TRC

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July 24, 2024

Mr. Tony Peterson
Waste and Materials Management Program
Wisconsin Department of Natural Resources
Eau Claire Service Center
1300 W. Clairemont Avenue
Eau Claire, WI  54701

Subject: Dairyland Power Cooperative – Alma Off-Site Disposal Facility Phase IV Landfill Plan of Operation Modification for Initial Permitting of Coal Combustion Residuals (CCR) Landfills – Addendum 2, Town of Belvidere, Buffalo County, Wisconsin (License #4126)

Dear Mr. Peterson:

On behalf of Dairyland Power Cooperative (DPC), this letter provides responses to the Wisconsin Department of Natural Resources (WDNR)'s April 15, 2024 Incompleteness Determination (Incompleteness Letter) for the Plan of Operation Approval Modification for Initial Permitting of CCR Landfills at the DPC Alma Off-Site Disposal Facility, Phase IV Landfill (Phase IV Landfill). This is Addendum 2 to the January 30, 2023 Plan of Operation Modification for the Phase IV Landfill (January 2023 Plan Mod).

This addendum is presented in the form of a letter such that each item requiring additional information is shown in bold text followed by DPC's response. If additional materials are needed to supplement the textual response, these supplemental materials are provided within attachments to this Addendum 2.

**Attachment 1** contains the certification statement for this Addendum. **Attachment 2** provides the Incompleteness Letter and communication from the WDNR following the May 2, 2024 meeting between WDNR, TRC, and DPC.

1. ***Section NR 504.04(5)(j), Wis. Adm Code: Provide a revised leachate removal system for Cell 4 which includes a sump and side slope riser design.***

   Response: DPC previously obtained an exemption from this requirement in the May 2001 Conditional Plan of Operation Approval. Based on the May 2, 2024 meeting conducted between WDNR, DPC, and TRC it is our understanding that WDNR is re-evaluating this granted exemption due to changes to chs. NR 500-538 resulting from the promulgation of the federal CCR rules. It should be noted that the Federal CCR Rule does not include specific design requirements for the leachate collection and removal system other than the following: (1) designed and operated to maintain less than 30-centimeters depth of leachate over the composite liner, (2) constructed of materials that are chemically resistant to CCR….and of sufficient strength and thickness to prevent collapse under the pressures exerted by the overlying waste, and (3) designed and operated to minimize clogging during the active life and post-closure care period. Therefore, the promulgation of the Federal CCR rule should not impact the existing status of the previously approved exemption request.

   However, as requested by the WDNR, DPC is re-requesting an exemption from s. NR 504.04(5)(j) to allow for the required horizontal liner penetration to accommodate the existing design of the gravity drained system for Cells 4A and 4B of the Alma Off-Site Phase IV Landfill. To justify this request, the following information has been provided below: discussion of the existing gravity leachate collection system design including its pipe penetration, evaluation of the existing system, components of the future system that are currently installed for Cell 4, discussion of the benefits and preferred use of the system, and quality control that is conducted during construction.

As noted above, DPC currently utilizes a gravity drain leachate collection system for the conveyance of generated leachate to the existing leachate collection tank in all of the constructed cells of the Landfill, Cells 1 through 3. This accounts for approximately 63 percent of the total permitted landfill acreage. In the existing cells, this accounts for four existing penetrations through the base liner of the landfill. In the future Cell 4, two additional pipe penetrations would be constructed as proposed in the 2000 Plan of Operation.

The gravity drain leachate collection system consists of the 6-inch perforated SDR 11 HDPE leachate collection pipe located within the limits of waste. The 6-inch perforated pipe generally runs north to south along the base of the landfill. Near the southern toe of slope, the perforated pipe transitions to a non-perforated 6-inch diameter SDR 11 HDPE pipe while remaining within the limits of waste, north of the liner penetration location. Following the liner penetrations, the piping transitions to a dual encased pipe (non-perforated 6-inch diameter SDR 17 within a non-perforated 10-inch diameter SDR 11). This dual encased pipe is routed into currently constructed manholes and gravity drains to the leachate collection tank south of the Phase IV Landfill.

The liner penetrations are designed to contain leachate within the lined landfill and the dual encased transfer pipes. A double HDPE pipe boot is installed at the location where the transfer piping exits the liner system. The double HDPE boot consists of two pipe boots that are welded to the non-perforated pipe and are offset from each other. At each liner penetration, the inner pipe boot was installed first and welded to the pipe and then the secondary boot was placed over the initial boot and welded in a way that the second pipe boot covers the initial pipe boot welds. A detail of the double pipe boot and liner penetration components that were installed during the construction of Cell 3A is included in **Attachment 3**. The double pipe boot provides additional protection against migration of leachate into the environment.

Outside the base grades (top of soil barrier layer) the transfer piping is wrapped in a geosynthetic clay liner (GCL) wrap. The GCL wrap was installed along the length of the non-perforated pipe outside the limits of waste to where the pipe transitions from the single pipe to a dual encased pipe, approximately 24 feet from the base of the landfill. The GCL wrap provides a low permeability layer that acts as a secondary containment around the pipe in case of potential leaks. In addition, a minimum 2-foot-thick low-permeability soil (soil barrier layer) that is used to construct the base of the composite liner system is also placed in all directions around the pipe from the liner penetration to beyond the termination of the GCL wrap. Approximately 21 feet from the base of the landfill the GCL wrapped 6-inch non-perforated pipe passes through a 4-foot by 4-foot HDPE anti-seep collar that is installed within the southern berm of the of the Phase IV Landfill. The anti-seep collar provides additional protection from potential leakage. These features provide multiple layers of safety measures to minimize the potential for migration of leachate from the liner penetration.

The existing gravity drain system has operated as designed and intended. No significant problems have been noted. DPC regularly jets the leachate collection lines and if indications of clogging arise, additional jetting occurs at the site.

Groundwater monitoring has been conducted at the Phase IV Landfill during its active life. When reviewing the previous 6 years of groundwater monitoring reports, the Phase IV Landfill has not seen any statistically significant increases (SSIs) within the wells of the monitoring network and the site has continued to remain within detection monitoring. During the regular inspection of the existing leachate conveyance system, evidence of leaks of have not been noted. Groundwater results from downgradient wells have not shown evidence of leaks through the liner system, and liquids have not been identified within the dual encased piping located beyond the anti-seep collar.

Because the non-perforated piping associated with Cell 4, Module A and B is routed within a portion of the Cell 3 build-out, a portion of Cell 4, Module A's gravity conveyance system was installed during liner construction of Cell 3A in 2012. This installed infrastructure consists of manhole MH7 along with the dual encased piping located between manholes MH6 and MH7, and two lines of piping from future Cells 4A and 4B to manhole MH7. Select low permeability soil (soil barrier layer) was placed around the northern 10 feet of the pipes and extended 2 feet in all directions. The installed pipes were capped for the future connections to occur during the construction of Cell 4A. Therefore, the only connections that need to occur are the connections that will occur at the liner penetration and within the limits of waste for the Cell 4A and 4B leachate collection piping if no changes are made to the design. The installed infrastructure is shown on Sheet 6 in **Attachment 3**.

Revising the design of the of the leachate collection system for Cell 4 would require several changes in operation and construction for future buildout of the landfill. As noted above, construction of a portion of the Cell 4A and 4B system was required during Cell 3A construction due to the location of piping with the Cell 3A perimeter berm. This includes piping and the manhole that the piping is connected to. Changes to the design to incorporate a sump and pump system would require removal of this piping within the perimeter berm of Cell 3A and changes to the installed manhole to allow a forcemain to be connected to the existing gravity drain transfer system. Electrical infrastructure required for a pump system is not currently available at the landfill. This would require an electrical conductor to be routed up to the landfill to service one cell of the landfill and would require the addition of a pump and electrical controls and communication between electrically actuated valves near the leachate collection tank and the pump in Cell 4. The electricity would need to be routed to avoid existing landfills and infrastructure on the property, and would result in significant construction cost and complexity.

In addition, the gravity system provides simpler operation for DPC. There is generally reduced operational and maintenance requirements for a gravity drain system. Due to the lack of pumps, there are no pumps to fail that would need to be replaced and/or repaired. Floats and valves do not need to be maintained to allow for proper pump operation. If a pumped system is added to Cell 4, this would result in differing operation and maintenance requirements across the landfill, adding complexity to the current simple system.

The current design's performance meets the requirements of the site. If leachate volume drastically increases, DPC has protocols in place to allow for direct leachate removal from the landfill via temporary pump systems that can directly load leachate into tanker trucks. Though a pump system may be able to move more liquid in a shorter time, DPC does not necessarily have the infrastructure in place to manage that on a consistent basis. At the Phase IV landfill, the limiting factors for the leachate collection and transfer system are the size of the transfer pipes, the storage capacity of the tank and the hauling limitations of the transfer tankers. For these reasons, there is not a significant advantage to having a permanent pumped system installed to service Cell 4.

As part of the general inspection and monitoring associated with the Landfill, DPC will continue to monitor for potential leaks from the proposed liner penetration within Cell 4. During routine landfill operations, inspections of the manholes, televising of pipes, and inspection of the exterior slopes and vegetation will provide indicators in the unlikely event of potential leakage from the landfill. In addition, groundwater monitoring will continue at the wells located across the site, and if statistically significant increases are observed, an investigation into the cause will be conducted.

During construction, thorough quality control testing will be completed on the pipe penetration location similar to the testing that has been completed in the other constructed cells. This includes electrical resistivity testing of the liner and completing spark testing along welds of the pipe boot. Observation and testing on the subbase of the piping will be completed to confirm that the pipe is being placed on a stable and unyielding subgrade to minimize settlement and damage to the piping due to movement.

Based on the information presented, a gravity drained system as currently designed and partially installed for Cell 4 is expected to operate in a similar manner as the systems currently in-place at the landfill. No significant complications or releases due to the gravity drain system and its corresponding liner penetration have been noted at the site. The system is designed and installed with safety measures in place to minimize the potential of leakage through the liner system. Therefore, DPC requests that the WDNR re-approve the use of the existing gravity drain system and the penetration through the liner for the remaining cell (Cell 4) of the Phase IV Landfill.

2. ***Section NR 514.07(10), Wis. Adm. Code: Provide additional information for the operational plans required for the CCR landfill.***

   a. ***Section NR 514.07(10)(b)(3), Wis. Adm. Code: Provide an estimated schedule for construction of the storm water control structures. This can be an estimate based on an assumed CCR filling rate.***

      Response: An estimated schedule for the remaining run-on and runoff control structures is provided in Appendix D of the Run-on and Run-off Control System Plan (**Attachment 4**). This schedule is based on an estimated filling rate of approximately 49,000 cubic yards per year. It should be noted that construction may be conducted differently than the schedule presented as filling rates will fluctuate on a yearly basis. Construction and closure of cells will be dependent on the projected disposal requirements at the time and when final waste grades are obtained.

      No other changes to the plan were made.

*b.* ***Section NR 514.01(10)(c)(6), Wis. Adm. Code: Provide an estimated schedule of final cover construction activities including the year and number of acres of each construction event. This can be an estimate based on an assumed CCR filling rate.***

Response: An estimated schedule containing the estimated acres to be closed in each event and the year that the event will begin is provided as Table 1 in the attached Closure Plan (**Attached 5**). Table 2 shows compliance with the schedule requirement in s. NR 506.083(3)(a), which is associated with the timeline following initiation of closure (e.g. date of final receipt of CCR waste and any non-CCR waste stream or final removal of CCR from the CCR landfill for the purpose of beneficial use of CCR). This breaks out the steps of the final closure activity for the site to show that it can be accomplished within 6 months as required by s. NR 506.083(3)(a).

The estimated schedule is based on an annual filling rate of approximately 49,000 cubic yards per year. It should be noted that actual closures may be conducted differently than the schedule presented as filling rates will fluctuate on a yearly basis and closure will be dependent on when final waste grades are obtained.

*3.* ***Section NR 520.07(1), Wis. Adm. Code: Provide an updated long-term care cost estimate table that includes the estimated cost for video inspection of the leachate collection system every five years.***

Response: **Attachment 6** provides an updated long-term care cost estimate table, which includes leachate line televising.

*4.* ***Provide a chronological listing of all previous department issued plan of operation and modification approvals, including expedited plan modifications, along with a listing of their approval conditions, indicating the status (active, completed or superseded) of each condition. This will assist the department with potentially rescinding or superseding outdated conditions of past approvals.***

Response: DPC and TRC conducted a virtual meeting with Tony Peterson and Matthew Bachman of the WDNR on May 2, 2024. During this meeting, each of the comments of the April 15 Incompleteness letter were discussed. During this discussion, WDNR noted that this request was not required but would generally be appreciated.

DPC and TRC provided WDNR, for their convenience, copies of previous approval letters for the Plan of Operation and modifications that were approved in the January 2023 Modification to the Plan of Operation. It is the opinion of DPC that these should be sufficient in WDNR's determination of the active statuses of previous site approval conditions. No other documentation will be provided, as this request is not required for this submittal.

DPC is requesting that the WDNR review and provide an approval for the Phase IV Landfill. Please feel free to contact Leif Tolokken at (608) 386-2675 or me at (608) 622-9382 with questions regarding this document.

Sincerely,

TRC

Todd W. Martin

Todd Martin
Principal Project Manager

cc: See attached Distribution List

**List of Enclosures**

Attachment 1: Addendum Certification Statement
Attachment 2: WDNR Communication
Attachment 3: Supporting Documentation for Item 1
Attachment 4: Updated Run-on and Run-off Control System Plan
Attachment 5: Updated Closure Plan
Attachment 6: Long-term Care Costs

**Distribution List**

| Recipient | Hard Copy | Electronic Copy[1] |
|---|---|---|
| Anthony Peterson<br>Wisconsin Department of Natural Resources<br>141 NW Barstow Street #180<br>Waukesha, WI 53188 | 1 | Yes |
| Matthew Bachman<br>Wisconsin Department of Natural Resources<br>1300 W Clairemont Ave<br>Eau Claire, WI 54701 | 1 | Yes |
| Leif Tolokken<br>Dairyland Power Cooperative<br>3200 East Avenue South<br>La Crosse, WI 54601 | | Yes |
| Don Loock<br>Dairyland Power Cooperative<br>S2180 State Hwy 35<br>Alma, WI 54610 | | Yes |
| BreAnne Kahnk<br>TRC<br>999 Fourier Drive, Suite 101<br>Madison, WI 53717 | | Yes |

Footnotes:

(1) Electronic copies to be sent via an e-mail link.

# Attachment 1

# Addendum Certification Statement

## Certification Statement

"I, ______________________, hereby certify that I am a licensed professional engineer in the
Douglas R. Genthe, P.E.

State of Wisconsin in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 500 to 538, Wis. Adm. Code."

I, ______________________, hereby certify that I am a licensed professional geologist
Stephen Sellwood, P.G.

in the State of Wisconsin in accordance with the requirements of Chapter GHSS 2, Wisconsin Administrative Code; that the preparation of this document has not involved any unprofessional conduct as detailed in Chapter GHSS 5, Wisconsin Administrative Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in Chapters NR 500 to NR 538, Wisconsin Administrative Code.

# Attachment 2

# WDNR Communication

**State of Wisconsin**
**DEPARTMENT OF NATURAL RESOURCES**
**1300 W. Clairemont Ave.**
**Eau Claire, WI 54701-6127**

Tony Evers, Governor

Telephone 608-266-2621
Toll Free 1-888-936-7463
TTY Access via relay - 711

April 15, 2024

FID #606043900
Buffalo County
SW/Correspondence

Mr. Leif Tolokken
Dairyland Power Cooperative
JPM Station
500 Old State Highway 35
Alma, WI 54610

Subject: Incompleteness Determination for the Plan of Operation Approval Modification for Initial Permitting of Coal Combustion Residuals (CCR) Landfill for the Dairyland Power Cooperative Alma Off-Site Disposal Facility, Phase IV Landfill (License #4126)

Dear Mr. Tolokken:

The Department of Natural Resources (department) has reviewed for completeness the plan of operation modification for initial permitting of a CCR Landfill ("the plan"), dated January 30, 2023, along with the addendum to the plan dated January 17, 2024, both submitted on behalf of Dairyland Power Cooperative (DPC), by TRC Companies for the Dairyland Power Cooperative Alma Off-Site Disposal Facility, Phase IV Landfill.

The department has determined the plan is not complete since the minimum requirements of chs. NR 500 to 520, Wis. Adm. Code, have not been met in accordance with s. NR 514.045, Wis. Adm. Code. The department understands the complexity of the new CCR rules and its implementation and will be available to discuss the following items while you work to prepare the addenda to your initial submittal.

The following information must be provided in order for the department to issue a determination that the plan is complete:

1. **Section NR 504.06(5)(j), Wis. Adm. Code:** Provide a revised leachate removal system for Cell 4 which includes a sump and side slope riser design.

2. **Section NR 514.07(10), Wis. Adm. Code:** Provide additional information for the operational plans required for the CCR landfill.

    a. Section NR 514. 07(10)(b)3, Wis. Adm. Code: Provide an estimated schedule for construction of the storm water control structures. This can be an estimate based on an assumed CCR filling rate.

    b. Section NR 514. 07(10)(c)6, Wis. Adm. Code: Provide an estimated schedule of final cover construction activities including the year and number of acres of each construction event. This can be an estimate based on an assumed CCR filling rate.

3. **Sections NR 520.07(1), Wis. Adm. Code:** Provide an updated long-term care cost estimate table that includes the estimated cost for video inspection of the leachate collection system every five years.

4. Please provide a chronological listing of all previous department issued plan of operation and modification approvals, including expedited plan modifications, along with a listing of their approval conditions, indicating the status (active, completed or superseded) of each condition. This will assist the department with potentially rescinding or superseding outdated conditions of past approvals.

This incompleteness determination is not a denial of the plan, but merely indicates that additional information is needed for the department to determine the plan is complete. Submittal of this information does not ensure approval, nor does it preclude the department from requiring additional information if continued review indicates it is needed.

If you have any questions regarding this letter, please contact Tony Peterson at (715) 491-8546 or anthony.peterson@wisconsin.gov, or Matthew Bachman at (608) 512-3233 or matthew.bachman@wisconsin.gov.

Sincerely,

John Morris, Professional Soil Scientist, Regional Supervisor
Northern and West Central Regions
Waste and Materials Management Program

cc: Brian Kalvelage – Dairyland Power Cooperative (brian.kalvelage@dairylandpower.com)
BreAnne Kahnk – TRC Companies (bkahnk@trccompanies.com)
Todd Martin – TRC Companies (twmartin@trccompanies.com)
Tony Peterson – DNR/WA (anthony.peterson@wisconsin.gov)
Matthew Bachman – DNR/WA (matthew.bachman@wisconsin.gov)
Joseph Lourigan – DNR/WA (joseph.lourigan@wisconsin.gov)
Malena Grimm – DNR/WA (malena.grimm@wisconsin.gov)

**State of Wisconsin**
**DEPARTMENT OF NATURAL RESOURCES**
**141 NW Barstow St. Room 180**
**Waukesha, WI 53188**

**Tony Evers, Governor**

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May 9, 2024

FID: 606043900
Buffalo County
SW/Correspondence

Mr. Leif Tolokken
Dairyland Power Cooperative
JPM Station
500 Old State Highway 35
Alma, WI 54610

Subject: Follow-Up Letter from Department's Meeting with Dairyland Power Cooperative (Co-Op) on May 2, 2024, Regarding the Plan of Operation Approval Modification for Initial Permitting of Coal Combustion Residuals (CCR) Landfill for the Dairyland Power Co-Op Alma Off-Site Disposal Facility, Phase IV Landfill (License #4126)

Dear Mr. Tolokken:

The Department of Natural Resources (department) met with Dairyland Power Co-Op and TRC Companies to discuss the department's second incompleteness determination letter dated April 15, 2024 (incompleteness letter) for the plan of operation approval modification (plan modification) for initial permitting for a CCR landfill for the Dairyland Power Cooperative Alma Off-Site Disposal Facility, Phase IV Landfill (landfill).

During the meeting Dairyland Power Co-Op expressed interest in continuing the discussion on item number 1 of the incompleteness letter, which requested that the leachate collection system of Cell 4 of the landfill be revised to include a sump and sideslope riser system to avoid penetrations through the landfill liner system as required by s. NR 504.06(5)(j), Wis. Adm. Code.

The department may grant an exemption to the requirements of chs. NR 500 to 538, Wis. Adm. Code, in special cases where the proposal will not cause environmental pollution as defined under s. 299.01 (4), Wis. Stats. In considering a proposal for an exemption under s. NR 500.08 (4), Wis. Adm. Code, the department shall take into account such factors as the population of the area being served, the amount of waste being generated, the geologic and hydrogeologic conditions at the facility, the design of the facility, the operational history of the facility, the physical and chemical characteristics of the waste, and any other information that may be appropriate.

If Dairyland Power wishes to request an exemption, please include the relevant information to show how the proposed landfill is a special case, how the exemption will not cause environmental pollution and the supporting factors that the department should consider in reviewing the request that shows why the exemption is warranted.

Suggested information that may be relevant to an exemption request includes the following:

- An evaluation of the performance of the current gravity drain leachate collection and removal system operating within Cells 1 through 3 of the landfill.
- An explanation of the existing leachate collection and removal system infrastructure already constructed for Cell 4.
- An explanation of why the gravity drain leachate collection and removal system would be preferential to a sump and sideslope riser leachate collection and removal system for Cell 4 of the landfill with regards to operations, maintenance, and performance.

- An explanation of how potential leaks through the penetrations of landfill liner would be identified.

Please note that the department does not guarantee that if an exemption to s. NR 504.06(5)(j), Wis. Adm. Code, is requested as part of the plan modification that it would be approved. The department would need to review the exemption request in its entirety before making a decision.

If you have any questions regarding this letter, please contact Tony Peterson at (715) 491-8546 or anthony.peterson@wisconsin.gov, or Matthew Bachman at (608) 512-3233 or matthew.bachman@wisconsin.gov.

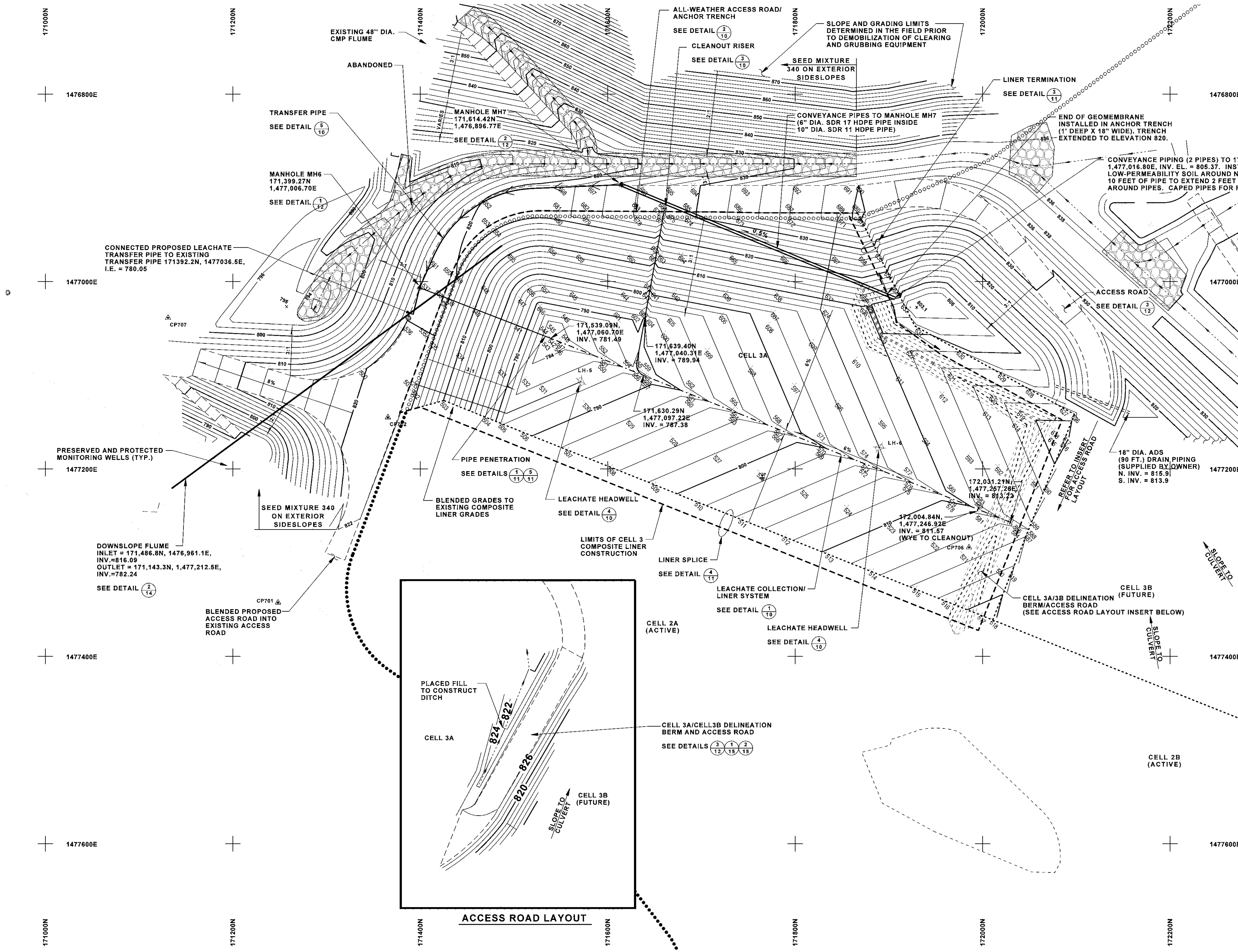
Sincerely,

Tony Peterson
Waste Management Engineer
Southeast Region

cc: Brian Kalvelage – Dairyland Power Cooperative (brian.kalvelage@dairylandpower.com)
BreAnne Kahnk – TRC Companies (bkahnk@trccompanies.com)
Todd Martin – TRC Companies (twmartin@trccompanies.com)
Tony Peterson – DNR/WA (anthony.peterson@wisconsin.gov)
Matthew Bachman – DNR/WA (matthew.bachman@wisconsin.gov)
Joseph Lourigan – DNR/WA (joseph.lourigan@wisconsin.gov)
Tess Brester – DNR/WA (tess.brester@wisconsin.gov)
John Morris – DNR/WA (john.morris@wisconsin.gov)

# Attachment 3

# Supporting Documentation for Item 1




## NOTES

1. REFER TO PLAN SHEET 2 OF THIS PLAN SET FOR LEGEND, BASE MAP NOTES AND BENCHMARK LOCATIONS.

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

| NO. | BY | DATE | REVISION | APP'D. |
|---|---|---|---|---|
| 3. | | | | |
| 2. | | | | |
| 1. | | | | |

PROJECT: DAIRYLAND POWER COOPERATIVE PHASE IV, CELL 3A LINER CONSTRUCTION DOCUMENTATION

SHEET TITLE: BASE GRADES

| | | | | |
|---|---|---|---|---|
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| CHECKED BY: TWM | | | FILE NO. | 187576.06.SHT06-BG.PLT |
| APPROVED BY: KDP | DATE PRINTED: | | SHEET 6 OF 16 | |
| DATE: JANUARY 2013 | | | | |


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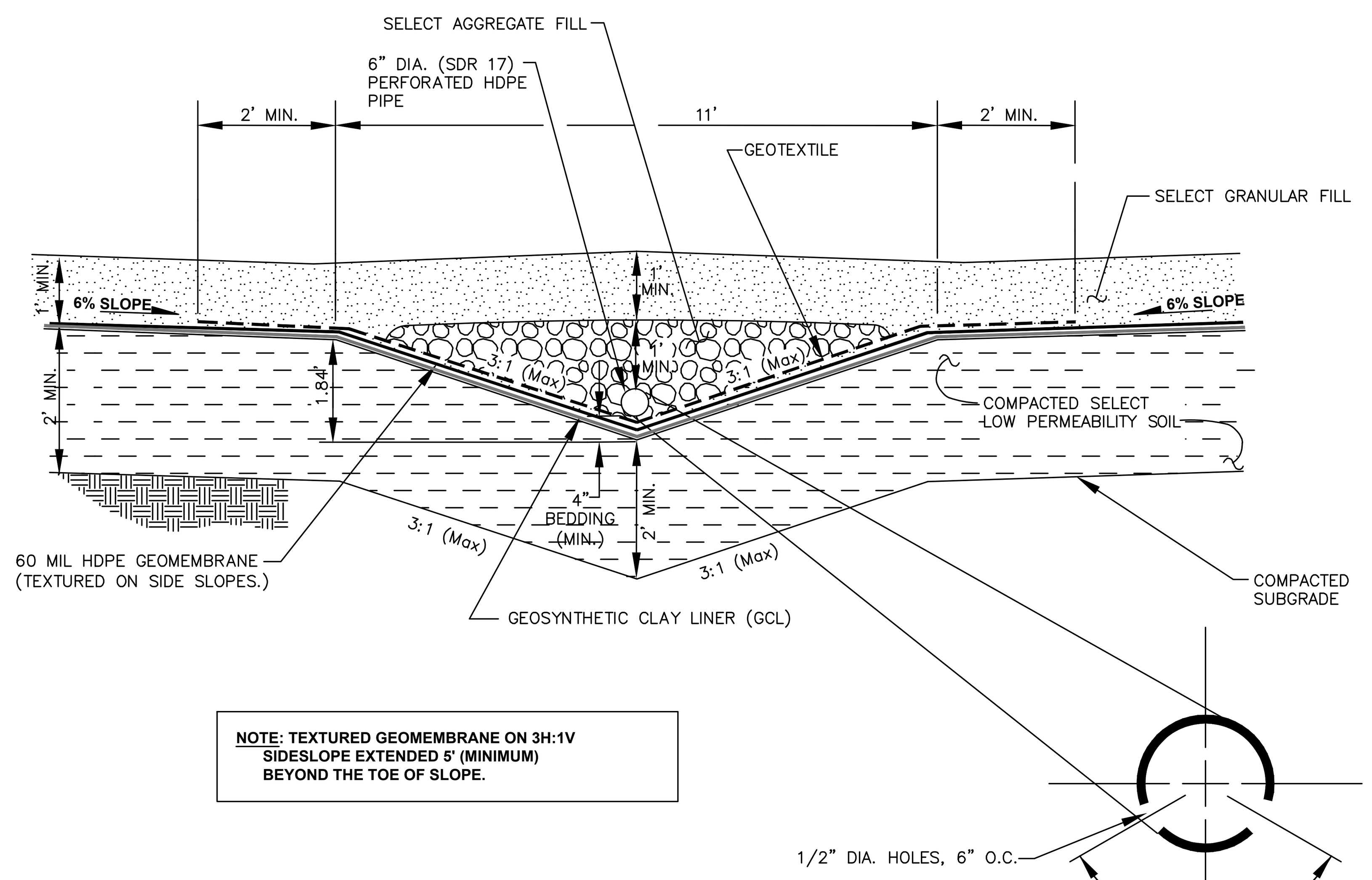
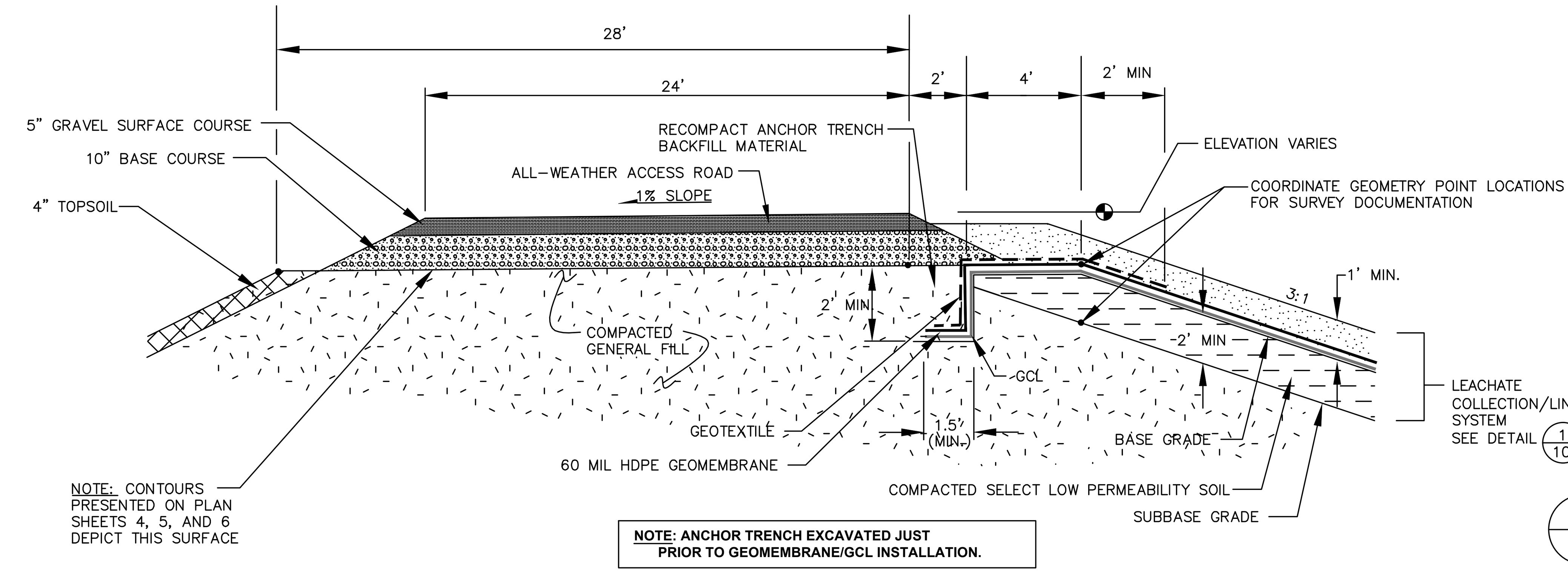


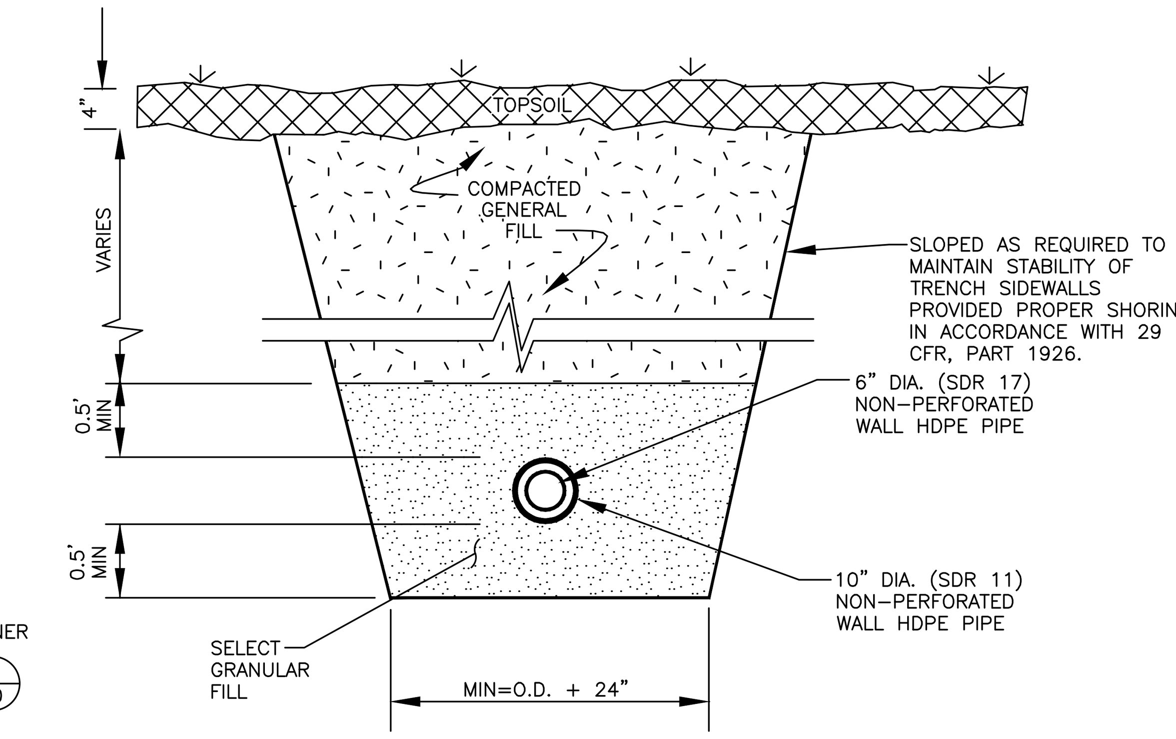

1 / 10 **LEACHATE COLLECTION/LINER SYSTEM**

(NOT TO SCALE)



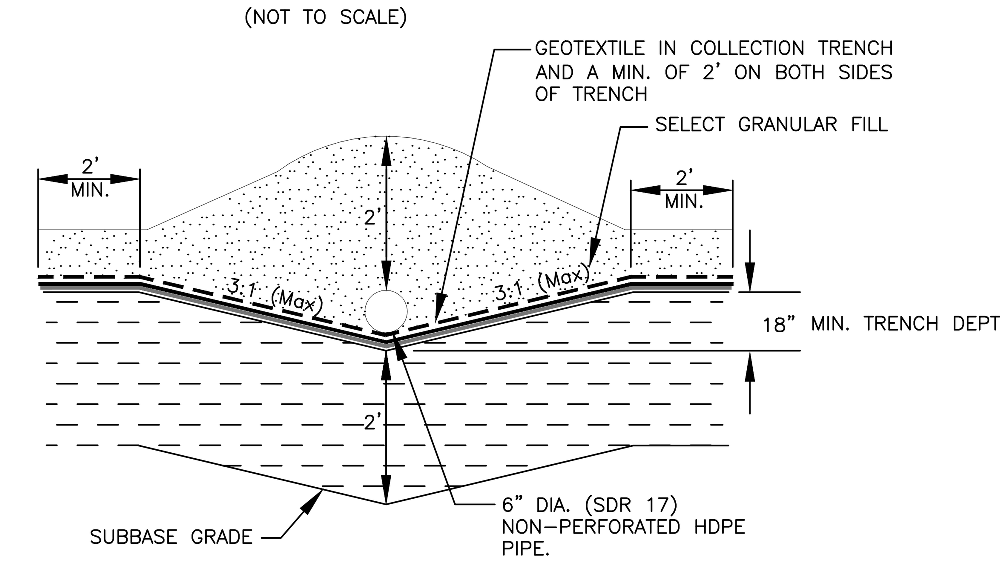

2 / 10 **ALL-WEATHER ACCESS ROAD/ ANCHOR TRENCH**

(NOT TO SCALE)



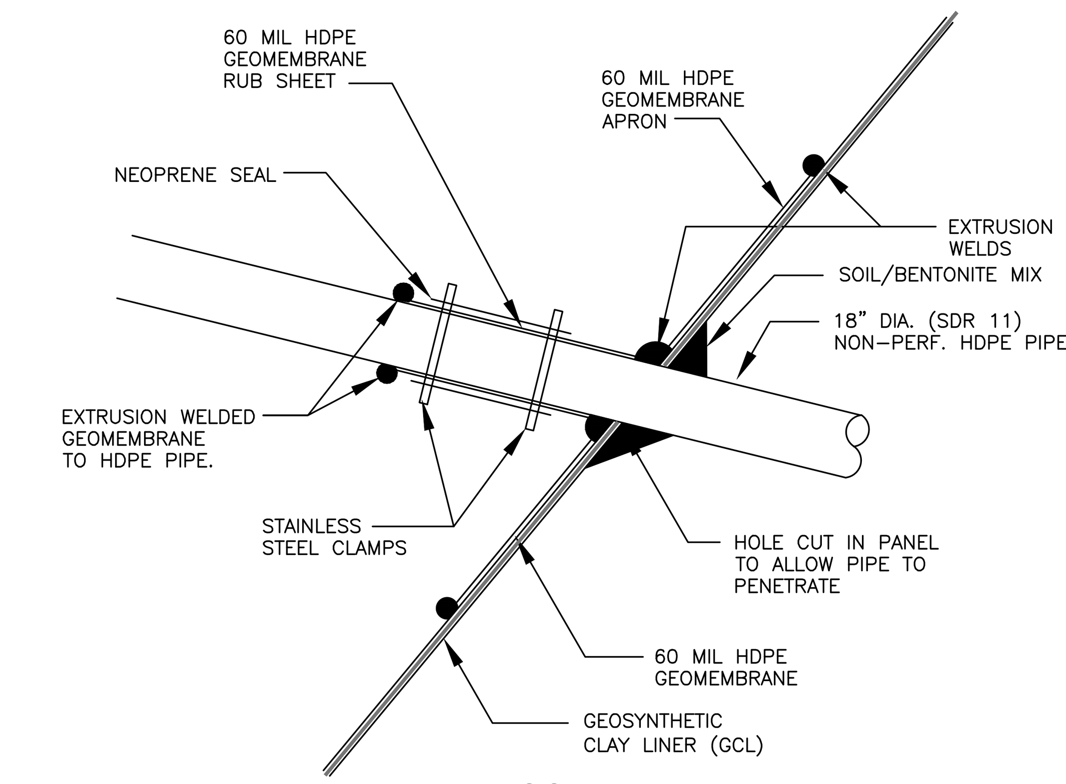

5 / 10 **TRANSFER PIPE**

(NOT TO SCALE)



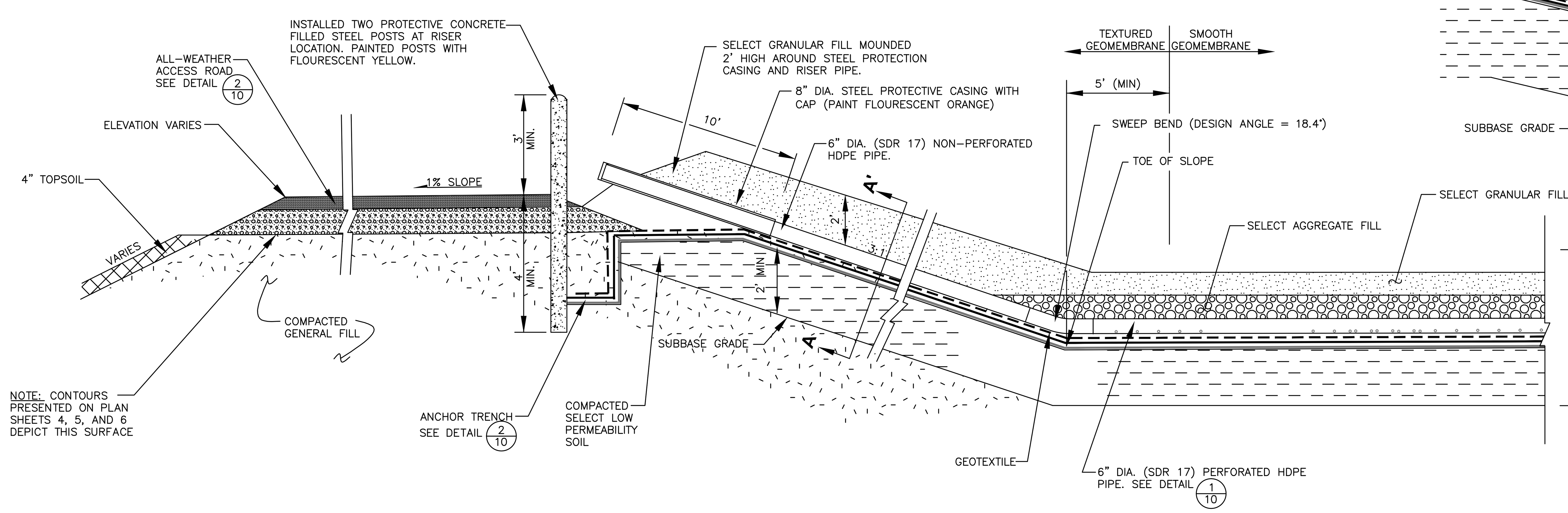

**SECTION A-A'**

RISER PIPE



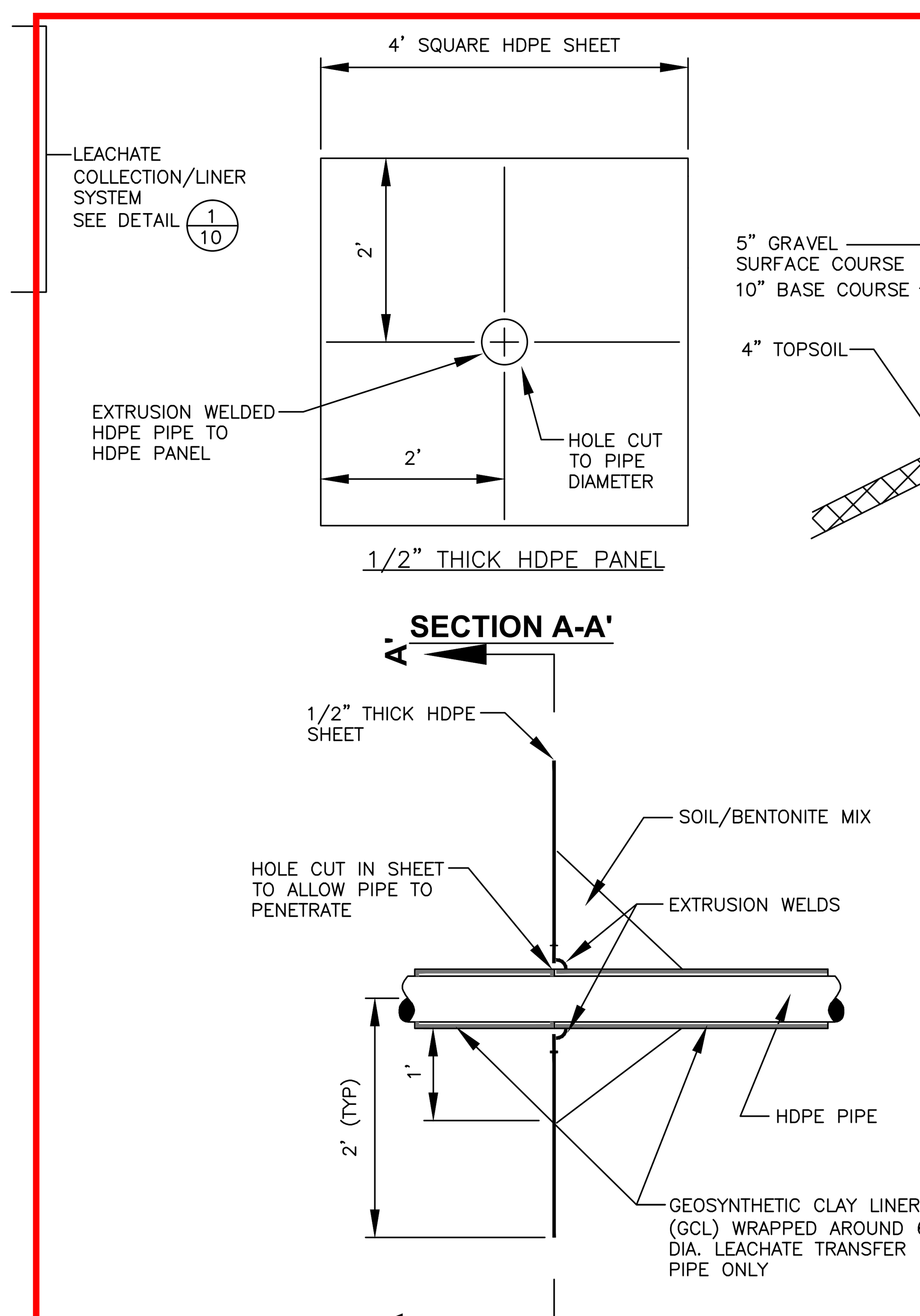

6 / 10 **PIPE BOOT**

(NOT TO SCALE)



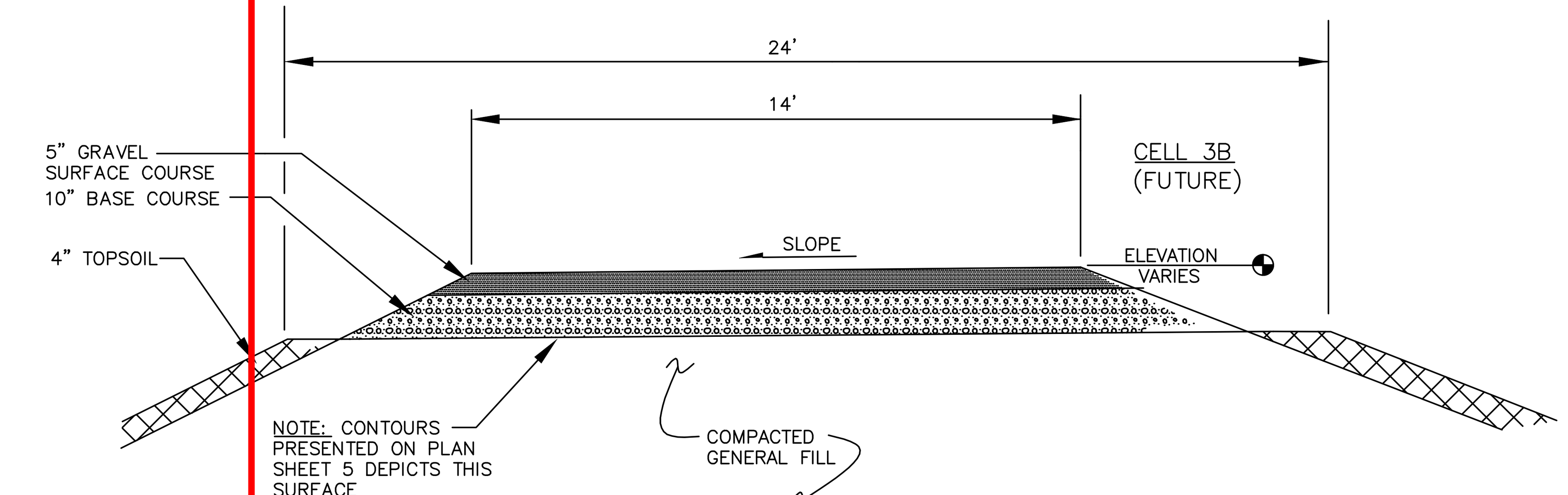

3 / 10 **CLEANOUT RISER**

(NOT TO SCALE)



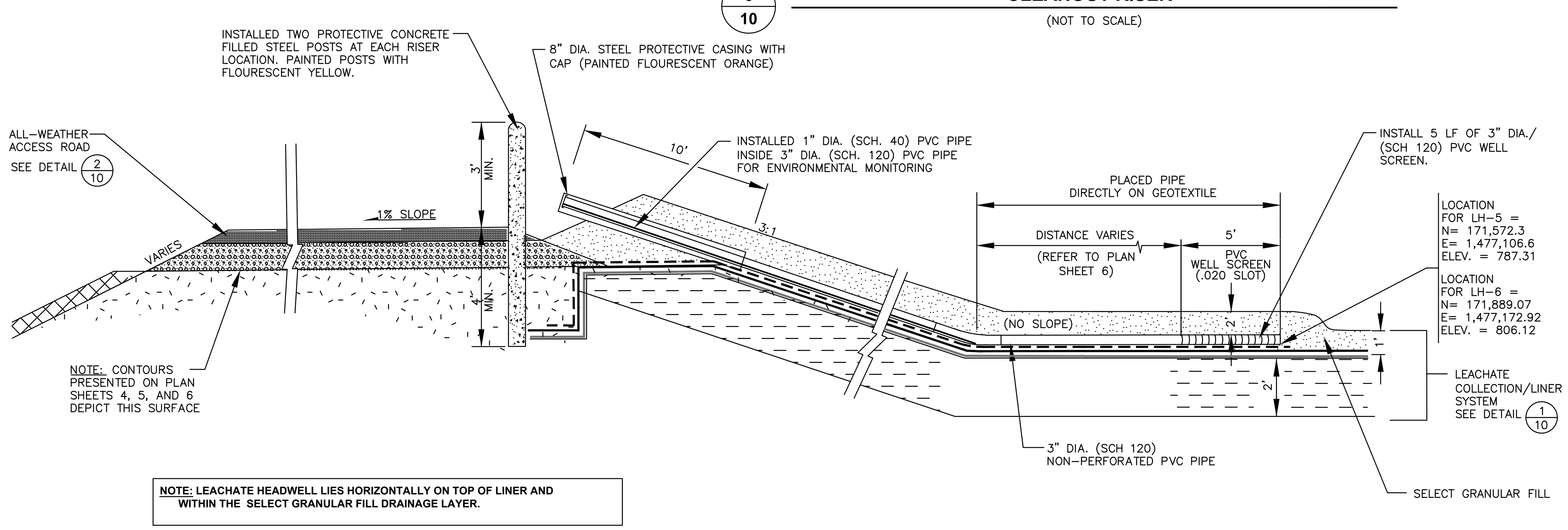

7 / 10 **ANTI-SEEP COLLAR**

(NOT TO SCALE)




8 / 10 **ALL-WEATHER ACCESS ROAD (NORTH)**

(NOT TO SCALE)




4 / 10 **LEACHATE HEADWELL LH-5 & LH-6**

(NOT TO SCALE)

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

| NO. | BY | DATE | REVISION | APP'D. |
|---|---|---|---|---|
| 3. | | | | |
| 2. | | | | |
| 1. | | | | |

PROJECT: **DAIRYLAND POWER COOPERATIVE PHASE IV, CELL 3A LINER CONSTRUCTION DOCUMENTATION**

SHEET TITLE: **DETAILS**

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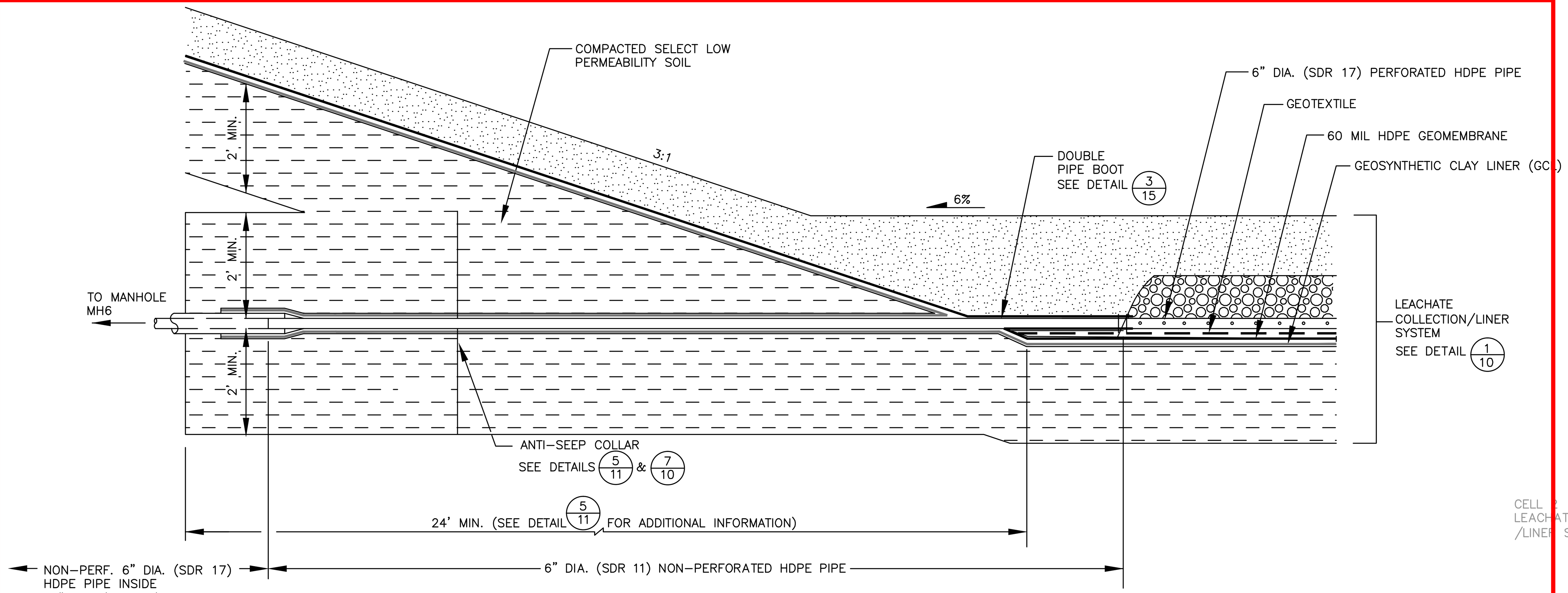
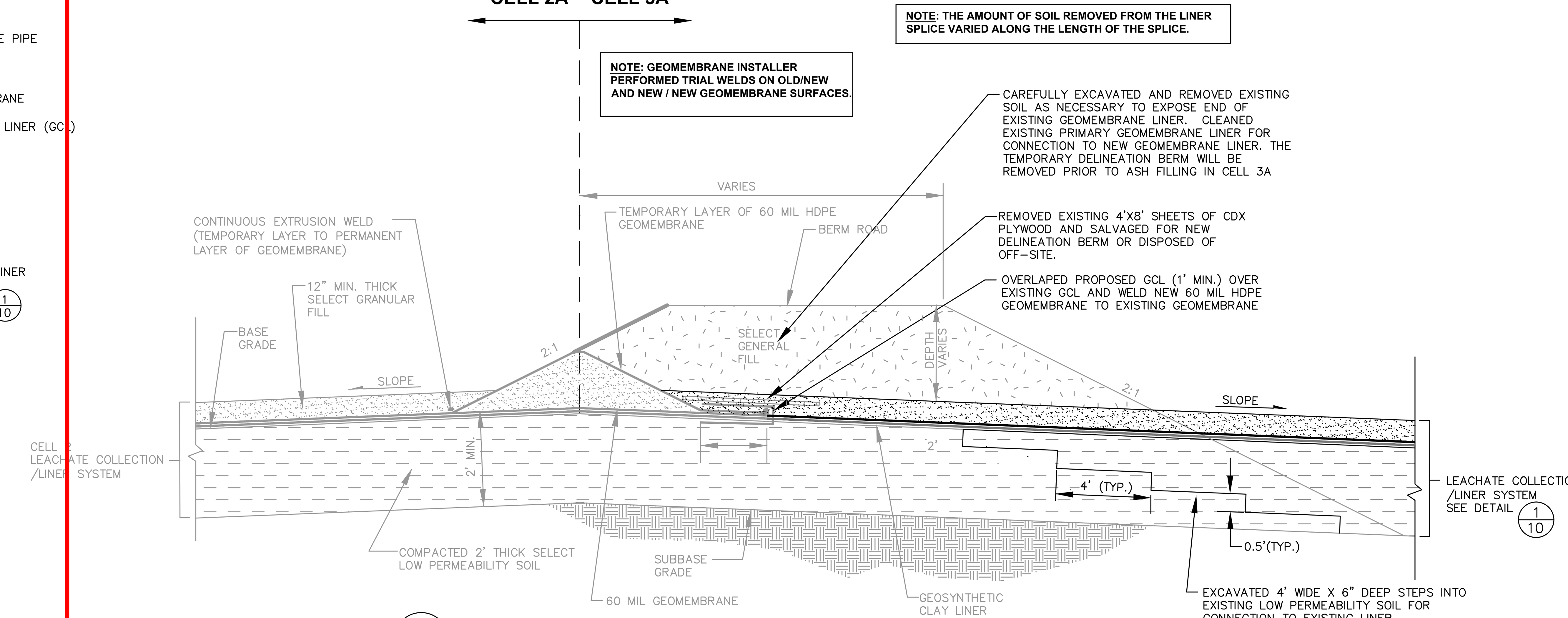


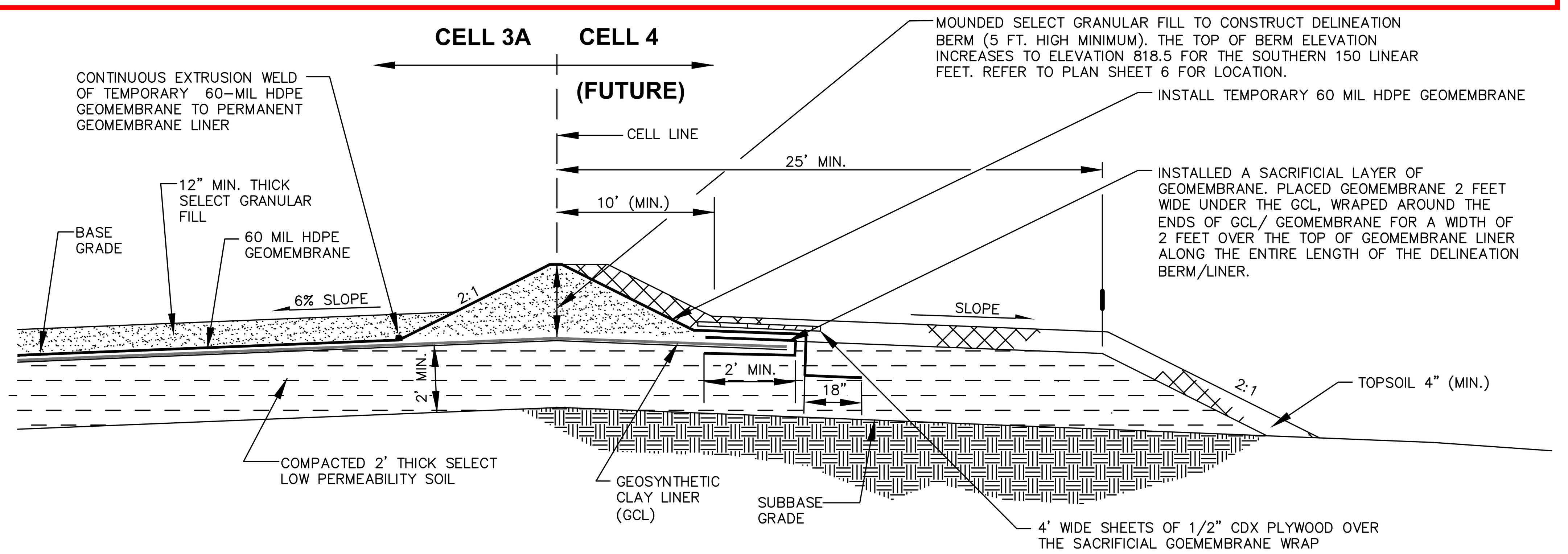

**1/11 PIPE PENETRATION THROUGH LANDFILL PERIMETER BERM (PROFILE LOOKING WEST)**

(NOT TO SCALE)



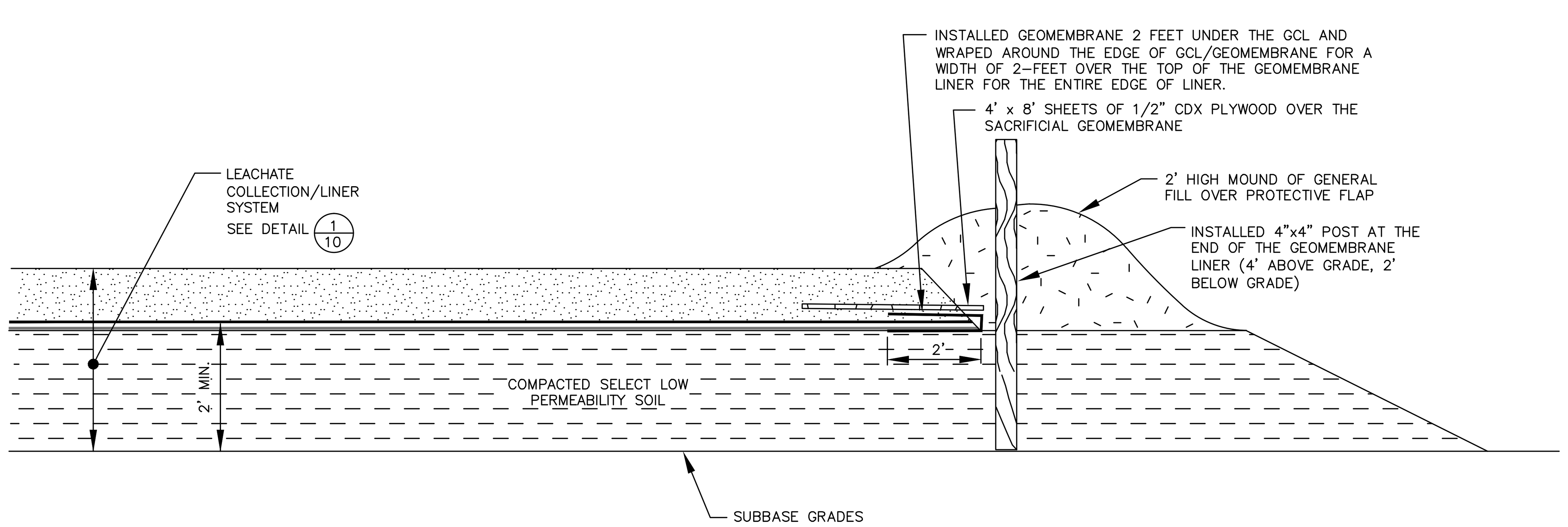

**4/11 LINER SPLICE**

(NOT TO SCALE)




**2/11 DELINEATION BERM**

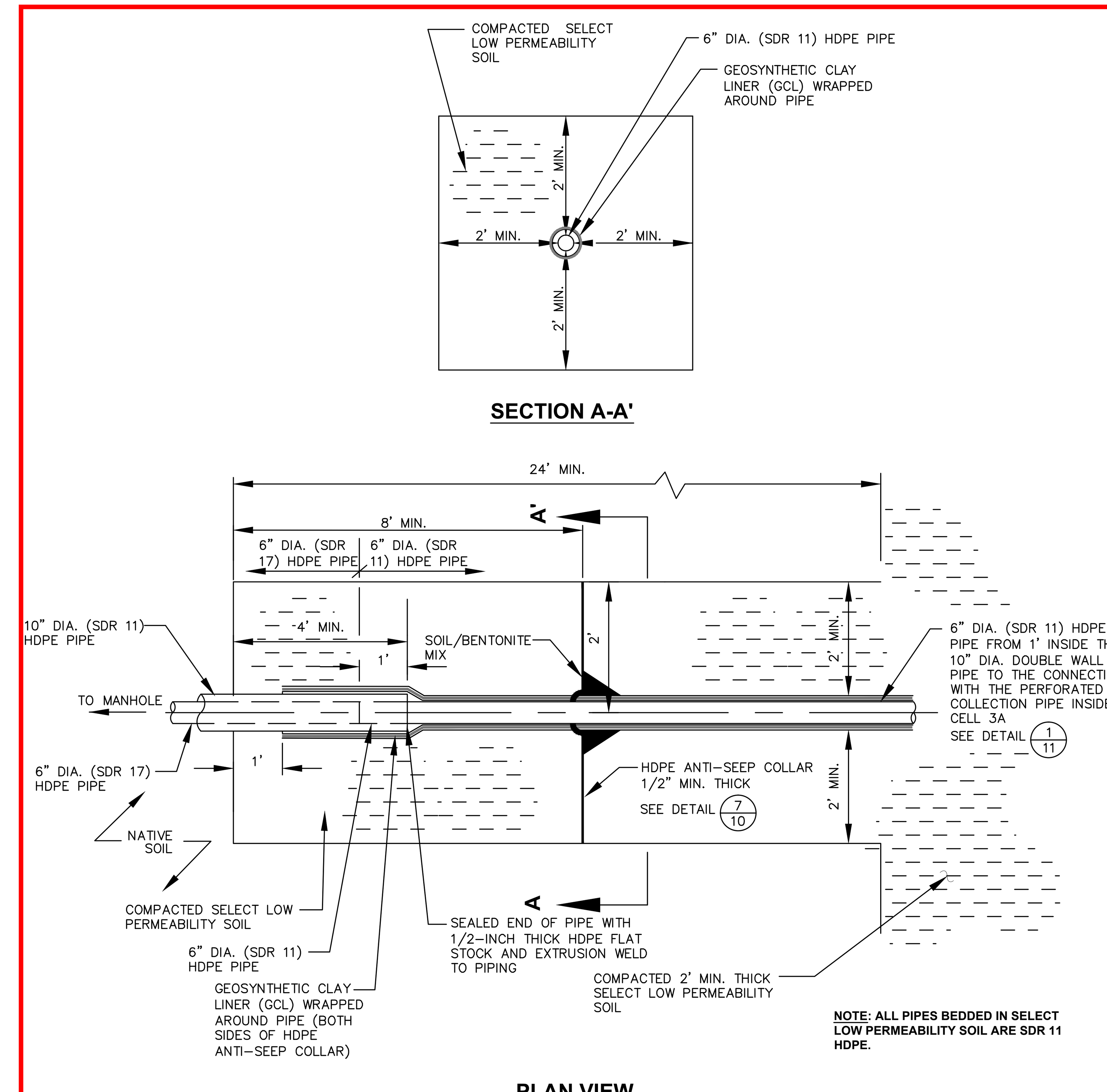
(NOT TO SCALE)




NOTE: APPLIES ABOVE ELEV. 820' ON 3:1 SIDESLOPES.

**3/11 LINER TERMINATION**

(NOT TO SCALE)




**5/11 PIPE PENETRATION THROUGH COMPACTED SELECT LOW PERMEABILITY SOIL**

(NOT TO SCALE)

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

| NO. | BY | DATE | REVISION | APP'D. |
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PROJECT: **DAIRYLAND POWER COOPERATIVE PHASE IV, CELL 3A LINER CONSTRUCTION DOCUMENTATION**

SHEET TITLE: **DETAILS**

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| APPROVED BY: KDP | DATE PRINTED: | SHEET 11 OF 16 | |
| DATE: JANUARY 2013 | | | |

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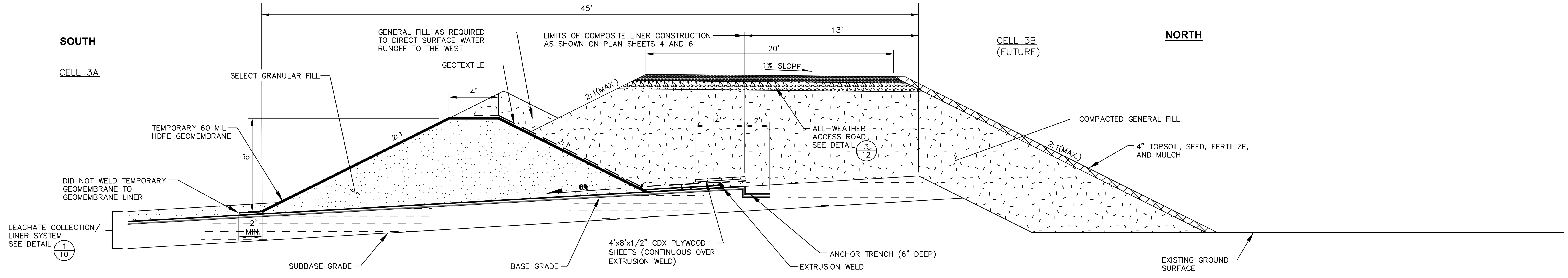
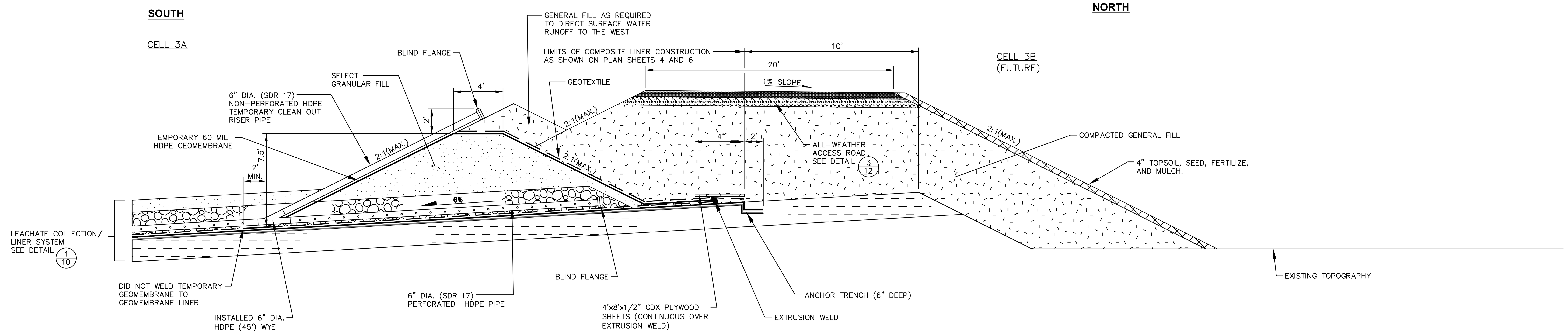


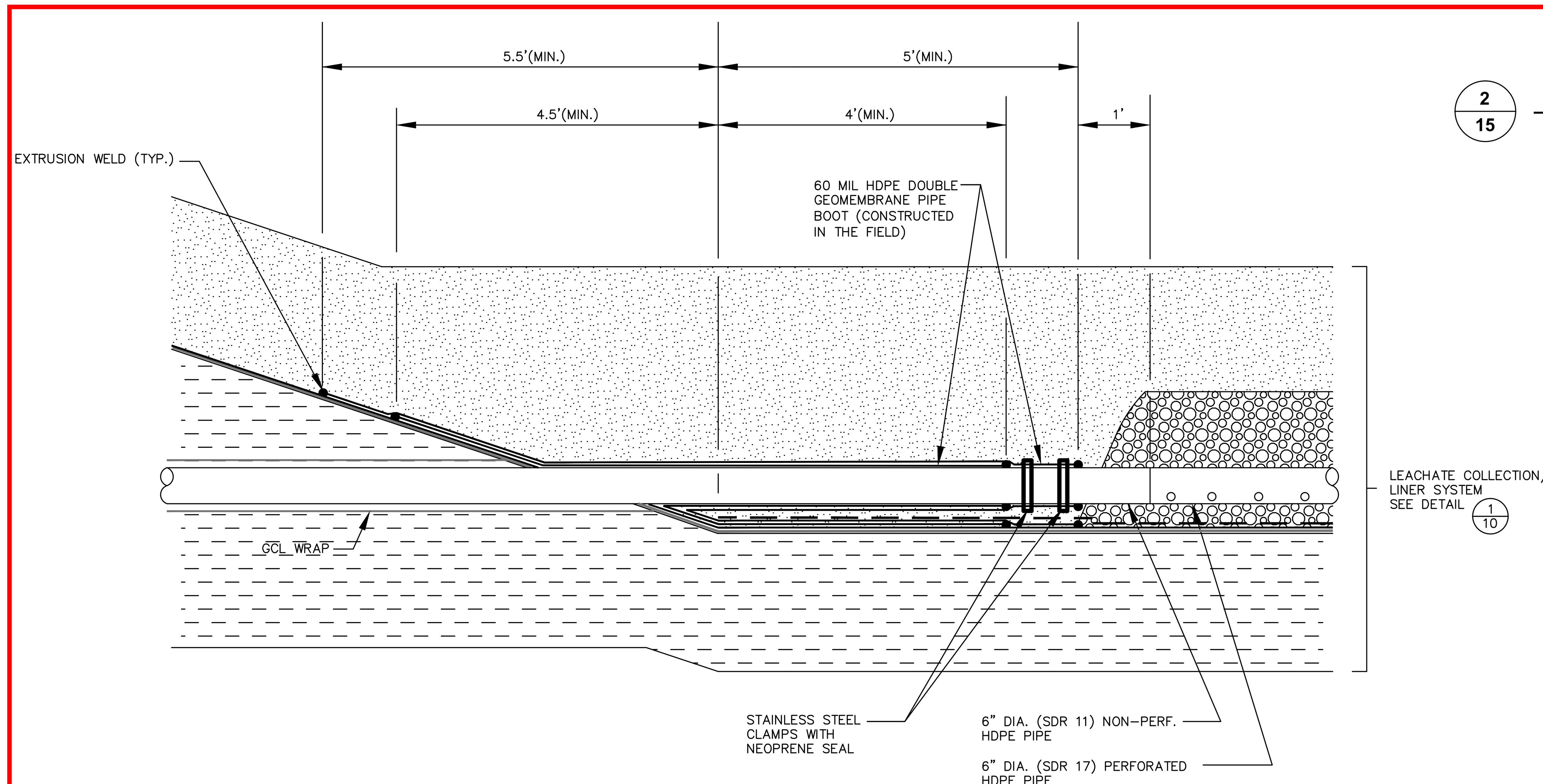

1/15 **CELL 3A/CELL 3B DELINEATION BERM**

(NOT TO SCALE)




2/15 **CELL 3A/CELL 3B DELINEATION BERM AT LEACHATE COLLECTION LINE**

(NOT TO SCALE)




3/15 **DOUBLE PIPE BOOT- PIPES PENETRATING THROUGH COMPACTED SELECT LOW PERMEABILITY SOIL (TYPICAL)**

(NOT TO SCALE)

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

| NO. | BY | DATE | REVISION | APP'D. |
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PROJECT: **DAIRYLAND POWER COOPERATIVE PHASE IV, CELL 3A LINER CONSTRUCTION DOCUMENTATION**

SHEET TITLE: **DETAILS**

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# Attachment 4

# Updated Run-on and Run-off Control System Plan

# Run-On and Run-Off Control System Plan

## Alma Offsite Disposal Facility
## Phase IV Landfill
## Alma, Wisconsin

October 2016
Revised October 2021
Revised January 2024
Revised July 2024

**Prepared For:**

Dairyland Power Cooperative
3200 East Avenue South
La Crosse, Wisconsin 54601

**Prepared By:**

TRC
999 Fourier Drive, Suite 101
Madison, Wisconsin 53717

BreAnne Kahnk, P.E.
Senior Project Engineer

Todd Martin
Principal Project Manager

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# TABLE OF CONTENTS



## APPENDICES

## REVISION HISTORY

| Revision Number | Revision Date | Section Revised | Summary of Revisions |
|---|---|---|---|
| 1 | 10/6/2021 | 1.2, 2.2, 2.3, 3.0, App. B | 5-year periodic revision, revised text and Appendix B |
| 2 | 10/11/2023 | Inserted Section 3 | Requirements to meet WDNR standards |
| 3 | 7/24/2024 | App. D | Estimated Construction Schedule |
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# 1.0 Introduction

## 1.1 Purpose and Scope

This Run-On and Run-Off Control System Plan (Plan) was prepared by TRC Environmental Corporation (TRC) on behalf of Dairyland Power Cooperative (DPC) for the Alma Offsite Disposal Facility, Phase IV Landfill (Landfill) where coal combustion residuals (CCR) are disposed. The approximately 32.1 acre Landfill is located in Sections 18 and 19, T21N, R12W, Town of Belvidere, Buffalo County, Wisconsin.

This Plan meets the run-on and run-off control system requirements of the United States Environmental Protection Agency's (USEPA) CCR Rule (Title 40 Code of Federal Regulations (CFR) parts 257 Subpart D – "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments"). This text and its accompanying appendices and plan sheets present the plans and specifications of the run-off and run-on control systems of the Landfill. The plan sheets and the text, with its appendices, complement each other and should be reviewed and used as one document.

# 2.0 Engineering Design Concepts for Controlling Run-On and Run-Off

## 2.1 General

The Landfill design has been developed to provide environmentally sound CCR disposal. The storm water run-on and run-off control systems for the Landfill have been designed and meet the requirements of 40 CFR 257.81.

The supporting calculations for the run-on and run-off design are referenced throughout the text and are included in the appendices. Details and drawings illustrating design layout and specifications are referenced as applicable and presented on the plan sheets and figures. The majority of the calculations provided in the appendices were prepared during the initial permitting of the Phase IV Disposal Area and included in the October 2000 Plan of Operation (POO) in accordance with Wisconsin Administrative Code, Chapters 500 through 520, and conversations with the Wisconsin Department of Natural Resources (WDNR). Plan sheets included in Appendix C are the relevant plan sheets from the October 2000 POO drawing plan set. For the purposes of this Plan, the terms surface water and storm water have been used interchangeably and reflect precipitation routed over land or temporarily stored to manage run-on and run-off. No streams, wetlands, or bodies of water are located in areas that would impact run-on and run-off at the Landfill.

## 2.2 Run-On Control System

### *2.2.1 General*

The run-on control system for the Landfill consists of perimeter berms, diversion berms, downslope flumes, ditching, sedimentation basins, and culverts, designed and constructed to control surface water during both the operational and post-closure periods of the Landfill. The design of the surface water controls have been performed for the operational periods when the combination of surface conditions and contributing acreage would result in the greatest run-off volume, and for the post-closure period. Given the location of the site, the surface water management system was designed utilizing the 100-year, 24-hour storm event at the time of the design, which exceeds the current 25-year, 24-hour storm event required by 40 CFR 257.81(a)(1). Calculations for the surface water run-on control designs are included in Appendix A.

The surface water control system design has been performed to meet the following requirements:

- Run-off curve numbers (RCNs) used in the analysis provide a conservative analysis of the potential land uses of the upland areas. Upland areas within the watershed primarily include wooded areas and agricultural lands. The wooded areas are located on the steeper-sloped areas of the valley and are unlikely to be affected by future land uses. High RCNs for the agricultural lands were selected to represent a conservative fallow condition with exposed bare soil. The RCNs selected for these areas were 86.
- Surface water run-on controls have been designed to divert off-site surface water away from the active fill areas. On-site surface water is routed to sedimentation basins, except surface water in contact with active fill areas, which is treated as leachate.

### 2.2.2 Control of Surrounding Run-On

Surface water from areas west, north, and east of the Landfill currently drain to existing drainage channels that have formed in the valleys near the Landfill. These drainage channels converge at the location of the Landfill, are conveyed around the Landfill by perimeter diversion ditches, and continue to the south in a single drainage ditch. The main drainage ditch then routes the water to the south for approximately 1.5 miles before discharging into the Mississippi River (see Plan Sheet 5 in Appendix C).

Diversion ditches are designed to route off-site surface water around the Landfill in a controlled manner. These ditches are constructed in phases as the Landfill is developed.

During previous construction events, the perimeter drainage ditch along the eastern, western, and northern sides of the Landfill were constructed to route storm water from the east, west, and north around the Landfill. Cells 1, 2, and 3 of the Landfill have been constructed (see Plan Sheet 9 in Appendix C). A temporary drainage ditch/diversion berm was constructed on the northwestern side of the Landfill to route surface water from areas northwest of the Landfill around the Landfill. During Cell 4, Module B development, the remaining surface water controls will be completed (see Plan Sheets 11 and 12 in Appendix C).

Temporary and permanent ditching and diversion berms were designed and constructed to manage the peak flows associated with the 100-year, 24-hour storm event.

### 2.2.3 Diversion Berms

Diversion berms are designed along the final cover system to collect and transfer surface water to the receiving downslope flume or sedimentation basin (see Detail 2 on Plan Sheet 19 in Appendix C). These diversion berms concentrate and control flow, and discharge the non-contact surface water (water that has not come into contact with the CCR) from the Landfill away from the final cover. The swales created by the diversion berms are designed at 2 percent typical slopes along the flow lines. The locations of the surface water diversion berms are shown on Plan Sheet 12 in Appendix C.

Drainage areas for the Landfill are defined by the proposed surface water diversion berms at the site. Run-off computations were performed for the site with the proposed diversion berms in-place and are contained in Appendix A. Figure K-2 in Appendix A shows the post-closure drainage areas for the Landfill.

### 2.2.4 Downslope Flumes

Downslope flumes are included in the design to collect and transfer surface water from the diversion berms on the final cover to the sedimentation basins. Plan Sheet 12 shows the location of the downslope flumes. The downslope flumes have been designed as enclosed pipe flumes to limit erosion and to control the flow as it crosses roads. Downslope flume calculations are included in the culvert design subsection of Appendix A.

### 2.2.5 Ditching

Surface water ditching has been designed to minimize velocities and depths of flow. Velocities for the grass-lined ditching have been limited to 4 feet per second (fps). In areas where velocities exceed 4 fps, permanent erosion matting, or grouted riprap are used to limit erosion and reduce velocities. Ditch sizing calculations are contained in Appendix A. Designed ditch locations are shown on Figure K-3 in Appendix A. The ditching to route surface water around the Landfill and away from the active areas of the Landfill are designed at a minimum 2-foot depth as shown on Detail 8 on Plan Sheet 23 in Appendix A. Ditch sizing calculations for operational and post-closure conditions show that a minimum freeboard of 0.4 feet occurs as the worst case condition in the ditches for the 100-year 24-hour storm event. Therefore, the calculations indicate that run-on to the active areas of the Landfill should not occur for the 25-year 24-hour storm event as required by 40 CFR 257.81(a)(1).

### 2.2.6 Sedimentation Basins

Two permanent sedimentation basins are designed to capture and treat non-contact run-off from the Landfill final cover system. The locations of the permanent sedimentation basins are shown on Plan Sheet 5 in Appendix C. The basins have been designed with a minimum surface area that exceeds the surface area required to settle 0.015 mm particles. The sedimentation basins are designed to accommodate the surface water run-off from a 100-year, 24-hour storm event. The emergency spillways are designed to control the run-off from a storm greater than the 100-year, 24-hour storm event.

### 2.2.7 Culverts

Several culverts are designed to transport non-contact run-off from the Landfill final cover and surrounding areas. The locations of the permanent culverts are shown on Plan Sheet 12 in Appendix C. The culverts have been designed to allow the peak run-off associated with a 100-year, 24-hour storm to pass through it without creating surface water breaching (i.e., berm overflow and run-on into active areas of the Landfill) or excessive backwater levels. Culvert sizing was performed using design charts developed by the U.S. Department of Transportation Federal Highway Administration. Culvert sizing calculations are provided in Appendix A.

### 2.2.8 Temporary Surface Water Controls

In addition to the permanent surface water management features discussed above, temporary surface water controls are also implemented during operation of the Landfill to control surface water from entering the active disposal area and to limit erosion of the final cover. These temporary control features include diversion berms, downslope discharge structure, and culverts. Temporary diversion berms will be constructed as needed along the transition from an active area to an area that has reached final grade, or that has intermediate cover, in order to control surface water from entering the active area. Temporary downslope discharge structures will be used to route non-contact run-off from diversion berms (either temporary or permanent) to the perimeter ditches.

## 2.3 Run-Off Control System

### *2.3.1 General*

The leachate collection and handling system in conjunction with cell delineation berms (see detail 5 on Plan Sheet 17 in Appendix C) and perimeter berms comprise the control system for preventing contact surface water run-off from the active portions of the Landfill. Contact surface water is managed as leachate. The leachate collection system for the Landfill has been designed to provide effective drainage, collection, and removal of leachate from the Landfill.

### *2.3.2 Leachate Collection System*

The primary components of the leachate collection system consist of a drainage layer, leachate collection and transfer piping, cleanouts, manholes, a storage tank, and a load-out facility. The leachate collection system layout is shown on Plan Sheet 5 in Appendix C. The drainage layer is placed over the geomembrane on the base and sidewalls. The drainage layer promotes the efficient transmission of leachate to the leachate collection trenches and pipes. The drainage layer is a minimum of 12 inches thick and has a minimum hydraulic conductivity of $1.0 \times 10^{-2}$ centimeters per second (cm/s).

The leachate collection piping is placed in vee-shaped trenches and consists of 6-inch–diameter perforated high density polyethylene (HDPE) pipe. Pipe bedding material is placed around the perforated pipe and mounded as shown on Plan Sheet 17 in Appendix C.

Leachate collection pipes in each cell are placed parallel to each other in valleys over the herringbone design across the base. These lines drain at a 4 to 6 percent slope to the leachate removal and transfer system.

Temporary cell delineation berms are used along the cell boundaries to control surface water run-off from exiting the active areas of the Landfill. Refer to Detail 5 on Plan Sheet 17 for further details on the temporary cell delineation berm design.

### *2.3.3 Leachate Removal and Transfer System*

The perforated leachate collection piping will transition to 6-inch–diameter nonperforated leachate transfer piping within the Landfill just prior to where the transfer piping penetrates the liner system at the southern toe-of-slope of each cell. The horizontal pipe penetration has been designed to prevent leachate from leaving the Landfill liner system through the liner penetration.

Outside of the limits of CCR, concrete manholes provide a location for transfer piping to manifold into a single perimeter transfer pipe around the southern end of the Landfill, and to provide a location for cleanout access piping.

The combined transfer piping then extends to the leachate storage tank located near the ash processing facility. Leachate collected in the tank is pumped into tanker trucks and transported to a nearby wastewater treatment plan for treatment which complies with 40 CFR 257.81(b). Plan Sheet 5 illustrates the location of the transfer piping, manholes, and the storage tank.

### 2.3.4 Leachate Storage Capacity From a 25-Year 24-Hour Storm Event

The proposed phasing plans and existing conditions were reviewed to determine the worst-case scenario for leachate generation. This worst-case scenario was used to show that run-off from the active area of the Landfill would not occur from a 25-year 24-hour storm event. Calculations contained in Appendix B show that there is approximately 14,700 cubic feet of leachate storage capacity remaining in the leachate collection system after a 25-year 24-hour storm event. Therefore, sufficient infrastructure is provided to prevent run-off from the active area of the Landfill as required by 40 CFR 257.81(a)(2).

### 2.3.5 Conclusions

This Plan has demonstrated that the Landfill has a run-on control system and a run-off control system sufficient to prevent flow onto or off of the active portion during a 24-hour 25-year storm event. The Landfill is in compliance with the requirements of 40 CFR 257.81.

# 3.0 Construction of Run-on and Run-off Control System

## 3.1 Run-on Control Systems

As noted in Section 2.2, the run-on control system consists of perimeter berms, diversion berms, downslope flumes, ditching, sedimentation basins, and culverts. Run-on controls have been designed to divert off-site surface water away from the active fill areas. On-site water is routed to sedimentation basins, except surface water in contact with active fill areas which is treated as leachate.

As summarized in Section 2.2.2, the run-on features are constructed incrementally during both the liner construction and final cover construction events. The previously constructed features were constructed per the site specifications with construction oversight directed by a professional engineer licensed in the State of Wisconsin. Documentation reports for construction events at the Landfill were prepared, submitted to the WDNR, and approved by the WDNR.

Temporary systems are used at the limits of the construction event to assist in the run-on control system until the remainder of the components are completed. The remainder of the run-on control system components will be completed during development of Cell 4B and following its closure. Specific schedules of exactly when features will be developed is not practicable, as the development and closure of the Landfill is dependent on filling activities, which are highly variable. Future construction will meet the previously approved design and specifications as noted in the October 2000 Plan of Operation, and construction oversight will be directed by a professional engineer licensed in the State of Wisconsin.

