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HAZARD POTENTIAL CLASSIFICATION ASSESSMENT
ASH POND 2
JOLIET 29 STATION
OCTOBER 2016

This initial hazard potential classification assessment (HPCA) addresses the requirements of §257.73(a)(2) of the Coal Combustion Residuals (CCR) regulations, Code of Federal Regulations Title 40, Part 257 for Ash Pond 2 at the Joliet 29 Station (Site) in Joliet, Illinois. The CCR regulations were published in the Federal Register on 17 April 2015 and became effective as of 19 October 2015. The Site is currently a gas-fired power station, owned and operated by Midwest Generation, LLC (Midwest Generation). The Station previously operated as a coal-fired power station through March 2016.

Ms. Jane Soule, P.E., of Geosyntec, prepared this HPCA in accordance with §257.73(a)(2). Mr. Robert White reviewed this report in accordance with Geosyntec's peer review policy.

Summary

Based on the results of the analysis provided in this report, Ash Pond 2 is classified as a significant hazard potential CCR surface impoundments because a failure would not result in probable loss of life, but could result in economic and environmental losses.

1. Regulation Requirements - §257.73(a)(2)

According to the Preamble of the CCR regulations (page 21377), "a hazard potential classification provides an indication of the potential for danger to life, development, or the environment in the event of a release of CCR from a surface impoundment." This classification is not an assessment of the likelihood of a release or failure, but rather an evaluation of the potential impacts if one were to occur. Per §257.73(a)(2), "the owner or operator must document the hazard potential of each CCR unit as either a high hazard potential CCR surface impoundment, a significant hazard potential CCR surface impoundment or a low hazard potential surface impoundment." The assessment must include certification from a qualified professional engineer stating that the initial hazard potential classification (and each subsequent periodic classification) was conducted in accordance with these requirements. Section 257.53 provides the following definitions for hazard potential classifications:

- A high hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation will probably cause loss of human life;

- A 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; and
- A low hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the surface impoundment owner's property.

Based on the definitions contained in §257.53, a demonstration that an impoundment does not qualify for either a low or high hazard potential classification results in a hazard classification of significant by default.

2. Site Plan

The Site is bounded on the north by U.S. Route 6 and on the south by the Des Plaines River. Because of geographic constraints, the watershed area for the Site is limited.

A Site Plan identifying the Pond and key Site elements, including buildings and other surface waters, is shown in Figure 1. Ash Pond 2 is east of the main powerblock building and approximately 400 feet north of the Site's intake canal which connects to the Des Plaines River. Pond 1 is located west of Ash Pond 2 and has embankment crest elevations consistent with those of Ash Pond 2 (approximately 535 feet Mean Sea Level [MSL]). A surface water collection pond is located south of Ash Pond 2. The Site slopes southward from a maximum elevation of approximately 540 feet MSL along the northern perimeter to elevations of approximately 508 to 514 feet MSL along the banks of the inlet canal to the south.

Based on site observations and a review of available construction documents, Ash Pond 2 was constructed with elevated embankments on the south, east, and west perimeters. There are no embankments on the north side of the pond where existing ground elevations generally increase to the north and a 5-foot high, non-structural berm exists between Ash Pond 2 and US route 6. Due to these topographic constraints, run-on to the Pond is generally limited to the embankment crests and access road along the north of the embankment. The Pond capacity and embankment height are shown in Table 1 below.

Table 1: Estimated Capacity and Maximum Height

Estimated Capacity	45.0 acre-feet
Estimated Maximum Embankment Height	19 feet

3. Pond Failure Impact Evaluation

In order to classify the hazard potential of the Pond, impacts of a potential failure must be evaluated. Due to the proximity of the Pond to the Site's inlet canal, which is connected to the Des Plaines River, potential failure of the southern embankment of the Pond could result in environmental losses resulting from discharge of CCR and/or CCR-laden water to a water of the United States. This potential impact excludes the Pond from a low hazard classification.

