ONSITE TREATMENT

Amphidrome®

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Agenda

- System Description
- Installation
- Locations
- Performance
- Questions

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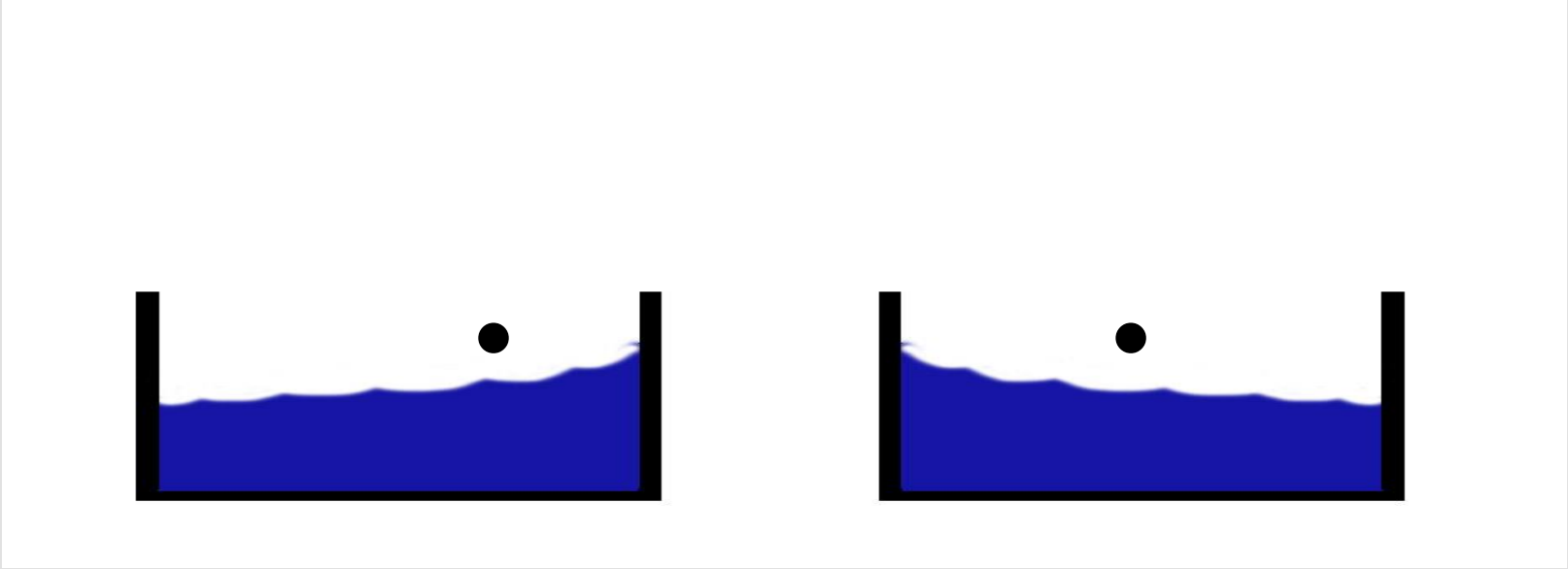
- Definition in Oceanography
  - The position in the ocean where the tide vanishes to zero