An estimated schedule for these systems, based on an assumed CCR filling rate is included as Appendix D.

## 3.2 Run-off Control Systems

As noted in Section 2.3, the run-off control system consists of the leachate collection system in conjunction with cell delineation berms and perimeter berms. The previously constructed features for the active area were constructed during the liner installation of the associated module/cell. The remaining portions of the run-off control system will be constructed during the construction events for Cells 4A and 4B. The general placement of the leachate collection system is summarized in Section 2.3.2 and is detailed in the approved October 2000 Plan of Operation.

Previous and future construction have been/will be completed in accordance with the site specifications and design, as shown in Appendix C. Construction oversight has/will be directed by a professional engineer licensed in the State of Wisconsin. Documentation reports for previous construction events have been prepared, submitted to the WDNR, and previously approved by the WDNR. Following construction of future landfill cells/modules, reports documenting construction will be prepared and submitted to the WDNR as required by ch. NR 516.

An estimated schedule for these systems, based on an assumed CCR filling rate is included as Appendix D.

# 4.0 Amendment of the Plan and Notification

This Plan was completed in compliance with the requirements set forth in 40 CFR 257.81. This document has been placed in the operating record, posted to the publicly accessible website, and government notifications have been provided.

A Run-On and Run-Off Control System Plan must be prepared every 5 years from the completion date of this Plan.

The Plan must be amended whenever the periodic review period is reached or if changes in site conditions, either intentionally or unintentionally, occur that will sustainably impact the current written plan in effect.

# 5.0 Engineer's Certification

Pursuant to 40 CFR 257.81 and by means of this certification I attest that:

(i) I am familiar with the requirements of the federal CCR rule (40 CFR 257);

(ii) this Run-On and Run-Off Control System Plan has been prepared in accordance with good engineering practice; and

(iii) this Run-On and Run-Off Control System Plan meets the requirements of 40 CFR 257.81(c).

For the purpose of this document, "certify" and "certification" shall be interpreted and construed to be a "statement of professional opinion." The certification is understood and intended to be an expression of my professional opinion as a Wisconsin licensed professional engineer, based upon knowledge, information, and belief. The statement(s) of professional opinion are not and shall not be interpreted or construed to be a guarantee or a warranty of the analysis herein.

Signature of Registered Professional Engineer

Registration No. E-46825 State: Wisconsin

WISCONSIN BREANNE N. KAHNK E-46825 MIDDLETON, WI 7-24-24 PROFESSIONAL ENGINEER

# Appendix A: Surface Water Run-On Control System Calculations

Note: For clarification purposes, these run-on calculations estimate "run-off" quantities from areas in and surrounding the Landfill that develop non-contact surface water that is managed to prevent run-on to the active Landfill areas.

- Surface Water Run-off Calculations
  - Purpose/Methodology/Assumptions/Results/References
  - Post-closure Run-off Calculations
  - Operational Run-off Calculations
  - Reference Information
- Diversion Berm, Perimeter Ditch, and Spillway Design Calculations
  - Purpose/Methodology/Assumptions/Results/References
  - Calculations – Post-closure Landfill Conditions
  - Calculations – Operational Landfill Conditions
  - Reference Information
- Culvert/Downslope Flume Design Calculations
  - Purpose/Methodology/Assumptions/Results/References
  - Calculations – Post-closure Landfill Conditions
  - Calculations – Temporary Culverts, Operational Conditions
- Vegetation Information

# Surface Water Run-off Calculations

**Purpose/Methodology/Assumptions/Results/References**

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

| PROJECT/PROPOSAL NAME | PREPARED | | CHECKED | | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| | By: | Date: | By: | Date: | |
| Dairyland Power Cooperative | BJK | 5/97 | BLP | 6/97 | 3081.40 |

# SURFACE WATER RUNOFF CALCULATIONS

## Purpose

The purpose of the surface water runoff calculations was to estimate the amount of surface water runoff and the peak discharge for the 25-year, 24-hour and 100-year, 24-hour storms at the proposed Dairyland Power Landfill. Calculations were performed for the pre- and post-development conditions. Calculations were also performed for operational conditions for the 25-year, 24-hour storm. Once determined, the surface water runoff quantities were compared to determine the effect of the proposed landfill on the existing drainage patterns. The runoff calculations were also used to size diversion ditches, sedimentation basins, culverts, and downslope flumes.

## Methodologies

Surface water runoff calculations consist of delineating drainage areas (watersheds), as shown on the attached figures, estimating runoff characteristics, and calculating the peak and total runoff rate and volume for each drainage area. The methods for computing surface water runoff were based on the methodologies presented in the Technical Release No. 55 - "Urban Hydrology for Small Watersheds" by the United States Soil Conservation Service.

The calculations were performed using the QUICK TR-55 computer program developed by Haestad Methods (Haestad 1989). The program incorporates rainfall quantities, storm distributions, surface runoff characteristics, drainage areas, times of concentration, and travel times to generate a hydrograph from which the volume of surface water runoff and the peak discharge are obtained.

It is noted that the storm water control structures have been designed using a 100-year, 24-hour storm event and a TR-55 Type II storm distribution to determine peak flow rates. Rainfall distributions for the Type II storm event include "nested" higher intensity storm events within those needed for longer durations at the same probability. The resulting peak flows using this design method meet or exceed the peak flows obtained using a 25-year, time of concentration storm event (required by NR 504.09).

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|---|---|---|---|---|---|
| Dairyland Power Cooperative | BJK | 5/97 | BLP | 6/97 | 3081.40 |

## Assumptions

The following assumptions were made in developing the hydrographs (Note: The figures and values referenced in these assumptions have been included in the references portion of this appendix):

- A 2-year, 24-hour storm event in the vicinity of the landfill is 2.8 inches based on rainfall maps prepared by the U.S. Weather Bureau.
- A 25-year, 24-hour storm event in the vicinity of the landfill equates to 4.9 inches based on rainfall maps prepared by the U.S. Weather Bureau.
- A 100-year, 24-hour storm event in the vicinity of the landfill equates to 6.1 inches based on rainfall maps prepared by the U.S. Weather Bureau.
- A Type II rainfall distribution was used, based on SCS storm distribution maps provided in the TR-55 manual.
- Cover types for the pre-development conditions, from which runoff curve numbers were determined, were based on USGS topographic maps and an aerial photograph.
- For the post-development landfill conditions, a runoff curve number of 74 was assumed, based on values provided in the TR-55 manual.
- Based on the USDA-SCS General Soil Map for Buffalo County, Wisconsin, the primary soil formations present include the Dubuque silt loam and the Fayette silt loam. These soils are a Type B soil, based on tables provided in the TR-55 manual.
- Runoff curve numbers for the non-landfill areas ranged from 55 to 86, based on values provided in the TR-55 manual. Refer to the attached calculations for the breakdown and description of each of the curve numbers used for the various drainage areas.

## Results

The table below summarizes the results of the surface water runoff analyses and provides a comparison of the pre- and post-development conditions:

| STORM | TOTAL RUNOFF (acre-ft) | | | PEAK DISCHARGE (cfs) | | |
|---|---|---|---|---|---|---|
| | PRE- | POST- | Δ | PRE- | POST- | Δ |
| 25-year | 153 | 148 | (5) | 1,170 | 1,028 | (142) |
| 100-year | 232 | 225 | (7) | 1,895 | 1,622 | (273) |

Based on the results of the surface water runoff calculations, the proposed landfill is not anticipated to have an adverse impact on the existing surface water at the site. Total runoff volumes to the existing drainageways are not anticipated to change in the pre- and post-development conditions. Peak runoff volumes to the existing drainageways for post-

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| PROJECT/PROPOSAL NAME | PREPARED By: | Date: | CHECKED By: | Date: | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| Dairyland Power Cooperative | BJK | 5/97 | BLP | 6/97 | 3081.40 |

development conditions are slightly lower than the pre-development conditions. This is primarily due to the use of sedimentation basins to dissipate peak flows from the landfill to the surrounding areas. The reduced peak flows will result in reduced sediment transport from the site.

The results of these surface water runoff calculations have also been used in the attached diversion berm, perimeter ditch, spillway, and sedimentation basin calculations. These structures have been designed to handle the peak runoff from the 100-year, 24-hour storm event.

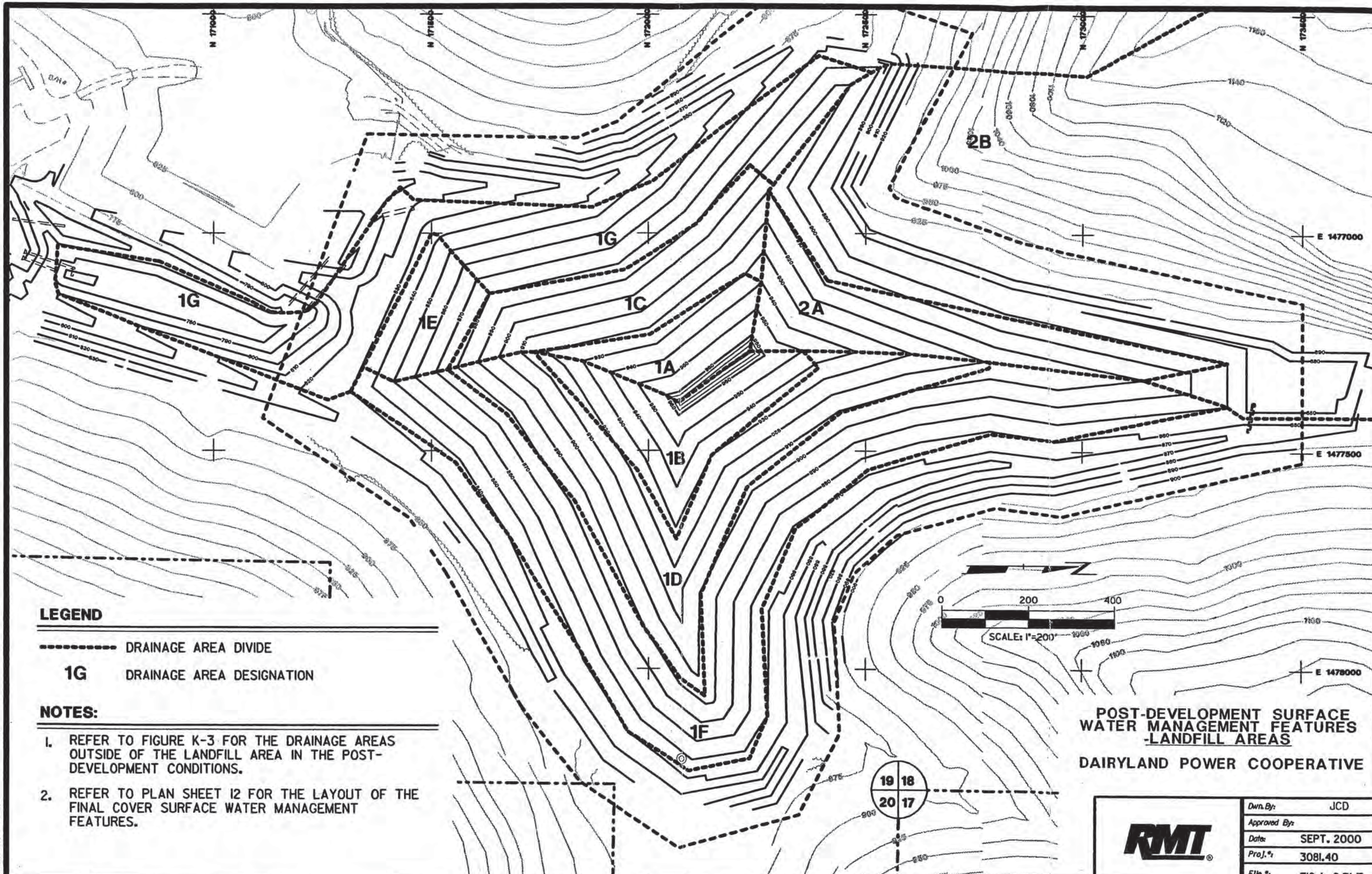
## References

US Department of Agriculture, Soil Conservation Service. Urban Hydrology for Small Watersheds. Technical Release No. 55. 2nd Edition. June 1986.

US Department of Agriculture, Soil Conservation Service. 1986. Engineering Field Manual for Conservation Practices. November 1986.

Haestad Methods. Pond Pack, QUICK TR-55. Hydrology for Small Watersheds. December 1989.

**Post-closure Run-off Calculations**




## LEGEND

DRAINAGE AREA DIVIDE (dashed line)

1G DRAINAGE AREA DESIGNATION

## NOTES:

1. REFER TO FIGURE K-3 FOR THE DRAINAGE AREAS OUTSIDE OF THE LANDFILL AREA IN THE POST-DEVELOPMENT CONDITIONS.
2. REFER TO PLAN SHEET 12 FOR THE LAYOUT OF THE FINAL COVER SURFACE WATER MANAGEMENT FEATURES.

Design File = ...081\40\FIG-L-2.PLT
DEFOE,Plot Dc = Tue Sep 19 11:21:06 2000
Plot File = ...081\40\FIG-L-2.prf
Pen Table = ...DNET\TBL\default.tbl
Levels On = 1-63

Ref. File 1 = bmclient.dgn
Ref. File 2 = bmrmt.dgn
Ref. File 3 = proposed.dgn
Ref. File 4 = surface.dgn

(1) 4-6,9,10,12,21,23,24,26-28,32,34,40,43,45,54,55,57,61
(2) 1-16
(3) 33,45-50
(4) 2,3,14-16

RMT COMPUTER AIDED DESIGN & DRAFTING

FIGURE K-2

Quick TR-55 Ver.5.46 S/N:
Executed: 09:52:46 04-09-1997

Dairyland Power Coop.
Feasibility Report
Landfill Runoff
BJK 3/97

RUNOFF CURVE NUMBER SUMMARY

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

| Subarea Description | Area (acres) | CN (weighted) |
|---|---|---|
| 1A | 1.40 | 74 |
| 1B | 2.20 | 74 |
| 1C | 2.90 | 74 |
| 1D | 5.30 | 74 |
| 1E | 1.20 | 74 |
| 1F | 9.50 | 74 |
| 1G | 7.40 | 84 |

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Dairyland Power Coop.
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RUNOFF CURVE NUMBER DATA

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

Composite Area: 1A

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Landfill Cover | 1.40 | 74 ✓ | |
| COMPOSITE AREA ---> | 1.40 | 74.0 | ( 74 ) |

::::::::::::::::::::::::::::::::::::::::::::::::::::::

Composite Area: 1B

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Landfill Cover | 2.20 | 74 ✓ | |
| COMPOSITE AREA ---> | 2.20 | 74.0 | ( 74 ) |

::::::::::::::::::::::::::::::::::::::::::::::::::::::

Composite Area: 1C

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Landfill Cover | 2.90 | 74 ✓ | |
| COMPOSITE AREA ---> | 2.90 | 74.0 | ( 74 ) |

::::::::::::::::::::::::::::::::::::::::::::::::::::::

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Composite Area: 1D

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Landfill Cover | 5.30 | 74 ✓ | |
| COMPOSITE AREA ---> | 5.30 | 74.0 | ( 74 ) |

Composite Area: 1E

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Landfill Cover | 1.20 | 74 ✓ | |
| COMPOSITE AREA ---> | 1.20 | 74.0 | ( 74 ) |

Composite Area: 1F

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Landfill Cover | 9.50 | 74 ✓ | |
| COMPOSITE AREA ---> | 9.50 | 74.0 | ( 74 ) |

Composite Area: 1G

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Landfill Cover | 4.40 | 74 ✓ | |
| Sedimentation Basin | 3.00 | 98 ✓ | |
| COMPOSITE AREA ---> | 7.40 | 83.7 | ( 84 ) |

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RUNOFF CURVE NUMBER SUMMARY

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

| Subarea Description | Area (acres) | CN (weighted) |
|---|---|---|
| 2A | 2.70 | 74 |
| 2B | 21.50 | 69 |

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Dairyland Power Coop.
Feasibility Report
Landfill Runoff
BJK 3/97

RUNOFF CURVE NUMBER DATA

Composite Area: 2A

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Landfill Cover | 2.70 | 74 | |
| COMPOSITE AREA ---> | 2.70 | 74.0 | ( 74 ) |

Composite Area: 2B

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Landfill Cover | 2.70 | 74 | |
| Graded/Grassed Area | 2.00 | 61 | |
| Woods/Brush | 15.80 | 67 | |
| Sedimentation Basin | 1.00 | 98 | |
| COMPOSITE AREA ---> | 21.50 | 68.8 | ( 69 ) |

Quick TR-55 Ver.5.46 S/N:
Executed: 08:55:25 06-18-1997 a:COVER1.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.
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| Subarea descr. | Tc or Tt | Time (hrs) |
|---|---|---|
| 1A | Tc | 0.18 |
| 1B | Tc | 0.23 |
| 1C | Tc | 0.23 |
| 1D | Tc | 0.35 |
| 1E | Tc | 0.18 |
| 1F | Tc | 0.45 |
| 1G | Tc | 0.22 |

Quick TR-55 Ver.5.46 S/N:
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Tc COMPUTATIONS FOR: 1A

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Dense Grass | |
| Manning's roughness coeff., n | | 0.2400 | |
| Flow length, L (total < or = 300) | ft | 150.0 | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.2500 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.13 | = 0.13 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 420.0 | |
| Watercourse slope, s | ft/ft | 0.0200 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 2.2818 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.05 | = 0.05 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Cross Sectional Flow Area, a | sq.ft | 0.00 | |
| Wetted perimeter, Pw | ft | 0.00 | |
| Hydraulic radius, r = a/Pw | ft | 0.000 | |
| Channel slope, s | ft/ft | 0.0000 | |
| Manning's roughness coeff., n | | 0.0000 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 0.0000 | |
| Flow length, L | ft | 0 | |
| T = L / (3600*V) | hrs | 0.00 | = 0.00 |

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TOTAL TIME (hrs) 0.18

Quick TR-55 Ver.5.46 S/N:
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Tc COMPUTATIONS FOR: 1B

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Dense Grass | |
| Manning's roughness coeff., n | | 0.2400 | |
| Flow length, L (total < or = 300) | ft | 125.0 | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.2500 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.11 | = 0.11 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 960.0 | |
| Watercourse slope, s | ft/ft | 0.0200 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 2.2818 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.12 | = 0.12 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Cross Sectional Flow Area, a | sq.ft | 0.00 | |
| Wetted perimeter, Pw | ft | 0.00 | |
| Hydraulic radius, r = a/Pw | ft | 0.000 | |
| Channel slope, s | ft/ft | 0.0000 | |
| Manning's roughness coeff., n | | 0.0000 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 0.0000 | |
| Flow length, L | ft | 0 | |
| T = L / (3600*V) | hrs | 0.00 | = 0.00 |

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TOTAL TIME (hrs) 0.23

Quick TR-55 Ver.5.46 S/N:
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Tc COMPUTATIONS FOR: 1C

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Dense Grass | |
| Manning's roughness coeff., n | | 0.2400 | |
| Flow length, L (total < or = 300) | ft | 165.0 | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.2500 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.14 | = 0.14 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 720.0 | |
| Watercourse slope, s | ft/ft | 0.0200 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 2.2818 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.09 | = 0.09 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Cross Sectional Flow Area, a | sq.ft | 0.00 | |
| Wetted perimeter, Pw | ft | 0.00 | |
| Hydraulic radius, r = a/Pw | ft | 0.000 | |
| Channel slope, s | ft/ft | 0.0000 | |
| Manning's roughness coeff., n | | 0.0000 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 0.0000 | |
| Flow length, L | ft | 0 | |
| T = L / (3600*V) | hrs | 0.00 | = 0.00 |

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TOTAL TIME (hrs) 0.23

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Tc COMPUTATIONS FOR: 1D

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Dense Grass | |
| Manning's roughness coeff., n | | 0.2400 | |
| Flow length, L (total < or = 300) | ft | 160.0 ✓ | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.2500 ✓ | |
| $T = \dfrac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.13 | = 0.13 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 1770.0 ✓ | |
| Watercourse slope, s | ft/ft | 0.0200 ✓ | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 2.2818 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.22 | = 0.22 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Cross Sectional Flow Area, a | sq.ft | 0.00 | |
| Wetted perimeter, Pw | ft | 0.00 | |
| Hydraulic radius, r = a/Pw | ft | 0.000 | |
| Channel slope, s | ft/ft | 0.0000 | |
| Manning's roughness coeff., n | | 0.0000 | |
| $V = \dfrac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 0.0000 | |
| Flow length, L | ft | 0 | |
| T = L / (3600*V) | hrs | 0.00 | = 0.00 |

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TOTAL TIME (hrs) 0.35

Quick TR-55 Ver.5.46 S/N:
Executed: 08:55:25 06-18-1997 a:COVER1.TCT

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Tc COMPUTATIONS FOR: 1E

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Dense Grass | |
| Manning's roughness coeff., n | | 0.2400 | |
| Flow length, L (total < or = 300) | ft | 175.0 ✓ | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.2500 ✓ | |

$$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$$ hrs 0.14 = 0.14

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 250.0 ✓ | |
| Watercourse slope, s | ft/ft | 0.0200 ✓ | |

$$Avg.V = Csf * (s)^{0.5}$$ ft/s 2.2818

where: Unpaved Csf = 16.1345
Paved Csf = 20.3282

T = L / (3600*V) hrs 0.03 = 0.03

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Cross Sectional Flow Area, a | sq.ft | 0.00 | |
| Wetted perimeter, Pw | ft | 0.00 | |
| Hydraulic radius, r = a/Pw | ft | 0.000 | |
| Channel slope, s | ft/ft | 0.0000 | |
| Manning's roughness coeff., n | | 0.0000 | |

$$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$$ ft/s 0.0000

Flow length, L ft 0

T = L / (3600*V) hrs 0.00 = 0.00

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TOTAL TIME (hrs) 0.18

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Tc COMPUTATIONS FOR: 1F

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Dense Grass | |
| Manning's roughness coeff., n | | 0.2400 | |
| Flow length, L (total < or = 300) | ft | 150.0 | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.2500 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.13 | = 0.13 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 2650.0 | |
| Watercourse slope, s | ft/ft | 0.0200 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 2.2818 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.32 | = 0.32 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Cross Sectional Flow Area, a | sq.ft | 0.00 | |
| Wetted perimeter, Pw | ft | 0.00 | |
| Hydraulic radius, r = a/Pw | ft | 0.000 | |
| Channel slope, s | ft/ft | 0.0000 | |
| Manning's roughness coeff., n | | 0.0000 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 0.0000 | |
| Flow length, L | ft | 0 | |
| T = L / (3600*V) | hrs | 0.00 | = 0.00 |

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TOTAL TIME (hrs) 0.45

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Tc COMPUTATIONS FOR: 1G

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Dense Grass | |
| Manning's roughness coeff., n | | 0.2400 | |
| Flow length, L (total < or = 300) | ft | 170.0 | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.2500 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.14 | = 0.14 |

SHALLOW CONCENTRATED FLOW

| | | | | |
|---|---|---|---|---|
| Segment ID | | 2 | 3 | |
| Surface (paved or unpaved)? | | Unpaved | Unpaved | |
| Flow length, L | ft | 780.0 | 370.0 | |
| Watercourse slope, s | ft/ft | 0.0600 | 0.0800 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 3.9521 | 4.5635 | |
| where: Unpaved Csf = 16.1345 | | | | |
| Paved Csf = 20.3282 | | | | |
| T = L / (3600*V) | hrs | 0.05 + | 0.02 | = 0.08 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Cross Sectional Flow Area, a | sq.ft | 0.00 | |
| Wetted perimeter, Pw | ft | 0.00 | |
| Hydraulic radius, r = a/Pw | ft | 0.000 | |
| Channel slope, s | ft/ft | 0.0000 | |
| Manning's roughness coeff., n | | 0.0000 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 0.0000 | |
| Flow length, L | ft | 0 | |
| T = L / (3600*V) | hrs | 0.00 | = 0.00 |

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

TOTAL TIME (hrs) 0.22

Quick TR-55 Ver.5.46 S/N:
Executed: 08:57:44 06-18-1997 a:COVER2.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.
Feasibility Report
Landfill Final Cover
BJK 3/97

| Subarea descr. | Tc or Tt | Time (hrs) |
|---|---|---|
| 2A | Tc | 0.28 |
| 2B | Tc | 0.18 |

Quick TR-55 Ver.5.46 S/N:
Executed: 08:57:44 06-18-1997 a:COVER2.TCT

Dairyland Power Coop.
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Tc COMPUTATIONS FOR: 2A

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Dense Grass | |
| Manning's roughness coeff., n | | 0.2400 | |
| Flow length, L (total < or = 300) | ft | 200.0 ✓ | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.2500 ✓ | |

$$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$$ hrs 0.16 = 0.16

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 940.0 ✓ | |
| Watercourse slope, s | ft/ft | 0.0200 ✓ | |

$$Avg.V = Csf * (s)^{0.5}$$ ft/s 2.2818

where: Unpaved Csf = 16.1345
Paved Csf = 20.3282

T = L / (3600*V) hrs 0.11 = 0.11

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Cross Sectional Flow Area, a | sq.ft | 0.00 | |
| Wetted perimeter, Pw | ft | 0.00 | |
| Hydraulic radius, r = a/Pw | ft | 0.000 | |
| Channel slope, s | ft/ft | 0.0000 | |
| Manning's roughness coeff., n | | 0.0000 | |

$$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$$ ft/s 0.0000

Flow length, L ft 0

T = L / (3600*V) hrs 0.00 = 0.00

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TOTAL TIME (hrs) 0.28

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Quick TR-55 Ver.5.46   S/N:
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                        Landfill Final Cover
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                     Tc COMPUTATIONS FOR: 2B

SHEET FLOW (Applicable to Tc only)
   Segment ID                                   1
   Surface description                      Brush
   Manning's roughness coeff., n                 0.1300
   Flow length, L (total < or = 300)     ft     300.0
   Two-yr 24-hr rainfall, P2              in     2.800
   Land slope, s                        ft/ft   0.2000
                      0.8
        .007 * (n*L)
   T = --------------                    hrs     0.15                 = 0.15
           0.5    0.4
         P2   *  s

SHALLOW CONCENTRATED FLOW
   Segment ID                                   2        3
   Surface (paved or unpaved)?               Unpaved  Unpaved
   Flow length, L                        ft     560.0    300.0
   Watercourse slope, s                ft/ft   0.4400   0.0800

                        0.5
   Avg.V =  Csf *  (s)                 ft/s  %10.7024  4.5635
   where:   Unpaved Csf = 16.1345
       .    Paved   Csf = 20.3282

   T = L / (3600*V)                      hrs     0.01  +   0.02   =  0.03


CHANNEL FLOW
   Segment ID
   Cross Sectional Flow Area, a        sq.ft     0.00
   Wetted perimeter, Pw                   ft     0.00
   Hydraulic radius, r = a/Pw             ft    0.000
   Channel slope, s                     ft/ft   0.0000
   Manning's roughness coeff., n                0.0000

                  2/3    1/2
        1.49  *  r    *  s
   V = --------------------            ft/s   0.0000
                  n

   Flow length, L                        ft        0

   T = L / (3600*V)                      hrs     0.00                 = 0.00

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                          TOTAL TIME (hrs)            0.18
```

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
BJK 3/97

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used | |
|---|---|---|---|---|---|---|---|---|
| 1A | 1.40 | 74.0 | 0.20 | 0.00 | 4.90 | 2.28 | I.14 | .14 |
| 1B | 2.20 | 74.0 | 0.20 | 0.00 | 4.90 | 2.28 | I.14 | .14 |
| 1C | 2.90 | 74.0 | 0.20 | 0.00 | 4.90 | 2.28 | I.14 | .14 |
| 1D | 5.30 | 74.0 | 0.40 | 0.00 | 4.90 | 2.28 | I.14 | .14 |
| 1E | 1.20 | 74.0 | 0.20 | 0.00 | 4.90 | 2.28 | I.14 | .14 |
| 1F | 9.50 | 74.0 | 0.50 | 0.00 | 4.90 | 2.28 | I.14 | .14 |
| 1G | 7.40 | 84.0 | 0.20 | 0.00 | 4.90 | 3.18 | 1.08 | .10 |

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 29.90 acres or 0.04672 sq.mi
Peak discharge = 67 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

Total Runoff =

$$\frac{22.5\ ac\,(2.28") + 7.4\ ac\,(3.18\ in)}{12}$$

= 6.2 ac-FT

>>>> Computer Modifications of Input Parameters <<<<<

| Subarea Description | Input Values Tc (hr) | Input Values * Tt (hr) | Rounded Values Tc (hr) | Rounded Values * Tt (hr) | Ia/p Interpolated (Yes/No) | Ia/p Messages |
|---|---|---|---|---|---|---|
| 1A | 0.18 | 0.00 | 0.20 | 0.00 | Yes | -- |
| 1B | 0.23 | 0.00 | 0.20 | 0.00 | Yes | -- |
| 1C | 0.23 | 0.00 | 0.20 | 0.00 | Yes | -- |
| 1D | 0.35 | 0.00 | 0.40 | 0.00 | Yes | -- |
| 1E | 0.18 | 0.00 | 0.20 | 0.00 | Yes | -- |
| 1F | 0.45 | 0.00 | 0.50 | 0.00 | Yes | -- |
| 1G | 0.22 | 0.00 | 0.20 | 0.00 | No | Computed Ia/p < .1 |

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

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>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| 1A | 4 | 12.2 |
| 1B | 6 | 12.2 |
| 1C | 8 | 12.2 |
| 1D | 11 | 12.3 |
| 1E | 3 | 12.1 |
| 1F | 17 | 12.4 |
| 1G | 29 | 12.2 |
| Composite Watershed | 67 | 12.2 |

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
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Composite Hydrograph Summary (cfs)

| Subarea Description | 11.0 hr | 11.3 hr | 11.6 hr | 11.9 hr | 12.0 hr | 12.1 hr | 12.2 hr | 12.3 hr | 12.4 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1A | 0 | 0 | 0 | 1 | 2 | 3 | 4 | 2 | 1 |
| 1B | 0 | 0 | 0 | 1 | 3 | 5 | 6 | 4 | 2 |
| 1C | 0 | 0 | 0 | 2 | 4 | 7 | 8 | 5 | 3 |
| 1D | 0 | 0 | 1 | 1 | 2 | 5 | 8 | 11 | 11 |
| 1E | 0 | 0 | 0 | 1 | 2 | 3 | 3 | 2 | 1 |
| 1F | 0 | 1 | 1 | 2 | 3 | 5 | 9 | 15 | 17 |
| 1G | 1 | 1 | 2 | 8 | 15 | 27 | 29 | 18 | 9 |
| Total (cfs) | 1 | 2 | 4 | 16 | 31 | 55 | 67 | 57 | 44 |

| Subarea Description | 12.5 hr | 12.6 hr | 12.7 hr | 12.8 hr | 13.0 hr | 13.2 hr | 13.4 hr | 13.6 hr | 13.8 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1A | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1B | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 1C | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1D | 8 | 6 | 4 | 3 | 2 | 2 | 1 | 1 | 1 |
| 1E | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1F | 17 | 13 | 10 | 8 | 5 | 3 | 3 | 2 | 2 |
| 1G | 6 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 |
| Total (cfs) | 36 | 28 | 21 | 16 | 12 | 9 | 7 | 6 | 5 |

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

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Composite Hydrograph Summary (cfs)

| Subarea Description | 14.0 hr | 14.3 hr | 14.6 hr | 15.0 hr | 15.5 hr | 16.0 hr | 16.5 hr | 17.0 hr | 17.5 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1A | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1D | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 1E | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1F | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1G | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Total (cfs) | 4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |

| Subarea Description | 18.0 hr | 19.0 hr | 20.0 hr | 22.0 hr | 26.0 hr |
|---|---|---|---|---|---|
| 1A | 0 | 0 | 0 | 0 | 0 |
| 1B | 0 | 0 | 0 | 0 | 0 |
| 1C | 0 | 0 | 0 | 0 | 0 |
| 1D | 0 | 0 | 0 | 0 | 0 |
| 1E | 0 | 0 | 0 | 0 | 0 |
| 1F | 1 | 1 | 1 | 0 | 0 |
| 1G | 1 | 1 | 0 | 0 | 0 |
| Total (cfs) | 2 | 2 | 1 | 0 | 0 |

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55
Watershed file: --> A:COVER1 .MOP
Hydrograph file: --> A:COVER100.HYD

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Fesibility Study
Landfill Cover
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/BLB
8/20/98

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used | |
|---|---|---|---|---|---|---|---|---|
| 1A | 1.40 | 74.0 | 0.20 | 0.00 | 6.10 | 3.27 | I.12 | .12 |
| 1B | 2.20 | 74.0 | 0.20 | 0.00 | 6.10 | 3.27 | I.12 | .12 |
| 1C | 2.90 | 74.0 | 0.20 | 0.00 | 6.10 | 3.27 | I.12 | .12 |
| 1D | 5.30 | 74.0 | 0.40 | 0.00 | 6.10 | 3.27 | I.12 | .12 |
| 1E | 1.20 | 74.0 | 0.20 | 0.00 | 6.10 | 3.27 | I.12 | .12 |
| 1F | 9.50 | 74.0 | 0.50 | 0.00 | 6.10 | 3.27 | I.12 | .12 |
| 1G | 7.40 | 84.0 | 0.20 | 0.00 | 6.10 | 4.29 | I.06 | .10 |

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 29.90 acres or 0.04672 sq.mi
Peak discharge = 98 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

Total Runoff =

$$\frac{22.5\text{ ac }(3.27'') + 7.4\text{ ac }(4.29'')}{12}$$

= 8.8 ac-FT

>>>> Computer Modifications of Input Parameters <<<<<

| Subarea Description | Input Values Tc (hr) | Input Values * Tt (hr) | Rounded Values Tc (hr) | Rounded Values * Tt (hr) | Ia/p Interpolated (Yes/No) | Ia/p Messages |
|---|---|---|---|---|---|---|
| 1A | 0.18 | 0.00 | 0.20 | 0.00 | Yes | -- |
| 1B | 0.23 | 0.00 | 0.20 | 0.00 | Yes | -- |
| 1C | 0.23 | 0.00 | 0.20 | 0.00 | Yes | -- |
| 1D | 0.35 | 0.00 | 0.40 | 0.00 | Yes | -- |
| 1E | 0.18 | 0.00 | 0.20 | 0.00 | Yes | -- |
| 1F | 0.45 | 0.00 | 0.50 | 0.00 | Yes | -- |
| 1G | 0.22 | 0.00 | 0.20 | 0.00 | No | Computed Ia/p < .1 |

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55
Watershed file: --> A:COVER1 .MOP
Hydrograph file: --> A:COVER100.HYD

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>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| 1A | 6 | 12.2 |
| 1B | 9 | 12.2 |
| 1C | 12 | 12.2 |
| 1D | 16 | 12.3 |
| 1E | 5 | 12.2 |
| 1F | 25 | 12.4 |
| 1G | 40 | 12.2 |
| Composite Watershed | 98 | 12.2 |

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55
Watershed file: --> A:COVER1 .MOP
Hydrograph file: --> A:COVER100.HYD

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Composite Hydrograph Summary (cfs)

| Subarea Description | 11.0 hr | 11.3 hr | 11.6 hr | 11.9 hr | 12.0 hr | 12.1 hr | 12.2 hr | 12.3 hr | 12.4 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1A | 0 | 0 | 0 | 1 | 3 | 5 | 6 | 3 | 2 |
| 1B | 0 | 0 | 0 | 2 | 4 | 8 | 9 | 5 | 3 |
| 1C | 0 | 0 | 1 | 3 | 6 | 11 | 12 | 7 | 4 |
| 1D | 0 | 1 | 1 | 2 | 4 | 7 | 12 | 16 | 15 |
| 1E | 0 | 0 | 0 | 1 | 2 | 4 | 5 | 3 | 2 |
| 1F | 1 | 1 | 1 | 2 | 4 | 8 | 14 | 22 | 25 |
| 1G | 1 | 2 | 2 | 10 | 20 | 37 | 40 | 24 | 12 |
| Total (cfs) | 2 | 4 | 5 | 21 | 43 | 80 | 98 | 80 | 63 |

| Subarea Description | 12.5 hr | 12.6 hr | 12.7 hr | 12.8 hr | 13.0 hr | 13.2 hr | 13.4 hr | 13.6 hr | 13.8 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1A | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1B | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1C | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1D | 12 | 8 | 6 | 4 | 3 | 2 | 2 | 2 | 1 |
| 1E | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1F | 24 | 19 | 14 | 11 | 7 | 5 | 4 | 3 | 3 |
| 1G | 8 | 6 | 5 | 4 | 3 | 3 | 3 | 2 | 2 |
| Total (cfs) | 51 | 38 | 30 | 23 | 16 | 12 | 11 | 9 | 8 |

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55
Watershed file: --> A:COVER1 .MOP
Hydrograph file: --> A:COVER100.HYD

Dairyland Power Coop.
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Composite Hydrograph Summary (cfs)

| Subarea Description | 14.0 hr | 14.3 hr | 14.6 hr | 15.0 hr | 15.5 hr | 16.0 hr | 16.5 hr | 17.0 hr | 17.5 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1A | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1C | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1D | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1E | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1F | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 1G | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Total (cfs) | 6 | 6 | 6 | 4 | 3 | 3 | 3 | 3 | 3 |

| Subarea Description | 18.0 hr | 19.0 hr | 20.0 hr | 22.0 hr | 26.0 hr |
|---|---|---|---|---|---|
| 1A | 0 | 0 | 0 | 0 | 0 |
| 1B | 0 | 0 | 0 | 0 | 0 |
| 1C | 0 | 0 | 0 | 0 | 0 |
| 1D | 1 | 0 | 0 | 0 | 0 |
| 1E | 0 | 0 | 0 | 0 | 0 |
| 1F | 1 | 1 | 1 | 1 | 0 |
| 1G | 1 | 1 | 1 | 1 | 0 |
| Total (cfs) | 3 | 2 | 2 | 2 | 0 |

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:16
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER225.HYD

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>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used |
|---|---|---|---|---|---|---|---|
| 2A | 2.70 | 74.0 | 0.30 | 0.00 | 4.90 | 2.28 | I.14 .14 |
| 2B | 21.50 | 69.0 | 0.20 | 0.00 | 4.90 | 1.89 | I.18 .18 |

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 24.20 acres or 0.03781 sq.mi
Peak discharge = 54 cfs

WARNING: Drainage areas of two or more subareas
differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

| Subarea Description | Input Values Tc (hr) | Input Values * Tt (hr) | Rounded Values Tc (hr) | Rounded Values * Tt (hr) | Ia/p Interpolated (Yes/No) | Ia/p Messages |
|---|---|---|---|---|---|---|
| 2A | 0.28 | 0.00 | 0.30 | 0.00 | Yes | -- |
| 2B | 0.18 | 0.00 | 0.20 | 0.00 | Yes | -- |

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:16
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER225.HYD

Dairyland Power Coop.
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>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| 2A | 6 | 12.2 |
| 2B | 48 | 12.2 |
| Composite Watershed | 54 | 12.2 |

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:16
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\COVER2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\COVER225.HYD

Dairyland Power Coop.
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BJK 3/97

Composite Hydrograph Summary (cfs)

| Subarea Description | 11.0 hr | 11.3 hr | 11.6 hr | 11.9 hr | 12.0 hr | 12.1 hr | 12.2 hr | 12.3 hr | 12.4 hr |
|---|---|---|---|---|---|---|---|---|---|
| 2A | 0 | 0 | 0 | 1 | 2 | 4 | 6 | 6 | 4 |
| 2B | 1 | 1 | 2 | 9 | 20 | 42 | 48 | 31 | 17 |
| Total (cfs) | 1 | 1 | 2 | 10 | 22 | 46 | 54 | 37 | 21 |

| Subarea Description | 12.5 hr | 12.6 hr | 12.7 hr | 12.8 hr | 13.0 hr | 13.2 hr | 13.4 hr | 13.6 hr | 13.8 hr |
|---|---|---|---|---|---|---|---|---|---|
| 2A | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 2B | 11 | 9 | 7 | 6 | 5 | 4 | 4 | 4 | 3 |
| Total (cfs) | 14 | 11 | 8 | 7 | 6 | 5 | 5 | 5 | 3 |

| Subarea Description | 14.0 hr | 14.3 hr | 14.6 hr | 15.0 hr | 15.5 hr | 16.0 hr | 16.5 hr | 17.0 hr | 17.5 hr |
|---|---|---|---|---|---|---|---|---|---|
| 2A | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2B | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| Total (cfs) | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |

| Subarea Description | 18.0 hr | 19.0 hr | 20.0 hr | 22.0 hr | 26.0 hr |
|---|---|---|---|---|---|
| 2A | 0 | 0 | 0 | 0 | 0 |
| 2B | 1 | 1 | 1 | 1 | 0 |

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 15:19:47
Watershed file: --> A:\COVER2 .MOP
Hydrograph file: --> A:\COVER200.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
BJK 3/97

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used |
|---|---|---|---|---|---|---|---|
| 2A | 2.70 | 74.0 | 0.30 | 0.00 | 6.10 | 3.27 | I.12 .12 |
| 2B | 21.50 | 69.0 | 0.20 | 0.00 | 6.10 | 2.79 | I.15 .15 |

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 24.20 acres or 0.03781 sq.mi
Peak discharge = 82 cfs

WARNING: Drainage areas of two or more subareas differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

| Subarea Description | Input Values Tc (hr) | Input Values * Tt (hr) | Rounded Values Tc (hr) | Rounded Values * Tt (hr) | Ia/p Interpolated (Yes/No) | Ia/p Messages |
|---|---|---|---|---|---|---|
| 2A | 0.28 | 0.00 | 0.30 | 0.00 | Yes | -- |
| 2B | 0.18 | 0.00 | 0.20 | 0.00 | Yes | -- |

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 15:19:47
Watershed file: --> A:\COVER2 .MOP
Hydrograph file: --> A:\COVER200.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
BJK 3/97

>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| 2A | 9 | 12.2 |
| 2B | 73 | 12.2 |
| Composite Watershed | 82 | 12.2 |

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 15:19:47
Watershed file: --> A:\COVER2 .MOP
Hydrograph file: --> A:\COVER200.HYD

Dairyland Power Coop.
Fesibility Study
Landfill Cover
BJK 3/97

Composite Hydrograph Summary (cfs)

| Subarea Description | 11.0 hr | 11.3 hr | 11.6 hr | 11.9 hr | 12.0 hr | 12.1 hr | 12.2 hr | 12.3 hr | 12.4 hr |
|---|---|---|---|---|---|---|---|---|---|
| 2A | 0 | 0 | 1 | 1 | 3 | 6 | 9 | 9 | 6 |
| 2B | 2 | 2 | 3 | 16 | 33 | 65 | 73 | 45 | 24 |
| Total (cfs) | 2 | 2 | 4 | 17 | 36 | 71 | 82 | 54 | 30 |

| Subarea Description | 12.5 hr | 12.6 hr | 12.7 hr | 12.8 hr | 13.0 hr | 13.2 hr | 13.4 hr | 13.6 hr | 13.8 hr |
|---|---|---|---|---|---|---|---|---|---|
| 2A | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 2B | 16 | 13 | 10 | 9 | 7 | 6 | 6 | 5 | 5 |
| Total (cfs) | 20 | 16 | 12 | 11 | 8 | 7 | 7 | 6 | 6 |

| Subarea Description | 14.0 hr | 14.3 hr | 14.6 hr | 15.0 hr | 15.5 hr | 16.0 hr | 16.5 hr | 17.0 hr | 17.5 hr |
|---|---|---|---|---|---|---|---|---|---|
| 2A | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2B | 4 | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| Total (cfs) | 5 | 5 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |

| Subarea Description | 18.0 hr | 19.0 hr | 20.0 hr | 22.0 hr | 26.0 hr |
|---|---|---|---|---|---|
| 2A | 0 | 0 | 0 | 0 | 0 |
| 2B | 2 | 2 | 1 | 1 | 0 |

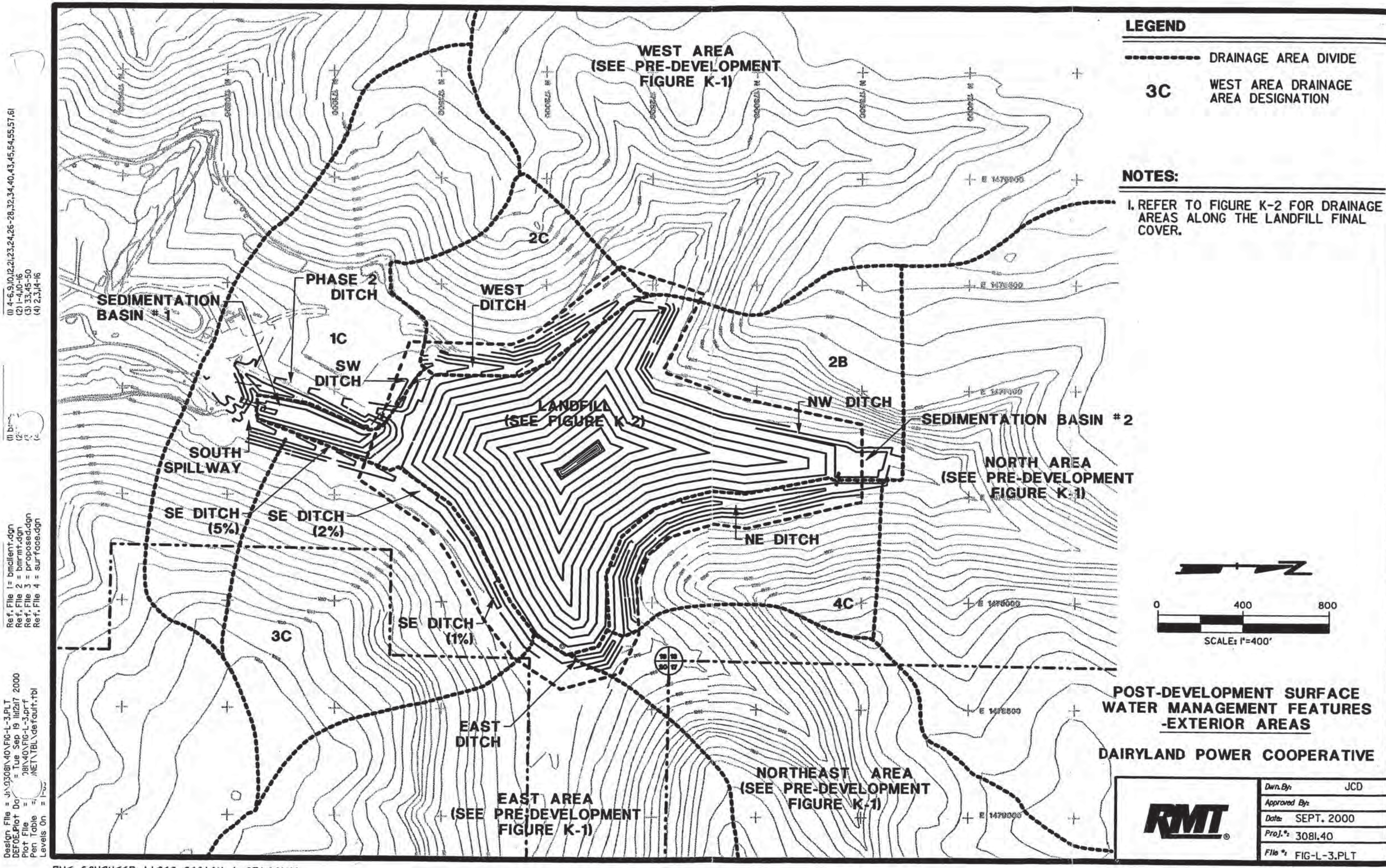
LEGEND
DRAINAGE AREA DIVIDE
3C
WEST AREA DRAINAGE AREA DESIGNATION
NOTES:
1. REFER TO FIGURE K-2 FOR DRAINAGE AREAS ALONG THE LANDFILL FINAL COVER.
WEST AREA (SEE PRE-DEVELOPMENT FIGURE K-1)
2C
PHASE 2 DITCH
WEST DITCH
SEDIMENTATION BASIN #1
1C
SW DITCH
2B
NW DITCH
SEDIMENTATION BASIN #2
LANDFILL (SEE FIGURE K-2)
NORTH AREA (SEE PRE-DEVELOPMENT FIGURE K-1)
SOUTH SPILLWAY
SE DITCH (5%)
SE DITCH (2%)
NE DITCH
4C
3C
SE DITCH (1%)
EAST DITCH
EAST AREA (SEE PRE-DEVELOPMENT FIGURE K-1)
NORTHEAST AREA (SEE PRE-DEVELOPMENT FIGURE K-1)
0 400 800
SCALE: 1"=400'
POST-DEVELOPMENT SURFACE WATER MANAGEMENT FEATURES -EXTERIOR AREAS
DAIRYLAND POWER COOPERATIVE
RMT
Dwn. By: JCD
Approved By:
Date: SEPT. 2000
Proj. #: 3081.40
File #: FIG-L-3.PLT
Ref. File 1 = bmclient.dgn
Ref. File 2 = bmrmt.dgn
Ref. File 3 = proposed.dgn
Ref. File 4 = surface.dgn
RMT COMPUTER AIDED DESIGN & DRAFTING

FIGURE K-3

Quick TR-55 Ver.5.46 S/N:
Executed: 11:43:33 07-30-1998

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 rev 7/98

RUNOFF CURVE NUMBER SUMMARY

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

| Subarea Description | Area (acres) | CN (weighted) |
|---|---|---|
| 1C | 42.00 | 67 |
| 2C | 15.00 | 56 |
| 3C | 33.00 | 58 |
| 4C | 16.00 | 57 |
| East | 520.00 | 67 |
| Northeast | 80.00 | 63 |
| North | 236.00 | 63 |
| West | 100.00 | 71 |

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Dairyland Power Coop.
Feasibility Report
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RUNOFF CURVE NUMBER DATA

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

Composite Area: 1C

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Woods (35%) | 15.00 | 55 | |
| Existing Landfill (50%) | 21.00 | 74 | |
| Graded Areas (10%) | 4.00 | 61 | |
| Fallow - Bare Soil (5%) | 2.00 | 86 | |
| COMPOSITE AREA ---> | 42.00 | 66.5 | ( 67 ) |

::::::::::::::::::::::::::::::::::::::::::::::::::::::

Composite Area: 2C

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Woods (85%) | 12.80 | 55 | |
| Graded Areas (15%) | 2.20 | 61 | |
| COMPOSITE AREA ---> | 15.00 | 55.9 | ( 56 ) |

::::::::::::::::::::::::::::::::::::::::::::::::::::::

Composite Area: 3C

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Woods (80%) | 27.00 | 55 | |
| Graded Areas (10%) | 3.00 | 61 | |
| Fallow - Bare Soil (10%) | 3.00 | 86 | |
| COMPOSITE AREA ---> | 33.00 | 58.4 | ( 58 ) |

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Composite Area: 4C

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Woods (75%) | 12.00 | 55 | |
| Graded Areas (25%) | 4.00 | 61 | |
| COMPOSITE AREA ---> | 16.00 | 56.5 | ( 57 ) |

Composite Area: East

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Woods (60%) | 312.00 | 55 | |
| Fallow - Bare Soil (40%) | 208.00 | 86 | |
| COMPOSITE AREA ---> | 520.00 | 67.4 | ( 67 ) |

Composite Area: Northeast

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Woods (75%) | 60.00 | 55 | |
| Fallow - Bare Soil (25%) | 20.00 | 86 | |
| COMPOSITE AREA ---> | 80.00 | 62.8 | ( 63 ) |

Composite Area: North

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Woods (75%) | 177.00 | 55 | |
| Fallow - Bare Soil (25%) | 59.00 | 86 | |
| COMPOSITE AREA ---> | 236.00 | 62.8 | ( 63 ) |

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Executed: 11:43:33 07-30-1998

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Composite Area: West

| SURFACE DESCRIPTION | AREA (acres) | CN | |
|---|---|---|---|
| Woods (50%) | 50.00 | 55 | |
| Fallow - Bare Soil (50%) | 50.00 | 86 | |
| COMPOSITE AREA ---> | 100.00 | 70.5 | ( 71 ) |

Quick TR-55 Ver.5.46 S/N:
Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

**SUMMARY SHEET FOR Tc or Tt COMPUTATIONS**
**(Solved for Time using TR-55 Methods)**

**Dairyland Power Coop.**
**Feasibility Report**
**PostDevelopment Conditions**
**BJK 5/97**

| Subarea descr. | Tc or Tt | Time (hrs) |
|---|---|---|
| 1C | Tc | 0.35 |
| 2C | Tc | 0.32 |
| 3C | Tc | 0.41 |
| 4C | Tc | 0.38 |
| East | Tc | 0.68 |
| Northeast | Tc | 0.37 |
| North | Tc | 0.53 |
| West | Tc | 0.52 |

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Quick TR-55 Ver.5.46   S/N:
Executed: 09:21:09   05-09-1997    a:POSTDVTC.TCT

                      Dairyland Power Coop.
                       Feasibility Report
                    PostDevelopment Conditions
                            BJK 5/97

                   Tc COMPUTATIONS FOR: 1C

SHEET FLOW (Applicable to Tc only)
  Segment ID                                     1
  Surface description                      Woods
  Manning's roughness coeff., n                 0.4000
  Flow length, L (total < or = 300)    ft      300.0
  Two-yr 24-hr rainfall, P2            in      2.800
  Land slope, s                      ft/ft     0.2700
                     0.8
       .007 * (n*L)
  T =  --------------                  hrs      0.33            =  0.33
           0.5    0.4
         P2    *  s

SHALLOW CONCENTRATED FLOW
  Segment ID                                     2
  Surface (paved or unpaved)?                  Unpaved
  Flow length, L                        ft     650.0
  Watercourse slope, s                ft/ft    0.5000

                     0.5
  Avg.V =  Csf *  (s)                 ft/s    %11.4088
  where:   Unpaved Csf = 16.1345
           Paved   Csf = 20.3282

  T = L / (3600*V)                    hrs      0.02             =  0.02


CHANNEL FLOW
  Segment ID                                     3
  Cross Sectional Flow Area, a       sq.ft     42.00
  Wetted perimeter, Pw                  ft     28.00
  Hydraulic radius, r = a/Pw            ft     1.500
  Channel slope, s                    ft/ft    0.1500
  Manning's roughness coeff., n                0.0450

                  2/3    1/2
      1.49  *  r   *  s
  V = --------------------            ft/s    %16.8040
                n

  Flow length, L                        ft      500

  T = L / (3600*V)                    hrs      0.01             =  0.01

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                                         TOTAL TIME (hrs)          0.35
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6/17/97

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Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
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Tc COMPUTATIONS FOR: 2C

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Woods | |
| Manning's roughness coeff., n | | 0.4000 | |
| Flow length, L (total < or = 300) | ft | 300.0 | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.4200 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.27 | = 0.27 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 370.0 | |
| Watercourse slope, s | ft/ft | 0.4200 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | %10.4564 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.01 | = 0.01 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 3 | |
| Cross Sectional Flow Area, a | sq.ft | 17.00 | |
| Wetted perimeter, Pw | ft | 17.00 | |
| Hydraulic radius, r = a/Pw | ft | 1.000 | |
| Channel slope, s | ft/ft | 0.0600 | |
| Manning's roughness coeff., n | | 0.0450 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 8.1105 | |
| Flow length, L | ft | 1050 | |
| T = L / (3600*V) | hrs | 0.04 | = 0.04 |

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TOTAL TIME (hrs) 0.32

Quick TR-55 Ver.5.46 S/N:
Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

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Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97

Tc COMPUTATIONS FOR: 3C

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Row Crops | |
| Manning's roughness coeff., n | | 0.1700 ✓ | |
| Flow length, L (total < or = 300) | ft | 300.0 ✓ | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.0500 ✓ | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.32 | = 0.32 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 1020.0 ✓ | |
| Watercourse slope, s | ft/ft | 0.3600 ✓ | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 9.6807 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.03 | = 0.03 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 3 | |
| Cross Sectional Flow Area, a | sq.ft | 150.00 ✓ | |
| Wetted perimeter, Pw | ft | 45.00 ✓ | |
| Hydraulic radius, r = a/Pw | ft | 3.333 | |
| Channel slope, s | ft/ft | 0.0150 ✓ | |
| Manning's roughness coeff., n | | 0.0600 ✓ | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 6.7868 | |
| Flow length, L | ft | 1450 ✓ | |
| T = L / (3600*V) | hrs | 0.06 | = 0.06 |

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TOTAL TIME (hrs) 0.41

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Tc COMPUTATIONS FOR: 4C

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Woods | |
| Manning's roughness coeff., n | | 0.4000 | |
| Flow length, L (total < or = 300) | ft | 300.0 | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.3700 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.29 | = 0.29 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 390.0 | |
| Watercourse slope, s | ft/ft | 0.5000 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | %11.4088 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.01 | = 0.01 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 3 | |
| Cross Sectional Flow Area, a | sq.ft | 28.00 | |
| Wetted perimeter, Pw | ft | 20.00 | |
| Hydraulic radius, r = a/Pw | ft | 1.400 | |
| Channel slope, s | ft/ft | 0.0200 | |
| Manning's roughness coeff., n | | 0.0500 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 5.2741 | |
| Flow length, L | ft | 1670 | |
| T = L / (3600*V) | hrs | 0.09 | = 0.09 |

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TOTAL TIME (hrs) 0.38

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PostDevelopment Conditions
BJK 5/97

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Tc COMPUTATIONS FOR: East

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Row Crops | |
| Manning's roughness coeff., n | | 0.1700 | |
| Flow length, L (total < or = 300) | ft | 300.0 | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.0500 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.32 | = 0.32 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 2000.0 | |
| Watercourse slope, s | ft/ft | 0.0700 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 4.2688 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.13 | = 0.13 |

CHANNEL FLOW

| | | | | |
|---|---|---|---|---|
| Segment ID | | 3 | 4 | |
| Cross Sectional Flow Area, a | sq.ft | 27.00 | 27.00 | |
| Wetted perimeter, Pw | ft | 16.40 | 16.40 | |
| Hydraulic radius, r = a/Pw | ft | 1.646 | 1.646 | |
| Channel slope, s | ft/ft | 0.0700 | 0.0400 | |
| Manning's roughness coeff., n | | 0.0700 | 0.0700 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 7.8521 | 5.9356 | |
| Flow length, L | ft | 2500 | 3000 | |
| T = L / (3600*V) | hrs | 0.09 + | 0.14 | = 0.23 |

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TOTAL TIME (hrs) 0.68

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Tc COMPUTATIONS FOR: Northeast

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Row Crops | |
| Manning's roughness coeff., n | | 0.1700 | |
| Flow length, L (total < or = 300) | ft | 300.0 ✓ | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.0800 ✓ | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.27 | = 0.27 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 600.0 ✓ | |
| Watercourse slope, s | ft/ft | 0.0700 ✓ | |
| Avg.V = $Csf * (s)^{0.5}$ | ft/s | 4.2688 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.04 | = 0.04 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 3 | |
| Cross Sectional Flow Area, a | sq.ft | 27.00 | |
| Wetted perimeter, Pw | ft | 16.40 | |
| Hydraulic radius, r = a/Pw | ft | 1.646 | |
| Channel slope, s | ft/ft | 0.1400 ✓ | |
| Manning's roughness coeff., n | | 0.0700 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | %11.1045 | |
| Flow length, L | ft | 2400 ✓ | |
| T = L / (3600*V) | hrs | 0.06 | = 0.06 |

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TOTAL TIME (hrs) 0.37

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Feasibility Report
PostDevelopment Conditions
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Tc COMPUTATIONS FOR: North

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Surface description | | Row Crops | |
| Manning's roughness coeff., n | | 0.1700 | |
| Flow length, L (total < or = 300) | ft | 300.0 | |
| Two-yr 24-hr rainfall, P2 | in | 2.800 | |
| Land slope, s | ft/ft | 0.0500 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.32 | = 0.32 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 2 | |
| Surface (paved or unpaved)? | | Unpaved | |
| Flow length, L | ft | 1000.0 | |
| Watercourse slope, s | ft/ft | 0.0600 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 3.9521 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.07 | = 0.07 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 3 | |
| Cross Sectional Flow Area, a | sq.ft | 27.00 | |
| Wetted perimeter, Pw | ft | 16.40 | |
| Hydraulic radius, r = a/Pw | ft | 1.646 | |
| Channel slope, s | ft/ft | 0.0830 | |
| Manning's roughness coeff., n | | 0.0700 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 8.5502 | |
| Flow length, L | ft | 4200 | |
| T = L / (3600*V) | hrs | 0.14 | = 0.14 |

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TOTAL TIME (hrs) 0.53

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Quick TR-55 Ver.5.46   S/N:
Executed: 09:21:09   05-09-1997    a:POSTDVTC.TCT

                         Dairyland Power Coop.
                           Feasibility Report
                       PostDevelopment Conditions
                               BJK 5/97

                       Tc COMPUTATIONS FOR: West

SHEET FLOW (Applicable to Tc only)
   Segment ID                                      1
   Surface description                      Row Crops
   Manning's roughness coeff., n               0.1700
   Flow length, L (total < or = 300)    ft      300.0
   Two-yr 24-hr rainfall, P2            in      2.800
   Land slope, s                      ft/ft    0.0500
                     0.8
        .007 * (n*L)
   T = --------------                  hrs      0.32             = 0.32
            0.5    0.4
          P2   *  s

SHALLOW CONCENTRATED FLOW
   Segment ID                                      2
   Surface (paved or unpaved)?                Unpaved
   Flow length, L                        ft    1600.0
   Watercourse slope, s               ft/ft    0.0850

                       0.5
   Avg.V =  Csf *  (s)                ft/s    4.7040
   where:   Unpaved Csf = 16.1345
            Paved   Csf = 20.3282

   T = L / (3600*V)                    hrs      0.09             = 0.09


CHANNEL FLOW
   Segment ID                                      3
   Cross Sectional Flow Area, a       sq.ft     17.00
   Wetted perimeter, Pw                  ft     16.40
   Hydraulic radius, r = a/Pw            ft     1.037
   Channel slope, s                   ft/ft    0.1000
   Manning's roughness coeff., n               0.0700

                  2/3    1/2
        1.49  *  r    *  s
   V = --------------------            ft/s    6.8943
                  n

   Flow length, L                        ft      2600

   T = L / (3600*V)                    hrs      0.10             = 0.10

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                                         TOTAL TIME (hrs)        0.52
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Quick TR-55 Ver.5.46 S/N:
Executed: 11:30:57 06-18-1997 a:POSTDVTT.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97

| Subarea descr. | Tc or Tt | Time (hrs) |
|---|---|---|
| 1C | Tt | 0.00 |
| 2C | Tt | 0.05 |
| 3C | Tt | 0.01 |
| 4C | Tt | 0.09 |
| East | Tt | 0.07 |
| Northeast | Tt | 0.09 |
| North | Tt | 0.18 |
| West | Tt | 0.08 |

Quick TR-55 Ver.5.46 S/N:
Executed: 09:24:17 05-09-1997 a:POSTDVTT.TCT

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PostDevelopment Conditions
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6/17/97

Tt COMPUTATIONS FOR: 2C

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Surface description | | | |
| Manning's roughness coeff., n | | 0.0000 | |
| Flow length, L (total < or = 300) | ft | 0.0 | |
| Two-yr 24-hr rainfall, P2 | in | 0.000 | |
| Land slope, s | ft/ft | 0.0000 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.00 | = 0.00 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Surface (paved or unpaved)? | | | |
| Flow length, L | ft | 0.0 | |
| Watercourse slope, s | ft/ft | 0.0000 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 0.0000 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.00 | = 0.00 |

CHANNEL FLOW

| | | | |
|---|---|---|---|
| Segment ID | | 1 | |
| Cross Sectional Flow Area, a | sq.ft | 17.00 | |
| Wetted perimeter, Pw | ft | 17.00 | |
| Hydraulic radius, r = a/Pw | ft | 1.000 | |
| Channel slope, s | ft/ft | 0.0500 ✓ | |
| Manning's roughness coeff., n | | 0.0450 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 7.4039 | |
| Flow length, L | ft | 1200 ✓ | |
| T = L / (3600*V) | hrs | 0.05 | = 0.05 |

TOTAL TIME (hrs) 0.05

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Tt COMPUTATIONS FOR: 3C

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SHEET FLOW (Applicable to Tc only)
    Segment ID
    Surface description
    Manning's roughness coeff., n                    0.0000
    Flow length, L (total < or = 300)      ft         0.0
    Two-yr 24-hr rainfall, P2              in        0.000
    Land slope, s                        ft/ft       0.0000
                        0.8
         .007 * (n*L)
    T =  --------------                  hrs         0.00              = 0.00
            0.5    0.4
          P2   *  s

SHALLOW CONCENTRATED FLOW
    Segment ID
    Surface (paved or unpaved)?
    Flow length, L                         ft         0.0
    Watercourse slope, s                 ft/ft       0.0000

                           0.5
    Avg.V =  Csf *  (s)                  ft/s        0.0000
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                     hrs         0.00              = 0.00


CHANNEL FLOW
    Segment ID                                         1
    Cross Sectional Flow Area, a        sq.ft       42.00 ✓
    Wetted perimeter, Pw                   ft       28.00 ✓
    Hydraulic radius, r = a/Pw             ft        1.500
    Channel slope, s                     ft/ft      0.1500 ✓
    Manning's roughness coeff., n                   0.0450

                      2/3    1/2
         1.49  *  r   *  s
    V =  --------------------            ft/s      %16.8040
                    n

    Flow length, L                         ft         550 ✓

    T = L / (3600*V)                     hrs         0.01              = 0.01

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                              TOTAL TIME (hrs)         0.01
```

Quick TR-55 Ver.5.46 S/N:
Executed: 09:24:17 05-09-1997 a:POSTDVTT.TCT

✓BJG
6/17/97

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97

Tt COMPUTATIONS FOR: 4C

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Surface description | | | |
| Manning's roughness coeff., n | | 0.0000 | |
| Flow length, L (total < or = 300) | ft | 0.0 | |
| Two-yr 24-hr rainfall, P2 | in | 0.000 | |
| Land slope, s | ft/ft | 0.0000 | |

$$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$$ hrs 0.00 = 0.00

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Surface (paved or unpaved)? | | | |
| Flow length, L | ft | 0.0 | |
| Watercourse slope, s | ft/ft | 0.0000 | |

$$Avg.V = Csf * (s)^{0.5}$$ ft/s 0.0000

where: Unpaved Csf = 16.1345
Paved Csf = 20.3282

T = L / (3600*V) hrs 0.00 = 0.00

CHANNEL FLOW

| | | | | |
|---|---|---|---|---|
| Segment ID | | 1 | 2 | |
| Cross Sectional Flow Area, a | sq.ft | 150.00 | 42.00 | |
| Wetted perimeter, Pw | ft | 45.00 | 28.00 | |
| Hydraulic radius, r = a/Pw | ft | 3.333 | 1.500 | |
| Channel slope, s | ft/ft | 0.0150✓ | 0.1500 ✓ | |
| Manning's roughness coeff., n | | 0.0600 | 0.0450 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 6.7868 | %16.8040 | |
| Flow length, L | ft | 1950✓ | 550 ✓ | |
| T = L / (3600*V) | hrs | 0.08 + | 0.01 | = 0.09 |

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

TOTAL TIME (hrs) 0.09

```
Quick TR-55 Ver.5.46   S/N:
Executed: 09:24:17   05-09-1997     a:POSTDVTT.TCT

                    Dairyland Power Coop.
                      Feasibility Report
                  PostDevelopment Conditions
                          BJK 5/97

               Tt COMPUTATIONS FOR: East

SHEET FLOW (Applicable to Tc only)
    Segment ID
    Surface description
    Manning's roughness coeff., n              0.0000
    Flow length, L (total < or = 300)    ft      0.0
    Two-yr 24-hr rainfall, P2            in    0.000
    Land slope, s                      ft/ft   0.0000
                     0.8
          .007 * (n*L)
    T =  --------------               hrs      0.00              = 0.00
              0.5    0.4
            P2   *  s

SHALLOW CONCENTRATED FLOW
    Segment ID
    Surface (paved or unpaved)?
    Flow length, L                       ft      0.0
    Watercourse slope, s               ft/ft   0.0000

                      0.5
    Avg.V =  Csf *  (s)                ft/s   0.0000
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                   hrs      0.00              = 0.00


CHANNEL FLOW
    Segment ID                                  1          2
    Cross Sectional Flow Area, a      sq.ft   150.00     42.00
    Wetted perimeter, Pw                 ft    45.00     28.00
    Hydraulic radius, r = a/Pw           ft    3.333     1.500
    Channel slope, s                   ft/ft  0.0150✓   0.1500✓
    Manning's roughness coeff., n             0.0600    0.0450

                   2/3   1/2
         1.49  *  r   *  s
    V =  --------------------          ft/s   6.7868   X16.8040
                    n

    Flow length, L                       ft     1600✓     550✓

    T = L / (3600*V)                   hrs      0.07  +   0.01   = 0.07

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                          TOTAL TIME (hrs)      0.07
```

BJK (initials, handwritten) 6/17/97

Quick TR-55 Ver.5.46 S/N:
Executed: 11:30:57 06-18-1997 a:POSTDVTT.TCT

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97

BJB 6/17/97

Tt COMPUTATIONS FOR: Northeast

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Surface description | | | |
| Manning's roughness coeff., n | | 0.0000 | |
| Flow length, L (total < or = 300) | ft | 0.0 | |
| Two-yr 24-hr rainfall, P2 | in | 0.000 | |
| Land slope, s | ft/ft | 0.0000 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.00 | = 0.00 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Surface (paved or unpaved)? | | | |
| Flow length, L | ft | 0.0 | |
| Watercourse slope, s | ft/ft | 0.0000 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 0.0000 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.00 | = 0.00 |

CHANNEL FLOW

| | | | | |
|---|---|---|---|---|
| Segment ID | | 1 | 2 | |
| Cross Sectional Flow Area, a | sq.ft | 150.00 | 42.00 | |
| Wetted perimeter, Pw | ft | 45.00 | 28.00 | |
| Hydraulic radius, r = a/Pw | ft | 3.333 | 1.500 | |
| Channel slope, s | ft/ft | 0.0150 ✓ | 0.1500 ✓ | |
| Manning's roughness coeff., n | | 0.0600 | 0.0450 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 6.7868 | %16.8040 | |
| Flow length, L | ft | 1870 ✓ | 550 ✓ | |
| T = L / (3600*V) | hrs | 0.08 + | 0.01 | = 0.09 |

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

TOTAL TIME (hrs) 0.09

Quick TR-55 Ver.5.46 S/N:
Executed: 11:30:57 06-18-1997 a:POSTDVTT.TCT

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97

✓ BLB 6/17/97

Tt COMPUTATIONS FOR: North

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Surface description | | | |
| Manning's roughness coeff., n | | 0.0000 | |
| Flow length, L (total < or = 300) | ft | 0.0 | |
| Two-yr 24-hr rainfall, P2 | in | 0.000 | |
| Land slope, s | ft/ft | 0.0000 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.00 | = 0.00 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Surface (paved or unpaved)? | | | |
| Flow length, L | ft | 0.0 | |
| Watercourse slope, s | ft/ft | 0.0000 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 0.0000 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.00 | = 0.00 |

CHANNEL FLOW

| | | | | |
|---|---|---|---|---|
| Segment ID | | 1 | 2 | |
| Cross Sectional Flow Area, a | sq.ft | 28.00 | 150.00 | |
| Wetted perimeter, Pw | ft | 20.00 | 45.00 | |
| Hydraulic radius, r = a/Pw | ft | 1.400 | 3.333 | |
| Channel slope, s | ft/ft | 0.0200 ✓ | 0.0150 ✓ | |
| Manning's roughness coeff., n | | 0.0500 | 0.0600 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 5.2741 | 6.7868 | |
| Flow length, L | ft | 1670 ✓ | 2250 ✓ | |
| T = L / (3600*V) | hrs | 0.09 + | 0.09 | = 0.18 |

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TOTAL TIME (hrs) 0.18

Quick TR-55 Ver.5.46 S/N:
Executed: 09:24:17 05-09-1997 a:POSTDVTT.TCT

1 BLG
6/17/97

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97

Tt COMPUTATIONS FOR: West

SHEET FLOW (Applicable to Tc only)

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Surface description | | | |
| Manning's roughness coeff., n | | 0.0000 | |
| Flow length, L (total < or = 300) | ft | 0.0 | |
| Two-yr 24-hr rainfall, P2 | in | 0.000 | |
| Land slope, s | ft/ft | 0.0000 | |
| $T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$ | hrs | 0.00 | = 0.00 |

SHALLOW CONCENTRATED FLOW

| | | | |
|---|---|---|---|
| Segment ID | | | |
| Surface (paved or unpaved)? | | | |
| Flow length, L | ft | 0.0 | |
| Watercourse slope, s | ft/ft | 0.0000 | |
| $Avg.V = Csf * (s)^{0.5}$ | ft/s | 0.0000 | |
| where: Unpaved Csf = 16.1345 | | | |
| Paved Csf = 20.3282 | | | |
| T = L / (3600*V) | hrs | 0.00 | = 0.00 |

CHANNEL FLOW

| | | | | |
|---|---|---|---|---|
| Segment ID | | 1 | 2 | |
| Cross Sectional Flow Area, a | sq.ft | 17.00 | 17.00 | |
| Wetted perimeter, Pw | ft | 17.00 | 17.00 | |
| Hydraulic radius, r = a/Pw | ft | 1.000 | 1.000 | |
| Channel slope, s | ft/ft | 0.0600 | 0.0500 | |
| Manning's roughness coeff., n | | 0.0450 | 0.0450 | |
| $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$ | ft/s | 8.1105 | 7.4039 | |
| Flow length, L | ft | 1050 | 1200 | |
| T = L / (3600*V) | hrs | 0.04 + | 0.05 | = 0.08 |

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TOTAL TIME (hrs) 0.08

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used | |
|---|---|---|---|---|---|---|---|---|
| 1C | 42.00 | 67.0 | 0.40 | 0.00 | 4.90 | 1.73 | I.2 | .20 |
| 2C | 15.00 | 56.0 | 0.30 | 0.10 | 4.90 | 0.99 | I.32 | .32 |
| 3C | 33.00 | 58.0 | 0.40 | 0.00 | 4.90 | 1.11 | I.3 | .30 |
| 4C | 16.00 | 57.0 | 0.40 | 0.10 | 4.90 | 1.05 | I.31 | .31 |
| East | 520.00 | 67.0 | 0.75 | 0.00 | 4.90 | 1.73 | I.2 | .20 |
| Northeast | 80.00 | 63.0 | 0.40 | 0.10 | 4.90 | 1.45 | I.24 | .24 |
| North | 236.00 | 63.0 | 0.50 | 0.20 | 4.90 | 1.45 | I.24 | .24 |
| West | 100.00 | 71.0 | 0.50 | 0.10 | 4.90 | 2.04 | I.17 | .17 |

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total Runoff
= 141.9 ac-ft

Total area = 1042.00 acres or 1.6281 sq.mi
Peak discharge = 1027 cfs

WARNING: Drainage areas of two or more subareas
differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

| Subarea Description | Input Values Tc (hr) | Input Values * Tt (hr) | Rounded Values Tc (hr) | Rounded Values * Tt (hr) | Ia/p Interpolated (Yes/No) | Ia/p Messages |
|---|---|---|---|---|---|---|
| 1C | 0.35 | 0.00 | 0.40 | 0.00 | Yes | -- |
| 2C | 0.32 | 0.05 | 0.30 | 0.10 | Yes | -- |
| 3C | 0.41 | 0.01 | 0.40 | 0.00 | Yes | -- |
| 4C | 0.38 | 0.09 | 0.40 | 0.10 | Yes | -- |
| East | 0.68 | 0.07 | 0.75 | 0.00 | Yes | -- |
| Northeast | 0.37 | 0.09 | 0.40 | 0.10 | Yes | -- |
| North | 0.53 | 0.18 | 0.50 | 0.20 | Yes | -- |
| West | 0.52 | 0.08 | 0.50 | 0.10 | Yes | -- |

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| 1C | 61 | 12.3 |
| 2C | 11 | 12.4 |
| 3C | 28 | 12.4 |
| 4C | 12 | 12.5 |
| East | 533 | 12.7 |
| Northeast | 84 | 12.5 |
| North | 219 | 12.6 |
| West | 145 | 12.5 |
| Composite Watershed | 1027 | 12.6 |

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

Composite Hydrograph Summary (cfs)

| Subarea Description | 11.0 hr | 11.3 hr | 11.6 hr | 11.9 hr | 12.0 hr | 12.1 hr | 12.2 hr | 12.3 hr | 12.4 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1C | 1 | 1 | 2 | 5 | 9 | 22 | 43 | 61 | 61 |
| 2C | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 9 | 11 |
| 3C | 0 | 0 | 0 | 0 | 1 | 6 | 17 | 27 | 28 |
| 4C | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 10 |
| East | 9 | 13 | 17 | 25 | 33 | 52 | 102 | 197 | 329 |
| Northeast | 1 | 1 | 2 | 4 | 7 | 14 | 31 | 57 | 80 |
| North | 2 | 3 | 4 | 6 | 8 | 13 | 28 | 66 | 126 |
| West | 3 | 5 | 6 | 11 | 17 | 30 | 56 | 95 | 128 |
| Total (cfs) | 16 | 23 | 31 | 51 | 75 | 138 | 283 | 518 | 773 |

| Subarea Description | 12.5 hr | 12.6 hr | 12.7 hr | 12.8 hr | 13.0 hr | 13.2 hr | 13.4 hr | 13.6 hr | 13.8 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1C | 48 | 34 | 26 | 20 | 13 | 10 | 8 | 7 | 7 |
| 2C | 10 | 8 | 6 | 5 | 3 | 2 | 2 | 2 | 2 |
| 3C | 24 | 18 | 13 | 11 | 7 | 6 | 5 | 4 | 4 |
| 4C | 12 | 11 | 9 | 7 | 4 | 3 | 3 | 2 | 2 |
| East | 454 | 527 | 533 | 490 | 350 | 248 | 183 | 143 | 117 |
| Northeast | 84 | 74 | 58 | 45 | 28 | 20 | 16 | 14 | 12 |
| North | 187 | 219 | 217 | 191 | 130 | 86 | 62 | 49 | 41 |
| West | 145 | 136 | 115 | 92 | 58 | 39 | 29 | 24 | 20 |
| Total (cfs) | 964 | 1027 | 977 | 861 | 593 | 414 | 308 | 245 | 205 |

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17
Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP
Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

Composite Hydrograph Summary (cfs)

| Subarea Description | 14.0 hr | 14.3 hr | 14.6 hr | 15.0 hr | 15.5 hr | 16.0 hr | 16.5 hr | 17.0 hr | 17.5 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1C | 6 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 3 |
| 2C | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3C | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| 4C | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| East | 98 | 81 | 69 | 59 | 53 | 47 | 42 | 38 | 36 |
| Northeast | 11 | 9 | 8 | 8 | 7 | 6 | 6 | 5 | 5 |
| North | 35 | 30 | 26 | 23 | 21 | 19 | 17 | 16 | 14 |
| West | 18 | 15 | 13 | 12 | 11 | 10 | 9 | 8 | 7 |
| Total (cfs) | 174 | 146 | 126 | 111 | 100 | 90 | 81 | 74 | 69 |

| Subarea Description | 18.0 hr | 19.0 hr | 20.0 hr | 22.0 hr | 26.0 hr |
|---|---|---|---|---|---|
| 1C | 3 | 2 | 2 | 2 | 0 |
| 2C | 1 | 1 | 1 | 0 | 0 |
| 3C | 2 | 1 | 1 | 1 | 0 |
| 4C | 1 | 1 | 1 | 1 | 0 |
| East | 34 | 30 | 27 | 22 | 0 |
| Northeast | 5 | 4 | 4 | 3 | 0 |
| North | 14 | 12 | 10 | 9 | 0 |
| West | 7 | 6 | 5 | 5 | 0 |
| Total (cfs) | 67 | 57 | 51 | 43 | 0 |

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28
Watershed file: --> A:\POSTDV2 .MOP
Hydrograph file: --> A:\POSTDV00.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used | |
|---|---|---|---|---|---|---|---|---|
| 1C | 42.00 | 67.0 | 0.40 | 0.00 | 6.10 | 2.61 | I.16 | .16 |
| 2C | 15.00 | 56.0 | 0.30 | 0.10 | 6.10 | 1.66 | I.26 | .26 |
| 3C | 33.00 | 58.0 | 0.40 | 0.00 | 6.10 | 1.82 | I.24 | .24 |
| 4C | 16.00 | 57.0 | 0.40 | 0.10 | 6.10 | 1.74 | I.25 | .25 |
| East | 520.00 | 67.0 | 0.75 | 0.00 | 6.10 | 2.61 | I.16 | .16 |
| Northeast | 80.00 | 63.0 | 0.40 | 0.10 | 6.10 | 2.25 | I.19 | .19 |
| North | 236.00 | 63.0 | 0.50 | 0.20 | 6.10 | 2.25 | I.19 | .19 |
| West | 100.00 | 71.0 | 0.50 | 0.10 | 6.10 | 2.98 | I.13 | .13 |

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total Runoff
= 215.7 ac-ft

Total area = 1042.00 acres or 1.6281 sq.mi
Peak discharge = 1618 cfs

WARNING: Drainage areas of two or more subareas
differ by a factor of 5 or greater.

>>>> Computer Modifications of Input Parameters <<<<<

| Subarea Description | Input Values Tc (hr) | Input Values * Tt (hr) | Rounded Values Tc (hr) | Rounded Values * Tt (hr) | Ia/p Interpolated (Yes/No) | Ia/p Messages |
|---|---|---|---|---|---|---|
| 1C | 0.35 | 0.00 | 0.40 | 0.00 | Yes | -- |
| 2C | 0.32 | 0.05 | 0.30 | 0.10 | Yes | -- |
| 3C | 0.41 | 0.01 | 0.40 | 0.00 | Yes | -- |
| 4C | 0.38 | 0.09 | 0.40 | 0.10 | Yes | -- |
| East | 0.68 | 0.07 | 0.75 | 0.00 | Yes | -- |
| Northeast | 0.37 | 0.09 | 0.40 | 0.10 | Yes | -- |
| North | 0.53 | 0.18 | 0.50 | 0.20 | Yes | -- |
| West | 0.52 | 0.08 | 0.50 | 0.10 | Yes | -- |

* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28
Watershed file: --> A:\POSTDV2 .MOP
Hydrograph file: --> A:\POSTDV00.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| 1C | 96 | 12.3 |
| 2C | 20 | 12.4 |
| 3C | 49 | 12.4 |
| 4C | 20 | 12.5 |
| East | 837 | 12.6 |
| Northeast | 136 | 12.4 |
| North | 360 | 12.6 |
| West | 223 | 12.5 |
| Composite Watershed | 1618 | 12.6 |

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28
Watershed file: --> A:\POSTDV2 .MOP
Hydrograph file: --> A:\POSTDV00.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

Composite Hydrograph Summary (cfs)

| Subarea Description | 11.0 hr | 11.3 hr | 11.6 hr | 11.9 hr | 12.0 hr | 12.1 hr | 12.2 hr | 12.3 hr | 12.4 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1C | 2 | 3 | 4 | 9 | 18 | 38 | 71 | 96 | 94 |
| 2C | 0 | 0 | 0 | 1 | 2 | 4 | 10 | 18 | 20 |
| 3C | 1 | 1 | 1 | 2 | 6 | 15 | 33 | 48 | 49 |
| 4C | 0 | 0 | 0 | 1 | 1 | 3 | 7 | 13 | 19 |
| East | 19 | 27 | 36 | 53 | 69 | 105 | 190 | 343 | 547 |
| Northeast | 3 | 4 | 5 | 10 | 18 | 36 | 70 | 109 | 136 |
| North | 6 | 9 | 11 | 17 | 22 | 33 | 63 | 127 | 224 |
| West | 6 | 9 | 12 | 20 | 32 | 56 | 102 | 165 | 209 |
| Total (cfs) | 37 | 53 | 69 | 113 | 168 | 290 | 546 | 919 | 1298 |

| Subarea Description | 12.5 hr | 12.6 hr | 12.7 hr | 12.8 hr | 13.0 hr | 13.2 hr | 13.4 hr | 13.6 hr | 13.8 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1C | 73 | 51 | 38 | 29 | 19 | 14 | 12 | 10 | 9 |
| 2C | 18 | 13 | 10 | 7 | 5 | 4 | 3 | 3 | 3 |
| 3C | 39 | 28 | 21 | 17 | 11 | 9 | 7 | 6 | 6 |
| 4C | 20 | 18 | 14 | 11 | 7 | 5 | 4 | 3 | 3 |
| East | 733 | 837 | 830 | 756 | 531 | 370 | 270 | 208 | 168 |
| Northeast | 132 | 110 | 85 | 65 | 40 | 28 | 23 | 19 | 17 |
| North | 315 | 360 | 350 | 303 | 200 | 130 | 92 | 71 | 59 |
| West | 223 | 201 | 163 | 128 | 79 | 53 | 40 | 32 | 27 |
| Total (cfs) | 1553 | 1618 | 1511 | 1316 | 892 | 613 | 451 | 352 | 292 |

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28
Watershed file: --> A:\POSTDV2 .MOP
Hydrograph file: --> A:\POSTDV00.HYD

Dairyland Power Coop.
Feasibility Report
PostDevelopment Conditions
BJK 5/97 REV 9/98

Composite Hydrograph Summary (cfs)

| Subarea Description | 14.0 hr | 14.3 hr | 14.6 hr | 15.0 hr | 15.5 hr | 16.0 hr | 16.5 hr | 17.0 hr | 17.5 hr |
|---|---|---|---|---|---|---|---|---|---|
| 1C | 8 | 7 | 7 | 6 | 5 | 5 | 4 | 4 | 4 |
| 2C | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 3C | 5 | 5 | 4 | 4 | 3 | 3 | 3 | 3 | 2 |
| 4C | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 |
| East | 141 | 115 | 97 | 83 | 74 | 66 | 59 | 53 | 49 |
| Northeast | 15 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 7 |
| North | 51 | 44 | 38 | 33 | 30 | 27 | 24 | 22 | 20 |
| West | 24 | 21 | 18 | 16 | 14 | 13 | 12 | 11 | 10 |
| Total (cfs) | 249 | 209 | 180 | 157 | 139 | 126 | 112 | 102 | 94 |

| Subarea Description | 18.0 hr | 19.0 hr | 20.0 hr | 22.0 hr | 26.0 hr |
|---|---|---|---|---|---|
| 1C | 4 | 3 | 3 | 2 | 0 |
| 2C | 1 | 1 | 1 | 1 | 0 |
| 3C | 2 | 2 | 2 | 2 | 0 |
| 4C | 1 | 1 | 1 | 1 | 0 |
| East | 47 | 42 | 37 | 30 | 0 |
| Northeast | 6 | 6 | 5 | 4 | 0 |
| North | 19 | 17 | 15 | 13 | 0 |
| West | 10 | 8 | 7 | 6 | 0 |
| Total (cfs) | 90 | 80 | 71 | 59 | 0 |

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Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

| Time (hrs) | POSTDV25 (cfs) | BSN1OUT1 (cfs) | BSN2OUT1 (cfs) | TPTPST25 (Total) |
|---|---|---|---|---|
| 11.00 | 16.0 | 0.0 | 0.0 | 16.0 |
| 11.10 | 18.0 | 0.2 | 0.2 | 18.4 |
| 11.20 | 21.0 | 0.2 | 0.2 | 21.4 |
| 11.30 | 23.0 | 0.3 | 0.2 | 23.5 |
| 11.40 | 26.0 | 0.3 | 0.2 | 26.5 |
| 11.50 | 28.0 | 0.3 | 0.2 | 28.5 |
| 11.60 | 31.0 | 0.4 | 0.2 | 31.6 |
| 11.70 | 38.0 | 0.4 | 0.3 | 38.7 |
| 11.80 | 44.0 | 0.4 | 0.3 | 44.7 |
| 11.90 | 51.0 | 0.5 | 0.3 | 51.8 |
| 12.00 | 75.0 | 0.5 | 0.4 | 75.9 |
| 12.10 | 138.0 | 0.6 | 0.4 | 139.0 |
| 12.20 | 283.0 | 0.6 | 0.5 | 284.1 |
| 12.30 | 518.0 | 0.7 | 0.5 | 519.2 |
| 12.40 | 773.0 | 0.7 | 0.5 | 774.2 |
| 12.50 | 964.0 | 0.7 | 0.6 | 965.3 |
| 12.60 | 1027.0 | 0.7 | 0.6 | 1028.3 ← Peak |
| 12.70 | 977.0 | 0.7 | 0.6 | 978.3 |
| 12.80 | 861.0 | 0.7 | 0.6 | 862.3 |
| 12.90 | 727.0 | 0.7 | 0.6 | 728.3 |
| 13.00 | 593.0 | 0.8 | 0.6 | 594.3 |
| 13.10 | 503.0 | 0.8 | 0.6 | 504.4 |
| 13.20 | 414.0 | 0.8 | 0.6 | 415.4 |
| 13.30 | 361.0 | 0.8 | 0.6 | 362.4 |
| 13.40 | 308.0 | 0.8 | 0.6 | 309.4 |
| 13.50 | 277.0 | 0.8 | 0.6 | 278.4 |
| 13.60 | 245.0 | 0.8 | 0.6 | 246.4 |
| 13.70 | 225.0 | 0.8 | 0.6 | 226.4 |
| 13.80 | 205.0 | 0.8 | 0.6 | 206.4 |
| 13.90 | 190.0 | 0.8 | 0.6 | 191.4 |
| 14.00 | 174.0 | 0.8 | 0.6 | 175.4 |
| 14.10 | 165.0 | 0.8 | 0.6 | 166.4 |
| 14.20 | 155.0 | 0.8 | 0.6 | 156.4 |
| 14.30 | 146.0 | 0.9 | 0.6 | 147.5 |
| 14.40 | 139.0 | 1.2 | 0.6 | 140.8 |
| 14.50 | 133.0 | 1.5 | 0.6 | 135.1 |
| 14.60 | 126.0 | 1.8 | 0.6 | 128.4 |
| 14.70 | 122.0 | 2.0 | 0.6 | 124.6 |
| 14.80 | 118.0 | 2.2 | 0.6 | 120.8 |
| 14.90 | 115.0 | 2.3 | 0.6 | 117.9 |

Combined Post-Development Hydrograph 25yr storm

Basin 1 +
Basin 2 +
Surrounding watershed.