The next step in classification is to evaluate the potential for failure or mis-operation to cause loss of human life by modeling the most critical breach scenario. Figure 1 identifies the location of buildings in the vicinity of the Pond, including both occupied and unoccupied buildings[1]. Occupied buildings, including the main power block, are located approximately 300 feet to 800 feet south and west of the Pond; no occupied buildings are located east of the Pond within the potential impact area. Potential failure modes were evaluated to determine the location of a breach with the greatest potential impact on human life. Failure of the western embankment of Ash Pond 2 (directly adjacent to Pond 1) is not anticipated to instigate a failure of the Pond 1 embankments, as the embankment crests for Pond 1 and Ash Pond 2 are at similar elevations. Based on visual observation of site topographic conditions and the location of nearby buildings, a breach of the southern embankment of the Pond could result in a potential impact on human life. As such, the modeled embankment breach scenario assumes that the breach would occur in the southern embankment. Detailed modeling, discussed below, was used to assess the impact of a potential failure of the southern embankment.

3.1 Southern Embankment Failure Modeling

Breach modeling was performed for a scenario where the Pond is at full capacity prior to embankment failure and downstream depressions or other surface water collection ponds within the impact area are full and not capable of containing additional flow (flood conditions failure scenario). As discussed in Section 2, run-on to the Pond is limited and inflow is generally limited to direct precipitation. Therefore, modeling of the Probable Maximum Precipitation (PMP) or other precipitation frequency event was not performed as the inflow of the precipitation event is minimal compared to the capacity of the Pond.[2]

[1] Building identification numbers used in this report were generated for reference purposes only and may not correspond to identifications names or numbers utilized at the Site. Buildings are assumed to be occupied if there is at least one human occupant for a minimum of 12 hours per day.

[2] The total volume of direct precipitation from PMP event during the estimated duration of the failure (less than 24 minutes) is minimal compared with the volume that would be released during a failure.

HEC-HMS Version 4.1 (HEC-HMS, 2013) modeling software was used to estimate the breach hydrographs which are plots of the rate of flow over time. A FLO-2D model (FLO-2D, 2009) was then used to estimate flow depth and velocity resulting from the selected hydrograph. The results of the modeling are described below. Details of the modeling methods and procedures are provided in Geosyntec (2016).

The calculated maximum flow depth and maximum velocity from the Pond breach modeling are shown in Figures 2 and 3, respectively. The results of the FLO-2D model show that flow through the modeled breach travels from Ash Pond 2 toward the south, southeast, and southwest with a majority of the flow heading southwest. Flow from the Pond eventually reaches the inlet canal to the south. Buildings impacted by Ash Pond 2 failure include Building 8, 9, 10 (occupied) and Buildings 7, 11, and 12 (unoccupied). Table 2 below summarizes the estimated water depths and velocities for the building impacted by the Ash Pond 2 failure.

Table 2: Estimated Water Depths and Velocities near Buildings

Building	Estimated Maximum Flow Depth (feet)	Estimated Maximum Flow Velocity (fps)
Building 8 (Occupied)	1.2	1.3
Building 9 (Occupied)	1.1	1.8
Building 10 (Occupied)	0.5	1.4
Building 7 (Unoccupied)	2.1	9.1
Building 11 (Unoccupied)	1.3	2.9
Building 12 (Unoccupied)	3.2	15.3

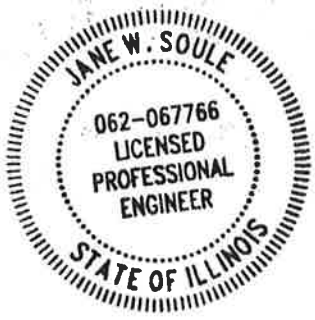
4. Hazard Classification Assessment

A CCR surface impoundment is classified as having a high hazard potential if failure or mis-operation will probably cause loss of human life. Guidelines for evaluating potential loss of life during flood conditions are provided in USBR (1988). Figure 4, adapted from USBR (1988), presents a relationship between danger to human life and flood flow depth and velocity for a house-type structure. Figure 4 presents the modeled depth-velocity combinations for the occupied buildings within the impact zone. As seen on Figure 4, the modeled results indicate that the occupied buildings are considered to be within the ‘low danger zone’ which corresponds to zero lives seriously in danger from that particular scenario (USBR, 1988).

