John Elias Baldacci
Governor

Maine Department of Health and Human Services

Maine Center for Disease Control and Prevention
286 Water Street, 3rd Floor
11 State House Station
Augusta, ME 04333-0011

Brenda M. Harvey,
Commissioner

Dora Anne Mills, MD, MPH
Public Health Director
Maine CDC Director

June 7, 2007

Infiltrator Systems, Inc.
Attn.: David Lentz, P.E.
P. O. Box 768
Old Saybrook, CT 06475

Subject: Product Registration, Remediator

Dear Mr. Lentz:

The Division of Environmental Health has completed a review of a registration application for your company's product. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules), for code registration, for use in Maine.

Product Description

The Remediator consists of a re-branded Prianaco Pirana. The Pirana was approved by the Division in a letter dated 03/27/03, which is incorporated herein by reference.

Determination

Since the Remediator is identical to the previously approved Pirana, the Division has determined that the Remediator is acceptable for general use in the State of Maine, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and Purchase/Installation Agreement.

In the event that the product fails to perform as claimed by the applicant, use of the product in Maine, including all installations approved pursuant to Chapter 18 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

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 Remediator. 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.

Please note that this approval does not authorize use of the product in an onsite sewage disposal system which has experienced a hydraulic malfunction, i.e., a "break-out" and overland run off. Such malfunctions are imminent public health hazards and must be replaced in an expeditious manner under provisions of the Rules.

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

Sincerely,

James A. Jacobsen

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

/jaj

xc: Infiltrator File
Pirana File

INFILTRATOR® SYSTEMS INC
The world leader in chamber technology

December 21, 2000

JAJ 12/26/00

DEC 2000
Received
Div. of Health
Engineering

James A. Jacobsen
Wastewater & Plumbing Control, Mgr.
Division of Health Engineering
State House Station 10
Augusta, ME 04333-5689

Subject: Infiltrator Systems, Inc. Contour Wedge Unit for Standard and High Capacity Chambers.

Dear Mr. Jacobsen:

Just wanted to follow up in writing what we discussed earlier today on the phone regarding the use of Infiltrator Systems, Inc. new Contour Wedge.

As we discussed, there is no additional sizing or sq/ft linked to the Wedge in relation to the sizing of the leachfield. The Contour Wedge is made from the same material our chambers are made of (PolyTuff) and offers left and right turns in 15 degree increments so that the Site Evaluator can maneuver the leachfield around natural contours, obstructions and other restrictive site conditions. The Wedge will be available for both Standard and High Capacity Chambers and interlocks with endplates, chambers and other wedge units. The Wedge units also support 16,000 lbs./axle, equivalent to an H-10 AASHTO rating. I have enclosed a fact sheet on the Wedge unit for your records.

Thank you for the opportunity to discuss this new product. I'm sure it will become a useful tool for Site Evaluators throughout Maine. Feel free to contact me directly at 629-5413 if you have any questions.

Best Wishes,

Tim Fortin

Tim Fortin
Infiltrator Systems, Inc.
Field Representative

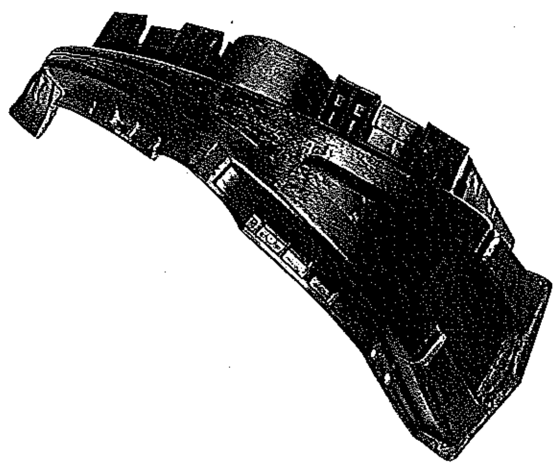
cc: Chris Stewart
Carl Thompson

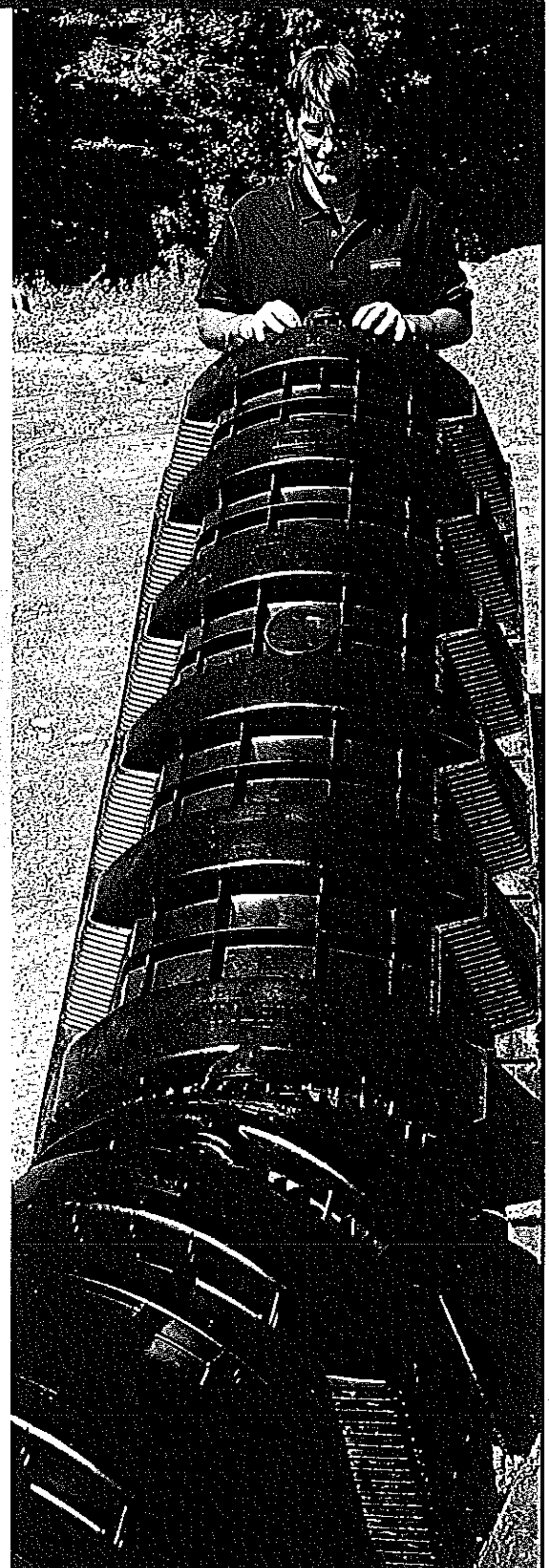
The

Contour™ Wedge

INFILTRATOR® SYSTEMS INC

Environmental Onsite Wastewater Solutions℠





The versatile Contour Wedge allows you to change the leachfield direction in 15° increments to accommodate natural terrain features and avoid obstructions. The Contour Wedge is available in right- and left-turn options for use with Standard or High Capacity Infiltrator® and SideWinder® Chambers. The unit interlocks with chambers, end plates and other wedge units. With 12" of compacted cover, it supports 16,000 lbs./axle, equivalent to an H-10 AASHTO rating.

The Contour Wedge Offers You These Unique Benefits:

- Allows left and right turns in the direction of the leachfield
- Made from PolyTuff™, a proprietary blend of recycled resins for strength and chemical resistance
- Accommodates natural contours of the land while still maintaining a shallow trench depth
- Allows installations on sites with hills, obstructions, limited space and other restrictive conditions

Tested and Proven with a 99.5% Success Rate

- Infiltrator is the number-one septic leachfield chamber system in the onsite industry.
- More than 550,000 systems (and counting) have been installed, with more than 15 million units in-ground in all 50 states and 13 countries.
- Infiltrator's established history of performance and reliability began in 1987.
- Field surveys of septic system performance and failure rates show Infiltrator chamber systems are measurably more resistant to hydraulic failure than stone and pipe systems.

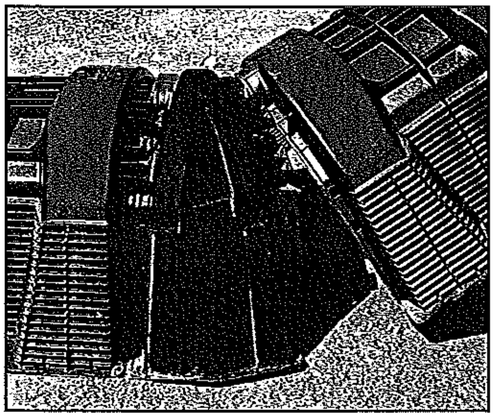
Approved in ____________________

The **Contour**™ Wedge

Installation Instructions

1. Install chambers and end plates according to Infiltrator Systems installation instructions.
2. At the point that a change in direction is desired, install left or right Contour Wedge. Do this by inserting the side of the wedge marked INLET into the outlet side of the chamber. Hold the wedge at a 45° angle and lower the wedge to lock it into position.
3. Continue adding wedges and chambers until the desired directional change is achieved.
4. Refer to Infiltrator Systems installation instructions to complete installation.

Note: Left- and right-turn wedges can be interchanged to achieve a serpentine trench configuration.



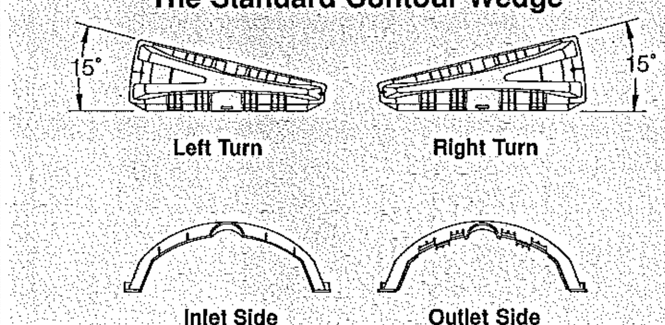
Standard Contour Wedge

Size (W x L x H)	34" x 9.5" x 12"
Storage Capacity	10 gal./1.4 ft³
Weight	3.5 lb.

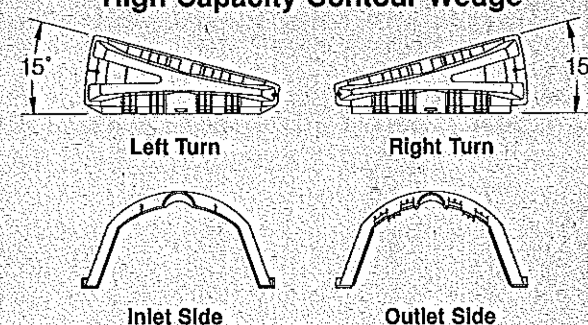
High Capacity Contour Wedge

Size (W x L x H)	34" x 9.5" x 16"
Storage Capacity	13 gal./1.8 ft³
Weight	4 lb.

The Standard Contour Wedge



High Capacity Contour Wedge



INFILTRATOR SYSTEMS, INC. STANDARD LIMITED WARRANTY

INFILTRATOR SYSTEMS, INC., ("Infiltrator") STANDARD LIMITED WARRANTY FOR SEPTIC PRODUCTS

(a) The structural integrity of each chamber and end plate manufactured by Infiltrator (collectively referred to as "Units"), when installed and operated in a leachfield of an onsite septic system in accordance with Infiltrator's installation instructions, is warranted to the original purchaser ("Holder") against defective materials and workmanship for one (1) year from the date upon which a septic permit is issued for the septic system containing the Units; provided, however, that if a septic permit is not required for the septic system by applicable law, the one (1) year warranty period will begin upon the date that installation of the septic system commences. In order to exercise warranty rights, Holder must notify Infiltrator in writing at its corporate headquarters in Old Saybrook, Connecticut, within fifteen (15) days of the alleged defect. Infiltrator will supply replacement Units for those Units determined by Infiltrator to be defective and covered by this Limited Warranty. Infiltrator's liability specifically excludes the cost of removal and/or installation of the Units.

(b) THE LIMITED WARRANTY AND REMEDIES IN SUBPARAGRAPH (a) ARE EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE UNITS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

(c) The Limited Warranty does not extend to incidental, consequential, special or indirect damages. Infiltrator shall not be liable for penalties or liquidated damages, including loss of production and profits, labor and materials, overhead costs or other losses or expenses incurred by the Holder or any third party. Specifically excluded from Limited Warranty coverage is damage to the Units due to ordinary wear and tear, alteration, accident, misuse, abuse or neglect of the Units; the Units being subjected to vehicle traffic or other conditions which are not permitted by the installation instructions; failure to maintain the minimum ground covers set forth in the installation instructions; the placement of improper materials into the system containing the Units; failure of the Units or the septic system due to improper siting, improper sizing, excessive water usage, improper grease disposal or improper operation or any other event not caused by Infiltrator. This Limited Warranty shall be void if the Holder fails to comply with all of the terms set forth in this Limited Warranty.

Further, in no event shall Infiltrator be responsible for any loss or damage to the Holder, the Units, or any third party resulting from installation or shipment, or from any product liability claims of Holder or any third party. For this Limited Warranty to apply, the Units must be installed in accordance with all site conditions required by state and local codes, all other applicable laws and Infiltrator's installation instructions.

(d) No representative of Infiltrator has the authority to change this Limited Warranty in any manner whatsoever, or to extend this Limited Warranty. No warranty applies to any party other than the original Holder.

....

The above represents the standard Limited Warranty offered by Infiltrator. A limited number of states and counties have different warranty requirements. Any purchaser of Units should contact Infiltrator's corporate headquarters in Old Saybrook, Connecticut, prior to such purchase, to obtain a copy of the applicable warranty and should carefully read that warranty prior to the purchase of Units.

Infiltrator Systems does not recommend installing onsite systems under pavement.
Chambers must be installed according to manufacturer's instructions. Failure to install according to manufacturer's instructions will void warranty.
Infiltrator Systems recommends the use of septic tank filters and laundry filters with all onsite septic systems.

INFILTRATOR® SYSTEMS INC

Environmental Onsite Wastewater Solutions℠

6 Business Park Road P.O. Box 768
Old Saybrook, CT 06475
800-221-4436 860-388-6639
FAX 860-388-6810
www.infiltratorsystems.com

1-800-221-4436

For technical assistance, installation instructions or customer service, call Infiltrator Systems at 1-800-221-4436.

U.S. Patents: 4,759,661; 5,017,041; 5,156,488; 5,336,017; 5,401,116; 5,401,459; 5,511,903; 5,716,163; 5,588,778; 5,839,844
Canadian Patents: 1,329,959; 2,004,564 Other patents pending.

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

JOHN ELIAS BALDACCI
GOVERNOR

JOHN R. NICHOLAS
ACTING COMMISSIONER

April 14, 2004

Infiltrator Systems, Inc.
Attn.: Stephen P. Minor, Sales Representative
4303 Vineland Road, Suite F1
Orlando, FL 32811

Subject: Design and Installation Manual, High Capacity Sidewinder, Standard Sidewinder, and EQ-24 Chambers

Dear Mr. Minor:

Thank you for your letter dated March 22, 2004 regarding a revised Design and Installation Manual (Manual) for your company's products. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules).

Product Description

The High Capacity Sidewinder, Standard Sidewinder, and EQ-24 Chambers consists of plastic chambers with louvered sides. The High Capacity Sidewinder, Standard Sidewinder, and EQ-24 Chambers is designed for use with conventional onsite sewage disposal areas and drip irrigation disposal areas.

Determination

On the basis of the information submitted, the Division has determined that the revised Manual for your company's products, specifically the High Capacity Sidewinder, Standard Sidewinder, and EQ-24 Chambers, meets the requirements of the Subsurface Wastewater Disposal Rules.

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 High Capacity Sidewinder, Standard Sidewinder, and EQ-24 Chambers. 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.

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

Sincerely,

James A. Jacobsen

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

/jaj

xc: Product File

INFILTRATOR® SYSTEMS INC

Environmental Onsite Wastewater Solutions℠

March 22, 2004

RECEIVED

MAR 23 2004

WASTEWATER & PLUMBING PROGRAM

Russell G. Martin, PE NSPE
Program Director, Waste water & Plumbing Control
Division of Health Engineering
Department of Human Services
11 State House Station
Augusta, ME 04333-0011

Subject: Infiltrator Systems Inc. Approval Request

Dear Russell,

Infiltrator Systems Inc. requests approval for a revised Design and Installation Manual for the High Capacity Sidewinder, Standard Sidewinder and EQ-24 Chamber. Enclosed please find the Design and Installation Manual for Infiltrator Chambers in Maine dated March 4, 2004. We have reviewed this manual with your office and have included any recommended changes. We request that footnotes a,b,c and d in appendix B be deleted for EQ-24, Standard and High Capacity Infiltrator's and a new footnote be added stating center to center spacing per manufacturer's installation manual.

Thank you very much for your review of this request. Please contact me at 207-377-8319 if any further information is required.

Sincerely,

Stephen P. Minor
Sales Representative

Eastern Regional Office
4303 Vineland Road, Suite F1 • Orlando, FL 32811 • (407) 316-0095 • Fax (407) 316-0104

3/4/04

Design and Installation Manual for Infiltrator Chambers in Maine

INFILTRATOR® SYSTEMS INC

DRAFT

MADE IN THE USA

MARCH 2004

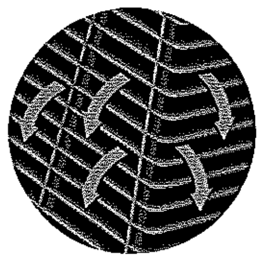
DRAFT 3/4/04

The purpose of this manual is to provide the minimum design and installation information for the use of Infiltrator chambers in Maine. Exceptions and changes may be made, but should be confirmed by Infiltrator Systems Inc. Each revised version of this manual supersedes the previous version.

The manual provides a brief description of each Infiltrator chamber with its sizing specifications. For more detailed design information, please contact Infiltrator Systems at 1-800-221-4436 for your local Maine Infiltrator representative.

SideWinder® Sidewall

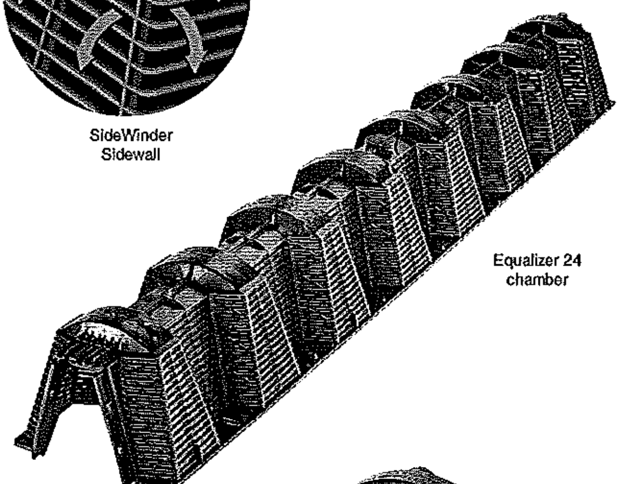
Infiltrator leaching chambers are an effective replacement for stone and pipe in septic leachfields. The products' unique, fully-louvered SideWinder sidewall wraps continuously around it for maximum infiltration area. The chamber design offers twice the leaching area below the invert than that of a same-length stone and pipe system.



SideWinder Sidewall

Infiltrator® Chambers

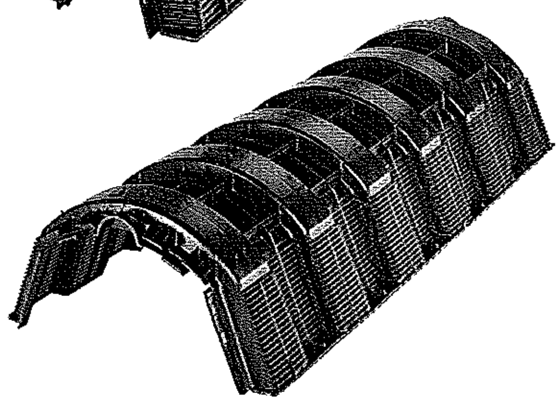
The Equalizer 24 chamber fits in an 18-inch or 24-inch wide trench. High Capacity and Standard Chambers can be installed in a 36-inch wide trench.



Equalizer 24 chamber

Equalizer 24 nominal chamber specifications

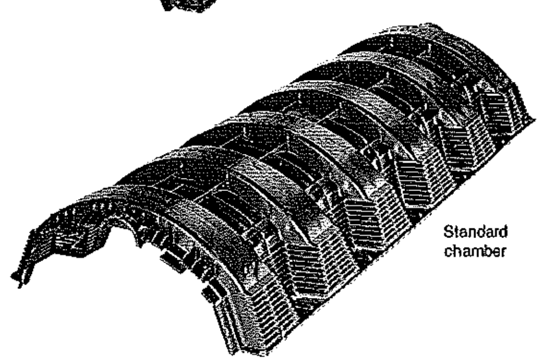
Size (W x L x H)	15" x 100" x 11"
Weight	23 lbs.
Storage	34 gal (4.6 ft³)



High Capacity chamber

High Capacity nominal chamber specifications

Size (W x L x H)	34" x 75" x 16"
Weight	38 lbs.
Storage	112 gal (15.0 ft³)



Standard chamber

Standard nominal chamber specifications

Size (W x L x H)	34" x 75" x 12"
Weight	26 lbs.
Storage	78 gal (10.4 ft³)

Maine Department of Health and Human Services

Maine Center for Disease Control and Prevention
286 Water Street, 3rd Floor
11 State House Station
Augusta, ME 04333-0011

John Elias Baldacci
Governor

Brenda M. Harvey,
Commissioner

Dora Anne Mills, MD, MPH
Public Health Director
Maine CDC Director

June 7, 2007

Infiltrator Systems, Inc.
Attn.: David Lentz, P.E.
P. O. Box 768
Old Saybrook, CT 06475

Subject: Product Registration, Remediator

Dear Mr. Lentz:

The Division of Environmental Health has completed a review of a registration application for your company's product. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules), for code registration, for use in Maine.

Product Description

The Remediator consists of a re-branded Prianaco Pirana. The Pirana was approved by the Division in a letter dated 03/27/03, which is incorporated herein by reference.

Determination

Since the Remediator is identical to the previously approved Pirana, the Division has determined that the Remediator is acceptable for general use in the State of Maine, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and Purchase/Installation Agreement.

