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TECHNICAL MEMORANDUM No. 3

Date: November 22, 2006

Subject: Impoundment Liner Upgrade Priority, and Liner System Options and Cost

From: Heather Simon, PE, Laurie Parsons, PE, and Bruce Hensel, PG

Introduction

This memorandum describes a refinement to the prioritization system that Natural Resource Technology, Inc. (NRT) developed for upgrading impoundment and basin liners at Midwest Generation's Joliet 29, Waukegan, Powerton, Will County, and generating stations. The original prioritization system was outlined in Technical Memorandum No. 1 (Memo 1) dated December 21, 2005, and was entirely based on environmental factors. This memorandum builds on Memo 1 by incorporating input from Midwest Generation on the environmental scoring, adding plant schedule and operational need considerations, and adding planning level cost estimates for the liner upgrades. The prioritization system is designed as a working tool that can be refined and easily updated, particularly with respect to plant schedule and operation needs.

The environmental scores are relative; with a positive score suggesting a low priority for liner upgrade and a negative score suggesting a relatively high priority. A range of values was initially assigned to each of four environmental criteria based on NRT's collective knowledge of the water quality of materials managed in the impoundments, performance of liner materials, susceptibility of geologic settings to groundwater contamination, and potential issues with sensitive waters, and then calibrated based on observed site conditions at the power stations. Data and descriptive information used in prioritizing the impoundments are listed on the attached matrix.

Scores for plant schedule and operational needs were based on information gathered during on-site plant surveys (an example questionnaire is attached). To reflect the results of the plant survey and emphasize plant-specific operations, values were assigned to each of five plant operation factors: scheduled outages, dredging schedule, ease of construction, need for modification, and current maintenance effort.

Based on the environmental and plant schedule/operations scores, the suggested timeframe and priority for liner upgrades are shown on the two attached graphs. Data used in developing the scores, and comments related to the plant surveys and individual scores, are listed on the attached matrix.

In addition to prioritizing impoundment/basin liner upgrades, recommendations and associated costs are provided for upgrading the liners. Due to the performance standard approach utilized for permitting ash impoundments in Illinois, specific liner permeability recommendations are necessarily conservative. In most cases, other than fly ash management impoundments, an alternative approach based on water chemistry and calculations (possibly using a simple analytical fate and transport model) may enable permitting of a less-stringent liner design.

EXHIBIT
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Prioritization of Liner Upgrades

Environmental Criteria

The environmental scores are based on four criteria:

1. **Existing liner condition:** considering type, age, and known condition based on the Pond Characterization document (Midwest Generation, June 2005) and Midwest Generation's knowledge of the liners. In particular, the Poz-O-Pac liner systems were constructed more than 25 years ago, and are reportedly in poor condition. The scoring system reflects the large differences in performance expected from the existing liner systems:

   10 – HDPE in excellent condition, new
   5 – Formed concrete, aged
   3 – Concrete in unknown condition, aged
   2 – Asphalt in unknown condition, aged
   1 – Poz-O-Pac or earthen/clay in poor condition, aged
   0 – Unknown, gravel, or no liner

   Since Memo 1 was issued in December 2005, Midwest Generation reviewed the estimated areas and capacities of each impoundment as listed in the Pond Characterization document and developed revised capacity estimates. NRT compared the newly revised values to the values in Memo 1, and the majority of the values were similar. The only significant difference was for the Collection Basin at Powerton; the matrix was updated with the revised capacity for this pond (8,000 ft^3).

2. **Impoundment use:** This criterion is based on the Pond Characterization document, the NPDES permit applications provided for Powerton and and aerial photographic review of near-by features. For instance, the aerial photograph of Will County indicates that the south run-off basin generally receives parking lot run-off, which was reflected in the scoring as relatively clean stormwater.

   Redacted

   These features were reflected in the impoundment use scoring. The scoring system is set-up such that negative scores were given to uses most likely to cause exceedances of Illinois groundwater quality standards in the event of a leak:

   Redacted

   1 – Slag settling.[1]

   -5 – Fly ash settling/disposal.[1]

3. **Geologic setting:** based on regional geology as depicted in the Illinois State Geological Survey stack unit map (ISGS Circular 542), local geology from the KPRG Geotechnical Analysis of Soil Surrounding the Basins, and the map of Potential for Contamination of Shallow Aquifers (ISGS Circular 532). Consideration was also given for one pond within a groundwater management zone (Joliet 9 Quarry Pond).

[1] The score for the slag settling basin was changed from 0 to 1, and the score for fly ash settling/disposal was changed from -3 to -5, compared to the December 2005 scores.

The ISGS designated areas of high contamination potential as having sand and gravel or transmissive bedrock near the land surface and areas of low contamination potential as having thick sequences of fine-grained silt and clay or less-transmissive bedrock near the land surface. The scoring system was set up to reflect these designations; however, because it is preferable to prevent releases of potentially contaminated water than to rely on geologic conditions to contain releases, the range of values assigned to the geologic setting is narrower than the ranges for the liner type/condition and impoundment use, effectively placing less weight on this criterion:

- 0 – Regional fine-grained materials (typically silty/clayey diamicton), confirmed by adjacent soil boring indicating fine-grained soils: relatively low contamination potential.
- -1 – Regional fine-grained materials (typically silty/clayey diamicton), not confirmed by adjacent soil boring, which indicated coarse-grained soils: contamination potential uncertain.
- -3 – Regional conditions indicating bedrock or sand and gravel formation or highly permeable man-made conditions, confirmed by adjacent soil boring indicating generally coarse-grained material: relatively high contamination potential.[2]