Based on the results of the analysis provided in this report, Ash Pond 2 is classified as a significant hazard potential surface impoundment because its failure would not result in probable loss of life, but could result in impacts to the Des Plaines River, creating potential economic loss and environmental damage.

5. Limitations and Certification

This hazard potential classification assessment report was prepared to comply with §257.73(a)(2) of the Code of Federal Regulations Title 40, Part 257, Subpart D, and was prepared in accordance with current practices and the standard of care exercised by scientists and engineers performing similar tasks in the field of civil engineering. The contents of this report are based solely on the observations of the conditions observed by Geosyntec personnel and information provided to Geosyntec by Midwest Generation. Consistent with applicable professional standards of care, our opinions and recommendations were based in part on data furnished by others, which was consistent with other information that we developed in the course of our performance of the scope of services. The information contained in this report is intended for use solely by Midwest Generation and their subconsultants.



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Illinois Professional Engineer No. 062-067766
Expiration Date: 11/30/2017

6. References

FLO-2D, 2009. *FLO-2D Basic*, FLO-2D Software, Inc., Arizona 2009.

Geosyntec, 2016. Ash Pond 2 – Hazard Potential Classification Assessment Embankment Breach Analysis, Joliet 29 Station, Joliet, Illinois, October.

HEC-HMS, 2013. HEC-HMS Hydrologic Modeling System – User's Manual, Version 4.0, U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC), Davis, California, December 2013.

United States Department of the Interior, Bureau of Reclamation (USBR), 1988. Downstream Hazard Classification Guidelines, ACER Technical Memorandum No. 11.

Attachments

Figure 1 – Site Map
Figure 2 – Ash Pond 2 Flood Conditions – Maximum Flow Depth
Figure 3 – Ash Pond 2 Flood Conditions – Maximum Velocity
Figure 4 – Estimated Flood Danger Levels


Building 5
Building 4
Building 3
Building 2
Building 1
Ash Pond 2
Pond 1
Building 13
Building 7
Building 12
Building 8
Building 6
Intake Canal
Surface Water Collection Pond
Building 11
Main Powerblock Building
Building 9
Building 10
Des Plaines River
N
Legend
Buildings
Occupied
Unoccupied
0 100 200 400
Feet
Site Map
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Figure 1


Building 13
Ash Pond 2
Building 4
Building 5
Pond 1
V ≈ 9.1 fps
V ≈ 15.3 fps
Building 3
Building 7
Building 8
Building 12
V ≈ 1.3 fps
Building 2
Building 6
Intake Canal
Building 9
Surface Water Collection Pond
V ≈ 2.9 fps
Building 11
Main Powerblock Building
V ≈ 1.8 fps
Des Plaines River
V ≈ 1.4 fps
Building 1
Building 10
Legend
Computational Boundary
CCR Pond
Buildings
Occupied
Unoccupied
Calculated Maximum Flow Depth (feet)
0.0 - 1.0
1.0 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
> 5.0
0 100 200 400
Feet
Joliet 29 - Ash Pond 2
Flood Conditions - Maximum Flow Depth
Midwest Generation, LLC
Joliet, Illinois
Geosyntec consultants
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Figure 2

