SWM MD-378 Pond Checklist Training 10/17/07

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ROLES AND RESPONSIBILITIES Small Pond Approval

- MDE, WMA, Dam Safety Division
  Authority (COMAR 26.17.04.03)
- Soil Conservation Districts
  Delegated Authority (COMAR 26.17.04.05 G)
- NRCS
- Others such as County Governments and Cities

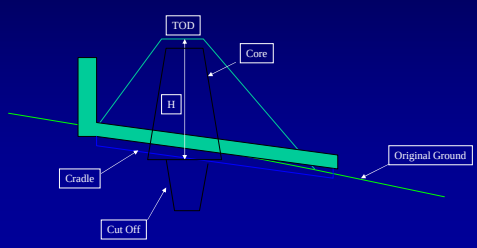
Exemptions

- Exemption is only for District Small Pond Approval
- Intent
- NO Urban pond or Rural pond is exempted from MD-378.
  - Excavated or embankment

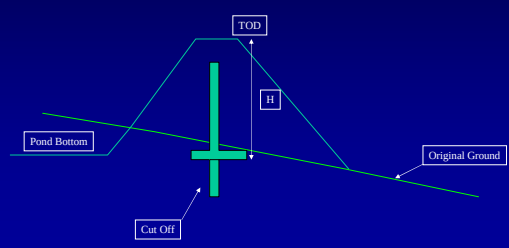
EMBANKMENT HEIGHT

- Measured from the Top Of Dam (TOD) to lowest point of excavation along the centerline of the dam, excluding the cut off trench.

Height of Dam Riser and Barrel



Height of Dam Weir Wall



SMALL POND APPROVAL MAY BE EXEMPTED FOR CLASS "A" PONDS WHERE:

- The embankment height is less than *4* feet

OR

- Storage at ES Crest or DHW (if no ES) is less than or equal to 40,000 ft^3

AND

- the embankment height is 6' or less

OR

EXEMPTION

- L = 10H + 20; where H = TOD - PB
- Horizontal projection L, DS from the pond bottom, is below ground,

AND

- DS slope (within projection L) is less than or equal to 10 % at any point.

CHECKLIST

- Minimum submittal requirements
  - Included in the plans and design
  - To recommend District small pond approval

Hydrology

- Drainage Area Map
  - Show TR-55 T_c path (Post Dev)
  - Indicate Flow Regimes
    - Sheet, Shallow Concentrated, Open Channel
    - Distance, Slope, Velocity as required

Hydrology/Hydraulics

- Routing Program
  - Show complete input and output data
    - Where routing started from
    - Tc used (Post Dev)
    - RCN (Post)
    - DA
    - Stage/Storage/Discharge Table
    - RF and duration
    - 10 and 100 Yr WSEL (Summary Table)

Computations

- MD 14 Pond Summary Sheet
  - District submits to MDE
  - Pick up from Cons District Office

Computations
Riser Floatation

- Buoyant Force
  - Outside dimensions of the riser plus the base
- Weight of the structure minus openings
- S.F. > or = 1.2

Computations
Collar Design

- Increase saturated flow length by 15% (4:1 phreatic line)
- Measure projection from the outside of the pipe
  - Concrete Pipe from cradle
- Min projection is 2'
- > 2' from a joint
- Min spacing – 5X min projection
- Max spacing – 14X min projection

Computations
Filter Diaphragms

- NRCS TR-60, Earthen Dams and Reservoirs
- 3ft thick
- 3X Pipe OD or Cradle
- 2 ft below
- C-33 Sand

Computations – Weir Details

- Notched weir with top of wall at 100 year WSEL or higher
- Show all dimensions
- Show steel requirements
- Overturning comps
- Cutoff
  - To the bottom of the cutoff trench
- Footer on in-situ soils

Computations
Pre-Cast Risers

- Provide Shop Drawings on the plans sealed by a P.E.
- Include dimensions and steel requirements
- Include joint requirements if there will be differential backfill

Computations
Pre-Cast Risers

- Joint requirements
  - Watertight joints
    - Butyl rubber with non-shrink grout
- Differential backfill
  - Joint fasteners with computations

DAM BREACH ANALYSIS HAZARD CLASS JUSTIFICATION

Hazard Class Justification

- Class “a” - Structures located in rural, agricultural or urban areas dedicated to remain in flood tolerant usage where failure may damage non-inhabited buildings, agricultural land, floodplains or county roads.