4. **Adjacency of impoundments to a sensitive water body (Lake Michigan):** only one of the six stations is located adjacent to Lake Michigan, with the remainder located on rivers. The Great Lakes are considered more environmentally sensitive than regional rivers, as reflected by initiatives such as the Great Lakes Water Quality Initiative. Therefore, an additional score was assigned to account for this sensitivity:

- 0 – Impoundment/basin located adjacent to river.
- -2 – Impoundment/basin located adjacent to Lake Michigan (Waukegan).[3]
- -5 – Impoundment/basin located 20 feet from Lake Michigan (Waukegan).[3]

Plant Operation Criteria

Liner upgrade priority, from a plant operations perspective, was scored based on two categories: operational need and opportunity, and maintenance and modification considerations. The plant surveys occurred in August and September 2006 as follows:

Plant	Date of Site Visit	Midwest Generation Contact
	Redacted	
Joliet 29	September 14, 2006	Elsie Briette
Powerton	September 15, 2006	Mark Kelly and Joe Heredia
Waukegan	August 4, 2006	Mark Nagel, Mark Wehling and Mary Connor
Will County	September 8, 2006	Fred Veenbaas and Craig Lucke

Operational Needs and Opportunities (Time Frame for Upgrade)

Impoundments were grouped according to whether opportunities for upgrade will occur in the near term (0 to 3 years; i.e., 2007 to 2010) or long term (greater than 3 years; i.e., 2010 and beyond) based on operational needs and opportunities. The operational needs and opportunities of each impoundment are based on three plant operation factors: scheduled outages, dredging schedule, and ease of construction.

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[2] The score for confirmed highly permeable formations was changed from -2 to -3, compared to the December 2005 scores.
[3] The weight of this criterion was increased relative to the weight assigned in December 2005. The general score for Waukegan was increased from -1 to -2, and a new score (-5) was added for impoundments located very close to the Lake.

1. **Scheduled outages:** Plant personnel were able to provide, up to one year in advance, notice of a scheduled outage. The scoring system was set up to reflect the opportunity for a liner upgrade during a scheduled outage:

   1 – Outage scheduled, in which case the impoundment was placed in the short term group.
   0 –No outage scheduled to date, in which case the grouping was based on the next two criteria.

2. **Dredging schedule:** An impoundment must be dredged to remove accumulated solids prior to performing a liner upgrade; therefore, it is more cost effective to perform the upgrade after a regularly-scheduled dredging than to perform a special dredge operation in order to upgrade the liner. The frequency of dredging was compared to the last time the impoundment was dredged to determine if it is scheduled to be dredged within the next three years.[4] If an impoundment is scheduled for dredging within the next three years, or if it is frequently dredged, then it is a candidate for the short term group, otherwise it was placed in the long-term group. Impoundments that have never been dredged or that have no dredging frequency were assumed to have minimal accumulated solids, and were therefore candidates for the short term group.

3. **Ease of construction:** Whether or not an impoundment can be upgraded in the short term is partially dependent on the amount of planning needed to temporarily remove the impoundment from service while it is upgraded. For example, limited lay down space or alternatives for rerouting flow may require significant planning efforts. The scoring system was set up to reflect that extra planning:

   1 – Possible conflicts or factors that will effect planning and/or operations; impoundments with these issues were grouped as long term upgrades.
   0 – No known conflicts that may effect planning and/or operations exist, in which case an impoundment was a candidate for the short term group.

Impoundments that are listed in the short term graph (0 to 3 year) either have a scheduled outage, are dredged frequently, or are scheduled for dredging within the next three years. The impoundments listed in the long term graph (4 to 10 year) may not be due for dredging for several years or may have other factors that will require extra planning prior to upgrade.

Maintenance and Modification Considerations

Maintenance and modification considerations are based on the plant surveys. The impoundments were scored based on two plant operation factors: need for modification, and current maintenance effort.

1. **Need for modification:** This category covers factors other than liner condition that may cause an impoundment to require modification from a plant operations perspective (e.g. small capacity). The scoring system was set up to reflect the level of modification needed to make the impoundment more efficient:

   2 – Significant modification needed (e.g. need more capacity or elimination of short circuiting).
   1 – Minor modification needed (e.g. a weir replacement).
   0 – No modifications needed or identified from plant survey.

2. **Current maintenance effort:** This category reflects the level of current maintenance resources required by the plant to keep an impoundment operational, focusing mainly on liner maintenance issues:

[4] In cases where plant personnel did not know the last time the impoundment was dredge, NRT assumed the current year (2006), as indicated by italics on matrix. This resulted in a conservative (short term) dredging schedule.

1 – Impoundment requires more than routine maintenance work (e.g. repair liner).
0 – Maintenance was not identified as an issue during the plant survey.

Maintenance and modification considerations are color coded on the attached graphs:

- Red indicates that an impoundment requires a significant modification (total maintenance and modification score of 2 or 3).
- Orange indicates that an impoundment requires a minor modification or requires more than routine maintenance work (total maintenance and modification score of 1).
- Blue indicates that the impoundment has no planned modifications and no maintenance issues (total maintenance and modification score of 0).