In the event that the product fails to perform as claimed by the applicant, use of the product in Maine, including all installations approved pursuant to Chapter 18 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

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 Remediator. 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.

Please note that this approval does not authorize use of the product in an onsite sewage disposal system which has experienced a hydraulic malfunction, i.e., a "break-out" and overland run off. Such malfunctions are imminent public health hazards and must be replaced in an expeditious manner under provisions of the Rules.

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

Sincerely,

James A. Jacobsen

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

/jaj

xc: Infiltrator File
Pirana File

INFILTRATOR® SYSTEMS INC

Environmental Onsite Wastewater Solutions℠

RECEIVED
JUN 06 2007
WASTEWATER & PLUMBING PROGRAM

May 29, 2007

Mr. James Jacobsen
Subsurface Wastewater Program
Division of Environmental Health
Maine Department of Health and Human Services
286 Water Street, 3rd Floor
Augusta, ME 04333-0011

Re: Notification of Licensing Agreement for Piranaco Pirana

Dear Mr. Jacobsen,

Infiltrator Systems Inc. has entered into a licensing agreement with Piranaco to market and distribute a branded version of the Pirana (Attachment 1). A copy of your March 7, 2003 letter to Piranaco regarding registration of the Pirana under provisions of Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules is provided in Attachment 2.

Infiltrator Systems Inc. will market and distribute the branded version of the Pirana. Under the Infiltrator Systems Inc. name, the device will be branded as the Remediator™.

Please accept this letter as notification that Infiltrator Systems Inc. is planning to market and distribute the Remediator for use in Maine. By way of this letter, we are requesting written acknowledgement that the Maine Department of Health and Human Services (DHHS) has received this notification. Written acknowledgement from the DHHS will serve as verification that the Remediator is equivalent to the Piranaco Pirana and can be used in Maine under the provisions of the March 7, 2003 Pirana acceptance letter.

A suggested draft acknowledgement letter is provided in Attachment 3.

Thank you for your review of this notification. Please contact me at (860) 577-7198 if any further information is required.

Very truly yours,

David Lentz

David Lentz, P.E.
Senior Engineer
Science & Government Affairs

cc: Judd Efinger, Infiltrator Systems Inc.
Jim Healy, Infiltrator Systems Inc.
Alan Barbaro, Infiltrator Systems Inc.

Attachment 1

Verification of Licensing Agreement between Infiltrator Systems Inc. and Piranaco

PIRANA™

May 11, 2007

Mr. Dennis F. Hallahan, P.E.
Technical Director
Infiltrator Systems, Inc.
6 Business Park Rd
P.O. Box 768
Old Saybrook, CT 06475

RE: Pirana Certification for Infiltrator Systems Inc.

Dear Dennis:

Please let this correspondence serve as confirmation that Infiltrator Systems, Inc. (ISI) has a license agreement with Pirana. Infiltrator Systems, Inc. is an approved licensee of the patented Pirana Technology as approved in many states and by IAPMO.

Please contact me if I can be of further assistance.

Sincerely,

Jerome Fife, Inventor
President Pirana Co

Jerry Fife
Pirana System
1875 Joy Road, Occidental, CA 95465
Phone: (888) 511-5400 Fax: (707) 324-8900
Email: fife@sonic.net or jerry_pirana@yahoo.com
Web Site: www.pirana.biz or www.piranasystem.com

Attachment 2

Pirana Product Registration for General Use

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

JOHN ELIAS BALDACCI
GOVERNOR

March 7, 2003

Septic Solutions, LLC
Attn.: Stephen Dix, P.E.
2 Coult Lane
Old Lyme, CT 06371

Subject: Product Registration for General Use, Piranaco *Pirana*

Dear Mr Dix:

Thank you for your information regarding the Piranaco *Pirana* for registration under provisions of Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules).

Product Description

The Piranaco *Pirana* 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 plates of cuspated plastic sheeting. A remote air pump feeds air to a proprietary diffuser beneath the cuspated plates. A biological film is generated, which adheres to the cuspated plates and provides treatment of the water-borne contaminants. The Piranaco *Pirana* is inserted into conventional septic tanks, and a proprietary innoculant is introduced at regular intervals.

Claim

You have submitted testing data from two installations at the Massachusetts Alternative Septic System Test Center (Center), for the period from May of 2002 to December of 2002, rather than data from 50 installations pursuant to Section 1802.4 of the Subsurface Wastewater Disposal Rules (Rules). Since the data acquired from the installations at the Center are from controlled conditions, this office finds the submission an acceptable alternative to the requirements of Section 1802.4 of the Rules.

According to the information in our files, the Piranaco *Pirana* reduces nitrate and BOD[5] levels to less than 100 Mg/l (often, to less than 50 Mg/l); reduces suspended solids in the effluent; and rejuvenates biologically clogged disposal areas by application of low-nutrient, high dissolved oxygen effluent. The levels of total nitrogen are reduced on the order of 60 percent.

Determination

On the basis of the foregoing, the Division has determined that the Piranaco *Pirana* is acceptable for general use in the State of Maine, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and Purchase/Installation Agreement.

In the event that the product fails to perform as claimed, use of the product in Maine, including all installations approved pursuant to Chapter 18 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

OFFICE: 161 CAPITOL STREET TTY: (207) 287-2070 FAX: (207) 287-4172

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 Piranco *Piranha*. 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.

Please note that this approval does not authorize use of the product in an onsite sewage disposal system which has experienced a hydraulic malfunction, i.e., a "break out", and overland run off. Such malfunctions are imminent public health hazards and must be replaced in an expeditious manner under provisions of the Rules.

Please also note that this approval is separate from any previous approval of the product formerly known as *Pirahna*.

You may distribute copies of this letter as appropriate. 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@state.me.us

/jaj

xc: Product File
Sunstream Environmental
Piranco

Attachment 3

Suggested Draft Acknowledgement Letter Regarding
Use of the Remediator in Maine

DRAFT

STATE OF MAINE

David Lentz, P.E.
Infiltrator Systems Inc.
6 Business Park Road
P.O. Box 768
Old Saybrook, CT 06475

Subject: Product Registration for General Use, Infiltrator Systems Inc. Remediator

Dear Mr. Lentz,

Thank you for your submittal regarding the Infiltrator Systems Inc. Remediator for registration under provisions of Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules).

Product Description

The Infiltrator Systems Inc. Remediator 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 plates of cuspated plastic sheeting. A remote air pump feeds air to a proprietary diffuser beneath the cuspated plates. A biological film is generated, which adheres to the cuspated plates and provides treatment of the water-borne contaminants. The Remediator is inserted into conventional septic tanks, and a proprietary inoculant is introduced at regular intervals.

Determination

On the basis of the foregoing, the Division has determined that the Remediator is acceptable for general use in the state of Maine, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and Purchase/Installation Agreement.

In the event that the product fails to perform as claimed, use of the product in Maine, including all installations approved pursuant to Chapter 18 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

Because installation and system maintenance have 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 Remediator. 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.

Please note that this approval does not authorize use of the product in an onsite sewage disposal system which has experienced a hydraulic malfunction, and overland run off. Such malfunctions are imminent public health hazards and must be replaced in an expeditious manner under provisions of the Rules.

You may distribute copies of this approval as appropriate. If you have any questions please feel free to contact me at (207) 287-5605.

James A. Jacobsen, Environmental Specialist IV

Wastewater and Plumbing Control Program
Division of Health Engineering

PIRANA™

Piranaco Northeast
P. O. Box 275
Cape Elizabeth, ME 04107

1/3/2006

Dear Professional Site Evaluator,

I am writing to introduce you to The Pirana™ Aerobic Bacterial Generator.

The Pirana™ is being widely used in new and existing systems in Maine and across the U.S. It has been approved for remediation and for reduction in Maine. Our approval can be seen at: http://www.maine.gov/dhhs/eng/plumb/misc/products_list_12-07-05.xls

We are also certified by I.A.P.M.O. See that organization at: http://www.iapmo.org/iapmo/index.asp .

We have had great success remediating failed leach fields and we are building an interest in this state for installations in new systems. We have been installing in new systems in other parts of the country for over 10 years.

The Pirana™ has several advantages for both industry professionals and property owners.

1. Significant increase in leach field longevity.
2. Minimum site disturbance. No excavation necessary.
3. High level of treatment in a conventional system.
4. Significant reduction of environmental impact.
5. Affordable advanced wastewater treatment.
6. Reductions in leach fields using tried and true pipe and gravel field material.
7. 50% reduction when a Pirana™ is incorporated in a design.
8. An additional reduction of up to 50% if combined with other advanced systems under appropriate conditions.
9. Simple, uncomplicated, tested, effective.

The reduction comes from table 603.1 of the Subsurface Wastewater Disposal Rules.

Strength of waste water entering the disposal field (BOD5 plus TSS)	Adjustment factor (AF)
30 or less milligrams/liter	0.5
52	0.6
82	0.7
122	0.8
175	0.9
240	1.0
320	1.1
420	1.2
530	1.3
660	1.4
810	1.5
985	1.6
1180	1.7
1400	1.8
1645	1.9
1920	2.0

JOHN ELIAS BALDACCI
GOVERNOR

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

April 3, 2003

George Vinskey
77 Glendale Road
Amherst MA 01002

Subject: White Knight and Pirana treatment units

Dear Mr. Vinskey:

Thank you for your letter of March 27, 2003. As you requested, here are the contact data for both the Pirana and the White Knight.

Septic Solutions, LLC Attn.: Stephen Dix, P.E. 2 Coult Lane Old Lyme, CT 06371	Knight Treatment Systems Attn.: Jay Knight 281 Country Route 51A Oswego, NY 13126

If you have any further 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: Pirana File
White Knight File

PRINTED ON RECYCLED PAPER

77 Glendale Rd
Amherst MA 01002
27 March 2003

State of Maine (State House)
Division of Engineering Health
Augusta, Maine 04330

APR 2003

Dear Sir or Madam:

I read a recent news item that Maine has given approval of a new Septic System technology. I am interested in learning more about this new system. I would be grateful to you if you would send me the address of the Companies you are dealing with —

The white Knight and Pirone

I would be grateful to you for any information you can send me regarding your experience with this system.

Thank you for your kind attention to this matter.

Sincerely
George Vinskey

George Vinskey
Lt. Col. USAF (Ret.)
77 Glendale Road
Amherst, MA 01002

Jacobsen, James

From: Jacobsen, James
Sent: Wednesday, April 02, 2003 9:57 AM
To: 'Stephen Dix'
Cc: Murphy, James F. (DEP); Martin, Russell
Subject: RE: Information for MA

Stephen,

Again, I don't **have** that knowledge. I am not aware, firsthand, secondhand, or otherwise, of **any** Pirana units' installation up here.

The supporting data in the Piranaco application was from various installations in California, which it should be obvious I have not seen. The rest of the supporting data came from your submission of MASSTC data. Again, I have not seen this test installation. Further, I am not aware if any Pirana units have even **been** installed in Maine yet.

I cannot testify to that which I do not know. Sorry.

James Jacobsen, ES IV

-----Original Message-----
From: Stephen Dix [mailto:sdix@ctol.net]
Sent: Wednesday, April 02, 2003 9:31 AM
To: Jacobsen, James
Subject: Re: Information for MA

on 4/2/03 8:58 AM, Jacobsen, James at James.Jacobsen@maine.gov wrote:

> Stephen,
>
> Sorry, but I can't do that. I have not seen any installed Piriana units,
> and I have had zero feedback from owners. I simply don't have the knowledge
> you want me to pass on. The only system I have personal, first hand
> knowledge of is a Pirahna/White Knight unit installed before the "split"
> beteween Piranaco and Knight Treatment Systems.
>
> James Jacobsen, ES IV
>
>
> -----Original Message-----
> From: Stephen Dix [mailto:sdix@ctol.net]
> Sent: Monday, March 31, 2003 2:49 PM
> To: Jacobsen, James
> Cc: Murphy, James F. (DEP)
> Subject: Information for MA
>
>
> Jim,
> Just as you have applied the research data generated from the MAASTC to
> approve the product in Maine the regulatory officials at MA DEP would like
> your opinion of the performance of early residential Pirana systems in
> Maine. Given the test data from MASSTC they are only interested in the
> hydraulic performance. Jim Murphy at MA DEP told me he would like a simple
> statement from you concerning recovery of test systems. He has statements
> from officials in Maryland stating that all the systems are working fine and
> that the home owers are very pleased with the technology. They reported to
> Jim that the observed high effluent levels have not occurred following the
> installation of the treatment process. Given your review of the reports
> and observations could you call or write Jim and provide a similar
> statement? If you care to write his address is:
>
> James Murphy
> Alternative Wastewater Systems
> MA DEP
> 1 Winter Street
> Boston, MA 02211

>
> You could also call him at 617-292-5677.
>
> I will pass your name and number on to him this week. I'm sure he will
> call you at 207-287-5695 if he does not hear from you shortly.
>
> We greatly appreciate your help leading the way on system field testing for
> this product. Developing the documentation for any new product takes time
> and hopefully with your experience in writing we can minimize future
> requests for communication to other state regulatory officials.
>
> Sincerely,
>
> Stephen P. Dix, P.E.
> Septic Solutions LLC
>
>

Jim,
MA DEP is seeking any information on the early init(s). Whatever you can provide, even if it just on one system would be fine. They also greately respect your opinion so just a simple statement concerning when the system was installed and it current operating status would be fine. Again, they are not interested in water quality but the ability of the system to keep the effluent below ground. If you know more such as how much of the system is in use that would be icing on the cake. Any chance you could get a note to Jim Murphy today?

Steve

From: Jacobsen, James
Sent: Wednesday, April 02, 2003 8:58 AM
To: 'Stephen Dix'; Jacobsen, James
Cc: Murphy, James F. (DEP); Martin, Russell
Subject: RE: Information for MA

Jacobsen, James.vcf

Stephen,

Sorry, but I can't do that. I have not seen any installed Piriana units, and I have had zero feedback from owners. I simply don't have the knowledge you want me to pass on. The only system I have personal, first hand knowledge of is a Pirahna/White Knight unit installed before the "split" beteween Piranaco and Knight Treatment Systems.

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-----Original Message-----
From: Stephen Dix [mailto:sdix@ctol.net]
Sent: Monday, March 31, 2003 2:49 PM
To: Jacobsen, James
Cc: Murphy, James F. (DEP)
Subject: Information for MA

Jim,

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James Murphy
Alternative Wastewater Systems
MA DEP
1 Winter Street
Boston, MA 02211

You could also call him at 617-292-5677.

I will pass your name and number on to him this week. I'm sure he will call you at 207-287-5695 if he does not hear from you shortly.

We greatly appreciate your help leading the way on system field testing for this product. Developing the documentation for any new product takes time and hopefully with your experience in writing we can minimize future requests for communication to other state regulatory officials.

Sincerely,

Stephen P. Dix, P.E.
Septic Solutions LLC

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

JOHN ELIAS BALDACCI
GOVERNOR

March 7, 2003

Septic Solutions, LLC
Attn.: Stephen Dix, P.E.
2 Coult Lane
Old Lyme, CT 06371

Subject: Product Registration for General Use, Piranaco ***Pirana***

Dear Mr. Dix:

Thank you for your information regarding the Piranaco ***Pirana*** for registration under provisions of Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules).

Product Description

The Piranaco ***Pirana*** 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 plates of cuspated plastic sheeting. A remote air pump feeds air to a proprietary diffuser beneath the cuspated plates. A biological film is generated, which adheres to the cuspated plates and provides treatment of the water-borne contaminants. The Piranaco ***Pirana*** is inserted into conventional septic tanks, and a proprietary innoculant is introduced at regular intervals.

Claim

You have submitted testing data from two installations at the Massachusetts Alternative Septic System Test Center (Center), for the period from May of 2002 to December of 2002, rather than data from 50 installations pursuant to Section 1802.4 of the Subsurface Wastewater Disposal Rules (Rules). Since the data acquired from the installations at the Center are from controlled conditions, this office finds the submission an acceptable alternative to the requirements of Section 1802.4 of the Rules.

According to the information in our files, the Piranaco ***Pirana*** reduces nitrate and BOD^5 levels to less than 100 Mg/l (often, to less than 50 Mg/l); reduces suspended solids in the effluent; and rejuvenates biologically clogged disposal areas by application of low-nutrient, high dissolved oxygen effluent. The levels of total nitrogen are reduced on the order of 60 percent.

Determination

On the basis of the foregoing, the Division has determined that the Piranaco ***Pirana*** is acceptable for general use in the State of Maine, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and Purchase/Installation Agreement.

In the event that the product fails to perform as claimed, use of the product in Maine, including all installations approved pursuant to Chapter 18 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

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 Piranaco ***Pirana***. 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.

Please note that this approval does not authorize use of the product in an onsite sewage disposal system which has experienced a hydraulic malfunction, i.e., a "break-out" and overland run off. Such malfunctions are imminent public health hazards and must be replaced in an expeditious manner under provisions of the Rules.

Please also note that this approval is separate from any previous approval of the product formerly known as ***Pirahna***.

You may distribute copies of this letter as appropriate. If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen

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

/jaj

xc: Product File
Sunstream Environmental
Piranaco

From: Stephen Dix [sdix@ctol.net]
Sent: Friday, February 07, 2003 10:33 AM
To: james.jacobsen@maine.gov
Subject: MA Pirana Testing

2-7 MASlo graphs 2).doc

Jim,

Here is a summary of the testing at the MASSTC at Otis. I hope you can consider this adequate documentation for general use given the other field testing of a similar product. The most recent results I receive yesterday show that the system continues to perform under exceptionally cold conditions with only 12 inches of sand. Note we cnosider this a soil treatment system with the Pirana conditioning the wastewater with bacteria that both remove pathogens and nitrogen while increasing soil acceptance rates. I'll give you a call later today to answere any questions you may have.

Stephen P. Dix PE

Jacobsen, James

From: Jacobsen, James
Sent: Wednesday, February 12, 2003 9:17 AM
To: 'Stephen Dix'
Cc: Martin, Russell; Toppan, Clough
Subject: RE: MA Pirana Testing

Jacobsen, James.vcf

Mr. Dix,

I've had a chance to give the data a very quick look, and it looks good at first glance. This office is willing to consider your request for General Use approval, based upon the data from the Massachussetts test facility, even though the data apparently only encompasses the period from July to December of 2002.

However, we can not grant General Use status for Prianaco's product based upon field data for an similar product, as you requested. Prianaco's product, the Pirana, must be reviewed on its own merit, not that of a competitor's product.

Therefore, the terms and conditons of Pirana's Provisional Approval dated April 11, 2002 remain in effect while your current proposal is under review.

Feel free to contact me if you have any questions.

James Jacobsen, ES IV

-----Original Message-----
From: Stephen Dix [mailto:sdix@ctol.net]
Sent: Friday, February 07, 2003 10:33 AM
To: james.jacobsen@maine.gov
Subject: MA Pirana Testing

Jim,
Here is a summary of the testing at the MASSTC at Otis. I hope you can consider this adequate documentation for general use given the other field testing of a similar product. The most recent results I receive yesterday show that the system continues to perform under exceptionally cold conditions with only 12 inches of sand. Note we cnosider this a soil treatment system with the Pirana conditioning the wastewater with bacteria that both remove pathogens and nitrogen while increasing soil acceptance rates. I'll give you a call later today to answere any questions you may have.

Stephen P. Dix PE

Jacobsen, James

From: Stephen Dix [sdix@ctol.net]
Sent: Friday, February 07, 2003 10:24 AM
To: james.jacobsen@maine.gov
Subject: Pirana Test Data

MATC Summary 2-7.xls

Jim,
Please select the tabs and print off the various spread sheets and figures. These figures are referred to in the report. Sorry for making this so complicated but it the best way to send it give file size limits.

Steve

Overview of MASSTC Testing

Two Pirana biological incubators were inserted into existing mature septic tanks at the Massachusetts Alternative Septic Systems Test Center (MASSTC) in May 2002. Ponded septic trenches received the effluent. Daily loading of 330 gallons a day follow an ETV protocol with all operations and sampling managed by full time test facility staff. Laboratory analysis by a certified lab followed NSF/EPA QA/QC requirements.

Hydraulic acceptance rates increased dramatically as ponding dropped, eventually leading to flux rates (Q/wetted area) of three to almost eight gallons per day per square foot. In the winter of 2003 these levels dropped slightly. Pathogen reduction was significant as the biological mat created by the new ecology maintained unsaturated flow.

Weekly, then biweekly samples revealed a progressive reduction in nitrogen. This was the result of the conversion of residual solids in the tank and the sand fill to a new ecology by facultative aerobes. Theses aerobes were generated in the tank and discharged into the sand soil by the Pirana technology. One system showed an average total nitrogen reduction of 60 percent with average concentration of 14.7 mg/l after the tank was pumped. A second former Title 5 system exhibited a low of 2.1 mg/l total nitrogen, with concentrations in a two-foot pan dropping to less than 20 mg/l in the fall. A mass balance analysis of the sump concentrations strongly suggests that the Pirana system enables the soil to reduce nitrogen levels to less than 10 mg/l. Cold temperatures do not appear to affect the reaction rates or loss of nitrogen even with the higher than normal loading rates

Test Procedure

Pirana filters were installed in two septic tanks containing 12 inches of solids. One soil system was previously installed to test alternative media. The lysimeter utilized a liner and sump below 12 inches of washed sand as shown in Figure 1. The second system upgraded an existing Title 5 control system (F2) that had a similar sludge level in the septic tank. Figure 2 show the general cross section of the Title 5 and F2-Pirana lysimeters. After about two months of testing, both Pirana tanks were pumped and restarted. The septic tank controls remained unpumped for the entire period.

The Test Center pumped sewage from a main line that served military housing. The sewage was mixed and then pumped to each test system. Under the ETV protocol, each tank received 330 gallons a day from 20 dosing events with diurnal peak flow in the morning and late afternoon and no flow between midnight and 6:00 AM. All samples were pulled from the septic tank outlet T or d-box during peak loading periods in the morning and likely reflect average concentrations discharged from these 1250-gallon tanks.

Evaluation of the transformation in the soil was through the collection effluent from pans placed two feet below the trenches or from sumps that drained the liners. A composite sample from three alterative media (Tire chip trenches) reflect treatment through12 inches of sand. Two, two-foot pans and samples from the F sump characterized soil treatment at a 2 foot or 5 foot depth. Samples at the sump were taken only because of a lack of effluent in the two-foot control pans. The sump samples reflect a blend of 67 percent Pirana effluent and 33 percent Title 5-trench effluent. A complete printout of the data is available from the test center.