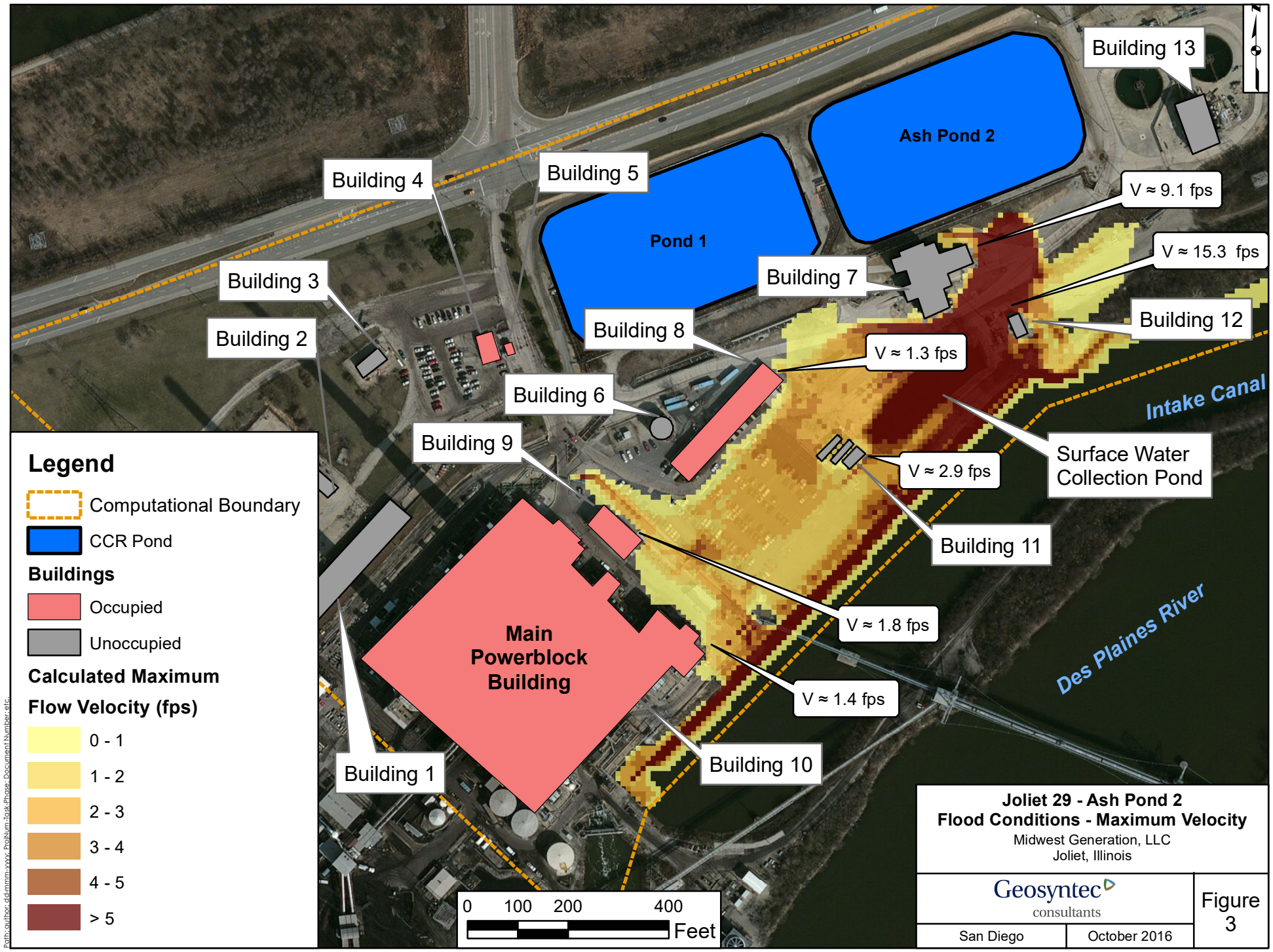
Building 13
Ash Pond 2
Building 4
Building 5
Pond 1
V ≈ 9.1 fps
V ≈ 15.3 fps
Building 3
Building 7
Building 2
Building 8
Building 12
V ≈ 1.3 fps
Building 6
Intake Canal
Building 9
Surface Water Collection Pond
V ≈ 2.9 fps
Building 11
Main Powerblock Building
V ≈ 1.8 fps
Des Plaines River
V ≈ 1.4 fps
Building 1
Building 10
Legend
Computational Boundary
CCR Pond
Buildings
Occupied
Unoccupied
Calculated Maximum Flow Velocity (fps)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
> 5
0 100 200 400
Feet
Joliet 29 - Ash Pond 2
Flood Conditions - Maximum Velocity
