HYDROLOGY STUDY FOR
CCLAY, INC.

SKELTON CREEK OPERATION
P-3934 REVISION R-1
JEFFERSON COUNTY, ALABAMA

BY

PERC ENGINEERING CO., INC.
1606 HWY. 78 WEST
JASPER, ALABAMA 35501

PRIMARY ROAD 4P & 5P DESIGN PLANS

ATTACHMENT III-B-5

MARCH 21, 2012

PERC
ENGINEERING CO., INC.

Telephone: (205) 384-5553
Facsimile: (205) 295-3114 - Main Building
(205) 295-3115 - Water Lab
Web Address: www.percengineering.com

March 21, 2012

Mr. Gary Heaton, P.E.
Alabama Surface Mining Commission
Post Office Box 2390
Jasper, Alabama 35502-2390

RE: CClay, Inc.
Skelton Creek Operation
P-3934

Dear Gary:

I hereby certify the attached detailed design plans for Primary Road 4P and Primary Road 5P for the above referenced mine are in accordance with current prudent engineering practices and the Regulations of the Alabama Surface Mining Commission and are true and correct to the best of my knowledge and belief.

If you have any questions or required additional information, please feel free to call.

Sincerely,
PERC Engineering Co., Inc.

Leslie G. Stephens, P.E., P.L.S.
Alabama Registration No. 14117-E

ALABAMA
PROFESSIONAL ENGINEER AND LAND SURVEYOR
REGISTERED
No. 14117
LESLIE G. STEPHENS

P.O. Box 1712 • Jasper, Alabama 35502 • 1606 Highway 78 West • Jasper, Alabama 35501

SPECIFICATIONS FOR THE CONSTRUCTION, MAINTENANCE AND RECLAMATION OF PRIMARY ROADS

1. Primary roads shall be designed by or under the direction of a registered professional engineer in accordance with the Alabama Surface Mining Commission rules and regulations and prudent engineering practice.

2. Each roadway embankment will be designed and constructed so as to have a minimum static safety factor of 1.3.

3. To the extent possible, roads will be located on ridges or on the most stable available slopes to prevent or minimize erosion, downstream sedimentation and flooding in an effort to prevent adverse effects to fish, wildlife and related environmental values.

4. To the extent possible, roads will be located above the sediment basins to be constructed for the mining operation in an effort to control or prevent additional contributions of suspended solids to stream flow or runoff outside the permit area and to comply with State and Federal water quality standards applicable to receiving waters and avoid the alteration of the normal flow of water in streambeds or drainage channels while preventing or controlling damage to public or private property. Where it is not possible or is impractical to locate roads in this manner, sediment control devices such as silt fencing, hay bale check dams and rock filter check dams will be used as necessary to maintain water quality. No fording of intermittent or perennial streams will be conducted unless specifically approved by the Alabama Surface Mining Commission as temporary routes to be used during road construction.

5. Prior to construction, the roadway will be cleared, grubbed and will have the topsoil removed. The clearing limits will be kept to the minimum necessary to accommodate the roadbed and associated ditch construction.

6. Roads will be constructed of suitable compacted subgrade material. The material will be free of sod, roots, stones over 12 inches in diameter, and other objectionable materials. The material will be placed and spread over the entire fill area, starting at the lowest point in layers not to exceed 12 inches in thickness. The material will be compacted to 95 percent of the density, based on standard proctor as outlined in ASTM.

7. Primary roads will have a minimum width of eighteen feet and a maximum width necessary to accommodate the largest equipment traveling the road.

8. Roadbeds will be cut to consolidated non-erodible material or will be surfaced with durable non-toxic, non-acid forming substances. The wearing surface will consist of durable sandstone, chert, crushed limestone, crushed concrete, crushed asphalt, red rock, ironore refuse, gravel, or other durable non-toxic, non-acid forming material approved by the Regulatory Authority. The wearing surface will be placed on the roadbed to a depth of four inches.

9. No sustained grades will exceed ten percent unless deemed necessary, in which case appropriate sediment control facilities will be constructed. If grades in excess of fifteen percent are required, cross drains, ditch relief drains and road drainways will be located at a minimum distance of three-hundred feet.

10. Roads will be constructed so as to have adequate drainage utilizing ditches, culverts, cross

drains and ditch relief drains designed to safely pass the peak runoff from a ten year, six hour precipitation event. Drainage pipes and culverts shall be installed as designed and will be maintained in a free and operating condition to prevent and control erosion at inlets and outlets. Culverts have been designed to support the load of the heaviest equipment to travel the road and are based on the Handbook of Steel Drainage and Highway Construction Products by the American Iron and Steel Institute and the equipment specifications. Drainage ditches will be constructed and maintained in accordance with the approved design to prevent uncontrolled drainage over the road surface and embankment. Roads will not be located in the channel of an intermittent or perennial stream unless specifically approved by the Alabama Surface Mining Commission. Additionally, no relocation and/or alteration of an intermittent or perennial stream will be done unless specifically approved by the Alabama Surface Mining Commission. In the event that it becomes evident that any drainage structures including culverts, bridges and/or low water crossings will be required in order to cross an intermittent or perennial stream, the structure will be designed and constructed in accordance with Alabama Surface Mining Commission requirements and prudent engineering practice and the approval of the design(s) will be acquired prior to the commencement of construction. Hay bale check dams and silt fences will be used at strategic locations when necessary to control sediment runoff. Immediately upon completion of construction, the side slopes of the road embankments and/or cuts will be fertilized, seeded with annual and perennial grasses and mulch will be added to aid in the prevention of erosion and to enhance seed germination. The seed mix will consist of, but is not limited to, some combination of the following species: bermuda grass, fescue, lespedeza, rye grass, brown top millet, clover and vetch. The particular species to be planted will vary with the planting season at the time of seed application. Upon completion of construction of each phase of the roadway the construction will be certified to the Alabama Surface Mining Commission as having been done in accordance with the approved plans for the roadway and associated facilities.

11. Routine maintenance will be required to assure that the road continually meets performance standards and will consist of periodic grading, resurfacing, dust suppression and maintenance of sediment control facilities. Dust suppression will consist of the application of water, chemical binders and/or other dust suppressants. No oil will be utilized in this process. Spot seeding, fertilizing and mulching will be performed as necessary to improve vegetative cover on roadway slopes. A road damaged by a catastrophic event shall be repaired as soon as practicable after the damage has occurred.

12. Roads not to be retained as part of the post mine land use shall be reclaimed in accordance with the approved reclamation plan for this permit as soon as practicable after they are no longer needed as part of the mining and reclamation operation, using the following procedures:

    a. The road will be closed to traffic.
    b. All bridges, culverts and other drainage structures not approved as part of the post mine land use will be removed.
    c. All road surfacing materials that are not compatible with the post mine land use or revegetation requirements will be properly disposed of on-site or removed from the site for re-use.
    d. Roadway cut and fill slopes shall be regraded and reshaped to be compatible with the post mine land use and to compliment the natural drainage pattern of the surrounding terrain.
    e. The natural drainage patterns shall be protected from surface runoff and erosion

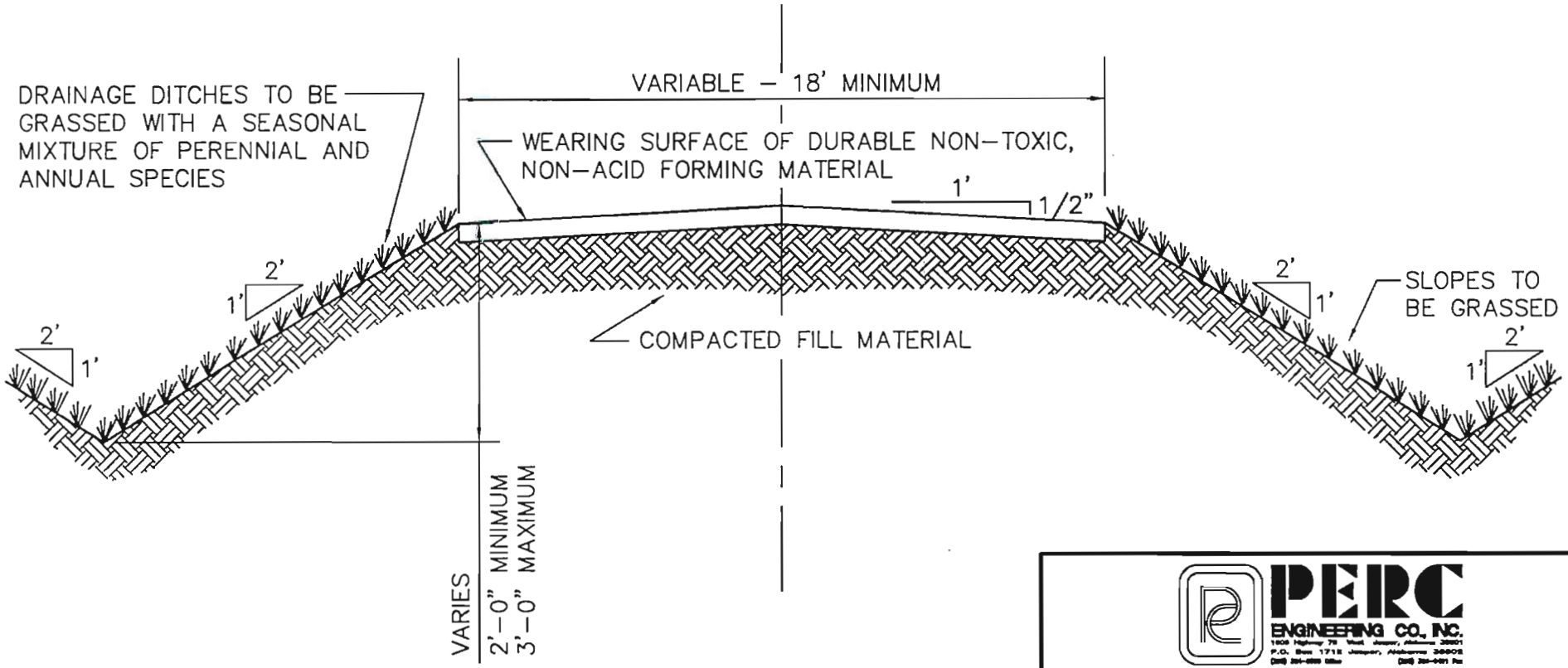
utilizing the installation of dikes and/or cross drains as necessary.

f. The roadbed shall be ripped or scarified as necessary, the topsoil or substitute or approved growing medium shall be replaced and revegetated in accordance with the approved reclamation plan for this permit.

13. The drawings and data contained in the specific design plans illustrate typical roadbed configurations for primary roads as well as site specific design of drainage structures, stability analysis and ditch sections.

TYPICAL HAUL ROAD
FILL SECTION

NO SCALE



PERC ENGINEERING CO., INC.

TYPICAL FILL SECTION
PRIMARY HAUL ROAD

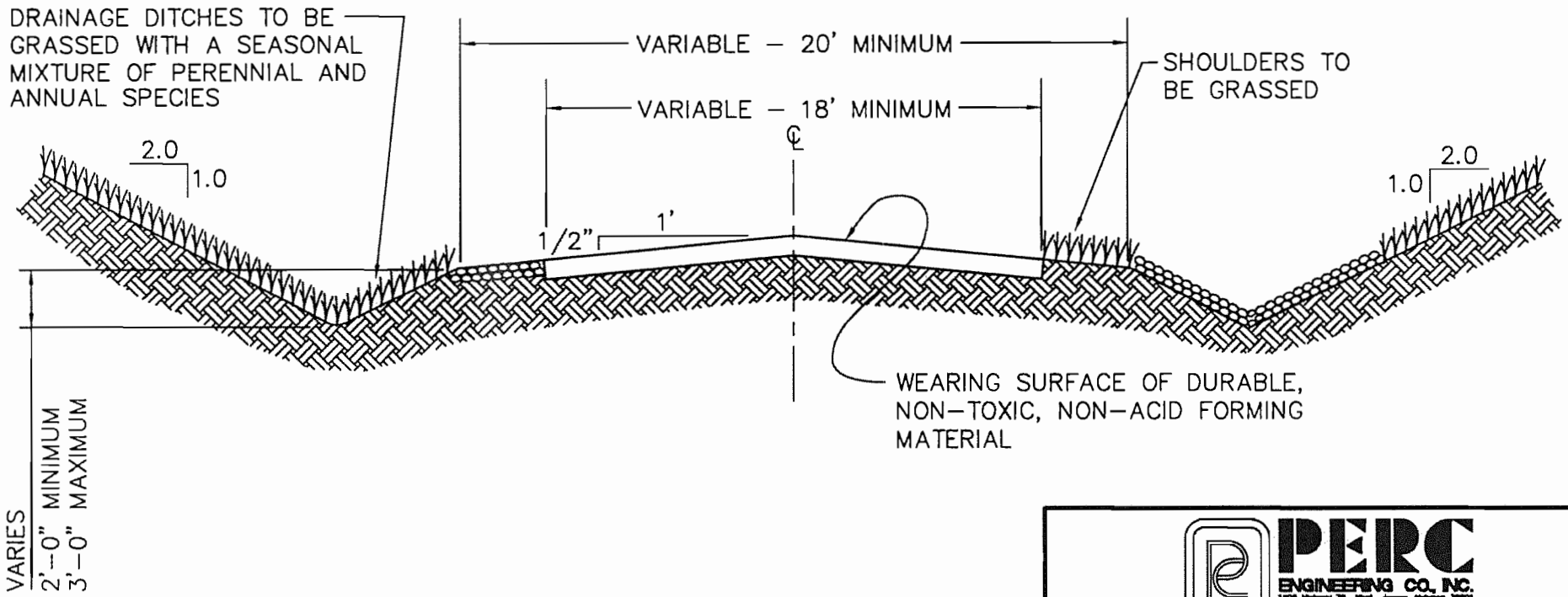
DRAWN BY:	K.D.P.	DATE:	2–3–97
DWG. NAME:	TYPHAULF		
APPROVED BY:	S.R.I.	SCALE:	NONE

ATTACHMENT III.–B.–5.

K:\SS\TYPHAULF 02/03/97 16:01

TYPICAL HAUL ROAD
CUT SECTION

NO SCALE



PERC ENGINEERING CO., INC.

TYPICAL CUT SECTION
PRIMARY HAUL ROAD

DRAWN BY:	K.D.P.	DATE:	2–3–97
DWG. NAME:	TYPHAULC		
APPROVED BY:	S.R.I.	SCALE:	NONE

ATTACHMENT III.–B.–5.

K:\S\TYPHAULC 02/03/97 15:56

NOTES

1) Due to there being no significant cut or fill section, no stability analysis is required.

2) Drainage Structure DS1P for Primary Road 4P shall consist of (4) 84" diameter corrugated metal pipes. (See cross-section for DS1P for Primary Road 4P.)

3) Drainage Structure DS1P shall consist of a 36" diameter corrugated metal pipe (See cross-section for DS1P for Primary Road 5P.)

4) Drainage Structure DS2P for Primary Road 5P shall consist of (2) 42" diameter corrugated metal pipes. (See cross-section for DS2P for Primary Road 5P.)

