilities	LS	1	465,000.00	465,000			
New Proposed Facilities							
Headworks Building (Architectural, Structural, HVAC and Plumbing)							
	SF				2,304	250.00	576,000
Operations and Laboratory Building (Architectural, Structural, HVAC and Plumbing)							
	SF				3,750	250.00	937,500
SCADA	LS	1	750,000.00	750,000	1	750,000.00	750,000
Maintenance, Storage and Chemical Facility							
6" Thick Concrete to Contain PCBs in Wall	CY				80	800.00	64,000
6" Thick Concrete to Contain PCBs on Foundation	CY				65	350.00	22,750
1st Floor Concrete Topping Slab	CY				65	350.00	22,750
1st Floor Roofing Membrane	SF				3,750	25.00	93,750
Basement Improvements	LS				1	200,000.00	200,000
ATS / Main Distribution Switchgear Enclosure	SF				120	300.00	36,000
Generator Savings (See Alt. No. E-4)	LS	1	184,000.00	184,000			
Overhead Electrical Line Savings (see Alt. No. C-1)	LS	1	252,000.00	252,000			
Site Yard Piping Savings @ Headworks	LS	1	100,000.00	100,000			
Subtotal				5,134,000			2,702,750
Markup (%) at	**91.2%**			4,682,208			2,464,908
TOTAL				9,816,208			5,167,658
TOTAL (ROUNDED)				9,816,000			5,168,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **G-2**
DESCRIPTION:	**USE INSULATED PRECAST CONCRETE EXTERIOR WALLS FOR THE NEW BUILDINGS IN LIEU OF BRICK AND BLOCK**	SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

The proposed design for the exterior building walls varies from building to building as noted below.

- Headworks Building – concrete block / brick cavity wall construction
- Solids Building - concrete block / brick cavity wall construction
- BAF Facility – concrete / brick and concrete block / brick cavity wall construction
- Operations and Laboratory Building - concrete block / brick cavity wall construction and metal studs with a brick veneer

ALTERNATIVE:

Use architectural precast concrete insulated wall panels with a brick veneer finish in lieu of cavity wall construction for the exterior walls of the buildings.

ADVANTAGES:

- Expedites the construction schedule
- Aligns with the original architectural treatment proposed
- Less labor and material required to construct the exterior walls
- Less material required to be brought on site, minimizing truck traffic
- Eliminates the need for material storage on site

DISADVANTAGES:

- Requires a crane on site for the installation of the wall panels

DISCUSSION:

The VE team recommends modifying the exterior walls of each facility from cavity wall (multi-wythe) construction to architectural precast concrete insulated wall panels. The cavity wall is composed of an inner wythe of concrete block, a cavity with insulation and an outer wythe of a brick veneer. The architectural precast concrete wall panels are prefabricated off site and can be erected upon delivery. The panels can vary in height and width to accommodate each building. The panels are insulated and the architectural treatment on the exterior face of the panels can be finished to match the brick veneer of the existing Grit Building. The following text outlines the proposed modifications for each building:

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,754,000	—	$ 1,754,000
ALTERNATIVE	$ 1,127,000	—	$ 1,127,000
SAVINGS (Original minus Alternative)	$ 627,000	—	$ 627,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALTERNATIVE NO.: **G-2**

DESCRIPTION: **USE INSULATED PRECAST CONCRETE EXTERIOR WALLS FOR THE NEW BUILDINGS IN LIEU OF BRICK AND BLOCK**

SHEET NO.: **2 of 4**

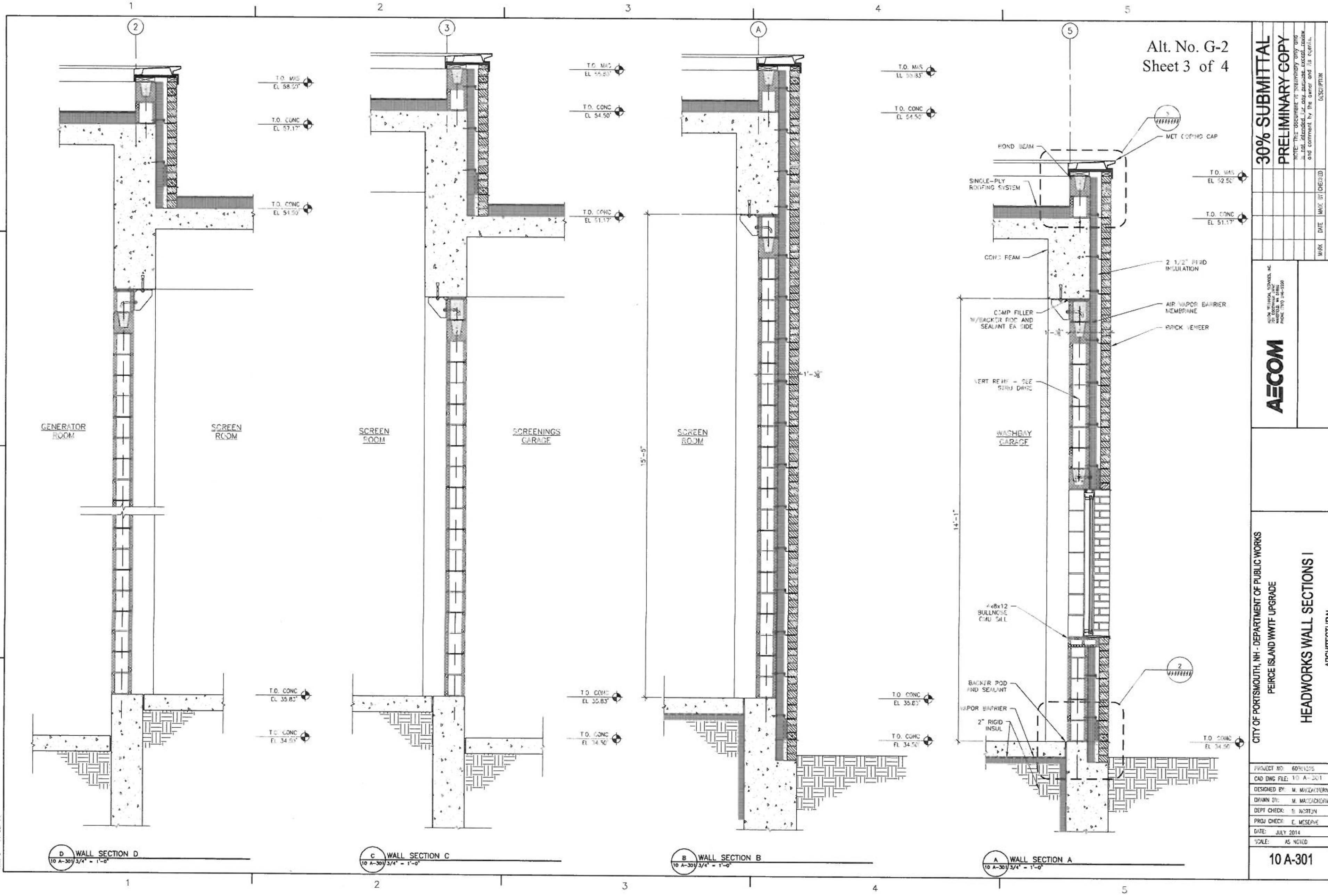
DISCUSSION:

Headworks Building – Replace the proposed concrete block / brick cavity wall with an insulated architectural precast wall panel with a brick veneer to match existing.

Solids Building - Replace the proposed concrete block / brick cavity wall with an insulated architectural precast wall panel with a brick veneer to match existing.

BAF Facility – Replace the proposed concrete block / brick cavity wall with an insulated architectural precast wall panel with a brick veneer to match existing. Modify the proposed concrete / brick cavity wall by deleting the brick veneer from the face of the concrete walls. For the purposes of this alternative the concrete would be exposed with no additional finish. It should be noted that the surface of the exposed concrete could be finished with a form-liner that would match the finish of the architectural precast concrete wall panels. Another alternative to break-up the mass of the concrete walls would be to incorporate a modular metal grid system to the south face of the concrete walls to accommodate Virginia Creeper vines.

Operations and Laboratory Building – Replace the proposed lower level concrete block / brick cavity wall construction and upper level metal studs with a brick veneer with an insulated architectural precast wall panel with a brick veneer to match existing.



Alt. No. G-2
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HEADWORKS WALL SECTIONS I
ARCHITECTURAL
PROJECT NO: 60901525
CAD DWG FILE: 10 A-301
DESIGNED BY: M. MACEACHERN
DRAWN BY: M. MACEACHERN
DEPT CHECK: B. NORTON
PROJ CHECK: E. MESERVE
DATE: JULY 2014
SCALE: AS NOTED
10 A-301
GENERATOR ROOM
SCREEN ROOM
SCREENINGS GARAGE
WASHBAY GARAGE
MET COPING CAP
BOND BEAM
SINGLE-PLY ROOFING SYSTEM
CONC BEAM
2 1/2" RIGID INSULATION
AIR/VAPOR BARRIER MEMBRANE
BRICK VENEER
CAMP FILLER W/BACKER ROD AND SEALANT EA SIDE
VERT REINF - SEE STRU DWGS
4x8x12 BULLNOSE CMU SILL
BACKER ROD AND SEALANT
VAPOR BARRIER
2" RIGID INSUL
T.O. MAS EL 58.50'
T.O. CONC EL 57.17'
T.O. CONC EL 51.50'
T.O. MAS EL 55.83'
T.O. CONC EL 54.50'
T.O. CONC EL 51.17'
T.O. MAS EL 52.50'
T.O. CONC EL 35.83'
T.O. CONC EL 34.50'
15'-5"
14'-1"
1'-3"
D WALL SECTION D 10 A-301 3/4" = 1'-0"
C WALL SECTION C 10 A-301 3/4" = 1'-0"
B WALL SECTION B 10 A-301 3/4" = 1'-0"
A WALL SECTION A 10 A-301 3/4" = 1'-0"

COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*					ALTERNATIVE NO.: **G-2**		
						SHEET NO.: **4 of 4**		

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Headworks Building							
Exterior Cavity Wall	SF	6,000	28.91	173,460			
Precast Concrete Exterior Walls					6,000	38.00	228,000
Solids Building							
Exterior Cavity Wall	SF	4,560	42.14	192,158			
Precast Concrete Exterior Walls					4,560	38.00	173,280
BAF Building							
Exterior Cavity Wall	SF	1,390	42.14	58,575			
Brick Veneer over Concrete Wall	SF	15,140	25.00	378,500			
Precast Concrete Exterior Walls					1,390	38.00	52,820
OPS/Lab Building							
Exterior Cavity Wall	SF	1,500	42.14	63,210			
Brick Veneer over Metal Studs	SF	2,067	25.00	51,675			
Precast Concrete Exterior Walls					3,567	38.00	135,546
Subtotal				917,578			589,646
Markup (%) at 91.2%				836,831			537,757
TOTAL				1,754,409			1,127,403
TOTAL (ROUNDED)				1,754,000			1,127,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **G-3**
DESCRIPTION:	**USE JUMBO BRICK IN LIEU OF STANDARD BRICK FOR THE EXTERIOR WALLS OF THE NEW BUILDINGS**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN:

The proposed design for the exterior building walls currently incorporates a standard size brick for the outer veneer.

ALTERNATIVE:

Use an oversized brick in lieu of a standard size brick for the outer veneer for all the exterior building walls.

ADVANTAGES:

- Expedites the construction schedule
- Less labor required to construct the exterior veneer

DISADVANTAGES:

- Aesthetically there will be a minor variation in the appearance of the facade

DISCUSSION:

The VE team suggests modifying the veneer of the exterior walls to reduce labor costs. Currently, the proposed veneer is a standard size brick that matches the existing Grit Building. The use of an oversized brick will be aesthetically similar to the existing standard brick, but the time associated with the installation will be reduced.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,465,000	—	$ 1,465,000
ALTERNATIVE	$ 938,000	—	$ 938,000
SAVINGS (Original minus Alternative)	$ 527,000	—	$ 527,000

COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.:	**G-3**
		SHEET NO.:	**2 of 2**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Headworks Building							
Exterior Cavity Wall - Std. Brick	SF	6,000	25.00	150,000			
Exterior Cavity Wall - Jumbo Brick	SF				6,000	16.00	96,000
Solids Building							
Exterior Cavity Wall - Std. Brick	SF	4,560	25.00	114,000			
Exterior Cavity Wall - Jumbo Brick	SF				4,560	16.00	72,960
BAF Building							
Exterior Cavity Wall	SF	1,390	25.00	34,750			
Brick Veneer over Concrete Wall	SF	15,140	25.00	378,500			
Exterior Cavity Wall - Jumbo Brick	SF				1,390	16.00	22,240
Jumbo Brick Veneer over Conc. Wall	SF				15,140	16.00	242,240
OPS/Lab Building							
Exterior Cavity Wall - Std. Brick	SF	1,500	25.00	37,500			
Brick Veneer over Metal Studs	SF	2,067	25.00	51,675			
Exterior Cavity Wall - Jumbo Brick	SF				1,500	16.00	24,000
Jumbo Brick Veneer over Metal Studs	SF				2,067	16.00	33,072
Subtotal				766,425			490,512
Markup (%) at 91.2%				698,980			447,347
TOTAL				1,465,405			937,859
TOTAL (ROUNDED)				1,465,000			938,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **G-4**
DESCRIPTION:	**USE SINGLE WYTHE WALLS IN LIEU OF CAVITY WALLS FOR THE EXTERIOR WALLS OF THE NEW BUILDINGS**	SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

The proposed design for the exterior building walls varies from building to building as noted below:

- Headworks Building – concrete block / brick cavity wall construction
- Solids Building - concrete block / brick cavity wall construction
- BAF Facility – concrete / brick and concrete block / brick cavity wall construction
- Operations and Laboratory Building - concrete block / brick cavity wall construction and metal studs with a brick veneer

ALTERNATIVE:

Utilize single wythe walls (split-faced concrete block, split-ribbed concrete block or ground-faced concrete block) in lieu of cavity wall construction for the exterior walls of the buildings. Provide insulation within the block.

ADVANTAGES:

- Expedites the construction schedule
- Less labor and material required to construct the exterior walls
- Less material required to be brought on site, minimizing truck traffic

DISADVANTAGES:

- Potential water infiltration if an integral waterproof system is not incorporated into the design of the exterior walls
- Aesthetically different from the visual impact of the brick veneer

DISCUSSION:

The VE team suggests modifying the exterior walls of each facility from cavity wall (multi-wythe) construction to single-wythe construction. The cavity wall is composed of an inner wythe of concrete block, a cavity with insulation and an outer wythe of a brick veneer. The single wythe wall is typically constructed of a decorative concrete block (split-faced concrete block, split-ribbed concrete block or ground-faced concrete block). The color for a split-faced and split-ribbed concrete block can be integral or surface applied. The color for a ground-faced concrete block is integral. The insulation for this wall type is installed within the cells of the block. The following text outlines the proposed modifications for each building:

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,754,000	—	$ 1,754,000
ALTERNATIVE	$ 498,000	—	$ 498,000
SAVINGS (Original minus Alternative)	$ 1,256,000	—	$ 1,256,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **G-4**
DESCRIPTION:	**USE SINGLE WYTHE WALLS IN LIEU OF CAVITY WALLS FOR THE EXTERIOR WALLS OF THE NEW BUILDINGS**	SHEET NO.: **2 of 4**

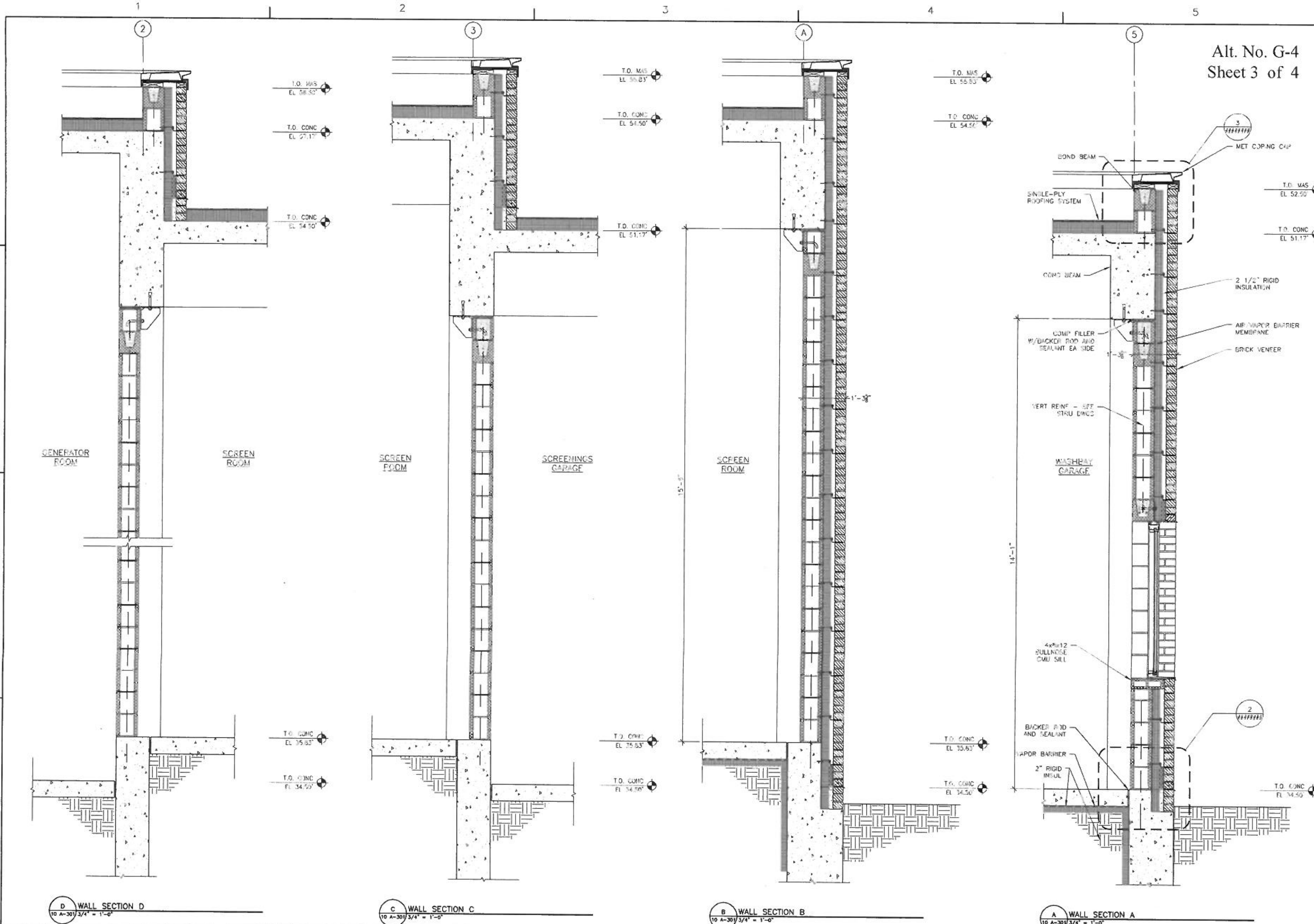
DISCUSSION: (continued)

Headworks Building – Replace the proposed concrete block / brick cavity wall with a single wythe construction incorporating split-faced concrete block.

Solids Building - Replace the proposed concrete block / brick cavity wall with a single wythe construction incorporating split-faced concrete block.

BAF Facility – Replace the proposed concrete block / brick cavity wall with a single wythe construction incorporating split-faced concrete block. Modify the proposed concrete / brick cavity wall by deleting the brick veneer from the face of the concrete walls. For the purposes of this alternative the concrete would be exposed with no additional finish. It should be noted that the surface of the exposed concrete could be finished with a form-liner that would introduce a decorative finish to the face of the concrete. Another alternative to break-up the mass of the concrete walls would be to incorporate a modular metal grid system to the south face of the concrete walls to accommodate Virginia Creeper vines.

Operations and Laboratory Building – Lower Level - Replace the proposed concrete block / brick cavity wall with a single wythe construction incorporating split-faced concrete block. Upper Level – replace the metal studs / brick veneer with metal studs / split-faced concrete block veneer.



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MARK	DATE	MADE BY	CHECKED	DESCRIPTION

REVISIONS

AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

HEADWORKS WALL SECTIONS I

ARCHITECTURAL

PROJECT NO:	60701525
CAD DWG FILE:	10 A-301
DESIGNED BY:	M. MACCACHERN
DRAWN BY:	M. MACCACHERN
DEPT CHECK:	B. NORTON
PROJ CHECK:	E. MENDIVE
DATE:	JULY 2014
SCALE:	AS NOTED

10 A-301

COST WORKSHEET

ARCADIS

PROJECT:	PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE *City of Portsmouth, NH*	ALTERNATIVE NO.: G-4 SHEET NO.: 4 of 4

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Headworks Building							
Exterior Cavity Wall	SF	6,000	28.91	173,460			
Single Wythe Wall	SF				6,000	18.00	108,000
Solids Building							
Exterior Cavity Wall	SF	4,560	42.14	192,158			
Single Wythe Wall	SF				4,560	18.00	82,080
BAF Building							
Exterior Cavity Wall	SF	1,390	42.14	58,575			
Brick Veneer over Concrete Wall	SF	15,140	25.00	378,500			
Single Wythe Wall	SF				1,390	18.00	25,020
OPS/Lab Building							
Exterior Cavity Wall	SF	1,500	42.14	63,210			
Brick Veneer over Metal Studs	SF	2,067	25.00	51,675			
Single Wythe Wall	SF				1,500	18.00	27,000
Block Veneer over Metal Studs	SF				2,067	9.00	18,603
Subtotal				917,578			260,703
Markup (%) at	**91.2%**			836,831			237,761
TOTAL				1,754,409			498,464
TOTAL (ROUNDED)				1,754,000			498,000

SUMMARY OF VALUE ENGINEERING ALTERNATIVES

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	INITIAL COST SAVINGS	RECURRING COST SAVINGS	TOTAL PW LCC SAVINGS
				PRESENT WORTH OF COST SAVINGS		
CONSTRUCTABILITY						
C-1	Run overhead electrical and other services from the swimming pool area to the fence line of the site and then go underground	$482,000	$0	$482,000		$482,000
C-2	Allow the contractor to use the pool parking lot during the off-season	DESIGN SUGGESTION				
C-3	Reduce the use of flagpersons when the swimming pool is closed	$666,000	$111,000	$555,000		$555,000
C-7	Straighten the access road east of the swimming pool house to eliminate the blind curve and delete the use of flagpersons at this location	$666,000	$144,000	$522,000		$522,000
C-8	Allow night work on site but limit the amount of truck traffic at night	DESIGN SUGGESTION				
C-9	Move temporary construction fence along the plant access road to behind the existing guardrail along the road	DESIGN SUGGESTION				
C-11	Allow use of a snow melt machine and allow contractor to use snow disposal area year-round	DESIGN SUGGESTION				
C-12	Allow the contractors to use barges to store construction material	DESIGN SUGGESTION				
C-14	Consolidate storage areas in process buildings into one commercial building	$5,124,000	$4,369,000	$755,000		$755,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **C-1**
DESCRIPTION:	**RUN OVERHEAD ELECTRICAL AND OTHER SERVICES FROM THE SWIMMING POOL AREA TO THE FENCE LINE OF THE SITE AND THEN GO UNDERGROUND**	SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

Provide an underground, concrete encased conduit duct bank for utility power, cable, TV and fiber optic cable from the swimming pool area to the new PSNH transformer (power) and to the Headworks Building (cable TV and fiber optic cable). See sheet 00 E-004.

ALTERNATIVE:

Run the utility power, cable TV, and fiber optic cable on poles to the fence line of the wastewater treatment facility (WWTF). Then run the cables underground to their respective destinations.

ADVANTAGES:

- Lowers capital cost

DISADVANTAGES:

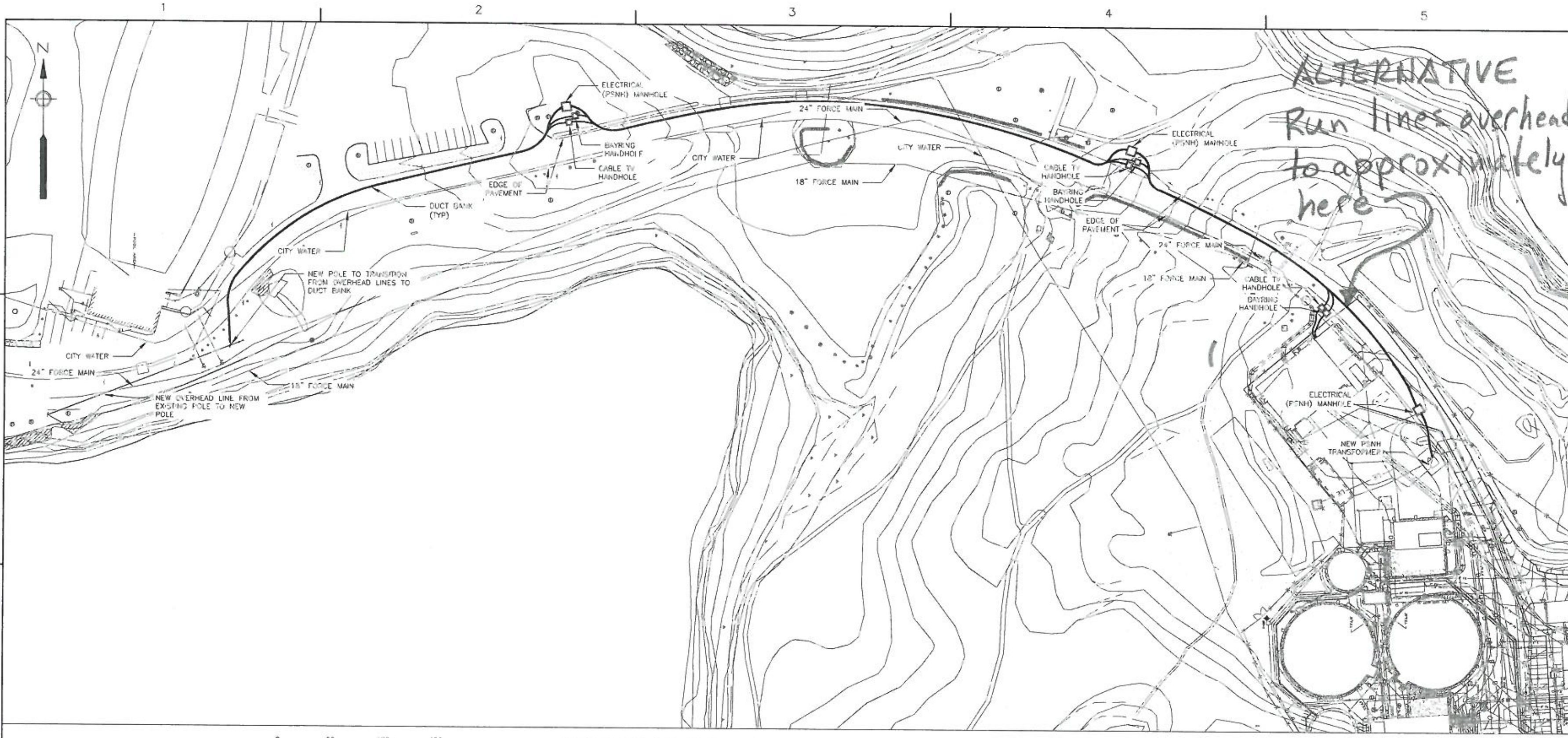
- Less pleasing aesthetically

DISCUSSION:

The present design shows the new 12.47 kV utility service beginning near the swimming pool, going from an existing power pole to a new pole, and then approximately 1350 feet underground via two 5 inch conduits (1-active, 1-spare) to the WWTF site, with approximately 1200 feet of that run outside the fence. Since the cable TV and fiber optic cables are also shown in the same underground duct bank, it is assumed these reached the pool area aerially just as the 12.47 kV cables do. Four 4-in.-diameter conduits are included in the ductbank for the cable TV, the fiber, and spares.

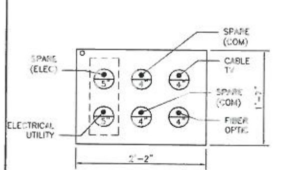
Significant capital costs can be saved by having the electric utility company extend the overhead pole line to the fence line of the WWTF perimeter fence. Arrangements can then be made with the utility company for the cable TV and fiber optics lines to be installed on the poles. Underground conduits for power, cable TV, and fiber can then be run from the fence line to their final destinations. The aesthetic appearance of the pole line will be no better or worse than the overhead pole line running from the mainland to the swimming pool on the island.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 482,000	—	$ 482,000
ALTERNATIVE	$ 0	—	$ 0
SAVINGS (Original minus Alternative)	$ 482,000	—	$ 482,000



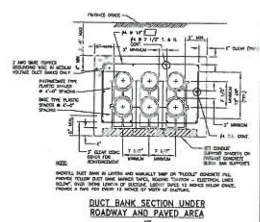
ELECTRICAL AND COMMUNICATION UTILITIES DUCT BANK PLAN

SCALE 1"=50'



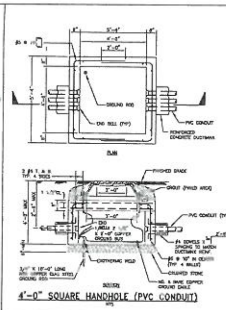
ELECTRICAL AND COM UTILITIES DUCT BANK SECTION

SCALE NOT TO SCALE



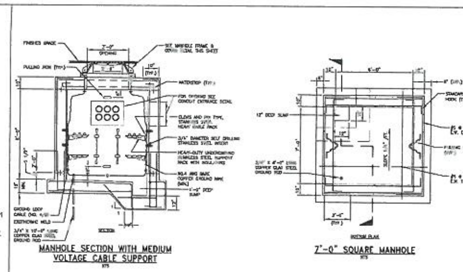
UNDER ROAD DUCT BANK DETAIL

SCALE NOT TO SCALE



HANDHOLE DETAIL

SCALE NOT TO SCALE



MANHOLE DETAIL

SCALE NOT TO SCALE

MANHOLE, HANDHOLE AND DUCT BANK NOTES

1. ALL CONCRETE INSERTS, FITTINGS AND ACCESSORIES ARE TO BE FABRICATED FROM HEAVY-DUTY STAINLESS STEEL.
2. ALL CONCRETE FOR MANHOLES AND DUCT RUNS TO BE CLASS "A" (4000 PSI) AS PER THE STRUCTURAL SPECIFICATIONS.
3. ALL CONDUIT AND OTHER EQUIPMENT IN MANHOLES SHALL BE BONDED WITH A NO. 4, STRANDED COPPER CABLE (MINIMUM).
4. ALL 4" OR LARGER STEEL CONDUIT BENDS SHALL HAVE A 36" RADIUS (MINIMUM).
5. ALL CABLES SHALL BE TAGGED WITH A PROTECTED PLASTIC TAG OF DISTINCTIVE COLOR AND MARKING FOR EACH VOLTAGE. THE TAGS WILL GIVE VOLTAGE AND CIRCUIT NUMBER ASSIGNED BY THE CONTRACT DRAWING CONDUIT AND WIRE SCHEDULE.
6. CONTRACTOR TO SIZE THE CIRCULAR OPENINGS IN THE MANHOLE ROOF FROM FRAMES ACTUALLY FURNISHED.
7. PLASTIC DUCT SPACERS SHALL BE INSTALLED ON 4 FT. CENTERS. JOINTS ARE TO BE STAGGERED BETWEEN TIERS TO PROVIDE NOT LESS THAN 12 INCH LONGITUDINAL SEPARATION BETWEEN JOINTS SEPARATION BETWEEN JOINTS IN ANY TWO ADJOINING CONDUITS.
8. THE SIZE OF A MANHOLE WINDOW DEPENDS ON THE NUMBER OF CONDUITS IN THE INCOMING DUCTLINE. TO DETERMINE THE ACTUAL WINDOW SIZE AND LOCATION, SEE THE DUCT SECTION. THE WINDOW OPENING MUST ALSO BE A MINIMUM OF ONE FOOT ABOVE MANHOLE FLOOR AND / OR ONE FOOT BELOW MANHOLE ROOF. EACH MANHOLE WINDOW SHOULD BE OFFSET FROM THE CENTER OF THE WALL SO THAT ONE VERTICAL EDGE IS CLOSE TO THE INTERSECTION OF TWO WALLS.
9. ALL STEEL CONDUIT SHALL BE TERMINATED IN MANHOLES WITH CONDUIT GROUNDING BUSHINGS.
10. MANHOLE COVER SHALL HAVE THE WORD "ELECTRIC" CAST ON THE COVER.
11. INSTALL TWO PULLING-IN IRONS OPPOSITE CENTER OF EACH ENTERING DUCT RUN. ONE 6" BELOW ROOF AND ONE 6" ABOVE FLOOR.
12. ALL DUCTS SHALL DRAIN FROM HIGH POINT TO MANHOLE WITH A SLOPE OF NOT LESS THAN 4" PER 100 FEET.

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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS

PEIRCE ISLAND WWTF UPGRADE

UTILITY SERVICE SITE PLAN

00 GENERAL

PROJECT NO:	60301525
CAD DWG FILE:	00 E-004
DESIGNED BY:	C. MURPHY
DRAWN BY:	C. MURPHY
DEPT CHECK:	Y. RIZK
PROJ CHECK:	E. MCGERMC
DATE:	JULY 2014
SCALE:	AS NOTED

00 E-004

Att. No. C-1 Sht. 2 of 4

CALCULATIONS

ARCADIS

PROJECT: PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE
City of Portsmouth, New Hampshire

ALTERNATIVE NO.: C-1

SHEET NO.: 3 of 4

Project Title- Peirce Island

8/21/2014 8:18

Engineer's Estimate- Electrical

$ 251,039

Section	Category	Item	ID	MEANS Ref. Page	Quantities AMT.	UNITS	Unit Rates MATERIAL	HRS	Labor@ $50/hr	Extended Unit Rate Material	Hours	Labor	Extended Material	Hours	Labor	Total
26 05 33.13-RIGID CONDUIT	PVC #40:	4"		10-136	4800	LF	11.95	0.178	8.90	$ 13.74	0.20	$ 10.24	$ 65,964.00	982.56	$ 49,128.00	$ 115,092.00
26 05 33.13-RIGID CONDUIT	PVC #40:	5"		10-136	2400	LF	16.55	0.229	11.45	$ 19.03	0.26	$ 13.17	$ 45,678.00	632.04	$ 31,602.00	$ 77,280.00
26 05 33.13-RIGID CONDUIT Total													#########	1,614.60	$ 80,730.00	$ 192,372.00
26 05 43.13-UNDERGROUND DUCTBANKS FOR ELECTRICAL SYSTEMS	Cast in place concrete	> 5 CY		10-332	135	CY	116.00	2.000	100.00	$ 133.40	2.30	$ 115.00	$ 18,009.00	310.50	$ 15,525.00	$ 33,534.00
26 05 43.13-UNDERGROUND DUCTBANKS FOR ELECTRICAL SYSTEMS	Excavation			07-303	320	CY	5.55	0.148	15.10	$ 6.38	0.17	$ 17.36	$ 2,042.40	54.46	$ 5,555.19	$ 7,597.59
26 05 43.13-UNDERGROUND DUCTBANKS FOR ELECTRICAL SYSTEMS	Backfill			07-303	185	CY	0.49	0.521	0.88	$ 0.56	0.60	$ 1.01	$ 104.25	110.84	$ 187.62	$ 291.87
26 05 43.13-UNDERGROUND DUCTBANKS FOR ELECTRICAL SYSTEMS Total													$ 20,155.65	475.81	$ 21,267.81	$ 41,423.46
26 05 43.23-MANHOLES AND HANDHOLES FOR ELECTRICAL SYSTEMS	Manholes, precast with iron racks, cover:	4' x 6' x 7' deep		10-331	3	EA	1,975.00	28.000	1,400.00	$ 2,271.25	32.20	$ 1,610.00	$ 6,813.75	96.60	$ 4,830.00	$ 11,643.75
26 05 43.23-MANHOLES AND HANDHOLES FOR ELECTRICAL SYSTEMS	Handholes, precast concrete with cover:	2' x 2' x 3' deep		10-331	6	EA	395.00	8.330	416.50	$ 454.25	9.58	$ 478.98	$ 2,725.50	57.48	$ 2,873.85	$ 5,599.35
26 05 43.23-MANHOLES AND HANDHOLES FOR ELECTRICAL SYSTEMS Total													$ 9,539.25	154.08	$ 7,703.85	$ 17,243.10
Grand Total													#########	2,244.48	$ 109,701.66	$ 251,038.56
	ELECTRICAL SUBCONTRACT SUBTOTALS												$ 141,337	2,244	$ 109,702	$ 251,039
													Project Subtotal			$ 251,039

Aluminum Conduit	1.00	Materials:	100.00
PVC Coated RGS Conduit	1.00	Uncounted Modifier	1.15
Copper Wire	1.00		

Total $ 251,039

Grand Total $ 252,000

COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.: **C-1** SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Ductbank (Pool to Fence)	LF	1,200	210.00	252,000			
Subtotal				252,000			
Markup (%) at 91.2%				229,824			
TOTAL				481,824			
TOTAL (ROUNDED)				482,000			

VALUE ENGINEERING ALTERNATIVE ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **C-2**
DESCRIPTION:	**ALLOW CONTRACTOR TO USE POOL PARKING LOT DURING OFF SEASON**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

The swimming pool operations are June 23 - August 24, 2014. The Snow Disposal Area is used from November 1 – June 1. The public will not be allowed to use the Dog Park or any area south of the pool parking lot. Due to the snow disposal operation, no overhead power lines or contractor use of the snow disposal area can be allowed.

ALTERNATIVE:

Based on the City's plan to eliminate access south of the pool parking lot for the entire construction period, thus eliminating the need for public access to the swimming pool parking, consider allowing the contractor to utilize the parking lot as necessary from September 1st through June 1st and be required to repave the parking lot following construction at the plant.

As an alternative, consider using this area for the snow storage area and allow the contractor to have access to the current snow disposal location. The contractor would be obligated to spread snow that still resides on the parking lot after May 1, to encourage full melting by the time the pool opens.

ADVANTAGES:

- Allows contractor additional work area
- Allows for overhead power lines to plant through the snow area
- Increases lay-down area and permits more cost efficient construction

DISADVANTAGES:

- May need a new or modified permit for snow disposal location
- Parking lot maintenance increases

DISCUSSION:

This alternative provides the contractor with an additional work area at a site that is highly constrained, thus allowing his operations to be more efficient and potentially lowering his bid price.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **C-3**
DESCRIPTION:	**REDUCE THE USE OF FLAG PERSONS WHEN THE SWIMMING POOL IS CLOSED**	SHEET NO.: **1 of 2**

ORIGINAL DESIGN:

The original design requires the contractor to provide two flag persons at the curve in the road near the swimming pool house for construction traffic.

