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# CALCULATION SUMMARY SHEET



PROJECT NUMBER: 143418

PROJECT NAME: USEN – Trench 13 Design

DATE: April 4, 2015

CALCULATION NUMBER: C.06 Revision: 1 (March 11, 2016)

**CALCULATION TITLE: LCRS and LDS Sump Capacities**

**DESCRIPTION OF CALCULATION:**

Using the design of the sump configuration, determine the holding capacity of the LCRS and the LDS Sumps, with 1 foot of leachate on the Sump Floor and within the boundaries of the Sump.

**REFERENCES USED:**

1. Sump Geometry from Design Drawings
2. Autocad Area and Volume Tables
3. Fetter, C.W. Applied Hydrology. Third Edition. 1994.
4. Freeze and Cherry. 1979

**REVIEW COMMENTS:**

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| | | | |
|---|---|---|---|
| CALCULATION MADE BY: | CAB | DATE: | 04/04/15 |
| CALCULATION CHECKED BY: | CWK | DATE: | 04/29/15 |
| CALCULATION REVISED BY: | CAB | DATE: | 05/14/15 |
| CALCULATION REVIEWED BY: | PAZ | DATE: | 05/15/15 |

## PURPOSE OF CALCULATION

Determine the holding capacity of the LCRS and the LDS Sumps, with 1 foot of leachate in the Sump and within the boundaries of the Sump.

## METHOD

Use Autocad Civil 3D and geometric analysis to determine volumes of LDS and LCRS Sumps.

## CALCULATION

### LDS

Geometry: The LDS sump pit has a floor dimension of 7.0 ft by 9.5 ft, is 1.5 ft deep with a 45 degree slope on the south side, and 27 degree slopes on the north, east, and west sides. See **Reference 1**

LDS Sump Pit Floor with 1 ft of Head

- The area of the LDS sump with 1 foot of head in the sump pit = 125 $ft^2$
- The volume of the LDS sump pit with 1 foot of head was calculated by Autocad surface comparison to be 89 $ft^3$.

Holding Capacity: Assume Porosity of gravel fill in sump pit at 37.5% (see **Reference 3** for sorted gravel). Therefore the liquid holding capacity of the LDS within the limits of the sump is 89 $ft^3$ x 37.5% = 34 $ft^3$ = **250 gallons**

LDS Sump Pit

The area calculated by polyline is 182.65 square feet.

- The volume calculated by Autocad surface comparison = 180 $ft^3$

Holding Capacity: Assume Porosity of gravel fill in sump pit at 37.5% (see **Reference 3** for sorted gravel). Liquid holding capacity of LDS pit sump = 180 $ft^3$ x 37.5% = 67.5 $ft^3$ = **505 gallons**

LDS Capacity within the Sump Limits

The LDS includes the sump pit and geocomposite runout under the LCRS. The geocomposite is 300 mils or 0.3 inches thick or 0.025 ft

- The LDS geocomposite area, by Autocad polyline = 5,896 ft2.

Holding Capacity: The volume of the LDS geocomposite is 0.025 ft X 5,896 $ft^2$ = 147 $ft^3$ or 1,102 gallons. Assuming the geocomposite has a porosity of 80%, the liquid holding capacity of the LDS within the limits of the sump is 1,102 gallons x 80% = 882 gallons

Sump pit liquid holding volume (505) + geocomposite liquid holding volume (882 gallons) = approximately **1,400 gallons**.

## LCRS

LCRS with 1 foot of Head on the Sump Floor

Geometry: The LCRS sump is 4.0 ft deep and filled with well sorted gravel. See **Reference 1**.

- The area of the LCRS sump pit with 1 foot of head, by Autocad Polyline = 973 $ft^2$
- The volume of 1 ft of liquid head in the sump determined from Autocad surface comparison = 552 $ft^3$ (see **Reference 2**).

Holding Capacity: Assume Porosity of gravel fill in sump pit at 37.5%. The liquid holding capacity of the LCRS sump with 1 foot of head on the sump pit floor is 552 $ft^3$ x 37.5% = 207 $ft^3$ = approximately **1,550 gallons**

LCRS within the Sump Limits

- The area of the LCRS sump calculated by AutoCad polyline = 5,896 $ft^2$
- The volume of the LCRS sump calculated by Autocad surface comparison = 9,963 $ft^3$ (see **Reference 2**).

