Maine Center for Disease Control and Prevention
An Office of the Department of Health and Human Services
Paul R. LePage, Governor
Mary C. Mayhew, Commissioner
Tel. (207) 287-5672

Department of Health and Human Services
Maine Center for Disease Control and Prevention
286 Water Street
11 State House Station
Augusta, Maine 04333-0011
Tel. (207) 287-8016
Fax (207) 287-9058; TTY (800) 606-0215
Fax (207) 287-4172

Subsurface Wastewater Unit

July 10, 2012

Septic Preservation Services
Attn.: Robert F. Silva, Vice President
P. O. Box 2217
South Portland, ME 04106

Subject: Revised Product Registration, White Knight Microbial Inoculator Generator

Dear Mr. Silva:

The Division of Environmental Health has completed a review of a registration application for White Knight Microbial Inoculator Generator (White Knight). This information was submitted pursuant to Section 6.HH of the Subsurface Wastewater Disposal Rules (Rules) for registration for use in Maine.

White Knight was approved for use in Maine in February of 2003 with a condition which prohibited use of the product in onsite sewage disposal systems which had experienced a hydraulic malfunction, i.e., a "break-out" and overland run off. White Knight was approved for a 50 percent reduction in disposal area size, in July of 2004, based upon data which demonstrated that White Knight significantly reduced ponding in established disposal areas.

You have now provided new data regarding subsurface pond reduction, in many cases to negligible levels, in systems which had experienced excess ponding and/or breakouts. In these systems, sources of excess water (inflow and infiltration) were identified and eliminated, the septic tank and disposal area were pumped, and a White Knight installed. The data you submitted supports this process, itself documented in the ***Design, Installation, Operation, & Service Manual*** dated November 2008. You have requested that the original prohibition against using White Knight in disposal systems which had experienced a hydraulic malfunction be rescinded based upon this process and these data.

On the basis of the information and sample product submitted, the Division has determined that the product is acceptable for use in the State of Maine for existing disposal areas which have experienced excess subsurface ponding, surface ponding or hydraulic breakout with the following conditions:

1. The White Knight Microbial Inoculator Generator must be installed, operated, and maintained in conformance with the manufacturer's directions. For malfunctioning systems, the process outlined above and in the ***Design, Installation, Operation, & Service Manual*** must be followed.

2. Should the Local Plumbing Inspector determine that the malfunction of any system is so severe as to comprise an immediate public health threat, she or he may require the system to be replaced as expeditiously as possible.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of the product. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar or competing products.

If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen

James A. Jacobsen
Project Manager, Webmaster
Division of Environmental Health
Drinking Water Program
Subsurface Wastewater Unit
e-mail: james.jacobsen@state.me.us

/jaj

xc: Product File

hand delivered 6/4/12 jaj

SEPTIC PRESERVATION SERVICES

6/4/12

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
161 Capitol St
11 State House Station
Augusta, ME 04333

Jim,

As the authorized representative of Knight Treatment Systems I would like to respectfully request a revision to the current approval letter for the White Knight. Under the current approval letter if the existing septic system has experienced breakout the White Knight may not be used. I would like to request the wording be changed to allow the use of the White Knight even if breakout has occurred. Understanding the seriousness of any breakout condition I think it would be prudent to also add that if breakout continues that the system would need to be replaced.

Septic Preservation Services has successfully remediated several hundred septic systems in the State of Maine. As experienced installers of this technology we have developed a strict procedure for installation, which ensures that breakout will not reoccur. I have attached a copy of the Design, Installation, and Service Manual for your review. Our strict installation procedure includes, but is not limited to;

- An in depth site evaluation to ensure the system is not in hydraulic overload due to a leaky toilet, sump pump, storm water infiltration, etc.
- Pumping of the entire system (prior to White Knight installation) including the field to the bottom of the stone in the field
- Installation of observation ports in the field to allow us to observe effluent levels and take corrective action, if needed, prior to breakout reoccurring
- Jetting of the leach field laterals to remove any solids or obstructions
- Installation of the White Knight
- Adding lime to the area of breakout
- Applying grass seed and hay over the breakout area.
- Weekly inspections until the system is confirmed to be functioning properly

Our response time can be quite fast, typically within 1 week, and with the procedures outlined above we are able to bring a system back into compliance and eliminate the breakout much quicker than if an owner has to go through the process of a complete leach field replacement.

PO Box 2217, South Portland, ME 04106 Email: info@septicpreservation.com
Telephone 877-378-4279 Fax 508-222-2499

SEPTIC PRESERVATION SERVICES

We have encountered regulations that mandate a system be replaced if it presents a risk to public health, however these regulations were written before biological remediation existed. While it is important that a system be repaired it may not need to be replaced.

Picture D is of a system with severe breakout prior to installation. Picture E is of the same location 3 months later.

When the White Knight is used to remediate an existing failed system the remediation process does not distinguish between systems that have experienced breakout and systems that have not. The effluent from the White Knights is very low in BOD and very high in dissolved oxygen. This creates a condition where the entire field is converted to an aerobic digester and the clogging material in the field is consumed and removed, restoring the proper function of the system. To educate ourselves on how this process progresses we have installed level loggers in several fields to track the remediation process. In all cases the ponding level has decreased without going back into a breakout condition. Please see the remediation graphs provided. Each of these graphs shows the ponding level in the field.

In both septic and aerobic systems there is waste, bacteria, and oxygen. In the septic system oxygen is the limiting factor thus allowing an excess of waste to build up and clog the soils in the field. Once converted to aerobic conditions oxygen is no longer the limiting factor creating a situation where the waste is the limiting factor. In this situation the bacteria will reproduce until they have consumed all of the waste that is clogging the field, restoring the proper operation of the leach field. Picture A shows a clog matt in a septic leach field. The black slime is excessive waste that has collected on the bottom of the leach field clogging the soils. Pictures B & C show the healthy aerobic biomatt in the same system 1 year after installation.

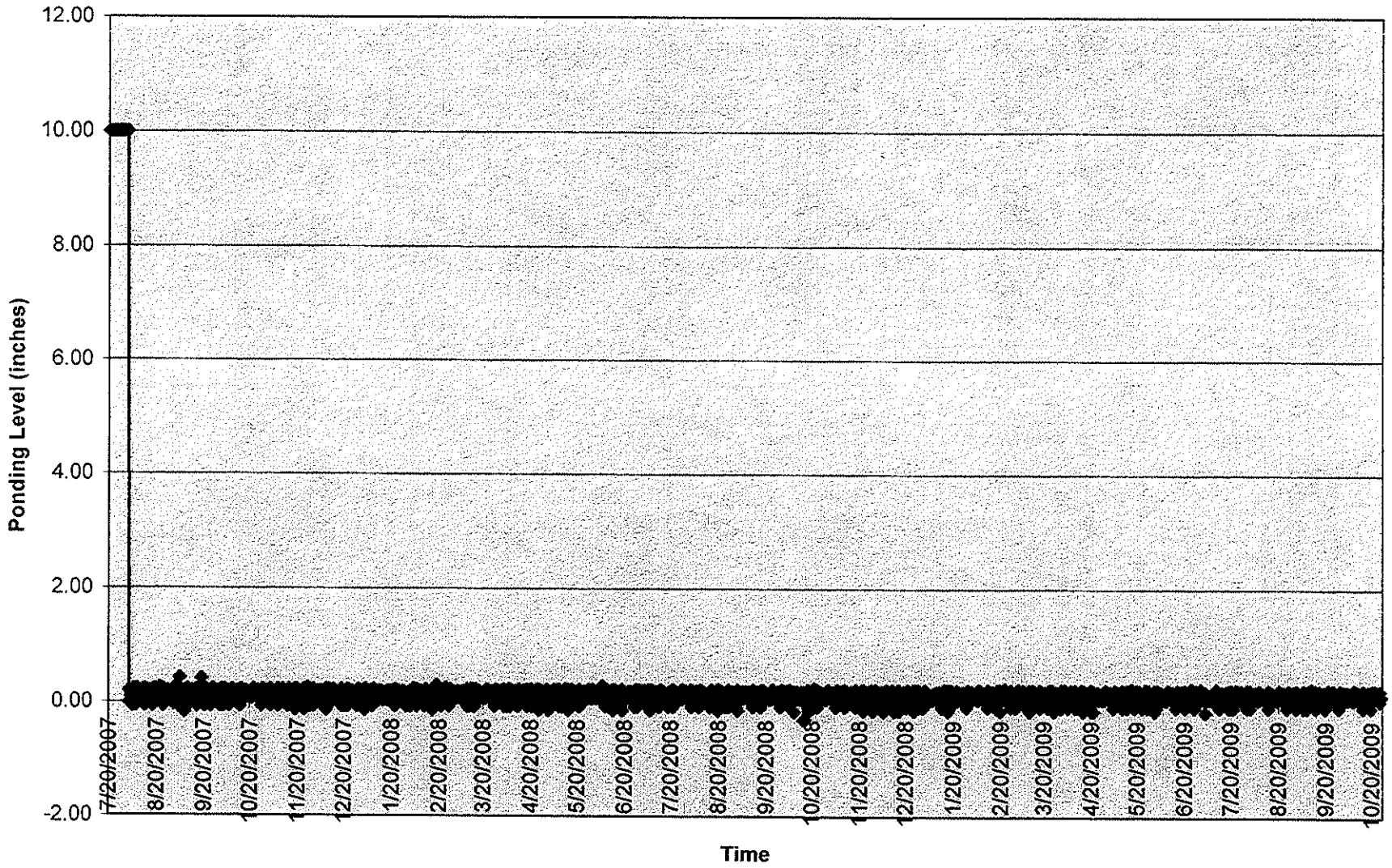
Please feel free to contact me with any questions or requests for additional information.

Sincerely,

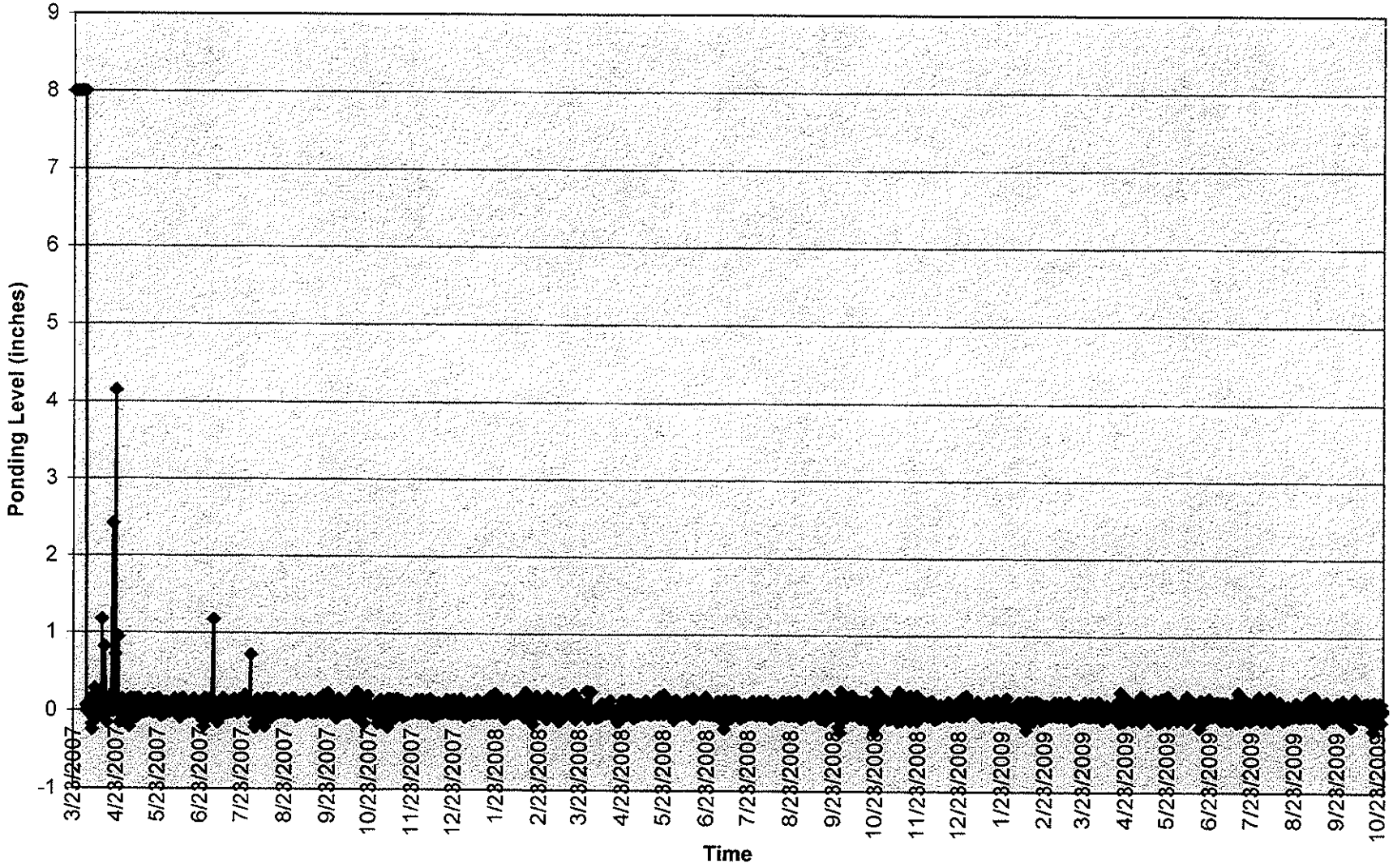
Robert F. Silva
Vice President

PO Box 2217, South Portland, ME 04106 Email: info@septicpreservation.com
Telephone 877-378-4279 Fax 508-222-2499

Lakeville 7 Fairway



Lakeville 16 Keith



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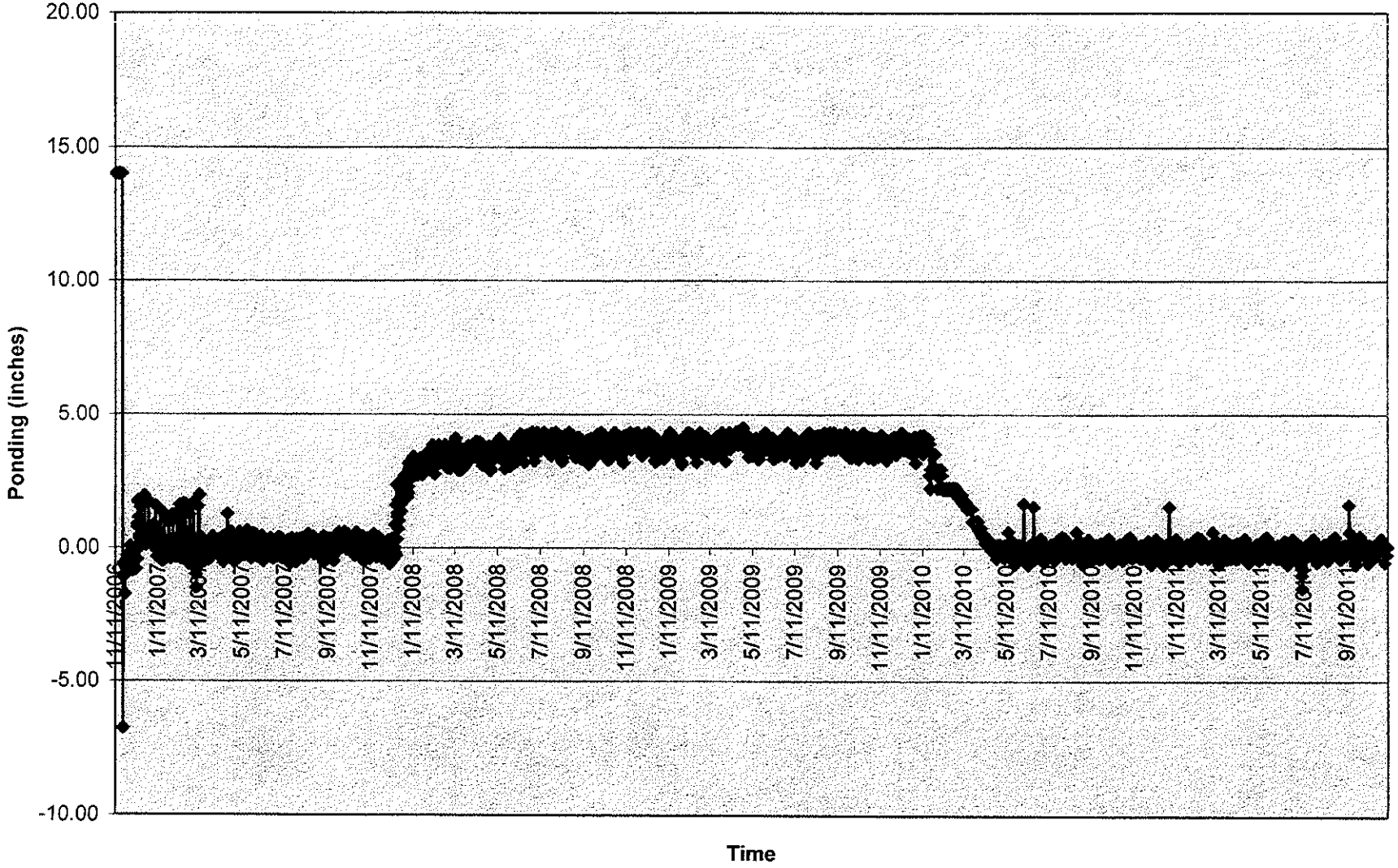
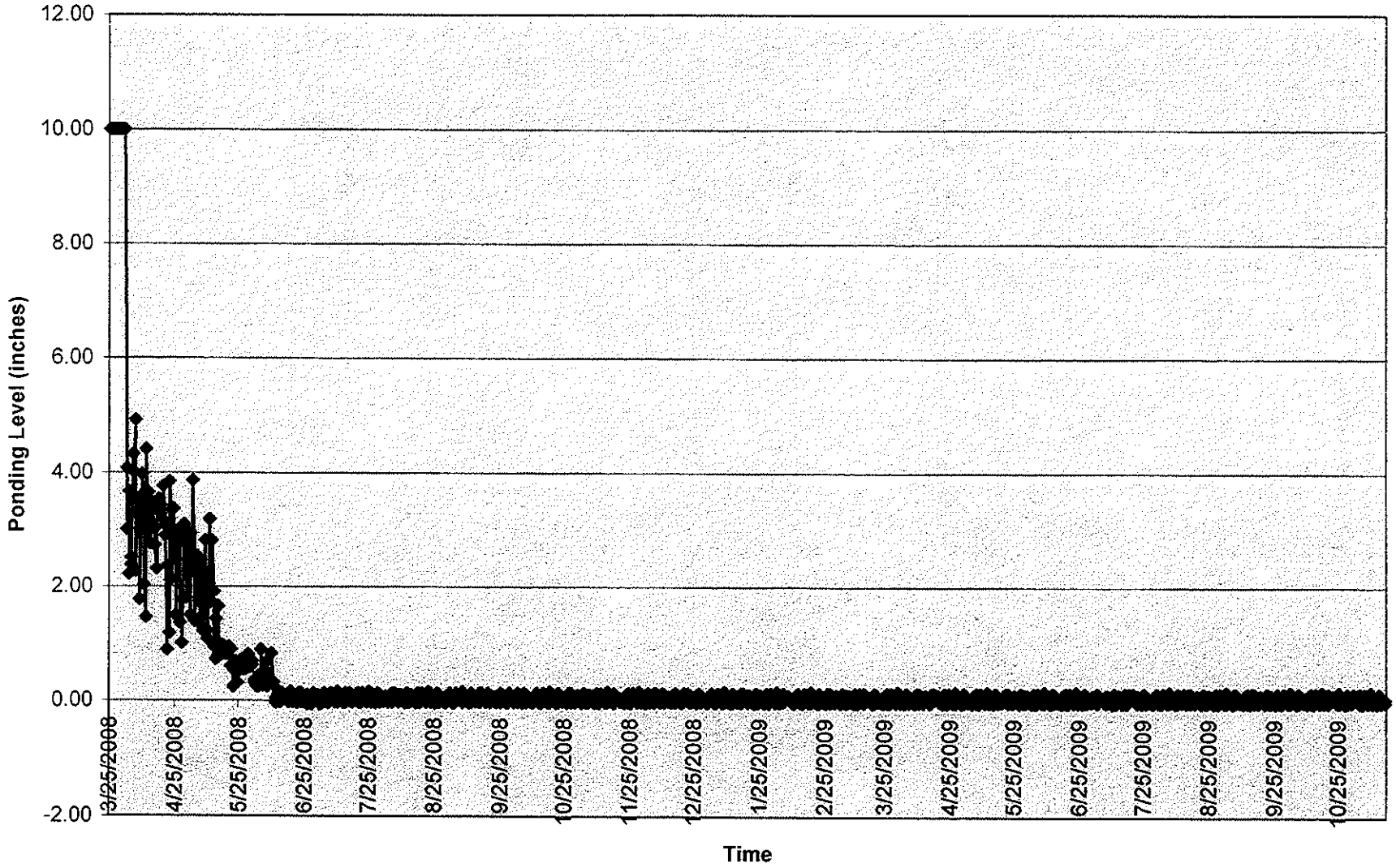
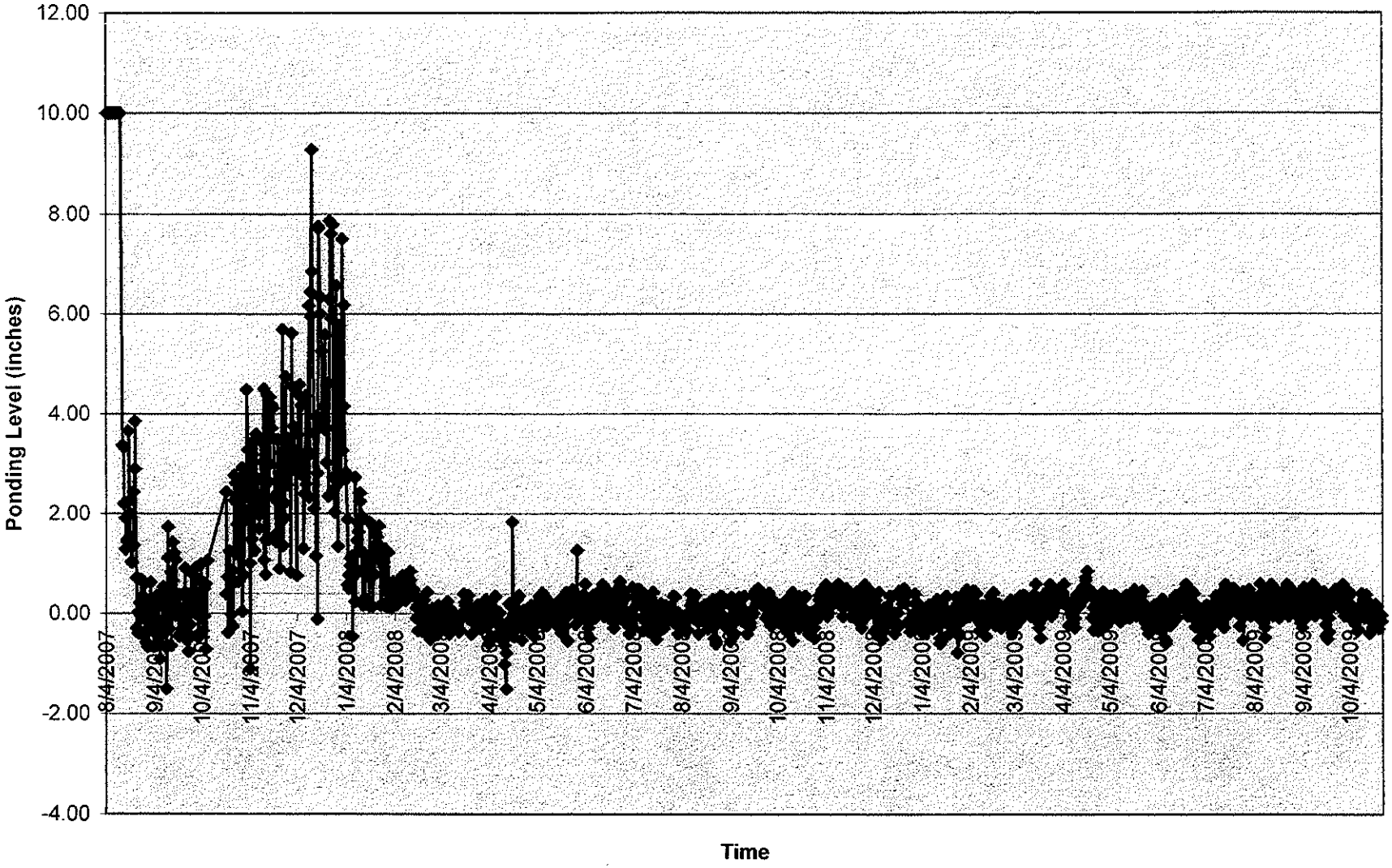


Lakeville 190 County



Mansfield 10 Gander



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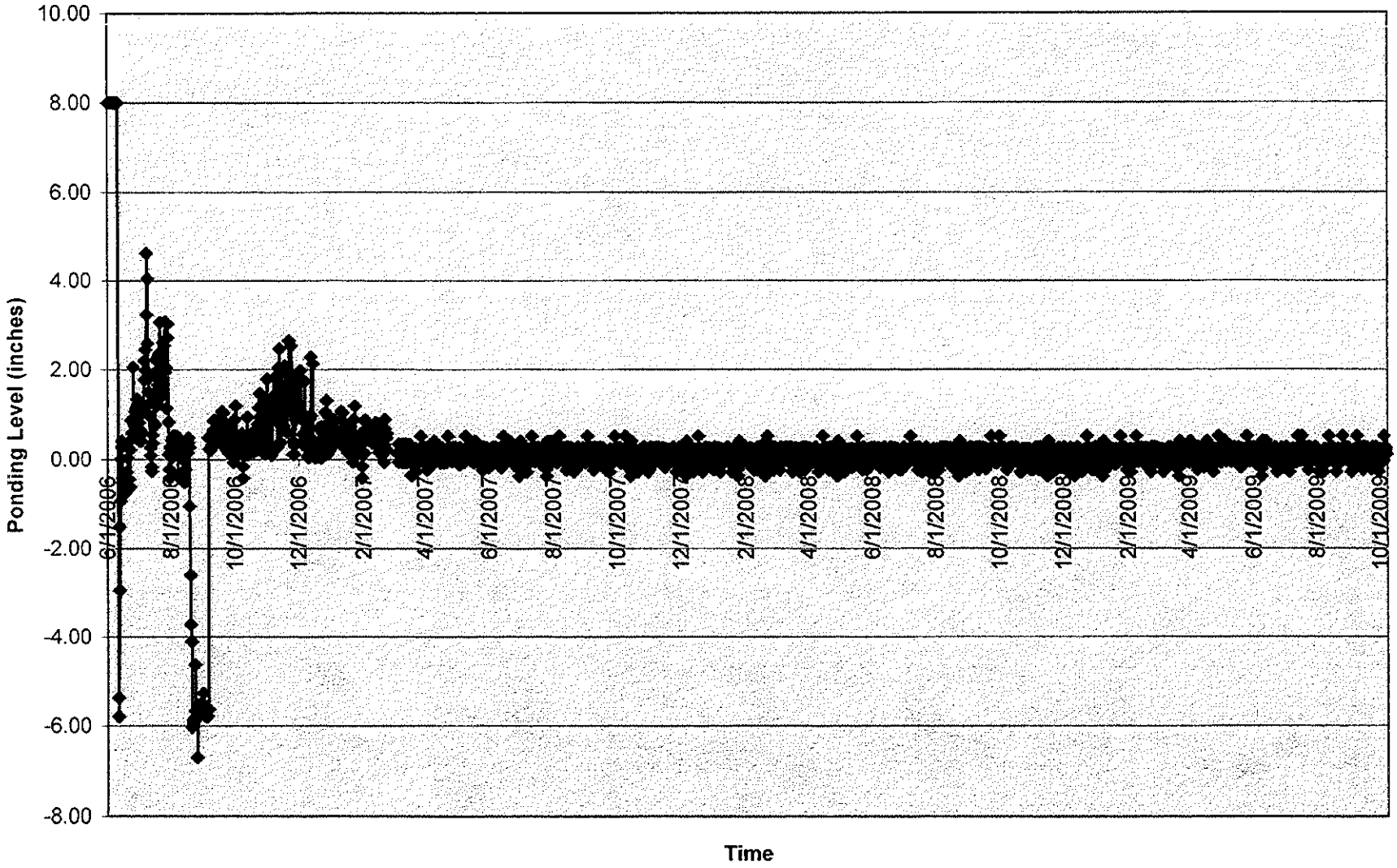

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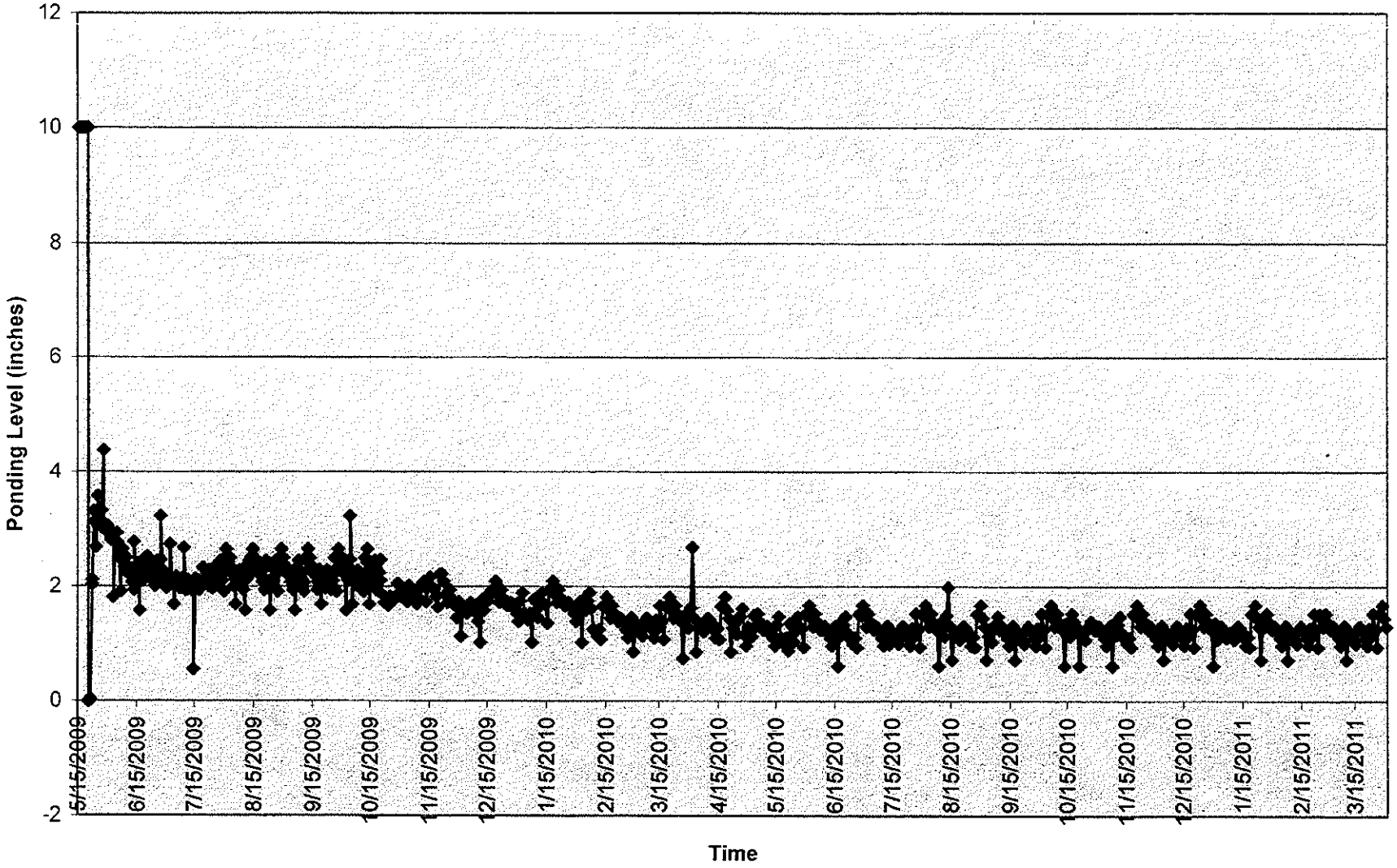

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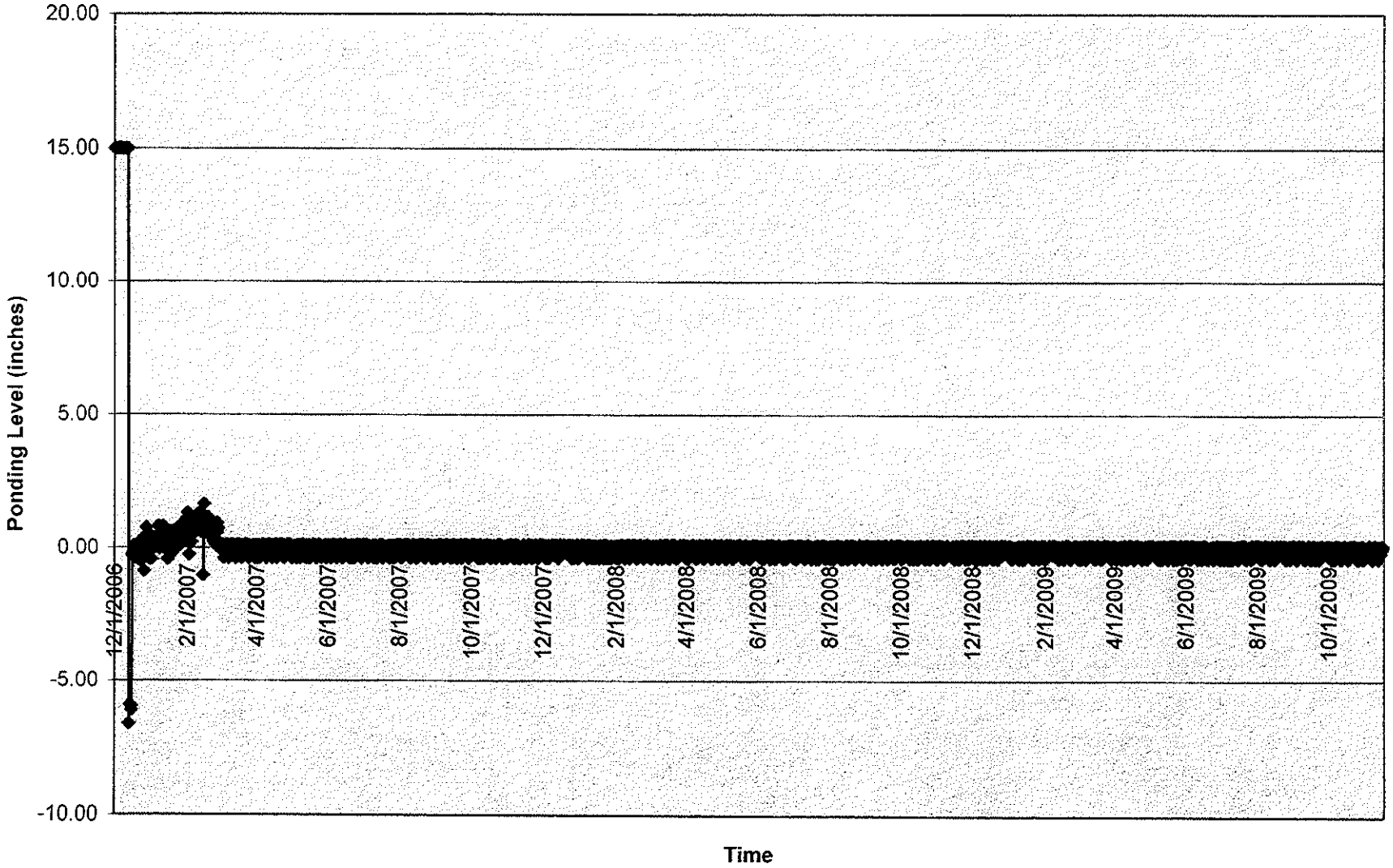
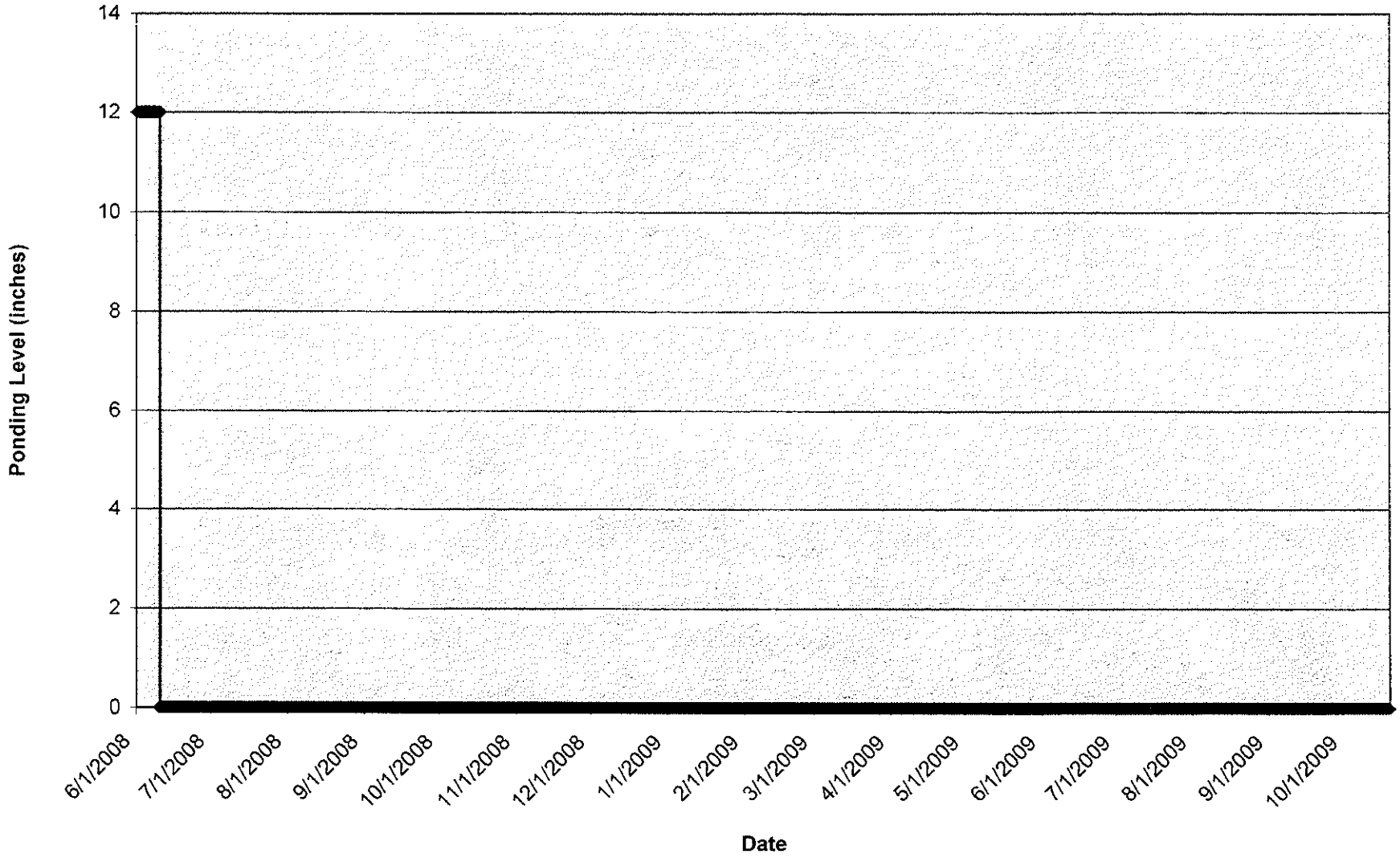
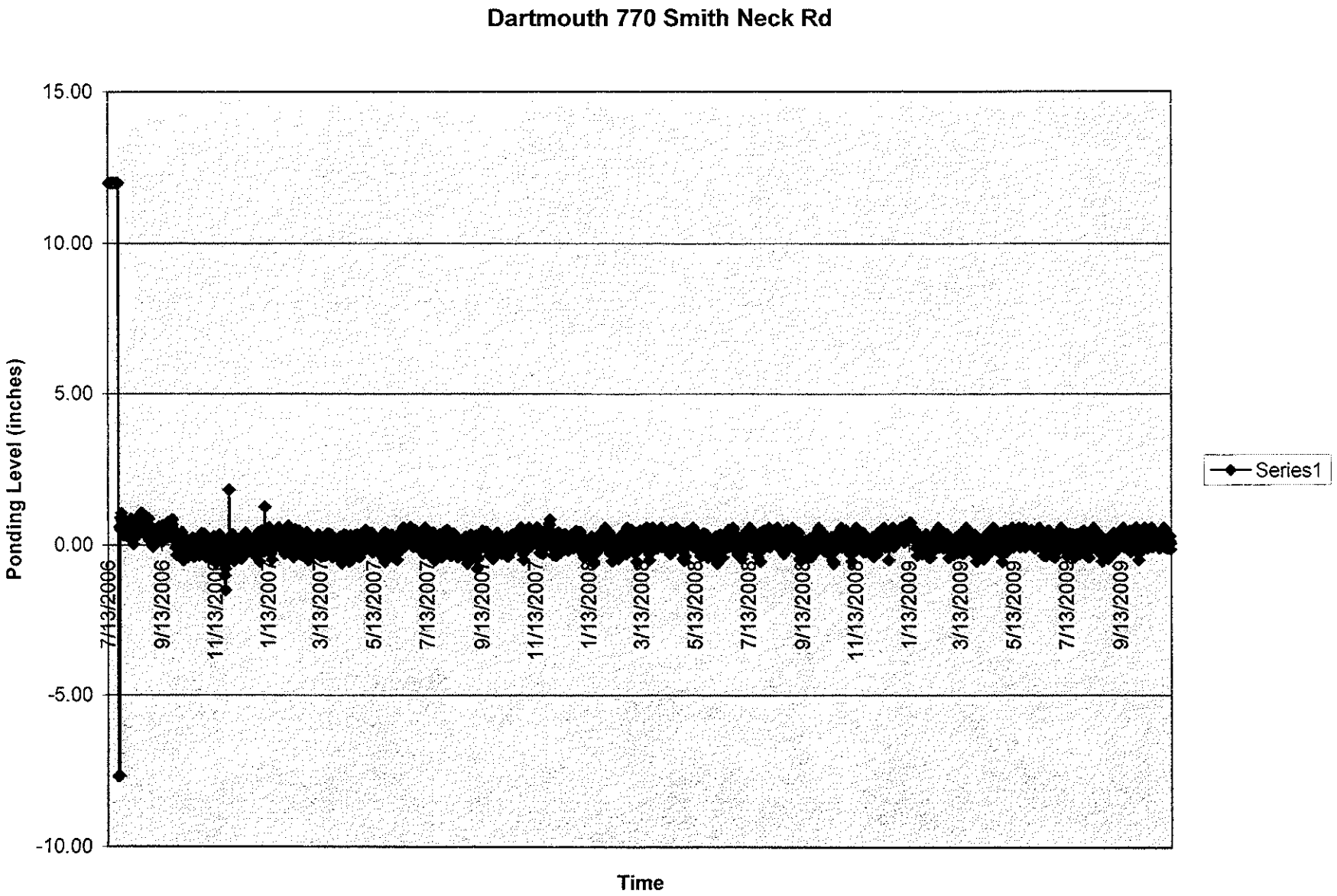


