



REPORT

NORTHERN INDIANA PUBLIC SERVICE COMPANY

R.M. SCHAHFER GENERATING STATION

Hazard Potential Classification Assessment and
Visual Inspection Report - RCRA CCR Units

Pursuant to 40 CFR 257.73

WASTE DISPOSAL AREA, DRYING AREA, MATERIAL
STORAGE RUNOFF BASIN & METAL CLEANING
WASTE BASIN – SURFACE IMPOUNDMENTS

Submitted To: Northern Indiana Public Service Company (NIPSCO)
2723 East 1500 North
Wheatfield, IN 46392

Submitted By: Golder Associates Inc.
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Lansing, MI 48906 USA

September 28, 2016

Project No. 1651599

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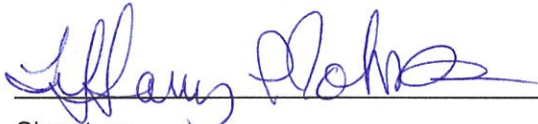


CERTIFICATIONS

Professional Engineer Certification Statement [40 CFR 257.73(a)(2)(ii)]

I hereby certify that having reviewed the attached documentation, and being familiar with the provisions of Title 40 of the Code of Federal Regulations Section 257.73 (40 CFR Part 257.73), I attest that this Hazard Potential Classification Assessment Report is accurate has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of 40 CFR Part 257.73.

Golder Associates Inc.



Signature

September 28, 2016

Date of Report Certification

Tiffany D. Johnson, P.E.

Name

Indiana PE #11500730





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Appendix B Excerpts from Federal Guidelines for Dam Safety: Hazard Potential Classification for Dams, Federal Emergency Management Agency (“FEMA”) (reprinted January 2004).



1. INTRODUCTION

The United States Environmental Protection Agency (EPA) promulgated the Resource Conservation and Recovery Act (RCRA) Coal Combustion Residuals (CCR) Rule (Rule) on April 17, 2015, with an effective date of October 19, 2015. The Rule requires owners or operators of existing CCR surface impoundments to have Periodic Hazard Potential Classification Assessments certified by a qualified professional engineer in accordance with 40 CFR 257.73(a)(2). The initial hazard potential assessments are required to be completed and the results certified (per 40 CFR 257.73(a)(2)(ii)) for CCR surface impoundments. Golder Associates Inc. (Golder) was retained by Northern Indiana Public Service Company (NIPSCO) to perform the assessment and certification of the Waste Disposal Area (WDA), the Drying Area (DA), the Materials Storage Runoff Basin (MSRB), and the Metal Cleaning Waste Basin (MCWB), which are CCR surface impoundments located at the R.M. Schahfer Generating Station (RMSGs, Site). This report includes a visual site inspection as part of the initial hazard potential classification assessments.

As per the 40 CFR Preamble - Hazard Potential Ratings, each impoundment assessed was given a Hazard Potential Classification rating of either Less-than-Low, Low, Significant, and High. The hazard potential ratings refer to the potential for loss of life or damage if there is a dam failure. The ratings do not refer to the condition or structural stability of the dam, or the potential for the dam to fail. The four hazard potential classifications are defined as:

- High hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation will probably cause loss of human life.
- Significant hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns.
- Low hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of life and low economic and/or environmental losses. Losses are principally limited to the surface impoundment's owner's property.
- Less than low hazard potential means a diked surface impoundment does not pose a high, significant, or low hazard.

Previous classifications performed for the Site's surface impoundments were determined following the General Guidelines For New Dams And Improvements To Existing Dams In Indiana, Indiana Department of Natural Resources, Division of Water (IDNR-DOW) (updated 2010). These were reviewed and amended as necessary to reflect guidance from the Federal Guidelines for Dam Safety: Hazard Potential Classification for Dams, Federal Emergency Management Agency ('FEMA') (reprinted January 2004) for which the CCR Rule is based.



Per the CCR Rule, owners and operators of all CCR surface impoundments must determine each unit's hazard potential classification through a hazard potential classification assessment. Hazard potential classification assessments must be certified by a qualified professional engineer and documentation must be provided that supports the basis for the current hazard potential rating. An initial hazard potential assessment must be conducted within one year of the effective date of the rule for existing units and prior to the initial receipt of CCR in the unit for new units or lateral expansions.

CCR unit owners/operators must perform the hazard potential classification assessment for the following timeframes, as per the CCR Rule:

- initial assessments must be completed by October 17, 2016 and
- periodic re-assessment every five years.



2. BACKGROUND INFORMATION

This report presents the basis for the certification of the initial hazard potential classification assessment of the WDA, DA, MSRB, and MCWB CCR surface impoundment units at the NIPSCO RMSGS, located in Wheatfield, Jasper County, Indiana. The assessments were conducted to comply with 40 CFR 257.73(a)(2)(i) of the CCR Rule.

To supplement the initial hazard potential classification assessment, Golder reviewed available information regarding the status and condition of the CCR units and performed an onsite visual inspection which was conducted on June 2, 2016. The objectives of the inspections included the following:

- Review of Operational Records (as applicable, see Table 1):
 - Design and construction information.
 - Results of previous hazard potential classification assessments.
 - Results of previous annual inspections.
- A visual inspection of the CCR units to identify features that would affect the initial hazard potential classification assessment.

In accordance with 40 CFR 257.73(a)(2)(ii), this report has been prepared by a qualified professional engineer documenting the operational records review, visual inspection, and identifying the following:

- Any changes in geometry of the CCR surface impoundment since previous annual inspections.
- Any changes in downstream features (roads, ditches, rivers, houses, and the like).
- Any other change(s) which may have affected the results of the initial hazard potential classification assessment.



3. REVIEW OF OPERATIONAL RECORDS

The existing reports reviewed for this assessment are summarized below.

