Rosebud Power Plant CCR Landfill Post Closure Care Plan

Prepared for Colstrip Energy Limited Partnership.
by Allied Engineering Services, Inc.

October 17, 2016

Contents

Appendices

INTRODUCTION

This report outlines the plan for post closure care of the CCR landfill at the Rosebud Power Plant *in Rosebud County, Montana* owned by Colstrip Energy Limited Partnership (CELP) in order to fulfill the requirements of the CCR rule as published in the Federal Register on April 17, 2015 and July 2, 2015 and its effective date of October 17, 2015. The applicable rule section is 40 CFR Parts 257 and 261. This report fulfills the requirements of 40 CFR § 257.104(d). The landfill addressed in this report holds hydrated coal ash, which is solid and practically impermeable to water, similar to concrete.

The project site is located approximately seven miles north of the town of Colstrip, Montana in the southwest quarter of Section 29 and the northwest quarter of Section 32, Township 3 North, Range 41 East (Latitude 45.978859°, Longitude -106.663772° (WGS 84)). A vicinity map is included on Sheet C0-1 of the plan set included in Appendix A. The landfill serves an on-site Power Plant owned by Colstrip Energy Limited Partnership. The Power Plant and the landfill are operated by Rosebud Operating Services, Inc.

The landfill area covered by this report is an active landfill located on the subject property. There is also a closed landfill, last used in October, 2005, that has since been reclaimed in general accordance with applicable permits and regulations in effect at closure in accordance with 40 CFR § 257.50(d).. This closed landfill is not subject to regulation by the above referenced rules and is not the subject of this report. The active landfill includes Phase I and Phase II of a contiguous landfill permitted in 1997 and placed in service in October, 2005. This active landfill is subject to regulation by the above referenced CCR rules.

The information contained herein is based on an investigation and analysis of the property's topographical and subsurface conditions, a review of existing permits, regulatory requirements, maps and literature for the project area as related to the landfilling operations of combusted coal residuals (CCR), more familiarly referred to as bottom ash and fly ash. The purpose of this report is to provide a design plan and monitoring recommendations that will fulfill the Post-Closure requirements of the CCR rule.

The CCR unit is a landfill that will remain in place once the power plant ceases operations and the remaining CCR is landfilled and hydrated per plant operating procedures. Currently the plant is planned to operate until July 1, 2024. The landfill design and operation includes the run-on and run-off provisions (CFR §257.81) as part of the CCR rule. Operating procedures also include construction and reclamation of the final cover system as the CCR is placed and advances upwards in elevation. Reclamation of side-slopes as landfilling progresses provides erosion control measures that will minimize sediment transport as well as ensure that reclamation/closure techniques are tested and perfected prior to final closure.

Final closure will essentially include the construction of the final cap cover and upper side-slopes that have not been reclaimed, construction of perimeter drainage-ways in accordance with the run-on/run-off provisions of the rule, and plugging and abandonment of the piping that runs underneath the landfill.

REGULATORY SETTING

As of April 17, 2015, new rules for coal combustion residuals (CCR) were published in the Federal Register Volume 80, Number 74, dated Friday April 17, 2015. The applicable sections include 40 CFR Parts 257 and 261. These rules spell out the conditions for existing operating CCR landfills such as the active landfill at the Rosebud Power Plant. The rules over all provide closure planning, location

restrictions, structural stability assessment requirements, groundwater monitoring requirements, surface water protection, design and operating criteria, along with inspection requirements. Part of the requirements includes the preparation of an Annual Engineers Inspection Report. The first report was completed and posted to the CELP website in accordance with the CCR rule.

The power plant is currently operating under several permits that include protection criteria for air, surface water and groundwater quality. Permits include:

- Montana Ground Water Pollution Control System (MGWPCS) Permit No. MTX000052
- Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activity. Permit No. MTR000058
- Air Quality Permit Nos. #2035-06 and OP2035-3

The applicable requirements of the current CCR rule cover active CCR landfills and exclude closed landfills.

BACKGROUND

Rosebud Power Plant is a waste coal burning facility using a fluidized bed reactor. During the burning process of the coal, bottom and fly ash or combusted coal residuals (CCR) are produced. The CCR are either sold for commercial/industrial purposes or landfilled on-site near the power plant. The active landfill, consisting of two phases, is located northwest of the power plant.

In 1996, Chandler Geotechnical, Inc. (a predecessor to Allied Engineering Services, Inc.) was hired as a sub-consultant to JSM, Inc. to provide engineering analysis and design of the current active landfill. Over the course of operations at the plant, fly ash was sold during some years; thus the amount of fly ash placed in the Phase 1 area was less than anticipated with the original design and has not yet reached its maximum storage capacity. These changes resulted in the need for minor modifications of the original design of the landfill area. Phase 2 modifications began in September of 2015 with simultaneous re-design and construction. Construction has been ongoing for Phase 2 of the active landfill in general conformance with the original 1996 design with modifications undertaken during construction under the direction of Allied Engineering Services, Inc.

POST CLOSURE CARE

Post closure care will include monitoring and maintenance in accordance with the 30-year requirement as outlined in the CCR Rule. In order to provide efficiency and consistency, the post closure care will generally be performed in accordance with the facility operating permits previously listed.

As final stabilization of the cover system and drainage ways is completed and the closure and monitoring components of the aforementioned permits are satisfied, post closure care will continue with the monitoring and documentation of inspection and corrective actions as outlined in these permits. Adherence to the inspection, monitoring, corrective action, reporting and record retention requirements for all of the permits (including the CCR Rule) will follow the most conservative or stringent relevant requirements until termination, or until permit conditions are satisfied.

MGWPCS Permit No. MTX000052 - The groundwater monitoring requirements will continue until final termination of the authorization. The Groundwater Monitoring Plan as required under the CCR rule will continue through the 30-year post closure care period.

Air Quality Permit Nos. #2035-06 and OP2035-3 – The fugitive dust requirements of the CCR Rule will continue during post closure care. Once final stabilization is achieved, fugitive dust will be mitigated by vegetation establishment.

Multi Sector General Permit for Storm Water Discharges Associated with Industrial Activity. Permit No. MTR000058 – This authorization will continue until final stabilization is reached (anticipated November 1, 2027). Post closure monitoring will include observations related to sedimentation, turbidity or erosion related to storm water management. Any related corrective actions will be included in the amendment of the plans or during annual reporting for maintenance activities.

POST CLOSURE MONITORING

Post closure monitoring will continue through the 30-year post closure care period. Weekly monitoring will continue through the closure phase of landfill construction in accordance with the CCR Rule. Following final closure, weekly monitoring will continue until the general onset of winter in the year following final closure. During the winter months (typically December through March), Inspections will be completed monthly unless there is a significant rain precipitation event of 0.50 inches or more, and/or a significant melt event that results in surface water flow. Inspections will return to weekly during the non-winter months until final vegetation establishment/stabilization is achieved. Final stabilization will be achieved when the site is substantially vegetated (70% ground cover). Final stabilization is anticipated within one to three growing seasons following final closure. Once final stabilization is achieved, monitoring will continue at least annually and will be considered complete once the reports are entered in the operating record as outlined in the CCR Rule.

The content of the inspection report will be in accordance with the weekly inspections that are currently being performed. A summary of the periodic inspections will be included in the ongoing Annual Engineers Inspection Report as outlined in the CCR Rule.

REGULATORY ACKNOWLEDGEMENT AND CLARIFICATION

The following include the relevant CCR Rule citations (*italics*) followed by the response (**bold**):

§ 257.104 Post-closure care requirements.
(a) Applicability.
(1) Except as provided by either paragraph (a)(2) or (3) of this section, § 257.104 applies to the owners or operators of CCR landfills, CCR surface impoundments, and all lateral expansions of CCR units that are subject to the closure criteria under § 257.102.
(b) Post-closure care maintenance requirements. Following closure of the CCR unit, the owner or operator must conduct post-closure care for the CCR unit, which must consist of at least the following:
(1) Maintaining the integrity and effectiveness of the final cover system, including making repairs to the final cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover;
Post closure monitoring includes corrective action follow up. Accelerated erosion, settlement or subsidence are not anticipated. However in the event of such failures, an investigation into the cause of the failure will be conducted and rectified by addressing the root cause of the failure and replacing the cover system to the design configuration. Run-on or run-off failures will be addressed accordingly and may require amending the design of the run-on and run-off control system.

(2) If the CCR unit is subject to the design criteria under § 257.70, maintaining the integrity and effectiveness of the leachate collection and removal system and operating the leachate collection and removal system in accordance with the requirements of § 257.70; and
(3) Maintaining the groundwater monitoring system and monitoring the groundwater in accordance with the requirements of §§ 257.90 through 257.98.
No leachate collection system is required as part of the landfill design. The groundwater monitoring system will include detection monitoring and if applicable, assessment monitoring throughout the post closure care period.

(c) Post-closure care period. (1) Except as provided by paragraph (c)(2) of this section, the owner or operator of the CCR unit must conduct post-closure care for 30 years.
(2) If at the end of the post-closure care period the owner or operator of the CCR unit is operating under assessment monitoring in accordance with § 257.95, the owner or operator must continue to conduct post-closure care until the owner or operator returns to detection monitoring in accordance with § 257.95.
Acknowledged.

(d) Written post-closure plan—
(1)Content of the plan. The owner or operator of a CCR unit must prepare a written post-closure plan that includes, at a minimum, the information specified in paragraphs (d)(1)(i) through (iii) of this section.
(i) A description of the monitoring and maintenance activities required in paragraph (b) of this section for the CCR unit, and the frequency at which these activities will be performed;
(ii) The name, address, telephone number, and email address of the person or office to contact about the facility during the post-closure care period; and
Post-Closure Care Administrator@rosi-boise.com
Phone: (208)344-3570
1087 River St Suite #200
Boise, ID 83702

(iii) A description of the planned uses of the property during the post-closure period. Post-closure use of the property shall not disturb the integrity of the final cover, liner(s), or any other component of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in this subpart. Any other disturbance is allowed if the owner or operator of the CCR unit demonstrates that disturbance of the final cover, liner, or other component of the containment system, including any removal of CCR, will not increase the potential threat to human health or the environment. The demonstration must be certified by a qualified professional engineer, and notification shall be provided to the State Director that the demonstration has been placed in the operating record and on the owners or operator's publicly accessible Internet site.
Post closure land use will be consistent with surrounding land use practices. However, no structures will be built or placed and no grading, excavating, or filling of the landfill area or drainage ways will be allowed. An easement will be recorded that will include specific language regarding allowable uses on the property. Grazing may be allowed, but not for at least two-years following final stabilization. Post closure monitoring will evaluate any effects of grazing on the capping system and management adjustments will be made as necessary.

(2) Deadline to prepare the initial written post-closure plan—

(i) Existing CCR landfills and existing CCR surface impoundments. No later than October 17, 2016, the owner or operator of the CCR unit must prepare an initial written post-closure plan consistent with the requirements specified in paragraph (d)(1) of this section.
Acknowledged

(ii) New CCR landfills, new CCR surface impoundments, and any lateral expansion of a CCR unit. No later than the date of the initial receipt of CCR in the CCR unit, the owner or operator must prepare an initial written postclosure plan consistent with the requirements specified in paragraph (d)(1) of this section.
Not applicable. The existing landfill has the capacity to store the volume of generated CCR from the Rosebud Power Plant until anticipated plant closure in 2024.

(iii) The owner or operator has completed the written post-closure plan when the plan, including the certification required by paragraph (d)(4) of this section, has been placed in the facility's operating record as required by § 257.105(i)(4).
Acknowledged.

(3) Amendment of a written post-closure plan. (i) The owner or operator may amend the initial or any subsequent written post-closure plan developed pursuant to paragraph (d)(1) of this section at any time.
Acknowledged.

(ii) The owner or operator must amend the written closure plan whenever:
(A) There is a change in the operation of the CCR unit that would substantially affect the written post-closure plan in effect; or
(B) After post-closure activities have commenced, unanticipated events necessitate a revision of the written post-closure plan.
(iii) The owner or operator must amend the written post-closure plan at least 60 days prior to a planned change in the operation of the facility or CCR unit, or no later than 60 days after an unanticipated event requires the need to revise an existing written post-closure plan. If a written post-closure plan is revised after post-closure activities have commenced for a CCR unit, the owner or operator must amend the written post-closure plan no later than 30 days following the triggering event.
Acknowledged.

4) The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the initial and any amendment of the written post-closure plan meets the requirements of this section.
Acknowledged.

(e) Notification of completion of post-closure care period. No later than 60 days following the completion of the post-closure care period, the owner or operator of the CCR unit must prepare a notification verifying that post-closure care has been completed. The notification must include the certification by a qualified professional engineer verifying that post-closure care has been completed in accordance with the closure plan specified in paragraph (d) of this section and the requirements of this section. The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(i)(13).
Acknowledged.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(i), the notification requirements specified in § 257.106(i), and the Internet requirements specified in § 257.107(i).

Acknowledged.

CERTIFICATION

This report was prepared by Allied Engineering Services, Inc., under the direction of Douglas S. Chandler, PhD, PE, with assistance from Andrew Graham, PE, and Ronald Orton, Environmental Scientist, and QC review by Brock Athman, PE.

ALLIED ENGINEERING SERVICES, INC

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QC Approval: Brock D. Athman, PE

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PROFESSIONAL ENGINEER

REFERENCES

1. Environmental Protection Agency, 2015. "*Federal Register"*, Vol. 80, No. 74, Part 257.
2. Natural Resource Conservation Service, Web Soil Survey. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm Accessed 12/23/15.
3. Rosebud Power Plant Ash Disposal Site Engineering Design and Construction Specifications by Chandler Geotechnical. Chandler, D.S. dated July 16, 1996.

Appendix A: **Plan Set - Rosebud Power Plant, Fly Ash Landfill Post Closure Design – Dated September 15, 2016** (31 sheets)

ROSEBUD POWER PLANT

FLY ASH LANDFILL POST-CLOSURE DESIGN

PROJECT LOCATION: 6.5 MILES NORTH OF COLSTRIP, MT ON HIGHWAY 39

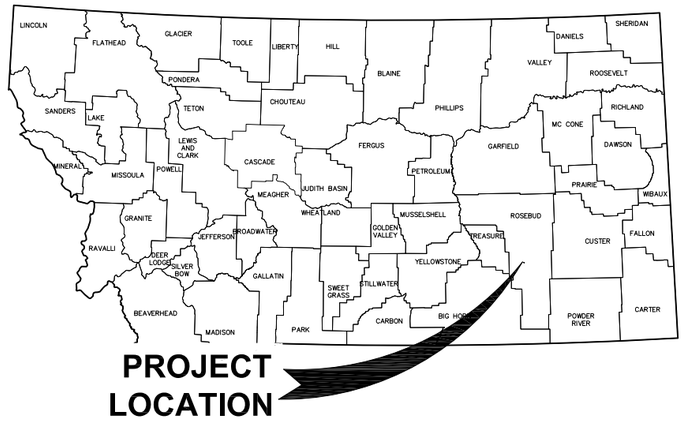
LEGAL DESCRIPTION: NW $\frac{1}{4}$, SECTION 32, TOWNSHIP 3N, RANGE 41E, P.M.M., ROSEBUD COUNTY, MT

OWNER: COLSTRIP ENERGY LIMITED PARTNERSHIP (CELP)
1087 W. RIVER STREET, SUITE 200
BOISE, ID 83702

CLIENT: ROSEBUD OPERATING SERVICES, INC.
1087 W. RIVER STREET, SUITE 200
BOISE, ID 83702

SEPTEMBER 15, 2016

SET NO. _____



PRINCIPAL-IN-CHARGE: DOUG CHANDLER, PE, Ph.D

PROJECT ENGINEER: ANDREW S. GRAHAM, PE

QC REVIEW: BROCK D. ATHMAN, PE

PROJECT SURVEYOR: KYLE THOMPSON, PLS
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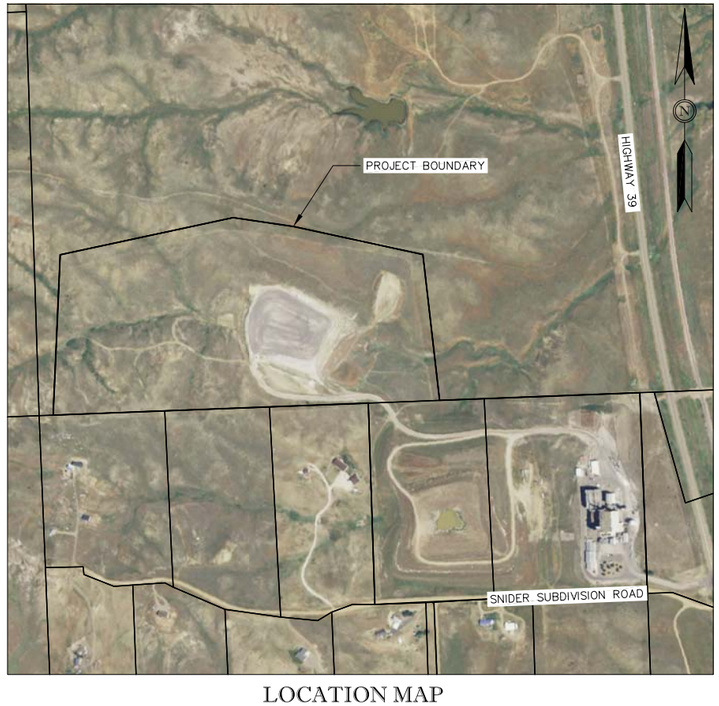

LOCATION MAP

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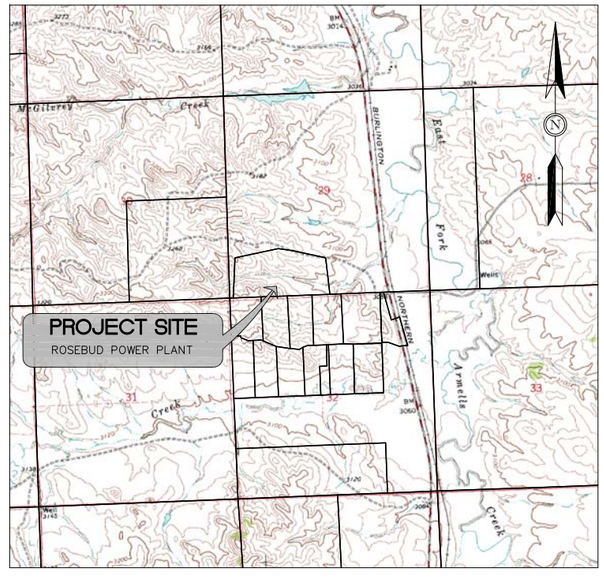


VICINITY MAP

0 2000 4000 6000

SCALE (FEET)

ROSEBUD POWER PLANT
ROSEBUD COUNTY, MONTANA

NO.	REVISIONS	DATE

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\POST-CLOSURE COVER & NOTES.dwg

ROSEBUD POWER PLANT
CO-1 COVER SHEET

SHEET INDEX

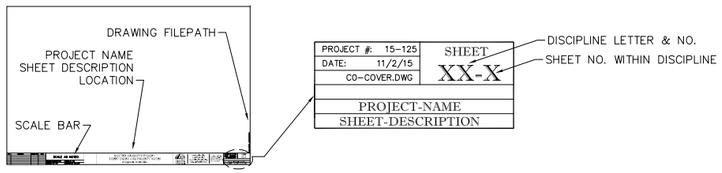
GENERAL NOTES:

1. THESE PLANS PRESENT FIELD AND DESIGN CHANGES TO THE ORIGINAL PLAN SET, ROSEBUD FLYASH DISPOSAL - DATED MAY, 1996. THESE ORIGINAL PLANS WERE CREATED BY CHANDLER GEOTECHNICAL, INC. FOR THE DESIGN OF PHASE 1 AND PHASE 2 OF THE FLYASH LANDFILL. ASH PLACEMENT IN PHASE 1 BEGAN IN 2005 AND CONSTRUCTION OF PHASE 2 BEGAN IN AUGUST, 2015. THESE PLANS ARE A CONTINUATION TO THE ROSEBUD POWER PLANT, FLY ASH LANDFILL DESIGN MODIFICATIONS - DATED JANUARY 7, 2016.
2. THIS PROJECT SHALL BE CONSTRUCTED IN ACCORDANCE WITH ALLIED ENGINEERING'S PLAN SET; ALONG WITH THE MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS (MPWSS), SIXTH EDITION.
3. ALL DuroMaxx PIPE IS TO BE INSTALLED PER ALLIED ENGINEERING'S PLANS AND SPECIFICATIONS; ALONG WITH CONTECH'S DuroMaxx STEEL REINFORCED PE TECHNOLOGY INSTALLATION GUIDE.