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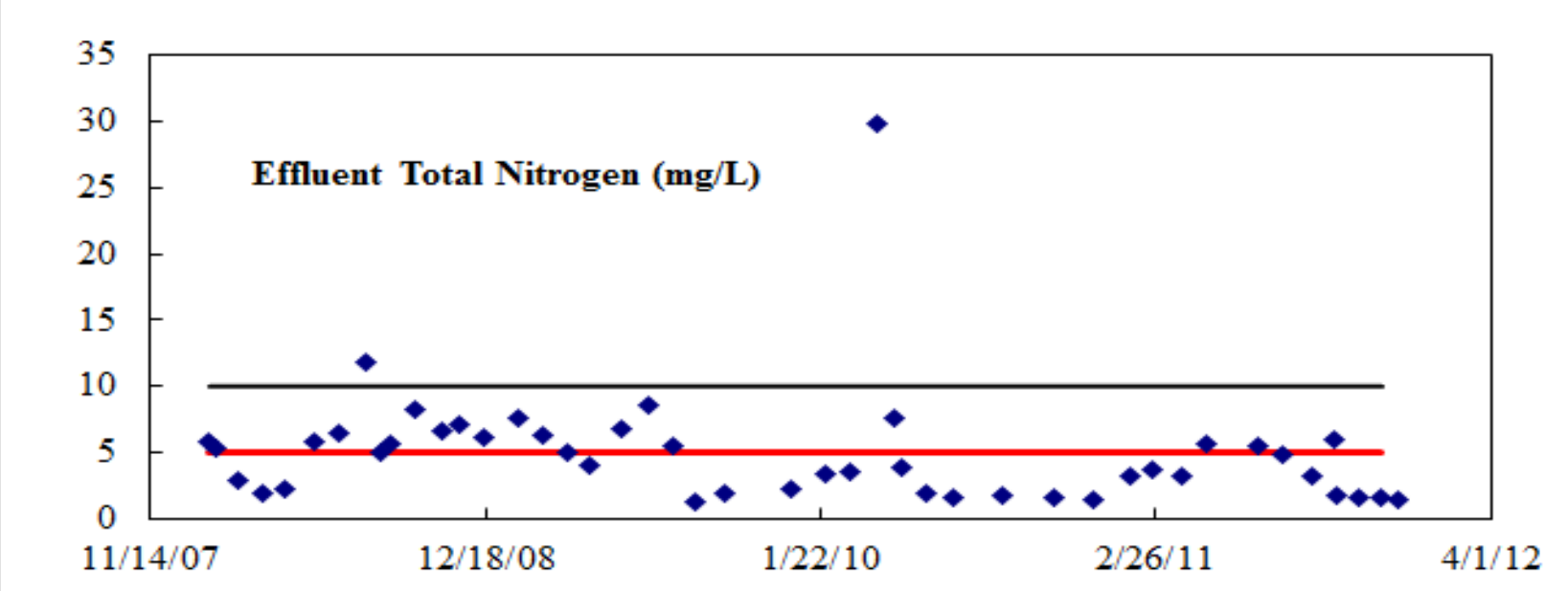
- Definition in Wastewater
  - A submerged attached-growth bioreactor (SAGB) in which the nitrogen vanishes to *nearly* zero



Amphidrome® Process Description

- Biological Nutrient Removal (BNR) Process
  - TSS
  - BOD_5
  - Total Nitrogen
  - Oil and Grease
- One Reactor
  - A submerged attached growth bioreactor (SAGB) operating in sequencing batch mode
  - SAGB is also commonly referred to as a BAF (biological aerated filter).

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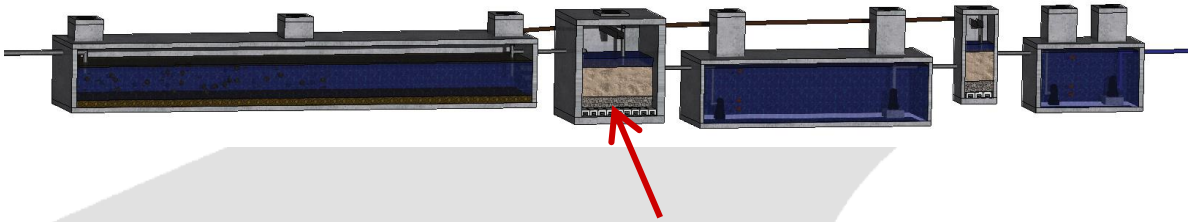
System Consists Of 2 Tanks And 1 Reactor

- Anoxic / Equalization Tank
- Amphidrome^{tm} Reactor
- Clear Well Tank

Anoxic/Equalization Tank

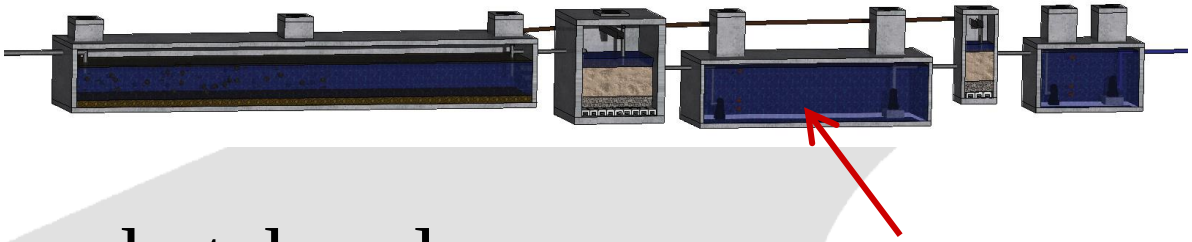
- Solids settling
- Sludge storage
- Secondary functions
  - Buffers the dissolved oxygen in the recycled flow
  - Mixes recycle with influent organic carbon to promote de-nitrification