Loading Rate Adjustment

While each septic or Pirana tank receives the same flow, the soil trenches receive a percentage of flow from these test tanks. Additional outlets in the d-box bypass a set percentage. For example, the Title 5 trench received effluent from a dipper d-box with four outlets. Only one outlet is connected to the trench thus 75 percent is bypassed.

To maintain flow and ponding that seems to be essential to collecting pan effluent, the loading was increased by closing the bypass outlet in the dipper box receiving Pirana effluent. As each bypass outlet was sealed the flows increased from 25 percent to 33 percent, to 50 percent, and finally 100 percent of the 330-gpd flow from the Pirana tank. Figure 3 shows the change in flow to the trenches over time. The three alternative media cells each received 1/6 the flow followed by an increase to 1/3 the flow, with each replicate trench receiving 1/3 the flow. Continued ponding in these cells likely reflects the limited unsaturated soil prior to the capture of effluent by the liner.

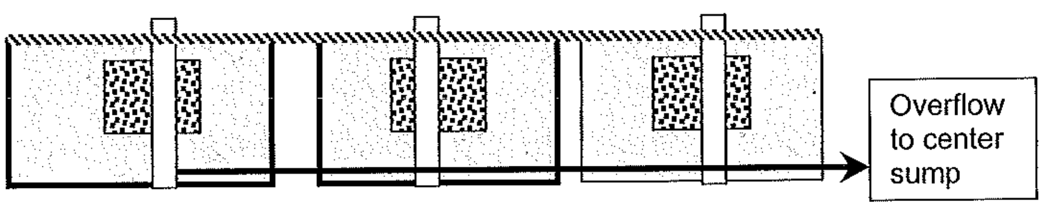
Table 1 Trench Loading Rates in 2002

Date	Loading Rates (gpd)		
	F1&F3	F2	TC
7/2	82.5	82.5	55
7/3	82.5	82.5	55
7/12	82.5	110	55
7/17	82.5	110	110
7/24	82.5	110	110
7/31	82.5	110	110
8/2	82.5	110	110
8/7	82.5	110	110
8/14	82.5	110	110
8/21	82.5	165	110
8/28	82.5	165	110
9/4	82.5	165	110
9/11	82.5	165	110
9/18	82.5	[redacted]	110

Two Title 5 systems, F1 and F3 receive 25 percent of the forward flow and follow the design-loading rate for a three-foot by two-foot deep aggregate trench in sand.

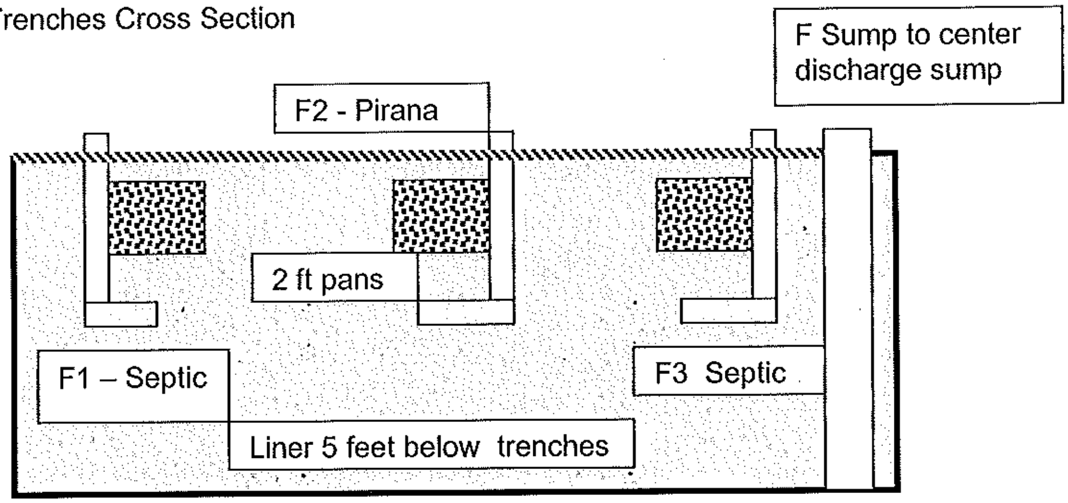
A SepticWatch 24/7 Monitor was added to both Pirana tanks. This allows a comparison of sludge levels, temperature, and scum levels to the F3 Title 5 control tank previously equipped with this sensor and data logger. Valuable insight into the changes in sludge during the summer months when temperature and biological activity increased is very useful to solids management.

Figure 1 TC Trench Cross Section



12 inches of sand between the liner and media. Each trench 11 feet by 2 feet is loaded at 110 gpd from a Pirana Tank.

Figure 2 F Trenches Cross Section



Results and Discussion

Hydraulic Analysis

After about one month of operation, the MASSTC staff began recording ponding levels in the absorption trenches. Soon after this activity was initiated and it was evident that ponding levels were dropping, bypass outlets in the d-boxes were systematically closed and loading rates increased as shown below in Table 1. Only one adjustment was made to the d-box for the Pirana/TC Tank, while three outlets were successively closed in the F2 Pirana tank d-box. Loading of the Title 5 control trenches remained constant. No further adjustments were made after September 18th as all effluent loaded from the test tanks was finally directed into the absorption trenches.

In general, it is clear that as the temperature of the effluent and soil increased, ponding levels dropped in all trenches. In the late fall when moisture increased and temperatures decreased, we see the reverse. This is consistent with the analysis of absorption trenches reported by Tyler. Lower temperatures increase soil water viscosity and reduce reaction rates, while increases in soil moisture reduce oxygen transfer. The combined affect is an increase in biological resistance to water flow and thus an increase in ponding. It should be noted that the ponding levels were measured some time in the morning during peak loading, and thus the variation may reflect when the measurements were made. Therefore, a general trend and range of values is appropriate, not a comparison of values on a given day. While some dramatic changes were observed between various readings, the biomat and level of ponding was relatively stable and did not reflect dramatic breakthroughs that have been discussed in the literature.

Table 2 Ponding levels in absorption trenches

Table 2 Ponding Depth in Absorption Trenches (Inches)

Date	F1	F2	F3	TC 1A	TC 1B	TC 2A	TC 2B	TC 3A	TC 3B
7/2	8	0	5.5	3.5	4.75	4.25	7.3	4	5.2
7/3	9.8	0	7.5	4.25	5.25	5	7.8	6	7.5
7/12	6.8	0	6.3	3.6	3.4	2	5.0	6	7.5
7/17	7.5	1.5	6	3.5	2.5	3.25	6.3	5.5	7.25
7/24	7	2	4.5	0	0.25	0.5	3.3	6.5	8.25
7/31	6.5	2.38	3	1.5	0.5	0.75	4.0	4.75	6.75
8/2	5.5	2.75	3	3.5	0	1	4.0	4.25	6.33
8/7	3.5	1.13	2.5	0.25	0.38	0.38	2.9	4.25	5.63
8/14	3.3	0.25	2.5	0.13	0.25	0.25	2.0	2.75	4.13
8/21	3	0	2.5	0.25	0.25	0.25	2.0	1.75	3.75
8/28	0	0	1.8	0.5	0.5	0.25	2.4	2.75	3.75
9/4	0	0	0	0.25	0	0.5	3.0	0	5
9/11	3	0	0	0.5	1	1	4.5	0.5	5.5
9/18	0	0	2.8	1.5	0.75	0	1.6	4.75	6
9/25	0	0	0	2.5	1.75	0	1.5	2.5	2
10/2	1.3	0.18	0	0	0.25	0	0.3	0.5	0.5
10/9	0	0	0	0	0.5	0.5	1.5	2.5	4
10/16	0.8	0	0	0	0.35	0.75	2.5	2.5	4.75
10/23	1.5	0	0	2.75	2.5	0.25	3.5	5.38	7.75
10/30	0	0	0	0	0	0.5	1.3	3	2
11/6	1	0	0	0	0	0	1.0	1	3
11/13	1.1	1	0	0	0.25	0.25	1.8	1.75	2.5
11/20	0.3	0	0	0	1.5	0.75	4.3	6.75	7.5
11/27	3	3.5	1.5	1	1.25	2.5	6.8	7	8.5
12/4	2	2.5	0			3.8			6.5
12/11	2.5	2.75	1.3	2.5	4.25	4.5		6.75	9
12/19	2.5	0	0.8			0.25	6.5	8.25	7.5
12/24	1.3	2.5	0	3.75	4.25	5.5	7.0	9.25	9.25
12/31	4.5	2.75	0	2.25	3	4.75	7.5	8	9

Flux Analysis

A better understanding of the absorption rate results from an analysis of the rate of effluent movement or flux across the soil interface. Using the continuity equation we can solve for v to get a general estimate of the flow across this interface where the area equals twice the average depth in the trench added to the basal area. Plugging in the ponding depths we can solve for the flux rate for each ponding measurement and thus drive the flow rate into the soil. Figure 2 shows these rates over time.

Figure 2 Trench Flux Rates

The estimated flux rate is a function of ponding under a constant daily loading from the pretreatment tank. As the ponding increases and the surface area increases the rate across this boundary must decrease. More even distribution of effluent compared to the unponded bottom area is also very likely, as the ponded effluent must be pulled from the biomat. The wetted rim of the trench may also discharge more effluent up and way from the trench given the greater tension gradient at this location. It should be noted that the sand at the test sight is relatively uniform and washed with a Ksat near the upper limits (1000 cm/day) reported by EPA. Therefore, the flux rates are likely well below four percent of the soils capacity to move water.

Removal of pathogens reflects this unsaturated flow. The most dramatic reduction is reflected in samples taken from the sump that received effluent after five feet of sand from both Title 5 and Pirana trenches. We need to keep in mind that the effluent is a composite from three trenches, one discharging 330 gallons (67 percent) following the Pirana and two Title 5 tenches discharging 165 gallons.

The septic tank effluent shows concentrations of 10^{7}, while after one foot of sand with Pirana effluent we are in the range of 10^{3} and after two feet of sand and septic effluent we are at 10^{2}. With the composite sample and four feet of sand dropping another log. Figure 3 presents this data graphically.

When reviewing this data we need to keep in mind the difference in loading and sampling location. The pan installed in the soil does not receive effluent consistently while the sumps represent a composite sample for all effluent treated in the soil. The loading rates to the soil are also much greater following the Pirana. The combination of an unponded surface, higher loading rate, and thus less consistent flow to the two-foot pan may explain the higher variability in data. Effluent reaching the pan after the Title 5 septic tank reflects effluent that reached this location under greater tension.

Given the challenge of collecting moisture held under tension in the soil, the sump effluent likely serves as the best estimate of pathogen reduction. While 12 inches of sand is less than desired considering the loading rate, the reduction in pathogens was remarkable. With five feet of sand, the pathogens were well below expected. The Pirana's performance is likely somewhere between less than 10 and 1000 pfu per 100 ml, well below the limits of any treatment system where samples are collected directly below the system. Comparing this pathogen reduction to a slow sand drinking water filter, an argument could be made that this soil-based system will protect groundwater at least as well as a Title 5 system.

Figure 4 Composite F Trench Sump Effluent Quality (see spreadsheet Tab)

Review of the average total nitrogen concentration values is necessary to compare changes in nitrogen as it moves through the treatment process. Wastewater is mixed in the Septic or Pirana Tank and may take several days to move through the soil. Further delays are evident as reported by Dr. Robert Siegrist. Due to these time lags, a comparison of individual samples cannot be made on a given date. Therefore, a comparison of the averages and trends over time provides the most meaningful comparison. Figures 2, 3, and 4 show the total nitrogen over time passing through the Title 5 control system. (Appendix 1 shows the forms of nitrogen.)

The control cell shows no change in average concentration as it passes though the soil, contrary to earlier findings. An average of 39 mg/l enters the system and 40 mg/l leaves the lysimeter. High values were found leaving the septic tank that may reflect when and how the samples were taken or the fact that stored solids were more volatile in the summer. More organic nitrogen was found leaving the tank compared to that entering.

Figure 5 Influent, Septic Tank and Lysimeter Total Nitrogen in T5 Septic System

The above two figures suggest an increase in nitrogen during the summer in a standard septic tank. Sampling during the morning hours with some short circuiting of fresh effluent could have lead to the high level on a few occasions, creating the impression of an increase. Release of solids stored in the tank over the winter may also explain this change during the summer. Fall readings are more in line with averages, with the colder temperature reading suggesting a possible increase in solids.

As shown in Figure 4 below, this conservation of nitrogen is evident in the effluent draining from the lysimeter with the average very similar to concentrations in the raw wastewater.

The greater variability in the soil also reflects the variation in drainage into the pan. On a number of occasions insufficient effluent was available suggesting that some evapotranspiration may have affected concentrations leaching from the soil. Unequal flow and possible release of solids stored organic in the soil may also have affected the concentrations reaching the two foot pan. Ponding levels dropped in the summer, exposing the biomat to air and allowing aerobic digestion of the biomat to occur. The fact remains that the average concentration was 40 mg/l, which is equivalent to the concentration measured in the raw influent.

Estimated Pirana Performance based on F Sump and F Pan

While the Title 5 systems shows a conservation of nitrogen Figure 6 show s the reduction in nitrogen in the soil following the Pirana. The greater lag time for reduction in the F2 trench likely reflect time needed to process the more solids in the soil and convert the bacteria to those that can utilize the nitrite and thus compete with nitrobactor. Performance in December suggests a tolerance for colder temperatures while the process continues to mature. A summary of F Sump Effluent quality and the mass balance of the F sump effluent using the average pan values for Title 5 effluent strongly suggest that the Pirana is producing effluent near the 10mg/l level.

Composite F Trench Sump Effluent Quality

Date	Notes	Temp	pH	Sp Cond(uS)	DO	Total Nitrogen	TKN	NH4(mg/l)	Nitrate	Nitrite	BOD5	CBOD	TSS (mg/l)	Alkalinity (mg/l)	Fecal Coliform
10/10		19.60	5.38	407		30	0	1.1	30.2	0.03		1.0	3.5	7	5
10/17		18.60	5.41	443		28	0	0.1	27.3	0.03		1.0	0.6	2	0
10/31		17.10	5.36	394		5	0	1.0	4.7	0.03		1.0	0.5	12	10
11/27		-	5.50	-		19	0	0.2	19.0	0.05		3.0	2.2	7	10

Estimated Pirana TN Concentration

Date	Composit F Sump TN	% Septic	Septic 2' Pan TN	% Pirana	Esimated Pirana TN
10/10	30.48	33%	40	67%	10.77
10/17	27.57	33%	40	67%	7.87
10/31	4.97	33%	40	67%	-
11/27	19.05	33%	40	67%	-

=(composit concentration - (Avg Septic concentration * % septic))
% Pirana Effluent

(Based on 2 foot Pan TN (40 mg/l) and % flow contributed by each system

Conclusion

Testing at the MASSTC demonstrates the increased efficiency and rapid recovery of trenches previously loaded with septic effluent. Actual acceptance rates, primarily at the base of the trench in sandy soil are between five and eight gpd/sf.

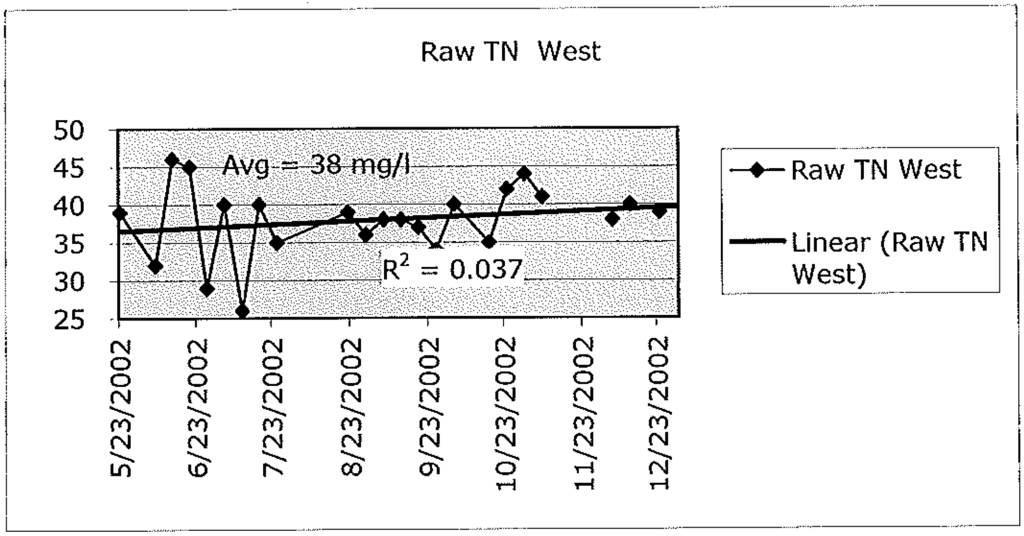
Pathogen reduction is also consistent with that found for septic effluent when more than two feet of unsaturated sand is provided. Even with as little as 12 inches of sand, a three to four log reduction can be anticipated at the base of the trench. This is consistent with the performance of single pass sand filters receiving septic effluent.

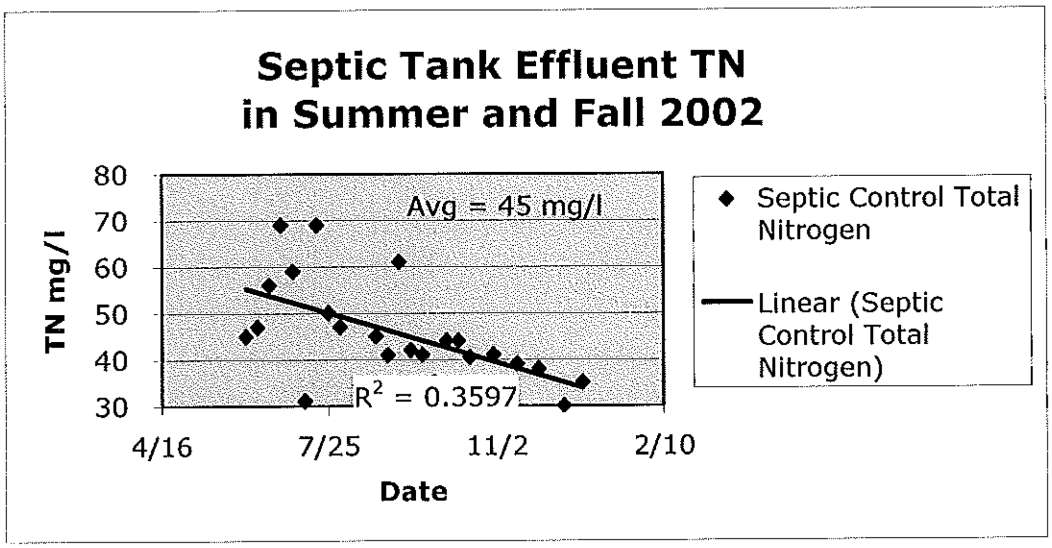
Total nitrogen concentrations are significantly lower than that found for septic systems and is consistently less than 20 mg/l with less than 12 inches of sand if the tank is pumped of residual solids at startup. Digestion of these solids, and conversion of nitrogen in these solids, can lead to higher nitrogen concentrations.

Because the soil and effluent distribution likely varies over time in a trench, pan lysimeters likely reflect localized drainage and treatment of effluent near the pan. Comparison of these values with that in a sump that drains the entire system suggests that higher levels of treatment are very likely below 10 mg/l with fecal Coliform bacteria less than 10 pfu/100 ml after passing the effluent through four feet of sand.

Given the simple installation and operation of this system, there is little question that the Pirana provides the most cost effective method for system remediation. Coupled with the 24/7 Monitor it can provide reliability second to none in the industry.