CIVIL ABBREVIATIONS:

AESI	ALLIED ENGINEERING SERVICES, INC.
AC	ACRE
AVE	AVENUE
BLDG	BUILDING
BM	BENCHMARK
BOG	BACK OF GRATE (GUTTER)
CI	CAST IRON
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
COB	CITY OF BOZEMAN
CONC	CONCRETE
CY	CUBIC YARD
DI	DUCTILE IRON
DIA	DIAMETER
DWG	DRAWING
E	EAST
EA	EACH
EG	EXISTING GRADE
ELEV	ELEVATION
EOG	EDGE OF GRAVEL
EOP	EDGE OF PAVEMENT
EX	EXISTING
FETS	FLARED END TERMINAL SECTION
FG	FINISHED GRADE
FHYD	FIRE HYDRANT
FL	FLANGE
FL	FLOWLINE
FM	SEWER FORCE MAIN
FT	FEET
GPM	GALLONS PER MINUTE
GV	GATE VALVE
HDPE	HIGH DENSITY POLYETHYLENE
HORZ	HORIZONTAL
HP	HIGH POINT
HWY	HIGHWAY
IE	INVERT ELEVATION
IN	INCH
INV	INVERT
LF	LINEAR FEET
LP	LOW POINT
LT	LEFT
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MJ	MECHANICAL JOINT
MP	MID POINT
MPWSS	MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS
MSU	MONTANA STATE UNIVERSITY
N	NORTH
PC	POINT OF CURVATURE
PE	PLAIN END
PE	POLYETHYLENE
PI	POINT OF INTERSECTION
PL	PROPERTY LINE
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE
R	RADIUS
RP	RADIUS POINT
RCP	REINFORCED CONCRETE PIPE
ROW	RIGHT-OF-WAY
RT	RIGHT
S	SOUTH
SCH	SCHEDULE
SD	STORM DRAIN
SECT	SECTION
SG	SUBGRADE
S	SANITARY SEWER MAIN
SS	SANITARY SEWER SERVICE
ST	STREET
STA	STATION
STD	STANDARD
SY	SQUARE YARD
TBM	TEMPORARY BENCH MARK
TBC	TOP BACK OF CURB
TDH	TOTAL DYNAMIC HEAD
TYP	TYPICAL
UG	UNDERGROUND
VC	VITRIFIED CLAY
VERT	VERTICAL
W	WATER MAIN
W	WEST
W/	WITH
W/O	WITHOUT
WS	WATER SERVICE

AESI STANDARD BORDER FORMAT



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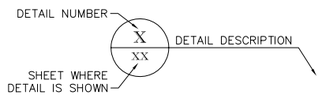

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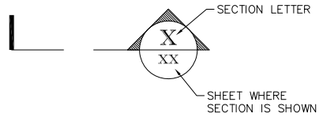

LEGEND

- 4770 — MAJOR CONTOUR - FG
- 4771 — MINOR CONTOUR - FG
- 4770 — MAJOR CONTOUR - EG
- 4771 — MINOR CONTOUR - EG
- FOUND MONUMENT AS NOTED
- SET MONUMENT
- CONTROL POINT
- X — X — FENCE - EXISTING
- OHP — OVERHEAD POWER - EXISTING
- G — G — UTILITY GAS - EXISTING
- TEL — UTILITY PHONE - EXISTING
- E — E — UTILITY ELECTRIC - EXISTING
- UTILITY POWER POLE - EXISTING
- LIGHT POLE - EXISTING
- E — ELECTRICAL PEDESTAL - EXISTING
- EM — ELECTRICAL METER - EXISTING
- TEL — TELEPHONE PEDESTAL - EXISTING
- GM — GAS METER - EXISTING
- GAS VALVE - EXISTING
- GUY ANCHOR - EXISTING
- EASEMENT LINE
- BOUNDARY/ LOT LINE
- ROAD CENTERLINE
- ROAD - CURB
- CONCRETE SIDEWALK
- STREET SIGN
- S — SEWER MAIN
- S — SEWER MAIN - EXISTING
- SEWER SERVICE
- (S) — SANITARY SEWER MANHOLE
- (CO) — SEWER CLEANOUT
- W — WATER MAIN
- W — WATER MAIN - EXISTING
- WATER SERVICE
- FIRE HYDRANT
- (BO) — BLOW-OFF HYDRANT
- WV — WATER VALVE
- (W) — WELL
- (MW) — MONITORING WELL
- SD — STORM MAIN
- CULVERT - EXISTING
- DITCH-CENTERLINE - EXISTING
- (D) — STORM MAIN JOINT,BEND, OR STRUCTURE

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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG, BDA	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
SHEET INDEX, LEGEND, & GENERAL NOTES
ROSEBUD COUNTY, MT

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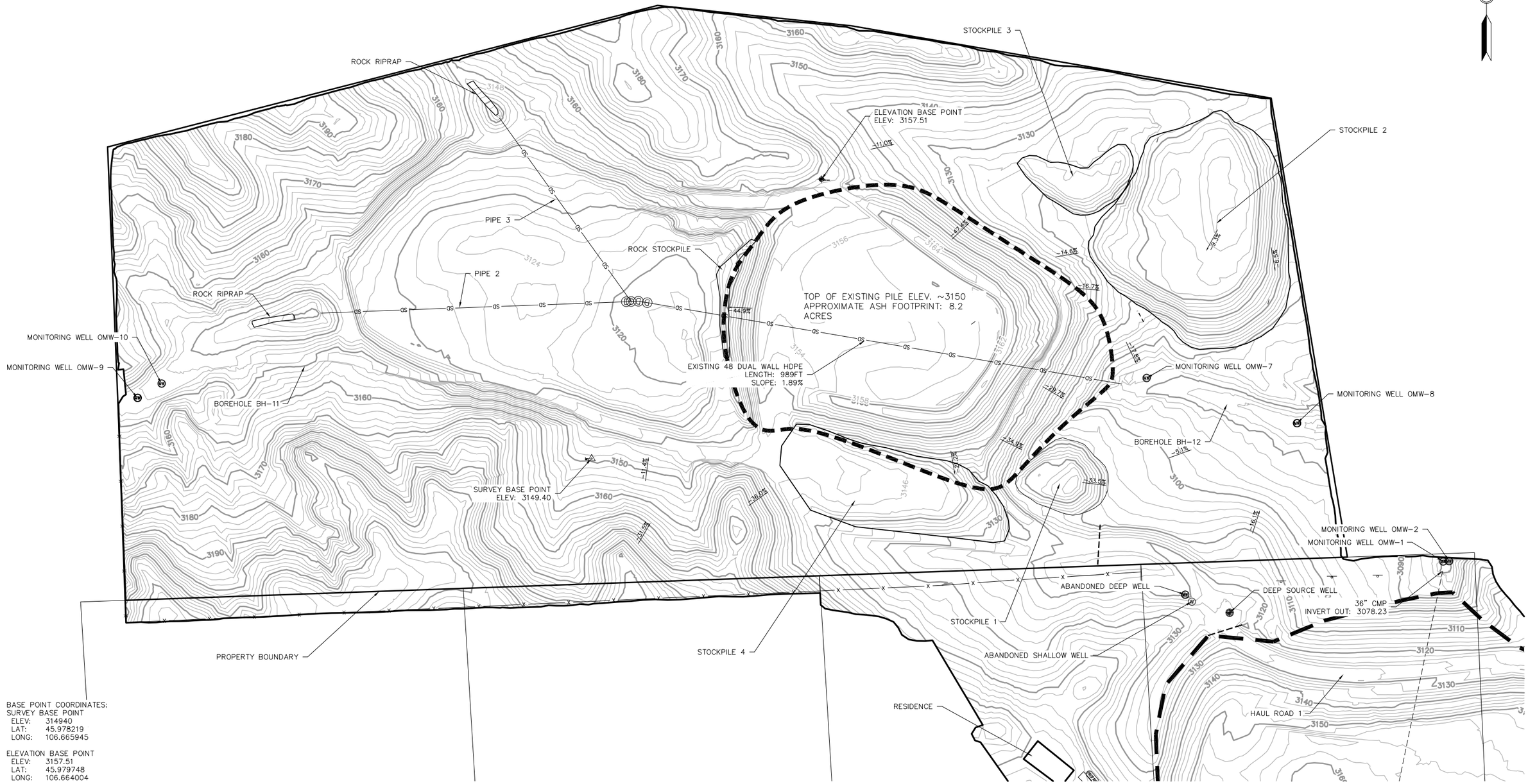
FAX (406) 582-5770
www.alliedengineering.com

Civil Engineering
Geotechnical Engineering
Land Surveying

ALLIED ENGINEERING SERVICES, INC. Diverse Projects Common Thread

PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C0-2
	INDEX, LEGEND, & NOTES

SURVEY OF PHASE 1 LANDFILL AND SURROUNDING AREA
BASED ON TOPOGRAPHIC SURVEYS COMPLETED ON:
9/14/15 BY GREG FINCK OF AESI
1/27/16 BY GREG FINCK AND KYLE THOMPSON OF AESI



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LAT: 45.978219
LONG: 106.665945

ELEVATION BASE POINT
ELEV: 3157.51
LAT: 45.979748
LONG: 106.664004

NO.	REVISIONS	DRAWN BY	DATE

0 100 200 300
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EXISTING CONDITIONS (AS-BUILT)
ROSEBUD COUNTY, MT

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FAX (406) 582-5770
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Civil Engineering
Geotechnical Engineering
Land Surveying

ALLIED ENGINEERING SERVICES, INC.
Diverse Projects

PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C0-3
	EXISTING CONDITIONS

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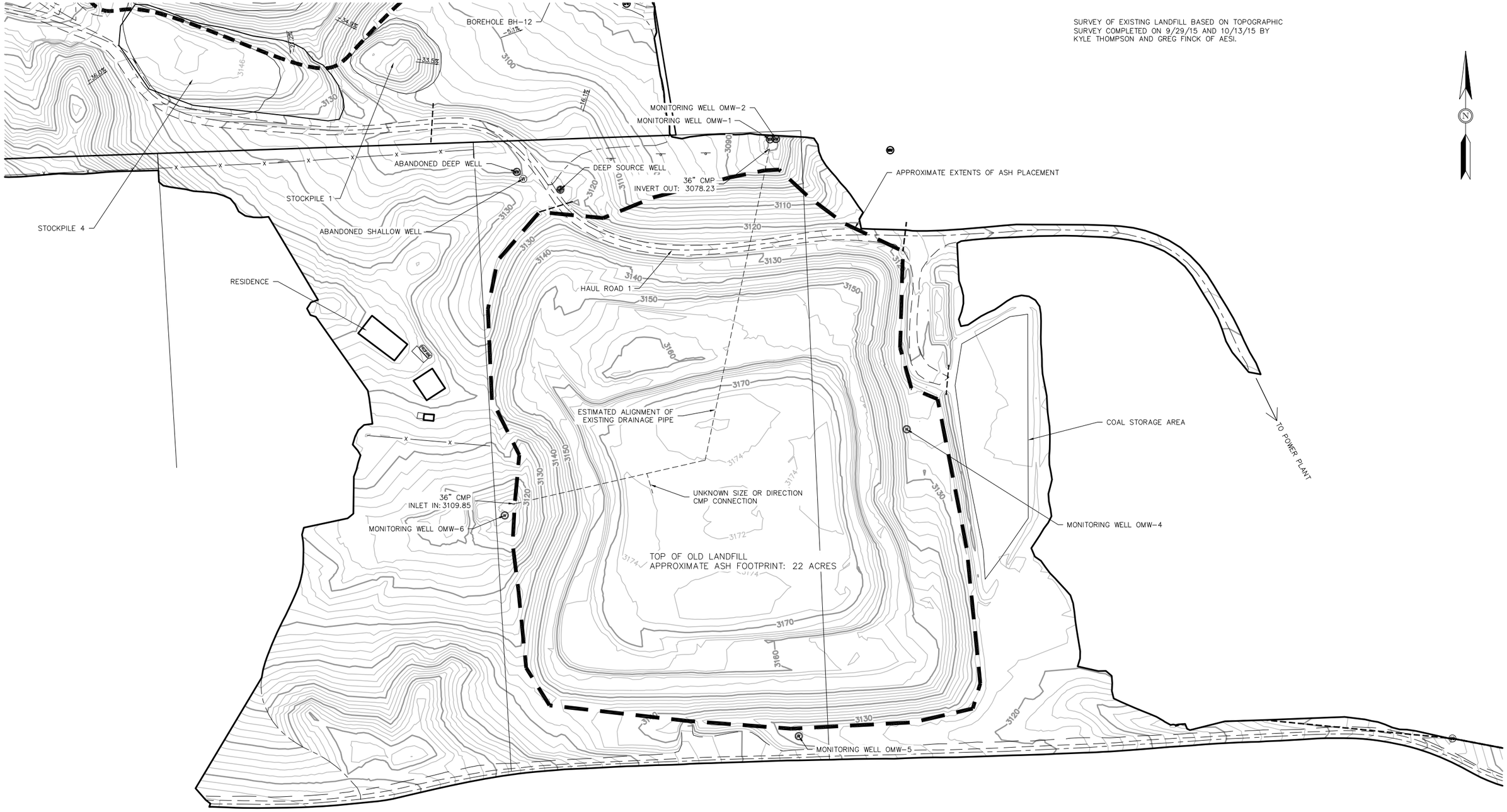
SURVEY OF EXISTING LANDFILL BASED ON TOPOGRAPHIC SURVEY COMPLETED ON 9/29/15 AND 10/13/15 BY KYLE THOMPSON AND GREG FINCK OF AESI.



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NO.	REVISIONS	DRAWN BY	DATE

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SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EXISTING CONDITIONS
ROSEBUD COUNTY, MT

32 DISCOVERY DRIVE
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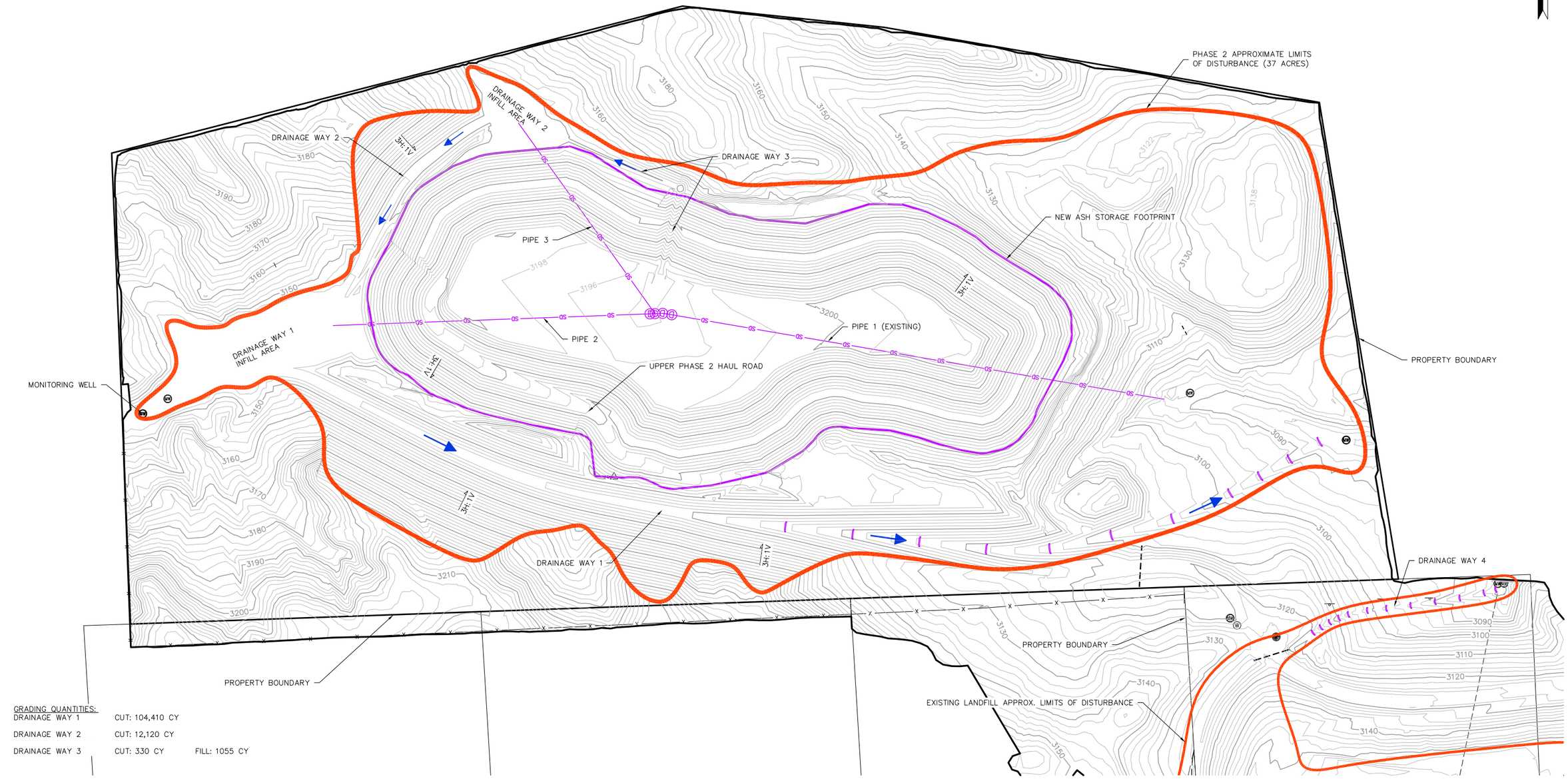
ALLIED ENGINEERING SERVICES, INC. Diverse Projects

PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C0-4

EXISTING CONDITIONS

LEGEND

- EG MAJOR CONTOUR
- EG MINOR CONTOUR
- FG MAJOR CONTOUR
- FG MINOR CONTOUR
- EDGE OF ROAD
- ROAD CENTERLINE
- STORM DRAINAGE PIPE
- LIMITS OF DISTURBANCE
- EXTENTS OF NEW LANDFILL EXPANSION ELEV: 3150
- FLOW ARROW
- ROCK GRADE CONTROL



GRADING QUANTITIES:

DRAINAGE WAY 1	CUT: 104,410 CY	
DRAINAGE WAY 2	CUT: 12,120 CY	
DRAINAGE WAY 3	CUT: 330 CY	FILL: 1055 CY

NO.	REVISIONS	DRAWN BY	DATE

0 100 200 300
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DESIGN PLAN - DRAINAGE WAY 1 & 2
ROSEBUD COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
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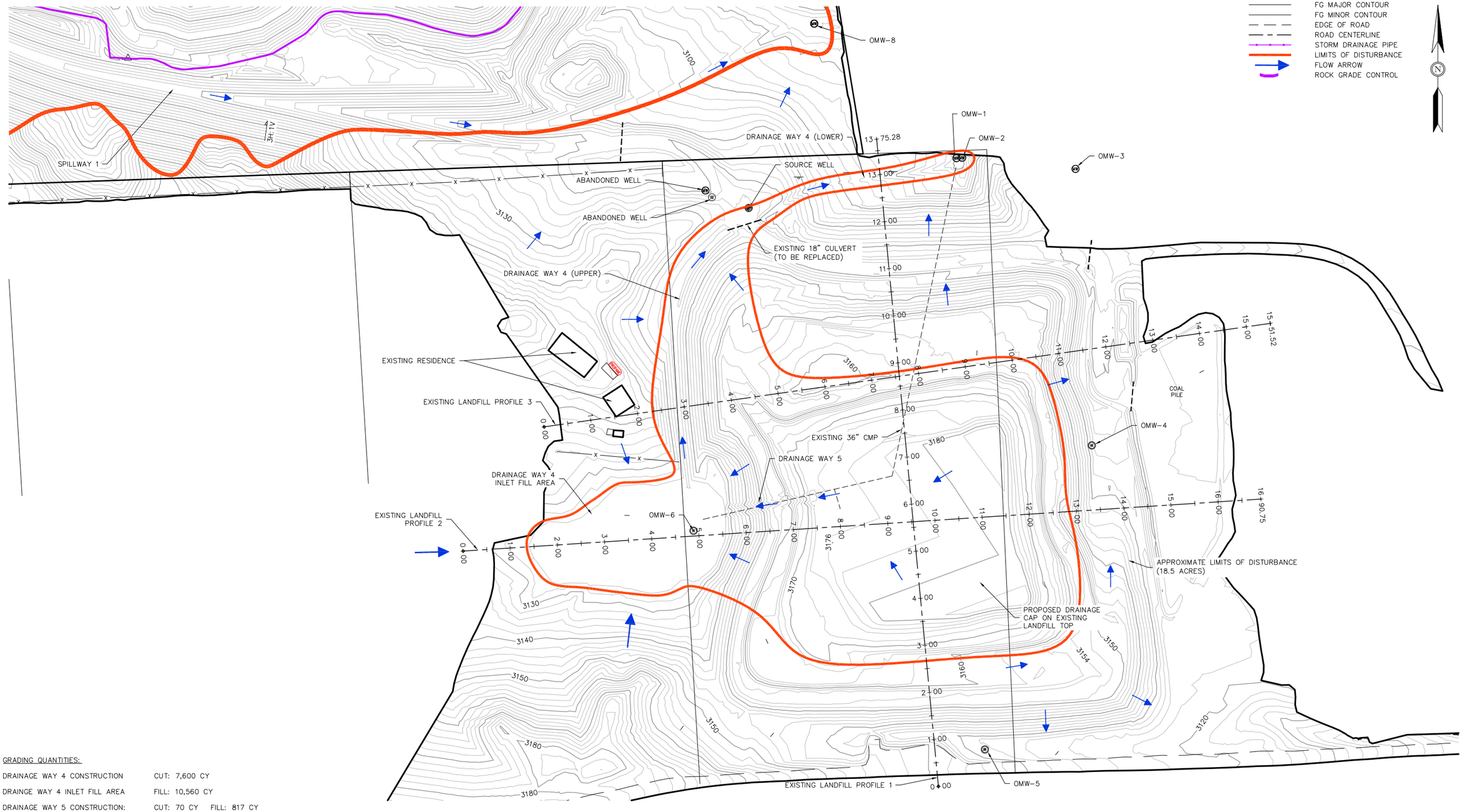
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C1-1
	DESIGN PLAN -DRAINAGE

