

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT

SUBPART C – DAMS

IN520.23 Responsibility for Classification

(d) All dams built with NRCS technical and consultative assistance will be classified according to hazard. The classification will be documented in writing and filed in the case file. (See 520.23(g)).

(e) Exhibit No. 1 summarizes the relationship between hazard classification, damage to properties and loss of life.

(f) Exhibit No. 2 gives general definitions of properties and damage useful in evaluating hazards. These definitions particular site conditions and damage potential. For example, a county road with a gravel surface may be the only access to homes or communities. Under these conditions, it may be considered a main highway. A bridge on a county road or railroad that would sustain severe damage from dam failure should result in upgrading the dam hazard classification. Normally loss of life is associated with people being trapped in temporary or permanent residences. However, the potential for loss of life should be considered when schools, churches, commercial establishments, recreational areas, roads, and railroads are involved. The ability to warn people of a dam failure and remove them from the hazard should strongly influence the hazard classification.

(g) Form IN-ENG-44 (Exhibit No. 3) or Form IN-ENG-44A (Exhibit No. 4) shall be used to document the dam hazard classification. Form IN-ENG-44A may only be used for class 'a' dams with a drainage area less than 30 acres, a principal spillway less than 12 inches diameter, a total dam height less than 20 feet and a storage to top of dam less than 50 acre feet. If any of these parameters are exceeded, Form IN-ENG-44 shall be used. Supplemental information shall be attached to IN-ENG-44 to support the hazard classification determined, such as topo maps, dam breach routing, flood hazard maps, etc.

(h) Technical Release No. 66, Simplified Dam-Breach Routing Procedure, provides a tool for predicting flood stages downstream from a dam breach. An alternative to the use of TR-66 is the National Weather Service procedure for dam-breach routing. Dam breach routing should be used to determine hazard class, whenever any question concerning the hazard class of a dam needs to be resolved.

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT

EXHIBIT NO. 1
 POTENTIAL HAZARDS FOR DAM
 CLASSIFICATION – NEM 520.20 & TR-60

SUMMARY

DAMAGE TO	HAZARD CLASSIFICATION		
	a	b	c
LOCATION	Rural or Agricultural	Predominantly Rural or Agricultural	Developing or Urban
ROADS			
Township & County	May Damage		
Main Highways	No Damage	May Damage	Serious Damage
RAILROADS			
Minor	No Damage	May Damage	Serious Damage
Main			Serious Damage
BUILDINGS			
Farm	May Damage		
Homes	No Damage	May Damage	Serious Damage
Industrial	No Damage		Serious Damage
Commercial			Serious Damage
Public			Serious Damage
UTILITIES			
Relatively Important (local)	No Damage or Interruption	May Cause Interruption	
Important (Regional)	No Damage or Interruption	No Damage	Serious Damage
LOSS OF LIFE	NO	NO	YES

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT

EXHIBIT NO. 2
 POTENTIAL HAZARDS FOR DAM
 CLASSIFICATION – NEM 520.20 & TR-60

HAZARD CLASSIFICATION

DAMAGE TO	a	b	c
LOCATION	Rural or agricultural areas of mostly farming. Urban housing developments do not exist and none expected during structure design life. Agricultural land – used for agricultural production. Wildlife on forest land used for timber production on native animal habitat.	Predominantly Rural or Agricultural	Developing or Urban
ROADS			
<u>County roads</u> State Roads – 2 lane, narrow right-of-way with alternate routes available if closed.	May Damage Damage may occur when road surface acts as weir and depth of flow greater than 2 feet over road.		
<u>Main highways</u> U.S., Interstate, and turnpike highways, and any concrete or bituminous or state road that serves as the only access to a community.	No Damage	May damage Damage may occur when road surface acts as weir and depth of flow greater than 2 feet over road.	Serious damage Interruption of service for more than 1 day.
RAILROADS			
<u>Minor</u> Intrastate railroads when used as frequently as 1 time per day. Materials carried are relatively nonperishable, agricultural products, or products if disrupted would not adversely affect local economy, safety, or general well-being of area.	No damage	May damage Damage may occur when road surface acts as weir and depth of flow greater than 2 feet over railroad.	

