SR-13A MINE PERMIT AMENDMENT APPLICATION PERMIT No. M-1977-311

Response to Adequacy Review #2

February 1, 2013

Prepared by Cotter Corporation (N.S.L.)

AND

O'Connor Design Group, Inc.

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Cotter Corporation N.S.L. (Cotter) submits this response to the December 20, 2012 letter from Dustin Czapla, Division of Reclamation, Mining and Safety ("DRMS") to Glen Williams, Cotter. The DRMS' comments are in italics and Cotter's responses are in bold.

SR-13A Mine, File No. M-1977-311, Amendment (AM1) Application Adequacy Review (2)

1. *Page ESWMP-3, first paragraph. This paragraph suggests the primary vegetative cover is Pinon-Juniper. Site photos in Exhibit B (Photos B1 and B2) suggest the vegetative cover is primarily herbaceous (with respect to runoff curve numbers (CN)). Please discuss why Pinon-Juniper cover was selected for the vegetation cover.*

   The primary vegetative cover is Pinon-Juniper. Site photos B1 and B2 are mainly showing portions of Onsite Basin 30 which are covered by previously placed waste rock which has been pocked and partially reclaimed to aid in erosion protection and retention of stormwater. This material makes up a significant portion of the onsite area. It consists of sandy material partially fractured and crushed during the mining process. The hillside below the portal is generally covered with this material. The area below the hillside is a sandy terrace, gently sloping to the west. Stands of Pinon-Juniper can be seen in the backgrounds of both photos. Additional site photos are included in attachment #1 of this document to help demonstrate these conditions.

2. *Page ESWMP-3, third paragraph. This paragraph states the surface soils at the site are Soil Map Unit (SMU) 23 (Bodot) and 76 (Pinon-Bowdish-Rock outcrop). The soil group on Figure T3 indicates the natural soils in the area defined by subasins Onsite 30 and Offsite 10 analyzed are SMU 57 (Minchey fine sandy loam) and SMU 88 (Rock outcrop-Orthents complex), respectively. According to the Soil Survey of San Miguel Area, Colorado Parts of Dolores, Montrose, and San Miguel Counties, Table 19 lists the Minchey series as Hydrologic Soil Group (HSG) B, and the Rock outcrop-Orthents complex as HSG D. Please revise the selected curve numbers (CN) to reflect the appropriate HSG and vegetative cover as discussed in Comment 1 (i.e. Offsite 10 CN=93 – poor herbaceous cover/HSG D, Onsite 30 CN=80 – poor herbaceous cover/HSG B).*

   Figure T-3 in the overall amendment document correctly illustrates that the majority of Onsite Basin 30 is within SMU 57 (Minchey fine sandy loam). By definition in the USDA report, it consists of well drained, gravelly, sandy

material with a high permeability. It is alluvium derived from the parent sandstone outcrops above. This is the base soil generally encompassed within Onsite Basin 30. As discussed in the previous response, additional waste rock material was placed over a portion of the site during previous mining operations. This material is a free draining material consisting of fractured and crushed sandstone. In addition, the added material was pocked and partially re-vegetated to aid in water retention. Assigning this area a CN value of 75, as we did, is conservatively high, in our professional opinion. While much of the area above the site, making up the offsite basins, is characterized as SMU 88 (Rock outcrop-Orthents complex), these areas are not made-up simply of exposed rock. In fact, the exposed rock portions of the site are typically in very steep faces which comprise only a small percentage of the overall site acreage. The outcrops themselves are obviously very impermeable regarding stormwater, but the surrounding soil, again by USDA definition, consists of gravelly, stony loams in the typical profile (Minchey fine sandy loam in the making). The mine site evaluated by this office was visited on multiple occasions by experienced personnel. During these visits, part of the observations included evaluation of the vegetative cover and the general soils types found there for future quantification of runoff. These observations were not only performed for the specific mine site, but also for the probable offsite watersheds thought to affect the area. Broad-based soil evaluations, such as the one included in the Application Amendment, tend to cover very large areas of a regional analysis. Our selection of CN and Manning's "N" coefficients involves looking at a variety and range of possible values found in several reliable and respected resources such as: tables from the SCS TR-55 Manual (Urban Hydrology for Small Watersheds), the National Engineering Handbook (Section 4, Hydrology), V.T. Chow (Open Channel Hydraulics), and the Mesa County Stormwater Management Manual which includes tables from many of these sources. Copies of the tables referred to here are included in attachment # 2 of this response. We feel that the original designations of CN values for the areas are reasonable and applicable.

3. *Page ESWMP-5, section 7.2. Please state the specific design storm depths used for runoff analyses for both the 10-year and 100-year, 24-hour events.*

   The design storm depths used in the analysis for this site are 1.9 inches and 3.0 inches, respectively, for the 10-year and 100-year, 24-hour events. This information was taken from the NOAA ATLAS 2, Volume III isopluvial charts. Copies of these charts were included in the original project submittal. A copy of the software worksheet entitled "Design Storms Summary" found in attachment #3 is included with this document to demonstrate the utilization of this data in the analysis.

4. *Page ESWMP-5, section 7.3, second paragraph. Please correct this paragraph based on Comments 1 and 2 above.*

   Based on the information included in this document, no revision is necessary to the referenced paragraph.

5. *Page ESWMP-6, second paragraph and FlowMaster output pages. It is stated the channels are "capable of transporting the 100-year flows". A Manning's n =0.038 is existing channels and 0.045 for the OFF10 diversion channel. However, no rationale is provided for the selected roughness coefficients. Because channel roughness is seldom uniform, the DRMS requires channels be evaluated for both stability and capacity, i.e., minimum and maximum expected roughness. For example, an excavated earth channel, after weathering would be expected to have a minimum n = 0.018 (use to evaluate stability or maximum expected velocity); and a maximum n = 0.025 (use to evaluate capacity). In addition, the DRMS requires channel freeboard be evaluated for all engineered channels: channels shall be designed with a minimum of 0.5 feet of freeboard unless the velocity head ($v^2/2g$) is significant, then the minimum required freeboard is half the velocity head, or $v^2/4g$.*
   a. *Please provide a rationale for the selected roughness coefficients, and evaluate each designated channel/ditch design slope for both capacity and stability.*
   b. *Please design all engineered ditches with the appropriate freeboard and provide channel design depths for construction.*

   Manning's N values for earth channels constructed in rocky terrain vary from 0.030 to 0.050, in our professional opinion. Several charts referencing this are included in attachment #2 of this document. Even grass lined channels, well established and uniform, are indicated to have a minimum value of 0.030. This is an extreme condition, as is the value of 0.050, in our opinion, which should be disregarded. Our original analysis fell within those

values. We now include additional analysis for the reasonable range of 0.035 to 0.045 to adhere with the Division's request to evaluate for both capacity and stability in the proposed channels. The results of this analysis indicated a need to increase the depth of the diversion ditch collecting runoff from area Offsite 10 to allow the required freeboard, and to provide armoring for the upper portion of the ditch where it will be installed at grades exceeding 7.0% slope (where velocities would exceed 5 fps). Copies of the analysis worksheets (attachment #4) and the revised drawings (attachment #6) are included in this document.