FIGURE 5 TITLE 5 TOTAL NITROGEN COMPARISON





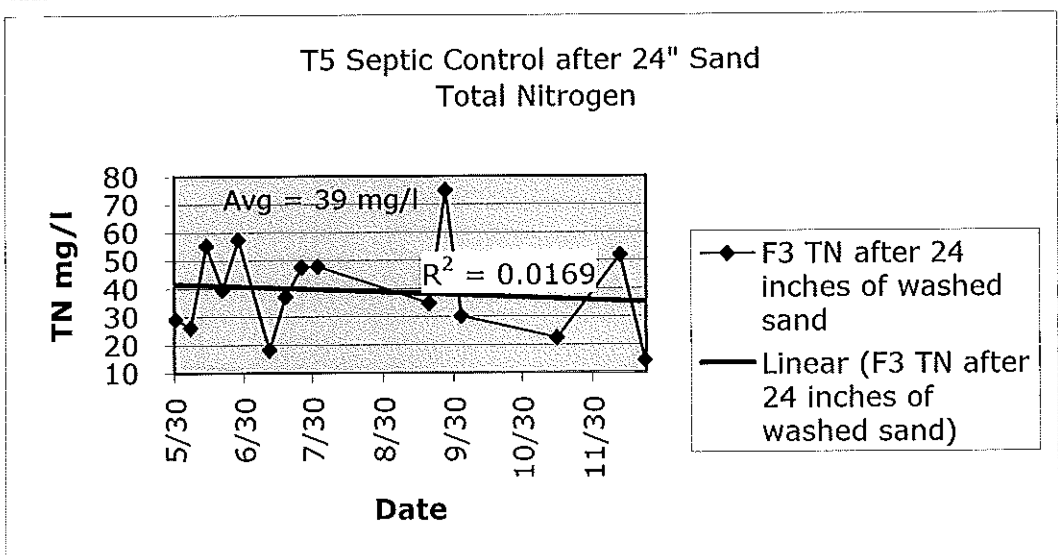
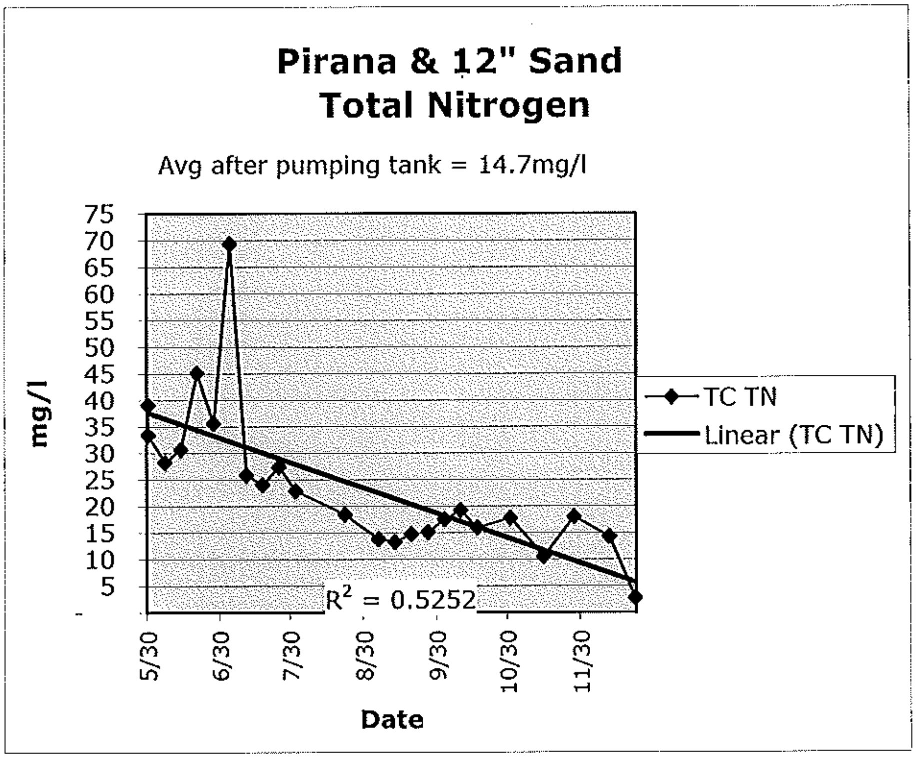
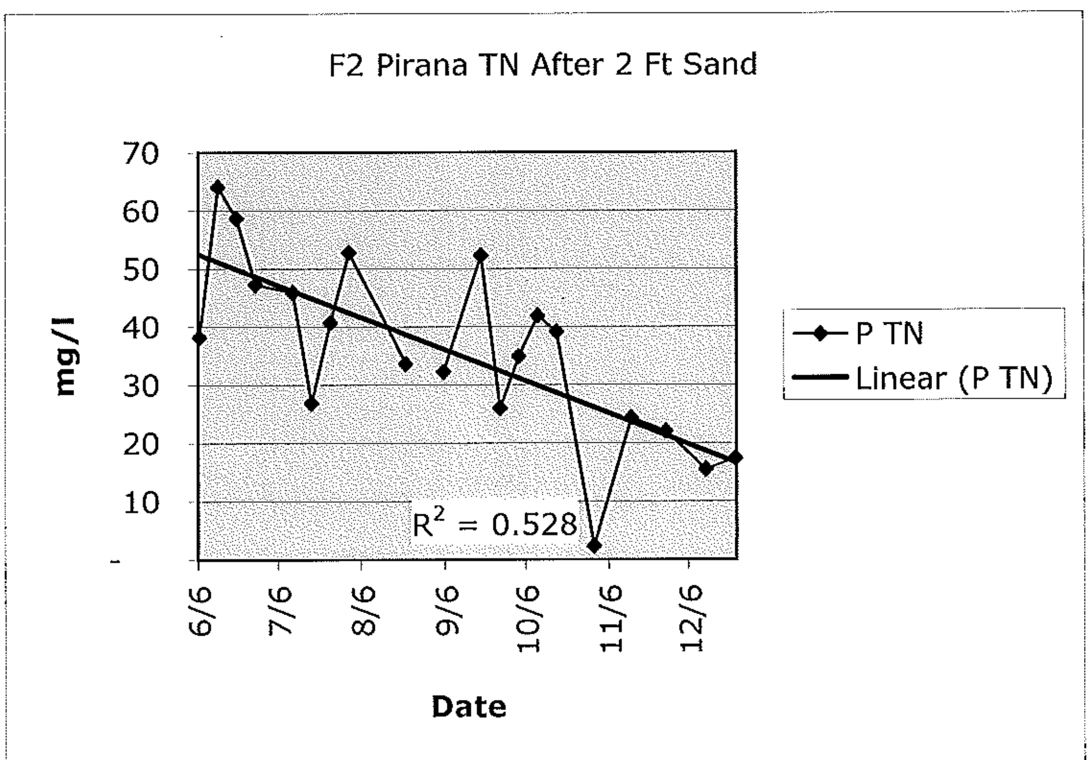


Figure 6 Total Nitrogen After Pirana





Estimated Pirana TN Concentration

Date	Composit F Sump TN	% Septic	Septic 2' Pan TN	% Pirana	Esimated Pirana TN
10/10	30.48	33%	39	67%	11.27
10/17	27.57	33%	39	67%	8.37
10/31	4.97	33%	39	67%	-
11/27	19.05	33%	39	67%	-

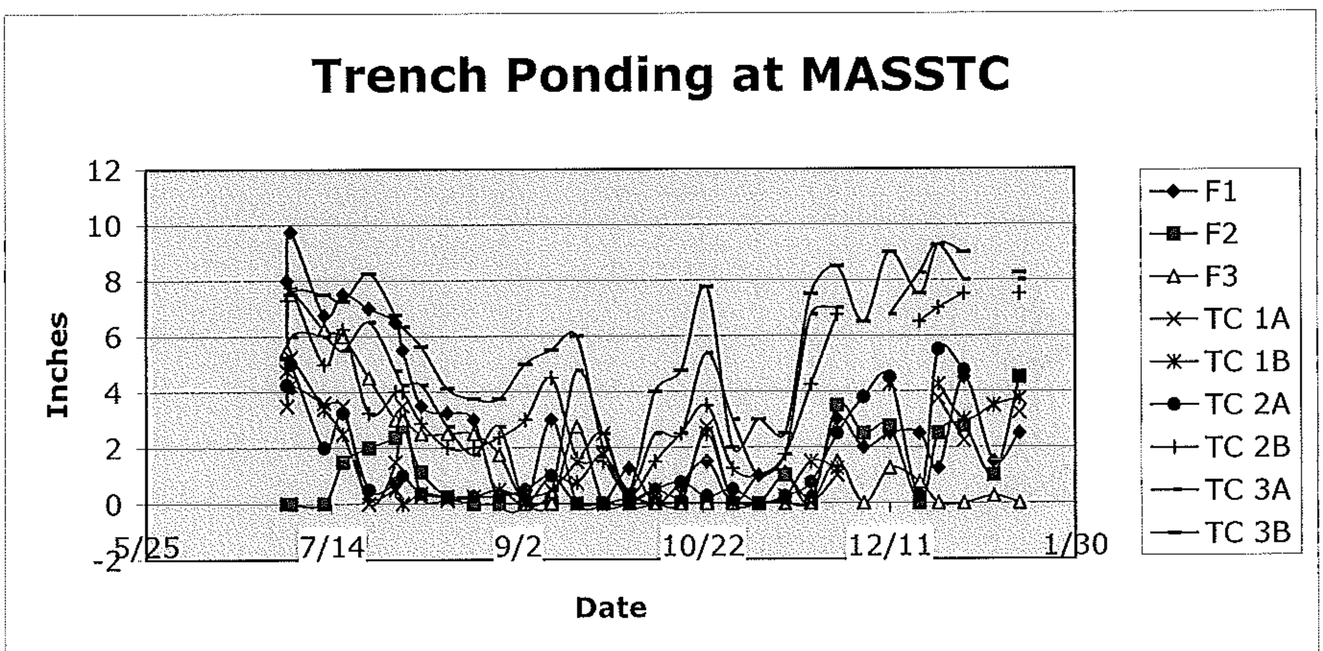
Pirana Concentration =(composit concentn x 100% - (Avg Septic concentn x % septic))
% Pirana Effluent

(Septic 2 foot Pan => TN of 39 mg/l)

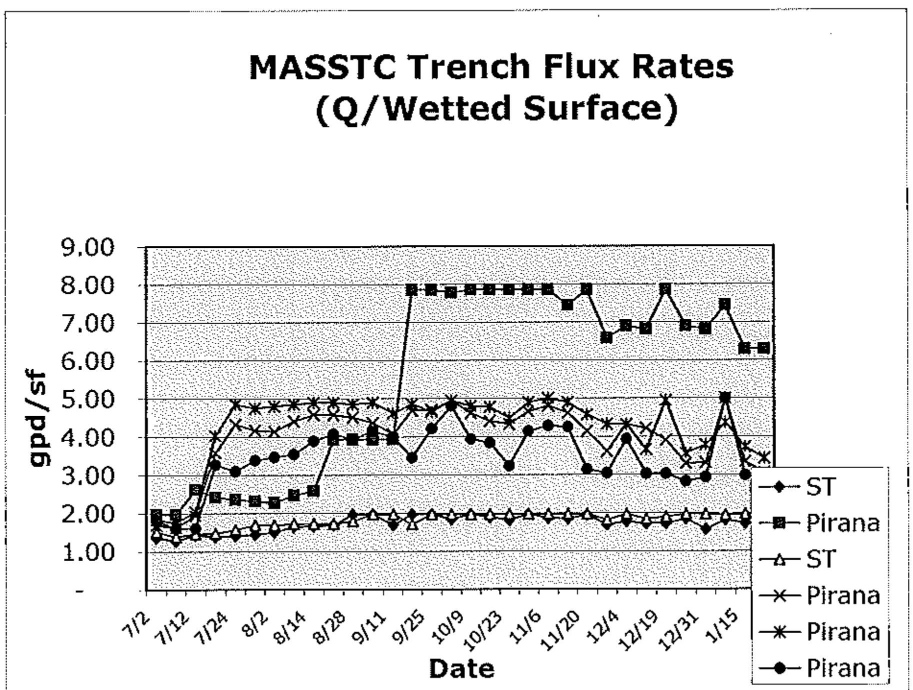
14.7 ===> 62% reduction

39

Date	Time	Date	F1	F2	F3	TC 1A	TC 1B	TC 2A	TC 2B	TC 3A	TC 3B
7/2/2006		7/2	8	0	5.5	3.5	4.75	4.25	7.3	4	5.2
7/3/2006		7/3	9.8	0	7.5	4.25	5.25	5	7.8	6	7.5
######		7/12	6.8	0	6.3	3.6	3.4	2	5.0	6	7.5
######		7/17	7.5	1.5	6	3.5	2.5	3.25	6.3	5.5	7.25
######		7/24	7	2	4.5	0	0.25	0.5	3.3	6.5	8.25
######		7/31	6.5	2.38	3	1.5	0.5	0.75	4.0	4.75	6.75
8/2/2006		8/2	5.5	2.75	3	3.5	0	1	4.0	4.25	6.33
8/7/2006		8/7	3.5	1.13	2.5	0.25	0.38	0.38	2.9	4.25	5.63
######		8/14	3.3	0.25	2.5	0.13	0.25	0.25	2.0	2.75	4.13
######		8/21	3	0	2.5	0.25	0.25	0.25	2.0	1.75	3.75
######		8/28	0	0	1.8	0.5	0.5	0.25	2.4	2.75	3.75
9/4/2006		9/4	0	0	0	0.25	0	0.5	3.0	0	.5
######		9/11	3	0	0	0.5	1	1	4.5	0.5	5.5
######		9/18	0	0	2.8	1.5	0.75	0	1.6	4.75	6
######		9/25	0	0	0	2.5	1.75	0	1.5	2.5	2
######		10/2	1.3	0.18	0	0	0.25	0	0.3	0.5	0.5
######		10/9	0	0	0	0	0.5	0.5	1.5	2.5	4
######		10/16	0.8	0	0	0	0.35	0.75	2.5	2.5	4.75
######		10/23	1.5	0	0	2.75	2.5	0.25	3.5	5.38	7.75
######		10/30	0	0	0	0	0	0.5	1.3	3	2
######		11/6	1	0	0	0	0	0	1.0	1	3
######		11/13	1.1	1	0	0	0.25	0.25	1.8	1.75	2.5
######	8-9:3	11/20	0.3	0	0	0	1.5	0.75	4.3	6.75	7.5
######	9:30-	11/27	3	3.5	1.5	1	1.25	2.5	6.8	7	8.5
######	1:00-	12/4	2	2.5	0			3.8			6.5
######		12/11	2.5	2.75	1.3	2.5	4.25	4.5		6.75	9
######		12/19	2.5	0	0.8			0.25	6.5	8.25	7.5
######		12/24	1.3	2.5	0	3.75	4.25	5.5	7.0	9.25	9.25
######		12/31	4.5	2.75	0	2.25	3	4.75	7.5	8	9
1/8/2007		1/8	1.5	1	0.3		3.5				
######		1/15	2.5	4.5	0	3.25	3.75	4.5	7.5	8	8.25



Date	Time of Date		F1	F2	F3	TC 1A	TC 1B	TC 2A	TC 2B	TC 3A	TC 3B	Date	Loading Rates (gpd) F1&F3	F2	TC	Date
7/2/2002		7/2	8	0	5.5	3.5	4.75	4.25	7.3	4	5.2	7/2	82.5	82.5	55	7/2
7/3/2002		7/3	9.8	0	7.5	4.25	5.25	5	7.75	6	7.5	7/3	82.5	82.5	55	7/3
######		7/12	6.8	0	6.3	3.6	3.4	2	5	6	7.5	7/12	82.5	110	55	7/12
######		7/17	7.5	1.5	6	3.5	2.5	3.25	6.25	5.5	7.25	7/17	82.5	110	110	7/17
######		7/24	7	2	4.5	0	0.25	0.5	3.25	6.5	8.25	7/24	82.5	110	110	7/24
######		7/31	6.5	2.38	3	1.5	0.5	0.75	4	4.75	6.75	7/31	82.5	110	110	7/31
8/2/2002		8/2	5.5	2.75	3	3.5	0	1	4	4.25	6.33	8/2	82.5	110	110	8/2
8/7/2002		8/7	3.5	1.13	2.5	0.25	0.38	0.38	2.88	4.25	5.63	8/7	82.5	110	110	8/7
######		8/14	3.3	0.25	2.5	0.13	0.25	0.25	2	2.75	4.13	8/14	82.5	110	110	8/14
8/21/200		8/21	3	0	2.5	0.25	0.25	0.25	2	1.75	3.75	8/21/20	82.5	165	110	8/21/200
######		8/28	0	0	1.8	0.5	0.5	0.25	2.38	2.75	3.75	8/28	82.5	165	110	8/28
9/4/2002		9/4	0	0	0	0.25	0	0.5	3	0	5	9/4	82.5	165	110	9/4
######		9/11	3	0	0	0.5	1	1	4.5	0.5	5.5	9/11	82.5	165	110	9/11
######		9/18	0	0	2.8	1.5	0.75	0	1.63	4.75	6	9/18	82.5	330	110	9/18
######		9/25	0	0	0	2.5	1.75	0	1.5	2.5	2	9/25	82.5	330	110	9/25
######		10/2	1.3	0.18	0	0	0.25	0	0.25	0.5	0.5	10/2	82.5	330	110	10/2
######		10/9	0	0	0	0	0.5	0.5	1.5	2.5	4	10/9	82.5	330	110	10/9
######		10/16	0.8	0	0	0	0.35	0.75	2.5	2.5	4.75	10/16	82.5	330	110	10/16
######		10/23	1.5	0	0	2.75	2.5	0.25	3.5	5.38	7.75	10/23	82.5	330	110	10/23
######		10/30	0	0	0	0	0	0.5	1.25	3	2	10/30	82.5	330	110	10/30
######		11/6	1	0	0	0	0	0	1	1	3	11/6	82.5	330	110	11/6
######		11/13	1.1	1	0	0	0.25	0.25	1.75	1.75	2.5	11/13	82.5	330	110	11/13
######	8-9:30	11/20	0.3	0	0	0	1.5	0.75	4.25	6.75	7.5	11/20	82.5	330	110	11/20
######	9:30-10	11/27	3	3.5	1.5	1	1.25	2.5	6.75	7	8.5	11/27	82.5	330	110	11/27
######		12/4	2	2.5	0			3.8			6.5	12/4	82.5	330	110	12/4
######		12/11	2.5	2.75	1.3	2.5	4.25	4.5		6.75	9	12/11	82.5	330	110	12/11
12/19		12/19	2.5	0	0.8			0.25	6.5	8.25	7.5	12/19	82.5	330	110	12/19
12/24		12/24	1.3	2.5	0	3.75	4.25	5.5	7	9.25	9.25	12/24	82.5	330	110	12/24
12/31		12/31	4.5	2.75	0	2.25	3	4.75	7.5	8	9	12/31	82.5	330	110	12/31
1/8/2007		1/8	1.5	1	0.3		3.5					1/8	82.5	330	110	1/8
######		1/15	2.5	4.5	0	3.25	3.75	4.5	7.5	8	8.25	1/15	82.5	330	110	1/15
######		1/22	2.5	4.5	0	4	5	6	9.5	8	9.75	1/22	82.5	330	110	1/22



Key to SamplinDC=> Raw wastewater fed to Septic or Pirana tanks;
FSU = effluent in sump after 4 foot of washed sand from F1+F2+F3 test cells
F2=> Pirana & 2FT = pan effluent after two feet of washed sand; DB= effluent from pretreatment tank
F3 => Standard Septic Tank; 2FT = pan effluent after 2 feet of washed sand; DB = outlet T effluent

TC => Pirana: TCSU => composit sample of 3 Pirana trenches after 12 inches of washed sand

Infiltration Rates (gpd/sf)					
ST	Pirana	ST	Pirana	Pirana	Pirana
1.36	1.96	1.50	1.69	1.82	1.81
1.27	1.96	1.39	1.63	1.75	1.60
1.43	2.62	1.46	1.94	2.04	1.60
1.39	2.42	1.47	3.58	4.03	3.27
1.41	2.36	1.57	4.32	4.85	3.10
1.44	2.31	1.68	4.17	4.75	3.38
1.50	2.27	1.68	4.14	4.80	3.47
1.64	2.46	1.72	4.40	4.85	3.54
1.66	2.58	1.72	4.57	4.90	3.89
1.68	3.93	1.72	4.57	4.90	4.07
1.96	3.93	1.79	4.51	4.85	3.93
1.96	3.93	1.96	4.36	4.90	4.14
1.68	3.93	1.96	4.07	4.62	4.00
1.96	7.86	1.70	4.68	4.85	3.45
1.96	7.86	1.96	4.71	4.66	4.21
1.84	7.78	1.96	4.95	4.95	4.80
1.96	7.86	1.96	4.62	4.80	3.93
1.89	7.86	1.96	4.40	4.78	3.84
1.81	7.86	1.96	4.32	4.49	3.23
1.96	7.86	1.96	4.66	4.90	4.14
1.86	7.86	1.96	4.80	5.00	4.29
1.85	7.44	1.96	4.62	4.90	4.25
1.94	7.86	1.96	4.14	4.57	3.14
1.68	6.58	1.81	3.61	4.32	3.04
1.77	6.90	1.96	4.32	4.32	3.93
1.72	6.82	1.84	4.21	3.66	3.02
1.72	7.86	1.89	3.90	4.95	3.02
1.84	6.90	1.96	3.29	3.56	2.82
1.57	6.82	1.96	3.31	3.78	2.93
1.81	7.44	1.94	5.00	4.36	5.00
1.72	6.29	1.96	3.33	3.72	2.98
1.72	6.29	1.96	3.04	3.43	2.87

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

JOHN ELIAS BALDACCI
GOVERNOR

April 11, 2002

Sunstream Environmental
Attn.: Tom Caron
122 Old Ocean House Road
Cape Elizabeth, ME 04074

Subject: Product Registration, Piranaco ***Pirana***

Dear Mr. O'Connor:

Thank you for your information regarding the Piranaco ***Pirana*** for registration under provisions of Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules).

Product Description

The Piranaco ***Pirana*** 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 plates of cuspated plastic sheeting. A remote air pump feeds air to a proprietary diffuser beneath the cuspated plates. A biological film is generated, which adheres to the cuspated plates and provides treatment of the water-borne contaminants. The Piranaco ***Pirana*** is inserted into conventional septic tanks, and a proprietary innoculant is introduced at regular intervals.

Claim

According to the information in our files, the Piranaco ***Pirana*** reduces nitrate and BOD_5 levels to less than 100 Mg/l (often, to less than 50 Mg/l); reduces suspended solids in the effluent; and rejuvenates biologically clogged disposal areas by application of low-nutrient, high dissolved oxygen effluent. The files contain colloquial accounts of over 30 successful installations, principally but not exclusively in California.

Determination

On the basis of the foregoing, the Division has determined that the Piranaco ***Pirana*** is acceptable for use in the State of Maine on a Provisional Approval basis, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and Purchase/Installation Agreement.

No more than 50 installations of the Piranaco ***Pirana*** may be installed under Provisional Approval. Pilot Approval installations shall be limited to sites which do not otherwise require any variance or waiver to the Rules. On no less than a monthly basis for a period of not less than 12 months, the applicant shall test the influent and effluent of each installed Piranaco ***Pirana*** for the following parameters: five day Biochemical Oxygen Demand, Total Suspended Solids, Total Nitrogen, and coliform bacteria. The results of these tests shall be submitted to the Division on no less than a quarterly basis. Historic data from other jurisdictions may be submitted, if available.

Upon successful operation under Provisional Approval, the applicant may apply for General Use Approval, which allows use with no testing or reporting requirements by the Department.

In the event that the product fails to perform as claimed, use of the product in Maine, including all installations approved pursuant to Chapter 18 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

COPY

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 Piranaco ***Pirana***. 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.

Please note that this approval is separate from the previous approval of the product formerly known as ***Pirahna***.

You may distribute copies of this letter as appropriate. 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@state.me.us

/jaj

xc: Product File

STATE OF MAINE
DEPARTMENT OF HUMAN SERVICES
DIVISION OF HEALTH ENGINEERING
10 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0010

ANGUS S. KING, JR.
GOVERNOR

KEVIN W. CONCANNON
COMMISSIONER

April 11, 2002

Sunstream Environmental
Attn.: Tom Caron
122 Old Ocean House Road
Cape Elizabeth, ME 04074

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Please note that this approval is separate from the previous approval of the product formerly known as ***Pirahna***.

You may distribute copies of this letter as appropriate. If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen

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

/jaj

xc: Product File

August 23, 2002

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
State of Maine Department of Human Services
161 Capitol Road
Augusta, Maine 04333-0101

Re: Product Registration Application

Dear Mr. Jacobsen,

I have enclosed the product registration application and relevant product literature regarding the **Pirana System** for registration under provisions of Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules.

