FINAL REPORT
ROUND 7 DAM ASSESSMENT
CONSUMERS ENERGY COMPANY - D.E. KARN PLANT
1 & 2 SOLID WASTE DISPOSAL AREA
ESSEXVILLE, MICHIGAN

June 30, 2011

PREPARED FOR:

U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

PREPARED BY:

GZA GeoEnvironmental, Inc.
19500 Victor Parkway, Suite 300
Livonia, MI 48152
GZA File No. 01.0170142.20

GZA
GeoEnvironmental, Inc.

Engineers and Scientists

June 30, 2011
File No. 01.0170142.20

Mr. Stephen Hoffman
U. S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

19500 Victor Parkway
Suite 300
Livonia, MI 48152
734-462-0207
FAX 734-462-0508
www.gza.com

Re: Round 7 Dam Assessment - Final Report
EPA Contract No. EP10W001313
Consumers Energy Company - D.E. Karn Plant
D.E. Karn 1 & 2 Solid Waste Disposal Area
Essexville, Michigan

Dear Mr. Hoffman:

In accordance with our proposal 01.P000177.11, dated August 11, 2010, and U.S. Environmental Protection Agency (EPA) Contract No. EP10W001313, Order No. EP-CALL-0001, GZA GeoEnvironmental, Inc. (GZA) has completed our inspection of the Consumer's Energy Company (CEC) D.E. Karn Plant (DEKP, Site) D.E. Karn 1 & 2 Solid Waste Disposal Area (Karn Disposal Area) located in Essexville, Michigan. The Site visit was conducted on September 27 and 28, 2010. The purpose of our efforts was to provide the EPA with a Site-specific inspection of the impoundments to assist EPA in assessing the structural stability of the impoundments under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act Section 104(e). We are submitting one hard copy and one CD-ROM copy of this Final Report directly to the EPA.

Based on our visual inspection, and in accordance with the EPA's criteria, the Karn Disposal Area is currently in **SATISFACTORY** condition, in our opinion. Further discussion of our evaluation and recommended actions are presented in the Round 7 Dam Assessment Report. The report includes: (a) completed Field Assessment Checklists; (b) figures of the impoundments; and (c) selected photographs with captions. Our services and report are subject to the Limitations found in **Appendix A** and the Terms and Conditions of our contract agreement.

We are happy to have been able to assist you with this inspection and appreciate the opportunity to continue to provide you with dam engineering consulting services. Please contact the undersigned if you have any questions or comments regarding the content of this Round 7 Dam Assessment Report.

Sincerely,

GZA GEOENVIRONMENTAL, INC.

Thomas R. Boom, P.E. (MI)
Project Manager
thomas.boom@gza.com

Walter Kosinski, P.E. (MI)
Principal
walter.kosinski@gza.com

Peter H. Baril
Project Director
peter.baril@gza.com

FINAL REPORT

EXECUTIVE SUMMARY

This Inspection Report presents the results of a visual inspection of the Consumers Energy Company (CEC, Owner) D.E. Karn Plant (DEKP, Site) DE Karn 1 & 2 Solid Waste Disposal Area (Karn Disposal Area) in Essexville, Michigan. The inspection was performed on September 27 and 28, 2010 by representatives of GZA GeoEnvironmental, Inc (GZA), accompanied by representatives of CEC.

The Karn Disposal Area, in its current configuration, has a maximum height of approximately 17 feet above the perimeter dike, and a maximum combined storage volume of approximately 4,422 acre-feet (at the maximum permitted elevation in each Pond). Under U.S. Army Corps of Engineers (COE) guidelines, the Karn Disposal Area is classified as an **Intermediate** size structure. It is noted that the State of Michigan regulates the Karn Disposal Area as a Type III landfill and thus does not provide a size classification rating for coal ash impoundments.

Since the Karn Disposal Area is regulated as a Type III landfill in Michigan and not a dam, the State of Michigan has not assigned it a hazard potential rating. Under the EPA classification system, it is GZA's opinion that the Karn Disposal Area would be considered as having a **Low** hazard potential based on the low potential for loss of human life and low economic and environmental losses in the potential event of dike failure. Failure of the dikes may lead to an interruption of power generation or power delivery, but potential losses would likely be principally limited to the Owner's property.

Based on the results of the visual inspection, discussions with CEC personnel, and a review of available design documentation, the following deficiencies were noted at the Karn Disposal Area:

1. Presence of heavy vegetation along the dike slopes, especially along the northern slope and in the Discharge Canal. It should be noted that, according to the MDEQ[13], an interim vegetation management plan was approved by the MDEQ on September 28, 2010 and a final plan dated December 30, 2010 is currently under MDEQ review. Additionally, CEC has begun removing vegetation on the dike slopes and waste slopes[13] since the time of GZA's inspection;
2. Presence of erosion channels in the dike near the Intake Channel;
3. Unclear methods used to abandon former NPDES outfall;
4. Lack of an operation and maintenance checklist specific to the perimeter dike stability; and,
5. Lack of an Emergency Action Plan (EAP), though this is not required by DNRE Part 115 regulations.

GZA recommends that the Owner arrange for the following to be performed at the Karn Disposal Area:

Studies and Analyses:

1. Develop an operation and maintenance checklist that includes dike structural items at the Karn Disposal Area for CEC field personnel to observe and record on a daily basis; and,

2. Although not required by DNRE Part 115 regulations, it is our opinion that CEC develop a formal EAP for the Karn Disposal Area and communicate that plan to Site personnel and the local emergency response agencies. This EAP could become a part of existing safety plans for the Site specifically addressing conditions of the Karn Disposal Area.

Operation & Maintenance Activities:

1. Clear vegetation, including small brush and grass, from the heavily vegetated areas to increase visibility of the slopes for monitoring purposes;
2. Develop a maintenance plan for monitoring of the large trees along the downstream slope. Trees that are damaged or uprooted by storm events should be removed and the dike area repaired;
3. Install riprap or other stabilizing material on the outer slope near the Intake Channel to reduce surface erosion. Similarly, CEC should consider flattening the dike slope along the Discharge Canal as recommended by AECOM; and,
4. Complete and/or analyze other embankment stability improvements recommended by AECOM.

Repair Recommendations:

1. Remove the former NPDES discharge structure, including excavating and removing the former pipes, and replace with compacted fill.

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PREFACE

The assessment of the general condition of the dikes at the Consumers Energy Company D.E. Karn Plant in Essexville, Michigan is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of this report.

In reviewing this report, it should be realized that the reported condition of the embankment is based on observations of field conditions at the time of inspection, along with data available to the inspection team. In cases where an impoundment is lowered or drained prior to inspection, such action, while improving the stability and safety of the embankment, removes the normal load on the structure and may obscure certain conditions, which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is critical to note that the condition of the embankment depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the embankment will continue to represent the condition of the embankment at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Prepared by:

GZA GEOENVIRONMENTAL, INC.

STATE OF MICHIGAN
WALTER KOSINSKI
ENGINEER
No. 38731
LICENSED PROFESSIONAL ENGINEER

Walter Kosinski, P.E.
Michigan License No.: 6201038731

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KARN DISPOSAL AREA
CONSUMERS ENERGY COMPANY – D.E. KARN PLANT
ESSEXVILLE, MICHIGAN

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1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The United States Environmental Protection Agency (EPA) has retained GZA GeoEnvironmental, Inc. (GZA) to perform a visual inspection and develop a report of conditions for the Consumers Energy Company (CEC, Owner) D.E. Karn Plant (DEKP, Site) DE Karn 1 & 2 Solid Waste Disposal Area (Karn Disposal Area) in Essexville, Michigan. This inspection was authorized by the EPA under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e). This inspection and final report were performed in accordance with Round 7 of the Assessment of Dam Safety of Coal Combustion Surface Impoundments, RFQ-DC-13, dated August 5, 2010, and EPA Contract No. EP10W001313, Order No. EP-CALL-0001. The inspection generally conformed to the requirements of the Federal Guidelines for Dam Safety[1], and this report is subject to the limitations contained in **Appendix A** and the Terms and Conditions of our Contract Agreement. The EPA, the Michigan Department of Environmental Quality (MDEQ), and CEC reviewed the draft report dated January 12, 2011, and provided comments to GZA on May 17, 2011. A copy of the EPA, MDEQ, and CEC comments and GZA's response to their comments is included in **Appendix F**.

1.1.2 Purpose of Work

The purpose of this investigation was to visually inspect and evaluate the present condition of the Karn Disposal Area and appurtenant structures to attempt to identify conditions that may adversely affect their structural stability and functionality, to note the extent of any deterioration that may be observed, review the status of maintenance and needed repairs, and to evaluate the conformity with current design and construction standards of care.

The investigation was divided into five parts: 1) obtain and review available reports, investigations, and data from the Owner pertaining to the impoundments and appurtenant structures; 2) perform an on-Site review with the Owner of available design, inspection, and maintenance data and procedures for the management unit; 3) perform a visual inspection of the Site; 4) prepare and submit a field assessment checklist; and, 5) prepare and submit a draft and final report presenting the evaluation of the structure, including recommendations and proposed remedial actions.

1.1.3 Definitions

To provide the reader with a better understanding of the report, definitions of commonly used terms associated with dams are provided in **Appendix B**. Many of these terms may be included within this report. The terms are presented under common categories associated with dams which include: 1) orientation; 2) dam components; 3) size classification; 4) hazard classification; 5) general; and 6) condition rating.

[1] FEMA/ICODS, April 2004: http://www.ferc.gov/industries/hydropower/safety/guidelines/fema-93.pdf.

1.2 Description of Project

1.2.1 Location

The DEKP is located about five miles northeast of Bay City, Michigan, along the shores of Lake Huron, at the address 2742 North Weadock Highway in Essexville, Michigan. The DEKP Karn Disposal Area is located about ½ mile northeast of the DEKP at latitude 43˚ 38' 45" North and longitude 83˚ 49' 57" West. A Site locus of the Karn Disposal Area and surrounding area is shown on **Figure 1**. An aerial photograph of the Karn Disposal Area and surrounding area is provided as **Figure 2**. The Karn Disposal Area may be accessed by vehicles from the DEKP or by boat from Lake Huron.

1.2.2 Owner/Caretaker

The Karn Disposal Area is owned and operated by CEC, the principal business of CMS Energy.

	Karn Disposal Area Owner/Caretaker
Name	Consumers Energy Company, Karn/Weadock Generating Complex
Mailing Address	2742 North Weadock Highway
City, State, Zip	Essexville, MI 48732
Contact	Richard G. Hall
Title	Site Environmental and Technical Services Lead
E-Mail	rghall@cmsenergy.com
Phone Number	989-891-3464

1.2.3 Purpose of the Karn Disposal Area

The DEKP is a power generating plant with two coal burning units and two oil and gas co-fired units with a maximum generating capacity of approximately 1,791 megawatts. The DEKP is located adjacent to the J.C. Weadock Plant (JCWP), which is a separate power generating plant owned by CEC. The DEKP and JCWP each have their own licensed ash disposal area, known as the Karn Disposal Area and the Weadock Disposal Area. Wastewater discharged from the Site, including from the Karn and Weadock Disposal Areas, is regulated under the same National Pollution Discharge Elimination System (NPDES) permit[2]. Each discharge location has its own set of discharge requirements.

Commercial operation of the DEKP facility began in 1959. The Karn Disposal Area was constructed in the late 1950's for the purpose of storing and disposing coal combustion byproducts, including non-recyclable plant wastewater, fly ash, and bottom ash from the DEKP facility. Between 1965 and 1977, interior divider dikes were constructed within the Karn Disposal Area to create Ponds A, B, C, D, E, and F. Refer to **Figure 3** for the location of each Pond.

[2] National Pollutant Discharge Elimination System (NPDES) Permit No. MI0001678, Consumers Energy Company DE Karn and JC Weadock Plant, Michigan Department of Natural Resources and Environment, October 1, 2007.

Fly ash has not been placed in the DEKP since February 2009 after a dry fly ash handling system was installed. Currently, fly ash from the DEKP is pumped in a dry condition to the Weadock Disposal Area by the dry fly ash handling system. Bottom ash slurry is sluiced from the DEKP into the Karn Disposal Area via four above ground steel pipelines. The bottom ash slurry flows through a series of channels and ponds designed to promote settlement of the bottom ash prior to discharging at the NPDES outfall into the DEKP Discharge Canal. The Karn Disposal Area is authorized to discharge a maximum of 21.753 million gallons per day (MGD) of fly ash and bottom ash transport water, chemical metal cleaning wastes, coal pile runoff, miscellaneous low volume wastes and stormwater runoff. The overall Karn Disposal Area plan is shown on **Figure 3**.

1.2.4 Description of the Karn Disposal Area and Appurtenances

The following description of the Karn Disposal Area is based on the Owner interviews, design reports, as-built drawings, and field observations by GZA.

The Karn Disposal Area covers an area of approximately 174 acres and has a perimeter length of approximately 3.1 miles that serves as an access road. The Karn Disposal Area was developed by reclaiming land from Saginaw Bay through the construction of a series of breakwater and perimeter dikes. The majority of the perimeter consists of dikes with an average height (from the lowest toe elevation to the top of the dike) of approximately 10 feet, with a maximum height of approximately 17 feet near Pond A. The Karn Disposal Area dikes were constructed on the existing natural ground surface, which also forms the liner, at an approximate elevation of 580 feet International Great Lakes Datum of 1985 (IGLD 85)[3]. As such, the Karn Disposal Area has a structural height of approximately 17 feet.

According to CEC, there is no true dike bordering the south side of the Karn Disposal Area. Reportedly, the original shoreline of Saginaw Bay was likely used as the southern boundary because it would have been above the high lake water level[4]. Refer to **Figure 4** for the reported location of the original shoreline.

The top of the crest generally has a width of approximately 20 feet and an elevation ranging from 590 to 597 feet. Based on construction drawings from 1973[5], the outer and inner slopes of the dikes have a slope of approximately 2 horizontal to 1 vertical (2H:1V). Until 1986, the Karn Disposal Area was operated as a surface impoundment. In 1986, the MDEQ approved a plan to vertically expand the interior of the Karn Disposal Area by compacting conditioned fly ash in an engineered, structural fill. The vertical expansion did not increase the height of the dikes or the areal extent of the Karn Disposal Area, but is being accomplished by placing the compacted, conditioned fly ash at a maximum slope of 4H:1V to a maximum elevation of 641 feet at a minimum setback distance of 100 feet from the ordinary high water mark on the exterior facing dike slope[6]. Refer to Section 1.3.5 for further discussion of the Karn Disposal Area history.

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[3] Historically, the datum used at the Site was United States Lake Survey (USLS). Recently, the plant datum was updated to IGLD 85. Unless otherwise stated, elevations provided in this report are based on IGLD 85.

[4] Potential Failure Mode Analysis Report, D.E. Karn Generating Facility, AECOM, October 30, 2009.

[5] Consumers Power Company, D.E. Karn Plant, Ash Dike Improvements, Drawing No. M695-F1906, Sheets 6 and 7, Fargo Engineering Company, April 1973.

[6] Letter from Gary Dawson of CEC to EPA dated March 26, 2009 in response to EPA's Request for Information Under Section 104 (e) of the CERCLA, 42 U.S.C. 9604(e).

The Karn Disposal Area discharge structure located in Pond F is a vertical reinforced concrete pipe drop structure connected to a buried horizontal reinforced concrete discharge pipe. The drop structure consists of a 4.5-foot diameter vertical reinforced concrete pipe with an 8-foot diameter metal skimmer ring mounted to the top. Water is forced to flow under the metal ring and over the top of the vertical reinforced concrete pipe to minimize clogging. Water is discharged from Pond F to the Discharge Canal, which discharges into Saginaw Bay. Further discussion of the hydrology and hydraulics of the Karn Disposal Area are provided in Section 2.5.

According to CEC, instrumentation at the Karn Disposal Area includes eight porewater monitoring wells, seven potentiometric wells, two leachate monitoring wells, four survey monuments installed at the Site, multiple staff gauges throughout the Karn Disposal Area, and an electronic water level meter at the NPDES outfall.