Table 1: Summary of Background Document Review

Document	Date	Author
Various construction drawings	1982	Sargent & Lundy Engineers
Assessment of Dam Safety of Coal Combustion Surface Impoundments, NIPSCO, RM Schahfer Generating Station	July 2010	CDM for the EPA
Report on Inspection of The Waste Disposal Area	January 2011	Golder Associates Inc.
Final Hazard Classification Review Report – NIPSCO Schahfer Generating Station	January 2011	Golder Associates Inc.
Embankment Elevation Survey, Waste Disposal Area and Recycle Pond, NIPSCO Schahfer Generating Station	December 2011	Marbach, Brady and Weaver, Inc.
Schahfer Spillway Hydrologic and Hydraulic Evaluation	December 2011	Golder Associates Inc.
Final Geotechnical Investigation and Embankment Stability Analyses	June 2012	Golder Associates Inc.
Report on Inspection of The Waste Disposal Area	September 2012	Golder Associates Inc.
Construction in a Floodway Permit Application, NIPSCO R.M. Schahfer Generating Station,	November 2012	Golder Associates Inc.
Basin Operation, Maintenance and Inspection Plan, NIPSCO R. M. Schahfer Generating Station,	February 2013	Golder Associates Inc.



Emergency Action Plan, Final Settling Basin (FSB), Intake Settling Basin (ISB), Waste Disposal Area (WDA), Recycle Basin (RB), Northern Indiana Public Service Company (NIPSCO), R.M. Schahfer Generating Station	February 2013	Golder Associates Inc.
State of Indiana Department of Natural Resources (DNR), Certificate of Approval, After-the-Fact, Construction in a Floodway	April 23, 2013	State of Indiana DNR
Report on Inspection of The Waste Disposal Area	April 2014	Golder Associates Inc.
Construction Observation Documentation Report, Surface Water Basin Erosion Repairs, NIPSCO R.M. Schahfer Generating Station	October 2014	Golder Associates Inc.
First Annual RCRA CCR Unit Inspection Report – NIPSCO Schahfer Generating Station	January 2016	Golder Associates Inc.



4. FACILITY DESCRIPTIONS AND VISUAL INSPECTION

The 2016 onsite inspection of the WDA, DA, MSRB, and MCWB was performed by Ms. Tiffany Johnson, P.E. and Mr. Alexander Williams, P.E. of Golder on June 2, 2016. Ms. Johnson is a Professional Engineer, licensed in the State of Indiana. Golder's inspectors were accompanied by Mr. Joe Kutch, Coal Combustion Residuals Program Manager with NIPSCO for a portion of the inspection.

4.1 Waste Disposal Area (WDA)

The WDA was designed by Sargent & Lundy Engineers of Chicago, Illinois in 1982. The WDA is formed by a ring earth-fill dike with slurry trench core that is approximately 17 feet high and 7,540 feet long (including the common embankment) enclosing an area of approximately 80 acres, with a crest elevation of 681 feet above mean sea level (See Table 1 - Marbach, 2011). The WDA was constructed for NIPSCO, put in service in 1982, and has been continuously owned and operated by NIPSCO since.

The WDA accepts sluiced bottom ash and boiler slag CCR and various sump discharges from the generating station. The sluiced CCR enters the WDA via elevated pipes at the north side and also via buried pipes located at the northwest corner. Water exits the WDA via an overflow weir, to the Recycle Basin, or through the auxiliary spillway located at the northwest side. The overflow weir is located at the southern end of the east side of the WDA. There is a spillway consisting of two, 24-inch diameter corrugated steel pipes with a concrete down-slope channel transitioning to a rip-rap lined downstream channel located near the northwest corner of the WDA. The east side of the WDA is common with the west side of the adjacent Recycle Basin. A survey of the WDA was performed by Marbach, Brady and Weaver, Inc. in December 2011 (See Table 1 – Marbach, 2011). At the time of inspection, the freeboard was greater than 2 feet.

Based on visual observations made on June 2, 2016, the overall condition of the WDA is acceptable. Based on visual observations made on June 2, 2016, there were no visual conditions identified that would likely impact the basis documentation for the initial hazard potential classification assessment.

4.2 Metal Cleaning Waste Basin

In addition to receiving overflow water from the MSRB, the MCWB also receives plant demineralizer waste, air heater wash water, and storm water runoff. Water is pumped from this basin to the Final Settling Basin to the northeast.

Available drawings indicate the MCWB is formed by a 4-foot high embankment with 3H:1V side slopes and a 15.5-foot wide crest around three sides and 12.25-foot wide crest on one side. The MCWB is approximately 7 feet deep and has an estimated capacity of approximately 77,400 cubic yards. The approximate area of the MCWB is 13.4 acres. Available drawings note that the core of the MCWB



embankment is constructed with a slurry wall and on-site compacted soils. At the time of inspection, the freeboard was greater than 2 feet.

Based on visual observations made on June 2, 2016, the overall condition of the MCWB is acceptable. Based on visual observations made on June 2, 2016, there were no visual conditions identified that would likely impact the basis documentation for the initial hazard potential classification assessment.

4.3 Material Storage Runoff Basin

The MSRB receives water from the yard runoff pond, from coal pile storage runoff, and from scrubber process sumps. Water is discharged to the Final Settling Basin and to the MCWB Basin through an open channel located on the southern end of the divider berm.

Available drawings indicate the MSRB is formed by a 4-foot high embankment with a 15.5-foot wide crest around three sides and 12.25-foot wide crest on one side and 3H:1V side slopes. The MSRB is approximately 7 feet deep and has an estimated capacity of approximately 77,400 cubic yards. The approximate area of the MSRB is 13.4 acres. Available drawings note that the core of the MSRB embankment is constructed with a slurry wall and on-site compacted soils. At the time of inspection, the freeboard was greater than 2 feet.

Based on visual observations made on June 2, 2016, the overall condition of the MSRB is acceptable. Based on visual observations made on June 2, 2016, there were no visual conditions identified that would likely impact the basis documentation for the initial hazard potential classification assessment.

