

HELLO!

CHRIS BENEDICT, R.A.
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LINDEN GROVE

223 LINDEN STREET, BROOKLYN, NY

DEVELOPER: GILBANE + BLUE SEA DEVELOPMENT

ARCHITECT: CHRIS BENEDICT, R.A.

STRUCTURAL ENGINEER: MURRAY ENGINEERING

ELECTRICAL, PLUMBING, FIRE ALARM, SPRINKLER:

MECHANICAL: CHRIS BENEDICT, R.A.

153 APARTMENTS FOR SENIORS

13 STORIES

MODULAR CONSTRUCTION

100% ELECTRIC

PASSIVE HOUSE CERTIFIED



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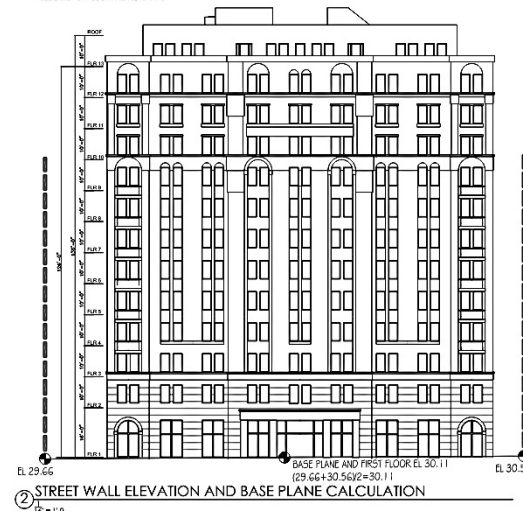
ZONING ANALYSIS - LINDEN GROVE	
BOROUGH	BROOKLYN
BLOCK	3325
LOT	1 AND NEW TAX LOT 60
ZONING MAP	13b
ZONING DISTRICT	R6 with C2-3 overlay
TAX LOT AREA, LOT 1	104,550
NEW TAX 60 LOT AREA	15,450
COMBINED LOTS (ZONING LOT)	120,000
EXISTING BUILDINGS FOOTPRINT	357.16
EXISTING BUILDINGS FLOOR AREA	107,148
NEW BUILDING FOOTPRINT	8092.5
NEW BUILDING FLOOR AREA	100000
BUILDING CODE OCCUPANCY GROUP	FIRST FLOOR: B AND R-2 SECOND-THIRTEENTH FLR:R2
CONSTRUCTION CLASSIFICATION	1B

[illegible]

I GROVE
BROOKLYN NY 11221

[illegible]

TONING ANALYSIS - SQUARE FOOTAGES				UNIT COUNT				
FLOOR	GROSS FLOOR AREA	LESS FLOOR AREA FOR STAIRS	COM FACILITY FLOOR AREA	FLOOR	STUDIO	1	2	TOTAL
1	8092.5	8092.5	0	1	0	0	0	0
2	8092.5	8092.5	0	2	0	0	0	0
3	8092.5	8092.5	0	3	0	0	0	0
4	8092.5	8092.5	0	4	10	4	0	0
5	8092.5	8092.5	0	5	10	4	0	0
6	8092.5	8092.5	0	6	10	4	0	0
7	8092.5	8092.5	0	7	10	4	0	0
8	8092.5	8092.5	0	8	10	4	0	0
9	8092.5	8092.5	0	9	10	4	0	0
10	8092.5	8092.5	0	10	10	4	0	0
11	8092.5	8092.5	0	11	10	4	0	0
12	8092.5	8092.5	0	12	10	4	0	0
13	2890	2890	0	13	0	0	0	0
TOTAL	110000	108002	1998	TOTAL	139	43	1	151



ISSUES WITH FLOOR/CEILING THICKNESS AND SETBACKS WERE RESOLVED BY RECEIVING A MAYORAL OVERRIDE

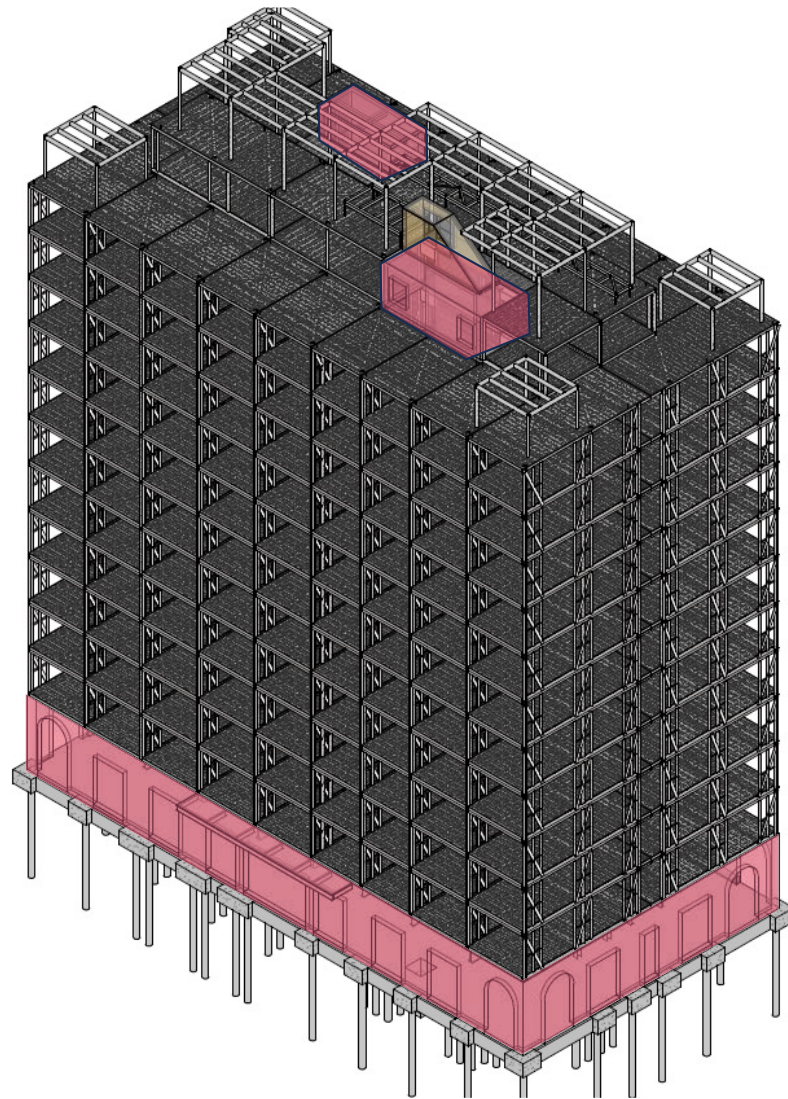
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BLUE SEA DEVELOPMENT/GILBANE



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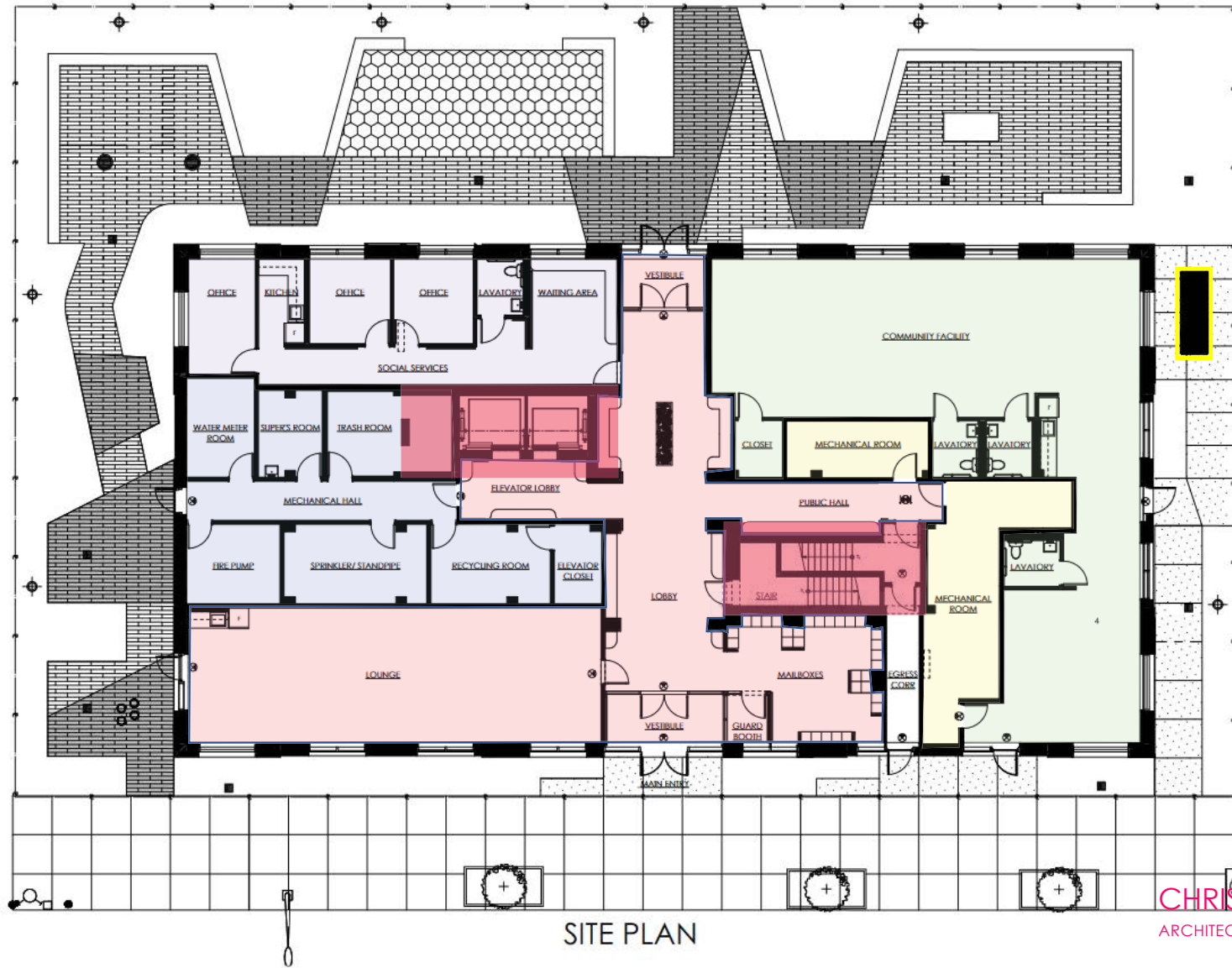


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SITE PLAN

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LINDEN GROVE TYPICAL FLOOR PLAN

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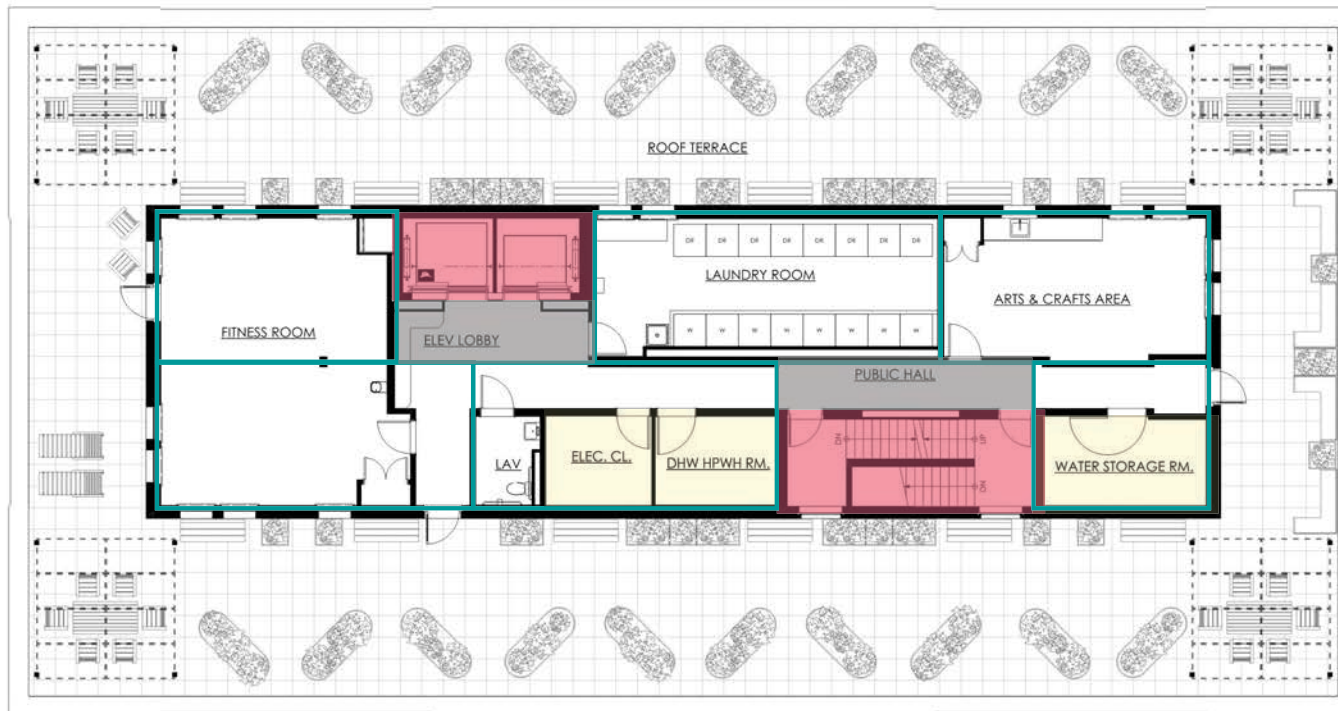
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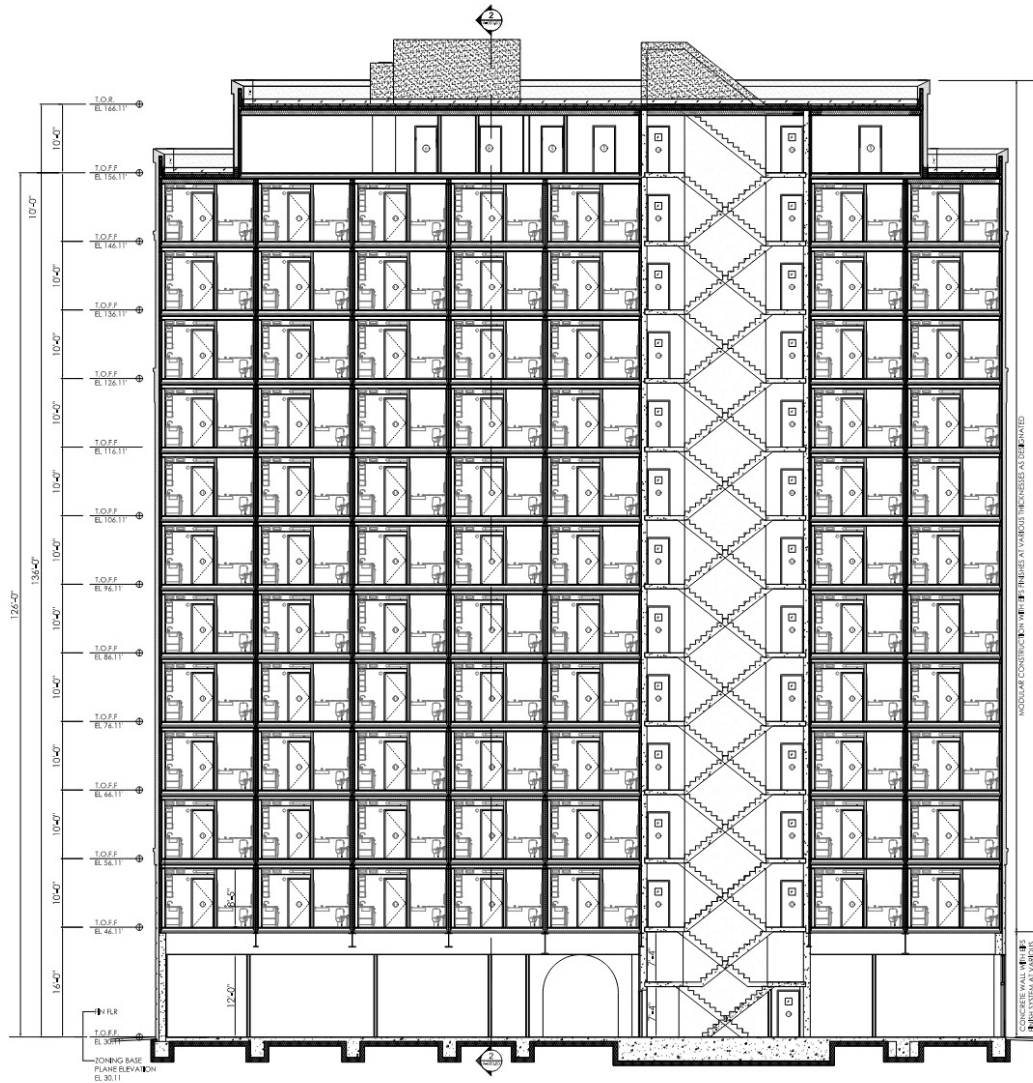
LINDEN GROVE 12TH FLOOR PLAN

BLUE SEA DEVELOPMENT/GILBANE

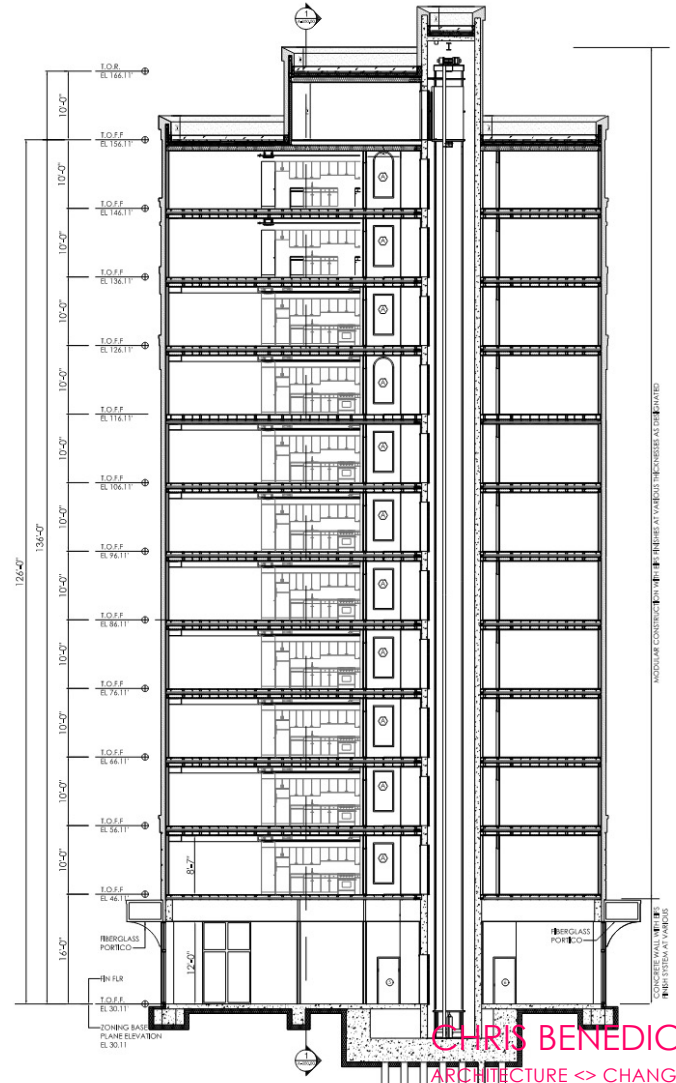
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LINDEN GROVE 13TH FLOOR PLAN

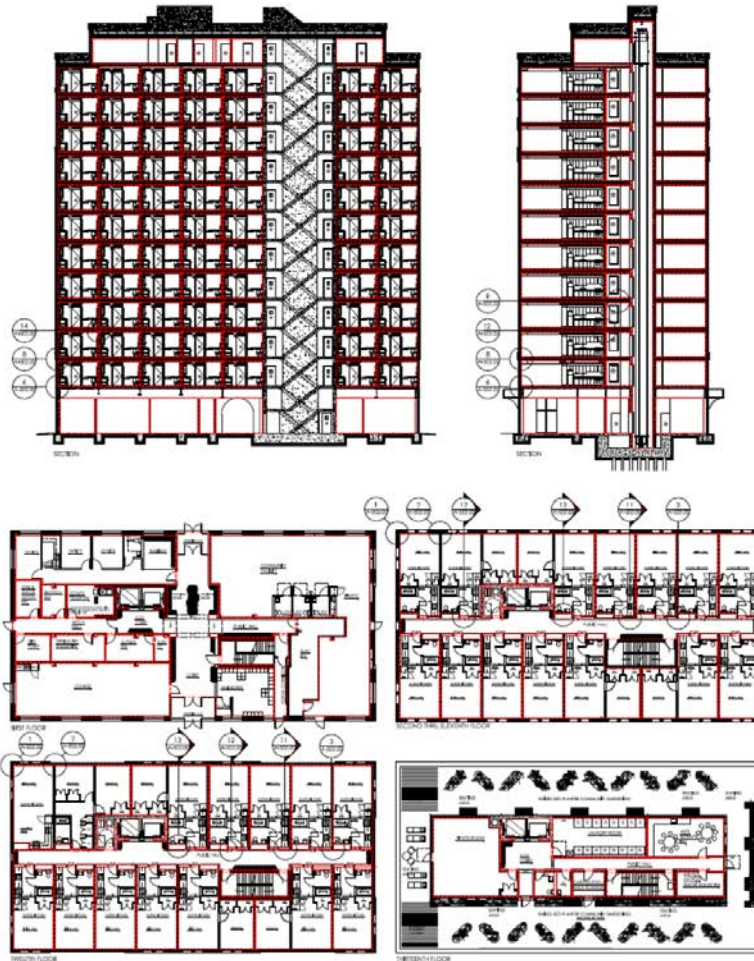


1 LONGITUDINAL SECTION THROUGH STAIR
SCALE: 1/8" = 1'-0"



2 TRANSVERSE SECTION
SCALE: 1/8" = 1'-0"

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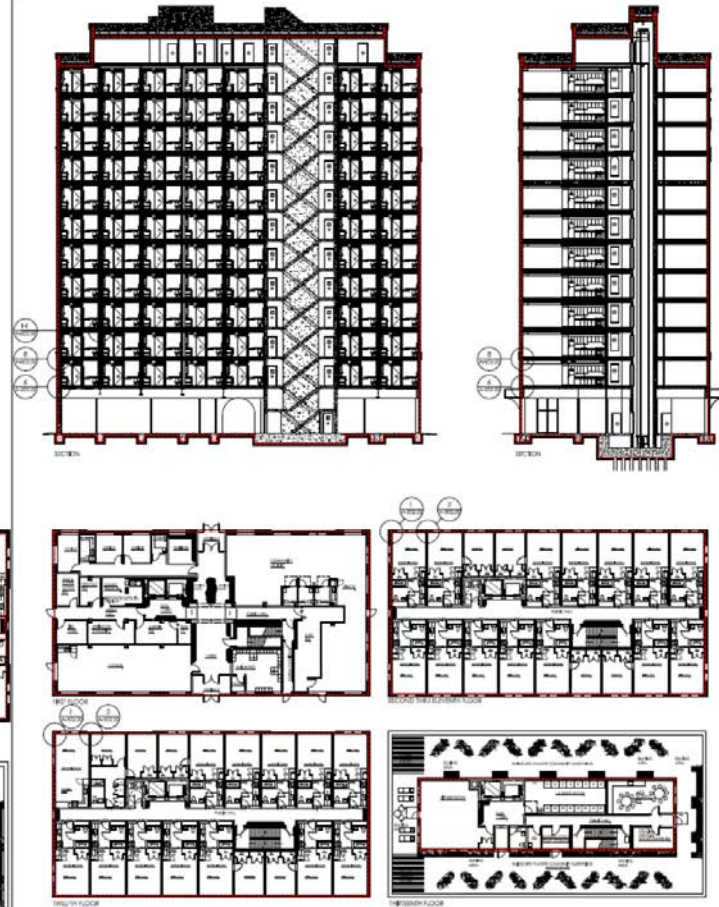


COMPARTMENTALIZATION

GENERAL FIRE-RISK ANALYSIS: FIRE-RISK ANALYSIS: IN ACCORDANCE TO CAUSE AND SEPARATION OF FIRE AT WINDOWS AND DOORS. CONSTRUCTION JOINTS AND PENETRATIONS MUST BE SEALED FOR SOUND ATTENUATION AND FIRE STOPPING. FOLLOW DETAILS SHOWN IN THIS DOCUMENT.

SEE SHEET 4401-01-01 AND 4401-01-02 FOR ADDITIONAL INFO AND DETAILS.

BLUE SEA DEVELOPMENT/GILBANE



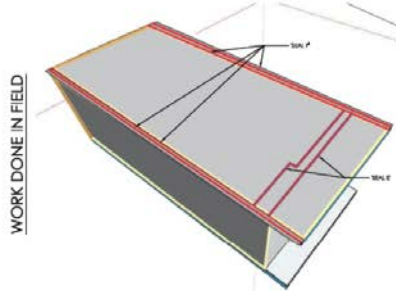
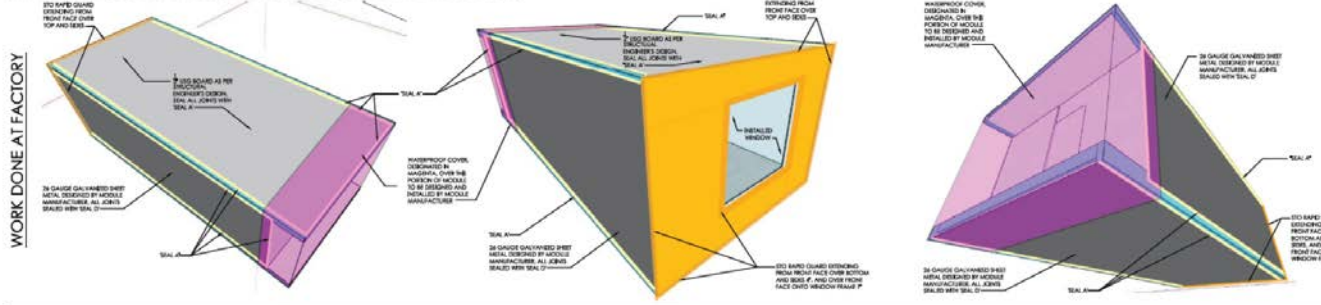
EXTERIOR AIR BARRIER

GENERAL FIRE-RISK ANALYSIS: FIRE-RISK ANALYSIS: IN ACCORDANCE TO CAUSE AND SEPARATION OF FIRE AT WINDOWS AND DOORS. CONSTRUCTION JOINTS AND PENETRATIONS MUST BE SEALED FOR SOUND ATTENUATION AND FIRE STOPPING. FOLLOW DETAILS SHOWN IN THIS DOCUMENT AND MANUFACTURER'S REQUIREMENTS FOR ETC. BE INCLUDING THE APPLICATION OF JOINT SEALANT, AND JOINT SEALANT.

SEE SHEET 4401-01-01 AND 4401-01-02 FOR ADDITIONAL INFO AND DETAILS.

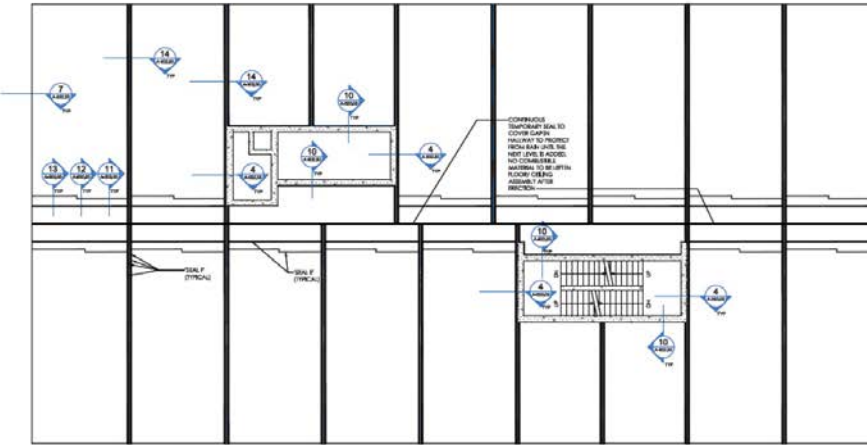
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THREE DIMENSIONAL AIR BLOCKAGE AND COMPARTMENTALIZATION



SEALANT SCHEDULE

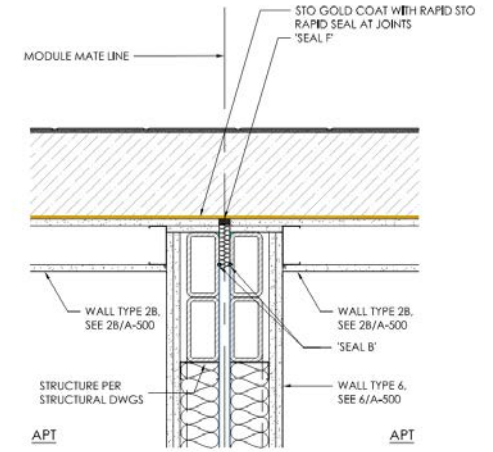
NAME	TYPE	WHEN AND WHERE INSTALLED
SEAL A	PECORA AC-20	WHEN INSTALLING CEMENT BOARD OVER MODULE IN FACTORY
SEAL B	PECORA AC-20	WHEN INSTALLING WATERPROOF JACKET OVER MODULE IN FACTORY
SEAL C	ACRYLIC ACoustical	DURING CONSTRUCTION OF MODULE IN FACTORY
SEAL D	DESIGN POLYMERIC 1030	WHEN INSTALLING WATERPROOF JACKET OVER MODULE IN FACTORY
SEAL E	1 1/2" FOAM MARINOWARE HOT ROD	PRIOR TO DROPPING MODULE ON STACK IN FIELD
SEAL F	HILTI CP 606	PRIOR TO DROPPING MODULE ON STACK IN FIELD



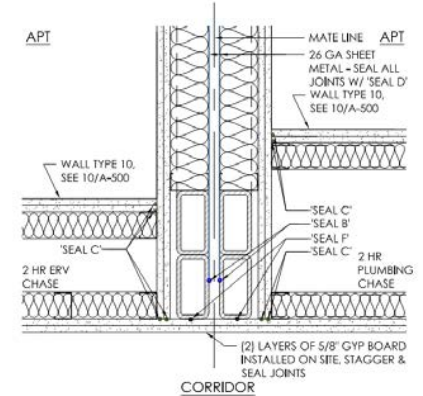
① LAYOUT OF SEALANTS PRIOR TO NEXT LEVEL INSTALLATION

AFTER MODULE STACKING:

FOLLOW DETAILS ON A-502 TO CREATE A CONTINUOUS AIR BARRIER ON THE FACADE FACES. THE STRUCTURE SHALL BE COMPLETELY COVERED WITH STG GOLD COAT, WITH STG RAPID GUARD COVERING ALL GAPS INCLUDING: BETWEEN MODULES HORIZONTALLY AND VERTICALLY AROUND ALL WINDOW AND DOOR OPENINGS AROUND ALL STRUCTURAL PLATES



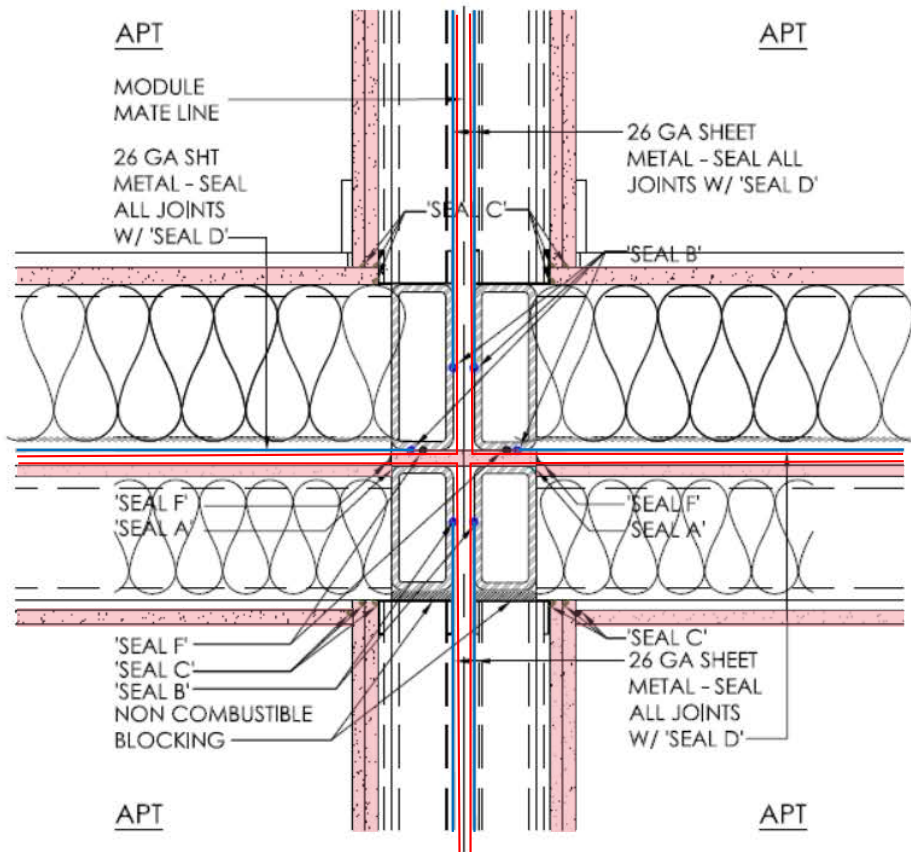
② TYP. JOINT (PLAN) BUILDING EXTERIOR MODULE TO MODULE CONNECTION SCALE: 1-1/2" = 1'-0"



③ TYP. JOINT (PLAN) MODULE TO MODULE CONNECTION @ CORRIDOR WALL SCALE: 1-1/2" = 1'-0"

BLUE SEAR DEVELOPMENT/GRANITE

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SEALANT SCHEDULE

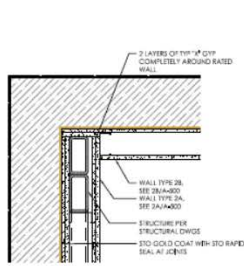
NAME	TYPE	WHEN AND WHERE INSTALLED
'SEAL A'	PECORA AC-20	WHEN INSTALLING CEMENT BOARD OVER MODULE IN FACTORY
'SEAL B'	PECORA AC-20	WHEN INSTALLING WATERPROOF JACKET OVER MODULE IN FACTORY
'SEAL C'	ACRYLIC ACCOUSTICAL	DURING CONSTRUCTION OF MODULE IN FACTORY
'SEAL D'	DESIGN POLYMERICS 1030	WHEN INSTALLING WATERPROOF JACKET OVER MODULE IN FACTORY
'SEAL E'	1"x1" FOAM MARINOWARE HOT ROD	PRIOR TO DROPPING MODULE ON STACK IN FIELD
'SEAL F'	HILTI CP 606	PRIOR TO DROPPING MODULE ON STACK IN FIELD

