Blending RAS and AquaPonics: Engineering Flexibility Into Fish & Plant Production Systems

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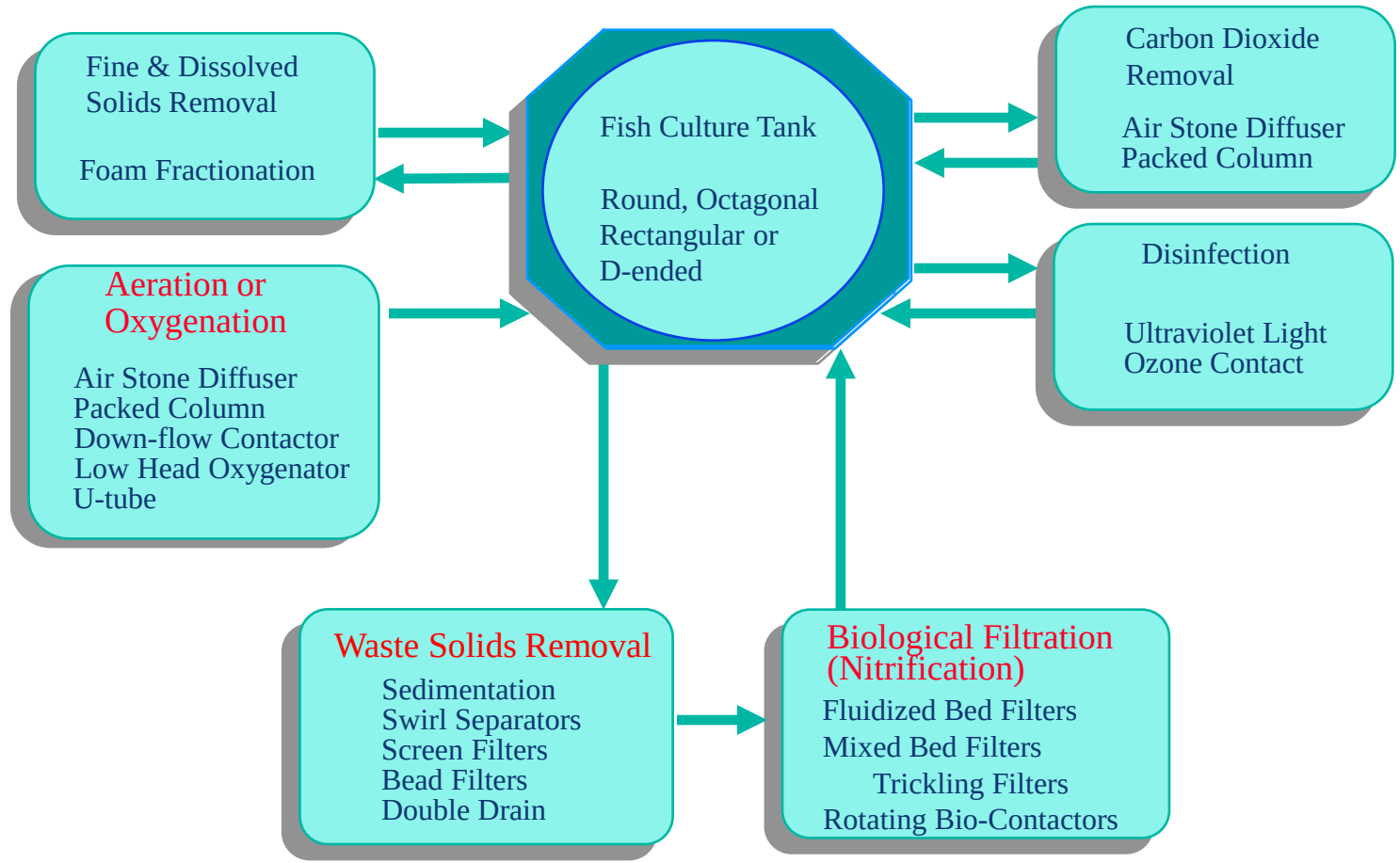
Recirculating Aquaculture Systems (RAS)

- Intensive Fish Culture Tanks
- Solids Removal Components
- Biofiltration (Nitrification)
- Carbon Dioxide Removal
- UV Filters
- Oxygenation Components
- Denitrification Loop
- Wastewater Treatment
- Typical Discharge 10 – 20% of System Volume per Day



The Basics of RAS Technology has been developing for over 40 years

Traditional Balanced AquaPonics Systems

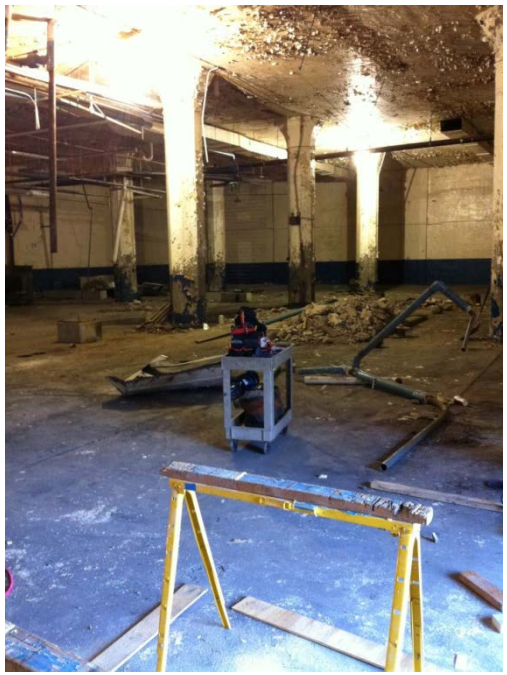
- Fish Culture Tanks
- Solids Removal; Often Settling Technology
- Fine Solids Removal within Floating Plant Roots
- Nutrient Removal with the Plant Culture
- Aeration Provide at Fish Culture Tanks
- Typical 7 : 1 Plant Area to Fish Area Ratio

University of the Virgin Islands System
Annual Output
5,000 kg of fish
1,400 Cases of Lettuce
5,000 kg of Basel
2,900 kg of Okra