4.4 Drying Area

The DA was also designed by Sargent & Lundy Engineers of Chicago, Illinois in 1982. The DA, MSRB, and MCWB comprise a single larger impounding structure. This larger structure consists of an incised area with a slurry trench ring wall that is approximately 5,425 feet long (including the common embankment). The total enclosed area of the DA is approximately 5.9 acres at an elevation of 681 feet above mean sea level. The structure was constructed for NIPSCO, placed in service in 1983, and has been continuously owned and operated by NIPSCO since.

The DA accepts various CCR material that is moved to the area with heavy equipment. It is left to dry for a period of time before being removed by heavy equipment to the solid waste landfill to the east of the station.

Based on visual observations made on June 2, 2016, the overall condition of the DA is acceptable. Based on visual observations made on June 2, 2016, there were no visual conditions identified that would likely impact the basis documentation for the initial hazard potential classification assessment.



4.5 CCR Unit Visual Inspection Summary

The visual inspection of units at the site served to confirm that the assumptions and information used during the initial hazard potential classification assessment were correct and accurately reflected the current condition of the site and the surrounding environment.

The visual inspection found no anomalous findings or discrepancies that would alter the findings of the Hazard Potential Classification Assessment detailed in Section 5.

Table 2 summarizes the construction information provided to Golder by NIPSCO.

Table 2: R.M. Schahfer Generating Station – CCR Unit Summary Information

CCR Unit	Approx. Area	Approx. Low Crest Elevation (ft-amsl)	Year Put In Service	Dike Height	Basin Depth	Construction	Estimated Ash Capacity (cubic yards)	Input
	(acres)			(feet above surrounding ground)	(feet below crest)			
Waste Disposal Area	80	681	1982	17	18	Slurry Wall	1,880,000	Boiler Room Sumps, Low volume waste, Bottom ash sluice, Unit 14 economizer and SCR fly ash
Metal Cleaning Waste Basin	13.4	667	1982	4	7	Slurry wall	77,400 cubic yards	Demineralizer water and waste, air heater wash water, overflow of MSRB, and some storm water
Material Storage Runoff Basin	13.4	667	1982	4	7	Slurry wall	77,400 cubic yards	Coal storage runoff, Plant area storm drains, FGD sumps
Drying Area	5.9	681	1983	3	5	Compacted soil	Not Applicable	CCR material from various station housekeeping activities.



5. INITIAL HAZARD POTENTIAL CLASSIFICATION BREACH ANALYSIS

5.1 Hydraulic Model

Golder conducted a breach analysis of the WDA in 2011 (See Table 2 – Golder, 2011) using the Army Corps of Engineers (ACOE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) Version 4.0 computer modeling program. HEC-RAS 4.0 is a one-dimensional unsteady-state hydrodynamic river routing computer model. As part of this analysis, Golder updated the model using HEC-RAS 5.0.1 to take advantage of the programs new two-dimensional routing routines. Golder furthermore included a breach of the combined MCWB and MSRB to the model. With the DA containing mostly solid material and being smaller in size than the combined MCWB and MSRB system, a breach of the DA would result in a smaller inundation area and thus was not directly modeled.

The model and resultant inundation area was based on the LiDAR derived elevation model from the 2013 Indiana Orthophotography (RGBI), LiDAR and Elevation dataset obtained from the Indiana Spatial Data Portal <gis.iu.edu>.

5.2 Potential Breach Inundation Areas

5.2.1 WDA

Figure 2 depicts the potential area of inundation in the event of a sunny-day catastrophic failure of the WDA. Breach flows will divide following three routes. Breach flow will travel overland to the South inundating low-lying areas and homes along E 1300N, E 1275 N and E 1250 N, joining the Wolf at the Northeast corner of Wheatfield, Indiana. Flows will DAp around to the North along Davis Ditch, turning west along E 1400 N inundating low-lying areas and homes along E 1350 N, E 1400 N and IN-49. Flows will continue north following Davis Ditch ultimately joining the Kankakee River.

Within the breach inundation zone, 23 properties have been identified with buildings that may be flooded. Of these properties, 13 have residential buildings that may flood and 10 have non-residential or agricultural buildings that may flood. The residential building with the greatest potential for flooding may flood to a depth up to 2.4 feet. The non-residential or agricultural building with the greatest potential for flooding may flood to a depth up to 3.1 feet. Because of the large number of potentially impacted structures, and a peak flooding depth on a residential home being more than 2 feet, it can be concluded that a failure of the WDA will probably cause loss of human life. The WDA, therefore, meets the definition of a high hazard dam according to the CCR Rules.



5.2.2 DA, MSRB, and MCWB

The DA, MSRB, and MCWB have been determined to be Low Hazard as defined as a diked surface impoundment where a failure or mis-operation results in no probable loss of life and low economic and environmental losses.

The DA, MSRB and MCWB are all adjacent and located near the center of the NIPSCO property. The DA is generally dry storage with a low potential for catastrophic release. Any release from the DA would discharge into the ponds to the north including the MCWB.

The MSRB and MCWB are separated by a small berm and hydraulically connected by way of an opening in the berm. A failure of one, would likely result in a release of the other. With the DA located to the south and the coal storage are located to the west, the MSRB and MCWB can only release to the north or east. The north and east embankments range between 3 to 5 feet in height. Any release would discharge towards the plant facilities and be contained on NIPSCO property as shown on Figure 2. Road and railroad berms throughout the site would contain and settled ash with water flows being directed to a network of culverts and channels. Discharge, if uninterrupted, would eventually be directed to Davis Ditch and the Kankakee River. Any released solids would settle and be removed from the discharge before reaching the Kankakee River such that no environmental impacts are expected. The DA, MSRB, and the MCWB therefore, meet the definition of a low hazard dam according to the CCR Rules.