Holding Capacity: Assume porosity of gravel fill in LCRS sump at 37.5%. Liquid holding capacity of LCRS sump =9,963 $ft^3$ x 37.5% = 3,736 $ft^3$ = **27,950 gallons**.

## Anticipated Maximum Flow to the LDS and LCRS

Based on the findings of **Calculation C.08**, the ALR for the LDS is 150 gallons per acre day with a maximum flow to the LDS sump of 1,480 gallons per day (Phases A and E as calculated in **Calculation C.08**).

Based on the findings of **Calculation C.04**, the maximum estimated flow to the LCRS just after Phase construction and after the operations layer has been installed is 23 gallons per minute or approximately 33,000 gallons per day.

## CALCULATION RESULT

With a maximum head of 1 ft on the secondary liner as measured in the sump pit, the LDS has the capacity to hold approximately 250 gallons of liquid. The LDS Sump pit has the capacity to hold 505 gallons and the LDS Sump, within the Sump boundary has the capacity to hold 1,400 gallons. The maximum liquid entering the LDS at the ALR is 1,480 gallons per day.

With a maximum head of 1 ft on the primary liner as measured in the sump pit, the LCRS has the capacity to hold approximately 1,550 gallons of leachate. The capacity of

the LCRS at the sump perimeter is 27,950 gallons. The maximum anticipated leachate entering the LCRS just after Phase construction (including the operations layer) and in conjunction with a 25 year/24 hour precipitation event is 33,120 gallons per day

With leachate levels limited to no greater than 1.0 foot of head on the LDS and LCRS liners, liquid observations might be necessary more frequently than once a day during initial Phase operations.