ALTERNATIVE:

Restrict public access beyond the State Boat Ramp area during times when the swimming pool is closed to reduce the amount of time flag persons are required.

ADVANTAGES:

- Cost savings

DISADVANTAGES:

- Less public access
- Need for strict enforcement of speed limits around the swimming pool area

DISCUSSION:

The swimming pool is only open in the summer months. By restricting access to the public beyond the State Boat Ramp area when the swimming pool is not open, the need for two flag persons could be reduced to about two months per year, saving significant project costs.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 666,000	—	$ 666,000
ALTERNATIVE	$ 111,000	—	$ 111,000
SAVINGS (Original minus Alternative)	$ 555,000	—	$ 555,000

COST WORKSHEET

ARCADIS

PROJECT:	PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE *City of Portsmouth, NH*	ALTERNATIVE NO.: C-3 SHEET NO.: 2 of 2

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Flagger (Ordinary -2)	MH	11,616	30.00	348,480			
Flagger (Ordinary -2)	MH				1,936	30.00	58,080
Subtotal				348,480			58,080
Markup (%) at 91.2%				317,814			52,969
TOTAL				666,294			111,049
TOTAL (ROUNDED)				666,000			111,000

VALUE ENGINEERING ALTERNATIVE ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **C-7**
DESCRIPTION:	**STRAIGHTEN THE ACCESS ROAD EAST OF THE SWIMMING POOL TO ELIMINATE THE BLIND CURVE AND DELETE THE USE OF FLAGPERSONS AT THIS LOCATION**	SHEET NO.: **1 of 3**

ORIGINAL DESIGN:

The original design requires the contractor to provide two flag persons at the curve in the access road near the swimming pool house to control construction traffic.

ALTERNATIVE: (sketch attached)

Straighten the access road east of the swimming pool to improve visibility around the swimming pool area and eliminate the need for the two flag persons during the construction period.

ADVANTAGES:

- Cost savings
- Improves construction vehicle accessibility by providing a better line of sight
- Improves safety during and after construction
- No net increase in impervious surface

DISADVANTAGES:

- Requires restoration of the area where the existing road is located
- May need a permit to realign the road
- Will have to remove some rock to realign the road

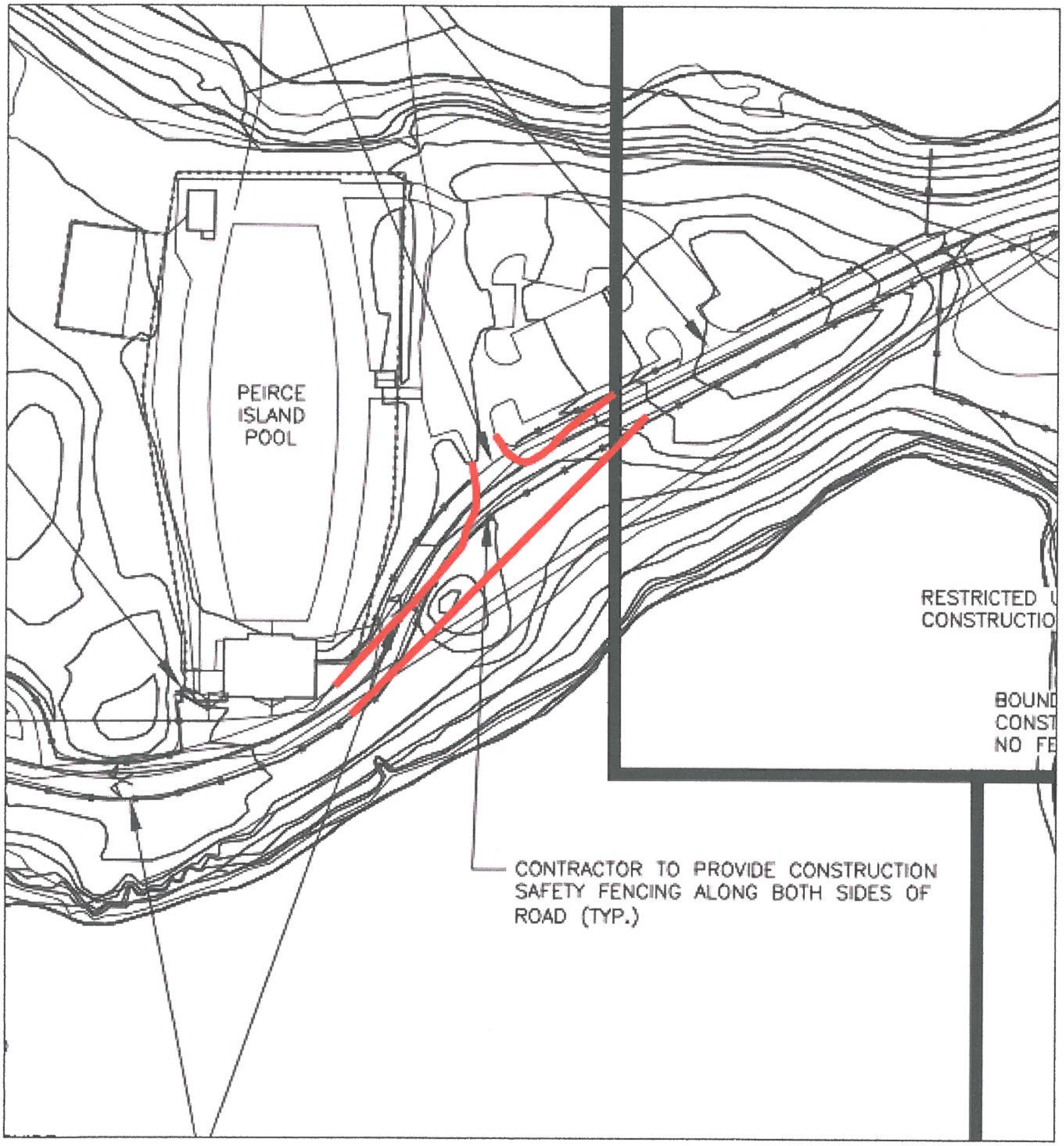
DISCUSSION:

The swimming pool area sees heavy pedestrian use, particularly in the summer months. Improvements to realign the roadway around the swimming pool house would be a long-term improvement to provide safer access to the wastewater treatment plant and would lessen the construction traffic impact on this project.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 666,000	—	$ 666,000
ALTERNATIVE	$ 144,000	—	$ 144,000
SAVINGS (Original minus Alternative)	$ 522,000	—	$ 522,000

SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **C-7**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **2 of 3**



COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.: **C-7** SHEET NO.: **3 of 3**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Flagger (Ordinary -2)	MH	11,616	30.00	348,480			
Survey/Layout	LS				1	2,000.00	2,000
Site Prep	LS				1	5,000.00	5,000
Asphalt Pavement Removal	SY				350	10.00	3,500
Site Paved Roadway	SY				350	25.78	9,023
Site Restoration	LS				1	5,000.00	5,000
Rock Excavation	CY				425	120.00	51,000
Subtotal				348,480			75,523
Markup (%) at	**91.2%**			317,814			68,877
TOTAL				666,294			144,400
TOTAL (ROUNDED)				666,000			144,000

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **C-8**
DESCRIPTION:	**ALLOW NIGHT WORK ON SITE BUT LIMIT THE AMOUNT OF TRUCK TRAFFIC AT NIGHT**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

A dual working shift is not going to be permitted at the site.

ALTERNATIVE:

Allow the contractor to work during the nighttime hours providing that the work can be accomplished with less than a designated number of trucks entering or exiting the site during the hours being worked.

ADVANTAGES:

- Allows contractor to install underground utilities when there is minimal vehicular traffic on the site
- Avoids trucks entering and leaving the site during nighttime hours
- Allows contractor to advance the construction schedule if necessary

DISADVANTAGES:

- Will require temporary lighting to be used on site during nighttime hours

DISCUSSION:

The contractor will need to demolish underground utilities and install new utilities in the roadway at the front of the plant. This work could easily be accomplished during nighttime hours when there is no one at the plant and there is no plant vehicular traffic. If there is a desire to limit truck traffic through the City, the contractor can be limited to a specific number of trucks entering or leaving the site during these hours. Knowing this limitation, it could deliver the necessary equipment and materials for the work during the daytime work shift.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **C-9**
DESCRIPTION:	**MOVE TEMPORARY CONSTRUCTION FENCE ALONG THE PLANT ACCESS ROAD TO BEHIND THE EXISTING GUARDRAIL ALONG THE ROAD**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

The contractor is being required to install a temporary fence along the access road to the plant. It appears that the fence is to be located on the road side of the existing guardrail.

ALTERNATIVE:

Require that the temporary fence be placed behind the existing guardrail.

ADVANTAGES:

- Maintains the space between the edge of road and vehicle and avoids having vehicles shy away from the fence and closer to the centerline of this narrow road

DISADVANTAGES:

- None apparent

DISCUSSION:

There is a concern that if the space between the edge of the road and the nearest object is reduced, vehicles will shy away from the object and move toward the center of a narrow road increasing the potential to collide with an oncoming vehicle. This alternative maintains the roadside configuration as is, lessening a driver's potential to move toward the middle of the road.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **C-11**
DESCRIPTION:	**ALLOW USE OF A SNOW MELT MACHINE AND ALLOW CONTRACTOR TO USE SNOW DISPOSAL AREA YEAR-ROUND**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

The original design restricts contractor use of the City's permitted snow disposal area between December 1st and April 30th.

ALTERNATIVE:

Allow the contractor to use part of this space year-round if a snow melting machine is provided.

ADVANTAGES:

- More space is available to the contractor to make its work more efficient
- Reduces staging and relocating of trailers and stored materials

DISADVANTAGES:

- May require review for acceptability under the existing snow disposal permit

DISCUSSION:

The potential cost savings seen by making more space available to the contractor year round would potentially offset the cost of snow melting.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **C-12**
DESCRIPTION:	**ALLOW THE CONTRACTORS TO USE BARGES TO STORE CONSTRUCTION MATERIAL**	SHEET NO.: **1 of 1**

ORIGINAL DESIGN:

An analysis of using barges to transport vehicles to the site in lieu of running trucks through the City and over the bridge to the island showed that this was not practical. Barges were not considered for use as stationary platforms located at the shoreline to store materials.

ALTERNATIVE:

Allow the contractors the option of using barges anchored off the shore to store materials.

ADVANTAGES:

- Provides material storage space near the point of use

DISADVANTAGES:

- Contractors will have to acquire the required permits to pursue this option

DISCUSSION:

There is limited space around the plant site to store materials needed to construct the facility. Allowing the contractors the opportunity to create space adjacent to the site through the use of barges anchored near the shoreline could allow them to operate more efficiently and cost effectively. If a contractor should choose this option, he would be responsible for obtaining the necessary permits from the various regulatory agencies. The goal of this alternative is to not have the construction documents preclude this option for the contractors.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS (Original minus Alternative)			

VALUE ENGINEERING ALTERNATIVE

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE**
City of Portsmouth, New Hampshire

ALTERNATIVE NO.: **C-14**

DESCRIPTION: **CONSOLIDATE STORAGE AREAS IN PROCESS BUILDINGS INTO ONE COMMERCIAL BUILDING**

ORIGINAL DESIGN:

The original design includes storage and maintenance areas in multiple facilities.

ALTERNATIVE: (sketch attached)

Provide a centralized maintenance and storage facility using a pre-engineered building.

ADVANTAGES:

- Centralizes maintenance and storage
- Reduces potential for odors in the maintenance and storage areas
- Cost savings for reducing the size of the Headworks and Operations and Laboratory Buildings
- Potential cost savings by constructing as commercial building space

DISADVANTAGES:

- Requires a separate structure and location on the site

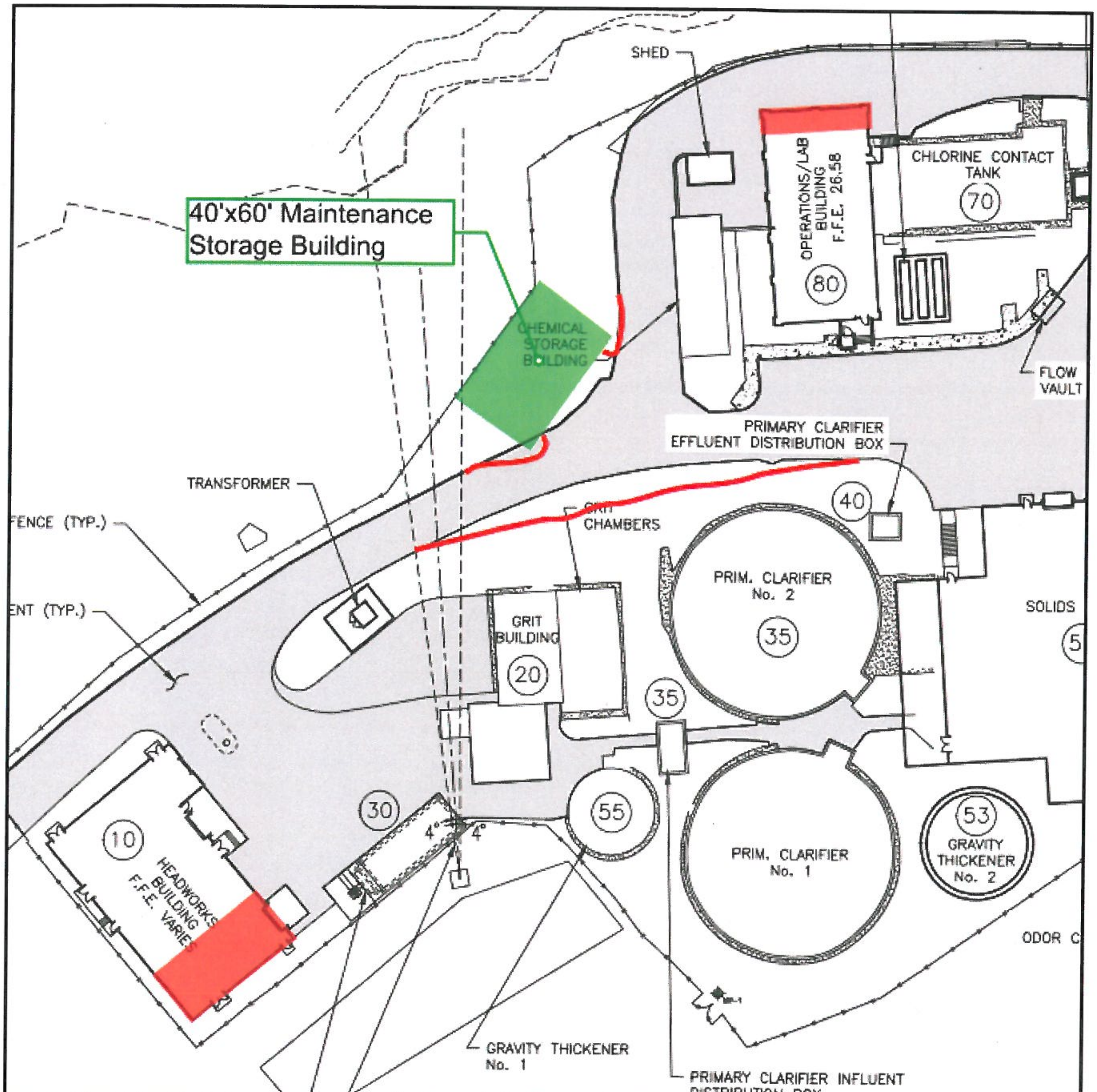
DISCUSSION:

Providing a centralized location for maintenance and storage will result in a reduction of the Headworks Building and Operations and Laboratory Building sizes. It is estimated that the Headworks Building cost could be reduced by approximately 20%, and the Operations and Laboratory Building cost could be reduced by 10%. The cost for the maintenance and storage building is based on a 40 ft. x 60 ft. pre-engineered building.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 5,124,000	—	$ 5,124,000
ALTERNATIVE	$ 4,369,000	—	$ 4,369,000
SAVINGS (Original minus Alternative)	$ 755,000	—	$ 755,000

SKETCH ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, New Hampshire*	ALTERNATIVE NO.: **C-14**
ORIGINAL DESIGN ☐	ALTERNATIVE DESIGN ☒ BOTH ☐	SHEET NO.: **2 of 3**



COST WORKSHEET

ARCADIS

PROJECT:	**PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE** *City of Portsmouth, NH*	ALTERNATIVE NO.:	**C-14**
		SHEET NO.:	**3 of 3**

PROJECT ITEM		ORIGINAL ESTIMATE			ALTERNATIVE ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Headworks (Building Only)	TOTAL	1	1,230,000	1,230,000			
Operations Lab Building	TOTAL	1	1,450,000	1,450,000			
Smaller Headworks	TOTAL				1	861,000	861,000
Smaller Operations Lab Building	TOTAL				1	1,160,000	1,160,000
Pre-Eng Central Maint. and Storage	SF				2,400	110	264,000
Subtotal				2,680,000			2,285,000
Markup (%) at	**91.2%**			2,444,160			2,083,920
TOTAL				5,124,160			4,368,920
TOTAL (ROUNDED)				5,124,000			4,369,000

SECTION THREE PROJECT DESCRIPTION

(Note that most of this section is taken from the Designer's 30% Preliminary Engineering Report.)

BACKGROUND

The City of Portsmouth, New Hampshire Wastewater Treatment Facility (WWTF) Upgrade project rehabilitates the plant and upgrades it to meet the requirements of a Consent Decree issued by the United States Environmental Protection Agency (EPA) to provide secondary treatment. In response to the requirements of the Consent Decree, the City completed a Draft Wastewater Master Plan and Long Term Control Plan Update (WWMP/LTCP Update). The Draft WWMP/LTCP Update was developed to address the requirements of the Consent Decree while also taking into consideration the long-term needs of the City's wastewater collection and treatment system. The City presented its Final Wastewater Master Plan in November, 2010. The compliance strategy was focused on upgrading the existing WWTF to include secondary treatment and stay within the existing fence line.

This was planned to be accomplished by reusing the existing Filter Building at the Peirce Island WWTF to achieve secondary treatment in accordance with the National Pollutant Discharge Elimination System (NPDES) permit issued in 2007. The compliance strategy was based on using high rate, small footprint treatment technologies to provide secondary treatment. The Final Wastewater Master Plan Submission recommended that the technologies be piloted to determine the most applicable technology for use in upgrading the Peirce Island WWTF in the compliance strategy. It was also recommended that due to a lack of data on existing wastewater characteristics, a wastewater characterization program be completed during the piloting effort. The piloting program was then undertaken in phases.

WWMP Piloting – Phase 1 Engineering Evaluation

In the Phase 1 Engineering Evaluation, potential high rate technologies were identified, developed, and compared to select the most promising technologies for piloting in Phase 2, the Initial Piloting Phase. As part of the Phase 1 Engineering Evaluation, existing flow and loading data for the Peirce Island WWTF were reviewed to identify projected dry weather flows and loadings for the proposed secondary treatment processes. The projected flows and loadings were used in developing conceptual planning level unit process sizes and estimated capital, operating, and maintenance costs for each technology for comparison.

The eight technologies considered included:

- Biological Aerated Filter (BAF)
- Sequencing Batch Reactor (SBR) with BioMag
- Conventional Activated Sludge (CAS) with BioMag
- Moving Bed Bioreactor (MBBR) & ActiFlo
- Moving Bed Bioreactor (MBBR) & CoMag
- Moving Bed Bioreactor (MBBR) & DAF
- Membrane Bioreactor (MBR)
- Conventional Activated Sludge (CAS)

Each technology was evaluated to review its ability to achieve different treatment levels including conventional secondary treatment (monthly average BOD5 and TSS of less than 30 mg/L) and nitrogen removal to monthly average concentrations of 8, 5 and 3 mg/L. Each technology was objectively compared to one another using a weighted evaluation matrix to rank the technologies. Based on this review, piloting was conducted for BAF (Option 1), CAS with BioMag (Option 3), and MBBR and DAF (Option 6) in the Phase 2 Initial Piloting effort. The results of this evaluation were summarized in the Technology Evaluation Final Technical Memorandum dated September 26, 2011, hereinafter referred to as the Phase 1 Evaluation.

WWMP Piloting – Phase 2 Initial Piloting

The primary focus of the Phase 2 Initial Piloting was to evaluate the ability of the three technologies to meet the secondary treatment effluent limits as defined in the NPDES permit issued to the City by EPA in 2007. The pilot protocol was later revised to evaluate the ability of the three processes to meet effluent nitrogen levels of 8 mg/l and 3 mg/l. Other goals of the piloting effort included:

- Complete a wastewater characterization program to define the loadings to be treated at the upgraded WWTF.
- Establish the design flows for the upgraded WWTF.
- Confirm Manufacturer/Vendor sizing criteria and space requirements to provide secondary treatment/nitrogen removal using each technology.
- Define technology performance under varying flow conditions.
- Identify operational and maintenance factors specific to each technology.

In accordance with the City's Consent Decree, a Piloting Technical Memorandum was submitted on September 28, 2012. This memorandum showed that all three of the technologies were capable of consistently achieving 8 mg/L and inconsistently achieving 3 mg/L total nitrogen in the effluent. The memorandum included a life cycle cost summary which showed that the BAF technology had the lowest life cycle cost of the three piloted technologies. Additionally, the BAF was shown to have the highest value ratio based on an evaluation of qualitative factors important to the long-term operation and maintenance of the facility. AECOM recommended the BAF technology for implementation at the Peirce Island WWTF based on these findings. Further development of the concept showed that it was able to fit within the WWTF existing fence line. On April 8, 2013, the City Council voted to move forward with the design of a two-stage BAF system capable of achieving 8 mg/L on a seasonal rolling average basis and construct all of the necessary upgrades within the existing fence line.

Design Phase 1

Design Phase 1 advanced the design of the necessary upgrades to approximately the 10% completion level. Major facets of this phase of the design included:

- Site investigations
- Preliminary permitting
- Advancement of the process and hydraulic design
- Evaluation of the existing facilities
- Development of construction constraints, and

- Review of potential sustainable features

The Design Phase 1 Summary Memorandum dated March 2014 summarized the results of the Design Phase 1 efforts and provided a comprehensive summary of the scope of the plant upgrade project.

Consent Decree Requirements

The Consent Decree between the City and EPA was executed in August 2009 and modified in July 2012 and contained milestones and dates for the completion of the Draft and Final WWMP/LTCP Updates. The City has met the required milestone dates contained in the original Consent Decree. During the course of the piloting evaluation, EPA and the City negotiated a modification to the Consent Decree which contains further milestones and dates for implementation of both the CSO Long Term Control Plan projects and the upgrade of the Peirce Island WWTF to secondary treatment. The relevant milestones and dates for the Peirce Island WWTF upgrade are presented in Table 1-1 and reflect the modified Consent Decree from July 2012.

Table 1-1. Current Consent Decree Peirce Island WWTF Milestones and Dates
Milestone Action Date

The City shall complete pilot testing of potential treatment technologies for achieving secondary treatment, including, but not necessarily limited to:

Biologically Aerated Filters (BAF), BioMag, Moving Bed Biofilm Reactors (MBBR) w/ Dissolved Air Flotation (DAF), and Conventional Activated Sludge with BioMag.	June 30, 2012
The City shall complete a data summary relative to the pilot testing.	July 30, 2012
The City shall submit a Piloting Technical Memorandum that includes data from piloting and a recommendation on the design and capacity of secondary treatment facilities.	October 1, 2012
The City shall commence final design of secondary treatment facilities.	July 1, 2013
The City shall complete design of secondary treatment facilities.	August 31,2014
The City shall commence construction of secondary treatment facilities.	March 1, 2015
The City shall complete construction of secondary treatment facilities.	March 1, 2017
The City shall achieve compliance with secondary treatment limits in the Permit.	May 1, 2017

With the initiation of work on Design Phase 1 in June 2013, the City commenced design of secondary treatment facilities in advance of the Consent Decree date. As shown in Table 1-1, the above schedule was negotiated based on an upgrade for secondary treatment. However, the upgrade under design includes facilities capable of removing nitrogen. The additional facilities necessary for nitrogen removal substantially increase the scope and cost of the project to the point that extraordinary measures would be necessary on the part of the City, the design engineer, and the construction contractor to meet the current Consent Decree schedule. As such, the City has requested a modification to the above schedule which would extend the overall schedule by a total of 18 months in order to incorporate the nitrogen removal treatment facilities. The proposed schedule is shown below in Table 1-2. The City and AECOM are currently working towards the schedule in Table 1-2.

Table 1-2. Proposed Consent Decree Modification Peirce Island WWTF Milestones and Dates Milestone Action Date

The City shall complete design of nitrogen removal treatment facilities.	March 1, 2015
The City shall commence construction of nitrogen removal treatment facilities.	September 1, 2015
The City shall complete construction of nitrogen removal treatment facilities.	June 1, 2018
The City shall achieve compliance with nitrogen removal treatment limits in the Permit.	November 1, 2018

PROJECT DESCRIPTION

The oldest portions of the Peirce Island WWTF were constructed around 1965 and consisted of primary treatment and disinfection. The plant was upgraded around 1990 with an aerated grit system, new primary clarifiers, a primary effluent sand filter system (that is currently out of service), an Administration Building, and sludge thickening, storage and dewatering. The plant was upgraded again around 2005 to provide chemically enhanced primary treatment (CEPT) with ferric chloride and polymer storage and feed systems and other miscellaneous improvements.

The current treatment process consists of aerated grit chambers, chemically enhanced primary settling, and chlorination/dechlorination. Sludge is thickened in a gravity thickener and then temporarily stored in aerated sludge storage tanks before being dewatered by belt filter presses.

This project consists of an upgrade of the WWTF to allow for the operation of the WWTF for the next 20 years and to provide nitrogen removal. A significant portion of the project is to upgrade existing equipment, systems, and facilities. Major WWTF additions include a new headworks, a new gravity thickener, replacement of the existing Administration Building with a new Solids Building, a new two-stage Biological Aerated Filter (BAF) system, and replacement of the existing Solids Processing Building with a new Operations/Lab Building. The upgrades for the WWTF will be constructed through two separate contracts.

The first contract will include the replacement of the primary clarifier equipment, replacement of Gravity Thickener No. 1 equipment, and modifications to the Primary Clarifier Influent Distribution Box. Construction for the first contract is planned to be substantially completed by fall of 2015. The second contract will include a new headworks, Gravity Thickener No. 2, new Solids Building, new Operations/Lab Building, equipment replacement and the BAF system. Construction for the second contract is planned to be completed by June 1, 2018.

The plant treats wastewater from a combined sewer system, resulting in a large variation between average and peak flows. The peak design flow is 22.0 mgd. The design flow for the BAF system with all cells operating is 6.13 MGD average and 10.33 MGD peak (not including recycle flows). At times of high wet weather flow, all of the flow will undergo CEPT. A portion of this wet weather flow will bypass the BAF system and flow directly to disinfection.

The following sections describe the upgrades proposed throughout the WWTF.

Liquid Process

Headworks Building

The project includes a new influent screening system to be installed in the new Headworks Building. Flow from the Mechanic Street Pump Station and flow from the Town of New Castle join together ahead of the influent screens. The flow from New Castle is conveyed from the existing River Road Pump Station through an existing force main that is extended to the new Headworks Building. The force main from the River Road Pump Station is provided with a new flow meter. Flow from the Mechanic Street Pump Station is measured with the existing flow meter located within the existing pump station.

Two mechanically cleaned bar screens with 6 mm spacing are provided, each capable of passing 11.0 MGD. Each screen discharges collected screenings into a dedicated wash press. The wash presses will clean and dewater the screenings to remove organic material and to minimize odors. The wash presses will discharge washed screenings into a container, located at grade level, for off-site disposal. As a back up to the screen a manually cleaned bar rack will be installed in a third channel. The wash presses are connected to the plant water system for wash water supply. The current layout for the Headworks is based on Mahr bar screens. The wastewater channels are covered and connected to a new biofilter for odor control. A new influent automatic sampler is provided with the sample point located upstream of the influent screens.

Aerated Grit Chamber Rehabilitation

The project includes the reuse of the existing Aerated Grit Chambers. Modifications for the aerated grit chambers include replacement of the existing aeration piping, diffusers, blowers, grit pumps and piping. Additionally, the influent and baffling arrangement within the Aerated Grit Chambers will be modified to improve performance.

The grit pumps are replaced with three variable speed, recessed impeller pumps. The grit piping is provided with connections to the plant water system for flushing and includes air taps for cleaning and long radius bends. A portable air compressor will be used for cleaning of grit piping. All three existing blowers for the aerated grit chambers and Sludge Storage Tank No. 3 and 4 are being replaced with three variable speed, rotary lobe blowers.

The existing grit screw conveyors have been removed from the grit hopper in each grit chamber. A new, chain-driven screw conveyor is provided at the same location as the previous conveyor for each chamber. The slide gates associated with the aerated grit chamber at the influent, effluent and bypass channels are being replaced due to their deteriorated condition.

In addition to the mechanical equipment replacement, the weirs in the grit chamber are being replaced, new baffles installed, and the flow pattern within the grit chamber altered so that influent enters on the opposite side of the tank to improve the air-induced spiral roll. The grit chambers are covered with an aluminum cover, and exhaust air from the headspace above the grit chambers will be conveyed to a biofilter for odor control.

The existing grit classifier is being replaced. The new grit classifier is provided with two cyclone grit separators. The new grit classifier has an overflow basin and level sensor, similar to the existing classifier. The Grit Classifier Room will be connected to the biofilter for odor control.

<u>Primary Clarifier and Distribution Box Rehabilitation</u>

Primary Clarifiers and Influent Distribution Box

The equipment replacement and upgrades at the primary clarifiers and influent distribution box is also being completed in a separate contract. The connection of the primary clarifiers and influent distribution box to the biofilter for odor control will be included with this contract. Sludge blanket level sensors are also included as part of the WWTF Upgrade.

Primary Clarifier Effluent Distribution Box

The project includes rehabilitation of the Primary Clarifier Effluent Distribution Box including:

- Structural repairs based on inspections during construction
- Addition of an inverted gate for CEPT flow
- Aluminum plate cover to allow for odor control

Pumps & Other Mechanical Equipment

The project includes the removal and replacement of existing primary sludge pumps and primary scum pumps. The three existing primary sludge pumps are replaced with three, variable speed, rotary lobe pumps. Two grinders will be provided on the primary sludge suction piping. The primary sludge pumps will have the capability to pump to Gravity Thickener No. 1 and Gravity Thickener No. 2. The primary sludge pumps will also have the capability to pump to the Primary Clarifier Influent Box for draining the primary clarifiers. The suction piping for the primary sludge pumps will have a cross connection to the screw press feed pump suction piping to allow for dewatering of primary sludge.

The three existing primary scum pumps are replaced with two, variable speed, recessed impeller type pumps. The primary scum pumps will have the capability to pump to the grit chambers and Sludge Storage Tank No. 1 and 2. These pumps will also have the capability of pumping down the scum well at Gravity Thickener No. 2.

Secondary Treatment Process

Secondary Influent Pump Station

A new Secondary Influent Pump Station will be located in the new Solids Building. The design of the Secondary Influent Pump Station will include two wet wells and four dry-pit submersible solids handling pumps with variable speed drives. The secondary influent pump discharge piping has space for automatic strainers on the discharge of each pump. Hatches and monorails is provided for equipment maintenance purposes. A new automatic sampler is provided to take samples of primary effluent from the wet well.

Stage 1 BAF

The Stage 1 BAF system includes a 6-cell Kruger BAF system designed for carbon oxidation and nitrification. The Stage 1 BAF will be an upflow filter, where flow will enter the cell at the bottom and flow upward through the filter media. The filter media is a polystyrene material and retained by the nozzle slab located at the top of each cell. Air diffusers are located below the media bed to provide air to the entire filter bed. Influent flow to the BAF cells are controlled with flow meters and modulating butterfly valves. Effluent will flow to the Nitrified Effluent Channel, located above the Denitrified Effluent Channel. Backwash for the Stage 1 BAF cells will flow by gravity from the Nitrified Effluent Channel, downward through the BAF cell and discharge to the Stage 1 Mudwell. Three mudwell pumps will be provided for the Stage 1 Mudwell. The mudwell pumps are variable speed, submersible pumps and will pump backwash water to the Primary Clarifier Influent Distribution Box or to Gravity Thickener No.2.

Kruger has been preselected as the sole source vendor of the Stage 1 BAF system.

Stage 2 BAF

The Stage 2 BAF system includes a 6-cell Kruger BAF system designed for denitrification. The Stage 2 BAF will be an upflow filter, where flow will enter the cell at bottom and flow upward through the filter media. The filter media is a polystyrene material and retained by the nozzle slab located at the top of each cell. Air diffusers are located below the media bed to provide air scouring during backwash. Stage 2 BAF influent flow will flow by gravity from the Nitrified Effluent Channel into a single header.

Influent flow from the nitrified effluent header to the Stage 2 BAF will be controlled with flow meters and modulating butterfly valves at each cell. Micro C is used for a carbon source and will be injected into the nitrified effluent header before flow is split to each cell. The Micro C will be mixed with a pump diffusion flash mix system located in the nitrified effluent header. Denitrified effluent will flow from each cell to the Denitrified Effluent Channel and then to the Effluent Distribution Box located near the Chlorine Contact Tanks. A flow meter is provided on the denitrified effluent pipe, within the Gallery of the BAF Facility.

Within the Gallery of the BAF Facility the denitrified effluent pipe includes an oversized section of pipe to reduce flow velocity to allow for removal of entrained air from the denitrified effluent. The oversized section of pipe will include a vent pipe that will discharge into the Denitrified Effluent Channel. Sodium hypochlorite will be injected into the denitrified effluent pipe at the BAF Facility.

Backwash for the Stage 2 BAF cells will flow by gravity from the Denitrified Effluent Channel, downward through the BAF cell and discharge to the Stage 2 Mudwell. Three mudwell pumps are provided for the Stage 2 Mudwell. The mudwell pumps are variable speed, submersible pumps and will pump backwash water to the Primary Clarifier Influent Distribution Box or to Gravity Thickener No.2.

Kruger has been preselected as the sole source vendor of the Stage 2 BAF system.

Disinfection System Rehabilitation

The existing Chlorine Contact Tanks and Dechlorination Structure are being reused. Sodium hypochlorite will be injected into the denitrified effluent at the BAF facility. During wet weather, when the daily forward flow exceeds 9.06 MGD, sodium hypochlorite will also be injected at the Primary Clarifier Effluent Distribution Box, downstream of the wet weather weir. Sodium bisulfite will be injected at the existing Dechlorination Structure. A chlorine analyzer is provided near the beginning of each chlorine contact tank and the measured chlorine residual used to trim the sodium hypochlorite dose. An Oxidation-Reduction Potential (ORP) analyzer and auto sampler are provided at the effluent chamber after the Dechlorination Structure and the measured ORP used to trim the sodium bisulfite dose.

The existing scum collection system located in the Chlorine Contact Tanks remains. The existing Chlorine Contact Tanks have cracking and spalling in the walkways and slabs, which are being repaired. The common wall shared with the existing Solids Processing Building and associated slab and beams is being replaced when the existing Solids Processing Building is demolished.

Effluent Meter Structure Rehabilitation

The existing Effluent Meter Structure is currently used only for flow distribution between the two chlorine contact tanks. The existing parshall flume at the Effluent Meter Structure is not in operation. The existing Effluent Meter Structure will be modified to become the Effluent Distribution Box and will be used to combine secondary effluent and wet weather secondary bypass flow and distribute the combined plant flow between the two Chlorine Contact Tanks.

Upgrades to the existing Effluent Meter Structure include:

- Demolition of the Parshall Flume and construction of new wall
- Replacement of slide gates
- New slide gate at discharge of denitrified effluent pipe
- Miscellaneous concrete repairs

Solids Handling

<u>Sludge Thickening</u>

Gravity Thickener No.1 Rehabilitation

The equipment replacement and upgrades at Gravity Thickener No. 1 will be completed in a separate contract. The connection of Gravity Thickener No. 1 to the biofilter for odor control is included with this contract.

Gravity Thickener No. 2

Gravity Thickener No. 2 is 40-feet in diameter and covered with a dome cover. The air space will be exhausted to the odor control system. The gravity thickener equipment is similar to equipment for Gravity Thickener No. 1. Two new thickened sludge pumps are provided for Gravity Thickener No. 2. These pumps are variable speed plunger pumps and located in the new Solids Building. Flow to Gravity Thickener No. 2 will be measured with a magnetic flow meter. Dilution water is provided at the gravity thickeners to provide a consistent hydraulic loading rate. Dilution water for the gravity thickeners is supplied from the plant water system. Gravity Thickener No. 2 is elevated and has an exterior perimeter walkway.

Thickened Sludge Pumping

The three existing thickened sludge pumps, located in the Grit Building, are replaced with two new variable speed plunger pumps, located in the same area as the existing pumps. The thickened sludge pumps have the flexibility to pump from Gravity Thickener No. 1 and Sludge Storage Tank No. 3 and 4 to Sludge Storage Tank No. 1 through 4. Existing valves in the thickened sludge piping are replaced. The thickened sludge piping is provided with plant water connections for flushing.

The project includes two new thickened sludge pumps located in the new Solids Building. These pumps are variable speed plunger pumps and will have the flexibility to pump from Gravity Thickener No. 2 and Sludge Storage Tank No. 1 and 2 to Sludge Storage Tank No. 1 through 4. The thickened sludge piping is provided with plant water connections for flushing.

<u>Sludge Storage</u>

Thickened sludge from the gravity thickeners will be pumped to aerated sludge storage tanks.

Sludge Storage Tank Rehabilitation

The existing facility has four sludge storage tanks. Sludge Storage Tank No. 1 and 2 are located adjacent to the existing Administration Building and Sludge Storage Tank No. 3 and 4 are located adjacent to the Grit Building. The project includes rehabilitation of Sludge Storage Tank No. 3 and 4. The rehabilitation of the existing sludge storage tanks includes new aeration piping and coarse bubble diffusers, connection to new odor control system, new protective coating, structural repairs as necessary and new level instrumentation.

Sludge Storage Tank No. 1 and 2 will be demolished with the demolition of the existing Administration Building and are replaced with two new sludge storage tanks as part of the new Solids Building. The new tanks are covered, connected to the odor control system and aerated with coarse bubble diffusers. The tanks are provided with access hatches for maintenance purposes. The new tanks are sized to provide three days of storage during max day sludge production conditions.