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT

EXHIBIT NO. 2 (cont.)
 POTENTIAL HAZARDS FOR DAM
 CLASSIFICATION – NEM 520.20 & TR-60

DAMAGE TO	HAZARD CLASSIFICATION		
	a	b	c
RAILROADS (Cont'd)			
<u>Main</u>			
Intrastate or interstate railroads used more frequently than 1 time per day. disruption would adversely affect economy, safety, and general well-being of area.	No damage	May damage Damage may occur when road surface acts as weir and depth of flow greater than 2 feet over railroad.	Serious damage Interruption of service for more than 1 day.
<u>Abandoned</u>			
Right-of-way with tracks, no longer in service. Caution-change in service may change hazard class	May damage Damage due to overtopping greater than 2 feet and breach of fills less than 10 feet.	Serious Damage Damage to important structural works such as bridges, trestles, culverts or complete breach of high fills.	Serious damage
BUILDINGS			
<u>Farm</u>			
Farm Buildings - On Farm buildings not occupied by people or having potential for occupancy.	May damage Damage will usually occur when the product of velocity f.p.s. at building, times the depth of flow in feet at the building exceeds a value of 15.		
<u>Homes</u>			
Single family residences, apartments, nursing homes, motels, hotels, and hospitals.	No damage	May damage Any flooding above ground floor level.	Serious damage Damage will usually Occur when product of velocity f.p.s. at the building times the depth of flow in feet at the building exceeds a value of 15.

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT

EXHIBIT NO. 2 (cont.)
 POTENTIAL HAZARDS FOR DAM
 CLASSIFICATION – NEM 520.20 & TR-60

HAZARD CLASSIFICATION

DAMAGE TO	a	b	c
<p><u>Isolated</u> Single family dwellings on farms and ranches. Does not include homes in developing areas.</p>	<p>No damage</p>	<p>May damage Any flooding above ground floor level.</p>	<p>Serious damage Damage will usually occur when product of velocity f.p.s. at building, times the depth of flow in feet at the building exceeds a value of 15.</p>
<p>Industrial/Commercial</p>	<p>No Damage</p>	<p>May damage Kind, construction, and contents of building must be evaluated. General damage may occur at any depth of flooding.</p>	<p>Serious damage Kind, construction, and contents of building must be evaluated. General damage may occur at a depth of 3 feet or more and at a velocity of 4 f.p.s. or more.</p>
<p>Public Schools, churches libraries, etc.</p>	<p>No damage</p>	<p>May damage Kind, construction, and contents of building must be evaluated. General damage may occur at any depth of flooding.</p>	<p>Serious damage Kind, construction, and contents of building must be evaluated. General damage may occur at a depth of 3 feet or more and at a velocity of 4 f.p.s. or more.</p>
<p>UTILITIES Relatively important</p>	<p>No damage</p>	<p>May damage Damage may occur when buried lines can be exposed by erosion and when towers, poles, and above ground lines can be damaged by undermining or by debris produced from the flood plain.</p>	

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT

EXHIBIT NO. 2 (cont.)
 POTENTIAL HAZARDS FOR DAM
 CLASSIFICATION – NEM 520.20 & TR-60

DAMAGE TO	HAZARD CLASSIFICATION		
	a	b	c
Important Interstate and intrastate power and communication lines serving towns, communities, and significant military and commercial facilities in which disruption of power and communication would adversely affect the economy, safety, and general well-being of the area.			Serious damage - Interruption of service for more than 1 day.
LOSS OF LIFE Potential for loss of life - flood depths greater than 1 foot in living quarters; such as residences, apartments, nursing homes, motels, hotels, and hospitals, and no escape routes from such living quarters. Potential of loss of life should be considered for schools and recreational areas where adequate warning systems are not available.	NO	NO	YES

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT
EXHIBIT NO.3

U.S. Department of Agriculture
Natural Resources Conservation Service

IN-ENG-44
12/99
File Code 210-28

DETERMINATION OF DAM HAZARD CLASSIFICATION

Location: Latitude _____ Longitude _____
_____ 1/4, _____ 1/4, Section _____, T _____, R _____, _____ County, Indiana
Nearest downstream town is _____ (Population _____) _____ miles from dam

NRCS Program
() CO-01 () Pilot () RC&D () Other (specify) _____
() WF-03 () PL-566 Watershed _____

Landowner (or Site) _____

Purposed (more than one may be checked)
() flood prevention () recreation () irrigation () grade stabilization
() debris control () hydro power () M&I () fish & wildlife
() livestock () other _____

Is dam in series? Yes _____ No _____
If yes, identify other structures and explain _____

Site Information:

Drainage area:

Controlled _____ acres _____ sq. mi.
Uncontrolled _____ acres _____ sq. mi.
Total _____ acres _____ sq. mi.