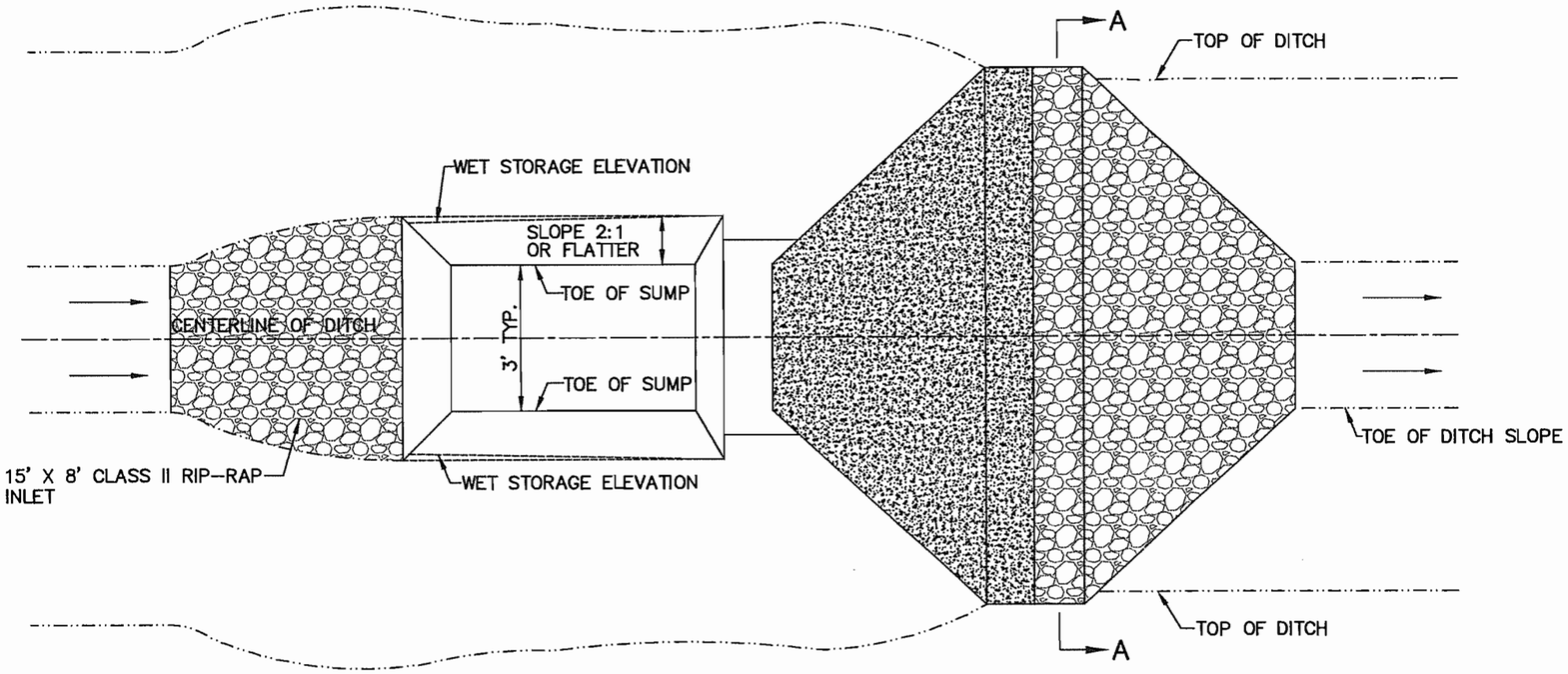
5) Drainage Structure DS3P for Primary Road 5P shall consist of (1) 18" diameter corrugated metal pipe. (See cross-section for DS3P for Primary Road 5P.)

6) A 3 foot wide grass lined roadside ditch will run along the east side of Primary Road 5P and be used to divert rainfall runoff to the correct corresponding drain structures as shown on the Primary Road Location Map and Roadside Ditch Watershed Map.

7) A stop sign will be place 15' from the edge of pavement of Highway 269 for the outgoing lane.

8) Coal trucks crossing the east end of Basin 006P embankment entering onto Primary Road 5P will be confined to the area shown on the Plan View Map of Basin 006P. Any settling caused by haulage over the embankment will be corrected immediately to insure proper freeboard for the entire embankment of Basin 006P.

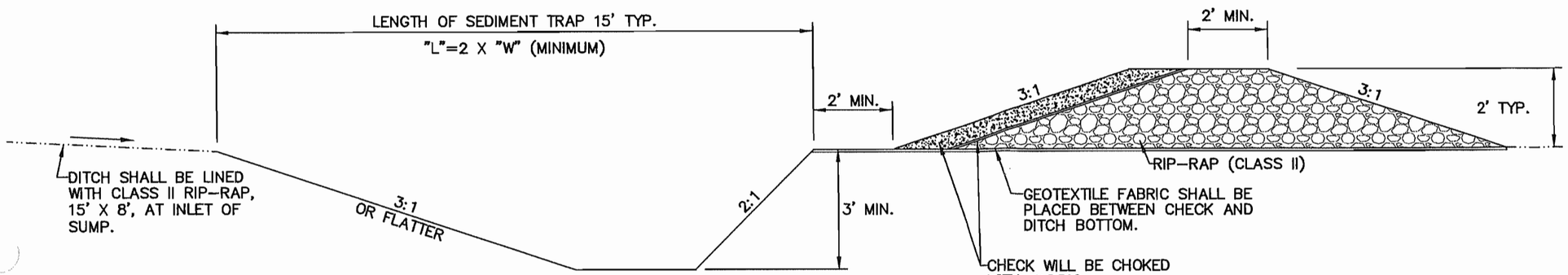
9) Two Erosion Control Sedimentation Traps will be installed within the roadside ditches of DS1P for Primary Road 4P & DS2P for Primary Road 5P before the ditches discharge into the drainage structures. The Erosion Control Sedimentation Traps will be 15'x30'x3' (see Erosion Control Sump Stream Crossing Typical for details). Roadway safety berms will be placed along the edge of the road at each stream crossing. The berms will a minimum of height of ½ the diameter of the wheels of the largest piece of equipment travelling the road but no less than 2 feet, with a top width of 4 feet and 2H:1V side slopes. The upstream and downstream slopes of the stream crossings will be lined with no less than 16 inches of Class II sandstone or limestone rip-rap with silt fence to be place at the bottom toe of the slopes.



PLAN VIEW

NOTES

1) TO BE PLACED AT DITCH DRAIN INTO STREAM CROSSING, ON UPHILL CUT SECTION DITCH OUTLET, 100' FROM STREAM BANK.



SECTION A–A

PROFILE VIEW

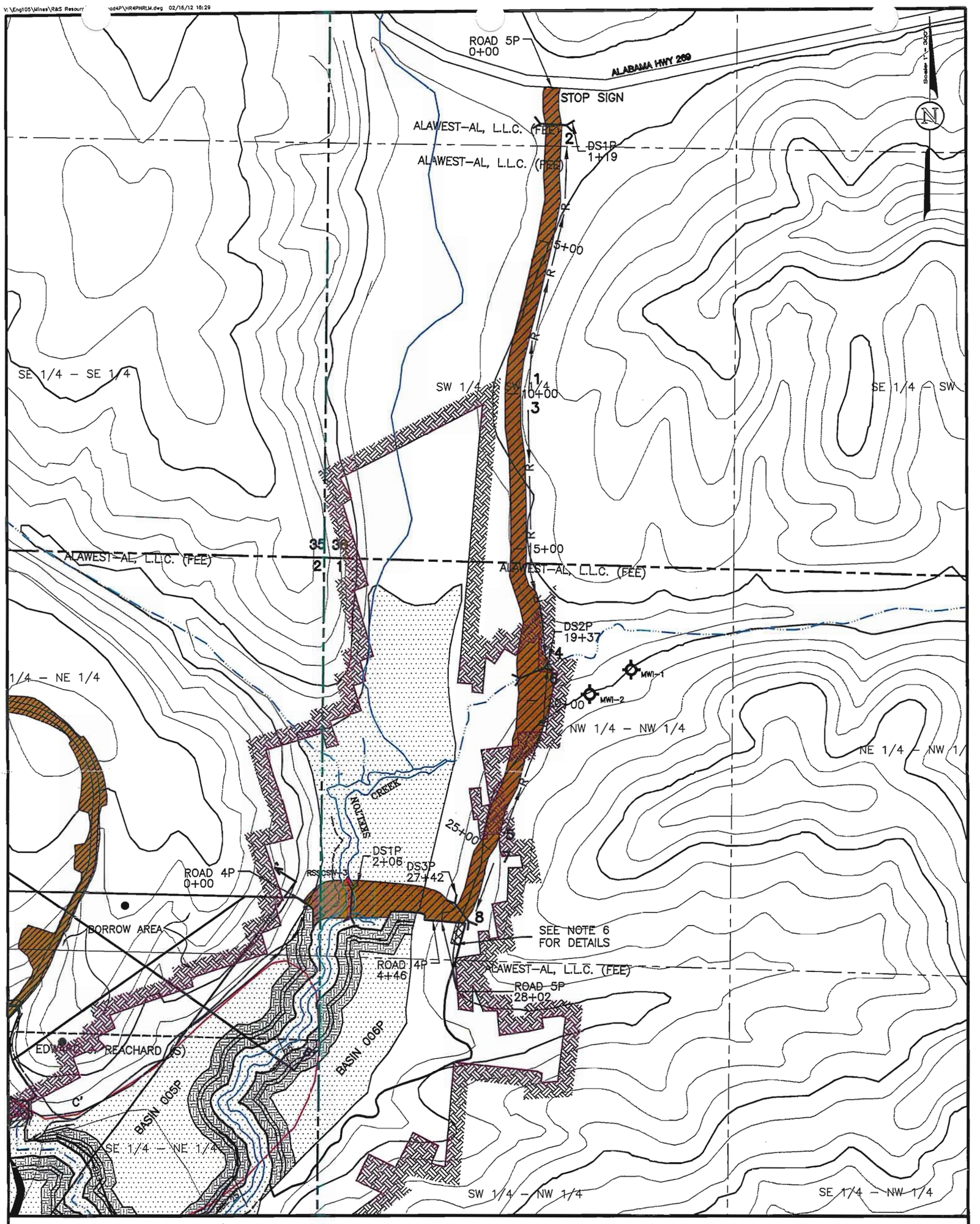
PERC ENGINEERING CO., INC.
1606 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-5553 Office (205) 295-3114 Fax

CClay, Inc.
Skelton Creek Operation
Primary 4P & 5P
Erosion Control Sumps
Stream Crossing Typical
P-3934 Revision R-1

DRAWN BY: J.W.T. DWG. NAME: CCSCECSSCT	DATE: 06/14/2012
APPROVED BY: L.G.S.	SCALE: Not To Scale

v:\Eng105\Mines\R&S Rec
ulrosd4P\CCSCECSSCT.dwg 06/14/12 15:12

V:\Eng105\Mines\R&S Resourc ad4P\HR4PHRLM.dwg 02/16/12 15:29



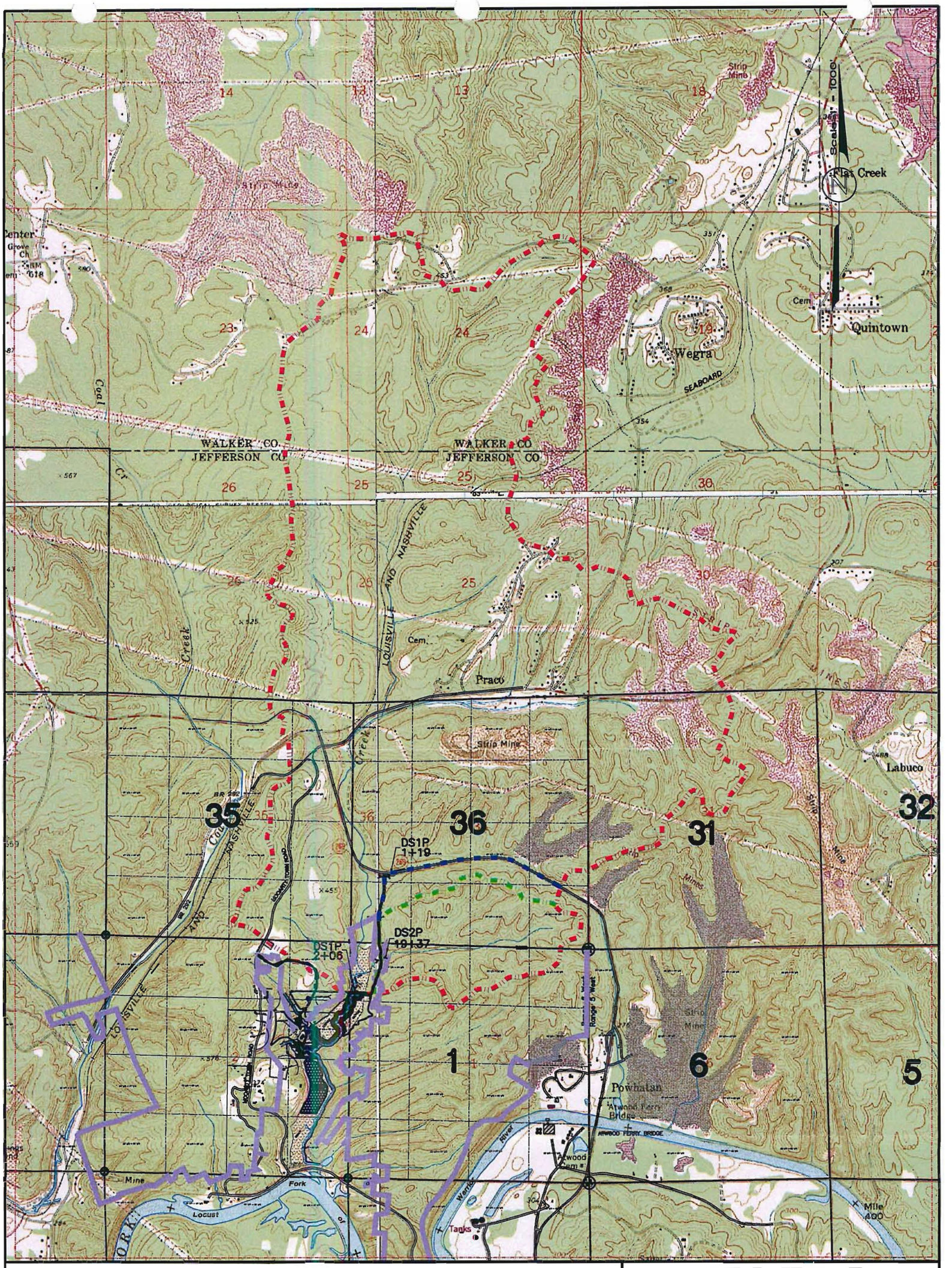
LEGEND

- Permit Boundary
- 600 Surface Contour
- 001 Sediment Basin
- Perennial Stream
- Intermittent Stream
- Diversion Ditch
- P-3601
- Primary Road
- Previously Disturbed Area
- Pond Embankment/Berm
- Existing Impoundment
- SBZ Stream Buffer Zone
- Praco Mines – Mary Lee Seam
- FRB Fines Removal Boundary – Located with HandheldNavigation Grade GPS on 1/19/2012.