TYP. JOINT (SECTION)
INT. OF FOUR MODULES

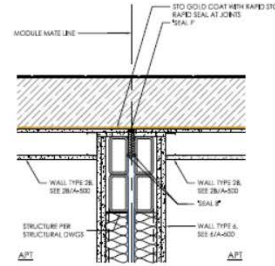
SCALE: 1-1/2" = 1'-0"

14

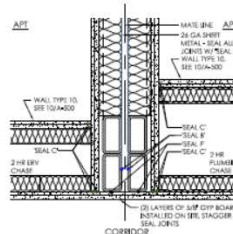
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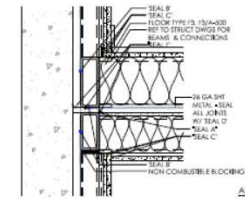
1 TYP. JOINT (PLAN)
BUILDING EXTERIOR CORNER
SCALE: 1/12" = 1'-0"



2 TYP. JOINT (PLAN)
BUILDING EXTERIOR MODULE TO MODULE CONNECTION
SCALE: 1/12" = 1'-0"

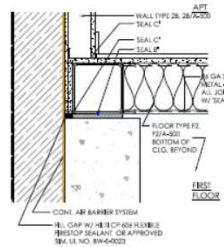


3 TYP. JOINT (PLAN)
MODULE TO MODULE CONNECTION @ CORRIDOR WALL
SCALE: 1/12" = 1'-0"

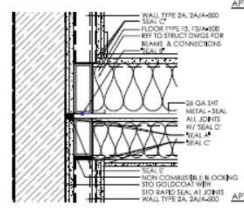


4 TYP. JOINT (SECTION)
NEXT TO ELEVATOR OR STAIRWELL
SCALE: 1/12" = 1'-0"

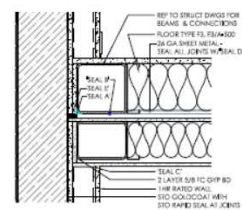
5 NOT USED
SCALE: 1/12" = 1'-0"



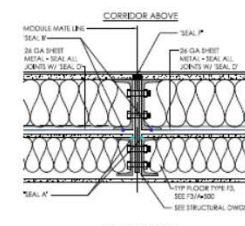
6 TYP. JOINT (SECTION)
EXT. MODULE FLOOR BEAM @ CONC. BEARING WALL
SCALE: 1/12" = 1'-0"



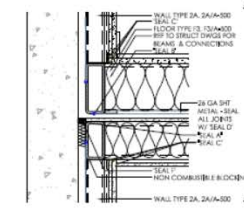
7 TYP. JOINT (SECTION)
EXT. MODULE TO MODULE VERTICAL SEAM
SCALE: 1/12" = 1'-0"



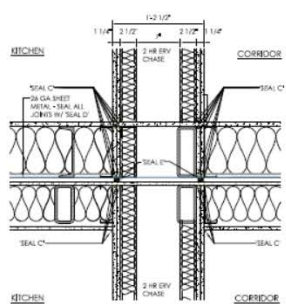
8 TYP. JOINT (SECTION)
EXT. MODULE TO MODULE VERTICAL SEAM
SCALE: 1/12" = 1'-0"



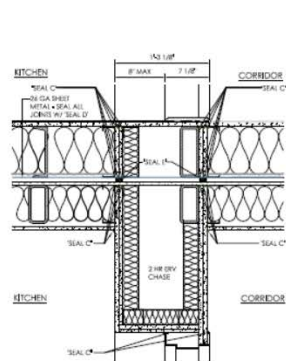
9 TYP. JOINT (SECTION)
MODULE TO MODULE @ CENTER OF CORRIDOR
SCALE: 1/12" = 1'-0"



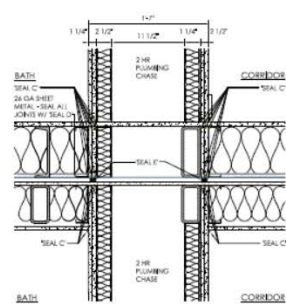
10 TYP. JOINT (SECTION)
MODULE NEXT TO ELEVATOR OR STAIRWELL
SCALE: 1/12" = 1'-0"



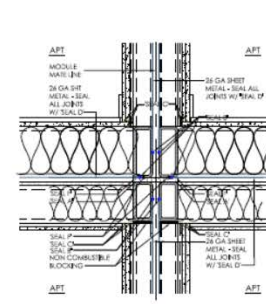
11 TYP. JOINT (SECTION)
INT. MODULE TO MODULE @ NON-BEARING PARTITION
SCALE: 1/12" = 1'-0"



12 TYP. JOINT (SECTION)
INT. MODULE TO MODULE @ APT. ENTRY DOOR
SCALE: 1/12" = 1'-0"



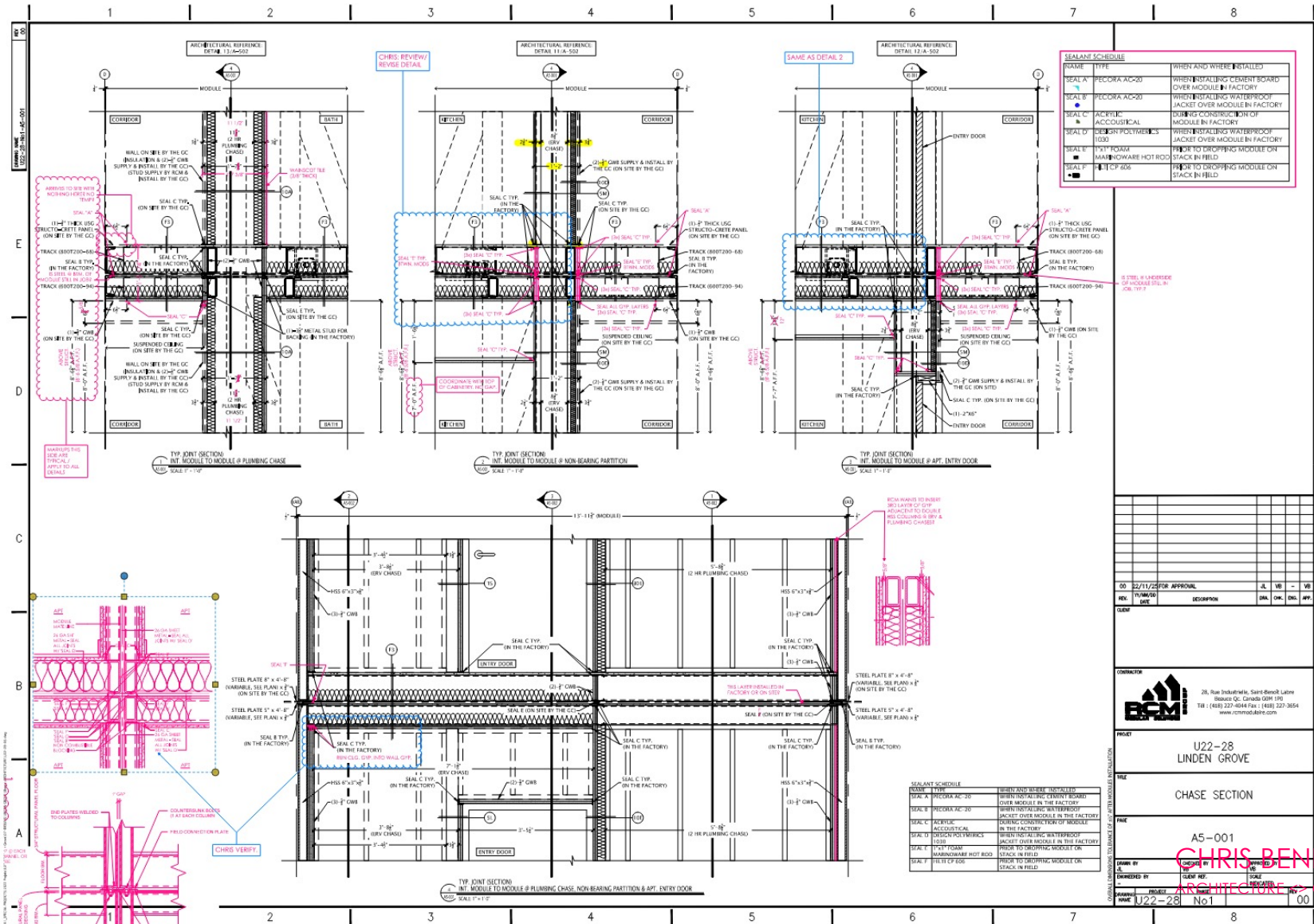
13 TYP. JOINT (SECTION)
INT. MODULE TO MODULE @ PLUMBING CHASE
SCALE: 1/12" = 1'-0"



14 TYP. JOINT (SECTION)
INT. OF FOUR MODULES
SCALE: 1/12" = 1'-0"

NAME	TYPE	WHEN AND WHERE INSTALLED
SEAL A	PECCORA AC-20	WHEN INSTALLING CEMENT BOARDS OVER MODULE IN FACTORY
SEAL B	PECCORA AC-20	WHEN INSTALLING WATERPROOF JACKET OVER MODULE IN FACTORY
SEAL C	ACRYLIC	DURING CONSTRUCTION OF MODULE IN FACTORY
SEAL D	DESIGN POLYMERICS 1030	WHEN INSTALLING WATERPROOF JACKET OVER MODULE IN FACTORY
SEAL E	PETFOAM	PRIOR TO DROPPING MODULE ON STACK IN FIELD
SEAL F	HELTCP 605	PRIOR TO DROPPING MODULE ON STACK IN FIELD

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SEALANT SCHEDULE	SEALANT	TYPE	WHEN AND WHERE INSTALLED
SEAL A	PECORA AC-20		WHEN INSTALLING CEMENT BOARD OVER MODULE IN FACTORY
SEAL B	PECORA AC-20		WHEN INSTALLING WATERPROOF JACKET OVER MODULE IN FACTORY
SEAL C	ACRYLIC ACoustical		DURING CONSTRUCTION OF MODULE IN FACTORY
SEAL D	DESIGN POLYMERS 1000		WHEN INSTALLING WATERPROOF JACKET OVER MODULE IN FACTORY
SEAL E	TEST FOAM		PRIOR TO DROPPING MODULE ON STACK IN FIELD
SEAL F	MAINTENANCE HOT ROD		PRIOR TO DROPPING MODULE ON STACK IN FIELD

DATE	02/11/2019	FOR APPROVAL	JL	VB	-	VB
REV	1	DESCRIPTION	DATE	CHK	DATE	APP

CONTRACTOR

 28, Rue Industrielle, Saint-Basile-Levée
 Québec, Canada G0P 1P0
 Tél : (418) 227-6044 Fax : (418) 227-3654
 www.bpm.qc.ca

PROJECT
 U22-28
 LINDEN GROVE

FILE
 CHASE SECTION

DATE
 A5-001

DESIGNED BY
 CHAS

CHECKED BY
 VB

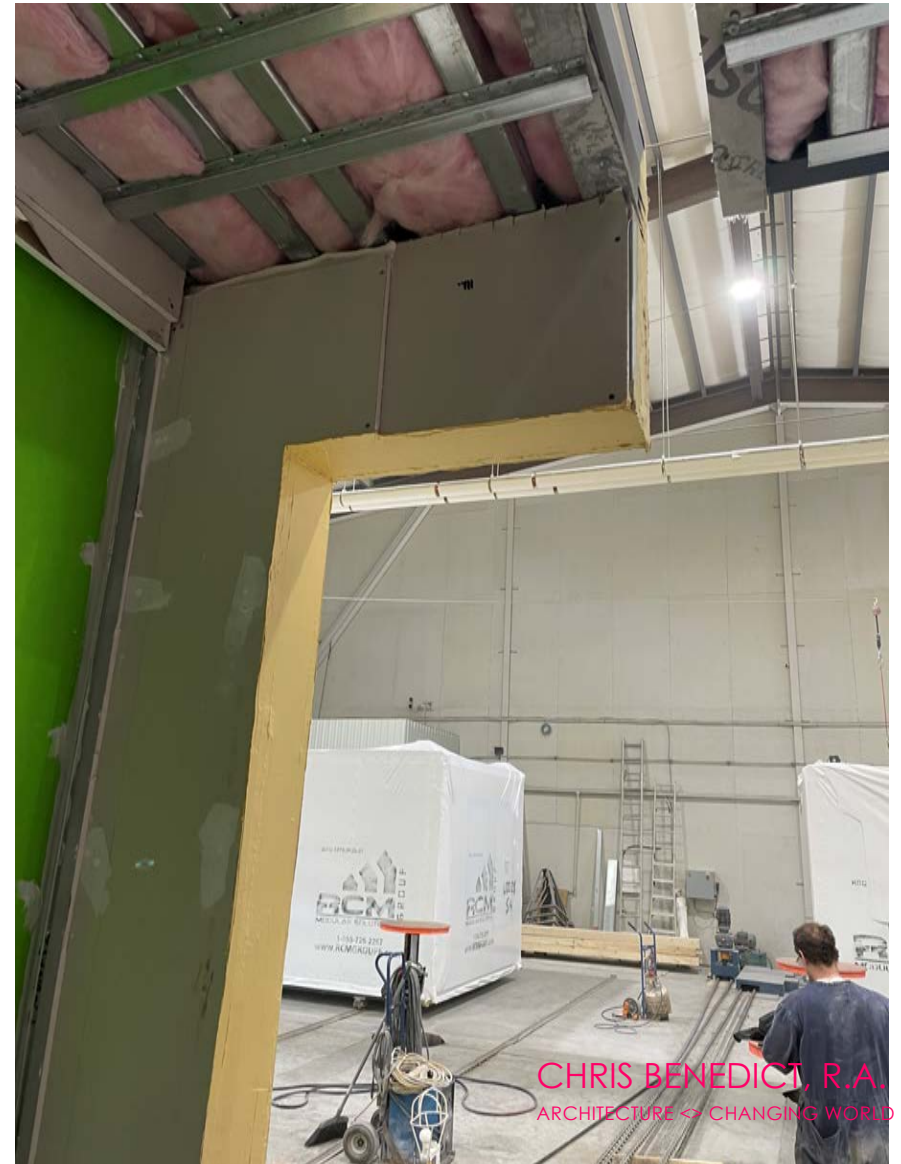
DATE
 02/11/2019

PROJECT
 U22-28

FILE
 No1

DATE
 00

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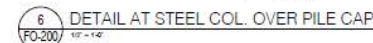
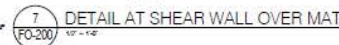
BLUE SEA DEVELOPME

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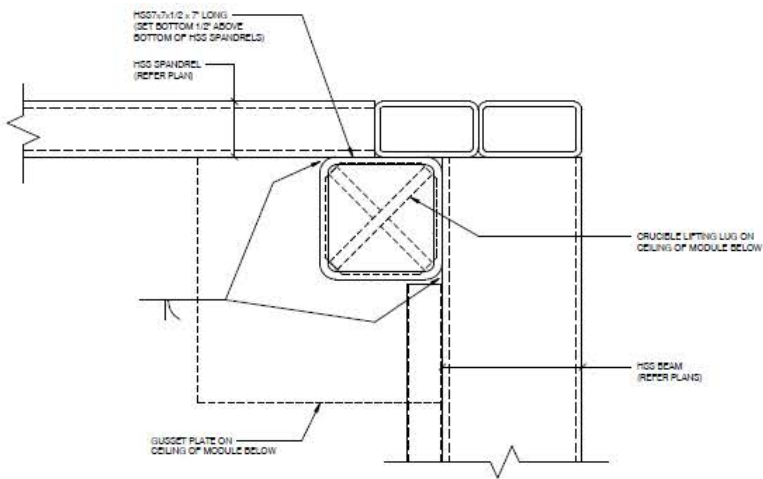
STRUCTURE

BLUE SEA DEVELOPMENT/GILBANE

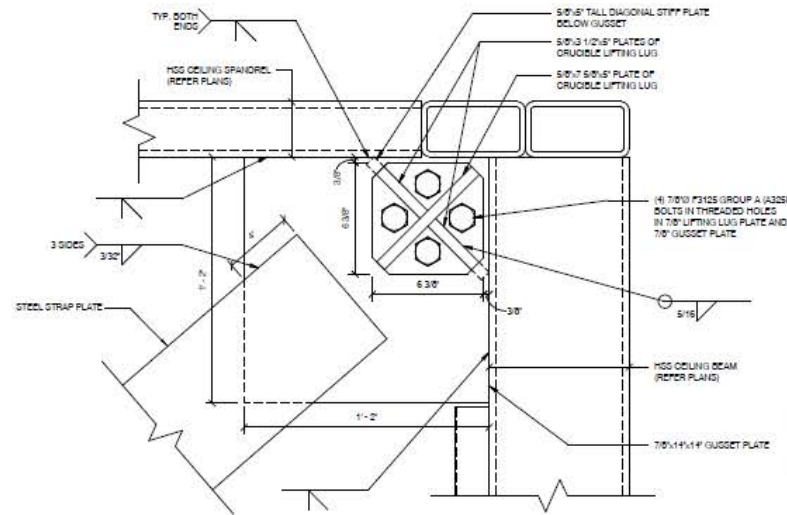
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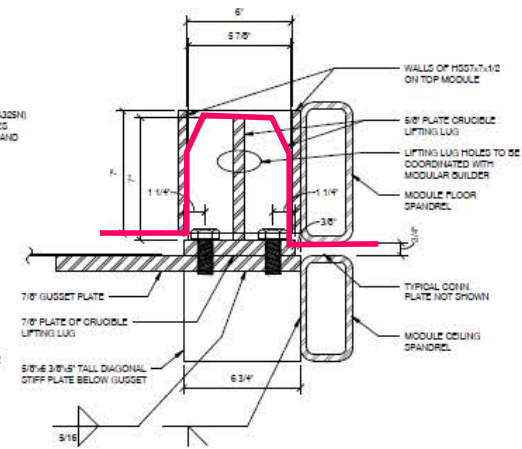
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ALIGNMENT TUBE AT FLOOR PLAN DETAIL



LIFTING LUG AND GUSSET PLATE PLAN DETAIL AT CEILING



LIFTING LUG SECTION

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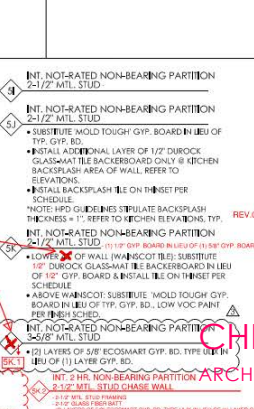
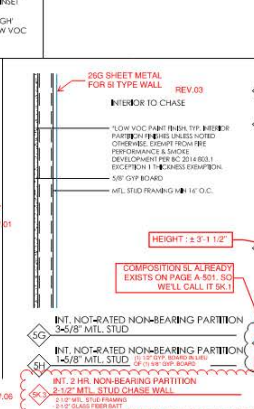
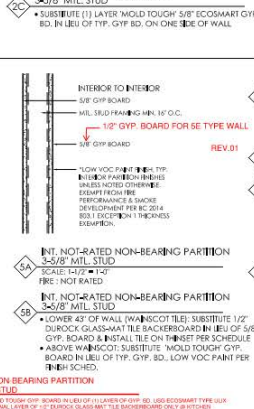
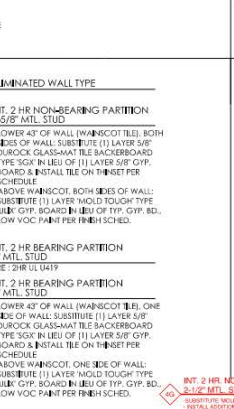
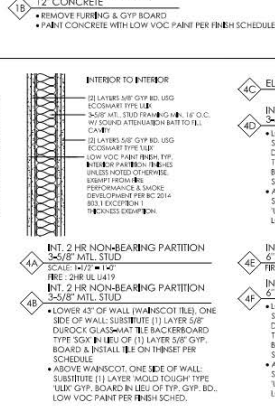
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SHOP DRAWINGS & SUBMITTALS

BLUE SEA DEVELOPMENT/GILBANE

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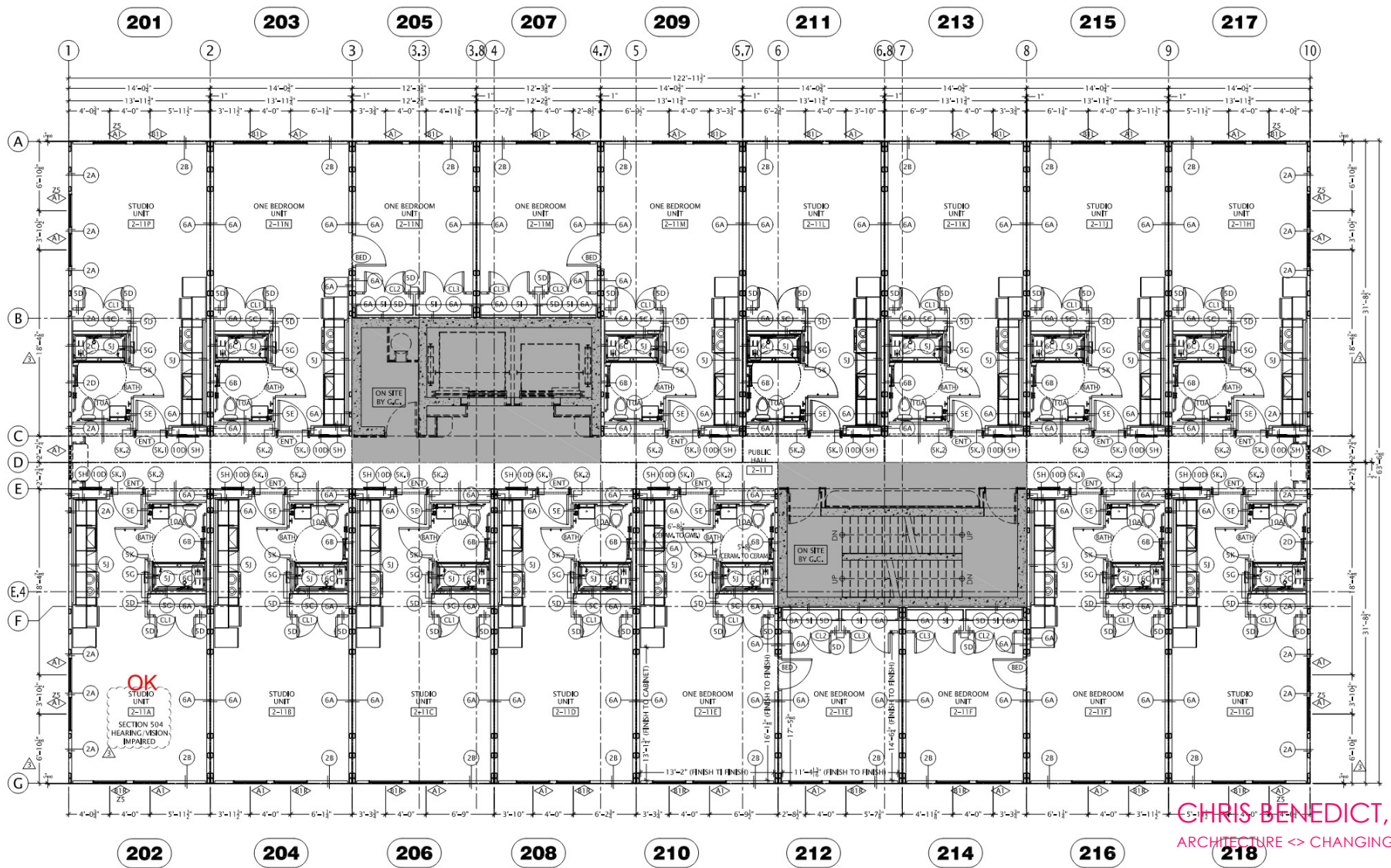
INTERIOR WALL TYPES



ARCH-DETAIL CHRIS BENEDICT, R.A. ARCHITECTURE <> CHANGING WORLD 317 EAST PINE STREET NYC 10003 212 471 4816	
PROJECT	
LINDEN GROVE 223 LINDEN STREET, BROOKLYN NY 11221	
157	
CONFORMED SET	
SEAL & SIGNATURE	
REV 06 - 28/03/21	
REV 07 - 28/03/21	
REV 04 - 25/03/19	
REV 03 - 25/03/00	
REV 02 - 23/03/00	
Rev 1 - 06/05/2022	
31 BULLETIN 1 BULLETIN #2 9/30/2022 2 BULLETIN #3 10/4/2022 3 BULLETIN #5 11/22/2022	
TYP. WALL ROOF, FLOOR TYPES DATE: 12 AUG 2022 © CHRIS BENEDICT R.A.	
A-500.00 CHRIS BENEDICT ARCHITECTURE <> CHANGING WORLD	

A-500.00

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FACADE

BLUE SEA DEVELOPMENT/GILBANE

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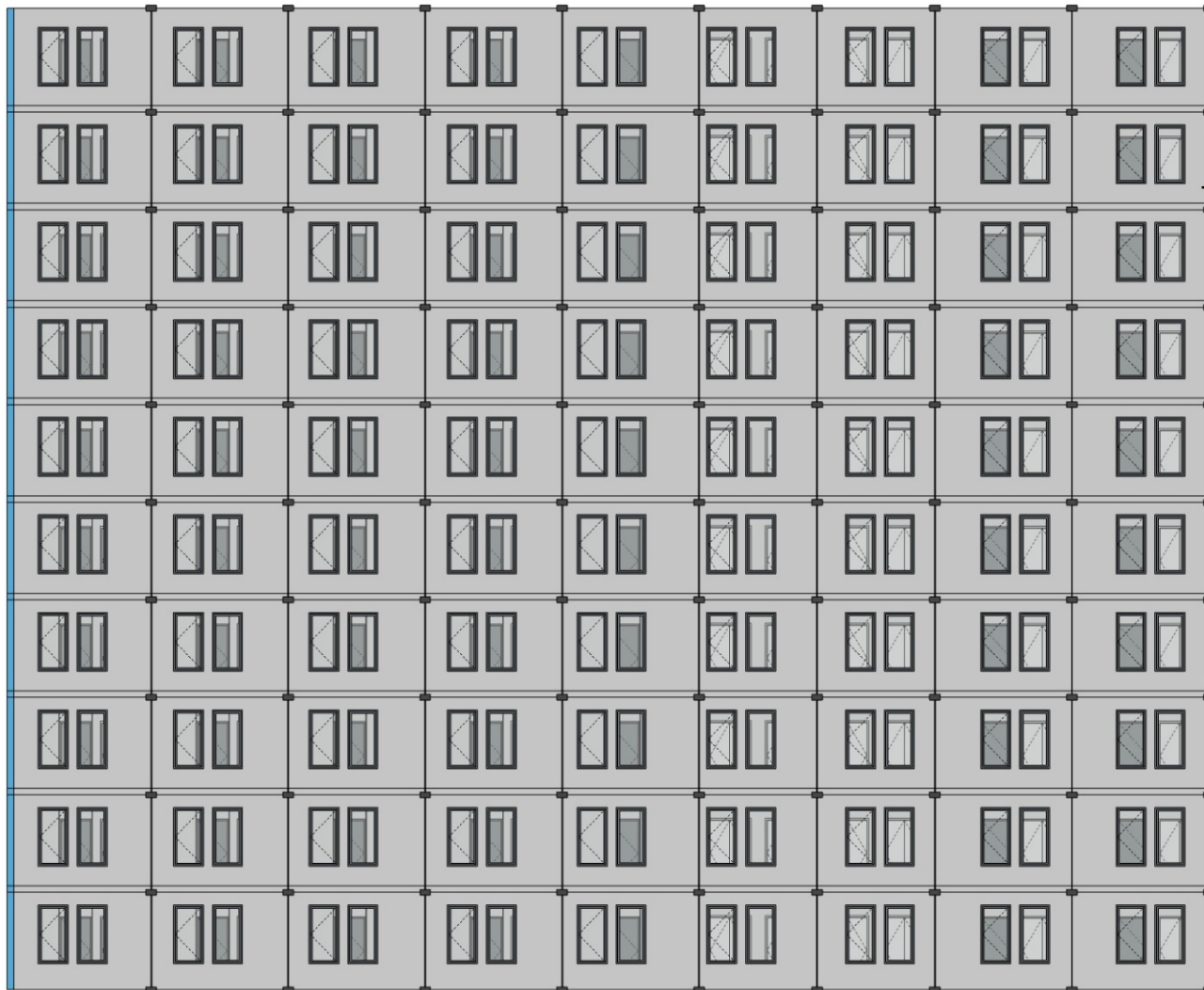
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BLUE SEA DEVELOPMENT/GILBANE



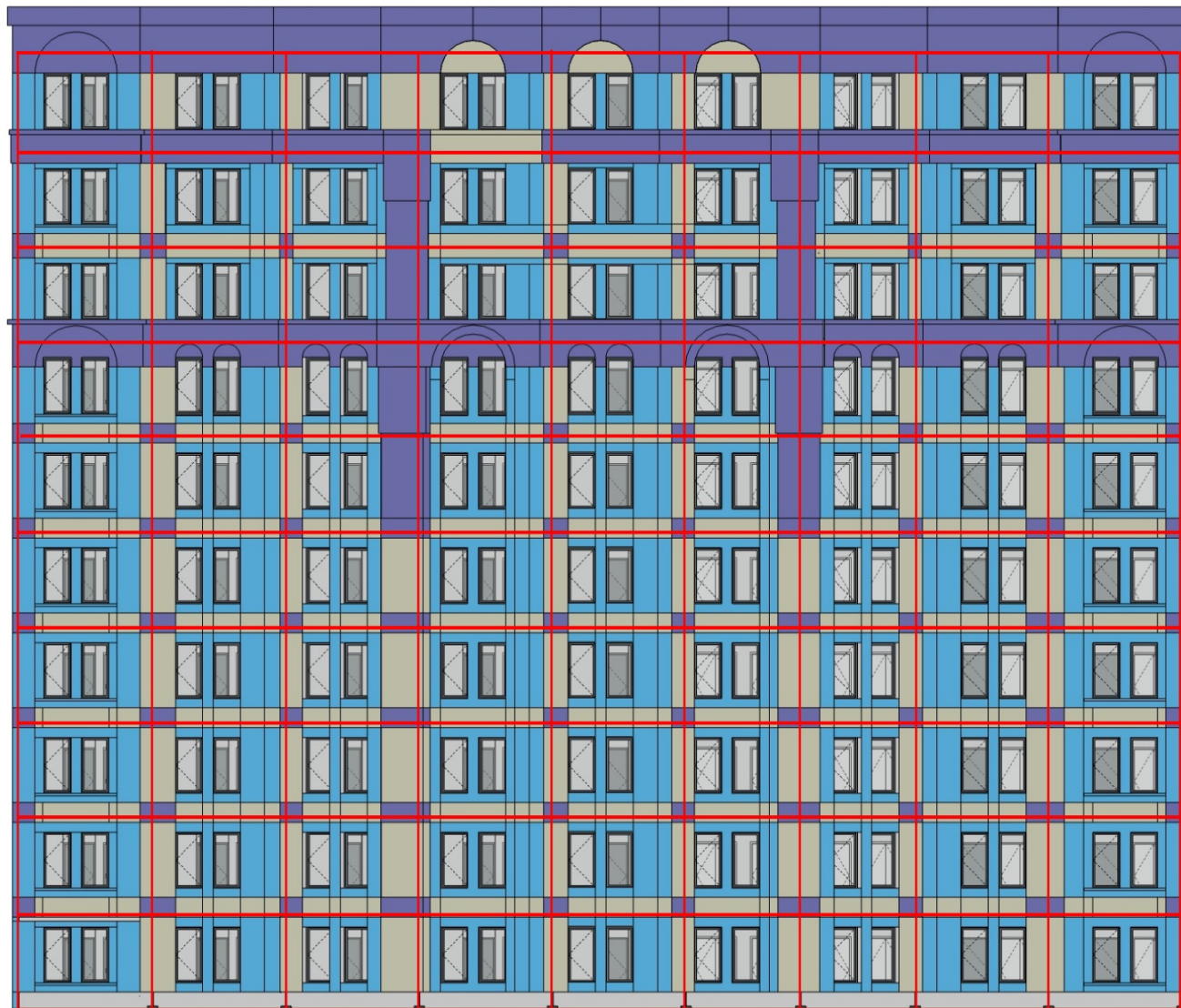
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← MODULES WITHOUT EIFS

