



DESERET POWER
ELECTRIC COOPERATIVE

**BONANZA POWER PLANT
COAL COMBUSTION RESIDUAL (CCR) UNIT
RUN ON / RUN OFF CONTROL PLAN**

VERSION 1 (INITIAL)

PREPARED BY: DESERET POWER ENGINEERING

October 2016

**Deseret Generation and Transmission Co-operative
10714 S. Jordan Gateway St. 300
South Jordan, UT 84095**

Qualified Professional Engineer Certificate

I, Tyler S. Esplin, a registered Professional Engineer (PE) in the State of Utah, certify under penalty of law that this CCR Run On / Run Off Control Plan meets the requirements of Subpart D, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments pursuant to 40 CFR 257.81. It is my opinion that the information within this report is true and accurate according to the guidelines outlined in the said rule.

Dated this 12 day of October 20 16



Registered Professional Engineer
Number 323799-2202
State of Utah

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I. SITE INFORMATION

Deseret Generation and Transmission Co-operative
Bonanza Power Plant
12500 East 25500 South
Vernal, Utah 84078
Phone: 435-789-9000

Title V Permit Number: V-UO-000004-00.02
Responsible Official: Eric Olsen, PE (Plant Manager)
Company Contact: Tyler Esplin, PE (Environmental Superintendent)

Bonanza is operated by Deseret Generation and Transmission Cooperative (Deseret) and is located approximately 35 miles southeast of Vernal, Utah. Bonanza is a 500 MW gross coal fired steam turbine and generator.

II. INTRODUCTION

In accordance with 40 CFR 257.81, this document fulfills the *Run-On / Run-Off Control Plan* for the Bonanza Power Plant's (Bonanza) existing coal combustion residual (CCR) units. This plan documents the control systems that are designed, constructed, operated, and maintained to:

- Prevent storm water run-on flow onto the active portion of the CCR unit during peak discharge from a 24-hour, 25-year storm; and
- Prevent storm water run-off flow from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

III. LANDFILL INFORMATION

Deseret Power maintains the following two CCR landfill units, classified as existing landfills under 40 CFR 257.53, at the Bonanza Power Plant site:

- A. Bottom Ash Landfill
- B. Fly Ash / Flue Gas Desulfurization (FGD) Sludge Landfill

These landfills contain fly ash, bottom ash, boiler slag, and flue gas desulfurization materials. All of these materials can be found in either landfill. However, the landfill title represents its primary constituent(s).

Refer to Figure 1 for relative landfill locations.

A. Bottom Ash Landfill

Located on the southern end of the plant and primarily consisting of bottom ash and boiler slag. CCR is hauled from the boiler area and deposited off an existing plateau where native soils gradually slope to elevations approximately 30-feet lower. The landfill is built out as an extension of the existing plateau with an approximate elevation of 5030 feet above Mean Sea Level (MSL). The existing footprint measures approximately 53 acres, however only portions of the landfill have reached final plateau elevation.

B. Fly Ash / FGD Sludge Landfill

Located on the northern end of the plant and primarily consisting of a dried mixture of processed fly ash and flue gas desulfurization (FGD) sludge material. The landfill consists of piled CCR that is built up from native soil elevations to an approximate plateau elevation of 5160 feet above MSL. The existing footprint area measures approximately 152 acres, however only portions of the landfill have reached plateau elevation.

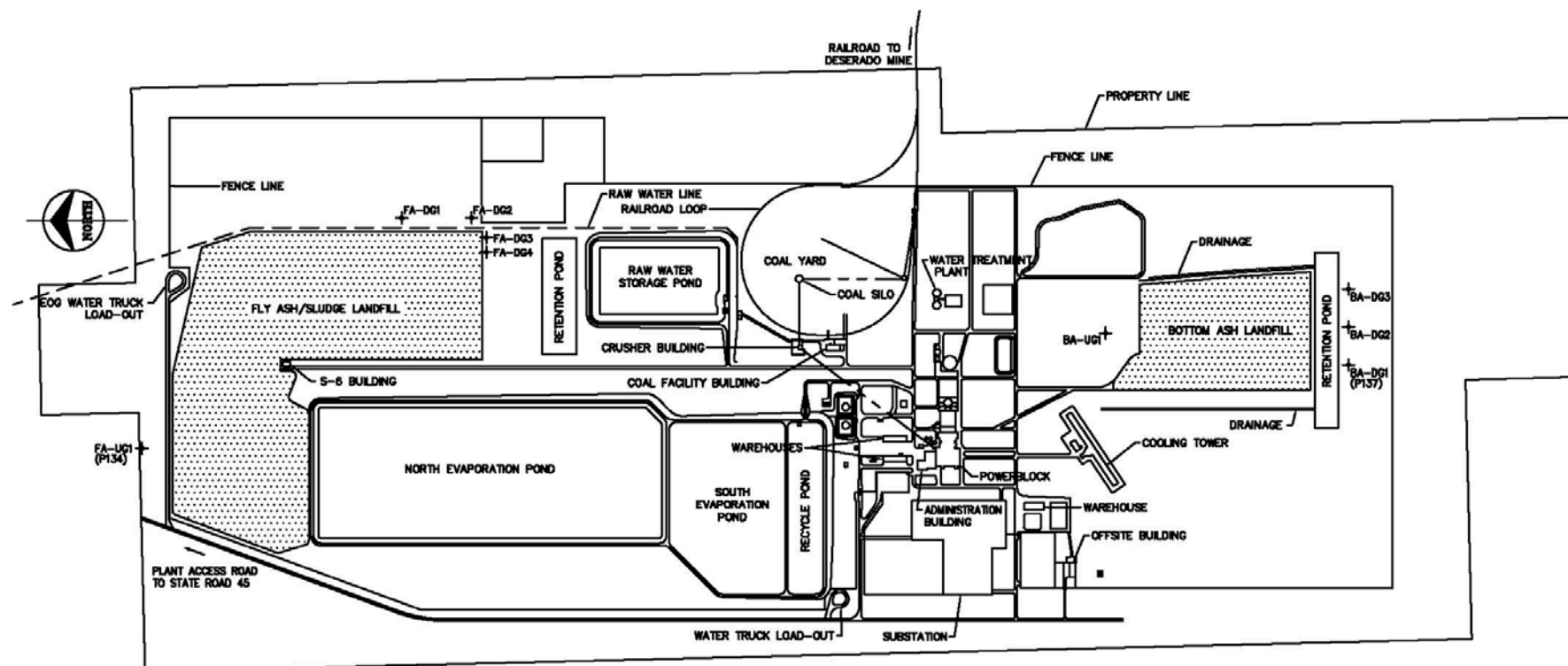


Figure 1

IV. RUN-ON CONTROL SYSTEMS

Each CCR landfill is protected from storm water run-on by storm water channels, elevated roads, berms, culverts and grading that divert potential run-on around the landfills to lower elevations. The locations of these features are depicted on Figures 2 and 3.

Peak storm water flows have been calculated using hydrologic calculations. The capacity of storm water control features, such as ditches and storm water channels, have been calculated using Manning's equations and designed to exceed potential run-on from outside locations.

A. Bottom Ash Landfill

Storm water at the Bottom Ash Landfill is controlled by the following features:

- | | |
|---------------------|---|
| North Boundary: | The topography on the northern boundary is relatively flat with mild grades sloping toward the landfill. Storm water channel 1-1 runs along the northern landfill boundary with an elevated berm on the landfill side. Storm water is diverted around the landfill and directed downgradient to storm water channel 1-2. Culvert 1-1 conveys potential run-on under the north-east access road. |
| East Boundary: | Storm channel 1-2 receives water from areas up gradient of the landfill and conveys the flow away from the Eastern base of the landfill to Retention Pond 1. |
| West Boundary: | The area west of the landfill primarily slopes to the south and toward the retention pond. Storm water channel 1-3 conveys water away from the western base of the landfill to Retention Pond 1 immediately down gradient of the landfill. A low berm has been constructed on the western edge of the channel and diverts small drainages away from the channel. |
| Northwest Boundary: | Storm water channel 1-4 conveys water collected on the north-eastern landfill access roadway and other potential run-on areas to storm water channel 1-3. |
| South Boundary: | Retention Pond 1 is located on the south side of the landfill and is down gradient of the landfill. No potential for storm water run on. |