Hazard Class Justification

- Class “b” - Structures located in rural, agricultural, or urban areas **where failure may damage isolated homes**, main highways or minor railroads or cause interruption of use or service of relatively important public utilities.

(If breach water can enter the this may be considered damage.)

Supporting Documentation

Dam Breach Analysis which includes

- Q_{max} discharge (Sunny Day).
- Description of Dam.
- Description of all roads, structures and utilities down stream of pond.
- Map showing pond, downstream structures, cross section locations and proposed breach wave.
- All appropriate, routing, computations and supporting cross sections.
- Conclusion.

Dam Failure Methods for Small Dams

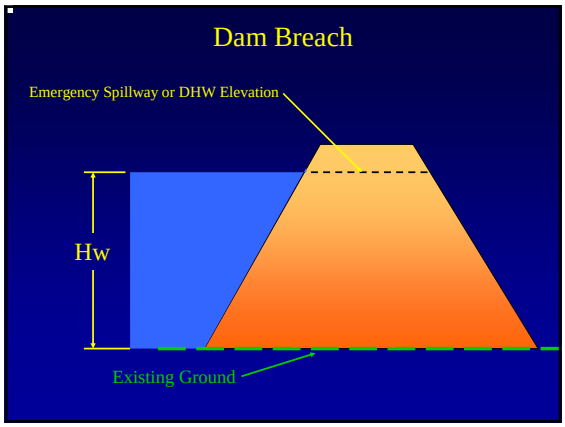
- Use Breach Equation to determine Breach Flows
- Determine Downstream Flood Depths
  - Simple approach, Manning’s formula with downstream cross sections
  - HECRAS Model
- Stop Danger Reach when hazard no longer exists

Dam Breach

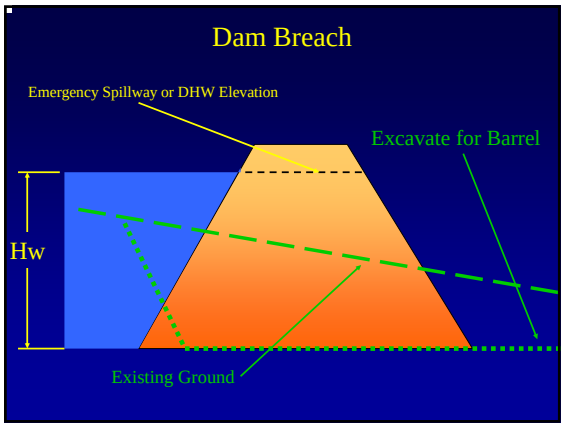
The minimum peak discharge is as follows:

- $\mathbf{Q_{max} = 3.2\ H_w^{2.5}}$ where,
- Q_{max} = the peak breach discharge, (cfs).
- H_w = depth of water at the dam at the time of failure, (feet). This is measured to the crest of the emergency spillway or to design high water, if no emergency spillway exists.