AquaPonics Usually Produces More Plants than Fish

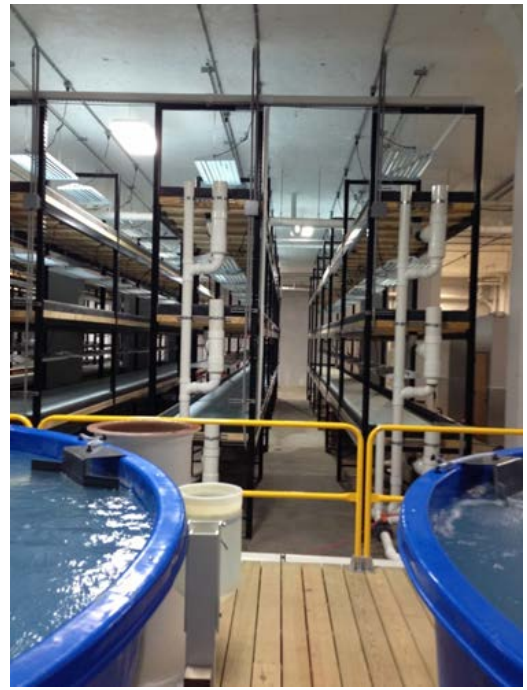
Goals for this Project

- Create a Fish and Plant Production Systems within the City
- Existing Building Provides Advantages of Lower Capital Costs & Subsidies for Redevelopment
- Create a System that Produces Fish and Plants at Rates to meet our Market Demand