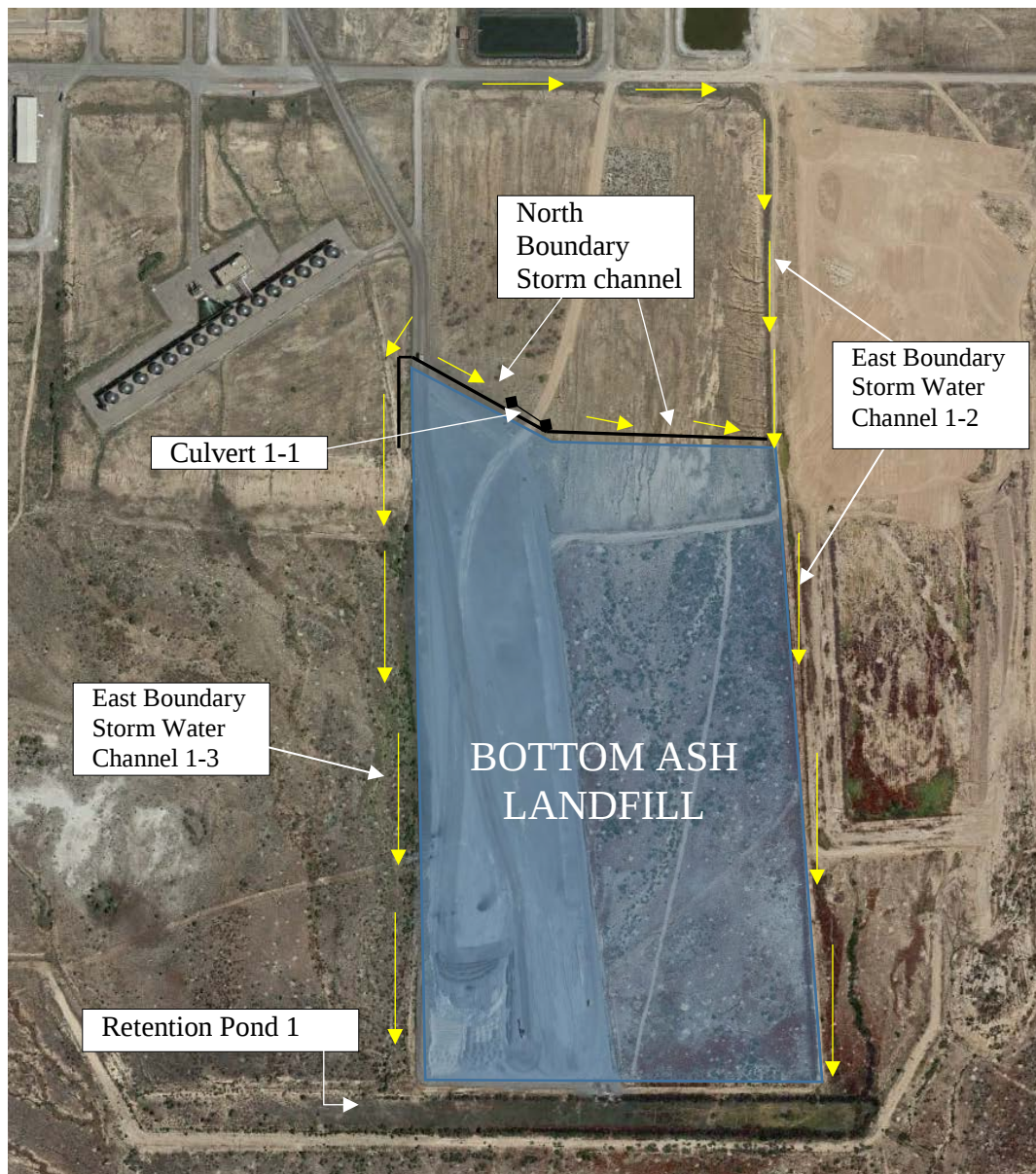


Figure 2

B. Fly Ash / FGD Sludge Landfill

The Fly Ash / FGD Sludge Landfill is protected from storm water run-on by the following features:

- | | |
|-----------------|--|
| North Boundary: | The Kennedy Wash Diversion Canal located along the northern and north-eastern plant boundaries. Starting at the north-west corner of the plant and running east, the canal diverts storm water from the Kennedy wash and other tributaries around the facility to reconnect to the natural wash down gradient of the facility. |
| West Boundary: | The west boundary is protected from storm water run-on by a storm water diversion ditch constructed adjacent to the Deseret Power Plant Road. Storm water is conveyed parallel to the plant to the Kennedy Wash Diversion Canal and to lower elevations to the south. The southern extension of the landfill is protected from storm water run-on by the landfill access road and storm water channel 1-2. |
| East Boundary: | Areas East of the landfill are down gradient from the landfill, hence they pose no run-on potential. |
| South Boundary: | Areas South of the landfill are down gradient from the landfill, hence they pose no run-on potential. |

All of these run-on control features can be seen on Figure 3.

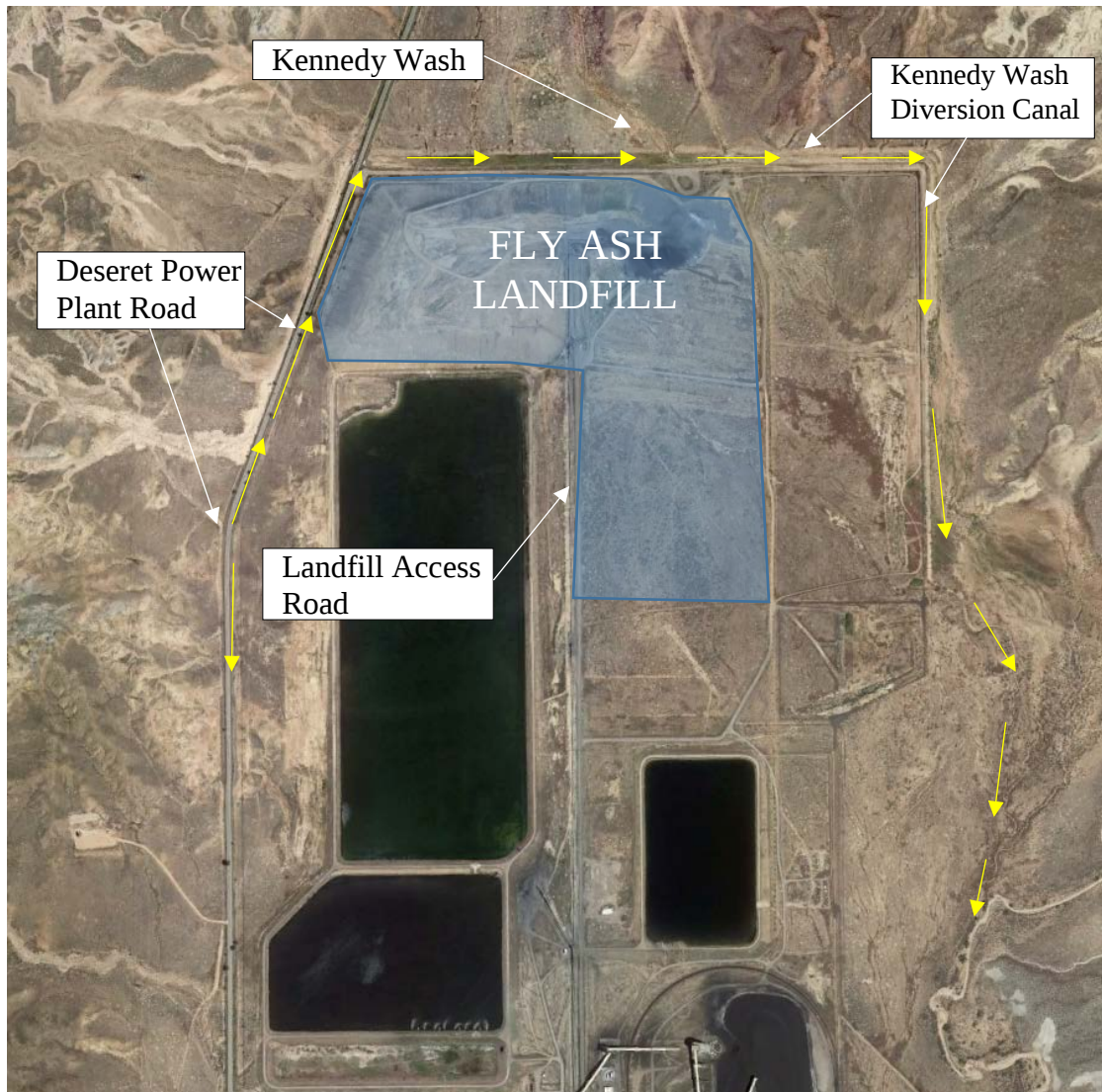


Figure 3

V. RUN-OFF CONTROL SYSTEM

Storm water retention ponds collect run-off from each CCR landfill and adjacent water shed areas. Each retention pond has been designed and constructed to retain at least the volume anticipated by a 24-hour, 25-year storm event. The run-off control system has been designed such that no run-off shall leave the plant site and no pollutants shall be discharged into waters of the United States pursuant to 40 CFR 257.3-3.

