Hart Exhibit 33
Docket No. E-2, Sub 1219

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Issue: Increased Coal Combustion Product Production	**Lead: Alan Madewell~~Rob Reynolds~~**

Affected Sites: *All coal burning sites*

Description:

New CCP being produced (synthetic gypsum) as a result of FGD units being placed in service. Due to the downturn in construction markets (e.g., wallboard, concrete, and cement), the demand for beneficial reuse of these products has declined. On site storage space is limited for both synthetic gypsum and coal ash. PEC and PEF do not have contingency storage built into any of our facilities, and therefore our operations could negatively be impacted by the volatility of market demand. PEC and PEF ash ponds and landfills are filling up and new facilities need to be constructed. Construction of new ash ponds will most likely not be allowed by new regulations and landfill permitting will likely meet increased opposition. Cost trade-offs of design (single vs double liner) and future requirements not settled. Groundwater studies could impact technical design requirements.

Asheville: Status – minimal. Majority of gypsum production under contract and currently being sold. Ash production is currently being beneficially reused in engineered/approved airport structural fill project. Projections indicate additional ash storage space not needed until 2016. Active GW impact study could drive DFA/DBA sooner. No current candidate monofill site.

Cape Fear: Status – severe. Current estimates indicate 24 months remaining life for CF ash pond. A dike extension project is budgeted and currently being evaluated. This could add an additional 24 months to the life of CF's ash pond. Engineering work associated with dry fly ash conversion and construction of a monofill currently on hold. Planned GW study could impact.

Lee: Status – minimal. The current plan for Lee involves conversion to natural gas CT/CC~~dry fly ash handling and construction of a monofill~~ by 20134. ~~All capital associated with this plan is budgeted to start in 2010.~~ Planned GW study could impact.

Mayo: Status – minimal. Conversion of Mayo's ash system to accommodate 100% dry handling is almost complete. Dry ash handling and hauling will commence mid-2009 and the ash will be transported to Roxboro's landfill. DBA also in capital plan. Site selection efforts associated with Mayo's monofill are underway. Engineering efforts will begin mid-2009. Possible synergy with scrubber wastewater. DFA/DBA should ameliorate risk from planned GW study.

Robinson: Status – significant. Current estimates indicate approximately 24 months remaining life for Robinson's ash pond. An interim restacking project is planned for 2010 extending the life of Robinson's ash pond until mid-2013. Capital funds are budgeted to develop and construct a monofill by mid-2013. Planned GW study could impact.

Roxboro: Status – moderate. Gypsum production is exceeding sales. Storage pad is nearing capacity. Ash landfill is nearing capacity. Development of next landfill phase underway adding an estimated additional 5 year capacity. Trying to get approval for single liner design.

Sutton: Status – moderate. Current estimates indicate approximately 18 to 24 months remaining capacity. A dike extension is planned for 2010 extending the life of Sutton's ash pond through 2012. Additional efforts associated with dry fly ash conversions and monfill construction on hold. Active GW study could impact.

Weatherspoon: Status – minimal. Ash sales efforts to date have added an additional 3 years of capacity to Weatherspoon's ash pond. Planned GW study could impact.

Crystal River: Status – significant. Current estimates for ash disposal indicate approximately 20-36 months of remaining capacity. Efforts are underway to optimize the current ash storage area to create additional available storage space. Additionally, efforts to evaluate long term storage options including development of a new on-site landfill are just beginning. Gypsum production resulting from installation of scrubbers will begin this year and start ramping up as the second unit comes on-line and coal sources change. Current storage capacities equate to approximately two weeks. Efforts to sell the gypsum production are underway however due to economic drivers there is interest in only about 50% of total full load production. Additional efforts are in progress to evaluate and select alternative off-site storage options.

Significance Analysis

Probability	Very Low	Low	Moderate	High	Very high
	<10%	11-33%	34-65%	66-89%	>89%
	1	2	3	4	5
Explanation	Whether gypsum or ash, all sites will need additional storage space at some time in the future.				
Impact	Minimal	Moderate	Significant	Severe	Critical
	1	2	3	4	5

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Safety Environmental Reliability Cost Other	Asheville Lee Mayo Weatherspoon	Roxboro Sutton	Crystal River Robinson	Cape Fear	
Explanation	For all facilities with impact ratings above "Moderate" a solution will need to be determined and acted upon this year. For Crystal River, this is likely a new on-site landfill. For Robinson, if we are not successful marketing the ash production will likely need to accelerate the development/construction of landfill. For Cape Fear, time is of the essence. We are nearing end of life for the currently operating ash pond and we are running out of time to sufficiently develop a cost effective alternative.				

Action Plan

Asheville – continue beneficial reuse of ash in airport structural fill project. Evaluate additional structural fill projects planned for future airport projects. Continue to transport gypsum off-site to commercial end users.

Cape Fear – currently evaluating dike construction. Assess options for off-site disposal if necessary.

Lee – continue with current strategy of conversion to natural gas CT/CC~~of ash system to dry and construction of monofill~~ beginning in 20130.

Mayo – complete dry fly ash conversion. Continue with site selection and engineering efforts for on-site monofill.

Robinson – inner dike construction planned for 2010. Viable commercial outlets currently being evaluated.

Roxboro – complete next phase of on-site landfill. Identification of approved off-site disposal options for gypsum recently completed.

Sutton – continue plan for interim capital project (dike extension) in 2010.

Weatherspoon - continue with sales to cement kilns.

Crystal River – plant personnel to evaluate options for optimizing ash storage area. FPO to evaluate options for on-site monofill for ash/gypsum. FPO to continue marketing efforts for gypsum during interim period.

Communication & Collaboration Plan

- EHSS Top 5 Issues List: Brenda Brickhouse, monthly
- CCP Steering Committee: Barbara Coppola, monthly
- CCP Team Update: Rob Reynolds, monthly

Project Assurance Review

- Reviewed by:
- Date reviewed:

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EISENSTEIN MALANCHUK LLP

September 7, 2011

BY FEDERAL EXPRESS

Kenneth Ryan, Esq.
Wiley Rein LLP
1776 K Street, N.W.
Washington, D.C. 20006

Re: Carolina Power & Light/AEGIS – ash pond issues

Dear Ken:

Following up our recent meeting, I am writing to provide further information to explain why we believe that the ash pond issues relating to Progress Energy are now ripe for resolution, and specifically why action is going to be required in the near-term to remediate ash facilities.

First, let me emphasize that what led Progress Energy to renew discussions on the ash ponds, and to provide an updated notice letter, was the increased, aggressive regulatory oversight by the State of North Carolina. Regardless of when the EPA may act, or what other States may do, North Carolina is taking aggressive action on coal ash facilities, commencing with the boundary well monitoring that was required at the end of 2010. Tab 1 discusses how coal ash is already regulated in North Carolina by NCDEHNR; bullet 4 explains why Progress has installed monitoring wells in North Carolina. In turn, tab 2 describes the Corrective Action process if there are exceedances at the compliance boundaries under the existing North Carolina Administrative Code. While EPA CCR regulations might be more prescriptive about exactly what has to be done, existing North Carolina regulations also raise the potential for the same closure scheme. North Carolina is already actively commencing work on ash pond issues, and as we indicated at the meeting exceedances are already being detected at the relevant Progress Energy ash ponds.

In addition, it should be noted that there is a very active network of non-governmental organizations in North Carolina which is specifically pressing for remedial action on North Carolina ash ponds. This, of itself, creates a significant driver that is even more pressing than the lobbying on the federal side. Thus, for example, tab 3 provides a white paper of various organizations detailing their perception of problems with coal ash regulation in North Carolina. Tab 4 provides just a small sampling of a large number of articles and press releases that recurrently appear in North Carolina, urging action on ash pond facilities in that State. In short,

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there is a significant constituency pressing for action in North Carolina, regardless of what may happen on the federal level.

At the same time, we do not minimize the risks of more rapid action by EPA. I realize you are more skeptical of when EPA action will take place. However let us emphasize that, in addition to the potential issuance of CCR regulations by EPA, there are other important regulatory considerations that must be borne in mind, all pointing toward the demise of coal-fired plants. In addition to the CCR rules under RCRA, there is rulemaking underway in the Clean Air Act (CAA) and the Clean Water Act (CWA). Under the CAA there are two new rules, the Clean Air Transport Rule (CATR) and the Hazardous Air Pollutant (HAP) Maximum Achievable Control Technology (MACT), the HAP MACT. Under the CWA there will be rulemaking for the cooling water intake structure requirements. Taken together, it is anticipated that utilities will be driven to make decisions in the near future on the fate of their coal ash facilities, and indeed Progress Energy has already announced the retirement of four of its coal burning power plants. Tab 5 includes a couple of articles on why regulatory requirements are accelerating coal plant retirements. Given the regulatory situation, the reality is that the wise policy decision is to retire older plants. As these plants are retired, remediation obligations will, of course, come to the fore.

Again, let me emphasize that we do not see the remediation that will be required at ash ponds to be either minimal or far in the horizon. We are interested in discussing a potential settlement of these liabilities at this time, in the interest of having some funding available to assist in remediation efforts, and to wrap up these issues before a potential change in the management at Progress Energy with the upcoming merger. However, to the extent our positions are at odds, we are not interested in a *de minimus* settlement, as we anticipate that, with the passage of time, the threat from these issues will continue to become more real, and indeed more expensive.

I look forward to talking further after you have reviewed this letter and the attached material.

Sincerely,

Laurence J. Eisenstein

Attachments

cc (w/o attachments):
Steven Antunes
Peter Alvey
Charles Madison
John Malanchuk

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EISENSTEIN MALANCHUK LLP

October 25, 2011

Steven Antunes, Esq.
Senior Litigation Counsel
AEGIS Insurance Services, Inc.
10 Exchange Place
Jersey City, New Jersey 07302

Re: Carolina Power & Light/AEGIS – ash pond settlement negotiations

Dear Steven:

I am writing in response to your September 29th letter, in which you assert you are ending settlement negotiations over CP&L's ash pond claims. We want to make it clear that we feel that this decision is in error, and that North Carolina law clearly supports the conclusion that the looming remediation costs associated with the contamination from the ash ponds will be recoverable under the AEGIS policies.

First, with respect to whether there has been an occurrence as defined by the AEGIS policies, the costs being incurred by CP&L go beyond any requirements posed in the permits for these ash ponds and, as such, cannot be construed as simply a normal part of CP&L doing business in this area. To the contrary, the North Carolina regulators, and potentially the Environmental Protection Agency (EPA) as well, as imposing substantial new remediation obligations based on contamination due to ash disposal facilities. We see this as no different than the obligations imposed under the Superfund laws, which at one point were themselves considered "new" with regard to environmental issues faced by utilities, including at manufactured gas plant sites.

Courts in North Carolina have not hesitated to impose coverage obligations for remediation of routine business operations that result in contamination. Thus the North Carolina courts have construed substantially similar policy language and found that the contamination of soil and groundwater from waste disposal areas constitutes an occurrence. In Waste Management of Carolinas, Inc. v. Peerless Ins. Co., the owner of a landfill sought indemnification from his insurer to cover the cost of responding to groundwater contamination from a landfill that the owner routinely used to store industrial waste materials during the policy period. 340 S.E.2d 374, 376 (N.C. 1986). The North Carolina Supreme Court rejected the insurer's argument that the

contamination was not an "occurrence" (i.e., an unexpected and unintended event) because it resulted from the landfill owner routinely dumping waste into the landfill. Id. at 380. The North Carolina Supreme Court held that, while dumping the waste may have been a routine part of the owner's business, the damage caused by that act was unexpected and unintended and, therefore, constituted an occurrence. Id. at 380, 383; see also Peerless Ins. Co. v. Strother, 765 F. Supp. 866, 870-71 (E.D.N.C. 1990) (contamination from oil that leached from transformers was an occurrence). Furthermore, whether the damage was expected or intended is based in North Carolina upon the insured's subjective expectations and intentions at the time of the occurrence, and not what the insured arguably should have expected. McCoy v. Coker, 620 S.E.2d 691, 698 (N.C. Ct. App. 2005). We are confident that CP&L neither expected nor intended the contamination from the ash ponds at any time prior to or during the AEGIS policy periods. As such, we feel the law is solidly in our favor that any contamination from the ash ponds is an occurrence under the policies.

To the extent you are further suggesting that coverage would not exist in the absence of a lawsuit being filed against CP&L, the North Carolina Supreme Court has rejected this view, and held that the costs incurred in complying with a state agency's remediation orders are "damages" to which coverage extends. C.D. Spangler Constr. Co. v. Indus. Crankshaft & Eng'g Co., Inc., 388 S.E.2d 557, 565 (N.C. 1990); see also Bond/Tec, Inc. v. Scottsdale Ins. Co., 622 S.E.2d 165, 168 (N.C. Ct. App. 2005) (holding that the insured's voluntary payments to the injured third party did not preclude coverage under a general liability policy).

Exceedances of State guidelines are now being found in the boundary monitoring wells at ash pond facilities; further State orders on remediation, stemming directly from such contamination and not simply due to the business of operating a coal-fired power plant, thus seem inevitable. CP&L will face state-mandated remediation orders regarding its ash ponds and will incur the related costs. That conclusion is all the more likely given EPA's recent attention to coal combustion residue and the pressure from non-governmental organizations regarding ash ponds.

CP&L asks that you reconsider your position in light of the above. Please feel free to contact us for further discussion of how this can be accomplished.

Sincerely,

Laurence J. Eisenstein

cc: Kenneth E. Ryan, Esq.

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Gatorian, Michael

From: Ryan, Kenneth
Sent: Monday, August 22, 2011 10:44 AM
To: 'Antunes Steven'
Cc: Minix, Joshua
Subject: FW: CPL
Attachments: Document.pdf

Steven:

Atty-Client Communication/Work Product

Ken

From: Peter Alvey [mailto:palvey@rouxinc.com]
Sent: Monday, August 22, 2011 8:22 AM
To: Ryan, Kenneth
Subject: FW: CPL

Atty-Client Communication/Work Product

Pete

From: Malanchuk, John [mailto:jmalanchuk@em-law.com]
Sent: Thursday, August 18, 2011 10:24 AM
To: Peter Alvey
Subject: FW: CPL

Peter-

Here is the answer from Progress. With this I am happy to give you my assurance that nothing else exists re closure plans for the ash ponds.

Redacted

Good luck.

John

8/22/2011

John L. Malanchuk PhD

Eisenstein Malanchuk LLP
1048 Potomac Street NW
Washington, DC 20007
202.965.4700
202.965.1808 Fax

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From: Toepfer, John [mailto:John.Toepfer@pgnmail.com]
Sent: Thursday, August 18, 2011 10:05 AM
To: Malanchuk, John
Cc: Kemp, Daniel; Madewell, Alan; Holt, Fred
Subject: RE: CPL

John – the Cape Fear Plant NPDES permit has been updated recently and will go into effect Sept. 1, 2011. You were sent the NPDES permit for Cape Fear which is valid through August 2011. Within the permit that goes into effect September 1, 2011, there is a requirement for Ash Pond Closure. I attach that one page with that language. No other PEC NPDES permit has this language. As of today (08/18/11), PEC has not completed closure plans for any ash pond in the system. PEC is beginning the process to develop a closure plan for the Weatherspoon Plant ash pond since the coal fired portion of this plant is slated to cease operation in October 2011. Let me know of any questions. thanks

John R. Toepfer, P.E.
Senior Environmental Specialist
410 S. Wilmington Street/PEB4
Raleigh, NC 27601

919-546-7863 phone
VN: 770-7863
919-632-3714 cell
919-546-4409 fax

From: Malanchuk, John [mailto:jmalanchuk@em-law.com]
Sent: Friday, August 12, 2011 11:27 AM
To: Toepfer, John
Subject: FW: CPL

John-

Please see the email below. This is from the environmental consultant representing the insurance company, AEGIS. Am I safe giving Peter my assurance per his request below? (I assume he means no other permits than the ones I sent him.)

Thanks,

John

John L. Malanchuk PhD

Eisenstein Malanchuk LLP
1048 Potomac Street NW
Washington, DC 20007
202.965.4700
202.965.1808 Fax

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From: Peter Alvey [mailto:palvey@rouxinc.com]
Sent: Friday, August 12, 2011 10:07 AM
To: Malanchuk, John
Subject: CPL

John,

I received the permits. As I am sure you discovered also, they don't say much about the operation or closure of the ash ponds. At a minimum I will need an assertion by you or CPL that no permits for the ponds exist and that no closure plans are available for the ponds.

Thanks,

Peter Alvey

****

Peter Alvey, P.E.
Vice President
Roux Associates, Inc.
2000 Spring Road
Suite 420
Oak Brook, Illinois 60523
Telephone (630) 572-3300
Direct Dial (630) 468-1051
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Roux Associates, Inc.

http://www.rouxinc.com

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8/22/2011

A. 6. Intake Screen Backwash

The discharge of intake screen backwash is permitted without limitations or monitoring requirements.

A. 7. Biocide Condition

The permittee shall not use any biocides except those approved in conjunction with the permit application. The permittee shall notify the Director in writing not later than ninety (90) days prior to instituting use of any additional biocide used in cooling systems which may be toxic to aquatic life other than those previously reported to the Division of Water Quality. Such notification shall include completion of Biocide Worksheet Form 101 and a map locating the discharge point and receiving stream. Completion of a Biocide Worksheet 101 is not necessary for the introduction of a new biocide into an outfall currently being tested for toxicity.

A. 8. Domestic Wastewater Treatment Plant

The domestic wastewater treatment plant shall be properly operated and maintained to ensure treatment of sanitary effluent to secondary standards.

A. 9. Groundwater Monitoring Well Construction and Sampling

The permittee shall conduct groundwater monitoring to determine the compliance of this NPDES permitted facility with the current groundwater Standards found under 15A NCAC 2L .0200. The monitoring shall be conducted in accordance with the Sampling Plan approved by the Division.

A. 10. Section 316 (b) of CWA

The permittee shall comply with the Cooling Water Intake Structure Rule per 40 CFR 125.95.

A. 11. Structural Integrity Inspections of Ash Pond Dam

The facility shall meet the dam design and dam safety requirements per 15A NCAC 2K.

A. 12. Ash Pond Closure

The facility shall prepare an Ash Pond Closure Plan in anticipation of the facility closure. This Plan shall be submitted to the Division one year prior to the closure of the facility.

A. 13. Fish Tissue Monitoring Near Ash Pond Discharge

The facility shall conduct fish tissue monitoring once during the permit term and submit the results with the NPDES permit renewal application. The objective of the monitoring is to evaluate potential uptake of pollutants by fish tissue near the Ash Pond discharge. The parameters analyzed in fish tissue shall be arsenic, selenium, and mercury. The monitoring shall be conducted in accordance with the Sampling Plan approved by the Division.

Duke Energy's Position on the Regulation of Surface Impoundments and Landfills Used to Manage Coal Combustion Residues

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Duke Energy is committed to the continued management of its coal combustion residues (CCR) in a manner that is protective of human health and the environment.

Duke Energy believes that the development of additional federal and state regulation of CCR management is appropriate. Specifically, Duke Energy supports the regulation of CCR as a non-hazardous waste under a Resource Conservation and Recovery Act (RCRA) Subtitle D program that can be implemented by the states. Duke Energy also supports the development of structural integrity standards for surface impoundments. Duke Energy is, however, adamantly opposed to the regulation of CCR as a RCRA Subtitle C hazardous waste. That option is not legally authorized and would result in significant adverse consequences; including devastating the CCR beneficial use market; imposing excessive and costly controls on power plant operations; and creating a serious short-fall in disposal capacity. Furthermore, the incremental cost to the electric utility industry from regulating CCR under Subtitle C, costs that would ultimately be paid by consumers, would be significantly greater than the cost of a properly designed Subtitle D program, yet would provide no additional protection to human health and the environment.

EPA's final regulation should adhere to the following fundamental principles.

- Retain unchanged the EPA's determination in 2000 that CCR do not warrant regulation as hazardous waste.
- Employ performance based non-hazardous waste standards for landfills and surface impoundments managing CCR.
- No mandatory phase out of wet handling of CCR or associated low volume wastewaters managed in surface impoundments meeting applicable dam integrity and ground water performance standards.
- State groundwater performance standards should guide any corrective action for CRR landfills and surface impoundments.
- Continue to support the beneficial use of CCR.

The following is Duke Energy's recommended approach to regulating **CCR under RCRA Subtitle D per comments to the EPA dated November 19, 2010.**

- The regulatory program would include a mechanism under which the states would administer the performance based ground water standards and dam integrity standards.
- All CCR landfills and surface impoundments would be required to obtain a permit from the state to insure compliance with ground water protection standards, and dam integrity standards for surface impoundments.
- Ground water monitoring wells would be required at all existing CCR landfills and surface impoundments to determine compliance with applicable state ground water performance standards. Any unit not in compliance would be required to take appropriate steps to come into compliance or to implement a closure plan, under a schedule determined by the state permitting authority.
- The horizontal expansion of existing CCR units or the construction of new CCR units would be required to use composite liner systems or an equivalent alternative systems approved by the state.
- All active CCR surface impoundments would be required to comply with dam integrity standards modeled after Mine Safety and Health Administration standards with appropriate adjustments, or be closed.
- Owners of CCR landfills and surface impoundments would be required to develop closure and post-closure plans, allowing for in-place closure for all active and inactive surface impoundments. The closure schedule would be established based on best engineering management practices.
- Location restrictions would not apply to existing CCR surface impoundments and landfills.
- Where performance criteria standards are satisfied, legitimate beneficial use of CCR should be allowed in encapsulated applications, and in unencapsulated applications that include gypsum use in agricultural applications and coal ash use in engineered structural fills such as road sub base and embankments.

Duke Energy
526 South Church Street
Charlotte, NC 28202
800-521-2232
www.duke-energy.com

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Recently the Company has retired designated fossil units in NC while their associated ash basins continue to remain active for a period. In some cases, waste streams other than ash (e.g., coal pile run-off, drains, etc.) will need to continue to be transported to the ash basins for treatment until those plant support systems can be decommissioned fully. Currently federal regulatory programs do not specifically address the decommissioning and closure of ash basins; however, state regulations provide some options for closure framework. The company is working closely with NCDENR to define a closure process that provides a framework for certainty in the absence of specific federal regulatory requirements.

It is important for the corporation to move forward with ash basin closures under the process to be submitted to NCDENR, to minimize environmental risks and costs (mostly O&M) associated with maintaining ash basins for an extended period until federal rulemakings are complete and final. Other timing considerations include:

1. Ash basin closures can take years to complete so beginning the process is important.
2. While a final federal coal combustion residuals (CCR) rule is not expected before 2014, and lack of a federal ruling introduces an element of uncertainty, state requirements exist now. There is reasonable belief with internal company experts that any federal rule would be based on Subtitle D requirements to be implemented by the states.
3. Until the ash basin is dewatered, the NPDES permit must be maintained, or possibly renewed in certain cases, thus opening the renewal process to regulatory and greater public scrutiny (including public comments supporting clean closure). O&M Costs would continue to accumulate especially while the permit is active.
4. Dewatering the ash basins in accordance with the NPDES permit will over a relatively brief time reduce and/or eliminate seepage which the company is currently addressing.
5. Shaping and capping the ash basins soon after dewatering will help address possible dusting issues. Other dusting measures during dewatering will be needed.
6. Capping the basins soon will help begin the process of natural attenuation or other means to reduce constituents in groundwater. Constituent levels monitored in groundwater wells can take many years to observe substantial reductions.
7. Ash basin closure has recently seen increased attention and scrutiny and that scrutiny can only be expected to increase while the ash basins have no approved closure plan and reasonable efforts to close them are not underway.

To address these concerns representatives from Environmental, Strategic Engineering, and Plant Demolition conducted a Value Stream Analysis in 2012 to develop a standard process for ash basin closure option evaluation and decision-making, including factors such as timing, technologies, environmental and geotechnical considerations, risks, resources, and costs. The team developed a combined company ash basin closure process, which was analyzed using the Weatherspoon site. The team then completed a Kepner-Tregoe problem solving/decision analysis to determine the best closure design options for the Weatherspoon ash basin closure using site scoping information already collected.

While the site conditions supported a simple soil cover in earlier analysis, the K-T analysis considered other factors including environmental protection, long-term maintenance costs, public perception and risk minimization, and concluded that an HDPE geo-synthetic cap system would be the best solution for Weatherspoon ash basin closure.

The recommended strategy is to dewater, cap the Weatherspoon ash basin, and monitor. The ash basin strategy does not address lay-of land ash disposal areas such as landfills and possibly other historic ash placements. An engineering design is currently being performed for ash basin closure at Weatherspoon based on the recommended strategy. The conceptual design was utilized to further define scope, cost, and schedule of ash basin closures. This design will be submitted to NCDENR in May 2013, expecting final approval in July 2013.

Once NCDENR approval is received, the team recommends closure of the Weatherspoon ash basin for the following reasons.

1. This closure strategy process and NCDENR approval will establish precedent with the state on the method for future ash basin closure.
2. The Weatherspoon ash basin is one of the simplest and smallest basins on the system. Cost for closure is estimated to be approximately $18 - $34 million. It will provide a useful test case for lessons learned that can be applied to future closures.
3. Defining future costs for closure is critical to estimating liabilities for corporate reporting.
4. While the federal Coal Combustion Residual (CCR) rule has not yet been finalized, EPA's current thinking, based on recent agency comments, is that regulation of CCR disposal under RCRA Subtitle D may be "adequate".
5. It is anticipated that final CCR regulations requiring ash basin closure will be finalized no earlier than 2014. Assuming a Subtitle D rule contemplated by federal legislative efforts, state rulemaking will be initiated to create the framework for state implementation of the federal program. Duke Energy's retired plants in the Carolinas have at least 20 ash basins that will need to be closed. It is important that the corporation be proactive in developing the expertise in closure methods and have the qualified contractors on board to help meet this challenge.
6. The Plant Demolition and Retirement team includes individuals who are capable of performing the work utilizing trained fuel handling operators and existing equipment for basin grading. The project will be supplemented with engineering, QA and liner/specialty contractors. Future ash basin closures will be managed similarly to Weatherspoon. However, grading services may be contracted depending on in-house resource availability.

Current activities include budget development with Strategic Engineering and Cape Fear, Dan River, Lee (NC), and Buck ash basins site characterization studies.

[redacted]

O&M Cost Reduction:

Anticipated ongoing O&M work for retired facilities include:

1. Inspections
2. Dike maintenance (Mowing slopes, brush cutting, toe ditch and interior slope maintenance)
3. Fugitive dust mitigation
4. Repairs as needed (reseeding, runoff, animal burrow)

Anticipated cost per site is $50K-$150k

Support for the Process of natural attenuation caused by capping:

Attached are selected pages from the most recent groundwater monitoring report conducted by Blackrock Engineers for the Roxboro landfill. Note highlighted discussion from a couple of sections of the report regarding the downward trend in contaminant concentrations and the fact that the lined landfill is partially intended to minimize recharge and thus allow for concentration reduction to occur which is happening. Following the text is a series of graphs that support the generally downward concentration trend.

Roxboro Landfill
Groundwater Data Tr

Capital cost bases:

The range provided for closure is based on $18 million closure estimate based on Belews Creek ash land fill closure and $34 million estimate from Strategic Engineering.

[redacted]

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Apr 18 2020

STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH
DOCKET NO. E-7 Sub 1146

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of	)	
Application of Duke Energy Carolinas,	)	ATTORNEY GENERAL'S OFFICE
LLC for Adjustment of Rates and	)	LATE-FILED EXHIBIT 1
Charges Applicable to Electric	)	
Utility Service in North Carolina	)	

A. Guidance on Developing Closure Plans for Ash Basins, dated September 27, 2012, Duke_USAO_01448333

B. Ash Pond Closure Value Stream Analysis (VSA) presentation, dated October 17-19, 2012, Duke_USAO_00879828

C. Affinity Diagram – Ash Pond Closure (a slide from the Ash Pond Closure Value Stream Analysis presentation), Duke_USAO_00822754

D. Decommissioning Update – Environmental Issues, dated January 22, 2013, Duke_USAO_01450148

E. Ash Basin Closure Strategy, undated, Duke_USAO_01448357

F. Demolition and Plant Retirement presentation given by Issa Zarzar, dated February 16, 2013, Duke_USAO_01450124

G. Slides from presentation to Regulatory Policy and Operations Committee Meeting, dated May 1, 2013, Duke_USAO_01448457

H. North Carolina Work Plan for 2013 Environmental Issues, dated May 30, 2013, Duke_USAO_01448665

I. Environmental Review Talking Points for August 27, 2013 presentation to Board of Directors, Duke_USAO_01448447

J. Plant Demolition and Retirement Presentation for the Executive Governance Committee, dated October 14, 2013, Duke_USAO_01619234

K. Ash Basin Groundwater Summaries, dated November 4, 2013, Duke_USAO_01448181

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L. Ash Basin Closure Strategy presentation given by Joe Miller and Dave Mitchell to the Senior Management Committee, dated November 25, 2013, Duke_USAO_01329797

M. Ash basin closure planning, dated January 2014, Duke_USAO_01448332

N. Environmental Compliance Implementation Team Meeting Minutes, dated February 4, 2014, Duke_USAO_01619360

O. Active Ash Pond Closure Project, undated, Duke_USAO_01448322

Respectfully submitted this the 18th day of April, 2018.

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A. Guidance on Developing Closure Plans for Ash Basins, dated September 27, 2012

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Guidance on Developing Closure Plans for Ash Basins

Prepared by:
Duke Energy
Energy Supply – Environmental Services

Revision 0
September 27, 2012

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1.0 Introduction

The purpose of this document is to outline the overall process and provide general guidance and information concerning environmental considerations in planning and implementation of closure options for ash basins at Duke Energy plants. The scope of this document includes ash basins, sometimes known as ash ponds or ash surface impoundments, and ash storage areas, or ash fills or stacks, associated with the ash basin.

Permitted landfills and permitted structural fills are not included in the scope of this document.

Before initiating a closure project for an ash basin or ash storage area, the appropriate corporate Environmental Services personnel should be engaged to ensure that the appropriate procedures are incorporated and the necessary permits are obtained.

The overall goals of the closure option selection process are to:

- Provide long-term environmental protection of human health and the environment by reducing or eliminating potential risk of release of constituents from ash
- Minimize infiltration of precipitation into the closed ash basin or ash storage area to minimize generation of leachate by promoting surface drainage and maximizing runoff
- Minimize long-term maintenance costs for the closed area
- Perform closure activities in a safe manner and in conformance with Duke Energy's safety/environmental procedures, related company guidance documents and all applicable permits.

This document was developed to outline the overall process involved in the planning and implementation of closure options with a focus on the environmental aspects and is not intended to be a detailed manual encompassing all aspects of closure. This does not provide specific engineering guidance on complex geotechnical aspects of closure potentially associated with ash basins and the associated fills, such as: stability issues associated excessive pore-water pressures, dewatering, settlement, static stability, seismic stability, static and dynamic liquefaction, etc. In addition, it should be noted that the general guidance and information in this document is purposefully broad to encompass regulations in multiple states, but does not specifically reference any particular state regulations.

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2.0 Closure Options

The closure options may be prescribed by specific environmental regulations in some jurisdictions. Absent such prescriptive regulation, the selection of a closure option will be influenced by factors such as regulations, type of ash facility (ash basin or ash storage area), site conditions, existing environmental considerations, risk tolerance, future land/property uses, or business requirements.

These options, in general, will be Clean Closure, Closure in Place, Hybrid Closure, and Closure & Reuse. The selection of the closure option should be based on consideration of the feasibility, the cost effectiveness, the desired long term protection offered, and the alternatives for closure for the particular site.

When evaluating the closure options for an ash basin or an adjacent ash storage area, consideration should be given to utilizing material from or otherwise including the other ash basins or ash storage areas at the site.

For example, basins or fills may serve as sources of fill material or with the proper geotechnical preparation these areas may be developed as foundations for current or future beneficial uses. There may be cost synergies achieved by performing the closure in coordination with the proposed closure option, or otherwise using the other ash basin material.

Clean Closure – Clean Closure is defined as the removal of all ash from a basin (or adjacent ash storage area). This option would also include the removal of any soil which may have been impacted by the ash. Clean Closure may require meeting state-specific numeric cleanup levels for impacts to the soil from the ash. The removed ash and contaminated soil may be viewed as solid waste in most states and would require disposal in a permitted (lined) landfill.

Closure in Place – Closure in Place for surface impoundments would be performed by eliminating free liquid, consolidating or stabilizing the remaining ash and ash basin residues (by dewatering or other means) to support the final cover, and installing an engineered cover system.

The purpose of the cover system would be to minimize infiltration of precipitation through the remaining ash, thereby, reducing the potential impacts to groundwater. Post-closure care would involve monitoring and/or maintaining the integrity of the cover system for the indefinite future, in addition to potential groundwater monitoring.

Closure in Place for ash storage areas adjacent to or associated with ash basins would be performed by removing vegetation, grading the slopes to an acceptable grade, and installing an engineered cover system. Post-closure care would involve monitoring and/or maintaining the integrity of the cover system for the indefinite future, in addition to potential groundwater monitoring.

Hybrid Closure – Hybrid Closure is described as closure of selected area (ash basin or ash storage area) by clean closure while other areas at the site are closed in place. Hybrid Closure

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might be considered in order to minimize the surface area of an engineered cover system or to minimize the amount of borrow material from other sources. For example, a partially filled ash basin might be closed in place utilizing material from the clean closure of another ash basin at the site.

Closure & Reuse – Closure & Reuse is described as closure of selected areas (impoundments, fills) at a site and incorporating the design of a current or future site use into the closure. This option might be considered at a site where removal of material is not required for closure and where there is a benefit to retaining a feature or aspect of the site after an ash basin or ash storage area is closed. For example, there may be sites where it is desirable to construct a wastewater pond for site use after closure of an ash basin. In some cases it may be possible to construct a landfill over a closed ash basin, effectively capping it and providing a disposal site for additional CCR generated at the site. There may also be sites that have limited flat areas where it may be desirable to utilize a closed-in-place ash basin or ash storage area for laydown area, after closure.

The specific closure option will depend on site specific factors, environmental characterization of the facility to be closed, and post closure uses. The specific closure options for a site may range from no action to a soil cover system to an engineered cover system. A list of possible options for cover systems is provided in Table 1.

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3.0 Potential Regulatory Issues/Requirements

Consideration of a number of regulatory issues/requirements is necessary in determining the closure options for a particular site. These regulatory issues/requirements will vary based on many factors such as: the local or state jurisdiction, the type of ash facility (ash basin or ash storage area), site geology/hydrogeology, current and future site uses, etc.

Coal Combustion Residuals - Proposed EPA Rule
In June 2010, the US Environmental Protection Agency (EPA) issued a proposed rule[1] that considers two possible regulatory options for the management of coal combustion residuals (CCRs). The EPA definition of coal combustion residuals includes fly ash, bottom ash, flue gas desulfurization (FGD) materials (including synthetic gypsum), and boiler slag. Both regulatory options fall under the Resource Conservation and Recovery Act (RCRA). Under the first option, EPA would list these residuals as special wastes subject to regulation under Subtitle C of RCRA when destined for disposal in landfills or surface impoundments. Under the second option, EPA would regulate CCRs under Subtitle D of RCRA[2] as a non-hazardous waste.

The EPA has solicited public comments on the proposed rule and is developing a final rule. It is anticipated that no final rule will be issued in 2012. The effective dates for the rule will vary from six months after the rule is finalized for the Subtitle D option to one to two years after the rule is finalized for the Subtitle C option.

Federal regulations for management of coal ash residuals are not well defined at this time; however, there is no reason to believe an engineered cover system designed to meet Subtitle D requirements will not be considered adequate in the future. Therefore, while detailed modeling may indicate that a Subtitle D cover system is not required this type of cover system will likely be necessary in most cases. Therefore in any preliminary planning and budgeting process, before the detailed is performed, the Subtitle D cover system would be the most appropriate assumption. As the process moves forward, this initial assumption will confirmed or refuted as the process in Section 5.0 is performed.

A brief discussion on the Subtitle D cover system requirements is provided in Appendix I.

Other potential regulatory issues associated with closure are categorized below by the affected media:

Water:

- Groundwater contamination – Existing groundwater exceedances at ash basin monitoring wells or at ash storage areas/structural fill/unlined landfills may affect options considered for closure.

[1] Federal Register: June 21, 2010, Volume 75, Number 118, Proposed Rules Page 35127-35264.
[2] Minimum technical requirements for closure of MSW landfills (MSWLFs) regulated under RCRA Subtitle D are contained in Title 40 of the Code of Federal Regulations, Section 258.60 (40 CFR §258.60).

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- National Pollutant Discharge Elimination System (NPDES) Permits – Closure options may affect NPDES permits by: closing existing NPDES outfalls, permit modifications due to changes in flow or parameters, relocation of outfalls, etc.
- Wetlands/Stream Impacts – Site wetlands or streams may be impacted by closure due to site construction activities or due to dewatering activities associated with ash basins.
- Dam safety – Potential issues related to dam safety may include: issues with existing conditions of embankments (seepage, slope issues, etc.), issues associated with previous dam construction methods (embankments constructed on ash or unstable areas), issues associated with closure options, etc. Also, dam safety requirements can be a driver for certain design considerations (e.g. a Closure Plan might also address existing embankment stability issues). Regulatory agencies overseeing dam safety may require notification or approval of closure plans prior to initiation of construction activities associated with closure.
- Watershed Regulations - Protected watershed regulations may prevent construction of new landfills (or certain other facilities) on or near a site.
- High yield aquifers – State regulations may prohibit certain activities/facilities above designated high yield aquifers.
- Anti-degradation water rules - Anti-degradation rules can be used by regulators as a catchall to mandate (or prevent) certain approaches to closure.
- Bevill Amendment Exemption for Co-managed Wastes –EPA has determined that certain low-volume wastes that result from supporting processes that are ancillary to the combustion and power generation processes are exempt from regulation under Subtitle C of RCRA if they are co-managed with high volume wastes that are excluded by the Bevill Amendment[3] exemption. When ash is no longer sluiced to an ash basin, the Bevill amendment exemption for co-management of these low volume wastes may be lost. For example, a site may currently be sluicing FGD wastewater to an ash basin. The wastewater may contain constituents that would lose the Bevill amendment co-management exemption if the basin is closed.
- Steam Electric Effluent Guidelines – The limitations mandated by the pending effluent guidelines rule (final rulemaking expected in 2014) may affect certain options related to discharges. It is likely that this rulemaking will prohibit the sluicing of flyash, thereby necessitating ash basin closure.
- Clean Water Act Section 401/404 – Dredge or fill activities associated with construction of closure options require permitting under Clean Water Act Section 401/404.
- Stormwater management – Ash basins have historically been integral parts of the site stormwater management system (including discharges from plant sumps, coal piles, and other plant areas). Certain closure options may require re-routing or other treatment options for these discharges.
- Wastewater treatment – Temporary treatment processes may be necessary for treatment/handling of effluent from ash basin dewatering during the construction of the closure option.

[3] Section 3001(b)(3)(A)(i) of Resource Conservation and Recovery Act (RCRA) is known as the Bevill Amendment (exclusion or exemption). The Bevill Amendment excluded high volume waste (fly ash, bottom ash, boiler slag, and flue gas emission control wastes) from regulation as hazardous waste under Subtitle C of RCRA.

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- State Water Regulations/Guidance – State water regulations/guidance concerning the closure of ash basins may prescribe designs for closure and may require investigation/characterization of material in the facility and the soil and groundwater at the facility. These state regulations may also prescribe disposal requirements for material associated with the ash basins.

Waste:

- State Solid Waste Regulations – State solid waste regulations/guidance concerning the closure of ash storage areas may prescribe specific requirements for closure. These regulations may require investigation/characterization of material in the facility, and the soil and groundwater at the facility. These state regulations may also prescribe disposal requirements for material removed from the ash basins. There may be implications of moving material from ash basins or ash storage areas for disposal (different piles of ash may have very different regulatory ramifications depending on their source, storage methodology, and ultimate disposition).
- Cover System Requirements – Closure cover system design requirements for ash basins and ash storage areas are generally not well-defined in the regulations; though some states have developed guidance for closure. The current regulatory trend is towards requiring a cover system similar to Subtitle D requirements.
- Groundwater Monitoring Requirements – Long term monitoring of groundwater quality will likely be required until the performance of the closure option can be verified.

Air:

- Fugitive dust – Control of fugitive dusting during construction of the closure system will be required.
- Modification to Air Permits during Construction– Construction activities (truck traffic, mobile generators, etc.) associated with closure activities may require modification to site air permits.
- Title V Permits – Title V permits may require modification. For example, it may be necessary to remove requirements for visible emissions notations.

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4.0 Planning Considerations – Development of Closure Plan

Development of a formal Closure Plan, incorporating input and review from the appropriate internal and external entities, is essential to ensure the proper options are considered and that the risks, schedule, and cost implications are understood. In addition to providing a formal process for consideration and selection of a closure option, portions of the Closure Plan could be used for the regulatory approval or notification process.

The Closure Plan should include the following:

Goals and Objectives of Closure
Develop and state the overall goals and objectives of closure – the goals and objectives for closure may be based on site specific issues such as decommissioning, conversion to dry ash handling, or changes in regulations.

Design Scoping Phase
In order to identify site specific issues associated with ash basin closure the following should be included in the Design Scoping Phase:

Step 1 - Identify land uses for site – Identify current and future land uses at the site to ensure consideration is given to these needs during the design phase. Current and future land uses would include power production areas, ash disposal and other disposal areas, transmission lines and associated rights-of-way, laydown and storage areas, parking areas, stormwater ponds, wetlands, streams, etc.

Step 2 - Identify local zoning regulations for site – Local zoning regulations may prohibit development of landfills through zoning restrictions such as watershed designations, or they may require special zoning processes, such as obtaining a Special Use permit, or may contain other restrictive considerations. These local regulations should be identified early in the process and reviewed for schedule impacts and to identify possible use restrictions.

Step 3 - Identify type of facility to be closed – The Closure Plan should identify the type of facility to be closed; ash basin, ash storage area.

Step 4 - Identify types and quantity of ash in the facility- Identification of the type of ash (bottom ash, fly ash, a mix of both) and the quantity of ash in the facility. This may require a current bathymetric survey for ash basins. Determination of volumes for ash storage areas may require a current topographic survey and obtaining preconstruction topography of the ash storage area.

Step 5 - Identify potential operational impacts to operating power production or transmission facilities at site and develop plans to address these potential impacts.

Examples of this type of potential impact are: impacts to ancillary waste streams previously or currently routed to the basin, rerouting of discharges, rerouting of stormwater flows impacted by re-grading, treatment and routing of discharge from active dewatering system used to dewater ash during closure, etc.

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Step 6 - Determine type of closure to be pursued – Describe the type of closure (Clean Closure, Closure in Place, Hybrid Closure, or Closure & Reuse) to be pursued.

Step 7 - Regulatory Review – Identify permits and notifications required for closure. This includes permits required for closure, regulatory required documents that would need to be revised, permit modifications, as well as rescinding some permits that would be required for closure. Examples include: Stormwater Permits, Spill Prevention, Control and Countermeasure (SPCC) Plan, NPDES permit, Dam Safety notifications, and erosion and sediment control permits.

Step 8 - Preliminary Geotechnical and Hydrogeologic Investigation – The preliminary geotechnical and hydrogeologic investigation would be used to obtain design information required to develop the preliminary closure design and preliminary cost estimate. The scope of work required would depend on the type of closure to be pursued. For example, if Clean Closure is required or selected, the scope of work would be targeted to obtaining the information required to support Clean Closure, such as selecting the location of a disposal area, obtaining groundwater data and/ or other information to support dewatering, etc.

This investigation would require: review of existing dike inspection reports and design calculations, obtaining current site topographic map, collection of soil and ash samples for classification and testing, review of site groundwater monitoring system and dike instrumentation to determine if additional wells or piezometers are needed. This information would be used to determine the method and schedule for dewatering or stabilizing ponded ash and to determine if additional investigations are required. A preliminary borrow study may be needed to identify potential sources of soil.

Step 9 - Environmental Characterization and Selection of Closure Option – This step uses information developed in the Preliminary Geotechnical and Hydrogeologic Investigation, supplemented by an evaluation on existing groundwater and soil quality data and testing to verify the adequacy of the closure option selected in Step 6.

The scope of work required would depend on the type of closure to be pursued. For example, if Clean Closure is required or selected, the scope of work would be targeted to obtaining the information required to support Clean Closure, such as evaluation of existing groundwater/soil quality to determining the extent of soil to be removed, evaluation of the need for additional measures, etc.

i. Evaluate site hydrogeologic conditions
ii. Identify potential receptors and water supply wells/aquifers
iii. Evaluate existing groundwater/soil quality
iv. Perform ash/soil characterization
v. Select Closure Option and cover system (If Clean Closure was not selected in Step 6)

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vi. Predict post closure groundwater conditions and quality – perform groundwater modeling if required

vii. Verify adequacy of Closure Option selected

viii. Evaluate need for additional measures

A detailed description of the Environmental Characterization and Selection of Closure Option is described in Section 5.0.

Develop Preliminary Closure Design Options

The preliminary design options would be developed using the information from the design scoping phase. The preliminary design options should consider the geotechnical aspects of closure potentially associated with ash basins and the associated fills such as, stability issues associated excessive pore-water pressures, dewatering, settlement, static stability, seismic stability, static and dynamic liquefaction, etc. The geotechnical aspects are outside of the scope of this guidance but consideration of the extent and schedule of work associated with these issues should be incorporated in this phase of the process.

For each proposed design option the following would be developed:

- Costs to implement closure
- Costs for long term monitoring and post closure care (inspections and maintenance)
- Schedule considering site uses, regulatory requirements, drivers for closure (regulatory drivers, budget drivers, end use drivers)
- Summary of benefits and risks associated with each closure option

Develop Final Closure Design

From the scoping phase and the list of preliminary closure options, a Final Closure Design is selected. The Final Closure Design process would include the following:

- Development of Final Closure Design – The final closure design drawings and plans including final cover system design, stormwater controls, rerouting of discharges (if required), erosion and sedimentation control, consideration of geotechnical aspects of the closure option, etc.
- Health and safety plans
- Communication Plan – The development of the communication plan should consider site specific risk tolerance and public perception factors
  - Internal communications – develop communications plan for internal stakeholders
  - External communications – develop communications plan for neighbors and external stakeholders (public, media, etc.)
- Contingency Plans –develop contingency plans for addressing unanticipated issues with contamination, dike issues, etc.
- Construction Monitoring Plans – develop plan to monitor progress of closure actions, including inspections, maintenance, and monitoring
- Plans for long term monitoring and post closure care (inspections and maintenance)

This process is shown in Flow Chart 1.

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5.0 Environmental Characterization and Selection of Closure Option

This section describes performing the environmental characterization and the selection of the closure option. The closure option term includes a range of cover options, including Clean Closure, Closure in Place, Hybrid Closure, and Closure and Reuse, and possible additional measures that may be employed separately or in conjunction with a cover system. These additional measures could include dewatering, solidification, chemical stabilization, installing groundwater flow control measures, or any requisite groundwater remediation efforts to address large or small scale groundwater impacts.

In the absence of a specific cover system required by regulation, or in the absence of selecting Clean Closure, the evaluation of the existing groundwater quality/soil quality and the characterization of the ash/soil are used to determine if a cover system is required and the extent and type of cover system.

As described in Section 4.0, if Clean Closure is required or is selected, the scope of work would be targeted to obtaining information required to support Clean Closure, such as evaluation of site hydrogeologic conditions, evaluation of existing groundwater/soil quality to determine the extent of soil to be removed and to determine if additional measures are needed, etc.

In the environmental characterization process, data is gathered on environmental and hydrogeologic conditions to support a decision on the type of closure option selected.

The environmental characterization process will require the following:

- Development of Site Hydrogeologic Conceptual Model – The site hydrogeologic conceptual model (SHCM) is an interpretation or working description of the characteristics of the physical hydrogeologic system. The purpose in developing the site hydrogeologic conceptual model is to understand and to adequately characterize the site hydrogeologic system and to incorporate this information into the planning and evaluation process.

  Both regional and site specific geologic, hydrogeologic, and hydraulic data are incorporated into the development of the SHCM. The following site specific information would be included:

  - Evaluate Site Hydrogeologic Conditions – The evaluation of site hydrogeologic conditions is required to effectively develop closure options. Ash basins may present artificially elevated aquifer conditions while operating, but may experience a decrease in groundwater elevations after sluicing operations end. Even after active or passive dewatering to achieve stable material properties, with closure options other than clean closure, site groundwater may continue to flow through remaining ash providing a continuing source of leachate from ash to the groundwater.

    The first step will be to develop a desktop hydrogeologic study which will be used to determine the location of groundwater monitoring wells. The installation of

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additional groundwater monitoring wells and or piezometers may be required to establish aquifer conditions, and for collection of information on aquifer hydraulic properties (i.e., depth of soil or rock layers, porosity, and hydraulic conductivity).

- Identify Potential Receptors and Water Supply Wells/Aquifers – The identification of potential groundwater receptors and adjacent water supply wells/high value aquifers should be included in the site characterization and is a factor in evaluating the closure options. Groundwater use by individual users, by groups of individual users, or by community wells can alter site groundwater flow and may provide pathways for contaminant transport. The effect of a particular closure option, if any, to adjacent receptors or adjacent water supply wells/aquifers will depend on the local site conditions and the groundwater conditions.

- Evaluate Existing Groundwater/Soil Quality – Groundwater monitoring systems installed for monitoring groundwater quality and compliance during operations, if present, may provide useful information on the existing groundwater quality at the facility. However, the existing wells may not provide adequate information on groundwater quality to effectively develop closure options. Additional wells or groundwater sampling may be required.

  In addition, soil samples need to be collected below the ash/soil interface to determine if there are impacts to site soils. These soil samples would be analyzed for total metals concentrations to determine the extent and depth of soil potentially impacted by ash.

- Perform Ash/Soil Characterization – Impacts to groundwater from ash vary based on a number of factors including, type of coal, type of ash (fly or bottom), presence of pyrites/mill rejects, pollution controls, leaching conditions, etc. The geochemistry of ash and changes in factors such as pH, of both the ash and the leaching solution, can cause changes in the timing and the concentrations of constituents leached from the ash.

  The site characterization should include leaching tests performed on material collected from the facility to be closed and should be accomplished by performing SPLP[4] or other approved leaching tests. Consideration should be given to performing sequential leaching tests to understand the variability of leached constituents over time. Samples collected for the leaching tests should be collected at both different depths in the facility and over the extent of the facility. The results from these leaching tests should be compared to the appropriate groundwater standards to determine if additional evaluation or groundwater modeling is required. Additional samples of ash should be collected and analyzed for total metals concentrations.

  The material in the ash basin or ash storage area must be evaluated to determine if gas will be produced after closure. Although coal ash alone is not known to produce methane (the typical landfill gas), organic debris and other material in an ash basin or ash storage area may be capable of producing gas during decomposition. If an impermeable barrier

[4] US EPA SW 846 Method 1312 Synthetic Precipitation Leaching Procedure (SPLP).

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is used in the final cover system, gas generation may generate uplift pressures and damage to the cover system unless the gas is quickly and efficiently removed through a properly designed collection and venting system.

- Select Closure Option and Cover System (If Clean Closure is not selected) – In the absence of a specific cover system required by regulation or if Clean Closure is not selected, an evaluation of the existing groundwater quality/soil quality and the characterization of the ash/soil are performed to determine if a cover system is required and the extent and type of cover system. The performance of the cover system will be evaluated by groundwater modeling.

- Predict Post Closure Groundwater Conditions and Quality – If a closure option other than Clean Closure is selected, groundwater modeling is required to determine the post closure groundwater conditions (e.g. elevation, flow rates, flow directions, concentrations of constituents of concern) and to evaluate the effect of potential closure options on future groundwater quality. This modeling should be performed by consideration of future site hydrogeologic conditions, including post closure groundwater elevations and flow conditions, post closure infiltration, and using geochemical or leaching properties of the ash.

  Infiltration models such as the Hydrologic Evaluation of Landfill Performance[5] (HELP) model can be used to predict future infiltration through the proposed closure system into the ash. By extension, this modeling will also provide the quantity of leachate migrating from the closed facility.

  Analytical fate and transport models such as, MYGRT (EPRI), BIOSCREEN (US EPA), and MULTIMED (US EPA) may be useful as tools in preliminary modeling. However, due to the complexity of most sites and the variability in the site conditions, aquifer properties and contaminant concentrations, the simplifying assumptions used in these models may not adequately account for site and facility conditions. These models also lack hydraulic modeling capabilities needed to provide prediction of post closure groundwater conditions (e.g. groundwater elevation, flow rates, and direction of flow). These analytical models may be useful at sites or locations at a particular site where extensive data is not available, where site conditions are consistent with the boundary conditions used in the model, and where the constituent properties can be properly modeled.

[5] THE HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE (HELP) MODEL, *ENGINEERING DOCUMENTATION FOR VERSION 3.07*, Environmental Laboratory, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

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Numerical groundwater flow and contaminant transport models for, such as MODFLOW and MT3D,[6] are frequently used for groundwater quality modeling. These models have the capability of handling temporal and spatial variability in site conditions and in contaminant concentrations. The MODFLOW model has extensive hydraulic modeling capabilities and may be useful in prediction of post closure elevation, flow rates and direction of flow. The MT3D model is linked to the flow modeling performed by MODFLOW and performs the contaminant fate and transport modeling. Sampling of site soils and testing to determine the attenuation capacity of the site soil may be needed as input to the MT3D model.

The use of MODFLOW/MT3D models may be desirable since regulators may have experience with these models. Depending on site characteristics and data availability, MODFLOW models may be developed as three dimensional (3-D) or as two dimensional (2-D) cross sections.

In addition to numerical models for groundwater flow and contaminant transport, models such as PHREEQC[7] perform aqueous geochemical calculations such as speciation and saturation-index calculations, batch reaction, and one dimensional (1-D) transport calculations. It is important to note that geochemical reaction modeling requires extensive experience and geochemical inputs. Additional considerations with the use of this model are: (1) PHREEQC was developed to be utilized in low ionic strength conditions and the equations used may not correctly perform in higher ionic strength conditions, and (2) a lack of consistency exists in the databases used to perform the speciation calculations.[8]

- Verify Adequacy of Closure Option Selected – The results from the groundwater model will be used to verify the adequacy of the Closure Option selected.

  If the proposed closure option does not provide the required results, then a closure option providing more protection should be selected and the groundwater model analysis would be re-run for verification.

[6] Modular Three-Dimensional Finite-Difference Groundwater Flow (MODFLOW), U.S. Geologic Survey. MODFLOW can be used to develop one-dimensional to three-dimensional models, and is a cell-centered, finite-difference model that can perform both steady-state and transient simulations using a variety of boundary conditions. Modular Three-Dimensional Transport (MT3D) model performs contaminant fate and transport modeling in conjunction with MODFLOW. The MT3D model was developed by S.S. Papadopulos & Associates, Inc. for the United States Environmental Protection Agency (EPA).

[7] Parkhurst, D.L. and Appelo, C.A.J., 1999, *User's guide to PHREEQC (Version 2)* - A computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations: U.S. Geological Survey Water-Resources Investigations Report 99-4259, 310 p.

[8] Parkhurst, D.L. and Appelo, C.A.J., 1999, *User's guide to PHREEQC (Version 2)*, Program Limitations.

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- Evaluate Need for Additional Measures – Post closure groundwater flow through material remaining in the ash basin or existing groundwater/soil contamination may require additional measures or may require consideration of removal of material from the basin and pursing Clean Closure.

  The extent and types of measures required would depend on many factors such as the contaminant, the extent of contamination, the location and number of receptors, etc. A discussion of these measures is beyond the scope of this guidance but may include: additional site characterization, risk assessment, monitored natural attenuation, barrier systems including cut-off walls installed to prevent or redirect upgradient groundwater flow from going through the remaining material, pumping systems to control groundwater levels, passive reactive walls, in-situ chemical treatment or stabilization, etc.

This process is shown in Flow Chart 2.

[redacted]

Table 1 Closure Cover Systems for Ash Basins and Adjacent Ash Storage Areas

Cover System Number	Cover System	Description
CS-0	No action	Facility or area can be left as is.
CS-1	Soil cover with vegetation	Soil cover with vegetation installed at thickness to prevent erosion and to prevent dusting.
CS-1A	Engineered soil only cover system with vegetation	Soil cover thickness designed to minimize infiltration and to maximum run-off and evapotranspiration. Cover system may be designed with locally available, low permeability material such as clay. Soil layer and vegetation selected to minimize infiltration.
CS-2A	Engineered cover system – Geomembrane barrier layer with vegetated upper layer	Cover system similar to Subtitle D landfill – 2 feet of soil over geocomposite, with geomembrane (PVC, HDPE, LLDPE) layer underneath as barrier layer. The uppermost layer is minimum 2 foot thick soil cover with vegetation.
CS-2B	Engineered cover system – Geosynthetic clay liner barrier layer with vegetated upper layer	Cover system similar to Subtitle D landfill – 2 feet of soil over sand drainage layer with geosynthetic clay layer (GCL) underneath as barrier layer. The uppermost layer is minimum 2 foot thick soil cover with vegetation. (See Note 2)
CS-2C	Engineered cover system – Evapotranspiration cover system	Soil cover system designed to minimize infiltration by use of evapotranspiration (ET). Design may be either monolithic ET cover or capillary barrier ET cover system. (See Note 3)
CS-2D	Engineered cover system – Geomembrane upper layer, no soil cover	Single layer cover system - geomembrane only cover. No soil cover layer.

Notes:

1. The cover systems described above may be used individually or in combination. For example, a portion of an area might require an engineered soil only cover system (CS-1A) and an adjacent portion of that same area might require an engineered cover system consisting of a geomembrane barrier layer with vegetated upper layer (CS-2A).
2. Any of the cover systems listed could be designed with post closure use features such as basins, laydown areas, alternative energy sources (photovoltaic solar panels), or other uses.
3. Due to stability concerns associated with GCL's, this option is limited to low slope applications. Long term data on performance of GCL's used as cover systems is limited.
4. This application is likely limited to low precipitation areas.
5. As discussed in Section 3.0, while detailed modeling may indicate that a Subtitle D cover system is not required, it likely will be necessary in most cases and therefore should be considered the default cover until modeling shows otherwise. A brief discussion on the Subtitle D cover system requirements is provided in Appendix I.

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Flow Chart 1 – Development of Closure Plan

Begin Development of Closure Plan

Identify Goals and Objectives of Closure

Design Scoping Phase

Step 1 - Identify land uses for site (current and future land uses)
Step 2 - Identify local zoning regulations for site
Step 3 - Identify type of facility to be closed
Step 4 - Identify types and quantity of ash in the facility
Step 5 - Identify potential operational impacts to operating power production or transmission facilities at site and develop plans to address these potential impacts
Step 6 - Determine type of closure to be pursued – Clean Closure, Closure in Place, Hybrid Closure, and Closure & Reuse
Step 7 - Preliminary Geotechnical and Hydrogeologic investigation
Step 8 - Environmental Characterization and Selection of Closure Option (See Flow Chart 2)
Step 9 - Regulatory Review – Identify permits and notifications for closure.

Develop Preliminary Closure Design Options

- Development of Preliminary Closure Design Options
  - Costs to implement closure option
  - Schedule considering site uses, regulatory requirements, drivers for closure (regulatory drivers, budget drivers, end use drivers)
  - Summary of benefits and risks associated with each closure option

Develop Final Closure Design

The Final Closure Design process would include the following:

- Development of Final Closure Design
- Health and safety plans
- Communication Plan
  - Internal
  - External
- Contingency Plans

Complete Closure Plan

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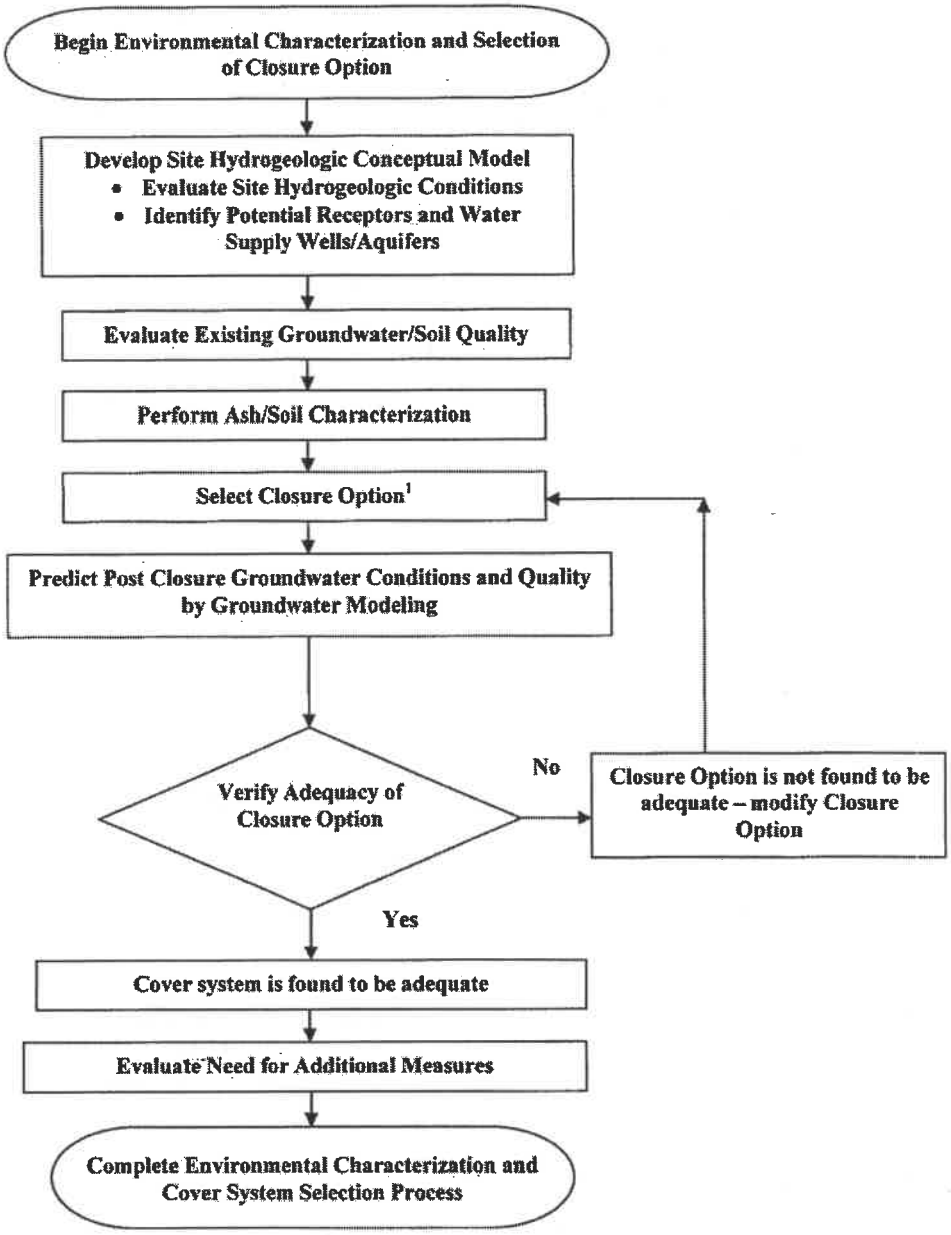
Flow Chart 2 – Environmental Characterization and Selection of Closure Option



[1]Closure Option - term includes a range of cover options, including Clean Closure, Closure in Place, Hybrid Closure, and Closure and Reuse, and possible additional measures that may be employed separately or in conjunction with a cover system. See Section 5.0.

