FINAL DRAINAGE REPORT

BULLDOG #5-31H-790
COMPLETION PIT
MOFFAT COUNTY, COLORADO

PREPARED FOR:
AXIA ENERGY INC.
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DENVER, CO 80202
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CONTACT: JESS PEONIO

PREPARED BY:
OLSSON ASSOCIATES
826 21 ½ ROAD
GRAND JUNCTION, CO 81505
PH: (970) 263-7800
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WYATT E. POPP, PE, LEED AP

JULY 9, 2012

OLSSON ASSOCIATES
PROJECT NO. 012-1222

ENGINEER'S STATEMENT

I hereby certify that this *Final Drainage Report* for the design of Axia Energy Inc., Bulldog #5-31H-790 Completion Pit was prepared by me, or under my direct supervision, in accordance with the provisions of the *Stormwater Management Manual* for the owners thereof. I understand that Moffat County does not and will not assume liability for drainage facilities designed by others.

COLORADO REGISTERED WYATT EARP PORP 38514 PROFESSIONAL ENGINEER

Wyatt E. Po[illegible], PE
Registered Professional Engineer
State of Colorado No. 38514

7/11/12
Date

OWNER'S STATEMENT

I, J. Peonio / Axia Energy, hereby certify that the drainage facilities for Axia Energy Inc., Bulldog #5-31H-790 Completion Pit shall be constructed according to the design presented in this report. I understand that Mesa County does not and will not assume liability for the drainage facilities designed and/or certified by my engineer. I understand that Mesa County reviews drainage plans but cannot, on behalf of Axia Energy Inc., Bulldog #5-31H-790 Completion Pit, guarantee that final drainage design review will absolve _____ and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the Final Plat and/or Final Development Plan does not imply approval of my engineer's drainage design.

Axia Energy, LLC
Owner/Developer

Authorized Signature

7/11/12
Date

TABLE OF CONTENTS

I. INTRODUCTION

A. Background

This Final Drainage Report has been prepared for Axia Energy LLC, Bulldog #5-31H-790 Completion Pit (the SITE) by Olsson Associates. This report evaluates the SITE's historic drainage patterns, analyzes the change in stormwater quantity/quality associated with existing development, and provides design to alleviate the impacts of increased stormwater runoff due to the proposed development.

B. Project Location

The SITE is located in the NW ¼ of the NE ¼ of Section 5, Township 7 North, Range 90 West of the Sixth Principal Meridian, County of Moffat, State of Colorado. Refer to Figure 1 for project location.

The SITE is approximately 5.5 miles north of the town of Craig, Colorado on County Road 112. County Road 112 is located approximately 0.85 miles west of the site, and County Road 22 is located approximately 1.6 miles to the south.

Figure 1: Vicinity Map

C. Property Description

The SITE consists of a total disturbance around 3.4 acres which consists of a completion pit graded into hilly terrain and an access road turnaround. Prior to development, the SITE is covered by native vegetation, and sheet flows from southwest to northeast.

According to the NRCS Web Soil Survey, soils in the area of the SITE consist of Forelle loam on 3 to 12% slopes, which are classified as hydrologic group Type B. A soil map and description of NRCS soil groups from NRCS is included within Appendix A.

D. Previous Investigations

To our knowledge, no previous drainage studies have been approved for the SITE.

II. DRAINAGE SYSTEM DESCRIPTION

A. Existing Drainage Conditions

The SITE drains to Coon Gulch to the northeast which eventually empties into Fortification Creek to the east. Refer to the General Location Map in Appendix A for the SITE location relative to major tributary drainage ways.

The SITE generally slopes from the southwest to the northeast at approximately 4.0% to 7.0% slope. The SITE generally drains via overland flow to existing swales which flow to Coon Gulch. The Rational Method for determining runoff per the Colorado Floodplain and Stormwater Criteria Manual (the MANUAL) and the Urban Drainage and Flood Control District's *Urban Storm Drainage Criteria Manual* has been applied resulting in Historic peak flow rates listed in Table 1, and calculations of each flow rate are presented in Appendix B.

Table 1: Historic Peak Runoff

Drainage Basin	Area (Ac)	25-YR Peak Flow (cfs)	100-YR Peak Flow (cfs)
NORTH - Swale on the north side of Completion Pit	2.93	1.94	3.38
SOUTH - Swale on the south side of Completion Pit	0.19	0.16	0.27
CP – Completion Pit Area	2.82	2.22	3.87

B. Master Drainage Plan

To our knowledge, no master drainage studies have analyzed the SITE.

C. Offsite Tributary Area

The SITE will not be adversely affected by stormwater from adjacent land. The offsite run-on will be diverted around the site by proposed grass lined drainage swale and released. For the purposes of this study, all adjacent land was assumed to remain undeveloped in the

foreseeable future.

