0031

File No. ACT/015/032

#3

October 2, 1987

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Dear Mr. Leatherwood:

Genwal Coal Company has requested that I respond to Division questions regarding reclamation diversion channel RD-4 as currently proposed in the Permit Application Package. These questions concern (1) the dissipation of energy from the steep section of RD-4 (termed Section 3 in Appendix 7-7 of the PAP) at the head of the downstream mild section (Section 4 of Appendix 7-7) and (2) the abrupt nature of the confluence of RD-4 with RD-5.

Energy Dissipation

An energy dissipation basin has been designed in place of the splash apron previously proposed. This basin was designed in accordance with Hydraulic Engineering Circular No. 14 of the Federal Highway Administration. The design of this basin is provided in the attached calculation sheets (labeled as pages 27s2 through 27s6 and 27t). These pages (14 copies of which are included herewith) are to replace the present page 27t found in Appendix 7-7 of the PAP.

RD-4/RD-5 Confluence

The downstream end of RD-4 will be curved to meet RD-5 at a 30° angle. Details of this curve will be indicated on Plate 3-5 of the PAP and provided to the Division as soon as we receive the original of this Plate from Genwal.

Please contact me if you have any additional questions.

Sincerely,

Richard B. White

Richard B. White, P.E.
Principal Hydrologist

cc: Andy King, Genwal

Enclosures

Design of Energy Dissipation Basin at Downstream Edge of Section 3 Channel (where rock face meets pad) – use the design procedure of Corry et al. (1975):

Depth of flow in basin – Assume 1% slope on basin floor
4 ft bottom width
2:1 sideslopes

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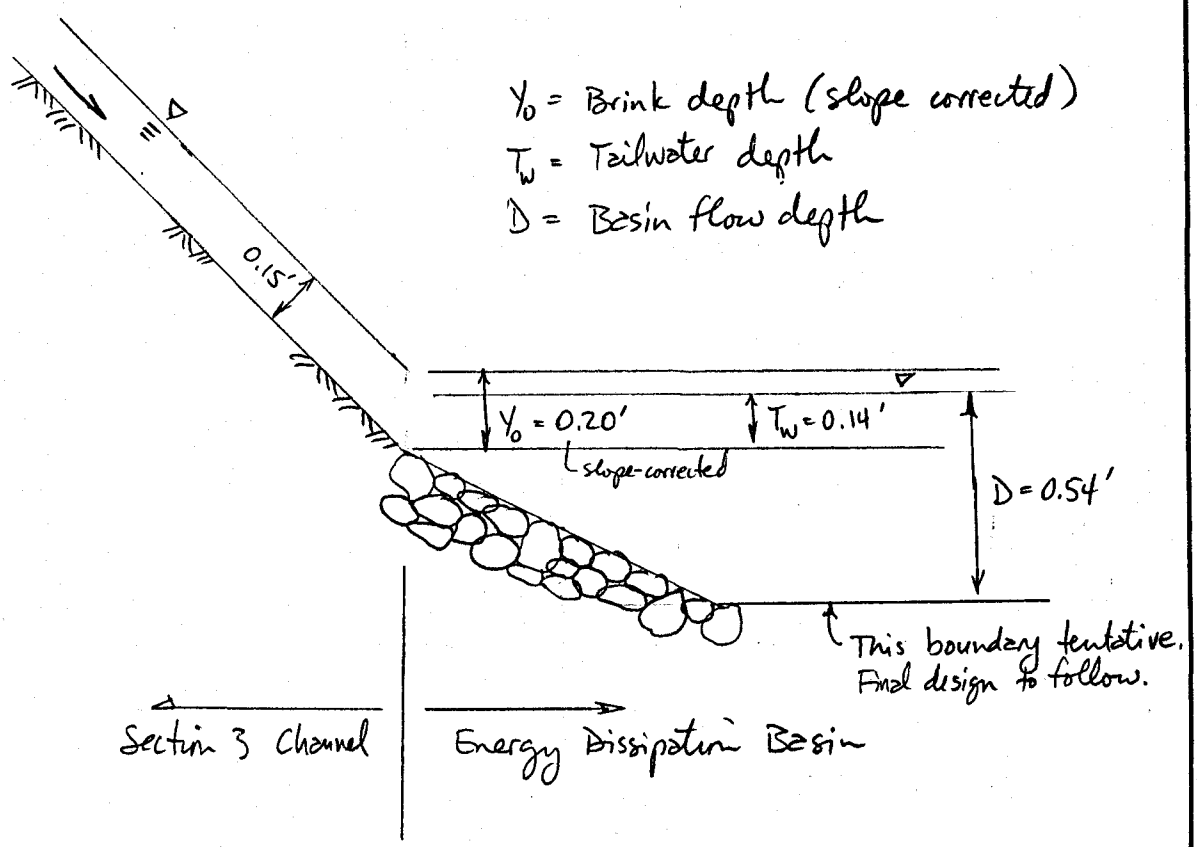
TRAP1 results:

Bed Slope =	.01	
Manning's N =	.035	
Bottom Width =	4	feet
Channel Side Slope =	.5	
Flow Depth =	.5392388	feet
Cross Sectional Area =	2.738512	square feet
Wetted Perimeter =	6.41155	feet
Hydraulic Radius =	.4271218	feet
Discharge =	6.62	cubic feet/sec
Velocity =	2.417371	feet/sec
Froude Number =	.5801293	

General schematic:



$$\frac{T_W}{Y_0} = \frac{0.14}{0.20} = 0.70 < 0.75 \quad \underline{\underline{OK}}$$

Determine riprap sizing for basin — see pg 27s4 of this calc:

Select d_{50} such that $0.25 < \frac{d_{50}}{Y_e} < 0.45$

AND

$2 < \frac{h_s}{d_{50}} < 4$

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Y_e = equivalent depth = $(A/2)^{1/2}$ where A is for Section 3 channel

$= \frac{(2.74/2)^{1/2}}{\sin 47.5°}$

$= 1.59$ ft

Assume $d_{50}/Y_e = 0.35 \Rightarrow d_{50} = (0.35)(1.59)$
$= 0.56$ ft (min)

Use $d_{50} = 0.70$ ft (same as Section 1/2 riprap) for ease of handling

From pg 27s4 $\rightarrow \frac{h_s}{Y_e} = 0.90 \Rightarrow h_s = (0.90)(1.59)$
$= 1.43$ ft (scour hole depth)

$\frac{h_s}{d_{50}} = \frac{1.43}{0.70} = 2.04 \Rightarrow$ OK

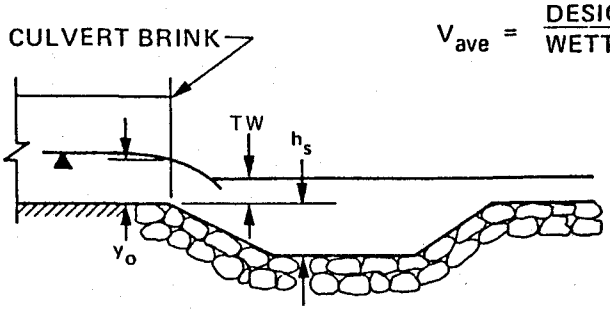
Basin length = $10 h_s = 14.3$ ft $\Rightarrow$ use 15 ft

Apron length = $5 h_s = 7.15$ ft $\Rightarrow$ use 7.5 ft

Freeboard = 1.0 ft

Total basin depth = $h_s + Y_0 + 1.0$
$= 1.43 + 0.20 + 1.00$
$= 2.63$ ft $\Rightarrow$ Construct with depth = 2.75 ft

Design sections $\rightarrow$ see pg 27s5 and 27s6 of this calc.