Blowers

The project includes replacement of the two existing sludge storage tank blowers in the existing Administration Building. Three variable speed rotary lobe blowers are provided to serve Sludge Storage Tank No. 1 and 2 and located in the lower level of the new Solids Building.

<u>Sludge Dewatering</u>

Sludge will be dewatered via new rotary screw presses located in the new Solids Building. Dewatered sludge will be conveyed and distributed to new containers or trailers in two truck bays.

Screw Presses

Three screw presses will have the capacity to dewater the maximum week sludge production in 40 hours or less with all units operating. The screw presses are located in the new Solids Building. Pressate from the screw presses will be directed to the Stage 2 Mudwell. Alternatively, the pressate could be directed to the Secondary Influent Pump Station Wet Well. Each screw press is connected to Odor Control System No. 2. The screw presses have the following items:

- Polymer storage and feed systems
- A permanganate feed system
- Piping and carrier water systems
- Removal method for screws for maintenance
- Polymer injection rings
- Air compressors

Pumps & Other Mechanical Equipment

The three existing belt filter press feed pumps will be replaced with four screw press feed pumps, located in the lower level of the Solids Building. The screw press feed pumps are variable speed rotary lobe pumps. In-line grinders are provided on the screw press feed pump suction piping. Each screw press has a dedicated feed pump and flow meter. The suction piping for the screw press feed pumps is provided with a cross connection to the primary sludge pump suction piping to allow for dewatering of primary sludge. The suction piping for the screw press feed pumps is cross-connected with the thickened sludge piping from Gravity Thickener No. 2. Thickened sludge piping associated with the screw press feed pumps is provided with connections to the plant water system.

Conveyors

Three shaftless screw conveyors are provided to convey sludge from the screw presses to either containers or trailers in two truck bays. The two conveyors in the truck bays have multiple discharge points to evenly distribute dewatered solids into containers or trailers and are reversible. Discharge points are isolated with pneumatically actuated gates, which provide the plant staff with the ability to control where sludge is discharged to. The sludge conveyors are covered and connected to the odor control system and connections to plant water for flushing are provided.

Ancillary Systems and Facilities

A number of WWTF ancillary facilities upgrades are provided including the following:

- Ferric Chloride Storage & Feed System
- Polymer Systems
- Sodium Hypochlorite Feed System
- Sodium Bisulfite Feed System
- Micro-C Storage & Feed System
- Pump Diffusion Flash Mix System
- Caustic Soda Storage & Feed System
- Potassium Permanganate Storage & Feed System
- Odor Control
- Flow Meter Vaults
- Control, Instrumentation, and Communication Systems
- Compressed Air Systems
- HVAC Upgrades
- Electrical Systems
- Main Switchgear
- Emergency Generator
- Plant Water System
- Plant Drain System
- Fuel Oil Systems
- Buildings and Architectural Components
- New Headworks Building
- Reconfiguration of the Grit Building
- New Stage 1 and Stage 2 BAF Facility
- New Solids Building
- New Operations/Lab Building
- Plant Security
- Demolition

These systems are described below.

Ferric Chloride Storage & Feed System

A ferric chloride storage and feed system is provided for coagulation. The existing ferric chloride bulk storage tanks are replaced with two new ferric chloride tanks. The new tanks have the same capacity as the existing tanks and are located in the same area. New metering pumps and a day tank are located in a new Ferric Chloride Room in the lower level of the Grit Building. Two sets of ferric chloride metering pumps are provided. One set of metering pumps are sized for CEPT flow and the second set sized for backwash coagulation. New transfer pumps are provided to transfer ferric chloride from the bulk storage tanks to the new day tank. The transfer pumps are located in a heated enclosure in the ferric chloride storage area, similar to the existing system. The ferric chloride metering pumps are peristaltic pumps.

Polymer Systems

Two polymer storage and feed systems are provided. The system located in the Grit Building is for flocculation for CEPT flow and backwash. The system located in the Solids Building is for dewatering. These systems consist of the following:

- Polymer blend units designed for emulsion polymers
- Polymer tote storage
- Secondary containment
- Dilution water and piping

The polymer system in the Grit Building is located in a dedicated room and includes four polymer blend units and storage area for two polymer totes. The totes are located on an elevated platform and handled with a forklift. The elevated platform and polymer blend units are located within a secondary containment curb. The polymer system will dose the entire plant flow as well as the periodic backwash flow.

The polymer system in the Solids Building is located in the Truck Bay and includes four polymer blend units and storage area for six polymer totes. The Polymer Area has a depressed floor and grating to provide secondary containment as well as easy access for tote removal and replacement. Each polymer blend unit has the capacity to dose polymer for a dedicated screw press. One standby polymer blend unit is provided for dewatering.

Sodium Hypochlorite Storage & Feed System

A sodium hypochlorite feed system is provided for disinfection of final effluent and includes the following:

- A set of metering pumps for denitrified effluent flow
- A set of metering pumps for wet weather secondary bypass flow
- Carrier water and piping
- Secondary containment

The sodium hypochlorite storage and feed system reuses the existing sodium hypochlorite storage bulk tanks located in the existing Chemical Storage Building. The new sodium hypochlorite feed system is located in the lower level of the new Operations/Lab Building within a secondary containment curb.

Sodium hypochlorite will be injected into the denitrified effluent pipe at the BAF Facility for disinfection of denitrified effluent. Sodium hypochlorite will be injected at the Primary Clarifier Effluent Distribution Box, downstream of the wet weather weir for disinfection of secondary bypass flow. Sodium hypochlorite will also be injected into the plant water system to minimize biological growth throughout the plant water system. Additional disinfection of the plant water system will be periodic and one of the spare sodium hypochlorite metering pumps will be used to dose this injection point. Due to the wide range of dosing requirements for each injection point, a dedicated set of metering pumps is provided for each injection point. The sodium hypochlorite metering pumps are peristaltic pumps.

Sodium Bisulfite Storage & Feed System

A sodium bisulfite feed system will be provided for dechlorination of final effluent. This system includes the following:

- Metering pumps
- New sodium bisulfite bulk storage tank
- Carrier water and piping
- Secondary containment

The new sodium bisulfite storage and feed system includes the replacement of the existing sodium bisulfite tank located in the existing Chemical Storage Building. The new sodium bisulfite feed system is located in the lower level of the new Operations/Lab Building within a secondary containment curb. Sodium bisulfite will be injected at the existing Dechlorination Structure. The sodium bisulfite metering pumps are peristaltic pumps.

Micro-C Storage & Feed System

A Micro-C storage and feed system is provided for carbon addition into the nitrified effluent header. This system includes the following:

- Two bulk storage tanks
- Metering pumps
- Carrier water and piping
- Secondary containment

The Micro-C system is located in the BAF Facility in a dedicated room. Micro-C will be injected into the nitrified effluent header before flow is split to the Stage 2 BAF cells. Micro-C will be mixed within the nitrified effluent header with a pump diffusion flash mix system. The Micro-C metering pumps are peristaltic pumps.

Caustic Soda Storage & Feed System

A Caustic Soda storage and feed system is provided for alkalinity addition. This system includes the following:

- Two storage tanks
- Metering pumps
- Carrier water and piping

- Secondary containment

The caustic soda storage and feed system are located in a dedicated room in the new Solids Building. Caustic soda will be injected into the wet wells at the Secondary Influent Pump Station. The caustic soda metering pumps are peristaltic pumps.

Potassium Permanganate Storage & Feed System

A potassium permanganate storage and feed system is provided for dewatering and sludge storage odor control. This system includes the following:

- Metering pumps
- Dry potassium permanganate eductor system
- Mixing tank and mixer
- Drum storage area
- Water supply and piping

The potassium permanganate storage and feed system is located in a dedicated room in the new Solids Building. The room is provided with an area to store three drums of dry potassium permanganate. The dry potassium permanganate eductor system will transfer dry product from the drums to the mixing tank. Each metering pump will have the capacity to dose potassium permanganate for a dedicated screw press as well as the sludge storage tanks. The potassium permanganate metering pumps are peristaltic pumps. The existing potassium permanganate piping to Sludge Storage Tank No. 3 and 4 is being reused as applicable. The Potassium Permanganate Room has secondary containment.

Odor Control

A new distributed odor control system and odor control fans is provided. Exhaust air from the following areas will be conveyed to the odor control system:

- Headworks - Screen Channels, Screens and Wash Presses
- Headworks - Screenings Dumpster Area
- Grit Classifier Room
- Grit Chambers and Channels
- Primary Clarifier Distribution Boxes
- Primary Clarifier Launders
- Secondary Influent Pump Station Wet Well
- Sludge Storage Tank No. 1 through 4
- Gravity Thickener No. 1 and 2
- Screw Presses and Conveyors
- Dewatered Sludge Truck Bays

The new odor control system is distributed between two odor control systems to treat odorous air from these sources. Odor Control System No. 1 is a biofilter system and located outdoors. Odor Control System No. 1 will treat odors from the Headworks, Grit Building, primary clarifier effluent launders and Gravity Thickener No. 1. The odor control system is housed in a concrete structure. Inside the concrete structure is an inlet air humidification system, air distribution plenum, media support system, and the manufactured media. Removable covers are provided to better control environmental conditions inside the biofilter and allow the air to be discharged through short stacks. The enclosed odor control fan is located near the odor control system. Odor Control System No. 1 is located at grade with H-20 rated covers.

Odor Control System No. 2 is a dry, dual media carbon system and located outdoors. Odor Control System No. 2 will treat odors from Gravity Thickener No. 2 and the Solids Building. The system includes a grease/mist eliminator, an enclosed fan, and a 10 ft. diameter, 10 ft. tall radial flow fiberglass reinforced plastic (FRP) adsorber vessel housing layers of both activated carbon and permanganate impregnated media. The odor control fan is located near the odor control system.

Flow Meter Vault

A flow meter vault is provided for the magnetic flow meter that will measure the primary effluent wet weather flow that bypasses secondary treatment and flows directly to the chlorine contact tanks. The meter is located on the existing 36-inch primary clarifier effluent pipe, between the Primary Clarifier Effluent Distribution Box and the Effluent Distribution Box. The vault is a precast structure with access hatches rated for H-20 loading and provided with lighting and drains.

<u>Control, Instrumentation, and Communication Systems</u>

Plant Control Systems, Software, and Instrumentation

The existing plant supervisory control and data acquisition (SCADA) system consists of both manual local control and has limited ability to monitor and control plant systems. Many of the control systems and instrumentation components are the original equipment from the 1985 upgrade. The existing plant control system and instrumentation components is being replaced.

The project includes a full upgrade to the plant SCADA system, which includes monitoring and control functions of the major plant systems and equipment. The upgraded SCADA system will be able to monitor and control the City's remote pump stations that currently report back to the existing SCADA system and will have the ability to be expanded in the future to monitor and control all of the City's remote pump stations. The new SCADA system will have new software and system configurations including real-time historical reporting software to allow for historical process equipment monitoring as well assist in the generation of required reports for regulatory purposes.

Communications System

Internet access is provided over a new fiber optic link to the BayRing municipal area network (MAN). Copper internet network connections are provided to the various rooms on the upper level of the Operations/Lab Building only. Connections will also be provided to the various systems requiring internet access such as the CCTV system.

Phone is provided over the BayRing fiber link. The management of the phone system will be performed by BayRing on their servers. The primary hardware required by the City will be the phones. A connection to the local cable TV provider will be installed in the duct bank along the access road. The cable TV service will terminate in the Operations/Lab Building. Cable TV drops will be distributed to selected room on the upper level of the Operations/Lab Building.

Fire Alarm System

A site wide networked fire alarm system is provided. It is an addressable system with remote fire alarm control panels at each building. A fiber optic network is provided to network the fire alarm panels together. Notification to the fire department will be provided in compliance with the requirements of the fire department. Alarm initiating devices are provided.

HVAC Systems

New HVAC systems are being provided for the Headworks, Grit Building, BAF Facility, new Solids Building and new Operations/Lab Building. All of the new buildings have dedicated mechanical rooms and spaces. Propane will be the fuel source for the heating systems throughout the WWTF. Air conditioning is provided in electrical rooms as required. Air conditioning is provided in the Operations/ Lab Building as well as the Office in the Solids Building.

Electrical Systems

The project includes the replacement of the plant's electrical equipment. New underground duct banks and electrical distribution system is included. Site lighting will be designed to suit the needs of the new buildings and site layout. A fire alarm system is to be included in the design as well as lightning protection.

The electrical, phone and internet services will enter the site in the area of the main entrance into the WWTF. The new utility transformers are located off the main road on the site, near the Grit Building. Fiber optic cable is provided for phone and internet.

Electrical Service

Currently the Public Service New Hampshire (PSNH) power cables enter the WWTF site over water. The existing electrical service is fed from a transformer located on the east side of the site, near the existing Filter Building. Due to maintenance, access, and permitting issues, this method of providing electrical power to the WWTF is no longer feasible and the existing electrical service will be demolished. The new power cables will interconnect with the existing PSNH network at a new electrical pole located in close proximity to the pool and will continue in a duct bank under the access road into the WWTF site and will feed the new utility transformer. The new utility transformer is located behind the WWTF sign located near the entrance. From the utility transformer the service conductors run through a duct bank into the Electrical/Switchgear Room in the Headworks.

Main Switchgear

The existing main switchgear is located in the existing Filter Building. With the demolition of the existing

Filter Building and the relocation of the electrical service to the main entrance to the site, a new main switchgear is being provided at the Headworks. The main switchgear is located in the Electrical/ Switchgear Room, located near the emergency generator.

Emergency Power

The existing emergency generator is located in the existing Filter Building. With the demolition of the existing Filter Building and the new main switchgear located in the Headworks Building, a new emergency generator is now located in the Generator Room in the Headworks Building. The new generator is diesel powered and has a below ground diesel storage tank located nearby. The new generator is designed to provide backup power for the entire facility. The emergency generator is provided with 48 hours of fuel storage at maximum rated power output.

<u>Plant Water System</u>

The project includes a new plant water pumping system with hydropneumatic tank and associated compressors and pumps. The new plant water system includes a distribution system throughout the site to supply all buildings and processes requiring plant water. Existing yard washdown hydrants are connected to the new plant water system.

Plant Drain System

The existing filtrate pump station, located near the existing Sludge Processing Building, will be demolished. A new pump station replaces the existing pump station at Manhole East. Drainage from the Operations/Lab Building will flow to the new pump station. The new pump station is provided with duplex submersible pumps which discharge to the Headworks Building. A new sanitary pump station is to be located near the new Solids Building. The sanitary pump station has duplex submersible grinder pumps which will discharge to the Headworks Building.

Heating Fuel Storage

There are two underground fuel oil storage tanks at the WWTF, which will be removed as well as the existing propane tanks at the existing Solids Building. Where heating fuel is needed, propane will be provided as a source of fuel. Three below ground propane storage tanks are provided, each with a capacity of approximately 2,000 gallons. These propane storage tanks are located near the Operations/ Lab Building and Chlorine Contact Tanks. The propane tanks are manifolded together and distribution piping routed throughout the site to provide propane where necessary. The existing odor control system and filtrate pump station located in this area will be demolished to provide an area to locate the propane storage tanks.

<u>Buildings and Architectural Components</u>

Headworks Building

The design of the upgraded facility includes a new Headworks Building. The Headworks Building is comprised of a cast-in-place concrete structure, brick and block cavity wall construction for the exterior wall and a flat roof. The floor elevation in the Screen Room is raised above grade to accommodate the hydraulic grade line and provide approximately 2 feet of freeboard at peak flow. Stairs and platforms are provided for access to this room as needed. Floor elevations for all other rooms in the Headworks Building are at grade. Roll-up doors are provided for the Wash Bay Garage and the Screenings Garage. Louvers are provided as required for the emergency generator and HVAC system.

Grit Building

The Grit Building will undergo an interior renovation that will include new rooms and separation of chemical and electrical spaces from process areas. This renovation includes interior improvements to meet current building codes including isolation of the grit classifier area, enclosing the existing stairwell and separation of dissimilar environments. Dedicated rooms are provided for the ferric chloride day tank and metering pumps, polymer system and Electrical Room.

Other upgrades included with the design:

- Provide new energy efficient doors windows
- Weather-stripping at overhead garage door
- Refinish protective coating in chemical containment areas as needed
- Cleaning and re-painting of the lower level and grade level including bar joists and underside of
- metal roof deck
- Provide physical separation from the grit classifier area.
- Provide access for polymer deliveries

BAF Facility

The project includes a new building for the BAF Facility to be constructed at the location of the existing Filter Building. The building includes Stage 1 and Stage 2 BAF cells, Stage 1 and Stage 2 Mudwells, a pipe gallery, a Micro-C storage and feed area, a blower room, a mechanical room, and an electrical/ control room. Most of the structure will be concrete tanks faced with brick although portions will be brick and block with a flat roof.

Solids Building

A new Solids Building will be constructed in the location of the existing Administration Building. The existing structure of the Administration Building will be demolished. The new building is provided with doors for truck bay access with sludge containers or trailers. A dedicated room is provided for caustic soda and potassium permanganate. Access is provided as needed for handling polymer and potassium permanganate. The building construction will be brick and block with a cast-in-place concrete frame. Exterior concrete is faced with brick. The roof is an insulated flat roof, pitched for drainage.

The new Solids Building includes the following:

- Office
- Bathroom
- Electrical room

- Mechanical room
- Dewatering room area
- Secondary influent wet well
- Secondary influent pump area
- Aerated sludge storage tanks
- Pump and blower gallery
- Two truck bays
- Potassium permanganate storage and feed area
- Polymer storage and feed area
- Caustic soda storage and feed area

Operations/Lab Building

The project includes a new Operations/Lab Building, which located in place of the existing Solids Processing Building. The existing Solids Processing Building will be demolished, including the common wall shared with the Chlorine Contact Tanks. A new wall will be constructed for the Chlorine Contact Tanks prior to the demolition of the common wall. The slab on the Chlorine Contact Tanks, near the existing Solids Processing Building, and associated beams are replaced as part of this construction. The lower level of the Operations/Lab Building is for the sodium hypochlorite and sodium bisulfite feed systems, a mechanical room, an electrical room, a storage/work area and plant water system. The grade level of the Operations/Lab Building is used for operations and laboratory space. Other design items for this building include:

- File and storage areas
- SCADA/operations area
- One office
- Laboratory with lab office and storage
- Lunch Room
- Men's and women's locker rooms

Plant Security

The project includes a new main plant security gate that would be open during operating hours. During off-hours the gate will be closed, but can be opened with remote controls or override key. An intercom, security camera and fire department lock box is provided at the main gate. The video signal from the camera will be brought back to a facility video management system in the Operations/Lab Building. The first floor of the Operations/Lab Building is provided door with contacts only. All other buildings and rooms at the WWTF are provided with door locks only. The security system for the main plant security gate and the door contacts at the Operations/Lab Building are connected to the SCADA system.

Demolition

The following structures will be demolished as part design of the facility upgrades:

- Existing odor control system
- Existing Administration Building

- Existing Filter Building
- Existing Solids Processing Building (refer to Appendix C for more information)
- Portions of the existing Effluent Meter Structure
- Garage near existing Effluent Meter Structure
- Portions of the existing Chlorine Contact Tanks
- Existing Filtrate Pump Station
- Existing drainage manhole east of the existing Solids Processing Building

COST AND SCHEDULE

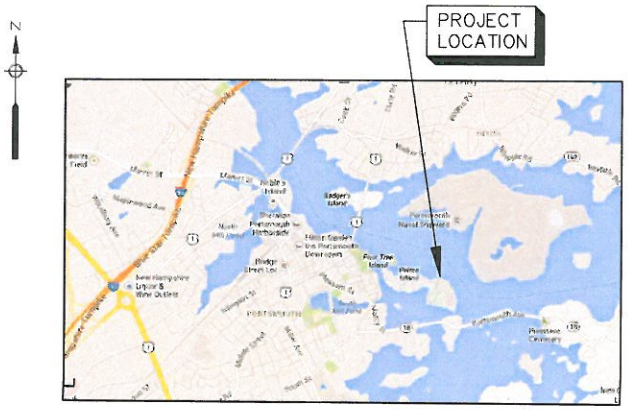
The estimated project cost for the second construction project and the subject of this VE study is approximately $85.2 million and the cost of the entire project is approximately $92 million. The proposed schedule for completing the work is described in Table 1-2 above.

DRAWINGS

Several drawings from the designer's 30% design submission follow for reference.

CITY OF PORTSMOUTH, NEW HAMPSHIRE

PEIRCE ISLAND
WASTEWATER TREATMENT FACILITY UPGRADE
JULY 2014



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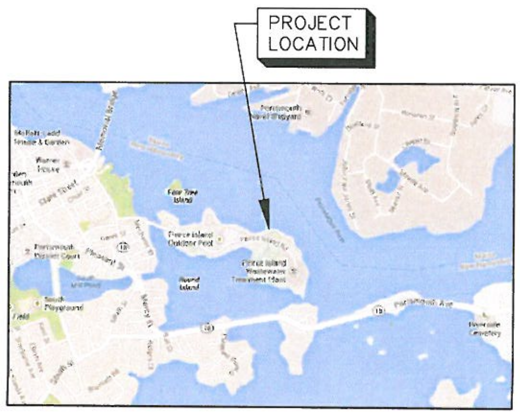

LOCATION PLAN
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SCALE: 1"=1000'

30% SUBMITTAL
PRELIMINARY COPY
NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

MARK	DATE	MADE BY	CHECKED	DESCRIPTION

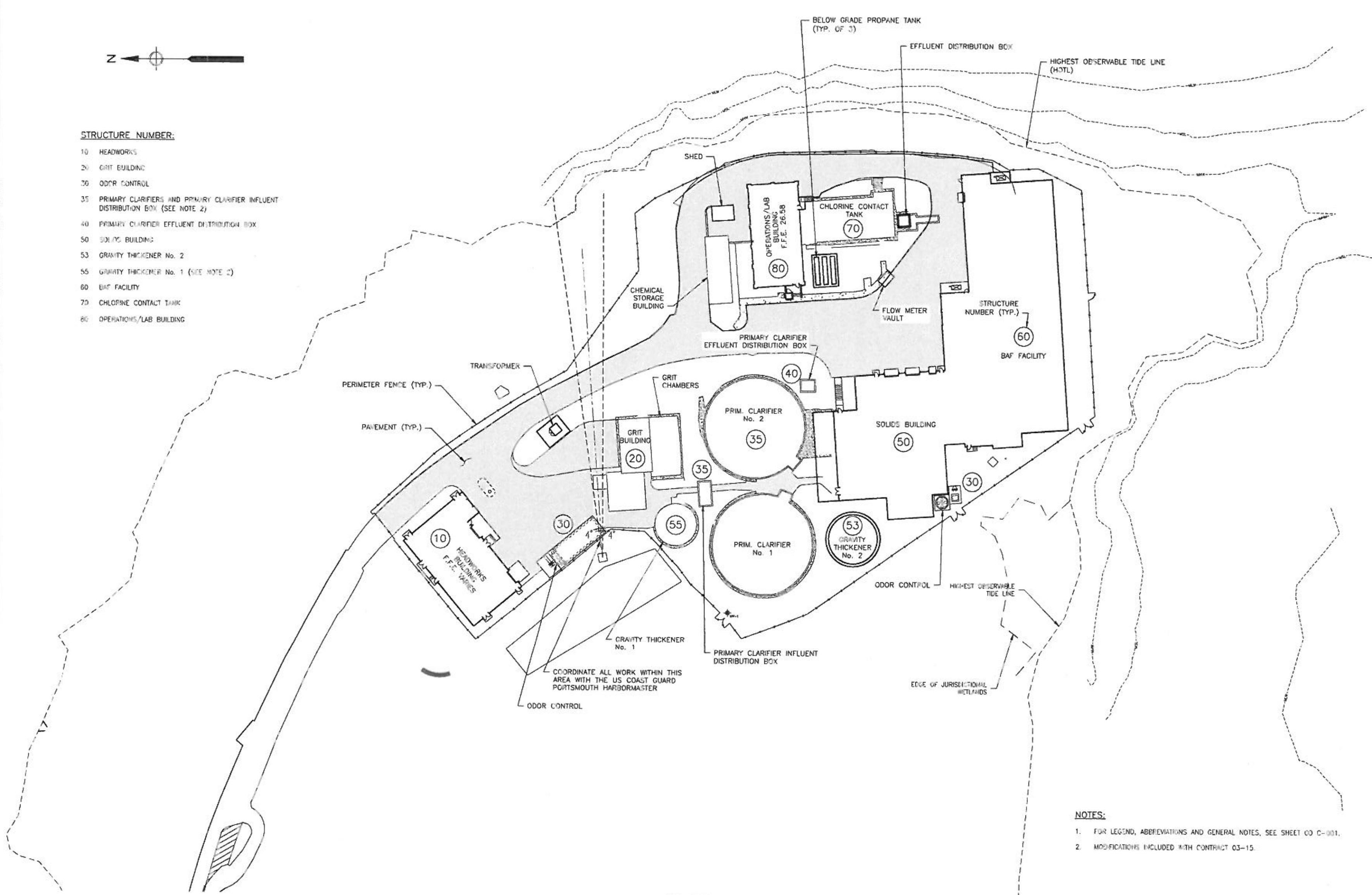
REVISIONS

AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE
COVER SHEET AND LOCUS PLAN
GENERAL

PROJECT NO:	60301525
CAD DWG FILE:	00 G-001
DESIGNED BY:	T. WASSELL
DRAWN BY:	N. YEE
DEPT CHECK:	C. BENDIJER
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

00 G-001



STRUCTURE NUMBER:

- 10 HEADWORKS
- 20 GRIT BUILDING
- 30 ODOR CONTROL
- 35 PRIMARY CLARIFIERS AND PRIMARY CLARIFIER INFLUENT DISTRIBUTION BOX (SEE NOTE 2)
- 40 PRIMARY CLARIFIER EFFLUENT DISTRIBUTION BOX
- 50 SOLIDS BUILDING
- 53 GRAVITY THICKENER No. 2
- 55 GRAVITY THICKENER No. 1 (SEE NOTE 2)
- 60 BAF FACILITY
- 70 CHLORINE CONTACT TANK
- 80 OPERATIONS/LAB BUILDING

NOTES:

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES, SEE SHEET 00 G-001.
2. MODIFICATIONS INCLUDED WITH CONTRACT 03-15.

PLAN

SCALE: 1"=40'

1" = 40' 0 40 80 120 SCALE FEET

30% SUBMITTAL

PRELIMINARY COPY

NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

MARK	DATE	MADE BY	CHECKED	DESCRIPTION

REVISIONS

AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS

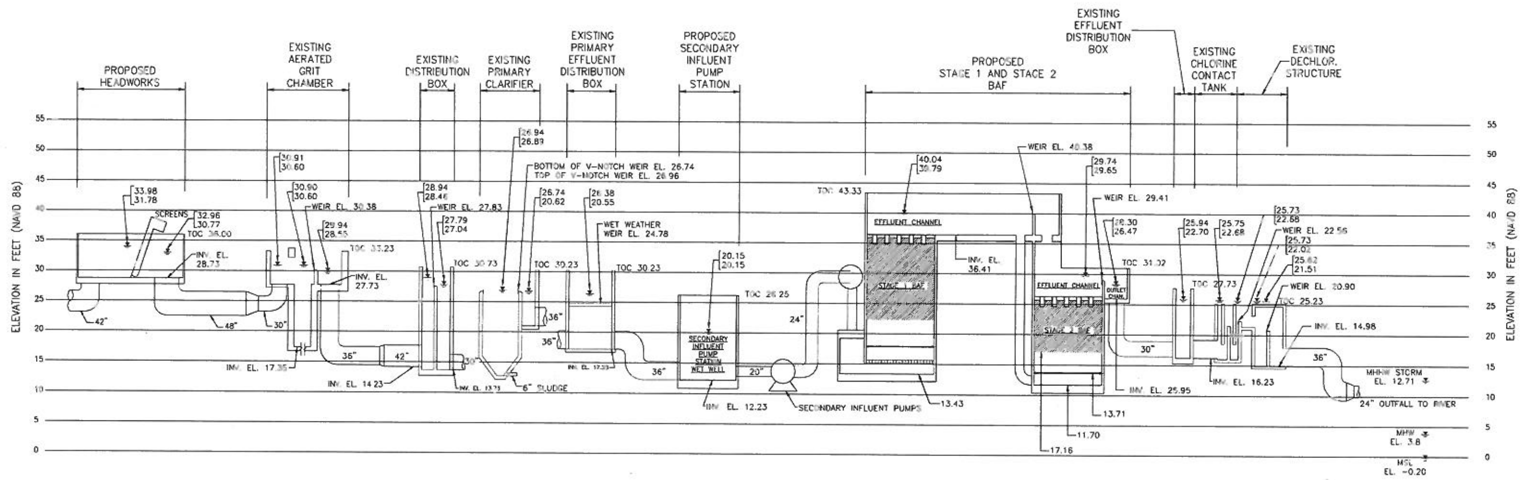
PEIRCE ISLAND WWTF UPGRADE

OVERALL SITE PLAN

GENERAL

PROJECT NO:	60301525
CAD DWG FILE:	00 G-004
DESIGNED BY:	T. WASSELL
DRAWN BY:	H. YEE
DEPT CHECK:	C. BENCIGER
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

00 G-004



ABBREVIATIONS

ANN	ANNUAL
AVG	AVERAGE
MAX	MAXIMUM
MHHW	MEAN HIGHER HIGH WATER
MHHW STORM	MEAN HIGHER HIGH WATER WITH 100 YEAR STORM SURGE
MSL	MEAN SEA LEVEL
TBD	TO BE DETERMINED
TOC	TOP OF CONCRETE

FLOW CONDITIONS

MAX HOUR	=	22.0 MGD (PRIMARY AND DISINFECTION)
MAX HOUR	=	10.33 MGD (SECONDARY)
AVERAGE ANNUAL	=	6.13 MGD

LEGEND

MHHW STORM

MAX HOUR – ALL UNITS ONLINE

AVG ANN – ALL UNITS ONLINE

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AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

HYDRAULIC PROFILE

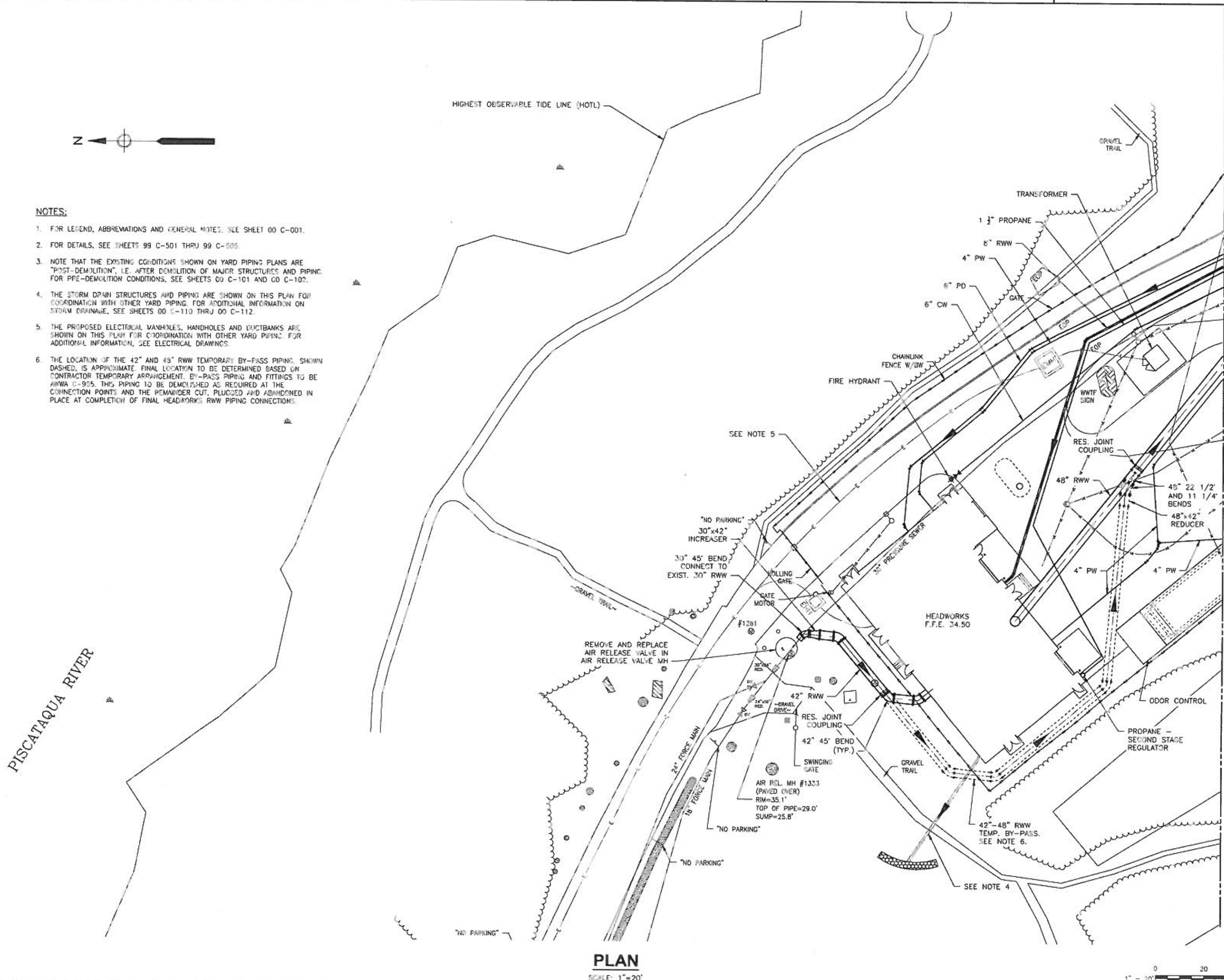
GENERAL

PROJECT NO:	60301525
CAD DWG FILE:	00 G-005
DESIGNED BY:	T. WASSELL
DRAWN BY:	N. YEE
DEPT CHECK:	C. BENZIGER
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

00 G-005

NOTES:

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES, SEE SHEET 00 C-001.
2. FOR DETAILS, SEE SHEETS 99 C-501 THRU 99 C-505.
3. NOTE THAT THE EXISTING CONDITIONS SHOWN ON YARD PIPING PLANS ARE "POST-DEMOLITION", I.E. AFTER DEMOLITION OF MAJOR STRUCTURES AND PIPING. FOR PRE-DEMOLITION CONDITIONS, SEE SHEETS 00 C-101 AND 00 C-102.
4. THE STORM DRAIN STRUCTURES AND PIPING ARE SHOWN ON THIS PLAN FOR COORDINATION WITH OTHER YARD PIPING. FOR ADDITIONAL INFORMATION ON STORM DRAINAGE, SEE SHEETS 00 C-110 THRU 00 C-112.
5. THE PROPOSED ELECTRICAL MANHOLES, HANDHOLES AND DUCTBANKS ARE SHOWN ON THIS PLAN FOR COORDINATION WITH OTHER YARD PIPING. FOR ADDITIONAL INFORMATION, SEE ELECTRICAL DRAWINGS.
6. THE LOCATION OF THE 42" AND 48" RWW TEMPORARY BY-PASS PIPING, SHOWN DASHED, IS APPROXIMATE. FINAL LOCATION TO BE DETERMINED BASED ON CONTRACTOR TEMPORARY ARRANGEMENT. BY-PASS PIPING AND FITTINGS TO BE AWWA C-905. THIS PIPING TO BE DEMOLISHED AS REQUIRED AT THE CONNECTION POINTS AND THE REMAINDER CUT, PLUGGED AND ABANDONED IN PLACE AT COMPLETION OF FINAL HEADWORKS RWW PIPING CONNECTIONS.



PLAN

SCALE: 1"=20'

0 20 40 60
1" = 20'
SCALE FEET

30% SUBMITTAL
PRELIMINARY COPY

NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

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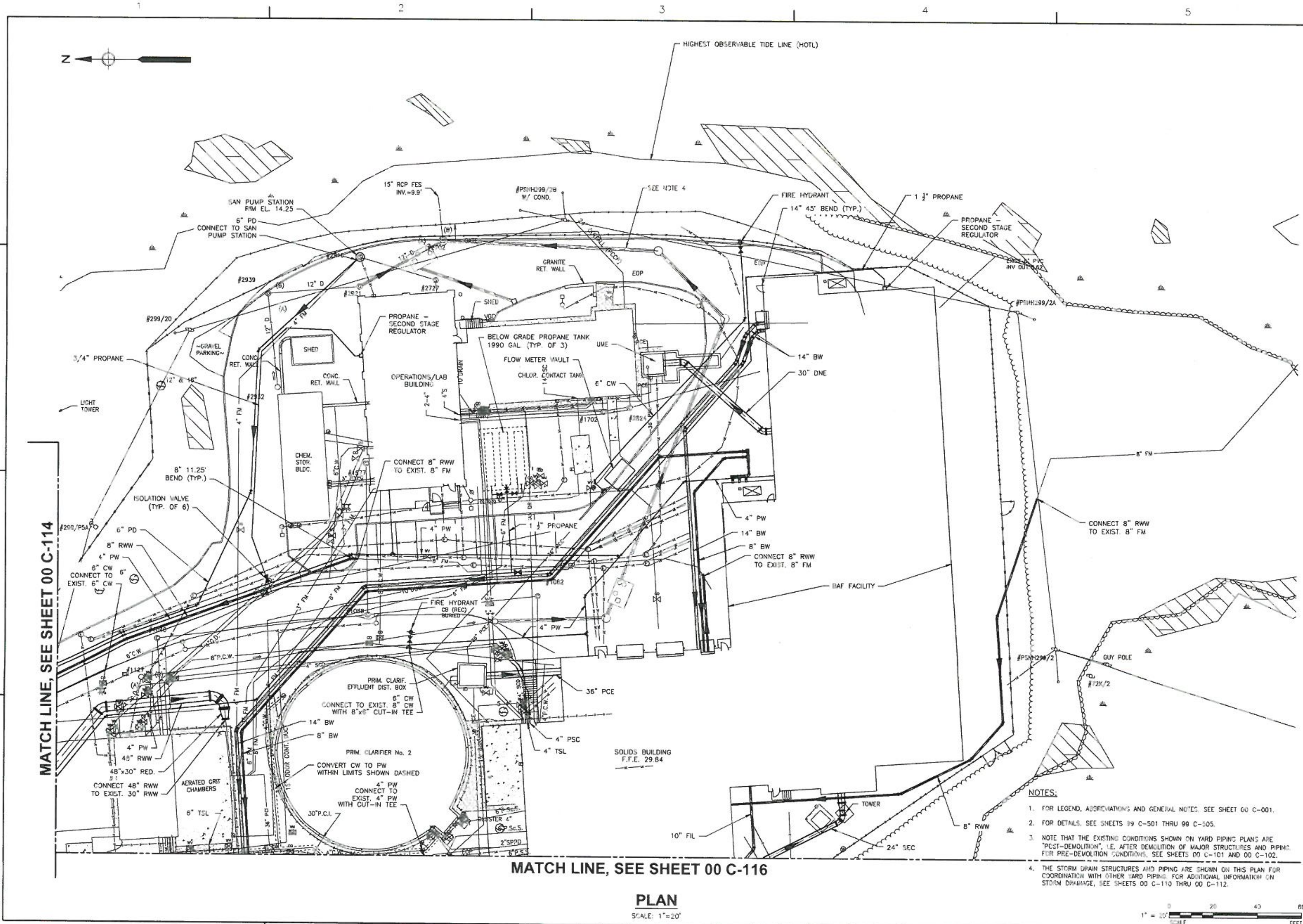
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

YARD PIPING PLAN I

CIVIL

PROJECT NO:	60301525
CAD DWG FILE:	00 C-114
DESIGNED BY:	T. WASSELL
DRAWN BY:	N. YEE
DEPT CHECK:	C. BENZIGER
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

00 C-114



NOTES:

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES, SEE SHEET 00 C-001.
2. FOR DETAILS, SEE SHEETS 99 C-501 THRU 99 C-505.
3. NOTE THAT THE EXISTING CONDITIONS SHOWN ON YARD PIPING PLANS ARE "POST-DEMOLITION", I.E. AFTER DEMOLITION OF MAJOR STRUCTURES AND PIPING. FOR PRE-DEMOLITION CONDITIONS, SEE SHEETS 00 C-101 AND 00 C-102.
4. THE STORM DRAIN STRUCTURES AND PIPING ARE SHOWN ON THIS PLAN FOR COORDINATION WITH OTHER YARD PIPING. FOR ADDITIONAL INFORMATION ON STORM DRAINAGE, SEE SHEETS 00 C-110 THRU 00 C-112.