6. SUBSEQUENT CCR RULE REQUIREMENTS OF SIGNIFICANT HAZARD POTENTIAL CLASSIFICATION ASSESSMENT

For the WDA, a significant hazard potential classification assessment for existing CCR surface impoundments triggers the use of the 1000-year flood event in the inflow design flood control system and the structural stability assessment as required in 40 CFR 257.82 and 40 CFR 257.73, respectively. It also triggers an emergency action plan be developed as required in 40 CFR 257.73.

For the DA, MSRB and MCWB a low hazard potential classification assessment for existing CCR surface impoundments triggers the use of the 100-year flood event in the inflow design flood control system as required in 40 CFR 257.82.



7. CLOSING

This report has been prepared in general accordance with normally accepted civil engineering practices to fulfill the Resource Conservation and Recovery Act (RCRA) reporting requirements in accordance with 40 CFR 257.73(a)(2). Based on our review of the information provided by NIPSCO, Golder's on-site visual inspection, and the Hazard Potential Classification documentation, the WDA is a High Hazard. The Hazard Potential Classifications for the DA, MSRB, and MCWB are all Low Hazard. Golder's assessment is limited to the information provided to us by NIPSCO and to the features that could be inspected visually in a safe manner. Golder cannot attest to the condition of subsurface or submerged structures.

This report must be placed in the facility's operating record in accordance with 257.105(f) and must be made available on the facility's publicly accessible internet site in accordance with 257.107(f).

Sincerely,

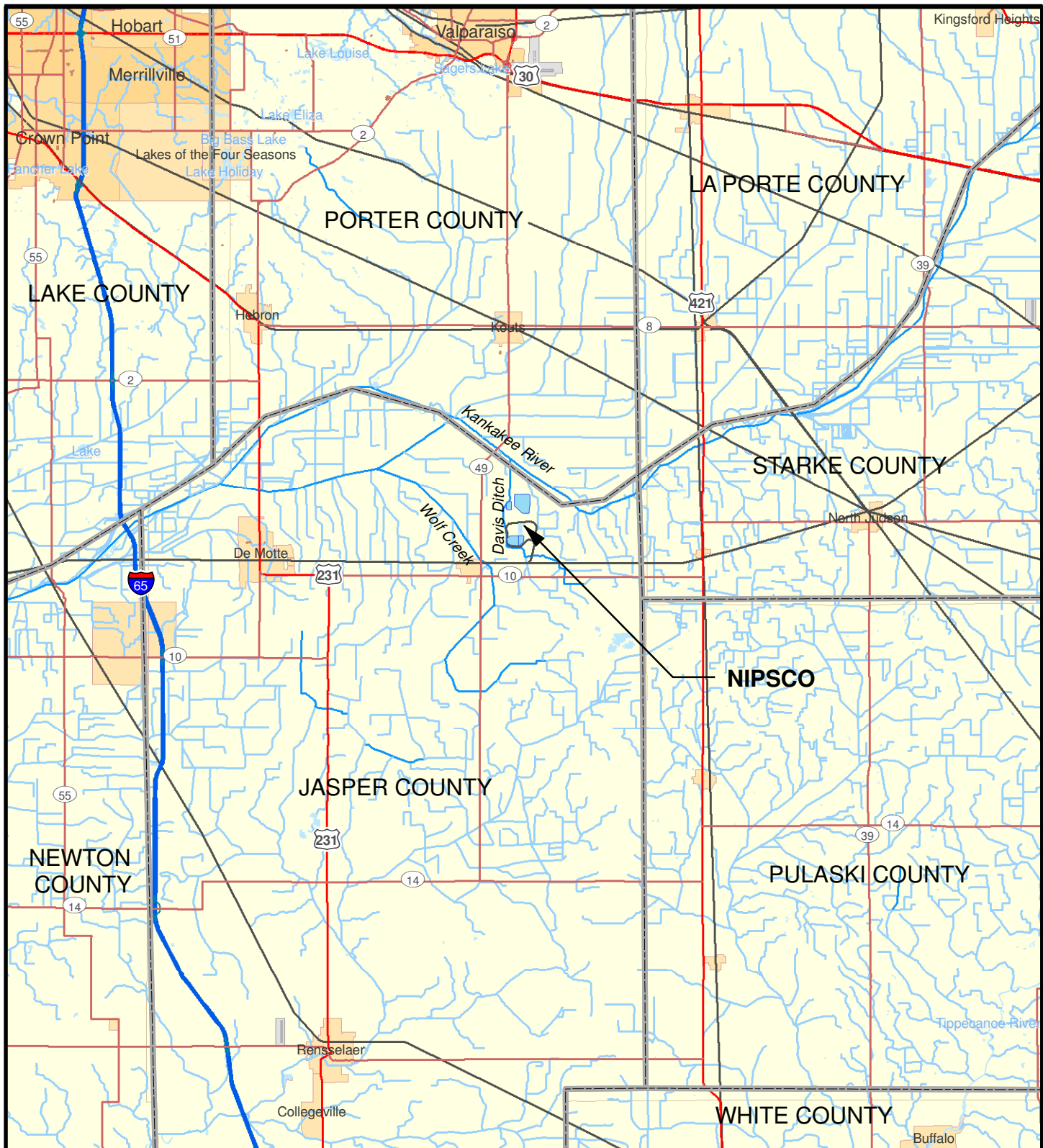
GOLDER ASSOCIATES INC.