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Appendix I
Subtitle D Cover System Requirements

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RCRA Subtitle D Cover System Requirements

In 2004 EPA published the *EPA (Draft) Technical Guidance for RCRA/CERCLA Final Covers.*[9] The document was developed as a tool for facility owners, engineers, and regulators involved in landfill design and permitting. This guidance document provides an update to the previous U.S. Environmental Protection Agency (EPA) guidance on this subject "Design and Construction of RCRA/CERCLA Final Covers" (EPA, 1991a).

While the RCRA Subtitle D requirements are specifically for cover systems on landfills, the concepts are directly applicable to cover systems designed to minimize infiltration at ash basins. In general these cover systems have an uppermost layer that is a vegetated soil cover layer. Under that layer is a drainage layer that conveys infiltration to a drainage system. Beneath the drainage layer is a barrier layer, typically a compacted clay liner (CCL) or geomembrane (GM) made of high or linear low density polyethylene (HPDE or LLDPE) material.
It is important to note the following:

- The permeability requirements are based on preventing the "bathtub" effect where a cover system is designed with a permeability that is greater than the permeability of the soil or liner system underlying the landfill. This condition would allow more water in through the cover than could flow out through the liner and create a "bathtub" or accumulation of water in the facility.
- These requirements are minimum requirements for landfills and thicknesses of soil layer, hydraulic capacity for the drainage layer, and permeability of the barrier layer should be designed to meet site specific requirements for the facility being closed.

The text on the following pages, enclosed in the boxed area was taken from *EPA (Draft) Technical Guidance for RCRA/CERCLA Final Covers.* This text discusses cover requirements for RCRA and CERCLA projects:

[9] EPA 540-R-04-007 OSWER 9283.1-26 April 2004.

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Text in Box Taken From *EPA (Draft) Technical Guidance for RCRA/CERCLA Final Covers*

Minimum technical requirements for closure of MSW landfills (MSWLFs) regulated under RCRA Subtitle D are contained in Title 40 of the Code of Federal Regulations, Section 258.60 (40 CFR §258.60). The regulation allows either a minimum criteria cover system or a performance-based cover system design. The specific requirements of that regulation are as follows:

"(a) Owners or operators of all MSWLF units must install a final cover system that is designed to minimize infiltration and erosion. The final cover system must be designed and constructed to:

(1) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 x 10^{-5} cm/sec, whichever is less, and

(2) Minimize infiltration through the closed MSWLF by the use of an infiltration layer that contains a minimum 18-inches of earthen material, and

(3) Minimize erosion of the final cover by the use of an erosion layer that contains a minimum 6-inches of earthen material that is capable of sustaining native plant growth.

(b) The Director of an approved State may approve an alternative final cover design that includes:

(1) An infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (a)(1) and (a)(2) of this section, and

(2) An erosion layer that provides equivalent protection from wind and water erosion as the erosion layer specified in paragraph (a)(3) of this section."

After the foregoing regulations were issued in October 1991, EPA clarified their intent with respect to the permeability requirement of the prescriptive minimum criteria cover system in 40 CFR §258.60(a)(1). The Agency's clarification was contained in the Federal Register in June 1992, at 57 FR 28628 (EPA, 1992b). According to this clarification, the cover system is required to have a hydraulic conductivity less than or equal to that of any underlying liner system or natural subsoils. The purpose of this requirement is to prevent what the Agency calls the "bathtub" effect, wherein percolation into the landfill exceeds leakage through the liner system, causing the accumulation of liquid in the facility. The hydraulic conductivity must also be no greater than 1 × 10^{-7} m/s.

The EPA (1992b) clarification to the minimum requirements for MSW landfill cover systems is illustrated in Figure 1-6 for: (i) unlined landfills constructed prior to the effective date of Subtitle D regulations (Figure 1-6(a)); (ii) landfills with a CCL *(compacted clay liner)*[10] beneath the waste (Figure 1-6(b)); and (iii) landfills underlain by a Subtitle D composite liner consisting of a GM upper component and a CCL lower component (with the CCL having a maximum hydraulic conductivity of 1 x 10^{-9} m/s) (Figure 1-6(c)). While these minimum requirements seem to

[10] The definition of CCL as "clay compacted liner" added for clarity.

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Text in Box Taken From *EPA (Draft) Technical Guidance for RCRA/CERCLA Final Covers*
(Continued)

indicate that less protective cover systems are allowed at landfills with less protective liner systems, EPA believes that, all other factors being equal (e.g., comparable hydrogeologic setting, types of waste, etc.), more protective cover systems should be used at unlined landfills compared to lined landfills to minimize the percolation of water though the cover systems and, consequently, the formation of leachate and migration of such leachate from the units.

It should also be noted that the cover systems required by 40 CFR §258.60 regulations do not represent "complete" designs in the sense that they are based on a permeability design criterion only and do not address other design criteria. For example, the cover system shown in Figure 1-6(c) does not include a drainage layer above the GM barrier or an adequate thickness of cover soil to allow sufficient water storage for healthy surface vegetation. As another example, none of the designs presented in Figure 1-6 have an adequate thickness of soil protection above the CCL component of the cover system to protect the CCL from freeze-thaw damage for sites located in northern climates. As a final example, none of the designs addresses the important matter of landfill gas transmission beneath the cover system.

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Figure Below Taken From *EPA (Draft) Technical Guidance for RCRA/CERCLA Final Covers*

(Note: This figure does not show design level detail and omits the drainage layer over the barrier layer)

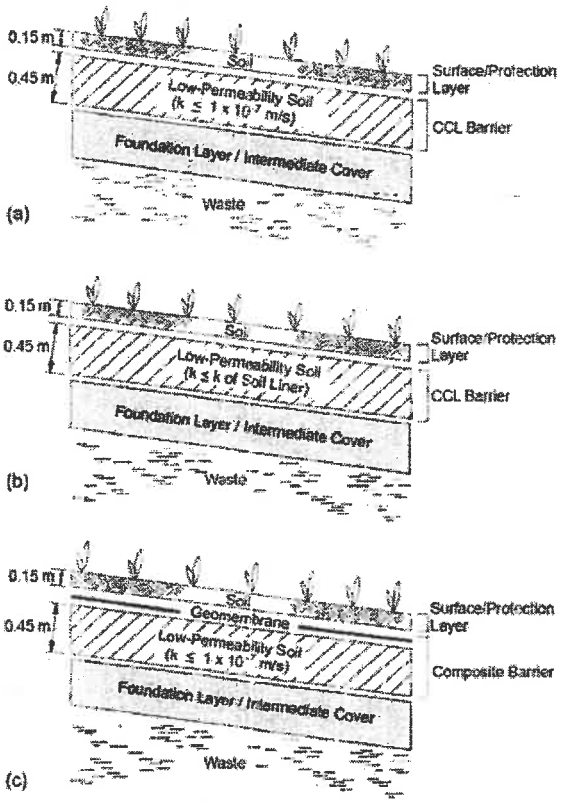

Figure 1-6. EPA Prescriptive Minimum Criteria Cover Systems for: (a) Unlined MSW Landfills; (b) MSW Landfills Underlain by a CCL; and (c) MSW Landfills Underlain by a GM/CCL Composite Liner.

DRAFT - DO NOT CITE OR QUOTE 1-9

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B. Ash Pond Closure Value Stream Analysis (VSA) presentation, dated October 17-19, 2012

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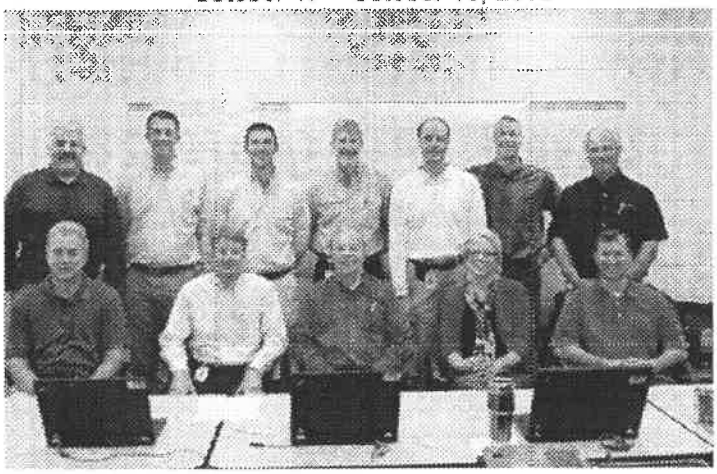
Ash Pond Closure VSA

October 17 – October 19, 2012



Sitting: Chris Hallman, Ed Sullivan, Dave Waugh, Linda Hickok, John Toepfer.
Standing: Issa Zaizar, Jeff Geswein, Chris Ussery, Tom Leap, Allan Stowe, John Velte, Dennis Cole
Not shown: Dan Kemp, Tim Russell

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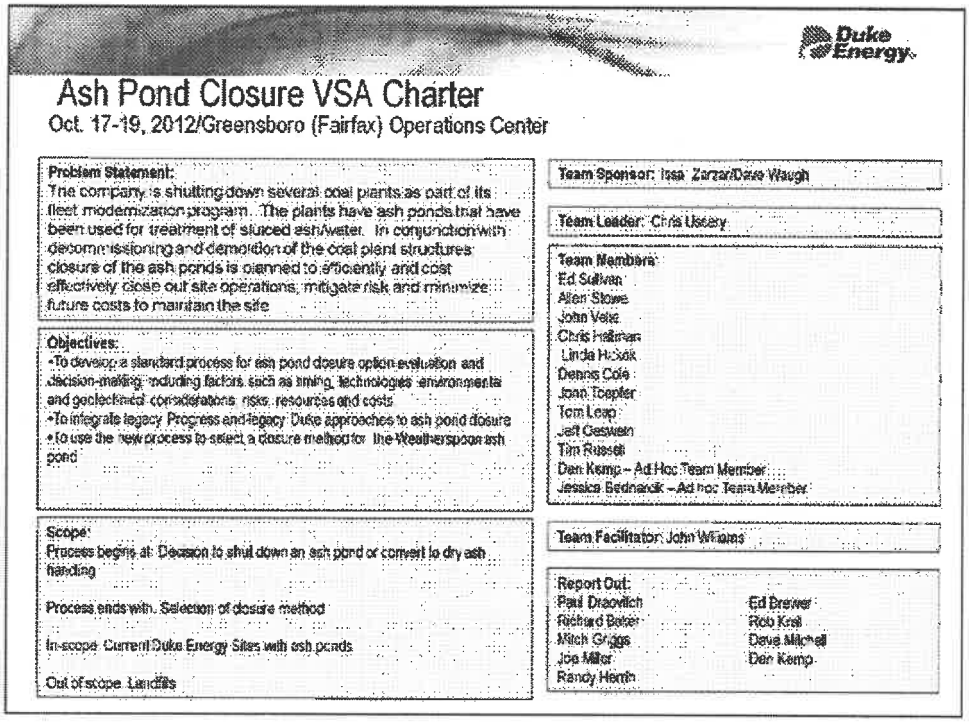

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Ash Pond Closure VSA Charter

Oct. 17-19, 2012/Greensboro (Fairfax) Operations Center

Problem Statement:
The company is shutting down several coal plants as part of its fleet modernization program. The plants have ash ponds that have been used for treatment of sluiced ash/water. In conjunction with decommissioning and demolition of the coal plant structures, closure of the ash ponds is planned to efficiently and cost effectively close out site operations, mitigate risk and minimize future costs to maintain the site.

Objectives:
- To develop a standard process for ash pond closure option evaluation and decision-making, including factors such as timing, technologies, environmental and geotechnical considerations, risks, resources and costs
- To integrate legacy Progress and legacy Duke approaches to ash pond closure
- To use the new process to select a closure method for the Weatherspoon ash pond

Scope:
Process begins at: Decision to shut down an ash pond or convert to dry ash handling

Process ends with: Selection of closure method

In-scope: Current Duke Energy Sites with ash ponds

Out of scope: Landfills

Team Sponsor: Issa Zarzar/Dave Waugh

Team Leader: Chris Ussery

Team Members:
Ed Sullivan
Allen Stowe
John Veitz
Chris Hallman
Linda Hobbs
Dennis Cole
Joan Toepfer
Tom Leap
Jeff Geswein
Tim Russell
Dan Kemp – Ad Hoc Team Member
Jessica Bednarcik – Ad hoc Team Member

Team Facilitator: John Williams

Report Out:
Paul Draovitch
Richard Baker
Mitch Griggs
Joe Miller
Randy Heath
Ed Brewer
Rob Krsl
Dave Mitchell
Dan Kemp

To align the cells, select the cells that you want to align and then click the "arrange" drop down on the home tab, click "align" and then select how the cells should be aligned. (ie; align right)

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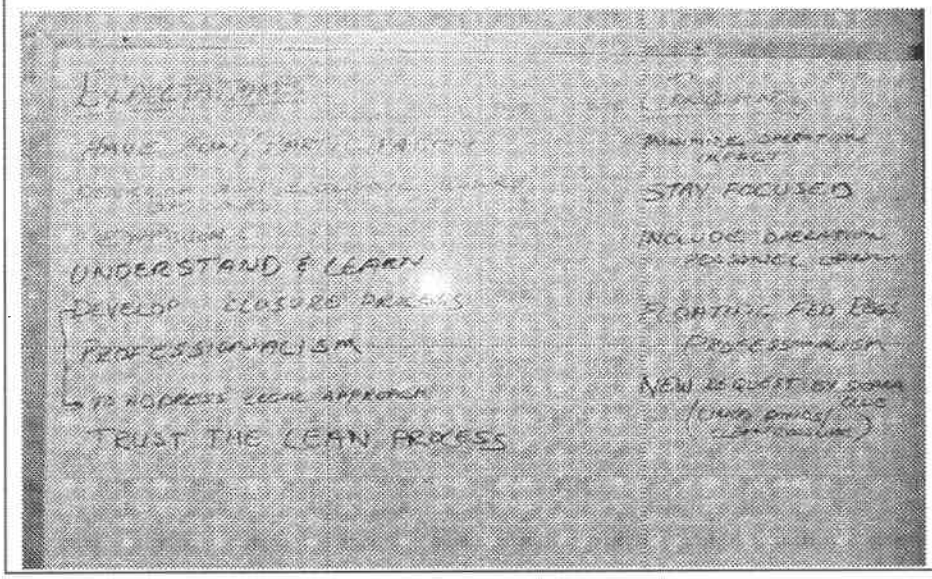
Team Expectations and Concerns



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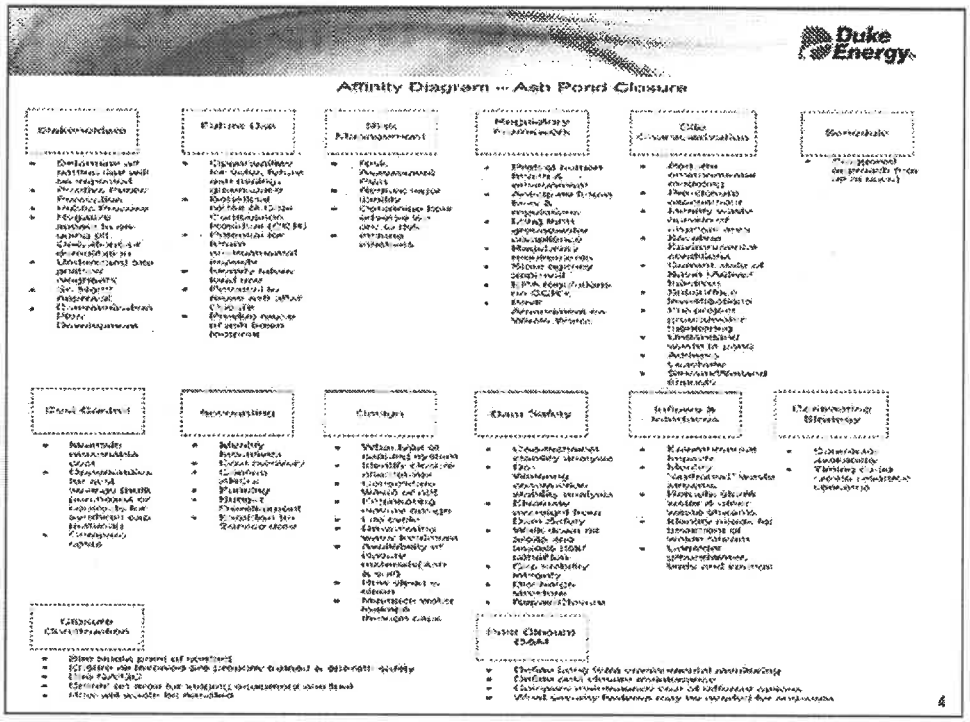

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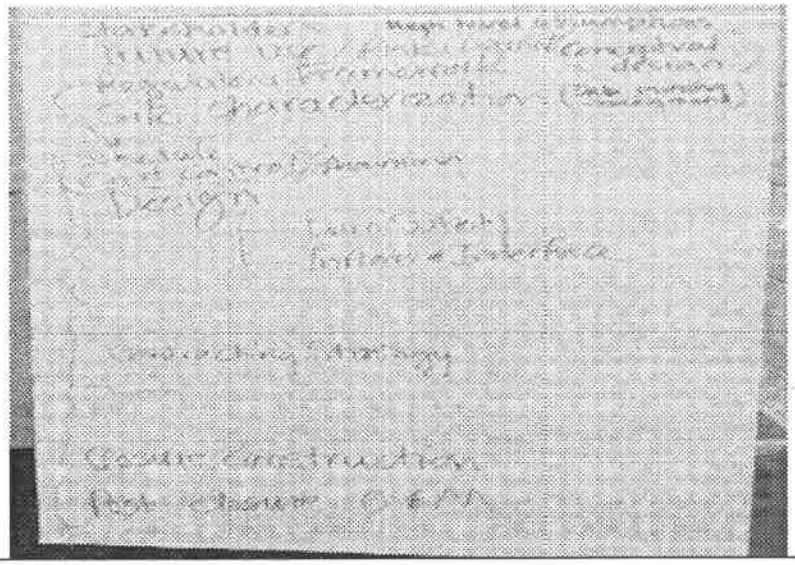
Affinity Diagram Analysis



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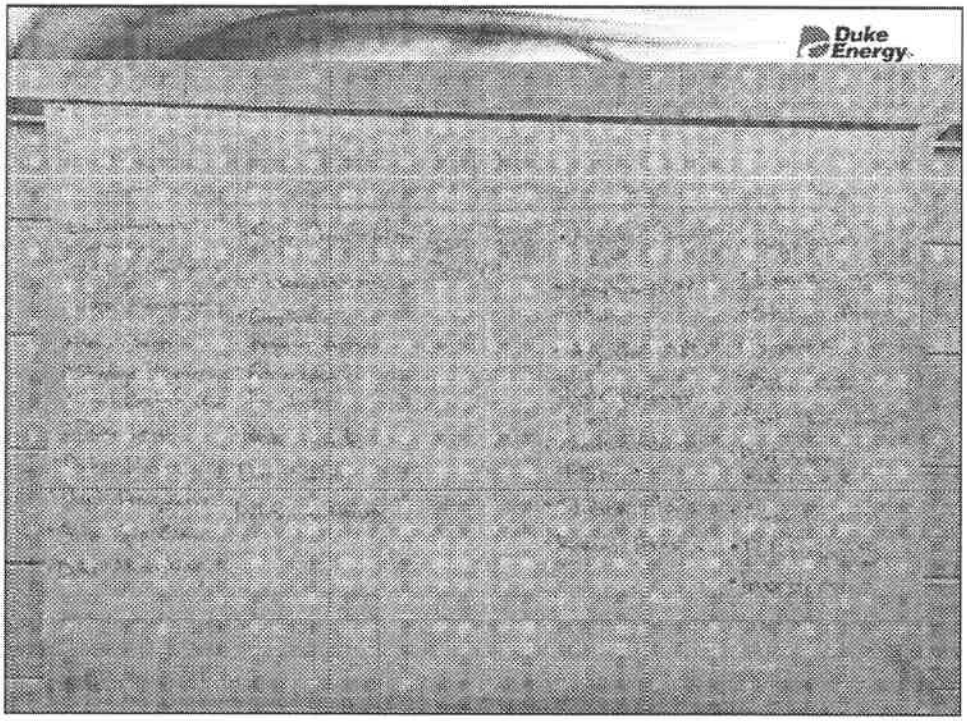

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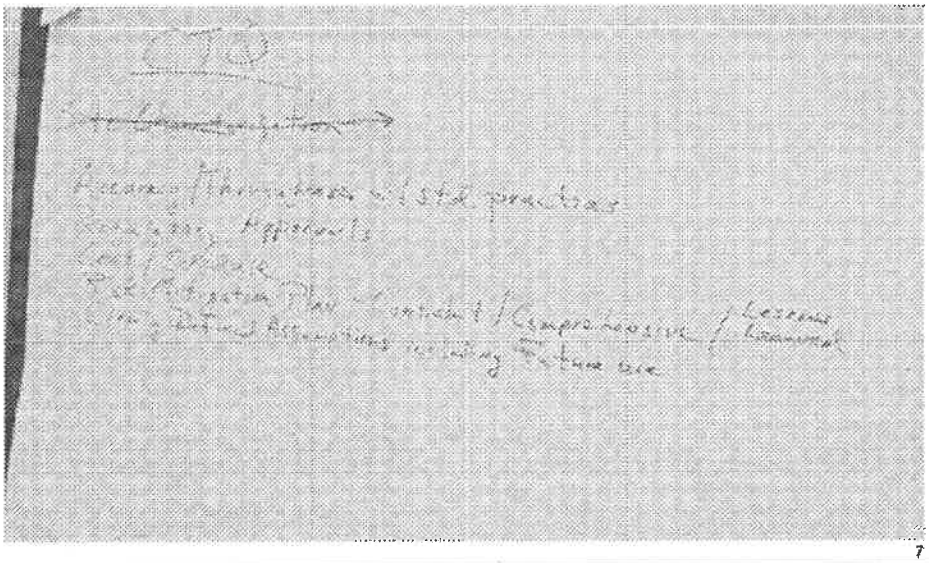
Critical to Quality Elements



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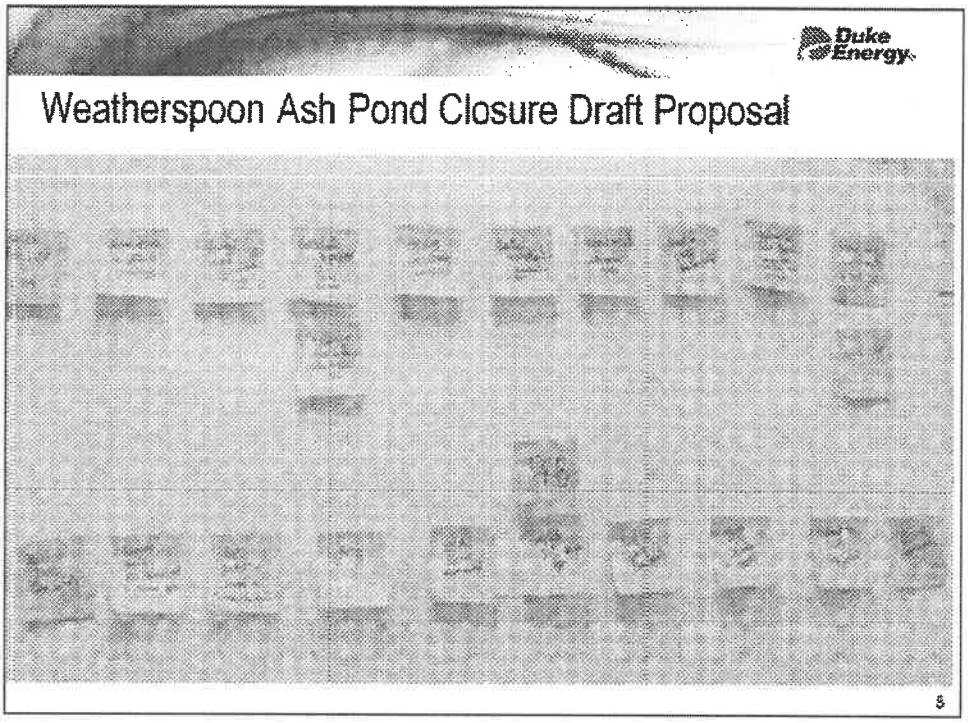

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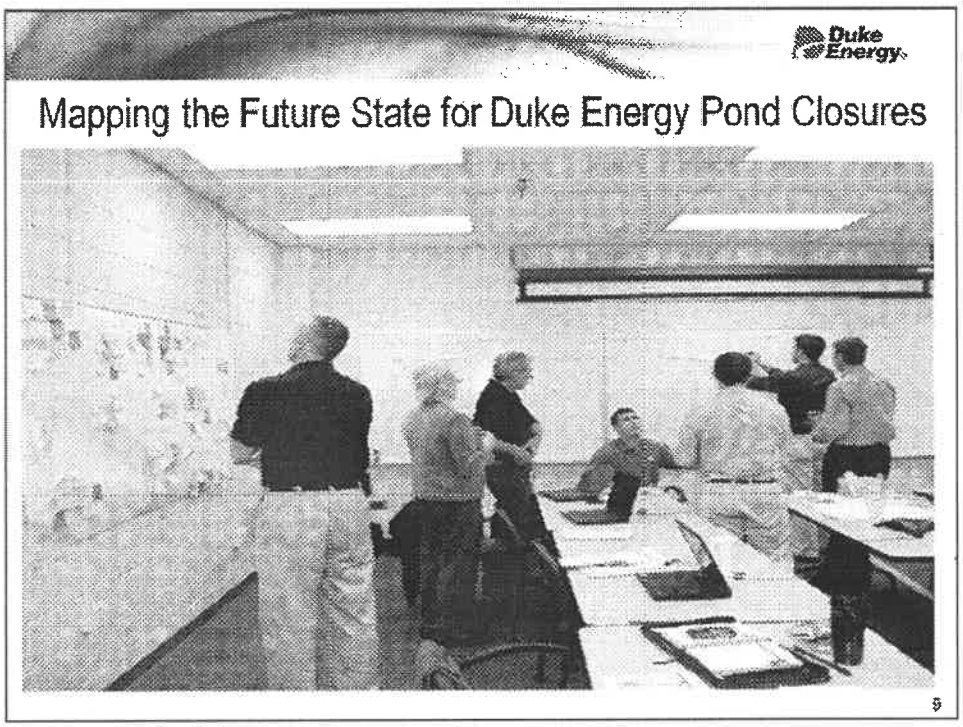

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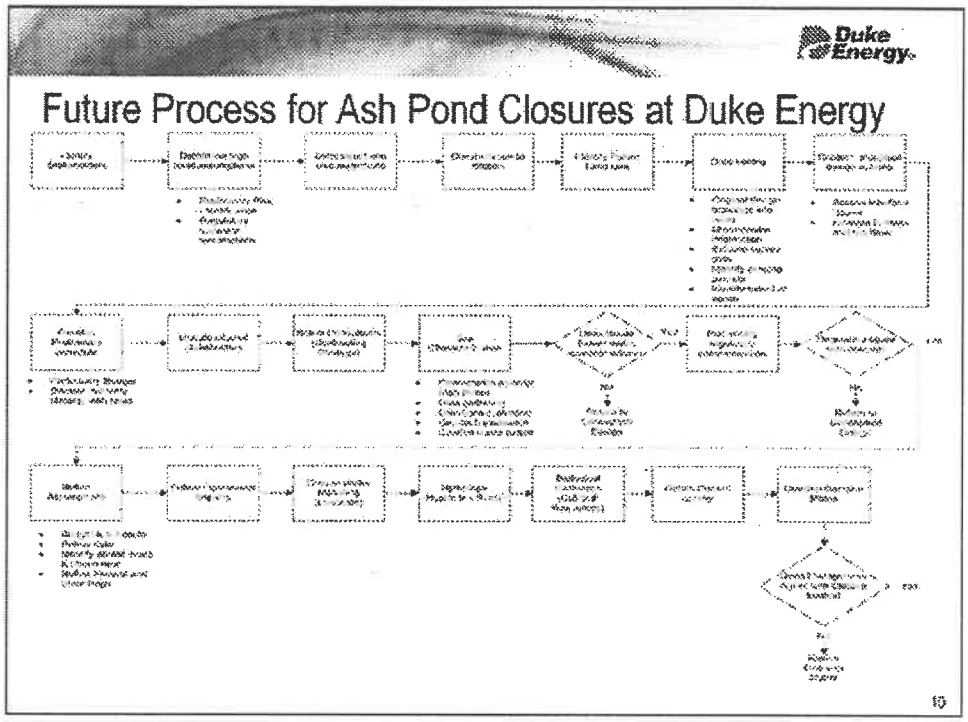

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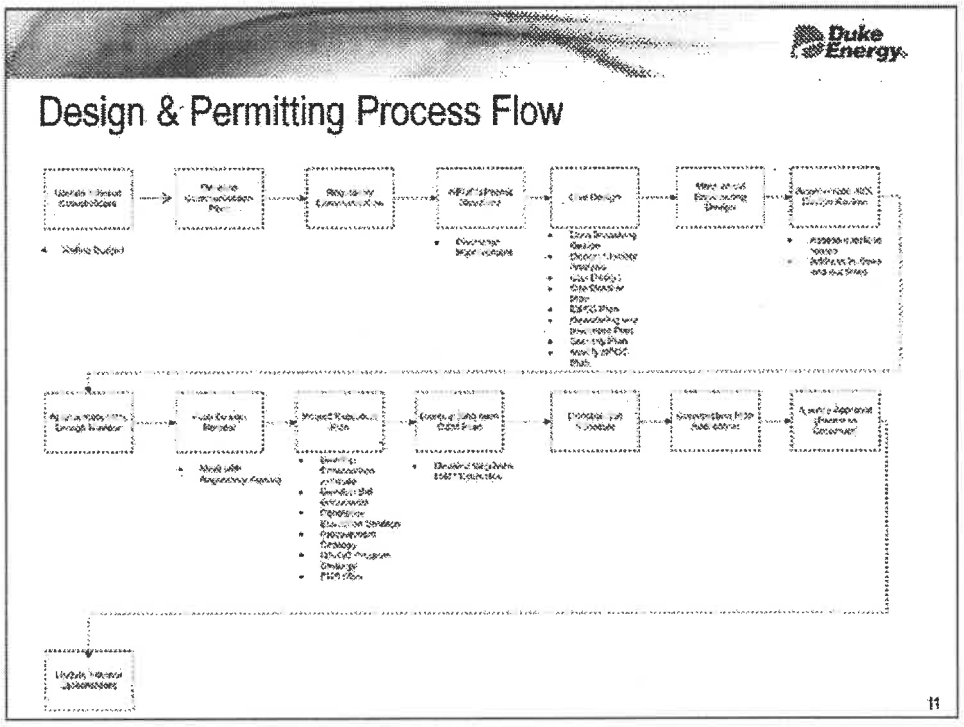

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Decision Factors

- Effectiveness – protect human health and environment
- Meets regulatory requirements
- Future regulatory risk and expected requirements
- Political risk – opportunities/threats
- Public relations risk
- Schedule-secondary factor (lower rank)
- Cost – initial, O&M (cover system life, repairability)
- Impacts on Operations
- Long-term business liability – site contamination and remediation
- Constructability – fugitive dusting, landfill availability, cover material, dewatering
- Impact on neighbors or other stakeholders
- Leachate treatment risks
- Precedent
- Future Use of the site

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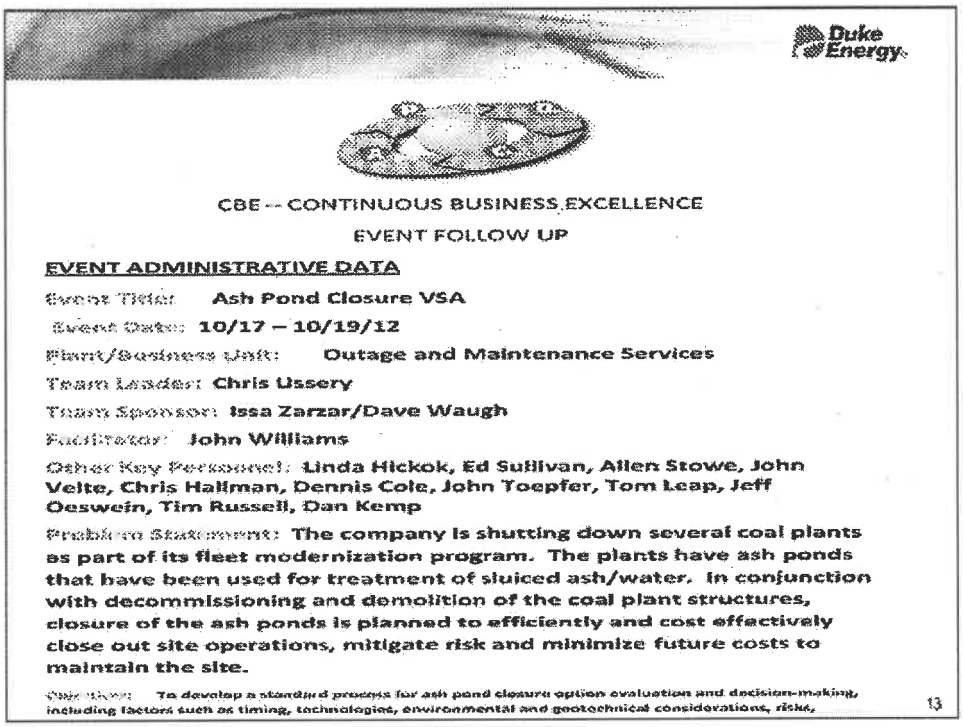

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CBE -- CONTINUOUS BUSINESS EXCELLENCE

EVENT FOLLOW UP

EVENT ADMINISTRATIVE DATA

Event Title: **Ash Pond Closure VSA**

Event Date: **10/17 – 10/19/12**

Plant/Business Unit: **Outage and Maintenance Services**

Team Leader: **Chris Ussery**

Team Sponsor: **Issa Zarzar/Dave Waugh**

Facilitator: **John Williams**

Other Key Personnel: **Linda Hickok, Ed Sullivan, Allen Stowe, John Velte, Chris Hallman, Dennis Cole, John Toepfer, Tom Leap, Jeff Oeswein, Tim Russell, Dan Kemp**

Problem Statement: **The company is shutting down several coal plants as part of its fleet modernization program. The plants have ash ponds that have been used for treatment of sluiced ash/water. In conjunction with decommissioning and demolition of the coal plant structures, closure of the ash ponds is planned to efficiently and cost effectively close out site operations, mitigate risk and minimize future costs to maintain the site.**

Goal Statement: ***To develop a standard process for ash pond closure option evaluation and decision-making, including factors such as timing, technologies, environmental and geotechnical considerations, risks,***

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PDCA con't

Use organized follow-up activities/calls:

- **30 day follow up call – Chris Ussery**
- **60 day follow up call – Chris Ussery**
- **90 day follow up call – Chris Ussery**
- **120 day follow up call – Chris Ussery**

Summarize actual [illegible]:

-

Recommended Adjustments/Future Improvements:

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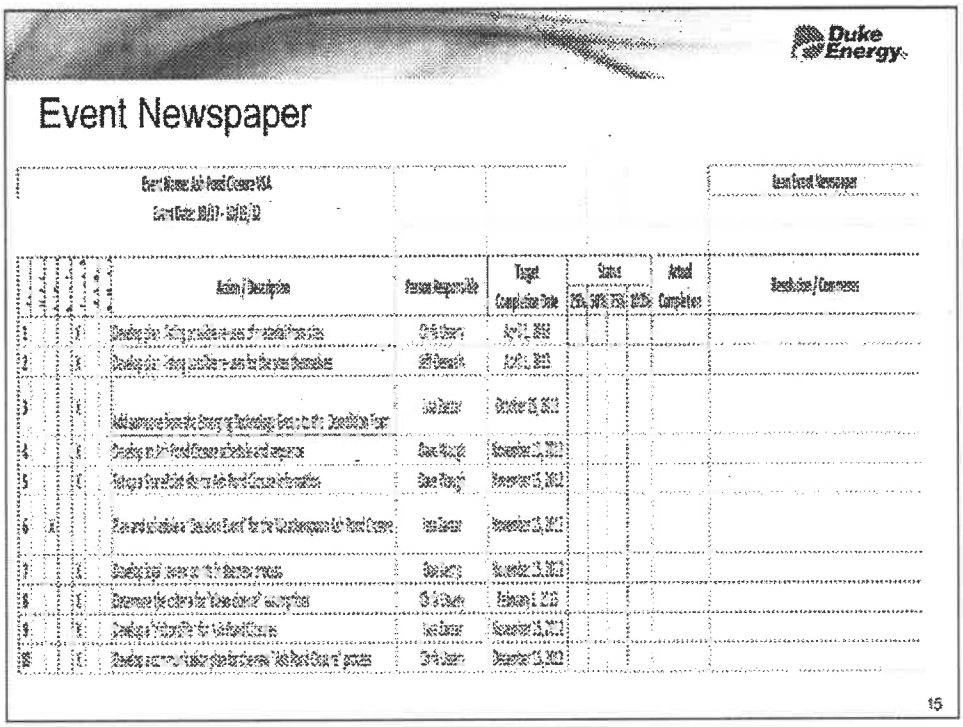

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Event Newspaper

			Action / Description	Person Responsible	Target Completion Date	Status 0% 50% 75% 100%	Actual Completion	Resolution / Comments
1		0						
2		0						
3		0						
4		0						
5		0						
6		0						
7		0						
8		0						
9		0						
10		0						

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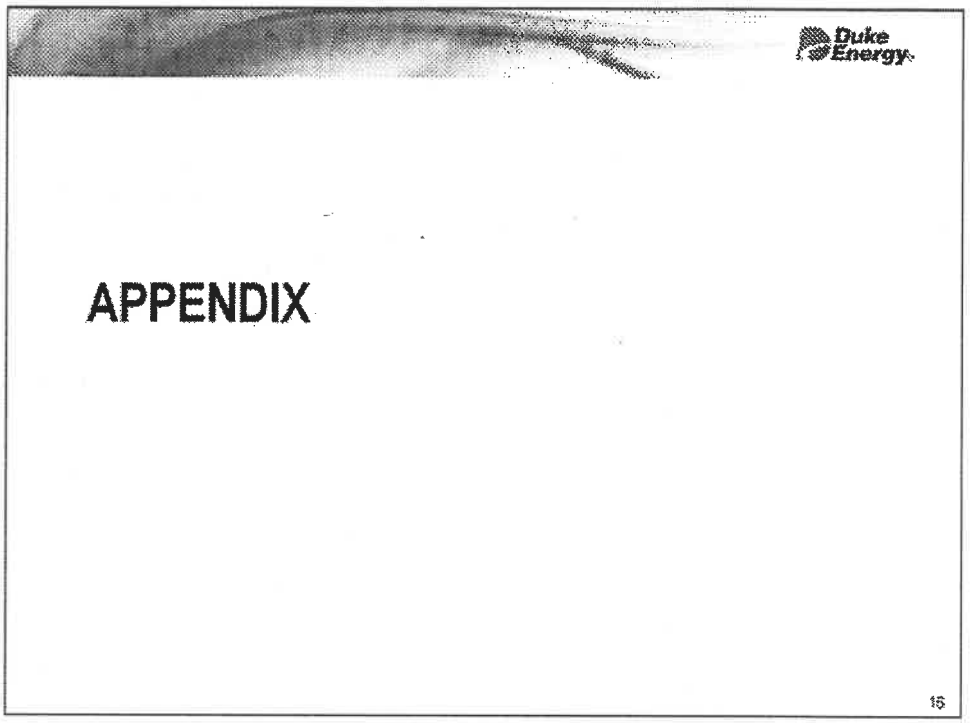

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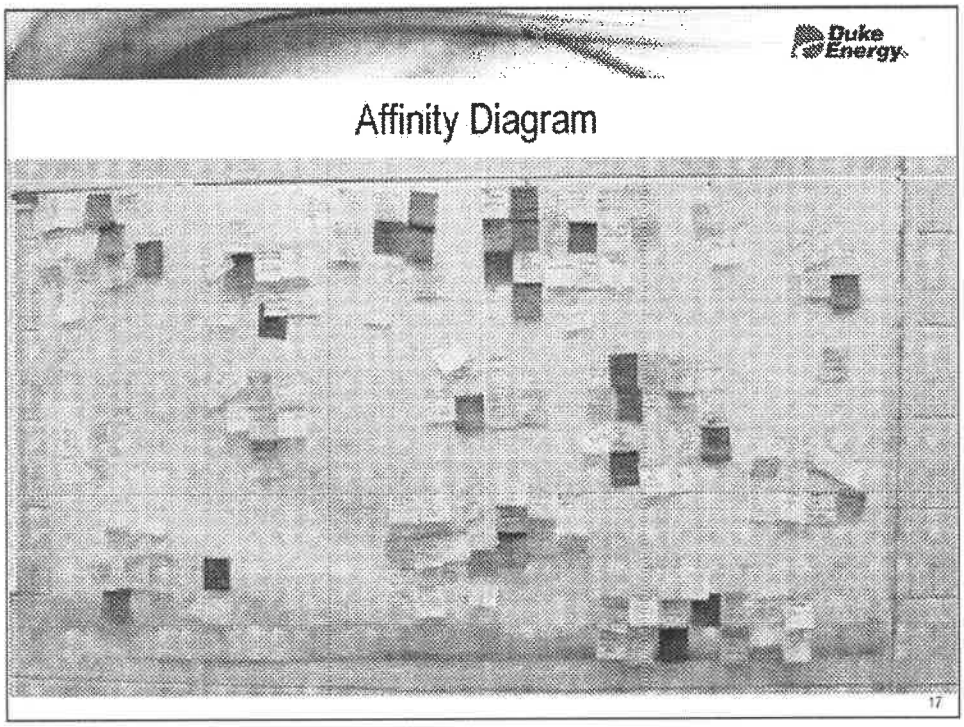

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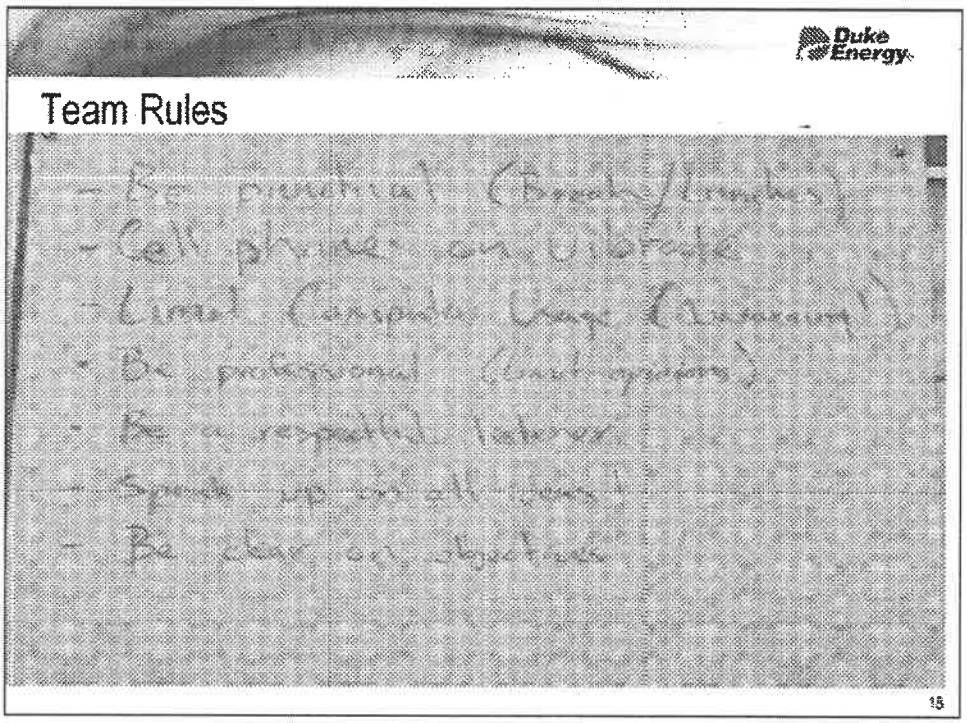

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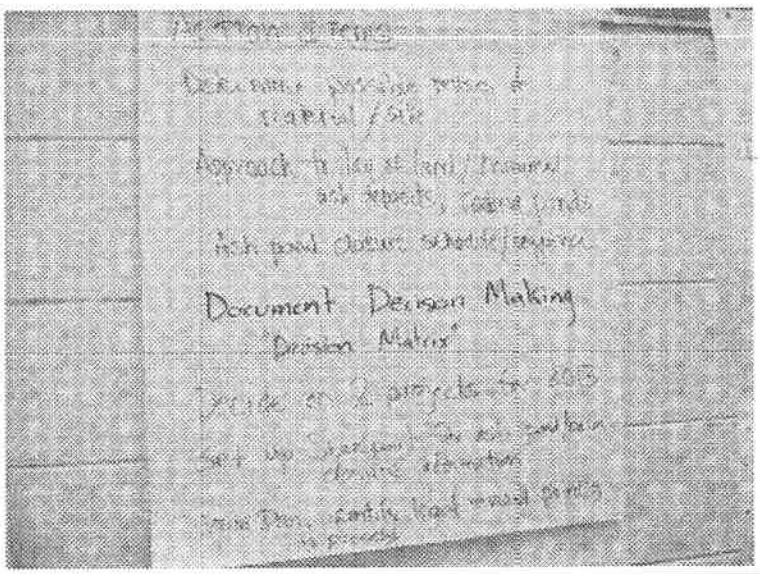
Action Items



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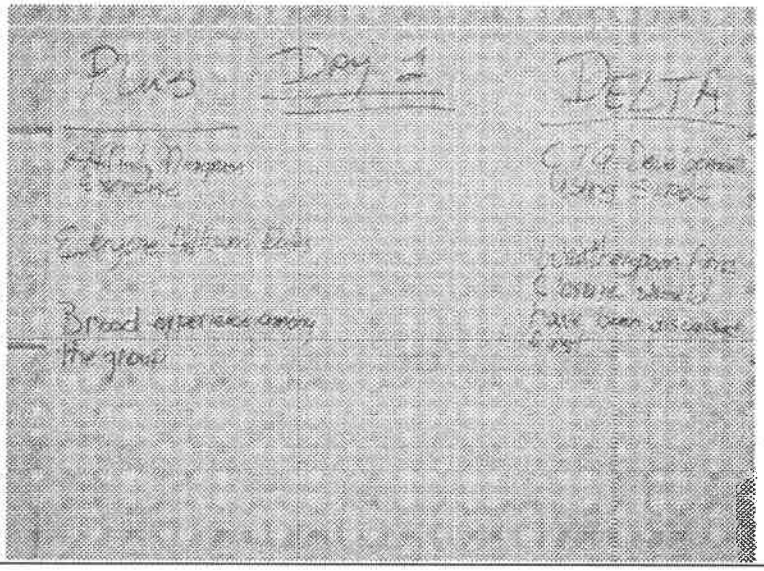
Day 1 – Plus/Delta



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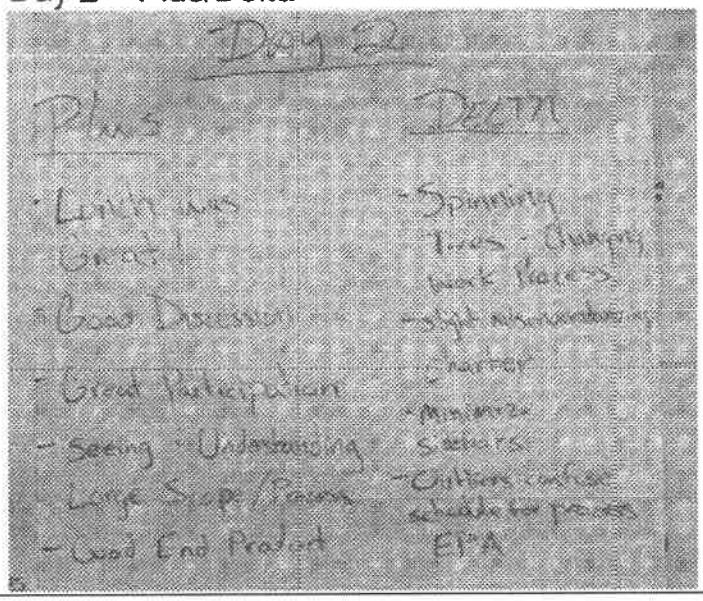
Day 2 – Plus/Delta



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C. Affinity Diagram – Ash Pond Closure (a slide from the Ash Pond Closure Value Stream Analysis presentation)

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Affinity Diagram – Ash Pond Closure

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Stakeholders

- Determine all parties that will be impacted
- Positive Public Perception
- Public Process
- Negative impact to on-going plt. Operations or demolitation
- Understand site politics/ neighbors
- Sr. Mgmt. Approval
- Communication Plan Development

Future Use

- Opportunities for solar, future ash mining, greenspace
- Beneficial reuse of Coal Combustion Residual (CCR)
- Potential for future environmental impacts
- Identify future land use
- Potential to reuse ash after closure
- Provide reuse of ash basin footprint

Risk Management

- Risk Assessment Plan
- Reduce legal liability
- Determine how adverse we are to risk
- Include Inactives

Regulatory Framework

- Protect human health & environment
- Anticipate future laws & regulations
- Long term groundwater compliance
- Regulatory requirements
- State agency approval
- EPA regulations on CCR's
- Bevil Amendment on Waste Water

Site Characterization

- Perform environmental modeling
- Pre-closure assessment
- Identify waste outside of disposal area
- Baseline Environmental conditions
- Current state of Basin (Active/ Inactive)
- Subsurface investigations
- Pre-project groundwater monitoring
- Understand waste in pond
- Address Leachate
- Stream/Wetland Impacts

Schedule

- Staggered approach (not all at once)

Cost Control

- Maintain reasonable cost
- Opportunities for cost savings (bulk purchases or contracts for synthetic cap material)
- Compare costs

Accounting

- Identify Incentives
- Cost recovery
- Confirm ARO's
- Funding
- Budget Development
- Establish In-Service date

Design

- What type of capping system
- Identify closure alternatives
- Consolidate waste or not
- Engineering closure design
- Life cycle
- De-watering water treatment
- Availability of closure materials(Ash & soil)
- How clean is clean
- Minimize water leakage through caps

Dam Safety

- Geo-technical stability analysis
- De-Watering construction stability analysis
- Eliminate oversight from Dam Safety
- Walk down all areas and assess risk/ condition
- Cap stability integrity
- Discharge structure
- Repair/Closure

Inflows & Interfaces

- Environmental Impacts
- Identify "orphaned" waste streams
- Reroute storm water & other waste streams
- Identify needs for treatment of waste stream
- Consider groundwater, beds and springs

Contracting Strategy

- Contractor availability
- Timing could create resource concerns

Closure Construction

- Site single point of contact
- Ensure all involved are properly trained & operate safely
- Site QA/QC
- Create an area for staging equipment and fuel
- How will waste be handled

Post Closure O&M

- Define Long term environmental monitoring
- Define post closure maintenance
- Compare maintenance cost of different options
- What security features may be needed for end-state

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D. Decommissioning Update – Environmental Issues, dated January 22, 2013

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Decommissioning Update – Environmental Issues

January 22, 2013

- Env. Issues and Risks Documents – issued for **Weatherspoon, Lee (NC), Cape Fear, Morehead City, Robinson, Dan River**; will be issued before end of January for **Cliffside** and **Buzzard Roost**. To be completed in Spring 2013 for **Riverbend** and **Buck; Sutton** and **Lee (SC)** later. Plan is to work with Env. Field Support to periodically review and update.
- All work is in Carollnas – drawing on some experience in Indiana and Florida. Future Midwest and Florida projects – not in current scope.
- Developing Environmental Appendix for the Demolition Bid Spec. Weatherspoon and Lee (NC) will be the first two sites to be bid.
- Use of painted masonry materials in demolition plans
- Guidance documents for surface soil cleanups, coal pile closures, track removal/cleanup
- Weatherspoon Cooling Pond Cleanup and Ash Pond closure; demolition could begin near end of 2Q 2013.
- Obtaining bids for assessment of Dan River and Cape Fear ash ponds. Likely to begin discussions with DENR later this year.

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NC Report – January 18, 2013

- North Carolina

The NC Environmental Management Commission (EMC) met on January 9 and 10 for their first meeting of 2013. A new member, Yvonne Bailey from Martin and Marietta, was sworn in to take the seat on the Commission reserved for a representative from a manufacturing company in NC. There are three items on the full Commission agenda of interest to Duke Energy:

1. The full EMC rejected the recommendation of their hearing officer on a proposed change to the method of setting groundwater standards. The Commission approved a staff supported view of the rule change which is consistent with Duke Energy comments in the hearing record.
2. The EMC delayed adoption of the methodology proposed by the Division of Water Quality for establishing impaired waters for 2014. Duke will be invited to participate in a working group to modify the process and return to the EMC in March..

An initial meeting January 17 with DENR senior staff has identified several options to reduce the costs associated with demolition plans for retiring coal plants. The basic concepts should dramatically reduce the amount of construction debris that would have to be taken to a landfill. There are considerable costs saving for any material that can be disposed of onsite and avoid transportation and tipping fees at a landfill. At least two options were identified that could allow demolition and use of the debris as fill material on site without need for a permit. A follow-up meeting will include representatives of Environmental Services and Waste Management staff to reach agreement on testing protocols for the material.

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E. Ash Basin Closure Strategy, undated

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Ash Basin Closure Strategy

Recently the Company has retired designated fossil units in NC while their associated ash basins continue to remain active for a period. In some cases, waste streams other than ash (e.g., coal pile run-off, drains, etc.) will need to continue to be transported to the ash basins for treatment until those plant support systems can be decommissioned fully. Currently federal regulatory programs do not specifically address the decommissioning and closure of ash basins; however, state regulations provide some options for closure framework. The company is working closely with NCDENR to define a closure process that provides a framework for certainty in the absence of specific federal regulatory requirements.

It is important for the corporation to move forward with ash basin closures under the process to be submitted to NCDENR, to minimize environmental risks and costs (mostly O&M) associated with maintaining ash basins for an extended period until federal rulemakings are complete and final. Other timing considerations include:

1. Ash basin closures can take years to complete so beginning the process is important.
2. While a final federal coal combustion residuals (CCR) rule is not expected before 2014, and lack of a federal ruling introduces an element of uncertainty, state requirements exist now. There is reasonable belief with internal company experts that any federal rule would be based on Subtitle D requirements to be implemented by the states.
3. Until the ash basin is dewatered, the NPDES permit must be maintained, or possibly renewed in certain cases, thus opening the renewal process to regulatory and greater public scrutiny (including public comments supporting clean closure). O&M Costs would continue to accumulate especially while the permit is active.
4. Dewatering the ash basins in accordance with the NPDES permit will over a relatively brief time reduce and/or eliminate seepage which the company is currently addressing.
5. Shaping and capping the ash basins soon after dewatering will help address possible dusting issues. Other dusting measures during dewatering will be needed.
6. Capping the basins soon will help begin the process of natural attenuation or other means to reduce constituents in groundwater. Constituent levels monitored in groundwater wells can take many years to observe substantial reductions.
7. Ash basin closure has recently seen increased attention and scrutiny and that scrutiny can only be expected to increase while the ash basins have no approved closure plan and reasonable efforts to close them are not underway.

To address these concerns representatives from Environmental, Strategic Engineering, and Plant Demolition conducted a Value Stream Analysis in 2012 to develop a standard process for ash basin closure option evaluation and decision-making, including factors such as timing, technologies, environmental and geotechnical considerations, risks, resources, and costs. The team developed a combined company ash basin closure process, which was analyzed using the Weatherspoon site. The team then completed a Kepner-Tregoe problem solving/decision analysis to determine the best closure design options for the Weatherspoon ash basin closure using site scoping information already collected.

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While the site conditions supported a simple soil cover in earlier analysis, the K-T analysis considered other factors including environmental protection, long-term maintenance costs, public perception and risk minimization, and concluded that an HDPE geo-synthetic cap system would be the best solution for Weatherspoon ash basin closure.

The recommended strategy is to dewater, cap the Weatherspoon ash basin, and monitor. The ash basin strategy does not address lay-of land ash disposal areas such as landfills and possibly other historic ash placements. An engineering design is currently being performed for ash basin closure at Weatherspoon based on the recommended strategy. The conceptual design was utilized to further define scope, cost, and schedule of ash basin closures. This design will be submitted to NCDENR in May 2013, expecting final approval in July 2013.

Once NCDENR approval is received, the team recommends closure of the Weatherspoon ash basin for the following reasons.

1. This closure strategy process and NCDENR approval will establish precedent with the state on the method for future ash basin closure.
2. The Weatherspoon ash basin is one of the simplest and smallest basins on the system. Cost for closure is estimated to be approximately $18 - $34 million. It will provide a useful test case for lessons learned that can be applied to future closures.
3. Defining future costs for closure is critical to estimating liabilities for corporate reporting.
4. While the federal Coal Combustion Residual (CCR) rule has not yet been finalized, EPA's current thinking, based on recent agency comments, is that regulation of CCR disposal under RCRA Subtitle D may be "adequate".
5. It is anticipated that final CCR regulations requiring ash basin closure will be finalized no earlier than 2014. Assuming a Subtitle D rule contemplated by federal legislative efforts, state rulemaking will be initiated to create the framework for state implementation of the federal program. Duke Energy's retired plants in the Carolinas have at least 20 ash basins that will need to be closed. It is important that the corporation be proactive in developing the expertise in closure methods and have the qualified contractors on board to help meet this challenge.
6. The Plant Demolition and Retirement team includes individuals who are capable of performing the work utilizing trained fuel handling operators and existing equipment for basin grading. The project will be supplemented with engineering, QA and liner/specialty contractors. Future ash basin closures will be managed similarly to Weatherspoon. However, grading services may be contracted depending on in-house resource availability.

Current activities include budget development with Strategic Engineering and Cape Fear, Dan River, Lee (NC), and Buck ash basins site characterization studies.

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Appendices

O&M Cost Reduction:

Anticipated ongoing O&M work for retired facilities include:

1. Inspections
2. Dike maintenance (Mowing slopes, brush cutting, toe ditch and interior slope maintenance)
3. Fugitive dust mitigation
4. Repairs as needed (reseeding, runoff, animal burrow)

Anticipated cost per site is $50K-$150k

Support for the Process of natural attenuation caused by capping:

Attached are selected pages from the most recent groundwater monitoring report conducted by Blackrock Engineers for the Roxboro landfill. Note highlighted discussion from a couple of sections of the report regarding the downward trend in contaminant concentrations and the fact that the lined landfill is partially intended to minimize recharge and thus allow for concentration reduction to occur which is happening. Following the text is a series of graphs that support the generally downward concentration trend.

Roxboro Landfill
Groundwater Data Tr

Capital cost bases:

The range provided for closure is based on $18 million closure estimate based on Belews Creek ash land fill closure and $34 million estimate from Strategic Engineering.

