Appendix B-13

Response Action Plan, Leak Detection System Trench 11

RESPONSE ACTION PLAN

LEAK DETECTION SYSTEM

TRENCH 11

US ECOLOGY NEVADA

OCTOBER 2009

RESPONSE ACTION PLAN
TRENCH 11
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RESPONSE ACTION PLAN

11.1.0 Introduction

The U.S. Environmental Protection Agency (EPA) promulgated rules on January 29, 1992, mandating the preparation of Response Action Plans (RAP) for new hazardous waste landfill units which commence construction after January 29, 1992, or expansion of existing units after July 29, 1992 (57 FR 3462). At the US Ecology Nevada (USEN) Facility, Trench 11 is a regulated unit under this rule.

This RAP was developed to meet the requirements of 40 CFR §264.304 and to provide predetermined, site-specific actions that will detect leaks at the earliest practical time complemented by early follow-up actions that effectively minimize migration of hazardous substances from Trench 11.

11.2.0 Action Leakage Rate

The Action Leakage Rate (ALR) is the leakage rate that requires implementation of a response action to prevent hazardous constituent migration out of the unit. The regulations specify that a leakage rate be established for each leak detection sump in a regulated unit. The ALR for an individual sump may be based on an approach similar to the EPA proposed definition for rapid and extremely large leakage rate as provided in the January 29, 1992 rule. The calculation of the ALR is based on the maximum design leakage rate that the unit's leak detection system can remove without the fluid head on the bottom liner exceeding one foot. The EPA did not propose a standard ALR for regulated units. Regulated facilities may use the formula proposed by the EPA in the January 29, 1992 Final Rule to determine ALRs or justify higher ALRs through the use of different models, formulas, or demonstrating the exceedence of minimum technology standards.

In this submission, the ALR has been calculated for each individual detection sump located in Trench 11 based on the maximum flow that the leak detection system can deliver and remove (see Table 1).

Table 1 - ALR Determination

Sump No.	Total Flow (gal/day)	Pump Capacity (gal/day)	ALR* (gal/acre/day)
1D	211	12,960	70
2D	211	12,960	104
3D	211	12,960	84
4D	211	12,960	44

*The total flow is limited by the capacity of the sump collection trench to 211 gal/day. The ALRs were all calculated based on that flow. See Attachment A for ALR calculations.

11.2.1 Trench 11 ALRs

The leak detection system in Trench 11 consists of a geonet drainage layer on the cell floor and sidewalls. The geonet drains to a gravel-filled collection sump. A pump located within a perforated riser pipe is used for liquid removal.

11.2.2 Function of ALR

The ALRs established in this document will serve as a trigger for response actions for Trench 11. US Ecology will contact the Nevada Division of Environmental Protection (NvDEP) within seven days after confirmation of an exceedence of the ALR. Measured rates of leakage less than the ALR will be addressed by the collection and removal of pumpable liquids from the detection sump to minimize head on the bottom liner. Pumping will follow the facility pumping schedule outlined below. All amounts of leachate pumped from the leak detection system will be documented in the facility operating record.

11.2.3 Trench 11 Collection Sump Action Levels

The collection system in Trench 11 consists of three (3) sumps draining the primary liner on the cell floor and sidewalls. The trench is constructed so that the liner drains to a gravel-filled collection sump. A pump located within a perforated riser pipe is used for liquid removal. The sumps are constructed such that water levels of at least 1.75 feet are required to actuate the pumps. The following levels are an indication of 1 foot of hydraulic head exists on the collection liner (see Table 2).

Table 2 - Collection Sump Levels

Sump No.	Total Water Level (feet)
1C	1.75
2C	Closed
3C	3.9
4C	4.0

11.2.4 Function of the Collection Sump Action Levels

The collection sump action levels established in this document will serve as response actions for Trench 11. Should water levels in the collection sumps reach the listed values, actions will be undertaken by the facility to remove water from the sumps.

11.3.0 Leachate Removal

The purpose of the leachate collection and removal system (LCRS) is to remove pumpable liquids from the primary liner system, thereby minimizing the possibility of leachate escaping the primary liner into the leak detection system. To assure pumpable liquids are removed from this primary system, USEN will monitor the LCRS sumps and ensure that liquids are removed such the head on the primary liner does not exceed 1 foot.