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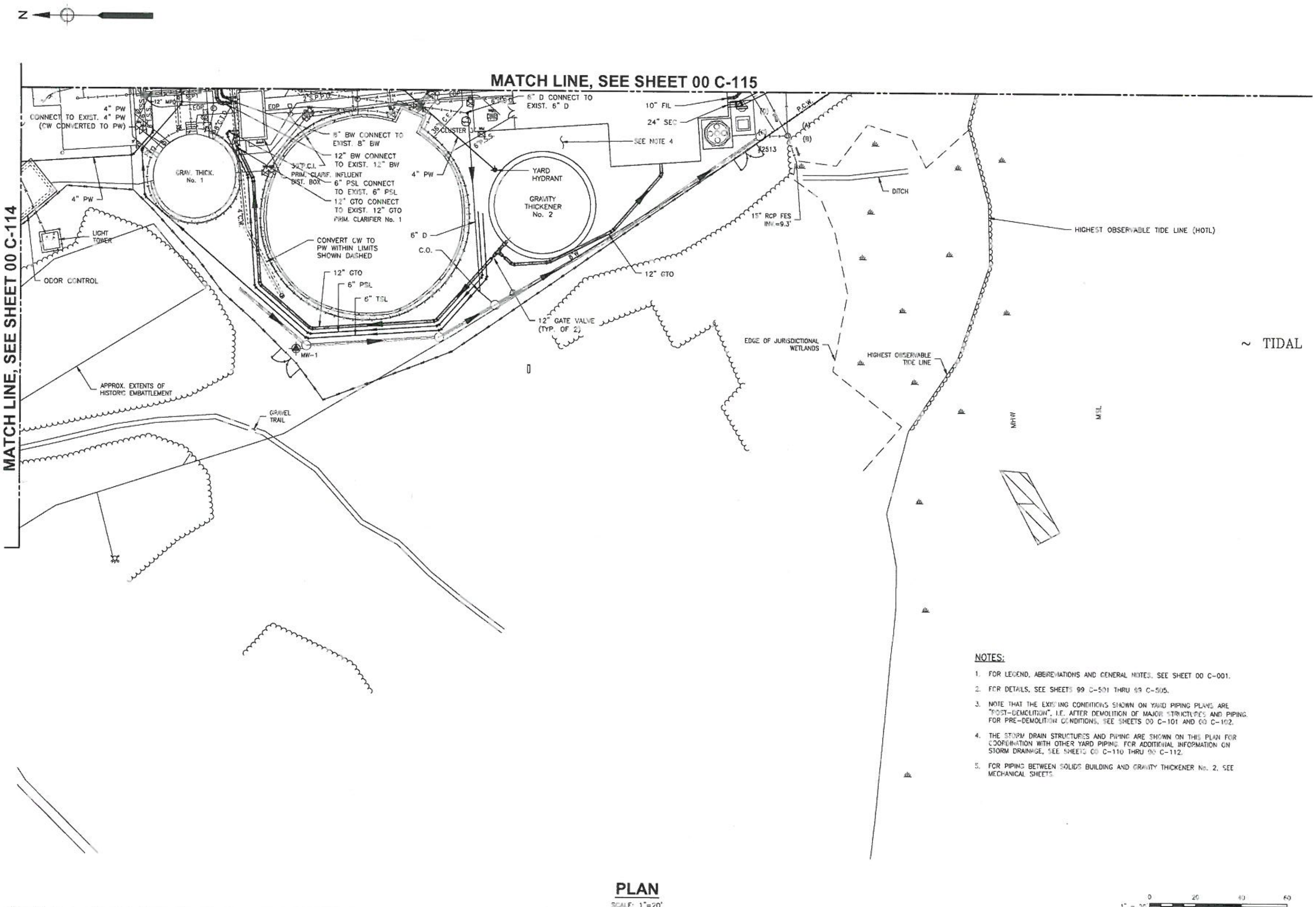
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

YARD PIPING PLAN II

CIVIL

PROJECT NO.	60301525
CAD DWG FILE:	00 C-115
DESIGNED BY:	T. WASZELL
DRAWN BY:	N. YEE
DEPT CHECK:	C. BENZIGER
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

00 C-115



PLAN

SCALE: 1"=20'

1" = 20' 0 20 40 60 SCALE FEET

NOTES:

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES, SEE SHEET 00 C-001.
2. FOR DETAILS, SEE SHEETS 99 C-501 THRU 99 C-505.
3. NOTE THAT THE EXISTING CONDITIONS SHOWN ON YARD PIPING PLANS ARE "POST-DEMOLITION", I.E. AFTER DEMOLITION OF MAJOR STRUCTURES AND PIPING. FOR PRE-DEMOLITION CONDITIONS, SEE SHEETS 00 C-101 AND 00 C-102.
4. THE STORM DRAIN STRUCTURES AND PIPING ARE SHOWN ON THIS PLAN FOR COORDINATION WITH OTHER YARD PIPING. FOR ADDITIONAL INFORMATION ON STORM DRAINAGE, SEE SHEETS 00 C-110 THRU 00 C-112.
5. FOR PIPING BETWEEN SOLIDS BUILDING AND GRAVITY THICKENER No. 2, SEE MECHANICAL SHEETS.

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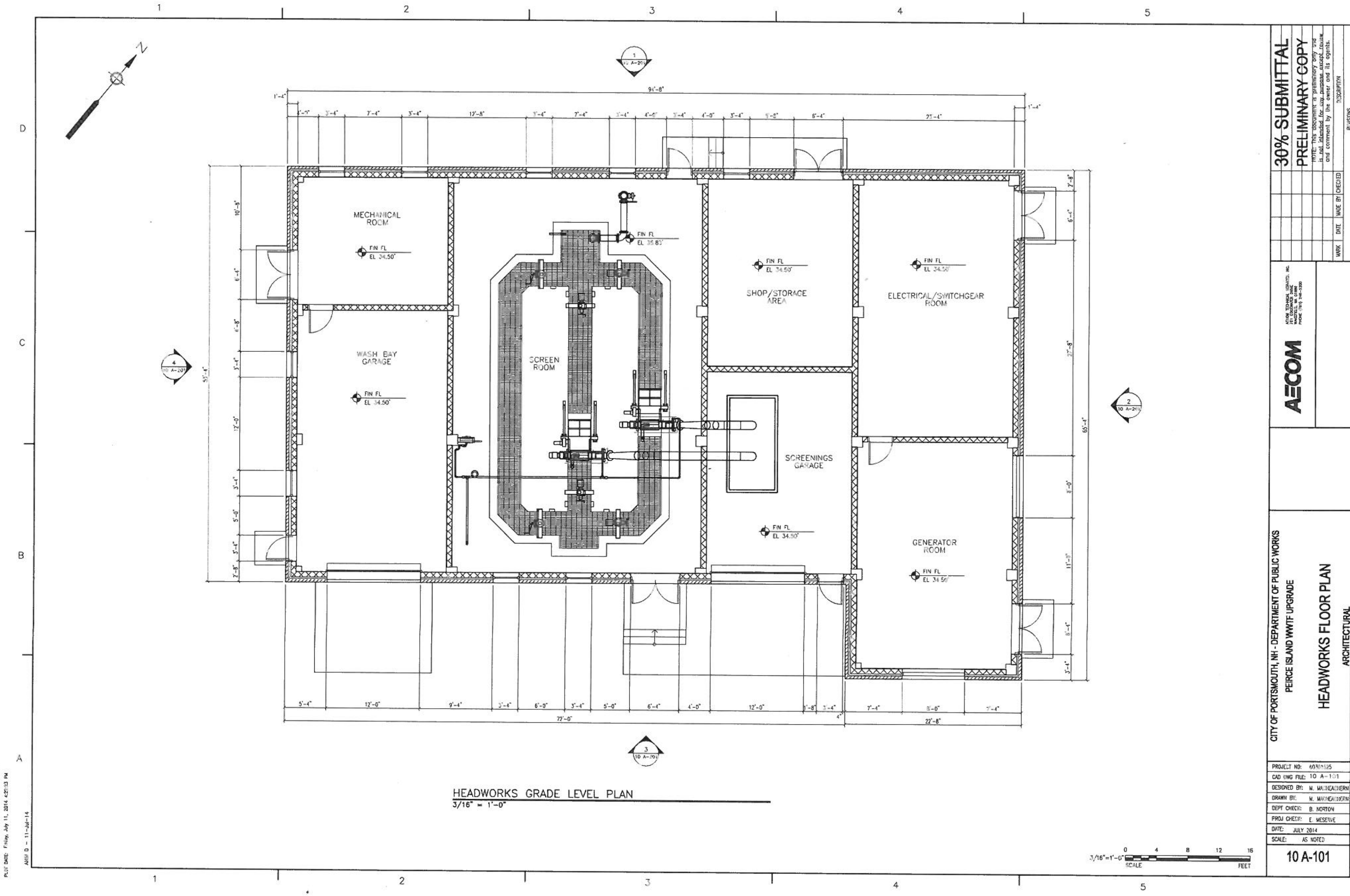
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

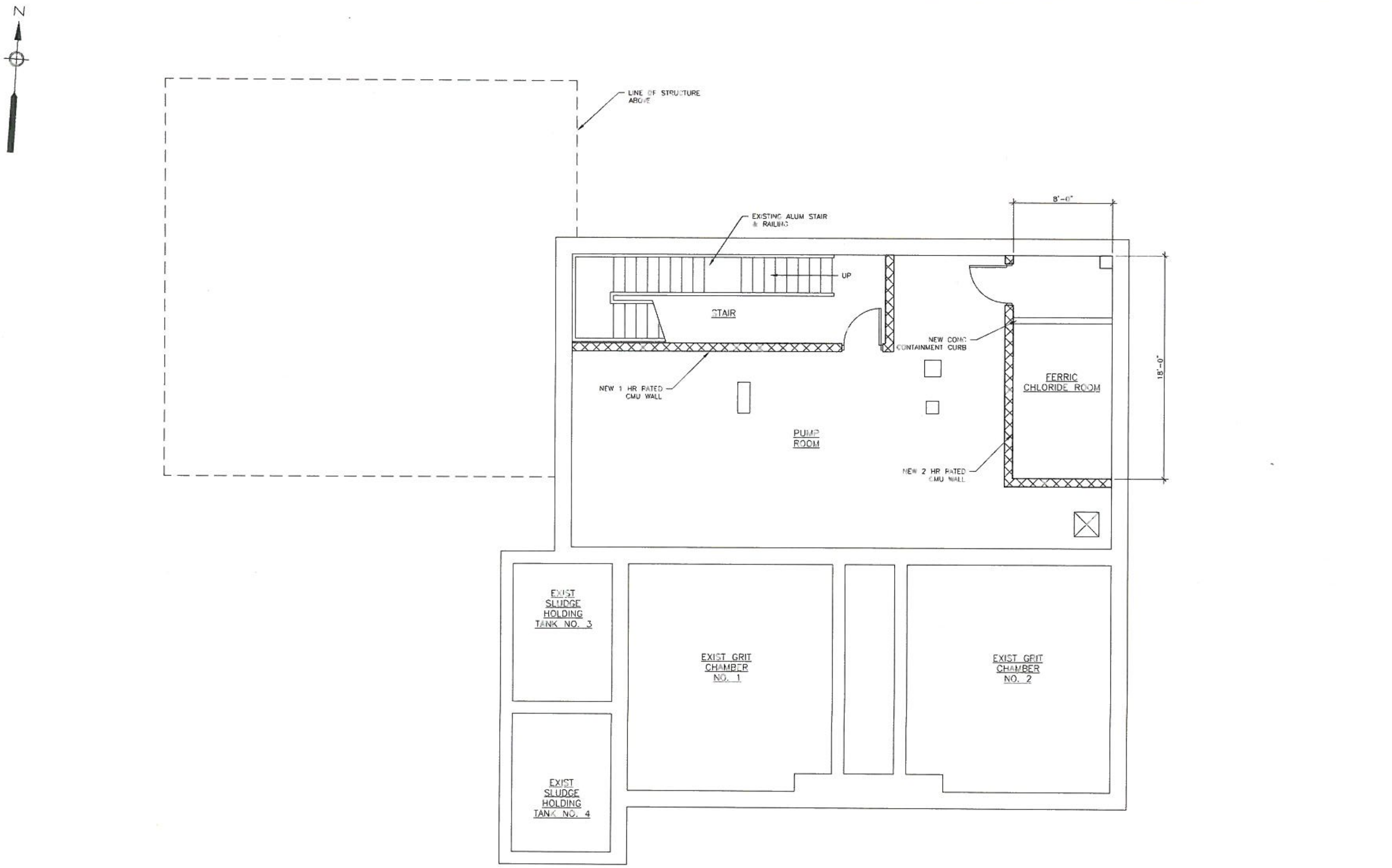
YARD PIPING PLAN III

CIVIL

PROJECT NO:	60301525
CAD DWG FILE:	00 C-116
DESIGNED BY:	T. WASSELL
DRAWN BY:	N. YEE
DEPT CHECK:	C. BENZIGER
PROJ. CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

00 C-116


MECHANICAL ROOM
WASH BAY GARAGE
SCREEN ROOM
SHOP/STORAGE AREA
ELECTRICAL/SWITCHGEAR ROOM
SCREENINGS GARAGE
GENERATOR ROOM
FIN FL EL 34.50'
FIN FL EL 35.83'
94'-8"
72'-0"
22'-8"
53'-4"
65'-4"
HEADWORKS GRADE LEVEL PLAN
3/16" = 1'-0"
30% SUBMITTAL
PRELIMINARY COPY
AECOM
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE
HEADWORKS FLOOR PLAN
ARCHITECTURAL
PROJECT NO: 60301525
CAD DWG FILE: 10 A-101
DESIGNED BY: M. MACNEACHERN
DRAWN BY: M. MACNEACHERN
DEPT CHECK: B. NORTON
PROJ CHECK: E. MESERVE
DATE: JULY 2014
SCALE: AS NOTED
10 A-101



GRIT BUILDING LOWER LEVEL PLAN
1/4" = 1'-0"

1/4"=1'-0" SCALE 0 4 8 12 FEET

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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

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REVISIONS

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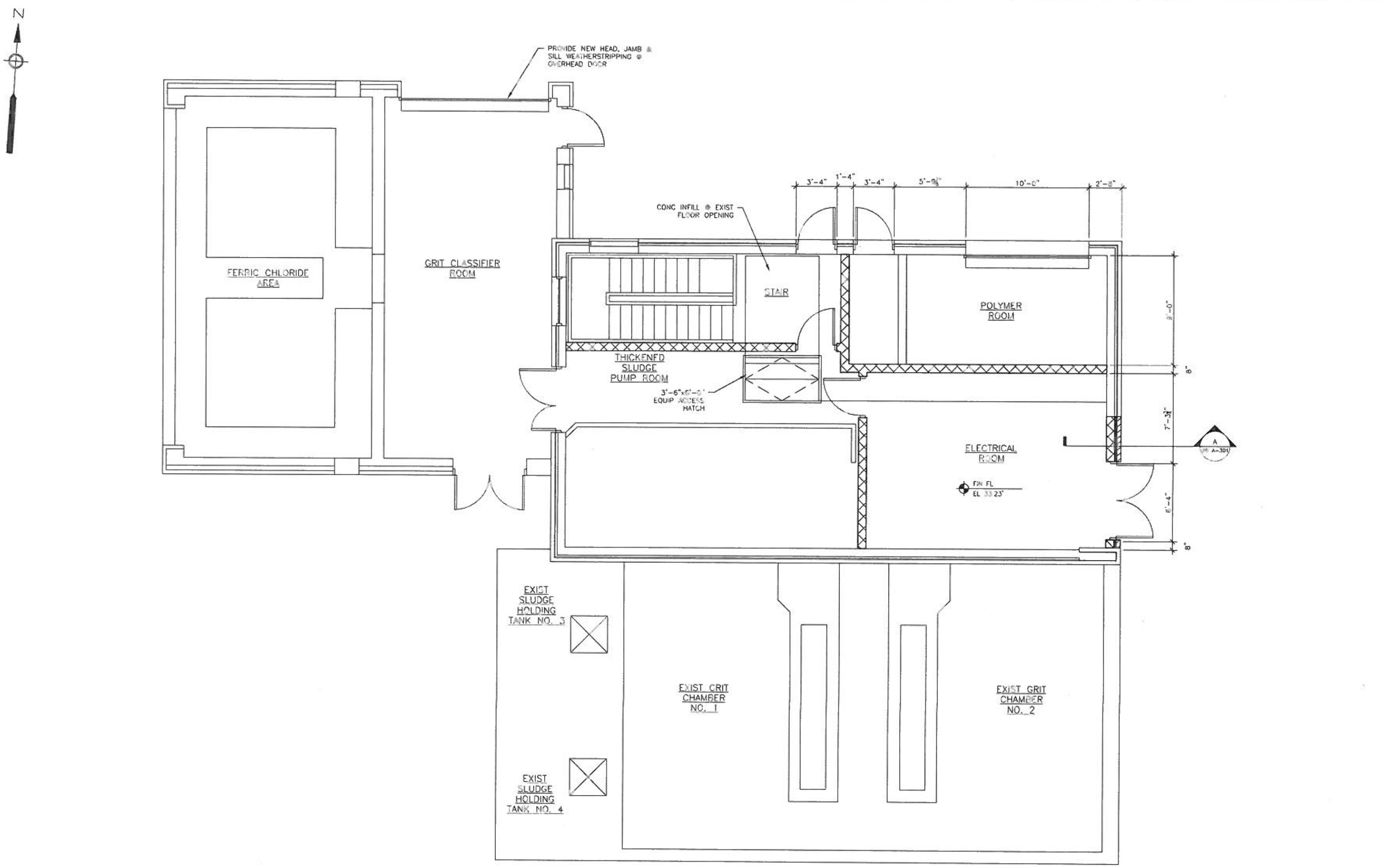
PEIRCE ISLAND WWTF UPGRADE

GRIT BUILDING LOWER LEVEL PLAN
ARCHITECTURAL

PROJECT NO:	60301525
CAD DWG FILE:	20 A-101
DESIGNED BY:	M. MACEACHERN
DRAWN BY:	M. MACEACHERN
DEPT CHECK:	B. NORTON
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

20 A-101



GRIT BUILDING UPPER LEVEL PLAN
1/4" = 1'-0"

1/4"=1'-0" SCALE 0 4 8 12 FEET

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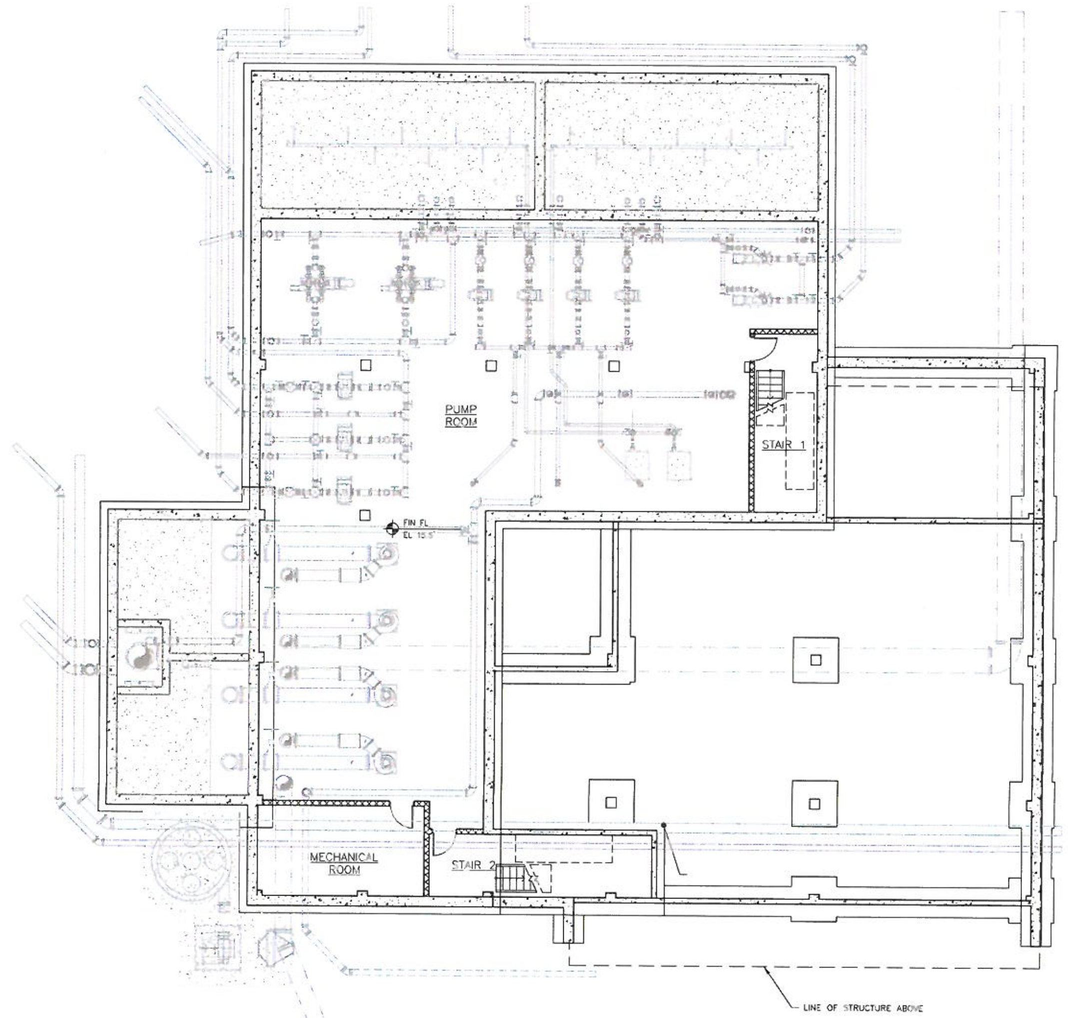
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

GRIT BUILDING UPPER LEVEL PLAN
ARCHITECTURAL

PROJECT NO:	60301525
CAD DWG FILE:	20 A-102
DESIGNED BY:	M. MACEACHERN
DRAWN BY:	M. MACEACHERN
DEPT CHECK:	B. NORTON
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

20 A-102

PATH/FILENAME: P:\60301525 - PORTSMOUTH WWTF UPGRADE\SHEETS\IP-2\A\20 A-102.DWG
LAST UPDATE: Friday, July 11, 2014 1:26:45 PM
PLOT DATE: Friday, July 11, 2014 4:23:00 PM
ANSI D - 11-Jul-14



SOLIDS BUILDING LOWER LEVEL PLAN
1/8" = 1'-0"

1/8"=1'-0" 0 4 8 12 16 20 24 SCALE FEET

30% SUBMITTAL
PRELIMINARY COPY
NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

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REVISIONS

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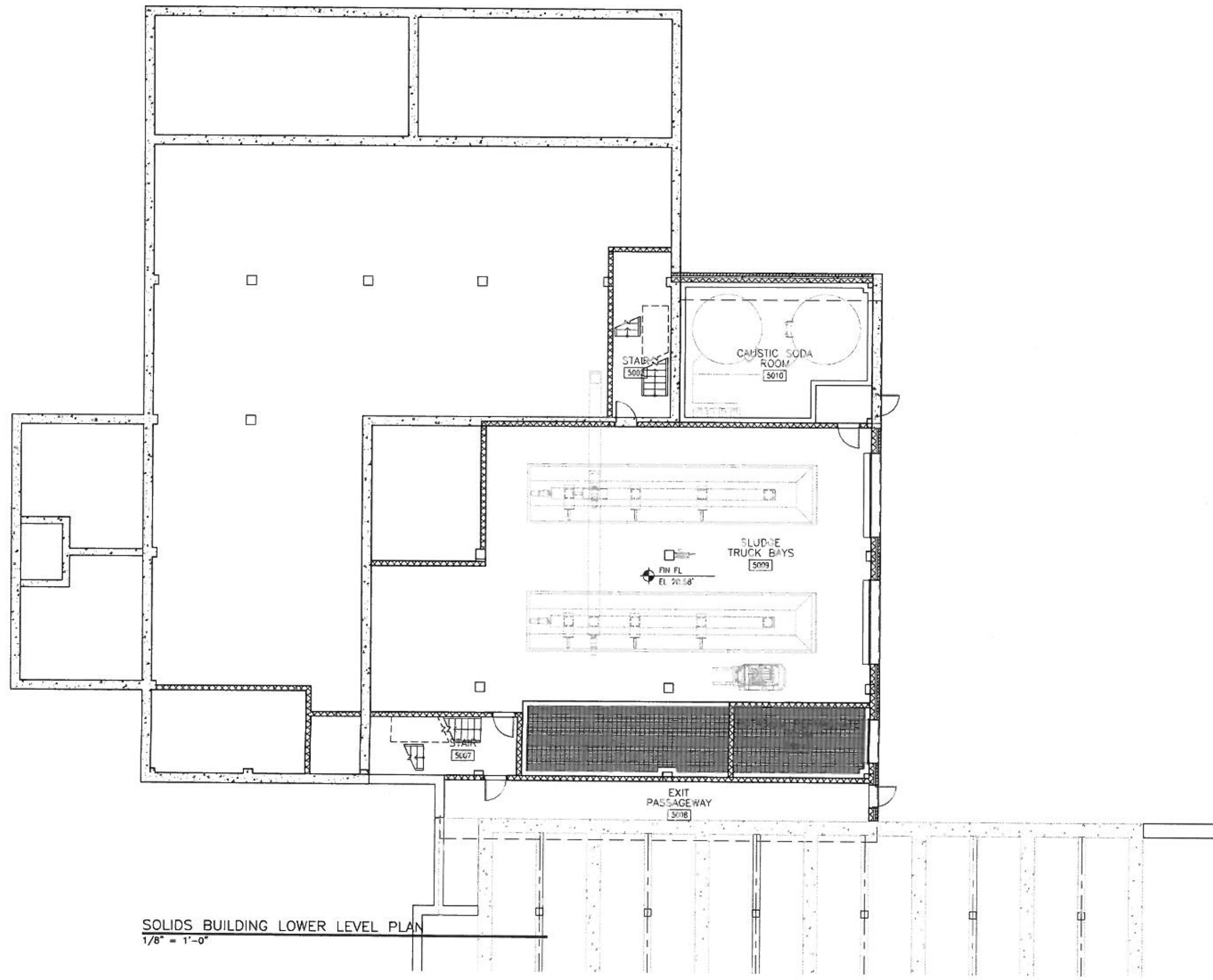
PEIRCE ISLAND WWTF UPGRADE

SOLIDS BUILDING LOWER LEVEL PLAN
ARCHITECTURAL

PROJECT NO:	60301525
CAD DWG FILE:	50 A-101
DESIGNED BY:	----
DRAWN BY:	----
DEPT CHECK:	----
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

50 A-101

PATH/FILENAME: ...\60301525 - PORTSMOUTH WWTF UPGRADE\SHEETS\BP-2\A\50 A-101.DWG
LAST UPDATE: Tuesday, June 24, 2014 8:25:18 PM
PLOT DATE: Friday, July 11, 2014 4:23:19 PM
ANSI D - 24-Jun-14



SOLIDS BUILDING LOWER LEVEL PLAN
1/8" = 1'-0"

1/8"=1'-0" SCALE 0 4 8 12 16 20 24 FEET

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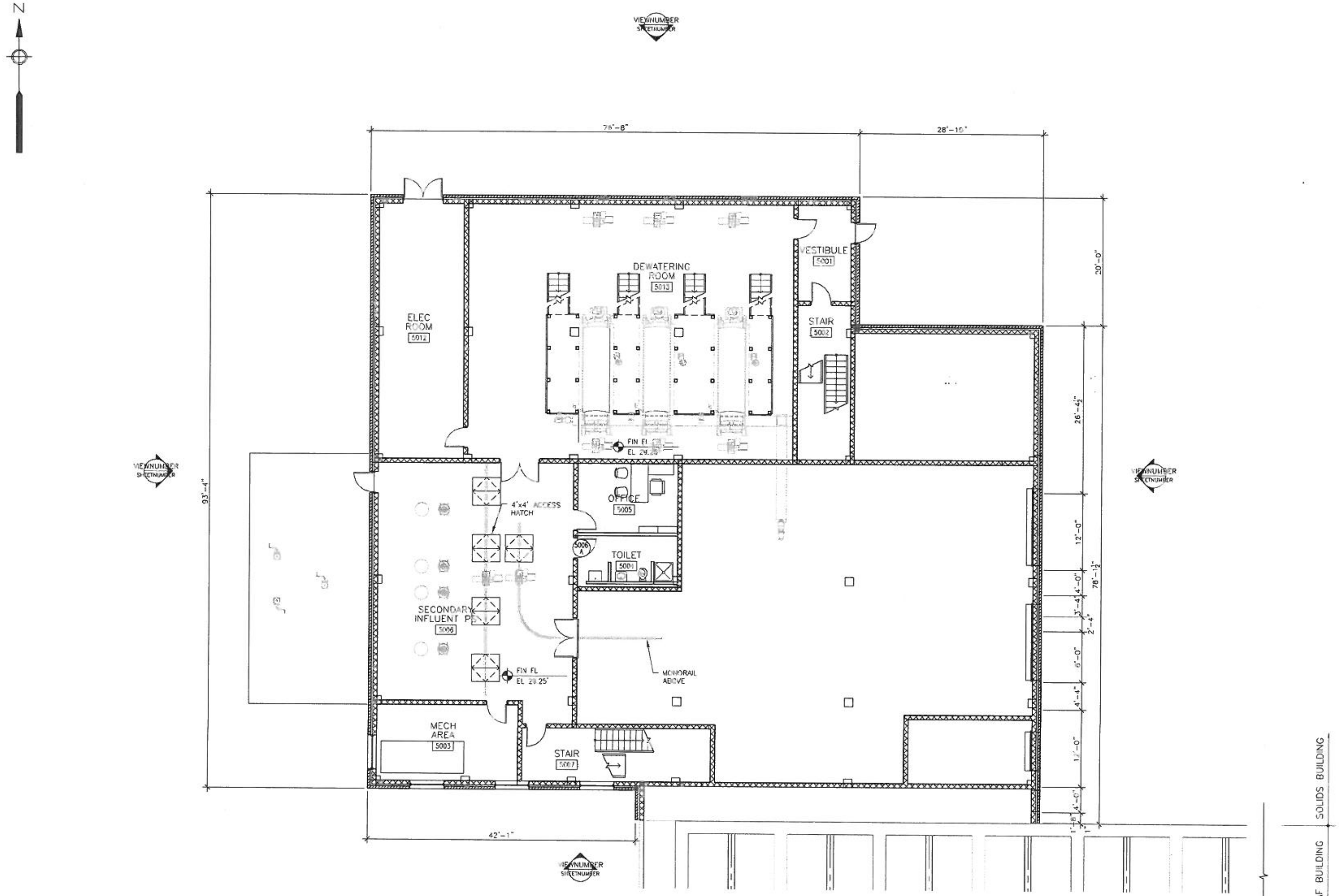
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

SOLIDS BUILDING TRUCK BAY LEVEL PLAN

50 SOLIDS BUILDING

PROJECT NO:	60301525
CAD DWG FILE:	50 A-102
DESIGNED BY:	----
DRAWN BY:	----
DEPT CHECK:	----
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

50 A-102



SOLIDS BUILDING UPPER LEVEL PLAN
1/8" = 1'-0"

1/8"=1'-0" SCALE 0 4 8 12 16 20 24 FEET

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REVISIONS: MARK | DATE | MADE BY | CHECKED | DESCRIPTION

AECOM

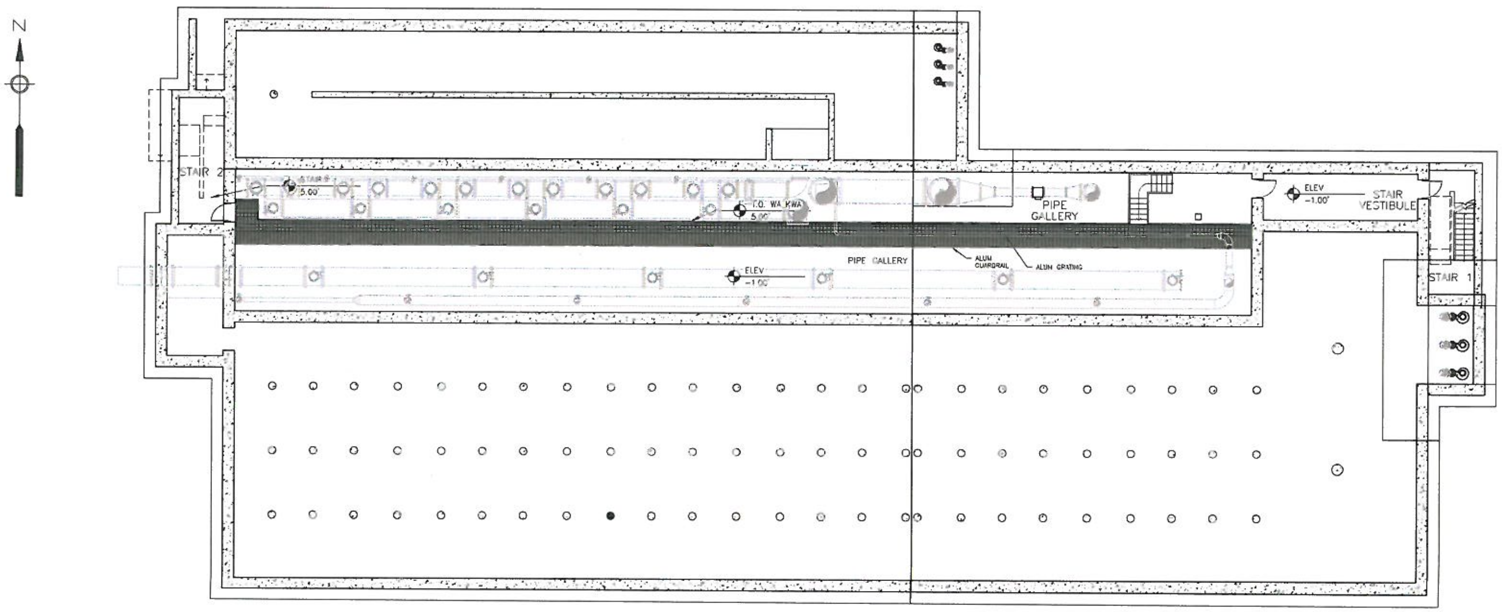
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

SOLIDS BUILDING UPPER LEVEL PLAN
ARCHITECTURAL

PROJECT NO: 60301525
CAD DWG FILE: 50 A-103
DESIGNED BY: ----
DRAWN BY: ----
DEPT CHECK: ----
PROJ CHECK: E. MESERVE
DATE: JULY 2014
SCALE: AS NOTED

50 A-103

175



BAF FACILITY GALLERY LEVEL PLAN

3/32" = 1'-0"