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F. Demolition and Plant Retirement presentation given by Issa Zarzar, dated February 16, 2013

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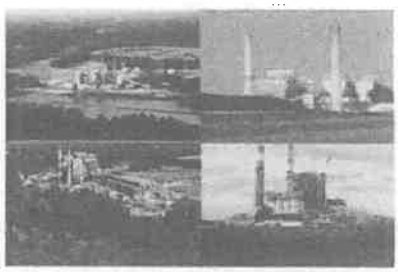
Demolition and Plant Retirement PMT

Issa Zarzar



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Agenda

- 3:00 – 3:15 Safety
- 3:15 – 3:45 Overall Program Update
  - Program Safety Update
  - Financial Update
  - Ash Pond Update
- 3:45 – 4:45 Site Specific Updates
- 4:45 – 5:00 Action Items & Roundtable
  - Legacy Duke Budget Approval
  - Review Open Action Items

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Program Safety Update

- Chargeable injuries
  - Edwardsport Contractor Fall Injury
- First Aids
  - Debris in contractor eye at WSPN
- Near Misses
  - Tree clearing activities at CF. Tree limb fell on active line
  - Fender damage on Lowboy while moving ash pond equipment
- Developed generic orientation program, emergency plan, and contractor monthly safety reporting documents
- Will be adding an additional contract safety specialist for support of legacy Duke sites

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Edwardsport Contractor Injury

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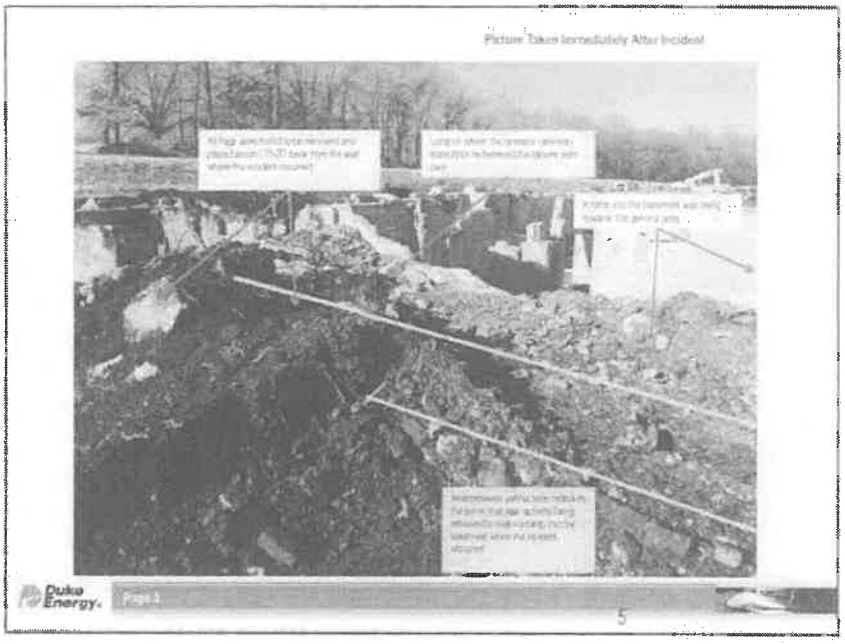

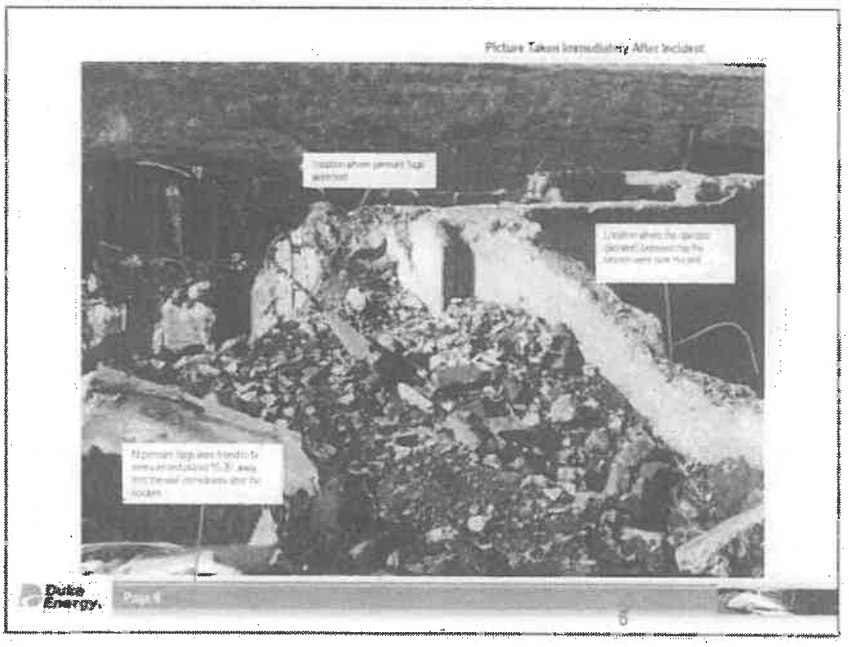

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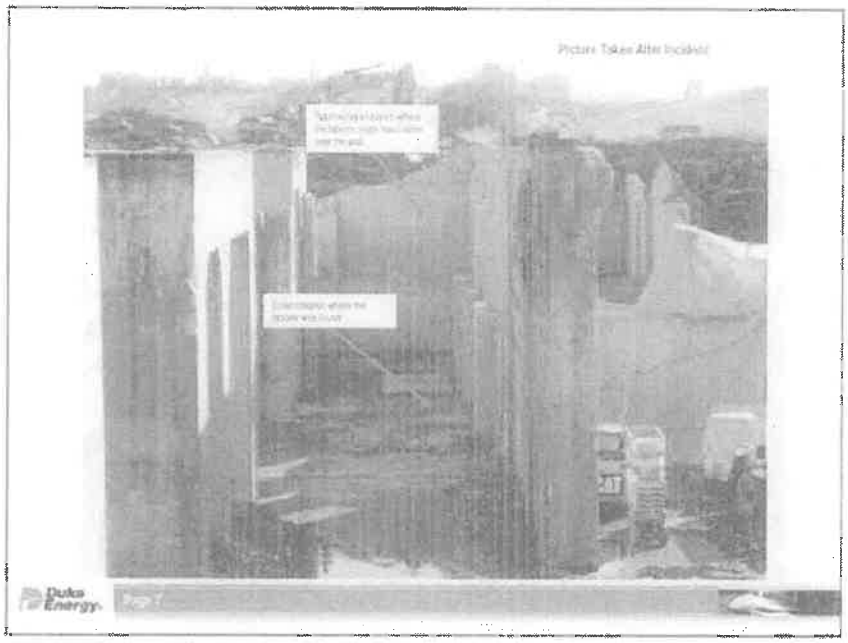

Safety Update

- Root Causes:
  - Employee either failed to recognize, or ignored a fall hazard.
  - Employee did not have proper fall protection equipment to complete the task.
  - Employee did not have proper tools to complete the task (ex. tool to cut flags).
  - Improper oversight of new employee?
- Corrective Actions:
  - Retrain all Brandenburg personnel fall hazard recognition, fall protection equipment, etc.
  - Having Brandenburg reevaluate the ways in which new workers are accounted for while working on site?
- Lessons Learned:
  - Special attention must be given to new personnel.
  - Demolition activities can often create unique hazards.

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Plant Update – Equipment Sales

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PROGRAM EQUIPMENT SALES

- 2012 Program Equipment Sales - $385,132
  - $256,920 – Weatherspoon Total Sales
    - Transformer - $120,945
    - Safety Valves - $29,750
  - $65,790 – Cape Fear Total Sales
    - Allis-Chalmers Pump - $24,000
    - Motor, 1100 HP TECO - $10,000
  - $62,422 – Lee Total Sales
    - Recovery Seeker - $48,620
- 2013 Expected Program Sales - $245,000
  - Weatherspoon Transformer - $120,000
  - Lee and Cape Fear Safety Valves - $100,000
  - Cape Fear Water Treatment - $25,000

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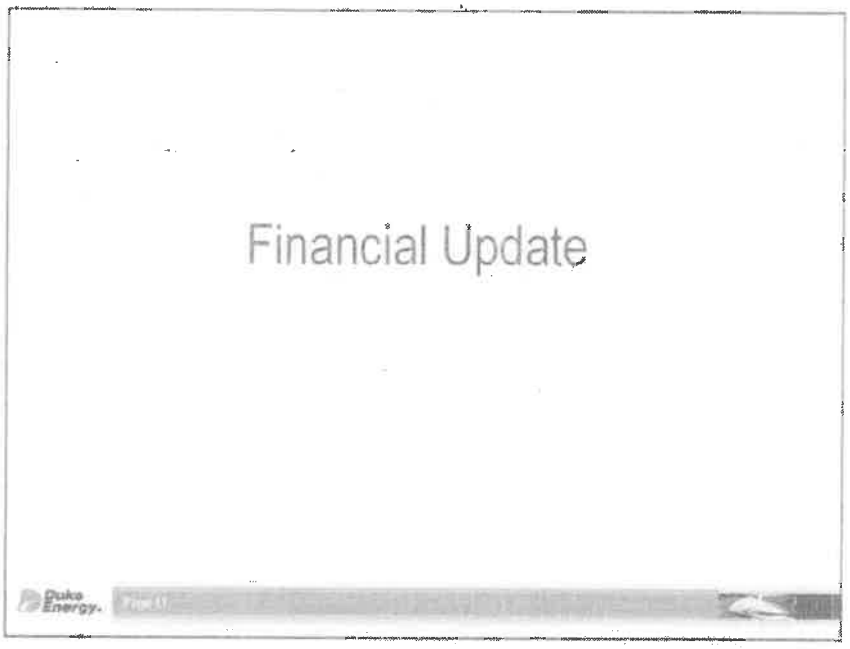

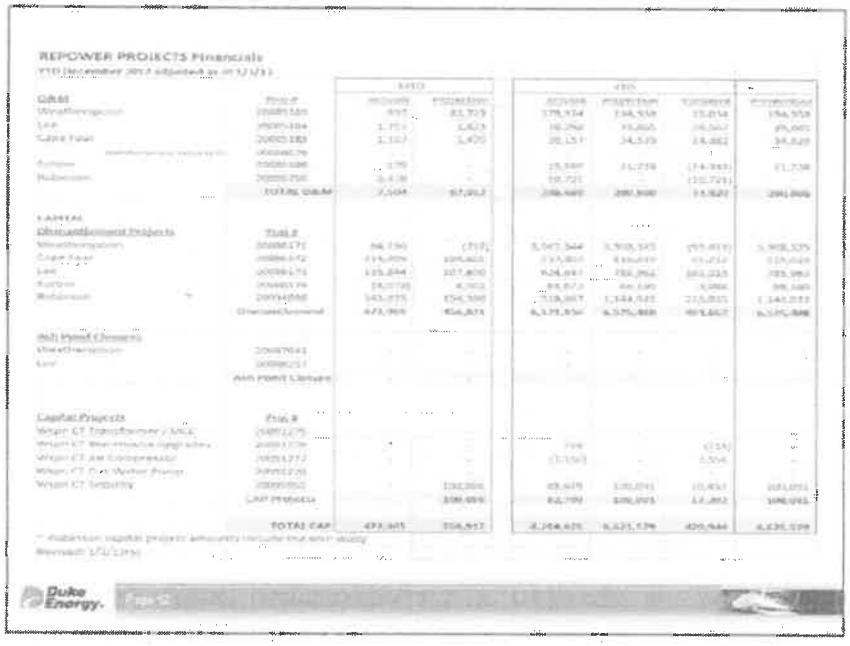

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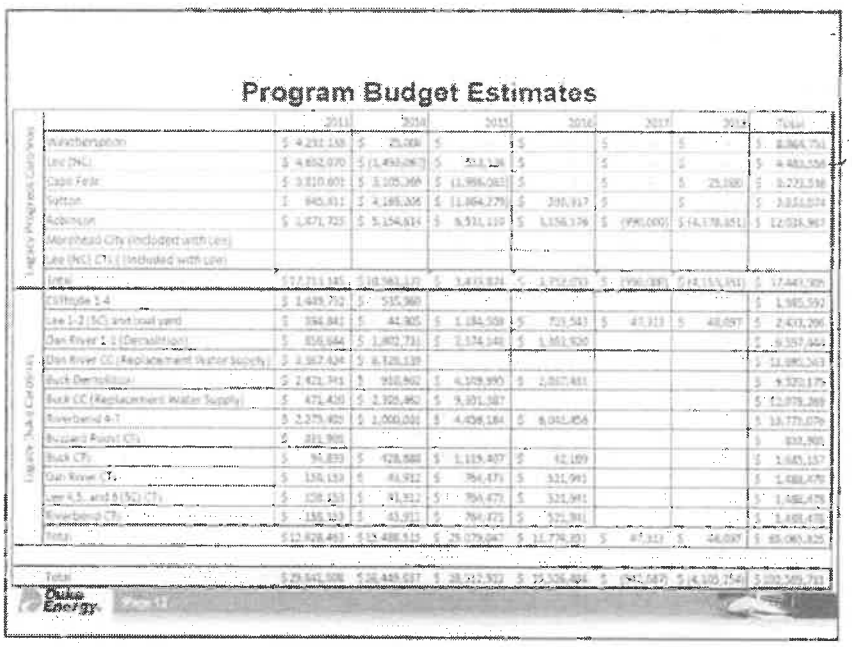

Program Budget Estimates

	2013	2014	2015	2016	2017	2018	2019	Total
Legacy Progress Projects								
Weatherspoon	$ 4,232,139	$ 25,000	$ -	$ -	$ -	$ -		$ 8,864,750
Lee (NC)	$ 4,802,070	$ (1,490,067)	$ 513,128	$ -	$ -	$ -		$ 4,483,556
Cape Fear	$ 3,810,601	$ 3,105,269	$ 11,996,043	$ -	$ -	$ 25,000		$ 3,721,536
Sutton	$ 845,931	$ 4,185,206	$ 11,864,279	$ 291,917	$ -	$ -		$ 3,013,073
Robinson	$ 1,471,725	$ 5,154,614	$ 8,531,119	$ 3,156,176	$ (990,000)	$ (4,178,351)		$ 12,035,961
Morehead City (included with Lee)								
Lee (NC) CTs (included with Lee)								
Total	$ 15,162,466	$ 10,980,022	$ 33,904,569	$ 3,448,093	$ (990,000)	$ (4,153,351)		$ 32,149,876
Legacy Ash Closure								
Cliffside 1-4	$ 1,449,792	$ 535,960						$ 1,985,752
Lee 1-2 (SC) and coal yard	$ 884,841	$ 44,905	$ 1,184,559	$ 723,543	$ 47,313	$ 48,097		$ 2,933,258
Dan River 1-2 (Demolition)	$ 856,664	$ 1,802,731	$ 2,574,148	$ 1,302,920				$ 6,357,464
Dan River CC (Replacement Water Supply)	$ 2,367,424	$ 8,728,139						$ 11,095,563
Buck Demolition	$ 2,421,341	$ 910,862	$ 4,209,995	$ 2,007,481				$ 9,320,179
Buck CC (Replacement Water Supply)	$ 471,420	$ 2,399,462	$ 9,101,387					$ 11,972,269
Riverbend 4-7	$ 2,275,402	$ 1,000,000	$ 4,498,184	$ 8,001,456				$ 15,775,042
Buzzard Point CTs	$ 331,905							$ 331,905
Buck CTs	$ 94,833	$ 428,888	$ 1,119,407	$ 42,109				$ 1,685,157
Dan River CTs	$ 156,133	$ 44,912	$ 764,473	$ 321,941				$ 1,488,479
Lee 4,5, and 6 (SC) CTs	$ 156,133	$ 44,912	$ 764,473	$ 321,941				$ 1,488,479
Riverbend CTs	$ 156,133	$ 44,912	$ 764,473	$ 321,941				$ 1,488,479
Total	$ 12,826,463	$ 15,488,515	$ 25,079,047	$ 12,774,331	$ 47,313	$ 48,097		$ 65,080,825
Total	$ 27,988,929	$ 26,469,537	$ 58,983,616	$ 16,222,424	$ (942,687)	$ (4,105,254)		$ 97,230,701

Duke Energy Page 12

Program Budget Estimates

Ash Basin Closure

	2013	2014	2015	2016	2017	2018	2019	Total
Legacy Progress								
Weatherspoon	$ 1,911,618	$ 1,140,354	$ 1,850,000	$ -	$ -	$ -	$ -	$ 7,402,225
Lee (NC)	$ 1,031,257	$ 5,167,285	$ 5,749,313	$ 10,864,190	$ 5,219,627	$ -	$ -	$ 32,951,101
Cape Fear	$ 134,217	$ 674,719	$ 3,662,624	$ 10,933,842	$ 4,065,794	$ -	$ -	$ 21,205,496
Sutton	$ -	$ 45,622	$ 379,887	$ 1,452,079	$ 5,300,000	$ 6,407,412	$ 4,250,000	$ 19,555,000
Robinson	$ -	$ 350,000	$ 767,306	$ 1,883,429	$ 4,214,317	$ 4,910,317	$ -	$ 14,009,175
Total	$ 3,077,610	$ 7,377,980	$ 12,409,130	$ 25,133,540	$ 18,799,738	$ 11,317,729	$ 4,250,000	$ 95,123,727
Legacy Ash Closure								
Lee 1-2 (SC)	$ -	$ 922,806	$ 817,448	$ 10,627,860	$ 1,899,341	$ -	$ -	$ 14,267,455
Dan River 1-2	$ 1,018,876	$ 817,448	$ 14,437,282	$ 1,099,141	$ -	$ -	$ -	$ 17,372,747
Buck	$ 126,522	$ 3,223,189	$ 10,931,040	$ 29,808,251	$ 1,954,781	$ -	$ -	$ 46,043,783
Riverbend 4-7	$ -	$ 126,522	$ 1,231,160	$ 10,921,040	$ 18,196,231	$ 1,954,781	$ -	$ 32,429,734
Total	$ 1,145,398	$ 5,089,965	$ 27,416,930	$ 52,456,292	$ 22,050,353	$ 1,954,781	$ -	$ 110,113,719
Total	$ 4,223,008	$ 12,467,945	$ 39,826,060	$ 77,589,832	$ 40,850,091	$ 13,272,510	$ 4,250,000	$ 205,237,446

Legacy Progress budgets are in LRP, Dan River and Buck are in PROMET

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PGC Plant Retirement Program Financial Update

- Variance for 2012 ($421K under projections):
  - $120K Transformer sale funds received
  - $220K Nuclear study under budget
  - $ 50K Teresa Wilson fixed distribution
  - Potable water modifications were not completed in 2012
- Current Activities
  - 2013 O&M and Capital Budget Update
  - Repowering Cross Charge Projects
  - New Tasks Update
  - Project Controls Processes

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Ash Pond Update

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Ash Pond Update

- Final design and DHEC closure plans should be completed 2nd Quarter
  - S&ME currently completing design
  - Three separate submittals to DHEC: Dam Safety, Water Quality, and Erosion Control Plan
- Site investigation scopes/budgets being developed for Dan River, Cape Fear
  - Currently preparing RFP documents
- Will be performing ash pond surveys to determine acreage for estimates
- Dealing with fugitive dust issues at sites with no water flow
- Developing a program comprehensive inspection and maintenance plan

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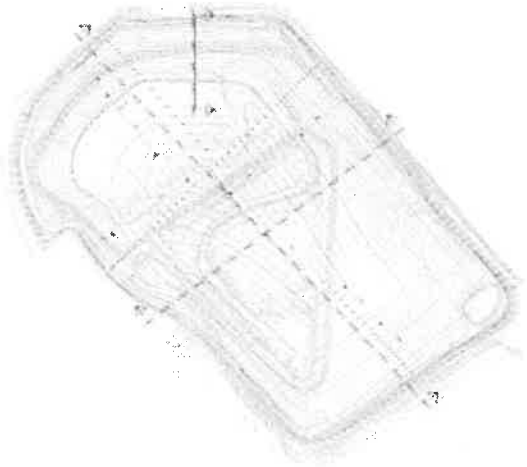
Proposed Grading Plan



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Site Specific Updates

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Duke Energy Carolinas Plant Retirement Program

Duke Carolinas sites with retired facilities or facilities planned for retirement

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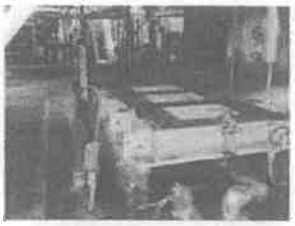
Buzzard Roost Project Update

- Achievements
  - Disconnected from 100 KV substation
  - Cataloged and redeployed all materials applicable to other sites
  - Listed all Units for sale by resource recovery
  - Purged all natural gas lines and capped from source
  - Completed asbestos and PCB inspection
- Current / Future Activities
  - Continue decommissioning activities
  - Design site final grading plan and obtain sediment and erosion control permit
  - Sale of units and equipment
  - Demolition 3rd Q. 2013

Duke Energy. Page 31

Cape Fear Project Update

- Achievements
  - Purged hydrogen & removed from site
  - Vacuumed and washed Units 5&6 boilers and precipitators
  - Removed all turbine oil from equipment and shipped off site
  - Cleaned and removed PCB tank
  - Removed all ash sluice piping and cleaned the ash ditch
- Current / Future Activities
  - Continue equipment oil draining
  - Design site final grading plan and install sediment and erosion control measures
  - Flush fuel oil tank and piping
  - Continue phase 1 of coal yard closure
  - Begin asbestos abatement 2Q. 2013



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Cliffside Project Update

- Achievements
  - Completed asbestos survey
  - Completed 80% decommissioning activities
  - Completed vacuuming activities
- Current / Future Activities
  - Continuing power delivery switchyard work
  - Continuing wash down activities
  - Design site final grading plan and obtain sediment and erosion control permit
  - Asbestos abatement and demolition 3rd Q 2013

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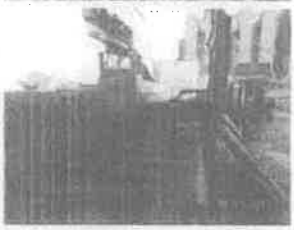
Dan River Project Update

- Achievements
  - Removed 86,000 Tons of coal
  - Repaired ash basin
  - Completed environmental issues list
  - Competed site interface agreement with CC
  - Completed vacuum and wash down
  - Completed security fence installations
- Current / Future Activities
  - Complete site asbestos survey
  - Design CC raw water reroute
  - Transfer Dan River fuel oil, acid and caustic to Lincoln CT
  - Continue oil draining, battery removal, and mercury removal
  - Design site final grading plan and obtain sediment and erosion control permit



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Edwardsport Project Update

- Achievements
  - Demolished all buildings and structures on site except for New Crib House
- Current / Future Activities
  - New Crib House demolition.
  - Power House basement lead abatement.
  - Backfill Power House basement.
  - Remediate coal yard.
  - Final site grading and closure.
  - Perform project closeout activities.

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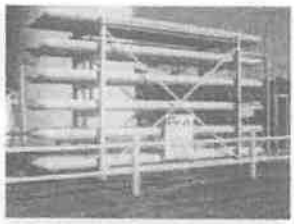
Lee (NC) Project Update

- Achievements
  - Purged all plant hydrogen systems
  - Removed plant bulk lube oil and removed 90% of ICTG bulk lube oil
  - Completed 85% oil removal from plant equipment
  - Flushed fuel oil tank and piping
  - Completed vacuuming activities
- Current / Future Activities
  - Complete construction interface activities
  - Design lake makeup water reroute
  - Transfer fuel oil from Morehead ICTG
  - Complete silo, bunker, and boiler wash
  - Begin asbestos abatement 2Q, 2013



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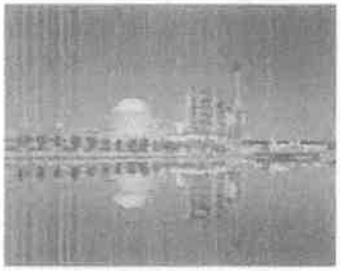
Robinson Project Update

- Achievements
  - Completed study for systems needed by Robinson Nuclear
  - Purged all hydrogen from Unit 1 systems
  - Completed washing and vacuuming
- Current / Future Activities
  - Continue decommissioning activities
  - Begin Asbestos mapping and sampling
  - Determine schedule and scope for end state of decommissioning/demolition
  - Transfer resources to nuclear
  - Coal pile area close out
  - Begin asbestos abatement 2Q, 2013



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Weatherspoon Project Update

- Achievements
  - Removed 653 Tons of asbestos
  - Disconnected U1, U2, U3 MBT & OCB's from grid
  - Modified cooling lake recirculation system
  - Sold all site transformers and removed from site
- Current / Future Activities
  - Install security fencing for existing CTs
  - Complete potable water modification for CTs
  - Move from old Admin building into double wide trailer
  - Isolate condenser tunnels
  - Design final grade plan
  - Coal yard closure
  - Begin demolition 2Q, 2013

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Decommissioning and Demolition Upcoming Major Activities

- Complete asbestos and demolition contractor evaluation (1st Q 2013)
- Complete engineering support contract evaluation (1st Q 2013)
- Begin demolition for Weatherspoon (2nd Q 2013)
- Begin asbestos abatement and demolition for Buzzard Roost and Cliffside (3rd Q 2013)
- Begin final grade engineering for Buzzard Roost, Cliffside, and Weatherspoon (2nd Q 2013)
- Continue decommissioning activities at Lee (NC), CF, and Dan River
- Continue interface projects and planning with existing CT/CC at all sites
- Begin asbestos abatement for Lee (NC) and CF (3rd Q 2013)
- Begin planning for Sutton, Buck, and Riverbend plant retirement

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Program Issues/Concerns

- Safety – Continuing to see near misses
  - Working on improving contractor safety and field oversight
- Transmission- Schedule concerns
  - Will be meeting with Caren Andrews
- Transformer Oil Leaks
  - When retiring transformers, leaks are developing
- New Challenges
  - Edwardsport – Identifying additional areas to remediate
  - Cape Fear – Units 1 through 4 boilers caving in
- Staffing
  - Buck and Riverbend
  - Project Management Support
- Nuclear
  - Robinson Unit 2 Interface

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Actions

- PMT needed action
  - Legacy Duke projects budgeted in 2013 but currently have no approved funding:
    - 2013 Expected Funding Requirements (estimated amounts)
      - $1.3M - DRCC/DRSS Decoupling engineering and partial demo
        (Full funding is expected to be $5-$7 M which should occur in 1Q14)
      - $1.5M - DRSS Decommissioning partial demo & site maintenance
        (Full funding has not been estimated in detail but is budgeted for $6.7 M total)
      - $2.0M - Buck Decommissioning lay-up, engineering, ACM/PCB survey
      - $1.0M - BKCC/BKSS Decoupling engineering and partial demo
      - $2.0M - Riverbend Decommissioning lay-up, engineering, ACM/PCB survey
- Next meeting date – February 25, 2013

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Appendix

- Program Drivers
- Program Organization
- Program Enterprise Support Matrix
- American Metal Market Steel Scrap Price Trend
- Cost Difference Between Bartow and Carolina Plants
- Program Gating Diagram
- Program Reporting and Review Process
- Reserves - Severance (For Legacy Progress Sites)
- Reserves - Inventory
- Reserves - Construction Work In Progress (CWIP)
- Proposed Plant Decommissioning Schedule
- Proposed Ash Basin Closure Schedule
- Ash Basin Closure Cost Difference
- Program Update

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Program Drivers

- Legislative and Regulatory Expectations
- Environmental Expectations
- Business Strategy – Fleet Modernization
- Recovery Mechanisms
- Initiatives and Study Projects

Program Integration

- Communication Plan
- Retirement Event Plan
- Document Disposition
- Safety Plan
- Contracting Strategy
- Ash Basin Closure Process
- Environmental Approach

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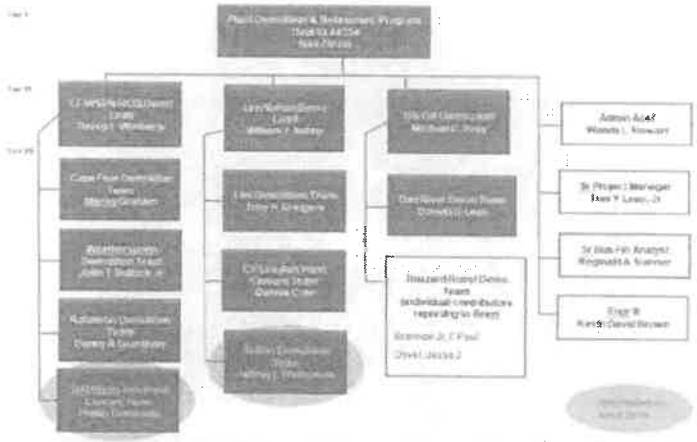
Plant Demolition and Retirement Organization



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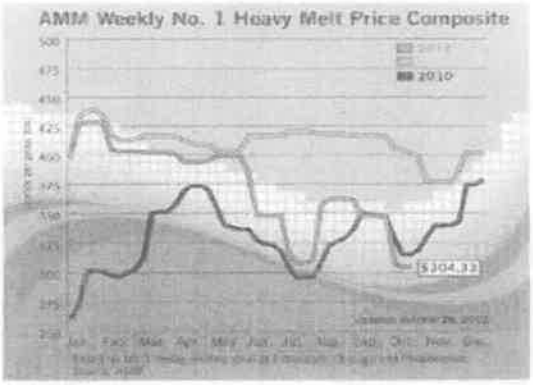
Plant Retirement Program Enterprise Support Matrix

American Metal Market Steel Scrap Price Trend



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Cost Difference Between Bartow and Carolina Plants

- Larger amounts of asbestos containing materials (specifically transite)
- Coal fired units require ash vacuuming, washing, and clinker blasting
- Coal fired units have coal storage and coal handling equipment
- Coal fired units have ash ponds
- Potential for flushed transformer PCB leachate
- Remaining CTs infrastructure isolation requirements
- Remaining CTs will require additional security measures

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Plant Retirement Program Gating Diagram

"Proposed" Gate Definitions	
Gate 0	Initiate
Gate 1	Decommission/Design Ash Pond Closure
Gate 2A	Asbestos Abatement
Gate 2B	Demolition/Site Restoration
Gate 2C	Ash Pond Closure
Gate 3	Project Close/Turnover

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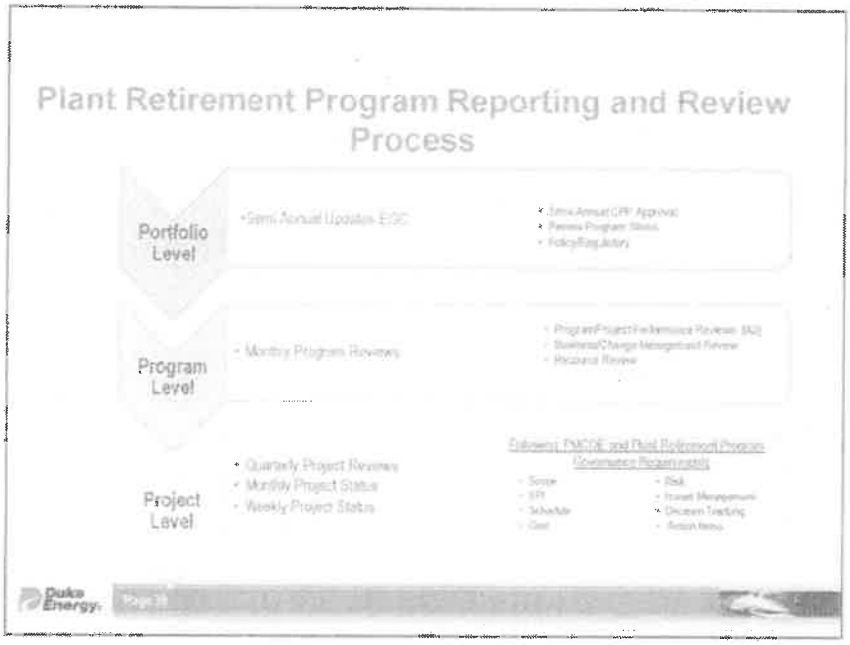

Reserves – Severance (For Legacy Progress Sites)

Plant	Severance (as of 12/31/09)	Severance (as of 3/31/11)	Severance (as of 6/30/11)	Severance (as of 9/30/11)	Severance (as of 09/30/12)
Lee	$1,414,462	$1,148,558	$1,072,606	$1,014,949	$1,538,918
Cape Fear	$2,089,730	$1,783,623	$1,949,195	$1,783,623	$2,259,999
Sutton	$2,585,113	$1,340,311	$1,232,133	$1,344,343	$2,066,760
Weatherspoon	$1,908,976	$592,500	$592,500	$575,692	$605,803
Robinson	N/A	N/A	N/A	N/A	$1,720,475
Total	$7,798,281	$4,864,991	$4,744,835	$4,718,507	$8,211,955

- Severance amounts are adjusted to reflect redeployment changes

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Reserves - Inventory

Plant	Inventory Reserve (as of 12/31/10)	Inventory (as of 12/31/10)	Inventory Reserve (as of 12/31/11)	Inventory (as of 12/31/11)	Inventory Reserve (as of 09/30/12)	Inventory (as of 09/30/12) (excluding burdens)
Lee	$4,890,000	$4,612,118	$4,890,000	$4,407,686	$4,757,432	$4,278,661
Cape Fear	$3,330,000	$3,078,941	$3,330,000	$3,066,039	$3,512,713	$3,187,580
Sutton	$6,625,000	$6,311,561	$6,625,000	$5,458,946	$7,443,152	$6,712,162
Robinson	N/A	N/A	N/A	N/A	$2,251,620	$2,009,551
Weatherspoon	$2,225,000	$1,679,641	$2,225,000	$1,581,145	N/A	N/A
Total	$17,070,000	$14,682,261	$17,070,000	$14,513,826	$17,964,917	$16,178,954

- Inventory reviews are being conducted quarterly to review inventory.
- For Legacy Duke sites, Dan River, Buzzard Roost, and Cliffside 1-4 are written off.
- River Bend ($3.4M), Lee SC ($4 M), and Buck ($3 M)

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Reserves - Construction Work In Progress (CWIP)

Plant	CWIP Projects	Accounting Treatment
Lee	$92,953	Written off
Cape Fear	$486,232	Reserve
Sutton	$1,424,050	Reserve
Weatherspoon		
Total	$2,013,235	

No Change from Q3 2011

- CWIP projects were projects associated with coal combustion products (CCP) projects.
- Based on plant retirement decisions work is no longer in progress on the CCP projects associated with the impacted plants.
- Cost associated with projects listed above are Capital.
- On September 30, 2012, POG Finance completed a review of the outstanding capital projects for Lee, Cape Fear, Robinson, Sutton and Weatherspoon and it was determined that there were no additional projects to add to the above list.

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Allocated Net Book Value

Plant	Estimated Retirement	Allocated Net Book Value (Grossed up for CDR) as of 9/30/12 (in millions)
Weatherspoon Units 1-3	Retired - 10/1/2011	$15.0
Cliffside Units 1-4	Retired - 10/1/2011	$2.1
Dan River Units 1-3	Retired - 4/1/2012	$11.9
Buck Units 3 & 4	Retired - 3/15/2011	$0.0
Lee (NC) Units 1-3	6/30/2020	$58.7
Lee (NC) Old CTs (1c-8c)	6/30/2047	$46.0
Cape Fear 5 & 6	Retired - 10/1/2012	$46.0
Robinson Unit 1	Retired - 10/1/2012	$47.0
Buzzard Roost CTs (6-15)	6/30/2012	$0.1
Buck Old CTs (7-9)	6/30/2012	$13.5
Dan River Old CTs (4c-6c)	Retired - 4/1/2012	($0.1)
Lee (SC) Old CTs	Retired - 10/1/2012	$4.0
Riverbend Old CTs (8-11)		$0.1
Cape Fear 28 CT	Retired - 10/1/2012	$0.0
Morehead City CT	Retired - 10/1/2012	$0.0
Sutton Units 1-3	12/1/2013	$67.0
Buck Units 5 & 6	6/30/2015	$67.9
Riverbend Units 4-7	6/30/2015	$29.6
Lee (SC) 1-2 Coal Units and Material Handling	Retired - 9/15/2012	$42.0

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Proposed Plant Decommissioning Schedule

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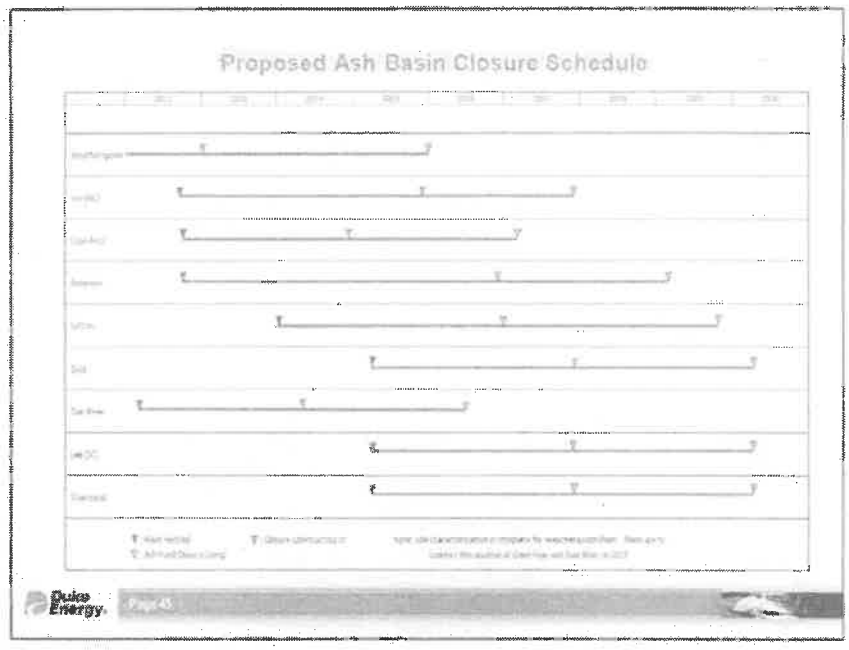

Ash Basin Closure Cost Difference

- Estimates for Progress Plants are based on high-level studies performed by Burns & McDonnell. Assumptions include a closure in place with the ponds dewatered and capped with a geo-membrane and geo-net drainage layer, 18" of soil and a vegetative cover. Estimates were made assuming station shutdown as a part of a overall decommissioning estimate for the stations (no detailed breakdown provided). B&M cost estimates range from $91,000/acre to $133,000/acre.
- Near-term estimates for Progress plants, such as Weatherspoon, assume internal workforce for closure versus the use of contractors.
- Progress plant estimates are for ash ponds only and do not include other areas where ash may be on site.

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Ash Basin Closure Cost Difference (Continued)

- Estimates for Duke Carolinas plants are high-level based on internal estimates and a quick study estimate performed by Crowder and GAI on Riverbend Station. Assumptions include a closure in place with the ponds dewatered and capped with a geo-membrane and geo-net drainage layer, 18" of soil and a 6" vegetative cover. Estimates assume Stations continue to operate where applicable and account for all known ash locations on site. Costs range from $200,000/acre to $309,000/acre depending on Station and terrain. These are best-case costs.
- Major difference between Progress and Duke estimates is the cost of maintaining sites active and the relocation of stormwater/wastewater during the closure process.
- Legacy Duke estimates constitute a range from best-case (non-hazardous, close in place) to worst case (hazardous, remove to landfill).

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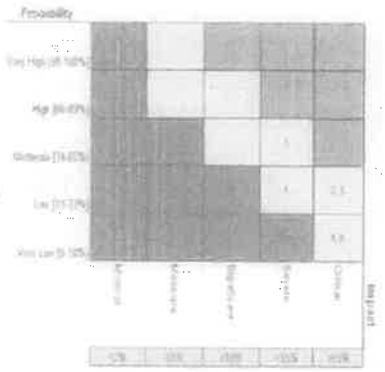
Program Risk Assessment

Program Risk

1. Investment Recovery from Scrap Metal
2. Demolition Safety
3. First Time Evolution Risk
4. Unforeseen Environmental Issues
5. Regulatory
6. Infrastructure Degradation
7. Impact of Demolition on Existing Plant/Systems
8. Program Environmental Approach
9. Asbestos Abatement
10. Site Security



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G. Slides from presentation to Regulatory Policy and Operations Committee Meeting, dated May 1, 2013

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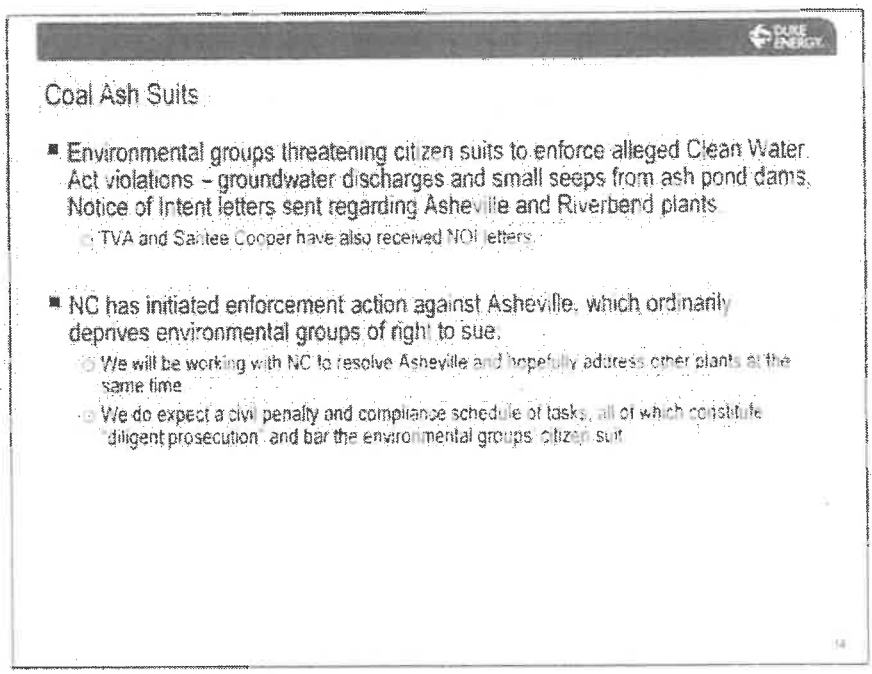

Coal Ash Suits

Environmental groups have shifted their attack on coal from air emissions to coal ash. They seek the elimination of coal as a fuel source and seek to require utilities to remove ash from existing ponds and/or line existing ponds, which would entail great expense on coal-fired power plants. As they have seen increased air regulations result in plant retirements, they want to increase compliance costs and push additional plants into retirement.

Duke received Notice of Intent letters from the Southern Environmental Law Center (SELC) regarding their intent to initiate citizens suits on behalf of their clients like the Sierra Club and local riverkeeper organizations for alleged ash related seeps and discharges from the Asheville and Riverbend coal plants in North Carolina.

In response to the notice letters, the NC Department of Environment and Natural Resources initiated civil enforcement action against the Asheville plant. The Riverbend notice letter came after the Asheville letter, but we expect NCDENR to bring civil enforcement cases for Riverbend and the remaining 12 coal-fired plants in NC. We will be negotiating terms of a consent decree, which will likely include a civil penalty and a compliance schedule, and hope to have that completed by late May.

The terms of the consent decree should constitute "diligent prosecution" by the state agency and defeat the claims for citizens suit actions by the environmental

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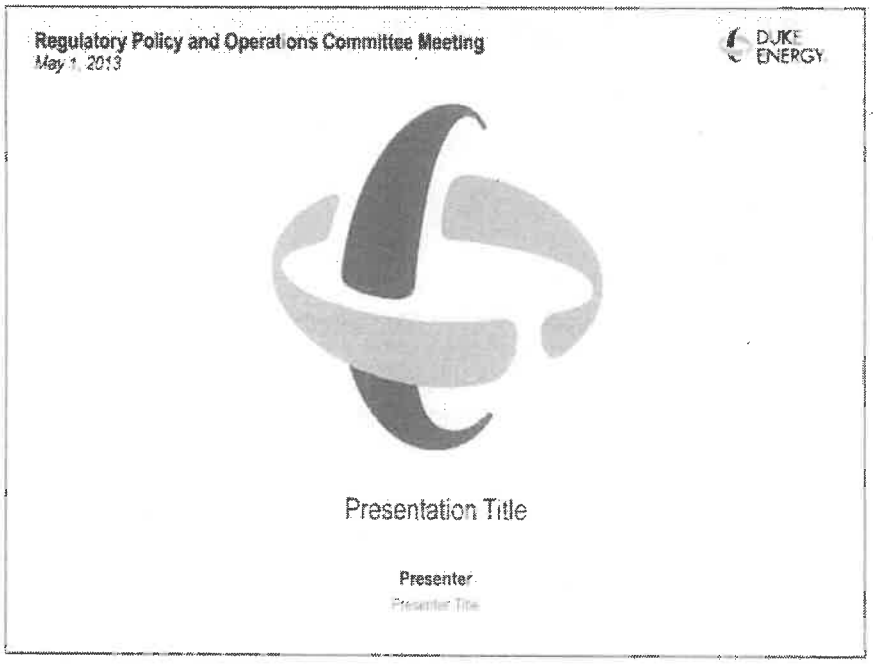

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Emerging Environmental Issues with Potential Significant Impacts

- Coal Ash – roughly half of our expected capital environmental costs in the next 10 years is related to coal ash.
  - Ash Pond Litigation
  - EPA Rulemaking
  - Legislative Action
- Steam Electric Effluent Limitation Guidelines
- Section 316(b) Cooling Water Intake Structure Rulemaking

- Notable Issues with little impact to the Company
  - CSAPR – EPA and environmental NGOs petitioning Supreme Court – doubtful the Court will consider the case. Replacement rulemaking most likely and years away.
  - Nitrogen Dioxide (NO_2) Rule – Supreme Court denied certiorari – minimal impact except in certain specific plant siting and permitting matters.
  - New Source Performance Standard (NSPS) for Carbon Dioxide/coal units – no new coal units are expected to be built.

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Coal Ash

- Environmental NGOs threatening citizen suits to enforce alleged Clean Water Act violations – groundwater discharges and small seeps from ash ponds dams. Notice of Intent letters sent re Asheville and Riverbend plants. TVA and Santee Cooper have also received NOI letters. NC has initiated enforcement action against Asheville, which ordinarily deprives NGOs of right to sue. This is a good development. We will be working with NC to resolve Asheville and hopefully address other plants at the same time. Revised permits explicitly permitting seep discharges would be a good outcome. We do expect a civil penalty and compliance schedule of tasks, all of which constitute "diligent prosecution" and bar the citizen suit.
- Meanwhile EPA has proposed a rule that would regulate coal ash either as a hazardous waste or as non-hazardous but with additional restrictions. We prefer the latter. Hazardous waste designation would halt reuse and impose onerous "cradle-to-grave" operational requirements. Many besides utilities are advocating for a non-hazardous designation. A final rule is not expected until 2014 or later.
- Congress continues to work on a legislative fix that would ensure that coal ash is not deemed a hazardous waste. However, prospects for passage and signature by the President are low.

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MATS
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Steam Electric Effluent Limitation Guidelines

- The addition of air pollution control equipment over the last 20 years has changed utility plant wastewater, adding new pollutants (contaminants removed from the air).
- Revised Effluent Limitation Guidelines would affect coal plants with wet ash sluicing systems or any with wet flue gas desulfurization scrubbers.
- Likely impacts: conversion from wet to dry fly ash and bottom ash handling systems; closure of coal ash ponds; additional treatment of scrubber wastewater; and treatment for other waste streams (boiler cleaning) that currently go to the ash ponds. Could be very similar to measures required by EPA's coal ash regulation.
- Proposed rule is expected soon.
- Final rule expected by May 22, 2014 -- EPA entered into stipulated court order.
- Compliance required by mid 2017.

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Section 316(b) Cooling Water Intake Structure Rulemaking

- Steam electric generating plants that use water for cooling (nuclear, coal, combined cycle natural gas) have intake structures that pump the water from the lake or river into the plant.
- These high capacity pumps create intake velocities that can impinge (trap) fish on intake screens and/or entrain (suck them into the cooling pipes) fish.
- Section 316(b) of the Clean Water Act is EPA's authority for placing requirements on both new and existing intake structures.
- EPA proposed a rule in April of 2011.
- Final rule is expected in June 2013, pursuant to court order.
- EPA's proposal contains four different potential outcomes.
- Worst-case outcome, which we believe is unlikely, would require installation of cooling towers and would likely result in some additional unit retirements.
- At least 18 units across the system are at risk
- The impact and outcome won't be known until the final rule is issued this summer.

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H. North Carolina Work Plan for 2013 Environmental Issues dated May 30, 2013

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Docket No. E-7, Sub 1146

North Carolina Work Plan for 2013 Environmental Issues

May 30, 2013 Update

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State Regulatory Initiatives (NC DENR and EMC)

- Asheville, Riverbend DWQ complaint/SELC intervention – ***ongoing - working group includes Legal, Environmental Services and Environmental Policy***
- EMC appointments – ***June – candidate resumes being developed in conjunction with NC Manufacturers Alliance, NC Chamber, Farm Bureau, and the NC League of Municipalities*** expire 6/30
- NPDES permit renewals – ***ongoing – Environmental Services and Environmental Policy***
- Ash pond closure plans – ***June – draft has been submitted to DWQ and it has been reviewed and returned to Duke for final comments – Environmental Services and Environmental Policy***
- Sierra Club 1-hour SO_2 modeling results, DAQ evaluation – ***ongoing – Environmental Services and Environmental Policy have discussed next steps with DAQ. DAQ will undertake some additional modeling and will consider Duke Energy comments and suggestions***
- Air toxics revisions – ***end of August – Environmental Services and Energy Policy are providing suggestions for statutory and regulatory language to the DAQ***
- Startup, shutdown, malfunction rules – ***underway with completion several years out***
- Variable operating scenarios under Title V permits – ***ongoing***
- EMC representation – ***Energy Policy attends and participates as needed in every EMC meeting***

State Legislative Agenda

- Demolition debris/inert debris – Legislation to allow manufacturing facilities, including electric generating stations, to dispose of construction debris on-site has been signed by the Governor with an ***effective date of July 1, 2013. Environmental Services, Legal, Government Affairs and Environmental Policy worked cooperatively to achieve a positive outcome.***
- Various drafts of legislative bills, and now the Senate version of the budget, include provisions that would end the terms of the current members of the Environmental Management Commission effective June 30, 2013. Duke Energy is working with other interested business groups (see above) to offer a list of qualified candidates to the Governor and House and Senate leaders for possible appointments. Under the new language, the Governor will make 9 appointments, with the House and Senate each making 3 appointments. Since the next scheduled meeting of the Commission is July 8th and 9th, ***the process will proceed quickly***.
- Compliance boundary clarification – This legislation would codify the long-standing practice of DWQ to establish compliance boundaries around waste disposal facilities. A positive outcome would potentially terminate ongoing legal hearings related to groundwater compliance issues around some of Duke Energy's ash ponds. ***Passed Senate and 1st reading in House. Government Affairs, Legal, and Environmental Policy working with DENR to get a bill approved in 2013 session.***
- Revise NC groundwater standards – this legislation will conform the NC groundwater standards with the federal Safe Drinking Water Act drinking water standards where such standards exist. It will also require the EMC to use the most recent and most relative science in establishing groundwater standards for constitutes for which no federal standard exists. ***2014 Short Session***
- Repeal the NC Environmental Policy Act of 1971 – The Act was adopted in 1971 but the environmental statutes, rules and regulations in place today preclude the value of the Act today. ***2014 Short Session***

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North Carolina Work Plan for 2013 Environmental Issues

May 30, 2013 Update

- Provide uniformity in time allowed to appeal environmental permits – Under current law, a permit holder has 30 days to appeal a permit decision. A third party has up to 60 days. Amend the law to provide uniform appeal period for all parties. ***2014 Short Session***
- Eliminate unnecessary public notice of air permits – Align the notice requirements with federal requirements. ***2014 Short Session***

Duke Internal Working Groups

- Water Steering Team – ***Tami Styre leads the team that includes staff from Government Affairs, Public Affairs, Environmental Policy, Hydro Strategy, Environmental Services, Strategic Engineering, and Legal***
- Roxboro Wastewater Evaluation Team – ***Mark McIntire leads the team that includes staff from Roxboro Station, Environmental Services, Strategic Engineering, Major Projects, and Environmental Policy***
- Nuclear Groundwater Protection Initiative – ***Team includes Environmental Services and Environmental Policy***
- Bromide Steering Team – ***Allen Stowe leads the team that includes staff from Environmental Services, Strategic Engineering, and Environmental Policy***
- NPDES Peer Group – ***John Velte leads the team that includes staff from Environmental Service and Environmental Policy***

Duke External Working Groups

- NC Chamber Environmental Committee
- Board of Directors – The Nature Conservancy
- Board of Directors – Foundation for Soil and Water Conservation
- Board of Directors – Professional Engineers of North Carolina
- Water Resources Research Institute – Technical Advisory Committee
- Water Environment Association – Government Affairs Committee
- Ecological Flows Science Advisory Board
- Air Quality Outside Involvement Group
- Carolinas Air Pollution Control Association

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I. Environmental Review Talking Points for August 27, 2013 presentation to Board of Directors

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Board of Directors
August 27, 2013
Environmental Review Talking Points

Slide 2 - Coal ash pond issue progression

- **Management of coal ash ponds** has increasingly been in the news, in the court room and on the regulatory agenda
- Scrutiny really increased after the **TVA ash dike failure in December 2008**
- **Duke Energy has properly managed coal ash ponds for decades** beginning with our water discharge permits and ash dike inspection program, and advancing to groundwater analyses, seepage reporting, and ash basin closure planning
- Duke Energy has **61 (4 inactive but not closed) unclosed ash ponds** and a combined 58 unclosed landfills and structural fills (23 active landfills, 4 active structural fills, 31 inactive structural fills)
- Landfill is disposal while structural fill has a beneficial use (e.g., plant staging area, parking lot, warehouse, etc.)
- **Now, environmental groups have expanded their "war on coal"** demanding utilities close ponds and remove ash to landfills

Slides 3 and 4 - Coal ash pond risk management

- **There are many risks associated with managing coal ash ponds** including compliance/legal, public and media scrutiny, and financial.
    - Ash Dike Stability: **inspections, repairs and addressing agency recommendations**
        - Note: hazard rating of dike (e.g., High Hazard) has nothing to do with condition of structure, only potential impacts to humans or environment if there was a failure
    - Groundwater: **Programs that guide monitoring, review of results, and actions for potential receptors**
    - Reputation: **Communications Plans**
    - Regulatory: **legislative/regulatory advocacy to avoid an unfounded and costly "hazardous waste" reclassification**
    - Retired Facilities: **closure plans and agency approval**
    - Operating Facilities: **dry fly ash conversions, scrubber wastewater treatment, and indentifying seeps to the state**
- **Proactive actions have included** funding municipal drinking water and phased closure of some ash ponds in Indiana (Gibson and Cayuga); also have an

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Board of Directors
August 27, 2013
Environmental Review Talking Points

interceptor well at Beckjord (to route GW back to permitted discharge) – no additional concerns over impacts to potential receptors at this time.

- **Indiana does not have a GW standard for boron but actions were taken for Gibson and Cayuga** based on the existence of downstream receptors and elevated boron concentrations in residential drinking water wells.
- **The Beckjord interceptor well was installed in the 1990s (and continues to operate successfully)** to prevent sulfate concentrations (secondary non-health standards) from reaching adjacent public drinking water wells.

Slide 5 - Highlighted issues

- **Allegations: Seeps are unpermitted discharges and GW violations**
  - **Seepage:**
    - **Necessary for dam structural integrity**
    - Surface flow a **collection of very small seeps**
    - Riverbend permitted ash basin **discharge flow 500 times seepage flow rate**
  - **Groundwater Standards:**
    - **Vary by state;** set to protect drinking water
    - **Can include secondary** (non health-based, such as odor or taste) such as iron, manganese and pH **and/or primary** (health-based) standards such as arsenic, chromium, selenium and thallium

Slide 6 - Seepage

- **Routinely informed the state of seeps; identified in detail** to state agencies during recent water permit renewals
- Whether seeps are unpermitted discharges is a legal interpretation for the state agency (basis for environmental group allegations)

Slide 7 - Exceedances of groundwater standards

- **Duke Energy Program**

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Board of Directors
August 27, 2013
Environmental Review Talking Points

  - **Monitoring conducted since 2007** or before
  - **Exceedances** of certain GW standards **at all ash ponds**
  - **Most sites are for secondary standards; some sites include primary standards**
  - **A few sites have possible receptors** in the vicinity of the ponds
  - **Taken corrective action at three sites** with receptors where there was a potential impact to neighbors
  - **No indication of impacts at the few other receptor sites**
  - **In NC, monitored concentrations of iron, manganese and pH (secondary standards) may be all or mostly naturally occurring in GW.**
- **State Agency Response: generally requiring monitoring and assessment**
  - State response could increase if potential groundwater impacts to drinking water supplies exist

Slide 8 - Asheville/Riverbend proposed consent decree – terms

- **NCDENR initiated litigation against Asheville and Riverbend** following NOI issued by Southern Environmental Law Center
  - **Consent decree** would resolve state enforcement litigation
  - **$99K civil penalties** ($60k Ashville, $39k Riverbend)
  - **Compliance schedule**
- **NCDENR initiated litigation against other 12 NC sites on August 16**
  - Consent decree could become model for resolving litigation
  - Duke expressed concern to NCDENR over likelihood of series of environmental group lawsuits over multiple years; NCDENR concurred once Sutton NOI was filed by SELC and decided to take action to resolve in comprehensive way

Slide 9 - Asheville/Riverbend proposed consent decree - projected costs

- **Consent Decree cost estimated $4 to 5 million** for all NC sites
- Expect the majority of the expense to be capital
- Generally within the scope of EPA's potential rules; but **timing accelerated**
- **Other NC Site Strategy: provide flexibility and Consent Decree serves as model**

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Board of Directors
August 27, 2013
Environmental Review Talking Points

- **Other State Strategy- revise the NPDES water permits** to explicitly permit the seeps

Slide 10 - Inventory of ash ponds and fills & closure costs

- **Fleet Unclosed Inventory: 4,969 acres and 200 million tons ash**
  - Order of magnitude – about 50 Bank of America Stadiums for Duke ash
- **Closure Costs:**
  - Moderate Case **(non-hazardous, cap in place): $1.5 billion**
  - Strict Case **(hazardous, clean closure): $11.5 billion (8x)**
  - Expect **recovery** of expense **through decommissioning or general rate increases; Ohio work may be non-recoverable**

Slides 11 & 12 - Pending environmental regulations

- **Summary of air, water and waste regulations** discussed in SEC Reporting and by Investor Relations
- **Coal ash outcome most influenced by Coal Combustion Residuals rule and Effluent Limitation Guidelines rule**

Slide 13 - Total environmental 10-Year capital cost forecast

- Forecast from rules in slides 11 and 12
- **Cost of new control equipment that may need to be installed on existing power plants to comply with EPA regulations could total $5 billion to $6 billion,** excluding AFUDC, over the next 10 years (Closure Active and Closure Inactive lines on table)
- Closure and other Environmental expenses on sheet are based on current understanding of final, proposed and likely rulemaking and are subject to changes based on changing rules and future decisions to upgrade existing facilities

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J. Plant Demolition and Retirement Presentation for the Executive Governance Committee, dated October 14, 2013

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DUKE ENERGY.

Plant Demolition and Retirement
Presentation For the
Executive Governance Committee

Al Smith

October 14, 2013

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Agenda

- Objectives
- Program Safety
- Governance Policy Overview
- Comprehensive Program Plan Overview
- Current Activities
- Ash Basin Closure
- Finance
- Program Issues and Concerns
- Requested Approvals
- 2014 Meetings

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Meeting Objectives

DUKE ENERGY.

- Governance Policy Approval
- 2014 Comprehensive Program Plan (CPP) Approval
- 2014 Funding Plan Approval
- Approve Weatherspoon ash basin closure and approve ash basin closure design/site characterization at various locations
- Guidance on non-regulated plant involvement
- Set 2014 Meeting Dates

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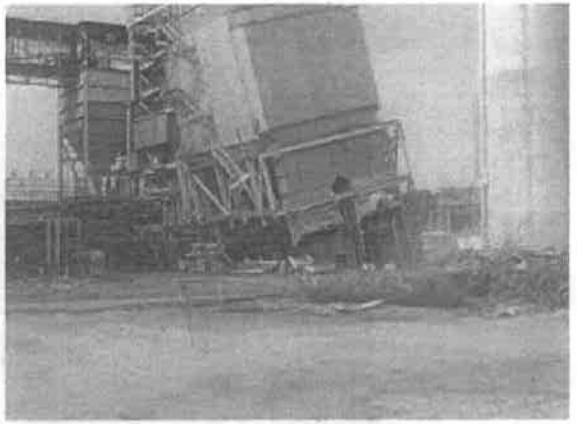
Program Safety

- YTD - no employee recordables or lost time accidents: (2) contractor recordables.
- Supporting each site with dedicated program and site safety specialist
- Utilizing program specific safety plans and pre-job briefs
- Utilizing program specific approach to infrastructure deterioration
- Performing comprehensive reviews of all equipment drop plans before activities commence
- Implementing a comprehensive security plan at each site
- Developing implosion communication plans



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Governance and Authorities

Governance Structure	Decision Authority
Executive Governance Committee (EGC)	• Approve the Comprehensive Program Plan (CPP) • Approve the Governance Policy • Charter the Program Management Team (PMT) • Approve annual program funding and commitment requests
Program Management Team (PMT)	• Manage allocation of resources within the Program • Allocate approved funding within the Program • Proposes needed changes to Program Comprehensive Program Plan (CPP)
Plant Retirement Program Project Teams	• Manage execution of projects to approved budget, scope and schedule • Escalate changes to budget, schedule and scope to PMT and EGC

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Governance Membership

DUKE ENERGY.