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Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

| Time (hrs) | POSTDV25 (cfs) | BSN1OUT1 (cfs) | BSN2OUT1 (cfs) | TPTPST25 (Total) |
|---|---|---|---|---|
| 15.00 | 111.0 | 2.4 | 0.6 | 114.0 |
| 15.10 | 109.0 | 2.5 | 0.6 | 112.1 |
| 15.20 | 107.0 | 2.6 | 0.6 | 110.2 |
| 15.30 | 104.0 | 2.7 | 0.6 | 107.3 |
| 15.40 | 102.0 | 2.7 | 0.6 | 105.3 |
| 15.50 | 100.0 | 2.8 | 0.6 | 103.4 |
| 15.60 | 98.0 | 2.8 | 0.6 | 101.4 |
| 15.70 | 96.0 | 2.8 | 0.6 | 99.4 |
| 15.80 | 94.0 | 2.9 | 0.6 | 97.5 |
| 15.90 | 92.0 | 2.9 | 0.6 | 95.5 |
| 16.00 | 90.0 | 2.9 | 0.6 | 93.5 |
| 16.10 | 88.0 | 2.9 | 0.6 | 91.5 |
| 16.20 | 86.0 | 2.9 | 0.6 | 89.5 |
| 16.30 | 85.0 | 2.9 | 0.6 | 88.5 |
| 16.40 | 83.0 | 2.7 | 0.6 | 86.3 |
| 16.50 | 81.0 | 2.6 | 0.6 | 84.2 |
| 16.60 | 80.0 | 2.5 | 0.6 | 83.1 |
| 16.70 | 78.0 | 2.4 | 0.6 | 81.0 |
| 16.80 | 77.0 | 2.3 | 0.6 | 79.9 |
| 16.90 | 75.0 | 2.3 | 0.6 | 77.9 |
| 17.00 | 74.0 | 2.2 | 0.6 | 76.8 |
| 17.10 | 73.0 | 2.2 | 0.6 | 75.8 |
| 17.20 | 72.0 | 2.2 | 0.6 | 74.8 |
| 17.30 | 71.0 | 2.1 | 0.6 | 73.7 |
| 17.40 | 70.0 | 2.1 | 0.6 | 72.7 |
| 17.50 | 69.0 | 2.1 | 0.6 | 71.7 |
| 17.60 | 69.0 | 2.1 | 0.6 | 71.7 |
| 17.70 | 68.0 | 2.1 | 0.6 | 70.7 |
| 17.80 | 68.0 | 2.0 | 0.6 | 70.7 |
| 17.90 | 67.0 | 2.0 | 0.6 | 69.6 |
| 18.00 | 67.0 | 2.0 | 0.6 | 69.6 |
| 18.10 | 66.0 | 2.0 | 0.6 | 68.6 |
| 18.20 | 65.0 | 2.0 | 0.6 | 67.6 |
| 18.30 | 64.0 | 2.0 | 0.6 | 66.6 |
| 18.40 | 63.0 | 2.0 | 0.6 | 65.6 |
| 18.50 | 62.0 | 2.0 | 0.6 | 64.6 |
| 18.60 | 61.0 | 2.0 | 0.6 | 63.6 |
| 18.70 | 60.0 | 2.0 | 0.6 | 62.6 |
| 18.80 | 59.0 | 2.0 | 0.7 | 61.7 |
| 18.90 | 58.0 | 2.0 | 0.7 | 60.8 |
| 19.00 | 57.0 | 2.0 | 0.8 | 59.8 |

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Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

| Time (hrs) | POSTDV25 (cfs) | BSN1OUT1 (cfs) | BSN2OUT1 (cfs) | TPTPST25 (Total) |
|---|---|---|---|---|
| 19.10 | 56.0 | 2.0 | 0.8 | 58.8 |
| 19.20 | 56.0 | 2.0 | 0.9 | 58.9 |
| 19.30 | 55.0 | 2.0 | 0.9 | 57.9 |
| 19.40 | 55.0 | 2.0 | 0.9 | 57.9 |
| 19.50 | 54.0 | 2.0 | 0.9 | 56.9 |
| 19.60 | 53.0 | 1.9 | 0.9 | 55.9 |
| 19.70 | 53.0 | 1.8 | 0.9 | 55.7 |
| 19.80 | 52.0 | 1.6 | 1.0 | 54.6 |
| 19.90 | 52.0 | 1.5 | 1.0 | 54.5 |
| 20.00 | 51.0 | 1.4 | 1.0 | 53.4 |
| 20.10 | 51.0 | 1.4 | 1.0 | 53.3 |
| 20.20 | 50.0 | 1.3 | 1.0 | 52.3 |
| 20.30 | 50.0 | 1.2 | 1.0 | 52.2 |
| 20.40 | 49.0 | 1.2 | 1.0 | 51.2 |
| 20.50 | 49.0 | 1.2 | 1.0 | 51.2 |
| 20.60 | 49.0 | 1.1 | 1.0 | 51.1 |
| 20.70 | 48.0 | 1.1 | 1.0 | 50.1 |
| 20.80 | 48.0 | 1.1 | 1.0 | 50.1 |
| 20.90 | 47.0 | 1.1 | 1.0 | 49.1 |
| 21.00 | 47.0 | 1.0 | 1.0 | 49.0 |
| 21.10 | 47.0 | 0.8 | 1.0 | 48.8 |
| 21.20 | 46.0 | 0.8 | 1.0 | 47.8 |
| 21.30 | 46.0 | 0.8 | 1.0 | 47.8 |
| 21.40 | 45.0 | 0.8 | 1.0 | 46.8 |
| 21.50 | 45.0 | 0.8 | 1.0 | 46.8 |
| 21.60 | 45.0 | 0.8 | 1.0 | 46.8 |
| 21.70 | 44.0 | 0.8 | 1.0 | 45.8 |
| 21.80 | 44.0 | 0.8 | 1.0 | 45.8 |
| 21.90 | 43.0 | 0.8 | 1.0 | 44.8 |
| 22.00 | 43.0 | 0.8 | 1.0 | 44.8 |
| 22.10 | 42.0 | 0.8 | 1.0 | 43.8 |
| 22.20 | 41.0 | 0.8 | 1.0 | 42.8 |
| 22.30 | 40.0 | 0.8 | 1.0 | 41.8 |
| 22.40 | 39.0 | 0.8 | 1.0 | 40.8 |
| 22.50 | 38.0 | 0.8 | 1.0 | 39.8 |
| 22.60 | 37.0 | 0.8 | 1.0 | 38.8 |
| 22.70 | 35.0 | 0.8 | 1.0 | 36.8 |
| 22.80 | 34.0 | 0.8 | 1.0 | 35.8 |
| 22.90 | 33.0 | 0.8 | 1.0 | 34.8 |
| 23.00 | 32.0 | 0.8 | 1.0 | 33.8 |
| 23.10 | 31.0 | 0.8 | 1.0 | 32.8 |

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File Summary for Composite Hydrograph

| Time (hrs) | POSTDV25 (cfs) | BSN1OUT1 (cfs) | BSN2OUT1 (cfs) | TPTPST25 (Total) |
|---|---|---|---|---|
| 23.20 | 30.0 | 0.8 | 1.0 | 31.8 |
| 23.30 | 29.0 | 0.8 | 1.0 | 30.8 |
| 23.40 | 28.0 | 0.8 | 1.0 | 29.8 |
| 23.50 | 27.0 | 0.8 | 1.0 | 28.8 |
| 23.60 | 26.0 | 0.8 | 1.0 | 27.8 |
| 23.70 | 25.0 | 0.8 | 1.0 | 26.8 |
| 23.80 | 24.0 | 0.8 | 1.0 | 25.8 |
| 23.90 | 23.0 | 0.8 | 1.0 | 24.8 |
| 24.00 | 22.0 | 0.8 | 0.9 | 23.7 |
| 24.10 | 20.0 | 0.8 | 0.7 | 21.5 |
| 24.20 | 19.0 | 0.8 | 0.6 | 20.4 |
| 24.30 | 18.0 | 0.8 | 0.6 | 19.4 |
| 24.40 | 17.0 | 0.8 | 0.6 | 18.4 |
| 24.50 | 16.0 | 0.8 | 0.6 | 17.4 |
| 24.60 | 15.0 | 0.8 | 0.6 | 16.4 |
| 24.70 | 14.0 | 0.8 | 0.6 | 15.4 |
| 24.80 | 13.0 | 0.8 | 0.6 | 14.4 |
| 24.90 | 12.0 | 0.8 | 0.6 | 13.4 |
| 25.00 | 11.0 | 0.8 | 0.6 | 12.4 |
| 25.10 | 10.0 | 0.8 | 0.6 | 11.4 |
| 25.20 | 9.0 | 0.8 | 0.6 | 10.4 |
| 25.30 | 8.0 | 0.8 | 0.6 | 9.4 |
| 25.40 | 6.0 | 0.8 | 0.6 | 7.4 |
| 25.50 | 5.0 | 0.8 | 0.6 | 6.4 |

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File Summary for Composite Hydrograph

Combined Post - Development Hydrograph - 100 yr Storm
Basin 1 +
Basin 2 +
Surrounding Watershed.

| Time (hrs) | POSTDV00 (cfs) | BSN1OUT2 (cfs) | BSN2OUT2 (cfs) | TOTPST00 (Total) |
|---|---|---|---|---|
| 11.00 | 37.0 | 0.0 | 0.0 | 37.0 |
| 11.10 | 42.0 | 0.2 | 0.2 | 42.4 |
| 11.20 | 48.0 | 0.3 | 0.2 | 48.5 |
| 11.30 | 53.0 | 0.3 | 0.2 | 53.5 |
| 11.40 | 58.0 | 0.4 | 0.3 | 58.6 |
| 11.50 | 64.0 | 0.4 | 0.3 | 64.7 |
| 11.60 | 69.0 | 0.4 | 0.3 | 69.7 |
| 11.70 | 84.0 | 0.4 | 0.3 | 84.7 |
| 11.80 | 98.0 | 0.5 | 0.3 | 98.8 |
| 11.90 | 113.0 | 0.5 | 0.4 | 113.9 |
| 12.00 | 168.0 | 0.6 | 0.4 | 169.0 |
| 12.10 | 290.0 | 0.6 | 0.5 | 291.1 |
| 12.20 | 546.0 | 0.7 | 0.5 | 547.2 |
| 12.30 | 919.0 | 0.7 | 0.6 | 920.3 |
| 12.40 | 1298.0 | 0.7 | 0.6 | 1299.3 |
| 12.50 | 1553.0 | 0.8 | 0.6 | 1554.4 |
| 12.60 | 1618.0 | 2.8 | 1.2 | 1622.0 ← Peak |
| 12.70 | 1511.0 | 8.2 | 3.7 | 1522.9 |
| 12.80 | 1316.0 | 12.2 | 5.2 | 1333.4 |
| 12.90 | 1104.0 | 14.8 | 6.1 | 1124.9 |
| 13.00 | 892.0 | 15.7 | 6.6 | 914.3 |
| 13.10 | 752.0 | 15.5 | 6.9 | 774.4 |
| 13.20 | 613.0 | 14.8 | 7.0 | 634.8 |
| 13.30 | 532.0 | 14.0 | 7.0 | 553.0 |
| 13.40 | 451.0 | 13.3 | 7.0 | 471.3 |
| 13.50 | 402.0 | 12.5 | 7.0 | 421.5 |
| 13.60 | 352.0 | 11.7 | 6.9 | 370.6 |
| 13.70 | 322.0 | 10.8 | 6.7 | 339.5 |
| 13.80 | 292.0 | 10.0 | 6.6 | 308.6 |
| 13.90 | 270.0 | 9.6 | 6.5 | 286.0 |
| 14.00 | 249.0 | 9.1 | 6.3 | 264.3 |
| 14.10 | 236.0 | 8.5 | 6.0 | 250.6 |
| 14.20 | 222.0 | 8.1 | 5.8 | 235.9 |
| 14.30 | 209.0 | 7.7 | 5.7 | 222.4 |
| 14.40 | 199.0 | 7.4 | 5.4 | 211.9 |
| 14.50 | 190.0 | 7.2 | 5.2 | 202.3 |
| 14.60 | 180.0 | 7.0 | 4.8 | 191.8 |
| 14.70 | 174.0 | 6.8 | 4.5 | 185.3 |
| 14.80 | 168.0 | 6.6 | 4.2 | 178.8 |
| 14.90 | 163.0 | 6.2 | 4.0 | 173.2 |

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File Summary for Composite Hydrograph

| Time (hrs) | POSTDV00 (cfs) | BSN1OUT2 (cfs) | BSN2OUT2 (cfs) | TOTPST00 (Total) |
|---|---|---|---|---|
| 15.00 | 157.0 | 5.8 | 3.8 | 166.6 |
| 15.10 | 153.0 | 5.5 | 3.6 | 162.1 |
| 15.20 | 150.0 | 5.3 | 3.5 | 158.8 |
| 15.30 | 146.0 | 5.0 | 3.4 | 154.4 |
| 15.40 | 143.0 | 4.6 | 3.3 | 150.9 |
| 15.50 | 139.0 | 4.3 | 3.3 | 146.6 |
| 15.60 | 136.0 | 4.1 | 3.2 | 143.3 |
| 15.70 | 134.0 | 3.9 | 3.2 | 141.1 |
| 15.80 | 131.0 | 3.8 | 3.1 | 137.9 |
| 15.90 | 129.0 | 3.6 | 3.1 | 135.7 |
| 16.00 | 126.0 | 3.5 | 3.1 | 132.6 |
| 16.10 | 123.0 | 3.4 | 3.1 | 129.5 |
| 16.20 | 120.0 | 3.4 | 3.1 | 126.4 |
| 16.30 | 118.0 | 3.3 | 3.0 | 124.2 |
| 16.40 | 115.0 | 3.2 | 2.8 | 121.0 |
| 16.50 | 112.0 | 3.2 | 2.6 | 117.8 |
| 16.60 | 110.0 | 3.2 | 2.5 | 115.7 |
| 16.70 | 108.0 | 3.1 | 2.4 | 113.5 |
| 16.80 | 106.0 | 3.1 | 2.3 | 111.4 |
| 16.90 | 104.0 | 3.1 | 2.3 | 109.3 |
| 17.00 | 102.0 | 3.1 | 2.2 | 107.3 |
| 17.10 | 100.0 | 3.1 | 2.2 | 105.2 |
| 17.20 | 99.0 | 3.0 | 2.1 | 104.2 |
| 17.30 | 97.0 | 3.0 | 2.1 | 102.2 |
| 17.40 | 96.0 | 3.0 | 2.1 | 101.1 |
| 17.50 | 94.0 | 3.0 | 2.1 | 99.1 |
| 17.60 | 93.0 | 3.0 | 2.1 | 98.1 |
| 17.70 | 92.0 | 3.0 | 2.0 | 97.1 |
| 17.80 | 92.0 | 3.0 | 2.0 | 97.1 |
| 17.90 | 91.0 | 3.0 | 2.0 | 96.0 |
| 18.00 | 90.0 | 3.0 | 2.0 | 95.0 |
| 18.10 | 89.0 | 3.0 | 2.0 | 94.0 |
| 18.20 | 88.0 | 3.0 | 2.0 | 93.0 |
| 18.30 | 87.0 | 3.0 | 2.0 | 92.0 |
| 18.40 | 86.0 | 3.0 | 2.0 | 91.0 |
| 18.50 | 85.0 | 2.9 | 2.0 | 89.9 |
| 18.60 | 84.0 | 2.8 | 2.0 | 88.8 |
| 18.70 | 83.0 | 2.6 | 2.0 | 87.6 |
| 18.80 | 82.0 | 2.5 | 2.0 | 86.5 |
| 18.90 | 81.0 | 2.4 | 2.0 | 85.4 |
| 19.00 | 80.0 | 2.4 | 2.0 | 84.4 |

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Data directory: p:\data\projects\3081\40\sw*.HYD

File Summary for Composite Hydrograph

| Time (hrs) | POSTDV00 (cfs) | BSN1OUT2 (cfs) | BSN2OUT2 (cfs) | TOTPST00 (Total) |
|---|---|---|---|---|
| 19.10 | 79.0 | 2.3 | 2.0 | 83.3 |
| 19.20 | 78.0 | 2.2 | 2.0 | 82.2 |
| 19.30 | 77.0 | 2.2 | 2.0 | 81.2 |
| 19.40 | 76.0 | 2.2 | 2.0 | 80.2 |
| 19.50 | 76.0 | 2.1 | 2.0 | 80.1 |
| 19.60 | 75.0 | 2.1 | 1.9 | 79.0 |
| 19.70 | 74.0 | 2.1 | 1.7 | 77.8 |
| 19.80 | 73.0 | 2.1 | 1.6 | 76.7 |
| 19.90 | 72.0 | 2.1 | 1.5 | 75.5 |
| 20.00 | 71.0 | 2.0 | 1.4 | 74.4 |
| 20.10 | 70.0 | 2.0 | 1.3 | 73.3 |
| 20.20 | 70.0 | 2.0 | 1.3 | 73.3 |
| 20.30 | 69.0 | 2.0 | 1.2 | 72.2 |
| 20.40 | 69.0 | 2.0 | 1.2 | 72.2 |
| 20.50 | 68.0 | 2.0 | 1.1 | 71.1 |
| 20.60 | 67.0 | 2.0 | 1.1 | 70.1 |
| 20.70 | 67.0 | 2.0 | 1.1 | 70.1 |
| 20.80 | 66.0 | 2.0 | 1.1 | 69.1 |
| 20.90 | 66.0 | 2.0 | 1.0 | 69.1 |
| 21.00 | 65.0 | 2.0 | 1.0 | 68.1 |
| 21.10 | 64.0 | 2.0 | 1.0 | 67.0 |
| 21.20 | 64.0 | 2.0 | 1.0 | 67.0 |
| 21.30 | 63.0 | 2.0 | 1.0 | 66.0 |
| 21.40 | 63.0 | 2.0 | 1.0 | 66.0 |
| 21.50 | 62.0 | 2.0 | 1.0 | 65.0 |
| 21.60 | 61.0 | 2.0 | 1.0 | 64.0 |
| 21.70 | 61.0 | 2.0 | 1.0 | 64.0 |
| 21.80 | 60.0 | 2.0 | 1.0 | 63.0 |
| 21.90 | 60.0 | 2.0 | 1.0 | 63.0 |
| 22.00 | 59.0 | 2.0 | 1.0 | 62.0 |
| 22.10 | 58.0 | 2.0 | 1.0 | 61.0 |
| 22.20 | 56.0 | 2.0 | 1.0 | 59.0 |
| 22.30 | 55.0 | 2.0 | 1.0 | 58.0 |
| 22.40 | 53.0 | 2.0 | 1.0 | 56.0 |
| 22.50 | 52.0 | 2.0 | 1.0 | 55.0 |
| 22.60 | 50.0 | 2.0 | 1.0 | 53.0 |
| 22.70 | 49.0 | 2.0 | 1.0 | 52.0 |
| 22.80 | 47.0 | 2.0 | 1.0 | 50.0 |
| 22.90 | 46.0 | 2.0 | 1.0 | 49.0 |
| 23.00 | 44.0 | 2.0 | 1.0 | 47.0 |
| 23.10 | 43.0 | 1.9 | 1.0 | 45.9 |

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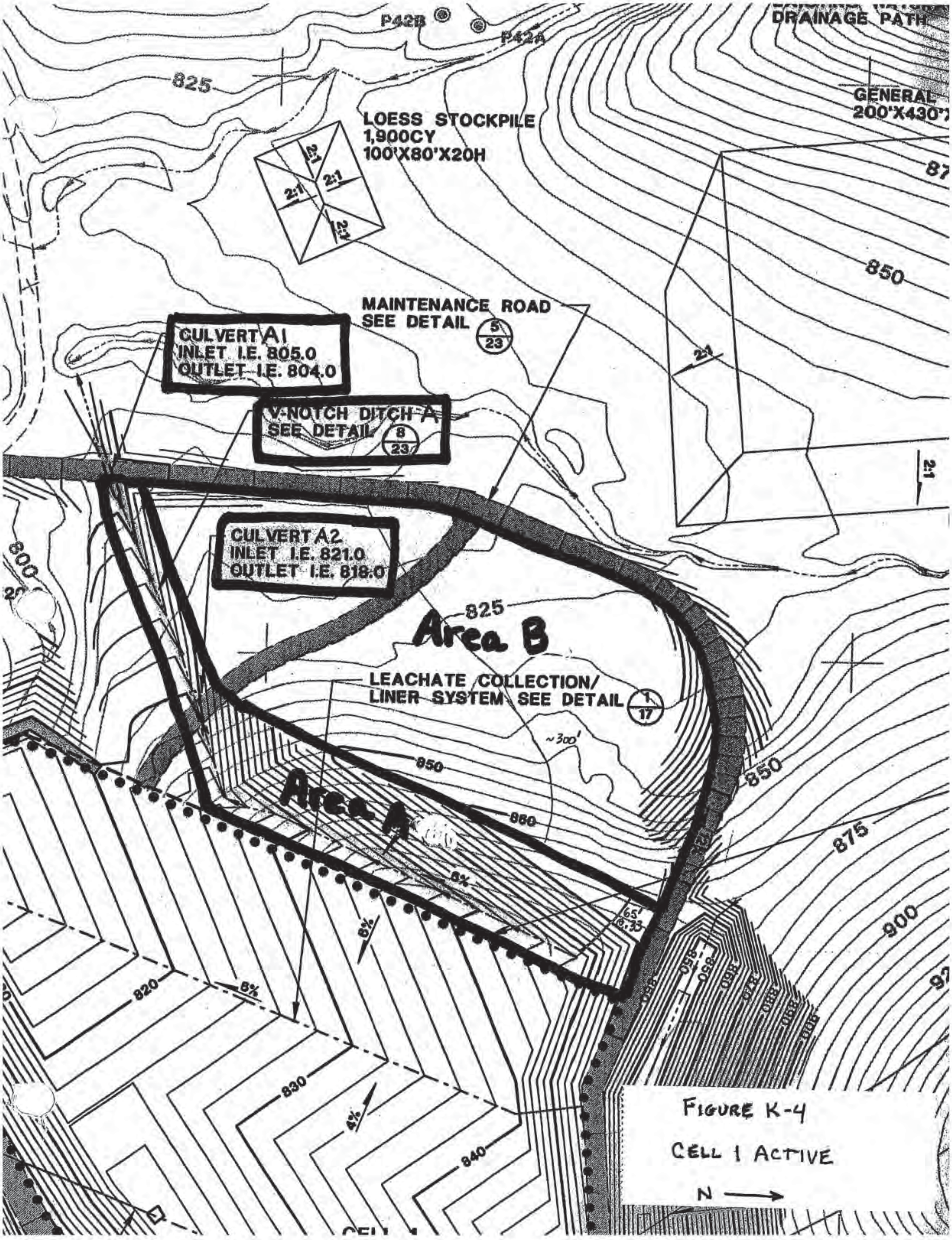
File Summary for Composite Hydrograph

| Time (hrs) | POSTDV00 (cfs) | BSN1OUT2 (cfs) | BSN2OUT2 (cfs) | TOTPST00 (Total) |
|---|---|---|---|---|
| 23.20 | 41.0 | 1.8 | 1.0 | 43.8 |
| 23.30 | 40.0 | 1.6 | 1.0 | 42.6 |
| 23.40 | 38.0 | 1.5 | 1.0 | 40.5 |
| 23.50 | 37.0 | 1.4 | 1.0 | 39.4 |
| 23.60 | 35.0 | 1.4 | 1.0 | 37.3 |
| 23.70 | 34.0 | 1.3 | 1.0 | 36.3 |
| 23.80 | 32.0 | 1.2 | 1.0 | 34.2 |
| 23.90 | 31.0 | 1.2 | 1.0 | 33.2 |
| 24.00 | 30.0 | 1.2 | 0.9 | 32.1 |
| 24.10 | 28.0 | 1.1 | 0.7 | 29.9 |
| 24.20 | 27.0 | 1.1 | 0.6 | 28.7 |
| 24.30 | 25.0 | 1.1 | 0.6 | 26.7 |
| 24.40 | 24.0 | 1.1 | 0.6 | 25.7 |
| 24.50 | 22.0 | 1.1 | 0.6 | 23.7 |
| 24.60 | 21.0 | 1.0 | 0.6 | 22.6 |
| 24.70 | 19.0 | 1.0 | 0.6 | 20.6 |
| 24.80 | 18.0 | 1.0 | 0.6 | 19.6 |
| 24.90 | 16.0 | 1.0 | 0.6 | 17.6 |
| 25.00 | 15.0 | 0.9 | 0.6 | 16.5 |
| 25.10 | 13.0 | 0.8 | 0.6 | 14.4 |
| 25.20 | 12.0 | 0.8 | 0.6 | 13.4 |
| 25.30 | 10.0 | 0.8 | 0.6 | 11.4 |
| 25.40 | 9.0 | 0.8 | 0.6 | 10.4 |
| 25.50 | 7.0 | 0.8 | 0.6 | 8.4 |

# Operational Run-off Calculations



P42B
P42A
DRAINAGE PATH
825
LOESS STOCKPILE
1,900CY
100'X80'X20H
2:1
GENERAL
200'X430'
850
MAINTENANCE ROAD
SEE DETAIL 5/23
CULVERT A1
INLET I.E. 805.0
OUTLET I.E. 804.0
V-NOTCH DITCH A
SEE DETAIL 8/23
CULVERT A2
INLET I.E. 821.0
OUTLET I.E. 818.0
800
825
Area B
LEACHATE COLLECTION/
LINER SYSTEM SEE DETAIL 1/17
~300'
850
860
Area A
875
900
8%
820
830
4%
840
FIGURE K-4
CELL 1 ACTIVE
N

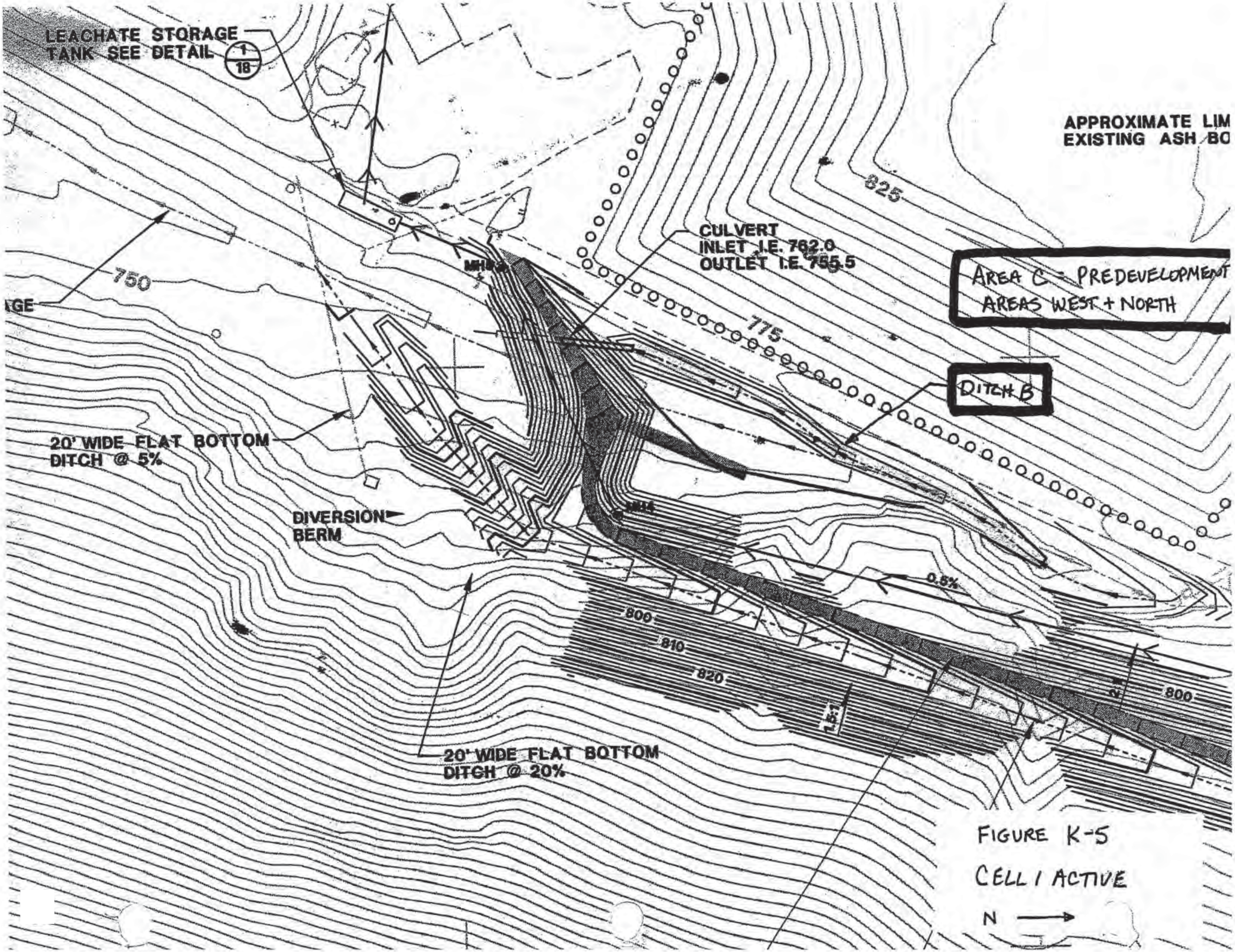



FIGURE K-5

CELL I ACTIVE

N →

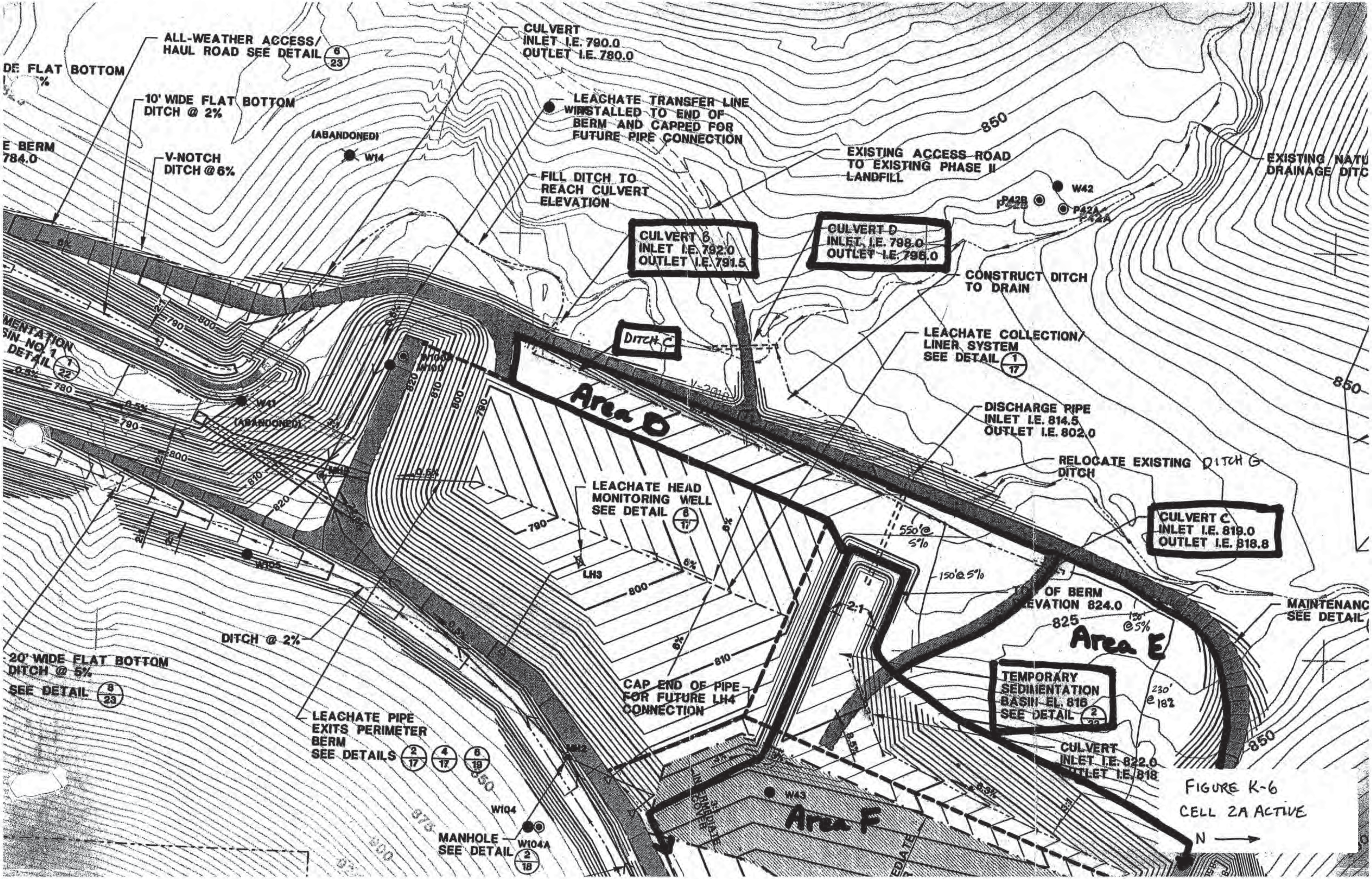



FIGURE K-6
CELL 2A ACTIVE

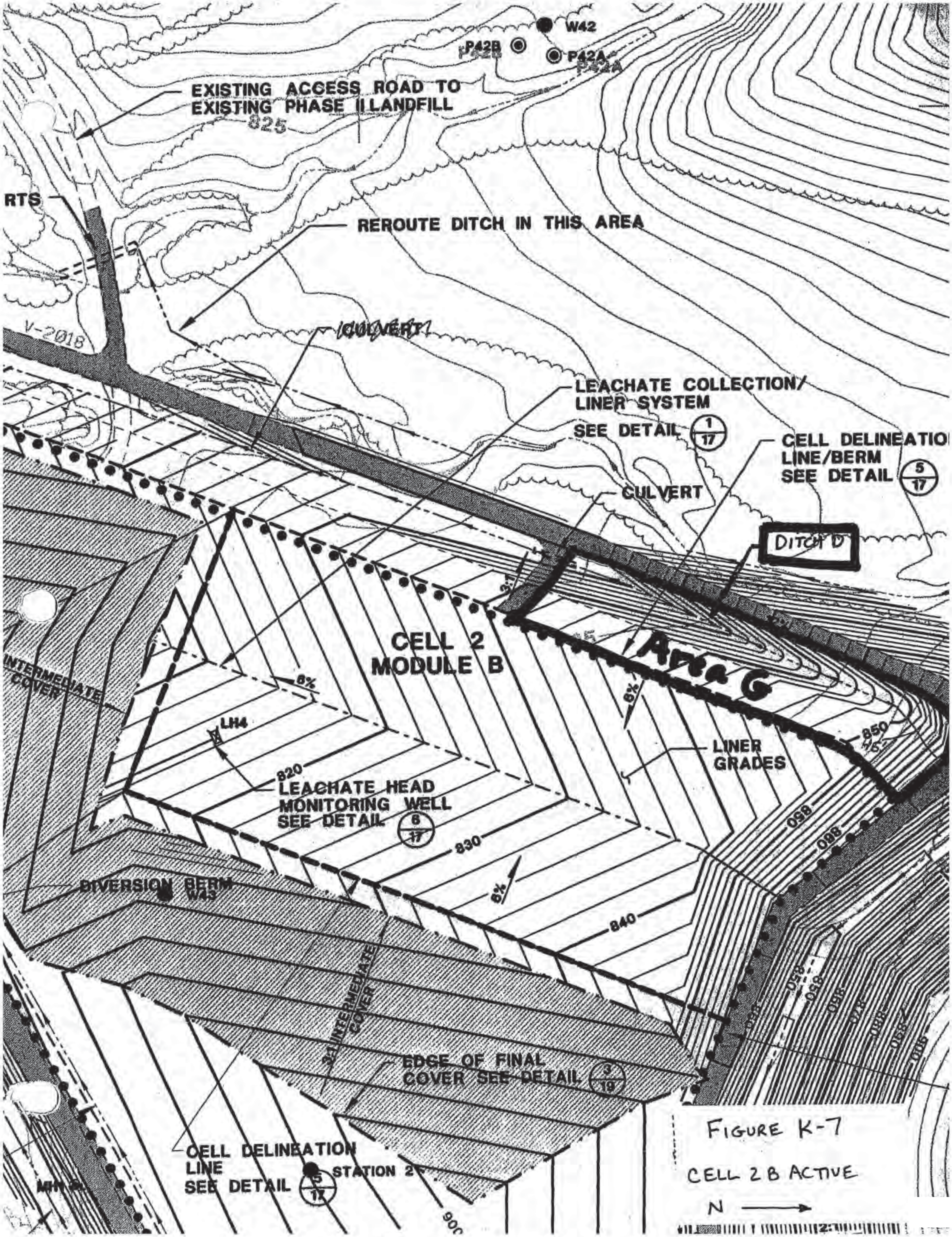
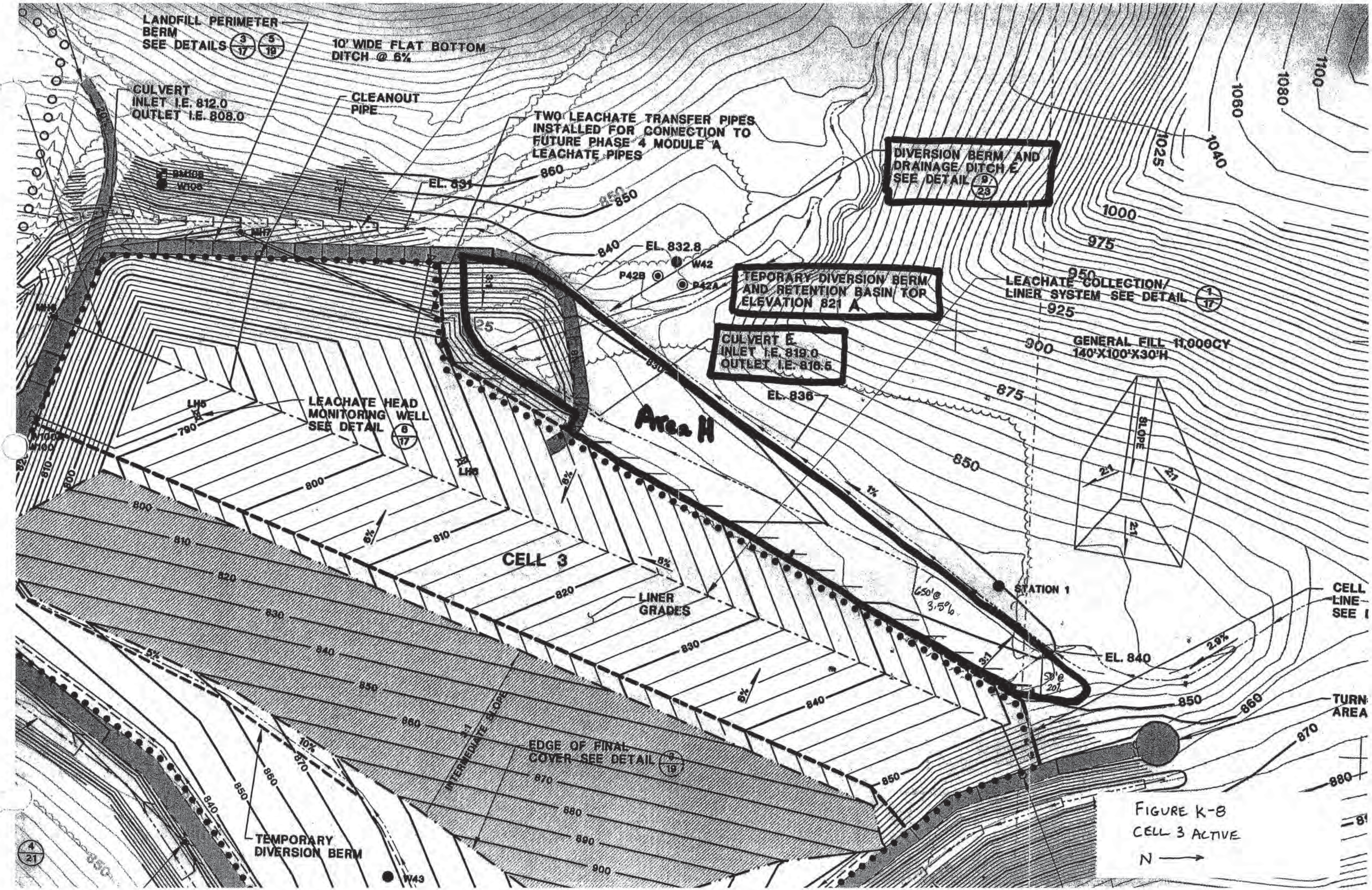


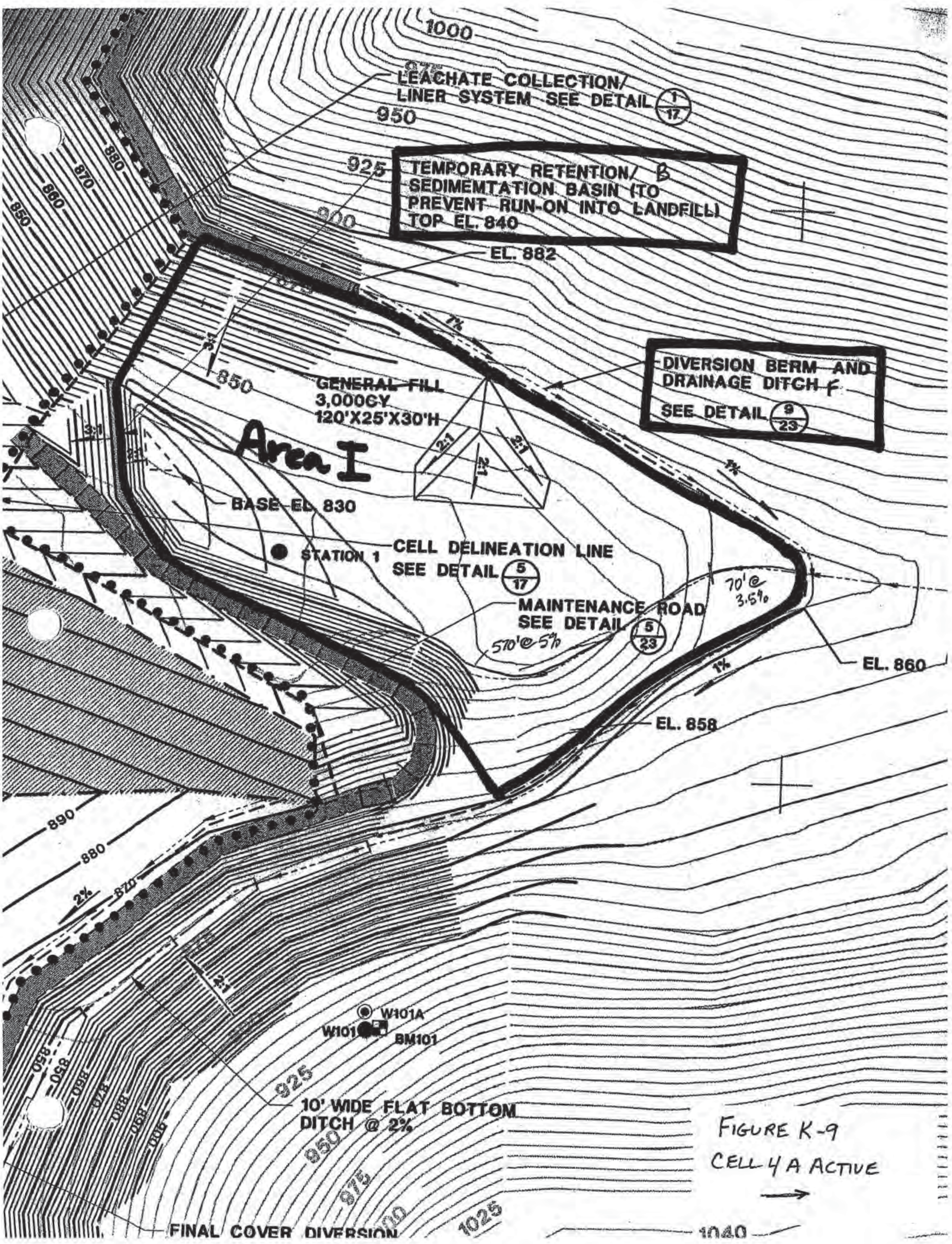

FIGURE K-7

CELL 2 B ACTIVE

N →



LANDFILL PERIMETER BERM SEE DETAILS 3/17 5/19
10' WIDE FLAT BOTTOM DITCH @ 6%
CULVERT INLET I.E. 812.0 OUTLET I.E. 808.0
CLEANOUT PIPE
TWO LEACHATE TRANSFER PIPES INSTALLED FOR CONNECTION TO FUTURE PHASE 4 MODULE A LEACHATE PIPES
DIVERSION BERM AND DRAINAGE DITCH E SEE DETAIL 9/23
EL. 831
EL. 832.8
W42
P42B
P42A
TEPORARY DIVERSION BERM AND RETENTION BASIN TOP ELEVATION 821 A
LEACHATE COLLECTION/ LINER SYSTEM SEE DETAIL 1/17
CULVERT E INLET I.E. 819.0 OUTLET I.E. 816.5
GENERAL FILL 11,000CY 140'X100'X30'H
EL. 836
Area H
LEACHATE HEAD MONITORING WELL SEE DETAIL 6/17
CELL 3
LINER GRADES
STATION 1
650'@ 3.5%
EL. 840
TURN AREA
EDGE OF FINAL COVER SEE DETAIL 3/19
INTERMEDIATE SLOPE
TEMPORARY DIVERSION BERM
W43
FIGURE K-8
CELL 3 ACTIVE
N →



LEACHATE COLLECTION/
LINER SYSTEM SEE DETAIL 1/17
TEMPORARY RETENTION/ B
SEDIMEMTATION BASIN (TO
PREVENT RUN-ON INTO LANDFILL)
TOP EL. 840
EL. 882
DIVERSION BERM AND
DRAINAGE DITCH F
SEE DETAIL 9/23
GENERAL FILL
3,000CY
120'X25'X30'H
Area I
BASE EL 830
STATION 1
CELL DELINEATION LINE
SEE DETAIL 5/17
MAINTENANCE ROAD
SEE DETAIL 5/23
570'@5%
70'@ 3.5%
EL. 860
EL. 858
W101A
W101
BM101
10' WIDE FLAT BOTTOM
DITCH @ 2%
FINAL COVER DIVERSION
FIGURE K-9
CELL 4A ACTIVE

Quick TR-55 Ver.5.46 S/N:
Executed: 19:42:40 10-12-2000 p:\data\projects\3081\40\sw\op\OPERAT.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.
Plan of Operation
Operational Conditions

| Subarea descr. | Tc or Tt | Time (hrs) |
|---|---|---|
| Area A | Tc | 0.08 |
| Area B | Tc | 0.21 |
| Area D | Tc | 0.06 – Round to 0.10 |
| Area E | Tc | 0.15 |
| Area F | Tc | 0.24 |
| Area G | Tc | 0.05 – Round to 0.10 |
| Area H | Tc | 0.10 |
| Area I | Tc | 0.15 |

```
Quick TR-55 Ver.5.46   S/N:
Executed: 19:42:40   10-12-2000    p:\data\projects\3081\40\sw\op\OPERAT.TCT

                          Dairyland Power Coop.
                            Plan of Operation
                          Operational Conditions


                   Tc COMPUTATIONS FOR: Area A

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                  1
    Surface description                   grass
    Manning's roughness coeff., n               0.1500
    Flow length, L (total < or = 300)     ft     65.0
    Two-yr 24-hr rainfall, P2             in    2.800
    Land slope, s                      ft/ft    0.3330
                        0.8
        .007 * (n*L)
    T = --------------                    hrs     0.04                 = 0.04
           0.5    0.4
         P2   *  s

 SHALLOW CONCENTRATED FLOW
    Segment ID                                  2
    Surface (paved or unpaved)?                 Unpaved
    Flow length, L                         ft    625.0
    Watercourse slope, s               ft/ft    0.0600

                         0.5
    Avg.V =  Csf *  (s)                 ft/s   3.9521
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                      hrs     0.04                 = 0.04


 CHANNEL FLOW
    Segment ID
    Cross Sectional Flow Area, a      sq.ft     0.00
    Wetted perimeter, Pw                   ft     0.00
    Hydraulic radius, r = a/Pw             ft    0.000
    Channel slope, s                   ft/ft    0.0000
    Manning's roughness coeff., n               0.0000

                    2/3    1/2
        1.49  *  r    *  s
    V = --------------------             ft/s    0.0000
                  n

    Flow length, L                         ft        0

    T = L / (3600*V)                      hrs     0.00                 = 0.00

   ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                          TOTAL TIME (hrs)      0.08
```

```
Quick TR-55 Ver.5.46   S/N:
Executed: 19:42:40   10-12-2000    p:\data\projects\3081\40\sw\op\OPERAT.TCT

                         Dairyland Power Coop.
                           Plan of Operation
                        Operational Conditions


                  Tc COMPUTATIONS FOR: Area B

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                   1
    Surface description                     grass
    Manning's roughness coeff., n                0.1500
    Flow length, L (total < or = 300)    ft     300.0
    Two-yr 24-hr rainfall, P2            in     2.800
    Land slope, s                      ft/ft    0.1700
                     0.8
        .007 * (n*L)
    T = --------------                   hrs     0.18            = 0.18
           0.5    0.4
         P2   *  s

 SHALLOW CONCENTRATED FLOW
    Segment ID                                   2
    Surface (paved or unpaved)?                  Unpaved
    Flow length, L                       ft     220.0
    Watercourse slope, s               ft/ft    0.0200

                      0.5
    Avg.V =  Csf *  (s)                 ft/s    2.2818
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                     hrs     0.03            = 0.03


 CHANNEL FLOW
    Segment ID
    Cross Sectional Flow Area, a       sq.ft     0.00
    Wetted perimeter, Pw                 ft      0.00
    Hydraulic radius, r = a/Pw           ft     0.000
    Channel slope, s                   ft/ft    0.0000
    Manning's roughness coeff., n               0.0000

                   2/3    1/2
        1.49  *  r   *  s
    V = --------------------            ft/s    0.0000
                 n

    Flow length, L                       ft         0

    T = L / (3600*V)                     hrs     0.00            = 0.00

    ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                         TOTAL TIME (hrs)        0.21
```

```
Quick TR-55 Ver.5.46   S/N:
Executed: 19:42:40   10-12-2000    p:\data\projects\3081\40\sw\op\OPERAT.TCT

                         Dairyland Power Coop.
                          Plan of Operation
                        Operational Conditions


                     Tc COMPUTATIONS FOR: Area D

SHEET FLOW (Applicable to Tc only)
   Segment ID                                  1
   Surface description                   soil
   Manning's roughness coeff., n               0.0110
   Flow length, L (total < or = 300)     ft     150.0
   Two-yr 24-hr rainfall, P2             in     2.800
   Land slope, s                       ft/ft   0.0500
                     0.8
       .007 * (n*L)
   T = --------------                    hrs     0.02              = 0.02
          0.5    0.4
        P2   *   s

SHALLOW CONCENTRATED FLOW
   Segment ID                                  2
   Surface (paved or unpaved)?                 Unpaved
   Flow length, L                        ft     550.0
   Watercourse slope, s                ft/ft   0.0500

                      0.5
   Avg.V =  Csf *  (s)                  ft/s   3.6078
   where:   Unpaved Csf = 16.1345
            Paved   Csf = 20.3282

   T = L / (3600*V)                      hrs     0.04              = 0.04


CHANNEL FLOW
   Segment ID
   Cross Sectional Flow Area, a        sq.ft     0.00
   Wetted perimeter, Pw                  ft      0.00
   Hydraulic radius, r = a/Pw            ft     0.000
   Channel slope, s                    ft/ft   0.0000
   Manning's roughness coeff., n               0.0000

                  2/3    1/2
       1.49  *  r    *  s
   V = --------------------             ft/s   0.0000
                 n

   Flow length, L                        ft         0

   T = L / (3600*V)                      hrs     0.00              = 0.00

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                          TOTAL TIME (hrs)        0.06
```

```
Quick TR-55 Ver.5.46   S/N:
Executed: 19:42:40   10-12-2000    p:\data\projects\3081\40\sw\op\OPERAT.TCT

                         Dairyland Power Coop.
                           Plan of Operation
                         Operational Conditions


                    Tc COMPUTATIONS FOR: Area E

SHEET FLOW (Applicable to Tc only)
    Segment ID                                       1
    Surface description                         grass
    Manning's roughness coeff., n                  0.1500
    Flow length, L (total < or = 300)      ft      230.0
    Two-yr 24-hr rainfall, P2              in      2.800
    Land slope, s                        ft/ft     0.1800
                      0.8
         .007 * (n*L)
    T =  --------------                   hrs       0.14              =  0.14
            0.5    0.4
          P2   *  s

SHALLOW CONCENTRATED FLOW
    Segment ID                                      2
    Surface (paved or unpaved)?                     Unpaved
    Flow length, L                          ft      150.0
    Watercourse slope, s                 ft/ft     0.0500

                        0.5
    Avg.V =  Csf *  (s)                  ft/s      3.6078
    Where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                      hrs       0.01              =  0.01


CHANNEL FLOW
    Segment ID
    Cross Sectional Flow Area, a        sq.ft       0.00
    Wetted perimeter, Pw                   ft       0.00
    Hydraulic radius, r = a/Pw             ft      0.000
    Channel slope, s                    ft/ft     0.0000
    Manning's roughness coeff., n                 0.0000

                 2/3    1/2
        1.49  *  r   *  s
    V = --------------------             ft/s      0.0000
                 n

    Flow length, L                         ft           0

    T = L / (3600*V)                      hrs       0.00              =  0.00

   ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                             TOTAL TIME (hrs)        0.15
```

```
Quick TR-55 Ver.5.46   S/N:
Executed: 19:42:40   10-12-2000    p:\data\projects\3081\40\sw\op\OPERAT.TCT

                         Dairyland Power Coop.
                          Plan of Operation
                        Operational Conditions


                    Tc COMPUTATIONS FOR: Area F

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                   1
    Surface description                     grass
    Manning's roughness coeff., n                0.1500
    Flow length, L (total < or = 300)     ft     185.0
    Two-yr 24-hr rainfall, P2             in     2.800
    Land slope, s                       ft/ft    0.2500
                      0.8
        .007 * (n*L)
    T = --------------                   hrs      0.10              = 0.10
           0.5    0.4
         P2   *  s

 SHALLOW CONCENTRATED FLOW
    Segment ID                                   2
    Surface (paved or unpaved)?                  Unpaved
    Flow length, L                        ft     1370.0
    Watercourse slope, s                ft/ft    0.0300

                        0.5
    Avg.V =  Csf *  (s)                 ft/s     2.7946
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                     hrs      0.14              = 0.14


 CHANNEL FLOW
    Segment ID
    Cross Sectional Flow Area, a        sq.ft     0.00
    Wetted perimeter, Pw                  ft      0.00
    Hydraulic radius, r = a/Pw            ft      0.000
    Channel slope, s                    ft/ft     0.0000
    Manning's roughness coeff., n                 0.0000

                    2/3    1/2
        1.49  *  r   *  s
    V = --------------------             ft/s     0.0000
                   n

    Flow length, L                        ft         0

    T = L / (3600*V)                     hrs      0.00              = 0.00

   ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                                 TOTAL TIME (hrs)     0.24
```

```
Quick TR-55 Ver.5.46   S/N:
Executed: 19:42:40   10-12-2000    p:\data\projects\3081\40\sw\op\OPERAT.TCT

                         Dairyland Power Coop.
                           Plan of Operation
                        Operational Conditions


                    Tc COMPUTATIONS FOR: Area G

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                    1
    Surface description                       grass
    Manning's roughness coeff., n                0.1500
    Flow length, L (total < or = 300)    ft      45.0
    Two-yr 24-hr rainfall, P2            in     2.800
    Land slope, s                       ft/ft   0.3300
                      0.8
        .007 * (n*L)
    T = --------------                  hrs      0.03              =  0.03
           0.5    0.4
         P2    *  s

 SHALLOW CONCENTRATED FLOW
    Segment ID                                   2
    Surface (paved or unpaved)?                 Unpaved
    Flow length, L                       ft      320.0
    Watercourse slope, s                ft/ft   0.1200

                       0.5
    Avg.V =  Csf *  (s)                 ft/s   5.5892
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                    hrs      0.02              =  0.02


 CHANNEL FLOW
    Segment ID
    Cross Sectional Flow Area, a       sq.ft     0.00
    Wetted perimeter, Pw                 ft      0.00
    Hydraulic radius, r = a/Pw           ft     0.000
    Channel slope, s                    ft/ft   0.0000
    Manning's roughness coeff., n               0.0000

                     2/3    1/2
        1.49  *  r   *  s
    V = --------------------            ft/s    0.0000
                 n

    Flow length, L                       ft         0

    T = L / (3600*V)                    hrs      0.00              =  0.00

   ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                             TOTAL TIME (hrs)      0.05
```

```
Quick TR-55 Ver.5.46   S/N:
Executed: 19:42:40   10-12-2000    p:\data\projects\3081\40\sw\op\OPERAT.TCT

                         Dairyland Power Coop.
                           Plan of Operation
                        Operational Conditions


                    Tc COMPUTATIONS FOR: Area H

 SHEET FLOW (Applicable to Tc only)
    Segment ID                                 1
    Surface description                   grass
    Manning's roughness coeff., n              0.1500
    Flow length, L (total < or = 300)    ft     50.0
    Two-yr 24-hr rainfall, P2            in    2.800
    Land slope, s                      ft/ft   0.2000
                     0.8
        .007 * (n*L)
    T = --------------                  hrs     0.04              = 0.04
           0.5    0.4
         P2   *  s

 SHALLOW CONCENTRATED FLOW
    Segment ID                                 2
    Surface (paved or unpaved)?                Unpaved
    Flow length, L                       ft     650.0
    Watercourse slope, s               ft/ft   0.0350

                      0.5
    Avg.V =  Csf *  (s)                 ft/s   3.0185
    where:   Unpaved Csf = 16.1345
             Paved   Csf = 20.3282

    T = L / (3600*V)                    hrs     0.06              = 0.06


 CHANNEL FLOW
    Segment ID
    Cross Sectional Flow Area, a       sq.ft    0.00
    Wetted perimeter, Pw                 ft     0.00
    Hydraulic radius, r = a/Pw           ft    0.000
    Channel slope, s                   ft/ft   0.0000
    Manning's roughness coeff., n              0.0000

                  2/3    1/2
        1.49  *  r   *  s
    V = --------------------            ft/s   0.0000
                   n

    Flow length, L                       ft        0

    T = L / (3600*V)                    hrs     0.00              = 0.00

  :::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                          TOTAL TIME (hrs)        0.10
```

```
Quick TR-55 Ver.5.46   S/N:
Executed: 19:42:40   10-12-2000    p:\data\projects\3081\40\sw\op\OPERAT.TCT

                    Dairyland Power Coop.
                     Plan of Operation
                   Operational Conditions


              Tc COMPUTATIONS FOR: Area I

SHEET FLOW (Applicable to Tc only)
   Segment ID                               1
   Surface description                 grass
   Manning's roughness coeff., n            0.1500
   Flow length, L (total < or = 300)   ft     70.0
   Two-yr 24-hr rainfall, P2           in     2.800
   Land slope, s                      ft/ft   0.0350
                    0.8
       .007 * (n*L)
   T = --------------                 hrs     0.10            =  0.10
            0.5   0.4
         P2   *  s

SHALLOW CONCENTRATED FLOW
   Segment ID                               2
   Surface (paved or unpaved)?              Unpaved
   Flow length, L                      ft     570.0
   Watercourse slope, s               ft/ft   0.0500

                     0.5
   Avg.V =  Csf *  (s)                ft/s   3.6078
   where:   Unpaved Csf = 16.1345
            Paved   Csf = 20.3282

   T = L / (3600*V)                   hrs     0.04            =  0.04


CHANNEL FLOW
   Segment ID
   Cross Sectional Flow Area, a      sq.ft    0.00
   Wetted perimeter, Pw                ft     0.00
   Hydraulic radius, r = a/Pw          ft     0.000
   Channel slope, s                   ft/ft   0.0000
   Manning's roughness coeff., n              0.0000

                 2/3   1/2
      1.49  *  r   *  s
   V = --------------------           ft/s   0.0000
                 n

   Flow length, L                      ft        0

   T = L / (3600*V)                   hrs     0.00            =  0.00

  ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                                      TOTAL TIME (hrs)         0.15
```

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:42
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL1 .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL1 .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 1

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used | |
|---|---|---|---|---|---|---|---|---|
| Area A | 1.10 | 69.0 | 0.10 | 0.00 | 6.10 | 2.79 | .15 | .10 |
| Area B | 2.70 | 69.0 | 0.20 | 0.00 | 6.10 | 2.79 | .15 | .10 |

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 3.80 acres or 0.00594 sq.mi
Peak discharge = 14 cfs

>>>> Computer Modifications of Input Parameters <<<<<

| | Input Values | | Rounded Values | | Ia/p | |
|---|---|---|---|---|---|---|
| Subarea Description | Tc (hr) | * Tt (hr) | Tc (hr) | * Tt (hr) | Interpolated (Yes/No) | Ia/p Messages |
| Area A | 0.10 | 0.00 | ** | ** | No | -- |
| Area B | 0.21 | 0.00 | 0.20 | 0.00 | No | -- |

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:42
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL1 .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL1 .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 1

>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| Area A | 5 | 12.1 |
| Area B | 9 | 12.1 |
| Composite Watershed | 14 | 12.1 |

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:49
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL2A .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL2A .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2A

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used |
|---|---|---|---|---|---|---|---|
| Area D | 1.30 | 69.0 | 0.10 | 0.00 | 6.10 | 2.79 | .15 .10 |
| Area E | 1.60 | 69.0 | 0.20 | 0.00 | 6.10 | 2.79 | .15 .10 |

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 2.90 acres or 0.00453 sq.mi
Peak discharge = 11 cfs

>>>> Computer Modifications of Input Parameters <<<<<

| Subarea Description | Input Values Tc (hr) | Input Values * Tt (hr) | Rounded Values Tc (hr) | Rounded Values * Tt (hr) | Ia/p Interpolated (Yes/No) | Ia/p Messages |
|---|---|---|---|---|---|---|
| Area D | 0.10 | 0.00 | ** | ** | No | -- |
| Area E | 0.15 | 0.00 | 0.20 | 0.00 | No | -- |

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:49
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL2A .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL2A .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2A

>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| Area D | 6 | 12.1 |
| Area E | 6 | 12.2 |
| Composite Watershed | 11 | 12.1 |

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:57
Watershed file: --> p:\data\projects\3081\40\sw\op\TEMPBAS .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\TEMPBAS .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2A Temporary Basin

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used |
|---|---|---|---|---|---|---|---|
| Area F | 7.60 | 69.0 | 0.20 | 0.00 | 6.10 | 2.79 | .15 .10 |

* Travel time from subarea outfall to composite watershed outfall point.

Total area = 7.60 acres or 0.01187 sq.mi
Peak discharge = 27 cfs

>>>> Computer Modifications of Input Parameters <<<<<

| Subarea Description | Input Values Tc (hr) | Input Values * Tt (hr) | Rounded Values Tc (hr) | Rounded Values * Tt (hr) | Ia/p Interpolated (Yes/No) | Ia/p Messages |
|---|---|---|---|---|---|---|
| Area F | 0.24 | 0.00 | 0.20 | 0.00 | No | -- |

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:57
Watershed file: --> p:\data\projects\3081\40\sw\op\TEMPBAS .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\TEMPBAS .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2A Temporary Basin

>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| Area F | 27 | 12.2 |
| Composite Watershed | 27 | 12.2 |

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:03
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL2B .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL2B .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2B

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used |
|---|---|---|---|---|---|---|---|
| Area G | 0.60 | 69.0 | 0.10 | 0.00 | 6.10 | 2.79 | .15 .10 |

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 0.60 acres or 0.00094 sq.mi
Peak discharge = 3 cfs

>>>> Computer Modifications of Input Parameters <<<<<

| | Input Values | | Rounded Values | | Ia/p | |
|---|---|---|---|---|---|---|
| Subarea Description | Tc (hr) | * Tt (hr) | Tc (hr) | * Tt (hr) | Interpolated (Yes/No) | Ia/p Messages |
| Area G | 0.10 | 0.00 | ** | ** | No | -- |

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:03
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL2B .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL2B .HYD

Dairyland Power Coop.
Plan of Opertaion
Operational Conditions
Cell 2B

>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| Area G | 3 | 12.1 |
| Composite Watershed | 3 | 12.1 |

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:08
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL3 .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL3 .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 3

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used |
|---|---|---|---|---|---|---|---|
| Area H | 1.70 | 69.0 | 0.10 | 0.00 | 6.10 | 2.79 | .15 .10 |

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 1.70 acres or 0.00266 sq.mi
Peak discharge = 7 cfs

>>>> Computer Modifications of Input Parameters <<<<<

| Subarea Description | Input Values Tc (hr) | Input Values * Tt (hr) | Rounded Values Tc (hr) | Rounded Values * Tt (hr) | Ia/p Interpolated (Yes/No) | Ia/p Messages |
|---|---|---|---|---|---|---|
| Area H | 0.10 | 0.00 | ** | ** | No | -- |

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:08
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL3 .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL3 .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 3

>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| Area H | 7 | 12.1 |
| Composite Watershed | 7 | 12.1 |

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:21:09
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL4A .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL4A .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 4A

>>>> Input Parameters Used to Compute Hydrograph <<<<

| Subarea Description | AREA (acres) | CN | Tc (hrs) | * Tt (hrs) | Precip. (in) | Runoff (in) | Ia/p input/used |
|---|---|---|---|---|---|---|---|
| Area I | 3.60 | 69.0 | 0.20 | 0.00 | 6.10 | 2.79 | .15 .10 |

* Travel time from subarea outfall to composite watershed outfall point.

Total area = 3.60 acres or 0.00562 sq.mi
Peak discharge = 13 cfs

>>>> Computer Modifications of Input Parameters <<<<<

| Subarea Description | Input Values Tc (hr) | Input Values * Tt (hr) | Rounded Values Tc (hr) | Rounded Values * Tt (hr) | Ia/p Interpolated (Yes/No) | Ia/p Messages |
|---|---|---|---|---|---|---|
| Area I | 0.15 | 0.00 | 0.20 | 0.00 | No | -- |

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 10-12-2000 20:21:09
Watershed file: --> p:\data\projects\3081\40\sw\op\CELL4A .WSD
Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL4A .HYD

Dairyland Power Coop.
Plan of Operation
Operational Conditions
Cell 4A

>>>> Summary of Subarea Times to Peak <<<<

| Subarea | Peak Discharge at Composite Outfall (cfs) | Time to Peak at Composite Outfall (hrs) |
|---|---|---|
| Area I | 13 | 12.2 |
| Composite Watershed | 13 | 12.2 |

**Reference Information**

**Table 2-2a.—Runoff curve numbers for urban areas[1]**

| Cover description | | Curve numbers for hydrologic soil group— | | | |
|---|---|---|---|---|---|
| Cover type and hydrologic condition | Average percent impervious area[2] | A | B | C | D |
| *Fully developed urban areas (vegetation established)* | | | | | |
| Open space (lawns, parks, golf courses, cemeteries, etc.)[3]: | | | | | |
| Poor condition (grass cover < 50%) | | 68 | 79 | 86 | 89 |
| Fair condition (grass cover 50% to 75%) | | 49 | 69 | 79 | 84 |
| Good condition (grass cover > 75%) | | 39 | 61 | 74 | 80 |
| Impervious areas: | | | | | |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Streets and roads: | | | | | |
| Paved; curbs and storm sewers (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Paved; open ditches (including right-of-way) | | 83 | 89 | 92 | 93 |
| Gravel (including right-of-way) | | 76 | 85 | 89 | 91 |
| Dirt (including right-of-way) | | 72 | 82 | 87 | 89 |
| Western desert urban areas: | | | | | |
| Natural desert landscaping (pervious areas only)[4] | | 63 | 77 | 85 | 88 |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) | | 96 | 96 | 96 | 96 |
| Urban districts: | | | | | |
| Commercial and business | 85 | 89 | 92 | 94 | 95 |
| Industrial | 72 | 81 | 88 | 91 | 93 |
| Residential districts by average lot size: | | | | | |
| 1/8 acre or less (town houses) | 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 |
| 2 acres | 12 | 46 | 65 | 77 | 82 |
| *Developing urban areas* | | | | | |
| Newly graded areas (pervious areas only, no vegetation)[5] | | 77 | 86 | 91 | 94 |
| Idle lands (CN's are determined using cover types similar to those in table 2-2c). | | | | | |

[1]Average runoff condition, and $I_a = 0.2S$.
[2]The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
[3]CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4]Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5]Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b.—Runoff curve numbers for cultivated agricultural lands[1]

| Cover description | | | Curve numbers for hydrologic soil group— | | | |
|---|---|---|---|---|---|---|
| Cover type | Treatment[2] | Hydrologic condition[3] | A | B | C | D |
| Fallow | Bare soil | — | 77 | 86 | 91 | 94 |
| | Crop residue cover (CR) | Poor | 76 | 85 | 90 | 93 |
| | | Good | 74 | 83 | 88 | 90 |
| Row crops | Straight row (SR) | Poor | 72 | 81 | 88 | 91 |
| | | Good | 67 | 78 | 85 | 89 |
| | SR + CR | Poor | 71 | 80 | 87 | 90 |
| | | Good | 64 | 75 | 82 | 85 |
| | Contoured (C) | Poor | 70 | 79 | 84 | 88 |
| | | Good | 65 | 75 | 82 | 86 |
| | C + CR | Poor | 69 | 78 | 83 | 87 |
| | | Good | 64 | 74 | 81 | 85 |
| | Contoured & terraced (C&T) | Poor | 66 | 74 | 80 | 82 |
| | | Good | 62 | 71 | 78 | 81 |
| | C&T + CR | Poor | 65 | 73 | 79 | 81 |
| | | Good | 61 | 70 | 77 | 80 |
| Small grain | SR | Poor | 65 | 76 | 84 | 88 |
| | | Good | 63 | 75 | 83 | 87 |
| | SR + CR | Poor | 64 | 75 | 83 | 86 |
| | | Good | 60 | 72 | 80 | 84 |
| | C | Poor | 63 | 74 | 82 | 85 |
| | | Good | 61 | 73 | 81 | 84 |
| | C + CR | Poor | 62 | 73 | 81 | 84 |
| | | Good | 60 | 72 | 80 | 83 |
| | C&T | Poor | 61 | 72 | 79 | 82 |
| | | Good | 59 | 70 | 78 | 81 |
| | C&T + CR | Poor | 60 | 71 | 78 | 81 |
| | | Good | 58 | 69 | 77 | 80 |
| Close-seeded or broadcast legumes or rotation meadow | SR | Poor | 66 | 77 | 85 | 89 |
| | | Good | 58 | 72 | 81 | 85 |
| | C | Poor | 64 | 75 | 83 | 85 |
| | | Good | 55 | 69 | 78 | 83 |
| | C&T | Poor | 63 | 73 | 80 | 83 |
| | | Good | 51 | 67 | 76 | 80 |

[1]Average runoff condition, and $I_a = 0.2S$.
[2]*Crop residue cover* applies only if residue is on at least 5% of the surface throughout the year.
[3]Hydrologic condition is based on combination of factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes in rotations, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.
*Poor*: Factors impair infiltration and tend to increase runoff.
*Good*: Factors encourage average and better than average infiltration and tend to decrease runoff.

**Table 2-2c.—Runoff curve numbers for other agricultural lands[1]**

| Cover description | | Curve numbers for hydrologic soil group— | | | |
|---|---|---|---|---|---|
| Cover type | Hydrologic condition | A | B | C | D |
| Pasture, grassland, or range—continuous forage for grazing.[2] | Poor | 68 | 79 | 86 | 89 |
| | Fair | 49 | 69 | 79 | 84 |
| | Good | 39 | 61 | 74 | 80 |
| Meadow—continuous grass, protected from grazing and generally mowed for hay. | — | 30 | 58 | 71 | 78 |
| Brush—brush-weed-grass mixture with brush the major element.[3] | Poor | 48 | 67 | 77 | 83 |
| | Fair | 35 | 56 | 70 | 77 |
| | Good | [4]30 | 48 | 65 | 73 |
| Woods—grass combination (orchard or tree farm).[5] | Poor | 57 | 73 | 82 | 86 |
| | Fair | 43 | 65 | 76 | 82 |
| | Good | 32 | 58 | 72 | 79 |
| Woods.[6] | Poor | 45 | 66 | 77 | 83 |
| | Fair | 36 | 60 | 73 | 79 |
| | Good | [4]30 | 55 | 70 | 77 |
| Farmsteads—buildings, lanes, driveways, and surrounding lots. | — | 59 | 74 | 82 | 86 |

[1]Average runoff condition, and $I_a = 0.2S$.

[2]*Poor:* <50% ground cover or heavily grazed with no mulch.
*Fair:* 50 to 75% ground cover and not heavily grazed.
*Good:* >75% ground cover and lightly or only occasionally grazed.

[3]*Poor:* <50% ground cover.
*Fair:* 50 to 75% ground cover.
*Good:* >75% ground cover.

[4]Actual curve number is less than 30; use CN = 30 for runoff computations.

[5]CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6]*Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
*Fair:* Woods are grazed but not burned, and some forest litter covers the soil.
*Good:* Woods are protected from grazing, and litter and brush adequately cover the soil.

### Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overton and Meadows 1976) to compute $T_t$:

$$T_t = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,s^{0.4}} \qquad \text{[Eq. 3-3]}$$

**Table 3-1.—Roughness coefficients (Manning's n) for sheet flow**

| Surface description | n[1] |
|---|---|
| Smooth surfaces (concrete, asphalt, gravel, or bare soil) | 0.011 |
| Fallow (no residue) | 0.05 |
| Cultivated soils: | |
| Residue cover ≤20% | 0.06 |
| Residue cover >20% | 0.17 |
| Grass: | |
| Short grass prairie | 0.15 |
| Dense grasses[2] | 0.24 |
| Bermudagrass | 0.41 |
| Range (natural) | 0.13 |
| Woods:[3] | |
| Light underbrush | 0.40 |
| Dense underbrush | 0.80 |

[1]The n values are a composite of information compiled by Engman (1986).
[2]Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
[3]When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

where

$T_t$ = travel time (hr),
n = Manning's roughness coefficient (table 3-1),
L = flow length (ft),
$P_2$ = 2-year, 24-hour rainfall (in), and
s = slope of hydraulic grade line (land slope, ft/ft).

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

### Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

### Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

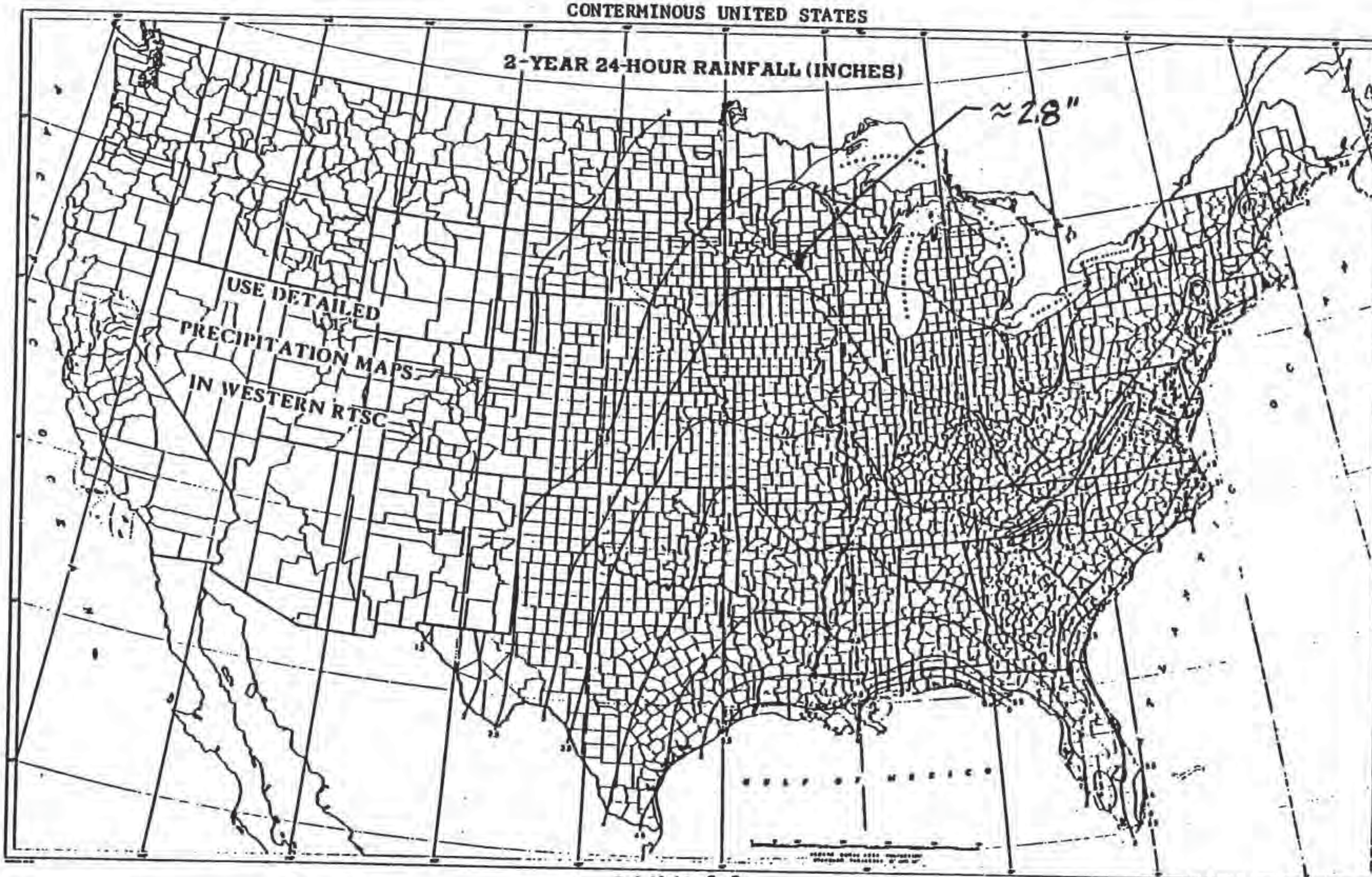
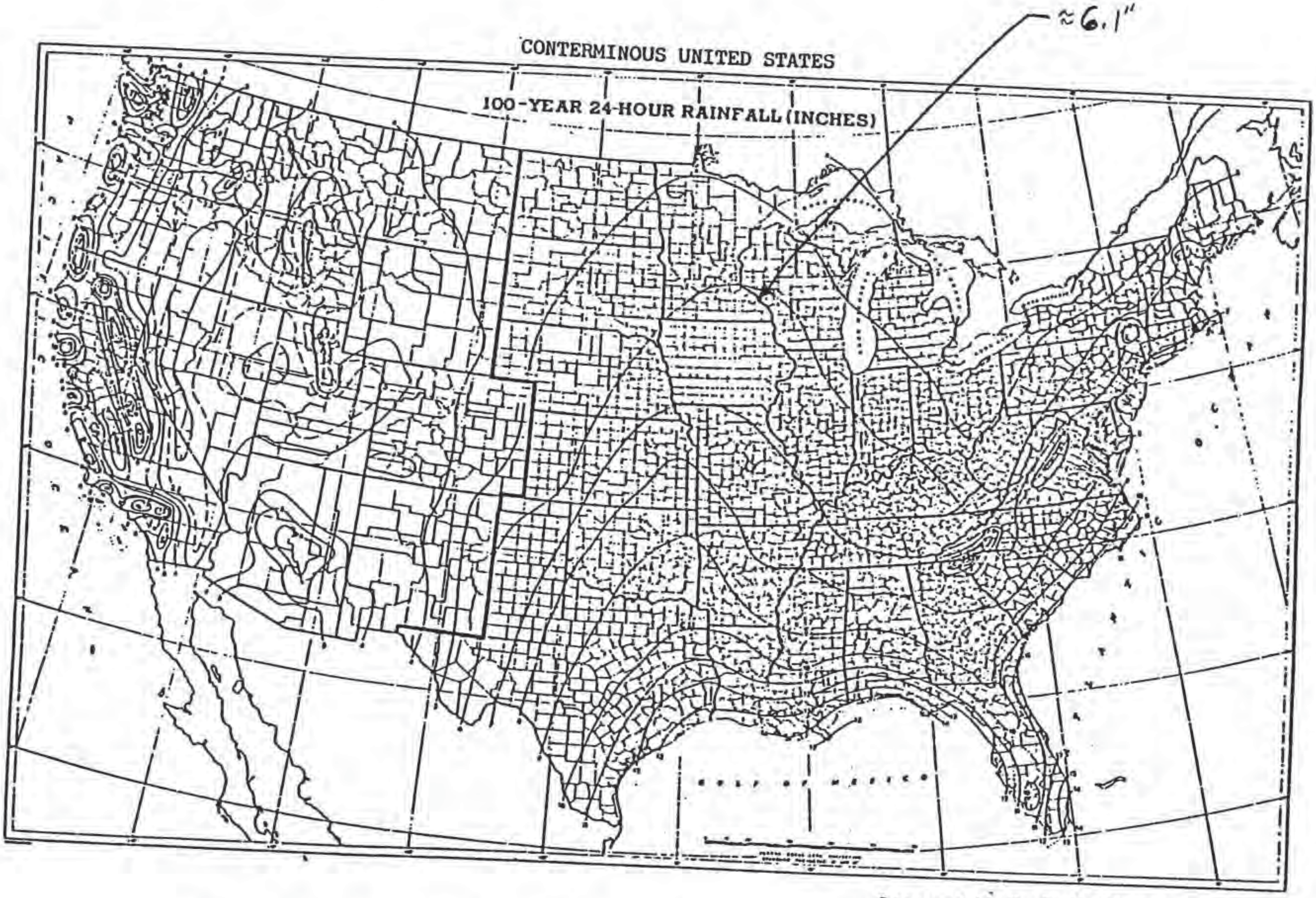


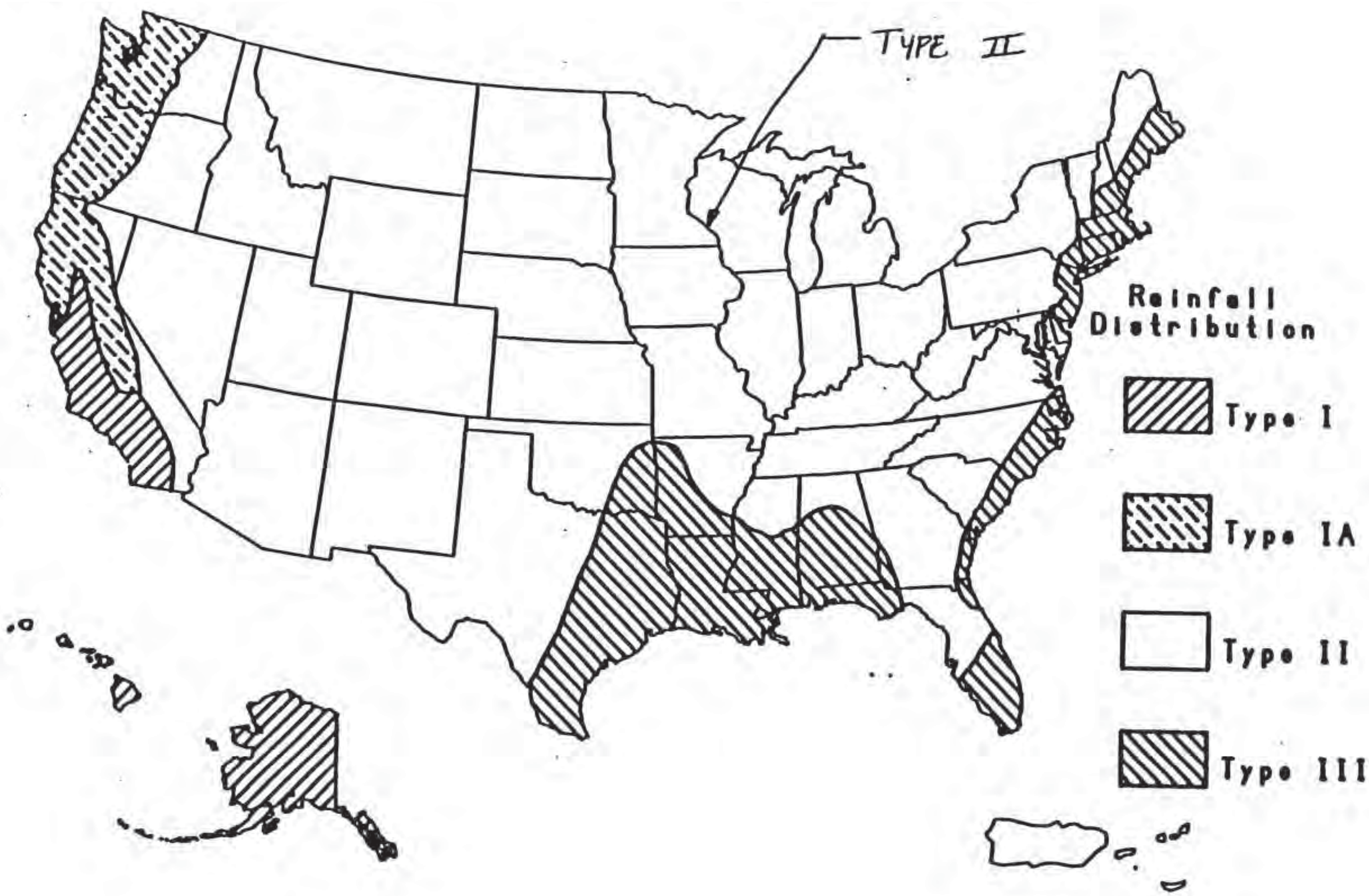

Exhibit 2-3
Sheet 1 of 5

Prepared by U. S. Weather Bureau




Prepared by U. S. Weather Bureau

FROM: Urban Hydrology for Small Watersheds. [ n.p. ]: U.S. Department of Agriculture. Soil Conservation Service Engineering Division, ( Technical Release No. 55 ). 1975, as revised 1981.




—Approximate geographic boundaries for SCS rainfall distributions.

# Diversion Berm, Perimeter Ditch, and Spillway Design Calculations

# Purpose/Methodology/Assumptions/Results/References

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

| PROJECT/PROPOSAL NAME | PREPARED | | CHECKED | | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| | By: | Date: | By: | Date: | |
| Dairyland Power Cooperative | BJK | 9/00 | | | 3081.40 |

# DIVERSION BERM, PERIMETER DITCH, AND SPILLWAY DESIGN CALCULATIONS

## Purpose

To size the diversion berms, perimeter ditches and spillway at the proposed Dairyland Power Cooperative Landfill to adequately handle the surface water runoff from a 100-year, 24-hour storm.

## Methodologies

Ditches, diversion berms and spillways were designed to channel the surface water runoff from the landfill drainage areas to the sedimentation basins, receiving ditches, or spillways. The direction of surface water runoff from the drainage areas surrounding the proposed landfill is towards the proposed landfill. Perimeter drainage ditches were therefore incorporated into the design to route the surface water runoff from outside the proposed landfill limits along the perimeter of the landfill area to the existing main channel at the south end of the landfill. These ditches are labeled as the NW, NE, West, SE, and SW ditches. The perimeter ditches sized in this subsection of the appendix, then, include ditches to collect runoff from the landfill drainage areas as well as ditches to collect surface water run-on from the drainage areas surrounding the landfill.

The adequacy of the diversion berms and ditches in handling the surface water runoff and run-on and in limiting the amount of erosion is based on the depth of flow and velocity, respectively, in the ditch. An in-house RMT spreadsheet incorporating Manning's equation was used to assist in the design of the diversion berms and ditches. This program allows the user to input the ditch geometry, the peak flow (as determined by the surface water runoff calculation), and the vegetative retardance factor (Chow, 1959). The program then begins an iterative process which adjusts the flow depth and Manning's coefficient until the trial velocity and the resultant velocity are within 0.002 feet per second (fps) of each other. The end result is the peak flow depth and peak velocity for the geometry and peak flow entered. Design software provided by Synthetic Industries was also used to select erosion control matting for ditches and grouted riprap for spillways.

Permanent ditches, diversion berms, and spillways will be constructed as early in the site development as practicable. Where temporary ditching is required, these temporary ditches have been designed to the same standards as the permanent ditches. Calculations for the sizing of the temporary ditches are also attached.

RMT®

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

# COMPUTATION SHEET



| PROJECT/PROPOSAL NAME | PREPARED By: | Date: | CHECKED By: | Date: | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| Dairyland Power Cooperative | BJK | 9/00 | | | 3081.40 |

It is noted that the storm water control structures have been designed using a 100-year, 24-hour storm event and a TR-55 Type II storm distribution. As noted in the surface water runoff calculations, the peak flows calculated using this method meet or exceed the peak flows calculated using a 25-year, time of concentration storm event (required by NR 504.09).

