AquaMats®

# PROCESS

## SITE STATS:

Average Daily Flow: .1 MGD
Location: North Central Virginia
Water Temperature: Avg. Low (1°C), Avg. High (20°C)

## PROVISIONAL PERMIT(S):

- $BOD_5$ – 20 mg/L
- TSS – 20 mg/L
- NH3 – 5 mg/L

## RATIONALE FOR AQUAMATS® PROCESS UPGRADE:

During 2003, Frederick County, Virginia felt that improvements to their Landfill Leachate Treatment Facility were necessary and began active efforts to improve facility performance for compliance with state regulations. Meridian engineers determined that for optimal performance an upgrade of the entire process was necessary. The design of our upgrade proposal focused on removal of ammonia nitrogen (NH3) at the requested flow volumes. Frederick County Landfill's permit requirements were achieved with an AquaMats® Process upgrade that converted the current primary and polishing treatment lagoons into high performance bioreactors.

Frederick County was impressed with the performance history of the AquaMats® Process and its predicted capability to provide solid year round performance, even with cold climate conditions, and to substantially reduce the high cost associated with periodic sludge disposal. **Briefly, the AquaMats® Process provides the quality treatment of mechanical plants in lagoons at significant savings in capital and operating costs.** The AquaMats® Process combines ADS's proprietary diffusion aeration products, engineered surface area ("AquaMats® ") and bioaugmentation ("Bacta-Pur®") technologies to form a very stable, and low-maintenance integrated system for natural microbial treatment of municipal wastewater. Operational costs are typically very low. Because of the efficiency of the AquaMats® Process, sludge handling is typically not necessary for up to 10 years or longer.

Frederick County considered a number of different proposals and selected the AquaMats® Process from Meridian because it offered the most impressive performance at low capital and O & M costs.

## DESCRIPTION OF AQUAMATS® PROCESS SITE DATA:

We are very committed to providing unbiased, objective evidence that the process is efficient, cost-effective and reliable. As evidence of this, we work regularly with our customers to gather as much data as we can about their system on a regular basis. IMPORTANT: None of the data is gathered by us directly, it is all provided to us by our customers and then presented here for your review.

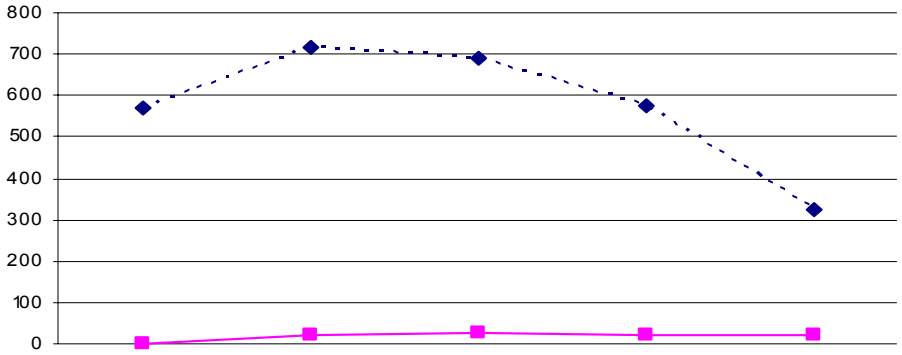
# Case Study Snapshots Frederick County Leachate Landfill, VA