Prioritization Results and Example Upgrade Plan

Based on the above criteria, the scores were totaled and plotted to graphically illustrate the priority for liner upgrade based on environmental sensitivity, and maintenance and modification considerations. Figure 1 shows impoundments where liners can be upgraded in the near term, and Figure 2 shows impoundments that may be considered for upgrades over the long term. Impoundments with non-negative environmental scores and no modification or maintenance issues are not presented on the figures. The length of each bar on the figures is based on the environmental score. The color of each bar is based on the maintenance and modification considerations, as detailed above. Estimates of planning-level upgrade costs are also displayed on the figure; development of these costs is described later in this memorandum.

Some of the impoundments displayed on the short term graph (Figure 1) may have a lower environmental risk than those on the long term graph (Figure 2); however, an impoundment on the long term graph may require additional time or effort for planning the upgrade, so planning on these could be performed while impoundments on the short term graph are in the construction stage.

Figure 1. Candidates for Near Term Liner Upgrade
2007 to 2010

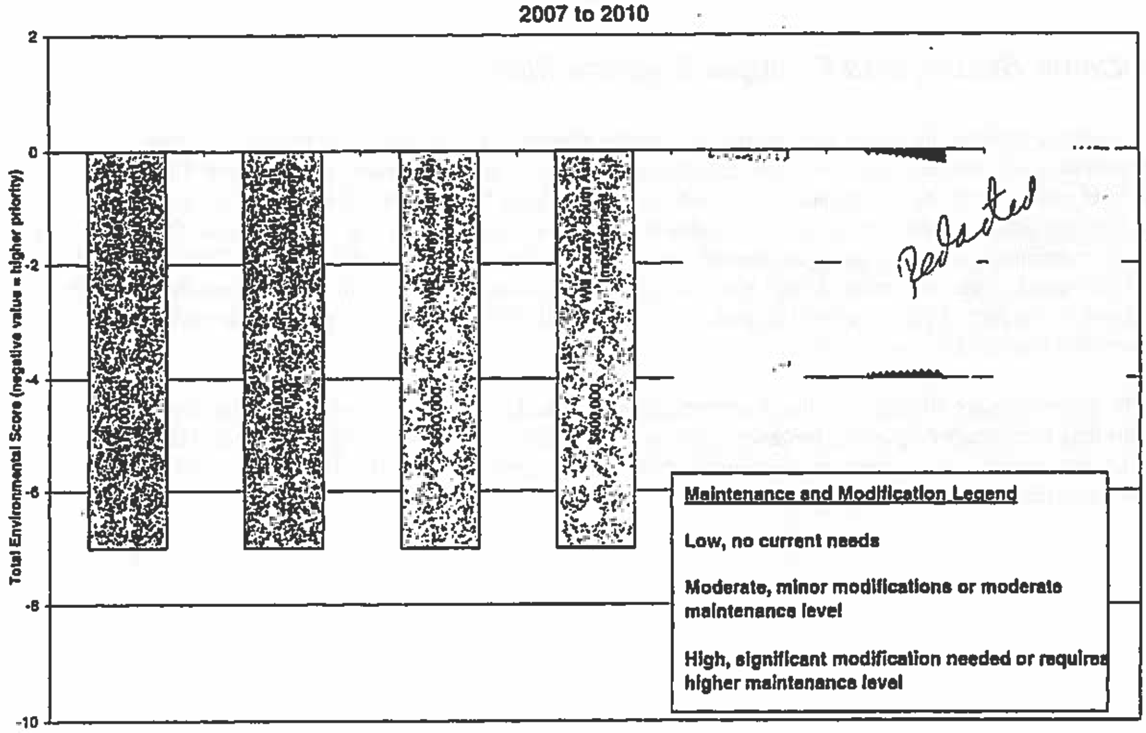
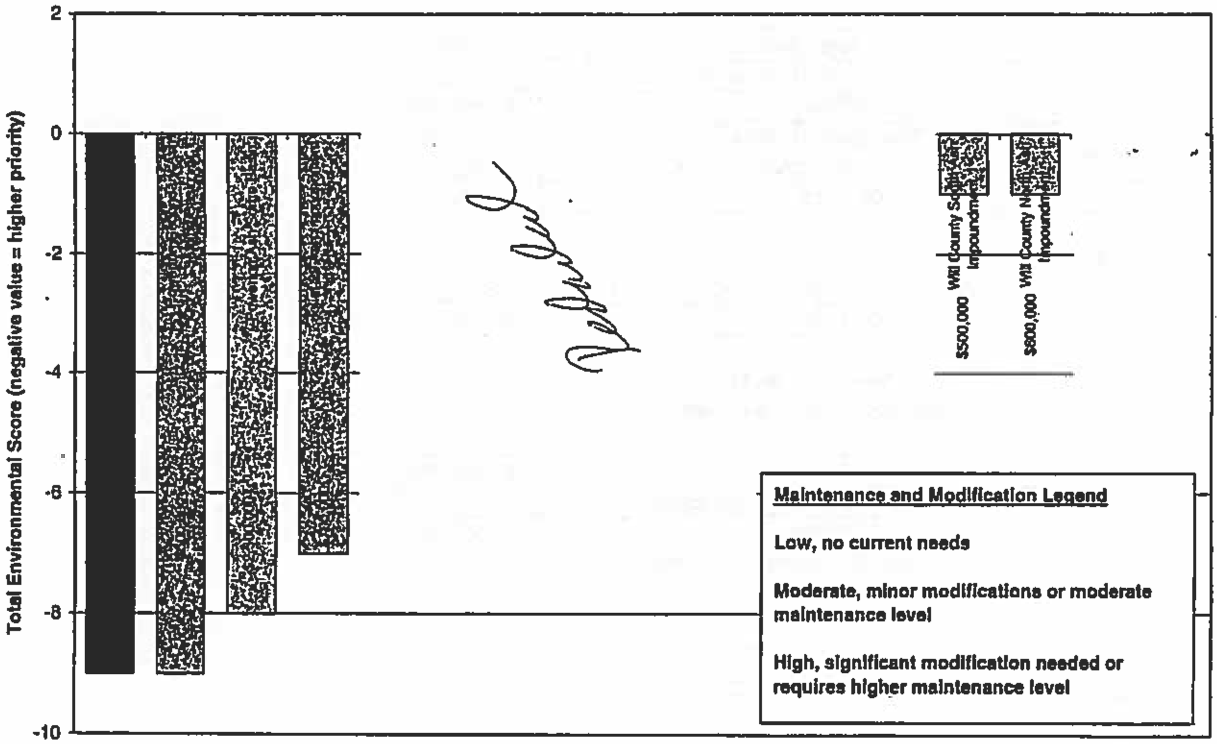