40 CFR §264.301 (c)(4) requires the facility to collect and remove pumpable liquids found in the leak detection system sumps to minimize the head on the bottom liner. "Pumpable liquids" are defined as any amount of liquid that can be reasonably pumped out of the sump based on sump dimensions, pump operating levels for automated pump systems, and the goal of minimizing the head in the sump and backup of liquids (from the sump and drainage tile or pipes) into the drainage layer. The distance from the bottom of the leak detection sump in Trench 11 to the top of the primary liner is approximately 3.25 feet. The leak detection sump pumps require approximately 1.75 feet of head to operate properly. The pump operating level for the leak detection sumps in Trench 11 has therefore been established at

1.75 feet. This will avoid backup of liquids into the drainage layer, minimize the head on the bottom liner, and allow the pump to function properly.

11.4.0 Sump Monitoring

1. All leachate sumps (LCRS and detection) in Trench 11 will be monitored at least weekly during the active life of the trench. The results of this monitoring (depth of leachate in the sump and volume of leachate removed if pumping is required) will be recorded in the sump monitoring log maintained for each sump.

    a. If liquid is detected in a leak detection sump with a depth of 1.75 feet (pump operating level) or greater, the sump will be pumped, within 24 hours, until evacuated or liquid removal is no longer possible or is below the 1.75 feet pump operating level. The volume of leachate pumped will be recorded on the sump monitoring log for that sump.

    b. If liquid is detected in a LCRS sump with a depth of 1.75 feet or greater, the sump will be pumped, within 24 hours, until evacuated or liquid removal is no longer possible. The volume of leachate pumped will be recorded in the sump monitoring log for that sump.

2. If liquid is pumped from a LCRS or leak detection sump, the frequency of monitoring that sump will be increased to daily (daily is defined for this RAP as each day that the facility is open for operation – normally Monday through Friday, excluding weekends and holidays), until the liquid level in the sump is maintained below 1.75 feet in depth for two (2) consecutive days. If the leachate measurement in a sump is 2.5 feet or greater; the sump monitoring frequency will be increased to daily including Saturday, Sunday and holidays, until the liquid level in that sump is maintained below 2.5 feet for two (2) consecutive days. At that time, monitoring will be reduced to operational days only (Monday through Friday).

3. During the post-closure period (which begins after the final cover is installed), the leachate sumps will be routinely monitored on a monthly basis (see NOTE). If the leachate level in a LCRS or leak detection sump stays below the pump operating level (1.75 feet) for two (2) consecutive months, the leachate in that sump will be monitored on at least a quarterly basis. If the leachate level in a LCRS or leak detection sump stays below the pump operating level (1.75 feet) for two (2) consecutive quarters, the leachate level in that sump will be monitored on at least a semi-annual basis.

    If at any time during the post-closure period the pump operating level is exceeded in a leak detection sump monitored on a quarterly or semi-annual basis, that sump will return to monitoring on a monthly basis until the liquid level in the sump again stays below the pump operating level for two (2) consecutive months/quarters before relaxing the frequency of monitoring.

    Note: If at any time during the post-closure period, if the leachate levels noted above are exceeded in a sump that is being monitored on a monthly basis, that sump will return to monitoring as outlined for monitoring during the active life of the trench (as outlined above). This monitoring frequency will continue until the liquid level in the sump again stays below the 1.75 feet level for two (2) consecutive days/weeks before relaxing the frequency of monitoring.

11.5.0 Determination of LCRS or Leak Detection Issues

ALR Exceedence

An ALR exceedence is suspected to have occurred when the volume of liquid pumped from any leak detection pump exceeds 211 gal/day over a 7-day period. Facility personnel will report to the Facility Manager[1] should this volume be pumped from any leak detection monitoring well in one 24 hour period. The volume of leachate pumped from each detection sump in the leak detection system will be recorded in the facility operating record.

The average leakage rate, in gallons per acre per day (GAPD), based on site operations that pump leachate each day of the week, is calculated as follows.

$$GPAD = \frac{\textit{[Sum of pumped volumes for the last 7 days]}}{\textit{[acreage served by sump]}}$$

11.6.0 Repairs to Liner System During Operation

If during routine operations the liner is damaged and requires repairs, the facility will initiate repairs according to recommended procedures by the High Density Polyethylene (HDPE) liner manufacturers. All inspection reports showing damage and subsequent repairs shall be documented in the facility operating record. All repairs will be made in accordance with the Trench 11 specifications and construction quality assurance program to ensure that repairs meet design criteria. Repairs shall be completed to the extent practicable within 20 working days after their discovery.