Executive Governance Committee

- Sponsor - Executive VP & COO, Regulated Utilities
- Chair - Vice President, Outage & Maintenance Services
- Senior Vice President, Power Generation Operations
- Vice President, Regulated Utility Financial Planning
- Vice President, Environmental Services
- Deputy General Counsel, Legal

Authorize changes of $50M of current year appropriations and $50M of future year appropriations per project (Semi-annual updates to be provided)

Program Management Team

- Sponsor – Vice President, Outage & Maintenance Services
- Chair – Director, Plant Demolition and Retirements
- Senior Vice President, Power Generation Operations
- General Manager, Plant Integration & Retirement
- Director, Power Generation Operations Finance
- Director, EHS Support
- Director of Environmental Services
- Director, Environmental, Air and Waste/CCR
- Managing Director, Fossil-Hydro Generation Supply Chain
- Associate General Counsel, Legal
- Director, Regulated Utilities and Customer Communication
- Vice President, Power Generation (one from each region)

Authorize changes of $10M of current year appropriations and $10M of future year appropriations per project (Quarterly updates to be provided)

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Program Comprehensive Plan

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Objective

The Plant Demolition and Retirement Program efforts include initiating and planning the strategy, cost estimates, and risk assessments associated with plant decommissioning and demolition, performing decommissioning and demolition of the units (existing components, equipment and structures) to grade-level and closing the ash basins at designated sites and future sites as required.

Strategy	• Decommission site to a safe and environmentally neutral state • Demolition site to grade-level with no sale of sites • Bundle approach for Asbestos Abatement and Demolition and Engineering • Cap and monitor ash basins
Approach	• Minimize environmental risks including permit strategy • Market inventory & assets internally and externally • Sell scrap metal • Self perform/manage contracting strategy (Following PMCoE procedures)
Equipment Configuration	• Maintain CT / CC operation where applicable • Maintain intake structures where applicable • Maintain switchyard operations • Document final site disposition

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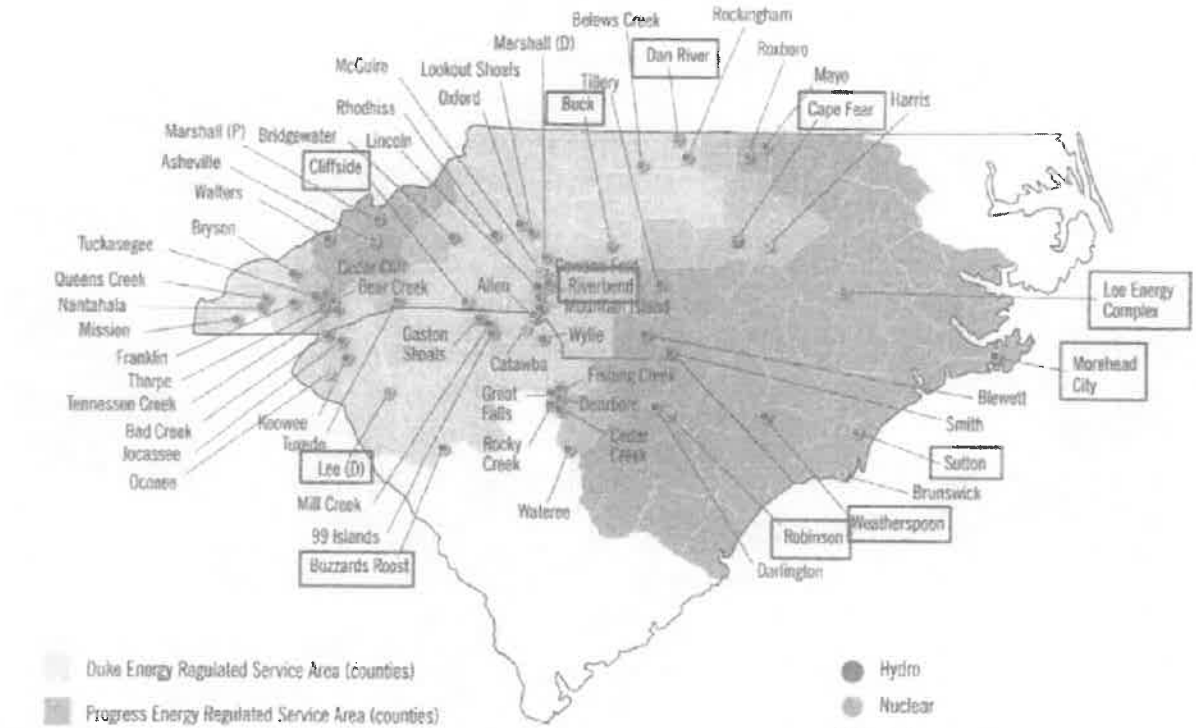
Duke Energy Carolinas Plant Retirement Program



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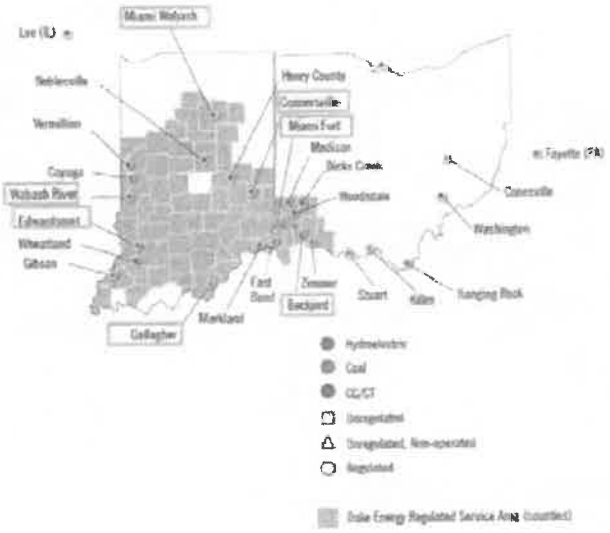
Duke Energy Midwest and Florida Plant Retirement Program

DUKE ENERGY.



Duke Energy sites with retired facilities or facilities planned for retirement

so what is status/plans for these sites?

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Plants Currently In The Program

Plant	Summer Capacity (MW)	In-Service Date of First Unit	Proposed/Retirement Date
Lee (SC) Old CTs	90	1968	January 2007
Miami Wabash 4C	17		2011
Edwardsport 6-8	160	1944	March 2011
Buck Units 3 & 4 [1]	113	1941	May 2011
Weatherspoon Units 1-3	171	1949	October 2011
Cliffside Units 1-4	198	1940	October 2011
Dan River Units 1-3	276	1949	April 2012
Gallagher 1 & 3	280	1959	January 2012
Lee (NC) Units 1-3	397	1951	September 2012
Lee (NC) Old CTs	75		October 2012
Cape Fear 5-6 [2]	316	1956	October 2012
Robinson Unit 1	177	1960	October 2012
Buzzard Roost CTs	196	1971	October 2012
Buck Old CTs	62	1970	October 2012
Dan River Old CTs	48	1968	October 2012
Riverbend Old CTs	64	1969	October 2012
Cape Fear 2B CT	11	1969	October 2012
Morehead City CT	12	1968	October 2012
Cape Fear 1A, 1B, 2A	35	1969	March 2013
Robinson CT	11	1968	March 2013
Sutton Units 1-3	575	1954	December 2013
Buck Units 5 & 6	256	1953	April 2013
Riverbed Units 4 -7 [3]	454	1952	April 2013
Lee (SC) 1-2 Coal Units and Material Handling	180	1951	April 2015
Miami Ft 6 (reg)			April 2015
Wabash River 2-5		1953	April 2015
Beckjord 1-6 (unreg)[4]	862	1952	April 2015
Suwannee River 1,2 [5] & 3	129	1953	June 2016
Various Florida CT's [6]			June 2016
Crystal River 1 & 2			April 2018

Notes:

(1) The Buck project will include the dismantlement of inactive units (Units 1 & 2) on the site.

(2) The Cape Fear project will include the dismantlement of inactive units (Units 1 & 2 CC, Unit 3 & 4 turbines and the boilers 1- 8) on the site. The in-service date for the first unit on-site was 1923.

(3) The Riverbend project will include the dismantlement of inactive units (Units 1-3) on the site.

(4) The program will only provide consultation to unregulated sites at this time

(5) Potential for early retirement

(6) Includes Rio Pinar, Avon Park, Higgins, and Turner P1 and P2 CT's (9 Units total)

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Decommissioning and Demolition Current Status

- Completed asbestos abatement at Weatherspoon. Began demo 3rd Q2013
- Completed asbestos abatement at Buzzard Roost. Began demo 3rd Q 2013
- Began asbestos abatement at Cliffside, Dan River, and Lee (NC) 3rd Q 2013
- Coal yard cleanup complete for Weatherspoon, Robinson, Lee (NC), and Cape Fear
- Continue decoupling projects at Buck and Dan River
- Continue decommissioning activities at Buck, and Riverbend plant retirement
- Completed contractor evaluation for Cape Fear and Robinson asbestos abatement and demolition (4th Q 2013)
- Continue planning for Sutton retirement (4th Q 2013)

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Decommissioning and Demolition Upcoming Major Activities

- Implode Weatherspoon stacks and boilers (November 2013) As is E ready for this?
- Continue planning for retirements in Florida and Mid West
- Complete ash basin site characterization for Cape Fear, Buck, Dan River, and Lee (NC)
- Begin ash basin closure at Weatherspoon
- Begin ash basin site characterization at Riverbend, Robinson, Beckjor, Wabash, and Sutton ?

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Ash Basin Closure Strategy

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- Developed a combined company basin closure process and benchmarked this process against Weatherspoon site
- Completed a Kepner-Tregoe problem solving/decision analysis to determine the best cap system for the Weatherspoon ash basin closure.
  - The analysis indicated that an HDPE geo-synthetic cape system would be the best solution for Weatherspoon ash basin closure.
- Current activities
  - Aligning budget with Strategic Engineering
  - Complete CF, Dan River, Buck, and Lee (NC) ash basins site characterization studies
- Future activities
  - Once state approval is received, the team will begin closure of Weatherspoon ash basin
  - Riverbend, Robinson, and Sutton ash basins site characterization studies

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Program Budget Estimates (DEC)

Decommissioning, Interface Projects, and Demolition ($000)

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Description	2012	2013	2014	2015	2016	2017	2018	Total
Buck Steam Station Decommission	$ -	$ 1,495	$ 2,465	$ 1,701	$ 1,858	$ 3,352		$ 10,871
Buck CT's Decommission	$ (1)	$ 127	$ 211	$ 653	$ 42			$ 1,032
Buzzard Roost CTs (6-15) Decommission (2014)	$ 156	$ 526	$ 163	$ -				
Cliffside Retire Units 1-4	$ 548	$ 2,302	$ 757	$ -				$ 3,607
Dan River Decommissioning Retirement	$ 1,345	$ 3,003	$ 1,727	$ (533)	$ 4,128			$ 9,670
Dan River Retire Combustion Turbines	$ 44	$ 246	$ 46	$ 67	$ 522			$ 925
Decommissioning Lee Units 1 & 2	$ -	$ 105	$ 454	$ 1,276	$ 793	$ 53	$ 54	$ 2,735
Lee Units 4,5 and 6 (SC) CT's Decommissioning	$ -	$ 158	$ 214	$ 824	$ 572			$ 1,768
Riverbend CTs Retirement (2014)	$ -	$ 138	$ 47	$ 835	$ 580			$ 1,600
Riverbend Units 4-7 Retirement	$ 123	$ 2,158	$ 3,858	$ 2,447	$ 7,032			$ 15,618
	$ 2,215	**$ 10,258**	**$ 9,942**	**$ 7,270**	**$ 15,527**	**$ 3,405**	**$ 54**	**$ 35,923**
Buck Replacement Water Supply	$ -	$ 145	$ 9,961	$ 417	$ 11			$ 10,534
Dan River Replacement Water Supply	$ -	$ 2,455	$ 9,299					$ 11,754
	$ -	**$ 2,600**	**$ 19,260**	**$ 417**	**$ 11**	**$ -**	**$ -**	**$ 22,288**
Buck Ash Basin Closure	$ -	$ 525	$ 3,754	$ 13,790	$ 25,671	$ 2,761		$ 46,501
Dan River Ash Basin Closure	$ -	$ 399	$ 1,749	$ 6,427	$ 14,411	$ 1,007		$ 23,993
Riverbend Ash Basin Closure	$ -	$ -	$ 3,099	$ 11,386	$ 24,598	$ 1,784		$ 40,867
	$ -	**$ 924**	**$ 8,602**	**$ 31,603**	**$ 64,680**	**$ 5,552**	**$ -**	**$ 111,361**
DEC Total	**$ 2,215**	**$ 13,782**	**$ 37,804**	**$ 39,290**	**$ 80,218**	**$ 8,957**	**$ 54**	**$ 182,320**

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Program Budget Estimates (DEP)

Decommissioning, Interface Projects, and Demolition ($000)

DUKE ENERGY.

Description	2012	2013	2014	2015	2016	2017	2018	Total
Cape Fear Steam Decommissioning	$ 591	$ 2,846	$ 3,235	$ 1,062				$ 7,734
Lee Steam Decommissioning	$ 658	$ 4,605	$ (1,042)	$ 557				$ 4,778
Robinson Decommission	$ 935	$ 3,536	$ 5,371	$ 6,935	$ 3,407	$ (1,087)	$ (4,663)	$ 12,512
Sutton Steam Decommissioning	$ 63	$ 515	$ 3,082		$ 540			$ 540
Weatherspoon Steam Decommissioning	$ 3,837	$ 2,719	$ 339					$ 6,895
	$ 6,084	**$ 14,221**	**$ 10,985**	**$ 8,554**	**$ 3,947**	**$ (1,087)**	**$ (4,663)**	**$ 32,459**
Cape Fear Ash Basin Closure	$ -	$ 1,057	$ 6,981	$ 25,648	$ 48,349	$ 4,019		$ 86,054
Lee (NC) Ash Basin Closure	$ -	$ 1,270	$ 5,344	$ 19,634	$ 41,422	$ 3,077		$ 70,747
Robinson Ash Basin Closure	$ -	$ -	$ 2,921	$ 10,732	$ 16,862	$ 1,682		$ 32,197
Sutton Ash Basin Closure	$ -	$ -	$ 5,645	$ 20,738	$ 34,054	$ 3,249		$ 63,686
Weatherspoon Basin Pond Closure	$ -	$ -	$ 2,794	$ 10,266	$ 18,732	$ 1,609		$ 33,401
	$ -	**$ 2,327**	**$ 23,685**	**$ 87,018**	**$ 159,419**	**$ 13,636**	**$ -**	**$ 286,085**
DEP Total	**$ 6,084**	**$ 16,548**	**$ 34,670**	**$ 95,572**	**$ 163,366**	**$ 12,549**	**$ (4,663)**	**$ 324,126**
Program Total	**$ 8,299**	**$ 30,330**	**$ 72,474**	**$ 134,862**	**$ 243,584**	**$ 21,506**	**$ (4,609)**	**$ 506,446**

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Project Cost Comparisons ($000)

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- NI AD closure

do we think actual?

Line Item *	Weatherspoon	H.F. Lee	Bartow	Edwardsport
MW	171	397	426	135
Safety (labor and related costs)	$ 240	$ 245	$ -	$ 443
Asbestos	$ 1,878	$ 3,299	$ 1,077	$ 1,800
Decommissioning Activities (vacuuming, washing, cleaning, etc.)	$ 1,640	$ 2,505	$ 884	$ 909
Engineering (project planning, design, studies, etc.)	$ 186	$ 211	$ -	$ 172
Site Security	$ 156	$ -	$ 19	$ -
Coal Yard Clean -up (estimated)	$ 500	$ 500	$ -	$ 1,757
Decoupling Activities	$ 1,665	$ 518	$ 1,560	$ 264
Demolition (net cost)	$ (1,193)	$ (4,424)	$ 1,722	$ 15
Site Restoration (estimated)	$ 750	$ 1,050	$ 2	$ 500
Total Site Charges	$ 5,822	$ 3,904	$ 5,264	$ 5,860

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Requested Approvals

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- Approve the Plant Demolition and Retirement Governance Policy
- Approve the Plant Demolition and Retirement Comprehensive Program Plan
- Approve 2014 Decommissioning and Decoupling Budgets ($40 million)
- Approve Weatherspoon ash basin closure and complete ash basin closure design and site characterization at various sites ($25 million)
- Provide guidance on non-regulated plant involvement

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2014 Meetings

- Recommended 2014 EGC updates in May and October

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Questions?

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Appendix

- Program Drivers
- Program Organization
- American Metal Market Steel Scrap Price Trend
- Plant Retirement Program Enterprise Support Team
- Ash Pond Cost Information
- Program Phases
- Program Reporting and Review Process
- Proposed Plant Decommissioning Schedule

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Program Drivers

- Legislative and Regulatory Expectations
- Environmental Expectations
- Business Strategy – Fleet Modernization
- Recovery Mechanisms
- Initiatives and Study Projects

Program Integration

- Communication Plan
- Retirement Event Plan
- Document Disposition
- Safety Plan
- Contracting Strategy
- Ash Basin Closure Process
- Environmental Approach

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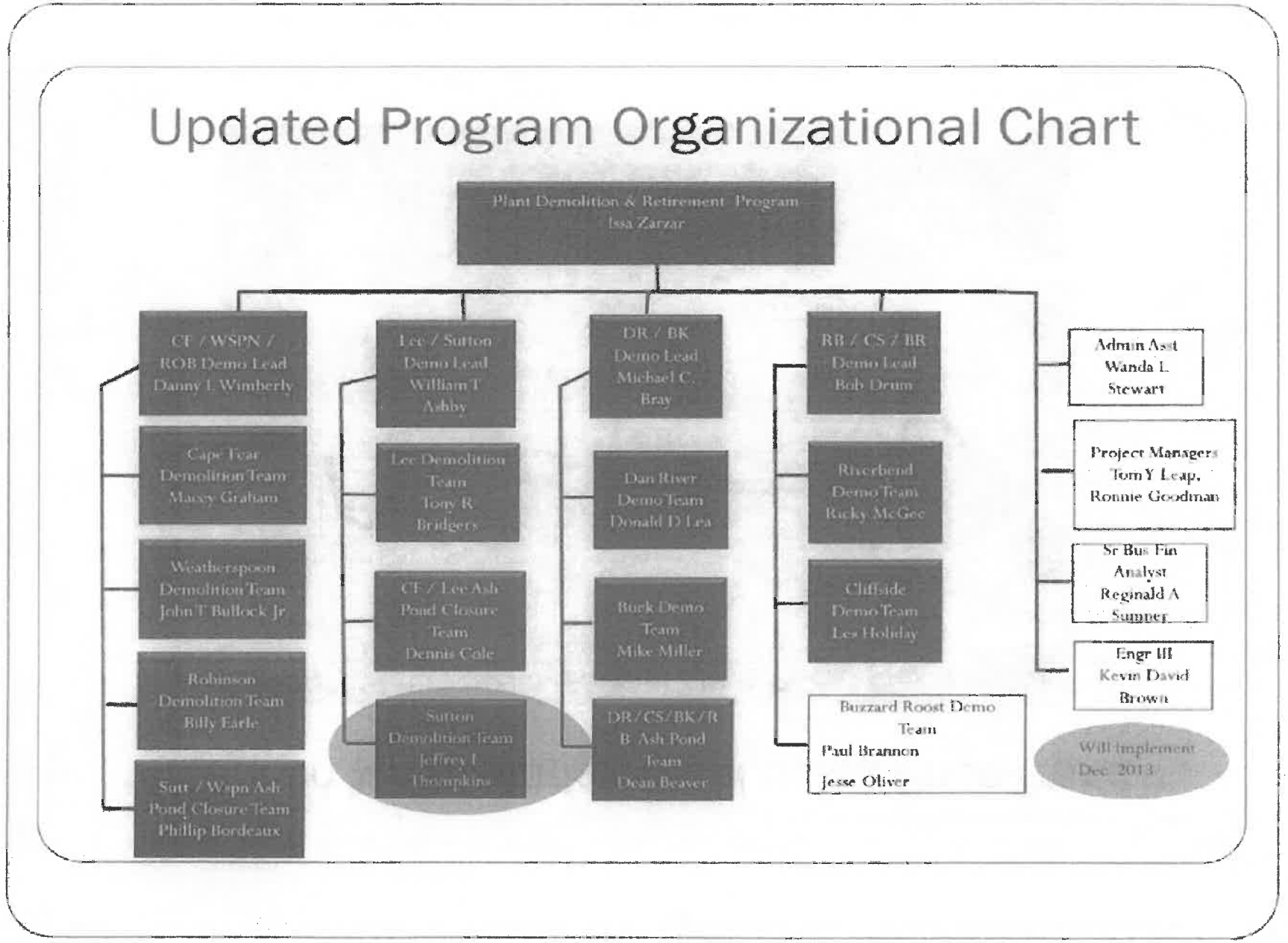

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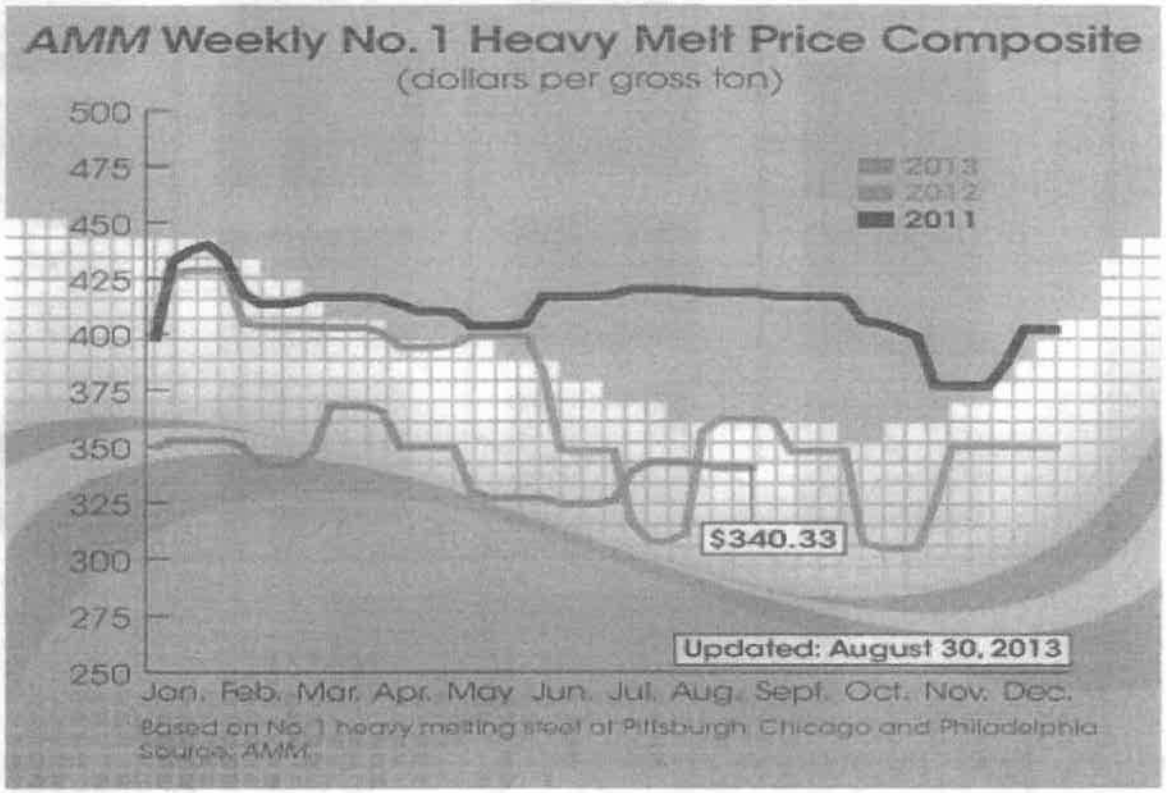
American Metal Market Steel Scrap Price Trend



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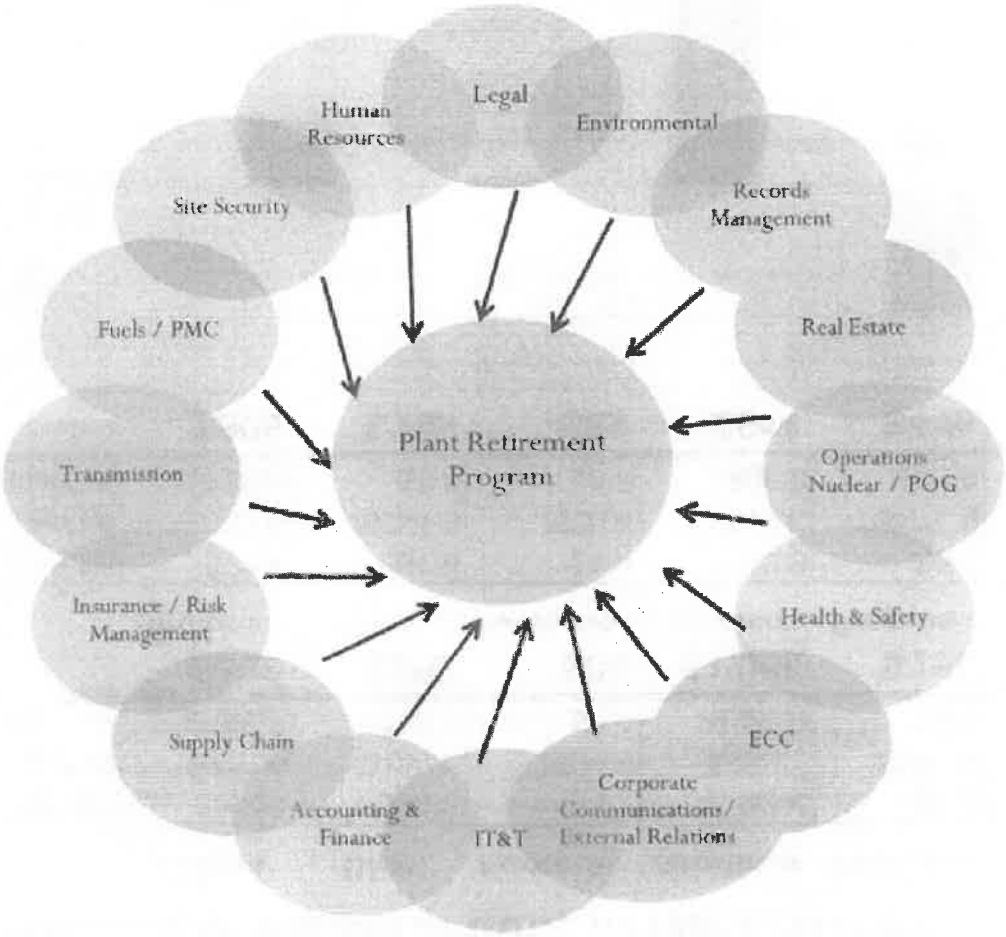
Plant Retirement Program Enterprise Support Team



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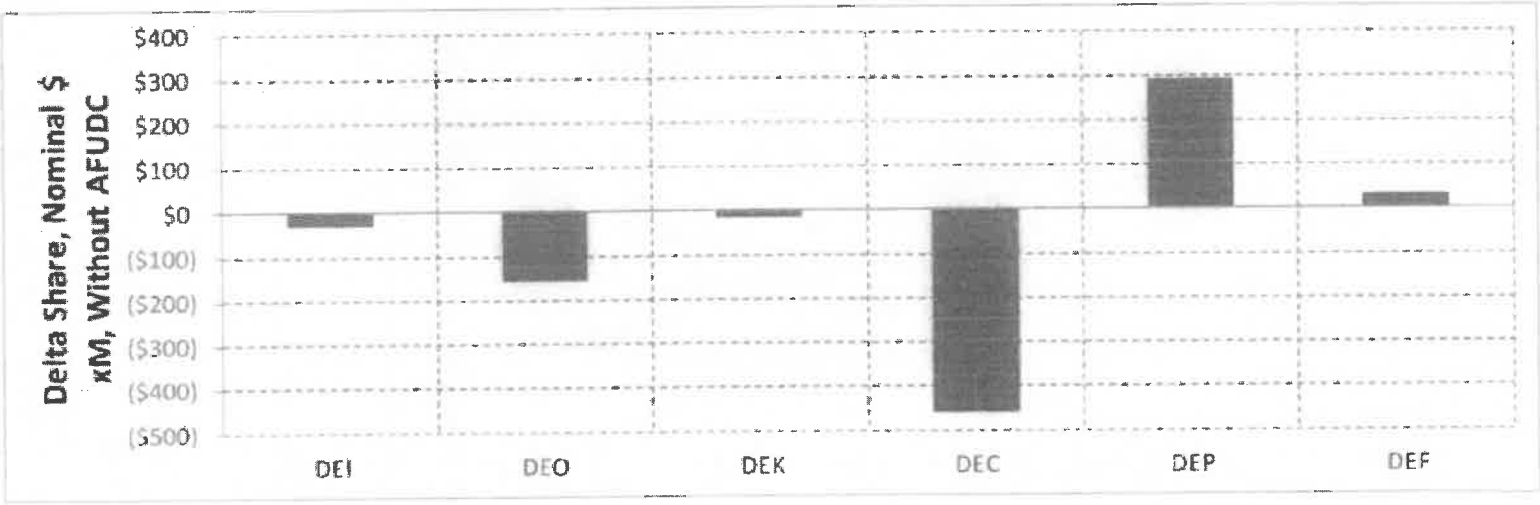
8&4 vs. 12&0 Forecast Pond Closure Costs

do these as BOD present?

Capital: Share Nominal $ xM, Without AFUDC; 10-Year 2012-2021

8&4	Indiana	Ohio	Kentucky	Carolinas	Progress	Florida	Total
Landfill	$49.6	$24.2	$1.2	$3.4	$0.0	$0.0	$78.4
Closure Active	$111.8	$134.6	$34.9	$938.1	$155.9	$0.0	$1,375.3
Closure Inactive	$168.4	$103.5	$0.0	$126.3	$0.0	$0.0	$398.2
Total	**$330**	**$262**	**$36**	**$1,068**	**$156**	**$0**	**$1,852**

12&0	Indiana	Ohio	Kentucky	Carolinas	Progress	Florida	Total
Landfill	$21.4	$4.8	$1.4	$3.3	$0.0	$0.0	$31.0
Closure Active	$163.5	$104.0	$20.4	$513.6	$371.9	$32.2	$1,205.6
Closure Inactive	$120.0	$0.0	$0.0	$96.8	$73.2	$0.7	$290.8
Total	**$305**	**$109**	**$22**	**$614**	**$445**	**$33**	**$1,527**



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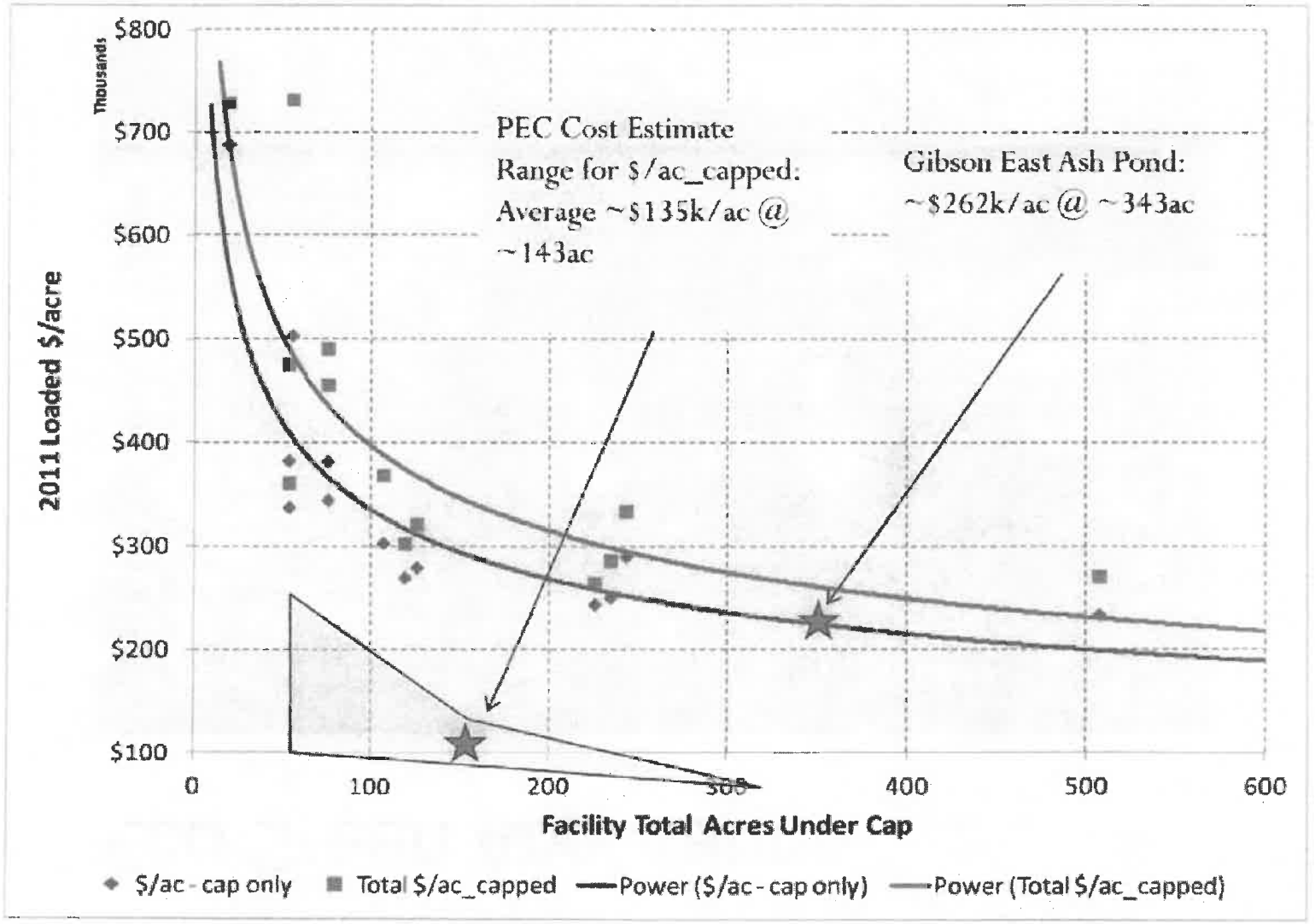

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Eco-Green Application

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Decommissioning Phase

- Perform shutdown activities, such as washing boilers and precipitators, vacuuming and clinker blasting
- Environmental clean-up, such as removing hazardous waste, universal waste and chemicals and asbestos abatement
- Plant interface modifications, such as relocating relays and rerouting piping and wiring
- Transfer and sell inventory and assets
- Flush and clean underground piping and leave in place

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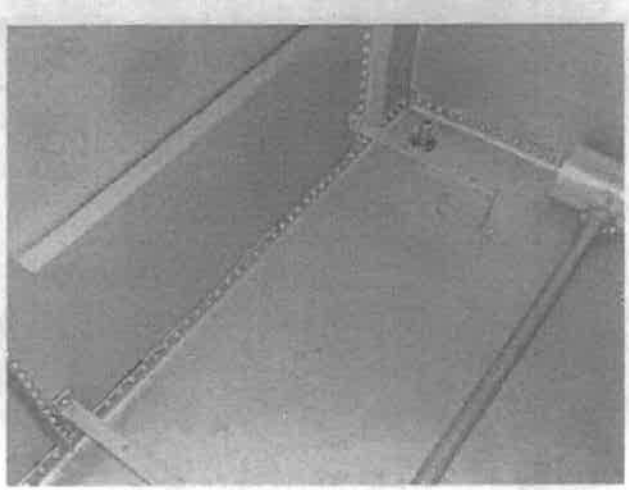
Decommission



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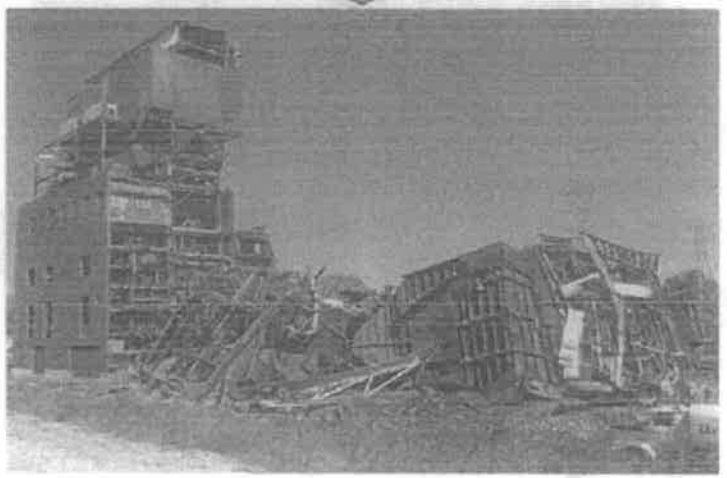
Demolition Phase

- Dismantle the site to grade-level
  - Removal of equipment
  - Demolition of structures



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Site Restoration Phase

- Restore the site to grade-level
- Fill in basements (based on site designs)
- Backfill, grade, and seed
- Sustain the Site
  - On-going monitoring and reporting

Site Restoration

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Program Components

- Benchmarking
  - Bartow Dismantlement Project in PEF
  - EPRI Plant Closure User Group
  - Fossil Decommissioning Network Group
- Investment Recovery
  - Ramp down inventory levels prior to retirement dates
  - Market inventory and assets internally and externally
  - Sale of scrap metal to be incorporated into the demolition contract
- Donations
  - Equipment and tools to local technical colleges.
  - Duke Energy donated to the Carpenter's International Training Fund the Cliffside Steam Station's unit 4 steam turbine. The unit will be utilized to train aspiring millwrights just entering their field.

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Program Components (Continued)

- Contracting Strategy
  - Combine asbestos abatement with demolition contract
  - Utilize bundled approach for engineering services
  - Three contracting options available: (Over 80 contractor/vendor inquiries)
    - Duke Energy Managed
    - Turn Key (Other contractor manage)
    - Sale of asset / site
  - Program strategy is to self perform / manage contracting strategy (Following PMCoE procedures)
- Current Staffing
  - Decommissioning / Retirement Team – 80 team members
    - The majority of the team member will receive VSP or ISP at completion
  - Ash Pond Closure Teams – 15 team members

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Plant Retirement Program Gating Diagram

"Proposed" Gate Definitions	
Gate 0	Initiate
Gate 1	Decommission/Design Ash Pond Closure
Gate 2A	Asbestos Abatement
Gate 2B	Demolition/Site Restoration
Gate 2C	Ash Pond Closure
Gate 3	Project Close/Turnover

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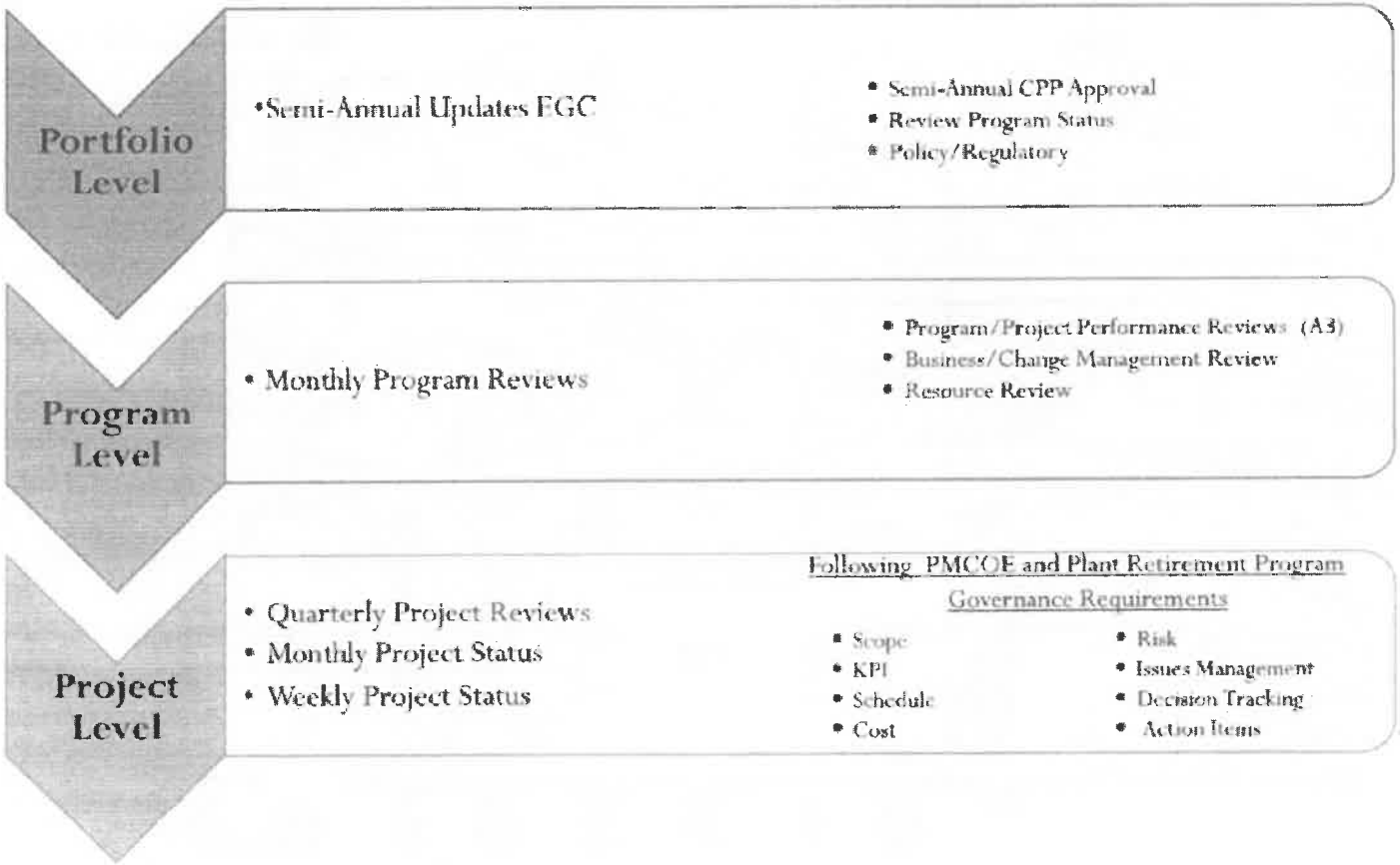
Plant Retirement Program Reporting and Review Process



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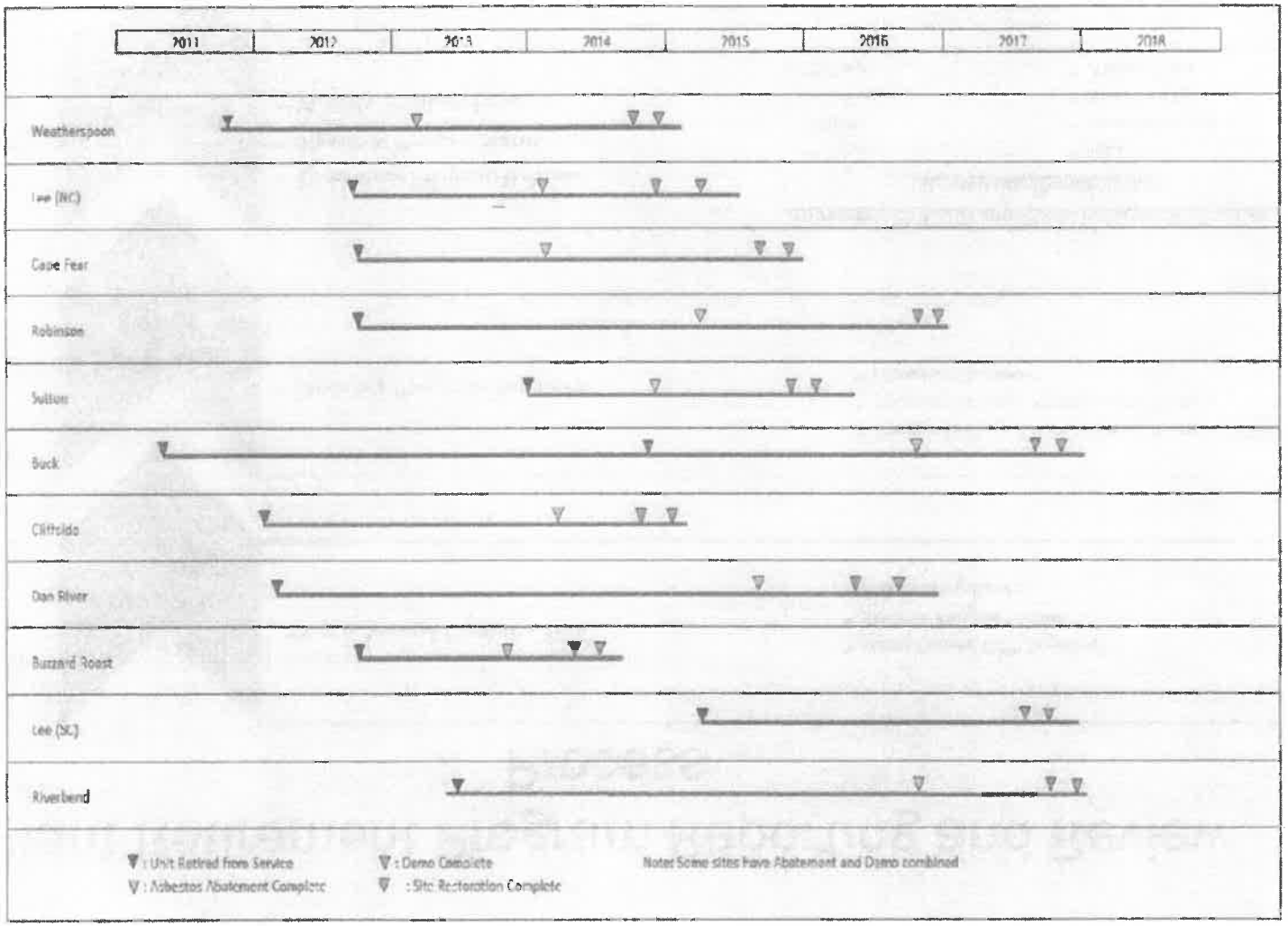
Proposed Plant Decommissioning Schedule



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K. Ash Basin Groundwater Summaries, dated November 4, 2013

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SFN what is on back page?

Ash Basin Groundwater Summaries

November 4, 2013

assessments?

- table of receptor status + actions (w/ timeline?)
- table w/ closure status + timeline.
- tie closure costs/time to GW impacts/receptors? eg, MSS, RBSS, Cokerille, BCSS re ASP time first plan
- table w/ fly/bottom ash actions w/ dates
- dep. item on submittal of ASP – pros/cons
- deep info from Belews Creek
- receptors & WHE GW issues around ASRT complex?

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Plant Summary	Exceedance of primary standards	Exceedance of secondary standards	Active regulatory interest	Potential receptors	Corrective Action
Indiana					
Cayuga	✓	✓		✓	✓
Edwardsport IGCC					✓
Gallagher Cell A and Secondary	✓	✓			
Gallagher Pond B Ash Basin		✓			
Gibson East Ash Pond System	✓	✓		✓	✓
Gibson North Ash Pond	✓	✓			
Wabash River Station		✓			
Ohio & Kentucky					
W. C. Beckjord Ash Pond A		✓		✓	✓
W. C. Beckjord C & C Extension		✓			
East Bend		✓			
Miami Fort		✓			
North Carolina & South Carolina					
Allen Steam Station	✓	✓	✓		
Asheville Plant	✓	✓	✓	✓	
Belews Creeks (NC)		✓	✓		
Buck Steam Station (NC)	✓	✓	✓		
Cape Fear Plant	✓	✓	✓		
Cliffside Steam Station (NC)		✓	✓		
Dan River Steam Station (NC)	✓	✓	✓		
Lee Plant	✓	✓	✓		
WS Lee Steam Station (SC)	✓	✓	✓		
Marshall Steam Station (NC)		✓	✓		
Mayo Plant	✓	✓	✓	✓	
Riverbend Steam Station (NC)		✓	✓		
Robinson Plant	✓				
Roxboro Plant		✓	✓		
Sutton Plant	✓	✓	✓	✓	
Weatherspoon Plant		✓	✓		

Note: "Primary standards" includes boron.

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
✓	Potential receptors
✓	Corrective Action

Site: Cayuga Station

Facility: Primary and Secondary Ash Basins

Parameters/Concentrations/Standards: There has been one exceedance of a primary standard for selenium in one of the ash pond monitoring wells. There have been multiple exceedances of secondary standards in 4 monitoring wells. The secondary standard exceedances are for sulfate and total dissolved solids (TDS). Boron, which does not have a groundwater standard or drinking water limit in Indiana, has a concentration greater than 2 mg/L in each of the ash pond monitoring wells.

Receptors: There were three residential receptors and one industrial facility with elevated boron concentrations as well as elevated concentrations of secondary standards. The industrial well has other contaminant issues resulting from their operations and is not used as a drinking water source.

Mitigation Completed: There were three residential receptors with elevated boron concentrations as well as elevated concentrations of secondary standards. One of the residences has been demolished, and the other two were connected to a municipal water supply.

Status & Schedule:

- Cease sluicing of ash to Ash Disposal Area #1 — January 2015
- Begin placement of structural fill to establish final cover slope — May 2015
- Reduce Normal Pool Elevation of Primary Ash Settling Basin from ~EL 509 to ~EL 487 — January 2017
- Begin construction of final cover system — May 2017
- Complete placement of structural fill to establish final cover slope — November 2023
- Complete construction of final cover system — November 2024
- Submittal of closure certification for Ash Disposal Area #1 — March 2025

Comments: An ash pond closure plan has been approved by the Indiana Department of Environmental Management (IDEM). Groundwater modeling has predicted that pond closure activities will address the ash pond related impact.

[redacted]

	Exceedance of primary standards
	Exceedance of secondary standards
	Active regulatory interest
	Potential receptors
✓	Corrective Action

Site: Edwardsport IGCC

Facility: Primary and Secondary Basins

Parameters/Concentrations/Standards: There are no groundwater monitoring wells at the Edwardsport IGCC. This is a voluntary program in Indiana and with the plan several years ago to clean out the basins and convert to water treatment ponds, groundwater monitoring wells were not installed.

Receptors: The only known receptor is the White River.

Mitigation Completed: None

Status & Schedule:

Comments: During construction of the IGCC the Legacy Edwardsport Ash Basins were cleaned out and a liner installed for the use of water treatment at the IGCC. If this system went away then we would probably be required to go back and fulfill the IDEM requirements for ash pond closure. IDEM was aware of our intentions from the beginning.

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Gallagher Generating Station

Facility: Cell A and Secondary Ash Basin

Parameters/Concentrations/Standards: Exceedances of the Indiana groundwater standards have been detected at the compliance boundary in multiple wells. These exceedances are for iron, manganese, pH, sulfate and TDS (secondary standards) and arsenic (primary standards).

Receptors: The only known receptor is the Ohio River. Groundwater migration into the Ohio River is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk.

Mitigation Completed: None

Status & Schedule:

Comments: Gallagher Station has evaluated ash pond closure options, clean closure and cap in place. Final decision will be made once the ELG and CCR Rules are finalized. Through this process we have evaluated the potential water treatment pond needs in the future.

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	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Gallagher Generating Station

Facility: Pond B Ash Basin

Parameters/Concentrations/Standards: Exceedances of the Indiana groundwater standards have been detected at the compliance boundary in multiple wells. These exceedances are for iron, manganese, pH, sulfate and TDS (secondary standards). There are no exceedances of primary standards at Gallagher Pond B Ash Basin.

Receptors: The only known receptor is the Ohio River. Groundwater migration into the Ohio River is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk.

Mitigation Completed: None

Status & Schedule:

Comments: The Gallagher Landfill is constructed over Pond B ash basin and semi-annual ground water monitoring is conducted as compliance with the Gallagher Landfill RWS I FP 22-01 Permit

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
✓	Potential receptors
✓	Corrective Action

Site: Gibson Station

Facility: East Ash Pond System

Parameters/Concentrations/Standards: There have been exceedances of the USEPA primary MCL for arsenic in 10 of the 32 monitoring wells, although some of these exceedances may be naturally occurring. There have been multiple exceedances of secondary MCLs for chloride, iron, manganese, sulfate, pH, and total dissolved solids. Boron (which does not have an MCL or drinking water limit in Indiana) has a concentration greater than 2 mg/L in 25 of the 32 ash pond monitoring wells.

Receptors: There were residential receptors with elevated boron concentrations that have been connected to a municipal water supply.

Mitigation Completed: The East Ash Pond System consists of 3 cells. One cell has been closed by capping in place and a second is being capped. One cell remains active and receives sluiced ash. There were residential receptors with elevated boron concentrations that have been connected to a municipal water supply.

Status & Schedule:

- Submittal of partial closure certification for Cell 3 January 2014 (already complete ahead of schedule)
- Cell 1 closure will occur between 2014 and 2017
- Cell 2 closure originally scheduled between 2017 to 2020 but may close ahead of schedule

Comments: An ash pond closure plan has been approved by the Indiana Department of Environmental Management (IDEM). Groundwater modeling has predicted that pond closure activities will address the ash pond related impact.

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Gibson Station

Facility: North Ash Pond

Parameters/Concentrations/Standards: There have been exceedances of the USEPA primary standards for arsenic in the single down gradient monitoring well, although the arsenic may be naturally occurring. There have been exceedances of secondary standards for iron, manganese, sulfate, and total dissolved solids. Boron (which does not have an MCL or drinking water limit in Indiana) has a concentration greater than 2 mg/L in the down gradient monitoring well.

Receptors: The only known receptor is the Wabash River. Groundwater migration into the Wabash River is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk.

Mitigation Completed: None

Status & Schedule:

Comments: This pond will stop receiving fly ash but will continue to receive bottom ash starting in late 2013 when Gibson's dry fly ash handling system is commissioned.

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	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Wabash River Station Generating Station

Facility: Primary, Secondary and South (lined) Ash Basin

Parameters/Concentrations/Standards: Exceedances of the Indiana groundwater standards have been detected at the compliance boundary in multiple wells. These exceedances are for iron, manganese, and TDS (secondary standards). There are no exceedances of primary standards at Wabash River Station.

Receptors: The only known receptor is the Wabash River. Groundwater migration into the Wabash River is insignificant relative to the volume/flow of the river; therefore there are no environmental or health risk

Mitigation Completed: None

Status & Schedule:

Comments: Wabash River Station has evaluated ash basin closure options, either clean closure or cap in place. Final decision will be made once the ELG and CCR Rules are finalized

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Bridgard

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	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
✓	Potential receptors
✓	Corrective Action

Site: W.C. Beckjord Station

Facility: Ash Pond A

Parameters/Concentrations/Standards: Exceedances of the OH groundwater standards have been detected within the ash pond boundary and inside the compliance boundary in multiple wells. These exceedances are for sulfate, and pH (secondary standards). There have been exceedances of primary standards for selenium at two wells in the Ash Pond A groundwater monitoring network. The two wells which had exceedances for selenium are either inside the ash pond or just at the ash pond boundary. Groundwater from the area around these wells is not at risk for reaching the drinking water receptors mentioned below because it is located within the capture zone of the interceptor well.

Receptors: There are drinking water receptors just north of this ash basin. The Pierce Union Batavia drinking water wells which feed the public water system in the area border the Beckjord Station property. Sulfate was found above the secondary drinking water standard in the public drinking water wells in the late 80's. The sulfate contamination was attributed to the Beckjord Station Ash Pond A. There is no environmental or health risk to the public drinking water wells since mitigation has been completed for this site to address the sulfate contamination. There is also groundwater migration into the Ohio River, but it is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk related to migration to the Ohio River.

Mitigation Completed: In the late 80's and early 90's, after sulfate levels were found to be above secondary drinking water standards in public drinking water wells bordering Beckjord Station property, a four phase study was done to confirm that the sulfate contamination could be attributed to Ash Pond A. A mitigation plan was put in place which included an interceptor well and a groundwater monitoring network which continues to be monitored quarterly. The interceptor well has successfully been intercepting the groundwater migrating from the Ash Pond A area before it reaches the public drinking water wells. The discharge from the interceptor well is through an NPDES permitted outfall. No sulfate levels above secondary standards have been detected beyond the interceptor well since the well has been installed.

Status & Schedule:

Comments: Quarterly groundwater monitoring reports are submitted to the state and the county for review. Periodic meetings are held with the state and county to keep them informed of the monitoring program and of projects involving maintenance to the interceptor well. Both the county and state are satisfied with the program.

[redacted]

	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
	Potential receptors
	Corrective Action

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Site: W.C. Beckjord Station

Facility: Ash Ponds C & C Extension

Parameters/Concentrations/Standards: Exceedances of the OH groundwater standards have been detected at the compliance boundary in multiple wells. These exceedances are for iron, manganese, sulfate, TDS and pH (secondary standards). There are no exceedances of primary standards at these particular ash ponds at Beckjord Station to-date.

Receptors: There are no direct drinking water receptors for this ash basin complex. Groundwater migration into the Ohio River is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk.

Mitigation Completed: None needed.

Status & Schedule:

Comments: There is no regulatory agency or public interest in this monitoring program to date.

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	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
	Potential receptors
	Corrective Action

Site: East Bend Station

Facility: Ash Pond

Parameters/Concentrations/Standards: Exceedances of the KY groundwater standards have been detected at the compliance boundary in multiple wells. These exceedances are for chloride, iron, manganese, sulfate and TDS (secondary standards). There are no exceedances of primary standards at this ash pond at East Bend Station to-date.

Receptors: There are no direct drinking water receptors for this ash basin complex. Groundwater migration into the Ohio River is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk.

Mitigation Completed: At Kentucky Department of Environmental Protection's (KDEP) request, a human health and environmental risk assessment was completed several years ago and found no risk to human health or the environment under the current conditions. The deed to specific parcels of property at East Bend Station was modified to prohibit the installation of residential drinking water wells on the property in the future.

Status & Schedule:

Comments: One well in particular exhibits an upward trend for key indicator parameters such as chloride and sulfate. While there is no environmental or human health risk identified, actions are under way to reverse the upward trends. KDEP has been notified and has not indicated they are interested in taking any action to elevate the issue at this time.

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	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Miami Fort Station

Facility: Ash Ponds A and B

Parameters/Concentrations/Standards: Exceedances of the OH groundwater standards have been detected at the compliance boundary in multiple wells. These exceedances are for chloride, iron, manganese, sulfate, TDS and pH (secondary standards). There have been exceedances of the primary standard for arsenic. This has been in one well, and it has been clearly defined as a "site condition" issue and not a condition related to the ash ponds.

Receptors: There are no direct drinking water receptors for this ash basin complex. Groundwater migration into the Ohio River is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk.

Mitigation Completed: None needed.

Status & Schedule:

Comments: There is no regulatory agency or public interest in this monitoring program to-date. The Ohio EPA was approached about the arsenic exceedance and accepts that it is not related to the ash pond based on additional data gathered with their input.

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North Carolina/South Carolina

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Allen Steam Station (NC)

Facility: Ash Basin System

Parameters/Concentrations/Standards: Exceedances of NC groundwater standards have been detected in multiple compliance boundary wells. These exceedances are for boron, iron, manganese, nickel and pH.

Boron exceedances have been consistently detected in one well (AB-9S), and that well is located inside of the 500-foot compliance boundary. Model projections indicate the concentrations would still exceed the State standard at the compliance boundary. The boron concentrations have remained relatively steady and only slightly above the State standard (historical exceedances range from 708-735 µg/L. State standard is 700 µg/L).

Nickel exceedances have also been consistently detected in one well (AB-14D), and the concentrations have been trending downward toward the State standard. The most recent sampling event indicated a nickel concentration of 104 µg/L, the lowest concentration since monitoring began (historical exceedances range from 104-544 µg/L; State standard is 100 µg/L). Groundwater in this well may be affected by identified off-site scrap metal deposited adjacent to the well.

Exceedances for iron, manganese and pH are widespread, but these parameters only have federal secondary MCLs.

Receptors: The only known receptor is the Catawba River/Lake Wylie. Groundwater migration into the Catawba River is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk.

There are some neighbors on the west side of the ash basin in close proximity to the waste boundary, but there has been no evidence of impacts from the ash basin.

Mitigation Completed: None

Status & Schedule: On August 16, 2013, NCDENR filed a complaint alleging violations at several Duke coal-fired stations, including Allen Steam Station, related to ash basin seepage and groundwater monitoring data that show some concentrations above groundwater standards. A consent order between NCDENR and Duke is likely to be reached in the months ahead.

Comments: No federal MCL exists for boron or nickel. Only federal secondary MCLs exist for iron, manganese and pH. It is strongly believed that naturally occurring conditions contribute significantly to iron, manganese and pH exceedances.

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Asheville

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
✓	Potential receptors
	Corrective Action

Site: Asheville Plant

Facility:
Two separate ash basins with one compliance boundary monitoring network consisting of 3 background wells and 8 compliance wells. Monitoring began in fall 2010 and is current through July 2013.

Parameters/Concentrations/Standards: Exceedances of the NC groundwater standards have been detected at multiple wells during multiple events for primary standard chromium, nitrate, selenium and thallium. The chromium exceedances were at one background well and one compliance well. The nitrate exceedance was a one-time event at one well. The selenium and thallium exceedances are more problematic. The remaining exceedances are for boron, chloride, iron, manganese, sulfate, total dissolved solids (TDS) and pH (secondary standards).

Receptors: Development around the Plant is on municipal water. However, a receptor survey identified five private wells sidegradient from the Plant. Groundwater flow is toward the French Broad River. Testing completed above and below the Asheville Plant in the river shows no environmental or health risk. As of October 23, 2013, DENR Asheville Regional Office required the company to supply water to the residence at 38 Bear Leah Trail due to high iron and manganese results at the well at this address. The company voluntarily agreed to also supply water to 40 Bear Leah Trail (both residences owned by same owner). Both of these residences are sidegradient from the Plant.