Additional information on the construction and performance history of the Karn Disposal Area is provided in Section 1.3.6 of this report.

1.2.5 Operations and Maintenance

Industrial waste in Michigan is regulated under the provisions of Part 115, Solid Waste Management, of Michigan's Natural Resources Environmental Protection Act (NREPA), Public Act 451 of 1994, as amended. Coal ash impoundments in Michigan are exempt from regulation under the Michigan Dam Safety Rules, Part 315 of the NREPA, because they contain Type III wastes. The Karn Disposal Area operates under MDEQ Solid Waste Disposal Operating License No. 9234 (Operating License), which must be renewed every five years. The current Operating License expires on October 15, 2014.

Operation and maintenance of the Karn Disposal Area is regulated by the EPA and the MDEQ under the NPDES Permit. The Karn Disposal Area is operated and maintained by CEC personnel. CEC is required to submit a monthly report to the MDEQ that includes NPDES monitoring data. Specifically, at Monitoring Point 001B, the Karn Disposal Area discharge, CEC is required to perform the following actions:

- Record the flow twice per month;
- Collect a grab sample for total suspended solids twice per month; and,
- Collect a grab sample for total copper and total iron on a daily basis only during discharge events from the chemical treatment facility, prior to discharge into the Karn Disposal Area.

The condition of the dike is observed once per day and field notes are recorded. Any unusual observations are reported to the shift supervisor. The height of the freeboard within Pond F is inspected on a daily basis, along with a visual inspection for oil and grease. The discharge channel is observed for flow twice per day. CEC has developed an Environmental Manual that provides written procedures for environmental compliance, including groundwater quality monitoring, fly ash placement and testing, freeboard and dike monitoring, and final cover installation and certification. CEC reports that an operation and maintenance checklist specific to the structural stability of the dike will be added to the daily field inspection checklist currently being used for the Karn Disposal Area.

The Karn Disposal Area is also inspected quarterly by MDEQ Waste and Hazardous Material Division (WHMD) personnel. A report of the MDEQ visual inspections, including recommended actions to correct any deficiencies, is sent to CEC personnel following each inspection. In order to maintain the Operating License, CEC is required to address any deficiencies noted in the inspection and provide MDEQ with documentation that the noted deficiencies have been addressed. Based on GZA's discussions with CEC personnel and MDEQ personnel, the operations and maintenance of the Karn Disposal Area is consistent with the performance requirements under the current Operating License.

The Karn Disposal Area is currently authorized by the MDEQ to discharge wastewater to the aquifer directly underlying the impoundment by Groundwater Discharge Authorization GWE-005. Refer to Section 1.3.6 for further discussion of the leachate and groundwater monitoring program.

1.2.6 Size Classification

For the purposes of this EPA-mandated inspection, the size classifications will be based on United States Army Corps of Engineers (COE) criteria. According to guidelines established by the COE, dams with a storage volume between 1,000 and 50,000 acre-feet and/or a height between 40 and 100 feet are classified as Intermediate sized structures. Based on a combined storage volume of approximately 4,422 acre-feet (at the maximum permitted elevation in each Pond) and the maximum height of 17 feet, the Karn Disposal Area is classified as an **Intermediate** sized structure. It is noted that the State of Michigan regulates the Karn Disposal Area as a Type III landfill and thus does not provide a size classification rating for coal ash impoundments.

Since the dikes were reportedly constructed on the natural ground surface and minimal excavation work was performed prior to constructing the dikes, the maximum height of approximately 17 feet is also the structural height of the Karn Disposal Area.

1.2.7 Hazard Potential Classification

Since the Karn Disposal Area is regulated as a Type III landfill in Michigan and not a dam, the MDEQ has not assigned it a hazard potential rating. Under the EPA classification system, as presented on page 2 of the EPA checklist (**Appendix C**) and Definitions section (**Appendix B**), it is GZA's opinion that the Karn Disposal Area would be considered as having a **Low** hazard potential. The hazard potential rating is based on the low potential for loss of human life and low economic and environmental losses in the potential event of dike failure. Failure of the dikes may lead to an interruption of power generation or power delivery, but potential losses would likely be principally limited to the Owner's property.

1.3 Pertinent Engineering Data

1.3.1 Drainage Area

The Karn Disposal Area is a series of dikes built up from the natural ground surface. As such, the contributory drainage area is the surface area of the disposal area, approximately 174 acres. The disposal area is highlighted on **Figure 3**.

1.3.2 Karn Disposal Area

The Karn Disposal Area is located near Lake Huron and is enclosed by the Saginaw River and CEC's Intake Channel to the west, Saginaw Bay to the north, CEC's Discharge Canal to the east, and the DEKP to the south. The total capacity of the Karn Disposal Area is the sum of the diked area and the vertical expansion. The capacity of the diked area, assuming 2 feet of freeboard in accordance with the Part 115 Rules, is 4,175,000 cubic yards, and the capacity of the vertical expansion is approximately 2,960,000 for a total of 7,135,000 cubic yards, or approximately 4,432 acre-feet. CEC personnel estimate that, currently, it is approximately half filled with fly ash[6]. Based on the 1986 fly ash production volume of 148,000 cubic yards per year, the Karn Disposal Area vertical expansion was designed for a 20 year life span[7]. However, due to recently switching the fly ash disposal method from wet sluicing in the Karn Disposal Area to dry placement at the Weadock Disposal Area, the life span of the Karn Disposal Area is greater than 20 years. Fly ash has not been placed in the Karn Disposal Area since February 2009.

The Karn Disposal Area was reportedly constructed on native alluvium and lacustrine soils that are underlain by overconsolidated glacial till. Lacustrine clays and silts are typically found chiefly underlying extensive, flat, low lying areas formerly inundated by glacial Great Lakes[8]. The glacial till layer generally exists at a depth of 25 to 75 feet below the natural ground surface. Bedrock generally exists at 90 feet below the natural ground surface[3].

According to the Basis of Design Report[9] which detailed the results of soil borings drilled on the perimeter dike, fill soils were encountered within the upper 1 to 8 feet of the soil immediately below the dike crest. The fill soils consisted of black, gray, light gray, grayish brown loose to dense silty sand, or bottom ash. Fly ash was encountered intermittently in the fill soils along the intake channel segment of the perimeter dike. Below the fill materials were intermixed layers of silty clays and silty sands classified as alluvial deposits. The alluvial deposits extended to elevations between 565 and 575 feet along the perimeter dike with the exception of the areas bordering the Intake Channel and the Saginaw River, where the alluvial deposits extended to bedrock at an elevation of 502 feet.

Specifically, according to a Feasibility Study[10] conducted by AECOM, subsurface conditions of the dikes can be grouped into four distinct cross sections represented by the dike near the Intake Channel north of the Chemical Treatment Ponds, the northern and western perimeter dikes, the dike near the Discharge Canal, and the dike near the Intake Channel south of the Chemical Treatment Ponds. The locations of three of the cross-sections are detailed on **Figure 4**.

The reported subsurface profile of the dike area near the Intake Channel north of the Chemical Treatment Ponds is presented on **Figure 5**. The dike in this area was reportedly initially constructed with a mechanically-placed clay compacted over sluiced fly ash that was placed on the natural ground surface. A later expansion raised the dike elevation with

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[7] Construction Permit Application and Support Documents, D.E. Karn Ash Disposal Areas A Through E, Consumers Power Company, August 1986.

[8] Quaternary Geology of Michigan, University of Michigan and the MDEQ, Geological Survey Division, 1982.

[9] D.E. Karn Fly Ash Disposal Area Soil-Bentonite Cutoff Wall Basis of Design Report, AECOM, December 31, 2009.

[10] Subsurface Investigation and Soil-Bentonite Wall Feasibility Study, D.E. Karn Ash Landfill, AECOM, December 4, 2009.

compacted fly ash. The dike material is underlain by natural sands with interbedded native organic clay and silt strata. The natural sands are underlain by native medium silty clays.

The reported subsurface profile of the northern and western perimeter dikes is presented on **Figure 6**. The dike in this area reportedly consists of a mechanically-placed clay dike constructed over sand fill. Fly ash is present along the upstream side of the dike but did not appear to extend below the original dike material. The dike fill materials are underlain by natural sands with interbedded clay layers. The natural sands are underlain by native stiff clays. A relatively thin strata of natural organic clay and/or organic silt is present at the interface between the dike material and natural foundation soils.

The reported subsurface profile of the dike area near the Discharge Canal is presented on **Figure 7**. The dike materials in this area reportedly consist of sand fill overlying clay fill. The dike materials are underlain by natural sands that overlie natural hard clays.

A subsurface profile of the dike area near the Intake Channel south of the Chemical Treatment Ponds was not available. The dike material along this part of the dike reportedly consisted of bottom ash fill overlying natural sand foundation soils.

1.3.3 Discharges at the Site

Discharges at the Site are regulated under the previously mentioned NPDES Permit. Under normal operating conditions, wastewater from the Karn Disposal Area is discharged continuously from Pond F to Monitoring Point 001B at an average rate between 11 and 13 MGD, based on information provided by CEC. The NPDES permit allows for a discharge of 21.753 MGD from this location. The water level is measured continuously by an electronic water level meter at the discharge structure. Currently, wastewater from bottom ash sluice is discharged. CEC estimates that the bottom ash slurry has a detention time of three to four hours within the Karn Disposal Area prior to it being discharged to the Discharge Canal.

1.3.4 General Elevations

Karn Disposal Area elevations presented in this report are taken from design drawings, reports, and survey monument monitoring data provided by CEC. Elevations are based upon the IGLD 85 vertical datum.

A. Crest of Dike, Maximum	± 597.0 feet
B. Crest of Dike, Minimum	± 590.0 feet
C. Toe of Dike	± 580.0 feet
D. Operating Pool, Pond F	± 581.82 feet
E. Discharge Structure Inlet Elevation	± 581.49 feet

1.3.5 Design and Construction Records and History

According to information provided by CEC, the original dike design drawings could not be located and CEC is unsure if the dikes were designed by a professional engineer. The vertical expansion approved by the MDEQ in 1986 was prepared and reviewed by professional engineers. The following paragraphs summarize information provided in the Potential Failure Mode Analysis Report[3] by AECOM.

The shoreline property on which the Karn Disposal Area was constructed was deeded to CEC in 1956 by the State of Michigan. The Karn Disposal Area was developed by reclaiming land from Saginaw Bay through the construction of breakwater and perimeter dikes. Sometime between 1956 and 1959, the original dike structures were constructed. The reported approximate location of the original shoreline and dikes is depicted on **Figure 4**.

By 1963, the Karn Disposal Area had been reclaimed from Saginaw Bay. Reportedly, it was not clear what construction techniques were used to prepare the foundations and construct the dikes in areas where the ground was below the bay water level. There is no true dike bordering the south side of the Karn Disposal Area. CEC does not have documentation which indicates that a dike was constructed in this area; however, the current elevation of the access roads along the south side of the Karn Disposal Area indicate that the ground level was raised from approximately 581 feet to 590 feet. The nature of the fill material used to raise the grade along the south side of the Karn Disposal Area is unknown.

Between 1965 and 1977, Ponds A, B, C, D, E, and F were reportedly created by constructing interior divider dikes within the Karn Disposal Area. Ponds A, B, and C were intended for storage of dry compacted ash. Ponds D, E, and F were used as settling and clarifying ponds for the coal ash slurry water prior to discharge. Also during this time, the settling channels were lengthened to promote ash settling to meet the NPDES requirements.

Circa 1973, portions of the perimeter dike were raised from an approximate elevation of 588 feet up to an average elevation of 590 feet as part of an inboard construction event. Material used to raise the dikes consisted of silty sands, clean sands, silts, and clay. In 1981, the perimeter dike surrounding Pond A was raised again to an approximate elevation of 596.5 feet using primarily bottom ash as a construction material.

In 1986, CEC submitted a plan for vertical expansion of the interior of the Karn Disposal Area to the MDEQ in order to increase the coal ash storage capacity of the impoundment by 2,960,000 cubic yards. The plan involved stacking and compacting dry, conditioned fly ash in Ponds A, B, and C and continuing to use Ponds D, E, and F as settling ponds for precipitation runoff and bottom ash transport water[7]. The MDEQ approved the vertical expansion plan and CEC began placing and compacting dry fly ash in the Karn Disposal Area. The configuration of the vertical expansion plan was updated and approved by the MDEQ in 2002 to address offset distances due to transmission towers and overhead lines.[11]

In 2005, Natural Resource Technology, Inc. (NRT) reported that sand lenses in the perimeter dikes of the Karn Disposal Area could provide a pathway for venting groundwater to migrate to the surrounding waters of the State. Hydraulic tests performed within the sand material in the dike confirmed a limited discharge along portions of the dike In 2009, CEC retained AECOM to conduct a feasibility analysis[10] and a basis of design[9] for the potential installation of a slurry wall. The feasibility analysis evaluated the structural integrity of the existing dikes by comparing the results of a stability analysis to recognized industry standards. Based on the results of the feasibility study, AECOM reported that a soil-bentonite slurry wall could be constructed around the perimeter of the Karn Disposal Area without negatively affecting the overall structural integrity of the existing dikes. In accordance with the Operating License, the construction of a slurry wall is not required unless groundwater monitoring

[11] Letter from Harold Register of CEC to EPA, Subject: Draft Report, Round 7 Dam Assessment, Consumers Energy Company – D.E. Karn Plant 1&2 Solid Waste Disposal Area, Essexville, Michigan, dated March 23, 2011.

performance criteria cannot be met[11]. According to the MDEQ[12], a subsequent evaluation of a slurry wall completed after GZA's site assessment questioned the feasibility of installing a slurry wall in certain areas. Based on discussion with CEC personnel, CEC had not made the decision to install the slurry wall at the time of GZA's inspection.

1.3.6 Operating Records

Operations records were provided to GZA by CEC. An annual aerial survey is conducted for the Karn Disposal Area that contours the surface at 1-foot intervals with individual survey points accurate up to +/- 0.1-feet[11].

Seventeen monitoring wells are present at the Karn Disposal Area. Water sampling is conducted in accordance with a MDEQ-approved Hydrogeological Monitoring Plan dated February 5, 2010 and approved on March 1, 2010. Annual collection of unfiltered leachate samples is performed at two monitoring wells located within the Karn Disposal Area, LH-101 and LH-102. Quarterly collection of water samples is performed at a minimum 15 monitoring wells surrounding the Karn Disposal Area: MW-31, OW-32, MW-32, MW-33, OW-34, MW-35, OW-35, MW-36, MW-37, OW-37, MW-38, MW-39, OW-40, MW-10R, and MW-11.

1.3.7 Previous Inspection Reports

Visual inspections of the Karn Disposal Area are conducted by the MDEQ WHMD on a quarterly basis. MDEQ WHMD inspection reports were not available for GZA's review.

The most recent inspection performed at the Karn Disposal Area by AECOM occurred on August 17, 2009 and was detailed in the October 30, 2009 Inspection Report – D.E. Karn Generating Facility Ash Dike Risk Assessment (Inspection Report). According to the Inspection Report, the Karn Disposal Area appeared to be in satisfactory condition, but most containment dike slopes were covered in heavy vegetation and could not be inspected. Key observations resulting from the August 2009 inspection included:

- Heavy vegetation (including large trees and tall grasses) was growing on the slopes. Due to the heavy vegetation, an adequate visual inspection of the surface and toe of the slopes could not be performed;
- Surface erosion was noted on the ash fill slope adjacent to the intake channel;
- Perimeter ditches designed to convey storm water runoff inboard of the containment dike were present around the Site but were typically choked with tall grasses. The outlets of these ditches were assumed to discharge to internal ponds but outlets could not be visually identified due to the heavy vegetation;
- There was no dike structure present along the south side of the Site. However, a new perimeter ditch was being excavated along the south perimeter access road. This ditch was not completed during the inspection and it was not known where the outlet would be located as there were no design plans for the ditch;
- Visual inspections indicated that there was little to no riprap present on the outboard slope of the perimeter dike along portions of the intake channel; and,
- The abandonment methods used for the original outfall could not be determined based on the Site inspection.