Figure 2. Candidates for Long Term Liner Upgrade
2010 and Beyond



NRT understands that Midwest Generation intends to use the prioritization system developed here as the basis for a program to upgrade impoundment liners. As an example, the following ten-year prioritization schedule was developed based on the results of the analysis described here and presented in Figures 1 and 2. Considerations used in developing this example upgrade plan were:

- Highest potential environmental impact combined with near term operational priorities were given first priority in the schedule (through 2010).
- After 2010, highest potential environmental impact *and* plant operational needs were both considered, while balancing the considerations below.
- Upgrades were grouped by common location within the same year or between adjacent years if possible and/or reasonable considering their operational function.
- Potential cost impacts were distributed as evenly as possible from year to year through the planning period.

Year	Impoundment	Total
2007	Joliet 29 Ash Impoundment 2	$1,100,000
	2007 Total	**$1,100,000**
2008	Joliet 29 Ash Impoundment 1	$1,100,000
	Will County South Ash Impoundment 3	$600,000
	2008 Total	**$1,700,000**
2009	Will County South Ash Impoundment 2	$600,000
	2009 Total	**$1,600,000**
2010	Powerton Bypass Basin	$300,000
	Powerton Secondary Ash Settling Basin	$500,000
	2010 Total	**$1,800,000**
2011	Powerton Ash Surge Basin	$2,500,000
	2011 Total	**$2,500,000**
2012	Joliet 29 Ash Impoundment 3	$700,000
2013	Redacted	
2014		
2015	Will County South Ash Impoundment 1	$500,000
	2015 Total	**$900,000**
2016	Will County North Ash Impoundment	$600,000
	2016 Total	**$1,100,000**

This schedule is provided for Midwest Generation's use as an example and would likely need refinement considering other internal and corporate objectives not identified or included by this analysis. The costs provided are for relative planning level purposes, subject to the assumptions stated later in this document.

Recommended Permeability and Materials for Liner Upgrades

For each type of impoundment and for establishing planning level cost estimates, we have recommended a liner permeability and material. Recommendations were based on Midwest Generation's desire for cost-effective, low maintenance liner materials. The table below summarizes our recommendations for each type (category) of impoundment and estimated unit costs for the upgrade.

Category	Impoundment Use	Liner Permeability and Basis	Recommended Liner Upgrade Material (1)	Estimated Construction Cost per square foot
I	Fly Ash Settling/Disposal	$1x10^{-7}$ cm/s max., typically required for basin permitting, may also facilitate eventual closure	-Compacted clay (5 ft thick **) ** refer to category I discussion below	$ 7 to $10
			-Geomembrane (60 mil HDPE **)	$5 to $7
		Redacted		
IV	Bottom Ash/Slag Settling	$1x10^{-7}$ cm/s approx. or protective of groundwater quality standards	-Compacted Clay (typically 2 ft thick)	$5 to $8
			-4 to 6" asphalt or concrete	Asphalt $6 to $8 Concrete $10 to $13
		Redacted		

Note:

(1) Recommendations of liner material for the categories listed may need to be refined for plant specific circumstances, such as close proximity to water bodies · Redacted

Liner materials that have been proven over the years to have a permeability of less than 1×10^{-7} cm/s are compacted clay and geomembranes, when constructed according to material specific quality assurance and testing requirements. For impoundments, the geomembrane material typically selected is HDPE due to its high resistance to breakdown when exposed to sunlight. Although PVC is less expensive and easier to install than HDPE, it will break down over time if exposed to sunlight. Therefore, PVC would require a significant level of maintenance on to either maintain side slope and protect the material from exposure to sunlight, or to actually repair or replace the PVC in areas where side slopes eroded and were not maintained. Clay can be cost-effective, if a near-by borrow source is available, and is typically a low maintenance liner material. Due to availability concerns, an alternative to clay was also recommended for each type of impoundment. Clay liner installation is straightforward for most contractors if the liner material and quality control testing requirements are specified in the bid documents. If damaged, a clay liner can be easily repaired, unlike geomembranes, which typically require a certified installer to perform repairs.