PERC ENGINEERING CO., INC.
1608 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-3153 Office (205) 384-3161 Fax

Attachment III-B-5
CClay, Inc.
Skelton Creek Operation
P-3934 / Revision R-1
Primary Road Map

DRAWN BY: S.D.M. DWG. NAME: HR4PHRLM	DATE: 2/16/2012
APPROVED BY: L.G.S.	SCALE: 1"=300'



LEGEND

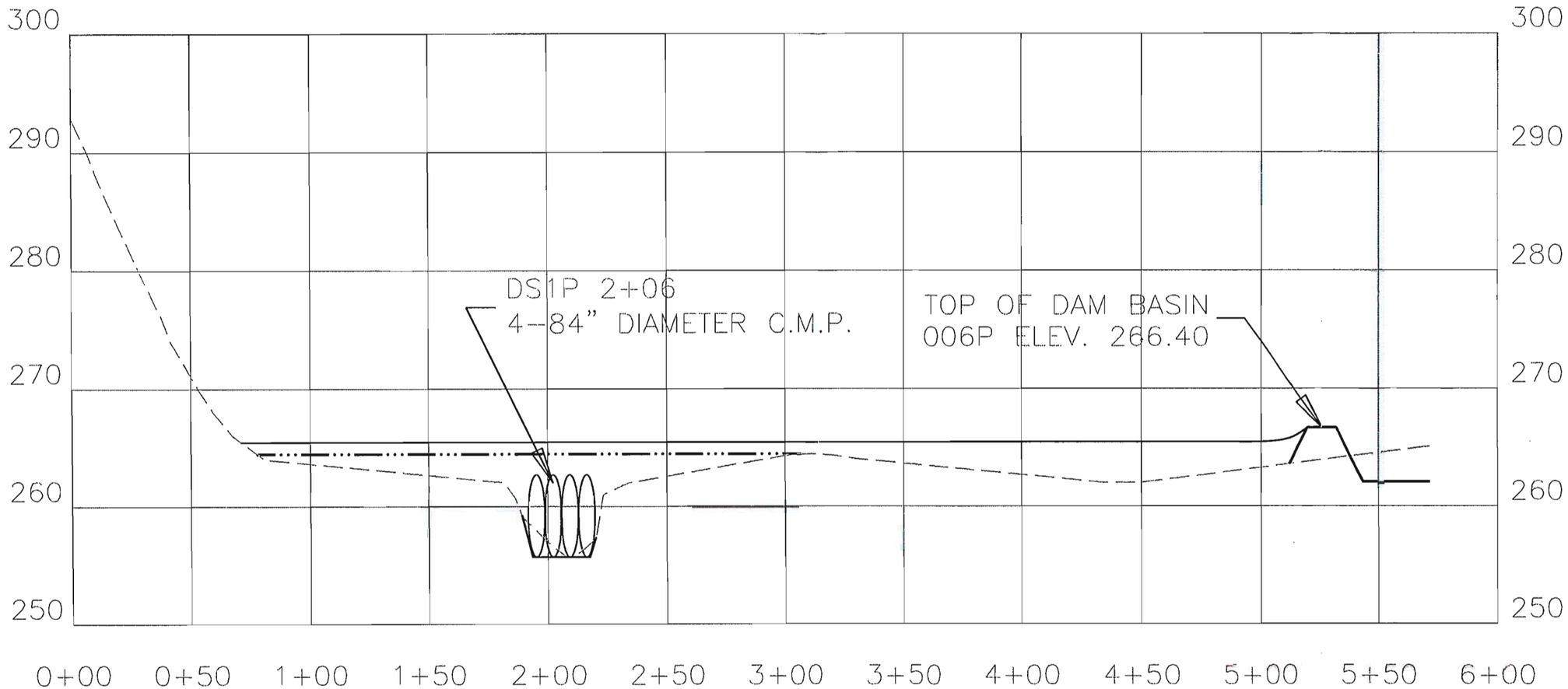
- Permit Boundary
- Watershed Boundary DS1P 2+06
- Watershed Boundary DS1P 1+19
- Watershed Boundary DS2P 19+37
- Praco Mines – Mary Lee Seam

NOTE:
THE AREA WITHIN THE WATERSHED BOUNDARY IS UNMANAGED TIMBERLAND WITH A CURVE NUMBER, 70.

PERC ENGINEERING CO., INC.

ATTACHMENT III-B-5
HAULROAD WATERSHED MAP
CCLAY, INC.
SKELTON CREEK OPERATION

DRAWN BY: J.W.T. DWG. NAME: HR4PWSM	DATE: 02/14/2012
APPROVED BY: L.G.S.	SCALE: 1"=2000'



LEGEND

- - - - - - NATURAL GROUND
——— PROPOSED FINISHED GRADE
—··— MAXIMUM WATER ELEVATION

HORIZONTAL SCALE: 1"=50'
VERTICAL SCALE: 1"=10'

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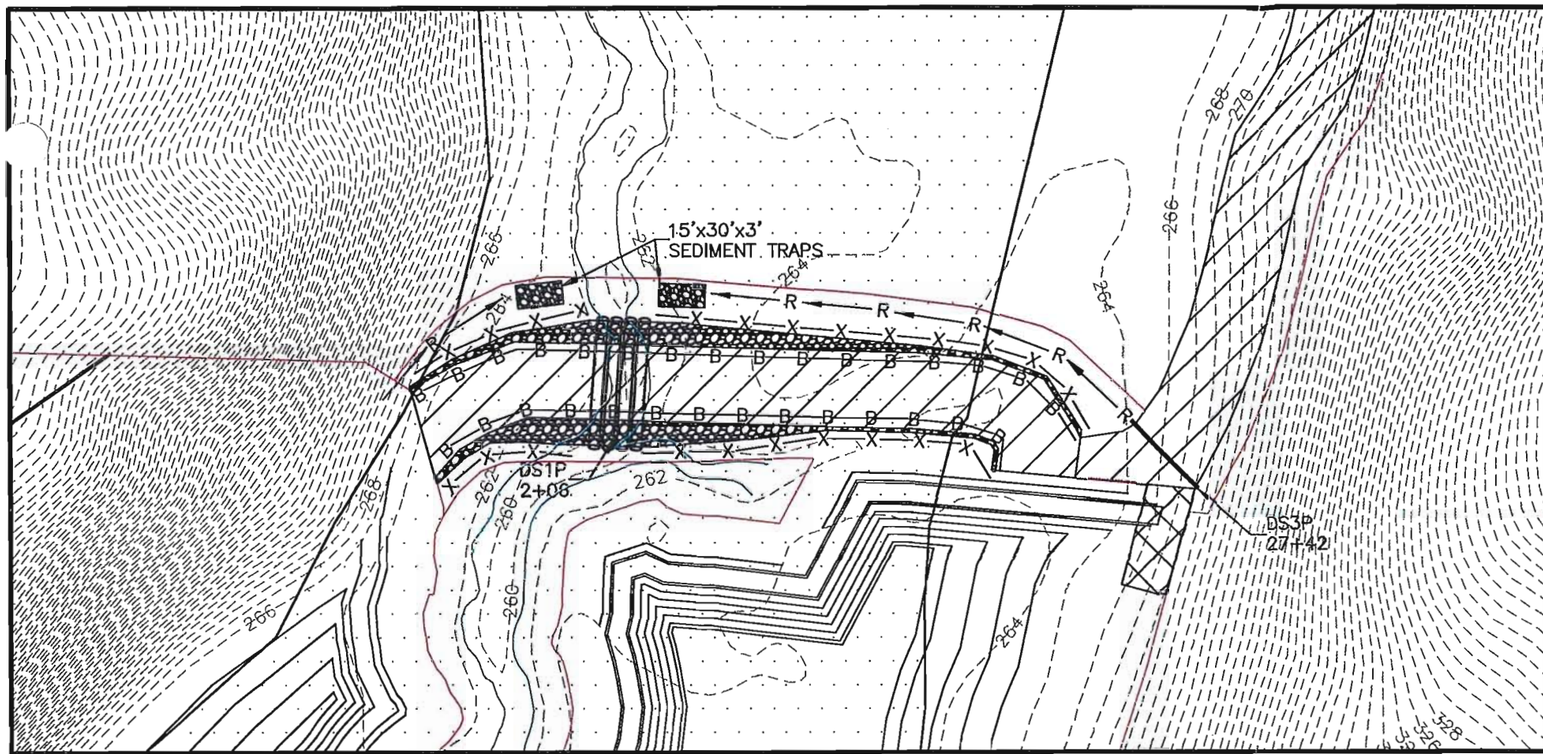
1606 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-3153 Office (205) 293-3114 Fax

CClay, Inc.
Skelton Creek Operation
P-3934
Primary Road 4P Profile

DRAWN BY: J.W.T. DWG. NAME: SCDSCS	DATE: 02/14/2012
APPROVED BY: L.G.S.	SCALE: AS NOTED

W:\Eng105\Mines\R&S Resor ...roadP\SCDSCS.dwg 06/14/12 14:46

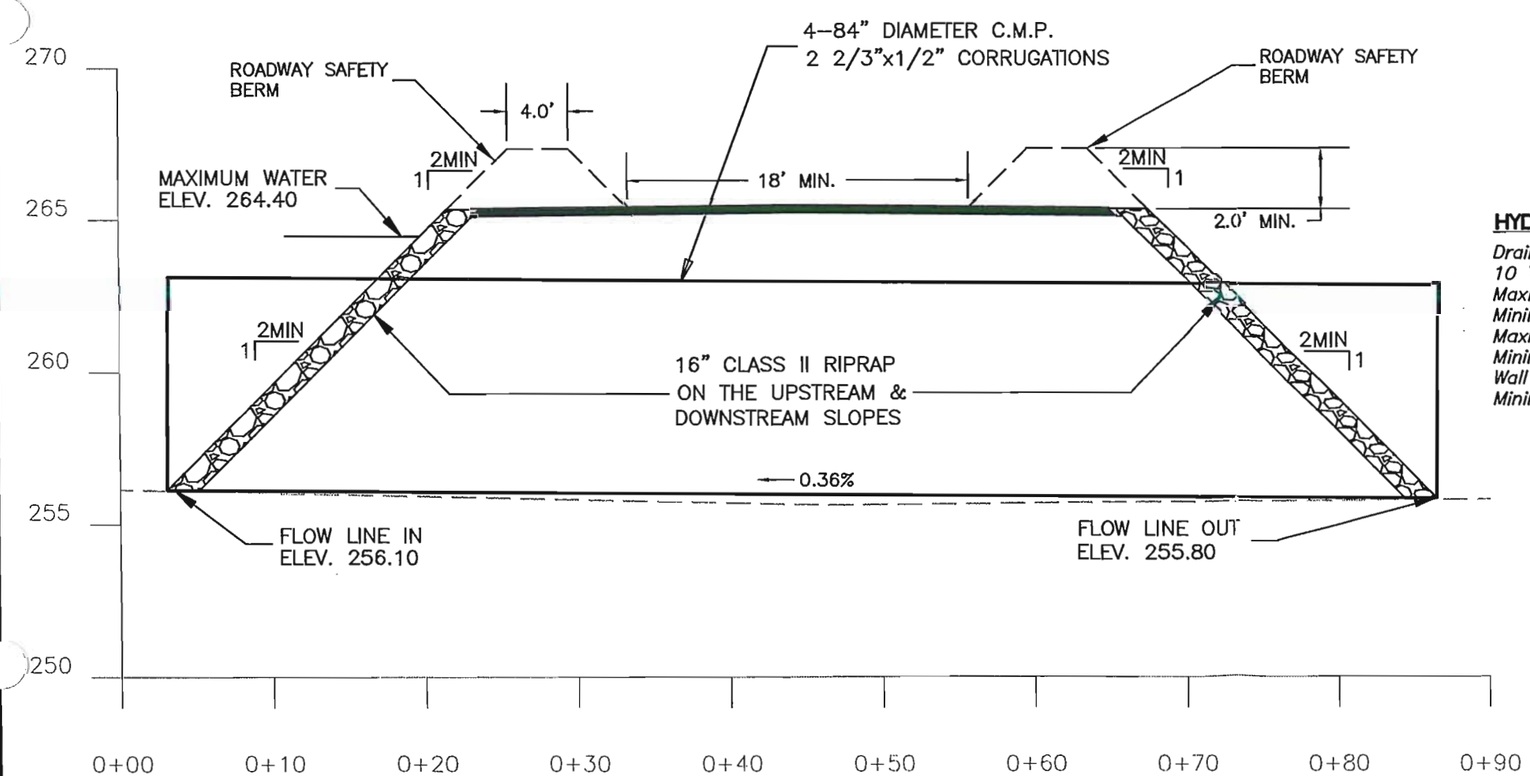


MAP LEGEND

- ROADSIDE DITCH
- SILT FENCE
- ROADWAY SAFETY BERM
- PERMIT BOUNDARY

PLAN VIEW

1" = 100'



HYDRAULICS INFORMATION

Drainage Area = 2630 Acres
10 YR.-6 HR., Q = 1240.9 C.F.S.
Maximum Water Elev. = 264.4
Minimum Fill Elev. = 265.4
Maximum Allowable Cover 84" C.M.P. = 66'
Minimum Allowable Cover 84" C.M.P. = 1'
Wall Thickness = 0.168"
Minimum Freeboard = 1'

CROSS SECTION

HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"=5'

PERC ENGINEERING CO. INC.