An access road will be constructed across an existing channel. A culvert will be designed to handle the 100-YR flow from the tributary area draining to this point. Calculations are shown in Appendix C.

During construction, run-off from the SITE should be treated prior to leaving the SITE using methods described in Vol. 3 of the Urban Drainage and Flood Control District's Urban Storm Drainage Criteria Manual, including use of straw bales and/or other methods to provide temporary water quality.

D. Proposed Drainage System Description

Three basins were used to model the SITE and existing run-on. Stormwater generated by the existing run-on will be collected in two grass lined drainage swales on the north and south sides of the Completion Pit. The drainage swales will direct stormwater around the Completion Pit and discharge along the north and south corners of the SITE. The proposed access road across the north swale will be conveyed under the road via a culvert.

Drainage Basin	Area (Ac)	25-YR Peak Flow (cfs)	100-YR Peak Flow (cfs)
NORTH	2.93	1.92	3.35
SOUTH	0.19	0.14	0.24
CP*	2.82	7.92	10.30

*CP – Completion Pit facility will not release stormwater.

The Completion Pit will be rectangular, approximately 19'-7" deep with 2:1 side slopes. The dimensions will be 250'x400' at the top of the embankment, which is at elevation 6519.00', providing 2'-0" of freeboard height. Access to the detention pond for maintenance can be provided on the north portion of the embankment.

The Completion Pit will provide storage for 206,198 Barrels of used water at the maximum design elevation of 6517.0'. The pond will not release any water and will not have an outlet structure or overflow spillway. Stormwater captured by the water impoundment pond will not be discharged onto the existing adjacent property. The waters contained within the completion pit will be trucked in and out. The pond will be self-contained and lined with a single impervious HDPE liner and will be equipped with a leak detection system. The bottom of the pond has a 1% slope swale to facilitate draining, and the bottom is sloped at 2% to the swale.

The pond will not be considered jurisdictional, as the maximum difference in height between the embankment and existing ground is 9.5 feet. Without any outlet structure or overflow spillway, the definition of a jurisdictional embankment height becomes 10 feet or more from the top of the embankment to the existing ground.

The drainage swales will be triangular in shape, 6 feet wide, 1 foot deep, with side slopes of 3:1. The swales have a capacity of 15 cfs at a 3% slope, which is more than adequate to convey the 100-year off-site stormwater flows. Although larger than necessary, swales of

any smaller size become difficult to construct and maintain.

Refer to Appendix B for developed condition hydrologic calculations and Appendix C for hydraulic calculations.

E. Drainage Facility Maintenance

The owner shall be responsible for maintaining all on-site drainage facilities. A minor amount of continuous maintenance will be necessary to keep vegetation established and the leak detection system working in its original designed capacity. Although the completion pit is not meant for stormwater, the pond bottom should be scraped and regraded as needed to remove sediment build-up. In addition, the pond should be examined after any significant rainfall event to ensure proper functionality.

III. DRAINAGE ANALYSIS AND DESIGN CRITERIA

A. Regulations

This report has been prepared in accordance with criteria set forth in the MANUAL and the Urban Drainage and Flood Control District's Urban Storm Drainage Criteria Manual.

B. Development Criteria

There are no known constraints placed on the SITE due to floodplain studies, master studies or adjacent property drainage studies. The SITE will not receive any tributary flows from upstream land or adjacent development.

C. Hydrologic Criteria

Hydrologic calculations have been prepared in accordance with criteria set forth in the MANUAL. Refer to Appendix B for all hydrologic calculations.

D. Hydraulic Criteria

Hydraulic calculations have been prepared in accordance with criteria set forth in the MANUAL and the Urban Drainage and Flood Control District's Urban Storm Drainage Criteria Manual. Refer to Appendix C for all hydraulic calculations.

E. Variance from Criteria

No variances from criteria set forth in the MANUAL are requested at this time.

IV. POST-CONSTRUCTION STORMWATER MANAGEMENT

A. Stormwater Quality Control Measures

The proposed grass lined drainage swale will provide a means for offsite run-on stormwater to be routed around the SITE during all post-construction storm events.

B. Calculations

All Hydrologic Calculations can be found in Appendix B.

All Hydraulic Calculations can be found in Appendix C.

V. CONCLUSIONS

A. Compliance with Manual

This report has been prepared in accordance with criteria set forth in the MANUAL and the Urban Drainage and Flood Control District's Urban Storm Drainage Criteria Manual.

B. Design Effectiveness

Proper implementation of the proposed measures outlined in this report will alleviate the direct impacts of stormwater run-off on adjacent, downstream lands. The quantity of stormwater released from the SITE will be equivalent to, or less than historic conditions.