11.7.0 RESPONSE EVALUATION

If the 211 gal/day limit is exceeded in the detection sumps, facility personnel will notify the Facility Manager immediately. The Facility Manager will review the sump monitoring log and determine through calculation if the ALR has been exceeded. Should it be determined an ALR exceedence has occurred, the facility will follow the procedure listed below.

11.8.0 Response Action Plan for Leakage Greater Than ALR

Upon confirmation of ALR exceedence, the following actions will be initiated.

1. Notify NDEP and EPA Region IX in writing within seven (7) days of determining that the ALR has been exceeded.

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1 All references to the Facility Manager will include his/her designee and are herein-after referred to collectively as the "Facility Manager."

2. Submit a preliminary written assessment to NDEP within 14 days of the determination. This report will document the amount of liquids removed from the leak detection sump; likely sources of the liquids; possible location, size and cause of any leaks; and short-term actions taken and planned.

3. Assess the source or liquids and amounts of the liquids by source.

4. Conduct a fingerprint, hazardous constituent or other analysis to identify the sources of liquids and possible locations of any leaks, and the hazard and mobility of the liquid.

5. Assess the seriousness of the leak in terms of potential for escaping into the environment.

6. Determine, to the extent practicable, the location, size, and cause of any leak.

7. Determine whether waste receipt should cease or be curtailed; whether any waste should be removed from the unit for inspection, repairs, or controls; and whether or not the unit should be closed.

8. Determine if any other short-term and long-term actions need to be taken to mitigate or stop any leaks.

9. Within 30 days after the initial notification to NDEP that the action leakage rate has been exceeded, submit a report to NDEP containing the information and determinations specified in items 3 through 8 above.

10. Thereafter, submit monthly reports to NDEP as long as the flow rate in the leak detection systems exceeds the action leakage rate summarizing the results of any remedial actions taken and actions planned.

Appendix 11- A

ALR Calculations

AMERICAN ECOLOGY
PROJECT: BEATTY ORDER RESPONSE
ALR CALCULATIONS

COVER SHEET PAGE 1
CALCULATION NO. NV161002
BY: [illegible]
CHECKED: LR
DATE: OCTOBER 10, 1995
Rev. December 5, 1995

I. SCOPE

The Order for the facility dated August 7, 1995, requires that the leak detection system (LDS) for Cell 11 be reevaluated and the action leakage rates (ALRs) adjusted, if necessary. The Order also required that the test performed on the geonet at 8,000 lb/ft^2 overburden pressure, and referenced in the current Response Action Plan (RAP) for the facility, be repeated at an overburden of 10,000 lb/ft^2.

II. ALR DETERMINATION

The following calculations, Calculation No. NV161002, Sheet Nos. 1-9, evaluate the ability of the LDS to transmit flow. The calculations, not including this cover sheet, will be included as an attachment to the RAP.

Preferential flow for the majority of the cell floor is to the LDS sump trench because of cell geometry. A small area of the floor flows directly to the sump. The sump trench was determined to be a limiting factor in transmitting flow to the sump. Once the geonet at the sump is flowing full, additional flow will be transmitted across the cell floor, although at a lower gradient. Because flow is transmitted across the entire cell floor, the sump perimeter becomes the limiting factor in the system. The maximum flow that the system can remove is determined by the maximum flow that can be transmitted at the sump perimeter and removed through the riser pipe and pump. At the maximum flow rate that the system can deliver, converted to an ALR, the geonet in the cell will flow full, or partially full, and fluid head will not increase with time (mound).

The riser pipe perforations were evaluated and determined to be adequate for transmitting the system flow. In addition, the smallest pump used in the LDS system is a two inch pump. The current pump being used has a maximum flow rate of nine gallons per minute, which is greater than the maximum flow that the system can deliver. A specification sheet for the current pump is included in Attachment 1.

