Nutter

Eliza Cox
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December 4, 2015
0106967-00002

Jon Idman, Esq., Chief Regulatory Officer
Cape Cod Commission
3225 Main Street
Barnstable, MA 02630

Re: Paesano Place - 123 Waterhouse Road, Bourne

Dear Jon:

As discussed in our meeting last month with Scott Michaud on the above matter, I enclose the following information:

1. Correspondence from Jack Landers-Cauley dated December 2, 2015, describing plan modifications based on our discussions with Scott;

2. Updated proposed condition nitrogen loading calculations yielding a nitrogen load of just 2.98ppm (and representing a significant reduction beyond existing conditions);

3. Information regarding the Amphidrome wastewater treatment system now proposed at the site;

4. A Landscape Operations and Management Plan dated December 1, 2015;

5. Civil Site Plan set, consisting of 3 sheets, dated July 29, 2010, last revised on December 1, 2015; and

6. Landscape Plan dated November 19, 2015.

Under separate cover we have provided Steve Tupper with a draft Travel Demand Management Plan. Please review the enclosed information and let us know if you have any questions or comments. Kindly let Scott know that he can feel free to contact Jack Landers-Cauley directly should he have any questions regarding the enclosed materials.

It is our hope that this matter can be brought before the Committee on Planning and Regulation at the earliest convenient date. In that regard, please let me know where Commission Staff stands with respect to the request so that we can advance toward such a meeting.

Thank you very much.

Very truly yours,

Eliza Cox

EZC:
Enclosures

cc: Franco Raponi

2968833.1

J.E. LANDERS-CAULEY, P.E.
civil-environmental engineering
P.O. Box 364
West Falmouth, MA 02574
(508)-540-7733; 508-540-3344 fax

Mr. Scott Michaud
Cape Cod Commission
3225 Main Street
PO Box 226
Barnstable, MA 02563

December 02, 2015

Re: Nitrogen Loading and Modified Drainage Design
123 Waterhouse Road
Bourne, MA

Mr. Michaud,

Attached are: a Landscape Plan prepared by Greener Image; a landscape operations and management plan for 123 Waterhouse Road, Bourne dated:12/01/2015; updated nitrogen calculations-dated: 12/02/2015; a proposal titled: Amphidrome Wasterwater Treatment System Proposal for 123 Waterhouse Road-dated:12/2/2015; Amphidrome Specifications 123 Waterhouse Road, Bourne, MA, not dated; revised site plans, with a final revised date of: 12/01/15; and, finally a letter from my office dated: October 20, 2015.

Nitrogen loading:

It is our belief these documents provide sufficient information to demonstrate compliance with the requirement to provide a post construction development of less than 5.0ppm nitrogen discharge for the proposed daily flow of 1862gpd.

The nitrogen calculations were calculated using the nitrogen loading program the CCC utilizes. The wastewater concentration computed is based upon a warranty from the manufacturer that a final discharge of 10mg/l can be consistently maintained. This assertion is based upon data from existing similar facilities within Massachusetts and greater New England. The site plans have been updated to reflect the system components as described by the manufacturer's staff.

The landscape designer has reassured us the landscaping plan being submitted has no new cultivated lawn (turf) areas being proposed. In addition, those areas with lawn/turf which exist will be entirely eliminated and replaced with a combination indigenous plantings and stone. These details are shown on the landscape plan.

Storm-water:

The plans have been modified as to design the swale and detention/ retention areas with 3/1 side slopes. To accomplish the 3/1 slope design, it was necessary to have incorporated the use of rock filled gabions to retain the shoulders of the swale and detention/retention area.

There is no reduction in the percolation characteristics by utilizing the design of rock filled gabions to retain the shoulders of the forebay or retention/detention areas. The design incorporates the use a permeable membrane to permit the continual percolation of stormwater during periods of excessive rainfalls.

The flattening of the slopes from 2/1 to 3/1 have increased the volume capacities of the swale and detention/retention areas in the order of 15-20%. However no reduction in the size of the basins are being proposed.

As in our earlier letter, we are following the recommendations of the Commission staff and proposing to discharge the roof drainage for the proposed building into a separate leaching basin. The conductors pipes are proposed to discharge into a subsurface drainage system which will directly discharge into the leaching pit. See the plans for the details. This modification to the drainage design reduces the surface water runoff to the swale/forebay and detention area. The net result is the swale/ forebay drainage areas will have sufficient capacity to maintain the 1" rainfall event.

The landscape plans have been modified to incorporate the use of a rain garden. The rain garden has been designed by the landscape company to incorporate extended the hydraulic residence time and reduce the TSS. It is our opinion and certify the rain garden will reduce the TSS to the minimum standards recommended by the Storm Water Guidelines.

Jack landers-cauley

p:jack\old computer\office\drainage-123 Waterhouse Dec2015

NON-RESIDENTIAL NO3-N LOADING

12/2/2015

PROJECT: 123 WATERHOUSE ROAD- PAESANO revised loading rate
TOWN: BOURNE

Title V Wastewater Flow =	1862	gpd
OFFICE USE- SF	18508	ft2
Total Land Area =	120742	ft2
Paved Area =	57500	ft2
Roof Area =	11230	ft2
Lawn Area = (est.)	0	ft2
Natural Area =	52012	ft2

ASSUMED VALUES

Impervious Recharge Rate =	40	in/yr
Roof Runoff Concentration	0.75	mg/L
Road Runoff Concentration	1.50	mg/L
Lawn Nitrogen Leaching =	25	%
Wastewater Concentration =	10	mg/L*
Average Lawn Size =	5000	ft2
Recharge Rate =	21	in/yr
Nitrogen Application Rate	3	lbs/1000ft2

*-35 Without I/A system, 25 or less with

CALCULATIONS

Title V Wastewater Loading	70476.70	mg	Title V Wastewater Recharge	7047.67	liters
Total Impervious Loading	24485.16	mg			
Roof Loading	2178.31	mg	Roof Recharge	2904.42	liters
Paved Loading	22306.85	mg	Paved Recharge	14871.23	liters
Lawn Loading	0.00	mg	Natural Area Recharge	7062.23	liters
Title V Total Loading	94961.86	mg	Title V Total Recharge	31885.55	liters

TITLE V NITROGEN LOADING CONCENTRATION = **2.98 ppm**

34.66 kg/yr
12.50 kg/acre/yr

Appendix B

EQUIPMENT WARRANTY

F. R. Mahony and Associates, Inc. (FRMA) warrants to the original purchaser and the end user all new equipment manufactured by it to be free from defects in material and workmanship, and at the election of FRMA, Inc. will repair or replace, f.o.b. its factories or other locations designated, and as determined by FRMA any part or parts returned to it, transportation/freight prepaid, which examination shall show to have failed under normal use and service by the original user within one (1) year following start-up or (18) months from shipment, whichever occurs first. Such repair or replacement shall be free of charge except for freight and those parts such as media, chemicals, oil, grease, belts and like that are consumable under normal use. FRMA's obligation under this warranty is conditioned upon it receiving prompt written notice within 30 days of claimed defects during the one year warranty period. Discovery thereof during the one year warranty period is limited to repair or replacement as aforesaid. No allowance will be made for labor, transportation, or other charges incurred in the replacement of repaired defective parts and/or equipment furnished.

THIS WARRANTY, INCLUDING THE STATED REMEDIES, IS EXPRESSLY MADE BY FRMA AND IS ACCEPTED BY ORIGINAL PURCHASER IN LIEU OF ALL OTHER WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, WHETHER WRITTEN, ORAL, EXPRESS, IMPLIED OR STATUTORY. FRMA NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME IT FOR ANY OTHER LIABILITIES WITH RESPECT TO ITS EQUIPMENT. FRMA SHALL NOT BE LIABLE FOR NORMAL WEAR AND TEAR, NOR FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE DUE TO INOPERABILITY OF ITS EQUIPMENT FOR ANY REASON NOR ON ANY CLAIM THAT ITS EQUIPMENT WAS NEGLIGENTLY DESIGNED OR MANUFACTURED.

This warranty shall not apply to equipment or parts thereof which have been altered or repaired outside of FRMA factory or damaged by improper installation, storage, application, erosion, or corrosion of any sort, or subjected to misuse, abuse, neglect, or accident. This warranty is null and void if payment is delayed, not made, or if not in accordance with the terms and conditions of FRMA equipment proposal.