A. Bottom Ash Landfill (Drainage Basin 1)

The Bottom Ash Landfill is completely encompassed inside an existing drainage basin that is run off protected by retention pond 1 and adjacent dikes. This pond was originally built during plant construction and is still in use today. Dikes divert storm water from the landfill and surrounding drainage basin into the retention pond. Figure 5 depicts the approximate drainage basin area and calculations are shown in the appendix.

Retention Pond	Capacity (ft ³)	Calculated 24 hour 25- year Storm Event (ft ³)
#1	1,100,000	420,000

The following design features protect storm water run-off from leaving the retention pond 1 drainage basin:

North Boundary:	The northern boundary is up gradient from the landfill, hence no run-off is anticipated.
East Boundary:	Storm water channel 1-2 runs along the landfill eastern boundary and slopes to retention pond 1. The landfill sits approximately three feet above the channel and has been conservatively designed to accommodate run off from the eastern half of the land fill and areas up gradient in the water shed.
West Boundary:	Storm water channels 1-3 and 1-4 run along the landfill western boundary and slopes to retention pond 1. The channels have been conservatively designed to accommodate all potential run-off from the western half of the landfill.
South Boundary:	Areas south of the landfill are down gradient from the landfill, hence they pose no run-on potential.

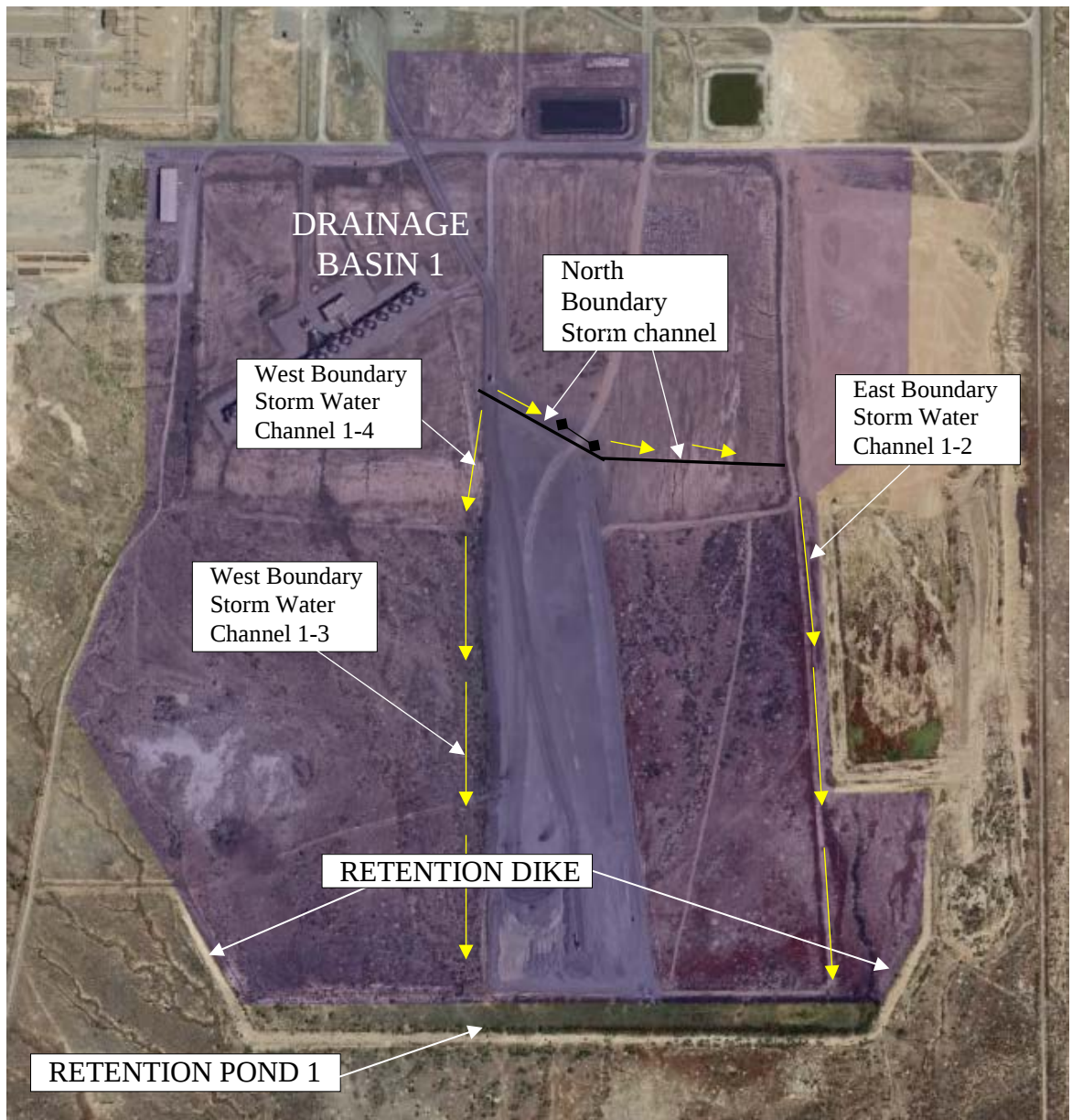


Figure 4

B. Fly Ash / FGD Sludge Landfill

The landfill is graded into three drainage basins, numbered 2 through 4, and each drainage basin features a correspondingly numbered retention pond; See Figure 5.

Retention Pond	Capacity (ft ³)	Calculated 24 hour 25- year Storm Event (ft ³)
#2	750,000	240,000
#3 (North Evap. Pond)	75,000,000	809,000
#4	35,000	20,000

i. Drainage Basin 2

Bounded by storm water channels 2-1 and 2-2 on the east and west side; respectively. These channels carry storm water to retention pond 2. Additional run off will be collected from the area east of the north evaporation pond and routed through culvert 2-2.

ii. Drainage Basin 3

Includes the landfill plateau area and southern slopes immediately North of the North Evaporation Pond. Most storm water shall be retained on top of the landfill for natural evaporation. A newly constructed dike shall prevent storm water from collecting in low areas and concentrating into erosion channels. The North Evaporation Pond serves as the retention pond (3) for this drainage basin.

iii. Drainage Basin 4

Includes the landfill western slopes and northern slopes (below the northern plateau access road) immediately north of the evaporation pond. Retention Pond 4 has been constructed to capture storm water run-off. A storm water channel (4-1) and culvert (4-1) have been installed to divert storm water to the Retention Pond 4.



Figure 5

VI. AMMENDMENT OF THE PLAN

This plan has been prepared and certified by a professional engineer (see cover page) and will be reviewed periodically to update any conditions that may arise. The owner or operator may amend the written run-on and run-cuff control system plan at any time provided the revised plan is placed in the facility's operating record as required by §257.105(g)(3). The owner or operator will amend the written plan whenever there is a change in conditions that would substantially affect the written plan in effect.

VII. TIMEFRAMES FOR PREPARING INITIAL PLAN

The initial plan for the existing CCR landfills must be prepared no later than October 17, 2016. Any new CCR landfills and any lateral expansion of an existing CCR landfill must prepare an initial run-on and run-off control plan no later than the date of initial receipt of CCR in the CCR unit.

VIII. PLAN REVISIONS

A periodic revision of this plan will be prepared every five-years. A revised plan may be completed earlier than the prescribed five-years, however the five-year deadline for the subsequent revision will be based on the date of placement to the facility's operating record.

IX. PLAN CERTIFICATION

The initial and all subsequent periodic plans will obtain a certification from a qualified professional engineer stating that the plans meet the requirements of §257.81. Refer to beginning of this plan for the PE certification.

X. RECORD KEEPING

This plan must comply with the recordkeeping, notification, and website requirements pursuant to 40 CFR 257.105(g). Copies of records in electronic and paper formats will be kept at the facility in a written operating record. Records will be retained for at least five years from the date of occurrence, measurement, maintenance, corrective action, report, record, or study.