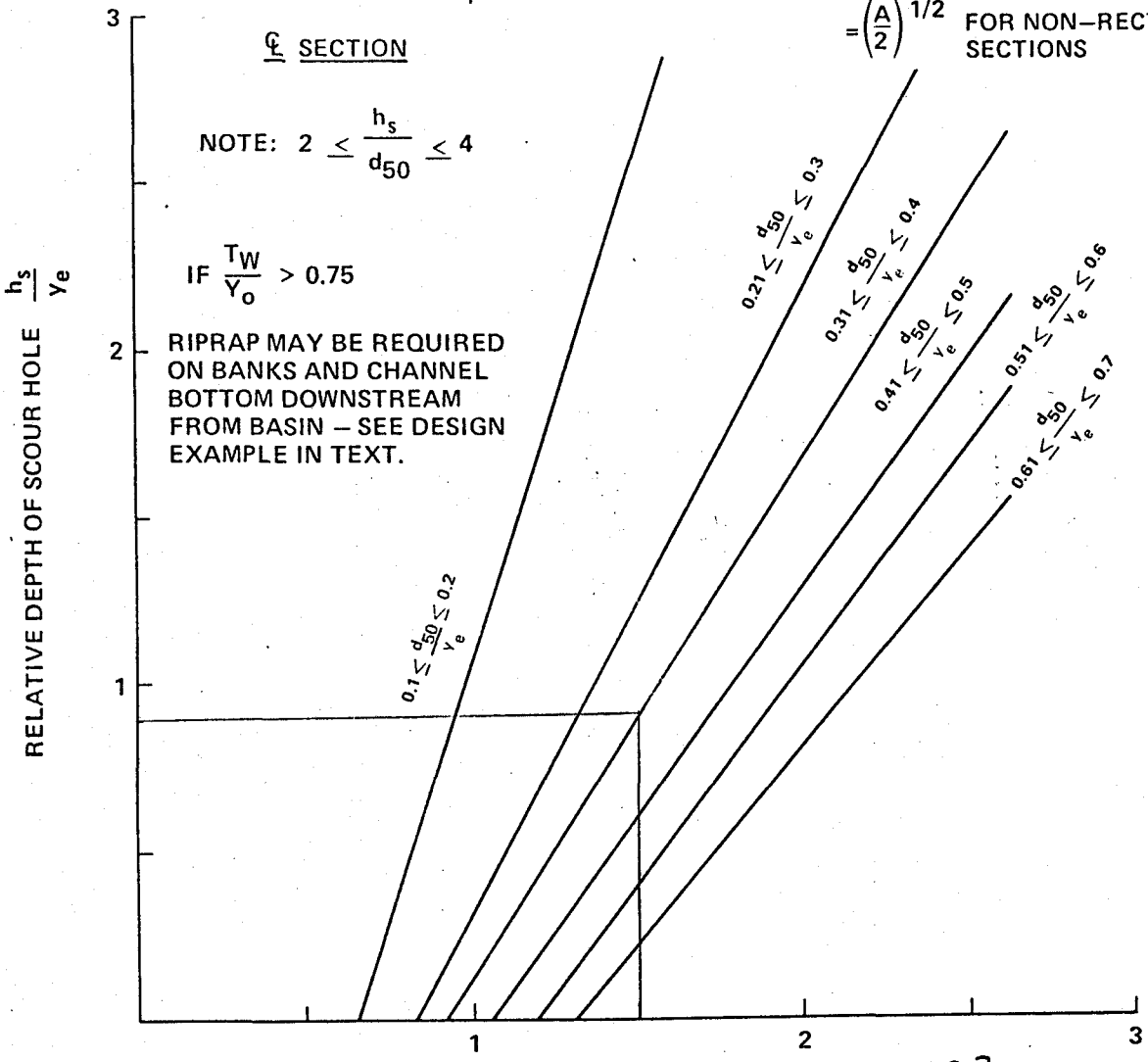
$$V_{ave} = \frac{\text{DESIGN DISCHARGE} - Q}{\text{WETTED AREA AT BRINK OF CULVERT}}$$

d_{50} = THE MEDIAN SIZE OF ROCK BY WEIGHT. ROUNDED ROCK OR ANGULAR ROCK.