30% SUBMITTAL

PRELIMINARY COPY

NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

MARK	DATE	MADE BY	CHECKED	DESCRIPTION

REVISIONS

AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS

PEIRCE ISLAND WWTF UPGRADE

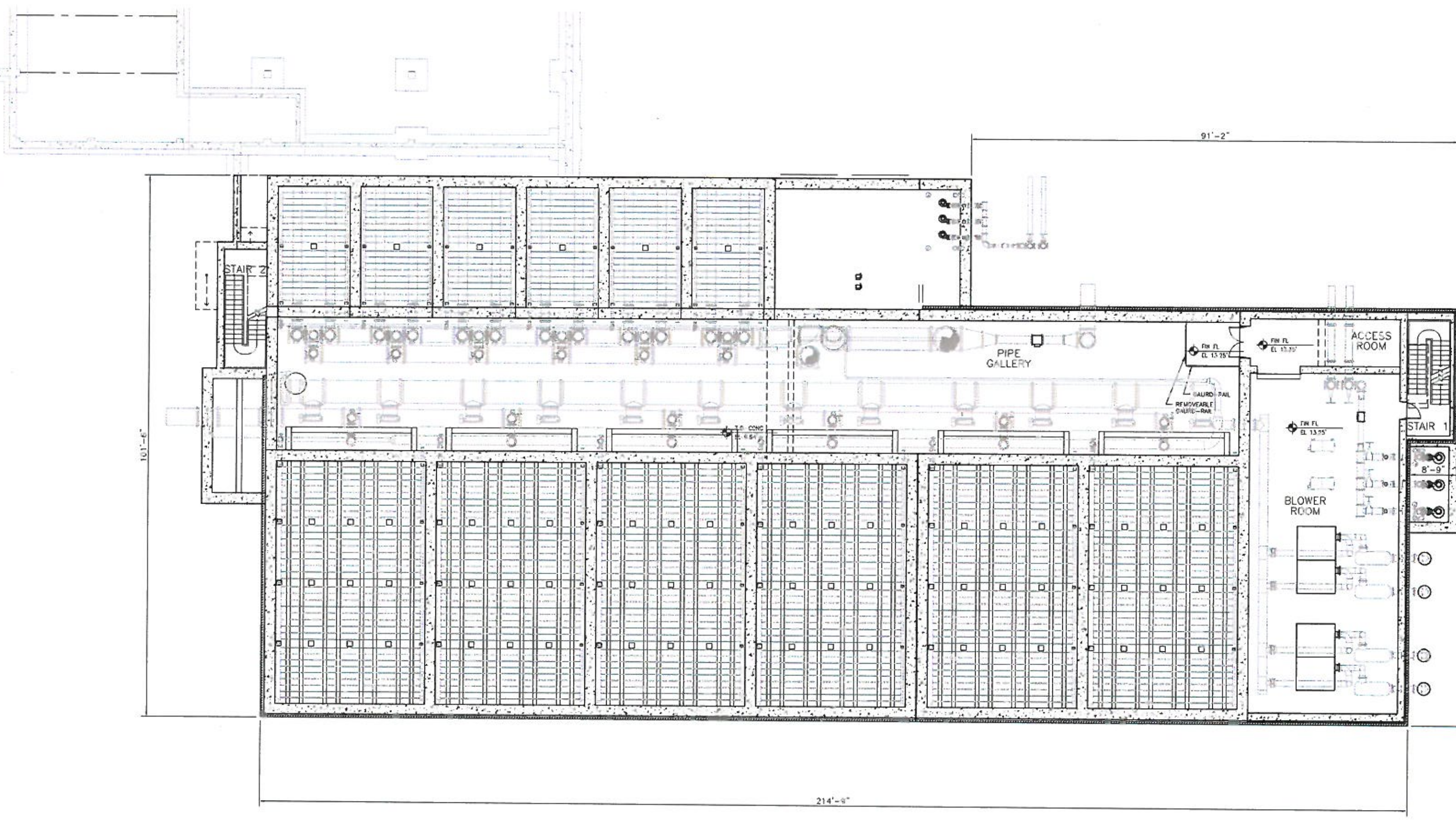
BAF FACILITY GALLERY LEVEL PLAN

ARCHITECTURAL

PROJECT NO:	60301535
CAD DWG FILE:	60 A-101
DESIGNED BY:	K. COLLINS
DRAWN BY:	K. COLLINS
DEPT CHECK:	B. NORTON
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

60 A-101

PATH/FILENAME: P:\60301535 - PORTSMOUTH WWTF UPGRADE\SHEETS\BP-2\A\60 A-101.DWG
LAST UPDATE: Thursday, July 10, 2014 6:10:39 PM
PLOT DATE: Friday, July 11, 2014 4:23:46 PM
ANSI D - 10-Jul-14



BAF FACILITY LOWER LEVEL PLAN
3/32" = 1'-0"

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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

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REVISIONS

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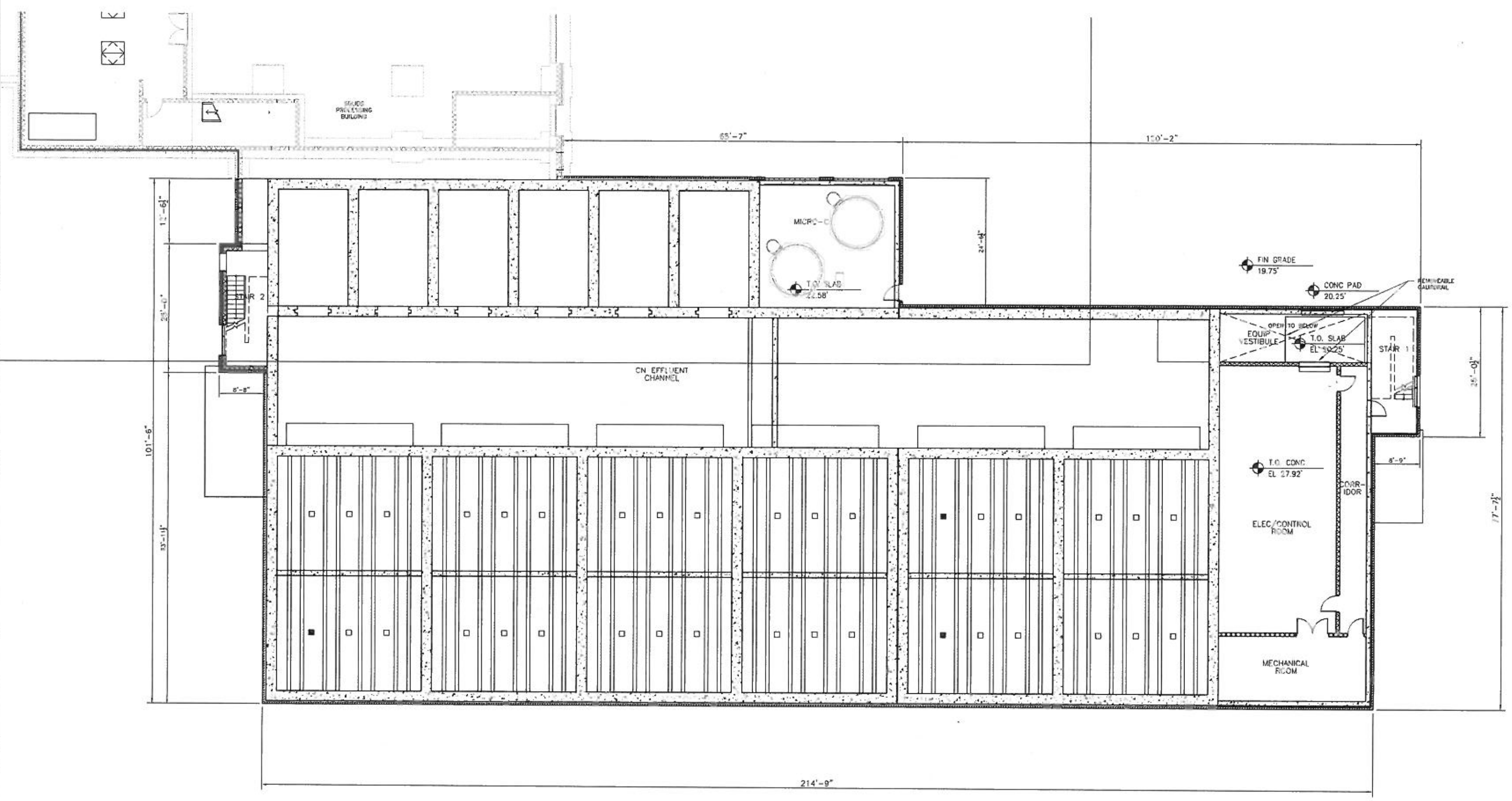
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

BAF FACILITY LOWER LEVEL PLAN

60 BAF FACILITY

PROJECT NO:	60301525
CAD DWG FILE:	60 A-102
DESIGNED BY:	K. COLLINS
DRAWN BY:	K. COLLINS
DEPT CHECK:	B. NORTON
PROJ CHECK:	E. MESCHKE
DATE:	JULY 2014
SCALE:	AS NOTED

60 A-102



BAF FACILITY UPPER LEVEL PLAN
3/32" = 1'-0"

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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

MARK	DATE	MADE BY	CHECKED	DESCRIPTION

REVISIONS

AECOM

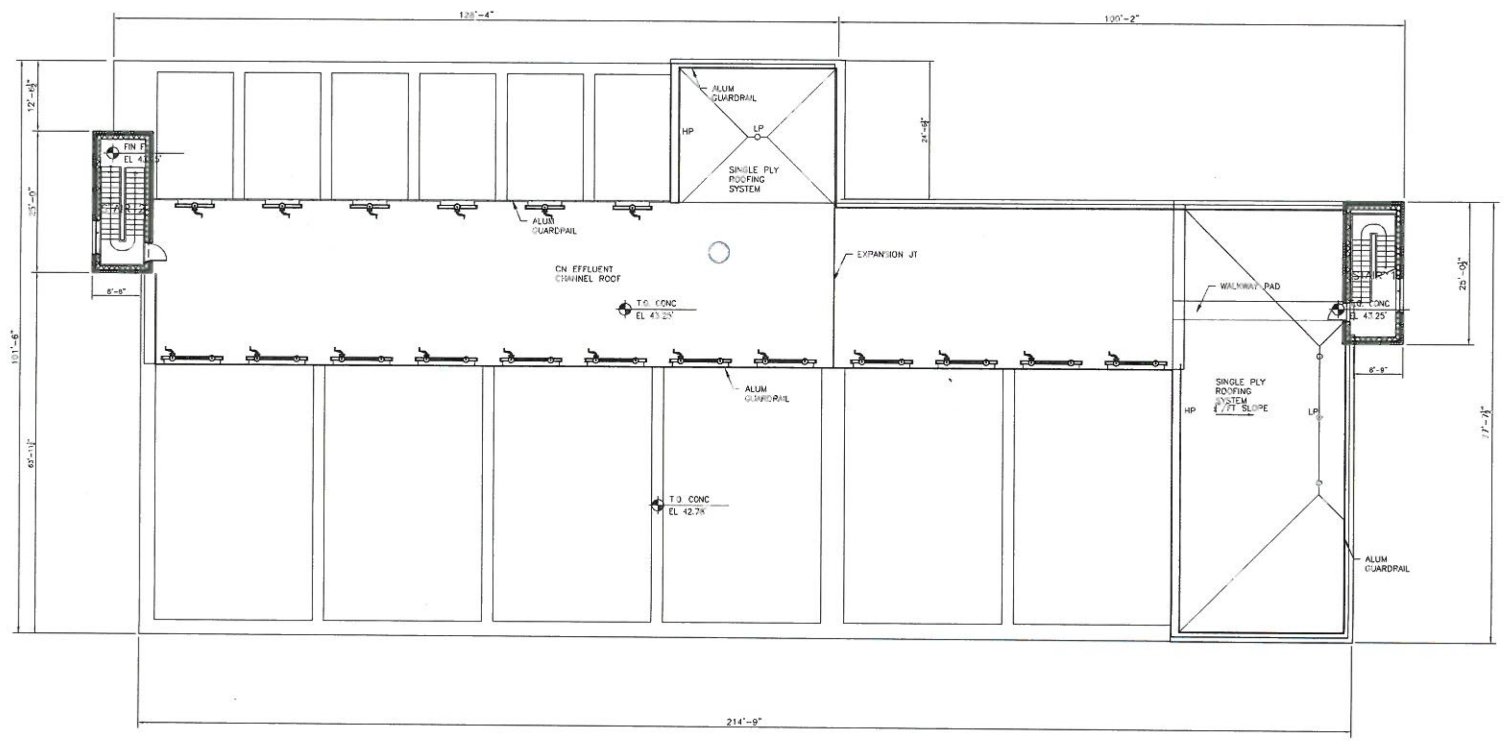
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

BAF FACILITY UPPER LEVEL PLAN
ARCHITECTURAL

PROJECT NO:	60301525
CAD DWG FILE:	60 A-103
DESIGNED BY:	K. COLLINS
DRAWN BY:	K. COLLINS
DEPT CHECK:	B. NORTON
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

60 A-103

178
ANSI D - 10-Jul-14



BAF FACILITY ROOF LEVEL PLAN
3/32" = 1'-0"

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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

MARK	DATE	MADE BY	CHECKED	DESCRIPTION

REVISIONS

AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

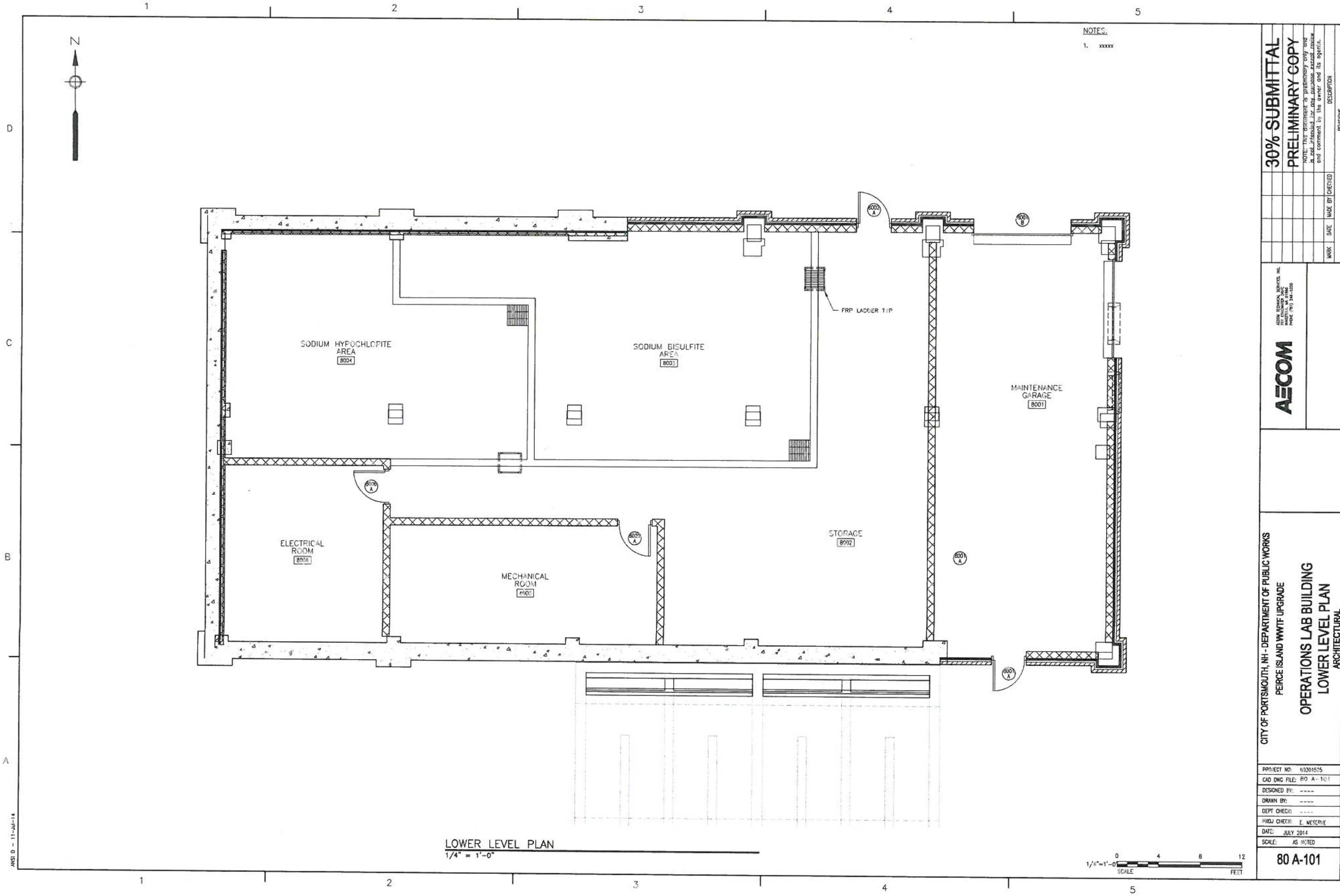
BAF FACILITY ROOF LEVEL PLAN

ARCHITECTURAL

PROJECT NO:	60301525
CAD DWG FILE:	60 A-104
DESIGNED BY:	K. COLLINS
DRAWN BY:	K. COLLINS
DEPT CHECK:	B. NORTON
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

60 A-104

PATH/FILENAME: P:\60301525 - PORTSMOUTH WWTF UPGRADE\SHEETS\BP-2\V60 A-104.DWG
LAST UPDATE: Thursday, July 10, 2014 8:34:27 PM
PLOT DATE: Friday, July 11, 2014 4:24:02 PM



NOTES:
1. xxxxx
N
SODIUM HYPOCHLORITE AREA
8004
SODIUM BISULFITE AREA
8003
FRP LADDER TYP
MAINTENANCE GARAGE
8001
ELECTRICAL ROOM
8006
MECHANICAL ROOM
8005
STORAGE
8002
LOWER LEVEL PLAN
1/4" = 1'-0"
1/4"=1'-0"
0 4 8 12
SCALE
FEET
30% SUBMITTAL
PRELIMINARY COPY
NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.
MARK DATE MADE BY CHECKED DESCRIPTION
REVISIONS
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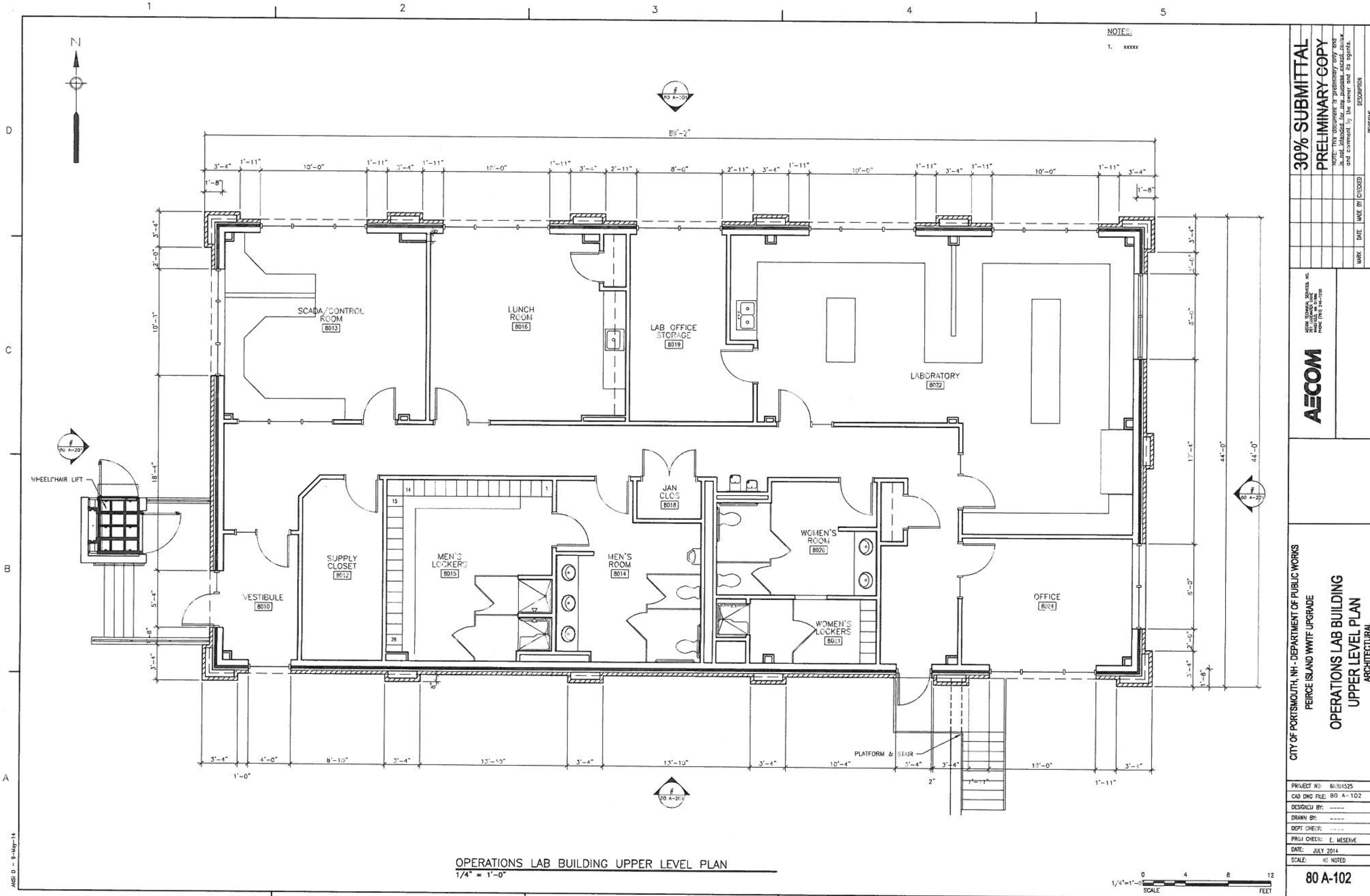
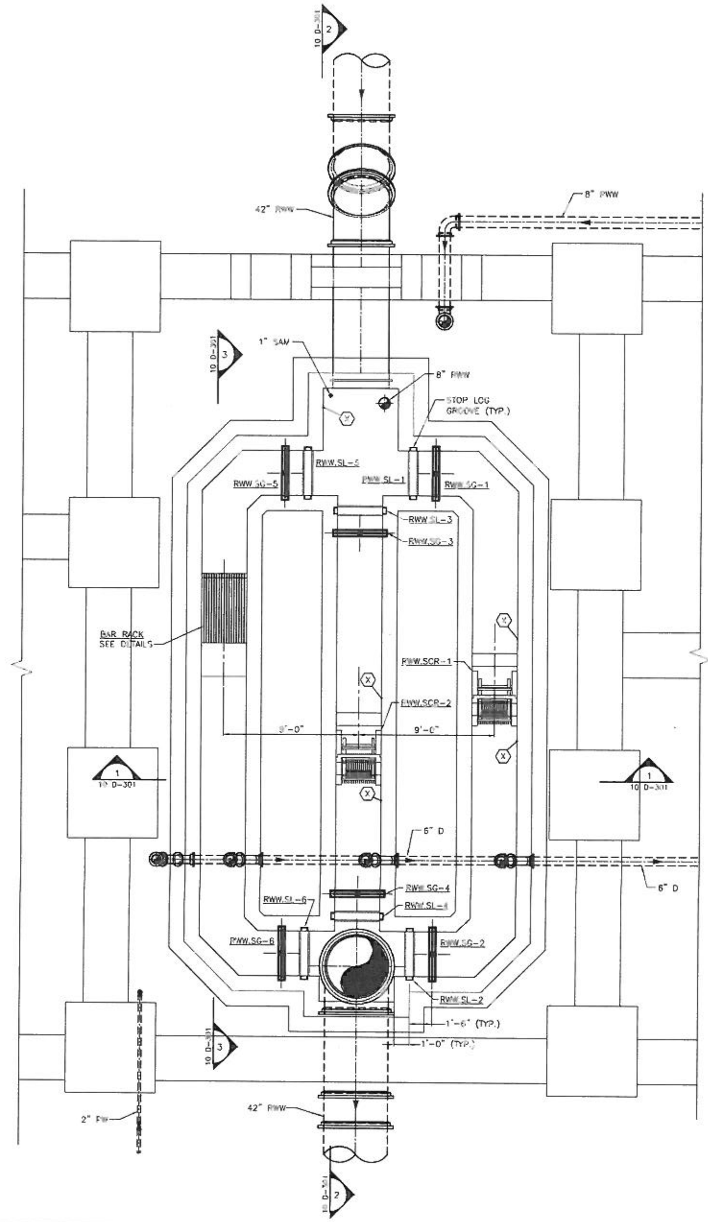
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE
OPERATIONS LAB BUILDING
LOWER LEVEL PLAN
ARCHITECTURAL
PROJECT NO: 60301525
CAD DWG FILE: 80 A-101
DESIGNED BY: ----
DRAWN BY: ----
DEPT CHECK: ----
PROJ CHECK: E. MESERVE
DATE: JULY 2014
SCALE: AS NOTED
80 A-101


NOTES:
1. xxxxx
89'-2"
44'-0"
SCADA/CONTROL ROOM
8013
LUNCH ROOM
8016
LAB OFFICE STORAGE
8019
LABORATORY
8022
WHEELCHAIR LIFT
VESTIBULE
8010
SUPPLY CLOSET
8012
MEN'S LOCKERS
8015
MEN'S ROOM
8014
JAN CLOS
8018
WOMEN'S ROOM
8020
WOMEN'S LOCKERS
8021
OFFICE
8024
PLATFORM & STAIR
OPERATIONS LAB BUILDING UPPER LEVEL PLAN
1/4" = 1'-0"
SCALE
FEET
30% SUBMITTAL
PRELIMINARY COPY
REVISIONS
AECOM
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE
OPERATIONS LAB BUILDING
UPPER LEVEL PLAN
ARCHITECTURAL
PROJECT NO: 60301525
CAD DWG FILE: 80 A-102
PROJ CHECK: E. MESERVE
DATE: JULY 2014
SCALE: AS NOTED
80 A-102



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MARK	DATE	MADE BY	CHECKED	DESCRIPTION

REVISIONS

AECOM

AECOM TECHNICAL SERVICES, INC.
701 EDGEWATER DRIVE
WAKEFIELD, MA 01880
PHONE (781) 246-5200

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

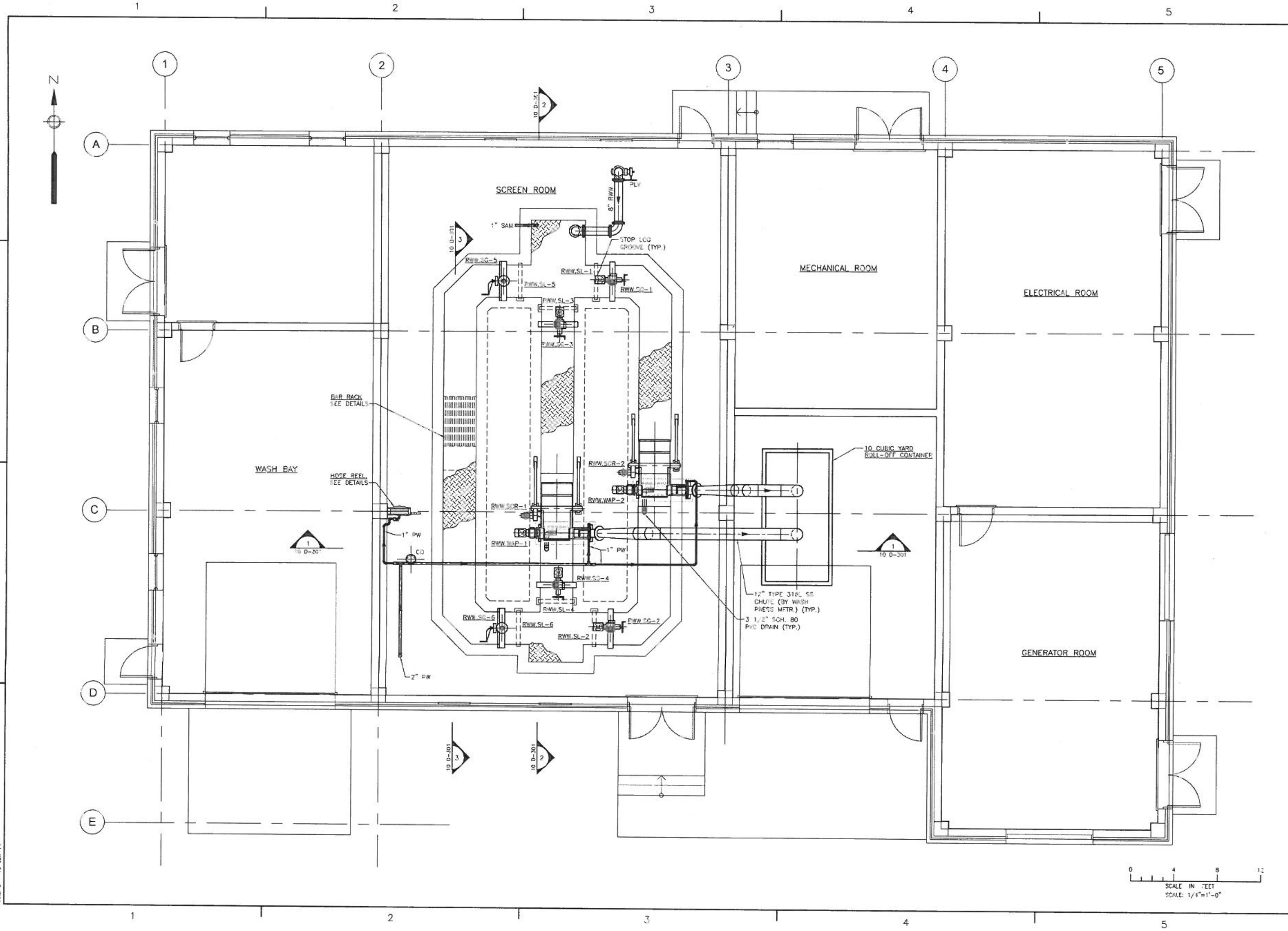
HEADWORKS - LOWER PLAN

MECHANICAL PROCESS

PROJECT NO:	60301525
CAD DWG FILE:	10 D-101
DESIGNED BY:	D. YURK
DRAWN BY:	S.A. COTE
DEPT CHECK:	C. GALLIGAN
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

10 D-101

PATH/FILENAME: P:\60301525 - PORTSMOUTH WWTF UPGRADE\SHEETS\BP-2\D\10 D-101.DWG
LAST UPDATE: Monday, July 14, 2014 4:56:29 PM
PLOT DATE: Tuesday, July 15, 2014 2:32:52 PM
ANSI D - 14-Jul-14



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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

MARK	DATE	MADE BY	CHECKED	DESCRIPTION

REVISIONS

AECOM

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

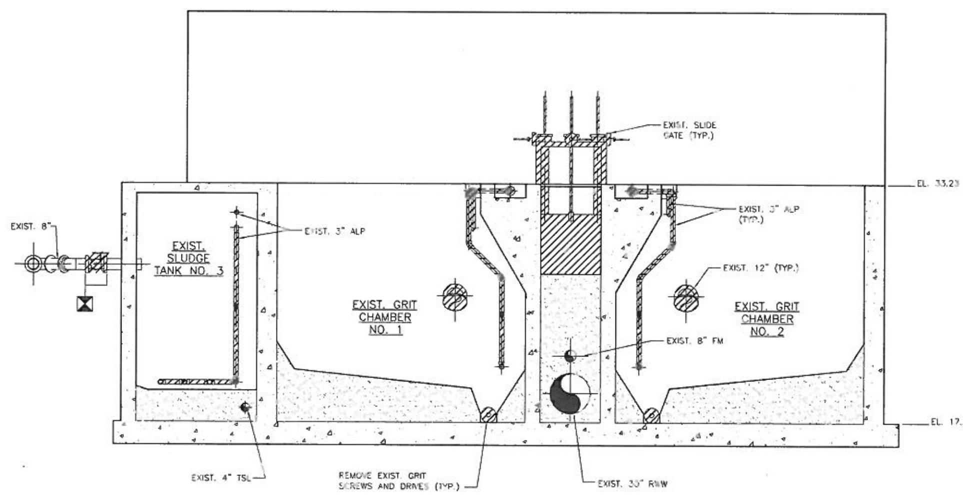
HEADWORKS - UPPER PLAN
MECHANICAL PROCESS

PROJECT NO:	60301535
CAD DWG FILE:	10 D-102
DESIGNED BY:	B. YURK
DRAWN BY:	S.A. COTE
DEPT CHECK:	C. GALLIGAN
PROJ CHECK:	E. VESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

10 D-102

ANSI D - 16-Jun-14

183



SECTION 3 / 20 DD-301
SCALE: 1/4"=1'-0"

0 4 8 12
SCALE IN FEET
SCALE: 1/4"=1'-0"

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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

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AECOM TECHNICAL SERVICES, INC.
701 EDGEWATER DRIVE
WAKEFIELD, MA 01880
PHONE (781) 246-5200

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

GRIT BUILDING - DEMOLITION SECTIONS II

MECHANICAL PROCESS

PROJECT NO:	60301525
CAD DWG FILE:	20 DD-302
DESIGNED BY:	D. YURK
DRAWN BY:	S.A. COTE
DEPT CHECK:	C. GALLIGAN
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

20 DD-302

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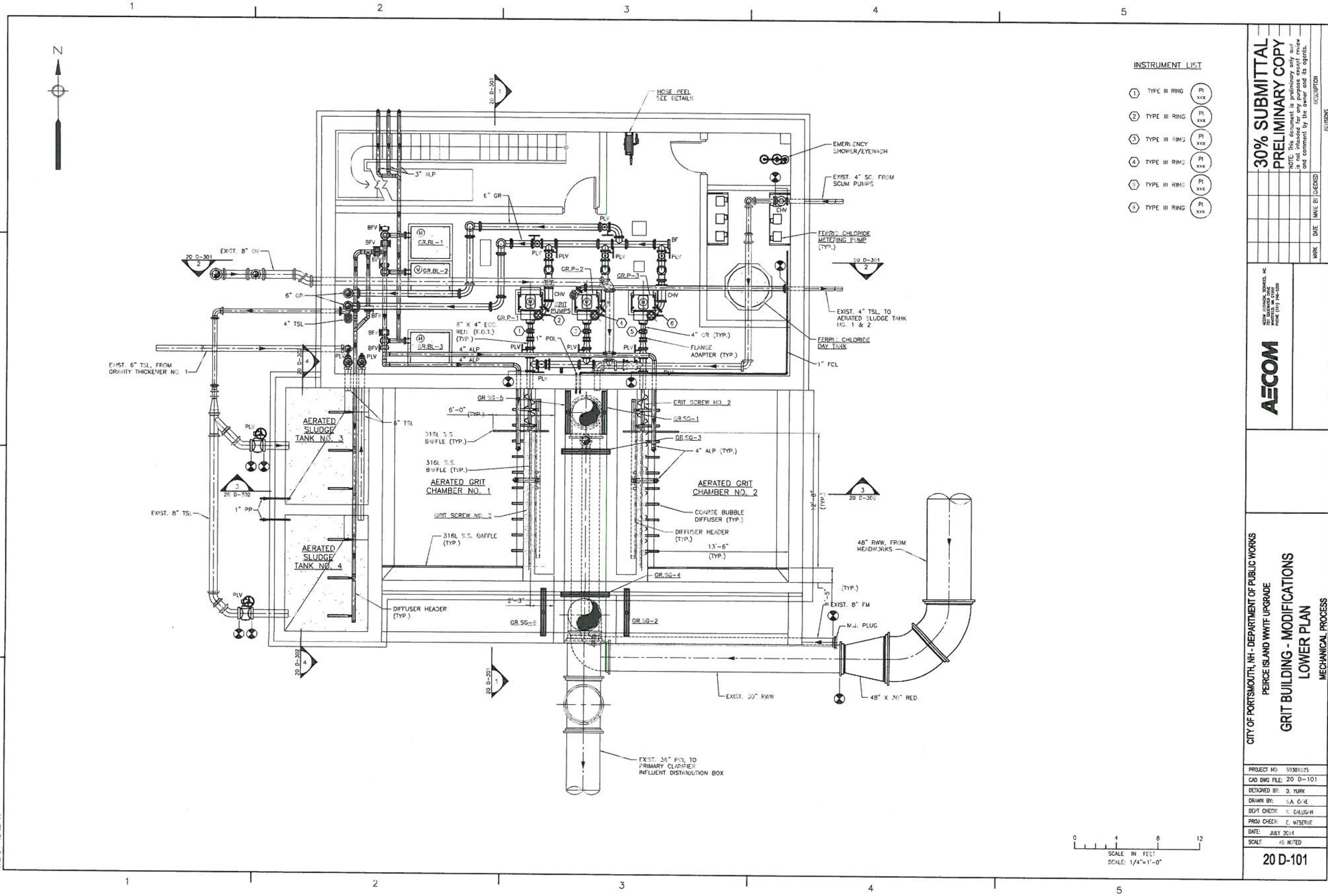
ANSI D - 10-Jul-14