CClay, Inc.
Skelton Creek Operation
P-3934
Primary Road 4P
Drainage Structure DS1P 2+06
NW 1/4 of NW 1/4 of Section 1,
Township 17 South,
Range 6 West,
Jefferson County, Alabama

DRAWN BY:	J.W.T.	DATE:	02/14/2012
DWG. NAME:	SCDSCS		
APPROVED BY:	L.G.S.	SCALE:	AS NOTED

CURRENT DATE: 07-11-2012 FILE DATE: 07-11-2012
CURRENT TIME: 10:40:15 FILE NAME: SKELTON

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.2

CULV NO.	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	256.10	255.80	83.50	4 CSP	7.00	7.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: SKELTON DATE: 07-11-2012

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
259.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
259.18	180.0	180.0	0.0	0.0	0.0	0.0	0.0	0.00	1
260.12	360.0	360.0	0.0	0.0	0.0	0.0	0.0	0.00	1
261.06	540.0	540.0	0.0	0.0	0.0	0.0	0.0	0.00	1
261.96	720.0	720.0	0.0	0.0	0.0	0.0	0.0	0.00	1
262.80	900.0	900.0	0.0	0.0	0.0	0.0	0.0	0.00	1
263.61	1080.0	1080.0	0.0	0.0	0.0	0.0	0.0	0.00	1
264.37	1240.8	1240.8	0.0	0.0	0.0	0.0	0.0	0.00	1
265.36	1440.0	1440.0	0.0	0.0	0.0	0.0	0.0	0.00	1
266.24	1620.0	1575.2	0.0	0.0	0.0	0.0	0.0	43.25	2
267.00	1800.0	1681.7	0.0	0.0	0.0	0.0	0.0	118.24	3
265.40	1446.3	1446.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

Design flow

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: SKELTON DATE: 07-11-2012

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
259.00	0.000	0.00	0.00	0.00
259.18	0.000	180.00	0.00	0.00
260.12	0.000	360.00	0.00	0.00
261.06	0.000	540.00	0.00	0.00
261.96	0.000	720.00	0.00	0.00
262.80	0.000	900.00	0.00	0.00
263.61	0.000	1080.00	0.00	0.00
264.37	0.000	1240.85	0.00	0.00
265.36	0.000	1440.00	0.00	0.00
266.24	-0.007	1620.00	1.54	0.10
267.00	0.000	1800.00	0.05	0.00

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 07-11-2012 FILE DATE: 07-11-2012
CURRENT TIME: 10:40:15 FILE NAME: SKELTON

PERFORMANCE CURVE FOR CULVERT 1 - 4(7.00 (ft) BY 7.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	259.00	0.00	2.90	0-NF	0.00	0.00	0.00	3.20	0.00	0.00
180.00	259.18	2.50	3.08	3-M1t	2.20	1.67	3.20	3.20	2.62	0.00
360.00	260.12	3.63	4.02	3-M2t	3.21	2.41	3.20	3.20	5.25	0.00
540.00	261.06	4.57	4.96	3-M2t	4.11	2.99	3.20	3.20	7.87	0.00
720.00	261.96	5.46	5.86	2-M2c	5.04	3.49	3.49	3.20	9.39	0.00
900.00	262.80	6.32	6.70	2-M2c	7.00	3.91	3.91	3.20	10.19	0.00
1080.00	263.61	7.22	7.51	2-M2c	7.00	4.31	4.31	3.20	10.88	0.00
1240.85	264.37	8.08	8.27	2-M2c	7.00	4.62	4.62	3.20	11.53	0.00
1440.00	265.36	9.26	9.23	2-M2c	7.00	4.99	4.99	3.20	12.28	0.00
1575.21	266.24	10.14	9.94	2-M2c	7.00	5.21	5.21	3.20	12.85	0.00
1681.71	267.00	10.90	10.65	7-M2c	7.00	5.38	5.38	3.20	13.27	0.00

El. inlet face invert 256.10 ft El. outlet invert 255.80 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	0.00 ft
INLET ELEVATION	256.10 ft
OUTLET STATION	83.50 ft
OUTLET ELEVATION	255.80 ft
NUMBER OF BARRELS	4
SLOPE (V/H)	0.0036
CULVERT LENGTH ALONG SLOPE	83.50 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	7.00 ft
BARREL MATERIAL	CORRUGATED STEEL
BARREL MANNING'S n	0.024
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	THIN EDGE PROJECTING
INLET DEPRESSION	NONE

CURRENT DATE: 07-11-2012 FILE DATE: 07-11-2012
CURRENT TIME: 10:40:15 FILE NAME: SKELTON

ÄÄ
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ TAILWATER ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
ÄÄ
ÄÄ

CONSTANT WATER SURFACE ELEVATION
259.00

ÄÄ
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ROADWAY OVERTOPPING DATA ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
ÄÄ

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH	20.00 ft
CREST LENGTH	20.00 ft
OVERTOPPING CREST ELEVATION	265.40 ft

ÄÄ
▯

COMPANY: CClay, Inc.

LOCATION: Skelton Creek Operation

PROJECT: DSIP – PR4P

PERC ENGINEERING CO., INC.
1608 Highway 78 West • Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-5553 Office (205) 295-3114 Fax
www.percengco.com (205) 295-3115 Lab Fax

DATE: 03-20-2012

JOB NO.: P-3934

LEADER:

National Flood Frequency Program

$Q_{10} = 482A^{0.669} =$

$482(4.11^{0.669}) =$

$\boxed{1240.85 \text{ CFS}}$ used for Hydrain Analysis & Design

Flow Calculations (CFS)

A = Area in Square miles

$1 \text{ ac} = 0.0015625 \text{ mi}^2$

$2630.5 \text{ acres} \times \frac{0.0015625 \text{ mi}^2}{1 \text{ ac}} =$

$\boxed{4.11 \text{ mi}^2}$

$1 \text{ mi}^2 = 640 \text{ ACRES}$

$\frac{2630.5 \text{ ACRES}}{640 \text{ ACRES}} =$

USGS
science for a changing world

The National Flood-Frequency Program—Methods for Estimating Flood Magnitude and Frequency in Rural and Urban Areas in Alabama

Introduction

Estimates of the magnitude and frequency of flood-peak discharges and flood hydrographs are used for a variety of purposes, such as for the design of bridges, culverts, and flood-control structures; and for the management and regulation of flood plains. To provide simple methods of estimating flood-peak discharges, the U.S. Geological Survey (USGS) has developed and published equations for every State, the Commonwealth of Puerto Rico, and a number of metropolitan areas in the United States. In 1993, the USGS, in cooperation with the Federal Emergency Management Agency and the Federal Highway Administration, compiled all current USGS statewide and metropolitan area equations into a computer program, titled "The National Flood-Frequency (NFF) Program" (Jennings and others, 1994).

Since 1993, new or updated equations have been developed by the USGS for various areas of the Nation. These new equations have been incorporated into an updated version of the NFF Program.

Fact sheets that describe application of the updated NFF Program to various areas of the Nation are available. This fact sheet describes the application of the updated NFF Program to streams that drain rural and urban areas in Alabama.

Rural Basins

Alabama is divided into four hydrologic regions (fig. 1) on the basis of geology, physiography, and analyses of flood-frequency distributions. Atkins (1996) developed regression equations for estimating peak discharges (Q_T), in cubic feet per second, that have recurrence intervals (T) that range from 2 to 500 years for ungaged, unregulated, rural streams. The regression equations are not applicable to streams in urban areas, which were defined by Atkins (1996) as sites in which more than 5 percent of the drainage area is covered by impervious surfaces, or regulated or channelized streams.

Contributing drainage area (A) is the most statistically significant explanatory watershed variable and the only explanatory watershed variable that is used in the regression equations. Contributing drainage area is the total area that contributes runoff upstream of the stream site of interest. Contributing drainage areas were measured in square miles for the equations determined by Atkins (1996), but the NFF Program will accept input and report results in either the inch-pound or metric system of units.

The regression equations, the average standard errors of prediction, the equiva-

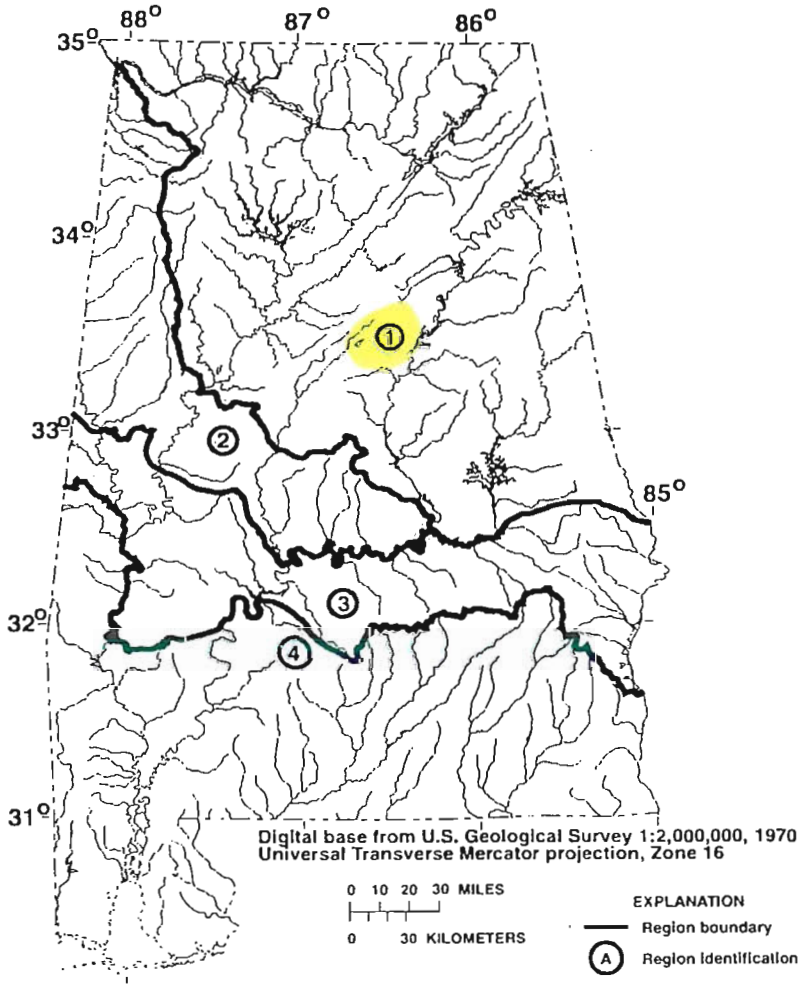


Figure 1. Hydrologic regions for Alabama.

lent years of record, and the range of the drainage area that is applicable for use in the equations are shown in table 1. The average standard error of prediction is a measure of the average accuracy of a regression equations when used to estimate peak-discharge values for ungaged watersheds similar to those that were used to derive the regression equations. The equivalent years of record is the number of years of streamflow record needed to achieve the same accuracy as the regression equation. The standard error of prediction increases appreciably when drainage-area values that are outside the quoted range of data used to develop the equations are applied in the equation.

When the drainage area of the site of interest is in more than one region, a weighted estimate of the peak discharge should be computed. The equations for the appropriate regions should be applied independently using basinwide estimates of the required explanatory variables as if the entire basin was in each region. The weighted estimate is then computed by multiplying each regional estimate against the fraction of the drainage area in that region and summing the products. The NFF Program provides an algorithm for this computation.

The regression equations were developed by using peak-discharge data for streamflow-gaging stations with at least 10 years of record collected through September 1991 at 198 locations in Alabama and 72 locations in Florida, Georgia, Mississippi, and Tennessee. Atkins (1996) summarized observed station-record, peak-discharge estimates, and regression-weighted estimates for 270 streamflow-gaging stations in Alabama and parts of adjacent States. Atkins (1996) also presented graphs of peak discharge as a function of drainage area for selected recurrence intervals for the Alabama, the Black Warrior, the Cahaba, the Choctawhatchee, the Conecuh, and the Tombigbee Rivers.

Urban Basins

Olin and Bingham (1982) developed regression equations for estimating urban peak discharges (Q_T) that have recurrence intervals (T) that range from 2 to 100 years (table 2). The explanatory basin variables used in the equations are contributing drainage area (A), in square miles, and the

Table 1. Flood-peak discharge regression equations and associated statistics for streams that drain rural areas in Alabama (modified from Atkins, 1996)

[Q_T, peak discharge for recurrence interval T, 2 to 500 years, in cubic feet per second; A, contributing drainage area; Do., ditto]

Regression equation	Average standard error of prediction, in percent	Equivalent years of record	Applicable range of drainage area, in square miles
	Region 1		
$Q_2 = 227A^{0.672}$	35	3	0.44–1,027
$Q_5 = 374A^{0.669}$	34	4	Do.
$Q_{10} = 482A^{0.669}$	35	5	Do.
$Q_{25} = 627A^{0.668}$	37	7	Do.
$Q_{50} = 739A^{0.667}$	39	7	Do.
$Q_{100} = 855A^{0.667}$	41	8	Do.
$Q_{200} = 974A^{0.666}$	43	9	Do.
$Q_{500} = 1,135A^{0.666}$	46	9	Do.
	Region 2		
$Q_2 = 163A^{0.664}$	40	3	0.13–831
$Q_5 = 295A^{0.654}$	36	4	Do.
$Q_{10} = 406A^{0.648}$	35	6	Do.
$Q_{25} = 573A^{0.640}$	35	9	Do.
$Q_{50} = 716A^{0.634}$	36	10	Do.
$Q_{100} = 877A^{0.628}$	37	11	Do.
$Q_{200} = 1,057A^{0.622}$	39	12	Do.
$Q_{500} = 1,327A^{0.614}$	43	12	Do.
	Region 3		
$Q_2 = 347A^{0.573}$	37	3	0.44–1,097
$Q_5 = 517A^{0.607}$	35	5	Do.
$Q_{10} = 638A^{0.626}$	34	7	Do.
$Q_{25} = 796A^{0.648}$	33	10	Do.
$Q_{50} = 914A^{0.663}$	33	12	Do.
$Q_{100} = 1,032A^{0.677}$	33	15	Do.
$Q_{200} = 1,148A^{0.689}$	34	17	Do.
$Q_{500} = 1,302A^{0.704}$	35	18	Do.
	Region 4		
$Q_2 = 169A^{0.616}$	38	3	1.44–1,344
$Q_5 = 313A^{0.608}$	33	6	Do.
$Q_{10} = 444A^{0.600}$	33	9	Do.
$Q_{25} = 650A^{0.592}$	35	12	Do.
$Q_{50} = 831A^{0.587}$	38	13	Do.
$Q_{100} = 1,035A^{0.583}$	42	13	Do.
$Q_{200} = 1,262A^{0.579}$	46	13	Do.
$Q_{500} = 1,601A^{0.576}$	52	13	Do.

Table 2. Flood-peak discharge regression equations and associated statistics for streams that drain urban areas in Alabama (from Olin and Bingham, 1982)

[Q_T, peak discharge for recurrence interval T, 2 to 100 years, in cubic feet per second; A, contributing drainage area; IA, impervious area; do., Do., ditto]

Regression equation	Average standard error of estimate, in percent	Applicable range of drainage area, in square miles	Applicable range of percent impervious area
$Q_2 = 150A^{0.70}\,IA^{0.36}$	26	0.16–83.5	8.3–42.9
$Q_5 = 210A^{0.70}\,IA^{0.39}$	24	do.	Do.
$Q_{10} = 266A^{0.69}\,IA^{0.39}$	24	do.	Do.
$Q_{25} = 337A^{0.69}\,IA^{0.39}$	24	do.	Do.
$Q_{50} = 396A^{0.69}\,IA^{0.38}$	25	do.	Do.
$Q_{100} = 444A^{0.69}\,IA^{0.39}$	25	do.	Do.

percentage of the basin that is covered by impervious area (IA). These variables can be estimated from topographic maps; IA can also be estimated from aerial photographs. The applicable range of basin variables used to develop the equations and the standard errors of estimate are summarized in table 2. The standard error of estimate is the standard deviation of the regression residuals and is a measure of the accuracy of a regression equation applied to the data used to develop the regression.

The urban equations are not applicable to region 3 (fig. 1), which is underlain by impervious chalk and marl. Caution should be used in estimating flood magnitudes in basins underlain by soluble limestone and in basins with sinkholes, quarries, or storage reservoirs. Such features can be identified by study of geologic and topographic maps or by reconnaissance of the basin. The equations do not apply to urban streams that are subject to temporary in-channel storage or overbank storage. For basins that contain less than 5 percent impervious area, the rural equations should be used.

Prepared by Robert R. Mason, Jr., of the U.S. Geological Survey; and Jeffrey N. King and Wilbert O. Thomas, Jr., of Michael Baker, Jr., Inc.