As indicated in Technical Memorandum No. 2 (dated December 21, 2005), properly installed asphalt and concrete liners may initially meet the 10^{-7} cm/s permeability value, but they fail to meet this permeability over time due to cracking or other wear (via mechanical equipment or natural causes). Therefore, asphalt and concrete liners are not recommended for impoundments that contain highly concentrated water (e.g., fly ash sluice water, undiluted demineralizer regenerant), since leakage could result in groundwater quality standard exceedances. Both materials can be formulated to provide adequate resistance to the chemicals in power plant process waters. These types of liners can be more practical than clay and HDPE in basins from which sludge is removed either occasionally or periodically because they are more resistant to damage by heavy machinery. Concrete is more resistant to damage than asphalt, but is also more expensive. Both will require maintenance for sealing of cracks (if low permeability must be maintained). Asphalt's lower compressive strength makes it more susceptible to damage by mechanical equipment (i.e. front end loader) than concrete; however, it may be adequate if a reasonable level of care is taken. One approach is to use concrete for smaller basins where sludge removal is more frequently necessary (one or more times per year) and to use asphalt for larger run-off basins where sludge removal is less frequent (once every couple years). In either case, if a lower permeability liner is the goal, supplemental liner protection such as compacted clay or HDPE below the asphalt/concrete may need to be considered.

Impoundment Category and Use

Category I: Fly Ash Settling/Disposal Impoundments

Fly ash management basins typically have concentrations of boron and sulfate that are higher than Illinois Class I groundwater quality standards. In addition, depending on redox conditions in the basins, some trace metals may have elevated concentrations. Illinois has based permit approvals for impoundments largely on expected performance of the proposed liner material in a site-specific setting for ultimate protection of Part 620 groundwater quality standards (Class I in most cases). Industry standards on liner permeabilities for ash impoundments exist based our knowledge of the Illinois approval process. Liner permeability of 1×10^{-7} cm/s or better is typical of what is required to obtain a permit from the IEPA Bureau of Water Section. However, liner permabilities of greater than 1×10^{-7} cm/s may be approved if fate and transport groundwater modeling indicates that this higher permeability is protective of groundwater quality standards.

Midwest Generation may also consider future closure of the ash impoundment when designing a liner. Unless a separate agreement is negotiated, ash impoundments are typically closed under solid waste landfill regulations, and an adjusted standard may be required if the liner of a newly constructed impoundment does not meet liner requirements (e.g. 5 ft of clay or 60 mil geomembrane) as specified in 35 Ill. Adm. Code Parts 811.306 through 811.308. Consideration may also be given to installing a leachate collection system, which would not be used until the impoundment was closed, and would again address potential Part 811 issues upon closure.

[redacted]

<u>Categories III and IV: [redacted] ıd Bottom Ash/Slag Settling Basins</u>

From a regulatory perspective, liner permeabilities for [redacted] bottom ash/slag settling basins are based on predicted site-specific performance and demonstration of protection of groundwater quality standards. Waters in these basins typically have concentrations of inorganic constituents, such as sulfate and sometimes boron, that are higher than Part 620 groundwater quality standards. Without the use of site-specific groundwater modeling, we referred to the Illinois regulations of sewage and livestock impoundments (Sewage: 35 Ill. Adm. Code Part 370.930(d)(2)(D); Livestock: 35 Ill. Adm. Code Part 506.205). These regulations specify a permeability of 1×10^{-7} cm/s, using a 2-foot thick clay liner or geosynthetic material. Due to Midwest's desire for low maintenance liners and the relatively low concentration waters managed in these basins (suggesting less stringent permeability requirements), NRT recommends asphalt or concrete for sludge removal reasons, or clay as an alternate to these materials.

[redacted]

Liner Construction Cost

The estimated unit construction costs (cost per acre) and planning level estimates shown in Figures 1 and 2 are based on the following assumptions:

- Planning level estimates were generated using the upper range of the unit costs presented above, and the surface areas listed for each impoundment or basin in the attached summary matrix.
- The planning level estimates for liner category I assume HDPE because its unit cost is less variable than liner-grade clay, that is subject to the proximity of a suitable borrow source.
- The planning level estimates for liner category II assume HDPE because its unit cost is lower than concrete or asphalt. If concrete or asphalt are deemed preferable for a specific basin, planning level costs would increase, depending on the permeability goal.

- The planning level estimate for liner categories III and IV assume clay because its unit cost is lower than concrete or asphalt.
- Earthern liners are assumed for category V.
- Unit costs for geomembrane, asphalt, and concrete liners include a subgrade preparation layer (suitable bedding) and field construction quality assurance testing.
- Unit costs for liner construction (all types) include mobilization/demobilization, site preparation, restoration, minor earthwork, and grading.
- Unit costs for liner construction (all types) exclude planning, engineering, and major demolition work.
- Location-specific costs for ancillary work required to perform the upgrade are not included (e.g. cost to reroute water flow or temporary bypass capacity).
- Costs do not include dredging or dewatering, which is assumed to either be unnecessary because there are no solids, or to be performed prior to liner upgrade as part of routine plant operations.

Attachments: Example Power Station Impoundment/Basin Questionnaire
Impoundment Matrix

Power Station Impoundment/Basin Questionnaire

Midwest Generation

Site Visit (Date):

- ☐ Crawford ☐ Joliet 29 ☐ Waukegan
- ☐ Joliet 9 ☐ Powerton ☐ Will County

Contact Information

Address	City	State	Zip
Contact Person	Title		
E-mail address	Phone	Fax	

Other Contact Information

Contact Person	Title	
E-mail address	Phone	Fax

General Plant Questions

Compliance

1. Is the facility operating under a permit(s)? If so, what permit(s) is the facility currently operating under and what is the status of the permit(s) (type, issued date, expiration date, etc.)?
2. In the past, has the facility obtained permit variances related to work conducted on any basin?

