

Supporting Document 2

Conceptual Design Report



Twin Creeks Environmental Centre Landfill
Optimization Project Environmental Assessment

Waste Management of Canada Corporation

Watford, Ontario

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Prepared by:

WSP Canada Inc.
55 King Street, Suite 700
St. Catharines, ON L2R 3H5





Revision History

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Acronyms, Units and Glossary

Acronyms

Acronym	Definition
EA	Environmental Assessment
EAA	<i>Environmental Assessment Act</i>
ECA	Environmental Compliance Approval
EVGS	Early Vertical Gas System
FEM	Finite Element Model
GHG	Greenhouse Gas
IDF	Intensity-Duration-Frequency
LFG	Landfill Gas
MECP	Ministry of Environment, Conservation and Parks
PLCS	Primary Leachate Collection System
SRF	Strength Reduction Factor
TCEC	Twin Creeks Environmental Centre
ToR	Terms of Reference
WM	Waste Management of Canada Corporation

Units

Unit	Definition
cm/s	centimetres per second
ha	hectare
GPa	gigaPascal
km	kilometre
kN/m ³	kiloNewtons per cubic metre
kPa	kilopascal
MPa	megapascal
m	metre
m ² /s	square metres per second
m ³	cubic metres
mm	millimetres
scfm	standard cubic feet per minute
T/m ³	tonnes per cubic metre

Glossary

Term	Definition
Approval	Permission granted by an authorized individual or organization for a project to proceed. This may be in the form of program approval, certificate of approval or provisional certificate of approval.
Capacity (Disposal Volume)	The total volume of air space available for disposal of waste at a landfill site for a particular design (typically in m ³); includes both waste and daily cover materials, but excludes the final cover.
Circular Failure Surface	A hypothetical curved plane within a slope along which a potential soil failure might occur.
Composting	The controlled microbial decomposition of organic matter, such as food and yard wastes, in the presence of oxygen, into finished compost (humus), a soil-like material. Humus can be used in vegetable and flower gardens, hedges, etc.
Composting facility	A facility designed to compost organic matter either in the presence of oxygen (aerobic) or absence of oxygen (anaerobic).
Environment	As defined by the Ontario <i>Environmental Assessment Act</i> , environment means: • air, land or water; • plant and animal life, including human life; • the social, economic and cultural conditions that influence the life of humans or a community; • any building, structure, machine or other device or thing made by humans; • any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from human activities; or • any part or combination of the foregoing and the interrelationships between any two or more of them (ecosystem approach).
Environmental Assessment (EA)	A systematic planning process that is conducted in accordance with applicable laws or regulations aimed at assessing the effects of a proposed project on the environment.
Evaluation criteria	Evaluation criteria are considerations or factors taken into account in assessing the advantages and disadvantages of various alternatives being considered.
Greenhouse gas (GHG)	Any of the gases whose absorption of solar radiation is responsible for the greenhouse effect, including carbon dioxide, methane, ozone, and the fluorocarbons.
Indicators	Indicators are specific characteristics of the evaluation criteria that can be measured or determined in some way, as opposed to the actual criteria, which are fairly general.
Landfill gas (LFG)	The gases produced from the wastes disposed in a landfill; the main constituents are typically carbon dioxide and methane, with small amounts of other organic and odour-causing compounds.
Landfill site	An approved engineered site/facility used for the final disposal of waste. Landfills are waste disposal sites where waste is spread in layers, compacted to the smallest practical volume, and typically covered by soil.
Leachate	Liquid that drains from solid waste in a landfill and which contains dissolved, suspended and/or microbial contaminants from the breakdown of this waste.
Mitigation	Measures taken to reduce adverse impacts on the environment.
Project	Is defined in the <i>Environmental Assessment Act</i> as: one or more enterprises or activities or a proposal, plan or program in respect of an enterprise or activity.
Proponent	A person who: • carries out or proposes to carry out a project; or • is the owner or person having charge, management or control of a project.

Glossary

Term	Definition
Receptor	The person, plant or wildlife species that may be affected due to exposure to a contaminant.
Terms of Reference (ToR)	A Terms of Reference is a document that sets out detailed requirements for the preparation of an Environmental Assessment.
Time of concentration	The time required for water falling on the most remote point of a drainage basin to reach the outlet where remoteness relates to time of travel rather than distance.
Waste	Refuse from places of human or animal habitation; unwanted materials left over from a manufacturing process.

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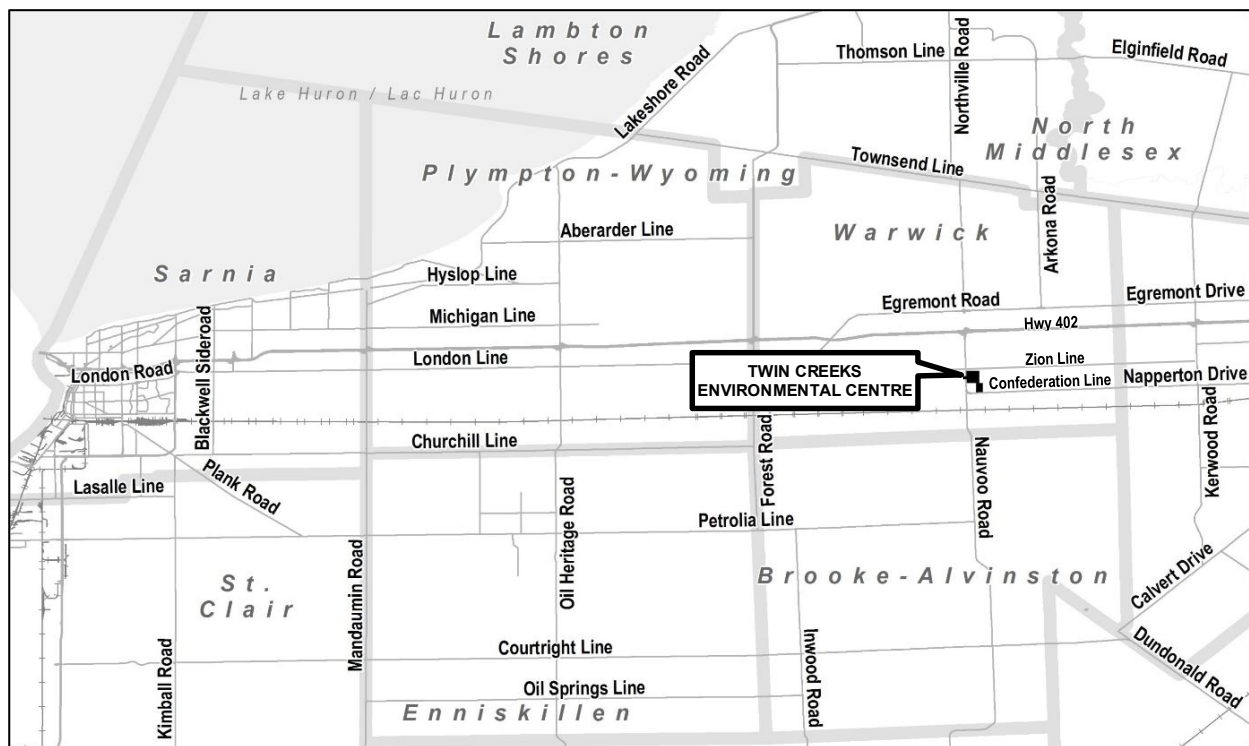
1 Introduction

1.1 Background

WM Canada (WM), the owner and operator of the Twin Creeks Environmental Centre (TCEC) in Watford, Ontario, has initiated the Environmental Assessment (EA) seeking approval to develop additional landfill disposal capacity as part of the optimization of the design and operation of the TCEC landfill. The proposed optimization would provide additional airspace of approximately 14.3 million cubic metres (m³), which could extend the site life by approximately 12 years (from 2031 to 2043) and may be achieved through alternative landfill configurations or alternative methods within the existing 301 hectare (ha) TCEC site area. No changes are proposed to the size of the TCEC site area, approved service area, or annual fill rate.

The TCEC is located in the Township of Warwick near the Village of Watford, at the corner of Nauvoo Road and Zion Line, within the County of Lambton (Figure 1-1).

Figure 1-1. Location of the TCEC



The TCEC began operation as the Warwick Landfill in 1972. WM has owned and operated the TCEC since 1996. The landfill was approved under the *Environmental Assessment Act (EAA)* for expansion in 2007 and has total airspace capacity of 26,508,000 m³ over an area of 101.8 ha (referred to as the Closed Old Landfill and Expansion Landfill). The landfill provides safe and convenient disposal services for

communities, businesses and industries serving the Province of Ontario. This landfill is approved to receive municipal, industrial, commercial, and institutional solid non-hazardous wastes, including non-hazardous contaminated soil. The TCEC is permitted to receive 1.4 million tonnes per year of waste including contaminated soil for disposal at the site.

The landfill is engineered with environmental protection systems that meet or exceed regulatory requirements and is subject to highly regulated monitoring and reporting requirements. Systems include engineered liners and covers, leachate collection and management, landfill gas collection and control, and on-site leachate disposal through a phytoremediation system consisting of a 9.3 ha poplar system planted on the existing landfill cap in 2003. Surplus leachate is trucked off-site to approved wastewater treatment plants.

The Environmental Compliance Approval (ECA) A032203 for the TCEC allows the landfill to receive 1.4 million tonnes per year of waste including contaminated soil for disposal at the site. The TCEC typically receives between 5,000 to 7,500 tonnes of residual waste, with an average of 200 waste hauling vehicles, per weekday. There are approximately 5 years of approved airspace capacity remaining at the Expansion Landfill (i.e., capacity will be reached in approximately 2031).

The layout of the TCEC is shown on **Figure 1-2**.

Figure 1-2. Layout of the TCEC



Source: HDR

The EA is being carried out in accordance with the requirements of the *Environmental Assessment Act (EAA)* and Terms of Reference (ToR), which was approved by the Ministry of Environment, Conservation and Parks (MECP) on December 13, 2022.

‘Alternative methods’ of carrying out the Project are different ways of implementing the proposed Project. As outlined in the approved ToR, the development of additional landfill capacity within the TCEC site area can be achieved through a vertical expansion of the currently approved Expansion Landfill footprint (75.4 ha within the 101.8 ha landfill area) or a horizontal expansion into other areas of the TCEC site. Based on a qualitative consideration of the potential vertical and horizontal expansion methods available within the site area, in addition to potentially locating waste in close proximity to the Village of Watford, horizontal alternative methods would result in significant additional costs and would not optimize the use of the available and constructed infrastructure at the site to the extent possible. Given the financial, technological, and community risks and concerns associated with the horizontal alternative methods, WM identified a preference for a vertical alternative method.

WM committed to undertaking a screening of vertical and horizontal alternative methods as part of the EA to confirm that a vertical alternative method would be preferred. The screening of alternative methods examined the development of approximately 14.3 million m³ of landfill capacity within the 301 ha TCEC site area through a:

- vertical expansion within the currently-approved Expansion Landfill footprint (as per the EA submitted in 2005 and approved in 2007, and the 2017 Environmental Screening);
- horizontal expansion into other available areas of the TCEC site; or
- horizontal expansion over the closed Old Landfill to the east of the Expansion Landfill.

Representative concepts were developed for vertical and horizontal alternative methods within the defined development areas to accommodate the required landfill capacity. The representative concepts were intended to encompass several different landfill configurations that could occur within the defined development areas. These three representative alternative methods were evaluated and comparatively screened against each other using criteria consisting of:

- Environmental considerations;
- Cost and Constructability considerations;
- Technical considerations;
- Social and Cultural considerations; and
- Land Use considerations.

The results of the screening indicate that the representative vertical alternative method located within the expansion landfill footprint is preferred over the horizontal alternative methods for all criteria and considerations (HDR, 2024).

WM is proceeding with developing specific vertical alternative methods within the expansion landfill footprint area to achieve the additional landfill capacity. These vertical alternative methods will be assessed and comparatively evaluated in the EA in order to identify a preferred alternative.

1.2 Objectives

This Conceptual Design Report presents the conceptual design and operations details for three vertical alternative methods within the Expansion Landfill area, which are based on the preliminary alternative methods identified in the approved ToR. The ToR identified four preliminary vertical alternative methods; however, flexibility was included in the ToR to adjust the alternative methods to be considered in the EA.

The purpose of this report is to provide sufficient detail to enable each environmental discipline to assess the potential environmental effects of the alternative methods and to form the basis of their comparison. The outcome of the comparison will be the identification of a preferred alternative which will be compared against the 'Do Nothing' Alternative. The 'Do Nothing' Alternative is the Expansion Landfill as currently approved in the 2005 EA and 2017 Environmental Screening.

The aspects of the design and operations of the alternative methods included in this Conceptual Design Report are as follows:

- Landfill design and geometry (location, orientation, volume, key design features);
- Buffer zones around the waste footprint;
- Site development (phasing and schedule of landfill development and construction activities);
- Leachate generation, management, and treatment;
- Landfill gas generation, management, and treatment;
- Stormwater management;
- Ancillary facilities;
- Traffic management; and
- Landfill operations (operating hours, site equipment, waste placement, daily and intermediate cover, and nuisance controls).

The vertical expansion is intended to be carried out in accordance with O. Reg. 232/98 and the associated guidance document "Landfill Standards: A Guideline on the Regulatory and Approval Requirement for New or Expanding Landfilling Sites" (MOE, 2012).

A discussion is also provided on climate change considerations including the effects of climate change on the conceptual design (stormwater, operations, landfill gas, leachate) and the effects of the conceptual design on climate change (generation and emissions of landfill gas).

Upon selection of a preferred alternative for the Project, and completion of the EA, WM will proceed to develop the detailed design for the preferred alternative. It is understood that the concept presented in this report will be refined during detailed design.

2 Conceptual Design of Alternative Method 1

2.1 Overview

Alternative Method 1 includes the increase of final landfill side slopes from 4H:1V to 3H:1V between the original grade and elevation 320 masl (about 16 m in grade change), transitioning to a 20H:1V upper slope and peaking at elevation 324.5 masl (**Drawing 1.1**) over the Expansion Landfill. The proposed landfill expansion consists of five stages, as shown by the different colours for the contour lines as indicated in the legend of **Drawing 1.1**. The details of these stages are discussed in **Section 2.4.1**.

The Expansion Landfill is fully engineered and has an approved peak elevation of 280 masl. Alternative Method 1 will provide an additional 14.3 million m³ of landfill capacity.

Considering the proposed final side slopes of 3H:1V are steeper than the current 4H:1V, as per O. Reg. 232/98, a geotechnical feasibility review was performed to confirm the slope stability and settlement. The geotechnical assessment showed that this alternative is acceptable with respect to the stability of the final slopes (3H:1V) and proposed peak profile height. The results of the geotechnical feasibility review for Alternative Method 1 are discussed in **Section 2.2**.

2.2 Landfill Design and Geometry

The geometry of Alternative Method 1 is shown in plan view in **Drawing 1.1**. Under the proposed vertical expansion, the existing approved waste disposal footprint area of the TCEC would not change, but rather, the maximum permitted height of waste would be increased by 44.5 m, from 280 masl (the current approved elevation for top of waste) to 324.5 masl, which is the maximum elevation of the top of the final cover for Alternative Method 1. The 3H:1V side slopes will start at the existing landfill toe of slope continuing to elevation 320 masl, and then will transition to a finished grade of 5% as indicated in **Drawing 1.2** and **Drawing 1.3**. This will increase the current landfill capacity by approximately 14.3 million m³.

To assess the stability of the final slopes and proposed peak profile height, a preliminary slope stability analysis was performed. The slope stability analysis

involved: reviewing the design of Alternative Method 1; reviewing existing background information; and building a 2-Dimensional Finite Element Model (FEM) using Slide2 Modeler version 9.020 software and adopting the Morgenstern-Price factor of safety method.

Slope stability for the landfill side slopes has been assessed considering rotational (circular) failure mechanisms, which are generally governing for engineered earth structures founded on relatively uniform soil profiles. Translational (block-type) failures typically occur where distinct, laterally continuous weak planes or interfaces are present at shallow inclinations, such as pronounced stratification or low-strength seams. In the area of the Project, the landfill is underlain by a thick, stiff, and laterally continuous deposit of Rannoch Till over competent bedrock, with no evidence of persistent low-strength horizontal or gently dipping layers that would control translational failure. As such, rotational stability analysis is considered the appropriate and controlling failure mechanism for assessing landfill side slope stability under both static and seismic loading conditions.

For the purposes of numerical modelling, the landfill design cross-sections were simplified into three primary layers (from top to bottom): Landfill Waste; Rannoch Till Subsoil; and Bedrock. Additionally, the following assumptions were made:

- Landfill base liners and drainage layers were ignored in the modelling analysis as these materials are thin compared to the overall profile, and their effect on the results are negligible.
- Groundwater levels at the site are close to the original ground surface (approx. 238 masl). Groundwater is captured by the primary drainage layer within the landfill area.
- No internal leachate mound is expected to develop. Leachate is captured and removed by the primary drainage layer.

A summary of selected engineering properties used in the FEM is provided in **Table 2-1**.

Table 2-1. Geotechnical Parameters

Material	Parameter	Typical Range ¹	Assigned Modelling Values
Landfill Waste (including daily cover material)	Unit Weight	12-15 kN/m ³	12 kN/m ³ (based on Alston, 2006)
	Effective Internal Friction Angle	30-35 degrees	30 degrees
	Apparent Effective Cohesion	0-10 kPa	0
	Material Type		Elastic, Drained
Rannoch Till Subsoil	Unit Weight	19-22 kN/m ³	20 kN/m ³
	Effective Internal Friction	30-35 degrees	32 degrees
	Apparent Effective Cohesion	0-25 kPa	10 kPa

Table 2-1. Geotechnical Parameters

Material	Parameter	Typical Range ¹	Assigned Modelling Values
	Deformation Modulus (M)	10-35 MPa	13 MPa
	Over-Consolidation Ratio	3 to 6	-
	Pre-Consolidation Pressure	300-450 kPa	-
	Material Type		Plastic, Drained
Bedrock	Unit Weight	20-27.5 kN/m ³	27 kN/m ³
	Deformation (Young's) Modulus	varies	20 GPa
	Poisson's Ratio	0.2 to 0.3	0.25
	Material Type		Elastic, Drained

Note 1: Typical Range based on available background data (Alston, 2006)

Based on the results of the model, the factor of safety of the circular failure surface for Alternative Method 1 is 1.76. Therefore, Alternative Method 1 meets the recommended minimum factor of safety of 1.3 for the side slopes. The minimum factor of safety (FS) of 1.3 is consistent with standard geotechnical practice for static conditions and is supported by literature such as Duncan et al. (2014), which recommends FS values between 1.3 and 1.5 depending on risk and material characterization.

The landfill base design is site-specific and comprises a compacted clay liner with two (2) separate leachate drainage layers. Both primary and secondary drainage layers (leachate collection systems) have been designed to comply with O. Reg. 232/98. The landfill base was designed with a 0.5% minimum grade toward the leachate collectors, which are spaced such that the drainage path for leachate is no longer than 50 m for the primary collectors and 100 m for the secondary collectors.

Settlement for Alternative Method 1 was evaluated during the ToR stage using a range of MSW unit weights (12–15 kN/m³). The CDR applied both the lower-bound value (12 kN/m³) and the upper-bound value (15 kN/m³) to reflect the expected range of waste placement conditions. The higher bound (15 kN/m³) represents the more critical condition for slope stability and settlement, while the lower bound (12 kN/m³) is relevant for assessing drainage layer loading. This approach provides a realistic range of potential landfill performance outcomes. Settlement was calculated at intervals along the base of the landfill for the approved landfill profile and Alternative Method 1 considering a unit weight of waste of 12 kN/m³. Based on the results of the model, the overall slope in westerly direction (i.e., toward pumping station) will be maintained despite the slight changes in the approved landfill base grades due to long-term settlement under the heavier inferred waste loading. Additionally, base flattening on the west side will not exceed initial base conditions on the east side, which are considered minimum as defined by O. Reg. 232/98. Therefore, it is concluded that Alternative Method 1 will not have a significant effect on the functionality of the leachate collection system, and leachate will continue to drain toward the designated

withdrawal points. The maximum calculated settlement at the landfill centre for Alternative Method 1 is 480 mm.

To determine if the existing primary leachate collection piping can withstand the loading associated with Alternative Method 1, the pipe specifications were reviewed and the deflection under the proposed design conditions was calculated.

The primary leachate collection piping is a 250 mm diameter high-density polyethylene (HDPE) Sclairpipe DR6, with perforations in accordance with Schedule 2, O. Reg. 232/98. Considering a unit weight of overlying material of 12 kN/m³, the pipe deflection is around 5.75%.

The calculation requires supplier-recommended values for pipe deformation modulus and material strength reduction factors. The supplier has verified that the calculated deflection is acceptable relative to the maximum deflection criterion of 7.5%, as per CSA B182.11. In accordance with the Plastic Pipe Institute, a deflection limit of 7.5% provides at least a 3-to-1 safety factor against reverse curvature.

Deflection calculations for the primary leachate collection piping were performed in the Geotechnical Feasibility Review using a waste unit weight range of 12–15 kN/m³, ensuring deflections remained below the 7.5% CSA B182.11 limit. A similar approach was applied to Alternative Method 1, with the upper-bound unit weight (15 kN/m³) representing the more critical loading condition for pipe performance. This ensures that structural performance of the leachate collection system is maintained under worst-case waste loading scenarios. The landfill gas collection system is constructed using high-density polyethylene (HDPE) consistent with the leachate collection system and is encased in compacted granular material. The gas collection system is located at higher elevations within the landfill and is subject to less loading as a result. In addition, the granular material minimizes differential settlement and ensures uniform structural support throughout the gas collection pipeline alignment.

For the geonet performance, it is understood that Solmax Tendrain II HDPE Triplanar Geonet was used for the landfill secondary drainage layer. According to supplier documents, this geonet has a reported transmissivity of 3.5×10^{-3} m²/s at normal load of 720 kPa and a hydraulic gradient of 0.1. Laboratory test reports for the supplied material are attached in **Appendix A**. At normal stress of 800 kPa and hydraulic gradient of 0.1, the 100-hr transmissivity was reported as 0.9×10^{-3} m²/s. A transmissivity of 0.83×10^{-3} m²/s was used in the design.

Geonet research (IntechOpen, 2019) indicates that triplanar geonet strains approach 30% at normal compressive loads up to 2 MPa. Based on a 0.1 hydraulic gradient, transmissivity of triplanar geonet reportedly decreases by up to 50% between normal loads of 800 and 1,500 kPa, which is the case for all proposed alternative methods.

The flow capacity (i.e., $q = \text{transmissivity} \times \text{gradient}$) of the Solmax Tendrain geonet calculated under the 0.005 gradient for the original design is 4.2×10^{-6} m²/s (GENIVAR, 2009). Applying the 50% transmissivity reduction suggested above, the geonet flow capacity under the Alternative Method 1 expansion loading reduces to

$2.1 \times 10^{-6} \text{ m}^2/\text{s}$, which is still higher than the flow capacity design requirement of $3.1 \times 10^{-7} \text{ m}^2/\text{s}$. Therefore, it is concluded that geonet secondary drainage capacity performance will meet the design requirements for Alternative Method 1.

In summary, it is concluded that Alternative Method 1 is acceptable with respect to:

- Post-settlement landfill base grades meeting O. Reg. 232/98 requirements and maintaining acceptable leachate collection in the primary drainage layer;
- Stability of the final slope (3H:1V maximum) and proposed peak profile height;
- Available collector pipe strength within the primary drainage layer; and
- Flow capacity of geonet within the secondary layer.

2.3 Buffer Zones

The TCEC is bounded to the north by Zion Line, to the east by the Twin Creeks Greenhouse and agricultural lands, to the south by lands owned by WM used for agricultural production and by Confederation Line, and to the west by Nauvoo Road (**Drawing 1.1**). The setbacks from the Expansion Landfill footprint to the property boundaries are 101 m to the north, about 206 m to the east, 100 m to 256 m to the south, and 235 m to the west.

Since Alternative Method 1 would not change the existing approved landfill limit of waste, the existing property boundaries and buffer width will remain the same after the vertical expansion. Therefore, the buffer area for Alternative Method 1 will meet the requirements of Section 7 of O. Reg. 232/98.

2.4 Site Development

2.4.1 Phasing and Schedule of Site Development

The proposed landfill expansion consists of five (5) stages as shown in **Table 2-2** and **Drawing 1.2**. The areas and volumes of the stages shown in **Table 2-2** are approximate and will be confirmed through detailed design; however, the total landfill volume of Alternative Method 1 will remain at approximately 14.3 million m^3 .

Table 2-2. Alternative Method 1 Stage Areas and Volumes

Stage	Peak Elevation (masl)	Volume (M m^3)
Stage 1	287.4	3.5
Stage 2	287.4	3.5
Stage 3	305.2	2.6
Stage 4	305.2	2.1
Stage 5	324.5	2.6
TOTAL	-	14.3

The site development phases have taken into consideration to have adequate space to allow disposal and operational vehicles to operate in the same area. The phases are proposed to be developed from west to east, considering the removal of final/interim cover along the side slopes prior to waste placement (as explained in **Section 2.4.2**, below). The landfill gas collection system will be progressively expanded as waste is placed and cells reach final grades. Temporary separation berms between lateral phases will be implemented for surface water control and will be removed as the next phase becomes operational.

Considering the approved landfilling rate is 1.4 million tonnes per year, the additional airspace could extend the site life by approximately 12 years.

Based on the estimated volumes provided for each phase in **Table 2-2**, Stage 1 and Stage 2 can provide a site life of about 3.5 years each while the site life of the other stages will range between 2.1 to 3.5 years.

2.4.2 Construction Activities

The Expansion Landfill area has been already prepared for landfilling and currently is active. Some areas have interim/final cover that will require the removal of soil cover prior to waste placement. This operation procedure will take place as the staging progresses. The current fill rate of 1.4 million tonnes per year will apply to the proposed expansion.

Transfer trailers with walking floors will discharge their contents at the rear of the truck. Piston-driven pusher types will push out their loads. Similarly, packer trucks will be discharged by the ram push. Roll-off trucks will raise the hydraulic hoist to discharge the load. There may even be a few smaller trucks that will be unloaded manually, although most vehicles are anticipated to have hydraulic cylinders to lift and unload the truck box.

The waste, once tipped from the trucks, will be pushed over the active cell in a uniform layer by the compactors. Waste placement will continue to be in daily lifts of 2.5 m to 3 m thickness. The compactors will compact the waste by making three to four passes on each loose lift.

Waste haul vehicles (packer trucks, roll-off trucks, trailers, etc.) will travel to the working face via access roads. These access roads will be constructed prior to the active cells becoming operational.

In addition to waste placement, the landfill gas collection system expansion will be constructed as part of the landfill development sequence.

Daily/interim cover will continue to be placed as part of the landfill operations as per current landfill operations. The final cover will be placed on the side slopes of the phases that are no longer operational as an erosion control measure and to minimize the potential for leachate seeps.

Considering the factor of safety encountered for the slope stability assessment for each alternative method was above 1.3, the constructability of the final cover will be done in phases. Considering the landfill is being filled in stages, soil cover will be placed along the side slopes as final waste grades are achieved. The area will be topsoiled and seeded to minimize erosion. As part of the ongoing landfill operations, areas under final cover that are encountered to have been affected by failed vegetation growth, washouts, or settlement will be repaired. The repairs can involve applying additional topsoil and seed, to implementing rip-rap channels for stormwater management.

2.4.2.1 Closure Activities

Closure planning is part of the ECA process. An amendment to the existing Waste ECA No. A032203 will be required prior to the start of the Project, which will include updates to the Design and Operations (D&O) Report. The D&O Report will describe the design and development plans for the landfill expansion including site closure, and post-closure monitoring and maintenance.

As per the current Waste ECA No. A032203, a detailed Site Closure Plan pertaining to the termination of landfilling operations at the TCEC, post-closure inspection, maintenance and monitoring, and end use will be developed prior to landfill closure. The Site Closure Plan will include the following:

- a) a plan showing Site appearance after closure;
- b) a description of the proposed end use of the Site;
- c) a description of the procedures for closure of the Site, including:
 - i) advance notification of the public of the landfill closure;
 - ii) posting of a sign at the Site entrance indicating the landfill is closed and identifying any alternative waste disposal arrangements;
 - iii) completion, inspection and maintenance of the final cover and landscaping;
 - iv) site security;
 - v) removal of unnecessary landfill-related structures, buildings and facilities; and
 - vi) final construction of any control, treatment, disposal and monitoring facilities for leachate, groundwater, surface water and landfill gas;
- d) a schedule indicating the time-period for implementing sub-conditions i) to vi) above.
- e) descriptions of the procedures for post-closure care of the Site, including:
 - i) operation, inspection and maintenance of the control, treatment, disposal and monitoring facilities for leachate, groundwater, surface water and landfill gas;
 - ii) record keeping and reporting; and

- iii) complaint contact and response procedures;
- f) an assessment of the adequacy of and need to implement the contingency plans for leachate and methane gas;
- g) an updated estimate of the contaminating life span of the Site, based on the results of the monitoring programs to date; and
- h) an update of the cost estimates for financial assurance and the amount which has been provided to the MECP Director to date.

The Site will be closed in accordance with the Site Closure Plan as approved by the MECP Director.

Upon closure of the Site, the following features will be inspected, recorded on a quarterly basis and maintained as required on a seasonal basis:

- a) evidence of settlement;
- b) possible leachate seeps and springs;
- c) cover soil integrity;
- d) vegetative cover;
- e) surface water drainage works;
- f) erosion and sediment in surface water drainage system; and
- g) groundwater monitoring wells.

In accordance with the ECA, a vegetative cover consisting of vegetation that is suited to local conditions and that is capable with minimal care of providing vigorous, plentiful cover no later than its third growing season will be established over all completed areas to control erosion and maximize evapotranspiration. WM will complete planting as soon as possible after reaching final contours. If weather conditions do not allow timely placement of final and vegetative cover, silt curtains will be employed to minimize silt loadings to surface water bodies.

As per the ECA, WM will consult with affected stakeholders on the proposed end uses as committed to in Item 35 of Schedule "A" of the ECA prior to the submission of its closure report under the *Environmental Protection Act (EPA)*. The ECA indicates that the proposed end use activities should be consistent with the types of activities consulted upon during the 2005 Warwick Landfill EA, which included private open space and/or public open space end uses.

2.5 Leachate Management

2.5.1 Leachate Generation

Alternative Method 1 will not change the current expected infiltration rate, instead, it will increase the rate of run-off due to higher side slopes. Consequently, the leachate collection system will not require changes as a result of Alternative Method 1. Details of the leachate generation assessment are provided below.

A leachate generation assessment was previously completed by Henderson Paddon & Associates Limited in 2008 for the Expansion Landfill, as summarized in Section 6.1.1 (page 6-1) of the 2008 Design and Operations (D&O) Report. A Hydrologic Evaluation of Landfill Performance (HELP) model (version 3.07) was also developed as part of the previous studies.

Leachate generation for the different landfill expansion alternative methods was estimated using the HELP model. The maximum leachate elevation above the primary drainage layer averages less than 1 mm. As per current ECA A032203, Condition 7.18, the maximum leachate head of 300 mm on the landfill liner is not exceeded except after significant precipitation events.

For the proposed landfill optimization, the previous HELP model was used as a basis of current study with some modifications. For calculating leachate generation, infiltration rates of 450 mm/year, 150 mm/year, and 100 mm/year were adopted for active areas, areas of interim cover, and areas of final cap, respectively. These are the same infiltration rates that were contemplated in the previous studies.

Additionally, the current HELP model considers:

- the landfill final cap (i.e., model layer 2) was simulated as a 'barrier layer' type, to allow use of the HELP model default clay material type (hydraulic conductivity $k = 1.2 \times 10^{-6}$ centimetres per second (cm/s));
- the default hydraulic conductivity of 1×10^{-3} cm/s was simulated for the three waste layers;
- simulation of the geotextile separators was included;
- the "drainage" options for the primary drainage layer and secondary drainage layer were activated;
- a hydraulic conductivity of 5×10^{-8} cm/s was used to simulate the primary liner;
- evaporative zone depth of 15 cm was simulated; and
- two models were developed to simulate both the top of waste mound and sideslopes. For Alternative Method 1, the average waste thicknesses for each model were adjusted to 96 m for the top of the waste mound and 53 m for the sideslopes.

The existing design profile is currently split with 67% on top of the mound and 33% sideslopes, while Alternative Method 1 inverts these proportions. Higher slope grades generally result in increased runoff and lower infiltration; as such, Alternative Method 1 could conceptually be expected to generate less leachate than the existing design.

Two HELP models were created to assess infiltration for Alternative Method 1: one to simulate infiltration at the top of waste mound and another to simulate infiltration on the sideslopes. The predicted infiltration in both cases is around 96 mm/year. An average annual infiltration rate of about 96 mm/year is also predicted for both the top of waste mound and sideslopes for the existing design. Thus, the results suggest that

leachate generation at the Expansion Landfill is insensitive to either the slope of the final cap or the total waste thickness. This means that Alternative Method 1 will not change the expected infiltration rate used in the predicted leachate generation rates for the Expansion Landfill as outlined in Table 6.1 of the 2008 D&O Report.

The maximum leachate generation for Alternative Method 1 is predicted to peak at 120,500 m³ per year (330 m³ per day) in Year 3 after completion of Stage 1 (approximately 2036). Leachate generation will then decrease to approximately 106,700 m³ per year (292 m³ per day) following placement of the final cover in Year 12 (estimated to be in 2045). **Appendix B** provides the modelling results. An additional 25,550 m³ of leachate annually (70 m³ per day) is estimated to be generated from the closed Old Landfill.

Based on the above, maximum leachate generation is estimated at 400 m³ per day (330 m³ + 70 m³) from both Alternative Method 1 (including the Expansion Landfill) and the closed Old Landfill, which is expected to occur in Year 3 (approximately 2036).

WM developed a leachate management framework and supporting documents in 2017 which identified that the HELP model produced overly conservative estimates of leachate generation at TCEC. In addition, since the Expansion Landfill footprint began operating in late 2009, WM has implemented a range of design and operational practices to minimize leachate generation. The March 2023 Leachate Management Plan reported that the volume of leachate extracted from the Expansion Landfill remained consistent for the past four years, at approximately 41,000 to 44,000 m³ per year. Based on the annual leachate extraction volumes to the end of 2022, it is evident that the leachate generation estimates from the HELP model are overestimated. In addition, WM plans to continue to reduce the volume of leachate stored within the closed Old Landfill over several years. Initially, WM is targeting a reduction of 5,000 m³ per year in the total volume stored.

Leachate generation volumes increased in 2023 to approximately 70,400 m³. This is approximately 60% of the predicted peak generation of 120,500 m³/year for Alternative Method 1. The Expansion Landfill continued to develop including construction of a new stage increasing the amount of open area and reopening previously covered areas for filling, resulting in increased leachate generation. The annual leachate volume is anticipated to continue to fluctuate as landfilling areas are opened and closed each year.

Based on the information presented, future generation of leachate should be anticipated to be at annual volumes between the HELP predictions and current levels.

Leachate seeps during the active landfill will be managed as part of the landfill operations. The slopes will be capped and seeded as part of the landfill closure, and leachate seeps, if they occur, will be repaired as part of the post-closure maintenance.

2.5.2 Leachate Treatment

The current approach to managing leachate generated at the TCEC includes phytoremediation of a portion of the leachate volume generated through irrigation of the on-site Poplar System. The Poplar System is anticipated to manage approximately 44,000 m³ of leachate per year. The balance of the leachate generated is removed from the site and sent to an off-site wastewater treatment plant for disposal.

The automated leachate pumping stations allow the leachate to be pumped to the equalization tank (capacity of 2,300 m³) or to the Poplar System irrigation tanks. The irrigation liquid is applied to the Poplar System from May to mid-October and the remaining leachate is hauled for off-site treatment and disposal. The Poplar System refers to the poplar trees planted on the final cover of the closed Old Landfill. A new equalization tank with the same capacity as the existing tank will be implemented in 2026. This additional storage capacity will provide contingency and capacity for condensate from the RNG Facility.

The 2005 EA for the Expansion Landfill identified the preferred alternative for leachate treatment as full on-site treatment with no liquid effluent discharge to surface water. Subsequently, a leachate treatment facility was designed and permitted with a rated capacity to treat 146,000 m³/year (400 m³/day).

When considering the leachate generation estimates being identified through the HELP model compared to actual leachate generation observed at the Expansion Landfill, the leachate treatment facility design is significantly oversized and, as a result, would not operate as intended. The leachate treatment facility has not yet been constructed and would require redesign and permitting prior to construction.

The proposed approach for leachate management and disposal for Alternative Method 1 is consistent with the current approach and includes a combination of the following:

- Phytoremediation of a portion of the leachate volume generated through irrigation of the on-site poplar system (up to approximately 44,000 m³/year).
- Trucking of leachate to an off-site wastewater treatment plant (up to 8 trucks per day).
- Modification of the rated capacity required for the leachate treatment facility to reflect actual leachate generation being observed, updating of the rated capacity, and design and construct a leachate treatment facility prior to landfill closure.

WM has discussed future leachate management with the MECP. WM will develop an on-site leachate treatment facility within five years of the landfill expansion capacity being developed. In addition, WM will continue to assess other available options for management of leachate which may provide comparable or better environmental outcomes.

2.6 Landfill Gas Management

2.6.1 Landfill Gas Generation

Landfill gas (LFG) is produced as a by-product of the biological decomposition of organic matter within the waste and typically increasing throughout the operational period of the landfill development and peaking upon site closure.

The LFG production rate slowly declines over the years after the landfill is closed, until the waste has finished decomposing. Many factors affect LFG generation rates including, but not limited to, the waste moisture content, water movement (infiltration), temperature, pH, waste composition, waste age, and nutrient availability.

The generated LFG production was estimated by using the USEPA LANDGEM model, which is a recognized method by the MECP. The model considers a Methane Generation Capacity (Lo) of 108 m³ per metric ton of waste and Reaction Constant (k) of 0.045 per year, which are representative of municipal waste.

For the Degradable Organic Carbon (DOC) content and the Reaction Constant, the default values as suggested by Environment and Climate Change Canada (ECCC) for Ontario are used (Canada National Inventory Report 1990-2018, published in 2020). Lo values are calculated based on a methane concentration in pure LFG of 60% and a DOCf (Fraction of degradable organic carbon which decomposes) of 50% (default value of ECCC).

The produced LFG estimated for the Old Landfill and Expansion Landfill with Alternative Method 1 (**Table 2-3**), estimates that the landfill will produce a peak amount of LFG of approximately 20,203 m³/hr in 2043, of which 18,169 m³/hr are estimated to be collected (**Figure 2-1**). Collection efficiency for the Old Landfill is assumed to be 67% as this gives the best fit with real operational data. For the Expansion Landfill and vertical expansion, the collection efficiency of 75% is assumed for areas with waste and LFG collection systems in place but without final cover. The collection efficiency is increased to 90% for areas with a final cover and an LFG collection system.

Guidance provided by the US EPA "Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Municipal Solid Waste Landfills", dated June 2011 suggests that 75% collection efficiency can be expected from intermediate cover areas.

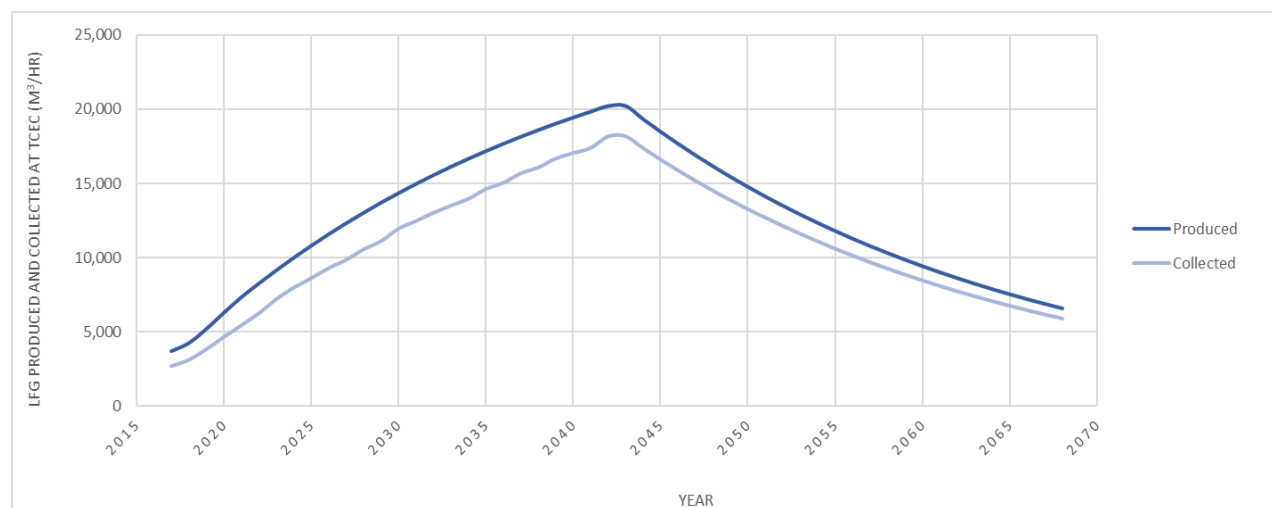
The increase in collection efficiency for the Expansion Landfill under final cover to 90% is reflective of the enhanced final cap that will be installed including 2 m of cover (1.85 m clay and 0.15 m topsoil) with active gas collection. This aligns with the above noted guidance provided by the US EPA as well as the Canada Gazette, Part I, Volume 158, Number 26: Regulations Respecting the Reduction in the Release of Methane (Waste Sector)", dated June 29, 2024.