INSTRUMENT LIST
TYPE III RING
HOSE REEL SEE DETAILS
EMERGENCY SHOWER/EYEWASH
EXIST. 4" SC. FROM SCUM PUMPS
FERRIC CHLORIDE METERING PUMP (TYP.)
EXIST. 4" TSL TO AERATED SLUDGE TANK NO. 1 & 2
FERRIC CHLORIDE DAY TANK
1" FCL
EXIST. 8" OV
EXIST. 6" TSL FROM GRAVITY THICKENER NO. 1
3" ALP
6" GR
4" TSL
GR.BL-1
GR.BL-2
GR.BL-3
GR.P-1
GR.P-2
GR.P-3
GRIT PUMPS
8" X 4" ECC. RED. (F.O.T.) (TYP.)
4" ALP
1" POL
4" GR (TYP.)
FLANGE ADAPTER (TYP.)
AERATED SLUDGE TANK NO. 3
AERATED SLUDGE TANK NO. 4
6" TSL
EXIST. 8" TSL
1" PP
316L S.S. BAFFLE (TYP.)
AERATED GRIT CHAMBER NO. 1
AERATED GRIT CHAMBER NO. 2
GRIT SCREW NO. 2
316L S.S. BAFFLE (TYP.)
GRIT SCREW NO. 2
GR.SG-1
GR.SG-2
GR.SG-3
GR.SG-4
GR.SG-5
GR.SG-6
4" ALP (TYP.)
COARSE BUBBLE DIFFUSER (TYP.)
DIFFUSER HEADER (TYP.)
13'-6" (TYP.)
12'-0" (TYP.)
6'-0" (TYP.)
48" RWW, FROM HEADWORKS
EXIST. 8" FM
M.J. PLUG
EXIST. 30" RWW
48" X 30" RED.
EXIST. 36" PCL TO PRIMARY CLARIFIER INFLUENT DISTRIBUTION BOX
SCALE IN FEET
SCALE: 1/4"=1'-0"
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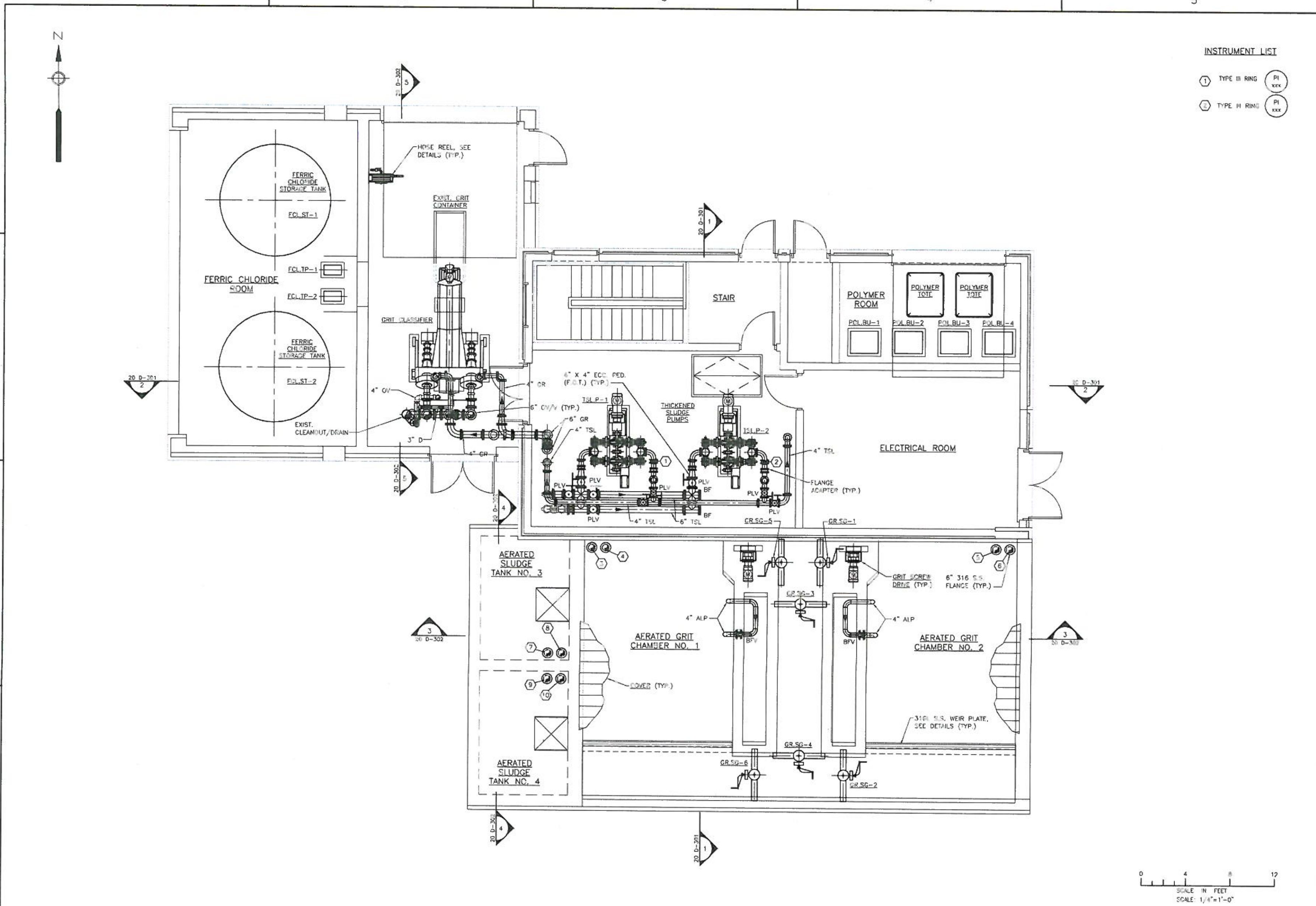
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE
GRIT BUILDING - MODIFICATIONS
LOWER PLAN
MECHANICAL PROCESS
PROJECT NO: 60301525
CAD DWG FILE: 20 D-101
DESIGNED BY: D. YURK
DRAWN BY: S.A. CYR
DEPT CHECK: C. CALLIGAN
PROJ CHECK: E. WESERVE
DATE: JULY 2014
SCALE: AS NOTED
20 D-101



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PEIRCE ISLAND WWTF UPGRADE

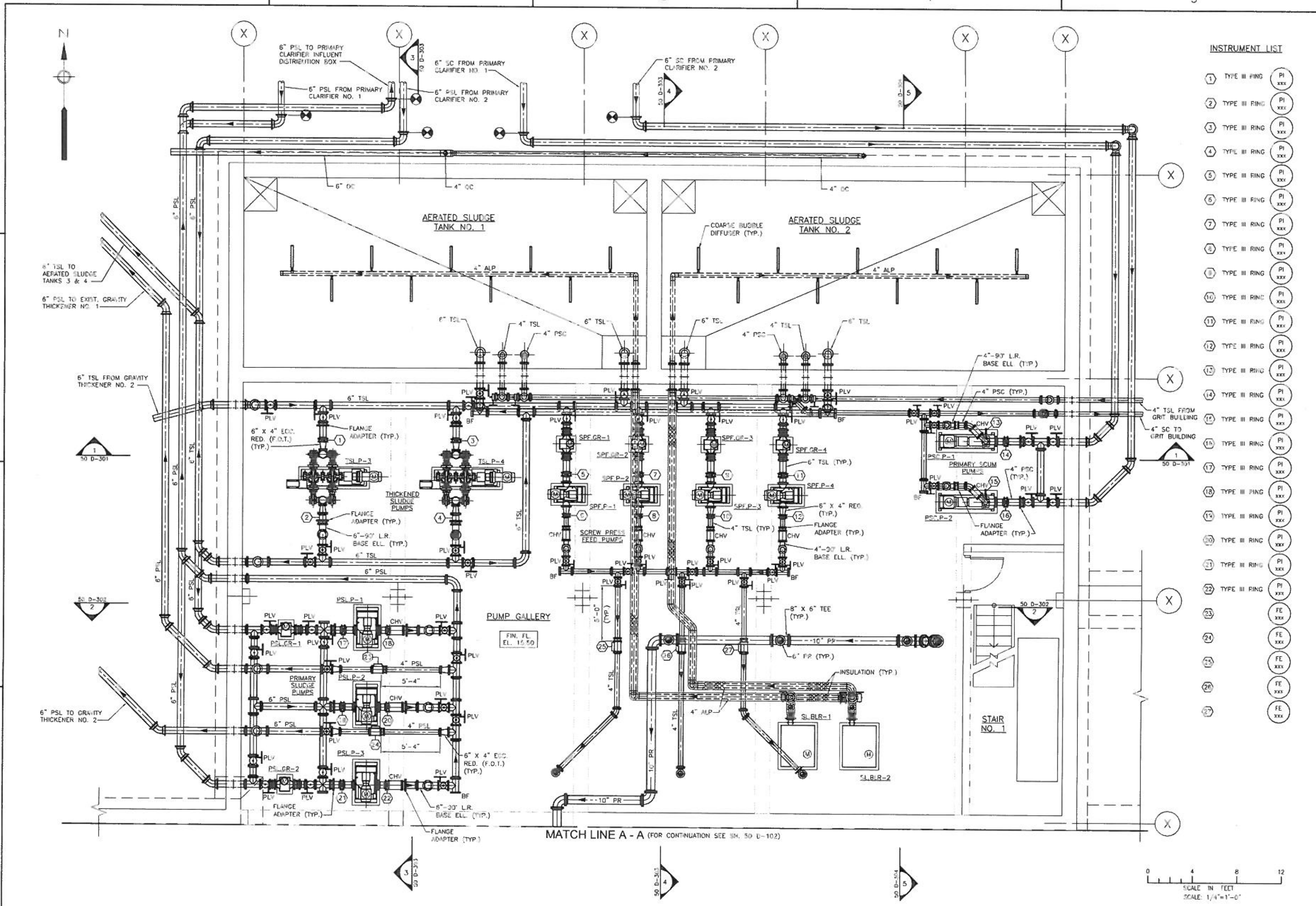
GRIT BUILDING - MODIFICATIONS UPPER PLAN

MECHANICAL PROCESS

PROJECT NO:	60301125
CAD DWG FILE:	20 D-102
DESIGNED BY:	D. YURK
DRAWN BY:	S.A. COTE
DEPT CHECK:	C. GALLIGAN
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

20 D-102

ANSI D - 15-Jul-14



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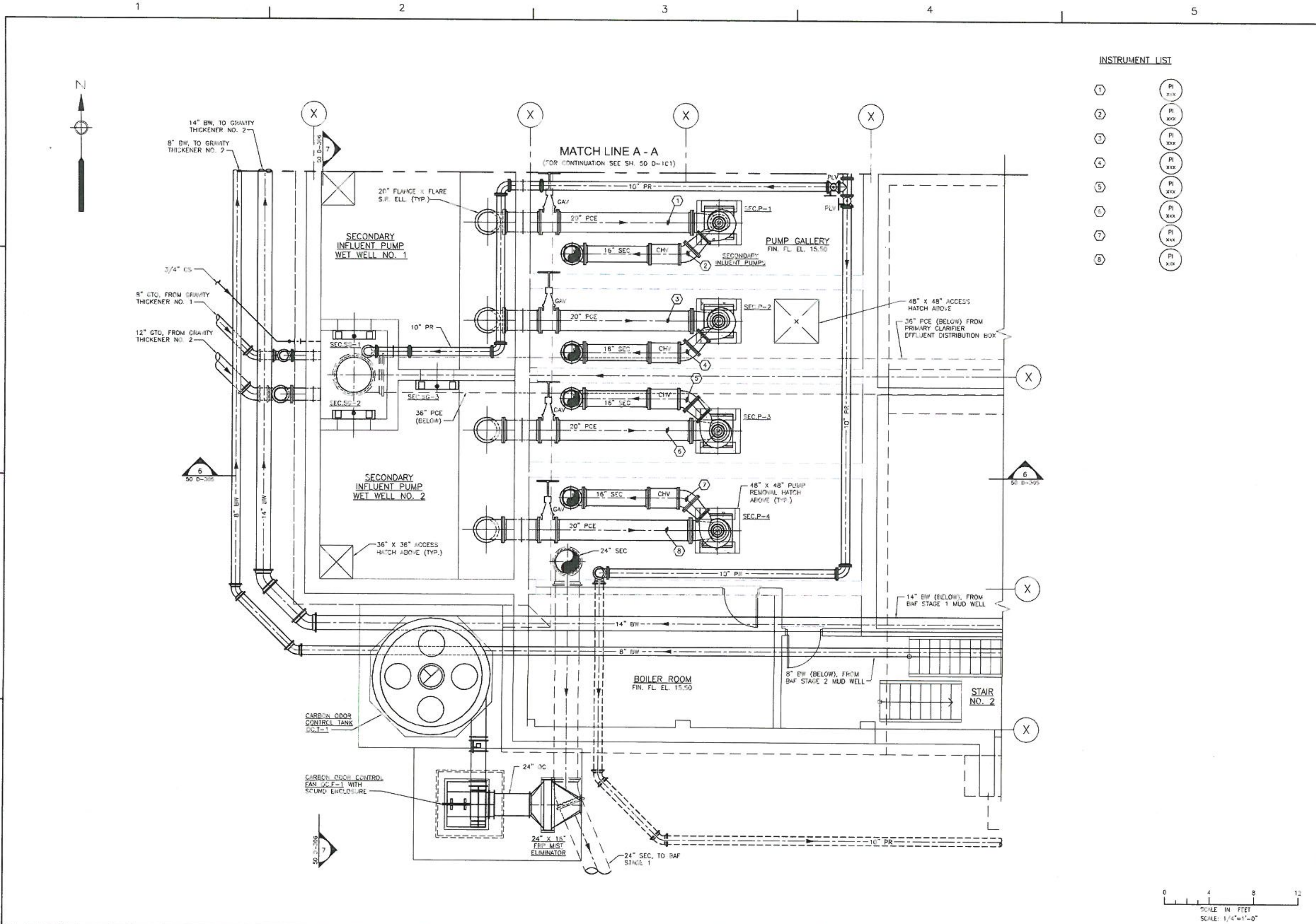
PEIRCE ISLAND WWTF UPGRADE

NEW SOLIDS BUILDING - MODIFICATION
LOWER PLAN I
MECHANICAL PROCESS

PROJECT NO:	60301525
CAD DWG FILE:	50 D-101
DESIGNED BY:	D. YURK
DRAWN BY:	S.A. COTE
DEPT CHECK:	C. CALLIDAN
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

50 D-101

ANSI D - 15-Jul-14



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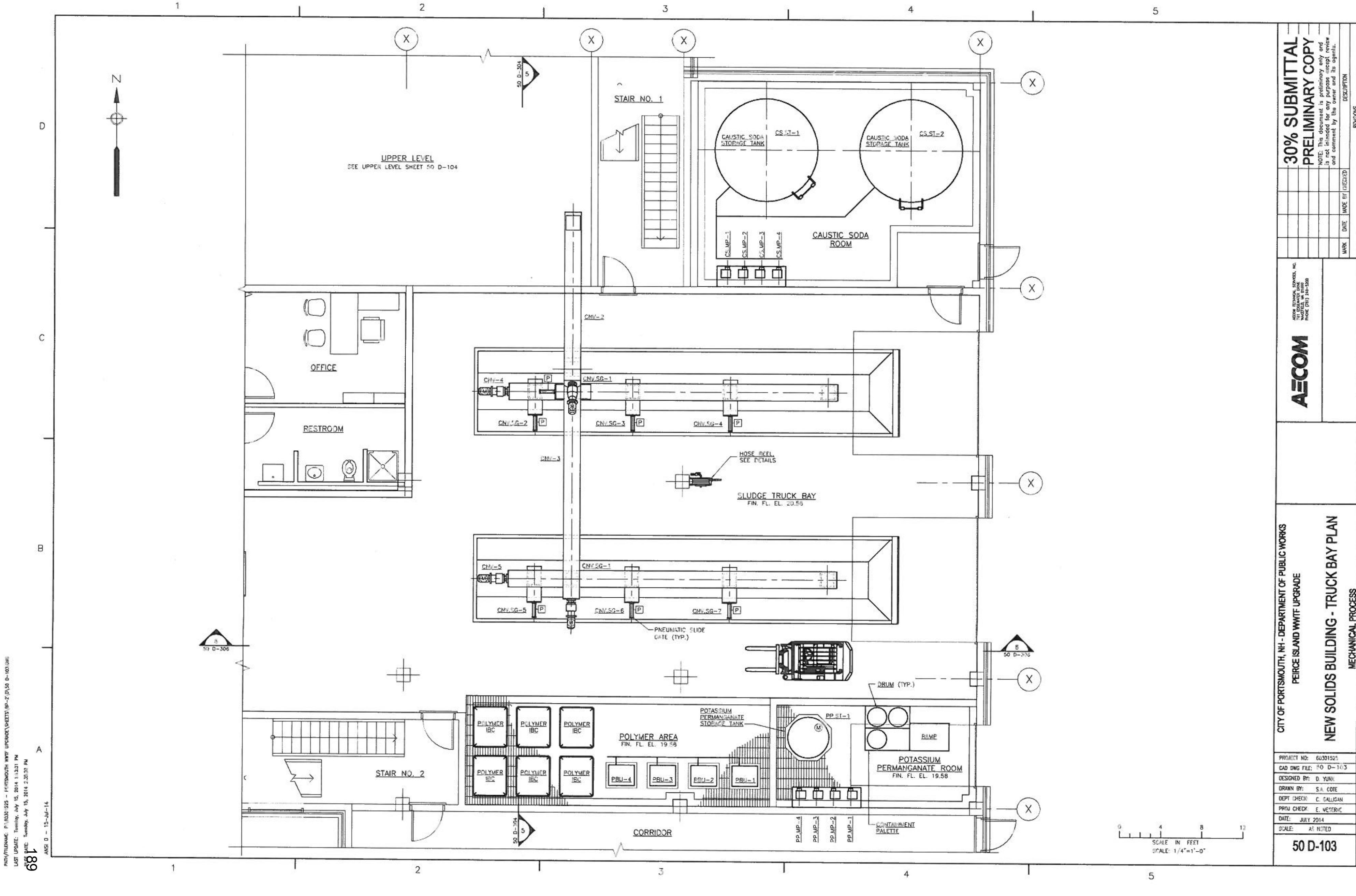
PEIRCE ISLAND WWTF UPGRADE

NEW SOLIDS BUILDING - MODIFICATIONS
LOWER PLAN II
MECHANICAL PROCESS

PROJECT NO:	60301535
CAD DWG FILE:	50 D-102
DESIGNED BY:	D. YURK
DRAWN BY:	S.A. COTE
DEPT CHECK:	C. GALLIGAN
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

50 D-102



UPPER LEVEL
SEE UPPER LEVEL SHEET 50 D-104
STAIR NO. 1
CAUSTIC SODA STORAGE TANK
CS.ST-1
CS.ST-2
CAUSTIC SODA ROOM
CS.MP-1
CS.MP-2
CS.MP-3
CS.MP-4
OFFICE
RESTROOM
CNV-2
CNV-3
CNV-4
CNV-5
CNV.SG-1
CNV.SG-2
CNV.SG-3
CNV.SG-4
CNV.SG-5
CNV.SG-6
CNV.SG-7
HOSE REEL SEE DETAILS
SLUDGE TRUCK BAY
FIN. FL. EL. 20.56
PNEUMATIC SLIDE GATE (TYP.)
DRUM (TYP.)
POLYMER IBC
POLYMER AREA
FIN. FL. EL. 19.58
PBU-1
PBU-2
PBU-3
PBU-4
POTASSIUM PERMANGANATE STORAGE TANK
PP.ST-1
RAMP
POTASSIUM PERMANGANATE ROOM
FIN. FL. EL. 19.58
PP.MP-1
PP.MP-2
PP.MP-3
PP.MP-4
CONTAINMENT PALETTE
STAIR NO. 2
CORRIDOR
SCALE IN FEET
SCALE: 1/4"=1'-0"
30% SUBMITTAL
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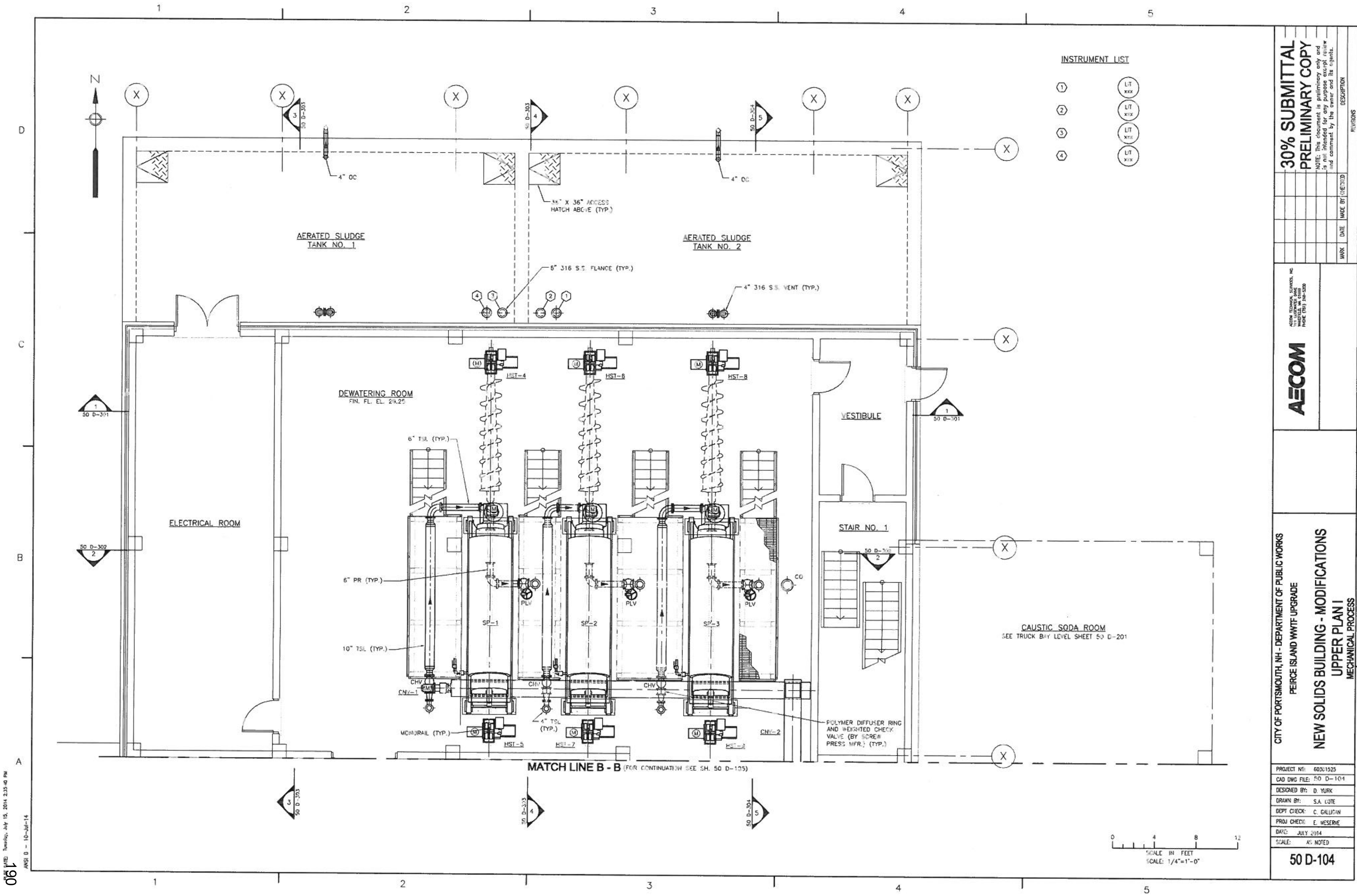
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE
NEW SOLIDS BUILDING - TRUCK BAY PLAN
MECHANICAL PROCESS
PROJECT NO: 60301525
CAD DWG FILE: 50 D-103
DESIGNED BY: D. YUNK
DRAWN BY: S.A. COTE
DEPT CHECK: C. GALLIGAN
PROJ CHECK: E. MESERVE
DATE: JULY 2014
SCALE: AS NOTED
50 D-103



INSTRUMENT LIST
L/T xxx
4" OC
36" X 36" ACCESS HATCH ABOVE (TYP.)
AERATED SLUDGE TANK NO. 1
AERATED SLUDGE TANK NO. 2
6" 316 S.S. FLANGE (TYP.)
4" 316 S.S. VENT (TYP.)
ELECTRICAL ROOM
DEWATERING ROOM
FIN. FL. EL. 29.25
VESTIBULE
STAIR NO. 1
HST-4
HST-6
HST-8
HST-5
HST-7
HST-9
6" TSL (TYP.)
6" PR (TYP.)
10" TSL (TYP.)
SP-1
SP-2
SP-3
PLV
CO
CHV
CNV-1
CNV-2
MONORAIL (TYP.)
4" TSL (TYP.)
POLYMER DIFFUSER RING AND WEIGHTED CHECK VALVE (BY SCREW PRESS MFR.) (TYP.)
CAUSTIC SODA ROOM
SEE TRUCK BAY LEVEL SHEET 50 D-201
MATCH LINE B - B (FOR CONTINUATION SEE SH. 50 D-105)
50 D-301
50 D-302
50 D-303
50 D-304
SCALE IN FEET
SCALE: 1/4"=1'-0"
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REVISIONS
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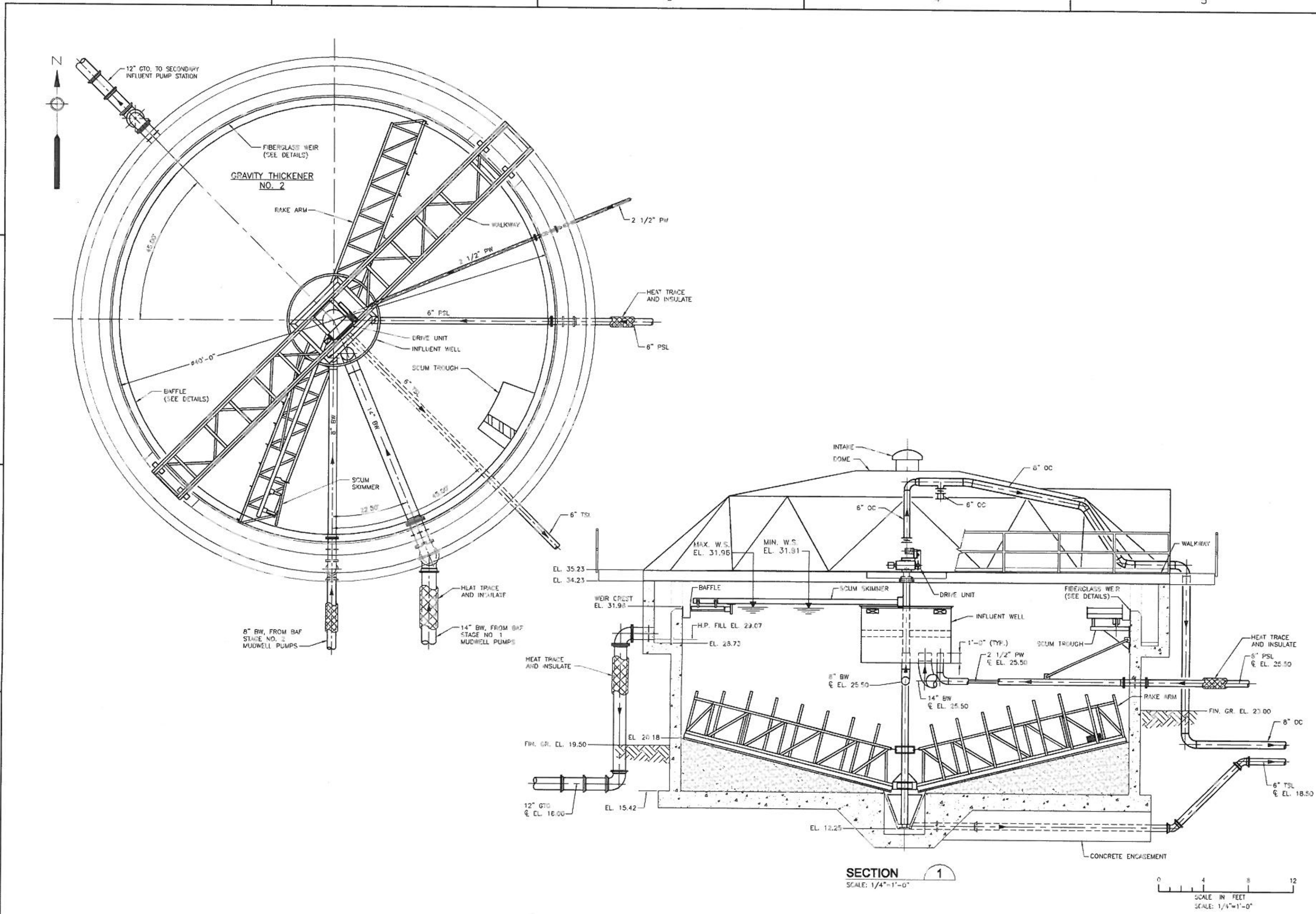
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE
NEW SOLIDS BUILDING - MODIFICATIONS
UPPER PLAN I
MECHANICAL PROCESS
PROJECT NO: 60301525
CAD DWG FILE: 50 D-104
DESIGNED BY: D. YURK
DRAWN BY: S.A. COTE
DEPT CHECK: C. GALLIGAN
PROJ CHECK: E. MESERVE
DATE: JULY 2014
SCALE: AS NOTED
50 D-104

190



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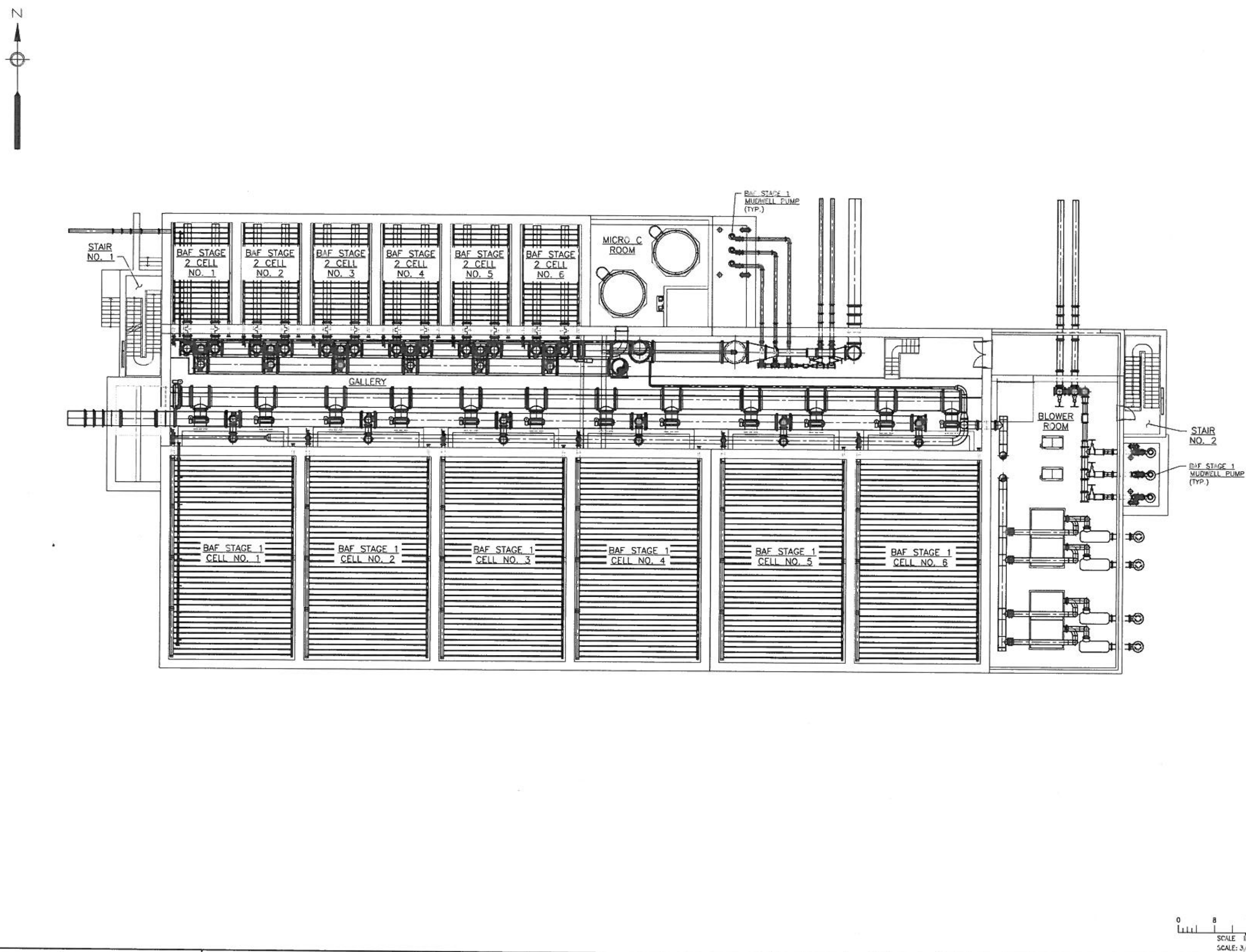
PEIRCE ISLAND WWTF UPGRADE

GRAVITY THICKENER NO. 2 - PLAN AND SECTION
MECHANICAL PROCESS

PROJECT NO:	60301525
CAD DWG FILE:	53 D-101
DESIGNED BY:	G. YURK
DRAWN BY:	S.A. COTE
DEPT CHECK:	C. GALLIGAN
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

53 D-101

ANSI D - 15-Jul-14



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PEIRCE ISLAND WWTF UPGRADE

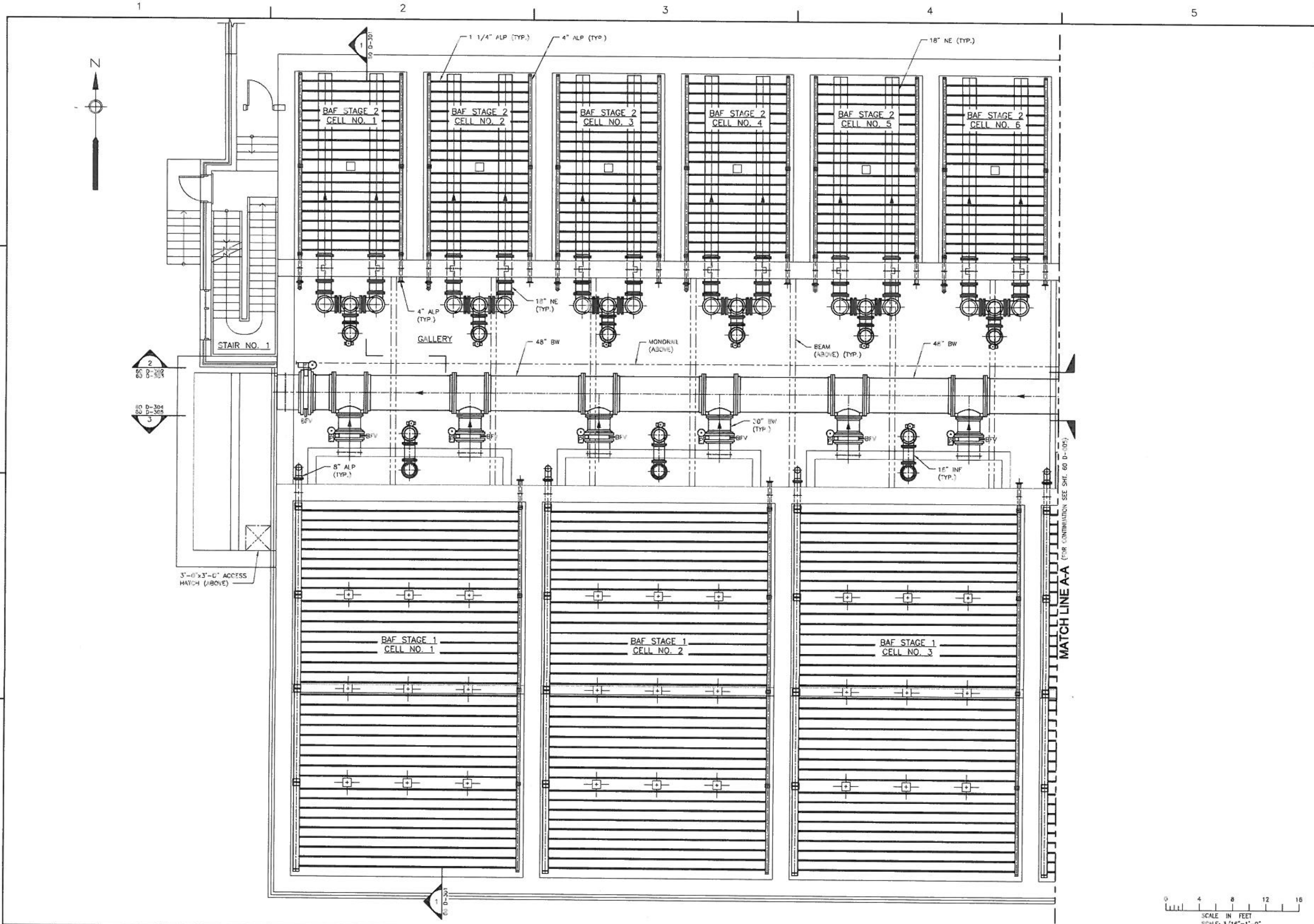
BAF FACILITY
OVERALL PLAN
MECHANICAL PROCESS

PROJECT NO:	60301525
CAD DWG FILE:	60 D-001
DESIGNED BY:	D YURK
DRAWN BY:	N. RUBINI
DEPT CHECK:	C. GALLIGAN
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

60 D-001

ANSI D - 15-Jul-14

192



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CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE

BAF FACILITY LOWER PLAN I AT EL. 27.92
MECHANICAL PROCESS

PROJECT NO:	60301535
CAD DWG FILE:	60 D-004
DESIGNED BY:	D. YURK
DRAWN BY:	N. RUBIN
DEPT CHECK:	C. GALLIGAN
PROJ CHECK:	C. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

60 D-004

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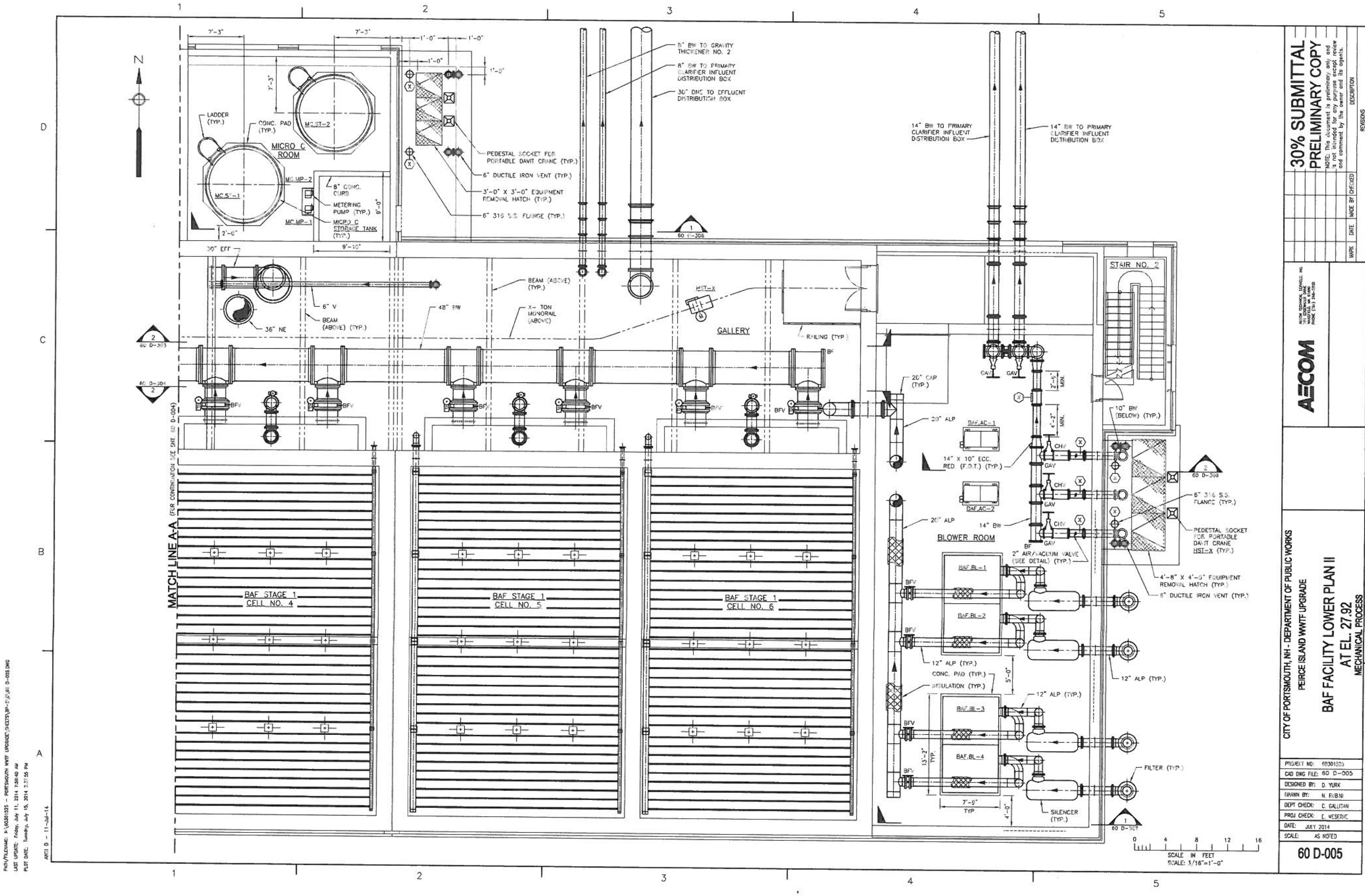
LAST UPDATE: Friday, July 11, 2014 9:50:57 AM
PLOT DATE: Tuesday, July 15, 2014 2:37:42 PM
ANSI D - 11-Jul-14