Operation and Maintenance

3. Do current facility operations follow the attached plant flow diagram? If not, please describe the modification and provide an updated flow diagram.
4. Are there any planned physical changes to the plant (e.g., addition of an SCR or FGD) that may affect future basin capacity or use? If so, what is the schedule for these changes?
5. Is there a basin that requires more maintenance or attention than the others? If so, why?
6. Has a hydrogeologic study been completed for the plant?

Plant Logistics

7. Are there any utilities (aboveground and/or underground) near the basins? Does a plant diagram of all the utilities exist?
8. Does an aerial topographic map of the facility exist?

Schedule

9. Does the plant have a maintenance schedule for the basin/basins at the facility? If so, what is the schedule for basin maintenance?
10. Is the plant scheduled for a shutdown in the near future? If so, when? What is planned for repairs and/or installed during shutdown?

Individual Basin Questions

Compliance

11. Are there any existing operations that differ from when the permit was issued?
12. Is groundwater being monitored in the vicinity of the basin? If so, is it required or voluntary and where and why is the groundwater monitored? Do the concentrations meet the standards?
13. Are there water quality samples collected at outfalls? If so, is it required or voluntary? When was the most-recent sample collected? Do the concentrations meet the standards and was oil and grease observed on the water?

Operation and Maintenance

14. Are the basins sized appropriately for the current use (adequate capacity, any limitations, water level variation, water level at desired free board, control of water level, if dry, when, etc.)
15. Are inlets/outlets adequately sized for the current and future use of the basins?
16. Does the plant have plans to modify the operations of the basin in the near future (i.e. pumps, conveyance systems, capacity)? If so, when?
17. Is there an opportunity to reroute flow from the basin to another basin without having to get a variance on the discharge permit?

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18. Are there any plant process areas that discharge to the basin (i.e. metal cleaning process)? If so, what constituents are in the process discharge? Summarize/update expected quality of water and materials within basin.

19. Have there been any improvements and/or new features added to any of the basins post construction?

20. What are the inlet and outlet flow rates of each basin?

21. How many and what size pumps operate each basin? Do any of the pumps require more maintenance than the others?

22. What is the solids loading rate to the basins? Do any of the basins require dredging as part of a maintenance plan or for any other reasons? If so, how often, how long does it take, how much is removed, and what equipment is used? Summarize solids accumulation rates and dredging/cleanout activities.

23. Do any of the conveyance systems to the basins require maintenance? If so, how often, and what is involved to do so?. If the conveyance system is an earthen ditch, what is the ditch lined with?

24. Are there any non-stormwater inputs into the coal or yard run-off basins?

25. Has a hydrogeologic study been completed for the ash disposal basin(s)?

Plant Logistics

26. Is there vehicle or equipment traffic adjacent to any of the basins? Would construction activities affect the traffic flow? Is there an alternate route?

Attachments

Plant Flow Diagram
Aerial Photo
Individual Basin Description
Basin Characteristics Summary Table

Impoundment Matrix
Midwest Generation - 2006

FACILITY LOCATION: JOLIET 29 (Adjacent to Des Plaines River)

Impoundment ID	Ash Impoundment 1	Ash Impoundment 2	Ash Impoundment 3
Use	Ash settling	Ash settling	Clarifying pond
Contributing Waters/ Waste	Ash settling	Ash settling	Ash settling
Discharge Point	Des Plaines River	Des Plaines River	Des Plaines River
Primary Water Routing	Ash Impoundment 3	Ash Impoundment 3	Outfall 001g
Impoundment Use Score	-5	-5	-5
Approx. Width (ft)	168	168	220
Approx. Length (ft)	419	419	340
Approx. Depth (ft)	19	19	15
Estimated Capacity (ft^3)	2,055,500	2,055,500	1,086,100
Midwest Est. Capac. (ft^3)	2,000,000	2,000,000	1,100,000
Estimated Liner Surface Area (ft^2)	154,700	154,700	103,200
Liner Material	2-6" lifts Poz-O-Pac liner on bottom and sides	2-6" lifts Poz-O-Pac liner on bottom and sides	2-6" lifts Poz-O-Pac liner on bottom and sides (based on 1&2)
Liner Condition, if known	Poor	Poor	Poor
Liner Constructed in:	1978	1978	1978
Liner Condition Score	1	1	1
Soil Description	Sandy gravel, trace clay	Poorly graded gravel w/clay and sand	Limestone with fine to coarse sand
Revised Soil Description (1)	--	--	--
USCS	GW	GP-GC	GP
Contamination Potential (2)	High	High	High
Stack Unit Designation	Silurian & some Devonian rocks, mostly dolomite	Silurian & some Devonian rocks, mostly dolomite	Silurian & some Devonian rocks, mostly dolomite
Geologic Setting Score (2)	-3	-3	-3
Receiving Water Sensitivity Score	0	0	0
Total Environmental Score	-7	-7	-7
Recommended Replacement Liner Permeability and Material, By Category (3)	I	I	I
Operational Needs and opportunities			
Schedule Outage	1	1	1
Last Dredge (year)⁴	2004	2003	0
Dredging Frequency (year)	4	4	0
Score for Ease of Construction	0	0	1
Suggested Timeframe	0-3	0-3	4-10
[redacted]			
[redacted]	0	0	0
[redacted]	0	0	0
[redacted]	[illegible]	[illegible]	[illegible]
Comments Related to Plant Survey and Input	- Dredged in 2004 - Dredge every 3 to 4 yr - Unit 7 and 8 power outage schedule in 2007	- Dredge every 3 to 4 yr - Unit 7 and 8 power outage schedule in 2007 - Conveyance system and linear upgrade schedule in 2007	- No by-pass - Ash Imp. 1 & 2 discharge to Ash Imp. 3 - Unit 7 and 8 power outage schedule in 2007