Table 2-3. LFG Produced and Collected Rates Alternative Method 1, 2 and 3

Year	LFG Produced at Old Landfill (m³/hr)	LFG Produced at Expanding Landfill (m³/hr)	Total LFG Produced at TCEC with Vertical Expansion (m³/hr)	Total LFG Collected at TCEC with Vertical Expansion (m³/hr)
2017	585	2,757	3,680	2,716
2018	559	3,259	4,224	3,126
2019	534	4,122	5,180	3,844
2020	510	5,105	6,271	4,665
2021	487	6,044	7,315	5,450
2022	465	6,882	8,244	6,252
2023	444	7,682	9,133	7,205
2024	424	8,447	9,982	7,988
2025	405	9,179	10,793	8,621
2026	387	9,878	11,569	9,302
2027	370	10,547	12,311	9,850
2028	353	11,186	13,020	10,564
2029	337	11,797	13,699	11,119
2030	322	12,381	14,347	11,951
2031	308	12,939	14,967	12,472
2032	294	13,473	15,559	13,027
2033	281	13,984	16,125	13,505
2034	268	14,472	16,667	13,962
2035	256	14,938	17,185	14,618
2036	245	15,384	17,679	15,043
2037	234	15,810	18,153	15,680
2038	223	16,218	18,605	16,074
2039	213	16,607	19,037	16,675
2040	204	16,980	19,451	17,040
2041	195	17,336	19,846	17,389
2042	186	17,676	20,224	18,161
2043	178	17,690	20,231	18,169
2044	170	16,911	19,341	17,370
2045	162	16,167	18,489	16,605
2046	155	15,456	17,676	15,874
2047	148	14,776	16,898	15,176
2048	141	14,125	16,154	14,508
2049	135	13,504	15,443	13,870
2050	129	12,910	14,764	13,259
2051	123	12,342	14,114	12,697

Year	LFG Produced at Old Landfill (m ³ /hr)	LFG Produced at Expanding Landfill (m ³ /hr)	Total LFG Produced at TCEC with Vertical Expansion (m ³ /hr)	Total LFG Collected at TCEC with Vertical Expansion (m ³ /hr)
2052	118	11,799	13,493	12,138
2053	112	11,279	12,899	11,604
2054	107	10,783	12,331	11,093
2055	103	10,309	11,789	10,605
2056	98	9,855	11,270	10,138
2057	94	9,421	10,774	9,692
2058	89	9,007	10,300	9,265
2059	85	8,610	9,846	8,858
2060	82	8,232	9,413	8,468
2061	78	7,869	8,999	8,095
2062	74	7,523	8,603	7,739
2063	71	7,192	8,224	7,398
2064	68	6,876	7,862	7,073
2065	65	6,573	7,516	6,762
2066	62	6,284	7,185	6,464
2067	59	6,007	6,869	6,180

Figure 2-1. Landfill Gas Produced and Collected Curves for Alternative Method 1, 2 and 3



2.6.2 Landfill Gas Collection and Treatment

LFG is currently collected from the closed Old Landfill and the Expansion Landfill. The LFG collection system includes conventional vertical wells within the closed Old Landfill footprint and mostly Early Vertical Gas System (EVGS) wells within the Expansion Landfill. The Expansion Landfill also draws gas from the Primary Leachate

Collection System (PLCS). All wells are connected to a network of laterals and sub-headers directing flow to the LFG Facility through a 900 mm diameter header pipe, which is sufficient to handle the generated LFG after vertical expansion. LFG is discharged to the on-site blower building and to fully enclosed flares.

The EVGS wells are extended upward as landfill operations progress and cells are filled. The LFG collection system is extended sequentially following horizontal and vertical growth of the Expansion Landfill. At approximately 15-metre intervals, additional gas subheaders and laterals are installed within the landfill. Condensate drains by gravity into several drain traps equipped with compressed air powered pumps which transfer liquid by forcemain for disposal into the PLCS. Vertical wells are extended as the waste placement progresses to minimize odours and reduce the amount of LFG escaping.

The expanded LFG collection system will be similar to the existing design and will comprise vertical wells, LFG subheaders, and LFG laterals that are connected to the main 900 mm header pipe located along the perimeter of the landfill.

The LFG collection system has a collection efficiency of approximately 75% for areas without final cover based on operational data and can be increased to 90% for areas with final clay cover. It is anticipated that this level of collection efficiency will continue to be achieved for Alternative Method 1. At peak LFG generation, approximately 18,169 m³/hour (**Table 2-3**) of landfill gas will be collected and require treatment.

The landfill has four approved LFG flares. Flares 1 to 4 provide a combined capacity of approximately 25,847 m³/hr or 15,213 scfm. The new Renewable Natural Gas (RNG) Facility, which is currently being constructed at the TCEC, has the capacity to process up to 13,592 m³/hr or 8,000 scfm of LFG on a dry basis and transform it into RNG, reducing greenhouse emissions over the operating life of the site and during post-closure years. Additionally, Flares 5 and 6 are being constructed as part of the RNG Facility and will provide a capacity of 10,188 m³/hr or 5,996 scfm.

In total, the TCEC has an approved combined treatment/flare operational capacity of 49,627 m³/hr or 29,209 scfm (considering the four flares, the RNG Facility capacity and two flares), which provides an excess capacity of approximately 63% more than the estimated peak volume of LFG being generated at the site.

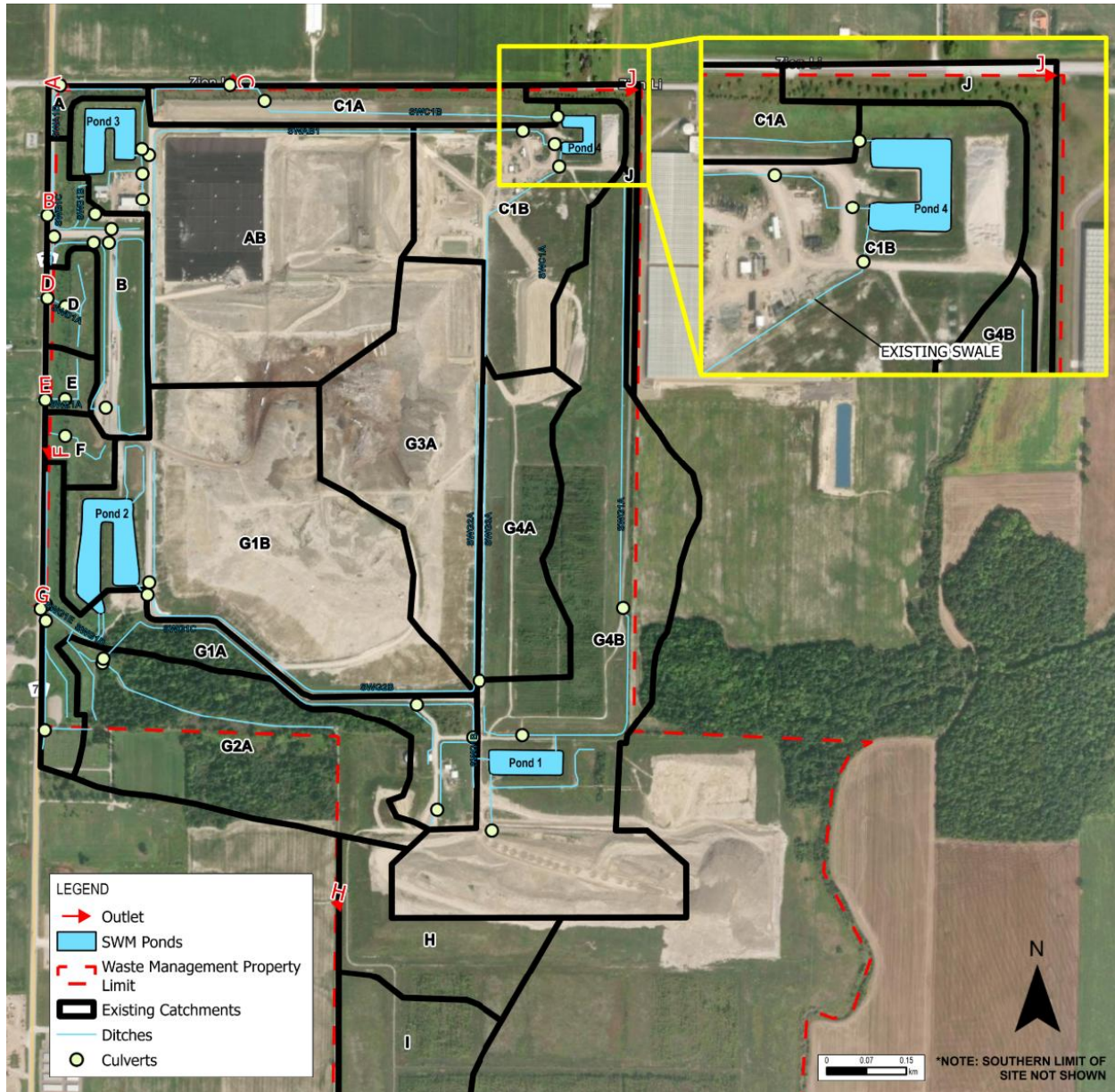
2.7 Stormwater Management

2.7.1 Existing System

Stormwater is currently managed on site through swales and detention ponds. Swales direct runoff to the ponds and outlets, providing infiltration along the way. Four stormwater management ponds that are situated at the corners of the Expansion Landfill footprint collect runoff from the surface of the landfill and release flows through culvert outlets. In this manner, they maintain peak site runoff at pre-development levels. There are ten stormwater outlets from the site, labelled A-J, four of which

receive water from the detention ponds. **Figure 2-2** shows the layout of the existing stormwater management system, including the locations of the ponds, swales, and outlets. Details on these aspects of the stormwater management system is available in the Surface Water Quantity Existing Conditions Report.

Figure 2-2. Existing Stormwater Management



2.7.1.1 Analysis of System Capacity

An analysis of the existing stormwater management system was conducted for the Surface Water Quantity Existing Conditions Report. It was found that, so long as regular maintenance removes excess sediment buildup, there is sufficient capacity in the four detention ponds to hold a 4-hour 1:100-year storm. This was verified by

modelling the stormwater management ponds within a hydrological software (Visual OTTHYMO Model Version 6.2).

Furthermore, the 3-hour Chicago storm was also run, however the 4-hour results were found to be more conservative (i.e. higher peak flows and higher storage volumes). As such, the 4-hour Chicago storm results were chosen to be presented within this report. The results from both the 100-year 3-hour Chicago and the 100-year 4-hour Chicago are included in Appendix C.

Additionally, water quality treatment for runoff from the site will also be provided by the stormwater management ponds with a 75% TSS removal rate. Further, a 4-hour, 25-mm storm event was modelled within Visual OTTHYMO to confirm that the ponds have the capacity to store/treat the runoff volume generated from the landfill site.

Swales are designed for a 25-year return period; the swales were also found to have sufficient capacity under existing conditions.

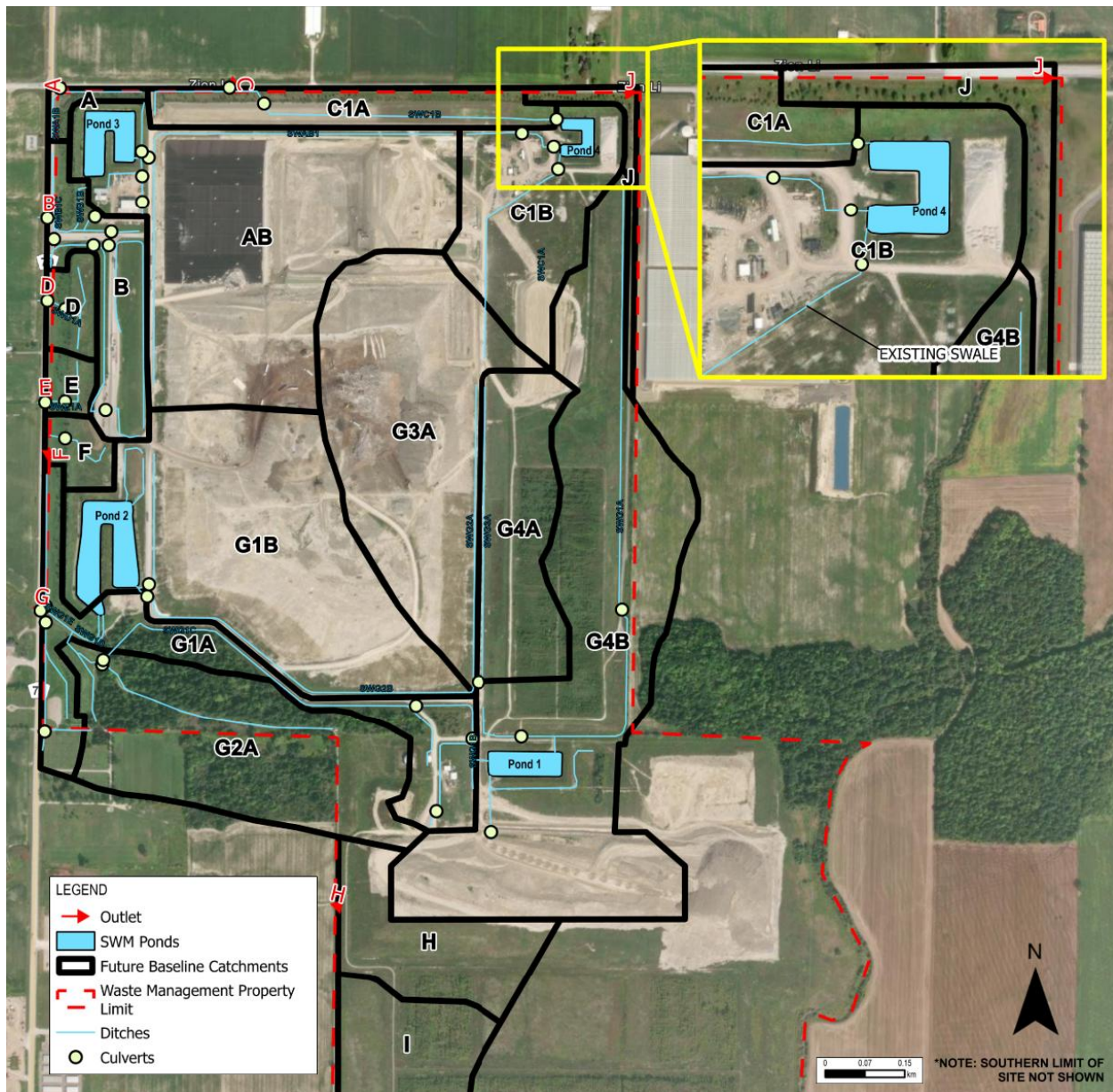
2.7.2 Future Baseline Scenario

Should the landfill optimization not proceed, the landfill development will continue until it has reached its full horizontal footprint and currently approved height of 280 masl. This will alter the outlets' catchment areas, land cover, and time of concentration, as well as the path of the swales in the northeast corner. This scenario is considered the future baseline and was modelled as part of the assessment of the proposed expansion as detailed below.

The full buildout of the landfill in the northeast corner will move the bordering swales to the east as shown in **Figure 2-3**.

The swale leading to Pond 4 will be slightly shorter (now 0.4 km in length), while the swale heading south towards Pond 2 will be longer (1.6 km total). A new culvert will be required under the servicing road. These new and realigned components of the stormwater system will be finalized during detailed design and as such were sized appropriately for the 25-year return period storm under Alternative Method 1 as described below.

Figure 2-3. Approved Stormwater Management



2.7.3 Impact of Alternative Method 1

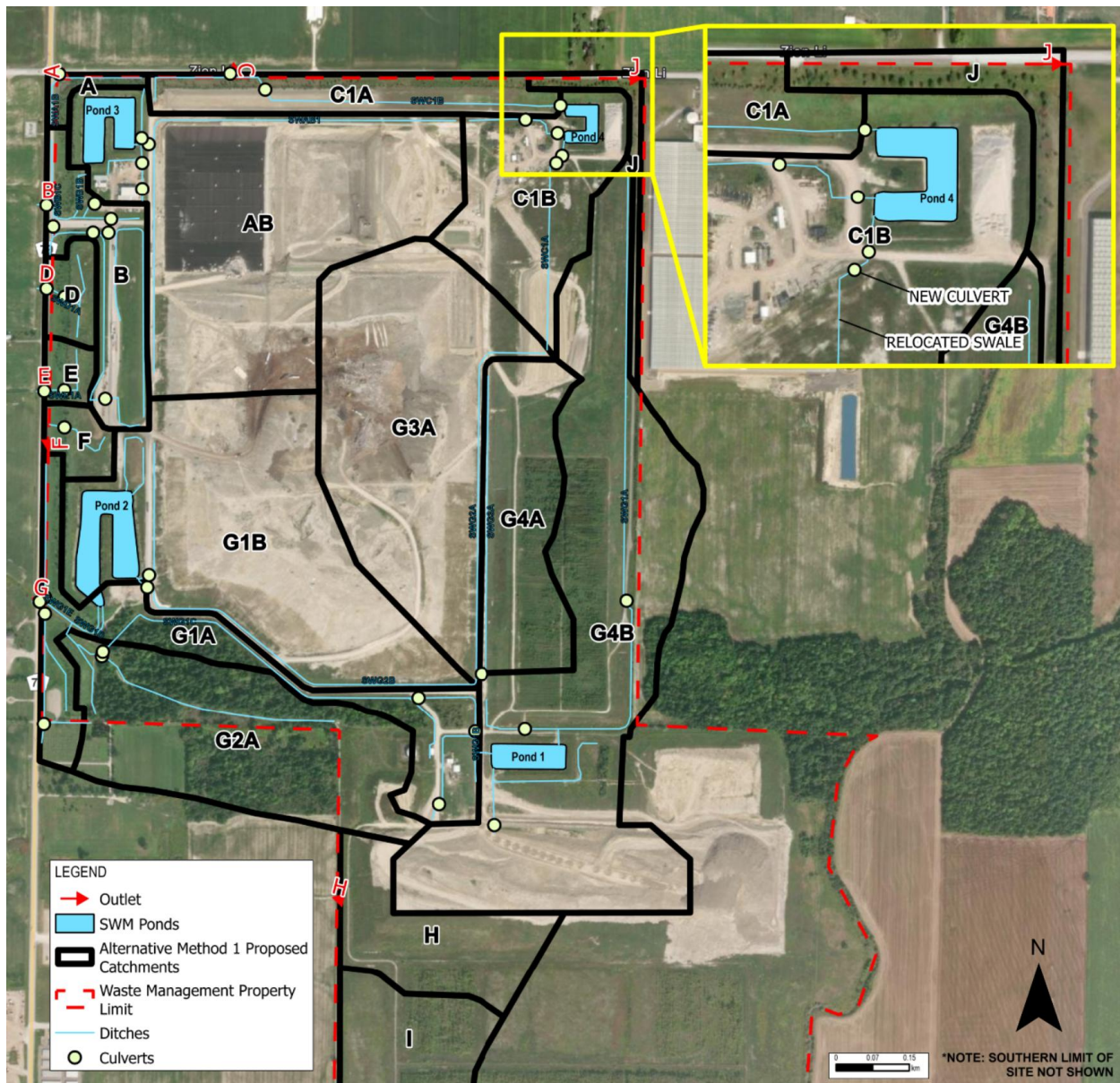
The proposed vertical landfill expansion will impact the stormwater management system in two ways:

1. Altering catchment areas within the landfill site; and
2. Decreasing time of concentration.

It is noteworthy that the landfill optimization will not change total runoff volume from the landfill site; however, the timing of peak flows and the redistribution of catchment areas is expected to increase or decrease some of the peak flows leaving through the

outlets as shown in **Table 2-4**. For this reason, all catchments experiencing one or both of these above-noted changes under Alternative Method 1 were modelled under Existing Conditions, and Future Baseline, and Alternative Method 1 scenarios to both compare changes to stormwater runoff and assess any capacity issues with the detention ponds and swales. This excluded Catchments D, E, F, H, I, and J, as they will not be physically altered in any way from their existing characteristics. The results of this analysis are presented in **Table 2-4** and **Table 2-5**. Full results showing all return period storms are available in **Appendix C**. The locations of the named outlets, ponds, and swales are shown in **Appendix C**. The redistributed catchment areas for Alternative Method 1 are shown in **Figure 2-4**.

Figure 2-4. Stormwater Management for Alternative Method 1



The geometries of the realigned swales (SWC1A and SWG2A) and new culvert have been designed to blend with the grades of the existing surface and to mirror the cross-section and profile of the existing swales. Their required dimensions under the Alternative Method 1 + Climate Change conditions are presented in **Table 2-4** (please see **Section 5.1.1** for a discussion of the climate change modelling procedure).

Table 2-4. Changes to Site Outlet peak flows during 100-year event

Outlets	Peak Runoff (cms / % increase from Existing Conditions)				
	Existing Conditions	Future Baseline		Alternative Method 1	
A	0.261	0.275	5%	0.276	6%
B	1.006	0.97	-4%	0.97	-4%
C	0.643	0.518	-19%	0.52	-19%
G	1.627	1.825	12%	1.81	11%

Table 2-5. SWM Pond function during 100-year event

Pond	Capacity (ha-m)	Peak Storage Used (ha-m)		
		Existing Conditions	Future Baseline	Alternative Method 1
1	2.773	0.943	0.943	0.943
2	5.271	1.625	1.838	1.824
3	2.857	0.732	0.75	0.75
4	1.099	0.347	0.285	0.282

The data presented in **Table 2-4** shows peak outflows from different outlets leaving the landfill site. The results for the Alternative Method 1 scenario closely mirror those of the Future Baseline scenario; in both, Outlets A and G experience an increase in peak flow compared to existing levels, while Outlets B and C demonstrate a decrease. It is noteworthy that Stormwater Management Pond 3 discharges flows to Outlets A and B and as seen from **Table 2-4**, Outlet A shows an increase in flows of approximately 6% and conversely Outlet B shows a decrease in flows of approximately 4% when compared to existing conditions. Outlet C shows a decrease in flows of approximately 19% when compared to existing conditions. Outlet G shows an approximate increase of 11% in flows when compared to existing conditions. However, it should be noted that the swales conveying the flows to Outlet G have sufficient capacity and are able to convey the flows downstream safely.

Further, the data presented in **Table 2-5** indicates that all four stormwater management ponds on the landfill site have enough capacity to store the 100-year flows across the Future Baseline and Alternative Method 1 scenarios. They do not require alteration or enlargement.

The existing swales around the landfill site currently are also able to safely convey the 25-year design storm (**Table 2-6**) without overtopping. Hence, a modification to the existing cross-section geometries of the swales is not warranted. The relocated swales

(SWC1A) and SWG2A) and new culvert will also be able to convey these flows appropriately when constructed to the design requirements listed in **Table 2-7**.

Table 2-6. Swale function during 25-year event

Swale	Flow Capacity (L/s)	Peak Flow (L/s)	
		Future Baseline	Alternative Method 1
SWAB1A	9,384	1,539	1,594
SWA1B	6,256	193	193
SWB1B	23,461	216	215
SWB1C	120,733	773	773
SWC1A	3,699	577	570
SWC1B	191,849	483	484
SWD1A	28,626	233	233
SWE1A	100,850	213	213
SWG1A	3,981	1,103	1,103
SWG1B	17,669	463	463
SWG1C	11,847	813	813
SWG1D	6,229	409	400
SWG1E	10,909	1,216	1211
Stream	18,095	1,216	1,211
SWG2A	1,592	668	691
SWG2B	12,631	2,813	2,723
SWG3A	1,246	297	297

Table 2-7. Design geometry of modified swales and new culvert

Name	Bottom Width / Diameter (m)	Depth (m)	Side Slope (x:1)	Slope
SWC1A	3	0.90	3:1	0.09%
SWG2A	1	0.54	3:1	0.64%
New Culvert (HDPE – 1 pipe)	1.2			0.44%

2.8 Ancillary Facilities

No additional ancillary facilities, beyond those already existing on the site, will be required for Alternative Method 1.

2.9 Site Traffic

There are no operational changes anticipated for the landfill optimization and the landfill will operate consistent with current conditions with the same annual tonnage limit. There is no proposed change to the effective catchment area for the facility, the

origin-destination patterns of vehicles travelling to or from the TCEC, or the maximum daily trips generated. Accordingly, there should be little to no impact to the surrounding road network or along the haul routes within the greater context.

The landfill optimization is not expected to increase its average daily tonnage received. Therefore, traffic conditions are expected to remain the same as they are today. An existing traffic analysis (HDR, 2026) was prepared that reflected a peak operating day for the TCEC (the highest vehicular activity).

Weigh scale and turning movement count data was used to project traffic volumes for the TCEC under the following assumptions:

- Employee traffic volumes remain unchanged.
- The origins/destinations of site traffic do not change.
- Haul routes do not change.
- The hourly, daily, and seasonal patterns remain stable.
- The breakdown of vehicle types and average vehicle loads remain stable.

Turning movement counts (TMCs) were collected in November 2022 and validated with landfill weigh scale data. Site traffic was adjusted using the weigh scale information to adjust the site traffic so that it was representative of a peak day. There are typically 47 inbound and 77 outbound trips during the weekday AM peak hour, 44 inbound and 52 outbound trips during the midday peak hour, and 26 inbound trips and 30 outbound trips during the weekday PM peak hour.

No off-site road network improvements are required to accommodate the extension of the landfill's operating life to approximately 2043.

Traffic related to landfill construction is not anticipated (e.g., landfill cell preparation in advance of waste placement) as the landfill liner will be fully constructed prior to vertical expansion of the landfill. Current construction traffic and any materials used for landfill cover are captured in the weigh scale data provided for the traffic impact analysis and is therefore included in the projected vehicle trips.

2.10 Landfill Operations

2.10.1 Operating Hours

Waste is currently received at the site from 7:00 a.m. to 7:00 p.m. Monday to Saturday, excluding statutory holidays. On-site equipment used for daily operations can operate from 6:00 a.m. to 8:00 p.m. Monday to Saturday. No changes to the landfill operating hours are anticipated as a result of the landfill optimization.

2.10.2 Site Equipment

The list of normal site equipment will remain unchanged during the landfill optimization and will consist of the following:

- Working Face:
 - 2 CAT 836 Compactors
 - 2 CAT D8R Dozers
 - 1 CAT D6R Dozer
 - 2 Tippers
- Daily Cover and Capping:
 - 2 – Articulated CAT D400 Trucks
 - 1 – Excavator CAT 330L
- Road Maintenance
 - 1 – CAT 140H Grader
- Other Equipment:
 - 1 - Tracked Loader
 - 1 - Portable Air Compressor
 - 1 - Portable Pressure Washer
 - 1 - Utility Tractor with sweeper attachment, rear mounted scraper blade and bush hog-type mower
 - 1 - Portable Electric Generator and Lighting Plant;
 - 1 - Roll-off Truck, complete with roll-off bins
 - 1 - Pelican Road Sweepers with Water Flush System
 - 1 - Portable 100-mm Diesel Water Pump
 - 1 - 3/4 tonne 4 x 4 Pickup Truck, complete with hydraulic-operated snow plough and diesel fuel tank and pump
 - 1 - Cat 950F Rubber-Tired Loader
 - Other auxiliary equipment, such as pickup trucks, maintenance equipment, steam jennies, welders, small tools, portable diesel generator for variable use and portable construction pumps, and power road sweeper attachment for farm tractor.
 - 1 - Portable Wood Crusher / Screener - periodic only
 - 1 - Wood tub Grinder, 1 - Chipper - periodic only

2.10.3 Waste Placement

There are no operational changes anticipated to result from the landfill optimization and it will operate consistent with current conditions with the same 1.4 million tonnes annual capacity. Landfilling of waste will continue to occur in phases. Contaminated soil is anticipated to be disposed of in the active portions of the Expansion Landfill.

Contaminated soil used for daily cover is only used where precipitation runoff would not be directed to a surface water drainage course (i.e., an inside sideslope).

The working face will be approximately 1,500 m², according to current site operations. This is a reasonable area for dozers to push the waste, to spread and level the waste from the tip face, and for the compactors to operate. An active face this wide could accommodate two (2) tippers, six (6) transfer trailers and four (4) packers unloading simultaneously. This width should be adequate for peak hour traffic during average day capacities. If additional capacity were required for peak days, the width or length of the working face would be adjusted accordingly.

2.10.4 Daily and Intermediate Cover

At the end of each working day, at least 75% of the working face will be covered with 0.15 m of soil cover or an approved alternative cover material.

Areas remaining inactive for six months or longer should be provided with 0.30 m intermediate cover of soil or an approved alternative cover material.

Cover materials that may be used as an alternative to soil include contaminated soil, automobile shredder residue, wood chips, or tarps.

2.10.5 Nuisance Controls

WM employs a variety of proactive measures to minimize nuisance effects related to odour, litter, dust, noise, and birds on the surrounding environment. These established measures, detailed below, are expected to continue at the TCEC until landfill closure.

2.10.5.1 Odour

Odour has been managed in the site in accordance with the Best Management Plan (Odour) prepared by RWDI listed as Item 84 in Schedule "A" of the ECA No. A032203. This plan will be applicable for any of the Alternative Methods.

The walkabout surveys are scheduled for completion in the spring and the early fall to identify unexplained odour events. The results of these walkabout surveys, the times they were completed, and any remedial actions will each be noted in the site odour log. Routine visual inspections of the landfill cap integrity will also occur on a monthly basis to identify possible problem areas. In addition, during the survey of site and during regular inspection periods, detectable odours from the site will be noted and recorded. At a minimum, the odour information will include a description of the odour, time of day (to correspond with wind conditions) and if possible, an indication of the main sources contributing to the odour.

The odour control measures relate largely to on-going monitoring and maintenance that has been identified in the Best Management Plan. However, there are a number of specific details including:

- Progressively expand and activate the landfill gas collection and flaring system (two installed and two flares proposed) to minimize the amount of odourous landfill gas that escapes through the mound. The systems should be constructed in a manner to ensure that a minimum of 70% collection efficiency is achieved on a regular basis.
- Regular repairs to the covered landfill areas (existing and future landfill areas) based on identifying any fissures, cracks or erosion of the soil cover that would allow for unmitigated landfill gas to escape directly to the atmosphere. These areas will be identified in the “walkabout” survey as described above. The areas requiring repair should be covered with clay, compacted, and then covered with topsoil.
- Routinely monitor the size of the active working face of the landfill. The size of the working face will be minimized, accounting for traffic at the working face.
- Regular inspection and monitoring of temperature and moisture of the compost windrows. If waste from the diversion area becomes unacceptable for composting or overly odourous, the material should be removed from this area and landfilled.
- Cap completed cells as quickly as possible with final cover to minimize odourous emissions.

2.10.5.2 Litter

Litter has been retrieved from the external access roads, on site, adjacent properties, and on more remote properties, if required. WM personnel (waste hauler drivers) are instructed to stop and retrieve any litter observed along the access route. On-site litter is controlled by the use of good operating practices such as prompt compaction of loose waste at the active face, daily cover application, interim cover (300 mm) of areas sitting dormant, final capping and vegetation of completed portions of the landfill, gull control, landfilling at a lower elevation during high wind events, high litter barrier fence on the downgradient side of high winds, moveable litter barriers near the active face that can be moved to the downwind side of the compaction and landfilling operation, prompt retrieval of blown litter both off and on site, and tree plantings on property lines to catch any loose litter before it reaches neighbouring properties.

A series of portable litter barriers will be used to shield the downwind side of the active face from escaping litter. These barriers will be skid-mounted and can be towed into place. Labourers will be engaged to pick litter regularly, both on and off WM property.

2.10.5.3 Dust

The TCEC has created a Best Management Practices Plan for dust that is implemented at the site and will be in effect after completion of Alternative Method 1. All TCEC employees are trained in the contents of the plan. The combined efforts of the mitigation measures and implementation of the Dust Management Plan will limit the number of total suspended particulate (TSP) exceedances during the periods of heavy construction and beyond.

Currently, particulate emission mitigation measures are in place at the TCEC and consist of watering on-site roadways and construction sites as well as a number of other practices as outlined in the Best Management Practices Plan for dust. The practices will not occur if precipitation events cause these activities to become redundant or if the ground is sufficiently wet from previous precipitation events.

As part of the dust control strategy, the shift supervisor will be responsible to see that a record of roadway sweeping and watering is maintained. The control measure will be initiated whenever a visible plume behind vehicles is longer than $\frac{1}{4}$ the length of the vehicle. These logs will be kept on-site for a period of not less than two (2) years and will be made available for inspection.

2.10.5.4 Noise

As outlined in Section 4.3.13 of the 2008 D&O Report, all landfill perimeter berms, road berms, and fills have been constructed to provide visual barriers, noise barriers, and dust barriers along the landfill and TCEC perimeter. The operational berms have significantly reduced noise from the operational face. Additionally, in accordance with the Noise Impact Assessment conducted in 2005, the operation of the dozer(s) for applying daily cover in the evening or removing it in the morning outside of daytime hours has been restricted (see **Section 2.10.1**).

The TCEC's obligations with respect to noise reporting are described in Amended Environment Compliance Approval Number A032203 (ECA) dated June 20, 2025. Monitoring of the facility noise levels are completed quarterly at four (4) monitoring sites around the perimeter of the TCEC. All measurements are conducted in compliance with requirements outlined in the Ministry Publication NPC-103 – Procedures (MOE 1978).

2.10.5.5 Birds

The following acoustic devices have been used to scare away gulls:

- Whistling and/or Pyrotechnic Pistol Cartridges;
- Shots fired from a starter pistol or other type of gun;
- Propane canons (“bird bangers”); and
- Electronic distress calls.

The above devices produce impulsive noise which is less than the MECP Landfill sound level limit of 70 dBAI, for all receptors, regardless of the position of firing within the TCEC.

In addition to using acoustic devices, trained birds of prey such as falcons, hawks, eagles or owls have been used in TCEC for bird control. The bird of prey is flown at intervals throughout the day, serving as a natural deterrent for seagull control.

2.10.6 Emergency Management

The current Waste ECA No. A032203 contains information on emergency situations. In the event of a fire or discharge of a contaminant to the environment, Site staff will contact the MECP Spills Action Centre and the District Office of the MECP. WM will submit a written report to the MECP District Manager within three (3) days of the spill or incident, outlining the nature of the incident, remedial measures taken and measures taken to prevent future occurrences at the Site. WM will ensure that adequate fire fighting and contingency spill clean up equipment is available in accordance with Item 66 of Schedule "A" of the ECA and that emergency response personnel are familiar with its use and location.

The operations and procedures manual for the Site includes discussions on contingency plans and emergency procedures as required by the ECA, and employees are trained in the emergency response procedures.

3 Conceptual Design of Alternative Method 2

3.1 Overview

Alternative Method 2 includes the increase of final landfill side slopes from 4H:1V to 2.5H:1V between elevation 250 masl and elevation 313 masl, about 60 m in grade change, transitioning to a 20H:1V upper slope and peaking at elevation 319 masl (**Drawing 2.1**) over the Expansion Landfill. The Expansion Landfill is fully engineered and has an approved peak elevation of 280 masl. Alternative Method 2 will provide an additional 14.3 million m³ of landfill capacity.

Considering the proposed final side slopes of 2.5H:1V are steeper than the current 4H:1V as per O. Reg. 232/98, a geotechnical feasibility review was performed to confirm the slope stability and settlement. The geotechnical assessment showed that this alternative is acceptable with respect to the stability of the final slopes (2.5H:1V) and proposed peak profile height. The results of the geotechnical feasibility review for Alternative Method 2 are discussed in **Section 3.2**.

3.2 Landfill Design and Geometry

The geometry of Alternative Method 2 is shown in plan view in **Drawing 2.1**. Under the proposed vertical expansion, the existing approved waste disposal footprint area of the TCEC would not change, but rather, the maximum permitted height of waste would be increased by 39 m, from 280 masl (the current approved elevation for top of waste) to 319 masl, which is the maximum elevation of the top of the final cover for Alternative Method 2. The 2.5H:1V side slopes will start at elevation 250 masl (about 48 m in grade change) and continue to elevation 313 masl, and then transition to a grade of 5% and peaking at elevation 319 masl as indicated in **Drawing 2.1** and

Drawing 2.2. This will increase the current landfill capacity by approximately 14.3 million m³.

To assess the stability of the final slopes and proposed peak profile height, a preliminary slope stability analysis was performed. The slope stability analysis involved: reviewing the design of Alternative Method 2; reviewing existing background information; and building a 2-Dimensional Finite Element Model (FEM) using Slide2 Modeler version 9.020 software and adopting the Morgenstern-Price factor of safety method. For the assumptions used in the model and the summary of selected engineering properties used in the FEM, please refer to **Section 2.2** and **Table 2-1**.

Based on the results, the static safety factors for Alternative Method 2 are expected to be 1.51 and 1.50 under waste loads of 12 and 15 kN/m³, respectively, and the seismic safety factors are expected to be 1.48 under both load cases. Therefore, Alternative Method 2 meets the recommended minimum factor of safety of 1.3 for slopes.

Settlement was calculated at intervals along the base of the landfill for the approved landfill profile and Alternative Method 2 considering a unit weight of waste of 12 kN/m³ and 15 kN/m³. Based on the results of the model, the overall slope in westerly direction (i.e., toward pumping station) will be maintained despite the slight changes in the approved landfill base grades due to long-term settlement under the heavier inferred waste loading.

Additionally, base flattening on the west side will not exceed initial base conditions on the east side, which are considered minimum as defined by O. Reg. 232/98. Therefore, it is concluded that Alternative Method 2 will not have a significant effect on the functionality of the leachate collection system, and leachate will continue to drain toward the designated withdrawal points. The maximum calculated settlement at the landfill centre for Alternative Method 2 is 674 mm (12 kN/m³) and 842 mm (15 kN/m³).

For the details of the leachate collection piping, please refer to **Section 2.2**. Considering a unit weight of overlying material of 12 kN/m³, the pipe deflection under the loading associated with the Alternative Method 2 is around 6.8%, which is lower than the deflection limit of 7.5%, as described in **Section 2.2**.

For the geonet, based on what is mentioned in **Section 2.2**, it is concluded that geonet secondary drainage capacity performance will meet the design requirements for Alternative Method 2.

In summary, it is concluded that Alternative Method 2 is acceptable with respect to:

- Post-settlement Landfill base grades meeting O. Reg. 232/98 requirements and maintaining acceptable leachate collection in the primary drainage layer;
- Stability of the final slope (2.5H:1V maximum) and proposed peak profile height;
- Available collector pipe strength within the primary drainage layer; and
- Flow capacity of geonet within the secondary layer.

3.3 Buffer Zones

Since Alternative Method 2 would not change the existing approved landfill limit of waste, the existing property boundaries and buffer width, as mentioned in **Section 2.3**, will remain the same after the vertical expansion as indicated in **Drawing 2.1**. Therefore, the buffer area for Alternative Method 2 will meet the requirements of Section 7 of O. Reg. 232/98.

3.4 Site Development

3.4.1 Phasing and Schedule of Site Development

The proposed landfill expansion consists of four (4) stages as shown in **Table 3-1** and **Drawing 2.2**. The areas and volumes of the stages shown in **Table 3-1** are approximate and will be confirmed through detailed design; however, the total landfill volume of Alternative Method 2 will remain at approximately 14.3 million m³.

Table 3-1. Alternative Method 2 Stage Areas and Volumes

Stage	Peak Elevation (masl)	Volume (M m ³)
Stage 1	313	3.2
Stage 2	313	4.3
Stage 3	319	3.0
Stage 4	319	3.8
TOTAL	-	14.3

The site development phases have taken into consideration to have adequate space to allow disposal and operational vehicles to operate in the same area. The phases will be developed from west to east, considering the removal of final/interim cover along the side slopes prior to waste placement (as explained in **Section 2.4.2**).

Considering the approved landfilling rate is 1.4 million tonnes per year, the additional airspace could extend the site life by approximately 12 years.

Based on the estimated volumes provided for each phase in **Table 3-1**, Stage 3 can provide a site life of about 3.0 years while the other phases site life will range between 3.2 to 4.3 years.

3.4.2 Construction Activities

Please refer to **Section 2.4.2**.

3.4.2.1 Closure Activities

Please refer to **Section 2.4.2.1**.

3.5 Leachate Management

Similar to Alternative Method 1, Alternative Method 2 will not change the current expected infiltration rate, instead, it increases the rate of run-off due to the higher side slopes compared to the existing condition. Therefore, the leachate collection system will remain the same after vertical expansion. For more details, please refer to **Section 2.5**.