[12] Email correspondence from Greg Morrow of the MDEQ to the EPA, RE: Comment Request on Consumers Energy DE Karn, Weadock, and JR Whiting Draft Reports, dated February 25, 2011.

AECOM recommended the implementation of improvements based on the observations made during the August 2009 inspections, including the following:

- Remove the trees (including roots) and shrubs on the downstream slopes of the dikes. In addition, cut the grass at least once per year;
- Clean the perimeter stormwater ditches and culverts on the inboard side of the perimeter dike by removing some trees and mowing the grass;
- Complete the ditch construction along the south side of the facility;
- Repair or install riprap along the dike at the intake canal where needed; and,
- Confirm and document that all pipe penetrations through the dike are fully grouted or have been removed and replaced with compacted fill.

2.0 INSPECTION

2.1 Visual Inspection

The Karn Disposal Area was inspected on September 27 and 28, 2010 by Walter Kosinski, P.E. and Thomas Boom, P.E. of GZA. For both days, the weather was partly cloudy with temperatures in the 60°s Fahrenheit. Photographs to document the current conditions of the dikes were taken during the inspection and are included in **Appendix D**. Underwater areas were not inspected, as this level of investigation was beyond GZA's scope of services. A copy of the EPA Checklist and a copy of the GZA inspection checklist are included in **Appendix C**.

With respect to our visual inspection, there was no evidence of prior releases, failures, or patchwork observed by GZA.

2.1.1 General Findings

In general, the Karn Disposal Area was found to be in **SATISFACTORY** condition. An overall Karn Disposal Area plan showing the pertinent features and observations made during the current inspection, including the location and orientation of photographs provided in **Appendix D**, is detailed on **Figure 3**. Specific concerns are identified in more detail in the sections below.

2.1.2 Dike Slopes (Photos 1, 2, 3, 5, 7, 8, 9, 10, 14 through 20, 22, 26, 27, 28, 33, and 34)

Trees and vegetation were growing on a majority of the outer dike slopes, making it difficult to observe the dike conditions. In areas with less vegetation where the slopes could be observed, the outer dike slope generally appeared to be in good condition. No unusual movement or sloughing was observed in the slope. Riprap of varying sizes was observed on the outer slopes, except along portions of the Intake Channel. Erosion channels were noted in the dike near the Intake Channel where riprap was not present (Photo 3). Significant vegetation along portions of the Discharge Canal obscured the slope and a visual inspection could not be performed in this area (Photos 26, 27, and 28). The exterior slope of the compacted ash appeared to be in good condition and was lightly vegetated. A pipe of unknown origin or purpose was noted near the northwest corner of the Karn Disposal Area (Photo 9). This pipe did not appear to penetrate the dike.

2.1.3 Crest (Photos 4, 7, 8, 10, 16, 17, 20, and 27)

The crest of the Karn Disposal Area has a gravel and bottom ash cover layer. The alignment of the top of embankment appeared generally level, with no depressions or irregularities observed.

2.1.4 Appurtenant Structures (Photos 6, 25, 30, 31, 32, 33, 37, 38, 40, 41, and 45)

The water level in the Karn Disposal Area is controlled by a vertical reinforced concrete pipe drop structure. The condition of this structure could not be observed because it was under water during the inspection. The drop structure consists of a 4.5-foot diameter vertical reinforced concrete pipe with an 8-foot diameter metal skimmer ring mounted to the top. Water was flowing under the metal ring and over the top of the vertical reinforced concrete pipe during the inspection. The electronic water level meter installed on the top of the metal skimmer ring was measuring the height of the water above the metal ring (Photos 31 and 32).

The vertical reinforced concrete pipe drop structure is connected to a buried horizontal reinforced 3.5-foot diameter concrete discharge pipe that conveys water downstream to the Discharge Canal, which discharges into Saginaw Bay. The condition of the discharge pipe outlet could not be observed due to heavy vegetation along the dike near the NPDES outlet (Photo 33). The presence of this vegetation was noted in the August 2009 AECOM Inspection Report, which recommended that the vegetation be removed. The vegetation observed during the current inspection appears to be consistent to that shown in the August 2009 AECOM Inspection Report photos.

The condition of an abandoned outfall structure (Photo 25) (refer to **Figure 3** for its location) could not be determined due to presence of dense vegetation. CEC personnel indicated that the discharge piping had been removed and that the outfall was probably backfilled with concrete.

2.2 Caretaker Interview

Maintenance of the land disposal facility is the responsibility of CEC personnel. As detailed in previous sections, GZA met with CEC personnel and discussed the current operations and maintenance procedures, regulatory requirements, and the history of the Karn Disposal Area since its construction.

2.3 Operation and Maintenance Procedures

As discussed in Section 1.2.5, CEC personnel are responsible for the regular operation and maintenance of the Karn Disposal Area. CEC has developed checklists for observations that operators complete on a daily basis. The condition of the dike is observed once per day and field notes are recorded. Any unusual observations are reported to the shift supervisor. There is also a security check of the perimeter dike three times per day for general observations (i.e., once per shift with three shifts per day). The height of the freeboard within Pond F is inspected on a daily basis, along with a visual inspection for oil and grease. The Discharge Canal is observed for flow twice per day. CEC has developed an Environmental Manual that provides written procedures for environmental compliance, including: groundwater quality monitoring, fly ash placement and testing, freeboard and dike monitoring, and final cover installation and certification. However, there is not a formal operation and maintenance plan that has been

developed to provide instructions for daily operations. Currently there is no standard operating procedure to maintain a specific elevation in the ditches or internal ponds. CEC reports that an operation and maintenance checklist specific to the structural stability of the dike will be added to the daily field inspection checklist currently being used for the Karn Disposal Area.

2.4 Emergency Action Plan

An Emergency Action Plan (EAP) has not been developed for the Karn Disposal Area and is not required by the MDEQ Part 115 Rules.

2.5 Hydrologic/Hydraulic Data

GZA did not perform an independent assessment of the hydraulics and hydrology for the Karn Disposal Area as this was beyond our scope of services. However, we did review available design documentation. No records were found relating to flood or design flow capacity of the outfall structure.

The elevation of the water level within Pond F is controlled by the discharge structure at an elevation of approximately 581.82 feet. CEC may adjust this elevation up or down. As recently as last year, the water level at the discharge structure was 583.8 feet. Assuming a crest elevation of 590 feet, the freeboard has varied from approximately 6 to 8 feet within the last year. Rule 299.4309 of the Part 115 Rules requires a minimum freeboard of no less than 2 feet.

Bottom ash wastewater is conveyed downstream by gravity from its discharge point at the Bottom Ash Pond to the discharge structure by a series of cascading ditches through drop structures and culverts. The ditches promote the settling of bottom ash prior to the discharge location. The elevation of each successive ditch is approximately 1 foot lower than the one that preceded it. According to CEC personnel, the bottom ash wastewater is detained with the Karn Disposal Area for three to four hours prior to being discharged from Pond F.

2.6 Structural and Seepage Stability

The original structural and seepage stability analyses, if any, were not available to GZA at the time of inspection. Seepage analyses, foundation liquefaction analyses, slope stability, and settlement analyses reports were also not available. The structural stability of the dikes has been evaluated on at least two separate occasions. The first stability analysis, Fill Design and Stability Analysis[13] (FDSA), was performed by CEC in 1983 and the second stability analysis was performed by AECOM in 2009 as part of the slurry wall feasibility analysis[10]. Additionally, a potential failure mode analysis was performed by AECOM in 2009[3].

The FDSA evaluated factors of safety against a loss of ash containment at four separate sections of the Karn Disposal Area dike. Minimum safety factors were found to range from 1.63 to 1.89. The analyses did not include non-circular failures or undrained conditions. Reportedly, several conservative assumptions were made to simplify the analysis, including the following:

- Only the friction portion of the soil strength was considered and the cohesion factor was set to zero for all strata;

[13] Fill Design and Stability Analysis, D.E. Karn Ash Disposal Area, Consumers Power Company, May 10, 1983.

- The beneficial effect of armor stone or slope protection on the downstream sides of the dike was not considered; and,
- The beneficial effect of vegetated soil or cement stabilized fly ash on the final slopes of the ash storage pile was not considered.

The material properties used to evaluate the dike stability for the FDSA were based on a separate report by Woodward-Clyde titled Geotechnical Investigations – Coal Ash Disposal Areas, dated May 10, 1983. This report also included a review of the stability analyses performed by CEC. According to Woodward-Clyde, the resulting safety factors for the design consideration were considered to be adequate with respect to the overall stability. The overall factor of safety exceeded 1.5 in all cases for the deep-seated stability of the dike.

In 2009, AECOM evaluated the structural integrity of the existing dikes at three separate locations by comparing stability analysis results to recognized industry standards[10]. The factors of safety were evaluated for four failure surfaces, including shallow circular, deep seated circular, shallow block, and deep seated block. The following minimum factors of safety were recommended, based on industry standards:

- For permanent loading conditions – 1.5;
- For temporary loading conditions – 1.3; and,
- For earthquake loading – 1.0.

The three locations evaluated by AECOM were the dike area near the Intake Channel, the northern and western perimeter dikes, the dike near the Discharge Canal. Based on the existing dike geometry and permanent loading conditions, the minimum factor of safety for the dike area near the Intake Channel was 1.1, the minimum factor of safety for the northern and western perimeter dikes was 1.8, and the minimum factor of safety for the dike near the Discharge Canal was 1.2.

AECOM recommended modifications to the dike near the Intake Channel and the dike near the Discharge Canal to increase the minimum factor of safety to 1.5. To stabilize the dike near the Intake Channel, AECOM recommended the placement of a buttress fill along the eastern and northern banks that would flatten the outer slope and increase the width of the top of the dike, thereby increasing the resisting force on the outside of the dike and increasing the overall stability of the slope. To increase the factor of safety near the Discharge Canal, AECOM recommended either flattening the slope, buttressing the banks, or regrading to a slope of 2H:1V. According to the MDEQ[13], a subsequent evaluation of a slurry wall completed after GZA's site assessment indicated that the calculated factors of safety for the slope along the discharge channel that were less than 1.5 could be considered acceptable if a slope monitoring plan were put in place.

The purpose of the potential failure modes analysis (PFMA) was to identify potential failure modes (PFM) at the Karn Disposal Area and classify each identified failure mode into one of four categories as follows:

I. Highlighted Potential Failure Modes;
II. Potential Failure Modes Considered But Not Highlighted;
III. More Information or Analyses Needed in Order to Classify; and,

IV. Other Consideration (Potential Failure Mode Ruled Out). Potential failure modes discussed but not developed in detail because they were judged to be too improbable were classified as IV-ND.

The PFMA performed by AECOM identified 58 PFMs. No Category I PFMs were identified. Four PFMs were classified as Category II, twelve were Category III, eight were Category III/IV, twenty-seven were Category IV, three were Category IV/ND, and four were Category Not Applicable. The PFMA identified measures to reduce the potential for the occurrence of the failure modes. Twenty-six measures were identified.

3.0 ASSESSMENTS AND RECOMMENDATIONS

3.1 Assessments

In general, based upon our observations, the overall condition of Karn Disposal Area is judged to be **SATISFACTORY.**

The Karn Disposal Area was found to have the following deficiencies:

1. Presence of heavy vegetation along the dike slopes, especially along the northern slope and in the Discharge Canal. It should be noted that, according to the MDEQ[13], an interim vegetation management plan was approved by the MDEQ on September 28, 2010 and a final plan dated December 30, 2010 is currently under MDEQ review. Additionally, CEC has begun removing vegetation on the dike slopes and waste slopes[13] since the time of GZA's inspection;
2. Presence of erosion channels in the dike near the Intake Channel;
3. Unclear methods used to abandon former NPDES outfall;
4. Lack of an operation and maintenance checklist specific to the perimeter dike stability; and,
5. Lack of an Emergency Action Plan (EAP), though this is not required by MDEQ Part 115 regulations.

The following recommendations and remedial measures generally describe the recommended approach to address current deficiencies at the Karn Disposal Area. Prior to undertaking recommended maintenance, repairs, or remedial measures, the applicability of environmental permits needs to be determined for activities that may occur within resource areas under the jurisdiction of the appropriate regulatory agencies.

3.2 Studies and Analyses

GZA recommends the following studies and analyses:

1. Develop an operation and maintenance checklist that includes dike structural items at the Karn Disposal Area for CEC field personnel to observe and record on a daily basis; and,
2. Although not required by MDEQ Part 115 regulations, it is our opinion that CEC develop a formal EAP for the Karn Disposal Area and communicate that plan to Site personnel and the local emergency response agencies. This EAP could become a part of existing safety plans for the Site specifically addressing conditions of the Karn Disposal Area.

3.3 Recurrent Operation & Maintenance Recommendations

GZA recommends the following operation and maintenance level activities:

1. Clear vegetation, including small brush and grass, from the heavily vegetated areas to increase visibility of the slopes for monitoring purposes;
2. Develop a maintenance plan for monitoring of the large trees along the downstream slope. Trees that are damaged or uprooted by storm events should be removed and the dike area repaired;
3. Install riprap or other stabilizing material on the outer slope near the Intake Channel to reduce surface erosion. Similarly, CEC should consider flattening of the dike slope along the Discharge Canal as recommended by AECOM; and,
4. Complete and/or analyze other embankment stability improvements recommended by AECOM.

3.4 Repair Recommendations

GZA recommends the following repairs which may improve the overall condition of the Karn Disposal Area, but do not alter the current design of the dike. The recommendations may require design by a professional engineer and construction contractor experienced in dike construction.

1. Remove the former NPDES discharge structure, including excavating and removing the former pipes, and replace with compacted fill.

3.5 Alternatives

There are no practical alternatives to the repairs itemized above.

4.0 ENGINEER'S CERTIFICATION

I acknowledge that the management unit referenced herein, the Karn Disposal Area, has been assessed to be in **SATISFACTORY** condition on September 28, 2010.