Attached you will find the application and product features/performance appendices; marketing literature; product studies; engineering specifications, validations of product results in California and New York and product test results.

If you have any questions or concerns regarding the registration application or other enclosed material please do not hesitate to contact me at Piranaco@maine.rr.com or (207) 885-9538.

Sincerely,

Tom Caron
Sunstream Environmental
122 Old Ocean House Rd.
Cape Elizabeth, Maine
(207) 767-5400

Maine Department of Human Services
Bureau of Health
Division of Health Engineering
Wastewater & Plumbing Control Program

APPLICATION FOR REGISTRATION OF
EXPERIMENTAL SYSTEM/INNOVATIVE TECHNOLOGY
OR ONSITE SEWAGE DISPOSAL SYSTEM PRODUCT

Please complete the following Sections. Please print or type.

Applicant

Company Name: Sunstream Environmental

Contact Person: Tom Caron

Address: 122 Old Ocean House Rd.

Town/City: Cape Elizabeth State/Province: ME Zip Code: 04074

Country: USA

Telephone: (207) 767-5400 e-mail: piranaco@maine.rr.com

Product

Product Name: Pirana

Model: ______

Product Classification (choose one)

Primary or Secondary Treatment Unit

[ ] Septic Tank [ ] Extended Aerobic Treatment Unit [ ] Recirculating Aerobic Unit

[ ] Aerobic Fixed Film Unit [X] Other (specify) microbial inoculator/generator

Effluent Filter

[ ] Septic Tank Outlet Filter [ ] Post-Tank Filter [ ] Other (specify) ______

Disposal Device

[ ] Gravel-less Disposal Pipe [ ] Gravel-less Disposal Bed [
] Chamber, Plastic

[ ] Chamber, Other [ ] Other (specify) ______

Miscellaneous

[ ] Pipe [ ] Effluent Flow Distribution Device [ ] Other (specify) ______

Claim

Describe the product's features (attach additional sheets if necessary).
See attached sheets

Describe the product's performance (attach additional sheets if necessary).
See attached sheets

Has the product received National Sanitation Foundation or Canadian Standards Authority approval?

[ ] No [ ] Yes (If "yes", enclose a copy of the certification.)

IMPORTANT NOTE!

Don't forget to enclose relevant product literature, engineering specifications, studies, and third party certifications with this application.

I, Tom Caron, am the [X] applicant [ ] agent for the applicant of the subject product.
(print name)
I state that the information submitted is correct to the best of my knowledge and understand that any falsification is reason for the Department to deny registration for use of the product in Maine.

[X] Signature of Applicant
[ ] Signature of Agent for Applicant

8/23/2002
Date

Appendix I

Describe the Product's Features:

The Pirana utilizes a simple air-lift column to aerate and circulate effluent within a treatment vessel for the express purpose of generating an active culture of introduced bacterial species contained in the patented Pirana Blend bacterial formula.

The Pirana Blend formula is introduced into the Pirana by suspending a porous sack of the blend in a riser installed in the center of the unit so that the bacteria are held in the aerated portion of the column.

Water is circulated through the unit by the airlift and food passes to the bacteria.

A wrapping of cuspated plastic "works" is contained in the unit that provides a surface area for colonization by the introduced bacteria as a fixed film. The contents of a standard septic tank are cycled over 40 times a day through these microbial works in the form of a hyper-oxygenated foam.

The Pirana can be installed in almost any septic tank ranging from 400-gallon wooden cesspools to 1,500 gallon compartmented concrete tanks. Once in place, air is pumped to the tank at low pressure through a PVC pipe, supplied by a 40-watt air pump set conveniently near a household GFI protected 110V outlet.

This air pump is contained in a Poly basin that protects it and provides a totally silent operation.

Appendix II

Describe the Product's Performance:

The Pirana is the most efficient aerator of septic effluent. The Pirana introduces the powerful concept of "bioremediation", which has been widely used to break up oil spills from the Alaska coast to the Gulf of Mexico.

Once the Pirana is installed, there is no need for regular septic tank pumping. Solids that enter the septic tank are digested and leave the septic system as gas.

As a consequence, the organic contents of the tank are almost completely eliminated, vastly reducing the organic load to leach fields receiving this odor-free clarified effluent, rich in facultative bacteria.

As these bacteria pass into the trench, they rapidly consume the slimy, anaerobic "biomat". It is this biomat that clogs the soil and causes a leach field to fail.

More importantly, the effluent streams contain a rich bacterial population consisting of species of Bacillus, facultative anaerobes capable of surviving the course through an anaerobic leach trench and remaining viable when arriving at the aerobic zone of the leach trench side wall soil.

These species in the Pirana Blend culture are known to have a substantial ability to digest the muco-polysaccharide slimes that typically clog the sidewall of such trenches.

As these bacteria pass into the trench, they rapidly consume the slimy, anaerobic "biomat". It is this biomat that clogs the soil and causes a leach field to fail.

A secondary benefit is that ammonia from the tank is no longer converted to stable nitrates that can contaminate groundwater.

When generated in a septic tank with the Pirana unit, the bacteria do not cause the nitrification of ammonia in the tank. When the effluent stream arrives at the soil surrounding the leach trench it contains an abundant population of facultative anaerobic denitrifying bacteria.

The ammonia simply becomes gaseous nitrogen and escapes harmlessly into the atmosphere.

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(con't from Product's Features description)

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When generated in a septic tank with the Pirana unit, the bacteria do not cause the nitrification of ammonia in the tank. When the effluent stream arrives at the soil surrounding the leach trench it contains an abundant population of facultative anaerobic denitrifying bacteria.

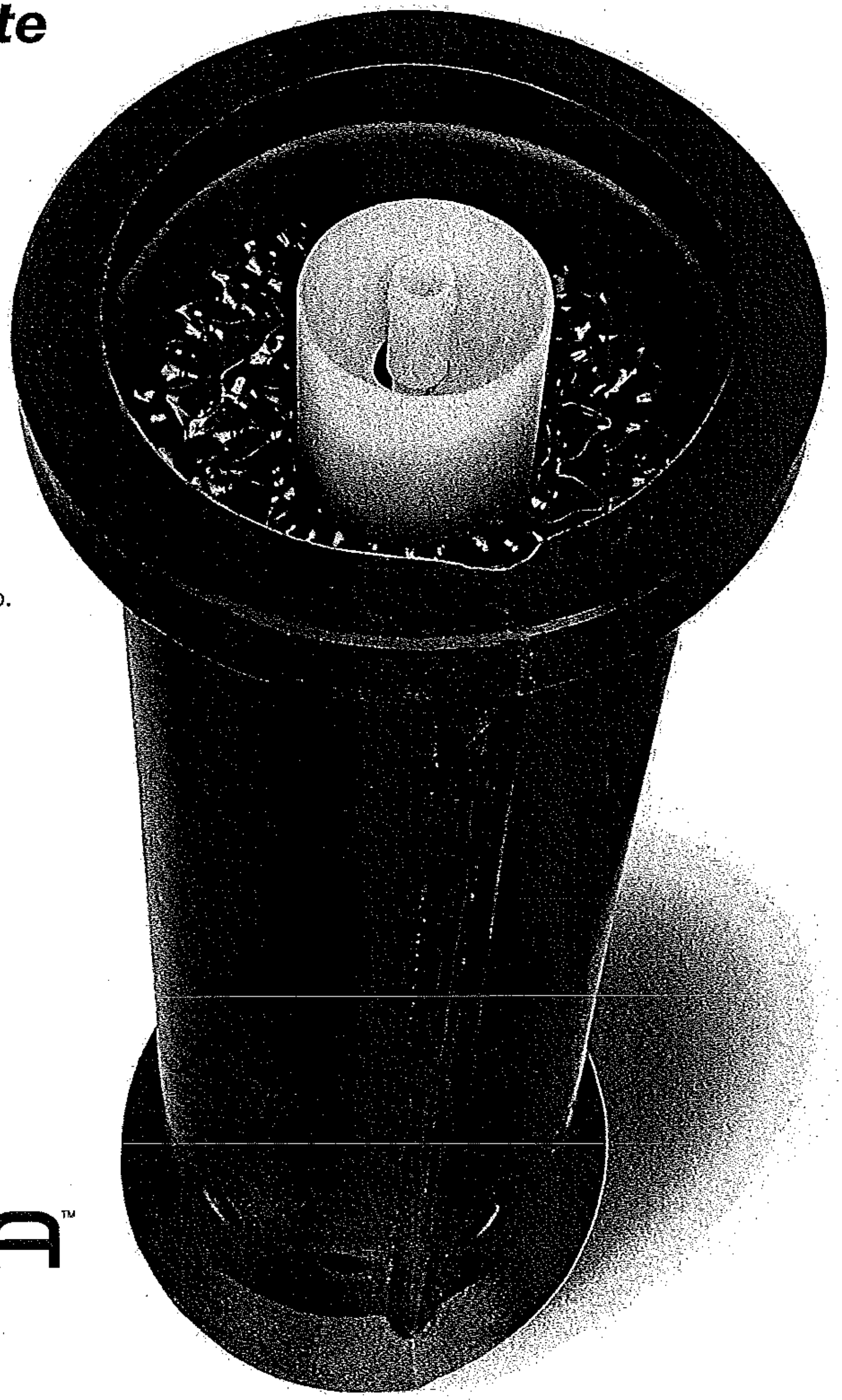
When the effluent reaches the aerobic soil, powerful denitrifying bacteria in the Pirana Blend act on it. The ammonia simply becomes gaseous nitrogen and escapes harmlessly into the atmosphere.

The effluent also contains a residual of carbon in the form of bacterial biomass that stimulates a rapid and nearly immediate denitrification of virtually all ammonia in the effluent.

Introducing

The Pirana

The Newest Concept in Septic Tank Waste Treatment Uses Nature's Oldest Technology!



All conventional septic tank systems have one basic flaw: they try to fool Mother Nature. Over billions of years, Nature has evolved aerobic (air-breathing) bacteria to be the most effective at breaking down and removing bio-wastes from the environment. Septic tanks, buried deep underground and poor in oxygen, force less efficient, slime-producing, system-clogging, anaerobic bacteria to partially break down wastes until their aerobic cousins in the leach field can finish the job.

By providing abundant, life-giving oxygen for specially cultivated aerobic bacteria, The Pirana System literally breathes new life into septic tanks and increases their efficiency the natural way.

NATURE KNOWS BEST!

- Pirana restores failed systems
- Eliminates septic tank pumping
- Improvement begins immediately
- Low cost...operates at pennies a day
- Protects environmentally sensitive sites
- Quickly installed without site damage
- Reduces traditional 3-part ATU systems to one simple step!

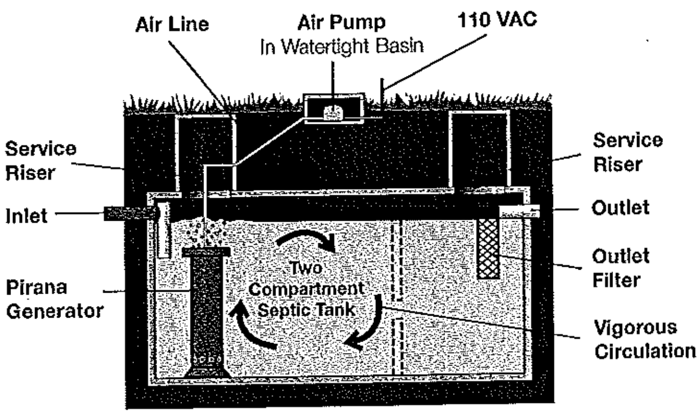
PIRANA™

Nature Called. We Answered!

The Pirana Breathes New Life Into Septic System Technology

THE PIRANA PUTS NATURE TO WORK

- After installing the Pirana into any single volume tank, or either chamber of a two compartment septic tank, the Pirana Blend of powerful biological agents immediately begins processing wastes (including nitrates) within the tank and continues its work throughout the leach field system.
- The Pirana aerates, circulates and inoculates the entire contents of a septic chamber at the rate of over 25,000 gallons a day.
- Within the Pirana, circulating septic tank liquids pass over 150 ft² of surface on which a dense colony of Pirana Blend bacteria attach and thrive.
- As the septic liquid passes over the bacteria, organic wastes are rapidly digested. In single volume tanks, cesspools and inlet chambers of septic tanks, this digestion is so complete that regular pumping is no longer necessary!



THE NATURAL WAY TO CLEAN UP

- Bacteria in the Pirana Blend are so aggressive ("The Pirana Effect") they starve out the resident slime-producing, anaerobic bacteria that produce "biomat" clogging. Leach fields are quickly opened up, further increasing the efficiency of the entire system.
- *The EPA estimates that 95% of septic system failures (over a million a year) are caused by "biomat" clogging, which simply cannot reoccur where the Pirana is in operation.*
- The nitrification phase of treated effluent is virtually eliminated, resulting in direct denitrification!

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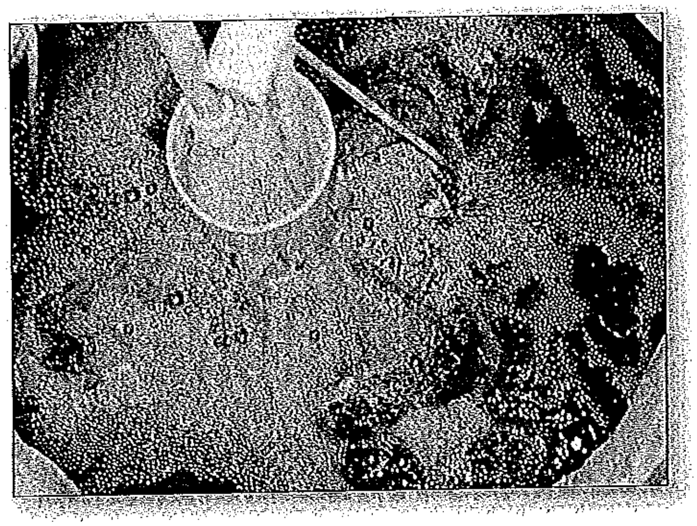

TIME PROVEN TECHNOLOGY

- The two components of the system include the Pirana Blend bacterial culture and the Pirana devices. Experience with the use of these bacterial agents in wastewater treatment goes back over 15 years and includes extensive application in bioremediation of contaminated soil, manure ponds, and municipal treatment plants.
- The Pirana has been applied in homes, commercial and industrial applications with a broad array of septic-based treatment systems, situated in a wide variety of site configurations and soil types across the country.

For complete technical information contact:

Piranaco Company
Tel. 707-824-1170 • Fax. 707-824-8154
Email: Pirana@monitor.net

PIRANA™

Nature Called. We Answered!

Frequently Asked Questions

How long will it take to rejuvenate my disposal field?

There will be an immediate improvement in septic tank function. Some systems require more time to improve disposal field performance than others. Generally, in temperate weather climates, we see an improvement in the disposal field within one to two weeks. We have seen an improvement within one week in a reasonable percentage of installations. In less temperate climates where there is sub zero weather in winter, we see the same improvement in the septic tank but there are longer periods for improvement in the disposal field. Your local installer will explain the factors affecting your area. Complete rejuvenation, to the point where soil has returned to normal porosity, can take a year or more in temperate climates. In areas with harsh freezing winters, this process can take many times longer.

What does it cost?

Generally between $2500 and $3000

How do I know if my septic system is failing?

Symptoms of a failed septic system vary from surfacing effluent in the area of the disposal field, surfacing over the septic tank, strong odors, green lush grass over the disposal field, backed up plumbing and drains.

What happens to the excess bacteria after the disposal field has recovered?

The Pirana continues to inoculate the natural PIRANA BLEND bacteria into the effluent stream. The bacteria continue to inoculate the soil pores and keep the disposal system from future failure. The numbers of bacteria respond to a food to organism ratio: more food, more bacteria; less food, less bacteria. If, at any future time, there are insufficient nutrients in the effluent stream to "feed" the PIRANA BLEND bacteria in the soil, the surplus bacteria die and become "cell hulls" or humus. If there is an increase in nutrients in the effluent stream, the PIRANA BLEND bacteria in the soil multiply accordingly and consume these nutrients. It can be said the system is self-regulating.

How much does it cost to operate the Pirana system?

The airlift pump uses 25 watts of power. At 14 cents a kilowatt, your cost would be about 5 to 7 cents per day.

What happens if I sell my property?

A warranty is transferable to the new owners after the Certified Pirana Installer evaluates the change of usage the septic system can expect. A limited warranty may be issued. If it is determined that no change in septic usage is expected, so long as the new owners continue the annual maintenance agreement, the warranty continues in effect for the life of the home.

What is the cost of the annual maintenance agreement?

Currently, it is $150.00 per year for a single inspection. A typical installation requires only one inspection per year in temperate climates. In areas with harsh freezing winter weather, a second inspection may be required during the remediation phase prior to or after the winter period. Once the system is functioning properly then one inspection per years is all that would be required.

Will I have to have my septic tank pumped or leach lines jetted before or after installation of the Pirana System?

Again, in temperate climates, there normally is no need to pump the septic tank or jet the disposal lines before installation of the Pirana. Once the Pirana is installed, there is no need for regular septic tank pumping. Solids that enter the septic tank are digested and leave the septic system as gas. There could be cases where a physical problem occurs with some construct of the system that would require the septic tank be pumped to make a necessary correction. In less temperate climates, with harsh freezing winter weather, there may be a need to perform these procedures due to the build up of sludge and other solid waste in the disposal field from reduced bacterial activity in winters prior to the Pirana installation.

How does the Pirana work?

Our septic systems are closed systems by design. This means, other than household wastes, no other material is allowed to enter the system. This also means that no other bacteria may enter the system until the septic effluent enters the soil pores. Unfortunately for us, this means the vast majority of bacteria in the septic system are anaerobic (without air) intestinal bacteria that are inoculated into the system every time we flush our toilets. These bacteria create the major problem in septic system failure. They secrete a slime like material, scientifically referred to as a mucalpolysaceride. This slime like material protects the bacteria while in our intestines from acids and enzymes from our stomach, our immune system in the intestinal absorption tissues, other bacteria and predators of bacteria that pass into the intestines. Importantly, the slime protects these anaerobic bacteria from oxygen. Oxygen is toxic to these anaerobic intestinal bacteria. The problems occur when these intestinal bacteria, entrained in the effluent from our septic tanks, contact the soil in the disposal field and form a continuous colony over the entire soil surface. These intestinal bacteria continue to secrete this slime like material. When enough of the soil voids and pores are clogged with this slime, liquid cannot pass through the slime layer at a rate equal to the liquid we put into the system. The disposal field fails. This slime, having clogged the soil pores of the disposal field, is called Biomat. In 95% of disposal field failures, the cause is Biomat clogging of the soil pores. The Pirana solves this problem simply. The Pirana is the most efficient aerator of septic effluent. The exposure to oxygen kills the anaerobic intestinal bacteria in the septic tank. The Pirana also inoculates the septic tank with powerful PIRNAA-BLEND soil bacteria that digest the organic material in the septic tank. The PIRANA BLEND bacteria then travel within the highly treated septic tank effluent into the failed disposal field. There, the PIRANA BLEND bacteria digest the Biomat that is clogging the soil pores. With the Biomat gone, the soil pores are free to accept septic effluent again. The disposal field is restored. As long as the Pirana is operated in the septic tank, the system cannot fail from Biomat clogging.

Do I need a permit?

Many jurisdictions do not require a permit for this technology. Your Certified Pirana Installer will know the permit requirements in your local area.

What are my responsibilities?

There is no homeowner maintenance that needs to be performed. It is important that you use reasonable septic system practices. Do not allow toxic substances into the septic system. Do not put petroleum products into the system. Be aware that fungicides and other pesticides can kill bacteria. Do not allow non-biodegradable materials into the septic tank. Latex or rubber products, aluminum foil, plastic and metal items are examples. Paper and cotton products are okay to flush. If there is ongoing antibiotic treatment (more than 10 days and of indefinite duration) or chemotherapy treatment for any member of the household being served by the septic system, your Certified Pirana Installer should be contacted immediately. It may be necessary to increase number of maintenance inspections. The frequency in the replacement of the PIRANA BLEND bacteria may also be required. The maintenance inspection will guarantee you a trouble free septic system.

BIOLOGICAL INNOVATIONS IN WASTEWATER NUTRIENT ELIMINATION

By

Dr. Daniel Wickham, Pirana Co

Presented to

California Water Environment Association
CWEA

Annual Conference

September, 2001

Redding, California

BIOLOGICAL INNOVATIONS IN WASTEWATER NUTRIENT ELIMINATION

By
Dr. Daniel E. Wickham
Pirana Co

Introduction

Releases of nitrogen and phosphor compounds from treated wastewater effluent are a worldwide problem. Compounds of these elements present different threats to environment based on their individual chemical behaviors and bio-geochemical cycles they participate in. Phosphate is typically not a problem when discharged to soil since it is readily adsorbed by negatively charged soil particles, however, in municipal systems discharging to surface waters, phosphate is primary source of eutrophication (EPA, 1972). Ammonia, like phosphate, is readily adsorbed in receiving soils but, again, is a threat to waters receiving surface discharge. Nitrate passes through soil and represents a threat to subsurface drinking water sources or to nearby water bodies. It also is the main contributor to blooms of toxic dinoflagellates in nearshore marine environments.

Biological control of phosphate and nitrogen compounds has been widely implemented in a variety of technologies. I will discuss advances in biological nutrient control made possible with two novel biological systems and stress the importance of management of these systems at the biological species level .

Subsurface "Ecochamber" Forest Disposal

Ecochambers are subsurface devices that receive wastewater treated to various levels and discharge into soil within the root zone of trees associated with the chambers. They consist of a 30" long by 12" diameter pipe fitted with end plates that are perforated with holes filled with redwood tree bark fibers that act as filter elements. The units are laid horizontally at a depth of about 24" and pipes connect the devices in series so water flows into the top of the unit on one end and out of the unit at the other.

The City of Santa Rosa placed a system of 10 Ecochambers in a 30 year old redwood grove at Sonoma State University in Cotati, CA. A dosing tank receives tertiary treated wastewater from the Santa Rosa WWTP. This water is released to the Ecochamber system and flows to a sump where it is recycled back to the dosing tank by pump. A flow meter measures the amount of treated effluent delivered to the dosing tank.