When the initial or subsequent plans are posted to the operating record, notifications will be made within 30 days to the appropriate Tribal Authority:

Ute Indian Tribe
EPA Contact - Title V Permit
P.O. Box 190
Ft. Duchesne, UT 84026

This plan is available on a publicly accessible internet website at:
<https://apps.deseretpower.com/apex/f?p=107:1:8421128017314:::::>

Appendix A
CALCULATIONS



NOAA Atlas 14, Volume 1, Version 5
Location name: Jensen, Utah, US*
Latitude: 40.0167°, Longitude: -109.1833°
Elevation: 5514 ft*
 * source: Google Maps



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.106 (0.091-0.125)	0.136 (0.117-0.162)	0.187 (0.160-0.223)	0.235 (0.199-0.280)	0.311 (0.258-0.370)	0.381 (0.308-0.455)	0.464 (0.365-0.557)	0.559 (0.426-0.680)	0.713 (0.515-0.881)	0.851 (0.592-1.07)
10-min	0.161 (0.138-0.190)	0.207 (0.178-0.247)	0.284 (0.243-0.339)	0.357 (0.303-0.425)	0.473 (0.393-0.563)	0.580 (0.469-0.693)	0.705 (0.556-0.847)	0.852 (0.648-1.03)	1.08 (0.784-1.34)	1.30 (0.901-1.63)
15-min	0.199 (0.172-0.235)	0.256 (0.221-0.306)	0.352 (0.302-0.420)	0.443 (0.376-0.527)	0.587 (0.487-0.698)	0.719 (0.582-0.859)	0.874 (0.689-1.05)	1.06 (0.803-1.28)	1.34 (0.972-1.66)	1.61 (1.12-2.02)
30-min	0.268 (0.231-0.317)	0.345 (0.297-0.412)	0.474 (0.406-0.565)	0.596 (0.507-0.709)	0.791 (0.656-0.940)	0.968 (0.783-1.16)	1.18 (0.928-1.41)	1.42 (1.08-1.73)	1.81 (1.31-2.24)	2.16 (1.50-2.72)
60-min	0.332 (0.286-0.392)	0.427 (0.368-0.510)	0.587 (0.503-0.699)	0.738 (0.627-0.878)	0.978 (0.812-1.16)	1.20 (0.969-1.43)	1.46 (1.15-1.75)	1.76 (1.34-2.14)	2.24 (1.62-2.77)	2.68 (1.86-3.37)
2-hr	0.395 (0.344-0.465)	0.496 (0.430-0.586)	0.664 (0.573-0.785)	0.820 (0.700-0.970)	1.08 (0.894-1.27)	1.31 (1.06-1.56)	1.59 (1.25-1.91)	1.93 (1.46-2.34)	2.48 (1.78-3.08)	2.98 (2.05-3.77)
3-hr	0.446 (0.391-0.521)	0.561 (0.490-0.653)	0.736 (0.639-0.859)	0.896 (0.770-1.04)	1.15 (0.965-1.34)	1.37 (1.13-1.61)	1.64 (1.31-1.95)	1.97 (1.53-2.37)	2.50 (1.86-3.11)	3.01 (2.15-3.81)
6-hr	0.567 (0.503-0.646)	0.706 (0.630-0.809)	0.897 (0.796-1.02)	1.06 (0.936-1.22)	1.31 (1.13-1.49)	1.51 (1.28-1.73)	1.75 (1.45-2.02)	2.05 (1.67-2.40)	2.58 (2.03-3.14)	3.08 (2.36-3.85)
12-hr	0.694 (0.627-0.778)	0.859 (0.778-0.964)	1.07 (0.959-1.20)	1.25 (1.11-1.40)	1.50 (1.33-1.70)	1.71 (1.49-1.95)	1.94 (1.66-2.23)	2.20 (1.85-2.57)	2.68 (2.19-3.18)	3.15 (2.51-3.89)
24-hr	0.809 (0.754-0.879)	1.01 (0.936-1.10)	1.25 (1.16-1.36)	1.46 (1.35-1.58)	1.76 (1.62-1.90)	2.00 (1.82-2.17)	2.25 (2.03-2.43)	2.53 (2.27-2.73)	2.92 (2.58-3.21)	3.22 (2.82-3.92)
2-day	0.903 (0.832-0.982)	1.12 (1.03-1.22)	1.40 (1.28-1.51)	1.62 (1.49-1.76)	1.95 (1.77-2.10)	2.19 (1.99-2.38)	2.46 (2.22-2.65)	2.75 (2.47-2.97)	3.14 (2.79-3.40)	3.45 (3.04-3.96)
3-day	0.980 (0.902-1.07)	1.22 (1.12-1.33)	1.51 (1.39-1.64)	1.75 (1.61-1.90)	2.09 (1.91-2.26)	2.35 (2.14-2.55)	2.63 (2.38-2.85)	2.92 (2.63-3.17)	3.33 (2.96-3.61)	3.64 (3.22-4.07)
4-day	1.06 (0.971-1.15)	1.31 (1.22-1.43)	1.62 (1.49-1.77)	1.88 (1.73-2.05)	2.23 (2.05-2.43)	2.51 (2.29-2.72)	2.81 (2.54-3.05)	3.10 (2.79-3.37)	3.52 (3.13-3.82)	3.84 (3.40-4.18)
7-day	1.21 (1.10-1.32)	1.50 (1.37-1.64)	1.84 (1.68-2.02)	2.14 (1.95-2.35)	2.54 (2.29-2.78)	2.85 (2.57-3.12)	3.19 (2.85-3.49)	3.53 (3.13-3.87)	4.00 (3.51-4.41)	4.38 (3.80-4.83)
10-day	1.34 (1.23-1.48)	1.67 (1.53-1.83)	2.06 (1.89-2.26)	2.37 (2.17-2.59)	2.79 (2.54-3.04)	3.12 (2.81-3.39)	3.45 (3.11-3.75)	3.78 (3.39-4.11)	4.24 (3.76-4.61)	4.58 (4.04-5.00)
20-day	1.75 (1.60-1.90)	2.17 (1.99-2.37)	2.66 (2.43-2.89)	3.04 (2.77-3.30)	3.54 (3.23-3.85)	3.92 (3.56-4.26)	4.29 (3.89-4.67)	4.67 (4.20-5.08)	5.16 (4.62-5.62)	5.53 (4.93-6.04)
30-day	2.05 (1.90-2.21)	2.54 (2.35-2.75)	3.08 (2.85-3.33)	3.50 (3.23-3.78)	4.03 (3.72-4.36)	4.42 (4.07-4.78)	4.80 (4.40-5.20)	5.18 (4.73-5.62)	5.66 (5.14-6.14)	6.01 (5.43-6.53)
45-day	2.46 (2.29-2.66)	3.05 (2.85-3.30)	3.68 (3.43-3.98)	4.16 (3.87-4.49)	4.77 (4.42-5.15)	5.21 (4.82-5.63)	5.63 (5.19-6.08)	6.05 (5.56-6.54)	6.57 (6.00-7.12)	6.94 (6.32-7.54)
60-day	2.85 (2.64-3.06)	3.53 (3.28-3.78)	4.22 (3.93-4.53)	4.73 (4.39-5.07)	5.36 (4.96-5.74)	5.81 (5.37-6.22)	6.23 (5.75-6.68)	6.61 (6.09-7.10)	7.09 (6.49-7.63)	7.41 (6.78-8.00)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

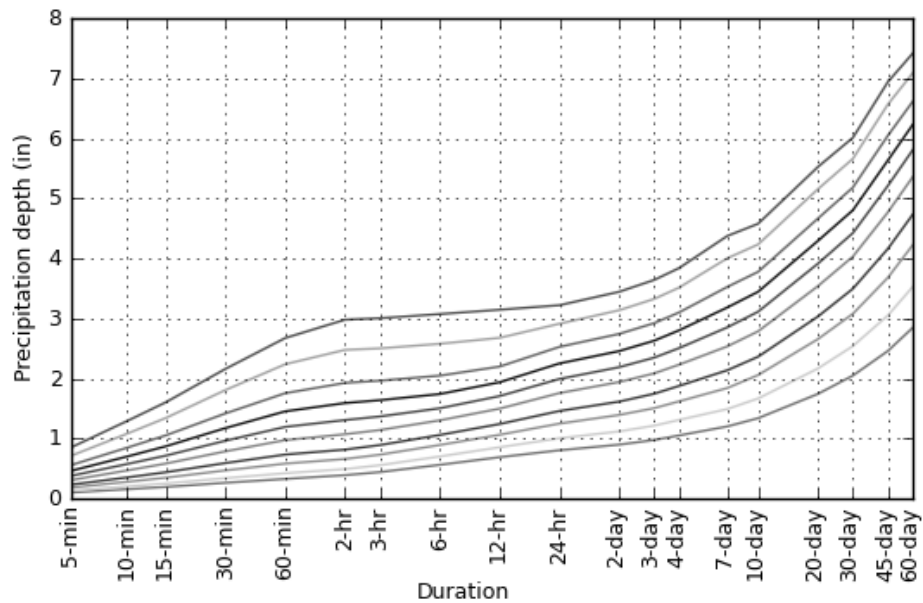
Please refer to NOAA Atlas 14 document for more information.