Y_e = EQUIVALENT BRINK DEPTH

= BRINK DEPTH FOR BOX CULVERT

$= \left(\frac{A}{2}\right)^{1/2}$ FOR NON–RECTANGULAR SECTIONS



$$\text{FROUDE NUMBER} = \frac{V_{ave}}{\sqrt{(32.2)(Y_e)}} = \frac{10.7}{\sqrt{(32.2)(1.59)}} = 1.50$$ for Section 3 channel

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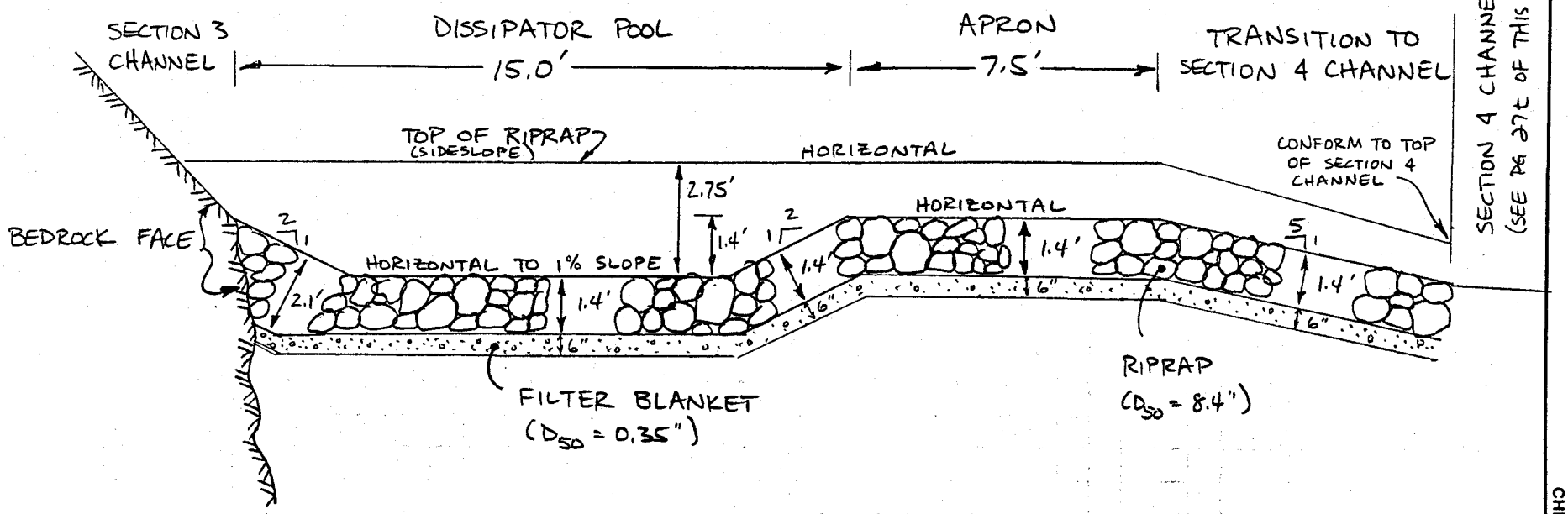
Source: Corry et al. (1975)



ENERGY DISSIPATION BASIN
CENTER LINE SECTION

SCALE: 1" = 4'

