Technical Advisory Group Meeting
“Interactive Decision Support Tool for Leachate Management”
By D.E. Meeroff and R. Teegavarapu (Florida Atlantic University)
Funded by the Bill Hinkley Center for Solid and Hazardous Waste Management (BHCSHWM)

**DATE:** Friday, April 17, 2009  
**TIME:**  
11:00 am  
**WHERE:** Florida Atlantic University Boca Raton Campus  
Computer Center Building  
CM Building (22), Room 130 (Studio 1)  
777 Glades Road, Boca Raton, Florida 33431

**Participants**

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Address</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tim Vinson</td>
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<td>561-681-6672</td>
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<tr>
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<td>Brownfields Coordinator, FDEP</td>
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<td>561/681-6676</td>
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<td>561-681-6667</td>
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<tr>
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<td>Engineering Manager, P.E.</td>
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<td>863-284-4319</td>
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<tr>
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<td>Associate Regional Manager</td>
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<td>561-922-1040</td>
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<tr>
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<td>Student</td>
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<td><a href="mailto:aruffini@fau.edu">aruffini@fau.edu</a></td>
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MEETING AGENDA
Friday, April 17, 2009
11:30 AM – 12:50 PM

1. 11:45 AM: Opening address by Dr. Meeroff followed by introduction of the group members and participants

2. Introduction of Landfill Leachate Project by Dr. Meeroff
   - Objectives, overview, need for research, conventional/existing leachate management options, the future of leachate management, new web-based methodology.
   - Dr. Meeroff discussed the objectives of the project tasks including the evaluation of alternatives, evaluation of energized processes, and compilation of the best management practices guide/database.

3. Discussion of Study Methodology by Dr. Teegavarapu
   - Dr. Teegavarapu discussed development of the decision support tool, previous decision support tools developed by his research group for other applications, and the framework established for this project.

4. Discussion of Future Work by Dr. Meeroff
   - Dr. Meeroff presented information about the energized processes of photocatalytic oxidation and photochemical iron-mediated aeration.
   - Dr. Meeroff presented the project website and introduced opportunities for TAG member input for the ranking criteria, the technology matrix, the user-interface profile data collection tool, site-specific information (leachate quantities, issues, past experiences, etc.), and the web survey.
   - Dr. Meeroff discussed opportunities to partner with FAU for the upcoming pilot studies planned to test the two new treatment technologies.

5. Discussion of TAG Input Needs (Open Forum)
   - “What are you looking for from vendors?”
We are looking to modify reactors that are in place and allow for study…

- “What type of flow [for pilot study]?”
  - The initial thought is 100’s of gallons/day…
- “What is the duration of the pilot study?”
  - We would like to do [wet vs. dry] seasons…
- “Leachate changes over time.”
  - We can continually test the pilot unit…
- “What exactly is lab scale?”
  - Approximately 100-250 mL per batch…
- “How ‘smart’ will the system model be?”
  - It will be able to adapt to different landfills, but it will only be as good as the data that users put in…
- “UV light comes from the sun. What is different?”
  - We use the catalyst reaction; PIMA (iron) and TiO₂
- “How much energy will the UV cost?”
  - This is exactly why we need a pilot study. We are not sure how increasing the scale will affect the unit cost…
- Kennedy Space Center did something similar with Chlorine (for Haz waste).”
  - Chlorine alone (or UV alone for that matter) does not work for leachate…
- “What costs are you looking for (cost per gallon)?”
  - We are looking for utility costs, capital costs, O&M, labor costs, etc. to be broken down…
- “Will there be use for constructed wetlands?”
  - We have it listed in our database as natural attenuation…
- “Are you looking for funding or partners?”
  - At this point we have too many variables to answer. Depending on the partners, we will outline the best case relationship…
- “How is permitting used for a pilot?”
The FDEP will need to be involved from the beginning…

- “How long for permitting?”
  - Joe Lurix (FDEP) answered: 90 days, but may be more for pre-permitting

- “How large of a pilot are you looking for?”
  - Preferably, 1/3 full scale, but we need to work with a vendor partner for this...

- “Are you looking to work outside of Florida? How would you take this further?”
  - We would use the web decision support tool and hope that entrepreneurs and solid waste managers outside of Florida would participate in the survey. Also, the more information we have, the better the module will perform...

- “Do you just have leachate aeration?”
  - For the energized processes, we know that we need air to activate the reaction. Air alone does not get us to where we need to go for sewer discharge in all cases. For the energized processes, we can combine air stripping and aeration, or they can be two separate unit processes. We would like to know if you would like to have them separate or in one unit...

- “Tallahassee has a pre-treatment study.”
  - We would like to investigate those results, can you provide a contact person?

- “Have you captured all the information from all over the country?”
  - We have an evolving study...