A registered licensed engineer in the state of Colorado has been consulted for the preparation of construction plans related to the recommendations outlined within this report.

C. Areas in Flood Hazard Zone

The SITE is not within a FEMA-designated flood hazard zone. Refer to the FIRM Map in Appendix A for the SITE location relative to FEMA designated flood plains.

D. Variance from Manual

No variances from the MANUAL are requested at this time.

VI. REFERENCES

1) Colorado Floodplain and Stormwater Criteria Manual
2) Urban Drainage and Flood Control District Urban Storm Drainage and Criteria Manual, Vols. 1-3

APPENDIX A: MAPS AND EXHIBITS

DRAINAGE PLAN NOTES:

1. NO BUILDING, STRUCTURE, OR FILL WILL BE PLACED IN THE COMPLETION PIT AND NO CHANGES OR ALTERATIONS AFFECTING THE HYDRAULIC CHARACTERISTICS OF THE COMPLETION PIT WILL BE MADE WITHOUT THE APPROVAL OF THE COUNTY.
2. MAINTENANCE AND OPERATION OF THE COMPLETION PIT AREA IS THE RESPONSIBILITY OF THE PROPERTY OWNER. IF OWNER FAILS IN THIS RESPONSIBILITY, THE COUNTY HAS THE RIGHT TO ENTER THE PROPERTY, MAINTAIN THE COMPLETION PIT AREA, AND BE REIMBURSED FOR COSTS INCURRED.
3. COMPLETION PIT VOLUMES AND BASIN BOUNDARIES SHALL BE VERIFIED. AS-BUILT DRAWINGS SHALL BE PREPARED BY A REGISTERED PROFESSIONAL ENGINEER PRIOR TO ISSUANCE OF CERTIFICATE OF OCCUPANCY FOR ANY STRUCTURE WITHIN THE DEVELOPMENT.
4. PERMISSION TO REPRODUCE THESE PLANS IS HEREBY GIVEN TO MOFFAT COUNTY FOR COUNTY PURPOSES ASSOCIATED WITH PLAN REVIEW, APPROVAL, PERMITTING, INSPECTION AND CONSTRUCTION OF WORK.

LEGEND

- DRAINAGE BOUNDARY
- 6400 PROPOSED MAJOR CONTOUR
- 6400 PROPOSED MINOR CONTOUR
- PROPOSED DRAINAGE FLOW DIRECTION

XX — BASIN DESIGNATION
X.XX — 25-YR RUNOFF COEFF.
.XX — 100-YR RUNOFF COEFF.
.XX — BASIN AREA IN AC.

N

1" = 40'

0' 20' 40' 80'

SCALE IN FEET

OLSSON ASSOCIATES
4690 Table Mountain Drive, Suite 200
Golden, CO 80403
TEL 303.237.2072
FAX 303.237.2659
www.olssonassociates.com

NOTE
THIS DOCUMENT HAS BEEN RELEASED BY OLSSON ASSOCIATES ONLY FOR REVIEW BY REGULATORY AGENCIES AND OTHER PROFESSIONALS, AND IS SUBJECT TO CHANGE. THIS DOCUMENT IS NOT TO BE USED FOR CONSTRUCTION.

OLSSON ASSOCIATES ASSUMES NO RESPONSIBILITY FOR EXISTING UTILITY LOCATIONS (HORIZONTAL OR VERTICAL). THE EXISTING UTILITIES SHOWN ON THIS DRAWING HAVE BEEN PLOTTED FROM THE BEST AVAILABLE INFORMATION. IT IS HOWEVER THE RESPONSIBILITY OF THE CONTRACTOR TO FIELD VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION ACTIVITIES.

811 Know what's below. Call before you dig.
CALL 811 SEVENTY-TWO HOURS PRIOR TO DIGGING, GRADING OR EXCAVATING FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES

REV. NO.	DATE	REVISIONS DESCRIPTION
		REVISIONS

DRAINAGE PLAN

AXIA ENERGY COMPLETION PIT
MOFFAT COUNTY, COLORADO

CRAIG, COLORADO

2012

drawn by:	MEO
checked by:	WEP
approved by:	WEP
QA/QC by:	LP
project no.:	012-1222
drawing no.:	
date:	06.22.2012

SHEET
6

DWG: F:\Projects\012-1222_WTRS\Final_Plans\121222_DRNG.dwg USER: cuhrich
DATE: Jul 09, 2012 5:21pm XREFS: 121222_XBASE 121222_PBASE 121222_BRDR 121222_PTOPO 121222_XTOPO Drainage