Type of Dam	Principal Spillway	Emergency Spillway
() earth	() concrete pipe	() none
() gravity	() CMP	() vegetated
() rockfill	() concrete box	() earth
() other	() open concrete	() rock
	() other	() structural
		() other

<u>Dam and Reservoir Data:</u>	<u>Elevation</u>	<u>Area</u>	<u>Total Storage</u>
Top of dam	_____	_____ acres	_____ ac. ft.
Emergency spillway crest	_____	_____ acres	_____ ac. ft.
Normal pool	_____	_____ acres	_____ ac. ft.
Channel bottom elevation under centerline of fill.	_____		
Floodplain elevation at toe of fill	_____		
Channel outlet elevation at toe of fill	_____		
Depth of normal pool at upstream toe of dam	_____ feet		
Effective height of dam (TR60 definition)	_____ feet		
Total height of dam (top of fill to channel outlet)	_____ feet		

Storage Capacity			
sediment	_____ ac. ft.	flood storage	_____ ac. ft.
other beneficial	_____ ac. ft.	surcharge	_____ ac. ft.
		total	_____ ac. ft.

Is there a drawdown pipe? Yes _____ No _____
If yes, what is the lowest elevation pool can be drawn down to? _____

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT
EXHIBIT NO.3 (cont.)

Downstream Conditions: (Use supplemental sheets as necessary)

1. Valley Conditions -
Convergent _____ Divergent _____ Parallel _____ Slope _____ %
Describe _____

2. Stream channel dimensions -
Bottom width _____ feet; Depth _____ feet; Side Slopes _____
3. Roughness or Retardance - Estimated "n" or description of cover -
Valley: _____
Channel: _____
4. Buildings & Utilities:
Describe kind, distance downstream and height above stream channel bank.

5. Transportation Facilities:
 - a. Roads & Railroads
Describe kind, distance downstream of dam and height above stream channel bank to low point of road approaches.

 - b. Bridges -
Describe kind, area of opening (s) and distance from stream channel bank to deck.

6. Potential for Downstream Development:

Hazard Class Assigned: _____
Rationale: _____

Attachments: () breach routings () map(s) () cross sections
() other (identify) _____

Hazard Analysis by _____ Date _____
Name Title

Approved by _____ Date _____
(Classes I to V) Name Title

Approved by _____ Date _____
(Class VI to VIII) Name Title

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT
EXHIBIT NO.4

U.S. Department of Agriculture
Natural Resources Conservation Service

IN-ENG-44a
12/99
File Code 210-28

DOCUMENTATION OF DAM HAZARD CLASSIFICATION
Class "a" Dams Only

Landowner: _____

Location: _____ ¼ _____ ¼ of Section _____ Township _____ Range _____

Tract Number _____ County _____

Description:

Type of Fill: () Earth () Other – specify _____

Drainage area (less than 30 acres): _____ acres

Principal spillway diameter (less than 12"): _____ inches

Total height (less than 20 feet): _____ feet

Total storage to top of dam (less than 50 acre-feet): _____ acre-feet

Estimate Pool Volume:

$\frac{1}{2} \times (\text{fill height}) \times (\text{pond area})$

$0.5 \times (\text{_____}) \times (\text{_____}) = \text{_____ acre-feet}$

In series? () Yes () No If yes, identify other structure and explain:

Downstream Valley: () Convergent () Divergent () Parallel

Slope: _____ % Width: _____ feet

Land Use: _____

Existing Downstream Development: _____

Potential Downstream Development: _____

Notes: _____

HAZARD CLASS ASSIGNED () If not "a", use IN-ENG-44

Analysis by: _____ Date: _____

Concurred: _____ Date: _____

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT
SUBPART C - DAMS

IN-520.24 Special Considerations.