Previous studies investigated the hydraulic capacity of this system and found that it could safely irrigate anywhere from 5-10 times the annual volume of wastewater than was possible with the City's alternative surface irrigation system (Wickham, 2000). Nutrients were not measured because it was assumed they would be taken up through tree transpiration. The current study was implemented to investigate the fate of nutrients in reclaimed water delivered to the system in excess of the transpiration rate.

Sample wells were dug at three locations near an individual Ecochamber emitter. The Ecochamber was approximately 4 feet from the center of an adjacent redwood tree. Well #1 was located 1 foot from the discharge end of the Ecochamber. Well #2 was 4 feet from the Ecochamber and midway into the root zone of the tree. Well #3 was 12 feet from the Ecochamber on the opposite side of the tree root zone. Grab samples were taken and analyzed by the Santa Rosa WWTP Environmental Laboratory on three different occasions from the dosing tank and from the three sample wells for concentration of Ortho and total phosphate (as P), Ammonia, Nitrate, and TKN.

Table 1. Nutrient concentrations (mg/L) from water sampled from the dosing tank and root zone sample wells.

Date	Nutrient	Dosing Tank	Well #1	Well #2	Well#3
12/4/00	Ortho-P	1.1	0.4	<0.1	<0.1
	Total-P	1.4	0.7	0.5	<0.1
	NH3	<.2	1.8	0.3	<.2
	NO3	4.7	<.4	<.4	<.4
	TKN	1.1	2.1	1.9	0.6
1/26/01	Ortho-P	2.4	0.2	0.1	<0.1
	Total-P	2.4	0.3	0.4	0.5
	NH3	0.9	0.8	0.9	0.5
	NO3	5.7	4.1	1.0	1.3
	TKN	2.3	2.2	2.9	2.5
6/8/01	Ortho-P	3.4	0.7	0.3	0.2
	Total-P	3.6	0.8	0.5	0.4
	NH3	0.3	1.3	0.5	0.4
	NO3	13.9	6.8	5.4	5.5
	TKN	1.5	2.1	2.6	1.6

Mass loading to the Redwood system can be estimated based on total flow rates to the system during the sampling periods. I assume that the minimal annual flow to the system of 3,500 gpd/acre in February, 2001 was all leach (Wickham, 2000). This is conservative since measurements of water potential showed that transpiration was active the entire year (Lydia McCready, personal communication). Subtracting this from the total delivered to the system approximates the volume taken up through tree transpiration.

The only sample period with excess leach is that of June 8 where the system had been purposely overloaded to insure enough supply to reach Well #3. Flow during July was reduced to the point where only Well #1 captured any flow, indicating that the entire volume was taken through transpiration.

Table 2. Flows and mass balance for nitrate at the SSU subsurface forest.

Date	Flows	Nitrate Loading
12/4/00	10,757 to system	@ 4.7 mg/L = .41 lb/acre/day
	7,257 transpired	.28 lb/acre absorbed by tree
	3,500 to leach	.01 lb/acre residual @<.4 mg/L
		98% mass reduction

1/26/01	8,584 to system	@5.9 mg/L = .42 lb/acre/day
	5,084 to trees	.23 lb/acre absorbed by tree
	3,500 to leach	0.04 lbs residual @ 1.3 mg/L
		90% mass reduction
6/08/01	23,915 to system	@13.9 mg/L = 2.35 lb/acre/day
	15,000 to trees	1.72 lb/acre absorbed by tree
	8,915 to leach	0.4 lbs residual @ 5.5 mg/L
		83% mass reduction
7/6/01	11,035 to system	@13.9 mg/L = 1.27 lb/acre/day
	11,035 to trees	1.27 lb/acre absorbed by tree
	0 to leach	0 residual
		100 % mass reduction
7/10/01	14,639 to system	@13.9 mg/L = 1.68 lb/acre/day
	14,639 to trees	1.68 lb/acre absorbed by tree
	0 to leach	0 residual
		100% mass reduction

Samples were not analyzed for nitrate in July, however, using the previous sample concentration, calculations could be made of uptake. In any event, uptake was through transpiration as, even at the high delivery rate, sample wells 2 and 3 were dry indicating transpiration of all delivered water.

Bacterial Enhancement of Denitrification

Experience with a newly developed device that introduces an air column for establishment and maintenance of a viable culture of facultative bacteria species within the genera *Bacillus*, shows that rates of denitrification can be dramatically enhanced through inoculation. This device is marketed as the Pirana and, when placed in a standard household septic tank, converts the tank into an aerated bacterial generator for delivery of bacterial cultures to soil-based disposal. Oxygen is supplied with an efficiency of approximately 33 lbs. O_2/ Horsepower/ Hour. A standard Pirana, operated with a 40 watt air-pump capable of delivering 1.5 CFM, delivers almost 40 lbs. of O_2 to septic tanks that typically receive loads of about 1 lb. BOD per day.

This air current circulates water through a column containing a medium of approximately 150 square feet on which a fixed-film bacterial colony forms. Approximately 25-30 gpm is circulated resulting in a daily flow of approximately 30,000-40,000 gallons over the attached bacterial colony. A culture of the proprietary Pirana-Blend bacterial is introduced into a refugium within the Pirana.

The first sampling indicating enhanced denitrification was analyzed by the City of Santa Rosa Subregional WWTP environmental laboratory. This sample was obtained from a

1,500 gallon septic tank serving a 1,000 sq.ft. mound disposal system at the Victor Treatment Center that had become clogged by anaerobic sludge. Installation of the Pirana restored percolation to the system within 2 weeks through digestion of the mucopollysacharrides in the sludge. Samples were taken from the dosing chamber of the septic system and from the monitoring well in the mound that penetrated into the lower sand portion of the mound.

Table 3. Concentration of various nitrogen compounds (mg/L) from the pump station and sand well of the Victor Treatment Center mound system.

	NH3,	NO2,	NO3,	TKN
Septic Pump Station	83	<2	<2	89
Mound Sand Well	0.9	<2	<2	5

Following this result five Pirana installations in individual home septic tanks were monitored for ammonia, nitrate and nitrite using Hach coloriometric analytical field kits with a detection limit of 0.1 mg/L.

Typical sampling consisted of one grab sample from the effluent at the point where it left the septic tank and a sample obtained from a well dug approximately 6" from the sidewall of the leach trench serving the system. These wells were dug to the depth necessary to allow seepage of effluent into the well, typically about 3-4 feet.

Table 4. Concentration (mg/L) of ammonia and nitrate in septic tanks effluent and in percolated effluent from soil surrounding leach trenches in systems with installed Pirana bacterial generators.

Site	Sample	NH3	NO3
De Wolfe	Tank	41	ND
	Soil	ND	0.6
Horowinski	Tank	23	0.2
	Soil	ND	<0.1
Madden	Tank	25	ND
	Soil	ND	ND
Victor	Tank	90	ND
	Mound	ND	ND* (system was Positive at 3.0 Mg/l NO_2)

One septic tank, the Doherty system, had the Pirana unit installed and aeration was begun without introduction of the Pirana-Blend bacterial culture. This system was monitored over time as a colony of wild spores was introduced through the aeration system.

Sampling over two month period tracked the development of a nitrification colony in the tank.

Table 5. Concentration (mg/L) of ammonia and nitrate at the Doherty system.

Date	Sample	NH3	NO3
3/12	Tank	30	0.75
	Soil	<0.1	ND
4/16	Tank	3.0	4.5
	Soil	27	ND
5/1	Tank	10	8.0
	Soil	29	ND

Discussion

The above results suggest that conventional means of nutrient removal in biological treatment systems leave wide opportunities for improvement that can best be accessed by a fresh look at the biology of these reactions. One of the most important messages in these observations is that a more rigorous control of the organisms introduced into wastewater systems at the species level will result in increased performance efficiency.

Virtually all technologies involving micro-biological processes recognize the absolute necessity to control microbial inocula at the species level. Such technologies include winemaking, brewing, baking, yogurt, sour cream, soy sauce, sauerkraut production, cheese making, enzyme production, pharmaceuticals, etc. Virtually every one of these industries controls absolutely the nature of the organisms that are allowed into their process systems. They do so with the simple expedient of inoculation with selected strains of micro-organisms. The wastewater treatment industry, probably the largest of all of these technologies, is the only one that relies on an almost complete random selection of colonizing species of an entirely unidentified nature. Almost no treatment plant operator, with the small exception of the few who purchase bacteria for inoculation, can identify the bacterial species significant to treatment in their plants.

We have seen in the few studies mentioned in this paper that levels of performance, at least with regard to nutrient control, can be greatly enhanced by introduction of specific organisms, both from natural and from commercial sources.

In the instance of treatment potential offered by the Redwood subsurface Ecochamber system, we see that selection of the tree species *Sequoia sempervirens* increases the hydraulic capacity of a reclamation system by almost an order of magnitude over conventional surface pasture irrigation systems. This performance improvement is a function of several physical and biological factors including elevation of the transpiration surface into the turbulent zone, removal of the transpiration surfaces from saturation by the delivery system, three dimensional diffusion from the delivery point, root enhancement of percolation rates in the soils, transport potential of water by the root system, depth of the root zone, proximity of water delivery to the receiving roots, etc.

The nutrient uptake potential of such a system is dramatically increased as a function of the increased transpiration potential. However, that is only one component of nutrient control. Control of phosphorus releases is achieved both by a substantial root uptake by the Redwoods, but also by physical sequestration in the soils. This, however, is greatly enhanced by the biological conditioning of that soil by the presence of the trees. This contribution comes from both the enhancement of soil percolation, thus increasing the volume of water allowed to pass through the soils, and also through the contribution of tremendous volumes of natural organic carbon in the form of leaf litter.

The importance of the humic contribution to these soils by the leaf fall cannot be stressed enough. Nutrient releases from reclamation/irrigation are an important restriction on the efficiency of these systems. Pasture irrigation of manure pond effluent at dairies is a case in point. Most such systems have dramatically impacted soils with very low percolation rates. This results from a number of factors including compaction by cattle, sealing of the surface by energetic surface spray which mobilizes the fine particles which seal the micro-layer just beneath the surface, sealing by muco-polysaccharide slime in the manure, minimal root intrusion by the grasses, etc. As a consequence much of the nutrient load built up during summer months is mobilized by winter rains and runs off directly into receiving waters. Relatively little of this nutrient load is processed by the biological community of the pasture.

The sampling of water not taken by transpiration in the Redwood forest shows that the forest soil microbial community contributes yet another powerful biological system for nutrient control. The phosphate removal potential is not unexpected, but because of the dramatic increase in the tilth of the soil, allowing for greater flows, the mass loading is significantly increased.

Nitrate control is the most impressive component of this community. In two of the sample periods there appears to be a transformation of nitrate in the wastewater to ammonia. This suggests a high level of bacterial activity and, given the high carbon load from leaf fall, suggests that a localized anaerobiosis occurs. This ammonia, however, is rapidly degraded and apparently lost to either active root uptake, uptake by soil microrhyzae in the fungal community, or to the atmosphere as gaseous nitrogen. In any event nitrate is quickly eliminated.

The sampling in June, conducted during the period of heaviest wastewater loading, shows that the denitrification potential, while appreciable, is not unlimited. This is expected because the carbon sources necessary for carrying out denitrifiction, or the biological community capable of incorporating it, is limited. Carbon is low in tertiary treated water and typically limiting for denitrification reactions.

The mass loading data is consistent with estimates by the EPA (1995) of a range of 150-300 lbN/acre/yr. in forest systems compared to pasture with loads of 15 lbN/acre/yr.

Lowrance (1992) found increased levels of bacterial denitrification in soils of riparian forests and attributed this to many of the factors discussed above. While we made no attempt to measure bacterial denitrification specifically it is likely important contributor since nitrate loss occurred over a relatively short spatial dimension.

The Pirana-Blend of bacteria used in the septic tanks experiments with the Pirana bacterial generator consists of isolates from the soil community important at the SSU forest site. *Bacillus subtilis, B. licheniformis* are the important species in the blend, originating in the forest leaf zone. *A priori* there is every reason to expect this community to be well adapted for waste treatment. It is this terrestrial community that annually receives the highest carbon load in the form of billions of tons of fallen leaves. They are extremely eurythermal, able to function over temperatures ranging from freezing to over 40^{o} C. They tend to be facultative anaerobes because their natural environment is a mosaic of aerobic and anaerobic zones, especially in moist leaf mats. As anaerobes these species utilize oxygenated compounds such as nitrate and operate with a metabolic efficiency nearly as high as strict aerobes, even under anoxic conditions. They possess the enzymes to degrade some of the most recalcitrant compounds found in nature such as lignin, terpenes, hemicellulose, and the multitude of natural biocides produced by trees.

The results from septic tanks containing the Pirana bacterial generator provide further evidence that the species of soil bacteria found in leaf litter are powerful denitrifiers when introduced into wastewater treatment streams. It is clear from the lack of nitrate in the tanks that these species not only appear to be incapable of creating nitrate under aerobic conditions but also out-compete those species that do. Virtually all nitrogen in the tanks was in ammonia form even under extensive aeration. At the Victor Treatment Center TKN was 89 mg/L while ammonia was 83 mg/L also indicating relatively complete digestion of proteins in the tank.

What is striking in this study is the fact that nitrate never reaches significant levels at any point in the treatment or disposal cycle. By the time the effluent passed through 3-6 " of soil in the aerobic zone all ammonia disappears, while at the same time no nitrate is formed. This is dramatically different from the typical case wherein ammonia from anaerobic septic effluent released to soils or mound systems converts almost completely to nitrate (Bohrer, 2000).

The experience with the Doherty system, in which a Pirana unit was installed without inoculation with the Pirana-Blend bacteria, shows that this system acts like a typical ATU or any other aerobic treatment system. By relying on wild spores introduced through the aeration stream, as is typical in the industry, colonies form that inevitably create nitrates. The Doherty tank began to shift from ammonia to nitrate after about 2 months of treatment as the wild colony formed.

At Doherty's ammonia was eliminated in the soil in the March sample, but not later. This was due to the fact that the sample well in March was about 1 foot from the leach trench. The later samples had to be taken with about 3 " of the trench due to drying of the soil after the rains stopped. In these samples there was an abundance biomat from the anaerobic discharge over thirty years. Unlike the inoculated systems in which the clogging biomat disappeared rapidly, the un-inoculated Doherty system recovered sufficient porosity to allow function, but bio-mat die back was a prolonged process.

Nitrification of ammonia is important where effluents are released to surface waters due to toxicity of ammonia to aquatic life. Our experience shows that for soil based disposal systems maintenance of nitrogen in ammonia form, when accompanied by abundant denitrifying bacteria and sufficient carbon, allows denitrification to proceed at a much higher rate and to a far more complete level than seen in any treatment system yet devised. The key is providing a natural, or in the case of the Victor mound, an artificial soil matrix that allows the reaction to proceed.

Based on these data it appears that ammonia is first converted to nitrite, as was seen in the Victor mound, when it encounters an aerobic soil matrix. Because the effluent is impregnated with a rich culture of denitrifying bacteria this nitrite is almost immediately transformed into gaseous nitrogen compounds that rapidly leave the system.

It is clear from the Doherty system that introduction of known species of bacteria, utilizing a method capable of maintaining their viability in a system of a hostile nature, is the key to achieving real and economical nitrate control. At the same time the ability of these bacteria to maintain soil percolation provides an indirect method to achieve phosphate control since more effluent can pass into soils with restored permeability. Without this level of biological control it is impossible to achieve complete and economic elimination of nutrients in wastewater effluent.

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Description of Piranha Installations as of June 2001

1. Willow Creek Treatment Center (Oasis), Sonoma County, California – installation August 2000

Failed mound. Effluent surfacing in heavy quantities from top of mound. Mound 10 years old. Mound impacted with heavy sludge to top of gravel bed. Very heavy use over design load by factor of 3. Designed for three bedroom, single family residence. Used as treatment center for young teenage boys requiring special care. Occupancy is 6 to 8 boys plus 4 full time staff. Many frequent visitors to site. Have counted 10 to 16 cars in parking area numerous times. Installed Piranha in outlet chamber of 1500 gal septic tank and aerator /diffuser in 1500 gal dosing tank. System was inspected by county EHD after 2 to 3 weeks of operation and removed from failed status. To date the system has performed with out problems.

2. Horwinsky, Sonoma County, California – installation August 2000

Failed leach field from very heavy undigested organic material in lines. Failed 2 or 3 years prior. D boxe opened and effluent was draining into large open field. Clay soil, non-friable, over sized leach field, 500 t 600 l/f of standard leach trench, 1500 gal two-chamber septic tank. System less than 10 years old. Septi tank half full in both chambers with suspended non treated organic material. No typical septic odors. No evidence of methane gas production in either chamber. Organic material easily recognized as to what constituted it. System completely pumped 3 months before inspection. The residence is occupied by fan of 6 including 3 teenagers and grandmother. Also full time CPA business with several employees. Grandmother on chemotherapy for 3 years. System failed when grandmother started chemo regimen. Installed Piranha in inlet chamber and cesspool model into outlet chamber. System began functioning wi 24 hours. No sign of failure to date. Stopped using cesspool unit in outlet chamber after 4 months. No solids in inlet chamber.

3. Troglin, Sonoma County, California – installation August 2000

1 1/2 acre property with 5 duplexes. Each duplex has its own septic system. Systems are 30 to 40 years old. All are marginal. All leach fields are considered undersized for occupancy and load. Soil is fine san Gold Ridge. Leach lines are deep; rock filled trenches from 2 to 10 feet. All leach lines were clogged with biomat impregnated sand. No visible pore space. Installed Piranha units in outlet chambers of the two systems with the most serious observable problems. Systems were barely functional. Within 2 weeks systems were performing as new. No sign of problems have been observed. Owner states he has never seen bottom of D boxes before.

4. Rosenbloom, Sonoma County, California – installation August 2000

Three bedroom single family residence. Septic system installed in late 50's. Redwood 1500 gal two chamber tank with approx. 150 l/f of standard leach field. Lot size ¾ acre. Soil is Gold Ridge. Leach line have some clogging with biomat impregnated sand. Occupied by family of 4. System totally failed. Efflu backing up into tank and surfacing. Installed Piranha in inlet chamber. System functioned properly within weeks. No sign of failure. No observable solids in inlet chamber post installation of Piranha. Piranha digests solids within 24 hours.

5. De Wolf, Sonoma County, California – installation September 2000

Property recently purchased. Septic system 40 plus years old with 1200 gal two chamber redwood septic tank and 3 standard leach lines totaling approx. 150 l/f. All three lines were clogged with biomat-impregnated roots and sand. Only 30 l/f were found to be clog free. Soil was loamy Gold Ridge. County EHD inspector stated system was in failure and required a mound. To get through the winter the entire leach field was to be abandoned and temporary 100-l/f leach line was to be installed. The following sprin the new leach line was to be abandoned and a mound installed. A single adult previously occupied the house. The new occupants are a family of four with two children below the age of 10 years. We installed Piranha unit in the outlet chamber of the septic tank. The liquid level in the septic tank was 1 inch below t top. After one week of operation the liquid level in the tank dropped to the bottom of the outlet pipe. The liquid level has never changed.

6. Fontain, Sonoma County, California – installation September 2000

System was 15-year-old cesspool servicing one toilet and one occupant. There was a gray water system design and construction unknown, that may have tied into the cesspool by some undetermined means. S was alluvial sands and sediments. Biomat clogging of the soil surfaces around the cesspool construct caused system to back up into house. Occupant was 70 year old female with sever physical issues due t stroke. Toilet was backed up and contained 3 days of feces. Flushing flooded the house. We had cessp pumped to make physical inspection. We installed a cesspool Piranha unit and system operated reasonably. The owner complained about slow flushes and what appeared to be "bubbles" in the soil around the cesspool. After investigating complaints, it was determined that the problems were caused by leaking toilet, over use of the system by others who occasionally stayed in the house and by improperly installed inlet pipe into the cesspool. The bubbles were from air evacuating Piranha through soil because inlet pipe under septic liquid. There were no solids found in cesspool after installation of Piranha unit. Totally digested. Cesspool functioned properly as long as house remained occupied by one person.

7. Madden, Sonoma County, California – installation October 2000

Septic system approx. 25 years old with 1200 gal two chamber concrete septic tank and three 100 l/f leac lines. System had failed and effluent was surfacing over the septic tank. Soil was alluvial sediments with humus. All lines were clogged with biomat impregnated roots. The first line was clogged by roots from wi grapes planted within one foot of the line along its entire length. The other two lines were clogged by root from several large old oak trees. The system serviced a three-bedroom house occupied by a family of fou with two children under the age of 10 years. We installed the Piranha unit in the outlet chamber of the se tank. Within three days, the leach field accepted effluent so the surfacing stopped. The liquid level of the septic tank stayed at the bottom of the outlet pipe after two weeks. There has been no increase in liquid depth. The system is performing as designed.

8. Carrara, Sonoma County, California – installation October 2000

Three-bedroom house occupied by single parent and two teenagers plus friends. Septic effluent surfacing over redwood two chamber septic tank due to leach line failure from biomat clogging. Property one block from Rosenbloom residence. Soil type, age of system and other particulars the same as Rosenbloom. Installed Piranha in outlet chamber. Results identical to Rosenbloom excluding solids digestion.

9. D. Dent, Sonoma County, California – installation October 2000

System was a failed cesspool with surfacing effluent over rock filled leach pit. We installed a cesspool unit in renovated cesspool. The system was restored within a few days after installation of Piranha unit. No effluent has passed into the leach pit during five months of operation through the rain season. No solids were observed in the cesspool. Residence occupied by semi retired couple with occasional stay by children and grand children. No sign of failure.

10. J. Dent, Sonoma County, California –installation November 2000

Installed new cesspool system for one bedroom rental unit. Unit to be occupied by two adults. Minus leach pit, system identical to D. Dent. After installation and use, no solids visible in tank. Liquid depth never greater than two feet.

11. Lemer, Sonoma County, California – installation November 2000

Failed cesspool with 10 l/f of leach line due to biomat clogging. System served a 3-bedroom house occupied by 3 adults and 3 teenagers. Cesspool had surfacing effluent over the top. There was an operating gray water system. Cesspool serviced toilet(s) and kitchen sink. The family used a portable toilet for several months. The county EHD solution would have cost the family more than $15,000. The results after installation of Piranha cesspool unit identical to that of D. Dent.