Acton 5 Fletcher Court




Dartmouth 770 Smith Neck Rd
15.00
10.00
5.00
0.00
-5.00
-10.00
Ponding Level (inches)
7/13/2006
9/13/2006
11/13/2006
1/13/2007
3/13/2007
5/13/2007
7/13/2007
9/13/2007
11/13/2007
1/13/2008
3/13/2008
5/13/2008
7/13/2008
9/13/2008
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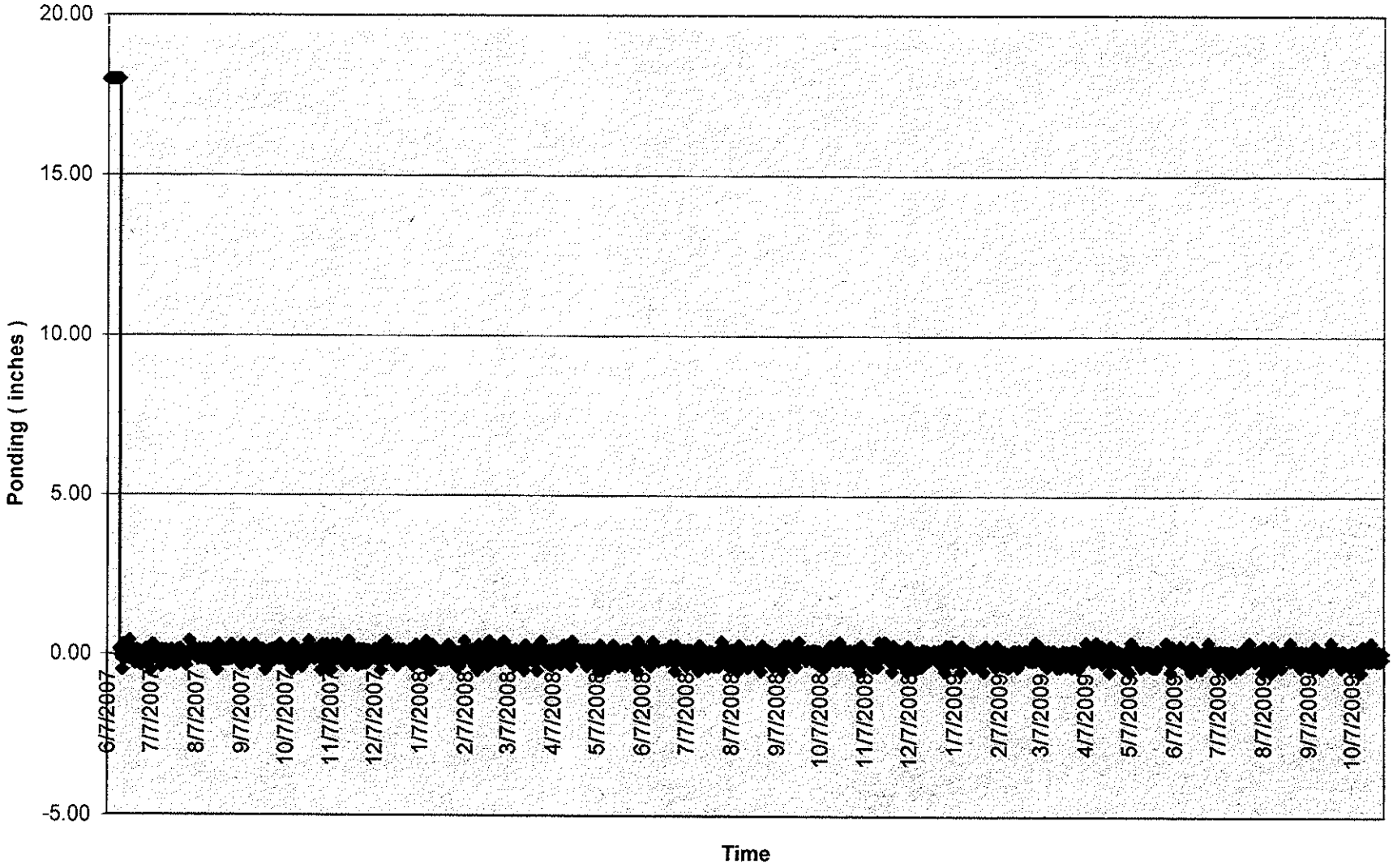
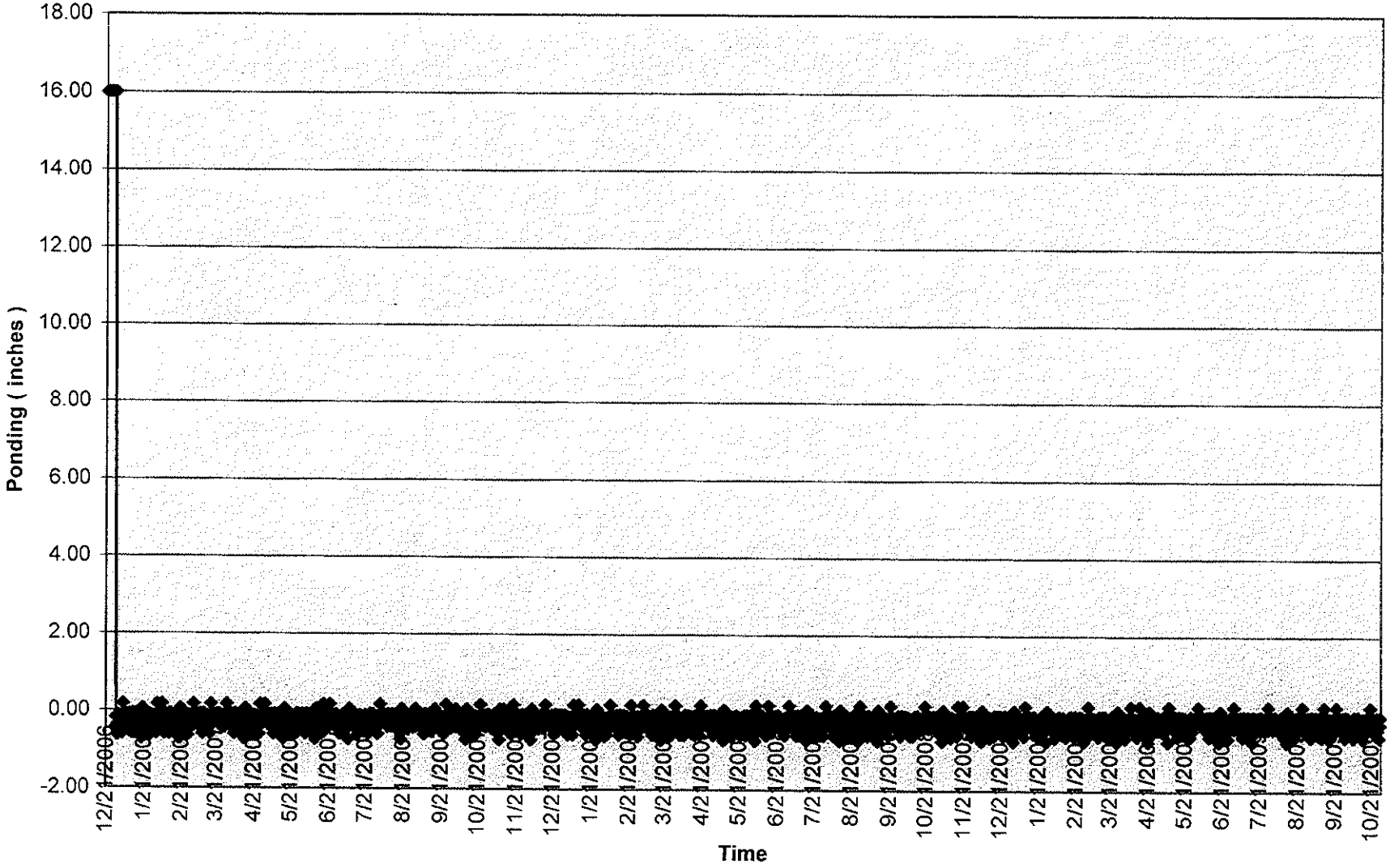
1/13/2009
3/13/2009
5/13/2009
7/13/2009
9/13/2009
Time
Series1

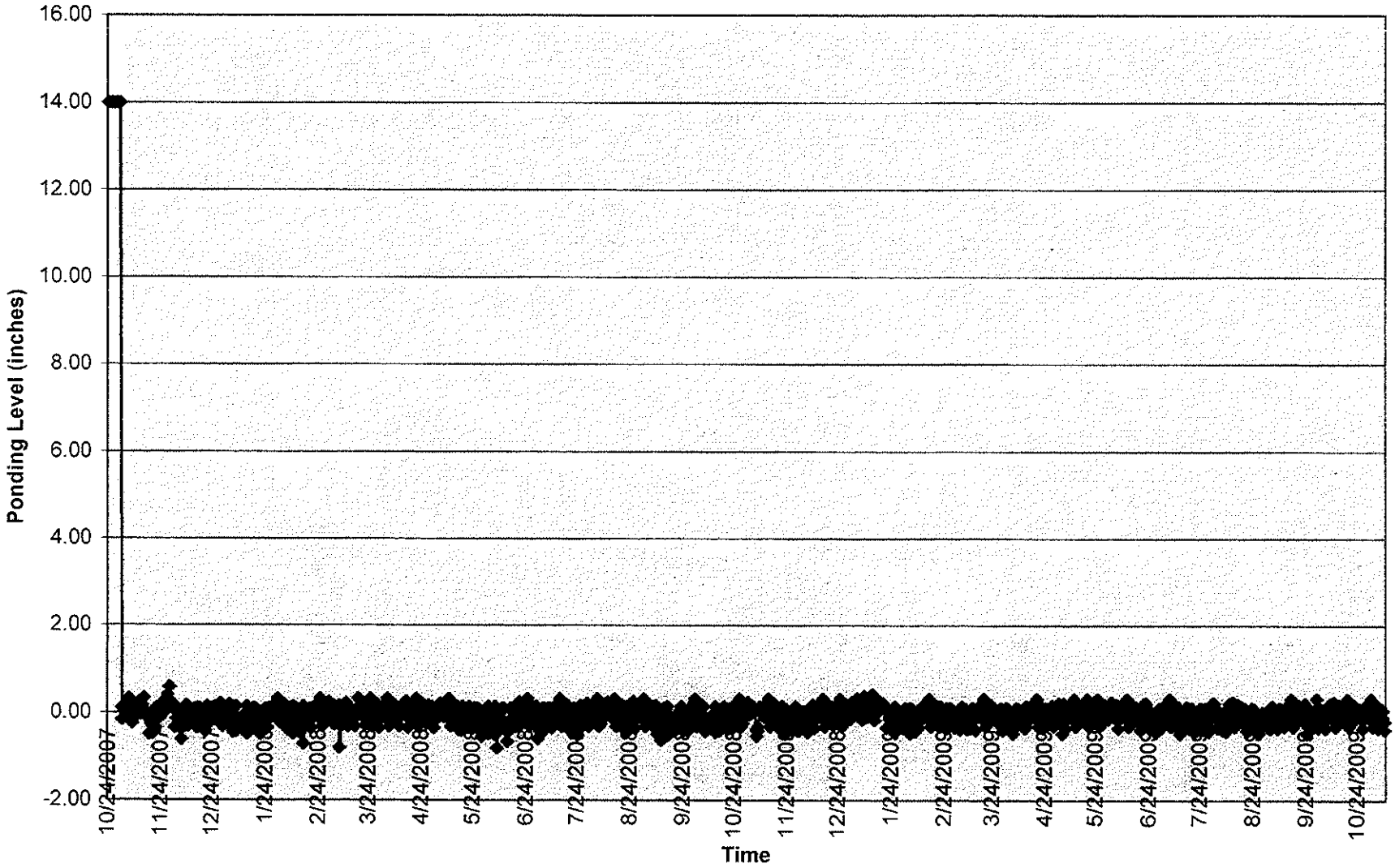
Fall River 223 Remmington



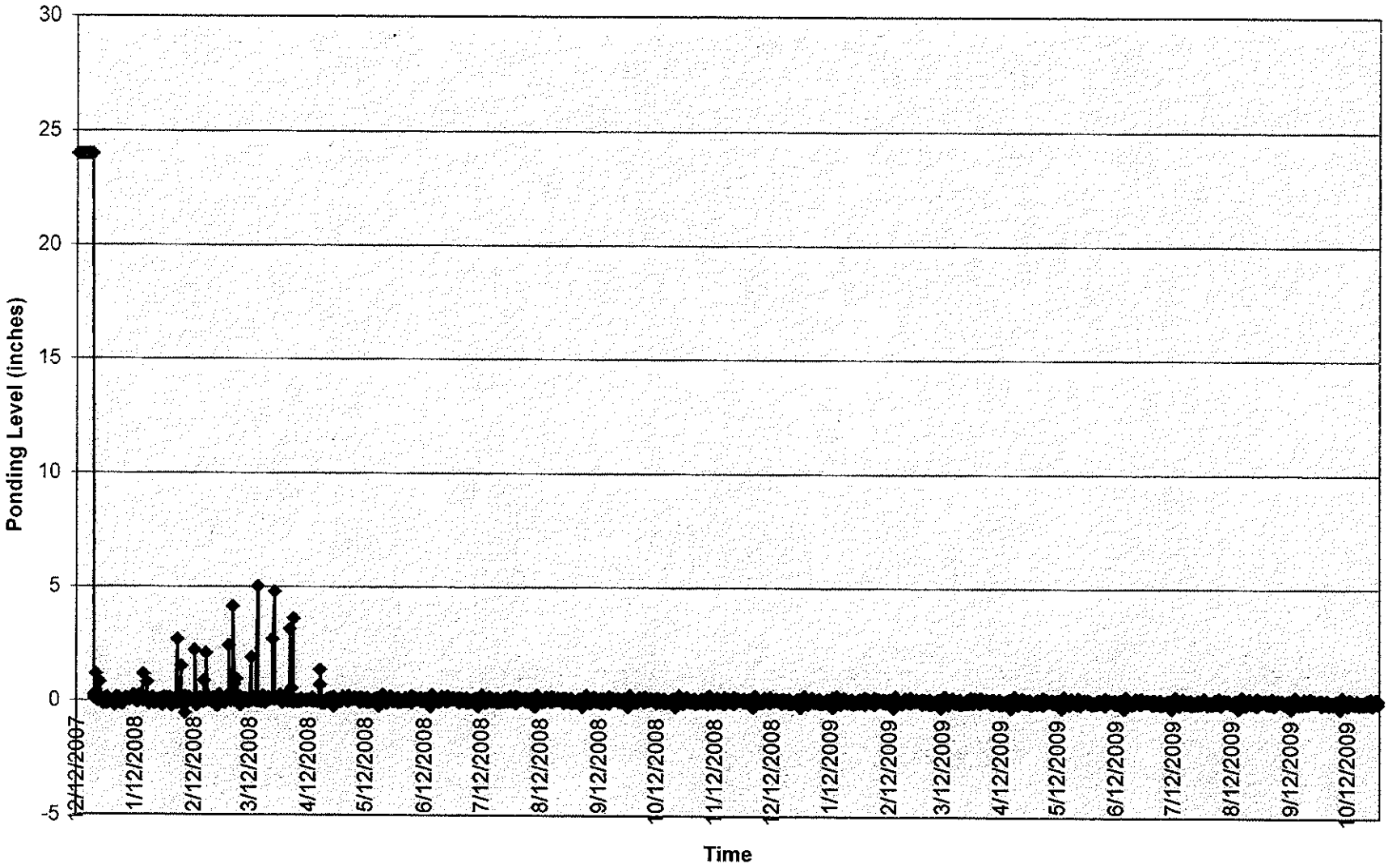
Foxboro 76 Granite

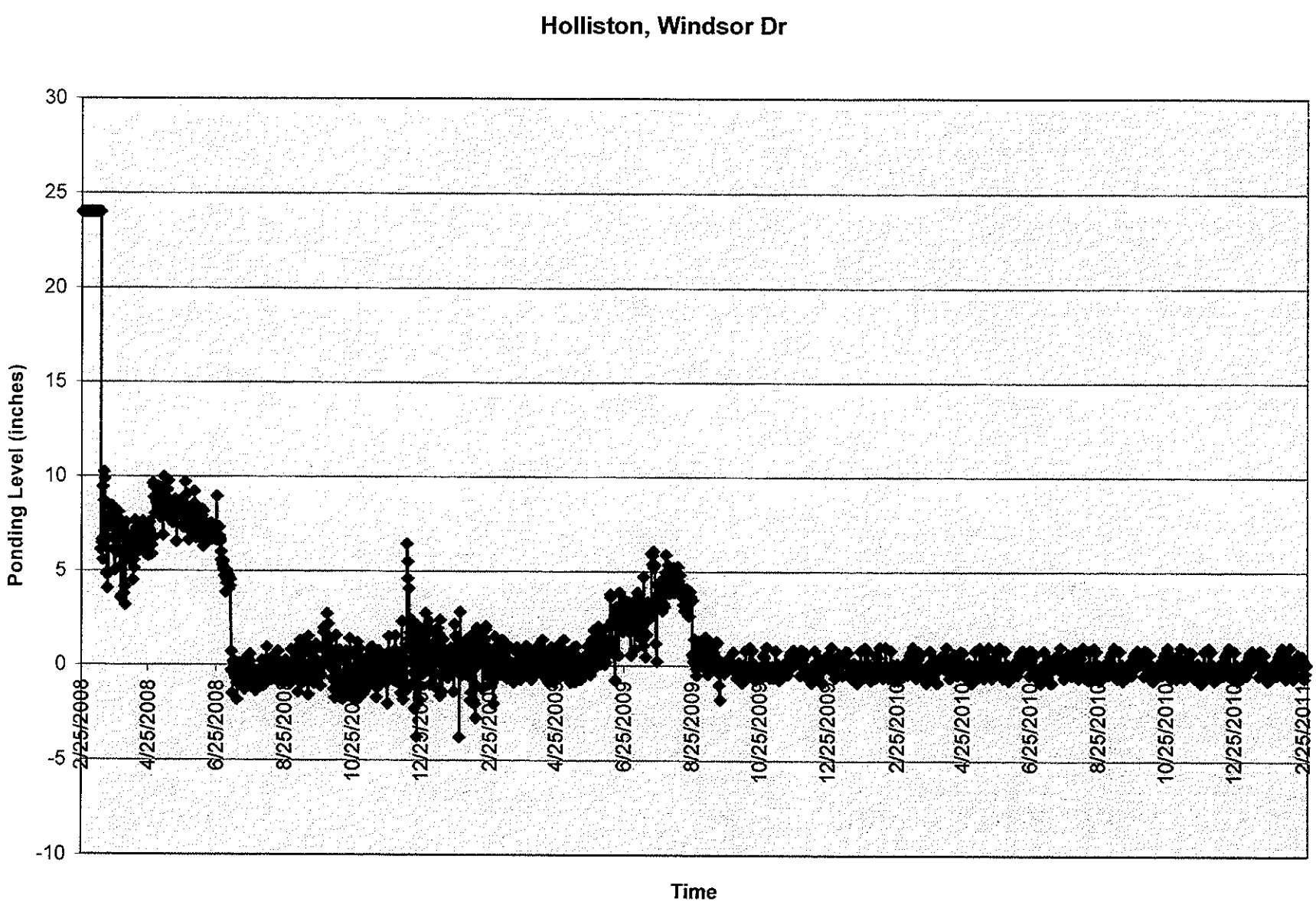


Foxboro 105 main St

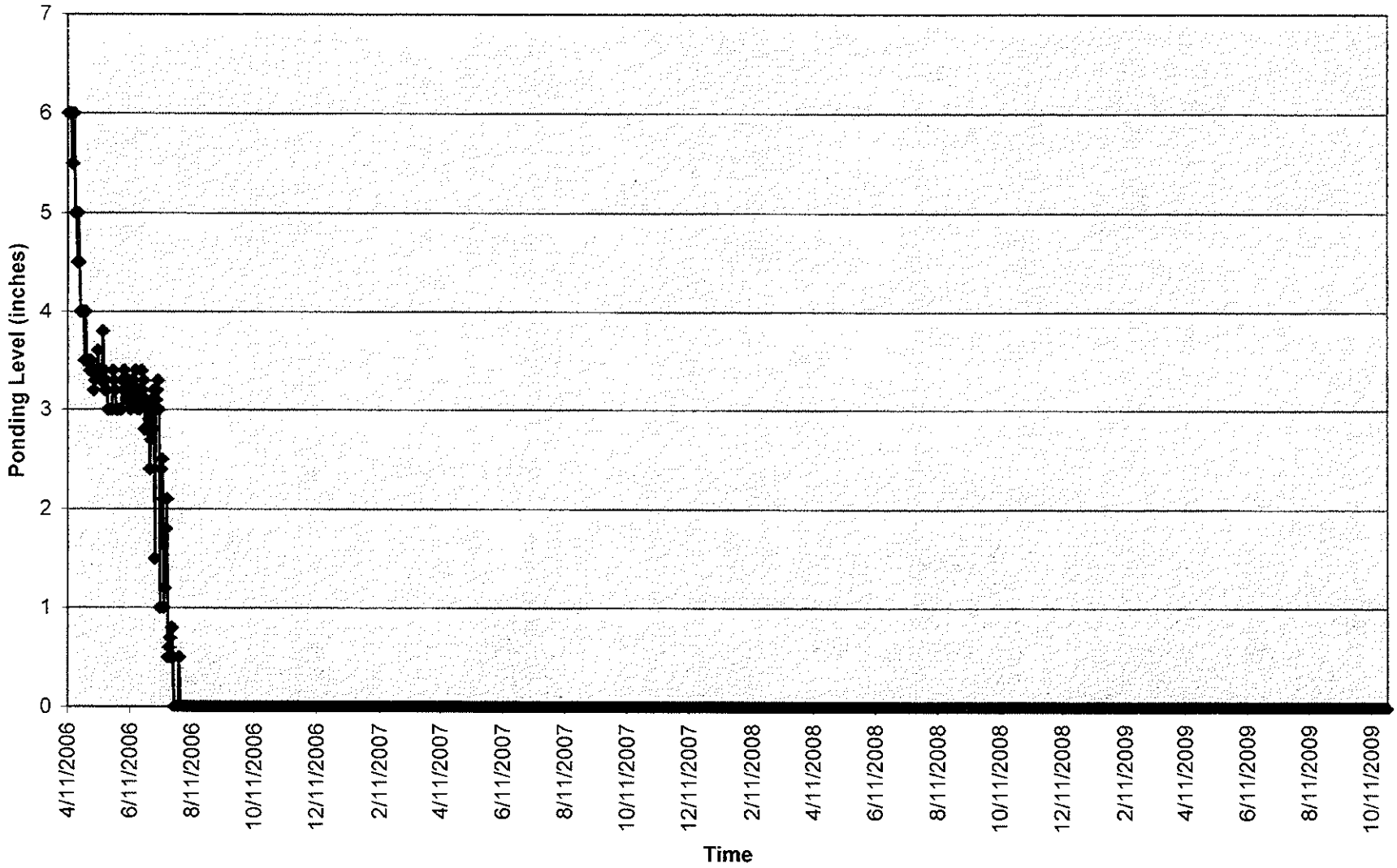


Foxboro 32 Commercial St

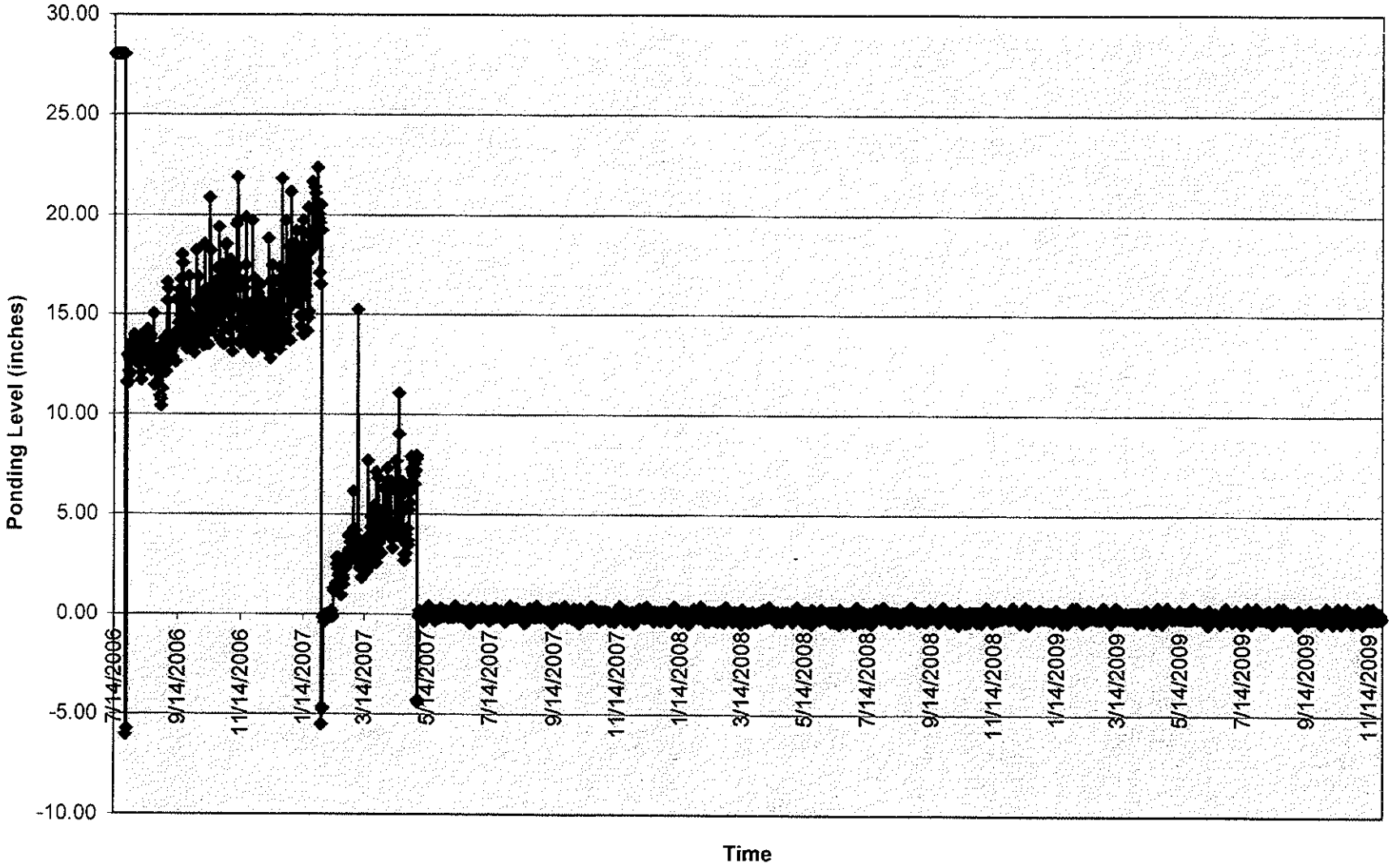



Holliston, Windsor Dr
Ponding Level (inches)
30
25
20
15
10
5
0
-5
-10
2/25/2008
4/25/2008
6/25/2008
8/25/2008
10/25/2008
12/25/2008
2/25/2009
4/25/2009
6/25/2009
8/25/2009
10/25/2009
12/25/2009
2/25/2010
4/25/2010
6/25/2010
8/25/2010
10/25/2010
12/25/2010
2/25/2011
Time

Lakeville 2 Mayflower



Lakeville 4 Edna Circle



JOHN ELIAS BALDACCI
GOVERNOR

STATE OF MAINE
DEPARTMENT OF HUMAN SERVICES
BUREAU OF HEALTH, DIVISION OF HEALTH ENGINEERING
161 CAPITOL STREET
11 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0011

JOHN R. B
COMMISSIONER

July 14, 2004

Knight Treatment Systems
Attn: Jay Knight, President
281 County Route 51A
Oswego, NY 13126

Subject: Revised Product Registration, Knight Treatment Systems ***White Knight***

Dear Mr. Knight:

Product Description

The Knight Treatment Systems ***White Knight*** consists of a 12 inch diameter plastic tube within which is a four inch diameter plastic tube. The space between the tubes is filled with loose spherical plastic media. A remote air pump feeds air to a proprietary diffuser beneath the cuspated plates. A biological film is generated, which adheres to the plastic media and provides treatment of the water-borne contaminants. An outlet filter prevents solids carryover. The Knight Treatment Systems ***White Knight*** is inserted into conventional septic tanks, and a proprietary innoculant is introduced at regular intervals.

Claim

According to the information in our files, the Knight Treatment Systems ***White Knight*** significantly reduces nitrate and BOD^5 levels; reduces suspended solids in the effluent; and rejuvenates biologically clogged disposal areas by application of low-nutrient, effluent with relatively high levels of dissolved oxygen. You have submitted additional data demonstrating that ponding in disposal areas is reduced, thereby restoring the absorptive capacity of the disposal area. Ref.: Letter dated 5/20/04 with enclosures. Although the combined BOD_5 and TSS exceed the reduction limits from Table 603.1 of the Subsurface Wastewater Disposal Rules, you have previously supplied data demonstrating that these levels represent aerobic microorganisms rather than untreated waste. On this basis you have requested a 50% design flow reduction for first time and replacement systems utilizing the Knight Treatment Systems ***White Knight***.

Determination

On the basis of the foregoing, the Division has determined that the Knight Treatment Systems ***White Knight*** is allowed a design flow reduction adjustment of 50%, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and Purchase/Installation Agreement.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of Knight Treatment Systems ***White Knight***. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar products.

This letter supersedes the letter dated July 7, 2004. If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@maine.gov

/jaj
xc: Product File
Septic Preservation Services.

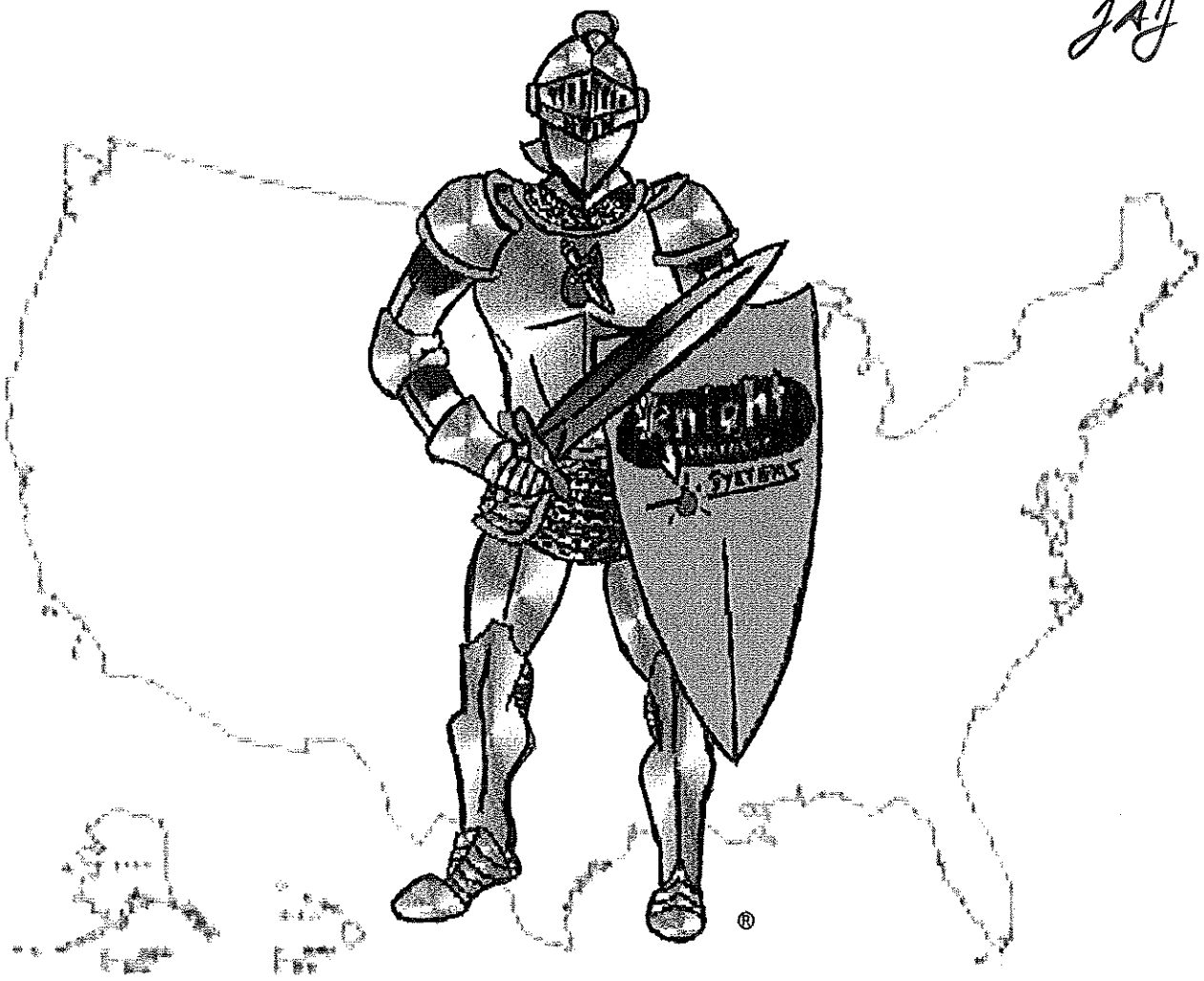
PHONE: (207) 287-5338
TTY: Deaf/Hard of Hearing (207) 287-5550

FAX: Admin./Plumbing/Eating & Lodging: (20
Drinking Water: (20

White Knight Microbial Inoculator Generator™

(Patent Pending)

hand delivered 6/4/12
JAJ



Design, Installation, Operation & Service Manual

Revised November 2008

Guardians of Water Quality®
281 County Route 51a, Oswego, NY. 13126
1-800-560-2454
www.knighttreatmentsystems.com

TABLE OF CONTENTS

(I) INTRODUCTION

The Enhanced Biological Augmentation of Onsite Wastewater Treatment Systems is the methodology of introducing a group of task specific selected microorganisms though inoculums in tandem with a microbial inoculation generation device that is placed into an onsite wastewater treatment train, typically the septic tank, to significantly improve overall treatment system performance, rehabilitate dysfunctional systems and assure system longevity.

The White Knight Microbial Inoculator Generator™ (MIG) continuously inoculates a septic tank or other treatment vessel with naturally occurring selected strains of non-pathogenic bacteria selected for their ability to metabolize organic material. Continuous inoculation is mediated through in-situ cultivation of IOS-500™ inoculumss. Through airlift mixing, recirculation, and fine bubble aeration principles the device brings the selected bacteria into contact with fixed film substrate and the suspended organic compounds in a septic tank, or other process treatment vessel. The introduced cultures of bacteria grow at logarithmic rates as they voraciously digest most of the organic constituents that are found in the wastewater in addition to the organic waste matter that has been transferred to the soil.

The fine bubble driven airlift features of the White Knight Microbial Inoculator Generator(MIG) are designed to allow for more efficient transfer of oxygen and low maintenance, high rate circulation of wastewater through the device, and across the fixed film media. An abundant oxygen supply supports the introduced IOS-500™ bacterial cultures providing for more rapid digestion. The tubular configuration internal media is clog resistant and provides for uninterrupted flow across abundant surface area for the establishment of the selected fixed-film culture.

Many of the natural bacteria found in wastewater such as the coliform group are not as aggressive at decomposition of the organic constituents found in wastewater and cannot compete with the IOS-500™ introduced cultures. The tank serves as the breeding reactor that cultivates and releases the introduced bacteria that are carried by the effluent stream out to the soil enhancing its treatment capabilities and hydraulic functionality.

(II) WHITE KNIGHT PRODUCT SPECIFICATIONS:

White Knight Microbial Inoculation Generation (MIG) Device:

1. The MIG device shall be manufactured from a rotationally molded single piece HDPE outer plastic housing.

2. The MIG device's housing shall have an internally partitioned ballast area in the base of the unit that is easily filled with pea stone ballast material in the field.

3. The internal ballast partition shall serve as the primary anchoring member for the fine bubble diffusion mechanism.

4. The internal fixed film media shall consist of a tubular clog resistant configuration that allows for the in service cleaning of the fine bubble diffusion membrane without disassembly of the MIG or requiring its removal from the tank.

5. The location of the IOS-500™ inoculant must be fixed to the inoculating wand and placed in the vertical path of flow just above the fixed film media of the MIG and in contact with the flow stream while in operation.

Air Supply:

1. Air shall be provided to the MIG by an external 120-volt AC single-phase linear air pump supplied by Knight Treatment Systems.

2. The supplied Control Panel shall be UL listed, equipped with an audio / visual alarm system that senses the loss of air pressure and optional high water sensing contacts in a NEMA 4x enclosure with a air pump run elapsed time meter.

3. Air supply pumps may be located in either an outdoor weather resistant enclosure or in an indoor protected area.

4. All relevant electrical work must comply with the appropriate electrical codes.

5. Air supply lines shall be installed in such a manner that provides protection from damage due to frost heave, vehicular and/or foot traffic.

Model Specifications:

Model #	BOD loading mg/l/ @ 500 gpd per unit	# of Columns per Model	Size of Column (dia" x height")	Minimum Air Pipe ID	Minimum tank size	Approx Diffuser Air Flow (CFM) @ 2 PSI
WK-40	up to 750	1	16" x 27.5"	½"	1000 Gal	1.5
WK-78	up to 1500	2	16" x 27.5"	¾"	1500 Gal	3.4

Residential Application Guidelines:

1. Model WK-40: 1 to 4 bedrooms based on minimum 1.5 day residency time of average daily flow within tank.

2. Model WK-78: 5 to 8 bedrooms based on minimum 1.5 day residency time of average daily flow within tank.

Institutional & Commercial Application Guidelines:

The use of multiple units may be required based on wastewater composition, existing tank size and average daily flow. *Consult with Knight Treatment System's representative for each specific potential application.* In general:

1. Institutional Waste Streams: Tank size must allow for minimum of 1.5 days residency time of average daily flow with 2 or more days preferred. (1) Model WK-78 unit per 2000 gallons or less of tank volume and up to 1500 mg/l/day BOD load @ 500 gpd.