193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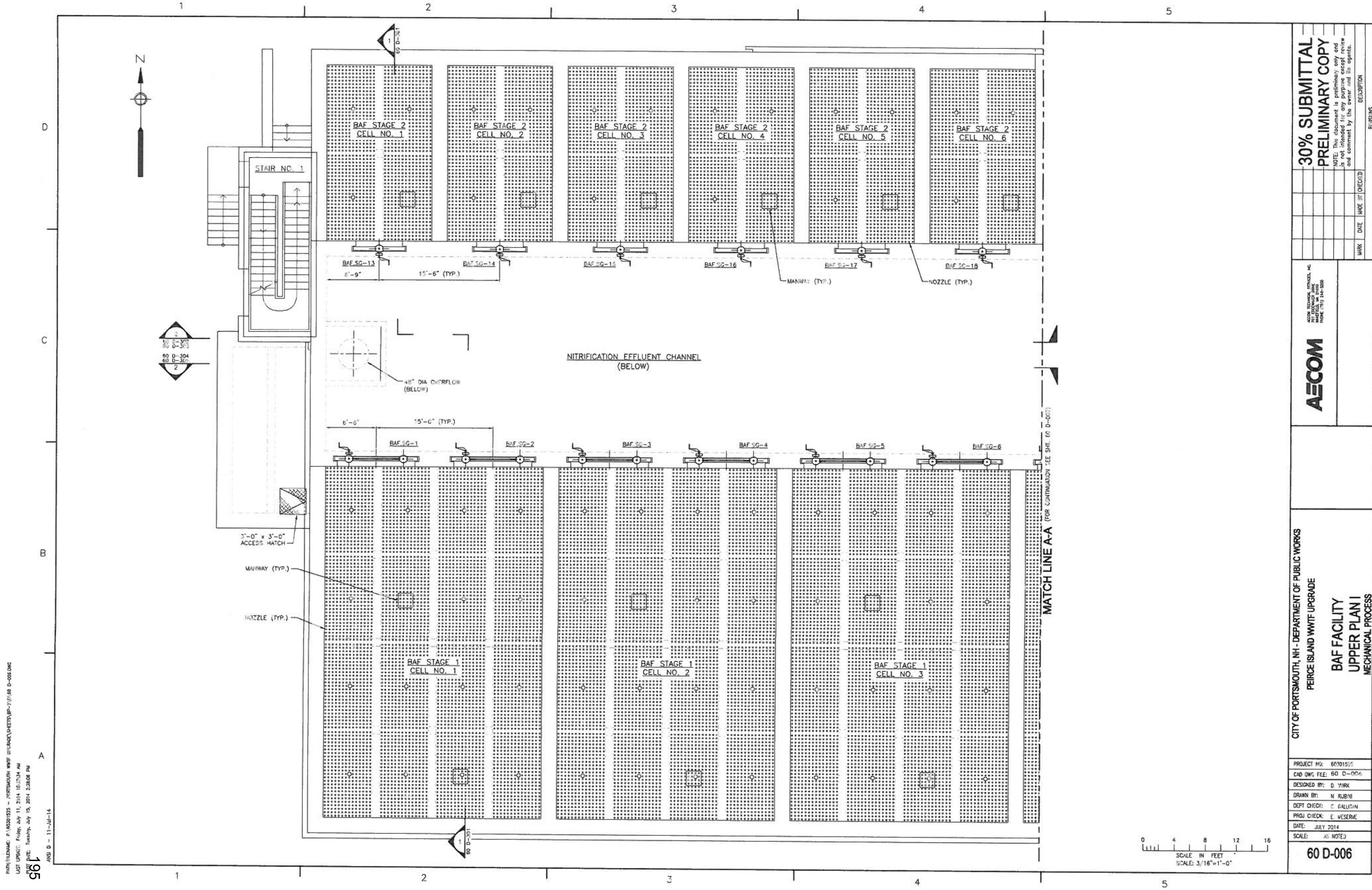
PEIRCE ISLAND WWTF UPGRADE
BAF FACILITY LOWER PLAN II
AT EL. 27.92
MECHANICAL PROCESS
PROJECT NO: 60301525
CAD DWG FILE: 60 D-005
DESIGNED BY: D. YURK
DRAWN BY: N. FABINI
DEPT CHECK: C. GALLIGAN
PROJ CHECK: C. MESERVE
DATE: JULY 2014
SCALE: AS NOTED
60 D-005
SCALE IN FEET
SCALE: 3/16"=1'-0"
MICRO C ROOM
GALLERY
BLOWER ROOM
STAIR NO. 2
BAF STAGE 1 CELL NO. 4
BAF STAGE 1 CELL NO. 5
BAF STAGE 1 CELL NO. 6
MATCH LINE A-A (FOR CONTINUATION SEE SHT. 60 D-004)
8" BW TO GRAVITY THICKENER NO. 2
8" BW TO PRIMARY CLARIFIER INFLUENT DISTRIBUTION BOX
30" DNE TO EFFLUENT DISTRIBUTION BOX
14" BW TO PRIMARY CLARIFIER INFLUENT DISTRIBUTION BOX
PEDESTAL SOCKET FOR PORTABLE DAVIT CRANE (TYP.)
6" DUCTILE IRON VENT (TYP.)
3'-0" X 3'-0" EQUIPMENT REMOVAL HATCH (TYP.)
6" 316 S.S. FLANGE (TYP.)
LADDER (TYP.)
CONC. PAD (TYP.)
8" CONC. CURB
METERING PUMP (TYP.)
MICRO C STORAGE TANK (TYP.)
MC.ST-1
MC.ST-2
MC.MP-1
MC.MP-2
30" EFF
6" V
36" NE
48" BW
BEAM (ABOVE) (TYP.)
X- TON MONORAIL (ABOVE)
HST-X
RAILING (TYP.)
BFV
20" CAP (TYP.)
20" ALP
BAF.AC-1
BAF.AC-2
14" X 10" ECC. RED (F.O.T.) (TYP.)
14" BW
2" AIR/VACUUM VALVE (SEE DETAIL) (TYP.)
GAV
CHV
10" BW (BELOW) (TYP.)
6" 316 S.S. FLANGE (TYP.)
PEDESTAL SOCKET FOR PORTABLE DAVIT CRANE HST-X (TYP.)
4'-8" X 4'-9" EQUIPMENT REMOVAL HATCH (TYP.)
6" DUCTILE IRON VENT (TYP.)
BAF.BL-1
BAF.BL-2
BAF.BL-3
BAF.BL-4
12" ALP (TYP.)
CONC. PAD (TYP.)
INSULATION (TYP.)
FILTER (TYP.)
SILENCER (TYP.)
MARK
DATE
MADE BY
CHECKED
REVISIONS
DESCRIPTION



BAF STAGE 2 CELL NO. 1
BAF STAGE 2 CELL NO. 2
BAF STAGE 2 CELL NO. 3
BAF STAGE 2 CELL NO. 4
BAF STAGE 2 CELL NO. 5
BAF STAGE 2 CELL NO. 6
STAIR NO. 1
BAF.SG-13
BAF.SG-14
BAF.SG-15
BAF.SG-16
BAF.SG-17
BAF.SG-18
6'-9"
15'-6" (TYP.)
MANWAY (TYP.)
NOZZLE (TYP.)
NITRIFICATION EFFLUENT CHANNEL (BELOW)
48" DIA OVERFLOW (BELOW)
6'-6"
15'-0" (TYP.)
BAF.SG-1
BAF.SG-2
BAF.SG-3
BAF.SG-4
BAF.SG-5
BAF.SG-6
3'-0" x 3'-0" ACCESS HATCH
MANWAY (TYP.)
NOZZLE (TYP.)
BAF STAGE 1 CELL NO. 1
BAF STAGE 1 CELL NO. 2
BAF STAGE 1 CELL NO. 3
MATCH LINE A-A (FOR CONTINUATION SEE SHT. 60 D-007)
60 D-301
60 D-304
SCALE IN FEET
SCALE: 3/16"=1'-0"
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REVISIONS
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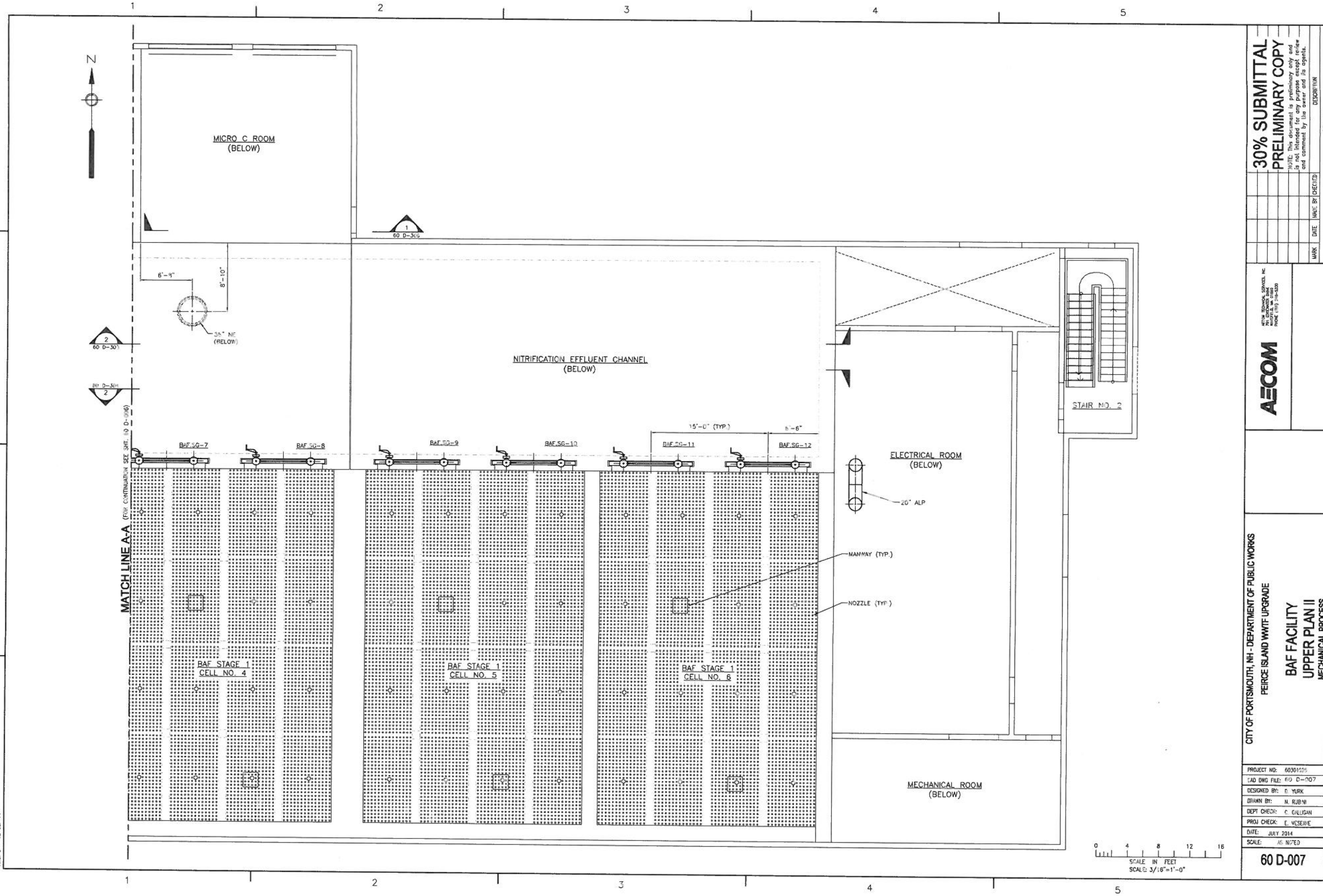
CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS
PEIRCE ISLAND WWTF UPGRADE
BAF FACILITY
UPPER PLAN I
MECHANICAL PROCESS
PROJECT NO: 60301525
CAD DWG FILE: 60 D-006
DESIGNED BY: D. WIRK
DRAWN BY: N. RUBINI
DEPT CHECK: C. GALLIGAN
PROJ CHECK: E. MESERVE
DATE: JULY 2014
SCALE: AS NOTED
60 D-006
ANSI D - 11-Jul-14

198

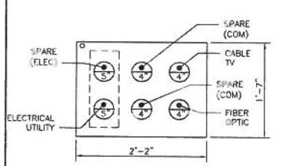


LAST UPDATE: Tuesday, July 15, 2014 10:35:17 AM
PLOT DATE: Tuesday, July 15, 2014 2:38:15 PM
ANSI D - 15-Jul-14

1" = 50' SCALE 0 50 100 150 FEET

ELECTRICAL AND COMMUNICATION UTILITIES DUCT BANK PLAN

SCALE: 1"=50'



ELECTRICAL AND COM UTILITIES DUCT BANK SECTION

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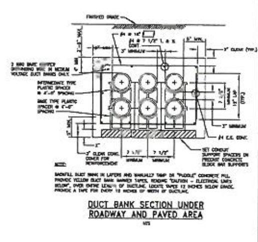
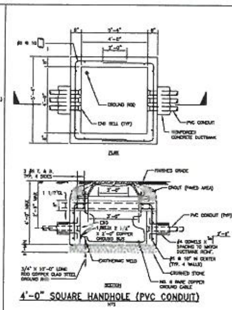


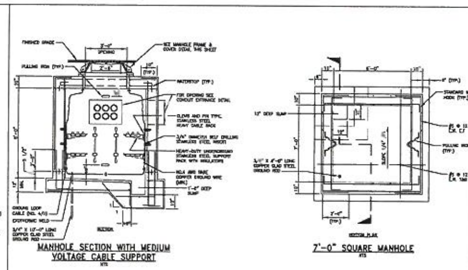
UNDER ROAD DUCT BANK DETAIL

SCALE: NOT TO SCALE



HANDHOLE DETAIL

SCALE: NOT TO SCALE



MANHOLE DETAIL

SCALE: NOT TO SCALE

MANHOLE, HANDHOLE AND DUCT BANK NOTES

1. ALL CONCRETE INSERTS, FITTINGS AND ACCESSORIES ARE TO BE FABRICATED FROM HEAVY-DUTY STAINLESS STEEL.
2. ALL CONCRETE FOR MANHOLES AND DUCT RUNS TO BE CLASS "A" (4000 PSI) AS PER THE STRUCTURAL SPECIFICATIONS.
3. ALL CONDUIT AND OTHER EQUIPMENT IN MANHOLES SHALL BE BONDED WITH A NO. 4, STRANDED COPPER CABLE (MINIMUM).
4. ALL 4" OR LARGER STEEL CONDUIT BENDS SHALL HAVE A 36" RADIUS (MINIMUM).
5. ALL CABLES SHALL BE TAGGED WITH A PROTECTED PLASTIC TAG OF DISTINCTIVE COLOR AND MARKING FOR EACH VOLTAGE. THE TAGS WILL GIVE VOLTAGE AND CIRCUIT NUMBER ASSIGNED BY THE CONTRACT DRAWING CONDUIT AND WIRE SCHEDULE.
6. CONTRACTOR TO SIZE THE CIRCULAR OPENINGS IN THE MANHOLE ROOF FROM FRAMES ACTUALLY FURNISHED.
7. PLASTIC DUCT SPACERS SHALL BE INSTALLED ON 4 FT. CENTERS. JOINTS ARE TO BE STAGGARED BETWEEN TIERS TO PROVIDE NOT LESS THAN 12 INCH LONGITUDINAL SEPARATION BETWEEN JOINTS SEPARATION BETWEEN JOINTS IN ANY TWO ADJOINING CONDUITS.
8. THE SIZE OF A MANHOLE WINDOW DEPENDS ON THE NUMBER OF CONDUITS IN THE INCOMING DUCTLINE. TO DETERMINE THE ACTUAL WINDOW SIZE AND LOCATION, SEE THE DUCT SECTION. THE WINDOW OPENING MUST ALSO BE A MINIMUM OF ONE FOOT ABOVE MANHOLE FLOOR AND / OR ONE FOOT BELOW MANHOLE ROOF. EACH MANHOLE WINDOW SHOULD BE OFFSET FROM THE CENTER OF THE WALL SO THAT ONE VERTICAL EDGE IS CLOSE TO THE INTERSECTION OF TWO WALLS.
9. ALL STEEL CONDUIT SHALL BE TERMINATED IN MANHOLES WITH CONDUIT GROUNDING BUSHINGS.
10. MANHOLE COVER SHALL HAVE THE WORD "ELECTRIC" CAST ON THE COVER.
11. INSTALL TWO PULLING-IN IRONS OPPOSITE CENTER OF EACH ENTERING DUCT RUN. ONE 6" BELOW ROOF AND ONE 6" ABOVE FLOOR.
12. ALL DUCTS SHALL DRAIN FROM HIGH POINT TO MANHOLE WITH A SLOPE OF NOT LESS THAN 4" PER 100 FEET.

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REVISIONS

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AECOM TECHNICAL SERVICES, INC. 701 EDGEWATER DRIVE WAKEFIELD, MA 01880 PHONE (781) 246-5200

CITY OF PORTSMOUTH, NH - DEPARTMENT OF PUBLIC WORKS

PEIRCE ISLAND WWTF UPGRADE

UTILITY SERVICE SITE PLAN

00 GENERAL

PROJECT NO:	60301525
CAD DWG FILE:	00 E-004
DESIGNED BY:	C. MURPHY
DRAWN BY:	C. MURPHY
DEPT CHECK:	Y. RIZK
PROJ CHECK:	E. MESERVE
DATE:	JULY 2014
SCALE:	AS NOTED

00 E-004

SECTION FOUR VALUE ANALYSIS AND CONCLUSIONS

INTRODUCTION

This section describes the procedures used during the VE study on the Peirce Island Wastewater Treatment Facility Upgrade facilitated by ARCADIS U.S., Inc., for the City of Portsmouth, New Hampshire. The workshop was performed August 4-7, 2014, at the Public Works Department in Portsmouth, NH. AECOM Technical Services, Inc. (AECOM) has been selected by the City to assist with the development of the project and has provided information for the VE team to use as the basis of the study.

A systematic approach was used in the VE study, which is divided into three parts: (1) Preparation Effort, (2) Workshop Effort, and (3) Post-Workshop Effort. A task flow diagram outlining each of the procedures included in the VE study is attached for reference.

Following this description of the procedures, separate narratives and supporting documentation identify the following:

- VE workshop agenda
- VE workshop participants
- Economic data
- Cost model
- Function analysis
- Creative ideas and evaluations

PREPARATION EFFORT

Preparation for the workshop consisted of scheduling workshop participants and tasks and gathering necessary project documents for team members to review before attending the workshop. These documents, listed below, were used as the basis for generating VE alternatives and for determining the cost implications of the selected VE alternatives:

- City of Portsmouth, New Hampshire, Peirce Island WWTF Upgrade Design 30% Final Design Report, dated July 2014, prepared by AECOM Technical Services, Inc.
- City of Portsmouth, New Hampshire, Peirce Island WWTF Upgrade Design 30% Design Opinion of Probable Cost, dated July 21, 2014, prepared by AECOM Technical Services, Inc.
- City of Portsmouth, New Hampshire, Peirce Island WWTF Upgrade Drawings, dated July 2014, prepared by AECOM Technical Services, Inc.
- City of Portsmouth, New Hampshire, Peirce Island WWTF Upgrade Design Phase 1 Summary Memorandum, March 2014, prepared by AECOM Technical Services, Inc.
- City of Portsmouth, Wastewater Master Plan, Phase 2 Initial Piloting Technical Memorandum, Volume One of Two, dated September 2012, prepared by AECOM Technical Services, Inc.
- City of Portsmouth, New Hampshire, Peirce Island WWTF Upgrade Primary Clarifier and Gravity Thickener Replacement bid documents, dated May 2014, prepared by AECOM Technical Services, Inc.

ARCADIS Value Engineering Study Task Flow Diagram

Preparation Effort

Coordinate Project
- Verify Schedule
- Suggest Format for Designer Presentation
- Outline Project Responsibilities
- Outline Needed Background Data
- Define *Project Value Objectives*
- Identify Project Constraints

Prepare for Workshop
- Collect Project Data
- Distribute Data to Team Members
- Verify Cost Data
- Team Members Become Familiar with Project

Construct Cost Models
- Construct Cost Models
- Construct Graphic Function Analysis
- Outline High Cost Areas

LCC Model
- Process Areas
- Staffing
- Chemicals
- Energy
- User Impact

Workshop Effort

Information Phase
- Introduction by VETL
- Project Description and Presentation by Designer
- Outline Owner Requirements
- Review Project Data
- Visit Project Site (Alt.)

Function Identification and Analysis Phase
- Analyze Project Costs and Energy Usage
- Perform Function Analysis and FAST Diagram
- Identify High Cost and Energy Areas
- Calculate Cost/Worth Ratios
- Identify Paradigms

List Ideas Generated During Function Analysis

Creative Phase
- Introduction by VETL
- Creative Idea Listing:
  - Quantity of Ideas
  - Association of Ideas

Brainstorming

Creative Thinking:
- Group & Individual

Use Checklist for Ideas

Evaluation Phase
- Eliminate Impractical Ideas
- Rank Ideas with Advantages/Disadvantages
- Evaluate Alternatives (Include Non-Economic considerations: Safety, Reliability, Environment, Aesthetics, O & M, etc.)
- Select Best Ideas for Implementation

Development Phase
- Develop Proposed Alternatives
- Prepare Alternative Design Sketches
- Estimate Costs
- Perform Life Cycle Comparison
  - Initial Cost
  - Redesign Cost
  - O & M Cost
  - LCC Cost

Presentation Phase
- Summarize Findings
- Present VE Ideas to Owner/User/Designer
- Oral Presentation

Post-Workshop Effort

VE Study Report
- Prepare Preliminary VE Report
- Designer Prepares Responses to VE Report
- Owner Evaluates Recommendations

Implementation Phase
- Participate in Implementation Meeting with Owner/User/Designer/VE Team, as needed
- Prepare Final VE Report

Final Acceptance
- Redesign by Designer

- Portsmouth NH Peirce Island WWTF Preliminary Yearly Energy Calculation, dated July 2014, prepared by AECOM Technical Services, Inc.

Information relating to the project's purpose and need, owner concerns, project stakeholder concerns, design criteria, project constraints, funding sources and availability, regulatory agency approval requirements, and the project's schedule and costs is very important as it provides the VE team with insight about how the project has progressed to its current state.

Project cost information provided by the designers is used by the VE team as the basis for a comparative analysis with similar projects. To prepare for this exercise, the VE team leader used the cost estimate prepared by AECOM to develop a cost models for the project. The models were used to distribute the total project cost among the various elements or functions of the project. The VE team used these models to identify the high-cost elements or functions that drive the project and the elements or functions providing little or no value so that the team could focus on reducing or eliminating their impact.

To obtain greater insight about the owner's definition of value as it relates to this project, the VE team leader sent the owner's representative and the design project manager a *Project Value Objectives*™ (PVO) Questionnaire to complete and return to the team leader at the workshop kickoff. The completed questionnaire was used by the VE team to evaluate ideas generated during the workshop.

VALUE ENGINEERING WORKSHOP EFFORT

The VE workshop was a 4-day effort beginning with an orientation/kickoff meeting on Monday, August 4, 2014, and concluding with the final VE Presentation on Thursday, August 7, 2014. During the workshop, the VE Job Plan was followed in compliance with SAVE International (the value society) and United States Environmental Protection Agency guidelines for conducting a VE study. The Job Plan guided the search for alternatives to mitigate or eliminate high-cost drivers, secondary functions providing little or no value, and potential project risks. Alternatives to specifically address the owner's project concerns and enhance value by improving operations, reducing maintenance requirements, enhancing constructability, and providing missing functions were also considered. The Job Plan includes six phases:

- Information Phase (with a site visit)
- Function Identification and Analysis Phase
- Creative Idea Generation Phase
- Evaluation/Judgment of Creative Ideas Phase
- Alternative Development Phase
- Presentation Phase

Information Phase

At the beginning of the study, the decisions that have influenced the project's design and proposed construction methods have to be reviewed and understood. For this reason, the workshop began with a presentation of the project by the City and AECOM to the team. The presentation highlighted the information provided in the documentation reviewed by the VE team before the workshop and expanded on it to include a history of the project's development and any underlying influences that caused the design to develop to its current state. During this presentation, VE team members were provided the opportunity to ask questions and obtain clarification about the information provided. Following the presentation, the VE team visited the project site to obtain first-hand information on existing site conditions in order for team members to enhance their understanding of the new project.

Function Identification and Analysis Phase

Having gained some information on the project, the VE team proceeded to define the functions provided by the project, identifying the costs to provide these functions, and determining whether the value provided by the functions has been optimized. Function analysis is a means of evaluating a project to see if the expenditures actually perform the requirements of the project or if there are disproportionate amounts of money spent on support functions. Elements performing support functions add cost to the project but have a relatively low worth to the basic function.

Function is defined as the intended use of a physical or process element. The team attempted to identify functions in the simplest manner using measurable noun/verb word combinations. To accomplish this, the team first looked at the project in its entirety and randomly listed its functions, which were recorded on Random Function Analysis Worksheets (provided in the Function Identification and Analysis section). Then the individual function(s) of the major components of the project depicted on the cost models were identified.

After identifying the functions, the team classified the functions according to the following:

Abbreviation	Type of Function	Definition
HO	Higher Order	The primary reason the project is being considered or project goal.
B	Basic	A function the must occur for the project to meet its higher order functions.
S	Secondary	A function that occurs because of the concept or process selected and may or may not be necessary.
R/S	Required Secondary	A secondary function that may not be necessary to perform the basic function but must be included to satisfy other requirements or the project cannot proceed.
G	Goal	Secondary goal of the project.
O	Objective	Criteria to be met.
LO	Lower Order	A function that serves as a project input.

Higher order and basic functions provide value, while secondary functions tend to reduce value. The goal of the next job phase is to reduce the impact of secondary functions and thereby enhance project value.

To further clarify the impact of the various functions, the team assigned costs to provide the functions or group of functions indicated by a specific project element using the cost estimate and cost model(s). Where possible, they seek to find the lowest cost, or worth, to perform the function. This is accomplished using published data from other sources or team knowledge obtained from working on other similar projects to establish cost goals and then comparing them to the current costs. By identifying the cost and worth of a function or group of functions, cost/worth ratios were calculated. Cost/worth ratios greater than one indicated that less than optimum value was being provided. Those project functions or elements with high cost/worth ratios became prime targets for value improvement.

As well as looking at areas with high cost/worth ratios, the team used the cost model(s) previously prepared to seek out the areas where most of the project funds are being applied. Because of the absolute magnitude of these high-cost elements or functions, they also became initial targets for value enhancement.

Overall, these exercises stimulated the VE team members to focus on apparently low value areas and initially channel their creative idea development in these places.

Creative Idea Generation Phase

This VE study phase involved the creation and listing of ideas. Starting with the functions or project elements with high cost/worth ratios, a high absolute cost compared to other elements in the project, and secondary functions providing little or no value and using the classic brainstorming technique, the VE team began to generate as many ideas as possible to provide the necessary functions at a lower total life cycle cost, or to improve the quality of the project. Ideas for improving operation and maintenance, reducing project risk, and simplifying constructability were also encouraged. At this stage of the process, the VE team was looking for a large quantity of ideas and free association of ideas. A Creative Idea Listing worksheet was generated and organized by the function or project element being addressed.

The City and AECOM may wish to review these creative lists since they may contain ideas that were not pursued by the VE team but can be further evaluated for potential use in the design.

Evaluation/Judgment of Creative Ideas Phase

Since the goal of the Creative Idea Generation Phase was to conceive as many ideas as possible without regard for technical merit or applicability to the project goals, the Evaluation/Judgment of Creative Ideas Phase focused on identifying those ideas that do respond to the project value objectives and are worthy of additional research and development before being presented to the owner. The selection process consisted of the VE team evaluating the ideas originated during the Creative Idea Generation Phase based on the City's value objectives identified through conversations and the owner's responses to the PVO™ Questionnaire. Based on the team's understanding of the owner's value objectives, each idea was compared with the present design concept, and the advantages and disadvantages of each idea were discussed. How well an idea met the design criteria was also reviewed.

Based on the results of these reviews, the VE team rated the idea by consensus using a scale of 1 to 5, with 5 or 4 indicating an idea with the greatest potential to be technically sound and provide cost savings or improvements in other areas of the project, 3 indicating an idea that provides marginal value but could be used if the project was having budget problems, 2 indicating an idea with a major technical flaw, and 1 indicating an idea that does not respond to project requirements. Generally, ideas rated 4 and 5 are pursued in the next phase and presented to the owner during the Presentation Phase.

The team also used the designation "DS" to indicate a design suggestion, which is an idea that may not have specific quantifiable cost savings but may reduce project risk, improve constructability, help to minimize claims, enhance operability, ease maintenance, reduce schedule time, or enhance project value in other ways. Design suggestions could also increase a project's cost but provide value in areas not currently addressed. These are also developed in the next phase of the VA process.

Alternative Development Phase

In this phase, each highly rated idea was expanded into a workable solution designated as a VE alternative. The development consisted of describing the current design and the alternative solution, preparing a life cycle cost comparison where applicable, describing the advantages and disadvantages of the proposed alternative solution, and writing a brief narrative to compare the original design to the proposed change and provide a rationale for implementing the idea into the design. Sketches and design calculations, where appropriate, were also prepared in this part of the study. The VE alternatives are included in the Study Results section of this report.

Design suggestions include the same information as the alternatives except that no cost analysis is performed. They also are included in the Study Results section.

Presentation Phase

The goals of the last phase of the workshop were to summarize the results of the study, to prepare the draft Summary of Potential Cost Saving worksheets to hand out at the presentation, and to present the key VE alternatives and design suggestions to the City of Portsmouth and the AECOM design team and other interested parties. The presentation was held on August 7, 2014 at the City of Portsmouth's Public Works Department facility. The purpose of the meeting was to provide the attendees with an overview of the suggestions for value enhancement resulting from the VE study and afford them the opportunity to ask questions to clarify specific aspects of the alternatives presented. Procedures for implementing the results of the study were discussed, and arrangements were made for the reviewers of the VE report to contact the VE team in order to obtain further clarifications, if necessary. Draft copies of the Summary of Value Engineering Alternatives worksheets were provided to the owner and design team to facilitate a timely review and speedy implementation of the selected ideas. On August 11, 2014, an electronic file of the developed draft alternatives and design suggestions were transmitted to the City for its use.

POST-WORKSHOP EFFORT

The post-workshop portion of the VE study consisted of the preparation of this VE Study Report. Personnel from the City and the AECOM design team will analyze each alternative and prepare a short response, recommending incorporation of the alternative into the project, offering modifications before implementation, or presenting reasons for rejection. ARCADIS is available at your convenience as you review the alternatives. Please do not hesitate to call on us for clarification or further information as you consider an implementation approach.

Upon completing their reviews, the owner and designer will meet and, by consensus, select VE alternatives and design suggestions to incorporate into the project and provide the VE Facilitator with a copy of the findings with regard to what alternatives were implemented and why and what alternatives were not implemented and why.

VALUE ENGINEERING WORKSHOP AGENDA

ARCADIS U.S., Inc. will conduct a four-day value engineering (VE) study on the proposed City of Portsmouth, New Hampshire Peirce Island Wastewater Treatment Facility Upgrade project during the week of August 4-7, 2014. The project is being designed by AECOM Technical Services, Inc. for the City of Portsmouth and is at the 30% design complete stage of development.

The study will be conducted at the:

City of Portsmouth, New Hampshire
Public Works Department
Training Room
680 Peverly Hill Road
Portsmouth, NH 03801
(603) 766-1421

AECOM will be available to answer questions during the study effort. A suggested outline for the designer's presentation follows the agenda. Representatives from the City are encouraged to attend.

AGENDA

Monday, August 4, 2014

8:30 am - 9:00 am **VE Team Gathers To Review Project**

9:00 am - 9:15 am **Introduction to the Workshop**

Welcome and opening remarks by the City
Team Member Introductions
VE Process, Workshop Organization and Agenda
Objectives of the Workshop

9:15 am - 11:30 pm **Owner's / Designer's Presentation / Information Gathering Phase**

Representatives from the owner and the design team will present information concerning the project, including: project goals; the rationale for the design; criteria for specific areas of study, project constraints and the reasons for the design decisions. Included should be a review and confirmation of the projects' budgets.

11:30 am - 1:00 pm **Site Visit**

The VE team will visit the sites to acquire first-hand knowledge of the sites and surrounding conditions.

1:00 pm - 2:00 pm **Lunch**

2:00 pm - 3:00 pm **Function Analysis Phase**

The VE team will familiarize themselves with the cost model(s) and the project data for each area of study. The cost model(s) will be refined, as necessary. The VE team will perform a function analysis by defining the function of each project element or system in the cost model, selecting the primary or basic functions, and determining the worth, or least cost, to provide the function. Cost / worth or value index ratios will be calculated, and high cost/low worth areas for study identified

3:00 pm - 5:30 pm **Creative Phase**

The team will conduct a brainstorming session and list as many ideas as possible for consideration. The aim is to obtain a large quantity of ideas through free association, by eliminating roadblocks to creativity and deferring judgment. The VE Team Leader will be responsible for developing an idea listing for the team.

<u>Tuesday, August 5, 2014</u>

8:00 am - 10:30 am **Creative Phase** (continued)

10:30 am - 12:00 pm **Evaluation Phase**

The VE team will analyze the ideas listed in the creative phase and select the best ideas based on criteria obtained from the *Project Value Objectives Questionnaire*™ (previously issued to the City for completion) and a discussion of the ideas advantages and disadvantages. This will be accomplished by assigning each idea a *Gut Feel Index* rating between 1 and 5, with 5 being the best, based on the team's consensus of how well the idea meets the noted criteria.

If it is necessary to chose one of several ideas for providing the same function, then the team may engage in an analysis that weighs the various criteria and then uses these weighted criteria to compare each of the alternative ideas prior to making the selection.

The team selects the highly rated ideas for research and development.

Noon - 1:00 pm **Lunch**

1:00 pm - 4:00 pm **Evaluation Phase** (continued)

4:00 pm - 5:30 pm **Development of VE Alternatives Phase**

The VE team will develop creative ideas into alternate designs. Initial and life cycle cost estimates comparing original and proposed alternatives will be prepared. Selected alternatives will be developed and supported with sketches, calculations and written substantiation for change. Suppliers of materials and equipment will be contacted and specialists consulted, as necessary. The VE team leader will describe how the forms used to present the VE alternatives are prepared.

Wednesday, August 6, 2014

8:00 am - 8:15 am **Review Status and Progress of the Team**

The VE team will assess their status and plan for completion of the alternatives development.

8:15 am - 12:00 pm **Development Phase** (continued)

Noon - 1:00 pm **Lunch**

1:00 pm - 5:30 pm **Development Phase** (continued)

Thursday, August 7, 2014

8:00 am - 8:15 am **Review Status and Progress of the Team**

The VE team will assess their status and plan for completion of the alternatives development.

8:15 am - 11:00 am **Development Phase** (continued)

11:00 am - 12:00 pm **Recommendation Phase**

The VE team prepares a summary of the value engineering alternatives with descriptions and initial and life cycle costs for a verbal presentation to representatives of the City and the AECOM design team. *Summary of Value Engineering Alternative* sheets and several copies of the draft alternative details are copied for distribution to VE presentation attendees.

Noon - 1:00 pm **Lunch**

2:00 pm - 3:45 pm **Presentation Phase**

The VE team presents its alternatives to the City of Portsmouth and the AECOM design team and is available to clarify any points.

3:45 pm - 4:00 pm **Implementation Procedures**

The process for accepting / accepting with modification / rejecting the VE alternatives is discussed and a meeting schedule is established to finalize implementation decisions.

4:00 pm **Adjourn**

OUTLINE FOR VE TEAM PRESENTATION

The owner and designers are actively involved in the planning and design of the project to be value engineered. They have spent a great deal of time and effort in developing their design.

However, the design is influenced by outside input from many sources. In order to perform its work most efficiently, the VE team needs to understand the factors that have influenced the design. The object is to avoid duplication of efforts and to aid the team in becoming familiar with the project.

To achieve this objective, the owner and designer are asked to give a presentation at the beginning of the VE workshop session. To assist the owner and designer, we have outlined the information that, as a minimum, should be addressed:

- Scope of the Designer's effort
- Participating firms
- Existing site conditions
- Regulatory requirements
- Basis of design
- Rationale and steps in development of design
- Design concepts for process, chemicals, civil, structural, mechanical, electrical, instrumentation & controls, security, etc.
- Hours of operation - Staffing Plan
- Pertinent information from user participation
- Constraints imposed by the Owner
- Appropriate codes
- Explanation of information provided by the Designer to the VE team
- Summary of cost estimate
- Construction phasing

This information is provided as an outline to aid the owner and designers. The presentation is the owner's and designers' responsibility and they may conduct the initial presentation in the manner they feel most comfortable.

VALUE ENGINEERING WORKSHOP PARTICIPANTS

The VE team was organized to provide specific expertise in the unique project elements involved with the City of Portsmouth, New Hampshire Peirce Island Wastewater Treatment Facility Upgrade project. The multidisciplinary team comprised professionals with wastewater treatment facility planning, design, construction and operations experience and a working knowledge of VE procedures. The following lists the ARCADIS VE team members:

Participant	Specialization
Jennifer Lachmayr, PE	Project Manager
Joseph Husband, PE, BCEE	Process Engineering
Timothy McDonald, PE	Process/Mechanical Engineering
Matt Palte, PE	Structural Engineering
Glenn Myres, PE	Electrical Engineering
David Crawford, RA	Architecture
Michael Kosier, PE	Civil Engineering/Cost/Constructability
Howard Greenfield, PE, CVS	VE Team Leader

DESIGNER'S PRESENTATION

An overview of the project was presented on August 4, 2014 by representatives from the City of Portsmouth and the AECOM design team. The purpose of this meeting, in addition to being an integral part of the Information Phase of the VE study, was to bring the VE team "up to speed" regarding the overall project specifics. Additionally, the meeting afforded the owner and design team the opportunity to highlight in greater detail those areas of the project requiring additional or special attention. An attendance list for the meeting is attached.