APPENDIX B: HYDROLOGIC CALCULATIONS

DESCRIPTION	Axia Bulldog #5-31H-790 Completion Pit
ULTIMATE OR INITIAL	Draft Drainage Study
DESIGNER	MEO
CITY OR COUNTY	Moffat County

1 HOUR DESIGN POINT RAINFALL VALUES-NOAA ATLAS FOR COLORADO

2 YR	0.56
5 YR	0.80
10 YR	0.90
25 YR	1.10
50 YR	1.25
100 YR	1.37

24 HOUR DESIGN POINT RAINFALL VALUES-NOAA ATLAS FOR COLORADO (MAY-OCT)

2 YR	1.10	0.95
5 YR	1.50	1.30
10 YR	1.70	1.50
25 YR	2.05	1.90
50 YR	2.25	2.10
100 YR	2.50	2.30

		Return Period					
		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Duration	6-hr	0.86	1.15	1.30	1.55	1.70	1.90
	24-hr	1.10	1.50	1.70	2.05	2.25	2.50
	1-hr	0.56	0.80	0.90	1.10	1.25	1.37

Elevation:	6520	feet	interpolated
	65	in hundreds of feet	

Estimating 1-hr: Region 3:

Yampa and Green River Basins above confluence of Green and Yampa Rivers
From Table 11, Atlas 2, Volume 3

$Y_2 = 0.019+0.711[(X_1)(X_1/X_2)]+0.001Z$

$Y_{100} = 0.338+0.670[(X_3)(X_3/X_4)]+0.001Z$

Y_2= 2-yr 1-hr estimated value

Y_{100}= 100-yr 1-hr estimated value

X_1= 2-yr 6-hr value from precipitation-frequency maps

X_2= 2-yr 24-hr value from precipitation-frequency maps

X_3= 100-yr 6-hr value from precipitation-frequency maps

X_3= 100-yr 24-hr value from precipitation-frequency maps

Z= point elevation in hundreds of feet

**1-HR VALUES NOT VALID FOR OTHER REGIONS OF COLORADO. SEE FIGURE 19, ATLAS 2, VOL 3

Basin	Subbasin	Undeveloped			Developed	TOTALS
Proposed		159800.5073	0	0	100000	259800.5073
	N	128893				128893.3522
	S	9506				9506
	CP	21401			100000	121401
						0
						0
						0
Existing		259800.2998	0	0	0	259800.2998
	NORTH	128893				128893.3522
	SOUTH	9506				9505.7925
	CP	121401				121401.1551

Total Site:	259800.2998

ACRES

Basin	Subbasin	Undeveloped			Developed	TOTALS
Proposed		3.67	0.00	0.00	2.30	5.9642
	N	2.96	0.00	0.00	0.00	2.9590
	0					
	S	0.22	0.00	0.00	0.00	0.2182
	0					
	CP	0.49	0.00	0.00	2.30	2.7870
	0					
	0	0.00	0.00	0.00	0.00	0.0000
	0					
	0	0.00	0.00	0.00	0.00	0.0000
	0					
	0	0.00	0.00	0.00	0.00	0.0000
Existing		5.96	0.00	0.00	0.00	5.9642
	NORTH	2.96	0.00	0.00	0.00	2.9590
	SOUTH	0.22	0.00	0.00	0.00	0.2182
	CP	2.79	0.00	0.00	0.00	2.7870

Total Site:	5.9642

COMPOSITE 'C' FACTORS (UNDEVELOPED)

LOCATION: Moffat County | Draft Drainage Study | BY: MEO | Soil Type: | DATE: 7/9/2012

BASIN						UNDEVELOPED									DEVELOPED									COMPOSITE C FACTOR					% IMPERVIOUS
DESIGNATION	UNDEV		DEV		TOTAL	2YR	5 YR	10 YR	25 YR	100 YR	2YR	5 YR	10 YR	100 YR	2YR	5 YR	10 YR	25 YR	100 YR	2YR	5 YR	10 YR	100 YR	2YR	5 YR	10 YR	25 YR	100 YR	
				Imperviousness =		2									10															
NORTH	2.96		0.00		2.96	0.00	0.08	0.17	0.26	0.36					0.06	0.14	0.22	0.31	0.40					0.00	0.08	0.17	0.26	0.36	2.00
SOUTH	0.22		0.00		0.22	0.00	0.08	0.17	0.26	0.36					0.06	0.14	0.22	0.31	0.40					0.00	0.08	0.17	0.26	0.36	2.00
CP	2.79		0.00		2.79	0.00	0.08	0.17	0.26	0.36					0.06	0.14	0.22	0.31	0.40					0.00	0.08	0.17	0.26	0.36	2.00
																								COMPOSITE I, %					TOTAL A, ac
																								2.00					3.18

