Water Environment Association
Preserving & Enhancing Ohio's Water Environment

2011 OWEA Annual Conference
June 22, 2011

When Disaster Strikes

Dan Miklos, Senior Associate, Midwest Region

HAZEN AND SAWYER
Environmental Engineers & Scientists

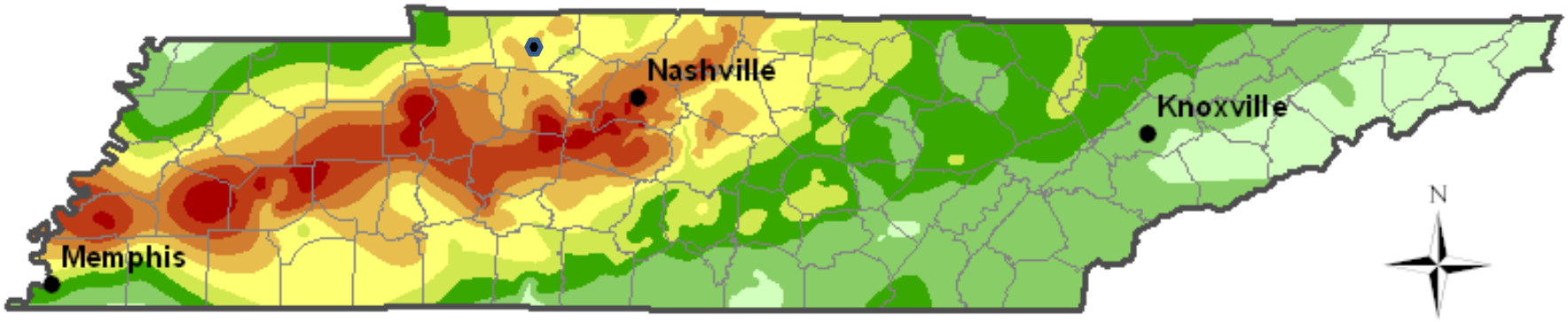
Agenda

- The Flood of 2010
  - Disaster provides an opportunity to re-think earlier decisions
  - Correcting long term design problems
  - Dewatering, Biosolids Processing and Disposal are changed
- Existing Sludge Processing and Disposal
  - Sludge Conditioning and High Pressure Pumping.
  - Plate and Frame Presses with Drag Chain Conveyance to RDP Class A Processing
  - RDP Processing to Class A Biosolids
- Current full scale pilot testing
  - Centrifuge
  - Belt Press
- Low technology solutions for long term disposal.

The Clarksville Flood of 2010

- Characterized as “far greater” than a 1,000 year rain event - 36 hours of rain totaled 17 inches on May 1 and May 2, 2010. 26 fatalities on May 2, 2010.
- BP Deepwater Horizon Oil Rig explosion and oil spill on April 20, 2010 kept the nation’s attention.
- The Army Corps of Engineers released 1.4B gallons of water in 1 hour to save upstream dams.
- The Clarksville WWTP was flooded and remained under water for approximately 6 days.
- Severe damage with prolonged submergence as opposed to a storm surge that quickly recedes. Every cable and conductor had to be removed.

Weekend Rainfall Totals - May 1st & 2nd, 2010
Tennessee



Source: CoCoRaHS

0 25 50 100 150
Miles

Precipitation Contours

In Inches

0.01" - 2.00"	8.01" - 10.00"
2.01" - 4.00"	10.01" - 12.00"
4.01" - 6.00"	12.01" - 14.00"
6.01" - 8.00"	14.01" - 16.00"
	16.01" - 20.00"

This map is an interpolation of actual reported values, but should be considered an estimation only.