FRMA makes no warranty with respect to parts, accessories, or components manufactured by others. The warranty applicable to such items is that offered by their respective manufacturers.

AMPHIDROME® FACILITY REPORT

Plant & Location: CVS, Jackson Twp, NJ

NJ Pinelands Application Number: 1981-2118.003

Facility type: Convenience Store

Chemical Feeds: Carbon & alkalinity

Design: This plant was designed to meet NJ Pinelands discharge limits including a total nitrogen limit of ≤ 10 mg/L. Design and average values are provided below.

Parameter	Design Values	Actual Values
Flow	1,825 gpd	110 gpd
BOD_5	500 mg/L	n/a
TKN	170 mg/L	n/a
C/N	2.9	-

C/N - Carbon-to-nitrogen ratio measured as BOD_5/TKN.

Summary: This Amphidrome® Plus was designed based on data obtained by sampling seven different CVS stores. Although the plant is currently receiving less than 10% of the design flow, the system is still operating well within discharge limits. The average effluent results for the life of the plant are shown in the table below.

	BOD_5	TSS	Total N
Permit Limit	*30 mg/L*	*30 mg/L*	*10 mg/L*
Average	n/a	n/a	4.9 mg/L

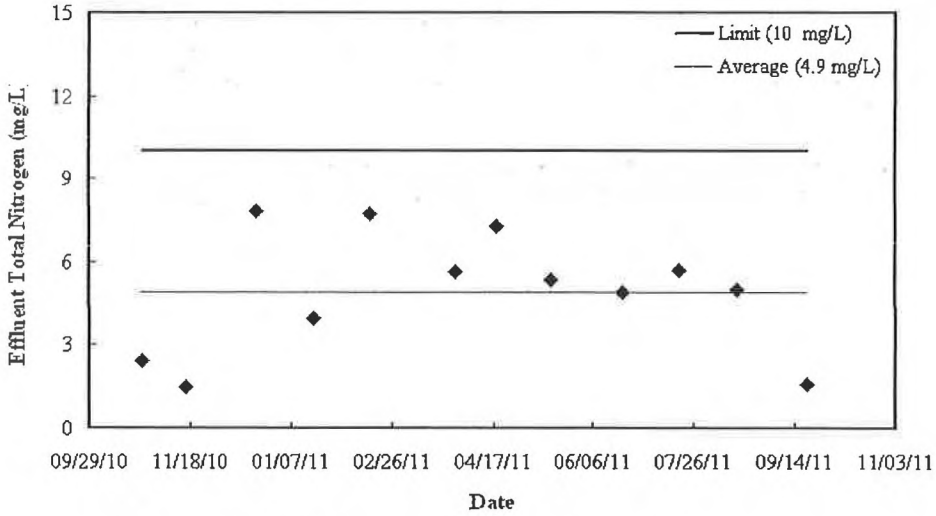


Figure 1. CVS Jackson Effluent Total Nitrogen

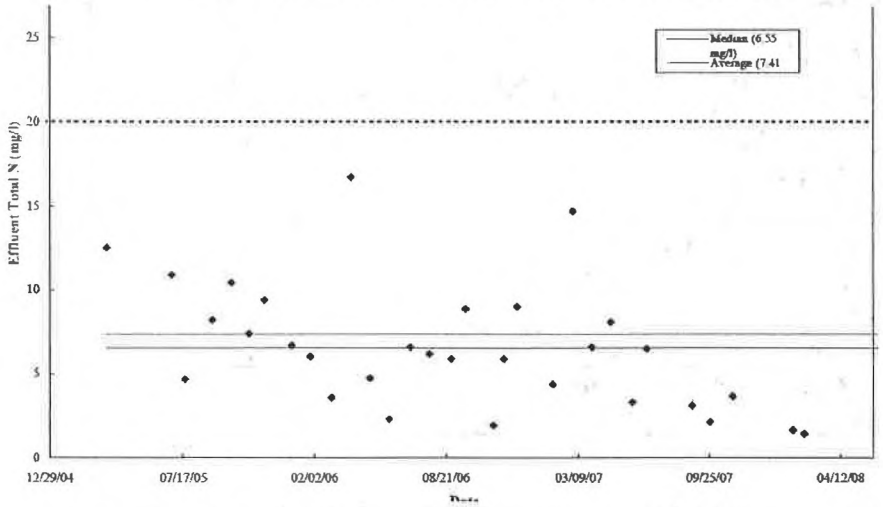
Appendix A

Chili's Restaurant

Hingham, MA

Design Flow 8,000 gpd

This single reactor Amphidrome® system provided exceptional treatment with high concentrations of Fats, Oils, and Grease



Chili's Restaurant, Hingham, MA - FOG Data

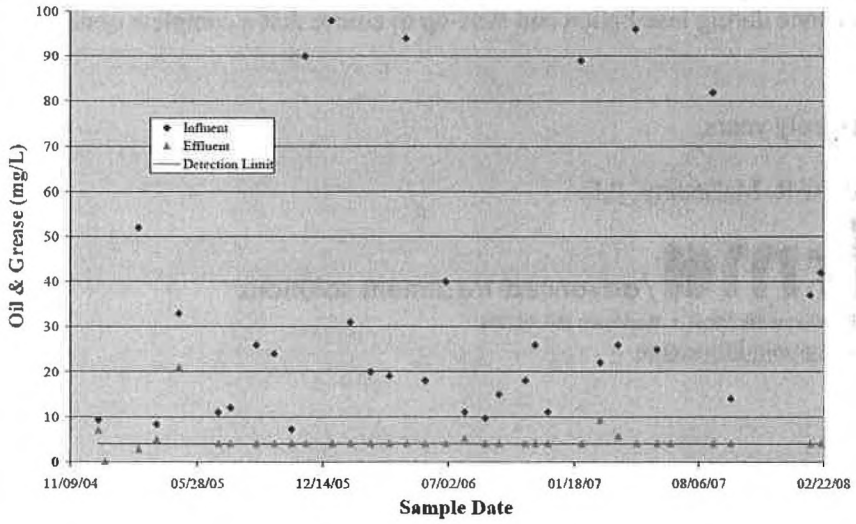


Table 4

Scope of Supply

MAJOR COMPONENTS	QUANTITY	MANUFACTURER
Amphidrome® Reactor Internals	One (1)	FRMA
Amphidrome® Plus Reactor Internals	One (1)	FRMA
Stilling Well for Anoxic Tank	One (1)	FRMA
Amphidrome® feed pumps	Two (2)	GOULDS
Return Flow and Backwash Pumps	One (1)	GOULDS
Amphidrome® Plus feed pumps	One (1)	GOULDS
Plus Backwash Pump	One (1)	GOULDS
Final Discharge Pumps	Two (2)	GOULDS
Base elbows and guide brackets for discharge	included	CONNERY
50 foot cord length for pumps and floats	included	
Required Float switches and stainless brackets	included	Anchor
Backwash Blower	One (1)	Conde
Process Blowers	Two (2)	Gast
Control Panel with Touch screen And Remote Wireless Access	One (1)	FRMA
Disconnect junction boxes for all pumps and floats	included	FRMA
Alkalinity Feed Pump with Tank & Agitator	One (1)	LMI
Carbon Feed Pump with Tank	One (1)	LMI
Auto Dialer	One(1)	PumpAlarm

The tanks, control building, external piping, and installation are to be provided by others. FRMA will provide assistance with the design and review the contract drawings and provide assistance during installation and start-up to ensure that a complete system is provided.