Walter Kosinski, P.E.
Principal

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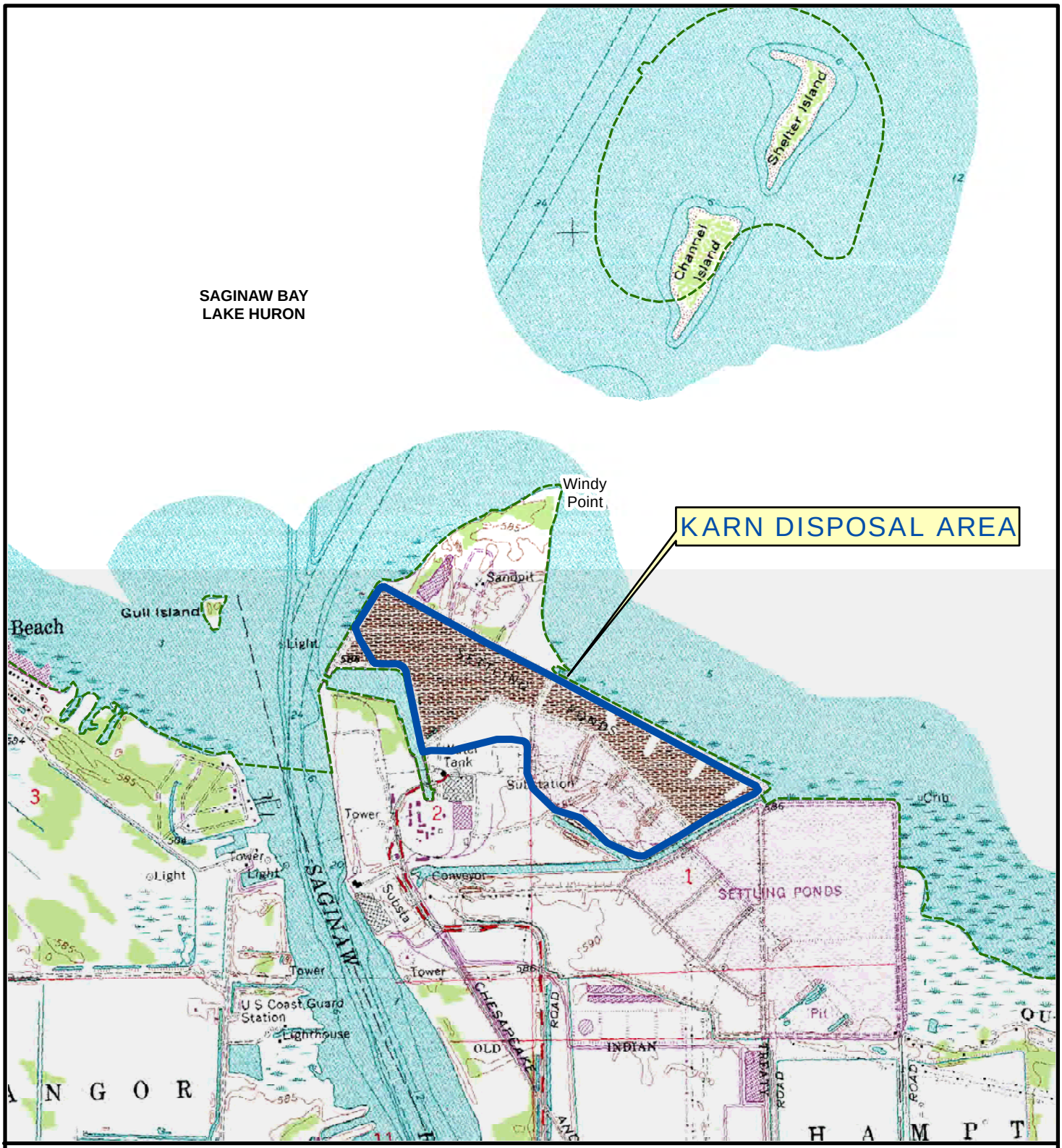
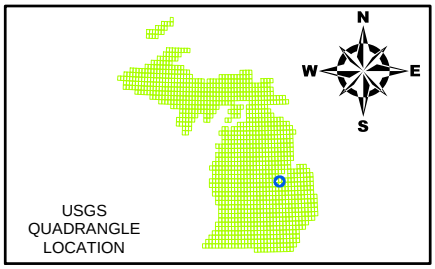
Figures





SOURCE: SCANNED USGS TOPOGRAPHIC QUADRANGLE PROVIDED BY THE MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION, MICHIGAN DEPARTMENT OF INFORMATION TECHNOLOGY DATA ACCESSED OCTOBER 2010

0 500 1,000 2,000 3,000 Feet

Data Supplied by :

MCGI

PROJ. MGR.: TRB
DESIGNED BY: TRB
REVIEWED BY: PHB
OPERATOR: NAM

DATE: 11-05-2010

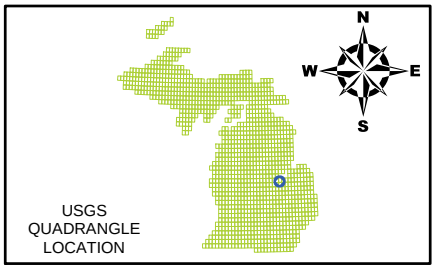
LOCUS PLAN
(USGS 7.5-MINUTE TOPOGRAPHIC QUAD)

CONSUMERS ENERGY - D E KARN PLANT
ESSEXVILLE, MICHIGAN

JOB NO.
01.0170142.20

FIGURE NO.
1

J:\01.xx Norwood\01.0170142.20 CCW Dams Round 7\Task 2 CLIN 019 Consumers DE Karn MI\Figures\GIS\Figure 1 - Locus Map - Quad.mxd



SOURCE: DIGITAL ORTHOPHOTO/AERIAL IMAGERY PROVIDED BY THE MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION, MICHIGAN DEPARTMENT OF INFORMATION TECHNOLOGY DATA ACCESSED OCTOBER 2010

0 500 1,000 2,000 3,000 Feet

Data Supplied by :

MCGI

GZA

PROJ. MGR.: TRB
DESIGNED BY: TRB
REVIEWED BY: PHB
OPERATOR: NAM

DATE: 11-05-2010

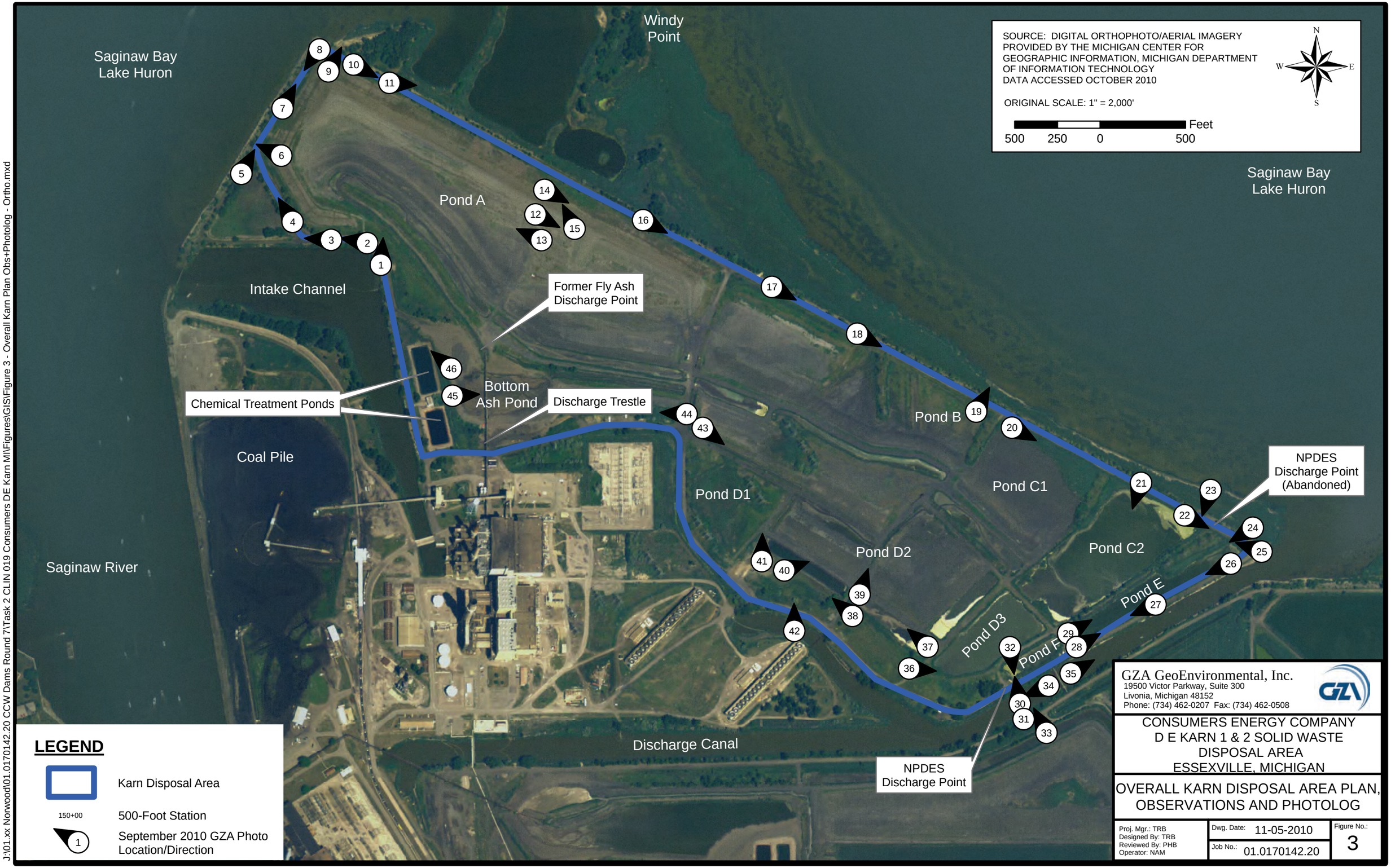
LOCUS PLAN
(DIGITAL ORTHOPHOTO/AERIAL IMAGERY)

CONSUMERS ENERGY - D E KARN PLANT
ESSEXVILLE, MICHIGAN

JOB NO.
01.0170142.20

FIGURE NO.
2

J:\01.xx Norwood\01.0170142.20 CCW Dams Round 7\Task 2 CLIN 019 Consumers DE Karn MI\Figures\GIS\Figure 2 - Locus Map - Ortho.mxd



GZA GeoEnvironmental, Inc.
19500 Victor Parkway, Suite 300
Livonia, Michigan 48152
Phone: (734) 462-0207 Fax: (734) 462-0508

CONSUMERS ENERGY COMPANY
D E KARN 1 & 2 SOLID WASTE DISPOSAL AREA
ESSEXVILLE, MICHIGAN

OVERALL KARN DISPOSAL AREA PLAN, OBSERVATIONS AND PHOTOLOG

Proj. Mgr.: TRB
Designed By: TRB
Reviewed By: PHB
Operator: NAM

Dwg. Date: 11-05-2010
Job No.: 01.0170142.20

Figure No.: 3

J:\01.xx Norwood\01.0170142.20 CCW Dams Round 7\Task 2 CLIN 019 Consumers DE Karn MI\Figures\GIS\Figure 3 - Overall Karn Plan Obs+Photolog - Ortho.mxd

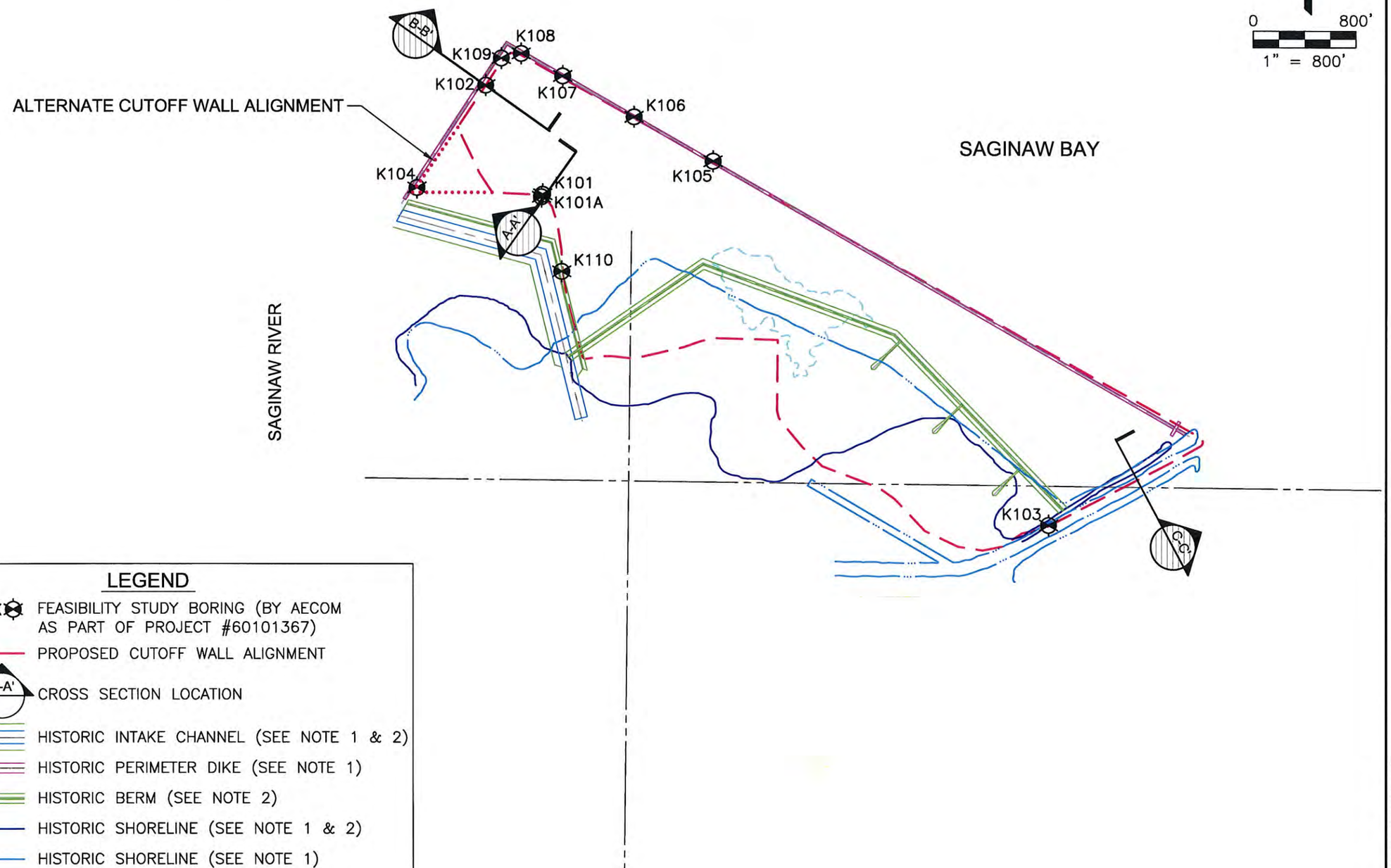
Figure 4

Ash Pond Construction History and Cross Section Locations

NOTES

NOTE 1: Information taken from drawing titled "Property Line Dike (Revision B)" prepared by Commonwealth Associates dated 5/14/1958.

NOTE 2: Information taken from drawing titled "Breakwater Dike (Revision B)" prepared by Commonwealth Associates dated 4/18/1958.



LEGEND

- K FEASIBILITY STUDY BORING (BY AECOM AS PART OF PROJECT #60101367)
- PROPOSED CUTOFF WALL ALIGNMENT
- A-A' CROSS SECTION LOCATION
- HISTORIC INTAKE CHANNEL (SEE NOTE 1 & 2)
- HISTORIC PERIMETER DIKE (SEE NOTE 1)
- HISTORIC BERM (SEE NOTE 2)
- HISTORIC SHORELINE (SEE NOTE 1 & 2)
- HISTORIC SHORELINE (SEE NOTE 1)
- HISTORIC MARSH AREA (SEE NOTE 2)

AECOM

ASH POND CONSTRUCTION HISTORY AND CROSS SECTION LOCATIONS
FEASIBILITY STUDY
CONSUMERS ENERGY COMPANY
D.E. KARN GENERATING FACILITY
ESSEXVILLE, MICHIGAN

Drawn:	CJD	08/31/2009
Checked:	MFP	08/31/2009
Approved:	JSM	11/18/2009
PROJECT NUMBER	60101-367	
FIGURE NUMBER	11	