Actions Completed: Actions completed per DENR Asheville Regional Office include a groundwater receptor survey within ½ mile from ash basin compliance boundary and a groundwater Site Conceptual Model. The results of both have been submitted to DENR Asheville Regional Office.

Status & Schedule:

Comments: Asheville Plant is the target of recent state enforcement action resulting from a threatened CWA citizen suit. The DENR letter dated October 23, 2013 requires the company to prepare a work plan and submit to DENR within 45 days from the date of the letter (by December 7, 2013).

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	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Belews Creek Steam Station (NC)

Facility: Ash Basin

Parameters/Concentrations/Standards: Exceedances of the NC groundwater standards have been detected at the compliance boundary in multiple wells. The exceedances are mostly iron and manganese. All of the wells including the background have low pH. There have also been historical exceedances of chromium (January 2011) in the deep background well and thallium (September 2012) in a network well. Recent sampling events have demonstrated no exceedances of these parameters. The well with thallium exceedance appears to be flowing towards the ash basin (rather than away).

The Belews Creek Ash Basin began an approved NCDENR assessment with the May 2013 sampling event. Assessment completion is expected in November 2013.

Receptors: The Belews Creek Ash Basin groundwater generally flows towards an unnamed tributary that flows northward to the Dan River. Currently there is no environmental or health risk.

Mitigation Completed: None

Status & Schedule: Assessment suspension was requested on September 30, 2013 until the outcome of pending litigation is realized. As of October 25, 2013 no return communication has been received from NCDENR.

Comments: Only federal secondary MCLs exist for TDS, iron, manganese and pH. It is strongly believed that naturally occurring conditions contribute significantly to iron, manganese and pH exceedances.

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Buck

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Buck Steam Station (NC)

Facility: Additional Primary, Old Primary and Secondary Ash Basins

Parameters/Concentrations/Standards: Exceedances of NC groundwater standards have been detected in multiple compliance boundary wells. These exceedances are for boron, chromium, iron, manganese, sulfate, TDS and pH.

Boron exceedances have been consistently detected in one well (MW-11D), and concentrations have remained steady (historical exceedances range from 1,130-1,290 µg/L; State standard is 700 µg/L).

Chromium exceedances were historically detected in one well, but the last exceedance was in November 2011.

Sulfate exceedances have been consistently detected in one well (MW-10D), and concentrations have remained relatively steady (historical exceedances range from 320-380 mg/L; State standard is 250 mg/L).

TDS exceedances have been consistently detected in one well (MW-10D), and concentrations are generally increasing, with the most recent sampling event detecting the highest historical concentration (historical exceedances range from 561-660 mg/L; State standard is 500 mg/L).

Exceedances for iron, manganese and pH are widespread, but these parameters only have federal secondary MCLs.

Receptors: The only known receptor is the Yadkin River. Groundwater migration into the Yadkin River is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk.

There are some neighbors to the southeast of the old primary and secondary ash basins in close proximity to the waste boundary, but there has been no evidence of impacts from the ash basin.

Mitigation Completed: None

Status & Schedule: On August 16, 2013, NCDENR filed a complaint alleging violations at several Duke coal-fired stations, including Buck Steam Station, related to ash basin seepage and groundwater monitoring data that show some concentrations above groundwater standards. A consent order between NCDENR and Duke is likely to be reached in the months ahead.

Comments: HDR has been selected for conceptual site closure of the Buck ash basin system. Site investigation will be ongoing during Fall 2013, and it is anticipated that ash basin closure activities would begin during 2014.

Chromium is currently below the State standard. No federal MCL exists for Boron. Only federal secondary MCLs exist for sulfate, TDS, iron, manganese and pH. It is strongly believed that naturally occurring conditions contribute significantly to iron, manganese and pH exceedances. Only iron, manganese and pH are being detected above 2L standards in wells located between the ash basins and residences.

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Cape Fear Plant

Facility: Five separate ash basins with one compliance boundary monitoring network consisting of 2 background wells and 11 compliance wells. Monitoring began in fall 2010 and is current through June 2013.

Parameters/Concentrations/Standards: Exceedances of the NC groundwater standards have been detected at multiple wells during multiple events for primary standards. One exceedance at one well for arsenic and cadmium (not same well and not same sampling event). One background well and one compliance well had an exceedance for antimony during the December 2010 sampling event (first event, believed artifact from well installation). Compliance well CMW-3 consistently above standard for selenium. The remaining exceedances are for boron, iron, manganese, sulfate, total dissolved solids (TDS) and pH (secondary standards).

Receptors: The only known receptor is the Cape Fear River. Testing completed above and below the Cape Fear Plant in the river shows no environmental or health risk.

Actions Completed: None

Status & Schedule:

Comments: The entire Cape Fear Plant has recently closed (coal units and combustion turbine units). Field investigations for ash basin closure began in summer 2013.

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	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Cliffside Steam Station (NC)

Facility: Active Ash Basin

Parameters/Concentrations/Standards: Exceedances of NC groundwater standards have been detected in multiple compliance boundary wells. These exceedances are for chromium, iron, manganese, sulfate, TDS and pH.

Chromium concentrations were historically detected in two wells, but the only exceedances were detected during the initial sampling event in April 2011.

Sulfate exceedances were historically detected in one well (MW-23D), but the last exceedance of the State standard was in December 2012.

TDS exceedances have been consistently detected in one well (MW-23D), and concentrations are increasing, with the most recent sampling event detecting the highest historical concentration (historical exceedances range from 590-820 mg/L; State standard is 500 mg/L).

Exceedances for iron, manganese and pH are widespread, but these parameters only have federal secondary MCLs.

Receptors: The only known receptor is the Broad River. Groundwater migration into the Broad River is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk.

Mitigation Completed: None

Status & Schedule: On August 16, 2013, NCDENR filed a complaint alleging violations at several Duke coal-fired stations, including Cliffside Steam Station, related to ash basin seepage and groundwater monitoring data that show some concentrations above groundwater standards. A consent order between NCDENR and Duke is likely to be reached in the months ahead.

Comments: Chromium and sulfate are currently below their State standards. Only federal secondary MCLs exist for TDS, iron, manganese and pH. It is strongly believed that naturally occurring conditions contribute significantly to iron, manganese and pH exceedances.

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Dan River Steam Station (NC)

Facility: Primary and Secondary Ash Basins

Parameters/Concentrations/Standards: Exceedances of NC groundwater standards have been detected in multiple compliance boundary wells. These exceedances are for antimony, arsenic, boron, iron, manganese, sulfate, TDS and pH.

Antimony exceedances have been historically detected in two wells and currently in one well (MW-22D). The current antimony exceedances in MW-22D appear to be decreasing and are only slightly above the State standard (the last two concentrations were 1.06 µg/L; the interim maximum allowable concentration (IMAC) for antimony is 1.0 µg/L). Reliability of antimony concentrations is uncertain since the antimony IMAC of 1.0 µg/L is the same as the laboratory detection limit of 1.0 µg/L.

Arsenic exceedances have been consistently detected in one well (MW-21S), and concentrations appear to be generally decreasing, with the lowest historical concentration measured during the most recent sampling event (historical exceedances range from approximately 21-45 µg/L; State standard is 10 µg/L).

Boron exceedances have been detected in two wells (MW-22D and MW-22S), and the timing of exceeding concentrations is intermittent. Boron exceedances in MW-22D have fluctuated above and below the State boron standard of 700 µg/L, with 3 of the last 5 sampled concentrations in excess of the standard. MW-22S experienced its first boron exceedance (903 µg/L) during the most recent sampling event in May 2013.

Sulfate exceedances have been consistently detected in one well (MW-21D), and concentrations have remained relatively steady (historical exceedances range from 310-350 mg/L; State standard is 250 mg/L).

TDS exceedances have been consistently detected in one well (MW-21D), and concentrations appear to be steady or slightly increasing (historical exceedances range from 643-770 mg/L; State standard is 500 mg/L).

Exceedances for iron, manganese and pH are widespread, but these parameters only have federal secondary MCLs.

Receptors: The only known receptor is the Dan River. Groundwater migration into the Dan River is insignificant relative to the volume/flow of the river, therefore there is no environmental or health risk.

Mitigation Completed: None

Status & Schedule: On August 16, 2013, NCDENR filed a complaint alleging violations at several Duke coal-fired stations, including Dan River Steam Station, related to ash basin seepage and groundwater monitoring data that show some concentrations

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above groundwater standards. A consent order between NCDENR and Duke is likely to be reached in the months ahead.

Comments: AMEC has been selected for conceptual site closure of the Dan River ash basin system. Site investigation will be ongoing during Fall 2013, and it is anticipated that ash basin closure activities would begin during 2014.

Arsenic concentrations are currently above the federal primary MCL in MW-22D. While antimony concentrations are above the State IMAC, they are well below the federal primary MCL. No federal MCL exists for Boron. Only federal secondary MCLs exist for sulfate, TDS, iron, manganese and pH. It is strongly believed that naturally occurring conditions contribute significantly to iron, manganese and pH exceedances. Only iron, manganese and pH are being detected above 2L standards in wells located between the ash basins and residences.

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Lee Plant (NC)

Facility: The 'active' ash basin compliance monitoring network consists of 2 background wells and 6 compliance wells. Monitoring began in fall 2010 and is current through June 2013. The three inactive ash basins have a separate compliance monitoring network that consists of 1 background well and 4 compliance wells. Monitoring began in fall 2011 and is current through June 2013.

Parameters/Concentrations/Standards: Exceedances of the NC groundwater standards have been detected at multiple wells during multiple events for the active ash basin for primary standards. Well CMW-10 has had chromium exceedances while well CMW-6 consistently exceeds the arsenic standard (50 fold). This well was approximately 80 feet from the ash basin. The company purchased additional property to obtain the full 500 foot compliance boundary and installed a replacement well. However the replacement well consistently exceeds the arsenic standard by a factor of 2.5. The remaining exceedances are for boron, iron, manganese and pH (secondary standards).

Exceedances of the NC groundwater standards have been detected at multiple wells during multiple events for the inactive ash basins. The exceedances are for boron, iron, manganese, total dissolved solids (TDS) and pH (secondary standards). There are no exceedances of primary standards at the inactive ash basins.

Receptors: The only known receptor is the Neuse River. Testing completed above and below the Lee Plant in the river shows no environmental or health risk.

Actions Completed: None

Status & Schedule:

Comments: The coal units at Lee Plant have recently closed. Field investigations for ash basin closure began in summer 2013.

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

Site: WS Lee Steam Station (SC)

Facility: Primary and Secondary Ash Basins

Parameters/Concentrations/Standards: Exceedances of State MCLs have been detected in multiple NPDES wells. These exceedances are for iron, manganese, and pH.

Exceedances for iron, manganese and pH are widespread, but these parameters only have federal secondary MCLs.

Receptors: The only known receptor is the Saluda River. Groundwater migration into Saluda River is insignificant relative to the volume/flow of the river; therefore there is no environmental or health risk.

Mitigation Completed: None

Status & Schedule:

Comments: Although there is no MCL for boron in South Carolina, boron concentrations in three of the wells are in excess of the North Carolina groundwater standard for boron. Only federal secondary MCLs exist for iron, manganese and pH. It is strongly believed that naturally occurring conditions contribute significantly to iron, manganese and pH exceedances.

	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

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Site: Marshall Steam Station (NC)

Facility: Ash Basin

Parameters/Concentrations/Standards: Exceedances of the NC groundwater standards have been detected at the compliance boundary in multiple wells. The exceedances are mostly iron and manganese. All of the wells except one have had consistent low pH levels. One well pair (deep and shallow) have had exceedances of the 2L standards for boron, sulfate, and TDS. The trend in this well pair is generally decreasing for boron, sulfate, and TDS.

Exceedances for iron, manganese and pH are widespread, but these parameters only have federal secondary MCLs.

Receptors: The only known receptor is Lake Norman. Groundwater migration into Lake Norman is insignificant relative to the volume/flow of the lake; therefore there is no current environmental or health risk.

Mitigation Completed: None

Status & Schedule: A suspension of the proposed Assessment Work Plan was requested on September 11, 2013 until the outcome of pending litigation is realized. As of October 25, 2013 no return communication has been received from NCDENR.

Comments: Only federal secondary MCLs exist for TDS, iron, manganese and pH. It is strongly believed that naturally occurring conditions contribute significantly to iron, manganese and pH exceedances.

Marshall Steam Station Ash Basin has an assessment work plan pending (submitted April 10, 2013) with NCDENR. The assessment will move forward when NCDENR provides notification.

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
✓	Potential receptors
	Corrective Action

Site: Mayo Plant

Facility: One ash basin with a compliance boundary monitoring network consisting of 2 background wells and 8 compliance wells. Monitoring began in fall 2010 and is current through July 2013.

Parameters/Concentrations/Standards: Exceedances of the NC groundwater standards have been detected at multiple wells during multiple events for primary standards. One exceedance at one well for cadmium and thallium (not same well but the sampling event). Both background wells and one compliance well had exceedances for chromium. The remaining exceedances are for iron, manganese, total dissolved solids (TDS) and pH (secondary standards).

Receptors: Groundwater movement is toward Mayo Creek, distant from the ash basin. There are no known receptors between the ash basin and Mayo Creek.

Actions Completed: None

Status & Schedule:

Comments: The Mayo monofill is scheduled to open 1st quarter 2014. After which, no ash (bottom or fly) will go to the Mayo ash basin. The ash basin is scheduled to remain open for treatment of other Plant wastewater streams.

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	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Riverbend Steam Station (NC)

Facility: Primary and Secondary Ash Basins

Parameters/Concentrations/Standards: Exceedances of NC groundwater standards have been detected in multiple compliance boundary wells. These exceedances are for iron, manganese, and pH.

Exceedances for iron, manganese and pH are widespread, but these parameters only have federal secondary MCLs.

Receptors: The only known receptor is Mountain Island Lake. Groundwater migration into Mountain Island Lake is insignificant relative to the volume/flow of the lake, therefore there is no environmental or health risk.

Mitigation Completed: None

Status & Schedule: A consent order has been signed between NCDENR and Duke to address ash basin seepage and exceedances of State groundwater standards. The interveners in the case are currently reviewing the consent order. The enforcement actions outlined in the consent order take effect once the judge presiding over the case grants approval, which is likely to occur after the first of the year.

Comments: Riverbend is the target of recent state enforcement action resulting from a threatened CWA citizen suit.

Only federal secondary MCLs exist for iron, manganese and pH. It is strongly believed that naturally occurring conditions contribute significantly to iron, manganese and pH exceedances.

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✓	Exceedance of primary standards
	Exceedance of secondary standards
	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Robinson Plant

Facility: One ash basin with a compliance boundary monitoring network consisting of 1 background well and 2 downgradient wells. Monitoring began in 1995 and is current through July 2013.

Parameters/Concentrations/Standards: Exceedances of the SC groundwater standards have been detected at multiple wells during multiple events for primary standards for arsenic and chromium. Arsenic exceedances have been observed in downgradient well MW-2 while chromium exceedances have been observed only in the background well. The remaining exceedances are for sulfate, total dissolved solids (TDS) and pH (secondary standards).

Receptors: Groundwater movement is toward Lake Robinson. There are no known receptors between the ash basin and Lake Robinson.

Actions Completed: None

Status & Schedule:

Comments: The only coal fired unit at Robinson has recently closed. There is a separate inactive ash basin at this site which does not have a groundwater monitoring network. Recent correspondence with DHEC established a date of March 17, 2017 by which the company must have completed the ash pond investigation for closure.

	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Roxboro Plant

Facility: Two ash basins with a compliance boundary monitoring network consisting of 1 background well and 7 compliance wells. Monitoring began in fall 2010 and is current through July 2013.

Parameters/Concentrations/Standards: Exceedances of the NC groundwater standards have been detected at multiple wells during multiple events for primary standard chromium. This includes one background well and three compliance wells. The remaining exceedances are for iron, manganese, sulfate, total dissolved solids (TDS) and pH (secondary standards).

Receptors: Groundwater movement is toward Hyco Lake. There are no known receptors between the ash basins and Hyco Lake.

Actions Completed: None

Status & Schedule:

Comments: The Roxboro monofill receives Plant fly ash for disposal along with excess gypsum. The on-site monofill is being developed over the east ash basin to effectively cap and close this ash basin. The west ash basin is active and receives Plant bottom ash.

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Sutton ICF?

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✓	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
✓	Potential receptors
	Corrective Action

Site: Sutton Plant

Facility: Two ash basins with a compliance boundary monitoring network consisting of 2 background wells and 15 compliance wells. Monitoring began in summer 2012 and is current through June 2013.

(all monitor, began in early 1990's inside CB. or distant from AB. Permanent.)

Parameters/Concentrations/Standards: Exceedances of the NC groundwater standards have been detected at multiple wells during multiple events for primary standard antimony, arsenic, cadmium, lead, selenium and thallium. The arsenic, cadmium and lead exceedances were only one time events (not same well, not same sampling event). The antimony exceedances were at one well in two separate events (out of three total). The selenium and thallium exceedances are more problematic. The remaining exceedances are for boron, iron, manganese, sulfate, total dissolved solids (TDS) and pH (secondary standards).

Receptors: The Cape Fear Public Utility Authority (CFPUA) has two wells on property adjacent to Sutton Plant. These two wells are approximately 2,500 feet from the ash basin compliance boundary. There are other non-potable wells used for industrial purposes which affect groundwater movement in the area of the ash basins (two separate concrete batch mix plants and the Sutton Plant). In October 2013, the company and the CFPUA agreed to a two year project to connect the area served by these two groundwater wells to the rest of the Wilmington, NC area drinking water system. After which, all CFPUA wells adjacent to Sutton Plant will be abandoned. The majority of the funding for this project came from the company.

Actions Completed: Because of the boron plume at Sutton Plant, a two phase investigation was completed per DENR Wilmington Regional Office. The first phase consisted of the installation of nested temporary monitoring wells. The second phase consisted of the installation of 13 permanent monitoring wells in fall 2011. Many of these monitoring wells were incorporated into the present monitoring network.

Status & Schedule:

Comments: Sutton Plant coal fired units will close in fall 2013. Groundwater monitoring at this site began in the early 1990's. However, the wells were either inside the compliance boundary near the ash basins or very distant from the ash basins. Monitoring of many of these wells was discontinued in summer 2012 when the present monitoring network began. Boron has been detected above NC standard at the property line.

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	Exceedance of primary standards
✓	Exceedance of secondary standards
✓	Active regulatory interest
	Potential receptors
	Corrective Action

Site: Weatherspoon Plant

Facility: The ash basin compliance boundary monitoring network consists of 1 background well and 3 compliance wells. Monitoring began in fall 2010 and is current through June 2013.

Parameters/Concentrations/Standards: Exceedances of the NC groundwater standards have been detected at the compliance boundary in multiple wells. These exceedances are for iron, manganese, and pH (secondary standards). There was an exceedance of primary standard thallium in the background well at Weatherspoon.

Receptors: The only known receptor is the cooling pond at the site. There is no environmental or health risk.

Actions Completed: The coal fired units at Weatherspoon have closed. The ash basin field investigations have been completed and a closure design is nearly completed.

Status & Schedule:

Comments: Submittal for ash basin closure to DENR for review and approval is expected in November 2013. Time frame for DENR review and approval is not known as this will be the first ash basin closure in the state. Once approval from DENR is received, time frame to complete closure is expected to be 1.5 years.

Antimony is well below its federal primary MCL of 6.0 µg/L. Arsenic is in excess of its federal primary MCL of 10 µg/L (same as State standard for arsenic). No federal MCL exists for boron. Only federal secondary MCLs exist for sulfate, TDS, iron, manganese and pH. It is strongly believed that naturally occurring conditions contribute significantly to iron, manganese and pH exceedances.

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L. Ash Basin Closure Strategy presentation given by Joe Miller and Dave Mitchell to the Senior Management Committee, dated November 25, 2013

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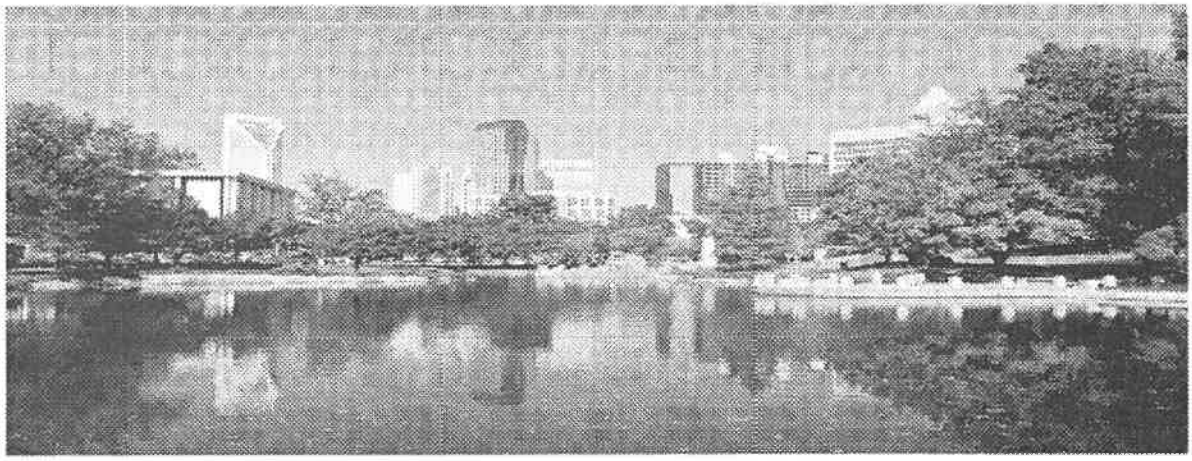
Senior Management Committee
November 25, 2013



Ash Basin Closure Strategy

Joe Miller, Strategic Engineering
Dave Mitchell, Environmental Services

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Coal Ash – What Is It, What's In It & How Much Is There?

- Byproduct from burning coal
  - Flyash (80%) – "flies" out from the boiler then collected
  - Bottom ash (20%) – falls to the bottom of the boiler
- Coals produce about 10% ash
  - Coal is not uniform; varies by type and location
- Chemical composition of bottom and fly ash is similar to shale
  - Arsenic, Selenium, Iron, Manganese, Copper, Mercury, etc.
- EPA has determined coal ash to be non-hazardous on multiple occasions

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Concentration ranges of trace constituents in fly ash, bottom ash, and FGD gypsum typically fall below the EPA residential and industrial soil screening levels for ingestion and dermal exposure, with the exception of arsenic. Many materials, including uncontaminated soils and other beneficially used materials, also commonly exceed the RSL and ISL for arsenic.

EPA is currently considering whether to change that designation and make it hazardous – the Coal Combustion Residuals rulemaking (CCR), expected to be completed by the end of 2014; proposal issued in June, 2010.

Toxic? Toxicity is dose dependent. Coal ash never failed a TCLP test. While coal ash contains elements that can be toxic in high dosages, so do multivitamins. Coal ash does not contain these elements at concentrations that are considered toxic. To say coal ash is toxic is flatly misleading.

Result of air pollution control – about 80% of coal ash is fly ash; 20% of ash is bottom ash

Storage of fly ash in ponds began which installation of electro-static precipitators starting in the late 1950s

Dry handling of fly ash has been done at some sites since the 1980s, which material sold for reuse.

Disposal of dry fly ash has occurred in on-site lined and unlined landfills.

Historically bottom ash was always sluiced to ponds

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Duke Energy Inventory of Unclosed Ash Ponds and Fills

	Ash Ponds (acres)	Total Fill (acres)	Total Acres	Ash Ponds (MM tons)	Total Fill (MM tons)	Total MM Tons
DEP	804	515	1,319	28.1	19.2	47.3
DEC	1,428	453	1,881	59.9	13.3	73.2
DEF	28	154	182	0.1	4.7	4.8
DEI	372	468	840	7.8	22.9	30.7
DEO & DEK	350	396	746	7.4	36.9	44.3
		Total Acres:	4,969		Total Tons:	200,411,361

- Total coal ash sites/structures- 24 sites/ 61 ponds; 58 structural/landfills
- Ash currently added to ponds- less than 1 million tons/year and decreasing
- Ponds serve multiple purposes (e.g., stormwater retention)

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Total Fill= Landfill is disposal while structural fill has a beneficial use (e.g., plant staging area, parking lot, warehouse, etc.)

New ash added to ponds is about 50/50 fly and bottom ash; most dry fly ash is being reused or disposed in lined landfills.

For example, MSS burns more than a unit train per day – a unit train is 120 cars, 10% ash

= 18,792 tons of coal/day and 1880 tons of ash/day

MSS 1-4 summer rating is 2087 MW (less than Belews Creek 1&2, Roxboro 1-4 and Crystal River 1, 2, 4, 5)

2014 estimate is about 4.5 MM tons produced with about 1 MM to ponds, 2.4 MM to landfills and 1.2 MM sold (rest is intra-station activity e.g., EBS and WHZ)

Ponds serve other functions – stormwater control, boiler chemical cleaning waste; other waste streams are treated and diluted in the ponds; ponds continue to operate after station is retired.

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Groundwater – What is it and How does it flow?

- Subsurface water, it can exist in different formations
- Flows along a gradient, generally following the land contour
  - Slowly, not like a river
- Constituents in the ground are transported by groundwater at different rates
- Receptors are those in the path of groundwater flow – i.e., downgradient
- Where groundwater flows into a water body, it is a barrier to distant receptors

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Presenter needs to be aware of question that may arise from the last bullet point.

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Receptors – Who is at Risk?

- Receptors are residential/industrial groundwater drinking water wells in the path of migrating groundwater
- Most drinking water is provided by municipal systems
- Individuals up-gradient are not at risk

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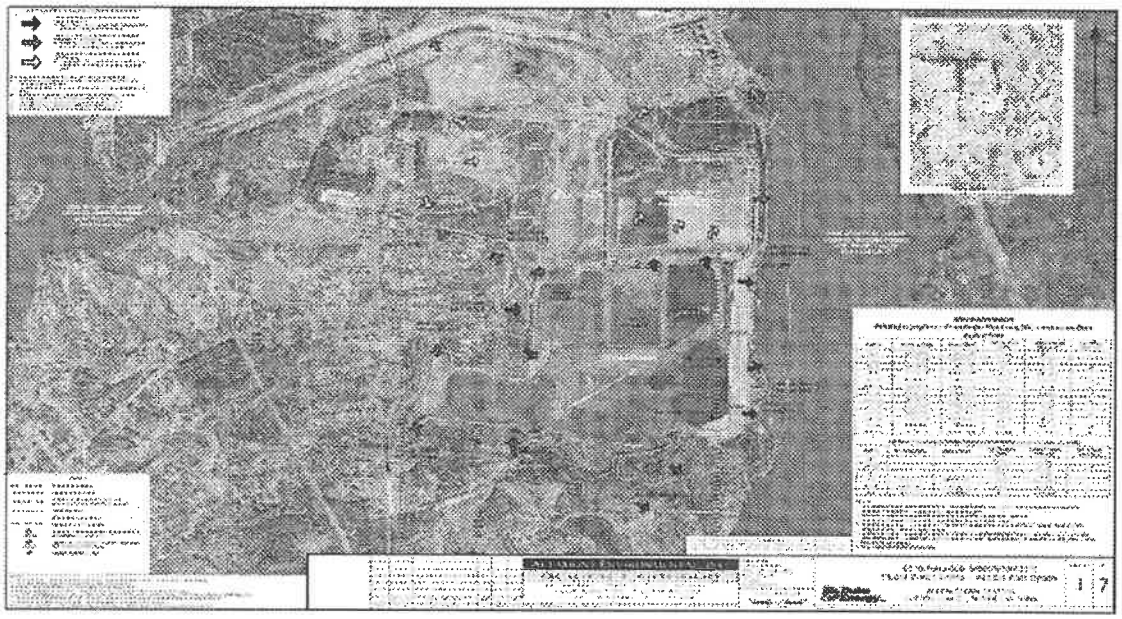
Example Groundwater Flow and Receptor Relationship



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Potentially Impacted Receptors: Status and Actions

Station	Constituent	Response
Asheville	Iron, manganese, thallium	Provided alternate water supply; more investigation
Sutton	Boron	Agreement to provide municipal connection to CFPUA
Allen	No impacts identified	NCDENR sampled neighbor's wells; results not back
Buck	Proximity only; No impacts identified	Continue monitoring
Cayuga	Boron	Provided municipal water connection; closing ash basin
Gibson	Boron	Provided municipal water connection; closing ash basin
Beckjord	Sulfate	Installed "interceptor" well

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Preemptive actions

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Ash Pond Closure Process- NC Example

1. Site Characterization and Select Closure Option
2. Develop Conceptual Closure Plan and Engage Regulator Input
3. Introduce Conceptual Closure Plan to Regulators/ Seek Concurrence
4. Develop Detailed Design
5. Regulatory Approval
   - NCDENR
   - US Army Corp of Engineers (Wetland Issues, Storm Water)
   - US Fish & Wildlife Svc/ NC Wildlife Resources Commission, if needed
6. Execution (Procurement, Construction)
7. Post-Closure Period (Groundwater Monitoring, Maintenance)

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- Materials – Ash quantities, ash depths
- Environmental – soil contaminant concentrations, ash concentrations, groundwater concentrations
- Geotechnical – information for evaluation of stability of ash and dikes
- For example, Buck Rookery Issue with USFWS and NCWRC

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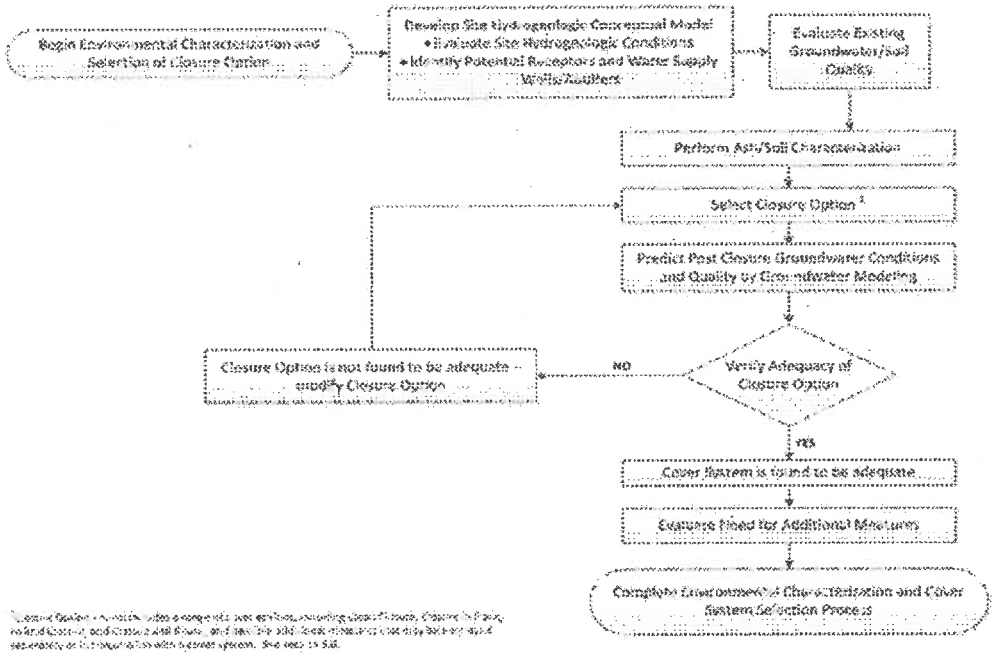
Environmental Characterization and Selection of Closure Option



Guidance for Developing Closure Plans for Ash Basins- Sept. 2012

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Illustrates site characterization closure option selection step in previous slide

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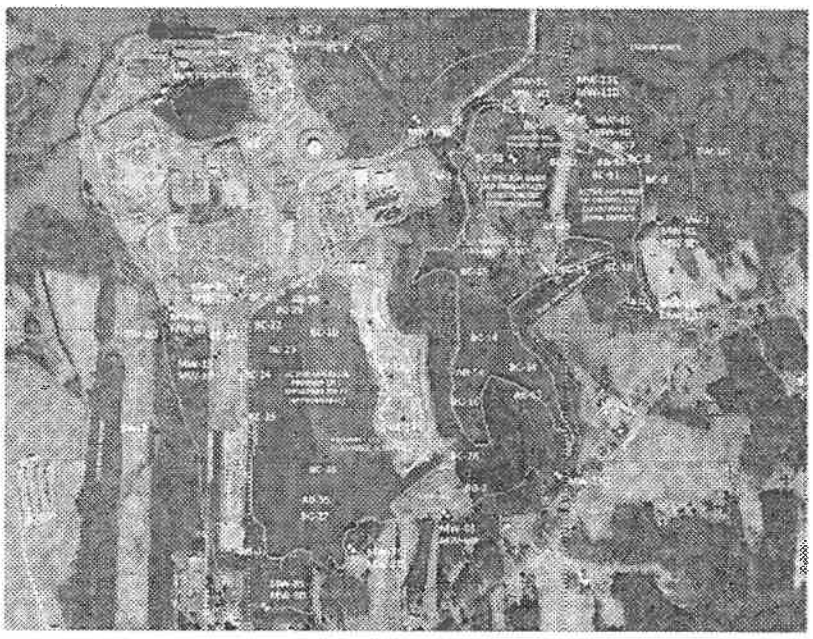
Example Investigation Plan – Buck Station



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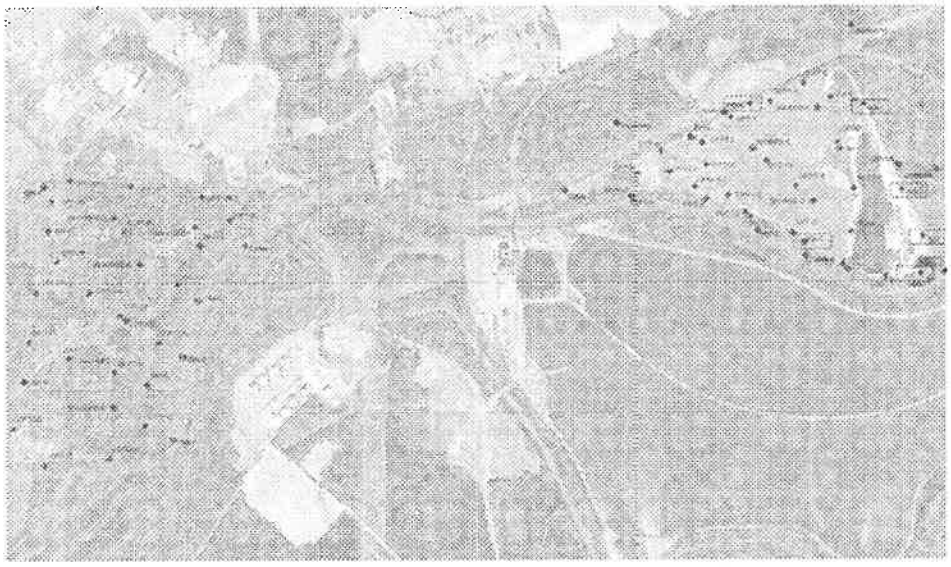
Example Investigation Plan – Lee (NC) Station



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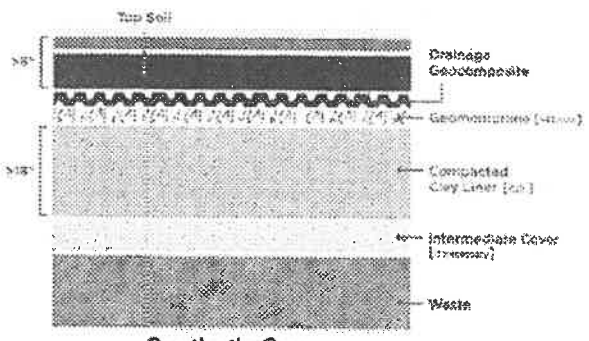
Current Closure Strategy

- Default Hybrid Closure Elements
  - Dewatering
  - Consolidating
  - Capping with synthetic cap
  - Monitoring (potentially 30 years)



Synthetic Cap

- Site specific studies – potentially will result in variations from default strategy
  - Geotechnical stability
  - Groundwater levels
  - Depth of ash
- Ensure Groundwater Quality

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Putting the synthetic cap in place takes over the primary function of the liner. The usefulness of a liner is very limited once a cap is installed.

Continue groundwater monitoring

Likely required for some period even with excavation and removal

Post-closure monitoring period is uncertain. Best guess is 30 years

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(same as closed Subtitle D landfills).

Costs: Ongoing maintenance (repair, mowing, fertilizing and seeding) regardless of method used

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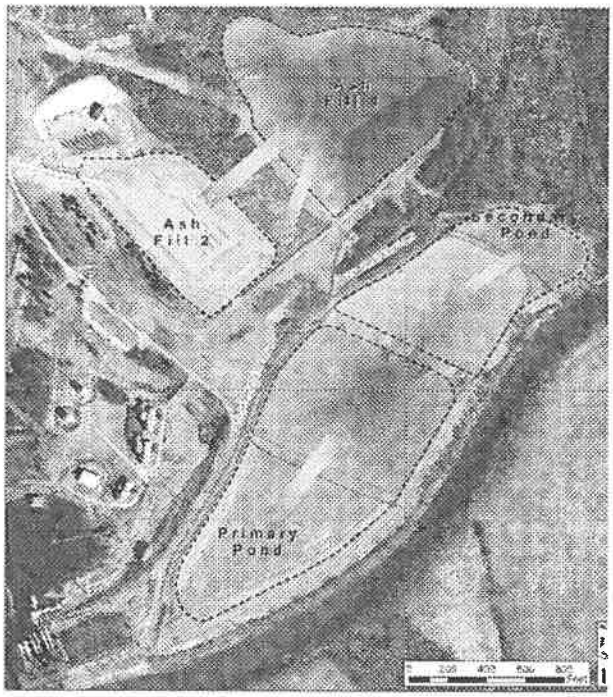
Ash Basin Closure Conceptual Design



Current Characterization & Design Work		
Station	Contractor	Complete
Weatherspoon	S&ME	Completed
Dan River	AMEC	1/17/2014
Buck	HDR	2/28/2014
Lee (NC)	Geosyntec	1/1/2014
Cape Fear	Geosyntec	1/1/2014

Scheduled for 2014		
Station	Start	Complete
Riverbend	Feb.	Aug.
Sutton	Feb.	Aug.
Robinson	April	Oct.
Wabash River	April	Oct.
Beckjord (Budget)	May	Nov.

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Accelerate the timing of closure – very limited ability; Already falling behind original retired plant schedule and dependent on state agency approval

Hybrid Closure might be considered in order to minimize the surface area of an engineered cover system or to minimize the amount of borrow material from other sources.

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Consolidating the Ash – Decreasing the Footprint

- Lowest cost of environmentally acceptable options
- Construction cost for the synthetic cap is expensive
  - Reducing the area to be capped reduces cost
  - Amount of consolidation will vary by site
- Smaller footprint results in lower post-closure maintenance/ monitoring costs
- Allows strategic movement of ash away from sensitive areas

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Requires less borrow soil material (e.g., secondary dike at Dan River or property line)

Beckjord last retired plant in fleet for ash basin closures likely 2023 based on budget available to begin site characterization in 2015 (about $650K for characterization and conceptual design)

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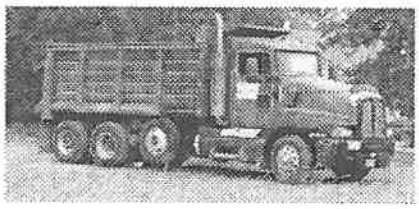
Excavate and Remove Option Considerations

- Siting, permitting and constructing lined landfill
  - 5 to 7 years after a suitable site
  - Going offsite increases time frame and litigation risk
  - Need to go offsite in nearly all cases
  - Litigation would extend timeline 2 to 3 years
  - Truck traffic
    - Virtually always a truck in sight
  - Substantial increased cost



750,000 tons/yr expected based on experience
6 days/week;12 hrs/day;120 truckload/day x 2 trips
= one truck every three minutes

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Increase extent of excavation and removal – increases both the timeline and overall cost; Removing from site requires an off-site landfill; this option delays commencement,

Hauling – 750,000 tons per year maximum – 6 days/week; 52 weeks/year; 120 truckloads x 2 trips = a truck every 3 minutes

Timeline to haul 1-36 years Miami Fort to Marshall

RBSS - 6 years

Sutton – 6.9 years

Allen – 15.1

Truck traffic

- Safety issues related to increased traffic- overturning, load loss, dusting, potential for crashes with passenger vehicles
- Community issues related to increased traffic- noise, roadway damage due to truck weight, traffic congestion

Substantial Increased cost

- Cost recovery issues, particularly where we choose to do more than is required

Landfill siting and permitting

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Paucity of suitable landfill sites may result in long haul distances

Opposition from environmental groups, site neighbors, and those along haul route

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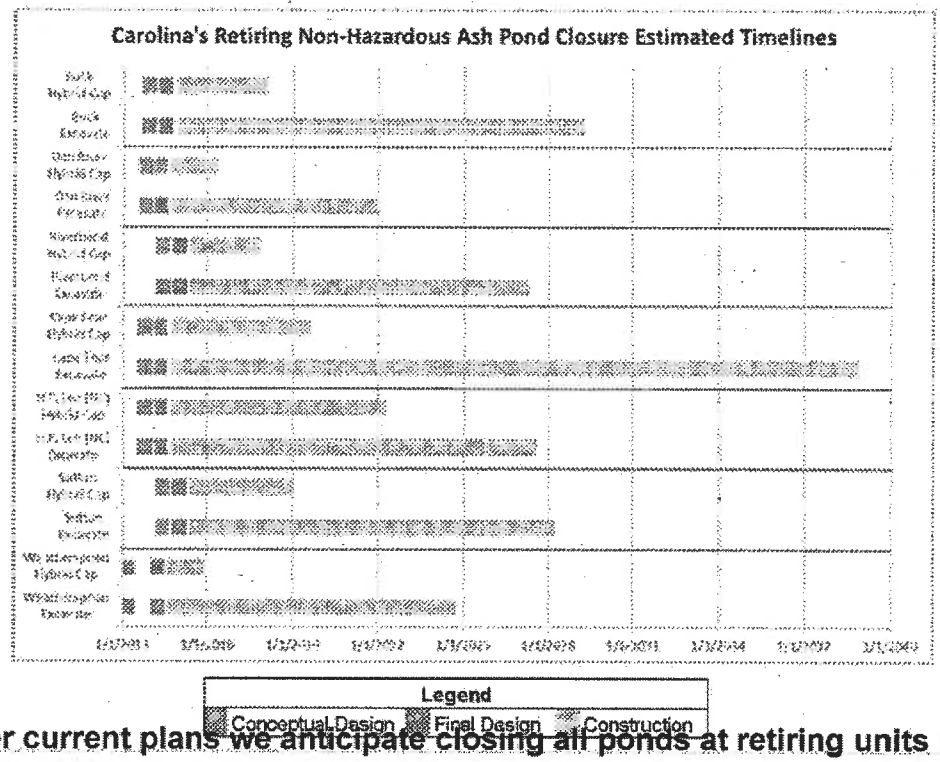

Under current plans we anticipate closing all ponds at retiring units using cap-in-place or hybrid by 2022 to 2023 (HF Lee; Beckjord)

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Litigation regarding the landfill permitting and construction could delay this schedule even longer.

Explain why Riverbend and Sutton not first in order and get date we plan to start study- 1st quarter next year – expectation is March. We will need to get out a RFQ in January so that the contractor could begin work around that time.

Landfill construction 5 to 7 years (additional 1 to 3 years if litigated)

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Dewatering

- Biggest environmental benefit of closure is dewatering
  - Less water flowing through ash
  - Less pressure "pushing" leachate into groundwater
  - Reduced seepage flow at some sites
- Before dewatering, stormwater must be rerouted
- Could possibly accelerate dewatering to achieve benefits sooner
  - Schedule for retired plants is already aggressive
  - Additional O&M to manage dust issues
  - Key driver for operating plants would be alternate wastewater treatment capacity

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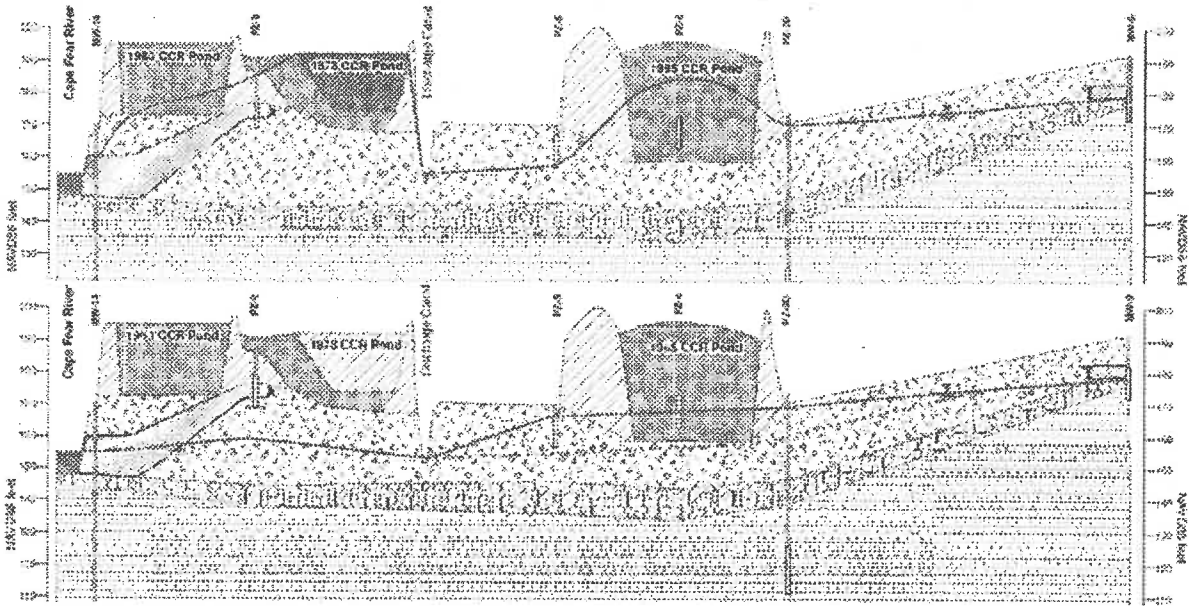
Representative Cross-Section of Pond Dewatering



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Ash Pond Closure Methodology

1. Have begun site characterization and conceptual closure design at several retired sites
2. Closure process for operating sites will be considered when regulatory risk of CCR and Effluent Limitations Guidelines (ELG) rules is manageable
3. Detailed engineering reviews ensure we understand all factors
4. Default strategy is cap-in-place/hybrid
5. Excavation and removal reviewed further if default strategy does not ensure groundwater quality
6. Throughout process, reuse options will be evaluated considering prudent cost, time to close and other factors
7. The selected closure plan will be implemented when cost effective reuse options do not exist (including other factors)

Our current hybrid strategy v. excavation and removal is:

- Protective of groundwater – more so if one considers timeliness
- Faster – benefits flow much sooner – decades in most cases
- More cost effective
  - Reduced impact to customers, responsible cost management and recovery issues

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Flexible - could excavate and remove if needed at a specific site

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Ash Ponds and Fills Closure Costs

	Non-Hazardous Cap-in-Place	Non-Hazardous Excavation	Hazardous Excavation	Comments
Tons Excavated	27.4M	146.5M	189.5M	Additional 40M tons already lined and/or capped would require excavation under hazardous classification (e.g., 20M tons in Gibson East Ash Pond)
Rate to Excavate, Load, Haul & Place	$5.66 to $7.05/ton	$8.44/ton	$60 to $104/ton	Hazardous handling estimates derived from EPRI study. Increased cost for certified drivers/operators, double-lined trucks, hazmat suits, cleaning, spill management, etc. Hazardous reclassification requires all off-site landfills for certain stations.
Acres of Additional Landfill	0	1,174	1,516	
Acres Capped (ponds & landfills)	3,327	1,591	1,945	
10-year Capital	$1.5B	$3.3B	$11.5B	
Capital to Completion	$1.5B	$7.1B	$23.0B	Excavation options extend beyond 10 years. Excavating 750,000 tons/year/station assumed

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Cap-in-place cost would not be lost if had to excavate & remove some (all) later since characterization studies, ash consolidation and other measures have value even for excavate and remove.

Typically look 10 years ahead for presentations. In previous presentation only the 10-year figure was provided. Total costs are over a 36-year period.

Assumptions & Risks:

Ash tonnages calculated using limited information. Due to age of the facilities, ash basin documentation is incomplete or does not exist, resulting in engineering estimates that are based upon some assumptions. Conceptual engineering studies will refine the ash tonnages.

Landfills were sited for each station and in many cases were offsite; selected by looking for open greenfields as close to the station as possible. No environmental, cultural, or public impacts were investigated; property values are unknown. If assumed locations are not available, costs will increase as the landfill location has to move outward, lengthening the haul distance.

Availability of qualified engineering firms to design, permit, and provide support during construction across the entire fleet during the same timeframe would be difficult and will increase costs. This is not factored into the estimates.

Availability and/or lack of qualified earthwork contractors and equipment to perform

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construction activities across the entire fleet during the same timeframe would be difficult and will increase costs. This is not factored into the estimates.

Closure costs recovery for going beyond what is legally acceptable may be difficult.

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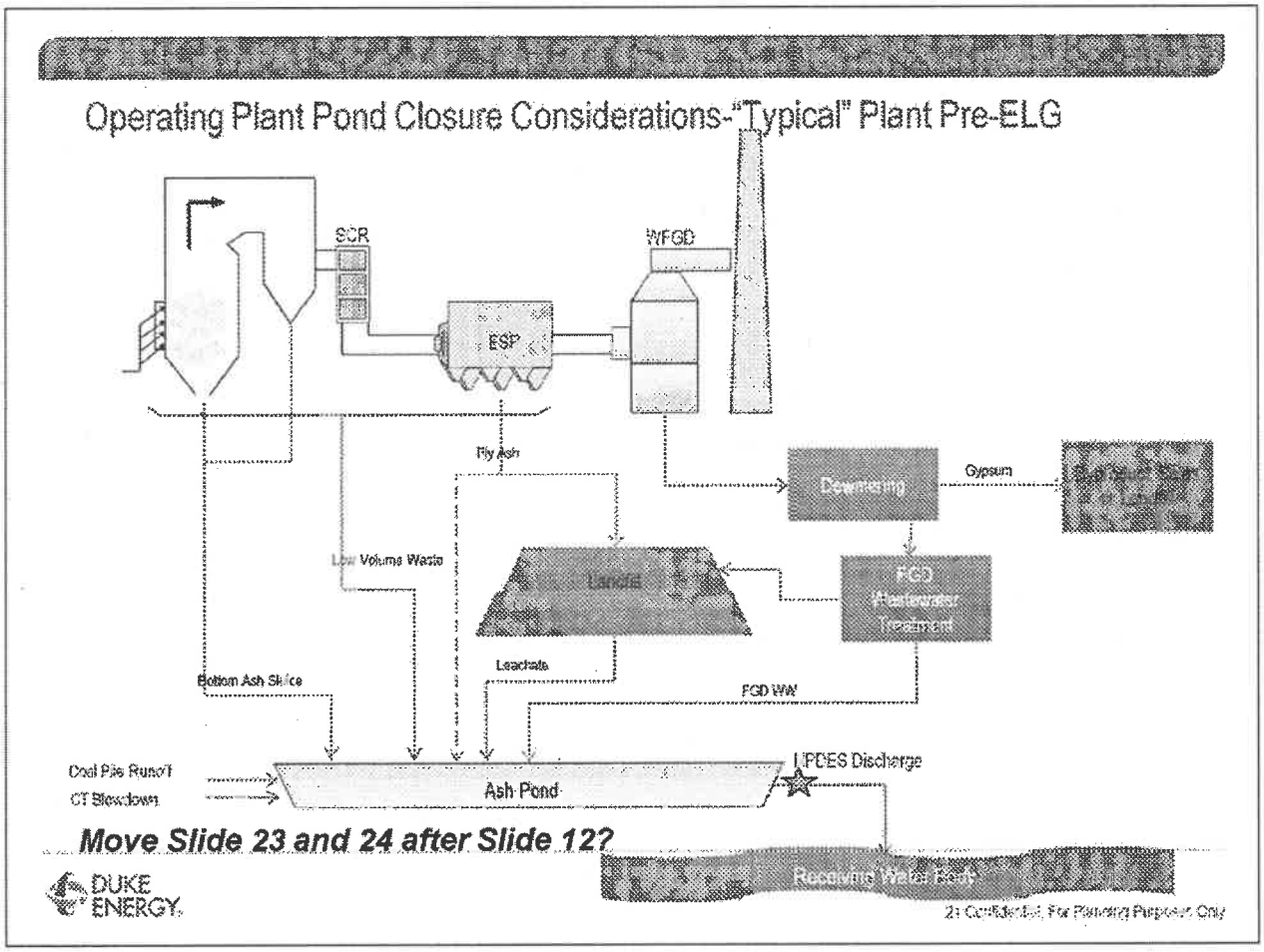

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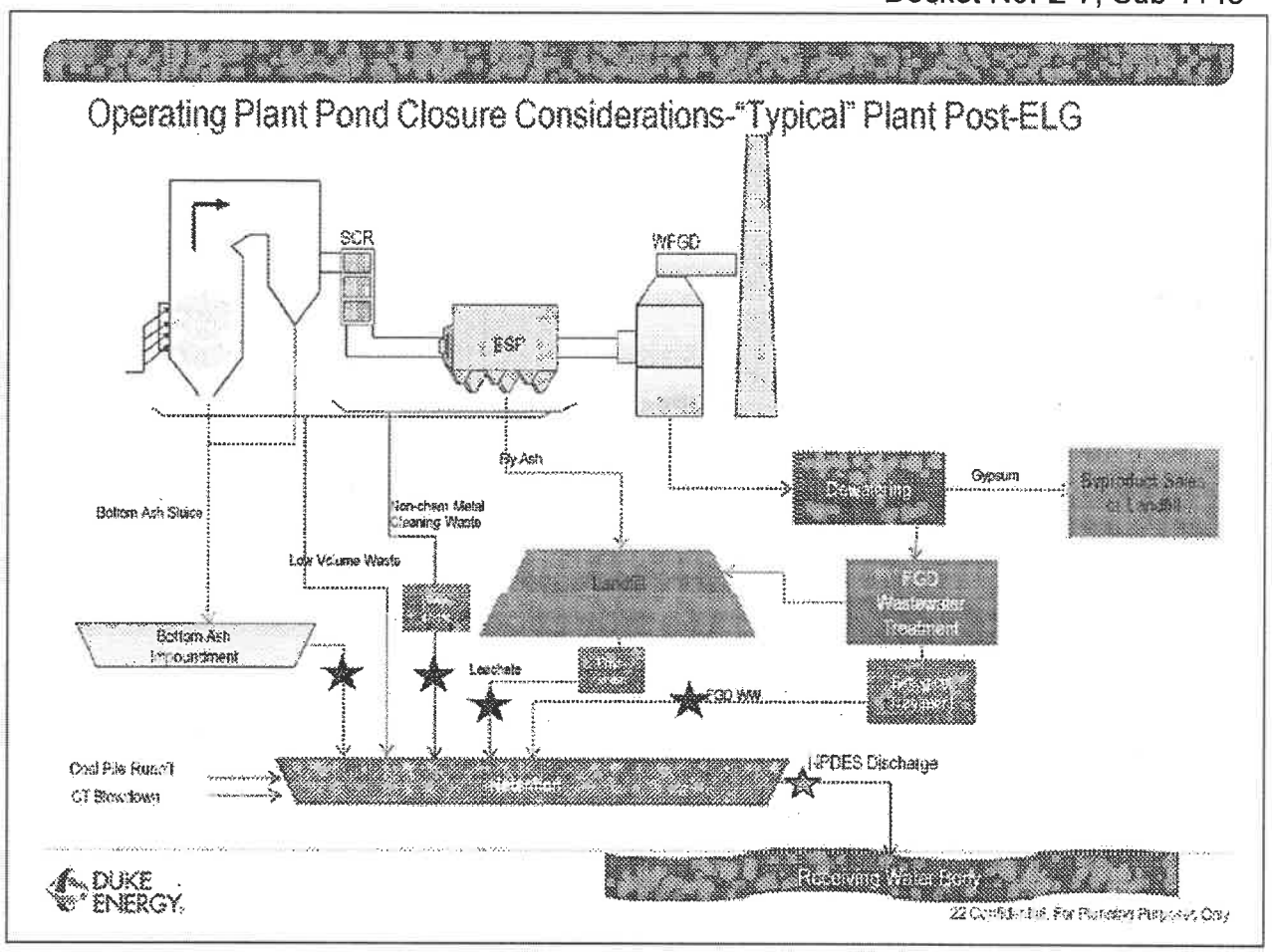

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Ash Basin Closure Plan Submittal

- Can take years to complete so beginning the process is important
  - Subject to state approval and likely litigation
- State requirements exist now and there is reasonable expectation that the federal rule will be based on Subtitle D
- Hastens natural attenuation to reduce constituents in groundwater
- Demonstrates effectiveness for other locations
- Weatherspoon Plan Ready for Submittal to NCDENR; Discussing Further

Expect vigorous SELC pushback when the plan is filed.

Scrutiny will only increase while reasonable efforts to close basins are not underway.

Concern over influence on judge in current consent decree and tie to recent Santee Cooper and SCANA decisions to excavate

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Riverbend Ash Pond Closure Options

– Airport option discussion

	Excavate to Airport	Excavate to Marshall	Hybrid Closure
Excavate Riverbend Pond	$2.75/ton	$7.13/ton	
Loading and Hauling Ash	$9.36/ton	$6.50/ton	
Landfill Development, Ash Placement & Closure	$15.84/ton	$8.55/ton	
	$27.95/ton	$22.28/ton	
	4.8M tons	4.8M tons	
Total	$134M	$107M	$35M

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Cost Recovery Issues

- The cost of retiring assets has been included in customer rates in the form of a Cost of Removal (COR) reserve
- Each jurisdiction's COR reserve is collected to build a reserve to be used to ultimately retire all assets (generation, transmission, distribution, etc.) other than those covered by the nuclear decommissioning fund
- The COR reserve continues to grow
- Future depreciation studies will determine the adequacy of the reserve to meet future retirements and collection of the COR reserve will be updated as necessary
- The COR reserve is not invested in a trust; therefore cash will have to be available to comply with the environmental regulations

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Option 1

Assumes: cap-in-place (inactive ponds only), cost estimates of $98M (DEC) and $265M (DEP) to be spent over 10 years and COR reserve used for all costs

Option 2

Assumes: cap-in-place (ALL ponds), cost estimates of $581M (DEC) and $463M (DEP) to be spent over 10 years and includes system upgrade costs of $310M (DEC) and $196M (DEP)

Option 3

Assumes: non-hazardous excavation, cost estimates of $4,212M (DEC) and $1,721M (DEP) to be spent over 20 years and approval to defer costs with a return between rate cases

The Company has been collecting dollars from customers for years to build a reserve to cover costs related the retirement of plant assets (particularly while the plant is still operating; interim retirements). The Cost of Removal Reserve covers all assets

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(generation, T&D, etc) other than those covered by the nuclear decommissioning reserve in the specific jurisdiction.

A depreciation study is usually conducted periodically (generally every 5 years) which includes updating the COR rates. If the reserve amount is lower than what the study determines is needed the COR portion of the depreciation rates would be increased. If the reserve is higher than what the study shows the COR portion of the depreciation rates increase would be decreased.

DEP in the Carolinas, very recently started including recovery for specific ash pond closure costs in their COR rates. DEC still does not have specific related ash pond closure costs in the COR rates.

COR dollars are not held separately (like a trust fund). So when the dollars are spent, it comes out of whatever cash the company has at that time (so liquidity is impacted).

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Cost Recovery Issues (Cont.)

$s in millions

	Total Cost of Removal Reserve (as of 6/30/15)	Steam Cost of Removal Reserve (as of 6/30/15)	Non-Hazardous Cap In Place	Non-Hazardous Excavation & Disposal	Hazardous Excavation & Disposal
DEC	$1,600	$224	$610	$1,300	$4,200
DEP	1,100	138	430	1,000	2,800
DEI	731	367	280	500	3,000
DEO	231	-	100	250	820
DEK	61	12	20	35	140
DEF	488	71	30	190	340
Total 10 year	$4,211	$812	~$1,500	~3,300	~11,500

- Total cost to completion for nonhazardous excavation is $7.1B and for hazardous excavation is $23.0B
- The company could potentially reallocate portions of the "total" COR to cover the cap-in-place ash pond costs
  - Regulatory approval likely to be required to do this

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This table shows the various 10 year scenarios and the COR reserve balances. The second column shows the portion reserved for the steam assets. Just because the "steam" reserve is lower than the planned costs does not mean we could not use some of the other "total" COR reserve to cover the ash pond costs.

There are different points of view as to what type of approval would be required to access the COR funds not specifically allocated to steam currently. One point of view is that no approval is needed and the other is that we would have to notify regulators of the usage. As mentioned earlier, the next depreciation study would likely show that you would need to replenish these reserves at the next rate case; especially anything beyond the steam COR.