Based on the above evaluation, the ALRs for Cell 11 are:

DESIGNATION	ALR (GAL/AC/DAY)
Sump D1	70
Sump D2	104
Sump D3	187
Sump D4	98

III. JUSTIFICATION OF ASSUMPTIONS

A. GEONET TRANSMISSIVITY

The test performed on the geonet and referenced in the RAP was not repeated. The specific material that was tested in 1989 is no longer manufactured. A replacement product is available; however, the manufacturing technique is different and the new product might yield greater flow characteristics than the old material according to the manufacturer. For this reason, historical data on geonet products, general transmissivity data, construction specifications and cell construction quality assurance (CQA) reports were used to quantify a transmissivity value.

The transmissivity value used in the LDS evaluation calculations is the 4 x 10^{-4} m^2/sec. This is the transmissivity required in the Specifications for Cell 11 Construction included in the Permit Application on file with the Nevada Department of Environmental Protection. The original specifications did not specify a corresponding overburden value for the transmissivity requirement. In the CQA Report for Cell 11, Phase I, Second Half, a revised specification sheet was included with the manufacturer's certification statements requiring a transmissivity of 4x10^{-4} cm/sec under a loading of 12,000 lb/ft^2 (see Attachment 2). An Engineering Revision Authorization was probably prepared to add this requirement, however, the original document has not been located.

The CQA reports for Cell 11 were reviewed and information concerning the geonet products used in each stage of construction were reviewed. The reports contained the following data.

Cell 11, Phase I, First Half (See Attachment 3)
Report Title: Geosynthetic and Natural Component Materials Quality Assurance Services, First Half of Trench 11, Phase I, Beatty Facility
Prepared By: Golder Associates, Inc.,
Product: Tensar NS1410(DN4-HD)
Transmissivity Certified by Manufacturer: 1x10^{-3} ft^2/sec at 10,000 lb/ft^2
Gradient of 1

Cell 11, Phase I, Second Half (See Attachment 4)
Report Title: Final Report to US Ecology, Inc. Construction Quality Assurance Observation and Testing Report, Trench 11, Phase I, Second Half, Beatty, Nevada, Quality Control Documents
Prepared By: Golder Associates, Inc.
Product: Tensar NS130590 (DN3)
Transmissivity Certified by Manufacturer: 2.82 gal/min/lf (5.8x10^{-4} m^2/sec) at 12,000 lb/ft^2 normal pressure
Gradient of 1

Cell 11, Phase II (See Attachment 5)
Report Title: US Ecology, Inc. Trench 11, Phase II, Quality Assurance Construction Report
Prepared By: Woodward-Clyde Consultants
Product: Tensar NS130592
Transmissivity Certified by Manufacturer: 0.3x10^{-3} ft^2/sec (2.7x10^{-5} m^2/sec) at 20,000 lb/ft^2
Gradient of 1

Cell 11, Phase III (See Attachment 6)
Report Title: Construction Quality Assurance Final Report, Trench 11, Phase 3 Construction
Prepared By: Vector Engineering, Inc.
Product: Gundle Gundnet
Transmissivity Certified by Manufacturer: 2 gal/min/ft (minimum) (4x10^{-4} m^2/sec)
11.41 gal/min/ft (2.4x10^{-3} m^2/sec) at 10,000 lb/ft^2
Gradient of 0.25

The transmissivity values stated above are for varying values of normal pressure (10,000 lb/ft^2 to 20,000 lb/ft^2) and for varying test conditions. The test conditions, or boundary conditions, when stated on manufacturer specification sheets are two aluminum plates. A comparison of current transmissivity test results for Tensar products with a boundary condition of two plates, and a boundary condition of two HDPE sheets, shows the values to be almost identical. The graphed test results are included in Attachment 7. These graphs also show a trend of increasing transmissivity with decreasing gradient. The geonet manufacturer stated that the referenced trend can be extrapolated to continue to increase with continued decreasing gradients.

Historical graphs of transmissivity data were found in the reference material for the Liner Waiver Request contained in Volume IV(A), Section 3-13 of the current permit application on file with the NDEP. These graphs are included in Attachment 8. Graph A shows that at high pressures (20,000 lb/ft^2), the transmissivity of the geonet material decreased with decreasing gradient. Graph B shows the transmissivity to increase with reduced gradients at pressures between 1000 lb/ft^2 and 5000 lb/ft^2, remain unchanged at a pressure of 15,000 lb/ft^2 and decrease at a pressure of 20,000 lb/ft^2. The transmissivity values reported at 10,000 lb/ft^2 to 15,000 lb/ft^2 and a gradient of 0.25 to one were assumed to be valid for lower gradients.