**Primary Cell (After)…
AquaMats® Process**

**Primary Cell (Before)
Surface Aerators Only**

SITE DATA * SITE DATA

## Frederick County, Virginia Landfill Leachate Facility
## Influent vs. Effluent Ammonia (mg/L), Since Sept "03

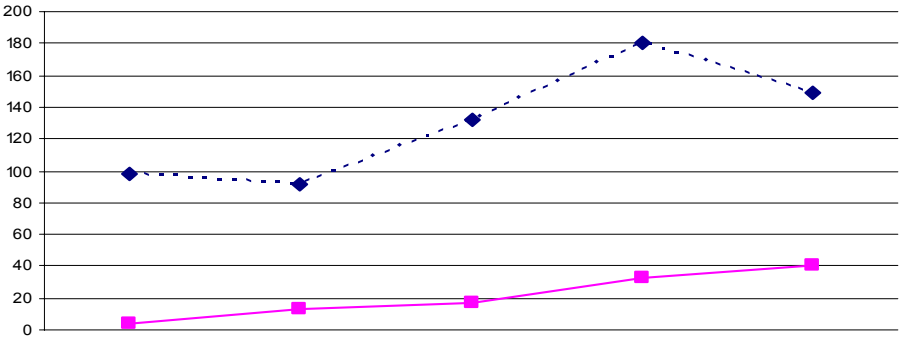



| | Dec-04 | Jan-05 | Feb-05 | Mar-05 | Apr-05 |
|---|---|---|---|---|---|
| Ammonia Influent | 571.3 | 718.3 | 691.5 | 573.3 | 326 |
| Ammonia Effluent | 2.5 | 18.9 | 26.7 | 23.5 | 19.6 |
| Ave. Removal Rate | 99.6% | 97.4% | 96.1% | 95.9% | 94.0% |

**FREDERICK COUNTY, VA LANDFILL LEACHATE AMMONIA INFLUENT EFFLUENT DATA TABLE**

| 2003 | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 Ammonia Influent | | | | | | | | | 469.5 | 435.5 | 308.5 | 495 |
| 2003 Ammonia Effluent | | | | | | | | | 0.6 | 2.5 | 0.7 | 9.3 |
| Ave. Removal Rate | | | | | | | | | 99.9% | 99.4% | 99.8% | 98.1% |
| **2004** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| 2004 Ammonia Influent | 671.8 | 415 | 479 | 412.8 | 528.5 | 517.3 | 523 | 301.2 | 456.3 | 614.3 | 677.8 | 571.3 |
| 2004 Ammonia Effluent | 10.5 | 26.8 | 41.8 | 18.3 | 1.4 | 0.7 | 0.5 | 0.7 | 0.8 | 0.5 | 0.6 | 2.5 |
| Ave. Removal Rate | 98.4% | 93.5% | 91.3% | 95.6% | 99.7% | 99.9% | 99.9% | 99.8% | 99.8% | 99.9% | 99.9% | 99.6% |
| **2005** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| 2005 Ammonia Influent | 718.3 | 691.5 | 573.3 | 326 | | | | | | | | |
| 2005 Ammonia Effluent | 18.9 | 26.7 | 23.5 | 19.6 | | | | | | | | |
| Ave. Removal Rate | 97.4% | 96.1% | 95.9% | 94.0% | | | | | | | | |

## Frederick County, Virginia Landfill Leachate Facility
## Influent vs. Effluent BOD (mg/L), Since Sept "03




| | Dec-04 | Jan-05 | Feb-05 | Mar-05 | Apr-05 |
|---|---|---|---|---|---|
| BOD Influent | 97.5 | 92 | 132.5 | 180.5 | 149 |
| BOD Effluent | 3.4 | 12.6 | 16.5 | 32.2 | 39.9 |
| Ave. Removal Rate | 96.5% | 86.3% | 87.5% | 82.2% | 73.2% |