Main Reactor Function



- Media provides the surface area for biofilm growth
- Provides solids separation, eliminating the need for downstream clarification
- Intermittent aeration
  - Typically 3 minutes on 15 minutes off

Clearwell Function



- Stores batch volume
- Stores some fraction of backwash volume
- Contains backwash and effluent pumps (or Plus™ feed pumps)

Controls

Control Panel

- Touch Screen
- Remote Access
- Operator Can ‘tune’ the system

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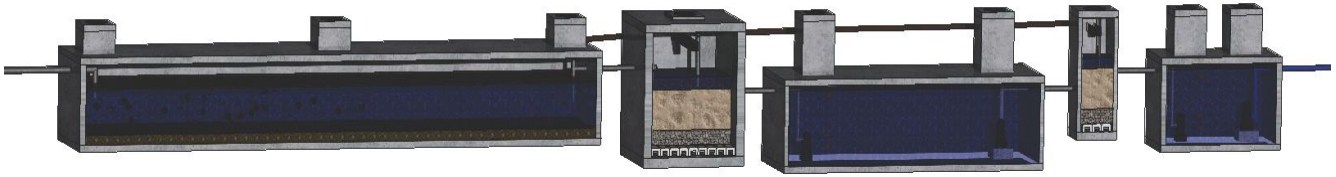
Amphidrome® System Benefits

- Highest Level of Nitrogen Removal of any system available
- Low Visual Impact
- Not affected by air temperature as are trickling filters
- All effluent filtered through deep sand bed to protect SAS

Installation



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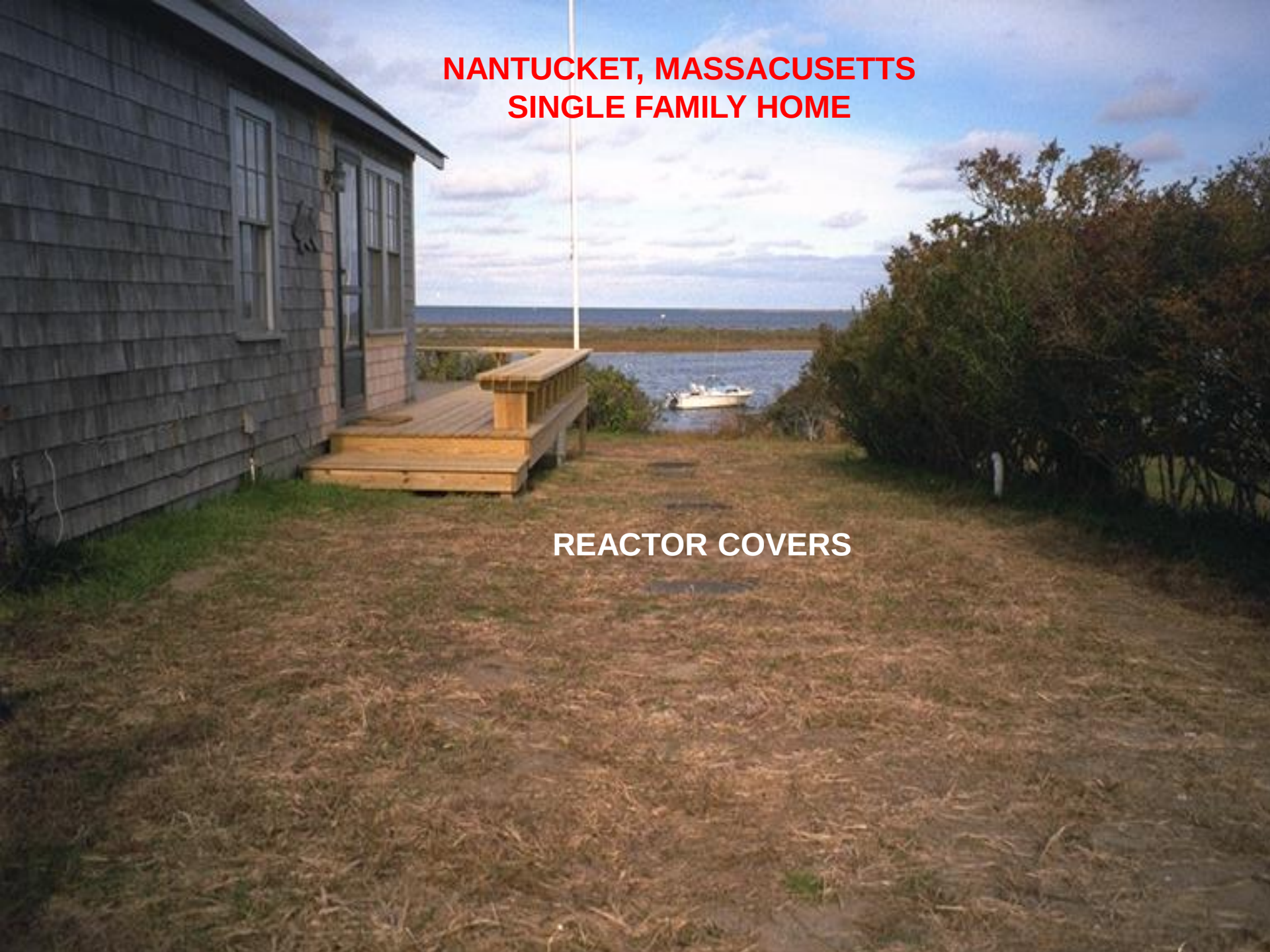
Three-tank system