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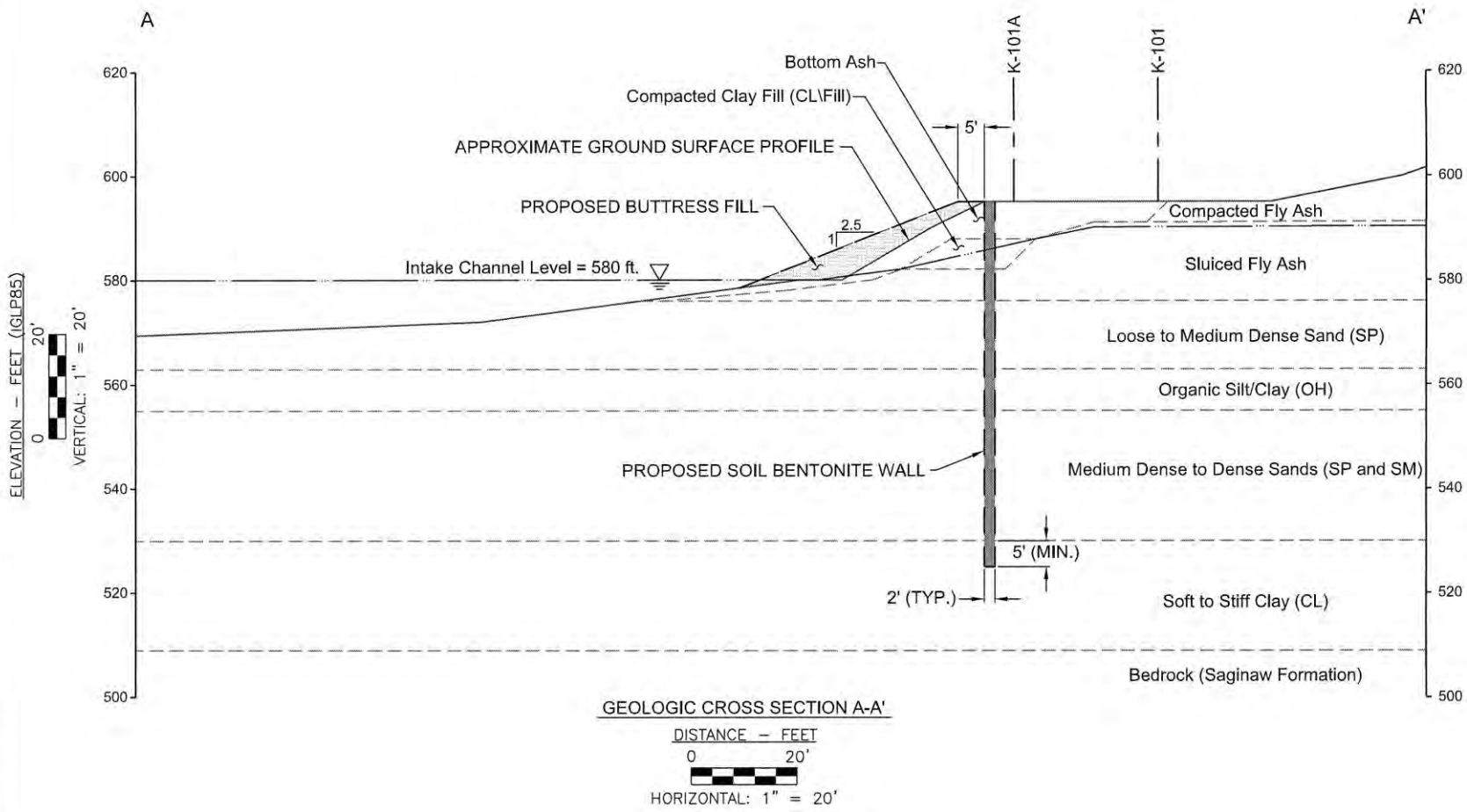
Figure 5

Cross Section A-A'



GEOLOGIC CROSS SECTION A-A'

DISTANCE – FEET

0 20'

HORIZONTAL: 1" = 20'

AECOM

CROSS SECTION A-A'
FEASIBILITY STUDY
CONSUMERS ENERGY COMPANY
D.E. KARN GENERATING FACILITY
ESSEXVILLE, MICHIGAN

Drawn:	CJD	08/31/2009
Checked:	MFP	08/31/2009
Approved:	JSM	11/18/2009
PROJECT NUMBER	60101367	
FIGURE NUMBER	12	

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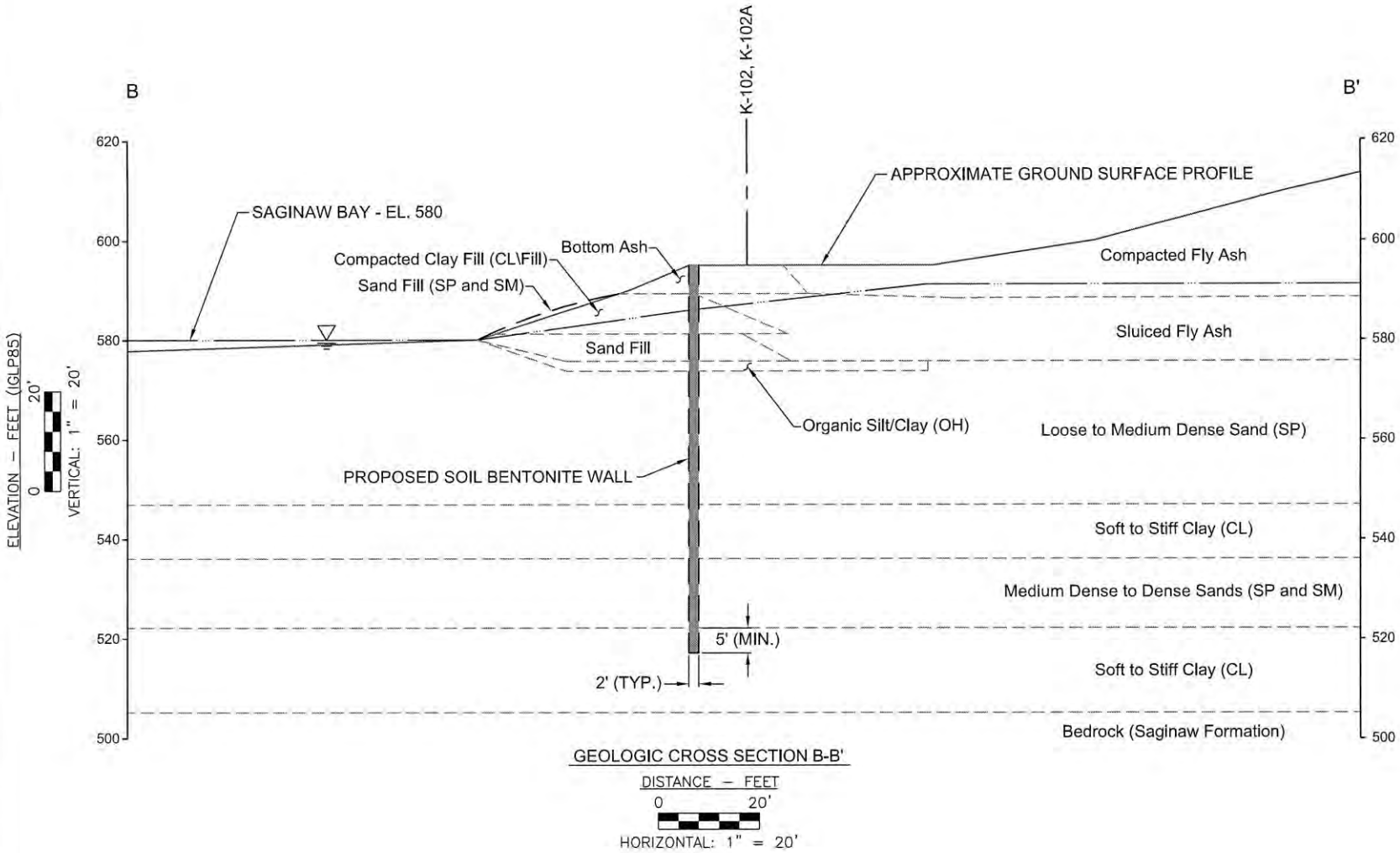
Figure 6

Cross Section B-B'



GEOLOGIC CROSS SECTION B-B'

DISTANCE – FEET

0 20'

HORIZONTAL: 1" = 20'

AECOM

CROSS SECTION B-B'
FEASIBILITY STUDY
CONSUMERS ENERGY COMPANY
D.E. KARN GENERATING FACILITY
ESSEXVILLE, MICHIGAN

Drawn:	CJD	08/31/2009
Checked:	MFP	08/31/2009
Approved:	JSM	11/18/2009
PROJECT NUMBER	60101367	
FIGURE NUMBER	13	

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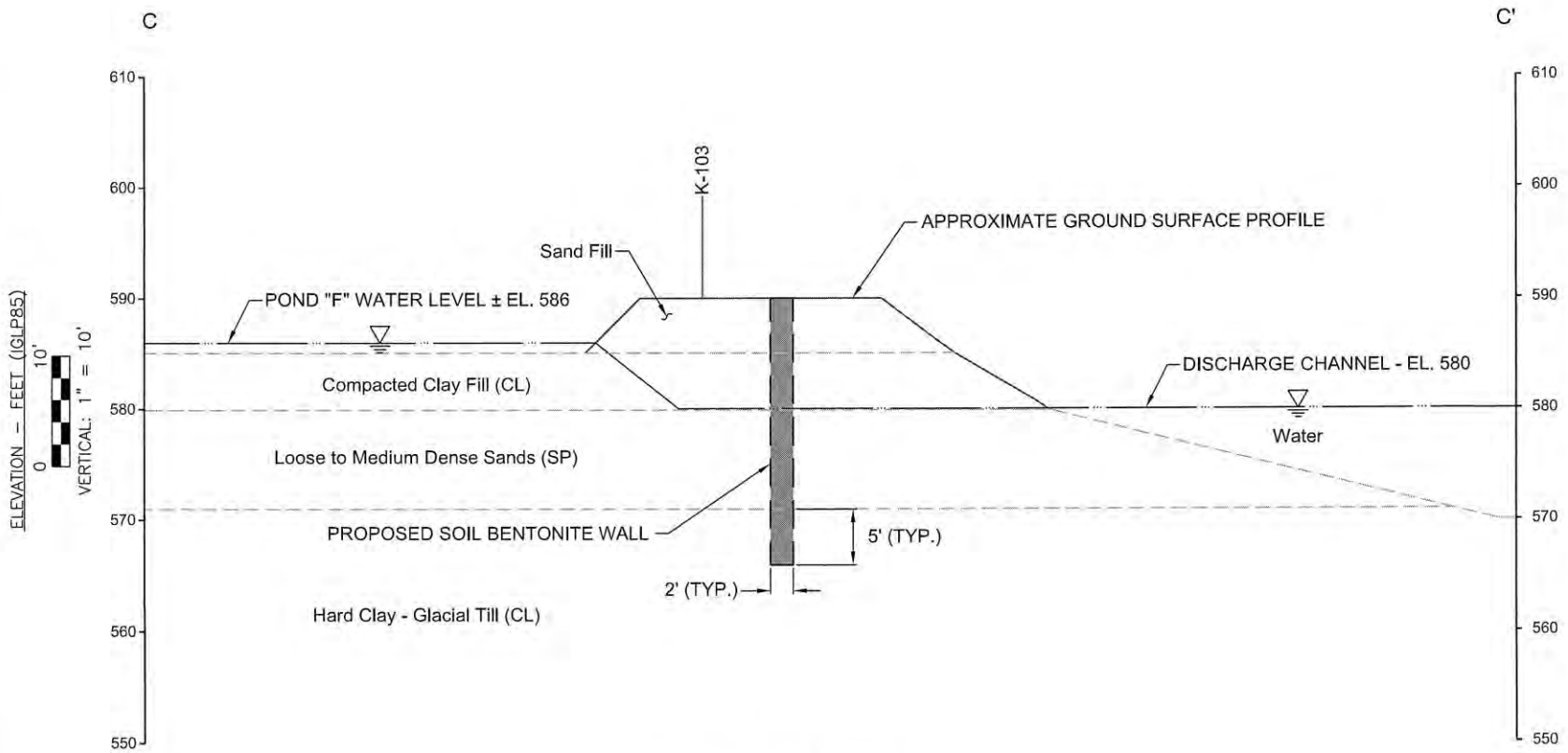
Figure 7

Cross Section C-C'



GEOLOGIC CROSS SECTION C-C'

DISTANCE – FEET

0 10'

HORIZONTAL: 1" = 10'

AECOM

CROSS SECTION C-C'
FEASIBILITY STUDY
CONSUMERS ENERGY COMPANY
D.E. KARN GENERATING FACILITY
ESSEXVILLE, MICHIGAN

Drawn:	CJD	08/31/2009
Checked:	MFP	08/31/2009
Approved:	JSM	11/18/2009
PROJECT NUMBER	60101367	
FIGURE NUMBER	14	

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Appendix A

Limitations

DAM ENGINEERING & VISUAL INSPECTION LIMITATIONS

1. The observations described in this report were made under the conditions stated herein. The conclusions presented in the report were based solely on the services described therein, and not on scientific tasks or procedures beyond the scope of described services.

2. In preparing this report, GZA GeoEnvironmental, Inc. (GZA) has relied on certain information provided by Consumers Energy Company as well as Federal, state, and local officials and other parties referenced therein. GZA has also relied on other parties which were available to GZA at the time of the inspection. Although there may have been some degree of overlap in the information provided by these various sources, GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this work.

3. In reviewing this Report, it should be noted that the reported condition of the dam is based on observations of field conditions during the course of this study along with data made available to GZA. The observations of conditions at the dam reflect only the situation present at the specific moment in time the observations were made, under the specific conditions present. It may be necessary to reevaluate the recommendations of this report when subsequent phases of evaluation or repair and improvement provide more data.

4. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions may be detected.

5. Water level readings have been reviewed and interpretations have been made in the text of this report. Fluctuations in the level of the groundwater and surface water may occur due to variations in rainfall, temperature, and other factors different than at the time measurements were made.

6. GZA's comments on the hydrology, hydraulics, and embankment stability for the dam are based on a limited review of available design documentation prepared by various consultants for Consumers Energy Company. Calculations and computer modeling used by in these analyses were not available and were not independently reviewed by GZA.

7. This report has been prepared for the exclusive use of US EPA for specific application to the existing dam facilities, in accordance with generally accepted dam engineering practices. No other warranty, express or implied, is made.

8. This dam inspection verification report has been prepared for this project by GZA. This report is for broad evaluation and management purposes only and is not sufficient, in and of itself, to prepare construction documents or an accurate bid.

Appendix B

Definitions

COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions refer to references published by the U.S. Army Corps of Engineers, the Federal Energy Regulatory Commission, the Department of the Interior Bureau of Reclamation, or the Federal Emergency Management Agency.

Orientation

Upstream – Shall mean the side of the dam that borders the impoundment.

Downstream – Shall mean the high side of the dam, the side opposite the upstream side.

Right – Shall mean the area to the right when looking in the downstream direction.

Left – Shall mean the area to the left when looking in the downstream direction.

Dam Components

Dam – Shall mean any artificial barrier, including appurtenant works, which impounds or diverts water.

Embankment – Shall mean the fill material, usually earth or rock, placed with sloping sides, such that it forms a permanent barrier that impounds water.

Crest – Shall mean the top of the dam, usually provides a road or path across the dam.

Abutment – Shall mean that part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.

Appurtenant Works – Shall mean structures, either in dams or separate there from, including but not be limited to, spillways; reservoirs and their rims; low level outlet works; and water conduits including tunnels, pipelines, or penstocks, either through the dams or their abutments.

Spillway – Shall mean a structure over or through which water flows are discharged. If the flow is controlled by gates or boards, it is a controlled spillway; if the fixed elevation of the spillway crest controls the level of the impoundment, it is an uncontrolled spillway.

General

EAP – Emergency Action Plan - Shall mean a predetermined plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam break.

O&M Manual – Operations and Maintenance Manual; Document identifying routine maintenance and operational procedures under normal and storm conditions.

Normal Pool – Shall mean the elevation of the impoundment during normal operating conditions.
Acre-foot – Shall mean a unit of volumetric measure that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet. One million U.S. gallons = 3.068 acre feet.

Height of Dam – Shall mean the vertical distance from the lowest portion of the natural ground, including any stream channel, along the downstream toe of the dam to the crest of the dam.

Spillway Design Flood (SDF) – Shall mean the flood used in the design of a dam and its appurtenant works particularly for sizing the spillway and outlet works, and for determining maximum temporary storage and height of dam requirements.

Condition Rating

SATISFACTORY - No existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria. Minor maintenance items may be required.

FAIR - Acceptable performance is expected under all required loading conditions (static, hydrologic, seismic) in accordance with the applicable safety regulatory criteria. Minor deficiencies may exist that require remedial action and/or secondary studies or investigations.

POOR - A management unit safety deficiency is recognized for any required loading condition (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Remedial action is necessary. POOR also applies when further critical studies or investigations are needed to identify any potential dam safety deficiencies.

UNSATISFACTORY - Considered unsafe. A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Reservoir restrictions may be necessary.

Hazard Potential

(In the event the impoundment should fail, the following would occur):

LESS THAN LOW HAZARD POTENTIAL: Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

LOW HAZARD POTENTIAL: Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

SIGNIFICANT HAZARD POTENTIAL: Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

HIGH HAZARD POTENTIAL: Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

Appendix C

Inspection Checklists

GZA
GeoEnvironmental, Inc.