6. *Page ESWMP-6, section 7.4 paragraph and Retention Pond Drainage Design Plan (Sheet 5 of 5). The 100-year, 24-hour runoff volume criteria used for sizing storage in the pond is acceptable. However, a spillway is necessary to pass runoff from successive storms as there is no way presented in the Retention Pond design plan to drain the pond via gravity. As such, the emergency spillway for the ponds needs to be designed to convey 100-year peak flow, assuming the ponds are full (to the spillway invert elevation) at the onset of the design storm. Please provide analyses and designs to demonstrate the spillway has the capacity to pass the peak flow resulting from the 100-year, 24-hour design storm. (NOTE – The DRMS checked with the Colorado Division of Water Resources (DOWR) District 63 water commissioner (Tom Brigham) regarding the status of the Dolores River appropriations. Mr. Brigham state that the Dolores River is not <u>currently</u> over appropriated and as such, DWR has no current requirement to release retained stormwater within 72 hours. He emphasized this condition is seasonal and is subject to change.) The DRMS suggests the Operator consider a low level outlet be designed into the pond in case a call is put on the Dolores River, the Operator can comply with the DOWR requirements.*

The retention pond has been redesigned, as requested, to provide "retention" storage of the 10-year event with an armored spillway capable of passing the 100-year event. In addition, based on your comments and those received later from the Division of Water Resources, the pond will have a small drain pipe with screened inlet in the bottom to allow the impoundment to drain fully within the 72 hour timeframe after a storm event. Revised drawings (sheets 3, 3, 3A and 5) are included in attachment #6 of this document.

7. *Page ESWMP-7, last paragraph. This paragraph references the Environmental Protection Plan for details related to the reclamation of stormwater features. The DRMS could find no discussion of stormwater feature reclamation in Exhibit T, nor any*

discussion of the retention pond in the Exhibit D Reclamation Plan. Please indicate whether the retention pond will be left in place, breached, filled in, etc.

It is now the intention to have the retention pond embankment partially removed at the final reclamation stage to allow stormwater to pass through the pond with no retention of surface runoff. Revised drawing Sheet 3A is included in attachment #5 to indicate this.

8. *Pages ESWMP-8—10, hydrographs. Peak flow computer software generated tables were not provided as was the case for M-1977-307, CM-25 mine. Please provide similar tabular input/output information.*

   The peak flow table was inadvertently omitted from the original submittal. It is now included in attachment #3 and labeled "Master Design Storm Summary".

9. *Pages ESWMP-11 – 13, weighted CNs. Please provide revised analysis worksheets based on Comments 2 above.*

   Based on the information provided in this document, no revision is necessary to the referenced worksheets.

10. *Page ESWMP-18, pond volume, Drawing E-6 and ESWMP Drawings 2 and 3. The drawings in Exhibit E and ESWMP Drawings 2 and 3 show very different retention pond configurations (triangular vs. square bottoms).*
    a. *Which retention pond configuration is correct?*
    b. *Which retention pond configuration is reflected in the "Elev-Area" table on page ESWMP-18?*

    Drawing E-6 in Exhibit E of the original amendment document incorrectly illustrates the pond as a triangular configuration, considered earlier in the drainage design. The drawings in the ESWMP portion show the correct configuration in a rectangular shape and are properly represented by the "Elev-Area" table in the original ESWMP document on page 18. A revised drawing E-6 is included as attachment 7.

Drawings:

11. *Sheet 2. Please label engineered design channel reaches on the drawing consistent with the labels used for the FlowMaster analyses to enable the DRMS to evaluate the channel slopes.*

    Sheet 2 of the ESWMP has been revised to reflect channel labels consistent with the cross-section details and flow worksheets. These drawings and analysis worksheets are included in attachments #4 and #6 of this document.

12. *Sheet 3. Please provide spillway location, design (sections and profile), and specifications sufficient to convey the design flow to the toe of the embankment.*

    The drawings (sheets 3 and 5 of attachment #6) have been revised to include an armored spillway capable of conveying the 100-year event to the toe of the embankment. The design was determined by comparing hydraulic analysis methods and utilizing the most conservative. The spillway was analyzed as a "broad-crested weir" and as an "open channel". Results were very similar, but the broad-crested weir showed a slightly greater flow depth in the outlet and this is what the channel dimensions and armoring limits were based on. Results are included in attachment #5 of this document, labeled "Worksheet for Broad Crested Weir - 1" and "Worksheet for Trapezoidal Channel – 1".

13. *Sheet 5. Please provide some material and compaction specification for the berm and the retention pond embankment.*

    Material and compaction specifications are now provided for the proposed containment berm and pond embankment. These can be seen on the revised drawings included in attachment #6.

General Comments:

14. *Pages ESWMP-5, second paragraph. The NRCS is referenced as the "National Resource Conservation Service". The "N" stands for "Natural", not "National".*

    Reference to NRCS has been corrected to reflect "Natural", instead of "National". This will be reflected in future printings.