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Regulatory Strategy for Ash Pond Cost Recovery

– To the extent COR reserves are not adequate or available to cover ash pond closure scenarios, recovery could be sought as described below:

- **DE Carolinas and DE Progress** – approval could be requested to defer any to the next rate case for recovery
- **DE Indiana** – costs could be addressed through a federal mandates rider that collects 80% of the costs if the expenditures are related to federal mandates and the remaining 20% will be deferred to the next rate case
- **DE Ohio** – recovery is less likely but various legislative initiatives are being considered at this time (pending asset transfer adds complexity to potential recovery)
- **DE Kentucky** – costs will be addressed through the normal ratemaking process or via the Environmental Surcharge Mechanism (ESM)
- **DE Florida** – all costs, not just the portion not covered by the COR reserve, will be addressed through the Environmental Cost Recovery Clause (ECRC)

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Regardless of closure method we expect to recover all costs over time, assuming prudent methodologies are chosen, the only unknown is DE Ohio

This slide shows the strategy we would use by jurisdiction in the case that COR funds cannot cover the ash closure costs or we do not get approval to use beyond the steam amount.

So depending on the closure costs there will be an impact on customer rates in the next rate case and we will have to prove to regulators that the decision made was the least cost choice and the dollars were spent prudently.

Regardless of closure method we expect to recover all costs over time, assuming prudent methodologies are chosen, the only unknown is DE Ohio.

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Intervening & Limiting Issues

- CCR and Effluent Limitation Guidelines (ELG)
  - Will vary from proposed rules adding some regulatory risk to current closure plans
  - Final ELG and CCR rules are not expected until the end of 2014
- Court Entry of NC Consent Order
  - Terms of the proposed Order are known but could be changed by the court
  - Entry is expected in 1Q14 for Asheville and Riverbend, and should serve as a template for the remaining NC plants (before any Plan approval)

USWAG believes that RCRA does not give EPA authority to regulate inactive CCR sites (i.e., that ceased receiving CCR prior to the effective date of the final rule).

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Appendix

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Pending Environmental Regulations

	Rule overview	Potential impacts to Duke Energy
Coal Combustion Residuals Rule (CCR)	• Regulates CCR (i.e., coal ash); proposed in June 2010 • Court-ordered deadline litigation October 2013 ruling • EPA indicating December 2014 before it finalizes the rule • Indications that final rule may be non-hazardous	• Close or upgrade wet ash ponds • Upgrade wet ash handling to dry • New wastewater treatment
Clean Water Act 316(b) Cooling Water Intake Structures Rule	• Targets minimizing the impact to aquatic life from the location or operation of cooling water intake structures • New rule proposed in April 2011; multiple delays have occurred • EPA now to finalize rule in January 2014 per settlement agreement	• Modification of existing cooling water intake structures or cooling tower installations • Timing of unit retirements if cooling towers are required
Steam Electric Power Generating Effluent Limitations Guidelines (ELG)	• Establishes technology-based wastewater discharge limits for steam electric generating facilities • Applies to coal, gas-fired, combined cycle, and nuclear, with proposed revisions primary affecting coal • Coordinated with the CCR rule • Proposed rule published on June 7, 2013 • EPA to finalize rule in May 2014 per settlement agreement but delay is likely	• Upgrade wet fly ash handling to dry • New/upgraded wastewater treatment systems

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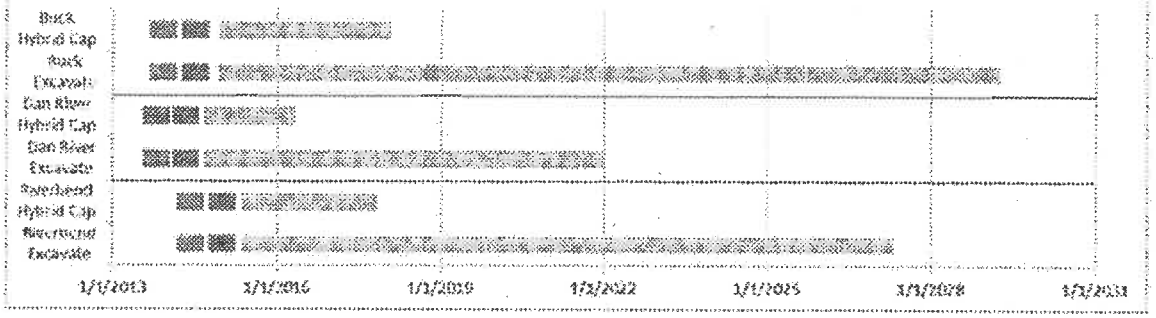
Duke Energy Carolinas Retired Ash Ponds

Station	Non-Hazardous Hybrid Cap (-10%,+20%)	Non-Hazardous Excavating (-10%,+40%)	Hazardous Excavating (-10%,+50%)
Buck	$ 41,160,030	$ 222,153,709	$ 520,247,681
Dan River	$ 21,660,223	$ 49,245,450	$ 74,136,450
Riverbend	$ 34,764,370	$ 180,110,921	$ 537,037,838

Legend
- Conceptual Design
- Final Design
- Construction

Non-Hazardous Closure Estimated Timelines



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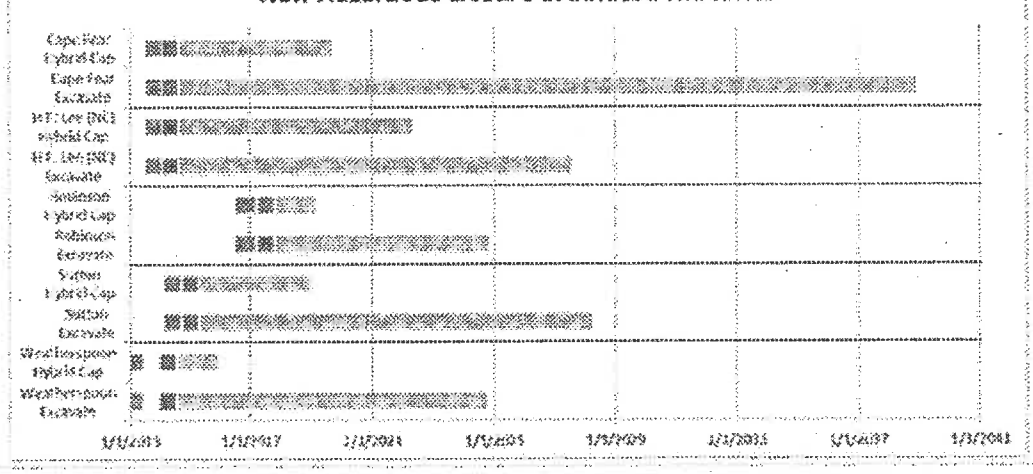
Duke Energy Progress Retired Ash Ponds

Station	Non-Hazardous Hybrid Cap (-10%,+20%)	Non-Hazardous Excavating (-10%,+40%)	Hazardous Excavating (-10%,+50%)
Cape Fear	$ 79,301,092	$ 557,413,424	$ 1,242,461,739
H.F. Lee (NC)	$ 64,791,241	$ 201,479,526	$ 475,915,193
Robinson	$ 30,062,445	$ 32,477,571	$ 55,332,632
Sutton	$ 59,452,176	$ 185,641,409	$ 476,781,193
Weatherspoon	$ 31,166,512	$ 111,809,658	$ 263,368,159

Legend
- Conceptual Design
- Final Design
- Construction

Non-Hazardous Closure Estimated Timelines



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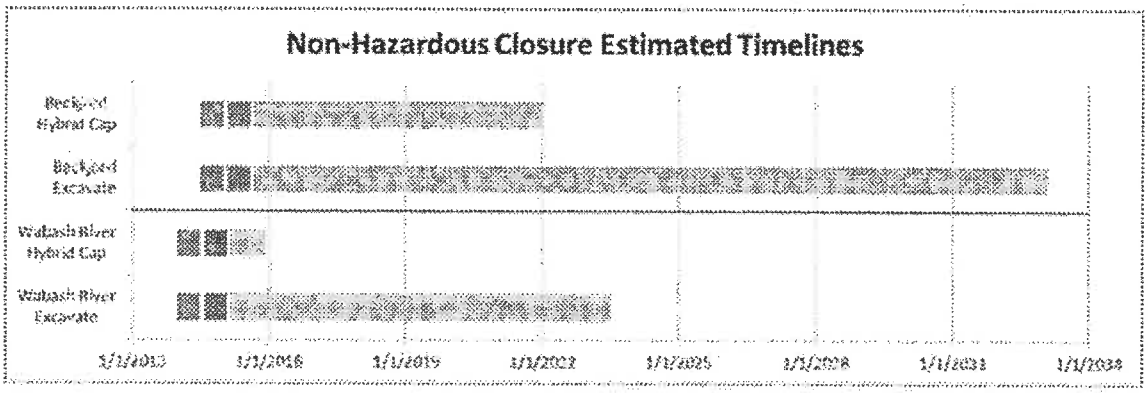
Duke Energy Ohio & Indiana Retired Ash Ponds			
Station	Non-Hazardous Hybrid Cap (-10%,+20%)	Non-Hazardous Excavating (-10%,+40%)	Hazardous Excavating (-10%,+50%)
Beckjord	$ 41,873,319	$ 317,288,305	$ 596,845,396
Wabash River	$ 48,004,780	$ 61,805,344	$ 440,338,625

Legend
- Conceptual Design
- Final Design
- Construction



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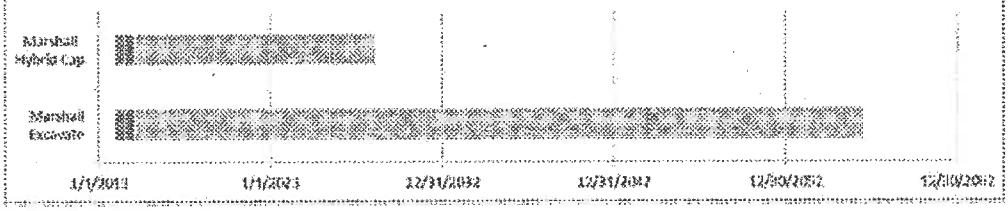
Duke Energy Operating Ash Ponds

Station	Non-Hazardous Hybrid Cap (-10%,+20%)	Non-Hazardous Excavating (-10%,+40%)	Hazardous Excavating (-10%,+50%)
Allen	$ 95,446,399	$ 497,485,022	$ 899,414,442
Asheville	$ 18,562,209	$ 60,987,762	$ 440,928,344
Belews Creek	$ 125,423,443	$ 564,761,515	$ 1,323,903,631
Cayuga	$ 52,444,779	$ 133,673,275	$ 648,318,307
Cliffside	$ 58,702,947	$ 228,776,058	$ 577,152,430
Crystal River	$ 33,186,482	$ 194,503,065	$ 343,961,931
East Bend	$ 17,252,091	$ 36,683,367	$ 116,673,722
Gallagher	$ 49,342,935	$ 165,216,969	$ 895,416,662
Gibson	$ 133,232,459	$ 190,124,858	$ 8,286,368,453
Lee (S.C.)	$ 29,801,516	$ 80,329,551	$ 205,768,454
Marshall	$ 203,566,551	$ 2,388,606,224	$ 2,731,780,088
Mayo	$ 63,406,161	$ 204,931,251	$ 579,539,991
Miami Fort	$ 12,839,993	$ 40,701,643	$ 195,581,562
Roxboro	$ 86,614,407	$ 366,670,125	$ 787,346,647

Legend
- Conceptual Design
- Final Design
- Construction

Non-Hazardous Marshall Estimated Timeline



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Duke Energy Ash Pond Closure Cost Estimates			
Region	Non-Hazardous Hybrid Cap (-10%,+20%)	Non-Hazardous Excavating (-10%,+40%)	Hazardous Excavating (-10%,+50%)
Duke Energy Carolinas	$ 610,545,479	$ 4,211,468,450	$ 6,869,441,014
Duke Energy Progress	$ 433,356,243	$ 1,721,410,726	$ 4,321,673,898
Duke Energy Florida	$ 33,186,482	$ 194,503,065	$ 343,961,931
Duke Energy Indiana	$ 283,024,953	$ 550,820,447	$ 10,270,442,047
Duke Energy Ohio	$ 51,273,242	$ 347,085,229	$ 761,260,518
Duke Energy Kentucky	$ 20,692,161	$ 47,586,086	$ 147,840,162

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Remaining Dry Ash Conversion Capital Project Cost Estimates (Non-Hazardous)

Project	Facility	Sum of 2013	Sum of 2014	Sum of 2015	Sum of 2016	Sum of 2017	Sum of 2018	Sum of 2019	TOTAL COSTS
Dry Flyash Collection	Asheville	$0	$0	$59,045	$79,668	$2,841,040	$8,535,920	$0	$15,409,573
	Cayuga	$11,386,088	$25,890,333	$6,973,706	$0	$0	$0	$0	$44,250,154
	Cliffside	$0	$0	$0	$2,377,075	$2,569,354	$13,365,744	$519,369	$24,831,672
	Killen	$0	$0	$0	$1,321,134	$4,762,687	$7,428,431	$288,729	$13,800,980
	Mayo	$325,348	$129,415	$207,010	$4,657,710	$0	$0	$0	$5,429,481
	Roxboro	$3,065,206	$16,298,109	$28,073,660	$1,485,458	$2,509,000	$0	$0	$51,342,431
	Sutton	$0	$0	$6,979,874	$3,171,692	$7,602,835	$6,259,174	$4,597,019	$24,130,615
	TOTAL	$14,726,835	$42,317,857	$35,967,326	$13,072,738	$29,375,916	$35,589,269	$5,345,265	$179,194,906
Dry Bottom Ash Collection	Allen	$0	$0	$0	$7,837,134	$11,685,958	$24,079,327	$21,701,849	$65,306,961
	Asheville	$0	$0	$625,912	$3,808,951	$2,747,014	$11,704,635	$266,840	$26,155,341
	Belews Creek	$0	$0	$0	$6,678,758	$16,223,481	$47,930,132	$13,001,907	$83,834,289
	Cayuga	$0	$0	$0	$3,277,056	$12,390,089	$21,576,692	$5,886,183	$43,119,920
	Cliffside	$0	$0	$0	$4,468,122	$14,172,471	$26,224,434	$980,421	$45,883,448
	Conesville	$0	$0	$0	$523,130	$2,361,294	$4,664,269	$4,383,920	$12,182,610
	East Bend	$0	$0	$0	$1,661,752	$8,845,540	$14,103,873	$12,711,116	$35,323,311
	Gallagher	$0	$0	$0	$1,036,535	$4,270,744	$8,797,730	$7,928,950	$22,034,018
	Gibson	$0	$0	$609,688	$10,126,837	$33,946,801	$54,793,619	$20,609,900	$120,087,756
	Killen	$0	$0	$0	$1,376,187	$5,592,185	$5,892,538	$544,469	$13,405,379
	Marshall	$0	$0	$0	$5,597,998	$21,171,342	$38,293,108	$20,269,672	$85,150,906
	Mayo	$6,705,400	$0	$0	$0	$0	$0	$0	$6,705,400
	Miami Fort	$0	$0	$1,339,463	$5,703,196	$11,487,603	$7,396,080	$276,979	$26,093,221
	Roxboro	$0	$0	$2,480,772	$12,747,200	$38,697,546	$38,374,717	$16,377,799	$80,615,034
	Sutton	$0	$0	$916,672	$5,192,949	$12,447,971	$13,622,581	$7,438,404	$39,608,578
	TOTAL	$6,705,400	$0	$5,973,518	$65,195,071	$202,122,947	$305,478,932	$142,109,372	$727,476,239
Dry Flyash Collection and Fixation	Gibson	$2,511,230	$103,885	$0	$0	$0	$0	$0	$2,615,115
	TOTAL	$2,511,230	$103,885	$0	$0	$0	$0	$0	$2,615,115
	GRAND TOTAL	$23,944,265	$42,421,742	$41,840,843	$78,267,809	$231,498,863	$343,068,201	$147,454,637	$909,296,360

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Duke Energy Steam Facility Data (As of 9/30/13)

Structure	Operating state	Jurisdiction	Steam unit/facility name	Owned capacity – summer rating (MW)	Fuel type	Current cooling method	Air Emissions controls	Ash handling (dry/wet, bottom ash)	Ash ponds on site (3)
Regulated	In Operation	DE Carolinas	Allen	1,429	Coal	Once-Through	Scrubber	Dry; Wet Sluice	Active and Inactive
Regulated	In Operation	DE Carolinas	Belews Creek	2,220	Coal	Once-Through	Scrubber and SCR	Dry; Wet Sluice	Active and Inactive
Regulated	In Operation	DE Carolinas	Cliffside 5	568	Coal	Closed Cycle	Scrubber and SCR	Wet Sluice; Wet Sluice	Active and Inactive
Regulated	In Operation	DE Carolinas	Cliffside 6	825	Coal	Closed Cycle	Scrubber and SCR	Dry; Dry	
Regulated	In Operation (2)	DE Carolinas	Lee	370	Coal	Once-Through		Wet Sluice; Wet Sluice	Active and Inactive
Regulated	In Operation	DE Carolinas	Marshall	2,658	Coal	Once-Through	658MW with Scrubber and SCR; 1428MW with Scrubber	Dry; Wet Sluice	Active and Inactive
Regulated	In Operation	DE Carolinas	Buck CC	599	Gas	Closed Cycle	SCR		Inactive
Regulated	In Operation	DE Carolinas	Dan River CC	620	Gas	Closed Cycle	SCR		Inactive
Regulated	In Operation	DE Carolinas	Oconee	1,866	Nuclear	Closed Cycle			
Regulated	In Operation	DE Carolinas	McGuire	2,200	Nuclear	Once-Through			
Regulated	In Operation	DE Carolinas	Oconee	2,538	Nuclear	Once-Through			
Regulated	In Operation	DE Progress	Asheville	376	Coal	Once-Through	Scrubber and SCR	Wet Sluice; Wet Sluice	Active and Inactive
Regulated	In Operation	DE Progress	Mayo	748	Coal	Cooling Lake	Scrubber and SCR	Dry; Dry	Inactive
Regulated	In Operation	DE Progress	Roxboro 1-4	2,327	Coal	Once-Through (1-3); Closed Cycle (4)	Scrubber and SCR	Dry; Wet Sluice	Active and Inactive
Regulated	In Operation (3)	DE Progress	Sutton 1-3	575	Coal	Cooling Lake		Wet Sluice; Wet Sluice	Active and Inactive
Regulated	In Operation	DE Progress	Smith 4-5	1,122	Gas	Closed Cycle	SCR		
Regulated	In Operation	DE Progress	Wayne County CC	830	Gas	Closed Cycle	SCR		Inactive
Regulated	In Operation	DE Progress	Brunswick	1,847	Nuclear	Once-Through			
Regulated	In Operation	DE Progress	Darlington	740	Nuclear	Cooling Lake			
Regulated	In Operation	DE Progress	Robinson	724	Nuclear	Once-Through			Inactive
Regulated	In Operation	DE Florida	Avon Park	1,641	Gas	Once-Through			
Regulated	In Operation	DE Florida	Bartow CC	1,133	Gas	Once-Through	SCR		
Regulated	In Operation (3)	DE Florida	Crystal River 1-2	873	Coal	Once-Through		Dry; Dry	Active
Regulated	In Operation	DE Florida	Crystal River 4-5	1,422	Coal	Closed Cycle	Scrubber and SCR	Dry; Dry	
Regulated	In Operation	DE Florida	Hines CC	1,917	Gas	Cooling Lake	SCR		
Regulated	In Operation	DE Florida	Suwannee River	749	Gas/Oil	Once-Through			
Regulated	In Operation	DE Florida	Tiger Bay	285	Gas	Closed Cycle			

(1) [illegible] potential to be retired; MATS compliance options are being reviewed

(3) "Inactive" means that the storage facility is not currently receiving ash

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Duke Energy Steam Facility Data, cont. (As of 9/30/13)

Structure	Operating state	Jurisdiction	Steam unit/facility name	Owned capacity—summer rating (MW)	Fuel type	Current cooling method	Air Emissions controls	Ash handling (fly ash; bottom ash)	Ash ponds on site (3) (4)
Regulated	In Operation	DE Indiana	Cayuga	1,005	Coal	Once-Through	Scrubber, SCR Lowe, Combustion	Wet Sluice (Dry Under Construction); Wet Sluice	Active and Inactive
Regulated	In Operation	DE Indiana	Gibson	2,922	Coal	Cooling Lake, No NPDES Permit	Scrubber and SCR	Dry; Wet Sluice	Active and Inactive
Regulated	In Operation (1)	DE Indiana	Wabash River	668	Coal	Once-Through		3 Wet/1 Dry; Wet Sluice; Wet	Active and Inactive
Regulated	In Operation	DE Indiana	Gallagher 2&4	280	Coal	Once-Through	Bagnouse	Dry; Wet Sluice	Active and Inactive
Regulated	In Operation	DE Indiana	Edwardsport IGCC	618	Coal	Closed Cycle - No Water	Selexol and SCR	Dry Slag Handling	
Regulated	In Operation	DE Indiana	Noblesville CC	310	Gas	Closed Cycle			
Regulated	In Operation	DE Kentucky	East Bend	414	Coal	Closed Cycle	Scrubber and SCR	Dry; Wet Sluice	Active
Regulated	In Operation (1)	DE Kentucky	Miami Fort 6	163	Coal	Once-Through		Wet Sluice; Wet Sluice	Active
Non-Regulated	In Operation	DE Ohio	Conesville 4	312	Coal	Closed Cycle	Scrubber and SCR	Dry; Wet Sluice	Active
Non-Regulated	In Operation	DE Ohio	Stuart 1-3	675	Coal	Once-Through	Scrubber and SCR	Wet Sluice; Wet Sluice	Active
Non-Regulated	In Operation	DE Ohio	Stuart 4	225	Coal	Closed Cycle	Scrubber and SCR	Wet Sluice; Wet Sluice	
Non-Regulated	In Operation	DE Ohio	Killen	158	Coal	Closed Cycle	Scrubber and SCR	Wet Sluice; Wet Sluice	Active
Non-Regulated	In Operation (1)	DE Ohio	Zimmer	333	Coal	Once-Through		150 Mw Dry; Wet 163 MW Wet; Wet	Active and Inactive
Non-Regulated	In Operation	DE Ohio	Miami Fort 7-8	649	Coal	Closed Cycle	Scrubber and SCR	Dry; Wet Sluice	Active
Non-Regulated	In Operation	DE Ohio	Beckjord	805	Coal	Closed Cycle	Scrubber and SCR	Dry; Dry	
Non-Regulated	In Operation	Duke Energy	Fayette CC	633	Gas	Closed Cycle	SCR		
Non-Regulated	In Operation	Duke Energy	Hanging Rock CC	1,226	Gas	Closed Cycle	SCR		
Non-Regulated	In Operation	Duke Energy	Washington CC	620	Gas	Closed Cycle	SCR		
Regulated	Under Construction	DE Progress	Sutton CC	621	Gas	Closed Cycle	SCR		

(1) [illegible]

(2) "Inactive" means that the storage facility is not currently receiving ash

(3) Other locations with inactive ash ponds include Buck, Dan River, Riverbend, Cape Fear, and Weatherspoon Stations

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(5) Coal-fired Fossil Steaming Facilities Only

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M. Ash basin closure planning, dated January 2014

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Ash basin closure planning

Duke Energy remains committed to closing ash basins in a way that protects groundwater long-term and is prudent for our customers and plant neighbors. Duke Energy is leveraging significant expertise to arrive at closure plans that will protect neighbors and the environment. Our decisions on ash basin closure are based on site-specific conditions and well-accepted industry and engineering practices.

As a regulated utility, the costs for ash basin closure and other activities are typically paid for by our customers, so it is our responsibility to make prudent, fact-based decisions.

Closure methods

Our preferred method for closing a basin is a hybrid closure, which involves some excavation to relocate and consolidate ash to a smaller footprint before installing a synthetic capping system. Each site is unique, however, and the solution will be customized. At sites where studies determine groundwater would not be well protected through a capping system, we will also evaluate excavation and removal of ash.

Capping ash basins with a synthetic barrier is significantly less expensive and can be completed faster than a full excavation. Excavation and removal brings a host of other considerations for our customers and plant neighbors, including a much longer completion date, substantially higher costs and heavy truck traffic. In many cases, removal would require siting, permitting and constructing a new offsite landfill before excavation could even begin.

Closure steps

picture of retired site?

- Conduct scientific and engineering studies
- Select most appropriate closure option
- Develop conceptual closure plan
- Engage regulator input
- Develop detailed engineering design
- Submit plan for regulatory approval with appropriate agencies
- Execute plan, including procurement and construction
    - Dewater basin
    - Consolidate ash
    - Install synthetic capping system
- Implement post-closure monitoring and maintenance program
    - Monitor groundwater 30 years unless otherwise specified by state regulators

January 2014

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N. Environmental Compliance Implementation Team Meeting Minutes, dated February 4, 2014

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Environmental Compliance Implementation Team - Meeting Minutes

Meeting Location: ECI-1101 / Live Meeting	**Date Prepared:** 2/7/14
Meeting Date: 2/4/14 2:00-4:30 p.m. EST	**Prepared By:** Dan Sympson
Subject: ECIT Monthly Meeting	
Attendees: Joe Miller, Mike Sharp, Peter Hoeflich, Dave Waugh, Brandon Delis, Mike Olive, Harry Lancaster, Brett Phipps, Dan Sympson, Ben Albright, Eric Kinstler, Dayna Herrick, Keith Pike	**Not Present:** Mitch Griggs, Shannon Todd (Dayna Herrick filled in), Dave Mitchell, Richard Baker, Mark Teague, Issa Zarzar, Reggie King (Eric Kinstler filled in) **SharePoint Address:** https://team.duke-energy.com/sites/AE/AE/ECIT/default.aspx

Item No.	Meeting Notes	Action By (Due Date)
1	***Safety Topic*** (Dayna Herrick): "Preparing for Emergencies in the Workplace" • The presentation has been uploaded to the SharePoint	
2	***Roll call*** (Dan Sympson) • Several ECIT members were assisting with the Dan River ash release and were not available for the meeting.	
3	***Future Regulatory Review Monthly Update*** *(Brandon Delis filled in for David Mitchell and Richard Baker)* • ELG Guidelines – EPA won't make their deadline of May 22nd, we are now expecting it to be delayed until at least September. We received a data request from the EPA for 6 of our facilities (Allen, Belews Creek, Cliffside, Miami Fort, Mayo and Roxboro). Our deadline for the data request is February 24th. USWAG received a similar data request. • 316(B) – The EPA agreed to provide the schedule by January 28th. Expectation is they will finalize the rule by March 1st. Update on February 10th from Nathan Craig stated new agreement with the Riverkeeper to move final rule deadline to April 17th. • CCR – Per the consent decree filed on January 29th the EPA is required for finalize the rule by December 19th, 2014.	
4	***12&0 Environmental Compliance Forecast Update and Process Overview*** (Keith Pike) • Keith presented the "ECIT Environmental Cost Forecast Development". • The presentation outlined the environmental compliance plan development, assumptions, rule timing, cost estimates and budgeting processes. • The presentation has been uploaded to the SharePoint	

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5	**Environmental Compliance Planning Updates 3:15 – 4:00** *(New standing agenda item)* • ***Air*** *(Peter Hoeflich)* o Peter talked from the "Feb 2014 ECIT Air Issues.pptm" document. o Eric Kinstler requested information ASAP if any changes to the Allen ACI strategy were going to be recommended. o The air Issues document has been uploaded to the SharePoint • ***Water*** (Brandon Delis) o Update on ELG data request. Nathan Craig is leading team. o ELG Rulemaking – Pilot station at AEP Amos station located in West Virginia is delayed another month. ▪ Focusing on trim technologies, i.e. media filters ▪ Manifold with 6 technologies are run in parallel o Frontier system is being tested at Belews Creek ▪ Performance is encouraging ▪ Working with USWAG on communication plan ▪ Effective on Se with less required resonance time ▪ Next trail planned for Crystal River o Misc water issues ▪ Roxboro – ZLD replaced with Phys-chem in the 12x0 plan, still evaluating all alternatives ▪ Asheville – investigating FGD waste water options ▪ Crystal River North – waste water KT rescheduled for March 18th – 19th • ***Waste*** (Dave Waugh) o Dan River – We have reviewed conceptual closure study by AMEC and should be ready to present it to ECIT by March 1st. o Weatherspoon – Should be ready to submit conceptual closure study later this month to NCDENR pending upper management review and approval. o Buck – KT planned toward the end of February to evaluate multiple scenarios. Conceptual closure study should be completed by April 1st. o Lee (North Carolina) – KT complete. Conceptual closure study should be finished by the end of this month. o Cape Fear – KT complete. Recommended hybrid closure on two active ponds. Phyto cover on old ash ponds. Finishing conceptual closure this month. o Riverbend, Robinson, Sutton - Preparing to kick-off RFP for conceptual closure in March. Contractors will be AMEC, HDR, or Geosyntec o Approval Process: Get blessing from DENR on conceptual closure then start detailed engineering. o Wabash River - Conceptual closure RFP. Study completed by the end of the year.	

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6	***Open Discussion*** (all) • Joe Miller asked about the status of MCG MATS Hg trim strategy. Ben Albright shared they plan to install Hg re-emission chemical and calcium bromide pump skids but not the storage tanks. Systems will be initially fed from totes. They are targeting late spring, early summer for completion of systems.	
7	***Status of open action items from previous meetings (meeting date)*** • None discussed during this meeting.	
8	***Identify Potential Future Agenda Items*** (all) • Geosyntec to present Phyto cover concept to ECIT for approval – Cape Fear (Geosyntec / Dave Waugh) – *Tentatively scheduled for March* • Dan River update and conceptual closure plan for Lee (Dave Waugh / Henry Taylor) - *Tentatively scheduled for March* • Asheville Ash Management Strategy Update (Brandon Delis) – *Tentatively scheduled for April* • Buck conceptual closure plan presented to ECIT for approval (Dave Waugh / Henry Taylor) - *Tentatively scheduled for April* • 316(B) Florida Specific issues (Nathan Craig, Brandon Delis) – *Tentatively scheduled for April* • Roxboro Cooling Pond Pre-KT Update (Brandon Delis, Derek Henderson) - *Tentatively scheduled for April* • Lined Bottom Ash Pond vs. Submerged Flight Conveyor – Timing with Environmental Rules (Dave Waugh) – *Not scheduled* • Potential demo list of retired assets at active generating stations per Charlie's request. List is requested by Charlie Gates by end of the 1st quarter. Issa is considering reviewing environmentally sensitive issues with the ECIT (Issa Zarzar). - *Not scheduled* • Sierra Club and other Interveners – Regional differences, function, drivers, etc... (Garry Rice) – *Remaining from EPSC, Not scheduled*	
9	***Next Meeting*** • 3/4/14: ECI-1101 / Lync Meeting, 2:00 – 5:00 p.m. EST	

February 2014 ECIT Air Issues

IURC / OUCC Phase 3 Filing / Hearing (March 13 & 14 2014)

- Gibson 5 ESP Refurbishment Scope

MATS Compliance Potential Strategy Revisions

- Gibson 5 and Marshall – Bypass flow management
- Gibson 1,2,3,& 5 – Reemission chemical system configuration and unit 5 need
- Cliffside 6 – Reemission chemical system need
- Allen – Unit 3 & 4 must run configuration (4&5)

Potential MATS Extensions – Allen and Marshall

Crystal River South

- Permit, etc.
- State ambient air monitor

Overall MATS Rule Gap Analysis

- Emission Limits
- Work Practice Standards
- Reporting

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O. Active Ash Pond Closure Project, undated

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Active Ash Pond Closure Project – info by mid-2014

- Review of all ponds not currently being addressed as part of the decommissioning eff
- Take into consideration both CCR and ELG propo
  - Based on the general expectations for p
    any risk concerns about starting this wo
- Review feasibility of closing all ash ponds at ope
  - This is not intended to be a detailed all i
  - For this effort it should be viewed as a p
    strategy planning.
- What work will be required on a per plant basis
- What is estimated capital cost
- What are impacts to on-going O&M expenses
- What is estimated timeline for work and expendi
- How would this work be addressed from a regula
  - What is covered by current COR account
  - Is anything covered by riders
  - Would any of the cost be recoverable in upcoming rate cases
- What are the overall customer implications
  - Rate increases
  - Publicity (positive or negative)
- Closure of ash ponds is main focus of this effort, but results will likely drive broader media strategy and discussions with other utilities

CD / CSA Basin Closure

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Active Ash Pond Closure Project – info by mid-2014

- Review of all ponds not currently being addressed as part of the decommissioning effort
- Take into consideration both CCR and ELG proposed rules
    - Based on the general expectations for planning, engineering, and approval do you have any risk concerns about starting this work now?
- Review feasibility of closing all ash ponds at operating coal sites
    - This is not intended to be a detailed all inclusive study.
    - For this effort it should be viewed as a preliminary, budgetary effort to be used for SMC strategy planning.
- What work will be required on a per plant basis
- What is estimated capital cost
- What are impacts to on-going O&M expenses
- What is estimated timeline for work and expenditures
- How would this work be addressed from a regulatory perspective
    - What is covered by current COR account
    - Is anything covered by riders
    - Would any of the cost be recoverable in upcoming rate cases
- What are the overall customer implications
    - Rate increases
    - Publicity (positive or negative)
- Closure of ash ponds is main focus of this effort, but results will likely drive broader media strategy and discussions with other utilities

I/A

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Hart Exhibit 42A
Docket No. E-2, Sub 1219

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DocumentID	NCD057454670
Site Name	DIAMOND SHAMROCK CORP/OCCIDENTAL
DocumentType	OTHER (O)
RptSegment	1
DocDate	3/1/1988
DocRcvd	2/20/2007
Box	SF180
AccessLevel	PUBLIC
Division	WASTE MANAGEMENT
Section	SUPERFUND
Program	IHS (IHS)
DocCat	FACILITY

Action Plan

RECEIVED
MAR 31 1988
GROUNDWATER SECTION
WILMINGTON REGIONAL OFFICE

Special Order By Consent
Occidental Chemical Corporation
Castle Hayne Plant
Castle Hayne, North Carolina

Prepared for

Occidental Chemical Corporation
Castle Hayne, North Carolina

March 1988

WCC File No. 87H377C

EXECUTIVE SUMMARY

The Occidental Chemical Corporation, formerly known as Diamond Shamrock Chemicals Company, operates a chemical plant located about three miles northeast of the town of Castle Hayne in New Hanover County, North Carolina. The plant site is situated along the south bank of the Northeast Cape Fear River.

This facility is involved in the manufacturing of chromium-based chemicals from chrome ore and has been in operation since 1971. Following the discovery of chromium in the groundwater on the plant property in 1975, plant officials notified environmental representatives of North Carolina. Since the discovery, the Plant has been actively managing the groundwater with guidance from outside geohydrology consultants and the North Carolina Department of Environmental Management, Wilmington Regional Office.

To date, the Plant has installed approximately 180 wells on or near the site, of which approximately 50 to 60 wells may be used for groundwater recovery and 90 to 100 wells may be used for detection monitoring. Most of the remainder are located near the perimeter of the plant downgradient from the pumping centers and are used primarily for detection and groundwater gradient control. In addition, extensive leak prevention and detection measures have been implemented on Plant sumps and tanks.

Annually, recovery wells have been pumped to produce between 20 and 25 million gallons for the recovery wells in the two pumping centers and between 60 and 80 million gallons in the remaining recovery wells. Chromium recovery in the form of bichromate equivalents has progressively decreased from over 55 tons per month in mid-1982 to about 7 tons per month at present. This has resulted from a decrease in contaminant concentrations achieved by the groundwater/chromium recovery efforts at the Plant. The number of recovery wells and the volume of water recovered have both increased during the same time period. All groundwater recovered is either used in the production process or treated in the Plant wastewater treatment facility.

Since the discovery of chromium in the groundwater in 1975, the Plant has spent more than 3 million dollars in investigation and consulting services, groundwater recovery, groundwater treatment, and leak prevention and detection activities. In addition to the consultants, a full time staff is maintained for well sampling and analysis, and a contractor is used full time for well maintenance.

In order to comply with North Carolina groundwater law and due to its commitment to environmental protection, Occidental has been voluntarily implementing these activities with the cooperation of representatives of the Division of Environmental Management and has been reviewing plans for investigation and recovery activities with these representatives prior to their implementation. Occidental has also been providing groundwater information and groundwater recovery reports to the Division of Environmental Management for their information.

Occidental requested and received the first groundwater consent order (SOC) in North Carolina. This Action Plan is submitted to address one of the requirements of this recently executed consent order between Occidental Chemical Corporation and the Environmental Management Commission. This plan is being provided as a draft plan for review by the Environmental Management Commission. The plan provides an outline of the activities that will be conducted by Occidental to further investigate groundwater conditions at the site and to develop five-year and long-term groundwater objectives that will help protect the groundwater of the State.

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	2.2 Compliance Monitoring Wells	2	B-1
3.0	GROUNDWATER PERIMETER OF COMPLIANCE ASSESSMENT	3	
	3.1 Chromium Contamination - Plant Area Source	3	B-2
	3.2 Groundwater Salinity and Classification Study	3	B-4
	3.3 Groundwater Quality	3	B-4
4.0	GROUNDWATER REMEDIATION OBJECTIVES	4	
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TABLE 1 SCHEDULE OF SUBMITTALS, SOC # EMC GW # 88-01

APPENDIX A COMPLIANCE PERIMETER WELL INSTALLATION PLAN

APPENDIX B GROUNDWATER ANALYSIS PLAN

APPENDIX C GROUNDWATER MONITORING PLAN

ACTION PLAN
GROUNDWATER QUALITY COMPLIANCE PROGRAM
OCCIDENTAL CHEMICALS CORPORATION
CASTLE HAYNE PLANT
CASTLE HAYNE, NORTH CAROLINA

1.0 INTRODUCTION

This Action Plan was developed in response to the requirements set forth in Special Order by Consent ("SOC") No. EMC GW # 88-01, approved on January 28, 1988, made and entered into pursuant to North Carolina General Statute 143-215.2, by and between Occidental Chemical Corporation (formerly Occidental Electrochemicals Corporation, formerly Diamond Shamrock Chemicals Company), hereinafter referred to as the COMPANY, and the Environmental Management Commission, an agency of the state of North Carolina, hereinafter known as the COMMISSION.

The purpose of this Action Plan is to outline the activities and schedule of actions to be conducted by the COMPANY proposed for approval by the COMMISSION to implement a groundwater quality compliance program at the COMPANY's Castle Hayne Plant. The activities outlined herein will be conducted by the COMPANY in its effort to comply with the requirements of the COMMISSION regarding groundwater quality standards and all pertinent provisions of the law and applicable rules and regulations of the COMMISSION.

The main items of this Action Plan are as follows:

- Develop a groundwater well system to monitor the perimeter of compliance;
- Assess contaminants of the source areas;
- Define performance remediation objectives;

- Develop remediation operating plans; and
- Develop monitoring programs to track cleanup performance and groundwater quality compliance.

Action items and schedules for submittals are discussed in the following sections and Table 1.

2.0 PERIMETER OF COMPLIANCE

2.1 Location of Perimeter of Compliance (Reference SOC II C)

The perimeter of compliance has been defined for the compliance monitoring program. Figure 1 shows two perimeters of compliance, one for the Plant Area and Lagoons, and the other located at the COMPANY's property boundary surrounding the adjacent Quarry site.

2.2 Compliance Monitoring Wells (Reference SOC III B.1)

A system of monitoring wells to enable the direct monitoring and/or modeling estimation of constituent concentrations at the perimeter of compliance will be developed. The well system will be installed and operational within six (6) months after approval of the SOC. Perimeter compliance wells will include existing and new shallow and deep wells with screened depths corresponding to the upper and lower Castle Hayne limestone aquifers and the PEE DEE aquifer. New wells will be installed in accordance with construction plans and specifications approved with the well permit.

Appendix A presents the Compliance Perimeter Well Installation Plan which describes the location of the perimeter of compliance wells and well construction details. This plan will be maintained through the initial term of this SOC.

3.0 GROUNDWATER PERIMETER OF COMPLIANCE ASSESSMENT

3.1 Chromium Contamination - Plant Area Source (Reference SOC III B.2)

An assessment of chromium levels in existing wells at the perimeter of compliance (and beyond if exceedance is indicated) for the Plant Area source will be conducted, and the findings will be submitted within 120 days after SOC approval.

3.2 Groundwater Salinity and Classification Study (Reference SOC III B.4)

A study will be conducted to define the natural salinity and other conditions to determine if GA classifications or alternative classifications should apply to the groundwater at the perimeter of compliance. The resulting classifications would identify the appropriate schedule of water quality standards listed in 15 NCAC 2L.0202 to be applied to the groundwater at these locations. Natural total dissolved solids (TDS) and chloride concentrations from wells at or outside the perimeter of compliance will be described for this study. Appendices B and C present the Groundwater Analysis Plan and the Groundwater Monitoring Plan. These plans describe sampling procedures and analyses to be used in defining constituents necessary to assess the proper classification of the groundwater. Wells to be sampled for groundwater classification may include existing and new wells. Additional wells off-site may also be added. These findings will be submitted within two (2) years after SOC approval.

3.3 Perimeter of Compliance Groundwater Quality (Reference SOC III B.4)

In addition to an assessment of chromium concentrations in the groundwater, a sampling and analytical program will be implemented, and reported within two years of SOC approval, to identify other constituents listed in the SOC (TDS, iron, color, pH and chlorides) that may exceed one-half of the underground water quality standards

found in 15 NCAC 2L.0202 and to establish the existing concentrations at both of the perimeters of compliance. An assessment of pH conditions will be compared against the minimum and maximum pH conditions identified during the classification study.

Groundwater Monitoring and Analysis Plans in the appendices describe sampling and analytical procedures for assessing constituent concentrations. These plan describe well purging, sampling method(s), sample preservation, labelling, chain-of-custody control, decontamination, analytical methods, and laboratory replicate and spiked sample analysis, and reporting procedures.

Changes to these plans will be submitted to the Director of the Division of Environmental Management or his representative for approval.

4.0 GROUNDWATER REMEDIATION OBJECTIVES

4.1 Plant Area Source (Reference SOC III B.3)

Groundwater remediation objectives (GROs) will be identified and assessed for total chromium in the Plant Area within 120 days of SOC approval. The GRO will be defined at the perimeter of compliance listed in the SOC and will be developed considering the following:

- Reliability of constituent data obtained;
- Measurability of the objectives;
- Underground water quality standard;
- Economic and technological feasibility of the objective; and
- Minimization of property and equipment damage from groundwater withdrawal activities.

4.2 Quarry Site and Plant Site (Constituents other than Cr)
(Reference SOC III B.5)

Five year GROs will be defined for groundwater contaminants listed in the SOC associated with both perimeters of compliance. The GROs will be developed considering the same conditions stated for the Plant Area source. The selected GROs will be defined within two (2) years of the SOC approval and may be submitted along with or following submittals reporting the groundwater classifications for those perimeters.

5.0 REMEDIATION OPERATING PLANS (Reference SOC III B.6)

5.1 Plant Area Source

A remediation operating plan (ROP) will be developed to meet the GROs for chromium at the perimeter of compliance surrounding the plant. The ROP will be submitted concurrently with the GROs within 120 days after SOC approval.

The ROP for the Plant Area will describe the methodology for remediation of chromium contamination and include area target goals as needed, design plans and specifications, treatment methods, pumping/recovery schedules, location of monitoring wells, and monitoring schedules. Pumping and monitoring schedules may be adjusted semi-annually as necessary to meet the ROP established for the Plant Area.

Action to implement the ROP for the Plant Area source will begin within 30 days after approval of the ROP by the Director of the Division of Environmental Management.

5.2 Quarry and Plant Perimeters of Compliance for All Constituents

Remediation operating plans will be developed to meet the GROs for both perimeters of compliance. The ROPs will be submitted concurrently with the GROs within two (2) years of SOC approval.

The ROPs will describe the methodology for remediation of those contaminants found to exceed or threaten to exceed the underground water quality standards consistent with the groundwater classification at the perimters of compliance. ROPs will include area target goals as needed, schedules for design plans and specifications for new construction, if required, treatment methods, pumping/recovery schedules, location of monitoring wells, and monitoring schedules. Pumping and monitoring schedules may be adjusted semi-annually as necessary to meet the GROs.

Action to implement the ROPs will begin within 30 days after approval of the ROPs by the Director of the Division of Environmental Management.

6.0 PERFORMANCE AND COMPLIANCE MONITORING

6.1 Description

Subsequent to implementation of the remediation operating plans, performance and compliance monitoring will be conducted during the term of the SOC. Performance monitoring is expected to be typically conducted on selected wells within the perimeter of compliance to track progress on meeting the GROs for the reduction of contaminant constituents at the perimeters of compliance for each of the source areas, and for meeting area target goals within the perimeters. Performance monitoring procedures will be developed with each perimeter of compliance GRO.

Compliance monitoring will be conducted on perimeter of compliance wells to monitor compliance with the groundwater quality standards found in 15 NCAC 2L.0202. The COMPANY will continue its remediation activities commenced pursuant to SOC III

A.5 beyond the expiration date of this SOC unless modifications are approved by the Director of the Division of Environmental Management.

6.2 Data Collection

Groundwater concentration data will be obtained by following the plans previously discussed and presented in the appendices.

6.3 Reporting (Reference SOC III B.7 and B.8)

Compliance monitoring data showing constituent concentrations at the perimeter of compliance (and beyond the perimeter of compliance if exceedances are so indicated) will be presented in quarterly reports submitted by the COMPANY after issuance of the SOC. The first quarterly report for the Plant Area portions of the perimeter of compliance will be submitted within 60 days following the first calendar quarter of monitoring, or May 29, 1988.

Data from performance and compliance monitoring activities will be presented in semi-annual evaluation reports covering the period of the quarterly reports. Averages of individual well data for the semi-annual period will be compared against the North Carolina groundwater standards. In the semi-annual reports, data from the previous six months will be compared against the remediation objectives and the area target goals for each constituent of concern. Also, revisions to the pumping/recovery and monitoring schedules for the next six-month period will be included in the semi-annual reports. Semi-annual reports will be submitted within 90 days following the completion of the 6-month period.

The first semi-annual report is scheduled to be submitted by September 28, 1988.

7.0 FINAL COMPLIANCE

Five-year GROs will be defined as a basis for establishing compliance requirements at the end of this SOC. Final compliance will be achieved and the COMPANY's obligations under this SOC will be satisfied when the groundwater contaminant concentrations either: (1) are restored to the quality of the level of the standard or (2) are restored to a level as close to the applicable standards as is economically and technologically feasible (Reference Title 15 Subchapter 2L Section .0103 (e)).

If at the end of this SOC compliance date, continued cleanup efforts do not demonstrate acceptable rates of contaminant removal and reductions in concentrations, and if criteria (2) above is applicable, then the COMPANY may request approval to discontinue remediation activities for those constituent concentrations which have not been reduced to the groundwater quality standard.

8.0 SCHEDULE OF SUBMITTALS (Reference SOC VI)

Action items required by the SOC will be completed before the scheduled deadlines stated in the SOC. The schedule of submittal requirements are summarized in Table 1. The COMPANY will submit, no later than fourteen (14) days after the deadline for completing each required item in the SOC, a certification to the Director of the Division of Environmental Management that the item has been performed.

Delays in meeting the SOC submittal deadlines may occur due to factors which are not controllable by the Company. The company will notify the Division of Environmental Management prior to the submittal deadline of expected delays in submittal items.

The schedule in Table 1 for submittals is dependent upon timely receipt of approvals by the Commission with no major changes to the proposed activities. Delays in meeting the SOC target dates due to delays in obtaining Commission approval or due to major changes in the proposed activities will be identified in the certifcation letter. Other factors outside of the control of the COMPANY which adversely affect the timing of the submittals will be identified in the certification letter.

TABLE 1

SCHEDULE OF SUBMITTALS

SOC EMC GW # 88-01

Item Ref. No.	Date[1] of Submittal/Action	Submittal Item
1	1/28/88	Commission Approval of SOC
2	2/27/88	Action Plan for Groundwater Quality Compliance Program including: • Perimeter of Compliance Well Installation Plan • Groundwater Sampling and Analysis Plan • Groundwater Monitoring Plan
3	3/13/88	Certification of Action Plan Submittal
4	5/27/88	Report presenting 120-day Chromium Contamination Assessment, GROs and ROPs for Plant Area Chromium (SOC III B.2, III B.3)
5	5/29/88[3]	Calendar Quarterly Report presenting constituent concentrations at Perimeter of Compliance for Plant Area source (within 60 days of completion of calendar quarter)
6	6/10/88	Certification of 120-Day Report Submittals
7	30 days[2] following approval of No. 4	Implementation of Approved ROP for Plant Area Source
8	44 days[2] following approval of No. 4	Certification of 30-day Implementation of Approved ROP for Plant Area source

(1) Submitted dates based on 1/28/88 SOC approval.
(2) Submittal deadline to be based on date of ROP approval
(3) Quarterly report submitted within 60 days of end of calendar quarter period will include the certification statement of compliance (SOC IV B.8)

TABLE 1

(Continued)

Item Ref. No.	Date[1] of Submittal/Action	Submittal Item
9	7/28/88	Completion of 6-month installation of Perimeter of Compliance wells
10	8/11/88	Certification of the installation of Compliance Wells (SOC III B.1)
11	8/29/88[3]	Calendar Quarterly Report presenting constituent concentrations for Plant Area source (within 60 days of completion of calendar quarter)
12	9/28/88[4]	Semi-Annual Report comparing previous 6 months' data to GROs for Plant Area source
13	11/29/88[3]	Calendar Quarterly Report presenting constituent concentrations at Perimeters of Compliance
14	2/29/89[3]	Calendar Quarterly Report presenting constituent concentrations at Perimeters of Compliance
15	3/31/89[4]	Semi-Annual Report comparing previous 6-months' data to GRO for Plant Area source
16	5/29/89[3]	Calendar Quarterly Report presenting constituent concentrations quality standards at Perimeters of Compliance
17	9/28/89[3]	Quarterly Reports presenting constituent concentrations at Perimeter of Compliance

(1) Submittal dates based on 1/28/88 SOC approval.
(2) Submittal deadline to be based on date of ROP approval.
(3) Quarterly report submitted within 60 days of end of the quarter period will include the certification statement of compliance (SOC IV B.8).
(4) Semi-annual report submitted within 90 days of end of semi-annual period will include the certification statement of compliance (SOC III B.7).

TABLE 1
(Continued)

Item Ref. No.	Time[1] of Submittal	Submittal Item
18	9/28/89[4]	Semi-Annual Report comparing previous 6-months' data to GROs for Plant area source
19	11/29/89[3]	Quarterly Reports presenting constituent concentrations at Perimeter of Compliance
20	1/28/90	Report of GROs and ROPs for both Perimeters of Compliance (SOC III B.5, III B.6)
21	2/11/90	Certification of 2-year reports (SOC III B.4, B.5, B.6)
22	30 days[2] following approval of No. 20	Implementation of ROPs for Quarry and Plant Areas
23	44 days[2] following approval of No. 20	Certification of implementation of ROPs for Quarry and Plant areas
24	3/31/90[4]	Semi-Annual Reports comparing previous 6-months' data to GROs.
25	60 days after end of quarter to 1/1993	Quarterly Reports presenting constituent concentrations at Perimeter of Compliance
26	90 days after end of semi-annual period to 1/1993	Semi-Annual Reports comparing previous 6-months' data to GROs.

(1) Submittal dates based on 1/28/88 SOC approval.
(2) Submittal deadline to be based on date of ROP approval.
(3) Quarterly report submitted within 60 days of end of the quarter period will include the certification statement of compliance (SOC IV B.8).
(4) Semi-annual report submitted within 90 days of end of semi-annual period will include the certification statement of compliance (SOC III B.7).

CJS/OCC/485-1

APPENDIX A

COMPLIANCE PERIMETER WELL INSTALLATION PLAN

CJS/OCC/485cp

COMPLIANCE PERIMETER WELL INSTALLATION PLAN
OCCIDENTAL CHEMICAL CORPORATION
CASTLE HAYNE, NORTH CAROLINA

1.0 INTRODUCTION

In accordance with the SOC, this compliance perimeter well installation plan has been prepared for the Occidental Chemical Corporation in Castle Hayne, North Carolina. Figure 1 shows two (2) perimeters of compliance. One perimeter of compliance is within the plant's property limits with the perimeter established at 500 ft from a discharge source or property line (whichever was smaller). The other perimeter of compliance surrounds the quarry with the perimeter established at the property line shown in Figure 1. Described in this plan are the locations and depths of the new and existing wells along the perimeter of compliance and detailed procedures for installing and developing these wells.

Mining operations have been performed in the past at the flooded quarry location west of the Occidental plant. This property is currently owned by Martin Marietta. Martin Marietta also owns and operates mining operations (formerly Ideal Cement) approximately one mile east of the Occidental plant with mining progressing away from the plant toward the east. The property adjacent to the south of the Occidental plant has been purchased by Martin Marietta. Based upon information supplied by Martin Marietta to Occidental, mining operations within this property are not planned for approximately fifteen years.

2.0 COMPLIANCE POINT WELL LOCATION DETERMINATIONS

Eighteen (18) new monitoring wells will be installed along the perimeters of compliances at the approximate locations shown on Figure 1. Two existing wells will be designated as perimeter compliance wells. These compliance perimeter wells will

monitor the groundwater conditions in the upper and lower aquifers. Detection of a plume from the project site requires migration of the contaminant through the hydrogeologic environment to the monitored compliance perimeter.

Hence, the plume geometry and strength at the compliance perimeter are highly dependent on the characteristics of the source (contaminant species, size, and location of the source from the compliance surface) and the hydrogeologic properties of the aquifer medium (transmissivity, storativity, lithology, recharge and discharge characteristics, etc.). The proposed compliance perimeter wells are located with due consideration to these factors and are described below.

2.1 Upper Aquifer Wells

A surficial sand stratum and the Upper Member of Castle Hayne Formation (limestone) contains the upper aquifer system at the site. The depth of these formations range from ground surface to approximately 35 ft. At the plant site, the upgradient groundwater elevation ranges from approximately 20 ft to 1 ft (MSL), and moves generally in a northerly direction at a flow rate on the order of 5 ft per year. Figure 5 shows the upper aquifer groundwater contours across the site based on water levels obtained June 1987.

Eight (8) new upper aquifer compliance perimeter wells are proposed at the locations shown in Figure 1. With one (1) existing upper aquifer well (Q-1) at the west boundary of the plant site, the total number of compliance perimeter wells within the upper aquifer will be nine (9). The distribution of these wells will be as described in the following paragraphs.

2.1.1 Plant Compliance Perimeter Wells (Upper Aquifer). Four (4) of the nine (9) upper aquifer monitoring wells are located along the plant perimeter of compliance. Of these, three of the wells (CPW-5S, -6S, and -7S) may be considered as downgradient wells which will monitor the groundwater quality along the north, east, and west legs

of the compliance perimeter. One well (CPW-1S) is located in the upgradient direction of the shallow aquifer at the plant site. Due to the large size of the potential discharge sources at the plant site (lagoon, neutralization/evaporation areas and chromic acid sump area) and the water soluble nature of the chemical species (chloride and chromium), the location, spacing, and number of shallow aquifer wells around the plant perimeters of compliance are considered to be sufficient.

2.1.2 Flooded Quarry Compliance Perimeter Wells (Upper Aquifer). Five (5) of the nine (9) shallow aquifer wells are distributed along the northern, western, and southern legs of the quarry compliance perimeter. Of these, four (4) wells (CPW-8S, -9S, -10S, and -11S) can be considered as downgradient wells and will monitor the groundwater quality along the northern leg of compliance perimeter (see Figure 1). One (1) well (CPW-12S) is located at an upgradient location. Again, the number, location, and spacing of the wells are deemed sufficient when the rather large size of the potential discharge source (flooded quarry) and the water-soluble nature of the chemical constituents are considered.

2.2 Lower Aquifer Wells

The project site lower aquifer exists within the Lower Member of the Castle Hayne and the Pee Dee Formations. These formations are encountered immediately below the Middle Member of the Castle Hayne Formation (aquitard) at depths below about 40 ft. At the plant site, the lower aquifer groundwater elevation ranges from approximately 5 ft to -10 ft (MSL) and generally moves towards the east to southeast at a flow rate on the order of 500 ft per year. Figure 6 shows the lower aquifer groundwater contours across the site based on water levels obtained June 1987.

Ten (10) new compliance perimeter wells will be installed in the lower aquifer. Also, there exists a lower aquifer well which will need to be redeveloped. With the existing well (CPW-2D), the total number of deep aquifer wells will be eleven (11). The distribution of the deep aquifer wells between the plant site and the flooded quarry is

given below.

2.2.1 Plant Compliance Perimeter Wells (Lower Aquifer). Six (6) of the eleven (11) lower aquifer monitoring wells are located along the plant perimeter of the compliance surface. Of these, three wells (CPW-2D, -3D, and -4D) are individually located along the southeastern perimeter. The other three (3) (CPW-5D, -6D, and -7D) are nested wells with one of the shallow aquifer wells on the north, west, and east.

2.2.2 Flooded Quarry Compliance Perimeter Wells (Lower Aquifer). The remaining five (5) deep aquifer monitoring wells are installed along the flood quarry perimeter of compliance. The flooded quarry has an excavated vertical depth on the order of 40 to 60 ft which extends through both the upper and lower aquifers. All the lower aquifer wells in this area are nested with the upper aquifer wells. Three (3) of the deep wells (CPW-8D, -9D, and -10D) are located along the northern perimeter to assess any radial flow from the upper aquifer and the possible extent of vertical interaction with the upper aquifer. The other two (2) wells are located on the west perimeter (CPW-11D) and on the south perimeter (CPW-12D).

3.0 WELL CONSTRUCTION DETAILS

3.1 Drilling and Soil Sampling

A wet rotary rig which is truck mounted will be used. Drilling fluids to be utilized will be potable water. A portable steel pit will be used to circulate drilling fluids and act as a screening device to remove drill cuttings from the drilling fluid.

Upper Aquifer Well Borings

Eight (8) upper aquifer well borings will be drilled from the ground surface to an approximate depth of 36 ft. Shallow aquifer well installation details are presented in Figure 2. Upon completion of drilling, borehole geophysics will be performed.

Lower Aquifer Well Borings

Lower aquifer well borings will be drilled to an approximate depth of 105 ft. Lower aquifer well installation details are presented in Figure 3 and 4.

When a boring is to penetrate into the lower aquifer at the plant site, care will be exercised to minimize vertical migration of contaminants within the borehole. To accomplish this, a surface (insulator) casing will be installed to isolate the upper aquifer. Surface casing will be a 10-inch Schedule 40 PVC casing with flush joint, threaded connections. The borehole for the surface casing installation will be approximately 14 inches in diameter.

Deep wells located along the quarry perimeter of compliance will not include surface casing since the depth of the quarry excavation is on the order of 40 to 60 ft which extends through both the upper and lower aquifers.

Male threads of each casing connection will be wrapped with teflon tape to form a leak resistant seal. Additionally, each connection will be sufficiently torqued with strap wrenches to prevent the connections from backing out as the casing is lowered into place.

After the surface casing has tagged bottom, it will be raised 3 to 6 inches off bottom to allow unrestricted flow of fluid. Fresh clean drilling fluid will be circulated through the casing, via a valved casing head, up the annulus prior to grouting operations. Fresh fluid will be circulated until the annulus surface returns are clean and free of cuttings.

Grouting of the surface casing will begin immediately subsequent to the circulation of the casing. The surface casing will be grouted into place with the use of a grout tremie pipe and a grout mixture of cement, fresh potable water and natural

bentonite. After the casing has been circulated, the casing head valve will be closed. A minimum one-inch PVC tremie pipe will be lowered to the bottom of the boring via the annulus. A viscous grout will then be pumped down the tremie pipe until all drilling fluids have been displaced from the hole and grout returns are observed at the surface. The tremie pipe will then be retrieved.

As an alternative casing and grout installation technique, the borehole may be flushed immediately after drilling with fresh clean water. Then the open borehole would be filled with viscous cement grout using a tremie until the surface returns are free of cuttings and all fluids are displaced by grout. The surface casing would then be lowered to the bottom and held in place with the drilling rig draw works. The grout inside the casing would be flushed out using the tremie pipe and a jetting tip with fresh water down to within 2 or 3 ft of the casing bottom prior to curing.

Sufficient time, approximately 24 hours, will be allowed to pass to achieve the correct grout cure before drilling operations resume.

After grout cure has been achieved, the casing head will be removed and the surface casing entered with a drill string. The cement plug which now exists at the bottom of the surface casing will be drilled out and drilling and sampling will resume.

Upon completion of drilling, borehole geophysics will be performed.

3.2 Borehole Geophysical Logging

Before any borehole or section of borehole which is to be used for monitoring well construction has been overreamed, cased and/or grouted, the open hole will be geophysically logged.

The suite of logs will consist of the following to define hydrostratigraphy of the borehole:

- o Electrical resistivity log (E log), including both short normal range to 1-ft sidewall penetration and long normal range to 3-ft sidewall penetration;
- o Natural gamma log (γ);
- o Compensated nuclear log;
- o Thermal neutron log; and
- o Borehole caliper log.

Electrical resistivity logs will yield information on rock material lithology and stratigraphy. Natural gamma logs will provide similar data with better definition of argillaceous (clayey) materials. The compensated γ-γ log will provide data on rock bulk density and formation fractures. The thermal neutron log will provide data on rock porosity and solution cavities. The borehole caliper log will be used to assess the competency of the borehole sidewall material yielding information on rock vugularity or presence of solution cavities. The caliper log will define areas where the other logging results might be questionable.