Engineers and Scientists

October 5, 2010
File No. 01.0170142.20

Mr. Stephen Hoffman
United States Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, D.C. 20460

19500 Victor Parkway
Suite 300
Livonia, Michigan 48152
(734) 462-0207
Fax (734) 462-0508
www.gza.com

Re: Coal Combustion Waste Impoundment Inspection Checklists
Consumers Energy, D.E. Karn Facility, Round 7 - CLIN 019
Hampton Township, Michigan

Dear Mr. Hoffman:

GZA GeoEnvironmental, Inc. (GZA) inspected the Coal Combustion Waste Impoundment at Consumers Energy, D.E. Karn facility in Hampton Township, Michigan (Round 7 - CLIN 019) on September 27, 2010 and completed discussions with facility staff on September 28, 2010. Attached to this transmittal letter is the completed checklist form. We will follow up with a draft report within 30 days of the inspection.

Please feel free to contact the undersigned with any questions or if you require additional information.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

Thomas Boom, P.E.
Project Manager

Walter Kosinski, P.E.
Principal

Attachments: Inspection Checklist: D.E. Karn 1&2 Solid Waste Disposal Area

cc: Mr. James Kohler, U.S. EPA

j:\...\checklist cover letter de karn MI.doc

An Equal Opportunity Employer M/F/V/H

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	DE Karn Plant	Date:	September 27, 2010
Unit Name:	DE Karn 1 & 2 Solid Waste Disposal Area	Operator's Name:	Consumers Energy
Unit I.D.:	MI DNRE Facility ID #392503	Hazard Potential Classification:	High Significant Low
Inspector's Name:	Walter Kosinski, P.E. & Thomas Boom, P.E.		

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Daily		18. Sloughing or bulging on slopes?		✔
2. Pool elevation (operator records)?	581.82 ft +/-		19. Major erosion or slope deterioration?		✔
3. Decant inlet elevation (operator records)?	581.49 ft		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		✔
5. Lowest dam crest elevation (operator records)?	590 ft		Is water exiting outlet, but not entering inlet?		✔
6. If instrumentation is present, are readings recorded (operator records)?	✔		Is water exiting outlet flowing clear?		✔
7. Is the embankment currently under construction?		✔	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	N/A		From underdrain?	N/A	
9. Trees growing on embankment? (If so, indicate largest diameter below)	✔		At isolated points on embankment slopes?	N/A	
10. Cracks or scarps on crest?		✔	At natural hillside in the embankment area?	N/A	
11. Is there significant settlement along the crest?		✔	Over widespread areas?	N/A	
12. Are decant trashracks clear and in place?	N/A		From downstream foundation area?	N/A	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✔	"Boils" beneath stream or ponded water?	N/A	
14. Clogged spillways, groin or diversion ditches?	N/A		Around the outside of the decant pipe?	N/A	
15. Are spillway or ditch linings deteriorated?	N/A		22. Surface movements in valley bottom or on hillside?		✔
16. Are outlets of decant or underdrains blocked?		✔	23. Water against downstream toe?	✔	
17. Cracks or scarps on slopes?		✔	24. Were Photos taken during the dam inspection?	✔	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

1) Consumers' performs a daily inspection. DNRE performs visual inspections quarterly. The last dam inspection performed by a third party consultant was on August 12 & 13, 2009.
2) Measured in November 2009.
6) Survey monuments are surveyed and recorded on an irregular basis.
9) Trees are growing along the embankment. The largest diameter tree is approximately 3 feet. Note however, the impoundment only contains dry ash fill in these areas.
12) The outlet structure does not have a trashrack. Trashracks are not necessary due to the over/under configuration of the outlet structure and boom protection adjacent the inlet.
16) We were not able to observe the outlet of the decant pipe due to vegetation.
20) We were not able to observe the outlet of the decant pipe due to vegetation.
23) Water is currently against the toe of the slope from approximately station 68+50 to 87+50 (Discharge Channel) and from station 129+00 to 146+00 (Intake Channel).

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # MI0001678 INSPECTOR Walter Kosinski, P.E. & Thomas Boom, P.E.

Date September 28, 2010

Impoundment Name DE Karn 1&2 Solid Waste Disposal Area

Impoundment Company Consumers Energy

EPA Region 5

State Agency (Field Office) Addresss MI Dept of Nat'l Resources & Environment 401 Ketchum Street Ste B, Bay City, MI 48708

Name of Impoundment DE Karn 1&2 Solid Waste Disposal Area

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update X

	Yes	No
Is impoundment currently under construction?		X
Is water or ccw currently being pumped into the impoundment?		X

IMPOUNDMENT FUNCTION: Containment of coal combustion waste. (currently dry operation only)

Nearest Downstream Town : Name None; adjacent Saginaw Bay.

Distance from the impoundment N/A

Impoundment Location:

Longitude 43 Degrees 38 Minutes 45 Seconds

Latitude 83 Degrees 49 Minutes 57 Seconds

State MI County Bay

Does a state agency regulate this impoundment? YES X NO _____

If So Which State Agency? MI Dept of Natural Resources & Environment

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

__x__ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

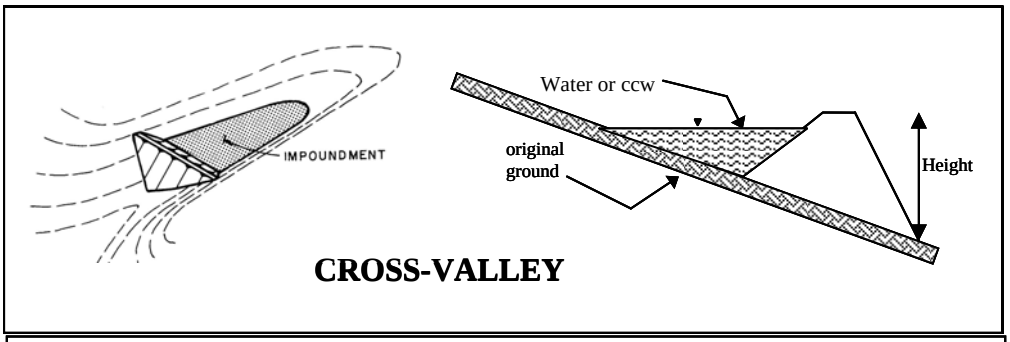
_____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

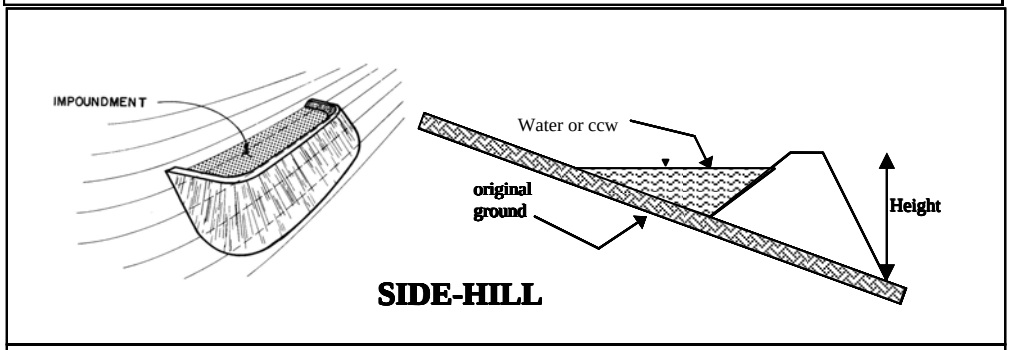
_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

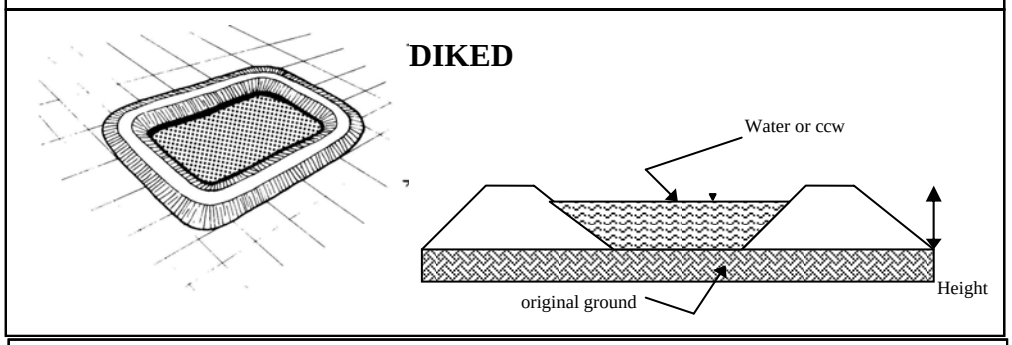
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

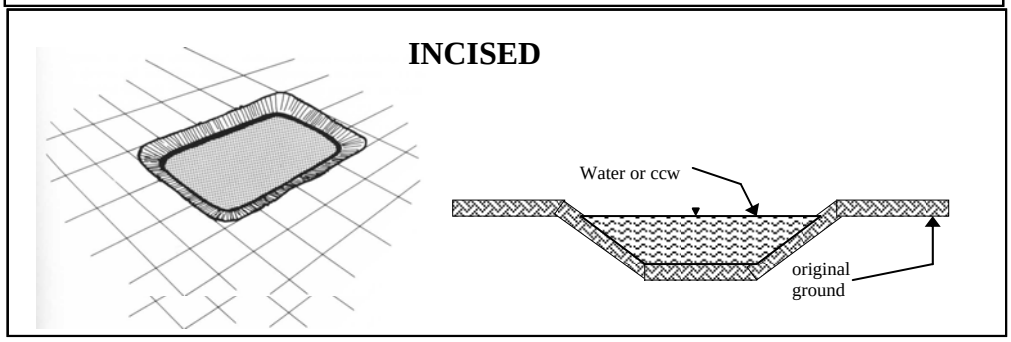
In the potential event of dam failure, losses would likely be limited to the owner's property. Failure could lead to an interruption of power generation or power delivery, but would not likely result in the loss of human life or high economic or environmental losses.

CONFIGURATION:









_____ Cross-Valley
_____ Side-Hill
_____ Diked
_____ Incised (form completion optional)
__X__ Combination Incised/Diked

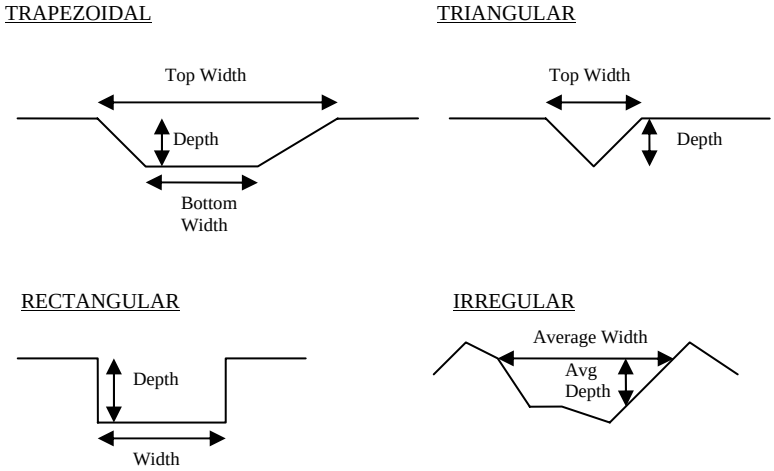
Embankment Height ___20___ feet * Embankment Material Silty Sand, Sand, Silt and Clay
Pool Area ___1.3___ acres** Liner None
Current Freeboard ___8.5___ feet Liner Permeability N/A

* Maximum height
** Area of discharge pond

TYPE OF OUTLET (Mark all that apply)

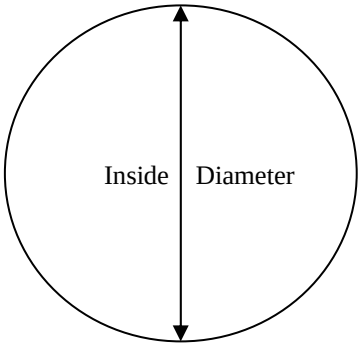
_____ **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

_____ depth
_____ bottom (or average) width
_____ top width



__X__ **Outlet**

__42"__ inside diameter



Material
_____ corrugated metal
_____ welded steel
__X__ concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) _____

Is water flowing through the outlet? YES __X__ NO _____

_____ **No Outlet**

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By The original records for the impoundment design could not be located; therefore, the designer is unknown. A structural fill vertical expansion permitted in 1986 was designed by professional engineers employed by Consumers Energy; CA Hunt and DL Sowers.

Has there ever been a failure at this site? YES _____ NO ____X_____

If So When? _____

If So Please Describe : _____

Has there ever been significant seepages at this site? YES _____ NO ___X___

If So When? _____

IF So Please Describe: _____

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES _____NO ___X____

If so, which method (e.g., piezometers, gw pumping,...)? _____

If so Please Describe : _____

DAM SAFETY INSPECTION CHECKLIST

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area

STATE ID #: MI DNRE Facilty ID# 392503

REGISTERED: ☐ YES ☑ NO

NID ID #: Not applicable

STATE SIZE CLASSIFICATION: None assigned

STATE HAZARD CLASSIFICATION: None assigned

CHANGE IN HAZARD CLASSIFICATION REQUESTED?: N/A

DAM LOCATION INFORMATION

CITY/TOWN: Essexville, Michigan

COUNTY: Bay

DAM LOCATION: 2742 North Weadock Highway
(street address if known)

ALTERNATE DAM NAME: Not applicable

USGS QUAD.: Bay City, Michigan

LAT.: 43º 38' 45" North

LONG.: 83º 49' 57" West

DRAINAGE BASIN: The Disposal Area

RIVER: None - discharge to Saginaw Bay of Lake Huron

IMPOUNDMENT NAME(S): DE Karn 1&2 Solid Waste Disposal Area

GENERAL DAM INFORMATION

TYPE OF DAM: Embankment/Impoundment

OVERALL LENGTH (FT): Appx. 16,300

PURPOSE OF DAM: Containment of coal combustion waste (fly ash)

NORMAL POOL STORAGE (ACRE-FT): 4,422

YEAR BUILT: Late 1950's

MAXIMUM POOL STORAGE (ACRE-FT): 4,422

STRUCTURAL HEIGHT (FT): 17.0

EL. NORMAL POOL (FT): 581.82 (IGLD 85)

HYDRAULIC HEIGHT (FT): 17

EL. MAXIMUM POOL (FT): 581.8 (IGLD 85)

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area

STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010

NID ID #: Not applicable

INSPECTION SUMMARY

DATE OF INSPECTION: September 27 and 28, 2010

DATE OF PREVIOUS INSPECTION: August 2009 2010 by AECOM

TEMPERATURE/WEATHER: 60s F, partly cloudy

ARMY CORPS PHASE I: ☐ YES ☑ NO If YES, date

CONSULTANT: GZA GeoEnvironmental

Previous DNRE Inspection: ☑ YES ☐ NO If YES, date 8/31/2010

BENCHMARK/DATUM: IGLD 85

OVERALL PHYSICAL CONDITION OF DAM: Satisfactory

DATE OF LAST REHABILITATION: 1986

SPILLWAY CAPACITY: No spillway

EL. POOL DURING INSP.: 581.82 (IGLD 85)

EL. TAILWATER DURING INSP.:

PERSONS PRESENT AT INSPECTION

NAME	TITLE/POSITION	REPRESENTING
Thomas Boom, P.E.	Project Manager	GZA GeoEnvironmental
Walter Kosinski, P.E.	Principal	GZA GeoEnvironmental
Harold D. Register, P.E.	Senior Engineer	Consumers Energy
Richard Hall	Site Environmental Services Lead	Consumers Energy
David Marshall	Site Ash Handling Supervisor	Consumers Energy
Stephanie Watson	Engineer	Consumers Energy
John Carpenter	Site Engineer	Consumers Energy
Jon Bloemker, P.E.	Saginaw Bay District Supervisor	MDNRE
Tom Fox	Environmental Engineer	MDNRE

NAME OF DAM:	DE Karn 1&2 Solid Waste Disposal Area	STATE ID #:	MI DNRE Facilty ID# 392503
INSPECTION DATE:	September 27 and 28, 2010	NID ID #:	Not applicable

