EXAMPLE DESIGN

GRASSED WATERWAY WITH STEEP GRADE

(Equal to or greater than 1%)

Steps

1. Drainage area: 60 acres, Putnam County

2. Average watershed slope: 9%; Slope factor: Steep

3. Waterway grade: 4% and 2%

4. Minimum design frequency: 10-year frequency, 24-hour duration storm

5. (a) CN: See Form IN-ENG-10.

   Soils of watershed: Russell, 40 acres, cultivated with conservation
   Hennepin, 20 acres, good pasture

   CN = 70

6. Rainfall: 4.3 inches

7. (a) Peak discharge: 74 cfs (See Form IN-ENG-10.)

8. Soils in waterway: Hennepin and Genesee which are easily eroded. (See soil survey.)

9. Retardance: "C" for fescue

10. Permissible velocity for tall fescue with a slope of 4% and easily eroded soil is 5 fps and also should not exceed 5 fps from Standard and Specification 412, Grassed Waterway or Outlet, Section IV of the Technical Guide.

11. Size of waterway required, using Exhibit 7-5, sheet 10 for 74 cfs:

    4% grade and V_1 maximum of 4.0 fps
    T (Top width) = 38.6 feet
    D (Depth) = 0.84 foot
    V_2 (Velocity for retardance "C") = 3.45 fps

    2% grade and V_1 maximum of 4.0 fps, use 3.5 fps
    T (Top width) = 30.3 feet
    D (Depth) = 1.09 feet
    V_2 (Velocity for retardance "C") = 3.14 fps

12. Fill out the sheets for the plan. Use seeding recommendations from Standard and Specification 412, Section IV of the Technical Guide.

13. Check all work for omissions and errors.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

IN-ENG-10
Rev. 3/81
File Code 210-11

PEAK RUNOFF COMPUTATION SHEET

Cooperator G. Clodfelter-Putnam Co. Project Grass Waterway

By Bob Wehrman Date 2/27/81 Checked by Geo: Murphey Date 2/27/81

HYDROLOGIC CURVE NUMBER (CN)

WATERSHED DESCRIPTION	MAJOR SOIL TYPES: Hydrologic Soil Group (Exhibit 2-1 EFM) A	B (Russ. Henn.)	C	D	ACRES	PRODUCT
Cultivated - without conservation treatment	72	81	88	91		
- with conservation treatment	62	(71)	78	81	40x71	2840
Pasture or range - poor condition	68	79	86	89		
- good condition	39	(61)	74	80	20x61	1220
Meadow	30	58	71	78		
Woods or Forest - thin stand, poor cover, no mulch	45	66	77	83		
- good cover	25	55	70	77		
Farmsteads	59	74	82	86		
Roads	74	84	90	92		
Other (Specify)						
			TOTALS		60	4060

Weighted CN = $\frac{\text{Product Total}}{\text{Total Acres}} = \frac{4060}{60} = 68$

CN Rounded to nearest Exhibit 2-10 Value (65, 70, 75, etc.) = 70
(Do not use less than CN 60 without approval of area engineer)

Average Watershed Slope: 9% (Flat = 0-3%; Moderate = 3-8%; Steep = >8%)

Adjustment Factors: Slope 0.9 Ponding - -

	Storm 1	Storm 2
From Technical Guide Section IV and EFM (Ex. IN 2-4)		
Design Frequency - Years	10	
Rainfall - inches	4.3"	
Storm Duration - hours	24	
From EFM, Exhibit 2-10, sheet 17 of 21	82x.9	
Peak Discharge - cfs	74	

Sheet 1 of 1

Vegetative Cover Fescue

DESIGN

(Circle one)

Soil type Hennepin-Genesee Avg. watershed slope 9 %; Flat - Moderate - Steep

Permissible Vel. 5 f.p.s. 10-year - 24-hour rainfall 4.3 inches

Retardance (V_2) "C" Describe outlet Rock Chute

Waterway number or reach	Drainage area acres	Runoff curve no.	Q_{10} or B curve c.f.s.	W.W. grade %	V_1 "D" ret. f.p.s.	V_2 Design Velocity f.p.s.	Top or bottom width ft.	Design depth ft.	S.S.
0to5+00	60	70	74	2	3.5	3.14	30.3	1.09	--
5to8+00	60	70	74	4	4.0	3.45	38.6	0.84	--

CONSTRUCTION CHECK

Waterway number or reach	Length ft.	Waterway grade %	Average total depth ft.	Total Waterway Width-feet		Area-acres	
				Const.	Seeded	Const.	Seeded
0to5+00	500	2.0	1.2	35	60	0.4	0.7
5to8+00	300	4.0	1.0	40	60	0.3	0.4
					Totals	0.7	1.1

Adequacy of vegetation: Waterway seeded and mulched - good stand.