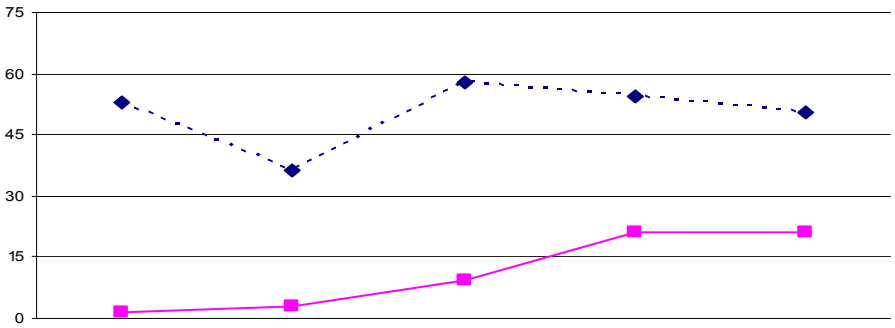
**FREDERICK COUNTY, VA LANDFILL LEACHATE AMMONIA INFLUENT EFFLUENT DATA TABLE**

| 2003 | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 BOD Influent | | | | | | | | | 272 | 404 | 206 | 98.5 |
| 2003 BOD Effluent | | | | | | | | | 14.2 | 17.7 | 5.65 | 9.9 |
| Ave. Removal Rate | | | | | | | | | 95.0% | 96.0% | 97.0% | 90.0% |
| **2004** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| 2004 BOD Influent | 119.8 | 64 | 115.5 | 236.3 | 157.3 | 128 | 142.5 | 77.5 | 158 | 156 | 152.3 | 97.5 |
| 2004 BOD Effluent | 14.5 | 15.1 | 27.7 | 29.9 | 13.6 | 3.9 | 4.6 | 2.3 | 2.7 | 2 | 2.3 | 3.4 |
| Ave. Removal Rate | 87.9% | 76.4% | 76.0% | 87.3% | 91.4% | 97.0% | 96.8% | 97.0% | 98.3% | 98.7% | 98.5% | 96.5% |
| **2005** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| 2005 BOD Influent | 92 | 132.5 | 180.5 | 149 | | | | | | | | |
| 2005 BOD Effluent | 12.6 | 16.5 | 32.2 | 39.9 | | | | | | | | |
| Ave. Removal Rate | 86.3% | 87.5% | 82.2% | 73.2% | | | | | | | | |

SITE DATA * SITE DATA

SITE DATA * SITE DATA

## Frederick County, Virginia Landfill Leachate Facility
## Influent vs. Effluent TSS (mg/L), Since Sept "03

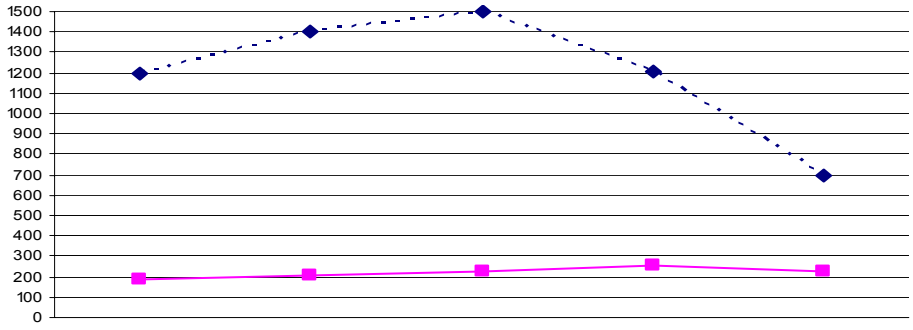



| | Dec-04 | Jan-05 | Feb-05 | Mar-05 | Apr-05 |
|---|---|---|---|---|---|
| TSS Influent | 52.8 | 36.4 | 58 | 54.2 | 50.6 |
| TSS Effluent | 1.6 | 2.7 | 9.5 | 21.3 | 21.2 |
| Ave. Removal Rate | 97.0% | 92.6% | 83.6% | 60.7% | 58.1% |

**FREDERICK COUNTY, VA LANDFILL LEACHATE AMMONIA INFLUENT EFFLUENT DATA TABLE**

| 2003 | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 TSS Influent | | | | | | | | | 96.3 | 126.5 | 97 | 76 |
| 2003 TSS Effluent | | | | | | | | | 14 | 5.5 | 18 | 4.8 |
| Ave. Removal Rate | | | | | | | | | 85.0% | 96.0% | 81.0% | 94.0% |
| **2004** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| 2004 TSS Influent | 64.7 | 66.1 | 58.4 | 61.6 | 73.5 | 80.1 | 81.2 | 29.3 | 84.7 | 64.4 | 38.9 | 52.8 |
| 2004 TSS Effluent | 7.7 | 7.9 | 19.7 | 23.6 | 10.2 | 8 | 5.4 | 5.5 | 5 | 2.1 | 1.1 | 1.6 |
| Ave. Removal Rate | 88.1% | 88.0% | 66.3% | 61.7% | 86.1% | 90.0% | 93.3% | 81.2% | 94.1% | 96.7% | 97.2% | 97.0% |
| **2005** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| 2005 TSS Influent | 36.4 | 58 | 54.2 | 50.6 | | | | | | | | |
| 2005 TSS Effluent | 2.7 | 9.5 | 21.3 | 21.2 | | | | | | | | |
| Ave. Removal Rate | 92.6% | 83.6% | 60.7% | 58.1% | | | | | | | | |

## Frederick County, Virginia Landfill Leachate Facility
## Influent vs. Effluent COD (mg/L), Since Sept "03




| | Dec-04 | Jan-05 | Feb-05 | Mar-05 | Apr-05 |
|---|---|---|---|---|---|
| COD Influent | 1195.5 | 1404.3 | 1501.5 | 1205.8 | 696 |
| COD Effluent | 184.3 | 203.5 | 229.3 | 251.2 | 229 |
| Ave. Removal Rate | 84.6% | 85.5% | 84.7% | 79.2% | 67.1% |