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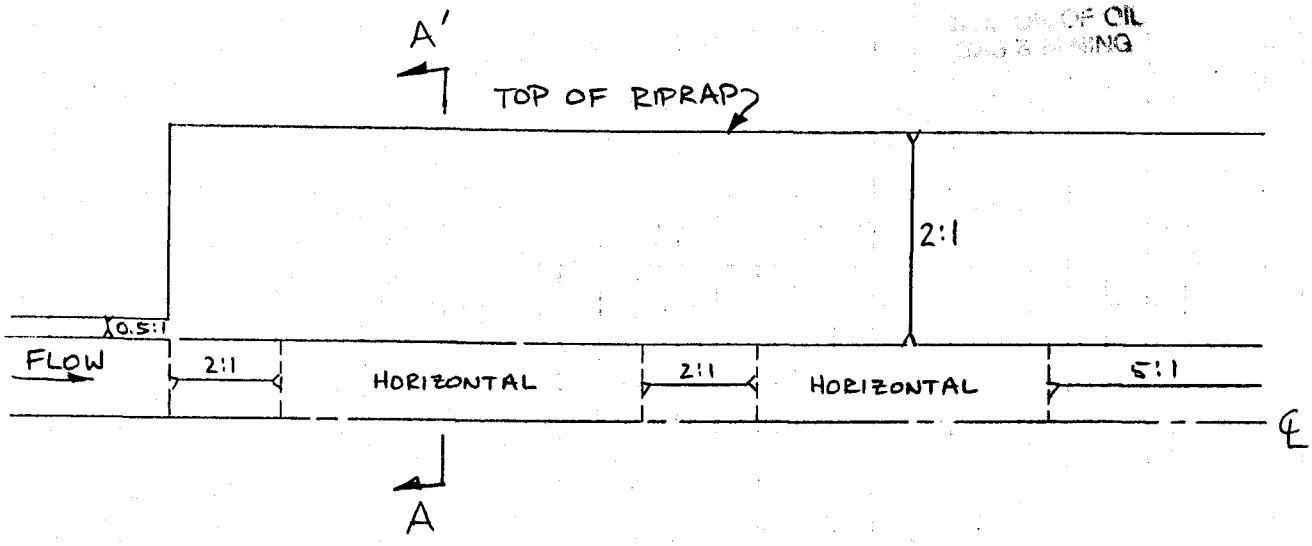
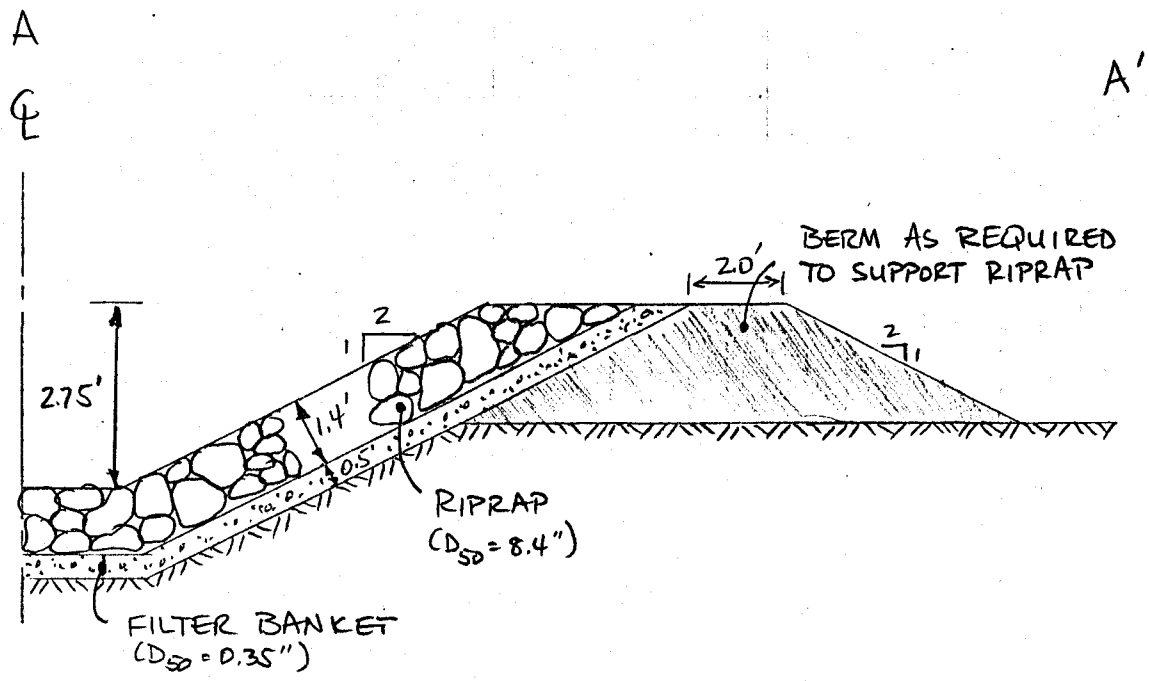