R = Estimated Depth; NA = Not Available; -- = Not Applicable
Items revised since Technical Memorandum 1 are highlighted in yellow
(1) Where applicable, NRT revised soil descriptions to match grain size distributions and USCS.
(2) Based on ISGS Circulars 532 and 542, see technical memorandum No. 1 for further explanation.
(3) Reference NRT Technical Memorandum No. 3 for category descriptions.
(4) Italicize year is set at current year in cases where plant personnel did not know last dredge year.

Reviewed

1792 Impoundment_Matrix Nov 22 2006 Final.xls
Last Revised: 11/22/06

Impoundment Matrix
Midwest Generation - 2006

FACILITY LOCATION: WAUKEGAN (Adjacent to Lake Michigan)

Impoundment ID	East Ash Impoundment	West Ash Impoundment	Coal Pile Runoff Basin
Use	Ash settling	Ash settling	Collection basin
Contributing Waters/ Waste	Ash settling	Ash settling	Coal pile runoff
Discharge Point	Lake Michigan	Lake Michigan	Lake Michigan
Primary Water Routing	WWTP - Outfall C01	WWTP - Outfall C01	WWTP - Outfall C01
Impoundment Use Score	-5	-5	-1
Approx. Width (ft)	437.5	437.5	172.5
Approx. Length (ft)	927.5	927.5	306.25
Approx. Depth (ft)	22.5	22.5	7.5
Estimated Capacity (ft³)	7,705,900	7,705,900	467,100
Midwest Est. Capac. (ft³)	7,700,000	6,500,000	170,000
Estimated Liner Surface Area (ft²)	502,000	502,000	73,700
Liner Material	HDPE on bottom and sides	HDPE on bottom and sides	Layer of gravel and a layer of dense aggregate, none on sides
Liner Condition, if known	Excellent	Excellent	--
Liner Constructed In:	2004	2005	1977
Liner Condition Score	10	10	0
Soil Description	Sand w/trace gravel	Sand w/trace gravel	Sand with trace gravel
Revised Soil Description [1]	--	--	--
USCS	SP	SP	SP
Contamination Potential [2]	High	High	High
Stack Unit Designation	Surface mines/man-made land	Surface mines/man-made land	Surface mines/man-made land
Geologic Setting Score [4]	-3	-3	-3
Receiving Water Sensitivity Score	-2	-2	-2
Total Environmental Score	0	0	-6
Recommended Replacement Liner Permeability and Material, By Category [3]	I	I	III
Operational Needs and opportunities			
Schedule Outage	0	0	0
Last Dredge (year)⁴	2005	2006	2006
Dredging Frequency (year)	2	2	4
Score for Ease of Construction	0	0	1
Suggested Timeframe	0-3	0-3	4-10
[redacted]			
	0	0	0
	0	0	0
	low	[illegible]	[illegible]
Comments Related to Plant Survey and Input	- Dredged in 2005 - Dredge every 2 years	- Dredged in 2006 - Dredge every 2 years	- Dredged in 2006 - Dredge every 3 to 5 years - Underground electrical

E = Estimated Depth; NA = Not Available; -- = Not Applicable
Items revised since Technical Memorandum 1 are highlighted in yellow
(1) Where applicable, NRT revised soil descriptions to match grain size distributions and USCS.
(2) Based on ISGS Circulars 532 and 542, see technical memorandum No. 1 for further explanati
(3) Reference NRT Technical Memorandum No. 3 for category descriptions.
(4) Italicize year is set at current year in cases where plant personnel did not know last dredge yea
(5) * = Geosynthetic liner recommended based on the basin's close proximity to Lake Michigan.

Redacted

1792 Impoundment_Matrix Nov 22 2006 Final.xls
Last Revised: 11/22/06

MWG13-15_23645

Impoundment Matrix
Midwest Generation - 2006

FACILITY LOCATION: POWERTON (Adjacent to Illinois River)