NANTUCKET, MASSACUSETTS
SINGLE FAMILY HOME
REACTOR COVERS


MEADOWS AT MAINSTONE
BELOW GRADE SYSTEM

OCEAN EDGE CONFERENCE CENTER

OCEAN EDGE CONFERENCE CENTER


HEALTH CARE FACILITY
KOHLER
REACTOR COVERS

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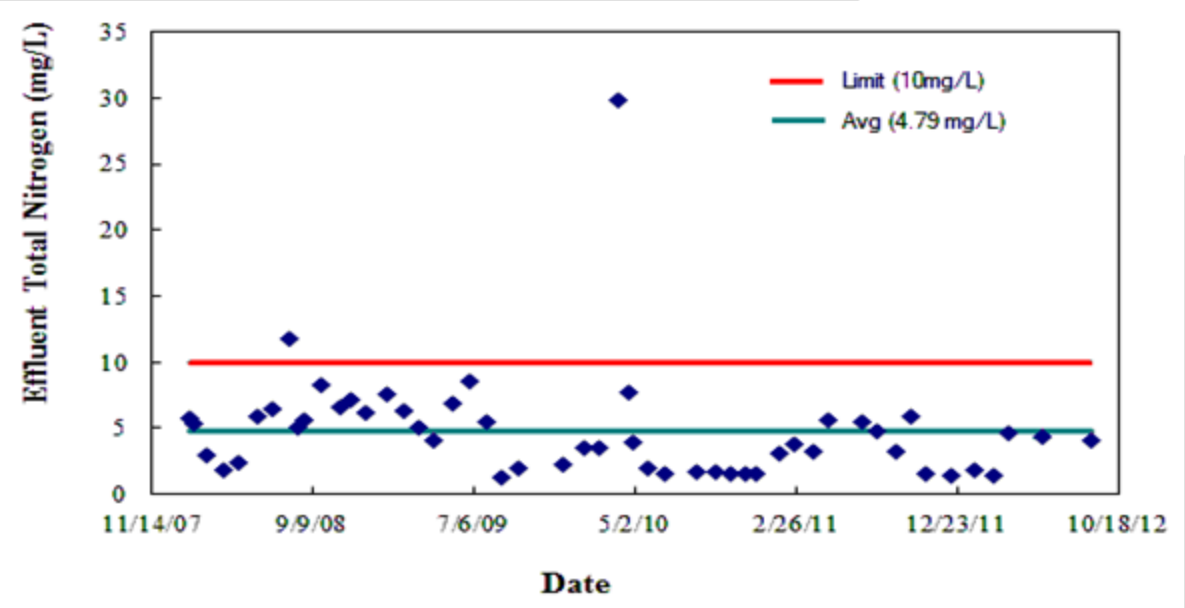
Where can you find us?