Dam Breach



Dam Breach



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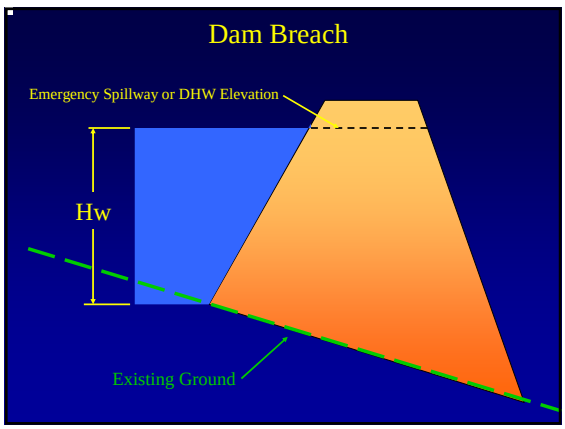
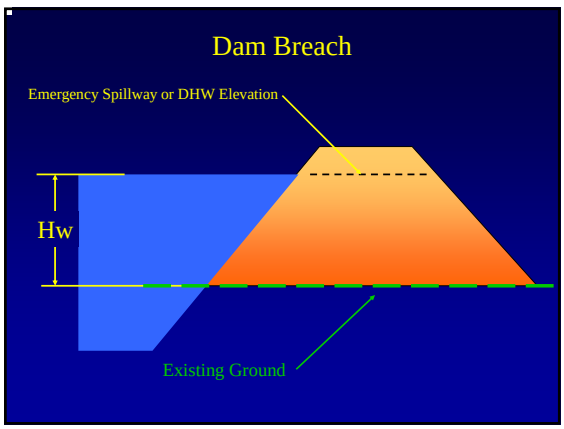


Dam Breach



Dam Breach

Where breach analysis has indicated that only overtopping of downstream roads will occur, the following guidelines will be used:

Class	Depth of Flow (d) ft.
"a"	$d \leq 1.5$
"b" & "c"	$d > 1.5$

importance of the roadway shall be considered when making a classification.

Dam Breach – How far downstream should the analysis be taken

- To a point where there are no structures present downstream of the pond.
- The breach wave enters a flood prone area where no structures are present.
- The total volume of proposed breach is stored within the downstream valley, another storage structure or by a roadway fill.

Example Dam Breach Analysis

DAM BREACH ANALYSIS

Embankment Facing Office Building

The embankment facing the office building is almost completely in cut. Louis Diequez at Anne Arundel Soil Conservation District stated that as a rule of thumb an embankment can be classified as excavated if the width of the embankment is ten times the height plus 20 feet. The height is measured from the pond bottom to the 100 year storm elevation. Using this criteria, the embankment facing the office building can be considered excavated and not a danger to breach. See cross-section BB. Soil borings in the area show that the soils are a classification of 'CL'. This soil type is specified in Md. 378 as acceptable material to construct the impervious core and core trench. Since the soils are of good quality for an embankment and because the pond can be considered as excavated in this area, a dam breach is highly improbable and not considered a danger.

Breach Towards Residential Area

The embankment facing the residential community is in the vicinity of the access drive to the bottom of the facility. Therefore, the width of the embankment is very large at the bottom and easily falls within the criteria for an excavated pond. However, a breach may occur towards the top of the embankment so an analysis was performed considering the bottom of the embankment to be at a point were the slope becomes less than 3:1 (see section AA). The following is an analysis assuming a breach under the above mentioned conditions:

Breach discharge = 3.2(Hw)^2.5

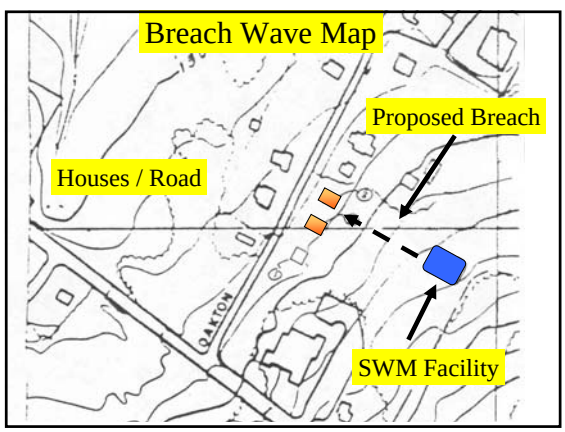
Hw = Design high water (100 yr. clogged elevation) - slope decrease = 195.3 - 192.0 = 3.3'