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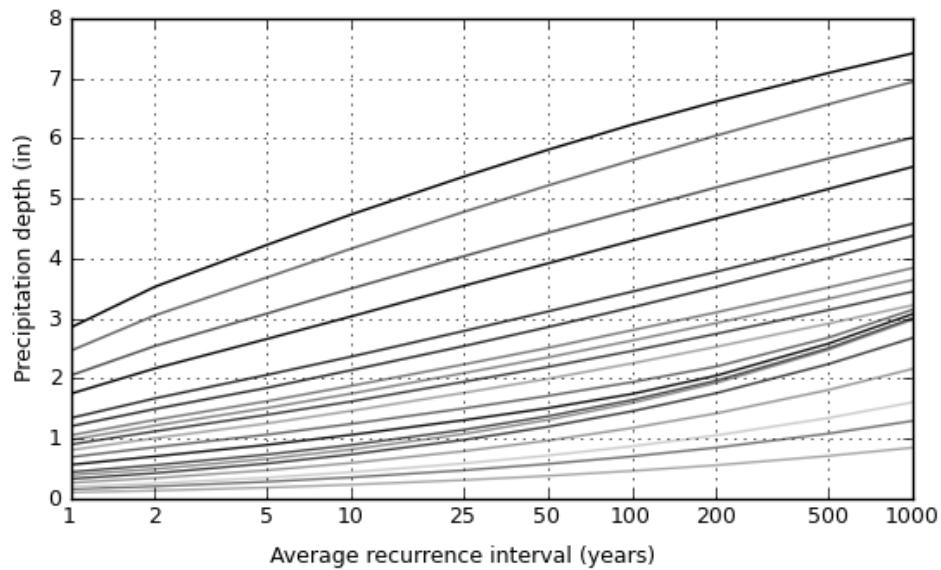
PF graphical

PDS-based depth-duration-frequency (DDF) curves

Latitude: 40.0167°, Longitude: -109.1833°



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

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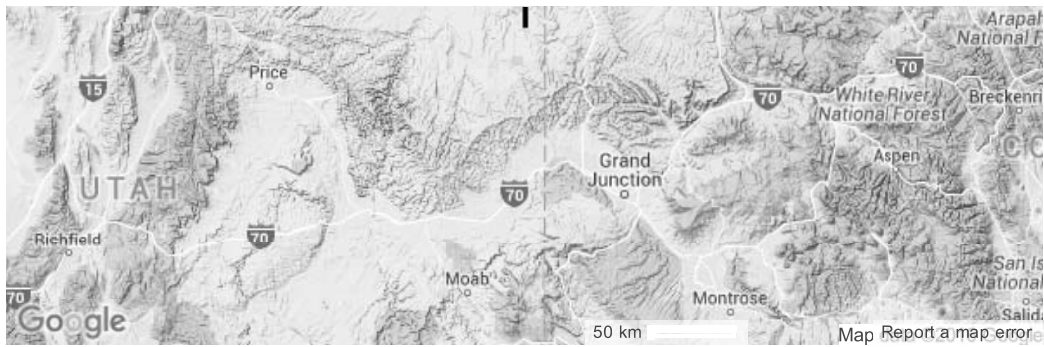
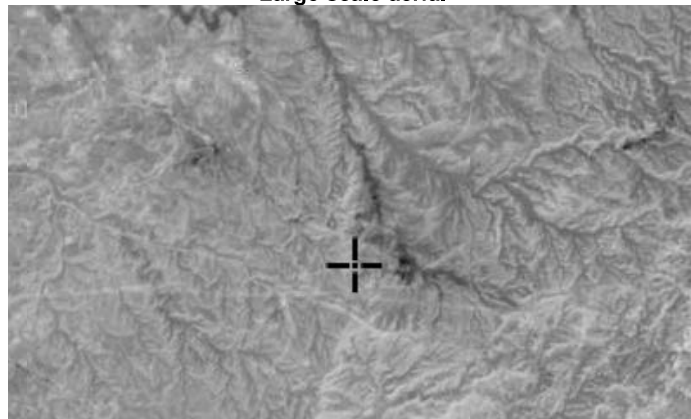
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Maps & aeriels

Small scale terrain



**Large scale terrain****Large scale map****Large scale aerial**



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[National Water Center](#)
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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Retention Pond 1 - Bottom Ash Landfill

Design Rainfall: 25-Year, 24 Hour

Pond Volume: 1,100,000 cu.ft

Area	acres	CN	CN x Area	Soil Type	Description
Native Soils*	143	80	11440	Turzo, B	Herbaceous, Poor
Land Fill Area	58	85	4930		Ash
Blow Down Pond	-1				
CT Area /Roads	5	98	490		Impervious
Total	205		16860		
Calc'd CN		82			

SCS Storm Distribution

Precipitation	P=	1.76 in	$S = \frac{1000}{CN} - 10$
Curve Number	CN=	82	
Potential Ret.	S=	2.16 in	$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$
Run Off	Q=	0.51 in	

Capacities

Run Off Volume	376,463	cu.ft	$V_{pond} = A_{db} \frac{Q}{12}$
Pond Surface Area	300,000	sq.ft	
Direct Precip to Pond	44,000	cu.ft	
Pond Volume:	1,100,000	cu.ft	
Pond Free Board	679,537	cu.ft	



Retention Pond 2 - Fly Ash Landfill

Design Rainfall: 25-Year, 24 Hour

Pond Volume: 750,000 cu.ft

Area	acres	CN	CN x Area	Soil Type	Description
Native Soils*	37	71	2627	Turzo, B	Herbaceous, Fair
Covered Landfill	103	80	8240	Turzo, B	Herbaceous, Poor
Ash Landfill	20	85	1700		Ash
Total	160		12567		
Calc'd CN		79			

SCS Storm Distribution

Precipitation	P=	1.76 in	
Curve Number	CN=	79	$S = \frac{1000}{CN} - 10$
Potential Ret.	S=	2.73 in	
Run Off	Q=	0.37 in	$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$

Capacities

Run Off Volume	216,832 cu.ft	
Pond Surface Area	156,000 sq.ft	
Direct Precip to Pond	22,880 cu.ft	$V_{pond} = A_{db} \frac{Q}{12}$
Pond Volume:	750,000 cu.ft	
Pond Free Board	510,288 cu.ft	



Retention Pond 3 - Fly Ash Landfill

Design Rainfall: 25-Year, 24 Hour
 Pond Volume: 75,000,000 cu.ft

Area	acres	CN	CN x Area	Soil Type	Description
Covered Landfill	30	80	2400	Turzo, B	Herbaceous, Poor

Total	30		2400		
Calc'd CN		80			

SCS Storm Distribution

Precipitation	P=	1.76 in		
Curve Number	CN=	80		$S = \frac{1000}{CN} - 10$
Potential Ret.	S=	2.50 in		
Run Off	Q=	0.42 in		$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$

Capacities

Run Off Volume	45,981	cu.ft	
Pond Surface Area	5,200,000	sq.ft	
Direct Precip to Pond	762,667	cu.ft	$V_{pond} = A_{db} \frac{Q}{12}$
Pond Volume:	75,000,000	cu.ft	
Pond Free Board*	74,191,352	cu.ft	

* Empty Capacity - Requires approximately 0.2 inches of freeboard to accommodate



Retention Pond 4 - Fly Ash Landfill

Design Rainfall: 25-Year, 24 Hour

Pond Volume: 35,100 cu.ft

Area	acres	CN	CN x Area	Soil Type	Description
Land Fill Area	11	80	880	Turzo, B	Herbaceous, Poor

Total	11		880		
Calc'd CN		80			

SCS Storm Distribution

Precipitation	P=	1.76 in		
Curve Number	CN=	80		$S = \frac{1000}{CN} - 10$
Potential Ret.	S=	2.50 in		
Run Off	Q=	0.42 in		$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$

Capacities

Run Off Volume		16,860 cu.ft	
Pond Surface Area		19,800 sq.ft	
Direct Precip to Pond		2,904 cu.ft	
Pond Volume:		35,100 cu.ft	
Pond Free Board*		15,336 cu.ft	$V_{pond} = A_{db} \frac{Q}{12}$