## Assumptions

The following assumptions were used to design the diversion berms and perimeter ditches:

- Diversion berms, perimeter ditches and the spillway were designed to handle the runoff from the 100-year, 24-hour storm event.
- Diversion berm ditches were designed as V-notch ditches with a minimum 0.5 foot of freeboard for the 25-year, 24-hour storm. Diversion berm ditches were designed to convey the 100-year, 24-hour storm without overtopping.
- Perimeter ditches were designed as both V-notch and flat bottom (10-foot and 20-foot-wide) ditches with a minimum 0.5 foot of freeboard for the 25-year, 24-hour storm. Perimeter ditches were designed to convey the 100-year, 24-hour storm without overtopping.
- Grass-lined diversion berm and perimeter ditches were designed for a maximum velocity of 4 fps. Ditches with velocities exceeding 4 fps were designed to be lined with erosion mat or riprap, as appropriate.
- The spillway was designed as 20-foot-wide, flat-bottom spillway with a minimum 0.5 foot of freeboard.
- The peak flows in the diversion berms, perimeter ditches and the spillway were obtained from the hydrographs generated in the "Surface Water Runoff Calculations" subsection of this appendix.
- Manning's numbers were selected for both "low" retardance (Type "D") and "moderate" retardance (Type "C") as given by the U.S. Soil and Conservation Service. Type "D" is typical of spring conditions while Type "C" is typical of summer conditions. For ditches lined with erosion matting, default Manning numbers from the Synthetic Industries design software were utilized.

## Results

The diversion berms and perimeter ditches were adequately sized to handle the surface water runoff from a 100-year, 24-hour storm event. The diversion berms at a 2 percent slope will be grass-lined. To limit erosion, permanent erosion matting will be placed in the diversion berms at a 6 percent slope, as well as in most of the perimeter ditching. Grouted riprap will be constructed in the spillways. The attached figure highlights the ditch sizing results.

RMT
# COMPUTATION SHEET

SHEET 3 OF 3

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

| PROJECT/PROPOSAL NAME | PREPARED | | CHECKED | | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| | By: | Date: | By: | Date: | |
| Dairyland Power Cooperative | BJK | 9/00 | | | 3081.40 |

## References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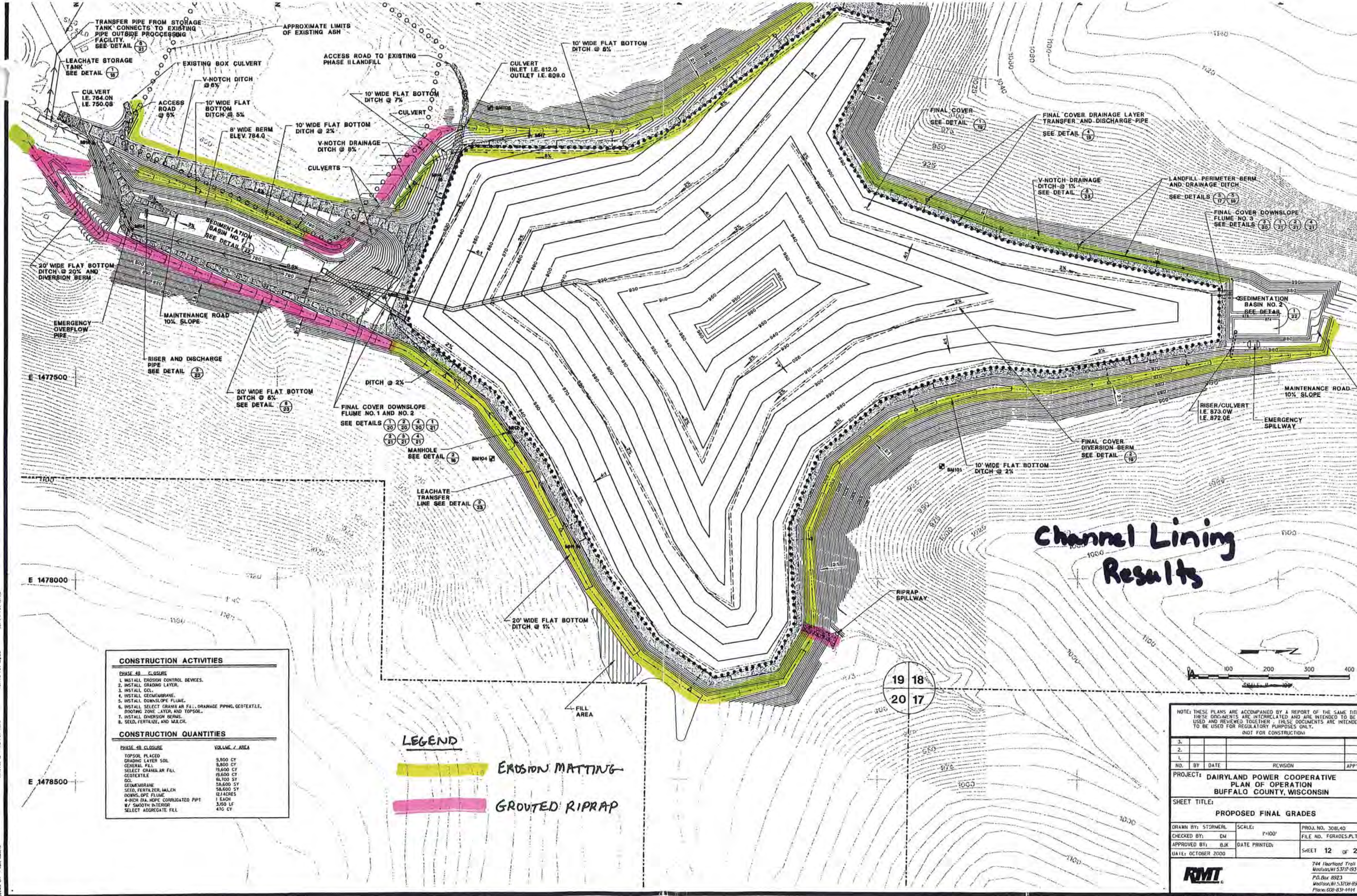


## CONSTRUCTION ACTIVITIES

PHASE 4B CLOSURE

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL GRADING LAYER.
3. INSTALL GCL.
4. INSTALL GEOMEMBRANE.
5. INSTALL DOWNSLOPE FLUME.
6. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL.
7. INSTALL DIVERSION BERMS.
8. SEED, FERTILIZE, AND MULCH.

## CONSTRUCTION QUANTITIES

| PHASE 4B CLOSURE | VOLUME / AREA |
|---|---|
| TOPSOIL PLACED | |
| GRADING LAYER SOIL | 9,800 CY |
| GENERAL FILL | 9,800 CY |
| SELECT GRANULAR FILL | 19,600 CY |
| GEOTEXTILE | 19,600 CY |
| GCL | 64,700 SY |
| GEOMEMBRANE | 58,600 SY |
| SEED, FERTILIZER, MULCH | 58,600 SY |
| DOWNSLOPE FLUME | 12.1 ACRES |
| 4-INCH DIA. HDPE CORRUGATED PIPE | 1 EACH |
| W/ SMOOTH INTERIOR | 3,150 LF |
| SELECT AGGREGATE FILL | 470 CY |

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.
(NOT FOR CONSTRUCTION)

| NO. | BY | DATE | REVISION | APP'D. |
|---|---|---|---|---|
| 3. | | | | |
| 2. | | | | |
| 1. | | | | |

PROJECT: DAIRYLAND POWER COOPERATIVE
PLAN OF OPERATION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:
PROPOSED FINAL GRADES

| | | |
|---|---|---|
| DRAWN BY: STORMERL | SCALE: 1"=100' | PROJ. NO. 3081.40 |
| CHECKED BY: DM | | FILE NO. FGRADES.PLT |
| APPROVED BY: BJK | DATE PRINTED: | SHEET 12 OF 23 |
| DATE: OCTOBER 2000 | | |

RMT®
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923
Madison, WI 53708-8923
Phone: 608-831-4444

FIGURE K-10

# Calculations – Post-closure Landfill Conditions

RMT, Inc.
Grass Channel Sizing Calculations

| | | | |
|---|---|---|---|
| Site: | Dairyland Power Cooperative | Date: | 10/1/98 |
| Project #: | 3081.33 | User: | BLP |
| Channel: | Diversion Berm (2%) - worst case flow | | |
| | Area 1F | | ✓ BBF 10/98 |

==========================================================================

I. Input Parameters.

| | | |
|---|---|---|
| A. Side slope, Z1 (hor/vert) = | 4.000 | ft/ft ✓ |
| B. Side slope, Z2 (hor/vert) = | 2.000 | ft/ft ✓ |
| C. Bottom width, B = | 0.000 | ft ✓ |
| D. Design channel slope, S = | 0.020 | ft/ft ✓ |
| E. Channel Peak Flow, Q = | 25.000 | cfs ✓ |
| F. Enter - 1 - for Type "C" Veg. Retardence<br>- 2 - for Type "D" Veg. Retardence | 1 | ← Summer Conditions ✓ |

II. Peak Flow Calculations.

| | | |
|---|---|---|
| A. Trial flow depth, D =<br>(Bisection method until Va=Vb) | 1.570 | ft 0.4' freeboard ✓ |
| B. Channel flow area, Ac =<br>(.5*Z1*D^2) + (B*D) + (.5*Z2*D^2) | 7.390 | sq ft |
| C. Wetted Perimeter, Pw =<br>(D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5) | 9.981 | ft |
| D. Hydraulic radius, Rh =<br>(Ac/Pw) | 0.740 | ft |
| E. Velocity and hydraulic radius, VR =<br>(Va * Rh) | 2.505 | sfps |
| F. Channel flow Manning's coeff, nc =<br>0 | 0.051 | |
| G. Trial velocity, Va =<br>(Q/Ac) | 3.383 | fps ✓ |
| H. Resultant velocity, Vb =<br>(1.49/nc) * (Rh^.667) * (S^.5) | 3.383 | fps < 4 fps |

Invoke Solution Macro by typing - 'ctrl' D

h:\data\common\template\sc-51\grasscha.xls

RMT, Inc.
Grass Channel Sizing Calculations

| | | | |
|---|---|---|---|
| Site: | Dairyland Power Cooperative | Date: | 10/1/98 |
| Project #: | 3081.33 | User: | BLP |
| Channel: | Diversion Berm (2%) - worst case flow<br>Area 1F | | √ [illegible] 10/98 |

==========================================================================

I. Input Parameters.

| | | |
|---|---|---|
| A. Side slope, Z1 (hor/vert) = | 4.000 | ft/ft ✓ |
| B. Side slope, Z2 (hor/vert) = | 2.000 | ft/ft ✓ |
| C. Bottom width, B = | 0.000 | ft ✓ |
| D. Design channel slope, S = | 0.020 | ft/ft ✓ |
| E. Channel Peak Flow, Q = | 25.000 | cfs ✓ |
| F. Enter - 1 - for Type "C" Veg. Retardence<br>- 2 - for Type "D" Veg. Retardence | 2 | ← Spring Conditions ✓ |

II. Peak Flow Calculations.

| | | |
|---|---|---|
| **A. Trial flow depth, D =**<br>(Bisection method until Va=Vb) | 1.456 | ft 0.5' freeboard |
| B. Channel flow area, Ac =<br>(.5*Z1*D^2) + (B*D) + (.5*Z2*D^2) | 6.357 | sq ft |
| C. Wetted Perimeter, Pw =<br>(D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5) | 9.257 | ft |
| D. Hydraulic radius, Rh =<br>(Ac/Pw) | 0.687 | ft |
| E. Velocity and hydraulic radius, VR =<br>(Va * Rh) | 2.701 | sfps |
| F. Channel flow Manning's coeff, nc =<br>0 | 0.042 | |
| G. Trial velocity, Va =<br>(Q/Ac) | 3.933 | fps |
| **H. Resultant velocity, Vb =**<br>(1.49/nc) * (Rh^.667) * (S^.5) | 3.933 | fps < 4 fps ✓ |

Invoke Solution Macro by typing - 'ctrl' D

h:\data\common\template\sc-51\grasscha.xls

RMT, Inc.
Grass Channel Sizing Calculations

| | | | |
|---|---|---|---|
| Site: | Dairyland Power Corp. | Date: | 31-July-98 |
| Project #: | 3081.33 | User: | SRC |
| Channel: | Ditch (8%) | | |
| | Area 1G - Flow From Landfill Portion - 15 cfs | | √ [illegible] 10/98 |

===================================================================

I. Input Parameters.

| | | |
|---|---|---|
| A. Side slope, Z1 (hor/vert) = | 3.000 | ft/ft |
| B. Side slope, Z2 (hor/vert) = | 2.000 | ft/ft |
| C. Bottom width, B = | 0.000 | ft |
| D. Design channel slope, S = | 0.080 | ft/ft |
| E. Channel Peak Flow, Q = | 15.000 | cfs |
| F. Enter - 1 - for Type "C" Veg. Retardence<br>- 2 - for Type "D" Veg. Retardence | 1 | ← summer conditions |

II. Peak Flow Calculations.

| | | |
|---|---|---|
| **A. Trial flow depth, D =**<br>**(Bisection method until Va=Vb)** | **1.071** | **ft** 0.9' freeboard |
| B. Channel flow area, Ac =<br>(.5*Z1*D^2) + (B*D) + (.5*Z2*D^2) | 2.870 | sq ft |
| C. Wetted Perimeter, Pw =<br>(D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5) | 5.784 | ft |
| D. Hydraulic radius, Rh =<br>(Ac/Pw) | 0.496 | ft |
| E. Velocity and hydraulic radius, VR =<br>(Va * Rh) | 2.593 | sfps |
| F. Channel flow Manning's coeff, nc =<br>0 | 0.051 | |
| G. Trial velocity, Va =<br>(Q/Ac) | 5.226 | fps |
| **H. Resultant velocity, Vb =**<br>**(1.49/nc) * (Rh^.667) * (S^.5)** | **5.226** | **fps** > 4fps |

use permanent erosion

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RMT, Inc.
Grass Channel Sizing Calculations

| | | | |
|---|---|---|---|
| Site: | Dairyland Power Corp. | Date: | 31-July-98 |
| Project #: | 3081.33 | User: | SRC |
| Channel: | Ditch (8%) | | |
| | Area 1G - Flow From Landfill Portion - 15 cfs | | VPJJK 10/98 |

==============================================================

I. Input Parameters.

A. Side slope, Z1 (hor/vert) = 3.000 ft/ft

B. Side slope, Z2 (hor/vert) = 2.000 ft/ft

C. Bottom width, B = 0.000 ft

D. Design channel slope, S = 0.080 ft/ft

E. Channel Peak Flow, Q = 15.000 cfs

F. Enter - 1 - for Type "C" Veg. Retardence
- 2 - for Type "D" Veg. Retardence
2 ← Spring conditions

II. Peak Flow Calculations.

A. Trial flow depth, D = 0.992 ft 1' freeboard
(Bisection method until Va=Vb)

B. Channel flow area, Ac = 2.459 sq ft
(.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)

C. Wetted Perimeter, Pw = 5.353 ft
(D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)

D. Hydraulic radius, Rh = 0.459 ft
(Ac/Pw)

E. Velocity and hydraulic radius, VR = 2.802 sfps
(Va * Rh)

F. Channel flow Manning's coeff, nc = 0.041
0

G. Trial velocity, Va = 6.101 fps
(Q/Ac)

H. Resultant velocity, Vb = 6.101 fps > 4 fps
(1.49/nc) * (Rh^.667) * (S^.5)

use permanent erosion matting

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✓ BLB 10/6/98

*****************************************************************************

NORTH AMERICAN GREEN - ECMDS VER.IV - CHANNEL PROTECTION - ENGLISH
USER SPECIFIED CHANNEL LINING ANALYSIS

*****************************************************************************

PROJECT NAME: Dairyland Power
PROJECT NO.: 3081.33
COMPUTED BY: BJK
DATE: 10-06-1998
FROM STATION/REACH: Area 1G - Fl
TO STATION/REACH:
DRAINAGE AREA:
DESIGN FREQUENCY: 100

| Channel Bottom Width (ft) | Side Slope Lt. (Horz. to 1) | Side Slope Rt. (Horz. to 1) | Channel Slope (ft/ft) | |
|---|---|---|---|---|
| 0.00 | 3.0 | 2.0 | 0.080 | ✓ |

| Discharge (cfs) | Peak Flow Period (hrs) | Velocity (ft/sec) | Area (ft^2) | Hydraulic Radius (ft) | Normal Depth (ft) | |
|---|---|---|---|---|---|---|
| 15.0 | 2.0 | 5.34 | 2.81 | 0.49 | 1.06 | ok |

| Lining Type | Growth Habit | Veg. Den | Manning Coefficient | Permissible Shear (lb/sf) | Calculated Shear (lb/sf) | Safety Factor | Remark | |
|---|---|---|---|---|---|---|---|---|
| P300 | | | 0.049 | 8.00 | 5.29 | 1.51 | STABLE | ✓ |

Staple E
Phase 3 (Mature Vegetation)

RMT, Inc.
Grass Channel Sizing Calculations

| | | | |
|---|---|---|---|
| Site: | Dairyland Power Corp. | Date: | 31-July-98 |
| Project #: | 3081.33 | User: | SRC |
| Channel: | Ditch (1%) | | |
| | Area 2B | | VWL 10K8 |

=====================================================================

I. Input Parameters.

| | | |
|---|---|---|
| A. Side slope, Z1 (hor/vert) = | 3.000 | ft/ft |
| B. Side slope, Z2 (hor/vert) = | 2.000 | ft/ft |
| C. Bottom width, B = | 0.000 | ft |
| D. Design channel slope, S = | 0.010 | ft/ft |
| E. Channel Peak Flow, Q = | 73.000 | cfs |
| F. Enter - 1 - for Type "C" Veg. Retardence<br>- 2 - for Type "D" Veg. Retardence | 1 | ← Summer conditions |

II. Peak Flow Calculations.

| | | |
|---|---|---|
| A. Trial flow depth, D =<br>(Bisection method until Va=Vb) | 2.593 | ft 0.4' freeboard |
| B. Channel flow area, Ac =<br>(.5*Z1*D^2) + (B*D) + (.5*Z2*D^2) | 16.814 | sq ft |
| C. Wetted Perimeter, Pw =<br>(D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5) | 14.000 | ft |
| D. Hydraulic radius, Rh =<br>(Ac/Pw) | 1.201 | ft |
| E. Velocity and hydraulic radius, VR =<br>(Va * Rh) | 5.214 | sfps |
| F. Channel flow Manning's coeff, nc =<br>0 | 0.039 | |
| G. Trial velocity, Va =<br>(Q/Ac) | 4.342 | fps |
| H. Resultant velocity, Vb =<br>(1.49/nc) * (Rh^.667) * (S^.5) | 4.341 | fps > 4 fps |

use permanent erosion matting

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RMT, Inc.
Grass Channel Sizing Calculations

| | | | |
|---|---|---|---|
| Site: | Dairyland Power Corp. | Date: | 31-July-98 |
| Project #: | 3081.33 | User: | SRC |
| Channel: | Ditch (1%) | | |
| | Area 2B | | √BK 10/98 |

==============================================================

I. Input Parameters.

| | |
|---|---|
| A. Side slope, Z1 (hor/vert) = | 3.000 ft/ft |
| B. Side slope, Z2 (hor/vert) = | 2.000 ft/ft |
| C. Bottom width, B = | 0.000 ft |
| D. Design channel slope, S = | 0.010 ft/ft |
| E. Channel Peak Flow, Q = | 73.000 cfs |
| F. Enter - 1 - for Type "C" Veg. Retardence<br>- 2 - for Type "D" Veg. Retardence | 2 ← Spring conditions |

II. Peak Flow Calculations.

| | |
|---|---|
| **A. Trial flow depth, D =**<br>(Bisection method until Va=Vb) | 2.512 ft 0.5' freeboard |
| B. Channel flow area, Ac =<br>(.5*Z1*D^2) + (B*D) + (.5*Z2*D^2) | 15.774 sq ft |
| C. Wetted Perimeter, Pw =<br>(D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5) | 13.560 ft |
| D. Hydraulic radius, Rh =<br>(Ac/Pw) | 1.163 ft |
| E. Velocity and hydraulic radius, VR =<br>(Va * Rh) | 5.383 sfps |
| F. Channel flow Manning's coeff, nc =<br>0 | 0.036 |
| G. Trial velocity, Va =<br>(Q/Ac) | 4.628 fps |
| **H. Resultant velocity, Vb =**<br>(1.49/nc) * (Rh^.667) * (S^.5) | 4.627 fps > 4 fps |

use permanent erosion matting

H:\data\common\src\GRASSCH8.xls

√BJG 10/6/98

*****************************************************************************

NORTH AMERICAN GREEN - ECMDS VER.IV - CHANNEL PROTECTION - ENGLISH
USER SPECIFIED CHANNEL LINING ANALYSIS

*****************************************************************************

PROJECT NAME: Dairyland Paower Coop. PROJECT NO.: 3081.33
COMPUTED BY: BJK DATE: 10-06-1998
FROM STATION/REACH: Area 2B TO STATION/REACH:
DRAINAGE AREA: DESIGN FREQUENCY: 100

| Channel Bottom Width (ft) | Side Slope Lt. (Horz. to 1) | Side Slope Rt. (Horz. to 1) | Channel Slope (ft/ft) |
|---|---|---|---|
| 0.00 | 3.0 | 2.0 | 0.010 ✓ |

| Discharge (cfs) | Peak Flow Period (hrs) | Velocity (ft/sec) | Area (ft^2) | Hydraulic Radius (ft) | Normal Depth (ft) |
|---|---|---|---|---|---|
| 73.0 | 2.0 | 3.64 | 20.08 | 1.31 | 2.83 ok |

| Lining Type | Growth Habit | Veg. Den | Manning Coefficient | Permissible Shear (lb/sf) | Calculated Shear (lb/sf) | Safety Factor | Remark |
|---|---|---|---|---|---|---|---|
| P300 Staple E Phase 3 (Mature Vegetation) | | | 0.049 | 8.00 | 1.77 | 4.52 | STABLE ✓ |

RMT Inc.
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

# COMPUTATION SHEET



| PROJECT / PROPOSAL NAME | PREPARED By: | Date: | CHECKED By: | Date: | PROJECT / PROPOSAL NO. |
|---|---|---|---|---|---|
| DAIRYLAND POWER COOP. | BJK | 5/9/97 | [illegible] | 6/17/97 | 3081.24 |

Rev BLP/BJK 10/94
Rev BJK 9/00

DITCH DESIGN CALCULATIONS - DESIGN INFORMATION (25 YR - 24 HR STORM)

SOUTH SPILLWAY

WIDTH = 20'
SLOPE = 20%
MIN DEPTH = 4'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS
3C + 4C + EAST + NORTHEAST + NORTH + BASIN 2 OUTFLOW ✓

18 + 11 + 445 + 68 + 194 + 10 = 746 cfs (25-YEAR)
↳ Round to 750 for calc's

28 + 18 + 837 + 110 + 360 + 21 = 1,374 cfs (100-year) ✓
Note: All flows @ 12.6 HRS (25 year)
and @ 12.5 HRS (100-YR Fallow)

SE DITCH (2%) & (5%)

WIDTH = 20'
SLOPE: 2%
MIN DEPTH = 5'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS
3C + 4C + EAST + NORHEAST + NORTH + BASIN 2 OUTFLOW ✓

see above = 750 cfs (25-YEAR)
= 1,374 (100-yr Fallow)

SE DITCH (1%)

SAME FLOWS AS ABOVE

WIDTH - 20'
SLOPE - 1%
MIN DEPTH - 6'

NE DITCH

WIDTH = 10'
SLOPE = 2%
MIN DEPTH = 10+'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

4C + NORTH + BASIN 2 OUT ✓

11 + 194 + 10 = 215 CFS (25-YEAR) ✓

18 + 360 + 21 = 399 cfs (100-YEAR FALLOW)
- ALL FLOWS AT 12.6 HRS (25 yr) and AT
12.5 HRS (100-YR FALLOW)

E Ditch

width = 10'
Slope = 2%
Min Depth: 10'+

Peak Flow - Contributing Drainage Areas
4C + Northeast + North + Basin 2 out
= 18 + 110 + 360 + 21 = 509 cfs (100 yr)

RMT INC.

# COMPUTATION SHEET



744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

| PROJECT / PROPOSAL NAME | PREPARED By: | Date: | CHECKED By: | Date: | PROJECT / PROPOSAL NO. |
|---|---|---|---|---|---|
| DAIRYLAND POWER COOP | BJK | | [illegible] | 6/17/97 | 3081.24 |

NW DITCH

WIDTH - 0' (V-NOTCH)
SLOPE - 1%
MIN DEPTH - 4 FT

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

2B - 48 CFS (25 YR) ✓

73 CFS (100 YR FALLOW)

WEST DITCH

WIDTH = 10'
SLOPE = 6%
MIN DEPTH = 6'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

2C + WEST AREA ✓

10 + 111 = 121 CFS (25-YEAR) ✓

18 + 223 = 241 CFS (100 YEAR - FALLOW) ✓

- FLOWS @ 12.5 HRS (25-YEAR) AND AT 12.5 HRS (100-YEAR FALLOW)

SW DITCH

WIDTH = 10'
SLOPE = 2%, 5%, 7.1%
MIN DEPTH = 4' +

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

1C + 2C + WEST AREA ✓

46 + 10 + 111 = 167 CFS (25-YEAR) ✓

94 + 20 + 209 = 323 cfs (100-YEAR FALLOW) ✓

FLOWS @ 12.5 HRS (25-YEAR) AND @ 12.4 HRS (100-YEAR FALLOW)

MAIN CHANNEL

WIDTH ~ 20' MIN
SLOPE ~ 6.3%
MIN DEPTH ~ 6'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

1C + 2C + 3C + 4C + EAST + NE + NORTH + WEST + BASIN 1 + BASIN 2 ✓

887 CFS + 8 + 10 = 905 CFS (25 YR)

1618 cfs + 21 + 21 = 1660 cfs (100-YR FALLOW) ✓

FLOWS @ 12.6 HRS (25-YEAR) AND @ 12.6 HRS (100-YEAR FALLOW)

RMT
744 Heartland Trail
Madison, WI 53717-1934
Tel. (608) 831-4444 • Fax (608) 831-3334



| PROJECT / PROPOSAL NAME / LOCATION: | | PROJECT / PROPOSAL NO. |
|---|---|---|
| SUBJECT: Dairyland Power Coop | | 3081.40 |
| PREPARED BY: [initials] | DATE: 9/00 | FINAL ☒ |
| CHECKED BY: | DATE: | REVISION ☐ |

AREA 1G DITCH

WIDTH - V-NOTCH
SLOPE · 8%
MIN DEPTH = 4'

PEAK FLOW - CONTRIBUTING DRAINAGE AREA

= 15 CFS FLOW FROM LF.

PHASE 2 DITCH

WIDTH: V-NOTCH
SLOPE : 6%
MIN DEPTH: 2'

PEAK FLOW - CONTRIBUTING DRAINAGE AREA

~1.5 ACRES OF PHASE 2 COVER
DRAINAGE AREA - 1C = 42 ACRES

$\frac{1.5}{42}$ (96 CFS) = 3.4 CFS

USE 4 CFS

## Analysis By:

| User Information: | Generated by EC-Design: |
|---|---|
| Bernie Krantz<br>RMT, Inc.<br>744 Heartland Trail<br><br>Madison, WI 53717 | SYNTHETIC INDUSTRIES<br>Geosynthetic Products Division<br>4019 Industry Drive • Chattanooga, TN 37416 • USA<br>(423) 899-0444 • (800) FIX-SOIL<br>www.fixsoil.com |

## General Information:

| Project Details: | | Project Notes: |
|---|---|---|
| Project Name: | DPC Plan of Operation | |
| Description: | Channel Lining | |
| State\Country: | WI | |
| City: | La Crosse | |
| Units: | English | |
| Created: | 01/19/99 @ 10:43 | |

## Disclaimer:

*The information presented herein is for general information only. While every effort has been made to ensure its accuracy, this information should not be used for a specific application without independent professional examination and verification of its suitability, applicability and accuracy.*

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **South Spillway**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **1374.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.20000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **270.00**
Bottom Width (ft): **20.00**
Channel Depth (ft): **4.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **1.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

Factor of Safety: **1.10**

Functional Longevity: **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Velocity Max. Allowed | Velocity Safety Factor | Shear Stress (lbs/sqft) Actual | Shear Stress Max. Allowed | Shear Stress Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | PYRAMAT | 0.0280 | 24.0 | 23.3 | 1.0 | 20.2 | 9.4 | 0.5 | 2.0857 | 1374.0 | No |
| | Bottom: | PYRAMAT | 0.0280 | 27.3 | 23.3 | 0.9 | 26.0 | 9.4 | 0.4 | | | |
| | Right: | PYRAMAT | 0.0280 | 24.0 | 23.3 | 1.0 | 20.2 | 9.4 | 0.5 | | | |
| **Analysis #2** | Left: | GABIONS | 0.0270 | 28.6 | 17.0 | 0.6 | 17.3 | 35.0 | 2.0 | 1.7968 | 1374.0 | No |
| | Bottom: | GABIONS | 0.0270 | 32.6 | 17.0 | 0.5 | 22.4 | 35.0 | 1.6 | | | |
| | Right: | GABIONS | 0.0270 | 28.6 | 17.0 | 0.6 | 17.3 | 35.0 | 2.0 | | | |
| **Analysis #3** | Left: | ROCK RIPRAP | 0.0300 | 26.6 | 50.0 | 1.9 | 18.3 | 45.0 | 2.5 | 1.9093 | 1374.0 | Yes |
| | Bottom: | ROCK RIPRAP | 0.0300 | 30.4 | 50.0 | 1.6 | 23.8 | 45.0 | 1.9 | | | |
| | Right: | ROCK RIPRAP | 0.0300 | 26.6 | 50.0 | 1.9 | 18.3 | 45.0 | 2.5 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Veleocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 50.4146 | 1.7190 | 0.0351 | 4.6638 | 4.6638 | 29.3276 | 27.2540 | 1374.0 | 3.06 |
| **Analysis #2** | 42.3935 | 1.5121 | 0.0270 | 4.0178 | 4.0178 | 28.0356 | 32.4106 | 1374.0 | 3.94 |
| **Analysis #3** | 45.4772 | 1.5935 | 0.0300 | 4.2694 | 4.2694 | 28.5387 | 30.2130 | 1374.0 | 3.55 |

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **SE Ditch (2%)**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **1374.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.02000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **200.00**
Bottom Width (ft): **20.00**
Channel Depth (ft): **5.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety:** **1.10**

**Functional Longevity:** **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Max. Allowed | Safety Factor | Shear Stress (lbs/sqft) Actual | Max. Allowed | Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | LANDLOK TRM | 0.0250 | 10.0 | 16.5 | 1.6 | 4.2 | 4.7 | 1.1 | 4.2678 | 1374.0 | No |
| | Bottom: | LANDLOK TRM | 0.0250 | 11.3 | 16.5 | 1.5 | 5.3 | 4.7 | 0.9 | | | |
| | Right: | LANDLOK TRM 435 | 0.0250 | 10.0 | 16.5 | 1.6 | 4.2 | 4.7 | 1.1 | | | |
| **Analysis #2** | Left: | LANDLOK TRM | 0.0250 | 10.0 | 16.8 | 1.7 | 4.2 | 6.5 | 1.6 | 4.2678 | 1374.0 | Yes |
| | Bottom: | LANDLOK TRM | 0.0250 | 11.3 | 16.8 | 1.5 | 5.3 | 6.5 | 1.2 | | | |
| | Right: | LANDLOK TRM 450 | 0.0250 | 10.0 | 16.8 | 1.7 | 4.2 | 6.5 | 1.6 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Veleocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 121.7841 | 3.1158 | 0.0397 | 9.5431 | 9.5431 | 39.0862 | 11.2823 | 1374.0 | .890 |
| **Analysis #2** | 121.7841 | 3.1158 | 0.0397 | 9.5431 | 9.5431 | 39.0862 | 11.2823 | 1374.0 | .890 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **SE Ditch (5%)**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **1374.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.05000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **750.00**
Bottom Width (ft): **20.00**
Channel Depth (ft): **5.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety: 1.10**

**Functional Longevity: 999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Max. Allowed | Safety Factor | Shear Stress (lbs/sqft) Actual | Max. Allowed | Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analysis #1 | Left: | LANDLOK TRM | 0.0260 | 14.3 | 19.1 | 1.3 | 7.8 | 7.5 | 1.0 | 3.2178 | 1374.0 | No |
| | Bottom: | LANDLOK TRM | 0.0260 | 16.2 | 19.1 | 1.2 | 10.0 | 7.5 | 0.8 | | | |
| | Right: | LANDLOK TRM | 0.0260 | 14.3 | 19.1 | 1.3 | 7.8 | 7.5 | 1.0 | | | |
| Analysis #2 | Left: | PYRAMAT | 0.0280 | 14.3 | 23.3 | 1.6 | 7.8 | 9.4 | 1.2 | 3.2184 | 1374.0 | No |
| | Bottom: | PYRAMAT | 0.0280 | 16.2 | 23.3 | 1.4 | 10.0 | 9.4 | 0.9 | | | |
| | Right: | PYRAMAT | 0.0280 | 14.3 | 23.3 | 1.6 | 7.8 | 9.4 | 1.2 | | | |
| Analysis #3 | Left: | ROCK RIPRAP | 0.0300 | 17.6 | 50.0 | 2.8 | 6.6 | 45.0 | 6.8 | 2.7285 | 1374.0 | Yes |
| | Bottom: | ROCK RIPRAP | 0.0300 | 19.9 | 50.0 | 2.5 | 8.5 | 45.0 | 5.3 | | | |
| | Right: | ROCK RIPRAP | 0.0300 | 17.6 | 50.0 | 2.8 | 6.6 | 45.0 | 6.8 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Veleocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| Analysis #1 | 85.0635 | 2.4735 | 0.0378 | 7.1952 | 7.1952 | 34.3903 | 16.1526 | 1374.0 | 1.47 |
| Analysis #2 | 85.0856 | 2.4739 | 0.0378 | 7.1967 | 7.1967 | 34.3933 | 16.1484 | 1374.0 | 1.47 |
| Analysis #3 | 69.4578 | 2.1569 | 0.0280 | 6.1010 | 6.1010 | 32.2020 | 19.7818 | 1374.0 | 1.96 |

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **SE Ditch (1%)**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **1374.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.01000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **1000.0**
Bottom Width (ft): **20.00**
Channel Depth (ft): **6.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety:** **1.10**

**Functional Longevity:** **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Velocity Max. Allowed | Velocity Safety Factor | Shear Stress (lbs/sqft) Actual | Shear Stress Max. Allowed | Shear Stress Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analysis #1 | Left: | LANDLOK TRM | 0.0250 | 7.7 | 16.5 | 2.2 | 2.6 | 4.7 | 1.8 | 5.2542 | 1374.0 | Yes |
| | Bottom: | LANDLOK TRM | 0.0250 | 8.6 | 16.5 | 1.9 | 3.3 | 4.7 | 1.4 | | | |
| | Right: | LANDLOK TRM 435 | 0.0250 | 7.7 | 16.5 | 2.2 | 2.6 | 4.7 | 1.8 | | | |
| Analysis #2 | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| Analysis #3 | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| Analysis #1 | 160.2976 | 3.6852 | 0.0413 | 11.7488 | 11.7488 | 43.4975 | 8.5716 | 1374.0 | .615 |
| Analysis #2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |
| Analysis #3 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **NE Ditch**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **399.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.02000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **1800.0**
Bottom Width (ft): **10.00**
Channel Depth (ft): **5.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety:** **1.10**

**Functional Longevity:** **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Velocity Max. Allowed | Velocity Safety Factor | Shear Stress (lbs/sqft) Actual | Shear Stress Max. Allowed | Shear Stress Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | LANDLOK TRM | 0.0250 | 7.1 | 16.5 | 2.3 | 3.1 | 4.7 | 1.5 | 3.1235 | 399.0 | Yes |
| | Bottom: | LANDLOK TRM | 0.0250 | 7.9 | 16.5 | 2.1 | 3.9 | 4.7 | 1.2 | | | |
| | Right: | LANDLOK TRM 435 | 0.0250 | 7.1 | 16.5 | 2.3 | 3.1 | 4.7 | 1.5 | | | |
| **Analysis #2** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 50.7483 | 2.1173 | 0.0440 | 6.9844 | 6.9844 | 23.9689 | 7.8623 | 399.0 | .735 |
| **Analysis #2** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-Design 2000 Channel Analysis Report



## Channel Analysis Information:

| Name: |
|---|
| Channel Analysis Name: **East Ditch** |

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **509.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.02000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **350.00**
Bottom Width (ft): **10.00**
Channel Depth (ft): **5.00**

**Channel Bend:**

Channel Bend: **Yes**
Bend Radius (ft): **200.00**
Outside Bend: **L**

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

Factor of Safety: **1.10**

Functional Longevity: **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Velocity Max. Allowed | Velocity Safety Factor | Shear Stress (lbs/sqft) Actual | Shear Stress Max. Allowed | Shear Stress Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | LANDLOK TRM | 0.0250 | 7.8 | 16.5 | 2.1 | 3.6 | 4.7 | 1.3 | 3.4942 | 509.0 | No |
| | Bottom: | LANDLOK TRM | 0.0250 | 8.6 | 16.5 | 1.9 | 4.4 | 4.7 | 1.1 | | | |
| | Right: | LANDLOK TRM | 0.0250 | 7.8 | 16.5 | 2.1 | 3.6 | 4.7 | 1.3 | | | |
| **Analysis #2** | Left: | LANDLOK TRM | 0.0250 | 7.8 | 16.8 | 2.2 | 3.6 | 6.5 | 1.8 | 3.4942 | 509.0 | Yes |
| | Bottom: | LANDLOK TRM | 0.0250 | 8.6 | 16.8 | 1.9 | 4.4 | 6.5 | 1.5 | | | |
| | Right: | LANDLOK TRM 450 | 0.0250 | 7.8 | 16.8 | 2.2 | 3.6 | 6.5 | 1.8 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 59.3615 | 2.3164 | 0.0429 | 7.8133 | 7.8133 | 25.6267 | 8.5746 | 509.0 | .760 |
| **Analysis #2** | 59.3615 | 2.3164 | 0.0429 | 7.8133 | 7.8133 | 25.6267 | 8.5746 | 509.0 | .760 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **NW Ditch**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **73.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.01000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **1000.0**
Bottom Width (ft): **0.01**
Channel Depth (ft): **4.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety:** **1.10**

**Functional Longevity:** **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Velocity Max. Allowed | Velocity Safety Factor | Shear Stress (lbs/sqft) Actual | Shear Stress Max. Allowed | Shear Stress Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | LANDLOK TRM | 0.0250 | 3.4 | 16.5 | 4.8 | 2.1 | 4.7 | 2.3 | 3.2826 | 73.0 | Yes |
| | Bottom: | LANDLOK TRM | 0.0250 | 3.4 | 16.5 | 4.8 | 2.0 | 4.7 | 2.3 | | | |
| | Right: | LANDLOK TRM | 0.0250 | 3.4 | 16.5 | 4.8 | 2.1 | 4.7 | 2.3 | | | |
| **Analysis #2** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 21.5836 | 1.4693 | 0.0564 | 7.3401 | 7.3401 | 14.6902 | 3.3822 | 73.0 | .331 |
| **Analysis #2** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **West Ditch**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **241.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.06000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **1020.0**
Bottom Width (ft): **10.00**
Channel Depth (ft): **6.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety:** **1.10**

**Functional Longevity:** **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Velocity Max. Allowed | Velocity Safety Factor | Shear Stress (lbs/sqft) Actual | Shear Stress Max. Allowed | Shear Stress Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | PYRAMAT | 0.0280 | 8.9 | 23.3 | 2.6 | 5.1 | 9.4 | 1.8 | 1.7595 | 241.0 | Yes |
| | Bottom: | PYRAMAT | 0.0280 | 10.1 | 23.3 | 2.3 | 6.6 | 9.4 | 1.4 | | | |
| | Right: | PYRAMAT | 0.0280 | 8.9 | 23.3 | 2.6 | 5.1 | 9.4 | 1.8 | | | |
| **Analysis #2** | Left: | LANDLOK TRM | 0.0260 | 8.9 | 19.1 | 2.1 | 5.1 | 7.5 | 1.5 | 1.7684 | 241.0 | No |
| | Bottom: | LANDLOK TRM | 0.0260 | 10.1 | 19.1 | 1.9 | 6.6 | 7.5 | 1.1 | | | |
| | Right: | LANDLOK TRM | 0.0260 | 8.9 | 19.1 | 2.1 | 5.1 | 7.5 | 1.5 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Veleocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 23.7860 | 1.3312 | 0.0439 | 3.9343 | 3.9343 | 17.8685 | 10.1320 | 241.0 | 1.24 |
| **Analysis #2** | 23.9376 | 1.3367 | 0.0438 | 3.9541 | 3.9541 | 17.9083 | 10.0679 | 241.0 | 1.23 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-Design 2000 Channel Analysis Report



## Channel Analysis Information:

**Name:**

Channel Analysis Name: **SW Ditch (7%)**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **323.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.07000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **225.00**
Bottom Width (ft): **10.00**
Channel Depth (ft): **4.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety:** **1.10**

**Functional Longevity:** **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Max. Allowed | Safety Factor | Shear Stress (lbs/sqft) Actual | Max. Allowed | Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | PYRAMAT | 0.0280 | 10.6 | 23.3 | 2.2 | 6.6 | 9.4 | 1.4 | 1.9335 | 323.0 | No |
| | Bottom: | PYRAMAT | 0.0280 | 12.0 | 23.3 | 1.9 | 8.4 | 9.4 | 1.1 | | | |
| | Right: | PYRAMAT | 0.0280 | 10.6 | 23.3 | 2.2 | 6.6 | 9.4 | 1.4 | | | |
| **Analysis #2** | Left: | ROCK RIPRAP | 0.0300 | 13.4 | 50.0 | 3.7 | 5.5 | 45.0 | 8.2 | 1.6178 | 323.0 | Yes |
| | Bottom: | ROCK RIPRAP | 0.0300 | 15.2 | 50.0 | 3.3 | 7.1 | 45.0 | 6.4 | | | |
| | Right: | ROCK RIPRAP | 0.0300 | 13.4 | 50.0 | 3.7 | 5.5 | 45.0 | 8.2 | | | |
| **Analysis #3** | Left: | | 0.0280 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 26.8125 | 1.4379 | 0.0419 | 4.3235 | 4.3235 | 18.6470 | 12.0466 | 323.0 | 1.40 |
| **Analysis #2** | 21.4118 | 1.2424 | 0.0300 | 3.6174 | 3.6174 | 17.2348 | 15.0851 | 323.0 | 1.94 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-Design 2000 Channel Analysis Report



## Channel Analysis Information:

**Name:**

Channel Analysis Name: **SW Ditch (2%)**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **323.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.02000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **300.00**
Bottom Width (ft): **10.00**
Channel Depth (ft): **4.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety:** **1.10**

**Functional Longevity:** **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Velocity Max. Allowed | Velocity Safety Factor | Shear Stress (lbs/sqft) Actual | Shear Stress Max. Allowed | Shear Stress Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | PYRAMAT | 0.0280 | 6.5 | 23.3 | 3.6 | 2.8 | 9.4 | 3.3 | 2.8325 | 323.0 | Yes |
| | Bottom: | PYRAMAT | 0.0280 | 7.3 | 23.3 | 3.2 | 3.5 | 9.4 | 2.7 | | | |
| | Right: | PYRAMAT | 0.0280 | 6.5 | 23.3 | 3.6 | 2.8 | 9.4 | 3.3 | | | |
| **Analysis #2** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Veleocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 44.3719 | 1.9575 | 0.0451 | 6.3337 | 6.3337 | 22.6675 | 7.2794 | 323.0 | .709 |
| **Analysis #2** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **SW Ditch (5%)**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **323.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.05000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **240.00**
Bottom Width (ft): **10.00**
Channel Depth (ft): **4.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety:** **1.10**

**Functional Longevity:** **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Max. Allowed | Safety Factor | Shear Stress (lbs/sqft) Actual | Max. Allowed | Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | PYRAMAT | 0.0280 | 9.3 | 23.3 | 2.5 | 5.2 | 9.4 | 1.8 | 2.1429 | 323.0 | Yes |
| | Bottom: | PYRAMAT | 0.0280 | 10.5 | 23.3 | 2.2 | 6.7 | 9.4 | 1.4 | | | |
| | Right: | PYRAMAT | 0.0280 | 9.3 | 23.3 | 2.5 | 5.2 | 9.4 | 1.8 | | | |
| **Analysis #2** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 30.6135 | 1.5632 | 0.0427 | 4.7917 | 4.7917 | 19.5835 | 10.5509 | 323.0 | 1.17 |
| **Analysis #2** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **Main Channel**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **1660.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.01300**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **3500.0**
Bottom Width (ft): **20.00**
Channel Depth (ft): **6.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety:** **1.10**

**Functional Longevity:** **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Max. Allowed | Safety Factor | Shear Stress (lbs/sqft) Actual | Max. Allowed | Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | LANDLOK TRM | 0.0250 | 9.1 | 16.5 | 1.8 | 3.4 | 4.7 | 1.4 | 5.3260 | 1660.0 | No |
| | Bottom: | LANDLOK TRM | 0.0250 | 10.2 | 16.5 | 1.6 | 4.3 | 4.7 | 1.1 | | | |
| | Right: | LANDLOK TRM | 0.0250 | 9.1 | 16.5 | 1.8 | 3.4 | 4.7 | 1.4 | | | |
| **Analysis #2** | Left: | LANDLOK TRM | 0.0250 | 9.1 | 16.8 | 1.8 | 3.4 | 6.5 | 1.9 | 5.3260 | 1660.0 | Yes |
| | Bottom: | LANDLOK TRM | 0.0250 | 10.2 | 16.8 | 1.6 | 4.3 | 6.5 | 1.5 | | | |
| | Right: | LANDLOK TRM | 0.0250 | 9.1 | 16.8 | 1.8 | 3.4 | 6.5 | 1.9 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 163.2521 | 3.7256 | 0.0400 | 11.9093 | 11.9093 | 43.8185 | 10.1683 | 1660.0 | .723 |
| **Analysis #2** | 163.2521 | 3.7256 | 0.0400 | 11.9093 | 11.9093 | 43.8185 | 10.1683 | 1660.0 | .723 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **Area 1G Ditch**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **2.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **15.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.08000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **140.00**
Bottom Width (ft): **0.10**
Channel Depth (ft): **4.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety: 1.10**

**Functional Longevity: 999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Max. Allowed | Safety Factor | Shear Stress (lbs/sqft) Actual | Max. Allowed | Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | LANDLOK TRM | 0.0250 | 4.7 | 16.5 | 3.5 | 6.3 | 4.7 | 0.8 | 1.2450 | 15.0 | No |
| | Bottom: | LANDLOK TRM | 0.0250 | 4.6 | 16.5 | 3.5 | 6.2 | 4.7 | 0.8 | | | |
| | Right: | LANDLOK TRM | 0.0250 | 4.7 | 16.5 | 3.5 | 6.3 | 4.7 | 0.8 | | | |
| **Analysis #2** | Left: | LANDLOK TRM | 0.0250 | 4.7 | 16.8 | 3.6 | 6.3 | 6.5 | 1.0 | 1.2450 | 15.0 | No |
| | Bottom: | LANDLOK TRM | 0.0250 | 4.6 | 16.8 | 3.6 | 6.2 | 6.5 | 1.1 | | | |
| | Right: | LANDLOK TRM | 0.0250 | 4.7 | 16.8 | 3.6 | 6.3 | 6.5 | 1.0 | | | |
| **Analysis #3** | Left: | PYRAMAT | 0.0280 | 4.7 | 23.3 | 5.0 | 6.3 | 9.4 | 1.5 | 1.2502 | 15.0 | Yes |
| | Bottom: | PYRAMAT | 0.0280 | 4.7 | 23.3 | 5.0 | 6.2 | 9.4 | 1.5 | | | |
| | Right: | PYRAMAT | 0.0280 | 4.7 | 23.3 | 5.0 | 6.3 | 9.4 | 1.5 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 3.2247 | 0.5689 | 0.0624 | 2.7840 | 2.7840 | 5.6680 | 4.6516 | 15.0 | .737 |
| **Analysis #2** | 3.2247 | 0.5689 | 0.0624 | 2.7840 | 2.7840 | 5.6680 | 4.6516 | 15.0 | .737 |
| **Analysis #3** | 3.2511 | 0.5713 | 0.0622 | 2.7956 | 2.7956 | 5.6912 | 4.6138 | 15.0 | .741 |

# EC-Design 2000 Channel Analysis Report



## Channel Analysis Information:

**Name:**

Channel Analysis Name: **Phase 2 Ditch**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **4.00**
Right Slope (xH:1V): **2.00**

**Flow\Velocity:**

Discharge (cfs): **4.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.06000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **560.00**
Bottom Width (ft): **0.01**
Channel Depth (ft): **2.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **Yes**
Vegetation Class: **C**

**Soil Filled:**

Soil Filled: **No**

**Factor of Safety:** **1.10**

**Functional Longevity:** **999**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Max. Allowed | Safety Factor | Shear Stress (lbs/sqft) Actual | Max. Allowed | Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | LANDLOK TRM | 0.0250 | 2.3 | 16.5 | 7.1 | 4.0 | 4.7 | 1.2 | 0.8207 | 4.0 | Yes |
| | Bottom: | LANDLOK TRM | 0.0250 | 2.0 | 16.5 | 8.1 | 3.1 | 4.7 | 1.5 | | | |
| | Right: | LANDLOK TRM | 0.0250 | 2.1 | 16.5 | 8.0 | 3.1 | 4.7 | 1.5 | | | |
| **Analysis #2** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 2.0287 | 0.3880 | 0.0955 | 3.3837 | 1.8351 | 5.2288 | 1.9717 | 4.0 | .415 |
| **Analysis #2** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

## Suggested Vegetation for: La Crosse,WI

| All Season Grasses | | | | | |
|---|---|---|---|---|---|
| Species | Scentific Name | Retardance Class | Seed Rate (lbs/ac) | Height at Maturity (in) | Recommended Planting Dates |
| Alsike Clover | Trifolium hybridum | A - E | 15 | | 4/1 - 5/31 or8/16 - 10/15 |
| Reed Canarygrass | Phalaris arundinacea | A- E | 20 | | 4/1 - 5/31 or 8/16 - 10/15 |
| Colonial Bentgrass | Agrostis tenius | A - E | 50 | | 4/1 - 5/31 or 8/16 - 10/15 |
| Creeping Bentgrass | Agrostis palustris | A - E | 50 | | 4/1 - 5/31 or 8/16 - 10/15 |
| Poa Trivialis | Poa trivialis | A - E | 50 | | 4/1 - 5/31 or 8/16 - 10/15 |
| Creeping Foxtrail | Alopecurus arundinaceus | A - E | 50 | | 4/1 - 5/31 or 8/16 - 10/15 |
| Meadow Foxtail | Alopecurus pratensis | A - E | 50 | | 4/1 - 5/31 or 8/16 - 10/15 |
| Perennial Ryegrass | Lolium perenne | A - E | 240 | | 4/1 - 5/31 or 8/16 - 10/15 |
| RedTop | Agrostis alba | A - E | 80 | | 4/1 - 5/31 or 8/16 - 10/15 |
| Meadow Fescue | Festuca elatior | A - E | 160 | | 4/1 - 5/31 or 8/16 - 10/15 |
| **Cold Season Grasses** | | | | | |
| Species | Scentific Name | Retardance Class | Seed Rate (lbs/ac) | Height at Maturity (in) | Recommended Planting Dates |
| Crested Wheatgrass | Agropyron desertorum | A | | 2 - 3 | |
| Green Needlegrass | Stipa viridula | A | | 3 - 4 | |
| Russian WildRye | Psathyrostachys gunceus | A | | 3 - 4 | |
| Smooth Bromegrass | Bromus inermis | A | | 3 - 4 | |
| Tall Fescue | Festuca arundinacea | A | | 3 - 4 | |
| Tall Wheatgrass | Elytriga pontica | A | | 4 - 5 | |
| Western Wheatgrass | Agropyron smithii | A | | 2 - 3 | |
| **Warm Season Grasses** | | | | | |
| Species | Scentific Name | Retardance Class | Seed Rate (lbs/ac) | Height at Maturity (in) | Recommended Planting Dates |
| Bermuda Grass | Cynodon dactylon | C | | 3/4 - 2 | |
| Big Bluestem | Andropogon gerardii | B | | 4 - 6 | |
| Blue grama | Boutelova gracillis | B | | 1 - 2 | |
| Buffalo grass | Buchloe dactyloides | D | | 1/3 - 1 | |
| Green Sprangletop | Leptochloa dubia | A | | 3 - 4 | |
| Indian grass | Sorghastrum nutans | A | | 5 - 6 | |
| Kleingrass | Panicum coloratum | A | | 3 - 4 | |
| Little bluestem | Schizachyrium scoparium | A | | 3 - 4 | |
| Plains bristlegrass | Setaria macrostachya | B | | 1 - 2 | |
| Sand bluestem | Andropogon hallii | A | | 5 - 6 | |
| Sideoats grama | Bouteloua curtipendula | A | | 2 - 3 | |
| Switch grass | Panicum Virgatum | A | | 4 - 5 | |
| Vine mesquitegrass | Panicum Obtusum | B | | 1 - 2 | |
| Weeping lovegrass | Eragrostis Curvula | A | | 3 - 4 | |

## Calculations – Operational Landfill Conditions

RMT
744 Heartland Trail
Madison, WI 53717-1934
Tel. (608) 831-4444 • Fax (608) 831-3334



| | | |
|---|---|---|
| PROJECT / PROPOSAL NAME / LOCATION: DPC - POO | | PROJECT / PROPOSAL NO. 3078.40 |
| SUBJECT: OPERATIONAL DITCH SIZING | | |
| PREPARED BY: BJK | DATE: 10/00 | FINAL ☒ |
| CHECKED BY: | DATE: | REVISION ☐ |

OPERATIONAL DITCHES (SEE FIGURES K-4 to K-9, OPERATIONAL RUNOFF CALCULATIONS)

| DITCH | LOCATION | 100-YR FLOW | SLOPE | SHAPE |
|---|---|---|---|---|
| V-NOTCH DITCH A | CELL 1 ACTIVE | 5 CFS | 6% | V-NOTCH |
| DITCH B | CELL 1 ACTIVE | ~~583~~ 561 CFS[1] | 2% | 10' FLAT |
| DITCH C | CELL 2A ACTIVE | 6 CFS | 6.3% | V-NOTCH |
| DITCH D | CELL 2B ACTIVE | 3 CFS | 12% | V-NOTCH |
| DITCH E | CELL 3 ACTIVE | ~~583~~ 561 CFS[1] ✓ | 1% | 10' FLAT |
| DITCH F | CELL 4A ACTIVE | ~~433~~ 373 CFS[2] | 1% | 10' FLAT |
| DITCH G | CELL 2A ACTIVE | 360 CFS[4] | | |

NOTES
1. FLOWS FROM PREDEVELOPMENT AREAS NORTH + WEST (See p. 95) @ 12.6 hrs
2. FLOWS FROM PREDEVELOPMENT AREAS NORTH + 2B @ 12.6 HRS (See p. 66/95)
3. PERMANANT DITCHES SIZED UNDER POST-DEVELOPMENT CALCULATIONS.
4. FLOW FROM PREDEVELOPMENT ~~AREA~~ AREA NORTH (See p. 95)

| | | | | |
|---|---|---|---|---|
| SW DITCH | CELL 2A ACTIVE | 561 CFS[1] | 5% | 10' FLAT |

FORM 383A

RMT, Inc.
Grass Channel Sizing Calculations

| | | | |
|---|---|---|---|
| Site: | Dairyland Power Cooperative | Date: | 10/00 |
| Project #: | 3081.40 | User: | BJK |
| Channel: | Ditch A | | |

==================================================================

I. Input Parameters.

| | | |
|---|---|---|
| A. Side slope, Z1 (hor/vert) = | 3.000 | ft/ft |
| B. Side slope, Z2 (hor/vert) = | 16.000 | ft/ft |
| C. Bottom width, B = | 0.000 | ft |
| D. Design channel slope, S = | 0.060 | ft/ft |
| E. Channel Peak Flow, Q = | 5.000 | cfs |
| F. Enter - 1 - for Type "C" Veg. Retardence<br>- 2 - for Type "D" Veg. Retardence | 2 | |

II. Peak Flow Calculations.

| | | |
|---|---|---|
| **A. Trial flow depth, D =**<br>(Bisection method until Va=Vb) | **0.533** | **ft** |
| B. Channel flow area, Ac =<br>(.5*Z1*D^2) + (B*D) + (.5*Z2*D^2) | 2.703 | sq ft |
| C. Wetted Perimeter, Pw =<br>(D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5) | 10.239 | ft |
| D. Hydraulic radius, Rh =<br>(Ac/Pw) | 0.264 | ft |
| E. Velocity and hydraulic radius, VR =<br>(Va * Rh) | 0.488 | sfps |
| F. Channel flow Manning's coeff, nc =<br>0 | 0.081 | |
| G. Trial velocity, Va =<br>(Q/Ac) | 1.850 | fps |
| **H. Resultant velocity, Vb =**<br>(1.49/nc) * (Rh^.667) * (S^.5) | **1.850** | **fps** ✓OK |

Invoke Solution Macro by typing - 'ctrl' D

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **Ditch B**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **3.00**
Right Slope (xH:1V): **3.00**

**Flow\Velocity:**

Discharge (cfs): **583.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.02000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **530.00**
Bottom Width (ft): **10.00**
Channel Depth (ft): **4.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **No**
Vegetation Class:

**Soil Filled:**

Soil Filled: **Yes**

**Factor of Safety:** **1.00**

**Functional Longevity:** **48**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Velocity Max. Allowed | Velocity Safety Factor | Shear Stress (lbs/sqft) Actual | Shear Stress Max. Allowed | Shear Stress Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | LANDLOK TRM | 0.0250 | 13.4 | 16.5 | 1.2 | 2.5 | 6.2 | 2.5 | 2.3594 | 583.0 | Yes |
| | Bottom: | LANDLOK TRM | 0.0250 | 14.5 | 16.5 | 1.1 | 2.9 | 6.2 | 2.1 | | | |
| | Right: | LANDLOK TRM 450 | 0.0250 | 13.4 | 16.5 | 1.2 | 2.5 | 6.2 | 2.5 | | | |
| **Analysis #2** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 40.2945 | 1.6168 | 0.0200 | 7.4611 | 7.4611 | 24.9222 | 14.4685 | 583.0 | 1.58 |
| **Analysis #2** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

RMT, Inc.
Grass Channel Sizing Calculations

| | | | |
|---|---|---|---|
| Site: | Dairyland Power Cooperative | Date: | 10/00 |
| Project #: | 3081.40 | User: | BJK |
| Channel: | Ditch C | | |

==========================================================================

I. Input Parameters.

| | | | |
|---|---|---|---|
| A. Side slope, Z1 (hor/vert) = | | 3.000 | ft/ft |
| B. Side slope, Z2 (hor/vert) = | | 16.000 | ft/ft |
| C. Bottom width, B = | | 0.000 | ft |
| D. Design channel slope, S = | | 0.063 | ft/ft |
| E. Channel Peak Flow, Q = | | 6.000 | cfs |
| F. Enter | - 1 - for Type "C" Veg. Retardence<br>- 2 - for Type "D" Veg. Retardence | 2 | |

II. Peak Flow Calculations.

| | | | |
|---|---|---|---|
| **A. Trial flow depth, D =** | (Bisection method until Va=Vb) | **0.550** | **ft** |
| B. Channel flow area, Ac = | (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2) | 2.870 | sq ft |
| C. Wetted Perimeter, Pw = | (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5) | 10.549 | ft |
| D. Hydraulic radius, Rh = | (Ac/Pw) | 0.272 | ft |
| E. Velocity and hydraulic radius, VR = | (Va * Rh) | 0.569 | sfps |
| F. Channel flow Manning's coeff, nc = | 0 | 0.075 | |
| G. Trial velocity, Va = | (Q/Ac) | 2.091 | fps |
| **H. Resultant velocity, Vb =** | (1.49/nc) * (Rh^.667) * (S^.5) | **2.091** | **fps** ✓OK |

Invoke Solution Macro by typing - 'ctrl' D

RMT, Inc.
Grass Channel Sizing Calculations

| | | | |
|---|---|---|---|
| Site: | Dairyland Power Cooperative | Date: | 10/00 |
| Project #: | 3081.40 | User: | BJK |
| Channel: | Ditch D | | |

==============================================================

I. Input Parameters.

| | | |
|---|---|---|
| A. Side slope, Z1 (hor/vert) = | 3.000 | ft/ft |
| B. Side slope, Z2 (hor/vert) = | 3.000 | ft/ft |
| C. Bottom width, B = | 0.000 | ft |
| D. Design channel slope, S = | 0.120 | ft/ft |
| E. Channel Peak Flow, Q = | 3.000 | cfs |
| F. Enter - 1 - for Type "C" Veg. Retardence<br>- 2 - for Type "D" Veg. Retardence | 2 | |

II. Peak Flow Calculations.

| | | |
|---|---|---|
| **A. Trial flow depth, D =**<br>(Bisection method until Va=Vb) | **0.547** | **ft** |
| B. Channel flow area, Ac =<br>(.5*Z1*D^2) + (B*D) + (.5*Z2*D^2) | 0.897 | sq ft |
| C. Wetted Perimeter, Pw =<br>(D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5) | 3.459 | ft |
| D. Hydraulic radius, Rh =<br>(Ac/Pw) | 0.259 | ft |
| E. Velocity and hydraulic radius, VR =<br>(Va * Rh) | 0.867 | sfps |
| F. Channel flow Manning's coeff, nc =<br>0 | 0.063 | |
| G. Trial velocity, Va =<br>(Q/Ac) | 3.344 | fps |
| **H. Resultant velocity, Vb =**<br>(1.49/nc) * (Rh^.667) * (S^.5) | **3.344** | **fps** ✓ ok |

Invoke Solution Macro by typing - 'ctrl' D

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **Ditch E**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **3.00**
Right Slope (xH:1V): **10.00**

**Flow\Velocity:**

Discharge (cfs): **583.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.01000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **1000.0**
Bottom Width (ft): **10.00**
Channel Depth (ft): **3.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **No**
Vegetation Class:

**Soil Filled:**

Soil Filled: **Yes**

**Factor of Safety:** **1.00**

**Functional Longevity:** **60**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Velocity (ft/s) Max. Allowed | Velocity (ft/s) Safety Factor | Shear Stress (lbs/sqft) Actual | Shear Stress (lbs/sqft) Max. Allowed | Shear Stress (lbs/sqft) Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analysis #1 | Left: | LANDLOK TRM | 0.0250 | 8.9 | 16.5 | 1.9 | 1.3 | 6.2 | 4.9 | 2.3865 | 583.0 | Yes |
| | Bottom: | LANDLOK TRM | 0.0250 | 9.6 | 16.5 | 1.7 | 1.5 | 6.2 | 4.2 | | | |
| | Right: | LANDLOK TRM | 0.0250 | 9.3 | 16.5 | 1.8 | 1.4 | 6.2 | 4.5 | | | |
| Analysis #2 | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| Analysis #3 | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Veleocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| Analysis #1 | 60.8850 | 1.4660 | 0.0200 | 7.5468 | 23.9840 | 41.5308 | 9.5754 | 583.0 | 1.06 |
| Analysis #2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |
| Analysis #3 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-Design 2000 Channel Analysis Report

## Channel Analysis Information:

**Name:**

Channel Analysis Name: **Ditch F**

## Channel Geometry & Hydraulics:

**Design By:**

Designed By: **FLOW**

**Channel Side Slopes:**

Left Slope (xH:1V): **3.00**
Right Slope (xH:1V): **5.00**

**Flow\Velocity:**

Discharge (cfs): **433.00**
Flow Duration (hrs): **1.00**
Average Velocity (ft/s): **0.00**

**Channel Geometry:**

Bed Slope (ft/ft): **0.01000**
Req. Freeboard (ft): **0.00**
Channel Length (ft): **750.00**
Bottom Width (ft): **10.00**
Channel Depth (ft): **3.00**

**Channel Bend:**

Channel Bend: **No**
Bend Radius (ft): **0.00**
Outside Bend:

**Vegetation:**

Vegetated: **No**
Vegetation Class:

**Soil Filled:**

Soil Filled: **Yes**

**Factor of Safety:** **1.00**

**Functional Longevity:** **0**

## Analysis Results:

| | Side | Lining Type | Manning's "n" | Velocity (ft/s) Actual | Max. Allowed | Safety Factor | Shear Stress (lbs/sqft) Actual | Max. Allowed | Safety Factor | Flow Depth (ft) | Discharge (cfs) | OK? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | Left: | LANDLOK TRM | 0.0250 | 9.1 | 16.5 | 1.8 | 1.2 | 6.2 | 5.1 | 2.2978 | 433.0 | Yes |
| | Bottom: | LANDLOK TRM | 0.0250 | 9.9 | 16.5 | 1.7 | 1.4 | 6.2 | 4.4 | | | |
| | Right: | LANDLOK TRM | 0.0250 | 9.5 | 16.5 | 1.7 | 1.3 | 6.2 | 4.7 | | | |
| **Analysis #2** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| **Analysis #3** | Left: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.0 | No |
| | Bottom: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| | Right: | | 0.0000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |

## Channel Calculation Results:

| | Flow Area (sq ft) | Hydraulic Radius (ft) | Composite 'n' | Left Wetted Perimeter(ft) | Right Wetted Perimeter(ft) | Total Wetted Perimeter(ft) | Average Velocity (ft/s) | Average Discharge (cfs) | Froude |
|---|---|---|---|---|---|---|---|---|---|
| **Analysis #1** | 44.0967 | 1.5215 | 0.0200 | 7.2662 | 11.7164 | 28.9826 | 9.8193 | 433.0 | 1.10 |
| **Analysis #2** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |
| **Analysis #3** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 | .000 |

# EC-DESIGN(R) 2000 Channel Analysis Report

## Project Information

**Project Name:** DPC
**Description:** Cell 2A operational Calcs
**Last Update:** 8/25/2003 10:58:10 A
**Units:** English
**Nearest City:**

**Notes:** Calculated for 1% slope section
Backwater from culvert / will
Protect 5% slope section

## Channel Design

**Channel Name:** SW Ditch - Operational 100 yr **Units:** English **Design life:** 1,200 months

| Design Criteria | |
|---|---|
| Flow Rate (Q) | |

| Vegetation and Soil | |
|---|---|
| **Vegetated** | Yes |
| **Vegetation Class** | B |
| **Soil Filled** | No |

| Channel Geometry | |
|---|---|
| **Bed Slope (ft/ft)** | 0.010 |
| **Req. Freeboard (ft)** | 0.000 |
| **Channel Length (ft)** | 475.000 |
| **Bottom Width (ft)** | 10.000 |
| **Channel Depth (ft)** | 6.000 |

| Flow/Velocity | |
|---|---|
| **Discharge (cf/s)** | 561.000 |
| **Flow Duration (hrs)** | 1.000 |
| **Avg. Velocity (ft/s)** | 5.490 |

| Channel Side Slopes | |
|---|---|
| **Left (H:1 V)** | 2.000 |
| **Right (H:1 V)** | 2.000 |

| Channel Bend | No |
|---|---|
| **Bend Radius (ft)** | 0.000 |
| **Outside Bend** | |

**Required Factor of Safety** 1.00

## Results

| Lining Materials | | Velocity (ft/s) | | | Shear Stress (lbs/sqft) | | | Avg. Flow Depth (ft) |
|---|---|---|---|---|---|---|---|---|
| | | Computed | Max Allowed | Safety Factor | Computed | Max Allowed | Safety Factor | 5.070 |
| Left | PYRAMAT | 5.100 | 23.340 | 4.580 | 2.720 | 9.400 | 3.460 | |
| Bottom | PYRAMAT | 5.510 | 23.340 | 4.240 | 3.170 | 9.400 | 2.970 | |
| Right | PYRAMAT | 5.100 | 23.340 | 4.580 | 2.720 | 9.400 | 3.460 | |

## Calculation Results:

| | | | |
|---|---|---|---|
| **Flow Depth (ft)** | 5.070 | **Left Wetted Perimeter (ft)** | 11.350 |
| **Flow Area (ft)** | 102.230 | **Bottom Wetted Perimeter (ft)** | 9.990 |
| | | **Right Wetted Perimeter (ft)** | 11.350 |
| | | **Total Wetted Perimeter (ft)** | 32.690 |
| **Hydraulic Radius (ft)** | 3.130 | **Avg. Velocity (ft/s)** | 5.490 |
| **Composite 'n'** | 0.0580 | **Avg. Discharge (cf/s)** | 561.000 |

# EC-DESIGN(R) 2000 Channel Analysis Report

## Project Information

**Project Name:** DPC

**Description:** Cell 2A operational Calcs

**Last Update:** 8/25/2003 10:53:12 A

**Units:** English

**Nearest City:**

**Notes:** For 5% slope section 25-yr storm

## Channel Design

**Channel Name:** SW Ditch - Operational 25 yr **Units:** English **Design life:** 48 months

### Design Criteria

Flow Rate (Q)

### Vegetation and Soil

| | |
|---|---|
| **Vegetated** | Yes |
| **Vegetation Class** | B |
| **Soil Filled** | No |

### Channel Geometry

| | |
|---|---|
| **Bed Slope (ft/ft)** | 0.050 |
| **Req. Freeboard (ft)** | 0.000 |
| **Channel Length (ft)** | 450.000 |
| **Bottom Width (ft)** | 10.000 |
| **Channel Depth (ft)** | 4.000 |

### Flow/Velocity

| | |
|---|---|
| **Discharge (cf/s)** | 355.000 |
| **Flow Duration (hrs)** | 1.000 |
| **Avg. Velocity (ft/s)** | 8.940 |

**Required Factor of Safety** 1.00

### Channel Side Slopes

| | |
|---|---|
| **Left (H:1 V)** | 2.000 |
| **Right (H:1 V)** | 2.000 |

### Channel Bend No

| | |
|---|---|
| **Bend Radius (ft)** | 0.000 |
| **Outside Bend** | |

## Results

| Lining Materials | | Velocity (ft/s) Computed | Velocity Max Allowed | Velocity Safety Factor | Shear Stress (lbs/sqft) Computed | Shear Stress Max Allowed | Shear Stress Safety Factor |
|---|---|---|---|---|---|---|---|
| Left | PYRAMAT | 8.030 | 23.340 | 2.910 | 6.450 | 9.400 | 1.460 |
| Bottom | PYRAMAT | 9.020 | 23.340 | 2.590 | 8.140 | 9.400 | 1.150 |
| Right | PYRAMAT | 8.030 | 23.340 | 2.910 | 6.450 | 9.400 | 1.460 |

**Avg. Flow Depth (ft)** 2.610

## Calculation Results:

| | |
|---|---|
| **Flow Depth (ft)** | 2.610 |
| **Flow Area (ft)** | 39.690 |
| **Hydraulic Radius (ft)** | 1.830 |
| **Composite 'n'** | 0.0554 |

| | |
|---|---|
| **Left Wetted Perimeter (ft)** | 5.830 |
| **Bottom Wetted Perimeter (ft)** | 10.000 |
| **Right Wetted Perimeter (ft)** | 5.830 |
| **Total Wetted Perimeter (ft)** | 21.660 |
| **Avg. Velocity (ft/s)** | 8.940 |
| **Avg. Discharge (cf/s)** | 355.000 |

# EC-DESIGN(R) 2000 Channel Analysis Report

## Project Information

**Project Name:** DPC
**Description:** Cell 2A operational Calcs
**Notes:**

**Last Update:** 8/25/2003 11:00:48 A
**Units:** English
**Nearest City:**

## Channel Design

**Channel Name:** Phase III South Slope Ditch | **Units:** English | **Design life:** 24 months

**Design Criteria**

Flow Rate (Q)

**Vegetation and Soil**

| | |
|---|---|
| **Vegetated** | No |
| **Vegetation Class** | |
| **Soil Filled** | Yes |

**Channel Side Slopes**

| | |
|---|---|
| Left (H:1 V) | 2.000 |
| Right (H:1 V) | 3.000 |

**Channel Bend** No

| | |
|---|---|
| **Bend Radius (ft)** | 0.000 |
| **Outside Bend** | |

**Channel Geometry**

| | |
|---|---|
| **Bed Slope (ft/ft)** | 0.060 |
| **Req. Freeboard (ft)** | 0.000 |
| **Channel Length (ft)** | 500.000 |
| **Bottom Width (ft)** | 1.000 |
| **Channel Depth (ft)** | 1.500 |

**Flow/Velocity**

| | |
|---|---|
| **Discharge (cf/s)** | 4.000 |
| **Flow Duration (hrs)** | 1.000 |
| **Avg. Velocity (ft/s)** | 6.280 |

**Required Factor of Safety** 1.00

## Results

| Lining Materials | | Velocity (ft/s) Computed | Velocity (ft/s) Max Allowed | Velocity (ft/s) Safety Factor | Shear Stress (lbs/sqft) Computed | Shear Stress (lbs/sqft) Max Allowed | Shear Stress (lbs/sqft) Safety Factor |
|---|---|---|---|---|---|---|---|
| Left | LANDLOK TRM 450 | 6.080 | 16.490 | 2.710 | 1.050 | 6.250 | 5.950 |
| Bottom | LANDLOK TRM 450 | 6.730 | 16.490 | 2.450 | 1.280 | 6.250 | 4.880 |
| Right | LANDLOK TRM 450 | 6.350 | 16.490 | 2.600 | 1.140 | 6.250 | 5.480 |

**Avg. Flow Depth (ft)** 0.340

## Calculation Results:

| | |
|---|---|
| **Flow Depth (ft)** | 0.340 |
| **Flow Area (ft)** | 0.640 |
| **Hydraulic Radius (ft)** | 0.220 |
| **Composite 'n'** | 0.0200 |

| | |
|---|---|
| **Left Wetted Perimeter (ft)** | 0.770 |
| **Bottom Wetted Perimeter (ft)** | 1.000 |
| **Right Wetted Perimeter (ft)** | 1.080 |
| **Total Wetted Perimeter (ft)** | 2.850 |
| **Avg. Velocity (ft/s)** | 6.280 |
| **Avg. Discharge (cf/s)** | 4.000 |

# EC-DESIGN(R) 2000 Channel Analysis Report

## Project Information

**Project Name:** DPC
**Description:** Cell 2A operational Calcs
**Notes:**

**Last Update:** 8/25/2003 11:00:48 A
**Units:** English
**Nearest City:**

## Channel Design

**Channel Name:** Ditch G
**Units:** English
**Design life:** 48 months

**Design Criteria**

Flow Rate (Q)

**Vegetation and Soil**

| | |
|---|---|
| **Vegetated** | No |
| **Vegetation Class** | |
| **Soil Filled** | No |

**Channel Geometry**

| | |
|---|---|
| **Bed Slope (ft/ft)** | 0.015 |
| **Req. Freeboard (ft)** | 0.000 |
| **Channel Length (ft)** | 1.000 |
| **Bottom Width (ft)** | 10.000 |
| **Channel Depth (ft)** | 4.000 |

**Flow/Velocity**

| | |
|---|---|
| **Discharge (cf/s)** | 360.000 |
| **Flow Duration (hrs)** | 1.000 |
| **Avg. Velocity (ft/s)** | 10.930 |

**Required Factor of Safety** 1.00

**Channel Side Slopes**

| | |
|---|---|
| **Left (H:1 V)** | 3.000 |
| **Right (H:1 V)** | 3.000 |

**Channel Bend** **No**

| | |
|---|---|
| **Bend Radius (ft)** | 0.000 |
| **Outside Bend** | |

## Results

| Lining Materials | | Velocity (ft/s) Computed | Velocity (ft/s) Max Allowed | Velocity (ft/s) Safety Factor | Shear Stress (lbs/sqft) Computed | Shear Stress (lbs/sqft) Max Allowed | Shear Stress (lbs/sqft) Safety Factor |
|---|---|---|---|---|---|---|---|
| Left | LANDLOK TRM 450 | 10.170 | 16.490 | 1.620 | 1.610 | 6.250 | 3.880 |
| Bottom | LANDLOK TRM 450 | 11.090 | 16.490 | 1.490 | 1.910 | 6.250 | 3.270 |
| Right | LANDLOK TRM 450 | 10.170 | 16.490 | 1.620 | 1.610 | 6.250 | 3.880 |

**Avg. Flow Depth (ft)** 2.040

## Calculation Results:

| | |
|---|---|
| **Flow Depth (ft)** | 2.040 |
| **Flow Area (ft)** | 32.920 |
| **Hydraulic Radius (ft)** | 1.440 |
| **Composite 'n'** | 0.0210 |

| | |
|---|---|
| **Left Wetted Perimeter (ft)** | 6.460 |
| **Bottom Wetted Perimeter (ft)** | 9.990 |
| **Right Wetted Perimeter (ft)** | 6.460 |
| **Total Wetted Perimeter (ft)** | 22.910 |
| **Avg. Velocity (ft/s)** | 10.930 |
| **Avg. Discharge (cf/s)** | 360.000 |

# Reference Information

roughness) varies with VR. The term VR is the product of velocity and the hydraulic radius. This relationship will be referred to as the "n-VR relationship", which is the recommended basis for vegetated channel design.

The five general retardance curves, designated as A, B, C, D, and E in Exhibit 7-1, have been developed for various cover conditions. The vegetal conditions under which the various retardance values apply are shown in Exhibit 7-2. These cover classifications are based on tests in experimental channels when the covers were green and generally uniform.

Most of the vegetation used in waterways does not exceed 18 inches in height and may be much shorter at times during the year. Therefore, it is recommended that when designing the channel for safe velocity, a retardance not greater than "D" be used. After designing the channel for safe velocity, it must be checked for capacity to accommodate the peak flow under conditions where vegetation gives the highest retardance. The retardance used in this instance is the curve corresponding to the expected vegetal cover and, in most cases, it will be retardance "C", though curve "B" may be used where considered appropriate.

All pertinent design data and computations should be recorded.

DESIGN DATA

The following information is required for designing a waterway:

1. Watershed area in acres, together with the soil characteristics, cover and topography. This information is used to estimate runoff by the procedures set forth in Chapter 2 of this manual.

2. Grade of the proposed waterway in percent slope (this is the fall in feet per 100 feet of length).

3. Vegetal cover adapted to site conditions.

4. Erodibility of the soil in the waterway.

5. Expected height at which vegetative cover will be maintained.

6. The permissible velocity for the conditions encountered.

7. Allowance for space that will be occupied by the vegetative lining.

8. Allowance for freeboard, if required by State Standards and Specifications.

NON-EROSIVE VELOCITY OF FLOW

In designing grassed waterways, care must be taken to insure that the design velocity is well within the limits of permissible velocities given in Exhibit 7-3. These values apply to average, uniform stands of each type of cover.

Source: U.S. Department of Agriculture, Soil Conservation Service. Engineering Field Manual. November 1986.

| Cover | Slope range 2/ (percent) | Permissible velocity 1/ | |
|---|---|---|---|
| | | Erosion resistant soils (ft.per sec.) | Easily eroded soils (ft.per sec.) |
| Bermudagrass | 0-5<br>5-10<br>over 10 | 8<br>7<br>6 | 6<br>5<br>4 |
| Bahia<br>Buffalograss<br>Kentucky bluegrass<br>Smooth brome<br>Blue grama<br>Tall fescue | 0-5<br>5-10<br>over 10 | 7<br>6<br>5 | 5<br>4<br>3 |
| Grass mixtures<br>Reed canarygrass | 2/ 0-5<br>5-10 | 5<br>4 | 4<br>3 |
| Lespedeza sericea<br>Weeping lovegrass<br>Yellow bluestem<br>Redtop<br>Alfalfa<br>Red fescue | 3/ 0-5 | 3.5 | 2.5 |
| Common lespedeza 4/<br>Sudangrass 4/ | 5/ 0-5 | 3.5 | 2.5 |

1/ Use velocities exceeding 5 feet per second only where good covers and proper maintenance can be obtained.

2/ Do not use on slopes steeper than 10 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

3/ Do not use on slopes steeper than 5 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

4/ Annuals--use on mild slopes or as temporary protection until permanent covers are established.

5/ Use on slopes steeper than 5 percent is not recommended.

Exhibit 7-3. Permissible velocities for channels lined with vegetation

Source: U.S. Department of Agriculture, Soil Conservation Service. Engineering Field Manual. November 1986.

# Culvert/Downslope Flume Design Calculations

**Purpose/Methodology/Assumptions/Results/References**

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

| PROJECT/PROPOSAL NAME | PREPARED By: | Date: | CHECKED By: | Date: | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| Dairyland Power Cooperative | BJK | 9/00 | RAA | 10/00 | 3081.40 |

# CULVERT DESIGN CALCULATIONS

## Purpose

To determine the appropriate culvert and downslope flume sizes for the anticipated peak flows resulting from the 100-year, 24-hour storm at the proposed Dairyland Power Cooperative Landfill.

## Methodologies

Culvert design involves the process of selecting an appropriate culvert size capable of allowing the estimated peak storm water runoff to pass through it without creating surface water breaching (i.e., berm overflow) or excessive backwater levels. Culvert sizing was performed using design charts developed by the U.S. Department of Transportation Federal Highway Administration.

Downslope flumes will convey flow from the final cover diversion berms to the sedimentation basin. Downslope flumes were also sized using design charts developed by the U.S. Department of Transportation Federal Highway Administration. The energy dissipater for the downslope flume was sized using design guidance from the US Department of the Interior, Bureau of Reclamation.

## Assumptions

The following assumptions were used in the culvert and downslope flume sizing analysis:

1. Culvert and downslope flume layout and allowable headwater levels are shown on the accompanying plan set.
2. Tailwater depths were assumed based on anticipated flows within the ditching. For culverts discharging into sedimentation basins, the tailwater elevation in the basin from the routing calculations.
3. Culverts are assumed to be corrugated metal culvert pipes or concrete box culverts.
4. Culverts were designed to maintain a minimum 1 to 2 feet of freeboard, depending on the location.

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|---|---|---|---|---|---|
| Dairyland Power Cooperative | BJK | 9/00 | RAA | 10/00 | 3081.40 |

## Results

The table below summarizes the results of the culvert pipe sizing analyses:

| CULVERT | SLOPE (%) | LENGTH (ft) | 100-YR. FLOW (cfs) | SIZE |
|---|---|---|---|---|
| Culvert #1 | 7.0 | 96 | 323 | 4'x 7' Box |
| Culvert #2 | 7.7 | 126 | 323 | 4'x 7' Box |
| Culvert #3 | 11.2 | 125 | 15 | 30" CMP |
| Culvert #4 | 9.3 | 75 | 15 | 30" CMP |
| Culvert #5 | 5 | 85 | 323 | 4' x 7' Box |

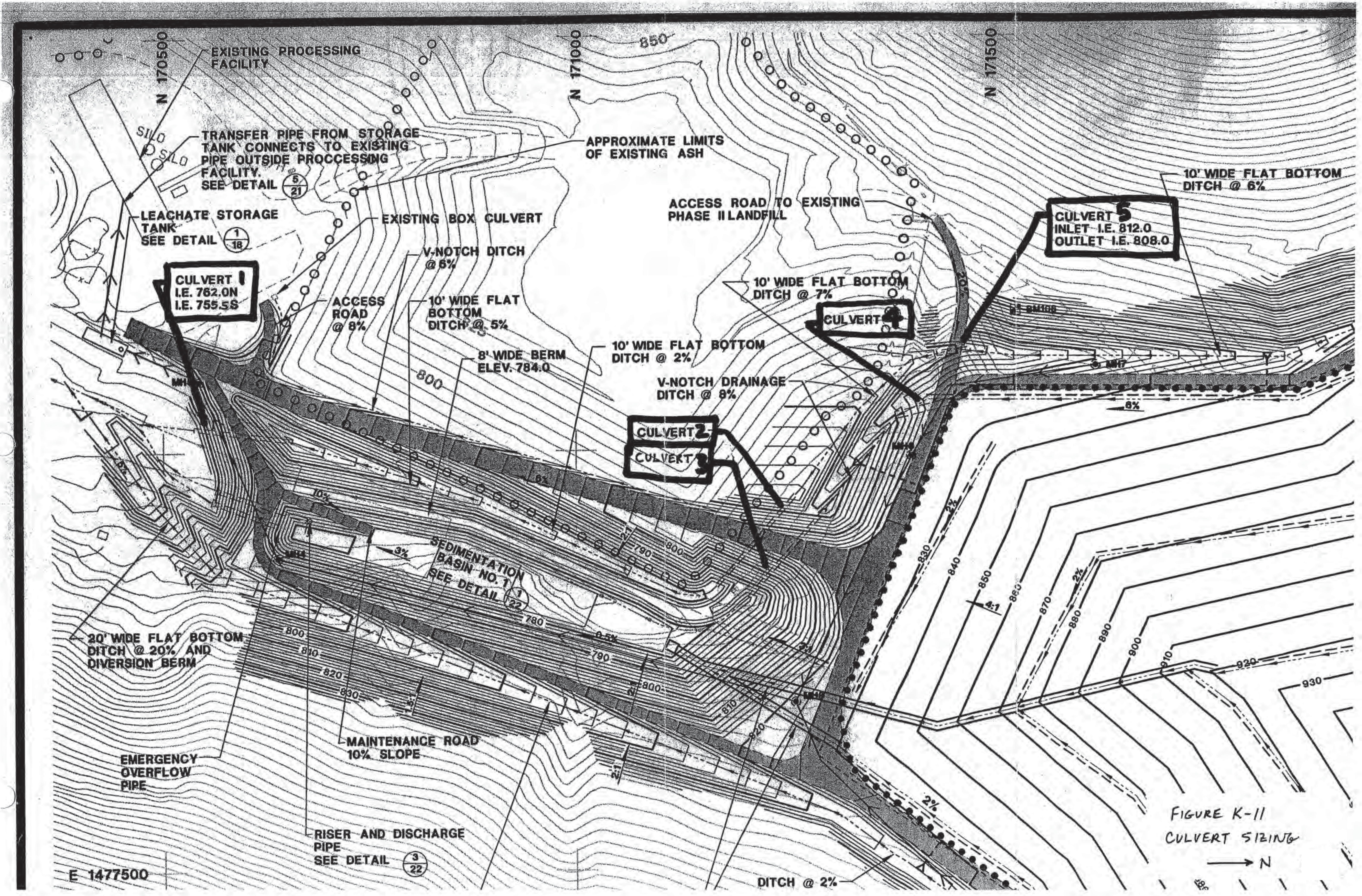
Note:
Culvert lengths to be adjusted based on available culvert section lengths.

Downslope pipe and energy dissipater sizing are shown on the engineering details included in the Plan Set.

## References

U.S. Department of Transportation. Hydraulics charts for the selection of highway culverts. Hydraulic engineering circular no. 5. December 1965.

U.S. Department of the Interior, Bureau of Reclamation. Hydraulic Design of Stilling Basins and Energy Dissipaters. Engineering Nomograph No. 25. May 1984.