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\08 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN - ACTIVE LANDFILL.dwg

LEGEND

- EG MAJOR CONTOUR
- EG MINOR CONTOUR
- FG MAJOR CONTOUR
- FG MINOR CONTOUR
- EDGE OF ROAD
- ROAD CENTERLINE
- STORM DRAINAGE PIPE
- LIMITS OF DISTURBANCE
- FLOW ARROW
- ROCK GRADE CONTROL



GRADING QUANTITIES:

DRAINAGE WAY 4 CONSTRUCTION	CUT: 7,600 CY
DRAINGE WAY 4 INLET FILL AREA	FILL: 10,560 CY
DRAINAGE WAY 5 CONSTRUCTION:	CUT: 70 CY FILL: 817 CY
EXISTING LANDFILL TOP FILL	FILL: 25,480 CY

NO.	REVISIONS	DRAWN BY	DATE

0 100 200 300
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DESIGN PLAN - EXISTING LANDFILL
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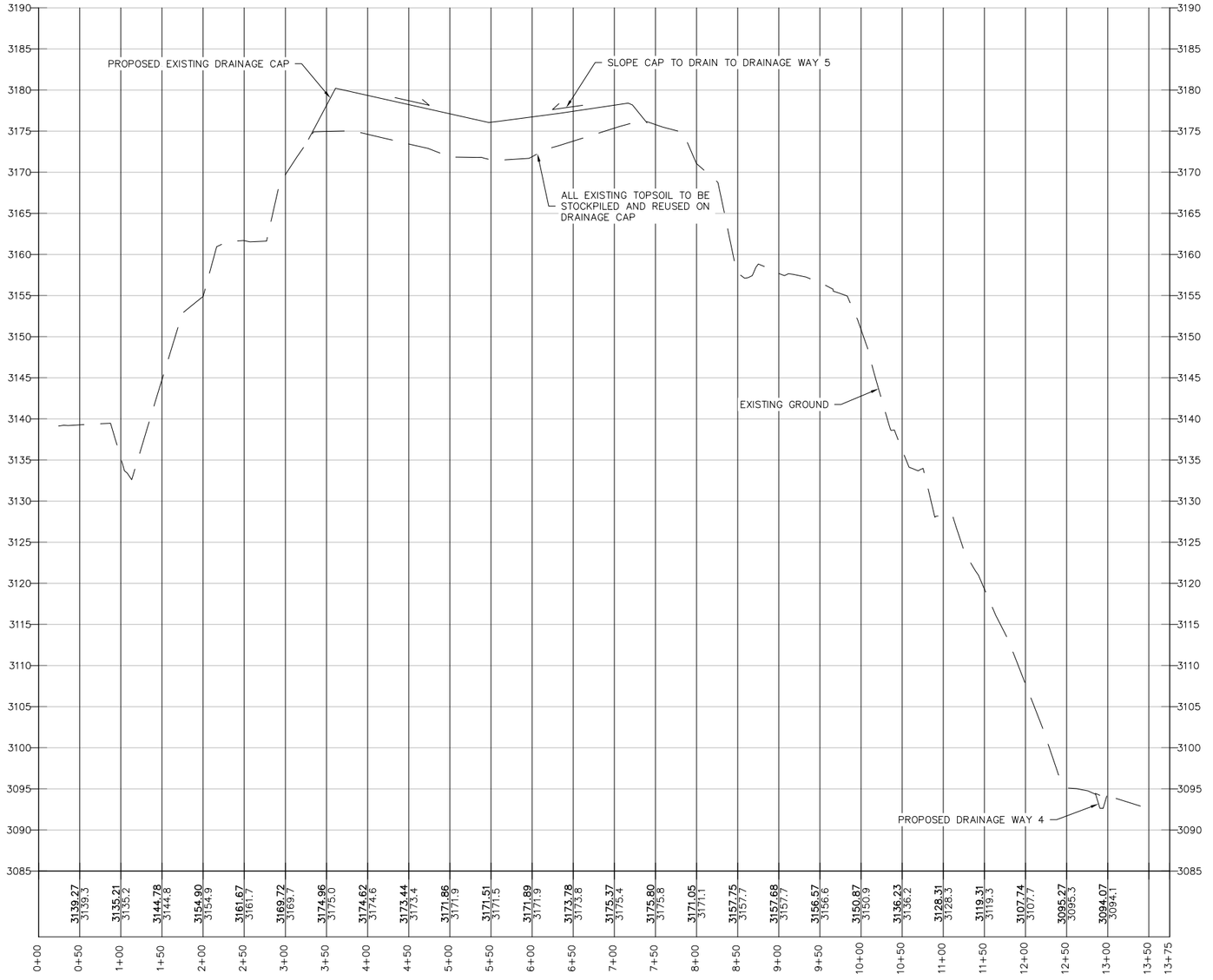
PROJECT #: 15-125	SHEET C1-2
DATE: 9/15/2016	

DESIGN PLAN - EXISTING

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN- EXISTING LANDFILL.dwg



PROFILE VIEW - EXISTING LANDFILL PROFILE 1

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN- EXISTING LANDFILL.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 80 160
VERTICAL SCALE FEET 0 8 16

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PROFILE VIEW - EXISTING LANDFILL PROFILE 1
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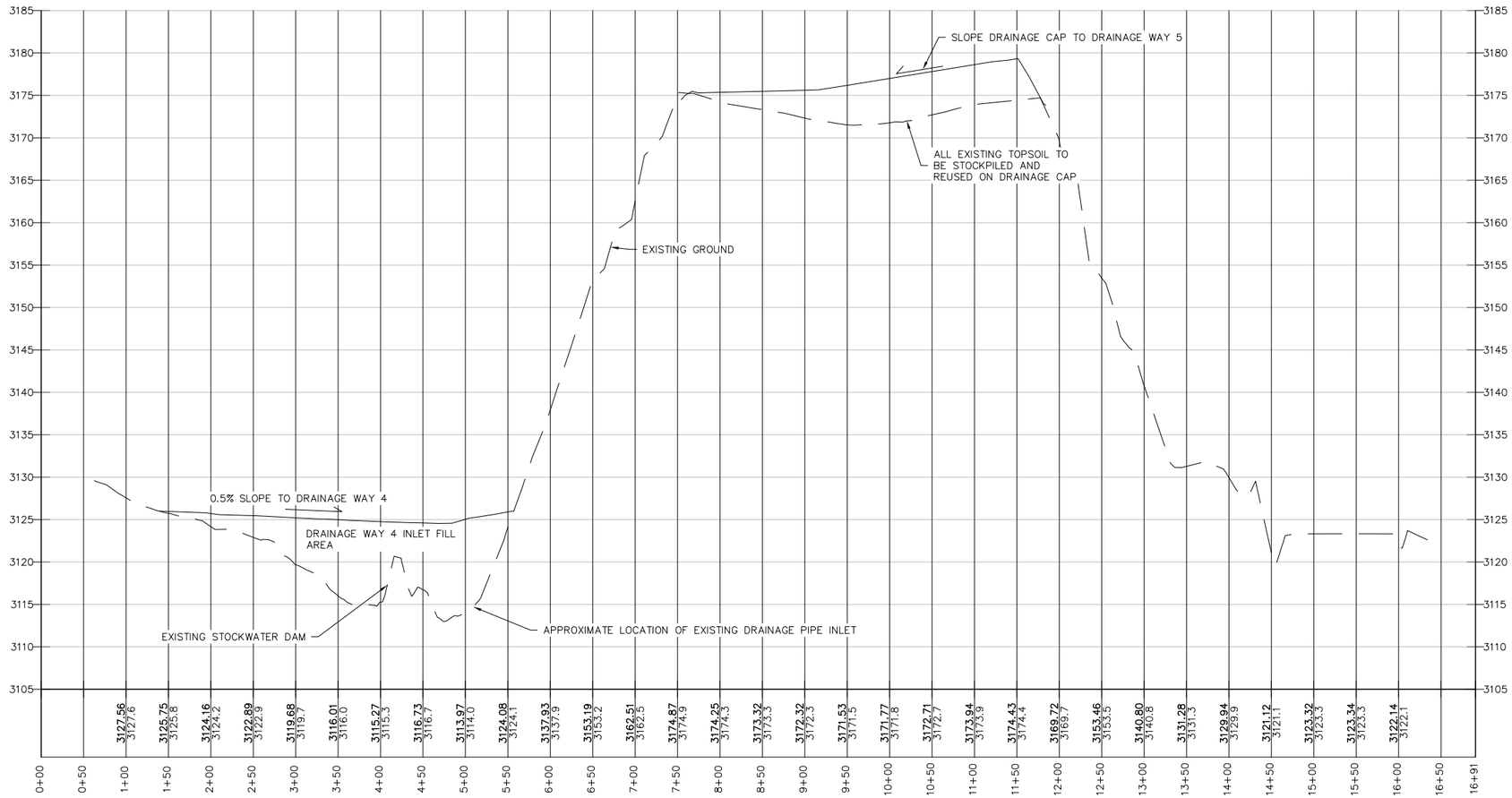
PROJECT #: 15-125
DATE: 9/15/2016
SHEET C1-3

DESIGN PLAN - EXISTING



PROFILE VIEW - PROFILE 2

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN- EXISTING LANDFILL.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 80 160
VERTICAL SCALE FEET 0 8 16

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PROFILE VIEW - EXISTING LANDFILL PROFILE 2
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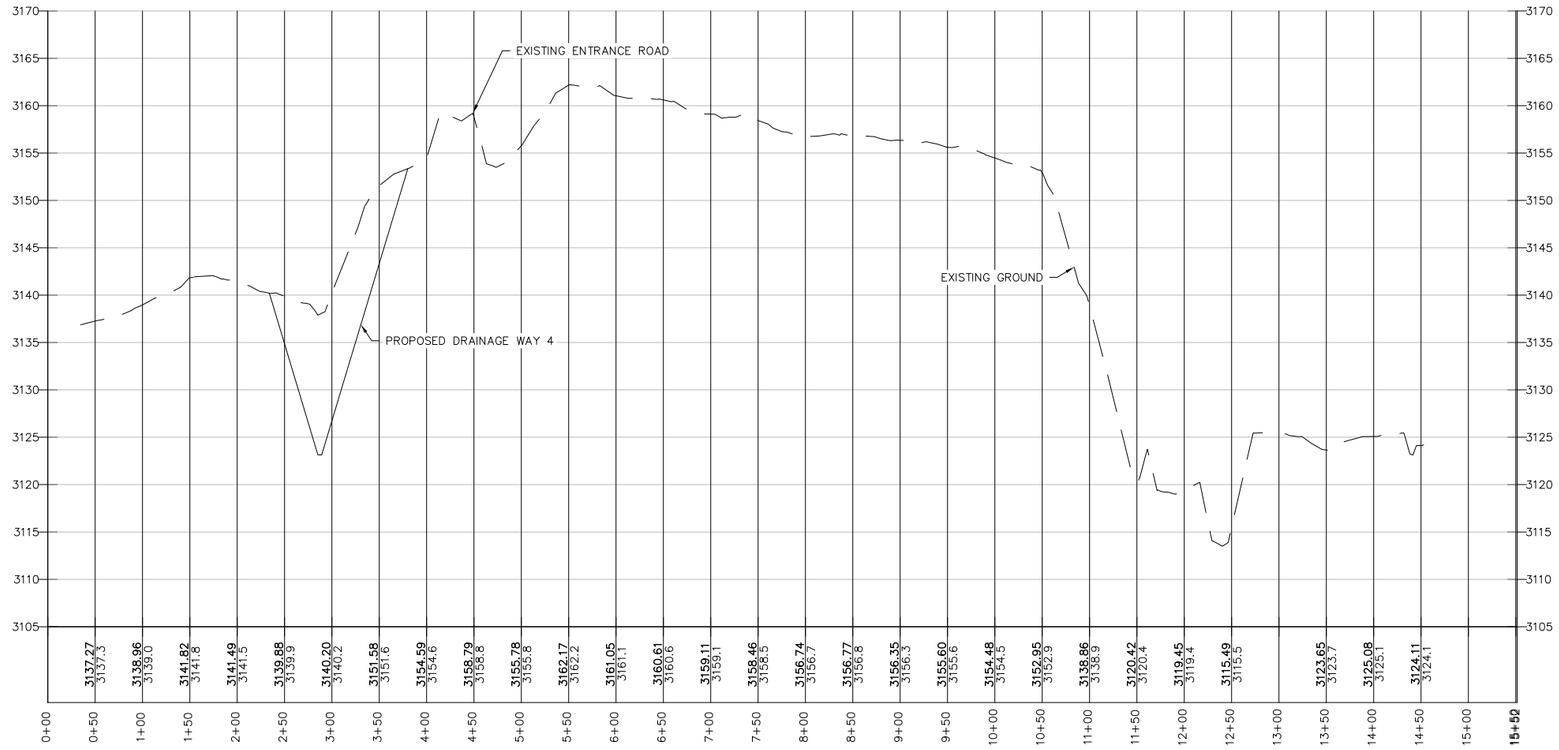
PROJECT #: 15-125
DATE: 9/15/2016
SHEET C1-4

DESIGN PLAN - EXISTING



PROFILE VIEW - PROFILE 3

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 80 160
VERTICAL SCALE FEET 0 8 16

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PROFILE VIEW - EXISTING LANDFILL PROFILE 3
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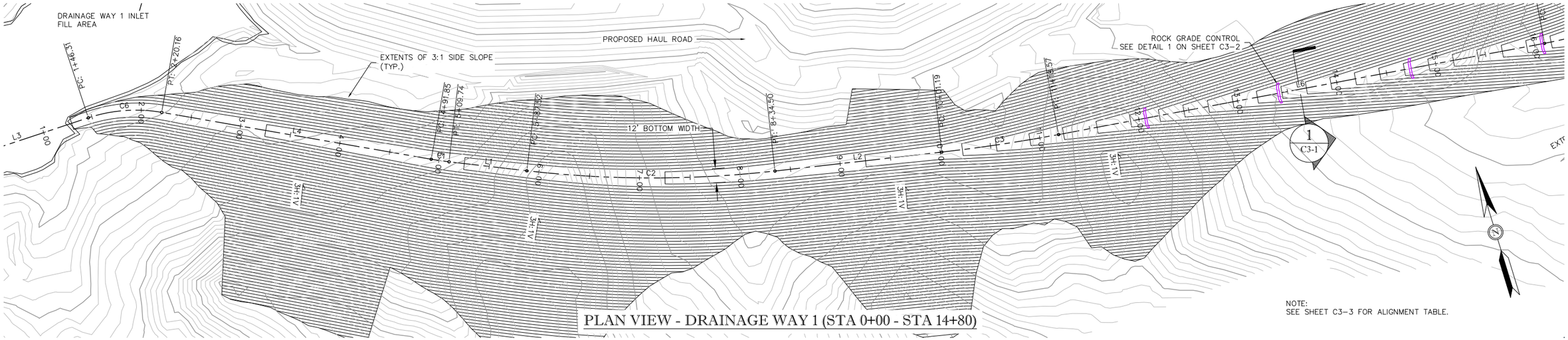
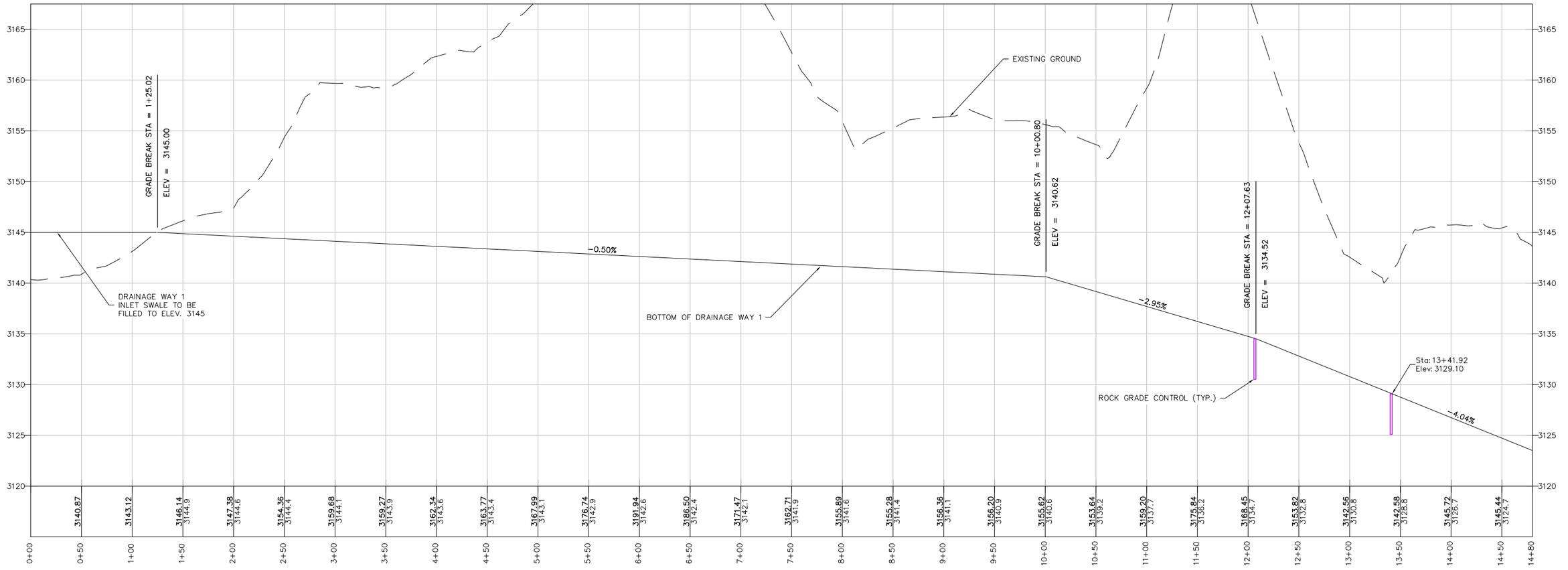
PROJECT #: 15-125
DATE: 9/15/2016
SHEET C1-5

DESIGN PLAN - EXISTING

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN- EXISTING LANDFILL.dwg



PLAN VIEW - DRAINAGE WAY 1 (STA 0+00 - STA 14+80)



PROFILE VIEW - DRAINAGE WAY 1 (STA 0+00 - STA 14+80)

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DRAINAGE WAY 1.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 50 100
VERTICAL SCALE FEET 0 5 10

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 1
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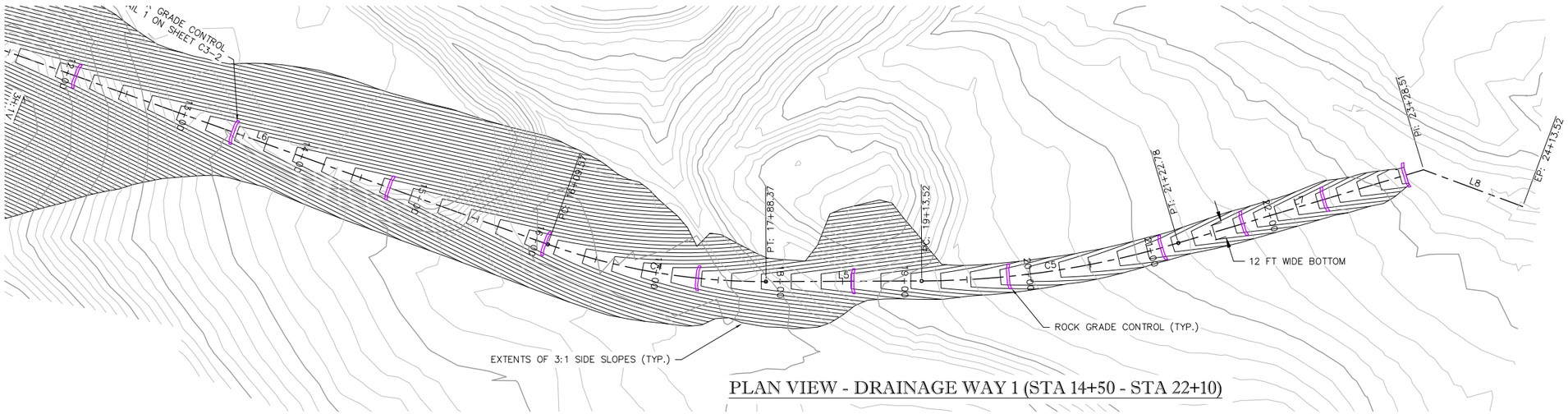
PROJECT #: 15-125
DATE: 9/15/2016