An assessment of groundwater quality will be made utilizing a pore fluid resistivity log which will detect changes or gradients in groundwater ion concentrations. Similar results can also be made utilizing data from the electrical resistivity logs and interpreted density and porosity results from the compensated γ-γ and thermal neutron logs.

Blank runs will be made in the field, and appropriate instrumentation settings and probe retrieval rates will be determined for use in the logging operations. Logging data will be digitized and loaded into a computerized data processing system. Interpretation of borehole profiles will be done onsite so that any necessary modifications can be made to screen elevations to fit the stratigraphy before the screens are installed.

Geophysical field data will be reduced as required and included in reports.

3.3 Well Construction

Upper Aquifer Well Construction

Upon completion of subsurface sampling activities during drilling, the borehole will be re-entered with the drill pipe using an 8-inch bit and the last sampled interval enlarged to a full gauged hole diameter. Drilling fluid will be circulated sufficiently to remove and clean all drill cuttings from the borehole.

After the borehole has been circulated, the drill pipe will be removed and the 4-inch PVC well casing lowered into place. Next, the well casing will be circulated with clear potable water until surface returns are clean. The screened interval of the monitoring well will be 20 ft long and will be sand packed with filter sand (Figure 7) to a level approximately 2 ft above the top of the screen. The sand will be introduced into the monitoring well by gravity feed through the boring annulus. After the sand pack has been positioned, a bentonite pellet seal will be spotted on top of the gravel pack to eliminate influence from overlying materials. The seal will consist of a 1-2 ft layer of bentonite pellets introduced into the boring annulus by gravity feed. The bentonite pellets will be given sufficient time to hydrate, approximately 30 minutes, after their placement before additional activities are continued. Finally, a standard cement-bentonite grout will be placed around the well casing. The grout will be tremied downhole to displace all drilling fluids and provide a void free grout from the bentonite seal up to ground surface.

The wells will be constructed with an above grade capped riser and a lockable steel protective casing, and in some cases lockable pumphouses.

A typical monitoring well installation detail for the shallow aquifer wells is shown in Figure 2.

Lower Aquifer Monitoring Well Construction

Upon achieving total depth, the boring advanced beneath the surface casing will be enlarged to accommodate the placement of a screened PVC well casing. Again, the enlarged borehole will be no less than four inches greater in diameter than that of the well casing to be used.

The screened PVC well casing will be run to a field selected depth or the order presented in Figures 3 and 4. The casing for the monitoring wells will be 4-inch Schedule 40 PVC with threaded flush joint connections. The male threads of each connection will be wrapped with teflon tape to provide a leak resistant seal. The casing joints will be torqued with strap wrenches to prevent the connections from backing-out as the casing is lowered into the boring.

The screen will be of threaded PVC construction and display a WOP or slotted pipe design. Optimally, it will be fitted at its base with a backwash valve and a 12 inch long pup joint to facilitate well installation and development. The screen will also be equipped with stainless steel centralizers for proper positioning in the borehole. The PVC screen length will be 40 ft and will have 0.012 inch slots.

After the well casing has tagged bottom, it will be raised 3 to 6 inches off bottom to allow unrestricted flow of fluid. Fresh clean potable water will be circulated through the casing via a casing head and up the bore annulus to remove cuttings and drilling fluids from the boring. Clean water will be circulated until the annulus surface returns are clean and free of cuttings and drilling fluid.

After the well casing has been been circulated, a sand pack will be placed around the screen to a height of two feet above the slotted interval. The sand pack will consist of graded filter sand (Figure 7) and will be placed into position by slow continuous gravity feed from the surface via the boring annulus. The volume of sand required for the sand pack will be calculated prior to its placement. The ultimate disposition of

the sand will be verified by tagging the sand pack with a weighted fiberglass tape.

The sand pack will be isolated from overlying material with the use of a bentonite pellet seal. A minimum 1-ft thickness of 1/2 inch bentonite pellets will be positioned in the boring annulus directly above the gravel pack. It will be introduced by slow continuous gravity feed from the surface. The volume of bentonite pellets required for the seal will be calculated prior to placement and the final thickness will be verified by tagging with a weighted fiberglass tape.

Sufficient time will be allowed (approximately 30 minutes) for the bentonite pellets to hydrate and swell.

The wells will be constructed with an above grade capped riser, sloped concrete pad, and a lockable steel protective casing. The wells will be developed and surveyed. A monitoring well installation details for the deep aquifer well are shown in Figures 3 and 4.

3.4 Well Development

Both existing and newly constructed monitoring wells will be developed either by pumping, air lift and/or surge block (also known as swabbing). The well development includes the process of flushing the aquifer interface with the well and cleaning the filter pack and the well screen slots of any drilling fluids introduced during the time of drilling. This also includes removal of silt and other fines from the filter pack and well screen so that subsequent water samples will not be abnormally turbid or contain undue suspended matter. The well development will continue until the well water is visually observed to be clear and turbidity readings are stable. Well development volume will be measured.

Selection of the well development method will be based upon water level, well discharge rate and well location access.

Well Development by Pumping

Submersible Pump: Well development by submersible pump may be used for deep aquifer wells. A 1.5 or larger HP submersible pump will be used. The steps to be followed are as follows:

A. Measure the groundwater level and measure the depth to the well bottom and calculate the well volume.

B. Lower submersible pump and power supply cable into position inside the well casing for sue with pump discharge pipe.

C. Hold the discharge pipe and power supply cable in suspension with a sanitary well seal.

D. Connect the power supply cable to a power source.

E. Connect polyethylene flow lines to the pump discharge pipe. The flow lines will extend to the outside discharge point.

F. Continue well development until turbidity values are stable and water is visually clear.

Peristalic Pumping: Peristaltic pumping is a fast and simple way of well development when a "screen shock" is not required.

The peristaltic pump will be used in the development of monitoring wells which have water level depths of less than 25 ft. Additionally, the required well discharge rate will be less than or equal to 1 gallon per minute and well accessibility will range from good to poor. This type of well development is applicable to the shallow aquifer wells.

The steps followed in the set up and use of a peristaltic pump are as follows:

A. Measure the water level to ensure the depth to water is less than 25 ft. Measure the depth to the well bottom and calculate the well volume.

B. Place one end of a length of nylon or polyethylene tubing into the monitoring well such that the tubing end is near the well bottom or below the level to which the water level will drop once pumping begins.

C. Attach to the end of the nylon or polyethylene tubing that remains outside the well casing a 13 to 18 inch length of 1/2 inch diameter flexible salistic surgical tubing. The attachment is made by slipping the salistic tubing over the nylon tubing approximately 1/2 inch to form a good seal.

D. Position the salistic tubing inside the peristaltic pump and clamp firmly into place. The nylon tubing must be connected to the suction side of the pump via the salistic tubing.

E. On the discharge side of the peristaltic pump insert into the salistic tubing another length of nylon tubing. Extend the nylon tubing to outside discharge point.

F. A portable generator or a rechargeable internal energy source may be used to power the pump or a 12 volt battery may be connected with cables to power the peristaltic pump. After selecting the desired power supply, turn the pump on to initiate pumping.

G. Continue well development until turbidity values are stable and water is visually clear.

Hand Pump: Hand pumping is a simple yet effective method of well development. The hand pump by Brainard-Kilman incorporates a riser pipe encasing an actuating rod and piston that extends to the sampling depths. Pumping is achieved by positive displacement of water by the piston as the actuating rod is moved up and down. All power is supplied by hand, and the hand pump has a rated flow of 2.75 gpm. The hand pump may be used for well depths of up to 100 ft. The pump length can be adjusted to 5-ft increments by the addition or deletion of threaded dual pipe extensions. The 1.7-inch O.D. pump conveniently fits down 2-inch I.D. wells.

The steps followed in the set up and use of the hand pump well development are as follows:

A. Measure the groundwater level and measure the depth to the well bottom and calculate the well volume.

B. Determine the required pump length and desired stick up.

C. Using the decontaminated holding dog provided for the hand pump or 2-inch pipe wrench, connect the pump cylinder section and appropriate number of dual pipe extensions and lower down the well casing, attaching the well head fixture unit with actuating rod handle and discharge spigot last above the top of the well casing.

D. Connect polyethylene tubing to the discharge spigot. The tubing will extend to the outside discharge point.

E. Pump the actuating rod with an up/down stroke of the well head fixture handle at the prescribed frequency to achieve the desired flow rate.

F. Continue well development until turbidity values are stable and water is visually clear.

Well Development by Air Lift

Air Lift. Air lift is another simple but effective method of well development. Air lift is capable of applying energy directly within the screened interval to deliver a "shock effect" which is at times required to fully develop a well. Selection of the air lift method will be based upon water level, well discharge and accessibility of well location.

The steps followed in the set up and use of air lift well development are as follows:

A. Measure water level depth to bottom of monitoring well and calculate the well volume (see groundwater sampling procedure below).

B. Insert a polyethylene air line into the monitoring well. The air line is constructed of two polyethylene tubes. One tube, the return or discharge line, is 1/2 inch in diameter. The second tube, the air injection line, is 1/4 inch in diameter. To assemble the air line, insert the 1/4 inch tube approximately 8 inches into the 1/2 inch tubing, such that the 1/4 inch line is discharging into the 1/2 inch tube. Using nylon ties, attache the 1/4 inch tube to the 1/2 inch tube and run the two lines together into the monitoring well until the depth of the screened interval is achieved.

C. Connect the 1/4 inch air line directly to the discharge of an air compressor which develops 15-25 cubic ft per minute of filtered air.

D. Run the 1/2 inch discharge line to the water containment vessel.

E. Admit filtered air into the 1/4 inch air line.

F. Well water will return to the containment vessel via the 1/2 inch discharge tube.

G. Continue well development until discharge water is visually clean and turbidity readings are stable.

3.5 Decontamination Procedures

Rigorous equipment decontamination procedures will be implemented during well installation and development to minimize the potential for contaminating the wells. All equipment cleaning will be performed onsite. To minimize the potential for using contaminated equipment, all drill rods, augers, samplers and other equipment which will not be used will be removed from the drilling rig prior to entering the site. Prior to beginning drilling, the drill rig and drilling equipment, including clean water tanks, pumps, mud pumps, hoses and tanks used to transfer water from the source to the drilling rig tank, will be steam cleaned using potable water. After cleaning, drilling equipment fittings may be greased and fluids may be added with care. Precautions will be taken to prevent contamination of the well with oil and grease. Lubricants will not be used on the drilling and sampling tools or fittings. Well casings, screens, stingers, centralizers, etc. will be steam cleaned using potable water prior to installation or will be decontaminated at the manufacturers facility and shipped to the site in a protected and covered condition. The decontamination operations described herein will be implemented prior to the installation of each well.

Well installation will proceed with care to minimize the potential for well contamination and aid in the installation of a high quality well. Drilling will be conducted using the wet rotary method with potable water and borehole casing as required. The use of organic drilling fluid additives is prohibited. Drilling personnel will not use greasy gloves when handling tools. Surgical gloves or new clean cotton work gloves will be used. Only new materials that have been certified by the manufacturer will be used (i.e., bagged cement, powdered bentonite in bags, containerized bentonite pellets). Well installation/construction will be performed in accordance with Figures 2 through 4.

3.6 Surveying

All upper and lower aquifer wells (existing and those installed under this work) will be surveyed with standard surveying techniques using the plant coordinate and elevation system.

At the completion of monitoring well construction activities, the elevations of all new well riser tops will be surveyed to 0.01 ft vertical and 1.0 ft horizontal accuracy.

3.7 Groundwater Measurements

Same day groundwater level measurements will be obtained in all the shallow and deep wells for an assessment of flow gradients. These measurements will be obtained using weighted tapes or electric sounders. All instruments which may contact the well groundwater will be decontaminated by dilute hydrochloric acid and rinsed with tap water followed by deionized water.

3.8 Slug Test

A slug test is a simple field test used to estimate the hydraulic conductivity of a water-bearing zone. The procedure involves the sudden removal or addition of a known volume of water from the well and recording the water level recovery as a function of time. The slug test procedure will be conducted in the following order of preference: (1) solid slug removal/analyses; (2) solid slug addition/analyses; (3) pumping method/analyses; and (4) bailing method/analyses.

Methods developed by Cooper et al (1967), Bredehoeft and Papadopulus (1980), Bouwer and Rice (1976), Bear (1979), and Dax (1987) will be used to assess permeabilities.

A list of slug test references is as follows:

1. Cooper, H. H. Bredehoeft, J. D. and Papadopulus, S.S., 1967. Response of a Finite-Diameter Well to an Instantaneous Charge of Water, Water Resources Res., 3(1): 263-269.

2. Bredehoeft, J. D. and Papadopulus, S. S., 1980. A Method for Determining the Hydraulic Properties of Tight Formation, Water Resource Res., 16 (1): 233-238.

3. Bouwer, H. and Rice, R. C., 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells, Water Resource Res., 12(3): 423-428.

4. Bear, J., 1979. Hydraulics of Groundwater, McGraw-Hill, New York, NY, 567pp.

5. Dax A. A Note on the Analysis of Slug Tests. Journal of Hydrology, 91 (1987): 153-177.

4.0 DOCUMENTATION

The data collected during conduct of the above described activities will be documented. A final report will be prepared which summarizes the field activities and specifically contains the following documents:

1. Borings logs
2. Geophysical logs
3. Well installation/construction (as-built) diagrams
4. Well development logs
5. Equipment decontamination forms.

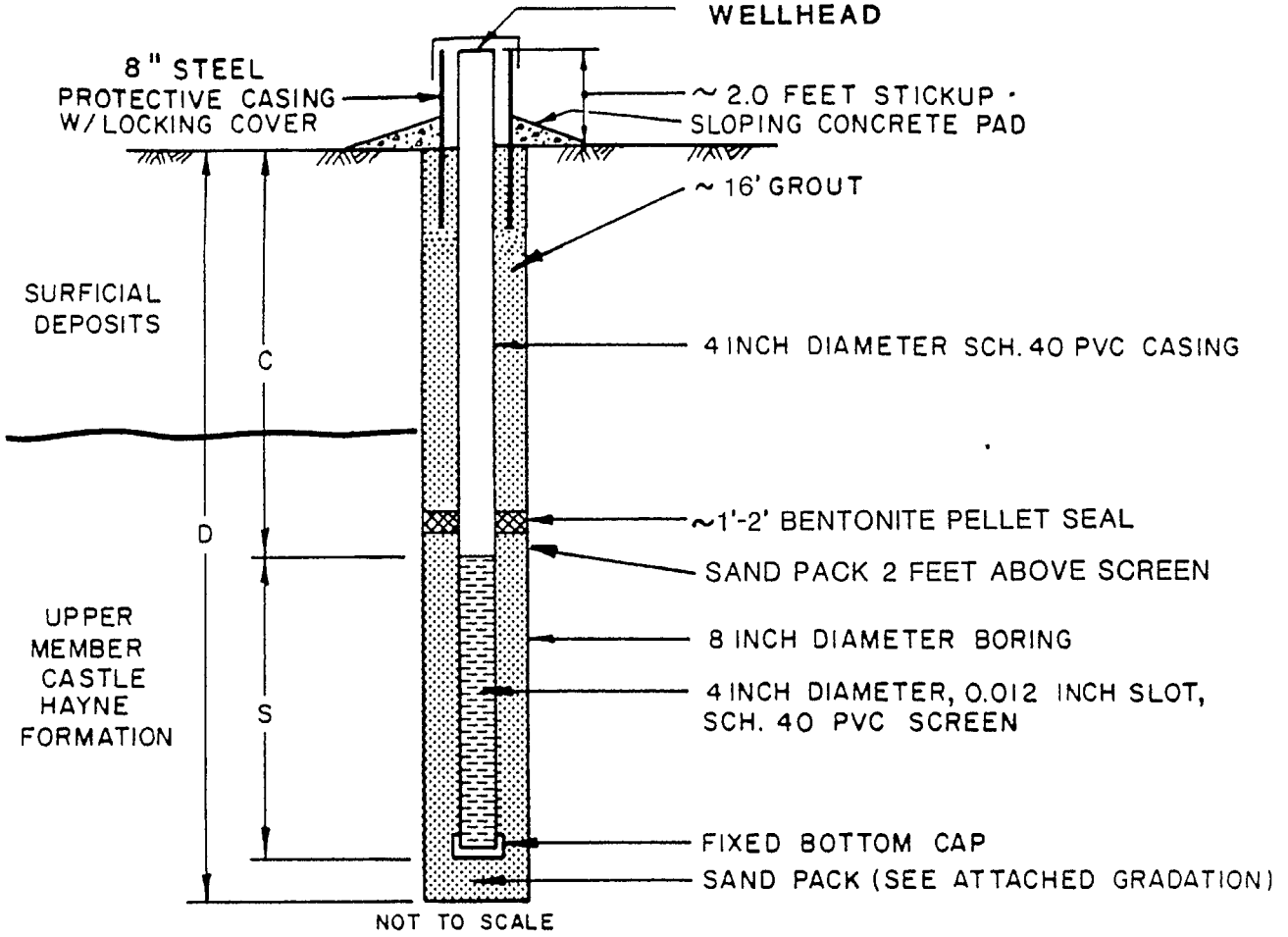
LEGEND

- PERIMETER OF COMPLIANCE
- CPW — COMPLIANCE POINT WELL
- ○ — SHALLOW WELLS
- ⊕ — DEEP WELLS
- (Q-1) — EXISTING WELL DESIGNATION

CPW-9S
CPW-9D
CPW-10S
CPW-10D
CPW-8S
CPW-8D
FLOODED QUARRY
NORTHEAST CAPE FEAR RIVER
CPW-6S
CPW-6D
CPW-5S
CPW-5D
LAGOON
CPW-11S
CPW-11D
Q-1
CPW-7D
COOLING TOWERS
WASTE TREATMENT FACILITY
TANK FARM
CHROMITE ORE PILE
STORAGE TANKS
CPW-12S
CPW-12D
EVAPORATION AREA
CHROMIC ACID SUMP AREA
NEUTRALIZATION AREA
KILN AREA
RIVER PUMP STATION
TIDE GUAGE
CHROMITE ORE PILE
CPW-4D
CPW-1S
OFFICE BUILDING
TECHNICAL SUPPORT BUILDING
CHANGE HOUSE
MAINTENANCE AREA
CPW-2D (L-17)
CPW-3D

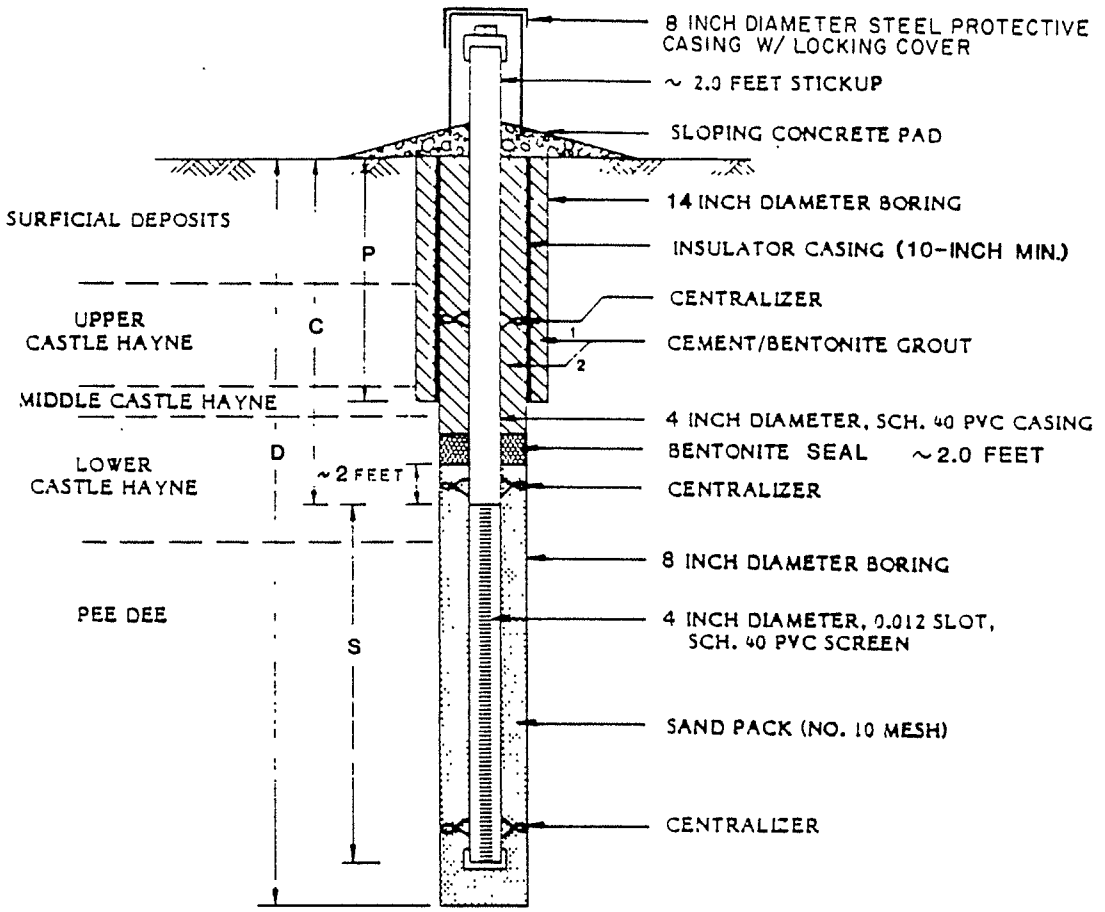
N 8000
N 7000
N 6000
N 5000
E 3000
E 4000
E 5000
E 6000
E 7000
E 8000
E 9000

NAME	COMPLIANCE PLAN
FOR	OCCIDENTAL CHEMICALS CO.
	Woodward-Clyde Consultants
SCALE: NOTED	MADE BY: R.S. DATE: 2-23-88 / CHECKED BY: DATE:
FILE No	87H377C
	COMPLIANCE POINT WELL LOCATION PLAN
FIGURE	1



WELL NUMBER	BORING DEPTH (D) FEET	CASING LENGTH (C) FEET	SCREEN LENGTH (S) FEET
CPW-1S	36	20	15
CPW-5S	36	20	15
CPW-6S	36	20	15
CPW-8S	36	20	15
CPW-9S	36	20	15
CPW-10S	36	20	15
CPW-11S	36	20	15
CPW-12S	36	20	15

NAME COMPLIANCE WELL PROGRAM	Woodward-Clyde Consultants		PROPOSED SHALLOW WELL DESIGN	FILE No 87H377C
FOR OCCIDENTAL CHEMICAL COMPANY	SCALE N.T.S.	MADE BY RWS DATE 2-23-98 CHECKED BY DATE		FIGURE 2



EXPLANATION:

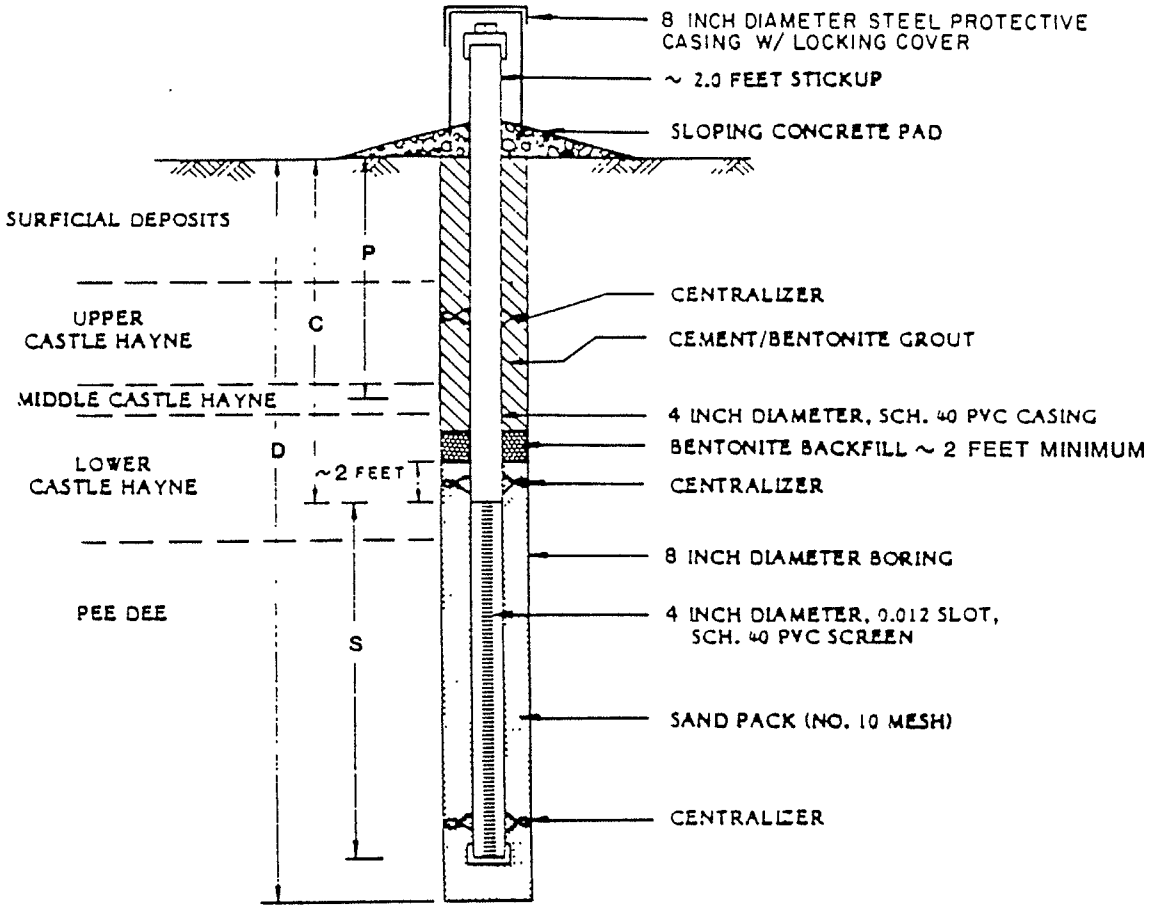
(1) GROUTED ANNULUS BETWEEN INSULATOR CASING AND 14 INCH DIAMETER BORE-HOLE (UPPER 35 FEET).

(2) GROUTED ANNULUS BETWEEN 4 INCH I.D. PVC SCH. 40 BLANK CASING AND INSULATOR CASING IN UPPER 35 FEET, AND 8 INCH BORE-HOLE FROM 35 TO 58 FEET BETWEEN SURFACE.

WELL NUMBER	BORING DEPTH (D) FEET	CASING DEPTH (C) FEET	SCREEN LENGTH (S) FEET	INSULATOR CASING (P) FEET*
CPW-3D	105	60	40	35
CPW-4D	105	60	40	35
CPW-5D	105	60	40	35
CPW-6D	105	60	40	35
CPW-7D	105	60	40	35

* THIS DEPTH SHOULD BE CONFIRMED TO PREVENT PENETRATION THROUGH THE AQUITARD BEFORE THE INSULATOR CASING IS SET.

NAME COMPLIANCE WELL PROGRAM	Woodward-Clyde Consultants	PROPOSED DEEP WELL DESIGN	FILE No. 87H377C
FOR OCCIDENTAL CHEMICAL COMPANY	SCALE: N.T.S. MADE BY: RWS DATE 2-23-88 CHECKED BY: DATE		FIGURE 3



WELL NUMBER	BORING DEPTH (D) FEET	CASING DEPTH (C) FEET	SCREEN LENGTH (S) FEET	INSULATOR CASING (P) FEET*
CPW-8D	105	60	40	0
CPW-9D	105	60	40	0
CPW-10D	105	60	40	0
CPW-11D	105	60	40	0
CPW-12D	105	60	40	0

* THIS DEPTH SHOULD BE CONFIRMED TO PREVENT PENETRATION THROUGH THE AQUITARD BEFORE THE INSULATOR CASING IS SET.

NAME COMPLIANCE WELL PROGRAM	Woodward-Clyde Consultants	PROPOSED DEEP WELL DESIGN	FILE No. 87H377C
FOR OCCIDENTAL CHEMICAL COMPANY	SCALE. N.T.S. MADE BY: DATE. 2-23-88 CHECKED BY: DATE.		FIGURE 4

E 5000 E 6000 E 7000 E 8000 E 9000

N 7000 N 6000 N 5000

NORTHEAST CAPE FEAR RIVER

WATER SURFACE ELEV.= +5.4'

WATER SURFACE ELEV.= +0.5'

A A'

1 3 5 7 9 11 13 15 17 19 21

LAGOON

F-1 F-2 E-1 E-2

C-2

44 30 31 24 35 36 26 25 23 40 127 128 126 125 122 123 120 121 99 100 101 102 87 55 88 51 52 53 54 58 82 80 50 48 43 27 42 28 64 84 85 75 76 77 45 49 12 16

CHROMITE ORE PILE

COOLING TOWER

TANK FARM

CHROMATE AREA

CHROMIC ACID SULFATE AREA

FILM AREA

CHROMITE ORE PILE

CHARGE HOUSE

MAINTENANCE AREA

OFFICE BUILDING

TECHNICAL SUPPORT BUILDING

RIVER PUMP STATION

TIDE GAUGE

CANAL

NOTE:

Groundwater contours based on readings taken June, 1987

▲ Denotes new wells installed during reporting period.

NAME	GROUNDWATER RECOVERY ASSESSMENT
FOR	OCCIDENTAL CHEMICAL CORP. CASTLE HAYNE PLANT
	Woodward-Clyde Consultants
SCALE: NOTED	MADE BY: RWS DATE: 2-23-88 FILE No. 87H377C
	CHECKED BY: DATE:
UPPER AQUIFER GROUNDWATER ELEVATIONS	FIGURE 5

E 5000 E 6000 E 7000 E 8000 E 9000

N 7000 N 6000 N 5000

NORTHEAST CAPE FEAR RIVER

Water Surface Level = 5.4'

Water Surface Level =+0.5'

LEGEND

- □ EXISTING DEEP WELL
- ■ PUMPED DEEP WELL

LAGOON

COOLING TOWERS

WASTE TREATMENT FACILITY

TANK FARM

STORAGE TANKS

CHROMITE ORE PILE

EVAPORATION AREA

CHROMIC ACID SLUMP AREA

NEUTRALIZATION AREA

KILN AREA

OFFICE BUILDING

TECHNICAL SUPPORT BUILDING

CHANGE HOUSE

MAINTENANCE AREA

RIVER PUMP STATION

TIDE GAUGE

CANAL

F-3 0.4

PW-1 PW-2 PW-4 PW-5 PW-6

E-3 -64.8 -51.1

L-1 -4.2 L-2 -5.7 L-3 -10.8 L-4 -8.6 L-5 -36.0 L-7 -9.9 L-8 -9.5 L-9 -1.2 L-10 -24.3 L-11 1.0 L-12 +0.5 L-13 -2.7 L-14 7.9 L-15 -10.3 L-16 -11.3 L-17 -5.2 L-18 -9.6 L-19 -4.6 L-20 -5.8 L-21 -9.9 L-22 -6.9 L-23 -5.8 L-24 -5.8

G-3 -0.7 G-3' D-3 -8.2 D-3'

2.2 6 5.1 11 -5.0 10 13

NOTE:

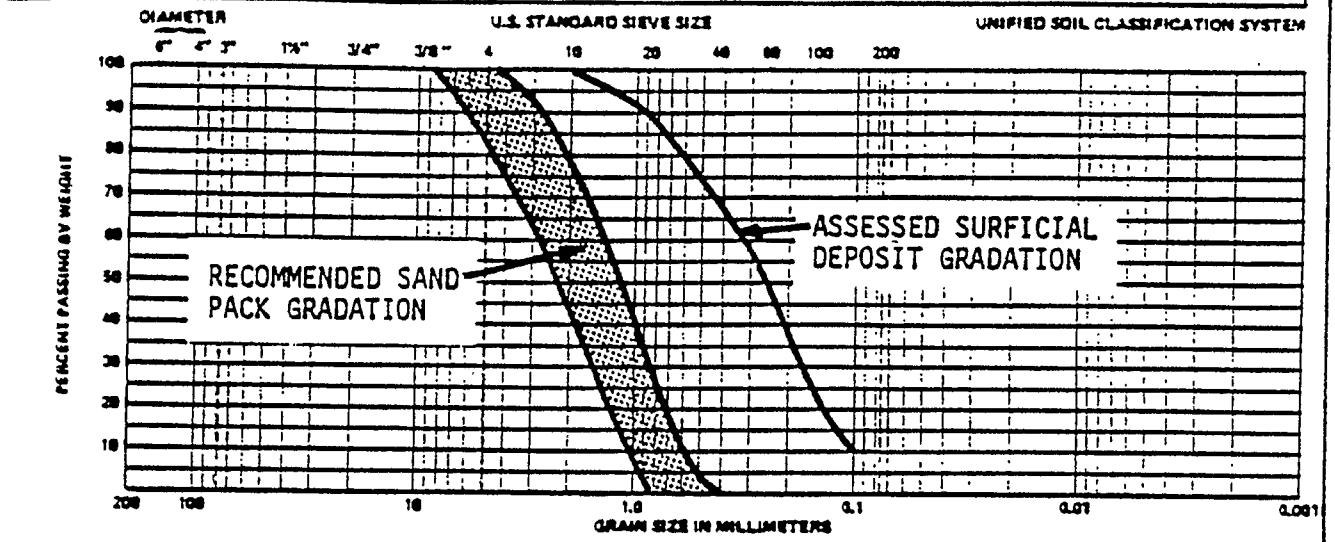
Groundwater Contour based on reading taken June, 1987

GRID NORTH TRUE NORTH

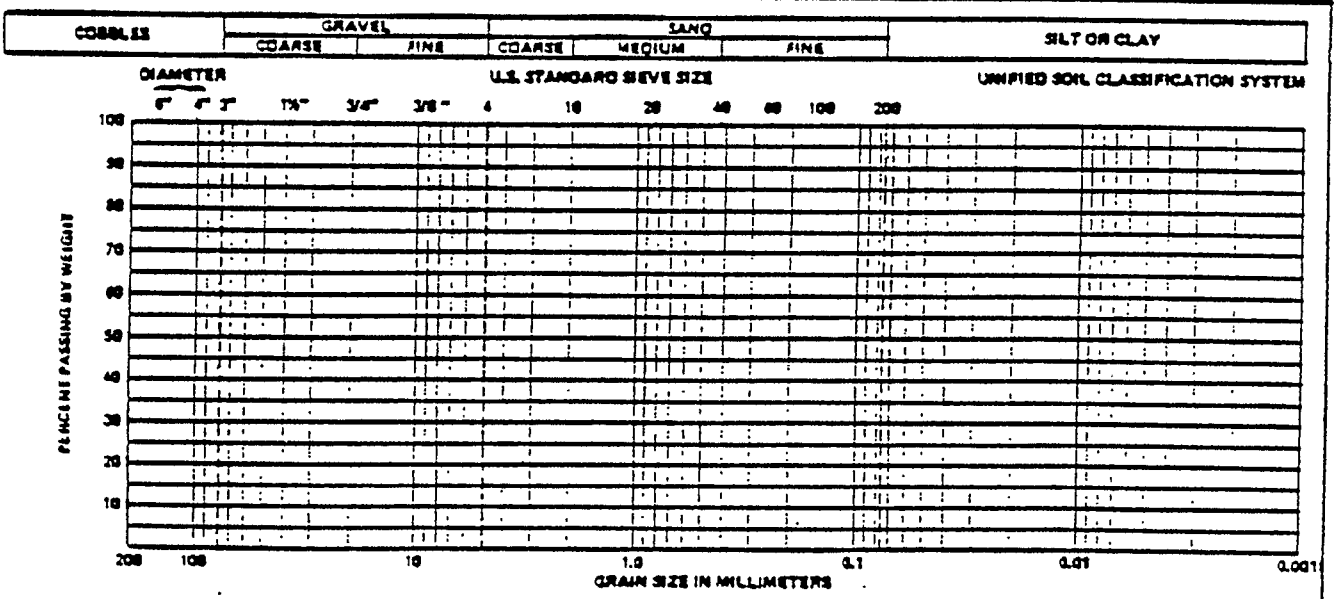
0 100 200 300 400 SCALE IN FEET

NAME	GROUNDWATER RECOVERY ASSESSMENT
FOR	OCCIDENTAL CHEMICAL CORP. CASTLE HAYNE PLANT
	Woodward-Clyde Consultants
SCALE: NOTED	MADE BY: RWS DATE: 2-23-88 FILE No. 87H377C
	CHECKED BY: DATE:
LOWER AQUIFER GROUNDWATER ELEVATION	FIGURE 6

GRAIN-SIZE DISTRIBUTION



BORING	SAMPLE	DEPTH (ft)	SYMBOL	CLASSIFICATION	w (%)	w_L (%)	w_p (%)
				RECOMMENDED SAND PACK GRADATION			



BORING	SAMPLE	DEPTH (ft)	SYMBOL	CLASSIFICATION	w (%)	w_L (%)	w_p (%)

WOODWARD-CLYDE CONSULTANTS

FIGURE 7

APPENDIX B

GROUNDWATER ANALYSIS PLAN

CJS/OCC/485cp

GROUNDWATER ANALYSIS PLAN

1.0 INTRODUCTION

The Groundwater Analysis Plan for the Groundwater Quality Compliance Program will assess the concentration of chromium, iron, chloride, dissolved solids, pH and color of the groundwater at the perimeter of compliance. The data will be used to assess compliance with the North Carolina groundwater standards in accordance with Special Order by Consent No. EMC GW # 88-01.

2.0 METHODS AND PROCEDURES

2.1 Method and Procedure References

Standard analytical methods will be used for groundwater analysis based on approved methods in 40 CFR 136. Most of the analytical methods are found in EPA's 1979 manual titled Methods for Chemical Analysis of Water and Waste. One alternate method for chlorides from Standard Methods for the Examination of Water and Wastewater may be used as an alternative approved procedure. Table 1 provides a listing of the parameters and analytical methods to be used. These methods are listed in 40 CFR 136 as approved federal analytical methods for water analysis.

2.2 Samples for Metal Analysis

Chromium and iron will be analyzed using the atomic absorption method for total recoverable metals. The analysis for recoverable metals is expected to be a reliable measurement of the total metal concentration available for groundwater transport through soils. Unfiltered samples for Total Recoverable metal analysis will be collected.

At OCC's option, a split sample may be analyzed for dissolved metal concentrations. This split sample will be filtered as soon as practical after collection using a 0.45 micron filter to obtain a representative groundwater sample. This will aid in assessing the dissolved metal concentration in groundwater. Filtered metal analysis would be an indicator of migration and soluble metal concentrations.

2.3 Sample Containers, Preservation and Holding Times

Table B-1 provides a listing of the type of sample containers and minimum sample volumes that will be collected for each analysis. Analytical parameters that will require field preservation such as acidification with nitric acid or cooling are also identified in Table B-1. One sample container may be used for more than one analysis provided the sample container type and preservation are consistent with method requirements.

Sample holding time requirements are also identified in Table 1. A holding time limit of 30 minutes is applied to the analytical requirements for pH (defined for this project as "immediate").

3.0 QA PARAMETERS

Total recoverable chromium and total recoverable iron will be analyzed with a minimum of 5% spiked and replicate samples or one spike and replicate sample during each day of analysis. These metals will also be analyzed with laboratory and field blanks a minimum of 5% of the time or once each day. Spike and replicate data document laboratory precision and accuracy of these analyses.

Chlorides, color, pH and total dissolved solids are not subject to spike requirements. These samples will also be analyzed in replicates a minimum of 5% or one replicate per parameter per day.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Key personnel responsible for the sampling, analysis, data quality review and overall QA/QC activities are identified below by job title and the name of the current OCC employee holding that position:

Activity	Responsible OCC Position	Current OCC Employee Name
Sampling	Castle Hayne Plant Laboratory Supervisor	John O'Janpa
Laboratory Analysis	Castle Hayne Plant Laboratory Supervisor	John O'Janpa
Data Quality Review	Castle Hayne Plant Laboratory Supervisor	John O'Janpa
Overall QA/QC (including audits)	Corporate QA Officer	W. Leroux (Grand Island, NY)

5.0 DISTRIBUTION OF ANALYSES

The Occidental Chemical Corporation laboratory at the Castle Hayne plant is a North Carolina certified laboratory for analyzing contaminants in water. This laboratory is currently authorized to analyze chromium, iron, chlorides and pH. At the current time, there is no certification requirement identified for total dissolved solids and color. This laboratory will be used to provide the groundwater analysis.

6.0 DATA QUALITY OBJECTIVES

Groundwater samples will be collected, handled and analyzed according to standard practices and procedures to help obtain analytical results that are representative of groundwater conditions. Precision and accuracy of the analytical results will be assessed by comparisons with those objectives listed in Table B-2.

6.1 Precision

Precision is the measure of the variability of individual sample measurements. Precision will be inferred through the use of replicate samples. If replicate samples contain identical contaminant concentrations, variability in the laboratory analyses must be due to variability induced by sampling, handling, or laboratory procedures. Acceptable precision values are described in Table B-2.

6.2 Accuracy

Accuracy is a measure of the system bias. Bias is defined as the difference between the mean (average) of the true sample values and mean (average) of the laboratory analyses. The exact system bias will never be known since the true sample values are not accessible; however, inferences can be drawn from an examination of field and trip blank analyses and laboratory matrix spiked sample analyses. Field blanks measure the bias introduced by contaminated equipment, sample handling and shipping, and laboratory procedures. Trip blanks measure the bias introduced by field, shipping and laboratory procedures. Laboratory method blanks and spiked samples measure biases in laboratory analyses.

Acceptable accuracy objectives are described in Table B-2. Accuracy of the pH meter will be checked by calibrating prior to daily use and a calibration check at the end of the day's use.

6.3 Data Representativeness

As a goal, individual samples will be representative of the location from which they were collected and the analysis will be representative of the sample.

6.4 Data Completeness

All valid data points will be reported.

7.0 SAMPLING PROCEDURE

Groundwater monitoring well sampling procedures are described in Appendix C of this document.

8.0 SAMPLE CHAIN-OF-CUSTODY

Samples will be collected in containers with unique sample numbers for identification. A chain-of-custody document will accompany each container and identify sample location well numbers, date and time of sample collection, sample container number and the type of preservation used. An example of a chain of custody document is provided in Figure B-1.

9.0 INSTRUMENT CALIBRATION METHODS

Standard instrument calibration methods that are part of the North Carolina laboratory certification program will be maintained in this laboratory for groundwater analysis under the SOC agreement.

10.0 DOCUMENTATION

Data sheets, chain of custody form, raw data, and notebooks will be kept by all applicable personnel. All such documents will be retained for 5 years or until OCC is released from SOC No. EMC GW # 88-01 by the State of North Carolina, whichever occurs first.

11.0 DATA VALIDATION

The local Quality Assurance Officer (QAO) will evaluate the data based on spike recoveries, replicate analyses, calibration standards, laboratory blanks, etc. The QAO will recommend corrective action if required. QA reports will be submitted with data submittals.

12.0 LABORATORY AUDITS

Performance and system audits will be performed once each year of the program of the OCC QAO. The OCC QAO will recommend corrective action if required. A QA audit report will be submitted .

13.0 QUALITY ASSURANCE REPORTS

QA reports include written evaluation of lab performance versus QA/QC objectives and/or evaluation of laboratory system.

TABLE B-1
GROUNDWATER SAMPLE ANALYSIS METHODS, CONTAINERS PRESERVATIVES AND HOLDING TIME

Parameter	Container Type & Size	Preservation	Holding Time	Method of Analysis	Comments
Total Recoverable Chromium	100 ml, plastic or glass	HNO_3 to pH < 2	6 months		Field Filtration of Split Sample
- Chelation - Extraction or				EPA 218.3/ STORET 01034	Preparation per AA Method 4.1.4
Furnace AA				EPA 218.2	Preparation per AA Method 4.1
- Direct Aspiration*				EPA 218.1/ STORET 01034	Preparation per AA Method 4.1.4
Total Recoverable Iron	100 ml, plastic or glass	HNO_3 to pH <2	6 months	EPA 236.1/ STORET 01045	Preparation per AA Method 4.1.4 Field Filtration of Split Sample
Total Dissolved Solids	100 ml, plastic or glass	Cool; 4° C	7 days	EPA 160.1/ STORET 70300	Filterable Residue Method
pH	25 ml, plastic or glass	---	30 minutes	EPA 150.1/ STORET 00400	
Chlorides	50 ml, plastic or glass	---	28 days	EPA 325.3/ STORET 00940	Alternate Method: Standard Methods 407A, Titrametric, Silver Nitrate
Color	50 ml, plastic or glass	Cool, 4° C	48 hours	EPA 110.1, 110.2 or 110.3/STORET 00080	

NOTE: Reference EPA's Methods for Chemical Analysis for Water and Wastes and 40 CFR 136
* Chromium analysis will be typically performed by Direct Aspiration procedures.

CJS/OCC/485B-1

TABLE B-2
PRECISION AND ACCURACY
GROUNDWATER ANALYSES OBJECTIVES

Parameter	EPA Method	Precision Objective Relative[1] Standard Deviation (σ)	Relative[1] Error Accuracy Objective	Completeness (%)
Chromium				
- Total Recoverable	218.3	NA[2][3]	NA[2][3]	95
- Direct Aspiration	218.1	26.4%[3]	2.3%[3]	95
Iron				
- Total Recoverable	236.1	16.5%[3]	0.6%	95
Total Dissolved Solids	160.1	10%[3]	NA[3]	95
pH	150.1	±0.1 pH unit[3]	±0.13 pH units[3]	95
Chlorides	325.3	3.3%[3]	2.9%[3]	95
Color	110.1, 110.2, or 110.3	NA[2][3]	NA[2][3]	95

(1) Relative percentages are as a percent of true or average values.

(2) Precision and accuracy taken from EPA Methods for Chemical Analysis of Water and Wastes, 1979.

(3) Precision and accuracy taken from Standard Methods for Examination of Water and Wastewater.

NA: Precision or accuracy objectives are not defined in either reference.

87H377CA

OCCIDENTAL CHEMICAL CORPORATION

CHAIN OF CUSTODY RECORD

GENERAL INFORMATION

PLANT _____ DATE _____

ADDRESS _____ PROJECT _____

TOTAL # SAMPLES _____ LOCATION _____

HANDLING REQUIREMENTS _____ _____

SAMPLE I.D. (FROM LABEL)	TIME SAMPLED	SAMPLER NAME & SIGNATURE

CUSTODY INFORMATION

RELINQUISHED BY	RECEIVER NAME & ADDRESS	DATE	TIME

(EP8-01)

FIG. B-1

APPENDIX C

GROUNDWATER MONITORING PLAN

CJS/OCC/485cp

GROUNDWATER MONITORING PLAN

This groundwater monitoring sampling plan is prepared to identify the field activities and procedures intended to be provided by Occidental Chemical Corporation as part of the groundwater monitoring requirements of the Special Order by Consent (SOC) Number EMC GW # 88-01 with the North Carolina Environmental Management Commission. This plan is being presented for approval by the Environmental Management Commission or the Division of Environmental Management. Groundwater sampling procedures will be completed in accordance with this plan to obtain the samples of groundwater specified in the SOC.

Initial Groundwater Monitoring Program

Perimeter of compliance groundwater monitoring wells will be sampled and analyzed at least quarterly for the first two years following the approval of the SOC for the constituents listed below:

- Total Recoverable Chromium
- Total Recoverable Iron
- Color
- Total Dissolved Solids
- pH
- Chlorides

The following wells are identified as perimeter of compliance wells that will be sampled on a quarterly basis following their installation:

Process Area Perimeter Wells	Quarry Perimeter Wells
CPW-1S, CPW-2D, CPW-3D, CPW-4D	CPW-8S, CPW-8D
CPW-5S, CPW-5D	CPW-9S, CPW-9D
CPW-6S, CPW-6D	CPW-10S, CPW-10D
CPW-7S, CPW-7D	CPW-11S, CPW-11D
	CPW-12S, CPW-12D

Subsequent Groundwater Monitoring Requirements

Following the completion of this two year monitoring period, the frequency of sampling and analysis for specific constituents may be reduced upon request of Occidental and approval by the Director of Environmental Management. The groundwater sampling procedures identified in this plan will be followed for all groundwater sampling activities under this SOC unless alternate procedures are approved by the Director or Environmental Management.

Sampling of Wells with Jet Pumps

Groundwater monitoring wells may be sampled and developed with jet pumps for the types of inorganic constituent analysis listed above. Wells with jet pumps that are being operated for groundwater recovery will be sampled from the discharge line of the pump during recovery operation.

Wells that are not in groundwater recovery operations may also be purged and sampled for analysis of the listed constituents with jet pumps. Jet pumps will remove a minimum of six volumes of well casing water before a sample is collected from the discharge line of the jet pumps from wells with standing casing water. Prior to placing a jet pump into a well for well casing water purging and sample collection, the jet pump and lines will be decontaminated with deionized water. If visible residue is present on the pump or lines, this equipment will be decontaminated with a dilute hydrochloric acid wash, followed by a tap water rinse prior to a final rinse with deionized water.

Alternate Sampling Procedures

In addition to the specific procedures identified above for sampling groundwater monitoring wells for these listed constituents of concern, standard EPA or North Carolina procedures for sampling with submersible pumps, bailers or nitrogen lift methods may be used.

Water Level Measurements

Water level measurements will be taken from perimeter of compliance monitoring wells prior to purging the standing water in the well casing. A weighted plunker tape or conductivity tape will be used to measure the water table distance from the top of the well casing. Surveyed measurements of the top of the well elevation will then be used to calculate the static water table elevation in perimeter of compliance wells. A dilute hydrochloric acid wash, followed by a tap water and deionized water rinse will be used to decontaminate the tape before it is placed in the well.

Sample Labeling and Chain-of-Custody

Samples to be analyzed on site will be collected in containers with unique sample numbers for identification. A chain-of-custody document will track all sample containers with respect to well number, date and time of sample collection, sample container number, and the type of preservation used.

OFFICIAL COPY

Hart Exhibit 42B
Docket E-2, Sub 1219

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LAGOON CLOSURE PLAN

OXYCHEM CASTLE HAYNE PLANT
CASTLE HAYNE, NEW HANOVER CO., NORTH CAROLINA

PREPARED FOR

OCCIDENTAL CHEMICAL CORPORATION
NIAGARA FALLS, NEW YORK

MAY 28, 1993

PREPARED BY: G&E ENGINEERING, INC.

James W. Hayman 5/28/93

James W. Hayman, PE, PG, CPG DATE
NC Professional Engineer, No. 17956

EXECUTIVE SUMMARY

The Occidental Chemical Corporation plant at Castle Hayne, North Carolina, utilized an onsite diked lagoon from 1971 to 1991 for the disposal of chrome ore washings and sludges from the plant's industrial wastewater treatment facility. Precipitation falling within the lagoon and percolating through the accumulated sludge creates a leachate containing iron, chlorides, and other total dissolved solids. As the leachate has infiltrated into the subsurface, the groundwater quality has been impacted. The purpose of the lagoon closure is to mitigate the continued impact to groundwater quality by substantially eliminating the infiltration of leachate. The development of this closure plan for the lagoon satisfies one of the Groundwater Remediation Objectives as defined in the 1990 Remediation Operation Plan for the Castle Hayne plant.

The lagoon will be capped to prevent precipitation from entering the sludge and, hence, substantially eliminate the production of leachate. The cap will consist of an impervious membrane (very low density polyethylene or plasticized polyvinyl chloride) placed between bedding fill and protective cover soil layers. The cap surface will be covered with topsoil and a hardy grass stand. Precipitation falling on the cap will (1) be retained in the top soil and protective fill layers and subsequently lost as evapotranspiration, (2) sheet flow across the cap as surface runoff, or (3) percolate through the cover soil to the impervious membrane. A geofabric drainage layer placed directly on top of the membrane will conduct percolating water to the perimeter of the cap. Cap surface runoff and underflow from the drainage layer will be discharged as sheet flow to the surrounding wetland areas.

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SECTION 1
INTRODUCTION

1.1 General. The Occidental Chemical Corporation (OxyChem) plant at Castle Hayne, North Carolina, processes chrome ore to manufacture a variety of chromium based chemical products (e.g., sodium chromates and chromic acid). Washings from the chrome ore and sludges from the plant's industrial wastewater treatment facility were pumped as a wet slurry to a diked lagoon for disposal. The lagoon was constructed in 1971, and its use was discontinued in 1991. Precipitation falling within the lagoon and percolating through the accumulated sludge creates a leachate containing iron, chlorides, and other total dissolved solids (TDS). As the leachate has infiltrated into the subsurface, the ambient groundwater quality has been impacted.

1.2 Purpose and Scope. One of the Groundwater Remediation Objectives as defined in the 1990 Remediation Operation Plan (ROP) for the OxyChem Castle Hayne Plant was to develop and implement a closure plan for the lagoon. Accordingly, the purpose and intent of the closure activities are to mitigate continued impact to the ambient groundwater quality from percolating leachate produced within the lagoon sludge. To accomplish this, two alternate schemes for capping the lagoon were evaluated; capping substantially eliminates precipitation from percolating through the sludge and producing leachate within the lagoon. The scope of this closure plan includes justifying a selected capping option, presenting the design of the selected closure scheme, and evaluating the impact of its construction. The groundwater impact from the historical operation of the lagoon is being addressed in the Special Order of Consent (SOC) between OxyChem and the North Carolina Department of Environment, Health, and Natural Resources; Division of Environmental Management (DEM).

SECTION 2
SUMMARY OF EXISTING LAGOON CONDITIONS

2.1 Configuration and Topography. The OxyChem facility is located on the south bank of the Northeast Cape Fear River (see Figure 1). The processing plant is situated on a river terrace at an approximate elevation of +24 feet. On the north side of the plant (i.e., the river side), the topography drops steeply forming a bluff, or escarpment, which separates the higher terrace to the south from the river flood plain (approximate elevation +2 feet). The width of the flood plain from the bluff to the river is 1,000 to 1,200 feet.

2.2 Perimeter Dike. The lagoon was created in 1971 by constructing an engineered dike around three sides of an approximately 16-acre area on the flood plain; the natural bluff forms the fourth (south) side of the enclosure (see Figure 2). The natural flood plain sediments formed the base of the lagoon. The dike was originally constructed to a height of 10 feet above the flood plain (i.e., elevation +12 feet), and the lagoon was divided into two separate impoundment areas by an east-west medial dike. The perimeter dike was later raised to its current height at elevation +22 feet; the medial dike was subsequently buried under accumulating sludge.

The perimeter dike is constructed of locally-derived borrow fill which is a silty, slightly clayey sand and sandy silt (Sirrine, 1992); these materials are in the Unified Soil Classification (USC) Groups SP and SM . The fill was placed and compacted in controlled lifts, or layers, in accordance with engineering design plans. The crest of the dike is 12 feet in width providing an access roadway. The interior and exterior dike side slopes are two feet horizontal to one foot vertical (2:1, or a descending angle of approximately 26.5 degrees); the generally 20-foot high dike is, therefore, approximately 92 feet wide from interior to exterior toe. The dike is designed to impound a water-saturated, fluid sludge and, accordingly, is considered to be an

earthen dam. The design and performance of the dike were evaluated and permitted under the dam safety regulations by the DEM Land Quality Section (LQS).

2.3 Nature of the Sludge. The sludge is a mixture of chrome ore washings and the sludges from the plant's industrial wastewater treatment facility; it is a predominantly silt-size soil material (Sirrine, 1992). Characteristic of a pure silt, the sludge is non-plastic to pseudo-plastic in behavior with a very high liquid limit and very low plasticity index; the sludge predominantly classifies as a USC Group ML.

The sludge was placed in the lagoon from south to north as a pumped slurry with a three-to-one ratio of water to solids. The transport water was decanted through stand-pipes in the lagoon and returned to the plant. The sludge retains moisture and has a high in-place moisture content. Water content of in-place sludge samples range from 35 to 61 percent (computed as the weight of water to the total sample weight). With this high moisture content, the sludge exhibits thixotropic behavior; that is, the shear strength of the sludge is reduced significantly when the sludge is disturbed. The sensitivity, or the ratio of the shear strength in the undisturbed soil to the shear strength when disturbed, ranges up to 15 (Sirrine, 1992). The seemingly soil-like sludge can become very fluid when disturbed by equipment vibration, excavation, or other mechanical activity.

2.4 Native Materials Below the Lagoon. The sludge was originally placed directly on the existing flood plain vegetation. At the base of the lagoon, therefore, is a relict organic-rich layer which represents the original vegetation mat. Below the organic layer are fine to medium sands typical of the flood plain (i.e., fluvial) deposits. (See Section 3.1 on hydrogeology for a more detailed description of the stratigraphy.)

2.5 Existing Soil Cap. As the lagoon was filled from the south, the sludge slurry discharge pipe was periodically moved from side to side and northward. Sludge accumulated in the southern third of the lagoon to within approximately two feet of

the dike crest elevation. For dust control, a common soil cap was placed on this completely filled portion of the lagoon in 1984. The average thickness of the soil cap is 1½ feet, and it consists of locally available silty sand fill. The fill was placed by light construction equipment working from south to north, always keeping the equipment on the fill already placed. No movement of the sludge ahead of the fill placement, a phenomenon known as "mud wave," was created.

While this existing dust control cap does not (nor was intended to) fulfill the purpose of a final closure, it does constitute a valuable field proof-test of construction techniques that can be utilized on the thixotropic sludge. The placement of the existing soil cap demonstrated that light earth-moving equipment can work from the previously placed fill without encountering severe difficulties with the strength-sensitive sludge.

SECTION 3

SUMMARY OF HYDROGEOLOGIC CONDITIONS

3.1 Hydrogeology. The stratigraphy beneath the lagoon site consists of the following formational units in descending order:

- **Fluvial Deposits:** River and flood plain deposits consisting of sands and gravel with fine-grained sediments; rich in organic material. Thickness ranges from approximately 3 to 20 feet with an average of approximately 15 feet.

- **Upper Castle Hayne (UCH):** White to light-gray coarse sand, glauconitic clay, marl, and weathered fossiliferous limestone. The UCH has been replaced by fluvial deposits near the river; elsewhere the thickness ranges from 1½ to 7 feet with an average of approximately 4 feet.

- **Middle Castle Hayne (MCH):** Light-gray, dense, crystalline limestone. The MCH is discontinuous and is absent near the river; elsewhere, the thickness ranges from ½ to 4½ feet with an average of approximately 3 feet.

- **Lower Castle Hayne (LCH):** Fossiliferous limestone with calcareous sandstone near the base. Thickness is approximately 20 feet and relatively uniform across the site.

- **Pee Dee (PD):** Sandstone, shelly limestone, and interbedded silty sands. Maximum thickness undetermined at the site.

Two water-bearing zones (aquifers) have been identified beneath the lagoon (Sirrine, 1992). The shallow (or surficial, or water-table) aquifer consists of the Fluvial Deposits and, where present, the UCH formation. The predominant groundwater flow direction is northward toward the river at an average gradient of 7×10^{-3} foot vertical per foot horizontal (ft/ft); the gradient may change radically with fluctuating river levels (greater when the river is low, and less when the river is at flood stage). The hydraulic conductivity of the shallow aquifer also varies significantly, from 1 to 19 feet per day (ft/d), which is typical of heterogeneous fluvial deposits. The average groundwater flow velocity is approximately 3×10^{-2} ft/d. The groundwater flow

direction and gradient in the shallow aquifer are influenced by active groundwater extraction wells in the area.

The deeper aquifer consists of the LCH and PD formations. The predominant groundwater flow direction is east-southeast at an average gradient of 4×10^{-3} ft/ft. Like the shallow aquifer, the deep aquifer flow is influenced by groundwater extraction wells in the area, particularly those in conjunction with ongoing quarrying operations to the east-southeast of the plant. The mean hydraulic conductivity is approximately 19 ft/d in the LCH and 2 ft/d in the PD; average groundwater flow velocity is 1×10^{-1} ft/d (Sirrine, 1992).

The two aquifers are separated by the MCH formation, which is not present across the entire site. Therefore, the aquifers are hydraulically connected. An average downward flow gradient of 1×10^{-1} ft/ft exists from the shallow to deep aquifers.

3.2 Precipitation, Percolation, and Leachate Production. The Castle Hayne area receives an average 51 (Sirrine, 1992) to 56 (NOAA, 1993) inches of rainfall annually, of which over three inches is lost due to direct runoff and approximately 40 inches is lost to evapotranspiration. Applying these climatic conditions to evaluation of the lagoon by the EPA's Hydrologic Evaluation of Landfill Performance (HELP) computer modeling program, a predicted 7½ inches percolates vertically through the impounded sludge (Sirrine, 1992). Over the approximately 16-acre area of the open lagoon, this represents approximately 3.25 million gallons per year of percolating precipitation.

The precipitation percolating through the sludge removes some amount of chemical constituents from the sludge and emanates as a leachate. The sludge [which is defined as non-hazardous waste under 40 CFR 261.4(b)(7)(xiv)] contains relatively high concentrations of chlorides, iron, and total chromium; these are the constituents potentially available for leaching. The chromium, however, exists predominantly in the reduced trivalent state, and analyses have revealed that the leaching potential for

chromium diminishes with depth. Chromium has not been detected in the groundwater receiving the leachate.

3.3 Groundwater Impact. Evaluation of the groundwater quality (Sirrine, 1992) in the area immediately surrounding the lagoon revealed that:

- In the shallow aquifer, the parameters of chloride, iron, total dissolved solids (TDS), and color exceeded the North Carolina standard for Class GA groundwater. Iron concentrations, however, did not exceed the groundwater quality standards established for fluvial deposits.
- In the deep aquifer, the parameters of iron, TDS, and color exceeded the Class GA standard. Chlorides exceeded the Class GA standard in groundwater samples from the LCH formation (upper portion of the deep aquifer) but not in samples from the PD formation (lower portion of the deep aquifer).
- Chromium was not detected in the groundwater samples from either aquifer.