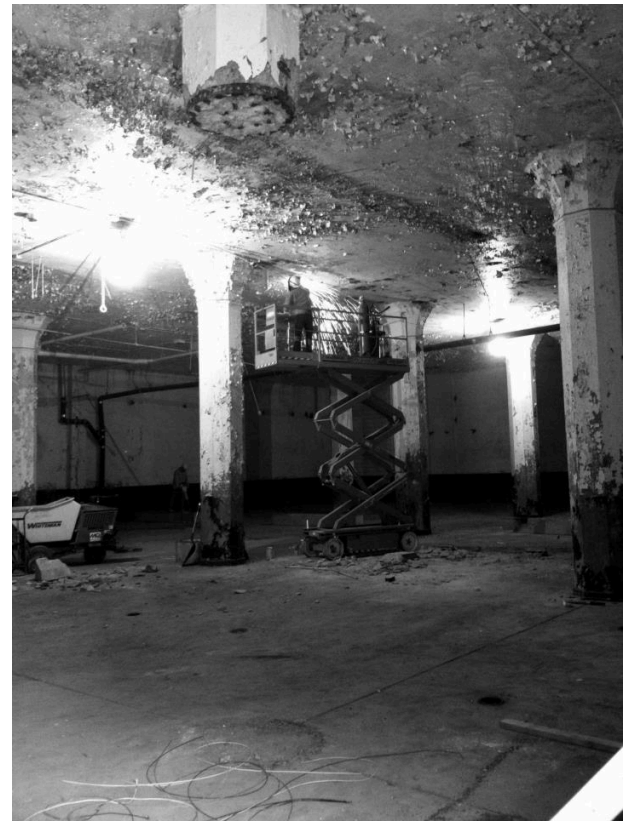
Making Abandoned This

Into Productive This



Take Unproductive Urban Structures and Make I Productive Again

We Started with This



A Well Insulated Sturdy Structure Close to Our Market at the Right Price

Started by Adding Infrastructure

A New Well for a Consistent Source of High Quality Water with High Alkalinity

Dependable Power with a Favorable Rate Structure

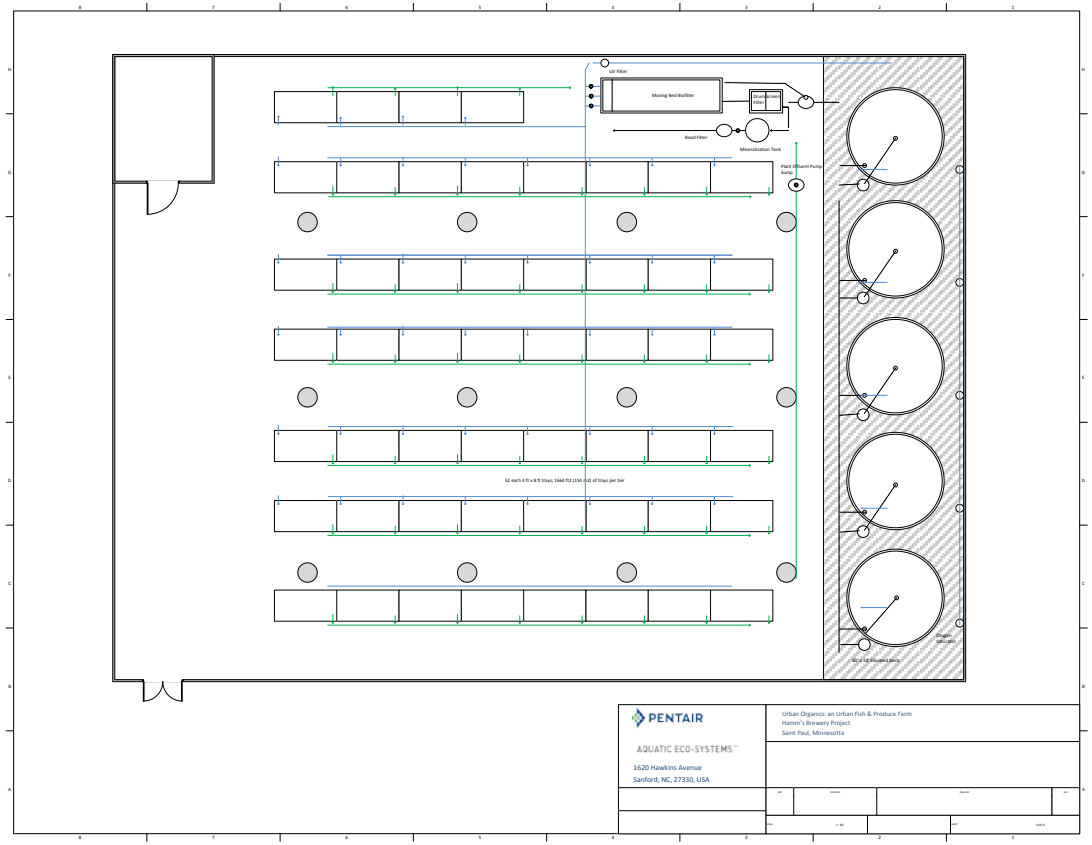
Updated and Modern Access

Newly Added Water, Power and Site Access

Then We Evaluated the Facility for Biosecurity

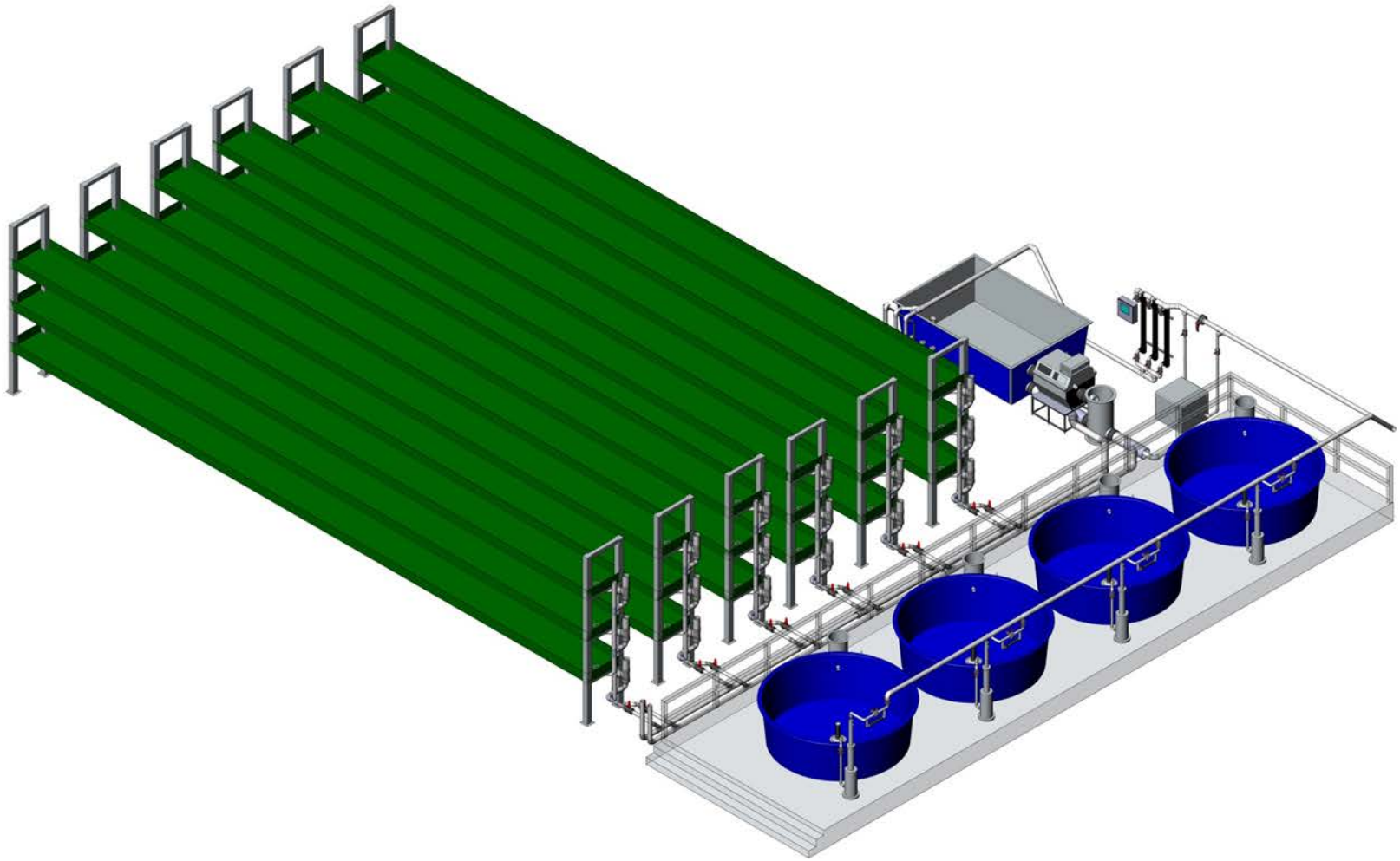
- Where to draw the line for Biosecurity?
  - Between Systems: One tank per a few Lines of trays?
  - Or Biosecurity between floors and all tanks and trays combined?

- Decided on a 5 Tank per floor layout and a combined RAS and Plant Treatment System



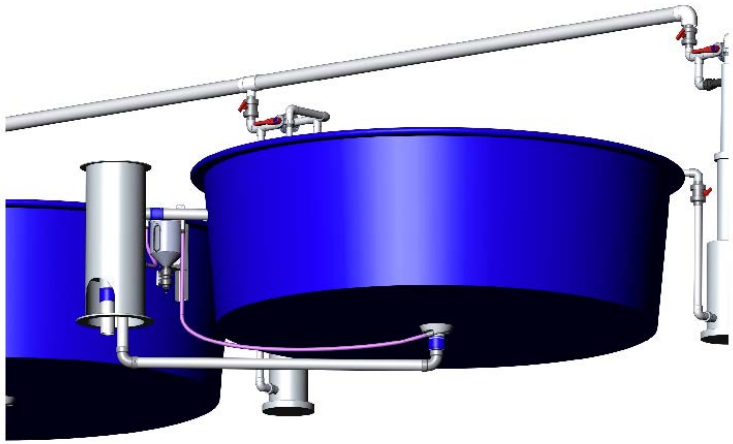
Biosecurity in this system is be between floors

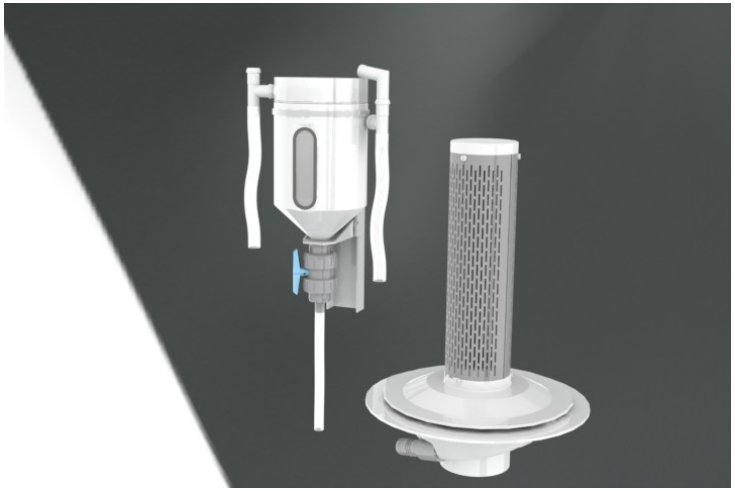
Created the Design: With CAD Solid Works