References

Atkins, J.B., 1996, Magnitude and frequency of floods in Alabama: U.S. Geological Survey Water-Resources Investigations Report 95–4199, 234 p.

Jennings, M.E., Thomas, W.O., Jr., and Riggs, H.C., comps., 1994, Nationwide summary of U.S. Geological Survey regional regression equations for estimating magnitude and frequency of floods for ungaged sites, 1993: U.S. Geological Survey Water-Resources Investigations Report 94–4002, 196 p.

Olin, D.A., and Bingham, R.H., 1982, Synthesized flood-frequency of urban streams in Alabama: U.S. Geological Survey Water-Resources Investigations Report 82–683, 23 p.

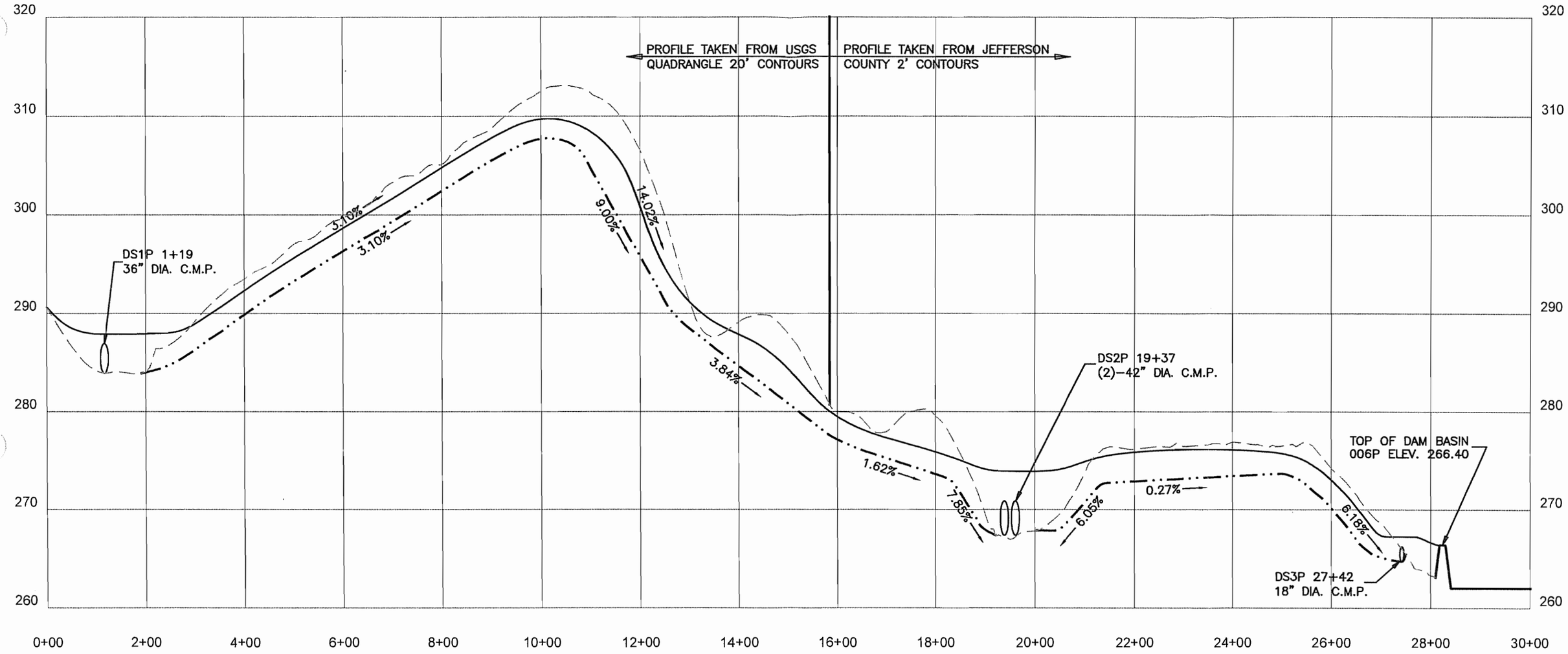
For more information contact:

U.S. Geological Survey
Office of Surface Water
415 National Center
Reston, Virginia 20192
(703) 648-5301

USGS hydrologic analysis software is available for electronic retrieval through the World Wide Web (WWW) at http://water.usgs.gov/software/ and through anonymous File Transfer Protocol (FTP) from water.usgs.gov (directory: /pub/software). The WWW page and anonymous FTP directory from which the National Flood-Frequency software and user documentation can be retrieved are http://water.usgs.gov/software/nff.html and /pub/software/surface_water/nff, respectively.

Additional earth science information is available from the USGS through the WWW at http://www.usgs.gov/ or by calling 1-800-426-9000.

Fact Sheet FS-088-97
Month and Year



LEGEND

- — — — NATURAL GROUND
- ——— PROPOSED FINISHED GRADE
- —··— PROPOSED ROADSIDE DITCH

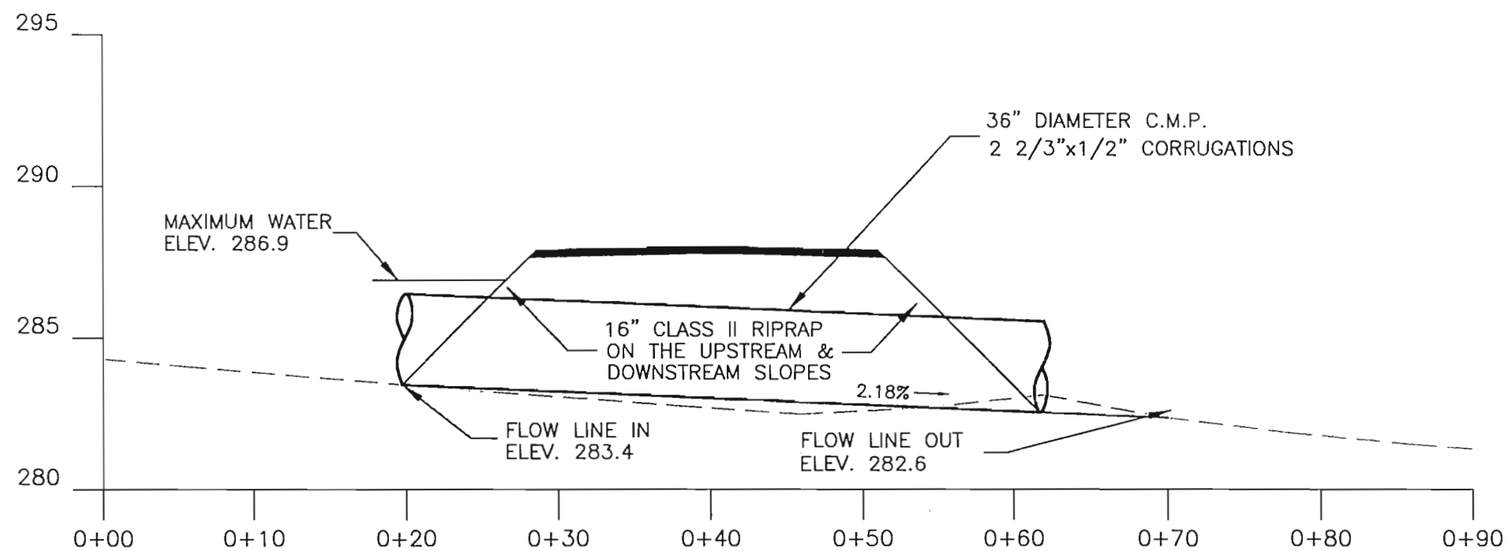
HORIZONTAL SCALE: 1"=200'
VERTICAL SCALE: 1"=10'

PERC ENGINEERING CO., INC.
1606 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-5553 Office (205) 295-3114 Fax

CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Primary Road 5P Profile

DRAWN BY:	J.W.T.	DATE:	02/16/2012
DWG. NAME:	SCDSCS		
APPROVED BY:	L.G.S.	SCALE:	AS NOTED

V:\Eng105\Lines\R&S Resto



CROSS SECTION

HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"=5'

HYDRAULICS INFORMATION

Drainage Area = 53.1 Acres
10 YR.-6 HR., Q = 34.1 C.F.S.
Maximum Water Elev. = 286.9
Minimum Fill Elev. = 287.9
Maximum Allowable Cover 36" C.M.P. = 83'
Minimum Allowable Cover 36" C.M.P. = 1'
Wall Thickness = 0.064"
Minimum Freeboard = 1'

PERC ENGINEERING CO., INC.

CClay, Inc.
Skelton Creek Operation
P-3934
Primary Road 5P
Drainage Structure DS1P 1+19
NW 1/4 of SW 1/4 of Section 1,
Township 16 South,
Range 6 West,
Jefferson County, Alabama

DRAWN BY: J.W.T. DWG. NAME: SCDSCS	DATE: 02/16/2012
APPROVED BY: L.G.S.	SCALE: AS NOTED

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CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Primary Road 5P
Drainage Structure DS1P

4.3 Inch, 10 Year-6 Hour

SCS 6 Hour

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	Rainfall Event

Accumulated Time (hrs)	Accumulated Depth (in)
0.00	0.0000
0.50	0.1510
1.00	0.3440
1.50	0.5810
2.00	0.9890
2.50	2.5800
3.00	3.0100
3.50	3.3540
4.00	3.5910
4.50	3.8060
5.00	3.9780
5.50	4.1500
6.00	4.3000

Peak 30-minute Intensity: 3.18 in/hr

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Culvert	#1	==>	End	0.000	0.000	~~SC5P~~ DS1P

#1
Culvert

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	53.100	53.100	34.11	5.41

Structure Detail:

Structure #1 (Culvert)

SC5P

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
60.00	2.18	0.0240	3.50	1.00	0.90

Culvert Results:

Design Discharge = 34.11 cfs

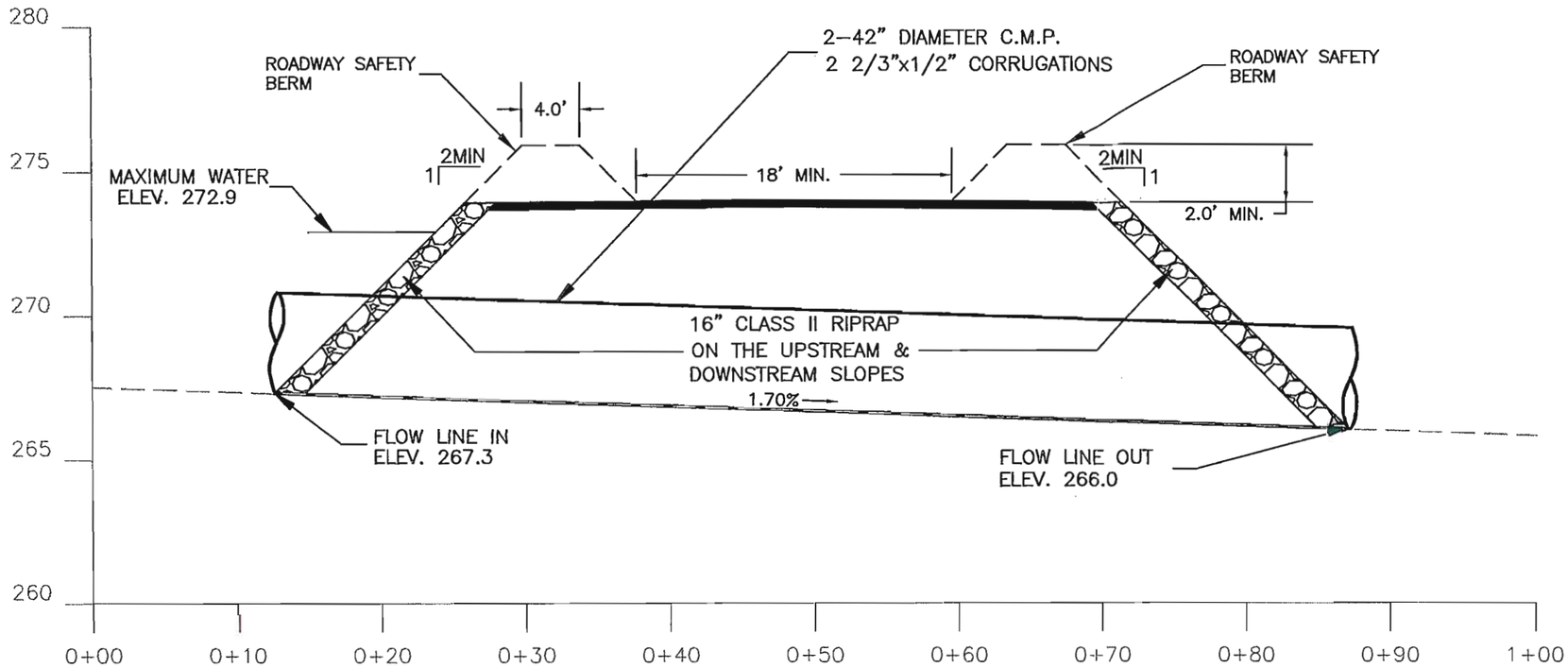
Minimum pipe diameter: 1 - 36 inch pipe(s) required

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	53.100	0.503	0.000	0.000	70.000	M	34.11	5.411
	$\sum$	**53.100**						**34.11**	**5.411**

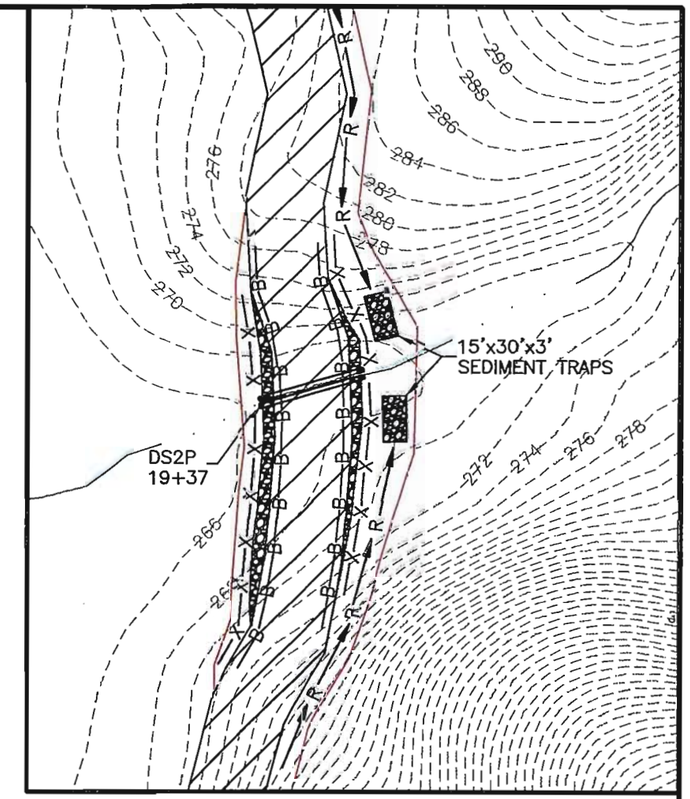
Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	21.00	42.00	200.00	1.150	0.048
		8. Large gullies, diversions, and low flowing streams	0.69	28.00	4,067.00	2.480	0.455
#1	**1**	**Time of Concentration:**					**0.503**



CROSS SECTION

HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"=5'



PLAN VIEW

1" = 100'

MAP LEGEND

—R—	ROADSIDE DITCH
—X—X—	SILT FENCE
—B—B—	ROADWAY SAFETY BERM
	PERMIT BOUNDARY

HYDRAULICS INFORMATION

Drainage Area = 187.5 Acres
10 YR.-6 HR., Q = 151.7 C.F.S.
Maximum Water Elev. = 272.9
Minimum Fill Elev. = 273.9
Maximum Allowable Cover 42" C.M.P. = 71'
Minimum Allowable Cover 42" C.M.P. = 1'
Wall Thickness = 0.064"
Minimum Freeboard = 1'

PERC ENGINEERING CO. INC.