The detection of chlorides and iron, in particular, indicates that the approximately 3.25 million gallons per year of infiltrating leachate from the lagoon has impacted the groundwater quality in both the shallow and hydraulically connected deep aquifers. This groundwater quality impact is being addressed by the SOC between OxyChem and the DEM.

SECTION 4
SELECTION OF THE CLOSURE CONCEPT

4.1 Selected Closure Scheme. The approach to closing the lagoon which best satisfies the purpose of the closure (eliminate leachate production which impacts groundwater quality) and creates the least collateral environmental concern is to cover the lagoon with an impervious cap to prevent precipitation from entering the impounded sludge. As discussed in previous sections, it is the infiltration of precipitation into the sludge that generates the leachate which then percolates to the underlying groundwater.

The impervious cap design selected includes:

- A soil bedding fill placed directly over the sludge and graded to establish the final shape and slope of the cap.
- An impervious membrane of very low density polyethylene (VLDPE) or polyvinyl chloride (PVC) laid on the bedding fill.
- A highly transmissive geosynthetic drainage material to prevent infiltrating precipitation from accumulating on the impervious membrane.
- A protective fill layer covering the membrane and drainage material to prevent exposure and damage to the membrane.
- A topsoil layer to establish a sound grass cover on the complete cap surface.

Precipitation which falls on the completed cap will be dissipated as runoff, evapotranspiration, and infiltration, just as with any natural vegetated area. The key difference is that the infiltrating precipitation can migrate only as far as the impervious membrane. At that point vertical percolation is blocked, and the drainage layer allows the percolating water to flow to the perimeter of the lagoon where it is released as

sheet flow to the surrounding area. This capping scheme effectively eliminates percolation of precipitation into the sludge and, hence, leachate production.

4.2 Justification for Selecting the Impervious Membrane Cap. In the previously prepared *Site Characterization and Remedial Assessment Report* (Sirrine, 1992), various options for effecting the lagoon closure were considered and evaluated. Providing an impervious cap was selected as the approach which best satisfies the purpose and intent of the closure. Two alternatives, a hardened cap and an impervious membrane, were justified as viable options. Both reduce the volume of infiltrating precipitation and, hence, the potential volume of leachate by greater than 99 percent.

In terms of dissipating precipitation which falls on the cap, the options are markedly different. The hardened cap scheme creates a 16-acre paved surface, and the precipitation falling on the cap essentially all becomes immediate runoff (with varying degrees of evaporative loss due to other climatic conditions). A perimeter storm water collection and retention system would be required to handle the runoff. In contrast, the impervious membrane scheme results in a soil and grass surface which absorbs much of the precipitation as would a naturally vegetated area. Much of the precipitation is retained by the soil cover and subsequently lost to evapotranspiration; a portion is lost as sheet flow from the gently sloping cap surface; and the portion of precipitation which in a natural setting would percolate as recharge to the groundwater is, instead, discharged with a time lag to the perimeter of the cap through the drainage layer. In discrete, short-term storm events (e.g., an afternoon thunder shower), virtually all the precipitation will be retained by the soil cap and subsequently lost to evapotranspiration or under-flow from the drainage layer; surface sheet flow will be minimal except in the record storm events (e.g., 10-year, 50-year, 100-year storms). Therefore, from considerations of storm water management, the impervious membrane capping scheme results in a more natural, time-delayed dissipation of precipitation than does the hardened cap.

Final grade slope on the hardened cap need not exceed 1.0 percent for drainage; careful selection of the membrane and drainage layer allows the impervious membrane cap to achieve a minimum 2.0 percent slope. The existing sludge surface is at a 1.8 to 2.0 percent slope; therefore, both options minimize the quantity of cap fill required since either can follow the existing sludge topography without significant adjustment of the existing sludge surface. Both alternatives allow the use of locally-derived borrow material, and neither has stringent soil compaction requirements (as would, for example, a compacted clay cap) which would be a construction concern on the thixotropic sludge.

For the hardened cap alternative, storm water basins with capacity for the 16-acre paved area would be necessary. However, the exterior toe of the perimeter dike on the east and north sides is bordered by wetlands; on the northwest, wetlands lie just beyond the access road which runs along the exterior dike toe. The location of the storm water retention basins would likely encroach on wetlands.

Since the construction considerations for the two alternatives are roughly equivalent, the storm water considerations justify the selection of the impervious membrane as the more suitable capping scheme.

SECTION 5
HYDROLOGIC IMPACT OF THE CLOSURE

5.1 Leachate Extrusion During Cap Construction. As fill for the cap is placed on the sludge, the fill weight will induce consolidation of the sludge. Consolidation tests performed on samples of sludge at various locations and depths within the lagoon (Sirrine, 1992) reveal that the sludge beneath the existing 1½-foot thick soil cover on the southern third of the lagoon has experienced slightly more consolidation than sludge in the remainder of the lagoon. Using the soil test data, the amount of consolidation settlement that will occur in the sludge under the weight of the 2½-foot to 4-foot thick proposed cap is calculated to be an average of 1½ inches with a maximum of three inches. Since the sludge has a very high moisture content, consolidation of the sludge will extrude that moisture as liquid leachate. An estimated 650,000 gallons of leachate will be extruded from the sludge in response to the weight of the cap.

5.2 Groundwater Impact. The sludge is a fine-grained but non-cohesive soil. Therefore, in response to the weight of the cap, settlement of the sludge and the resulting extrusion of leachate will occur rapidly. Most of the leachate will be produced during construction, and 95 percent of the leachate production will occur within a year of construction.

In the early stages of cap placement, as will be described in following sections, an indeterminate percentage of the leachate will extrude on the uncapped, downslope (northwest) surface of the sludge where it will combine with general storm water for collection and treatment at the plant's wastewater treatment facility. Hence, not all of the extruded leachate will percolate to the groundwater.

The short-term, first-year potential impact to groundwater quality will be the percolation of less than 650,000 gallons of leachate extruded from the sludge as a

result of cap construction. This volume represents less than three months of estimated leachate production from average rainfall on the lagoon in its current, non-capped condition. From the commencement of construction until the impervious membrane is completed and the lagoon is effectively capped, a period of approximately four months, leachate will be generated from both infiltrating precipitation and fluid extrusion from sludge consolidation. During the remaining period of construction, leachate will be produced only from the consolidation of the sludge, which will be occurring at a rapidly decreasing rate. In less than one year from commencement of the cap construction, the overall impact to the groundwater quality from the construction effort will be roughly the same as the impact of doing nothing to the lagoon for a similar period of time.

SECTION 6
CLOSURE DESIGN

6.1 Cap Design. The elements of the cap have been specifically designed to accommodate the lagoon configuration, locally available soil materials, and intent of the closure for the 100-year, 24-hour storm event.

6.1.1 Cap Section. The cap, from bottom to top, consists of five major elements (see Figure 3):

- **Bedding Fill:** A soil bedding fill will be placed directly on the sludge. It will serve three purposes: (1) create a stabilize working base on the thixotropic sludge; (2) establish the final shape and slope of the cap; and (3) provide a protective bedding for the impervious membrane. The thickness of the bedding fill will vary from approximately one to three feet.

- **Impervious Membrane:** An impervious membrane of either very low density polyethylene (VLDPE) or polyvinyl chloride (PVC) will be laid on the bedding fill. The membrane is the most critical element of the cap; it prevents the downward percolation of precipitation.

- **Drainage Layer:** A highly transmissive geosynthetic, or geotextile, drainage material will be placed directly on the impervious membrane. The purpose of the drainage layer is to prevent infiltrating precipitation from accumulating on the impervious membrane and saturating the overlying soil cover. The geotextile material is backed with a filter fabric on the top side to retain the overlying soil.

- **Protective Fill:** Protective fill will be placed directly on the drainage layer. The purpose of the fill is (1) to prevent exposure and damage to the membrane and drainage layer and (2) to provide a moisture retention soil zone below the topsoil. The protective fill layer will be a minimum of one foot thick.

- **Topsoil:** A topsoil layer will be placed over the protective fill in order to establish a sound grass cover on the completed cap surface. The topsoil layer will be approximately 6 inches thick.

6.1.2 Impervious Membrane. The sole function of the impervious membrane is to provide a virtually water-proof layer. To ensure this function over the long-term, the membrane material and its seams must (1) have sufficient strength to accommodate settlement of the sludge and cap, (2) resist puncture from particles in the bedding soil, (3) be chemically inert to any liquids or vapors in the sludge or cover soil, and (4) resist any other site-specific adverse conditions. Much of the design concern over the integrity of impervious membranes focuses on sanitary landfill settings where localized differential settlement (pot-holes) may be severe, overall settlement may be significant, liquids and gases may be solvent to the membrane or seams, and other site conditions (e.g., burrowing animals) may pose unique problems. These conditions do not exist at the lagoon. The sludge is generally homogeneous, so severe differential settlement and "pot-holes" are not anticipated, either during construction or over the long term. The sludge contains no compounds which are solvent to membrane materials or which produce vapors potentially detrimental to the membrane. There are no reported difficulties with rodents or burrowing animals in the area. Hence, the design constraints for the membrane in the lagoon closure application are not as severe as for landfill applications.

Several alternate materials and thicknesses have been considered for the membrane. Calculations of settlement and anticipated membrane stretching confirm that very low density polyethylene (VLDPE) at a thickness of 20 mils is sufficient for this lagoon application. However, installation contractors report that the seaming techniques for the relatively thin 20 mil VLDPE are somewhat more labor-intensive than for the thicker 30 mil VLDPE. Since the material cost for 30 mil is not significantly greater than 20 mil but the installation costs may be greater for 20 mil than for 30 mil, there may be no cost advantage to using the thinner material. The construction plans and specifications will, therefore, allow either as a bid alternate.

The use of plasticized polyvinyl chloride (PVC) of 30 mil thickness was also evaluated. The disadvantages normally associated with PVC (e.g., deterioration in prolonged exposure to sunlight, solvent vapors, edible to rodents, etc.) are not factors in this lagoon closure application. The strength properties of 30 mil PVC are adequate for the anticipated settlement conditions. Therefore, the use of 30 mil PVC will also be allowed as a bid alternate.

The impervious membrane will be placed as overlapping long strips (rolls) or as overlapping panels. In either case, joining the material and creating continuous seams is of critical importance to the integrity of the membrane; the seams must not allow leakage and must not compromise the strength of the membrane material. The recommendations of the membrane manufacturer will be followed as to the seaming technique (heat, solvent, or mastic) and inspection procedures (e.g., in-place vacuum testing, destructive test coupon testing, etc.). Regardless of the manufacturer's recommendation, a minimum overlap of six inches will be specified to ensure maintenance of the membrane strength integrity.

6.1.3 Geosynthetic Drainage Layer. Because of the need to maintain a minimal two percent slope to the cap (see Section 6.2), the drainage layer becomes a very important element of the cap design. Even with the minimal slope, the drainage layer must allow the percolating water to be freely transported to the cap perimeter and, therefore, minimize the buildup of hydrostatic head in the protective fill and topsoil layers. Otherwise, during the 100-yr, 24-hour storm event, for which the cap is designed, the overlying topsoil and protective fill would become over-saturated, and excessive erosion of the cap surface would result from the increase in runoff and decrease in soil stability. The HELP computer modeling program was used to identify the necessary transmissive properties of the drainage layer.

Commercially available geotextile products (such as AKZO Enkanet 4010) meet the drainage layer requirements. Rather than a filter-like fabric as often used for drainage material, these highly transmissive drainage materials are constructed from permeable net-work synthetic textiles as non-crushable waffles; the textile material itself is highly transmissive, and the waffle construction provides open channels. The top side of the textile is bonded to a geofabric filter cloth which allows free vertical percolation of the water into the drainage layer, but precludes entry of soil particles.

6.1.4 Properties of the Fill Materials. The bedding fill has few required properties other than being an easily workable soil. Its purpose is to provide that bulk material necessary to establish the shape and grade of the cap and to provide a relatively stable base for the impervious membrane. The bedding fill can be virtually any non-cohesive soil type or cohesive soil of low plasticity so long as it is free of large gravel, rocks, or debris which could puncture the membrane. Local borrow sources and soil from the perimeter dike to be partially excavated are suitable for bedding fill.

The protective fill must also be a workable soil free of rocks and debris that might puncture the underlying drainage layer; however, it must also have a moderately low permeability to be compatible with the drainage layer. The fill must be a silty, clayey sand or sandy silt. The HELP computer modeling program indicates that, in order to be compatible with the slope and drainage layer, the protective fill should have a permeability of $\leq 10^{-4}$ centimeters per second. The mean permeability value of local borrow sources and the permeability of the dike soils to be excavated meet this requirement.

Topsoil will be a locally-available common fill with sufficient organic content to support the grass cover and sufficient workability to be easily spread. The permeability can be no less than that of the protective fill. The topsoil will,

therefore, be a silty sand or sandy silt with humus. The completed cap will be seeded with a locally-common, dry-tolerant grass. Fertilization and irrigation will be provided as required to establish and maintain a thick stand of grass.

6.1.5 Percolation Properties of the Completed Cap. When completed, the cap from the surface down to the drainage layer will behave as a sandy silt soil terrane with natural vegetation. Discrete rainfall events will largely infiltrate the topsoil and protective fill, be retained as soil moisture, and be subsequently lost to evapotranspiration. During more significant storm events, the topsoil and protective fill will become saturated with downward percolating rain water. The drainage layer is designed to discharge the percolating water to the cap perimeter so that the cover soil does not become over-saturated, which would reduce the stability of the cover soil and promote the development of surface erosion features. (In other words, the topsoil and protective fill react as if the drainage layer was a significant thickness of soil of equal or greater permeability than the cover fill.)

Below the drainage layer, the impervious membrane will block vertical migration of precipitation into the underlying bedding fill and sludge with an estimated 99 percent efficiency.

6.2 Grading Plan. The cap grading plan controls the total quantity of fill required for the cap and the direction of storm water drainage.

6.2.1 Cap Slope Considerations. The general "rule-of-thumb" for landfill caps is that the final slope should be in the range of three to five percent. However, the existing sludge surface north of the previously capped area slopes northwestward at approximately two percent. Two factors were considered:

- Considering the thixotropic nature of the sludge, the existing lagoon topography cannot be significantly altered. Sludge cannot

be pushed or graded upslope with conventional earthwork equipment (bulldozers) to create a steeper slope.

- The greater the cap fill thickness (hence, weight), the greater the resulting consolidation of the sludge, and the greater the volume of extruded leachate.

Therefore, it is advantageous for the final cap surface to reflect the topography of the existing sludge surface to the greatest degree possible so that no significant quantity of sludge requires regrading and the cap can be a minimal thickness. For these reasons, the HELP computer modeling program was utilized to select the properties of cover fill and drainage layer materials that allow the final cap grade to be two percent.

In order to maintain a minimum slope of two percent and take full advantage of the existing sludge topography, the cap grade will have a crest located asymmetrically along the east side with a gently concave slope to the northwest. The conceptual cap grading plan is shown on Figure 4.

6.2.2 Lowering the Dike Crest. Currently, the crest of the dike is at approximately elevation +22 around the entire perimeter. The dike crest will be lowered to accommodate the final cap grade and allow runoff and underflow from the drainage layer to discharge down the exterior face of the dike. The dike will remain at full height at the southern end of the western side and along the southern half of the eastern side (see Figure 4). The crest elevation of the dike will slope to approximately elevation +12 along the northwest portion of the lagoon. The relationship of the final grade and dike elevation to the existing topography across the north end of the lagoon is shown on cross section C-C', which is cut on Figure 4 and presented on Figure 5.

As the dike is lowered, the crest width and interior face slope will remain constant; the exterior slope will be reduced, which is advantageous in

minimizing storm water flow velocity and erosion potential. The crest of the dike will be level with the top of the bedding fill; the impervious membrane and drainage layer will extend onto the dike crest and terminate at a gravel gabion. The gabion serves three critical purposes:

- Provides a transition to allow underflow from the drainage layer to discharge to the exterior dike surface.
- Retains the protective fill and topsoil layers.
- Provides a transition to allow surface runoff from the cap to discharge onto the steeper exterior dike slope.

The dike configuration at full and reduced height and the relationship among the cap, dike, and gabion are shown on Figure 6.

Located on the dike are a series of piezometers that were used to monitor hydrostatic conditions during dike construction and a series of groundwater monitoring wells (east and northeast portion of the dike). Two of the monitor wells are integral to the overall groundwater monitoring program for the plant site and must remain; construction will accommodate recompleting these wells at the new surface elevation. The NC DEM Groundwater Section has concurred that the remainder of the monitor wells and piezometers may be abandoned to facilitate construction of the cap. Prior to initiating cap construction, these wells will be abandoned in accordance with Title 15A, Subchapter 2c, Section .0113 of the North Carolina Administrative Code.

6.2.3 Storm Drainage. For discrete storm events (e.g., isolated thunder showers), most or all of the precipitation will percolate and be held in the top soil and protective fill where it will be eventually lost to evapotranspiration. Storm drainage from significant storm events (e.g., 10-year, 100-year, etc.) will consist of two components. Depending upon the magnitude of the event, 50

to over 60 percent of the precipitation will discharge as surface runoff, while an additional 8 to 12 percent will discharge as underflow from the drainage layer; there is a time lag between the peak surface runoff and the peak underflow discharge. Both components pass into the gravel gabion and discharge as sheet flow down the exterior dike slope. The majority of storm drainage, roughly 80 percent, will discharge to the northwest with the greatest portion discharging north of the mid-point on the western side of the dike. This is also the area of the lowest dike crest and most gentle exterior dike slope, hence, the least downslope drainage velocity. Even so, the upper portion of the slope immediately below the gravel gabion will be protected with permanent erosion control matting to minimize the potential for slope erosion. All exterior dike slopes will be hydroseeded to quickly establish a permanent grass cover.

All storm drainage discharging from the cap will do so as sheet flow down the grassed slopes of the perimeter dike. No storm drainage from the plant area will discharge north to the lagoon cap, and no significant cap drainage will discharge south into the plant.

6.3 Construction Methods and Stability Considerations. Due to the thixotropic nature of the sludge and the sensitivity of the surrounding wetlands to construction activity, the construction methods and sequence will be carefully specified to ensure that the purpose and goals of the closure are not compromised.

6.3.1 Dressing the Existing Lagoon Surface. Although no significant excavation or movement of the sludge will be attempted, minor topographic irregularities on the sludge surface will be dressed to a more regular surface using light flotation equipment (e.g., screw pontoon, "mud-bug", etc.). A topographic ridge of sludge paralleling the northeastern dike (see Figures 2 or 4) will be excavated with equipment on the dike crest and redistributed

upslope. Clearing and grubbing vegetation from and minor regrading of the previously placed cap will also be necessary.

6.3.2 Placing the Bedding Fill. The bedding fill will be placed directly upon the dressed sludge surface. As demonstrated during the placement of the soil cap in 1984, light earthmoving equipment always working from the filled toward the unfilled area can satisfactorily place the bedding fill. Placement of the fill will commence from the southeast and progress downslope toward the northwest.

Approximately half of the bedding fill volume must be imported from offsite, and this material will be placed first. The remaining bedding material will be excavated from the dike as the crest elevation is lowered and the slope of the exterior face reduced. The sequence of dike excavation and filling has significant impact upon the construction sedimentation and erosion control plan; this is discussed in more detail in Section 6.4).

6.3.3 Placement of the Impervious Membrane and Drainage Layer. When placement of the bedding fill is essentially complete, the impervious membrane will be placed over the entire cap and secured into the crest of the perimeter dike. Placement and seaming of the membrane and inspection of the seams will be in accordance with the manufacturer's specifications and warranty. As placement of the membrane progresses across the lagoon, placement of drainage layer will commence. The placement and joining of adjacent panels or strips of the drainage layer and geofabric backing will be in accordance with the manufacturer's specifications.

At the crest of the perimeter dike, the cap surface runoff and underflow from the drainage layer must both transition to sheet flow down the exterior dike face. To accomplish this transition, a gravel-filled gabion will be placed along

the top of the exterior slope face. The gabion will rest on a geofabric filter cloth to separate the gravel from the underlying dike soils. The gabion may also provide anchorage for erosion control matting on the exterior dike face and anchorage for the impervious membrane of the cap. The drainage layer terminates at the gravel gabion to allow free discharge of the underflow. Cap surface runoff will also enter the gabion, and the combined runoff and underflow will emerge on the dike face as sheet flow. The conceptual detail of this critical transition element is shown on Figure 7.

6.3.4 Placement of the Protective Fill and Topsoil. Utilizing a construction procedure similar to the one used for placement of the bedding fill, the protective fill will be placed by very light, wide-tracked earth moving equipment working always from the filled toward the unfilled areas to protect the drainage layer and membrane from damage. Fill for the protective cover will be select imported fill or excavated dike material, should there be excess from the bedding fill placement. Once the protective fill has been placed and dressed to grade, topsoil will be placed in a similar method. Other than light proof rolling, the topsoil and protective fill will not be compacted, and there are no compaction test requirements.

6.3.5 Alteration and Stability of the Perimeter Dike. The perimeter dike is an engineered feature which was constructed under earthwork and compaction specifications and which was later evaluated under the dam safety act. The stability of the dike at its full current height has been evaluated (1) for the loading conditions of the cap and gravel gabion transition element and (2) with storm water sheet flow down the exterior dike slope. The dike was found to be stable with acceptable safety factors for both surface seepage sliding and toe arc failure.

As the crest elevation of the dike is reduced and the slope of the exterior face is reduced from the current 2:1 to 4:1 or less, the dike becomes increasingly more stable. In addition, the exclusion of precipitation from the impounded sludge and the consolidation of the sludge under the weight of the cap render the sludge a more stable mass and somewhat reduce the loading on the dike.

6.4 Construction Sedimentation and Erosion Control (SEC) Plan. An SEC Plan will be prepared that specifies the measures and procedures to be employed during construction to minimize erosion within the construction area and prevent sediment from migrating outside of the construction area. Storm water runoff will be collected and controlled in two different phases and areas during construction:

- Storm water collecting within the perimeter dike. This storm water will commingle with leachate extruded from the sludge surface during the early phase of cap construction.
- Storm water discharging from the exterior face of the perimeter dike during work on the dike slopes and during the latter phases of cap construction.

6.4.1 Storm Water and Leachate Collection in Lagoon Interior. As described in Section 6.3.1, approximately half of the bedding fill will be imported from offsite and placed in the southern half of the lagoon. At that point, excavation of material from the perimeter dike will commence to furnish the remainder of the bedding fill. Until the final stages of the dike excavation and lowering of the crest elevation, the dike creates an impounding basin in the northwest corner of the lagoon. Storm water falling within the lagoon perimeter during this phase of construction will collect and be impounded in the northwest portion of the lagoon as it currently does. Also, as bedding fill is placed (working from the southeast to the northwest), leachate will be extruded from the sludge, a portion of which will collect with storm runoff in the impoundment area.

A stilling sump will be constructed in the sludge at the lowest point in the northwest corner. Storm water runoff and extruded leachate that collects in the northwest lagoon corner will be pumped to the plant's wastewater treatment facility prior to discharge from a permitted outfall. The former standpipes (used when the lagoon was an active disposal area) may be utilized as shown on Figure 2, or a totally separate temporary line may be laid to the wastewater facility. The stilling sump will remain until placement of the impervious membrane requires its removal and backfill.

6.4.2 Sedimentation and Erosion Control on Lagoon Exterior. When excavation of the perimeter dike for borrow material commences, a construction sedimentation perimeter will be established. Sediment from storm water runoff during construction activities on the exterior dike face and crest will be intercepted at the construction perimeter through the use of conventional sediment fences and straw bales.

When the appropriate crest elevation and exterior slope on the dike are attained, erosion control matting will be installed on the dike slope in areas impacted by the greatest percentage of sheet flow runoff, and all exterior dike slopes will be hydroseeded to establish grass cover in the minimum possible time.

The sedimentation fence perimeter will be located at the toe of the dike slope, which is the defined edge of wetlands, along the east and north sides. On the west, the fence will be placed along the west edge of the access road adjacent to the wetlands (see Figure 2). Under no circumstance will construction activities encroach upon the wetlands.

6.4.3 Final Construction. Following installation of the impervious liner and geotextile drainage layer, the protective fill and topsoil will be placed. After

final grading the entire cap will be seeded and fertilized according to the design specifications to establish a dense cover of dry-tolerant grass.

6.5 Environmental Permitting. Environmental permitting issues for the lagoon closure include the following:

- **Dredge and Fill Permit:** Corps of Engineers has determined upon site inspection that the construction as proposed requires no COE 404 Dredge and Fill permit.
- **North Carolina Coastal Area Management Act (CAMA):** NC Division of Coastal Management has determined upon site inspection that the construction as proposed requires no CAMA permit.
- **North Carolina Sedimentation and Erosion Control Plan:** To be submitted to Hanover County with copy to DEM.
- **North Carolina Storm Water Certification - 401 Water Quality Permit:** Letter confirming that impervious surface area is less that one acre to be submitted to DEM Water Quality Section.
- **National Pollutant Discharge Elimination System (NPDES) Notice of Intent:** To be submitted to DEM in Raleigh.
- **Modification to NPDES application for site-specific storm water discharge permit:** Check on need for permit modification with DEM in Raleigh.
- **Dam Safety Permit for alteration of dike:** Copy of Closure Plan to be submitted to DEM Land Quality Section, Wilmington, for determination if dike is still considered an impounding structure.

SECTION 7
CLOSURE SCHEDULE

The proposed closure design, construction, and related activities will extend into the fourth quarter of 1994. The schedule for specific closure activities is presented as Figure 8.

SECTION 8
CLOSURE DOCUMENTATION

8.1 Construction Sequence. During the construction activities, a log of the construction sequence will be maintained and will be available for DEM inspection.

8.2 As-Built Drawings. The design drawings will be amended and updated during construction to include revisions made by the Engineer of Record and to reflect ancillary features. The completed As-Built drawings will be sealed by the Engineer of Record (a licensed Professional Engineer in North Carolina) and submitted to the DEM for their permanent records.

SECTION 9

CAP INSPECTION AND MAINTENANCE PLAN

9.1 Vegetative Cover Maintenance. Maintaining the grass stand on the lagoon cap is critical to the long-term integrity of the lagoon closure. The following elements will be incorporated into the maintenance plan:

- Provisions for watering grass in extended dry periods.
- Minimal mowing as required to maintain health of grass.
- Periodic removal of deep-rooted plants which may be attempting to grow.
- Periodic removal of dead grass matting (thatch).
- Periodic fertilization and reseeding as necessary.

9.2 Erosion Repair. Minor gullies or other erosion features may develop in the topsoil, protective fill, and the exterior dike slope, particularly before the grass stand has thoroughly rooted or during significant storm events. If not repaired, erosion features could ultimately jeopardize the cap integrity. The basic repair plan will include the following elements:

- Reconstruction/repair of eroded areas to original design properties and dimensions.
- Erection of sedimentation fences around repair area.
- Reseeding of repaired areas.

9.3 Inspections. The inspection plan will include the following elements:

- Routine quarterly inspections, traversing the cap and slope areas on foot.

- Special inspections
  - During extended dry periods to determine need for watering.
  - To investigate an observed or reported incident, such as the sighting of a burrowing animal on the cap.
  - After major storm events to check for damage or erosion.
  - After periods of abnormally high river level.

SECTION 10
POST-CLOSURE CONSIDERATIONS

10.1 Long-Term Storm Water Drainage. In significant rainfall events, 30 to 45 percent of the precipitation will be retained in the topsoil and protective cover, 50 to 65 percent will be lost as surface runoff from the cap, and 8 to 12 percent will be lost as underflow from the drainage layer. The runoff and underflow will discharge as sheet flow down the exterior dike slope. Approximately 80 percent of the drainage will discharge over the northern half of the west side and western half of the north side of the perimeter dike. Drainage discharging to the west enters the wetlands along the river through a 100- to 150-foot wide, northeast-southwest trending swale between the lagoon and the flooded quarry, Section 1. (Limited wetland areas exist in the north end of the swale.) Drainage then proceeds northeastward through the wetlands to the river. At the peak discharge of the 100-year, 24-hour storm event, the volume of flow at the north end of the swale attributable to drainage from the capped lagoon will be approximately 47 cubic feet per second (cfs). During a more typical 2-year, 24-hour storm peak discharge, the flow from the swale will be approximately 11 cfs.

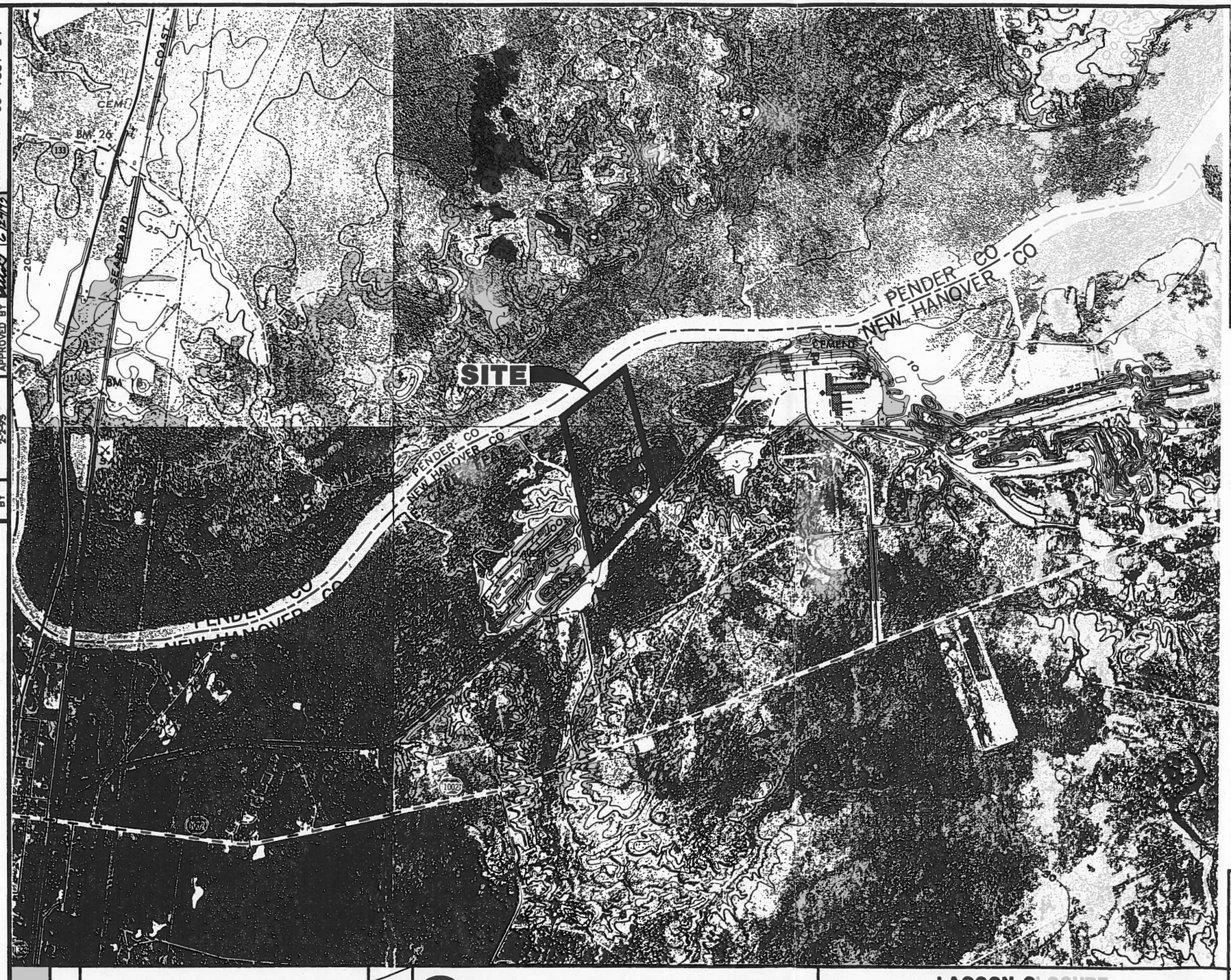
Sheet flow from the north side of the cap enters wetlands that border the river. The river is approximately 100 feet to the north. Sheet flow from the east side of the cap enters a wide expanse of unconfined wetlands.

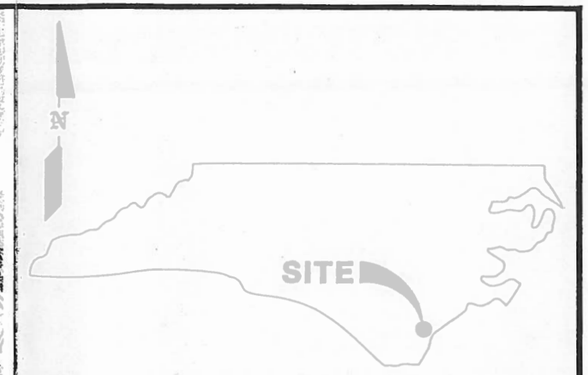
10.2 Groundwater Impact Monitoring. Monitoring of the groundwater quality in the vicinity of the closed lagoon is addressed in the SOC between OxyChem and the DEM.

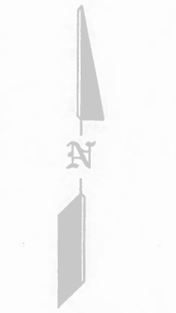
REFERENCES

Sirrine Environmental Consultants of NC, P.A., September 1992, *Site Characterization and Remedial Assessment Report*: prepared for Occidental Chemical Corporation, Castle Hayne, NC.

DRAWN BY: A.B. LAPRAIRIE 2-2-95
CHECKED BY:
APPROVED BY:
DRAWING NO. 60-1881-B4







RE: U.S.G.S. 7.5 MINUTE SERIES QUADRANGLE MAP, CASTLE HAYNE, N.C. 1970, ROCKY POINT, N.C. 1988, MOORETOWN, N.C. 1970, AND SCOTTS HILL, N.C. 1970.

DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATION
NIAGARA FALLS, NEW YORK
Client

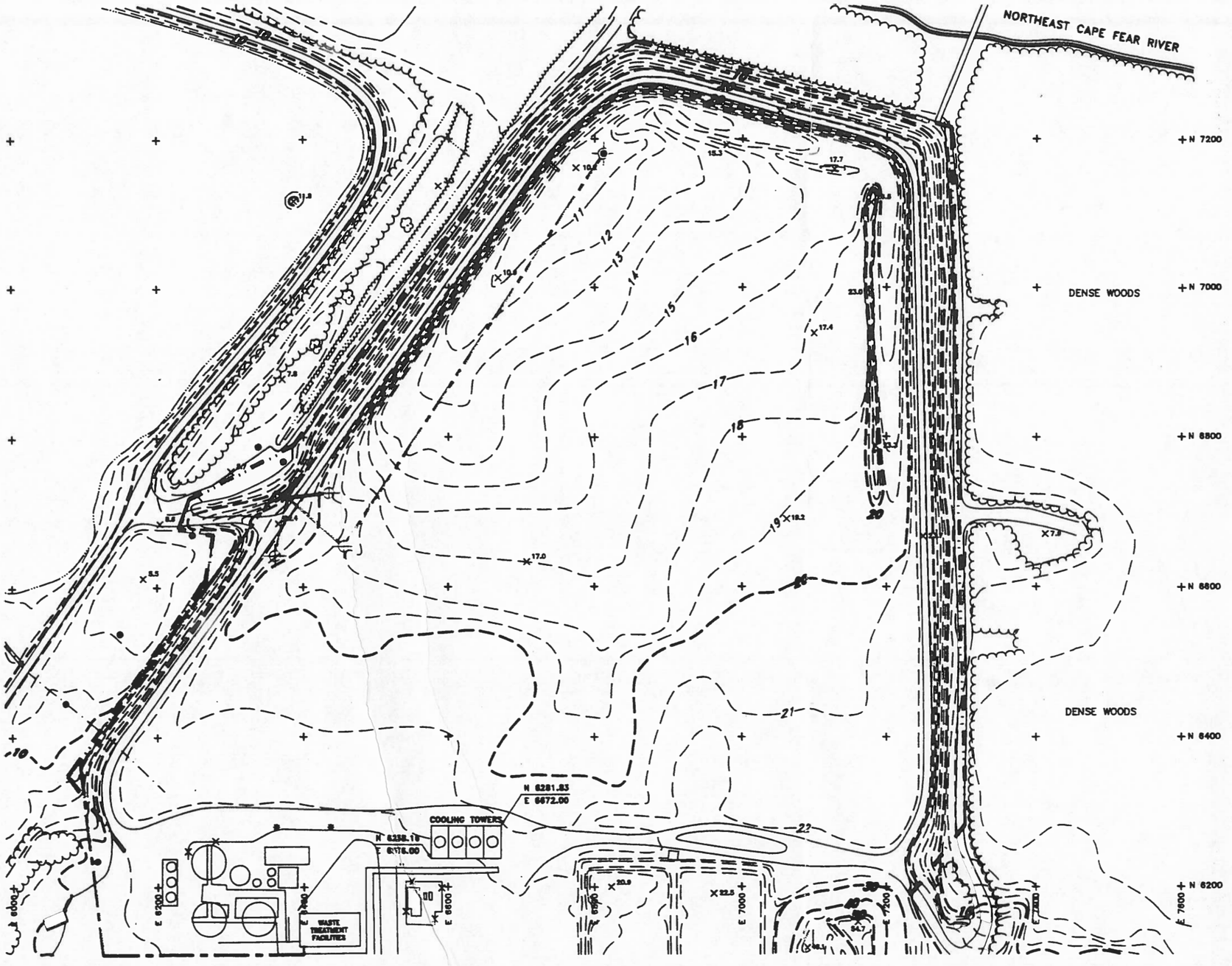
LAGOON CLOSURE
CASTLE HAYNE PLANT
CASTLE HAYNE, NORTH CAROLINA
Project Location

G&E ENGINEERING, INC.
ENVIRONMENTAL CONSULTANTS

VICINITY MAP

Fig. No. 1

DRAWN BY | A.B. LAFRARIE | 3-16-93
CHECKED BY | APPROVED BY | DRAWING NO. 10-.d81-B10



PLANT NORTH
N

LEGEND

- EXISTING CONTOUR
- EXISTING SUCTION PIPELINE
- PROPOSED TEMPORARY DISCHARGE/SUCTION LINE
- PROPOSED SILT FENCE/EROSION CONTROL
- EXISTING STANDPIPE STUBOUT
- PROPOSED SUMP

0 feet 150
SCALE

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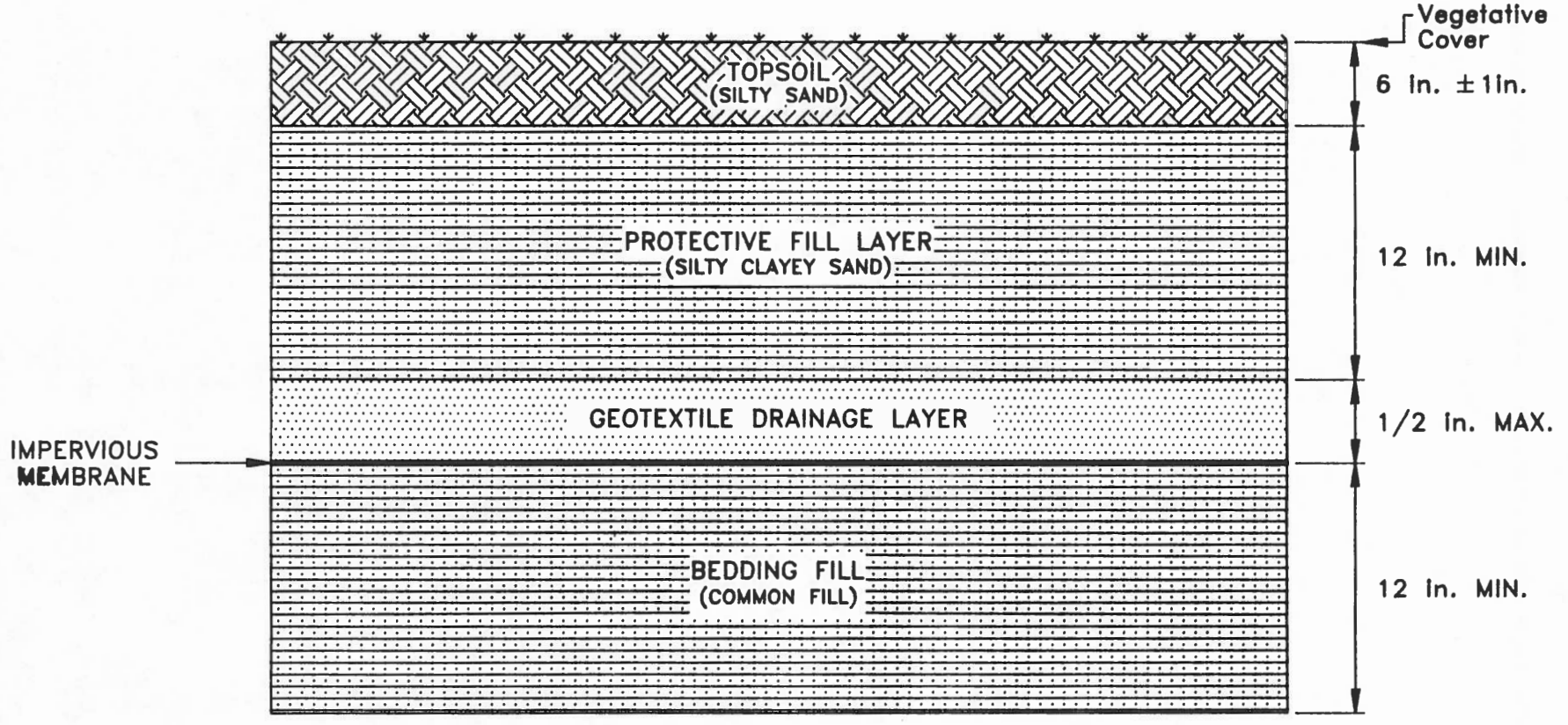
CASTLE HAYNE, NORTH CAROLINA
Client

LAGOON CLOSURE
CASTLE HAYNE PLANT
CASTLE HAYNE, NORTH CAROLINA
Project Location

SITE PLAN

2
Fig. No.



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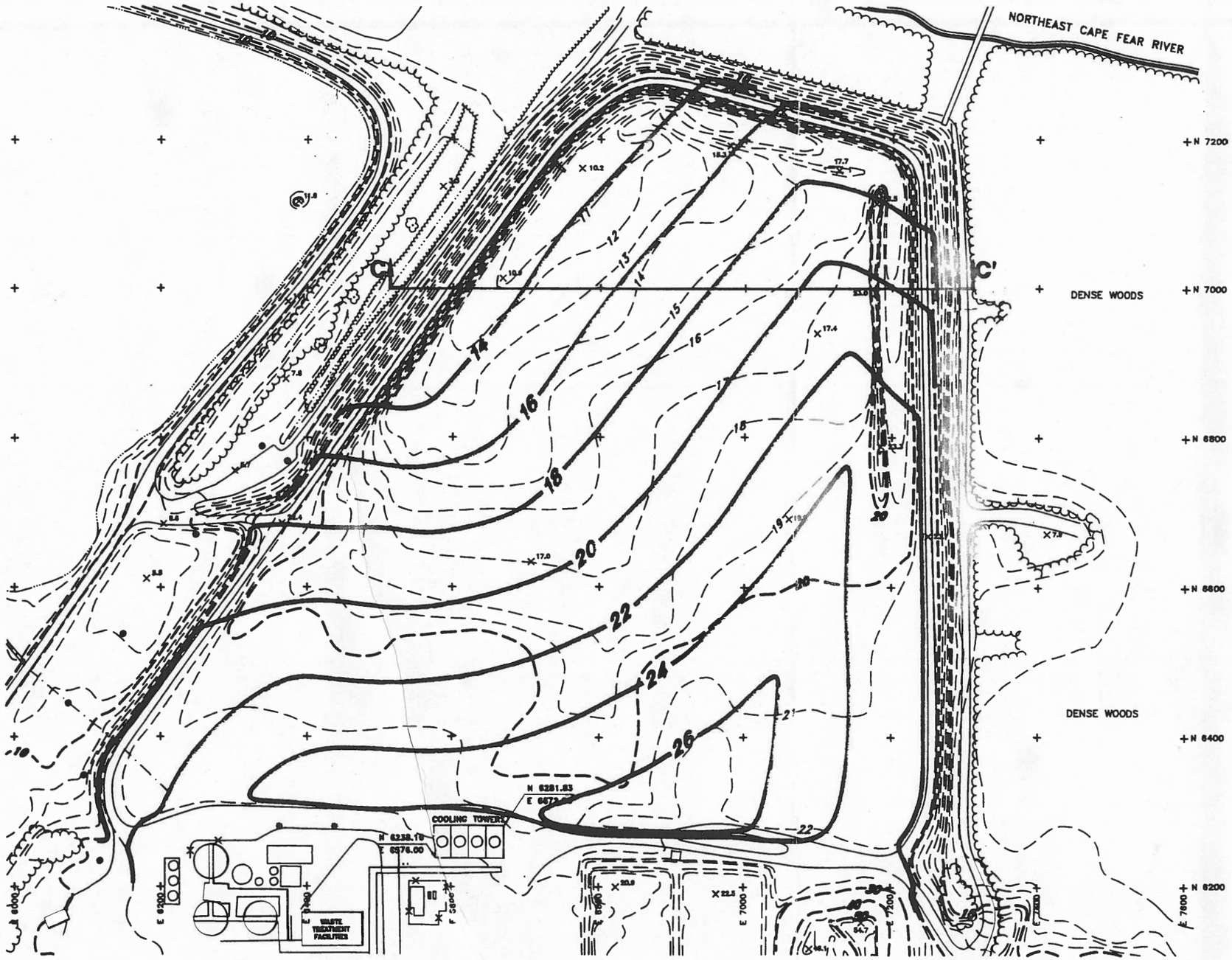
9-15-93 Date	1881-A5 File No.	OCCIDENTAL CHEMICAL CORPORATION NIAGARA FALLS, NEW YORK Client	**LAGOON CLOSURE** CASTLE HAYNE PLANT CASTLE HAYNE, NORTH CAROLINA Project Location	**CAP SECTION**	**3** Fig No.
DLB Drawn by	Ckd. by				

DRAWN BY	CHECKED BY	DRAWING NO.
A.B. LAPRADE 3-15-89	APPROVED BY	10-1881-B9



LEGEND

- EXISTING CONTOUR
- C C' CROSS-SECTION LOCATION
- PROPOSED CONTOUR

0 feet 150
SCALE

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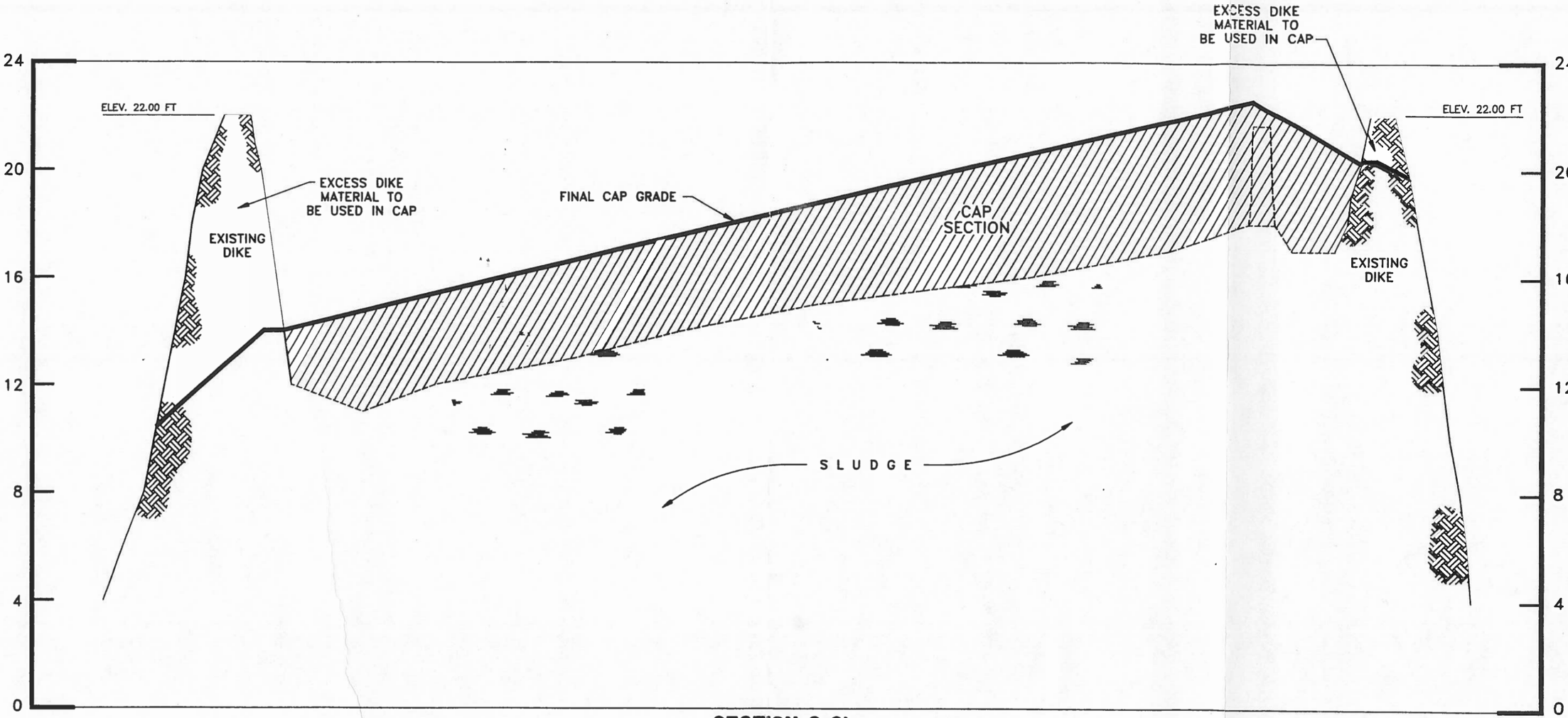
LAGOON CLOSURE
CASTLE HAYNE PLANT
CASTLE HAYNE, NORTH CAROLINA
Project Location

CONCEPTUAL CAP GRADING PLAN

4
Fig. No.

DRAWN BY: A.B. LAPRAIRIE 3-17-99 | CHECKED BY: APPROVED BY: [illegible] 4/13/93 | DRAWING NO. 60-1881-B12



SECTION C-C'

0 feet 60

HORIZONTAL SCALE
VERTICAL SCALE IS AS SHOWN

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CASTLE HAYNE, NORTH CAROLINA
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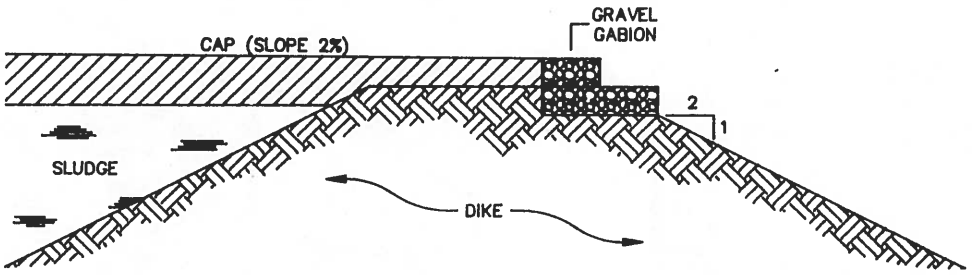
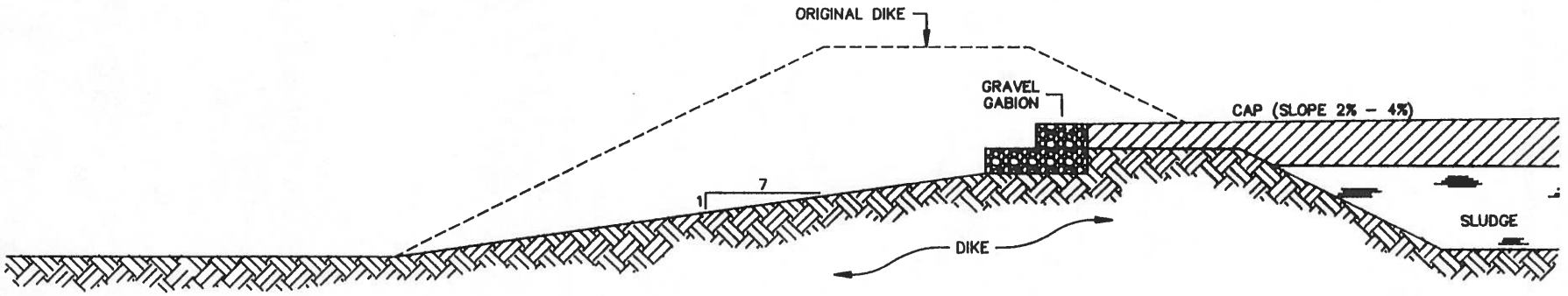
CROSS-SECTION C-C'

5
Fig. No.



DIKE AT HIGHEST POINT



DIKE AT LOWEST POINT

NOT TO SCALE

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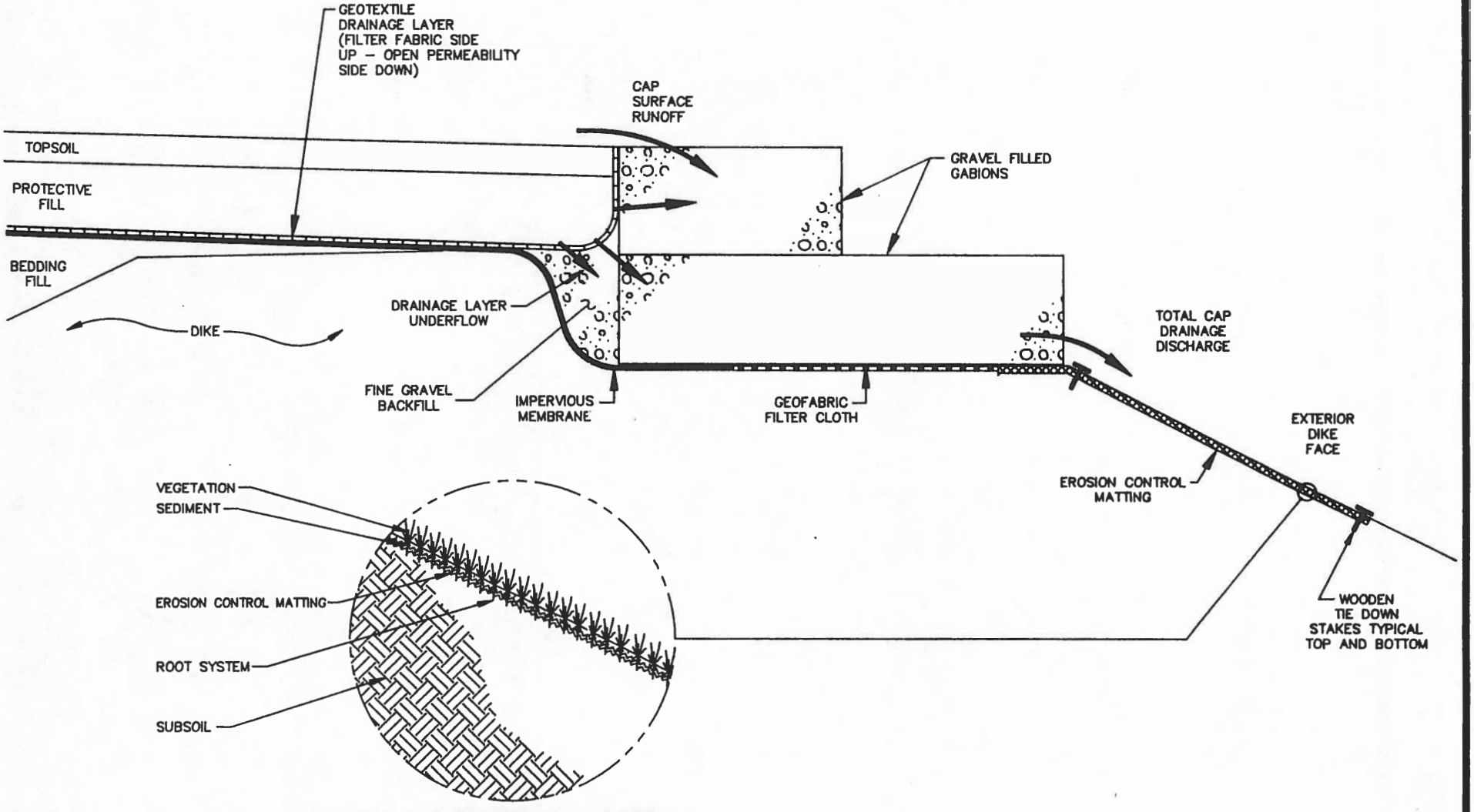
9-15-93 Date	1881-A13 File No.		OCCIDENTAL CHEMICAL CORPORATION NIAGARA FALLS, NEW YORK Client	**LAGOON CLOSURE** CASTLE HAYNE PLANT CASTLE HAYNE, NORTH CAROLINA Project Location	**PERIMETER DIKE**	**6** Fig No.
DLB Drawn by	11/23/93 Ckd. by					



DETAIL EROSION CONTROL MATTING (TYPICAL)

NOT TO SCALE

NOT TO SCALE

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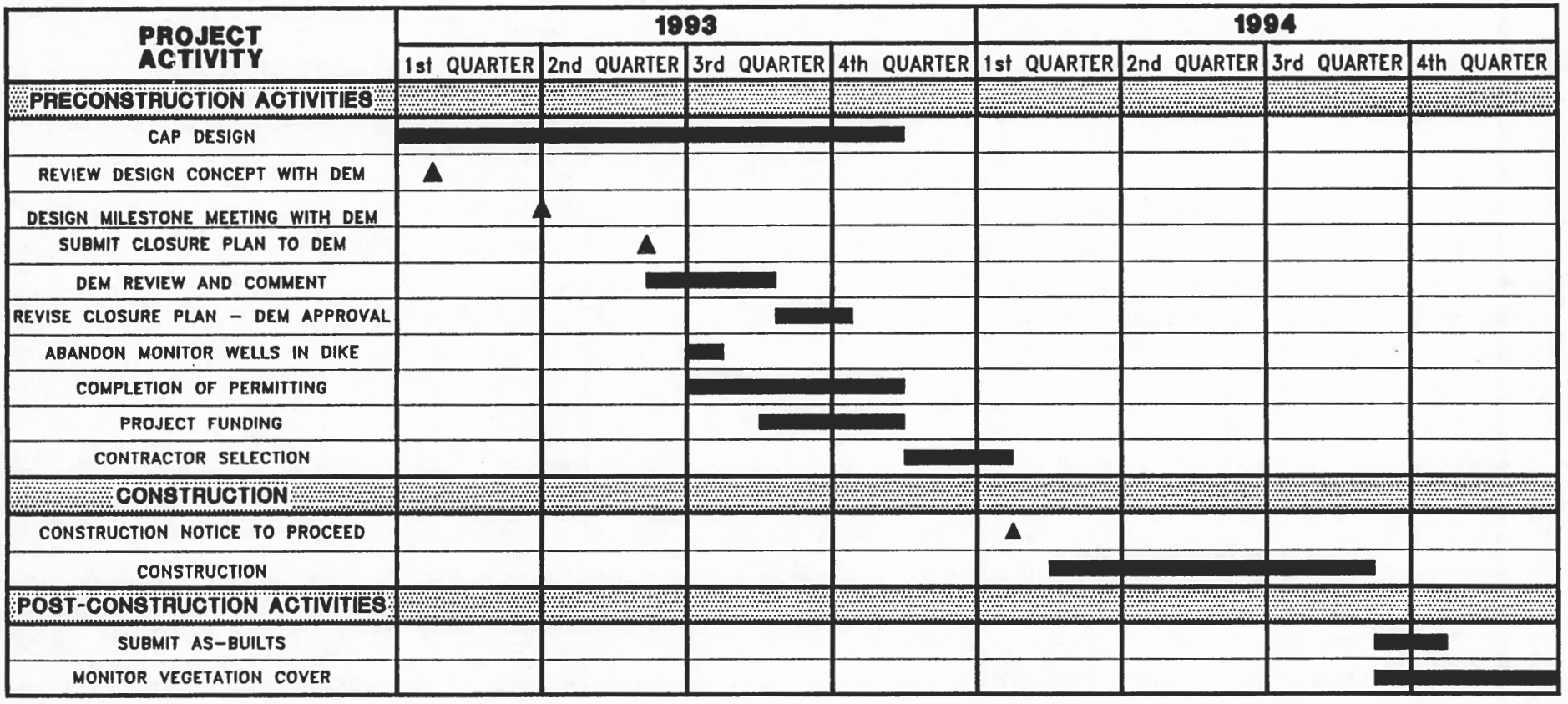
9-15-93 Date	1881-A16 File No.	OCCIDENTAL CHEMICAL CORPORATION NIAGARA FALLS, NEW YORK Client	**LAGOON CLOSURE** CASTLE HAYNE PLANT CASTLE HAYNE, NORTH CAROLINA Project Location	**DETAIL OF CAP TO DIKE TRANSITION**	**7** Fig No.
DLB Drawn by	Ckd. by				



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ABL Drawn by	LWG Ckd. by					