3.5.1 Leachate Generation

The maximum leachate generation for Alternative Method 2 is predicted to peak at 119,000 m³ per year (326 m³ per day) in Year 3 after completion of Stage 1 (approximately 2036). Leachate generation will then decrease to approximately 107,000 m³ per year (293 m³ per day) following placement of the final cover in Year 12 (estimated to be in 2045). **Appendix B** provides the modelling results. An additional 25,550 m³ of leachate annually (70 m³ per day) is estimated to be generated from the closed Old Landfill.

Based on the above, maximum leachate generation is estimated at 396 m³ per day (326 m³ + 70 m³) from both Alternative Method 2 (including the Expansion Landfill) and the closed Old Landfill, which is expected to occur in Year 3 (approximately 2036).

Details regarding the HELP modelling are provided in **Section 2.5.1**. Based on the information presented, future generation of leachate should be anticipated to be at annual volumes between the HELP predictions and current levels.

3.5.2 Leachate Storage and Treatment

Please refer to **Section 2.5.2**.

3.6 Landfill Gas Management

3.6.1 Landfill Gas Generation

Please refer to **Section 2.6.1**.

3.6.2 Landfill Gas Collection and Treatment

Please refer to **Section 2.6.2**.

3.7 Stormwater Management

3.7.1 Existing System

Please refer to **Section 2.7.1** for a discussion of the analysis of the existing system.

3.7.2 Future Baseline Scenario

Should the landfill optimization not proceed, the landfill development will continue until it has reached its full horizontal footprint and currently approved height of 280 masl. This will alter the outlets' catchment areas, land cover, and time of concentration, as well as the path of the swales in the northeast corner. This scenario is considered the future baseline and was modelled as part of the assessment of the proposed expansion as detailed below.

Please refer to **Section 2.7.2** for a discussion on the analysis of the Future Baseline scenario.

3.7.3 Impact of Alternative Method 2

The impacts of Alternative Method 2 would be similar to that of Alternative Method 1 in several ways. The factors altering the magnitude and timing of the peak flows (although not the total runoff volume) are the same. The same scenarios were modelled: Existing; Future Baseline; and Alternative Method 2. **Table 3-2** to **Table 3-4** highlight the differences in 100-year peak flows at the landfill outlets, SWM pond function under a 100-year design storm, and swale function under a 25-year design storm between the different scenarios. **Table 3-5** presents the geometric requirements of realigned swales SWC1A and SWG2A and the new culvert leading to Pond 4. Please refer to Section 2.7.3 for a more detailed description of the methodology used and **Appendix C** for the full results for storms of 2-year to 100-year return periods. The redistributed catchment areas for Alternative Method 2 are shown on **Figure 3-1**.

Table 3-2. Changes to Site Outlet peak flows during 100-year event

Catchment	Peak Runoff (cms / % increase from Existing Conditions)				
	Existing Conditions	Future Baseline		Alternative Method 2	
A	0.261	0.275	5%	0.279	7%
B	1.006	0.97	-4%	0.97	-4%
C	0.643	0.518	-19%	0.522	-19%
G	1.627	1.825	12%	1.794	10%

Table 3-3. SWM Pond function during 100-year event

Pond	Capacity (ha·m)	Peak Storage Used (ha·m)		
		Existing Conditions	Future Baseline	Alternative Method 2
1	2.773	0.943	0.943	0.943
2	5.271	1.625	1.838	1.808
3	2.857	0.732	0.75	0.757
4	1.099	0.347	0.285	0.284

Figure 3-1. Stormwater Management for Alternative Method 2

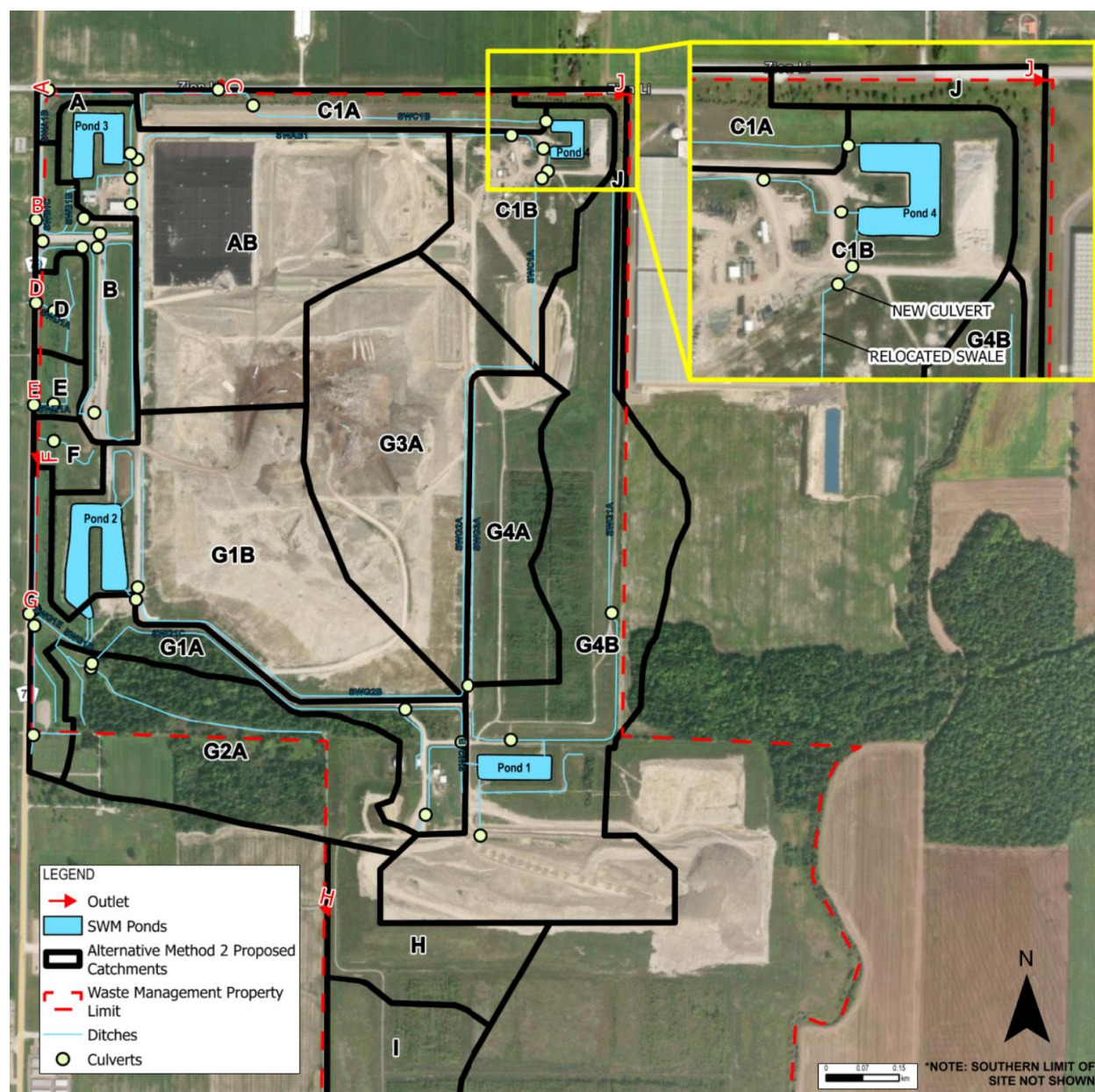


Table 3-4. Swale function during 25-year event

Swale	Flow Capacity (L/s)	Peak Flow (L/s)	
		Future Baseline	Alternative Method 2
SWAB1A	9,384	1,539	1,560
SWA1B	6,256	193	196
SWB1B	23,461	216	218
SWB1C	120,733	773	773
SWC1A	3,699	577	581

Swale	Flow Capacity (L/s)	Peak Flow (L/s)	
		Future Baseline	Alternative Method 2
SWC1B	191,849	483	485
SWD1A	28,626	233	233
SWE1A	100,850	213	213
SWG1A	3,981	1,103	1,103
SWG1B	17,669	463	463
SWG1C	11,847	813	813
SWG1D	6,229	409	391
SWG1E	10,909	1,216	1,209
Stream	18,095	1,216	1,209
SWG2A	1,592	668	661
SWG2B	12,631	2,813	2,696
SWG3A	1,246	297	297

Table 3-5. Design geometry of modified swales and new culvert

Name	Bottom Width / Diameter (m)	Depth (m)	Side Slope (x:1)	Slope
SWC1A	3	0.90	3:1	0.09%
SWG2A	1	0.54	3:1	0.64%
New Culvert (HDPE – 1 pipe)	1.2			0.44%

The data presented in the tables above mirror those of **Section 2.7.3**. Like Alternative Method 1, peak outflows from different outlets leaving the site under the Alternative Method 2 scenario are comparable to the Future Baseline scenario. It is noteworthy that Stormwater Management Pond 3 discharges flows to Outlets A and B and as seen from **Table 3-2**, Outlet A shows an increase in flows of approximately 7% and conversely Outlet B shows a decrease in flows of approximately 4% when compared to existing conditions. Outlet C shows a decrease in flows of approximately 19% when compared to existing conditions. Outlet G shows an approximate increase of 10% in flows when compared to existing conditions. However, it should be noted that the swales conveying the flows to Outlet G have sufficient capacity and are able to convey the flows downstream safely. These results are presented in greater detail in **Appendix C**. **Table 3-3** and **Table 3-4** demonstrate that the existing stormwater management ponds and swales will have enough capacity to process their respective design storms under Alternative Method 2. The relocated swales (SWC1A and SWG2A) and new culvert will also be able to convey these flows appropriately as long as they meet the design requirements listed in **Table 3-5**.

3.8 Ancillary Facilities

Please refer to **Section 2.8.**

3.9 Site Traffic

Please refer to **Section 2.9.**

3.10 Landfill Operations

3.10.1 Operating Hours

Please refer to **Section 2.10.1.**

3.10.2 Site Equipment

Please refer to **Section 2.10.2.**

3.10.3 Waste Placement

Please refer to **Section 2.10.3.**

3.10.4 Daily and Intermediate Cover

Please refer to **Section 2.10.4.**

3.10.5 Nuisance Controls

Please refer to **Section 2.10.5.**

3.10.5.1 Odour

Please refer to **Section 2.10.5.1.**

3.10.5.2 Litter

Please refer to **Section 2.10.5.2.**

3.10.5.3 Dust

Please refer to **Section 2.10.5.3.**

3.10.5.4 Noise

Please refer to **Section 2.10.5.4.**

3.10.5.5 Birds

Please refer to **Section 2.10.5.5.**

4 Conceptual Design of Alternative Method 3

4.1 Overview

Alternative Method 3 includes the increase of final landfill side slopes from 4H:1V to 2.5H:1V between elevation 260 masl and elevation 360 masl, about 100 m in grade change, peaking at elevation 360 masl (**Drawing 3.1**) over the Expansion Landfill. The Expansion Landfill is fully engineered and has an approved peak elevation of 280 masl. Alternative Method 3 will provide an additional 14.3 million m³ of landfill capacity.

Considering the proposed final side slopes of 2.5H:1V are steeper than the current 4H:1V, as per O. Reg. 232/98, a geotechnical feasibility review was performed to confirm the slope stability and settlement. The geotechnical assessment showed that this alternative is acceptable with respect to the stability of the final slopes (2.5H:1V) and proposed peak profile height. The results of the geotechnical feasibility review for Alternative Method 3 are discussed in **Section 4.2**.

4.2 Landfill Design and Geometry

The geometry of Alternative Method 3 is shown in plan view in **Drawing 3.1**. Under the proposed vertical expansion, the existing approved waste disposal footprint area of the TCEC would not change, but rather, the maximum permitted height of waste would be increased by 80 m, from 280 masl (the current approved elevation for top of waste) to 360 masl, which is the maximum elevation of the top of the final cover for Alternative Method 3. The 2.5H:1V side slopes will start at the existing landfill toe of slope (about 21 m in grade change) continuing to elevation 360 masl, and then peaking at elevation 360 masl as indicated in **Drawing 3.2** and **Drawing 3.3**. This will increase the current landfill capacity by approximately 14.3 million m³.

To assess the stability of the final slopes and proposed peak profile height, a preliminary slope stability analysis was performed. The slope stability analysis involved: reviewing the design of Alternative Method 3; reviewing existing background information; and building a 2-Dimensional Finite Element Model (FEM) using Slide2 Modeler version 9.020 software and adopting the Morgenstern-Price factor of safety method. For the assumptions used in the model and the summary of selected engineering properties used in the FEM, please refer to **Section 2.2** and **Table 2-1**.

Based on the results of the model, the factor of safety of the circular failure surface for Alternative Method 3 is 1.47. Therefore, Alternative Method 3 meets the recommended minimum factor of safety of 1.3 for slopes.

Settlement was calculated at intervals along the base of the landfill for the approved landfill profile and Alternative Method 3 considering a unit weight of waste of 12 kN/m³. Based on the results of the model, the overall slope in westerly direction (i.e., toward pumping station) will be maintained, despite the slight changes in the approved landfill

base grades due to long-term settlement under the increased waste loading. Additionally, base flattening on the west side will not exceed initial base conditions on the east side which are considered minimum as defined by O. Reg. 232/98. Therefore, it is concluded that Alternative Method 3 will not have a significant effect on the functionality of the leachate collection system and leachate will continue to drain toward the designated withdrawal points. The maximum calculated settlement at the landfill centre for Alternative Method 3 is 545 mm.

For the details of the leachate collection piping, please refer to **Section 2.2**. Considering a unit weight of overlying material of 12 kN/m^3 , the pipe deflection under the loading associated with the Alternative Method 3 is around 7.9%, which is slightly greater than the deflection limit of 7.5%, as described in **Section 2.2**. Therefore, Alternative Method 3 provides lower than 3 to 1 safety factor against reverse curvature and might require a reinforcement of the leachate collection system (i.e., building a perimeter leachate collection system).

For the geonet, based on what is mentioned in **Section 2.2**, it is concluded that geonet secondary drainage capacity performance will meet the design requirements for Alternative Method 3.

In summary, it is concluded that Alternative Method 3 is acceptable with respect to:

- Post-settlement Landfill base grades meeting O. Reg. 232/98 requirements and maintaining acceptable leachate collection in the primary drainage layer;
- Stability of the final slope (2.5H:1V maximum) and proposed peak profile height;
- Flow capacity of geonet within the secondary layer.

4.3 Buffer Zones

Since Alternative Method 3 would not change the existing approved landfill limit of waste, the existing property boundaries and buffer width, as mentioned in **Section 2.3**, will remain the same after the vertical expansion, as indicated in **Drawing 3.1**. Therefore, the buffer area for Alternative Method 3 will meet the requirements of Section 7 of O. Reg. 232/98.

4.4 Site Development

4.4.1 Phasing and Schedule of Site Development

The proposed landfill expansion consists of five (5) stages as shown in **Table 4-1** and **Drawing 3.2**. The areas and volumes of the stages shown in **Table 4-1** are approximate and will be confirmed through detailed design; however, the total landfill volume of Alternative Method 3 will remain at approximately 14.3 million m^3 .

Table 4-1. Alternative Method 3 Stage Areas and Volumes

Stage	Peak Elevation (masl)	Volume (M m ³)
Stage 1	290	3.2
Stage 2	290	3.8
Stage 3	325	2.7
Stage 4	325	2.3
Stage 5	360	2.3
TOTAL	-	14.3

The site development phases have taken into consideration to have adequate space to allow disposal and operational vehicles to operate in the same area. The phases will be developed from west to east, considering the removal of final/interim cover along the side slopes prior to waste placement (as explained in **Section 2.4.2**).

Considering the approved landfilling rate is 1.4 million tonnes per year, the additional airspace could extend the site life by approximately 12 years.

Based on the estimated volumes provided for each phase in **Table 4-1**, Stage 4 and 5 can provide a site life of about 2.3 years each, while the other phases site life will range between 2.7 to 3.8 years.

4.4.2 Construction Activities

Please refer to **Section 2.4.2**.

4.4.2.1 Closure Activities

Please refer to **Section 2.4.2.1**.

4.5 Leachate Management

Similar to Alternative Method 1, Alternative Method 3 will not change the current expected infiltration rate, instead, it increases the rate of run-off due to the higher side slopes compared to the existing condition. Therefore, the leachate collection system will remain the same after vertical expansion. For more details, please refer to **Section 2.5**.

4.5.1 Leachate Generation

The maximum leachate generation for Alternative Method 3 is predicted to peak at 118,500 m³ per year (325 m³ per day) in Year 3 after completion of Stage 1 (approximately 2036). Leachate generation will then decrease to approximately 101,700 m³ per year (279 m³ per day) following placement of the final cover in Year 12 (estimated to be in 2045). **Appendix B** provides the modelling results. An additional 25,550 m³ of leachate annually (70 m³ per day) is estimated to be generated from the closed Old Landfill.

Based on the above, maximum leachate generation is estimated at 395 m³ per day (325 m³ + 70 m³) from both Alternative Method 3 (including the Expansion Landfill) and the closed Old Landfill, which is expected to occur in Year 3 (approximately 2036).

Details regarding the HELP modelling are provided in **Section 2.5.1**. Based on the information presented, future generation of leachate should be anticipated to be at annual volumes between the HELP predictions and current levels.

4.5.2 Leachate Storage and Treatment

Please refer to **Section 2.5.2**.

4.6 Landfill Gas Management

4.6.1 Landfill Gas Generation

Please refer to **Section 2.6.1**.

4.6.2 Landfill Gas Collection and Treatment

Please refer to **Section 2.6.2**.

4.7 Stormwater Management

4.7.1 Existing System

Please refer to **Section 2.7.1** for a discussion on the analysis of the existing system

4.7.2 Future Baseline Scenario

Should the landfill expansion optimization not proceed, the landfill development will continue until it has reached footprint will reach its full horizontal footprint and currently approved height of 280 masl. This will alter the outlets' catchment areas, land cover, and times of concentration, as well as the path of the swales in the northeast corner. This scenario is considered the future baseline and was modelled as part of the assessment of the proposed expansion as detailed below.

Please refer to **Section 2.7.2** for a discussion of the analysis of the Future Baseline scenario.

4.7.3 Impact of Alternative Method 3

The impacts of Alternative Method 3 would be similar to that of Alternative Methods 1 and 2 in several ways. The factors altering the magnitude and timing of the peak flows (although not, again, the total runoff volume) are the consistent. The same scenarios were modelled: Existing; Future Baseline; and Alternative Method 3. **Table 4-2** to **Table 4-4** highlight the differences in 100-year peak flows at the landfill outlets, SWM pond function under a 100-year design storm, and swale function under a 25-year

design storm between the different scenarios. **Table 4-5** presents the geometric requirements of realigned swales SWC1A and SWG2A and the new culvert leading to Pond 4. Please refer to Section 2.7.3 for a more detailed description of the methodology used and **Appendix C** for the full results for storms of 2-year to 100-year return periods. The redistributed catchment areas for Alternative Method 3 are shown in **Figure 4-1**.

Table 4-2. Changes to Site Outlet peak flows during 100-year event

Catchment	Peak Runoff (cms / % increase from Existing Conditions)				
	Existing Conditions	Future Baseline		Alternative Method 3	
A	0.261	0.275	5%	0.273	5%
B	1.006	0.97	-4%	0.97	-4%
C	0.643	0.518	-19%	0.52	-19%
G	1.627	1.825	12%	1.806	11%

Table 4-3. SWM Pond function during 100-year event

Pond	Capacity (ha·m)	Peak Storage Used (ha·m)		
		Existing Conditions	Future Baseline	Alternative Method 3
1	2.773	0.943	0.943	0.943
2	5.271	1.625	1.838	1.823
3	2.857	0.732	0.75	0.746
4	1.099	0.347	0.285	0.281

Figure 4-1. Stormwater Management for Alternative Method 3

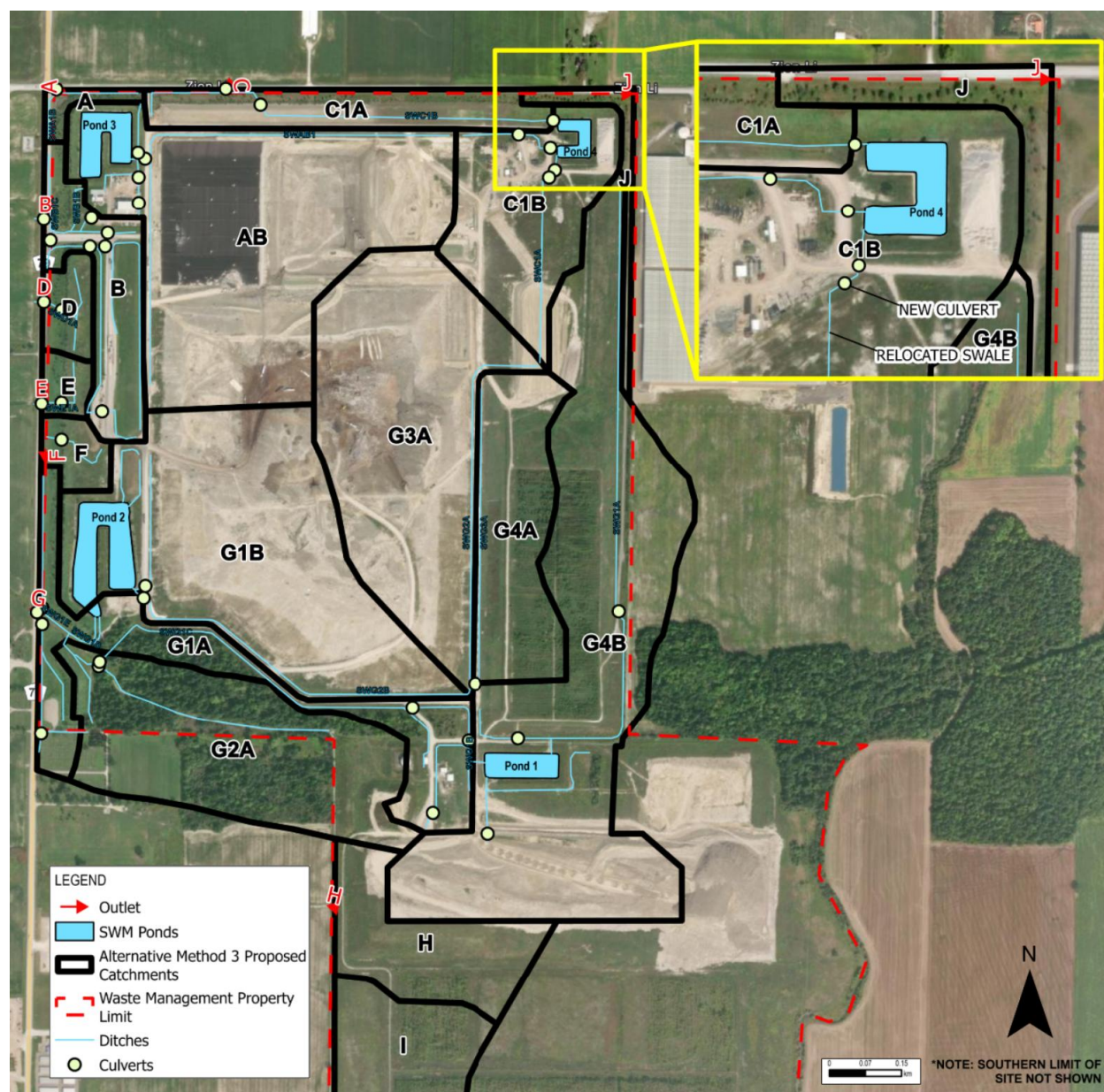


Table 4-4. Swale function during 25-year event

Swale	Flow Capacity (L/s)	Peak Flow (L/s)	
		Future Baseline	Alternative Method 3
SWAB1A	9,384	1539	1526
SWA1B	6,256	193	191
SWB1B	23,461	216	214
SWB1C	120,733	773	773
SWC1A	3,699	577	565

Swale	Flow Capacity (L/s)	Peak Flow (L/s)	
		Future Baseline	Alternative Method 3
SWC1B	191,849	483	483
SWD1A	28,626	233	233
SWE1A	100,850	213	213
SWG1A	3,981	1103	1103
SWG1B	17,669	463	463
SWG1C	11,847	813	813
SWG1D	6,229	409	400
SWG1E	10,909	1216	1211
Stream	18,095	1216	1211
SWG2A	1,592	668	658
SWG2B	12,631	2813	2753
SWG3A	1,246	297	297

Table 4-5. Design geometry of modified swales and new culvert

Name	Bottom Width / Diameter (m)	Depth (m)	Side Slope (x:1)	Slope
SWC1A	3	0.90	3:1	0.09%
SWG2A	1	0.54	3:1	0.64%
New Culvert (HDPE – 1 pipe)	1.2			0.44%

The data presented in the tables above mirror those of **Section 2.7.3**. Like Alternative Methods 1 and 2, peak outflows from different outlets leaving the site under the Alternative Method 3 scenario are comparable to the Future Baseline scenario. It is noteworthy that Stormwater Management Pond 3 discharges flows to Outlets A and B and as seen from **Table 4-2**, Outlet A shows an increase in flows of approximately 5% and conversely Outlet B shows a decrease in flows of approximately 4% when compared to existing conditions. Outlet C shows a decrease in flows of approximately 19% when compared to existing conditions. Outlet G shows an approximate increase of 11% in flows when compared to existing conditions. However, it should be noted that the swales conveying the flows to Outlet G have sufficient capacity and are able to convey the flows downstream safely. These results are presented in greater detail in **Appendix C**.

Table 4-3 and **Table 4-4** demonstrate that the existing stormwater management ponds and swales will have enough capacity to process their respective design storms under Alternative Method 3. The relocated swales (SWC1A) and SWG2A) and new culvert will also be able to convey these flows appropriately as long as they meet the design requirements listed in **Table 4-5**.

4.8 Ancillary Facilities

Please refer to **Section 2.8.**

4.9 Site Traffic

Please refer to **Section 2.9.**

4.10 Landfill Operations

4.10.1 Operating Hours

Please refer to **Section 2.10.1.**

4.10.2 Site Equipment

Please refer to **Section 2.10.2.**

4.10.3 Waste Placement

Please refer to **Section 2.10.3.**

4.10.4 Daily and Intermediate Cover

Please refer to **Section 2.10.4.**

4.10.5 Nuisance Controls

Please refer to **Section 2.10.5.**

4.10.5.1 Odour

Please refer to **Section 2.10.5.1.**

4.10.5.2 Litter

Please refer to **Section 2.10.5.2.**

4.10.5.3 Dust

Please refer to **Section 2.10.5.3**

4.10.5.4 Noise

Please refer to **Section 2.10.5.4.**

4.10.5.5 Birds

Please refer to **Section 2.10.5.5.**

5 Climate Change Considerations

The document entitled “Considering Climate Change in the Environmental Assessment Process” (MOECC, 2017) was used as a guide for incorporating measures in the landfill expansion design that reduce both its impact on climate change (i.e., climate change mitigation) and the impact of climate change on the landfill (i.e., climate change adaptation). These measures are described in the following sections.

5.1 Effects of Climate Change on Landfill Design and Operations

Climate change has resulted in extreme weather events including increasingly severe rainfall and wind events, temperature extremes, and reduced snow cover. The potential impacts of these events are expected to influence mainly the design of the stormwater management system as well as routine site operations. These events are not expected to have a significant influence on the design of the LFG or leachate management systems, although they may influence the rate of generation of leachate and LFG.

5.1.1 Stormwater Management Design

Extreme weather events caused by climate change are relevant to the design of stormwater management systems in the diversion/control of runoff, as well as erosion and sedimentation control. Climate change will impact the stormwater management system by increasing the intensity and frequency of storms, which will cause larger peak flows, sometimes by a significant amount. It is for this reason that the future conditions were modelled for the currently approved landfill buildout and the three Alternative Methods using current and future climate change intensity-duration-frequency (IDF) curves. These curves were taken from the Sarnia weather station as reported/predicted by Environment and Climate Change Canada. The 2071-2100 SSP2-4.5 (moderate emissions scenario) was used, representing a 27-29% in peak intensity. The analysis demonstrated that despite the increase in peak flows climate change will cause, the existing ponds and swales have sufficient capacity to manage the runoff under the design storms.

5.1.2 Landfill Operations

Extreme rainfall and wind events can influence landfill operations although these influences can be mitigated by adapting operating practices. The landfill operations will adapt to climate change by implementing by considering:

- Installing higher or longer litter control fences designed to handle stronger winds.

- Maintaining the on-site perimeter ditches and culverts clear of sediment to promote positive drainage during high intensity precipitation events.
- During extreme heat and cold weather, staff working outdoors will be required to follow WM health and safety operational procedures. On-site vehicles and heavy equipment will be maintained to provide climate-controlled conditions for the operational staff.

5.1.3 Landfill Gas Management System Design

The rate of generation of methane (e.g., Methane Generation Rate, k) is highly dependent upon the moisture in the waste mass, and the overall methane generation capacity (e.g., Methane Generation Capacity, L_0) depends on the type and composition of waste in the landfill. Extreme weather events caused by climate change may influence the amount of moisture within the waste and therefore the rate at which methane is generated. If climate change results in a lowering of moisture content, the generation rate will be reduced; conversely if the moisture content increases the generation rate will be increased.

The proposed landfill design includes a low permeability soil final cover that will be constructed progressively as the site is developed, and as the final covered area increases, the effect of variations in rain events on moisture content of the waste will be diminished. WM will monitor the landfill gas generation rate throughout the life of the site and will ensure that adequate gas management capability (e.g., RNG Facility and gas flaring) is maintained.

The gas treatment/flare system has sufficient operational capacity to manage up to 24,824 m³/hr, which is greater than the estimated gas generation rate of 18,169 m³/hour (**Table 2-3**), without considering the additional Flares 5 and 6 which will operate in the event the RNG Facility is not operational.

5.1.4 Leachate Collection System Design

Extreme weather events resulting from climate change are not expected to have a significant long-term effect on precipitation infiltration and generation of leachate considering the site will be progressively capped with a low permeability final cover. Additional infiltration will increase the leachate generation rate within the active cells (without soil cover), but the effect will be reduced by moisture initially going into storage in the waste mass, as well as the progressive closure of the site. The current leachate collection system is capable of managing the additional leachate generation rates.

5.2 Effect of the Landfill on Climate Change

The greatest potential influence of the landfill on climate change relates to the generation and emission of LFG, which is comprised primarily of methane and carbon dioxide, both of which are greenhouse gases (GHGs). This effect is anticipated to be minimal given the following aspects of the landfill design:

- The landfill optimization will incorporate an active LFG collection system with an estimated efficiency of 90% in areas under final cover, limiting LFG emissions to the atmosphere.
- Collected LFG will be processed and converted to Renewable Natural Gas (RNG) or combusted by on-site flares.
- Progressively placement of interim and final cover will reduce LFG emissions.

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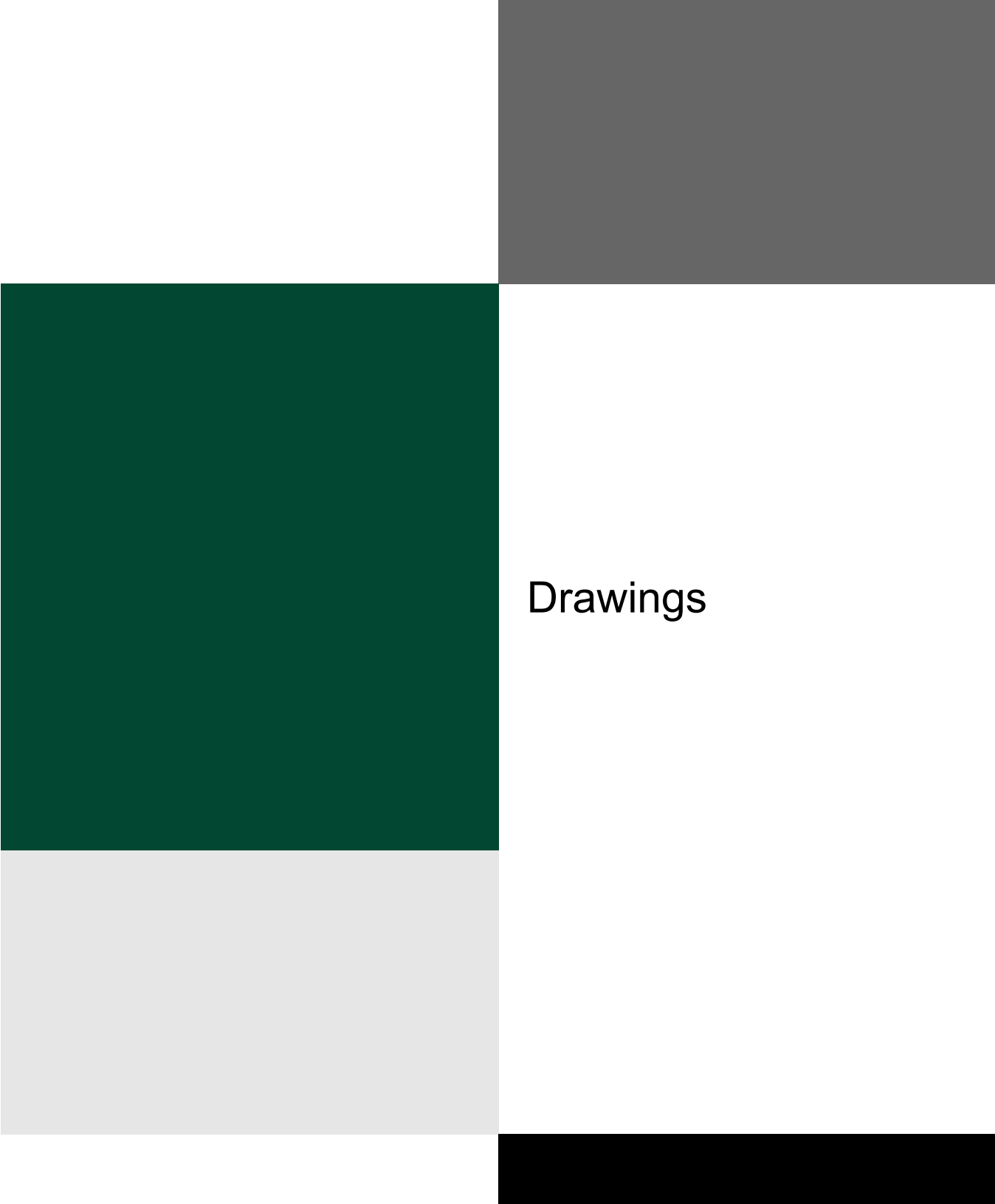
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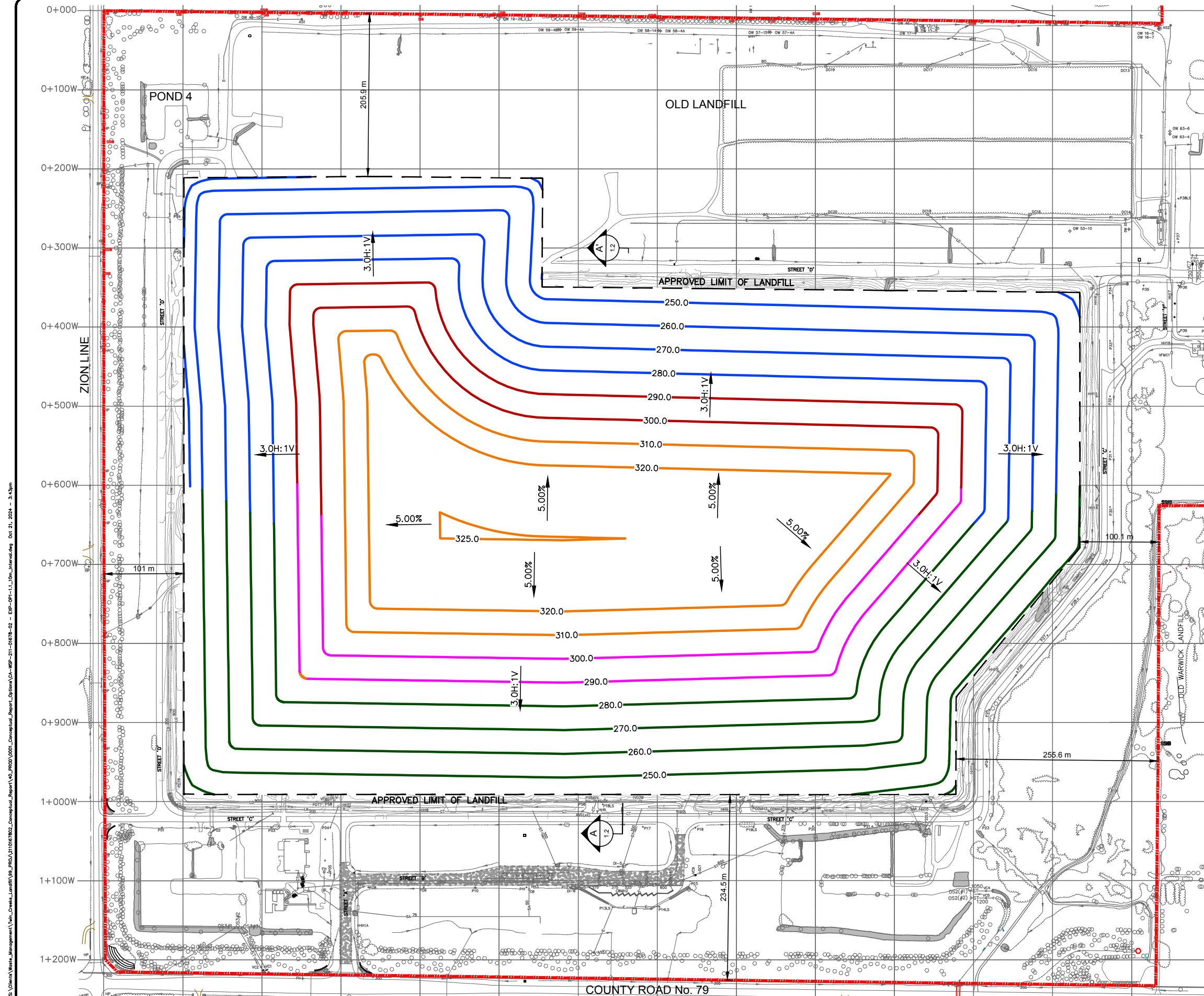
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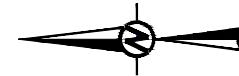
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Drawings



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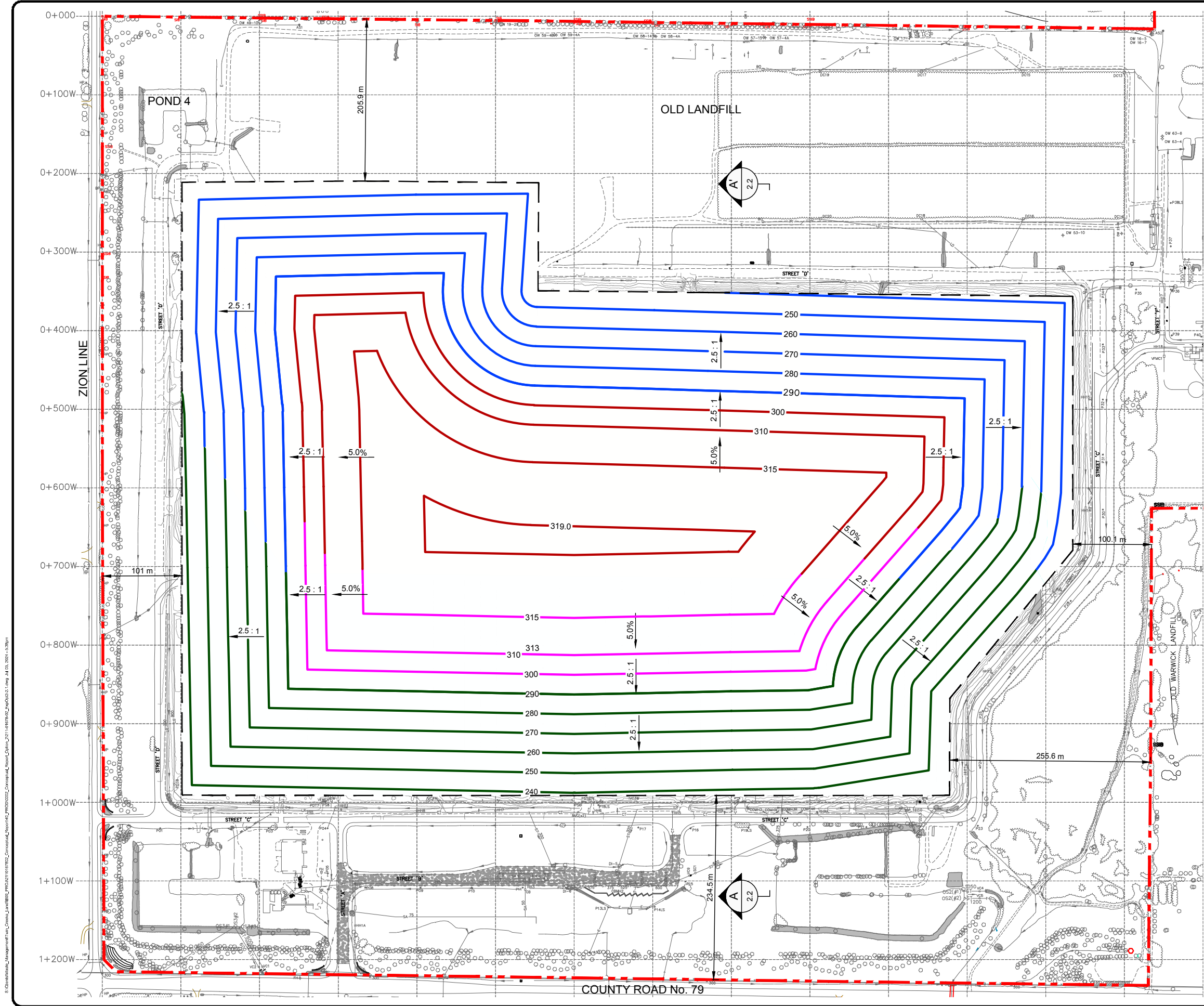