OWNER:		CARETAKER:	
ORGANIZATION	Consumers Energy	ORGANIZATION	Consumers Energy
NAME/TITLE	Harold Register/ Senior Engineer	NAME/TITLE	Rick Hall / Site Env. Services Lead
STREET	1945 West Parnall Road	STREET	2742 North Weadock Highway
TOWN, STATE, ZIP	Jackson, MI 49201	TOWN, STATE, ZIP	Essexville, MI 48732
PHONE	571-788-2982	PHONE	989-891-3464
EMAIL	hdregister@cmsenergy.com	EMAIL	rghall@cmsenergy.com
OWNER TYPE	Private		

PRIMARY SPILLWAY TYPE	None		
SPILLWAY LENGTH (FT)	N/A	SPILLWAY CAPACITY (CFS)	N/A
AUXILIARY SPILLWAY TYPE	None	AUX. SPILLWAY CAPACITY (CFS)	N/A
NUMBER OF OUTLETS	1	OUTLET(S) CAPACITY (CFS)	Unknown
TYPE OF OUTLETS	Concrete pipe drop structure	TOTAL DISCHARGE CAPACITY (CFS)	Unknown
DRAINAGE AREA (SQ MI)	0.23	SPILLWAY DESIGN FLOOD (PERIOD/CFS)	N/A

HAS DAM BEEN BREACHED OR OVERTOPPED ☐ YES ☑ NO IF YES, PROVIDE DATE(S) _____

FISH LADDER (LIST TYPE IF PRESENT) None

DOES CREST SUPPORT PUBLIC ROAD? ☐ YES ☑ NO IF YES, ROAD NAME: _____

PUBLIC BRIDGE WITHIN 50' OF DAM? ☐ YES ☑ NO IF YES, ROAD/BRIDGE NAME: _____

MHD BRIDGE NO. (IF APPLICABLE) _____

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010 NID ID #: Not applicable

EMBANKMENT (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	1. SURFACE TYPE	Gravel/Bottom Ash.	X		
	2. SURFACE CRACKING	None observed	X		
	3. SINKHOLES, ANIMAL BURROWS	None observed	X		
	4. VERTICAL ALIGNMENT (DEPRESSIONS)	Appears level, no depressions observed	X		
	5. HORIZONTAL ALIGNMENT	Alignment appears true	X		
	6. RUTS AND/OR PUDDLES	None observed. Crest is constructed primarily of bottom ash.	X		
	7. VEGETATION (PRESENCE/CONDITION)	Minimal vegetation observed on crest	X		
	8. ABUTMENT CONTACT	N/A			

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010 NID ID #: Not applicable

EMBANKMENT (D/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S SLOPE	1. WET AREAS (NO FLOW)	None observed	X		
	2. SEEPAGE	None observed	X		
	3. SLIDE, SLOUGH, SCARP	None observed	X		
	4. EMB.-ABUTMENT CONTACT	None observed	X		
	5. SINKHOLE/ANIMAL BURROWS	None observed	X		
	6. EROSION	Erosion noted near the Intake Channel			X
	7. UNUSUAL MOVEMENT	None observed	X		
	8. VEGETATION (PRESENCE/CONDITION)	Significant vegetation on majority of embankment d/s slope		X	

ADDITIONAL COMMENTS: Significant vegetation prevented the adequate inspection of the embankment d/s slope

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010 NID ID #: Not applicable

EMBANKMENT (U/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S SLOPE	1. SLIDE, SLOUGH, SCARP	None observed	X		
	2. SLOPE PROTECTION TYPE AND COND.	None observed	X		
	3. SINKHOLE/ANIMAL BURROWS	Minor animal burrowing on the interior of the bottom ash sluice area		X	
	4. EMB.-ABUTMENT CONTACT	None observed	X		
	5. EROSION	None observed	X		
	6. UNUSUAL MOVEMENT	None observed	X		
	7. VEGETATION (PRESENCE/CONDITION)	Presence of some large trees and vegetation. Most areas were mowed.	X		

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010 NID ID #: Not applicable

INSTRUMENTATION

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
INSTR.	1. PIEZOMETERS	None observed	X		
	2. OBSERVATION WELLS	Seventeen observation wells		X	
	3. STAFF GAGE AND RECORDER	Multiple staff gages. No recorder.		X	
	4. WEIRS	None observed	X		
	5. INCLINOMETERS	None observed	X		
	6. SURVEY MONUMENTS	One survey monument located on the top of the dry ash disposal area			
	7. DRAINS	Several stormwater drains were observed			
	8. FREQUENCY OF READINGS	Daily flow reading of the flow rate for the NPDES Permit. Water level is 1)			
	9. LOCATION OF READINGS	Discharge outlet at the Discharge Channel.			

ADDITIONAL COMMENTS: 1) electronically monitored.

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area

STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010

NID ID #: Not applicable

DOWNSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S WALLS	1. WALL TYPE				
	2. WALL ALIGNMENT				
	3. WALL CONDITION				
	4. HEIGHT: TOP OF WALL TO MUDLINE	min:			
	5. SEEPAGE OR LEAKAGE				
	6. ABUTMENT CONTACT				
	7. EROSION/SINKHOLES BEHIND WALL				
	8. ANIMAL BURROWS				
	9. UNUSUAL MOVEMENT				
	10. WET AREAS AT TOE OF WALL				

N/A

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area

STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010

NID ID #: Not applicable

UPSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S WALLS	1. WALL TYPE				
	2. WALL ALIGNMENT				
	3. WALL CONDITION				
	4. HEIGHT: TOP OF WALL TO MUDLINE	min:			
	5. ABUTMENT CONTACT				
	6. EROSION/SINKHOLES BEHIND WALL				
	7. ANIMAL BURROWS				
	8. UNUSUAL MOVEMENT				

N/A

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010 NID ID #: Not applicable

DOWNSTREAM AREA

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S AREA	1. ABUTMENT LEAKAGE	N/A - no abutments.	X		
	2. FOUNDATION SEEPAGE	None observed.	X		
	3. SLIDE, SLOUGH, SCARP	None observed.	X		
	4. WEIRS	None observed.	X		
	5. DRAINAGE SYSTEM	N/A	X		
	6. INSTRUMENTATION	None observed.	X		
	7. VEGETATION	Heavy vegetation along the Discharge Channel.			X
	8. ACCESSIBILITY	Limited due to heavy vegetation.			X
	9. DOWNSTREAM HAZARD DESCRIPTION	The Karn Disposal Area was constructed on land reclaimed from Saginaw Bay. As such, the downstream hazard is Saginaw Bay and Lake Huron.		X	
	10. DATE OF LAST EAP UPDATE	No written EAP.			X

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010 NID ID #: Not applicable

MISCELLANEOUS

AREA INSPECTED	CONDITION	OBSERVATIONS
	1. RESERVOIR DEPTH (AVG)	Varies based on depth of coal ash. Maximum depth from the crest to the natural ground surface 1)
	2. RESERVOIR SHORELINE	Very limited interior shoreline. Majority of disposal area is dry ash disposal.
	3. RESERVOIR SLOPES	Slopes are lined with rip rap.
MISC.	4. ACCESS ROADS	Access road is from the Karn Plant.
	5. SECURITY DEVICES	Security at Karn Plant entrance. Karn Disposal Area is accessible from Saginaw Bay by boat.
	6. VANDALISM OR TRESPASS	☐ YES ☑ NO WHAT:
	7. AVAILABILITY OF PLANS	☑ YES ☐ NO DATE: Various as built figures available.
	8. AVAILABILITY OF DESIGN CALCS	☑ YES ☐ NO DATE: 1986 design calculations available.
	9. AVAILABILITY OF EAP/LAST UPDATE	☐ YES ☑ NO DATE:
	10. AVAILABILITY OF O&M MANUAL	☐ YES ☑ NO DATE:
	11. CARETAKER/OWNER AVAILABLE	☑ YES ☐ NO DATE: 9/27/10 - 9/28/10
	12. CONFINED SPACE ENTRY REQUIRED	☐ YES ☑ NO PURPOSE:

ADDITIONAL COMMENTS: 1) is 17 feet.

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area

STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010

NID ID #: Not applicable

PRIMARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	N/A			
	WEIR TYPE				
	SPILLWAY CONDITION				
	TRAINING WALLS				
	SPILLWAY CONTROLS AND CONDITION				
	UNUSUAL MOVEMENT				
	APPROACH AREA				
	DISCHARGE AREA				
	DEBRIS				
	WATER LEVEL AT TIME OF INSPECTION				

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area

STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010

NID ID #: Not applicable

AUXILIARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	N/A			
	WEIR TYPE				
	SPILLWAY CONDITION				
	TRAINING WALLS				
	SPILLWAY CONTROLS AND CONDITION				
	UNUSUAL MOVEMENT				
	APPROACH AREA				
	DISCHARGE AREA				
	DEBRIS				
	WATER LEVEL AT TIME OF INSPECTION				

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area

STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010

NID ID #: Not applicable

OUTLET WORKS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
OUTLET WORKS	TYPE				
	INTAKE STRUCTURE				
	TRASHRACK				
	PRIMARY CLOSURE				
	SECONDARY CLOSURE				
	CONDUIT				
	OUTLET STRUCTURE/HEADWALL				
	EROSION ALONG TOE OF DAM				
	SEEPAGE/LEAKAGE				
	DEBRIS/BLOCKAGE				
	UNUSUAL MOVEMENT				
	DOWNSTREAM AREA				
	MISCELLANEOUS				

N/A

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010 NID ID #: Not applicable

CONCRETE/MASONRY DAMS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
GENERAL	TYPE	N/A			
	AVAILABILITY OF PLANS				
	AVAILABILITY OF DESIGN CALCS				
	PIEZOMETERS				
	OBSERVATION WELLS				
	INCLINOMETERS				
	SEEPAGE GALLERY				
	UNUSUAL MOVEMENT				

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area

STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010

NID ID #: Not applicable

CONCRETE/MASONRY DAMS (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	TYPE	N/A			
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	HORIZONTAL ALIGNMENT				
	VERTICAL ALIGNMENT				

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area

STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010

NID ID #: Not applicable

CONCRETE/MASONRY DAMS (DOWNSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S FACE	TYPE				
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	ABUTMENT CONTACT				
	LEAKAGE				

N/A

ADDITIONAL COMMENTS:

NAME OF DAM: DE Karn 1&2 Solid Waste Disposal Area STATE ID #: MI DNRE Facilty ID# 392503

INSPECTION DATE: September 27 and 28, 2010 NID ID #: Not applicable

CONCRETE/MASONRY DAMS (UPSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S FACE	TYPE	N/A			
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	ABUTMENT CONTACTS				

ADDITIONAL COMMENTS:

Appendix D

Photographs

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. EPA	Site Location: DE Karn 1 & 2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 1 **Date:** 9/27/2010

Direction Photo Taken:
North

Description:
Toe of the inner slope of the dike, the stormwater collection ditch, and dry storage of compacted coal ash.

Photo No. 2 **Date:** 9/27/10

Direction Photo Taken:
West

Description:
The dike abuts the D.E. Karn Plant's Intake Channel.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 3

Date: 9/27/2010

Direction Photo Taken:
West

Description:
Erosion channels in the dike near the Intake Channel.

Photo No. 4

Date: 9/27/10

Direction Photo Taken:
Northwest

Description:
The crest and inner slope of the dike near the northwestern portion of the impoundment. Note the trees growing on the exterior and interior slopes.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 5

Date: 9/27/2010

Direction Photo Taken:
Northeast

Description:
Vegetation growing on the outer slope of the dike near the northwestern corner of the impoundment. Rip rap is also present at this location.

Photo No. 6

Date: 9/27/2010

Direction Photo Taken:
Northwest

Description:
One of the monitoring wells at the Karn Disposal Area.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 7

Date: 9/27/2010

Direction Photo Taken:
Northeast

Description:
Rip rap and trees on the outer dike slope. Saginaw Bay abuts the dike at this location.

Photo No. 8

Date: 9/27/2010

Direction Photo Taken:
Southwest

Description:
Crest and outer dike slope near the northwestern corner of the Karn Disposal Area.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 9 **Date:** 9/27/2010

Direction Photo Taken:
Northeast

Description:
Pipe of unknown origin or purpose that does not appear to penetrate the dike.

Photo No. 10 **Date:** 9/27/2010

Direction Photo Taken:
Southeast

Description:
Vegetation and rip rap along the outer slope of the dike.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 11

Date: 9/27/2010

Direction Photo Taken:
West

Description:
Vegetation on the outer slope of the dike.

Photo No. 12

Date: 9/27/2010

Direction Photo Taken:
Southeast

Description:
Top of the compacted fly ash disposal area.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 13

Date: 9/27/2010

Direction Photo Taken:
Northwest

Description:
Top of the compacted fly ash disposal area.

Photo No. 14

Date: 9/27/2010

Direction Photo Taken:
Southeast

Description:
View from approximately the mid point between the toe of the inner dike slope and the top of the fly ash disposal area.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 15 **Date:** 9/27/2010

Direction Photo Taken:
Northwest

Description:
Overview of the fly ash disposal area slope, dike slope, and Lake Huron in the background.

Photo No. 16 **Date:** 9/27/2010

Direction Photo Taken:
Southeast

Description:
Vegetation and rip rap on the outer slope of the dike. Note the bottom ash that was used to build up the crest.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 17

Date: 9/27/2010

Direction Photo Taken:
Southwest

Description:
Rip rap and vegetation on the outer dike slope.

Photo No. 18

Date: 9/27/2010

Direction Photo Taken:
Southeast

Description:
Vegetation on the inner dike slope in the storm water drainage ditch.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 19

Date: 9/27/2010

Direction Photo Taken:
Northeast

Description:
Drift wood on top of the outer dike slope, indicating that the water level in Lake Huron has been as high as the rip rap.

Photo No. 20

Date: 9/27/10

Direction Photo Taken:
Southwest

Description:
The inner dike slope and stormwater ditch was recently mowed in this area.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 21

Date: 9/27/2010

Direction Photo Taken:
South

Description:
High voltage utility lines cross the Karn Disposal Area.

Photo No. 22

Date: 9/27/10

Direction Photo Taken:
Southeast

Description:
The inner dike slope and stormwater drainage ditch.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 23 **Date:** 9/27/2010

Direction Photo Taken:
South

Description:
Trash in the stormwater drainage ditch.

Photo No. 24 **Date:** 9/27/10

Direction Photo Taken:
Southwest

Description:
Pond E.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 25 **Date:** 9/27/2010

Direction Photo Taken:
West

Description:
The former NPDES discharge outlet equipment is still in place.

Photo No. 26 **Date:** 9/27/10

Direction Photo Taken:
Southwest

Description:
Vegetation and rip rap on the outer dike slope at the Discharge Canal.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 27

Date: 9/27/2010

Direction Photo Taken:
Southwest

Description:
Vegetation and rip rap on the outer dike slope at the Discharge Canal.

Photo No. 28

Date: 9/27/10

Direction Photo Taken:
Northeast

Description:
Vegetation on the outer dike slope at the Discharge Canal.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 29

Date: 9/27/2010

Direction Photo Taken:
Northeast

Description:
Pond E has been significantly drained within the last year.

Photo No. 30

Date: 9/27/10

Direction Photo Taken:
North

Description:
The NPDES outlet structure in Pond F.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 31

Date: 9/27/2010

Direction Photo Taken:
North

Description:
The metal ring and concrete pipe at the NPDES discharge structure. The electronic water level meter is in the lower right hand corner of the picture.

Photo No. 32

Date: 9/27/10

Direction Photo Taken:
South

Description:
The readout for the electronic water level meter.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 33

Date: 9/27/2010

Direction Photo Taken:
Northwest

Description:
View of the NPDES outlet into the Discharge Canal from the opposite side of the Karn Disposal Area. Note the heavy vegetation.

Photo No. 34

Date: 9/27/10

Direction Photo Taken:
Southwest

Description:
Vegetation growing on the outer dike slope at the Discharge Canal.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 35

Date: 9/27/2010

Direction Photo Taken:
Northeast

Description:
The Discharge Canal flows into Lake Huron. The gate shown prevents fishermen from driving up the Discharge Canal.