Created by the National Weather Service Forecast Offices Nashville, Tennessee & Louisville, Kentucky

City of Clarksville, TN
1,000 Year Flood Recovery Team

- Hazen and Sawyer, Project Management
- Allied Technical Services, Sharonville, OH, Site Dewatering, Underwater Services, Equipment repair/replacement
- MSD Equipment, Centerville, OH, Sludge Dewatering
- Shermco Industries, Dallas Texas, Electrical Contracting
  - Aggreko: Generators, dehumidification, air handling
  - Belfor: Property restoration/cleaning

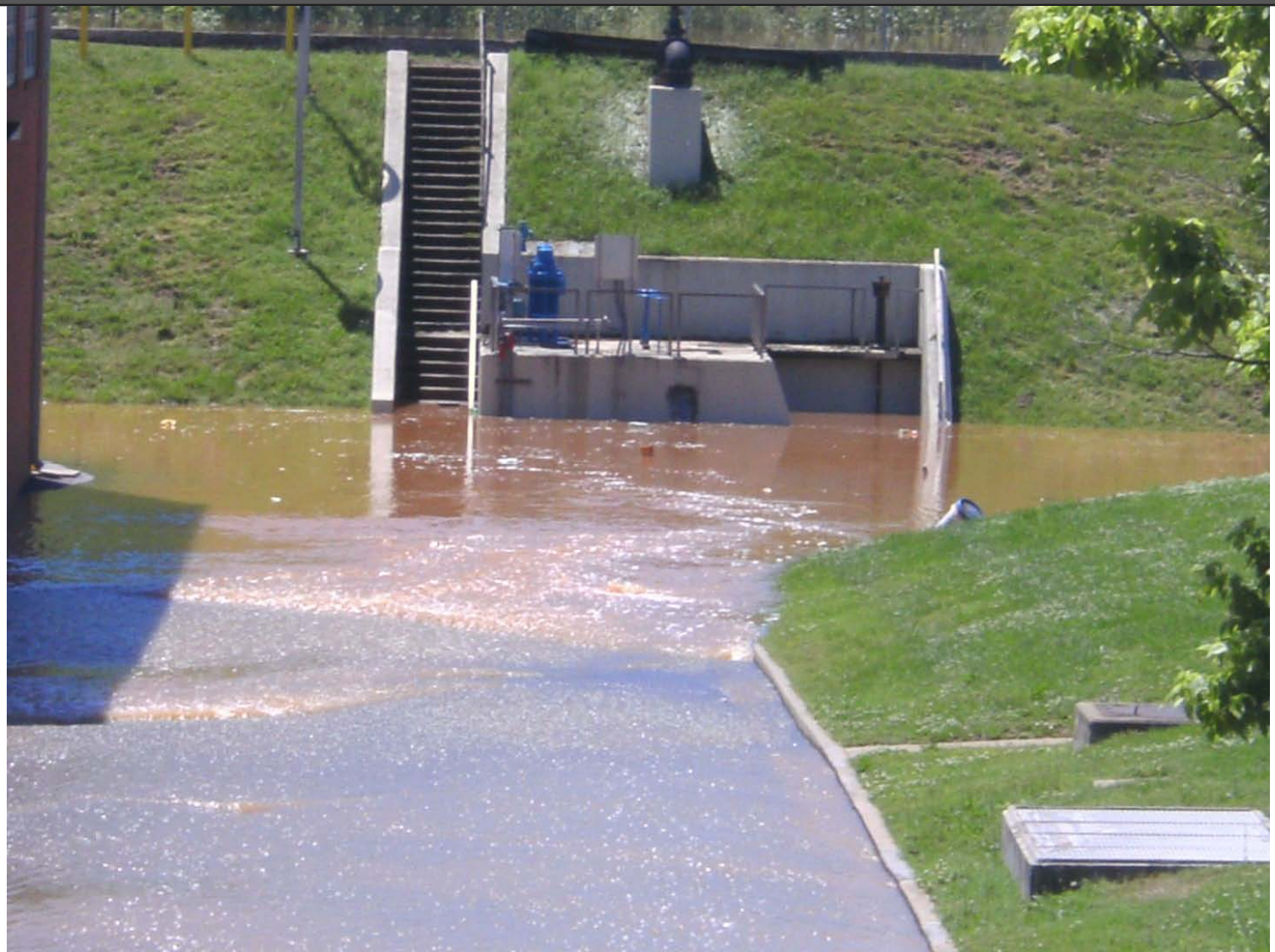
Clarksville, TN: May 1, 2010, Cumberland and Red River Confluence