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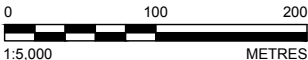
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 - EXISTING PAVED ROAD
 - EXISTING GRAVEL ROAD/TRAIL
 - EXISTING DITCH/SWALE
 - EXISTING CULVERT - PIPE
 - EXISTING CULVERT - CONCRETE BOX
 - EXISTING COMMON TRENCH
 - EXISTING STORM SEWER
 - EXISTING TREE LINE
 - EXISTING GROUND CONTOURS
 - 290 PROPOSED TOP OF LANDFILL CONTOURS (STAGE 1)
 - 290 PROPOSED TOP OF LANDFILL CONTOURS (STAGE 2)
 - 315 PROPOSED TOP OF LANDFILL CONTOURS (STAGE 3)
 - 319.0 PROPOSED TOP OF LANDFILL CONTOURS (STAGE 4)
 - 2.5:1 PROPOSED TOP OF LANDFILL SLOPE



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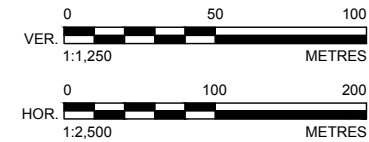
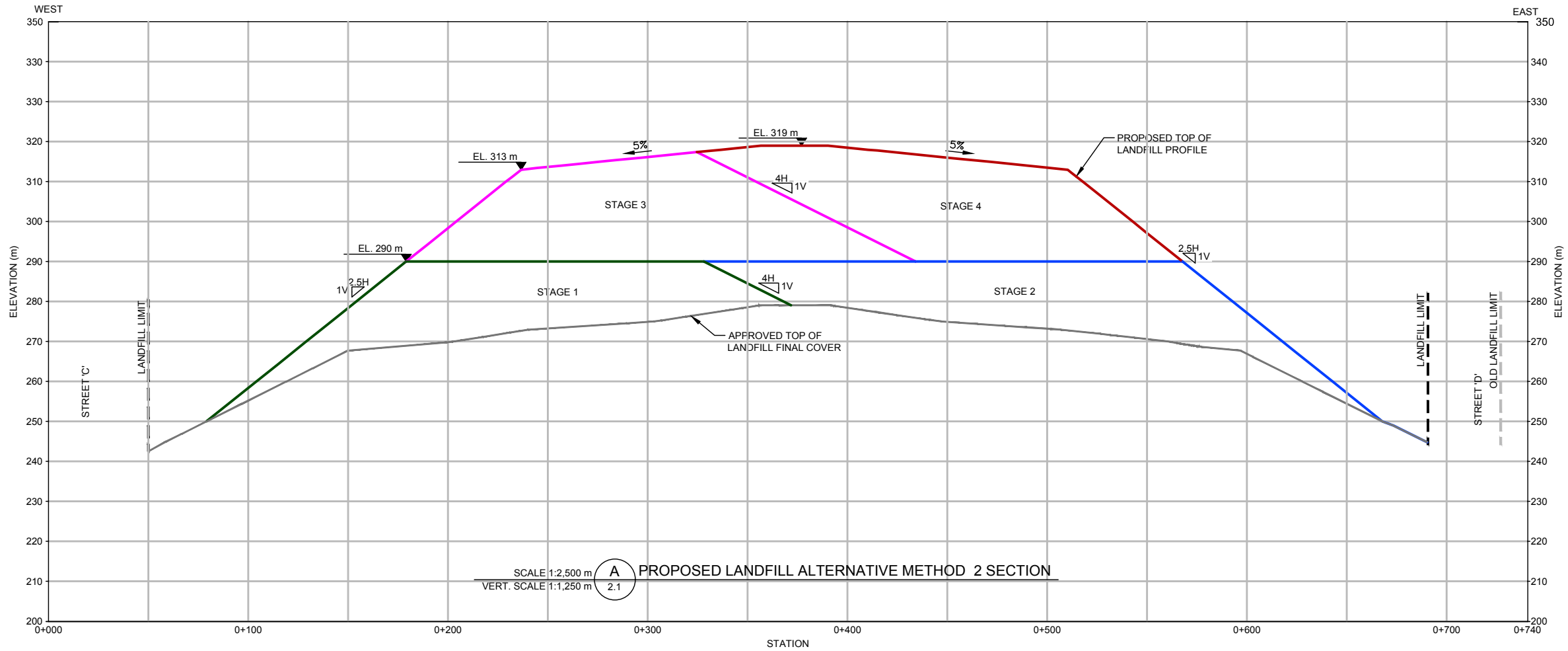


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TWIN CREEKS ENVIRONMENTAL CENTRE
WARWICK TOWNSHIP

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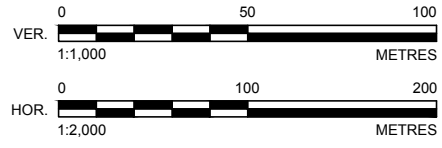
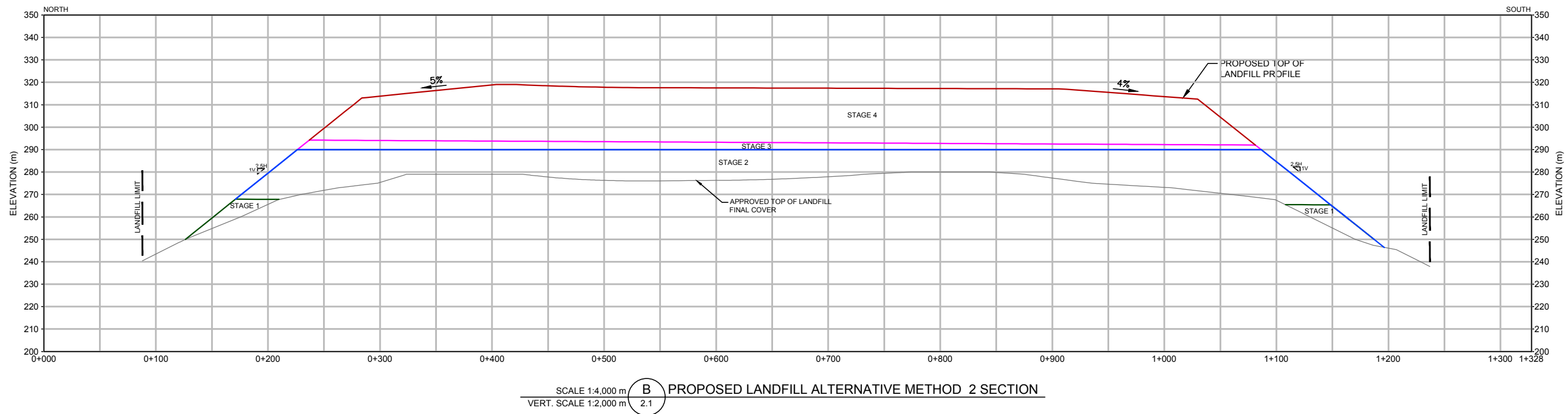
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TWIN CREEKS ENVIRONMENTAL CENTRE
WARWICK TOWNSHIP

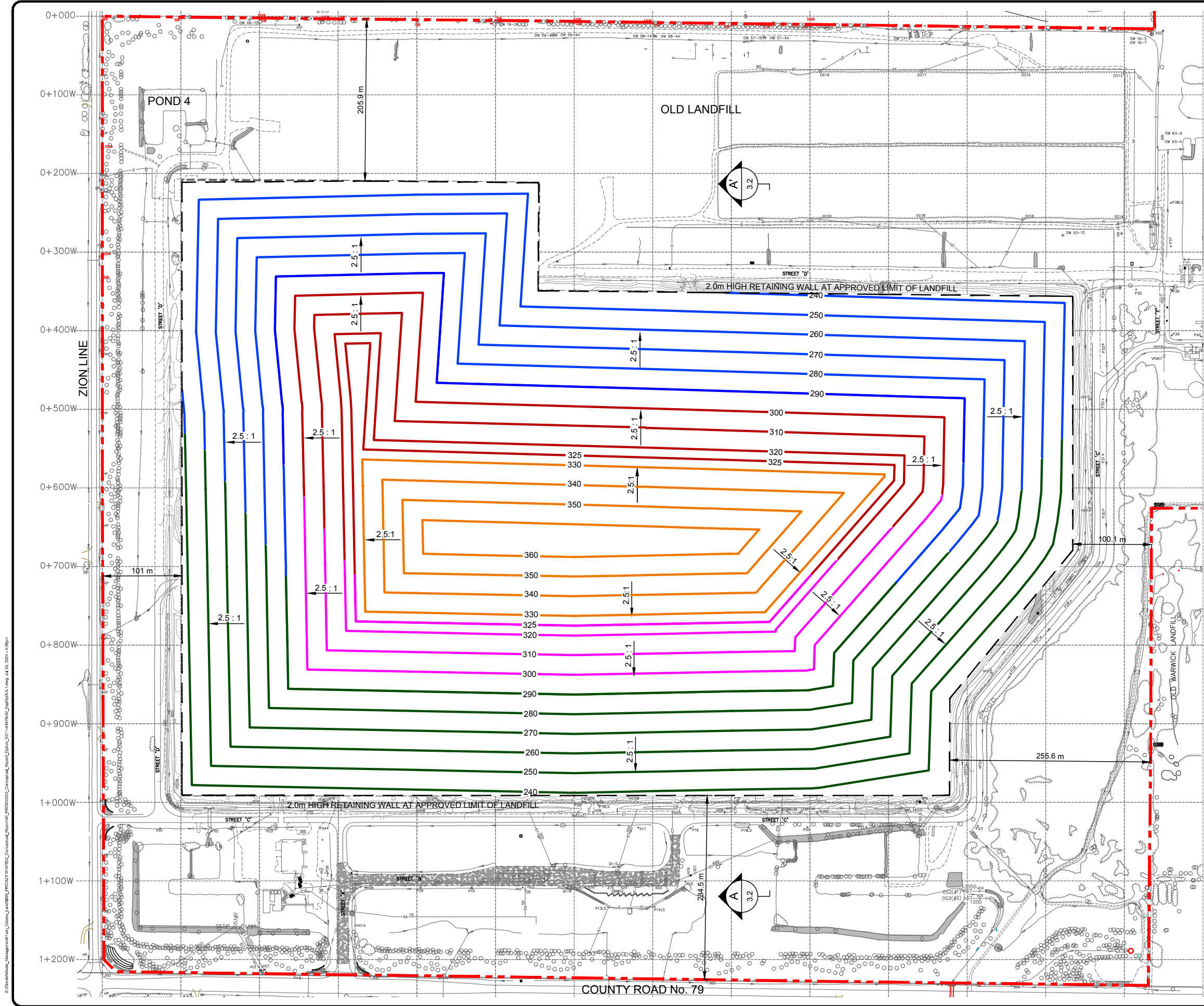


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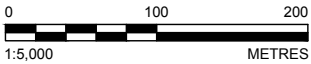


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 - APPROVED LIMIT OF LANDFILL
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 - EXISTING PAVED ROAD
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 - EXISTING GROUND CONTOURS
 - 290 PROPOSED TOP OF LANDFILL CONTOURS (STAGE 1)
 - 290 PROPOSED TOP OF LANDFILL CONTOURS (STAGE 2)
 - 325 PROPOSED TOP OF LANDFILL CONTOURS (STAGE 3)
 - 325 PROPOSED TOP OF LANDFILL CONTOURS (STAGE 4)
 - 360 PROPOSED TOP OF LANDFILL CONTOURS (STAGE 5)
 - 2.5:1 PROPOSED TOP OF LANDFILL SLOPE



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TWIN CREEKS ENVIRONMENTAL CENTRE
WARWICK TOWNSHIP

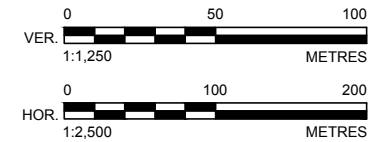
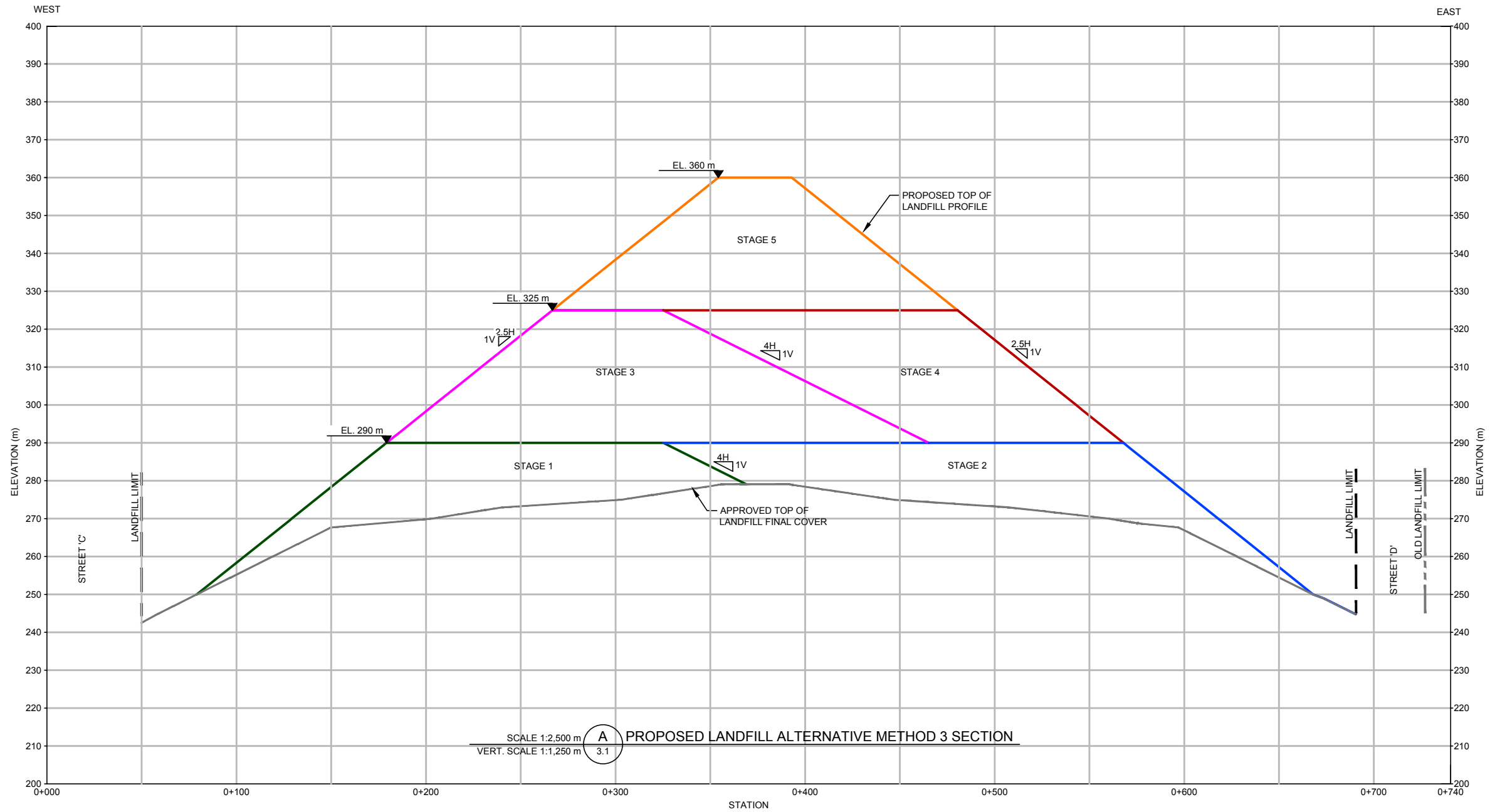
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CHK BY: C.O.R. SCALE: SEE BAR SCALE
WASTE MANAGEMENT OF CANADA CORP.
DRAWING NO. CA-WSP-211-01678-02-3.1

DRAWING
3.1

WSP
55 KING STREET, SUITE 700
ST. CATHARINES (ONTARIO) CANADA L2R 3H5
TEL: 905-687-4771 | WWW.WSP.COM



S:\Clients\Waste_Management\Twin_Creeks_Landfill\PR03\211616782_Conceptual_Report\CD\PR0300003_Conceptual_Report_Cover_001.rvt (09/24) E:\09/24\3.2.dwg Jul 03, 2024 - 5:41pm



DATE	DESCRIPTION	
	REVISION / ISSUE	

Do not sign or stamp here

A

Geonet Analysis Report

ANALYSIS REPORT
SCC Accreditation No.: 403

Mr Peter Brodzikowski

Date: October 25, 2010

Genivar

Report: S996-002-46085A

IDENTIFICATION: Installed structure (top to bottom): Clayey Silt / Drainage geocomposite Tendrain II 91010-2 / Rannoch Till

Project: #105716

Received: October 4, 2010

STANDARD:

TEST: (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geos. Using a Constant Head ASTM D4716 - 08

TEST CONDITIONS: 2 test specimens in machine direction (MD);
 Temperature of the water (°C): 22
 The test specimens were taken at less than one third of the edge ;
 Installation of the specimen: Clayey Silt / Drainage géocomposite / Rannoch Till
 Width of the test specimen (mm): 300
 Length of the test specimen (mm): 300
 Calibration of the apparatus: April 15, 2010
 The hydraulic losses of the equipment are in conformance with section 11.1.3 of the standard ;
 Tested from October 21 to 25, 2010

RESULTS:**Individual Data**

Hydraulic Gradient:	0.02			
Normal Compressive Stress:	800 kPa			
Seating time:	15min	1h	24h	100h
Transmissivity (E-04 m ² /s) :	19.2	19.0	19.4	17.5
Flow Rate (l/min) :	0.738	0.731	0.711	0.643
Flow Rate (gal/min) :	0.195	0.193	0.188	0.170

Hydraulic Gradient:	0.1			
Normal Compressive Stress:	800 kPa			
Seating time:	15min	1h	24h	100h
Transmissivity (E-04 m ² /s) :	10.4	10.3	10.5	9.0
Flow Rate (l/min) :	2.00	1.97	1.93	1.65
Flow Rate (gal/min):	0.528	0.521	0.509	0.436

Prepared by:

Approved by:

Maxime Gôté
 Maxime Côté, Tech.
 Technician

Eric Blond
 Eric Blond, Eng., M.Sc.A.
 Vice-President

Date: October 25, 2010

****For any information concerning this report, please contact Eric Blond****

The reports are identified by an alphanumeric code, the last character refers to the number of revision(s), this is emitted in ascending order. The samples in relation to this test are retained for a period of 30 days following the expedition day of the written report, unless other instructions are received. The fees for all services after the tests are 125.00 \$ per hour and for appraisal in Court, 195.00\$ per hour. The above reported results refer exclusively to the samples submitted for evaluation. This analysis report cannot be partly used or reproduced, unless in whole, without CTT Group prior written consent. CTT Group is accredited by the SCC for specific tests as listed on www.scc.ca. For customer's complete address, please refer to the front page.



ANALYSIS REPORT
SCC Accreditation No.: 40‡

Mr Peter Brodzikowski

Date: October 25, 2010

Genivar

Report: S996-002-46085A

IDENTIFICATION: Installed structure (top to bottom): Clayey Silt / Drainage geocomposite Tendrain II 91010-2 / Rannoch Till

Project: #105716

Received: October 4, 2010

STANDARD:

TEST: (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geos. Using a Constant Head ASTM D4716 - 08

RESULTS (CONT): Individual Data

Hydraulic Gradient: 1.0

Normal Compressive Stress: 800 kPa

Seating time: 15min 1h 24h 100h

Transmissivity (E-04 m²/s) : 4.0 3.9 3.9 3.5

Flow Rate (l/min) : 7.62 7.56 7.10 6.35

Flow Rate (gal/min): 2.01 2.00 1.88 1.68

Prepared by:

Maxime Côté
 Maxime Côté, Tech.
 Technician

Approved by:

Eric Blond
 Eric Blond, Eng., M.Sc.A.
 Vice-President

Date: October 25, 2010

****For any information concerning this report, please contact Eric Blond****

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ANALYSIS REPORT
SCC Accreditation No.: 40‡

Mr Peter Brodzikowski

Date: December 23, 2010

Genivar

Report: S996-002-46086B

IDENTIFICATION: Interface: Rannoch Till soil / Geocomposite Tendrain II 91010-2
 Project: #105716
 Received: October 7, 2010

STANDARD:

TEST: Coefficient of Soil and Geosynthetic or Geosynt. and Geosynt. Friction by the Direct Shear Method ASTM D5321-08

TEST CONDITIONS: Shear surface 304 x 304 mm;
 Rate of horizontal displacement(mm/min); 0.05 (0.002 in/min)
 Tested in machine direction ;
 Submerged interface (24 hours under 10 kPa, than consolidated under the tested normal stress);
 Testing configuration - Upper box / Lower box: textured steel plate / Rannoch Till soil / Tendrain II 91010-2 geocomposite / textured steel plate;
 The test was subcontracted to another laboratory ;
 Tested from November 3 to December 3, 2010

RESULTS: Individual Data

Normal Compressive Pressure (kPa):	130.3	239.9	399.9

PROPERTIES OF THE SOIL			
Water content of compaction (%):	14.4	14.4	14.4
Dry unit weight after compaction (kg/m³):	1842	1842	1842
Duration of the consolidation (hours):	24	24	24

TEST RESULTS			
Maximum Shear Stress (kPa):	78.6	125.5	203.4
Residual Shear Stress (kPa):	67.6	95.8	203.4

REMARKS:			
Secant friction angles: under 130 kPa : peak : 31°, residual: 27° under 240 kPa : peak : 28°, residual: 22° under 400 kPa : peak : 27°, residual: 27° The geocomposite did not exhibit any evidence of delamination under any normal load			

PROPERTIES OF THE SOIL

Water content of compaction (%):	14.4	14.4	14.4
Dry unit weight after compaction (kg/m³):	1842	1842	1842
Duration of the consolidation (hours):	24	24	24

TEST RESULTS

Maximum Shear Stress (kPa):	78.6	125.5	203.4
Residual Shear Stress (kPa):	67.6	95.8	203.4

REMARKS:

Secant friction angles:
 under 130 kPa : peak : 31°, residual: 27°
 under 240 kPa : peak : 28°, residual: 22°
 under 400 kPa : peak : 27°, residual: 27°
 The geocomposite did not exhibit any evidence of delamination under any normal load

Prepared by:

Jonathan Trudel
 Jonathan Trudel, Tech.
 Technician

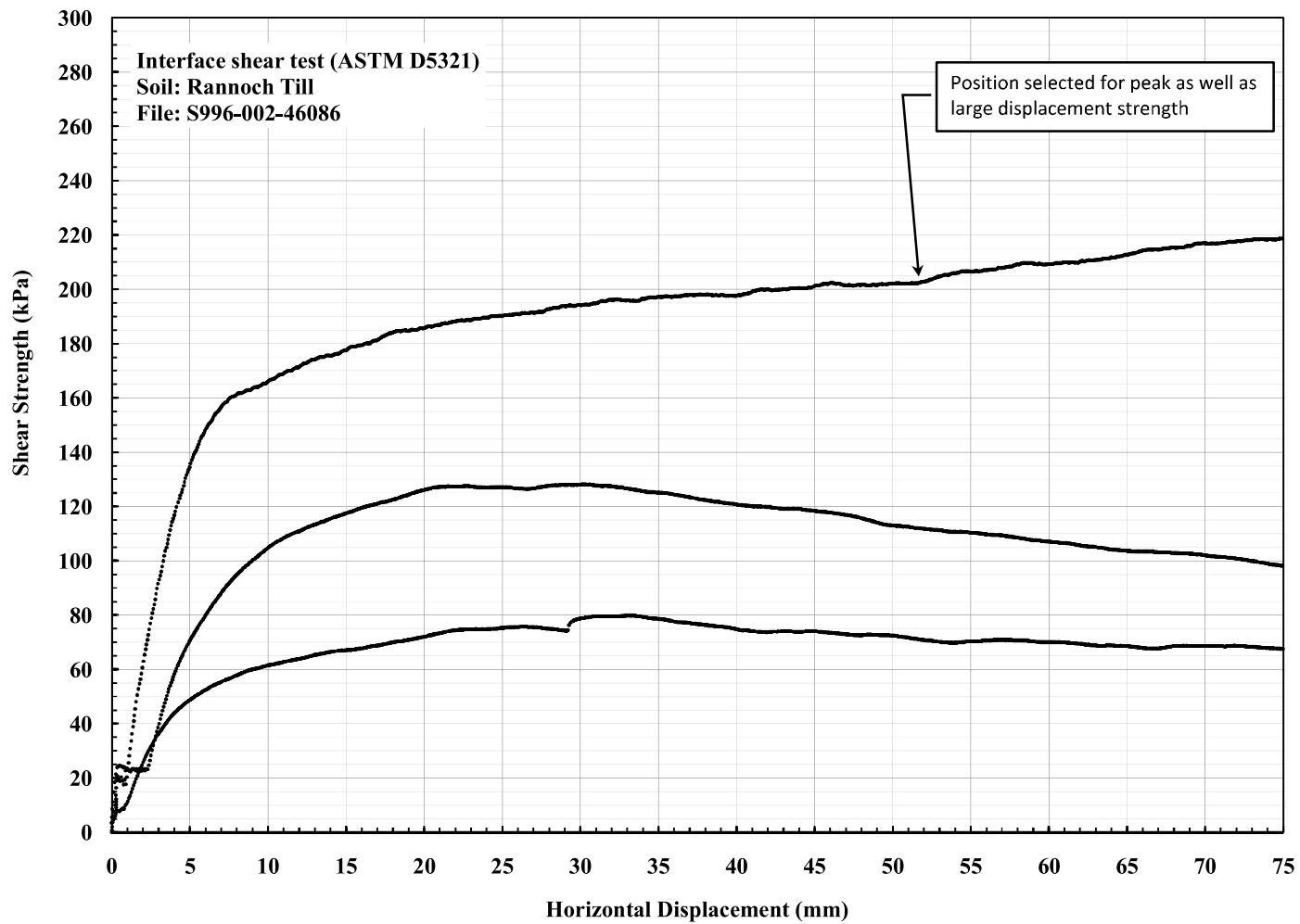
Approved by:

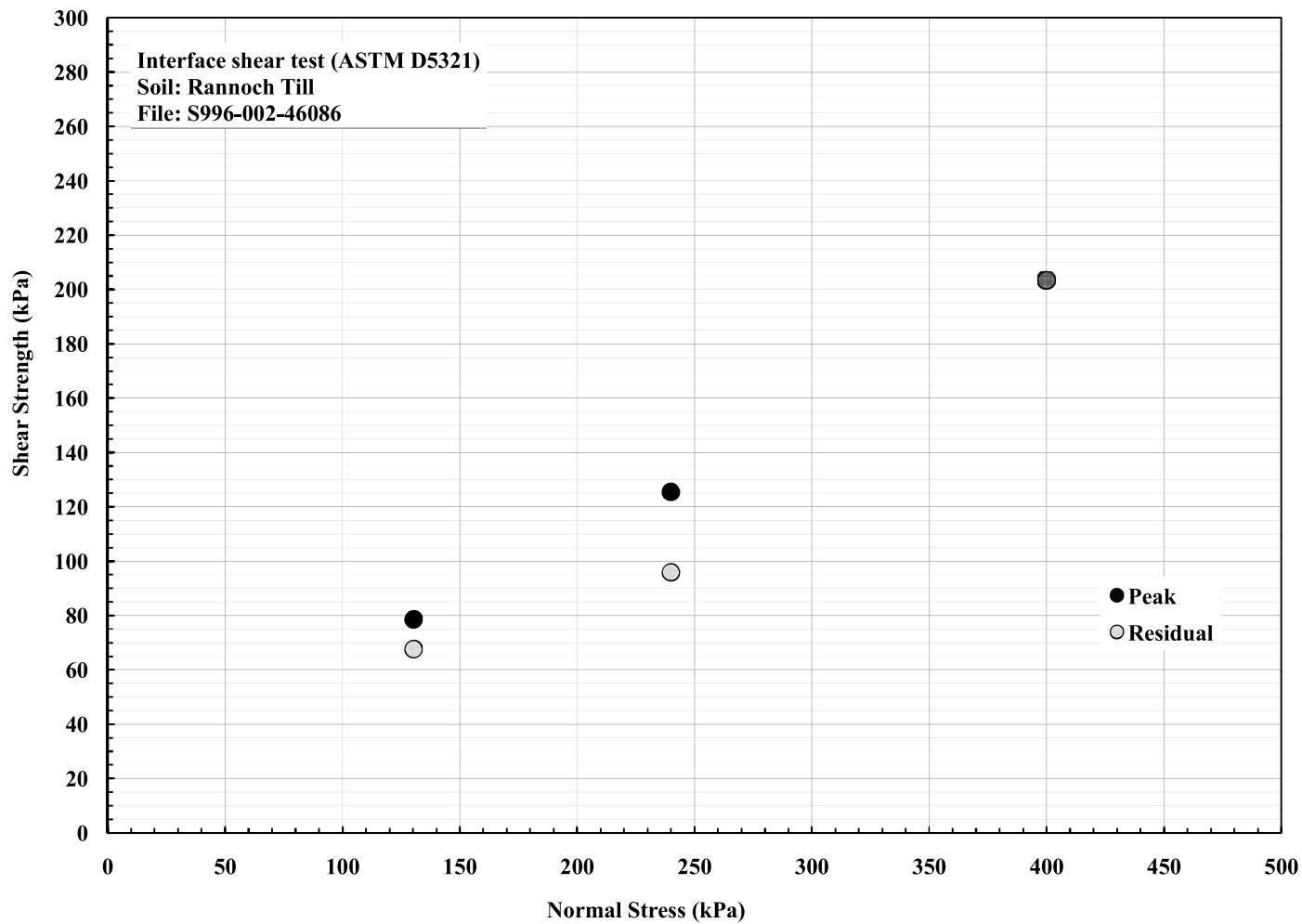
Eric Blond
 Eric Blond, Eng., M.Sc.A.
 Vice-President

Date: December 23, 2010

****For any information concerning this report, please contact Eric Blond****

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ANALYSIS REPORT
SCC Accreditation No.: 40‡

Mr Peter Brodzikowski

Genivar

Date: December 23, 2010

Report: S996-002-46966B

IDENTIFICATION: Interface: Clayey Silt soil / Geocomposite Tendrain II 91010-2
 Project: #105716
 Received: October 7, 2010

STANDARD:

TEST: Coefficient of Soil and Geosynthetic or Geosynt. and Geosynt. Friction by the Direct Shear Method **ASTM D5321-08**

TEST CONDITIONS: Shear surface 304 x 304 mm;
 Rate of horizontal displacement(mm/min); 0.05 (0.002 in/min);
 Tested in machine direction ;
 Submerged interface (24 hours under 10 kPa, than consolidated under the tested normal stress);
 Testing configuration - Upper box / Lower box: textured steel plate / Clayey Silt soil / Tendrain II 91010-2 geocomposite / textured steel plate;
 Tested from November 11 to 15, 2010

RESULTS:	Individual Data			Avg.	S.D.	% CV
Normal Compressive Pressure (kPa):	130.3	239.9	399.9			

PROPERTIES OF THE SOIL

Water content of compaction (%):	19.0	19.0	19.0
Dry unit weight after compaction (kg/m³):	1762	1762	1762
Duration of the consolidation (hours):	24	24	24

TEST RESULTS

Maximum Shear Stress (kPa):	75.2	144.1	221.3
Residual Shear Stress (kPa):	68.9	131.7	197.2
Estimated maximum angle of friction (°):	28		
Estimated maximum adhesion (kPa):	8.3		
Estimated residual angle of friction (°):	25		
Estimated residual adhesion (kPa):	11.7		

REMARKS: Secant friction angles:
 under 130 kPa : peak : 30°, residual: 28°
 under 240 kPa : peak : 31°, residual: 29°
 under 400 kPa : peak : 29°, residual: 26°
 The geocomposite did not exhibit any evidence of delamination under any normal load

Prepared by:

Jonathan Trudel
 Jonathan Trudel, Tech.
 Technician

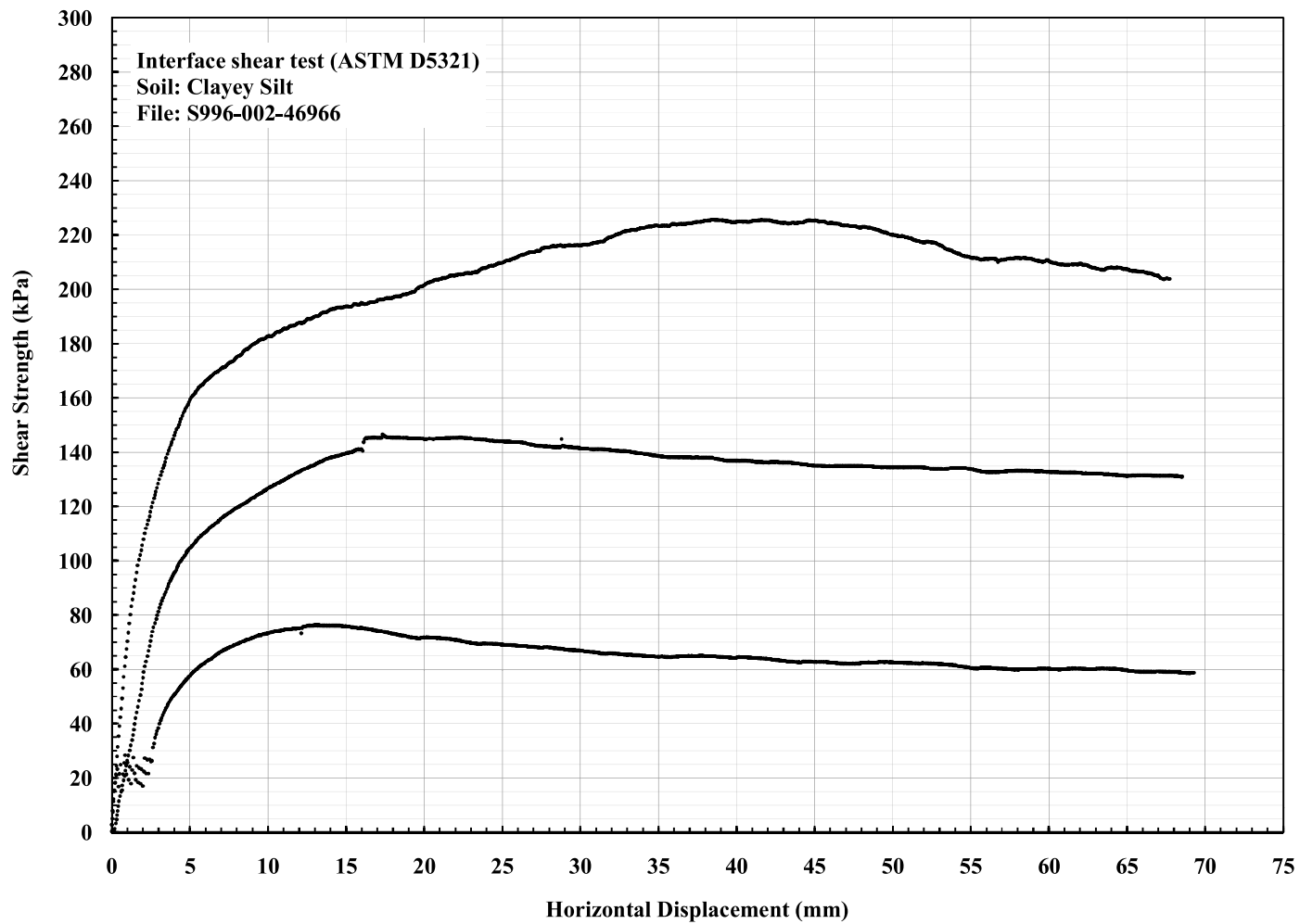
Approved by:

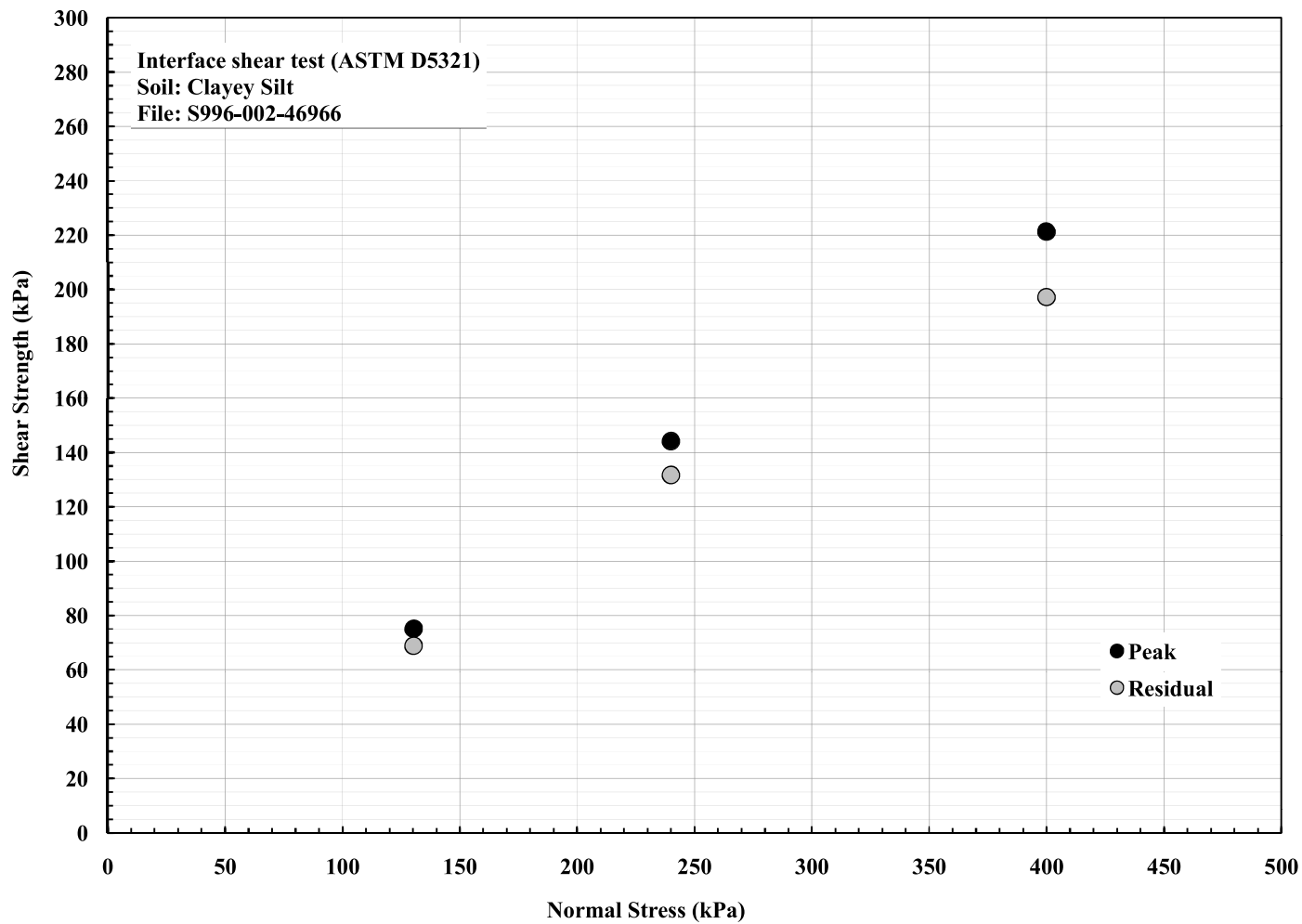
Eric Blond
 Eric Blond, Eng., M.Sc.A.
 Vice-President

Date: December 23, 2010

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B

HELP Modelling

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*
HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)
DEVELOPED BY ENVIRONMENTAL LABORATORY
USAE WATERWAYS EXPERIMENT STATION
FOR USEPA RISK REDUCTION ENGINEERING LABORATORY
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PRECIPITATION DATA FILE:  G:\2005\700\105716\help\weather\WAR50.D4
TEMPERATURE DATA FILE:   G:\2005\700\105716\help\weather\WAR50.D7
SOLAR RADIATION DATA FILE: G:\2005\700\105716\help\weather\WAR50.D13
EVAPOTRANSPIRATION DATA:  G:\2005\700\105716\help\weather\WARFG1M.D11
SOIL AND DESIGN DATA FILE: G:\2005\700\105716\help\soil\FCOVER1.D10
OUTPUT DATA FILE:         G:\2005\700\105716\help\output\FCOVER1.OUT

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TIME: 16:10 DATE: 12/14/2005

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*****
TITLE:  WARWICK LANDFILL EXPANSION
*****

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1 -----

```

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 9
THICKNESS           = 15.00 CM
POROSITY             = 0.5010 VOL/VOL
FIELD CAPACITY       = 0.2840 VOL/VOL
WILTING POINT       = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4984 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000006000E-03 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

```

LAYER 2 -----

```

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0
THICKNESS           = 185.00 CM
POROSITY             = 0.4750 VOL/VOL
FIELD CAPACITY       = 0.3780 VOL/VOL
WILTING POINT       = 0.2650 VOL/VOL

```

INITIAL SOIL WATER CONTENT = 0.3988 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.999999997000E-06 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS = 1000.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.999999975000E-04 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS = 2000.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.999999975000E-05 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS = 1700.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.999999997000E-06 CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS = 40.00 CM
POROSITY = 0.3970 VOL/VOL
FIELD CAPACITY = 0.0320 VOL/VOL
WILTING POINT = 0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.300000012000 CM/SEC
SLOPE = 0.50 PERCENT
DRAINAGE LENGTH = 50.0 METERS

LAYER 7

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	75.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000006000E-07	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	30.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000012000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	100.0	METERS

LAYER 9

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	1500.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 5. %
AND A SLOPE LENGTH OF 200. METERS.