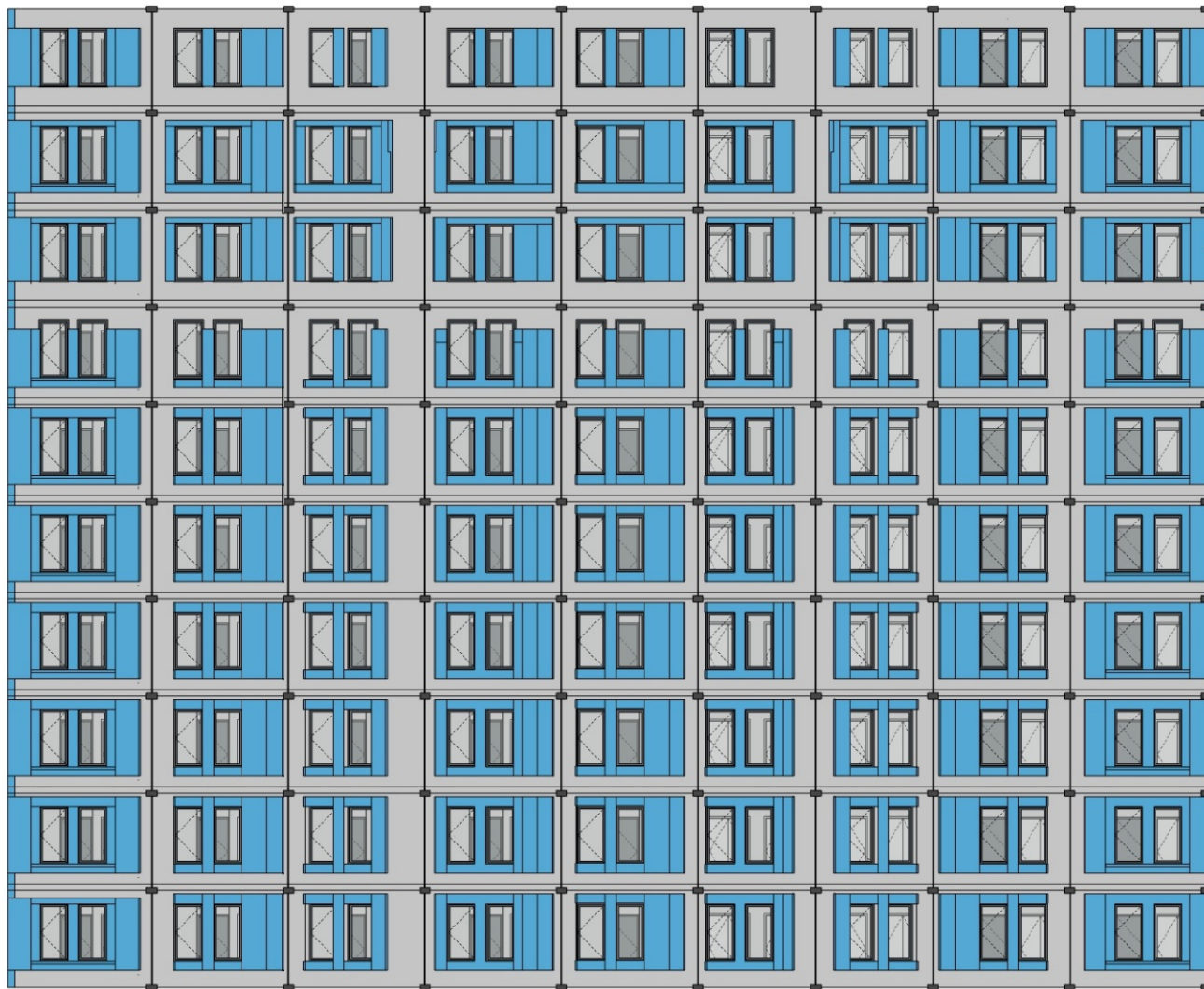


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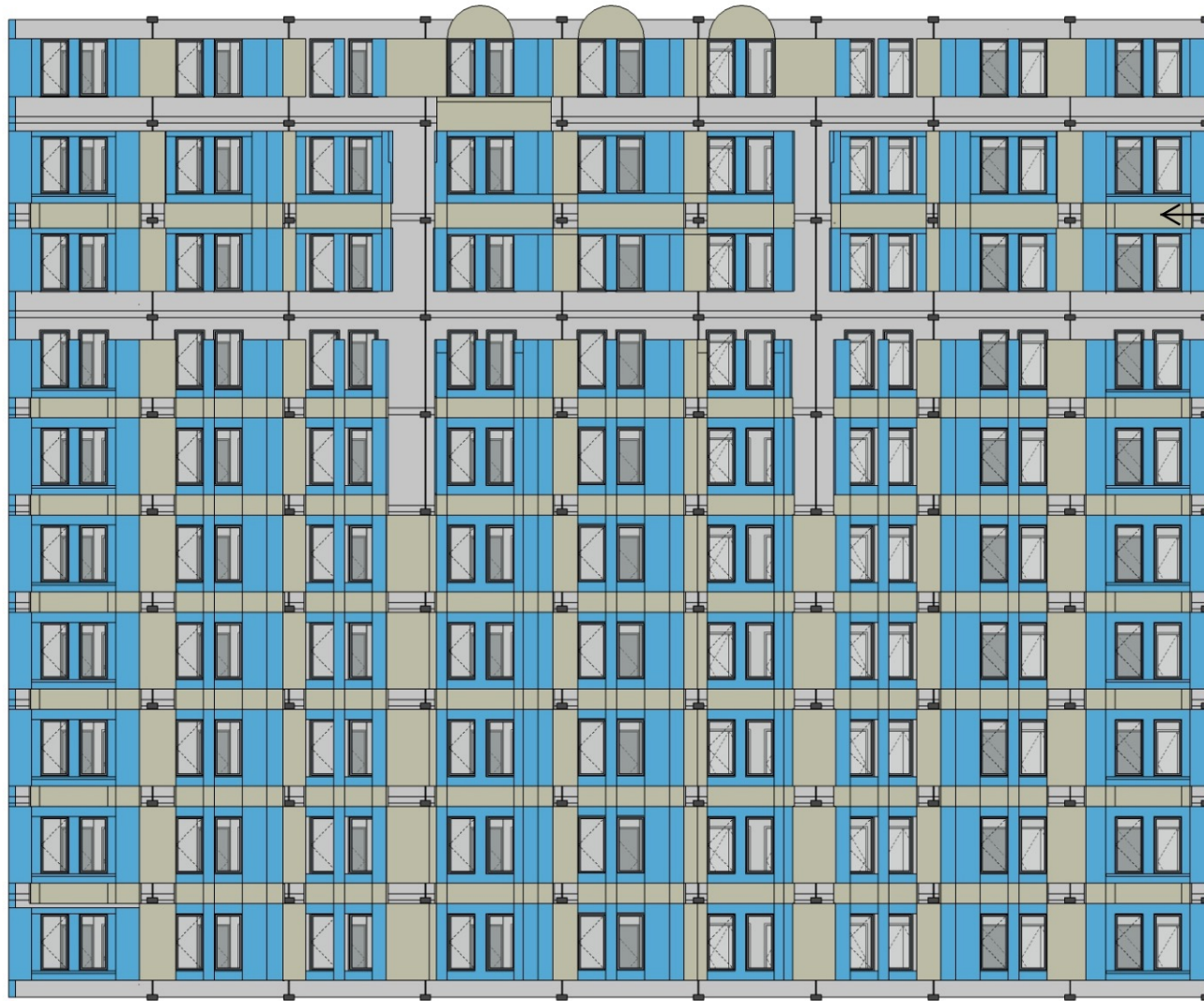
← MODULE BOUNDARIES

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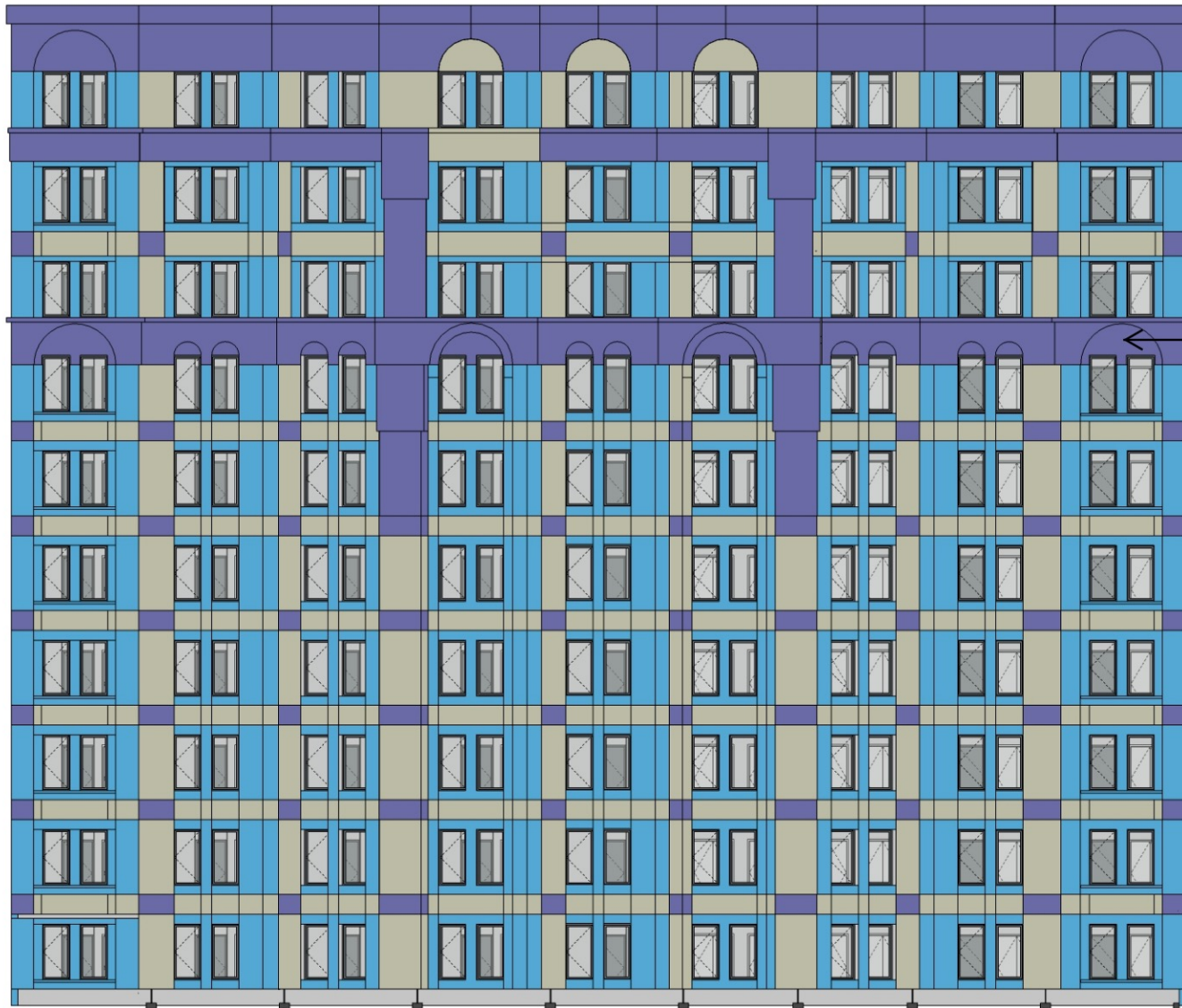
← EIFS THAT COULD BE
APPLIED AT THE FACTORY

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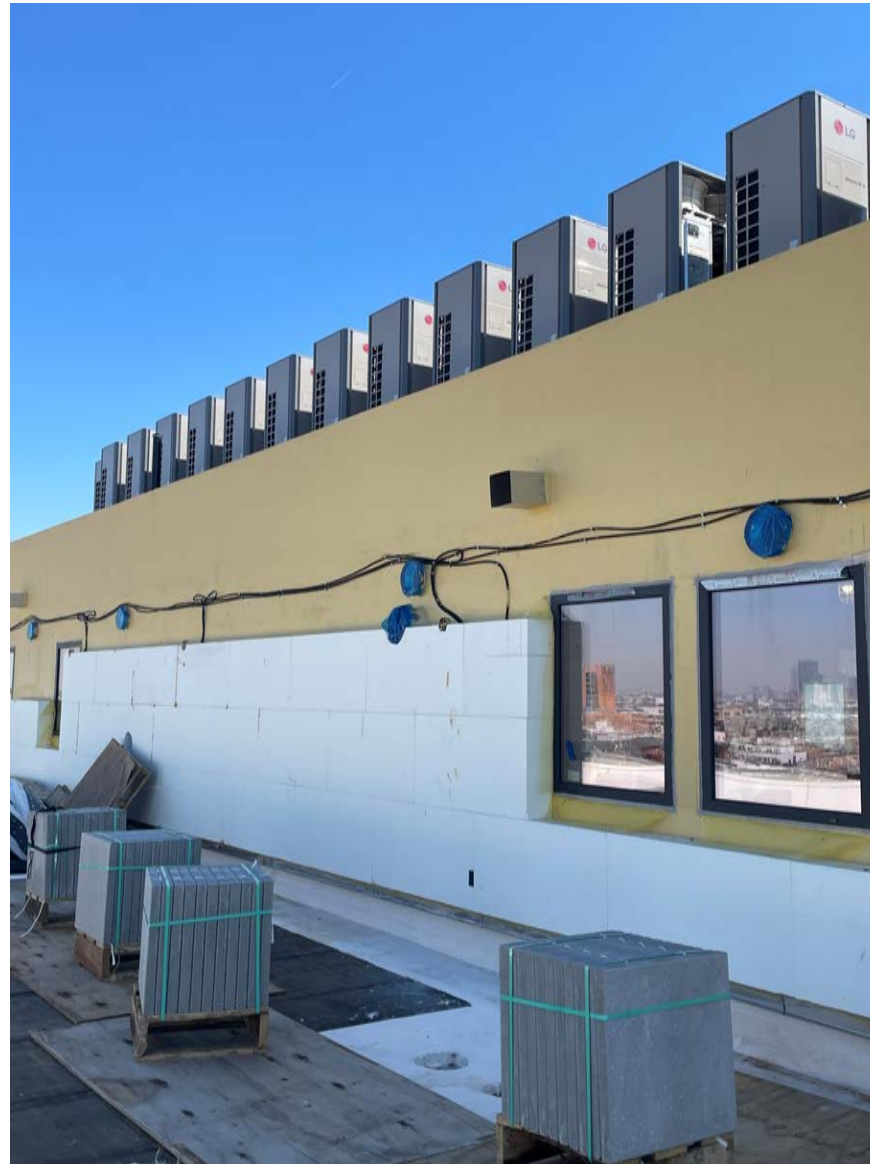
← EIFS APPLIED OVER VERTICAL
AND HORIZONTAL JOINTS
AFTER ERECTION

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← EIFS APPLIED OVER
INTERSECTIONS
AFTER ERECTION

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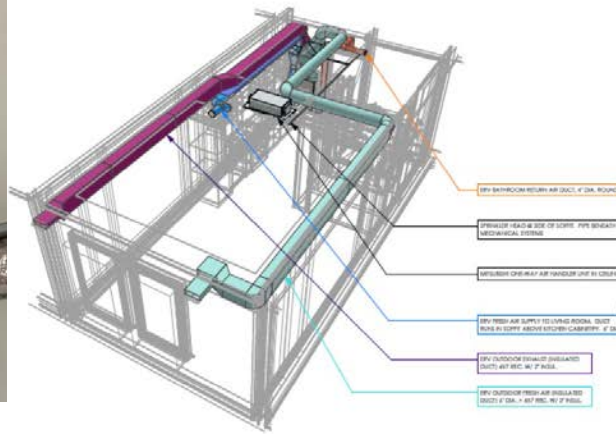


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ERV

BLUE SEA DEVELOPMENT/GILBANE

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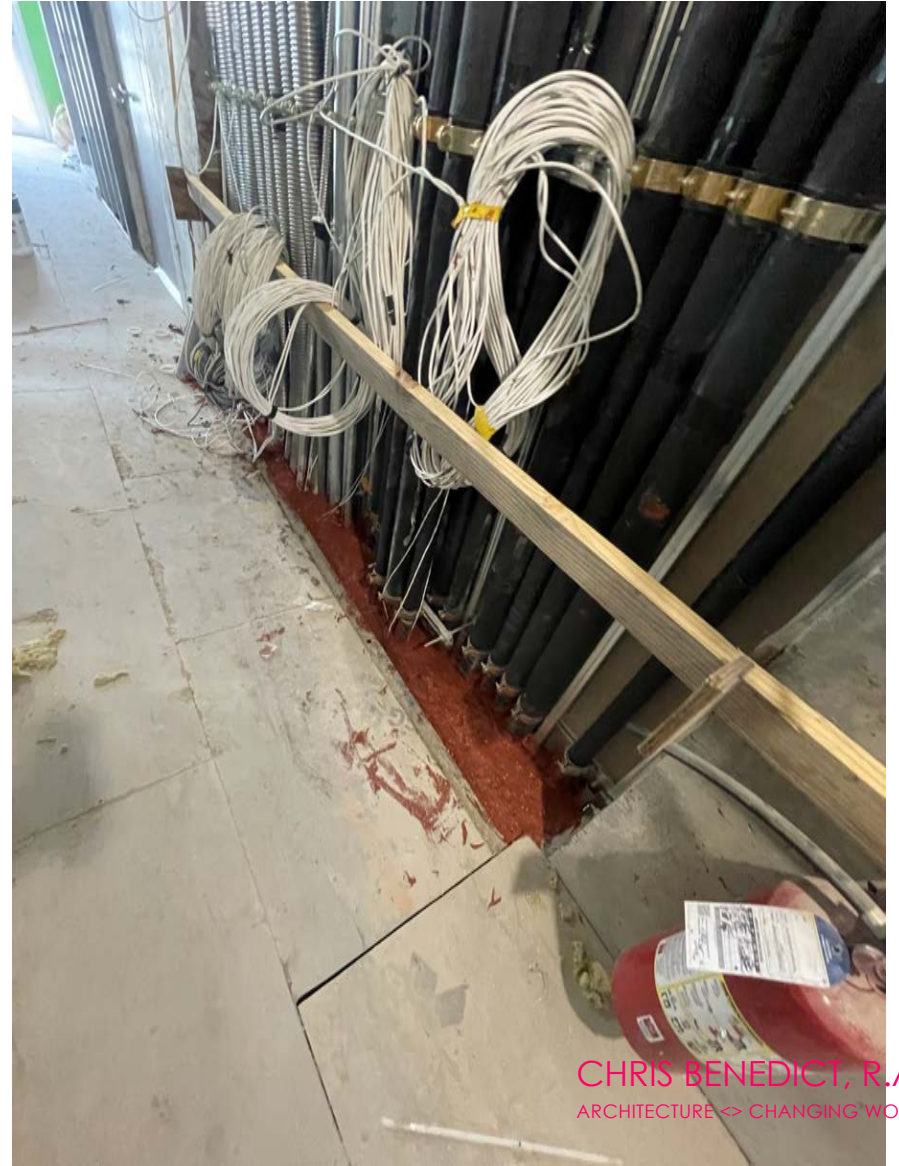
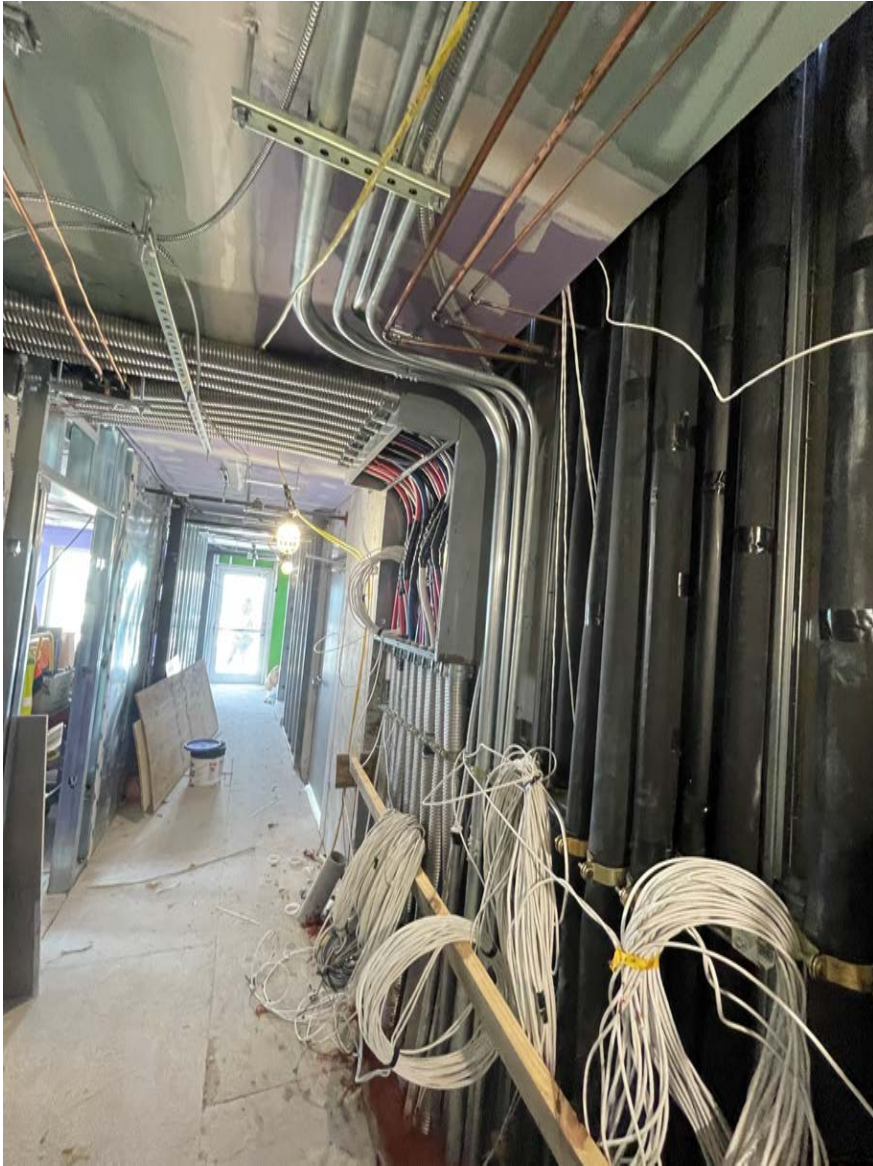
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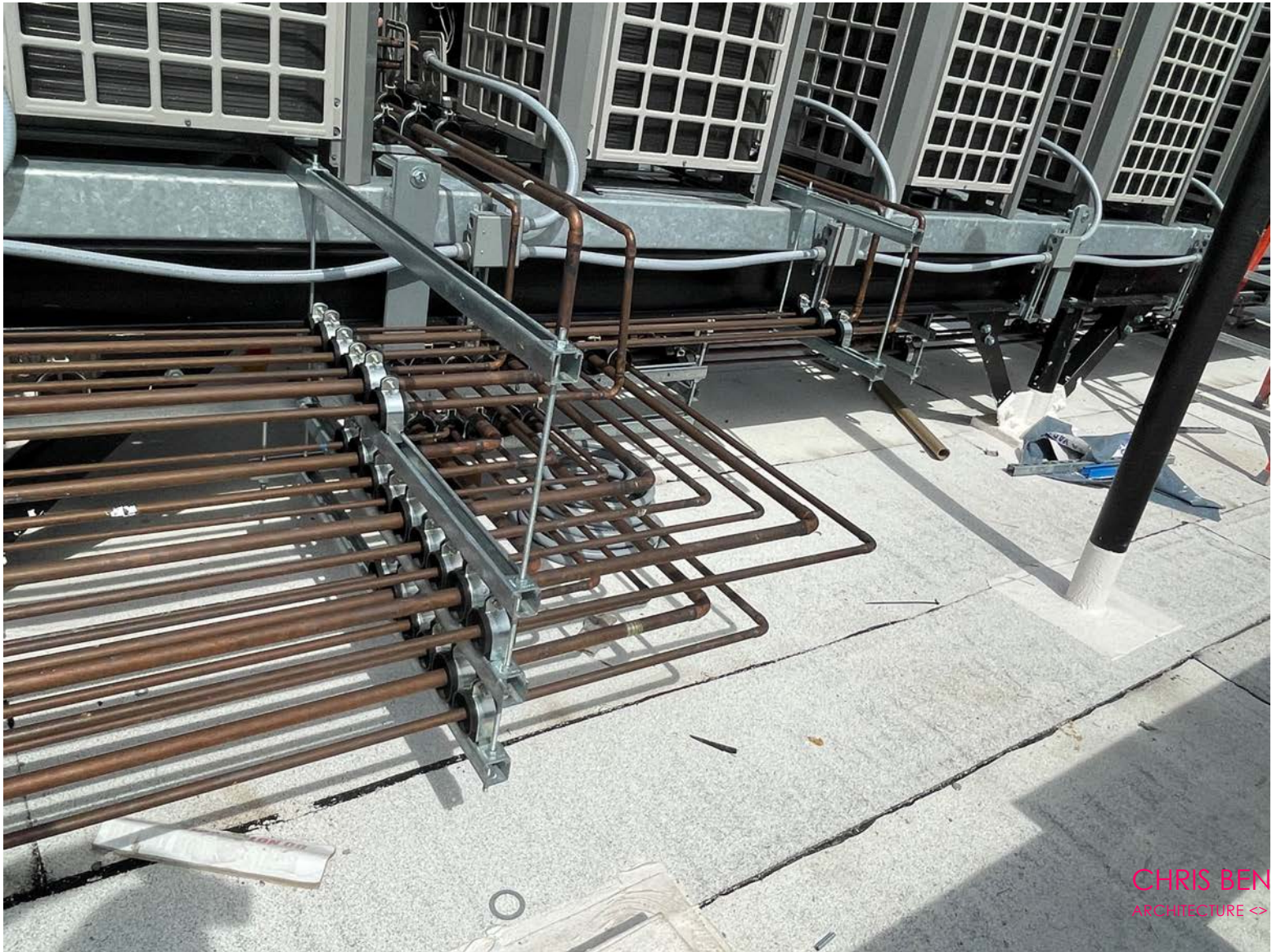
HEATING COOLING

BLUE SEA DEVELOPMENT/GILBANE

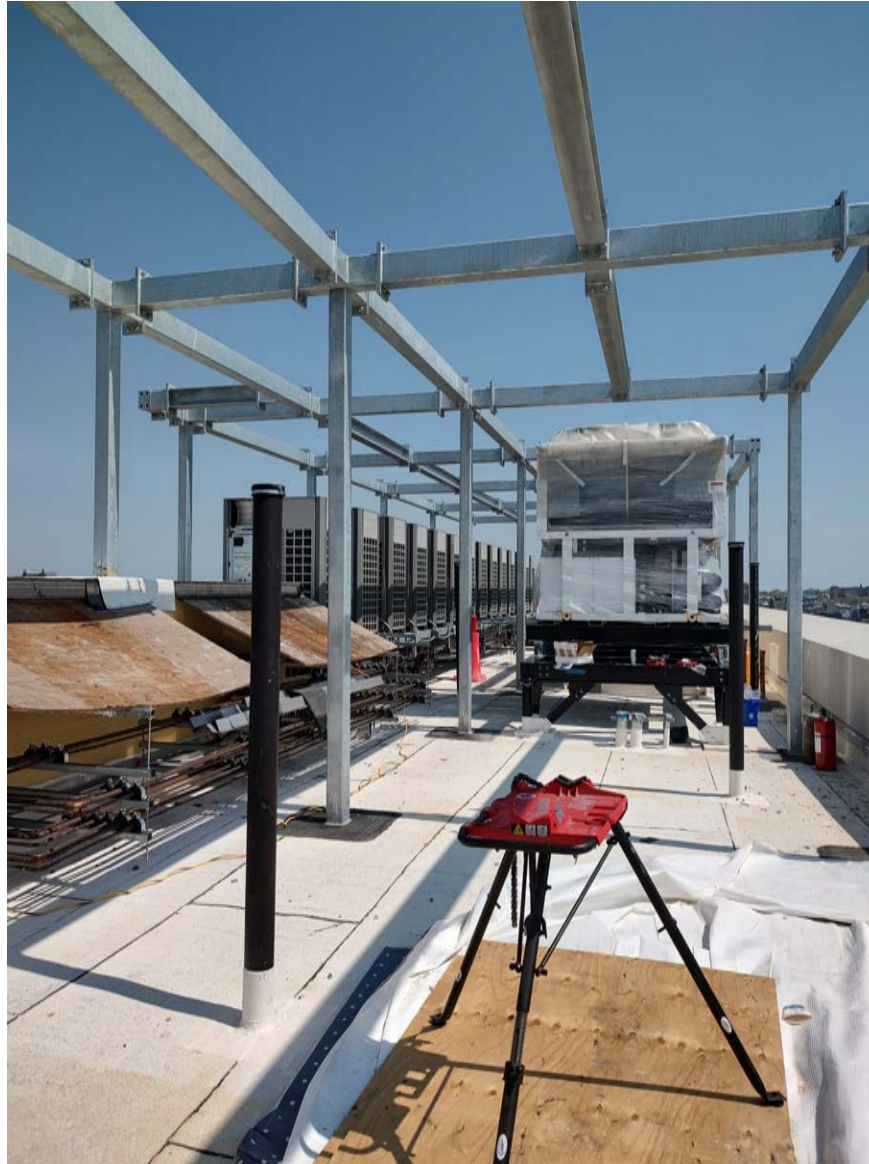
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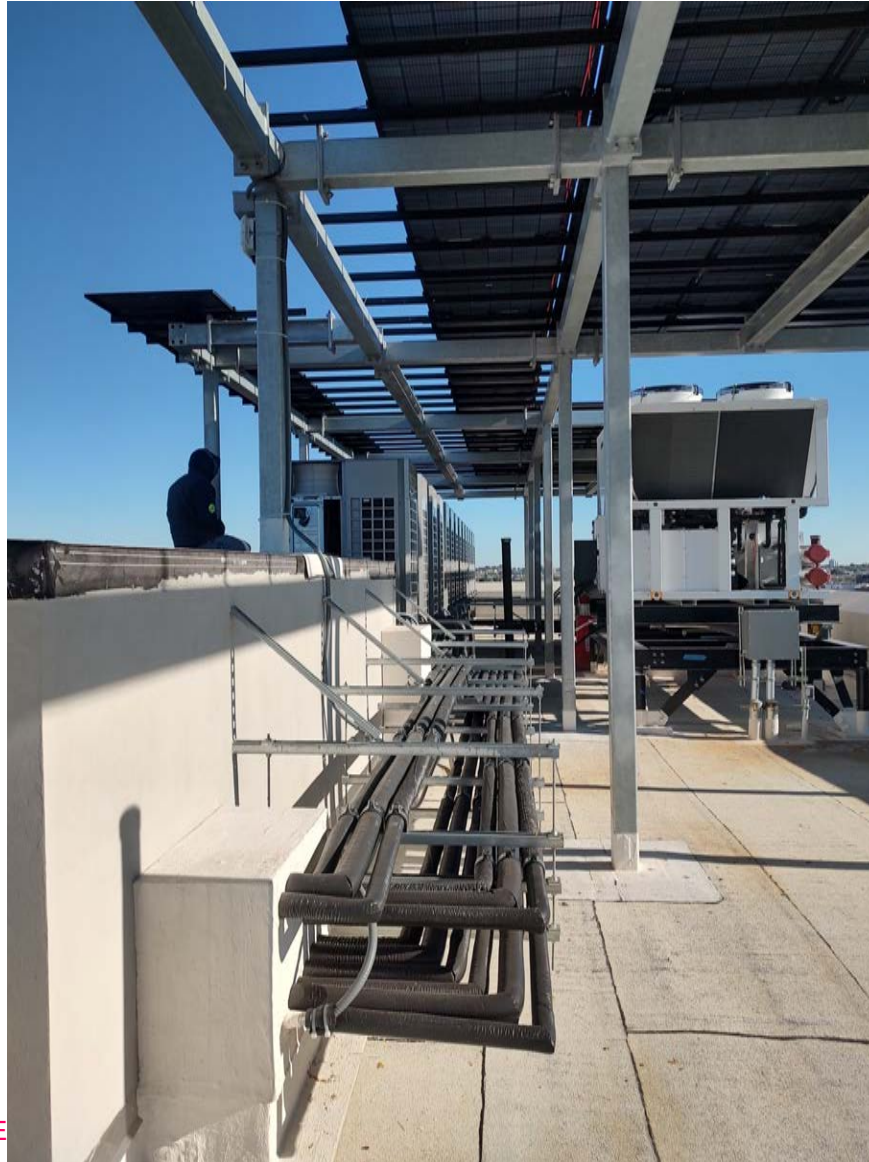
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BLUE SEA DEVELOPME

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DHW

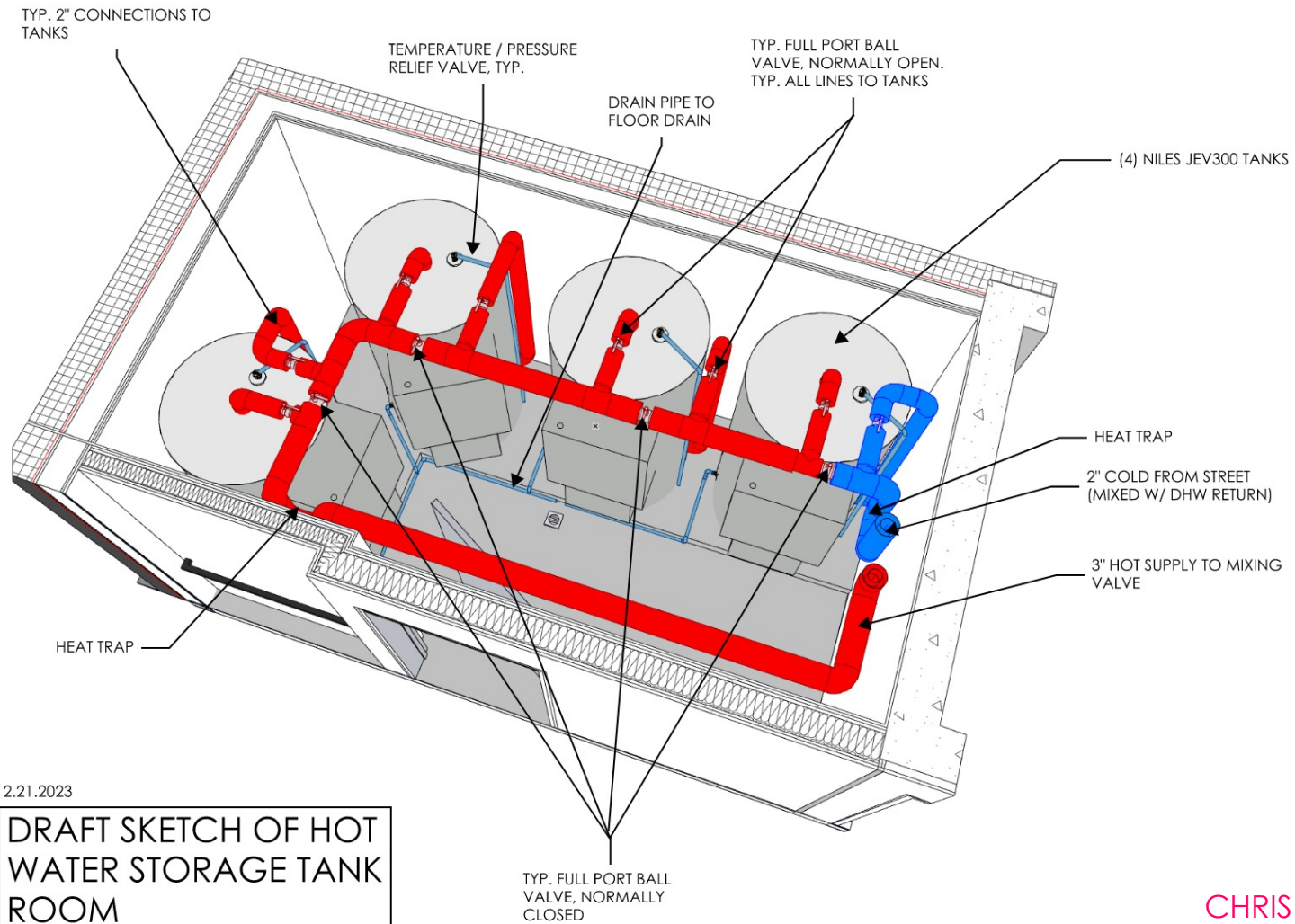
BLUE SEA DEVELOPMENT/GILBANE

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BLUE SEA DEVELOPME

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2.21.2023

DRAFT SKETCH OF HOT WATER STORAGE TANK ROOM

NO SCALE

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BLUE SEA DEVELOPME



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APPROVALS

BLUE SEA DEVELOPMENT/GILBANE

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Kazimir Vilenchik, P.E.
Acting Commissioner

Md Bhuyan, PE
Mechanical Engineer
mbhuyan@buildings.nyc.gov

280 Broadway
OTCR Division
New York, NY 10007
nyc.gov/buildings

+1 212 393 2071 tel
+1 212 566 3813 fax

March 06, 2023

OTCR Applicant:

Chris Benedict
317 East 9th St
New York, NY 10003

Owner:

NYCHA/Bushwick Senior Housing LLC
Mathew Charney
90 Church St
New York, NY 10007

Re: OTCR Site-Specific Acceptance of In-shop Monitor,
OTCR# 06-23
223 Linden St
Brooklyn, NY 11221
New Building Job No. B00685211-11

Dear Mr. Chris Benedict

On January 31, 2023, an OTCR-2 application (06-23) was submitted for site-specific approval of an in-shop monitor complying with Buildings Bulletin 2014-003. The Department is in receipt of the executed affidavit dated February 22, 2023, signed by Mathew Charney, owner and submitted in compliance with the OTCR requirements.