- New England
- Pennsylvania
- North Carolina
- Maryland
- Minnesota
- Internationally

Performance

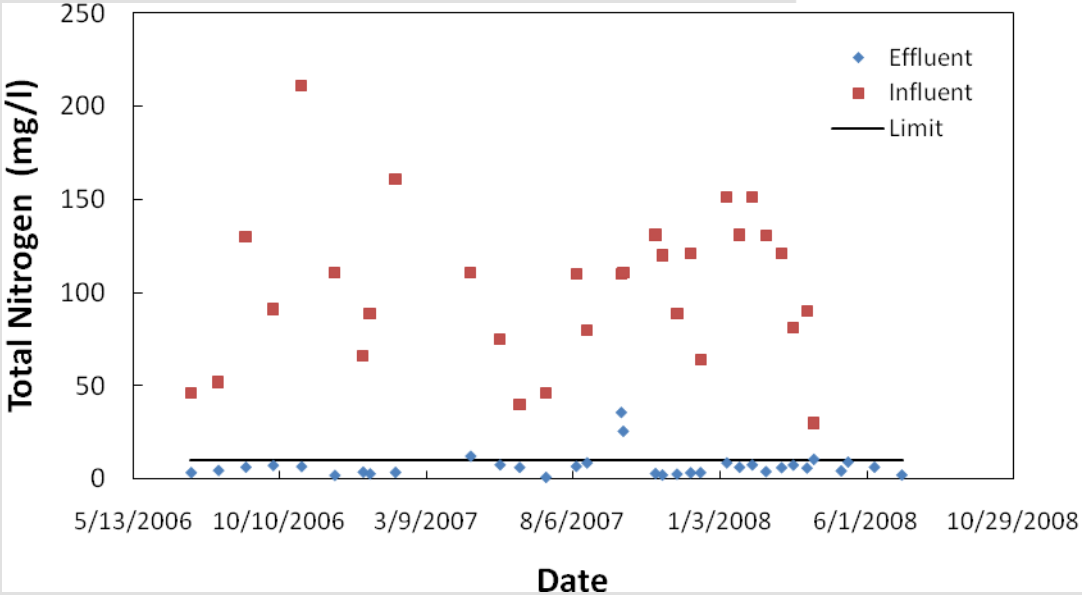
- Plant: Pleasant Bay Nursing Home
- Location: Brewster, MA
- Design Flow: 26,500 gpd



	BOD_5	TSS	Total N
Permit Limit	*30 mg/L*	*30 mg/L*	*10 mg/L*
Average	5.07 mg/L	6.3 mg/L	4.79 mg/L

Performance

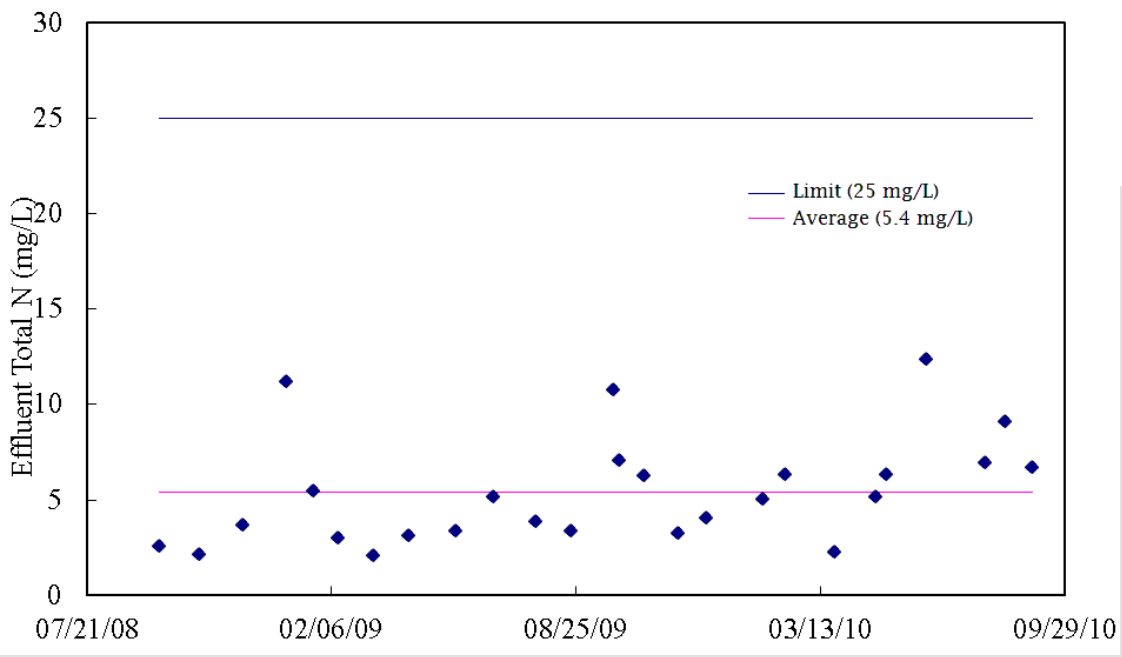
- Plant: Daniel Hand High School
- Location: Madison, CT
- Design Flow: 25,000 gpd