Tiffany D. Johnson, P.E.
Senior Consultant

David M. List, P.E.
Principal

FIGURES

\\at1-s-fs1\GIS\NIPSCO\09388638_Schahler Dam Classification\PROJECTS\FIGURES\Regional_Location.mxd



REV.	DATE	DES	REVISION DESCRIPTION	GIS	CHK	RWW
PROJECT						
NIPSCO DAM BREACH STUDY						
REGIONAL LOCATION						
PROJECT No.		1651599		FILE No. Regional_Location.mxd		
DESIGN	XXX	XXX	SCALE: 1:316,800 REV. 0			
GIS	MTC	6/23/16	FIGURE 1			
CHECK	TDJ	6/23/16				
REVIEW	DML	6/23/16				

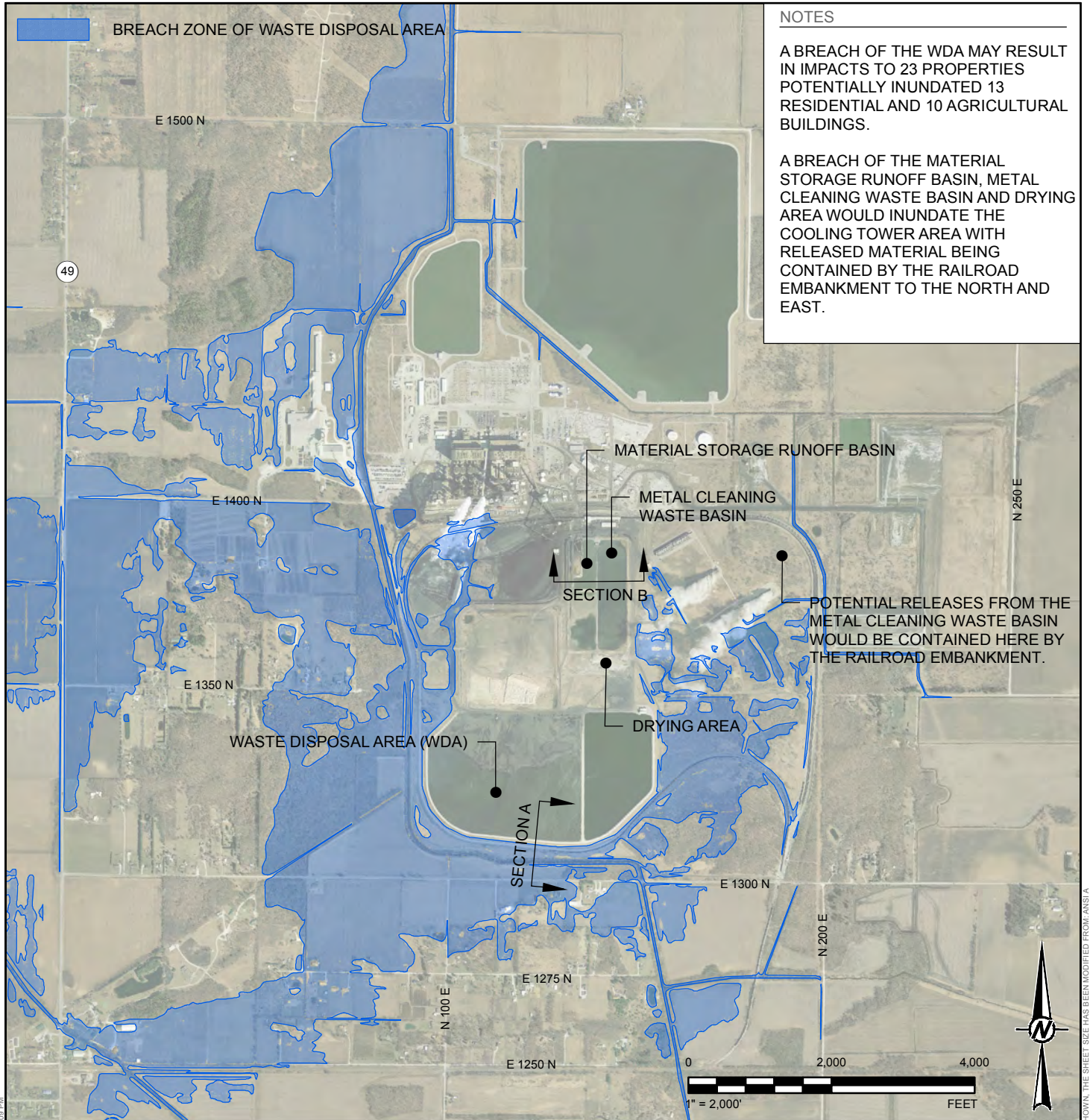


PROJECT No.	1651599	FILE No.	Regional_Location.mxd
DESIGN	XXX	XXX	SCALE: 1:316,800 REV. 0
GIS	MTC	6/23/16	FIGURE 1
CHECK	TDJ	6/23/16	
REVIEW	DML	6/23/16	

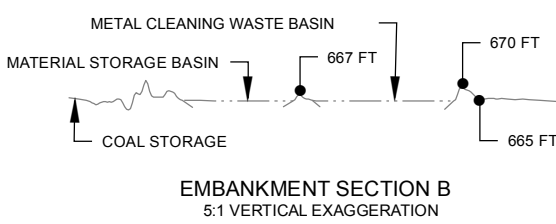
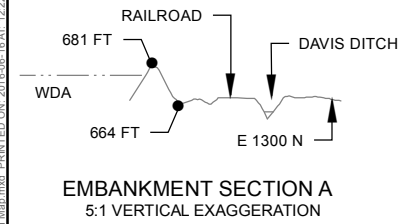
NOTES

A BREACH OF THE WDA MAY RESULT IN IMPACTS TO 23 PROPERTIES POTENTIALLY INUNDATED 13 RESIDENTIAL AND 10 AGRICULTURAL BUILDINGS.

A BREACH OF THE MATERIAL STORAGE RUNOFF BASIN, METAL CLEANING WASTE BASIN AND DRYING AREA WOULD INUNDATE THE COOLING TOWER AREA WITH RELEASED MATERIAL BEING CONTAINED BY THE RAILROAD EMBANKMENT TO THE NORTH AND EAST.



POTENTIAL RELEASES FROM THE METAL CLEANING WASTE BASIN WOULD BE CONTAINED HERE BY THE RAILROAD EMBANKMENT.