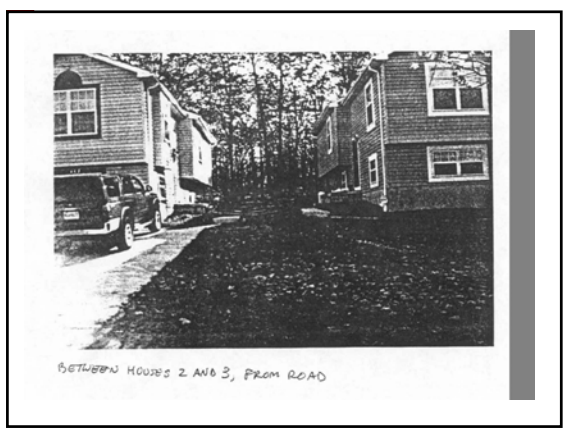
Q = 3.2(3.3)^2.5 = 63.3 cfs

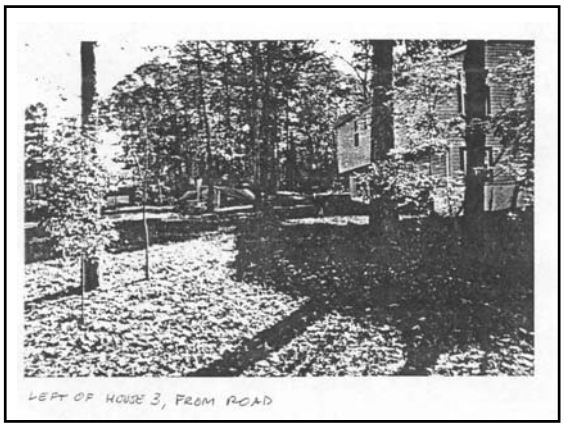
A dam breach towards the residential area would be minimal in affect. The breach discharge would spread out and flow between the various existing houses. The worst case scenario would be if all of the flow were to flow between two houses set closely together. A field inspection revealed that swales are graded between the existing houses. See photographs and Figure 2. An analysis using Flowmaster was performed to model the effects of 63 cfs flowing between two houses. The result would be a depth of flow about 3 to 4 tenths of a foot deep.

Conclusion

The pond embankment can be considered excavated for much of its length and therefore not a danger to breach. A limited breach could occur towards the residential area. In this case, the depth of flow would only be around 3 to 4 tenths of a foot deep. This depth of flow would cause little property damage and would pose no threat to lose of life. This facility can be safely classified as a type 'A' hazard.







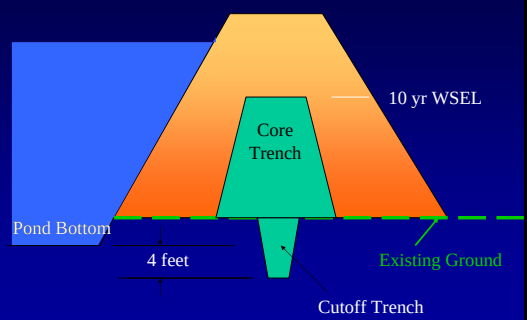
Soils Exploration Report

- Required
- Address Geotechs recommendations in the design
- Show borings on plan view
  - CL, ES, Borrow area
- Show soil logs in report
  - Unified Classification

Cutoff and Core Trench

- Cutoff extends 4' below pond bottom
  - unless specifically addressed by a geotech in the report
- Core trench to 10 year WSEL
- 1:1 SS with minimum 4' top/bottom
- CL, CH, SC, GC
- Where does fill come from

Cutoff and Core Trench



Embankment

- Top Width (Table 2 based on H)
- SS (total of 5:1)
- Must show profile of dam
- Must show XS through PS
- Settlement (min 5%)
- Freeboard Requirements

Embankment

- Freeboard Requirements
  - Dependent on H and DA (Table 1)
  - Typical Requirements for DA < 100 acres
    - 1' above ES DHW (100 yr)
    - 2 feet between Crest of ES and TOD
    - No ES, 2' above 100 yr WSEL
      - Min pipe diameter = 2ft
      - Requires Emergency Routing

Principle Spillway

- Must show profile
- Inlet is 1' below ES Crest
- Stable outlet to OUTLET CHANNEL
- Tables 3, 4, and 5 MD-378
  - Min gage and corrugations for metal pipe and requirements for plastic pipe