CClay, Inc.
Skelton Creek Operation
P-3934
Primary Road 5P
Drainage Structure DS2P 19+37
NW 1/4 of NW 1/4 of Section 1,
Township 17 South,
Range 6 West,
Jefferson County, Alabama

DRAWN BY: J.W.T. DWG. NAME: SCDSCS	DATE: 02/14/2012
APPROVED BY: L.G.S.	SCALE: AS NOTED

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CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Primary Road 5P
Drainage Structure DS2P

4.3 Inch, 10 Year-6 Hour

SCS 6 Hour

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	Rainfall Event

Accumulated Time (hrs)	Accumulated Depth (in)
0.00	0.0000
0.50	0.1510
1.00	0.3440
1.50	0.5810
2.00	0.9890
2.50	2.5800
3.00	3.0100
3.50	3.3540
4.00	3.5910
4.50	3.8060
5.00	3.9780
5.50	4.1500
6.00	4.3000

Peak 30-minute Intensity: 3.18 in/hr

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Culvert	#1	==>	End	0.000	0.000	~~SC5P~~ DS2P

#1
Culvert

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	187.500	187.500	151.69	19.18

Structure Detail:

Structure #1 (Culvert)

SC5P

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
60.00	1.70	0.0240	6.00	1.00	0.90

Culvert Results:

Design Discharge = 151.69 cfs

Minimum pipe diameter: 1 - 66 inch pipe(s) required

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	187.500	0.278	0.000	0.000	70.000	M	151.69	19.181
	Σ	**187.500**						**151.69**	**19.181**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	35.00	70.00	200.00	1.490	0.037
		8. Large gullies, diversions, and low flowing streams	2.92	130.00	4,454.00	5.120	0.241
#1	**1**	**Time of Concentration:**					**0.278**

CURRENT DATE: 02-15-2012 FILE DATE: 02-15-2012
CURRENT TIME: 14:55:53 FILE NAME: SKELTON2

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.2

CULVERT NO.	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	267.30	266.50	50.01	2 CSP	3.50	3.50	.024	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: SKELTON2 DATE: 02-15-2012

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
268.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
268.70	20.0	20.0	0.0	0.0	0.0	0.0	0.0	0.00	1
269.34	40.0	40.0	0.0	0.0	0.0	0.0	0.0	0.00	1
269.91	60.0	60.0	0.0	0.0	0.0	0.0	0.0	0.00	1
270.45	80.0	80.0	0.0	0.0	0.0	0.0	0.0	0.00	1
271.31	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.00	1
271.75	120.0	120.0	0.0	0.0	0.0	0.0	0.0	0.00	1
272.38	140.0	140.0	0.0	0.0	0.0	0.0	0.0	0.00	1
272.86	151.7	151.7	0.0	0.0	0.0	0.0	0.0	0.00	1
274.19	180.0	180.0	0.0	0.0	0.0	0.0	0.0	0.00	1
275.30	200.0	200.0	0.0	0.0	0.0	0.0	0.0	0.00	1
276.00	211.3	211.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

Design Flow

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: SKELTON2 DATE: 02-15-2012

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
268.00	0.000	0.00	0.00	0.00
268.70	0.000	20.00	0.00	0.00
269.34	0.000	40.00	0.00	0.00
269.91	0.000	60.00	0.00	0.00
270.45	0.000	80.00	0.00	0.00
271.31	0.000	100.00	0.00	0.00
271.75	0.000	120.00	0.00	0.00
272.38	0.000	140.00	0.00	0.00
272.86	0.000	151.69	0.00	0.00
274.19	0.000	180.00	0.00	0.00
275.30	0.000	200.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 02-15-2012 FILE DATE: 02-15-2012
CURRENT TIME: 14:55:53 FILE NAME: SKELTON2

PERFORMANCE CURVE FOR CULVERT 1 - 2(3.50 (ft) BY 3.50 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	268.00	0.00	0.70	0-NF	0.00	0.00	0.00	1.50	0.00	0.00
20.00	268.70	1.40	1.40	1-S2n	0.88	0.94	0.89	1.50	5.12	0.00
40.00	269.34	2.04	2.04	1-S2n	1.28	1.37	1.29	1.50	6.23	0.00
60.00	269.91	2.61	0.70	1-S2n	1.61	1.69	1.62	1.50	6.90	0.00
80.00	270.45	3.15	0.70	1-S2n	1.91	1.96	1.92	1.50	7.41	0.00
100.00	271.31	3.72	4.01	2-M2c	2.21	2.20	2.20	1.50	7.85	0.00
120.00	271.75	4.36	4.45	2-M2c	2.53	2.42	2.42	1.50	8.44	0.00
140.00	272.38	5.08	4.90	2-M2c	2.94	2.61	2.61	1.50	9.11	0.00
151.69	272.86	5.56	5.19	2-M2c	3.50	2.72	2.72	1.50	9.48	0.00
180.00	274.19	6.89	6.38	7-M2c	3.50	2.92	2.92	1.50	10.52	0.00
200.00	275.30	8.00	7.39	7-M2c	3.50	3.05	3.05	1.50	11.27	0.00

El. inlet face invert 267.30 ft El. outlet invert 266.50 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

```
***** SITE DATA ***** CULVERT INVERT **************
      INLET STATION                          0.00 ft
      INLET ELEVATION                      267.30 ft
      OUTLET STATION                        50.00 ft
      OUTLET ELEVATION                     266.50 ft
      NUMBER OF BARRELS                      2
      SLOPE (V/H)                            0.0160
      CULVERT LENGTH ALONG SLOPE            50.01 ft

***** CULVERT DATA SUMMARY ************************
      BARREL SHAPE          CIRCULAR
      BARREL DIAMETER         3.50 ft
      BARREL MATERIAL       CORRUGATED STEEL
      BARREL MANNING'S n    0.024
      INLET TYPE            CONVENTIONAL
      INLET EDGE AND WALL   THIN EDGE PROJECTING
      INLET DEPRESSION      NONE
```

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CURRENT DATE: 02-15-2012                                  FILE DATE: 02-15-2012
CURRENT TIME: 14:55:53                                    FILE NAME: SKELTON2

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           CONSTANT WATER SURFACE ELEVATION
                     268.00

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ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ROADWAY OVERTOPPING DATA  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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      ROADWAY SURFACE                         GRAVEL
      EMBANKMENT TOP WIDTH                     20.00 ft
      CREST LENGTH                             25.00 ft
      OVERTOPPING CREST ELEVATION             276.00 ft

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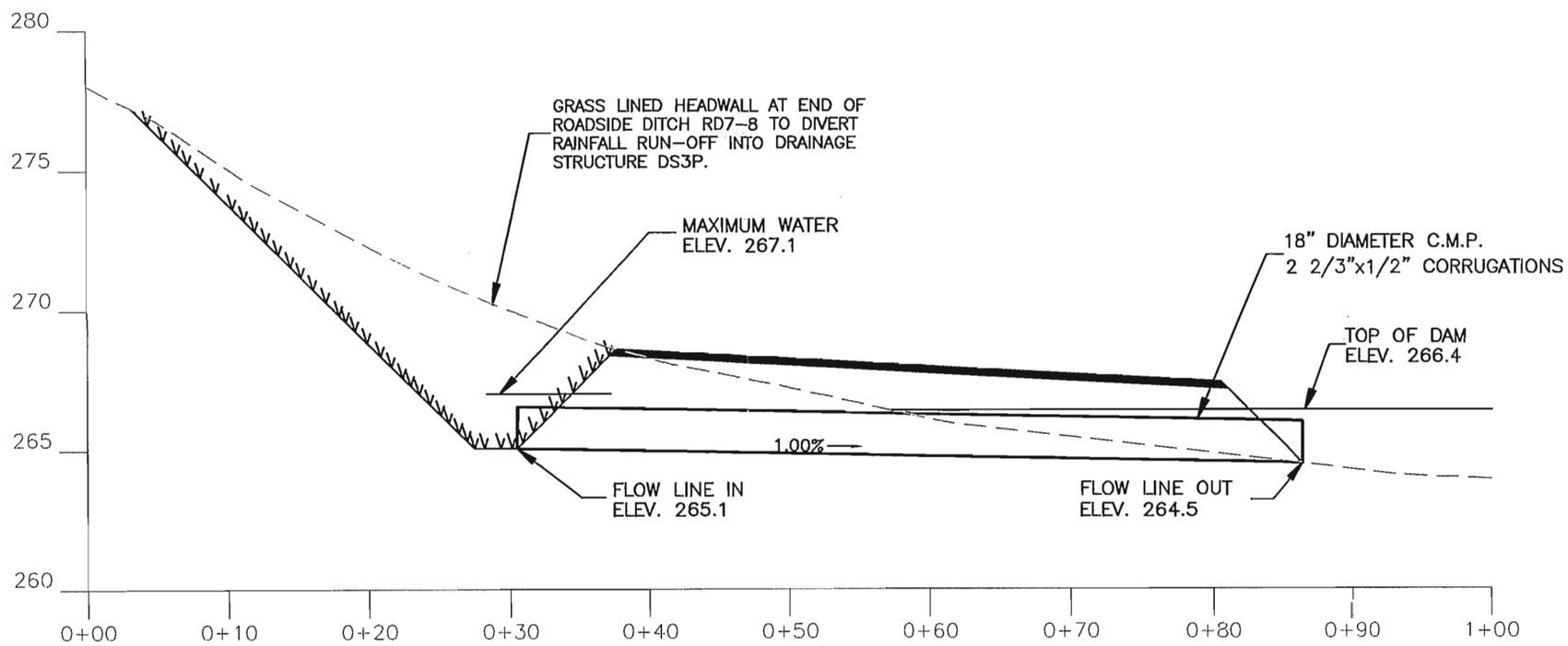


CROSS SECTION

HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"=5'

HYDRAULICS INFORMATION

Drainage Area = 2.1 Acres
10 YR.-6 HR., Q = 5.47 C.F.S.
Maximum Water Elev. = 272.5
Minimum Fill Elev. = 273.5
Maximum Allowable Cover 18" C.M.P. = 166'
Minimum Allowable Cover 18" C.M.P. = 1'
Wall Thickness = 0.064"
Minimum Freeboard = 1'

PERC ENGINEERING CO., INC.

CClay, Inc.
Skelton Creek Operation
P-3934
Primary Road 5P
Drainage Structure DS3P 27+42
NW 1/4 of NW 1/4 of Section 1,
Township 17 South,
Range 6 West,
Jefferson County, Alabama

DRAWN BY: J.W.T. DWG. NAME: SCDSCS	DATE: 06/08/2012
APPROVED BY: L.G.S.	SCALE: AS NOTED

CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Drainage Structure DS3P
Stations 27+42

4.3 Inch, 10 Year-6 Hour

NRCS Type II

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	4.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Culvert	#1	==>	End	0.000	0.000	Drainage Structure DS3P

#1
Culvert

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	2.100	2.100	5.47	0.27

Structure Detail:

Structure #1 (Culvert)

Drainage Structure DS3P

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
60.00	1.00	0.0240	2.00	1.00	0.90

Culvert Results:

Design Discharge = 5.47 cfs

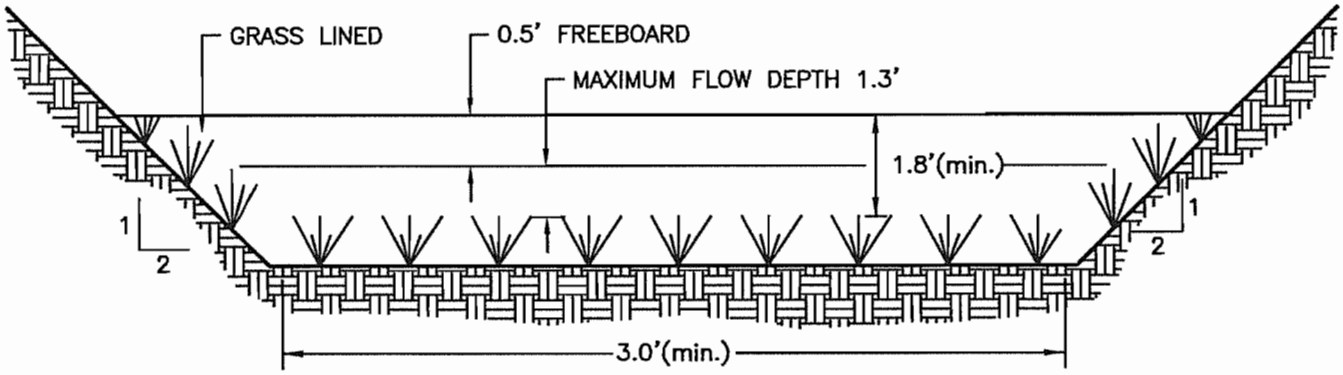
Minimum pipe diameter: 1 - 18 inch pipe(s) required

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	2.100	0.054	0.000	0.000	70.000	M	5.47	0.267
	$\sum$	**2.100**						**5.47**	**0.267**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	25.00	50.00	200.00	1.260	0.044
		8. Large gullies, diversions, and low flowing streams	13.81	58.00	420.00	11.140	0.010
#1	**1**	**Time of Concentration:**					**0.054**



GRASS LINING TO CONSIST OF BERMUDA GRASS.