REFERENCES

ELEVATION INFORMATION IS BASED ON A GROUND SURVEY COMPLETED IN 2009 BY FALK PLI, AND 2013 LIDAR DERIVED ELEVATION MODEL ACCESSED FROM THE INDIANA SPATIAL DATA PORTAL.

CLIENT
NORTHERN INDIANA PUBLIC SERVICE COMPANY

PROJECT
CCR SURFACE IMPOUNDMENT INTEGRITY ASSESSMENT
SCHAFFER GENERATING STATION
INITIAL HAZARD CLASSIFICATION

CONSULTANT



YYYY-MM-DD 2016-06-16
DESIGNED ####
PREPARED MTC
REVIEWED TDJ
APPROVED DML

TITLE
POTENTIAL BREACH INUNDATION ZONE

PROJECT NO. 1651599 CONTROL #### REV. 0 FIGURE 2

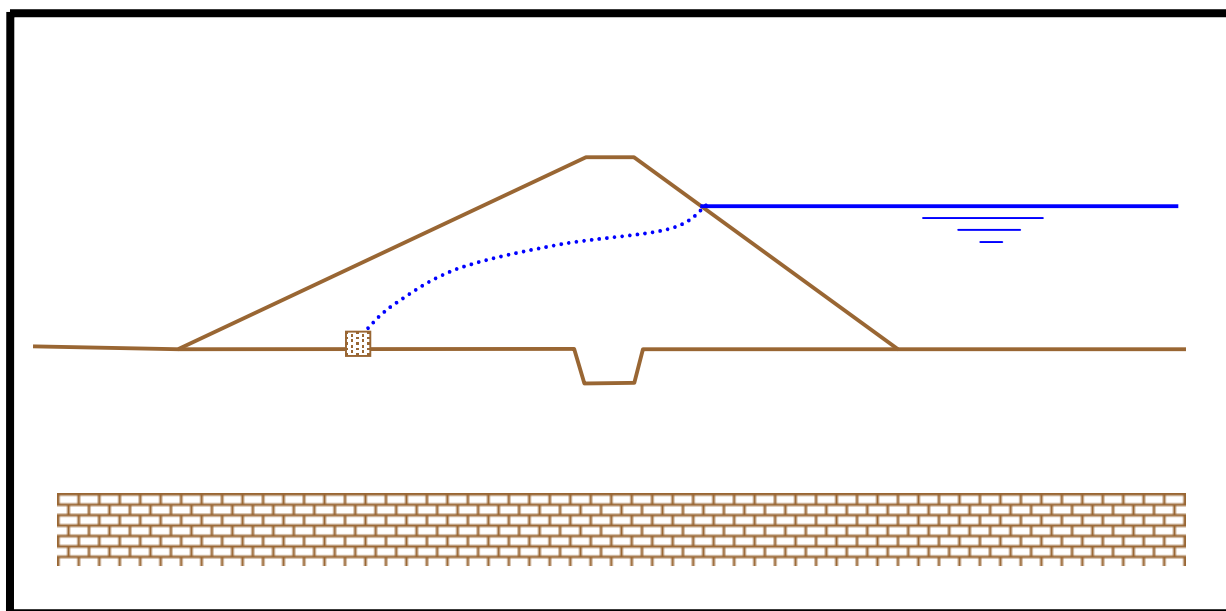
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APPENDIX A
EXCERPTS FROM GENERAL GUIDELINES FOR NEW DAMS AND IMPROVEMENTS TO
EXISTING DAMS IN INDIANA (UPDATED 2010)

GENERAL GUIDELINES FOR NEW DAMS AND IMPROVEMENTS TO EXISTING DAMS IN INDIANA

2001 Edition



Department of Natural Resources
Division of Water
Indianapolis, Indiana



GENERAL GUIDELINES FOR NEW DAMS AND IMPROVEMENTS TO EXISTING DAMS IN INDIANA

2001 Edition

Department of Natural Resources
Division of Water
Indianapolis, Indiana

2010 Appendix A, Appendix B Revisions included

of the drawdown pipe should be computed by the engineer and documented in both the Operation Plan and the Emergency Action Plan.

4.9 Spillway Materials

Proper selection and design of materials for a spillway system are as important as the capacity. Metal, concrete, riprap, geosynthetics, and high-density polymers are some of the materials available for spillway structures. The anticipated loads, required operations, expected performance, life cost, and the spillway environment should be considered in the selection of spillway materials.

Materials for pipe spillways should be selected carefully. Pipe spillways are designed for pressure flow. Corrugated metal pipe (CMP) joints are not designed to be watertight in high-pressure applications and are not recommended for use in spillway systems. Welded steel pipe is acceptable in low-head applications but cathodic protection should be provided to delay the onset of corrosion. Because of construction issues, past failures, and the lack of long-term performance documentation in spillway applications, the use of polyvinyl chloride (PVC) and high-density polyethylene (HDPE) pipes are not recommended for spillway pipes. Reinforced concrete pipe (RCP) is very durable and is typically used in pipe spillways. Bell and spigot joints with rubber o-ring gaskets provide a watertight joint in most RCP applications. The use of anti-seep collars and/or seepage control diaphragms should be included in the design and construction of conduit spillways through dams.

4.10 Hazard Evaluation and Dam Break Analyses

Properly designed, constructed, and operated dams can be expected to attenuate downstream discharges during flood events. However, failure of a dam during normal conditions or during a flood event can create a potential hazard far greater than that which existed without the dam. The consequences of dam failure should be fully evaluated and analyzed in order to properly identify and define the extent of the potential "hazard zone". The results of these analyses should be used in determining the hazard classification of the dam and developing the Emergency Action Plan procedures.

4.10.1 Dam Break Analysis Methods

The degree of study required to define the impacts of potential dam failures is site specific and will vary depending upon the type and height of dam, size of reservoir, and downstream conditions. In some cases, detailed studies referred to as, "dam break" or "dam breach" analyses, will be required to determine the anticipated downstream hazard zone.