## REFERENCES

**Reference 1: Design drawings**

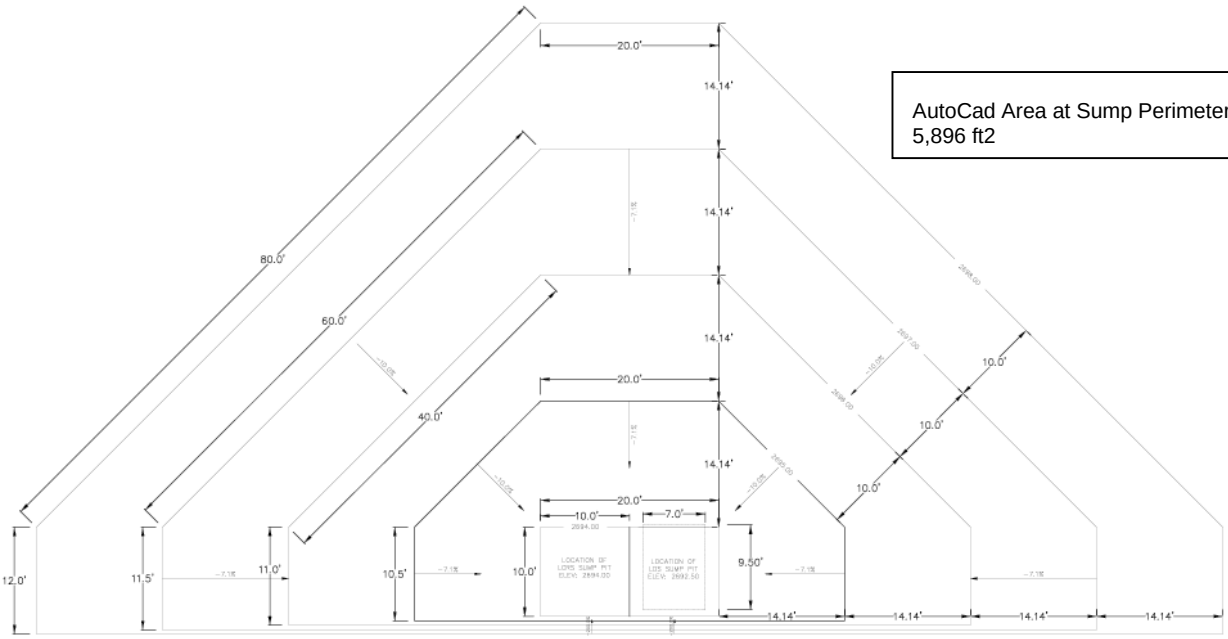
**Reference 2: Autocad volumes**

**Reference 3: Fetter, C.W. Applied Hydrology. Third Edition. 1994.**

**Reference 4: Freeze and Cherry. 1979.**

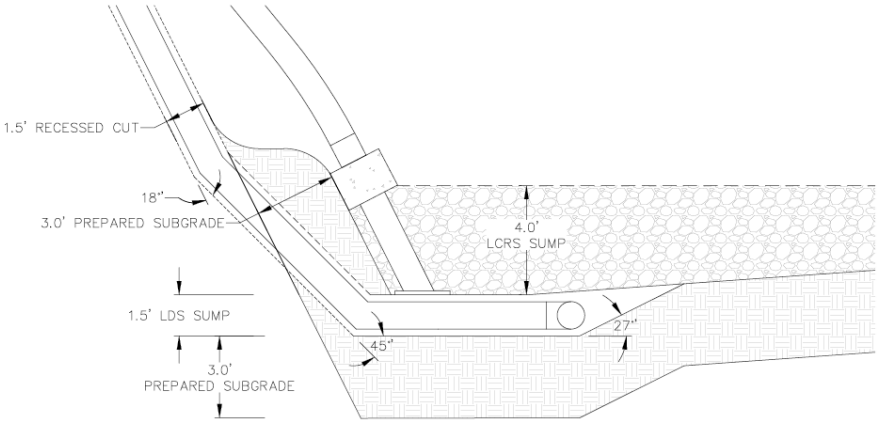
# REFERENCE 1 – SUMP GEOMETRY

## Typical Sump Plan View

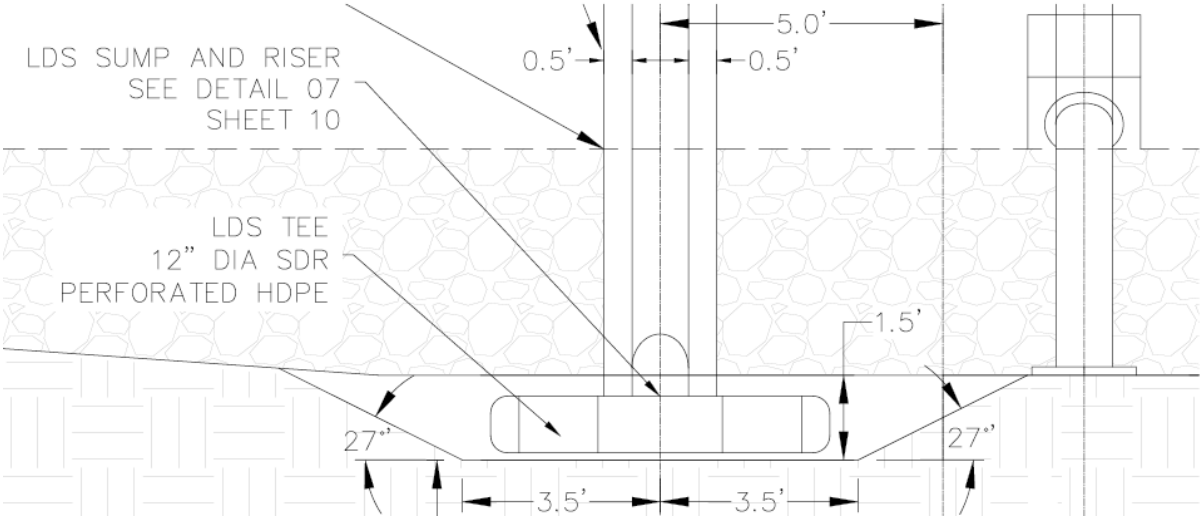



AutoCad Area at Sump Perimeter = 5,896 ft2

## Typical Sump Profile View



## Typical Sump Transverse View



# REFERENCE 2 – AUTOCAD AREAS AND VOLUMES

| | | | |
|---|---|---|---|
| | **LDS Sump with 1 foot on Sump Floor** | | |
| | | | |
| | | | |
| General | | | |
| | Minimum X coordinate | 11714.96' | |
| | Minimum Y coordinate | 7697.65' | |
| | Maximum X coordinate | 11725.82' | |
| | Maximum Y coordinate | 7709.38' | |
| | Minimum elevation | 2692.50' | |
| | Maximum elevation | 2693.50' | |
| | Mean elevation | 2692.78' | |
| | | | |
| | | | |
| | 2D surface area | 125.04 Sq. Ft. | |
| | | | |
| Volume | | | |
| | Base Surface | LDS Sump pit with 1 ft | |
| | Comparison Surface | LDS Sump Pit with 1ft Compare | |
| | Cut Factor | 1 | |
| | Fill Factor | 1 | |
| | Cut volume (adjusted) | 0.00 Cu. Yd. | |
| | Fill volume (adjusted) | 3.31 Cu. Yd. | |
| | Net volume (adjusted) | 3.31 Cu. Yd.<Fill> | |
| | Cut volume (unadjusted) | 0.00 Cu. Yd. | |
| | Fill volume (unadjusted) | 3.31 Cu. Yd. | |
| | Net volume (unadjusted) | 3.31 Cu. Yd.<Fill> | |
| | | 89 | cubic feet |
| | | 669 | gallons |