Values for transmissivity, for ALR determination, were not taken directly from the historical graphs in Attachment 7 because the tests were conducted under the conditions of soil, geotextile, geonet, geomembrane. This scenario will yield a lower transmissivity value than a test condition of geonet between HDPE materials. Graphs included in Attachment 9 of the same products tested under the two different boundary conditions show the referenced decrease in transmissivity.

The graph of transmissivity performed by the Geosynthetic Research Institute (GRI) and included in the current RAP was discounted. This graph depicts a linear relationship of transmissivity versus gradient. No other data, either current or historical, documents this type of relationship. In addition, no test procedures were included with the data. Manufacturer's specification sheets, dated about the same time as the GRI test, reference the use of a draft test method from ASTM for transmissivity determination. These specification sheets are included in the CQA documents referenced previously. In addition, the test was performed with a geotextile and sand as one boundary, which is not the working condition of the geonet in the LDS. In general, the data from the test procedure included in the current RAP did not correlate with any other located documentation and was discounted.

B. GRAVEL TRANSMISSIVITY

The gravel for Cell 11 construction was required to have a size range of between 1-1/2 inch to 3/8 inch. The specification is included in Attachment 10. For calculation purposes, the gravel was assumed to have a hydraulic conductivity of 4.5 cm/sec. This is a reasonable assumption based on generalized published data. In addition, similar gravel was used in construction at another American Ecology facility. The gradation curves and hydraulic conductivity test results for this gravel are included in Attachment 10 to substantiate the referenced assumption.

American Ecology

SHEET NO. 1 OF 9
CALC. NO. NV161002
DATE 10/7/95
COMPUTED BY GBS/GBS Rv.1
CHECKED BY LR LR Rv.1
REV 1 REV 2 REV 3

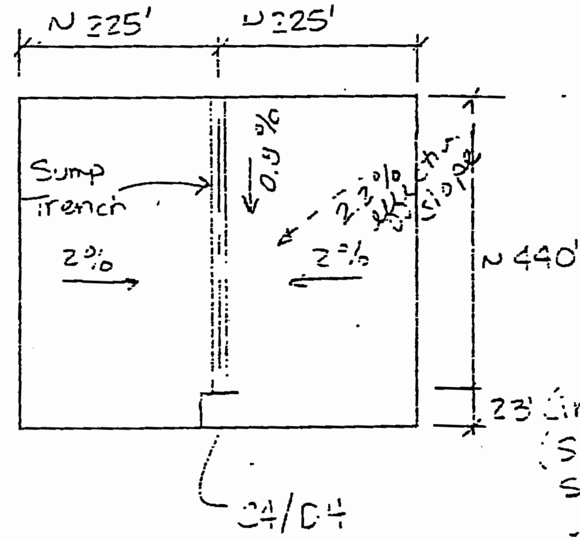
PROJECT Beatty Order Response
SUBJECT ALR Calculation

- Calculate ALR for Cell 11 Detection Sumps

- Use maximum flow rate that the system can deliver. Consider all limiting factors/ System components

SUMP C4/D4

→ Consider Sump C4/D4 because they serve the largest flow area



Sump Trench Slope = 1%

Floor Slope (@ trench) = 0.2%

Area to D4 (by CADD) = 4.767 Ac = 207,651 ft^2

A (by scaling drwgs) = (450')(440'+23') = 208,350 ft^2

→ Use CADD Area in calcs. requiring total area because more accurate

(S. side consists of sideslope + partial waste slope)
5' = side of sump only

- Geonet transmissivity = specified transmissivity = 4×10^{-4} m^2/sec

- Area Contributing to side of sump trench

$(440')(225') = 99{,}000$ ft^2 $\times 2 =$ 198,000 ft^2

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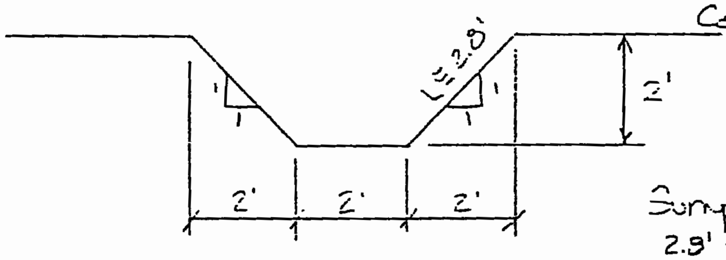
PROJECT Beatty Order Response
SUBJECT ALR Calculation

Sump Trench Dimensions (Ref Cell 11 Drawing NV87C50024-6)



Sump Trench Bottom Length
2.8' + 2' + 2.8' = 7.6 ft.