Flood Breach-North Levy
5/3/2010

Low Point-South End of Plant
5/3/2010

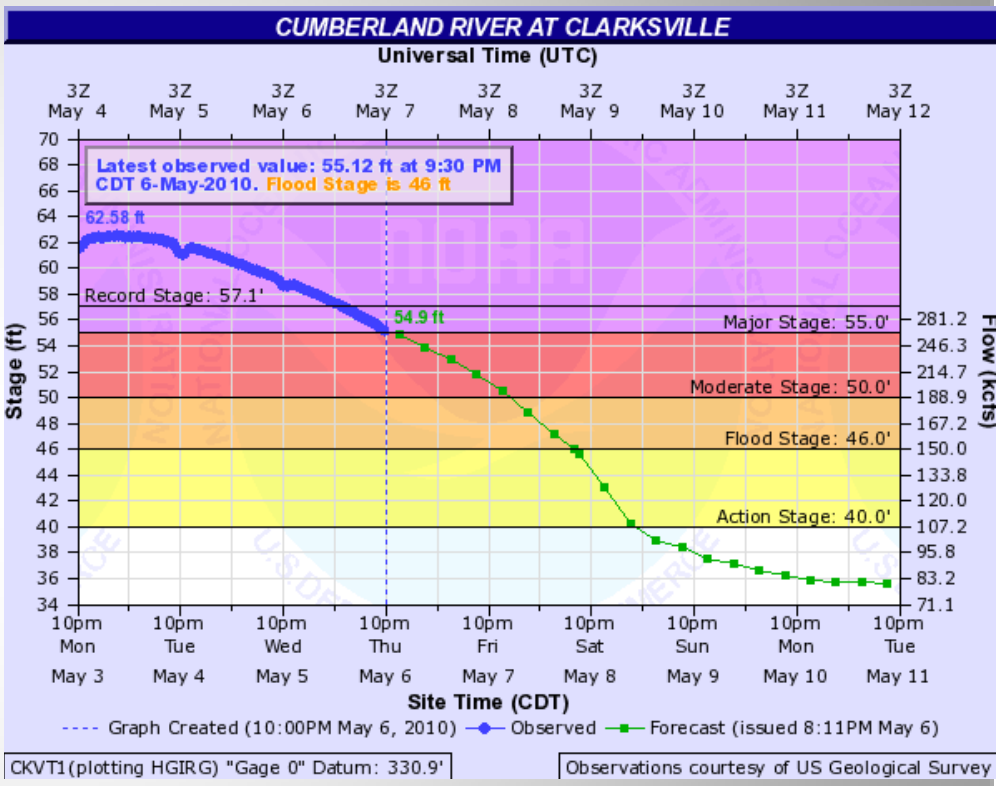
Site Drainage To Plants
Stormwater Pump Station
5/3/2010

Stormwater Pump Station
Too Much Flow!
5/3/2010



Initial Recovery Timeline

- Event: May 1-2
- WWTP Site Flooded: May 3
- River Crest: May 4
- Emergency response contractor hired (pumps, generators, manpower, electrician, etc.): May 4
- Site dewatered: May 5-9
- Primary Treatment restored: May 12
- Electrical Contractor Selected: May 14
- Temporary dewatering company selected: May 15
- Electrical contractor began work: May 15
- Site cleaning and disinfection contractor began work: May 16
- Temporary solids dewatering belt press on-site: May 21



NPDES Permit…Water Quality!

- Immediate communication with TDEC HQ and field office
- Daily written report to TDEC concerning flood recovery progress
- All floodwater from site disinfected and pumped through GeoTube
- All wastewater effluent disinfected prior to discharge (bulk hypochlorite)
- Primary Treatment: Wednesday, May 12 (3 days after site dewatered)
- Secondary Treatment: August (over 3 months after site dewatering complete) Turblex blowers, air system, diffusers, AB tanks, power, etc…

Deep Thoughts…FEMA

- Waterline matters…
- Keep lines of communication open.
- Define “emergency condition” and purchasing requirements associated with the emergency.
- But…the story can change…get it in writing
- Define Project Worksheet “projects” early.
- Don’t build in a COE flowage easement.
- Levee?
- More to come.