STANDARD FORM SF-2
TIME OF CONCENTRATION (UNDEVELOPED)

REMARKS

LOCATION: Moffat County | **Draft Drainage Study** | **BY: MEO** | **DATE: 7/9/2012**

FORMULAS:

*** Ti = 1.8 (1.1-C5)L^0.5/(S^1/3)**

**** V=Cv*(S/100)^0.5**

SUB-BASIN DATA			INIT./OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					TOTAL	Tc Check (Urbanized Basins)		FINAL Tc
DESIGNATION	C_5	AREA (AC)	LENGTH (FT)	SLOPE %	Ti (Min.)*	LAND SURFACE	LENGTH (FT)	SLOPE %	VEL. (FPS)**	Tt(Min.)	Ti+Tt(Min.)	LGTH. (FT)	Tc = (L/180) + 10	(minutes)
NORTH	0.08	2.96	75	2.70	11.45	BARE	485	5.26	2.29	3.52	14.98	560.00	13.11	14.98
SOUTH	0.08	0.22	75	3.20	10.82	BARE	235	9.00	3.00	1.31	12.13	310.00	11.72	12.13
CP	0.08	2.79	70	50.00	4.18	BARE	390	1.50	1.22	5.31	9.49	460.00	12.56	9.49

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE, STANDARD FOR SF-3)

DESIGN STORM: 25-YEAR UNDEVELOPED

Calc. by: MEO
Chk'd by: WEP
Date: 7/9/2012

Axia Bulldog #5-31H-790 Completion Pit | Draft Drainage Study | Moffat County

	DIRECT RUNOFF							TOTAL RUNOFF					DITCH		TRAVEL TIME			REMARKS
DESIGN POINT	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C*A	I (in./ hr.)	Q (cfs)	Sum Area	Tc (min)	I (in./hr.)	Sum C*A	Total Q (cfs)	SLOPE %	FLOW (CFS)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME Tt	
	NORTH	2.96	0.26	14.98	0.77	2.53	1.94											North Swale at culvert under Access Road
	SOUTH	0.22	0.26	12.13	0.06	2.79	0.16											South Swale
	CP	2.79	0.26	9.49	0.72	3.08	2.22											Completion Pit area

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE, STANDARD FOR SF-3)

DESIGN STORM: 100-YEAR UNDEVELOPED

Calc. by: MEO
Chk'd by: WEP
Date: 7/9/2012

Axia Bulldog #5-31H-790 Completion Pit | Draft Drainage Study | Moffat County

DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF					DITCH		TRAVEL TIME			REMARKS
	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C*A	I (in./ hr.)	Q (cfs)	Sum Area	Tc (min)	I (in./hr.)	Sum C*A	Total Q (cfs)	SLOPE %	FLOW (CFS)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME Tt	
	NORTH	2.96	0.36	14.98	1.07	3.16	3.38											North Swale at culvert under Access Road
	SOUTH	0.22	0.36	12.13	0.08	3.47	0.27											South Swale
	CP	2.79	0.36	9.49	1.01	3.84	3.87											Completion Pit area

DESCRIPTION	Axia Bulldog #5-31H-790 Completion Pit
ULTIMATE OR INITIAL	Draft Drainage Study
DESIGNER	MEO
CITY OR COUNTY	Moffat County

1 HOUR DESIGN POINT RAINFALL VALUES-NOAA ATLAS FOR COLORADO

2 YR	0.56
5 YR	0.80
10 YR	0.90
25 YR	1.10
50 YR	1.25
100 YR	1.37

24 HOUR DESIGN POINT RAINFALL VALUES-NOAA ATLAS FOR COLORADO (MAY-OCT)

2 YR	1.10	0.95
5 YR	1.50	1.30
10 YR	1.70	1.50
25 YR	2.05	1.90
50 YR	2.25	2.10
100 YR	2.50	2.30

		Return Period					
		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Duration	6-hr	0.86	1.15	1.30	1.55	1.70	1.90
	24-hr	1.10	1.50	1.70	2.05	2.25	2.50
	1-hr	0.56	0.80	0.90	1.10	1.25	1.37

Elevation:	6520	feet	interpolated
	65	in hundreds of feet	

Estimating 1-hr: Region 3:

Yampa and Green River Basins above confluence of Green and Yampa Rivers
From Table 11, Atlas 2, Volume 3