SCS RUNOFF CURVE NUMBER	=	81.30
FRACTION OF AREA ALLOWING RUNOFF	=	100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.0000 HECTARES
EVAPORATIVE ZONE DEPTH	=	50.0 CM
INITIAL WATER IN EVAPORATIVE ZONE	=	24.079 CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	24.140 CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	11.300 CM
INITIAL SNOW WATER	=	0.000 CM
INITIAL WATER IN LAYER MATERIALS	=	2128.451 CM
TOTAL INITIAL WATER	=	2128.451 CM
TOTAL SUBSURFACE INFLOW	=	0.00 MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
DETROIT MICHIGAN

STATION LATITUDE	=	42.90 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	134
END OF GROWING SEASON (JULIAN DATE)	=	286
EVAPORATIVE ZONE DEPTH	=	50.0 CM
AVERAGE ANNUAL WIND SPEED	=	16.32 KPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR DETROIT MICHIGAN

NORMAL MEAN MONTHLY PRECIPITATION (MM)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
75.3	61.2	72.9	81.3	71.7	84.8
72.1	78.5	90.0	72.7	95.2	102.2

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR DETROIT MICHIGAN

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-6.2	-5.3	0.5	7.1	13.1	18.3
21.0	20.0	16.0	9.7	3.8	-2.7

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR DETROIT MICHIGAN
AND STATION LATITUDE = 42.90 DEGREES

AVERAGE MONTHLY VALUES (MM) FOR YEARS 1 THROUGH 50

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	76.84 70.02	61.20 74.73	70.46 85.12	86.74 73.74	71.11 98.07	84.47 108.50
STD. DEVIATIONS	27.43 28.41	26.14 42.07	28.15 46.18	34.11 51.72	29.24 49.39	40.34 43.08
RUNOFF						
TOTALS	26.025 1.532	46.932 3.938	135.208 6.794	52.494 19.806	4.108 32.216	4.291 41.298

STD. DEVIATIONS	29.089	42.416	74.618	39.761	8.798	9.119
	6.286	10.726	14.270	34.154	34.639	47.906

 VAPOTRANSPIRATION

TOTALS	12.302	10.843	11.858	50.269	80.604	94.889
	120.463	63.701	52.763	29.898	18.149	12.213

STD. DEVIATIONS	2.171	2.217	3.636	23.110	23.262	26.517
	23.439	27.123	17.515	6.128	3.979	2.613

 LATERAL DRAINAGE COLLECTED FROM LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000

STD. DEVIATIONS	0.0001	0.0001	0.0000	0.0000	0.0000	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

 PERCOLATION/LEAKAGE THROUGH LAYER 7

TOTALS	0.0205	0.0170	0.0147	0.0137	0.0208	0.0190
	0.0243	0.0255	0.0249	0.0291	0.0215	0.0237

STD. DEVIATIONS	0.0290	0.0264	0.0231	0.0235	0.0243	0.0252
	0.0278	0.0307	0.0300	0.0324	0.0316	0.0317

 LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

 PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0205	0.0169	0.0147	0.0137	0.0208	0.0190
	0.0242	0.0255	0.0249	0.0290	0.0215	0.0237

STD. DEVIATIONS	0.0290	0.0264	0.0231	0.0234	0.0243	0.0252
	0.0278	0.0307	0.0300	0.0324	0.0316	0.0317

 AVERAGES OF MONTHLY AVERAGED DAILY HEADS (CM)

 DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

 DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 50

	MM	CU. METERS	PERCENT
PRECIPITATION	961.00 (137.551)	9610.0	100.00
RUNOFF	374.643 (106.2448)	3746.43	38.985
EVAPOTRANSPIRATION	557.952 (57.6968)	5579.52	58.059
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00050 (0.00041)	0.005	0.00005
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.25465 (0.20038)	2.546	0.02650
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00012 (0.00010)	0.001	0.00001
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.25452 (0.20028)	2.545	0.02649
AVERAGE HEAD ON TOP OF LAYER 9	0.000 (0.000)		
CHANGE IN WATER STORAGE	28.152 (2.8361)	281.52	2.929

approximately
equal to
infiltration

PEAK DAILY VALUES FOR YEARS	1 THROUGH 50	
	(MM)	(CU. METERS)
PRECIPITATION	84.30	843.000
RUNOFF	99.708	997.0773
DRAINAGE COLLECTED FROM LAYER 6	0.00001	0.00006
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.003135	0.03135
AVERAGE HEAD ON TOP OF LAYER 7	0.001	
MAXIMUM HEAD ON TOP OF LAYER 7	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 METERS	
DRAINAGE COLLECTED FROM LAYER 8	0.00000	0.00002
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.003133	0.03133
AVERAGE HEAD ON TOP OF LAYER 9	0.001	
MAXIMUM HEAD ON TOP OF LAYER 9	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 METERS	
SNOW WATER	382.02	3820.2476
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4823	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2260	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 50

LAYER	(CM)	(VOL/VOL)
1	6.7622	0.4508
2	81.4296	0.4402
3	293.9794	0.2940
4	685.1088	0.3426
5	516.9949	0.3041
6	1.2801	0.0320
7	32.0250	0.4270
8	0.9600	0.0320
9	640.5000	0.4270
SNOW WATER	10.171	


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**
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE          **
**          HELP MODEL VERSION 3.07 (1 November 1997)              **
**          DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**          USAE WATERWAYS EXPERIMENT STATION                      **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY        **
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PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather1.dat

TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather2.dat

SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather3.dat

EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P1398.VHP_weather4.dat

SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\I_387763.inp

OUTPUT DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\O_387763.prt

TIME: 11:19 DATE: 2/16/2024

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TITLE: TWIN CREEKS MODIFIED BASELINE MODEL - TOP OF WASTE MOUND

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 9

THICKNESS = 15.00 CM
 POROSITY = 0.5010 VOL/VOL
 FIELD CAPACITY = 0.2840 VOL/VOL
 WILTING POINT = 0.1350 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.4648 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 28

THICKNESS = 185.00 CM
 POROSITY = 0.4520 VOL/VOL
 FIELD CAPACITY = 0.4110 VOL/VOL
 WILTING POINT = 0.3110 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.4520 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.120000000000E-05 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 1000.00 CM
 POROSITY = 0.6710 VOL/VOL
 FIELD CAPACITY = 0.2920 VOL/VOL
 WILTING POINT = 0.0770 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 2000.00 CM
 POROSITY = 0.6710 VOL/VOL
 FIELD CAPACITY = 0.2920 VOL/VOL
 WILTING POINT = 0.0770 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1700.00	CM
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-02	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0578	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	40.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0619	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0555	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	50.0	METERS

LAYER 9

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	75.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000000000E-08	CM/SEC

LAYER 10

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0567	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 11

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	30.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0344	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 12

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	100.0	METERS

LAYER 13

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	1500.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 5. %
AND A SLOPE LENGTH OF 200. METERS.

SCS RUNOFF CURVE NUMBER	=	81.31	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.0000	HECTARES
EVAPORATIVE ZONE DEPTH	=	15.0	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	6.972	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.515	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.025	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	2139.115	CM
TOTAL INITIAL WATER	=	2139.115	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Detroit MI

STATION LATITUDE	=	42.38	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	134	
END OF GROWING SEASON (JULIAN DATE)	=	286	
EVAPORATIVE ZONE DEPTH	=	15.0	CM
AVERAGE ANNUAL WIND SPEED	=	16.32	KPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY PRECIPITATION (MM)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
47.2	42.9	64.5	80.0	70.4	87.1
78.7	81.5	57.2	53.8	59.2	64.0

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-4.8	-3.4	1.7	8.6	14.5	19.8
22.2	21.4	17.4	11.1	4.2	-1.9

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI
AND STATION LATITUDE = 42.12 DEGREES

AVERAGE MONTHLY VALUES (MM) FOR YEARS 1 THROUGH 50

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	48.12 76.39	42.89 77.73	62.16 54.72	85.25 54.45	69.82 61.24	86.67 67.98
STD. DEVIATIONS	17.19 31.02	18.35 43.75	24.90 30.18	33.49 38.15	28.70 30.79	41.38 26.95
RUNOFF						
TOTALS	22.781 1.571	34.131 4.374	64.386 0.348	28.850 4.011	0.727 4.640	2.094 14.477
STD. DEVIATIONS	21.523 5.857	24.299 11.021	40.269 2.281	36.320 10.684	3.879 9.846	5.852 21.559
EVAPOTRANSPIRATION						
TOTALS	11.889 72.976	10.938 64.332	12.948 47.450	68.602 33.990	66.267 23.707	80.477 14.901
STD. DEVIATIONS	2.816 25.310	2.243 30.279	6.410 21.937	22.342 12.149	26.764 6.144	28.622 4.241

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	1.8479	0.2622	3.2794	18.1242	7.6098	6.7250
	4.2548	5.5085	4.9173	10.5778	16.2633	16.5434
STD. DEVIATIONS	3.8158	0.4835	4.5097	7.2036	6.0280	6.5669
	3.5852	6.2091	5.7869	11.2897	11.5254	11.1435

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	6.0201	1.3030	0.9938	11.9769	11.4668	6.9792
	5.3648	4.5387	5.3523	8.4069	13.3604	18.7045
STD. DEVIATIONS	6.0677	0.5378	0.8944	8.9972	5.6041	4.9561
	3.9510	3.7693	4.6313	8.2897	11.4760	10.3396

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.1330	0.1203	0.1175	0.0975	0.1231	0.1160
	0.1219	0.1200	0.1177	0.1189	0.1136	0.1258
STD. DEVIATIONS	0.0028	0.0043	0.0169	0.0177	0.0103	0.0118
	0.0108	0.0132	0.0131	0.0147	0.0157	0.0115

LATERAL DRAINAGE COLLECTED FROM LAYER 12

TOTALS	0.0011	0.0011	0.0015	0.0021	0.0015	0.0014
	0.0014	0.0014	0.0014	0.0015	0.0015	0.0014
STD. DEVIATIONS	0.0003	0.0002	0.0004	0.0005	0.0005	0.0004
	0.0004	0.0004	0.0004	0.0005	0.0005	0.0004

PERCOLATION/LEAKAGE THROUGH LAYER 13

TOTALS	0.1064	0.0994	0.1179	0.1355	0.1179	0.1124
	0.1134	0.1163	0.1134	0.1189	0.1155	0.1146
STD. DEVIATIONS	0.0179	0.0151	0.0192	0.0210	0.0237	0.0156
	0.0187	0.0142	0.0160	0.0171	0.0164	0.0155

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (CM)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.2122	0.0005	0.6998	3.6723	0.9472	0.9930
	0.5173	0.9239	0.5000	1.9563	3.3251	3.2715
STD. DEVIATIONS	0.7806	0.0010	1.3578	1.7055	1.0191	1.2729
	0.6861	1.3847	0.8371	2.9477	3.5042	3.5461

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0112	0.0027	0.0019	0.0231	0.0214	0.0135
	0.0100	0.0085	0.0103	0.0157	0.0258	0.0349
STD. DEVIATIONS	0.0113	0.0011	0.0017	0.0174	0.0105	0.0096

0.0074 0.0070 0.0089 0.0155 0.0221 0.0193

DAILY AVERAGE HEAD ON TOP OF LAYER 13

AVERAGES	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 50

	MM	CU. METERS	PERCENT
PRECIPITATION	787.42 (105.243)	7874.2	100.00
RUNOFF	182.388 (63.8356)	1823.88	23.163
EVAPOTRANSPIRATION	508.476 (56.5529)	5084.76	64.575
PERCOLATION/LEAKAGE THROUGH LAYER 2	95.91358 (28.99812)	959.136	12.18068
AVERAGE HEAD ON TOP OF LAYER 2	14.183 (6.730)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	94.46727 (28.82835)	944.673	11.99700
PERCOLATION/LEAKAGE THROUGH LAYER 9	1.42527 (0.01958)	14.253	0.18100
AVERAGE HEAD ON TOP OF LAYER 9	0.149 (0.046)		
LATERAL DRAINAGE COLLECTED FROM LAYER 12	0.01735 (0.00228)	0.174	0.00220
PERCOLATION/LEAKAGE THROUGH LAYER 13	1.38165 (0.15339)	13.817	0.17546
AVERAGE HEAD ON TOP OF LAYER 13	0.001 (0.000)		
CHANGE IN WATER STORAGE	0.693 (1.5465)	6.93	0.088

PEAK DAILY VALUES FOR YEARS 1 THROUGH 50 and their
dates (DDDDYYY)

	(MM)	(CU. METERS)	
	-----	-----	
2190014 PRECIPITATION	74.30	743.00000	
630034 RUNOFF	69.037	690.36661	
3240007 PERCOLATION/LEAKAGE THROUGH LAYER 2	1.120847	11.20847	
AVERAGE HEAD ON TOP OF LAYER 2	150.000		
1310033 DRAINAGE COLLECTED FROM LAYER 8	1.36130	13.61301	
1310033 PERCOLATION/LEAKAGE THROUGH LAYER 9	0.004324	0.04324	
AVERAGE HEAD ON TOP OF LAYER 9	0.788		
MAXIMUM HEAD ON TOP OF LAYER 9	1.535		
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	1.3 METERS		
3470041 DRAINAGE COLLECTED FROM LAYER 12	0.00020	0.00198	
3470041 PERCOLATION/LEAKAGE THROUGH LAYER 13	0.008065	0.08065	
AVERAGE HEAD ON TOP OF LAYER 13	0.001		
MAXIMUM HEAD ON TOP OF LAYER 13	0.000		
LOCATION OF MAXIMUM HEAD IN LAYER 12 (DISTANCE FROM DRAIN)	0.0 METERS		
SNOW WATER	208.69	2086.9022	720009
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.5010	
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1350	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 50

LAYER	(CM)	(VOL/VOL)
1	4.5653	0.3044
2	83.6200	0.4520
3	292.0000	0.2920
4	584.0000	0.2920
5	496.4000	0.2920
6	0.0337	0.0673
7	2.5713	0.0643
8	0.0328	0.0655
9	32.0250	0.4270
10	0.0283	0.0566
11	1.1634	0.0388
12	0.0051	0.0102
13	640.5000	0.4270
SNOW WATER	5.638	


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**
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE          **
**          HELP MODEL VERSION 3.07 (1 November 1997)              **
**          DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**          USAE WATERWAYS EXPERIMENT STATION                      **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY        **
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PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather1.dat

TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather2.dat

SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather3.dat

EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P1398.VHP_weather4.dat

SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\I_387890.inp

OUTPUT DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\O_387890.prt

TIME: 11:43 DATE: 2/16/2024

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TITLE: TWIN CREEKS - MODIFIED BASELINE MODEL - SIDESLOPES

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 9

THICKNESS = 15.00 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4648 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 28

THICKNESS = 185.00 CM
POROSITY = 0.4520 VOL/VOL
FIELD CAPACITY = 0.4110 VOL/VOL
WILTING POINT = 0.3110 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4520 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.120000000000E-05 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 1000.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 1000.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1700.00	CM
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-02	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0578	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	40.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0619	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0555	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	50.0	METERS

LAYER 9

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	75.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000000000E-08	CM/SEC

LAYER 10

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0567	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 11

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	30.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0345	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 12

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	100.0	METERS

LAYER 13

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	1500.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 25. %
AND A SLOPE LENGTH OF 100. METERS.

SCS RUNOFF CURVE NUMBER	=	82.83	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.0000	HECTARES
EVAPORATIVE ZONE DEPTH	=	15.0	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	6.972	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.515	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.025	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	1847.118	CM
TOTAL INITIAL WATER	=	1847.118	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Detroit MI

STATION LATITUDE	=	42.38	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	134	
END OF GROWING SEASON (JULIAN DATE)	=	286	
EVAPORATIVE ZONE DEPTH	=	15.0	CM
AVERAGE ANNUAL WIND SPEED	=	16.32	KPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY PRECIPITATION (MM)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
47.2	42.9	64.5	80.0	70.4	87.1
78.7	81.5	57.2	53.8	59.2	64.0

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-4.8	-3.4	1.7	8.6	14.5	19.8
22.2	21.4	17.4	11.1	4.2	-1.9

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI
AND STATION LATITUDE = 42.12 DEGREES

AVERAGE MONTHLY VALUES (MM) FOR YEARS 1 THROUGH 50

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	48.12	42.89	62.16	85.25	69.82	86.67
	76.39	77.73	54.72	54.45	61.24	67.98
STD. DEVIATIONS	17.19	18.35	24.90	33.49	28.70	41.38
	31.02	43.75	30.18	38.15	30.79	26.95
RUNOFF						
TOTALS	22.776	34.124	64.391	28.893	0.840	2.265
	1.712	4.708	0.381	3.998	4.661	14.474
STD. DEVIATIONS	21.519	24.293	40.269	36.343	3.867	5.835
	5.815	11.457	2.284	10.661	9.830	21.538
EVAPOTRANSPIRATION						
TOTALS	11.890	10.938	12.956	68.550	66.374	80.189
	72.852	64.057	47.396	33.959	23.716	14.903

STD. DEVIATIONS	2.817	2.243	6.440	22.274	26.936	28.545
	25.311	30.100	21.822	12.132	6.092	4.239

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	1.8476	0.2606	3.2808	18.1316	7.5890	6.6368
	4.2586	5.4644	4.9070	10.5688	16.2660	16.5651
STD. DEVIATIONS	3.8157	0.4817	4.5107	7.1971	5.9792	6.5226
	3.5453	6.1812	5.7434	11.3134	11.5175	11.1243

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	6.0189	1.3028	0.9935	11.9810	11.4538	6.9077
	5.3438	4.5134	5.3242	8.4121	13.3593	18.7193
STD. DEVIATIONS	6.0683	0.5386	0.8947	8.9863	5.5889	4.8651
	3.9476	3.7409	4.6153	8.3113	11.4670	10.3242

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.1330	0.1204	0.1176	0.0975	0.1231	0.1160
	0.1218	0.1202	0.1175	0.1189	0.1135	0.1259
STD. DEVIATIONS	0.0028	0.0040	0.0169	0.0176	0.0103	0.0119
	0.0107	0.0131	0.0133	0.0148	0.0157	0.0114

LATERAL DRAINAGE COLLECTED FROM LAYER 12

TOTALS	0.0011	0.0011	0.0015	0.0021	0.0015	0.0014
	0.0014	0.0015	0.0014	0.0015	0.0015	0.0014
STD. DEVIATIONS	0.0003	0.0002	0.0004	0.0005	0.0005	0.0004
	0.0004	0.0003	0.0004	0.0005	0.0005	0.0004

PERCOLATION/LEAKAGE THROUGH LAYER 13

TOTALS	0.1065	0.0995	0.1179	0.1355	0.1179	0.1125
	0.1137	0.1165	0.1133	0.1190	0.1157	0.1146
STD. DEVIATIONS	0.0178	0.0150	0.0191	0.0208	0.0237	0.0150
	0.0184	0.0139	0.0158	0.0171	0.0164	0.0154

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (CM)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.2121	0.0005	0.6987	3.6684	0.9317	0.9678
	0.5070	0.9019	0.4906	1.9516	3.3203	3.2706
STD. DEVIATIONS	0.7802	0.0010	1.3561	1.7049	1.0008	1.2518
	0.6730	1.3570	0.8084	2.9382	3.5011	3.5470

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0112	0.0027	0.0019	0.0231	0.0214	0.0133
	0.0100	0.0084	0.0103	0.0157	0.0258	0.0349

STD. DEVIATIONS	0.0113	0.0011	0.0017	0.0173	0.0104	0.0094
	0.0074	0.0070	0.0089	0.0155	0.0221	0.0193

DAILY AVERAGE HEAD ON TOP OF LAYER 13

AVERAGES	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 50

	MM	CU. METERS	PERCENT
PRECIPITATION	787.42 (105.243)	7874.2	100.00
RUNOFF	183.223 (64.1070)	1832.23	23.269
EVAPOTRANSPIRATION	507.779 (56.3577)	5077.79	64.486
PERCOLATION/LEAKAGE THROUGH LAYER 2	95.77641 (28.96476)	957.764	12.16326
AVERAGE HEAD ON TOP OF LAYER 2	14.101 (6.707)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	94.32981 (28.77408)	943.298	11.97955
PERCOLATION/LEAKAGE THROUGH LAYER 9	1.42550 (0.01946)	14.255	0.18103
AVERAGE HEAD ON TOP OF LAYER 9	0.149 (0.045)		
LATERAL DRAINAGE COLLECTED FROM LAYER 12	0.01737 (0.00225)	0.174	0.00221
PERCOLATION/LEAKAGE THROUGH LAYER 13	1.38248 (0.15080)	13.825	0.17557
AVERAGE HEAD ON TOP OF LAYER 13	0.001 (0.000)		
CHANGE IN WATER STORAGE	0.693 (1.5475)	6.93	0.088

PEAK DAILY VALUES FOR YEARS 1 THROUGH 50 and their

dates (DDDDYYYY)

	(MM)	(CU. METERS)	
PRECIPITATION 2190014	74.30	743.00000	
RUNOFF 630034	69.037	690.36661	
PERCOLATION/LEAKAGE THROUGH LAYER 2 2260002	1.120847	11.20847	
AVERAGE HEAD ON TOP OF LAYER 2	150.000		
DRAINAGE COLLECTED FROM LAYER 8 1240022	1.35828	13.58280	
PERCOLATION/LEAKAGE THROUGH LAYER 9 1240022	0.004324	0.04324	
AVERAGE HEAD ON TOP OF LAYER 9	0.786		
MAXIMUM HEAD ON TOP OF LAYER 9	1.532		
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	1.3 METERS		
DRAINAGE COLLECTED FROM LAYER 12 3470041	0.00020	0.00198	
PERCOLATION/LEAKAGE THROUGH LAYER 13 3470041	0.008065	0.08065	
AVERAGE HEAD ON TOP OF LAYER 13	0.001		
MAXIMUM HEAD ON TOP OF LAYER 13	0.000		
LOCATION OF MAXIMUM HEAD IN LAYER 12 (DISTANCE FROM DRAIN)	0.0 METERS		
SNOW WATER	208.69	2086.9022	720009
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.5010	
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1350	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 50

LAYER	(CM)	(VOL/VOL)
1	4.5656	0.3044
2	83.6200	0.4520
3	292.0000	0.2920
4	292.0000	0.2920
5	496.4000	0.2920
6	0.0337	0.0673
7	2.5714	0.0643
8	0.0328	0.0656
9	32.0250	0.4270
10	0.0283	0.0566
11	1.1634	0.0388
12	0.0051	0.0102
13	640.5000	0.4270
SNOW WATER	5.638	


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**
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE          **
**          HELP MODEL VERSION 3.07 (1 November 1997)              **
**          DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**          USAE WATERWAYS EXPERIMENT STATION                      **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY        **
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**
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*****
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PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather1.dat

TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather2.dat

SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather3.dat

EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P1398.VHP_weather4.dat

SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\I_388341.inp

OUTPUT DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\O_388341.prt

TIME: 16: 6 DATE: 2/21/2024

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TITLE: TWIN CREEKS ALTERNATIVE 1 - TOP OF WASTE MOUND

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 9

THICKNESS = 15.00 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4648 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 28

THICKNESS = 185.00 CM
POROSITY = 0.4520 VOL/VOL
FIELD CAPACITY = 0.4110 VOL/VOL
WILTING POINT = 0.3110 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4520 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.120000000000E-05 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 6000.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 2000.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1700.00	CM
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-02	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0578	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	40.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0619	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0555	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	50.0	METERS

LAYER 9

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	75.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000000000E-08	CM/SEC

LAYER 10

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0567	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 11

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	30.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0344	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 12

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	100.0	METERS

LAYER 13

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	1500.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 5. %
AND A SLOPE LENGTH OF 200. METERS.

SCS RUNOFF CURVE NUMBER	=	81.31	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.0000	HECTARES
EVAPORATIVE ZONE DEPTH	=	15.0	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	6.972	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.515	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.025	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	3599.115	CM
TOTAL INITIAL WATER	=	3599.115	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Detroit MI

STATION LATITUDE	=	42.38	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	134	
END OF GROWING SEASON (JULIAN DATE)	=	286	
EVAPORATIVE ZONE DEPTH	=	15.0	CM
AVERAGE ANNUAL WIND SPEED	=	16.32	KPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY PRECIPITATION (MM)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
47.2	42.9	64.5	80.0	70.4	87.1
78.7	81.5	57.2	53.8	59.2	64.0

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-4.8	-3.4	1.7	8.6	14.5	19.8
22.2	21.4	17.4	11.1	4.2	-1.9

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI
AND STATION LATITUDE = 42.12 DEGREES

AVERAGE MONTHLY VALUES (MM) FOR YEARS 1 THROUGH 50

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	48.12 76.39	42.89 77.73	62.16 54.72	85.25 54.45	69.82 61.24	86.67 67.98
STD. DEVIATIONS	17.19 31.02	18.35 43.75	24.90 30.18	33.49 38.15	28.70 30.79	41.38 26.95
RUNOFF						
TOTALS	22.781 1.571	34.131 4.374	64.386 0.348	28.850 4.011	0.727 4.640	2.094 14.477
STD. DEVIATIONS	21.523 5.857	24.299 11.021	40.269 2.281	36.320 10.684	3.879 9.846	5.852 21.559
EVAPOTRANSPIRATION						
TOTALS	11.889 72.976	10.938 64.332	12.948 47.450	68.602 33.990	66.267 23.707	80.477 14.901

STD. DEVIATIONS	2.816	2.243	6.410	22.342	26.764	28.622
	25.310	30.279	21.937	12.149	6.144	4.241

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	1.8479	0.2622	3.2794	18.1242	7.6098	6.7250
	4.2548	5.5085	4.9173	10.5778	16.2633	16.5434

STD. DEVIATIONS	3.8158	0.4835	4.5097	7.2036	6.0280	6.5669
	3.5852	6.2091	5.7869	11.2897	11.5254	11.1435

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	6.0201	1.3030	0.9938	11.9769	11.4668	6.9792
	5.3648	4.5387	5.3523	8.4069	13.3604	18.7045

STD. DEVIATIONS	6.0677	0.5378	0.8944	8.9972	5.6041	4.9561
	3.9510	3.7693	4.6313	8.2897	11.4760	10.3396

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.1330	0.1203	0.1175	0.0975	0.1231	0.1160
	0.1219	0.1200	0.1177	0.1189	0.1136	0.1258

STD. DEVIATIONS	0.0028	0.0043	0.0169	0.0177	0.0103	0.0118
	0.0108	0.0132	0.0131	0.0147	0.0157	0.0115

LATERAL DRAINAGE COLLECTED FROM LAYER 12

TOTALS	0.0011	0.0011	0.0015	0.0021	0.0015	0.0014
	0.0014	0.0014	0.0014	0.0015	0.0015	0.0014

STD. DEVIATIONS	0.0003	0.0002	0.0004	0.0005	0.0005	0.0004
	0.0004	0.0004	0.0004	0.0005	0.0005	0.0004

PERCOLATION/LEAKAGE THROUGH LAYER 13

TOTALS	0.1064	0.0994	0.1179	0.1355	0.1179	0.1124
	0.1134	0.1163	0.1134	0.1189	0.1155	0.1146

STD. DEVIATIONS	0.0179	0.0151	0.0192	0.0210	0.0237	0.0156
	0.0187	0.0142	0.0160	0.0171	0.0164	0.0155

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (CM)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.2122	0.0005	0.6998	3.6723	0.9472	0.9930
	0.5173	0.9239	0.5000	1.9563	3.3251	3.2715

STD. DEVIATIONS	0.7806	0.0010	1.3578	1.7055	1.0191	1.2729
	0.6861	1.3847	0.8371	2.9477	3.5042	3.5461

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0112	0.0027	0.0019	0.0231	0.0214	0.0135

	0.0100	0.0085	0.0103	0.0157	0.0258	0.0349
STD. DEVIATIONS	0.0113	0.0011	0.0017	0.0174	0.0105	0.0096
	0.0074	0.0070	0.0089	0.0155	0.0221	0.0193

DAILY AVERAGE HEAD ON TOP OF LAYER 13

AVERAGES	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 50

	MM	CU. METERS	PERCENT
PRECIPITATION	787.42 (105.243)	7874.2	100.00
RUNOFF	182.388 (63.8356)	1823.88	23.163
EVAPOTRANSPIRATION	508.476 (56.5529)	5084.76	64.575
PERCOLATION/LEAKAGE THROUGH LAYER 2	95.91358 (28.99812)	959.136	12.18068
AVERAGE HEAD ON TOP OF LAYER 2	14.183 (6.730)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	94.46727 (28.82835)	944.673	11.99700
PERCOLATION/LEAKAGE THROUGH LAYER 9	1.42527 (0.01958)	14.253	0.18100
AVERAGE HEAD ON TOP OF LAYER 9	0.149 (0.046)		
LATERAL DRAINAGE COLLECTED FROM LAYER 12	0.01735 (0.00228)	0.174	0.00220
PERCOLATION/LEAKAGE THROUGH LAYER 13	1.38165 (0.15339)	13.817	0.17546
AVERAGE HEAD ON TOP OF LAYER 13	0.001 (0.000)		
CHANGE IN WATER STORAGE	0.693 (1.5465)	6.93	0.088

dates (DDDDYYYY)	PEAK DAILY VALUES FOR YEARS	1 THROUGH	50	and their
		(MM)	(CU. METERS)	
2190014	PRECIPITATION	74.30	743.00000	
630034	RUNOFF	69.037	690.36661	
3240007	PERCOLATION/LEAKAGE THROUGH LAYER 2	1.120847	11.20847	
	AVERAGE HEAD ON TOP OF LAYER 2	150.000		
1310033	DRAINAGE COLLECTED FROM LAYER 8	1.36130	13.61301	
1310033	PERCOLATION/LEAKAGE THROUGH LAYER 9	0.004324	0.04324	
	AVERAGE HEAD ON TOP OF LAYER 9	0.788		
	MAXIMUM HEAD ON TOP OF LAYER 9	1.535		
	LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	1.3 METERS		
3470041	DRAINAGE COLLECTED FROM LAYER 12	0.00020	0.00198	
3470041	PERCOLATION/LEAKAGE THROUGH LAYER 13	0.008065	0.08065	
	AVERAGE HEAD ON TOP OF LAYER 13	0.001		
	MAXIMUM HEAD ON TOP OF LAYER 13	0.000		
	LOCATION OF MAXIMUM HEAD IN LAYER 12 (DISTANCE FROM DRAIN)	0.0 METERS		
	SNOW WATER	208.69	2086.9022	720009
	MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.5010	
	MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1350	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 50

LAYER	(CM)	(VOL/VOL)
1	4.5653	0.3044
2	83.6200	0.4520
3	1752.0000	0.2920
4	584.0000	0.2920
5	496.4000	0.2920
6	0.0337	0.0673
7	2.5713	0.0643
8	0.0328	0.0655
9	32.0250	0.4270
10	0.0283	0.0566
11	1.1634	0.0388
12	0.0051	0.0102
13	640.5000	0.4270
SNOW WATER	5.638	


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**
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE          **
**          HELP MODEL VERSION 3.07 (1 November 1997)              **
**          DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**          USAE WATERWAYS EXPERIMENT STATION                      **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY        **
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PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather1.dat

TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather2.dat

SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather3.dat

EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P1398.VHP_weather4.dat

SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\I_388398.inp

OUTPUT DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\O_388398.prt

TIME: 16:18 DATE: 2/21/2024

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TITLE: TWIN CREEKS - ALTERNATIVE 1 - SIDESLOPES

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 9

THICKNESS = 15.00 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4648 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 28

THICKNESS = 185.00 CM
POROSITY = 0.4520 VOL/VOL
FIELD CAPACITY = 0.4110 VOL/VOL
WILTING POINT = 0.3110 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4520 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.120000000000E-05 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 3500.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 1000.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1700.00	CM
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-02	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0578	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	40.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0619	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0555	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	50.0	METERS

LAYER 9

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	75.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000000000E-08	CM/SEC

LAYER 10

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0567	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 11

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	30.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0343	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 12

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	100.0	METERS

LAYER 13

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	1500.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 33. %
AND A SLOPE LENGTH OF 250. METERS.

SCS RUNOFF CURVE NUMBER	=	82.06	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.0000	HECTARES
EVAPORATIVE ZONE DEPTH	=	15.0	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	6.972	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.515	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.025	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	2577.112	CM
TOTAL INITIAL WATER	=	2577.112	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Detroit MI

STATION LATITUDE	=	42.38	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	134	
END OF GROWING SEASON (JULIAN DATE)	=	286	
EVAPORATIVE ZONE DEPTH	=	15.0	CM
AVERAGE ANNUAL WIND SPEED	=	16.32	KPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY PRECIPITATION (MM)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
47.2	42.9	64.5	80.0	70.4	87.1
78.7	81.5	57.2	53.8	59.2	64.0

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-4.8	-3.4	1.7	8.6	14.5	19.8
22.2	21.4	17.4	11.1	4.2	-1.9

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI
AND STATION LATITUDE = 42.12 DEGREES

AVERAGE MONTHLY VALUES (MM) FOR YEARS 1 THROUGH 50

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	48.12 76.39	42.89 77.73	62.16 54.72	85.25 54.45	69.82 61.24	86.67 67.98
STD. DEVIATIONS	17.19 31.02	18.35 43.75	24.90 30.18	33.49 38.15	28.70 30.79	41.38 26.95
RUNOFF						
TOTALS	22.776 1.638	34.126 4.552	64.387 0.362	28.881 4.014	0.774 4.648	2.188 14.477
STD. DEVIATIONS	21.522 5.845	24.297 11.428	40.271 2.282	36.338 10.689	3.856 9.833	5.884 21.551
EVAPOTRANSPIRATION						
TOTALS	11.889 72.804	10.938 64.169	12.947 47.401	68.613 34.045	66.226 23.734	80.416 14.902

STD. DEVIATIONS	2.816	2.243	6.411	22.328	26.829	28.391
	25.423	30.199	21.898	12.140	6.040	4.241

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	1.8387	0.2608	3.2809	18.1202	7.6089	6.7541
	4.2571	5.4881	4.9428	10.5521	16.2569	16.5155

STD. DEVIATIONS	3.8199	0.4816	4.5093	7.2022	6.0153	6.5337
	3.5126	6.1861	5.8088	11.3121	11.5244	11.0636

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	5.9885	1.3013	0.9933	11.9852	11.4518	6.9640
	5.3809	4.5343	5.3653	8.4158	13.3420	18.6956

STD. DEVIATIONS	6.0467	0.5367	0.8939	9.0121	5.6055	4.8920
	3.9554	3.7085	4.6383	8.3045	11.4858	10.3241

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.1330	0.1203	0.1177	0.0975	0.1231	0.1159
	0.1218	0.1199	0.1175	0.1190	0.1135	0.1258

STD. DEVIATIONS	0.0028	0.0045	0.0168	0.0176	0.0103	0.0117
	0.0105	0.0131	0.0133	0.0147	0.0157	0.0113

LATERAL DRAINAGE COLLECTED FROM LAYER 12

TOTALS	0.0011	0.0011	0.0015	0.0021	0.0015	0.0014
	0.0014	0.0015	0.0014	0.0015	0.0015	0.0014

STD. DEVIATIONS	0.0003	0.0002	0.0004	0.0005	0.0005	0.0004
	0.0004	0.0004	0.0004	0.0005	0.0005	0.0004

PERCOLATION/LEAKAGE THROUGH LAYER 13

TOTALS	0.1064	0.0994	0.1179	0.1353	0.1179	0.1123
	0.1134	0.1163	0.1133	0.1187	0.1154	0.1145

STD. DEVIATIONS	0.0180	0.0152	0.0193	0.0211	0.0237	0.0158
	0.0190	0.0145	0.0162	0.0174	0.0166	0.0154

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (CM)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.2123	0.0005	0.7001	3.6685	0.9410	0.9870
	0.5068	0.9094	0.5036	1.9546	3.3276	3.2588

STD. DEVIATIONS	0.7814	0.0010	1.3580	1.7037	1.0104	1.2617
	0.6835	1.3594	0.8382	2.9467	3.5049	3.5408

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0112	0.0027	0.0019	0.0231	0.0214	0.0134

	0.0100	0.0085	0.0104	0.0157	0.0257	0.0349
STD. DEVIATIONS	0.0113	0.0011	0.0017	0.0174	0.0105	0.0094
	0.0074	0.0069	0.0089	0.0155	0.0222	0.0193

DAILY AVERAGE HEAD ON TOP OF LAYER 13

AVERAGES	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 50

	MM	CU. METERS	PERCENT
PRECIPITATION	787.42 (105.243)	7874.2	100.00
RUNOFF	182.822 (64.1171)	1828.22	23.218
EVAPOTRANSPIRATION	508.085 (56.4836)	5080.85	64.525
PERCOLATION/LEAKAGE THROUGH LAYER 2	95.87605 (28.99067)	958.761	12.17591
AVERAGE HEAD ON TOP OF LAYER 2	14.142 (6.720)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	94.41802 (28.78398)	944.180	11.99075
PERCOLATION/LEAKAGE THROUGH LAYER 9	1.42511 (0.01909)	14.251	0.18098
AVERAGE HEAD ON TOP OF LAYER 9	0.149 (0.045)		
LATERAL DRAINAGE COLLECTED FROM LAYER 12	0.01735 (0.00232)	0.173	0.00220
PERCOLATION/LEAKAGE THROUGH LAYER 13	1.38084 (0.15655)	13.808	0.17536
AVERAGE HEAD ON TOP OF LAYER 13	0.001 (0.000)		
CHANGE IN WATER STORAGE	0.701 (1.5481)	7.01	0.089

dates (DDDDYYYY)	PEAK DAILY VALUES FOR YEARS	1 THROUGH	50	and their
		(MM)	(CU. METERS)	
2190014	PRECIPITATION	74.30	743.00000	
630034	RUNOFF	69.037	690.36661	
2260002	PERCOLATION/LEAKAGE THROUGH LAYER 2	1.120847	11.20847	
	AVERAGE HEAD ON TOP OF LAYER 2	150.000		
1420002	DRAINAGE COLLECTED FROM LAYER 8	1.35891	13.58906	
1420002	PERCOLATION/LEAKAGE THROUGH LAYER 9	0.004324	0.04324	
	AVERAGE HEAD ON TOP OF LAYER 9	0.786		
	MAXIMUM HEAD ON TOP OF LAYER 9	1.532		
	LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	1.3 METERS		
1160049	DRAINAGE COLLECTED FROM LAYER 12	0.00020	0.00197	
1160049	PERCOLATION/LEAKAGE THROUGH LAYER 13	0.008035	0.08035	
	AVERAGE HEAD ON TOP OF LAYER 13	0.001		
	MAXIMUM HEAD ON TOP OF LAYER 13	0.000		
	LOCATION OF MAXIMUM HEAD IN LAYER 12 (DISTANCE FROM DRAIN)	0.0 METERS		
	SNOW WATER	208.69	2086.9022	720009
	MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.5010	
	MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1350	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 50

LAYER	(CM)	(VOL/VOL)
1	4.5398	0.3027
2	83.6200	0.4520
3	1022.0000	0.2920
4	292.0000	0.2920
5	496.4000	0.2920
6	0.0349	0.0699
7	2.6268	0.0657
8	0.0353	0.0705
9	32.0250	0.4270
10	0.0283	0.0566
11	1.1632	0.0388
12	0.0051	0.0102
13	640.5000	0.4270
SNOW WATER	5.638	


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**
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE          **
**          HELP MODEL VERSION 3.07 (1 November 1997)              **
**          DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**          USAE WATERWAYS EXPERIMENT STATION                      **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY        **
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PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather1.dat

TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather2.dat

SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather3.dat

EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P1398.VHP_weather4.dat

SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\I_388360.inp

OUTPUT DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\O_388360.prt

TIME: 9:43 DATE: 3/ 7/2024

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TITLE: TWIN CREEKS - ALTERNATIVE 2 - TOP OF WASTE MOUND

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 9

THICKNESS = 15.00 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4648 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 28

THICKNESS = 185.00 CM
POROSITY = 0.4520 VOL/VOL
FIELD CAPACITY = 0.4110 VOL/VOL
WILTING POINT = 0.3110 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4520 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.120000000000E-05 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 5300.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 2000.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1700.00	CM
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-02	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0578	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	40.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0619	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0555	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	50.0	METERS

LAYER 9

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	75.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000000000E-08	CM/SEC

LAYER 10

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0567	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 11

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	30.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0343	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 12

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	100.0	METERS

LAYER 13

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	1500.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 5. %
AND A SLOPE LENGTH OF 140. METERS.