Clarksville, TN: Clarksville WWTP Following Levee Breach

Clarksville WWTP: Solids Handling Facility

Administration Building Roof Lifted Tuesday 5/4/2010

Administration Building
Wednesday 5/5/2010

Clarksville WWTP:
Solids Handling Facility
May 6, 2010

Clarksville WWTP:
Solids Handling Facility
May 7, 2010

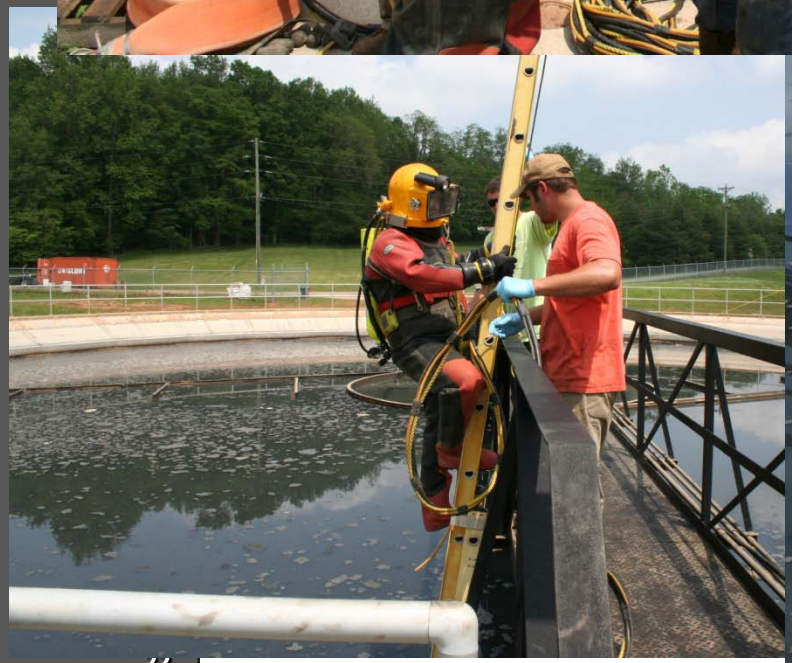
Clarksville WWTP:
Solids Handling Facility
May 8, 2010

Clarksville WWTP:
Solids Handling Facility
May 9, 2010

Administration Building
Saturday 5/8/2010

Flood Recovery Begins
All Site Dewatering to GeoTube Silt Bags

Allied Technical
Underwater Services
Primary Settling



Refrigerators Can Float
5/9/2010

Aeration Tanks Area Dewatering
5/7/2010

Sludge Conditioning Building
"Mud" and "Sludge"
5/12/2010

Site Dewatering
5/8/2010

Clari-Vac Systems In Secondary Clarifiers Floated Out of Tanks 5/9/2010

Clari-Vac Systems Floated Out of Tanks 5/18/2010

RECOVERY… a daunting task!

Flood Recovery Begins: Competing for Resources
Temp. Generators and Pumps Arrive
5/7/2010

Flood Recovery Begins
Generators and Dehumidifiers Arrive
5/15/2010

Cleaning Crews Mobilize
5/16/2010

Building Interiors Vacuumed 5/27/2010

Temporary Belt Press
5/27/2010

125 Contractors On-site: Daily coordination changes! Cleaning, Mech. & Elec. Repairs 5/27/2010

All Electrical Wire Removed and Salvaged 6/18/2010

Clari-Vac Systems Repaired 7/28/2010

New Clari-Vac LCP's 7/29/2010

Turblex Blowers Refurbished New LCPs. Motors Rewound 7/29/2010

Aeration Basins
Diffuser Replacement Tank No. 1
8/2/2010

Belt Thickener Building
Ashbrook GBT's Refurbished
8/3/2010

Belt Thickener Building
Ashbrook GBT's Refurbished
8/21/2010

Temporary Mobile Substation
8/21/2010

Effluent Pump Station
New VFD's for 5 Effluent Pumps
8/21/2010

May 5, 2011

Secondary Settling Tanks 5 through 9 Commissioning Completed 8/30/2010

Aeration Basins
Diffuser Replacement Tank No. 1 Complete
8/31/2010

New MCC
Primary Sludge Building
10/28/2010

New MCC
Belt Thickener Building
2/18/2011

Clarksville Solids Processing

- Three (3) Structures / Processes:
  - Sludge Conditioning and High Pressure Pumping.
  - Plate and Frame Presses with Drag Chain Conveyance to RDP Class A Processing
  - RDP Processing to Class A Biosolids
- Hazen and Sawyer recommended the City reconsider their sludge processing selection. The flood enabled the City to evaluate earlier decisions regarding capital investment in dewatering and Class A Processing.
- FEMA and flood insurance enabled the City to provide for re-investment with a change in technology approach.