6. Adjourn, thank you for participating (12:48 PM)
So, Why Am I Here?

- We need industry input
  - Regulators
  - Utilities
  - Operators
  - Consultants
  - Vendors
  - Other stakeholders

Need For Research

- Florida manages 35 million tons of MSW each year
- Almost 65% sanitary landfill disposal
- In 2006, Florida’s Class I landfills generated over 750 gpd of leachate per acre
- Variable types/ages of leachate require different management strategies
  - “One size does NOT fit all”
**Florida Atlantic University**

**Conventional Leachate Management**

- Sewer discharge
- Disrupts WWTP due to high COD and ammonia toxicity if Q > 2%
- Natural attenuation
- Deep well injection
- Evaporation ponds
- Hauling off-site
  - $50 per 1,000 gallons
  - Transportation risk
- On-site treatment
  - Biological treatment
  - Physical/Chemical treatment
  - Advanced oxidation
  - Energized processes
- Leachate recirculation may also be viable
  - Morris (2003) reported promising pollutant removal capacities

**Future Leachate Management**

- Must be sustainable
- Must be site-specific
- Must be capable of adaptation to:
  - Evolving regulations
  - Climate change
  - Population growth
- A likely approach:
  - On-site pretreatment, to reduce the toxicity of the leachate, and then discharge to sanitary sewer

**Florida Must Lead By Improving**

1. Measurement and evaluation of current leachate management practices
2. Design and implementation of new or upgraded systems
3. The regulatory framework to deal with changing technologies and lessons learned
4. Access to vital information on leachate management strategies and applications

**Objectives of the Research**

- **Objective 1**: Evaluate Alternatives
  - Review & collect leachate quality data
  - Identify trends
  - Rank alternatives (performance, risk, environmental and economic factors)
- **Objective 2**: Evaluate EPs
  - Preliminary cost analysis
  - Preliminary risk assessment
  - Web-based BMP guide
  - Interactive and goal-based
- **Objective 3**: Develop Management Tool
  - Preliminary cost analysis
  - Preliminary risk assessment
  - Web-based BMP guide
  - Interactive and goal-based

**How Do We Keep Up to Date with the Latest Innovations?**

- Pharmaceutical EDCs
- Alternative Water Supplies
- Plasma Arc Technology
- Green Engineering
- Waste to Fuels
- Alternative Water Supplies

**Florida Atlantic University**

- We need a groundbreaking new methodology
- That will allow regulators, consultants, and utilities to keep up to date with the latest practices and operational experiences regarding leachate management, available at their finger tips
- That solution is a web-based interactive decision support tool
Tasks

- Compile BMP database
- Identify user profile information
- Refine and map user needs to BMP matrix
- Design decision tree
- Identify host institution needs
- Develop user interface
- Beta testing
- Publish user’s manual
- Launch and monitor success

Project Schedule

Schedule:
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8

Future Work

1. Work with expanded TAG to update the BMP Guide
2. Develop management tool
   - BMP guide database
   - Decision support tree
   - User profile
   - Beta testing
   - Launch
3. Complete scoping tests for futuristic technologies
4. Update performance assessments with pilot test data

Decision Support Tool Architecture
Decision Support Systems

- Past experience in the development and implementation of two specialized decision support systems (DSS)
- Two Decision Support Systems (Teegavarapu et al., 2005, 2006)
  - STREAMS (STReam Environment Assessment and Monitoring System)
  - MIST (Model Identification and Selection Tool)

STREAMS

- Was primarily intended to provide a knowledge-based decision support system based on visual assessment protocols for stream health monitoring.
- Several visual assessment criteria were used to assess the health of impaired streams and to make recommendations for further monitoring.

MIST

- MIST is a knowledge-based assessment system for selection of water quality modeling environments and models. The system developed is modular in nature thus allowing the user to have control over the nature and level of consultation that is required. At a later stage, the integrated development environment (IDE) can also be used to link the models and also provide help to the user in selecting the appropriate parameters for the model.
The tool will be will be a standalone system initially and then ported to web based portal.

User profile needs to be developed before the consultation.

During this consultation phase, the tool elicits the user’s objectives, resources, preferences, constraints, etc. that must be factored into the selection of the appropriate strategies for a particular application.

As a knowledge-based system, the tool balances the multiple criteria that need to be weighted and prioritized to choose the best strategies from the BMP guide.

The user profile will interface with the BMP database and match the best fit technologies to generate a recommended set of alternatives.

Once the appropriate technology has been selected by the user and implemented, its performance must be tracked against the initial goals set by the user profile.

The tool will be prompted to answer detailed questions about critical characteristics needed to assess alternatives.

The user will continue to update the profile with specific measures to provide the feedback necessary to keep the BMP database and ranking system current, thus closing the loop.

Performance measures can then be assessed against other participating utilities, which will allow the database to be continually refined and adjusted to be as realistic and as useful as possible.

The user profile will interface with the BMP database and match the best fit technologies to generate a recommended set of alternatives.