Very truly yours,

Andrew R. McBrearty, P.E.

frma /advanced treatment solutions
273 Weymouth Street • Rockland, MA 02370
www.amphidrome.com

Table 2
Tank and Reactor Sizing

Tank	Capacity/Size
Anoxic/Equalization	3,000 gallons
Amphidrome® Reactor	3.0 ft.-dia. with 7.5 ft. media (Overall height 15.5 ft.)
Amphidrome® Clear Well	1,500 gallons minimum
Amphidrome® Plus Reactor	2.0 ft. diameter with 5 ft. media (Overall height 11.5 ft.)
Amphidrome® Final Effluent	1,000 gallons minimum

Table 3

Estimated Annual Operating electricity Costs @ $0.12/ kWh:

Process Air	Back wash air	RF/BW Pumps	Discharge Pumps	TOTAL
$100	$30	$75	$50	**$255**

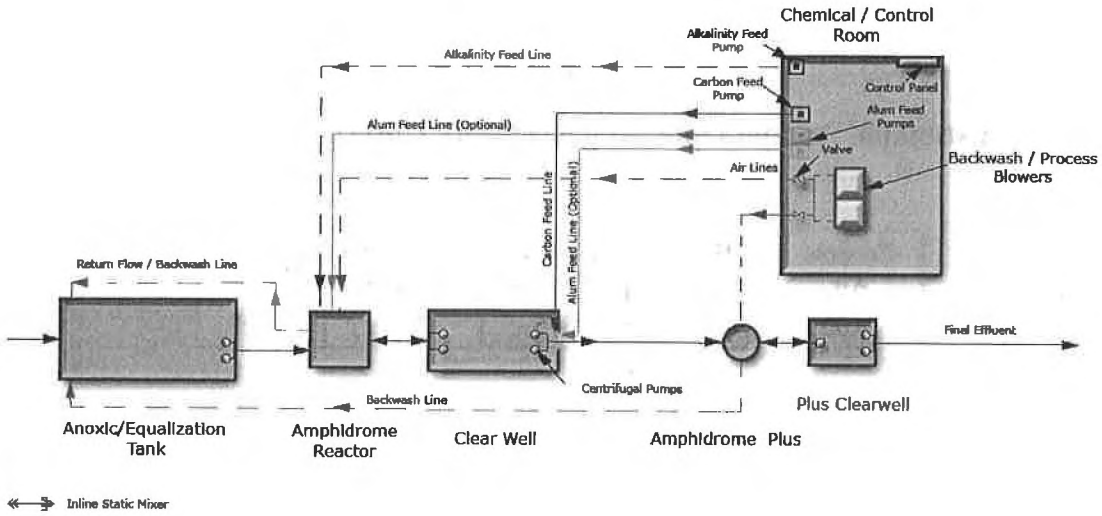
Design

Amphidrome™ Reactor
The most cost effective design for this facility is one (1) 3-ft. diameter reactor. The reactor will have a 7.5 ft. bed depth and an overall height of 15.5 feet.

Amphidrome™ Plus Reactor
The most cost effective design for this facility is one 2.0 ft. diameter reactor. The reactor will have a 5 ft. bed depth and an overall height of 11.5 feet.

See Tables 1-2 For Design Information And Tank Capacities.

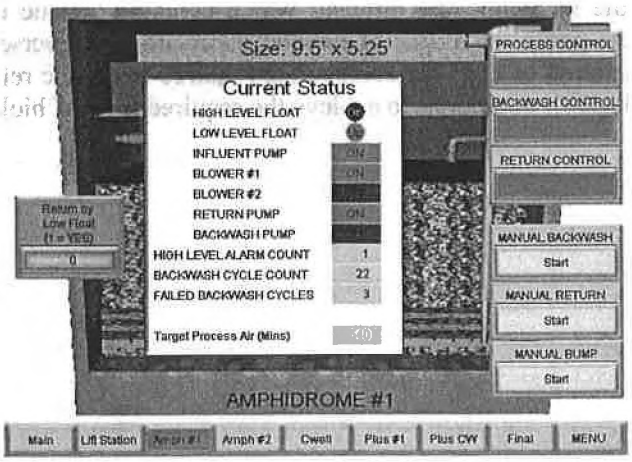
Process Flow Schematic



Controls:
The control system is PLC based with a user friendly operator touch screen interface

Wireless Process Control Access (WPCA)

Amphidrome systems are now provided with one year of online and phone technical support. The system will be supplied with a WPCA module that will allow the operator and FRMA to log into the system. This allows real time control and observation of the system remotely via the internet. Remote access to stored system trending data, alarm history etc. provides valuable insight on system operation and any adjustments that may need to be made to optimize performance. These adjustments can be made remotely in real time.



maintained. The media specific surface area of 250 $ft.^2/ft.^3$ results in a high concentration of biomass within the reactor, which means that the hydraulic retention time (HRT) is short; therefore the reactor requires a significantly smaller volume to treat a given waste strength than would be required by some other reactors.

Reactor Quiescent Flow

Reactor During Aeration

The influent wastewater enters the system through the anoxic/equalization tank, which has an equalization zone, a settling zone, and a sludge storage zone and serves as a primary clarifier for the SAGB. The wastewater then flows by gravity into the reactor. The driving force of the forward flow is the hydrostatic pressure created by the differential liquid levels within the tanks. Operation of the SAGB alternates between down-flow (forward flow) and up-flow (reverse flow) modes. The up-flow is accomplished by pumping from the clear well back up through the filter. To achieve the required aerobic and anoxic conditions within the biofilm, process air to the reactor is supplied intermittently-via the underdrain at the bottom of the reactor and is independent of the return flow cycles. During a return, water from the clear well is pumped back through the filter, following the exact same path through the reactor as it did in the forward flow cycle. However, a check valve in the influent line of the reactor prevents the flow from returning to the anoxic/equalization tank via the same route. Instead, the flow fills the reactor until it overflows into the return flow/backwash trough and flows back to the front of the anoxic/equalization tank by gravity. The recycled flow, which contains nitrates, mixes with the incoming raw influent, which contains organic carbon, and starts to flow forward again when the pump shuts off. The cyclical forward and reverse flow of the waste stream and the intermittent aeration of the filter achieve the required hydraulic retention time and create the necessary aerobic and anoxic conditions to achieve the required level of biological nitrogen removal.

The system operates as a sequencing batch reactor in which the waste water is cycled back and forth through the filter. The Amphidrome® reactor is intermittently aerated to achieve both the aerobic environment required for the oxidation of organics and nitrification and the anoxic environment required for denitrification.

The system includes an anoxic/equalization tank, one clear well, and a BAF. The Amphidrome® system is typically installed underground. The only structure required is a small building for the blowers and control panel.

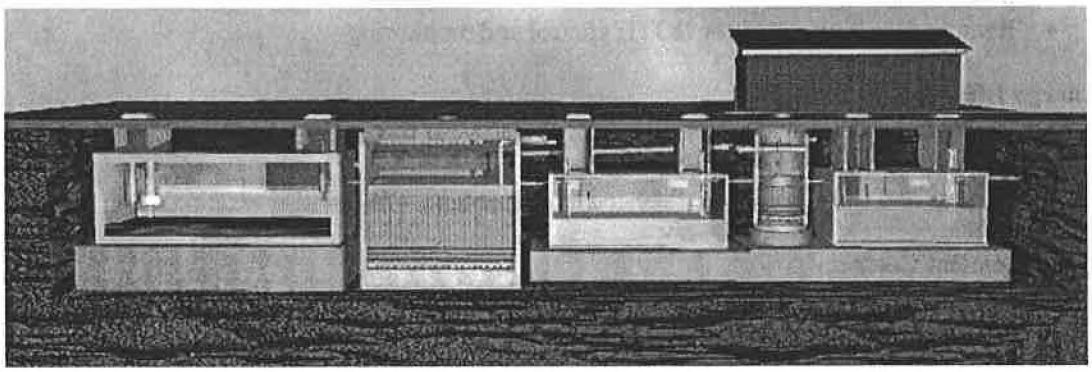
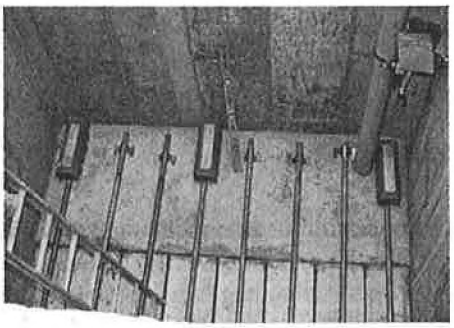
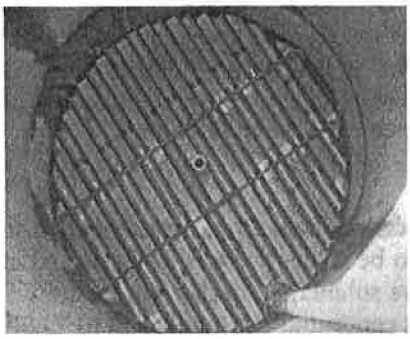


Figure 1. Section View of Amphidrome® System

The reactor consists of: 1) an underdrain, 2) support gravel, 3) filter media, and 4) a backwash trough. The underdrain, located at the bottom of the reactor, can be constructed of concrete blocks encased with high-density polyethylene and stainless steel piping or entirely out of stainless steel. It provides support for the media and even distribution of air and water into the reactor. The underdrain includes a manifold and laterals to distribute the air evenly over the entire filter bottom. The design allows for both the air and water to be delivered simultaneously--or separately--via individual pathways to the bottom of the reactor.