SCS RUNOFF CURVE NUMBER	=	81.68	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.0000	HECTARES
EVAPORATIVE ZONE DEPTH	=	15.0	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	6.972	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.515	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.025	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	3394.711	CM
TOTAL INITIAL WATER	=	3394.711	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Detroit MI

STATION LATITUDE	=	42.38	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	134	
END OF GROWING SEASON (JULIAN DATE)	=	286	
EVAPORATIVE ZONE DEPTH	=	15.0	CM
AVERAGE ANNUAL WIND SPEED	=	16.32	KPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY PRECIPITATION (MM)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
47.2	42.9	64.5	80.0	70.4	87.1
78.7	81.5	57.2	53.8	59.2	64.0

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-4.8	-3.4	1.7	8.6	14.5	19.8
22.2	21.4	17.4	11.1	4.2	-1.9

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI
AND STATION LATITUDE = 42.12 DEGREES

AVERAGE MONTHLY VALUES (MM) FOR YEARS 1 THROUGH 50

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	48.12	42.89	62.16	85.25	69.82	86.67
	76.39	77.73	54.72	54.45	61.24	67.98
STD. DEVIATIONS	17.19	18.35	24.90	33.49	28.70	41.38
	31.02	43.75	30.18	38.15	30.79	26.95
RUNOFF						
TOTALS	22.782	34.131	64.389	28.843	0.747	2.140
	1.600	4.513	0.355	4.021	4.643	14.475
STD. DEVIATIONS	21.521	24.301	40.270	36.325	3.854	5.885
	5.841	11.427	2.281	10.700	9.841	21.557
EVAPOTRANSPIRATION						
TOTALS	11.890	10.938	12.945	68.617	66.158	80.524
	72.856	64.223	47.462	34.008	23.709	14.899

STD. DEVIATIONS	2.815	2.244	6.423	22.319	26.727	28.419
	25.245	30.200	21.931	12.175	6.140	4.234

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	1.8537	0.2613	3.2797	18.1400	7.6494	6.7434
	4.2494	5.4839	4.9101	10.5399	16.2551	16.5456

STD. DEVIATIONS	3.8137	0.4823	4.5093	7.2219	6.0085	6.5696
	3.5898	6.2007	5.7625	11.3094	11.5531	11.1341

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	6.0245	1.3022	0.9936	11.9839	11.4780	7.0370
	5.3521	4.5369	5.3272	8.3886	13.3469	18.6937

STD. DEVIATIONS	6.0728	0.5384	0.8942	8.9960	5.6100	4.9454
	3.9490	3.7648	4.6174	8.2969	11.4971	10.3354

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.1330	0.1203	0.1176	0.0975	0.1230	0.1160
	0.1219	0.1200	0.1175	0.1190	0.1136	0.1258

STD. DEVIATIONS	0.0028	0.0045	0.0168	0.0178	0.0103	0.0117
	0.0109	0.0132	0.0133	0.0147	0.0156	0.0116

LATERAL DRAINAGE COLLECTED FROM LAYER 12

TOTALS	0.0011	0.0011	0.0015	0.0021	0.0015	0.0014
	0.0014	0.0014	0.0014	0.0015	0.0015	0.0014

STD. DEVIATIONS	0.0003	0.0002	0.0004	0.0005	0.0005	0.0004
	0.0004	0.0004	0.0004	0.0005	0.0005	0.0004

PERCOLATION/LEAKAGE THROUGH LAYER 13

TOTALS	0.1063	0.0994	0.1179	0.1353	0.1178	0.1124
	0.1132	0.1162	0.1134	0.1188	0.1154	0.1147

STD. DEVIATIONS	0.0180	0.0152	0.0193	0.0213	0.0237	0.0160
	0.0192	0.0146	0.0163	0.0174	0.0166	0.0158

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (CM)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.2122	0.0005	0.6995	3.6680	0.9490	0.9886
	0.5099	0.9148	0.4982	1.9566	3.3257	3.2744

STD. DEVIATIONS	0.7806	0.0010	1.3572	1.7033	1.0152	1.2691
	0.6816	1.3620	0.8342	2.9490	3.5024	3.5459

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0112	0.0027	0.0019	0.0231	0.0214	0.0136

	0.0100	0.0085	0.0103	0.0157	0.0257	0.0349
STD. DEVIATIONS	0.0113	0.0011	0.0017	0.0174	0.0105	0.0095
	0.0074	0.0070	0.0089	0.0155	0.0222	0.0193

DAILY AVERAGE HEAD ON TOP OF LAYER 13

AVERAGES	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 50

	MM	CU. METERS	PERCENT
PRECIPITATION	787.42 (105.243)	7874.2	100.00
RUNOFF	182.640 (64.0789)	1826.40	23.195
EVAPOTRANSPIRATION	508.227 (56.4464)	5082.27	64.543
PERCOLATION/LEAKAGE THROUGH LAYER 2	95.91131 (29.05740)	959.113	12.18039
AVERAGE HEAD ON TOP OF LAYER 2	14.165 (6.731)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	94.46456 (28.88364)	944.646	11.99666
PERCOLATION/LEAKAGE THROUGH LAYER 9	1.42524 (0.01954)	14.252	0.18100
AVERAGE HEAD ON TOP OF LAYER 9	0.149 (0.046)		
LATERAL DRAINAGE COLLECTED FROM LAYER 12	0.01734 (0.00233)	0.173	0.00220
PERCOLATION/LEAKAGE THROUGH LAYER 13	1.38074 (0.15755)	13.807	0.17535
AVERAGE HEAD ON TOP OF LAYER 13	0.001 (0.000)		
CHANGE IN WATER STORAGE	0.695 (1.5469)	6.95	0.088

dates (DDDDYYYY)	PEAK DAILY VALUES FOR YEARS	1 THROUGH	50	and their
		(MM)	(CU. METERS)	
2190014	PRECIPITATION	74.30	743.00000	
630034	RUNOFF	69.037	690.36661	
2260002	PERCOLATION/LEAKAGE THROUGH LAYER 2	1.120847	11.20847	
	AVERAGE HEAD ON TOP OF LAYER 2	150.000		
1310033	DRAINAGE COLLECTED FROM LAYER 8	1.36130	13.61301	
1310033	PERCOLATION/LEAKAGE THROUGH LAYER 9	0.004324	0.04324	
	AVERAGE HEAD ON TOP OF LAYER 9	0.788		
	MAXIMUM HEAD ON TOP OF LAYER 9	1.535		
	LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	1.3 METERS		
1160049	DRAINAGE COLLECTED FROM LAYER 12	0.00020	0.00197	
1160049	PERCOLATION/LEAKAGE THROUGH LAYER 13	0.008037	0.08037	
	AVERAGE HEAD ON TOP OF LAYER 13	0.001		
	MAXIMUM HEAD ON TOP OF LAYER 13	0.000		
	LOCATION OF MAXIMUM HEAD IN LAYER 12 (DISTANCE FROM DRAIN)	0.0 METERS		
	SNOW WATER	208.69	2086.9022	720009
	MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.5010	
	MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1350	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 50

LAYER	(CM)	(VOL/VOL)
1	4.5648	0.3043
2	83.6200	0.4520
3	1547.6000	0.2920
4	584.0000	0.2920
5	496.4000	0.2920
6	0.0337	0.0673
7	2.5733	0.0643
8	0.0330	0.0659
9	32.0250	0.4270
10	0.0283	0.0566
11	1.1633	0.0388
12	0.0051	0.0102
13	640.5000	0.4270
SNOW WATER	5.638	


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**
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE          **
**          HELP MODEL VERSION 3.07 (1 November 1997)              **
**          DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**          USAE WATERWAYS EXPERIMENT STATION                      **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY        **
**
**
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PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather1.dat

TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather2.dat

SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather3.dat

EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P1398.VHP_weather4.dat

SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\I_388417.inp

OUTPUT DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\O_388417.prt

TIME: 9:56 DATE: 3/ 7/2024

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TITLE: TWIN CREEKS - ALTERNATIVE 2 - SIDESLOPES

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 9

THICKNESS = 15.00 CM
 POROSITY = 0.5010 VOL/VOL
 FIELD CAPACITY = 0.2840 VOL/VOL
 WILTING POINT = 0.1350 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.4648 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC
 NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 28

THICKNESS = 185.00 CM
 POROSITY = 0.4520 VOL/VOL
 FIELD CAPACITY = 0.4110 VOL/VOL
 WILTING POINT = 0.3110 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.4520 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.120000000000E-05 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 1800.00 CM
 POROSITY = 0.6710 VOL/VOL
 FIELD CAPACITY = 0.2920 VOL/VOL
 WILTING POINT = 0.0770 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 1000.00 CM
 POROSITY = 0.6710 VOL/VOL
 FIELD CAPACITY = 0.2920 VOL/VOL
 WILTING POINT = 0.0770 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1700.00	CM
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-02	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0578	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	40.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0619	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0555	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	50.0	METERS

LAYER 9

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	75.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000000000E-08	CM/SEC

LAYER 10

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0567	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 11

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	30.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0344	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 12

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	100.0	METERS

LAYER 13

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	1500.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 40. %
AND A SLOPE LENGTH OF 170. METERS.

SCS RUNOFF CURVE NUMBER	=	82.54	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.0000	HECTARES
EVAPORATIVE ZONE DEPTH	=	15.0	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	6.972	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.515	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.025	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	2080.714	CM
TOTAL INITIAL WATER	=	2080.714	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Detroit MI

STATION LATITUDE	=	42.38	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	134	
END OF GROWING SEASON (JULIAN DATE)	=	286	
EVAPORATIVE ZONE DEPTH	=	15.0	CM
AVERAGE ANNUAL WIND SPEED	=	16.32	KPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY PRECIPITATION (MM)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
47.2	42.9	64.5	80.0	70.4	87.1
78.7	81.5	57.2	53.8	59.2	64.0

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-4.8	-3.4	1.7	8.6	14.5	19.8
22.2	21.4	17.4	11.1	4.2	-1.9

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI
AND STATION LATITUDE = 42.12 DEGREES

AVERAGE MONTHLY VALUES (MM) FOR YEARS 1 THROUGH 50

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	48.12	42.89	62.16	85.25	69.82	86.67
	76.39	77.73	54.72	54.45	61.24	67.98
STD. DEVIATIONS	17.19	18.35	24.90	33.49	28.70	41.38
	31.02	43.75	30.18	38.15	30.79	26.95
RUNOFF						
TOTALS	22.777	34.121	64.388	28.885	0.813	2.230
	1.676	4.643	0.373	4.001	4.655	14.475
STD. DEVIATIONS	21.520	24.287	40.270	36.315	3.863	5.858
	5.787	11.481	2.283	10.662	9.830	21.545
EVAPOTRANSPIRATION						
TOTALS	11.890	10.938	12.950	68.613	66.182	80.542
	72.710	64.100	47.382	34.003	23.754	14.904

STD. DEVIATIONS	2.816	2.243	6.429	22.322	26.758	28.255
	25.404	30.098	21.848	12.136	6.027	4.242

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	1.8385	0.2607	3.2795	18.1109	7.6051	6.6692
	4.2703	5.4914	4.9009	10.5704	16.2593	16.5171
STD. DEVIATIONS	3.8198	0.4819	4.5100	7.2036	6.0013	6.4768
	3.5258	6.1958	5.7354	11.3044	11.5143	11.0500

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	5.9891	1.3017	0.9934	11.9711	11.4282	6.9517
	5.3306	4.5474	5.3317	8.4220	13.3547	18.7049
STD. DEVIATIONS	6.0468	0.5375	0.8943	8.9962	5.6034	4.8312
	3.9217	3.7523	4.5799	8.3040	11.4679	10.3265

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.1330	0.1204	0.1177	0.0975	0.1230	0.1158
	0.1217	0.1200	0.1175	0.1190	0.1135	0.1259
STD. DEVIATIONS	0.0028	0.0041	0.0168	0.0176	0.0103	0.0117
	0.0106	0.0131	0.0134	0.0147	0.0157	0.0113

LATERAL DRAINAGE COLLECTED FROM LAYER 12

TOTALS	0.0011	0.0011	0.0015	0.0021	0.0015	0.0014
	0.0014	0.0015	0.0014	0.0015	0.0015	0.0014
STD. DEVIATIONS	0.0003	0.0002	0.0004	0.0005	0.0005	0.0004
	0.0004	0.0003	0.0004	0.0005	0.0005	0.0004

PERCOLATION/LEAKAGE THROUGH LAYER 13

TOTALS	0.1063	0.0995	0.1177	0.1354	0.1179	0.1127
	0.1134	0.1163	0.1134	0.1187	0.1155	0.1145
STD. DEVIATIONS	0.0179	0.0151	0.0191	0.0210	0.0237	0.0156
	0.0188	0.0142	0.0162	0.0172	0.0165	0.0153

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (CM)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.2120	0.0005	0.6994	3.6690	0.9409	0.9728
	0.5054	0.9066	0.4922	1.9517	3.3249	3.2574
STD. DEVIATIONS	0.7801	0.0010	1.3572	1.7033	1.0061	1.2507
	0.6760	1.3585	0.8166	2.9388	3.4994	3.5377

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0112	0.0027	0.0019	0.0231	0.0213	0.0134
	0.0100	0.0085	0.0103	0.0157	0.0258	0.0349

STD. DEVIATIONS	0.0113	0.0011	0.0017	0.0174	0.0105	0.0093
	0.0073	0.0070	0.0088	0.0155	0.0221	0.0193

DAILY AVERAGE HEAD ON TOP OF LAYER 13

AVERAGES	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 50

	MM	CU. METERS	PERCENT
PRECIPITATION	787.42 (105.243)	7874.2	100.00
RUNOFF	183.038 (64.0696)	1830.38	23.245
EVAPOTRANSPIRATION	507.967 (56.3099)	5079.67	64.510
PERCOLATION/LEAKAGE THROUGH LAYER 2	95.77329 (28.93037)	957.733	12.16286
AVERAGE HEAD ON TOP OF LAYER 2	14.111 (6.715)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	94.32661 (28.74858)	943.266	11.97914
PERCOLATION/LEAKAGE THROUGH LAYER 9	1.42525 (0.01880)	14.253	0.18100
AVERAGE HEAD ON TOP OF LAYER 9	0.149 (0.045)		
LATERAL DRAINAGE COLLECTED FROM LAYER 12	0.01736 (0.00229)	0.174	0.00220
PERCOLATION/LEAKAGE THROUGH LAYER 13	1.38142 (0.15424)	13.814	0.17544
AVERAGE HEAD ON TOP OF LAYER 13	0.001 (0.000)		
CHANGE IN WATER STORAGE	0.694 (1.5483)	6.94	0.088

PEAK DAILY VALUES FOR YEARS 1 THROUGH 50 and their

dates (DDDDYYYY)

	(MM)	(CU. METERS)	
2190014 PRECIPITATION	74.30	743.00000	
630034 RUNOFF	69.037	690.36661	
2260002 PERCOLATION/LEAKAGE THROUGH LAYER 2	1.120847	11.20847	
AVERAGE HEAD ON TOP OF LAYER 2	150.000		
1310033 DRAINAGE COLLECTED FROM LAYER 8	1.36130	13.61296	
1310033 PERCOLATION/LEAKAGE THROUGH LAYER 9	0.004324	0.04324	
AVERAGE HEAD ON TOP OF LAYER 9	0.788		
MAXIMUM HEAD ON TOP OF LAYER 9	1.535		
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	1.3 METERS		
1020025 DRAINAGE COLLECTED FROM LAYER 12	0.00020	0.00196	
1020025 PERCOLATION/LEAKAGE THROUGH LAYER 13	0.008019	0.08019	
AVERAGE HEAD ON TOP OF LAYER 13	0.001		
MAXIMUM HEAD ON TOP OF LAYER 13	0.000		
LOCATION OF MAXIMUM HEAD IN LAYER 12 (DISTANCE FROM DRAIN)	0.0 METERS		
SNOW WATER	208.69	2086.9022	720009
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.5010	
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1350	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 50

LAYER	(CM)	(VOL/VOL)
1	4.5652	0.3043
2	83.6200	0.4520
3	525.6000	0.2920
4	292.0000	0.2920
5	496.4000	0.2920
6	0.0337	0.0673
7	2.5730	0.0643
8	0.0329	0.0659
9	32.0250	0.4270
10	0.0283	0.0566
11	1.1635	0.0388
12	0.0051	0.0102
13	640.5000	0.4270
SNOW WATER	5.638	


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**
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE          **
**          HELP MODEL VERSION 3.07 (1 November 1997)              **
**          DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**          USAE WATERWAYS EXPERIMENT STATION                      **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY        **
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PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather1.dat

TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather2.dat

SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather3.dat

EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P1398.VHP_weather4.dat

SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\I_388379.inp

OUTPUT DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\O_388379.prt

TIME: 9:52 DATE: 3/ 7/2024

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TITLE: TWIN CREEKS - ALTERNATIVE 3 - TOP OF WASTE MOUND

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 9

THICKNESS = 15.00 CM
POROSITY = 0.5010 VOL/VOL
FIELD CAPACITY = 0.2840 VOL/VOL
WILTING POINT = 0.1350 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4648 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 28

THICKNESS = 185.00 CM
POROSITY = 0.4520 VOL/VOL
FIELD CAPACITY = 0.4110 VOL/VOL
WILTING POINT = 0.3110 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4520 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.120000000000E-05 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 9800.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 2000.00 CM
POROSITY = 0.6710 VOL/VOL
FIELD CAPACITY = 0.2920 VOL/VOL
WILTING POINT = 0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1700.00	CM
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-02	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0578	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	40.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0619	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0555	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	50.0	METERS

LAYER 9

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	75.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000000000E-08	CM/SEC

LAYER 10

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0567	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 11

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	30.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0343	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 12

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	100.0	METERS

LAYER 13

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	1500.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 5. %
AND A SLOPE LENGTH OF 5. METERS.

SCS RUNOFF CURVE NUMBER	=	84.83	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.0000	HECTARES
EVAPORATIVE ZONE DEPTH	=	15.0	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	6.972	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.515	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.025	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	4708.712	CM
TOTAL INITIAL WATER	=	4708.712	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Detroit MI

STATION LATITUDE	=	42.38	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	134	
END OF GROWING SEASON (JULIAN DATE)	=	286	
EVAPORATIVE ZONE DEPTH	=	15.0	CM
AVERAGE ANNUAL WIND SPEED	=	16.32	KPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY PRECIPITATION (MM)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
47.2	42.9	64.5	80.0	70.4	87.1
78.7	81.5	57.2	53.8	59.2	64.0

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-4.8	-3.4	1.7	8.6	14.5	19.8
22.2	21.4	17.4	11.1	4.2	-1.9

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI
AND STATION LATITUDE = 42.12 DEGREES

AVERAGE MONTHLY VALUES (MM) FOR YEARS 1 THROUGH 50

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	48.12 76.39	42.89 77.73	62.16 54.72	85.25 54.45	69.82 61.24	86.67 67.98
STD. DEVIATIONS	17.19 31.02	18.35 43.75	24.90 30.18	33.49 38.15	28.70 30.79	41.38 26.95
RUNOFF						
TOTALS	22.766 1.999	34.112 5.191	64.391 0.481	28.994 4.007	1.067 4.700	2.731 14.485
STD. DEVIATIONS	21.514 5.797	24.285 11.727	40.260 2.318	36.291 10.637	3.803 9.794	6.100 21.501
EVAPOTRANSPIRATION						
TOTALS	11.890 72.232	10.939 63.824	12.956 47.227	68.504 34.050	66.279 23.753	80.120 14.906

STD. DEVIATIONS	2.815	2.243	6.440	22.241	27.003	27.883
	25.178	29.999	21.724	12.150	6.033	4.247

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	1.8386	0.2585	3.2781	18.1011	7.5153	6.6030
	4.1410	5.3742	4.8373	10.5396	16.2117	16.4823

STD. DEVIATIONS	3.8195	0.4786	4.5089	7.1878	5.9289	6.3183
	3.4467	6.1314	5.6695	11.2946	11.5700	11.0833

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	5.9748	1.2966	0.9891	11.9639	11.3843	6.7952
	5.2675	4.4399	5.2621	8.3585	13.3359	18.6533

STD. DEVIATIONS	6.0570	0.5435	0.8957	8.9740	5.5448	4.6743
	3.9197	3.6489	4.5526	8.2799	11.4885	10.3537

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.1330	0.1203	0.1176	0.0974	0.1233	0.1154
	0.1220	0.1201	0.1175	0.1188	0.1135	0.1259

STD. DEVIATIONS	0.0028	0.0043	0.0169	0.0178	0.0103	0.0115
	0.0102	0.0131	0.0133	0.0146	0.0158	0.0113

LATERAL DRAINAGE COLLECTED FROM LAYER 12

TOTALS	0.0011	0.0011	0.0015	0.0021	0.0015	0.0014
	0.0014	0.0014	0.0014	0.0015	0.0015	0.0014

STD. DEVIATIONS	0.0003	0.0002	0.0004	0.0005	0.0005	0.0004
	0.0004	0.0004	0.0004	0.0005	0.0005	0.0004

PERCOLATION/LEAKAGE THROUGH LAYER 13

TOTALS	0.1062	0.0993	0.1178	0.1354	0.1176	0.1127
	0.1131	0.1162	0.1132	0.1187	0.1157	0.1144

STD. DEVIATIONS	0.0180	0.0152	0.0193	0.0213	0.0237	0.0155
	0.0189	0.0146	0.0160	0.0175	0.0172	0.0155

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (CM)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.2122	0.0005	0.6971	3.6560	0.9133	0.9224
	0.4712	0.8650	0.4689	1.9207	3.2970	3.2473

STD. DEVIATIONS	0.7813	0.0010	1.3534	1.6965	0.9811	1.1869
	0.6537	1.3217	0.7672	2.8901	3.4916	3.5395

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0112	0.0027	0.0018	0.0231	0.0213	0.0131

	0.0098	0.0083	0.0102	0.0156	0.0257	0.0348
STD. DEVIATIONS	0.0113	0.0011	0.0017	0.0173	0.0104	0.0090
	0.0073	0.0068	0.0088	0.0155	0.0222	0.0193

DAILY AVERAGE HEAD ON TOP OF LAYER 13

AVERAGES	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 50

	MM	CU. METERS	PERCENT
PRECIPITATION	787.42 (105.243)	7874.2	100.00
RUNOFF	184.925 (64.2508)	1849.25	23.485
EVAPOTRANSPIRATION	506.678 (55.9500)	5066.78	64.346
PERCOLATION/LEAKAGE THROUGH LAYER 2	95.18078 (28.94698)	951.808	12.08761
AVERAGE HEAD ON TOP OF LAYER 2	13.893 (6.658)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	93.72095 (28.62598)	937.209	11.90222
PERCOLATION/LEAKAGE THROUGH LAYER 9	1.42463 (0.01999)	14.246	0.18092
AVERAGE HEAD ON TOP OF LAYER 9	0.148 (0.045)		
LATERAL DRAINAGE COLLECTED FROM LAYER 12	0.01735 (0.00232)	0.173	0.00220
PERCOLATION/LEAKAGE THROUGH LAYER 13	1.38037 (0.15667)	13.804	0.17530
AVERAGE HEAD ON TOP OF LAYER 13	0.001 (0.000)		
CHANGE IN WATER STORAGE	0.702 (1.5517)	7.02	0.089

dates (DDDDYYYY)	PEAK DAILY VALUES FOR YEARS	1 THROUGH	50	and their
		(MM)	(CU. METERS)	
2190014	PRECIPITATION	74.30	743.00000	
630034	RUNOFF	69.037	690.36661	
2260002	PERCOLATION/LEAKAGE THROUGH LAYER 2	1.120847	11.20847	
	AVERAGE HEAD ON TOP OF LAYER 2	150.000		
1310033	DRAINAGE COLLECTED FROM LAYER 8	1.36101	13.61006	
1310033	PERCOLATION/LEAKAGE THROUGH LAYER 9	0.004324	0.04324	
	AVERAGE HEAD ON TOP OF LAYER 9	0.788		
	MAXIMUM HEAD ON TOP OF LAYER 9	1.535		
	LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	1.3 METERS		
1160049	DRAINAGE COLLECTED FROM LAYER 12	0.00020	0.00197	
1160049	PERCOLATION/LEAKAGE THROUGH LAYER 13	0.008027	0.08027	
	AVERAGE HEAD ON TOP OF LAYER 13	0.001		
	MAXIMUM HEAD ON TOP OF LAYER 13	0.000		
	LOCATION OF MAXIMUM HEAD IN LAYER 12 (DISTANCE FROM DRAIN)	0.0 METERS		
	SNOW WATER	208.69	2086.9022	720009
	MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.5010	
	MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1350	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 50

LAYER	(CM)	(VOL/VOL)
1	4.5326	0.3022
2	83.6200	0.4520
3	2861.6000	0.2920
4	584.0000	0.2920
5	496.4000	0.2920
6	0.0350	0.0700
7	2.6373	0.0659
8	0.0363	0.0726
9	32.0250	0.4270
10	0.0283	0.0566
11	1.1632	0.0388
12	0.0051	0.0102
13	640.5000	0.4270
SNOW WATER	5.638	