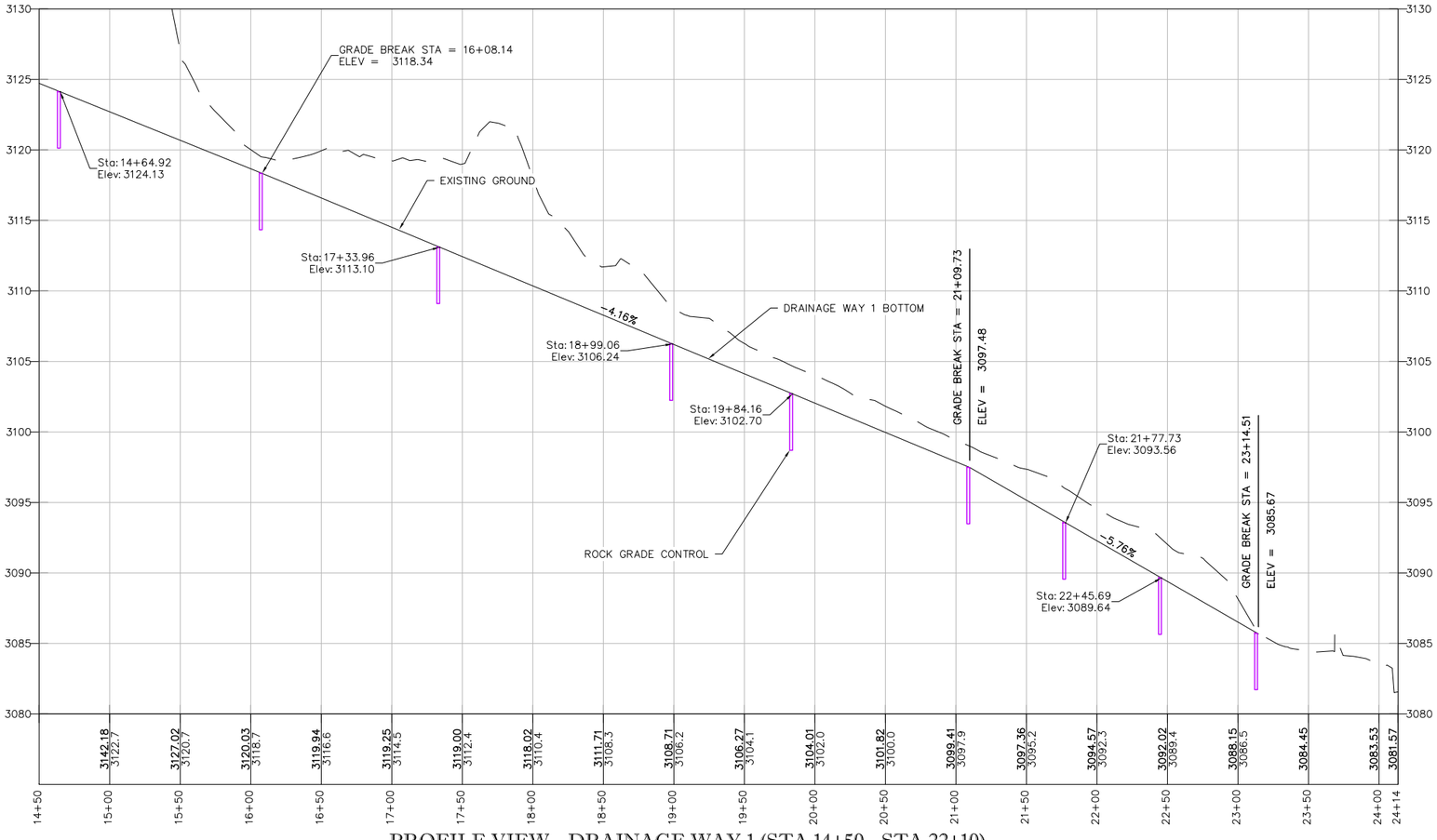
SHEET
C1-6

P & P - DRAINAGE WAY 1



PLAN VIEW - DRAINAGE WAY 1 (STA 14+50 - STA 22+10)

NOTE:
SEE SHEET C3-3 FOR ALIGNMENT TABLE.



PROFILE VIEW - DRAINAGE WAY 1 (STA 14+50 - STA 22+10)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0 50 100
VERTICAL SCALE FEET: 0 5 10

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 1
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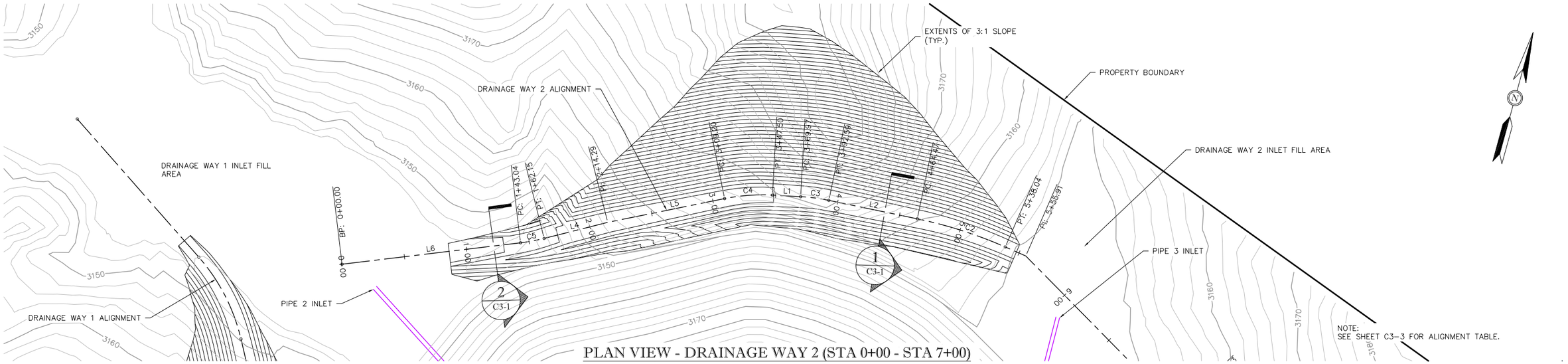
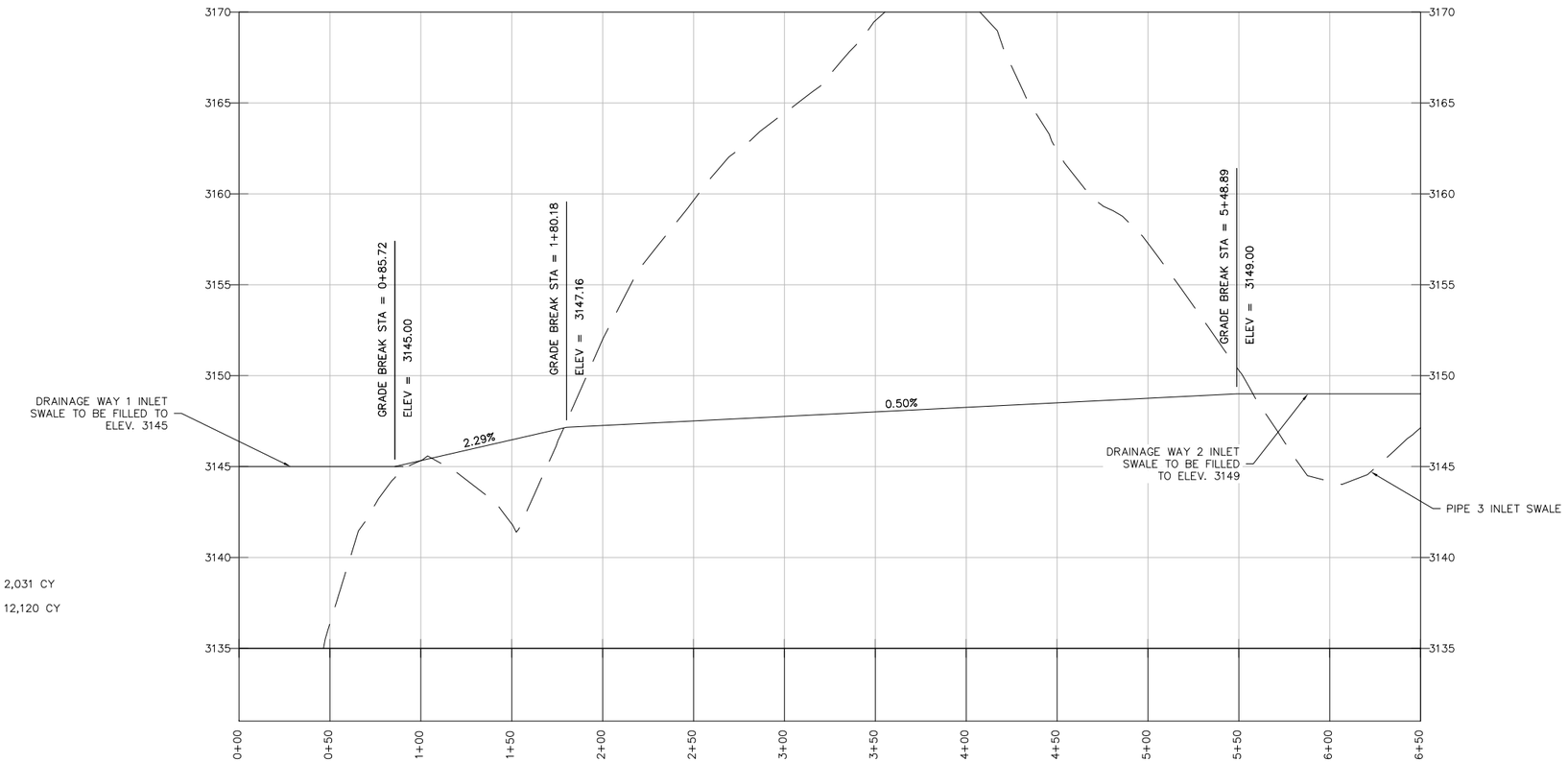
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C1-7

P & P - SPILLLWAY 1

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DRAINAGE WAY 1.dwg



PLAN VIEW - DRAINAGE WAY 2 (STA 0+00 - STA 7+00)



PROFILE VIEW - DRAINAGE WAY 2 (STA 0+00 - STA 7+00)

GRADING QUANTITIES:

DRAINAGE WAY 2 INLET FILL VOLUME: 2,031 CY

DRAINAGE WAY 2 CUT VOLUME: 12,120 CY

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DRAINAGE WAY 2.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 40 80

VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 2
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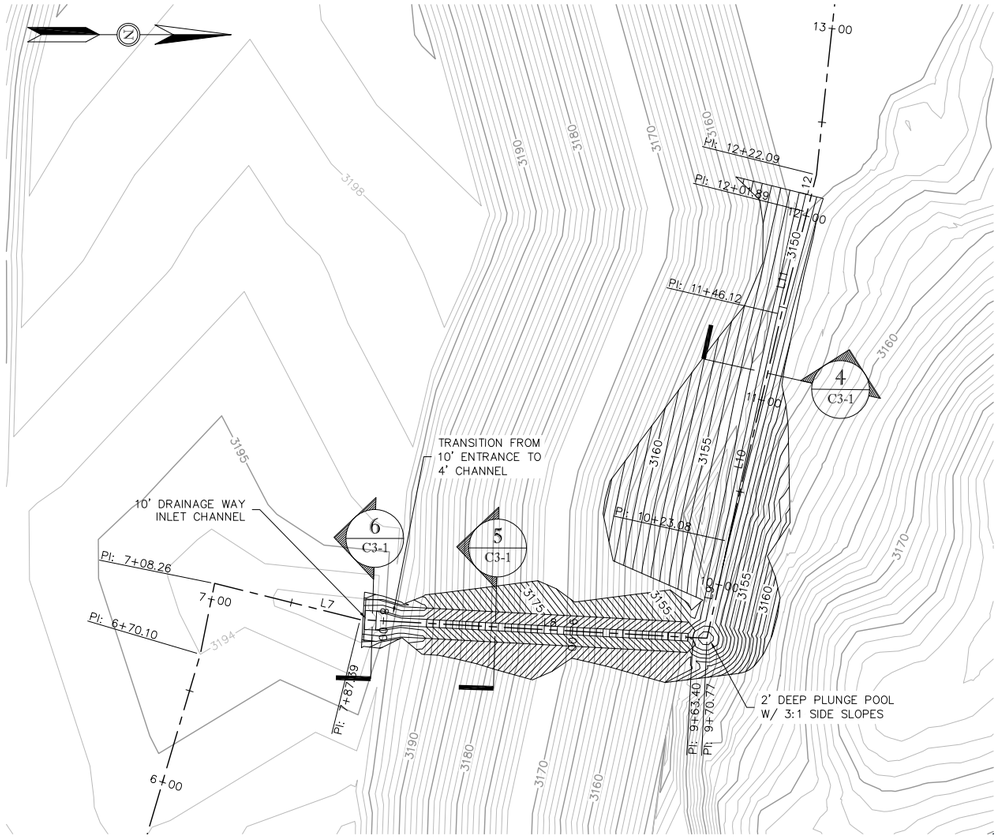
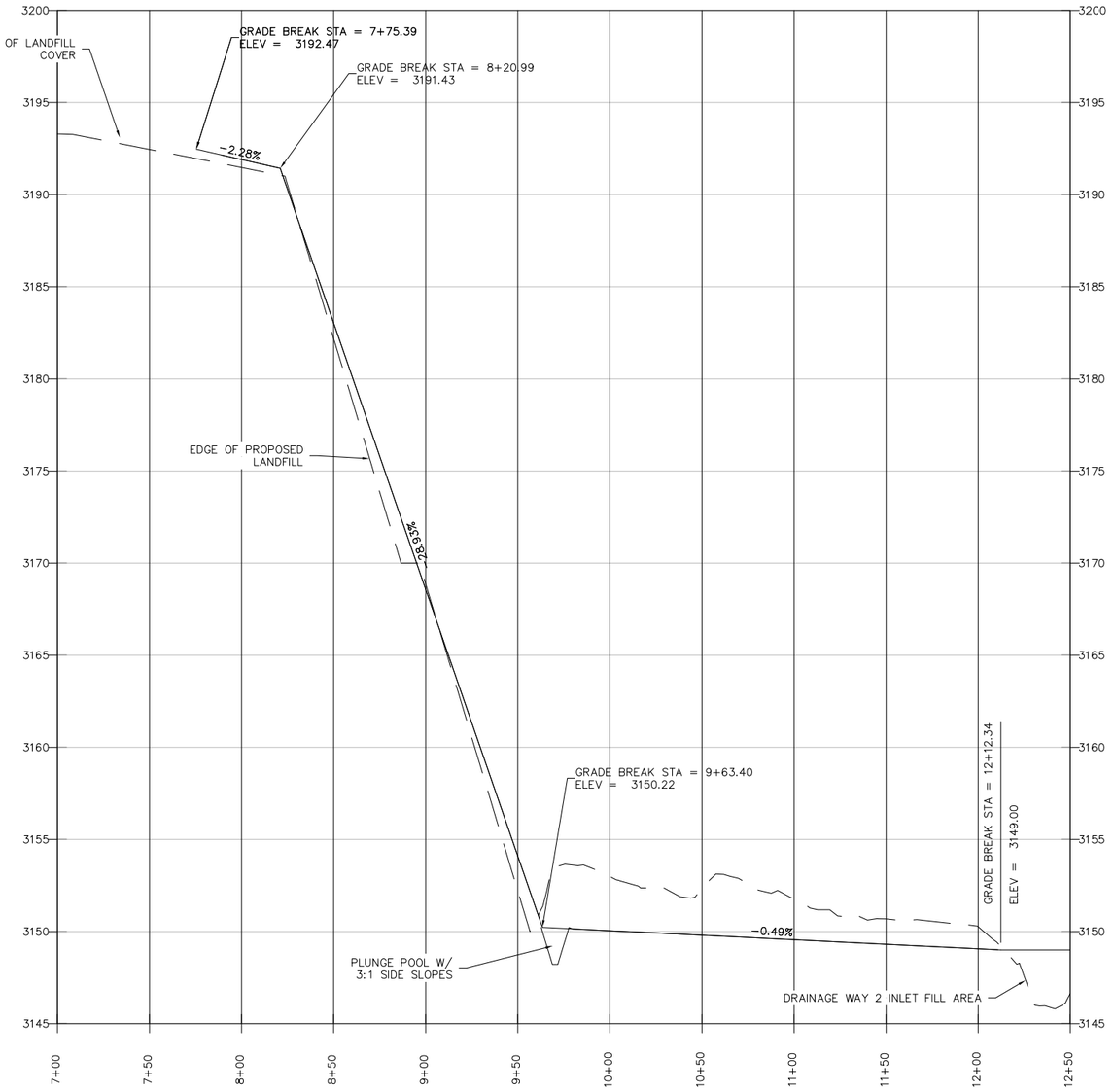
PROJECT #: 15-125
DATE: 9/15/2016

SHEET
C1-8

P & P - DRAINAGE WAY 2



PLAN VIEW - DRAINAGE WAY 3 (STA 7+00 - STA 10+00)



PROFILE VIEW - DRAINAGE WAY 3 (STA 7+00 - STA 10+00)

CONSTRUCTION NOTES:
ALIGNMENT TABLE: SEE SHEET C3-3

EROSION CONTROL: SEE SHEET C4-1

FOR CHANNEL TYPICAL CROSS-SECTIONS OF DRAINAGE WAY 3 ON SHEET C3-1.