	BIOCHEMICAL OXYGEN DEMAND	TOTAL SUSPENDED SOLIDS	TOTAL NITROGEN
INFLUENT	174 mg./L.	137 mg./L.	90 mg./L.
EFFLUENT	9.5 mg./L.	8.2 mg./L.	6.8 mg./L.
PERMIT LIMIT	30 mg./L.	30 mg./L.	10 mg./L.

Performance

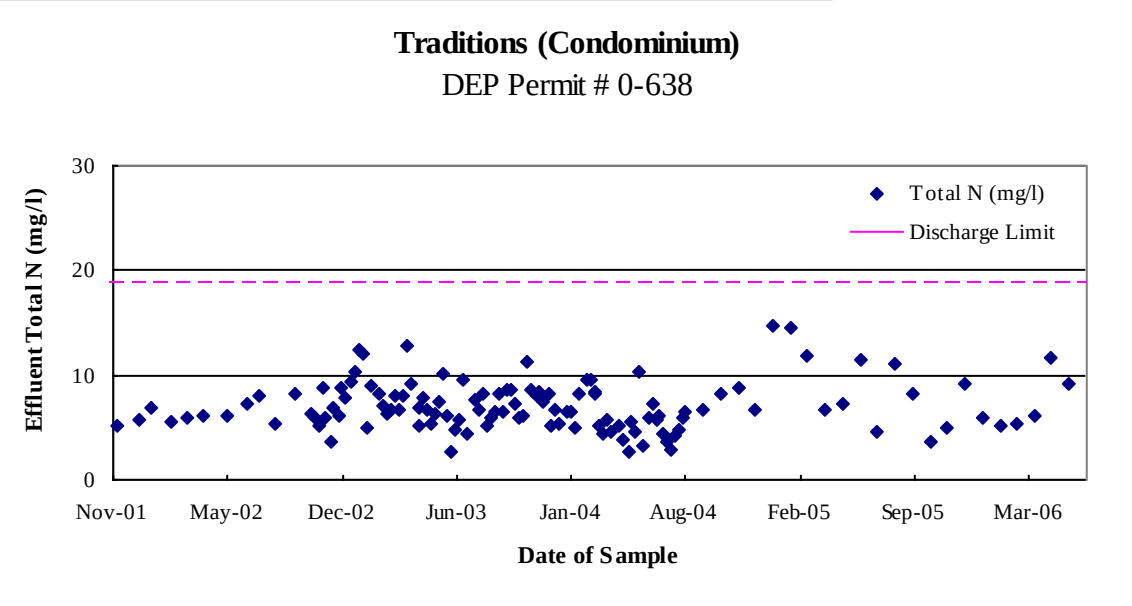
- Plant: Chili's Resturant
- Location: Hingham, MA
- Design Flow: 7,670 gpd



	BOD_5	TSS	Total N
Permit Limit	*30 mg/L*	*30 mg/L*	*25 mg/L*
Average	4.9 mg/L	8.2 mg/L	5.4 mg/L

Performance

- Plant: Traditions Condos
- Location: Wayland, MA
- Design Flow: 10,320 gpd



	BIOCHEMICAL OXYGEN DEMAND	TOTAL SUSPENDED SOLIDS	TOTAL NITROGEN
PERMIT LIMIT	30 mg./L.	30 mg./L.	19 mg./L.
EFFLUENT	10.22 mg./L.	15.34 mg./L.	7.04 mg./L.