Photo No. 36

Date: 9/27/10

Direction Photo Taken:
East

Description:
One of the drainage ditches that conveys Bottom Ash wastewater to Pond F.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 37

Date: 9/27/2010

Direction Photo Taken:
Northwest

Description:
One of the drainage ditches that conveys Bottom Ash wastewater to Pond F. The drop structures shown in the bottom of the photo are typical of the transfer structures in the drainage ditches.

Photo No. 38

Date: 9/27/10

Direction Photo Taken:
Northwest

Description:
One of the drainage ditches that conveys Bottom Ash wastewater to Pond F. Yellow turbidity curtains reduce particulate in the wastewater.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 39

Date: 9/27/2010

Direction Photo Taken:
North

Description:
The interior of the Karn Disposal Area.

Photo No. 40

Date: 9/27/10

Direction Photo Taken:
Northeast

Description:
Turbidity curtains in the bottom ash drainage ditches.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 41

Date: 9/27/2010

Direction Photo Taken:
Northwest

Description:
Outlet for transfer of bottom ash wastewater between the drainage ditches.

Photo No. 42

Date: 9/27/10

Direction Photo Taken:
North

Description:
Stormwater overflow outlet that empties the drainage ditches into the Discharge Canal.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 43

Date: 9/27/2010

Direction Photo Taken:
Southeast

Description:
One of the drainage ditches that conveys Bottom Ash wastewater to Pond F.

Photo No. 44

Date: 9/27/10

Direction Photo Taken:
West

Description:
Bottom Ash wastewater discharge pond.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: D.E. Karn 1&2 Solid Waste Disposal Area Consumers Energy Company Essexville, MI	Project No. 01.0170142.20

Photo No. 45

Date: 9/27/2010

Direction Photo Taken:
East

Description:
Bottom Ash wastewater discharge pond and pipe trestle.

Photo No. 46

Date: 9/27/10

Direction Photo Taken:
Northwest

Description:
Chemical treatment ponds are located within the Karn Disposal Area.

Appendix E

Reference List

DE KARN 1 & 2 SOLID WASTE DISPOSAL AREA
CONSUMERS ENERGY COMPANY - D.E. KARN PLANT
ESSEXVILLE, MICHIGAN

REFERENCE LIST

1. Hydrogeological Monitoring Plan – DE Karn Solid Waste Disposal Facility, Natural Resource Technology, dated February 5, 2010.

2. March 2009 response by Consumers Energy to EPA CERCLA Section 104(e) Information Request for Surface Impoundments, Enclosure 2.

3. Potential Failure Mode Analysis Report, D.E. Karn Generating Facility, Ash Dike Risk Assessment, AECOM, dated October 30, 2009.

4. Subsurface Investigation and Soil-Bentonite Wall Feasibility Study, D.E. Karn Ash Landfill, AECOM, dated December 4, 2009.

5. Inspection Report, D.E. Karn Generating Facility, Ash Dike Risk Assessment, AECOM, dated October 30, 2009.

6. NPDES Permit No. MI0001678 issued to the Consumers Energy Company for the D.E. Karn & J.C. Weadock Power Plant, dated July 30, 2007.

7. D.E. Karn Fly Ash Disposal Area Soil-Bentonite Cutoff Wall Basis of Design Report, AECOM, dated December 31, 2009.

8. Letter to Dr. Gary Dawson regarding Revisions to GSI Criteria and Facility Relicensing for the Weadock and Karn Landfills, MDEQ, dated August 26, 2009.

9. Solid Waste Disposal Area Operating License for the DE Karn 1&2 Solid Waste Disposal Area, MDEQ, dated October 15, 2009.

10. Interim Vegetation Management Plan for DE Karn Surface Impoundment Landfill, Consumers Energy, August 2, 2010.

11. Environmental Manual for Solid Waste Requirements, Consumers Energy, dated March 3, 2009.

12. Construction Permit Application and Support Documents – D.E. Karn Ash Disposal Areas A Through E, Consumers Power Company, dated August 1986.

13. Hydraulic Conductivity Results, Natural Resources Technology, dated November 20, 2003.

14. "Karn-Weadock Next Generation Baseline Monument Drawing." Generated by Rowe Professional Services Company. Drawing No. SG-20188, dated August 8, 2008.

15. "D.E. Karn Ash Pond Volumes." Generated by Rowe Professional Services Company. Drawing No. SG-20575, dated January 26, 2010.

Appendix F

GZA Response to Comments Received on Draft Report

EPA and MDEQ Comments Received on Draft Report

Comments on Karn Report

EPA: None

State:

From: "Morrow, Greg (DNRE)" <MORROWG@michigan.gov>
To: James Kohler/DC/USEPA/US@EPA, Stephen Hoffman/DC/USEPA/US@EPA
Cc: "Bloemker, Jon (DNRE)" <BLOEMKERJ@michigan.gov>, "Lee, Lonnie (DNRE)" <LEEL@michigan.gov>
Date: 02/25/2011 09:21 AM
Subject: RE: Comment Request on Consumers Energy DE Karn, Weadock, and JR Whiting Draft Reports

Gentlemen,

Please accept the following comments related to the Draft Assessment Reports prepared for the EPA relative to the Consumers Energy DE Karn and JC Weadock coal ash disposal sites in Michigan.

Please note that MDNRE is not drawing any conclusions as to whether the GZA and Dewberry and Davis evaluations are acceptable, but rather providing additional information that may be pertinent and pointing out a few unclear or incorrect statements. The comments are primarily related to additional evaluations/reports (by Consumers and their consultants) which were not available during the GZA and Dewberry and Davis evaluations of the Karn and Weadock sites.

Draft Report Round 7 Dam Assessment Consumers Energy Company-D.E. Karn Plant, dated January 12, 2011, prepared by GZA GeoEnvironmental, Inc. (GZA report)

- In Section 1.2.7 and other areas of the report, GZA indicates that a failure of the perimeter dike is likely to only result in losses (economic and environmental) generally limited to the Owner's property. The rationale for making this assertion is unclear as the disposal Facility is in close proximity to waters of the State. This conclusion could be based on a detailed review of the critical slope stability scenarios with the lowest factors of safety, but this is not clear in the report. To simply state that a dike failure anywhere at the facility would likely only impact the owner's property does not seem prudent.

- The last paragraph of Section 1.3.5 in the GZA report discusses a conclusion from AECOMs analysis that the installation of a slurry wall around the disposal area is feasible. It should be noted that a subsequent evaluation completed by NTH Consultants, Ltd. (Updated Slope Stability Analysis, dated 9/29/10) seemed to question the feasibility of installing a slurry wall in areas where the key-in layer was very deep and/or areas which were found to have marginal

factors of safety for potential shallow failure surfaces under existing conditions.

- Section 1.3.7 of the GZA report discusses AECOMs recommendations for the site to institute a vegetation removal and management plan. It can be noted that an interim vegetation management plan was approved by the DNRE on 9/28/10 and a final plan (dated 12/30/10) is currently under review. The facility has already begun to remove vegetation on the dike and waste slopes.

- Section 2.6 of the GZA report discusses AECOMs recommendations to complete slope improvements on portions of the perimeter dike along both the intake and discharge channels. The subsequent evaluation/report by NTH also recommended slope improvements along the intake channel, but suggests that the calculated factors of safety for the slope along the discharge channel, which were below 1.5 for some scenarios, could be considered acceptable if a slope monitoring plan were put in place. The DNRE has not yet provided comments to the company regarding this conclusion.

Coal Combustion Waste Impoundment Round 7-Dam Assessment Report J.C. Weadock (Site 20), dated October 2010, prepared by Dewberry & Davis, LLC (Dewberry Report)

- In Section 2.2 of the report, Dewberry indicates that a failure of the perimeter dike is likely to only result in losses (economic and environmental) generally limited to the Owner's property. The rationale for making this assertion is unclear as the disposal Facility is in close proximity to waters of the State. This conclusion could be based on a detailed review of the critical slope stability scenarios with the lowest factors of safety, but this is not clear in the report. To simply state that a dike failure anywhere at the facility would likely only impact the owner's property does not seem prudent.

- In Section 4.1.2 of the Dewberry Report it discusses the slurry wall which was installed within the perimeter dike at the facility. It should be noted that the slurry wall does not completely enclose the disposal area. A section of the perimeter, upstream of the fish barrier and NPDES monitoring point, did not have a slurry wall installed in order to provide a vent for water from the site to discharge.

- In Section 7.0 of the Dewberry report, the structural stability evaluation references previous evaluations conducted by MTC and AECOM. It should be noted that the DNRE provided technical comments regarding the stability evaluations performed by AECOM. In response, Consumers retained SME to collect additional field data and perform an updated slope stability evaluation (Report on Dike Slope Stability Analyses, dated November 23, 2010). The SME report indicates a minimum factor of safety for dike slope stability of 1.4 for long-term conditions, which occurs along a dike interior to the landfill property (i.e. not adjacent to Waters of the State). SME believes that for this less critical dike, a factor of safety of 1.4 for the long term condition is acceptable. The DNRE is currently reviewing the SME report and will be providing technical comments in the near future.

- In Section 7.3 and other sections of the Dewberry report, it indicates that the stability of the dike appears to be satisfactory based, in part, on the fact that State of Michigan Dam Safety program staff completes regular inspections at the facility. This is not true. The DNRE conducts inspections relative to environmental permits/licenses for the site, but I don't believe that the Dam Safety Program is involved with this site due to the fact that it is a licensed type III landfill.

- In Section 8.3.2 of the Dewberry report, it indicates that Consumers and the State are discussing vegetation management issues related to the dike slopes. It can be noted that an interim vegetation management plan was approved by the DNRE on 9/28/10 and a final plan (dated 12/30/10) is currently under review.

Thank you for the opportunity to review these draft reports and provide comments. Please contact me if you have any questions regarding this correspondence.

Sincerely,

Greg Morrow, Environmental Engineer
Environmental Resource Management Division
Department of Natural Resources and Environment
Southeast Michigan District
27700 Donald Court, Warren, MI 48092
Ph: 586-753-3852
Fax: 586-753-3831
morrowg@michigan.gov

CEC Comments Received on Draft Report

Consumers Energy

A CMS Energy Company

Environmental Services

March 23, 2011

Mr. Steve Hoffman
U.S. Environmental Protection Agency
Two Potomac Yard
2733 South Crystal Drive
5th Floor, N-5237
Arlington, VA 22202-2733

DRAFT REPORT, ROUND 7 DAM ASSESSMENT, CONSUMERS ENERGY COMPANY – D.E. KARN PLANT 1 &2 SOLID WASTE DISPOSAL AREA, ESSEXVILLE, MICHIGAN

Dear Mr. Hoffman,

Thank you for the opportunity to allow Consumers Energy to comment on the Draft Report Round 7 Dam Assessment prepared by GZA GeoEnvironmental, Inc. We have appreciated the opportunity to work closely with staff and your contractor, GZA GeoEnvironmental, Inc. to produce the most accurate document based on the reports provided as part of this assessment.

Please find the detailed review comments provided as an attachment.

Please feel free to contact me with any questions you may have concerning the attached comments. I look forward to working with you and your contractors to finalize this work product.

Sincerely,

Harold D. Register Jr.

Harold D. Register, Jr., P.E.
Sr. Engineer
Land and Water Management
Phone: (517)788-2982
Email: hdregister@cmsenergy.com

Enclosures

cc (via email):

Mr. Jim Kohler, P.E. (Kohler.James@epamail.epa.gov)

WRITTEN COMMENTS DRAFT REPORT, ROUND 7 DAM ASSESSMENT D.E. KARN 1 & 2

1. Page i, Executive Summary

This section states, "The Karn Disposal Area, in its current configuration, has a maximum height of approximately 17 feet above natural ground surface. Please revise to clarify that the 17-ft elevation refers to the perimeter dike and not the elevation of the landfill above grade.

2. Page ii, Operations & Maintenance Activities

Comment No. 4 denotes, "Complete and/or analyze other embankment stability and seepage improvements recommended by AECOM." Please revise to note that AECOM did not consider the seepage to be a structural or stability issue.

3. Page 4, Section 1.2.4 Description of the Karn Disposal Area and Appurtenances

The minimum setback distance from the placement of conditioned, dry fly is 100-feet from the interior toe of the dike slope. Please revise to clarify that the 100-ft set back distance is from the Ordinary High Water Mark (OHWM) on the **exterior** facing slope to the point where placement of conditioned, dry fly ash is to be placed.

4. Page 5, Section 1.2.5 Operations and Maintenance

This section states, in part, "An operation and maintenance checklist for daily field inspections has not been developed for the Karn Disposal Area." Please revise that such a checklist is in place pursuant to Consumers LM-100 procedures but may not contain all of the elements as expected by the inspection team.

5. Page 5, Section 1.2.5 Operations and Maintenance

Please revise to indicate that groundwater is monitored on a quarterly basis at a minimum of fifteen monitoring wells pursuant to the revised Hydrogeological Monitoring Plan (HMP) approved on March 1, 2010. Pursuant to the operating license, the HMP subsumes the requirements for the groundwater discharge authorization.

6. Page 6, Section 1.3.2, Karn Disposal Area

The third paragraph, in part, states, "Fly ash was encountered intermittently in the fill soils of the perimeter dike." Please revise to clarify that this was true only along the intake channel segment of the perimeter dike.

7. Page 8, Section 1.3.5 Design and Construction Records and History

The sixth paragraph indicates that the vertical expansion involved stacking and compacting dry, conditioned fly ash in Ponds A, B, and C with continued use Ponds D, E, and F for settling of precipitation runoff and bottom ash transport water. Please revise to clarify that the configuration of the vertical expansion was updated and approved by the Michigan Department of Environmental Quality in 2002 to address offset distances due to transmission towers and overhead lines.

8. Page 9, Section 1.3.5 Design and Construction Records and History

The section states, in part, "As a result, CEC and DNRE mutually agreed that a slurry wall was needed around the Karn Disposal Area to contain chemical constituents in the leachate[11]." The footnoted reference from the DNRE letter dated August 26, 2009 failed to mention that at the time of the "mutual agreement" the state considered the facility to be out of compliance with the groundwater discharge standard. Consumers had no recourse but to agree with this element of the proposed consent agreement. Upon further review of all available data, the state had, in fact, erred, and its calculated discharge standard was an order of magnitude too low. When this error was discovered, the consent agreement was abandoned and the license issued (October 15, 2009). Consumers agreed voluntarily to study the feasibility of a slurry wall, but such a wall or other control will not be built or implemented unless groundwater performance criteria cannot be met. Please revise this statement to align with the agreement per the re-issued license of October 15, 2009.

9. Page 9, Section 1.3.6 Operating Records

Please revise the statement, "Four survey monuments at the DEKP are surveyed annually to monitor settlement," to read that "An annual aerial survey is conducted for the DEKP ash disposal area contouring the surface at 1-ft intervals with individual survey points accurate up to +/- 0.1-ft."

10. Page 11, Section 2.2 Caretaker Interview

Please revise to clarify that maintenance of the land disposal facility is the responsibility of CEC personnel rather than classifying the structure as a dam.

11. Page 12, Section 2.3 Operation and Maintenance Procedure

Please revise to clarify that the condition of the dike is observed at least once per day by field technicians and field notes are recorded. There is a security check of the perimeter dike one per shift (three shifts per day) by security for more generalized observations.

GZA Response to Comments Received on Draft Report

APPENDIX F

GZA Response to Comments Received on Draft Report

GZA has reviewed the comments provided by the EPA, the MDEQ, and CEC for the draft report submitted to the EPA on January 12, 2011 for the Karn Disposal Area. GZA has addressed the comments, undated from the EPA, dated February 25, 2011 from the MDEQ, and dated March 23, 2011 from CEC, as follows:

EPA Comments:

The EPA had no comments.

MDEQ Comments:

GZA has modified the Final Report in accordance with the comments provided by the MDEQ. In regards to the first bulleted MDEQ comment, GZA did not indicate that a failure of the perimeter dike would only result in losses to the CEC property. However, to clarify, we modified the phrasing to include the word "principally" to be consistent with the EPA's definition of a Low hazard rating, as it is our opinion that the Karn Disposal Area meets this definition.

CEC Comments:

GZA agrees with and has modified the Final Report in accordance with the comments provided by CEC.