Questions will be related to: climate conditions, generation facilities, size, type of landfill, regulatory requirements, costs of operation, and current disposal practices.

It will also ask for subjective inputs such as desired range of costs and technologies to exclude, for instance.

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Criteria that need to be weighted and prioritized to choose the particular application.

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Previous Work
- "Options for Managing Municipal Landfill Leachate" - Englehardt and Meeroff (2005)
- "Investigation of Energized Options for Leachate Management Year One" - Meeroff and Tsai (2006)
- "Investigation of Energized Options for Leachate Management Year Two" - Meeroff and Tsai (2008)

Ranking Criteria
<table>
<thead>
<tr>
<th>Efficiency of Treatment (5)</th>
<th>Pollutant removal performance for the major contaminants of interest in leachate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Issues (4)</td>
<td>Includes environmental impacts, odors, dependency on climate conditions, etc.</td>
</tr>
<tr>
<td>Preliminary Costs (3)</td>
<td>Preliminary capital and O&amp;M costs for the proposed treatment process</td>
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<tr>
<td>Residuals (2)</td>
<td>Adverse by-products generated during treatment or as a consequence of treatment</td>
</tr>
<tr>
<td>Footprint (1)</td>
<td>Physical size requirements of the proposed treatment process</td>
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</tbody>
</table>

Results from Alternative Analysis
<table>
<thead>
<tr>
<th>Technology</th>
<th>Efficiency</th>
<th>Residuals</th>
<th>Footprint</th>
<th>Other</th>
<th>Total Weighted Score out of 60</th>
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<tbody>
<tr>
<td>Municipal Sewer Discharge</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>? 39</td>
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<tr>
<td>Leachate Recirculation Bioreactor</td>
<td>4 2 3 3</td>
<td>39</td>
<td></td>
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<tr>
<td>Evaporation</td>
<td>2</td>
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<td>1</td>
<td>3</td>
<td>? 27</td>
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<tr>
<td>Hauling Off-Site</td>
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<td>5</td>
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<td>? 15</td>
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<tr>
<td>Deep Well Injection</td>
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<td>5</td>
<td>3</td>
<td>0</td>
<td>? 13</td>
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</table>

- Evaluated 23 Engineering Alternatives
- Efficiency, economics, risk, footprint, and residuals disposal
- Energized processes scored high
- Ex. Advanced oxidation, PIMA, Photocatalytic oxidation, etc.

American Water Works Association (2008)

Preliminary Rankings

TAG Input Opportunity #1
- Refine the BMP guide
  - Step 1. Take a look at the alternative selection matrix, the selection criteria, the weighting scale, and the technologies evaluated
  - Step 2. Provide the research team with comments to refine the values and provide data to support your reasoning

http://labees.civil.fau.edu/LeachateMatrix.pdf
User Profile Data Collection

- We selected 52 landfill sites from all districts in Florida to provide data for mapping to the BMP guide
- 26 categories of user provided information
  - Ex. Class, Size, Age, Costs, Disposal, etc.
- We have an online survey
  - http://labees.civil.fau.edu/DST-tool.pdf
- We have some incomplete responses so far

User Provided Information

- Current database is incomplete

<table>
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<tbody>
<tr>
<td>FACILITY</td>
<td>NAME</td>
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<tr>
<td>Tons/day</td>
<td>Disposal Population of Service Area? Landfill Capacity Permitted Acres Expected Landfill Life in Years?</td>
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<tr>
<td>NWD</td>
<td>BAY</td>
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<tr>
<td>CD</td>
<td>BREVARD</td>
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Online Survey

- TAG Input Opportunity #2
- We need your input
- Please take a moment today to fill out as much as you can
http://labees.civil.fau.edu/DST-tool.pdf

Futuristic Leachate Technologies

- We need to know about your experiences with innovative treatment processes
- We need to continue to develop futuristic technologies
  - PIMA
  - Photocatalytic oxidation
  - Others
- These processes are capable of:
  - Conversion of refractory COD into more biodegradable BOD
  - Removal of heavy metals (Pb, As, Cd, Hg) through co-precipitation, adsorption, and redox
  - Conversion of ammonia to nitrate through aeration, and stripping of NH3(g)
  - Destruction of recalcitrant organics and stripping of VOCs
  - Disinfection
  - Color/odor treatment

Future Studies

- “Energized options for onsite leachate management”
- We are looking to pilot test futuristic advanced oxidation technologies developed in Year 1 and Year 2
- We need a partner landfill site for pilot testing
- We need a partner vendor for a pilot platform to mount the technology
Presentation to the HCSHWM Technical Advisory Group
Boca Raton, FL, April 17, 2009

Any Volunteers?

Agenda

1. Introductions/Opening Remarks
   Dr. Meeroff

2. Study Methodology
   Dr. Teegavarapu

3. Future Work/Project Website
   Dr. Meeroff

4. Open Forum/User Input
   Everyone

Did we miss anything?

Open Forum

Acknowledgments

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