Sludge Conditioning

Plate and Frame Presses

Drag Chain Conveyors

Pug Mill Operation with Post Lime Treatment for Class A Processing

Long Sweep Conveyors for Loading Station

Loading Station

Existing Sludge Processing Equipment: connected hp

	connected hp	Number	total hp
Grinder Pumps	3	2	6
Mixer Pit	1.5	1	1.5
Odor control	2	2	4
Lime feed tank mixer	15	1	15
Silo screw conveyor	5	1	5
Transfer screw conveyor	5	1	5
Lime Hose Pump	10	3	30
Ferric Pump	2	1	2
RDP Sludge Storage Mixer	1	2	2
Press Feed Pumps	25	5	125
Air Compressor	30	2	60
Drag chain conveyor	25	5	125
Transfer Screws	25	5	125
Sludge Lime Mixers	25	3	75
Pug mill	25	3	75
Cross Belt Plow	15	2	30
Cross Conveyors	5	2	10
Intermediate Conveyor	5	2	10
Shuttle Conveyor	2	2	4
Shuttle Trolley	2	2	4
Vibrator	1.32	3	3.96
Long sweep conveyor	25	2	50
		total hp	**767.5**

Sludge Processing Operating Costs:

Power:

total hp hrs	37,323	
hp/kw	1.34	
$/kwhr	$0.08	
total power cost	**$2,152**	***$/week***

Chemistry:

Lime Feed	Pressings/wk	lbs/pressing		
Lime Feed (1,000 lbs for Press)	51	1,000	51,000	*lb/week*
Lime Feed (1,200 lbs for Class A)	51	1,200	61,200	*lb/week*
		total lime	112,200	*lb/week*
	Lime Cost/ton		$168	*$/ton*
		lime cost	**$9,425**	***$/week***
Ferric Chloride (100 gals/press')	51	100	5,100	*gallons*
Ferric Chloride Cost/lb			$0.127	
Ferric Chloride Specific Gravity			1.41	
		ferric cost	**$7,617**	***$/week***

Sludge Processing Operating Costs:

Labor:

Operating hours/week for staffing	55	hrs	
Press Room Operators	2		
Control Room Operator (Pug mill)	1		
Truck and Front Loader	0.5		
	192.5	manhours/wk	
	$15.50	hourly rate	
	1.42	benefits rate	
		total labor cost	**$4,237** ***$/week***

Maintenance and Disposal Costs: **$2,000** ***$/week***

- Significant annual costs:
  - Drag chain conveyors at $140,000 per unit. One unit under repair when work stopped due to flood.
  - New plate and frame press @ $1.3M installed
  - Chemical feed, smaller conveyance systems, high pressure pumping all contributed to significant maintenance costs.
  - City was required to haul solids land application sites.

Sludge Conditioning Building
Temporary piping/grinders and flow metering

Pug Mill Building
Long Sweep Conveyors and Loading Station Removed

Frac Tank Blending
Flottweg Centrifuge
BDP Belt Press

BDP 3 Belt Press
MSD Equipment

Pug Mill Building

30 cyd Roll Off – BP and Centrifuge Loading

Future Sludge Processing Equipment: connected hp

Two Presses	connected hp	Number	total hp
Drive	5	2	10
Wash water	15	2	30
Gravity Section	2	2	4
Feedbox	0.5	2	1
Hydraulic System	3	2	6
Feed pump	20	2	40
		total hp	91

Projected Sludge Processing Operating Costs:

Power:

total hrs/wk	66
total hp hrs	6,006
hp/kw	1.34
$/kwhr	$0.08
total power	**$346 *$/week***

Chemistry:

emulsion polymer cost	$0.90	lb
activity	0.36	
assume 7 lbs active polymer / dt	7	lbs/dry ton
* high charge, high wt, large branch		
Polymer usage / dry ton	$17.50	cost/dry ton
emulsion polymer cost/day	$329.50	cost/day
Polymer cost	**$1,648 *$/week***	

Projected Sludge Processing Operating Costs:

Labor:

Press Room Operators	1	
Operator for Loading	0.5	
	99	manhours/wk
	$15.50	hourly rate
	1.42	benefits rate
Total labor	**$2,179**	***$/week***

Maintenance and Transportation Costs:

- Significant annual costs:
  - Example is landfill transportation and tipping fee (next slide)
  - In comparison, minimal maintenance anticipated.
  - Class B land application would require future land acquisition and cake storage for fecal reduction.