Attachment 1

1. Offsite Basin 20 channel passing near southwest corner of site.

2. Looking west at Offsite Basin 20 channel, standing on previous onsite waste rock (foreground).

3. Looking south across Offsite Basin 20 channel, previous site waste rock in foreground (pocked and reclaimed).

4. Looking west across toe of onsite waste rock, previously placed and pocked. Pinon-Juniper stands in background.

5. Mine portal showing typical rock outcrop with vertical face and sandy material below.

6. More onsite material showing pocked waste rock on top of native sandy material with vertical outcrops in background.

7. Pocked, reclaimed waste rock at Basin 30, looking south toward south side of Basin 20 channel in background.

8. Pocked waste rock (Onsite Basin 30) looking south toward Pinon-Juniper stands typical of vicinity.

9. Looking northwest toward more Pinon-Juniper stands.

10. Looking north from north end of Onsite Basin 30.

Attachment 2

STORMWATER MANAGEMENT MANUAL

RUNOFF CURVE NUMBERS

Land Use or Surface Characteristic	Average Imperv. (%)	Runoff Curve Number Soil Complex			
		A	B	C	D
Business					
Commercial Areas	85	89	92	94	95
Neighborhood Areas	70	80	87	91	93
Residential					
Single Family (note 1)	(note 1)				
Multi-unit (detached)	60	74	83	88	91
Multi-unit (attached)	75	83	89	92	94
Apartments	80	86	91	93	94
Industrial					
Light	80	86	91	93	94
Heavy	90	92	94	96	96
Parks, cemeteries	5	42	63	75	81
Playgrounds	10	45	65	76	82
Schools	50	69	80	86	89
Railroad yards	15	48	67	78	83
Irrigated Areas					
Lawns, parks, golf course	0	39	61	74	80
Agriculture	0	39	61	74	80
Undeveloped Areas					
Pre-development conditions	2	40	62	74	80
Greenbelts, agriculture	2	40	62	74	80
Off-site analysis when land use Unknown	45	66	78	85	88
Outcrops	70	80	87		94
Streets/Roads					
Paved	100	98	98	98	98
Gravel	40	63	76	84	87
Drives/Walks	90	92	94	96	96
Roofs	90	92	94	96	96

NOTE:
ESTIMATE IMPERVIOUS FROM FIGURES 703, 704, 705. THEN COMPUTE CURVE NUMBER, CN, FROM EQUATION 708, BASED ON NRCS SOILS TYPE. USE OF THIS TABLE IS LIMITED TO EVALUATION OF IMPERVIOUSNESS FOR FUTURE DEVELOPMENT PROJECTIONS WITHIN REGIONAL WATERSHED MASTER PLANS, OR IN CONCEPTUAL DRAINAGE PLANS.

Revision	Date
ORIGINAL ISSUE	3/27/

WRC ENGINEERING, INC.

REFERENCE: SCS TECHNICAL RELEASE NO. 55 (1986)

TABLE 704

FROM: SCS TR-55

Table 2-2.--Runoff curve numbers for selected agricultural, suburban, and urban land use. (Antecedent moisture condition II, and $I_a = 0.2S$)

LAND USE DESCRIPTION	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Cultivated land[1/]: without conservation treatment	72	81	88	91
: with conservation treatment	62	71	78	81
Pasture or range land: poor condition	68	79	86	89
good condition	39	61	74	80
Meadow: good condition	30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch	45	66	77	83
good cover[2/]	25	55	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.				
good condition: grass cover on 75% or more of the area	39	61	74	80
fair condition: grass cover on 50% to 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious).	81	88	91	93
Residential:[3/]				
Average lot size — Average % Impervious[4/]				
1/8 acre or less — 65	77	85	90	92
1/4 acre — 38	61	75	83	87
1/3 acre — 30	57	72	81	86
1/2 acre — 25	54	70	80	85
1 acre — 20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5/]	98	98	98	98
Streets and roads:				
paved with curbs and storm sewers[5/]	98	98	98	98
gravel	76	85	89	91
dirt	72	82	87	89

[1/] For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.

[2/] Good cover is protected from grazing and litter and brush cover soil.

[3/] Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

[4/] The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

[5/] In some warmer climates of the country a curve number of 95 may be used.

TYPICAL ROUGHNESS COEFFICIENTS FOR OPEN CHANNELS

TYPE OF CHANNEL AND DESCRIPTION	MINIMUM	NORMAL	MAXIMUM
EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plans in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035 } *
5. Stony bottom and weedy banks	0.025	0.035	0.040 } *
6. Cobble bottom and clean sides	0.030	0.040	0.050 } *
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040 } *
2. Jagged and irregular	0.035	0.040	0.050 } *
e. Channels not maintained, weeds and brush			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same as above, but highest state of flow	0.045	0.070	0.110
4. Dense brush, high state	0.080	0.100	0.140

Revision	Date
ORIGINAL ISSUE	3/27/(

WRC ENGINEERING, INC

REFERENCE:
CHOW, V.T., OPEN CHANNEL HYDRAULICS
McGRAW HILL BOOK COMPANY 1959

TABLE 802A

STORMWATER MANAGEMENT MANUAL

TYPICAL ROUGHNESS COEFFICIENTS FOR OPEN CHANNELS

TYPE OF CHANNEL AND DESCRIPTION	MINIMUM	NORMAL	MAXIMUM
LINED OR BUILT-UP CHANNELS			
a. CONCRETE			
1. TROWEL FINISH	0.011	0.013	0.015
2. FLOAT FINISH	0.013	0.015	0.016
3. GUNITE, GOOD SECTION	0.016	0.019	0.023
4. GUNITE, WAVY SECTION	0.018	0.022	0.023
b. CONCRETE, BOTTOM FLOAT FINISHED WITH SIDE OF			
1. DRESSED STONE IN MORTAR	0.015	0.017	0.020
2. RANSOM STONE IN MORTAR	0.017	0.020	0.024
3. DRY RUBBLE OR RIPRAP	0.020	0.030	0.035
c. GRAVEL BOTTOM WITH SIDES OF			
1. FORMED CONCRETE	0.017	0.020	0.025
2. RANDOM STONE IN MORTAR	0.020	0.023	0.026
3. DRY RUBBLE OR RIPRAP	0.023	0.033	0.036
d. ASPHALT			
1. SMOOTH	0.013	0.013	--
2. ROUGH	0.016	0.016	--
e. GRASSED	→ {0.030	0.040	0.050} *

Revision	Date
ORIGINAL ISSUE	3/27/C

WRC ENGINEERING, INC

REFERENCE:
CHOW, V.T., OPEN CHANNEL HYDRAULICS
McGRAW HILL BOOK COMPANY 1959

TABLE 802C

Attachment 3

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Type.... Design Storms                                    Page 4.02
Name.... Cotter Uravan                                    Event: 100 yr
File.... \\VBOXSVR\Documents\Cotter Corp\SR-13\
Storm... TypeII  24hr   Tag:    100