Concrete Block Underdrain



Stainless Steel Underdrain

On top of the underdrain is 1.5 ft (five layers) of four different sizes of gravel. Above the gravel is a deep bed of coarse, round silica sand media. The media functions as a filter, reducing suspended solids while providing the surface area on which an attached growth biomass can be

System **Benefits**

Low Visual Site Impact

- System below grade

Easy To Operate

- Touch screen with SCADA like equipment screens, data trending and built in troubleshooting guide
- Remote access provided for BOTH control and monitoring

Energy Efficient

- Intermittent aeration - Process air runs 3-5 hours per day
- Backwash blowers run 10 min per day
- Primary and waste solids are digested in anoxic tank – no aeration required

Low Chemical Costs

- Anoxic environment created to denitrify and reclaim alkalinity required for nitrification
- Intermittent aeration provides simultaneous nitrification-denitrification

Consistent Treatment

- Fixed film reactor with high biomass responds well to low and shock loads
- Anoxic tank equalizes mixes and dilutes incoming shock loads of chemicals dumped into the system
- Demonstrated ability to perform with high levels of Oil & Grease (See Chili's Data Appendix A)

Filtered Effluent

- Effluent is filtered through our deep media bed filter

Upgradable

- Easily upgraded for phosphorus reduction without adding additional filtration
- Easily upgraded for UV disinfection by adding an enclosed UV and using the discharge pumps to pump through it.

The process utilizes a biologically active filter (**BAF**) operating as a sequencing batch reactor. It may also be categorized as a submerged attached growth bioreactor (SAGB) because the media is always submerged in the process flow. The two primary advantages of SAGBs are the high biomass concentrations equivalent to **7,000 – 18,000 mg-VS/l** that may be achieved and the short hydraulic retention time (HRT), which result when media with a high specific surface area is used. The short HRTs result in compact reactors, which are advantageous when land area is limited. The media also provides physical filtration and therefore, the need for solids separation after the biological treatment process is eliminated.

Franco Raponi
Commercial Properties Investor
P.O. Box 3139
Pocasset, MA 02559-3139

RE: 123 Waterhouse Road

Dear Mr. Raponi,

We are pleased to present the preliminary design and proposal for an Amphidrome® Wastewater Treatment System for the **123 Waterhouse Road, Bourne, MA.**

The Design Parameters we have used for the facility are summarized below

Influent Values Are Assumed

Table 1

Design Summary

Constituent	Influent	Effluent Requirements
Flow	1,862 gpd	
BOD	150 mg/L	≤ 25 mg/L
TSS	150 mg/L	≤ 30 mg/L
TKN	70 mg/L	≤ 10 mg/L
Ammonia	60 mg/L	
Alkalinity	150 mg/L	

The Amphidrome® system has been used successfully for over **15** years in over **125** applications, from single family installations to small systems with flows in excess of 360,000 gallons per day and can be customized to fit site requirements.

Amphidrome®*

WASTEWATER TREATMENT SYSTEM PROPOSAL

PROJECT: 123 Waterhouse Road

LOCATION: Bourne, Massachusetts

PREPARED FOR: Mr. Franco Raponi

REVISION: 0 – FLOW 1,862 gpd

DATE: 12/2/2015

*Manufactured under license from DeNora Water Technologies

DE NORA

Amphidrome® Specifications
123 Waterhouse Road
Bourne, MA

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SECTION I.0 SCOPE OF WORK

The work under this section includes furnishing, installing and testing an Amphidrome® process system. The system shall be supplied by one manufacturer, with the exception of process tanks, reactor vessel and external piping, and provide miscellaneous parts for connection of internal piping assemblies provided by the manufacturer, who shall be responsible to the installing contractor for satisfactory operation of the system. The contractor shall install the system as shown on the plans and described here in. The system will include the following: reactor internals (i.e. stainless steel underdrain, media support gravel, process filtration media), return flow/ backwash pump, backwash check valve(s), backwash air blower(s), process air blower(s), de-nitrification process water supply pump(s), effluent pump(s), and system process control panel. Contractor supplied components shall include anoxic tank, reactor tank, clear well tank, external piping and access covers.

The Amphidrome® process system shall be designed to operate under the conditions indicated in Design Criteria and Data.

The Amphidrome® process system is especially designed for the simultaneous removal of BOD, ammonia, suspended solids, and nitrite and nitrate-nitrogen. A license to use the process and apparatus shall be provided by the manufacturer of the AMPHIDROME® process system.

The manufacturer of the Amphidrome® process system shall be F. R. Mahony & Associates, Inc., of Rockland, Massachusetts, in cooperation with De Nora Water Technologies.

SECTION 2.0 ANOXIC/EQUALIZATION TANK

The Contractor shall provide a minimum of a 3,000-gallon pre cast, reinforced concrete anoxic tank to conform to the design drawings and local specifications. All piping shall be made in accordance with the approved plans. The manufacturer shall supply piping assembly for the return & backwash energy dissipating TEE.

SECTION 3.0 AMPHIDROME® REACTOR

This design is a single train system consisting of one Amphidrome® reactor 3.0 ft in diameter and one 2.0 ft-diameter Amphidrome® Plus™ reactor as per system design. All tanks will be made of pre-cast concrete and furnished and installed by the contractor.

SECTION 3.1 REACTOR VESSELS

The reactor vessel shall be supplied and installed by the contractor and be made of pre-cast reinforced concrete or fiberglass with dimensions as shown on the

drawings. Each vessel shall be field assembled by the installing contractor complete with reactor internals, process and backwash air header, backwash trough, backwash check valve, and inlet and outlet piping. Backwash check valves are to be supplied by the Amphidrome® process system supplier.

SECTION 3.2.0 AMPHIDROME® REACTOR INTERNALS

The Amphidrome® reactor internals shall be installed in contractor supplied vessels as shown on the plans. All air piping is by the contractor. Reactor internals shall include the underdrain, (i.e. backwash and process air distribution header and laterals), gravel support layers, and filter media. The underdrain system shall be supplied by the manufacturer.

The underdrain system serves to distribute air and water uniformly over the entire area of the reactor vessel, as well as to support the gravel and filter media.

SECTION 3.2.1 REACTOR MEDIA

The process reactor underdrains shall be covered with a minimum of 18" of gravel arranged carefully in five layers. Each gravel layer shall consist of hard, durable, rounded particles of washed gravel having a specific gravity of not less than 2.6. The gravel shall be un-crushed naturally-occurring materials and shall contain not more than 2% by weight of thin, flat, or elongated pieces (pieces having a ratio of largest dimension to smallest dimension greater than 5:1) as determined by hand-picking from a representative sample, in accordance with AWWA Specification B100-89. The gravel shall be washed free from shale, mica, sand, clay, loam, and organic impurities of any kind. The washed and dried gravel, when digested for a period of 24 hours in cold, strong hydrochloric acid, shall not suffer weight loss in excess of 5%. The percent voids in any layer shall not be less than 35% or greater than 45%.

The gravel layers shall be sized as follows:

Top	4"	1/2" x 1/4"
Next	4"	1/4" x 1/8"
Next	4"	1/2" x 1/4"
Next	2"	3/4" x 1/2"
Bottom	4"	1-1/2" x 3/4"

A layer of silica sand media, at least seven and a half feet (7.5') deep in the Amphidrome® reactor, shall be placed on top of the gravel support layers. A layer of silica sand media, at least five feet (5.0') deep in the Amphidrome® Plus™ reactor, shall be placed on top of the gravel support layers. The sand shall be 6 x 9 mesh, well rounded, not flat or angular, with a maximum uniformity coefficient of 1.35. The hardness shall be 6 to 7 on the MOH scale and the minimum specific gravity shall be 2.6. The hydrochloric acid solubility shall not

exceed 0.3% when tested. The media should have a spherocity of 0.8 to 0.85 as determined by methods described in ***Elements of Water Supply and Wastewater Disposal,*** second edition, 1971, pages 404 - 406, Fair, Geyer, Okun, John Wiley & Sons, Inc.

SECTION 4.0 CLEAR WELL TANK

The Contractor shall provide a minimum of a 2,000-gallon pre-cast, reinforced concrete clear well tank. The clear well tank is to conform to the design drawings and local specifications. All piping shall be made in accordance with the approved plans. The manufacturer shall supply piping assemblies to include backwash/return pump assemblies and Plus™ feed pump as applicable.