The generally accepted procedure for dam break analysis involves application of unsteady flow and dynamic routing methods. The following computer programs apply this procedure:

- DAMBRK (National Weather Service)
- FLOODWAV (National Weather Service: combines the DAMBRK model with the DWOPER model)

The Corps of Engineers HEC-1 hydrologic model may also be used to perform a dam break analysis to determine downstream inundation areas. The HEC-1 dam break simulation assumes that the reservoir pool remains level while water is released through an incrementally changing triangular, rectangular, or trapezoidal breach in the dam. The HEC-1 model can be used with a river routing scheme to delineate downstream flood zones or in conjunction with the COE HEC-RAS or HEC-2 models to simulate steady, nonuniform flow conditions in the downstream channel and floodplain. When the COE models are used, the hydrologic methods are assumed to be appropriate for the dynamic flood wave. Under most conditions, these assumptions will be approximately true and will provide results that are sufficiently accurate for the determination of the downstream hazard zone. Appropriate care is recommended in interpreting the results of a dam break analysis based on these assumptions. If a higher order of accuracy is necessary, the National Weather Service unsteady flow models should be applied.

4.10.2 Dam Break Analysis Parameters

The accepted methods for determining dam break analysis scenarios require the user to select the dam failure parameters under a variety of failure modes. Table 2 provides typical values for these parameters. The parameters include the size, shape, and time of formation of the dam breach.

The conditions during which the simulated dam breach occurs is a critical component of the analysis. A "sunny day" breach analysis implies that the dam fails as a result of structural, geotechnical or mechanical failure, not as a result of overtopping of the dam. However, it is advisable, when performing a sunny day breach analyses, to assume (at a minimum) that the reservoir pool elevation is at the emergency spillway operating elevation. In the event that the reservoir does not have an emergency spillway or other open channel spillway outflow, the reservoir elevation should be considered to be at the minimum dam crest elevation.

Simulation of a dam break during the design storm is also advisable. This analysis should be considered in situations where there is the potential that the spillway system capacity could be significantly reduced as a result of blockage, operating failure, or some other condition. This dam break scenario assumes that the failure will occur as soon as the reservoir elevation exceeds the minimum dam crest elevation. Careful consideration should be given to the amount of inflow, the reservoir elevation at failure, and the downstream water elevation. If a recent storm event has occurred, downstream conditions may still be fully saturated or at a flood level.

When analyzing a sunny-day breach or a dam break during the design storm event, the flood storage provided by downstream dams may be considered by the engineer if these dams are approved by the state and regularly inspected. If a downstream dam is not approved by the Division of Water or if an approved downstream dam is found to overtop, the water stored by the dam is assumed to be released and included in the analysis.

Table 2: Suggested Breach Parameters for Indiana

Type of Dam	Avg. Breach Width BR (feet)	Breach Side Slope Z	Time to Failure TFH (Hours)
Arch	W	Vertical or Slope of Valley Walls	0.1
Masonry; Gravity	Monolith Width	Vertical	0.1 to 0.3
Rockfill	HD	---	---
Timber Crib	HD	Vertical	0.1
Slag; Refuse	80% of W	1.0 to 2.0	0.1 to 1.0
Earthen "non-engineered"	2HD to 5HD	0.0 to 1.0	0.1
Earthen "engineered"	0.5HD to 5HD	0.0 to 1.0	0.5 to 1.0

Definitions: BR Average Width of Breach
 HD Height of Dam
 TFH Time of Full Formation of the Breach
 W Crest Length
 Z Horizontal Component of Side Slope of Breach

4.11 Documentation

The hydrologic and hydraulic design and analysis of a dam consists of extensive technical work. The engineering report should clearly document the programs, assumptions, parameters, equations, tables, graphs, methodology, engineering judgement, results, and recommendations that were used in the evaluation process. When computer programs are used to perform hydrologic and hydraulic computations, copies of the data files should be submitted in electronic format (floppy disk or CD). The engineering report should be submitted with the permit application to facilitate the review and approval process.

Appendix A

Hazard Classification

Revised - February 2010

Rule 3 - Hazard Classification

312 IAC 10.5-3-1 Consideration of hazard classification

Authority: IC 14-27-7.5-8

Affected: IC 14-27-7.5

Sec. 1 (a) The division shall assign whether a dam is classified as:

- (1) high hazard;
- (2) significant hazard; or
- (3) low hazard;

based on best information available.

(b) In making the determination of assignment under subsection (a), the division shall apply existing U.S. Army Corps of Engineers Phase 1 reports and other appropriate documentation.

(c) The division may also consider observations of the dam and the vicinity of the dam, including the risk posed to human life and property if the dam fails.

(1) If an uncontrolled release of the structure's contents due to a failure of the structure may result in any of the following, the dam shall be considered high hazard:

- (A) The loss of human life.
- (B) Serious damage to:
 - (i) homes;
 - (ii) industrial and commercial buildings; or
 - (iii) public utilities.
- (C) Interruption of service for more than one (1) day on any of the following:
 - (i) A county road, state two-lane highway, or U.S. highway serving as the only access to a community.
 - (ii) A multilane divided state or U.S. highway, including an interstate highway.
- (D) Interruption of service for more than one (1) day on an operating railroad.
- (E) Interruption of service to an interstate or intrastate utility, power or communication line serving a town, community, or significant military and commercial facility, in which disruption of power and communication would adversely affect the economy, safety, and general well-being of the area for more than one (1) day.

(2) If an uncontrolled release of the structure's contents due to a failure of the structure may result in any of the following, the dam shall be considered significant hazard:

- (A) Damage to isolated homes.
- (B) Interruption of service for not more than one (1) day on any of the following:
 - (i) A county road, state two-lane highway, or U.S. highway serving as the only access to a community.