2. Commercial Grease Interceptors: Tank size must allow for minimum of 2 days residency time of average daily flow with 3+ preferred. (1) Model WK-78 per 1500 gallons or less of interceptor volume and up to 1500 mg/l/day BOD load @ 500 gpd.

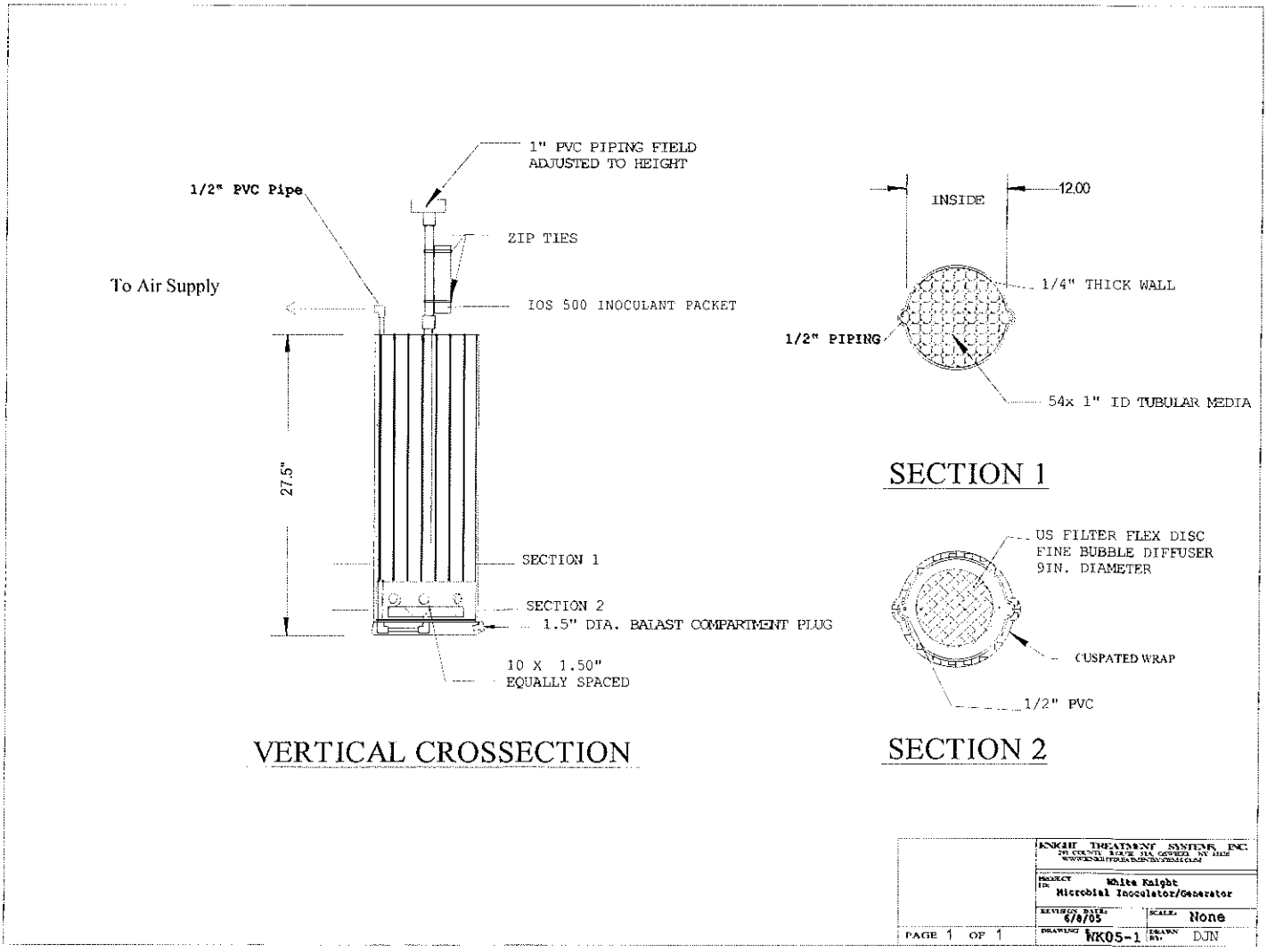
Air Supply Specifications:

Model #	Minimum Output @ 2 psi (CFM)	Maximum Air Pump Sound Level @ 3'	Amps	Volts
WK-40	1.5	32 dBA	1.2	120
WK-78	3.4	36 dBA	2.1	120

UL Listed Alarm/Control Minimum Specifications:

Model #	Voltage	Amps Max	Failure sensing	Alarm Type	Overload protection (amps)	Switching
WK-40	110 / 120	8	Pressure drop +/or float	Visual and Audible	8	Normal/ Silence only
WK-78	110 / 120	8	Pressure drop +/or float	Visual and Audible	8	Normal/ Silence only

White Knight MIG Column Drawing

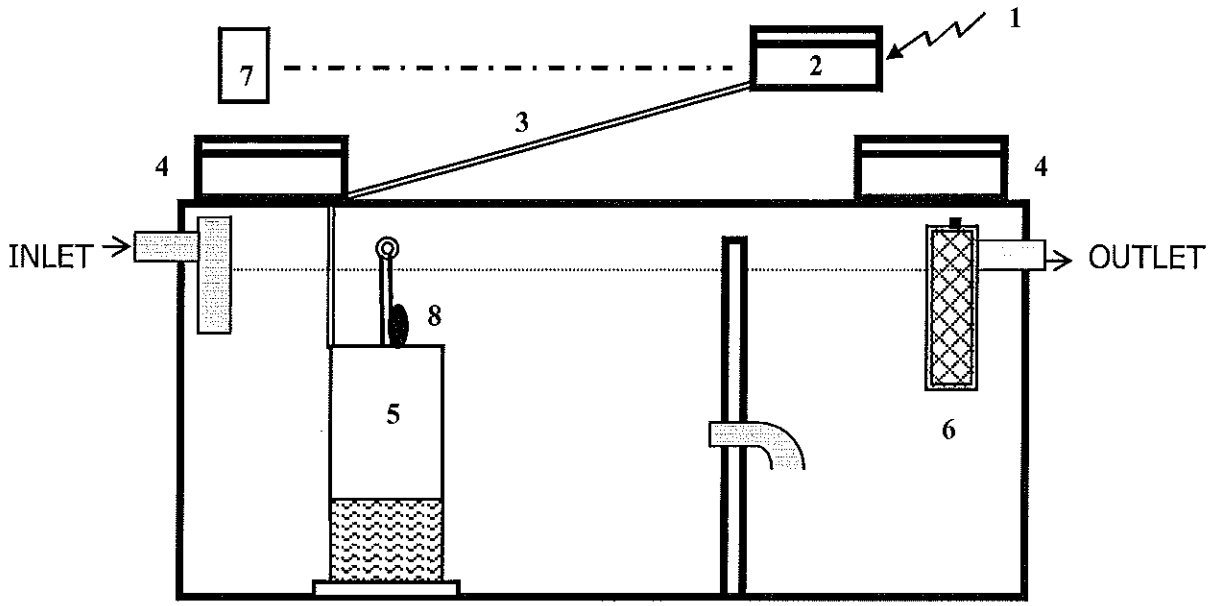


Installation Diagrams:

Important Note: All tanks must be water tight.

Typical In Tank Installation WK-40

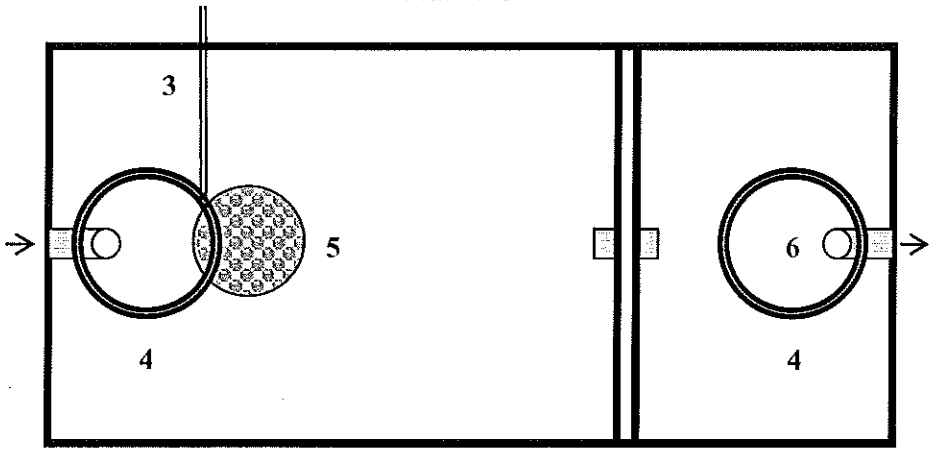
Cross Section View



1. 120 volt electrical supply through Alarm/Control Panel to Air Pump
2. Air pump installed in weather tight basin, outdoor location
3. ½" ID plastic air supply line from pump location
4. Service risers for monitoring and maintenance
5. White Knight Microbial Inoculator Generator™ Column in 1st compartment of 2 compartment tank.
6. Outlet equipped with Effluent Filter
7. System Alarm Panel
8. IOS-500™ Inoculant Packet

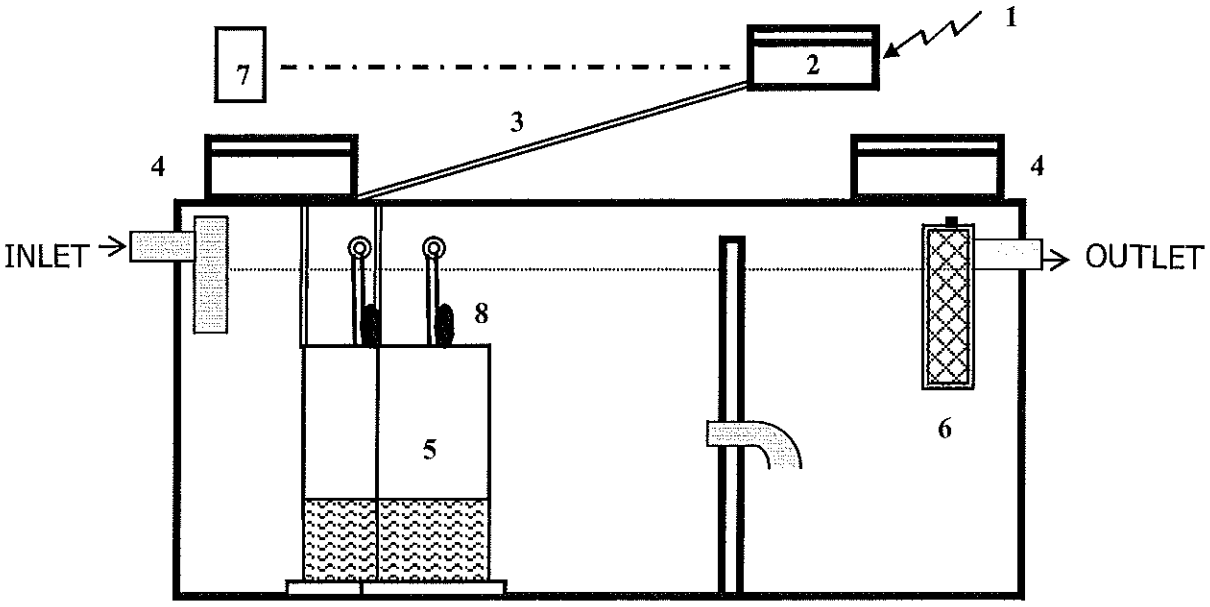
Typical In Tank Installation WK-40

Plan View



Typical In Tank Installation WK-78

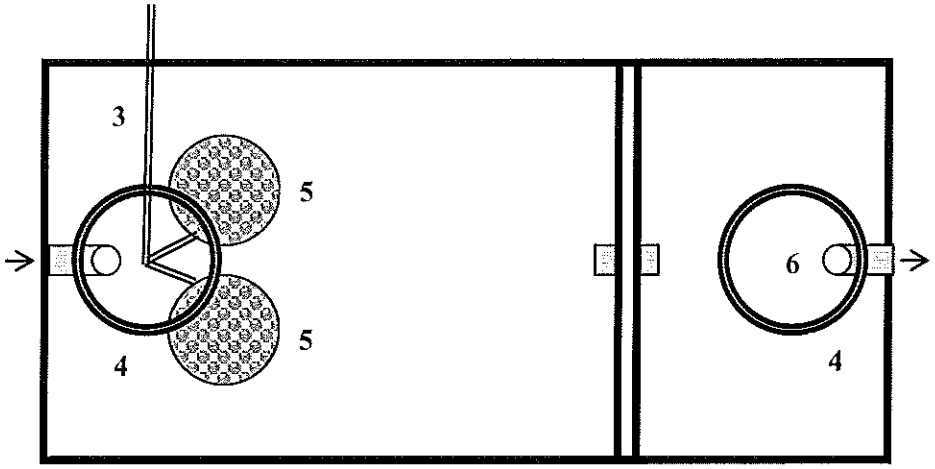
Cross Section View



1. 120 volt electrical supply through Alarm/Control Panel to Air Pump
2. Air pump installed in weather tight basin, outdoor location
3. ¾" ID plastic main air supply line from pump location to tee in riser. ½" ID flexible air line from each side of tee to each column
4. Service risers for monitoring and maintenance
5. (2) White Knight Microbial Inoculator Generator™ Columns in 1st compartment of 2 compartment tank.
6. Outlet equipped with Effluent Filter
7. System Alarm Panel
8. IOS-500™ Inoculant Packets

Typical In Tank Installation WK-78

Plan View



Deployment:

1. MIG installation shall only be performed by a Knight Treatment Systems (KTS) trained and authorized provider in conformance with KTS's guidelines and in compliance with an local regulatory requirements.

2. The MIG shall only be placed in structurally sound watertight septic tanks. The MIG must not be installed in cesspools, block, steel, or other substandard tanks or in any septic tank of volume less than 750 gallons.

3. The septic tank shall provide for a minimum of 1.5 days residency time of the total estimated daily flow of wastewater from the property and in any situation no less than 750 gallons in volume.

4. The outlet of the septic tank must be equipped with an acceptable effluent filter.

5. The septic tank must have acceptable service risers meeting local regulatory requirements to facilitate monitoring and maintenance.

6. In repair situations, a verifiable history of successful performance of the absorption system prior to dysfunction in tandem with a comprehensive site qualification performed by an authorized provider trained by Knight Treatment Systems or a KTS authorized Distributor is required.

Service & Warranty:

1. A manufacturer's component warranty program shall be provided to the property owner for each MIG installed.

2. A comprehensive service program shall be provided to the property owner for each MIG installed.

3. Service of the MIG shall only be conducted by KTS trained and authorized providers in compliance with any local regulatory requirements and at a minimum of 6-month intervals.

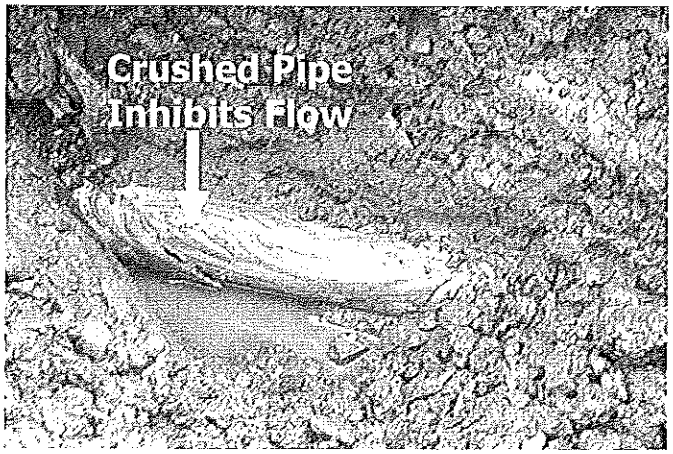
4. A minimum initial one-year Operation & Maintenance (O & M) contract shall be provided with each unit installed.

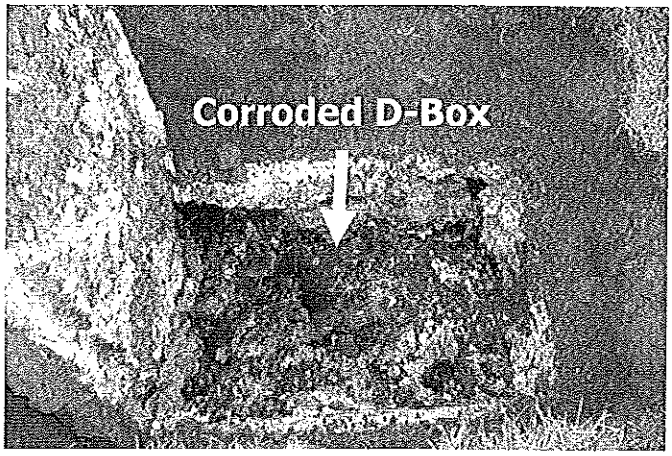
5. A valid O & M contract shall be in place for the life of the MIG.

(III) Site Qualification

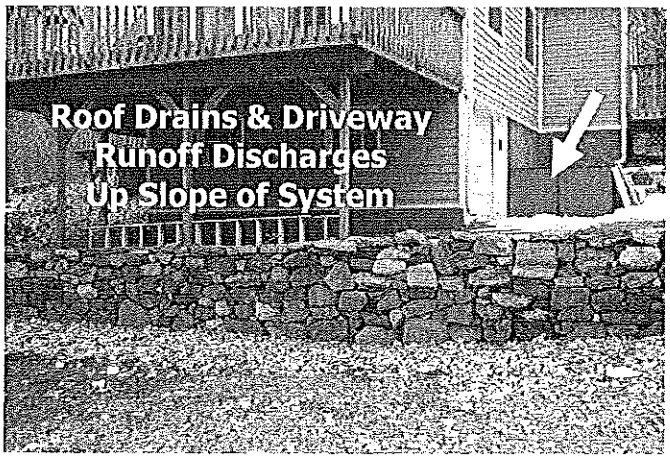
The White Knight Microbial Inoculator Generator's success is directly linked to the proper determination of the root cause of an onsite system's dysfunction. In order to determine whether or not the dysfunctional system is a candidate for enhanced biological rehabilitation a thorough site evaluation must be performed. To this end a competent authorized professional must perform a comprehensive site evaluation and owner/operator interview and record search in determining the actual nature of the problem(s) being experienced and to submit the appropriate permit application(s).

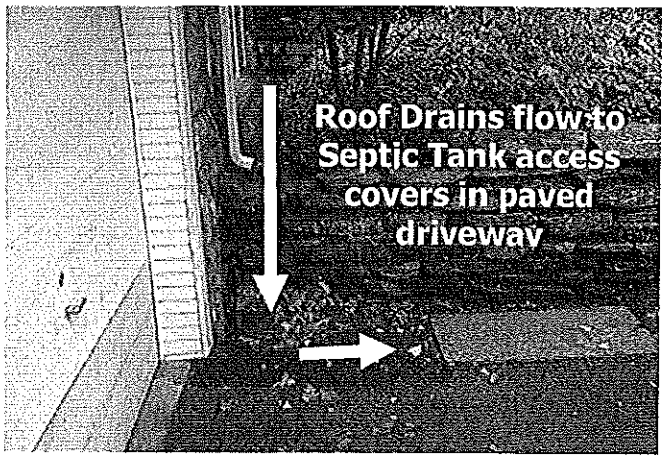
The system's infrastructure must be sound and free of defect. Septic Tanks, Distribution Boxes and other components must be evaluated and repaired or replaced if found to be damaged or deficient. All such repairs, if required by local authority, must be performed under an approved repair permit and may be incorporated in the repair application in which the installation of the White Knight is specified.



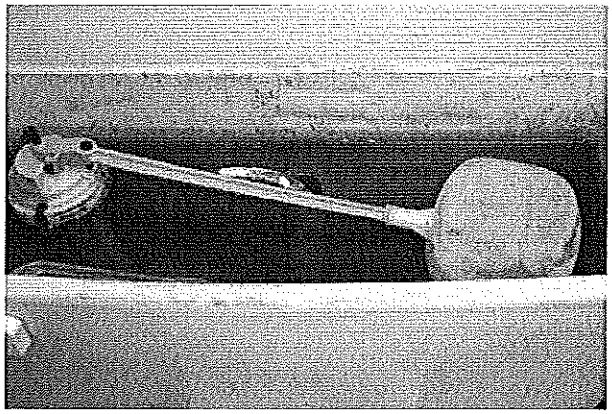


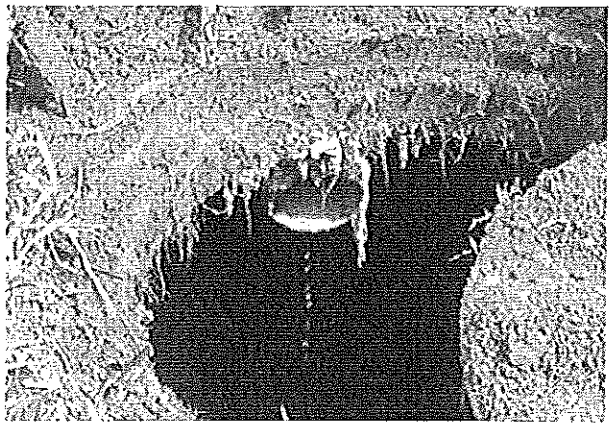
Surface water runoff infiltrating the system will have a major impact on the hydraulic performance and treatment efficiency of the absorption system contributing to its dysfunction.





Sources of concentrated flow from impermeable areas such as rooftops and driveways must be identified and directed away from system components. Visiting a dysfunctional system during or shortly after a significant rain event can be invaluable tool in assessing the drainage patterns of the property.





Inflows from leaky plumbing fixtures place a tremendous burden on the absorption system. Water continuously trickling into the septic tank is a positive sign that either inflow and/or infiltration are taking place.

Illicit discharge from sump pumps into the system may also be a contributing factor. Condensate from heating / air conditioning appliances and water softener backwash has been demonstrated to impact the processes of wastewater treatment systems. Conduct an in the home survey of all water using fixtures and any sump pump connections in the presence of the property owner and identify the appropriate corrective measures that would need to be taken.

For a dysfunctional OWTS application the physical verification of the existence of a clogging mat is an important evaluation practice. Typically the upslope edge of the leachfield is located with a probe and a small excavation is created in close proximity above the leachfield to a depth below the bottom of the leachfield.

Once the initial excavation is made and ground water is not encountered the excavation is moved towards the leachfield's soil interface to establish the presence of the clogging mat. Typically the internal hydrostatic pressures of the leachfield will breach the clog mat and fill the hole with effluent. The thickness of a clog mat will vary and is dependent upon soil structure and texture. Loose granular soils exhibit a thicker and more pronounced appearance than tighter soils.

Depth to ground water and its movement plays a major role in the functionality of a leachfield and its ability to treat wastewater. The hydrology of a lot can be impacted and dramatically change from the time of original system siting due to neighboring development. In such a situation the installation of a swale, curtain or perimeter drain may be a necessity to protect the leachfield from becoming saturated. Consult with the appropriate regulatory authority for direction if ground water impacts are discovered during the site evaluation.

(IV) Installation

The following components are provided with each White Knight MIG supplied by Knight Treatment Systems:

Model WK 40 - (1) Generator Column, H40 Air Pump, Air Pump Housing, (2) IOS-500™ Inoculant Packets, Pressure Sensing Alarm Panel with pump run hour meter, 25' Alarm Tubing with ½" PVC SCH40 sensing tee, 1st year of component warranty coverage, 1st year of 6-month & 12-month service notifications, (1) IOS-500™ Inoculant Packet shipped at time of 12-month service notification.

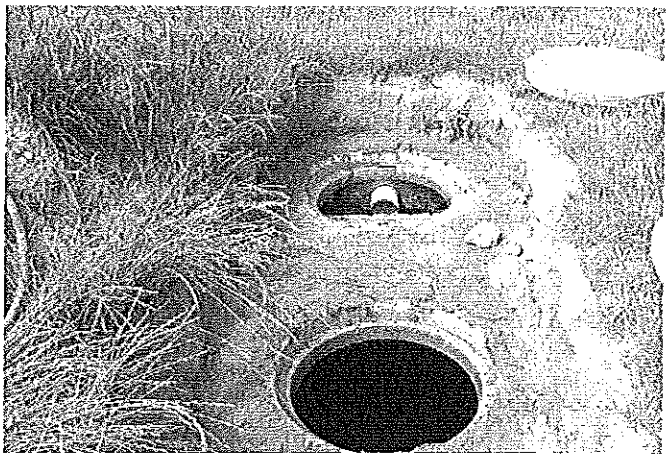
Model WK 78 - (2) Generator Columns, H80 Air Pump, Air Pump Housing, (4) IOS-500™ Inoculant Packets, Pressure Sensing Alarm Panel with pump run hour meter, 25' Alarm Tubing with ½" PVC SCH40 sensing tee, 1st year of component warranty coverage, 1st year of 6-month & 12-month service notifications, (2) IOS-500™ Inoculant Packet shipped at time of 12-month service notification.

All other components for a complete and proper installation shall be supplied by the installer, which include but are not limited to:

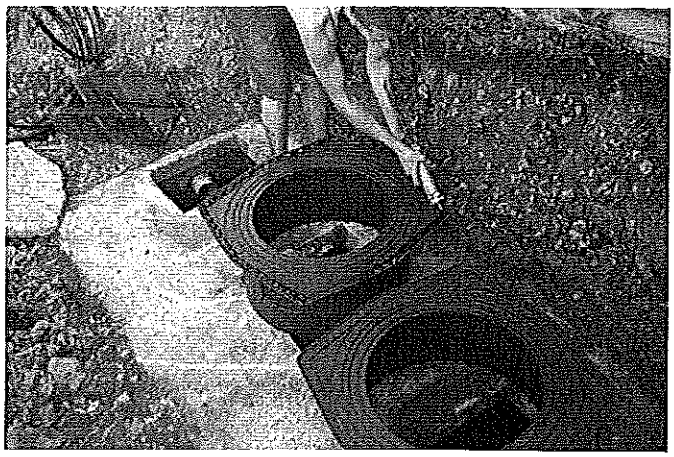
- Air supply line between air pump and MIG column locations.
- Air supply line transition fittings, glue, sealants, etc.
- Electrical supply to Alarm Panel and Air Pump
- Effluent filter.
- Replacement tank if necessary.
- Riser system if necessary.
- All tools and services required for a complete and proper installation.

Important Note: The following directions are provided with the assumption that those involved with the installation of the White Knight Microbial Inoculator Generator hold knowledge of, adhere to, practice and promote the protection of the health and safety of their colleagues, the public and the environment. Becoming educated in and complying with all Industry and OSHA Safety Requirements and governing Regulatory Requirements is the sole responsibility of the installer. Knight Treatment Systems, Inc. assumes no risk or liability for any omissions or actions of the installer or by others associated with the installation.

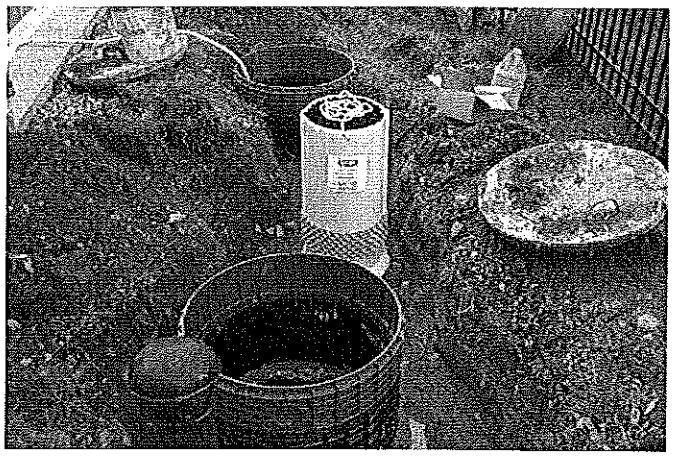
1) Expose the top of septic tank. The tank must be pumped, visually inspected and ALL solids removed prior to installation of the White Knight™. Tanks and risers must be watertight. Openings, risers, and tank interior must be structurally sound and intact. Septic tanks found to be corrupt must be replaced with a tank that meets local requirements.



2) A riser system meeting local regulatory requirements must be used where absent at the inlet location where the White Knight™ will be installed and at the outlet of the septic tank for effluent filter servicing. The minimum diameter of the opening for the White Knight should be 20 inches. Caution must be exercised in the modification of an existing opening for the installation of the White Knight.

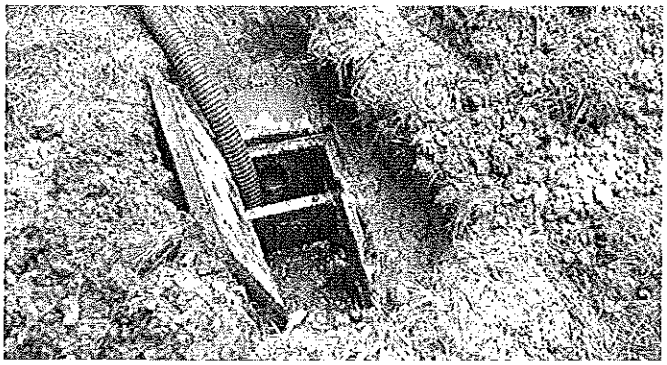


3) All risers must be installed watertight and extend just above finished grade. Lids shall conform to any local regulatory requirements and prevent unauthorized entry.



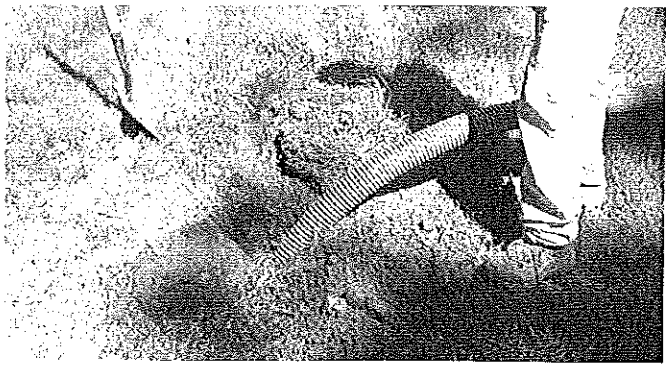
4) The Leachfield must also be drained of ponded effluent. This can be accomplished via access gained at the Distribution Box and by excavating at the lowest point of the Leachfield and pumping out the ponded effluent. Where absent, Knight Treatment Systems recommends that a Distribution Box Access Riser and Cover system be installed, be water tight and allows for the monitoring of system performance.

IMPORTANT NOTE: Lines containing settled sludge must be jetted.

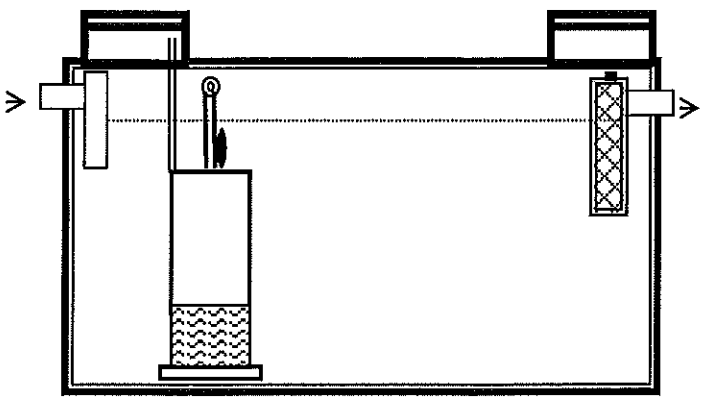


Ponded Effluent Removal from Distribution Box

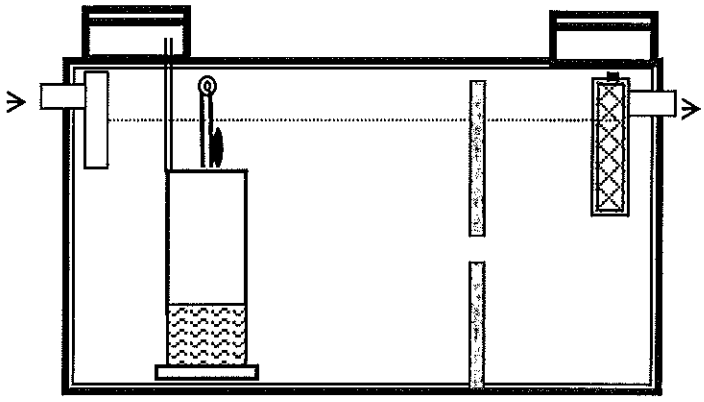
Ponded Effluent Removal from Leachfield



5) The location for the White Knight MIG Column™ is the inlet side of both single compartment and two-compartment tanks, centered as illustrated by the diagrams below. Column should be placed equidistant from the near end and side walls.



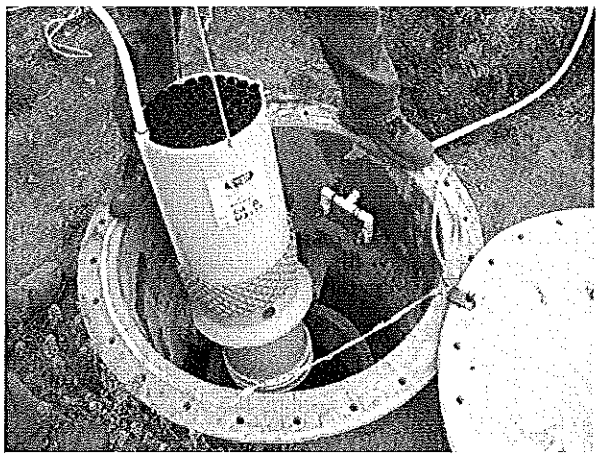
Single Compartment Tank



Dual Compartment Tank

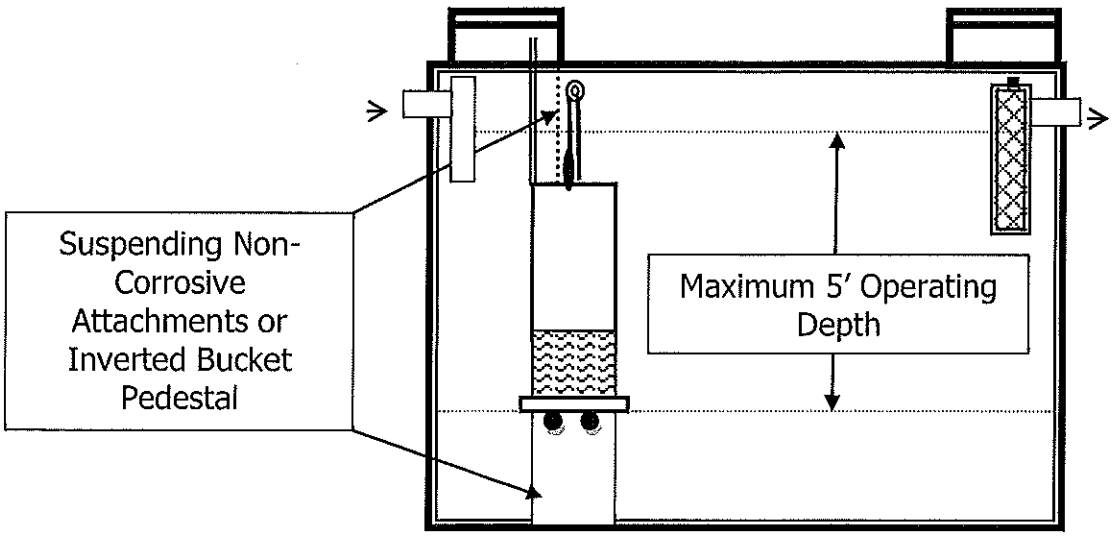
6) Installation and placement of the White Knight MIG Column must not interfere with the function of the inlet tee. If the tee is modified to facilitate installation it must be restored to code compliant condition.

7) Septic tank openings may need to be modified. If the White Knight Column cannot fit into an existing opening any opening modification must not compromise the overall integrity of the tank.



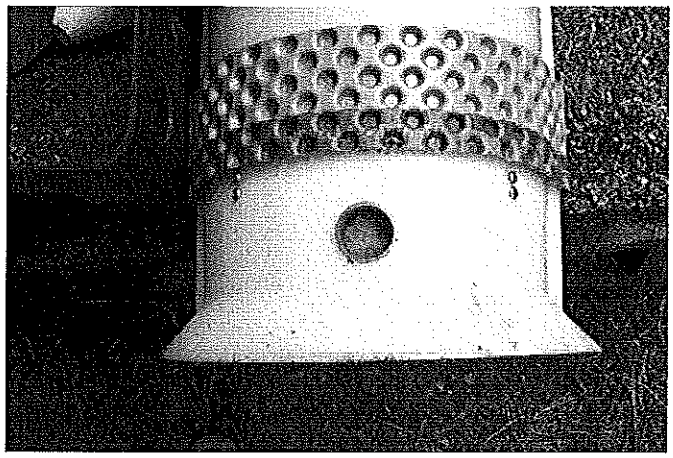
8) The optimum depth for the bottom of the White Knight™ is 4 feet below the surface of the liquid in the tank. When tanks are encountered with liquid operating depths greater than 5 feet elevate the White Knight™ to the optimum depth. Utilizing 6 stainless steel 1.5" long screws securely fasten an inverted 5-gallon plastic bucket to the bottom of the tower with holes created in the base of the bucket to prevent floatation. Trim sides of the inverted bucket to achieve the optimum depth. For tanks with depths greater than 6 feet suspending the White Knight from the riser with non-corrosive attachments is also an acceptable practice.

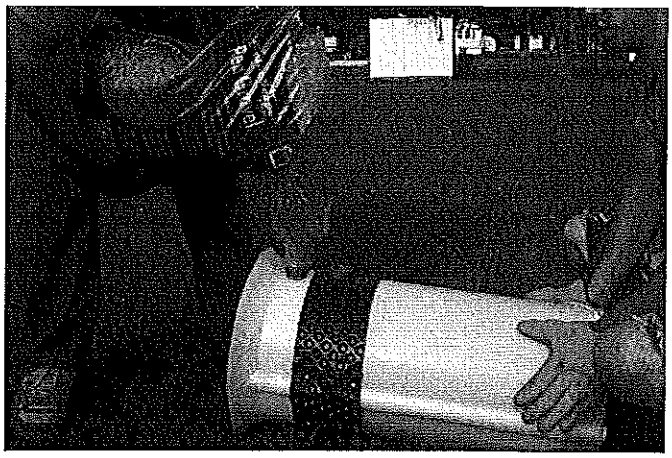
White Knight Depth Adjustment Illustration



***CAUTON:* NEVER ENTER A SEPTIC TANK OR OTHER CONFINED SPACE WITHOUT FOLLOWING OHSA REQUIREMENTS & PROCEEDURES!**

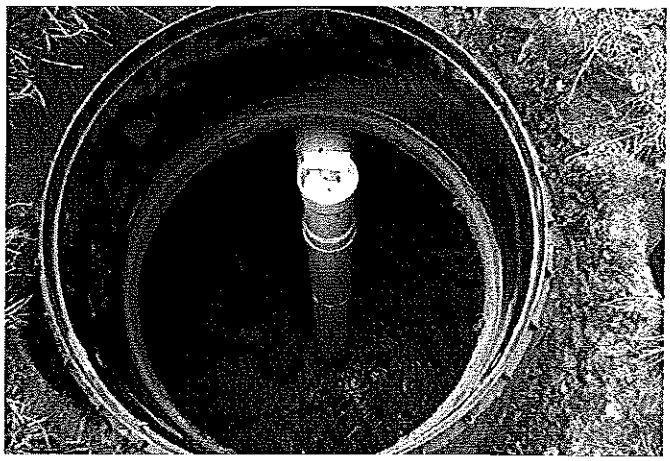
9) Ballast must be added to the White Knight prior to its placement into the tank. Locate the plug near the base of the tower and completely fill ballast compartment with clean, small diameter pea stone replacing plug when completed.



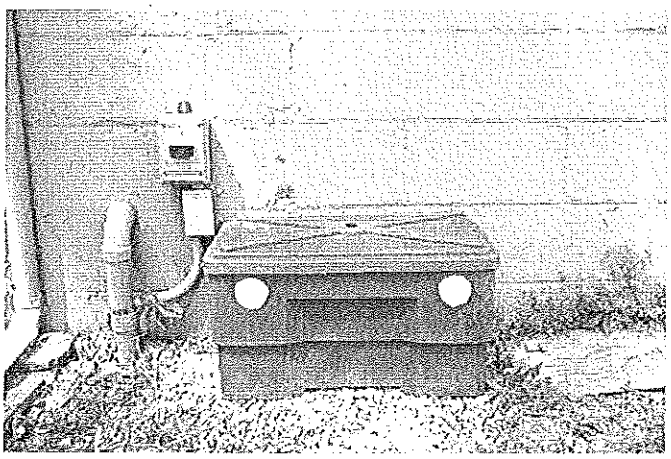


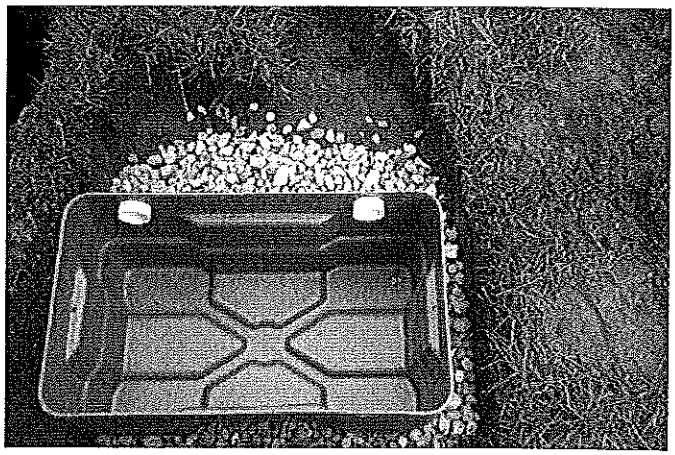
10) A effluent filter is required. When absent install an appropriate effluent filter and service riser system at the outlet of tank. Failure to install an effluent filter will result in voiding of any performance warranty.