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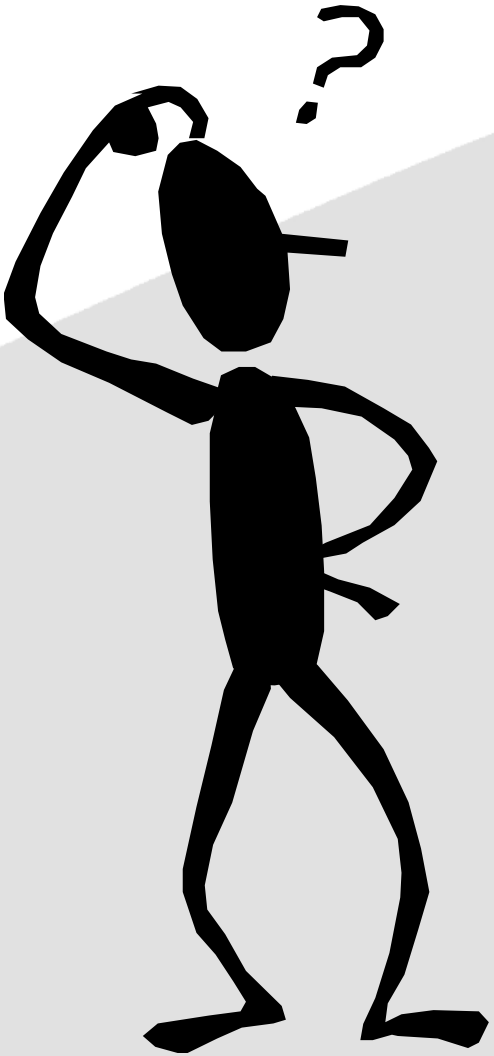
Questions



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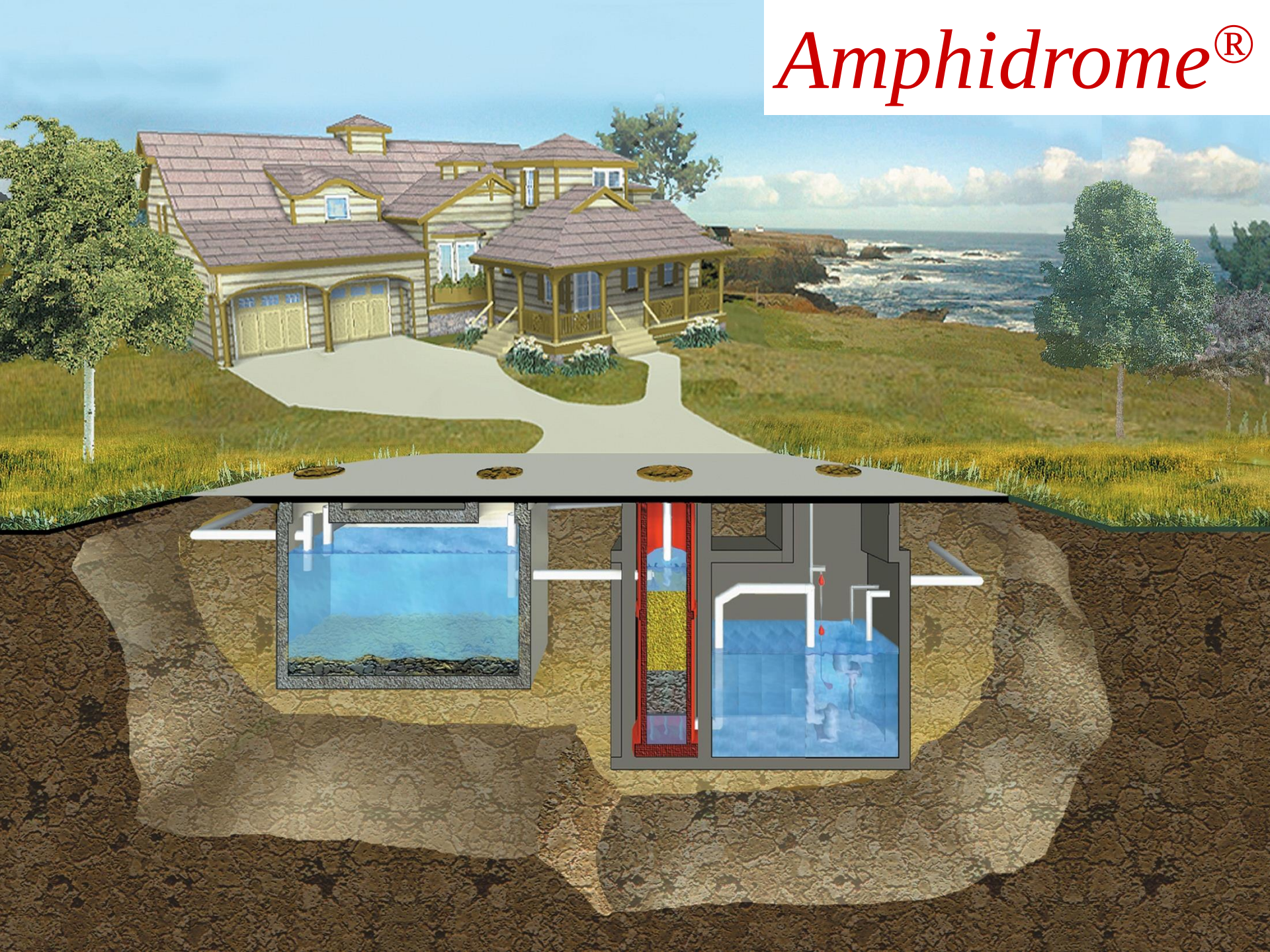