                DESIGN STORMS SUMMARY

 Design Storm File,ID =              Cotter Uravan


 Storm Tag Name      = 100
 ---------------------------------------------------------------------
 Data Type, File, ID = Synthetic Storm    TypeII  24hr
 Storm Frequency     = 100 yr
 Total Rainfall Depth= 3.0000 in
 Duration Multiplier =  1
 Resulting Duration  = 24.0000 hrs
 Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


 Storm Tag Name      =     10
 ---------------------------------------------------------------------
 Data Type, File, ID = Synthetic Storm    TypeII  24hr
 Storm Frequency     = 10 yr
 Total Rainfall Depth= 1.9000 in
 Duration Multiplier =  1
 Resulting Duration  = 24.0000 hrs
 Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs
```

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S/N: 721001007097           O'Connor Design Group
PondPack Ver. 9.0046               Time: 11:36 AM          Date: 1/24/2013
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MASTER DESIGN STORM SUMMARY

Network Storm Collection: Cotter Uravan

Return Event	Total Depth in	Rainfall Type	RNF ID
100	3.0000	Synthetic Curve	TypeII 24hr
10	1.9000	Synthetic Curve	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol cu.ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage cu.ft
*OUT OFF 10	JCT	100	14297		12.0000	5.16		
*OUT OFF 10	JCT	10	3897		12.0500	.96		
*OUT OFF 20	JCT	100	49494		12.0000	16.00		
*OUT OFF 20	JCT	10	10673		12.0500	1.24		
*POND ON 30 IN	POND	100	19113		12.0000	7.17		
*POND ON 30 IN	POND	10	6626		12.0500	2.12		
*POND ON 30 OUT	POND	100	0		10.9000	.00	5621.89	19063
*POND ON 30 OUT	POND	10	0		11.7500	.00	5620.14	6564
SUBAREA OFF 10	AREA	100	14297		12.0000	5.16		
SUBAREA OFF 10	AREA	10	3897		12.0500	.96		
SUBAREA OFF 20	AREA	100	49494		12.0000	16.00		
SUBAREA OFF 20	AREA	10	10673		12.0500	1.24		
SUBAREA ON 30	AREA	100	19113		12.0000	7.17		
SUBAREA ON 30	AREA	10	6626		12.0500	2.12		

Attachment 4

Worksheet for Sect 10-1max n, min s

Project Description		
Flow Element:	Triangular Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Input Data		
Roughness Coefficient:	0.045 ←	
Channel Slope:	0.01000 ←	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	3.00	ft/ft (H:V)
Discharge:	5.16	ft³/s
Results		
Normal Depth:	0.94 ← (1.5' DEPTH REQ'D) FOR 0.5' FREEBOARD	ft
Flow Area:	2.67	ft²
Wetted Perimeter:	5.97	ft
Top Width:	5.66	ft
Critical Depth:	0.71	ft
Critical Slope:	0.04465	ft/ft
Velocity:	1.93 ← OK	ft/s
Velocity Head:	0.06	ft
Specific Energy:	1.00	ft
Froude Number:	0.50	
Flow Type:	Subcritical	
GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	
GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Profile Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	0.94	ft