11) Any baffling that has been removed to facilitate installation must be returned to a code compliant condition.



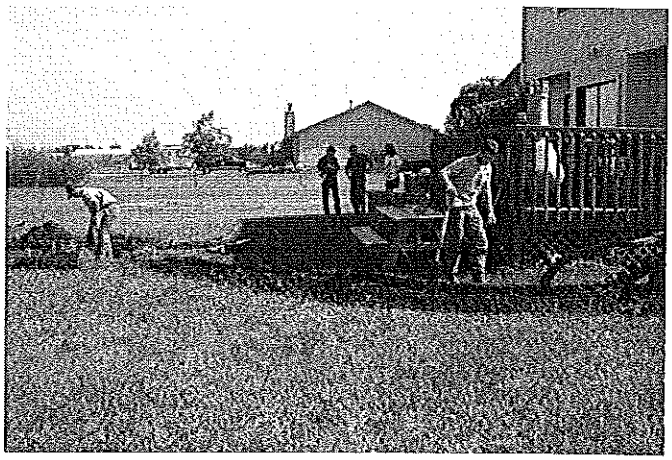
12) The locations for the Alarm Panel and Air Pump Basin should facilitate running of airline to the White Knight riser and the related electrical connections for the panel and air pump. The location should shield the basin from direct sunlight and weather events in so much as possible. Air Pump Basins should be slightly elevated when flooding is a possibility and always placed on a 2" bed of washed gravel to facilitate drainage. Drill airline entry hole in bottom of basin over sizing the penetration to allow for the drainage of any water that may find its way into the basin.



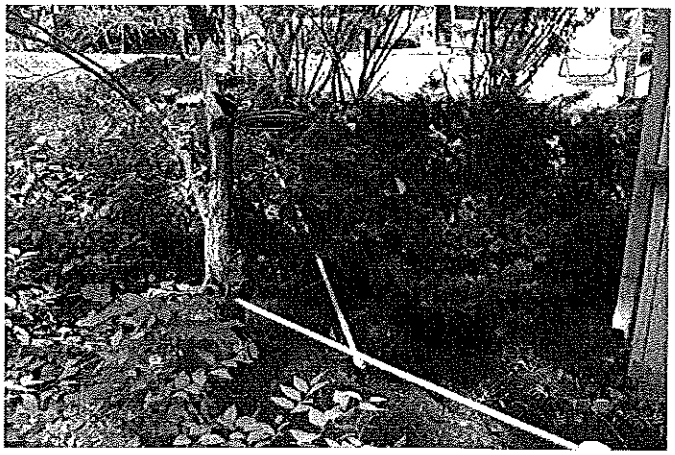


13)A trench must be provided for the air supply line between the Air Pump location and the White Knight service riser. Excavation may be accomplished by either hand or with the use of power equipment. Trench should uniformly slope from the air pump location to the service riser to prevent any airline condensate from pooling. When performing an excavation make sure you are in compliance with local procedure and safety practices with regard to the protection of underground utilities.

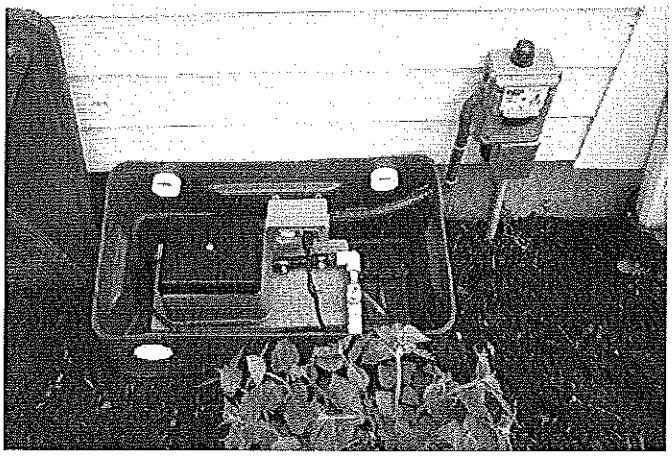
NOTE: Where an airline must cross vehicle traffic or parking areas such as a driveway the air supply line should be protected by placing it in a sleeve such as a 1" ID Schedule 80 PVC pipe installed a minimum of 12" below the surface of the traffic area.

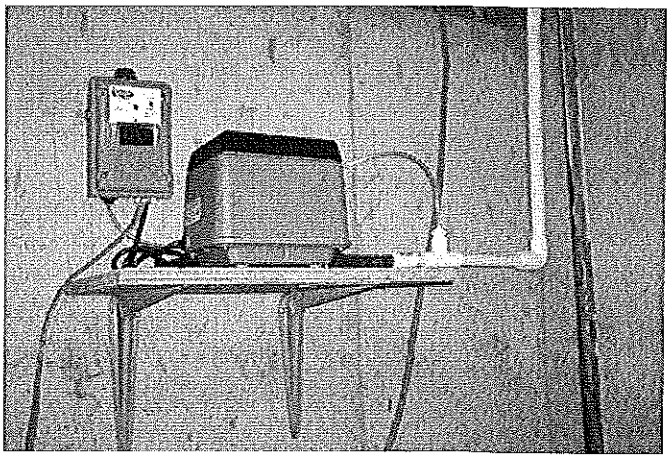


14. The air supply line can be either Schedule 40 PVC or HDPE piping, ½" ID minimum for White Knight Model WK-40, ¾" for White Knight Model WK-78. HDPE piping is recommended as it reduces the amount of connections to be made minimizing the potential for air leaks.



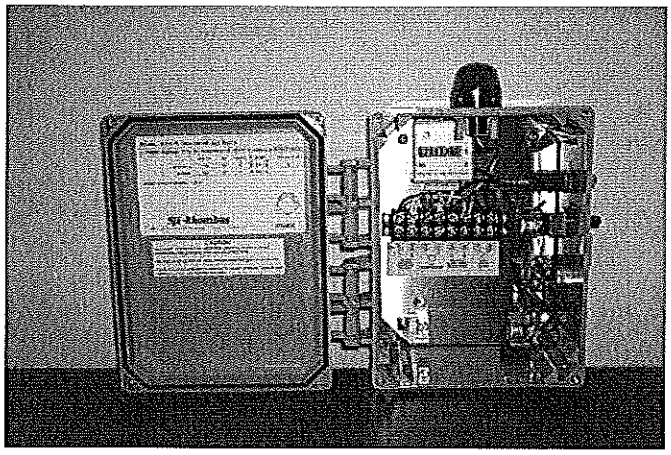
15. Place a 2" x 8" x 16" cinder or patio block in basin as a base for the Air Pump. Install airline through bottom of basin. Install the pressure-sensing tap near the Air Pump into the airline making the appropriate transitions in making connections.

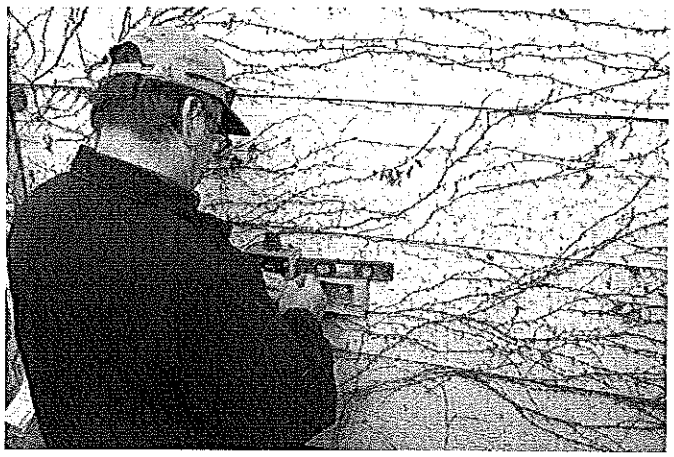




16. Indoor air pump locations may create service complications due to lack of accessibility during property owner or tenant absences and should be avoided if possible. When indoor installation is necessary, locate indoor air pumps in an easily accessible area of the building's basement, a garage or a utility room on a stable base.

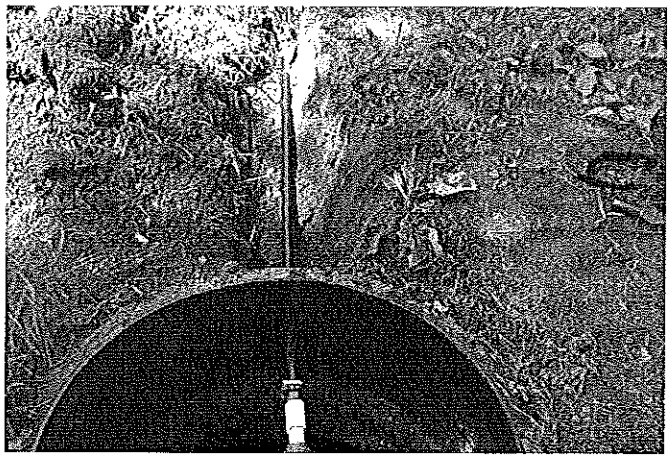
17. After positioning air pump, have an electrical contractor or qualified electrician, having obtained all necessary permits; connect the alarm panel and air pump according to the National Electrical Code, any applicable local codes, and in compliance with wiring diagram provided by Control / Alarm panel manufacturer. Do not turn on electricity at this point.

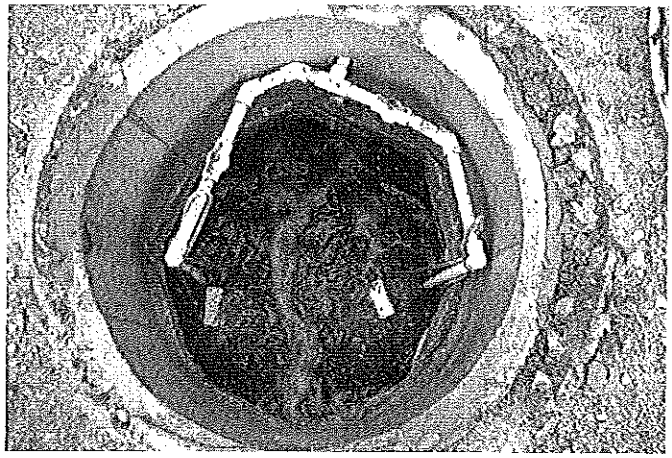




IMPORTANT NOTE: ALL EXTERIOR ELECTRICAL CONNECTIONS MUST BE INSTALLED AND PROTECTED BY NEMA LISTED EXTERIOR WEATHER TIGHT CONDUIT AND FITTINGS.

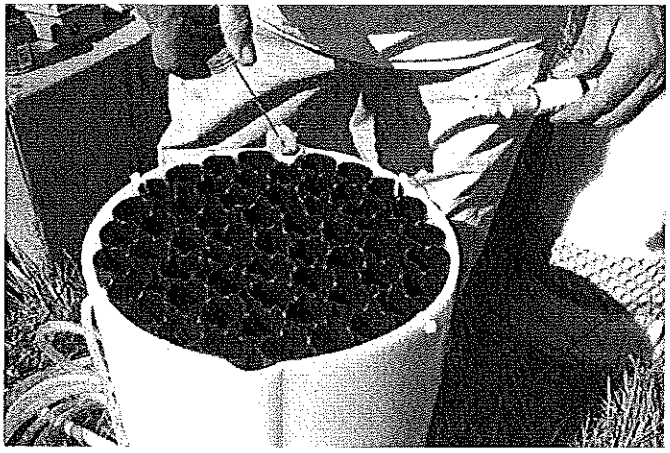
18. Run the airline into the riser. On installations where two White Knight towers are used, a tee and valves are required to divide and balance the airflow between the towers. When using ¾" piping for the main air supply line make the transition at the tee to ½" ID piping with adjustment valves to feed each tower.

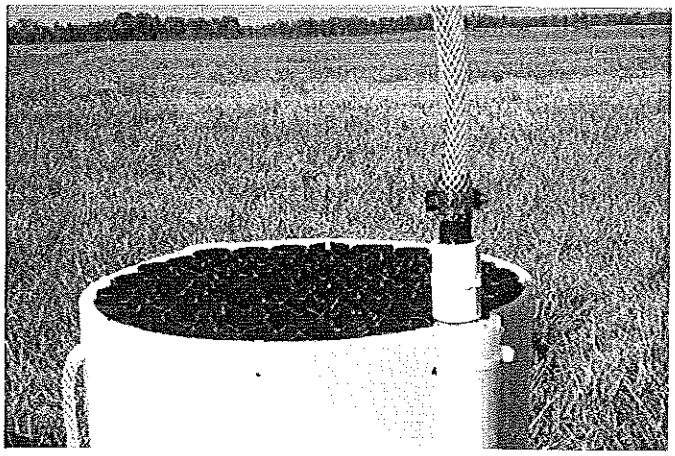




Piping and any manifolds should be configured so, that if necessary, the tower is capable of being removed without causing damage to the air supply line that enters the riser. Where an airline must cross vehicle traffic or parking areas such as a driveway the air supply line should be protected by placing it in a sleeve such as a 1" ID Schedule 80 PVC pipe installed a minimum of 12" below the surface of the traffic area.

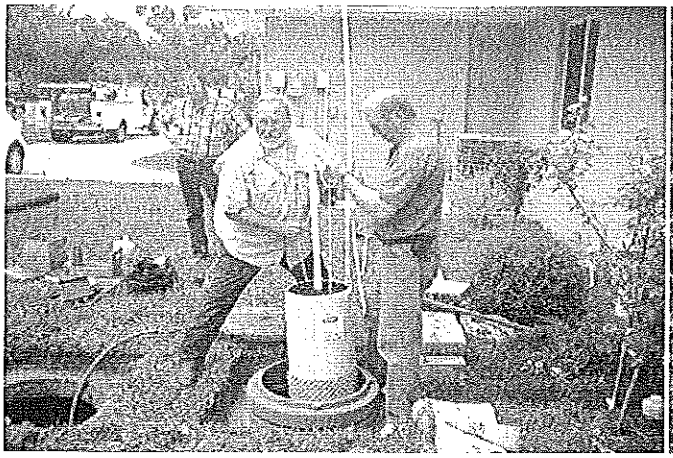
19. White Knight towers are manufactured to receive ½" ID Schedule 40 PVC pipe. A coupling is located at the top of the tower to one side for the air supply connection. PVC Solvent Weld Primer must be applied and PVC Solvent Weld Glue must be used. When gluing fittings together slowly twist the assembled components until a "set" can be felt.

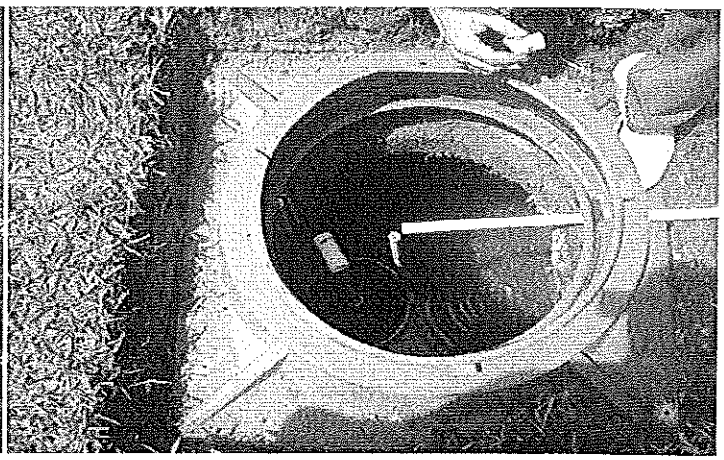




The use of flexible piping between the tower and air line entry point in the riser is acceptable and may facilitate the placement of multiple towers through a single access opening. Threaded connections must be airtight and the use of a liquid Teflon pipe joint compound should be used.

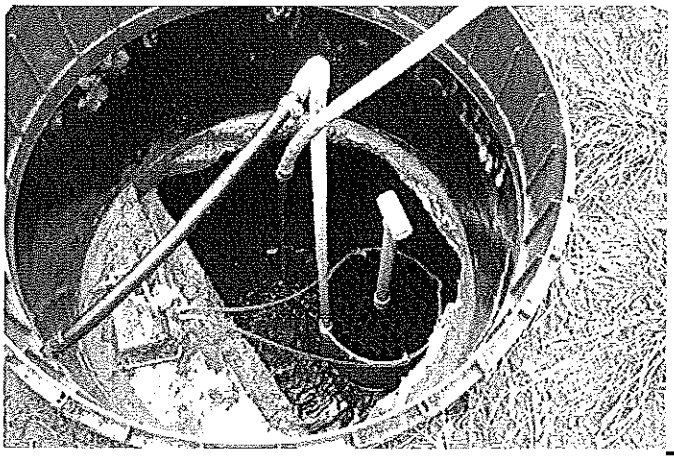
20. With a length of airline connected to the tower lower the tower into place. For deep installations in may be necessary to place an extension onto the supplied lifting rope. Make sure that the unit is resting level on the bottom if a pedestal is used, stable and centered as close as possible in the tank compartment in which it is being installed but accessible from the service riser. Connect the air supply lines and secure the lift out line.

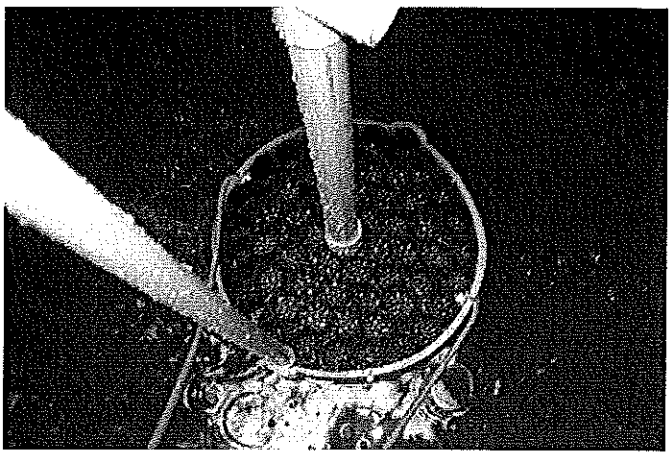




21. Activate the air pump and with the White Knight tower in place and refill the tank to normal operating level with clean water. Caution must be exercised for properties served by a well with regard to depleting the water supply. Always attain property owner permission to make use of their water supply. In situations where there is questionable well capacity water should be brought in to refill the tank.

DO NOT REFILL TANK WITH SEPTAGE FROM PUMPER TRUCK.

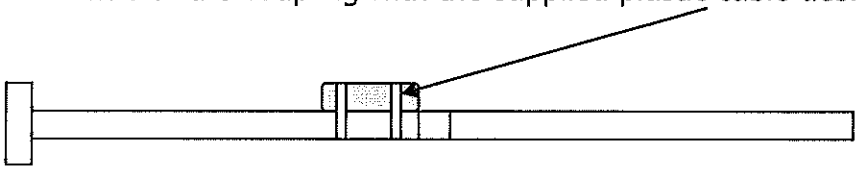




22. The IOS-500™ is placed into the system via a 1" PVC wand shipped with the unit that must be assembled.

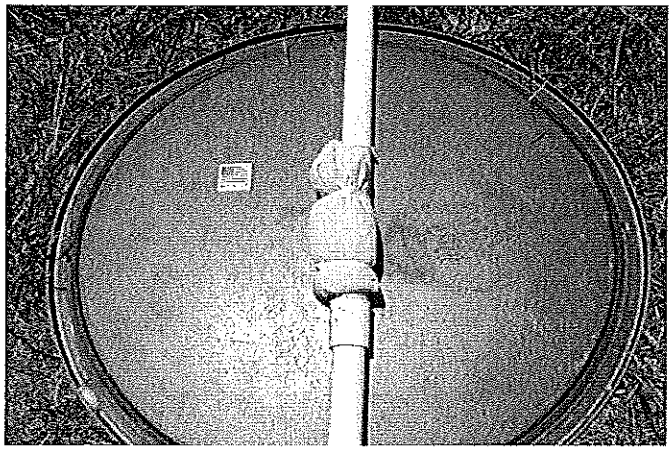
Wand Assembly

The wand is then inserted into the center of the tower's tubular media with the IOS-500™ inoculant packet affixed to the "Tee" side of the coupling with the supplied plastic cable ties.



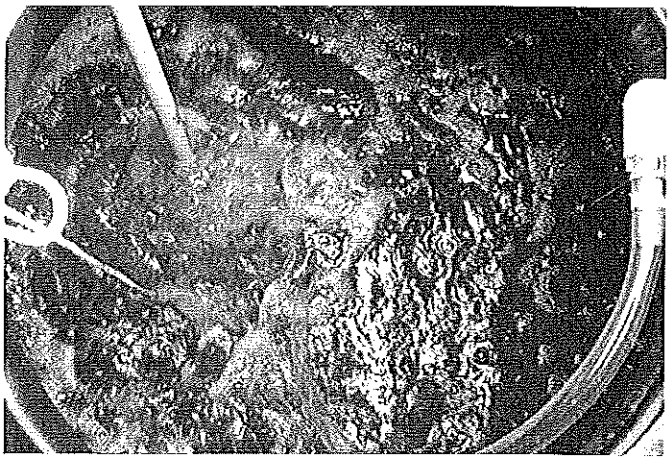
The coupling serves a dual purpose, as a stop to prevent the tapered end of the wand from coming into contact with the fine bubble diffuser located beneath and the method to attach the upper portion of the wand. The upper portion serves as the point of attachment for the IOS-500™ inoculating packet and is provided with a "Tee" fitting which facilitates wand placement, removal and allows for maximum circulation of the air lifted effluent throughout the tank. **The IOS-500™ inoculant must not be put into place until the system is active and the liquid level in the tank provides at least 2 ½" of cover over the top of the tower.**

23. Determine the amount of liquid that will cover the top of White Knight tower under normal operating conditions and adjust the inoculating wand so that the "Tee" of the wand protrudes 2" above the normal operating level of the wastewater.

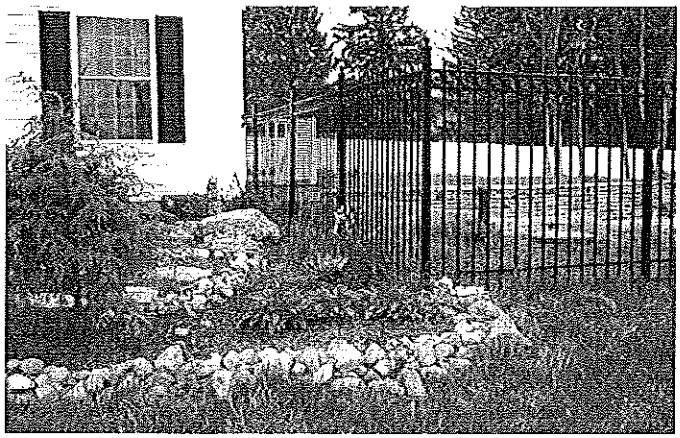


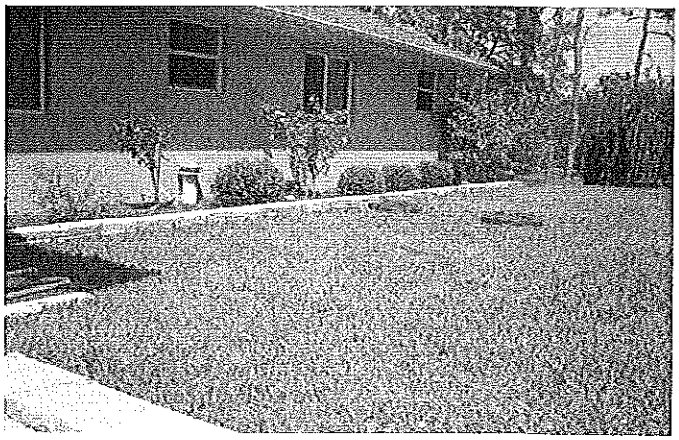
24. Fix the inoculant packet to the wand just above the coupling using the provided plastic cable ties. Trim tie ends and insert the wand into the center of the White Knight up flow until the coupling makes contact with the top of the tubular media.

25. The airlift action of White Knight should display a rolling robust circulation pattern at the surface of the liquid above the tower without noticeable glugs or gurgles. Visible bubbles should be very small in size and typically no larger than a small pea. An erratic flow pattern, larger size bubbles and unusual sounds are indicators that an air leak is present or something is caught in the tower's media column interfering with the upward flow pattern and must be corrected. Debris may be cleared by inserting a ½" diameter pole or ridged plastic tube, with sharp edges broken, down through the tubular media repeating the process several times until the blockage breaks free.

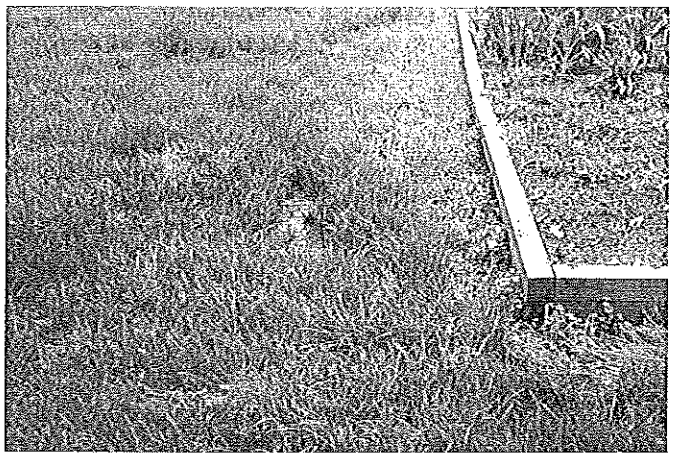


26. Secure all access covers and restore excavated areas. Complete the White Knight MIG™ Installation Registration Form provided with the unit returning it to Knight Treatment Systems in a prompt fashion.





27. Areas of the absorption system that had broken out and have untreated sewage exposed must be addressed. Apply lime to the affected area followed by a thin layer of topsoil, seed and mulch.



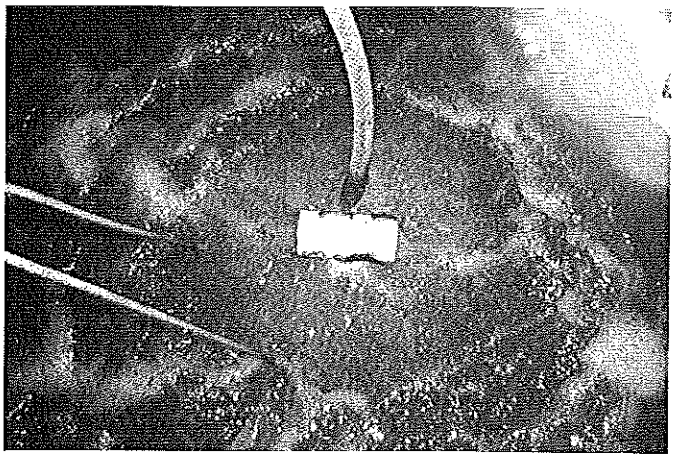
(V) Operation:

1) Following installation, operational guidelines and the requirement of routine periodic maintenance must be reviewed with the Owner / Operator of the system. A "White Knight Microbial Inoculator Generator™ Owners-Operators Manual" is supplied by the manufacturer to assist with this task.

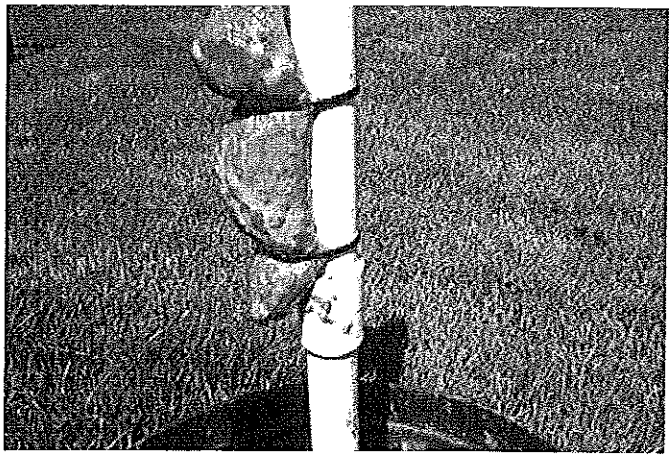
2) Each OWTS will develop its own unique operational personality over time based on operator input and change of usage patterns. Periodic adjustments may be required of the Owner-Operator as the operational personality evolves.

(VI) Service & Maintenance

1) Routine residential service is conducted every 6 months through a maintenance contract with a KTS authorized provider. Commercial / Institutional system requirements will vary and must be tailored for each specific application. However, approximately two weeks following the White Knight installation a follow up visit must be conducted by the installer and reinoculation performed. The second IOS-500™ inoculant packet that was shipped with the White Knight is used for this purpose.

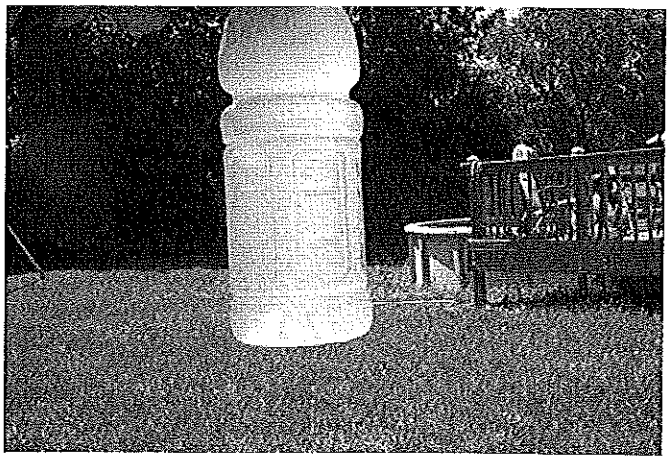


Knight Treatment Systems, Inc. will notify each system's registered service provider 30 days in advance of a normal service visit. Following installation, routine service must be conducted at the scheduled intervals with reinoculation occurring annually.



2) Upon removal of the wand the packet should exhibit brownish colored biofilm. This biofilm may also form on other system components. The bubble pattern should be robust and rolling, as it was when the unit was first activated.

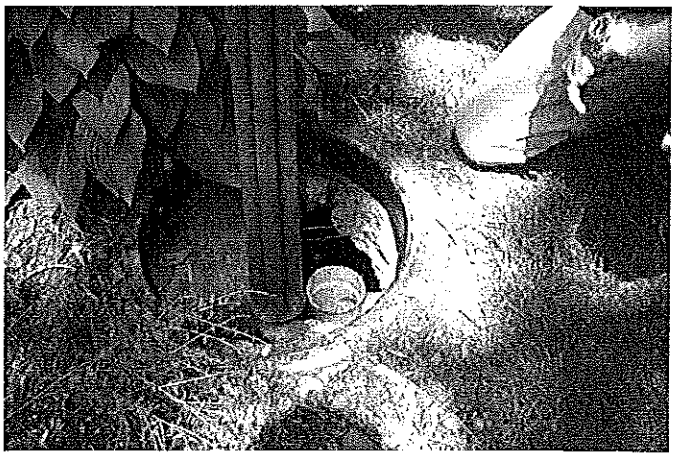
3) Wearing proper personal protection equipment, remove the old inoculant packet from the wand, open the packet and empty its contents back into the tank. Do not throw the used inoculant sack back into the tank. Place the sack and the removed zip ties into empty the plastic bag that the replacement packet came in, carefully seal the bag and place this into another suitable container and dispose of with household trash. Affix new inoculant packet to the wand and reinsert the wand into the White Knight tower.



4) Effluent removed from the flow stream of the White Knight and placed into a clear container should be translucent and light in color with an appearance similar to that of "Lemon Aid" with no offensive odor.

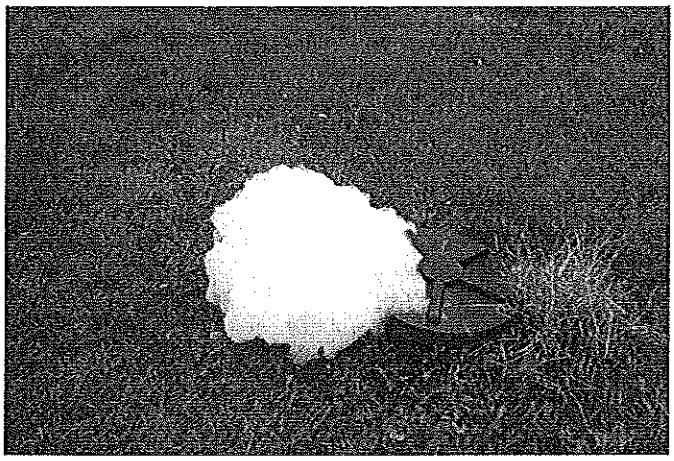
5) As part of each service visit a ½" diameter pole or ridged plastic tube with sharp edges removed should be inserted down through the media column of the tower and the diffuser membrane gently bumped several times while in operation. Biofilm sometimes form on the membrane, which could reduce fine bubble production if allowed to build up. "Bumping" the diffuser breaks free any biofilm.

6) The effluent filter must also be checked. It should appear relatively free of undigested organic materials and will typically have light brownish biofilm on it. Inorganic materials should be removed and disposed of properly. Do not remove the beneficial biofilm.



7) Should extraordinary amounts of foaming be encountered it is typically caused by the over use of detergents or the use of high sudsing formulations. Spraying the foam with water from a garden hose will knock down the suds so that the system can be maintained.

8) Infrequent foaming events will not have a major impact on the overall performance of the White Knight but can cause nuisance concerns and trouble calls should the foaming become visible. The user must be made aware of the situation and corrective actions implemented.



9) The air pump's air filter must be removed and cleaned annually unless unusual dust conditions exist. The foam filter is easily cleaned by washing in a mild soap and water solution, rinsed and allowed to dry. Cleaning and rinse water should be disposed of at the inlet side of the tank.

(VII) Forms

White Knight MIG™ Site Evaluation Form

Owner / Operator Interview:

Property usage

Single Family Residential____

Multi Family Residential____

Commercial/Institutional_____ Type of enterprise_____

How long has property been occupied? ____ years

Bedrooms ____ # Tubs/Showers ____ Hot tub, spa, whirlpool bath? **Y** **N**

Garbage Disposal Unit? **Y** **N**

Food Service? **Y** **N** Number of Meals Per Day____

Commercial Dish Washer? **Y** **N**

Grease Trap / Interceptor? **Y** **N** Size_____

Water Supply? **Well** **Municipal**

Water Meter? **Y** **N** If yes average daily flow_____

If well, does a water purification/softener backwash discharge into septic system? **Y** **N**

Does the property have a sump pump? **Y** **N** Discharge into septic system? **Y** **N**

Laundry discharge into septic system? **Y** **N** Laundry detergent? **Liquid** **Powder**

Describe Laundry & Cleaning Habits (products used and how often):

_____

_____

_____

Has property usage expanded since installation of original septic system **Y** **N**

Has usage of property changed since installation of original septic system? **Y** **N**

If yes, describe changes. _____

Trouble Symptoms

Drain back-up ___ Visible effluent ____ Evidence of Previous Breakout _____

Lush vegetation ____ High tank level ____ Liquid Level in Tank Above Outlet Invert _____

Odor ____ Frequent Pumping ___ Other _____

Septic System

Type of System _____
(Cesspool, tank and leach field, other)

Age of system _____ Plan available **Y N** Date last pumped _____
Attach copy of record of pumping, if available

Septic tank size _____ Tank Material **Concrete** **Plastic** **Metal**

Pump chamber **Y N** Distribution box **Y N Unkown**

Leachfield type & size

Pipe/stone___ Plastic Chambers___ Concrete Chambers___ Seepage Pit___

Other (specify) _____

Prior attempts to fix system **Y N** If yes, what and when _____

_____

_____

_____

Permit numbers for prior repair work performed _____

Site Investigation:

Time and Date ofSite Visit: _____

Septic tank size _____ Tank Material _____

Tank Condition (observed following pumping) _____

Inlet Access **Y N** Center Access **Y N** Discharge Access **Y N**

Date of Pump Out & Name of Pumper _____

Depth of tank from inside bottom to outlet invert _____ Depth of soil cover over tank _____

Baffle condition _____ Discharge effluent level _____" above outlet invert

Septic Tank Discharge pipe description_____

Grease Interceptor Size _____ Tank Material _____

Tank Condition (observed following pumping) _____

Inlet Access **Y** **N** Center Access **Y** **N** Discharge Access **Y** **N**

Date of Pump Out & Name of Pumper _____

Depth of tank from inside bottom to outlet invert _____ Depth of soil cover over tank _____

Baffle condition _____ Discharge effluent level _____" above outlet invert

Grease Interceptor Discharge pipe description_____

Ponded Effluent level in leach field/trenches _____

Biological clogging confirmed **Y** **N**
(If yes, attach photo)

Soil Type & Description _____
(Attach photo)

Observed Depth to Ground Water _____ Storm Water / Snow Melt Infiltration? **Y** **N**

Apparent structural damage or other unusual findings_____
(Attach photo)

_____

Provide sketch of system layout and cross section of absorption system below. Please indicate all breakout points, boundaries and depth of ponded effluent within system.

Installation Requirements:

Length of airline run _____ft Length of electrical run _____ft

Jet Lines: **Y** **N** RIDEM Approved Effluent Filter (circle one): **In Place / Must be Installed**

Tank(s) requires service riser(s) & covers? **Y** **N**

Tank(s) require replacement? **Y** **N**

Additional tanks required? **Y** **N**

Depth of tank top from finished grade _____in. Need _____in. of riser

Distribution Box requires service riser & cover? **Y** **N Box** is: Concrete___ Plastic____ Size ____

Depth of D-Box top from finished grade _____in. Need _____in. of riser

Distribution line or other modifications needed:

_____

_____

Does System qualify for White Knight? **Y** **N**

Additional Repair Permits Required**?** **Y** **N**

Additional Comments:

Evaluation Performed By: _____

White Knight Microbial Inoculator/Generator™

Service Visit Record

Owner Name_____ **Unit Serial Number** _____

Date Visited _____ **Field Technician** _____

Purpose of Visit ____ Routine Maintenance ___Customer Concern ___ 2 Week Spot Check

Tank

Liquid appearance: ___Translucent ___Clear ___Other (specify)_____

Liquid odor: ___ None __ Perfumed ___ Noxious ___ Other (specify)_____

Bubble Pattern: ___Normal ___Abnormal (describe) _____

Unusual observations: _____

Effluent Filter: ___ In Place

___ Housing to outlet pipe secure

___ Cleaned ___ Hair / Lint buildup

Notes: _____

White Knight: ___ Biological Growth Visible _____ Color

___ Ample flow through unit ___ Unit Clogged with _____

___ Inoculant replaced ___ Unit removed & cleaned

Notes: _____

_____

_____

Air Supply & Control Panel

Location: Outdoor ____ Indoor ____ Hour Meter Reading _____

___ Pump Operating Properly ___ Air Filter Clean ___ Alarm Operating Properly

Notes: _____

Soil Absorption System

Weather: Precipitation previous 48 hrs _____ Time of inspection _____

Surface Condition: ____ Dry & Firm ____ Soft & Spongy

____ Saturated _____ Breakout / Location(s) _____

Distribution Box accessibility via Riser to grade: ____ Yes _____ No

If yes ____ inches static water above outlet inverts.

Notes: _____

_____

_____

Repairs or Modifications Performed:

_____

_____

_____

Additional Comments:

_____

_____

_____

_____

_____ Service Visit Report Left With Property Owner

Technician's Signature _____

"Guardians of Water Quality"™

281 Co. Rt. 51A, Oswego, NY. 13126
1-800-560-2454 / 315-343-2454 / Fax 315-343-6114
website: www.knighttreatmentsystems.com

White Knight™ Specification Data

Unit Description

The *White Knight Microbial Inoculator/Generator*™ is commonly utilized for the bioremediation of soil based onsite wastewater treatment systems and may also be used to enhance the treatment capabilities of others. The unit is compact in size and easily fits into either new or sound existing tankage.