Principle Spillway Tables 3, 4, & 5

- CORRUGATED STEEL PIPE
  - 2 - 2/3 inches x 1/2 inch Corrugations
- CORRUGATED STEEL PIPE
  - 3 inches x 1 inch or 5 inch x 1 inch Corrugations
- CORRUGATED ALUMINUM PIPE
  - 2 - 2/3 inches x 1/2 inch Corrugations
- CORRUGATED ALUMINUM PIPE
  - 3 inches x 1 inch Corrugations

Principle Spillway

- Circular Cross Section
- Water Tight Joints
- Deflection Requirements (5%)
  - Modified Spangler Equation

Modified Spangler Equation

- Assumptions
  - Maximum deflection of the pipe = 5 percent
  - Deflection Lag Factor = 1.5
  - Weight of soil cover = 120 pcf
  - Bedding Constant = 0.10

Modified Spangler Equation

- h = [EI/(12) 2.5R3] + 0.0244E'
- Where:
  - h = Maximum permissible fill height measured from the top of the pipe
  - E = Pipe material modulus of elasticity
  - I = Moment of inertia for the pipe wall (in^4 / in)
  - R = Radius of pipe (in)
  - E' = Modulus of soil reaction of embedment material (Maryland will use 200 psi with less than 85% compaction typical for fine-grained soils compacted around pipe conduits.)

Trash Racks (WJ)

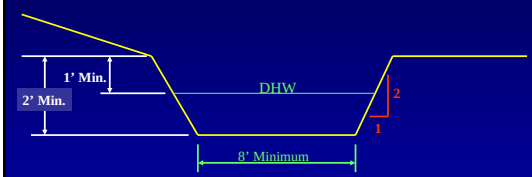
- NO flush trash racks
- Min openings > 6" but < ½ barrel diameter
- Not required on low flows < or = 6"
- Emergency Routing for low flows 6" or less.

EMERGENCY SPILLWAYS

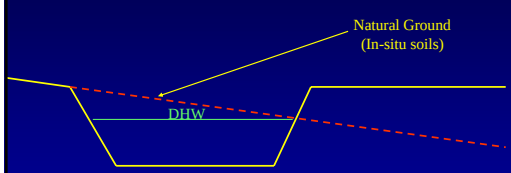
Emergency Spillways

- Earth spillways shall be trapezoidal and shall be located in undisturbed earth..
- The only design that may be utilized without an emergency spillway is: a principal spillway with a cross-sectional area of 3 square feet with a non clog trash rack and large enough to pass the required storm discharge.
- The minimum capacity of emergency spillways shall be as shown in Table 1

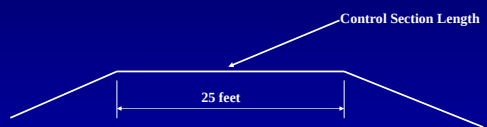
Emergency Spillway Minimum Dimensions Cross Sectional