Critical Depth:	0.71	ft
Channel Slope:	0.01000	ft/ft
Critical Slope:	0.04465	ft/ft

Worksheet for Sect 10-1 min n, min s

Project Description		
Flow Element:	Triangular Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.035 ←	
Channel Slope:	0.01000 ←	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	3.00	ft/ft (H:V)
Discharge:	5.16	ft^3/s

Results		
Normal Depth:	0.86 ←	ft
Flow Area:	2.21	ft^2
Wetted Perimeter:	5.43	ft
Top Width:	5.15	ft
Critical Depth:	0.71	ft
Critical Slope:	0.02701	ft/ft
Velocity:	2.33 ← OK	ft/s
Velocity Head:	0.08	ft
Specific Energy:	0.94	ft
Froude Number:	0.63	
Flow Type:	Subcritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Profile Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	0.86	ft
Critical Depth:	0.71	ft
Channel Slope:	0.01000	ft/ft
Critical Slope:	0.02701	ft/ft

Worksheet for Sect 10-1 max n, max s

Project Description		
Flow Element:	Triangular Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Input Data		
Roughness Coefficient:	0.045 ←	
Channel Slope:	0.12000 ←	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	3.00	ft/ft (H:V)
Discharge:	5.16	ft³/s
Results		
Normal Depth:	0.59 ←	ft
Flow Area:	1.05	ft²
Wetted Perimeter:	3.75	ft
Top Width:	3.55	ft
Critical Depth:	0.71	ft
Critical Slope:	0.04465	ft/ft
Velocity:	4.91 ← OK	ft/s
Velocity Head:	0.37	ft
Specific Energy:	0.97	ft
Froude Number:	1.59	
Flow Type:	Supercritical	
GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	
GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Profile Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	0.59	ft
Critical Depth:	0.71	ft
Channel Slope:	0.12000	ft/ft
Critical Slope:	0.04465	ft/ft

Worksheet for Triangular Channel B-B, max
(OR SECT. 10-1)

INDICATES:
MAXIMUM SLOPE = 7.0% w/o ROCK ARMOR

Project Description		
Flow Element:	Triangular Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.07000	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	3.00	ft/ft (H:V)
Discharge:	5.16	ft³/s

Results		
Normal Depth:	0.60	ft
Flow Area:	1.07	ft²
Wetted Perimeter:	3.77	ft
Top Width:	3.58	ft
Critical Depth:	0.71	ft
Critical Slope:	0.02701	ft/ft
Velocity:	4.84	ft/s
Velocity Head:	0.36	ft
Specific Energy:	0.96	ft
Froude Number:	1.56	
Flow Type:	Supercritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Profile Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	0.60	ft
Critical Depth:	0.71	ft
Channel Slope:	0.07000	ft/ft
Critical Slope:	0.02701	ft/ft

Worksheet for Triangular Channel B-B, max
(OR SECT. 10-1)

INDICATES:
MAXIMUM SLOPE = 7.0% W/O ROCK ARMOR

Project Description		
Flow Element:	Triangular Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.07000	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	3.00	ft/ft (H:V)
Discharge:	5.16	ft^3/s