12. Shamir, Sonoma County, California – installation November 2000

Septic system installed in early 60's. Old style 1000 gal fiberglass two chamber septic tank with collapsed top. The hoop tension in the now concave top kept sides intact. Could not pump tank. System failed from biomat-impregnated roots and silt. Owners couldn't afford $25,000 county EHD solution. Septic tank impacted with 20 to 24 inches of very heavy solids and grease. We installed Piranha grease trap unit into inlet chamber. After 2 weeks of operation, there was one flat blade shovel full of solids remaining. We changed grease trap unit for standard Piranha unit. The system has functioned perfectly to date.

13. Icoppetti, Contra Costa County, California – installation December 2000

Septic system was on hillside with a ten-foot elevation change between leach field and septic tank. Septic tank was older fiberglass 1500 gal two-chamber tank. System backed up into the house. Owner dug up septic tank and allowed tank to overflow on to surface of soil. House was approx. 4500 sq.ft. with four or five bedrooms. House was occupied be two adults and two teenage children. Septic system was 20 to 25 years old. System failed from biomat clogging of soil. Installed Piranha unit into inlet chamber of septic tank. System functioned properly within a week of installation. System has shown no sign of failure through the holiday season and our rain season.

14. Neals, Sonoma County, California – installation December 2000

System failed due to biomat clogging of soil. System leach field is 3 leach lines 100 l/f each. Owner usec leach field as parking lot for his business vehicles for at least 10 years. The ground was very compressec The residence was 3 bedrooms and occupied by 2 adults and 2 teenage girls. The system had surfaced over the septic tank. The soil was very heavy adobe clay. We installed Piranha unit into the inlet chambe of the septic tank. The owners report the system has had occasional problems with slow draining during periods of heavy rain. The system is functioning, though not properly. The system improves as time passes. There are no solids in the inlet chamber. This particular system may take longer to remediate du to owners parking of business vehicles over leach field.

15. Doughty, Sonoma County, California – installation December 2000

System failed due to biomat clogging of soil around leach field. Owners opened clean out and allowed effluent to surface on soil. The system comprised a 1200 gal concrete 2-chamber septic tank and two 10 leach lines. The 3-bedroom house was occupied by two adults and two toddlers. The soil was heavy cla with loam having some friable characteristics. Perc was likely 30 to 50 mpi. Options allowed by county E were beyond ability of young family to pay. We installed a Piranha unit into the inlet chamber of the septi tank. The system became functional within 3 days. We were able to cap the clean out at that time. The liquid level in the septic tank has remained at the bottom of the outlet pipe and there are no solids in the ir chamber. This system received no IOS 500 Bacteria Matrix. There are striking differences between this system and the others that received IOS bacteria.

16. Mr. Rooter Plumbing of Lake and Mendocino Counties, California – August thru December 200

Mr. Rooter Lake County has become a distributor / installer of the Piranha. Mr. Rooter purchased and installed 4 Piranha units in 2000 to the present. The systems were all failed due to biomat clogging of the soil around the leach field. All installations except one have been successful. The unsuccessful system h a structural problem with the leach line not the Piranha. No other system has been reported as again faile

17. Finch, Sonoma County, California – installation January 2001

This is property is one block from the Rosenbloom property. The failure and particulars about the site are the same as Rosenbloom. The system has been performing perfectly.

18. Porter, Mendocino County, California – installation January 2001

Septic system serviced a 4-unit apartment building. The system was comprised of an unknown volume "trash tank" connected to two 2000 or 2500 (?) gal inline tanks and a single rock filled leach trench approx 150 l/f. The depth of leach trench was 14 feet. The rock filled portion was from 7 ft. to 14 ft. The leach lin was under the asphalt parking area. The liquid level of the system was 2 ft. below the surface of the grou The system was being pumped bi-monthly. The apartments are occupied by large Latino families. The system appeared to have very heavy use. We installed one Piranha unit in each 2000/2500-gal tank. Within the first week the liquid level of the system dropped approx. 10 inches. Since the installation of the Piranha units, the leach field has accepted the daily effluent load and pumping the tanks has not been needed. The installation was carried out under the direction of the Mendocino EHD and a Licensed Soil Specialist. The system still has shown no signs of failure.

19. Ritterman, Mendocino County, California – January to May 2001

C. Ritterman has purchased 2 Piranha units and has ordered a 3rd. He is the Licensed Soil Specialist tha directed the Porter installation.

20. Hilton Park, Sonoma County, California – installation February 2001

Septic system failed due to biomat clogging in small leach field. Tank was a bottomless single chamber 500 gal redwood cesspool with overflow to the small leach field. The tank was full and system backed up into the house. The house is a small three bedroom occupied by two adults and two teenagers. The soil was alluvial sediments with a 10-mpi-perc rate. Installed a Piranha cesspool unit into tank. The liquid level of the tank dropped 9 inches in the first week. The solids in the tank were digested and no new solids have accumulated. The system is functioning properly with no signs of failure.

***21.* Williams, Contra Costa County, California – February to May 2001**

The Williams own and operate a pumping business in Contra Costa County. They have become distribut and installers of the Piranha. The first installation was done with our supervision. The site was a 25/30-year-old system with a failed leach field due to biomat clogging. The soil was heavy adobe clay. The lea lines were oversized because of soil type. The size of the leach field was unknown. The septic tank was two chambered redwood tank. The effluent was over the top of the tank. We installed the Piranha unit in the inlet chamber. The Piranha improved the permeability of the soil impacted by biomat in the 1st week. The liquid level began to drop during the 2nd week. The septic system has continued to improve to date. There are no signs of failure. A second system was installed under our supervision in April 2001.

22. Mr. Rooter Plumbing of Sonoma County, California – February to May 2001

Mr. Rooter Plumbing of Sonoma County has become a sub-distributor and installer for Mr. Rooter Plumbi of Lake County. To date Mr. Rooter S.C. has installed 5 systems. The 1st was in February. All systems I failed due to biomat clogging of the soil around the leach fields. All the systems are functioning properly.

23. Kornfield, Marin County, California – installation February 2001

The system is a 40-year-old side hill system with 15 feet elevation change between tank and leach lines. Leach lines were failed due to biomat clogging and effluent was surfacing out of the bottom leach line and flowing down to the roadside ditch. Septic tank was a two-chamber 1200 gal redwood tank. We installed Piranha in the inlet chamber. Owner notified us that the septic effluent has slowed down considerably. W have heard nothing further from the owner. We instructed owner to contact us if the surfacing did not stop within 3 weeks.

24. Mr. Rooter Plumbing of Lake and Mendocino Counties, California – February thru May 2001
Mr. Rooter Plumbing of L.&M. has ordered and installed 3 Piranha units. All septic systems failed due to biomat clogging of soil around leach lines. All systems are functioning properly.

25. Willow Creek Treatment Center (Whistler), Sonoma County, California – installation April 2001
Another mound with the exact same details as the site on Oasis. We installed Piranha in the inlet chamb of the septic tank instead of the outlet chamber. Results were the same. There were no solids in the sep tank 2 days after the installation of the Piranha.

26. Gladstone, Sonoma County, California – installation April 2001
Another hillside system with 20 to 30 feet of elevation change between tank and leach lines. System had failed due to biomat impregnated roots in leach lines. The soil is clay and forest loam. Effluent was surfacing out of bottom leach line and running down the slope toward a rental unit. Tank was a 1200 gal fiberglass 2 chambered septic tank. We installed a Piranha in the inlet chamber. The house has 4 bedrooms and is occupied by 1 adult and 2 teenagers. The system stopped surfacing in the first week. T system is continuing to improve.

27. Kazandrian, Sonoma County, California – installation April 2001
System was 30 years old. System was constructed on a slight slope. The leach field had failed due to biomat clogging of soil around leach field. Prior owner had made an overflow out of last D box and allowe effluent to drain on to the surface of the ground down the hill. We repaired the leach line and installed a Piranha in the inlet chamber of the 1200 gal septic tank. The house had three bedrooms plus a detached studio. One adult occupied the residence. Also installed modified Piranha into 60,000-gal pond for aerati and control of algae. This unit is working as desired.

28. O'Connor, Maine and New England – April to May 2001
Steve O'Connor operates one of the largest home inspection businesses in New England. He is a Piranh distributor / installer. He has ordered 15 Piranha units to date. We have frequent communication with Mr O'Connor. All Piranha units installed in Maine (or New England) by O'Connor have been successful in restoring the failed systems.

29. Parham, Monterey County, California – installation May 2001
At the request of Bill Parham of Parham Septic Tank Service, Carmel Valley, California with the approval of the local EHD, we installed a Piranha unit in the inlet chamber of a combo grease trap/septic tank servicing a restaurant serving 125 to 150 meals a day. The leach field had failed due to biomat and grease clogging of the soils around the leach trenches. A new 200-l/f-leach trench was installed. It failed within one day of installation and use. We installed a Piranha unit in the inlet chamber of the combo tank. With in a few days of operation, the new leach line would function for 3 days before failing. We have heard no further reports regarding this system.

30. Wolloon Lake, Michigan – installation May 2001
This was a unique site. Septic system was a combo grease trap/septic tank system. There were two 10C gal tanks in line connected by a 10-inch pipe at the top of the liquid level so grease and solids could pass from the inlet tank into the second tank. The effluent then flowed into an 800-gal pump tank that pumped effluent to community leach field. The first tank received the sewage / grease from a 50 seat restaurant, 6 8 rooms of an inn, and the sewage from a large 3 bedroom house occupied by at least two adults. We requested the 2 tanks be pumped 2 weeks prior to installation of the Piranhas. We supervised the installation of a Piranha unit into each tank. The tank accepting the influent had solids and a layer of grea ½ inch thick. The second tank had the same condition only 1/8 inch thick. We inspected the system afte 24 hours of operation and all solid matter was digested and the grease was in small balls and collecting ir corners of the tank as often seen in small wastewater plants. The liquid was clear and there was no septi

odor. The liquid in the pump tank was of the same quality. After a week of operation, the owner cum che the inn opened the inlet tank and said it was "beyond belief." The liquid was clear and had no odor. Ther was no evidence of solids or grease. After the Memorial Day Weekend, there are still no signs of grease and solids in the tank. More than 100 meals per day were served.

31. Koppisch, Ontario, Canada – installation May 2001
A Piranha unit was installed in a small leach bed system that had failed. The onsite research department the University at Guelph will monitor the performance of the Piranha. One week after installation, the system is showing signs of recovery. Mr. Koppisch, an engineer, is a Piranha distributor / installer in Ontario, Canada. He is working with the University at Guelph to get the Piranha approved for installation through out Canada.

32. Knight Treatment Systems, New York – installations May 2001
A Piranha unit was installed in a failed ATU / leach field system for the Silverstrand B&B having 6 rooms t let on Lake Cayuga, New York. The ATU was gutted and the Piranha installed in the resulting tank. The operation and performance of the Piranha will be monitored by the local EHD. Present at the installation were 4 representatives from two state watershed agencies, the department head of another county EHD, and a department head from the State University of New York College of Agriculture and Technology, Morrisville, New York. All present gave permission to install Piranhas in the their areas of authority. Douglas Nelson, CET of SUNY, Morrisville, N.Y. will oversee the evaluation of several Piranha installatior planned for the near future. One week after installation, the effluent is clear and system is operating properly. Knight Treatment Systems is a Piranha distributor / installer. Knight installed a second Piranha a failed septic system located on an Indian reservation in upstate New York.

33. Huber Design, New Hampshire – May 2001
Huber Designs (civil engineers) is installing Piranha units in two failed systems in New Hampshire the las1 week in May. The results will be monitored by the local EHD. He has six additional sites for installation within two weeks.

34. Anderson, Sonoma County, California – installation May 2001
Septic system installed in 1940's by owner. Septic tank is round metal of approx. 500 gals. Leach line is unknown. System is functional due to single occupant and gray water system handling most of liquid loac Pumped septic tank to allow examination. Top needed replacement. Added 24-inch riser. Installed Pirar in tank and filled with water. System has operated for 10 days. There are no solids in tank and liquid is clear with no odors.

WDK

Wayne D. Kant P.E. Consulting Engineer
133 Mohawk Avenue, Scotia, New York, 12302
(518) 381-6888, ShermanSpanner@albany.net
N.Y.S. License # 070962

Remediation of failed Raised Engineered On-site System
Woodridge Manor Trailer Park
Broadalbin, N.Y.

Background:

Woodridge trailer park is located in a rural area of up-state N.Y. in the Town of Broadalbin. During the 1980's failing standard absorption systems lead to the installation of several large raised bed systems each serving a cluster of trailers. The native soil is a mixture of medium sand, silt and some gravel. Extensive percolation tests have yielded stabilized rates of between 5:00 and 30:00 min/inch within the same formation. Seasonal high groundwater levels range from 6" to more than 60" in an area of approximately 30 acres.

Failed System Description:

The system referenced in this report is located near the main entrance to Woodridge Manor and services 5 single-width trailer homes. Sewage is collected through a 4" pipe and is conveyed to a single compartment 1000-gallon concrete septic tank. The total daily flow to this system is estimated a 700 gpd, extrapolated from the metered park average of 140 gpd/trailer. From the septic tank the clarified effluent flows through an abandoned d-box and then into a 750-gallon dual siphon-dosing tank. At one time the siphons would have alternated dosing two parallel disposal areas consisting of 6 x 80' conventional laterals each. The laterals were installed in a large raised bed of medium sand measuring 140' x 100' x 4' depth. Total lateral length is 960 linear feet. The calculated soil application rate, based on a basal area of 6205 sq.ft. And a flow of 700 gpd is .3 gallons/sq.ft. /day.

The condition of the system when this engineer first observed it this spring (2001) was that it was in gross failure with surfacing and ponding of raw effluent. The owner frequently had problems mowing the grass on the raised area and had to fence off a 15' diameter area where dark effluent surfaced. The dosing siphons had long since failed and effluent was flowing by gravity out of the dosing tank through two overflow channels.

Proposed Remediation:

The conventional solution to this failure would have been to dig out the old system, dispose of the old material and create a new-engineered system. Based on my experience this would have cost $15,000.00 to $20,000.00. Representatives of Knight Treatment Systems (KTS) instead proposed to remediate the existing raised bed through the use of a microbial innoculator/generator called the "Piranha".

The Piranha system is a proprietary device; composed of a reactor module, oil less compressor and an inoculant that is inserted into the reactor module. The reactor is lowered into an existing septic tank, hooked up to the compressor and inoculated. The piranha unit generates beneficial bacteria using the waste stream as a food source. After a period of time the beneficial bacteria flow into the clogged laterals and gradually un-clog the system by consuming the biofilm. KTS claims that if within 60 days there is not a measurable increase in system function that a full refund will be given for equipment purchased and the site will be restored to the pre-piranha condition. The total cost to install the piranha unit at Woodridge was under $4000.00.

Installation and Monitoring:

On June 27,2001 KTS technicians arrive at 9:00 A.M. to install a Piranha in the failed system. By 12:00 noon the piranha was installed in the tank and running.

In order to determine the precise failure mode we the excavated several test holes in the disposal area. We first dug between the laterals and found clean sand to below the bottom of the adjacent lateral. As we dug closer to the lateral we encounter blackened sand, which is indicative of bio fouling. Bio-fouling occurs when slime forming bacteria multiply in the interstitial spaces between sand particles and render the sand layer impervious to water flow.

Upon breaching the bio-fouled sand layer a dramatic sidewall collapse ensued as the hydrostatic pressure in the trenches blew out the trench wall, filling our hole with effluent.

We next installed several monitoring wells in the raised bed to determine static water levels both between and inside the absorption trenches. At days end the static water level was at surface level in the trench monitoring well and non-detectable between trenches (laterals).

Results:

Over the next three weeks, the site was regularly monitored for mechanical function, condition of the raised bed, effluent characteristics and levels.

The first dramatic observation (after 4days) was formation of thick flocks of white bacterial colonies in the dosing tank. This was concurrent with a disappearance of all black sludge and slime in the tank. Water levels in the monitoring well stayed constant for the first 18 days. There was however a marked change in the color and quantity of the effluent at the surfacing point with a gradual change from black and green to gray. It also became noticeably less damp over the entire surface of the raised area.

Between the 18th and 21st days of operation the water level in the trench area dropped from grade to 12" below grade and the surfacing halted. This system now is considered "not failing" as defined by the NYS Department of Health.

As of 7-30-01 the water levels in the trench area have dropped to 15" below grade and the fence surrounding the area previously surfacing effluent has been removed. The area is dry and has been reseeded. It is my professional opinion that the failure has been remediated. I will continue to monitor the system for at least one year to assess the long term operation of the Piranha and to determine if the biofilm (clogging) can be completely removed through non-invasive biological methods.

SepTech Co.

Piranha Microbial Generator

General Technology Overview

The Piranha device, owned by SepTech Co., was developed to act as a means of introducing and maintaining viable cultures of specific bacterial strains, known to be effective in wastewater digestion, into hostile environments such as septic tanks, grease traps or other treatment vessels.

The design of the device allows efficient transfer of oxygen into wastewater, highly effective circulation of wastewater within and through the device; a refugia for placement of specific introduced bacterial cultures, and an abundant surface area for establishment of a fixed-film bacterial culture.

The Piranha device, when placed in a standard household septic tank, performs well beyond the accepted wastewater treatment standards defined in the conventional literature. Oxygen is supplied with an efficiency of approximately 33 lbs. O_2/ Horsepower/ Hour. A standard Piranha, operated with a 40-watt air pump capable of delivering 1.5 CFM, delivers almost 40 lbs. of O_2 to septic tanks that typically receive biological loads of about 1 lb. BOD per day.

This same air current drives water circulation through the column at a rate of approximately 25-30 gpm, resulting in a daily circulation of approximately 30,000-40,000 gallons over a contained fixed-film bacterial colony of approximately 150 square feet. The Piranha device is thus sized to provide a treatment level well beyond any known treatment system or device, when measured on a per unit energy basis.

Beyond the physical design parameters is the use of the device to maintain active growing colonies of specific aerobic and facultative anaerobic bacterial species. Species within the genera *Bacillus* and *Pseudomonas* are known to be among the most powerful digesters of organic wastes. Natural populations of these bacterial species are introduced into the Piranha using the IOS-500 patented bacterial/enzyme formula produced by IOS Corporation of California. The species in the IOS-500 blend are endemic to the leaf litter zone of soils in forest floors where they are responsible for a large fraction of the natural organic digestive process. Because of their environment they possess characteristics that suit them well to wastewater digestion including large appetite for organic carbon and nitrogen in nitrate form, rapid reproductive rate typical of organisms dominating seasonal environments, tolerance to a wide range of temperatures, and the ability to function anaerobically when necessary.

Experience to Date

The two components to the SepTech system include the IOS-500 bacterial culture and the Piranha device. Experience with use of the IOS-500 culture in wastewater treatment goes back over 15 years and includes use in bio-remediation of contaminated soil, algae control in ponds, restoration of DO in polluted natural water bodies, treatment of manure ponds, and extensive experience in municipal treatment plants.

Experience with the Piranha device is more recent, however, in the last year we have installed over 40 such devices in homes with a wide array of septic-based treatment systems and situated in a wide variety of soil types. The Piranha was designed specifically to reduce the organic loads in effluents being released to soils clogged by slime forming anaerobic waste from standard septic tanks. The effluent stream is enriched with bacteria from the IOS-500 culture known for their propensity to consume the muco-polysaccharide "slime" compounds. They are carried to the leach field where soil porosity is enhanced by bacterial degradation of these clogging compounds.

Virtually all installations to date have been for the purpose of remediation of systems that were completely clogged and unable to accept discharged water. In all instances these systems have responded to the treatment and soil acceptance of discharged effluent has been restored to a degree sufficient that the systems can be used again. The rate of restoration of function has ranged depending on soil type, seasonal rainfall, and other specific factors. One system in Booneville, California, of two 2,500 gal. septic tanks serving four apartment units and discharging to a leach trench buried 14 feet deep under an asphalt parking lot have showed the slowest clearance rate so far. However, water level in this system has steadily declined by about 1" per week. This system had been being pumped every two weeks prior to treatment. Pumping has not been needed for over 4 months while full loading to the system has been resumed.

Monitoring of Piranha system performance has focused primarily on soil clearance behavior, as that is the parameter of interest in use of the system for restoration of leach function. Measurements of standard parameters such a BOD and TSS show that levels range from 20-30 mg/L in typical household tanks, up to about 100 mg/L in certain institutional homes with very heavy loading. The highest BOD's are found at the Victor Treatment Center in Santa Rosa. This home houses 9 teenage boys with a full-time staff of 4. It is served by a Wisconsin Mound that had failed prior to treatment by completely filling with organic sludge.

Function of this mound was restored in approximately 2 weeks and it has remained stable for the last full year. A BOD measurement taken from the monitoring well in the sand portion of the mound showed a concentration of 4.0 mg/L, underscoring the fact that performance in the tank is irrelevant in assessment of system function.

Data on nitrogen dynamics in Piranha systems further suggests that monitoring of treatment function of any device should focus on the final effluent in the soil as opposed to measurements in the treatment tank. Effluent from both the septic pump station and the sand monitoring well in the mound were analyzed with the following results expressed as mg/l:

	NH3,	NO2,	NO3,	TKN
Septic Pump Station	83	<2	<2	89
Mound Sand Well	0.9	<2	<2	5

The Laboratory of the Santa Rosa Subregional Wastewater Treatment system analyzed these samples. We began a sampling series for nitrogen at several other Piranha installations using a Hach Field colorimeter tester that had a much higher level of resolution (0.1 mg/l).

Typical sampling consisted of one sample from the effluent portion of the septic tank and a sample obtained from a well dug approximately 6" from the sidewall of the leach trench serving the system. These wells were dug to the depth necessary to allow seepage of effluent into the well, typically about 3-4 feet.