Site Visit

A site visit was held following the presentation of the project design.

VALUE ENGINEERING TEAM'S FORMAL PRESENTATION

A formal presentation was conducted by the VE team on August 7, 2014 to review VE alternatives with the owner and representatives from the design team. Copies of the Draft Summary of Value Engineering Alternatives worksheet and VE Alternatives and design suggestions were provided to the attendees. An attendance list for the meeting is attached.

VE STUDY SIGN-IN SHEET

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY**
City of Portsmouth, NH
In-Brief: August 4, 2014 *Out-Brief: August 7, 2014*

IN - BRIEF	OUT-BRIEF	NAME	ORGANIZATION/TITLE	PHONE NUMBER	EMAIL ADDRESS
✓	✓	Howard Greenfield	ARCADIS/VE Team Leader	443-421-0326	hgreenfield@arcadis-us.com
✓	✓	Timothy McDonald	ARCADIS/Process/ Mechanical	914-355-6920	Timothy.mcdonald@arcadis-us.com
✓	✓	Joe Husband	ARCADIS/Process	914-643-5644	Joe.husband@arcadis-us.com
✓	✓	Erik Meserve	AECOM	781-224-6069	Erik.meserve@aecom.com
✓	✓	Jon Pearson	AECOM	781-224-6220	Jon.pearson@aecom.com
✓	✓	Paula Anania	City of Portsmouth	603-817-7610	panania@cityofportsmouth.com
✓	✓	Terry Desmarais	City of Portsmouth	603-828-1915	tldesmarais@cityofportsmouth.com
✓	✓	David Crawford	ARCADIS/Architect	914-641-2855	David.crawford@arcadis-us.com
✓	✓	Matt Palte	ARCADIS/Structural	614-985-9275	Matt.palte@arcadis-us.com
✓	✓	Jennifer Lachmayr	ARCADIS/Project Manager	781-439-5181	Jennifer.lachmayr@arcadis-us.com
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✓	✓	Brian Hilliard	NHDES	603-419-0295	Brian.hilliard@des.nh.gov
✓		Don Chelton	AECOM	781-224-6025	Don.chelton@aecom.com

VE STUDY SIGN-IN SHEET

ARCADIS

PROJECT: **PEIRCE ISLAND WASTEWATER TREATMENT FACILITY**
City of Portsmouth, NH
In-Brief: August 4, 2014 *Out-Brief: August 7, 2014*

✓	✓	Michael Kosier	ARCADIS	518-280-7304	Michael.kosier@arcadis-us.com
✓	✓	Glenn Myres	ARCADIS	614-985-9251	Glenn.myres@arcadis-us.com
✓	✓	Brian Goetz	City of Portsmouth	603-766-1420	bfgoetz@cityofportsmouth.com
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	✓	Mike Merrill	City of Portsmouth	603-957-8558	Mwmerrill@cityofportsmouth.com
	✓	Mike Baker	City of Portsmouth	603-427-1553	mbaker@cityofportsmouth.com
	✓	David Allen	City of Portsmouth	603-610-7276	dsallen@cityofportsmouth.com

ECONOMIC DATA

The comparisons of life cycle costs between the VE alternatives and the current design solutions were performed on the basis of discounted present worth. To accomplish this, the VE team developed economic criteria to use in its calculations based on information gathered from the City of Portsmouth and the design team. The following parameters were used when calculating discounted present worth:

Year of Analysis:	2014
Construction Start Date:	September 2015
Construction Completion Date:	2018
Planning Period (n):	20

When computing capital costs, direct material, labor and equipment costs are marked up using a composite markup of 91.2% that includes:

Design Contingency	20.0%
Contractor, GC, Overhead & Profit	20.0%
Escalation	6.2%
Reduction in Labor Productivity	2.4%
Island Construction Premium	3.0%
Construction Engineering	10.0%
Project Contingency	10.0%

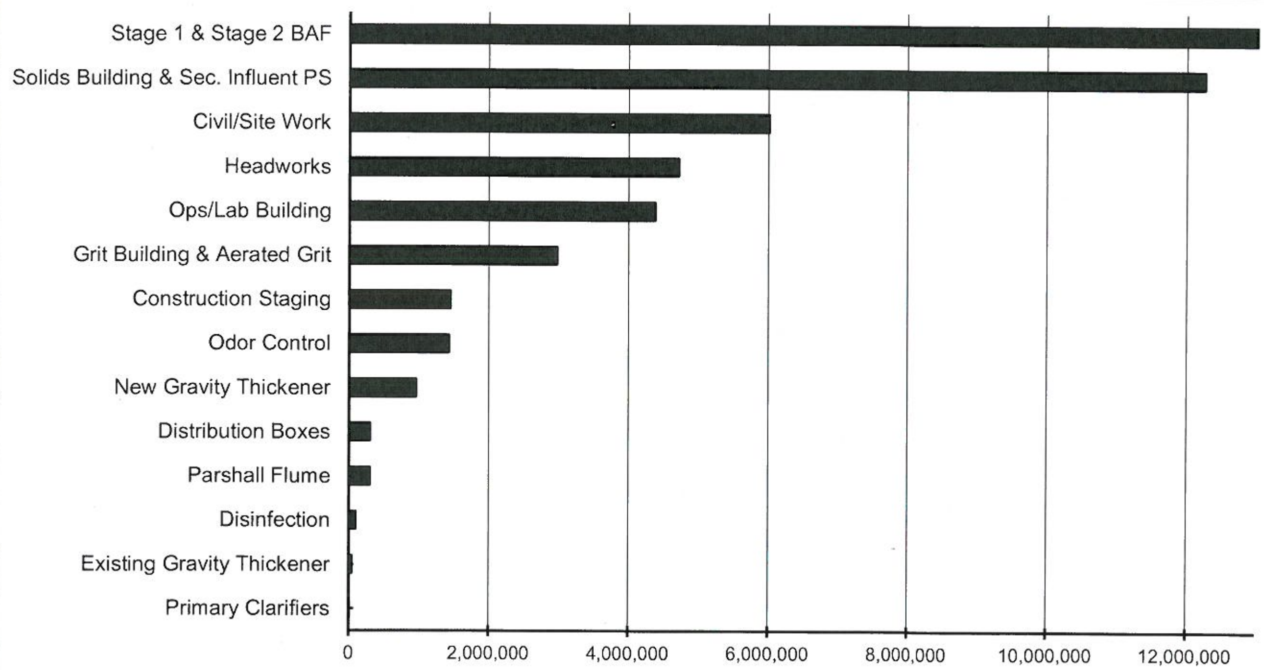
COST MODELS

Two cost models were prepared to assist the VE in its understanding of where the majority of the funds are allocated. The first model is a Cost Histogram which displays the costs by project element in descending order to identify where 80% of the costs lie so that the team makes sure to address these items during the workshop: BAF Building, Headworks Building, Solids Building and Civil Work. The second cost model is a matrix showing the primary specification elements that contribute to the project costs so that the team also addresses these items, specifically concrete, process equipment, site work and electrical equipment.

COST HISTOGRAM

ARCADIS

PROJECT: CITY OF PORTSMOUTH, NH PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE				
PROJECT ELEMENT		**COST**	**PERCENT**	**CUM. PERCENT**
Stage 1 & Stage 2 BAF	82%	33,040,723	48.62%	48.62%
Solids Building & Sec. Influent PS		12,259,724	18.04%	66.66%
Civil/Site Work		6,011,551	8.85%	75.51%
Headworks		4,715,581	6.94%	82.44%
Ops/Lab Building		4,381,019	6.45%	88.89%
Grit Building & Aerated Grit		2,975,450	4.38%	93.27%
Construction Staging		1,444,697	2.13%	95.40%
Odor Control		1,426,764	2.10%	97.50%
New Gravity Thickener		956,092	1.41%	98.90%
Distribution Boxes		300,031	0.44%	99.34%
Parshall Flume		297,853	0.44%	99.78%
Disinfection		98,182	0.14%	99.93%
Existing Gravity Thickener		43,360	0.06%	99.99%
Primary Clarifiers		6,733	0.01%	100.00%
Subtotal		**$ 67,957,760**	**100.00%**	
Reduction in Labor Productivity Due to Offsite Labor		**$ 1,620,000**		
Island Construction Premium	3.00%	**$ 2,040,000**		
Construction Engineering	10.00%	**$ 6,800,000**		
Project Contingency	10.00%	**$ 6,800,000**		
TOTAL		**$ 85,217,760**	**Comp Mark-up:**	25%



Costs in graph are not marked-up.

PEIRCE ISLAND WASTEWATER TREATMENT FACILITY UPGRADE
MATRIX OF FACILITIES AND SPECIFICATION ELEMENTS

Spec. Section \ Element	HEADWORKS	GRIT BUILDING & AERATED GRIT	PRIMARY CLARIFIERS	DISTRIBUTION BOXES	SOLIDS BLDG.& SECONDARY INFLUENT PS	STAGE 1 & STAGE 2 BAF	DISINFECTION	PARSHALL FLUME	ODOR CONTROL	OPS/LAB BUILDING	EXISTING GRAVITY THICKENER	NEW GRAVITY THICKENER	CONSTRUC-TION STAGING	CIVIL/SITE WORK	TOTALS	PERCENTAGE
General	-	-	-	-	160,645	-	-	-	-	-	-	-	-	-	160,645	0.24%
Civil/Site Work	55,946	-	-	223,874	288,346	2,650,682	7,169	207,595	164,819	1,192,854	20,779	117,741	1,444,697	2,932,160	9,306,662	13.68%
Concrete	776,751	6,027	-	14,421	2,000,659	11,200,531	26,609	20,502	24,702	678,417	-	308,925	-	47,984	15,105,528	22.20%
Masonry	345,251	48,777	-	-	487,979	768,703	19,309	-	-	71,202	-	-	-	-	1,741,221	2.56%
Metals	51,129	4,406	-	-	75,484	248,210	-	-	-	72,892	-	84,197	-	-	536,318	0.79%
Plastics	21,159	80,336	-	-	6,724	-	-	-	122,301	-	-	94,473	-	-	324,993	0.48%
Thermal & Moisture Protection	240,570	127,023	-	-	331,088	70,310	-	-	-	85,551	-	19,279	-	-	873,821	1.28%
Doors	41,359	35,620	-	-	58,959	22,427	-	-	-	135,366	-	-	-	-	293,731	0.43%
Finishes	-	24,737	-	-	-	-	-	-	-	21,324	-	-	-	-	46,061	0.07%
Specialties	-	-	-	-	-	-	-	-	-	80,014	-	-	-	-	80,014	0.12%
Equipment	1,179,960	1,093,771	-	58,370	3,418,951	12,256,861	8,805	69,757	756,060	291,587	-	233,256	-	-	19,367,378	28.46%
Furnishings	-	-	-	-	-	-	-	-	-	65,438	-	-	-	-	65,438	0.10%
I&C	100,655	221,099	6,733	3,366	1,080,313	226,868	20,941	-	55,053	784,532	2,872	20,912	-	23,038	2,546,382	3.74%
Conveying Equipment	29,879	175,749	-	-	19,914	21,123	-	-	-	-	-	-	-	-	246,665	0.36%
Electrical	1,214,711	676,575	-	-	1,883,584	1,661,627	15,360	-	110,106	384,309	-	58,314	-	2,972,785	8,977,371	13.19%
Plumbing	63,425	119,785	-	-	95,855	171,946	-	-	-	69,548	-	-	-	-	520,559	0.76%
HVAC	512,910	130,133	-	-	565,472	615,481	-	-	40,437	437,053	-	-	-	-	2,301,486	3.38%
Piping	81,876	327,233	-	-	1,785,749	3,125,955	-	-	153,288	10,932	19,708	18,995	-	35,584	5,559,320	8.17%
TOTALS	**4,715,581**	**3,071,271**	**6,733**	**300,031**	**12,259,722**	**33,040,724**	**98,193**	**297,854**	**1,426,766**	**4,381,019**	**43,359**	**956,092**	**1,444,697**	**6,011,551**	**68,053,593**	**100.00%**
PERCENTAGE	6.9292%	4.5130%	0.0099%	0.4409%	18.0148%	48.5510%	0.1443%	0.4377%	2.0965%	6.4376%	0.0637%	1.4049%	2.1229%	8.8336%	100.0000%	

FUNCTION ANALYSIS

A function analysis of the Peirce Island Wastewater Treatment Facility Upgrade project was prepared to (1) understand the project purpose and need, (2) define the requirements for each project element, (3) ensure a complete and thorough understanding by the VE team of the basic function(s) needed to attain the given project purpose and need, (4) identify other public goals, and (5) identify secondary functions that should be addressed by the VE team.

Function analysis is a means of evaluating a project to see if the expenditures actually perform the requirements of the project, or if there are disproportionate amounts of money spent on support functions. These elements add cost to the final product but have a relatively low worth to the basic function. This creates a high cost-to-worth ratio. Also, this exercise highlights functions which may be underfunded and need additional investment to adequately perform their functions.

A Random Function Analysis worksheets for the project elements is attached. This part of the function analysis stimulated the VE team members to think in terms of the areas in which to channel their creative idea development.

RANDOM FUNCTION ANALYSIS ARCADIS

PROJECT: **PEIRCE ISLAND WWTF UPGRADE**
City of Portsmouth, NH

SHEET NO.: **1 of 2**

DESCRIPTION		FUNCTION		
		VERB	NOUN	KIND
PROJECT FUNCTIONS		Protect	Health	HO
		Protect	Environment	HO
		Remove	Pollutants from Wastewater	B
		Control	Power	B
		Distribute	Power	B
Headworks	**$4.7M**	Remove	Debris	B
		Supply	Power	B
		Remove	Floatables	B
Grit System	**$3.0M**	Remove	Grit	B
		Contain	Odors	S
		Protect	Equipment	S
Primary Clarifiers	**$2.0M**	Remove	Settleable Solids	B
		Remove	Floatables	B
		Contain	Odors	S
Secondary Influent Pump Station	**$3.5M**	Lift	Water	B
Stage 1 BAF	**$33.0M**	Oxidizes	BOD	B
		Oxidizes	Ammonia	B
		Removes	Solids	B
Stage 2 BAF		Remove	Nitrate	B
		Remove	Solids	B
Disinfection	**$0.1M**	Kill	Pathogens	B
		Control	Chlorine Residual	B
Gravity Thickeners	**$1.0M**	Concentrate	Solids	B
		Contain	Odors	S
Sludge Storage Tanks		Store	Sludge	R/S
Odor Control System	**$1.4M**	Remove	Odors	S

Function defined as: Action Verb
Measurable Noun

Kind: B = Basic
S = Secondary
RS = Required Secondary
HO = Higher Order
LO = Lower Order
G = Goal

RANDOM FUNCTION ANALYSIS

ARCADIS

PROJECT: **PEIRCE ISLAND WWTF UPGRADE**
City of Portsmouth, NH

SHEET NO.: **2 of 2**

DESCRIPTION		FUNCTION: VERB	FUNCTION: NOUN	FUNCTION: KIND
Solids Handling	**$7.8M**	Thicken	Solids	B
		Transfer	Solids	B
		Contain	Odors	S
Operations/Laboratory Building	**$4.4M**	Analyze	Process	B
		House	Personnel	R/S
		Store	Chemicals	B
		Store	Maintenance Equipment	B
		Control	Process	B

Function defined as: Action Verb, Measurable Noun

Kind: B = Basic; S = Secondary; RS = Required Secondary; HO = Higher Order; LO = Lower Order; G = Goal

CREATIVE IDEA LISTING AND EVALUATION OF IDEAS

During the Creative Idea Generation Phase, numerous ideas were generated for the Peirce Island Wastewater Treatment Facility Upgrade project using conventional brainstorming techniques. These ideas were recorded and are shown with their corresponding ranking on the attached Creative Idea Listing Worksheets. For the convenience of tracking an idea through the VE process, the ideas were grouped into the following project elements and numbered according to the order in which they were conceived. The following letter prefixes were used to identify the project elements.

PROJECT ELEMENT	PREFIX
Civil/Site Work	CS
Headworks Building	H
BAF Building	BAF
Gravity Thickener	GT
Solids Building	SB
Operations/Laboratory Building	OL
Electrical	E
General	G
Constructability	C

Creative Idea Evaluation

The ideas were then ranked on a qualitative scale of 1 to 5 on how well the VE team believed the idea met the project purpose and need criteria. To assist the team in evaluating the creative ideas, the advantages and disadvantages of each new idea compared to the existing design solution were discussed based on the owner's value objectives for the project/the responses of the owner to the attached PVO Questionnaire™. The following are the top value objectives for this project:

- Capital and LCC cost – effective
- Meets consent order schedule
- Durability
- Sustainability
- Construction impacts (community/traffic)
- Operability
- Constructability
- Aesthetics

After discussing each idea, the team evaluated the ideas by consensus. This produced more than 45 ideas rated 4, 5 or design suggestion to research and develop into formal VE alternatives and design suggestions to be included in the Study Results section of the report. Highly rated ideas that were not developed further may have been combined with another related idea or discarded as a result of additional research indicating the concept as not being cost effective or technically feasible. The reader is encouraged to review the Creative Idea Listing and Evaluation worksheet since it may suggest additional ideas that can be applied to the design.

PROJECT VALUE OBJECTIVES

Project Name: City of Portsmouth, New Hampshire
Peirce Island Wastewater Treatment Facility Upgrade &

Participant: DON CHELTON / JON PEARSON / ERIK MESERVE

Organization: AECOM - DESIGNER

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PROJECT VALUE OBJECTIVES™

VALUE is defined by Webster as: *to rate or scale in usefulness, importance or general worth.* Improving value is a major objective of ARCADIS's value engineering (VE) studies. Value studies improve the design, constructability, and operability of your facility.

In conducting a value study, it is imperative that the value team understand the owner's specific requirements and priorities in undertaking the construction project. In other words, we must answer the question: What *value objectives* must we achieve? For instance, should the designer attempt to win a design award with the project; should materials be able to withstand a mortar attack; should systems be designed for ordinary or continuous usage; should the design be approached as a short-term solution to a problem? In a similar vein, does the owner want to create in the design a certain image that will influence the eventual user? Indeed, each project developer or owner has his own unique set of value objectives.

By clearly understanding your *value objectives*, the value team can better evaluate the ideas it generates based on how well each idea meets to those objectives. Moreover, the ideas generated by the value team will have a greater probability of being implemented by you and your designer because they reflect your specific requirements.

To assist ARCADIS' value team in understanding your *value objectives*, we have developed the following questionnaire. Please complete it prior to the coordination meeting so the Value Engineering Team Leader can discuss it with you.

During the orientation meeting/designers' presentation, the information derived from the questionnaire and the ensuing discussion will be transmitted to the value team, reviewed and made the basis of the evaluation of all ideas generated by the team. As the ideas are evaluated by the value team, their relative impact on the value objectives are appraised by arrows indicating improvement, degradation, or no change.

1. **Aesthetic Value - The aesthetics of the project should be such that:**

- ☐ the project wins a design award
- ☑ the project is pleasing to the general public
- ☐ the project makes a statement about the company, location, institution, etc.
- ☑ the project is pleasing to the board of directors, city council, etc.
- ☐ the facility is strictly utilitarian in nature
- ☐ the project is in compliance with a master plan or architectural theme
- ☐ other____________________________

2. **Durability - The project should be constructed to withstand:**

- ☐ light usage
- ☑ normal wear and tear on this type of facility
- ☐ excessive abuse including vandalism
- ☐ a mortar attack from a terrorist
- ☐ other____________________________

3. **Expected Useful Life - The project should be constructed for an economic planning period of:**

- ☐ under 5 years
- ☐ 5 to 10 years
- ☐ 10 to 20 years
- ☑ 20 to 30 year
- ☐ over 30 years
- ☐ other ____________________

4. **Capital Costs - The project's budget and your ability to meet that budget is:**

- ☐ critical to the project's survival
- ☑ vitally important to financial success
- ☐ flexible if improvements can be made
- ☐ moderately important
- ☐ of little importance
- ☐ other____________________

5. **Life Cycle Costs - The costs of operating and maintaining the facility are:**

- ☐ extremely important to consider
- ☑ to be kept to industry norms
- ☐ slightly important
- ☐ not important
- ☐ other ____________________

6. **Return on Investment - If a choice were to be made between spending money today and saving money over a defined period of time, how long a period of time should it take to save an equal amount of money as being spent today (simple payback period)?**

- ☐ 1 year
- ☐ 3 years
- ☑ 5 years
- ☐ over 5 years
- ☐ other____________

7. **User Concerns - The facility should be designed to accommodate primarily:**

- ☐ the workers in the facility
- ☐ the maintenance and operations staff
- ☐ the using public
- ☐ the equipment it houses
- ☑ all of the above
- ☐ other ____________________

8. **Neighbors - How important is the design of the facility with respect to the approval of those sharing adjacent properties?**

- ☑ extremely important
- ☐ should be considered
- ☐ slightly important
- ☐ of no importance

9. **End User Input - To what degree has the end user been involved in the project's formulation?**

- ☐ little input; A/E has done all the work
- ☑ active participation
- ☐ little interest from end user
- ☐ end user established criteria

10. **Reliability - Construction of the systems within the facility should be such that:**

- ☑ it remains fully operational under all conditions
- ☐ it remains partially operational under all conditions (to be further defined in discussions)
- ☐ it remains fully operational only during normal usage
- ☐ other____

11. **Time - The established date the facility is to be operational is:**

- ☐ critical and must be achieved
- ☐ critical and should be advanced if at all possible
- ☑ critical for part of the project and of nominal importance for other parts of the project (to be discussed later)
- ☐ moderately flexible
- ☐ totally flexible
- ☐ other ____

12. **Time vs. Money - If there were a choice between saving significant construction cost (5% or more) at the expense of delaying the completion date, how long of a delay is acceptable?**

- ☑ none
- ☐ one month
- ☐ two months
- ☐ six months
- ☐ more than six months

13. **Ease of Operation - The facility should be designed to be operated by:**

- ☐ unskilled labor
- ☐ highly skilled professionals
- ☑ skilled labor
- ☐ other____________________

14. **Safety - The degree to which safety features of the facility should affect the design is:**

- ☑ meet current industry norms
- ☐ facility has a tendency to be abused
- ☐ design must make users feel totally safe
- ☐ other______________________________

15. **Use this space for other objectives.**

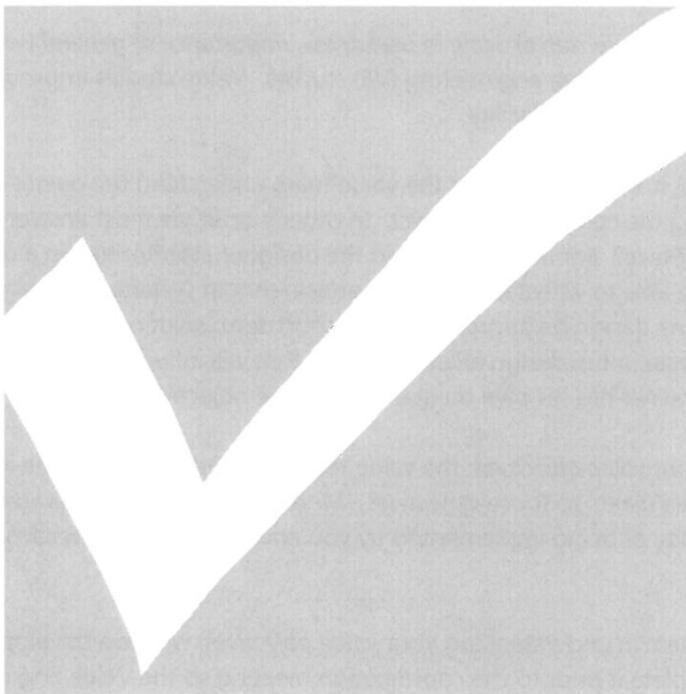
- ☐ ________________________________
- ☐ ________________________________

16. **Please indicate your top 5 value objects in constructing this project.**

____aesthetics	____durability	____expected life
__✓__capital costs	____life cycle costs	____return on investment
____convenience	____neighbors	____end user input

__✓__reliability __✓__time ____time vs. money
__✓__ease of operation __✓__safety ____other____________________

PROJECT VALUE OBJECTIVES



Project Name: City of Portsmouth, New Hampshire
Peirce Island Wastewater Treatment Facility Upgrade &

Participant: Brian Goetz

Organization: City of Portsmouth

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PROJECT VALUE OBJECTIVES™

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- ☐ the project makes a statement about the company, location, institution, etc.
- ☐ the project is pleasing to the board of directors, city council, etc.
- ☐ the facility is strictly utilitarian in nature
- ☐ the project is in compliance with a master plan or architectural theme
- ☒ other with Sustainable components at the forefront

2. Durability - The project should be constructed to withstand:

- ☐ light usage
- ☐ normal wear and tear on this type of facility
- ☐ excessive abuse including vandalism
- ☐ a mortar attack from a terrorist
- ☐ other________________________

3. **Expected Useful Life - The project should be constructed for an economic planning period of:**

- ☐ under 5 years
- ☐ 5 to 10 years
- ☐ 10 to 20 years
- ☐ 20 to 30 year
- ☒ over 30 years
- ☐ other ______

4. **Capital Costs - The project's budget and your ability to meet that budget is:**

- ☐ critical to the project's survival
- ☒ vitally important to financial success
- ☐ flexible if improvements can be made
- ☐ moderately important
- ☐ of little importance
- ☒ other Already growing beyond initial estimates

5. **Life Cycle Costs - The costs of operating and maintaining the facility are:**

- ☒ extremely important to consider
- ☐ to be kept to industry norms
- ☐ slightly important
- ☐ not important
- ☐ other Life cycle sustainability – carbon footprint – Operational staffing efficiency

6. **Return on Investment - If a choice were to be made between spending money today and saving money over a defined period of time, how long a period of time should it take to save an equal amount of money as being spent today (simple payback period)?**

- ☐ 1 year
- ☐ 3 years
- ☐ 5 years
- ☐ over 5 years
- ☒ other Looking @ 30 yr. bonding TO spread a good portion of capital costs

7. **User Concerns - The facility should be designed to accommodate primarily:**

- ☐ the workers in the facility
- ☐ the maintenance and operations staff
- ☐ the using public
- ☐ the equipment it houses
- ☒ all of the above
- ☐ other ______

8. **Neighbors - How important is the design of the facility with respect to the approval of those sharing adjacent properties?**

- ☒ extremely important
- ☐ should be considered
- ☐ slightly important
- ☐ of no importance

9. **End User Input - To what degree has the end user been involved in the project's formulation?**

- ☐ little input; A/E has done all the work
- ☒ active participation → Very high profile project on many fronts
- ☐ little interest from end user
- ☐ end user established criteria

10. Reliability - Construction of the systems within the facility should be such that:

- ☐ it remains fully operational under all conditions
- ☒ it remains partially operational under all conditions (to be further defined in discussions)
- ☐ it remains fully operational only during normal usage
- ☐ other____________________

11. Time - The established date the facility is to be operational is:

- ☒ critical and must be achieved
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- ☐ moderately flexible
- ☐ totally flexible
- ☐ other ____________________

12. Time vs. Money - If there were a choice between saving significant construction cost (5% or more) at the expense of delaying the completion date, how long of a delay is acceptable?

- ☒ none
- ☐ one month
- ☐ two months
- ☐ six months
- ☐ more than six months

13. Ease of Operation - The facility should be designed to be operated by:

- ☐ unskilled labor
- ☐ highly skilled professionals
- ☒ skilled labor
- ☐ other A totally new treatment scheme will require significant staff training and the ability to attract new skilled employees as staff turns over.

14. Safety - The degree to which safety features of the facility should affect the design is:

- ☒ meet current industry norms
- ☐ facility has a tendency to be abused
- ☐ design must make users feel totally safe
- ☐ other____________________

15. Use this space for other objectives.

- ☒ Integrates into the Island
- ☒ meets City's Sustainability goals
- ☒ limits vehicle trips

16. Please indicate your top 5 value objects in constructing this project.

____aesthetics	3 durability	~~5 expected life~~	2 sustainability
____capital costs	1 life cycle costs	____return on investment	
____convenience	4 neighbors	____end user input	

4 ease of operation

____reliability ____time ____time vs. money
____ease of operation ____safety ____other____________________

PROJECT VALUE OBJECTIVES

Project Name: City of Portsmouth, New Hampshire
Peirce Island Wastewater Treatment Facility Upgrade &

Participant: Terry Desmarais & Paula Anania

Organization: City

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PROJECT VALUE OBJECTIVES ™

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- ☒ the project is pleasing to the board of directors, city council, etc.
- ☐ the facility is strictly utilitarian in nature
- ☐ the project is in compliance with a master plan or architectural theme
- ☐ other____________________

2. **Durability - The project should be constructed to withstand:**

- ☐ light usage
- ☒ normal wear and tear on this type of facility
- ☐ excessive abuse including vandalism
- ☐ a mortar attack from a terrorist
- ☐ other____________________

3. **Expected Useful Life - The project should be constructed for an economic planning period of:**

- ☐ under 5 years
- ☐ 5 to 10 years
- ☐ 10 to 20 years
- ☒ 20 to 30 year equipment
- ☐ over 30 years
- ☒ other over 50 for structures

4. **Capital Costs - The project's budget and your ability to meet that budget is:**

- ☐ critical to the project's survival
- ☐ vitally important to financial success
- ☐ flexible if improvements can be made
- ☐ moderately important
- ☐ of little importance
- ☒ other CO requires work be done - currently $15m over CIP

5. **Life Cycle Costs - The costs of operating and maintaining the facility are:**

- ☒ extremely important to consider
- ☐ to be kept to industry norms
- ☐ slightly important
- ☐ not important
- ☐ other ______

6. **Return on Investment - If a choice were to be made between spending money today and saving money over a defined period of time, how long a period of time should it take to save an equal amount of money as being spent today (simple payback period)?**

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- ☐ 3 years
- ☐ 5 years
- ☒ over 5 years
- ☐ other______

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- ☐ the workers in the facility
- ☒ the maintenance and operations staff
- ☐ the using public
- ☐ the equipment it houses
- ☐ all of the above
- ☐ other ______

8. **Neighbors - How important is the design of the facility with respect to the approval of those sharing adjacent properties?**

- ☐ extremely important
- ☒ should be considered
- ☐ slightly important
- ☐ of no importance

On island

9. **End User Input - To what degree has the end user been involved in the project's formulation?**

- ☐ little input; A/E has done all the work
- ☒ active participation
- ☐ little interest from end user
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☐ it remains partially operational under all conditions (to be further defined in discussions)
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☐ other____________________________________

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☒ critical and must be achieved
☐ critical and should be advanced if at all possible
☐ critical for part of the project and of nominal importance for other parts of the project (to be discussed later)
☐ moderately flexible
☐ totally flexible
☒ other Consent Decree schedule

12. Time vs. Money - If there were a choice between saving significant construction cost (5% or more) at the expense of delaying the completion date, how long of a delay is acceptable?

☒ none w/respect to BAF
☐ one month
☒ two months w/respect to non-CD items
☐ six months
☐ more than six months

13. Ease of Operation - The facility should be designed to be operated by:

☐ unskilled labor
☐ highly skilled professionals
☒ skilled labor
☐ other____________________

14. Safety - The degree to which safety features of the facility should affect the design is:

☒ meet current industry norms
☐ facility has a tendency to be abused
☐ design must make users feel totally safe
☐ other__________________________

15. Use this space for other objectives.

☒ Limited space prevents use for other objectives
☐ ________________________________

16. Please indicate your top 5 value objects in constructing this project.

____aesthetics
_X_capital costs
____convenience
_X_durability
_X_life cycle costs
_X_neighbors
____expected life
____return on investment
_X_end user input

are →

↳ recreational users

____reliability ____time ____time vs. money
__X__ease of operation ____safety ____other____________________

CREATIVE IDEA LISTING

ARCADIS

PROJECT:	PEIRCE ISLAND WWTF UPGRADE *City of Portsmouth, NH*	SHEET NO.:	1 of 4

NO.	IDEA DESCRIPTION	RATING
CONSTRUCTABILITY (C)		
C-1	Use a hybrid of above and below ground electrical power feed	4
C-2	Allow contractor to use pool parking lot during off season	DS
C-3	Reduce use of flagmen during pool off-season by restricting road access before pool	4
C-4	In summer, limit construction to nighttime	2
C-5	Use a temporary light to control traffic at pool	Combine with C-3
C-6	Use a separate early contract for below ground utilities at plant	2
C-7	Provide better access to plant	5
C-8	Allow night shift work with a limit on trucks accessing site	DS
C-9	Relocate road fence – offset from road	DS
C-10	Reuse removed site fencing for temporary fencing	3
C-11	Allow contractor to install a snow melt machine and use snow storage area year round	DS
C-12	Allow the use of barges or dock for storage of materials	DS
C-13	Retain precast concrete plank from existing filter building for reuse	2
C-14	Consolidate storage areas	4
C-15	Place chemical storage tanks on top of chlorine contact tanks	1
ELECTRICAL (E)		
E-1	Use two transformers located closer to load centers	2
E-2	Use closed transition automatic transfer switch	DS
E-3	Use an above ground diesel storage tank in lieu of below grade	DS
E-4	Reduce size of transformer ATS and generator	5
E-5	Reuse existing transformer run overhead power to it (a) run underground power to IT (b)	5
E-6	Develop an electrical demand management plan	DS
E-7	Check alternative electric utility rate schedule	DS

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CREATIVE IDEA LISTING

ARCADIS

PROJECT:	PEIRCE ISLAND WWTF UPGRADE *City of Portsmouth, NH*	SHEET NO.: 2 of 4

NO.	IDEA DESCRIPTION	RATING
HEADWORKS BUILDING (H)		
H-1	Use metal deck and steel bar joists roof system	4
H-2	Use one roof height	4
H-3	Move electrical room	3
H-4	Use a single wythe in lieu of double wythe wall construction	See Others
H-5	Stop brick just above grade	3
H-6	Use block in lieu of cast-in-place concrete for perimeter wall	ABD
H-7	Use precast concrete for roof in lieu of cast-in-place concrete	5
H-8	Use precast concrete for walls in lieu of brick	See Others
H-9	Use cast-in-place concrete with a brick from liner for walls	2
H-10	Use skylights over screens in lieu of monorails and lower roof height	3
H-11	Use portable A-frame in lieu of monorails and lower roof height	4
H-12	Narrow screen room	See Others
H-13	Place screens on outside channels	2
H-14	Center inlet pipe between screens	DS
H-15	Place screens outdoors	1
H-16	Move generator outdoors in its own enclosure and reduce the size of the building	4
BAF		
BAF-1	Turn building 180° and terrace the roof levels and raise the basement level	2
BAF-2	Raise the basement level and reduce the rock elevation	4
BAF-3	Use form liner and concrete façade in lieu of brick	See Others
BAF-4	Use jumbo brick façade in lieu of normal brick	See Others
BAF-5	Use single wythe construction in lieu of double wythe	See Others
BAF-6	Reduce the height of Stage 1 mudwell	4
BAF-7	Combine mudwells	2
BAF-8	Align treatment cells to 3x3 and expand the building to the south	1
BAF-9	Retain parts of the existing structure as practical	4
BAF-10	Use crystalline concrete admixture in water containing areas	DS

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CREATIVE IDEA LISTING

ARCADIS

PROJECT:	**PEIRCE ISLAND WWTF UPGRADE** *City of Portsmouth, NH*	SHEET NO.:	**3 of 4**

NO.	IDEA DESCRIPTION	RATING
BAF (cont'd)		
BAF-11	Reconfigure mudwells to reduce rock excavation	See BAF-6
BAF-12	Move electrical room to create a rectangular building	2
BAF-13	Use a plain concrete structure in lieu of brick veneer	Combine with BAF-3
BAF-14	Use concrete block walls in lieu of cast-in-place concrete for electrical room	See Others
BAF-15	Provide flexibility to bypass BAF 2 with some BAF 1 effluent	DS
BAF-16	Change some piping from 316 L stainless steel to carbon steel or galvanized steel	DS
BAF-17	Revise air release piping	DS
BAF-18	Eliminate expansion joint	DS
OPERATIONS/LABORATORY BUILDING (OL)		
OL-1	Use alternate roof system	ABD
OL-2	Provide for equipment removal	DS
OL-3	Reuse existing slab for new building	3
OL-4	Combine operations/laboratory building solids building	2
OL-5	Incorporate wheelchair left into the building	DS
OL-6	Move administration/laboratory area to second floor of headworks and reuse bottom of existing building for chemical storage, encapsulate PCBs	See Others
OL-7	Reuse existing building by encapsulating PCBs	4
OL-8	Place operations/laboratory building at front of site and reuse old building for chemical storage	See Others
OL-9	Reuse existing laboratory equipment	DS
CIVIL/SITE WORK (CS)		
CS-1	Reuse asphalt for new pavement	2
CS-2	Use demolished concrete for rip rap	DS
CS-3	Reuse materials to be demolished on this project – brick, pipe, valves, pumps, etc. or off-site	DS
CS-4	Require a construction waste management plan	DS

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CREATIVE IDEA LISTING

ARCADIS

PROJECT:	PEIRCE ISLAND WWTF UPGRADE *City of Portsmouth, NH*	SHEET NO.:	4 of 4

NO.	IDEA DESCRIPTION	RATING
CIVIL/SITEWORK (CS)		
CS-5	Reduce or eliminate temporary influent bypass by going under the building or moving the building	4
CS-6	Make loop road capable of accommodating a semi	DS
CS-7	Eliminate granite curbs	4
SOLIDS BUILDING (SB)		
SB-1	Use centrifuges in lieu of screw presses	3
SB-2	Use single wythe wall construction	Combine with Others
SB-3	Use precast concrete roof structure in lieu of cast-in-place concrete	5
SB-4	Use jumbo brick in lieu of standard brick	Combine with Others
SB-5	Use precast concrete walls	Combine with Others
SB-6	Use a submersible pump station in lieu of dry pit submersible pump station and relocate	4
GRAVITY THICKENER (GT)		
GT-1	Use flat cover in lieu of dome cover	5
GT-2	Slope foundation in lieu of using grout to create slope	5
GT-3	Enlarge new gravity thickener and do not modify existing gravity thickener	2
GENERAL (G)		
G-1	Combine headworks with operations building and reduce the size of the headworks building	5
G-2	Use precast concrete walls	5
G-3	Use jumbo brick walls	5
G-4	Use single wythe walls	4

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