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**
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE          **
**          HELP MODEL VERSION 3.07 (1 November 1997)              **
**          DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**          USAE WATERWAYS EXPERIMENT STATION                      **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY        **
**
**
*****
*****
```

PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather1.dat

TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather2.dat

SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P1398.VHP_weather3.dat

EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P1398.VHP_weather4.dat

SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\I_388455.inp

OUTPUT DATA FILE: C:\WHI\VHELP22\data\P1398.VHP\O_388455.prt

TIME: 10: 0 DATE: 3/ 7/2024

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*****
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TITLE: TWIN CREEKS - ALTERNATIVE 3 - SIDESLOPES

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*****
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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 9

THICKNESS = 15.00 CM
 POROSITY = 0.5010 VOL/VOL
 FIELD CAPACITY = 0.2840 VOL/VOL
 WILTING POINT = 0.1350 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.4648 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.190000000000E-03 CM/SEC
 NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 28

THICKNESS = 185.00 CM
 POROSITY = 0.4520 VOL/VOL
 FIELD CAPACITY = 0.4110 VOL/VOL
 WILTING POINT = 0.3110 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.4520 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.120000000000E-05 CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 4800.00 CM
 POROSITY = 0.6710 VOL/VOL
 FIELD CAPACITY = 0.2920 VOL/VOL
 WILTING POINT = 0.0770 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS = 1000.00 CM
 POROSITY = 0.6710 VOL/VOL
 FIELD CAPACITY = 0.2920 VOL/VOL
 WILTING POINT = 0.0770 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.2920 VOL/VOL
 EFFECTIVE SAT. HYD. COND. = 0.100000000000E-02 CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS	=	1700.00	CM
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-02	CM/SEC

LAYER 6

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0568	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	40.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0619	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0556	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	50.0	METERS

LAYER 9

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	75.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000000000E-08	CM/SEC

LAYER 10

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0567	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 11

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 21

THICKNESS	=	30.00	CM
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0343	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000000000	CM/SEC

LAYER 12

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.50	CM
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	0.50	PERCENT
DRAINAGE LENGTH	=	100.0	METERS

LAYER 13

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	1500.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 40. %
AND A SLOPE LENGTH OF 270. METERS.

SCS RUNOFF CURVE NUMBER	=	82.08	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.0000	HECTARES
EVAPORATIVE ZONE DEPTH	=	15.0	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	6.972	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.515	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.025	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	2956.712	CM
TOTAL INITIAL WATER	=	2956.712	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Detroit MI

STATION LATITUDE	=	42.38	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	134	
END OF GROWING SEASON (JULIAN DATE)	=	286	
EVAPORATIVE ZONE DEPTH	=	15.0	CM
AVERAGE ANNUAL WIND SPEED	=	16.32	KPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	75.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY PRECIPITATION (MM)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
47.2	42.9	64.5	80.0	70.4	87.1
78.7	81.5	57.2	53.8	59.2	64.0

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES CELSIUS)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-4.8	-3.4	1.7	8.6	14.5	19.8
22.2	21.4	17.4	11.1	4.2	-1.9

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Detroit MI
AND STATION LATITUDE = 42.12 DEGREES

AVERAGE MONTHLY VALUES (MM) FOR YEARS 1 THROUGH 50

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	48.12 76.39	42.89 77.73	62.16 54.72	85.25 54.45	69.82 61.24	86.67 67.98
STD. DEVIATIONS	17.19 31.02	18.35 43.75	24.90 30.18	33.49 38.15	28.70 30.79	41.38 26.95
RUNOFF						
TOTALS	22.780 1.639	34.126 4.554	64.387 0.362	28.856 4.005	0.776 4.646	2.190 14.476
STD. DEVIATIONS	21.523 5.841	24.295 11.443	40.270 2.282	36.326 10.670	3.856 9.838	5.885 21.551
EVAPOTRANSPIRATION						
TOTALS	11.891 72.728	10.938 64.186	12.940 47.426	68.534 34.026	66.287 23.757	80.514 14.906

STD. DEVIATIONS	2.816	2.243	6.382	22.265	26.821	28.430
	25.403	30.199	21.894	12.129	6.030	4.245

PERCOLATION/LEAKAGE THROUGH LAYER 2

TOTALS	1.8386	0.2609	3.2795	18.1290	7.6446	6.6869
	4.2865	5.4899	4.9259	10.5577	16.2475	16.5020
STD. DEVIATIONS	3.8197	0.4817	4.5097	7.2224	6.0121	6.5364
	3.5287	6.1912	5.7886	11.3147	11.5153	11.0622

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	5.9854	1.3000	0.9926	11.9753	11.4980	6.9571
	5.3425	4.5501	5.3508	8.4127	13.3343	18.7031
STD. DEVIATIONS	6.0490	0.5387	0.8945	8.9960	5.6291	4.8813
	3.9296	3.7478	4.6135	8.2954	11.4711	10.3333

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.1330	0.1203	0.1177	0.0975	0.1231	0.1160
	0.1217	0.1200	0.1176	0.1190	0.1135	0.1259
STD. DEVIATIONS	0.0028	0.0045	0.0168	0.0177	0.0103	0.0117
	0.0107	0.0131	0.0133	0.0147	0.0157	0.0112

LATERAL DRAINAGE COLLECTED FROM LAYER 12

TOTALS	0.0011	0.0011	0.0015	0.0021	0.0015	0.0014
	0.0014	0.0014	0.0014	0.0015	0.0015	0.0014
STD. DEVIATIONS	0.0003	0.0002	0.0004	0.0005	0.0005	0.0004
	0.0004	0.0003	0.0004	0.0005	0.0005	0.0004

PERCOLATION/LEAKAGE THROUGH LAYER 13

TOTALS	0.1063	0.0994	0.1179	0.1353	0.1179	0.1124
	0.1135	0.1163	0.1133	0.1188	0.1155	0.1145
STD. DEVIATIONS	0.0179	0.0151	0.0193	0.0211	0.0237	0.0158
	0.0190	0.0144	0.0161	0.0174	0.0165	0.0154

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (CM)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.2121	0.0005	0.6993	3.6730	0.9452	0.9807
	0.5129	0.9110	0.4950	1.9538	3.3229	3.2575
STD. DEVIATIONS	0.7802	0.0010	1.3572	1.7058	1.0139	1.2560
	0.6818	1.3599	0.8255	2.9430	3.5026	3.5405

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0112	0.0027	0.0019	0.0231	0.0215	0.0134
	0.0100	0.0085	0.0103	0.0157	0.0257	0.0349

STD. DEVIATIONS	0.0113	0.0011	0.0017	0.0174	0.0105	0.0094
	0.0073	0.0070	0.0089	0.0155	0.0221	0.0193

DAILY AVERAGE HEAD ON TOP OF LAYER 13

AVERAGES	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 50

	MM	CU. METERS	PERCENT
PRECIPITATION	787.42 (105.243)	7874.2	100.00
RUNOFF	182.798 (64.1042)	1827.98	23.215
EVAPOTRANSPIRATION	508.131 (56.3933)	5081.31	64.531
PERCOLATION/LEAKAGE THROUGH LAYER 2	95.84898 (29.02104)	958.490	12.17247
AVERAGE HEAD ON TOP OF LAYER 2	14.137 (6.714)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	94.40202 (28.82358)	944.020	11.98872
PERCOLATION/LEAKAGE THROUGH LAYER 9	1.42531 (0.01913)	14.253	0.18101
AVERAGE HEAD ON TOP OF LAYER 9	0.149 (0.046)		
LATERAL DRAINAGE COLLECTED FROM LAYER 12	0.01735 (0.00231)	0.174	0.00220
PERCOLATION/LEAKAGE THROUGH LAYER 13	1.38115 (0.15583)	13.812	0.17540
AVERAGE HEAD ON TOP OF LAYER 13	0.001 (0.000)		
CHANGE IN WATER STORAGE	0.695 (1.5487)	6.95	0.088

PEAK DAILY VALUES FOR YEARS 1 THROUGH 50 and their

dates (DDDDYYYY)

	(MM)	(CU. METERS)	
PRECIPITATION 2190014	74.30	743.00000	
RUNOFF 630034	69.037	690.36661	
PERCOLATION/LEAKAGE THROUGH LAYER 2 2260002	1.120847	11.20847	
AVERAGE HEAD ON TOP OF LAYER 2	150.000		
DRAINAGE COLLECTED FROM LAYER 8 1420002	1.35877	13.58775	
PERCOLATION/LEAKAGE THROUGH LAYER 9 1420002	0.004324	0.04324	
AVERAGE HEAD ON TOP OF LAYER 9	0.786		
MAXIMUM HEAD ON TOP OF LAYER 9	1.532		
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	1.3 METERS		
DRAINAGE COLLECTED FROM LAYER 12 1160049	0.00020	0.00197	
PERCOLATION/LEAKAGE THROUGH LAYER 13 1160049	0.008032	0.08032	
AVERAGE HEAD ON TOP OF LAYER 13	0.001		
MAXIMUM HEAD ON TOP OF LAYER 13	0.000		
LOCATION OF MAXIMUM HEAD IN LAYER 12 (DISTANCE FROM DRAIN)	0.0 METERS		
SNOW WATER	208.69	2086.9022	720009
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.5010	
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1350	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

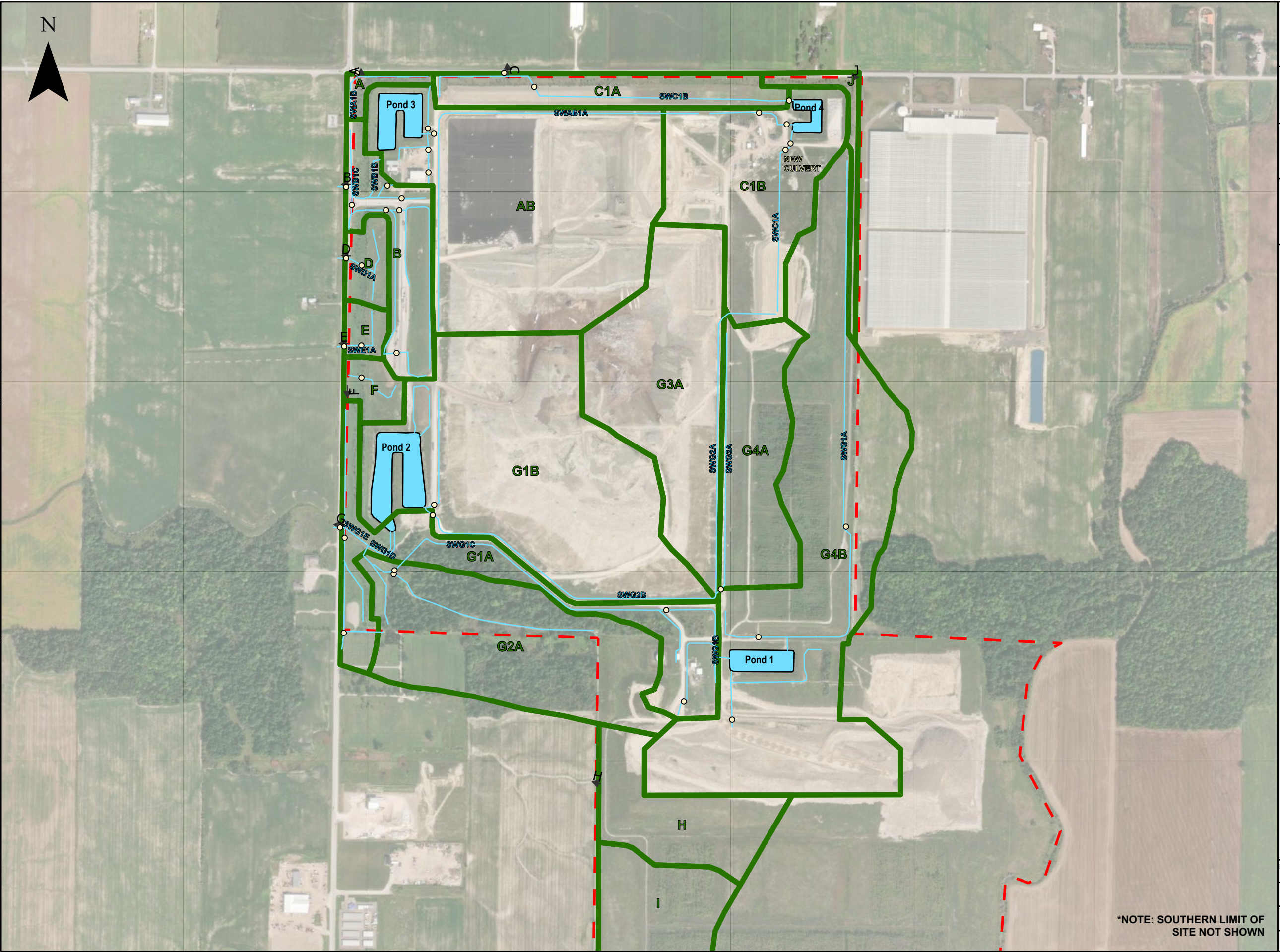
FINAL WATER STORAGE AT END OF YEAR 50

LAYER	(CM)	(VOL/VOL)
1	4.5651	0.3043
2	83.6200	0.4520
3	1401.6000	0.2920
4	292.0000	0.2920
5	496.4000	0.2920
6	0.0337	0.0673
7	2.5729	0.0643
8	0.0329	0.0659
9	32.0250	0.4270
10	0.0283	0.0566
11	1.1634	0.0388
12	0.0051	0.0102
13	640.5000	0.4270
SNOW WATER	5.638	

C

Hydrologic Modelling

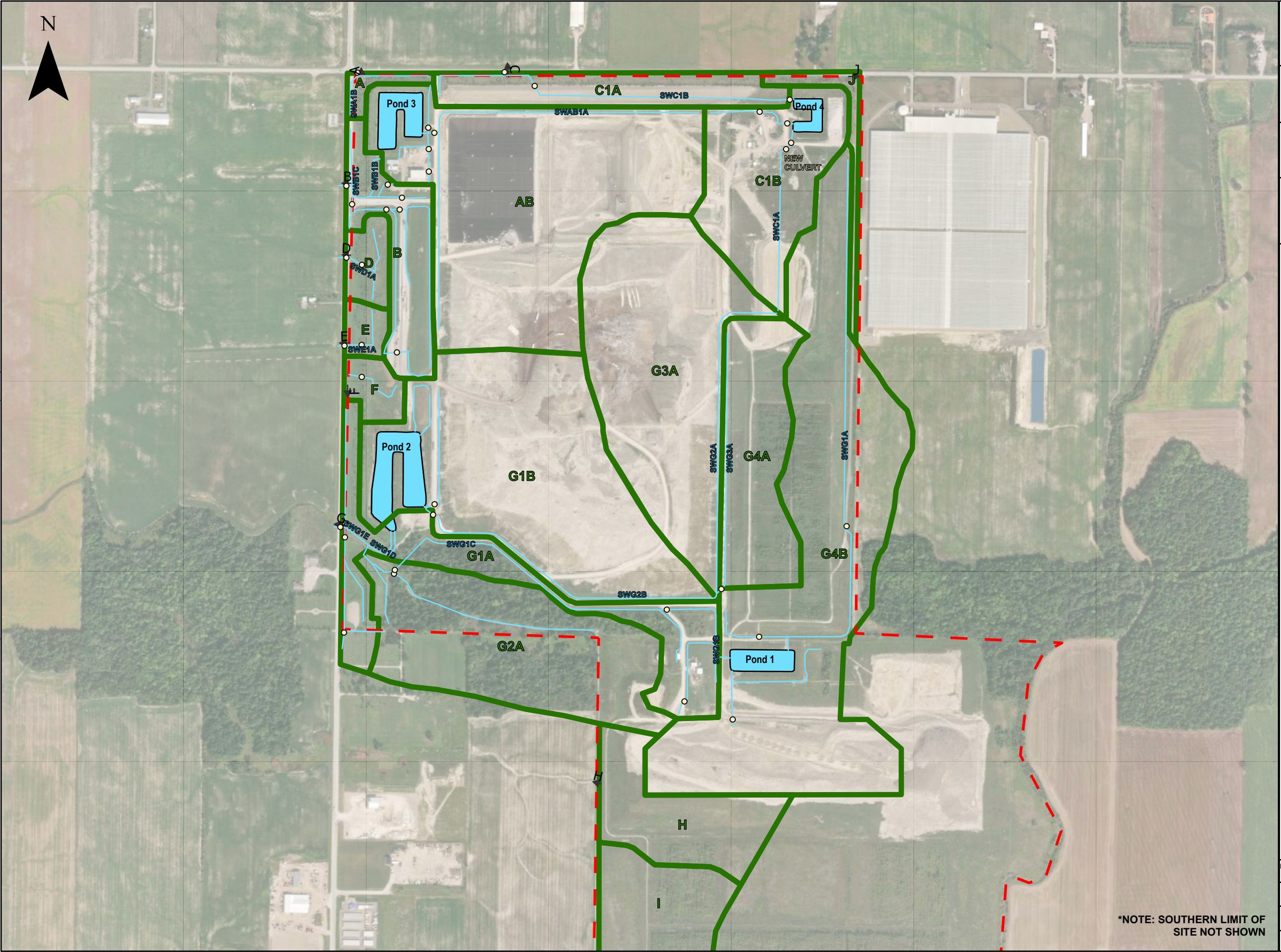
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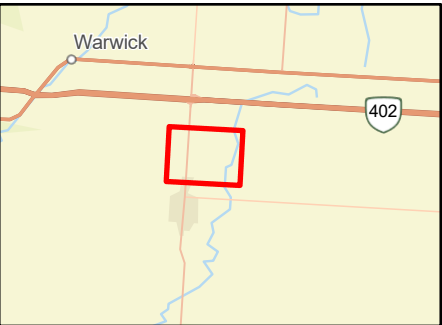
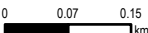


CLIENT WASTE MANAGEMENT OF CANADA CORP.	
PROJECT TWIN CREEKS LANDFILL OPTIMIZATION	
TITLE EXHIBIT 1 CATCHMENT AREAS EXISTING CONDITIONS	
LEGEND → Outlet SWM Ponds Waste Management Property Limit Proposed Ditches Proposed Culverts CatchmentsExisting	
DRAWN BY AB	CHECKED BY EK
April 2024	
NAD 1983 CSRS UTM Zone 17N 1:9,000	

*NOTE: SOUTHERN LIMIT OF
SITE NOT SHOWN

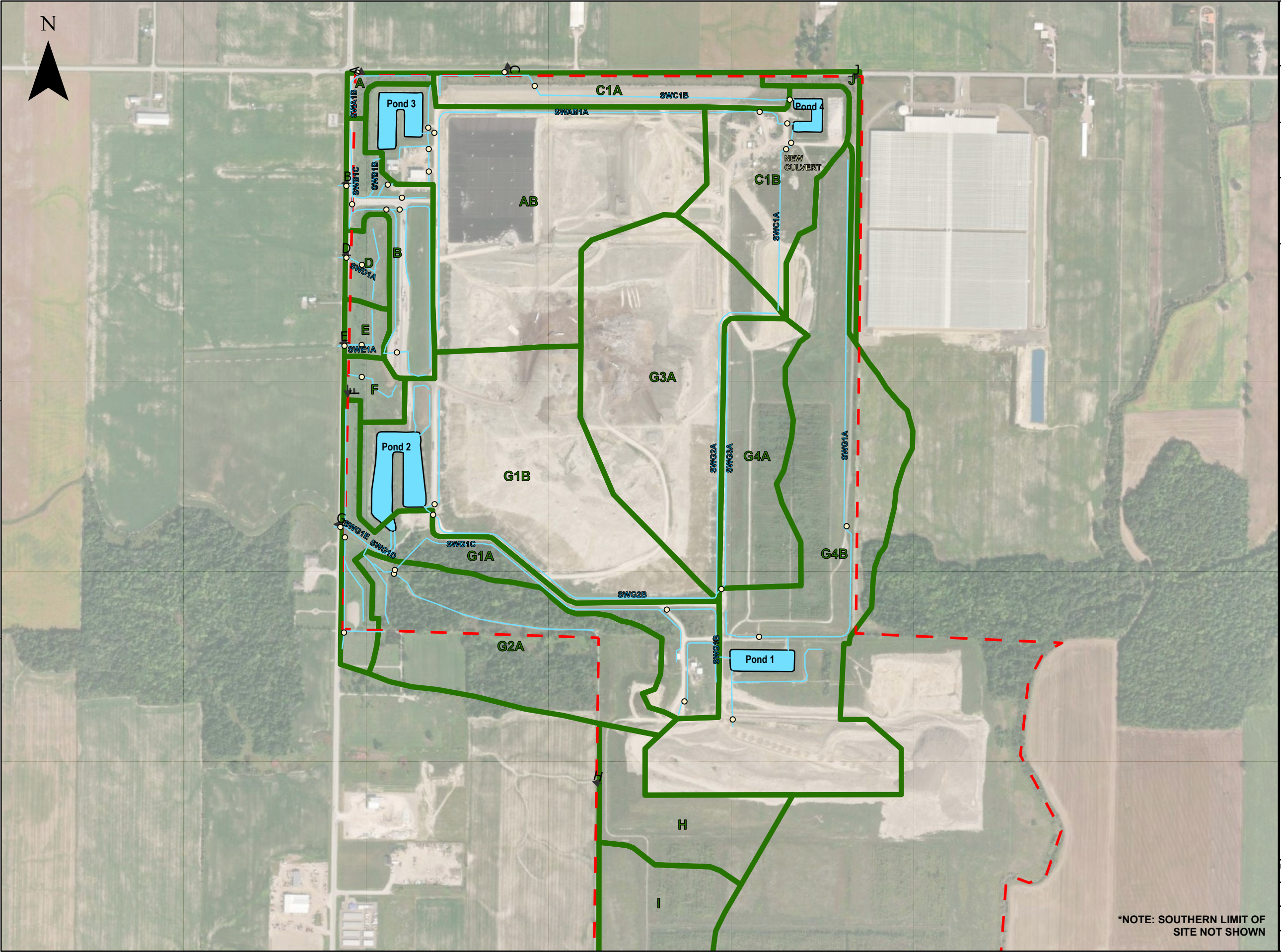
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CLIENT WASTE MANAGEMENT OF CANADA CORP.	
PROJECT TWIN CREEKS LANDFILL OPTIMIZATION	
TITLE EXHIBIT 1 CATCHMENT AREAS APPROVED FUTURE	
	
LEGEND → Outlet SWM Ponds Approved Future Catchments Waste Management Property Limit Proposed Ditches Proposed Culverts	
	
DRAWN BY AB	CHECKED BY EK
March 2024	
NAD 1983 CSRS UTM Zone 17N 1:9,000	

*NOTE: SOUTHERN LIMIT OF
SITE NOT SHOWN

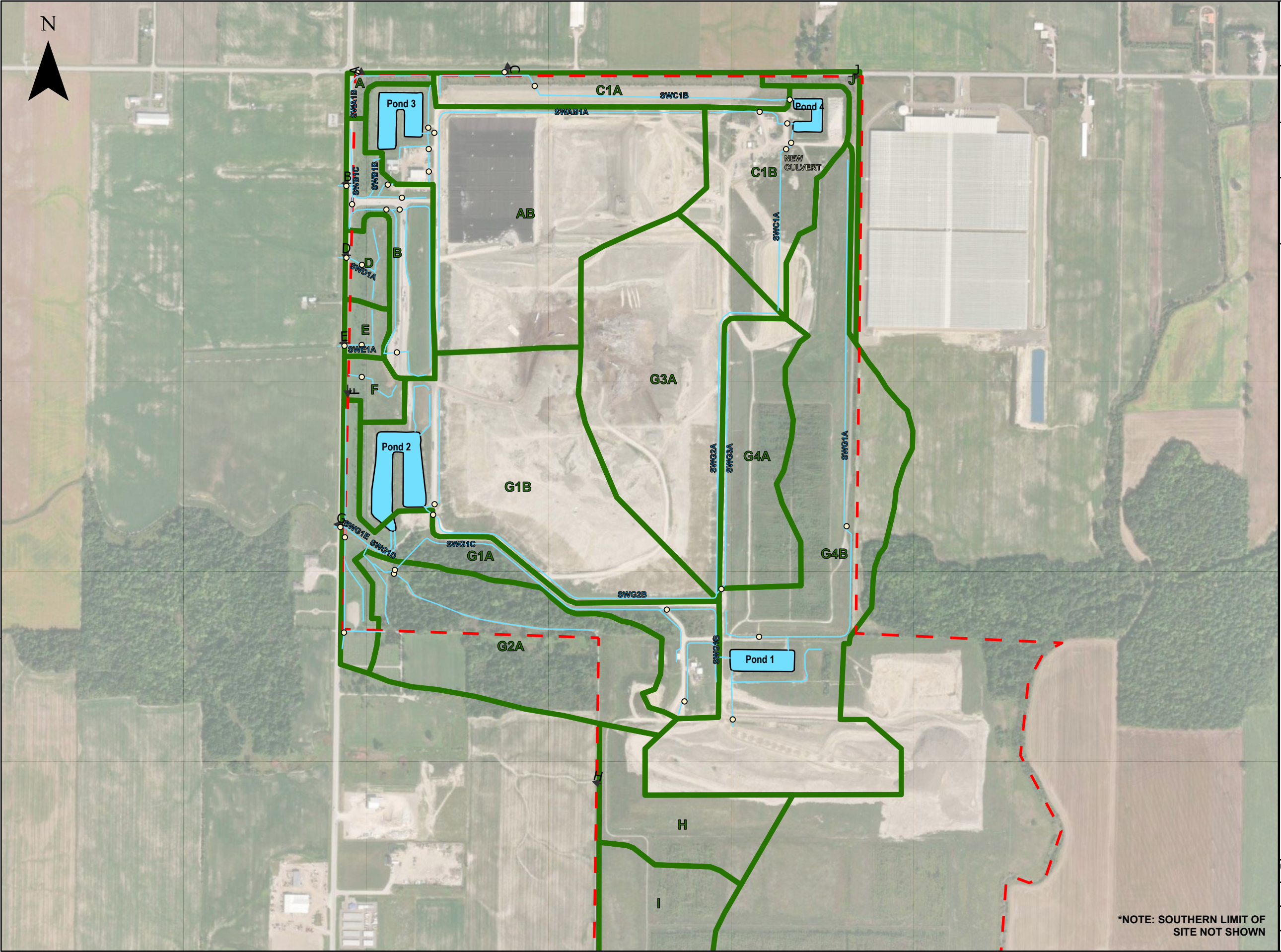
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CLIENT WASTE MANAGEMENT OF CANADA CORP.	
PROJECT TWIN CREEKS LANDFILL OPTIMIZATION	
TITLE EXHIBIT 1 CATCHMENT AREAS ALTERNATIVE METHOD 1	
LEGEND → Outlet SWM Ponds Alternative Method 1 Proposed Catchments Waste Management Property Limit Proposed Ditches Proposed Culverts	
DRAWN BY AB	CHECKED BY EK
March 2024	
NAD 1983 CSRS UTM Zone 17N 1:9,000	

*NOTE: SOUTHERN LIMIT OF SITE NOT SHOWN

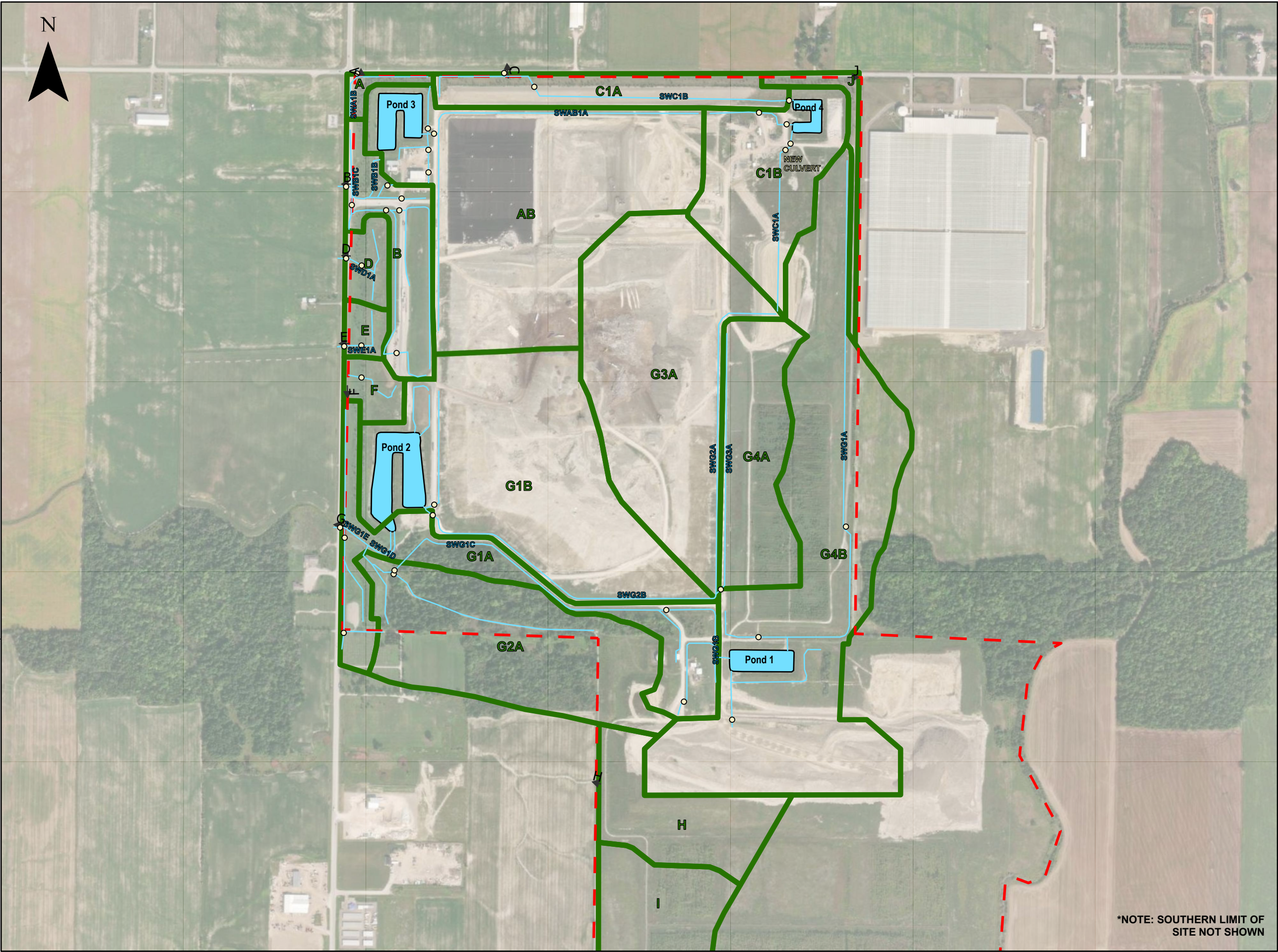
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CLIENT WASTE MANAGEMENT OF CANADA CORP.	
PROJECT TWIN CREEKS LANDFILL OPTIMIZATION	
TITLE EXHIBIT 1 CATCHMENT AREAS ALTERNATIVE METHOD 2	
LEGEND → Outlet SWM Ponds Alternative Method 2 Proposed Catchments Waste Management Property Limit Proposed Ditches Proposed Culverts	
DRAWN BY AB	CHECKED BY EK
March 2024	
NAD 1983 CSRS UTM Zone 17N 1:9,000	

*NOTE: SOUTHERN LIMIT OF
SITE NOT SHOWN

Document Path: C:\Users\CAAB010464\WSP_03651211-01678-02 Twin Creeks Landfill Optimization 2022 - 05_Technical\Surface Water\GIS\TwinCreeks-Proposed.aprx



CLIENT WASTE MANAGEMENT OF CANADA CORP.	
PROJECT TWIN CREEKS LANDFILL OPTIMIZATION	
TITLE EXHIBIT 1 CATCHMENT AREAS ALTERNATIVE METHOD 3	
LEGEND → Outlet SWM Ponds Alternative Method 3 Proposed Catchments Waste Management Property Limit Proposed Ditches Proposed Culverts	
DRAWN BY AB	CHECKED BY EK
March 2024	
NAD 1983 CSRS UTM Zone 17N 1:9,000	

*NOTE: SOUTHERN LIMIT OF SITE NOT SHOWN

Comparison of Catchment Areas (ha)

Catchment	Existing	Do Nothing	Method 1	Method 2	Method 3
A	0.94	0.94	0.94	0.94	0.94
AB	31.84	32.61	32.52	33.05	32.33
B	6.99	6.99	6.99	6.99	6.99
C1A	6.77	6.77	6.82	6.82	6.82
C1B	15.77	12.32	12.17	12.23	12.06
G1A	12.45	12.45	12.45	12.45	12.45
G1B	32.91	30.09	28.68	28.74	29.27
G2A	19.40	19.40	19.40	19.40	19.40
G3A	18.71	24.10	25.70	25.07	25.41
G4A	10.64	10.73	10.73	10.73	10.73
G4B	40.21	40.21	40.21	40.21	40.21

Comparison of Catchment Time to Peak (hrs)

Catchment	Existing	Do Nothing	Method 1	Method 2	Method 3
A	0.12	0.12	0.12	0.12	0.12
AB	0.93	0.55	0.52	0.55	0.55
B	n/a	n/a	n/a	n/a	n/a
C1A	0.50	0.50	0.50	0.50	0.50
C1B	0.42	0.55	0.55	0.54	0.55
G1A	1.03	1.03	1.03	1.03	1.03
G1B	0.60	0.40	0.41	0.41	0.40
G2A	0.66	0.66	0.66	0.66	0.66
G3A	2.44	1.12	1.11	1.14	1.17
G4A	1.12	1.12	1.12	1.12	1.12
G4B	1.20	1.20	1.20	1.20	1.20

Chicago 4-Hour Design Storm Results

Existing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0.067	0.102	0.135	0.181	0.221	0.261
B	0.417	0.573	0.676	0.808	0.907	1.006
C	0.145	0.246	0.318	0.430	0.520	0.643
D	0.075	0.132	0.174	0.233	0.281	0.329
E	0.068	0.120	0.159	0.213	0.257	0.301
F	0.054	0.094	0.124	0.164	0.197	0.230
G	0.410	0.696	0.903	1.177	1.389	1.627

Do Nothing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0.069	0.107	0.143	0.193	0.235	0.275
B	0.388	0.540	0.642	0.773	0.871	0.970
C	0.123	0.216	0.285	0.375	0.446	0.518
D	0.075	0.132	0.174	0.233	0.281	0.329
E	0.068	0.120	0.159	0.213	0.257	0.301
F	0.054	0.094	0.124	0.164	0.197	0.230
G	0.437	0.736	0.940	1.216	1.497	1.825

Alternative Method 1						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0.069	0.107	0.143	0.193	0.235	0.276
B	0.388	0.541	0.642	0.773	0.871	0.970
C	0.123	0.216	0.286	0.377	0.448	0.520
D	0.075	0.132	0.174	0.233	0.281	0.329
E	0.068	0.120	0.159	0.213	0.257	0.301
F	0.054	0.094	0.124	0.164	0.197	0.230
G	0.433	0.733	0.937	1.211	1.485	1.810

Alternative Method 2						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0.070	0.108	0.146	0.196	0.239	0.279
B	0.388	0.540	0.642	0.773	0.871	0.970
C	0.124	0.218	0.287	0.379	0.450	0.522
D	0.075	0.132	0.174	0.233	0.281	0.329
E	0.068	0.120	0.159	0.213	0.257	0.301
F	0.054	0.094	0.124	0.164	0.197	0.230
G	0.432	0.731	0.935	1.209	1.474	1.794

Alternative Method 3						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0.069	0.106	0.142	0.191	0.233	0.273
B	0.388	0.540	0.642	0.773	0.871	0.970
C	0.123	0.216	0.285	0.377	0.448	0.520
D	0.075	0.132	0.174	0.233	0.281	0.329
E	0.068	0.120	0.159	0.213	0.257	0.301
F	0.054	0.094	0.124	0.164	0.197	0.230
G	0.433	0.734	0.937	1.211	1.483	1.806

Future Approved Difference from Existing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	3%	5%	6%	7%	6%	5%
B	-7%	-6%	-5%	-4%	-4%	-4%
C	-15%	-12%	-10%	-13%	-14%	-19%
D	0%	0%	0%	0%	0%	0%
E	0%	0%	0%	0%	0%	0%
F	0%	0%	0%	0%	0%	0%
G	7%	6%	4%	3%	8%	12%

Alternative Method 1 Difference from Existing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	3%	5%	6%	7%	6%	6%
B	-7%	-6%	-5%	-4%	-4%	-4%
C	-15%	-12%	-10%	-12%	-14%	-19%
D	0%	0%	0%	0%	0%	0%
E	0%	0%	0%	0%	0%	0%
F	0%	0%	0%	0%	0%	0%
G	6%	5%	4%	3%	7%	11%

Alternative Method 2 Difference from Existing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	4%	6%	8%	8%	8%	7%
B	-7%	-6%	-5%	-4%	-4%	-4%
C	-14%	-11%	-10%	-12%	-13%	-19%
D	0%	0%	0%	0%	0%	0%
E	0%	0%	0%	0%	0%	0%
F	0%	0%	0%	0%	0%	0%
G	5%	5%	4%	3%	6%	10%

Alternative Method 3 Difference from Existing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	3%	4%	5%	6%	5%	5%
B	-7%	-6%	-5%	-4%	-4%	-4%
C	-15%	-12%	-10%	-12%	-14%	-19%
D	0%	0%	0%	0%	0%	0%
E	0%	0%	0%	0%	0%	0%
F	0%	0%	0%	0%	0%	0%
G	6%	5%	4%	3%	7%	11%

Alternative Method 2 Difference from Do Nothing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	1%	1%	2%	2%	2%	1%
B	0%	0%	0%	0%	0%	0%
C	1%	1%	1%	1%	1%	1%
D	0%	0%	0%	0%	0%	0%
E	0%	0%	0%	0%	0%	0%
F	0%	0%	0%	0%	0%	0%
G	-1%	-1%	-1%	-1%	-2%	-2%

Chicago 4-Hour Design Storm Results

Peak Pond Storage in 100-year storm (ha-m)

Pond	Available	Existing	Do Nothing	AM 1	AM 2	AM 3
1	2.773	0.943	0.943	0.943	0.943	0.943
2	5.271	1.625	1.838	1.824	1.808	1.823
3	2.857	0.732	0.750	0.750	0.757	0.746
4	1.099	0.347	0.285	0.282	0.284	0.281

Peak Swale Conveyance during 25-year Storm

Name	Contributing Catchments	Geometry					Peak Swale Conveyance (L/s)				
		Length (m)	Representative Bottom Width (m)	Representative Depth (m)	Representative Side Slope (X:1)	Average Slope (%)	Available	Future Approved	AM 1	AM 2	AM 3
SWAB1A	AB	665	1.8	0.8	4.8	0.8%	9384	1539	1594	1560	1526
SWA1B	Outlet A	105.3	1	0.77	3.9	0.9%	6256	193	193	196	191
SWB1B	Culvert 3(#2) + 3(#3)	121	2	1.15	3.7	1.1%	23461	216	215	218	214
SWB1C	Outlet B	63.2	2.7	1.7	4.7	1.7%	120733	773	773	773	773
SWC1A	C1B	380	3	0.9	3.0	0.1%	3699	577	570	581	565
SWC1B	Pond 4 + C1A	612	4	2.9	2.9	0.5%	191849	483	484	485	483
SWD1A	Outlet D	87	2.5	1	5.3	1.5%	28626	233	233	233	233
SWE1A	Outlet E	141	1	1.7	6.4	0.8%	100850	213	213	213	213
SWG1A	G4B	1280	1.5	0.62	6.9	0.3%	3981	1103	1103	1103	1103
SWG1B	Pond 1	456	1	1.3	3.8	0.4%	17669	463	463	463	463
SWG1C	Pond 1 + G1A	631	1.5	1	3.8	0.7%	11847	813	813	813	813
SWG1D	Pond 2	116	1.5	0.87	5.2	0.2%	6229	409	400	391	400
SWG1E	Outlet G	71	3	0.9	3.6	0.6%	10909	1216	1211	1209	1211
Stream	Outlet G	38	4	1.4	1.2	0.5%	18095	1216	1211	1209	1211
SWG2A	G3A	799	1	0.54	3.0	0.6%	1592	668	691	661	658
SWG2B	G3A+G4A+G1B	751	0.75	0.92	5.6	0.7%	12631	2813	2723	2696	2753
SWG3A	G4A	606	1	0.44	4.5	0.5%	1246	297	297	297	297

Chicago 3-Hour Design Storm Results

Existing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0.061	0.093	0.121	0.167	0.201	0.238
B	0.417	0.573	0.676	0.807	0.906	1.005
C	0.134	0.231	0.299	0.404	0.494	0.601
D	0.068	0.123	0.164	0.221	0.266	0.313
E	0.062	0.112	0.150	0.202	0.245	0.288
F	0.049	0.088	0.116	0.155	0.187	0.219
G	0.385	0.656	0.855	1.120	1.324	1.530

Do Nothing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0.062	0.095	0.128	0.179	0.220	0.263
B	0.388	0.540	0.642	0.772	0.870	0.969
C	0.114	0.202	0.267	0.355	0.423	0.492
D	0.068	0.123	0.164	0.221	0.266	0.313
E	0.062	0.112	0.150	0.202	0.245	0.288
F	0.049	0.088	0.116	0.155	0.187	0.219
G	0.408	0.695	0.892	1.157	1.369	1.648

Alternative Method 1						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0.062	0.096	0.129	0.181	0.222	0.263
B	0.388	0.540	0.642	0.772	0.870	0.969
C	0.115	0.202	0.268	0.356	0.425	0.495
D	0.068	0.123	0.164	0.221	0.266	0.313
E	0.062	0.112	0.150	0.202	0.245	0.288
F	0.049	0.088	0.116	0.155	0.187	0.219
G	0.405	0.692	0.888	1.152	1.363	1.634

Alternative Method 2						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0.062	0.097	0.130	0.182	0.224	0.267
B	0.388	0.540	0.642	0.772	0.870	0.969
C	0.115	0.204	0.270	0.358	0.427	0.497
D	0.068	0.123	0.164	0.221	0.266	0.313
E	0.062	0.112	0.150	0.202	0.245	0.288
F	0.049	0.088	0.116	0.155	0.187	0.219
G	0.403	0.690	0.887	1.151	1.361	1.621

Alternative Method 3						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0.061	0.094	0.126	0.177	0.217	0.261
B	0.388	0.540	0.642	0.772	0.870	0.969
C	0.115	0.202	0.268	0.356	0.425	0.494
D	0.068	0.123	0.164	0.221	0.266	0.313
E	0.062	0.112	0.150	0.202	0.245	0.288
F	0.049	0.088	0.116	0.155	0.187	0.219
G	0.405	0.692	0.889	1.153	1.364	1.629

Future Approved Difference from Existing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	2%	2%	6%	7%	9%	11%
B	-7%	-6%	-5%	-4%	-4%	-4%
C	-15%	-13%	-11%	-12%	-14%	-18%
D	0%	0%	0%	0%	0%	0%
E	0%	0%	0%	0%	0%	0%
F	0%	0%	0%	0%	0%	0%
G	6%	6%	4%	3%	3%	8%

Alternative Method 1 Difference from Existing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	2%	3%	7%	8%	10%	11%
B	-7%	-6%	-5%	-4%	-4%	-4%
C	-14%	-13%	-10%	-12%	-14%	-18%
D	0%	0%	0%	0%	0%	0%
E	0%	0%	0%	0%	0%	0%
F	0%	0%	0%	0%	0%	0%
G	5%	5%	4%	3%	3%	7%

Alternative Method 2 Difference from Existing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	2%	4%	7%	9%	11%	12%
B	-7%	-6%	-5%	-4%	-4%	-4%
C	-14%	-12%	-10%	-11%	-14%	-17%
D	0%	0%	0%	0%	0%	0%
E	0%	0%	0%	0%	0%	0%
F	0%	0%	0%	0%	0%	0%
G	5%	5%	4%	3%	3%	6%

Alternative Method 3 Difference from Existing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0%	1%	4%	6%	8%	10%
B	-7%	-6%	-5%	-4%	-4%	-4%
C	-14%	-13%	-10%	-12%	-14%	-18%
D	0%	0%	0%	0%	0%	0%
E	0%	0%	0%	0%	0%	0%
F	0%	0%	0%	0%	0%	0%
G	5%	5%	4%	3%	3%	6%

Alternative Method 2 Difference from Do Nothing						
Outlet ID	2-year	5-year	10-year	25-year	50-year	100-year
A	0%	2%	2%	2%	2%	2%
B	0%	0%	0%	0%	0%	0%
C	1%	1%	1%	1%	1%	1%
D	0%	0%	0%	0%	0%	0%
E	0%	0%	0%	0%	0%	0%
F	0%	0%	0%	0%	0%	0%
G	-1%	-1%	-1%	-1%	-1%	-2%

Chicago 3-Hour Design Storm Results

Peak Pond Storage in 100-year storm (ha-m)

Pond	Available	Existing	Do Nothing	AM 1	AM 2	AM 3
1	2.773	0.896	0.896	0.896	0.896	0.896
2	5.271	1.491	1.704	1.690	1.673	1.687
3	2.857	0.709	0.731	0.731	0.737	0.727
4	1.099	0.335	0.277	0.274	0.275	0.272

Peak Swale Conveyance during 25-year Storm

Name	Contributing Catchments	Geometry					Peak Swale Conveyance (L/s)				
		Length (m)	Representative Bottom Width (m)	Representative Depth (m)	Representative Side Slope (X:1)	Average Slope (%)	Available	Future Approved	AM 1	AM 2	AM 3
SWAB1A	AB	665	1.8	0.8	4.8	0.8%	9384	1458	1513	1478	1446
SWA1B	Outlet A	105.3	1	0.77	3.9	0.9%	6256	179	181	182	177
SWB1B	Culvert 3(#2) + 3(#3)	121	2	1.15	3.7	1.1%	23461	204	204	207	202
SWB1C	Outlet B	63.2	2.7	1.7	4.7	1.7%	120733	772	772	772	772
SWC1A	C1B	380	3	0.9	3.0	0.1%	3699	547	540	550	535
SWC1B	Pond 4 + C1A	612	4	2.9	2.9	0.5%	191849	457	148	459	456
SWD1A	Outlet D	87	2.5	1	5.3	1.5%	28626	221	221	221	221
SWE1A	Outlet E	141	1	1.7	6.4	0.8%	100850	202	202	202	202
SWG1A	G4B	1280	1.5	0.62	6.9	0.3%	3981	1053	1053	1053	1053
SWG1B	Pond 1	456	1	1.3	3.8	0.4%	17669	392	392	392	392
SWG1C	Pond 1 + G1A	631	1.5	1	3.8	0.7%	11847	726	726	726	726
SWG1D	Pond 2	116	1.5	0.87	5.2	0.2%	6229	325	321	317	321
SWG1E	Outlet G	71	3	0.9	3.6	0.6%	10909	1157	1152	1151	1153
Stream	Outlet G	38	4	1.4	1.2	0.5%	18095	1157	1152	1151	1153
SWG2A	G3A	799	1	0.54	3.0	0.6%	1592	637	659	630	627
SWG2B	G3A+G4A+G1B	751	0.75	0.92	5.6	0.7%	12631	2677	2590	2565	2619
SWG3A	G4A	606	1	0.44	4.5	0.5%	1246	283	283	283	283

Existing Conditions
100-year 4-hour Chicago

V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL
OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\88e08943-81bc-4969-8605-dc58f0779140\s
Summary filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\88e08943-81bc-4969-8605-dc58f0779140\s

DATE: 07-15-2025 TIME: 08:40:16
USER:

COMMENTS:

** SIMULATION : 100-year-4hr-Chicago **

| CHICAGO STORM | IDF curve parameters: A=1032.793
| Ptotal= 70.38 mm | B= 0.000
C= 0.743
used in: INTENSITY = A / (t + B)^C
Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

Table with 8 columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. Rows show rainfall intensity data at various time intervals.

| CALIB |
| NASHYD (0011) | Area (ha)= 12.45 Curve Number (CN)= 82.0

|ID= 1 DT= 5.0 min | Ia (mm)= 3.10 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 1.03

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 0.462

PEAK FLOW (cms)= 0.479 (i)
TIME TO PEAK (hrs)= 2.500
RUNOFF VOLUME (mm)= 36.792
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.523

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0012) | Area (ha)= 32.91 Curve Number (CN)= 84.0
|ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 0.60

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 2.095

PEAK FLOW (cms)= 2.050 (i)
TIME TO PEAK (hrs)= 2.000
RUNOFF VOLUME (mm)= 39.467
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.561

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0031) | Area (ha)= 18.71 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 2.44

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51

```

Unit Hyd Qpeak (cms)= 0.293

PEAK FLOW (cms)= 0.395 (i)
 TIME TO PEAK (hrs)= 4.333
 RUNOFF VOLUME (mm)= 38.267
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.544

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0041) | Area (ha)= 10.64 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51

```

Unit Hyd Qpeak (cms)= 0.363

PEAK FLOW (cms)= 0.400 (i)
 TIME TO PEAK (hrs)= 2.667
 RUNOFF VOLUME (mm)= 38.105
 TOTAL RAINFALL (mm)= 70.382

RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0051) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0012):  32.91  2.050    2.00    39.47
+ ID2= 2 ( 0031):  18.71  0.395    4.33    38.27
=====
ID = 3 ( 0051):  51.62  2.157    2.00    39.03
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0051) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0051):  51.62  2.157    2.00    39.03
+ ID2= 2 ( 0041):  10.64  0.400    2.67    38.10
=====
ID = 1 ( 0051):  62.26  2.460    2.08    38.87
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| RESERVOIR( 0002) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          OUTFLOW      STORAGE      | OUTFLOW      STORAGE
          (cms)      (ha.m.)      | (cms)      (ha.m.)
0.0000      0.0000      | 1.3450      2.1963
0.0302      0.2196      | 2.0056      2.4160
0.1060      0.4393      | 2.9861      2.6356
0.1484      0.6589      | 5.1073      3.0749
0.1976      0.8785      | 6.4750      3.5141
0.2620      1.0982      | 6.9124      3.9534
0.3256      1.3178      | 7.3312      4.3927
0.4719      1.5374      | 7.7329      4.8319
0.6161      1.7571      | 8.1186      5.2712
0.8070      1.9767      | 0.0000      0.0000
```

```

          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0051)  62.260    2.460    2.08    38.87
OUTFLOW: ID= 1 ( 0002)  62.260    0.529    5.25    38.84
```

PEAK FLOW REDUCTION [Qout/Qin] (%) = 21.50
TIME SHIFT OF PEAK FLOW (min) = 190.00
MAXIMUM STORAGE USED (ha.m.) = 1.6245

```
-----
| CALIB |
| NASHYD ( 0021) | Area (ha) = 19.40 Curve Number (CN) = 81.0
| ID= 1 DT= 5.0 min | Ia (mm) = 3.00 # of Linear Res. (N) = 3.00
-----
U.H. Tp (hrs) = 0.66
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083      5.06 | 1.083     26.53 | 2.083     10.53 | 3.08      5.93
```

0.167	5.06		1.167	26.53		2.167	10.53		3.17	5.93
0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57
0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 1.123

PEAK FLOW (cms)= 1.007 (i)
 TIME TO PEAK (hrs)= 2.083
 RUNOFF VOLUME (mm)= 35.760
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.508

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0042) | Area (ha)= 40.21 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.20

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN			
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr			
0.083	5.06		1.083	26.53		2.083	10.53		3.08	5.93
0.167	5.06		1.167	26.53		2.167	10.53		3.17	5.93
0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57
0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 1.280

PEAK FLOW (cms)= 1.490 (i)
 TIME TO PEAK (hrs)= 2.750
 RUNOFF VOLUME (mm)= 39.468
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.561

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0001) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----

```

OUTFLOW	STORAGE	OUTFLOW	STORAGE	
(cms)	(ha.m.)	(cms)	(ha.m.)	
0.0000	0.0000		0.7119	0.9480
0.0123	0.0780		1.9253	1.1420
0.0329	0.1570		2.5634	1.3440
0.0407	0.2380		2.7870	1.5530

0.0476	0.3210		2.9936	1.7700
0.0805	0.4060		3.1872	1.9930
0.1414	0.4920		3.3696	2.2250
0.1808	0.5790		3.6262	2.5860
0.2708	0.6690		3.7476	2.7730
0.4375	0.7600		0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0042)	40.210	1.490	2.75	39.47
OUTFLOW: ID= 1 (0001)	40.210	0.704	4.67	39.43

PEAK FLOW REDUCTION [Qout/Qin](%)= 47.22
 TIME SHIFT OF PEAK FLOW (min)=115.00
 MAXIMUM STORAGE USED (ha.m.)= 0.9427

```

-----
| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0001):  40.21  0.704    4.67   39.43
+ ID2= 2 ( 0011):  12.45  0.479    2.50   36.79
=====
ID = 3 ( 0052):  52.66  0.914    4.25   38.81
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0052) |
| 3 + 2 = 1 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0052):  52.66  0.914    4.25   38.81
+ ID2= 2 ( 0002):  62.26  0.529    5.25   38.84
=====
ID = 1 ( 0052):  114.92  1.398    4.50   38.83
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0052):  114.92  1.398    4.50   38.83
+ ID2= 2 ( 0021):  19.40  1.007    2.08   35.76
=====
ID = 3 ( 0052):  134.32  1.627    4.17   38.38
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| NASHYD ( 0017) | Area (ha)= 31.84 Curve Number (CN)= 85.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.50 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.93
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
      hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083    5.06 | 1.083    26.53 | 2.083    10.53 | 3.08    5.93
0.167    5.06 | 1.167    26.53 | 2.167    10.53 | 3.17    5.93
0.250    5.69 | 1.250   186.64 | 2.250     9.23 | 3.25    5.57
  
```

0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 1.308

PEAK FLOW (cms)= 1.451 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 40.044
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.569

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| RESERVOIR(0020) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	1.7783	1.1263
0.0245	0.1030	1.8455	1.2511
0.0690	0.2080	1.9113	1.3782
0.1181	0.3152	1.9743	1.5076
0.2257	0.4245	2.0363	1.6394
0.3402	0.5360	2.1548	1.9101
0.4374	0.6496	2.2669	2.1903
0.7664	0.7654	2.3755	2.4803
1.3220	0.8835	2.4795	2.7803
1.6822	1.0038	2.5047	2.8569

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0017)	31.840	1.451	2.42	40.04
OUTFLOW: ID= 1 (0020)	31.840	0.671	4.08	40.01

PEAK FLOW REDUCTION [Qout/Qin](%)= 46.23
TIME SHIFT OF PEAK FLOW (min)=100.00
MAXIMUM STORAGE USED (ha.m.)= 0.7319

| DIVERTHYD(0023) |
| IN= 1 # OUT= 5 |

Outflow / Inflow Relationships

Flow 1 + Flow 2 + Flow 3 + Flow 4 + Flow 5 = Total

(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.01	0.00	0.00	0.00	0.02
0.05	0.02	0.00	0.00	0.00	0.07
0.07	0.02	0.02	0.00	0.00	0.12
0.11	0.04	0.08	0.00	0.00	0.23
0.16	0.07	0.11	0.00	0.00	0.34
0.20	0.10	0.14	0.00	0.00	0.44
0.27	0.34	0.16	0.00	0.00	0.77
0.29	0.64	0.39	0.00	0.00	1.32
0.30	0.70	0.68	0.00	0.00	1.68
0.31	0.73	0.73	0.00	0.00	1.78
0.32	0.76	0.76	0.00	0.00	1.85
0.33	0.79	0.79	0.00	0.00	1.91

0.34	0.81	0.81	0.00	0.00	1.97
0.35	0.84	0.84	0.00	0.00	2.04
0.36	0.87	0.87	0.00	0.00	2.10
0.38	0.91	0.91	0.00	0.00	2.21
0.40	0.96	0.96	0.00	0.00	2.32
0.42	1.01	1.01	0.00	0.00	2.43
0.43	1.04	1.04	0.00	0.00	2.50

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD. (ID= 1):	31.84	0.67	4.08	40.01
=====				
ID= 2 (3) :	15.95	0.25	4.08	40.01
ID= 3 (3) :	8.86	0.27	4.08	40.01
ID= 4 (3) :	7.04	0.15	4.08	40.01
ID= 5 (3) :	0.00	0.00	0.00	0.00
ID= 6 (3) :	0.00	0.00	0.00	0.00