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DRAINAGE WAY 3.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 40 80
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 3
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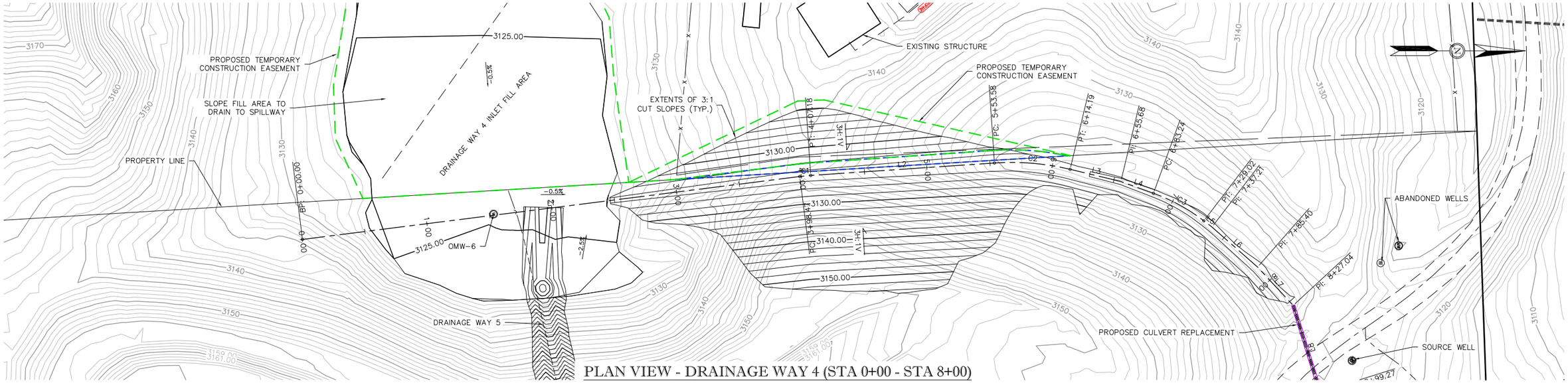
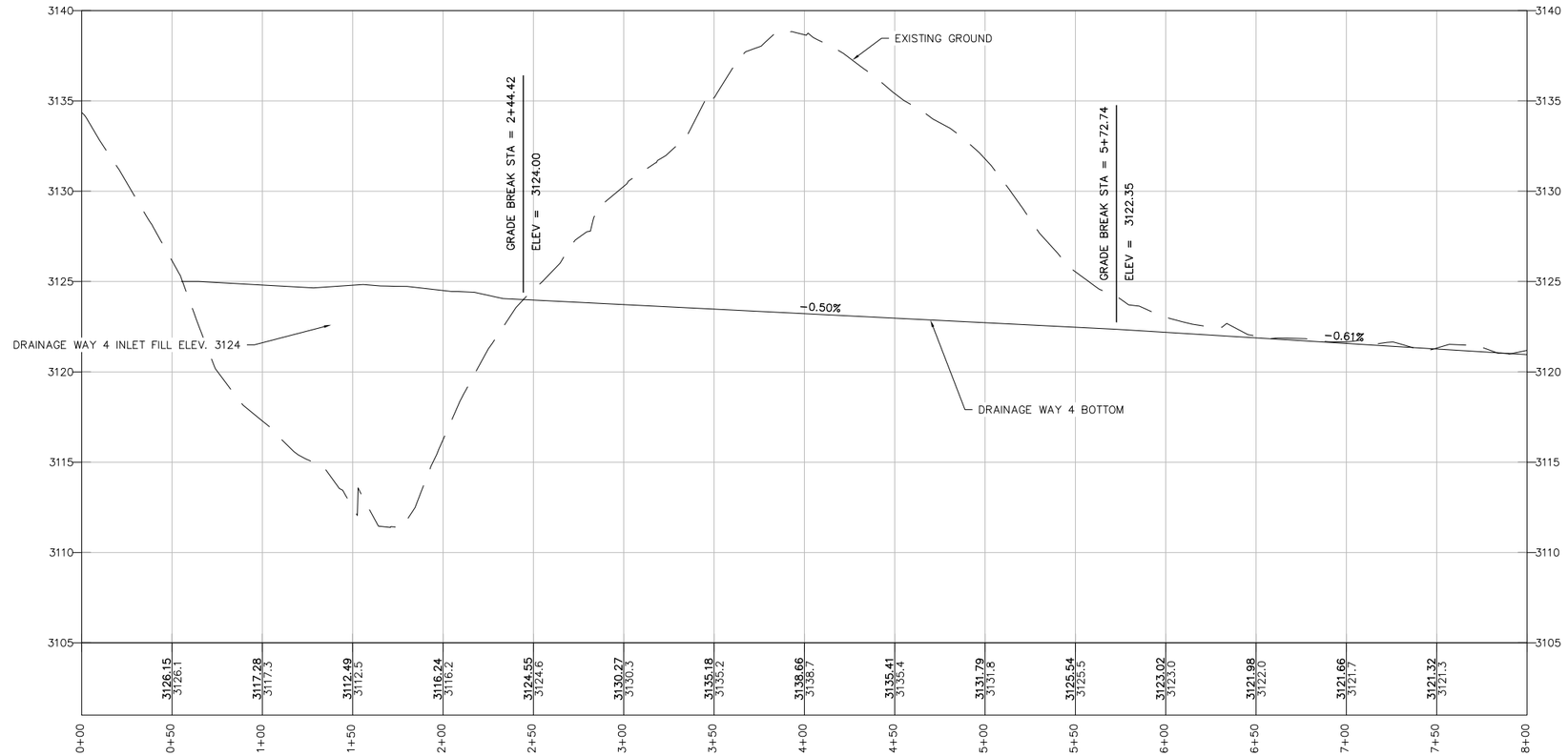
PROJECT #: 15-125
DATE: 9/15/2016

SHEET
C1-9

P & P - DRAINAGE WAY 3



PLAN VIEW - DRAINAGE WAY 4 (STA 0+00 - STA 8+00)



PROFILE VIEW - DRAINAGE WAY 4 (STA 0+00 - STA 8+00)

NOTE:
SEE SHEET C4-9 FOR ALIGNMENT TABLE.
SEE SHEET C1-8 FOR EASEMENT TABLE.

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DRAINAGE WAY 4.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 40 80
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 4
ROSEBUD COUNTY, MT

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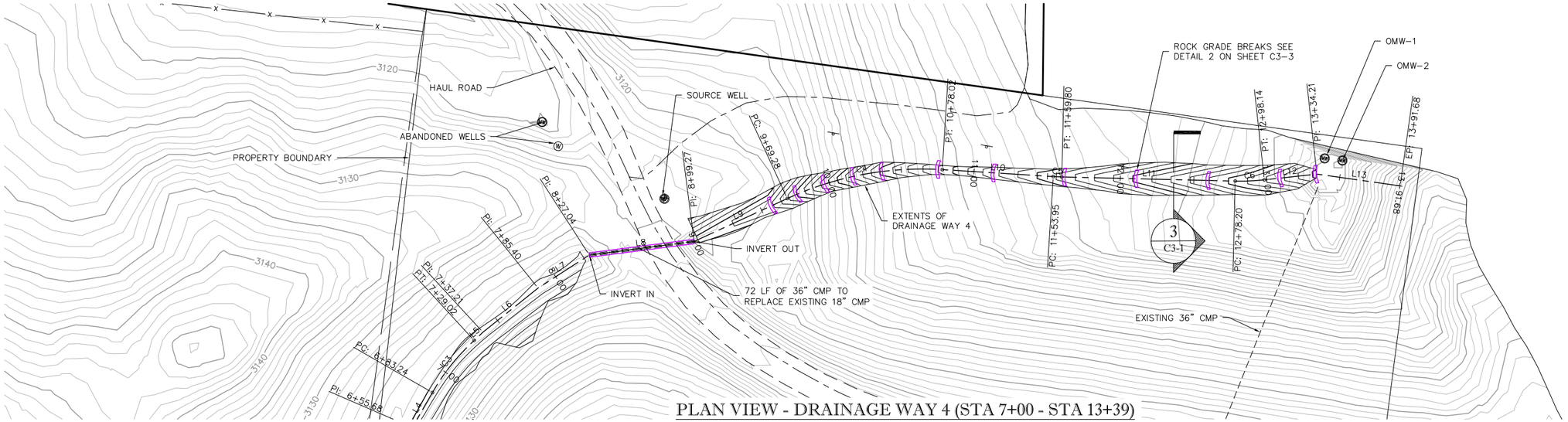
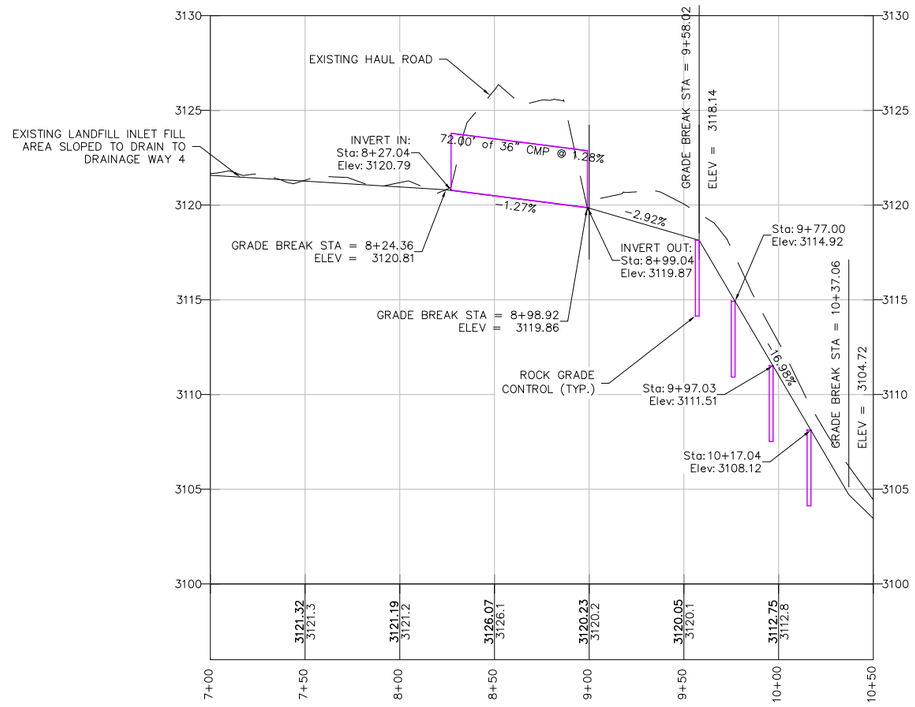
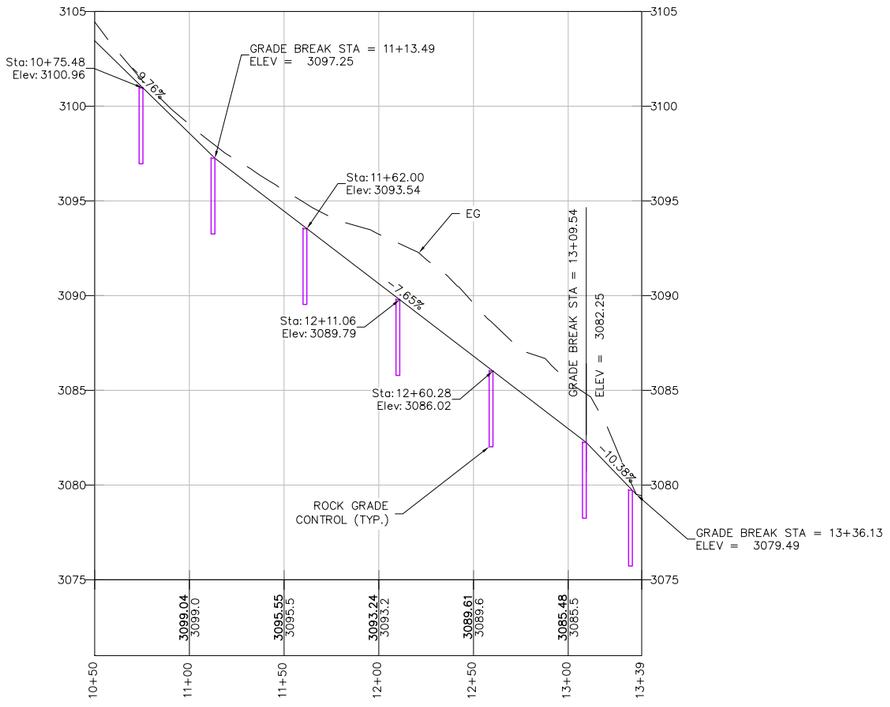
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C1-10

P & P - DRAINAGE WAY 4



PLAN VIEW - DRAINAGE WAY 4 (STA 7+00 - STA 13+39)





PROFILE VIEW - DRAINAGE WAY 4 (STA 7+00 - STA 13+39)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0 40 80
VERTICAL SCALE FEET: 0 4 8

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 4
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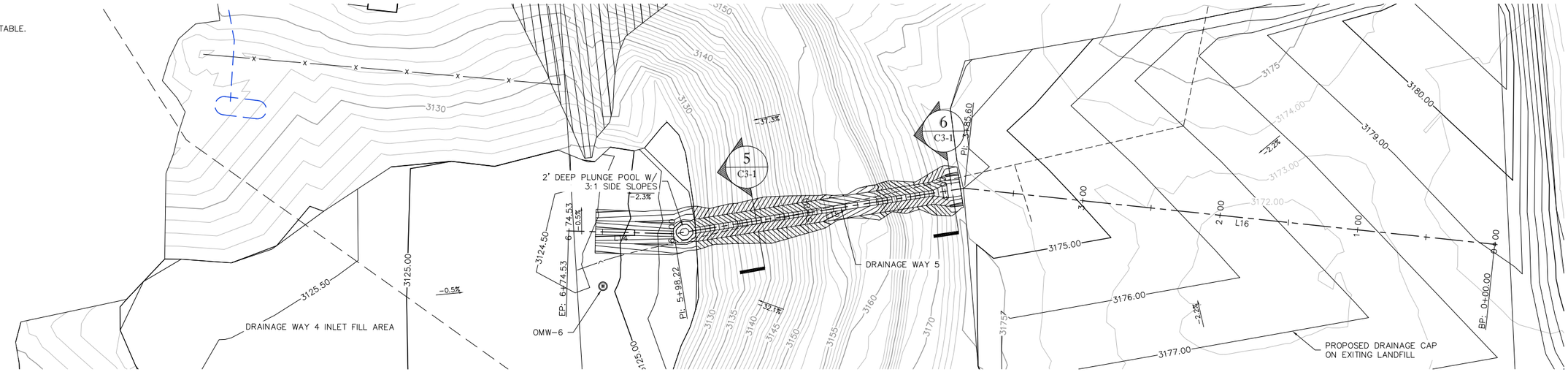
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C1-11

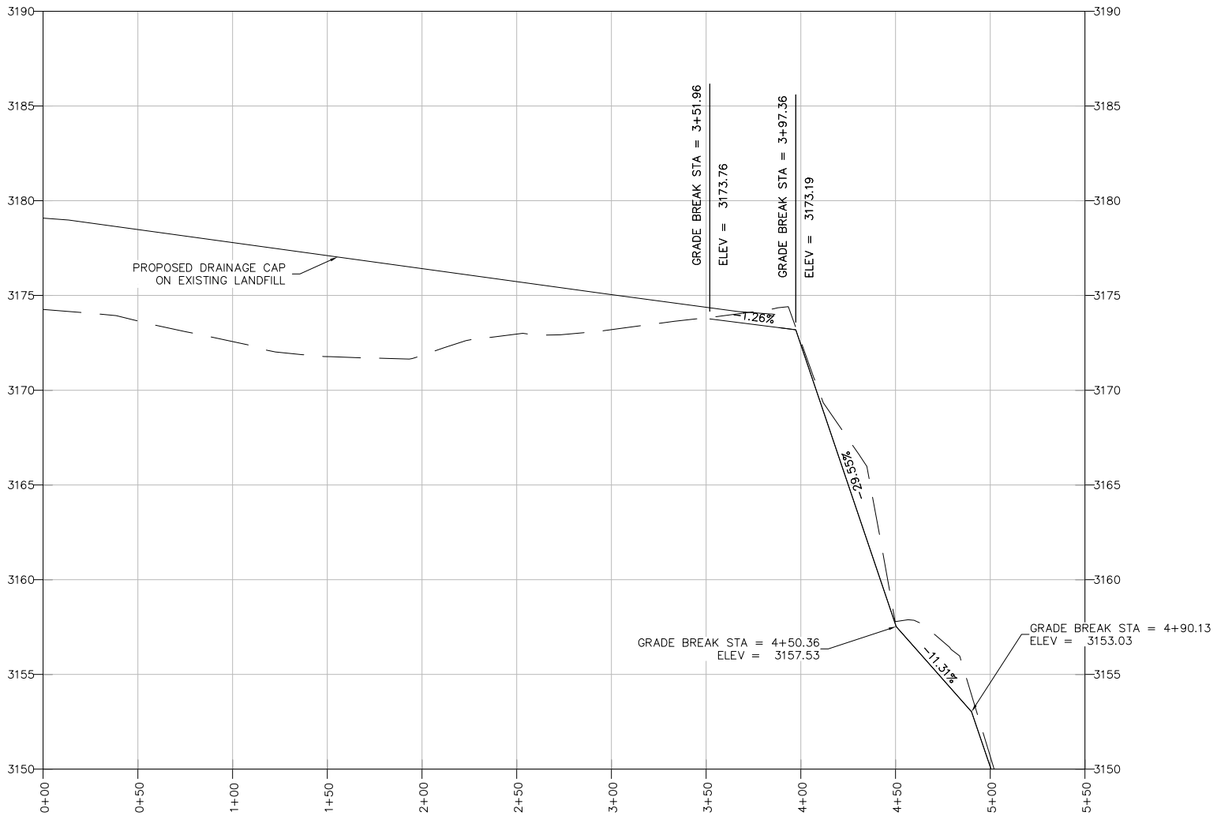
P & P - DRAINAGE WAY 4

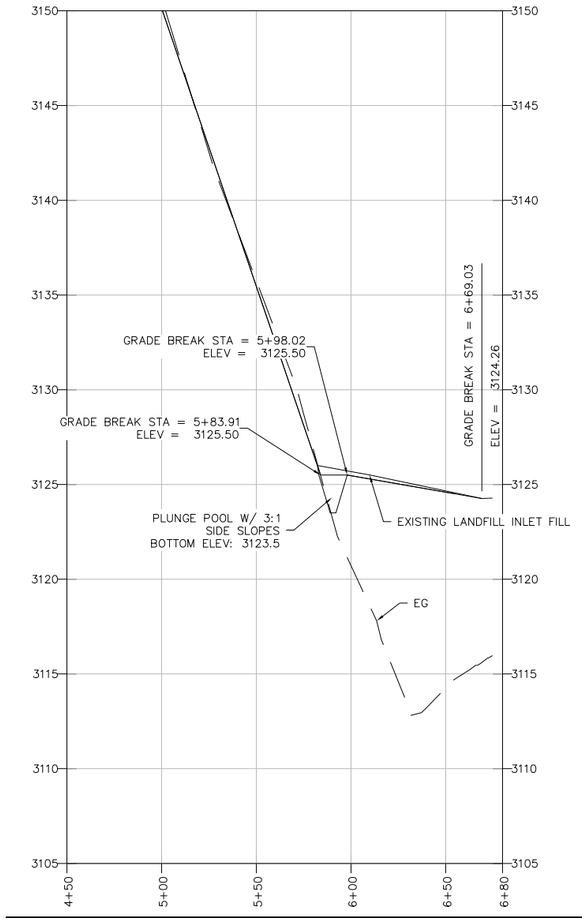
P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DRAINAGE WAY 4.dwg

NOTE:
SEE SHEET C3-3 FOR ALIGNMENT TABLE.



PLAN VIEW - DRAINAGE WAY 5 (STA 0+00 - STA 6+75)





PROFILE VIEW - DRAINAGE WAY 5 (STA 0+00 - STA 6+75)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 40 80
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
PLAN & PROFILE - DRAINAGE WAY 5
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PROJECT #: 15-125
DATE: 9/15/2016

SHEET
C1-12

P & P - DRAINAGE WAY 4

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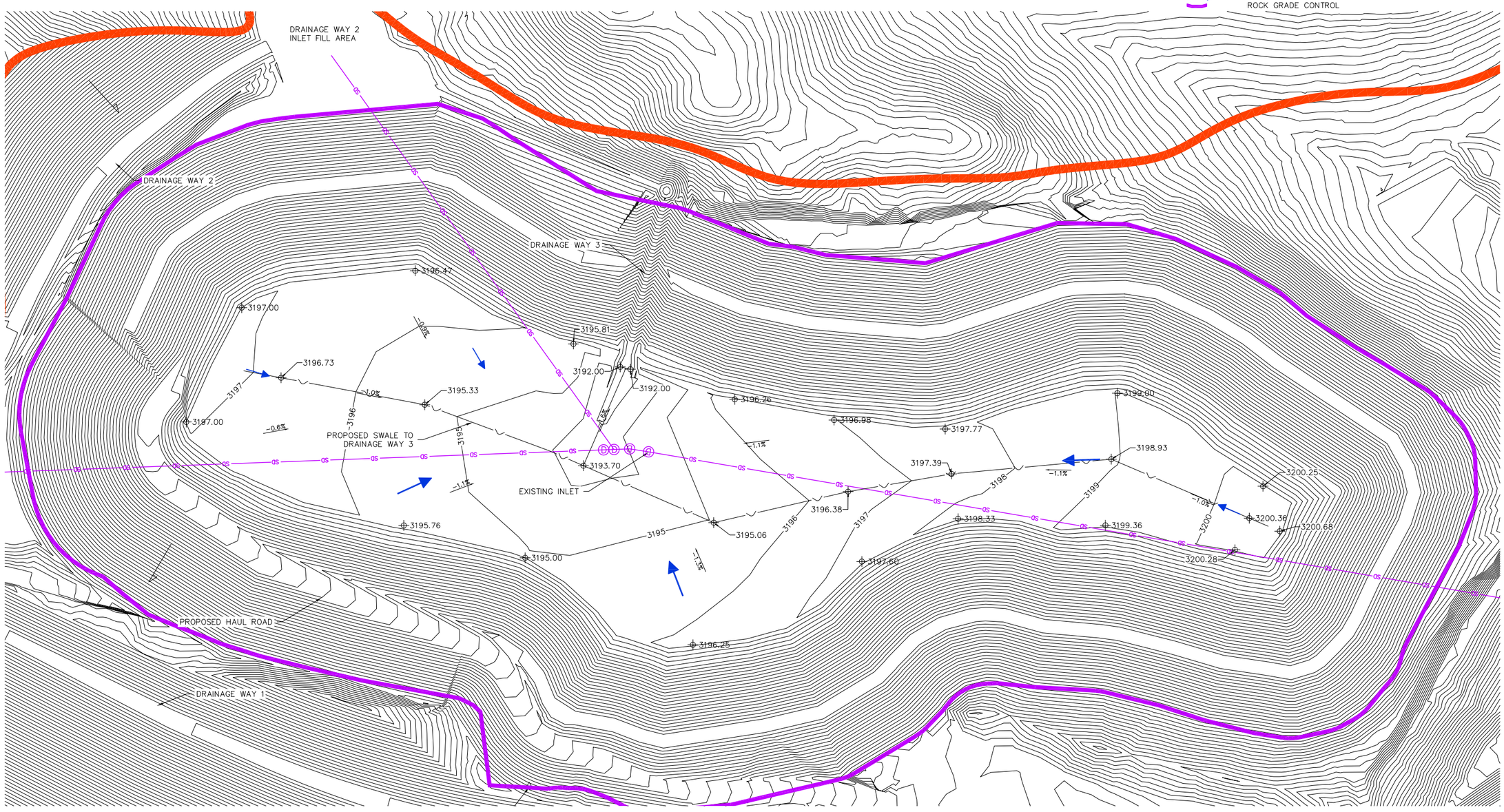
LEGEND

- FG MAJOR CONTOUR
- FG MINOR CONTOUR
- EDGE OF ROAD
- ROAD CENTERLINE
- STORM DRAINAGE PIPE
- LIMITS OF DISTURBANCE
- EXTENTS OF NEW LANDFILL EXPANSION ELEV: 3150
- FLOW ARROW
- ROCK GRADE CONTROL



CONSTRUCTION NOTES:
ALL ELEVATIONS SHOWN ARE FOR SUB-SOIL. ON TOP OF THIS SUB-SOIL WILL BE PLACED A MINIMUM OF 6 INCHES OF TOP SOIL.