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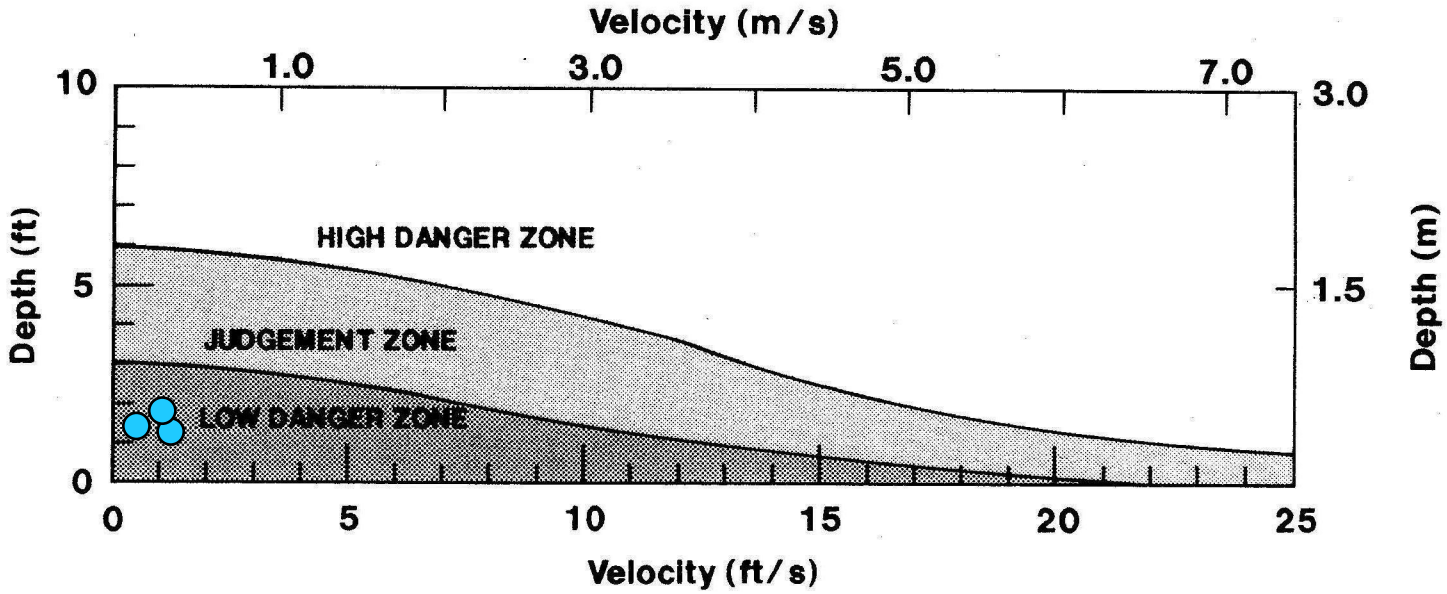
Figure 3

HIGH DANGER ZONE - Occupants of most houses are in danger from floodwater.

JUDGEMENT ZONE - Danger level is based upon engineering judgement.

LOW DANGER ZONE - Occupants of most houses are not seriously in danger from flood water.



● = Predicted maximum velocity and depth of water at occupied buildings resulting from potential failure of Ash Pond 2.

Adapted from Figure 2, USBR (1988), for houses/buildings built on foundations.

Estimated Flood Danger Levels
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Figure 4