Temporary or permanent erosion control measures: Small diversion was installed at at upper end temporarily. It has now been removed.

I certify that this job meets all the requirements of Indiana Standards and Specifications for Grassed Waterway or Outlet (Code 412) and the plans as designed.

Checked by: /s/Bob Wehrman

Date: 5-30-81

Remarks:

SEEDING RECOMMENDATIONS

Seed: Tall fescue - 30#/Ac.

Fertilizer: 600#/Ac of 13-13-13

Lime: 5 Tons/Ac.

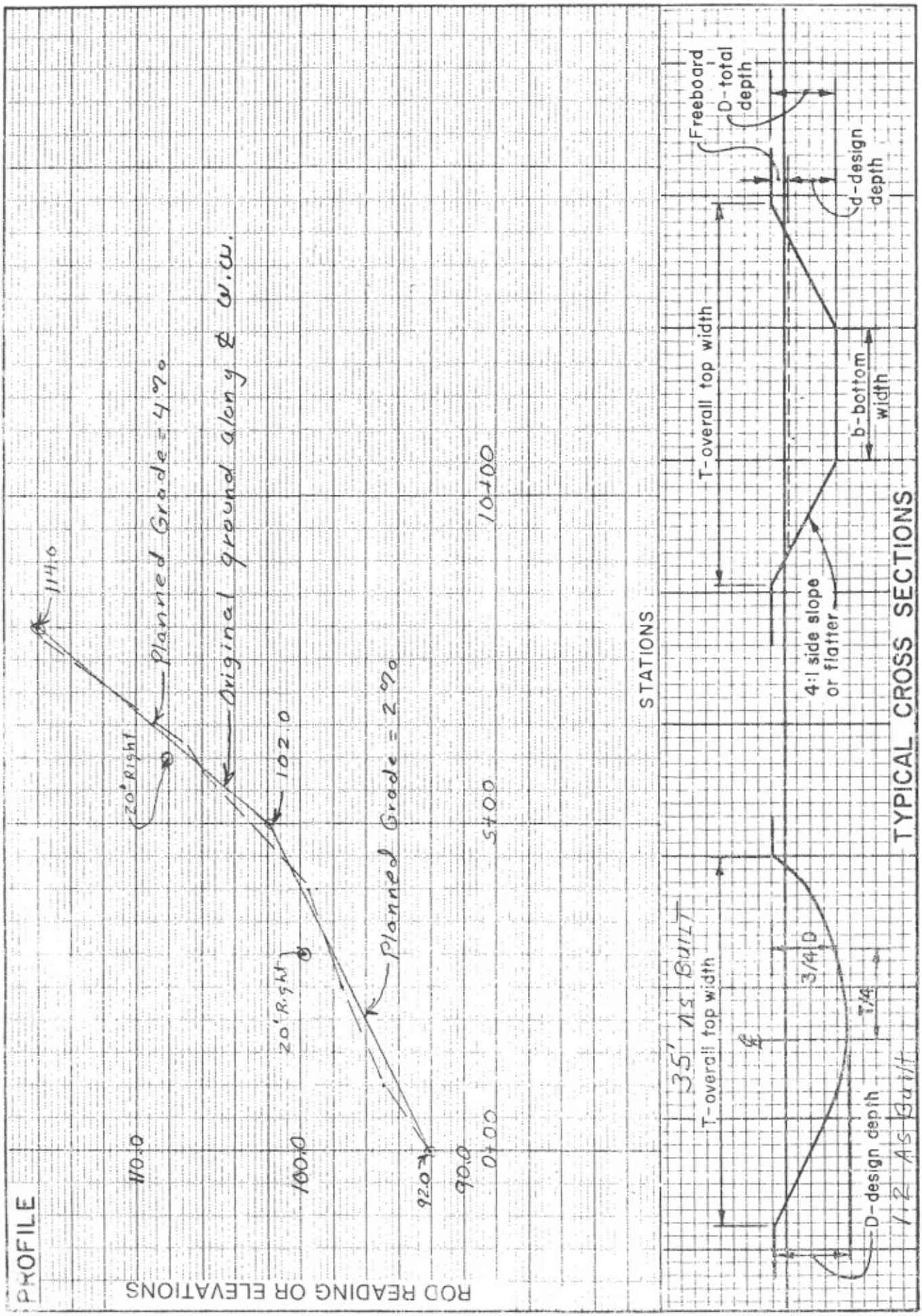
Mulch: 2 Tons/Ac.

GRASSED WATERWAY OR OUTLET

NAME Gene Clodfelter

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	B. Wehrman 2/81	Approved by	/s/B. Wehrman
Drawn	B. Wehrman	Title	S.C.T.
Checked	G. Murphey 2/81	Title	
Reviewed	G. Murphey	Sheet No. 1 of 1	Drawing No.



IN-ENG-14 2(2) REV. 6-81