Retention Pond 1 - Storm Water Channel 1-1

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 80

Potential Ret. S= 2.5 inches

Run Off Q= 0.42 inches

Hydraulic Length L= 1200 feet

Ave. Slope Y= 0.70 %

Time of Concentration Tc= 0.73 hrs

Initial Abstraction Ia= 0.5 in

Ia/p= 0.28

unit peak discharge qu= 358 csm/in

Area Am 0.017 sq mi

Run Off Flow Rate qp 2.6 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Retention Pond 1 - Storm Water Channel 1-1

Trapezoid-Ditch

Depth	y=	1 ft
Bottom Width	B=	2 ft
Top Width	T=	8 ft
Side Slope	z=	3
Slope of channel	S=	0.01 ft/ft
area	A=	5 ft ²

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

Wetted Perimeter P= 8.3 ft

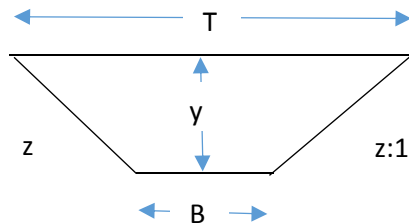
Ratio, Area/W.P. R= 0.60

Manning n n= 0.035

$$A = \frac{y}{2}(b + T)$$

Flow Velocity V= 3.0 ft/sec

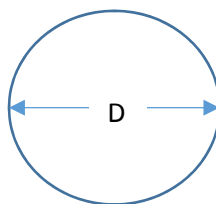
Flow Volumetric Rate Q= 15.2 ft³/sec



Culvert 1-1

Manning n	n=	0.012
Culvert Slope	S=	0.02 ft/ft
Diameter, Req'd	D=	0.8 ft
Diameter Installed	Di=	1.0 ft

$$D = \left[\frac{2.15 q_p n}{S^{0.5}} \right]^{0.375}$$



Retention Pond 1 - Storm Water Channel 1-1

Runoff Curve Number Calculation

Area	acres	CN	CN x Area	Soil Type	Description
Native Soils*	11	80	880	Turzo, B	Herbaceous, Poor
Total	11		880		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 1 - Storm Water Channel 1-2

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 83

Potential Ret. S= 2.10 inches

Run Off Q= 0.52 inches

Hydraulic Length L= 4000 feet

Ave. Slope Y= 0.72 %

Time of Concentration Tc= 1.74 hrs

Initial Abstraction Ia= 0.41 in

Ia/p= 0.23

unit peak discharge qu= 218 csm/in

Area Am 0.12 sq mi

Run Off Flow Rate qp 13.7 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Retention Pond 1 - Storm Water Channel 1-2

Trapezoid-Ditch

Depth	y=	1.5 ft
Bottom Width	B=	8 ft
Top Width	T=	14 ft
Side Slope	z=	2
Slope of channel	S=	0.0072 ft/ft
area	A=	16.5 ft ²

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

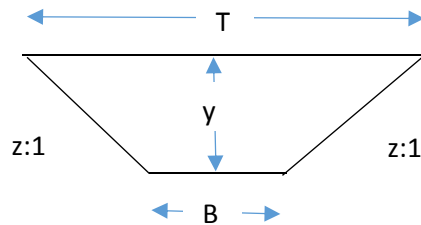
$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

Wetted Perimeter	P=	14.7 ft
Ratio, Area/W.P.	R=	1.12
Manning n	n=	0.035

$$A = \frac{y}{2}(b + T)$$

Flow Velocity	V=	3.9 ft/sec
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Flow Volumetric Rate	Q=	64.4 ft ³ /sec
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Retention Pond 1 - Storm Water Channel 1-2

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CNx		Soil Type	Description
		CN	Area		
Native Soils*	53	80	4240	Turzo, B	Herbaceous, Poor
Landfill Area	25	85	2125		Ash
Blow Down Pond	-1				Pond - Does not contribute
Total	77		6365		
Calc'd CN		83			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 1 - Storm Water Channel 1-3

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlass 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 85

Potential Ret. S= 1.76 inches

Run Off Q= 0.62 inches

Hydraulic Length L= 2100 feet

Ave. Slope Y= 0.72 %

Time of Concentration Tc= 0.96 hrs

Initial Abstraction Ia= 0.353 in

Ia/p= 0.20

unit peak discharge qu= 332 csm/in

Area Am 0.052 sq mi

Run Off Flow Rate qp 10.7 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Retention Pond 1 - Storm Water Channel 1-3

Trapezoid-Ditch

Depth	y=	1.5 ft
Bottom Width	B=	8 ft
Top Width	T=	14 ft
Side Slope	z=	2
Slope of channel	S=	0.0072 ft/ft
area	A=	16.5 ft ²

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

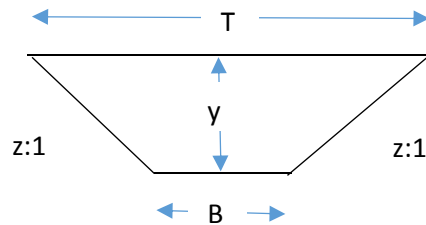
$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

Wetted Perimeter	P=	14.7 ft
Ratio, Area/W.P.	R=	1.12
Manning n	n=	0.035

$$A = \frac{y}{2}(b + T)$$

Flow Velocity	V=	3.9 ft/sec
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Flow Volumetric Rate	Q=	64.4 ft ³ /sec
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Retention Pond 1 - Storm Water Channel 1-3

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	33	85	2805		Ash
Total	33		2805		
Calc'd CN		85			

Retention Pond 1 - Storm Water Channel 1-4

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 82

Potential Ret. S= 2.26 inches

Run Off Q= 0.48 inches

Hydraulic Length L= 1200 feet

Ave. Slope Y= 0.50 %

Time of Concentration Tc= 0.83 hrs

Initial Abstraction Ia= 0.439 in

Ia/p= 0.25

unit peak discharge qu= 346 csm/in

Area Am 0.011 sq mi

Run Off Flow Rate qp 1.8 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Retention Pond 1 - Storm Water Channel 1-4

Trapezoid-Ditch

Depth	y=	1 ft
Bottom Width	B=	1 ft
Top Width	T=	7 ft
Side Slope	z=	2
Slope of channel	S=	0.008 ft/ft
area	A=	4 ft ²

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

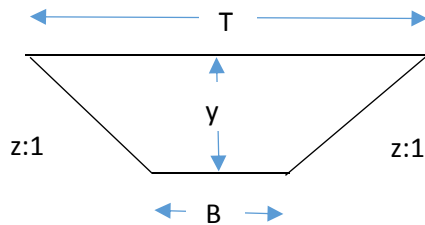
$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

Wetted Perimeter	P=	5.5 ft
Ratio, Area/W.P.	R=	0.73
Manning n	n=	0.035

$$A = \frac{y}{2}(b + T)$$

Flow Velocity	V=	3.1 ft/sec
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Flow Volumetric Rate	Q=	12.4 ft ³ /sec
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Retention Pond 1 - Storm Water Channel 1-4

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CNx		Soil Type	Description
		CN	Area		
Native Soils*	6.4	80	512	Turzo, B	Herbaceous, Poor
Asphalt	0.6	98	58.8		Impervious
Total	7		571		
Calc'd CN		82			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water Channel 2-1

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 80

Potential Ret. S= 2.50 inches

Run Off Q= 0.42 inches

Hydraulic Length L= 6070 feet

Ave. Slope Y= 13.6 %

Time of Concentration Tc= 0.61 hrs

Initial Abstraction Ia= 0.5 in

Ia/p= 0.28

unit peak discharge qu= 399 csm/in

Area Am 0.103 sq mi

Run Off Flow Rate qp 17.4 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Retention Pond 2 - Storm Water Channel 2-1

Trapezoid-Ditch

Depth	y=	2 ft
Bottom Width	B=	2 ft
Top Width	T=	14 ft
Side Slope	z=	3
Slope of channel	S=	0.005 ft/ft
area	A=	16 ft ²

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

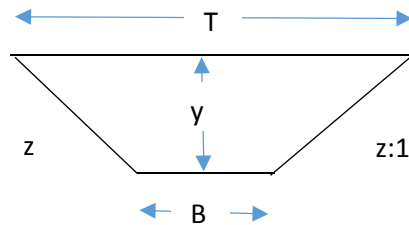
$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

Wetted Perimeter	P=	14.6 ft
Ratio, Area/W.P.	R=	1.09
Manning n	n=	0.035

$$A = \frac{y}{2}(b + T)$$

Flow Velocity	V=	3.2 ft/sec
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Flow Volumetric Rate	Q=	51.1 ft ³ /sec
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Retention Pond 2 - Storm Water Channel 2-1