Model Numbers and Typical Applications

WK-40 Residential applications
WK-78 Large residences and small commercial applications
WK-1xx Larger, custom designed, or municipal applications

Treatment Unit Specifications

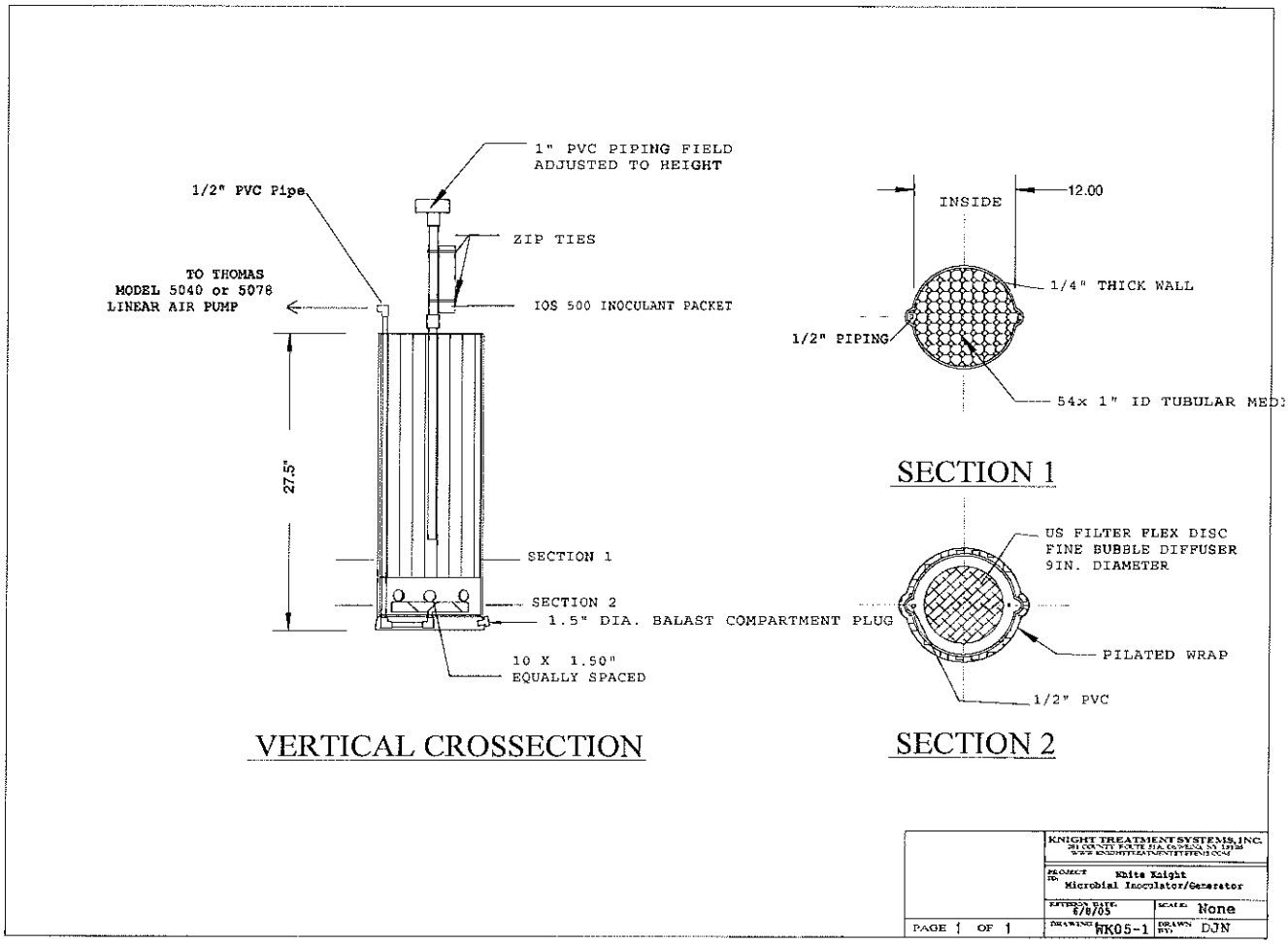
Model #	Maximum recommended BOD loading (lbs/day)	Minimum Tank Size (gallons)	# of Media Towers	Size of Media Tower (dia" x height")	Minimum Air Pipe size	Recommended maximum number of bedrooms	Approx Diffuser Air Flow (CFM)
WK-40	4	500	1	16" x 27.5"	½"	5	1
WK-78	6	1000	2	16" x 27.5"	¾"	8	2
WK-1xx	varies	1000	varies	16" x 44"	¾"	varies	Varies

Air Supply Specifications

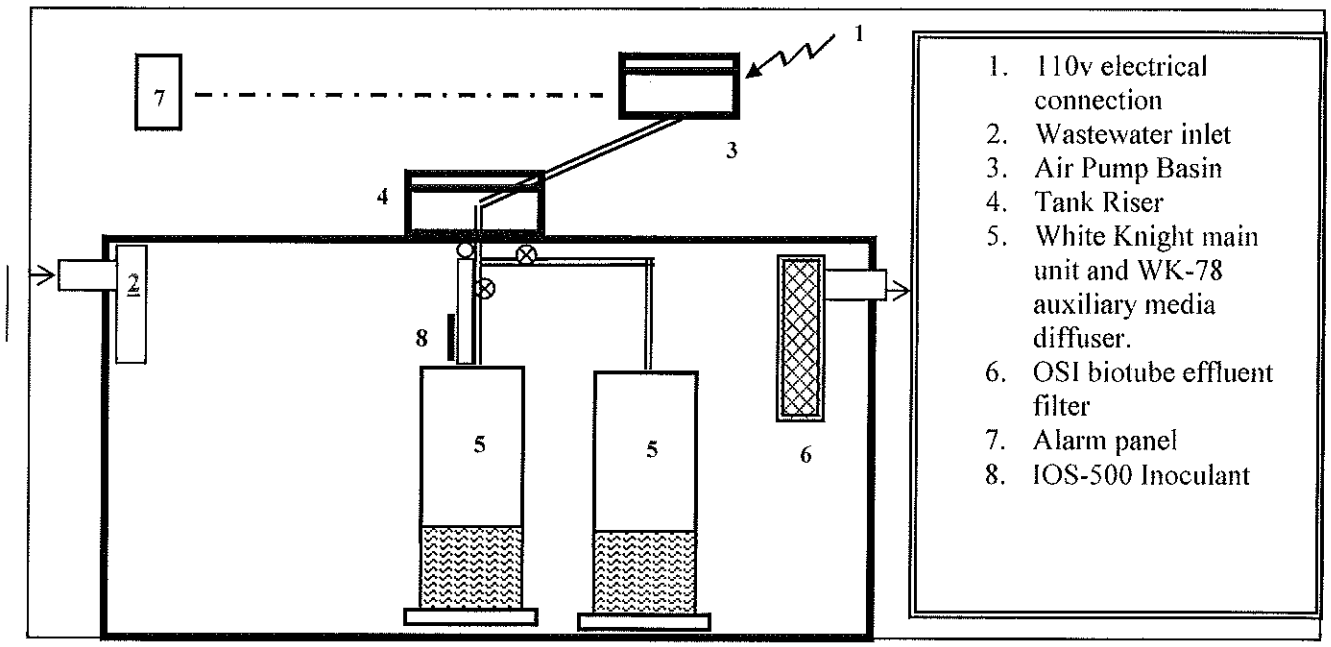
Model #	Pump Model #	Output @ 2 psi (CFM)	Watts	Amps	Volts	Pump Dimensions	Basin Dimensions
WK-40	Thomas 5040A	1.58	38	0.9	115	6.83" x 8.09" x 7.79"	13" H x 24" L x 16" W
WK-78	Thomas 5078S	3.2	92	2.1	115	8.94" x 7.05" x 8.59"	13" H x 24" L x 16" W
WK-1xx	Call for specifications						

Controller Specifications

Model #	Voltage	Amps Max	Failure sensing	Alarm Type	Overload protection (amps)	Switching
WK-40	115	8	Pressure drop +/or float	Visual and Audible	8	Normal/ Silence only
WK-78	115	8	Pressure drop +/or float	Visual and Audible	8	Normal/ Silence only
WK-1xx	115	Varies	Pressure drop +/or float	Visual and Audible	varies	Normal/ Silence only



Typical WK-78 Installation



Jeb Bush
Governor

FLORIDA DEPARTMENT OF HEALTH

John O. Agwunobi, M.D., M.B.A., M.P.H.
Secretary

August 24, 2005

Douglas J. Nelson, P.E.
Vice President, Science and Engineering
Knight Treatment Systems
281 Co. Rt 51A
Oswego, NY 13126

Re: White Knight™ Microbial Inoculator Generator

Dear Mr. Nelson:

This letter is in response to your August 22, 2005 letter requesting clarification of the status of the White Knight™ Microbial Inoculator Generator in Florida. The county health departments were advised by email dated November 15, 2002 that the department had no objection to the use of this product to inject the IOS-500 additive in accordance with manufacturer's recommendations. Installations must be in accordance with 64E-6 provisions for electrical wiring and tanks. This injection system, in combination with the IOS-500 product, may be used as an alternative repair method as set forth in s. 64E-6.015(3), F.A.C.

Be advised that the department is not a testing agency and that this determination reflects only a review of the information submitted by you for compliance with Florida Statutes and Florida Administrative Code. Our product evaluation does not investigate the validity of performance claims by manufacturers. For this reason, departmental acceptance must not be interpreted as certifying effectiveness, endorsing or recommending use of an additive. There shall be no advertising of the White Knight™ Microbial Inoculator Generator as state approved. The Florida Department of Health also does not assume liability for any promise, guarantee or expectation from purchasing or using the product. The department reserves the right to withdraw acceptance if product formulation, injection method or ingredients are modified after product evaluation by the department or subsequently found not to be in compliance with rule.

This letter of compliance is limited to Department of Health jurisdictional circumstances as defined in Chapter 64E-6, Florida Administrative Code and Chapter 381.0065, Florida Statutes. If we may be of further assistance or should you have any additional questions regarding this letter, please call Mr. Paul Booher at (352) 922-2159.

Sincerely,

Gerald R. Briggs, Chief
Bureau of Onsite Sewage Programs

Jeb Bush
Governor

FLORIDA DEPARTMENT OF HEALTH

John O. Agwunobi, M.D., M.B.A.
Secretary

April 12, 2002

Mr. Robert W. Rawson
International Organic Solutions
P.O. Box 157
Sebastopol, CA 95473

Dear Mr. Rawson:

This letter is to acknowledge receipt of the information concerning the product "**IOS-500**" for statewide use in Florida. No product sold in the state for use in onsite sewage treatment and disposal systems may contain any substance in concentrations or amounts that would interfere with or prevent the successful operation of such system, or that would cause discharges from such systems to violate applicable water quality standards, section 381.0065(4)(m), Florida Statutes.

The staff has reviewed the information provided in the MSDS, 96-hr LC_{50} toxicity test results, and laboratory results on volatile organic compounds for the product. The department has determined that the product, **IOS-500**, to be in compliance with s. 381.0065(4)(m), F.S. and has no objection to the use of the product in accordance with manufacturer's specifications. Please be advised that all rules pertaining to the use of the products shall be observed and that there shall be no advertising of the products as state approved.

Be advised that the department is not a testing agency and that this determination reflects only a review of the information submitted by you for compliance with Florida Statutes and Florida Administrative Code. The product evaluation does not investigate the validity of performance claims by manufacturers. For this reason, departmental acceptance must not be interpreted as certifying effectiveness, endorsing or recommending use of an additive. The Florida Department of Health also does not assume liability for any promise, guarantee or expectation from purchasing or using an additive. The department reserves the right to withdraw acceptance if product formulation or ingredients are modified after product evaluation by the department or subsequently found not to be in compliance with rule.

This letter of product compliance is limited to Department of Health jurisdictional circumstances as defined in Chapter 64E-6, Florida Administrative Code and Chapter 381.0065, Florida Statutes.

If we may be of further assistance or should you have any additional questions regarding this letter, please call Dr. Sonia Cruz at (407) 317-7325.

Sincerely,

Gerald Briggs, Chief
Bureau of Onsite Sewage Programs

Division of Environmental Health, Bureau of Onsite Sewage Programs
4052 Bald Cypress Way, Bin #A08, Tallahassee, Florida 32399-1713

International Organic Solutions

Robert W. Rawson
P.O. Box 157, Sebastopol, CA. 95473
Phone (707) 824-1282 Page (707) 323-2263
iws@sonic.net

Ms. Sonia Cruz
Florida DHS
(407)- 317-7325

Dear Sonia,

You asked me to send two items:

1. A clean or more readable copy of the VOC test results.
2. The product application rate as it is stated on the label.

1. I have attached a file called VOC.BIF which is a bitware fax file containing 11 pages that can be opened to produce a semi-clean readable copy of the VOC test results. It would take a week to load any other file type this large. I will send you a hard copy of the report by mail for your permanent file. In a subsequent set of E mail messages I will send you four large but more readable TIF files containing the LC-50 results (LC50= 197.68 mg/L. Since these are large files they need to be sent individually and separately so they will load and send in a reasonable length of time.

2. IOS 500 is supplied in several forms. We sell IOS-500 in 25 pound sacks and in one half pound porous packets. The manufacturers recommended dose rate for a one thousand gallon septic tank is:
8 ounces = 0.5 pound = 227 grams = 0.06 grams per liter

The label states: ***The recommended and maximum dose rate for use in aquatic applications is 0.06 grams per liter.***

The Label states: ***The recommended and maximum dose rate for septic tank treatment is 8 ounces per thousand gallon septic or grease interceptor tank volume.***

Please send me your mailing address so I can send clean hard copy. I am also copying our correspondence to Mr. Marshal Faircloth at joseph.faircloth@dep.state.fl.us and to Jay Knight the New York Distributor.

If you have any questions please do not hesitate to call me. I appreciate the effort you have made to assist us in this application.

Sincerely Yours,
Bob Rawson

03/25/2002

STATE OF MAINE
DEPARTMENT OF HUMAN SERVICES
BUREAU OF HEALTH, DIVISION OF HEALTH ENGINEERING
161 CAPITOL STREET
11 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0011

JOHN ELIAS BALDACCI
GOVERNOR

JOHN R. B
COMMISSIONER

July 14, 2004

Knight Treatment Systems
Attn: Jay Knight, President
281 County Route 51A
Oswego, NY 13126

Subject: Revised Product Registration, Knight Treatment Systems ***White Knight***

Dear Mr. Knight:

Product Description

The Knight Treatment Systems ***White Knight*** consists of a 12 inch diameter plastic tube within which is a four inch diameter plastic tube. The space between the tubes is filled with loose spherical plastic media. A remote air pump feeds air to a proprietary diffuser beneath the cuspated plates. A biological film is generated, which adheres to the plastic media and provides treatment of the water-borne contaminants. An outlet filter prevents solids carryover. The Knight Treatment Systems ***White Knight*** is inserted into conventional septic tanks, and a proprietary innoculant is introduced at regular intervals.

Claim

According to the information in our files, the Knight Treatment Systems ***White Knight*** significantly reduces nitrate and BOD^5 levels; reduces suspended solids in the effluent; and rejuvenates biologically clogged disposal areas by application of low-nutrient, effluent with relatively high levels of dissolved oxygen. You have submitted additional data demonstrating that ponding in disposal areas is reduced, thereby restoring the absorptive capacity of the disposal area. Ref.: Letter dated 5/20/04 with enclosures. Although the combined BOD_5 and TSS exceed the reduction limits from Table 603.1 of the Subsurface Wastewater Disposal Rules, you have previously supplied data demonstrating that these levels represent aerobic microorganisms rather than untreated waste. On this basis you have requested a 50% design flow reduction for first time and replacement systems utilizing the Knight Treatment Systems ***White Knight***.

Determination

On the basis of the foregoing, the Division has determined that the Knight Treatment Systems ***White Knight*** is allowed a design flow reduction adjustment of 50%, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and Purchase/Installation Agreement.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of Knight Treatment Systems ***White Knight***. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar products.

This letter supersedes the letter dated July 7, 2004. If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@maine.gov

jaj
xc: Product File
Septic Preservation Services.

PHONE: (207) 287-5338
TTY: Deaf, Hard of Hearing (207) 287-5550

FAX: Admin./Plumbing/Eating & Lodging: (20
Drinking Water: (20

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

IAN A. BOWLES
Secretary

LAURIE BURT
Commissioner

REVISED OF APPROVAL FOR REMEDIAL USE
Pursuant to Title, 310 CMR 15.000

Name and Address of Applicant:
Knight Treatment Systems
281 County Route 51A
Oswego, NY 13126

Trade name of Technology: White Knight Inoculator/Generator Alternative Treatment System (hereinafter called the "System"). Schematic drawing of a typical System and Technology checklist are attached and are a part of this Approval.

Transmittal Number:	X229939
Date of Issuance:	October 19, 2004, August 16, 2007, modified March 6, 2008, modified April 4, 2008, modified September 5, 2008, Renewed November 19, 2009, Revised December 22, 2010.
Expiration date:	November 19, 2014

Authority for Issuance

Pursuant to Title 5 of the State Environmental Code, 310 CMR 15.000, the Department of Environmental, Protection hereby issues this Approval for Remedial Use to: Knight Treatment Systems, 281 County Route 51A, Oswego, NY 13126(hereinafter "the Company"), approving the System described herein for Remedial Use in the Commonwealth of Massachusetts. Sale and use of the System are conditioned on compliance by the Company and the System owner with the terms and conditions set forth below. Any noncompliance with the terms or conditions of this Approval constitutes a violation of 310 CMR 15.000.

David R Ferris

David Ferris, Director
Wastewater Management Program
Bureau of Resource Protection

December 22, 2010
Date

I. Purpose

1. The purpose of this approval is to allow use of the System in Massachusetts, on a Remedial Use basis to repair systems failing to protect public health and safety and the environment where failure has occurred as described in 310 CMR 15.303 (1) (a) (1) and (2) due to clogging of the soil absorption system (SAS).

2. The System may only be installed on facilities that meet the criteria of 310 CMR 15.284(2).

3. This Approval for Remedial Use authorizes the use of the System where the local approving authority finds that the System is for upgrade of a failed, failing or nonconforming system and the design flow for the facility is less than 2,000 gallons per day (GPD).

II. Design Standards

1. The System consists of a microbial inoculator/generator consisting of: a linear air pump operated on a continuous basis and capable of providing 1.5 to 2.5 cfm of air; a bacterial inoculant is placed into the system in a sealed geotextile bag; and a fine bubble diffuser. The unit is installed in an existing septic tank or a new sep tic tank designed in accordance with 310 CMR 15.223 through 15.228 with an effluent tee filter. The System converts the septic tank into a bioreactor to treat residential strength wastewater from facilities with a design flow of less than 2,000 GPD. The treated effluent is discharged to the existing soil absorption system.

2. A microbial culture is established in the septic tank and maintained using the aeration device and the bacterial source. The aerator mixes the contents of the septic tank with the bacteria and aerates the liquid. The System's biomass reduces both the biochemical oxygen demand (BOD_5) and the total suspended solids (TSS) concentration in the effluent from the septic tank. The effluent from the septic tank contains dissolved oxygen and System bacteria that discharge to the SAS and act to reduce the thickness of the biomat improving the soil absorption capacity.

3. Prior to installation of the System, the site and existing system shall be evaluated in accordance with 310 CMR 15.100 through 15.107. The existing on-site system including the septic tank, distribution box and SAS shall be inspected in accordance with 310 CMR 15.302. The evaluation shall include identification of existing components, their compliance with 310 CMR 15.000, cause of failure, and the location for the upgrade of the system if required in the future.

4. A System shall not be proposed for installation where:

   A. The high groundwater elevation determined in accordance with 310 CMR 15.103 would be less than two feet in soils with recorded percolation rate more

than two minutes per inch or less than three feet in soils with a recorded percolation rate of two minutes per inch or less below the bottom of the SAS.

B. A facility for which the site investigation indicates that the existing onsite system was designed and installed for a design flow smaller than required by 310 CMR 15.203. The minimum area for the existing SAS shall not be less than 50 percent of the area required in accordance with 310 CMR 15.242.

C. The existing septic tank(s) has not been tested and shown to be watertight.

D. The existing system includes a leaching pit or cesspool.

E. A site investigation indicates that the existing soil absorption system must be removed and replaced prior to installation of the System.

5. For seasonal use, the System shall be reactivated by the addition of a fresh culture of bacteria at each start up and ensure System is operating properly.

6. System installation shall not include modifications, excavations, or any other changes to the existing SAS, with the exception of the work required in section III (7).

III. General Conditions

1. All provisions of 310 CMR 15.000 are applicable to the use of this System, the System owner and the Company, except those that specifically have been varied by the terms of this Approval.

2. Any required sample analysis shall be conducted by an independent U.S. EPA or DEP approved testing laboratory, or a DEP approved independent university laboratory. It shall be a violation of this Approval to falsify any data collected pursuant to an approved testing plan, to omit any required data or to fail to submit any report required by such plan.

3. The facility served by the System and the System itself shall be open to inspection and sampling by the Department and the local approving authority at all reasonable times.

4. In accordance with applicable law, the Department and the local approving authority may require the owner of the System to cease operation of the system and/or to take any other action as it deems necessary to protect public health, safety, welfare and the environment.

5. The Department has not determined that the performance of the System will provide a level of protection to public health and safety and the environment that is at least equivalent to that of a sewer system. No System shall be installed, upgraded or

expanded, if it is feasible to connect the facility to a sanitary sewer, unless as allowed by 310 CMR 15.004. When a sanitary sewer connection becomes feasible, the facility served by the System shall be connected to the sewer, within 60 days of such feasibility, and the System shall be abandoned in compliance with 310 CMR 15.354, unless a later time is allowed, in writing, by the approving authority.

6. Design, installation and operation shall be in strict conformance with the Company's DEP approved plans and specifications, 310 CMR 15.000 and this Approval.

7. A minimum of one (1) inspection port shall be provided within the SAS down to the lower stone/soil interface to enable monitoring for ponding. Existing inspection ports may be acceptable for use if found to be at appropriate depth and in good condition.

IV. Conditions Applicable to the System Owner

1. The System is approved for use with sanitary sewage only. Any wastes that are non-sanitary sewage generated or used at the facility served by the System shall not be introduced into the System and shall be lawfully disposed.

2. Operation and Maintenance Agreement:

   A. Throughout its life, the System owner shall operate and maintain the System in accordance with the Company and designer's operation and maintenance requirements and this Approval. To ensure proper operation and maintenance (O&M), the System owner shall enter into an O&M agreement. No O&M agreement shall be for less than one year.

   B. No System shall be used until an O&M agreement is submitted to the approving authority which:

      i. Provides for the contracting with the Company or its approved management company, trained by the Company as provided in Section V (7), to operate the System consistent with the System's specifications and the operation and maintenance requirements specified by the designer and any specified by the Department;

      ii. Contains procedures for notification to the Department and the local board of health within five days of a System failure or alarm event and for corrective measures to be taken immediately;

      iii. Provides the name of an O&M provider, which must be an approved Title 5 System Inspector trained by the Company that will operate and monitor the System. The O&M provider must inspect and maintain installed Systems at single family homes at least quarterly and anytime there is an alarm event; and

iv. For all other Systems the O&M provider must inspect and maintain the System at least every month and anytime there is an alarm event.

3. The System owner shall at all times have the System properly operated and maintained in accordance with this Approval, the designer's operation and maintenance requirements and the Company's approved operating procedures. The System owner shall notify the Department and the local approving authority in writing within seven days of any cancellation, expiration or other change in the terms and/or conditions of their O&M agreement.

4. Prior to transferring any or all interest in the property served by the System, or any portion of the property, including any possessory interest, the System owner shall provide written notice of all conditions contained in this Approval to the transferee(s). Any and all instruments of transfer and any leases or rental agreements shall include as an exhibit attached thereto and made a part thereof a copy of this Approval for the System. The System owner shall send a copy of such written notification(s) to the local approving authority within 10 days of such notice being given.

5. Monitoring Requirements:

A. For system's approved and installed prior to the date of this revised Approval and has an observation port or monitoring well within the SAS, then it shall monitor according to Section IV(5) (B) this Approval.

For system's approved and installed prior to the date of this revised Approval and do not has an observation port or monitoring well within the SAS, but has the monitoring device in the D-box, then shall continue monitoring as the following:

i. The System's monitoring device shall be maintained such that it provides data collection to include tracking the elevation of the ponding within the d-box. The data shall continue to be stored and reported with the high, low and average ponding levels on quarterly for single family homes and monthly for all other system installations;

ii. If the ponding in the d-box has been eliminated, monitoring may be reduced from monthly to quarterly; quarterly to every six months. Further reduction in monitoring is not allowed;

iii. If the System exhibit excessive ponding levels (ponding levels within the d-box equal to or greater than the ponding prior to installation of the System) then monitoring shall be continue monthly, if at that time the ponding in the d-box has been eliminated, monitoring may be reduced from monthly to quarterly; quarterly to every six months; and

iv. If the System is still excessive ponding (ponding within the d-box) for 6 consecutive months, that System shall be removed in accordance with Section V (8).

B. Systems approved and installed after the revised date of this Approval shall monitored quarterly for single family homes and monthly for all other system installations.

The system shall monitor the depth of the ponding below the leaching field after three months of System operation to indicates the dose storage (dose storage is the void space from the discharge pipes invert to the bottom of stone/naturally occurring soil interface.).

i. If the depth of the ponding indicates at least 50% of dose storage available then monitoring may be reduced from monthly to quarterly; quarterly to every six months. Further reduction in monitoring is not allowed;

ii. If the depth of the ponding indicates less than 50% of dose storage then repeat the monitoring 30 days later. If the second reading is at least 50% of dose storage then the previous observation port measurement reduced frequency may be continued. However if the second reading is not at least 50% of dose storage then the system must be monitor monthly, evaluated and a report provided to the local approving authority. The report shall include water use data as well as depth of ponding; and

iii. If the System continues to indicate excessive ponding for 6 consecutive months as defined above, the System is in failure and shall be removed in accordance with Section V (8).

Example for monitoring the depth of ponding: For a leaching field has 12 inches depth from the discharge pipes invert to the bottom of stone/ naturally occurring soil interface. If monitoring shows ponding level is more than 6 inches then 50% of dose storage is not met. If monitoring shows the ponding level is less than 6 inches then 50% of dose storage is met.

6. By February 15th of each year for the previous year, the System owner shall submit to the approving authority all data collected in accordance with item 5, above, and an O&M technology checklist, completed by the System O&M provider for each inspection performed during the previous calendar year. A copy of the technology checklist is attached to this Approval.

7. Prior to the issuance of a Certificate of Compliance for the System, the System owner shall record and/or register in the appropriate Registry of Deeds and/or Land Registration Office, a Notice disclosing the existence of the alternative system subject to this Approval on the property. If the property subject to the

Notice is unregistered land, the Notice shall be marginally referenced on the owner's deed to the property. Within 30 days of recording and/or registering the Notice, the System owner shall submit the following to the local approving authority: (i) a certified Registry copy of the Notice bearing the book and page/instrument number and/or document number; and (ii) if the property is unregistered land, a Registry copy of the owner's deed to the property, bearing the marginal reference.

V. Conditions Applicable to the Company

1. The Company shall develop and submit to the Department within 60 days of the revised date of this Approval: minimum site evaluation criteria and installation requirements; an operating manual, including information on substances that should not be discharged to the System; a technology checklist; and a recommended schedule for maintenance and replacement of components essential to consistent successful performance of the installed Systems. The Company shall develop and submit to the Department within 60 days of the revised date of this Approval a standard protocol for evaluating ponding within the SAS. System success is defined as ponding elevation consistently maintained at or below the naturally occurring soils elevation (below the designed discharge storage volume) within the SAS. The Company shall also submit to the local approving authority within 60 days of the revised date of this Approval a protocol for completing inspections and monitoring of the System and any procedures that will be implemented should the System fail. The Company shall make available, in print and electronic format, the above referenced procedures and protocols to owners, O&M providers, designers and installers of the System.

2. The Company shall develop and submit within 30 days of the revised date of this approval to the Department a plan for ensuring the submission of inspection reports by the O&M provider to the Company and local approving authority.

3. By February 15th of each year, the Company shall submit a report to the Department, signed by a corporate officer, general partner or Company owner that contains information on the System, for the previous calendar year. The report shall include the following information:

   A. The total number of units of the System sold for use in Massachusetts during the previous year; the address of each installed System, the owner's name and address, the type of use (e.g. residential, commercial, institutional) and the design flow;

   B. Date when system was installed and started up;

   C. Tabulation of the sampling parameters and results with backup inspection and laboratory sheets;

D. Tabulation of systems that are in failure as described in 310 CMR 15.303 (1)(a)(1) or (2) due to excessive ponding of effluent in the SAS, reasons for non-compliance and any corrective action taken including but not limited to design, installation and/or operation or maintenance changes required to reach compliance;

E. Completed technology inspection checklists shall be maintained by the Company or its representative on file for possible Department auditing;

F. A general summary of the results for the year, any recommended changes to the design, installation and/or operation and maintenance procedures and a schedule for implementing those changes; and

G. Warranty issues both resolved and unresolved or an explanation of any warranty claims that have been received and their resolution.

4. The Company or its designee shall review the plans and site evaluation conducted for the System prior to the sale of any unit to ensure that the proposed installation of the System is at a site consistent with this Approval and the System's capabilities. The Company shall certify in writing that the System plan and existing site conditions conform to the requirements of this Approval and any requirements of the Company and shall submit a copy of that certification to the local approving authority and the System owner.

5. Prior to the issuance of a Certificate of Compliance for the System, the Company or its designee shall submit to the local approving authority and the System owner a signed certification that the System has been installed in accordance with the Company's requirements, the approved plan and this Approval. This certification in no way changes the requirements of 310 CMR 15.021(3).

6. The Company or the Company's approved operation and maintenance contractor shall maintain a contract with the System owner that:

A. Provides for operating and maintaining the System with an O&M provider that has been trained by the Company to operate the System consistent with the System's specifications and any additional operation and maintenance requirements specified by the designer or by the Department;

B. Contains procedures for notification to the System owner, the Department and the local approving authority within five days of knowledge of a System failure and for corrective measures to be taken immediately;

C. Contains procedures for inspecting the plastic media bacterial source at each quarterly visit and if necessary replacing the media. At a minimum, the microbial inoculants shall be replaced annually; and

D. Contains a plan to determine if required after the first three months of operation why the effluent water surface elevations in the SAS are as high or higher than the water surface elevation when the System was installed.

7. The Company shall institute and maintain a program of O&M provider training and continuing education, as approved by the Department. The Company shall maintain and annually update, and make the list of qualified O&M providers available by February 15th of each year. The company shall update the list of qualified O&M providers and make the list known to users of the technology.

8. The Company shall provide to each System owner a written warranty transferable to a new owner that includes the following:

   A. Refund of the cost of equipment and installation should the System continue in failure as described in 310 CMR 15.303(1)(a)(1) and (2) after 120 days of operation that is conducted in accordance with the Company's specifications and oversight; or

   B. Refund of the cost of equipment and installation should the System fail as described in section IV(5) within two years of installation provided that the System owner has entered into and maintained an operation and maintenance contract with the Company and has operated the System in accordance with the Company's specifications.

9. The Company shall conduct a performance evaluation starting after the first 100 systems have been installed and operating for at least one year. A report shall be submitted to the Department no more than 180 days beyond the one year period evaluating whether at least 90 percent of the units installed for at least one year have demonstrated a reduction in depth and that the reduction in depth of the effluent elevation for the SAS systems has occurred within 120 days of start up or that ponding elevations are not excessive. Should the System not demonstrate the capability to reduce or eliminate ponding in 90 percent of the failed systems, the report shall detail the changes that must be made in site evaluation, design, installation and/or operation or maintenance to meet the goal and shall include a schedule containing a deadline for implementing those changes. No more than 100 systems shall be installed until the performance report has been completed and the results indicate that over 90 percent of the Systems are no longer in failure.

10. The Company shall include copies of this Approval and the procedures and protocol described in Section V (1) with each System that is sold. In any contract executed by the Company for distribution or re-sale of the System, the Company shall require the distributor or re-seller to provide each purchaser of the System with copies of this Approval and the procedures and protocol described in Section V (1).

11. The Company shall notify the Director of the Wastewater Management Program at least 30 days in advance of the proposed transfer of ownership of the technology for which this Approval issued. Said notification shall include the name and address of the proposed new owner and a written agreement between the existing and proposed new owner containing a specific date for transfer of ownership, responsibility, coverage and liability between them. All provisions of this Approval applicable to the Company shall be applicable to successors and assigns of the Company, unless the Department determines otherwise.

12. The Company shall furnish the Department any information that the Department requests regarding the System within 21 days of the receipt of that request.

13. If the Company wishes to continue this revised Approval after its expiration date, the Company shall apply for and obtain a renewal of this Approval. The Company shall submit a renewal application at least 180 days before the expiration date of this Approval, unless written permission for a later date has been granted in writing by the Department. This approval shall continue in force until the Department has acted on the renewal application.

14. Systems approved and installed after the revised date of this Approval, thirty (30) days prior to submitting an application for a Disposal System Construction Permit (DSCP), the Company or its representative shall provide to the Approving Authority a certification, signed by the owner of record for the property to be served by the unit, stating that the property owner:

    A. has been provided a copy of the Remedial Use Approval and all attachments and agrees to comply with all terms and conditions;

    B. has been informed of all the owner's costs associated with the operation including power consumption, maintenance, sampling, recordkeeping, reporting, and equipment replacement;

    C. understands the requirement for a contract with a company approved O&M provider and has been provided a current list of all approved O&M providers;

    D. agrees to fulfill his responsibilities to provide a Deed Notice as required by 310 CMR 15.287(10) and the Approval; and

    E. agrees to fulfill his responsibilities to provide written notification of the Approval conditions to any new owner, as required by 310 CMR 15.287(5).

VI. Reporting

1. All notices and documents required to be submitted to the Department by this Approval shall be submitted to:

Director

Wastewater Management Program
Department of Environmental Protection
One Winter Street - 5th floor
Boston, Massachusetts 02108

VII. Rights of the Department

1. The Department may suspend, modify or revoke this Approval for cause, including, but not limited to, non-compliance with the terms of this Approval, inadequate system performance demonstrated by the annual report required in Section VI (2) or other relevant information, non-payment of the annual compliance assurance fee, for obtaining the Approval by misrepresentation or failure to disclose fully all relevant facts or any change in or discovery of conditions that would constitute grounds for discontinuance of the Approval, or as necessary for the protection of public health, safety, welfare or the environment, and as authorized by applicable law. The Department reserves its rights to take any enforcement action authorized by law with respect to this Approval and/or the System against the owner, or O&M provider of the System and/or the Company.

VIII. Expiration Date

1. Notwithstanding the expiration date of this Approval, any System sold and installed prior to the expiration date of this Approval, and approved, installed and maintained in compliance with this Approval (as it may be modified) and 310 CMR 15.000, may remain in use unless the Department, the local approving authority, or a court requires the System to be modified or removed, or requires discharges to the System to cease.

State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES
6 Hazen Drive, P.O. Box 95, Concord, NH 03302-0095
(603) 271-3644 FAX (603) 271-2181

March 31, 2003

Mr. Douglas Nelson, PE
White Knight Treatment Systems
281 County Rte 51A
Oswego, NY 13126

Re: White Knight Wastewater Treatment Device

Dear Mr. Nelson:

The NH Department of Environmental Services (department) has reviewed the material you submitted requesting approval of the White Knight wastewater treatment device.

To summarize, the White Knight is a device that is inserted into a septic tank. Air is bubbled into the device, which also contains an inoculant of a proprietary mixture of bacteria chosen to degrade the contaminants in ordinary wastewater very quickly. The air bubbling process leads to circulation of dissolved oxygen and the proprietary bacteria throughout the septic tank and into the leaching facility downstream of the tank. The intent is to get the oxygen and bacteria into the leaching facility so that failed leaching facilities can be remediated.

Based on information received, the department finds that the White Knight wastewater treatment device can be used in New Hampshire as part of a repair of a failed system. The department's approval of the White Knight wastewater treatment device is, at this time, limited to this case-by-case repair scenario. The conditions of this approval are:

1. Units must be installed in accordance with the manufacturer's recommendations.

2. All other details of the overall wastewater disposal system using White Knight devices must comply with the provisions of NH Code of Administrative Rules, Chapter Env-Ws 1000. In this case, the parts of that rule that apply to repair of failed systems apply in full. We especially note the importance of digging a test pit to confirm that a failed leach field is sufficiently above the seasonal high water table.

3. As is the case with all mechanical treatment units approved for residential use in New Hampshire, maintenance must be performed by a licensed wastewater treatment plant operator. A fact sheet on DES's licensure program is available at http://www.des.state.nh.us/factsheets/wwt/web-2.htm. For small residential applications, a Grade 1 license will be sufficient.

4. A renewable maintenance contract must be sold with each White Knight unit.

5. Per Env-Ws 1024.06(c), a copy of this letter shall accompany any specific design involving the use of the White Knight treatment device under this approval which may be submitted to DES.

I hope this letter meets your needs. If you have questions, please contact me at 603-271-2941 or email at rminicucci@des.state.nh.us, or contact Mr. William Evans, PE, Administrator of the Subsurface Systems Bureau at 603-271-3304.

Sincerely,

Robert P. Minicucci II, PE
Innovative Technology Coordinator

WhiteKnight 3-03
CC: William Evans, PE, DES/SSB
James Falicon, DES/SSB
Rob Tardif, PE, DES/SSB
Jay Baas, DES/SSB

The City of New York

Department of Environmental Protection

Mark Noga, Vice-President
Knight Treatment Systems
281 Co. Rt. 51A
Oswego, NY 13126

August 25, 2002

Re: The White Knight System

Dear Mr. Noga: Mark

The New York City Department of Environmental Protection (the Department) has reviewed the information, including test results, of the White Knight System. While the results appear to be impressive, it is impossible for the Department to authorize the use of the White Knight System as an approved repair or remediation of a documented septic system failure. The Department's Watershed Rules and Regulations require that any failed septic system must be repaired or remediated utilizing the NYSDOH Appendix 75-A standards. Where this is not feasible due to site conditions, the system must be designed to meet these standards to the extent possible.

In addition, just to clarify the NYSDOH Appendix 75-A standards, the Department does not consider the White Knight to be an aerobic unit as defined in those standards. The White Knight has not been certified under the appropriate NSF Standards for aerobic units. Therefore, the Department view the White Knight system as a form of "additional" treatment, and as such, if a homeowner wishes to install the system to his fully operational septic system a added insurance, the Department would not object nor require its review and approval. The homeowner would have the full responsibility for this decision.

In summary, the Department cannot approve the White Knight system as a valid repair or remediation technique/design for a failed system. The system may be installed in an operational septic system as added treatment by the homeowner, and at the homeowner's own risk.

Thank you for the opportunity to comment.

Very truly yours,

Theodore W. Simroe

Theodore W. Simroe
Assistant Chief
Engineering

Cc: Edwin Polese, P.E.

STATE OF NEW YORK
DEPARTMENT OF HEALTH

Flanigan Square, 547 River Street, Troy, New York 12180-2216

Antonia C. Novello, M.D., M.P.H., Dr.P.H.
Commissioner

Dennis P. Whalen
Executive Deputy Commissioner

June 8, 2007

Mark C. Noga, VP
Knight Treatment Systems
281 County Route 51A
Oswego, New York 13126

Re: "White Knight" Microbial Inoculator Generator

Dear Mr. Noga:

This is in response to your recent request for NYSDOH's review of Knight Treatment Systems' "White Knight" Microbial Inoculator Generator absorption area rehabilitation product. As described in your literature, the White Knight facilitates treatment of wastewater through the use of a fine bubble aeration system to promote the transfer of oxygen and to deliver a proprietary blend of bacteria that rapidly digest organic materials in wastewater and biomat buildup in an absorption area. The product can be placed in a standard household septic tank to remediate systems failing due to biological soil "clogging".

10NYCRR, Appendix 75-A, Wastewater Treatment Standards – Individual Household Systems, applies to new construction only and not for remediation or replacement purposes, therefore, the use of the White Knight does not require Department approval. However, the Department has no objection to the use of the White Knight, in accordance with the manufacturer's recommendations, to recover biologically clogged absorption systems or as an enhancement to a system designed in accordance with Appendix 75-A.

This is not, nor should it be considered to be, an endorsement of this product. The use of proprietary products for onsite wastewater treatment systems is also subject to the conditions and requirements of local health departments or local code enforcement officers.

Sincerely,

James Meacham, P.E.
Bureau of Water Supply Protection
Residential Sanitation Section

cc: Ben Pierson, BWSP-RSS
Rebecca Dixon, BWSP-RSS

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
235 Promenade Street, Providence, RI 02908-5767 TDD 401-222-4462

Innovative/Alternative ISDS Technology Program

Vendor Information
Knight Treatment Systems, Inc.