SECTION 5.0 FINAL DISCHARGE TANK

The Contractor shall provide a minimum of a 1,000-gallon pre-cast, reinforced concrete final discharge tank. The Final discharge tank is to conform to the design drawings and local specifications. All piping shall be made in accordance with the approved plans. The manufacturer shall supply piping assemblies to include backwash/return pump assemblies, discharge pump and samplers as applicable.

SECTION 6.0 PROCESS EQUIPMENT

SECTION 6.1 BACKWASH AIR BLOWER

One (1) blower shall be supplied to provide backwash air to the Amphidrome® reactor. The blower shall have a minimum capacity as specified by the manufacturer and shall be driven by a (3.0) hp, single phase, 60 hertz motor.

SECTION 6.2 PROCESS AIR BLOWER

One (1) blower shall be supplied to provide process air to the Amphidrome™ Reactor. The blower shall have a minimum capacity as specified by the manufacturer and shall be driven by a (.75) hp, single phase, 60 hertz motor.

The blowers shall be mounted on a base plate. Each blower shall have an, inlet filter, pressure relief valve, wafer body split disc check valve, and discharge pressure gauge. The blowers must be placed inside a building, or in a weather tight enclosure.

SECTION 6.3 AMPHIDROME® FEED PUMPS

Two (2) Amphidrome® Feed Pumps shall be supplied by the Amphidrome® process system supplier to pump water from the anoxic tank to the

Amphidrome® reactor. The pumps will be submersible, dual-alternating, centrifugal, with a minimum capacity as specified by the manufacturer and shall be driven by a ½ hp, single phase, 60 hertz motor.

SECTION 6.4 REVERSE FLOW/BACKWASH PUMP

One (1) reverse, flow/backwash pump shall be supplied by the Amphidrome® process system supplier to pump water from the clear well to the Amphidrome® reactor during a return flow and a backwash. The pump will be submersible, centrifugal, with a minimum capacity as specified by the manufacturer and shall be driven by a ½ hp, single phase, 60 hertz motor.

SECTION 6.5 PLUS™ FEED PUMP

One (1) Plus™ Feed pump shall be supplied by the Amphidrome® process system supplier to pump the water from the clear well to the Amphidrome® Plus™ reactor. The pump will be submersible, centrifugal, each with a minimum capacity as specified by the manufacturer and shall be driven by a ½ hp, single phase, 60 hertz motor.

SECTION 6.6 PLUS™ BACKWASH PUMP

One (1) Plus™ Backwash pump shall be supplied by the Amphidrome® process system supplier to pump the water from the final discharge tank to the Amphidrome® Plus™ reactor during a bump flow and a backwash. The pump will be submersible, centrifugal, each with a minimum capacity as specified by the manufacturer and shall be driven by a 0.4 hp, single phase, 60 hertz motor.

SECTION 6.7 EFFLUENT PUMPS

Two (2) dosing pumps shall be supplied by the Amphidrome® process system supplier to pump the water from the clear well to the soil absorption system. The pump will be submersible, centrifugal, each with a minimum capacity as specified by the engineer and shall be driven by a ½ hp, single phase, 60 hertz motor. ***(Note: Site specific requirement)***

SECTION 6.8 JUNCTION BOXES AND SPLICES

All splices and electrical junction boxes shall be above grade and made to be watertight and enclosed in weather tight junction or splice boxes. Direct line splices shall not be permitted unless in approved junction box. Splices are not permitted unless done with splice kit approved by the manufacture.

SECTION 6.9 VENTING

Venting of the Amphidrome® reactor shall be to the leach field unless otherwise approved by the manufacturer.

SECTION 6.10 FLOAT SWITCHES

Float switches, for locations as indicated on the plans, will be furnished with fifty feet (50') of cord.

Section 6.11 CARBON FEED SYSTEM

The carbon feed system will include one (1) LMI- A151-920SI (Liquid Metronics) pump. The pump will be 120 volt, 1 phase, and have a capacity of 1.0 gph at 110 psi. The system will also include one (1) LMI-10783 safety wand.

Section 6.12 ALKALINITY FEED SYSTEM

The alkalinity feed system will include the following: One (1) chemical feed pump to supply alkalinity to Amphidrome® reactor. The pump shall be LMI-A151-920SI, 120 volt, 1 phase, capable of pumping 1.0 gph at 110 psi. The systems will also include one (1) LMI-26350-1 polyethylene storage tanks, and one (1) LMI-10590 agitators with suction shield.

SECTION 7.0 AMPHIDROME® CONTROL SYSTEM

The operational scheme of the Amphidrome® control system shall be initially set by the system supplier and shall be under the control of the system supplier until the performance testing is complete.

SECTION 7.1 PANEL AND INSTRUMENTS

A separate main control panel shall be supplied to operate the Amphidrome® process system. The main control panel shall be a wall-mounted NEMA 1 enclosure. The panel shall be shop wired to terminal strips for connection to field wiring as necessary.

The panel shall contain the necessary equipment, instruments, ancillary control devices, hardware and logic to perform the automation functions of the Amphidrome® process system. Panel devices shall also enable the operator to perform manual backwash sequencing for the reactors, and operation of pumps, blowers and auxiliary equipment.

All motor starters, and relays for the pumps and blowers.

All indicator lights, switches and wiring for a complete Amphidrome® control system.

SECTION 7.2 SUMMARY

All reactor operations are controlled from the main control panel (MCP). There are two (2) modes of operation: automatic and manual.

All automatic, reactor backwash operations are controlled by the control timer's operator functions are performed through the hardwired circuit. Amphidrome® backwashing and system discharge, are performed automatically at preset time intervals which are operator adjustable.

Each motor shall be capable of being operated from the main control panel through automatic and manual modes.

SECTION 8.0 DESIGN CRITERIA and DATA

Influent Characteristics:

CBOD total, mg/l	=	150	
TKN, mg/l	=	70	
Ammonium as N, mg/L	=	53	
TSS, mg/l	=	150	
pH, SU	=	7.3	
Alkalinity, mg/l $CaCO_3$	=	150	(Assumed)
Phosphate as P, mg/l	=	8.0	(Assumed)
Min. temp., deg. C.	=	11.0	(Assumed)

Required Effluent:

$CBOD_5$	=	30.0 mg/L
TSS	=	30.0 mg/L
Total Inorganic Nitrogen, mg/l	=	< 10.0 mg/L

SECTION 9.0 PROCESS PERFORMANCE

The performance of the deep-bed Amphidrome® process system shall be designed to produce an effluent that meets the design basis as indicated in Design Criteria and Data.

SECTION 10.0 INSTALLATION

Installation by the purchasing contractor shall be in strict accordance with the Amphidrome® process system manufacturer's instructions and recommendations. Prior to media installation, the underdrain shall be inspected by the system manufacturer, and/or manufacturer's representative. Construction over sight is the responsibility of the design engineer. Observation of the installation of both the gravel and the media, along with validation that the final elevations are correct; will be so stated and stamped by a registered

Professional Engineer. A final set of as built plans should be provided to F.R. Mahony & Associates, Inc.

SECTION 11.0 INSPECTION AND TESTING

The Amphidrome® process system manufacturer or licensed authorized representative shall furnish the services of a competent and experienced factory-trained representative who has complete knowledge of proper operation and maintenance of the equipment. The representative shall be in attendance, for one (1) scheduled visit. This visit is to inspect the installation of the media and the mechanical equipment. All reporting authorities that must be present during the process performance test should be present at this time as this is the final inspection and startup of the system. Additional days and trips, excluding those required to satisfy the process performance test, shall be reimbursed by the purchasing contractor to the manufacturer on a per diem basis.

A mechanical performance test shall be performed prior to the plant being placed into service. Present shall be the engineer and the system suppliers designated representative. The installing contractor shall furnish all labor, materials and equipment required for such tests and shall correct any deficiencies noted by repairing or replacing the defective equipment and completing the testing.

SECTION 12.0 GUARANTEE

The manufacturer shall have a minimum of five (5) years experience in the design and manufacture of factory-built BOD removal, nitrification and de-nitrification process reactor systems. The manufacturer shall guarantee for twelve (12) months from date of start-up, not to exceed eighteen (I8) months from date of shipment, that the equipment furnished will be free from defects in design, material and workmanship. Warranties and guarantees of the suppliers of various components in lieu of a single source responsibility by the manufacturer will not be acceptable.