The Department accepts the conditions specified in the above-referenced application and affidavit, including the use of Lorenzo Cruz Dimalanta, License Number NY PE 091326, as in-shop monitor(s) to certify that modular units comply with Buildings Bulletin 2014-003. Please be advised that this letter authorizes modular units to be assembled off-site. This letter does not approve construction documents, nor does it address whether the construction documents meet the applicable technical requirements of the NYC Construction Codes, Electrical Code, Housing Maintenance Code, Multiple Dwelling Law or Zoning Resolution. Any such approval of construction documents must be obtained by the applicable local borough office or the Department's Development HUB.

Additionally, as previously stated in the Department's OTCR requirements, any required special and/or progress inspections shall be performed by agencies or persons qualified to perform such inspections and the applicable Technical Reports (ie, TR1, TR8, etc) shall be submitted as



appropriate, unless such special inspections are exempted pursuant to an approved fabricator program in accordance with BC 1704.2.2.

After completion of the assembly of modular units, the in-shop monitor(s) identified above will be required to submit a Monitor Certification (see BB 2014-003 Exhibit 4) as a condition for signoff. Failure to comply with these conditions will result in the revocation of this approval and such other action as may be deemed appropriate.

Sincerely,

Md Bhuyan, P.E.
OTCR Project Manager

Cc: Joseph Ackroyd, P.E. Assistant Commissioner, Technical Affairs
Alan Price, P.E. Director OTCR
Lorenzo Cruz Dimalanta, T.R. Arnold & Associates Inc.



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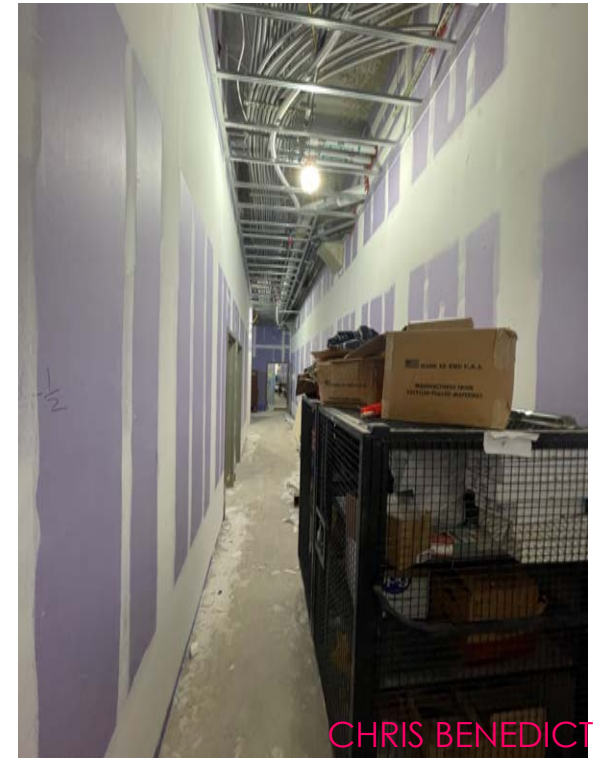
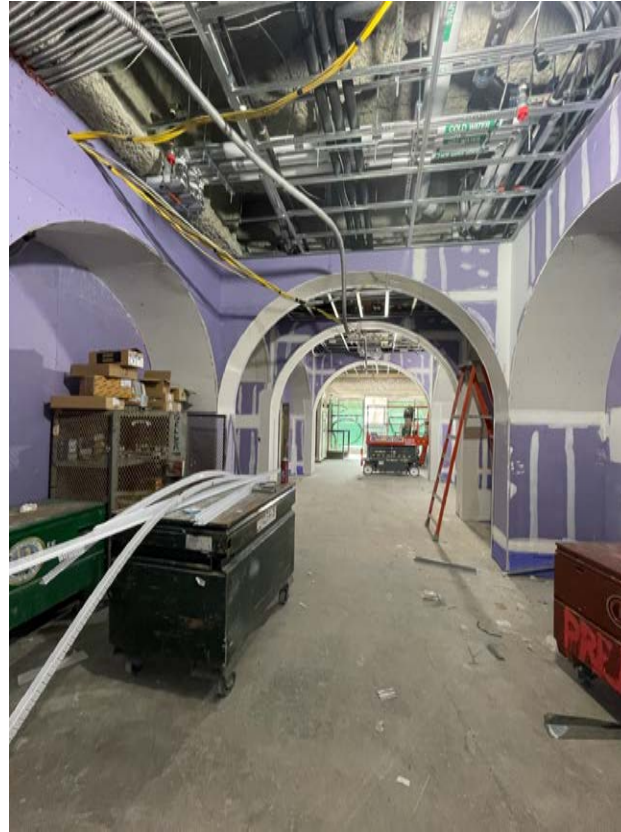
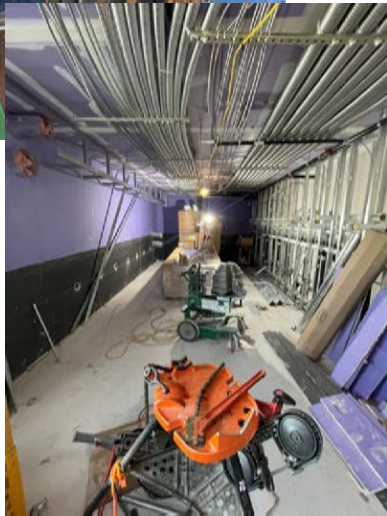
ELECTRICAL

BLUE SEA DEVELOPMENT/GILBANE

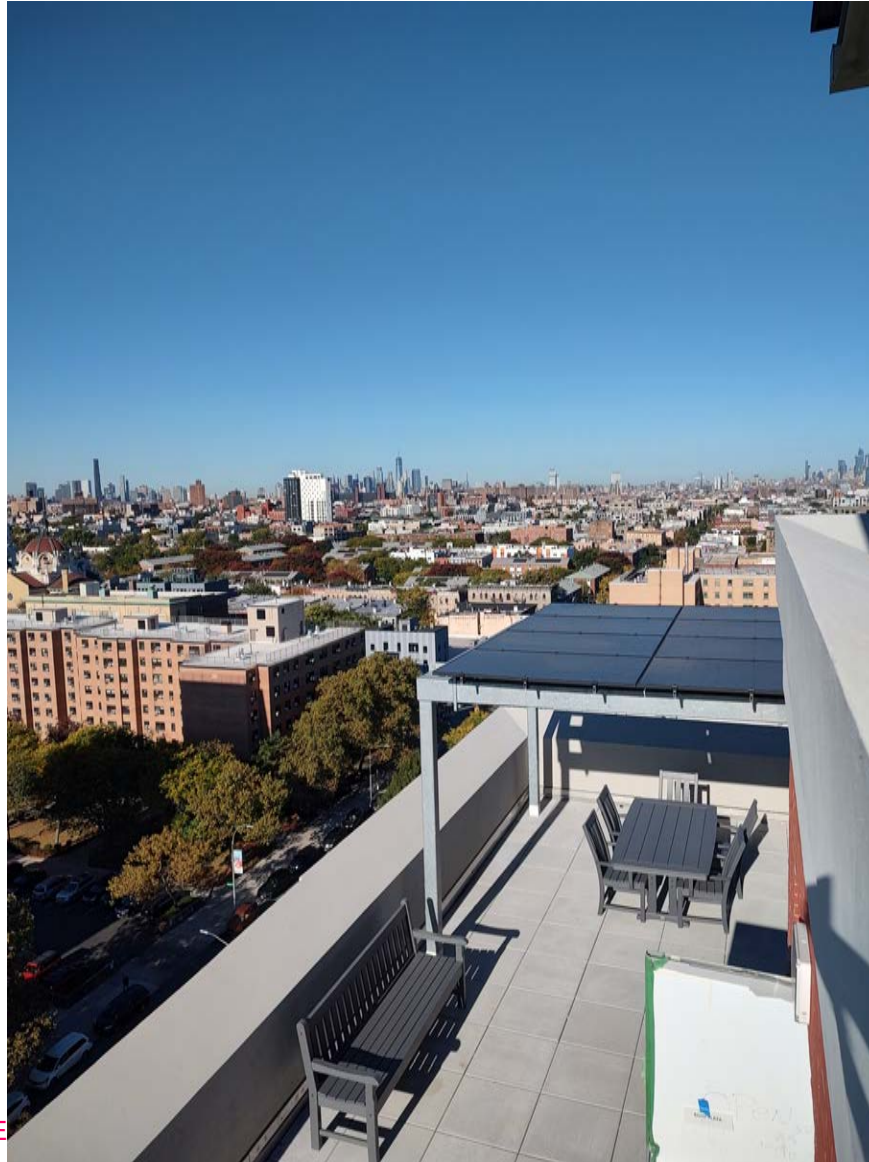
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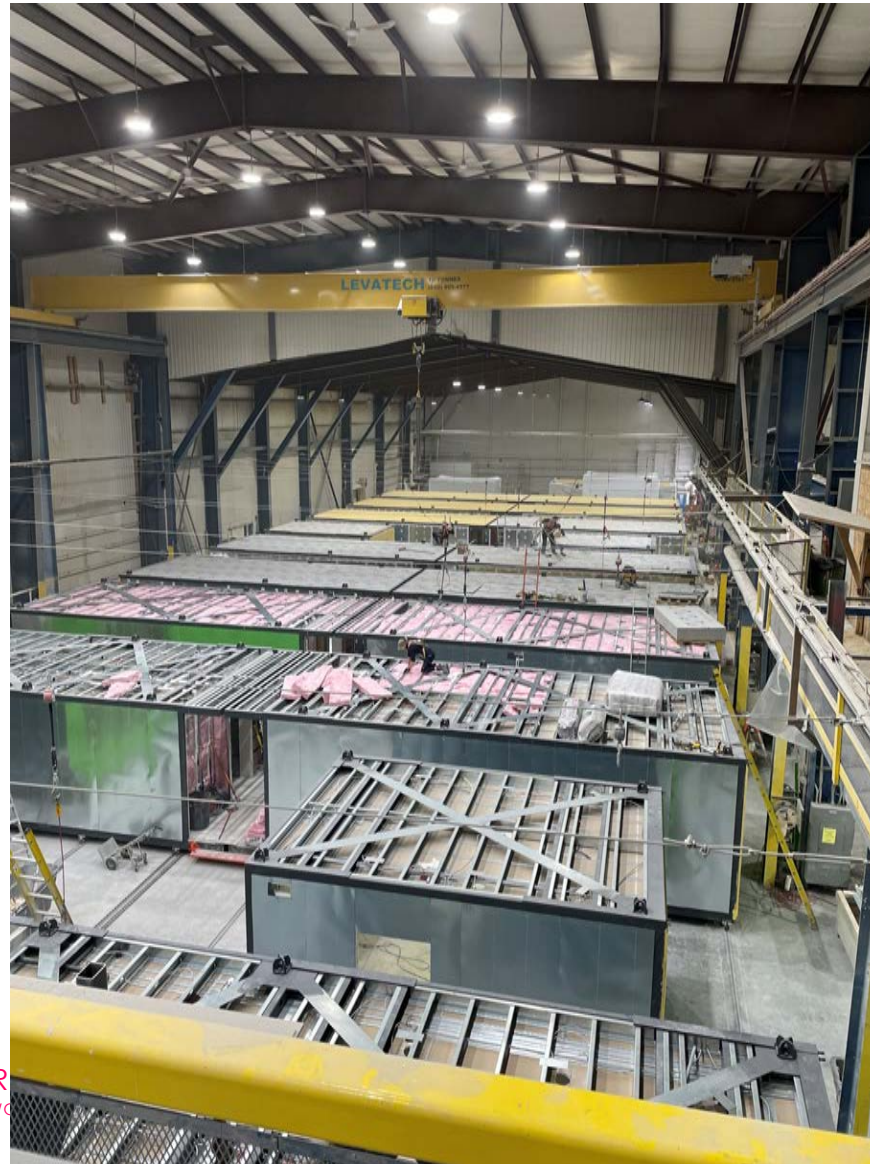
BLUE SEA DEVELOPMENT

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CONSTRUCTION

BLUE SEA DEVELOPMENT/GILBANE

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LIVE

A Few Clouds, Temp: 76F (feels like: 76F), RH: 78%
Dew Point: 68F, Wind: 10.4mph ENE, Gust: ...
Pressure: 29.70in, POP: 10 / day 0in

Camera Controls

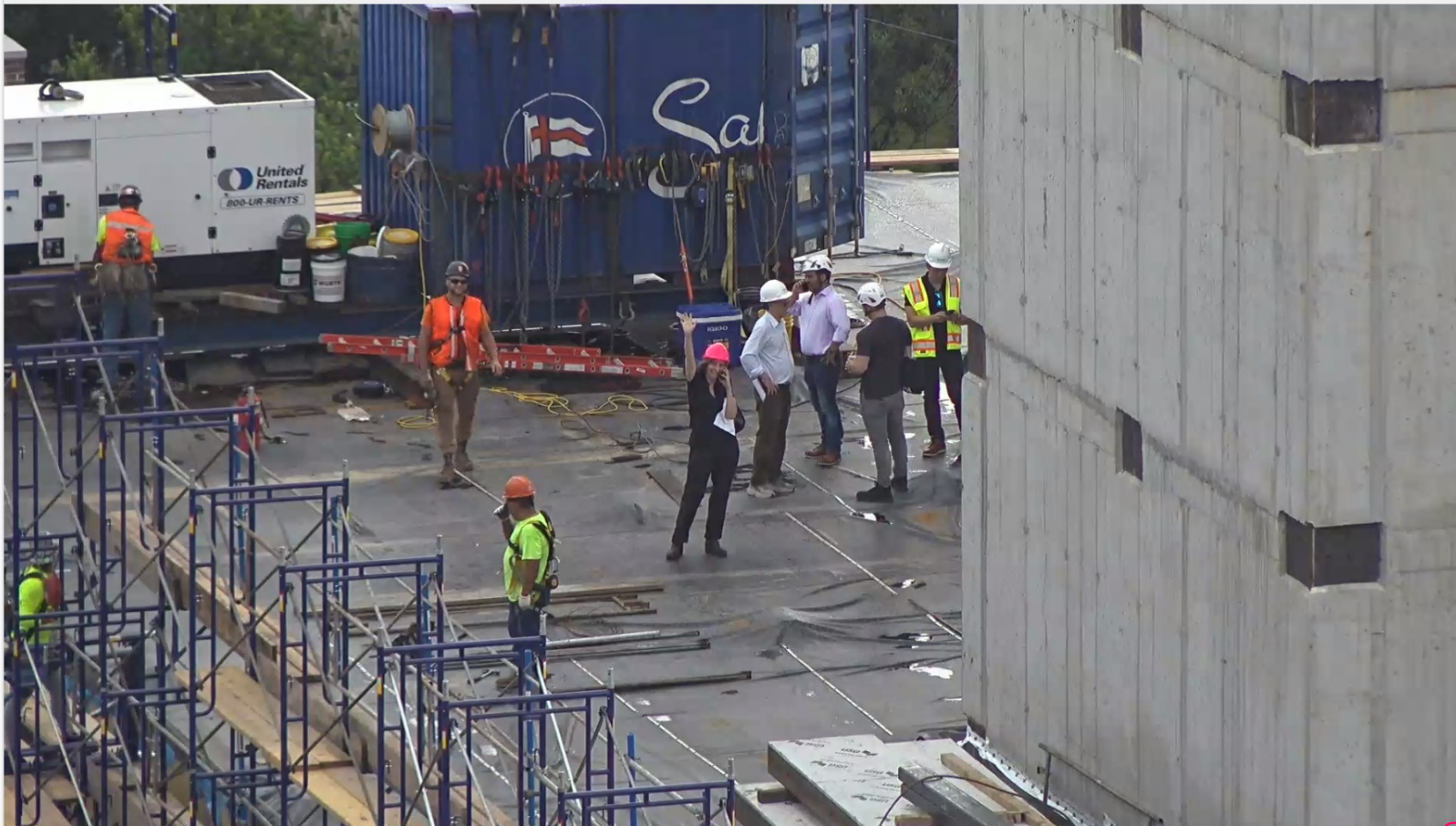


Presets



Field Of View

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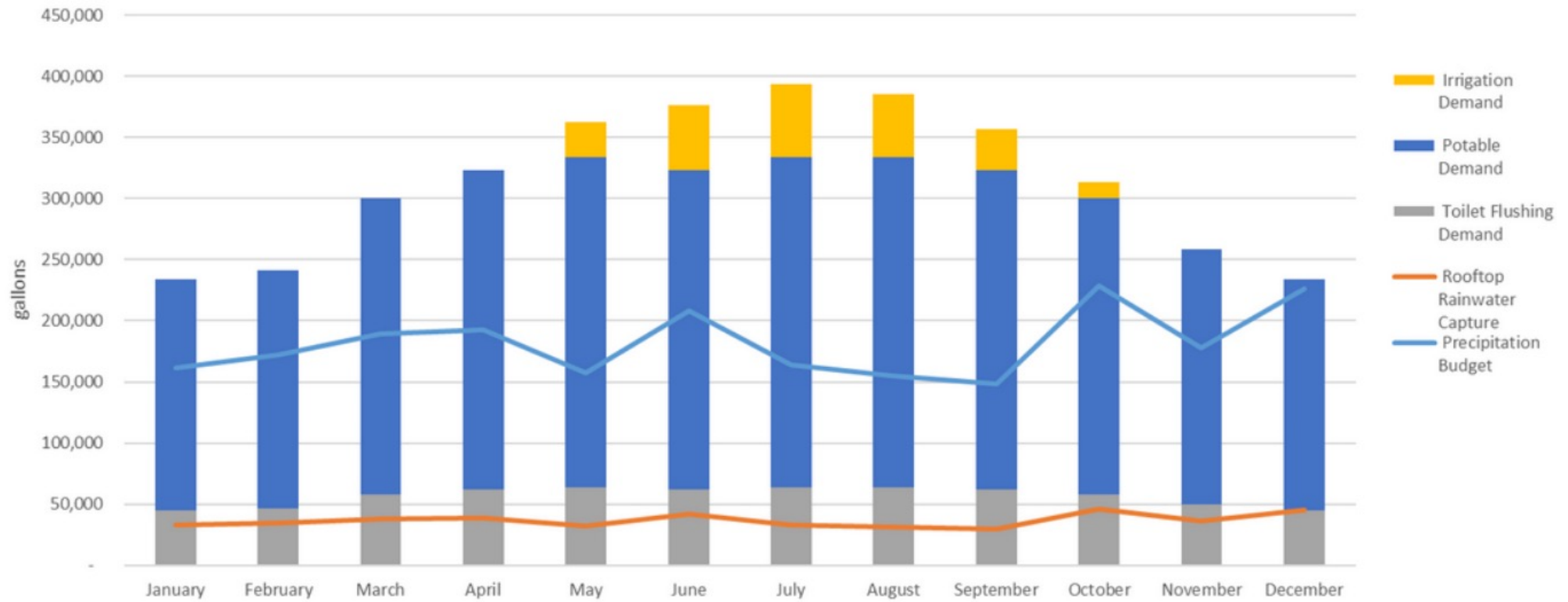


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An aerial photograph of a residential neighborhood. A large, multi-story house with a blue roof and red brick walls is the central focus. It is surrounded by lush green trees and a paved driveway. In the background, other houses and a street are visible. Three thick black diagonal lines are overlaid on the image: one in the top left, one in the top right, and one in the bottom right.

NET ZERO WATER CHALLENGE

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WHAT DOES IT TAKE TO
CLEAN THE WASTE WATER
FROM AN APARTMENT
BUILDING?

DIRECT POTABLE REUSE

BLACKWATER - POTABLE

Detailed System Descriptions

Big Spring, TX – Colorado River Municipal Water District

Description/Size: The plant's capacity is 1.8 MGD (or 7,600 m³/day). The treatment process sends disinfected tertiary municipal effluent (also stated as filtered secondary effluent) through de-chlorination + MF + RO + UV/AOP followed by blending in a transmission line (15/85 ratio of reclaimed water to untreated lake water) and conventional treatment. The facility serves a population of 19,000 people at a cost of \$13 million.

Status: The plant has been operational since May 2013.

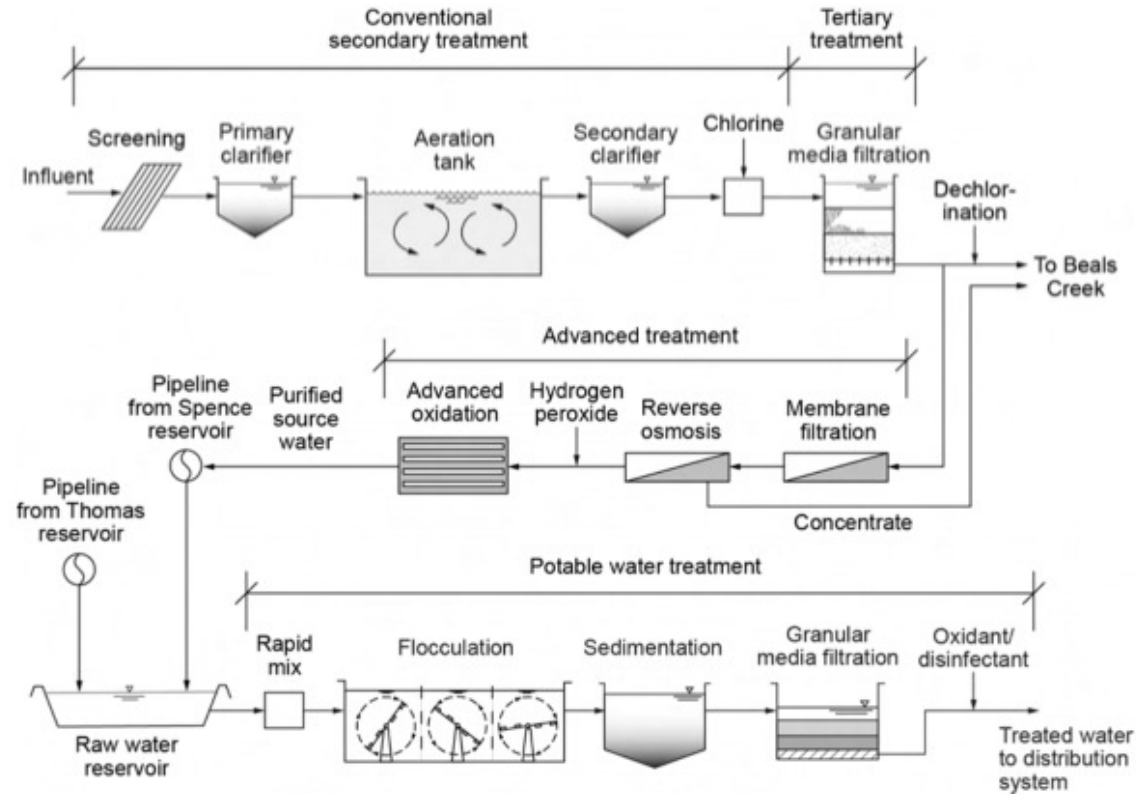


Figure 1 – Big Spring, TX – DPR System Schematic

DIRECT POTABLE REUSE

BLACKWATER - POTABLE



Passive House showed that we
could mine **HEAT** from people and
their activities in a building, **what
else can we mine?** Apartment
Buildings are a massive collector of
RESOURCES

RESOURCES - HOW CAN WE USE THEM?

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GREYWATER – POTABLE WATER

FROM ROUX ENGINEERING

Hi Chris,

Please see attached draft treatment train schematic and preliminary equipment specification for the treatment of greywater for potable water use. I will send a separate email with the greywater for irrigation use work.

We have also completed a draft layout of equipment. We can adjust it to make things fit a little closer together, but ultimately, there is a lot of equipment associated with potable water use and we need space between equipment for piping. As a result, the system will not fit inside the existing mechanical room and, we'd need to bring in a large trailer to house the remaining equipment.

As a reminder, as there is currently no regulatory framework in MA for greywater to potable water use, this would require special approval by the MassDEP.

Important staffing note:

Per 310 CMR 22.11B(2)(a), to operate a system of this caliber for potable water use, there would need to be a Primary Water Treatment Operator staffed to the system for at least 35 hours each work week that the system operates. Additionally, per 310 CMR 22.11B(2)(b), there would need to be a Secondary Water Treatment Operator staffed during all other operating hours when the Primary Water Treatment Operator is not present. To reduce staffing costs, we could operate the system in batches only during the time that the Primary Water Treatment Operator is on-site (i.e., at least 35 hours each work week). Under this set-up, the treatment system would need one full-time operator staffed to the site and the system would need to be offline when the operator is not on-site. Potable water would need to be supplied by the municipal public water supplier (e.g., MWRA or BWSC) at all other times.

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DIRECT POTABLE REUSE

GREYWATER - POTABLE



RAIN WATER

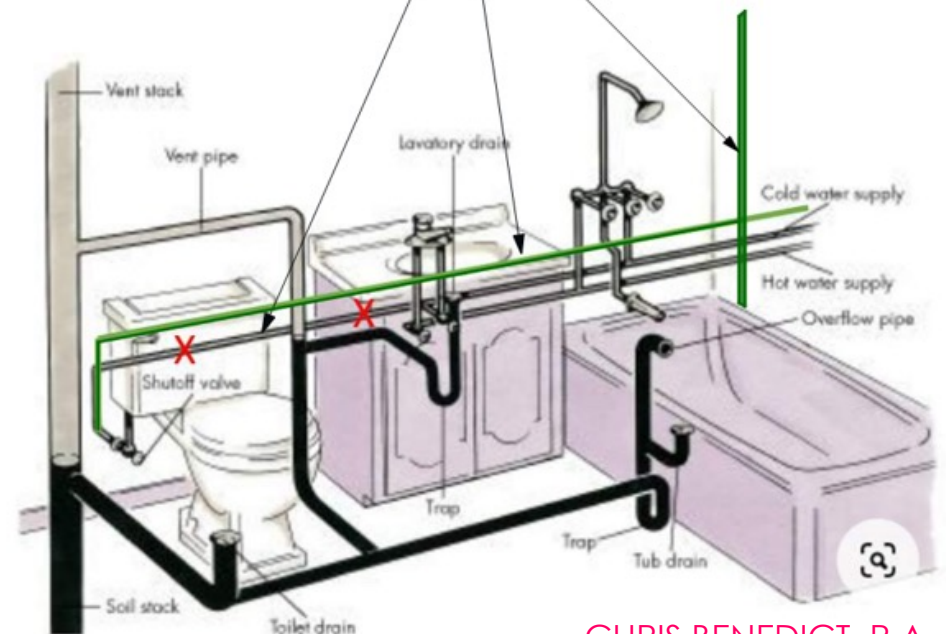
CAPTURED AND RECYCLED TO BE USED FOR **TOILET FLUSHING**

NEW RISERS AND DISTRIBUTION PIPES ADDED TO SUPPLY ALL TOILETS WITH RAIN WATER

ALL USED WATER (AKA BLACKWATER)

BROUGHT TO NEW BELOW GRADE SPACE, **FEECES SEPARATED TO MAKE METHANE** AND COMPOST, REMAINING BLACK WATER RUN THOUGH CONSTRUCTED WETLANDS FOR IRRIGATION WATER

PROVIDE NEW INSULATED COPPER WATER SUPPLY RISER PIPING & BRANCH PIPING TO TOILET IN EXISTING BATHROOM CHASE WALL. CAP & REMOVE EXISTING TOILET BRANCH PIPING.



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Wastewater Biogas Recovery System Concept

December 29, 2023

Recovery Potential

As summarized on Monday, December 18, 2023, the biogas recovery potential from collecting wastewater from the building (based on expected population ~180 people) is approximately 324 ft³/d or about 9 m³/d.

The recovered gas should be able to heat 500 gal/d of water from 55F to 120F. Cost savings with heat pump water heater is estimated at \$232 per year (assuming \$0.14kwh and 3.5 energy factor).

System Components

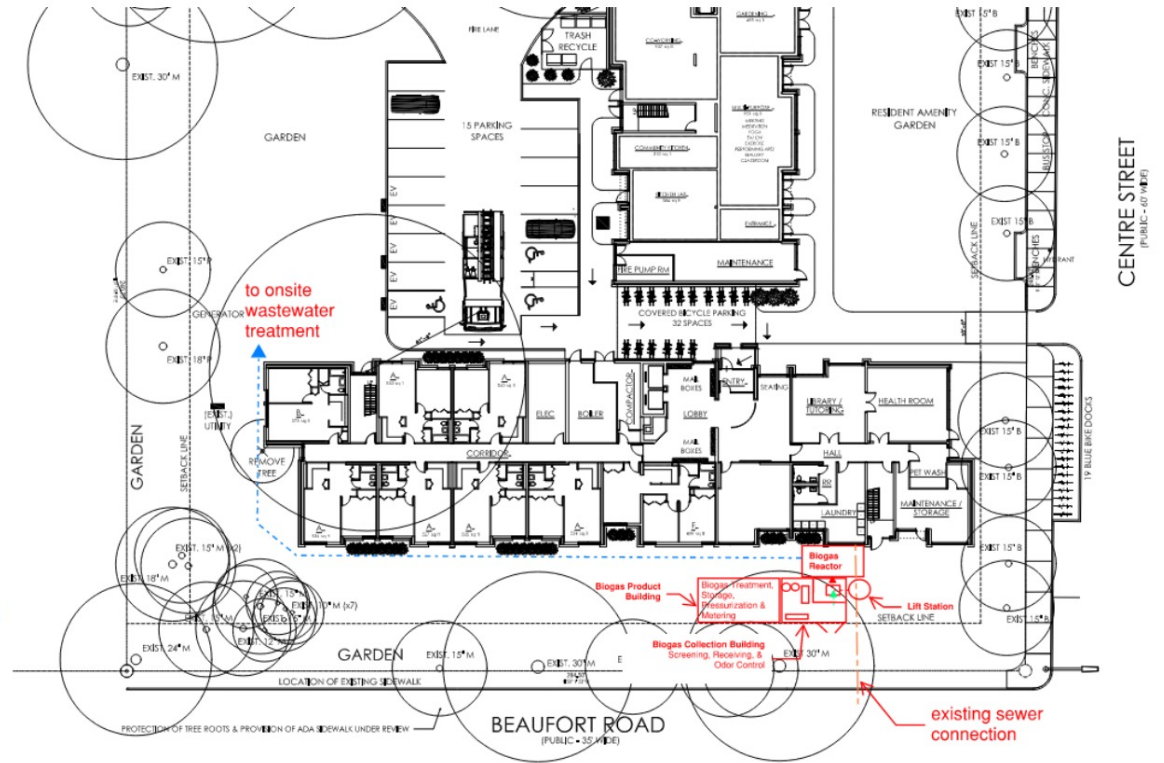
- Lift Station – below ground with grinder pump wastewater to Biogas Reactor
- Biogas Collection Building (300 sq ft with double doors for operations and maintenance)
 - Screening Equipment – fine screen in an enclosure – negative pressure room,
 - Receiving Station – to collect organic waste from the neighborhood,
 - Odor Control (fan & vessels) – from screening equipment and receiving station,
- Biogas Reactor (Insulated) with heating and mixing – built in a 20' long shipping container,
- Biogas Product Building (400 sq ft with double doors for operations and maintenance)
 - Biogas Treatment System
 - Biogas Storage
 - Biogas Pump and Controls

Financial Summary

Component	Cost Estimate	Notes
▪ Lift Station	\$50,000	civil to confirm
▪ Biogas Collection Building	\$50,000	allowance, architect to verify
- Filter Equipment	\$50,000	
- Receiving Station	\$20,000	allowance
- Odor Control	\$30,000	
▪ Biogas Reactor (in shipping container)	\$50,000	manuf. quote + shipping & install
▪ Biogas Product Building	\$50,000	allowance, architect to verify
- Biogas Treatment System	\$10,000	
- Biogas Storage	\$10,000	
- Biogas Pump and Controls	\$50,000	includes telemetry monitoring
TOTAL	\$370,000	no contingency
<i>Does not include design, permitting, or replacement cost</i>		
Annual savings	\$232	from not heating water
Annual O&M cost	\$50,000+	minimum estimate

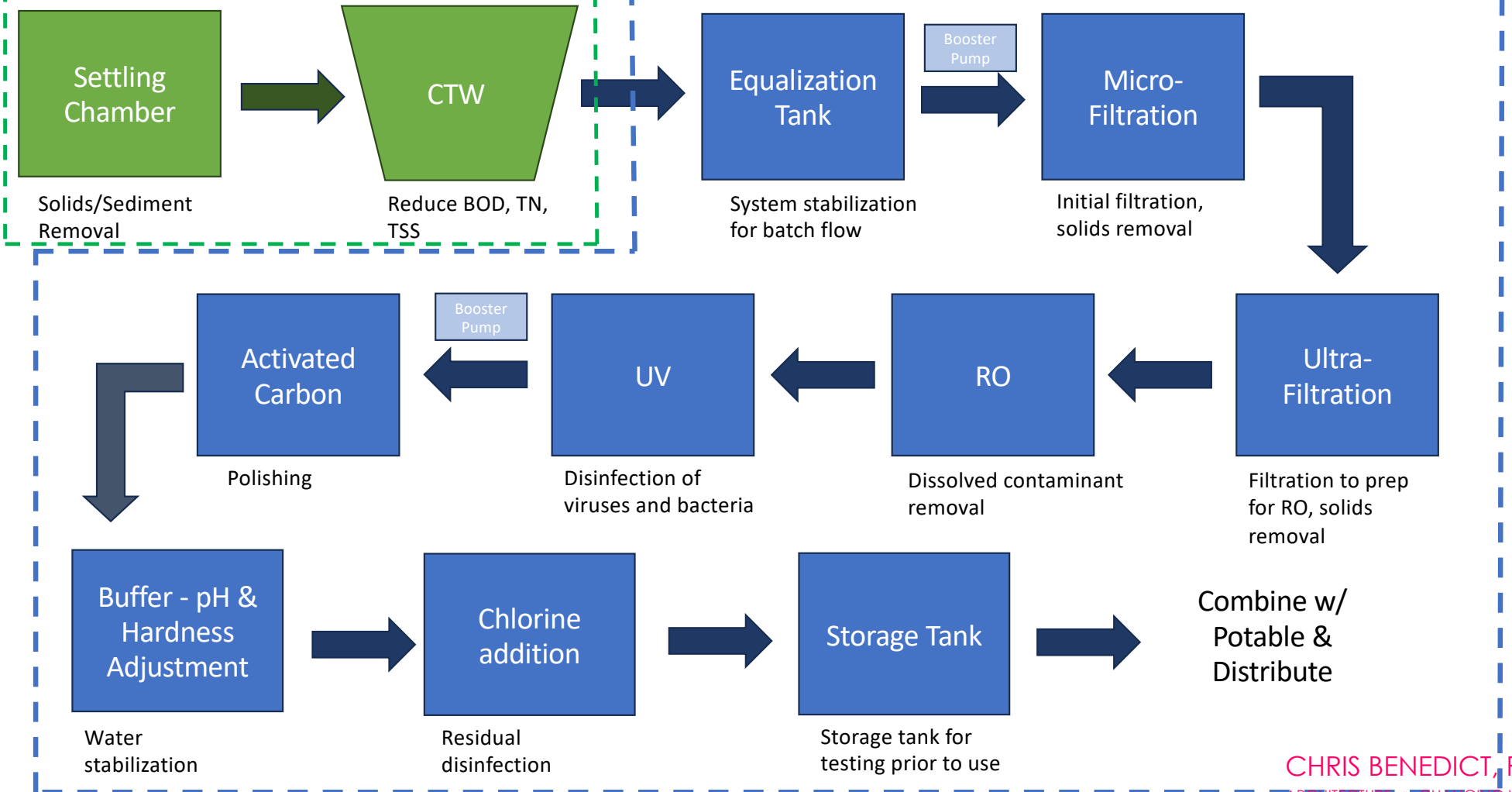
Additional Issues and Considerations

This assumes the digestate can be discharged to the sanitary sewer, which is not an insignificant issue. Same operator could operate biogas recovery system and onsite wastewater treatment/reuse system.