Contacts:
Jay Knight, President
281 County Route 51A
Oswego, NY 13126

Tel: 800-560-2454
Fax: 315-343-6114
Website: www.knighttreatmentsystems.com

Local Contacts:

Technology Name and Model Number:
White Knight™ Microbial Inoculator/Generator
Models WK-40 and WK-78

Technology Type:
Treatment System - Class II

Certification Date:
Issued: June 6, 2006
Expires: June 6, 2008
Reissued: June 6, 2008
Expires: June 6, 2010

CERTIFICATION

The RI Department of Environmental Management (Department) has reviewed the Innovative/ Alternative Technology application for the White Knight ™ Microbial Inoculator/Generator hereafter referred to as the "System". The System is contained within a HDPE cylinder, designed to be installed into a septic tank, continuously inoculating the tank with non-pathogenic ISO-500™ bacterial cultures. An air pump provides fine bubble aeration and circulation within the System bringing the bacteria into contact with fixed film substrate and the suspended organic compounds in the septic tank. The ISO-500™ bacteria released by the System digest organic wastes in the septic tank and in the leachfield.

Based upon information contained in the application submitted by Knight Treatment Systems, Inc., hereafter referred to as the "Vendor", the Department hereby accepts the System for placement on the Innovative/Alternative Technology List. Design, installation, and operation of the System shall be in accordance with the following terms and conditions:

I. Design Requirements

A. General

1. The System is approved for renovation of Individual Sewage Disposal Systems (ISDSs) which are organically clogged resulting in hydraulic failure. The System may also be installed in a properly functioning ISDS as well as a new ISDS, by application.

2. The System is approved for all uses with no design flow restriction.

3. No reduction in required leachfiled area may be attributed to use of this System.

4. The System may not be installed in cesspools, block, or steel tanks, or in substandard tanks.

5. In no case may the System be installed in a tank of a volume less than 1,000 gallons.

6. Septic tanks in which the System is to be installed shall be equipped or retro-fitted with an effluent filter.

7. Since constant aeration is necessary for proper performance of the System, the air pump must be operational 24 hours a day. To ensure owner/operator compliance with this condition, all Systems shall be equipped with an hour meter and a visible and audible motor/power failure warning light, mounted on a NEMA approved cabinet on the exterior of the building.

8. System design shall be in strict conformance with the Department approved System Design and Installation Manual and shall only be performed by appropriate Department-licensed persons who are authorized in writing by the Vendor to do so.

9. System installation shall be in strict conformance with the Department approved System Design and Installation Manual and shall only be performed by appropriate Department-licensed persons who are authorized in writing by the Vendor to do so.

10. Each System installation shall meet other applicable Department regulations and receive prior approval by the Department pursuant to the regulations in effect at the time of application.

B. Use With Existing ISDS

1. Before the Department will allow use of the System at a site, a Repair Application must be submitted.

2. A copy of the completed Vendor's Site Qualification form and a copy of the originally approved plan or a system plan based on the Vendor-required site investigation, identifying location and size of tank, d-box, if used and the type and size of leaching area in use, must be submitted with the ISDS repair application.

C. Incorporation in New Construction

1. Before the Department will allow use of the System at a site, a New Building Construction Application must be submitted.

2. Only conventional and Class I I/A leachfield technologies as referenced in the list of approved proprietary I/A technologies are permitted for use with this System.

II. General Requirements

1. This Class II Approval shall be effective until 2 years from the approval date.

2. If the Vendor wishes to extend this Class II Approval beyond its expiration date, the Vendor shall submit a renewal application with the appropriate renewal fee as denoted in SD 23(j)(4) at least 90 days in advance of the expiration date of the approval. Upon completion of Department review, written confirmation of the status of the Approval will be provided to the Vendor.

3. The Vendor shall notify the Department at least 30 days prior to any proposed transfer of ownership of the System. Notification shall include the name and address of the new owner and a written agreement between the existing and new owner specifying a date for transfer of ownership, responsibility, and liability for the technology. All provisions of this approval shall be applicable to any new owners.

4. The Vendor shall provide any purchaser of the System with a copy of this approval letter prior to the sale of the System.

5. The Vendor shall hold, or cause to be held, two training seminars for Rhode Island licensed designers before the expiration or renewal of this certification. The Vendor shall notify the Department of the proposed date and time of each training seminar at least one month in advance of the proposed seminar and coordinate any public announcement or solicitations with this office. A list of Vendor trained and approved distributors, with at least two names shall be submitted by the Vendor to the Department within 6 months of this approval.

   Training

   a) The Vendor shall hold two training seminars for Rhode Island Licensed Designers and Installers who wish to be trained before the expiration of this certification.

   b) The first shall be held within the first six (6) months of the date of this certification.

   c) The Vendor shall submit to the Department a detailed agenda, material to be distributed to attendees and a list of presenters and their credentials at least one month prior to offering a training seminar.

   d) Following the seminar, the Vendor is required to provide each attendee who successfully completes the training with documentation of having done so.

   e) Following each training seminar, a list of those who have satisfactorily completed the training shall be submitted to the Department.

   f) The Vendor shall make available to the public, a means of verifying individuals, by name and category, who have received training and are authorized in writing by the Vendor to design, install or maintain the System.

6. The Vendor shall maintain capacity either directly or through authorized distributors, to deliver the System to all holders of Rhode Island permits on which it is specified.

III. Operations and Maintenance Requirements

1. The Vendor must offer for sale a minimum two-year Operation and Maintenance (O & M) contract.

2. Detailed operating instruction shall be provided to the Owner/Operator.

3. Systems shall be maintained according to the manufacturer's specifications, which shall include requirements and scheduling for start-up and shutdown of seasonally used Systems, protection of the System and the biological component from freezing, and when the System may be turned off.

4. O & M requirements and an O & M agreement, for the System shall be recorded by the owner in the land evidence records of the applicable city/town prior to the Department issuance of a certificate of conformance for the installation.

5. The owner shall retain a Vendor-trained and Vendor-authorized O & M provider to perform preventative maintenance, perform repairs and respond to emergency calls for the life of the System. Such O & M provider shall perform inspections at least twice annually. No agreement with an O & M provider shall be for less than 2 years.

6. The Vendor shall have an inventory of replacement parts available locally.

IV. Reporting Requirements

1. The Vendor shall submit an annual report to the Department by November 30 of each year containing the following information for the previous 12 month period ending September 30 of the year:

   a) The number of Systems installed in Rhode Island,
   b) The address of each installation and name of the owner and permit number,
   c) For each system, the number of inspections / maintenance calls conducted and a brief comment regarding activities performed and observations including replenishment of the inoculum and ponding height, if any,
   d) All known problems or failures experienced with a brief summary of the cause and remedial measures taken,
   e) Number of and location of sites rejected and why.

   Electronic submission is encouraged.

2. The Vendor shall report any termination or non-renewal of maintenance agreements to the Department and to the local wastewater management authority should one exist for that area.

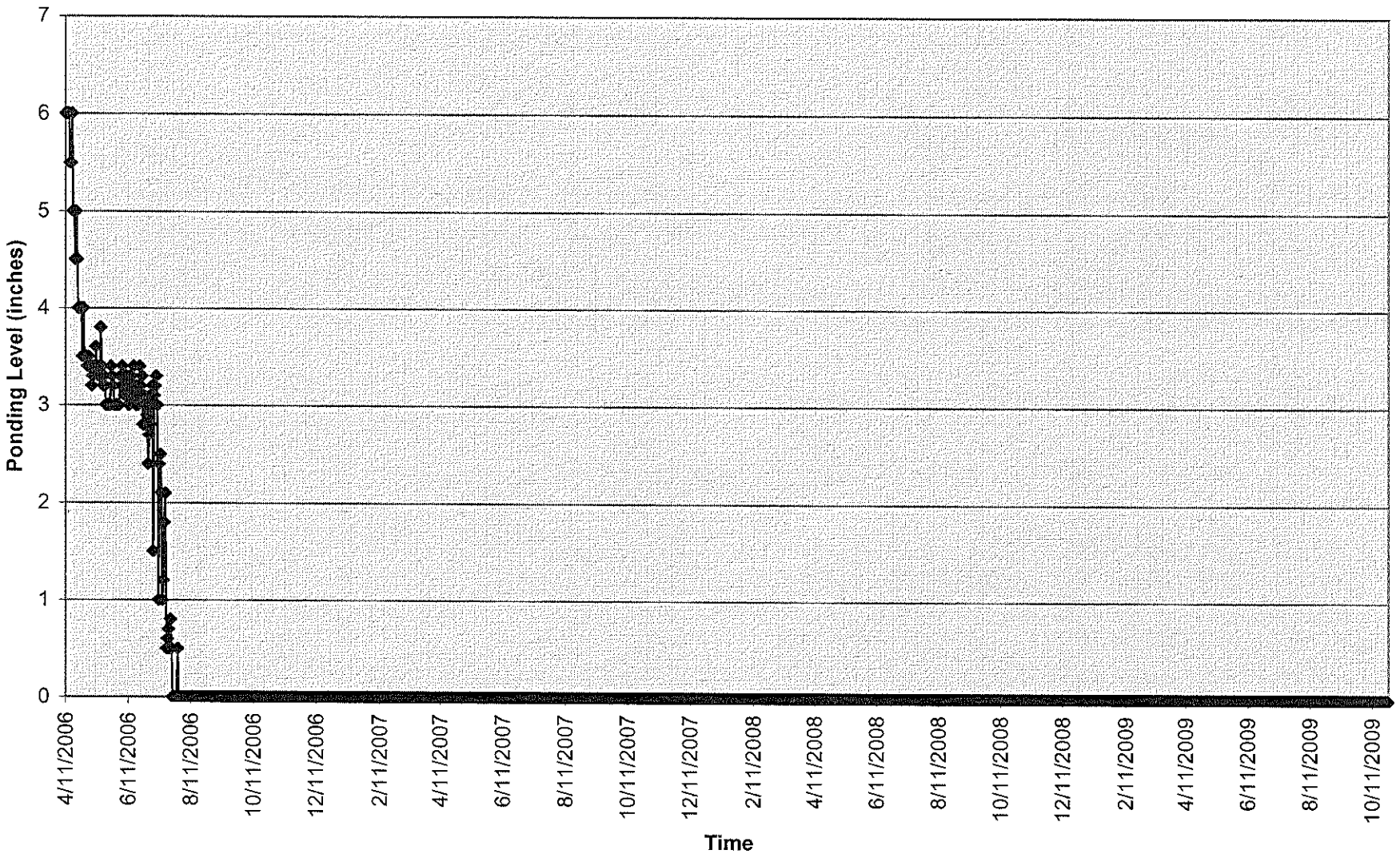
V. Rights of the Department

1. The Department may suspend, modify or revoke this approval for cause, including but not limited to: non-compliance with any of the conditions or provisions of this approval, misrepresentation or failure to disclose all relevant data, or receipt of new information indicating that the use of the System is contrary to the public interest, public health or the environment.

2. This approval does not represent an endorsement of the System by the Department. This letter of approval may be reproduced only in its entirety.

Issuance Date: 6/6/08

Russell J. Chateauneuf, P.E.
Chief of Groundwater and Wetlands Protection


Lakeville 2 Mayflower
Ponding Level (inches)
0
1
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Time

Sand Savior

A microbial inoculator generator successfully remediates a severe failure in an apartment building's sand filter treatment system

By Scottie Dayton

The sand filter for a 36-unit apartment complex in upscale Hyde Park, N.Y., had failed. Responding to initial complaints, Richard Robbins, head sanitarian for the Duchess County Health Department, found the most catastrophically clogged system he had ever seen.

Ponding was so atrocious that he mandated stopgap measures and that the system be replaced within 90 days. Jones Septic in Hyde Park capped the sand filter with 12 to 18 inches of coarse fill and gravel and installed a curtain drain around the perimeter. Sewage bubbling out was directed to the drain, passed through a chlorination chamber, and discharged into a stream.

During the interim, Robbins inspected a strip mall's drainfield that had been remediated by a White Knight Microbial Inoculator Generator. His investigative dig revealed clean effluent with no trace of fats, oils or grease, even though the field served a deli and two restaurants.

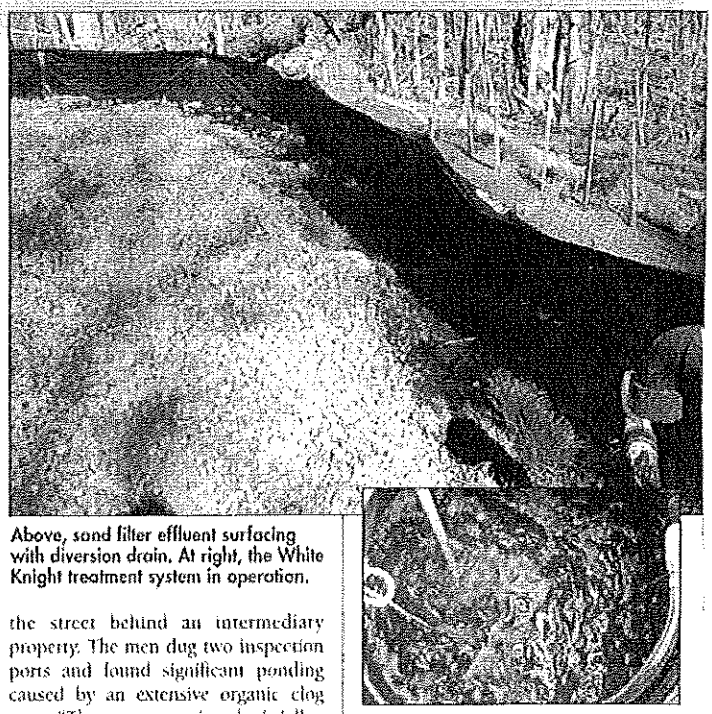
Impressed, Robbins returned to the apartment owner, recommended the reclamation process, and said that he wouldn't force him to replace the sand filter if the technology worked. He monitored the rehabilitated sand filter for three months, then gave it a clean bill of health.

Site conditions

Bob Rice of Hudson Valley White Knight Systems Inc. in Staatsburg, N.Y., and Mark Noga, vice president of market development for Knight Treatment Systems in Oswego, N.Y., visited the time-dosed sand filter, which had been installed in the early 1990s.

Three 4,000-gallon concrete septic tanks served three 12-unit apartment buildings. The 110- by 50-foot sand filter, designed for 8,000 gpd, was across the street behind an intermediary property. The men dug two inspection ports and found significant ponding caused by an extensive organic clog mat. "The pump station had fallen into such distepair that hydraulic pressure was gravity-feeding the bed," Rice says.

Although the tanks weren't leaking, they were under the parking lot and the manhole covers had settled, allowing collection and stormwater infiltration. Soils were poor and shallow. "We were diligent in our investigation to make sure that the problem was not due to mechanical or hydraulic issues," Noga says. "We're not the magic bullet for every system, but this one definitely had organic materials clogging the sand filter."



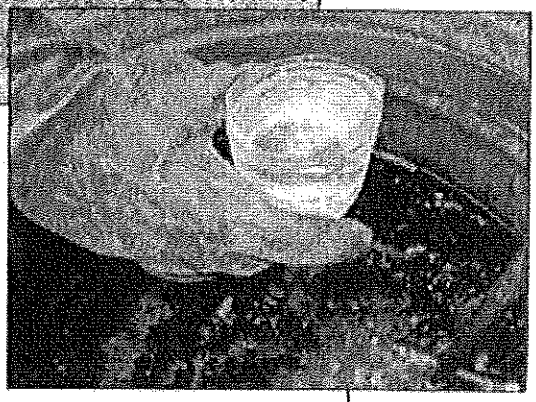
Above, sand filter effluent surfacing with diversion drain. At right, the White Knight treatment system in operation.

System components

- Three stand-alone commercial White Knight Microbial Inoculator Generators with auxiliary diffusers from Knight Treatment Systems Inc.
- Three A100-12 effluent filters with 1/16-inch screens from Zabel Environmental Technology, Crestwood, Ky.
- Three 1/6-hp lineal diaphragm air pumps from Reitschle Thomas, Louisville, Ky.
- Three 1/2-inch I.D. Schedule 40 PVC air supply lines.

System Profile

Location:	Hyde Park, N.Y.
Facility served:	Apartment complex with 36 units
Installer:	Hudson Valley White Knight Systems Inc., Staatsburg, N.Y.
Site conditions:	Biologically clogged sand filter with excessive ponding
Type of system:	White Knight Microbial Inoculator Generators with auxiliary diffusers, Knight Treatment Systems Inc., Oswego, N.Y.
Hydraulic capacity:	8,000 gpd



Top photo, an investigative dig into the old sand filter. Above, a typical water sample from a White Knight treatment tank sample. At left, the sand filter following remediation.

System operation

The tank's normal liquid level is above the top of the microbial unit. An air line introduces a fine bubble mix through the bottom of the diffuser to oxygenate the system. The air also flows up past an initial charge of IOS-500 aerobic and facultative bacteria, activating it.

As the microorganisms reproduce on the system's single-media treatment column, they eat the organic materials in the tank, are discharged to the filter bed, and continue their biological remediation there.

Installation

Rice and one employee installed the units in two-and-a-half days without disrupting service. Almost 100 percent of the installation was accomplished from the surface without tank entry. The tanks were pumped, but not power-washed, as the residuals fed the microorganisms while the tanks refilled.

The men, working at midday when the flow rate was lowest, placed the remediation units and auxiliary diffusers on either side of the inlet for greatest oxygen dispersal. "Judging from the amount of sludge and scum in the tanks, it looked as if they hadn't been serviced in more than a year," Rice says. "That's way too long with their daily flow rate."

To introduce inoculant-laden effluent into the clogged area as quickly as possible, the distribution lines were jetted. "We cleaned them two additional times over the next four months because the sludge kept settling," Rice says.

Each unit required a pump-failure alarm and a PVC air-supply line from the pump. The team hung the pipe on the underside of a parking garage and buried it beneath the parking lot. "We waited for the tanks to refill, then returned and placed two bags of inoculating matrix into each unit," says Rice. "Even though we saw static liquid in the observation ports, the curtain drain stopped discharging around two months after the units came online, so we knew the sand filter was gradually accepting wastewater at a greater pace."

"We knew that the effluent had reached equilibrium because it looked like pale lemonade and had visible colonies of thriving microorganisms."

— Bob Rice

Robbins had given Rice three months for the system to rejuvenate itself. One week before the grace period expired, the static liquid levels in the inspection ports started dropping. "We knew that the effluent had reached equilibrium because it looked like pale lemonade and had visible colonies of thriving microorganisms," Rice says. "The tanks didn't have any solids in them and smelled faintly like flowers, which we attributed to laundry products."

The ports have remained dry. Laboratory analysis of the liquid leaving the sand filter showed BOD at less than four 4 mg/l and TSS at 10 mg/l.

As the parking lot was being repaved, Rice installed risers on the manholes. The asphalt was then mounded around the risers to funnel water away. The last phase was excavating the coarse fill and gravel cap, covering the sand filter with topsoil, and seeding and mulching it.

Biological remediation saved the property owner some $80,000. He chose not to immediately replace the time-dosing mechanism. ■

Menu for Success

Three unique wastewater solutions and a combination of treatment techniques enable a small, seasonal restaurant in New York State to stay in business

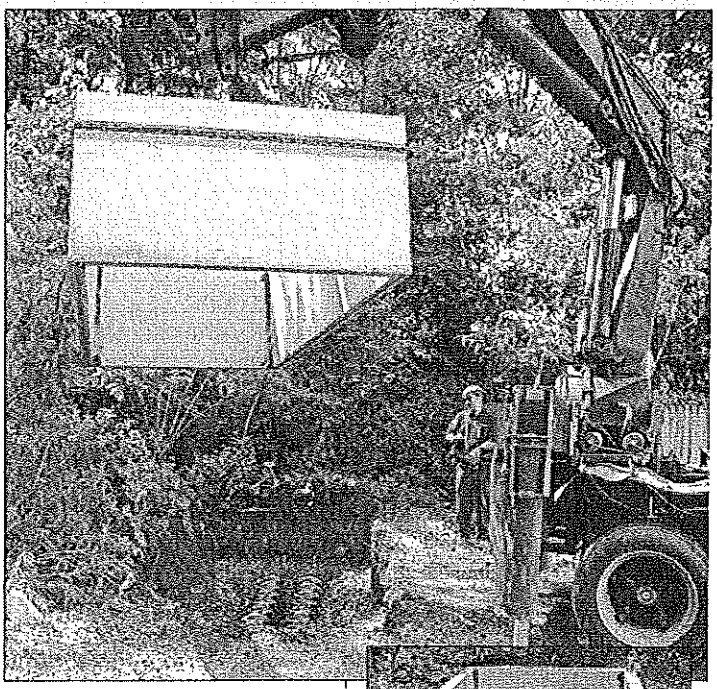
By Scottie Dayton

A 500-gallon metal septic tank with two dry wells served a three-bedroom home when it was built on Skaneateles Lake near Syracuse, N.Y., in 1939. Later, a seasonal 100-seat restaurant was added without updating the system. It failed every summer and healed itself every winter.

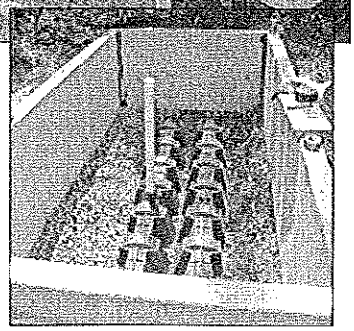
Skaneateles Lake Demonstration Project authorities evaluating lake properties in 2003 felt the site posed the biggest threat to the lake. Eric Murdock, P.E., chief engineer for Syracuse and manager of the project, evaluated various advanced treatment systems. The restaurant could not afford anything more than $75,000.

Size, electrical usage, and operation-management requirements eliminated many brands. Noise was a factor, too. "One manufacturer recommended using a 9-hp blower, which would have screamed," says Murdock. "It was not the ideal solution for a restaurant on a very quiet lake."

Murdock focused on a design that accounted for the proper settling of materials in the tanks. Research showed that for $15,000 more he could do pretreatment, too. His design incorporates a grease trap, split flows, time dosing, recirculation, biological remediation, and in-tank and subsurface soil treatment. The system configuration, which is achieving remarkable reductions in BOD, is efficient, cost effective, and applicable to many commercial facilities throughout the country.



A mobile crane operator sets the low-profile, 1,000-gallon bottomless concrete tank over the two rows of Infiltrator chambers to form the odor-recovery bed. (Photos courtesy of Eric E. Murdock, P.E.)



The odor-recovery bed is ready to be covered with organic-rich mulch. The vertical pipe is an observation port for evaluating air flow.

System Profile

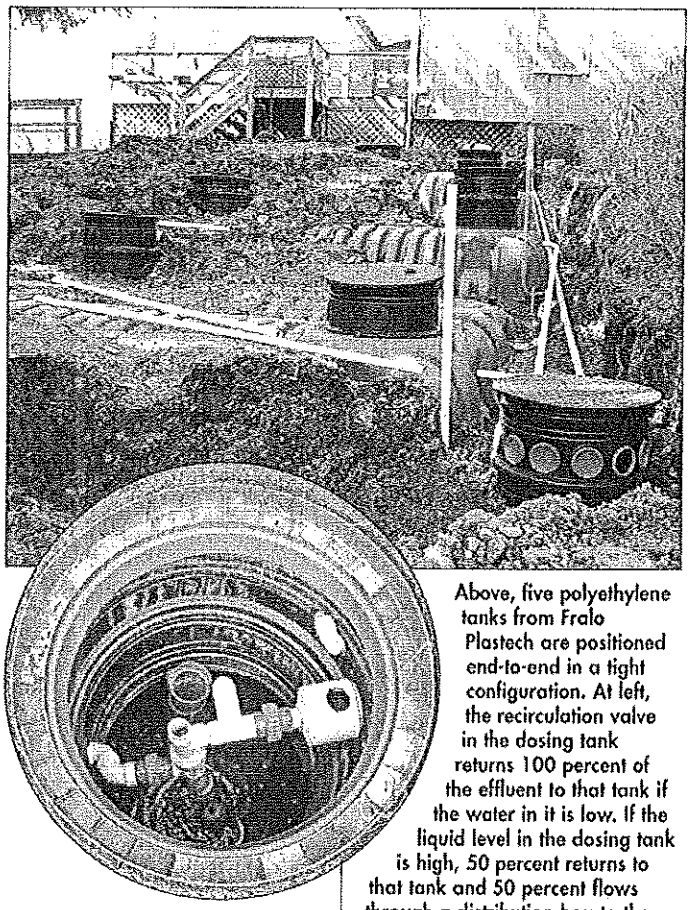
Location:	Skaneateles Lake, N.Y.
Facility served:	Glen Haven Hotel
Designer:	Eric Murdock, P.E., chief engineer, City of Syracuse, N.Y.
Installer:	Don Sweeney, Ted McBride Co., Cortland, N.Y.
Site conditions:	Hardpan to well compacted silt and clay, small area of rocky gravel, all with no percolation rate
Type of system:	White Knight Microbial Inoculator/Generator systems, Knight Treatment Systems Inc., Oswego, N.Y.; Equalizer 24 chamber drainfield, Infiltrator Systems Inc., Old Saybrook, Conn.
Hydraulic capacity:	950 gpd

Soil conditions

Soils varied from hardpan to well-compacted silt and clay with no percolation rate. Only a small patch of rocky gravel on the 5.8-acre parcel was suitable for the drainfield. The restaurant and parking lot are in a flat area at the bottom of a steep hill. A 16-slip marina is part of the development.

System components

To calculate design flow, Murdock took daily potable water meter readings throughout 2004 to deter-



Above, five polyethylene tanks from Fralo Plastech are positioned end-to-end in a tight configuration. At left, the recirculation valve in the dosing tank returns 100 percent of the effluent to that tank if the water in it is low. If the liquid level in the dosing tank is high, 50 percent returns to that tank and 50 percent flows through a distribution box to the trenches and dry wells.

mine water usage. Flows ranged from 65 to 1,850 gpd. To determine baseline waste strength, he collected septic tank samples from June through August, analyzing averages of five-day BOD (3,500 mg/l), TSS (1,656 mg/l), and oil and grease (520 mg/l). He sized the system to handle 950 gpd.

Major components are:

- 1,000-gallon, two-compartment polyethylene grease trap. All tanks from Fralo Plastech LLC, Syracuse, N.Y.
- Tank riser systems from Tuf-Tite Inc., Lake Zurich, Ill.
- 1,500-gallon, two-compartment septic tank.
- 5000-0011 Deluxe/Commercial effluent filter with 1/16-inch slot from Zoeller Pump Co., Louisville, Ky.
- Two 1,500-gallon, single-compartment tanks for equalization and dosing.
- 50/50/100 recirculation valve from Quanics Inc., Crestwood, Ky.
- 1/2-hp Goulds effluent pump.
- 1,500-gallon, two-compartment pretreatment tank.
- Two Model WK-80 White Knight Microbial Inoculator/Generator systems from Knight Treatment Systems Inc., Oswego, N.Y.
- 200 feet of Equalizer 24 chambers from Infiltrator Systems Inc., Old Saybrook, Conn., set on 60-inch centers.
- User Friendly Series programmable Simplex Control Panel from SJE-Rhombus Controls, Detroit Lakes, Minn.

System operation

Wastewater flows are separated inside the building. Grease-generating fixtures empty into the grease trap, then gravity-feed into the septic tank. All sanitary plumbing flows directly into the septic tank, which discharges by gravity into the 3,000-gallon equalization/dosing tank.

"The largest tank Fralo makes is 1,500 gallons, so we manifolded two together at the bottom, enabling them to act as one," says Murdock. "They fill simultaneously." All piping is pressure-rated 4-inch PVC Schedule 40, except for the line from the dosing tank to the treatment tank, which is 1.5-inch.

An effluent pump sends 25 gallons every 30 minutes from the flow equalization tank to the two microbial inoculator generators in the treatment tank. Each unit is a 12-inch-diameter, 35-inch-long, high-density polyethylene column with a 4-inch PVC pipe in the center. A bag of IOS-500 bacteria is suspended inside the pipe, which is surrounded by one cubic foot of plastic media.

An air pump introduces a steady supply of fine bubbles at the bottom of each generator. Rising oxygen mixes and distributes the microorganisms throughout the tank, where they digest organic matter. Every incoming dose displaces 25 gallons out the other end of the treatment tank. The liquid gravity-flows back to the dosing tank and passes through a recirculation valve.

If the water in the dosing tank is low, 100 percent of the effluent returns to the dosing tank. "Time-dosing enabled me to accommodate budget restrictions and address the variable flow rate," says Murdock. "Multiple recirculation also increases our treatment levels and keeps the microbes happy."

If the liquid level in the dosing tank is high, 50 percent returns to the dosing tank and 50 percent flows through a distribution box split six ways. Four pipes lead to 50-foot-long trenches, and two pipes lead to the dry wells.

"The original dry wells were abandoned in 1986 after reportedly failing," says Murdock. "We used the 6-foot-diameter precast concrete dry wells that replaced them."

Installation

The five tanks, positioned end-to-end in a tight configuration, were installed against a slight incline. Dan Sweeney from Ted McBride Co. in Cortland, N.Y., excavated all the soil from the embankment, placed the tanks on the flat surface, then backfilled around them to re-establish the same slope.

> **"We were hoping the system would achieve a 50 percent BOD reduction, then let the soil do the rest. However, we found that using time dosing and recirculation in this configuration produced a much higher reduction."**
>
> **Erik Murdock**

Assembling the drainfield in the gravel parking lot took half a day. Sweeney dug 24-inch-wide, 2-foot-deep trenches, then placed the traffic-rated chambers, backfilled with gravel, and covered the chambers with geotextile fabric. Lastly, the parking lot gravel was replaced. The entire installation took a week in April 2005.

According to Murdock, manufacturers of advanced treatment technologies typically treat wastewater to a secondary treatment level of 30 mg/l BOD and TSS. "We were hoping the system would achieve a 50 percent BOD reduction, then let the soil do the rest," he says. "However, we found that using time dosing and recirculation in this configuration produced a much higher reduction."

Once Murdock figured out what the system was doing, he installed a microbial inoculator generator in the grease trap and put its second aerator in the septic tank. He then calculated his standard percent reduction by comparing the 2004 baseline BOD samples

(3,500 mg/l) to the last samples collected on June 27, 2007 (408 mg/l).

"We were targeting a 50 percent reduction, but are achieving a 97 percent reduction from an untried system configuration," says Murdock. "That's nothing short of miraculous." One element of the system's success was limiting the amount of grease introduced and having kitchen personnel scrape off plates into garbage cans.

However, the air introduced into the microbial inoculator generators created an odor problem. Murdock had a 4-inch PVC vent pipe run up the side of the building and extended above the roof. It didn't work. Heavy, moist air sweeping down the steep hill kept odors on the ground. An inline fan installed in the pipe blew the air up the vent and into the atmosphere, where downward currents picked up the exhaust and dropped it into an outdoor dining area.

Pressed to the limit, Murdock devised an innovative odor recovery bed constructed in a low profile, 1,000-gallon bottomless concrete tank. "We installed an inline fan in a 4-inch pipe that branches into two rows of chambers surrounded by washed stone, then covered with mulch," he says. "I don't believe this approach has ever been tried before, but it worked. We never had another odor."

Maintenance

Knight Treatment Systems has the maintenance agreement. A technician services the system at the beginning and end of each season. He activates the system a week before the restaurant opens and changes out the microbial packs. By combining treatment techniques and thinking beyond conventional wisdom, Murdock created a system that is attracting much attention from the industry while saving the restaurant owner $50,000. ■

MORE INFO:

Drainfield Rehabilitation

NESC STAFF WRITER/EDITOR
Marilyn Dahl

The septic system, once thought of as a temporary solution for the treatment of domestic wastewater, is still the best choice for homes or residences and small communities where it would be cost-prohibitive to access public sewer systems. In the U.S., these onsite systems collect, treat, and release about four billion gallons of wastewater per day from an estimated 26 million homes.

Current interest in the impact of these systems on groundwater and surface water quality has increased interest in optimizing the systems' performance. It is now accepted that these onsite systems are not just temporary installations that will eventually be replaced by centralized sewers, but are a permanent part of the wastewater infrastructure.

Septic systems are typically simple in design, which makes them generally less expensive to install and maintain. And by using natural processes to treat the wastewater onsite, usually in a homeowner's backyard, septic systems don't require the installation of miles of sewer lines, making them less expensive and less disruptive to the environment. In addition, there are many innovative designs for septic systems that allow them to be placed in areas with shallow soils or other site-related conditions previously considered to be unsuitable for onsite treatment and dispersal.

Although the septic tank settles out most of the heavier solids and breaks down almost half of the suspended solids from household wastewater, the effluent still has a high amount of biodegradable organic materials, along with a high bacterial content that may include pathogens. Therefore, septic tank effluent is not suitable for direct discharge into surface waters or onto land surfaces. Further treatment is needed to remove these harmful pathogens. The most common way to do this and dispose of the partially treated wastewater is through subsurface soil absorption through the drainfield.

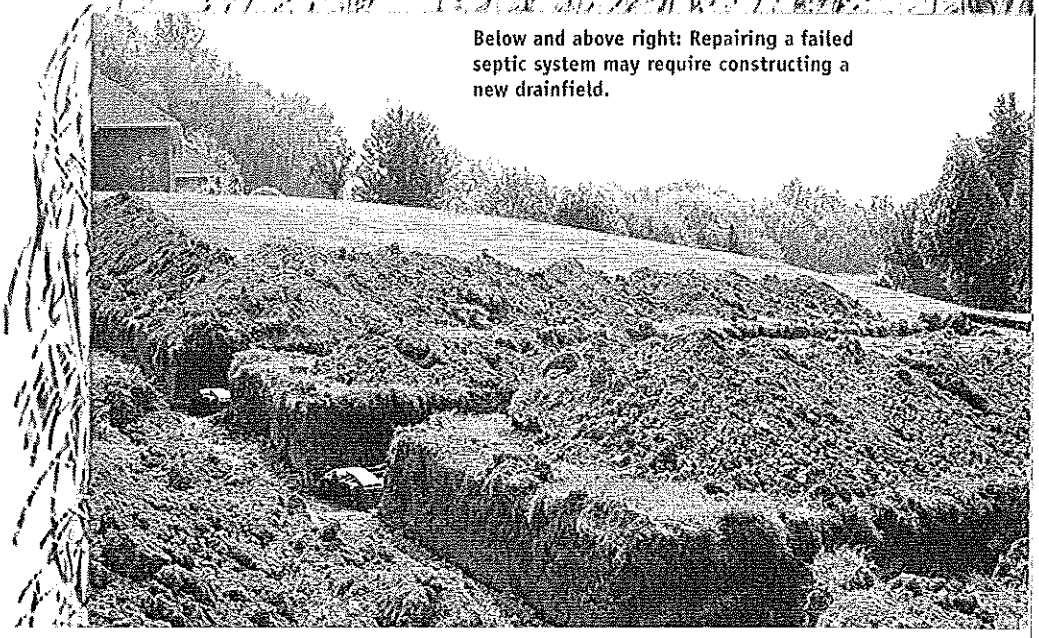
Septic systems were never intended for lifetime use without maintenance. Neglecting maintenance of system components only leads to failures. When properly designed, installed, and maintained, septic systems have a minimum life expectancy of 20 to 30 years.

The U.S. Environmental Protection Agency (EPA) *Onsite Wastewater Treatment Systems Manual* (2002) defines system failure as "a condition where performance requirements are not met." Typically, failures are declared when wastewater is observed on the surface of the ground or is backing up into the household plumbing.

When a septic system fails, it can pollute nearby water resources and endanger public health. Children are most susceptible to these health problems because they very often come into contact with the contaminated areas. There's really not all that much that is going to go wrong with the septic tank itself as long as it is watertight and pumped on a regular basis. However, what usually fails is the soil absorption system.

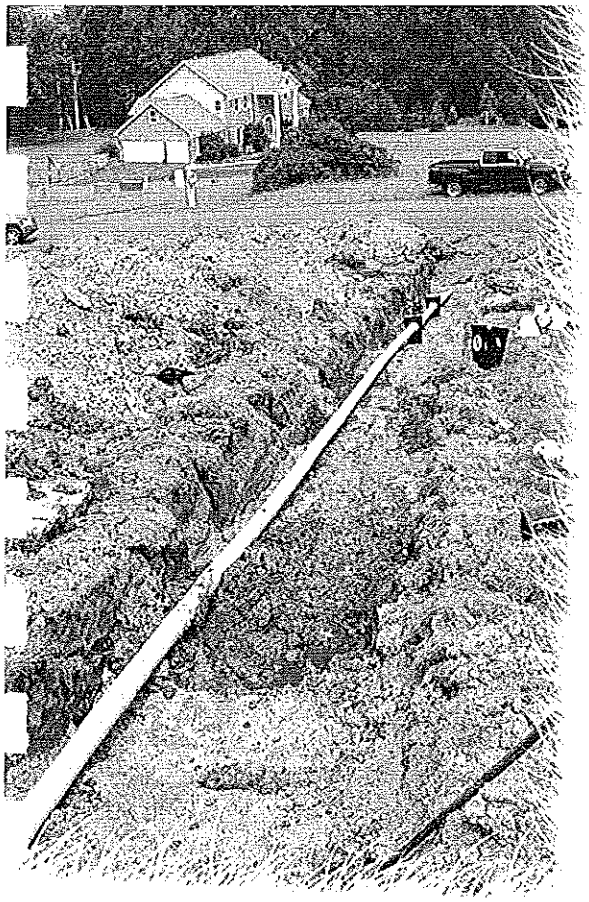
The soil absorption system, or drainfield, is an arrangement of perforated pipes or chambers buried underground that channel the pretreated wastewater—the liquid discharge (effluent) from the septic tank—out over a large area of the soil. The effluent then moves slowly down through the soil to become naturally purified before returning to the aquifer. The drainfield acts as a natural filter for effluent by absorbing the organic materials, reducing or removing bacteria and viruses, and removing some nutrients.

The most obvious sign of drainfield failure is surfacing effluent. If the soils can no longer accept the effluent being delivered, the effluent will either



Below and above right: Repairing a failed septic system may require constructing a new drainfield.

DESIGN BY JULIE BLACK



rise to the ground surface, or "blow out" at the end of the last trench. Either of these two events should alert the homeowner that there is a problem.

The reason the soil can no longer accept the pre-treated effluent is most often because of the biomat. As the effluent or pre-treated wastewater enters the drainfield, bacteria in the soil begin to thrive on the new food source. As these bacteria grow, they form a thick, slimy colony called the biomat that restricts the flow of effluent to the surrounding soil. **(See sidebar on page 21.)**

Causes for failure are many and varied—ranging from improper siting, design, or construction, to the simple overuse of water-generating appliances. It is vital that the exact cause for the failure is determined before attempting any remediation to the system. The suggested process for correcting system failure is to gather information about the system, determine the cause of failure, and design the corrective action.

Causes of Failure

Drainfield failure can be caused by many things, including excessive rainfall, tree roots interfering with the drainlines, or vehicles driving over the system and cracking pipes. But the two most common causes are hydraulic and organic overloading. Hydraulic overloading occurs when too much water is sent to an underdesigned system. Organic overloading is the result of too much organic matter in the effluent.

The initial design of a system is based on soil and site characteristics, including depth to groundwater or bedrock. Part of the design includes the system's capacity, which takes into account the number of people living in the home.

Capacity is usually based on the number of bedrooms in the home, but this may not be an accurate way to determine flow generation. Extra people or the addition of a hot tub, for instance, can quickly create more wastewater than the system and drainfield can handle.

The addition of appliances, such as garbage disposals and dishwashers, can greatly change the quality of the wastewater sent to the system. These appliances send increased amount of solids to the system, possibly causing organic overloading. Use these appliances in moderation, keeping in mind that a garbage disposal is not a waste receptacle.

Many local and state regulatory authorities require onsite systems to be sized larger to handle the additional load from such appliances as garbage disposals. Check with your local health department or permitting authority to see if this is the case in your area. Telephone numbers of such agencies are normally listed in the government or blue pages of the local telephone directory.