| | | | |
|---|---|---|---|
| | **LDS Sump Volume - AutoCad** | | |
| | | | |
| | | | |
| General | | | |
| | Minimum X coordinate | 11713.96' | |
| | Minimum Y coordinate | 7697.00' | |
| | Maximum X coordinate | 11726.96' | |
| | Maximum Y coordinate | 7711.05' | |
| | Minimum elevation | 2692.50' | |
| | Maximum elevation | 2694.39' | |
| | | | |
| | | | |
| | 2D surface area | 182.65 Sq. Ft. | |
| | | | |
| | | | |
| | | | |
| | | | |
| Volume | Base Surface | LDS Sump Pit | |
| | Comparison Surface | LDS Sump Pit Compare | |
| | Cut Factor | 1 | |
| | Fill Factor | 1 | |
| | Cut volume (adjusted) | 0.00 Cu. Yd. | |
| | Fill volume (adjusted) | 6.66 Cu. Yd. | |
| | Net volume (adjusted) | 6.66 Cu. Yd.<Fill> | |
| | Cut volume (unadjusted) | 0.00 Cu. Yd. | |
| | Fill volume (unadjusted) | 6.66 Cu. Yd. | |
| | Net volume (unadjusted) | 6.66 Cu. Yd.<Fill> | |
| | | 180 | cubic feet |
| | | 1,345 | Gallons |

| | | | |
|---|---|---|---|
| **LCRS Sump Pit with 1 foot on Sump Floor** | | | |
| | | | |
| General | | | |
| | Minimum X coordinate | 11691.31' | |
| | Minimum Y coordinate | 7696.50' | |
| | Maximum X coordinate | 11739.60' | |
| | Maximum Y coordinate | 7721.14' | |
| | Minimum elevation | 2694.00' | |
| | Maximum elevation | 2695.00' | |
| | | | |
| | | | |
| | 2D surface area | 972.76 Sq. Ft. | |
| | | | |
| Volume | | | |
| | Base Surface | LCRS with 1 foot | |
| | Comparison Surface | LCRS with 1 foot compare | |
| | Cut Factor | 1 | |
| | Fill Factor | 1 | |
| | Cut volume (adjusted) | 0.00 Cu. Yd. | |
| | Fill volume (adjusted) | 20.44 Cu. Yd. | |
| | Net volume (adjusted) | 20.44 Cu. Yd.<Fill> | |
| | Cut volume (unadjusted) | 0.00 Cu. Yd. | |
| | Fill volume (unadjusted) | 20.44 Cu. Yd. | |
| | Net volume (unadjusted) | 20.44 Cu. Yd.<Fill> | |
| | | 552 | cubic feet |
| | | 4,129 | Gallons |

| | | | |
|---|---|---|---|
| **LCRS Sump Volumes - AutoCad** | | | |
| | | | |
| General | | | |
| | Maximum Y coordinate | 7823.57' | |
| | Minimum elevation | 2694.00' | |
| | Maximum elevation | 2699.00' | |
| | Mean elevation | 2697.74' | |
| | | | |
| | | | |
| | 2D surface area | 5895.74 sq ft | |
| Volume | | | |
| | Base Surface | LCRS | |
| | Comparison Surface | LCRS Compare | |
| | Cut Factor | 1 | |
| | Fill Factor | 1 | |
| | Cut volume (adjusted) | 0.00 Cu. Yd. | |
| | Fill volume (adjusted) | 368.99 Cu. Yd. | |
| | Net volume (adjusted) | 368.99 Cu. Yd.<Fill> | |
| | Cut volume (unadjusted) | 0.00 Cu. Yd. | |
| | Fill volume (unadjusted) | 368.99 Cu. Yd. | |
| | Net volume (unadjusted) | 368.99 Cu. Yd.<Fill> | |
| | | 9,963 | cubic feet |
| | | 74,531 | Gallons |