Treatment processes required for grey water re-use
(subject to MassDEP approval)

Treatment processes required for potable water re-use
(subject to MassDEP approval)

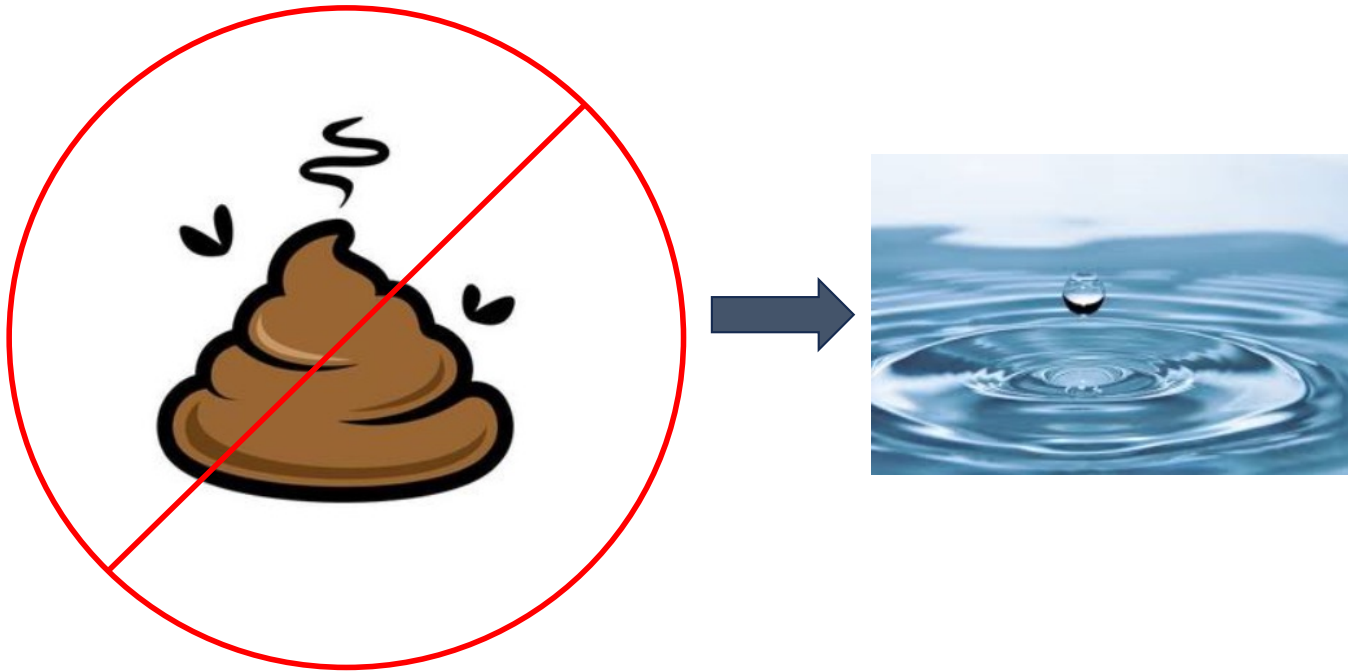


Preliminary Specification of Equipment for Greywater to Potable Water Use

Capital Equipment for Greywater to Potable Water		
Treatment Process	Equipment Needs	Specifications
Equalization	Tank	15,000 gallon capacity tank, polyethylene
Booster Pump	Pump	Centrifugal pump with at least 15 ft head at 10 gpm (similar to: Fristam Pumps Model 711, 1/4 HP pump, 105 mm impeller diameter, 2" inlet, 1.5" outlet)
Micro-filtration	Micro-filtration vessel Filter screen	Stainless steel filter casing with 30-micron screen filter; self cleaning if possible to minimize O&M cost
Ultra-Filtration	Ultra-filtration system Membrane cartridges	Stainless steel filter casing with 0.02 um nominal membrane pore size (similar to: DuPont IntegraTec MB 38)
Reverse Osmosis	Reverse Osmosis System (sediment and carbon pre-filters, high-pressure pump, RO membrane)	Similar to: FCI Watermarkers M4 Series, Model M4-6, which provides up to 15,600 GPD using six 4"x40" RO membranes, 3HP pump; system provides 50-60% recovery
UV	UV Reactor System (vessel, UV lamps, lamp sleeves, UV sensors, temperature sensors, control panel)	2x stainless steel chambers for dual UV lamps, 5 amps, lamp power 400 watts (similar to: Viqua Adenovirus PRO24-186 model)
Booster Pump	Pump	Centrifugal pump with at least 15 ft head at 10 gpm (similar to: Fristam Pumps Model 711, 1/4 HP pump, 105 mm impeller diameter, 2" inlet, 1.5" outlet)
Activated Carbon	Carbon adsorption vessel Liquid-phase granular activated carbon	2x carbon vessels each containing 5,000 lbs of liquid-phase granulated activated carbon (similar to: Xylem PV 5000)
Chemical Adjustment (pH, hardness, disinfectant)	Chemical injection pumps Housing for chemical storage (liquid soda ash for pH; magnesium sulfate and/or calcium carbonate for hardness; monochloramine reagents for residual disinfectant) Sensors	3x low-feed rate chemical injection pumps, flow analyzer capable of 5-50 gpm range, pH analyzer, hardness analyzer, conductivity analyzer, chlorine analyzer, secondary containment housing for material storage drums (for disinfectant, similar to: Clarity Water Sanitec 500 G/H Monochloramine Generator)
Holding Tank	Tank	15,000 gallon capacity tank, polyethylene



REALIZATION



MY PATH TO NET ZERO WATER

CHRIS BENEDICT, R.A.
ARCHITECTURE <> CHANGING WORLD

REALIZATION

Passive House showed
that we could mine **HEAT**
from people and their
activities in a building,
what else can we mine?
Apartment Buildings are a
massive collector of
NUTRIENTS!

SOURCE SEPARATION:

SEPARATION OF
TOILET PRODUCT (BLACK WATER)
FROM THE REST OF THE
WASTE WATER (GREY WATER)
FLOWING THROUGH THE BUILDING
EASES THE PROBLEM AND ALLOWS
FOR REPURPOSED WATER AND
COMPOST



A Sewer is a Mistake

From Les Misérables, by Victor Hugo, 1867

Paris throws five million a year into the sea. And this not metaphorically. How, and what way? Day and night. With what purpose? None. With what thought? Without thinking about it. For what use? For nothing. By means of what organ? By means of its intestine. What is its intestine? Its Sewer...

After long experimentation, science now knows that the most fertilizing and the most effective of manures is that of man. The Chinese, we must say to our shame, knew it before us. No Chinese peasant, Eckerberg tells us, goes to the city without carrying back, at the two ends of his bamboo pole, two buckets full of what we call filth. Thanks to human fertilizer, the earth in China is still as young as in the days of Abraham. Chinese wheat yields a hundred and twenty-fold.

There is no guano comparable in fertility to the detritus of a capital. A great city is the most powerful of dung producers. To employ the city to enrich the plain would be a sure success. If our gold is manure, on the other, our manure is gold. What is done with this gold, manure? It is swept into the abyss.

At great expense, we send out convoys of ships, to gather up at the South Pole the droppings of petrels and penguins, and the incalculable element of wealth that we have at hand we send to the sea. All the human and animal manure that the world loses, if restored to the land instead of being thrown into the water, would suffice to nourish the world...

This garbage heaped up beside the stone blocks, the tumbrels of mire jolting through the streets at night, the awful scavengers' carts, the fetid streams of subterranean slime that the pavement hides from you, do you know what all this is? It is the flowering meadow, it is the green grass, it is marjoram and thyme and sage, it is game, it is cattle, it is the satisfied lowing of huge oxen in the evening, it is perfumed hay, it is golden wheat, it is bread on your table, it is joy, it is life. So wills that mysterious creation, transformation on earth and transfiguration in heaven.

Put that into the great crucible; your abundance will spring from it. The nutrition of the plains make the nourishment of men. You have the power to throw away this wealth, and to think me ridiculous into the bargain. That will be the crowning glory of your ignorance...

The present system does harm in attempting to do good. The intention is good, the result is sad. Men think they are purging the city; they are emaciating the population...

A sewer is a mistake.

FROM PHOENIX
COMPOSTING
TOILET SITE!

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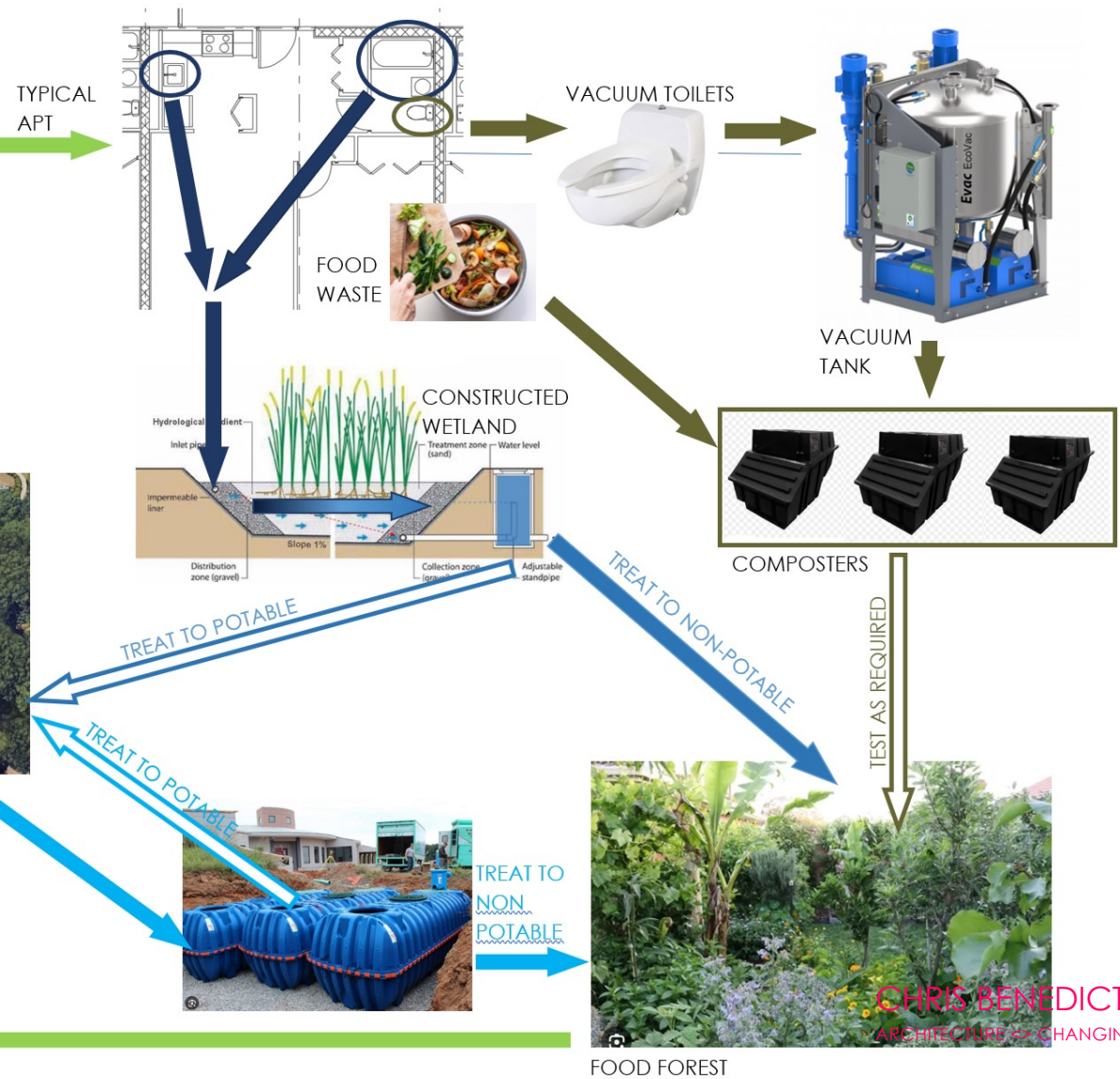
TENANTS



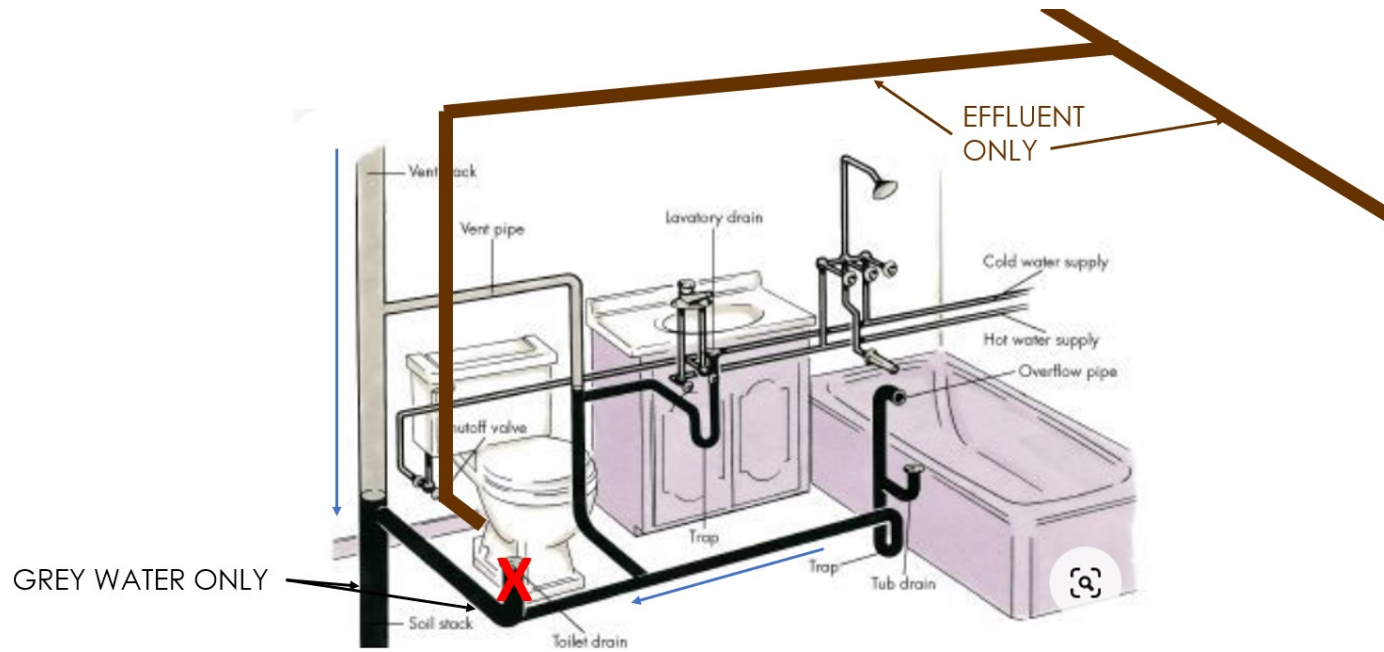
THE FORBES BUILDING



FOOD

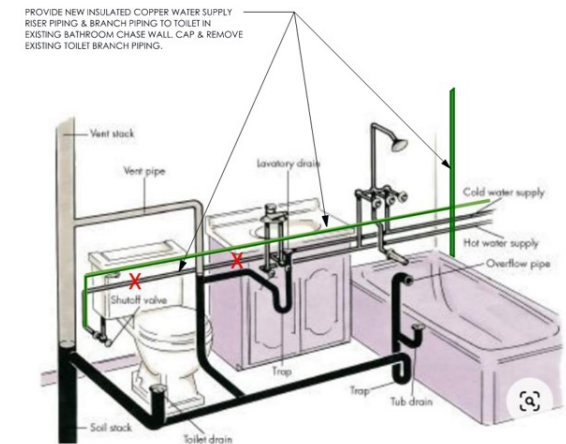


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RAIN WATER AND **GREY WATER** ARE PURIFIED AND USED AS CLEAN WATER FOR ALL PURPOSES

TOILET PRODUCT IS COMPOSTED AND SENT TO FOOD FARMS, FOOD FARM SENDS BACK FOOD?



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WHY DO THIS?

WE DON'T WASTE THE GIFT OF CLEAN WATER

WE CAN CAPTURE NUTRIENTS THAT WE NEED TO SURVIVE
(NPK) AND OTHER GOOD STUFF!

WE DON'T DUMP OUR WASTE INTO THE ENVIRONMENT AND
CAUSE HARM

**WE RECONNECT THE FLOW THROUGH OUR BODIES TO THE
CIRCLE OF LIFE**

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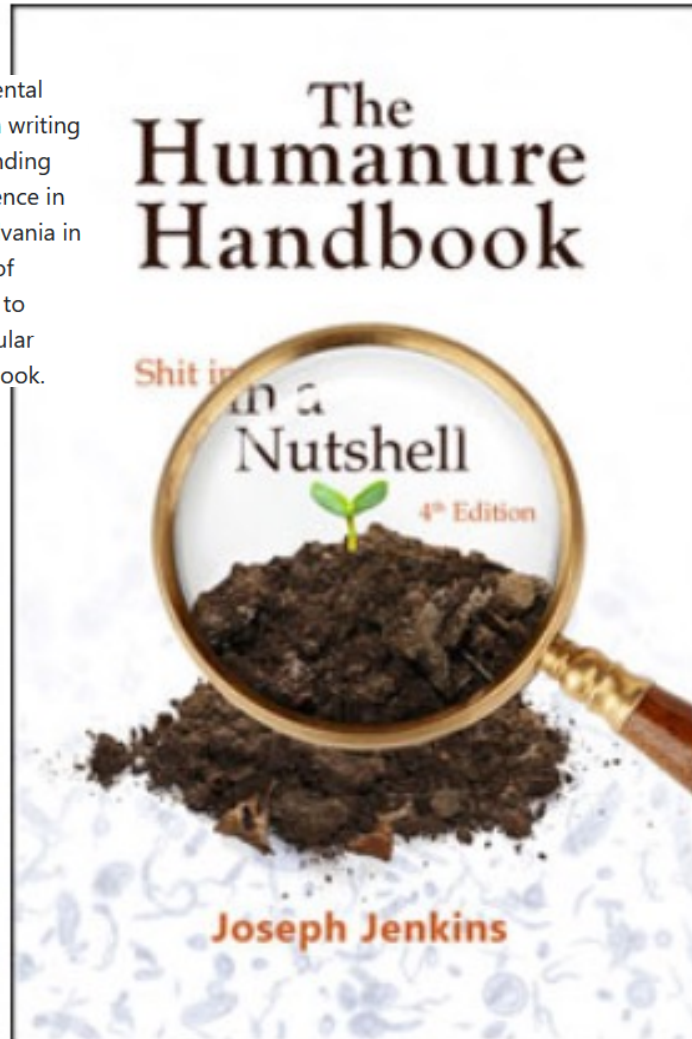
A man with grey hair and a beard, wearing a dark blue polo shirt, is sitting on a wooden bench inside a tiny house. He is looking towards the camera. In front of him on the bench is a green plate. The interior of the tiny house is made of wood and has various items hanging on the walls, including a roll of paper and some papers. The lighting is warm and indoor.

JOE JENKINS

LoveableLoo.com: Ph: 814-786-9085

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The Humanure Handbook was an accidental literary phenomenon. Joe Jenkins began writing the book as a master's thesis while attending Slippery Rock University's Master of Science in Sustainable Systems program in Pennsylvania in the early 90s. Fascinated with the topic of humanure composting, Jenkins decided to convert the book's language into a popular format and self-publish the thesis as a book.



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THERMOPHILIC PROCESS

◆ AI Overview

An aerobic thermophilic process is a biological waste treatment method that uses oxygen-breathing, heat-loving bacteria to rapidly break down organic material. It self-heats to high temperatures, typically between 55°C and 80°C (131°F to 176°F), driven entirely by the metabolic heat released during microbial oxidation. This technology is widely applied in advanced composting and [Autothermal Thermophilic Aerobic Digestion \(ATAD\)](#) for sewage or animal slurries. [PubMed Central \(PMC\) ... +7](#)



CARBON MATERIAL MUST BE ADDED FOR THIS PROCESS TO OCCUR –
WHAT IS THE URBAN CARBON MATERIAL TO ADD?

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CHALLENGES WITH FLUSH-TOILET CULTURES

Even though water shortages and sewage pollution plague the U.S., Jenkins's solutions haven't gotten as much traction here as they have abroad. Red-tape and onerous regulations make it expensive and difficult to pilot the humanure system at the community scale. To embrace compost toilet solutions in a flush-toilet culture is "an uphill battle," says Jenkins. However, his system is used in alternative living setups, including cabins, off-grid homes, as well as the [Kailash Ecovillage](#), in Portland, Oregon. There, a [large humanure system](#) processes feces and urine from the residents to make compost, all with city approval. The Portland project followed guidance in a green plumbing standard called [We-Stand](#), which is available for other communities to use, too.

KAILASH ECOVILLAGE



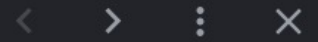
Compost bin system at Kailash Ecovillage in Portland, Oregon with child-proof gate, screened vents, and durable concrete blocks to prevent animals from getting in. Credit: Ole Ersson in *The Compost Toilet Handbook*

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KENDED BUILDING



The Kendeda Building - Georgia Tech



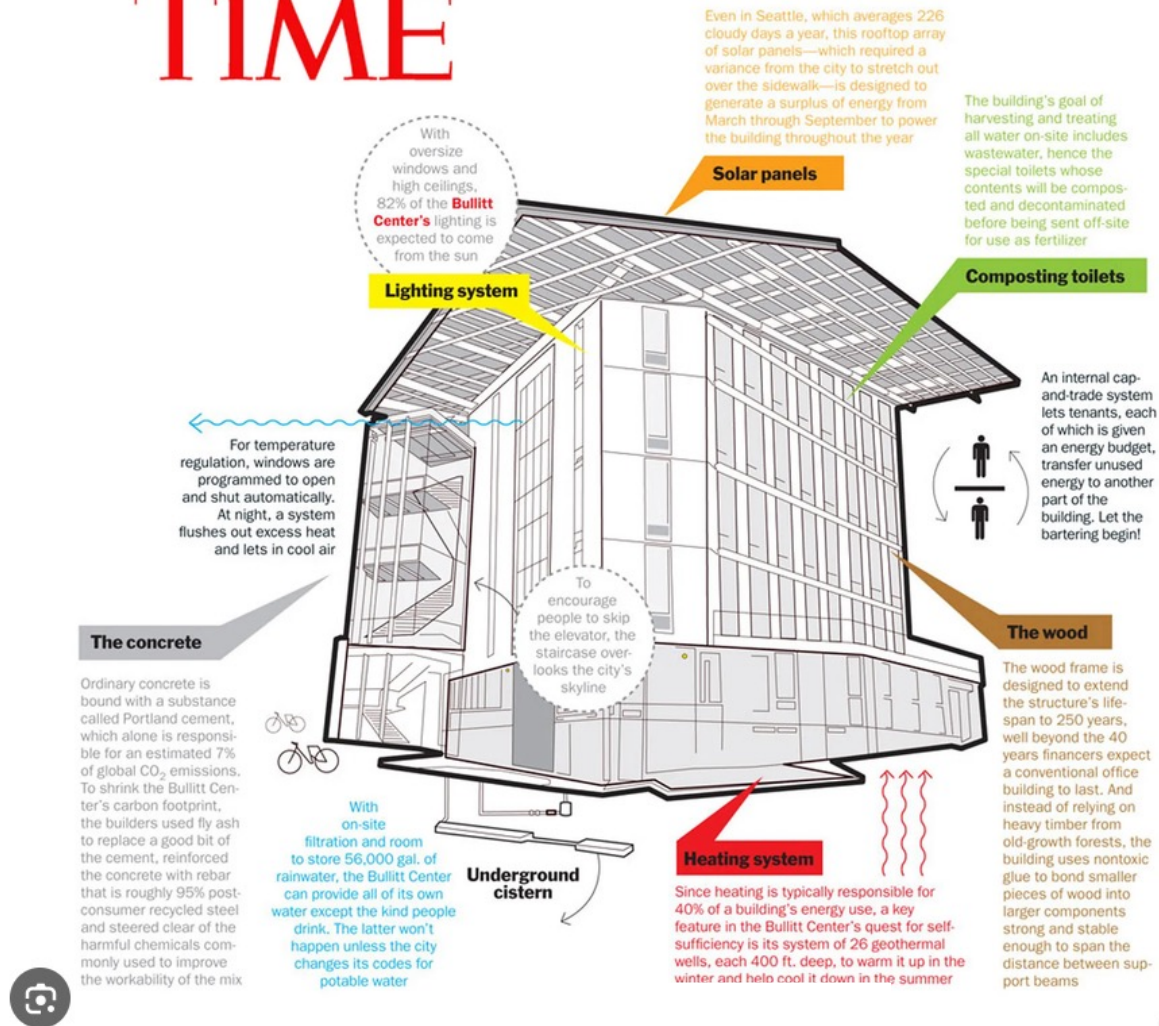
ESOL Composting Toilets | The Kendeda Building for Innovative Sustainable Design

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Visit

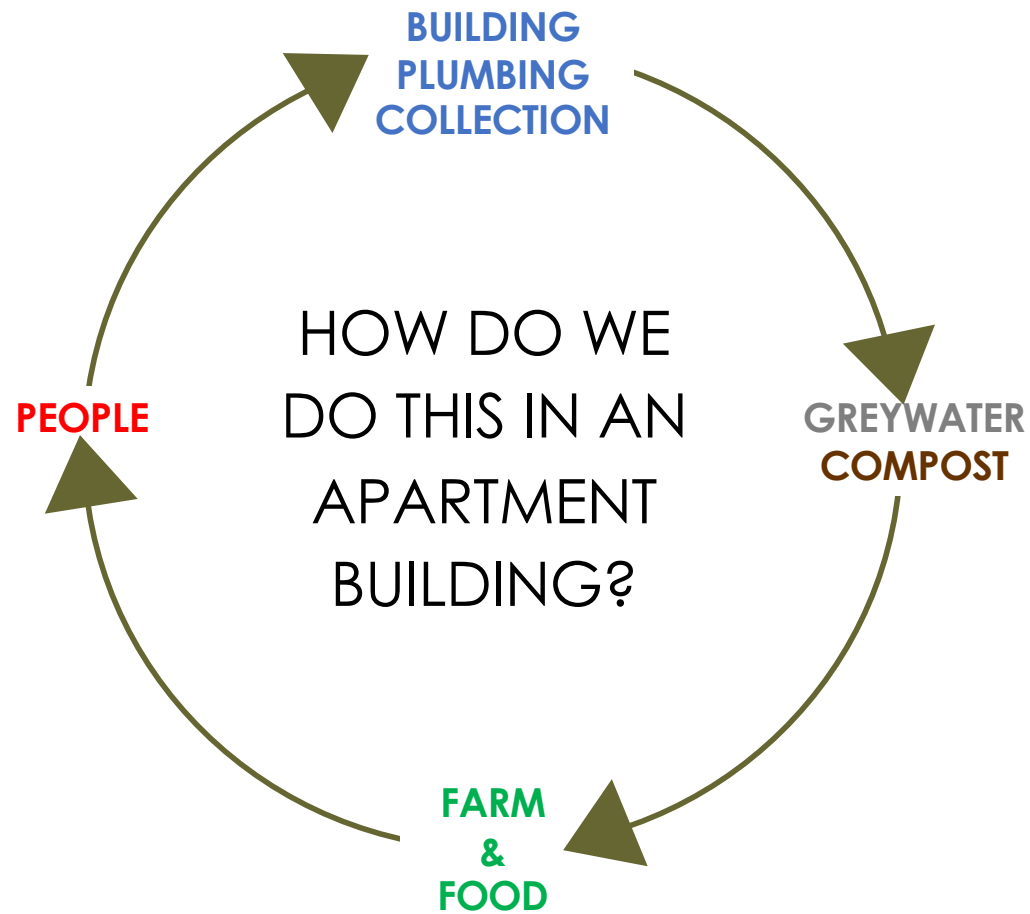
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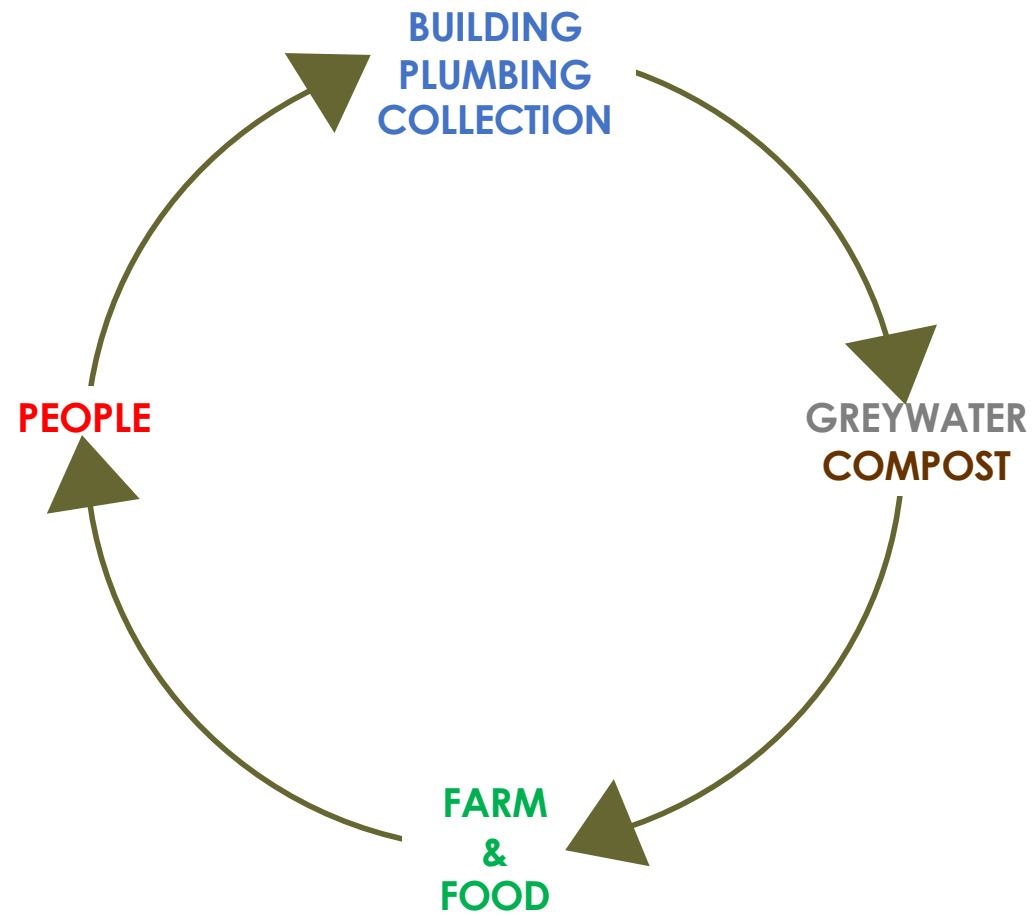


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2,100 x 1,800



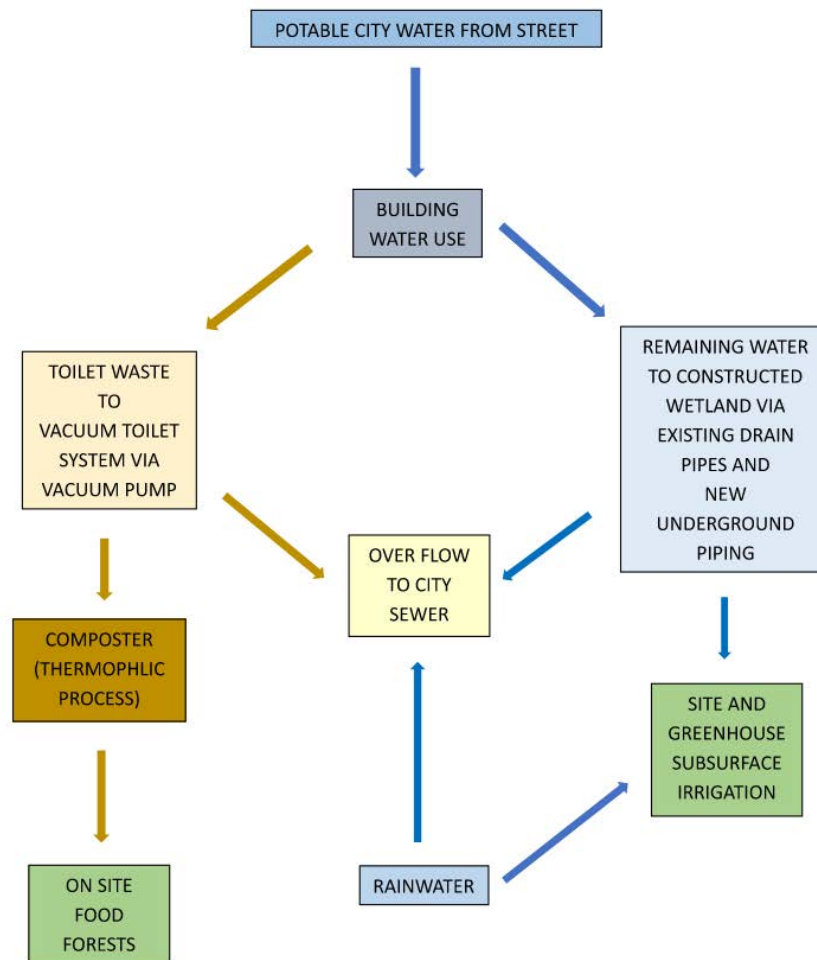
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HOW DO WE DO THIS IN AN APARTMENT BUILDING?