Results		
Normal Depth:	0.60	ft
Flow Area:	1.07	ft^2
Wetted Perimeter:	3.77	ft
Top Width:	3.58	ft
Critical Depth:	0.71	ft
Critical Slope:	0.02701	ft/ft
Velocity:	4.84	ft/s
Velocity Head:	0.36	ft
Specific Energy:	0.96	ft
Froude Number:	1.56	
Flow Type:	Supercritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Profile Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	0.60	ft
Critical Depth:	0.71	ft
Channel Slope:	0.07000	ft/ft
Critical Slope:	0.02701	ft/ft

Worksheet for Sect 20-1 min n

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.02500	ft/ft
Discharge:	16.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughnes:	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	5641.71	ft
Elevation Range:	5641.24 to 5646.94 ft	
Flow Area:	4.84	ft²
Wetted Perimeter:	14.03	ft
Top Width:	13.90	ft
Normal Depth:	0.47	ft
Critical Depth:	0.46	ft
Critical Slope:	0.02574	ft/ft
Velocity:	3.30	ft/s
Velocity Head:	0.17	ft
Specific Energy:	0.64	ft
Froude Number:	0.99	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00, 5646.94)	(0+77, 5646.68)	0.035

Section Geometry

Station	Elevation
0+00	5646.94
0+32	5644.13

Worksheet for Sect 20-1 max n

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.02500	ft/ft
Discharge:	16.00	ft³/s

Options		
Current Roughness Weighted Meth(	ImprovedLotters	
Open Channel Weighted Roughnes:	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.045	
Water Surface Elevation:	5641.77	ft
Elevation Range:	5641.24 to 5646.94 ft	
Flow Area:	5.69	ft²
Wetted Perimeter:	14.39	ft
Top Width:	14.24	ft
Normal Depth:	0.53	ft
Critical Depth:	0.46	ft
Critical Slope:	0.04256	ft/ft
Velocity:	2.81	ft/s
Velocity Head:	0.12	ft
Specific Energy:	0.65	ft
Froude Number:	0.78	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00, 5646.94)	(0+77, 5646.68)	0.045

Section Geometry

Station	Elevation
0+00	5646.94
0+32	5644.13

Worksheet for Sect 30-1 min n

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.02220	ft/ft
Discharge:	7.17	ft³/s

Options		
Current Roughness Weighted Meth‹	ImprovedLotters	
Open Channel Weighted Roughnes:	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	5622.57	ft
Elevation Range:	5622.05 to 5629.80 ft	
Flow Area:	2.80	ft²
Wetted Perimeter:	10.85	ft
Top Width:	10.80	ft
Normal Depth:	0.52	ft
Critical Depth:	0.49	ft
Critical Slope:	0.02863	ft/ft
Velocity:	2.56	ft/s
Velocity Head:	0.10	ft
Specific Energy:	0.62	ft
Froude Number:	0.89	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00, 5629.80)	(1+20, 5628.90)	0.035

Section Geometry

Station	Elevation
0+00	5629.80
0+21	5627.74

Worksheet for Sect 30-1 max n

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.02220	ft/ft
Discharge:	7.17	ft³/s

Options		