$Y_2 = 0.019+0.711[(X_1)(X_1/X_2)]+0.001Z$

$Y_{100} = 0.338+0.670[(X_3)(X_3/X_4)]+0.001Z$

Y_2= 2-yr 1-hr estimated value

Y_{100}= 100-yr 1-hr estimated value

X_1= 2-yr 6-hr value from precipitation-frequency maps

X_2= 2-yr 24-hr value from precipitation-frequency maps

X_3= 100-yr 6-hr value from precipitation-frequency maps

X_3= 100-yr 24-hr value from precipitation-frequency maps

Z= point elevation in hundreds of feet

**1-HR VALUES NOT VALID FOR OTHER REGIONS OF COLORADO. SEE FIGURE 19, ATLAS 2, VOL 3

Basin	Subbasin	Undeveloped			Developed	TOTALS
Proposed		158746.4	0	0	100000	258746.4
	N	127631				127630.8
	S	8276				8276.4
	CP	22839			100000	122839
						0
						0
						0
Existing		259800.2998	0	0	0	259800.2998
	NORTH	128893				128893.3522
	SOUTH	9506				9505.7925
	CP	121401				121401.1551

Total Site:	258746.4

ACRES

Basin	Subbasin	Undeveloped			Developed	TOTALS
Proposed		3.64	0.00	0.00	2.30	5.9400
	N	2.93	0.00	0.00	0.00	2.9300
	0					
	S	0.19	0.00	0.00	0.00	0.1900
	0					
	CP	0.52	0.00	0.00	2.30	2.8200
	0					
	0	0.00	0.00	0.00	0.00	0.0000
	0					
	0	0.00	0.00	0.00	0.00	0.0000
	0					
	0	0.00	0.00	0.00	0.00	0.0000
Existing		5.96	0.00	0.00	0.00	5.9642
	NORTH	2.96	0.00	0.00	0.00	2.9590
	SOUTH	0.22	0.00	0.00	0.00	0.2182
	CP	2.79	0.00	0.00	0.00	2.7870

Total Site:	5.9400

COMPOSITE 'C' FACTORS (DEVELOPED)

LOCATION: Moffat County | Draft Drainage Study | BY: MEO | Soil Type: B | DATE: 7/9/2012

BASIN						UNDEVELOPED									DEVELOPED								COMPOSITE C FACTOR					% IMPERVIOUS
DESIGNATION	UNDEV		DEV		TOTAL	2YR	5 YR	10 YR	25 YR	100 YR	2YR	5 YR	10 YR	100 YR	2YR	5 YR	10 YR	25 YR	100 YR	2YR	5 YR	10 YR	100 YR	2YR	5 YR	10 YR	25 YR	100 YR	
					Imperviousness =			2									100												
NORTH	2.93		0.00		2.93	0.00	0.08	0.17	0.26	0.36					0.89	0.90	0.92	0.94	0.96					0.00	0.08	0.17	0.26	0.36	2.00
SOUTH	0.19		0.00		0.19	0.00	0.08	0.17	0.26	0.36					0.89	0.90	0.92	0.94	0.96					0.00	0.08	0.17	0.26	0.36	2.00
CP	0.52		2.30		2.82	0.00	0.08	0.17	0.26	0.36					0.89	0.90	0.92	0.94	0.96					0.72	0.74	0.78	0.81	0.85	81.78
																								COMPOSITE I, %					TOTAL A, ac
																								39.87					5.94

STANDARD FORM SF-2
TIME OF CONCENTRATION (DEVELOPED)

LOCATION: Moffat County | **Draft Drainage Study** | **BY: MEO** | **DATE: 7/9/2012**

SUB-BASIN DATA			INIT./OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					TOTAL	Tc Check (Urbanized Basins)		FINAL Tc
DESIGNATION	C_5	AREA (AC)	LENGTH (FT)	SLOPE %	Ti (Min.)*	LAND SURFACE	LENGTH (FT)	SLOPE %	VEL. (FPS)**	Tt(Min.)	Ti+Tt(Min.)	LGTH. (FT)	Tc = (L/180) + 10	(minutes)
NORTH	0.08	2.93	75	2.70	11.45	BARE	470	4.90	2.21	3.54	14.99	545.00	13.03	14.99
SOUTH	0.08	0.19	75	3.20	10.82	BARE	235	9.00	3.00	1.31	12.13	310.00	11.72	12.13
CP	0.74	2.82	70	50.00	1.46	BARE	390	1.50	1.22	5.31	6.77	460.00	12.56	6.77

REMARKS

FORMULAS:

*** Ti = 1.8 (1.1-C5)L^0.5/(S^1/3)**

**** V=Cv*(S/100)^0.5**

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE, STANDARD FOR SF-3)