PERC ENGINEERING CO., INC.
1605 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-3553 Office (205) 384-9491 Fax

CClay, Inc.
Skelton Creek Mine
P-3934 Revision R-1
Roadside Ditch RD1-2 Cross Section
Station 1+93 to 10+16

DRAWN BY: J.W.T. DWG. NAME: SCHR5RDCS	DATE: 06/08/2012
APPROVED BY: L.G.S.	SCALE: NONE

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CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Roadside Ditch RD1-2
Stations 1+93 to 10+16

4.3 Inch, 10 Year-6 Hour

NRCS Type II

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	4.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Roadside Ditch RD1-2

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	5.500	5.500	14.32	0.70

Structure Detail:

Structure #1 (Vegetated Channel)

Roadside Ditch RD1-2

Trapezoidal Vegetated Channel Inputs:

Material: Bermuda grass

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.00	2.0:1	2.0:1	3.1	D, B	0.50			8.0

Vegetated Channel Results:

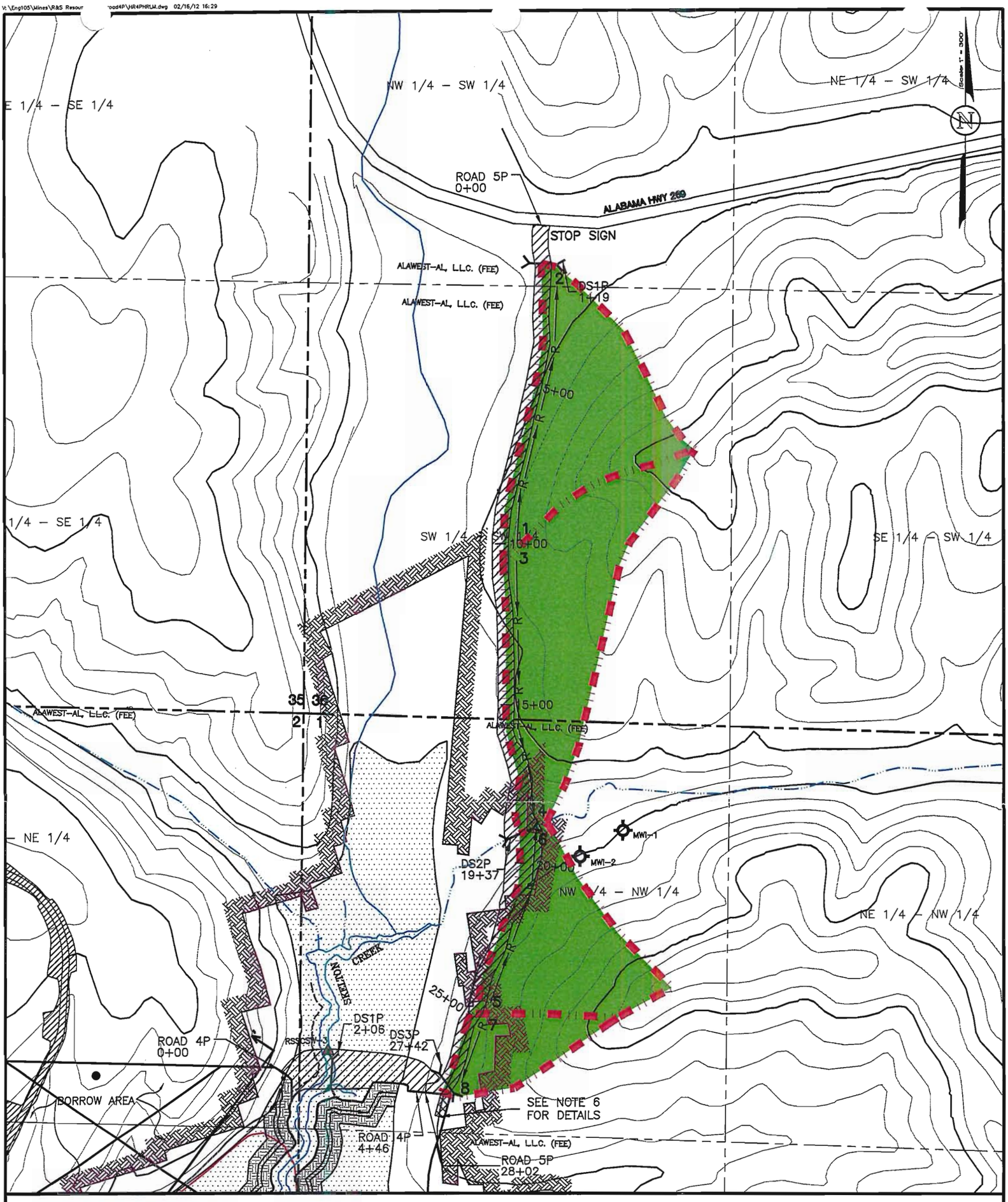
	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	14.32 cfs		14.32 cfs	
Depth:	0.80 ft	1.30 ft	1.30 ft	1.80 ft
Top Width:	6.21 ft	8.21 ft	8.19 ft	10.19 ft
Velocity:	3.88 fps		1.97 fps	
X-Section Area:	3.69 sq ft		7.26 sq ft	
Hydraulic Radius:	0.561 ft		0.825 ft	
Froude Number:	0.89		0.37	
Roughness Coefficient:	0.0460		0.1171	

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	5.500	0.093	0.000	0.000	70.000	M	14.32	0.700
	$\sum$	**5.500**						**14.32**	**0.700**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	12.50	25.00	200.00	0.890	0.062
		8. Large gullies, diversions, and low flowing streams	9.79	105.00	1,073.00	9.380	0.031
#1	**1**	**Time of Concentration:**					**0.093**



LEGEND

- Permit Boundary
- 600 Surface Contour
- 001 Sediment Basin
- Perennial Stream
- Intermittent Stream
- Diversion Ditch
- P–3601
- Primary Road
- Intermittent Stream
- Previously Disturbed Area
- Pond Embankment/Berm
- Existing Impoundment
- SBZ Stream Buffer Zone
- Praco Mines – Mary Lee Seam
- FRB Fines Removal Boundary – Located with HandheldNavigation Grade GPS on 1/19/2012.

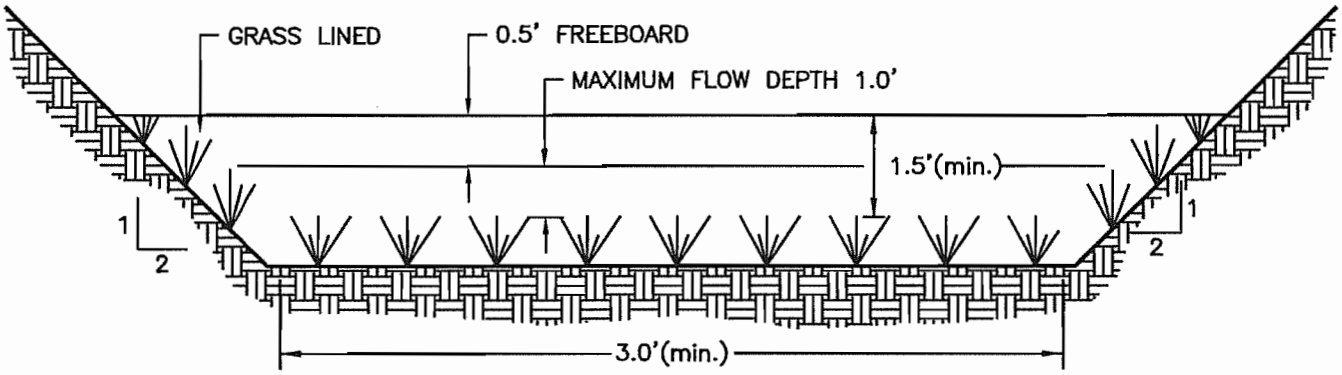
LAND USE INFORMATION

- Unmanaged Timberland, Curve Number 70

PERC ENGINEERING CO., INC.
1506 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-8553 Office (205) 384-9131 Fax

Attachment III-B-5
CClay, Inc.
Skelton Creek Operation
P-3934 / Revision R-1
ROADSIDE DITCH WATERSHED MAP

DRAWN BY: J.W.T. DWG. NAME: SCHR5RDWSM	DATE: 06/08/2012
APPROVED BY: L.G.S.	SCALE: 1"=300'



GRASS LINING TO CONSIST OF BERMUDA GRASS.

PERC ENGINEERING CO., INC.
1806 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-3533 Office (205) 384-9491 Fax

CClay, Inc.
Skelton Creek Mine
P-3934 Revision R-1
Roadside Ditch RD3-4 Cross Section
Station 10+16 to 12+59

DRAWN BY: J.W.T. DWG. NAME: SCHR5RDCS	DATE: 06/08/2012
APPROVED BY: L.G.S.	SCALE: NONE

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CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Roadside Ditch RD3-4
Stations 10+16 to 12+59

4.3 Inch, 10 Year-6 Hour

NRCS Type II

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	4.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Roadside Ditch RD3-4

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	6.700	6.700	17.44	0.85

Structure Detail:

Structure #1 (Vegetated Channel)

Roadside Ditch RD3-4

Trapezoidal Vegetated Channel Inputs:

Material: Bermuda grass

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.00	2.0:1	2.0:1	9.0	D, B	0.50			7.0

Vegetated Channel Results:

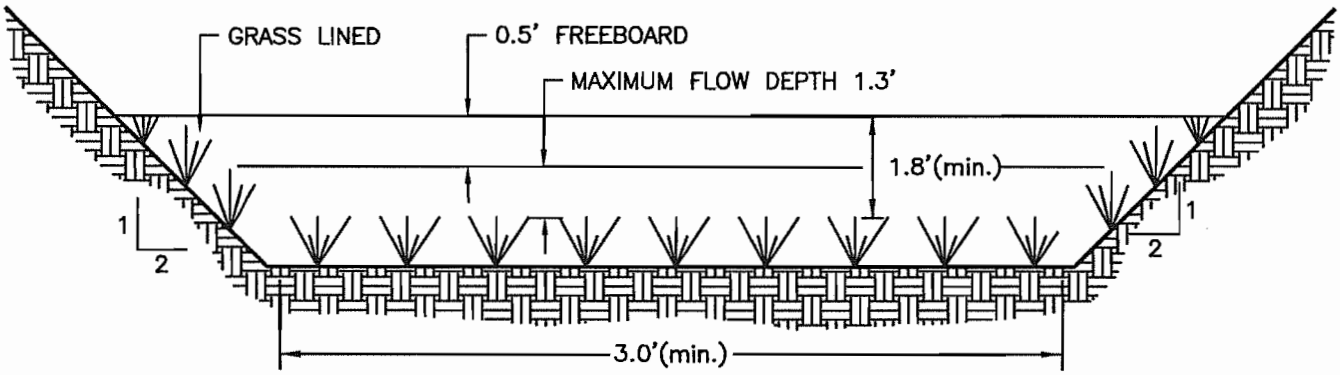
	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	17.44 cfs		17.44 cfs	
Depth:	0.64 ft	1.14 ft	0.99 ft	1.49 ft
Top Width:	5.54 ft	7.54 ft	6.97 ft	8.97 ft
Velocity:	6.42 fps		3.52 fps	
X-Section Area:	2.72 sq ft		4.95 sq ft	
Hydraulic Radius:	0.465 ft		0.665 ft	
Froude Number:	1.62		0.74	
Roughness Coefficient:	0.0418		0.0966	

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	6.700	0.083	0.000	0.000	70.000	M	17.44	0.853
	$\sum$	**6.700**						**17.44**	**0.853**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	20.00	40.00	200.00	1.130	0.049
		8. Large gullies, diversions, and low flowing streams	9.68	113.00	1,167.00	9.330	0.034
#1	**1**	**Time of Concentration:**					**0.083**



GRASS LINING TO CONSIST OF BERMUDA GRASS.

PERC ENGINEERING CO., INC.
1606 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-3551 Office (205) 384-9481 Fax

CClay, Inc.
Skelton Creek Mine
P-3934 Revision R-1
Roadside Ditch RD3-4 Cross Section
Station 12+59 to 15+84

DRAWN BY: J.W.T. DWG. NAME: SCHR5RDCS	DATE: 06/08/2012
APPROVED BY: L.G.S.	SCALE: NONE

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CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Roadside Ditch RD3-4
Stations 12+59 to 15+84

4.3 Inch, 10 Year-6 Hour

NRCS Type II

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	4.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Roadside Ditch RD3-4

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	6.700	6.700	17.44	0.85

Structure Detail:

Structure #1 (Vegetated Channel)

Roadside Ditch RD3-4

Trapezoidal Vegetated Channel Inputs:

Material: Bermuda grass

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.00	2.0:1	2.0:1	3.8	D, B	0.50			8.0

Vegetated Channel Results:

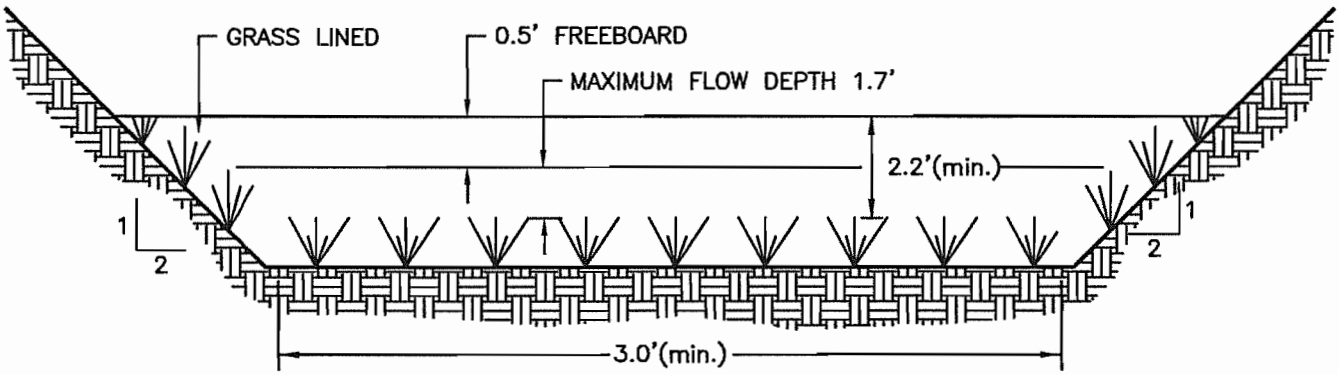
	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	17.44 cfs		17.44 cfs	
Depth:	0.82 ft	1.32 ft	1.29 ft	1.79 ft
Top Width:	6.27 ft	8.27 ft	8.15 ft	10.15 ft
Velocity:	4.61 fps		2.43 fps	
X-Section Area:	3.79 sq ft		7.18 sq ft	
Hydraulic Radius:	0.569 ft		0.820 ft	
Froude Number:	1.04		0.46	
Roughness Coefficient:	0.0434		0.1052	

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	6.700	0.083	0.000	0.000	70.000	M	17.44	0.853
	$\sum$	**6.700**						**17.44**	**0.853**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	20.00	40.00	200.00	1.130	0.049
		8. Large gullies, diversions, and low flowing streams	9.68	113.00	1,167.00	9.330	0.034
#1	**1**	**Time of Concentration:**					**0.083**



GRASS LINING TO CONSIST OF BERMUDA GRASS.