Septic system failure can also result from:

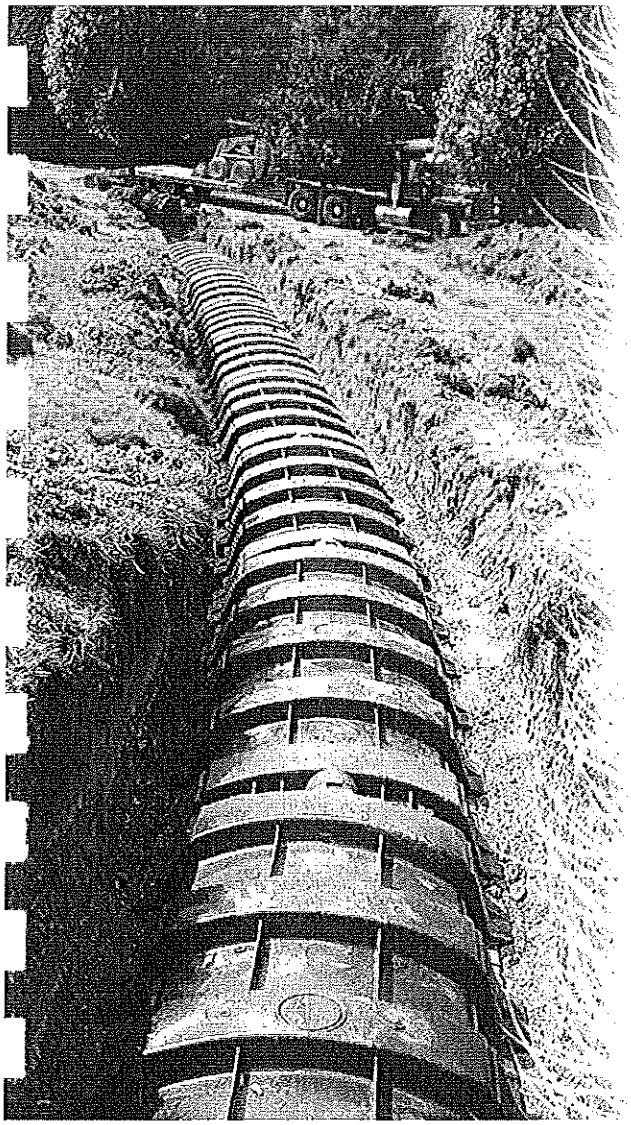
- Overloading with water. Homeowners should avoid putting too much water into the system at one time. It is better to stagger laundry loads throughout the week rather than having a "wash day" where you might do all the laundry within a 24- to 48-hour period. Divert your hot tub away from your onsite system when draining it.
- Discarding decay-resistant materials into the system, such as grease, sanitary napkins, and other solids.
- Allowing tree roots to clog or destroy the absorption system.
- Compacting soil over the drainfield. Avoid driving or parking vehicles over the drainfield.
- Age of the system. Septic systems are designed for an operational life of 20 to 30 years. If you have an aging system, it may be time to inspect and replace it.

The Correction Procedure

When an onsite system fails, it is important to gather specific information about the system in order to diagnose the problem and determine the appropriate corrective action.

Initial Data Gathering

- Visual observation of the failure should be made to confirm the problem. All system components should be inspected, and any mechanical components (such as float switches and flow diverters) should be tested by a qualified/certified system inspector.
- A complete history of operation and maintenance of the system should be reviewed. Frequently, a study of the past three to five years of operation and maintenance will reveal a possible problem. The correction may be as simple as pumping the tank or cleaning a tank filter.
- Obtain a copy of the original permit and any updates. This permit will contain a layout of the system from a site survey or drawings of the original design.
- Determine approximate loading rates from the original design and permit.



Alternating drainfields provide relief for a failing system. Here, a second drainfield is installed.

- Soil test results should be reviewed. If soil test results are not included in the permit, soil samples should be taken to determine the soil profile and to locate any soil boundaries that may be present. The age of system should also be determined.
- Obtain a complete report of the symptoms of failure. For example, surfacing effluent above the drainfield suggests that the soil may be overloaded, either with too much total water or that the water has inappropriate amounts of organic matter that has clogged the soil pores. Additionally, if the failure is seasonal, wet weather conditions are likely to be the cause.
- Determine the amount of wastewater entering the system. Using data from the dwelling's water meters, actual flow (even if estimated) is then compared to the design loadings. This will yield a good approximation of how much wastewater is entering the wastewater system. Leaking plumbing fixtures will skew this number, causing more water to enter the system. Thus, all leaking fixtures must be repaired.

Determining the Cause

From the information gathered through the above steps, ideas about the potential causes of failure should come to light. It might be necessary to do some additional steps to test the idea before any corrective actions are taken. Wastewater metering or testing, equipment testing and monitoring, or additional soil testing might help more clearly define the cause of the system failure.

Repair permits may be required before any corrective action begins. Contact your local health department or permitting agency to find out what is required to obtain such a permit.

Remediation Techniques

There are various repair or remediation techniques that may be considered, depending on the investigation into the causes of failure as described above, economic considerations, and the flexibility of the local permitting entities. State and local statutes vary as to what technologies are permitted. Homeowners must work closely with their local health departments or permitting authorities to make the best choice for their individual situation.

Short-Term Solutions

If the neighborhood is soon to receive public sewerage, it might be practical to use a short-term technique such as water conservation. But conservation and other management techniques are only part of most solutions. Drainfield failure must be considered a serious health hazard and as such, should be taken care of with long-term goals in mind.

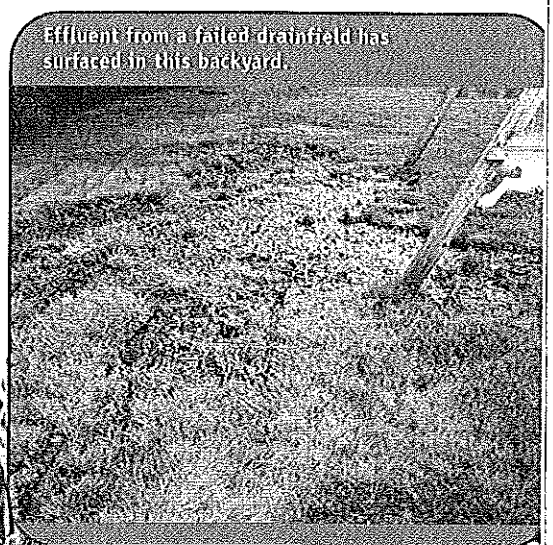
Sometimes the overloaded drainfield can recover if a strict policy of water conservation is observed by the homeowner. After pumping the septic tank, this would involve replacing water-guzzling appliances with more efficient ones, repairing leaking fixtures, and staggering showers and clothes washing times to reduce the output of effluent.

If the soil around the piping is allowed to dry out, it may be able to function properly once again. This method obviously requires a good deal of homeowner commitment. It usually takes a 30 percent reduction in water use to allow the drainfield to recover.

In cases of physical damage, system restoration may only require the leveling of the distribution box or repairing crushed or broken pipe. If tree roots are interfering with the operation of the soil absorption field, they can be removed. Broken or deteriorated baffles in the septic tank can allow solids to go to the drainfield; these should be replaced or repaired.

There are now some new technologies that may provide temporary relief to drainfield failure. The first is "jetting," a procedure that utilizes special pumps to inject high-pressure water into the drainlines to break up silt deposits and other solids, coupled with powerful vacuum lines that suck the broken-up solids out of the lines before they can settle again.

If the problem stems from poor or compacted soil, hope may come



Effluent from a failed drainfield has surfaced in this backyard.

Biomat Formation

As the effluent is discharged into the soil absorption system, bacterial growth develops beneath the distribution lines where they meet the gravel or soil.

As the effluent is discharged into the soil absorption system, bacterial growth develops beneath the distribution lines where they meet the gravel or soil.This layer is known as the clogging mat, clogging zone, biocrust, and biomat. This biomat (biological mat) is a black, jelly-like layer that forms along the bottom and sidewalls of the drainfield trench. This clogging zone reduces infiltration of the wastewater into the soils.

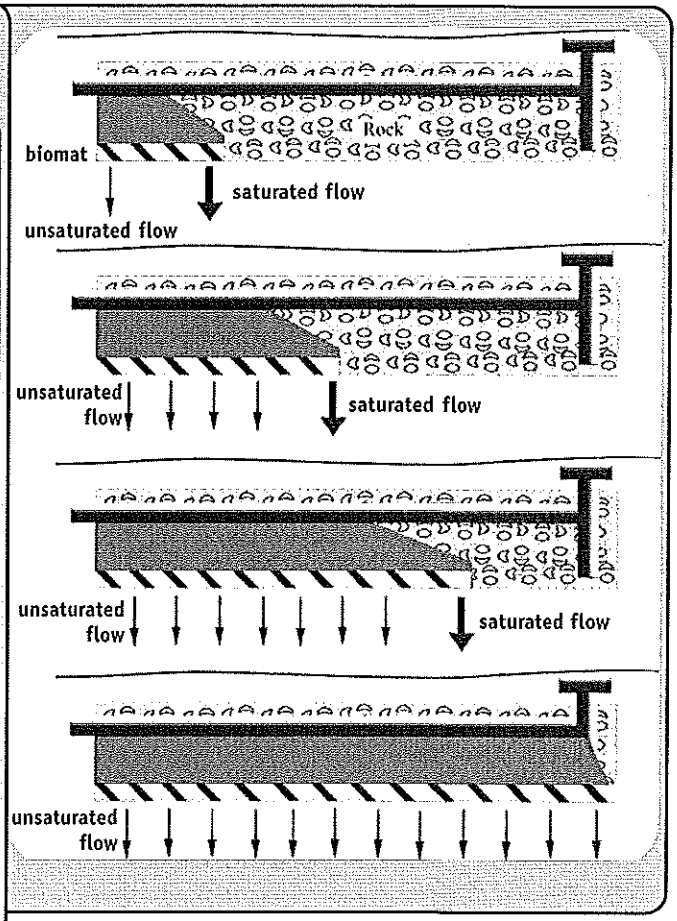
The biomat is composed of anaerobic microorganisms (and their byproducts) that anchor themselves to soil and rock particles. Their food is the organic matter in the septic tank effluent. Less than one centimeter to several centimeters thick, the biomat acts as the actual site for effluent treatment.

The biomat forms first along the trench bottom near the perforations where the effluent is discharged, and then up along trench walls. It is less permeable than fresh soil, so incoming effluent will move across the biomat and trickle along the trench bottom to an area where there is little or no biomat growth. (See growth pattern diagram at right.)

Biomats tend to restrict the flow of effluent through the drainfield, but are crucial because they filter out viruses and pathogens. As the biomat develops, the soil infiltration rate decreases. Once the hydraulic loading rate exceeds the soil infiltration rate, ponding starts. At some point, wastewater will either back up into the home or break out onto the soil surface.

Biomat formation cannot, and should not, be prevented, but septic tank filters, proper organic loading, and proper maintenance of the septic tank can slow the rate at which it forms. Septic tank filters prevent excess suspended solids from flowing into the drainfield and can be retrofitted to existing systems.

Other maintenance that should be performed on the septic system includes having the system inspected and the tank pumped at regular intervals. Pumping the tank allows it to better settle out solids, also reducing the organic load to the drainfield.



in the form of another new-technology solution known as "soil fracturing." Highly specialized equipment uses a pneumatic hammer to drive narrow probes down into the soil of the drainfield, typically to a depth of between three and six feet.

Air is then forced into the soil at a controlled rate, which fractures the hard soil and creates tiny open channels through it. Next, polystyrene pellets are injected into the newly aerated soil, which keeps the passages open so the soil will not simply compact again. This technology has met with mixed results and is only approved by certain states. It is very important to check with your local health officials to find out what similar process (if any) is approved for your situation.

Some of these more extreme procedures may provide some temporary relief for a failing system that is soon to be replaced or connected to a municipal system. In many states, the process falls between the regulatory cracks whether or not it is a repair and requires a repair permit.

Long-Term Solutions

In some cases, corrective measures are not enough; a new soil absorption system must be constructed. New soil absorption systems can be placed either in an isolated area so the old system is not disturbed in the process or in between the existing trenches if there is adequate room. These additional lines are considered part of an alternating drainfield system.

A diversion valve is installed so that in the future it will be possible

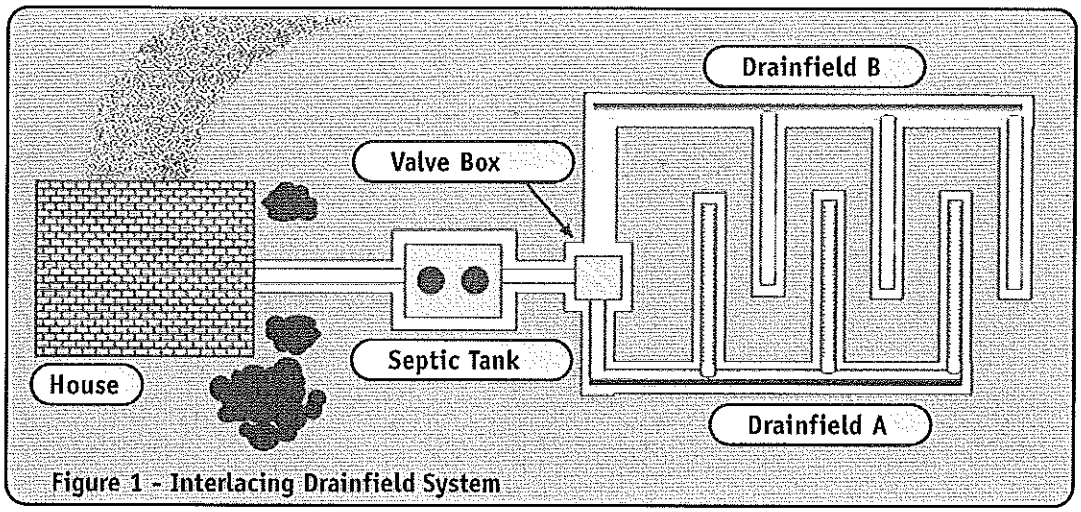


Figure 1 - Interlacing Drainfield System

to direct the flow from the septic tank to either of the soil absorption systems. After the new drainfield is in place, the flow is diverted from the old field, which will slowly rejuvenate itself and be available for use in the future.

The rejuvenation process takes about two years and involves naturally occurring organisms that decompose the clogging mat that has formed and return the absorptive system to near original capacity. (The old drainfield can recover faster if a septic tank pumper can open the field and remove as much of the ponded wastewater as possible.)

After a replacement system has been installed, a homeowner should switch back to the old drainfield after two years, and then switch back and forth between the two systems annually. This will result in a continuous use and rejuvenation cycle for both drainfields and should prevent future failures. An observation tube in each drainfield may be used to monitor the condition of the drainfields and can help the homeowner determine the frequency of alternating between the two fields.

If an adequate area for a new system does not exist, and the old system is a trench system with at least six feet of undisturbed soil between the trenches, it is possible to install new replacement trenches interlaced between the old ones. However, the plumbing for the new and old system must be entirely separate so that when one is in operation, the other has the opportunity to completely dry out. **(See Figure 1 above.)**

Another option to reduce the organic load on the drainfield is by adding an advanced treatment system such as an aerobic treatment unit or a sand filter. Sand filters and aerobic treatment units (ATUs) are systems that use natural processes to treat wastewater and are frequently used to renovate organically clogged, failing septic tank-soil absorption units. Typically, sand filters are used as the second step in wastewater treatment after the septic tank where solids in raw wastewater have been separated out. Constructed of a bed of sand about two or three feet deep and often contained in a liner, sand filters receive the partially treated effluent in intermittent doses. The effluent slowly trickles through the media and is collected in an underdrain and flows to further treatment and/or disposal.

Sand filters are very effective at reduction of organic matter and are capable of handling heavy hydraulic loads. These two qualities make them particularly useful in cases of drainfields that have been overloaded either hydraulically or organically.

Aerobic treatment units are similar to septic tanks in that they use natural processes to treat wastewater, but unlike septic treatment, the ATU process requires oxygen. ATUs use a mechanism to inject and circulate air inside the treatment tank. Bacteria that thrive in oxygen-rich environments work to break down and digest the wastewater inside the aerobic treatment unit.

Aerobically treated effluent is defined as effluent exiting a properly operating ATU or sand filter. This additional step reduces the amount of total suspended solids (suspended solids value of less than 10 to 15 mg/L, compared to typical septic tank effluent with suspended solids in the range of 100 to 250mg/L).

In situations where the soil absorption units have failed due to an excessive biomat formation, aerobic effluent reduces the symptoms. (Several states allow systems that are failing due to clogging biomat to be renovated using aerobically treated effluent, provided the site meets separation requirements between the aggregate/ soil interfaces and limiting conditions of high water table or bedrock.)

This article was first printed in the Winter 2005 issue of the NESC newsletter Pipeline.

References

Converse, James C., and E. Jerry Tyler. 1995. Aerobically treated domestic wastewater to renovate failing septic tank-soil absorption fields. *Proceedings: 8th Northwest On-site Wastewater Treatment Short Course and Equipment Exhibition.* (#L004343)

Olson, Todd. 1999. Q&A: Drainfield clogging and rehabilitation. *Small Flows.* Vol. 13. No. 2. (Spring) p. 20.

Stuth, William L., and Matthew M. Lee. 2001. Recovery of failing drainfields and a sand mound using aerobic effluent. *Proceedings: 9th National Symposium on Individual and Small Community Sewage Systems.* (#L006854)

Sussex County Planning Department and New Jersey Department of Environmental Protection. 1994. *A manual for managing septic systems.* (#WWBKOM41)

U.S. Environmental Protection Agency. 2002. *Onsite wastewater treatment systems manual.* EPA/625/R-00/008. (#WWCDDM99)

Winneberger, John H., et al. 1960. *Biological aspects of failure of septic-tank percolation systems.* University of California, Berkeley. August. (#L000436)

Items referenced above with # codes are available from the NESC at (800) 624-8301.

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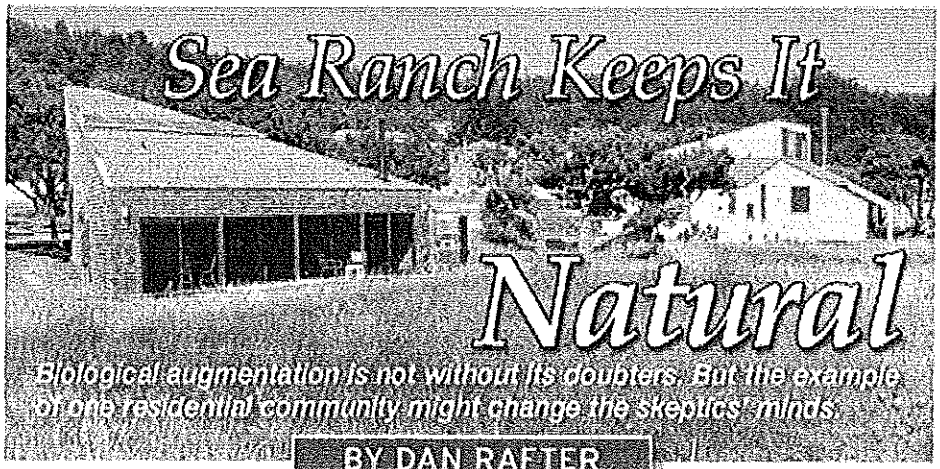

Sea Ranch Keeps It Natural

Biological augmentation is not without its doubters. But the example of one residential community might change the skeptics' minds.

BY DAN RAFTER

The Sea Ranch residential community features some of the most exclusive real estate in the country. A total of 1,500 homes sit on 2,500 lots on rugged, rocky land that hugs the California coastline for about 10 miles on either side of the famed Highway 1 in Sonoma County, CA. Picturesque views, abundant wildlife, and the feeling of "getting away from it all" are some of the reasons that draw scores of weekend and holiday residents. Officials with the Sea Ranch Association estimate that only 600 of the community's homes are lived in by full-timers—and because more than 1,200 of the community's homes rely on onsite septic systems, the high number of part-time residents can cause serious wastewater problems.

Maintaining an onsite septic system isn't always easy for the homeowners who live with them 365 days a year. Imagine, then, what a challenge it can be for people who visit the Sea Ranch after being spoiled by the power of their city sewer systems. Sea Ranch water department officials, unfortunately, don't have to imagine this. "You have renters or holiday visitors who come up from the city. They don't know either what a fireplace is or what a septic system is, and they have no idea how they really work," said Randy Burke, interim director of utilities for the Sea Ranch Association. "You have an uneducated populace up here that needs to have a turnkey system. They end up challenging their septic systems. A lot of things go down the toilet that people aren't supposed to flush down them."

Sea Ranch utility officials, though, have done a good job educating their part-time residents and renters about both the positives and negatives regarding onsite systems. The national failure rate of onsite septic systems stands at about 15%. At the Sea Ranch, this number is closer to 1%.

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Problem is, about half of the ranch's onsite systems—which come in a wide array, including sand filter, mounds, pressure distribution, and whitewater systems—have been operating for 20 or more years, and are nearing the end of their useful life spans. In the course of two decades, these systems have seen significant amounts of biological materials build up inside them. In the worst cases, the septic systems have begun failing, with wastewater bubbling to the surface. In other cases, draining time has increased significantly, resulting in odors no homeowner or renter wants to sniff.

Physical repair of these failing systems isn't an easy solution. Hiring contractors to repair or even service failing systems can cost owners up to $40,000, a large sum of money for homeowners who only want a nice vacation house.

"It's pretty serious to get hit with a bill like that," said Russ Hayter, field inspector at the Sea Ranch. "People aren't happy when they hear about how expensive it can be to solve their problems."

Sea Ranch Association officials, though, are trying something new: They're turning to Oswego, N.Y.-based Knight Treatment Systems and its White Knight septic tank insert, a product that uses a small aerator to distribute a blend of bacteria specifically designed to reopen soil passages clogged by biological materials.

"We've just started experimenting with this. If it works, it'll be a big help to some of our homeowners here who don't want to get hit with some huge repair bills," Hayter said. "We're hoping it'll give us the potential for keeping more of our older units functioning."

Background of Sea Ranch

The community got its start in 1963, when an architect and land planner named Al Boeke recommended that Oceanic California Inc., a division of developer Castle and Cooke, buy some rocky and rugged land hugging about 10 miles of coastline in Sonoma County. Boeke envisioned a community much like what Sea Ranch has become: a place where homeowners would live while impacting their surrounding

environment as little as possible. To this end, the Sea Ranch acts as a type of wildlife and game refuge. Any improvements made by either individuals or public workers must involve a minimum of grading. Utilities are required to be kept underground, and the population density low. Homes are supposed to blend into the natural landscape.

The Sea Ranch's remote location—at the north end of Sonoma County—adds to the community's charm. It also adds up to a challenge for Sea Ranch officials charged with monitoring and operating the community's water and sewer services.

"We don't get as much EPA enforcement out here as we'd like," Burke said. "We're kind of an island up here. Services are slow to get here. We have to do a lot of volunteer work or contracting ourselves, such as what we do with our sewer district."

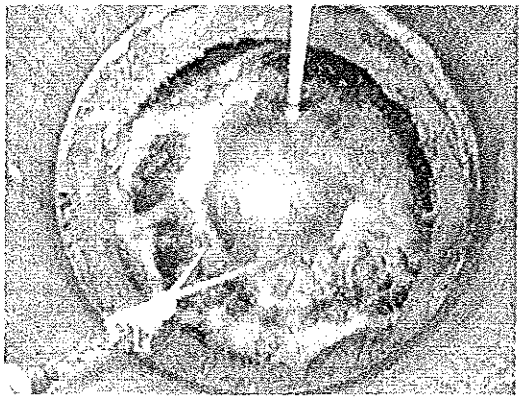
The Sea Ranch is unique because its residents are served by a combination of centralized and decentralized sewer services. The 600 homes here that aren't connected to onsite septic systems are instead served by one of two sewer treatment plants owned by the Sonoma County Water Agency. The staffers at the Sea Ranch Association Water Co. are contracted by the county to maintain and operate the water treatment plants. The community's central treatment plant can handle 27,000 gallons of water per day, while its north one can take 160,000 gallons daily. The ranch uses treated water from the north sanitation zone to irrigate its golf links. It uses treated wastewater from the central sanitation plant for irrigation.

In all, the water company is responsible for about 40 miles of pipeline, seven water tanks, and a 300-acre surface water reservoir.

The combination of decentralized and centralized systems has worked well, both the water treatment plants and the septic systems. But the high number of newer part-time residents has had an impact on the Sea Ranch's older onsite systems.

Biological Augmentation

White Knight, manufactured by Knight Treatment Systems, is an example of enhanced biological augmentation, a form of septic system care that is relatively new to the industry. The system uses specific types of bacteria to eat through clogged soil passages. The key, according to Mark Noga, vice president of market development with Knight Treatment Systems, is that the product uses bacteria specifically chosen for the job. "We act as a sort of employment agency prequalifying a biological workforce," Noga said.



Buildup of Biological material was slowing drain times in many older systems.

White Knight uses three specific microorganisms that work well together to rehabilitate organically clogged absorption systems. The company has been marketing the product for five years; earlier this summer it tackled its first onsite septic system at the Sea Ranch, about which Hayter and Burke each report positive results.

This doesn't surprise Noga. He's only surprised that more contractors and government officials have yet to give biological augmentation a try. "There is a lot of skepticism out there regarding this," he said. "That's predictable, though, in the beginning. There are a lot of people, especially those on the academic side, who view all flushable additives as snake oil. This, though, is different. White Knight really works."

To prove this, Knight Treatment Systems has conducted tests of its product in the states of Maine and New York, getting results showing that septic systems treated with White Knight perform significantly better, draining faster, after the bacteria are injected in their tanks.

The Sea Ranch provides a perfect venue for White Knight. The community features a number of septic systems nearing the ends of their design lives. The community itself sits in an environmentally sensitive area, a place where biological means to solve problems are appreciated. By flushing a system with White Knight, homeowners avoid the mess and environmental costs of having work crews displacing large chunks of land. This also minimizes the potential for future erosion.

Finally, the residents whose systems are treated with White Knight can save significant amounts of money working with White Knight rather than replacing an entire system. Biologically treating an existing septic system costs around $6,000, while replacement could easily cost nearly twice that amount, Hayter said.

"This is a win-win for everyone involved," Noga said. "There are economic advantages to the homeowners and you see minimal disturbance of the existing landscape." White Knight, though, cannot work for every onsite system. Company officials perform site investigations to first make sure that the system failures are the result of biological clogging. White Knight only corrects failures that are caused by this.

The system at Sea Ranch that has been treated with White Knight is an example of one that has failed because of biological reasons.

First Use

The Sea Ranch Association Water Co. currently monitors about 1,250 onsite septic systems. The company educates homeowners about how the systems work, how they should best take care of them, and what they should do if a system begins to fail.

Even with education, though, problems do arise, especially with the community's older systems.

"It's become an increasingly common issue with us," said Hayter. "On a lot of our older systems, the drain times are increasing because of the buildup [of biological material] in the drainfield. Before the biological augmentation process, the only option homeowners had was physical repair. That could cost many thousands of dollars and up—up to $40,000. It's a pretty serious issue to get hit with something like that."

This summer, the Sea Ranch turned to White Knight, applying the enhanced biological product with an aeration pump that is slightly larger than the pumps operating aquariums. This creates an augmented sludge filled with active bacteria that aggressively attack the dead bacteria that form clogs of biological material.

The first system treated with White Knight is connected with a rental unit that sits about 100 feet from the ocean bluff. Sea Ranch officials, and the home's owner, have had problems with the septic system for about four years, Hayter said.

Sea Ranch officials will be watching the system closely. Knight Treatment Systems estimates that it takes from three to six months to see any remediation effects from White Knight applications.

So far, though, Sea Ranch inspectors like what they see. Hayter and fellow water company staffers inspected the treated system a week after the application, concluding that White Knight appears to be working as advertised.

"I was impressed with the redemption of the odor coming from the system," Hayter said. "That's the first thing you notice. We are very hopeful about this. If it can remediate the biological material on this system, it can save our homeowner many thousands of dollars."

Noga expects the Sea Ranch's experiment to prove exactly this. And he expects homeowners in the community to turn to White Knight in the future as they see how the product works. He warns that White Knight is no cure-all, however. "A big part of getting our product to work correctly is to have a proper site evaluation done," Noga said. "We have to find the real cause of the problem up front. If it's not a problem caused by biological reasons, White Knight is not going to do anything. Sometimes we'll find that something else has to be done in conjunction with using White Knight to solve the problem."

In the meantime, Sea Ranch water company officials will continue to educate their homeowners about the importance of treating the onsite systems properly, an effort whose monthly news bulletin that usually includes a story by Hayter. Regular e-mails frequently contain information about onsite system care. The community also conducts regular tests of onsite systems to make sure they are operating properly.

"We open our doors to anyone who wants to come in and talk to us about their systems," Burke said. "We still have a lot of educating to do, though. A lot of people will be surprised and ask us if they have a cesspool. We'll tell them, no, they have a septic tank."

DAN RAFTER *is a technical writer based in Chesterton, IN.*

OW - September/October 2006

Headline News

N.Y. firm, NASA develop phosphorous system

By Tracy Hayhurst

It's a long way from outer space to an in-ground septic tank, but a small upstate New York firm and NASA have had a successful collaboration.

Knight Treatment Systems of Oswego, N.Y., developed a device to remove phosphorous contamination from wastewater after its three principal members returned from a lake association meeting that focused on water quality in the New York City watershed, but it took some contact with the U.S. space program before it became a reality.

Peach Lake, which straddles New York's Westchester and Putnam counties, is crowded with cottages and development with antiquated and traditional septic systems that have contributed to declining water quality, said Mark Noga, Knight's vice president for marketing and distribution.

"We were presenting on a number of modern and emergent technologies that can deal with failing septics and treating water," Noga said. "It was ironic that people said, 'You can treat it, but what can you do for phosphorous?' There's really nothing that a small [septic] system owner could do to address phosphorous."

Excessive phosphorous levels in water cause increased plant production, which chokes off oxygen, leading to a decline in water quality.

"Peach Lake is shallow, and an awful lot of plants spring up, which is a nuisance for recreation, and the decomposition affects the water quality and affects the aquatic life," Noga said.

"We were in the back seat of a vehicle we were sharing on the return ride home from that meeting, and we stopped for a piece of pizza, and it was the proverbial 'drew it on a napkin' scenario. We talked to a patent attorney and were surprised to get approval in less than 18 months," Noga said, recalling the three-way collaboration with company President Jay Knight and Doug Nelson, vice president of science and technology.

The patent is not for the gravity-flow device -- which is known as the Knight Nutrient Reduction Device, or KnuRD for short -- but for the method used to filter the wastewater on-site. It uses a combination of different manufactured media that allow charged phosphorous

particles to bind to them and be removed, Noga said.

"We developed it to address residential concerns, but we can configure the units -- they're modular -- for commercial flows, such as restaurants or convenience stores," Noga said.

Knight said his firm found several options to their media choice, but they were too expensive.

"We completed as much testing as our resources allowed, and we knew our technology worked; however, we were hoping to find a more effective media that would not necessitate a semiannual replacement," Knight said.

The company sought help from the NASA-funded Space Alliance Technology Outreach Program, which acts as a free help desk for small businesses that need technical assistance by sharing expertise from the U.S. space program, NASA field centers and universities, and by recruiting partner companies that volunteer their time and matching the firms to try and solve a problem, said Nancy Glasgow, a spokeswoman for the alliance.

The program connected Knight Treatment with AJT & Associates, a technical services, engineering and scientific company specializing in the aerospace industry.

"There is a definite need for a type of technology such as the KnuRD," said Todd Willoughby, an AJT employee who confirmed for Knight that the company was using the best possible media to handle phosphorous.

"There are many different types of media, many of which involve the addition of other chemicals or consumables," Willoughby said. "The media they are currently using is an excellent phosphorous removal system and is the most efficient in terms of removal and cost."

AJT, which is based in Cape Canaveral, Fla., is a platinum-level partner in the Space Alliance Technology Outreach Program, as are Boeing Co., New Mexico State University and Raytheon Co.

"Engineers at the partner companies really enjoy it," Glasgow said. "They find it very rewarding to help a small business with a situation or problem that could threaten the business' very survival."

For more information, contact Knight Treatment Systems at (800) 560-2454 or KnightTreatmentSystems.com.

[Home Page]

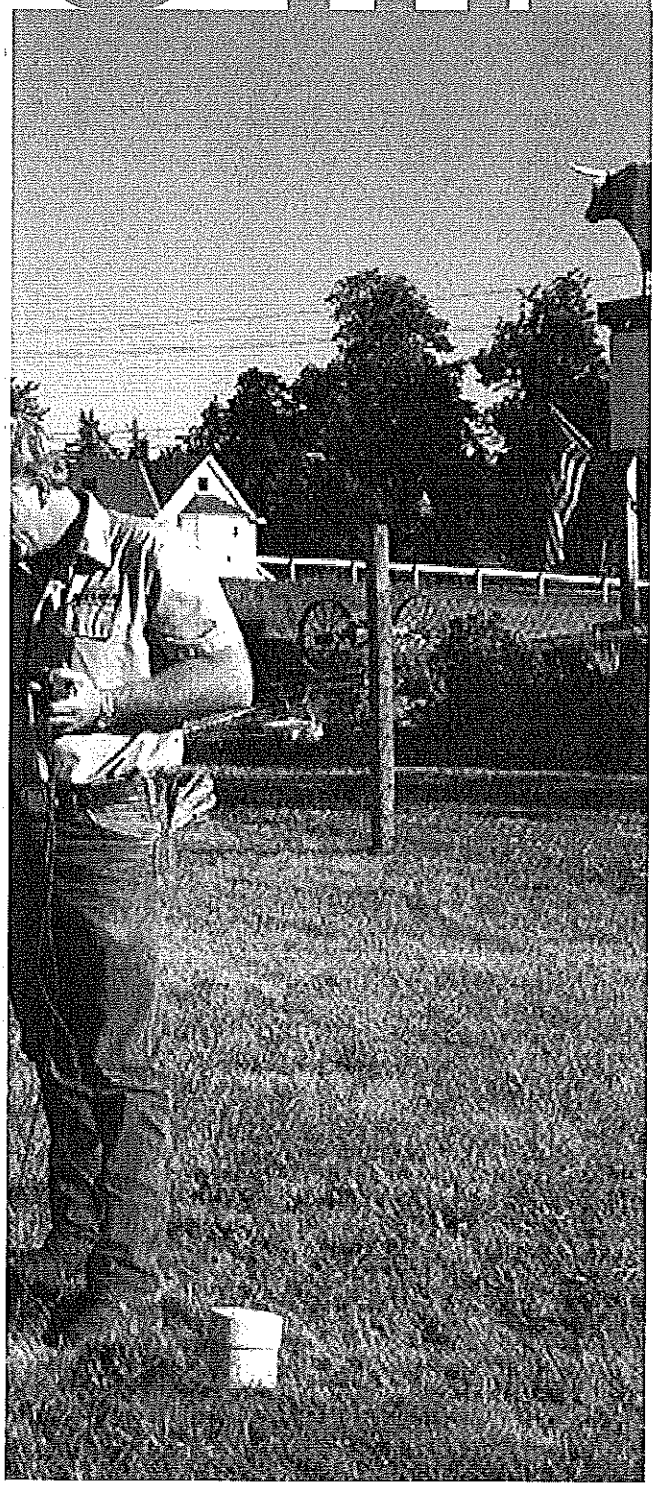
REMEDIATION T

Employees from the Town of Savannah, N.Y., and Knight Treatment Systems (Oswego, N.Y.) test the effectiveness of the district's microbial inoculator-generators.

Continual biological augmentation brings new life to eliminating the need for costly replacement

Douglas J. Nelson and Mark C. Noga

TO THE RESCUE



an old sand filter,

District 1 of Savannah, N.Y., was in trouble. Its cluster system, constructed in the late 1980s, was beginning to show its age. In early 2002, the district came under increased regulatory scrutiny because it was failing to meet its discharge permit limits (see table, p. 38). Operations staff felt the district's violations were directly related to its sand filter, which had a long-standing history of ponding. As a result, the sewer district and its residents had a tough decision: Replace the sand filter at a significant cost to the community or face a consent order. The district decided to pursue an alternate course.

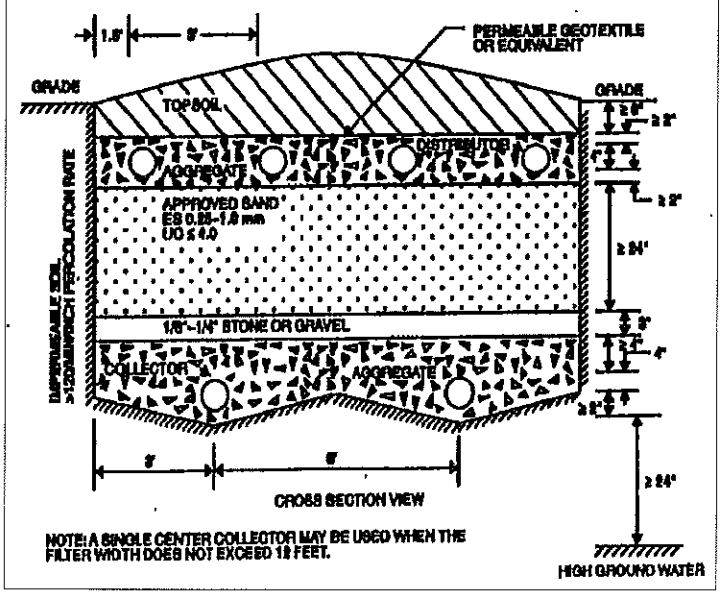
The Investigation

The Town of Savannah's decentralized plan was one of the first of its kind in the nation and was implemented as part of a U.S. Environmental Protection Agency demonstration. The town operates three separate wastewater treatment facilities that treat wastewater from three cluster-system sewer districts. All three districts use septic tanks at each parcel, with gravity effluent sewers and force mains feeding to primary treatment tanks for settling prior to secondary treatment by sand filtration. Sewer district personnel operate and maintain all home septic tanks. The facilities for District 1 use a single-pass, siphon-dosed subsurface sand filter. This system serves 22 homes.

In an effort to identify the root cause of ponding in the sand filter, operations and regulatory personnel met onsite and performed a minor excavation of the sand filter. They made the following observations:

- Water was ponded more than 0.6 m (2 ft) above the distribution piping located at the top of the filter.
- The design of the sand filter did not comply with New York State regulations (see Figure 1, p. 38); rather, the sand filter had been capped with more than 1 m (3 ft) of poor-quality soil to mitigate snowmelt and stormwater infiltration issues.
- There was a well-established, exceptionally heavy biological clogging mat at the upper surface of the sand within the filter.
- The operator was resting half of the filter periodically to promote clog mat dissipation, but the resting time was insufficient to allow acceptable drainage to resume when the filter was put back on-line.
- Sand below the clogging mat was very clean, not saturated, and in very good condition, meeting specification requirements for new sand filters.

Figure 1. Typical Sand Filter Design Under NYS Regulations



Investigators were convinced that the excessive biomat production stemmed from the soil cap, which caused reduced air exchange within the filter. While oxygen concentrations where not measured directly, the fact that a heavy, dark biomat was formed indicated that an oxygen-limiting condition existed at the surface of the sand. This heavy biogrowth, in turn, led to a saturated zone at the filter surface and decreased treatment effectiveness of the filter.

Operations personnel, in conjunction with operations assistance staff from the New York State Department of Environmental Conservation, began searching for operations-oriented solutions to the ponding. After several months of adjusted operation (primarily resting 50% of the filter area), they saw little improvement. It seemed that the filter would need to be rebuilt.

The town was in a quandary, as the cost of rebuilding the sand filter was beyond the financial means of the community. Therefore, it needed to find a cost-effective method for remediating the existing sand filter while restoring effluent quality to permit levels.

The Pilot

After gathering input from operations staff, regulatory officials, and vendors, town officials decided to install two microbial inoculator–generators within the existing District 1 primary treatment tank. The installation was a pilot study: The town agreed to pay for services and equipment after the facility had been operating successfully for 3 months.

The microbial inoculator–generator is a tank insert that is designed to grow and inoculate downstream treatment units with specific strains of bacteria. A patented matrix of *pseudomonas* and *bacillus* bacterial strains that are well-proven to reduce biomat growth are inoculated into the treatment unit, where they reproduce for discharge to the downstream device. The treatment device consists of fixed-growth media within a columnar housing. The pilot design featured a suspended growth medium that was retained within the treatment unit by a grating. (The unit is similar in design to larger units used for municipal wastewater treatment, known as the integrated fixed-film activated sludge process. Such systems are not inoculated with specific strains of bacteria as was done in this study.)

Tank contents are circulated over the growth media by airlift action created by a fine bubble

Permit Limits and Actual Performance

Parameter	Units	Influent-Average/max[1]	Permit Limit
Flow	gal/d	2079/2800[2]	3000
pH	Standard Units	7.2/7.5	6.0-9.5
Settleable Solids	mg/L	0.1/0.1	0.1
Dissolved Oxygen	mg/L		3.0
Total Suspended Solids	mg/L	441/1870	10
	#/day	-	0.250
Carbonaceous Biochemical Oxygen Demand (6/1-11/30)	mg/L	95/154	5.0
	#/day	-	0.125
Carbonaceous Biochemical Oxygen Demand (12/1-5/31)	mg/L	-	15.0
	#/day	-	0.375
NH_3 6/1-11/30	mg/L	71/160	2.0
NH_3 12/1-5/31	mg/L	-	10.0

[1] *Data supplied from NYSDEC taken from discharge monitoring reports.*

[2] *Flow is measured at an effluent weir after the sand filter.*

diffuser in the base of the unit. Flow through each unit is estimated to be 95 m^3/d (25,000 gal/d), thereby passing the contents of the 19,000-L (5000-gal) tank through each unit more than five times each day. Installation took place in May 2002 without the direct knowledge of the district residents to avoid atypical user patterns, which might skew the results.