In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the manufacturer shall repair or replace, at the engineer's discretion, upon return of such defective part to the systems supplier. The repair or replacement of those items normally consumed in service, such as seals, grease, etc., shall be considered as part of routine maintenance and upkeep.

SECTION 13.0 SHOP DRAWINGS, INSTALLATION INSTRUCTIONS AND O&M MANUALS

Installation and start-up and operations and maintenance manuals shall be furnished for all new equipment items installed as part of this project. A total of one (1) copy shall be provided with the equipment when shipped, one (1) copy

shall be sent directly to the office of the purchasing contractors for the homeowner. Additional copies are available upon request.

SECTION 14.0 ACCESS COVERS

Access covers for sampling and maintenance of pumps and reactors are required and shall be supplied by the contractor. Access may be by aluminum hatch cover, cast iron cover or HDPE cover provided cover is rated for the expected surface loading for the installed location. Cast Iron covers shall be provided to meet all h-20 loading conditions and HDPE covers shall be rated for 300 #/square foot walking areas.

DATED: 12/01/2015

123 Waterhouse Road, Bourne

Landscape Operations and Management Plans:

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A. LANDSCAPE MANAGEMENT APPROACH

In addition to meeting the Cape Cod Commission criteria, the landscape plan for this office development is designed to:

• Provide an enjoyable outdoor environment for patrons and an aesthetic amenity for residents and passers-by. Lush at-grade plantings to compliment the building with a variety of attractive and native plant species.

• Protect the health of residents, workers, and customers, as well as the environment, by minimizing use of pesticides (herbicides, insecticides, fungicides, and rodenticides). Plant selection emphasizes native plants and hardy cultivars to prevent pests and the use of harmful chemicals, especially where they may contact people or wash off in surface water. Pest, weed, and disease problems that arise are managed through "Integrated Pest Management" (IPM) methods described below.

B. LANDSCAPE MANAGEMENT SCHEDULE

See Sections C through F for definitions and specific practices required by this landscape management plan.

April:

• Prune any tree branches that interfere with public safety or sight lines. Prune all trees around the buildings yearly to encourage strong upward growth. Do not top trees.

• Check and remove sediment from fore bay and Bio-swale channel using hand methods (i.e. a person with a shovel) when cleaning to minimize disturbance to vegetation an underlying soils.

• Apply granular fertilizer around trees or shrubs in late April. Make application prior to a moderate rainfall so the rain will wash the fertilizer in. Do not fertilize swale plantings.

• Fertilize all designated landscape areas except for swale. The fertilization of shrubs/groundcover areas may be eliminated when the plants reach maturity or completely fill the planting areas, without space between them. Written authorization from the owner's representative is required before the fertilization may be eliminated from the required work.

• Flush out irrigation systems as needed, run and check for proper operation of each valve zone. Test sensors (rain, soil, or weather sensors).

• Clean or replace plugged sprinkler nozzles. Replace plugged drip emitters.

• Replace irrigation controller program back-up batteries.

• By April 15th, weather permitting all old mulch shall be removed from the base of shrubs and the root flare of all trees, and fresh mulch shall be applied. the depth of mulching shall be 2-3 inches, but shall not exceed 3 inches total.

• In bio-retention areas, only composted shredded hardwood bark mulch shall be used and shall be applied no deeper than 2-3 inches.

• For any of the plantings shown on the plans which are not within range of the Owner's automated irrigation system, these plantings shall be hand watered. Specifically, the root balls of the shrubs and trees shall be deeply irrigated every 5 to 7 days when rainfall does not provide 1 inch of water per week.

May:

• Turn on irrigation system, run and visually inspect for proper zone coverage. Set ET-based, weather or soil sensor-based.

• For any of the plantings shown on the plans which are not within range of the Owner's automated irrigation system, these plantings shall be hand watered. Specifically, the root balls of the shrubs and trees shall be deeply irrigated every 5 to 7 days when rainfall does not provide 1 inch of water per week.

June:

• Prune spring & winter-flowering shrubs as needed to maintain proper shape (natural, touching, not hedged or topiary except where specified by owner).

• Add new mulch to planters where the mulch depth has been reduced to less than 2 inches (5 cm) thick. Mulch not required where shrubs or groundcover completely hide the soil surface from view.

• For any of the plantings shown on the plans which are not within range of the Owner's automated irrigation system, these plantings shall be hand watered. Specifically, the root balls of the shrubs and trees shall be deeply irrigated every 5 to 7 days when rainfall does not provide 1 inch of water per week.

July:

• Add new mulch to planters where the mulch depth has been reduced to less than 2 inches (5 cm) thick. Mulch not required where shrubs or groundcover completely hide the soil surface from view.

• For any of the plantings shown on the plans which are not within range of the Owner's automated irrigation system, these plantings shall be hand watered. Specifically, the root balls of the shrubs and trees shall be deeply irrigated every 5 to 7 days when rainfall does not provide 1 inch of water per week.

August:

• Add new mulch to planters where the mulch depth has been reduced to less than 2 inches (5 cm) thick. Mulch not required where shrubs or groundcover completely hide the soil surface from view.

• For any of the plantings shown on the plans which are not within range of the Owner's automated irrigation system, these plantings shall be hand watered. Specifically, the root balls of the shrubs and trees shall be deeply irrigated every 5 to 7 days when rainfall does not provide 1 inch of water per week.

September:

• Fertilize all designated landscape areas except for swale in September or early October. The fertilization of shrubs/groundcover areas may be eliminated when the plants reach maturity or completely fill the planting areas, without space between them. Written authorization from the owner's representative is required before the fertilization may be eliminated from the required work. Fertilizer shall not be used in bio-retention areas unless it is organic and worked into the soil under the mulch.

• Soil and plant tissue shall be tested and slow-release fertilizer shall be applied as needed to maintain healthy growing conditions for shrubs, trees, and grasses.

• Inventory all plant materials. Inventory shall include an exact count of all shrubs and trees, itemized by planter. Replace any dead or missing plants subject to the terms of these specifications.

• Add new mulch to planters where the mulch depth has been reduced to less than 2 inches (5 cm) thick. Mulch not required where shrubs or groundcover completely hide the soil surface from view.

• For any of the plantings shown on the plans which are not within range of the Owner's automated irrigation system, these plantings shall be hand watered. Specifically, the root balls of the shrubs and trees shall be deeply irrigated every 5 to 7 days when rainfall does not provide 1 inch of water per week.

October:

• Check and remove sediment from fore bay and Bio-swale channel using hand methods (i.e. a person with a shovel) when cleaning to minimize disturbance to vegetation an underlying soils.

• Have backflow preventer (on irrigation water supply) tested annually by approved plumbing technician.

• Turn off and prepare irrigation system for winter. Make sure backflow preventer is well-insulated or drained prior to first freeze. Blow out pipes using compressed air in areas where freezing could result in breakage. Drain drip irrigation lines as recommended by manufacturer. Any winter damage to irrigation system due to insufficient winterization shall be the responsibility of the contractor to repair.

• Prune any tree branches that interfere with public safety. Prune all parking lot and street trees yearly as needed to remove dead and crossing branches and to encourage spreading and upward growth that fits the available space. Do not top trees.

• Prune summer and fall-blooming shrubs as needed to maintain proper shape.

• Add new mulch to planters where the mulch depth has been reduced to less than 2 inches (5 cm) thick. Mulch not required where shrubs or groundcover completely hide the soil surface from view.

• For any of the plantings shown on the plans which are not within range of the Owner's automated irrigation system, these plantings shall be hand watered. Specifically, the root balls of the shrubs and trees shall be deeply irrigated every 5 to 7 days when rainfall does not provide 1 inch of water per week.

C. LANDSCAPE MANAGEMENT AREAS

C.1. Grounds maintenance – all outdoor areas Clean-up:

• Remove biodegradable landscape debris to a yard waste recycling facility, leaves, branches, annuals, dead plant material, potting soil, etc.. No biodegradable material should be disposed of in garbage to land fill sites.

• All trash and sticks are to be picked up from designated planting areas prior to mowing.

• A biweekly general clean-up program will be performed. The clean-up program shall include a policing of all maintained areas for the removal of trash (paper, cans, bottles etc.) and landscape waste such as fallen sticks and limbs.

• All trash and landscape debris shall be removed and disposed of offsite.

• Mulch is to be maintained clear of building foundations and paved areas, and off utility covers.