DESIGN STORM: 25-YEAR DEVELOPED

Calc. by: MEO
Chk'd by: WEP
Date: 7/9/2012

Axia Bulldog #5-31H-790 Completion Pit | Draft Drainage Study | Moffat County

	DIRECT RUNOFF							TOTAL RUNOFF					DITCH		TRAVEL TIME			REMARKS
DESIGN POINT	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C*A	I (in./ hr.)	Q (cfs)	Sum Area	Tc (min)	I (in./hr.)	Sum C*A	Total Q (cfs)	SLOPE %	FLOW (CFS)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME Tt	
	NORTH	2.93	0.26	14.99	0.76	2.53	1.92											North Swale at culvert under Access Road
	SOUTH	0.19	0.26	12.13	0.05	2.79	0.14											South Swale
	CP	2.82	0.81	6.77	2.28	3.47	7.92											Completion Pit area

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE, STANDARD FOR SF-3)

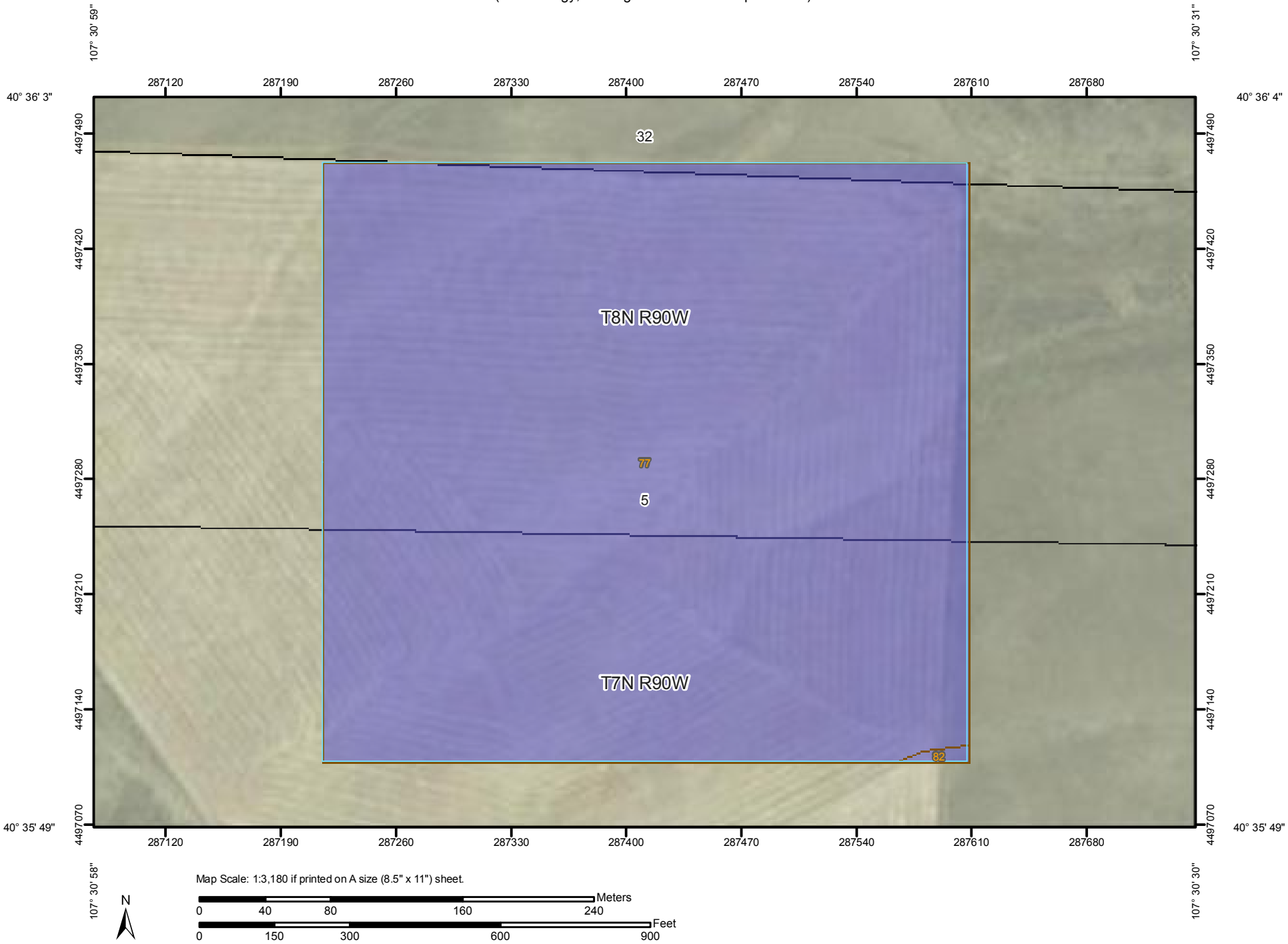
DESIGN STORM: 100-YEAR DEVELOPED

Calc. by: MEO
Chk'd by: WEP
Date: 7/9/2012

Axia Bulldog #5-31H-790 Completion Pit | Draft Drainage Study | Moffat County

DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF					DITCH		TRAVEL TIME			REMARKS
	BASIN	AREA (AC)	COEFF. (C)	Tc (Min.)	C*A	I (in./ hr.)	Q (cfs)	Sum Area	Tc (min)	I (in./hr.)	Sum C*A	Total Q (cfs)	SLOPE %	FLOW (CFS)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME Tt	
	NORTH	2.93	0.36	14.99	1.06	3.16	3.35											North Swale at culvert under Access Road
	SOUTH	0.19	0.36	12.13	0.07	3.47	0.24											South Swale
	CP	2.82	0.85	6.77	2.38	4.32	10.30											Completion Pit area