The following results were seen:

Site		Sample	NH3	NO3
De Wolfe		D-Box	41	ND
		Soil	ND	0.6
Horowinski		Tank	23	0.2
		Soil	ND	<0.1
Madden		Tank	25	ND
		Soil	ND	ND
Victor		Tank	90	ND
		Mound	ND	ND* (system was Positive at 3.0 Mg/l NO_2)
Doherty	3/12	Tank	30	0.75
(No IOS-500)		Soil	<0.1	ND
	4/16	Tank	3.0	4.5
		Soil	27	ND

The Doherty results are of interest because this system was installed and operated for a time period without introduction of the IOS-500 culture. The system improved the water quality markedly and brought the level in the septic tank down to the desired level, indicating improved soil acceptance. As can be seen by the nitrogen levels this system appears to become a nitrifier, as is typical with most ATU's on the market. Since the aerator is within a tank capable of maintaining anaerobic pockets standard denitrification appears to be higher than in typical ATU's, which usually need recirculation for this purpose.

While TKN was not measured in the Doherty system denitrification in the tank was evident. The sum of the nitrate and the ammonia reduced significantly over the sampling period. What is unusual is the result in the soil. There, the nitrate was re-ammoniated when it reached the soil. This sampling hole showed much evidence of old bio-mat from the period prior to treatment when the system had failed and this is the likely source of the ammonia. This differs empirically from observations at the other systems where the IOS-500 culture had been added. Soils around the leach trench showed little evidence of organic bio-mat. We attribute that to the fact that use of the Piranha with inoculation sends excess bacteria of a facultative nature into the leach field. Being facultative anaerobes they are able to survive the journey through the anaerobic leach trench to the aerobic soils where they can rapidly consume the aged bio-mat organic carbon. The system without bacterial inoculation is colonized by randomly introduced spores entering with the air stream. These appear to be dominated by strict aerobes incapable of surviving passage into the soil from within the trench. Improvement in soil porosity is therefore a function of starvation of existing bio-mat anaerobes, as opposed to active bio-remediation by introduced facultative organisms.

At this time it appears that addition of the bacterial culture plays an important role in allowing an almost total denitrification of treated effluent when it reaches the soil. Nitrifying bacteria in the tank appear to be totally excluded by the IOS-500 culture, so denitrification appears to be via the alternate direct aerobic pathway instead of the more typical anaerobic pathway. Most of the work on Aerobic Denitrification has been done by researchers outside the U.S. but they have identified members of the *Pseudomonas* genera, included in the IOS-500 culture, to be among the prominent denitrifiers, both aerobic and anaerobic.

December 2001		Envirocheck Microbial Generator Data Summary				
Serial #	Sample Date	BOD5	Fecal Coli	Nitrate	Total Suspended Solids	Lab ID
		mg/l	CFU 100mL	mg/l	mg/l	
ENV01050401	12/10/2001	38	420	18	35	AD30695
ENV01050701	12/19/2001	56	30,000	4.3	48	AD31033
ENV01050901	12/28/2001	88	4,000	6.4	130	AD31217
ENV01051101	12.28/2001	460	14,000,000	<0.5	210	AD31218
ENV01051601	12/28/2001	34	8,900	<0.5	17	AD31215
ENV01051602	12/28/2001	8	11,000	<0.5	5	AD31216
ENV01060401	12/17/2001	72	690,000	3.3	68	AD30944
ENV01061101	12/26/2001	50	6,800,000	16	25	AD31119
ENV01061301	12/21/2001	29	12	0.56	25	AD31088
ENV01062501	12/28/2001	120	2,100	<0.5	61	AD31214
ENV01073001	12/26/2001	370	1,700,000	<0.5	170	AD31117
ENV01100801	12/21/2001	29	1,000	0.96	16	AD31087
ENV01101101	12/17/2001	54	6,700	<0.5	130	AD30945
ENV01102401	12/19/2001	82	37,000	<0.5	66	AD31034
ENV01110201	12/13/2001	46	530	<0.5	76	AD30878
ENV01111301	12/10/2001	190	420,000	<0.5	600	AD30696
ENV01111401	12/26/2001	56	24,000	0.82	44	AD31116
ENV01111501	12/26/2001	78	1,080	<0.5	34	AD31115
ENV01111901	12/26/2001	100	6,400	<0.5	38	AD31118

January 2002		Envirocheck Microbial Generator Data Summary				
Serial #	Sample Date	BOD5	Fecal Coli	Nitrate	Total Suspended Solids	Lab ID
		mg/l	CFU/100mL	mg/l	mg/l	
ENV01050401	1/16/2002	13	980	17	35	AE00334
ENV01050701	1/21/2002	25	9,300	1.5	38	AE00426
ENV01051101	1/21/2002	190	110,000	<0.5	160	AE00427
ENV01051401	1/25/2002	41	52,000	6.6	16	AE00594
ENV01051601	1/24/2002	56	260,000	<0.5	26	AE00548
ENV01051602	1/24/2002	31	9,700	<0.5	6	AE00549
ENV01060401	1/18/2002	52	6,000	<0.5	43	AE00410
ENV01061101	1/24/2002	60	640,000	13	36	AE00552
ENV01061301	1/22/2002	22	332	<0.5	15	AE00467
ENV01062501	1/16/2002	170	42,000	<0.5	140	AE00332
ENV01073001	1/23/2002	290	<2,000,000	<0.5	120	AE00494
ENV01100801	1/15/2002	59	5,500	<0.5	40	AE00300
ENV01100901	1/15/2002	180	8,300	<0.5	210	AE00299
ENV01101101	1/18/2002	22	23,000	<0.5	37	AE00411
ENV01102401	1/21/2002	110	230,000	<0.5	100	AE00425
ENV01110201	1/25/2002	65	2,400	<0.5	17	AE00595
ENV01111301	1/15/2002	63	33,000	<0.5	57	AE00301
ENV01111401	1/22/2002	42	4,200	1.3	21	AE00469
ENV01111501	1/24/2002	35	12,000	<0.5	32	AE00551
ENV01111901	1/22/2002	190	310,000	<0.5	27	AE00468
ENV01112801	1/23/2002	39	520	<0.5	52	AE00493
ENV01121101	1/23/2002	66	1,600	<0.5	27	AE00495
ENV01121401	1/21/2002	80	67,000	<0.5	71	AE00422
ENV01122001	1/21/2002	110	68,000	<0.5	64	AE00421
ENV01122401	1/23/2002	62	1,400	<0.5	27	AE00496

February 2002 **Envirocheck Microbial Generator Data Summary**

Serial #	Sample Date	BOD5 mg/l	Fecal Coli CFU 100mL	Nitrate mg/l	Total Suspended Solids mg/l	Lab ID
ENV01050401	2/12/2002	18	8	16	27	AE01048
ENV01050701	2/20/2002	36	6,800	0.56	58	AE01260
ENV01050901	2/20/2002	60	2,900	1.2	89	AE01258
ENV01051101	2/20/2002	120	250,000	<0.5	190	AE01263
ENV01051401	2/27/2002	14	9,700	1.1	13	AE01488
ENV01051601	2/12/2002	12	28,000	<0.5	39	AE01044
ENV01051602	2/12/2002	16	4,200	<0.5	11	AE01047
ENV01060401	2/19/2002	43	2,200	1.4	23	AE01211
ENV01061101	2/15/2002	29	1,200,000	18	27	AE01189
ENV01061301	2/28/2002	53	77	<0.5	28	AE01559
ENV01062501	2/14/2002	63	290,000	<0.5	31	AE01129
ENV01073001	2/27/2002	290	650,000	<0.5	73	AE01487
ENV01100801	2/12/2002	84	220,000	<0.5	30	AE01045
ENV01100901	2/14/2002	76	2,900	0.92	63	AE 01130
ENV01101101	2/13/2002	21	28,000	<0.5	26	AE01077
ENV01102401	2/20/2002	100	440,000	<0.5	58	AE01262
ENV01110201	2/27/2002	19	2,300	<0.5	22	AE01490
ENV01111301	2/12/2002	90	100,000	<0.5	59	AE01046
ENV01111401	2/28/2002	40	91,000	0.61	170	AE01556
ENV01111501	2/15/2002	38	110,000	<0.5	20	AE01188
ENV01111901	None: Frozen line					
ENV01112801	2/28/2002	11	6	<0.5	13	AE01558
ENV01121101	2/28/2002	57	38,000	<0.5	48	AE01557
ENV01121401	2/22/2002	120	980,000	<0.5	38	AE01377
ENV01122001	2/13/2002	90	640,000	<0.5	160	AE01076
ENV01122401	2/27/2002	38	13,000	<0.5	55	AE01489
ENV02012501	2/27/2002	44	46,000	<0.5	18	AE01486

Piranha components

<u>The information contained in this document is partly taken from the patent information and must be treated as confidential.</u>

There are two issues that appear to be of concern in the application and use of the *Piranha* technology for use in the recovery of biologically failed onsite leach field systems—1) whether the system does, in fact, recover failed system and restore the system to original operating conditions, and 2) the longevity of the system for this recovery. The former, that is the science behind the technology, is well documented in several other papers and will not be addressed in this paper.

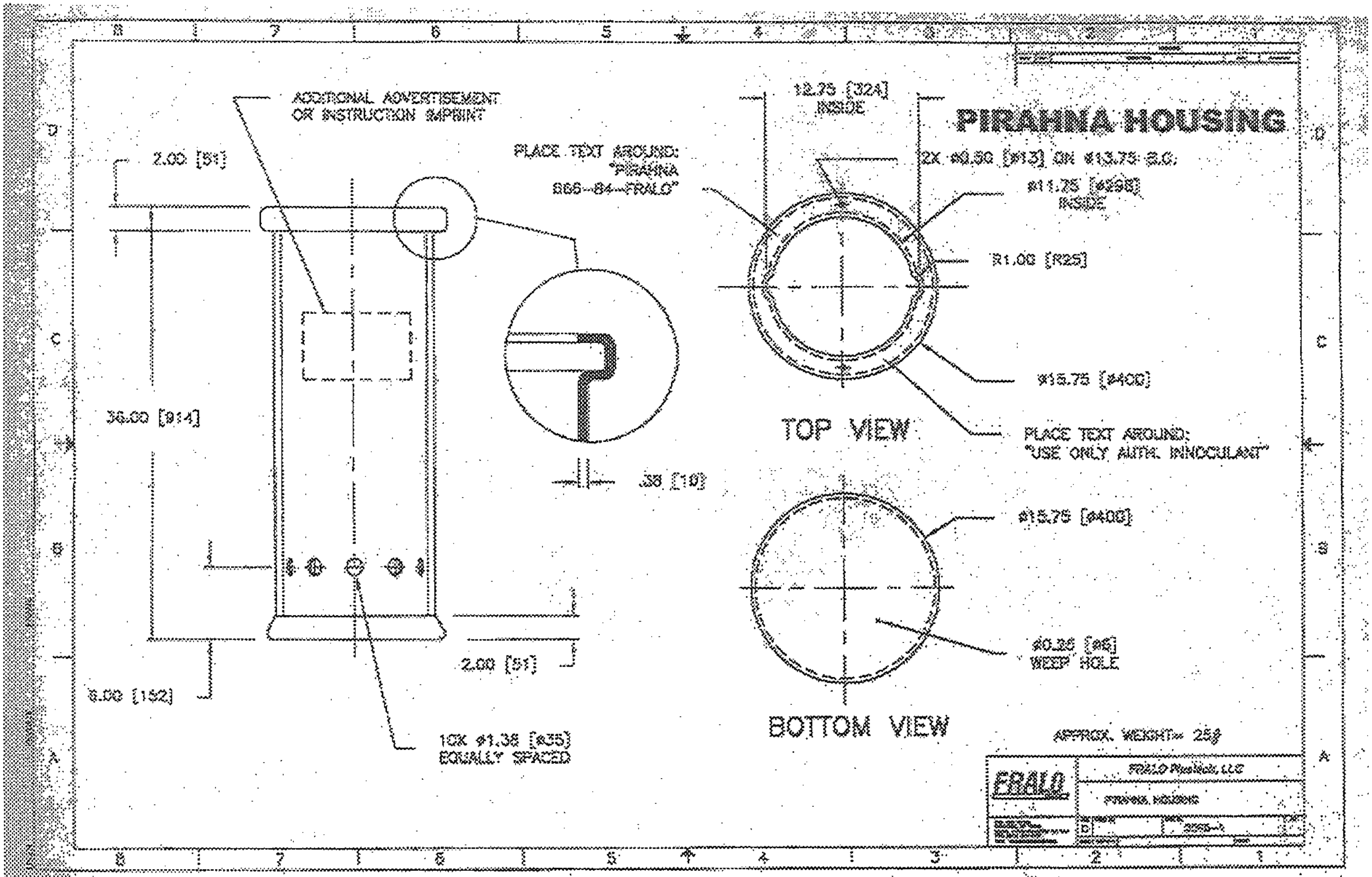
The major components of the *Piranha* are as follows:

- **ALITA Linear Air Pump,** Model AL-40, 60, or 80. ALITA air pumps are UL listed and are utilized in some NSF Standard 40 class 1 approved Aerobic Treatment Units. The technical information for these pumps is attached.
- **US Filter FlexDisc Fine Bubble Diffuser.** The following information is taken from the US Filter materials:
    - The FlexDisc fine bubble membrane diffuser is a 0.2m or 9in. disc diffuser with a 0.02m (0.75in.) NPT connection. FlexDisc diffusers are an ideal, low cost, energy efficient retrofit of existing coarse bubble diffusers that mount on the crown of a pipe. FlexDisc diffusers use the same proven EPDM membrane as DualAir diffusers.

      FlexDisc diffusers can be used in municipal and industrial applications. The membrane holder incorporates an integral flow control orifice for balanced air distribution throughout the system. The diffuser is designed for airflow rates of 14.2L/s to 85.0L/s (0.5 to 3.0SCFM).

  These diffusers are commonplace in all types of aeration systems for municipal and industrial wastewater treatment systems throughout the country. Many in the industry consider these membrane diffusers revolutionary.

- **Eljen PDS Cuspated Plastic material.** This material is used in the Eljen In-Drain leach field systems for onsite wastewater treatment/dispersal. The Eljen In-Drain system has been approved for use by a number of regulatory authorities as a direct replacement for the traditional stone and pipe type absorption system commonly used after a septic tank.
- **Pipes.** All piping material used in the *Piranha* system is ASTM certified and meets or exceeds the following standards:
    - **12"**—ASTM D 3034-96
    - **4"**—ASTM F810
    - **½" PVC**—ASTM D1785-96B
    - **½" CPVC**—ASTM D2846 NSF-pw
- **IOS 500 Innoculant.** The bacteria utilized in the *Piranha* are patented and well proven for use in wastewater systems. They are very benign and an MSDS is included for your review.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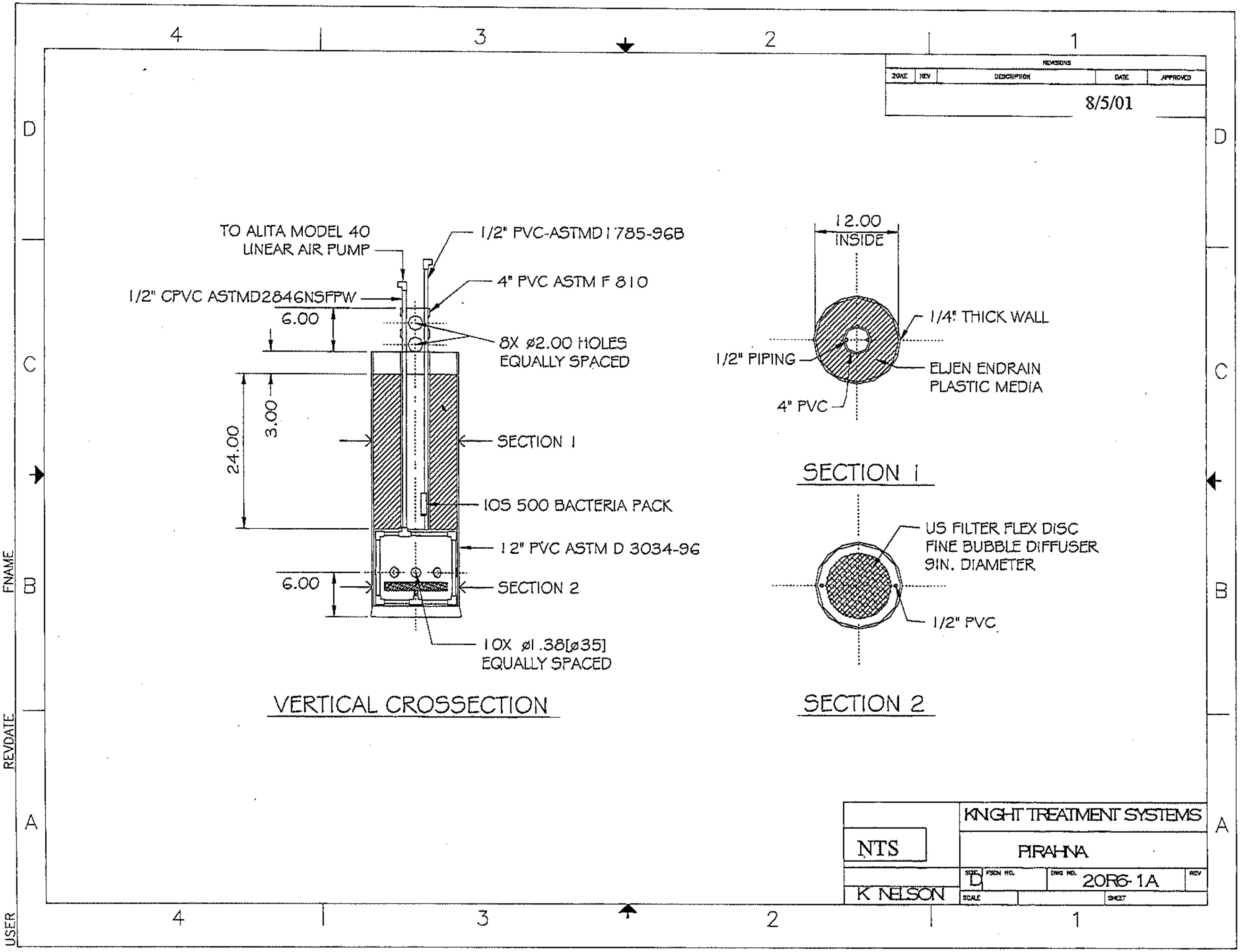
FRALO
FRALO Plastech, LLC


REVISIONS
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DESCRIPTION
DATE
APPROVED
8/5/01
TO ALITA MODEL 40
LINEAR AIR PUMP
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4" PVC ASTM F 810
1/2" CPVC ASTMD2846NSFPW
6.00
8X ø2.00 HOLES
EQUALLY SPACED
24.00
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IOS 500 BACTERIA PACK
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ELJEN ENDRAIN
PLASTIC MEDIA
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FINE BUBBLE DIFFUSER
9IN. DIAMETER
1/2" PVC
SECTION 2
KNIGHT TREATMENT SYSTEMS
NTS
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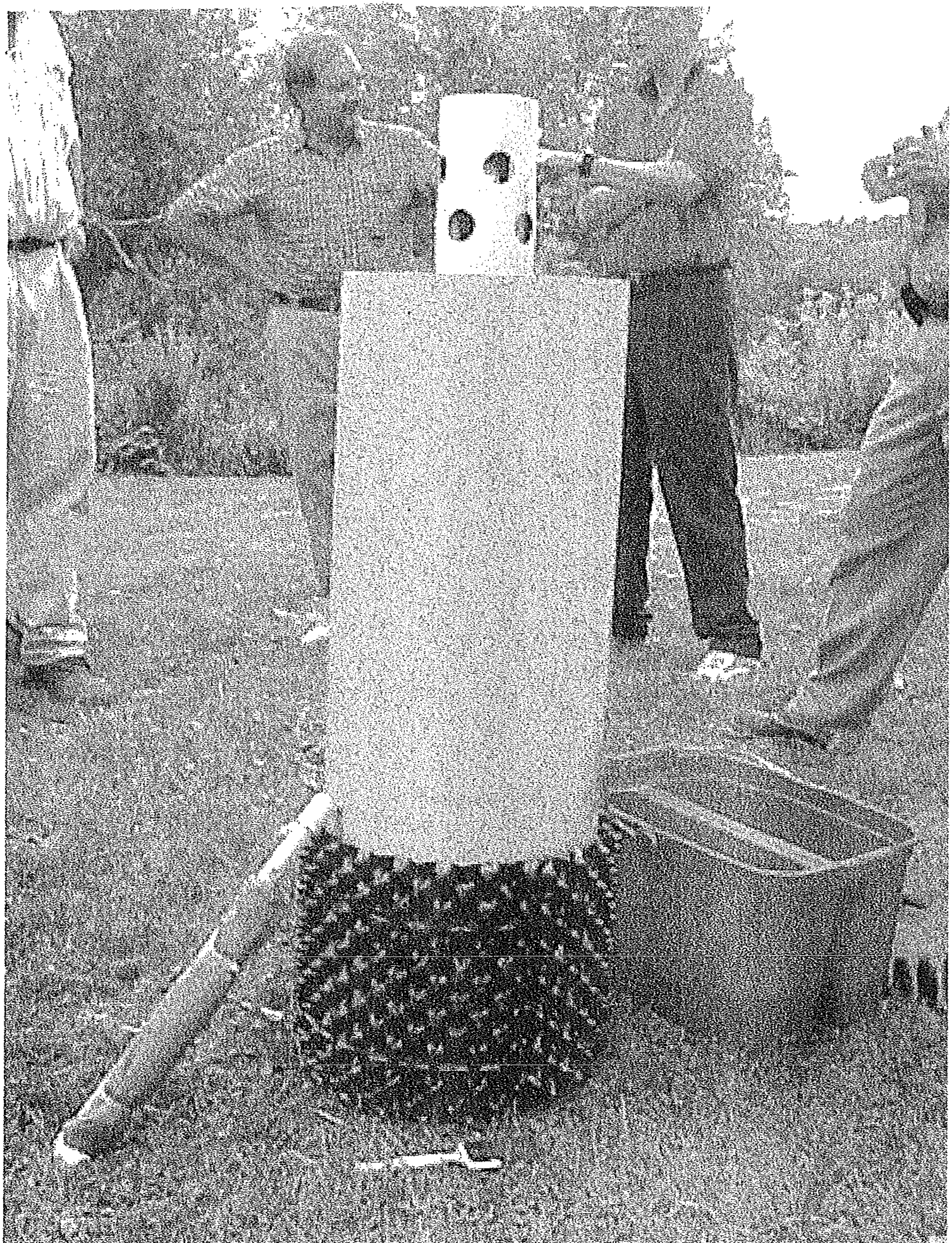

Pittston Site