For most important parameters, the discharge permit required effluent sampling and testing only on a quarterly basis, so the district developed a more frequent sampling and testing protocol to ensure that the facility was operating within permit limits during the 3-month evaluation. This protocol called for measuring field parameters at the time of installation and twice per week thereafter. Field parameters included the ponding level in the distribution boxes; solids levels in the distribution line turn-ups; and temperature, dissolved oxygen (DO), and pH at all three sampling locations.

The district also performed laboratory analysis for concentrations of carbonaceous biochemical oxygen demand (CBOD), total suspended solids (TSS), total Kjeldahl nitrogen (TKN), and nitrate at the time of installation and every 2 weeks thereafter. Grab samples were taken at the primary tank influent, the primary tank effluent at the dosing chamber, and the final effluent prior to the effluent step aerator. In total, the district conducted 25 sample events for field measurement and six sampling events for laboratory analysis.

The Results

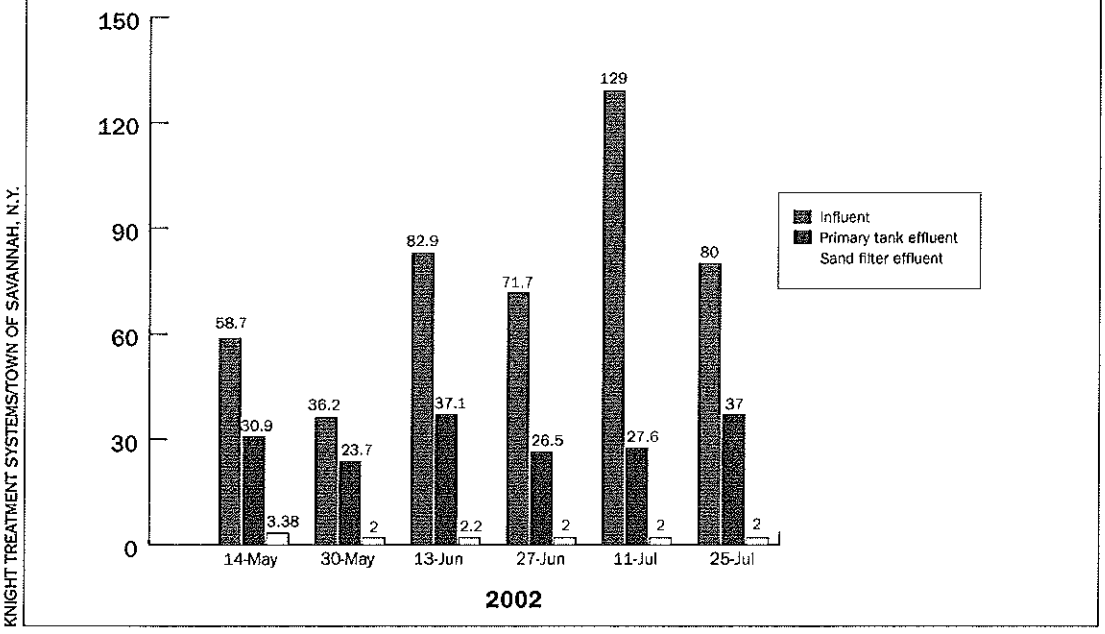
The town would consider the pilot successful if it reduced ponding within the sand filter. During his 17-year tenure at the facility, the operator had never seen the bottom of the sand filter distribution boxes during an inspection. But approximately 6 weeks after installation of the microbial inoculator–generators, the level of ponding had subsided enough to allow him to do just that.

Before installation of the microbial inoculator–generators, water was ponded more than 76 cm (30 in.) above the filter sand.

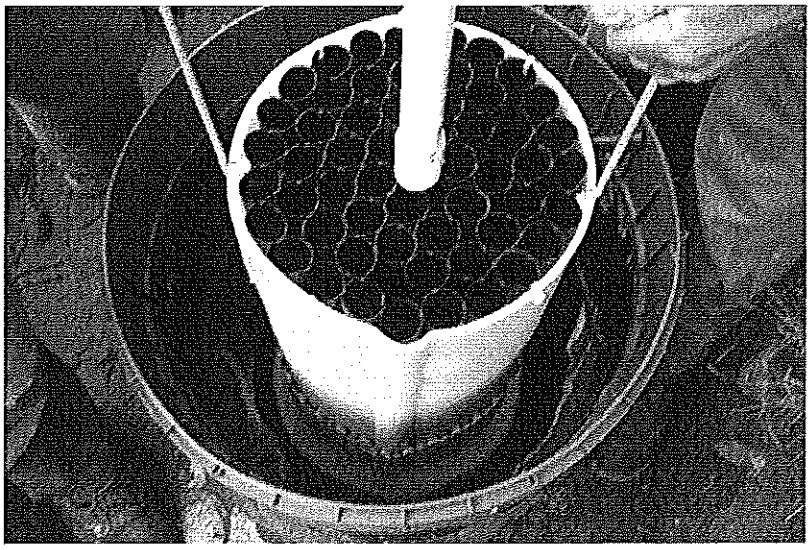
Test data were similarly encouraging. During the testing period, CBOD and TSS values for the effluent showed little change from preinstallation testing (see Figure 2, below, and Figure 3, p. 40). The level of treatment was not compromised by the reduction of the clogging mat originally found at the top of the sand in the filter. Physical observations of the filter surface indicated a significant biological growth that did not limit flow.

DO levels varied greatly, but these fluctuations

Figure 2. CBOD Reductions



KNIGHT TREATMENT SYSTEMS/TOWN OF SAVANNAH, N.Y.



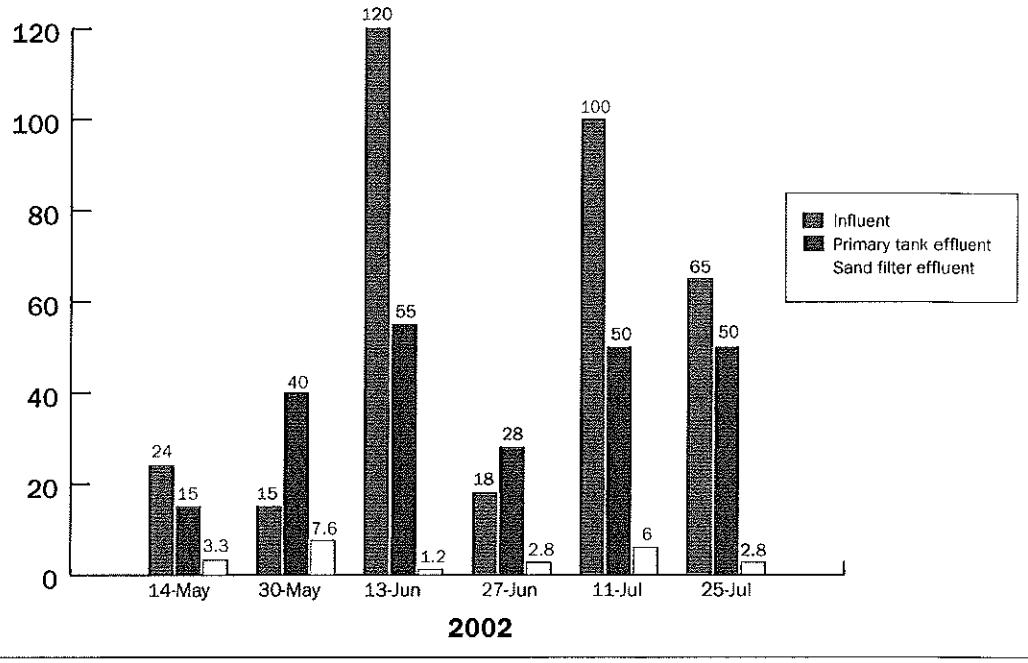
A microbial inoculator-generator is lowered into the treatment tank.

could be attributed to rain events and potential DO meter problems. It is important to note that the DO sampling point was at the beginning of the effluent aeration ladder. Effluent DO levels reportable to regulators were, in all likelihood, higher than those recorded at this sampling point.

The most notable outcome of the pilot study was the apparent effect on the nitrogen cycle. Laboratory results indicated some nitrification about 4 weeks into the study and greater nitrification as the study progressed. The onset of nitrification was caused by a combination of several factors, including rising influent temperature, decreasing CBOD within the system, and increased oxygen concentration. Nitrification has maintained the effluent TKN below 20 mg/L — more than a 60% reduction — consistently (see Figure 4, p. 41). It is assumed that nitrification was initiated by eliminating the ponding on the filter, thus lowering CBOD and increasing oxygen levels. Lack of alkalinity has not been eliminated as a limiting factor for further nitrification. Denitrification is probably taking place to a small degree, but with the low levels of CBOD within the sand filter, there is not enough carbon to support denitrification. Adding a carbon source could solve this problem.

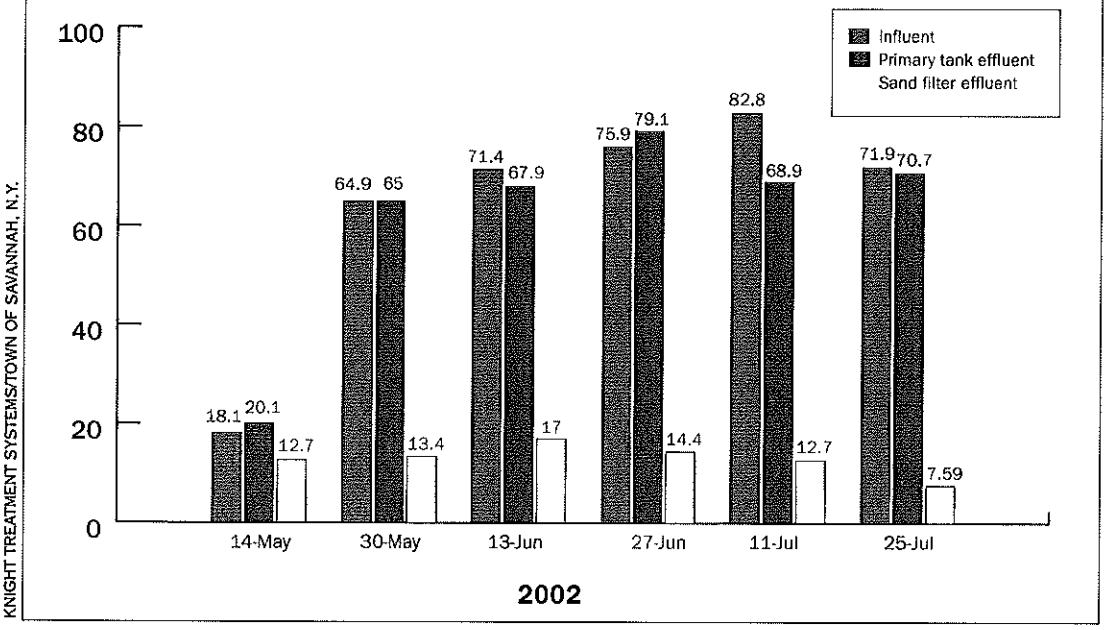
Test results for nitrates indicate two probable theories (see Figure 5, p. 41). Either denitrification was a significant factor during the July 11 sampling event or two sample containers, or their results, were inadvertently interchanged for that date. Unfortunately, there is no way to determine which of the two scenarios is correct. If the samples or their results were not switched during sampling, testing, or reporting, then the results indicate there was nearly complete nitrification within the treatment tank and equally effective denitrification within the sand filter on that date. This seems rather unlikely, and TKN

Figure 3. Total Suspended Solids Reduction



KNIGHT TREATMENT SYSTEMS/TOWN OF SAVANNAH, N.Y.

Figure 4. TKN Concentraion

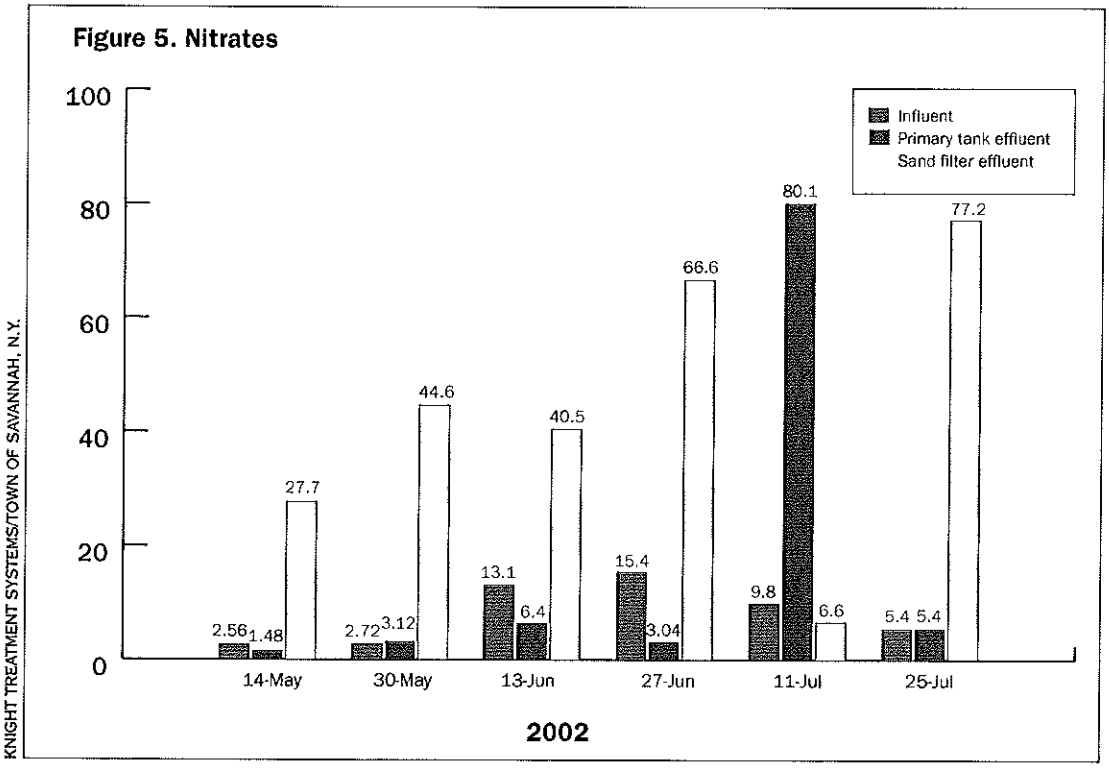


test results do not support this scenario. It is most likely that the samples were inadvertently placed into the incorrect bottles, but there is no direct evidence to support this theory.

Overall, the pilot was a success. The Town of Savannah conserved significant capital costs by choosing to bioremediate its existing sand filter. Effluent parameters of CBOD, TSS, TKN, and nitrates, as well as operational parameters of ponding level, pH, and DO, were maintained or improved as a result of the change of technology. The facility was able to maintain effluent quality as required under the State Pollutant Discharge Elimination System requirements at a very reasonable cost.

Douglas J. Nelson *is water and wastewater design supervisor and project engineer at Ruekert–Mielke Inc. (Waukesha, Wis.).* ***Mark C. Noga*** *is vice president of Knight Treatment Systems Inc. (Oswego, N.Y.).*

Figure 5. Nitrates



American Manufacturing Company, Inc.

P.O. Box 97, Elkwood, VA 22718

1-800-345-3132 www.americanonsite.com Fax 540-825-1785

July 23, 2007

Mr. Mark C. Noga
Knight Treatment Systems, Inc.
281 County Route 51A
Oswego, New York 13126

Re: White Knight Treatment Systems

Dear Mark,

Thank you for your interest in teaming with the American Manufacturing "Perc-Rite" Drip dispersal system. We accept the assurances you provided us of the water quality and reliability of the White Knight Treatment System when used in conjunction with your licensed and factory trained distributors.

We approve usage, upstream of our fully automatic ASD15 "Perc Rite" drip dispersal system, as an acceptable enhanced treatment system. A separate adequately sized stand alone drip system pump chamber must also be provided (by others) downstream of the White Knight Treatment System.

We appreciate your commitment to quality design and long term service and are therefore pleased to work with you and your dealers to provide "Perc-Rite" drip dispersal systems for onset dispersal of treated effluent.

Sincerely,

Bryan J. Allen, P.E.
American Manufacturing Company, Inc.

C:\data\wordpro\lists\White Knight Sales V.2 .lwp

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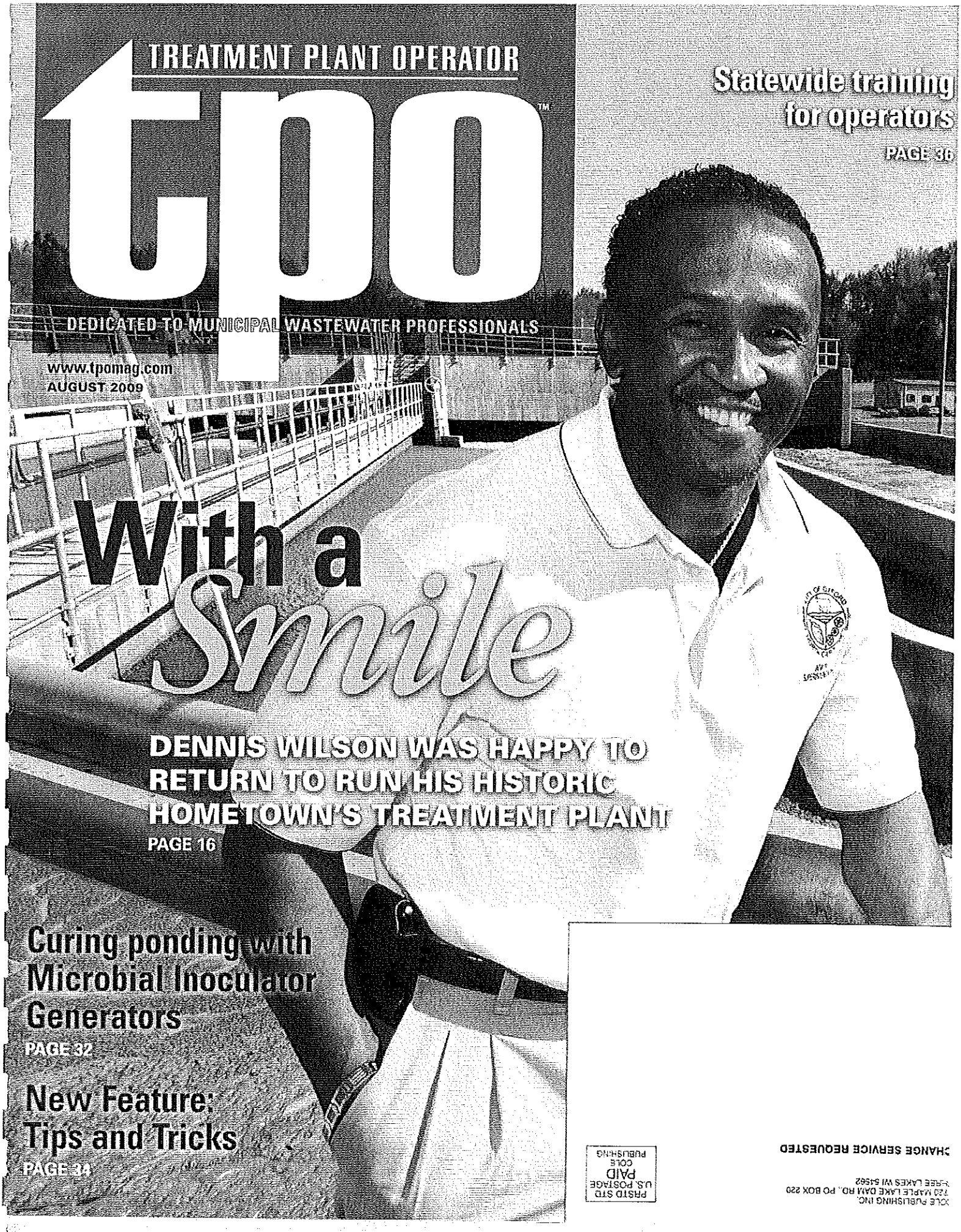

With a Smile

DENNIS WILSON WAS HAPPY TO RETURN TO RUN HIS HISTORIC HOMETOWN'S TREATMENT PLANT

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Statewide training for operators

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Curing ponding with Microbial Inoculator Generators

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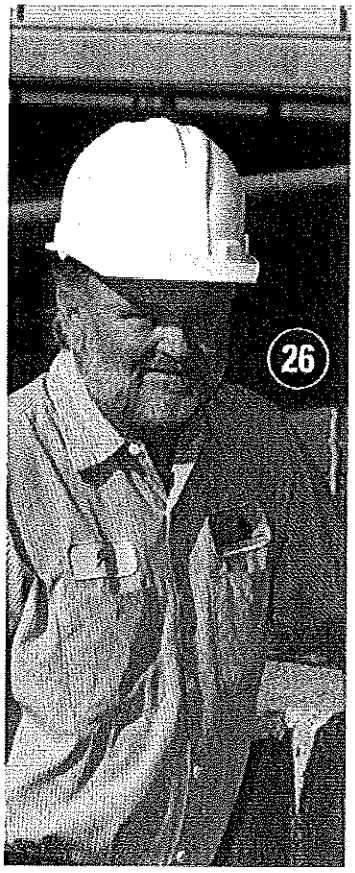

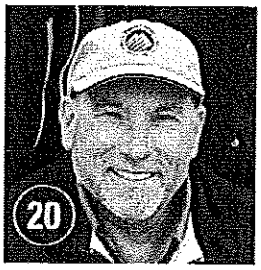

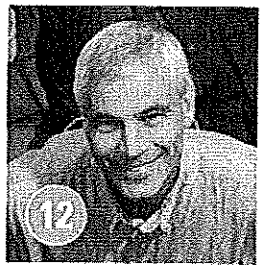

features

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Product Focus: Digital Technology

- Top Performer – Plant: Town of Crewe, Va.
- Top Performer – Plant: City of Pittsfield, Mass.
- Top Performer – Operator: Butch Green, Frisco (Colo.) Sanitation District
- Top Performer – Biosolids: City of Raleigh, N.C.
- How We Do It: Blower control system in Lockport, Ill.
- In My Words: Electronic O&M manuals at Orange County Sanitation District
- Hearts and Minds: Educational DVD in Maize, Kan.

departments

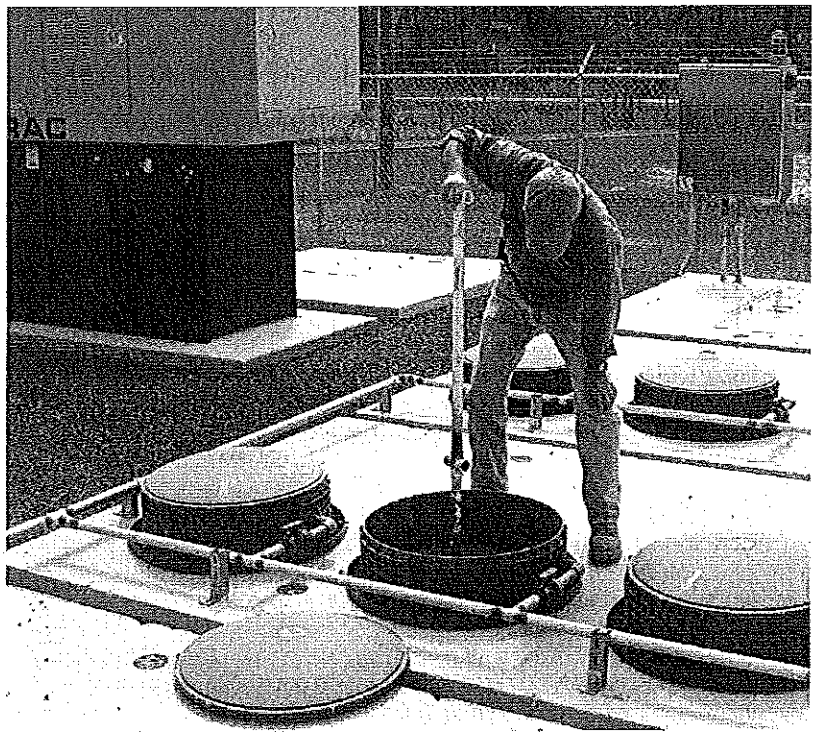
on the cover

Dennis Wilson, superintendent of the Oxford (N.C.) Wastewater Treatment Plant, loves his job of safeguarding local water resources. He learned the business working on other communities, but came back to his scenic and historic hometown in 2001. (Photography by Donn Young)

Biological Workforce

MICROBIAL INOCULATOR GENERATORS HELP A TREATMENT PLANT CURE PONDING IN TRICKLING FILTERS AND RESOLVE PERMIT ISSUES WHILE IMPROVING TREATMENT AND ODOR CONTROL

By Scottie Dayton



Assistant operator Mike Pierre checks a Microbial Inoculator Generator unit. (Photos courtesy of Rushville Wastewater Treatment Plant)

Ponding in its two open rock trickling filters and the manifold pressure relief tube spilling over during normal dose cycles plagued the Rushville (N.Y.) Wastewater Treatment Plant and produced dissolved oxygen and ammonia issues. The situation worsened each year with increased flows.

The breaking point arrived when the small lagoon system treating wastewater from the local high school neared the end of its life expectancy. The school board, which owned and operated the system, preferred hooking to the Rushville sewer instead of upgrading its facility. But the additional 8,000 gpd from the school would cause the plant to exceed its permitted discharge of 60,000 gpd.

The village hired Sniedze Associates, an engineering firm in Canandaigua, N.Y., to design a solution. Researching options, Tom Burke, P.E., learned that the town of Savannah, N.Y., had remediated its buried sand filters by using White Knight Microbial Inoculator Generators (Knight Treatment Systems Inc.). A visit to Savannah's facility and data collected on the system convinced Rushville consultants to use the technology to remediate their treatment process.

The solution proved cost-effective and ended ponding and odors, increased plant capacity, and eliminated clogging in both filter beds' pressure distribution manifolds.

THE EXPERIMENT

Each lot in Rushville, population 620, has its own septic tank maintained by the village. The tanks were connected to a sewer when the village treatment plant opened in 1988. It serves 275 residential and 12 commercial accounts generating 55,000 gpd.

Treating wastewater with filtration beds was an experiment for the state Department of Environmental Conservation. Although the technology is common and successful in the hot, arid southwest, bacteria in the exposed, uncovered beds went dormant during New York winters and drowned during spring and summer rains.

The combination created compliance issues. "Our ammonia permit is for 1.5 mg/l, and we hit 3.0 mg/l in winter," says public works supervisor Art Rilands. "We averaged 6.5 mg/l DO in summer, and we're permitted for 7.0 mg/l." Because the worst of the situations lasted only one month, regulatory authorities did not cite the plant.

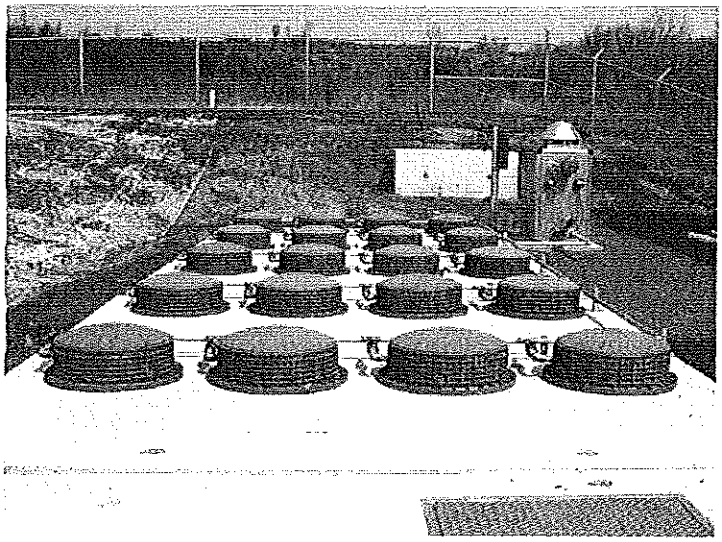
Until the upgrade, the settled wastewater from individual septic tanks gravity-fed through 4- and 8-inch PVC sewers into three 6,000-gallon community septic tanks, then into a lift station. Two 7.5-hp Hydromatic pumps in the lift station pumped the effluent 35 feet up to the plant, through a drum screen, and out to the dual 110- by 220-foot trickling filters.

SEEKING ANSWERS

To help meet CBOD and DO permit levels, 4-inch pipes at the bottom of the beds collected the liquids. Forty percent of the water gravity-flowed back to the plant for recirculation to the beds. The remainder flowed to a 10,000-gallon concrete aeration basin. A paddle-type aerator in the basin ran continuously to provide sufficient aeration before discharging water to a tributary of Canandaigua Lake.

The original design called for alternate dosing. As flows increased, however, plugged emitters became a big problem. Trying to prevent the open ones from

TPO welcomes news about interesting methods or uses of technology at your facility for future articles in the How We Do It column. Send your ideas to editor@tpomag.com or call 877/953-3301.



Wastewater passes through an aerobic "nursery" with five sections, each containing White Knight Microbial Inoculator Generator units from Knight Treatment Systems Inc.

ponding, Rilands' predecessor switched to dosing both beds simultaneously.

"That didn't work for very long," says Rilands. "He then tried enlarging the 1/8-inch emitters to 1/4 inch in the 2-inch distribution pipes. They did that on one-quarter of the west bed and gave up. It didn't work."

As a partial solution, Rilands and assistant Mike Pierre jetted the distribution lines twice a year using a DT 100 trailer-mounted pressure washer (Harben Inc.) with 3/4-inch hose. Although the jetter was rated at 8 gpm/3,000 psi, Rilands cleaned at 7 gpm/2,000 psi. It took one day to jet the lines in each bed. During cleaning, a gate valve in the plant diverted the flow to the alternate field.

UP WITH CAPACITY

The upgrade, which increased the plant's capacity to 79,000 gpd, went on-line in late August 2008. For the first time, the high school discharged to the sewer system.

> "The ponding has stopped, the microbes are eating the biomat in the filtration beds, and the odor control is much better."
> **ART RILANDS**

Before entering the plant, the settled wastewater now passes through an 80,000-gallon concrete surge tank with a coarse air diffuser, then into a 20,000-gallon concrete aerobic "nursery" tank divided into five sections. Each 4,000-gallon section holds five municipal model White Knight Microbial Inoculator Generator columns.

The 46-inch-high, 16-inch-diameter high-density polyethylene columns have 1-inch tubular growth media in the center. Inserted into the media is a packet of IOS-500 bacterial matrix fixed to an inoculating wand. Microorganisms reproduce on the media and within the mixed liquor flowing through and around the columns.

An air pump introduces a fine bubble mix through a diffuser in the bottom of each column. Rising bubbles oxygenate the wastewater and activate the initial charge of bacteria, which digest the organic constituents. Effluent from the generators is pumped through the drum screen, then to the filter beds. As the microorganisms populate the nursery, enough are discharged to the beds to continue biological remediation.

GETTING BETTER

Effluent is recirculated as before, except that a fine air diffuser has replaced the paddle-type aerator in the aeration basin. "The diffuser works better, allowing us to recirculate only 10 hours a day instead of 24," says Rilands.

Because of the late-season startup followed by a harsh winter, it could take six to 12 months before Rilands sees significant changes in DO, CBOD and ammonia levels, but he has noticed other improvements. "The ponding stopped, the microbes are eating the biomat in the filtration beds, and the odor control is much better," he says.

This spring produced a significant snow melt and heavy rains that exacerbated the treatment plant's serious infiltration issues. At the height of the event, 275,000 gpd ran through the facility without affecting treatment efficiency.

The amount of maintenance at the plant remains the same. The microbial system requires pumping every other month. "Mike and I pull the columns to make sure no debris is sticking to them," says Rilands. "The biggest culprit is paper that sometimes sneaks through. We tap the tubes with a plastic rod to dislodge any film. We also tap a rubber membrane at the bottom of the column to clean it. The work takes half a day."

The upgrade changes anaerobic wastewater to aerobic more quickly, and Rilands sees the whole treatment process working better and more efficiently. **tpo**

more info:

Harben Inc.
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www.harben.com

Knight Treatment Systems Inc.
800-560-2454
www.knighttreatmentsystems.com

The Case of the Failing Fans

Submitted by: Joe Young, wastewater water treatment supervisor, Ecology Management Inc., a business of OK Industries, Port Smith, Ark. Contact: JYoung@okfoods.com.

We have four blowers that aerate our activated sludge. Three are 100-hp and the other is 150-hp. I was having problems with overheating inside the cabinets, and it was causing all sorts of maintenance problems, including the blowers failing (quite costly at $10,000 to $15,000 per blower).

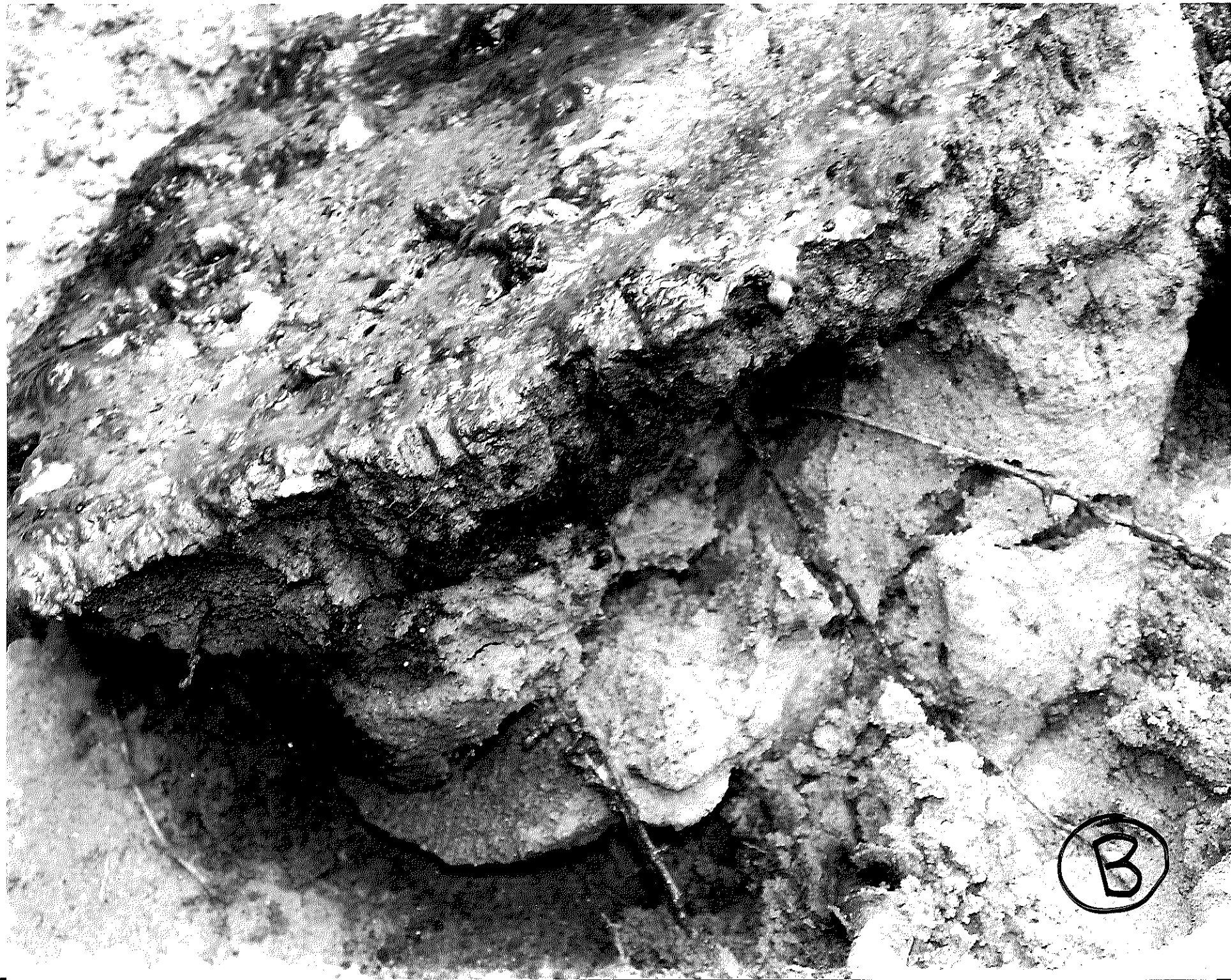
After observing the cabinets for a few days, I realized that the exhaust fans were failing. We all thought th were going out because of the blower problems, but it was just the opposit The fans were pulling cooler outside air in past the blowers for cooling pu poses. Then it would pull the heated air out of the top of the cabinets. Tl hot air had to travel over the exhaust fan motors, and the fans could n stand the extreme heat off the blowers.

I had one extra port cut into the top of each of the cabinets, for an ext fan to supply more cool air than the blower demanded. I also had the mou ing brackets flipped over. Now the fans push cool air past themselves a through the cabinets, and push the excess hot air out the original intal hole. Basically, we just reversed the path of the airflow. There are no mo overheating problems with fans or blowers — and that is a lot better for tl budget and the treatment process. tpo

Share Your Idea

Tips and Tricks is an occasional feature of *TPO* in which wastewater operators tell how they took innovative measures to solve problems.

We welcome reader contributions to this column. Please send them to editor@tpomag.com.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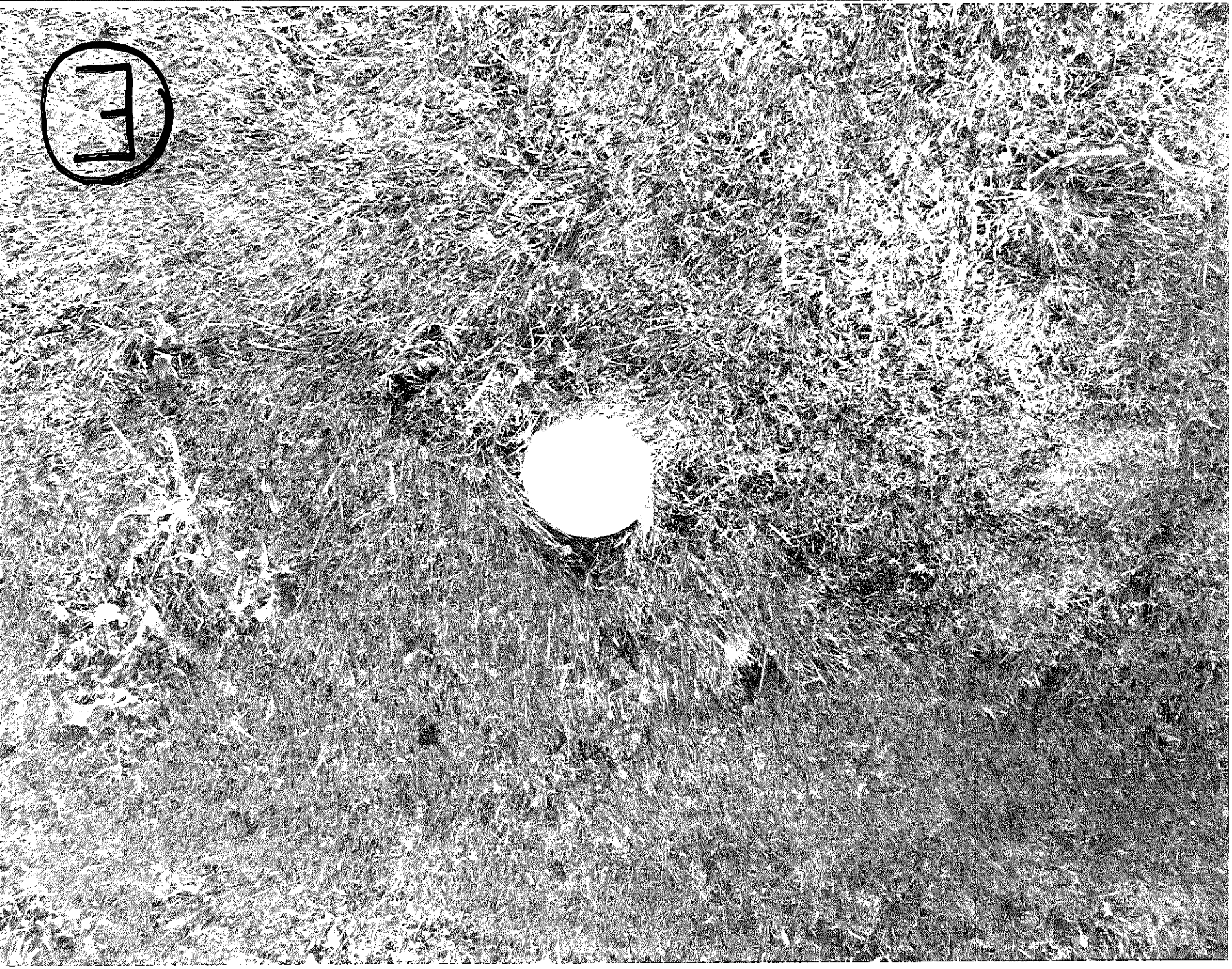
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