Hydrologic Soil Group—Moffat County Area, Colorado
(Axia Energy, Bulldog #5-31H-790 Completion Pit)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities
- PLSS Township and Range
- PLSS Section

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:3,180 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:31,680.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Moffat County Area, Colorado
Survey Area Data: Version 6, Feb 4, 2008

Date(s) aerial images were photographed: 8/28/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Moffat County Area, Colorado (CO686)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
77	Forelle loam, 3 to 12 percent slopes	B	35.2	99.8%
82	Forelle-Pinelli-Maysprings complex, 5 to 20 percent slopes	B	0.1	0.2%
Totals for Area of Interest			**35.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

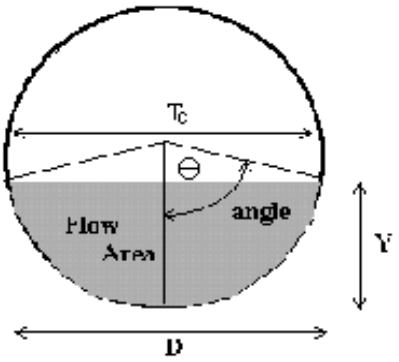
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX C: HYDRAULIC CALCULATIONS

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

Project: Axia Energy Completion Pit
Pipe ID: Access Road Swale Crossing



Design Information (Input)			
Pipe Invert Slope	So =	0.0590	ft/ft
Pipe Manning's n-value	n =	0.0240	*
Pipe Diameter	D =	12.00	inches
Design discharge	**Q =**	**4.70**	**cfs**

Full-flow Capacity (Calculated)			
Full-flow area	Af =	0.79	sq ft
Full-flow wetted perimeter	Pf =	3.14	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	4.70	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.26	radians
Flow area	An =	0.69	sq ft
Top width	Tn =	0.77	ft
Wetted perimeter	Pn =	2.26	ft
Flow depth	Yn =	0.82	ft
Flow velocity	Vn =	6.82	fps
Discharge	Qn =	4.70	cfs
Percent Full Flow	Flow =	100.00%	of full flow
Normal Depth Froude Number	Fr_n =	1.27	supercritical

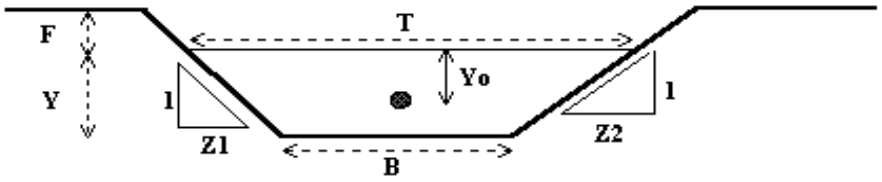
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.50	radians
Critical flow area	Ac =	0.74	sq ft
Critical top width	Tc =	0.60	ft
Critical flow depth	Yc =	0.90	ft
Critical flow velocity	Vc =	6.31	fps
Critical Depth Froude Number	Fr_c =	1.00	

*** Unexpected value for Manning's n**

Normal Flow Analysis - Trapezoidal Channel

Project: Axia Bulldog #5-31H-790 Completion Pit

Channel ID: Swales



Design Information (Input)			
Channel Invert Slope	So =	0.0300	ft/ft
Manning's n	n =	0.030	
Bottom Width	B =	0.00	ft
Left Side Slope	Z1 =	3.00	ft/ft
Right Side Slope	Z2 =	3.00	ft/ft
Freeboard Height	F =	0.00	ft
Design Water Depth	Y =	**1.00**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**15.70**	cfs
Froude Number	**Fr =**	**1.30**	
Flow Velocity	**V =**	**5.23**	fps
Flow Area	A =	3.00	sq ft
Top Width	T =	6.00	ft
Wetted Perimeter	P =	6.32	ft
Hydraulic Radius	R =	0.47	ft
Hydraulic Depth	D =	0.50	ft
Specific Energy	Es =	1.43	ft
Centroid of Flow Area	Yo =	0.33	ft
Specific Force	Fs =	0.22	kip