Area of Flow in Trench: $2(\frac{1}{2})(2')(2') + (2')(2') = 8\ ft^2$

Total area contributing to Sump D4: 4.762 Ac. = 207,433 ft²
(Ref Cell 11 PAP Area by CADD)

Area Contributing at sides of sump
(23')(225') = 5175 ft² (each side)

American Ecology

SHEET NO. 3 OF 9

CALC. NO. NV161002

DATE 10/7/95

PROJECT Beatty Order Response

SUBJECT ALR Calculation

COMPUTED BY CAG

CHECKED BY LR

REV 1 REV 2 REV 3

- Because entire leak detection system is geonet, except for sump area, the limiting component will probably be the largest flow area served by a limited geonet section. This will be at the sump trench which serves the majority of the cell floor.

Q_g transmitted by geonet = KiA

$K = \frac{T}{t}$ $\quad t = 0.2" \left(\frac{1 ft}{12"}\right) = 0.017$ ft.

$T = 4\times10^{-4}\, m^2/sec \left(\frac{10.78\, ft^2}{m^2}\right) = 0.00431\, ft^2/sec$

$= 0.259\, ft^2/min.$

$K = \frac{0.259\, ft^2/min}{t = 0.017\, ft} = 15.2\, ft/min$

Q_{cell} into sump trench (Max)

$Q = (15.2\, ft/min)(0.02)[(2)(440')(0.017')]$

$Q = 4.55\, ft^3/min$

Q through sump trench (Max)

Perimeter Length of Trench Sump (see pg. 2)

$Q_t = (15.2\, ft/min)(0.01)[(0.017')\underbrace{(7.6\, ft)}]$

$Q_t = 0.02\, ft^3/min$

→ The sump trench is limiting as anticipated

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SHEET NO. 4 OF 9
CALC. NO. NV16.002
DATE 10/10/95
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REV 1 REV 2 REV 3

PROJECT Beatty
SUBJECT ALR CALC

- Determine flow at sides of sump, "Q_1")
  (Sides of LDS geonet tie to gravel at top of gravel)

$Q_{1\,max} = K\,i\,A$ — Detection Sump intercept length (See Sht. 9)

$= (15.2\ ft/min)(0.02)[(2)(5')(0.017')]$

$= 0.052\ ft^3/min$

- Because the flow is restricted by the sump trench, flows will be transmitted over floor area also ("Q_2")

Under this scenario, the geonet at the perimeter of the sump will govern. The flattest floor slope will also govern for the flow from area sloping to sump trench

$Q = K\,i\,A$
where A = area of geonet at sump perimeter that intercepts floor flow that slopes to sump trench. Intercepts sump at bottom and side slopes of LCS Gravel $\cong 4.2' - 2.5' + 2.5' = 9.2$ (See Sht 9/9)

$Q_2 = (15.2\ ft/min)(0.008)[(9.2')(0.017')]$

$= 0.019\ ft^3/min$

Flow from sidewall + flow from cell floor that equalizes due to drainage area will contribute @ sidewall intercept w/ sump @ top of LCS gravel

conservative; assumes floor will govern

$Q = (15.2\ ft/min)(0.008)[(7.5')(0.017')] = 0.016\ ft^3/min$

$Q_{TOTAL} = Q_2(\text{FRONT}) + Q_1(\text{SIDES}) + Q_3(\text{SIDEWALL})$

$= 0.019\ ft^3/min + 0.052\ ft^3/min + 0.016\ ft^3/min$

$= 0.087\ ft^3/min$

* See Attached Dwg NV-161-CON-001, 002 for sump configuration

Also Ey. Dwg. NV 87050024 II for sump configuration.