**FREDERICK COUNTY, VA LANDFILL LEACHATE AMMONIA INFLUENT EFFLUENT DATA TABLE**

| 2003 | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 COD Influent | | | | | | | | | 1192 | 1385 | 1067 | 1077 |
| 2003 COD Effluent | | | | | | | | | 160 | 105 | 95 | 150 |
| Ave. Removal Rate | | | | | | | | | 87.0% | 92.0% | 91.0% | 86.0% |
| **2004** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| 2004 COD Influent | 64.7 | 66.1 | 58.4 | 61.6 | 73.5 | 80.1 | 81.2 | 29.3 | 84.7 | 64.4 | 38.9 | 52.8 |
| 2004 COD Effluent | 7.7 | 7.9 | 19.7 | 23.6 | 10.2 | 8 | 5.4 | 5.5 | 5 | 2.1 | 1.1 | 1.6 |
| Ave. Removal Rate | 88.1% | 88.0% | 66.3% | 61.7% | 86.1% | 90.0% | 93.3% | 81.2% | 94.1% | 96.7% | 97.2% | 97.0% |
| **2005** | **J** | **F** | **M** | **A** | **M** | **J** | **J** | **A** | **S** | **O** | **N** | **D** |
| 2005 COD Influent | 36.4 | 58 | 54.2 | 50.6 | | | | | | | | |
| 2005 COD Effluent | 2.7 | 9.5 | 21.3 | 21.2 | | | | | | | | |
| Ave. Removal Rate | 92.6% | 83.6% | 60.7% | 58.1% | | | | | | | | |

SITE DATA * SITE DATA

## DESCRIPTION OF AQUAMATS® PROCESS UPGRADE:

***Primary Cell…***

The principal function of the Primary Cell is to enhance treatment and removal of approximately 75% of the $BOD_5$ and TSS along with initial nitrification. Additionally, this must be achieved under conditions where the water level may vary from 6 to 10 feet in water depth and the hydraulic residence time may vary from 31-62 days. Oxygen and circulation for the Primary Cell as upgraded consists of two zones, the mixing zone and the treatment zone, respectively. The mixing zone consists of approximately the first 200 ft of the Primary Cell (commencing from the side with the inlet). Aeration for the mixing zone is accomplished with LTC disc diffusers supplied by Air Diffusion Systems.

Immediately following the mixing zone is a permeable submerged and surface baffle across the width of the Primary Cell to increase biological performance of the Primary Cell and to provide uniform flow distribution into the secondary treatment cell area. The baffles consist of 90 units of AquaMats® for Flow Control Model 16000 that rest on the bottom surface of the lagoon and extend upward 1.8 meters and a cable connected row of 60 AquaMats® for Biofiltration at the surface. Treatment areas following the Primary Cell consists of a sequence of AquaMats® bio-arrays separated by linear rows of diffusion aeration. In total, the SDF AquaMats® will provide the Primary Cell with approximately 12,616,000 sq. ft. of additional effective surface area for water treatment.

In order to provide for varying water levels, the AquaMats® for Biofiltration bio-arrays are outfitted with a counter compression spring system to adjust to the changing water depths. (This system of counter compression is ideal in maintaining line tension despite water level changes without the problems associated with conventional spring systems in an effort to alleviate the need for repair or replacement. These units are sized in the 5 foot range to compensate for the fluctuation in ballast area and the corresponding water level fluctuation).

Dissolved oxygen ("DO") and circulation for the treatment area of the Primary Cell are provided by two positive displacement, rotary lobe air blowers, one in operation and one on standby for peak loads and in the event of outage of a main unit. The wire drawn horsepower operating load is 50 HP which will provide 612 SCFM @ 6 psi. Air is distributed from the main blower building through 8" and 6" diameter feeder pipes to weighted fine bubble aeration tubing. The tubing requirement to meet the O2 demand of the aerated segments of the Primary Lagoon is 5,900 linear feet of LTC piping consisting of 3,900 feet in the mixing zone and 2,000 feet in the treatment zone. The primary cell provides approximately 75% of the required $BOD_5$ and TSS removal and nitrification of approximately 20-25% of the influent loading.

***Secondary Cell…***

The principal function of the Secondary Cell is nitrification of the remaining NH3 loading to the system to achieve the 5 mg/L NH3 treatment goal.

