Determining Adequate Drainage Capacity for Agricultural Open Ditches

Road School 2015
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Presentation Goals

- Discuss the nature of agricultural drainage watersheds
- Discuss key parameters for agricultural ditches
- Discuss appropriate design capacity for agricultural ditches
Nature of an Ag Drainage Watershed

- Extremely Flat (little topographic relief)
- May have areas that do not contribute direct runoff to outlet (potholes or ponded)
- Wet (naturally occurring high water tables)
Beginning of an Open Ditch
Key Parameters for Ag Ditches

- **Depth**
  - dictated by tile depth
  - sometimes constrained by limiting layer
  - sometimes constrained by outlet

- **Bank Slope**
  - stable, based on soil materials, farming practices and commodity prices

- **Grade**
  - slope, usually quite flat (5–10 ft/mi or less)
NRCS Standard 582, Open Ditch

“The capacity for open channels will be determined according to procedures applicable to the purposes to be served and according to related engineering standards and guidelines in handbooks.”

“The required capacity may be established by considering volume-duration removal rates, peak flow, or a combination of the two as determined by the topography, purpose of the channel, desired level of protection, and economic feasibility.”
Key Parameters for Ag Ditches (cont.)

- Capacity (cont.)

NEH, Section 16, Drainage of Agricultural Land

“Where the need for both surface and subsurface drainage exists in a watershed, consideration must be given to the requirements of each in computing the design capacity of the ditch which serves as the common outlet.”

“Any open ditch in an area subject rainstorms will periodically be subjected to runoff from storms of abnormally high intensity. The type of agriculture and other improvements in the flood plain will determine the feasibility of constructing the ditch to the size required to carry the runoff from these abnormally large rainstorms within the banks. Decisions are made on the evaluation of damages which would result from overbank flow and cost of improvements which would prevent it.”
“The level of protection on flatland refers to the duration and frequency of storms against which protection is afforded, to the extent that flooding to the depth and duration which will cause significant crop loss will not occur.”
Discharge Capacity

- CSM – cubic feet per second per square mile

- Retool your feeling of scale:

  1 Ac. Asphalt pavement, 10-year, 24-hour, Type II peak discharge, $Q = 5.9 \text{ cfs (cubic feet per second)} = 3,776 \text{ CSM}$
Iroquois River _ Renesselaer

- Contributing Drainage Area = 204.7 Sq.Mi.

- $Q_{10} = 2,080 \text{ cfs} = 10 \text{ CSM}$

- $Q$ (avg. annual flood) = 983 cfs = 4.8 CSM
Coordinated Discharges – Jasper Co.

- Contributing Area = 1 Sq.Mi.
- Q10 = 54 cfs = 54 CSM
- Contributing Area = 10 Sq.Mi.
- Q10 = 240 cfs = 24 CSM
Costello Ditch – Fulton Co.

- Contributing Drainage Area = 2.4 Sq.Mi.
- $Q_{10} = 299 \text{ cfs} = 125 \text{ CSM}$
Beginning of an Open Ditch
General use of curves – for flat lands, average slope less than 25 feet per mile.

**Curve A** – For good protection from overflow (not maximum flood runoff).
**Curve B** – For excellent drainage.
**Curve C** – For good agricultural drainage; basic drainage curve for grain crops.
**Curve D** – For fair agricultural drainage and drainage improved pastures.

For specific uses see design criteria or technical standards.

Exhibit 14-2 Drainage runoff curves for Northern humid areas
Discharge Example

- Contributing Drainage Area = 900 Ac. = 1.4 Sq.Mi.
- Tile Discharge = 14 cfs
- “B” Drainage Curve = 88 cfs = 62 CSM
- Total Discharge = 102 cfs = 73 CSM
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