ENERGY DISSIPATION BASIN
HALF PLAN
SCALE: 1" = 50'



ENERGY DISSIPATION BASIN
SECTION A-A'
SCALE: 1" = 4'

Section 4 → assume n = 0.031

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Bed Slope =	.057	
Manning's N =	.031	
Bottom Width =	4	feet
Channel Side Slope =	.5	
Flow Depth =	.3047183	feet
Cross Sectional Area =	1.40458	square feet
Wetted Perimeter =	5.362742	feet
Hydraulic Radius =	.2619145	feet
Discharge =	6.62	cubic feet/sec
Velocity =	4.713154	feet/sec
Froude Number =	1.504646	

Required d_{50} = 0.25 ft
= 3.0 in

n = 0.031 ⇒ OK

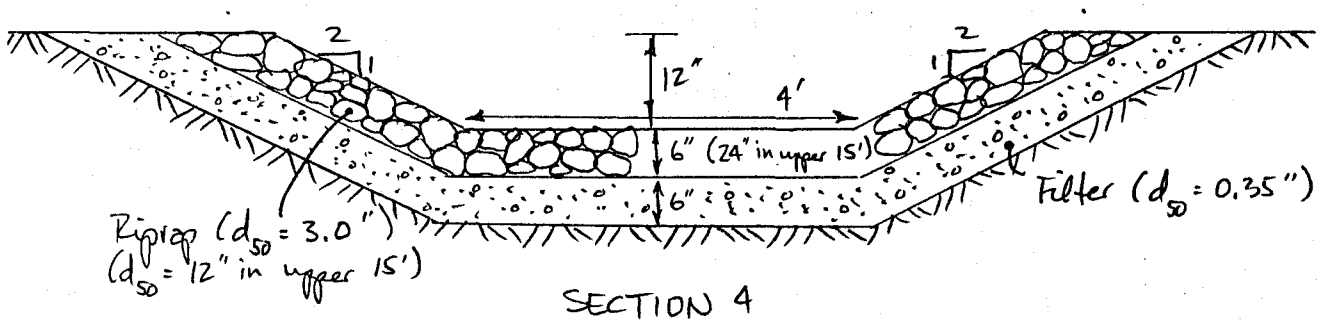
Gradation of Section 4 riprap → see pg. 27u of this calc.

Filter blanket requirement → compare with filter blanket designed for RD-2.

$$\frac{D_{15}\text{ (riprap)}}{D_{85}\text{ (filter)}} = \frac{1.25\text{ in}}{0.85\text{ in}} = 1.5 < 5 \quad \underline{\underline{OK}}$$

$$\frac{D_{15}\text{ (riprap)}}{D_{15}\text{ (filter)}} = \frac{1.25\text{ in}}{0.08\text{ in}} = 15.6 < 40 \quad \underline{\underline{OK}}$$

Use the filter blanket designed for RD-2.



SECTION 4
RD-4 ELEV. VIEW
SCALE: 1" = 2'