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CNx		Soil Type	Description
		CN	Area		
Landfill Area	66.2	80	5296	Turzo, B	Herbaceous, Poor
Total	66.2		5296		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water Channel 2-2

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 80

Potential Ret. S= 2.50 inches

Run Off Q= 0.42 inches

Hydraulic Length L= 3250 feet

Ave. Slope Y= 19.3 %

Time of Concentration Tc= 0.31 hrs

Initial Abstraction Ia= 0.5 in

Ia/p= 0.28

unit peak discharge qu= 573 csm/in

Area Am 0.079 sq mi

Run Off Flow Rate qp 19.1 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Retention Pond 2 - Storm Water Channel 2-2

Trapezoid-Ditch

Depth	y=	2 ft
Bottom Width	B=	2 ft
Top Width	T=	14 ft
Side Slope	z=	3
Slope of channel	S=	0.0074 ft/ft
area	A=	16 ft ²

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

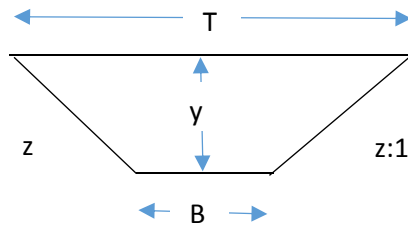
$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

Wetted Perimeter	P=	14.6 ft
Ratio, Area/W.P.	R=	1.09
Manning n	n=	0.035

$$A = \frac{y}{2}(b + T)$$

Flow Velocity	V=	3.9 ft/sec
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Flow Volumetric Rate	Q=	62.1 ft ³ /sec
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Retention Pond 2 - Storm Water Channel 2-2

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CNx		Soil Type	Description
		CN	Area		
Landfill Area*	50.5	80	4040	Turzo, B	Herbaceous, Poor
Total	50.5		4040		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-1

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 80

Potential Ret. S= 2.50 inches

Run Off Q= 0.42 inches

Hydraulic Length L= 3950 feet

Ave. Slope Y= 23.6 %

Time of Concentration Tc= 0.33 hrs

Initial Abstraction Ia= 0.5 in

Ia/p= 0.28

unit peak discharge qu= 557 csm/in

Area Am 0.058 sq mi

Run Off Flow Rate qp 13.6 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-1

Trapezoid-Ditch

Depth	y=	2 ft
Bottom Width	B=	2 ft
Top Width	T=	14 ft
Side Slope	z=	3
Slope of channel	S=	0.005 ft/ft
area	A=	16 ft ²

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

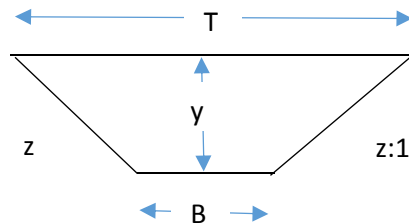
$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

Wetted Perimeter	P=	14.6 ft
Ratio, Area/W.P.	R=	1.09
Manning n	n=	0.035

$$A = \frac{y}{2}(b + T)$$

Flow Velocity	V=	3.2 ft/sec
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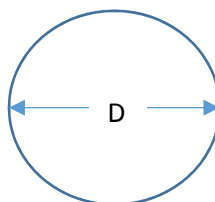
Flow Volumetric Rate	Q=	51.1 ft ³ /sec
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Culvert 2-1

Manning n	n=	0.012
Culvert Slope	S=	0.005 ft/ft
Diameter, Req'd	D=	1.8 ft
Diameter Installed	Di=	2.0 ft

$$D = \left[\frac{2.15 q_p n}{S^{0.5}} \right]^{0.375}$$



Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-1

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	37	80	2960	Turzo, B	Herbaceous, Poor
Total	37		2960		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water Channel 2-2 : POI Culvert 2-2

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 80

Potential Ret. S= 2.50 inches

Run Off Q= 0.42 inches

Hydraulic Length L= 1600 feet

Ave. Slope Y= 5.6 %

Time of Concentration Tc= 0.33 hrs

Initial Abstraction Ia= 0.5 in

Ia/p= 0.28

unit peak discharge qu= 558 csm/in

Area Am 0.026 sq mi

Run Off Flow Rate qp 6.1 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{l^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$

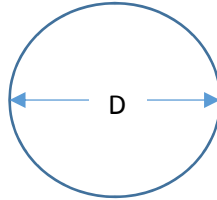


Retention Pond 2 - Storm Water Channel 2-2 : POI Culvert 2-2

Culvert 2-2

Manning n	n=	0.012
Culvert Slope	S=	0.021 ft/ft
Diameter, Req'd	D=	1.0 ft
Diameter Installed	Di=	1.5 ft

$$D = \left[\frac{2.15 q_p n}{S^{0.5}} \right]^{0.375}$$



Retention Pond 2 - Storm Water Channel 2-2 : POI Culvert 2-2

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CNx		Soil Type	Description
		CN	Area		
Landfill Area*	16.5	80	1320	Turzo, B	Herbaceous, Poor
Total	16.5		1320		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water : POI Culvert 2-3

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 80

Potential Ret. S= 2.50 inches

Run Off Q= 0.42 inches

Hydraulic Length L= 3320 feet

Ave. Slope Y= 4.7 %

Time of Concentration Tc= 0.64 hrs

Initial Abstraction Ia= 0.5 in

Ia/p= 0.28

unit peak discharge qu= 388 csm/in

Area Am 0.039 sq mi

Run Off Flow Rate qp 6.4 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Retention Pond 2 - Storm Water : POI Culvert 2-3

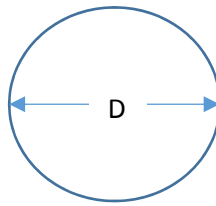
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Culvert 2-3

Manning n	n=	0.012
Culvert Slope	S=	0.01 ft/ft
Diameter, Req'd	D=	0.93 ft
Diameter Installed*	Di=	1.0 ft

*(2) Culverts installed (1/2 qp)

$$D = \left[\frac{2.15 q_p n}{S^{0.5}} \right]^{0.375}$$



Retention Pond 2 - Storm Water : POI Culvert 2-3

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CNx		Soil Type	Description
		CN	Area		
Landfill Area	25	80	2000	Turzo, B	Herbaceous, Poor
Total	25		2000		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-4

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 80

Potential Ret. S= 2.50 inches

Run Off Q= 0.42 inches

Hydraulic Length L= 5636 feet

Ave. Slope Y= 13.6 %

Time of Concentration Tc= 0.57 hrs

Initial Abstraction Ia= 0.5 in

Ia/p= 0.28

unit peak discharge qu= 413 csm/in

Area Am 0.08 sq mi

Run Off Flow Rate qp 13.9 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



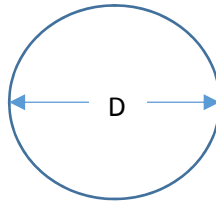
Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-4

Culvert 2-3

Manning n	n=	0.012
Culvert Slope	S=	0.0075 ft/ft
Diameter, Req'd*	D=	1.3 ft
Diameter Installed	Di=	1.5 ft

$$D = \left[\frac{2.15 q_p n}{S^{0.5}} \right]^{0.375}$$

*(2) Culverts installed (1/2 qp)



Retention Pond 2 - Storm Water Channel 2-1 : POI Culvert 2-4

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	51	80	4080	Turzo, B	Herbaceous, Poor
Total	51		4080		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 3

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 80

Potential Ret. S= 2.50 inches

Run Off Q= 0.42 inches

Hydraulic Length L= 3250 feet

Ave. Slope Y= 3.00 %

Time of Concentration Tc= 0.79 hrs

Initial Abstraction Ia= 0.5 in

Ia/p= 0.28

unit peak discharge qu= 344 csm/in

Area Am 0.087 sq mi

Run Off Flow Rate qp 12.6 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Retention Pond 3

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area*	55.4	80	4432	Turzo, B	Herbaceous, Poor
Total	55.4		4432		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Retention Pond 4 - Storm Water Channel 4-1

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 80

Potential Ret. S= 2.50 inches

Run Off Q= 0.42 inches

Hydraulic Length L= 1530 feet

Ave. Slope Y= 33.30 %

Time of Concentration Tc= 0.13 hrs

Initial Abstraction Ia= 0.5

Ia/p= 0.28

unit peak discharge qu= 852 csm/in

Area Am 0.017 sq mi

Run Off Flow Rate qp 6.2 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Retention Pond 4 - Storm Water Channel 4-1

Trapezoid-Ditch

Depth	y=	1.5 ft
Bottom Width	B=	2 ft
Top Width	T=	11 ft
Side Slope	z=	3
Slope of channel	S=	0.011 ft/ft
area	A=	9.75 ft ²