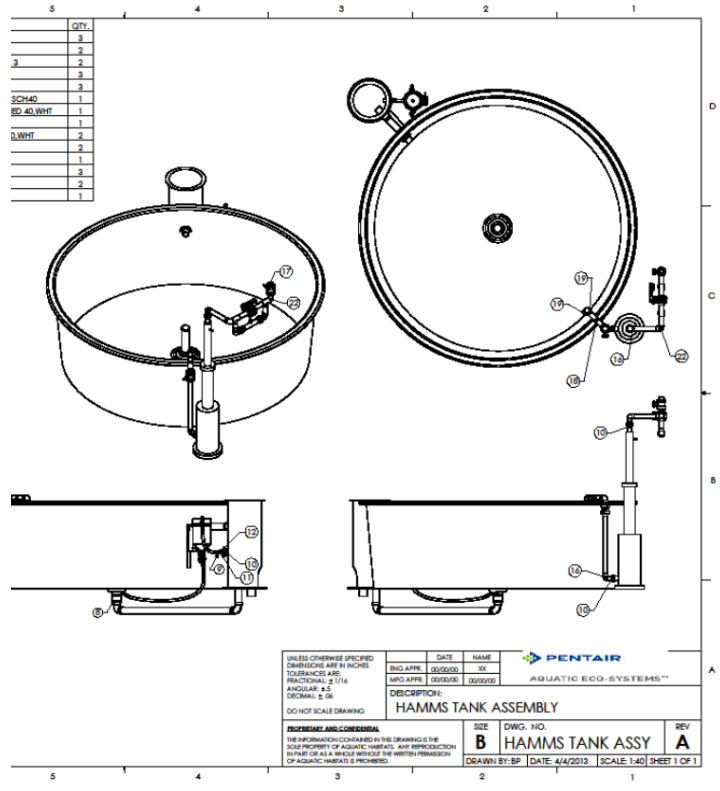


Designing a system that would fit within the walls and between the columns

Creating The Detail: 12.5 m³ Polytanks with EcoTrap 110 Particle Traps



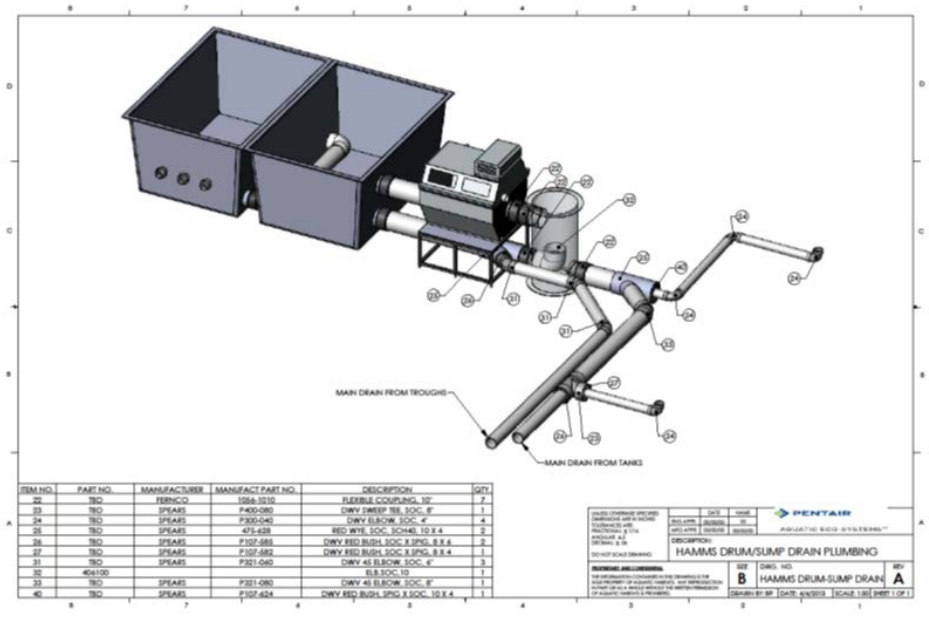


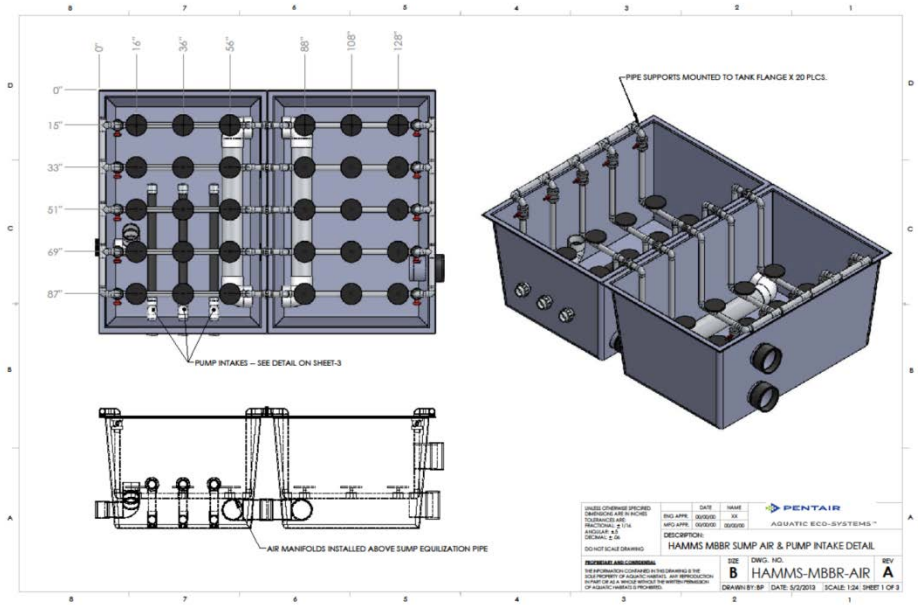


- Each Tank has a EcoTrap 110 Particle Trap, a Sludge Collector and external Stand Pipe