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WATER & WASTE FLOW CHART
11 AUGUST 2025

PREDICTED FLOWS:

147 APARTMENTS

250 PEOPLE

GREY WATER

7,258 GALLONS/DAY

7258 GALLONS/DAY < 10,000 GALLONS/DAY

TOILETS TO COMPOST

WATER CONTRIBUTION:

5 FLUSHES/DAY PER PERSON

.2 GAL/FLUSH

.2 GAL x 5 FLUSHES = 1 GAL WATER/PERSON/DAY

1 GAL/DAY x 250 PEOPLE = 250 GAL/DAY

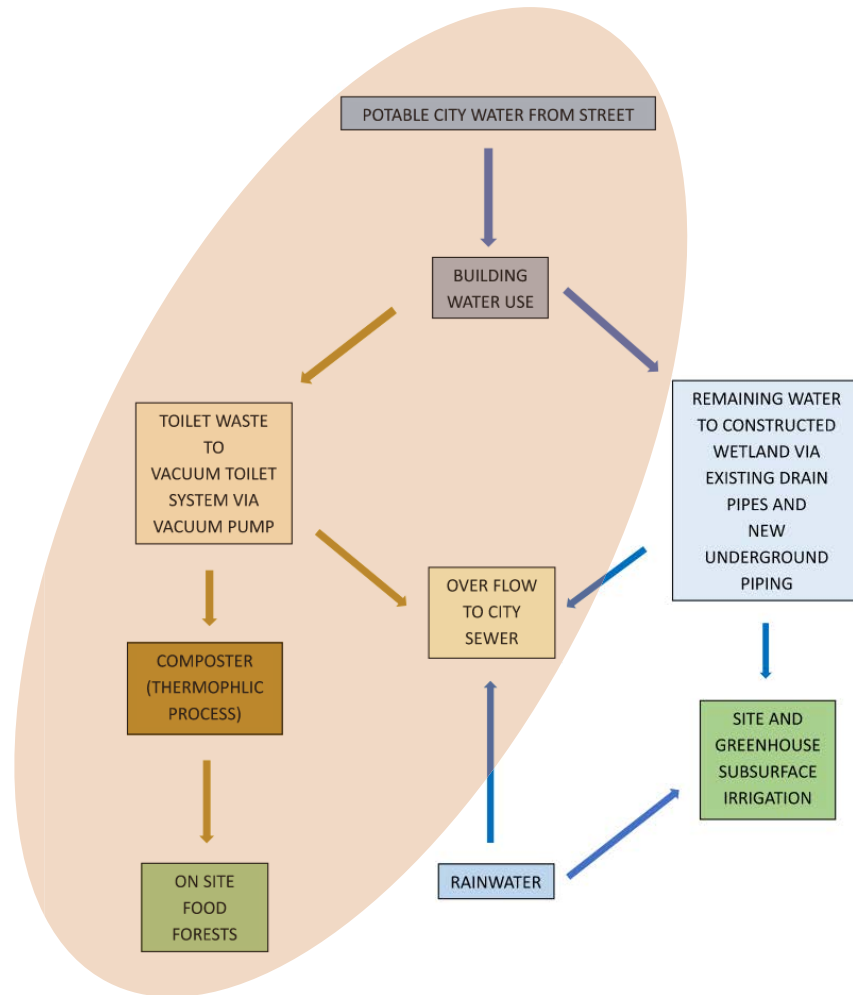
TOILET PRODUCT CONTRIBUTION:

.25 GAL OF TOILET PRODUCT PER DAY PER PERSON

.25 x 250 = 62.5 GAL OF TOILET PRODUCT PER DAY

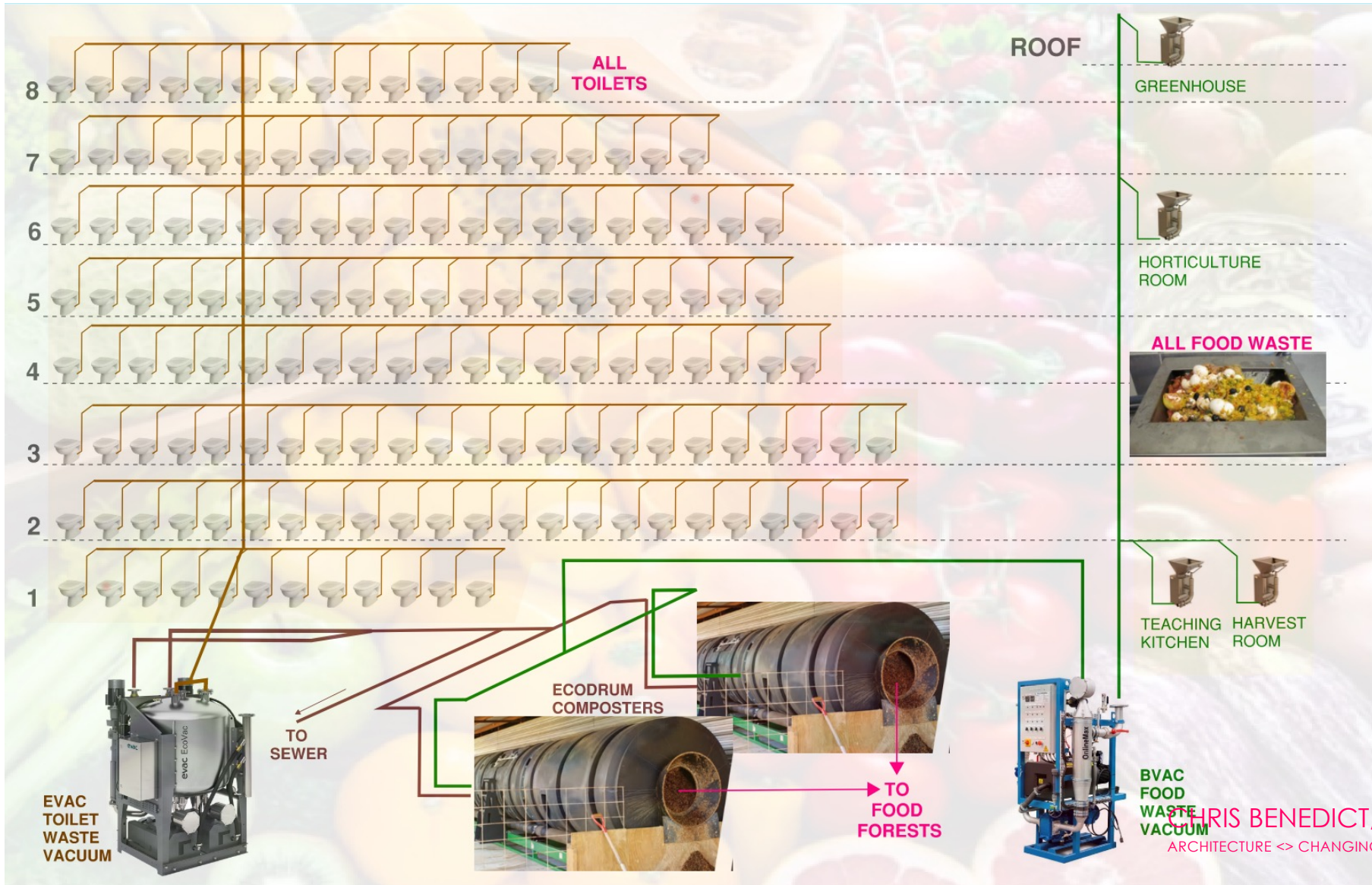
TOTAL TOILETS TO COMPOST: 312.5 GALLONS/DAY

312.5 GALLONS/DAY < 10,000 GALLONS/DAY



**545 CENTRE STREET
WATER & WASTE FLOW CHART**

Vacuum toilets/Ecodrum



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FOOTPRINT, ECODRUM MODEL 730

VOLTAGE: 240 V

AMPERAGE: 20 A

WEIGHT: 6,100 LBS

ALL DIMENSIONS FOR REFERENCE ONLY

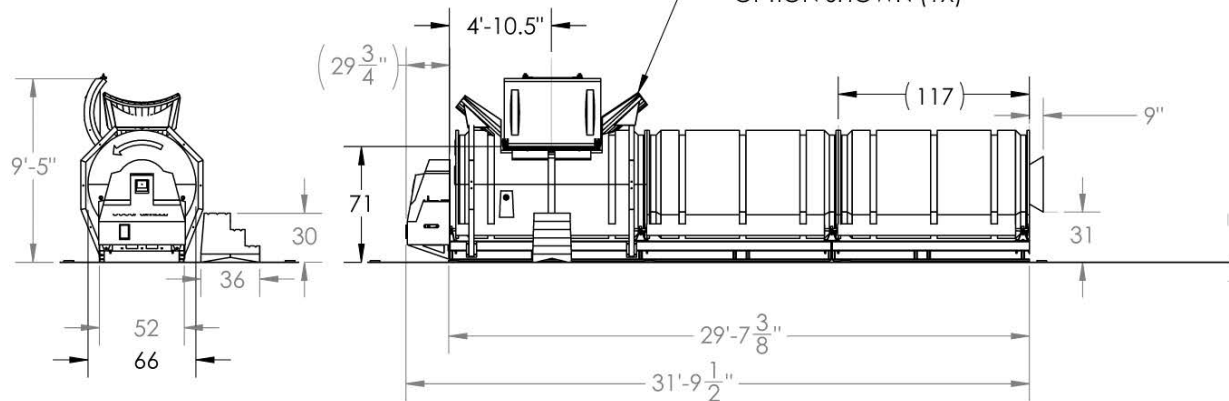


DOOR OPENING
58" X 36" TYP 1X

POLY PLATFORM STAIRS
PN 15200
OPTION SHOWN (1X)

LOAD ASSIST
PN 17900
OPTION SHOWN (1X)

DISCHARGE



				MATERIAL		TITLE: FOOTPRINT, 730 W STAIRS LOAD ASSIST AND CLEARANCE DRAWING NO.	NEXT ASSY:	
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				TOLERANCES: UNLESS OTHERWISE SPECIFIED			SCALE: 1:128 	
				FRACTION			SALES P/T	
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Why Ecodrum?

Ecodrum™ Composter is the leading provider of on-site in-vessel composting systems in North America.

In the past decade, Ecodrum™ has built relationships with over 1,000 clients worldwide. Ecodrum™ continues to work diligently with top universities on product development and compost research, including Texas A&M, Washington State University, University of Arkansas, and Louisiana State University, amongst others.

Cost Effective

The Ecodrum™ is a year-round controlled system. The cost of owning and operating the Ecodrum™ is comparable to, or less than that of other management options.

Fits Your Farm Operation

The specialized PLC controller (patent pending) allows for accurate automation of your composting operation. By simply choosing a pre-set cycle that matches your operation, the system will automatically adjust to your current needs.

Ecodrum™ Model					
410	420	720	730	740	750
55cu 25kg	110cu 50kg	330cu 150kg	525cu 240kg	690cu 315kg	925cu 420kg

* Actual usable diameter of drum for 4 series models is approximately 40" and 7 series models is approximately 57".

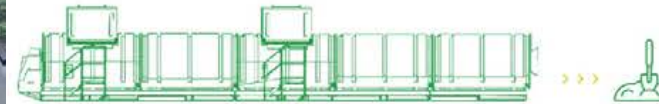
** Capacities listed are maximum estimated pounds of monthly. Actual capacity of any Ecodrum™ model may vary depending on factors such as species, slope and bedding material used. Feed material waste is approximately double the capacity that is shown.

Features

- Molded from corrosion-free polyethylene for longevity
- Control system is automated and easy to use
- Forced air exhaust
- Supported by heavy-duty drive
- Powered by a 1hp 220v motor for low energy cost
- Stainless steel temperature probe
- Quick latch door
- Automatically discharges compost every rotation
- Expandable with 10' and 20' kits available

Optional Equipment

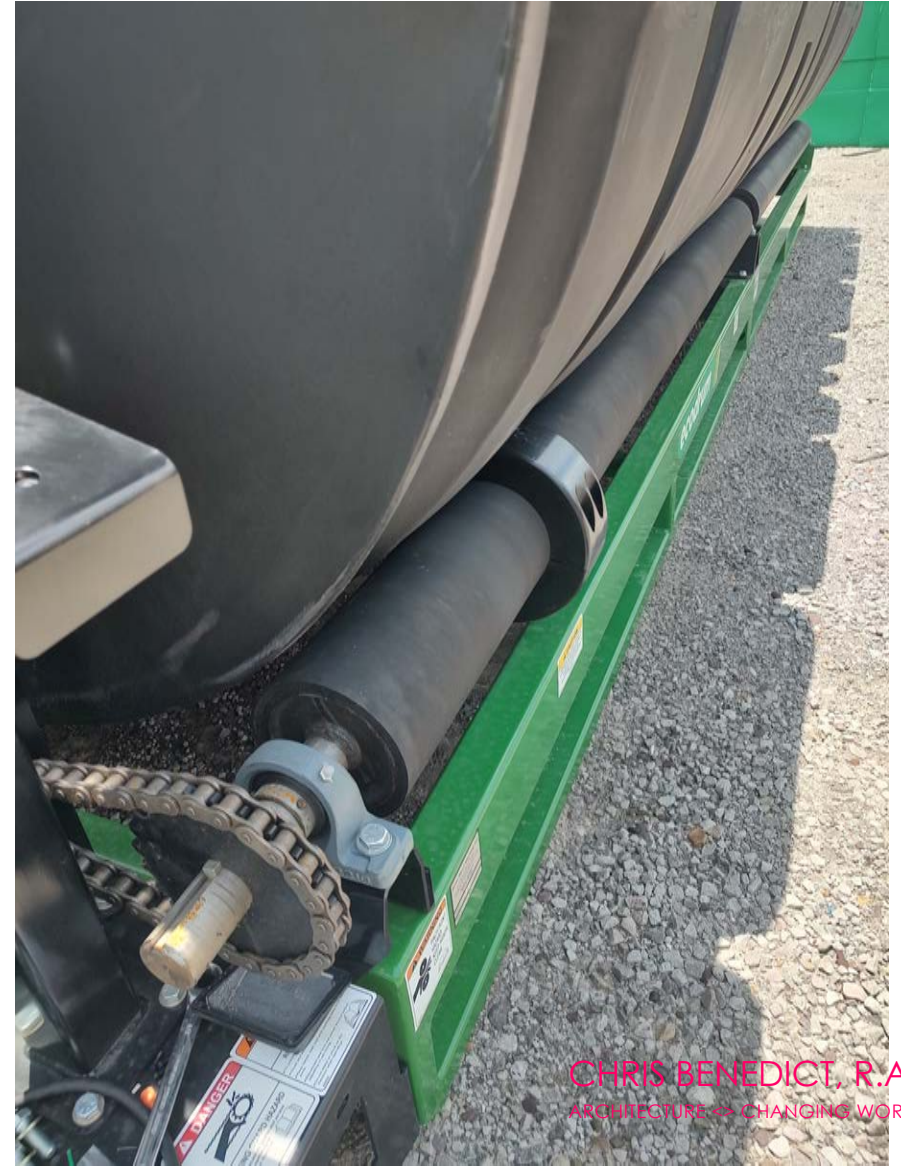
- Conveyors 20' or 30'
- Vertablend Mixer
- Scale system
- Bone crusher
- Bio filter



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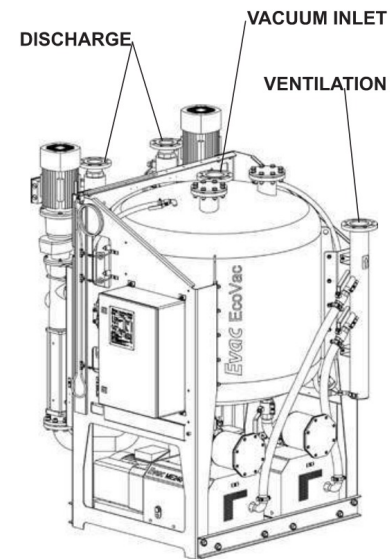
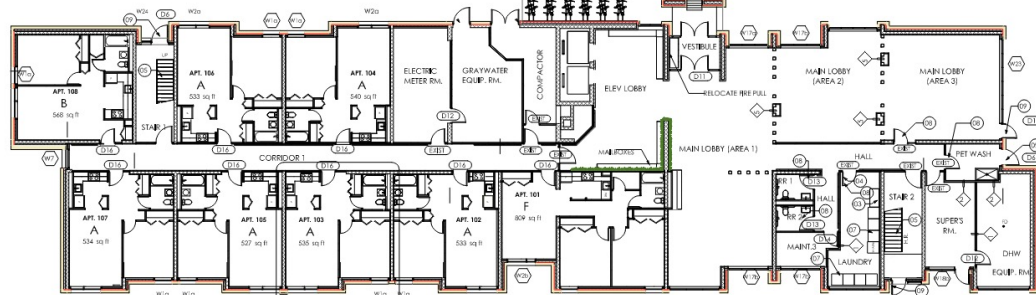
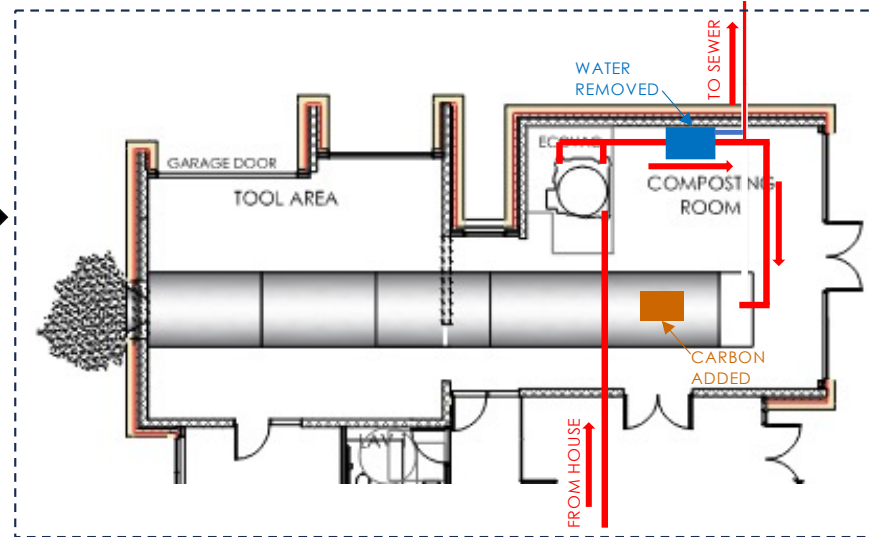
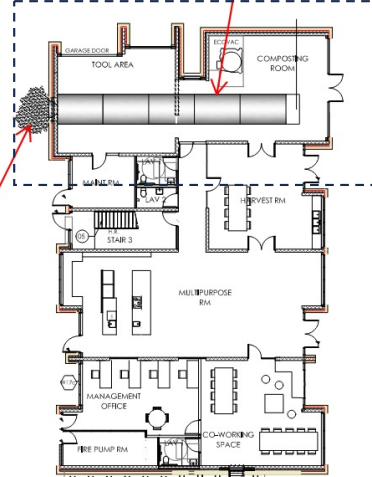
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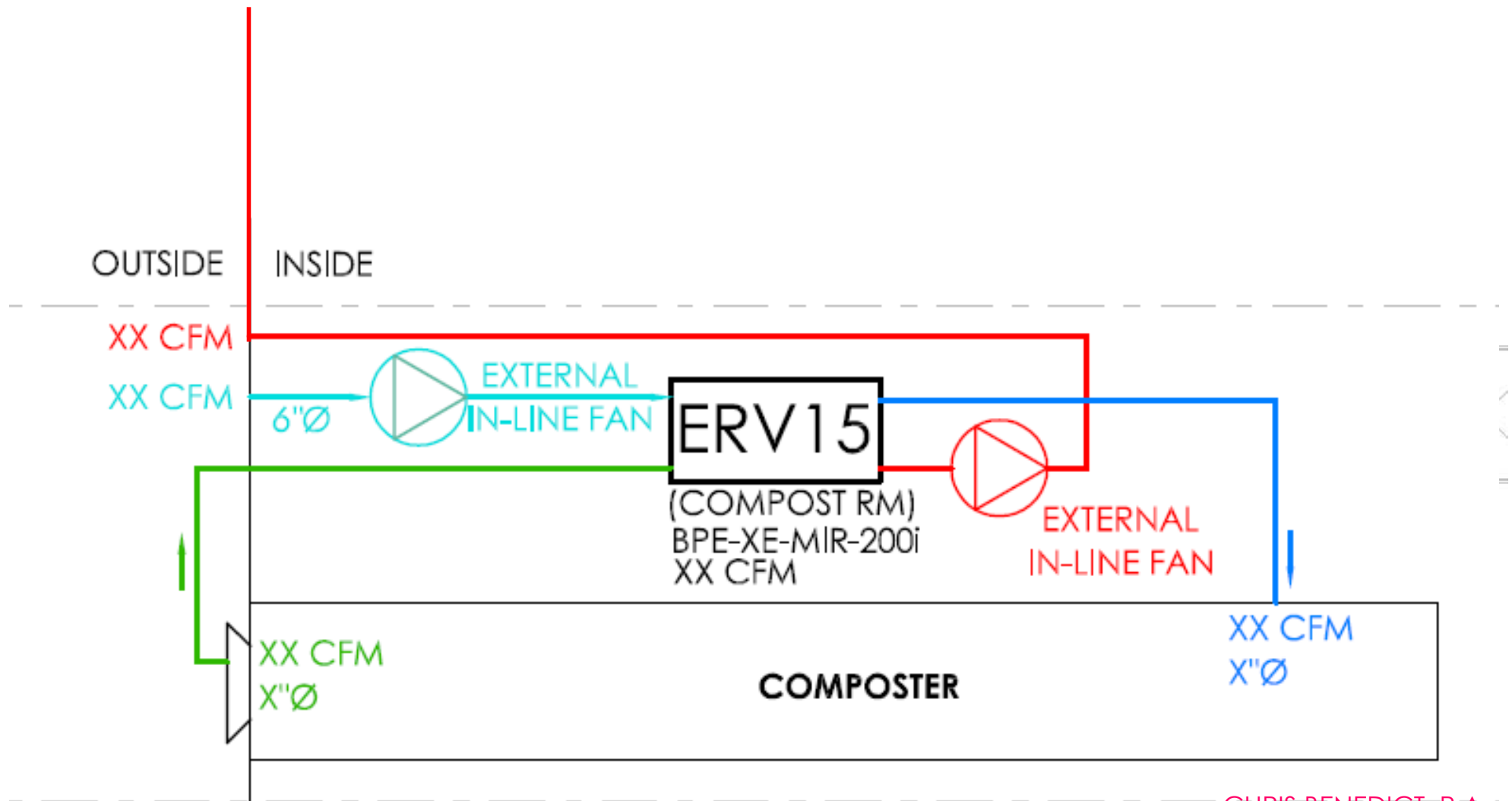
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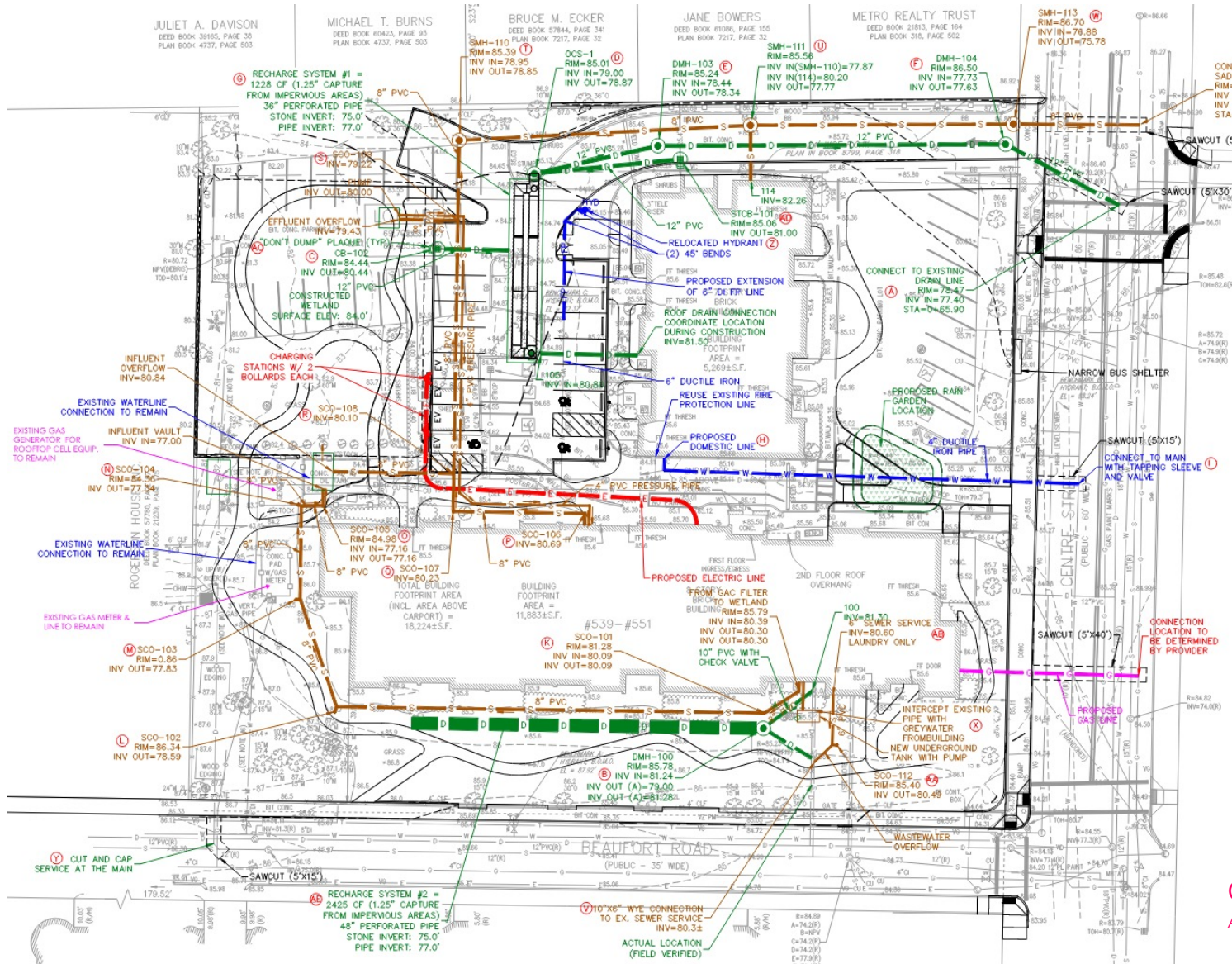
ONE
ECODRUM
WITH FIVE
CHAMBERS

ECODRUM
DUMPS
OUTSIDE
(END IS
THROUGH
THE WALL)



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BWSC INSPEI		BWSC INSPEI	
(A) CONNECT TO		(A) CONNECT TO	
(B) DMH-100		(B) DMH-100	
(C) CB-102		(C) DMH-100	
(D) OCS-1		(D) CB-102	
(E) DMH-103		(E) OCS-1	
(F) DMH-104		(F) DMH-103	
(G) RECHARGE		(G) DMH-104	
(H) DOMESTIC W		(H) RECHARGE	
(I) CONNECT TO		(I) DOMESTIC W	
(J) CONNECT TO		(J) CONNECT TO	
(K) SCO-101		(K) SCO-101	
(L) SCO-102		(L) CONNECT TO	
(M) SCO-103		(M) SCO-101	
(N) SCO-104		(N) SCO-102	
(O) SCO-105		(O) SCO-103	
(P) SCO-106		(P) SCO-104	
(Q) SCO-107		(Q) SCO-105	
(R) SCO-108		(R) SCO-106	
(S) SCO-109		(S) SCO-107	
(T) SMH-110		(T) SCO-108	
(U) SMH-111		(U) SCO-109	
(V) 10\"/>			
(W) 10\"/>			
(X) INTERCEPT		(X) 10\"/>	
(Y) CUT AND D		(Y) INTERCEPT I	
(Z) RELOCATED		(Z) CUT AND D	
(A) SCO-112		(A) RELOCATED	
(B) 6\"/>		(B) SCO-112	
(C) \"DON'T D		(C) 6\"/>	
(D) STGB-101		(D) \"DON'T D	
(E) RECHARGE		(E) STGB-101	
		(F) RECHARGE	

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VACUUM COLLECTION

Evac Optima 5S toilet

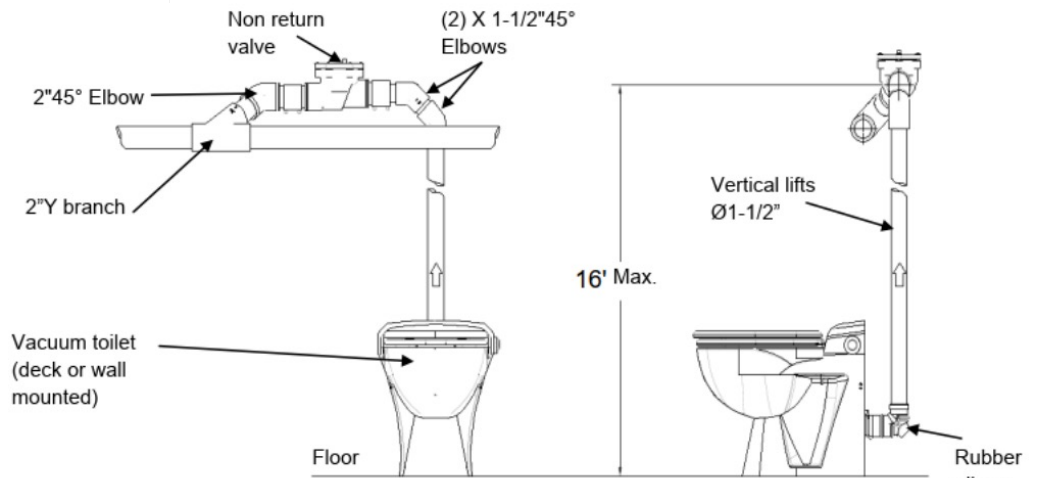
The Evac Optima® 5S is the next generation, ultra-silent vacuum toilet. The noise level of flush operation, 66db(A), is up to two times lower compared to other solutions on the market. The significant noise reduction will make visits to the toilet much more pleasant and is the optimal choice for passenger vessels and hospitality sector.