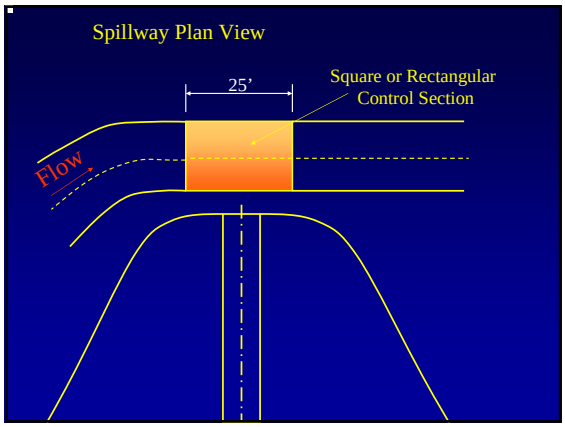


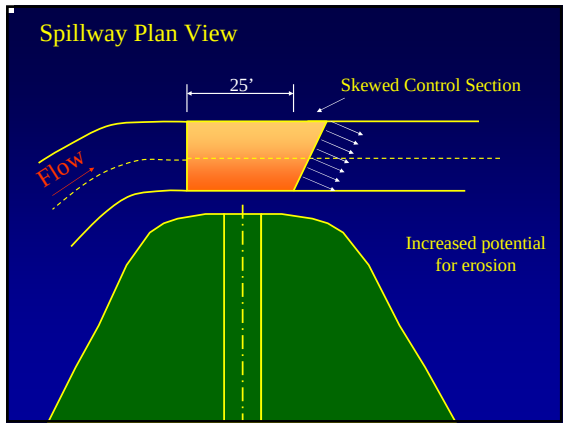
Design High Water With Natural Ground

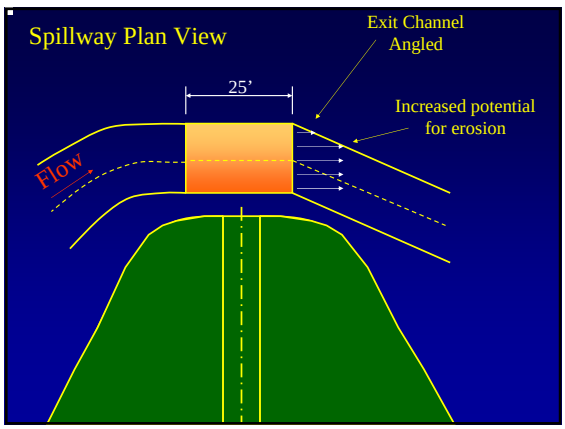


Emergency Spillway Minimum Dimensions Profile









Permissible Velocities

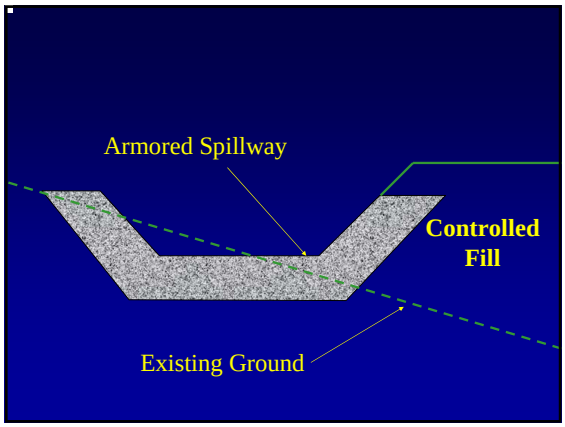
- Turf Reinforcement
- Rock armoring

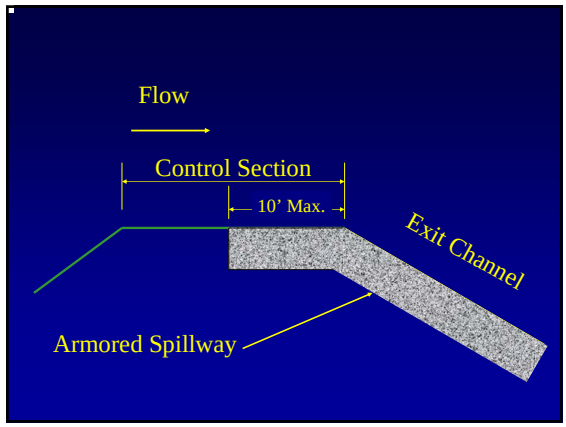
Turf Reinforcement

- Must be a permanent type of mating
- May be used in areas where velocity exceeds permissible for grass alone.
- Maximum velocity must not exceed manufactures recommendations but in no case **exceed 10 fps**
- Covering mating with 1 to 2 inches of top soil is not considered fill.

Rock Armoring

- May be used in areas where velocity exceeds permissible for grass alone.
- Where prolonged wetness may be a problem.





Top Soil

- Over excavate 1 to 2 inches.
- Cover with top soil
- Top soiling in this range is not considered fill.

Specification

- **Use updated specs January 2000**
- **Changes**
  - **Concrete - MSHA, Standard Specifications for Construction and Materials, Section *414*, Mix # 3.**
  - **Riprap - MSHA, Standard Specifications for Construction and Materials, Section *311*.**
  - **Geotextile - MSHA, Standard Specifications for Construction and Materials, Section *921.09 Class C*.**

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Website

www.md.nrcs.usda.gov

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