Current Roughness Weighted Metho	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.045	
Water Surface Elevation:	5622.62	ft
Elevation Range:	5622.05 to 5629.80 ft	
Flow Area:	3.38	ft²
Wetted Perimeter:	11.93	ft
Top Width:	11.87	ft
Normal Depth:	0.57	ft
Critical Depth:	0.49	ft
Critical Slope:	0.04732	ft/ft
Velocity:	2.12	ft/s
Velocity Head:	0.07	ft
Specific Energy:	0.64	ft
Froude Number:	0.70	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00, 5629.80)	(1+20, 5628.90)	0.045

Section Geometry

Station	Elevation
0+00	5629.80
0+21	5627.74

Worksheet for Sect 30-2 min n

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.05000	ft/ft
Discharge:	7.17	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughnes:	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	5626.84	ft
Elevation Range:	5626.50 to 5629.84 ft	
Flow Area:	2.40	ft²
Wetted Perimeter:	13.61	ft
Top Width:	13.59	ft
Normal Depth:	0.34	ft
Critical Depth:	0.37	ft
Critical Slope:	0.03079	ft/ft
Velocity:	2.99	ft/s
Velocity Head:	0.14	ft
Specific Energy:	0.48	ft
Froude Number:	1.25	
Flow Type:	Supercritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00, 5629.84)	(0+66, 5629.05)	0.035

Section Geometry

Station	Elevation
0+00	5629.84
0+12	5627.32

Worksheet for Sect 30-2 max n

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.05000	ft/ft
Discharge:	7.17	ft³/s

Options		
Current Roughness Weighted Meth	ImprovedLotters	
Open Channel Weighted Roughnes	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.045	
Water Surface Elevation:	5626.87	ft
Elevation Range:	5626.50 to 5629.84 ft	
Flow Area:	2.87	ft²
Wetted Perimeter:	14.63	ft
Top Width:	14.61	ft
Normal Depth:	0.37	ft
Critical Depth:	0.37	ft
Critical Slope:	0.05089	ft/ft
Velocity:	2.50	ft/s
Velocity Head:	0.10	ft
Specific Energy:	0.47	ft
Froude Number:	0.99	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00, 5629.84)	(0+66, 5629.05)	0.045

Section Geometry

Station	Elevation
0+00	5629.84
0+12	5627.32

Attachment 5

Worksheet for Broad Crested Weir - 1

Project Description		
Flow Element:	Broad Crested Weir	
Solve For:	Headwater Elevation	

Input Data		
Discharge:	7.17	ft^3/s
Crest Elevation:	5621.50	ft
Tailwater Elevation:	5621.95	ft
Crest Surface Type:	Gravel	
Crest Breadth:	15.00	ft
Crest Length:	4.00	ft

Results		
Headwater Elevation:	5622.25	ft
Headwater Height Above Crest:	0.75	ft
Tailwater Height Above Crest:	0.45	ft
Weir Coefficient:	2.77	US
Submergence Factor:	1.00	
Adjusted Weir Coefficient:	2.77	US
Flow Area:	3.00	ft^2
Velocity:	2.39	ft/s
Wetted Perimeter:	5.50	ft
Top Width:	4.00	ft

Worksheet for Trapezoidal Channel - 1

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Discharge	

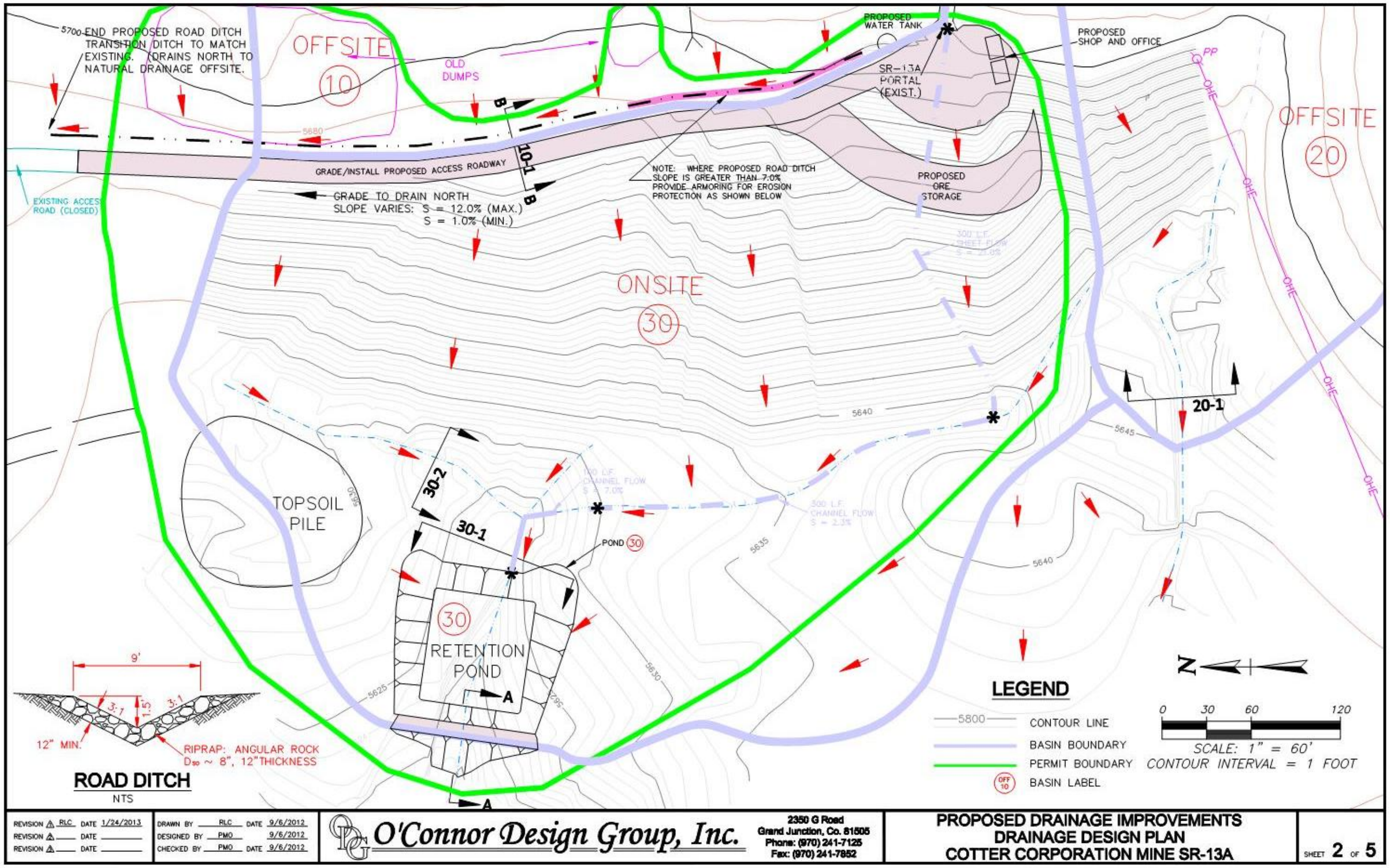
Input Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00500	ft/ft