THE FIRST 18 INCHES OF SUB-SOIL IS TO BE COMPACTED TO 95% OF PROCTOR DENSITY. REMAINING SUB-SOIL AND TOP SOIL IS ONLY TO BE COMPACTED TO 80% PROCTOR DENSITY TO PROMOTE PLANT GROWTH.

NO.	REVISIONS	DRAWN BY	DATE

0 100 200 300
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DESIGN PLAN - PHASE 1 & 2 DRAINAGE CAP
ROSEBUD COUNTY, MT

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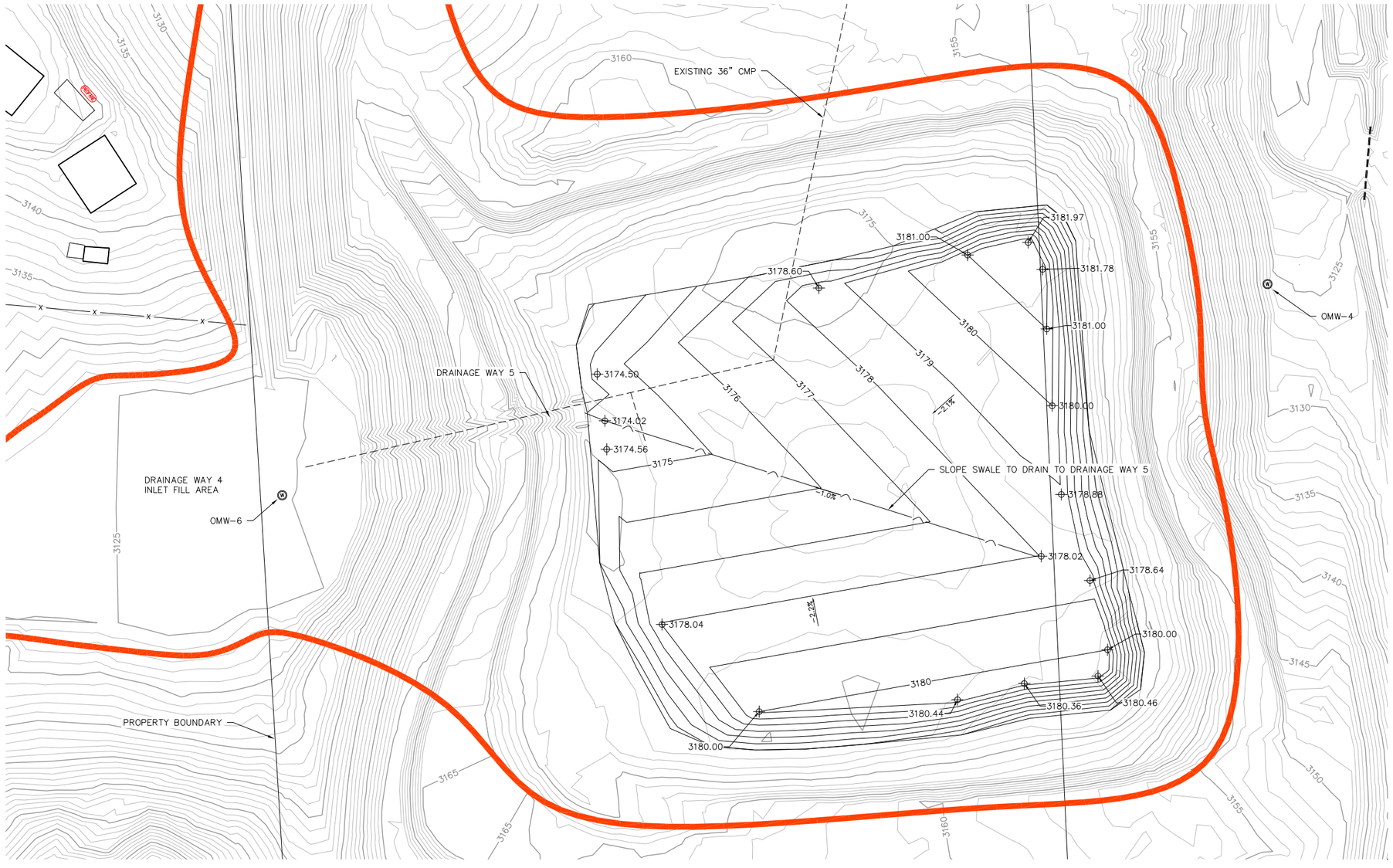
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C1-13

DESIGN PLAN -DRAINAGE

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\06 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN - ACTIVE LANDFILL.dwg



CONSTRUCTION NOTES:
ALL AREAS TO BE FILLED ARE TO BE STRIPPED OF ALL TOP SOIL.

ALL ELEVATIONS SHOWN ARE FOR SUB-SOIL. ON TOP OF THIS SUB-SOIL WILL BE PLACED A MINIMUM OF 6 INCHES OF TOP SOIL.

THE FIRST 18 INCHES OF SUB-SOIL IS TO BE COMPACTED TO 95% OF PROCTOR DENSITY. REMAINING SUB-SOIL AND TOP SOIL IS ONLY TO BE COMPACTED TO 80% PROCTOR DENSITY TO PROMOTE PLANT GROWTH.

NO.	REVISIONS	DRAWN BY	DATE

0 100 200 300
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DESIGN PLAN - EXISTING LANDFILL DRAINAGE CAP
ROSEBUD COUNTY, MT

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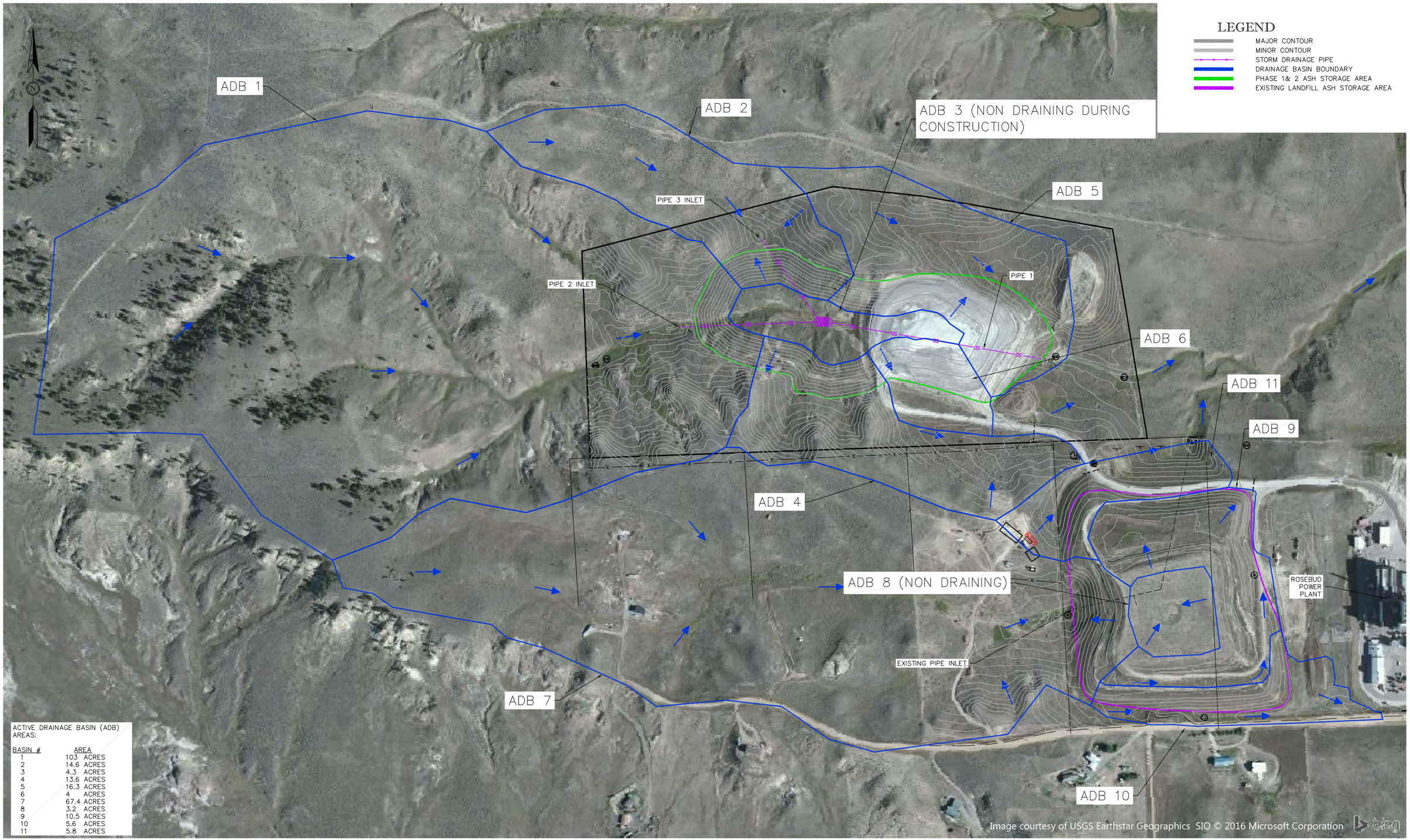
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C1-14

DESIGN PLAN - EXISTING

P:\2015\15-125 Rosebud Power Plant Ash Disposal Site\09 CAD Data\SHEET SET\POST-CLOSURE PLAN SET\DESIGN PLAN- EXISTING DRAINAGE CAP.dwg



ACTIVE DRAINAGE BASIN (ADB) AREAS:

BASIN #	AREA
1	103 ACRES
2	14.6 ACRES
3	4.3 ACRES
4	13.6 ACRES
5	16.3 ACRES
6	4 ACRES
7	67.4 ACRES
8	3.2 ACRES
9	10.5 ACRES
10	5.6 ACRES
11	5.8 ACRES

NO.	REVISIONS	DRAWN BY	DATE

0 200 400 600
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
ACTIVE LANDFILL DRAINAGE BASINS
ROSEBUD COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
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ALLIED ENGINEERING SERVICES, INC.

PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C2-1
	ACTIVE DRAINAGE BASINS

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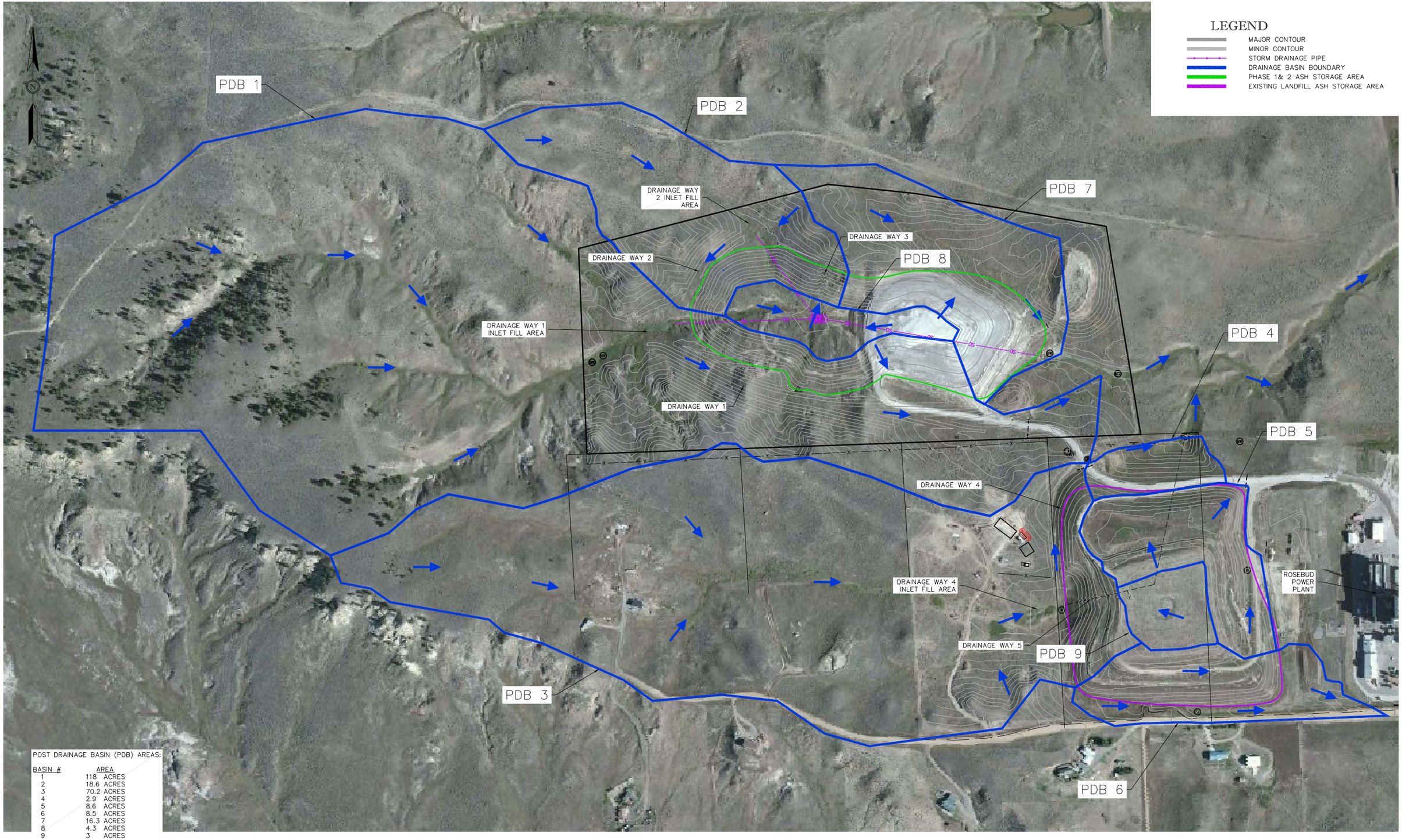

POST DRAINAGE BASIN (PDB) AREAS:

BASIN #	AREA
1	118 ACRES
2	18.6 ACRES
3	70.2 ACRES
4	2.9 ACRES
5	8.6 ACRES
6	8.5 ACRES
7	16.3 ACRES
8	4.3 ACRES
9	3 ACRES

NO.	REVISIONS	DRAWN BY	DATE

0 200 400 600
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
POST-CLOSURE DRAINAGE BASINS
ROSEBUD COUNTY, MT

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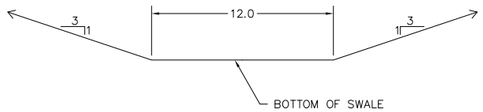
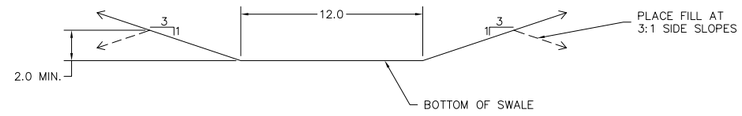
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C2-2

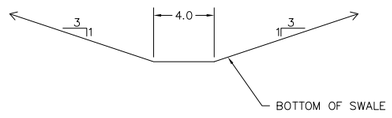
POST DRAINAGE BASINS



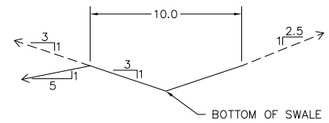
1 C1-3 SECTION
12' DRAINAGE SWALE
1" = 5'



2 C1-5 SECTION
12' DRAINAGE SWALE W/ RIGHT BERM
1" = 5'



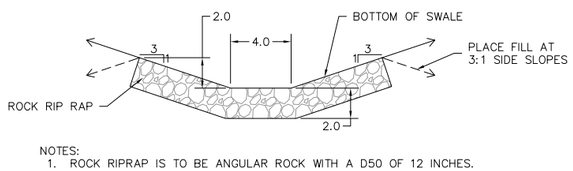
3 C1-7 SECTION
4' DRAINAGE SWALE
1" = 5'



NOTES:
1. PLACE LEFT SIDE DAYLIGHT FILL AT 5:1 SLOPES FILLING ANY DEPRESSIONS, AND DIRECTING DRAINAGE INTO SWALE.

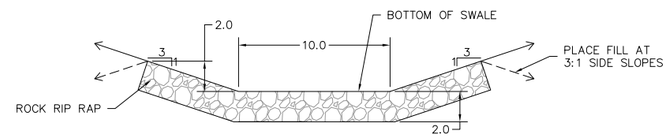
2. CUT RIGHT SIDE DAYLIGHT TO A 2.5:1 OR GREATER DEPENDING ON SOIL CONDITIONS ENCOUNTERED.

4 C1-9 SECTION
SPILLWAY 4
1" = 5'



NOTES:
1. ROCK RIPRAP IS TO BE ANGULAR ROCK WITH A D50 OF 12 INCHES.

5 C1-6 SECTION
4' DRAINAGE SWALE
1" = 5'



NOTES:
1. ROCK RIPRAP IS TO BE ANGULAR ROCK WITH A D50 OF 12 INCHES.

6 C1-6 SECTION
10' DRAINAGE SWALE
1" = 5'

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DETAILS - SWALE SECTIONS
ROSEBUD COUNTY, MT

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PROJECT #: 15-125
DATE: 9/15/2016
SHEET C3-1

DETAILS - SWALE SECTIONS

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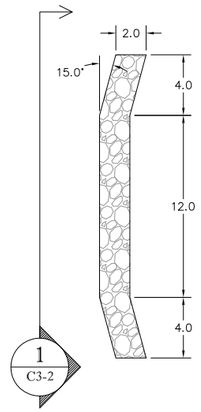
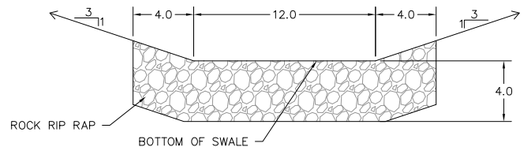
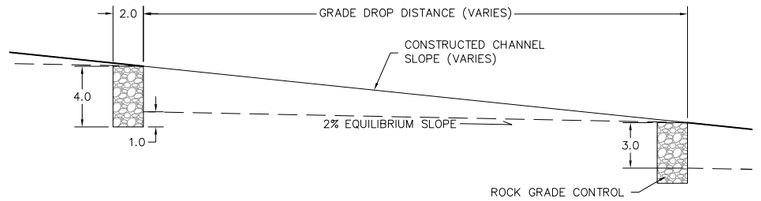


1 C3-2 DETAIL
SPILLWAY 1 GRADE CONTROL - PLAN VIEW
1 " = 5'



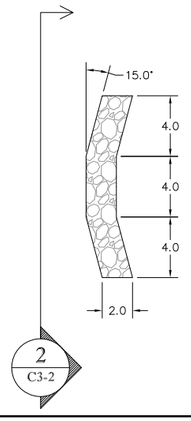
NOTES:
1. ROCK RIPRAP IS TO BE ANGULAR ROCK WITH A D50 OF 8 INCHES.

1 C3-2 SECTION
SPILLWAY 1 GRADE CONTROL
1" = 5'

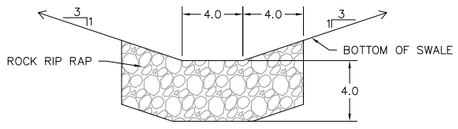


NOTES:
1. ROCK RIPRAP IS TO BE ANGULAR ROCK WITH A D50 OF 8 INCHES.
2. DISTANCE BETWEEN GRADE DROPS IS SHOWN ON PLANS. IT VARIES WITH CHANNEL SLOPE.
3. EQUILIBRIUM SLOPE WAS DETERMINED BY COMPARISON OF EXISTING SLOPES.

3 C3-2 DETAIL
TYPICAL GRADE CONTROL PROFILE
1 " = 5'



2 S3-3 DETAIL
SPILLWAY 3 GRADE CONTROL - PLAN VIEW
1 " = 5'



NOTES:
1. ROCK RIPRAP IS TO BE ANGULAR ROCK WITH A D50 OF 8 INCHES.