Impoundment ID	Ash Surge Basin	Secondary Ash Settling Basin	Bypass Basin
Use	Ash settling	Ash settling	Ash surge bypass
Contributing Waters/ Waste	Ash sluice, slag tank overflow, demin regen, filter backwash, metal cleaning & east yard trmt eff.	Same as ash surge basin	Same as ash surge basin
Discharge Point	Illinois River	Illinois River	Illinois River
Primary Water Routing	Sec. Ash Settling Basin	Outfall 001	Sec. Ash Settling Basin
Impoundment Use Score	-5	-5	-5
Approx. Width (ft)	250	223	135
Approx. Length (ft)	960	324	256.5
Approx. Depth (ft)	14	10 E	10 E
Estimated Capacity (ft^3)	4,104,400	594,400	264,900
Midwest Est. Capac. (ft^3)	4,100,000	NA	NA
Estimated Liner Surface Area (ft^2)	354,600	77,600	39,500
Liner Material	2-6" lifts Poz-O-Pac on bottom, hypalon on sides	No liner	Unknown
Liner Condition, if known	Poor	--	Unknown
Liner Constructed in:	1978	Unknown	Unknown
Liner Condition Score	1	0	0
Soil Description	Sand w/silt and gravel	Clayey sand, trace gravel	Silty sand, trace clay
Revised Soil Description (1)	--	--	--
USCS	SW-SM	SC/SM	SM
Contamination Potential (2)	High	High	High
Stack Unit Designation	Henry Formation (sand & gravel)	Henry Formation (sand & gravel)	Henry Formation (sand & gravel)
Geologic Setting Score (2)	-3	-3	-3
Receiving Water Sensitivity Score	-1	-1	-1
Total Environmental Score	-8	-9	-9
Recommended Replacement Liner Permeability and Material, By Category (3)	1	1	1
Operational Needs and opportunities			
Schedule Outage	0	0	0
Last Dredge (year) (4)	*2006*	0	*2006*
Dredging Frequency (year)	6	0	6
Score for Ease of Construction	0	0	0
Suggested Timeframe	4-10	4-10	4-10
[redacted]			
	0	0	2
	1	0	0
	medium	low	high
Comments Related to Plant Survey and Input	- Dredge every 6 years - Liner repairs often on hypalon often	- Has not needed to be dredge in last 14 years	- Dredge every 6 years w/ Ash Surge Basin - Capacity small

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(2) Based on ISGS Circulars 532 and 542, see technical memorandum No. 1 for further explanation.
(3) Reference NRT Technical Memorandum No. 3 for category descriptions.
(4) Italicize year is set at current year in cases where plant personnel did not know last dredge year.

Redacted

Impoundment Matrix
Midwest Generation - 2006

FACILITY LOCATION: WILL COUNTY (Adjacent to Chicago Sanitary and Ship Canal)

Impoundment ID		South Ash Impoundment 3	South Ash Impoundment 2	South Ash Impoundment 1	North Ash Impoundment
Use		Ash settling	Ash settling	Slag settling	Slag settling
Contributing Waters/ Waste		Ash settling	Ash settling	Slag settling	Slag settling
Discharge Point		Chicago Sanitary and Ship Canal	Chicago Sanitary and Ship Canal	Chicago Sanitary and Ship Canal	Chicago Sanitary and Ship Canal
Primary Water Routing		WWTP & Outfall 002	WWTP & Outfall 002	WWTP & Outfall 002	WWTP & Outfall 002
Impoundment Use Score		-5	-5	1	1
Approx. Width (ft)		234	178	195	167
Approx. Length (ft)		322	350	300	333
Approx. Depth (ft)		7	7	7	7
Estimated Capacity (ft^3)		532,200	505,900	461,700	506,500
Midwest Est. Capac. (ft^3)		530,000	510,000	460,000	520,000
Estimated Liner Surface Area (ft^2)		89,537	85,500	78,400	85,400
Liner Material		6-6" lifts Poz-O-Pac, bottom and sides	6-6" lifts Poz-O-Pac, bottom and sides	6-6" lifts Poz-O-Pac, bottom and sides	6-6" lifts Poz-O-Pac, bottom and sides
Liner Condition, If known		Poor	Poor	Poor	Poor
Liner Constructed in:		1977	1977	1977	1977
Liner Condition Score		1	1	1	1
Soil Description		Sandy fine to coarse gravel with clay	Sandy fine to coarse gravel with clay	Clayey gravelly fine to coarse sand	Sand with gravel
Revised Soil Description (1)		–	–	Clayey gravel with sand	–
USCS		GC	GC	*GC*	SC
Contamination Potential (2)		High	High	High	High
Stack Unit Designation		Silurian & some Devonian rocks, mostly dolomite	Silurian & some Devonian rocks, mostly dolomite	Silurian & some Devonian rocks, mostly dolomite	Silurian & some Devonian rocks, mostly dolomite
Geologic Setting Score (4)		-3	-3	-3	-3
Receiving Water Sensitivity Score		0	0	0	0
Total Environmental Score		-7	-7	-1	-1
Recommended Replacement Liner Permeability and Material, By Category (3)		I	I	I	I
Operational Needs and opportunities					
Schedule Outage		0	0	0	0
Last Dredge (year)[4]		2006	*2006*	*2006*	*2006*
Dredging Frequency (year)		1	1	5	5
Score for Ease of Construction		0	0	0	0
Suggested Timeframe		0-3	0-3	4-10	4-10
[redacted]					
[redacted]		1	1	1	1
[redacted]		0	0	0	0
[redacted]		moderate	moderate	moderate	moderate
Comments Related to Plant Survey and Input		- Dredge every year; to be dredge in 2006 - Weir needs work - Requires dredge work this year (2006) - Overhead electrical	- Dredge every year - Weir needs work - Overhead electrical	- Dredge every 5 years - Power outage scheduled in 2006 for Unit 1 and 2 - Weir needs work	- Dredge every 5 years - Power outage scheduled in 2006 for Unit 1 and 2 - Weir needs work - Has not been used for several years

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Items revised since Technical Memorandum 1 are highlighted in yellow
(1) Where applicable, NRT revised soil descriptions to match grain size distributions and USCS.
(2) Based on ISGS Circulars 532 and 542, see technical memorandum No. 1 for further explanation.
(3) Reference NRT Technical Memorandum No. 3 for category descriptions.
(4) Italicize year is set at current year in cases where plant personnel did not know last dredge year.