- ✓ Ultra-silent solution
- ✓ Extra-hygienic antimicrobial materials
- ✓ Reliable operation with flush memory

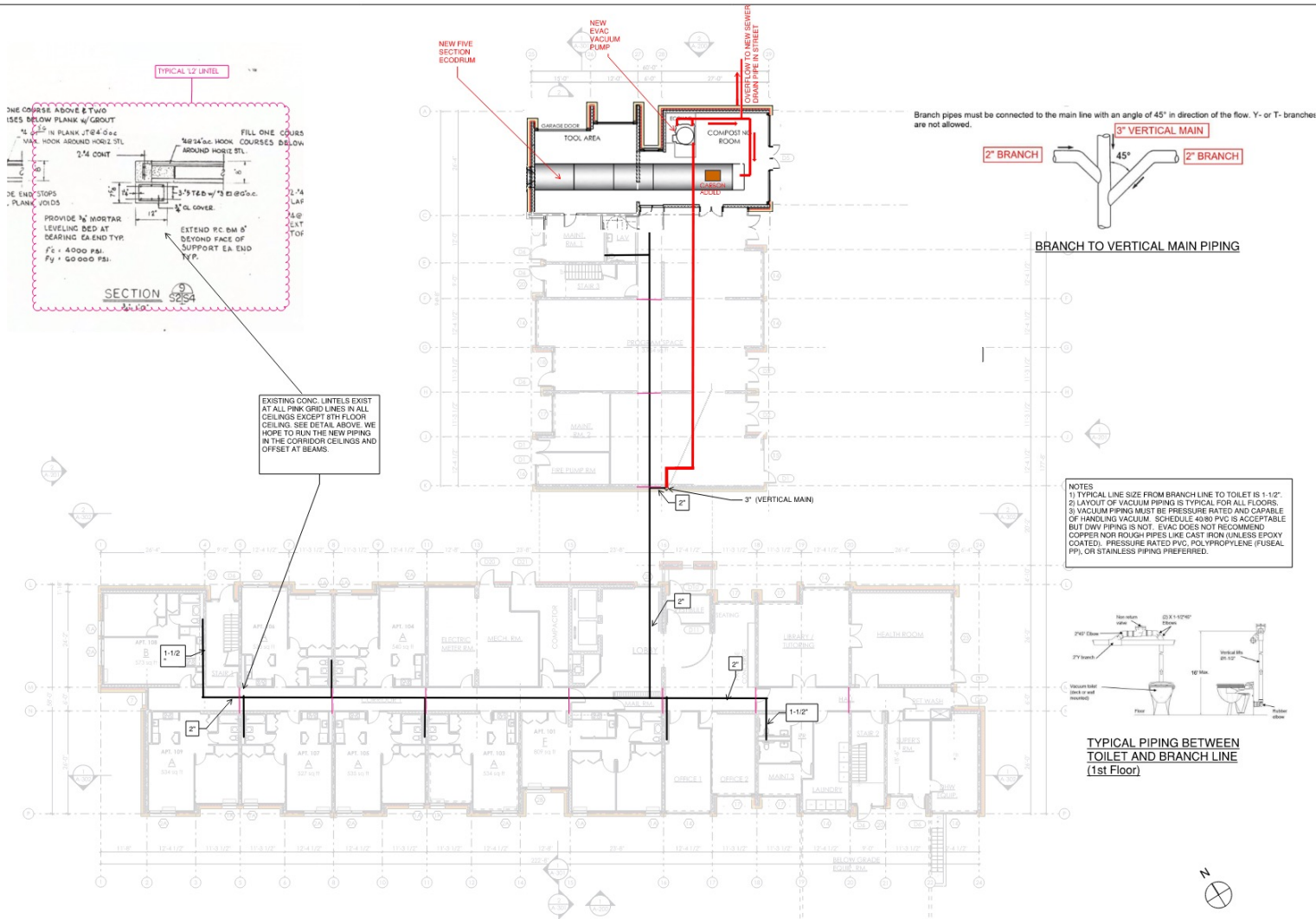
Key benefits

Technical data

Contact us



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1 1ST FLOOR PLAN - VACUUM TOILET LAYOUT
SCALE: 1" = 1'-0"

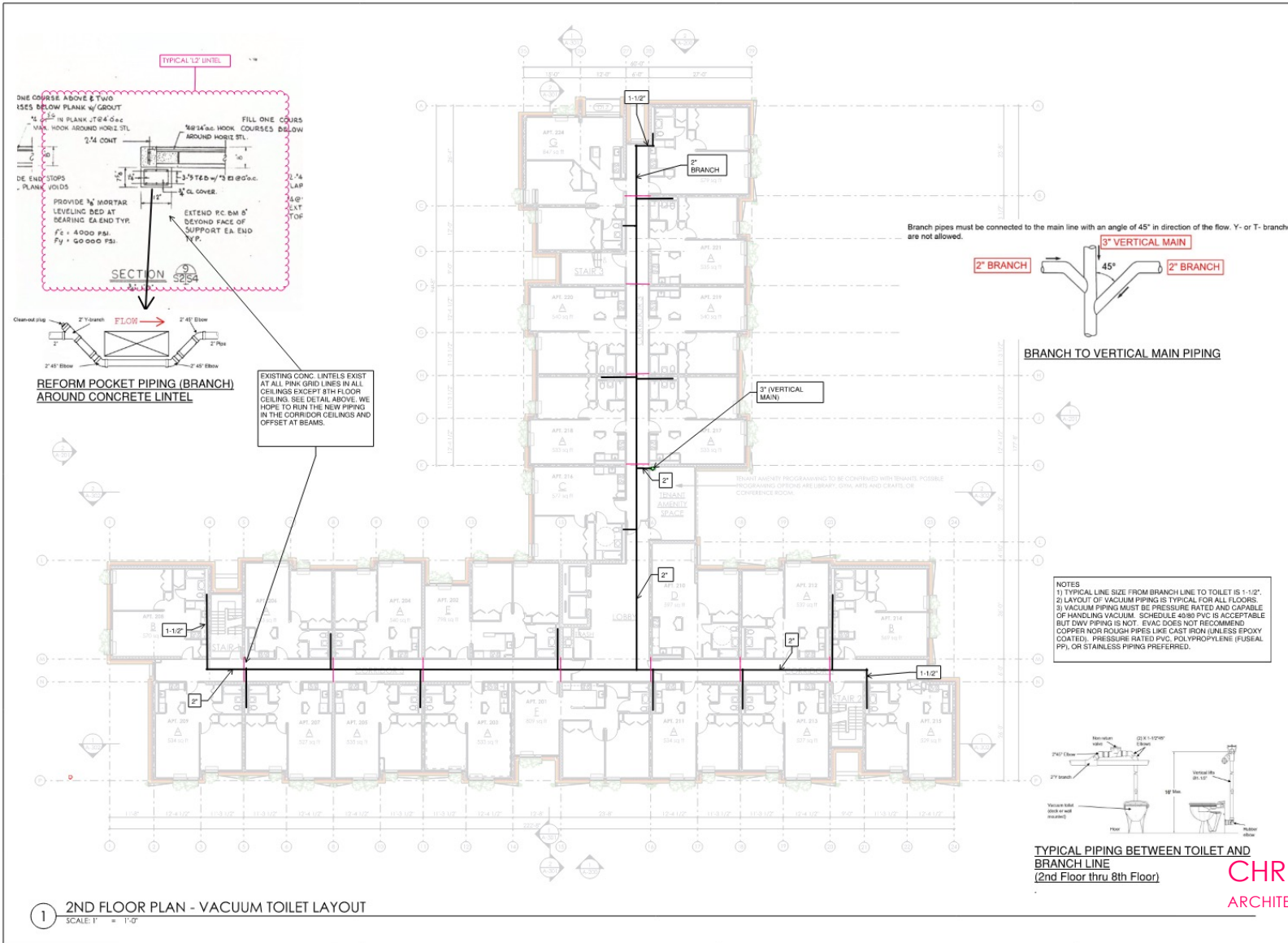
ARCHITECT
CHRIS BENEDICT, R.A.
ARCHITECTURE <> CHANGING WORLD
317 EAST 9TH STREET NYC 10003 212.477.4014

PROJECT
FORBES BUILDING
545 CENTRE STREET JAMAICA PLAN MA 02130

SET
BPDA
SEAL & SIGNATURE
REVISIONS
1ST FLOOR PLAN - VACUUM TOILET LAYOUT
DATE: 08 JUNE 2024
© CHRIS BENEDICT R.A.

P-401.00

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ARCHITECT

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317 EAST 9TH STREET NYC, 10003.212.477.4018

PROJECT

FORBES BUILDING
545 CENTRE STREET JAMAICA PLAIN MA 02130

1ST

50% CD SET

SEAL & SIGNATURE

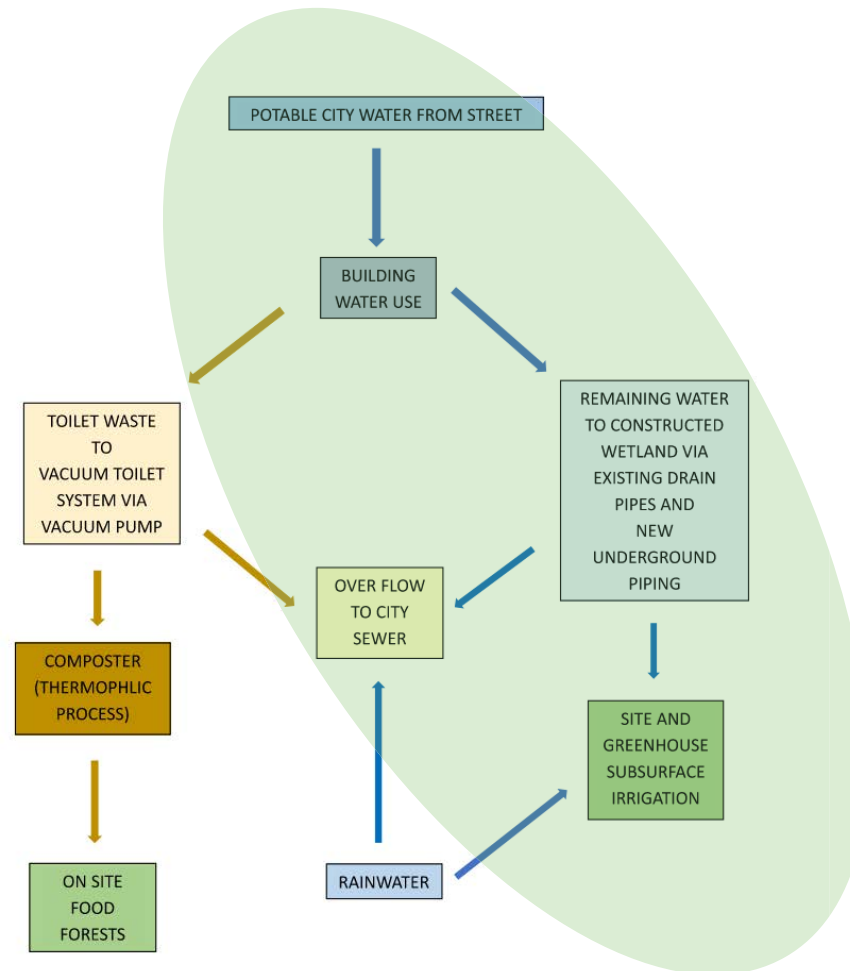
REVISIONS

2ND FLOOR PLAN - VACUUM TOILET LAYOUT
DATE: 30 JUNE 2025
© CHRIS BENEDICT, R.A.

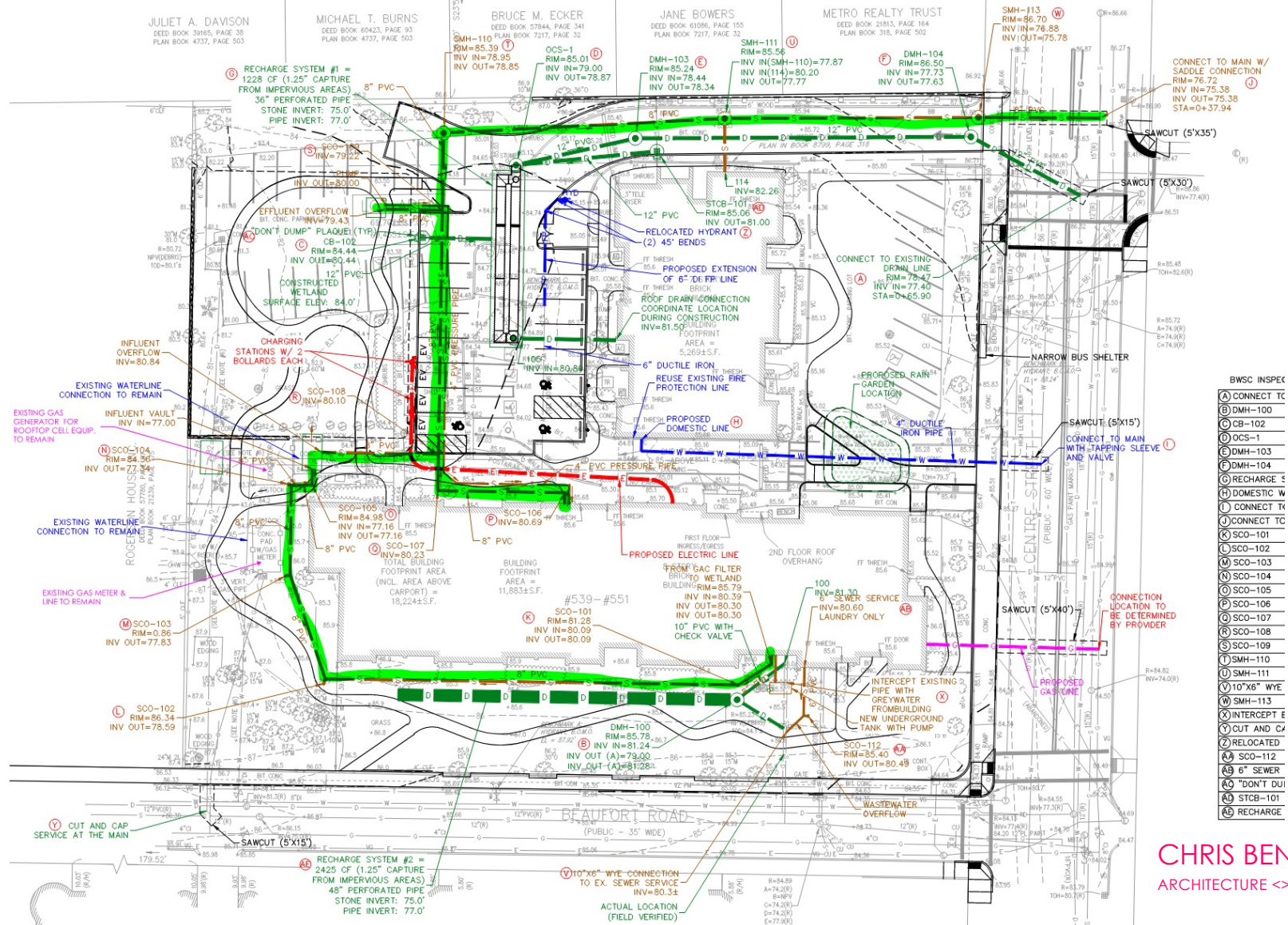
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CONSTRUCTED WETLAND

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**545 CENTRE STREET
WATER & WASTE FLOW CHART**



In Massachusetts, greywater treatment and reuse is regulated under 314 CMR 20.00, Reclaimed Water Permit Program and Standards; “Pursuant to M.G.L. c. 21, § 26, 27, and 43, the Department promulgates 314 CMR 20.00 to establish a program to regulate and permit reclaimed water systems. 314CMR 20.00 also establish requirements for the use, sale, distribution, and offering for use, sale, and distribution of reclaimed water.”

Under 314 CMR 20.00, there are three classes of reclaimed water that can be used for varying purposes, identified as Classes A, B, and C. Class A reclaimed water has the broadest use applications and consequently, has the most-stringent effluent limits. In accordance with 314 CMR 20.17(1), Class A reclaimed water may be used for any activity covered under Class B and C, as well as the following additional activities:

- **Agricultural use for food crop irrigation where there is contact between the reclaimed water and the edible portion of the crop.**
- **Irrigation at locations where individual members of the public are likely to come into contact with the reclaimed water, including:**
 - o Golf courses;
 - o Parks and playgrounds;
 - o Landscaping around schools, colleges, and universities;
 - o **Landscaping around residential and mixed-use developments;**
 - o Athletic fields;
 - o Cemeteries;
 - o Highway rest areas; and
 - o Non-residential developments, such as office complexes, public buildings, hotels, motels, and commercial malls.
- Toilet and urinal flushing in commercial, institutional, industrial facilities and buildings, including hotels and motels, and residential developments except single family homes, town houses, and two- and three-family homes where residents have access to the plumbing facilities for repairs or modifications.
- Other uses, including cooling water, industrial process water, commercial laundries and carwashes, snowmaking, fire protection, and creation of wetlands and recreational impoundments.

At the Site, Roux assumes greywater will be used exclusively for irrigation throughout the Site. The anticipated areas for irrigation are described below:

- Exterior ground floor irrigation
 - o Zone 1 (northeast corner of property, food forest)
 - o Zone 2 (southeast corner of property)
 - o Zone 3 (southern edge of property)
 - o Zone 4 (southwest corner of property, rain garden)
 - o Zone 5 (northwest corner of property)
 - o Zone 6 (throughout outdoor areas, grass patches along walkways)
- Exterior flower boxes on all facades
- Exterior 7 th floor terrace
- Interior landscaping
 - o Main lobby
 - o Main lobby green wall
 - o Elevator lobbies
 - o Greenhouse

Because the intended use of reclaimed water is for irrigation in locations where individual members of the public are likely to come into contact with the water, Roux assumes this use most closely aligns with the allowed uses of **Class A** reclaimed water. Confirmation with the MassDEP is recommended, particularly for irrigation of indoor areas. Assuming the anticipated use falls under Class A reclaimed water, Table 1 below summarizes the applicable effluent limits for treated greywater

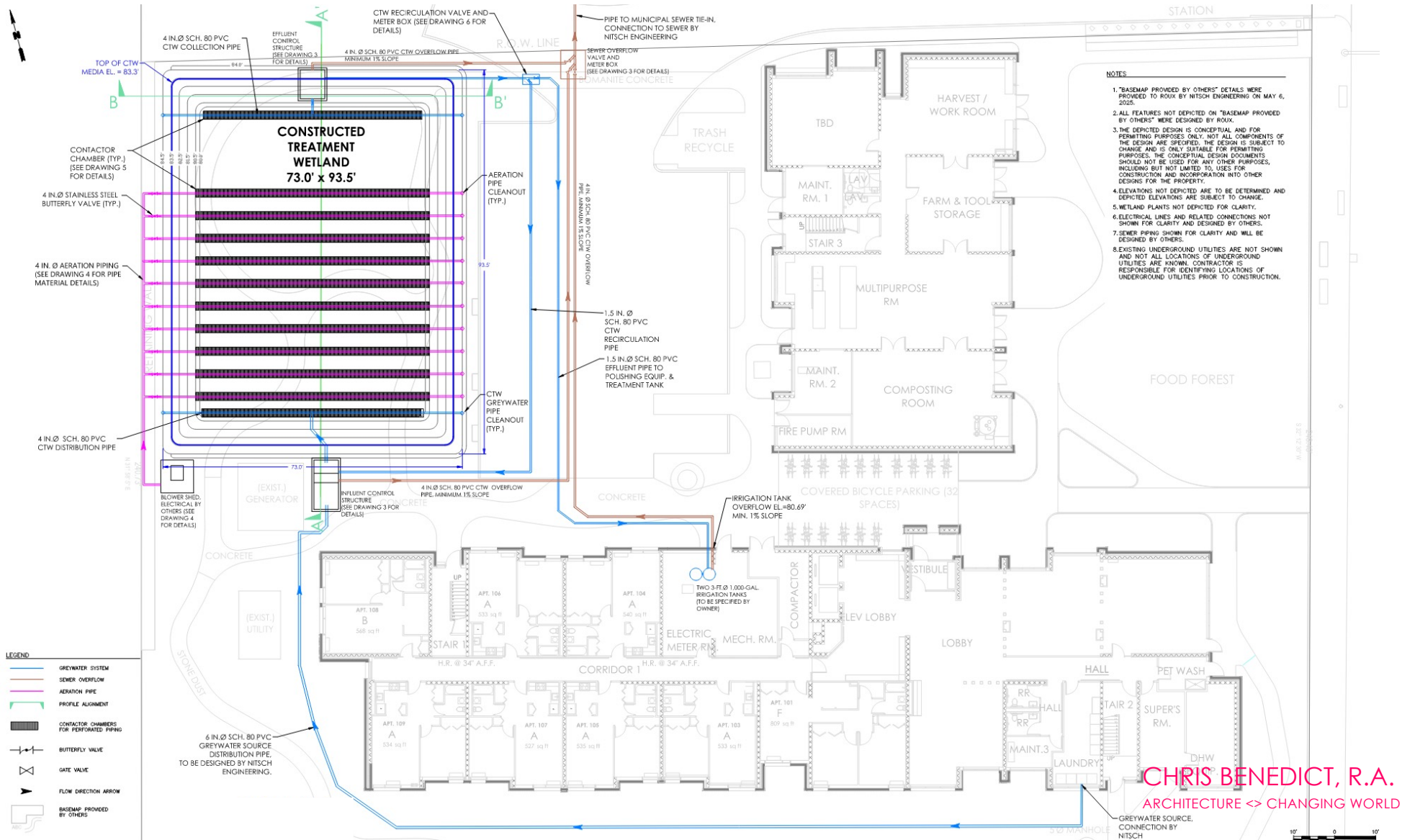
FROM ROUX ENGINEERING

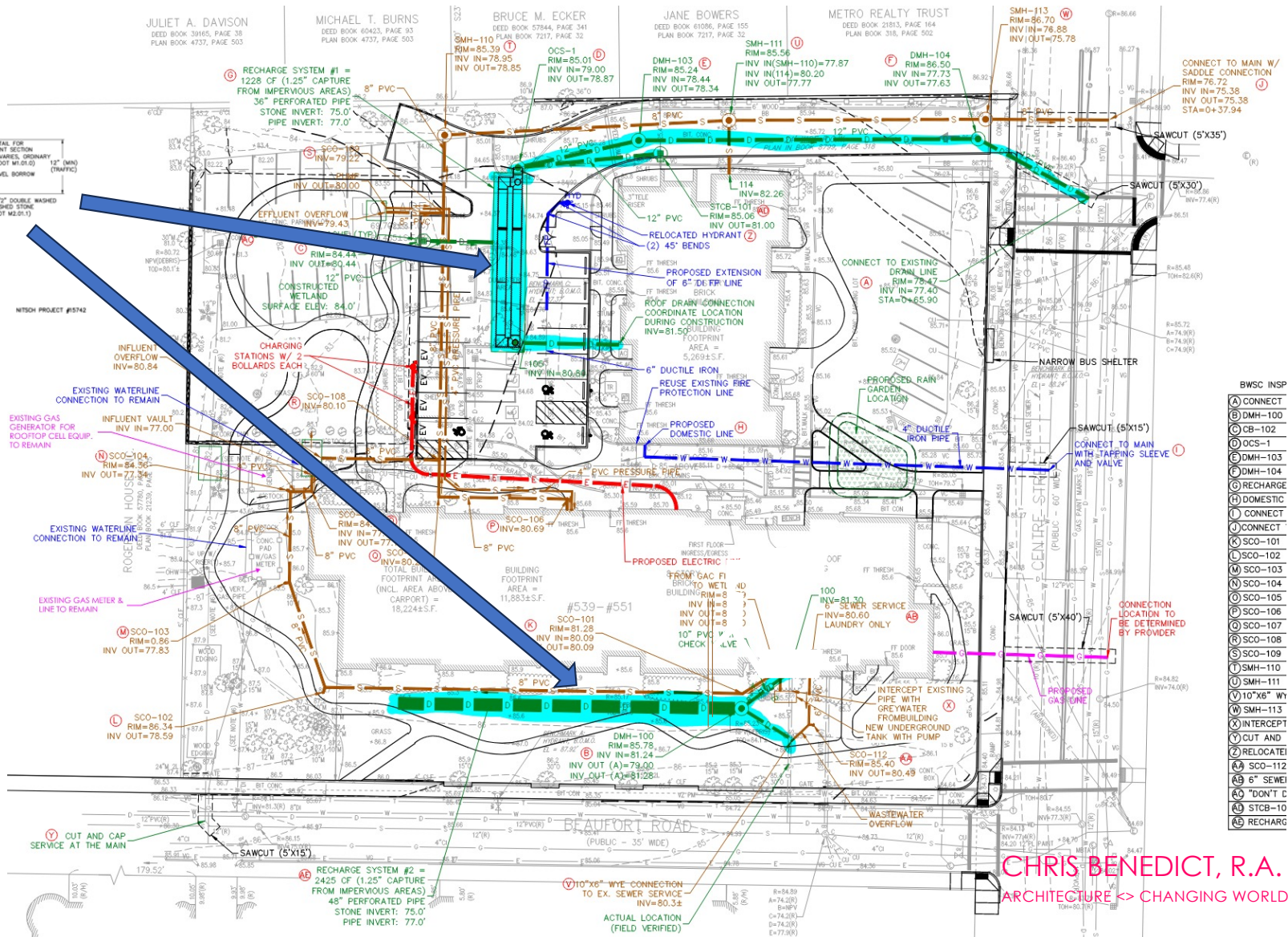
CLASS A RECLAIMED WATER

Table 1. Effluent Limits for Class A Reclaimed Water

Parameter (units)	Effluent Limit
pH (s.u.)	6.5 - 8.5
BOD (mg/L)	< 10
TSS (mg/L)	< 5
Turbidity (NTU)	< 2 avg over 24-hr period; ≤ 5 in 5% of samples; ≤ 10 at any time
Total Nitrogen (mg/L)	< 5
Fecal Coliform (cfu/100 mL)	ND median over 7-day period; ≤ 14 at any time
Other parameters as specified by the MassDEP	N/A

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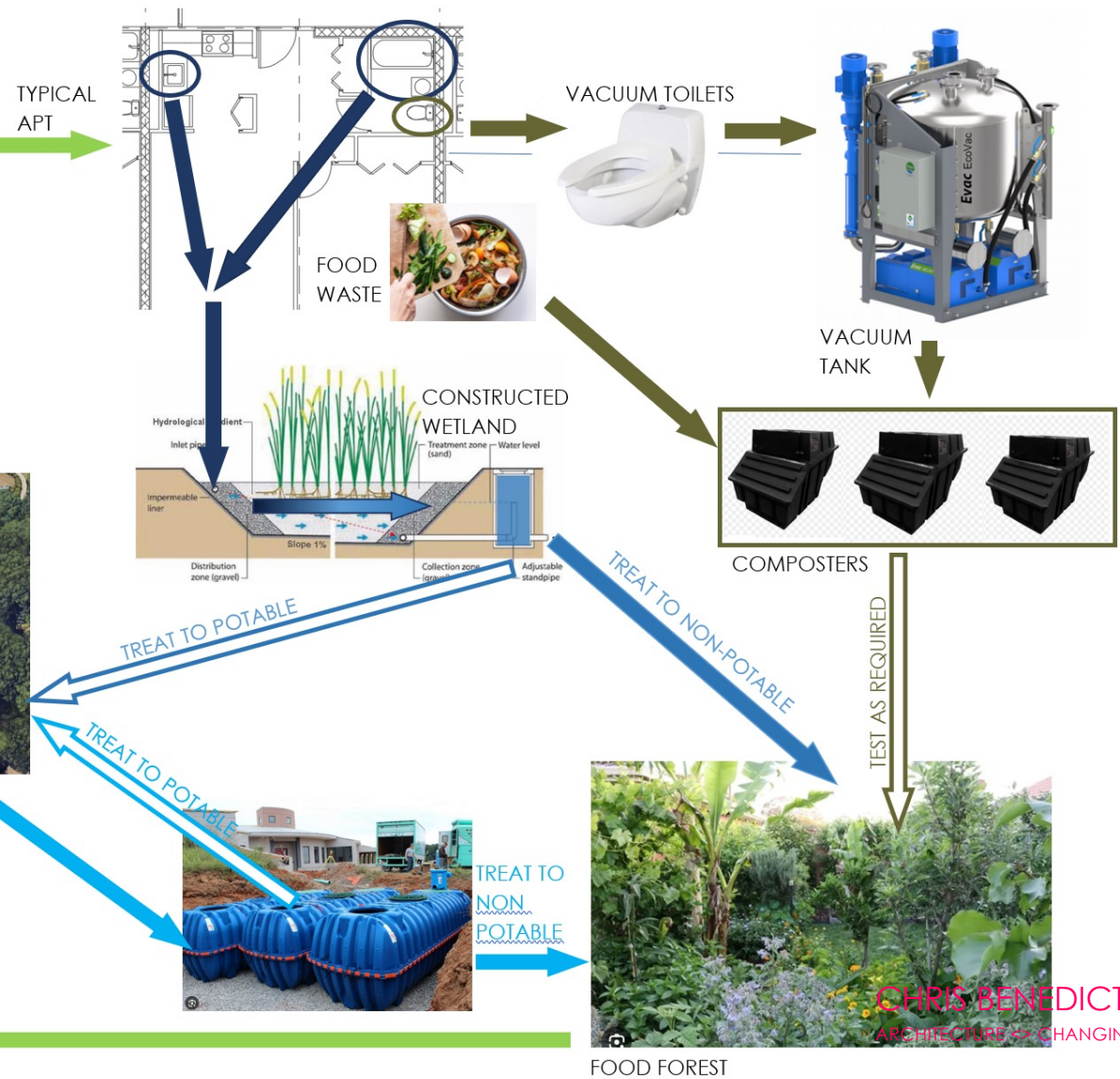
TENANTS



THE FORBES BUILDING



FOOD



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ARCHITECTURE BY CHANGING WORLD



TENANTS

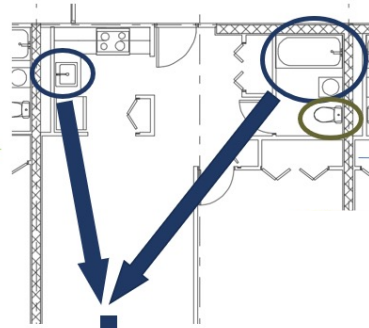


THE FORBES BUILDING



FOOD

TYPICAL
APT



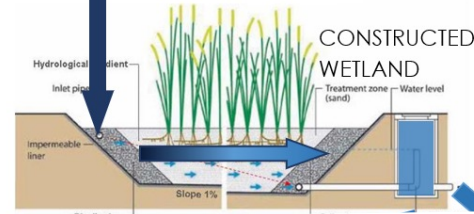
VACUUM TOILETS



VACUUM
TANK



COMPOSTERS



CONSTRUCTED
WETLAND

TREAT TO NON-POTABLE

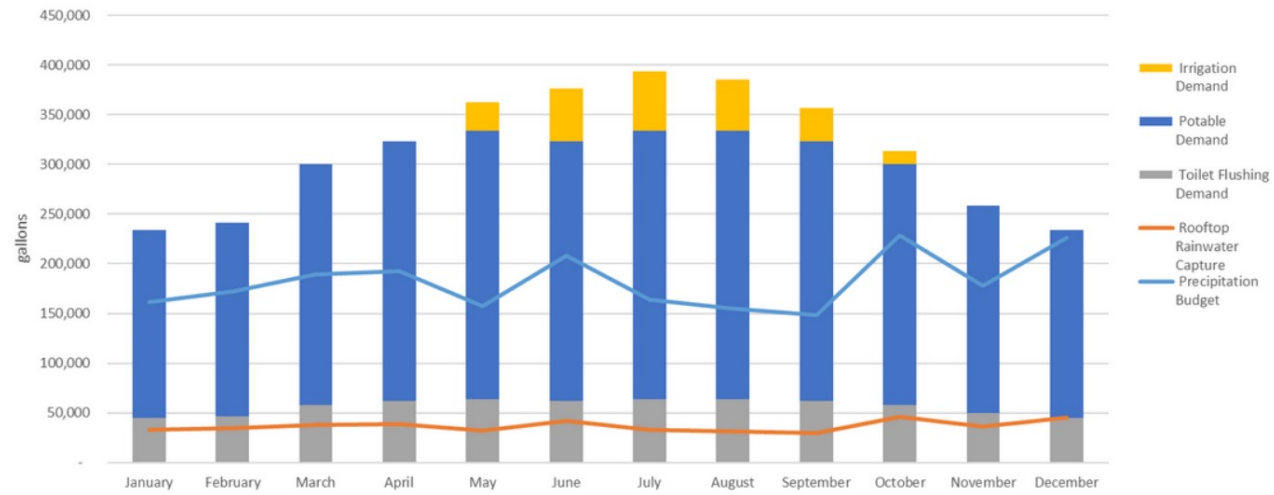
TEST AS REQUIRED

RECHARGE

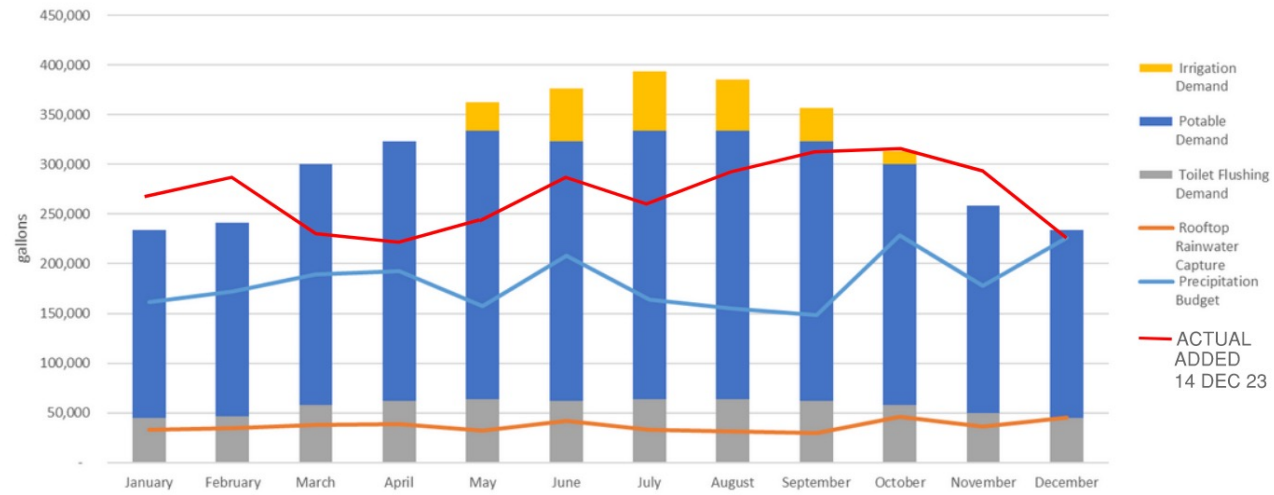


FOOD FOREST

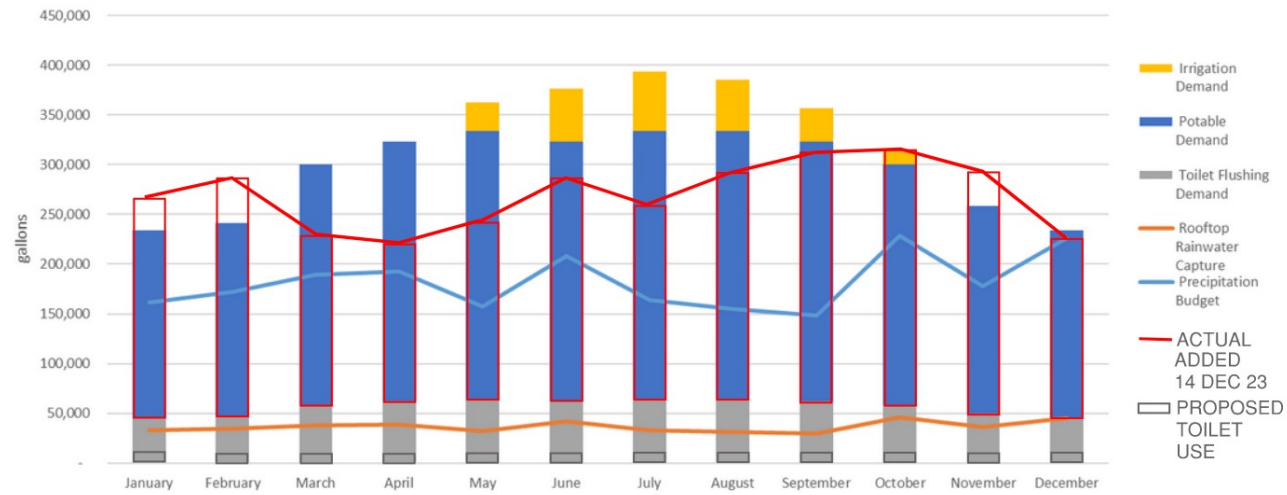
CHRIS BENEDICT, R.A.
ARCHITECTURE BY CHANGING WORLD



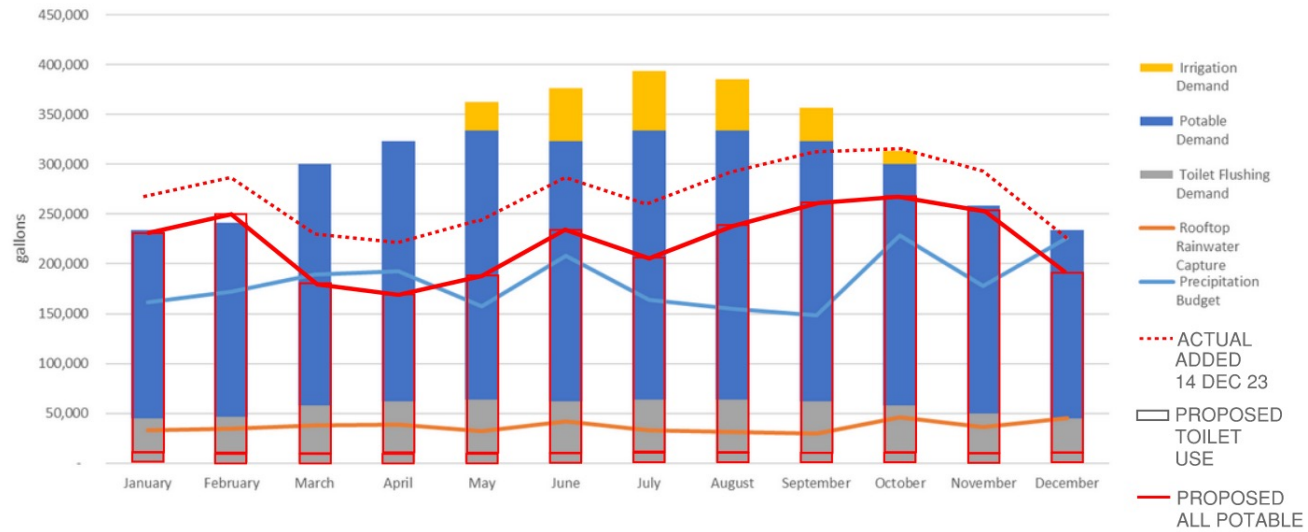
CHRIS BENEDICT, R.A.
ARCHITECTURE <> CHANGING WORLD