Poly-tanks fitted with EcoTraps with Sludge Collectors & External Stand Pipes

Creating the Detail: Flow to Drum-Screen & MBBR

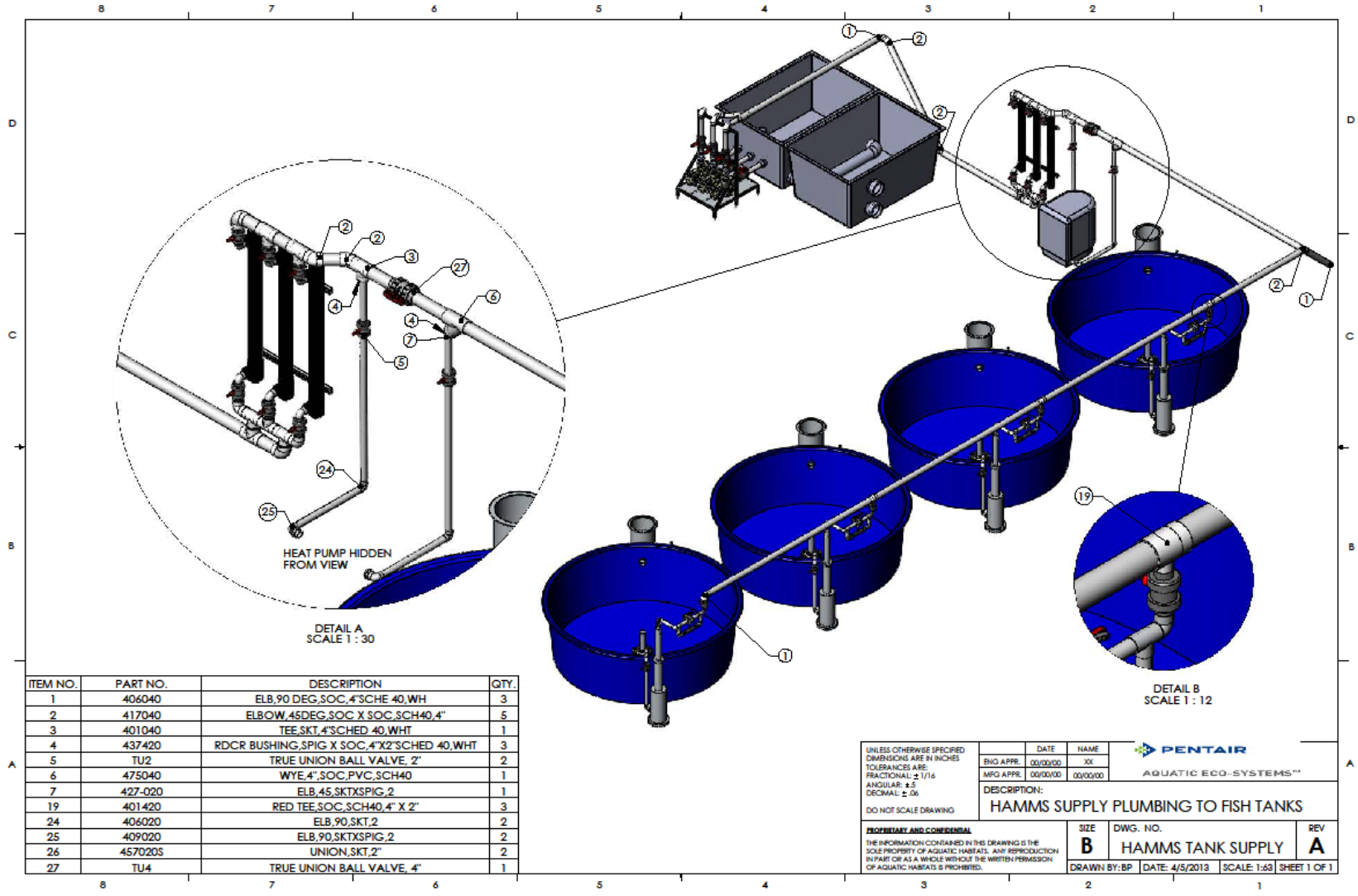




- Each Moving Bed Bio-Reactor Stage containes 2.5 m^3 Kaldnes media nitrifying ammonia from 40 kg feed / day
- Each Reactor contains 15 Disc Air Diffusers (90 cfm total)

Gravity flow through a Faivre Model 2-80 Drum Screen Filter with 60 micron screens

Creating the Detail: Water Return System



ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	406040	ELB,90 DEG,SOC,4"SCHE 40,WH	3
2	417040	ELBOW,45DEG,SOC X SOC,SCH40,4"	5
3	401040	TEE,SKT,4"SCHED 40,WHT	1
4	437420	RDCR BUSHING,SPIG X SOC,4"X2"SCHED 40,WHT	3
5	TU2	TRUE UNION BALL VALVE, 2"	2
6	475040	WYE,4",SOC,PVC,SCH40	1
7	427-020	ELB,45,SKTXSPIG,2	1
19	401420	RED TEE,SOC,SCH40,4" X 2"	3
24	406020	ELB,90,SKT,2	2
25	409020	ELB,90,SKTXSPIG,2	2
26	457020S	UNION,SKT,2"	2
27	TU4	TRUE UNION BALL VALVE, 4"	1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONAL: ± 1/16
ANGULAR: ±.5
DECIMAL: ± .06
DO NOT SCALE DRAWING

	DATE	NAME
ENG APPR.	00/00/00	XX
MFG APPR.	00/00/00	00/00/00

PENTAIR
AQUATIC ECO-SYSTEMS™

DESCRIPTION:
HAMMS SUPPLY PLUMBING TO FISH TANKS

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SIZE	DWG. NO.	REV
B	HAMMS TANK SUPPLY	A

DRAWN BY: BP | DATE: 4/5/2013 | SCALE: 1:63 | SHEET 1 OF 1

Constant Flow Pumps, UV Filters, Heat Pumps, Oxygen Contactors

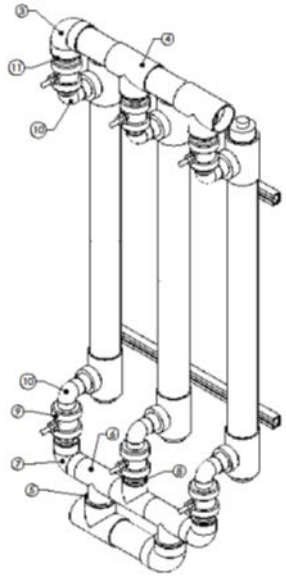
Creating the Detail: Pumping from the Moving Bed Reactors

- Three Pentair 3 kW Sparus Constant Flow Pumps
- Two for the RAS Loop
- One for the Plant Loop (530 lpm, 140 gpm)

Constant Flow pumps supply water up to 1,060 lpm (280 gpm) to Culture Tanks

Creating the Detail: UV Filters and Heat Pump

- Three Emperor Aquatics 150 W High Output UV Filters
- One Pentair UltraTemp Titanium Heat Exchanger Heat Pump for heating the culture tank and room dehumidification. 125 K BTU of heating, 71 K BTU of Cooling