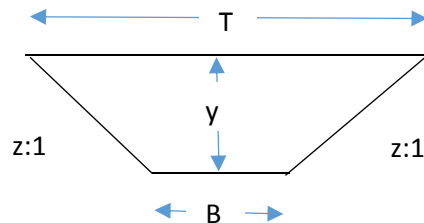
$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

Wetted Perimeter	P=	11.5 ft
Ratio, Area/W.P.	R=	0.85
Manning n	n=	0.035
Flow Velocity	V=	4.0 ft/sec
Flow Volumetric Rate	Q=	39.5 ft ³ /sec

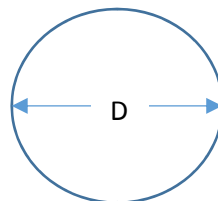
$$A = \frac{y}{2}(b + T)$$



Culvert 4-1

Manning n	n=	0.012
Culvert Slope	S=	0.011 ft/ft
Diameter, Req'd	D=	1.2 ft
Diameter Installed	Di=	1.5 ft

$$D = \left[\frac{2.15 q_p n}{S^{0.5}} \right]^{0.375}$$



Retention Pond 4 - Storm Water Channel 4-1

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx Area	Soil Type	Description
Landfill Area	11	80	880	Turzo, B	Herbaceous, Poor
Total	11		880		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Kennedy Wash - Storm Water Channel

SCS Method Lag Method

Design Rainfall: 25-Year, 24 Hour

Precipitation P= 1.76 inches (NOAA Atlas 14, Volume 1, version 5.0; Jensen Utah US)

Curve Number CN= 80

Potential Ret. S= 2.55 inches

Run Off Q= 0.41 inches

Hydraulic Length L= 53937 feet

Ave. Slope Y= 15.20 % 3.8

Time of Concentration Tc= 3.34 hrs

Initial Abstraction Ia= 0.5

Ia/p= 0.28

unit peak discharge qu= 130 csm/in

Area Am 23.1 sq mi

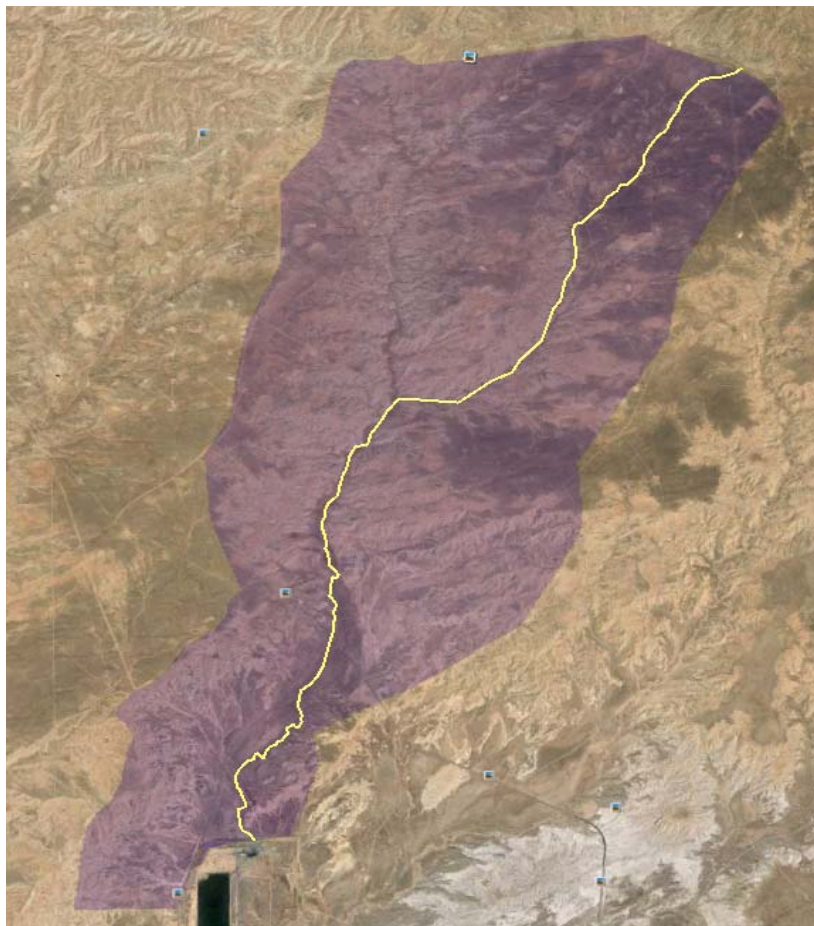
Run Off Flow Rate qp 1232 ft3/sec

$$S = \frac{1000}{CN} - 10$$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$T_c = \frac{L^{0.8} \left(\left(\frac{1000}{CN} \right) - 9 \right)^{0.7}}{1140 Y^{0.5}}$$

$$q_p = q_u A_m Q$$



Kennedy Wash - Storm Water Channel

Trapezoid-Ditch

Depth	y=	3.5 ft
Bottom Width	B=	85 ft
Top Width	T=	106 ft
Side Slope	z=	3
Slope of channel	S=	0.0077 ft/ft
area	A=	334.25 ft ²

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$$R = A/P$$

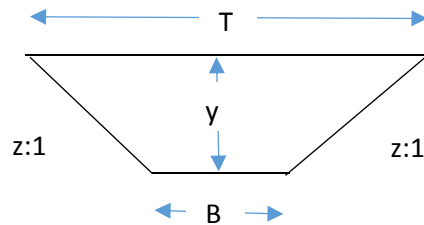
$$P = b + 2y(1 + z^2)^{\frac{1}{2}}$$

Wetted Perimeter	P=	107.1 ft
Ratio, Area/W.P.	R=	3.12
Manning n	n=	0.05

$$A = \frac{y}{2}(b + T)$$

Flow Velocity	V=	5.6 ft/sec
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Flow Volumetric Rate	Q=	1,866 ft ³ /sec
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Kennedy Wash - Storm Water Channel

Runoff Curve Number / Rational Coeff Calculation

Area	acres	CN	CNx	Soil Type	Description
			Area		
Drainage	6184	89	550376	D	Denco-Gerst Complex, 66
Drainage	4515	67	302505	B	Solirec-Abracon-Begay Complex, 213
Drainage	1412	80	112960	B	Turzo Complex, 241
Drainage	997.4	88	87771.2	D	Badland-Denco Complex, 8
Drainage	538.8	67	36099.6	B	Abracon Loam, 2
Drainage	464.6	89	41349.4	D	Badland-Rock Outcrop, 12
Drainage	361.1	67	24193.7	B	Shotnick Sandy Loam, 206
Drainage	140.9	67	9440.3	B	Shotnick-Ioka Complex, 208
Drainage	105	67	7035	B	Milok Fine Sandy Loam, 141
Drainage	76.1	88	6696.8	D	Denco Silty Clay Loam, 65
Total	14795		1178427		
Calc'd CN		80			

* USDA, Soil Survey of Uintah Area, Utah

Appendix B

REQUIREMENT / COMPLIANCE TABLE

Section	Requirement	Compliance Section
§257.81(a)	<i>The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain:</i>	
	(1) <i>A run-on control system to prevent flow onto the active portion of the CCR unit during peak discharge from a 24-hour, 25-year storm; and</i>	IV
	(2) <i>A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.</i>	V
§257.81(b)	<i>Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under §257.3-3</i>	V
§257.81(c)	<i>Run-on and run-off control system plan -</i>	
	(1) <i>Content of the plan. The owner or operator must prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator has completed the initial run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(3).</i>	IV,V, Appendix A
	(2) <i>Amendment of the plan. The owner or operator may amend the written run-on and run-off control system plan at any time provided the revised plan is placed in the facility's operating record as required by §257.105(g)(3). The owner or operator must amend the written run-on and run-off control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.</i>	VI
	(3) <i>Timeframes for preparing the initial plan -</i> (i) <i>Existing CCR landfills. The owner or operator of the CCR unit must prepare the initial run-on and run-off control system plan no later than October 17, 2016.</i> (ii) <i>New CCR landfills and any lateral expansion of a CCR landfill. The owner or operator must prepare the initial run-on and run-off control system plan no later than the date of initial receipt of CCR in the CCR unit.</i>	VII
	(4) <i>Frequency for revising the plan. The owner or operator of the CCR unit must prepare periodic run-on and run-off control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first subsequent plan. The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed a periodic run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(3).</i>	VIII
	(5) <i>The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section.</i>	IX
§257.81(d)	<i>The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in §257.105(g), the notification requirements specified in §257.106(g), and the internet requirements specified in §257.107(g).</i>	X