(c) Additional minimum special design considerations for earth fills in Indiana are shown in Exhibit No. 5.

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT
SUBPART C – DAMS

EXHIBIT NO. 5

ADDITIONAL MINIMUM SPECIAL CONSIDERATIONS
FOR THE DESIGN OF EARTH FILLS IN INDIANA

A. Unless specifically required for other purposes, the following additional minimum criteria shall apply to all earth fills designed in Indiana to which the requirements of Technical Release 60 apply:

1. SIDE SLOPES - 2 ½ horizontal to 1 vertical

2. BERMS:

a. Upstream

- (1) Single-purpose dams for flood prevention – one 10-foot wide berm at permanent (sediment) pool elevation. If there is more than 30-foot difference in elevation between permanent pool and constructed top of fill, additional 10-foot wide berms will be used at a maximum of 25-foot vertical intervals above the permanent pool elevation.
- (2) Multiple-purpose dams for flood prevention and recreation-one 10-foot wide berm 5 feet below permanent (normal or recreation) pool elevation. A 2-foot thick blanket of riprap, or other equivalent protection, will be placed on the fill from this berm to an elevation approximately 5 feet above the pool elevation.
- (3) Multiple purpose dams, including M&I water, one 10-foot berm at the sediment pool elevation. A 2-foot thick blanket of riprap, or other equivalent protection will be placed from there to approximately 5feet above normal pool level (top of M&I water storage elevation).

b. Downstream

- (1) One 10-foot wide berm at approximately the valley floor elevation (channel bank elevation to 5 feet above).
- (2) Additional 10-foot wide berms at a maximum of 25 foot vertical intervals to the top of the dam.

3. DRAINAGE

A foundation drain will be provided on all fills; except that the drain can be omitted if a zoned fill of sandy material is provided in downstream third of fill.

Location - approximately $c/b = 0.6$. But at or below, the contact line between foundation and fill.

Size - 3.5' x 3.5', minimum with collector and outlet pipes if required. A larger drain will be used if determined needed based on soils and amount of water to be moved.

Material - graded filter in accordance with Chapter 26 of the NEH, Part 633.

Extent - across valley and up abutments to an elevation two-thirds of the vertical distance above the normal or permanent pool elevation to the emergency spillway crest.

PART IN-520 SOIL AND WATER RESOURCE DEVELOPMENT
SUBPART C – DAMS

EXHIBIT NO. 5 (cont.)

4. COMPACTION - 90% of Standard Proctor Density

NOTE:

If a safe structure cannot be achieved with the above minimum criteria, the changes listed below should be made in the sequence listed.

- a. Increase compaction to 95% of Standard Proctor Density
- b. Flatten upstream sideslopes to 3:1
 - (1) Using 90% of Standard Proctor Density
 - (2) Using 95% of Standard Proctor Density
- c. Flatten downstream sideslopes to 3:1
 - (1) Using 90% of Standard Proctor Density
 - (2) Using 95% of Standard Proctor Density
- d. Strip foundation of weak material
 - (1) Using 2 1/2:1 fill sideslopes
 - (2) Using 3:1 fill sideslopes
- e. Widen Berms
 - (1) Using 2 1/2:1 fill sideslopes
 - (2) Using 3:1 fill sideslopes
- f. Use additional berms - 10-foot width minimum
- g. Flatten side slopes
- h. Increase compaction to 100% of Standard Proctor Density

This list is in no way to be considered as a restriction on the engineer from designing the most economical safe structure for the site. Particularly in the use of items d. through h. above, the net total cost of the structure will control which method, or combination of methods, should be used. The state engineering staff should be consulted for assistance in making the final design.

- B. The safety and stability of an earth dam can be greatly affected by earthquake activity. Studies indicate that hazards from earthquake activity should be treated independently of other hazards. Minimum requirements to protect dams against-earthquake activities are found in TSC Technical Note EN-LI-20 entitled "Guide to Earthquake Considerations for Earth Dams in the Midwest States." Based on past recorded earthquake intensities and distances from epicenter, all areas in Indiana have been divided into seismic zones, which are shown on the map in the appendix to EN LI-20 and in TR-60.