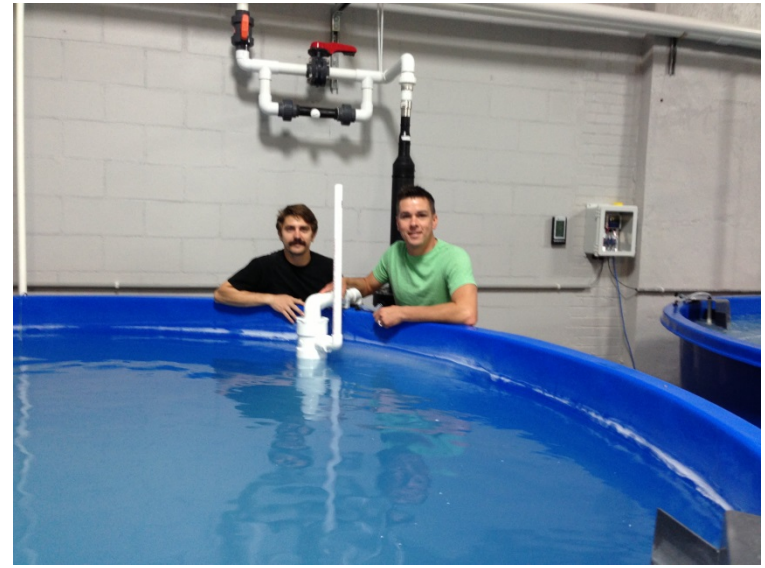


UV Filters to provide a UV dose of 30 mJ / cm^2, Heat Pump utilizes latent heat

Creating the Detail: Water Return to the Culture Tanks

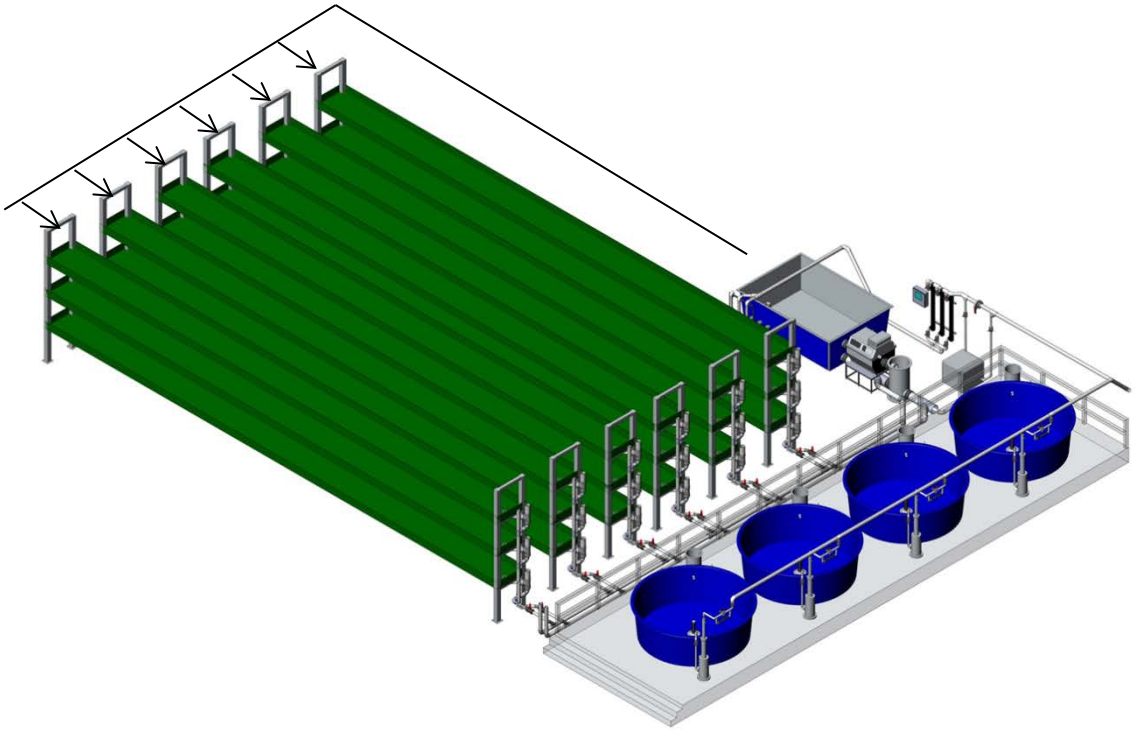
- One Oxygen Saturator PAES Model OY75 per Tank

- Water returns from the OY75 through a Vertical Manifold w/ flow manometer



OY75 Saturators transfer up 0.25 kg O2 / hour; Vertical Manifolds Create Self Cleaning Flow Conditions

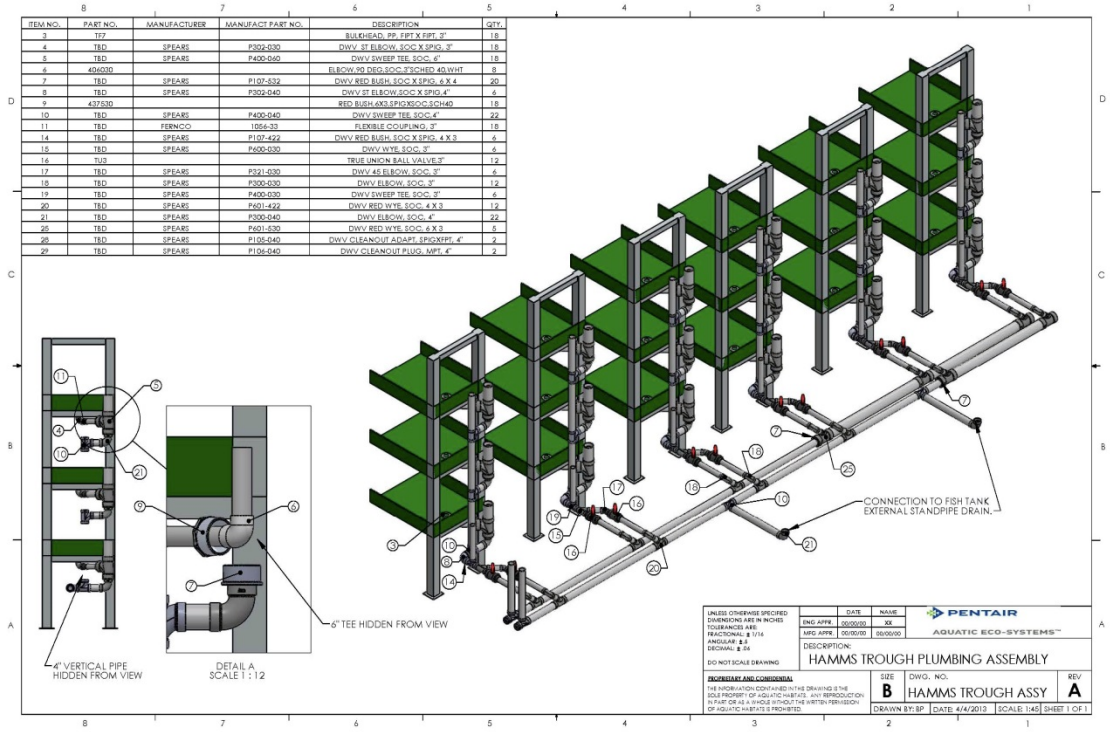
Creating the Detail: The Link to the Plant Production System