N 170500
N 171000
N 171500
850
EXISTING PROCESSING FACILITY
SILO
TRANSFER PIPE FROM STORAGE TANK CONNECTS TO EXISTING PIPE OUTSIDE PROCCESSING FACILITY. SEE DETAIL 5/21
APPROXIMATE LIMITS OF EXISTING ASH
ACCESS ROAD TO EXISTING PHASE II LANDFILL
10' WIDE FLAT BOTTOM DITCH @ 6%
LEACHATE STORAGE TANK SEE DETAIL 1/18
EXISTING BOX CULVERT
CULVERT 5 INLET I.E. 812.0 OUTLET I.E. 808.0
V-NOTCH DITCH @ 6%
CULVERT 1 I.E. 762.0N I.E. 755.5S
ACCESS ROAD @ 8%
10' WIDE FLAT BOTTOM DITCH @ 5%
10' WIDE FLAT BOTTOM DITCH @ 7%
CULVERT 4
8' WIDE BERM ELEV. 784.0
10' WIDE FLAT BOTTOM DITCH @ 2%
V-NOTCH DRAINAGE DITCH @ 8%
800
CULVERT 2
CULVERT 3
SEDIMENTATION BASIN NO. 1 SEE DETAIL 1/22
20' WIDE FLAT BOTTOM DITCH @ 20% AND DIVERSION BERM
MAINTENANCE ROAD 10% SLOPE
EMERGENCY OVERFLOW PIPE
RISER AND DISCHARGE PIPE SEE DETAIL 3/22
DITCH @ 2%
E 1477500
830
840
850
860
870
880
890
900
910
920
930
FIGURE K-11
CULVERT SIZING
N

## Calculations – Post-closure Landfill Conditions

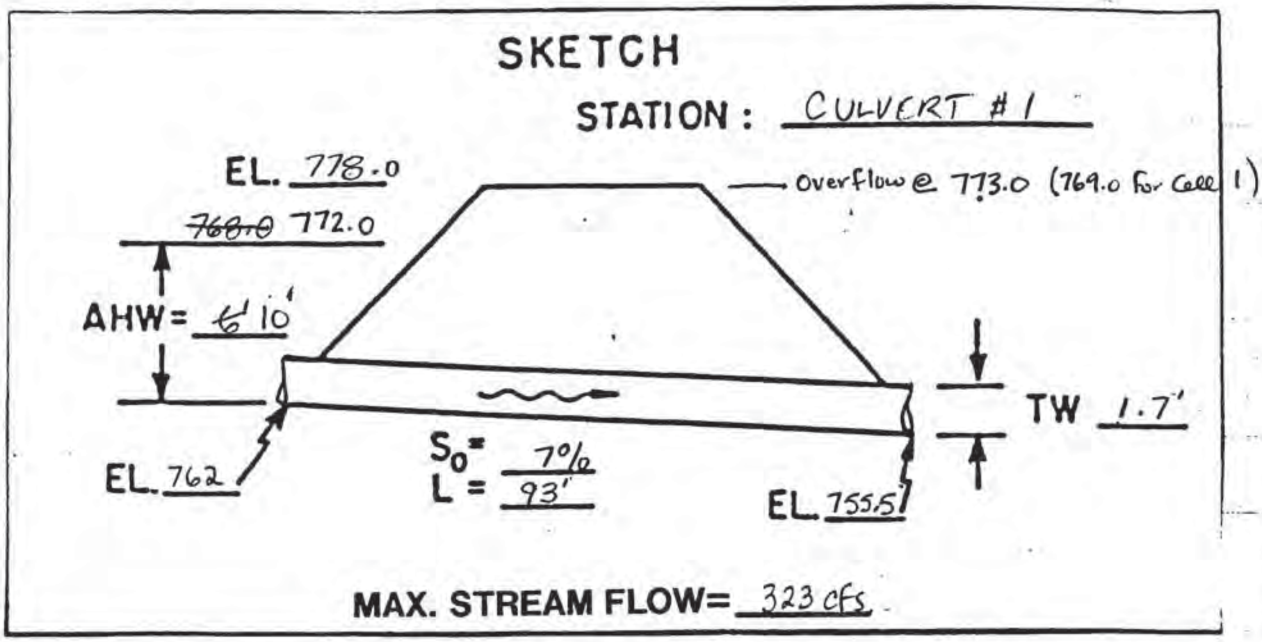
RMT INC.
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

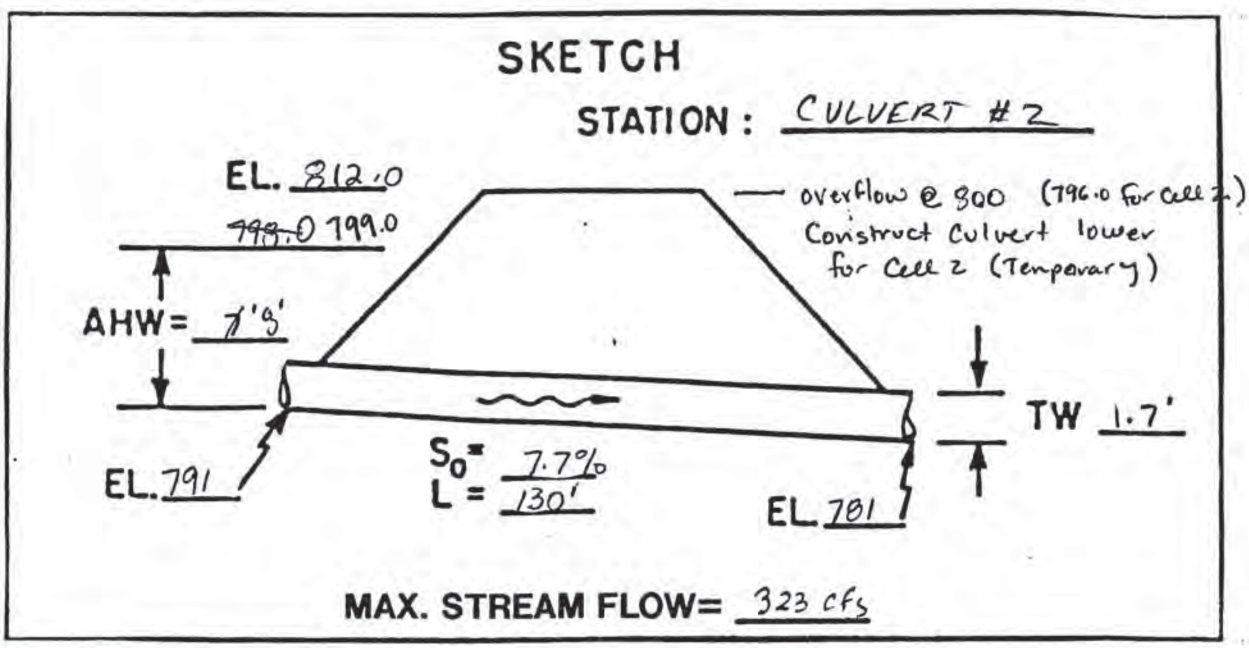
# COMPUTATION SHEET

SHEET ____ OF ____

| PROJECT / PROPOSAL NAME | PREPARED By: | Date: | CHECKED By: | Date: | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| DPC - PLAN OF OPERATION | BJK | 9/00 | | | 3081.40 |

Rev. 7/03
BJK



# COMPUTATION SHEET

RMT INC.

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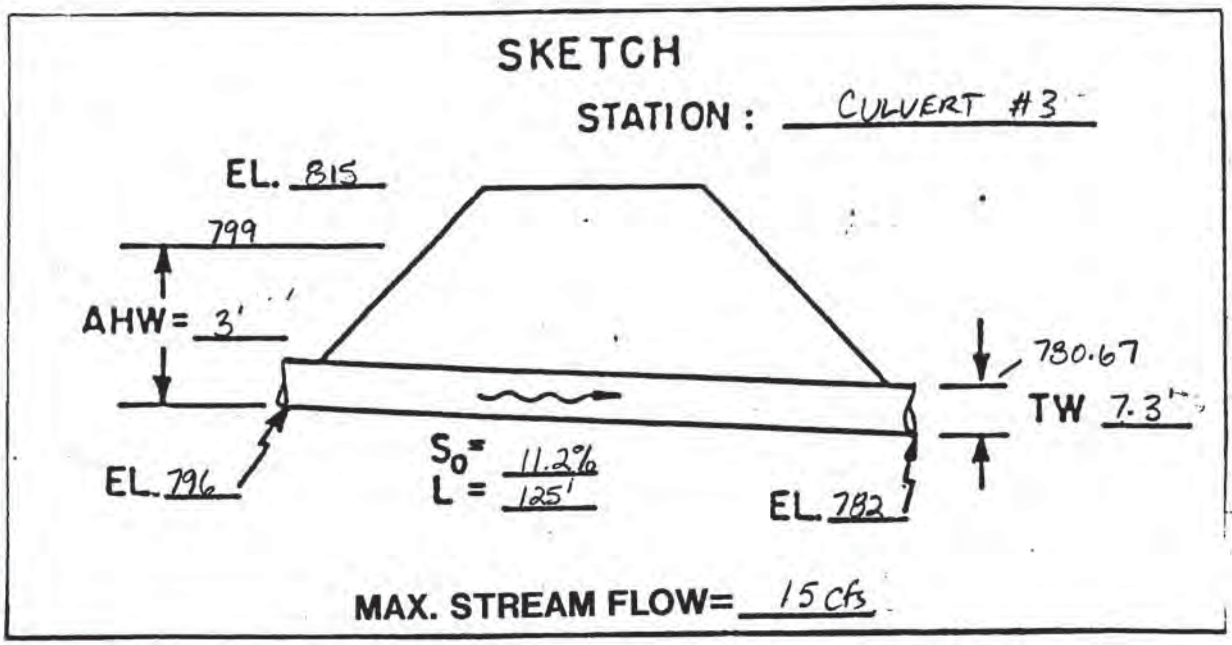
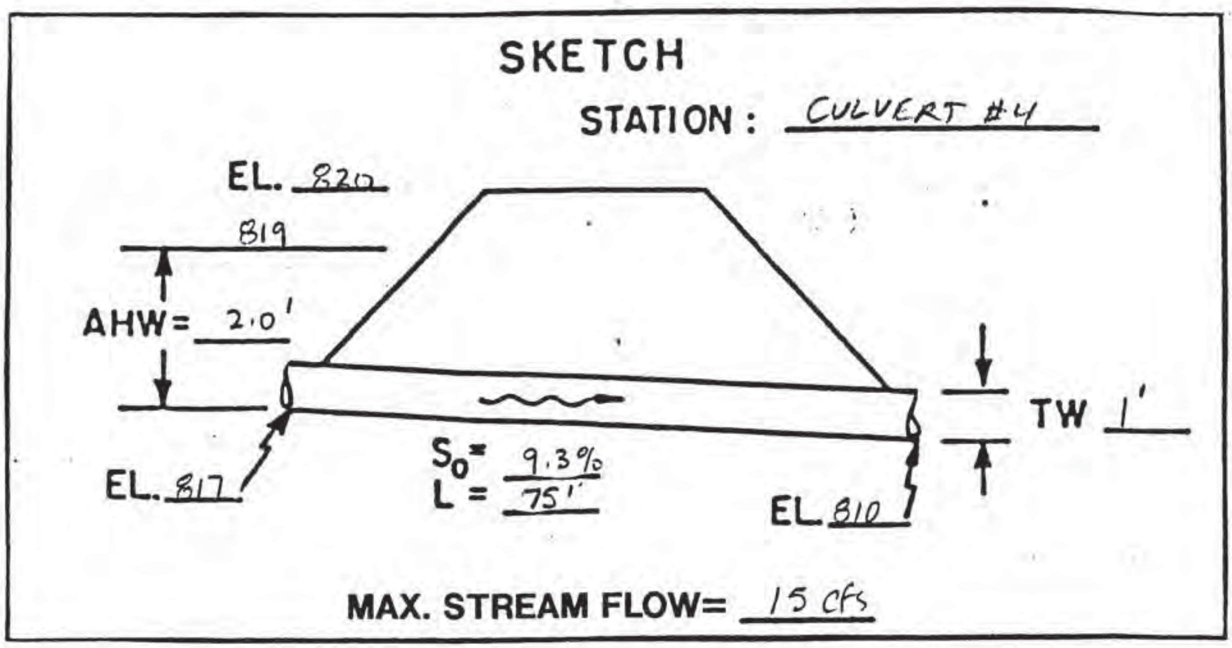
| PROJECT / PROPOSAL NAME | PREPARED | | CHECKED | | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| DPC · PLAN OF OPERATION | By: BJN | Date: 9/00 | By: | Date: | 3081.40 |



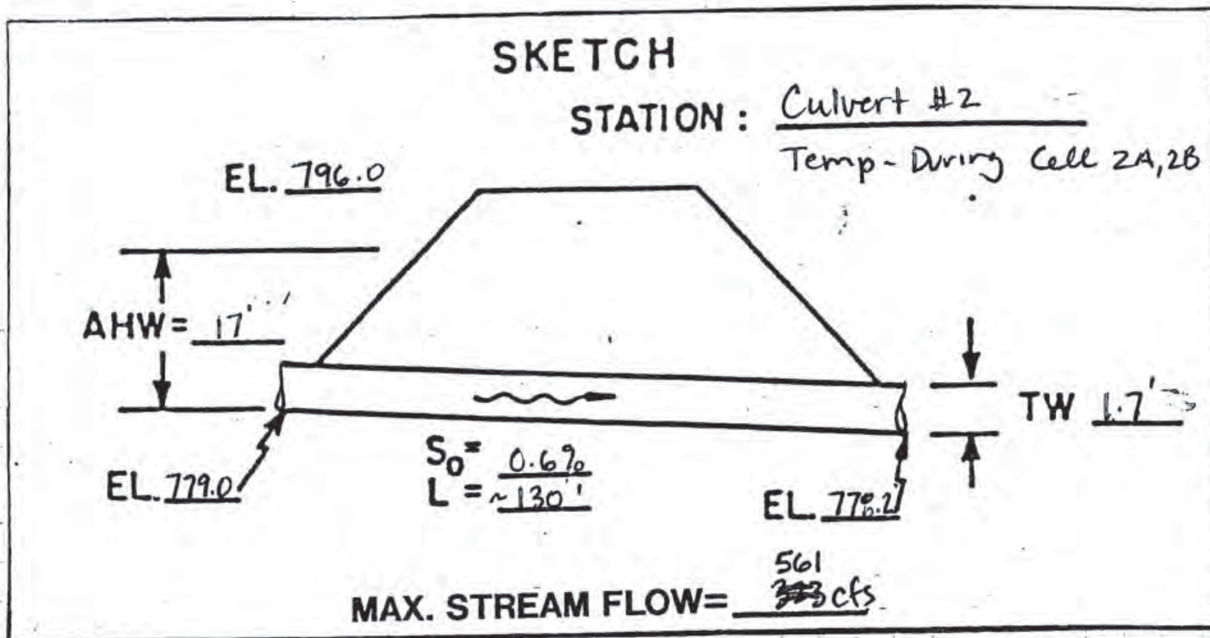



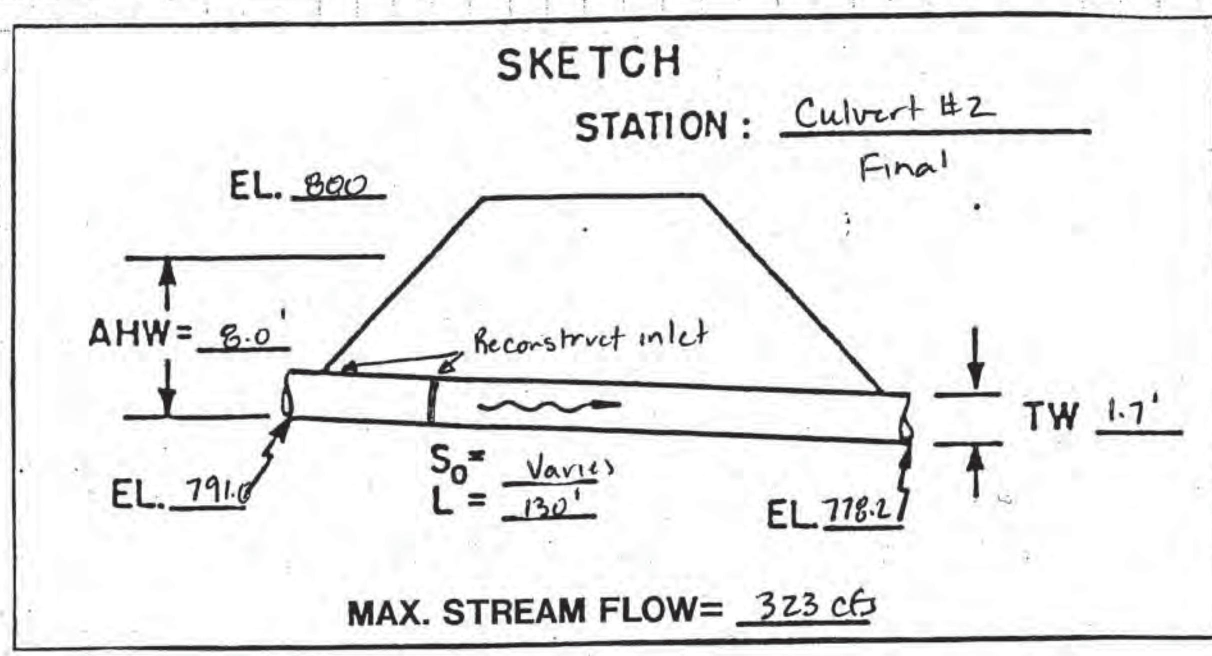
# COMPUTATION SHEET

RMT INC.
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

SHEET ____ OF ____

| PROJECT / PROPOSAL NAME | PREPARED | | CHECKED | | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| Dairyland Power – Phase IV | By: BJT | Date: 7/03 | By: | Date: | 3061.56 |



# Culvert Calculator Report
# Culvert 2 - Operational

Solve For: Headwater Elevation

| Culvert Summary | | | |
|---|---|---|---|
| Allowable HW Elevation | 796.00 ft | Headwater Depth/ Height | 3.86 |
| Computed Headwater Elevation | 794.45 ft | Discharge | 561.00 cfs |
| Inlet Control HW Elev | 792.30 ft | Tailwater Elevation | 779.90 ft |
| Outlet Control HW Elev | 794.45 ft | Control Type | Outlet Control |

| Grades | | | |
|---|---|---|---|
| Upstream Invert | 779.00 ft | Downstream Invert | 778.20 ft |
| Length | 130.00 ft | Constructed Slope | 0.006154 ft/ft |

| Hydraulic Profile | | | |
|---|---|---|---|
| Profile | Pressure | Depth, Downstream | 4.00 ft |
| Slope Type | N/A | Normal Depth | N/A ft |
| Flow Regime | N/A | Critical Depth | 4.00 ft |
| Velocity Downstream | 20.04 ft/s | Critical Slope | 0.022277 ft/ft |

| Section | | | |
|---|---|---|---|
| Section Shape | Box | Mannings Coefficient | 0.013 |
| Section Material | Concrete | Span | 7.00 ft |
| Section Size | 7 x 4 ft | Rise | 4.00 ft |
| Number Sections | 1 | | |

| Outlet Control Properties | | | |
|---|---|---|---|
| Outlet Control HW Elev | 794.45 ft | Upstream Velocity Head | 6.24 ft |
| Ke | 0.50 | Entrance Loss | 3.12 ft |

| Inlet Control Properties | | | |
|---|---|---|---|
| Inlet Control HW Elev | 792.30 ft | Flow Control | Submerged |
| Inlet Type | 18 to 33.7 ° wingwall flare, d=0.0830 | Area Full | 28.0 ft² |
| K | 0.48600 | HDS 5 Chart | 9 |
| M | 0.66700 | HDS 5 Scale | 2 |
| C | 0.02490 | Equation Form | 2 |
| Y | 0.83000 | | |

# Culvert Calculator Report
# Culvert 2 - Final

Solve For: Headwater Elevation

| Culvert Summary | | | |
|---|---|---|---|
| Allowable HW Elevation | 799.00 ft | Headwater Depth/ Height | 1.78 |
| Computed Headwater Elevation | 798.10 ft | Discharge | 323.00 cfs |
| Inlet Control HW Elev | 797.44 ft | Tailwater Elevation | 779.90 ft |
| Outlet Control HW Elev | 798.10 ft | Control Type | Entrance Control |

| Grades | | | |
|---|---|---|---|
| Upstream Invert | 791.00 ft | Downstream Invert | 778.20 ft |
| Length | 130.00 ft | Constructed Slope | 0.098462 ft/ft |

| Hydraulic Profile | | | |
|---|---|---|---|
| Profile | S2 | Depth, Downstream | 1.60 ft |
| Slope Type | Steep | Normal Depth | 1.32 ft |
| Flow Regime | Supercritical | Critical Depth | 4.00 ft |
| Velocity Downstream | 28.87 ft/s | Critical Slope | 0.007385 ft/ft |

| Section | | | |
|---|---|---|---|
| Section Shape | Box | Mannings Coefficient | 0.013 |
| Section Material | Concrete | Span | 7.00 ft |
| Section Size | 7 x 4 ft | Rise | 4.00 ft |
| Number Sections | 1 | | |

| Outlet Control Properties | | | |
|---|---|---|---|
| Outlet Control HW Elev | 798.10 ft | Upstream Velocity Head | 2.07 ft |
| Ke | 0.50 | Entrance Loss | 1.03 ft |

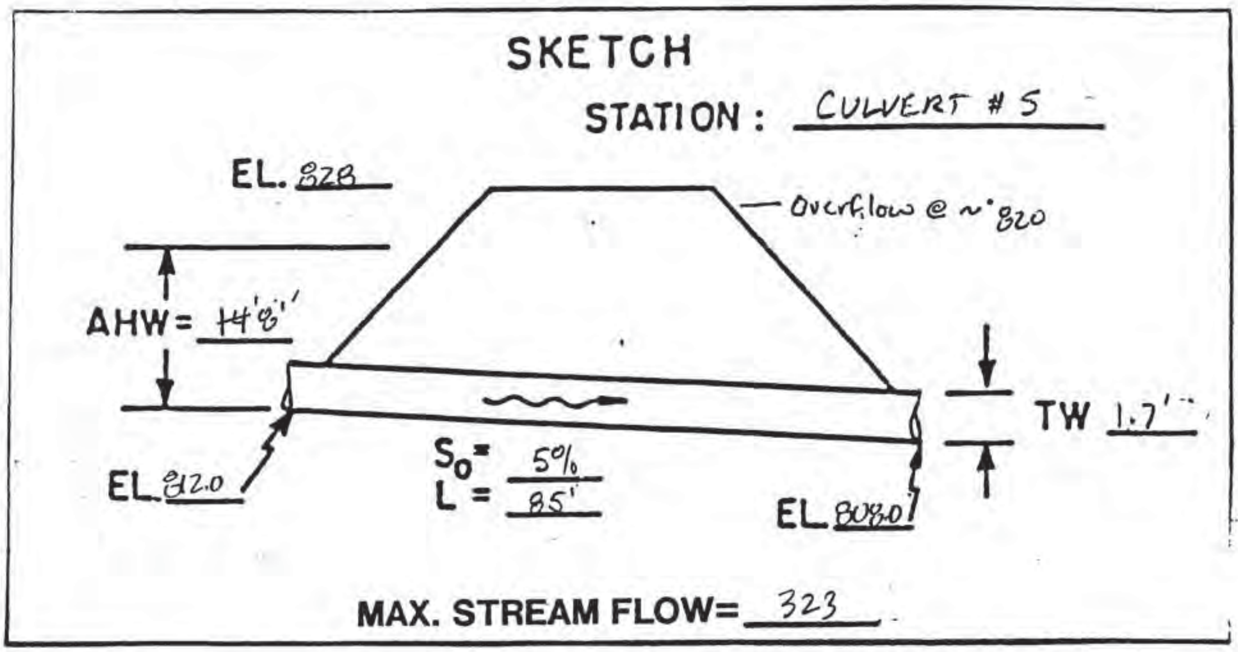
| Inlet Control Properties | | | |
|---|---|---|---|
| Inlet Control HW Elev | 797.44 ft | Flow Control | Submerged |
| Inlet Type | 18 to 33.7 ° wingwall flare, d=0.0830 | Area Full | 28.0 ft² |
| K | 0.48600 | HDS 5 Chart | 9 |
| M | 0.66700 | HDS 5 Scale | 2 |
| C | 0.02490 | Equation Form | 2 |
| Y | 0.83000 | | |

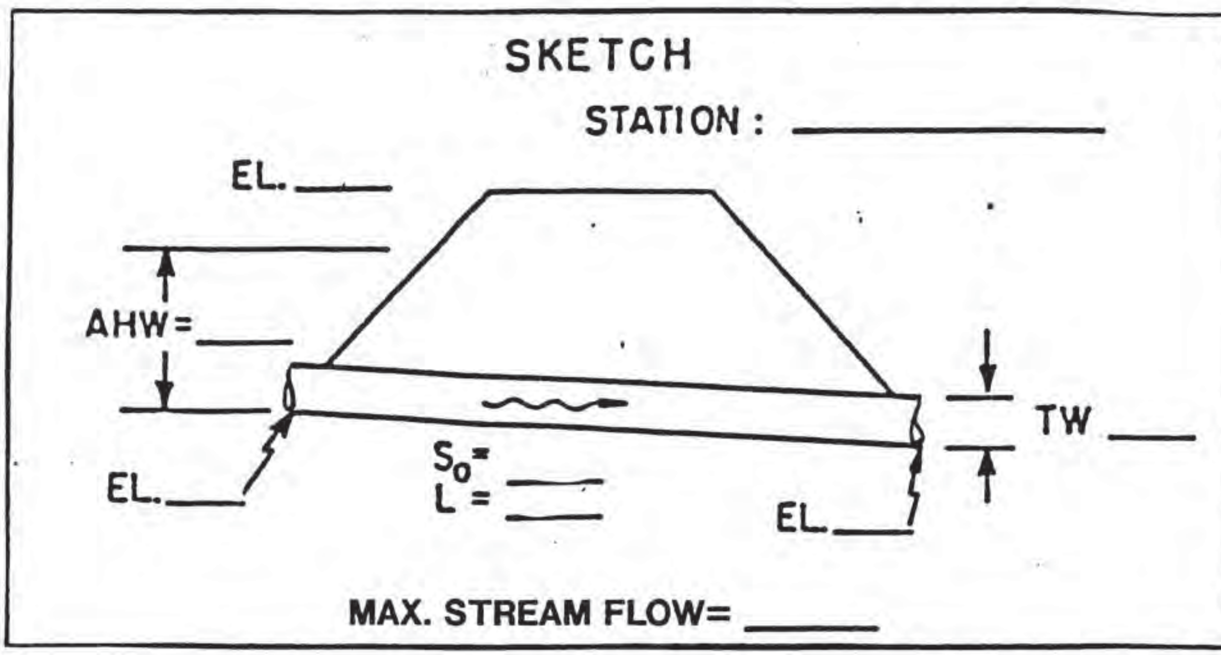
# COMPUTATION SHEET

RMT INC.
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

SHEET ____ OF ____

| PROJECT / PROPOSAL NAME | PREPARED | | CHECKED | | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| OPC POO | By: BJR | Date: 9/01 | By: | Date: | 3091.40 |



PROJECT: DPC POO

DESIGNER: BJK

DATE: 9/2000

HYDROLOGIC AND CHANNEL INFORMATION

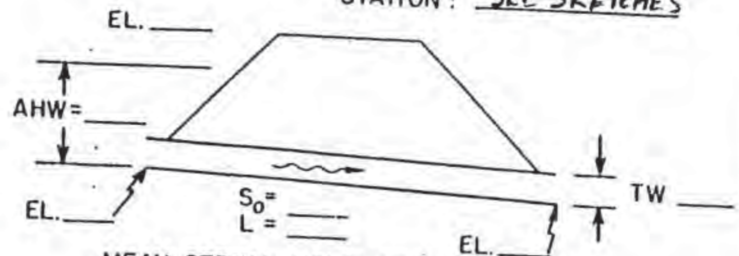
$Q_1$ = SEE SKETCHES  $TW_1$ = ____

$Q_2$ = ____  $TW_2$ = ____

( $Q_1$ = DESIGN DISCHARGE, SAY $Q_{25}$
$Q_2$ = CHECK DISCHARGE, SAY $Q_{50}$ OR $Q_{100}$ )

SKETCH

STATION: SEE SKETCHES




MEAN STREAM VELOCITY = ____

MAX. STREAM VELOCITY = ____

| CULVERT DESCRIPTION (ENTRANCE TYPE) | Q | SIZE | HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$ | INLET CONT. HW | OUTLET CONTROL $HW=H+h_o-LS_o$: $K_e$ | H | $d_c$ | $\frac{d_c+D}{2}$ | TW | $h_o$ | $LS_o$ | HW | CONTROLLING HW | OUTLET VELOCITY | COST | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CULVERT #1 CMP | 162 EA | 2-60" | 1.2 | 6' | | | | | | | | | | | | Not Rec. |
| CULVERT #1 BOX CULVERT | 323 46/ft | 7'x 4' | ~~1.45~~ 1.95 | ~~5.8~~ 7.8 | 0.4 | 3.8' | 4.0' | 4.0' | 1.7' | 4.0 | 6.5' | 1.3 | ~~5.8~~ 7.8 | | | Recommended |
| CULVERT #2 BOX CULVERT | 323 46/ft | 7'x 4' | ~~1.45~~ 1.95 | ~~5.8'~~ 7.8 | 0.4 | 3.8 | 4.0' | 4.0' | 1.7 | 4.0 | 10' | — | ~~5.8'~~ 7.8 | | | Recommended |
| CULVERT #3 CMP | 15 | 24" | 1.15 | 2.3' | 0.5 | 2.8' | 1.4 | 1.7 | 7.3' | 7.3' | 6' | 4.1 | | | | Not Rec. |
| CULVERT #3 CMP | 15 | 30" | 0.77 | 1.9 | 0.5 | 0.8 | 1.3 | 1.9 | 7.3' | 7.3' | 6' | 2.1 | | | | Recommended |

SUMMARY & RECOMMENDATIONS:

ACTUAL LENGTHS OF CULVERTS #1 & 2 = 96' and 126' RESPECTIVELY
BASED ON 6' CULVERT SECTION LENGTHS

Figure 7

PROJECT: DPC - POO

DESIGNER: BJK

DATE: 9/2000

## HYDROLOGIC AND CHANNEL INFORMATION

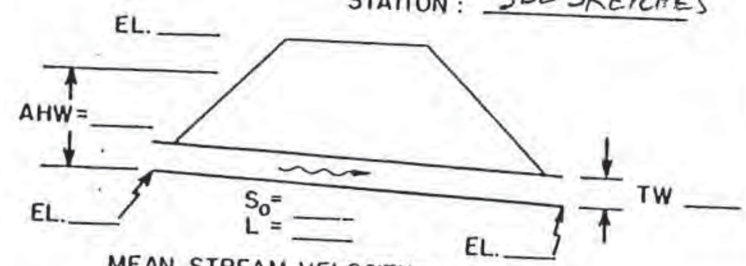
$Q_1$ = SEE SKETCHES  $TW_1$ = ______

$Q_2$ = ______  $TW_2$ = ______

( $Q_1$ = DESIGN DISCHARGE, SAY $Q_{25}$
$Q_2$ = CHECK DISCHARGE, SAY $Q_{50}$ OR $Q_{100}$ )

## SKETCH

STATION : SEE SKETCHES




MEAN STREAM VELOCITY = ______
MAX. STREAM VELOCITY = ______

| CULVERT DESCRIPTION (ENTRANCE TYPE) | Q | SIZE | HEADWATER COMPUTATION: INLET CONT. HW/D | INLET CONT. HW | OUTLET CONTROL $HW=H+h_o-LS_o$: $K_e$ | H | $d_c$ | $\frac{d_c+D}{2}$ | TW | $h_o$ | $LS_o$ | HW | CONTROLLING HW | OUTLET VELOCITY | COST | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CULVERT #4 CMP | 15 | 30" | 0.77 | 1.9' | 0.5 | 0.7 | 1.3 | 1.9 | 1.0 | 1.9 | 7' | — | 1.9' | | | Recommended |
| CULVERT #5 BOX CULVERT | 323 46/FI | 7'x 4' | ~~1.45~~ 1.95 | ~~5.8~~ 7.8 | 0.4 | 3.8 | 4.0 | 4.0 | 1.7 | 4.0 | 4' | 3.8 | ~~5.8~~ 7.8 | | | Recommended |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

SUMMARY & RECOMMENDATIONS:

Figure 7

## TABLE 1 - ENTRANCE LOSS COEFFICIENTS

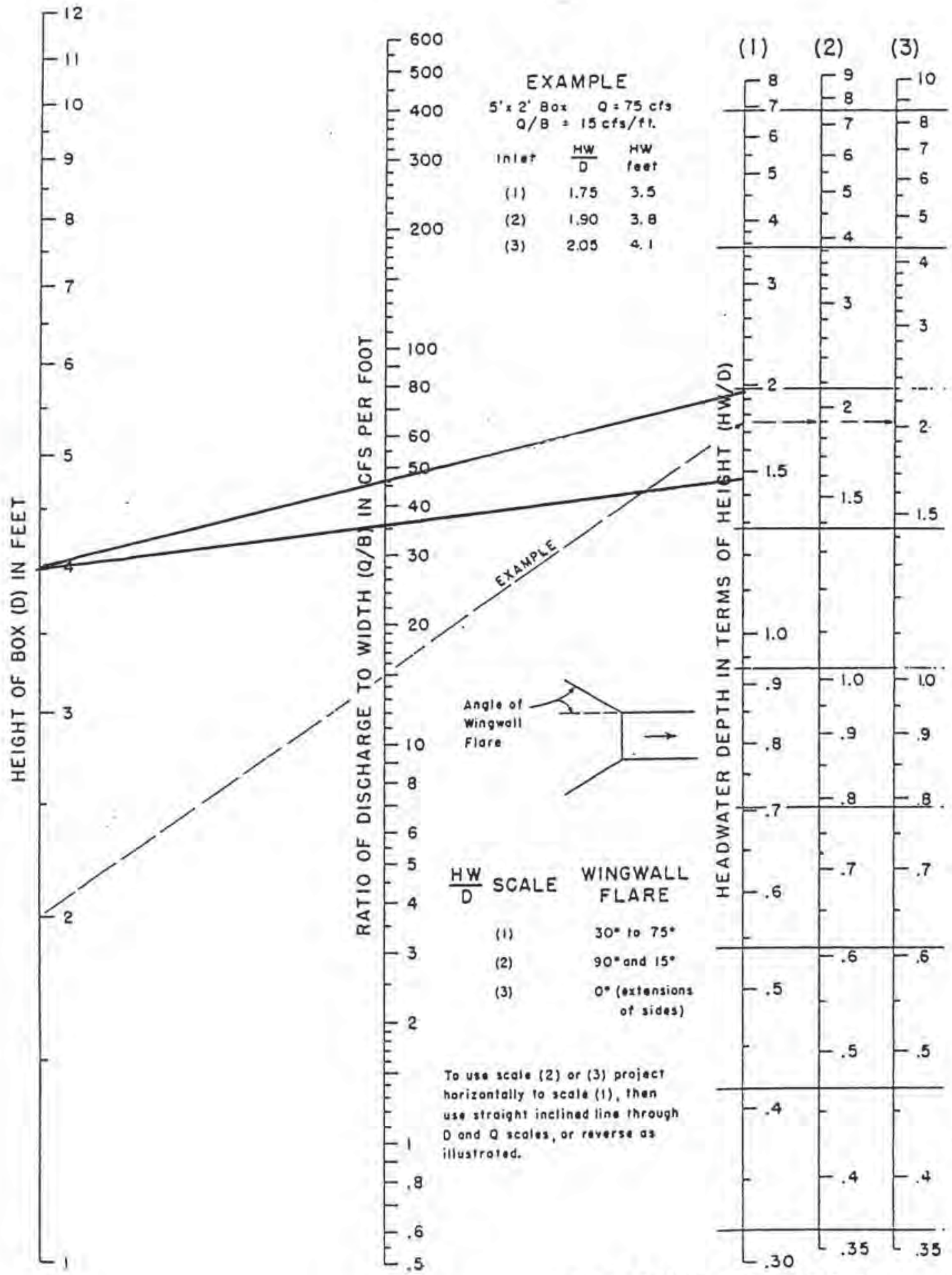
Outlet Control, Full or Partly Full

Entrance head loss $H_e = k_e \frac{V^2}{2g}$

| Type of Structure and Design of Entrance | Coefficient $k_e$ |
|---|---|
| **Pipe, Concrete** | |
| Projecting from fill, socket end (groove-end) . . . . | 0.2 |
| Projecting from fill, sq. cut end . . . . . . . . . | 0.5 |
| Headwall or headwall and wingwalls | |
| Socket end of pipe (groove-end) . . . . . . . . | 0.2 |
| Square-edge . . . . . . . . . . . . . . . . . | 0.5 |
| Rounded (radius = 1/12D) . . . . . . . . . . . . | 0.2 |
| Mitered to conform to fill slope . . . . . . . . . . | 0.7 |
| *End-Section conforming to fill slope . . . . . . . | 0.5 |
| Beveled edges, 33.7° or 45° bevels . . . . . . . . . | 0.2 |
| Side-or slope-tapered inlet . . . . . . . . . . . . . | 0.2 |
| **Pipe, or Pipe-Arch, Corrugated Metal** | |
| Projecting from fill (no headwall) . . . . . . . . . | 0.9 |
| Headwall or headwall and wingwalls square-edge . . | 0.5 |
| Mitered to conform to fill slope, paved or unpaved slope . . . . . . . . . . . . . . . . . . . . . . . | 0.7 |
| *End-Section conforming to fill slope . . . . . . . | 0.5 ← CULVERTS 3,4 |
| Beveled edges, 33.7° or 45° bevels . . . . . . . . . | 0.2 |
| Side-or slope-tapered inlet . . . . . . . . . . . . . | 0.2 |
| **Box, Reinforced Concrete** | |
| Headwall parallel to embankment (no wingwalls) | |
| Square-edged on 3 edges . . . . . . . . . . . . | 0.5 |
| Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides . . . . | 0.2 |
| Wingwalls at 30° to 75° to barrel | |
| Square-edged at crown . . . . . . . . . . . . . | 0.4 ← CULVERTS 1,2 |
| Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge . . . . . . . . | 0.2 |
| Wingwall at 10° to 25° to barrel | |
| Square-edged at crown . . . . . . . . . . . . . | 0.5 |
| Wingwalls parallel (extension of sides) | |
| Square-edged at crown . . . . . . . . . . . . . | 0.7 |
| Side-or slope-tapered inlet . . . . . . . . . . . . . | 0.2 |

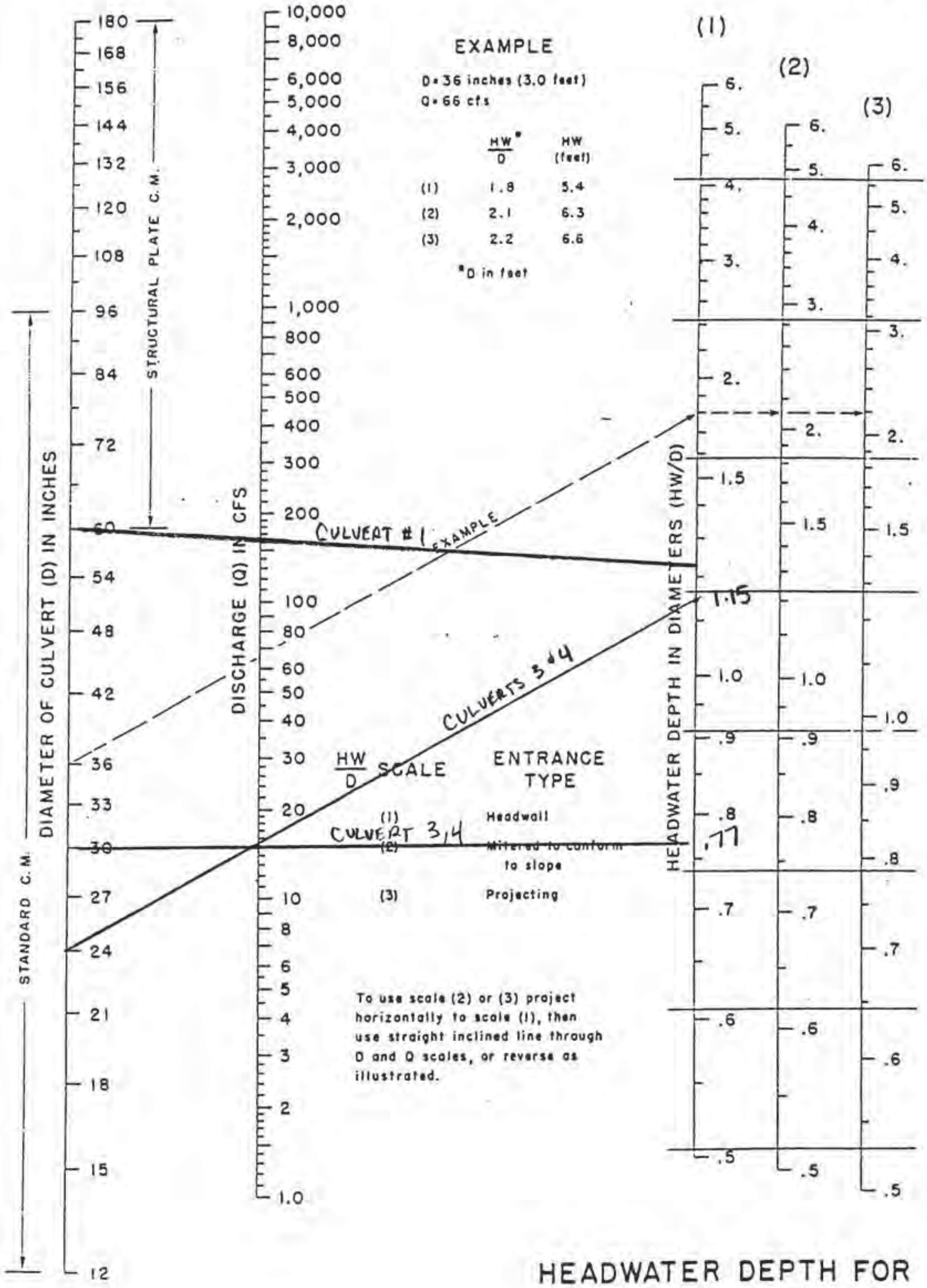
*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be designed using the information given for the beveled inlet, p. 5-13.

## CHART I



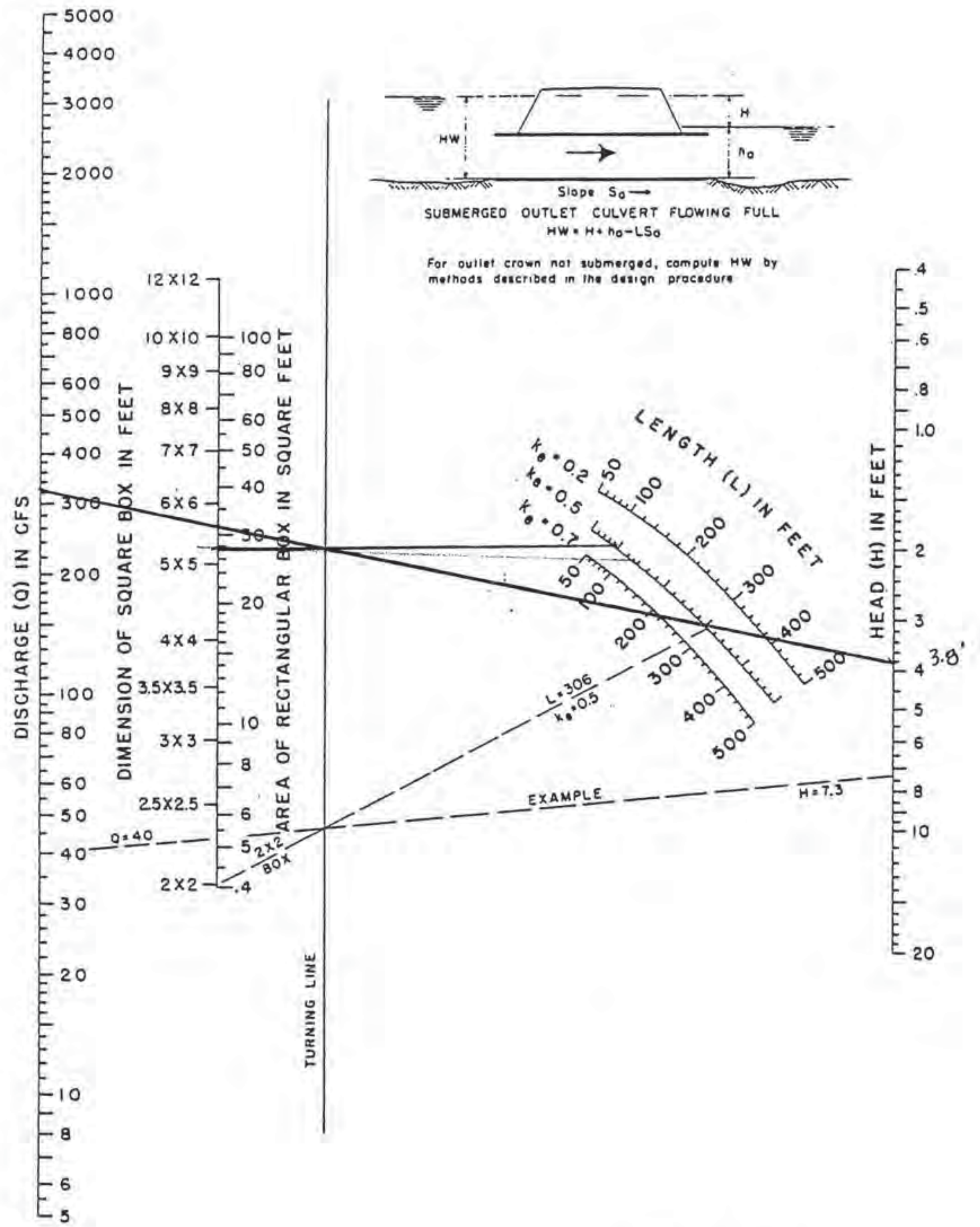

HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

CHART 5



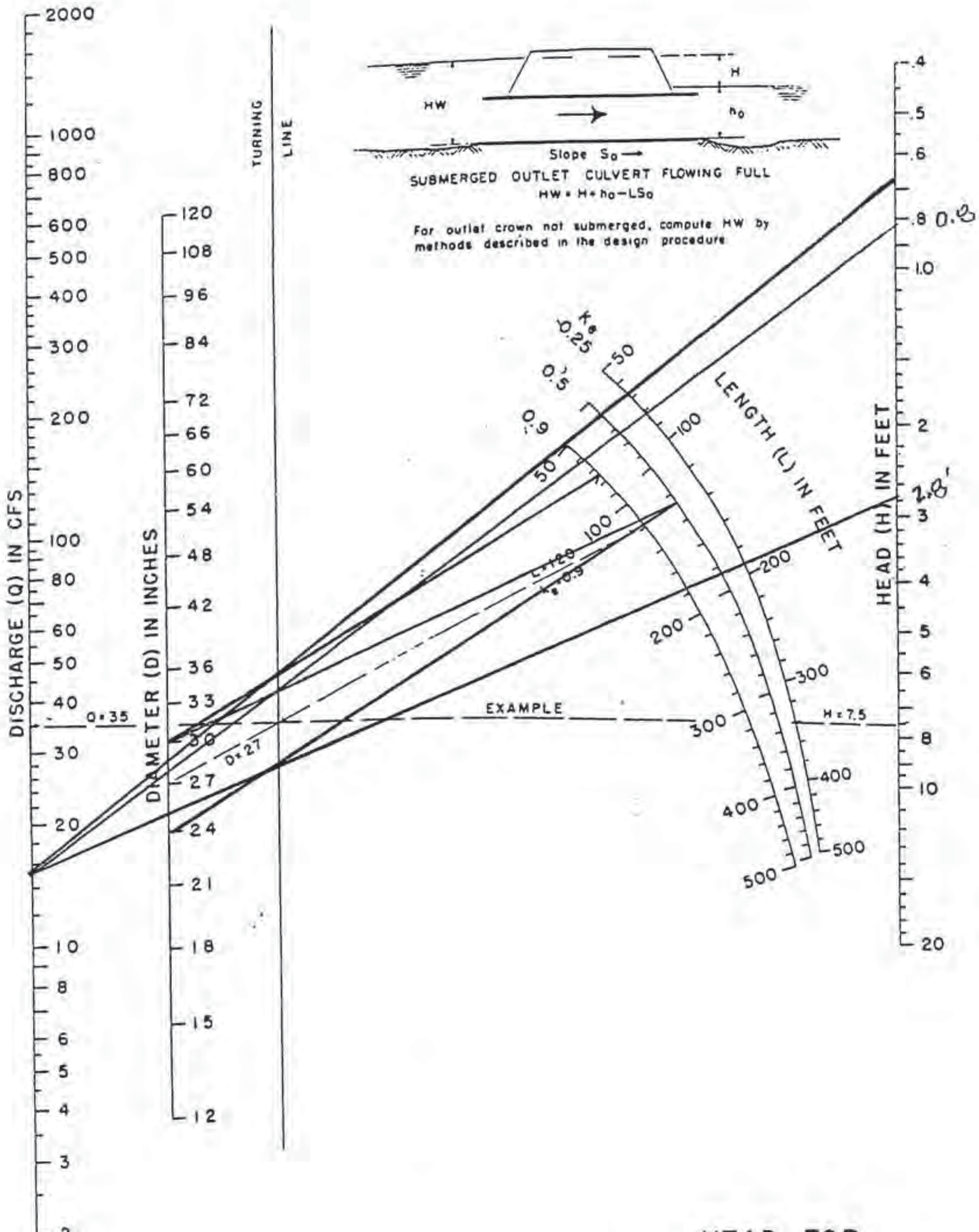

HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

CHART 8

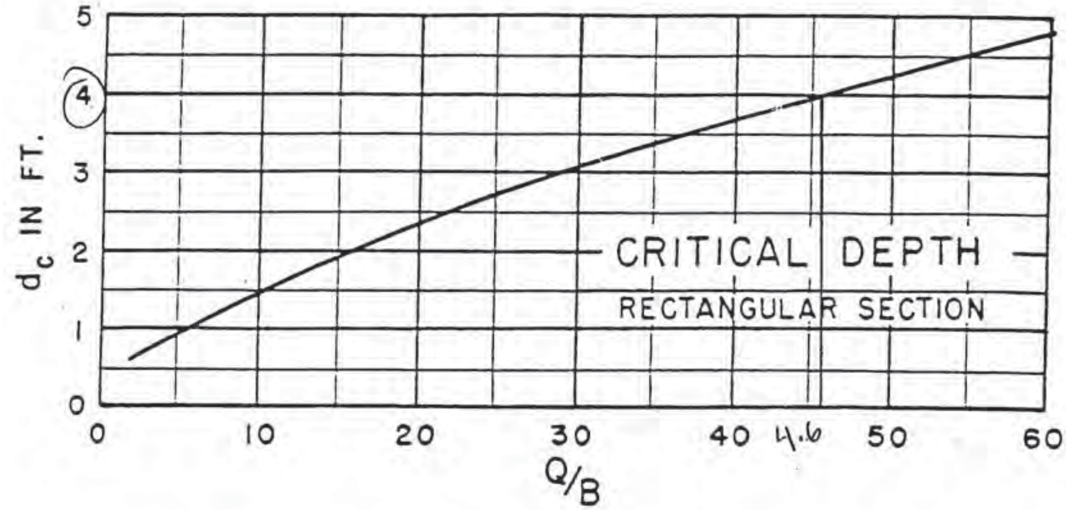


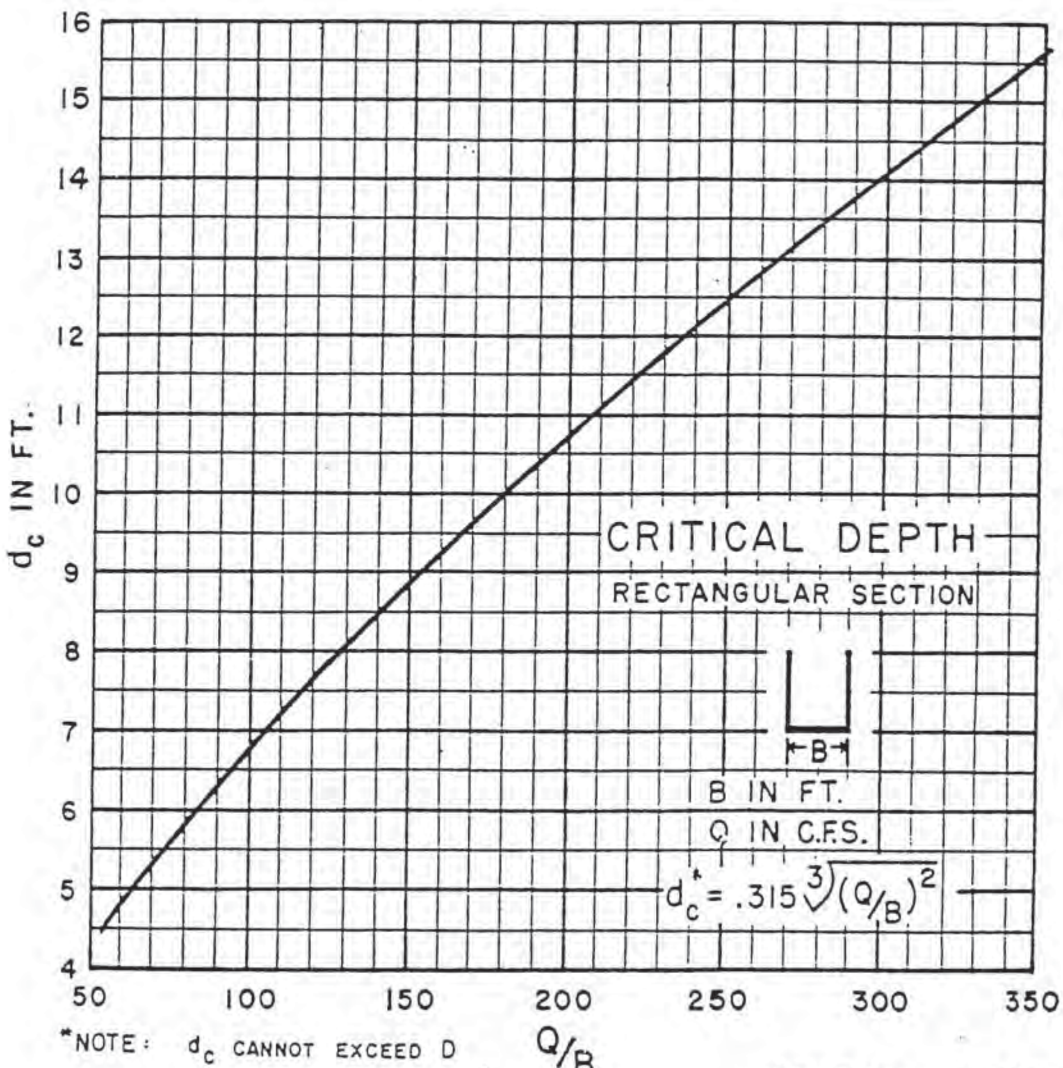

HEAD FOR
CONCRETE BOX CULVERTS
FLOWING FULL
n = 0.012

CHART 11




HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

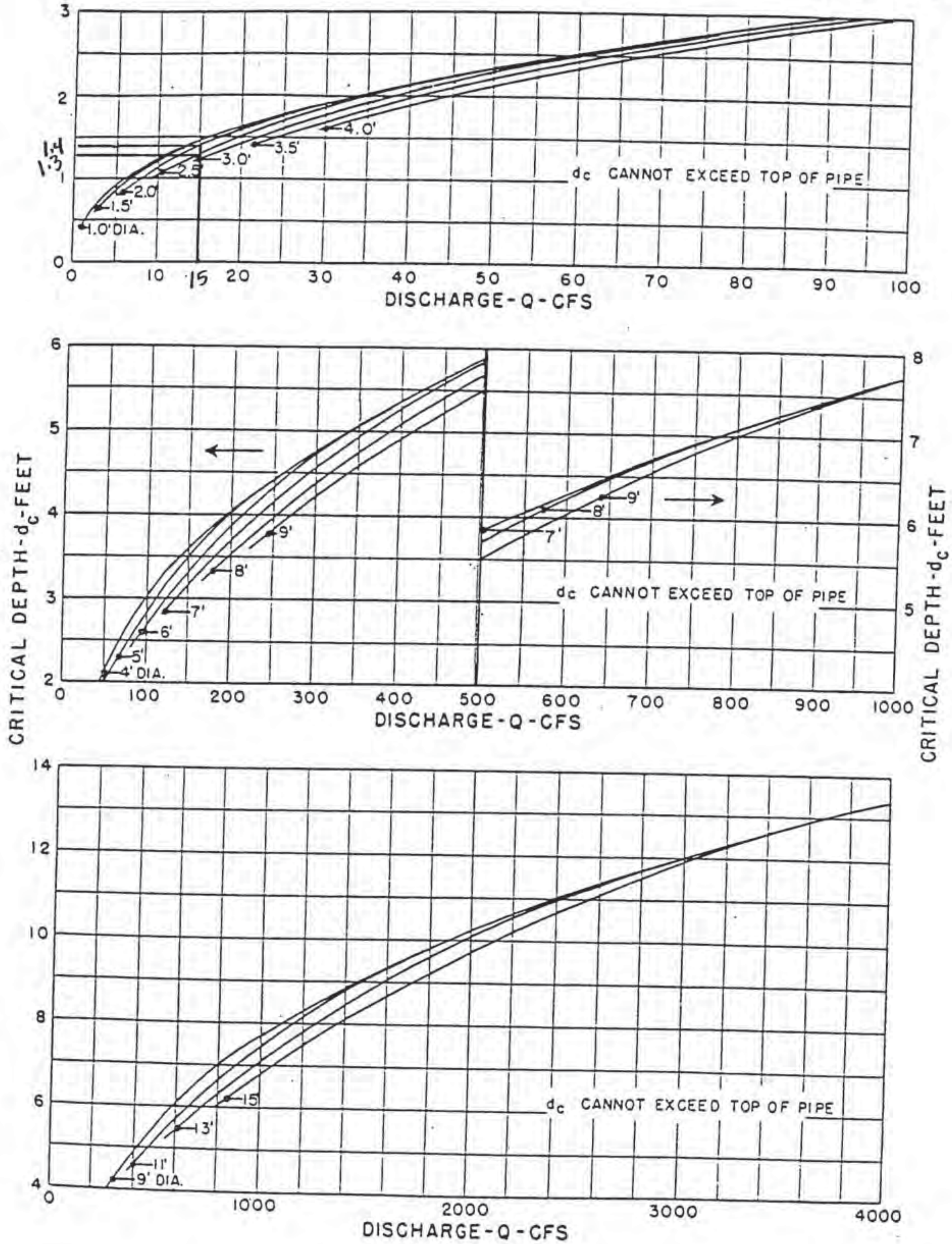



*NOTE: $d_c$ CANNOT EXCEED D

CRITICAL DEPTH
RECTANGULAR SECTION

CHART 16




CRITICAL DEPTH
CIRCULAR PIPE

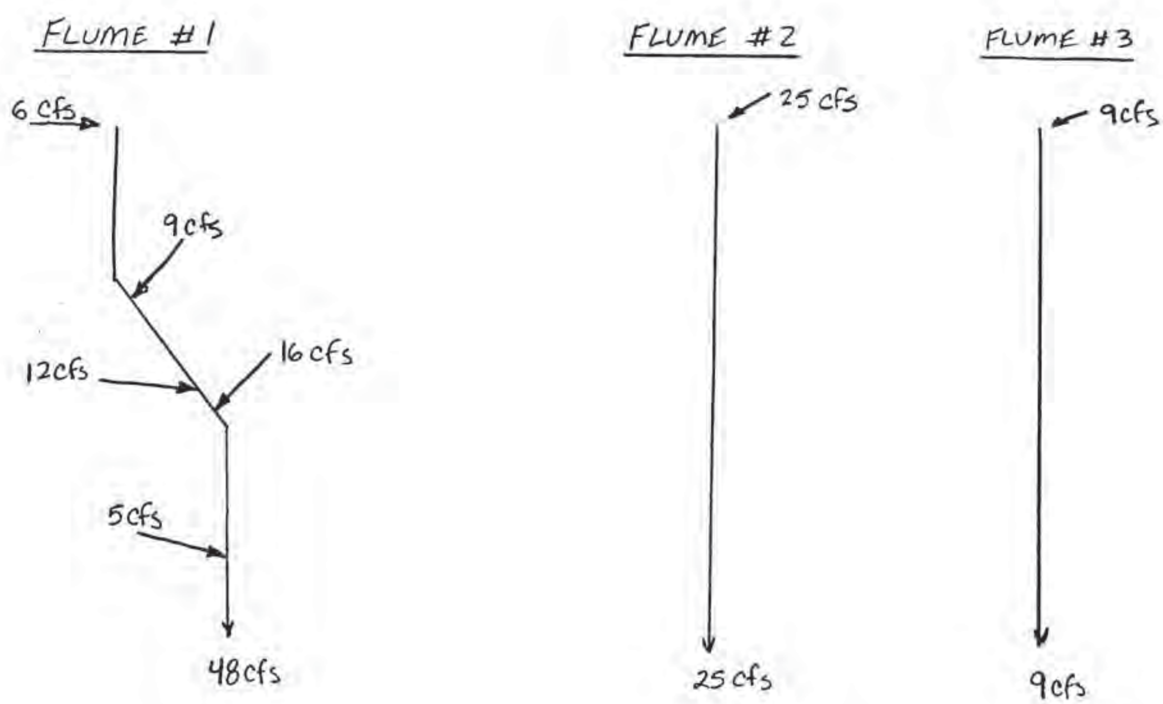
RMT
744 Heartland Trail
Madison, WI 53717-1934
Tel. (608) 831-4444 • Fax (608) 831-3334

SHEET_____ OF _____

| | | |
|---|---|---|
| PROJECT / PROPOSAL NAME / LOCATION: DAIRYLAND POWER - POO | | PROJECT / PROPOSAL NO. 3081.40 |
| SUBJECT: FLUME SIZING | | |
| PREPARED BY: B.J.K | DATE: 9/00 | FINAL ☐ |
| CHECKED BY: | DATE: | REVISION ☐ |

## DOWNSLOPE FLUME SIZING

1. SIZE INLET PIPES



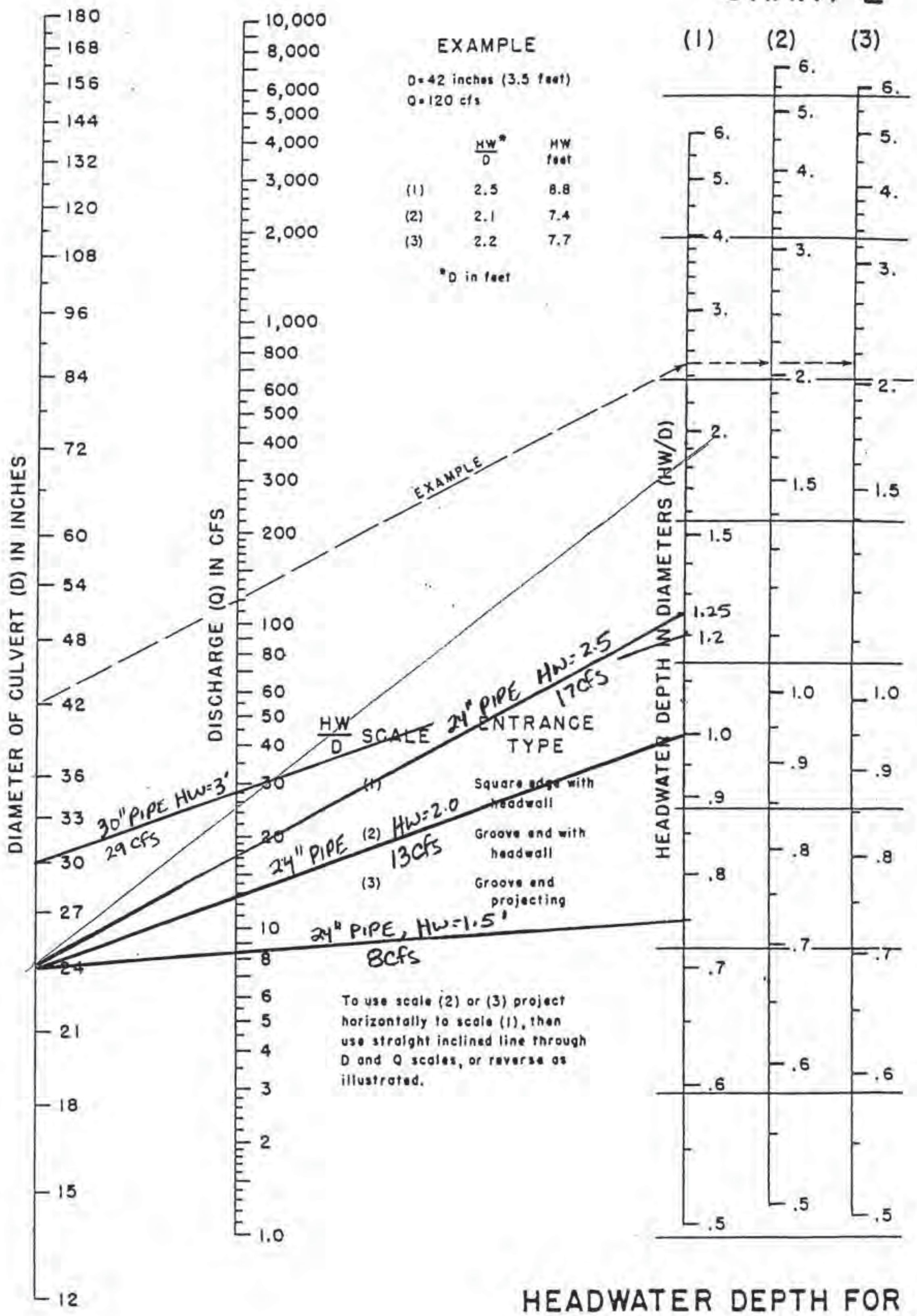

NOTE: PEAK FLOWS OBTAINED FROM RUNOFF CALCULATIONS
PEAK FLOWS ADDED TO OBTAIN TOTALS (CONSERVATIVE)

ESTABLISH INLET PIPE SIZES AND BERM HEIGHTS USING INLET CONTROL NOMOGRAPHS:

| FLOW RANGE | INLET PIPE SIZE | HW | REQ'D BERM HEIGHT |
|---|---|---|---|
| 0-8 cfs | 24" | 1.5' | 2.5' |
| 9-13 cfs | 24" | 2.0' | 2.5' |
| 14-17 cfs | 24" | 2.5' | 3.0' |
| 18-29 cfs | 30" | 3.0' | 3.5' |

FORM 383A

# CHART 2




HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

RMT
744 Heartland Trail
Madison, WI 53717-1934
Tel. (608) 831-4444 • Fax (608) 831-3334



| PROJECT / PROPOSAL NAME / LOCATION: DAIRYLAND POWER - POO | | PROJECT / PROPOSAL NO. |
|---|---|---|
| SUBJECT: FLUME SIZING | | 308140 |
| PREPARED BY: BJK | DATE: 9/00 | FINAL ☐ |
| CHECKED BY: | DATE: | REVISION ☐ |

CHECK STRAIGHT PIPE FLUME SIZING

WORST-CASE FLOW - FLUME #1

SLOPE = 20% (AT RIDGE)
PIPE DIA = 1.5'
MAX FLOW = 48 cfs

FULL PIPE FLOW:

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

$n$ = 0.010 for HDPE PIPE
$R = D/4 = 1.5/4 = 0.375$
$S = 0.20$ ft/ft
$A = \pi D^2/4 = \pi (1.5)^2/4 = 1.77 \text{ ft}^2$

$$Q_{FULL} = \frac{1.49}{0.01} (0.375)^{2/3} (0.20)^{1/2} (1.77)$$

$= 61$ cfs $> 48$ cfs ok ✓

A WATER RESOURCES TECHNICAL PUBLICATION

Engineering Monograph No. 25

# Hydraulic Design of Stilling Basins and Energy Dissipators

By A. J. PETERKA

Denver, Colorado

United States Department of the Interior

BUREAU OF RECLAMATION

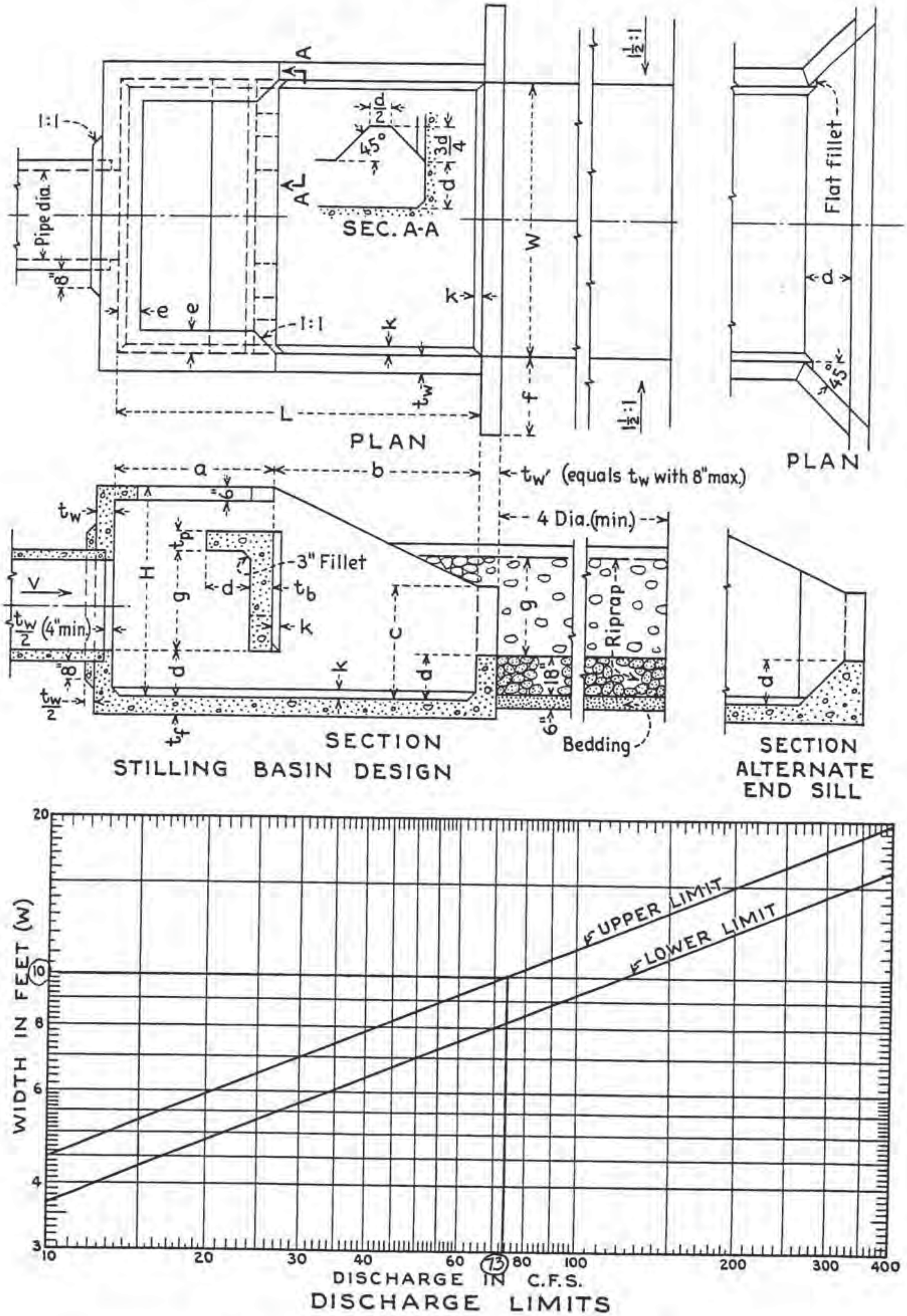



FIGURE 42.—*Impact-type energy dissipator (Basin VI).*

TABLE 11.—*Stilling basin dimensions (Basin VI). Impact-type energy dissipator.*

| Suggested pipe size [1] | | Max discharge Q | Feet and inches | | | | | | | | | | Inches | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dia in. (1) | Area (sq ft) (2) | (3) | W (4) | H (5) | L (6) | a (7) | b (8) | c (9) | d (10) | e (11) | f (12) | g (13) | $t_w$ (14) | $t_f$ (15) | $t_b$ (16) | $t_p$ (17) | K (18) | Suggested riprap size (19) [3] |
| 18 | 1.77 | [2] 21 | 5-6 | 4-3 | 7-4 | 3-3 | 4-1 | 2-4 | 0-11 | 0-6 | 1-6 | 2-1 | 6 | 6½ | 6 | 6 | 3 | 4.0 |
| 24 | 3.14 | 38 | 6-9 | 5-3 | 9-0 | 3-11 | 5-1 | 2-10 | 1-2 | 0-6 | 2-0 | 2-6 | 6 | 6½ | 6 | 6 | 3 | 7.0 |
| 30 | 4.91 | 59 | 8-0 | 6-3 | 10-8 | 4-7 | 6-1 | 3-4 | 1-4 | 0-8 | 2-6 | 3-0 | 6 | 6½ | 7 | 7 | 3 | 8.5 |
| 73cfs → 36 | 7.07 | 85 | 9-3 | 7-3 | 12-4 | 5-3 | 7-1 | 3-10 | 1-7 | 0-8 | 3-0 | 3-6 | 7 | 7½ | 8 | 8 | 3 | 9.0 |
| 42 | 9.62 | 115 | 10-6 | 8-0 | 14-0 | 6-0 | 8-0 | 4-5 | 1-9 | 0-10 | 3-0 | 3-11 | 8 | 8½ | 9 | 8 | 4 | 9.5 |
| 48 | 12.57 | 151 | 11-9 | 9-0 | 15-8 | 6-9 | 8-11 | 4-11 | 2-0 | 0-10 | 3-0 | 4-5 | 9 | 9½ | 10 | 8 | 4 | 10.5 |
| 54 | 15.90 | 191 | 13-0 | 9-9 | 17-4 | 7-4 | 10-0 | 5-5 | 2-2 | 1-0 | 3-0 | 4-11 | 10 | 10½ | 10 | 8 | 4 | 12.0 |
| 60 | 19.63 | 236 | 14-3 | 10-9 | 19-0 | 8-0 | 11-0 | 5-11 | 2-5 | 1-0 | 3-0 | 5-4 | 11 | 11½ | 11 | 8 | 6 | 13.0 |
| 72 | 28.27 | 339 | 16-6 | 12-3 | 22-0 | 9-3 | 12-9 | 6-11 | 2-9 | 1-3 | 3-0 | 6-2 | 12 | 12½ | 12 | 8 | 6 | 14.0 |

[1] Suggested pipe will run full when velocity is 12 feet per second or half full when velocity is 24 feet per second. Size may be modified for other velocities by Q=AV, but relation between Q and basin dimensions shown must be maintained.

[2] For discharges less than 21 second-feet, obtain basin width from curve of Fig. 42. Other dimensions proportional to W; $H=\frac{3W}{4}$, $L=\frac{4W}{3}$, $d=\frac{W}{6}$, etc.

[3] Determination of riprap size explained in Sec. 10.

**Calculations – Temporary Culverts, Operational Conditions**

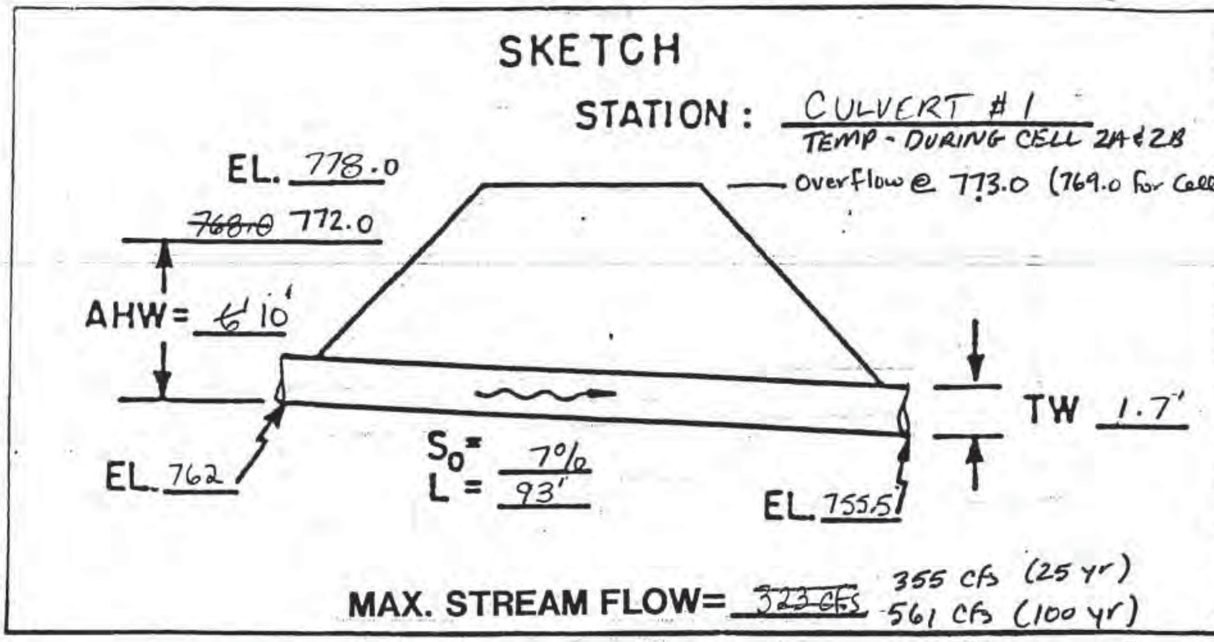
# COMPUTATION SHEET

RMT INC.
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

SHEET ______ OF ______

| PROJECT / PROPOSAL NAME | PREPARED | | CHECKED | | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| DPC - PLAN OF OPERATION | By: BJK | Date: 9/00 | By: | Date: | 3081.40 |

REV BJK 7/03




Flows for Areas North + West - See Pages 92 & 96 From POO Apx K

# Culvert Calculator Report
# Culvert 1 - Operational (25-Year)

Solve For: Headwater Elevation

| Culvert Summary | | | |
|---|---|---|---|
| Allowable HW Elevation | 773.00 ft | Headwater Depth/ Height | 1.94 |
| Computed Headwater Elevation | 769.75 ft | Discharge | 355.00 cfs |
| Inlet Control HW Elev | 769.18 ft | Tailwater Elevation | 757.20 ft |
| Outlet Control HW Elev | 769.75 ft | Control Type | Entrance Control |

| Grades | | | |
|---|---|---|---|
| Upstream Invert | 762.00 ft | Downstream Invert | 755.50 ft |
| Length | 93.00 ft | Constructed Slope | 0.069892 ft/ft |

| Hydraulic Profile | | | |
|---|---|---|---|
| Profile | S2 | Depth, Downstream | 2.10 ft |
| Slope Type | Steep | Normal Depth | 1.58 ft |
| Flow Regime | Supercritical | Critical Depth | 4.00 ft |
| Velocity Downstream | 24.17 ft/s | Critical Slope | 0.008921 ft/ft |

| Section | | | |
|---|---|---|---|
| Section Shape | Box | Mannings Coefficient | 0.013 |
| Section Material | Concrete | Span | 7.00 ft |
| Section Size | 7 x 4 ft | Rise | 4.00 ft |
| Number Sections | 1 | | |

| Outlet Control Properties | | | |
|---|---|---|---|
| Outlet Control HW Elev | 769.75 ft | Upstream Velocity Head | 2.50 ft |
| Ke | 0.50 | Entrance Loss | 1.25 ft |

| Inlet Control Properties | | | |
|---|---|---|---|
| Inlet Control HW Elev | 769.18 ft | Flow Control | Submerged |
| Inlet Type | 18 to 33.7 ° wingwall flare, d=0.0830 | Area Full | 28.0 ft² |
| K | 0.48600 | HDS 5 Chart | 9 |
| M | 0.66700 | HDS 5 Scale | 2 |
| C | 0.02490 | Equation Form | 2 |
| Y | 0.83000 | | |

# Culvert Calculator Report
# Culvert 1 - Operational (100-Year)

Solve For: Headwater Elevation

| Culvert Summary | | | |
|---|---|---|---|
| Allowable HW Elevation | 773.00 ft | Headwater Depth/ Height | 3.34 |
| Computed Headwater Elevation | 775.36 ft | Discharge | 561.00 cfs |
| Inlet Control HW Elev | 775.18 ft | Tailwater Elevation | 757.20 ft |
| Outlet Control HW Elev | 775.36 ft | Control Type | Entrance Control |

| Grades | | | |
|---|---|---|---|
| Upstream Invert | 762.00 ft | Downstream Invert | 755.50 ft |
| Length | 93.00 ft | Constructed Slope | 0.069892 ft/ft |

| Hydraulic Profile | | | |
|---|---|---|---|
| Profile | S2 | Depth, Downstream | 2.93 ft |
| Slope Type | Steep | Normal Depth | 2.18 ft |
| Flow Regime | Supercritical | Critical Depth | 4.00 ft |
| Velocity Downstream | 27.37 ft/s | Critical Slope | 0.022277 ft/ft |

| Section | | | |
|---|---|---|---|
| Section Shape | Box | Mannings Coefficient | 0.013 |
| Section Material | Concrete | Span | 7.00 ft |
| Section Size | 7 x 4 ft | Rise | 4.00 ft |
| Number Sections | 1 | | |

| Outlet Control Properties | | | |
|---|---|---|---|
| Outlet Control HW Elev | 775.36 ft | Upstream Velocity Head | 6.24 ft |
| Ke | 0.50 | Entrance Loss | 3.12 ft |

| Inlet Control Properties | | | |
|---|---|---|---|
| Inlet Control HW Elev | 775.18 ft | Flow Control | Submerged |
| Inlet Type | 18 to 33.7 ° wingwall flare, d=0.0830 | Area Full | 28.0 ft² |
| K | 0.48600 | HDS 5 Chart | 9 |
| M | 0.66700 | HDS 5 Scale | 2 |
| C | 0.02490 | Equation Form | 2 |
| Y | 0.83000 | | |

# COMPUTATION SHEET

RMT INC.

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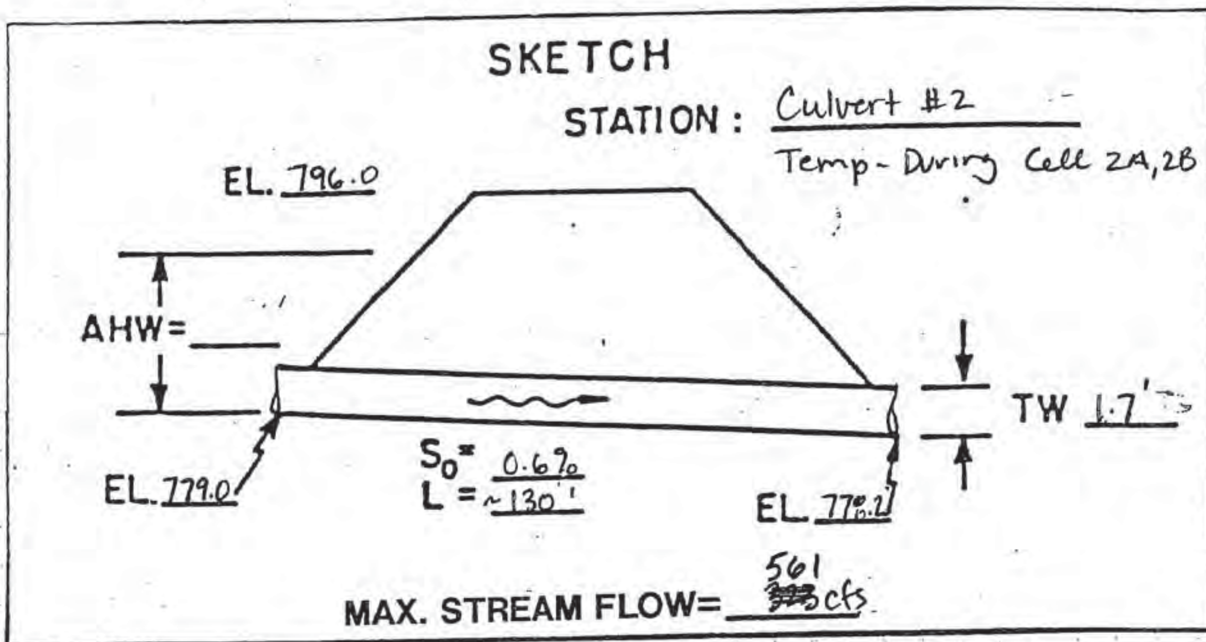
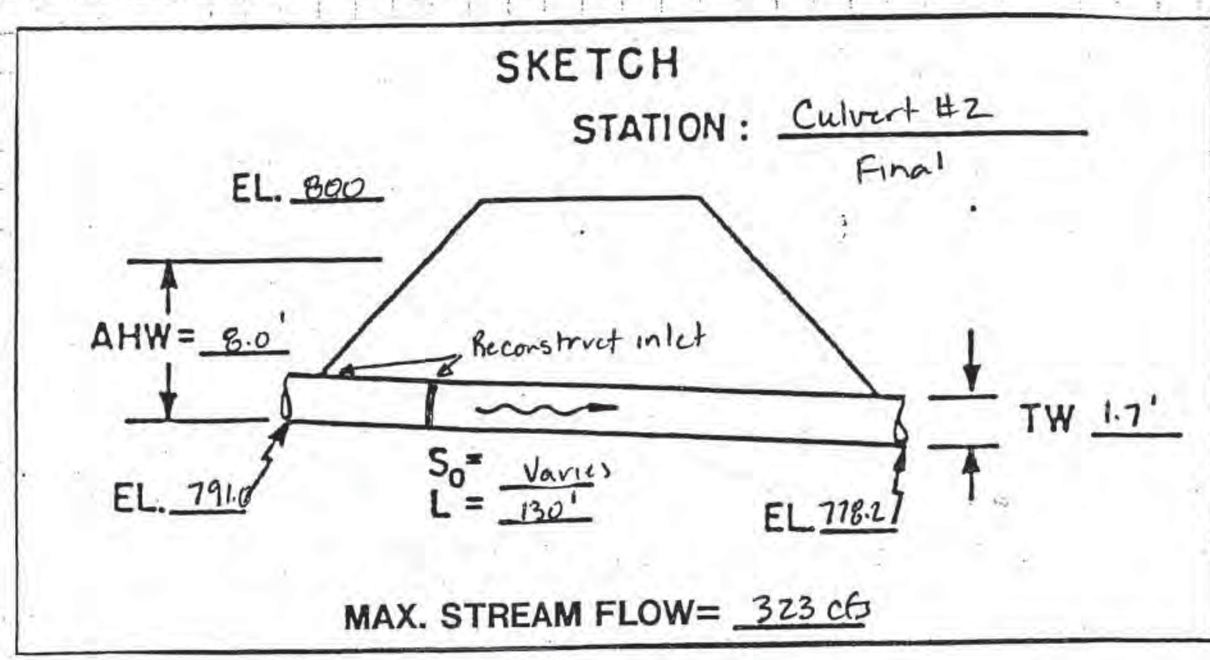
| PROJECT / PROPOSAL NAME | PREPARED | | CHECKED | | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| Dairyland Power - Phase IV | By: BJH | Date: 7/03 | By: | Date: | 3081.56 |



# Culvert Calculator Report
# Culvert 2 - Operational

Solve For: Headwater Elevation

| Culvert Summary | | | |
|---|---|---|---|
| Allowable HW Elevation | 796.00 ft | Headwater Depth/ Height | 3.86 |
| Computed Headwater Elevation | 794.45 ft | Discharge | 561.00 cfs |
| Inlet Control HW Elev | 792.30 ft | Tailwater Elevation | 779.90 ft |
| Outlet Control HW Elev | 794.45 ft | Control Type | Outlet Control |

| Grades | | | |
|---|---|---|---|
| Upstream Invert | 779.00 ft | Downstream Invert | 778.20 ft |
| Length | 130.00 ft | Constructed Slope | 0.006154 ft/ft |

| Hydraulic Profile | | | |
|---|---|---|---|
| Profile | Pressure | Depth, Downstream | 4.00 ft |
| Slope Type | N/A | Normal Depth | N/A ft |
| Flow Regime | N/A | Critical Depth | 4.00 ft |
| Velocity Downstream | 20.04 ft/s | Critical Slope | 0.022277 ft/ft |

| Section | | | |
|---|---|---|---|
| Section Shape | Box | Mannings Coefficient | 0.013 |
| Section Material | Concrete | Span | 7.00 ft |
| Section Size | 7 x 4 ft | Rise | 4.00 ft |
| Number Sections | 1 | | |

| Outlet Control Properties | | | |
|---|---|---|---|
| Outlet Control HW Elev | 794.45 ft | Upstream Velocity Head | 6.24 ft |
| Ke | 0.50 | Entrance Loss | 3.12 ft |

| Inlet Control Properties | | | |
|---|---|---|---|
| Inlet Control HW Elev | 792.30 ft | Flow Control | Submerged |
| Inlet Type | 18 to 33.7 ° wingwall flare, d=0.0830 | Area Full | 28.0 ft² |
| K | 0.48600 | HDS 5 Chart | 9 |
| M | 0.66700 | HDS 5 Scale | 2 |
| C | 0.02490 | Equation Form | 2 |
| Y | 0.83000 | | |

# Culvert Calculator Report
# Culvert 2 - Final

Solve For: Headwater Elevation

| Culvert Summary | | | |
|---|---|---|---|
| Allowable HW Elevation | 799.00 ft | Headwater Depth/ Height | 1.78 |
| Computed Headwater Elevation | 798.10 ft | Discharge | 323.00 cfs |
| Inlet Control HW Elev | 797.44 ft | Tailwater Elevation | 779.90 ft |
| Outlet Control HW Elev | 798.10 ft | Control Type | Entrance Control |

| Grades | | | |
|---|---|---|---|
| Upstream Invert | 791.00 ft | Downstream Invert | 778.20 ft |
| Length | 130.00 ft | Constructed Slope | 0.098462 ft/ft |

| Hydraulic Profile | | | |
|---|---|---|---|
| Profile | S2 | Depth, Downstream | 1.60 ft |
| Slope Type | Steep | Normal Depth | 1.32 ft |
| Flow Regime | Supercritical | Critical Depth | 4.00 ft |
| Velocity Downstream | 28.87 ft/s | Critical Slope | 0.007385 ft/ft |

| Section | | | |
|---|---|---|---|
| Section Shape | Box | Mannings Coefficient | 0.013 |
| Section Material | Concrete | Span | 7.00 ft |
| Section Size | 7 x 4 ft | Rise | 4.00 ft |
| Number Sections | 1 | | |

| Outlet Control Properties | | | |
|---|---|---|---|
| Outlet Control HW Elev | 798.10 ft | Upstream Velocity Head | 2.07 ft |
| Ke | 0.50 | Entrance Loss | 1.03 ft |

| Inlet Control Properties | | | |
|---|---|---|---|
| Inlet Control HW Elev | 797.44 ft | Flow Control | Submerged |
| Inlet Type | 18 to 33.7 ° wingwall flare, d=0.0830 | Area Full | 28.0 ft² |
| K | 0.48600 | HDS 5 Chart | 9 |
| M | 0.66700 | HDS 5 Scale | 2 |
| C | 0.02490 | Equation Form | 2 |
| Y | 0.83000 | | |

# COMPUTATION SHEET

RMT INC.