Process Chemistry

- Biochemical Transformations

  – $CH_2O + 0.309\ O_2 + 0.085\ NH_4^+ + 0.289\ HCO_3^- \Rightarrow 0.535\ C_5H_7O_2N + 0.633\ CO_2 + 0.515\ H_2O$ (aerobic)

  – $NH_4^+ + 3.30\ O_2 + 6.708\ HCO_3^- \Rightarrow 0.129\ C_5H_7O_2N + 3.373\ NO_3^- + 1.041\ H_2O + 6.463\ H_2CO_3$ (aerobic)

  – $NO_3^- + 0.324\ C_{10}H_{19}O_3N \Rightarrow 0.226\ N_2 + 0.710\ CO_2 +$

  – $0.087\ H_2O + 0.027\ NH_3 + 0.274\ OH^-$ (anoxic)

BNR - Process Chemistry

- **Oxidation of Carbonaceous BOD**:

Oxidation:

$COH + O_2 + \text{Bacteria} \Rightarrow CO_2 + \text{other end products} + \text{energy}$

organic matter

Cell Synthesis:

$COHNS + O_2 + \text{Bacteria} + \text{energy} \Rightarrow C_5H_7NO_2$

organic matter — new bacterial cells

Endogenous Respiration

$C_5H_7NO_2 + 5\,O_2 \Rightarrow 5\,CO_2 + NH_3 + 2\,H_2O + \text{energy}$

Process Chemistry

- **Oxidation of Nitrogen Based Compounds**

$NH^+_4 + 3/2\ O_2 \Rightarrow NO^-_2 + 2H^+ + H_2O$ Nitrosomonas Bacteria

ammonium nitrite

$NO^-_2 + 1/2\ O_2 \Rightarrow NO^-_3$ Nitrobacter

nitrite nitrate

Overall Energy Reaction:

$NH^+_4 + 2\ O_2 \Rightarrow NO^-_3 + 2H^+ + H_2O$

ammonium nitrate

Process Chemistry - Continued

•Reduction of Nitrite & Nitrate:

The nitrate reducing bacteria are facultative anaerobic heterotophs. Therefore, an organic carbon source is required. For the following equations methanol has been used as the carbon source.

First Energy Reaction:

$6\ NO^-_3 + 2\ CH_3OH \Rightarrow 6\ NO^-_2 + 2\ CO_2 + 4\ H_2O$

nitrate methanol nitrite

Second Energy Reaction:

$6\ NO^-_2 + 3\ CH_3OH \Rightarrow 3\ N_2 + 3\ CO_2 + 3\ H_2O + 6\ OH^-$

nitrite methanol nitrogen gas

Process Chemistry - Continued

Heterotrophic Cell Synthesis:

$3\ NO^-_3 + 14\ CH_3OH + CO_2 + 3\ H^+ \Rightarrow 3\ C_5H_7O_2N + H_2O$

nitrate methanol Biomass

Overall Nitrate Removal

$NO^-_3 + 1.08\ CH_3OH + 3\ H^+ \Rightarrow 0.065\ C_5H_7O_2N + 0.47\ N_2 + 0.76\ CO_2 + H_2O$

nitrate methanol Biomass