- Water from the second Moving Bed Filter is pumps by the closest Sparus CF pump to the head of each tray

Water flows equally through each of the three levels of trays

Creating the Detail: Trays , Water Flow and Plants



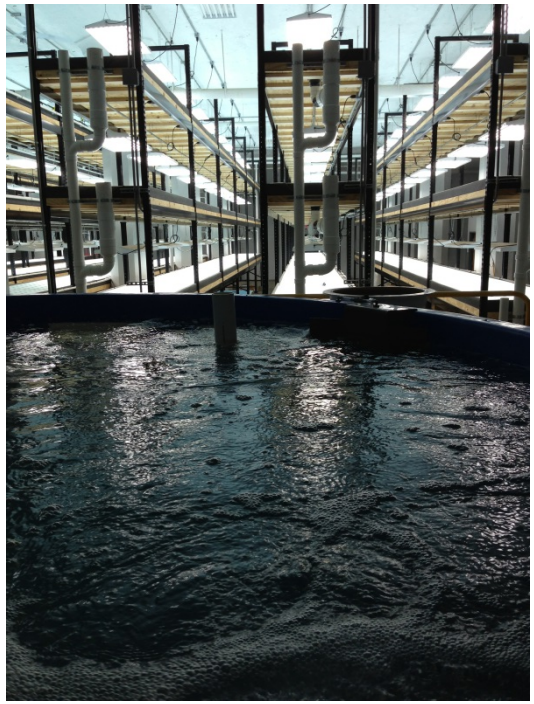
ITEM NO.	PART NO.	MANUFACTURER	MANUFACT PART NO.	DESCRIPTION	QTY.
3	TF7			BULKHEAD, PP, FIPT X FIPT, 3"	18
4	TBD	SPEARS	P302-030	DWV, ST ELBOW, SOC X SPIG, 3"	18
5	TBD	SPEARS	P400-060	DWV SWEEP TEE, SOC, 6"	18
6	406030			ELBOW,90 DEG,SOC,3"SCHED 40,WHT	8
7	TBD	SPEARS	P107-532	DWV, RED BUSH, SOC X SPIG, 6 X 4	20
8	TBD	SPEARS	P302-040	DWV ST ELBOW,SOC X SPIG,4"	6
9	437530			RED. BUSH,4X3,SPIGXSOC,SCH40	18
10	TBD	SPEARS	P400-040	DWV SWEEP TEE, SOC,4"	22
11	TBD	FERNCO	1056-33	FLEXIBLE COUPLING, 3"	18
14	TBD	SPEARS	P107-422	DWV, RED BUSH, SOC X SPIG, 4 X 3	6
15	TBD	SPEARS	P600-030	DWV WYE, SOC, 3"	6
16	TU3			TRUE UNION BALL VALVE,3"	12
17	TBD	SPEARS	P321-030	DWV, 45 ELBOW, SOC, 3"	6
18	TBD	SPEARS	P300-030	DWV, ELBOW, SOC, 3"	12
19	TBD	SPEARS	P400-030	DWV SWEEP TEE, SOC, 3"	6
20	TBD	SPEARS	P601-422	DWV, RED WYE, SOC, 4 X 3	12
21	TBD	SPEARS	P300-040	DWV, ELBOW, SOC, 4"	22
25	TBD	SPEARS	P601-530	DWV, RED WYE, SOC, 6 X 3	6
26	TBD	SPEARS	P105-040	DWV, CLEANOUT ADAPT, SPIGXFPT, 4"	2
29	TBD	SPEARS	P106-040	DWV, CLEANOUT PLUG, MPT, 4"	2

- Water from the second Moving Bed Filter is pumps by the closest Sparus CF pump to the head of each Tray

- The plants float on polystyrene rafts in 18.3 x 1.2 meter long plastic troughs. Three tiers on a rack, and six to eight racks per floor with up to 24 000 plants.