2 C3-2 SECTION
SPILLWAY 3 GRADE CONTROL
1" = 5'

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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DETAILS - ROCK GRADE CONTROLS
ROSEBUD COUNTY, MT

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PROJECT #: 15-125
DATE: 9/15/2016
SHEET C3-2
DETAILS - ROCK CONTROL

DRAINAGE WAY 1 ALIGNMENT

Number	Radius	Length	Line/Chord Direction	Start Station	End Station	Start Northing, Easting
L3		146.31	N88° 36' 59.04"E	0+00.00	1+46.31	643344.5741, 2687756.5228
C6	150.00	73.86	S77° 16' 41.83"E	1+46.31	2+20.16	643348.1068, 2687902.7880
L4		271.68	S63° 10' 22.69"E	2+20.16	4+91.85	643332.0065, 2687974.1047
C1	312.15	17.89	S64° 48' 54.31"E	4+91.85	5+09.74	643209.3966, 2688216.5469
L1		77.78	S66° 27' 25.94"E	5+09.74	5+87.52	643201.7835, 2688232.7365
C2	1084.22	246.98	S72° 58' 58.71"E	5+87.52	8+34.50	643170.7161, 2688304.0411
L2		166.70	S79° 30' 31.48"E	8+34.50	10+01.19	643098.5926, 2688539.6957
C3	1614.37	117.37	S81° 35' 29.84"E	10+01.19	11+18.57	643068.2396, 2688703.6054
L6		491.00	S83° 40' 28.20"E	11+18.57	16+09.57	643051.0800, 2688819.6928
C4	516.43	178.80	N86° 24' 25.40"E	16+09.57	17+88.37	642996.9829, 2689307.7071
L5		125.15	N76° 29' 19.00"E	17+88.37	19+13.52	643008.1319, 2689485.2646
C5	732.50	209.26	N68° 18' 16.74"E	19+13.52	21+22.78	643037.3726, 2689606.9542
L7		205.73	N60° 07' 14.48"E	21+22.78	23+28.51	643114.4664, 2689800.7281
L8		85.01	S82° 55' 28.98"E	23+28.51	24+13.52	643216.9581, 2689979.1158

DRAINAGE WAY 2 ALIGNMENT

Number	Radius	Length	Line/Chord Direction	Start Station	End Station	Start Northing, Easting
L6		143.04	N33° 10' 00.74"E	0+00.00	1+43.04	643431.7828, 2687980.2610
C5	150.00	19.11	N29° 31' 01.66"E	1+43.04	1+62.15	643551.5167, 2688058.5138
L4		52.14	N25° 52' 02.59"E	1+62.15	2+14.29	643568.1351, 2688067.9226
L5		94.91	N28° 30' 48.36"E	2+14.29	3+09.20	643615.0533, 2688090.6719
C4	150.00	38.30	N35° 49' 38.90"E	3+09.20	3+47.50	643698.4554, 2688135.9809
L1		22.47	N43° 08' 29.44"E	3+47.50	3+69.97	643729.4211, 2688158.3366
C3	150.00	22.62	N47° 27' 42.66"E	3+69.97	3+92.59	643745.8146, 2688173.6997
L2		71.88	N51° 46' 55.89"E	3+92.59	4+64.47	643761.0939, 2688190.3518
C2	355.54	73.57	N57° 42' 36.31"E	4+64.47	5+38.04	643805.5653, 2688246.8288

DRAINAGE WAY 3 ALIGNMENT

Number	Radius	Length	Line/Chord Direction	Start Station	End Station	Start Northing, Easting
L7		79.14	N23° 58' 15.77"E	7+08.26	7+87.39	643460.8902, 2688626.0039
L8		176.01	N13° 05' 01.79"E	7+87.39	9+63.40	643533.2022, 2688658.1555
L9		52.31	N67° 32' 36.83"W	9+70.77	10+23.08	643711.8326, 2688699.6038
L10		123.04	N66° 51' 54.52"W	10+23.08	11+46.12	643731.8139, 2688651.2609
L11		55.76	N65° 51' 12.83"W	11+46.12	12+01.89	643780.1573, 2688538.1121
L12		20.20	N66° 02' 56.78"W	12+01.89	12+22.09	643802.9681, 2688487.2288

DRAINAGE WAY 4 ALIGNMENT

Number	Radius	Length	Line/Chord Direction	Start Station	End Station	Start Northing, Easting
L1		398.47	N7° 12' 41.64"W	0+00.00	3+98.47	641989.0819, 2689783.7761
C1	150.00	8.71	N5° 32' 52.52"W	3+98.47	4+07.18	642384.3984, 2689733.7549
L2		146.40	N3° 53' 03.40"W	4+07.18	5+53.58	642393.0672, 2689732.9129
C2	200.00	60.61	N4° 47' 51.97"E	5+53.58	6+14.19	642539.1338, 2689722.9953
L3		41.48	N13° 28' 47.34"E	6+14.19	6+55.68	642599.3026, 2689728.0455
L4		27.57	N19° 55' 02.83"E	6+55.68	6+83.24	642639.6409, 2689737.7148
C3	150.00	45.78	N28° 39' 40.33"E	6+83.24	7+29.02	642665.5578, 2689747.1055
L5		8.19	N37° 24' 17.83"E	7+29.02	7+37.21	642705.5746, 2689768.9789
L6		48.18	N41° 16' 43.16"E	7+37.21	7+85.40	642712.0804, 2689773.9539
L7		41.65	N47° 12' 05.16"E	7+85.40	8+27.04	642748.2914, 2689805.7420
L8		72.23	N72° 35' 03.58"E	8+27.04	8+99.27	642776.5860, 2689836.2990
L9		70.01	N55° 15' 38.42"E	8+99.27	9+69.28	642798.2050, 2689905.2192
C4	219.87	108.74	N69° 25' 41.66"E	9+69.28	10+78.02	642838.0991, 2689962.7492
L10		75.94	N83° 35' 44.90"E	10+78.02	11+53.95	642875.9183, 2690063.5164
C5	150.00	5.84	N82° 28' 49.16"E	11+53.95	11+59.80	642884.3884, 2690138.9792
L11		118.41	N81° 21' 53.41"E	11+59.80	12+78.20	642885.1527, 2690144.7693
C6	150.00	19.94	N77° 33' 23.89"E	12+78.20	12+98.14	642902.9304, 2690261.8327
L12		36.07	N73° 44' 54.38"E	12+98.14	13+34.21	642907.2237, 2690281.2896
L13		57.47	N88° 02' 50.21"E	13+34.21	13+91.68	642917.3186, 2690315.9202

DRAINAGE WAY 5 ALIGNMENT

Number	Radius	Length	Line/Chord Direction	Start Station	End Station	Start Northing, Easting
L14		76.31	N88° 27' 10.46"W	5+98.22	6+74.53	642178.8475, 2689815.0061
L15		212.62	S81° 05' 30.77"W	3+85.60	5+98.22	642211.7723, 2690025.0646
L16		385.60	N83° 58' 06.39"W	0+00.00	3+85.60	642171.2554, 2690408.5251

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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC | DRAWN BY: ASG
DESIGNED BY: ASG | REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DETAILS - ALIGNMENT TABLES
ROSEBUD COUNTY, MT

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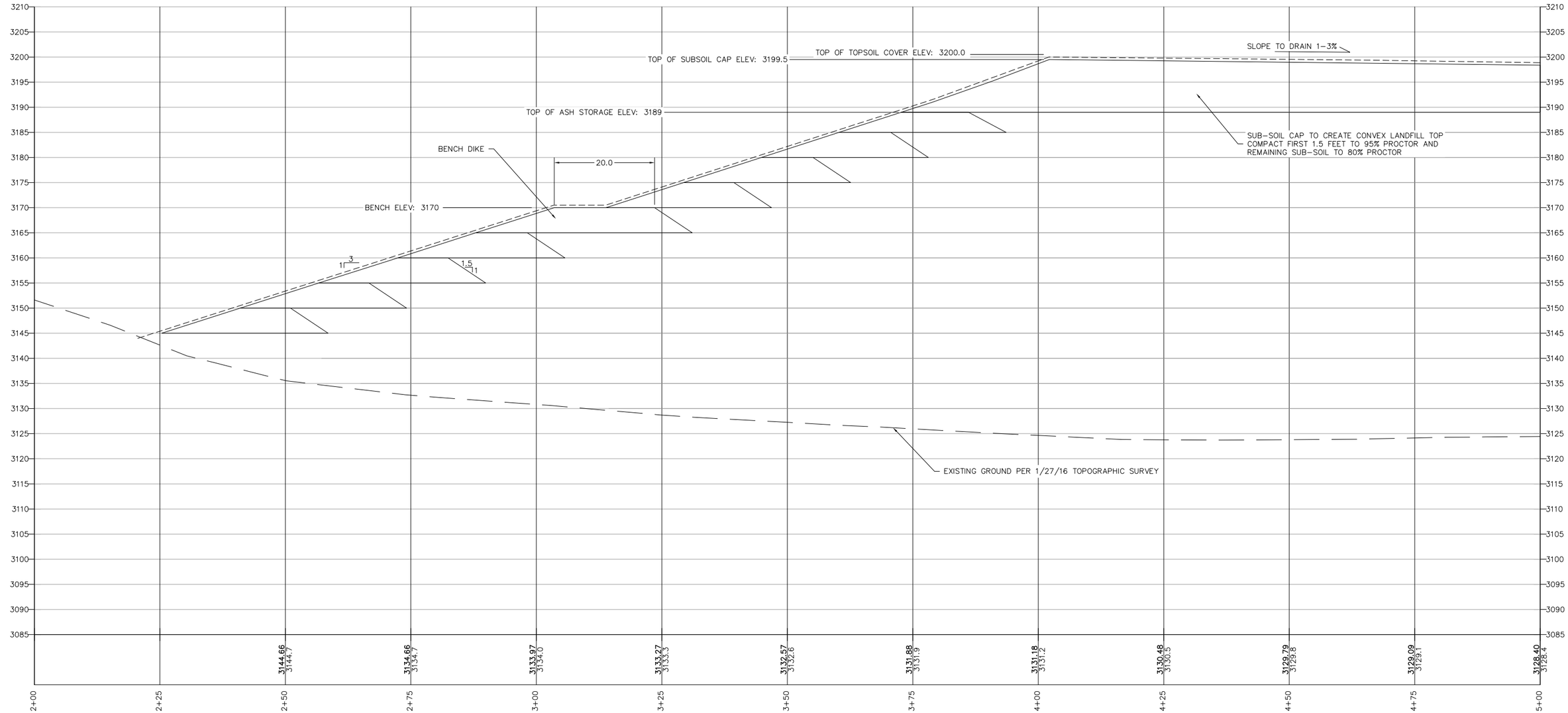
PROJECT #: 15-125
DATE: 9/15/2016

SHEET
C3-3

DETAILS - TABLES



PROFILE VIEW - LANDFILL CONTAINMENT BERMS AND TOP

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NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 10 20

VERTICAL SCALE FEET 0 10 20

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
DETAILS - LANDFILL TOP
ROSEBUD COUNTY, MT

32 DISCOVERY DRIVE
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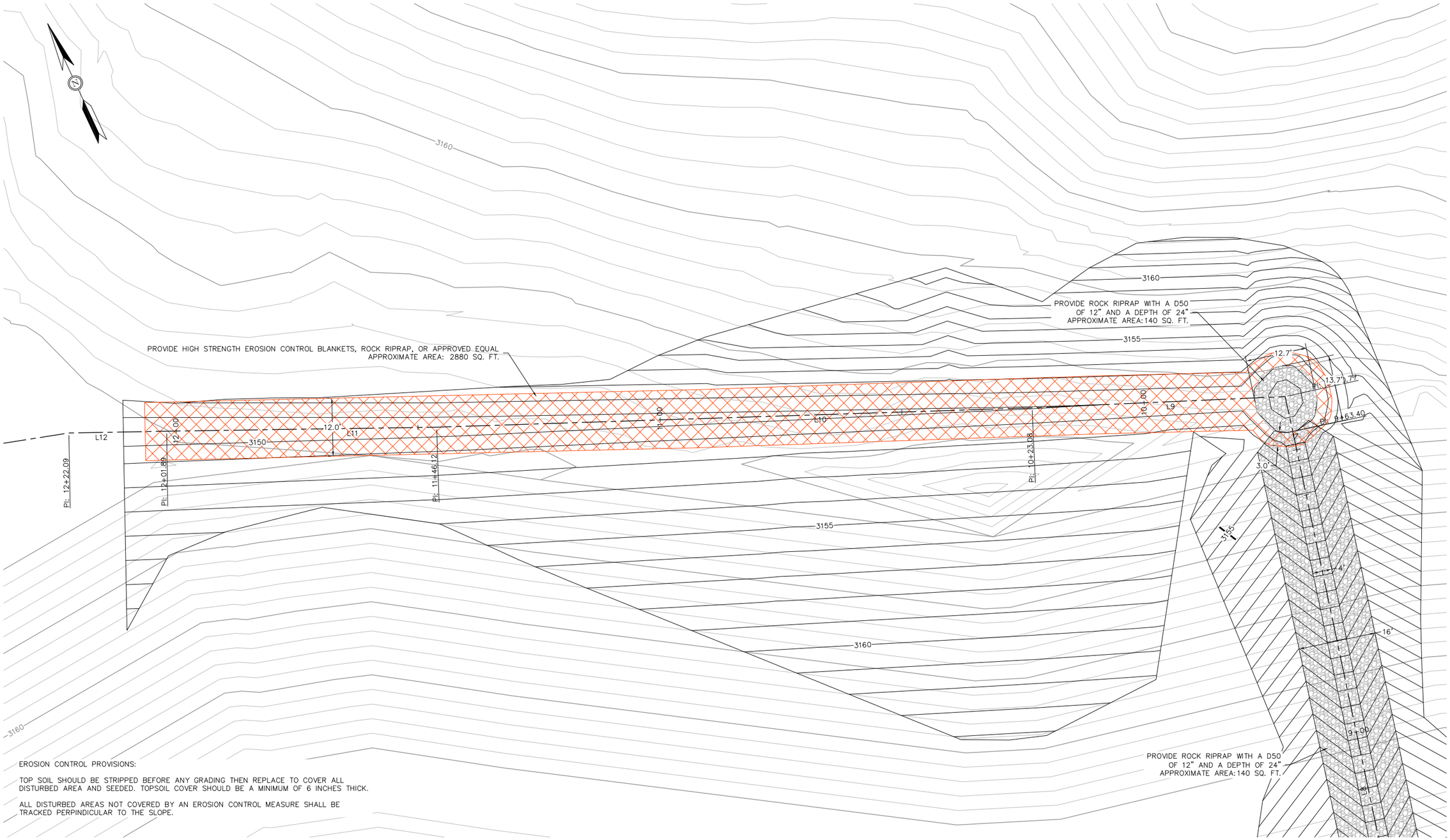
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C3-4
	DETAILS - LANDFILL TOP



EROSION CONTROL PROVISIONS:

TOP SOIL SHOULD BE STRIPPED BEFORE ANY GRADING THEN REPLACE TO COVER ALL DISTURBED AREA AND SEEDED. TOPSOIL COVER SHOULD BE A MINIMUM OF 6 INCHES THICK.

ALL DISTURBED AREAS NOT COVERED BY AN EROSION CONTROL MEASURE SHALL BE TRACKED PERPINDICULAR TO THE SLOPE.

NO.	REVISIONS	DRAWN BY	DATE

0 10 20 30
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EROSION CONTROL - DRAINAGE WAY 3
ROSEBUD COUNTY, MT

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PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C4-1

EROSION CONTROL

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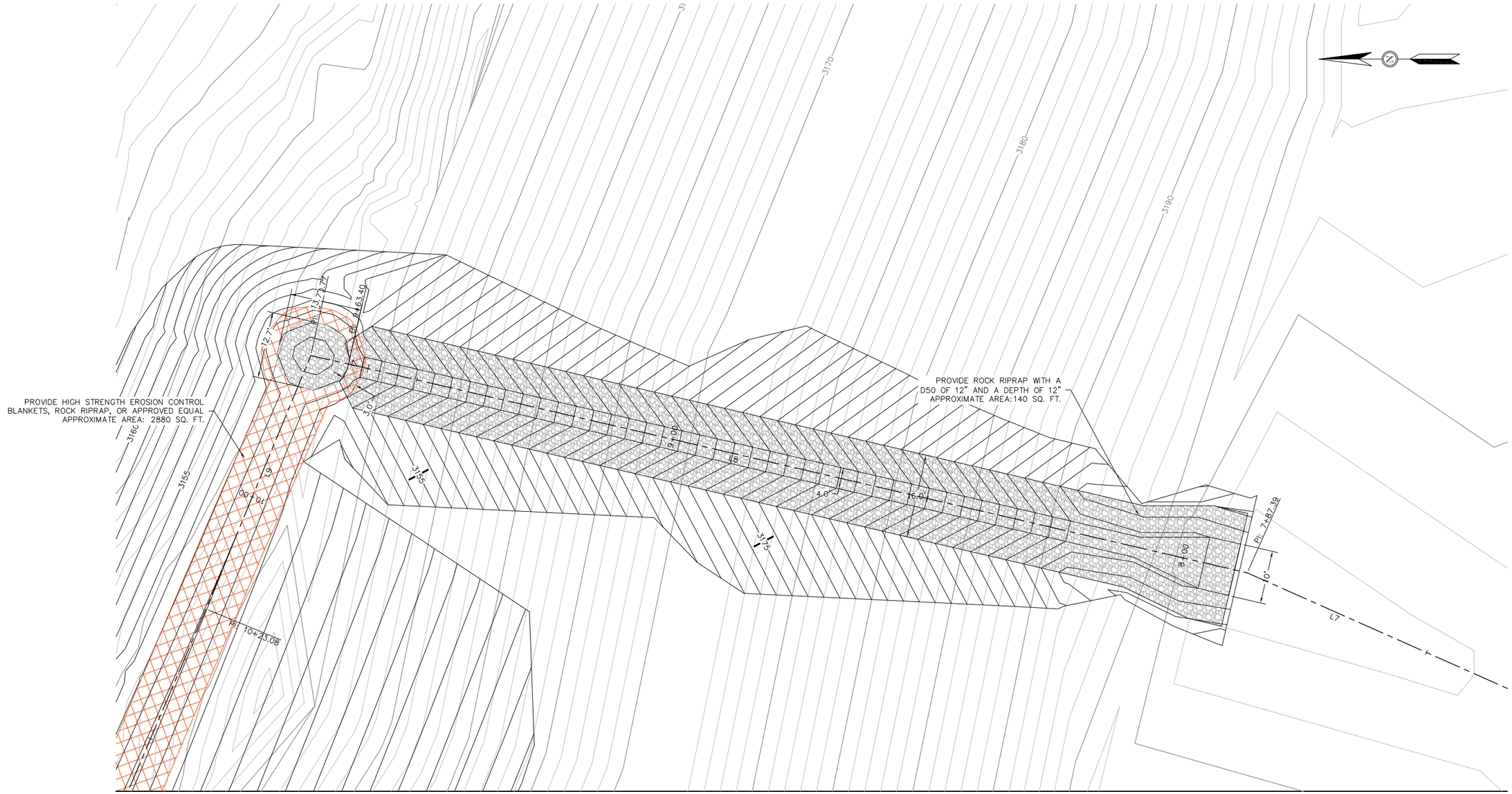

EROSION CONTROL PROVISIONS:

TOP SOIL SHOULD BE STRIPPED BEFORE ANY GRADING THEN REPLACE TO COVER ALL DISTURBED AREA AND SEEDED. TOPSOIL COVER SHOULD BE A MINIMUM OF 6 INCHES THICK.

ALL DISTURBED AREAS NOT COVERED BY AN EROSION CONTROL MEASURE SHALL BE TRACKED PERPENDICULAR TO THE SLOPE.

ALL DISTURBED AREAS ARE TO BE SEEDED.

NO.	REVISIONS	DRAWN BY	DATE

0 10 20 30
SCALE (FEET)

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EROSION CONTROL - DRAINAGE WAY 3
ROSEBUD COUNTY, MT

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PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C4-2

EROSION CONTROL

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NOTE:
SEE SHEET C3-3 FOR ALIGNMENT TABLE.

PROVIDE HIGH STRENGTH EROSION CONTROL BLANKETS, ROCK RIPRAP, OR APPROVED EQUAL
APPROXIMATE AREA: 2,314 SQ. FT.

2' DEEP PLUNGE POOL W/
3:1 SIDE SLOPES

PROVIDE ROCK RIPRAP WITH A D50
OF 12" AND A DEPTH OF 12"
APPROXIMATE AREA: 3,423 SQ. FT.