Normal Depth:	0.61	ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	3.00	ft/ft (H:V)
Bottom Width:	4.00	ft

Results		
Discharge:	7.34	ft^3/s
Flow Area:	3.56	ft^2
Wetted Perimeter:	7.86	ft
Top Width:	7.66	ft
Critical Depth:	0.42	ft
Critical Slope:	0.01932	ft/ft
Velocity:	2.06	ft/s
Velocity Head:	0.07	ft
Specific Energy:	0.68	ft
Froude Number:	0.53	
Flow Type:	Subcritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	0.61	ft
Critical Depth:	0.42	ft
Channel Slope:	0.00500	ft/ft

Attachment 6



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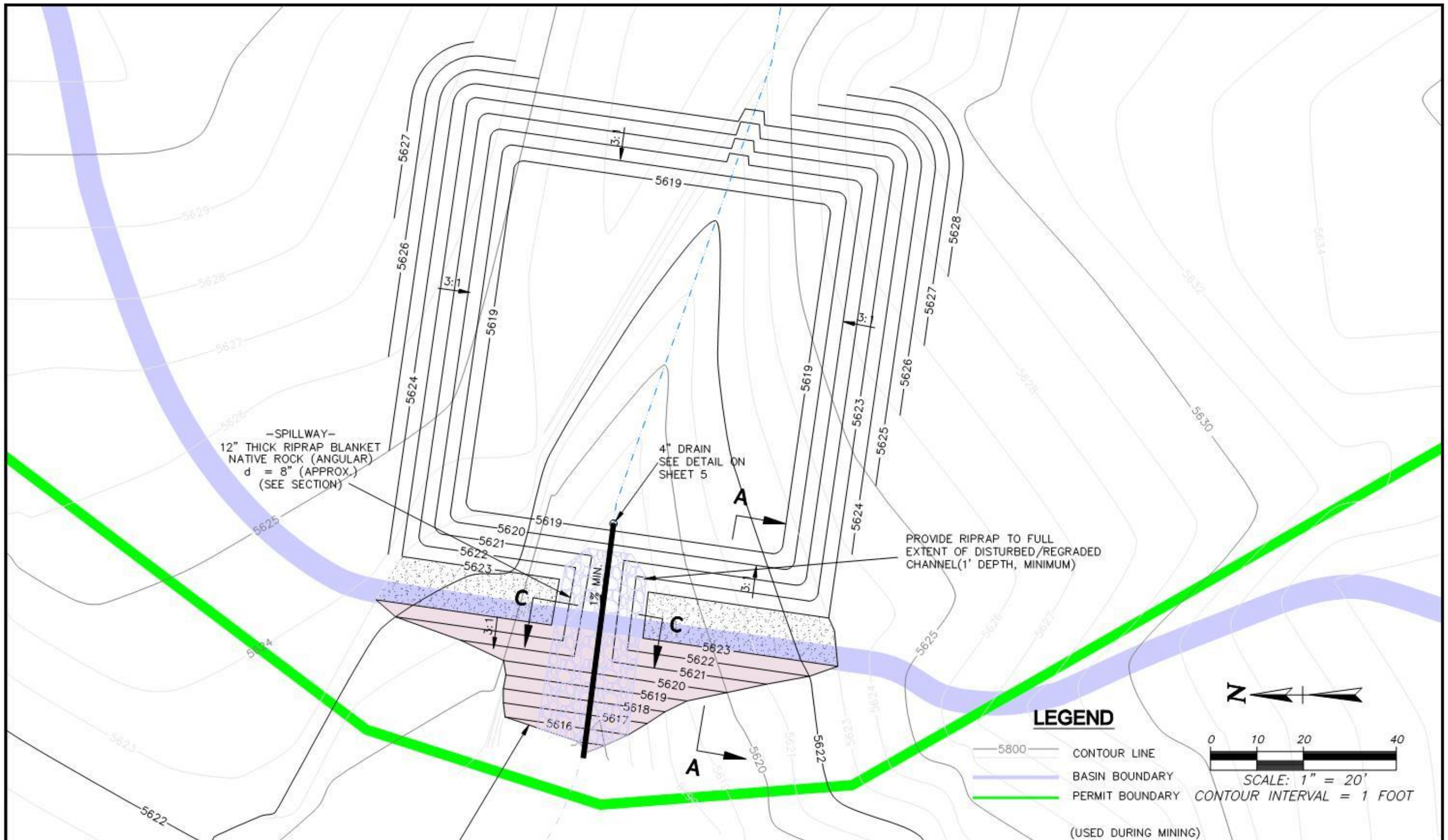


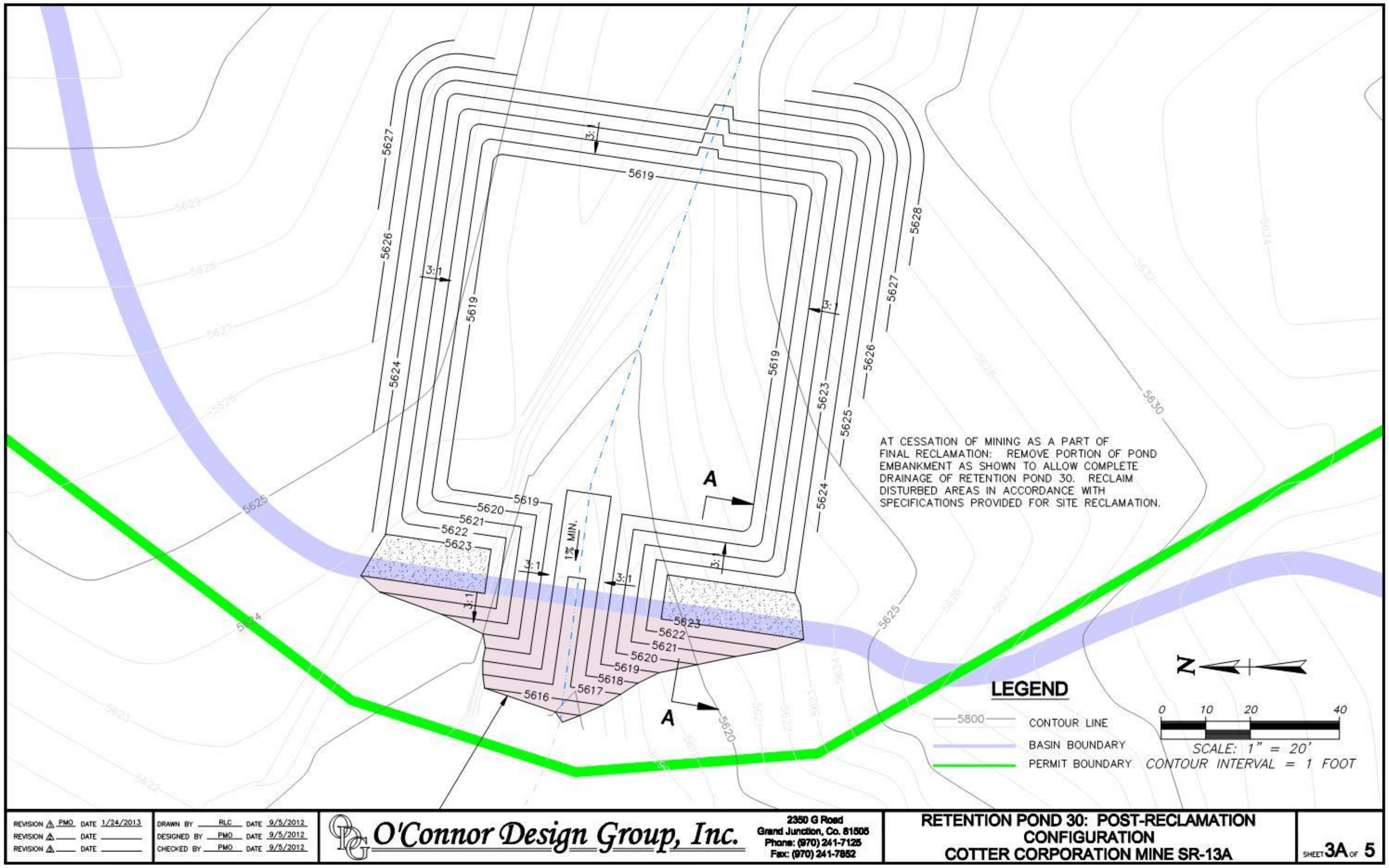
REVISION 1 PMO DATE 1/24/2013	DRAWN BY RLC DATE 9/5/2012	
REVISION 2 DATE	DESIGNED BY PMO DATE 9/5/2012	
REVISION 3 DATE	CHECKED BY PMO DATE 9/5/2012	

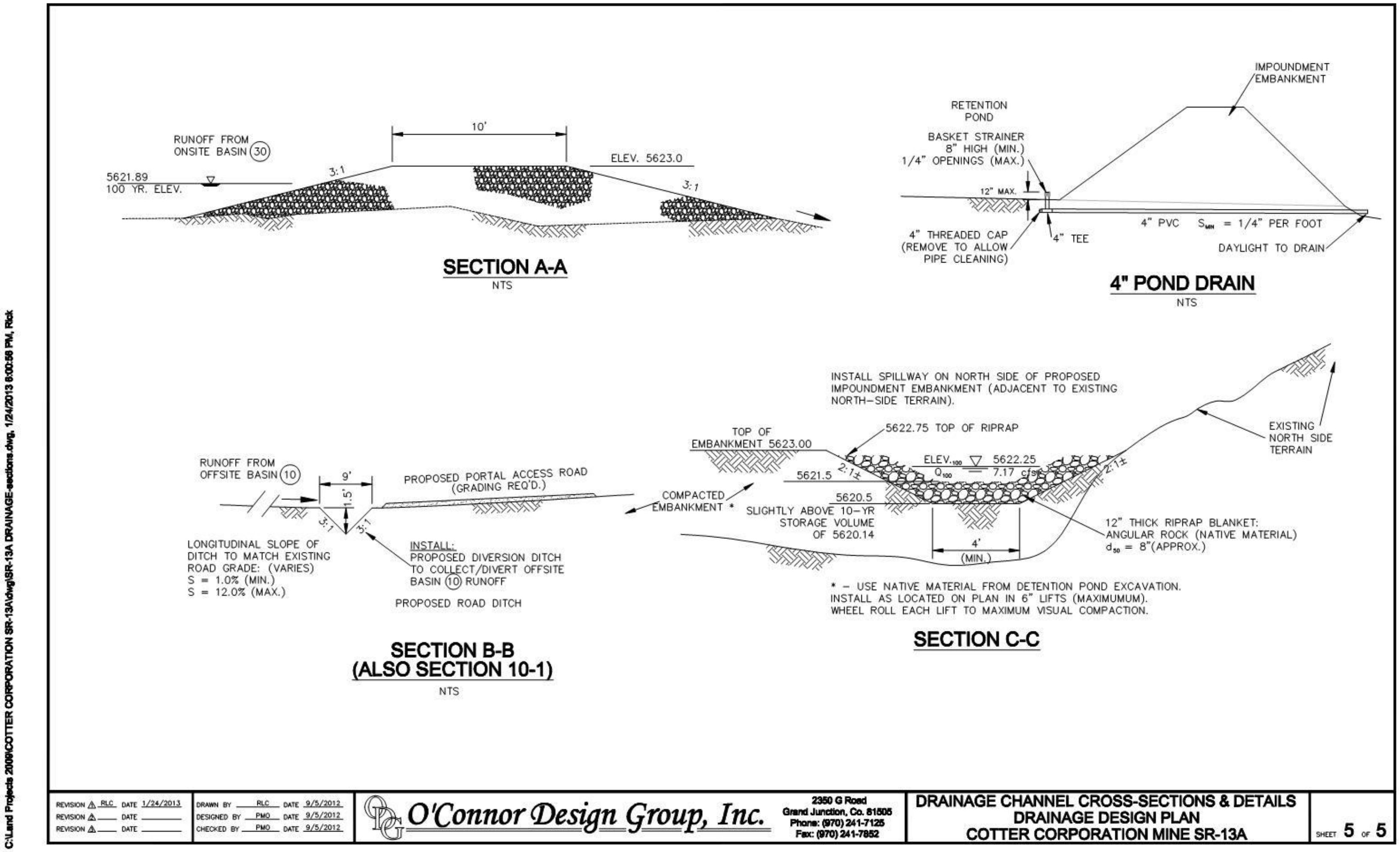
O'Connor Design Group, Inc.
2350 G Road
Grand Junction, Co. 81505
Phone: (970) 241-7125
Fax: (970) 241-7852

RETENTION POND 30: GRADING & DETAILS
DRAINAGE DESIGN PLAN
COTTER CORPORATION MINE SR-13A

SHEET 3 OF 5

C:\Land Projects 2008\COTTER CORPORATION SR-13A\dwg\SR-13A DRAINAGE-pond-RECLAIMED.dwg, 1/24/2013 8:02:35 PM, Rick




RUNOFF FROM ONSITE BASIN (30)
10'
ELEV. 5623.0
3:1
3:1
5621.89
100 YR. ELEV.
SECTION A-A
NTS
IMPOUNDMENT EMBANKMENT
RETENTION POND
BASKET STRAINER
8" HIGH (MIN.)
1/4" OPENINGS (MAX.)
12" MAX.
4" PVC S = 1/4" PER FOOT
4" THREADED CAP (REMOVE TO ALLOW PIPE CLEANING)
4" TEE
DAYLIGHT TO DRAIN
4" POND DRAIN
NTS
RUNOFF FROM OFFSITE BASIN (10)
9'
1.5'
3:1
3:1
PROPOSED PORTAL ACCESS ROAD (GRADING REQ'D.)
LONGITUDINAL SLOPE OF DITCH TO MATCH EXISTING ROAD GRADE: (VARIES)
S = 1.0% (MIN.)
S = 12.0% (MAX.)
INSTALL:
PROPOSED DIVERSION DITCH TO COLLECT/DIVERT OFFSITE BASIN (10) RUNOFF
PROPOSED ROAD DITCH
SECTION B-B
(ALSO SECTION 10-1)
NTS
INSTALL SPILLWAY ON NORTH SIDE OF PROPOSED IMPOUNDMENT EMBANKMENT (ADJACENT TO EXISTING NORTH-SIDE TERRAIN).
TOP OF EMBANKMENT 5623.00
5622.75 TOP OF RIPRAP
ELEV.100 5622.25
Q100 = 7.17 cfs
5621.5
2:1±
2:1±
5620.5
COMPACTED EMBANKMENT *
SLIGHTLY ABOVE 10-YR STORAGE VOLUME OF 5620.14
4' (MIN.)
EXISTING NORTH SIDE TERRAIN
12" THICK RIPRAP BLANKET: ANGULAR ROCK (NATIVE MATERIAL) d50 = 8"(APPROX.)
* - USE NATIVE MATERIAL FROM DETENTION POND EXCAVATION. INSTALL AS LOCATED ON PLAN IN 6" LIFTS (MAXIMUMUM). WHEEL ROLL EACH LIFT TO MAXIMUM VISUAL COMPACTION.
SECTION C-C
REVISION 1 RLC DATE 1/24/2013
DRAWN BY RLC DATE 9/5/2012
DESIGNED BY PMO DATE 9/5/2012
CHECKED BY PMO DATE 9/5/2012
O'Connor Design Group, Inc.
2350 G Road
Grand Junction, Co. 81505
Phone: (970) 241-7125
Fax: (970) 241-7852
DRAINAGE CHANNEL CROSS-SECTIONS & DETAILS
DRAINAGE DESIGN PLAN
COTTER CORPORATION MINE SR-13A
SHEET 5 OF 5

Attachment 7