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SHEET NO. 5 OF 9
CALC. NO. NY161002
DATE 10-19-95
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REV 1 REV 2 REV 3

PROJECT Beatty Order
SUBJECT ALR Calculation

- Check flow through gravel

  Use $K = 4.5\ \text{cm/sec}$

  $$4.5\ \text{cm/sec} \times \frac{\text{in}}{2.54\ \text{cm}} \times \frac{\text{ft}}{12\ \text{in}} = 0.148\ \text{ft/sec}$$

  $$= 8.86\ \text{ft/min.}$$

  For the 1' of gravel in sump area, use gradient corresponding to flattest contributing slope to define flow through gravel (max)

  $$Q = KiA$$

  $$Q = (8.86\ \text{ft/min})(0.003)\left[(1\ \text{ft})\left(\underbrace{(4.2'+25'+25')}_{\text{intercepts flow from bottom slope}} + \underbrace{(2)(5')}_{\text{floor flow from sides}} + \underbrace{(7.5')}_{\text{sidewall}}\right)\right]$$

  $Q = 1.89\ \text{ft}^3/\text{min}$ > contributing flow $(0.037\ \text{ft}^3/\text{min})$ O.K.

- Check flow through riser perforations

  1/2" holes / 4 holes per row (Ref. Drwg. NY87050024-6)

  Use orifice equation

  $$Q = CA\sqrt{2gh}$$

  C = orifice coeff. = 0.61 for sharp edges

  A = area = $\pi\left(\frac{0.5''}{2}\right)^2$

  $= 0.196\ \text{in}^2 = 1.36\times10^{-3}\ \text{ft}^2$

  h = head = 1 ft

  $$Q = (0.61)(1.36\times10^{-3}\ \text{ft}^2)\sqrt{(2)(32.2\ \text{ft/sec}^2)(1\ \text{ft})}$$

  $Q = 0.0067\ \text{ft}^3/\text{sec}$ per hole

  $= 0.402\ \text{ft}^3/\text{min/hole}$ > total flow O.K.

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SHEET NO. 6 OF 9
CALC. NO. NV161002
DATE 10/7/95
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REV 1 REV 2 REV 3

PROJECT Beatty
SUBJECT ALR Calc.

Because sumps have been determined to be the limiting factor in the LCS system, and C3/C5 have same design as C4/D4, the ALRs for these sumps should be calculated in the same manner:

The ALR shall not be greater than the flow that the system can deliver

Flow that system can deliver = 0.087 ft^3/min

$0.087\ ft^3/min \times 60 min/hr \times 24 hr/day \times 7.48 gal/ft^3 = 937\ gal/day$

$937\ gal/day \div 4.762\ Ac = 197\ gal/ac\ day$

Applying a SF of 2

$197\ gal/ac\ day \div 2 = 98\ gal/ac\ day$

An ALR of 98 gal/ac/day for sump D4

based on the maximum that the system can deliver. Because the sump perimeter and sump trench are the limiting components of the system, a point in these areas will be flowing full (max) under these conditions, while some floor areas will have only partial or no flux.

For D3, Area = 2.502 Ac

ALR (with SF=2) = $937\ gal/day \div 2.502 Ac \div 2$

$= 187\ gal/ac\ day$

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SHEET NO. 7 OF 9
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REV 1 REV 2 REV 3

PROJECT Beatty
SUBJECT ALR Calc.

Bench Sump

The maximum flow in the LDS for the bench sumps will similar to the flows for the floor sumps. However, the bench slopes are less than the floor slopes.

Use minimum bench slope for evaluation

Min. slope = 0.56 %

$Q = K i A$

$$\text{Perimeter Length} = \underbrace{(4.2' + 2.5' + 2.5' + 2(5') + 7.5')}_{\text{same as floor sump}}$$
$$= 26.7 \text{ L.F.}$$

$$Q = (15.2 \text{ ft/min})(0.0056)(0.017')(26.7')$$
$$= 0.039 \text{ ft}^3/\text{min} \left(\frac{7.48 \text{ gal}}{\text{ft}^3}\right)\left(\frac{60 \text{ min}}{\text{hr}}\right)\left(\frac{24 \text{ hr}}{\text{day}}\right)$$
$$= 420 \text{ gal/day}$$ for bench sumps

Area served by D1 = 2.987 Ac
Area served by D2 = 2.025 Ac

Sump D1: $ALR = 420 \text{ gal/day} \div 2.987 \text{ Ac} \div 2$
$= 70 \text{ gal/acre/day}$

Sump D2: $ALR = 420 \text{ gal/day} \div 2.025 \text{ Ac} \div 2$
$= 104 \text{ gal/ac/day}$