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

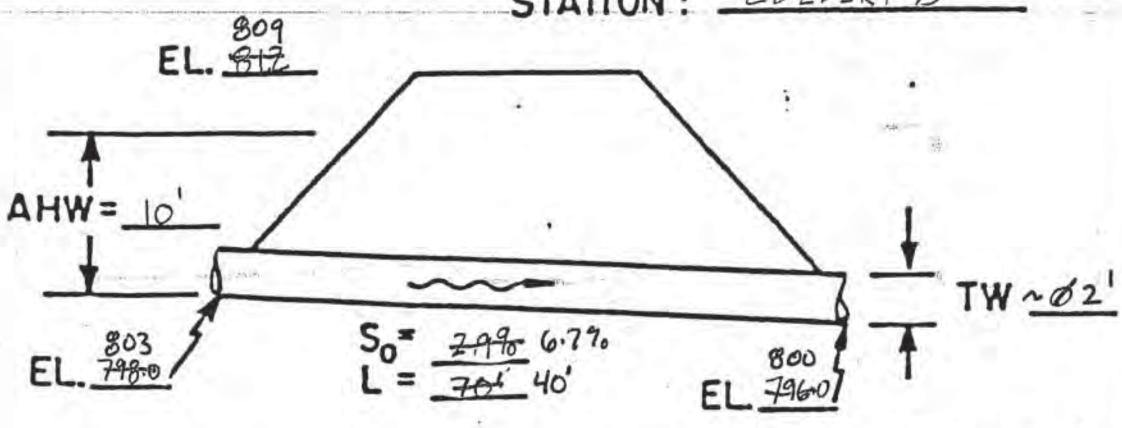
SHEET ______ OF ______

| PROJECT / PROPOSAL NAME | PREPARED By: | Date: | CHECKED By: | Date: | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| DPC-PLAN OF OPERATION | KAA | 9/29/00 | | | 3081.4C |

Rev BSK 8/03

## SKETCH

STATION: CULVERT D




MAX. STREAM FLOW = ~~583 cfs~~ 228 CFS (25-YR) 360 CFS (100-YR)

# Culvert Calculator Report
# Culvert D - 25 Year

Solve For: Headwater Elevation

| Culvert Summary | | | |
|---|---|---|---|
| Allowable HW Elevation | 809.00 ft | Headwater Depth/ Height | 1.40 |
| Computed Headwater Elevation | 808.61 ft | Discharge | 228.00 cfs |
| Inlet Control HW Elev | 807.84 ft | Tailwater Elevation | 802.00 ft |
| Outlet Control HW Elev | 808.61 ft | Control Type | Entrance Control |

| Grades | | | |
|---|---|---|---|
| Upstream Invert | 803.00 ft | Downstream Invert | 800.00 ft |
| Length | 45.00 ft | Constructed Slope | 0.066667 ft/ft |

| Hydraulic Profile | | | |
|---|---|---|---|
| Profile | S2 | Depth, Downstream | 1.74 ft |
| Slope Type | Steep | Normal Depth | 1.19 ft |
| Flow Regime | Supercritical | Critical Depth | 3.21 ft |
| Velocity Downstream | 18.70 ft/s | Critical Slope | 0.003975 ft/ft |

| Section | | | |
|---|---|---|---|
| Section Shape | Box | Mannings Coefficient | 0.013 |
| Section Material | Concrete | Span | 7.00 ft |
| Section Size | 7 x 4 ft | Rise | 4.00 ft |
| Number Sections | 1 | | |

| Outlet Control Properties | | | |
|---|---|---|---|
| Outlet Control HW Elev | 808.61 ft | Upstream Velocity Head | 1.60 ft |
| Ke | 0.50 | Entrance Loss | 0.80 ft |

| Inlet Control Properties | | | |
|---|---|---|---|
| Inlet Control HW Elev | 807.84 ft | Flow Control | Submerged |
| Inlet Type | 18 to 33.7 ° wingwall flare, d=0.0830 | Area Full | 28.0 ft² |
| K | 0.48600 | HDS 5 Chart | 9 |
| M | 0.66700 | HDS 5 Scale | 2 |
| C | 0.02490 | Equation Form | 2 |
| Y | 0.83000 | | |

# Culvert Calculator Report
# Culvert D - 100 Year

Solve For: Headwater Elevation

| Culvert Summary | | | |
|---|---|---|---|
| Allowable HW Elevation | 809.00 ft | Headwater Depth/ Height | 1.96 |
| Computed Headwater Elevation | 810.85 ft | Discharge | 360.00 cfs |
| Inlet Control HW Elev | 810.30 ft | Tailwater Elevation | 802.00 ft |
| Outlet Control HW Elev | 810.85 ft | Control Type | Entrance Control |

| Grades | | | |
|---|---|---|---|
| Upstream Invert | 803.00 ft | Downstream Invert | 800.00 ft |
| Length | 45.00 ft | Constructed Slope | 0.066667 ft/ft |

| Hydraulic Profile | | | |
|---|---|---|---|
| Profile | S2 | Depth, Downstream | 2.52 ft |
| Slope Type | Steep | Normal Depth | 1.63 ft |
| Flow Regime | Supercritical | Critical Depth | 4.00 ft |
| Velocity Downstream | 20.38 ft/s | Critical Slope | 0.009174 ft/ft |

| Section | | | |
|---|---|---|---|
| Section Shape | Box | Mannings Coefficient | 0.013 |
| Section Material | Concrete | Span | 7.00 ft |
| Section Size | 7 x 4 ft | Rise | 4.00 ft |
| Number Sections | 1 | | |

| Outlet Control Properties | | | |
|---|---|---|---|
| Outlet Control HW Elev | 810.85 ft | Upstream Velocity Head | 2.57 ft |
| Ke | 0.50 | Entrance Loss | 1.28 ft |

| Inlet Control Properties | | | |
|---|---|---|---|
| Inlet Control HW Elev | 810.30 ft | Flow Control | Submerged |
| Inlet Type | 18 to 33.7 ° wingwall flare, d=0.0830 | Area Full | 28.0 ft² |
| K | 0.48600 | HDS 5 Chart | 9 |
| M | 0.66700 | HDS 5 Scale | 2 |
| C | 0.02490 | Equation Form | 2 |
| Y | 0.83000 | | |

# Culvert Calculator Report
## Flume MH

Solve For: Headwater Elevation

| Culvert Summary | | | |
|---|---|---|---|
| Allowable HW Elevation | 8.00 ft → 827.5, adjacent pipe inlet | Headwater Depth/ Height | 1.98 |
| Computed Headwater Elevation | 825.18 ft | Discharge | 73.00 cfs |
| Inlet Control HW Elev | 825.18 ft | Tailwater Elevation | 780.67 ft |
| Outlet Control HW Elev | 824.72 ft | Control Type | Inlet Control |

| Grades | | | |
|---|---|---|---|
| Upstream Invert | 819.25 ft | Downstream Invert | 779.00 ft |
| Length | 185.00 ft | Constructed Slope | 0.217568 ft/ft |

| Hydraulic Profile | | | |
|---|---|---|---|
| Profile | S2 | Depth, Downstream | 0.91 ft |
| Slope Type | Steep | Normal Depth | 0.86 ft |
| Flow Regime | Supercritical | Critical Depth | 2.70 ft |
| Velocity Downstream | 40.57 ft/s | Critical Slope | 0.006248 ft/ft |

| Section | | | |
|---|---|---|---|
| Section Shape | Circular | Mannings Coefficient | 0.010 |
| Section Material | PVC | Span | 3.00 ft |
| Section Size | 36 inch | Rise | 3.00 ft |
| Number Sections | 1 | | |

| Outlet Control Properties | | | |
|---|---|---|---|
| Outlet Control HW Elev | 824.72 ft | Upstream Velocity Head | 1.85 ft |
| Ke | 0.50 | Entrance Loss | 0.92 ft |

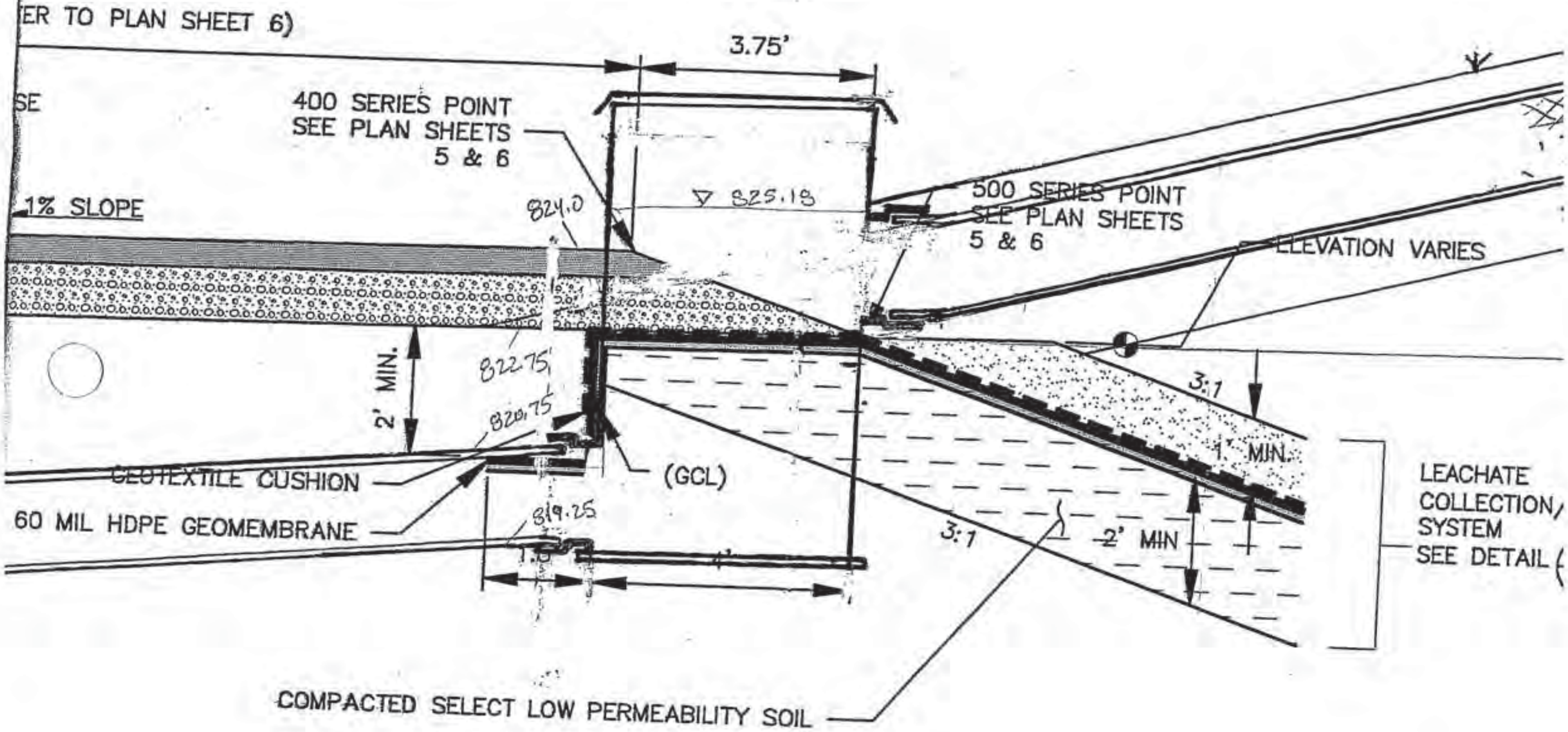
| Inlet Control Properties | | | |
|---|---|---|---|
| Inlet Control HW Elev | 825.18 ft | Flow Control | Submerged |
| Inlet Type | Square edge w/headwall | Area Full | 7.1 ft² |
| K | 0.00980 | HDS 5 Chart | 1 |
| M | 2.00000 | HDS 5 Scale | 1 |
| C | 0.03980 | Equation Form | 1 |
| Y | 0.67000 | | |

SUPPLY
LARRY WOOD
262-255-3030
5/27/03

$65/VF × 7 VF BARREL
PLATE 1"

2,200 - 2,500 (incl. $500 for lid)

d flange
lid add $500

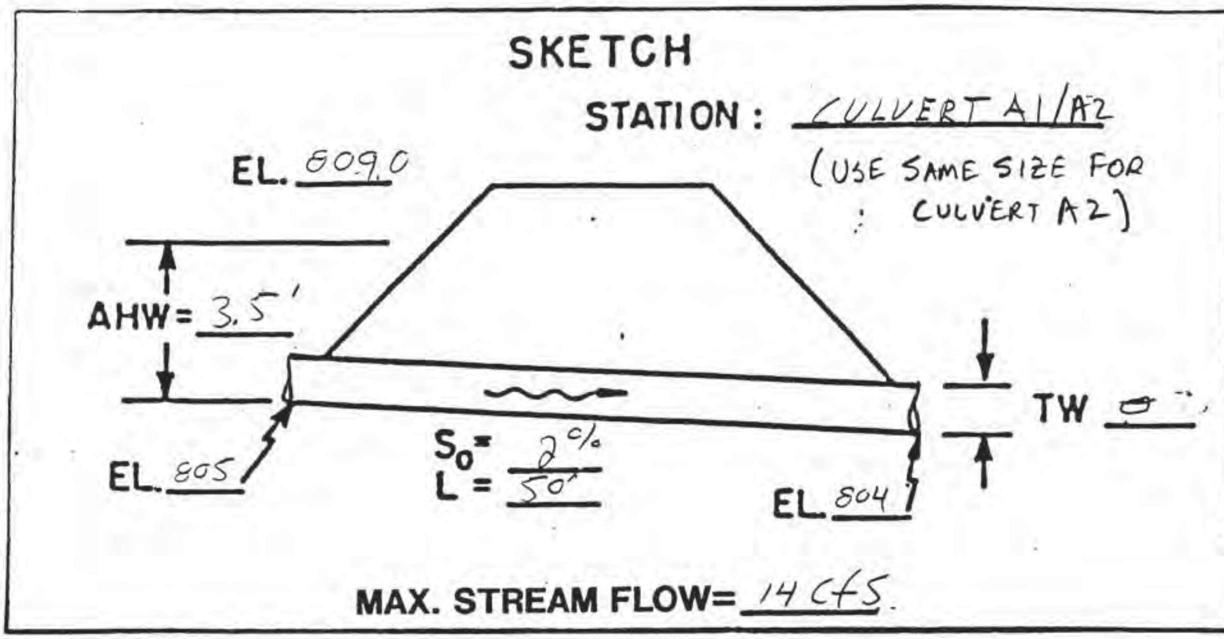


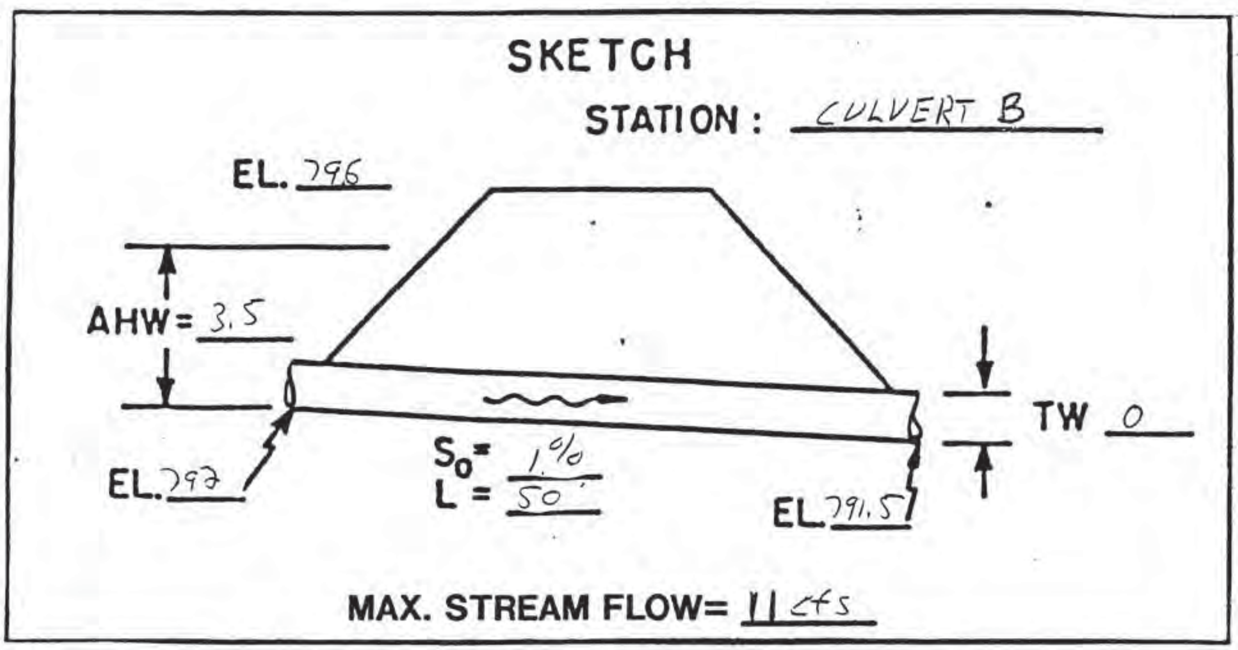
RMT INC.
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

# COMPUTATION SHEET

SHEET ______ OF ______

| PROJECT / PROPOSAL NAME | PREPARED | | CHECKED | | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| DPC - PLAN OF OPERATION | By: SAA | Date: 9/5/96 | By: BJK | Date: | 3CE1.40 |



# COMPUTATION SHEET

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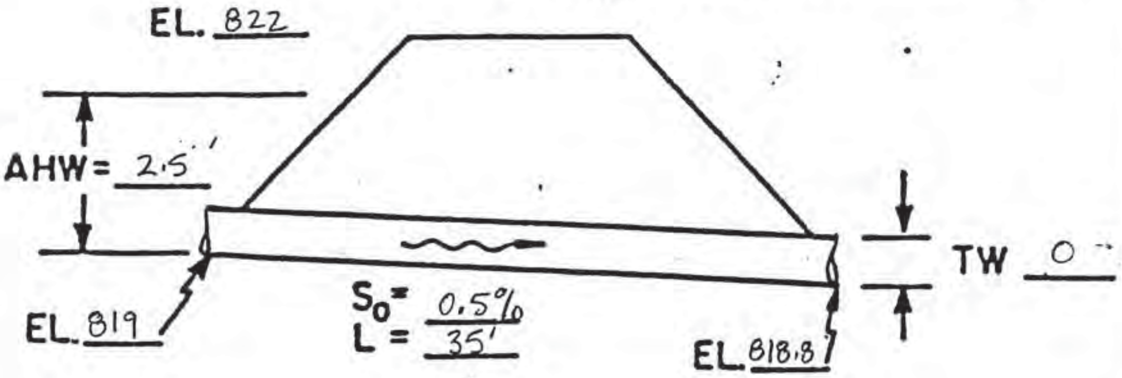
SHEET ______ OF ______

| PROJECT / PROPOSAL NAME | PREPARED By: | Date: | CHECKED By: | Date: | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| DPC- PLAN OF OPERATION | KAA | 9/29/00 | | | 30E1.4C |

## SKETCH

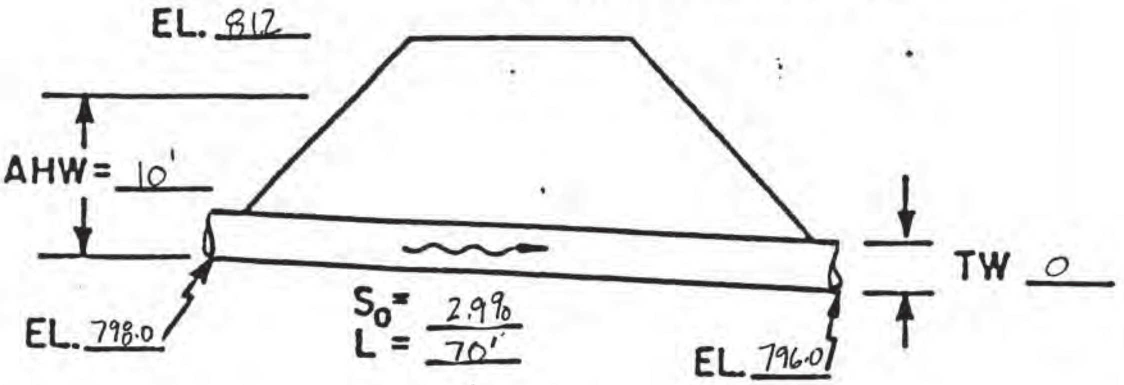
STATION : CULVERT C




MAX. STREAM FLOW= 6 cfs

## SKETCH

STATION : CULVERT D




MAX. STREAM FLOW= 583 cfs

# COMPUTATION SHEET

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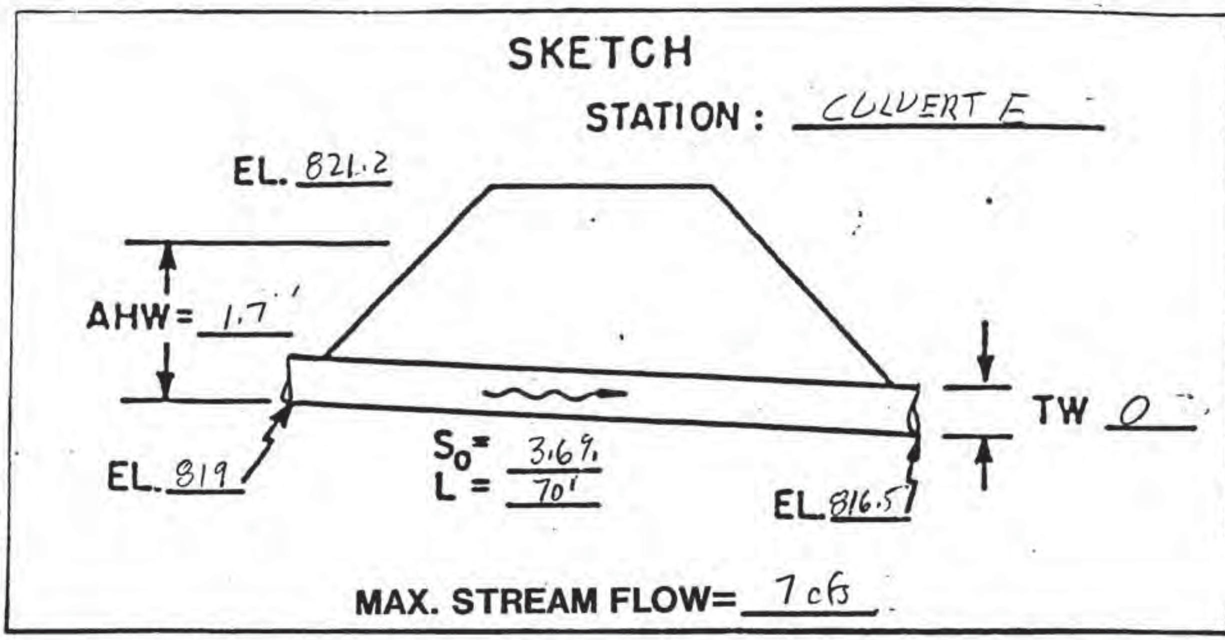
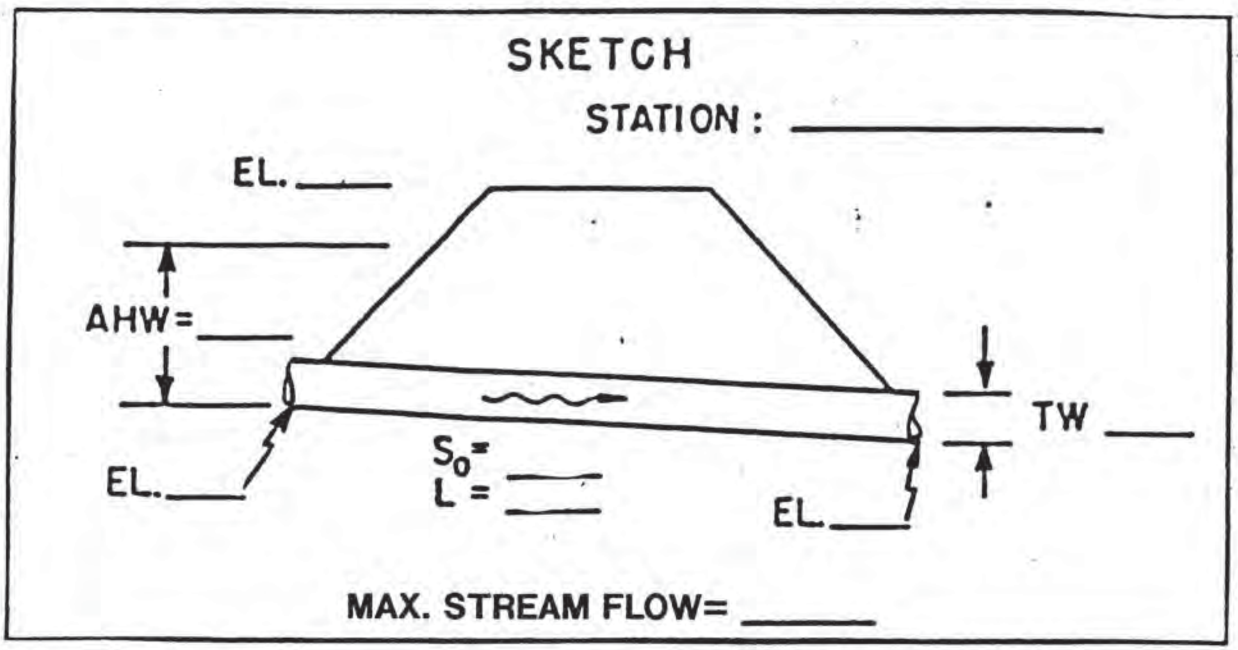
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

SHEET ______ OF ______

| PROJECT / PROPOSAL NAME | PREPARED By: | PREPARED Date: | CHECKED By: | CHECKED Date: | PROJECT/PROPOSAL NO. |
|---|---|---|---|---|---|
| DPC - PLAN OF OPERATION | BAA | 9/29/00 | | | 3C81.4C |



PROJECT: DPC PCO

DESIGNER: BAA

DATE: 9/29/60

## HYDROLOGIC AND CHANNEL INFORMATION

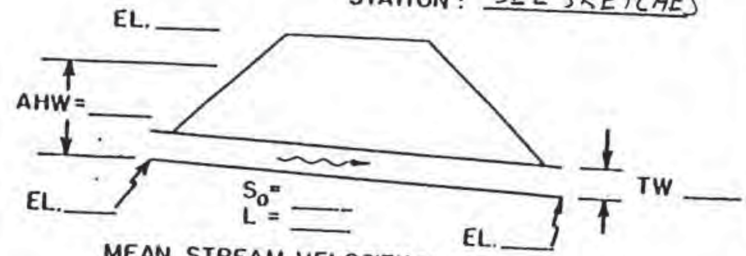
$Q_1$ = SEE SKETCHES    $TW_1$ = ______

$Q_2$ = ______    $TW_2$ = ______

( $Q_1$ = DESIGN DISCHARGE, SAY $Q_{25}$
$Q_2$ = CHECK DISCHARGE, SAY $Q_{50}$ OR $Q_{100}$ )

## SKETCH

STATION: SEE SKETCHES




MEAN STREAM VELOCITY = ______

MAX. STREAM VELOCITY = ______

| CULVERT DESCRIPTION (ENTRANCE TYPE) | Q | SIZE | HEADWATER COMPUTATION: INLET CONT. HW/D | INLET CONT. HW | OUTLET CONTROL $HW=H+h_o-LS_o$: $K_e$ | H | $d_c$ | $\frac{d_c+D}{2}$ | TW | $h_o$ | $LS_o$ | HW | CONTROLLING HW | OUTLET VELOCITY | COST | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CULVERT A CMP-PROJECTING | 14 | 24" | 1.15 | 2.3 | 0.9 | 1.3 | 1.4 | 1.7 | | 1.7 | 1 | 2 | 2.3 | | | OK |
| CULVERT A CONCRETE | 14 | 18" | 2 | 3 | 0.2 | 2.1 | 1.4 | 1.45 | | 1.45 | 1 | 2.55 | | | | OK |
| CULVERT B CMP | 11 | 24" | 1.0 | 2.0 | 0.9 | 0.8 | 1.2 | 1.6 | 0 | 1.6 | 1.0 | 1.4 | | | | RECOMMENDED |
| CULVERT C | 6 | 24" | .65 | 1.3 | 0.9 | 0.4 | 0.8 | 1.4 | 0 | 1.4 | 0.2 | 1.6 | | | | OK |

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: DPC P00

DESIGNER: BAA

DATE: 9/29/00

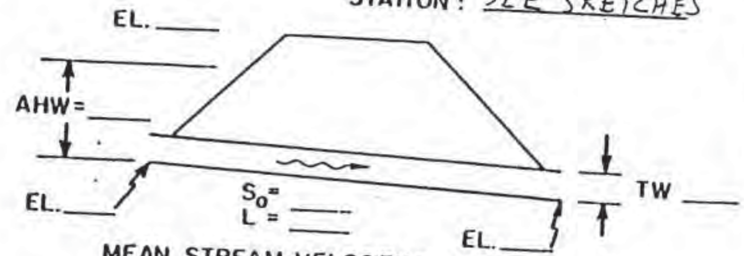
## HYDROLOGIC AND CHANNEL INFORMATION

$Q_1$ = SEE SKETCHES  $TW_1$ = ______
$Q_2$ = ______  $TW_2$ = ______

( $Q_1$ = DESIGN DISCHARGE, SAY $Q_{25}$
$Q_2$ = CHECK DISCHARGE, SAY $Q_{50}$ OR $Q_{100}$ )

## SKETCH

STATION: SEE SKETCHES



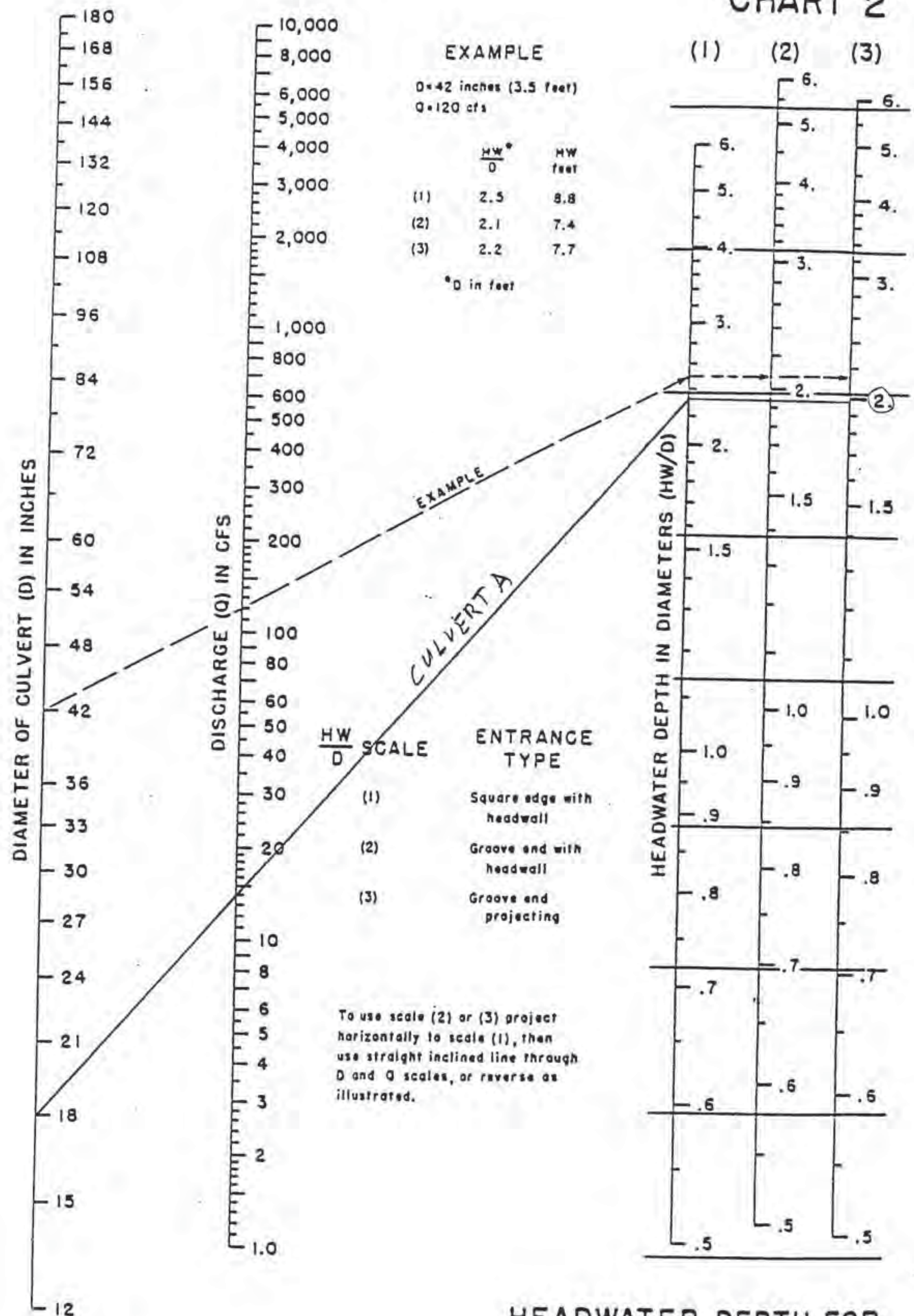

MEAN STREAM VELOCITY = ______
MAX. STREAM VELOCITY = ______

| CULVERT DESCRIPTION (ENTRANCE TYPE) | Q | SIZE | HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$ | INLET CONT. HW | OUTLET CONTROL $HW=H+h_o-LS_o$: $K_e$ | H | $d_c$ | $\frac{d_c+D}{2}$ | TW | $h_o$ | $LS_o$ | HW | CONTROLLING HW | OUTLET VELOCITY | COST | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CULVERT E CMP-PROJECTING | 7 | 24" | 0.7 | 1.4 | 0.9 | 0.4 | 0.8 | 1.4 | 0 | 1.4 | 2.5 | — | 1.4 | | | OK |
| | | | | | | | | | | | | | | | | |
| CULVERT D 7'x4' BOX | 583 | SAME FLOW AS PERMANENT CULVERTS 1, 2, and 5. | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

SUMMARY & RECOMMENDATIONS:

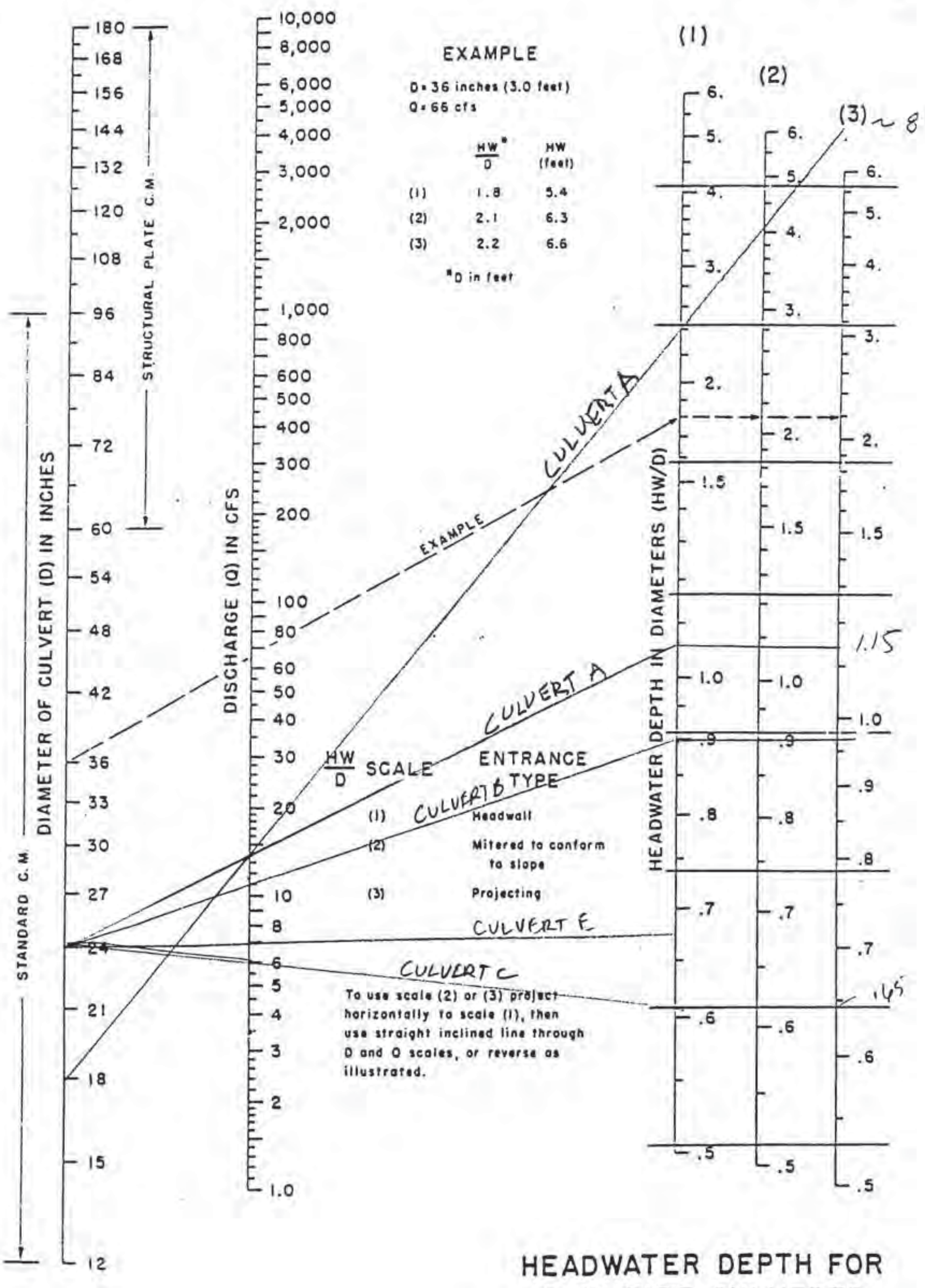
Figure 7

# CHART 2



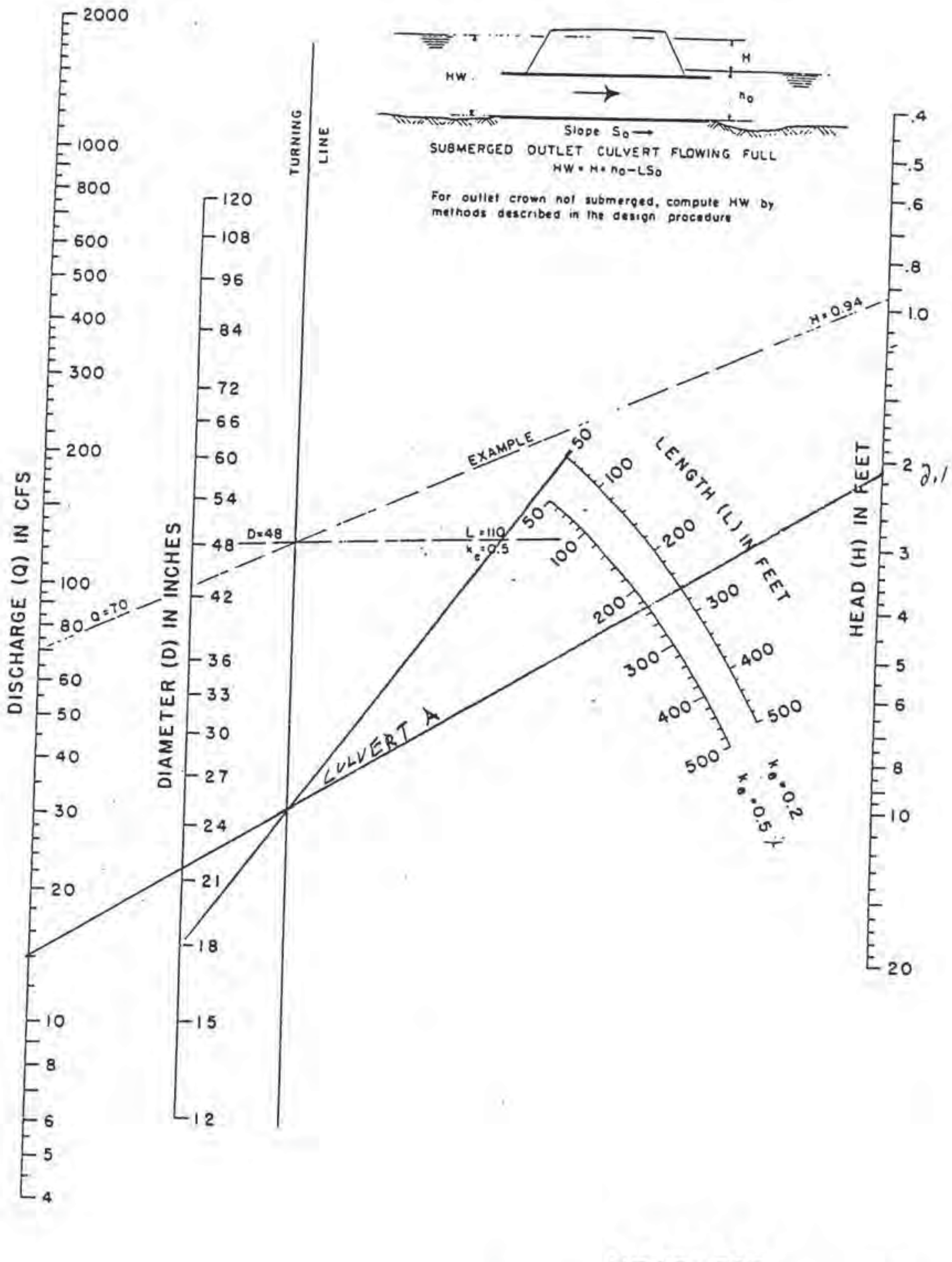

HEADWATER DEPTH FOR
CONCRETE PIPE CULVERTS
WITH INLET CONTROL

# CHART 5



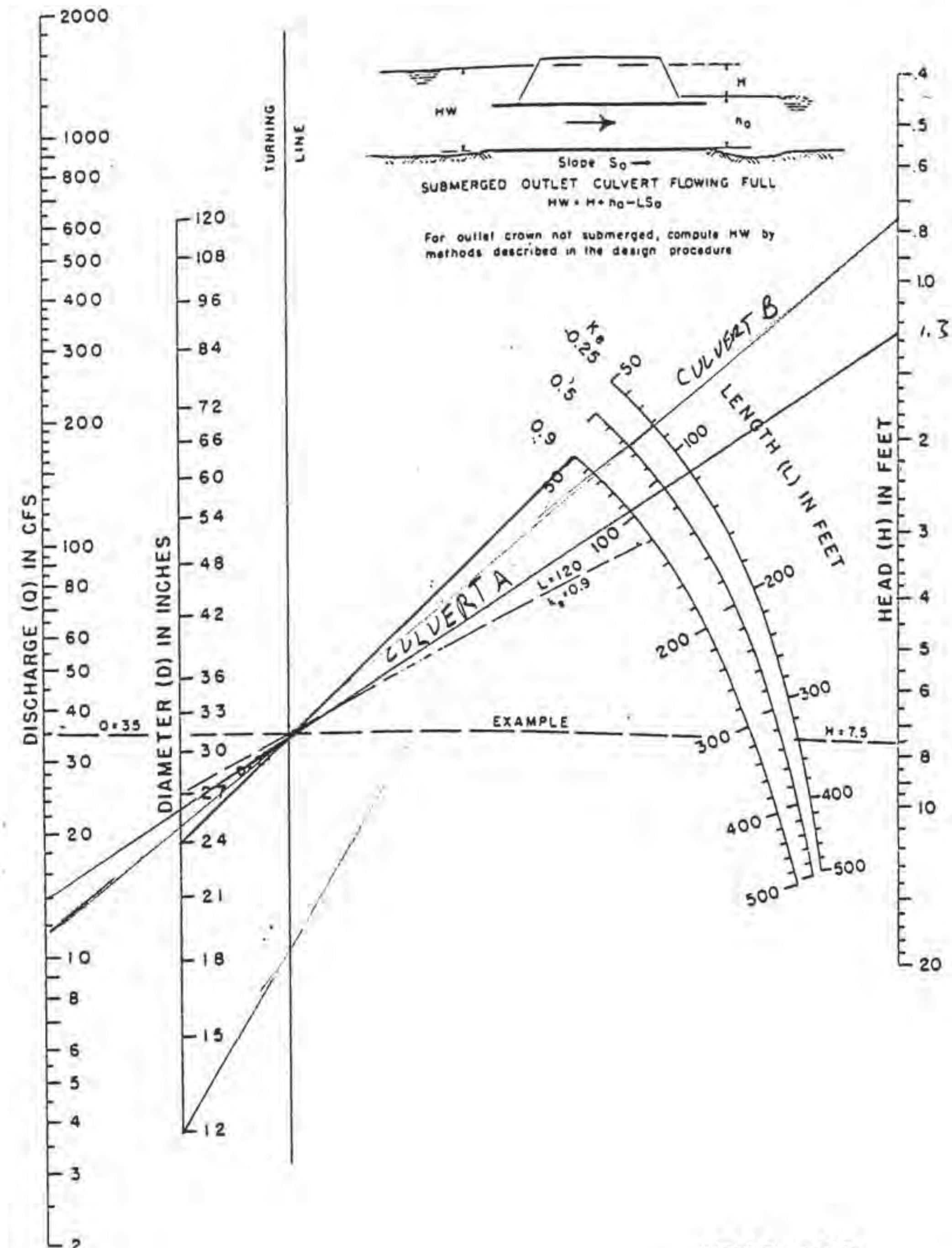

HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

# CHART 9



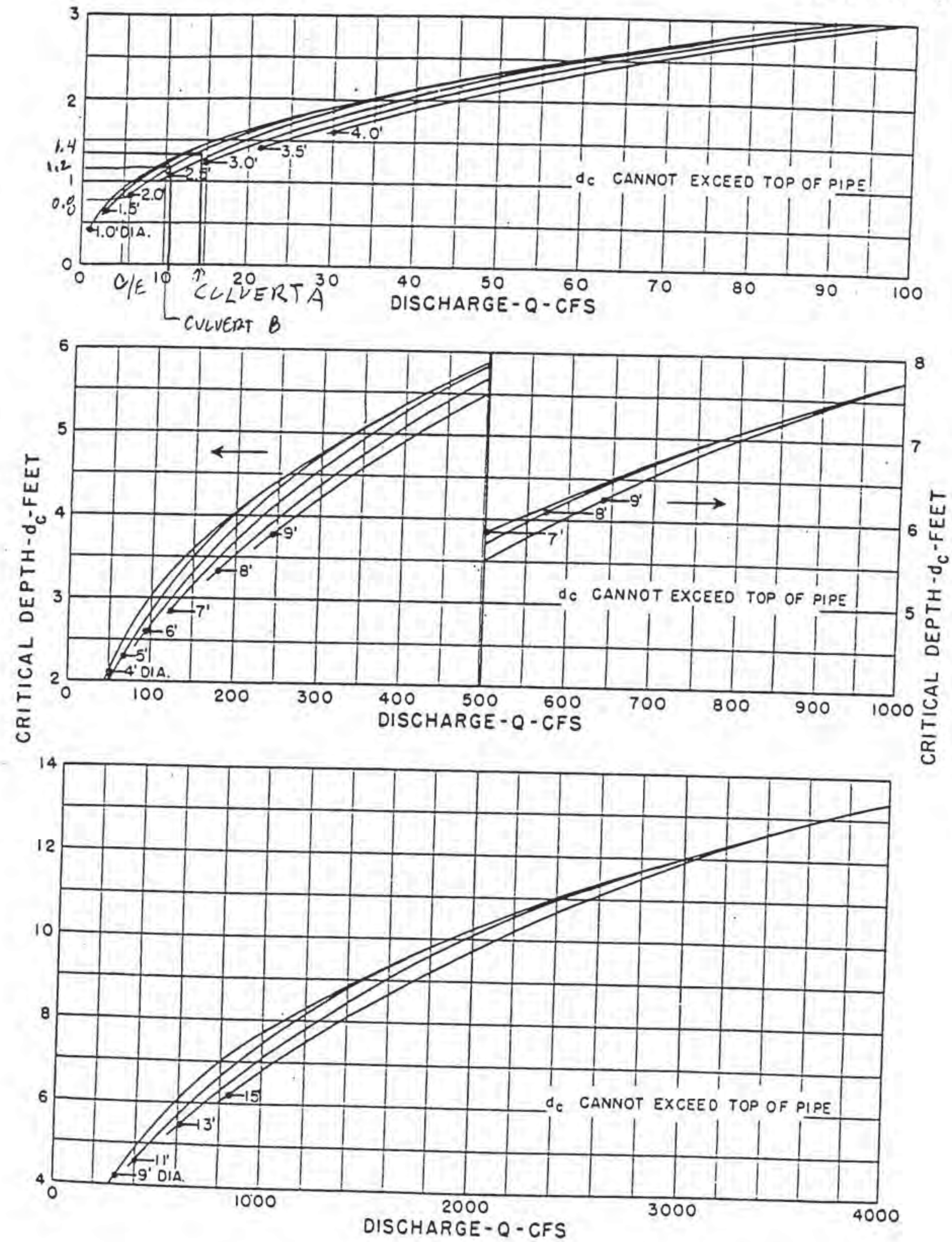

HEAD FOR
CONCRETE PIPE CULVERTS
FLOWING FULL
n = 0.012

# CHART 11




HEAD FOR
STANDARD
C. M. PIPE CULVERTS
FLOWING FULL
n = 0.024

CHART 16




# CRITICAL DEPTH
## CIRCULAR PIPE

## TABLE 1 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full

Entrance head loss $H_e = k_e \frac{V^2}{2g}$

| Type of Structure and Design of Entrance | Coefficient $k_e$ |
|---|---|
| **Pipe, Concrete** | |
| Projecting from fill, socket end (groove-end) . . . | 0.2 |
| Projecting from fill, sq. cut end . . . . . . . . . | 0.5 |
| Headwall or headwall and wingwalls | |
| Socket end of pipe (groove-end) . . . . . . . . | 0.2 |
| Square-edge . . . . . . . . . . . . . . . . | 0.5 |
| Rounded (radius = 1/12D) . . . . . . . . . . . . | 0.2 |
| Mitered to conform to fill slope . . . . . . . . . . | 0.7 |
| *End-Section conforming to fill slope . . . . . . . | 0.5 |
| Beveled edges, 33.7° or 45° bevels . . . . . . . . | 0.2 |
| Side-or slope-tapered inlet . . . . . . . . . . . . | 0.2 |
| **Pipe, or Pipe-Arch, Corrugated Metal** | |
| Projecting from fill (no headwall) . . . . . . . . . | 0.9 |
| Headwall or headwall and wingwalls square-edge . . | 0.5 |
| Mitered to conform to fill slope, paved or unpaved slope . . . . . . . . . . . . . . . . . . . . | 0.7 |
| *End-Section conforming to fill slope . . . . . . . | 0.5 |
| Beveled edges, 33.7° or 45° bevels . . . . . . . . | 0.2 |
| Side-or slope-tapered inlet . . . . . . . . . . . . | 0.2 |
| **Box, Reinforced Concrete** | |
| Headwall parallel to embankment (no wingwalls) | |
| Square-edged on 3 edges . . . . . . . . . . . . | 0.5 |
| Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides . . . . | 0.2 |
| Wingwalls at 30° to 75° to barrel | |
| Square-edged at crown . . . . . . . . . . . . . | 0.4 |
| Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge . . . . . . . . | 0.2 |
| Wingwall at 10° to 25° to barrel | |
| Square-edged at crown . . . . . . . . . . . . . | 0.5 |
| Wingwalls parallel (extension of sides) | |
| Square-edged at crown . . . . . . . . . . . . . | 0.7 |
| Side-or slope-tapered inlet . . . . . . . . . . . . | 0.2 |

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both <u>inlet</u> and <u>outlet</u> control. Some end sections, incorporating a <u>closed</u> taper in their design have a superior hydraulic performance. These latter sections can be designed using the information given for the beveled inlet, p. 5-13.

# Vegetation Information

√BLB 10/6/98

******************************************************************************

NORTH AMERICAN GREEN - ECMDS VER.IV - SLOPE PROTECTION - ENGLISH

USER SPECIFIED - PERMANENT PROTECTION RESULTS

******************************************************************************

PROJECT NAME: Dairyland Power Coop. PROJECT NO.: 3081.33
COMPUTED BY: BJK DATE: 10-06-1998
SLOPE DESCRIPTION: 2:1 Slopes

---

Slope Gradient: 2.00:1 ✓ Slope Length: 50 feet ✓
Soil Type: Clay Loam (K= 0.21) ✓ Annual R Factor: 125.0 ✓

| Slope Reach feet | Material | Type | Density | LS | C |
|---|---|---|---|---|---|
| 0 - 30 | Est. Veg. | Mix | 75-95% | 4.10 | .020 |
| 30 - 50 | P300 | Mix | 75-95% | 7.35 | .002 |

| Slope Reach feet | Material | Type | Density | ASLbare inch | ASLmat inch | SLT inch | Sf | Recommend |
|---|---|---|---|---|---|---|---|---|
| 0 - 30 | Est. Veg. | Mix | 75-95% | 0.641 | 0.013 | 0.03 | 2.3 | STABLE |
| 30 - 50 | P300 | Mix | 75-95% | 1.149 | 0.002 | 0.03 | 13.1 | STABLE |
| 0 - 50 | Composite | | | 0.844 | 0.009 | | | |

← For slope's 0'–30' use Mix No. 20 Vegetation

For slopes >30', use permanant erosion matting on bottom portion of slope (below 30') And No. 20 Vegetation on upper portion

Vegetation Density=Percentage of soil coverage provided by vegetation
C=Cover material performance factor (Fraction of soil loss of unprotected)
ASLbare=Average Soil Loss potential of unprotected soil (uniform inches)
ASLmat=Average Soil Loss potential w/material (uniform inches)
SLT=Soil Loss Tolerance for slope segment (uniform inches)
Sf=Safety Factor
Composite=Average soil loss from total slope length (uniform inches)

---

– See Attached For Vegetation Types

| Species Common Name | Species Botanical Name | Acceptable Varieties |
|---|---|---|
| Kentucky Bluegrass | Poa pratensis | |
| Red Fescue | Festuca rubra | Creeping |
| Hard Fescue | Festuca ovina var. duriuscula | Improved |
| Tall Fescue | Festuca arundinacea | Improved turf type |
| Salt Grass | Puccinella distans | Fult's |
| Redtop | Agrostis alba | |
| Timothy | Phleum pratense | |
| Little Bluestem* | Andropogon scoparius | |
| Sideoats Grama* | Bouteloua curtipendula | |
| Canada Wild Rye* | Elymus canadensis | |
| Perennial Ryegrass | Lolium perenne | |
| Perennial Ryegrass | Lolium perenne | Improved Fine |
| Annual Ryegrass | Lolium multiflorum | |
| Alsike Clover | Trifolium hybridum | |
| Red Clover | Trifolium pratense | |
| White Clover | Trifolium repens | |
| Birdsfoot Trefoil | Lotus corniculatus | Empire |
| Japanese Millet | Echinochola crusgalli var. frumentacea | |
| Annual Oats | Avena sativa | |
| Alfalfa | Medicago sativa | |
| Bromegrass | Bromus inermis | |
| Orchardgrass | Dactylis glomerata | |
| Ladino Clover | Trifolium repens var. latum | Ladino |
| Agricultural Rye | Secale cereale | |
| Winter Wheat | Triticum aestivum | |

*Pure Live Seed



| *Species* | *Purity Min. %* | *Germination min. %* | *Mixture Proportions, Percent* No. 10 | *No. 20* | *No. 30* | *No. 40* | *No. 50* | *No. 60* | *No. 70* |
|---|---|---|---|---|---|---|---|---|---|
| Kentucky Bluegrass | 85 | 80 | 40 | 6 | 10 | 35 | | | |
| Red Fescue | 97 | 85 | 25 | | 30 | 20 | | | |
| Hard Fescue | 97 | 85 | | 24 | 25 | 20 | | | 10 |
| Tall Fescue | 98 | 85 | | 40 | | | | | 25 |
| Salt Grass | 98 | 85 | | | 10 | | | | |
| Redtop | 92 | 85 | 5 | | | | | | |
| Timothy | 98 | 90 | | | | | | 12 | |
| Little Bluestem | | PLS* | | | | | | | 15 |
| Sideoats Grama | | PLS* | | | | | | | 15 |
| Canada Wild Rye | | PLS* | | | | | | 12 | 5 |
| Perennial Ryegrass | 97 | 90 | 20 | 30 | | | | | 30 |
| Improved Fine Perennial Ryegrass | 96 | 85 | | | 15 | 25 | | | |
| Annual Ryegrass | 97 | 90 | | | | | | 35 | |
| Alsike Clover | 97 | 90 | | | | | | 4 | |
| Red Clover | 98 | 90 | | | | | | 4 | |
| White Clover | 95 | 90 | 10 | | | | | | |
| Birdsfoot Trefoil | 95 | 80 | | | 10 | | 100 | | |
| Japenese Millet | 97 | 85 | | | | | | 8 | |
| Annual Oats* | 98 | 90 | | | | | | 25 | |

* Substitute winter wheat for annual oats in fall plantings started after September 1.

**630.2.1.5.1.1.2 Mixture to be Used.** The selection of the seed mixture or mixtures for use on the project shall meet with the approval of the engineer, and unless otherwise provided in the contract, shall be in accordance with the following:

Seed Mixture No. 10 is intended for use on projects where average loam, heavy clay or moist soils predominate.

Seed Mixture No. 20 is intended for use on projects where light, dry, well-drained, sandy or gravelly soils predominate and shall be used for all high cut and fill slopes (generally exceeding 1.8 to 2.4 m), except where No. 70 is used.

STATE OF WISCONSIN
DEPARTMENT OF TRANSPORTATION

# STANDARD SPECIFICATIONS

FOR

# HIGHWAY AND STRUCTURE CONSTRUCTION

1996 EDITION

*******************************************
*****   VEGETATION SELECTION   *****
*****   North American Green   *****
*******************************************

Region Number: 1

Predominant Soil Type: Clay - Clay Loam

Moisture Regime Conditions: Normal Moisture

Planned Maintenance: Medium - High Maintenance

| | Longevity | Growth Habit | Seed Rate lb/ac | Seed Rate kg/ha | |
|---|---|---|---|---|---|
| **Grasses** | | | | | |
| Tall Fescue (Festuca arundinacea) | P | B | 200 | 224 | (No. 20) |
| Chewings Fescue (Festuca rubra, commutata) | P | B | 120 | 134 | (No. 10) |
| Kentucky Bluegrass (Poa pratensis) | P | S | 80 | 90 | (No 10, No. 20) |
| Perennial Ryegrass (Lolium perenne) | P | B | 160 | 179 | (No. 10, No 20) |
| Annual Ryegrass (Lolium multiflorum) | A | B | 160 | 179 | |
| Orchardgrass (Dactylis glomerata) | P | B | 40 | 45 | |
| Timothy (Phleum pratense) | P | B | 80 | 90 | |
| Creeping Red Fescue (Festuca rubra) | P | S | 120 | 134 | |
| **Legumes** | | | | | |
| Alsike Clover (Trifolium hybridum) | P | | 15 | 17 | |
| White Dutch Clover (Trifolium repens) | P | | 5 | 6 | |
| White Sweet Clover (Melilotus alba) | P | | 15 | 17 | |

# Appendix B: Surface Water Run-Off Control System Calculations

- Leachate Storage Capacity for the 25-Year 24-Hour Storm Event
- References

# Leachate Storage Capacity for the 25-Year 24-Hour Storm Event

| PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill | | PROJECT / PROPOSAL NO. |
|---|---|---|
| SUBJECT: Active Area Leachate Disposal Capacity | | 421717.0000 |
| PREPARED BY: B. Kahnk | DATE: 4/27/2021 | FINAL X |
| CHECKED BY: J. Hotstream | DATE: 4/29/2021 | REVISION X |

Purpose: Determine the leachate storage capacity from a 25 year, 24-hour storm event during the critical leachate generation scenario.

Assumptions:
1. Critical leachate generation scenario occurs during the current condition with approximately 12.7 acres are operational (Portions of Cell 2 and the entirety of Cell 3) and approximately 7.6 acres have final cover. (See Figure 1 for this scenario).

2. The 25 year, 24-hour storm event is 5.40 inches (refer to attached sheet).

3. No portion of the leachate drainage layer within the open area is saturated.

4. The leachate drainage sand has a porosity of 30 percent. The bottom ash has a porosity of 25 percent.

5. The minimum thickness of the drainage layer is 1.0 foot.

6. A minimum of 1 foot of bottom ash was installed above the drainage layer in Cell 2A over an area of approximately 2.3 acres.

7.A minimum of 4 feet of bottom ash was installed above the drainage layer during the Cell 3A construction. Using a maximum elevation of 820 feet, this bottom ash covers an area of approximately 2.75 acres.

Method:
1. Determine the volume of rain collected in the open areas during the critical condition from a 25 year, 24-hour storm event.

2. Calculate the available storage volume for leachate in the drainage layer. Due to the slope of the landfill perimeter berm, the capacity of the drainage layer is based on the area of the drainage layer at or below an elevation of 820 feet. Elevation 820 represents the lowest top of berm base grade elevation documented during construction of Cell 3A (refer to attached base grades sheet).

3. The available storage volume within the pipe trenches, transfer piping, and leachate collection tank is ignored.

4. Calculate the available storage volume for leachate in the 4 feet of bottom ash placed above the drainage layer during Cell 3A construction and 1 foot of bottom ash placed above the drainage layer during Cell 2A construction.

5. Calculate the volume of storage required for the 25 year, 24-hour storm event.

| PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill | | PROJECT / PROPOSAL NO. |
|---|---|---|
| SUBJECT: Active Area Leachate Disposal Capacity | | 421717.0000 |
| PREPARED BY: B. Kahnk | DATE: 4/27/2021 | FINAL X |
| CHECKED BY: J. Hotstream | DATE: 4/29/2021 | REVISION ☐ |

Step 1. Determine volume of run-off collected during the 25 year, 24-hour storm event

Area: 12.7 acres - Area open (portions of Cell 2 and the entirety of Cell 3)

Rain Event: 5.43 inches

$$Runoff\ Volume(ft^3): Rain\ Event\ (inches) \times \frac{1ft}{12\ inches} \times Area\ (acres) \times \frac{43{,}560\ ft^2}{1\ acre}$$

Runoff Volume: 250,328 cubic feet

Step 2. Calculate the available storage volume for leachate in the drainage layer.

Area: 9.2 acres - see attached base grades plan
Thickness: 1 foot
Porosity: 0.3

$$Storage\ Capacity(ft^3): Area\ (acres) \times \frac{43{,}560\ ft^2}{1\ acre} \times Thickness\ (foot) \times Porosity$$

Storage Capacity: 120,226 cubic feet

Step 3. Ignore storage in pipe trenches, transfer piping and leachate collection tank

Step 4. Calculate the available storage volume in the bottom ash placed above the drainage layer

| Cell 2A: | | Cell 3A: | |
|---|---|---|---|
| Area: | 2.3 acre(s) | Area: | 2.75 acre(s) |
| Thickness: | 1 feet | Thickness: | 4 feet |
| Porosity: | 0.25 | Porosity: | 0.25 |

$$Storage\ Capacity(ft^3): Area\ (acres) \times \frac{43{,}560\ ft^2}{1\ acre} \times Thickness\ (foot) \times Porosity$$

| Cell 2A: | | Cell 3A: | |
|---|---|---|---|
| Storage Capacity: | 25,047 cubic feet | Storage Capacity: | 119,790 cubic feet |

Total Storage Capacity (Cell 2A + Cell 3A): 144,837 cubic feet

| | | | |
|---|---|---|---|
| PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill | | PROJECT / PROPOSAL NO. | |
| SUBJECT: Active Area Leachate Disposal Capacity | | 421717.0000 | |
| PREPARED BY: B. Kahnk | DATE: 4/27/2021 | FINAL | X |
| CHECKED BY: J. Hotstream | DATE: 4/29/2021 | REVISION | □ |

Step 5. Calculate the storage required for the 25 year, 24-hour storm event.

Required Storage:

$$Required\ Storage = Run\ Off\ Volume - Drainage\ Layer\ Capacity\ - Bottom\ Ash\ Capacity$$

| | | |
|---|---|---|
| Run-Off Volume: | 250,328 | cubic feet from Step 1 |
| Drainage Layer: | 120,226 | cubic feet, from Step 2 |
| Bottom Ash: | 144,837 | cubic feet from Step 4 |
| | | |
| Required Storage: | -14,734 | cubic feet |

The negative required storage calculated above indicates that there is sufficient storage capacity in the leachate collection drainage layer and the bottom ash that was placed in the cells above the drainage layer to contain the runoff from a 25 year, 24-hour storm event.

# References

**NOAA Atlas 14, Volume 8, Version 2**
**Location name: Alma, Wisconsin, US***
**Latitude: 44.3657°, Longitude: -91.9171°**
**Elevation: 1074 ft***
* source: Google Maps

## POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## 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 | 0.366 (0.300-0.455) | 0.436 (0.357-0.543) | 0.555 (0.453-0.692) | 0.657 (0.532-0.822) | 0.801 (0.626-1.03) | 0.915 (0.697-1.20) | 1.03 (0.757-1.38) | 1.16 (0.809-1.58) | 1.32 (0.887-1.85) | 1.45 (0.946-2.06) |
| 10-min | 0.536 (0.439-0.666) | 0.639 (0.523-0.795) | 0.813 (0.663-1.01) | 0.962 (0.779-1.20) | 1.17 (0.917-1.52) | 1.34 (1.02-1.75) | 1.51 (1.11-2.02) | 1.69 (1.19-2.31) | 1.94 (1.30-2.71) | 2.13 (1.39-3.02) |
| 15-min | 0.653 (0.535-0.812) | 0.779 (0.638-0.969) | 0.991 (0.809-1.24) | 1.17 (0.950-1.47) | 1.43 (1.12-1.85) | 1.64 (1.25-2.14) | 1.84 (1.35-2.46) | 2.06 (1.45-2.82) | 2.36 (1.58-3.31) | 2.59 (1.69-3.68) |
| 30-min | 0.908 (0.744-1.13) | 1.09 (0.894-1.36) | 1.40 (1.14-1.74) | 1.66 (1.34-2.08) | 2.03 (1.58-2.62) | 2.32 (1.76-3.03) | 2.62 (1.92-3.49) | 2.92 (2.05-4.00) | 3.34 (2.24-4.68) | 3.66 (2.39-5.19) |
| 60-min | 1.19 (0.978-1.48) | 1.42 (1.16-1.77) | 1.82 (1.48-2.27) | 2.17 (1.76-2.72) | 2.69 (2.12-3.51) | 3.13 (2.39-4.11) | 3.58 (2.63-4.81) | 4.07 (2.86-5.60) | 4.76 (3.20-6.70) | 5.31 (3.46-7.53) |
| 2-hr | 1.48 (1.22-1.82) | 1.75 (1.44-2.15) | 2.23 (1.84-2.76) | 2.68 (2.19-3.33) | 3.36 (2.67-4.37) | 3.94 (3.04-5.15) | 4.55 (3.38-6.09) | 5.22 (3.70-7.15) | 6.18 (4.20-8.66) | 6.96 (4.57-9.80) |
| 3-hr | 1.67 (1.38-2.04) | 1.95 (1.62-2.39) | 2.48 (2.05-3.05) | 2.99 (2.46-3.69) | 3.79 (3.04-4.93) | 4.48 (3.48-5.86) | 5.24 (3.92-7.00) | 6.07 (4.33-8.31) | 7.28 (4.97-10.2) | 8.28 (5.46-11.6) |
| 6-hr | 1.96 (1.64-2.38) | 2.28 (1.91-2.77) | 2.90 (2.41-3.53) | 3.50 (2.90-4.28) | 4.47 (3.63-5.79) | 5.32 (4.18-6.93) | 6.27 (4.73-8.33) | 7.32 (5.27-9.96) | 8.86 (6.11-12.3) | 10.1 (6.74-14.1) |
| 12-hr | 2.23 (1.88-2.68) | 2.59 (2.18-3.12) | 3.29 (2.76-3.96) | 3.96 (3.30-4.79) | 5.02 (4.10-6.43) | 5.96 (4.71-7.68) | 6.99 (5.31-9.21) | 8.13 (5.90-11.0) | 9.80 (6.81-13.5) | 11.2 (7.49-15.5) |
| 24-hr | 2.53 (2.15-3.01) | 2.91 (2.47-3.46) | 3.63 (3.07-4.33) | 4.33 (3.64-5.19) | 5.43 (4.47-6.89) | 6.40 (5.10-8.17) | 7.46 (5.72-9.75) | 8.65 (6.33-11.6) | 10.4 (7.26-14.2) | 11.8 (7.97-16.2) |
| 2-day | 2.94 (2.52-3.46) | 3.29 (2.81-3.87) | 3.97 (3.39-4.69) | 4.65 (3.94-5.53) | 5.76 (4.79-7.25) | 6.75 (5.44-8.56) | 7.86 (6.08-10.2) | 9.10 (6.72-12.1) | 10.9 (7.72-14.9) | 12.5 (8.48-17.0) |
| 3-day | 3.23 (2.79-3.79) | 3.58 (3.08-4.19) | 4.26 (3.65-5.01) | 4.95 (4.21-5.84) | 6.07 (5.07-7.59) | 7.07 (5.72-8.91) | 8.19 (6.37-10.6) | 9.45 (7.01-12.5) | 11.3 (8.02-15.3) | 12.8 (8.79-17.5) |
| 4-day | 3.48 (3.00-4.05) | 3.85 (3.32-4.49) | 4.57 (3.93-5.35) | 5.28 (4.51-6.21) | 6.42 (5.37-7.98) | 7.43 (6.03-9.31) | 8.55 (6.67-11.0) | 9.81 (7.30-12.9) | 11.6 (8.29-15.7) | 13.2 (9.04-17.9) |
| 7-day | 4.09 (3.56-4.73) | 4.59 (3.99-5.31) | 5.48 (4.75-6.37) | 6.30 (5.42-7.35) | 7.54 (6.31-9.20) | 8.58 (6.97-10.6) | 9.70 (7.58-12.3) | 10.9 (8.15-14.2) | 12.6 (9.03-16.9) | 14.0 (9.70-19.0) |
| 10-day | 4.64 (4.05-5.34) | 5.24 (4.57-6.03) | 6.27 (5.45-7.24) | 7.17 (6.20-8.32) | 8.50 (7.11-10.3) | 9.58 (7.80-11.7) | 10.7 (8.39-13.4) | 11.9 (8.91-15.4) | 13.6 (9.73-18.1) | 14.9 (10.4-20.1) |
| 20-day | 6.27 (5.53-7.14) | 7.04 (6.19-8.02) | 8.32 (7.29-9.51) | 9.40 (8.19-10.8) | 10.9 (9.19-13.0) | 12.1 (9.95-14.7) | 13.4 (10.6-16.6) | 14.7 (11.0-18.7) | 16.4 (11.8-21.6) | 17.7 (12.4-23.7) |
| 30-day | 7.70 (6.82-8.72) | 8.60 (7.61-9.75) | 10.1 (8.89-11.5) | 11.3 (9.91-12.9) | 13.0 (11.0-15.3) | 14.3 (11.8-17.2) | 15.7 (12.4-19.3) | 17.0 (12.9-21.6) | 18.8 (13.6-24.6) | 20.2 (14.2-26.9) |
| 45-day | 9.58 (8.53-10.8) | 10.7 (9.51-12.1) | 12.5 (11.1-14.1) | 13.9 (12.3-15.8) | 15.9 (13.4-18.5) | 17.3 (14.3-20.6) | 18.8 (14.9-22.9) | 20.2 (15.3-25.3) | 21.9 (15.9-28.5) | 23.3 (16.4-30.8) |
| 60-day | 11.2 (10.0-12.6) | 12.6 (11.2-14.1) | 14.7 (13.0-16.5) | 16.3 (14.4-18.5) | 18.5 (15.7-21.4) | 20.1 (16.6-23.7) | 21.5 (17.1-26.1) | 22.9 (17.4-28.7) | 24.7 (18.0-31.8) | 25.9 (18.4-34.2) |

[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.

Back to Top

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| | | |
|---|---|---|
| PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill | | PROJECT / PROPOSAL NO. |
| SUBJECT: Active Area Leachate Disposal Capacity | | 243332.0002 |
| PREPARED BY: J. Hotstream | DATE: 8/31/2016 | FINAL ☐ |
| CHECKED BY: | DATE: | REVISION ☐ |

# Volume Relationships of Sand

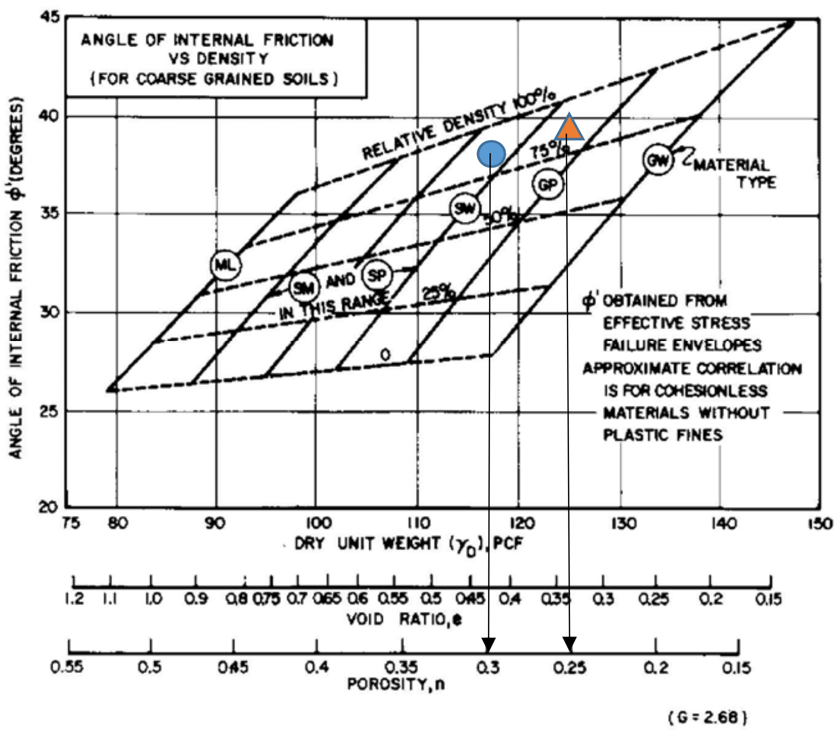
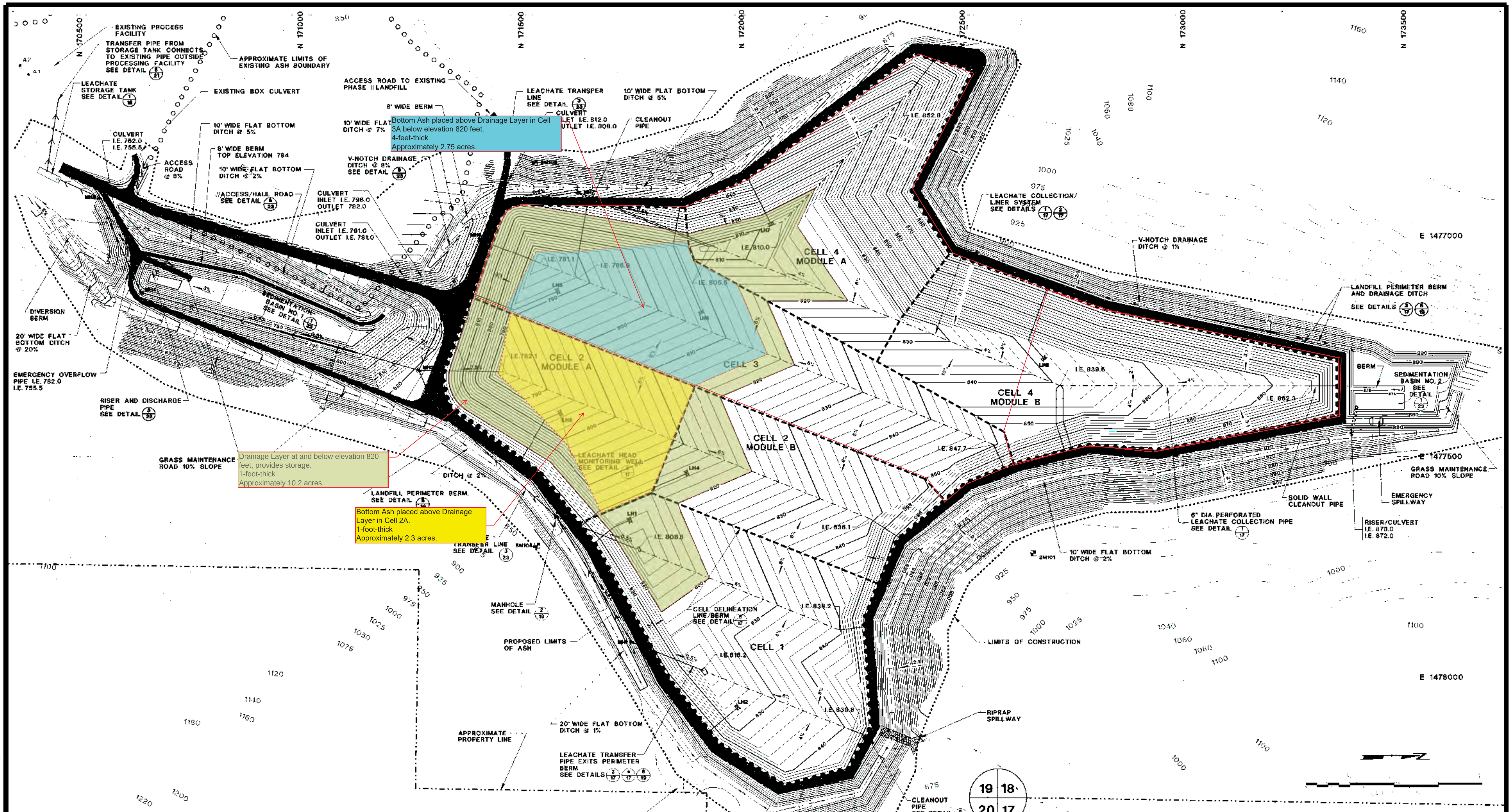



Figure from NavFac DM 7.1 (1986)

Drainage Layer Sand - Poorly Graded Sand (SP)

Bottom Ash - Poorly Graded Sand (SP) to
Poorly Graded Gravel (GP)




**NOTE:**

GRADES SHOWN INSIDE THE TOP OF THE PERIMTER BERM REPRESENT THE TOP OF THE 2-FOOT-THICK LOW PERMEABILITY SUBBASE SOIL LAYER.
GRADES SHOWN ON TOP AND OUTSIDE THE PERIMETER BERM REPRESENT THE TOP OF TOPSOIL

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY. (NOT FOR CONSTRUCTION)

| NO. | BY | DATE | REVISION | APP'D. |
|---|---|---|---|---|
| 3 | | | | |
| 2 | | | | |
| 1 | | | | |

PROJECT: DAIRYLAND POWER COOPERATIVE
PLAN OF OPERATION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE: PROPOSED BASE GRADES

| | | |
|---|---|---|
| DRAWN BY: reyzerd | SCALE | PROJ. NO. 3087.40 |
| CHECKED BY: DM | | FILE NO. BASEGRDS.PLT |
| APPROVED BY: BLK | DATE PRINTED: | SHEET 5 OF 23 |
| DATE: OCTOBER 2000 | | |

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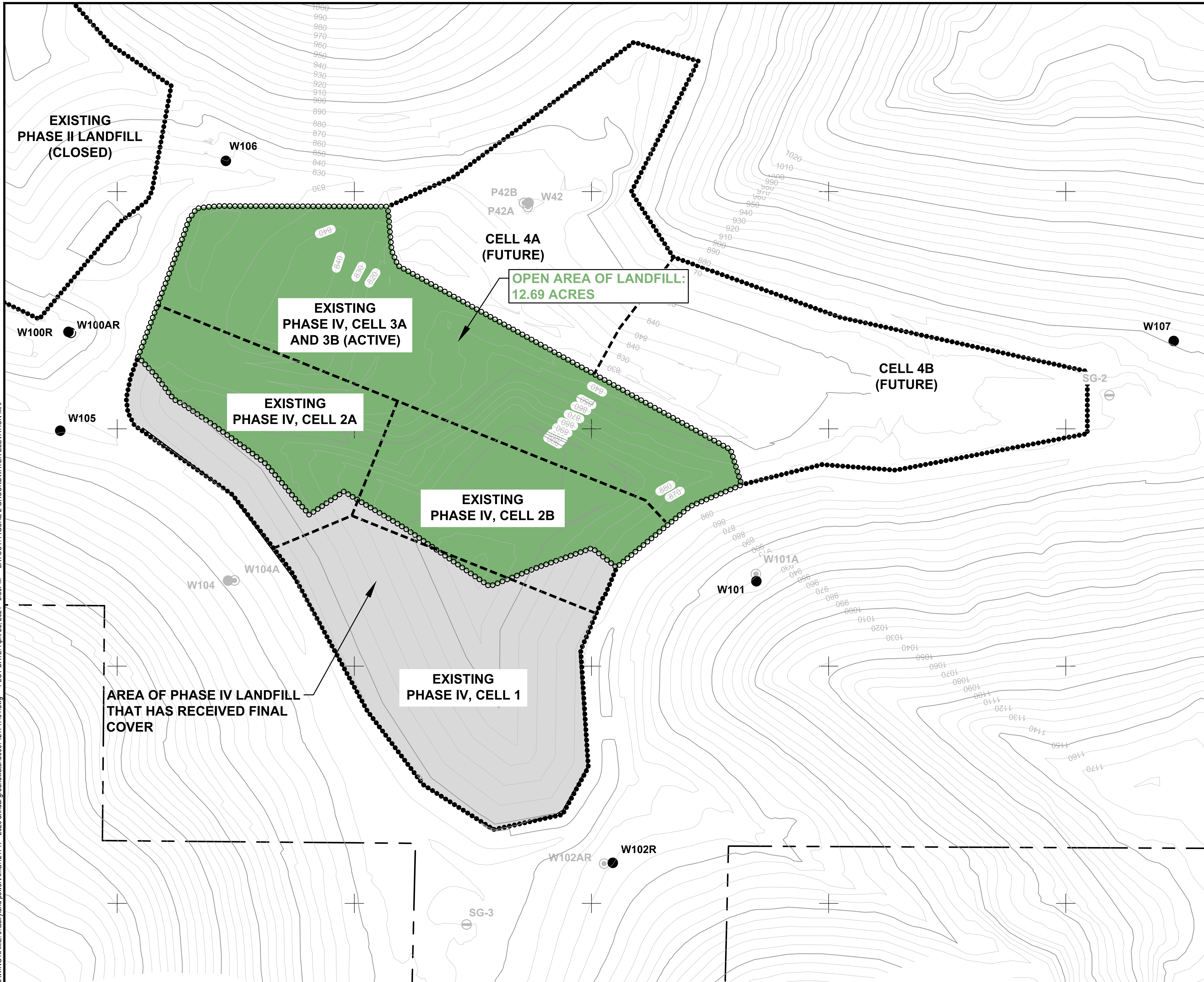


## LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- GRID LOCATION
- 890 — EXISTING 10' CONTOUR
- x 895.7 — EXISTING SPOT ELEVATION
- LIMITS OF PERMITTED LANDFILL
- LIMITS OF CCR DISPOSAL (ACTIVE LANDFILL)
- PHASE LINE
- W42 — MONITORING WELL (NOT INCLUDED IN FEDERAL GWMP)
- W42B — PIEZOMETER (NOT INCLUDED IN FEDERAL GWMP)
- W101 — MONITORING WELL LOCATION
- W101A — PIEZOMETER LOCATION

## NOTES

1. THE BASE MAP WAS COMPILED FROM THE CELL 3B LINER CONSTRUCTION DOCUMENTATION REPORT (OCTOBER, 2016) AND THE NOVEMBER 12, 2020 ANNUAL AIR SPACE SURVEY BY EXETER DESIGN, INC.
2. THE HORIZONTAL DATUM IS REFERENCED TO THE WISCONSIN STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NORTH AMERICAN DATUM 1983, US SURVEY FEET.
3. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 1988. CONTOUR INTERVAL IS 10 FEET.