• Debris shall not be carried into patios, entryways or doorways.

• Debris deposited by typical weather occurrences will be cleaned up.

• Sweep patios and sidewalks at least biweekly.

Fall leaf removal – September through October

• On a as needed basis remove leaves from Bio-swale to prevent heavy build-up and damage to Bio-swale by smothering. A single layer of leaves may be mulch-mowed into the Bio-swale. Thicker accumulations should be removed.

• Leaves may be raked or shredded by mower and blown into shrub beds for mulch as directed by Owner's Agent, or accumulated leaves will be raked and/or blown from designated planting areas, high maintenance bed areas and collected and removed from property and disposed of offsite.

C.2. Pruning – Trees, Shrubs, Vines and Groundcovers

TREES

• Trees shall be maintained in a healthy, vigorous growing condition, free from disease and large concentrations of pests.

• Prune trees only to remove dead, diseased, broken, dangerous, or crossing branches, and as required below.

• Prune in accordance with generally accepted standards for proper pruning. Use of a certified arborist, particularly with significant trees, is recommended.

• Discard all tree trimmings offsite using a legal method.

• Any tree found to be dead or missing shall be replaced with plant material of identical species at the landscape maintenance contractor's expense, unless the loss was due to excluded damage. Replacement trees shall be approved for size and appearance by the owner's authorized representative prior to planting.

• Remove tree stakes from trees after one growing seasons. Check tree ties to adjust and loosen as needed after the first growing season. Remove stakes from site and dispose of by a legal method. Recycle used stakes if possible.

• Once a year, prune all trees to encourage a high-branching structure. Remove all non-structural branches between the ground and a point half the tree's total height (for tall trees don't remove branch height (for tall trees don't remove branches higher than 20' [6 m] above the ground). Exception to the above: trees planted for screening purposes, such as those at rear perimeters of many sites shall not be pruned except as needed to remove dead, diseased, broken, dangerous, or crossing branches.

• All sucker growth from trunk and base of trees shall be removed monthly or as required up to twelve feet (12') from the ground to maintain a clean appearance.

• The cutting blades on pruning shears, clippers, blades, saws, etc. shall be sterilized after pruning each tree to minimize the possibility of spreading disease. When pruning trees known or

suspected to be diseased, cutting blades shall be sterilized (with 10% bleach solution or other approved) after each cut.

• A vertical clearance of 114 inches is required above all parking spaces. A vertical clearance of 80 inches is required above all walkways. Trim trees to remove all limbs within these areas.

SHRUBS

• Shrubs shall be kept in a healthy, vigorous condition, free from disease and large concentrations of pests.

• Shrubs shall be pruned only as needed to remove branches that are dead, broken, extending beyond the face of curbs or sidewalks, or are climbing building walls (not applicable to specified vines). Formal hedges and topiary shall be regularly pruned to maintain a uniform height and width. Except as noted previously, allow the shrubs to grow in their natural form to their mature sizes.

• Shrubs uniformly planted around the perimeter of tree pits shall be pruned so as to encourage a continuous planting where individual plants are not identifiable. Prune to encourage a dense, continuous planting, with natural shape and branches reaching fully to the ground.

• All other shrubs shall be pruned only as required for safety, visibility, and plant health, and allowed to develop into the natural shapes expected of the plant variety. Do not shear shrubs into topiary (shapes) unless specifically instructed.

• Allow shrubs two (2) months to rejuvenate following a hard frost prior to pruning or replacing.

• Any shrub found to be dead or missing shall be replaced with plant material of identical species at the landscape maintenance contractor's expense, unless the loss was due to excluded damage.

• When pruning shrubs known or suspected to be diseased, the cutting blades shall be sterilized after each cut.

GROUNDCOVERS

• Groundcover shall be maintained in a healthy, vigorous growing condition.

• Any groundcover found to be dead or missing shall be replaced with plant material of identical species at the landscape maintenance contractor's expense, unless the loss was due to excluded damage.

• Keep groundcover trimmed to edge of sidewalks, curbs, an
d paved areas on a monthly basis. Do not create vertical edges when pruning groundcover. Cut the edges at an angle /--\ for a more natural appearance and healthier plants. Prune so groundcover just overlaps adjoining paving; an open mulch strip here allows weeds to take hold and trash to accumulate.

• If regular foot traffic through a planter is preventing the groundcover from reaching full coverage of the soil, contact the owner's authorized representative to discuss options for redirecting the foot traffic. Consider installing pavers, stepping stones, a concrete walk, a gravel path, and/or barriers to redirect pedestrians.

C.3. Fertilizer - Trees, Shrubs, Vines and Groundcovers

• Do not fertilize plantings in the swale (rain garden).

• Fertilizers shall be either organically derived or slow-release synthetic products, to

minimize water pollution and feed plants over a longer period of time.

• Granular slow release or organic fertilizer shall be 5-5-5 formulation or similar, applied per label rate for plant type. Water immediately after applying to move the fertilizer into the soil and wash the fertilizer off of plant surfaces.

• When applying granular fertilizers to drip-irrigated areas, the fertilizer must be washed in by hand or rainfall before turning on the drip system. Running the drip system immediately after application will push the fertilizer away from the emitters, resulting in a high concentration of fertilizer at the edge of the wetted zone. This highly-concentrated fertilizer can kill or damage plants. It is recommended that granular fertilizers be applied to drip-irrigated areas only in early spring, just prior to a moderate rainfall.

C.4. Mulch layer - Trees, Shrubs, Vines and Groundcovers

Maintaining a deep layer of mulch greatly reduces the labor and materials needed to control weeds, reduces water use, and helps the plants stay healthy.

• Add additional mulch regularly to maintain a layer no less than 2 inches (5 cm) deep at all times in shrub planters, tree wells, and beds where plants have not yet closed in over soil surface. Decomposition of organic mulch is considered normal wear and tear, and replacement of decomposed mulch is required seasonally. Mulch is not required in areas where plant foliage completely covers the soil surface, such that the soil is not visible through the foliage. Any mulch found outside planter areas shall be returned to the planter on a biweekly basis.

• Mulch shall be uniform in color and appearance, and free of sticks or trash. Mulch may be compost, shredded fall leaves (with Owner's permission), or chipped or shredded wood, such as arborist chips, hog fuel, or play chips. Bark is less preferable, because it does not feed the soil as readily, may seal the surface preventing water entry, and may inhibit some plants' growth. When replacing existing mulch, use a mulch product that is similar in appearance to that already at the site.

D. INTEGRATED PEST (WEED, INSECT, AND DISEASE) MANAGMENT

Definition: "Integrated Pest Management, or IPM, is an approach to pest control [weeds, insects, and diseases] that uses regular monitoring to determine if and when treatments are needed, and employs physical, mechanical, cultural, and biological tactics to keep pest numbers low enough to prevent intolerable damage or annoyance. Least-toxic chemical controls are used as a last resort."

D.1. Weed Control for Trees, Shrubs, Vines, and Groundcovers

• Weeds in planted areas, sidewalks, curbs, gutters, or pavement shall be removed or killed weekly as the weeds emerge. Weeds shall be removed (not just killed) if they are larger than 2 inches (5 cm) in height or diameter. Dispose of weeds off-site. The cost of all weed control work shall be included in the contract price for landscape maintenance. Regular maintenance of the mulch layer will help minimize weeds in shrub and groundcover areas.

• Contractor is strongly encouraged to use Integrated Pest Management techniques for controlling weeds. Techniques include mulching, pulling, allowing plantings to grow densely and shade ground, heat and hot water controls. If herbicides must be used, choose the least toxic

available and spot apply on weeds. Pre-emergent herbicides are not allowed – maintaining a thick mulch layer combined with mechanical weeding is as effective.

D.2. Weed, Insect, and Disease Control for Planting Areas

• Weed invasion can be effectively prevented or reversed by growing dense lawn, through the above recommended practices. Tolerate some broad-leaved plants in planting areas. Identify problem (invasive) weeds and target only those species.

• Control weeds in planting areas by removal where practical (long-handled weed-pullers do this quickly), and remove them regularly before they go to seed. If weeds have over-run an area, spot-application of the least-toxic herbicide is permitted.

• No broadcast herbicide or "weed-and-feed" products may be applied.

• Moderately fertilized planting areas on well drained organic-rich soils rarely has serious disease problems. Correcting poor soil conditions or cultural practices (like over-watering or over fertilization) will prevent diseases.