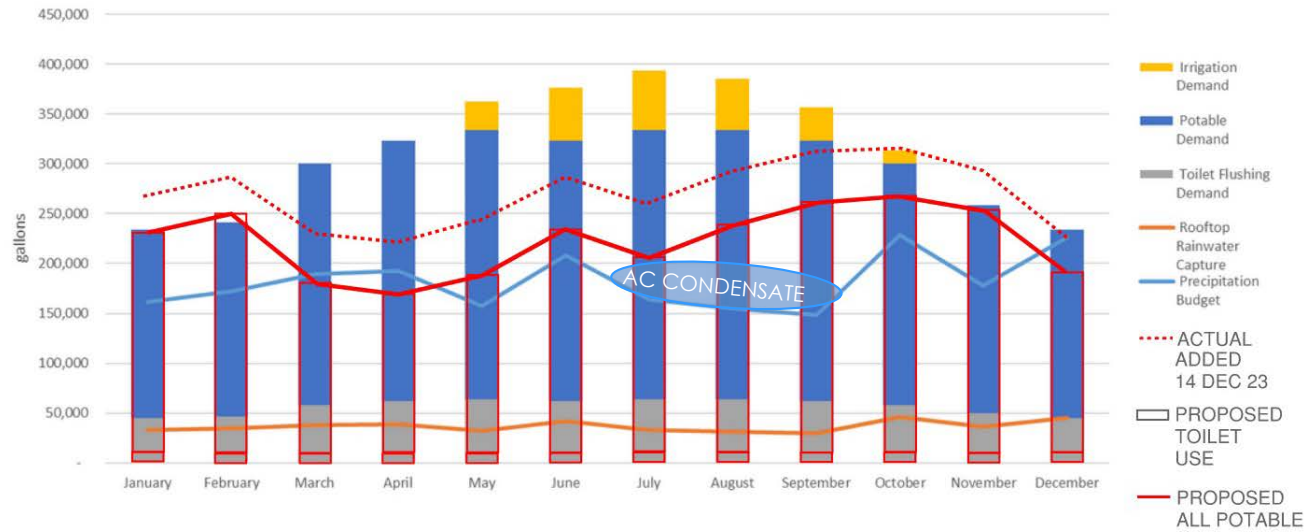
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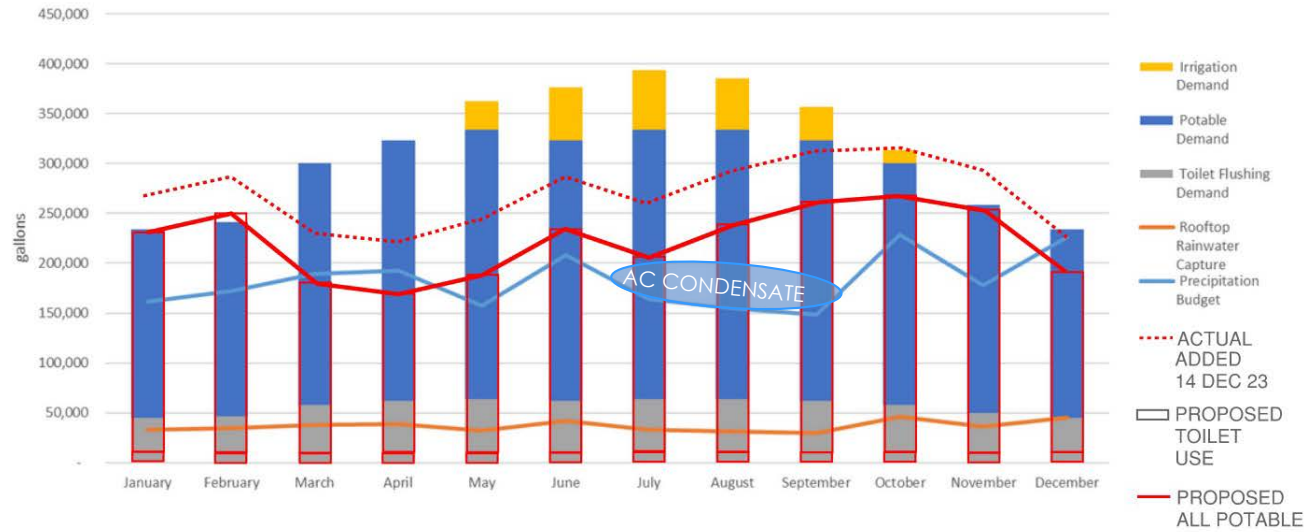
CHRIS BENEDICT, R.A.
ARCHITECTURE <> CHANGING WORLD



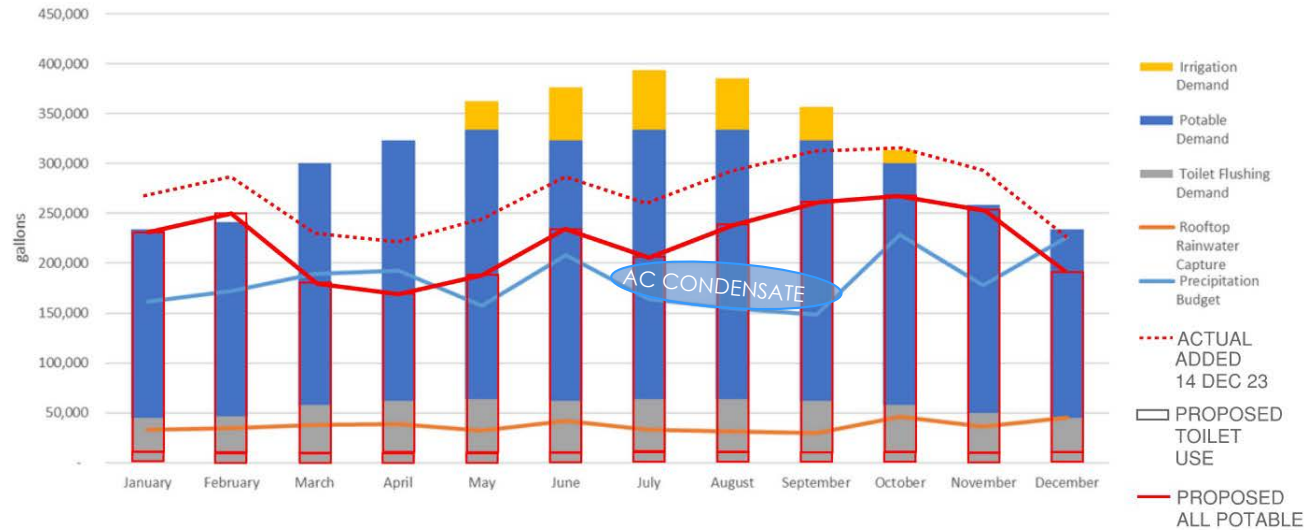
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ARCHITECTURE <> CHANGING WORLD

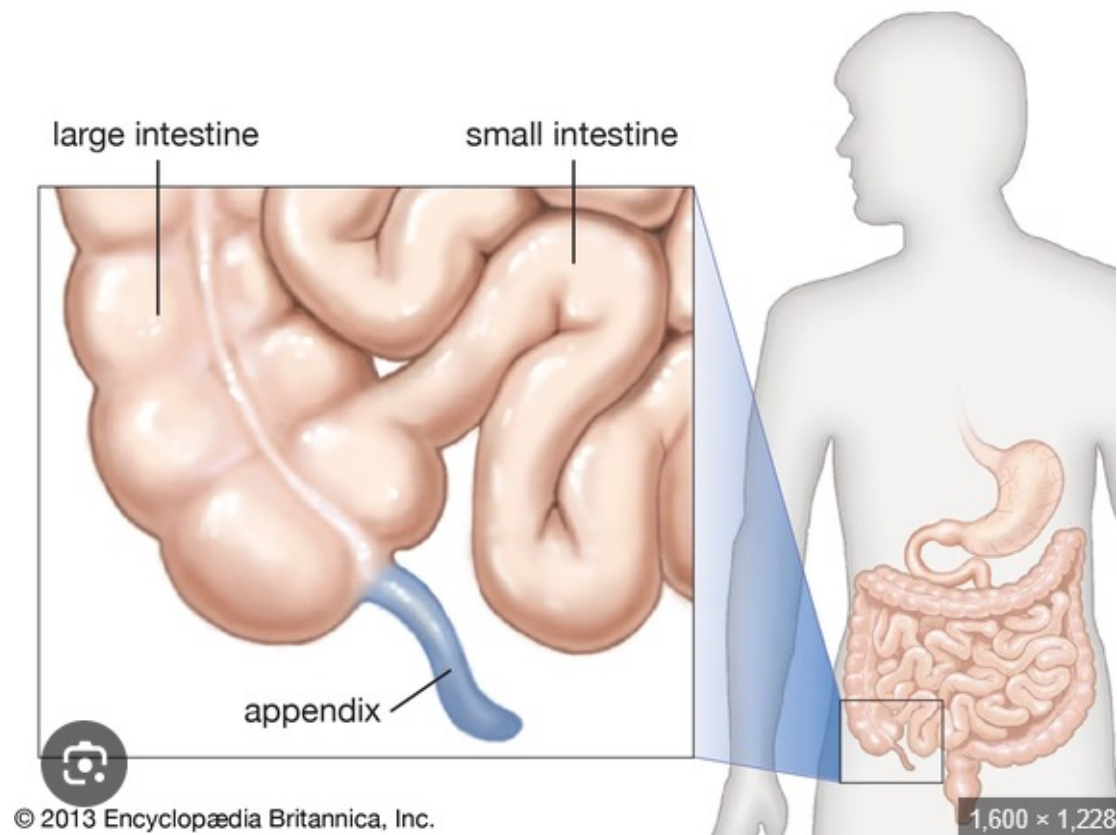


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BY REDUCING TOILET FLUSHING WATER WITH THE VACUUM SYSTEM
 WE APPROACH THE PROJECTED RAINFALL AMOUNT ON THE SITE,
 THIS COULD BE INTERPRETED AS NET ZERO WATER
 AND
 WE CAN LET THE RAINWATER GO BACK INTO THE ENVIRONMENT

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The appendix is a small, finger-shaped, tube-like pouch attached to the large intestine in the lower right side of the abdomen. It helps support the immune system and stores good bacteria for the gut. [Cleveland Clinic +2](#)

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Compost vs Fertilizer

FROM AI: Compost and fertilizer are both used to help plants grow, but **compost feeds the soil** while **fertilizer feeds the plants**

COMPOST IS FAR LESS DENSE WITH REGARD TO NPK, AND IT SLOW RELEASE THOSE NUTRIENTS INTO THE PLANTS

DIRECT MANURE/SLUDGE MAY ADD TOO MUCH NITROGEN IN ORDER TO GET THE PHOSPHORUS AND POTASSIUM RATIO NEEDED

NPK SUSTAINS THE WORLD FOOD SUPPLY

N - NITROGEN

P - PHOSPHOROUS

K – POTASSIUM

MODERN FERTILIZER:

N – ACTUALLY NH_3 FROM FOSSIL FUEL
(HABER BOSCH PROCESS)

P AND **K** FROM MINING

VS

COMPOST:

N FROM AMINO ACIDS

P AND **K** NOT USED BY THE BODY FLOWS
THROUGH BODY AND INTO THE TOILET PRODUCT
VIA URINE

AG IN MOTION 2026 COVERAGE

THE WESTERN PRODUCER

FREE NEWSLETTER

HOME NEWS OPINION MARKETS CROPS LIVESTOCK WEATHER FARM & FAMILY MACHINERY VIDEO CLASS

NEWS

Nitrogen fertilizer prices at mercy of global issues

By Sean Pratt
Reporter/Analyst
December 14, 2022 · 3 min read



Natural gas is the primary feedstock for ammonia production in nearly every producing region around the world. The fear is that the EU's restocking will drive up natural gas prices and subsequently nitrogen fertilizer prices. | Getty Images

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COMPOST QUALITY AND NUTRIENT CONTENT –

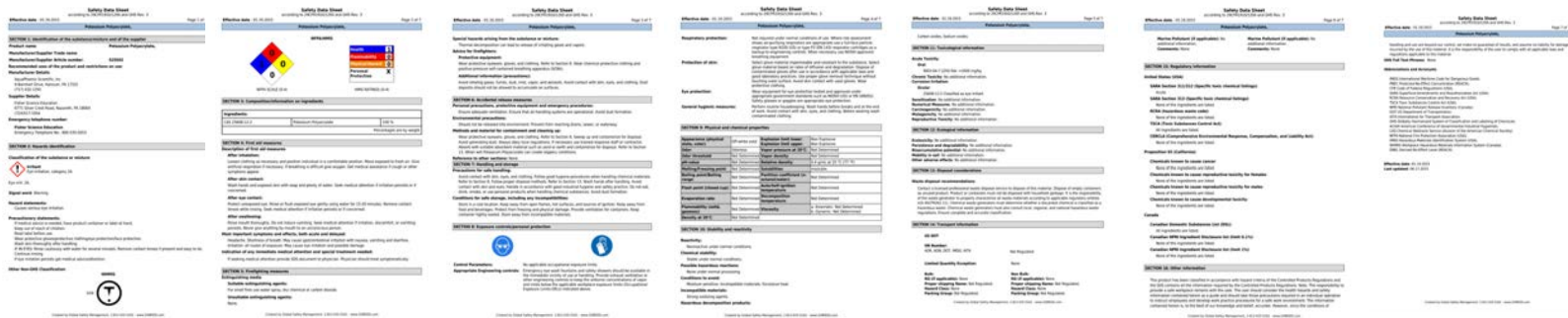
HOW GOOD CAN IT GET?

RULE OF THUMB DESIRED **2N:1P:1K**

COMPOST IS FAR LESS CONCENTRATED THAN MODERN
FERTILIZER AND RELEASES SLOWLY INTO PLANTS FROM THE SOIL

H₂O REMOVAL FORM THE VACUUM TOILET PRODUCT

THE MOST EFFICIENT THERMOPHILIC PROCESS REQUIRES
MUCH LESS WATER IN THE MIX THAN WHAT IS DELIVERED
VIA THE VACUUM TOILETS, CURRENT AMOUNT OF WATER
REQUIRES MORE BULKING MATERIAL



CAN WE REMOVE H2O WITHOUT REMOVING NUTRIENTS?

H2O PERMEABLE MEMBRANES? PEBAX® 1074?

EVAPORATION?

POTASSIUM POLYACRYLATE $(C_3H_3KO_2)_n$

VACUUM TOILET THAT SEPERATES URINE FROM FECES

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Urine - NPK

Feces – OTHER BENEFICIAL BATERIA

Urine – RICH EARTH INSTITUTE



Rent a Portable Toilet



Portable Peecycler



video.

Learn more and purchase here. The peecycler is a urine fertilizer collector designed and handmade by the Rich Earth Institute in Brattleboro, VT. These watertight containers are easy to use for collecting and transporting to one of our **Vermont urine depots** or to your garden!

You can also DIY a urine collector with our short **instructional**

Posted by **Julia Cavicchi** on April 9, 2026

RICH
EARTH
INSTITUTE



BRIGHTWATER
TOOLS



Thursday, April 30, 4:30 – 6:30 PM
355 Old Ferry Road, Brattleboro, VT 05301

RSVP >

The disastrous war on Iran is leading to global fertilizer shortages and skyrocketing prices, threatening farmers' livelihoods and putting food systems at risk. It's a vital reminder of the urgency to re-localize our nutrient sources so farmers can continue to grow the crops that feed our communities.

Join the Rich Earth Institute and Brightwater Tools for an Open House to learn how these two local organizations are working in tandem to harness an abundant source of nutrients in 'waste.' By completing food nutrient cycles locally—through practices such as urine diversion, blackwater systems, composting, and food waste digestion—we can build food security, healthy watersheds, and more resilient communities.

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PATHOGENS –

THERMOPHILIC PROCESS CAN EXCEED 160 DEGREES

PHARMACEUTICALS –

CASE OF THE MISSING PAPER (AND SCIENTIST):

DOES ANYONE KNOW GARY ANDERSEN AT LBL?



Can Compost Recycle Our Drugs?

Antibiotic resistance poses a threat to people and the environment. Now, a Berkeley, California-based scientist has set out to find out whether the composting process can remediate drugs in our water and waste.

BY ERIK NEUMANN • JUNE 1, 2016



A half-mile down the dusty road of a northern California ranch stands a large, black rectangle, silhouetted against the afternoon sun. Under a black water-resistant cover sit nine of the most sophisticated compost piles on earth. They're squeezed together with large hay bales. Buried inside are moisture and gas sensors, thermometers, air ventilators, and strangely, lots of prescription drugs. This is the site of an experiment by Gary Andersen, a researcher at the Lawrence Berkeley National Lab. With prescription drugs and antibiotics increasingly appearing in our drinking water or taken up by plants, Andersen wants to know whether the same tiny microorganisms that chew up your coffee grounds and apple cores, can also be used to destroy drugs so they don't wind up in our environment.

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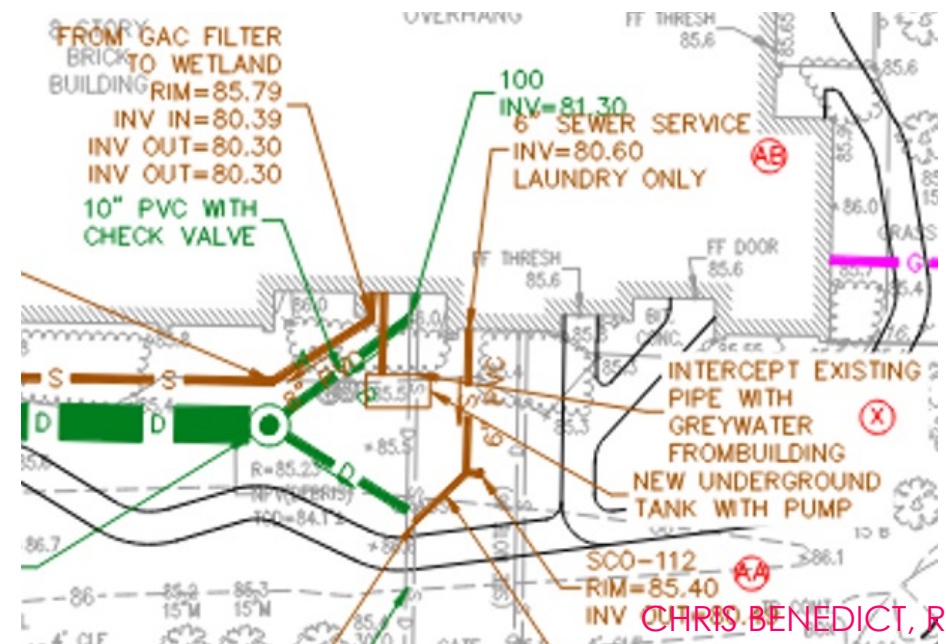
PFAS

BUILDING WAS TESTED, BOTH INCOMING AND OUTGOING WATER, RESULT WAS "NONE DETECTED"

PFAS By Method EPA 1633

- Dilution with Bulking Agents: Using "clean" bulking agents like wood chips or ground brush can dilute the concentration of PFAS in the final compost product.
- Source Control: Because there are no effective removal methods for compost, the most reliable strategy is to prevent PFAS-containing materials from entering the system.

SELL/PROVIDE
NON-TOXIC
CLEANING AND
TOILET PAPER TO THE
TENANTS ?



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PFAS LAB RESULTS

DOES ANYONE KNOW OF A RESIDENTIAL PROJECT WHERE THE
TOILET WASTE IS SEPARATED FROM THE REST OF THE WASTE WATER?

WE WANT TO TEST FOR PFAS!

URBAN Carbon sources

YARD WASTE

WOOD CHIPS

SAWDUST

CARDBOARD

FOOD SCRAPS

ENERGY CONSUMPTION

Pump	kW Rating	Hours/Day	Days/Year	Load Factor %	Energy kWh/Year	Cost Rate \$/kWh	Annual Energy Cost
Vacuum	4.8	6	365	80	8409.6	\$ 0.24	\$ 2,018.30
Discharge	3	1.5	365	80	1314	\$ 0.24	\$ 315.36
		anticipated run hours/day				based on 2024 MA state avg retail price from EIA	
TOTAL					9723.6		\$ 2,333.66

OR \$15 PER TOILET/YR

FROM MASS DEP

Wastewater discharge:

Onsite discharge of wastewater typically falls under two regulations in Massachusetts: 310 CMR 15.000 (a.k.a. Title 5) which regulates onsite septic systems for design flows under 10,000 gallons per day and 314 CMR 5.00 which regulates onsite discharge for design flows over 10,000 gallons per day which typically includes treatment in order to meet standard effluent limits. Both of these regulations are very prescriptive and require adhering to specific standards. An additional concern is how these regulations would fit for a site currently served by municipal sewers.

A 147-unit housing project generates a significant amount of wastewater. For your proposal of discharging greywater to a constructed wetland this likely would trip the regulatory threshold of 10,000 gallons per day and require a groundwater discharge permit. An open wetland system would not be permissible in such a situation.

Composting toilet waste:

Composting of wastewater solids appears to fall under the residual regulations at 310 CMR 32.00. These regulations are very stringent given the material involved as you can expect. An Approval of Suitability (AOS) would need to be obtained and that can be a time consuming and costly undertaking to ensure that the composted material meets standards. An AOS would require written approval from the city's Health Department. Type 1 compost is described in 310 CMR 32.81.

PREDICTED FLOWS:

147 APARTMENTS

250 PEOPLE

GREY WATER

7,258 GALLONS/DAY

7258 GALLONS/DAY < 10,000 GALLONS/DAY

TOILETS TO COMPOST

WATER CONTRIBUTION:

5 FLUSHES/DAY PER PERSON

.2 GAL/FLUSH

.2 GAL x 5 FLUSHES = 1 GAL WATER/PERSON/DAY

1 GAL/DAY x 250 PEOPLE = 250 GAL/DAY

TOILET PRODUCT CONTRIBUTION:

.25 GAL OF TOILET PRODUCT PER DAY PER PERSON

.25 x 250 = 62.5 GAL OF TOILET PRODUCT PER DAY

TOTAL TOILETS TO COMPOST: 312.5 GALLONS/DAY

312.5 GALLONS/DAY < 10,000 GALLONS/DAY

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Acceptable processes which will significantly reduce pathogens are:

- (1) Aerobic Digestion: A process during which sludge or septage is broken down by bacteria by agitating the sludge or septage, mixing it with air or oxygen, and maintaining residence times ranging from 60 days at 15°C to 40 days at 20°C, with a volatile solids reduction of at least 38%.
- (2) Air Drying: A process in which sludge or septage is allowed to drain and/or dry on under-drained sand beds, or paved or unpaved basins in either of which the sludge or septage is at a maximum depth of nine inches. This process is acceptable only if it occurs for at least three months during which temperatures must average, on a daily basis, above 0°C for two months.
- (3) Anaerobic Digestion: A process during which sludge or septage is broken down by bacteria in the absence of oxygen at residence times ranging from 60 days at 20°C to 15 days at 35°C through 55°C, with a volatile solids reduction of at least 38%.
- (4) Low Temperature Composting: A composting process using the within-vessel, static aerated pile, or windrow methods. For all three methods, the composting temperature shall be not less than 40°C for five consecutive days, and not less than 55°C during four hours of this five day period.
- (5) Lime Stabilization: A process in which lime is added to sludge or septage to produce a pH of 12 after two hours of contact with the sludge or septage.
- (6) Other methods: Other methods or operating conditions may be deemed acceptable by the Department if the owner or operator can provide data showing that the pathogen and vector attraction of the volatile solids are reduced to an extent equivalent to the reductions achieved by any of the other methods listed above in 310 CMR 32.80. Written approval of equivalency by the Department shall be required.

Additional processes which will further reduce pathogens are listed below. The processes listed in 310 CMR 32.81(5), (6), and (7) are in addition to processes listed or described in 310 CMR 32.80.

- (1) High Temperature Composting: A composting process using either the windrow, within-vessel, or static-aerated pile method; provided that whenever the windrow method is used, a composting temperature of not less than 55°C shall be continuously maintained for at least 15 days during the composting period, and that the windrow shall be turned at least five times during this 15-day period; and provided that whenever the static-aerated pile method or the within-vessel method is used, a composting temperature of not less than 55°C shall be continuously maintained for at least three consecutive days.
- (2) Heat Drying: A process in which a dewatered sludge cake is dried by direct or indirect contact with hot gases, and the moisture content is reduced to 10% or lower. Sludge particles shall reach temperatures well in excess of 80°C, or the wet bulb temperature of the gas stream in contact with the sludge at the point where it leaves the dryer shall be in excess of 80°C.
- (3) Heat Treatment: A process in which liquid sludge or septage is maintained at temperature of at least 180°C for at least 30 consecutive minutes.
- (4) Thermophilic Aerobic Digestion: The process by which liquid sludge or septage is agitated with air or oxygen to maintain aerobic conditions at a residence time of ten days at 55°C through 60°C, and has a volatile solids reduction of at least 38%.
- (5) Electron Radiation: A process in which sludge or septage is irradiated with electrons from an accelerator at dosages of at least 1.0 megarad at room temperature, *i.e.*, approximately 20°C.
- (6) Gamma Ray Irradiation: A process in which sludge or septage is irradiated with gamma rays from certain isotopes, such as Cobalt-60 or Cesium-137, at dosages of a least 1.0 megarad at room temperature, *i.e.*, approximately 20°C.
- (7) Pasteurization: A process in which sludge or septage is maintained for at least 30 continuous minutes at a temperature of not less than 70°C.
- (8) Other Methods: Other methods or operating conditions may be deemed acceptable by the Department if the owner or operator can provide data showing that the pathogen and vector attraction of the volatile solids are reduced to an extent equivalent to the reductions achieved by any of the other methods listed in 310 CMR 32.81. Written approval of equivalency by the Department shall be required.

DP

310 CMR: DEPARTMENT OF ENVIRONMENTAL PROTECTION

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32.12: Criteria for Approval of Suitability

In order to receive an Approval of Suitability, an owner or operator shall demonstrate that the sludge or septage shall meet the following criteria:

- (1) Stabilization.
 - (a) Minimum Requirement. All sludge and all septage shall be stabilized by a process which will significantly reduce pathogens. Acceptable processes which will significantly reduce pathogens are listed or described in Appendix A, 310 CMR 32.80.
 - (b) Additional Stabilization Requirements. Sludge or septage shall be further stabilized by a process listed or described in Appendix B, 310 CMR 32.81, if:
 - 1. the sludge is or is intended to be classified as Type I;
 - 2. the sludge or septage is or is intended to be land applied to a site where a crop for direct human consumption is or is intended to be planted within 24 months after the land application of such sludge or septage, and where such sludge or septage will be in direct contact with the edible portion of the crop; or
 - 3. the sludge or septage is not mixed into the soil within 48 hours after land application.
 - (c) Variance. An owner or operator who produces Type II or Type III sludge which, before any stabilization, contains insignificant levels of pathogens, may apply for a variance from the stabilization requirements in 310 CMR 32.12(1)(a);

(d) The Department may grant a variance from 310 CMR 32.12(1)(a) and (b) after consultation with the board of health of the city or town in which the sludge is or is intended to be land applied or, if unknown, the board of health of the city or town in which the owner's or operator's facility is located. The Department shall make note of any such variance in the Approval of Suitability. The Department shall grant no such variance for Type I sludge or for any septage.

- (2) Classification.
 - (a) Type I Sludge. **TYPE I SLUDGE**
 - 1. Septage shall not be eligible for classification as Type I.
 - 2. Sludge shall be classified as Type I if:
 - a. it is stabilized by a process deemed acceptable to the Department pursuant to 310 CMR 32.12(1)(b) and 32.81;
 - b. it is not putrescible; and
 - c. the concentration of substances it contains does not exceed the limits set forth in the following table:

TABLE 32.12(2)(a)

<u>Heavy Metals or Chemicals</u>	<u>Maximum Allowable Concentration in Parts Per Million Dry Weight</u>
Cadmium	14
Lead	300
Nickel	200
Zinc	2500
Copper	1000
Chromium (Total)	1000
Mercury	10
Boron (water soluble)	300
Molybdenum	40
PCBs in Type I sludge which is a commercial fertilizer pursuant to 310 CMR 32.11(6)	2
PCBs in Type I sludge which is soil conditioner pursuant to 310 CMR 32.11(6)	1



Langley, Lealdon (DEP)

To: me, and 9 others · Mon, Feb 9 at 3:36 PM ▾

follow up to our meeting, the wastewater program met internally to further discuss your proposal and how best to identify potential issues in a manner that will help facilitate a permitting pathway for this project.

As a result of that internal discussion and to further emphasize some issues that were discussed on the 14th, the Department offers the following comments for your consideration as you move forward:

1. **Regulatory oversight of composting/residuals.** Residuals management falls within the regulations at 310 CMR 32.00 (link: [310 CMR 32.00: Land application of sludge and septage | Mass.gov](#)).

- **Approval of Suitability:** As previously discussed, an Approval of Suitability (AOS) will need to be obtained via WP 28 and WP 29 permit applications (both are required). Due to using the composted material for food production, a Type 1 sludge requirement would need to be met. The AOS application can be found here: [WP 28, 29, 30, 31, 32: Residuals Management | Mass.gov](#). Additionally, the monitoring of PFAS in the compost will be a requirement of any AOS issued by the Department. Please note that PFAS in residuals/sludge is a growing concern. MassDEP anticipates proposing revisions to 310 CMR 32.00 for public comment. Those revisions would likely contain limits on the concentrations of PFAS that are permissible for land application. Absent available data on the proposed development it is difficult to predict whether those concentrations would be able to meet limits proposed in the future. If data from developments that have used the same or similar composting methods are available, we suggest you compare them to concentrations in residuals from AOS holders located in the Department's public portal located here: [Public PFAS portal with residuals data](#). MassDEP personnel are able to assist you with downloading these data into a format that might be easier to read, such as a graph, for your comparison purposes. A contingency plan is advisable for the disposal of compost in the event that future PFAS concentration limits cannot be attained. Currently AOS holders are required to sample for PFAS once per calendar quarter. MassDEP wants to make sure you are aware that the costs of PFAS sampling and other sampling required for the AOS are substantial, which could be difficult to sustain for a development of this size.

2. **Composting and composted material:** the Department would like to bring to your attention a number of concerns about composting management. Given the material involved, there may be nuisance conditions (e.g., odors, pest attraction) that should be addressed that may fall into the Department's permit review of residuals management authority or the authority of the local Board of Health. Please be aware that the 310 CMR 32.00 regulations require submittal of applications and subsequent renewals to the local Board of Health (the Boston Public Health Commission (BPHC), in this case) and to MassDEP. MassDEP will not be able to issue an AOS unless MassDEP either receives written concurrence from BPHC, or BPHC does not respond. Also, although 310 CMR 32.00 provides for a permit term of up to five years, MassDEP is currently only allowing AOSs to be approved for 18 months, in anticipation of the proposed revisions of the regulations discussed above. An AOS holder may reapply to MassDEP and the BPHC in this case at least six months prior to the date of expiration of the AOS. Odors, maintaining sufficient temperature conditions, trucking of excess compost, wintertime management of material, etc. are just some of the concerns that warrant attention. It is highly recommended that there is engagement with the BPHC for this operation prior to submitting any application to MassDEP.

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ARCHITECT <> CHANGING WORLD

3. **Greywater reuse/constructed wetland.** The proposal for greywater reuse after treatment by a constructed wetland requires compliance with the reclaimed water regulations at 314 CMR 20.00 (link: [314 CMR 20: Reclaimed Water Permit Program and Standards | Mass.gov](#)) and an application for the necessary reclaimed water permit (link: [WP84: Reclaimed Water Use | Mass.gov](#)). Using greywater for irrigation of landscaping at the development and irrigation of food crops would be considered a Class A reclaimed water and therefore subject to Class A standards. Please note that these standards, among other things, require daily sampling for fecal coliform and meeting a limit of: median of no detectable fecal coliform over continuous 7-day sampling periods, not to exceed 14/100 ml in any one sample. MassDEP's experience with wetland treatment systems is not robust and has not been shown to be very effective. MassDEP recommends providing additional details on the proposed wetland treatment system, including effluent data from systems already in use. If the constructed wetland could not meet Class A standards, a more traditional form of treatment technology may be needed to treat the wastewater to the standards.

4. **Wetland overflow to municipal sewer.** As the project proponent you may need to further investigate the overflow of the constructed wetland into the municipal sewer system to determine if any extraneous flow from precipitation, snow melt, or stormwater influences would enter the sewerage system. This would be looked at as sources of inflow that are typically prohibited in order to maintain sewer capacity. Given that Boston has a combined sewer system it is advantageous to remove any sources of inflow whenever possible.

5. **Toilet waste overflow to municipal sewer.** Please examine how the toilet waste would be discharged to municipal sewer in the event that the composting operations are taken off line. It is possible composting operations could have to be taken offline if 310 CMR 32.00 limits could not be met, or if an excess of compost had been generated. Would the toilet discharge system be able to maintain typical flow of wastewater to the municipal sewer system?

6. **Permit oversight/regulatory compliance and fees:** As with any project that needs a permit from the Commonwealth, there is a fee associated with obtaining these permits within a mandated timeline. This is all set by state fee regulations, 310 CMR 4.00. These permits typically need renewal every 5 years, at which point conditions or requirements may change. Additionally, permits such as the expected reclaimed water have annual compliance fees that you should be aware of.

7. **Ongoing operations.** Composting and reclaimed water treatment will need to be operated by a Massachusetts-licensed wastewater treatment plant operator. This can be expected to be an ongoing cost moving forward. The licensed operator will be responsible for all operations and maintenance along with sampling and reporting of data.

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NET ZERO WATER CHALLENGE

VISION:

EVERY APARTMENT BUILDING IS
CONNECTED TO A FARM

SHORT TERM GOAL:

AQUIRE A FARM AND AN APARTMENT
BUILDING IN EACH STATE TO DO THIS
WORK

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