Projected Sludge Processing Operating Costs:

Projected Cost of Operation (landfill disposal)@ 9.5 MGD		
Dumpster Charge (tipping and transportation)	$194.40	30 cyd dumpster
Projected primary and waste sludge cake	22.0%	
Projected dry lbs (primary & secondary)	37,657	dry lbs/day
Projected wet lbs (primary & secondary) cake	171,170	wet lbs/day
Cake solids weight/cf	60	lbs/cf
Projected Wet Volume to disposal	2,853	cf/day
Projected Wet Volume to disposal	106	cyd/day
dumpster volume	30	cy
dumpsters/day	3.5	
disposal cost at landfill	**$3,243**	**$/week**

Projected Sludge Processing Operating Costs:

Plate and Frame/Class A versus Belt Press/Class B

	P&F/Class A	BP/Class B
Dewatering		
Power	$2,152	$346
Chemistry	$17,041	$1,648
Labor	$4,237	$2,179
Maintenance/Disposal	$2,000	$3,423
total weekly cost	**$25,430**	**$7,596**
total annual cost	**$1,322,360**	**$394,992**

Considerations for the Future:

1. Do not underestimate capital equipment decisions and the momentum or direction that provides to a utility.
   - Capital investment reduces options as capitalization and the resulting debt service leaves less room in the budget. The City of Clarksville is not comfortable further impact debt service and limit future options by remaining a "Class A processing facility".
2. The first decision: abandon plate and frame presses:
   - Two (2) dewatering methods are being considered: Belt Press and Centrifuge. Full scale pilot units are being tested.
     - Flottweg Z5E with a 20.8 inch bowl
     - BDP – 1 meter – 3 belt
     - Lime addition for dewatering is **not** an option:

Drain Pump Station Discharge Header

Considerations for the Future:

3. Re-tool for long term biosolids disposal. Key issues for a successful venture: (con't)

    1. Site is land locked within the levee. Biosolids processing would limit the site for additional wet stream treatment.
    2. Sludge storage and processing must be located off-site. The City is committed to eliminating long standing odor problems at the facility with new upgrades throughout the facility.
    3. Minimize capital investment at the site to maintain "debt service options" off site. Class A capitalization showed no return on investment (ROI).
    4. Develop a more efficient and cost effective dewatering option as a starting point for long term disposal options. Further solids stabilization at the facility would occupy limited wet stream processing area and complicate an odor sensitive facility.

Considerations for the Future:

4. Evaluate the paradigm shift in the organization. Biosolids disposal commitment can range from:
   - minimal staff investment/commitment – landfill cake solids without further processing.
   - Increase staff investment/commitment by increasing material handling capability to achieve a more cost effective disposal option. Consider low technology / low capital alternatives:
     - Remote sludge storage for Class B compliance and land application
     - Remote sludge storage for cost effective access to area farms
     - Invest in farm purchase to incorporate disposal and crop rotation with surrounding farms.
     - Minimize sludge volume and handling requirements. Class A processing showed little return on investment. Class A processing averaged approximately 45% of the total disposal requirement.

Considerations for the Future:

5. "Class A" versus "Class B" is one of the few times that the selection and process design are based on factors that are outside the fence.
   - Beneficial use of biosolids is our goal, but the City has a responsibility to the rate payers to minimize cost.
   - Class A versus Class B needs to be a team decision with client ownership – it is not the design engineer's decision.
   - Effective dewatering is critical to any downstream processing. Optimize not only the dewatering process/equipment but also solids conditioning (or plan to eliminate it).
   - There is no right or wrong answer, but the successful decision must have ownership throughout the Utility

Operations staff return to normal duties

Questions???


THIS
BUILDING
IS
PARTIALLY
ENERGIZED
MIKE Dudley
15 Quarry Rd. % G.B.T. Bldg.
Clarksville, Tn. 04812