0 200 400
SCALE IN FEET

PROJECT: DAIRYLAND POWER COOPERATIVE
RUN-ON AND RUN-OFF CONTROL SYSTEMS PLAN
ALMA OFF-SITE PHASE IV LANDFILL
BUFFALO COUNTY, WISCONSIN

TITLE: EXISTING CONDITIONS

WORKING COPY

| | | | |
|---|---|---|---|
| DRAWN BY: | S. HAMWAY | PROJ NO.: | 421717 |
| CHECKED BY: | B. KAHNK | | FIGURE 1 |
| APPROVED BY: | | | |
| DATE: | OCTOBER 2021 | | |

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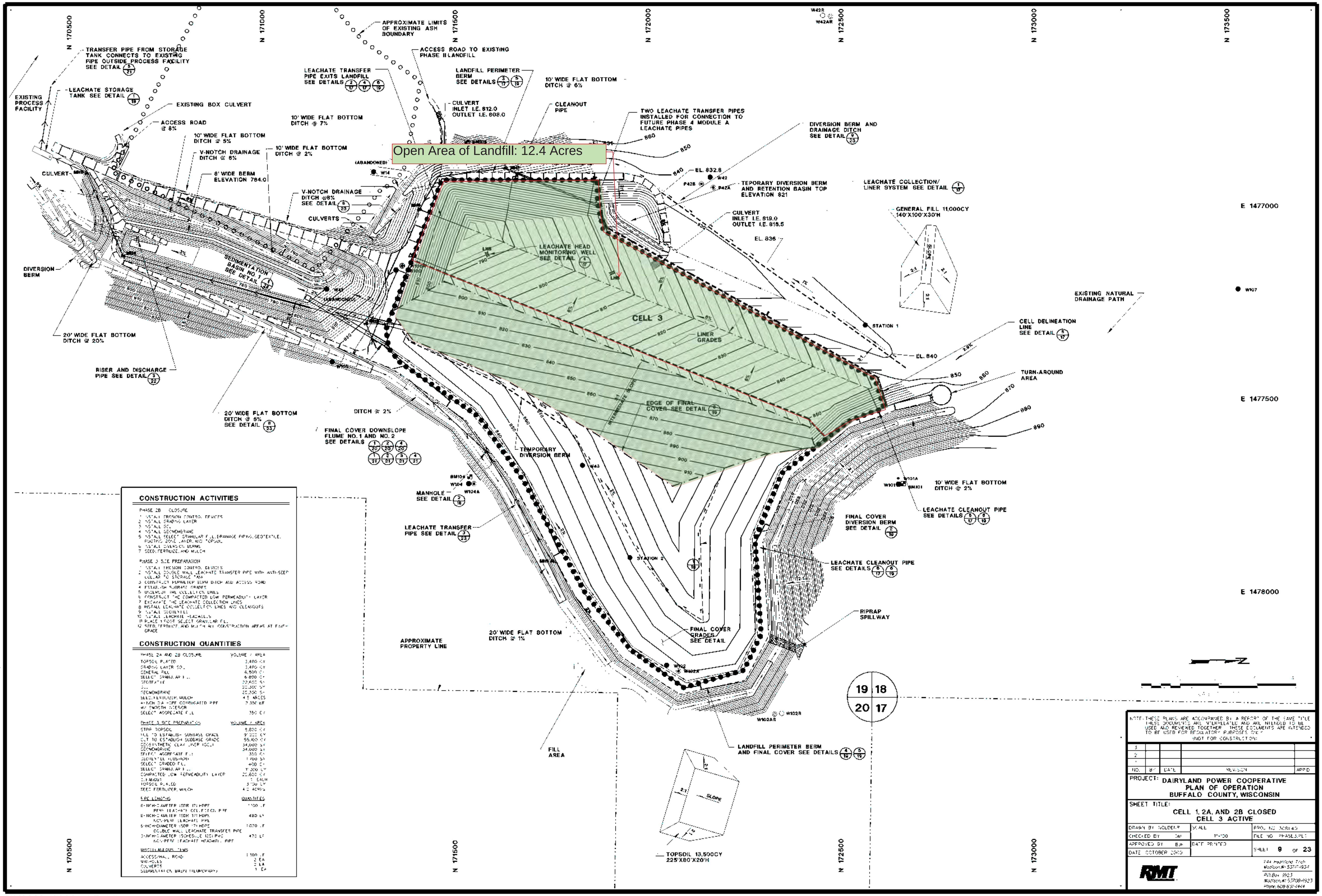
Phone: 608.826.3600

FILE NO.: 421717.01.dwg

Version: 2017-03-03




## CONSTRUCTION ACTIVITIES

PHASE 2B CLOSURE

1. INSTALL EROSION CONTROL DEVICES
2. INSTALL GRADING LAYER
3. INSTALL GCL
4. INSTALL GEOMEMBRANE
5. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL
6. INSTALL DIVERSION BERMS
7. SEED, FERTILIZE, AND MULCH

PHASE 3 SITE PREPARATION

1. INSTALL EROSION CONTROL DEVICES
2. INSTALL DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI-SEEP COLLAR TO STORAGE TANK
3. CONSTRUCT PERIMETER BERM DITCH AND ACCESS ROAD
4. ESTABLISH SUBBASE GRADES
5. UNDERCUT THE COLLECTION LINES
6. CONSTRUCT THE COMPACTED LOW PERMEABILITY LAYER
7. EXCAVATE THE LEACHATE COLLECTION LINES
8. INSTALL LEACHATE COLLECTION LINES AND CLEANOUTS
9. INSTALL GEOTEXTILE
10. INSTALL LEACHATE HEADWELLS
11. PLACE 1 FOOT SELECT GRANULAR FILL
12. SEED, FERTILIZE, AND MULCH ALL CONSTRUCTION AREAS AT FINISH GRADE

## CONSTRUCTION QUANTITIES

| PHASE 2A AND 2B CLOSURE | VOLUME / AREA |
|---|---|
| TOPSOIL PLACED | 3,400 CY |
| GRADING LAYER SOIL | 3,400 CY |
| GENERAL FILL | 6,900 CY |
| SELECT GRANULAR FILL | 6,800 CY |
| GEOTEXTILE | 22,600 SY |
| GCL | 20,300 SY |
| GEOMEMBRANE | 20,300 SY |
| SEED, FERTILIZER, MULCH | 4.5 ACRES |
| 4-INCH DIA HDPE CORRUGATED PIPE W/ SMOOTH INTERIOR | 2,350 LF |
| SELECT AGGREGATE FILL | 350 CY |

| PHASE 3 SITE PREPARATION | VOLUME / AREA |
|---|---|
| STRIP TOPSOIL | 9,800 CY |
| FILL TO ESTABLISH SUBBASE GRADE | 91,300 CY |
| CUT TO ESTABLISH SUBBASE GRADE | 55,100 CY |
| GEOSYNTHETIC CLAY LINER (GCL) | 34,000 SY |
| GEOMEMBRANE | 34,000 SY |
| SELECT AGGREGATE FILL | 350 CY |
| GEOTEXTILE (CUSHION) | 1,700 SY |
| SELECT GRADED FILL | 400 CY |
| SELECT GRANULAR FILL | 11,300 CY |
| COMPACTED LOW PERMEABILITY LAYER | 22,600 CY |
| CLEANOUT | 1 EACH |
| TOPSOIL PLACED | 3,100 CY |
| SEED, FERTILIZER, MULCH | 4.0 ACRES |

| PIPE LENGTHS | QUANTITIES |
|---|---|
| 6-INCH-DIAMETER (SDR 17) HDPE PERF LEACHATE COLLECTION PIPE | 1,100 LF |
| 6-INCH-DIAMETER (SDR 17) HDPE NON-PERF LEACHATE PIPE | 480 LF |
| 6-INCH-DIAMETER (SDR 17) HDPE DOUBLE WALL LEACHATE TRANSFER PIPE | 1,070 LF |
| 3-INCH-DIAMETER (SCHEDULE 120) PVC NON-PERF LEACHATE HEADWELL PIPE | 470 LF |

| MISCELLANEOUS ITEMS | |
|---|---|
| ACCESS/HAUL ROAD | 1,500 LF |
| MANHOLES | 2 EA |
| CULVERTS | 2 EA |
| SEDIMENTATION BASIN (TEMPORARY) | 1 EA |

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY. (NOT FOR CONSTRUCTION)

| NO. | BY | DATE | REVISION | APP'D |
|---|---|---|---|---|
| 3 | | | | |
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| 1 | | | | |

PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **CELL 1, 2A, AND 2B CLOSED CELL 3 ACTIVE**

| | | |
|---|---|---|
| DRAWN BY: GOLDENR | SCALE: 1"=100' | PROJ. NO. 3081.40 |
| CHECKED BY: DM | | FILE NO. PHASE3.PLT |
| APPROVED BY: BJK | DATE PRINTED | SHEET 9 OF 23 |
| DATE: OCTOBER 2000 | | |

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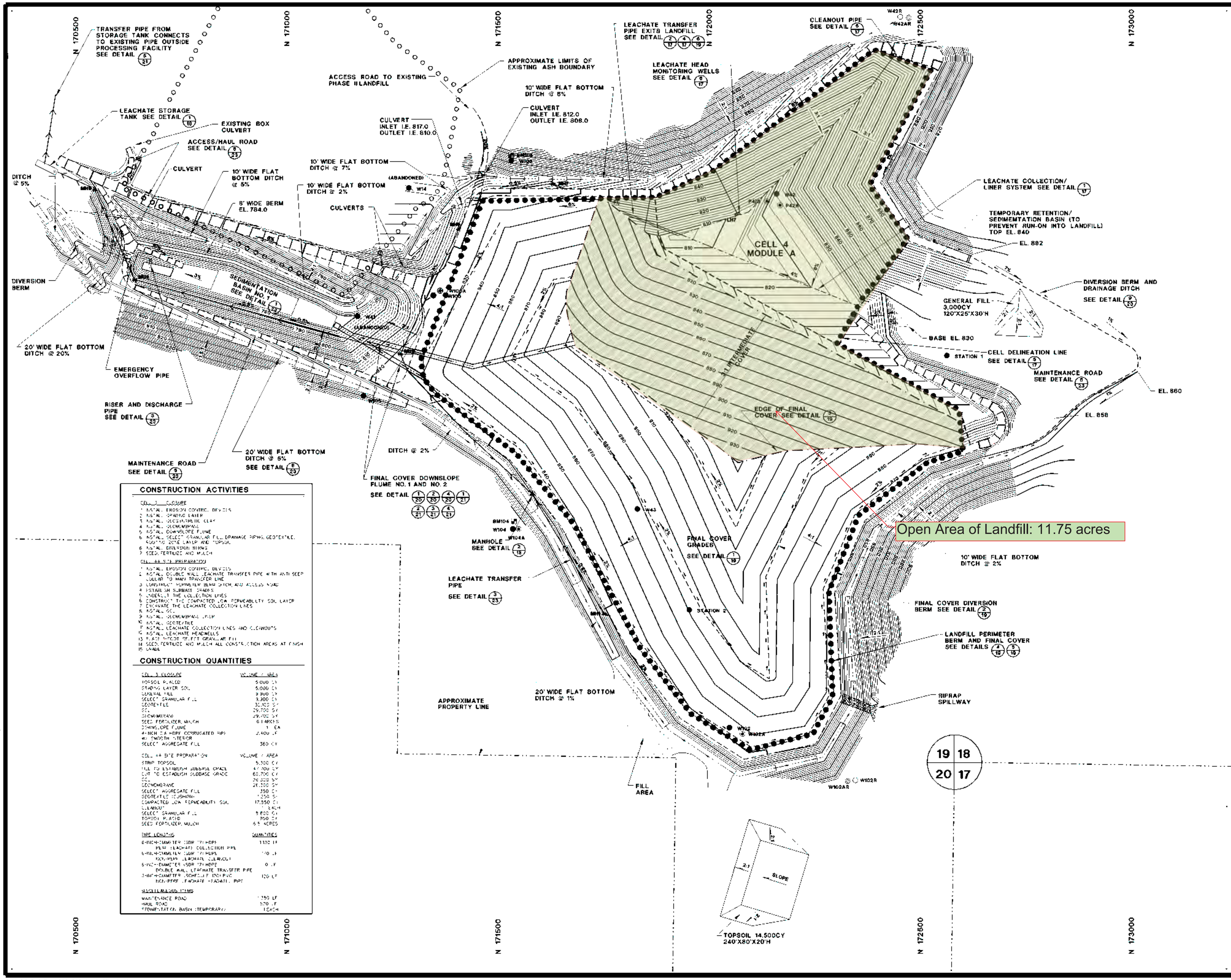
RMT COMPUTER AIDED DESIGN & DRAFTING




NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY. (NOT FOR CONSTRUCTION)

| NO. | BY | DATE | REVISION | APP'D |
|---|---|---|---|---|
| 3 | | | | |
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| 1 | | | | |

PROJECT: DAIRYLAND POWER COOPERATIVE
PLAN OF OPERATION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:
CELLS 1, 2A, 2B, AND 3 CLOSED
CELL 4A ACTIVE

| | | |
|---|---|---|
| DRAWN BY: SOLDENR | SCALE | PROJ. NO. 30814.0 |
| CHECKED BY: DM | | FILE NO. |
| APPROVED BY: BJK | DATE PRINTED | SHEET 10 OF 23 |
| DATE: OCTOBER 2000 | | |

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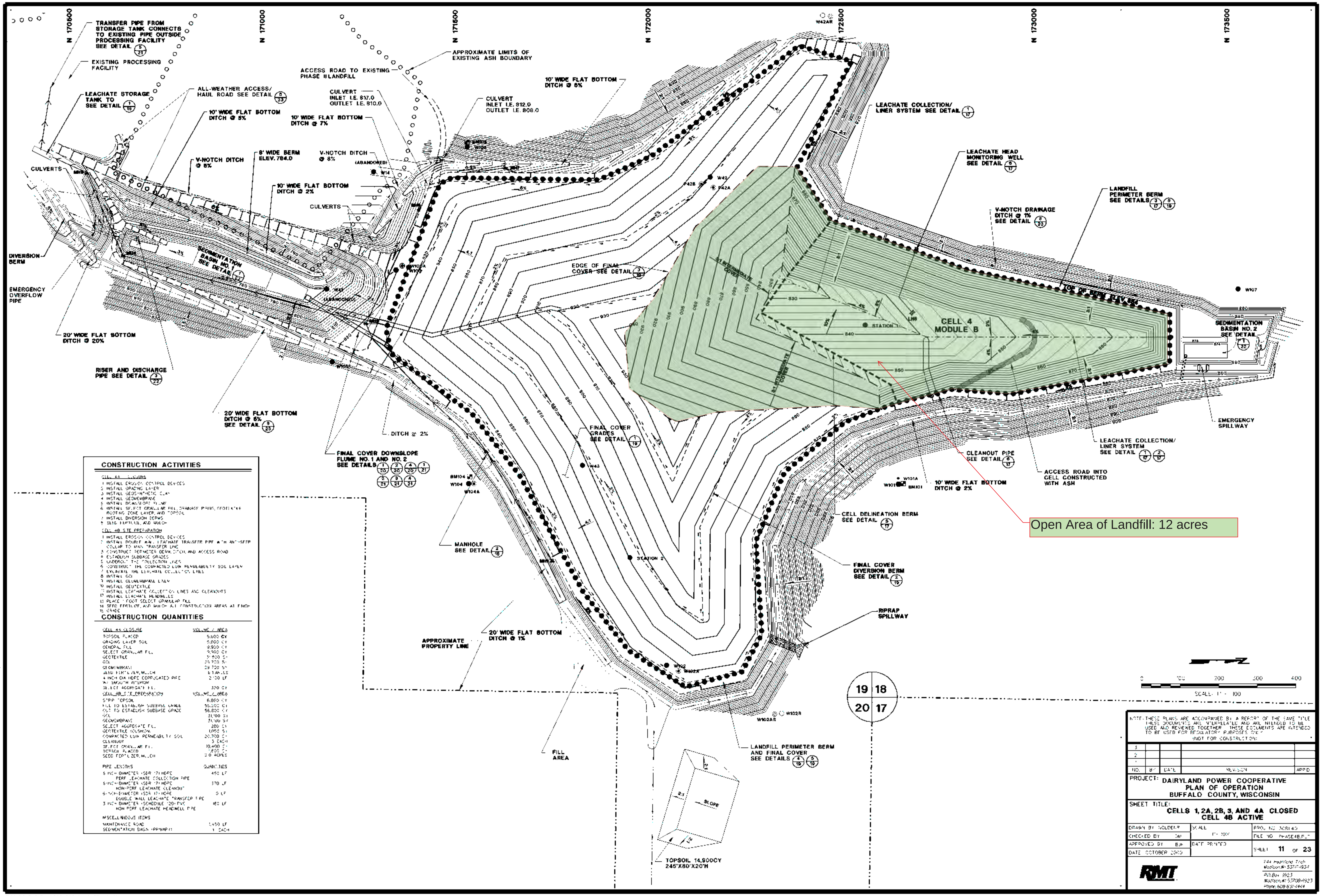
Phone: 608-831-4444




## CONSTRUCTION ACTIVITIES

CELL 4A CLOSURE

1. INSTALL EROSION CONTROL DEVICES
2. INSTALL GRADING LAYER
3. INSTALL GEOSYNTHETIC CLAY
4. INSTALL GEOMEMBRANE
5. INSTALL DOWNSLOPE FLUME
6. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE ROOTING ZONE LAYER, AND TOPSOIL
7. INSTALL DIVERSION BERMS
8. SEED, FERTILIZE, AND MULCH

CELL 4B SITE PREPARATION

1. INSTALL EROSION CONTROL DEVICES
2. INSTALL DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI-SEEP COLLAR TO MAIN TRANSFER LINE
3. CONSTRUCT PERIMETER BERM, DITCH, AND ACCESS ROAD
4. ESTABLISH SUBBASE GRADES
5. UNDERCUT THE COLLECTION LINES
6. CONSTRUCT THE COMPACTED LOW PERMEABILITY SOIL LAYER
7. EXCAVATE THE LEACHATE COLLECTION LINES
8. INSTALL GCL
9. INSTALL GEOMEMBRANE LINER
10. INSTALL GEOTEXTILE
11. INSTALL LEACHATE COLLECTION LINES AND CLEANOUTS
12. INSTALL LEACHATE HEADWELLS
13. PLACE 1 FOOT SELECT GRANULAR FILL
14. SEED, FERTILIZE, AND MULCH ALL CONSTRUCTION AREAS AT FINISH
15. GRADE

## CONSTRUCTION QUANTITIES

| CELL 4A CLOSURE | VOLUME / AREA |
|---|---|
| TOPSOIL PLACED | 5,000 CY |
| GRADING LAYER SOIL | 5,000 CY |
| GENERAL FILL | 9,900 CY |
| SELECT GRANULAR FILL | 9,900 CY |
| GEOTEXTILE | 31,900 SY |
| GCL | 29,700 SY |
| GEOMEMBRANE | 29,700 SY |
| SEED, FERTILIZER, MULCH | 6 ACRES |
| 4 INCH DIA HDPE CORRUGATED PIPE W/ SMOOTH INTERIOR | 2,100 LF |
| SELECT AGGREGATE FILL | 320 CY |

| CELL 4B SITE PREPARATION | VOLUME / AREA |
|---|---|
| STRIP TOPSOIL | 6,800 CY |
| FILL TO ESTABLISH SUBBASE GRADE | 55,000 CY |
| CUT TO ESTABLISH SUBBASE GRADE | 56,800 CY |
| GCL | 31,100 SY |
| GEOMEMBRANE | 31,100 SY |
| SELECT AGGREGATE FILL | 280 CY |
| GEOTEXTILE (CUSHION) | 1,050 SY |
| COMPACTED LOW PERMEABILITY SOIL | 20,700 CY |
| CLEANOUT | 3 EACH |
| SELECT GRANULAR FILL | 10,400 CY |
| TOPSOIL PLACED | 1,600 CY |
| SEED, FERTILIZER, MULCH | 2.0 ACRES |

| PIPE LENGTHS | QUANTITIES |
|---|---|
| 6 INCH DIAMETER (SDR 17) HDPE PERF. LEACHATE COLLECTION PIPE | 450 LF |
| 6 INCH DIAMETER (SDR 17) HDPE NON-PERF. LEACHATE CLEANOUT | 370 LF |
| 6 INCH DIAMETER (SDR 17) HDPE DOUBLE WALL LEACHATE TRANSFER PIPE | 0 LF |
| 3 INCH DIAMETER (SCHEDULE 120) PVC NON PERF. LEACHATE HEADWELL PIPE | 180 LF |

| MISCELLANEOUS ITEMS | |
|---|---|
| MAINTENANCE ROAD | 1,450 LF |
| SEDIMENTATION BASIN (PRIMARY) | 1 EACH |

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.
(NOT FOR CONSTRUCTION)

| NO. | BY | DATE | REVISION | APP'D |
|---|---|---|---|---|
| 3 | | | | |
| 2 | | | | |
| 1 | | | | |

PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **CELLS 1, 2A, 2B, 3, AND 4A CLOSED CELL 4B ACTIVE**

| | | |
|---|---|---|
| DRAWN BY: GOLDENR | SCALE: 1" = 100' | PROJ. NO. 3081.40 |
| CHECKED BY: DM | | FILE NO. PHASE4B.PLT |
| APPROVED BY: BJK | DATE PRINTED | SHEET 11 OF 23 |
| DATE: OCTOBER 2000 | | |

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Phone: 608-831-4444

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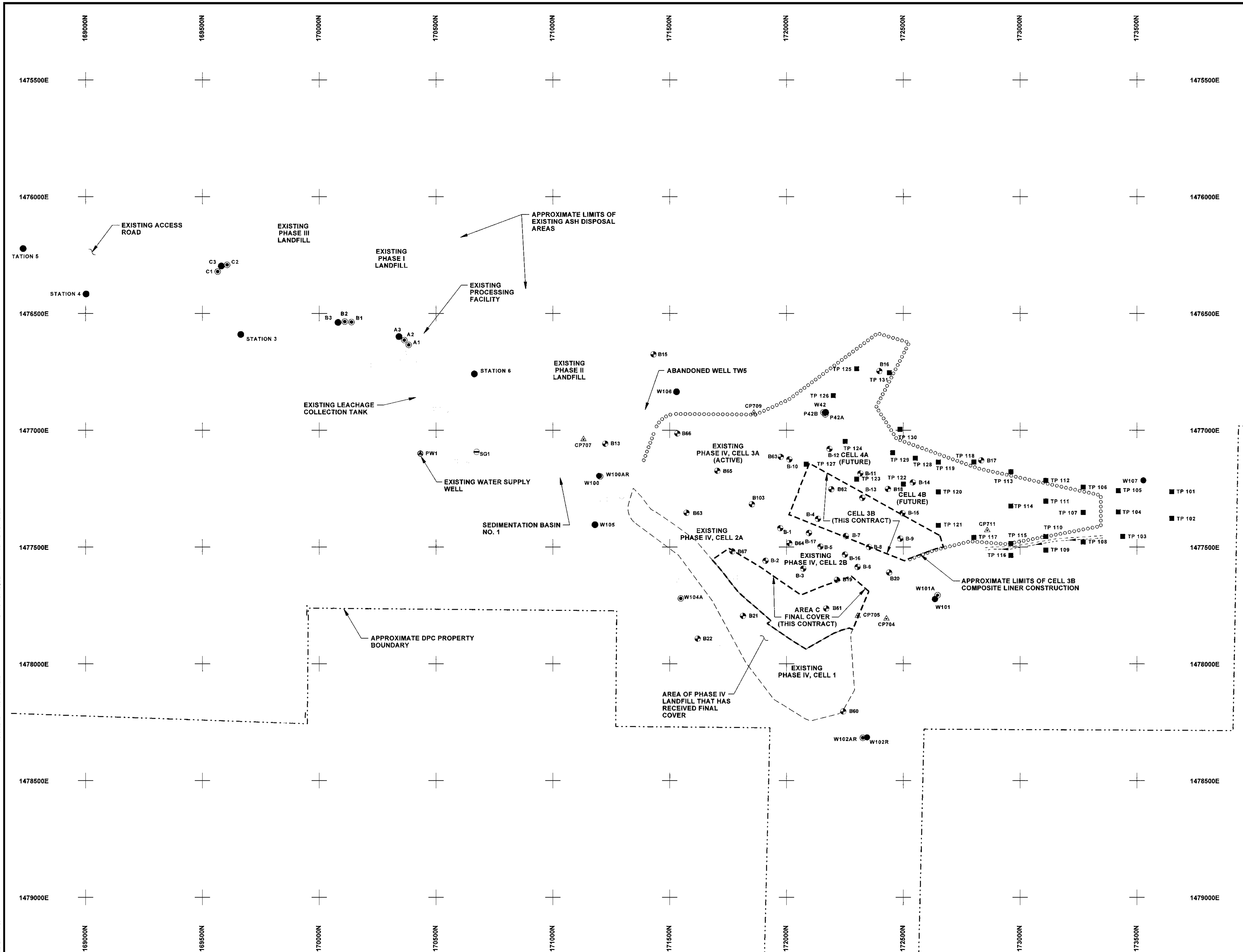
## Appendix C: Relevant October 2000 POO Plan Sheets

- Sheet 3 Existing Conditions Map – Phase IV, Cell 3B Liner & Area C (Over Cells 1 & 2) Final Cover Construction
- Sheet 5 Proposed Base Grades
- Sheet 9 Phasing Plan – Cell 1, 2A, and 2B Closed; Cell 3 Active
- Sheet 11 Phasing Plan – Cell 1, 2A, 2B, 3, and 4A Closed; Cell 4B Active
- Sheet 12 Proposed Final Grades
- Sheet 17 Details – Liner and Collection Pipes
- Sheet 19 Details – Final Cover
- Sheet 22 Details – Sedimentation Basins
- Sheet 23 Details – Miscellaneous




## NOTES

1. REFER TO PLAN SHEET 2 FOR STANDARD LEGEND, NOTES, AND BENCHMARK LOCATIONS.

0 200 400 600 800

SCALE IN FEET

NOTE: THE CONTRACTOR SHALL NOTIFY ALL AREA UTILITY COMPANIES PRIOR TO COMMENCING WORK ON THIS CONTRACT, IN ACCORDANCE WITH STATE AND LOCAL REQUIREMENTS.

NOTE: THESE PLANS ARE ACCOMPANIED BY A PROJECT MANUAL OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

| NO. | BY | DATE | REVISION | APP'D. |
|---|---|---|---|---|

PROJECT: DAIRYLAND POWER COOPERATIVE
PHASE IV, CELL 3B LINER & AREA C (OVER CELLS 1 & 2)
FINAL COVER CONSTRUCTION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE: **EXISTING CONDITIONS MAP**

| | | | |
|---|---|---|---|
| DRAWN BY: lstormer | SCALE: AS SHOWN | PROJ. NO. | 216851.0004 |
| CHECKED BY: DM | | FILE NO. | 215851.0004.SHT03-EC.PLT |
| APPROVED BY: TWM | DATE PRINTED: | SHEET 3 OF 13 | |
| DATE: MARCH 2015 | | | |

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Madison, WI 53717
Phone: 608.826.3600


NOTE:
GRADES SHOWN INSIDE THE TOP OF THE PERIMETER BERM REPRESENT THE TOP OF THE 2-FOOT-THICK LOW PERMEABILITY SUBBASE SOIL LAYER.
GRADES SHOWN ON TOP AND OUTSIDE THE PERIMETER BERM REPRESENT THE TOP OF TOPSOIL

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY. (NOT FOR CONSTRUCTION)

| NO. | BY | DATE | REVISION | APP'D. |
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| 3. | | | | |
| 2. | | | | |
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PROJECT: DAIRYLAND POWER COOPERATIVE
PLAN OF OPERATION
BUFFALO COUNTY, WISCONSIN

SHEET TITLE: PROPOSED BASE GRADES

| | | |
|---|---|---|
| DRAWN BY: reyzekd | SCALE: 1"=100' | PROJ. NO. 3081.40 |
| CHECKED BY: DM | | FILE NO. BASEGRDS.PLT |
| APPROVED BY: BJK | DATE PRINTED: | SHEET 5 OF 23 |
| DATE: OCTOBER 2000 | | |


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## CONSTRUCTION ACTIVITIES

PHASE 2B CLOSURE

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL GRADING LAYER.
3. INSTALL GCL.
4. INSTALL GEOMEMBRANE.
5. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL.
6. INSTALL DIVERSION BERMS.
7. SEED, FERTILIZE, AND MULCH.

PHASE 3 SITE PREPARATION

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI-SEEP COLLAR TO STORAGE TANK.
3. CONSTRUCT PERIMETER BERM, DITCH, AND ACCESS ROAD.
4. ESTABLISH SUBBASE GRADES.
5. UNDERCUT THE COLLECTION LINES.
6. CONSTRUCT THE COMPACTED LOW PERMEABILITY LAYER.
7. EXCAVATE THE LEACHATE COLLECTION LINES.
8. INSTALL LEACHATE COLLECTION LINES AND CLEANOUTS.
9. INSTALL GEOTEXTILE.
10. INSTALL LEACHATE HEADWELLS.
11. PLACE 1-FOOT SELECT GRANULAR FILL.
12. SEED, FERTILIZE, AND MULCH ALL CONSTRUCTION AREAS AT FINISH GRADE.

## CONSTRUCTION QUANTITIES

| PHASE 2A AND 2B CLOSURE | VOLUME / AREA |
|---|---|
| TOPSOIL PLACED | 3,400 CY |
| GRADING LAYER SOIL | 3,400 CY |
| GENERAL FILL | 6,800 CY |
| SELECT GRANULAR FILL | 6,800 CY |
| GEOTEXTILE | 22,600 SY |
| GCL | 20,300 SY |
| GEOMEMBRANE | 20,300 SY |
| SEED, FERTILIZER, MULCH | 4.5 ARCES |
| 4-INCH DIA. HDPE CORRUGATED PIPE W/ SMOOTH INTERIOR | 2,350 LF |
| SELECT AGGREGATE FILL | 350 CY |

| PHASE 3 SITE PREPARATION | VOLUME / AREA |
|---|---|
| STRIP TOPSOIL | 8,800 CY |
| FILL TO ESTABLISH SUBBASE GRADE | 91,200 CY |
| CUT TO ESTABLISH SUBBASE GRADE | 55,100 CY |
| GEOSYNTHETIC CLAY LINER (GCL) | 34,000 SY |
| GEOMEMBRANE | 34,000 SY |
| SELECT AGGREGATE FILL | 350 CY |
| GEOTEXTILE (CUSHION) | 1,700 SY |
| SELECT GRADED FILL | 400 CY |
| SELECT GRANULAR FILL | 11,300 CY |
| COMPACTED LOW PERMEABILITY LAYER | 22,600 CY |
| CLEANOUT | 1 EACH |
| TOPSOIL PLACED | 3,100 CY |
| SEED FERTILIZER, MULCH | 4.0 ACRES |

| PIPE LENGTHS | QUANTITIES |
|---|---|
| 6-INCH-DIAMETER (SDR 17) HDPE PERF. LEACHATE COLLECTION PIPE | 1,100 LF |
| 6-INCH-DIAMETER (SDR 17) HDPE NON-PERF. LEACHATE PIPE | 480 LF |
| 6-INCH-DIAMETER (SDR 17) HDPE DOUBLE WALL LEACHATE TRANSFER PIPE | 1,070 LF |
| 3-INCH-DIAMETER (SCHEDULE 120) PVC NON-PERF. LEACHATE HEADWELL PIPE | 470 LF |

| MISCELLANEOUS ITEMS | |
|---|---|
| ACCESS/HAUL ROAD | 1,300 LF |
| MANHOLES | 2 EA |
| CULVERTS | 2 EA |
| SEDIMENTATION BASIN (TEMPORARY) | 1 EA |

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| 1. | | | | |

PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **CELL 1, 2A, AND 2B CLOSED CELL 3 ACTIVE**

| | | |
|---|---|---|
| DRAWN BY: NOLDENR | SCALE: 1"=100' | PROJ. NO. 3081.40 |
| CHECKED BY: DM | | FILE NO. PHASE3.PLT |
| APPROVED BY: BJK | DATE PRINTED: | SHEET 9 OF 23 |
| DATE: OCTOBER 2000 | | |

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## CONSTRUCTION ACTIVITIES

CELL 4A CLOSURE

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL GRADING LAYER
3. INSTALL GEOSYNTHETIC CLAY
4. INSTALL GEOMEMBRANE
5. INSTALL DOWNSLOPE FLUME.
6. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL.
7. INSTALL DIVERSION BERMS.
8. SEED, FERTILIZE, AND MULCH.

CELL 4B SITE PREPARATION

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI-SEEP COLLAR TO MAIN TRANSFER LINE.
3. CONSTRUCT PERIMETER BERM, DITCH, AND ACCESS ROAD.
4. ESTABLISH SUBBASE GRADES.
5. UNDERCUT THE COLLECTION LINES.
6. CONSTRUCT THE COMPACTED LOW PERMEABLILTY SOIL LAYER.
7. EXCAVATE THE LEACHATE COLLECTION LINES.
8. INSTALL GCL
9. INSTALL GEOMEMBRANE LINER
10. INSTALL GEOTEXTILE.
11. INSTALL LEACHATE COLLECTION LINES AND CLEANOUTS.
12. INSTALL LEACHATE HEADWELLS.
13. PLACE 1-FOOT SELECT GRANULAR FILL.
14. SEED, FERTILIZE, AND MULCH ALL CONSTRUCTION AREAS AT FINISH
15. GRADE.

## CONSTRUCTION QUANTITIES

| CELL 4A CLOSURE | VOLUME / AREA |
|---|---|
| TOPSOIL PLACED | 5,000 CY |
| GRADING LAYER SOIL | 5,000 CY |
| GENERAL FILL | 9,900 CY |
| SELECT GRANULAR FILL | 9,900 CY |
| GEOTEXTILE | 31,800 SY |
| GCL | 29,700 SY |
| GEOMEMBRANE | 29,700 SY |
| SEED, FERTILIZER, MULCH | 6.1 ARCES |
| 4-INCH DIA. HDPE CORRUGATED PIPE W/ SMOOTH INTERIOR | 2,100 LF |
| SELECT AGGREGATE FILL | 320 CY |

| CELL 4B SITE PREPARATION | VOLUME / AREA |
|---|---|
| STRIP TOPSOIL | 6,800 CY |
| FILL TO ESTABLISH SUBBASE GRADE | 55,200 CY |
| CUT TO ESTABLISH SUBBASE GRADE | 58,800 CY |
| GCL | 31,100 SY |
| GEOMEMBRANE | 31,100 SY |
| SELECT AGGREGATE FILL | 280 CY |
| GEOTEXTILE (CUSHION) | 1,050 SY |
| COMPACTED LOW PERMEABILITY SOIL | 20,700 CY |
| CLEANOUT | 3 EACH |
| SELECT GRANULAR FILL | 10,400 CY |
| TOPSOIL PLACED | 1,600 CY |
| SEED FERTILIZER, MULCH | 2.0 ACRES |

| PIPE LENGTHS | QUANTITIES |
|---|---|
| 6-INCH-DIAMETER (SDR 17) HDPE PERF. LEACHATE COLLECTION PIPE | 450 LF |
| 6-INCH-DIAMETER (SDR 17) HDPE NON-PERF. LEACHATE CLEANOUT | 370 LF |
| 6-INCH-DIAMETER (SDR 17) HDPE DOUBLE WALL LEACHATE TRANSFER PIPE | 0 LF |
| 3-INCH-DIAMETER (SCHEDULE 120) PVC NON-PERF. LEACHATE HEADWELL PIPE | 180 LF |

| MISCELLANEOUS ITEMS | |
|---|---|
| MAINTENANCE ROAD | 1,450 LF |
| SEDIMENTATION BASIN (PRIMARY) | 1 EACH |

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PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **CELLS 1, 2A, 2B, 3, AND 4A CLOSED CELL 4B ACTIVE**

| | | |
|---|---|---|
| DRAWN BY: NOLDENR | SCALE: 1"= 100' | PROJ. NO. 3081.40 |
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| APPROVED BY: BJK | DATE PRINTED: | SHEET 11 OF 23 |
| DATE: OCTOBER 2000 | | |

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## CONSTRUCTION ACTIVITIES

PHASE 4B CLOSURE

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL GRADING LAYER.
3. INSTALL GCL.
4. INSTALL GEOMEMBRANE.
5. INSTALL DOWNSLOPE FLUME.
6. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL.
7. INSTALL DIVERSION BERMS.
8. SEED, FERTILIZE, AND MULCH.

## CONSTRUCTION QUANTITIES

| PHASE 4B CLOSURE | VOLUME / AREA |
|---|---|
| TOPSOIL PLACED | |
| GRADING LAYER SOIL | 9,800 CY |
| GENERAL FILL | 9,800 CY |
| SELECT GRANULAR FILL | 19,600 CY |
| GEOTEXTILE | 19,600 CY |
| GCL | 61,700 SY |
| GEOMEMBRANE | 58,600 SY |
| SEED, FERTILZER, MULCH | 58.600 SY |
| DOWNSLOPE FLUME | 12.1 ACRES |
| 4-INCH DIA. HDPE CORRUGATED PIPT | 1 EACH |
| W/ SMOOTH INTERIOR | 3,150 LF |
| SELECT AGGREGATE FILL | 470 CY |

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PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **PROPOSED FINAL GRADES**

| | | |
|---|---|---|
| DRAWN BY: NOLDENR | SCALE: 1"=100' | PROJ. NO. 3081.40 |
| CHECKED BY: DM | | FILE NO. FGRADES.PLT |
| APPROVED BY: BJK | DATE PRINTED: | SHEET 12 OF 23 |
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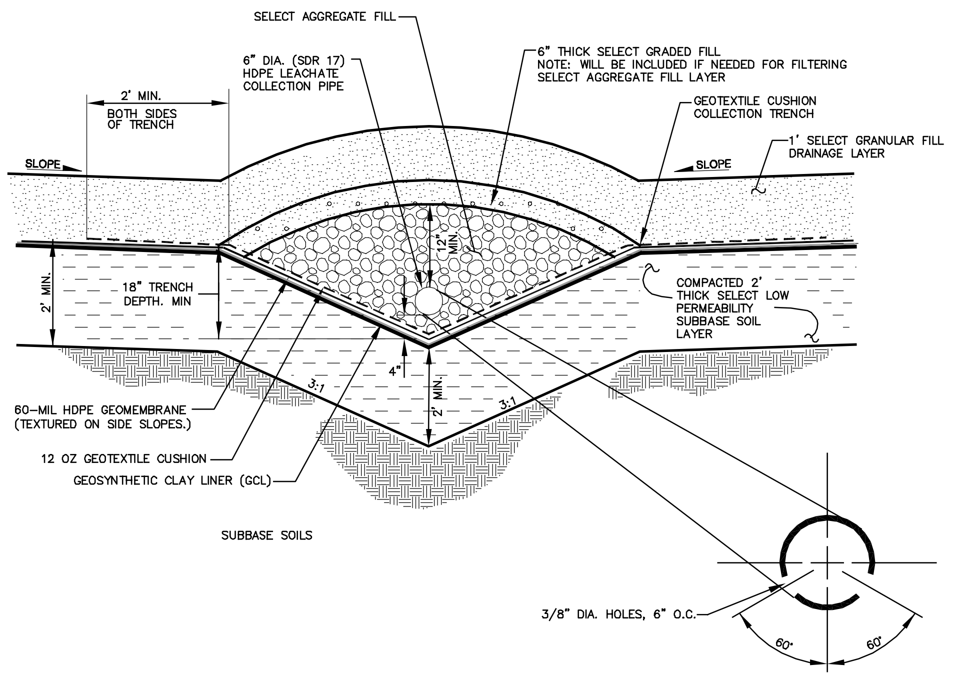
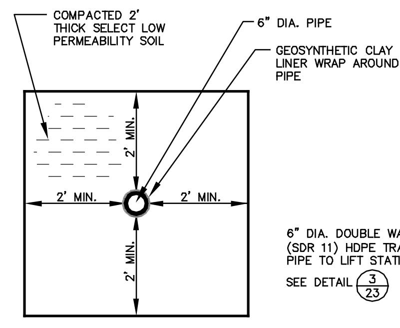
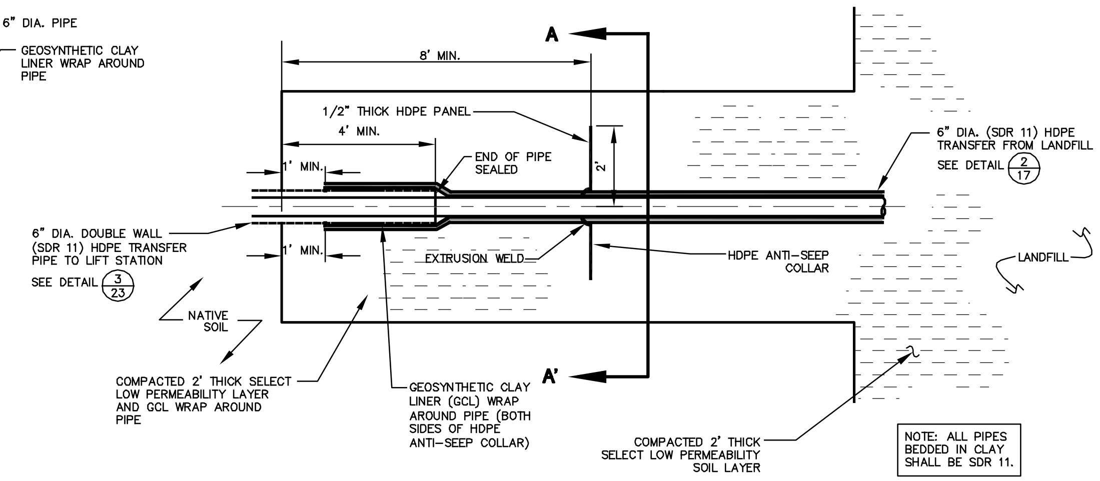



1/17 LEACHATE COLLECTION/LINER SYSTEM

(NOT TO SCALE)

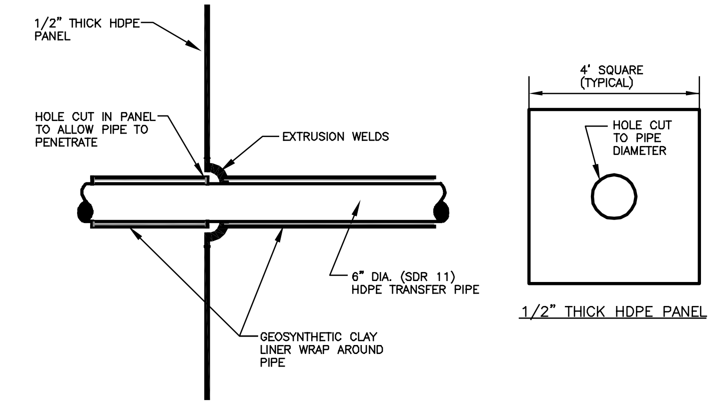



SECTION A-A'

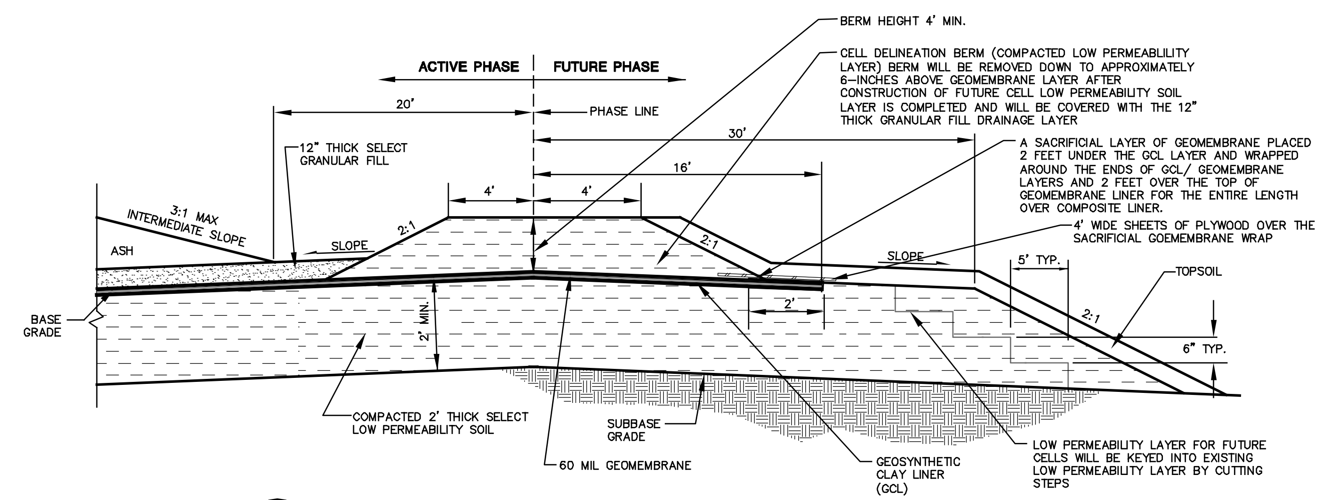



4/17 LEACHATE TRANSFER PIPE CLAY TRENCH CUT-OFF THROUGH PERIMETER BERM (TYPICAL)

(NOT TO SCALE)

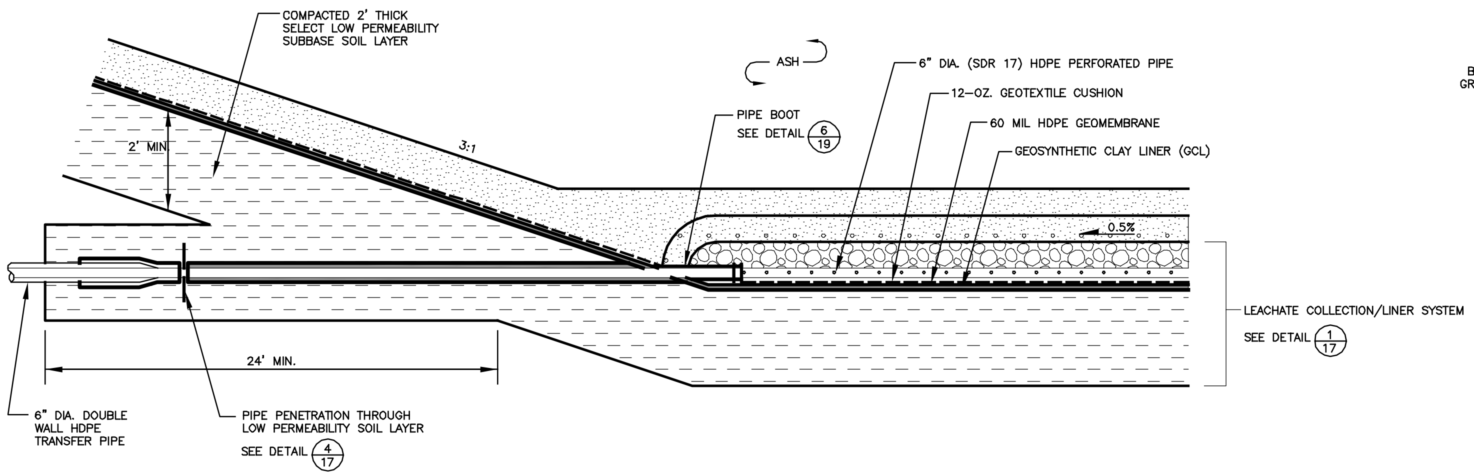



HDPE ANTI-SEEP COLLAR DETAIL (TYPICAL)




5/17 CELL DELINEATION BERM

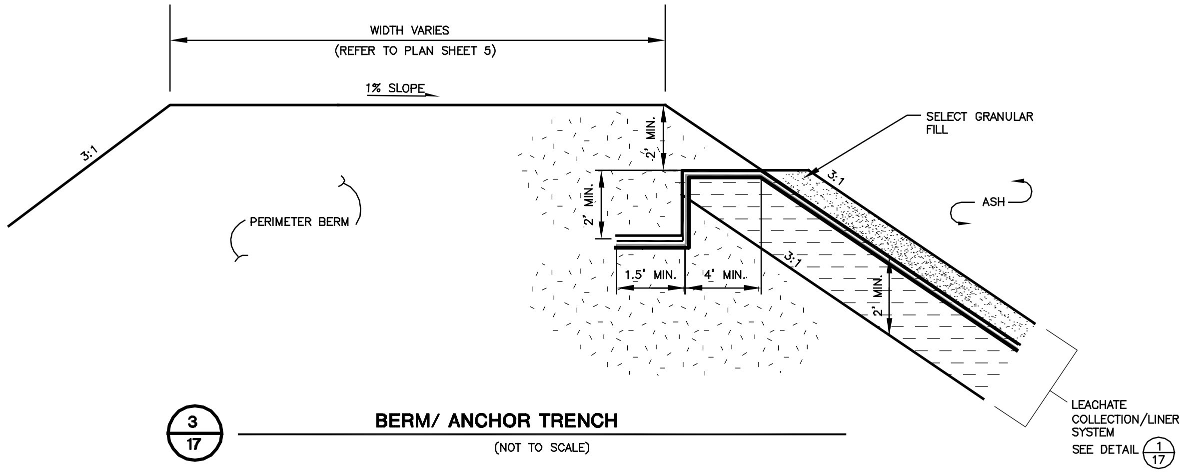
(NOT TO SCALE)




2/17 PIPE PENETRATION THROUGH LANDFILL PERIMETER BERM (TYPICAL)

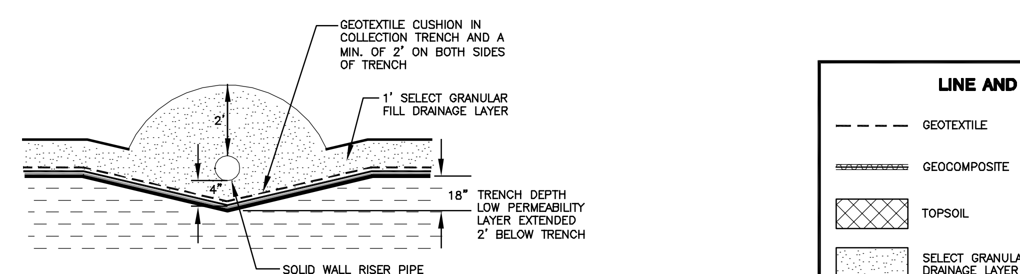
(NOT TO SCALE)

LOOKING EAST



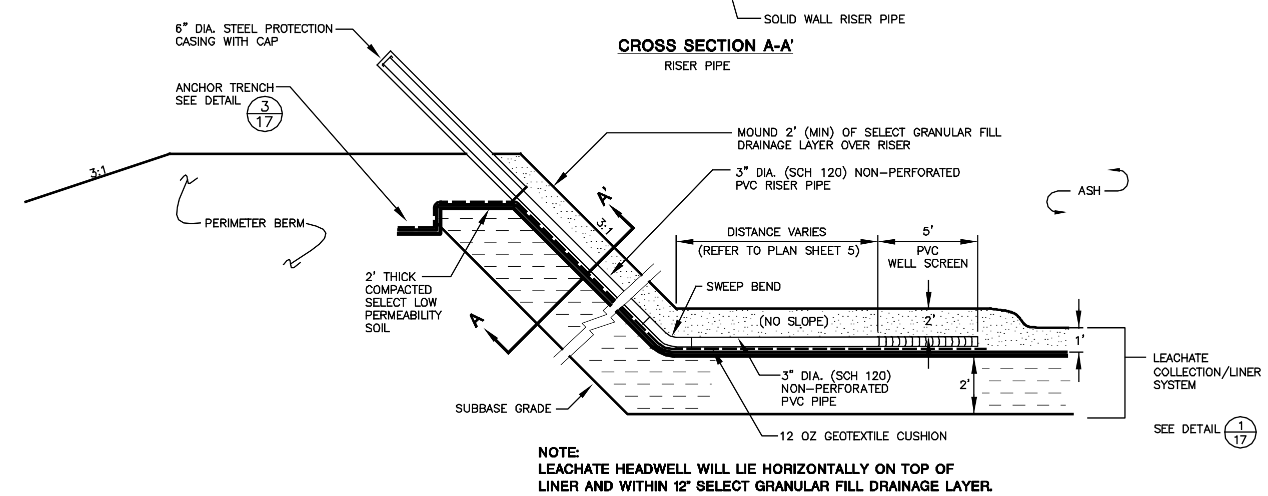

3/17 BERM/ ANCHOR TRENCH

(NOT TO SCALE)




CROSS SECTION A-A'

RISER PIPE




**NOTE:**
**LEACHATE HEADWELL WILL LIE HORIZONTALLY ON TOP OF LINER AND WITHIN 12" SELECT GRANULAR FILL DRAINAGE LAYER.**

**PIPE CONSTRUCTION ON BERM SIDE SLOPE IS ALSO TYPICAL FOR LEACHATE CLEANOUT PIPES.**

6/17 LEACHATE HEADWELL

(NOT TO SCALE)

## LINE AND SHADING LEGEND

| | | | |
|---|---|---|---|
| --- | GEOTEXTILE | ― | GEOMEMBRANE |
| | GEOCOMPOSITE | | GEOSYNTHETIC CLAY LINER (GCL) |
| | TOPSOIL | | NATIVE SOIL |
| | SELECT GRANULAR FILL DRAINAGE LAYER | | CONCRETE |
| | PIPE BEDDING MATERIAL | | RIPRAP |
| | SELECT AGGREGATE FILL | | GRAVEL |
| | COMPACTED SELECT LOW PERMEABILITY SOIL | | GENERAL FILL |

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PROJECT: DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN

SHEET TITLE: DETAILS- LINER AND COLLECTION PIPES

| | | |
|---|---|---|
| DRAWN BY: DEFOEJ | SCALE: | PROJ. NO. 3081.40 |
| CHECKED BY: DM | NOT TO SCALE | FILE NO. 30814005.DWG |
| APPROVED BY: BJK | DATE PRINTED: | SHEET 17 OF 23 |
| DATE: OCTOBER 2000 | | |


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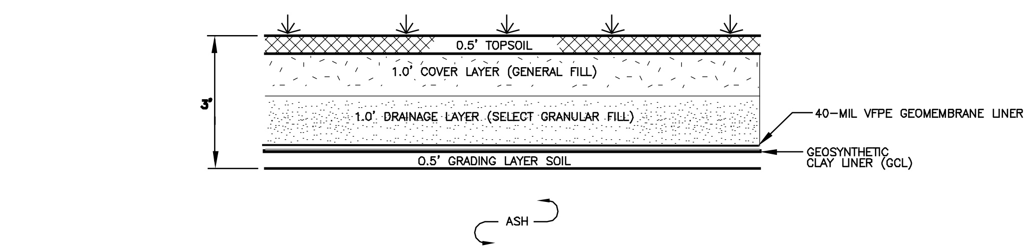
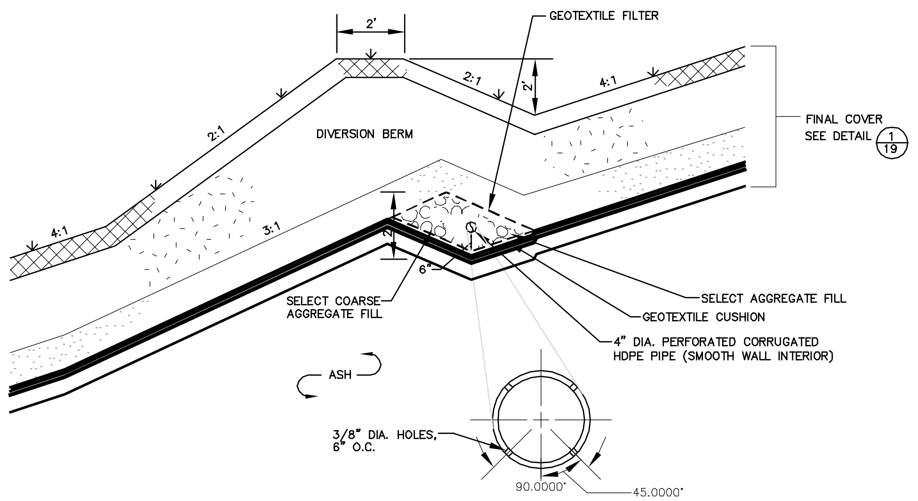



1/19 **FINAL COVER**

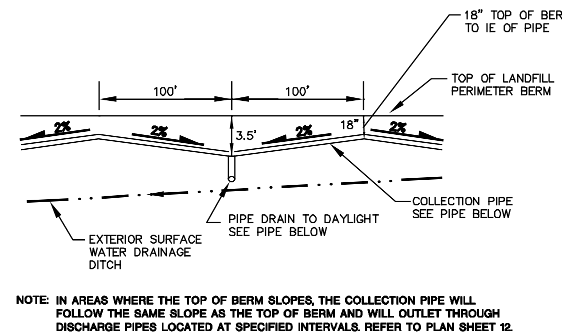
(NOT TO SCALE)




**NOTE:**
**A 4" DIA. PERFORATED CORRUGATED HDPE PIPE WILL BE LOCATED BELOW EVERY DIVERSION BERM ABOVE THE FINAL COVER EXCEPT THE LOWEST BERM LOCATED NEXT TO THE LANDFILL PERIMETER BERM. TO COLLECT WATER IN THE DRAINAGE LAYER ALONG THE PERIMETER BERM PIPES WILL BE CONSTRUCTED IN THE BERM AS SHOWN ON DETAIL 4 OF 19.**

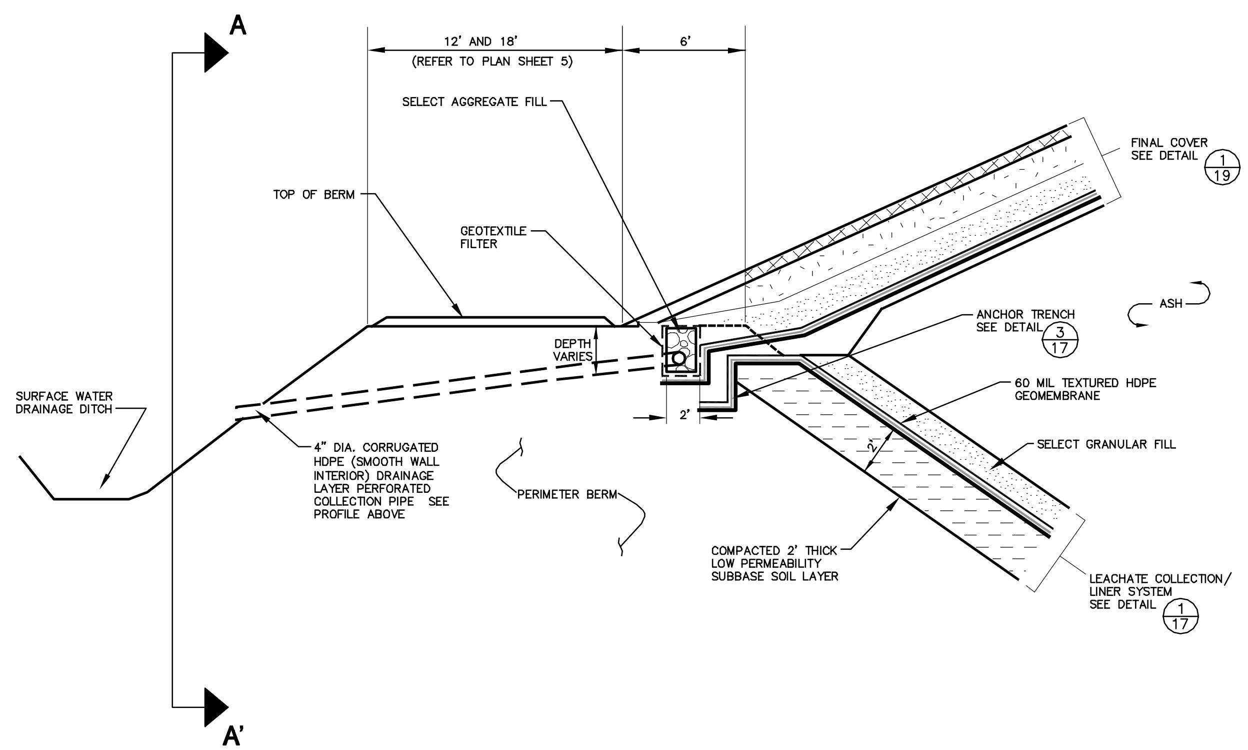
2/19 **SURFACE WATER DIVERSION BERM ON FINAL COVER (TYPICAL)**

(NOT TO SCALE)



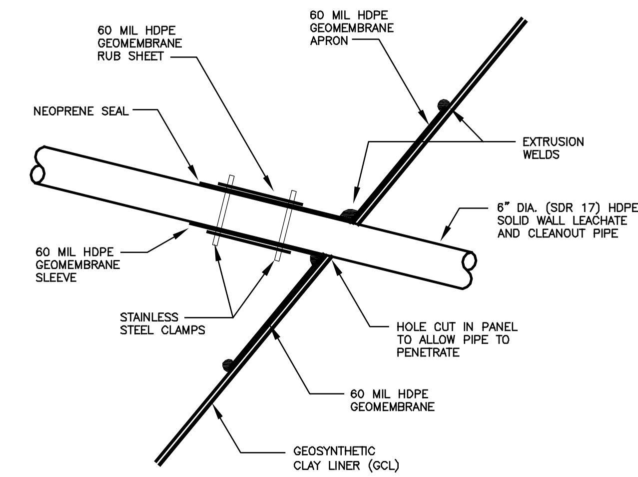

**NOTE: IN AREAS WHERE THE TOP OF BERM SLOPES, THE COLLECTION PIPE WILL FOLLOW THE SAME SLOPE AS THE TOP OF BERM AND WILL OUTLET THROUGH DISCHARGE PIPES LOCATED AT SPECIFIED INTERVALS. REFER TO PLAN SHEET 12.**

**SECTION A-A' OF FINAL COVER DRAINAGE LAYER**



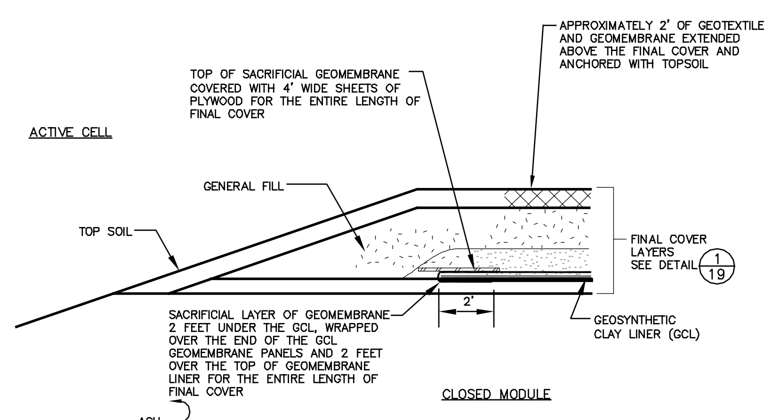

4/19 **PERIMETER BERM FINAL COVER DRAINAGE LAYER DISCHARGE PIPE (TYPICAL)**

(NOT TO SCALE)



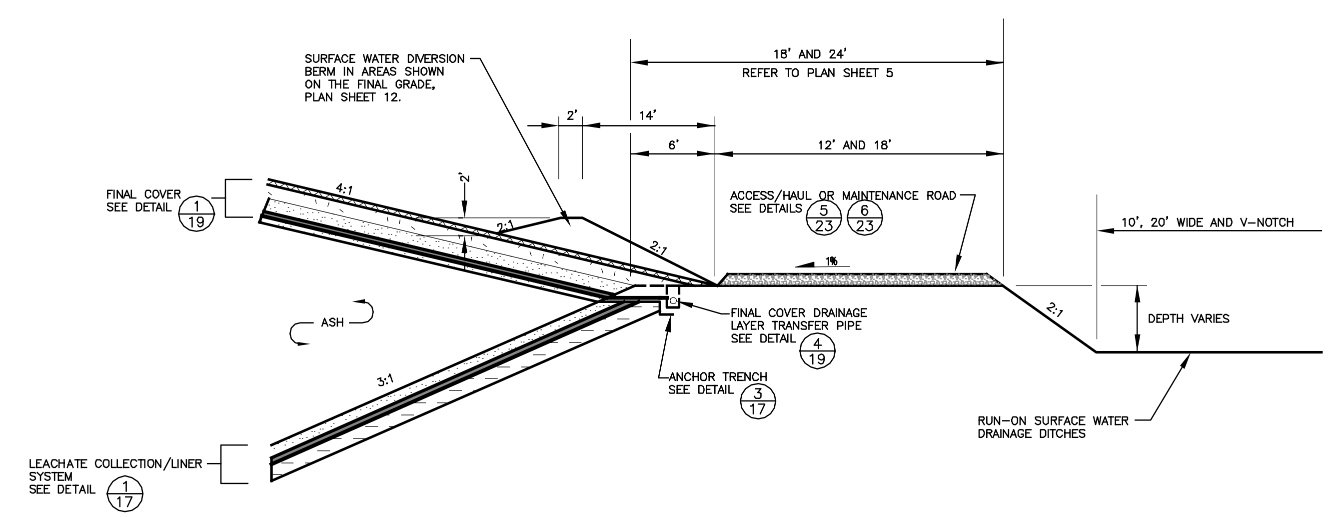

6/19 **PIPE BOOT- PIPES PENETRATING THROUGH FINAL COVER AND LOW PERMEABILITY LAYER (TYPICAL)**

(NOT TO SCALE)




3/19 **CONSTRUCTION OF FINAL COVER FOR SPLICING FUTURE FINAL COVER**

(NOT TO SCALE)




5/19 **LANDFILL PERIMETER BERM AND SURFACE WATER DRAINAGE DITCHES (TYPICAL)**

(NOT TO SCALE)

**LINE AND SHADING LEGEND**

| | | | |
|---|---|---|---|
| – – – – | GEOTEXTILE | ——— | GEOMEMBRANE |
| | GEOCOMPOSITE | ━━━ | GEOSYNTHETIC CLAY LINER (GCL) |
| | TOPSOIL | | NATIVE SOIL |
| | SELECT GRANULAR FILL DRAINAGE LAYER | | CONCRETE |
| | PIPE BEDDING MATERIAL | | RIPRAP |
| | SELECT AGGREGATE FILL | | GRAVEL |
| | COMPACTED SELECT LOW PERMEABILITY SOIL | | GENERAL FILL |

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| NO. | BY | DATE | REVISION | APP'D. |
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PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **DETAILS- FINAL COVER**

| | | |
|---|---|---|
| DRAWN BY: DEFOEJ | SCALE: NOT TO SCALE | PROJ. NO. 3081.40 |
| CHECKED BY: DM | | FILE NO. 30814004.dwg |
| APPROVED BY: BJK | DATE PRINTED: | SHEET 19 OF 23 |
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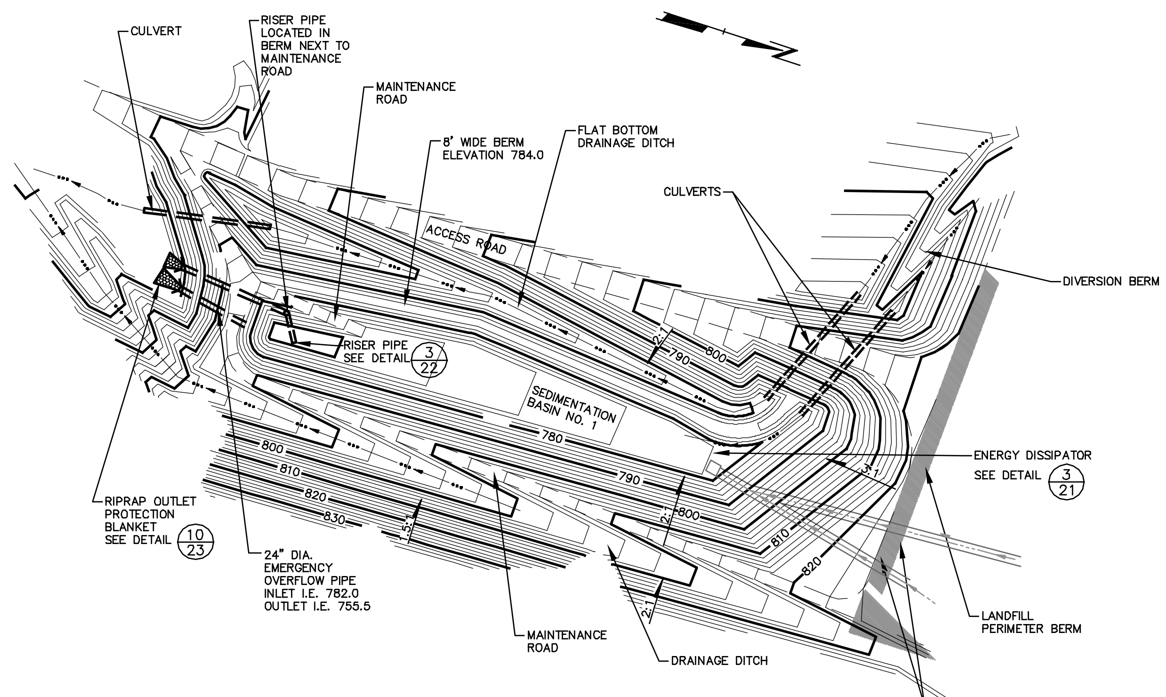
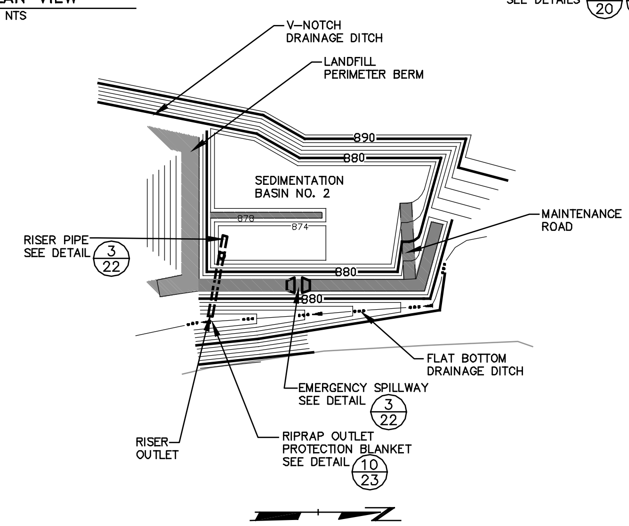
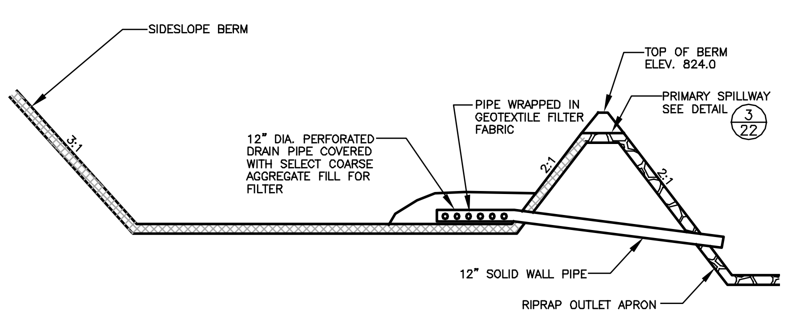



SEDIMENTATION BASIN #1
PLAN VIEW
NTS

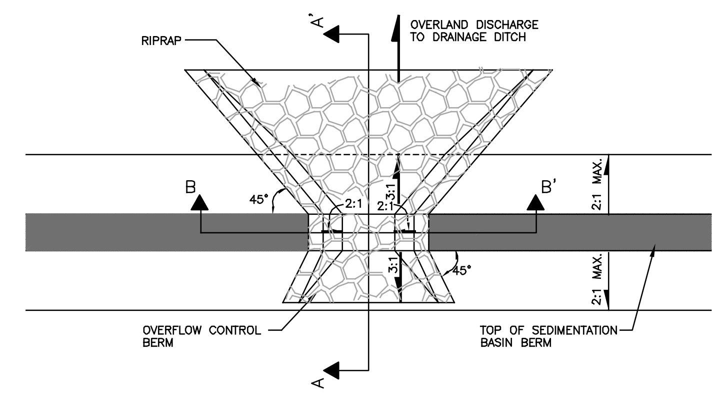



SEDIMENTATION BASIN #2
PLAN VIEW
NTS

**1/22 SEDIMENTATION BASINS NO. 1 AND NO. 2**
(NOT TO SCALE)

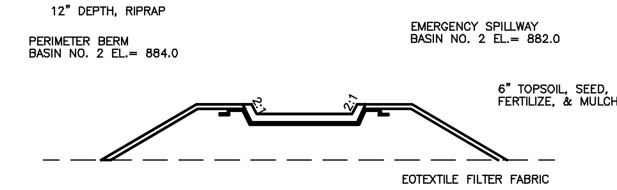



**2/22 TEMPORARY SEDIMENTATION BASIN (TYPICAL)**
(NOT TO SCALE)

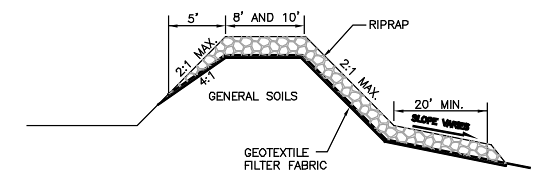



SURFACE WATER PRIMARY OR EMERGENCY SPILLWAY
PLAN VIEW

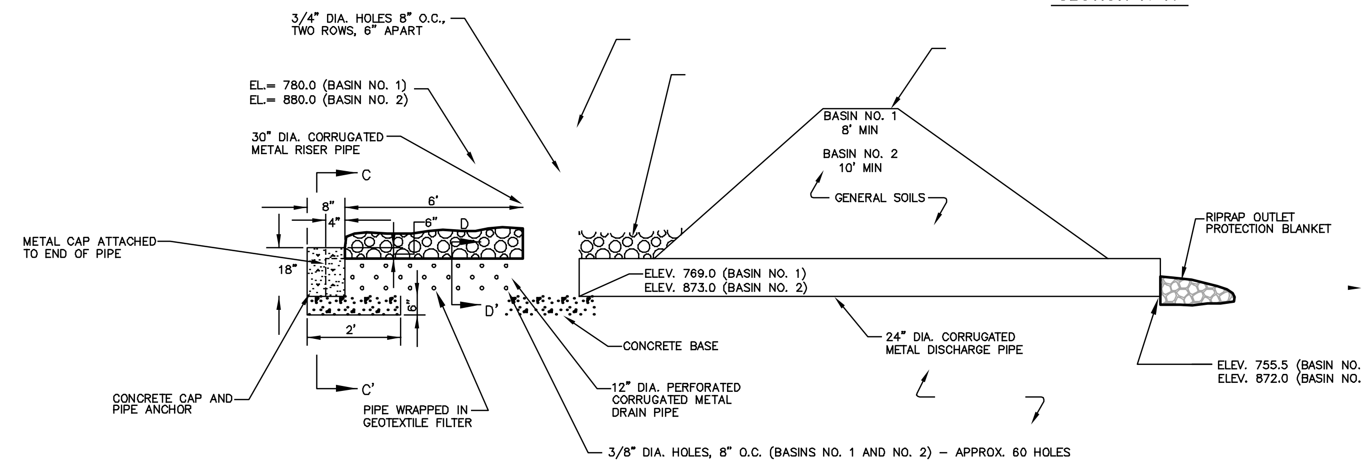
**NOTE:**
**SEDIMENTATION BASIN NO. 1 WILL HAVE A CULVERT PIPE INSTALLED FOR THE EMERGENCY OVERFLOW. SEE DETAIL 1 OF 22.**



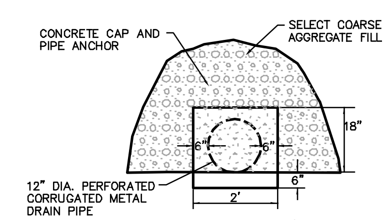

CROSSECTION B-B'



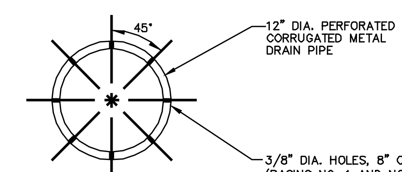

SECTION A-A'




RISER/DISCHARGE PIPE CROSS SECTION (TYPICAL)




SECTION C-C'




SECTION D-D'

**3/22 RISER/DISCHARGE PIPE/EMERGENCY SPILLWAY**
(NOT TO SCALE)

**LINE AND SHADING LEGEND**

| | | | |
|---|---|---|---|
| GEOTEXTILE | | GEOMEMBRANE | |
| GEOCOMPOSITE | | GEOSYNTHETIC CLAY LINER (GCL) | |
| TOPSOIL | | NATIVE SOIL | |
| SELECT GRANULAR FILL DRAINAGE LAYER | | CONCRETE | |
| PIPE BEDDING MATERIAL | | RIPRAP | |
| SELECT AGGREGATE FILL | | GRAVEL | |
| COMPACTED SELECT LOW PERMEABILITY SOIL | | GENERAL FILL | |

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PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **DETAILS- SEDIMENTATION BASINS**

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| DRAWN BY: DEFOEJ | SCALE: NOT TO SCALE | PROJ. NO. 3081.40 |
| CHECKED BY: DM | | FILE NO. 30814007.dwg |
| APPROVED BY: BJK | DATE PRINTED: | SHEET 22 OF 23 |
| DATE: OCTOBER 2000 | | |

RMT
744 Heartland Trail
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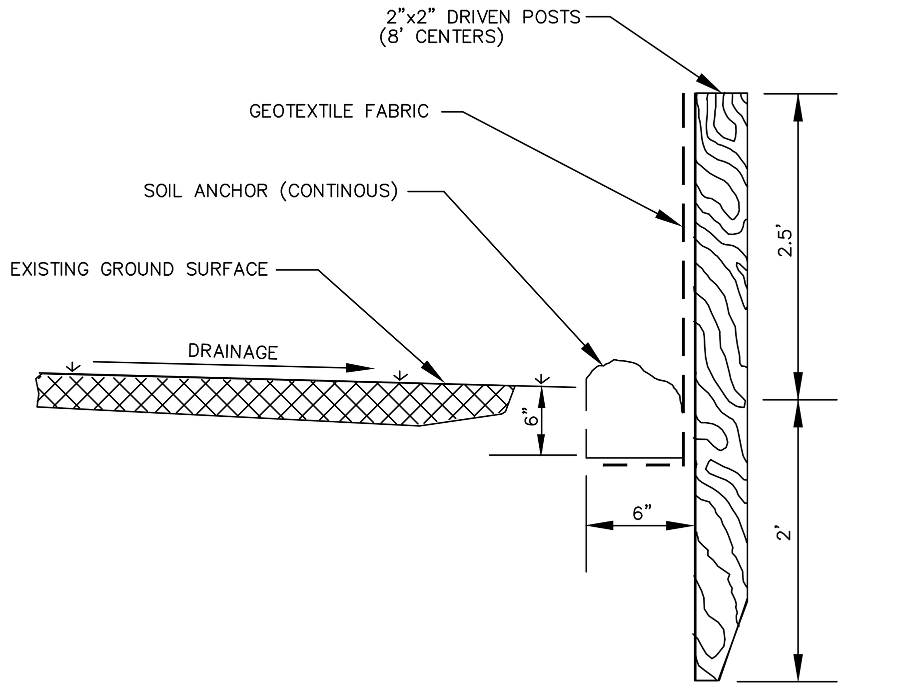
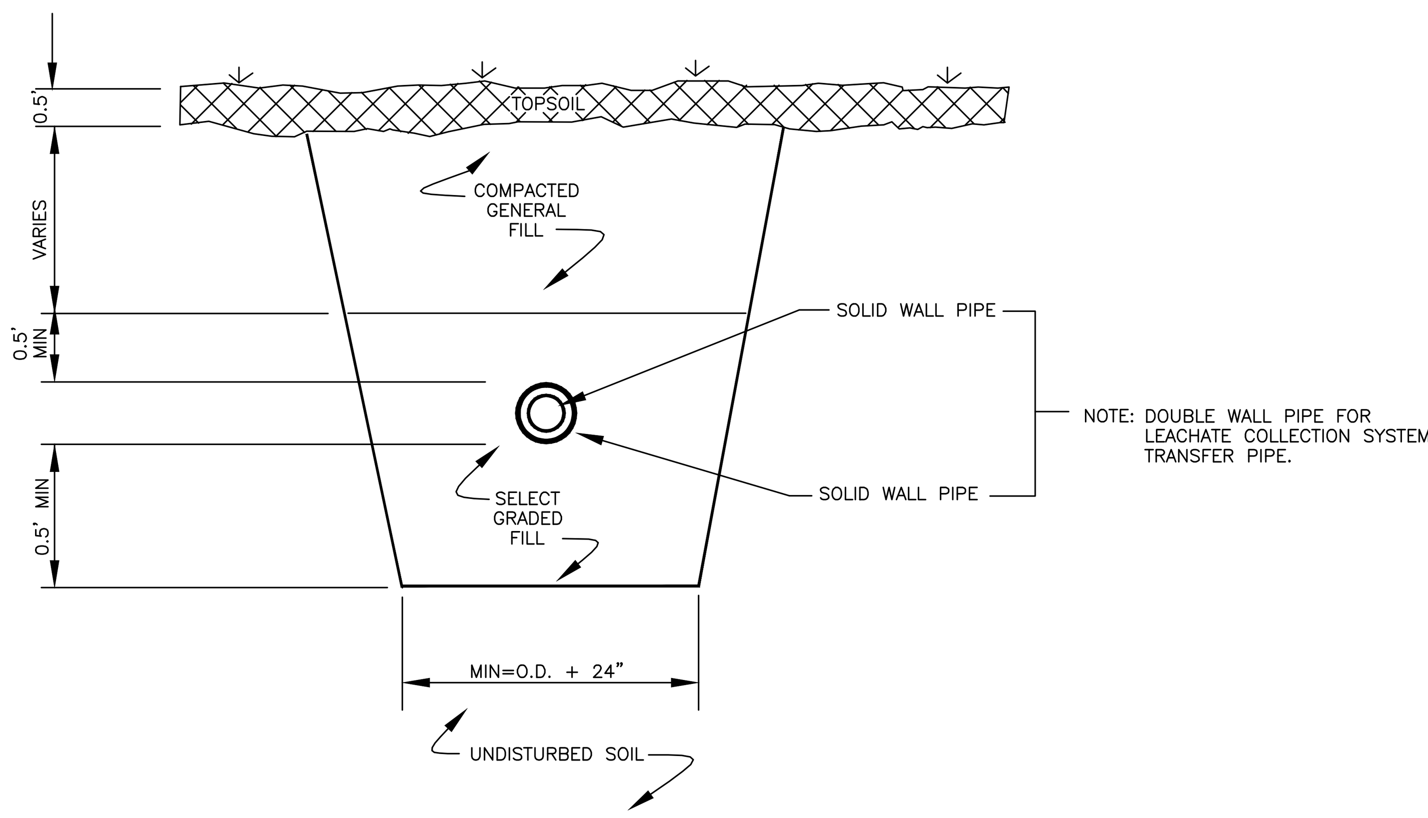



**NOTE:**
DETAIL SHOWN FOR PURPOSES OF IDENTIFYING INSTALLATION METHOD. LOCATION OF FENCE WILL BE DETERMINED AT DEVELOPMENT OF ENGINEERING PLANS FOR EACH PHASE OF CONSTRUCTION AND IN THE FIELD DURING ACTUAL CONSTRUCTION OF EACH PHASE.

1/23 **SEDIMENT CONTROL FENCE**
(NOT TO SCALE)




3/23 **DOUBLE WALL TRANSFER PIPE**
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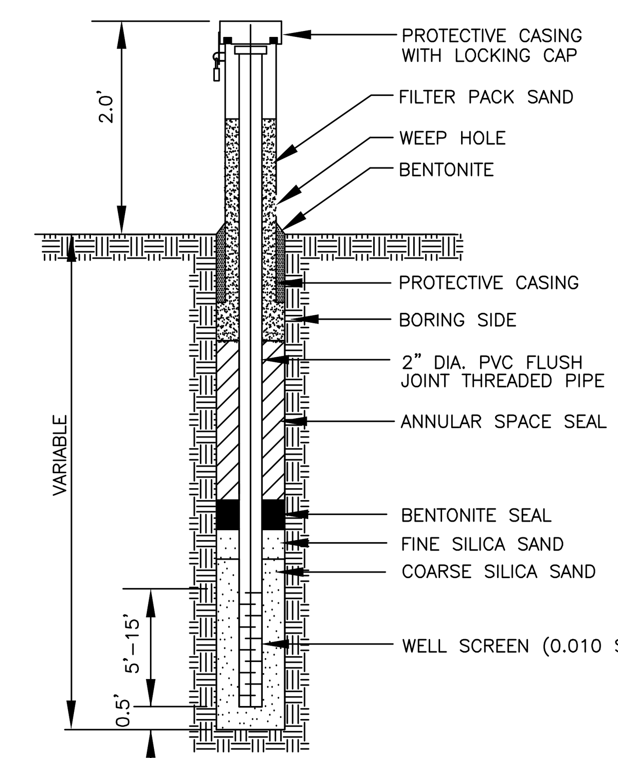


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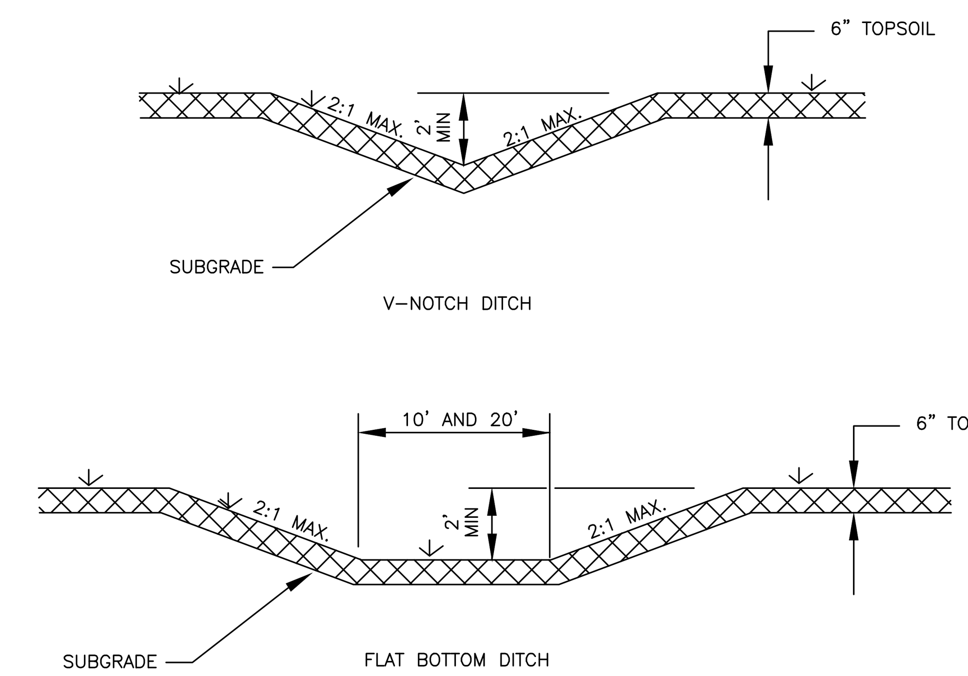


8/23 **DRAINAGE DITCH DETAILS OUTSIDE LANDFILL COVER**
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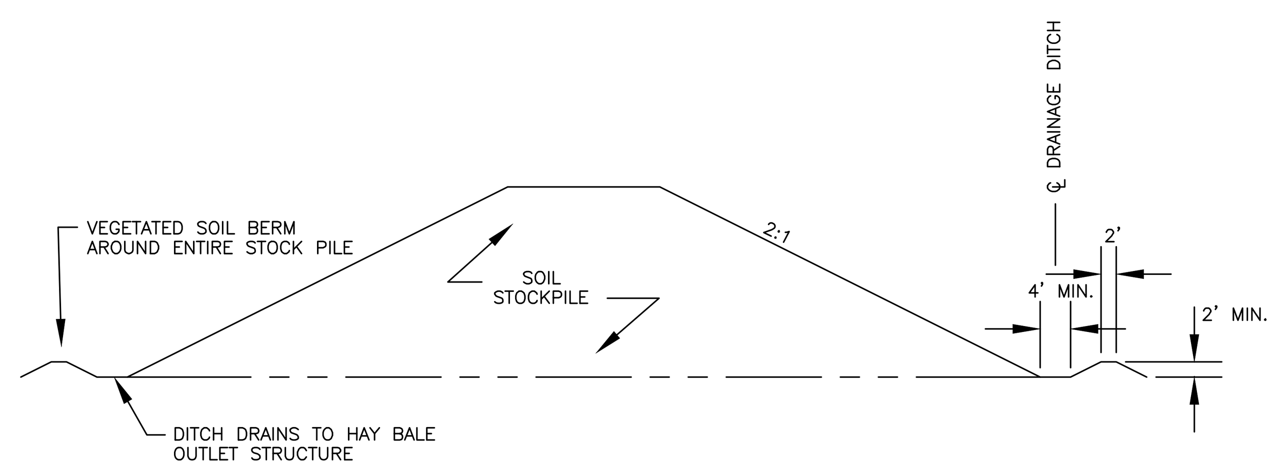
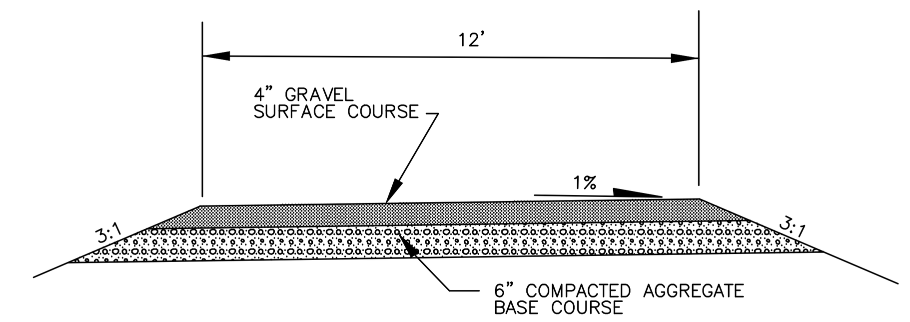



**SECTION B-B'**

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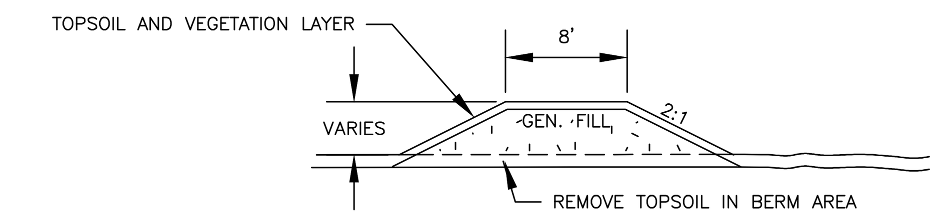


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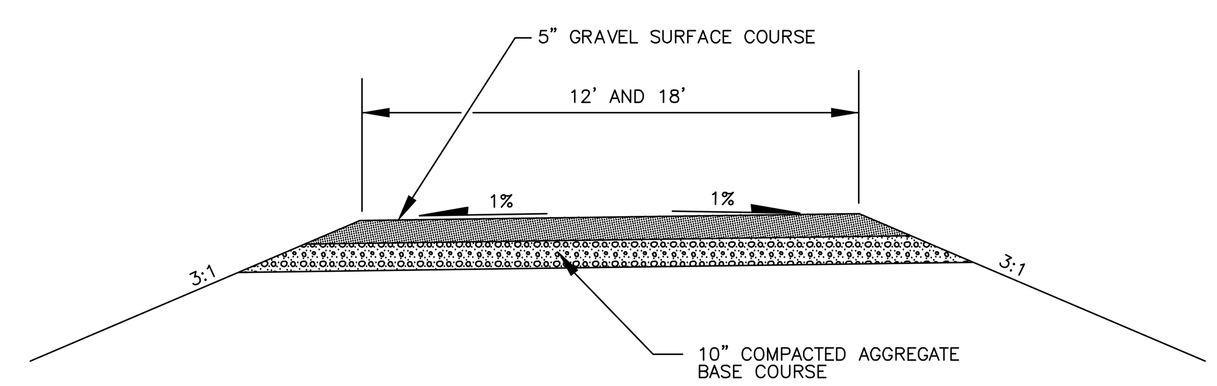


6/23 **ALL WEATHER ACCESS/ HAUL ROAD**
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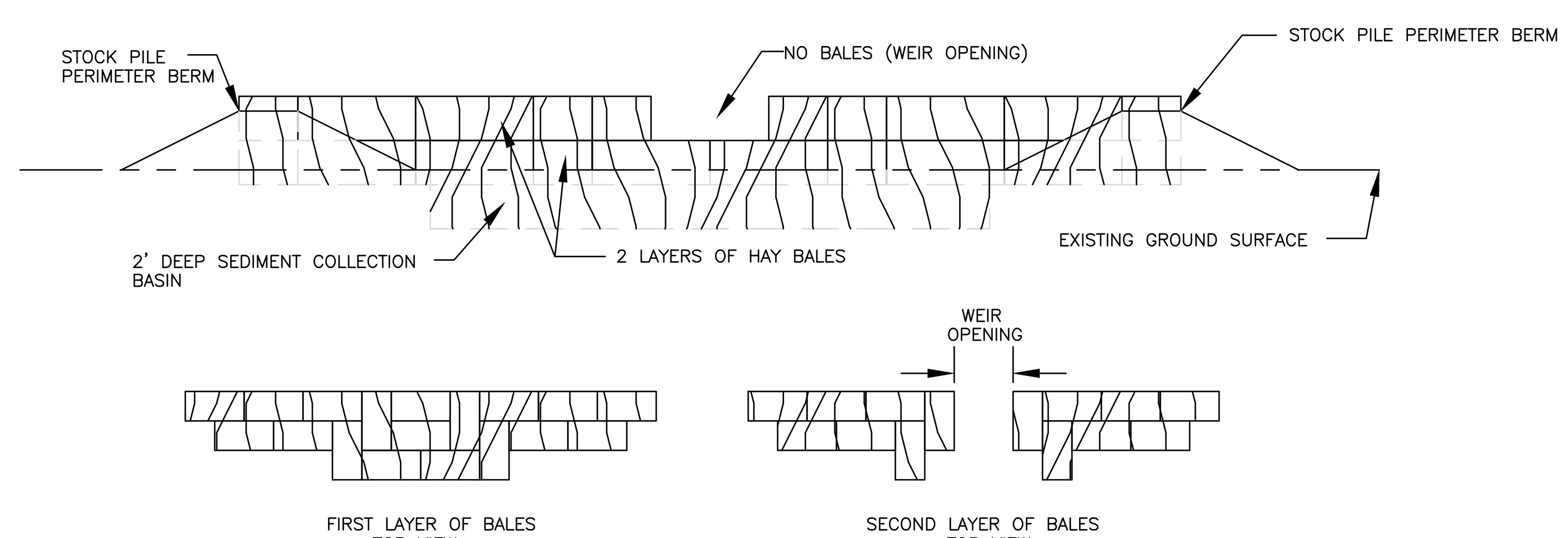
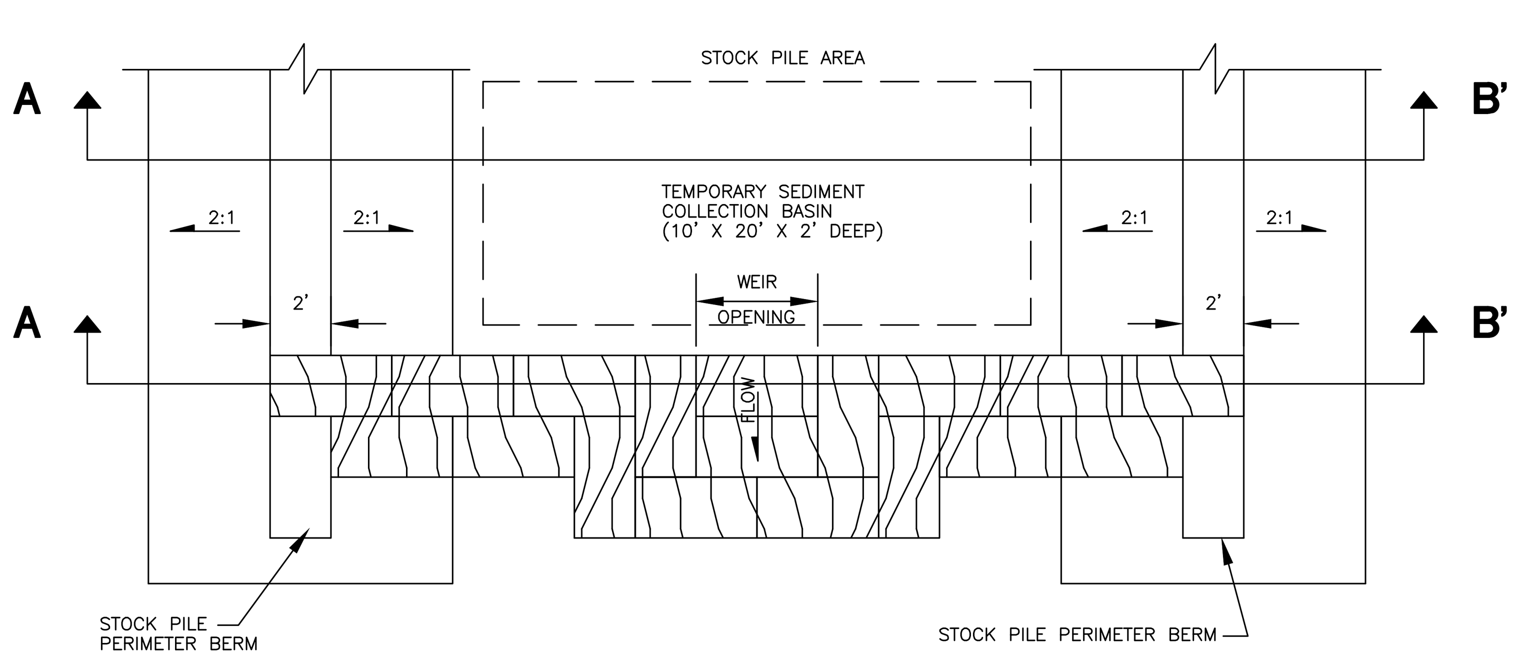



**SECTION A-A'**




2/23 **SURFACE WATER OUTLET FOR STOCKPILES**
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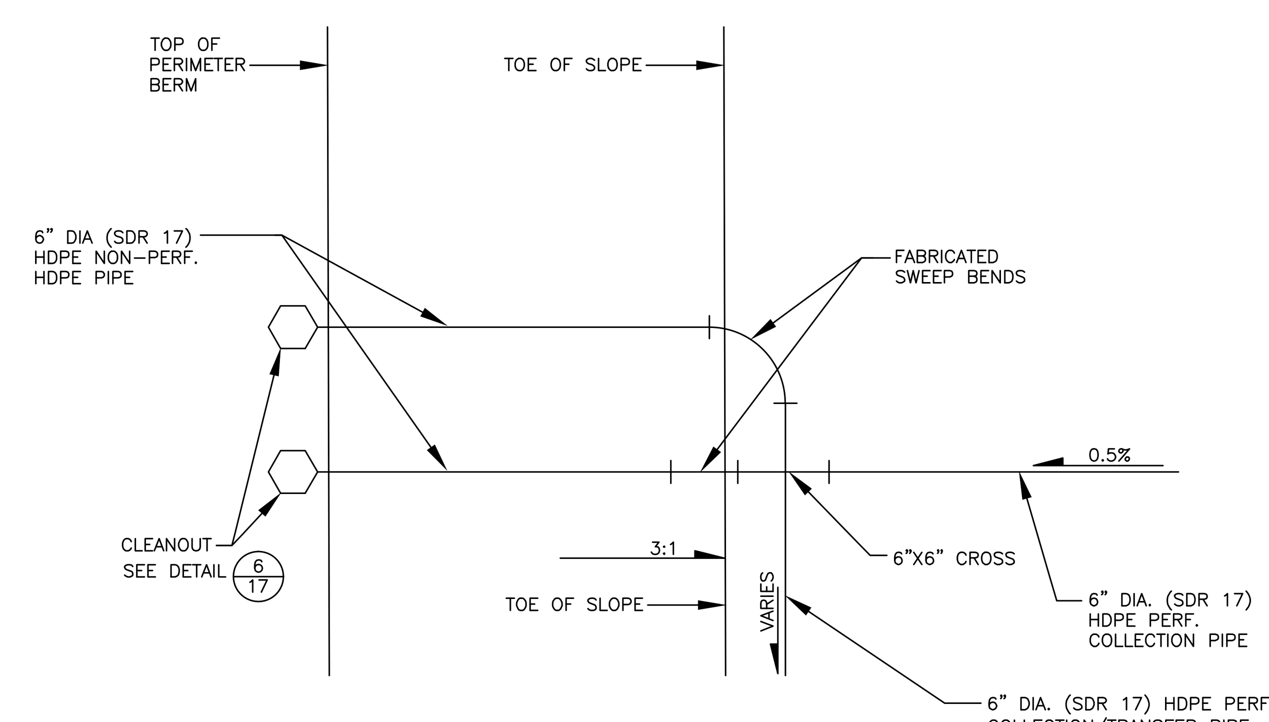


7/23 **PIPE CONNECTIONS (TYPICAL)**
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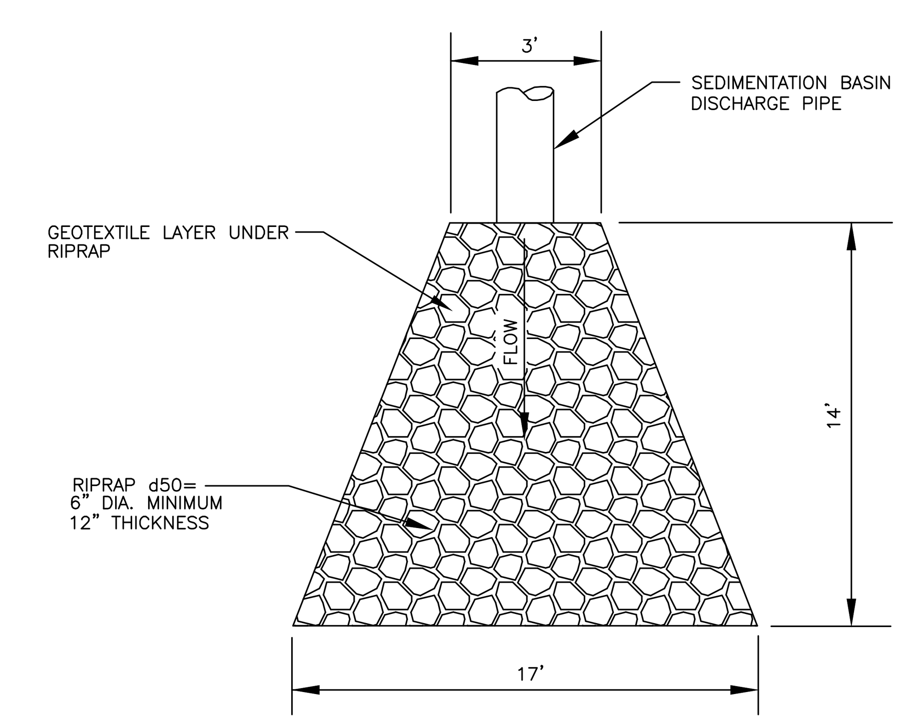
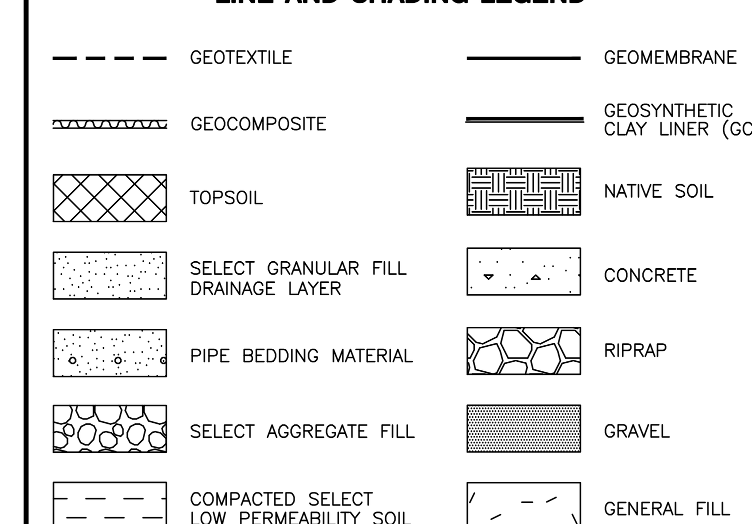



10/23 **DISCHARGE PIPE RIPRAP OUTLET PROTECTION BLANKET**
(NOT TO SCALE)

**LINE AND SHADING LEGEND**

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PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **DETAILS- MISCELLANEOUS**

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| DRAWN BY: DEFOEJ | SCALE: NOT TO SCALE | PROJ. NO. 3081.40 |
| CHECKED BY: DM | | FILE NO.30814003.dwg |
| APPROVED BY: BJK | DATE PRINTED: | SHEET 23 OF 23 |
| DATE: OCTOBER 2000 | | |


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# Appendix D:  Estimated Control System Construction Schedule

**Estimated Run-on and Run-off Structures Construction Schedule**
**Run-on and Run-off Control System Plan**
**Dairyland Power Cooperative, Alma Off-Site Disposal Facility**
**Plan Modification- June 2024**

| Control System | System Components | Construction Event | Anticipated Year of Construction |
|---|---|---|---|
| Run-on Control System<br><br><br><br><br><br><br>Run-off Control System | - Sedimentation Basin 1<br>- Perimeter Drainage Ditches around Cells 1-3<br>- Temporary diversion berm on the northern boundary of Cell 3<br>- Temporary retention basin on northern boundary of Cell 3<br>- Downslope Flume and diversion berms in final cover<br>- Stormwater culverts<br><br>- Leachate collection and transfer system for Cells 1 through 3 | Currently Constructed | N/A |
| Run-on Control System<br><br><br><br><br>Run-off Control System | - Perimeter Drainage Ditches around the northern perimeter of Cell 4A<br>- Stormwater culverts beneath access road<br>- Temporary diversion berm and drainage ditch within Cell 4B footprint<br>- Temporary sedimentation basin east of Cell 4A<br><br>- Leachate collection system for Cell 4A | Cell 4A Liner | 2026 |
| Run-on Control System | - Final Cover Diversion Berms and drainage outlets | Cell 3 Final Cover | 2029 |
| Run-on Control System<br><br><br>Run-off Control System | - Sedimentation Basin 2 construction<br>- Perimeter drainage ditch around remainder of Cell 4<br><br>- Leachate collection system for Cell 4B | Cell 4B Liner | 2036 |
| Run-on Control System | - Final Cover Diversion Berms and drainage outlets | Cell 4A Final Cover | 2038 |
| Run-on Control System | - Final Cover Diversion Berms and drainage outlets | Cell 4B Final Cover | 2057 |

# Attachment 5

# Updated Closure Plan

# Closure Plan

## Alma Offsite Disposal Facility, Phase IV Landfill Alma, Wisconsin

July 2024
Revision 2


**Prepared For:**

Dairyland Power Cooperative
3200 East Avenue South
La Crosse, Wisconsin 54601

**Prepared By:**

TRC
999 Fourier Drive, Suite 101
Madison, Wisconsin 53717

BreAnne Kahnk, P.E.
Senior Engineer

Todd W. Martin
Principal Project Manager


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## TABLES



## APPENDICES

## Revision History

| Revision Number | Revision Date | Section Revised | Summary of Revisions |
|---|---|---|---|
| 1 | 01/12/2023 | 1-3 | Text updates. |
| 2 | 07/09/2024 | 1-2, Tables | Text updates and Table 1 and Table 2 |
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# 1.0 Introduction

This Closure Plan (Plan) was prepared by TRC Environmental Corporation (TRC) on behalf of Dairyland Power Cooperative (DPC) for the Alma Off-Site Disposal Facility, Phase IV Landfill (Landfill) where coal combustion residuals (CCR) are disposed. The approximately 32.1 acres Landfill is located in Sections 18 and 19, T21N, R12W, Town of Belvidere, Buffalo County, Wisconsin. DPC owns and operates the Landfill in compliance with the Plan of Operation (RMT 2000) as permitted by the Wisconsin Department of Natural Resources (WDNR).