DRAINAGE WAY 5

EP: 6+74.53

L14

L15

16.0'

15.3'

16.4'

10.0'

4:1 OS

6.0'

4.0'

PI: 3+85.60

OMW-6

37.3%

2.3%

9.5%

32.1%

3130

3135

3140

3160

170

PLAN VIEW - DRAINAGE WAY 5 (STA 3+60 - STA 6+75)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0 40 80
VERTICAL SCALE FEET: 0 4 8

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EROSION CONTROL - DRAINAGE WAY 5
ROSEBUD COUNTY, MT

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PROJECT #: 15-125
DATE: 9/15/2016

SHEET
C4-3

P & P - DRAINAGE WAY 4

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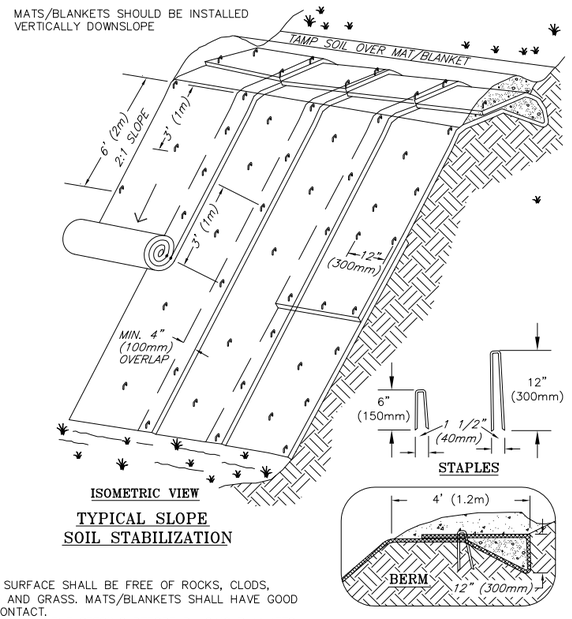
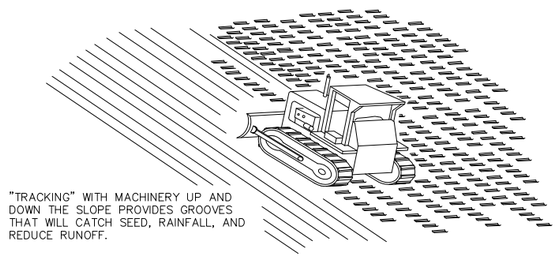


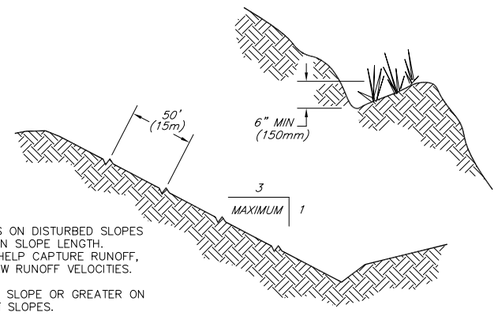
TYPICAL SLOPE
SOIL STABILIZATION

NOTES:
1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH SOIL. DO NOT STRETCH.



"TRACKING" WITH MACHINERY UP AND DOWN THE SLOPE PROVIDES GROOVES THAT WILL CATCH SEED, RAINFALL, AND REDUCE RUNOFF.

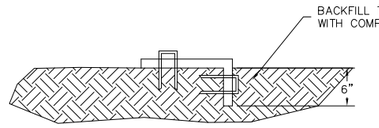
TRACKING



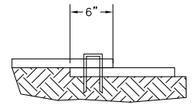
PLACE FURROWS ON DISTURBED SLOPES OVER 50 FEET IN SLOPE LENGTH. FURROWS WILL HELP CAPTURE RUNOFF, SEEDS AND SLOW RUNOFF VELOCITIES.

USE 3H:1V SIDE SLOPE OR GREATER ON ALL PERMANENT SLOPES.

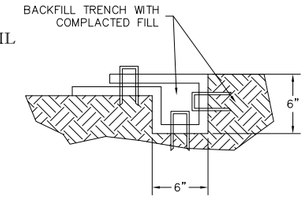
CONTOUR FURROWS



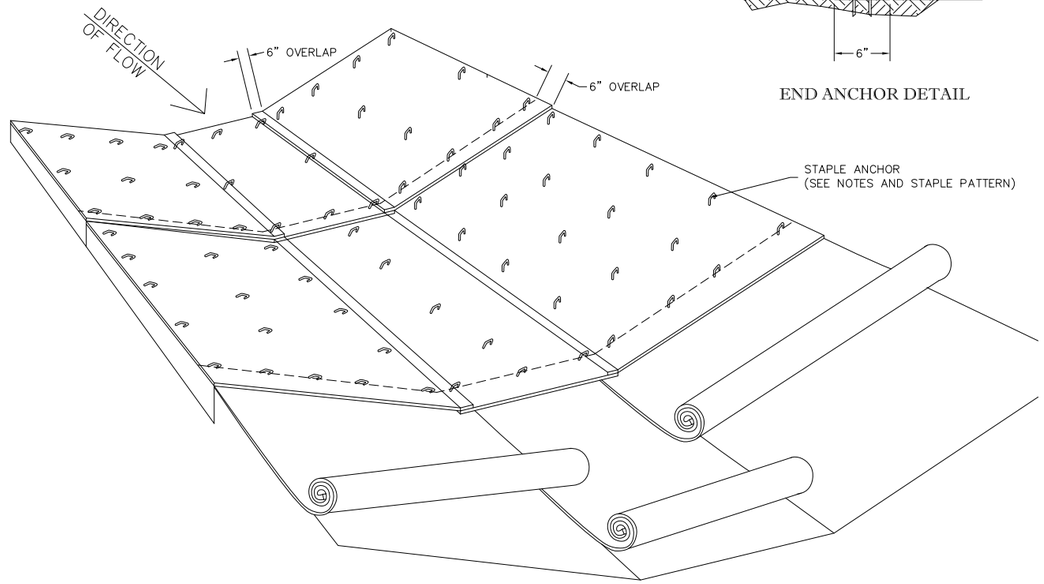
SIDE ANCHOR DETAIL



OVERLAP ANCHOR DETAIL



END ANCHOR DETAIL



ISOMETRIC VIEW

CONSTRUCTION NOTES:

1. PREPARE SOIL SO THAT AREA IS SMOOTH, THEN ADD SEED. AND FERTILIZER AS NEEDED.
2. START BY STAPLING THE BLANKET AT THE TOP OF THE CHANNEL IN A 6" DEEP X 6" WIDE TRENCH. BACKFILL AND COMPACT TRENCH SO THAT THE WATER WILL FLOW EVENLY ONTO THE BLANKET.
3. ROLL CENTER BLANKET IN THE BOTTOM OF THE CHANNEL AND PLACE 4 STAPLES EVENLY SPACED PER SQUARE YARD.
4. PLACE ADJOINING ENDS (SHINGLE STYLE) OVERLAPPING 6" SECURING THE OVERLAP WITH A DOUBLE ROW OF STAPLES STAGGERED 4" APART. OVERLAP EDGES OF BLANKET A MINIMUM OF 6" WITH PARALLEL BLANKETS.
5. THE FULL LENGTH OF THE BLANKET AT THE TOP OF THE CHANNEL MUST BE ANCHORED IN A 6"X6" TRENCH THEN BACKFILLED AND COMPACTED AFTER PLACING STAPLES IN THE TRENCH 3 FEET APART. INSURE COMPACTION SO THAT WATER CAN FLOW EVENLY ONTO THE BLANKETS FROM THE SIDES OF THE CHANNEL.
6. PLACE A DOUBLE ROW OF STAGGERED STAPLES 4" APART EVERY 33 FEET.
7. INSURE BLANKET IS PLACED ON SIDE BANKS OF CHANNEL 1 FOOT ABOVE FLOW LINE.
8. AT THE TERMINAL END OF THE CHANNEL, THE BLANKET MUST BE ANCHORED SUCH THAT THE WATER WILL FLOW TO THE DESIRED AREA. IF THE END OF THE CHANNEL IS A CULVERT, THE BLANKET BUST BE PLACED UNDER THE CULVERT AND SECURED WITH STAPLES 4" APART IN A STAGGERED PATTER. IF THE TERMINAL END IS A ROCK OUTFALL, THE BLANKET BUST BE PLACED IN A 6" WIDE X6" DEEP TRENCH STAPLED THE BACKFILLED, COMPACTED THE ROCKS PLACED ON THE TRENCH TO CREATE A SMOOTH TRANSITION.

1 DETAIL
EROSION CONTROL BLANKETS ON A SLOPE
NTS

2 DETAIL
SLOPE TEXTURING
NTS

3 DETAIL
EROSION BLANKETS IN A CHANNEL
NTS

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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EROSION CONTROL DETAILS
ROSEBUD COUNTY, MT

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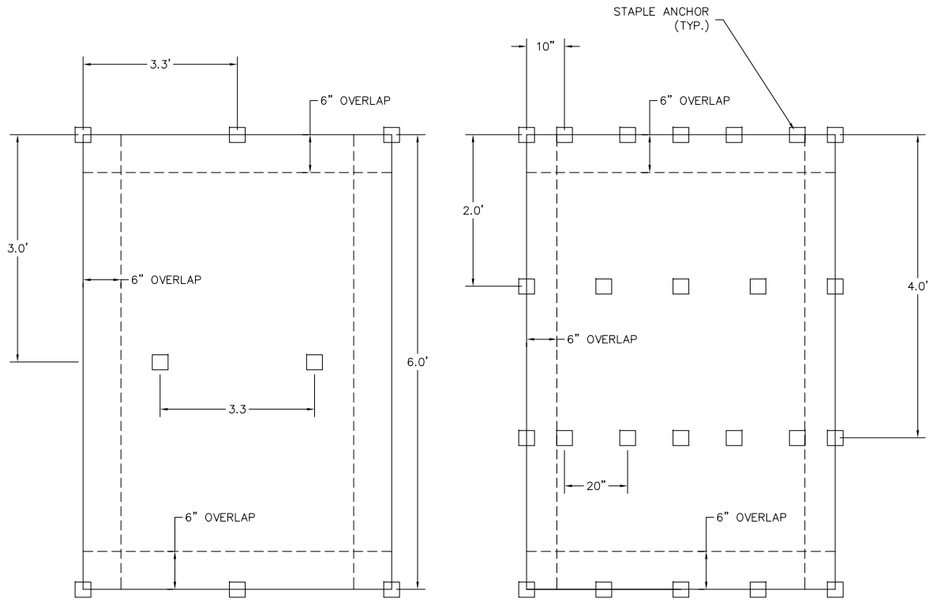
DATE: 9/15/2016	C4-4
EROSION CONTROL	

EROSION BLANKET ANCHORING PATTERNS



3:1 SIDE SLOPES

CHANNEL BOTTOM/HIGH FLOW AREAS

ANCHORING NOTES:

CHOICE OF STAPLES WILL DEPEND ON SOIL TYPE AND COMPACTION. STAPLES PLACED IN SOIL SHOULD NOT COME OUT EASILY BY HAND. STANDARD 6" STAPLES WILL BE USED IN MOST CONDITIONS. LONGER STAPLES 8"–12" MAY BE NEEDED IN SANDY SOILS. FOR VERY LOOSE SOILS A LONG PIN WITH WASHER MAY BE USED TO ANCHOR BLANKET.

BLANKET SHALL BE OVERLAPPED A MINIMUM OF 6" WITH THE UPSTREAM BLANKET COMING OVER THE DOWNSTREAM BLANKET (SHINGLE STYLE).

1 DETAIL
EROSION BLANKETS ANCHORING PATTERNS
NTS

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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: DSC	DRAWN BY: ASG
DESIGNED BY: ASG	REVIEWED BY: DSC, BDA

ROSEBUD POST-CLOSURE DESIGN
EROSION CONTROL DETAILS
ROSEBUD COUNTY, MT

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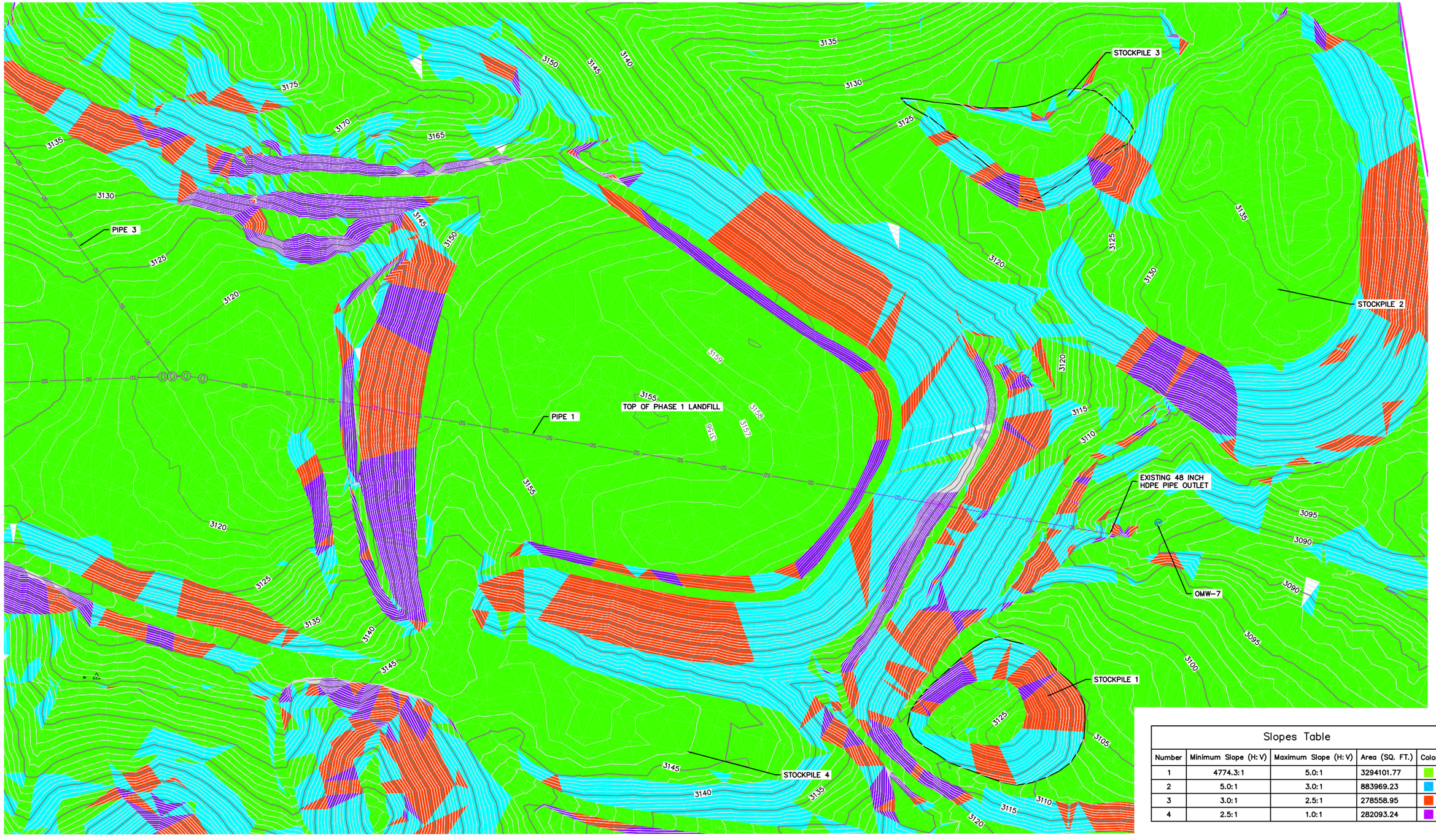
PROJECT #: 15-125	SHEET
DATE: 9/15/2016	C4-5

EROSION CONTROL



Slopes Table				
Number	Minimum Slope (H:V)	Maximum Slope (H:V)	Area (SQ. FT.)	Color
1	4774.3:1	5.0:1	3294101.77	
2	5.0:1	3.0:1	883969.23	
3	3.0:1	2.5:1	278558.95	
4	2.5:1	1.0:1	282093.24	

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NO.	REVISIONS	DRAWN BY	DATE

0 50 100 150
SCALE (FEET)

PROJECT ENGINEER: **DSC**	DRAWN BY: **ASG**
DESIGNED BY: **ASG**	REVIEWED BY: **DSC, BDA**

ROSEBUD POST-CLOSURE DESIGN
PHASE 1 LANDFILL SLOPES
ROSEBUD COUNTY, MT

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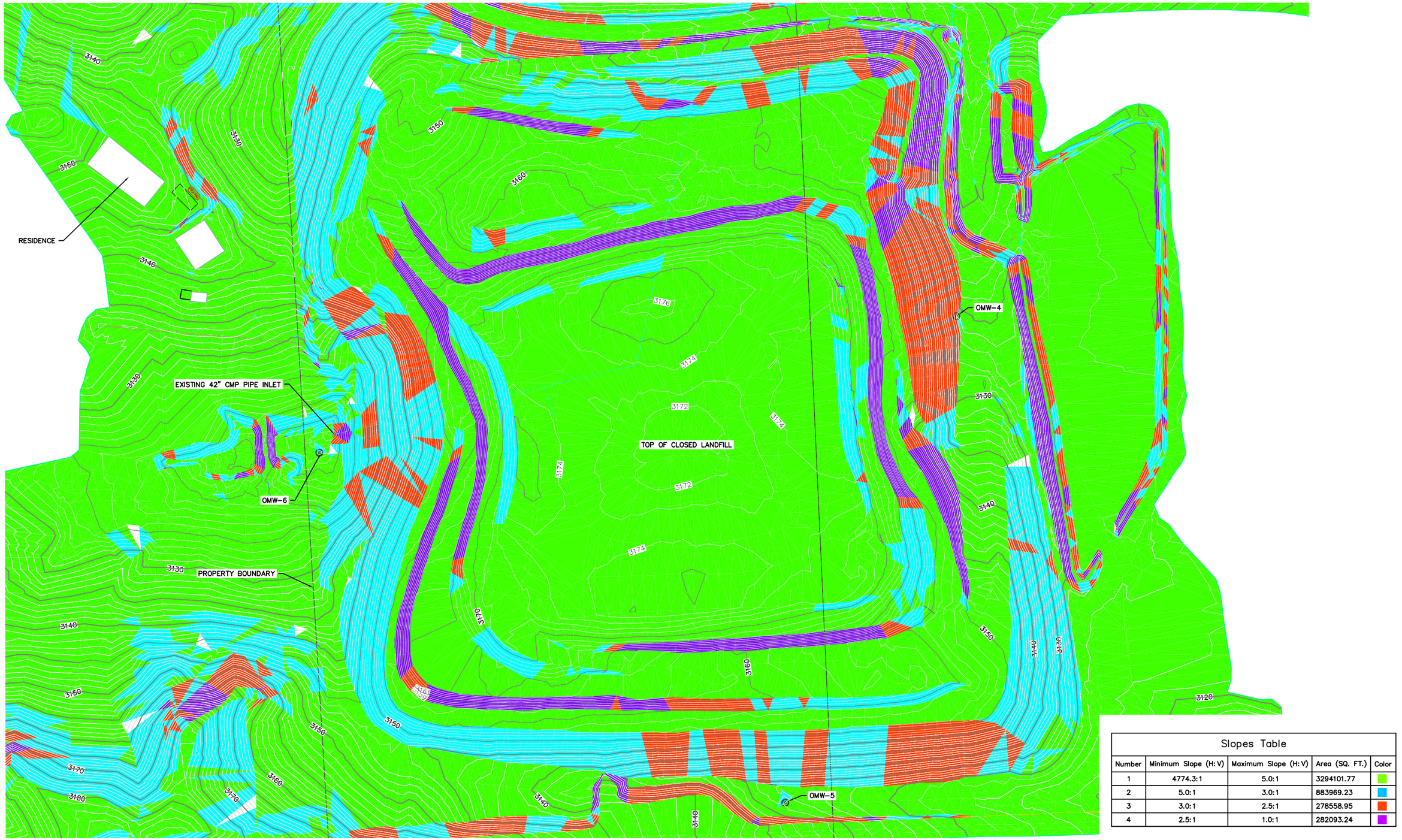
PROJECT #: **15-125**	SHEET
DATE: **09/15/16**	**S-1**



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3	3.0:1	2.5:1	278558.95	
4	2.5:1	1.0:1	282093.24	

NO.	REVISIONS	DRAWN BY	DATE

0 60 120 180
SCALE (FEET)

PROJECT ENGINEER: **DSC** | DRAWN BY: **ASG**
DESIGNED BY: **ASG** | REVIEWED BY: **DSC, BDA**

ROSEBUD POST-CLOSURE DESIGN
EXISTING CLOSED LANDFILL SLOPES
ROSEBUD COUNTY, MT

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PROJECT #: **15-125**
DATE: **09/15/2016**
SHEET **S-2**

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