The upgrade for the Secondary Cell includes approximately 1,596 units of AquaMats® for Biofiltration Model 15000 to enhance effective surface area for nitrification/denitrification processes of approximately 6,384,000 sq. ft. and additional aeration tubing. The estimated tubing requirement to meet the DO demand of the aerated segments of the Secondary Cell is 1,198 linear feet of LTC piping. The aeration grid deployment will provide not less than 3 mg/L DO at the inlet to the Secondary Cell and we project not less than 5 mg/L DO at the discharge.

# Case Study Snapshots Frederick County Leachate Landfill, VA

**Secondary Cell (After)… AquaMats® & Aeration**

**Secondary Cell (Before), Surface Aerators, Plant-Based Filtration Only**

## AQUAMATS® PROCESS COSTS---CAPITAL, OPERATING AND MAINTENANCE:

Capital costs incurred by Frederick County, Virginia for the AquaMats® Process upgrade were under $750,000 in equipment and installation related services.

## A WORD FROM THE ENGINEER…

Following completion of the installation in four months from contract execution, Meridian spoke with Frederick County's Consulting Engineer, Earl Sutherland of G.W. Clifford & Associates in Winchester, Virginia.

***Q - Why did you recommend the AquaMats® Process system?***

A - Well, the client had a significant investment in the current treatment lagoons and we did not want to get rid of it if we didn't have to. We felt as though the AquaMats® Process system was a reasonable compromise that enabled the customer to keep the existing lagoons in service while simultaneously meeting the new TAN permits.

***Q - What are your expectations?***

A - Meet the permit, the TAN limit. As an aside, I am now convinced that the UV disinfection system would not have worked without implementing the AquaMats® Process. The dramatic improvement in TSS reduction has finally given the UV a chance to what it was designed to do.

***Q - Have you been pleased with what you have seen so far?***

A - Very much. The visual clarity is strikingly different and the results of our first testing have indicated that the TAN permit requirement is being met.

## REFERENCES:

Mr. Ron Kimble
Environmental Manager
Frederick County
280 Landfill Road
Winchester, Virginia 22604
Phone: (540) 665-5658
Fax: (540) 665-6385

## INTERNET LINKS:

Meridian Aquatic Technology for High Performance AquaMats® Technology - http://www.aquamats.com/Biofiltration/biofiltration.html

Air Diffusion Systems, A John Hinde Co.: Lead supplier of aeration engineering and technology products and services - http://www.airdiffusion.com/

IET Aquaresearch for Bacta-Pur® and Bactivator™ Bioaugmentation Products - http://www.bactapur.com/

## REGIONAL REPRESENTATIVES FOR AQUAMATS® PROCESS:

C.B. Smith Co.
9238 Gravois Avenue
St. Louis, Missouri 63123
Contact: Cliff or Bruce Smith
Phone: (314) 631-5855
Fax: (314) 631-5592
Email: cbsmithco@att.net

Waterworks Sys. & Equip., Inc.
5275 Redding Drive
Lakeland, Michigan 44102
Contact: Chuck Kronk
or Greg Burk
Phone: (810) 231-1200
Fax: (810) 231-1331
Email: ckronkws@ismi.net

Sullivan Environmental
Technologies, Inc.
2553 Thirs Drive
Villa Hills, KY 41017
Contact: Dan Sullivan
Phone: (513) 515-6253
Email: djsullivan@insightbb.com

Aqua Sierra, Inc.
8350 South Mariposa Drive
Morrision, Colorado 80465
Contact: Christopher Fitzer
Phone: (303) 697-5486
or (800) 524-FISH
Fax: (303) 697-5069
Email: info@aqua-sierra.com

Kappe Associates Inc
P.O. Box 5578
Glen Allen, VA 23058
Contact: Matt Winschel
Phone: (804) 270-2556
Fax: (804) 270-2675

Nelson Environmental
101 Dawson Road N
Winnipeg, Manitoba R2J OS6
Canada
Contact: Martin Hildebrand
Phone: (204) 949-7500
Fax: (204) 237-0660
Email: mhildebrand@nelsonenvironmental.com
www.nelsonenviromental.com

LimnoTerra Limited
35A Shirk Place
Kitchener, Ontario N2K 1R3
Canada
Contact: Jon Planck
Phone: (519) 743-1780
Fax: (519) 743-1781
Email: rjplanck@sentex.net