Water is pumped to the Trays and flows by gravity back to the Biofilters

Creating the Detail: Trays and Lighting

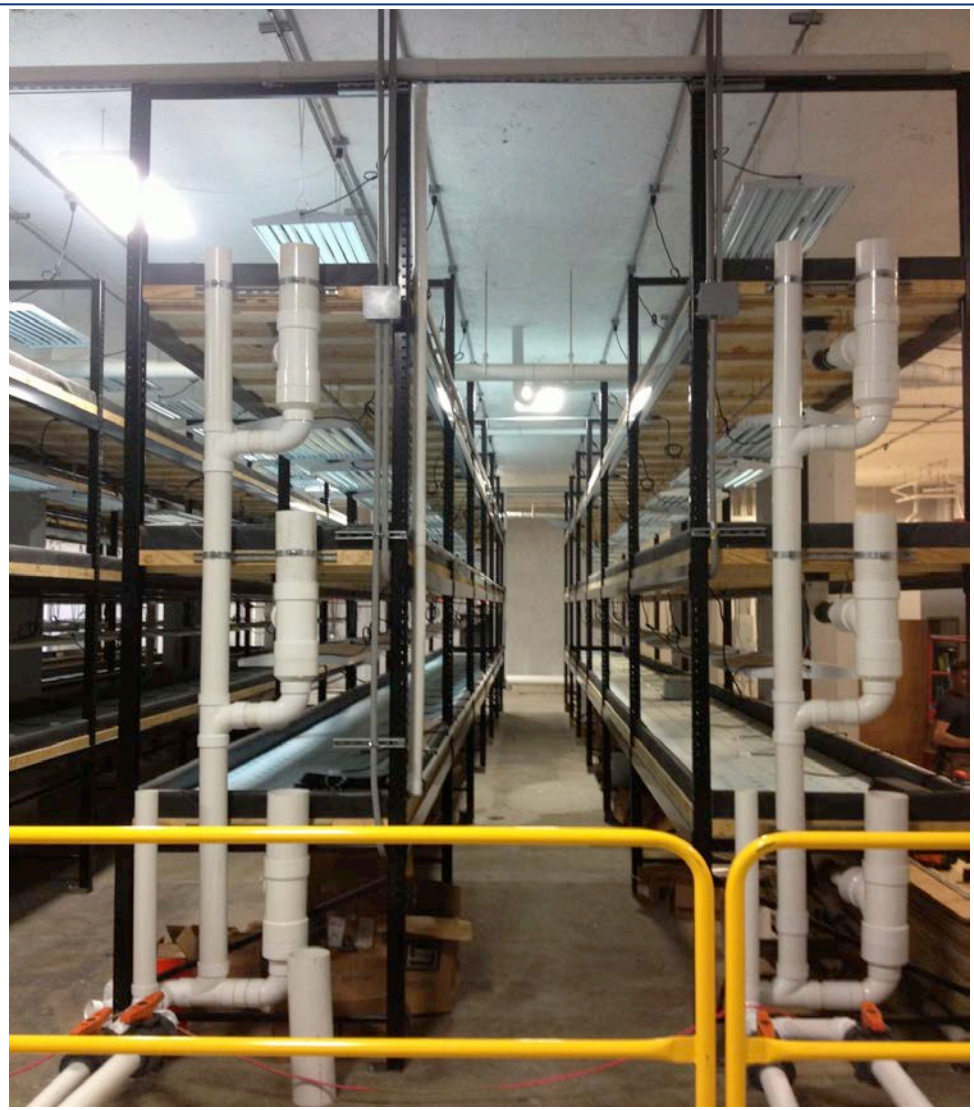


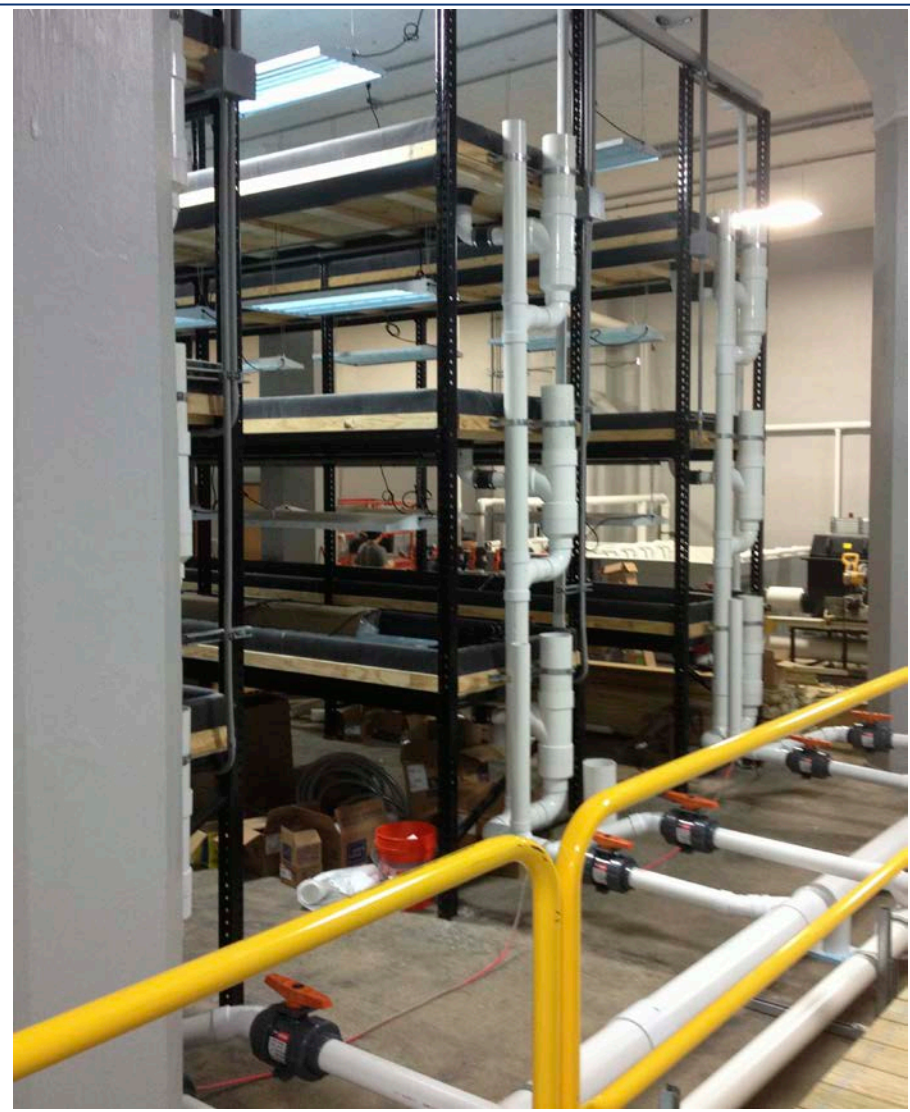
- Each Tray is lit with twenty 250-watt 6500k T5 Grow Lights suspended about 0.5 m above the plants; A total of 300 bulbs per floor.

- Pictured above are the drain lines leading from the Trays to the Drum Screen Filter or first stage of the Moving Bed Bio Reactor (MBBR)

Plant receive an optimum level of light yielding optimum growth rates

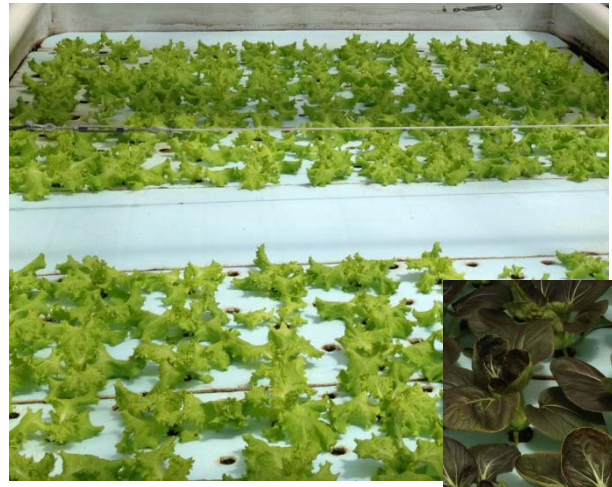
Plant Grown Trays and Lights (T-5)





90-110g feed/m2, plant to fish surface area 6.3:1

Expected Production from this Facility



- Fish production from the facility is expected to be 23 – 28 mt per year
- Annual plant yield of 450 mt of lettuce and fresh herbs

Waste water will be collected in the basement of the building, solids removed and some water reused

Acknowledgements

The Urban Organic Team

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Anthony Johannes

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Acknowledgements

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