PERC ENGINEERING CO., INC.
1808 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-5553 Office (205) 384-9491 Fax

CClay, Inc.
Skelton Creek Mine
P-3934 Revision R-1
Roadside Ditch RD3-4 Cross Section
Station 15+84 to 18+29

DRAWN BY: J.W.T. DWG. NAME: SCHR5RDCS	DATE: 06/08/2012
APPROVED BY: L.G.S.	SCALE: NONE

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CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Roadside Ditch RD3-4
Stations 15+84 to 18+29

4.3 Inch, 10 Year-6 Hour

NRCS Type II

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	4.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Roadside Ditch RD3-4

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	6.700	6.700	17.44	0.85

Structure Detail:

Structure #1 (Vegetated Channel)

Roadside Ditch RD3-4

Trapezoidal Vegetated Channel Inputs:

Material: Bermuda grass

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.00	2.0:1	2.0:1	1.6	D, B	0.50			8.0

Vegetated Channel Results:

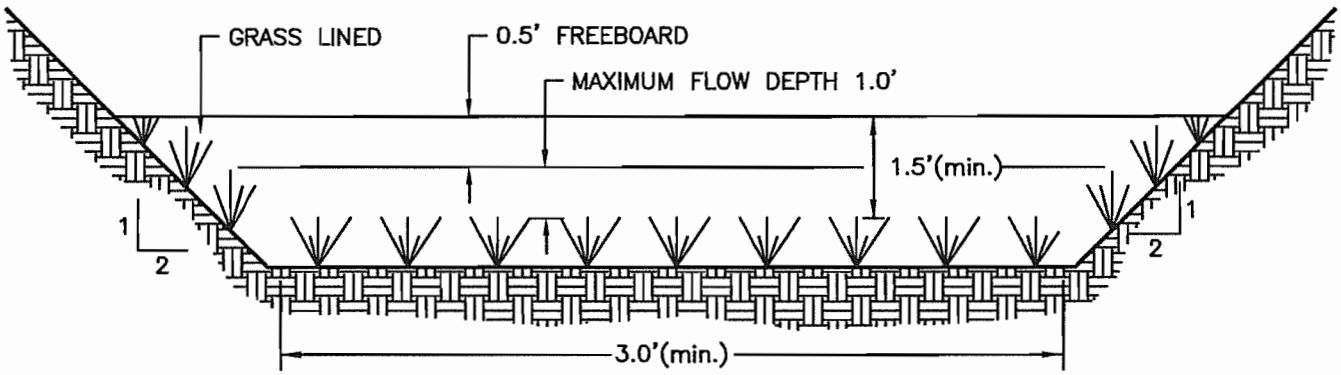
	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	17.44 cfs		17.44 cfs	
Depth:	1.05 ft	1.55 ft	1.67 ft	2.17 ft
Top Width:	7.18 ft	9.18 ft	9.67 ft	11.67 ft
Velocity:	3.27 fps		1.65 fps	
X-Section Area:	5.33 sq ft		10.56 sq ft	
Hydraulic Radius:	0.694 ft		1.010 ft	
Froude Number:	0.67		0.28	
Roughness Coefficient:	0.0454		0.1155	

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	6.700	0.083	0.000	0.000	70.000	M	17.44	0.853
	$\sum$	**6.700**						**17.44**	**0.853**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	20.00	40.00	200.00	1.130	0.049
		8. Large gullies, diversions, and low flowing streams	9.68	113.00	1,167.00	9.330	0.034
#1	**1**	**Time of Concentration:**					**0.083**



GRASS LINING TO CONSIST OF BERMUDA GRASS.

PERC ENGINEERING CO., INC.
1805 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-3553 Office (205) 384-9481 fax

CClay, Inc.
Skelton Creek Mine
P-3934 Revision R-1
Roadside Ditch RD3-4 Cross Section
Station 18+29 to 19+19

DRAWN BY: J.W.T. DWG. NAME: SCHR5RDCS	DATE: 06/08/2012
APPROVED BY: L.G.S.	SCALE: NONE

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CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Roadside Ditch RD3-4
Stations 18+29 to 19+19

4.3 Inch, 10 Year-6 Hour

NRCS Type II

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	4.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Roadside Ditch RD3-4

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	6.700	6.700	17.44	0.85

Structure Detail:

Structure #1 (Vegetated Channel)

Roadside Ditch RD3-4

Trapezoidal Vegetated Channel Inputs:

Material: Bermuda grass

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.00	2.0:1	2.0:1	7.8	D, B	0.50			7.0

Vegetated Channel Results:

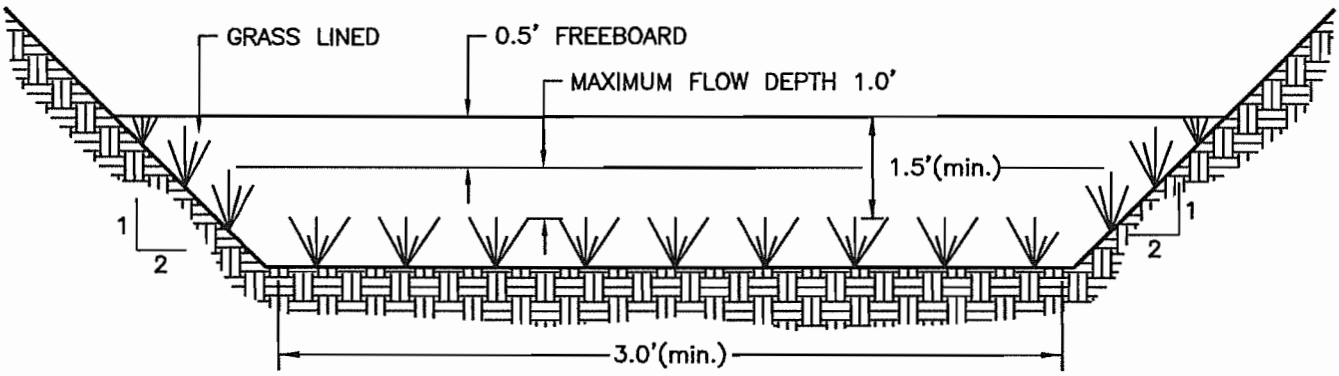
	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	17.44 cfs		17.44 cfs	
Depth:	0.66 ft	1.16 ft	1.03 ft	1.53 ft
Top Width:	5.65 ft	7.65 ft	7.14 ft	9.14 ft
Velocity:	6.09 fps		3.32 fps	
X-Section Area:	2.86 sq ft		5.25 sq ft	
Hydraulic Radius:	0.480 ft		0.688 ft	
Froude Number:	1.51		0.68	
Roughness Coefficient:	0.0420		0.0978	

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	6.700	0.083	0.000	0.000	70.000	M	17.44	0.853
	$\sum$	**6.700**						**17.44**	**0.853**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	20.00	40.00	200.00	1.130	0.049
		8. Large gullies, diversions, and low flowing streams	9.68	113.00	1,167.00	9.330	0.034
#1	**1**	**Time of Concentration:**					**0.083**



GRASS LINING TO CONSIST OF BERMUDA GRASS.

PERC ENGINEERING CO., INC.
1506 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-3553 Office (205) 384-9491 Fax

CClay, Inc.
Skelton Creek Mine
P-3934 Revision R-1
Roadside Ditch RD5-6 Cross Section
Station 20+04 to 21+30

DRAWN BY: J.W.T. DWG. NAME: SCHR5RDCS	DATE: 06/08/2012
APPROVED BY: L.G.S.	SCALE: NONE

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CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Roadside Ditch RD5-6
Stations 20+04 to 21+30

4.3 Inch, 10 Year-6 Hour

NRCS Type II

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	4.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Roadside Ditch RD5-6

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	4.200	4.200	10.93	0.53

Structure Detail:

Structure #1 (Vegetated Channel)

Roadside Ditch RD5-6

Trapezoidal Vegetated Channel Inputs:

Material: Bermuda grass

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.00	2.0:1	2.0:1	6.1	D, B	0.50			7.0

Vegetated Channel Results:

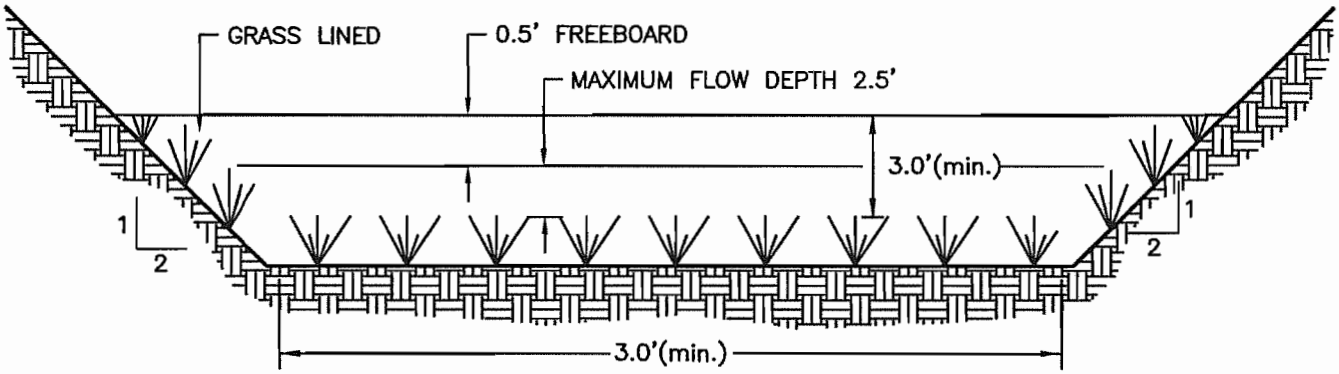
	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	10.93 cfs		10.93 cfs	
Depth:	0.59 ft	1.09 ft	0.98 ft	1.48 ft
Top Width:	5.36 ft	7.36 ft	6.92 ft	8.92 ft
Velocity:	4.43 fps		2.25 fps	
X-Section Area:	2.47 sq ft		4.85 sq ft	
Hydraulic Radius:	0.437 ft		0.658 ft	
Froude Number:	1.15		0.47	
Roughness Coefficient:	0.0476		0.1229	

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	4.200	0.081	0.000	0.000	70.000	M	10.93	0.534
	Σ	**4.200**						**10.93**	**0.534**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	12.50	25.00	200.00	0.890	0.062
		8. Large gullies, diversions, and low flowing streams	16.99	148.00	871.00	12.360	0.019
#1	**1**	**Time of Concentration:**					**0.081**



GRASS LINING TO CONSIST OF BERMUDA GRASS.

PERC ENGINEERING CO., INC.
1508 Highway 78 West Jasper, Alabama 35501
P.O. Box 1712 Jasper, Alabama 35502
(205) 384-3553 Office (205) 384-9491 Fax

CClay, Inc.
Skelton Creek Mine
P-3934 Revision R-1
Roadside Ditch RD5-6 Cross Section
Station 21+30 to 25+00

DRAWN BY: J.W.T. DWG. NAME: SCHR5RDCS	DATE: 06/08/2012
APPROVED BY: L.G.S.	SCALE: NONE

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CClay, Inc.

Skelton Creek Operation

P-3934 Revision R-1

Roadside Ditch RD5-6

Stations 21+30 to 25+00

4.3 Inch, 10 Year-6 Hour

NRCS Type II

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	4.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Roadside Ditch RD5-6

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	4.200	4.200	10.93	0.53

Structure Detail:

Structure #1 (Vegetated Channel)

Roadside Ditch RD5-6

Trapezoidal Vegetated Channel Inputs:

Material: Bermuda grass

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.00	2.0:1	2.0:1	0.3	D, B	0.50			8.0

Vegetated Channel Results:

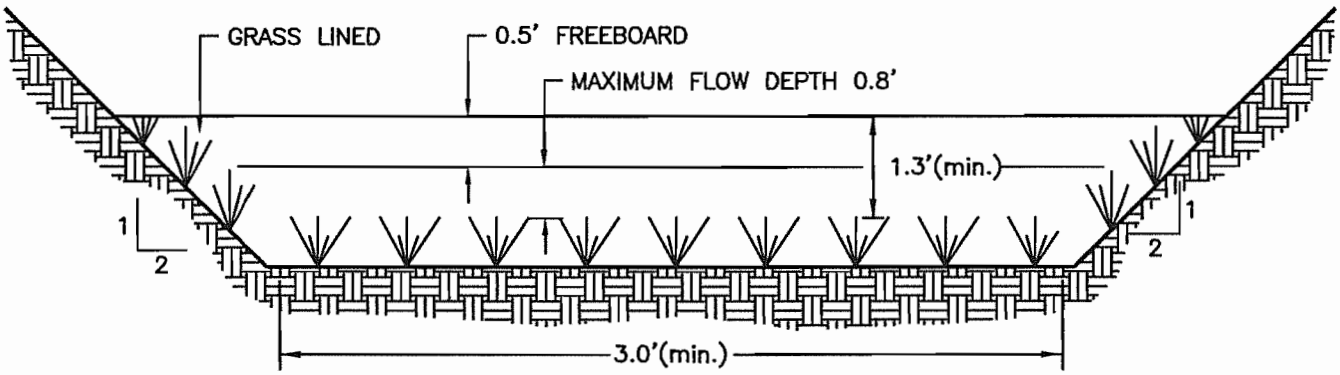
	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	10.93 cfs		10.93 cfs	
Depth:	1.44 ft	1.94 ft	2.46 ft	2.96 ft
Top Width:	8.76 ft	10.76 ft	12.85 ft	14.85 ft
Velocity:	1.29 fps		0.56 fps	
X-Section Area:	8.47 sq ft		19.51 sq ft	
Hydraulic Radius:	0.897 ft		1.392 ft	
Froude Number:	0.23		0.08	
Roughness Coefficient:	0.0557		0.1723	

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	4.200	0.081	0.000	0.000	70.000	M	10.93	0.534
	$\sum$	**4.200**						**10.93**	**0.534**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	12.50	25.00	200.00	0.890	0.062
		8. Large gullies, diversions, and low flowing streams	16.99	148.00	871.00	12.360	0.019
#1	**1**	**Time of Concentration:**					**0.081**



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CClay, Inc.
Skelton Creek Mine
P-3934 Revision R-1
Roadside Ditch RD7-8 Cross Section
Station 25+00 to 27+71

DRAWN BY: J.W.T. DWG. NAME: SCHR5RDCS	DATE: 06/08/2012
APPROVED BY: L.G.S.	SCALE: NONE

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CClay, Inc.
Skelton Creek Operation
P-3934 Revision R-1
Roadside Ditch RD7-8
Stations 25+00 to 27+71

4.3 Inch, 10 Year-6 Hour

NRCS Type II

JWT

PERC Engineering Co., Inc.
PO BOX 1712
Jasper, AL 35503

Phone: 205-384-5553
Email: John.Taylor@percengineering.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	4.300 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	Roadside Ditch RD7-8

#1
Chan'l

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	2.100	2.100	5.47	0.27

Structure Detail:

Structure #1 (Vegetated Channel)

Roadside Ditch RD7-8

Trapezoidal Vegetated Channel Inputs:

Material: Bermuda grass

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Retardance Classes	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.00	2.0:1	2.0:1	6.2	D, B	0.50			7.0

Vegetated Channel Results:

	Stability Class D w/o Freeboard	Stability Class D w/ Freeboard	Capacity Class B w/o Freeboard	Capacity Class B w/ Freeboard
Design Discharge:	5.47 cfs		5.47 cfs	
Depth:	0.44 ft	0.94 ft	0.79 ft	1.29 ft
Top Width:	4.76 ft	6.76 ft	6.17 ft	8.17 ft
Velocity:	3.20 fps		1.50 fps	
X-Section Area:	1.71 sq ft		3.64 sq ft	
Hydraulic Radius:	0.344 ft		0.556 ft	
Froude Number:	0.94		0.35	
Roughness Coefficient:	0.0566		0.1662	

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	2.100	0.054	0.000	0.000	70.000	M	5.47	0.267
	Σ	**2.100**						**5.47**	**0.267**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	25.00	50.00	200.00	1.260	0.044
		8. Large gullies, diversions, and low flowing streams	13.81	58.00	420.00	11.140	0.010
#1	**1**	**Time of Concentration:**					**0.054**