- (ii) A multilane divided state or U.S. highway, including an interstate highway.
- (C) Interruption of service for not more than one (1) day on an operating railroad.
- (D) Damage to important utilities where service would be interrupted for not more than one (1) day, but either of the following may occur:
 - (i) Buried lines can be exposed by erosion.
 - (ii) Towers, poles, and aboveground lines can be damaged by undermining or debris loading.

(3) If an uncontrolled release of the structure's contents due to a failure of the structure does not result in any of the items given in subdivision (1) or (2) and damage is limited to either farm buildings, agricultural land, or local roads, the dam shall be classified as low hazard.

(d) The division may modify an assignment of hazard classification, made previously under this article, if changes in the downstream development affect the potential for loss of human life and property. (Natural Resources Commission; 312 IAC 10.5-3-1; filed Jan 26, 2007, 10:45 a.m.: 20070221-IR-312060092FRA)

312 IAC 10.5-3-2 Reconsideration of hazard classification

Authority: IC 14-27-7.5-8

Affected: IC 14-27-7.5

Sec. 2 (a) This section establishes a process by which a dam owner or another affected person may request reconsideration of a determination of hazard classification made under section 1 of this rule.

(b) The dam owner or other affected person may submit any technical information or reports that were not previously available to the division.

(c) The dam owner's or other affected person's professional engineer may develop and submit a maximum breach inundation area and current damage evaluation assessing the downstream area affected by a dam breach.

(1) If the maximum breach inundation area and current damage evaluation predicts any of the following, the dam shall be classified as high hazard:

- (A) Flood depths greater than one (1) foot in any occupied quarters.
- (B) Loss of human life may occur.
- (C) Interruption of service for more than one (1) day on any of the following:
 - (i) A county road, state two-lane highway, or U.S. highway serving as the only access to a community.
 - (ii) A multilane divided state or U.S. highway, including an interstate highway.
- (D) Interruption of service for more than one (1) day on an operating railroad.
- (E) Damage to any occupied quarters where the flow velocity at the building compromises the integrity of the structure for human occupation.

- (F) Interruption of service to an interstate or intrastate, utility, power or communication line serving a town, community, or significant military and commercial facility, in which disruption of power and communication would adversely affect the economy, safety, and general well-being of the area for more than one (1) day.
- (2) If the maximum breach inundation area and current damage evaluation predicts any of the following, the dam shall be classified as significant hazard:
- (A) Interruption of service for not more than one (1) day on any of the following:
 - (i) A county road, state two-lane highway, or U.S. highway serving as the only access to a community.
 - (ii) A multilane divided state or U.S. highway, including an interstate highway.
 - (B) Interruption of service for not more than one (1) day on an operating railroad.
 - (C) Damage to any occupied quarters that would not render the structure unusable.
 - (D) Damage to important utilities where service would be interrupted for not more than one (1) day, but either of the following may occur:
 - (i) Buried lines can be exposed by erosion.
 - (ii) Towers, poles, and aboveground lines can be damaged by undermining or debris loading.
- (3) If the maximum breach inundation area and current damage evaluation results predict none of the items in subdivision (1) or (2) and damage is limited to farm buildings, agricultural land, or local roads, the dam shall be classified as low hazard.

(Natural Resources Commission; 312 IAC 10.5-3-2; filed Jan 26, 2007, 10:45 a.m.: 20070221-IR-312060092FRA)

The complete text of the IAC section should be reviewed. Up to date regulation can be found at the following URL:

<http://www.in.gov/dnr/water/>

APPENDIX B
EXCERPTS FROM FEDERAL GUIDELINES FOR DAM SAFETY: HAZARD POTENTIAL
CLASSIFICATION FOR DAMS, FEDERAL EMERGENCY MANAGEMENT AGENCY
(“FEMA”) (REPRINTED JANUARY 2004)



Federal Guidelines for Dam Safety

Hazard Potential Classification System for Dams

April 2004



FEMA

FEDERAL GUIDELINES FOR DAM SAFETY:
HAZARD POTENTIAL CLASSIFICATION
SYSTEM FOR DAMS

prepared by the
INTERAGENCY COMMITTEE ON DAM SAFETY

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
OCTOBER 1998

Reprinted January 2004

III. CLASSIFICATION SYSTEM

Three classification levels are adopted as follows: **LOW**, **SIGNIFICANT**, and **HIGH**, listed in order of increasing adverse incremental consequences. The classification levels build on each other, *i.e.*, the higher order classification levels add to the list of consequences for the lower classification levels, as noted in the table on the following page.

This hazard potential classification system should be utilized with the understanding that the failure of any dam or water-retaining structure, no matter how small, could represent a danger to downstream life and property. Whenever there is an uncontrolled release of stored water, there is the possibility of someone, regardless of how unexpected, being in its path.

A primary purpose of any classification system is to select appropriate design criteria. In other words, design criteria will become more conservative as the potential for loss of life and/or property damage increases. However, postulating every conceivable circumstance that might remotely place a person in the inundation zone whenever a failure may occur should not be the basis for determining the conservatism in dam design criteria.

This hazard potential classification system categorizes dams based on the probable loss of human life and the impacts on economic, environmental, and lifeline interests. Improbable loss of life exists where persons are only temporarily in the potential inundation area. For instance, this hazard potential classification system does not contemplate the improbable loss of life of the occasional recreational user of the river and downstream lands, passer-by, or non-overnight outdoor user of downstream lands. It should be understood that in any classification system, all possibilities cannot be defined. High usage areas of any type should be considered appropriately. Judgment and common sense must ultimately be a part of any decision on classification. Further, no allowances for evacuation or other emergency actions by the population should be considered because emergency procedures should not be a substitute for appropriate design, construction, and maintenance of dam structures.

1. 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.

2. SIGNIFICANT HAZARD POTENTIAL

Dams assigned the significant hazard potential classification are those dams where failure or mis-operation 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.

3. HIGH HAZARD POTENTIAL

Dams assigned the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life.

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)

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