This Plan meets the closure requirements of the U.S. Environmental Protection Agency's (USEPA) CCR Rule, Title 40 Code of Federal Regulations (40 CFR) Parts 257 and 261 Subpart D - "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" as well as ch. NR 500-520, Wisconsin Administrative Code. The Landfill is considered an existing CCR landfill according to the CCR rule (40 CFR 257.53).

DPC plans to close the Landfill by leaving the CCR in-place upon completion of CCR placement. The Landfill is operated by moisture conditioning CCR, placing, and compacting the waste in the active area. Final cover will be installed in phases as portions of the Landfill reach the design top of waste grades. The Landfill has a design waste capacity of 3,011,000 cubic yards. Based on the survey conducted on November 13, 2023, 1,322,200 cubic yards of waste has been placed within the landfill. Based on the available capacity (1,688,800 cubic yards as of November 2023) and estimated filling rate (49,000 cubic yards per year), it is anticipated that final closure will be initiated in 2057. This closure date is subject to change based on potential changes in volume of CCR accepted at the Landfill.

Between the Landfill current operations and final closure, several closure events on portions of the Landfill will be conducted. An estimated schedule from current operations (as of June 2024) to the closure of the last portion of the Landfill is provided in Table 1. This schedule includes the estimated acreage and year of when the closure activities for the phased closures would begin. This schedule is subject to changes based both on changes in the volume of CCR accepted at the material and the number of closure phases that would take place.

# 2.0 Closure Plan

## 2.1 Initiation of Closure Activities

The owner or operator of the CCR unit shall initiate closure no later than 30 days after the date on which the CCR unit either receives the known final receipt of waste or removes the known final volume of CCR for beneficial use in accordance with 40 CFR 257.102(e) and s. NR 506.083(2). Closure shall also be commenced if the unit has not received waste or is no longer removing CCR for beneficial use within two years of last receipt of waste or last removal for beneficial use. The owner or operator may secure an additional 2 years so long as they are able to demonstrate that there is reasonable likelihood that the unit will accept waste or remove CCR in the foreseeable future. Subsequent 2-year periods may be continued to be requested so long as they are able to continue to demonstrate the reasonable likelihood of CCR waste disposal or removal for beneficial use. Demonstrations must be placed in the operating recorded prior to the end of any two-year period following 40 CFR 257.102(e)(2)(ii and iii). Per s. NR 506.083(2)(b), these delays shall be requested in writing to the WDNR as a modification to the Closure Plan and include the requirements detailed in s. NR 506.083(2)(b)(1-3).

No later than the date of initiating closure, the owner or operator must prepare a notification of intent to close the Landfill including the certification of a qualified professional engineer for the final cover system design as required by 40 CFR 257.102(d)(3)(iii).

Closure activities have been initiated if the owner or operator has ceased placing waste and completes one of the following activities:

- Taken steps necessary to implement the written closure plan,
- Submitted a completed application for required state or agency permit or modification, or
- Taken steps necessary to comply with state or other agency standards that are pre-requisite to initiating or completing closure.

## 2.2 Closure Performance Standard

The owner or operator of the Landfill will close the CCR unit in a manner that controls post-closure infiltration of liquids into the waste, releases of waste, and leachate or contaminated run-off to groundwater or surface water and preclude the probability of impoundment of water, sediment, or slurry. Measures will be included that provide slope stability which will prevent movement of the final cover system during closure and post-closure. Need for further maintenance of the CCR unit will be minimized. The CCR unit closure should be completed in the shortest amount of time consistent with recognized and generally accepted engineering practices and be done in accordance with 40 CFR 257.102 and s. NR 506.083.

## 2.3 Final Cover System

Closure of the Landfill will occur by leaving the CCR in-place, which requires the construction of a final cover system compliant with 40 CFR 257.102(d) and s. NR 504.12(4). The final cover system shall meet the following requirements:

- Designed to be compliant with s. NR 504.07, or

- The hydraulic conductivity of the final cover must be less than or equal to 1 x $10^{-5}$ centimeters per second (cm/s), or less than or equal to the hydraulic conductivity of the bottom liner system or natural subsoils present, whichever is less.
- An infiltration layer of at least 18 inches of earthen material that meets the requirements of s. NR 504.12(4)(b)(2).
- An erosion layer of at least six inches of earthen material that is capable of sustaining native plant growth that meets the requirements of s. NR 504.12(4)(b)(3).
- The final cover system must be designed to minimize impacts due to settling and subsidence.

The Landfill will be closed using a composite final cover system. For all future final cover events, the following design will be used (from bottom to top):

- a 24-inch compacted soil barrier (barrier layer),
- GCL (barrier layer),
- a 40-mil textured linear low density polyethylene (LLDPE) geomembrane (barrier layer),
- a 12-inch–thick select granular fill drainage layer (infiltration layer),
- an 18-inch–thick general fill rooting layer (infiltration layer), and
- a 6-inch–thick topsoil layer (erosion layer).

In a 2004 Plan of Operation Modification, an alternate final cover system was presented, which has been used in the previous three final cover construction events. This system consisted of the following components (from bottom to top):

- 2-foot (24 inches) moisture-conditioned and compacted "select" fly ash (i.e. mixture containing a minimum of 40 percent of the more reactive J.P. Madgett fly ash) (barrier layer),
- 40-mil geomembrane (barrier layer),
- 1-foot-thick (12 inches) sand drainage layer (infiltration layer),
- 1.5-foot-thick (18 inches) general soil cover layer (infiltration layer), and
- 6-inch-thick topsoil layer (erosion layer).

The general function of each component of the final cover system is provided in parentheses above. The barrier layer consists of 2 feet of compacted material/soil and a 40-mil geomembrane which exceeds the hydraulic conductivity criteria of $1\times10^{-5}$ cm/s. The landfill was constructed with a composite liner system; therefore, a composite final cover system provides an equivalent hydraulic conductivity. The granular fill drainage layer removes water that infiltrates through the erosion and infiltration layers. The infiltration layer and erosion layer meet the requirements of the CCR rule and s. NR 504.07(6) and (7). This final cover system meets the requirements of 40 CFR 257.102(d)(3)(i) and s. NR 504.12(4).

Following placement of final cover and the surface water control features, the area will be fertilized, seeded, and mulched in order to establish vegetation.

The final cover system has design slopes of 25 percent, refer to Sheet 12 from the Plan of Operation in Appendix A. Because the waste is placed and compacted with control of the moisture conditions and the stability of CCR, significant settlement is not anticipated. Global stability of the Landfill and interface stability of the final cover system were evaluated in the Plan of Operation (RMT 2000) with resulting factors of safety that meet the CCR rule. Based on these considerations, the Landfill closure has been designed in a manner to minimize or eliminate infiltration into the waste, preclude the probability of future impoundment of water, provide stable slopes, and minimize future maintenance.

### *2.3.1 Final Cover Construction*

The final cover system will be constructed in phases as the top-of-waste grades are achieved to minimize the active area of the Landfill and leachate generation. The estimated closure phases and the year in which the closure of the phases are projected to be completed are detailed in Table 1. After final CCR placement in the Landfill, the remaining portion of the final cover system will be constructed. Surface water control features on this segment of the final cover will be constructed and connected with the existing surface water control features.

Future final cover will be constructed by fine grading the waste subbase, placing the soil barrier layer and GCL, deploying and installing the 40-mil thick textured geomembrane, placing the granular drainage layer, placing the general fill rooting layer, and placing the topsoil layer. A schedule estimate of closure activities for final closure is presented in Table 2. It is anticipated that closure construction can be completed within the 6-month timeframe, as required by s. NR 506.083(3)(a).

#### 2.3.1.1 Fine Grading the Waste Subbase

The waste subbase will be fine graded and leveled using heavy equipment to provide a surface for the placement of the grading layer and GCL.

#### 2.3.1.2 Soil Barrier Layer and GCL (Future Cover Construction)

The soil barrier layer material will meet the requirements specified in Condition 11b of the Plan of Operation Conditional Approval and January 2024 Addendum to the January 2023 Plan Modification for Initial Permitting of CCR Landfills. The soil barrier layer will have a minimum thickness of 24 inches measured vertically from the top of the ash waste.

The GCL will be deployed above the soil barrier layer such that there is a minimum of 6 inches of overlap on longitudinal seams and a minimum of 24 inches overlap on end seams or as recommended by the manufacturer, whichever is greater. The panels will be placed with the overlap on both longitudinal and end seams shingled down-slope. If the GCL requires granular bentonite to be placed along the seam, the overlapping panel edge will be pulled back and granular sodium bentonite will be poured continuously along all seams, at an application rate of ¼ pound per linear foot.

The GCL will be tested during manufacturing, and prior to installation. The results of manufacturer's testing will be submitted to the engineer for review and approval prior to the acceptance of GCL. Samples from selected rolls delivered to the site will also be collected for conformance testing prior to acceptance and installation.

#### 2.3.1.3 Select CCR Layer (Previously Completed Cover Construction)

The select CCR layer was moisture conditioned and compacted according to the construction specifications. The compaction of the select CCR material was observed by the engineer's representative while documenting construction. The select CCR layer had a minimum thickness of two feet measured vertically from the cover surface.

#### 2.3.1.4 40-mil LLDPE Geomembrane

If GCL is used, the LLDPE geomembrane will be deployed at a rate equivalent to that of the GCL deployment rate such that the GCL panels will be covered daily to prevent against physical damage and/or hydration of the GCL. The geomembrane will be fabricated from a polyethylene resin, which will have a density range of 0.939 g/cc or less for LLDPE. The nominal geomembrane thickness will be 40 mils for LLDPE, with no thickness measurements falling below the minimum industry-accepted manufacturing tolerance.

The geomembrane will be installed with the panels orientated perpendicular to the contours (i.e., running up and down the slope). The geomembrane will be deployed in a manner that does not adversely impact the barrier material below the geomembrane.

Geomembrane panels will be seamed in the field. Production seaming (linear seams) will be performed using the dual hot wedge (fusion type) seam method. Non-production seams (detail work and repairs) will be performed using the extrusion fillet weld process. Corners, butt seams, and long repairs will be fusion-welded where possible. The geomembrane component of the adjacent cell will be welded together for a continuous membrane surface.

The geomembrane will be tested during manufacturing, and prior to and during installation. The results of the manufacturer's testing will be submitted for review and approval prior to the acceptance of geomembrane rolls delivered to the site. Samples from selected rolls delivered to the site will also be collected for conformance testing by a third-party laboratory prior to acceptance and installation. Finally, during placement, both nondestructive and destructive testing of the geomembrane seams will be performed. Nondestructive testing will be performed by the installation contractor and observed by a third party. Destructive testing will consist of both field and third-party laboratory testing of the samples collected.

#### 2.3.1.5 Granular Drainage Layer

After placement and testing of the geomembrane, or portions thereof, a 12-inch–thick select granular fill drainage layer will be placed as soon as practicable to protect the geomembrane and to provide a confining pressure for the underlying GCL, if used. At a minimum, the select granular fill will be placed within 30 days of completing the membrane installation and quality assurance testing.

To minimize the potential for large wrinkles in the geomembrane, the drainage layer will be placed during cooler temperatures when possible. Wrinkles in the geomembrane that are higher than they are wide, will be smoothed or cut out and repaired prior to placing the drainage layer.

The initial lift of select granular fill will be 2 to 3 feet thick, depending on the type of equipment being used, to provide an access ramp. A minimum of 2 feet of material will be placed prior to operating tracked vehicles and flotation tire–equipped vehicles, while a minimum of 3 feet of material will be placed prior to operating trucks and other wheeled hauling equipment. The initial lifts of select granular fill will eventually be graded to the designed 1-foot–thick layer with a low ground pressure (< 5 psi) tracked vehicle. The procedure for deployment of the granular drainage blanket will be established at the preconstruction meeting.

#### 2.3.1.6 General Fill Rooting Layer

An 18-inch–thick uncompacted general fill rooting layer will be placed above the drainage layer in a single lift. The general fill rooting layer will provide a rooting zone for vegetation and will protect the cap from damage due to freeze-thaw and desiccation.

#### 2.3.1.7 Topsoil and Vegetation

The top layer of the final cover system will be a 6-inch–thick layer of topsoil. Topsoil stripped from the landfill and perimeter areas during site preparation will be stockpiled and reused in the final cover. After topsoil is placed, the area will be seeded, mulched, and fertilized. Prior to seeding, the topsoil layer will be prepared for seeding by disking and pulverizing soil within 2 inches of the surface.

DPC has established prairie vegetation on previously constructed phases of final cover with good performance. The prairie vegetation is suitable to soil quality/thickness, and slopes and moisture conditions, with minimal need for continuous maintenance. This prairie vegetation is planned for use in future final cover construction events. Erosion control measures will be installed as needed across the site to limit erosion prior to establishing vegetation.

### *2.3.2 Storm Water Control Features*

Storm water control features will be constructed and/or completed for each phase of final cover construction. Storm water control features consist of diversion berms, a downslope flumes, and energy dissipaters. These storm water control features on the final cover deliver water to perimeter ditches, sedimentation basins, and sediment traps that were constructed during liner construction of the various cells. The storm water control features will be constructed in accordance with the specifications and details presented in the Plan of Operation (RMT 2000), refer to Appendix A for relevant plan sheets from the Plan of Operation. These features are designed to manage runoff from 100-year 24-hour storm events and minimizing scour and erosion of the final cover. Additional details on the storm water control features are provided in the Run-On and Run-Off Control Systems Plan.

## 2.4 Completion of Closure Activities

Within 30 days of completion of closure activities the owner or operator shall prepare a notification of closure of a CCR unit with a certification from a qualified professional engineer that the closure has been performed in accordance with this Plan.

Per 40 CFR 257.102(i) the owner or operator must record a notation on the deed to the property, or some other instrument that is normally examined during title search, that the land has been used for a CCR unit and that it is restricted under the post-closure care requirements as provided in 40 CFR 257.104(d)(1)(iii). Per s. NR 506.083(4)(a), the deed notation (affidavit) is to be recorded within 60 days after closure is complete. A copy of the affidavit is required to be submitted to the WDNR and placed in the facility's operating record within 30 days of recordation.

## 2.5 Amendment of a Written Closure Plan

The owner or operator will amend the written closure plan in accordance with s. NR 514.04(6) whenever:

- There is a change in the operation of the Landfill that would substantially affect the plan in effect, or
- Before or after closure activities have commenced, unanticipated events necessitate a revision.

The closure plan must be amended and submitted in writing to the WDNR at least 60 days prior to a planned change in operation of the Landfill, or no later than 60 days after an unanticipated event occurs that requires the need to revise an existing closure plan. If a written closure plan is revised after closure activities have commenced for the Landfill, the current closure plan must be amended and submitted to the WDNR no later than 30 days following the triggering event.

# 3.0 Notification

## 3.1 Operating Record

The following items will be maintained in the operating record for a minimum of five years:

- 40 CFR 257.105(i)(4): the most recent written closure plan or amendment of the Plan must be maintained for the life of the operating record
- 40 CFR 257.105(i)(7): the notification of intent to close a CCR unit
- 40 CFR 257.105(i)(8): the notification of completion of closure of a CCR unit
- 40 CFR 257.105(i)(9): the notification of recording a notation on the deed

## 3.2 Notification Requirements

The following required notifications will be provided before the close of business on the day the notification is required to be completed:

- 40 CFR 257.106(i)(4)/s. NR 506.17(4)(c): a notification of the available written closure plan or amendment of the Plan
- 40 CFR 257.106(i)(7)/s. NR 506.083(1)(a): the notification of intent to close a CCR unit
- 40 CFR 257.106(i)(8) /s. NR 506.083(1)(b): the notification of completion of closure of a CCR unit
- 40 CFR 257.106(i)(9) /s. NR 506.083(4)(a): the notification of recording a notation on the deed

## 3.3 Publicly Accessible Internet Site

The following required items will be posted on the publicly accessible internet site within 30 days of placing the information in the operating record:

- 40 CFR 257.105(i)(4): the most recent written closure plan or amendment of the Plan must be maintained for the life of the operating record
- 40 CFR 257.107(i)(7): the notification of intent to close a CCR unit
- 40 CFR 257.107(i)(8): the notification of completion of closure of a CCR unit
- 40 CFR 257.106(i)(9): the notification of recording a notation on the deed

Information should be posted within 30 days of placing the pertinent information required by 40 CFR 257.105/NR 506.17(3)(c) in the operating record. Records will be made available to the public for at least five years following the date on which the information was posted to the internet site.

Additional postings to the operating record, notifications, and postings to the publicly accessible internet site may be needed if extensions under 40 CFR 257.102e(2)(ii) or 40 CFR 257.102(f)(2) are pursued.

# 4.0 References

RMT, Inc. 2000. Plan of Operation: Phase IV Disposal Area, Alma Off-site Ash Disposal Facility, Town of Belvidere, Buffalo County, Wisconsin. October 2000.

RMT, Inc. 2004. Plan of Operation Modification: Phase IV Disposal Area, Alma Off-site Disposal Facility, Town of Belvidere, Buffalo County, Wisconsin.

TRC Environmental Corporation. 2021. Run-On and Run-Off Control Systems Plan. October 2021.

## 5.0 Engineer's Certifications

Pursuant to 40 CFR 257.102 and by means of this certification I attest that:

(i) I am familiar with the requirements of the CCR rule (40 CFR 257);

(ii) I am familiar with the requirements of the ch. NR 500-520, Wisconsin Administrative Code;

(iii) this Closure Plan has been prepared in accordance with good engineering practice;

(iv) the design of the final cover system meets the requirements of 40 CFR 257.102(d)(3) and s. NR 504.12(4); and

(v) this Closure Plan meets the requirements of 40 CFR 257.102 and s. NR 514.07(10)(c).

For the purpose of this document, "certify" and "certification" shall be interpreted and construed to be a "statement of professional opinion." The certification is understood and intended to be an expression of my professional opinion as a Wisconsin licensed professional engineer, based upon knowledge, information, and belief. The statement(s) of professional opinion are not and shall not be interpreted or construed to be a guarantee or a warranty of the analysis herein.

Signature of Registered Professional Engineer

Registration No. E-46825 State: Wisconsin

WISCONSIN
BREANNE N. KAHNK
E-46825
MIDDLETON, WI
7-24-24
PROFESSIONAL ENGINEER

**Table 1: Estimated Schedule of Phased Closure**
**Alma Offsite Disposal Facility, Phase IV Landfill**

| Closure Phase | Acreage | Estimated Year of Closure[(1)] |
|---|---|---|
| Portion of Cell 1[(2)] | 3.6 acres | 2010 |
| Portion of Cell 2A and Cell 1[(2)] | 1.7 acres | 2012 |
| Portions of Cell 1/2A/2B[(2)] | 2.8 acres | 2017 |
| Cell 3 | 5.84 acres | 2029 |
| Cell 4A | 6.11 acres | 2038 |
| Cell 4B | 12.05 acre | 2057 |

Footnotes:

(1) Closure construction may be shifted to different years based on rate of filling.

(2) Closure phases currently constructed.

**Table 2: Schedule Estimate for Completing Closure**
**Closure Plan – Alma Offsite Disposal Facility, Phase IV Landfill**

| **Closure Area: 12.1 Acres - Final Phase of Final Cover on Plan of Operation Phasing Plans** | | | |
|---|---|---|---|
| **Task/Milestone** | **Start Date[1]** | **Duration** | **Estimated End Date** |
| Ash Filling Ceases | 2/1/2057 | -- | 2/1/2057 |
| Notification to Initiate Closure | 3/2/2057 | -- | 3/2/2057 |
| Fine Grading Waste | 3/5/2057 | 22 days | 3/26/2057 |
| Select CCR Placement and Compaction[2] | 3/27/2057 | 31 days | 4/26/2057 |
| Geomembrane Deployment and Installation | 4/27/2057 | 21 days | 5/17/2057 |
| Granular Drainage Layer Placement | 5/18/2057 | 18 days | 6/4/2057 |
| General Fill Rooting Zone Placement | 6/5/2057 | 21 days | 6/25/2057 |
| Topsoil Placement and Seeding | 6/26/2057 | 11 days | 7/6/2057 |
| Notification of Completion of Closure | 7/9/2057 | 31 days | 8/8/2057 |
| Deed Notation and Notification | 7/9/2057 | 61 days | 9/7/2057 |
| | **Total Duration:** | **124 days[3]** | |

Footnotes:

(1) Start date based on assumed beginning of 2057 construction season. Closure construction may be shifted to different years based on rate of filling.

(2) Previous final cover construction has utilized the modified final cover design. Timeframes associated for this modified final cover design will be used.

(3) Total duration provided in time to substantial completion of final cover placement. At this point, the CCR has been covered and the vegetation seed and temporary erosion control has been applied. Emergence and establishment of vegetation may require additional time.

Created By: J. Hotstream
Checked By: S. Sellner

Revised by: B. Kahnk
Checked By: Z. Bauman

# Appendix A: Engineering Drawings

- Plan of Operation – Title Sheet (Sheet 1)
- Plan of Operation – Final Grades (Sheet 12)
- Plan of Operation – Details – Final Cover (Sheet 19)
- Cell 3B Liner Construction and Area C (Over Cells 1 and 2) Final Cover Construction – Details (Sheets 12 and 13)

# DAIRYLAND POWER COOPERATIVE

DAIRYLAND Power
COOPERATIVE – LACROSSE, WISCONSIN

## PLAN OF OPERATION
## PHASE IV DISPOSAL AREA
## ALMA OFF-SITE ASH DISPOSAL FACILITY

WISCONSIN
CRAIG O. BARTHOLOMEW
G-451
MADISON
WI
PROFESSIONAL GEOLOGIST
10/13/00

WISCONSIN
BERNARD J. KRANTZ
E-30174
Madison, WI
PROFESSIONAL ENGINEER
10/13/00

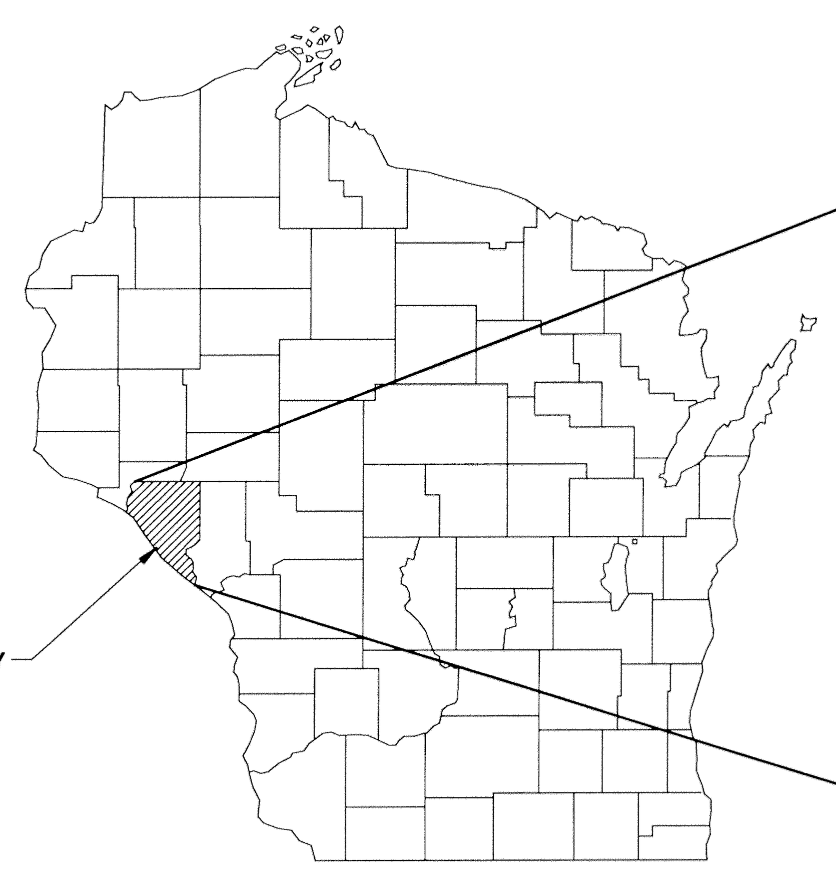
**PREPARED FOR:** DAIRYLAND POWER COOPERATIVE
LACROSSE, WISCONSIN

**PREPARED BY:** RMT, INC.
MADISON, WISCONSIN

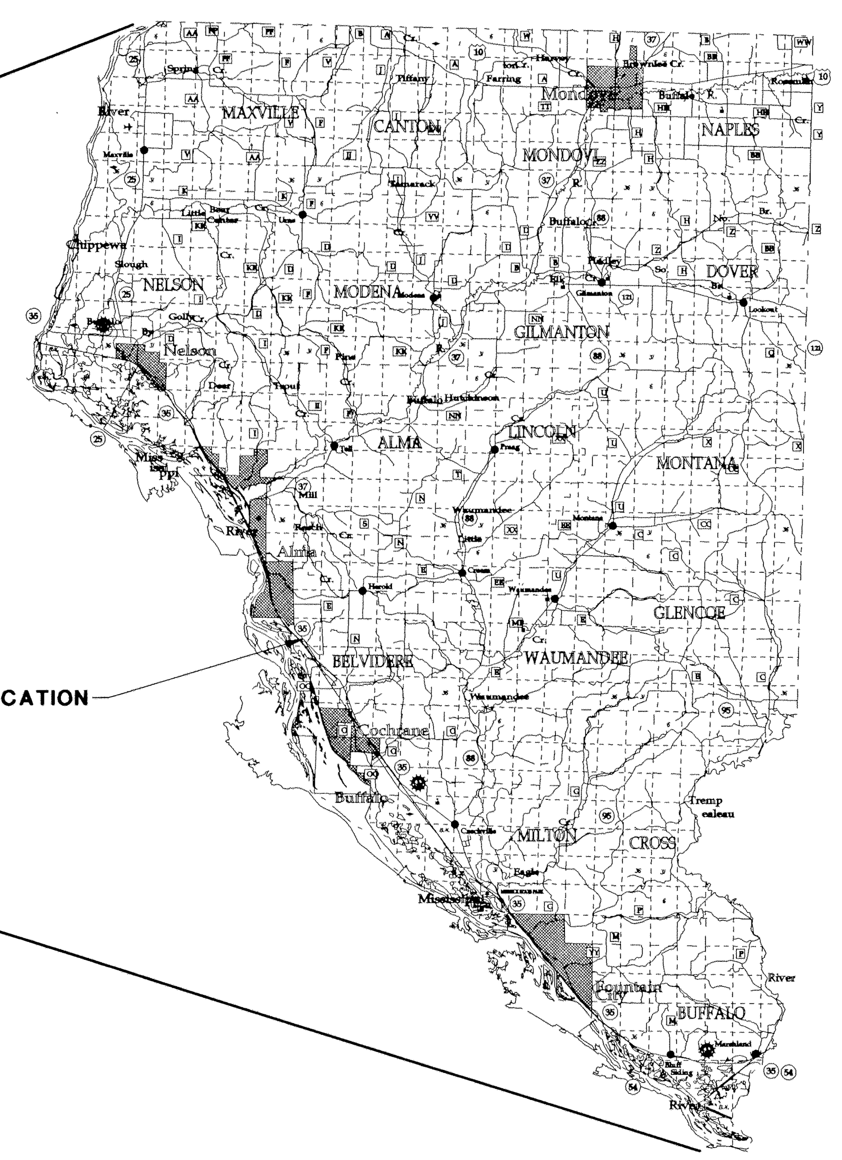
**DATE:** OCTOBER 2000

## INDEX

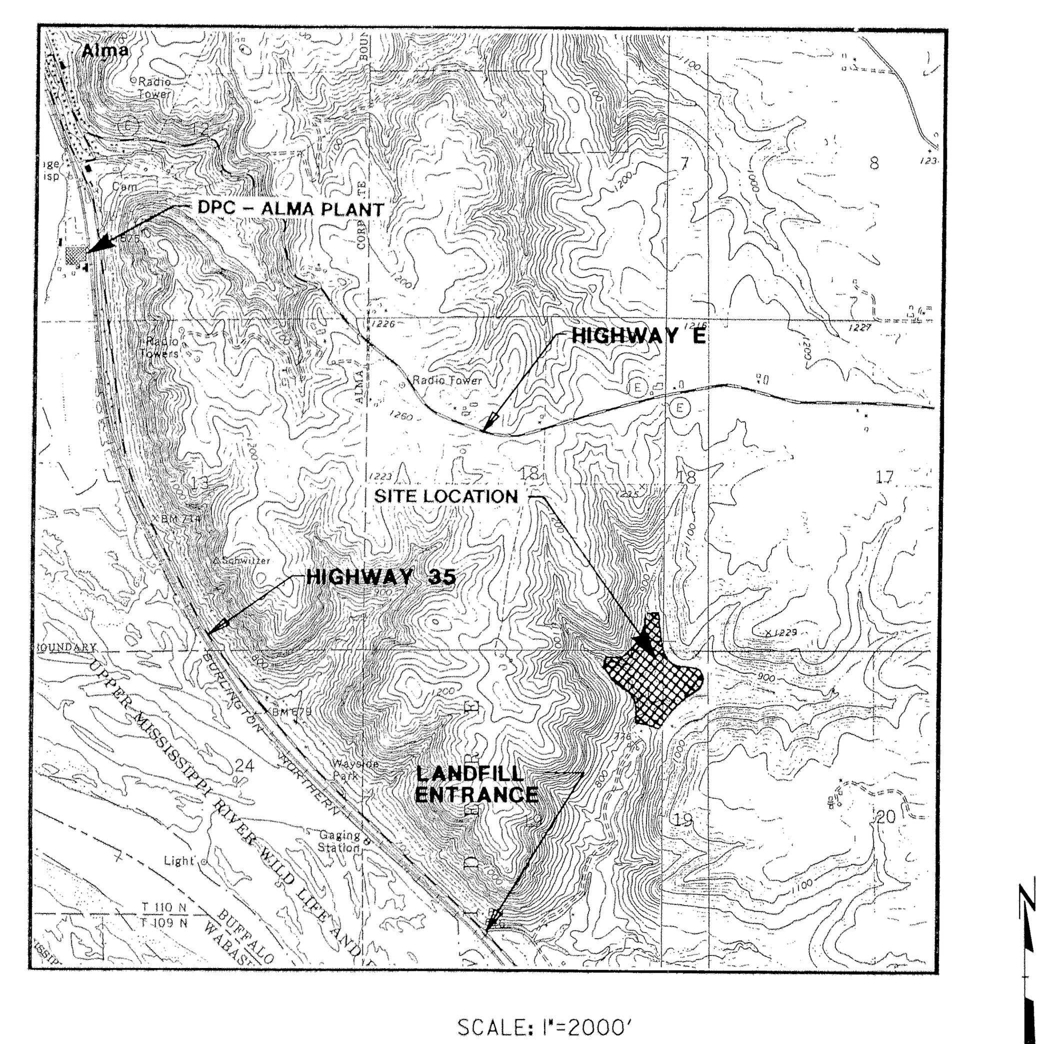





WISCONSIN




BUFFALO COUNTY




SCALE: 1"=2000'

MAP SOURCE: U.S.G.S. CREAM AND ALMA 7.5' QUADRANGLES, DATE 1974.

SITE LOCATION

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. (NOT FOR CONSTRUCTION)

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923
Madison, WI 53708-8923
Phone: 608-831-4444

RMT COMPUTER AIDED DESIGN & DRAFTING


## CONSTRUCTION ACTIVITIES

PHASE 4B CLOSURE

1. INSTALL EROSION CONTROL DEVICES.
2. INSTALL GRADING LAYER.
3. INSTALL GCL.
4. INSTALL GEOMEMBRANE.
5. INSTALL DOWNSLOPE FLUME.
6. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE, ROOTING ZONE LAYER, AND TOPSOIL.
7. INSTALL DIVERSION BERMS.
8. SEED, FERTILIZE, AND MULCH.

## CONSTRUCTION QUANTITIES

| PHASE 4B CLOSURE | VOLUME / AREA |
|---|---|
| TOPSOIL PLACED | |
| GRADING LAYER SOIL | 9,800 CY |
| GENERAL FILL | 9,800 CY |
| SELECT GRANULAR FILL | 19,600 CY |
| GEOTEXTILE | 19,600 CY |
| GCL | 61,700 SY |
| GEOMEMBRANE | 58,600 SY |
| SEED, FERTILZER, MULCH | 58.600 SY |
| DOWNSLOPE FLUME | 12.1 ACRES |
| 4-INCH DIA. HDPE CORRUGATED PIPT | 1 EACH |
| W/ SMOOTH INTERIOR | 3,150 LF |
| SELECT AGGREGATE FILL | 470 CY |

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| NO. | BY | DATE | REVISION | APP'D. |
|---|---|---|---|---|
| 3. | | | | |
| 2. | | | | |
| 1. | | | | |

PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE:

**PROPOSED FINAL GRADES**

| | | |
|---|---|---|
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| CHECKED BY: DM | | FILE NO. FGRADES.PLT |
| APPROVED BY: BJK | DATE PRINTED: | SHEET 12 OF 23 |
| DATE: OCTOBER 2000 | | |


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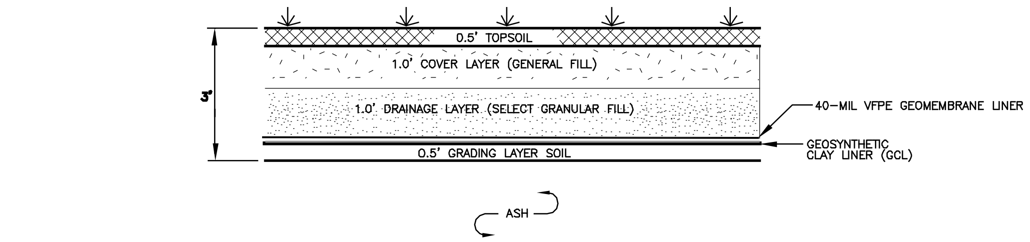
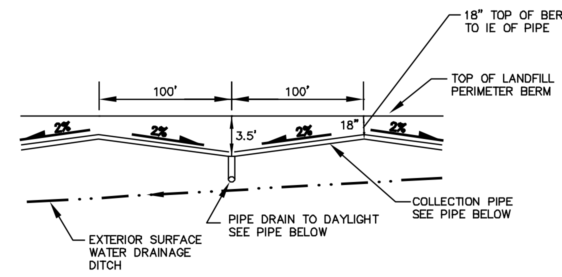


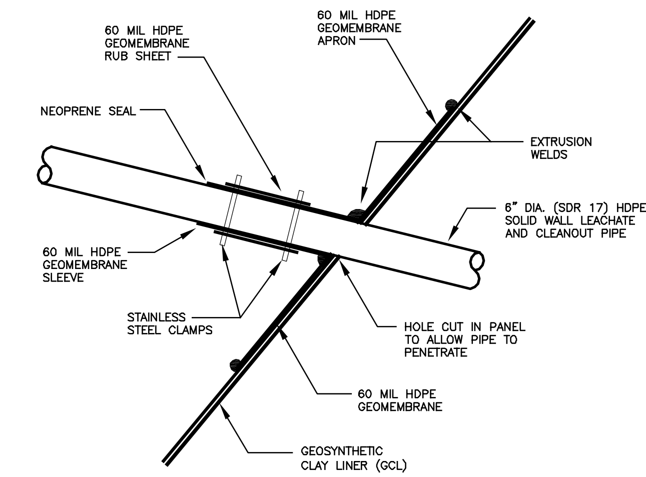

1/19 **FINAL COVER**

(NOT TO SCALE)



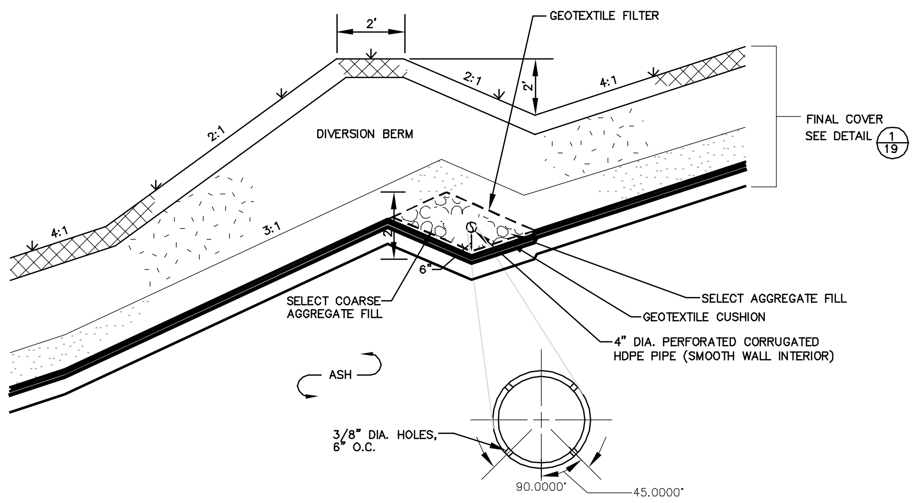

NOTE: IN AREAS WHERE THE TOP OF BERM SLOPES, THE COLLECTION PIPE WILL FOLLOW THE SAME SLOPE AS THE TOP OF BERM AND WILL OUTLET THROUGH DISCHARGE PIPES LOCATED AT SPECIFIED INTERVALS. REFER TO PLAN SHEET 12.

SECTION A-A' OF FINAL COVER DRAINAGE LAYER




6/19 **PIPE BOOT- PIPES PENETRATING THROUGH FINAL COVER AND LOW PERMEABILITY LAYER (TYPICAL)**

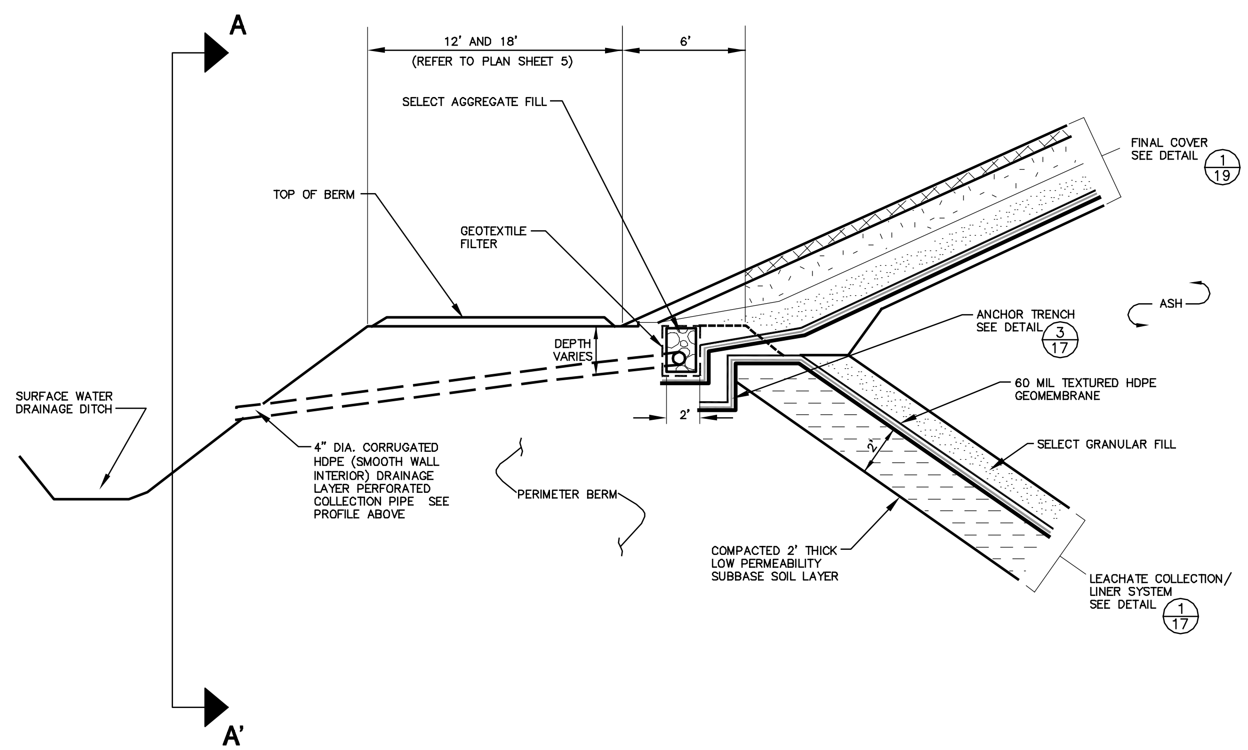
(NOT TO SCALE)




NOTE:
A 4" DIA. PERFORATED CORRUGATED HDPE PIPE WILL BE LOCATED BELOW EVERY DIVERSION BERM ABOVE THE FINAL COVER EXCEPT THE LOWEST BERM LOCATED NEXT TO THE LANDFILL PERIMETER BERM. TO COLLECT WATER IN THE DRAINAGE LAYER ALONG THE PERIMETER BERM PIPES WILL BE CONSTRUCTED IN THE BERM AS SHOWN ON DETAIL 4 OF 19.

2/19 **SURFACE WATER DIVERSION BERM ON FINAL COVER (TYPICAL)**

(NOT TO SCALE)



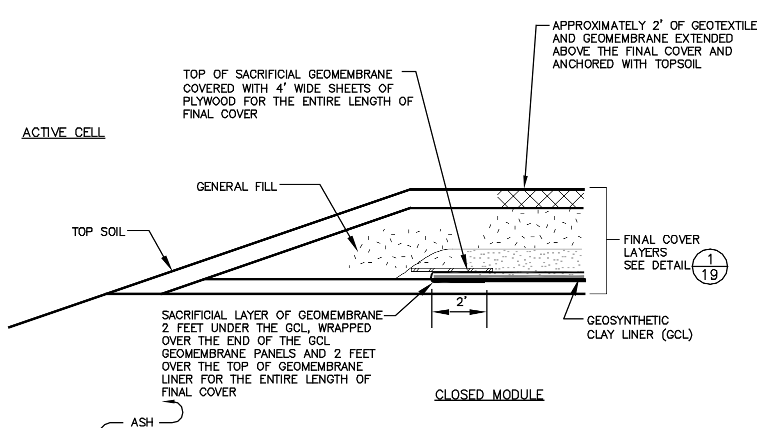

4/19 **PERIMETER BERM FINAL COVER DRAINAGE LAYER DISCHARGE PIPE (TYPICAL)**

(NOT TO SCALE)

**LINE AND SHADING LEGEND**

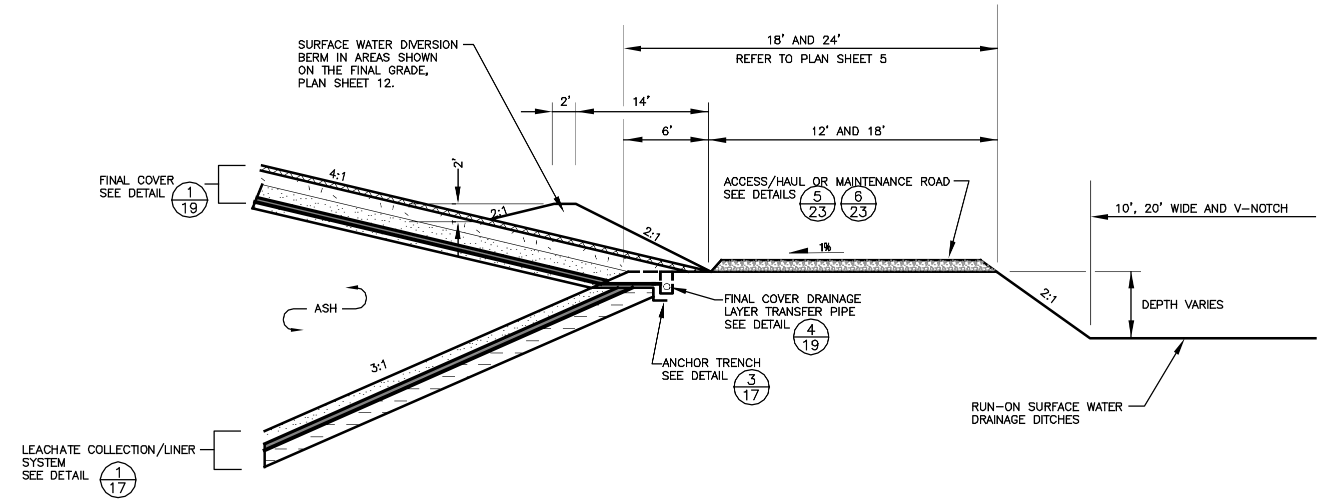
| | |
|---|---|
| GEOTEXTILE | GEOMEMBRANE |
| GEOCOMPOSITE | GEOSYNTHETIC CLAY LINER (GCL) |
| TOPSOIL | NATIVE SOIL |
| SELECT GRANULAR FILL DRAINAGE LAYER | CONCRETE |
| PIPE BEDDING MATERIAL | RIPRAP |
| SELECT AGGREGATE FILL | GRAVEL |
| COMPACTED SELECT LOW PERMEABILITY SOIL | GENERAL FILL |

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.
NOT FOR CONSTRUCTION




3/19 **CONSTRUCTION OF FINAL COVER FOR SPLICING FUTURE FINAL COVER**

(NOT TO SCALE)




5/19 **LANDFILL PERIMETER BERM AND SURFACE WATER DRAINAGE DITCHES (TYPICAL)**

(NOT TO SCALE)

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NOT FOR CONSTRUCTION

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|---|---|---|---|---|
| 3. | | | | |
| 2. | | | | |
| 1. | | | | |

PROJECT: **DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN**

SHEET TITLE: **DETAILS- FINAL COVER**

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| CHECKED BY: DM | | FILE NO.30814004.dwg |
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| DATE: OCTOBER 2000 | | |

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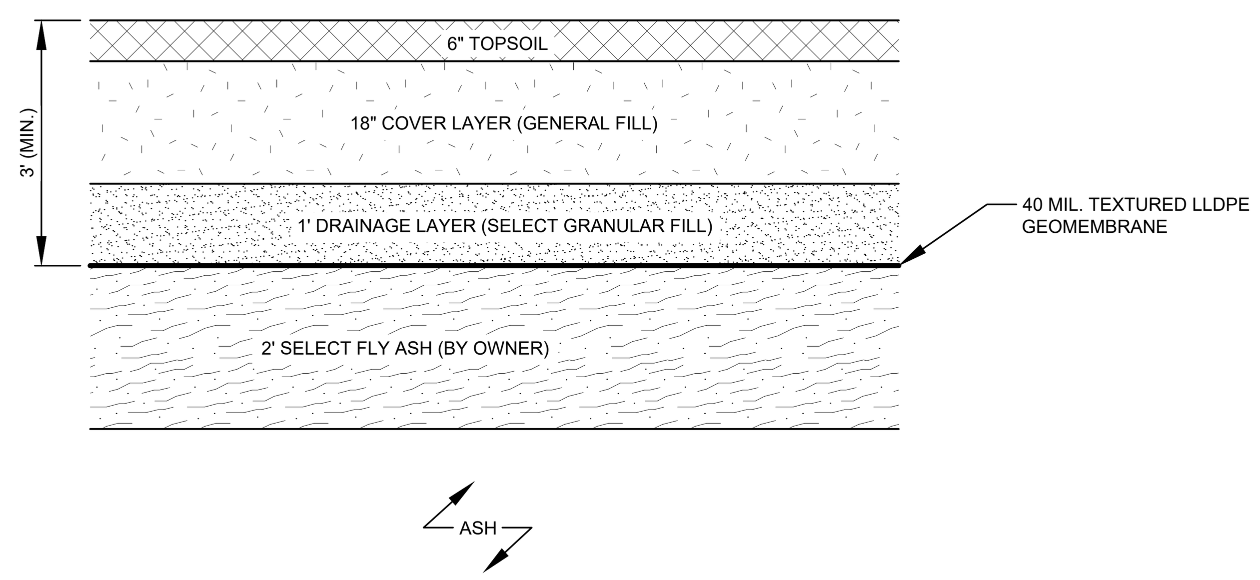
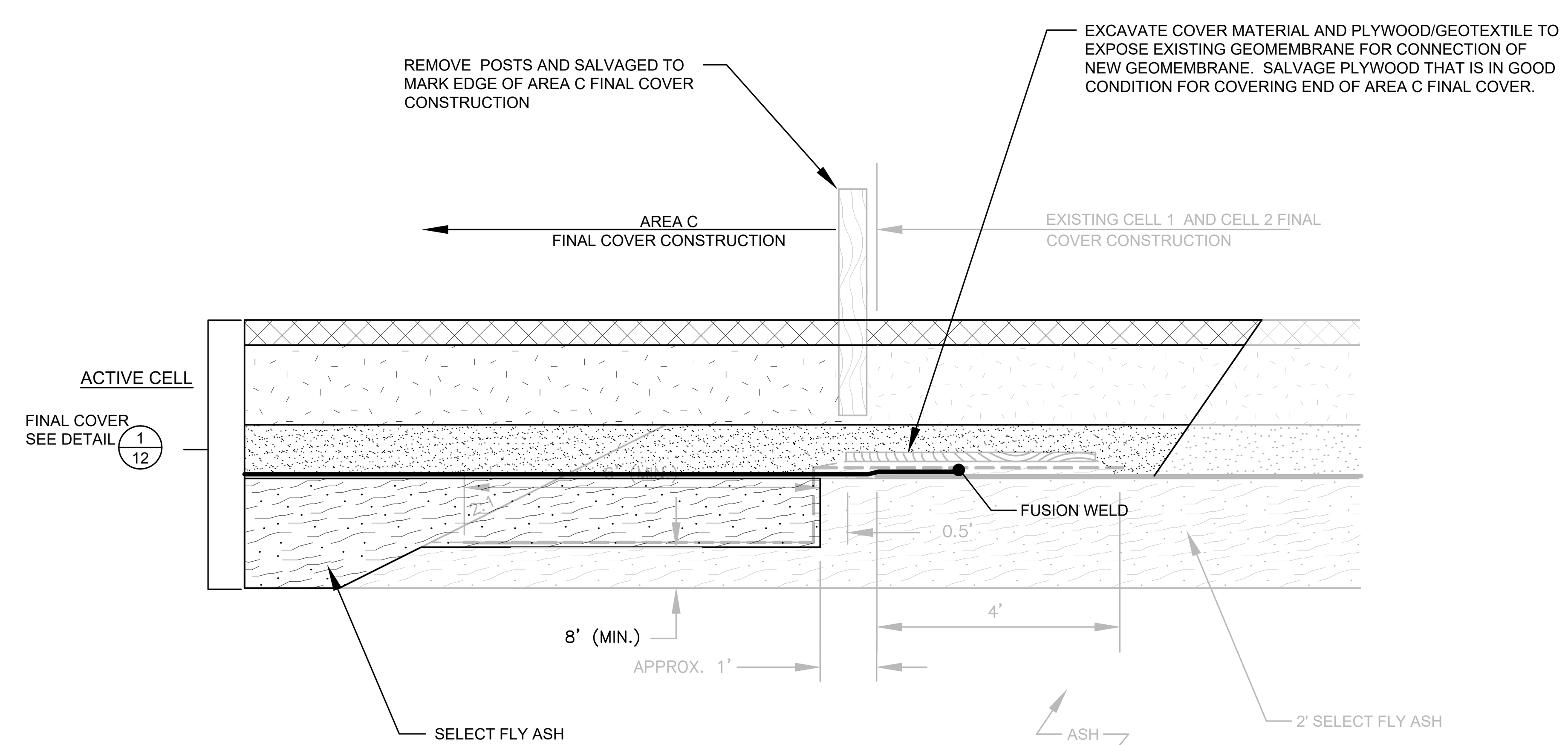
Phone: 608/831-4444



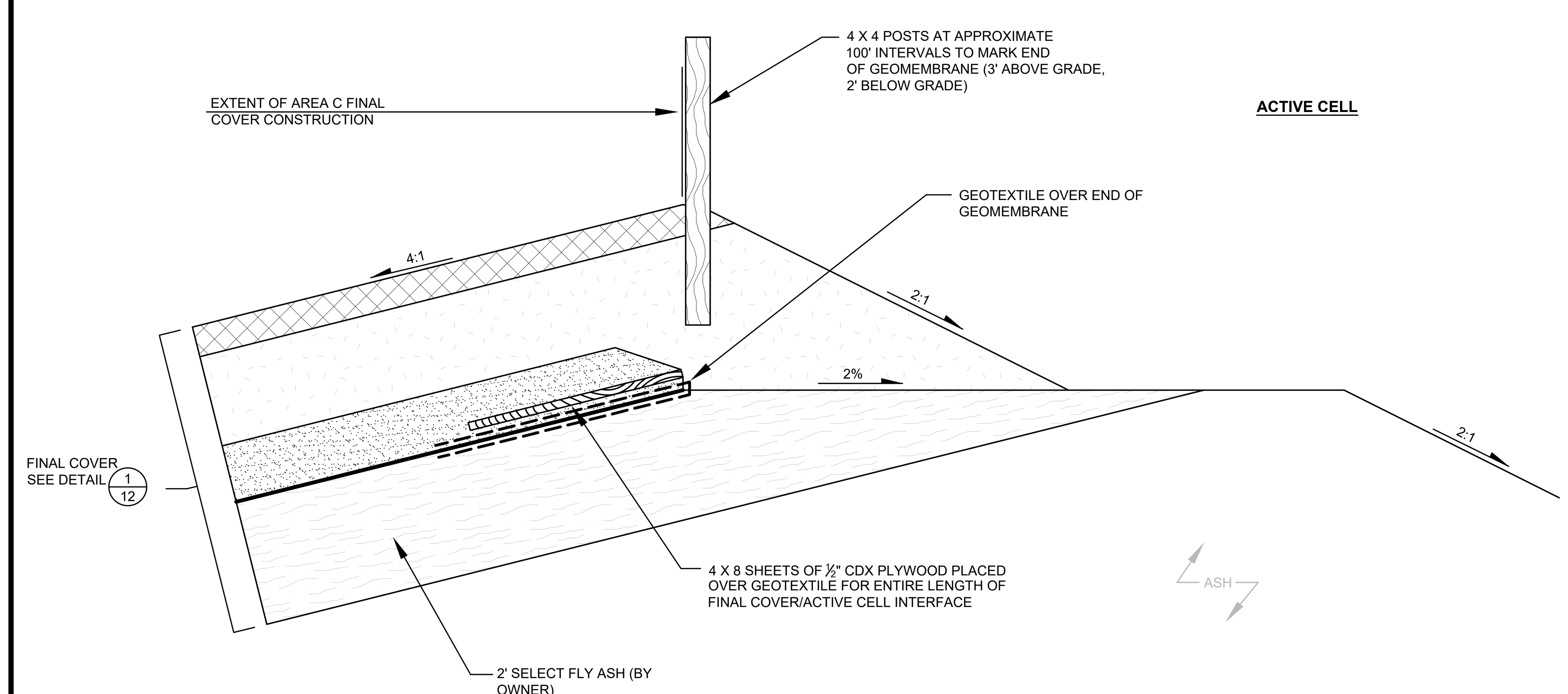

**1 / 12** **FINAL COVER**

(NOT TO SCALE)



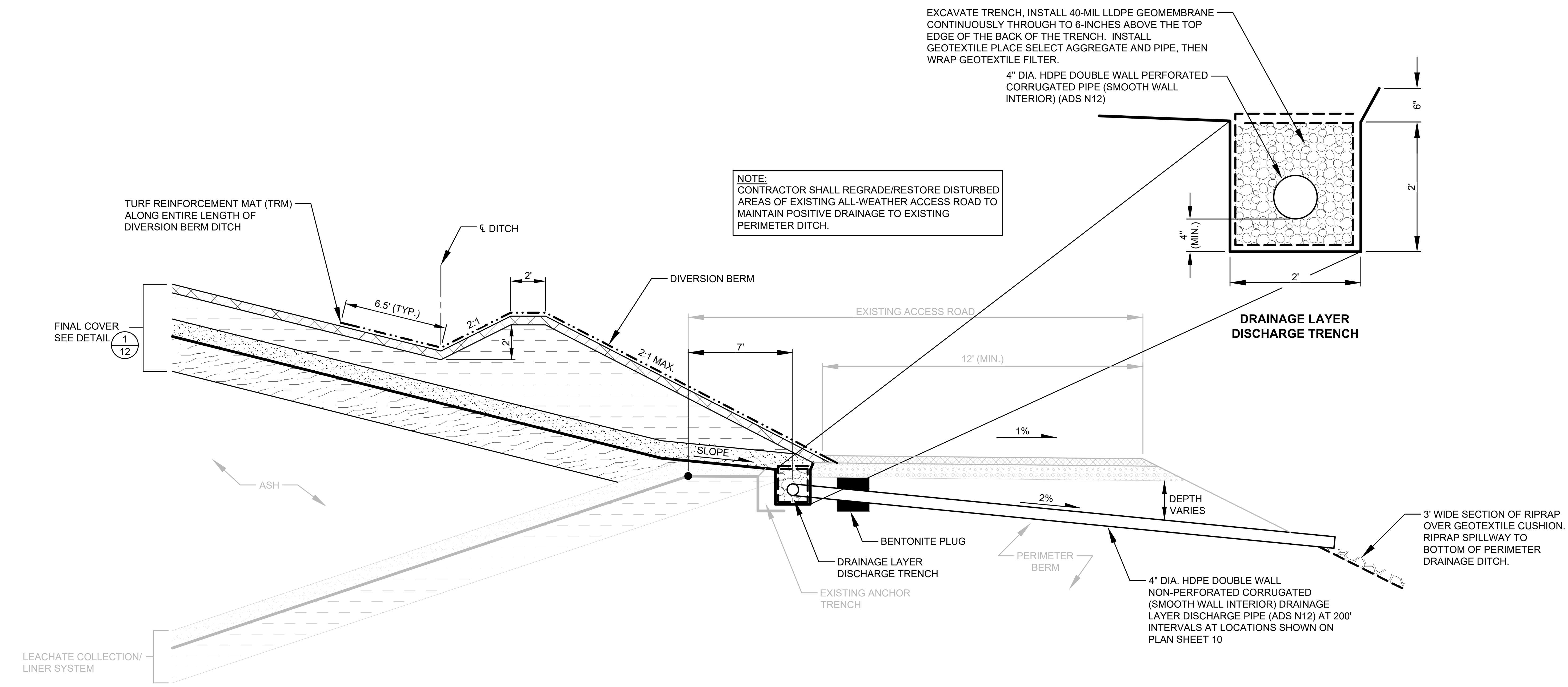

**2 / 12** **FINAL COVER CONNECTION**

(NOT TO SCALE)



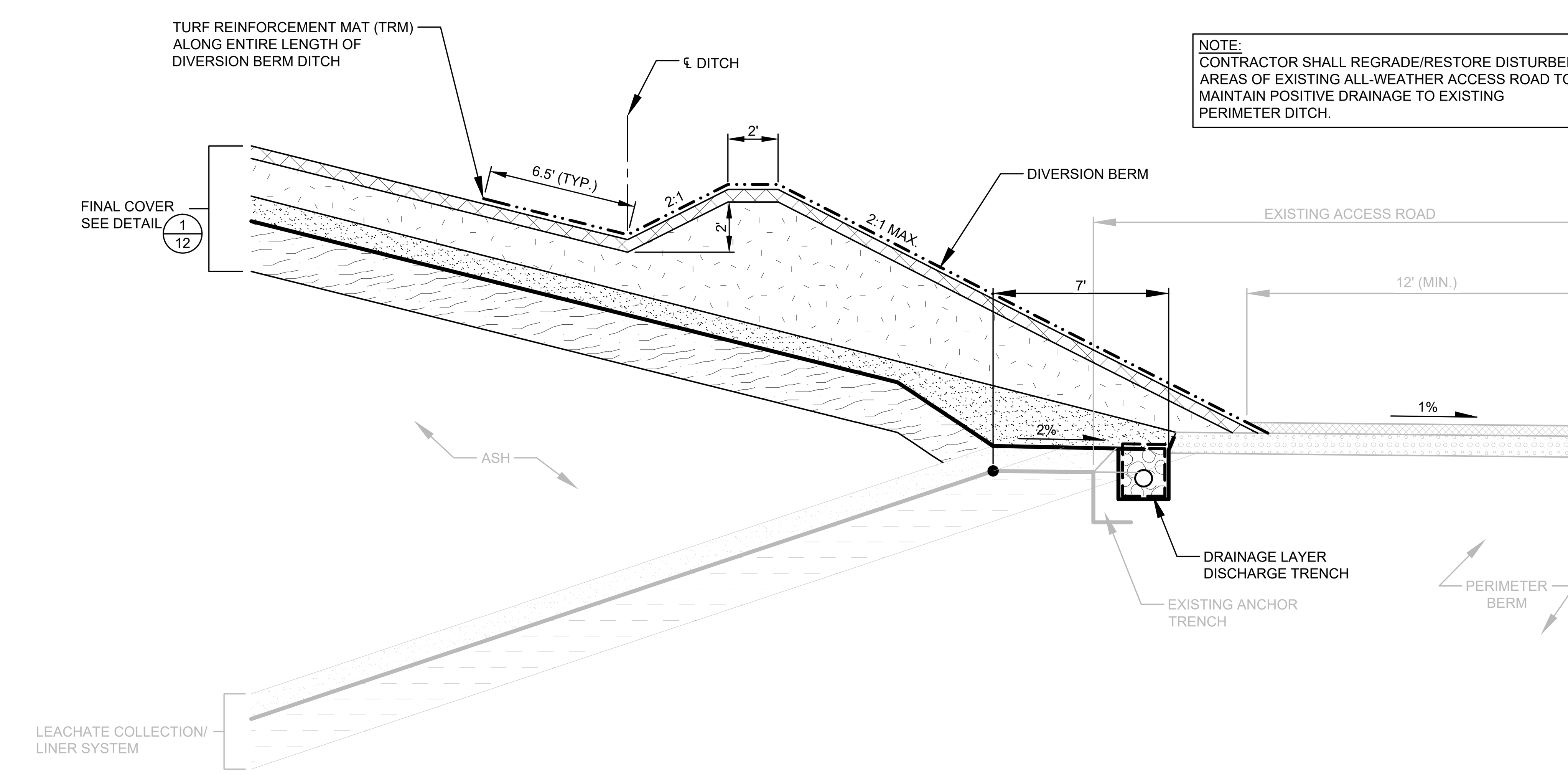

**3 / 12** **FINAL COVER TRANSITION**

(NOT TO SCALE)




**4 / 12** **FINAL COVER TERMINATION WITH TOE DRAIN DISCHARGE PIPE**

(NOT TO SCALE)




**5 / 12** **FINAL COVER TERMINATION (OVER CELL 1 LINER CONSTRUCTION)**

(NOT TO SCALE)

NOTE: THE CONTRACTOR SHALL NOTIFY ALL AREA UTILITY COMPANIES PRIOR TO COMMENCING WORK ON THIS CONTRACT, IN ACCORDANCE WITH STATE AND LOCAL REQUIREMENTS.

NOTE: THESE PLANS ARE ACCOMPANIED BY A PROJECT MANUAL OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER.

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|---|---|---|---|---|
| | | | | |

PROJECT:
**DAIRYLAND POWER COOPERATIVE**
**PHASE IV, CELL 3B LINER CONSTRUCTION & AREA C (OVER CELLS 1 & 2)**
**FINAL COVER CONSTRUCTION**
**BUFFALO COUNTY, WISCONSIN**

SHEET TITLE:
**DETAILS**

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| APPROVED BY: TWM | DATE PRINTED: | SHEET 12 OF 13 |
| DATE: MARCH 2015 | | |

TRC


708 Heartland Trail
Suite 3000
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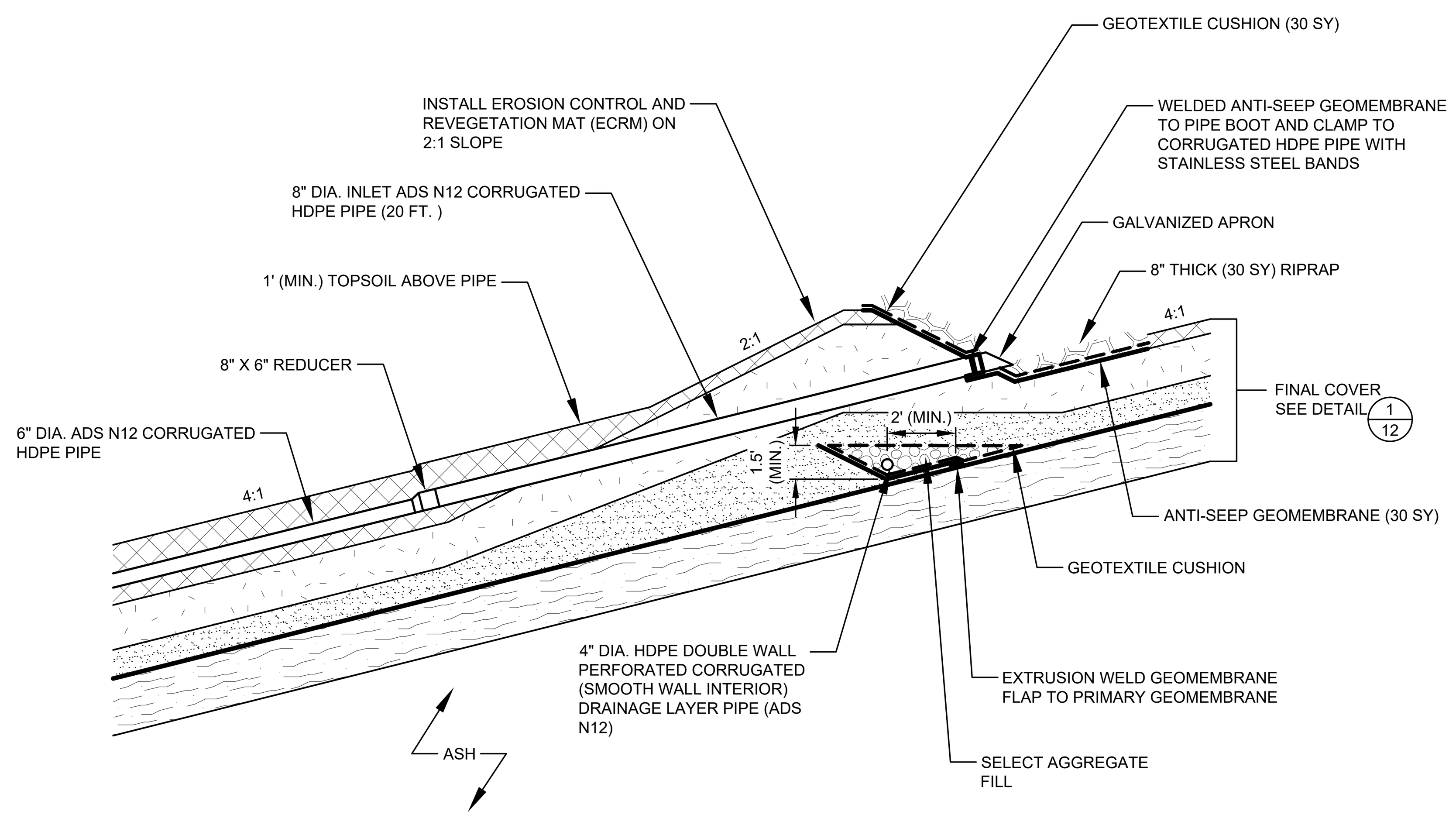
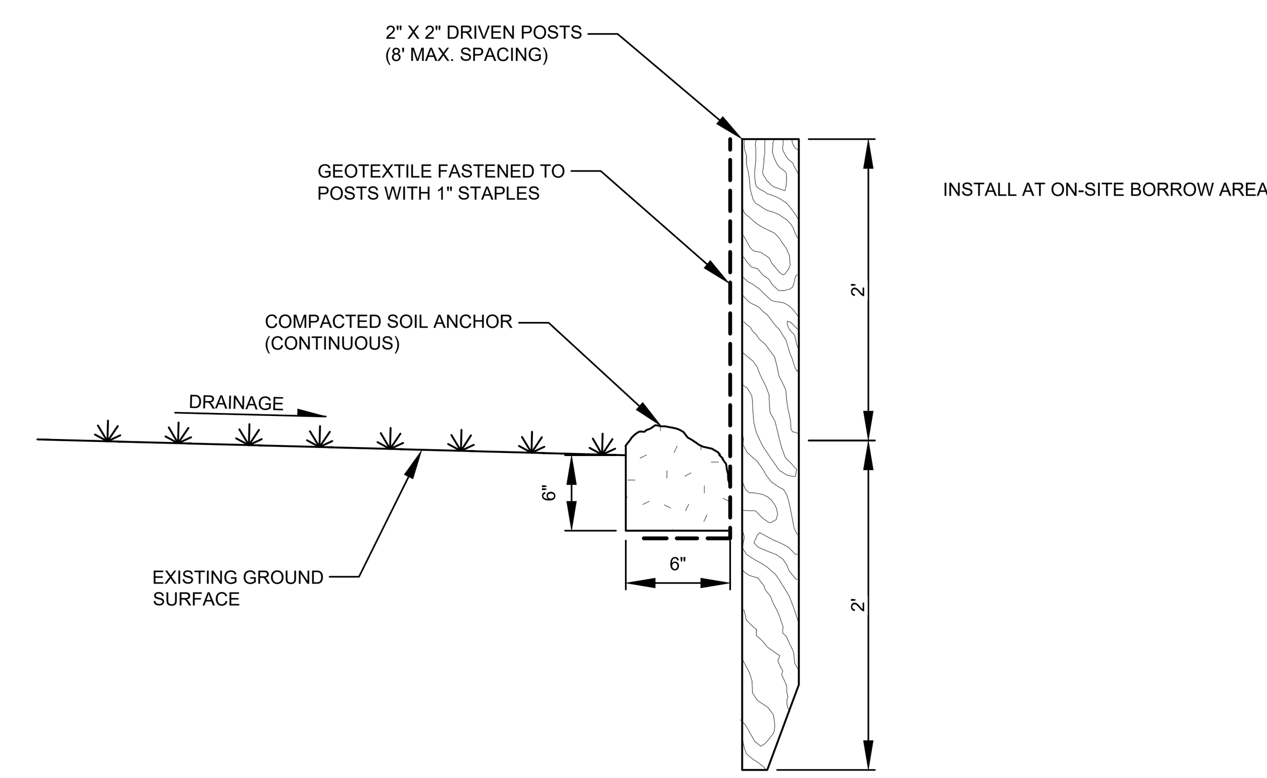



1/13

## 8" DIA. INLET STRUCTURE

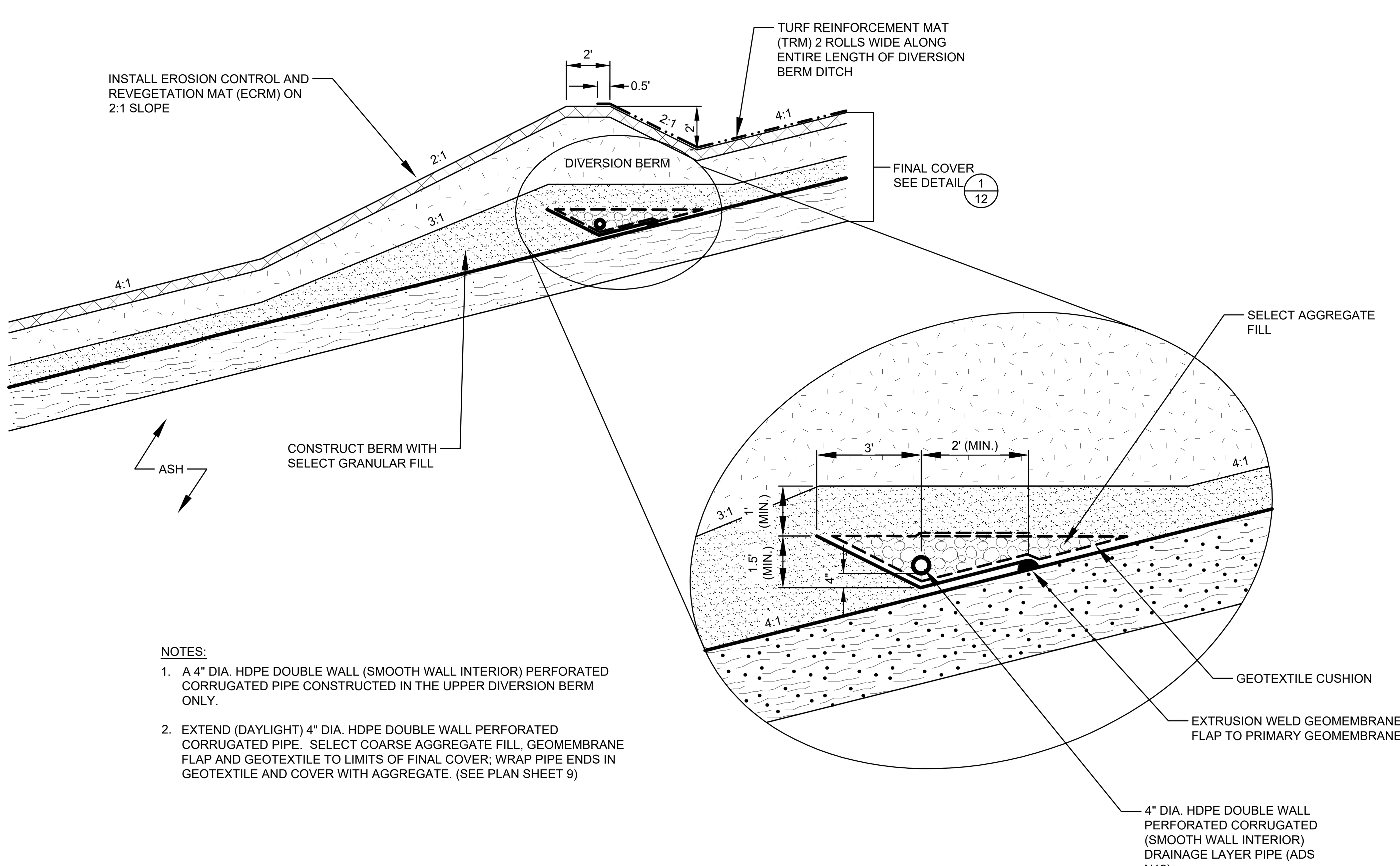
(NOT TO SCALE)




3/13

## SEDIMENT CONTROL FENCE

(NOT TO SCALE)




NOTES:

1. A 4" DIA. HDPE DOUBLE WALL (SMOOTH WALL INTERIOR) PERFORATED CORRUGATED PIPE CONSTRUCTED IN THE UPPER DIVERSION BERM ONLY.
2. EXTEND (DAYLIGHT) 4" DIA. HDPE DOUBLE WALL PERFORATED CORRUGATED PIPE. SELECT COARSE AGGREGATE FILL, GEOMEMBRANE FLAP AND GEOTEXTILE TO LIMITS OF FINAL COVER; WRAP PIPE ENDS IN GEOTEXTILE AND COVER WITH AGGREGATE. (SEE PLAN SHEET 9)

2/13

## DIVERSION BERM

(NOT TO SCALE)

NOTE: THE CONTRACTOR SHALL NOTIFY ALL AREA UTILITY COMPANIES PRIOR TO COMMENCING WORK ON THIS CONTRACT, IN ACCORDANCE WITH STATE AND LOCAL REQUIREMENTS.

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|---|---|---|---|---|
| | | | | |

PROJECT:
**DAIRYLAND POWER COOPERATIVE**
**PHASE IV, CELL 3B LINER CONSTRUCTION & AREA C (OVER CELLS 1 & 2)**
**FINAL COVER CONSTRUCTION**
**BUFFALO COUNTY, WISCONSIN**

SHEET TITLE:
**DETAILS**

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| CHECKED BY: DM | AS SHOWN | FILE NØ216851.0004.SHT13-DT.dwg | |
| APPROVED BY: TWM | DATE PRINTED: | SHEET 13 OF 13 | |
| DATE: MARCH 2015 | | | |

TRC
708 Heartland Trail
Suite 3000
Madison, WI 53717
Phone: 608.826.3600

PLOT DATA
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Layout: SHEET 13
File Size: 0.62 Mb
Plot Date: March 9, 2015
Plot Time: 1:24 PM
Attached Xref's:
Attached Images:

# Attachment 6

# Long-term Care Costs

**Opinion of Probable Cost**
**Long-term Care, Phase IV Landfill**
**Dairyland Power Cooperative, Alma Off-Site Disposal Facility**
**Plan Modification - June 2024**

| Major Cost Item | Unit | Unit Cost [1] | Quantity | Average Cost Per Year |
|---|---|---|---|---|
| **Land Surface Care and Site Maintenance** | | | | |
| Reseed/Erosion Damage | Acre | $ 830.00 | 32 | $ 27,000.00 |
| Lawn Mowing | LS | $ 5,310.00 | 1 | $ 6,000.00 |
| Snow Plowing | LS | $ 3,000.00 | 1 | $ 3,000.00 |
| Road Maintenance | LS | $ 2,000.00 | 1 | $ 2,000.00 |
| Storm Water Control Structures Maintenance | LS | $ 8,300.00 | 1 | $ 9,000.00 |
| Repair Cover from Settlement | Acre | $ 340.00 | 32 | $ 11,000.00 |
| Sedimentation Basin Cleaning | LS | $ 830.00 | 1 | $ 1,000.00 |
| **Groundwater Monitoring Maintenance** | | | | |
| Inspections and Maintenance/Purge/Resurvey, Pumps [2] | LS | $ 4,000.00 | 0.025 | $ 1,000.00 |
| Well Replacement/Abandonment [3] | LS | $ 10,000.00 | 0.375 | $ 4,000.00 |
| **Leachate Collection System** | | | | |
| Leachate Collection Line Cleaning | LS | $ 3,320.00 | 1 | $ 4,000.00 |
| Leachate Collection Line Televising [4] | LS | $ 1,200.00 | 0.2 | $ 300.00 |
| Operation and Maintenance | LS | $ 4,980.00 | 1 | $ 5,000.00 |
| Leachate Disposal | Gallon | $ 0.0415 | 876,000 | $ 37,000.00 |
| **Environmental Monitoring [5]** | | | | |
| Groundwater Monitoring (15 wells) | LS | $ 9,000.00 | 1 | $ 9,000.00 |
| Leachate Monitoring (1 tank) | LS | $ 1,000.00 | 1 | $ 1,000.00 |
| Surface Water Monitoring (2 locations) | LS | $ 1,000.00 | 1 | $ 1,000.00 |
| Data Preparation/Submittal | LS | $ 3,000.00 | 1 | $ 3,000.00 |
| **Inspection and Reporting** | | | | |
| Annual Inspections | LS | $ 3,400.00 | 1 | $ 4,000.00 |
| Annual Report | LS | $ 5,000.00 | 1 | $ 5,000.00 |
| | | | Long-term Care Subtotal: | $ 133,300.00 |
| | | | Contingency (10%): | $ 13,400.00 |
| | | | Yearly Grand Total: | $ 146,700.00 |
| | | | **40-year Long-term Care Cost:** | **$ 5,868,000.00** |

Note:

(1) Costs are in 2023 dollars according to Wisconsin DNR Owner Financial Responsibility Inflation Factor Table. Some totals may not agree due to rounding.

(2) Resurvey/rehabilitation - Assumed to occur once per 40 years.

(3) Replace 15 wells over 40 years.

(4) All lines televised once per five years.

(5) Assumes semiannual monitoring.

Update By: B. Kahnk 6/3/2024
Checked By: T. Martin 7/8/2024