D.3. General IPM Steps and Methods

IPM Steps Include:

1) Prevention first: plant vigorous, pest-resistant, site-adapted varieties. Plan cultural practices to minimize pests (watering, mulching, pruning, etc.).
2) Identify/know the pest (weed, etc.) life cycle.
3) Set action thresholds – tolerate some damage.
4) Monitor regularly (keep records of monitoring).
5) When pests exceed threshold, use control method with the least non-target impact. (Try cultural, physical, or biological methods first. As a last resort, use spot applications of least toxic chemical.) Only treat when the pest is most vulnerable and its natural enemies are in their least susceptible life stage.
6) Keep records of control methods and results, evaluate, and adapt cultural practices.
7) Replace problem plants/designs with more pest, disease, and weed-resistant varieties.

Weed Control Methods – General Guidelines:

• Crowd out weeds with dense healthy plantings, ground covers and shade canopies.

• Accept a few weeds – target the problem ones.

• Mulch beds in fall, winter, or early spring.

• Control weeds before they go to seed.

• Hoe, pull, mow, or till (mulch makes hoeing easier).

• Use barriers: newspaper or cardboard covered with mulch, root barriers for spreading plants. Landscape fabric can create problems as weeds grow through it – paper or cardboard is better.

• Don't over-fertilize – it promotes weeds and pests.

• Spot apply the least-toxic chemical (e.g. soap and vinegar-based weed killers, or cut-and-paint stems with systemic herbicides) to minimize non-weed impacts.

• If a pesticide must be used, post signs for at least 24 hours stating: area affected; date/time applied; specific pesticide used; re-entry cautions (from label); and phone number to call with questions. Always follow label for application and protection. Professional appliers

(including users of "weed & feed," or even low-risk herbicides like vinegar) must be licensed by State law.

E. IRRIGATION

All Areas

• Monitor the moisture levels around all ornamental plants including, but not limited to trees, shrubs, perennials, groundcovers and annuals. Report problems (including brown spots or saturated areas) to on-site management during normal maintenance visits.

• Fix irrigation system leaks and broken or misdirected heads as needed on every site visit.

• Hand watering of any ornamental plants not under irrigation is not assumed. Spring start-up

• Open the main valve(s), inspect and adjust all sprinkler heads, re-program and check battery backup in controller, and troubleshoot the entire system.

• Test sensors (rain, soil moisture, weather) and zone coverage while running.

• Set ET-based, seasonal, or weather- based manual or automatic programs. Post spring/summer/fall schedules (runtimes x days / zone) and train staff as needed to monitor through season.

Checks and repairs

• Once per month inspect entire irrigation system. Irrigation inspections shall include the following:

o Activation of each zone to inspect for valve function, lateral breaks, damaged heads, coverage or anything else that would indicate any malfunction of the irrigation system.

o Adjust irrigation heads for proper coverage.

o Adjust automatic controller to establish frequency and length of watering periods for seasonal requirements and water restrictions.

o Runoff of water from irrigation systems into or onto streets, sidewalks, stairs, or gutters is not permitted. Immediately shut down the irrigation system and make adjustments, repairs, or replacements as soon as possible to correct the source of the runoff.

• Do not over-water plantings. Use multiple-start times and short run times to prevent runoff. Drip systems should be left on for sufficient time to allow for saturation of the root zone. Shorter runs with drip irrigation do not provide sufficient water penetration for healthy root development. Avoid multiple-start times with drip systems if possible. Do not allow run-off from any irrigation.

• Rain sensors/weather sensor/soil moisture sensors: Install rain shut-off devices where possible. If no rain shut-off device, building manager shuts off irrigation at first sign of rain.

• Maintain the irrigation system, including cleaning of filter screens yearly or more often as needed, and flushing pipes.

• Drip irrigation systems need periodic flushing to remove sediment. Systems shall be flushed at least once a year. Open ends of drip lines and run for at least 15 minutes at full flow to flush. It may be necessary to install flush outlets in order to flush the drip system.

System repair

• Regardless of the cause of damage, take immediate action to prevent further damage by shutting off the damaged part of the irrigation system and commencing with hand watering as needed. The following items are considered to be minor repairs: damaged or clogged sprinkler nozzles, adjustment of sprinkler patterns or arcs, adjustment of sprinkler position (reorient; raise, lower, or straighten sprinkler head), replacement of clogged, broken, or missing barbed-style drip emitters, replacement or repositioning of drip distribution tubing smaller than 1/2 inch or 15 mm diameter. Any replacement of irrigation system components shall be made with materials of the same manufacturer and model as the original equipment.

• All repairs to the system shall be identical to the original installation, unless approved otherwise in advance by the owner's authorized representative. If a change to the installation will result in lower future maintenance costs, less frequent breakage, or an increase in public safety, request authorization to make the change from the owner's authorized representative.

• For safety, do not install sprinklers on risers above the ground level, even if the risers are flexible. Always use spring-operated, pop-up style, sprinkler heads. Sprinkler heads are available with pop-up heights up to 12 inches (30 cm) above ground level. If the existing sprinklers are mounted on above-ground risers, the replacements shall be pop-up type sprinklers. No exceptions.

• Annually submit recommendations for changes to system that would improve water efficiency while meeting the plants' needs.

Winterization

• Completely drain the sprinkler system (blowout) to prevent freeze damage to underground pipes and sprinkler heads. Close all valves and shut down the controller(s) for the winter.

F. SPECIAL LANDSCAPE AREAS

Bio-retention areas

• Swales and rain gardens, designed to capture and hold roof runoff, will not maintain optimal drainage rates if soils become compacted. Minimize foot traffic in this area, although occasional walking for maintenance is fine.

• In addition to preventing weeds, regular applications of mulch will maximize the swale's ability to capture and break down contaminants. In order to prevent runoff of excess nutrients, rain garden plantings should not be fertilized. Plant selection, a rich soil mix at time of installation, and regular mulching should provide sufficient nutrients to plantings in these areas.

• Mulch mow all Bio-swale areas on a as needed basis to maintain proper grass height. (Use mulching mower that chops clippings finely and blows mulch down into turf to decompose and feed soil.) Set the mower blades no lower than 3 to 4 inches above the ground. Do not mow beneath the depth of the design flow during the storm associated with the water quality event. Remove accumulated trash and debris prior to mowing.

• Mowing schedule: Mow as needed during active growth periods (April-October). Keep mower blades sharp.

• Clippings should always be left in Bio-swale areas ("mulch-mowing" or "grass cycling"), except if this will create a large surface buildup, for instance if saturated soft soils have prevented mowing for several weeks in spring and the grass is very tall. Grass cycling returns about 2 lb. nitrogen per 1000 sq. ft. per year, and improves resistance to drought damage and weed invasion.

• Modern "mulching" mowers are preferred because they chop clippings finely and blow the resulting mulch down to ground level, leaving a clean surface which is preferable, especially around building entrances where track-in can be a problem. Effective mulching requires about 20% more engine power, and it may be necessary to slow down in heavy areas or wet weather to get the best mulching results. For these reasons, equipment that converts easily from mulching to side-throw (leaving clippings on surface) is the most adaptable to varying conditions and mowing schedules.

• Mowing height: 3 to 4 inches high.

• Mowing frequency: to cause the least stress on the grass plant, mow often enough to remove only one-third of the blade length (e.g., when the grass is 3" high mow it down to 2"). Also, mow un-irrigated summer-dormant turf regularly enough to remove weed seed heads before they mature. Start mowing in late winter as soon as grass begins to grow. In Bio-swale areas these rules will result in mowing every 5-7 days through the height of the spring growth spurt, tapering to weekly on irrigated summer lawn or 10 days to 2 weeks on dormant lawn, weekly through the fall growth spurt, and once a month during winter.

• In addition to spring or fall Bio-swale renovations should include over seeding of thin or weed infested areas, or entire areas subject to heavy wear. This is a key weed control practice.

• Select certified seed appropriate for the site (perennial rye for sport lawn, rye and fescue blends for general lawn: contact the Cooperative Extension Service for site-adapted varieties, or buy from a reputable local supplier).

• Take soil plugs annually to verify that the compost is being incorporated into the soil profile below the aeration depth by earthworms and other soil biota, rather than accumulating on the surface where it could limit water infiltration. (This is a possible problem in cases of low soil biota due to overuse of fertilizers or pesticides, poor drainage, or conditions of acidic or compacted soils. Correct these problems to improve compost incorporation.)