```

-----
| ROUTEPIPE( 0028)|      PIPE Number      =    1.00
| IN= 2---> OUT= 1 |      Diameter      (mm)=1650.00
| DT=  5.0 min    |      Length        (m)= 500.00
-----
|                  |      Slope          (m/m)=  0.005
|                  |      Manning n      =    0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	8.86	0.27	4.08	40.01	0.22	1.44
OUTFLOW: ID= 1 (0028)	8.86	0.27	4.17	40.01	0.22	1.43

```

-----
| ROUTEPIPE( 0030)|      PIPE Number      =    1.00
| IN= 2---> OUT= 1 |      Diameter      (mm)=1650.00
| DT=  5.0 min    |      Length        (m)= 500.00
-----
|                  |      Slope          (m/m)=  0.005
|                  |      Manning n      =    0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67

0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	7.04	0.15	4.08	40.01	0.17	1.25
OUTFLOW: ID= 1 (0030)	7.04	0.15	4.17	40.01	0.17	1.25

```

| CALIB |
| STANDHYD ( 0019) | Area (ha)= 6.99
| ID= 1 DT= 5.0 min | Total Imp(%)= 28.00 Dir. Conn.(%)= 28.00

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.96	5.03
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	2.00	1.00
Length (m)=	215.87	712.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Max.Eff.Inten.(mm/hr)=	186.64	25.57
over (min)	5.00	90.00
Storage Coeff. (min)=	2.57 (ii)	86.92 (ii)
Unit Hyd. Tpeak (min)=	5.00	90.00
Unit Hyd. peak (cms)=	0.29	0.01

TOTALS

PEAK FLOW (cms)=	1.00	0.15	1.006 (iii)
TIME TO PEAK (hrs)=	1.33	2.75	1.33
RUNOFF VOLUME (mm)=	68.38	35.29	44.55
TOTAL RAINFALL (mm)=	70.38	70.38	70.38
RUNOFF COEFFICIENT =	0.97	0.50	0.63

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 82.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0029) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0019):    6.99    1.006    1.33    44.55
+ ID2= 2 ( 0028):    8.86    0.265    4.17    40.01
=====
ID = 3 ( 0029):   15.85    1.006    1.33    42.01
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0029) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0029):   15.85    1.006    1.33    42.01
+ ID2= 2 ( 0030):    7.04    0.152    4.17    40.01
=====
ID = 1 ( 0029):   22.88    1.006    1.33    41.40
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ROUTEPIPE( 0032) |
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          PIPE Number      = 1.00
          Diameter (mm)=1650.00
          Length (m)= 500.00
          Slope (m/m)= 0.005
          Manning n      = 0.013
```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	15.95	0.25	4.08	40.01	0.22	1.41
OUTFLOW: ID= 1 (0032)	15.95	0.25	4.08	40.01	0.22	1.41

```

-----
| CALIB |
| NASHYD ( 0018) | Area (ha)= 0.94 Curve Number (CN)= 84.0
|ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51

```

Unit Hyd Qpeak (cms)= 0.299

PEAK FLOW (cms)= 0.178 (i)
 TIME TO PEAK (hrs)= 1.333
 RUNOFF VOLUME (mm)= 37.965
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.539

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0033) |
| 1 + 2 = 3 |
-----
AREA    QPEAK    TPEAK    R.V.
(ha)    (cms)    (hrs)    (mm)
ID1= 1 ( 0018):  0.94  0.178    1.33   37.97
+ ID2= 2 ( 0032): 15.95  0.252    4.08   40.01
=====
ID = 3 ( 0033):  16.89  0.261    4.00   39.90

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| NASHYD ( 0034) | Area (ha)= 6.77 Curve Number (CN)= 83.0
|ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.50

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57

```

0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 0.517

PEAK FLOW (cms)= 0.451 (i)
 TIME TO PEAK (hrs)= 1.833
 RUNOFF VOLUME (mm)= 37.133
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.528

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0035) | Area (ha)= 15.77 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.42

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN			
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr			
0.083	5.06		1.083	26.53		2.083	10.53		3.08	5.93
0.167	5.06		1.167	26.53		2.167	10.53		3.17	5.93
0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57
0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 1.434

PEAK FLOW (cms)= 1.247 (i)
 TIME TO PEAK (hrs)= 1.750
 RUNOFF VOLUME (mm)= 38.475
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.547

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0036) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----

```

OUTFLOW	STORAGE	OUTFLOW	STORAGE	
(cms)	(ha.m.)	(cms)	(ha.m.)	
0.0000	0.0000		0.9922	0.4686
0.0150	0.0403		1.3581	0.5239
0.0508	0.0819		1.4554	0.5809
0.0745	0.1250		1.5104	0.6396
0.1065	0.1696		1.5636	0.6999
0.1567	0.2156		1.6156	0.7620
0.1928	0.2631		1.6657	0.8257

0.2872	0.3021		1.7150	0.8913
0.4020	0.3627		1.7631	0.9586
0.5684	0.4149		1.8561	1.0987

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0035)	15.770	1.247	1.75	38.48
OUTFLOW: ID= 1 (0036)	15.770	0.372	2.83	38.43

PEAK FLOW REDUCTION [Qout/Qin] (%)= 29.84
TIME SHIFT OF PEAK FLOW (min)= 65.00
MAXIMUM STORAGE USED (ha.m.)= 0.3471

| ADD HYD (0037) |
1 + 2 = 3
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 (0034): 6.77 0.451 1.83 37.13
+ ID2= 2 (0036): 15.77 0.372 2.83 38.43
=====

ID = 3 (0037): 22.54 0.643 2.25 38.04

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| NASHYD (0045) | Area (ha)= 2.10 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.14

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 0.573

PEAK FLOW (cms)= 0.329 (i)
TIME TO PEAK (hrs)= 1.417
RUNOFF VOLUME (mm)= 35.572
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.505

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0046) | Area (ha)= 1.31 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.08

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51
```

Unit Hyd Qpeak (cms)= 0.625

PEAK FLOW (cms)= 0.301 (i)
TIME TO PEAK (hrs)= 1.333
RUNOFF VOLUME (mm)= 33.811
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.480

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| NASHYD ( 0047) | Area (ha)= 1.89 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.22
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51
```

Unit Hyd Qpeak (cms)= 0.328

PEAK FLOW (cms)= 0.230 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 37.086
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.527

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

Existing Conditions
100-year 3-hour Chicago

=====
V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTTT TTTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO
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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\05ba6f71-d5d4-44a6-b1bd-4cde131d36ba\s
Summary filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\05ba6f71-d5d4-44a6-b1bd-4cde131d36ba\s

DATE: 07-15-2025 TIME: 08:40:08

USER:

COMMENTS: _____

** SIMULATION : 100-year-3hr-Chicago **

| CHICAGO STORM | IDF curve parameters: A=1032.793
| Ptotal= 65.35 mm | B= 0.000
| | C= 0.743

used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.00 6.55 | 0.83 186.64 | 1.67 10.53 | 2.50 6.36
0.17 7.79 | 1.00 33.08 | 1.83 9.23 | 2.67 5.93
0.33 9.78 | 1.17 20.27 | 2.00 8.25 | 2.83 5.57
0.50 13.66 | 1.33 15.20 | 2.17 7.49 |
0.67 26.53 | 1.50 12.37 | 2.33 6.87 |

| CALIB |
| NASHYD (0011) | Area (ha)= 12.45 Curve Number (CN)= 82.0

|ID= 1 DT= 5.0 min | Ia (mm)= 3.10 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 1.03

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.462

PEAK FLOW (cms)= 0.458 (i)
TIME TO PEAK (hrs)= 2.250
RUNOFF VOLUME (mm)= 32.837
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.502

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0012) | Area (ha)= 32.91 Curve Number (CN)= 84.0
|ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 0.60

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 2.095

PEAK FLOW (cms)= 1.959 (i)
TIME TO PEAK (hrs)= 1.667
RUNOFF VOLUME (mm)= 35.350
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0031) | Area (ha)= 18.71 Curve Number (CN)= 83.0
|ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 2.44

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.293

PEAK FLOW (cms)= 0.370 (i)
TIME TO PEAK (hrs)= 3.833
RUNOFF VOLUME (mm)= 34.227
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.524

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0041) | Area (ha)= 10.64 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.90 # of Linear Res.(N)= 3.00

U.H. Tp(hrs)= 1.12

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.363

PEAK FLOW (cms)= 0.382 (i)
TIME TO PEAK (hrs)= 2.333
RUNOFF VOLUME (mm)= 34.068
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.521

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| ADD HYD (0051) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.

(ha) (cms) (hrs) (mm)
ID1= 1 (0012): 32.91 1.959 1.67 35.35
+ ID2= 2 (0031): 18.71 0.370 3.83 34.23

=====

ID = 3 (0051):	51.62	2.058	1.67	34.94

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0051)				
3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
-----	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (0051):	51.62	2.058	1.67	34.94
+ ID2= 2 (0041):	10.64	0.382	2.33	34.07
=====				
ID = 1 (0051):	62.26	2.350	1.75	34.79

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

RESERVOIR(0002)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW	STORAGE		OUTFLOW STORAGE
-----	(cms)	(ha.m.)		(cms) (ha.m.)
	0.0000	0.0000		1.3450 2.1963
	0.0302	0.2196		2.0056 2.4160
	0.1060	0.4393		2.9861 2.6356
	0.1484	0.6589		5.1073 3.0749
	0.1976	0.8785		6.4750 3.5141
	0.2620	1.0982		6.9124 3.9534
	0.3256	1.3178		7.3312 4.3927
	0.4719	1.5374		7.7329 4.8319
	0.6161	1.7571		8.1186 5.2712
	0.8070	1.9767		0.0000 0.0000
	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0051)	62.260	2.350	1.75	34.79
OUTFLOW: ID= 1 (0002)	62.260	0.441	4.83	34.76
	PEAK FLOW REDUCTION [Qout/Qin] (%)=	18.76		
	TIME SHIFT OF PEAK FLOW	(min)=185.00		
	MAXIMUM STORAGE USED	(ha.m.)= 1.4909		

CALIB			
NASHYD (0021)	Area (ha)=	19.40	Curve Number (CN)= 81.0
ID= 1 DT= 5.0 min	Ia (mm)=	3.00	# of Linear Res. (N)= 3.00
-----	U.H. Tp(hrs)=	0.66	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 1.123

PEAK FLOW (cms)= 0.960 (i)

TIME TO PEAK (hrs)= 1.750
RUNOFF VOLUME (mm)= 31.882
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.488

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0042) | Area (ha)= 40.21 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res. (N)= 3.00

U.H. Tp(hrs)= 1.20

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57

Unit Hyd Qpeak (cms)= 1.280

PEAK FLOW (cms)= 1.428 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 35.350
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| RESERVOIR(0001) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
DT= 5.0 min
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.7119 0.9480
0.0123 0.0780 | 1.9253 1.1420
0.0329 0.1570 | 2.5634 1.3440
0.0407 0.2380 | 2.7870 1.5530
0.0476 0.3210 | 2.9936 1.7700
0.0805 0.4060 | 3.1872 1.9930
0.1414 0.4920 | 3.3696 2.2250
0.1808 0.5790 | 3.6262 2.5860
0.2708 0.6690 | 3.7476 2.7730
0.4375 0.7600 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0042) 40.210 1.428 2.42 35.35
OUTFLOW: ID= 1 (0001) 40.210 0.635 4.25 35.31

PEAK FLOW REDUCTION [Qout/Qin] (%)= 44.51
TIME SHIFT OF PEAK FLOW (min)=110.00
MAXIMUM STORAGE USED (ha.m.)= 0.8958

```

-----
| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
      ID1= 1 ( 0001):  40.21  0.635  4.25  35.31
+ ID2= 2 ( 0011):  12.45  0.458  2.25  32.84
=====
      ID = 3 ( 0052):  52.66  0.830  3.67  34.73

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0052) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
      ID1= 3 ( 0052):  52.66  0.830  3.67  34.73
+ ID2= 2 ( 0002):  62.26  0.441  4.83  34.76
=====
      ID = 1 ( 0052): 114.92  1.229  3.92  34.75

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
      ID1= 1 ( 0052): 114.92  1.229  3.92  34.75
+ ID2= 2 ( 0021):  19.40  0.960  1.75  31.88
=====
      ID = 3 ( 0052): 134.32  1.530  1.92  34.33

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| NASHYD ( 0017) | Area (ha)= 31.84 Curve Number (CN)= 85.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.50 # of Linear Res.(N)= 3.00
-----
          U.H. Tp(hrs)= 0.93

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

-----
          TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
          hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083      6.55 | 0.833      26.53 | 1.583      12.37 | 2.33      7.49
0.167      6.55 | 0.917     186.64 | 1.667      12.37 | 2.42      6.87
0.250      7.79 | 1.000     186.64 | 1.750      10.53 | 2.50      6.87
0.333      7.79 | 1.083      33.08 | 1.833      10.53 | 2.58      6.36
0.417      9.78 | 1.167      33.08 | 1.917       9.23 | 2.67      6.36
0.500      9.78 | 1.250     20.27 | 2.000       9.23 | 2.75      5.93
0.583     13.66 | 1.333     20.27 | 2.083       8.25 | 2.83      5.93
0.667     13.66 | 1.417     15.20 | 2.167       8.25 | 2.92      5.57
0.750     26.53 | 1.500     15.20 | 2.250       7.49 | 3.00      5.57

```

Unit Hyd Qpeak (cms)= 1.308

PEAK FLOW (cms)= 1.387 (i)

TIME TO PEAK (hrs)= 2.083

RUNOFF VOLUME (mm)= 35.861

TOTAL RAINFALL (mm)= 65.350

RUNOFF COEFFICIENT = 0.549

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| RESERVOIR(0020) |
| IN= 2---> OUT= 1 |
DT= 5.0 min

OVERFLOW IS OFF

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	1.7783	1.1263
0.0245	0.1030	1.8455	1.2511
0.0690	0.2080	1.9113	1.3782
0.1181	0.3152	1.9743	1.5076
0.2257	0.4245	2.0363	1.6394
0.3402	0.5360	2.1548	1.9101
0.4374	0.6496	2.2669	2.1903
0.7664	0.7654	2.3755	2.4803
1.3220	0.8835	2.4795	2.7803
1.6822	1.0038	2.5047	2.8569

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0017)	31.840	1.387	2.08	35.86
OUTFLOW: ID= 1 (0020)	31.840	0.606	3.67	35.83

PEAK FLOW REDUCTION [Qout/Qin] (%)= 43.72
TIME SHIFT OF PEAK FLOW (min)= 95.00
MAXIMUM STORAGE USED (ha.m.)= 0.7092

| DIVERTHYD(0023) |
IN= 1 # OUT= 5

Outflow / Inflow Relationships

Flow 1 + Flow 2 + Flow 3 + Flow 4 + Flow 5 = Total

(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.01	0.00	0.00	0.00	0.02
0.05	0.02	0.00	0.00	0.00	0.07
0.07	0.02	0.02	0.00	0.00	0.12
0.11	0.04	0.08	0.00	0.00	0.23
0.16	0.07	0.11	0.00	0.00	0.34
0.20	0.10	0.14	0.00	0.00	0.44
0.27	0.34	0.16	0.00	0.00	0.77
0.29	0.64	0.39	0.00	0.00	1.32
0.30	0.70	0.68	0.00	0.00	1.68
0.31	0.73	0.73	0.00	0.00	1.78
0.32	0.76	0.76	0.00	0.00	1.85
0.33	0.79	0.79	0.00	0.00	1.91
0.34	0.81	0.81	0.00	0.00	1.97
0.35	0.84	0.84	0.00	0.00	2.04
0.36	0.87	0.87	0.00	0.00	2.10
0.38	0.91	0.91	0.00	0.00	2.21
0.40	0.96	0.96	0.00	0.00	2.32
0.42	1.01	1.01	0.00	0.00	2.43
0.43	1.04	1.04	0.00	0.00	2.50

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD. (ID= 1):	31.84	0.61	3.67	35.83

=====

ID= 2 (3) :	16.48	0.24	3.67	35.83
ID= 3 (3) :	8.28	0.22	3.67	35.83
ID= 4 (3) :	7.08	0.15	3.67	35.83
ID= 5 (3) :	0.00	0.00	0.00	0.00
ID= 6 (3) :	0.00	0.00	0.00	0.00

=====

| ROUTEPIPE(0028) |
| IN= 2---> OUT= 1 |

PIPE Number = 1.00
Diameter (mm)=1650.00

```

| DT= 5.0 min      |      Length      (m)= 500.00
-----            |      Slope      (m/m)= 0.005
                   |      Manning n   = 0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	8.28	0.22	3.67	35.83	0.20	1.36
OUTFLOW: ID= 1 (0028)	8.28	0.22	3.75	35.83	0.20	1.35

```

-----
| ROUTEPIPE( 0030)|      PIPE Number   = 1.00
| IN= 2---> OUT= 1 |      Diameter      (mm)=1650.00
| DT= 5.0 min      |      Length      (m)= 500.00
-----            |      Slope      (m/m)= 0.005
                   |      Manning n   = 0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	7.08	0.15	3.67	35.83	0.17	1.24

OUTFLOW: ID= 1 (0030) 7.08 0.15 3.67 35.83 0.17 1.23

```
-----
| CALIB |
| STANDHYD ( 0019) | Area (ha)= 6.99
| ID= 1 DT= 5.0 min | Total Imp(%)= 28.00 Dir. Conn.(%)= 28.00
-----
```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.96	5.03
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	2.00	1.00
Length (m)=	215.87	712.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57
```

Max.Eff.Inten.(mm/hr)=	186.64	24.61
over (min)	5.00	90.00
Storage Coeff. (min)=	2.57 (ii)	88.22 (ii)
Unit Hyd. Tpeak (min)=	5.00	90.00
Unit Hyd. peak (cms)=	0.29	0.01

TOTALS

PEAK FLOW (cms)=	1.00	0.14	1.004 (iii)
TIME TO PEAK (hrs)=	1.00	2.50	1.00
RUNOFF VOLUME (mm)=	63.35	31.37	40.32
TOTAL RAINFALL (mm)=	65.35	65.35	65.35
RUNOFF COEFFICIENT =	0.97	0.48	0.62

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 82.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0029) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
| | (ha) (cms) (hrs) (mm)
-----
ID1= 1 ( 0019): 6.99 1.004 1.00 40.32
+ ID2= 2 ( 0028): 8.28 0.218 3.75 35.83
=====
ID = 3 ( 0029): 15.27 1.005 1.00 37.88
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
| ADD HYD ( 0029) |
| 3 + 2 = 1 |
-----
ID1= 3 ( 0029): 15.27 1.005 1.00 37.88
+ ID2= 2 ( 0030): 7.08 0.148 3.67 35.83
=====
ID = 1 ( 0029): 22.35 1.005 1.00 37.23
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
| ROUTEPIPE( 0032) |
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
PIPE Number = 1.00
Diameter (mm)=1650.00
Length (m)= 500.00
Slope (m/m)= 0.005
Manning n = 0.013
```

<----- TRAVEL TIME TABLE ----->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	16.48	0.24	3.67	35.83	0.21	1.39
OUTFLOW: ID= 1 (0032)	16.48	0.24	3.75	35.83	0.21	1.38

```
| CALIB |
| NASHYD ( 0018) |
| ID= 1 DT= 5.0 min |
-----
Area (ha)= 0.94 Curve Number (CN)= 84.0
Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.12
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57

0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57

Unit Hyd Qpeak (cms)= 0.299

PEAK FLOW (cms)= 0.169 (i)
TIME TO PEAK (hrs)= 1.000
RUNOFF VOLUME (mm)= 33.922
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.519

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0033) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0018):    0.94    0.169      1.00    33.92
+ ID2= 2 ( 0032):   16.48    0.238      3.75    35.83
=====
ID = 3 ( 0033):   17.42    0.238      3.75    35.72
-----
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| CALIB |
| NASHYD ( 0034) | Area (ha)= 6.77 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.50
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57
```

Unit Hyd Qpeak (cms)= 0.517

PEAK FLOW (cms)= 0.428 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 33.117
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.507

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| NASHYD ( 0035) | Area (ha)= 15.77 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.42
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 1.434

PEAK FLOW (cms)= 1.186 (i)
 TIME TO PEAK (hrs)= 1.417
 RUNOFF VOLUME (mm)= 34.377
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.526

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | RESERVOIR(0036) | OVERFLOW IS OFF
 | IN= 2---> OUT= 1 |
 | DT= 5.0 min |

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.9922	0.4686
0.0150	0.0403	1.3581	0.5239
0.0508	0.0819	1.4554	0.5809
0.0745	0.1250	1.5104	0.6396
0.1065	0.1696	1.5636	0.6999
0.1567	0.2156	1.6156	0.7620
0.1928	0.2631	1.6657	0.8257
0.2872	0.3021	1.7150	0.8913
0.4020	0.3627	1.7631	0.9586
0.5684	0.4149	1.8561	1.0987

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0035)	15.770	1.186	1.42	34.38
OUTFLOW: ID= 1 (0036)	15.770	0.350	2.58	34.33

PEAK FLOW REDUCTION [Qout/Qin] (%)= 29.51
 TIME SHIFT OF PEAK FLOW (min)= 70.00
 MAXIMUM STORAGE USED (ha.m.)= 0.3353

 | ADD HYD (0037) |
 | 1 + 2 = 3 |

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0034):	6.77	0.428	1.50	33.12
+ ID2= 2 (0036):	15.77	0.350	2.58	34.33
=====				
ID = 3 (0037):	22.54	0.601	2.00	33.97

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 | CALIB |
 | NASHYD (0045) | Area (ha)= 2.10 Curve Number (CN)= 82.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res.(N)= 3.00
 ----- U.H. Tp(hrs)= 0.14

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.573

PEAK FLOW (cms)= 0.313 (i)
 TIME TO PEAK (hrs)= 1.083
 RUNOFF VOLUME (mm)= 31.669
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.485

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | NASHYD (0046) | Area (ha)= 1.31 Curve Number (CN)= 82.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res.(N)= 3.00

 U.H. Tp(hrs)= 0.08

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.625

PEAK FLOW (cms)= 0.288 (i)
 TIME TO PEAK (hrs)= 1.000
 RUNOFF VOLUME (mm)= 30.101
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.461

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | NASHYD (0047) | Area (ha)= 1.89 Curve Number (CN)= 83.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00

 U.H. Tp(hrs)= 0.22

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.328

PEAK FLOW (cms)= 0.219 (i)

TIME TO PEAK (hrs)= 1.167

RUNOFF VOLUME (mm)= 33.075

TOTAL RAINFALL (mm)= 65.350

RUNOFF COEFFICIENT = 0.506

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

Future Baseline
100-year 4-hour Chicago

V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\92315c14-cd8e-48e1-929f-854439ae614b\s
Summary filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\92315c14-cd8e-48e1-929f-854439ae614b\s

DATE: 07-15-2025 TIME: 09:46:44

USER:

COMMENTS:

** SIMULATION : 100-year-4hr-Chicago **

| CHICAGO STORM | IDF curve parameters: A=1032.793
| Ptotal= 70.38 mm | B= 0.000
C= 0.743

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

Table with 8 columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. It displays rainfall intensity data at various time intervals.

| CALIB |
| NASHYD (0011) | Area (ha)= 12.45 Curve Number (CN)= 82.0

|ID= 1 DT= 5.0 min | Ia (mm)= 3.10 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 1.03

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 0.462

PEAK FLOW (cms)= 0.479 (i)
TIME TO PEAK (hrs)= 2.500
RUNOFF VOLUME (mm)= 36.792
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.523

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0012) | Area (ha)= 30.09 Curve Number (CN)= 84.0
|ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 0.40

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 2.873

PEAK FLOW (cms)= 2.534 (i)
TIME TO PEAK (hrs)= 1.667
RUNOFF VOLUME (mm)= 39.464
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.561

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0031) | Area (ha)= 24.10 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.80 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51

```

Unit Hyd Qpeak (cms)= 0.822

PEAK FLOW (cms)= 0.907 (i)
 TIME TO PEAK (hrs)= 2.667
 RUNOFF VOLUME (mm)= 38.186
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.543

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0041) | Area (ha)= 10.73 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51

```

Unit Hyd Qpeak (cms)= 0.366

PEAK FLOW (cms)= 0.403 (i)
 TIME TO PEAK (hrs)= 2.667
 RUNOFF VOLUME (mm)= 38.105
 TOTAL RAINFALL (mm)= 70.382

RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0051) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0012):  30.09  2.534    1.67    39.46
+ ID2= 2 ( 0031):  24.10  0.907    2.67    38.19
=====
ID = 3 ( 0051):  54.19  2.983    1.75    38.90
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0051) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0051):  54.19  2.983    1.75    38.90
+ ID2= 2 ( 0041):  10.73  0.403    2.67    38.10
=====
ID = 1 ( 0051):  64.92  3.195    1.83    38.76
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| RESERVOIR( 0002) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          OUTFLOW      STORAGE      | OUTFLOW      STORAGE
          (cms)      (ha.m.)      | (cms)      (ha.m.)
0.0000      0.0000      | 1.3450      2.1963
0.0302      0.2196      | 2.0056      2.4160
0.1060      0.4393      | 2.9861      2.6356
0.1484      0.6589      | 5.1073      3.0749
0.1976      0.8785      | 6.4750      3.5141
0.2620      1.0982      | 6.9124      3.9534
0.3256      1.3178      | 7.3312      4.3927
0.4719      1.5374      | 7.7329      4.8319
0.6161      1.7571      | 8.1186      5.2712
0.8070      1.9767      | 0.0000      0.0000
```

```

          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0051)  64.920      3.195      1.83      38.76
OUTFLOW: ID= 1 ( 0002)  64.920      0.686      4.67      38.74
```

PEAK FLOW REDUCTION [Qout/Qin] (%) = 21.49
TIME SHIFT OF PEAK FLOW (min) = 170.00
MAXIMUM STORAGE USED (ha.m.) = 1.8382

```
-----
| CALIB |
| NASHYD ( 0021) | Area (ha) = 19.40 Curve Number (CN) = 81.0
| ID= 1 DT= 5.0 min | Ia (mm) = 3.00 # of Linear Res. (N) = 3.00
-----
U.H. Tp(hrs) = 0.66
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083      5.06 | 1.083     26.53 | 2.083     10.53 | 3.08      5.93
```

0.167	5.06		1.167	26.53		2.167	10.53		3.17	5.93
0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57
0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 1.123

PEAK FLOW (cms)= 1.007 (i)
 TIME TO PEAK (hrs)= 2.083
 RUNOFF VOLUME (mm)= 35.760
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.508

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0042) | Area (ha)= 40.21 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.20

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN			
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr			
0.083	5.06		1.083	26.53		2.083	10.53		3.08	5.93
0.167	5.06		1.167	26.53		2.167	10.53		3.17	5.93
0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57
0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 1.280

PEAK FLOW (cms)= 1.490 (i)
 TIME TO PEAK (hrs)= 2.750
 RUNOFF VOLUME (mm)= 39.468
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.561

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0001) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----

```

OUTFLOW	STORAGE	OUTFLOW	STORAGE	
(cms)	(ha.m.)	(cms)	(ha.m.)	
0.0000	0.0000		0.7119	0.9480
0.0123	0.0780		1.9253	1.1420
0.0329	0.1570		2.5634	1.3440
0.0407	0.2380		2.7870	1.5530

0.0476	0.3210		2.9936	1.7700
0.0805	0.4060		3.1872	1.9930
0.1414	0.4920		3.3696	2.2250
0.1808	0.5790		3.6262	2.5860
0.2708	0.6690		3.7476	2.7730
0.4375	0.7600		0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0042)	40.210	1.490	2.75	39.47
OUTFLOW: ID= 1 (0001)	40.210	0.704	4.67	39.43

PEAK FLOW REDUCTION [Qout/Qin](%)= 47.22
 TIME SHIFT OF PEAK FLOW (min)=115.00
 MAXIMUM STORAGE USED (ha.m.)= 0.9427

```

-----
| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0001):  40.21  0.704    4.67   39.43
+ ID2= 2 ( 0011):  12.45  0.479    2.50   36.79
=====
ID = 3 ( 0052):  52.66  0.914    4.25   38.81
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0052) |
| 3 + 2 = 1 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0052):  52.66  0.914    4.25   38.81
+ ID2= 2 ( 0002):  64.92  0.686    4.67   38.74
=====
ID = 1 ( 0052):  117.58  1.587    4.42   38.77
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0052):  117.58  1.587    4.42   38.77
+ ID2= 2 ( 0021):  19.40  1.007    2.08   35.76
=====
ID = 3 ( 0052):  136.98  1.825    4.17   38.34
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| NASHYD ( 0017) | Area (ha)= 32.61 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.55
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
      hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083    5.06 | 1.083    26.53 | 2.083    10.53 | 3.08    5.93
0.167    5.06 | 1.167    26.53 | 2.167    10.53 | 3.17    5.93
0.250    5.69 | 1.250   186.64 | 2.250     9.23 | 3.25    5.57
  
```

0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 2.265

PEAK FLOW (cms)= 2.118 (i)
TIME TO PEAK (hrs)= 1.917
RUNOFF VOLUME (mm)= 38.642
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.549

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0020) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min      |
-----
| OUTFLOW          | STORAGE          | OUTFLOW          | STORAGE          |
| (cms)            | (ha.m.)          | (cms)            | (ha.m.)          |
| 0.0000           | 0.0000           | 1.7783           | 1.1263           |
| 0.0245           | 0.1030           | 1.8455           | 1.2511           |
| 0.0690           | 0.2080           | 1.9113           | 1.3782           |
| 0.1181           | 0.3152           | 1.9743           | 1.5076           |
| 0.2257           | 0.4245           | 2.0363           | 1.6394           |
| 0.3402           | 0.5360           | 2.1548           | 1.9101           |
| 0.4374           | 0.6496           | 2.2669           | 2.1903           |
| 0.7664           | 0.7654           | 2.3755           | 2.4803           |
| 1.3220           | 0.8835           | 2.4795           | 2.7803           |
| 1.6822           | 1.0038           | 2.5047           | 2.8569           |
|
| AREA             | QPEAK            | TPEAK            | R.V.             |
| (ha)             | (cms)            | (hrs)            | (mm)             |
INFLOW : ID= 2 ( 0017) 32.610 2.118 1.92 38.64
OUTFLOW: ID= 1 ( 0020) 32.610 0.722 3.25 38.61

```

PEAK FLOW REDUCTION [Qout/Qin](%)= 34.10
TIME SHIFT OF PEAK FLOW (min)= 80.00
MAXIMUM STORAGE USED (ha.m.)= 0.7502

```

-----
| DIVERTHYD( 0023) |
| IN= 1 # OUT= 5   |
-----

```

Outflow / Inflow Relationships

Flow 1 + Flow 2 + Flow 3 + Flow 4 + Flow 5 = Total					
(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.01	0.00	0.00	0.00	0.02
0.05	0.02	0.00	0.00	0.00	0.07
0.07	0.02	0.02	0.00	0.00	0.12
0.11	0.04	0.08	0.00	0.00	0.23
0.16	0.07	0.11	0.00	0.00	0.34
0.20	0.10	0.14	0.00	0.00	0.44
0.27	0.34	0.16	0.00	0.00	0.77
0.29	0.64	0.39	0.00	0.00	1.32
0.30	0.70	0.68	0.00	0.00	1.68
0.31	0.73	0.73	0.00	0.00	1.78
0.32	0.76	0.76	0.00	0.00	1.85
0.33	0.79	0.79	0.00	0.00	1.91

0.34	0.81	0.81	0.00	0.00	1.97
0.35	0.84	0.84	0.00	0.00	2.04
0.36	0.87	0.87	0.00	0.00	2.10
0.38	0.91	0.91	0.00	0.00	2.21
0.40	0.96	0.96	0.00	0.00	2.32
0.42	1.01	1.01	0.00	0.00	2.43
0.43	1.04	1.04	0.00	0.00	2.50

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD. (ID= 1):	32.61	0.72	3.25	38.61
=====				
ID= 2 (3) :	16.11	0.26	3.25	38.61
ID= 3 (3) :	9.50	0.30	3.25	38.61
ID= 4 (3) :	7.00	0.16	3.25	38.61
ID= 5 (3) :	0.00	0.00	0.00	0.00
ID= 6 (3) :	0.00	0.00	0.00	0.00

```

-----
| ROUTEPIPE( 0028)|      PIPE Number      =    1.00
| IN= 2---> OUT= 1 |      Diameter      (mm)=1650.00
| DT=  5.0 min    |      Length        (m)= 500.00
-----
|                  |      Slope          (m/m)=  0.005
|                  |      Manning n      =    0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	9.50	0.30	3.25	38.61	0.24	1.51
OUTFLOW: ID= 1 (0028)	9.50	0.30	3.25	38.61	0.24	1.51

```

-----
| ROUTEPIPE( 0030)|      PIPE Number      =    1.00
| IN= 2---> OUT= 1 |      Diameter      (mm)=1650.00
| DT=  5.0 min    |      Length        (m)= 500.00
-----
|                  |      Slope          (m/m)=  0.005
|                  |      Manning n      =    0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67

0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	7.00	0.16	3.25	38.61	0.18	1.26
OUTFLOW: ID= 1 (0030)	7.00	0.16	3.33	38.61	0.18	1.26

```

| CALIB |
| STANDHYD ( 0019) | Area (ha)= 6.99
| ID= 1 DT= 5.0 min | Total Imp(%)= 28.00 Dir. Conn.(%)= 28.00

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.96	5.03
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	0.64	1.23
Length	(m)=	215.87	712.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Max.Eff.Inten.(mm/hr)=	186.64	25.57
over (min)	5.00	85.00
Storage Coeff. (min)=	3.61 (ii)	82.89 (ii)
Unit Hyd. Tpeak (min)=	5.00	85.00
Unit Hyd. peak (cms)=	0.25	0.01

TOTALS

PEAK FLOW (cms)=	0.96	0.16	0.969 (iii)
TIME TO PEAK (hrs)=	1.33	2.67	1.33
RUNOFF VOLUME (mm)=	68.38	35.29	44.55
TOTAL RAINFALL (mm)=	70.38	70.38	70.38
RUNOFF COEFFICIENT =	0.97	0.50	0.63

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 82.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0029) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0019):    6.99    0.969    1.33    44.55
+ ID2= 2 ( 0028):    9.50    0.303    3.25    38.61
=====
ID = 3 ( 0029):   16.49    0.970    1.33    41.13
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0029) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0029):   16.49    0.970    1.33    41.13
+ ID2= 2 ( 0030):    7.00    0.155    3.33    38.61
=====
ID = 1 ( 0029):   23.49    0.970    1.33    40.38
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ROUTEPIPE( 0032) |
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          PIPE Number      = 1.00
          Diameter (mm)=1650.00
          Length (m)= 500.00
          Slope (m/m)= 0.005
          Manning n      = 0.013
```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	16.11	0.26	3.25	38.61	0.22	1.43
OUTFLOW: ID= 1 (0032)	16.11	0.26	3.33	38.61	0.22	1.43

```

-----
| CALIB |
| NASHYD ( 0018) | Area (ha)= 0.94 Curve Number (CN)= 84.0
|ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51

```

Unit Hyd Qpeak (cms)= 0.299

PEAK FLOW (cms)= 0.178 (i)
 TIME TO PEAK (hrs)= 1.333
 RUNOFF VOLUME (mm)= 37.965
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.539

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0033) |
| 1 + 2 = 3 |
-----
AREA    QPEAK    TPEAK    R.V.
(ha)    (cms)    (hrs)    (mm)
ID1= 1 ( 0018):  0.94  0.178  1.33  37.97
+ ID2= 2 ( 0032): 16.11  0.263  3.33  38.61
=====
ID = 3 ( 0033):  17.05  0.275  3.25  38.57

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| NASHYD ( 0034) | Area (ha)= 6.77 Curve Number (CN)= 83.0
|ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.50

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57

```

0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 0.517

PEAK FLOW (cms)= 0.451 (i)
 TIME TO PEAK (hrs)= 1.833
 RUNOFF VOLUME (mm)= 37.133
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.528

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB          |
| NASHYD ( 0035)| Area (ha)= 12.32 Curve Number (CN)= 84.0
|ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.55
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083  5.06 | 1.083  26.53 | 2.083  10.53 | 3.08   5.93
0.167  5.06 | 1.167  26.53 | 2.167  10.53 | 3.17   5.93
0.250  5.69 | 1.250 186.64 | 2.250   9.23 | 3.25   5.57
0.333  5.69 | 1.333 186.64 | 2.333   9.23 | 3.33   5.57
0.417  6.55 | 1.417  33.08 | 2.417   8.25 | 3.42   5.25
0.500  6.55 | 1.500  33.08 | 2.500   8.25 | 3.50   5.25
0.583  7.79 | 1.583  20.27 | 2.583   7.49 | 3.58   4.97
0.667  7.79 | 1.667  20.27 | 2.667   7.49 | 3.67   4.97
0.750  9.78 | 1.750  15.20 | 2.750   6.87 | 3.75   4.72
0.833  9.78 | 1.833  15.20 | 2.833   6.87 | 3.83   4.72
0.917 13.66 | 1.917  12.37 | 2.917   6.36 | 3.92   4.51
1.000 13.66 | 2.000  12.37 | 3.000   6.36 | 4.00   4.51
  
```

Unit Hyd Qpeak (cms)= 0.856

PEAK FLOW (cms)= 0.796 (i)
 TIME TO PEAK (hrs)= 1.917
 RUNOFF VOLUME (mm)= 38.478
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.547

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0036)| OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min    |
-----
OUTFLOW  STORAGE | OUTFLOW  STORAGE
(cms)    (ha.m.) | (cms)    (ha.m.)
0.0000   0.0000  | 0.9922   0.4686
0.0150   0.0403  | 1.3581   0.5239
0.0508   0.0819  | 1.4554   0.5809
0.0745   0.1250  | 1.5104   0.6396
0.1065   0.1696  | 1.5636   0.6999
0.1567   0.2156  | 1.6156   0.7620
0.1928   0.2631  | 1.6657   0.8257
  
```

0.2872	0.3021		1.7150	0.8913
0.4020	0.3627		1.7631	0.9586
0.5684	0.4149		1.8561	1.0987

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0035)	12.320	0.796	1.92	38.48
OUTFLOW: ID= 1 (0036)	12.320	0.245	3.33	38.42

PEAK FLOW REDUCTION [Qout/Qin] (%)= 30.81
TIME SHIFT OF PEAK FLOW (min)= 85.00
MAXIMUM STORAGE USED (ha.m.)= 0.2849

| ADD HYD (0037) |
1 + 2 = 3
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 (0034): 6.77 0.451 1.83 37.13
+ ID2= 2 (0036): 12.32 0.245 3.33 38.42
=====

ID = 3 (0037): 19.09 0.518 1.92 37.97

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| NASHYD (0045) | Area (ha)= 2.10 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.14

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 0.573

PEAK FLOW (cms)= 0.329 (i)
TIME TO PEAK (hrs)= 1.417
RUNOFF VOLUME (mm)= 35.572
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.505

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0046) | Area (ha)= 1.31 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.08

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51
```

Unit Hyd Qpeak (cms)= 0.625

PEAK FLOW (cms)= 0.301 (i)
TIME TO PEAK (hrs)= 1.333
RUNOFF VOLUME (mm)= 33.811
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.480

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| NASHYD ( 0047) | Area (ha)= 1.89 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.22
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51
```

Unit Hyd Qpeak (cms)= 0.328

PEAK FLOW (cms)= 0.230 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 37.086
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.527

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

Future Baseline
100-year 3-hour Chicago

V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\2c46dc20-1882-447b-8ab8-0ad9cb7b36f7\s
Summary filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\2c46dc20-1882-447b-8ab8-0ad9cb7b36f7\s

DATE: 07-15-2025 TIME: 09:46:38
USER:

COMMENTS:

** SIMULATION : 100-year-3hr-Chicago **

| CHICAGO STORM | IDF curve parameters: A=1032.793
| Ptotal= 65.35 mm | B= 0.000
C= 0.743
used in: INTENSITY = A / (t + B)^C
Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

Table with 8 columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. Rows show rainfall intensity data at various time intervals.

| CALIB |
| NASHYD (0011) | Area (ha)= 12.45 Curve Number (CN)= 82.0
|ID= 1 DT= 5.0 min | Ia (mm)= 3.10 # of Linear Res.(N)= 3.00

----- U.H. Tp(hrs)= 1.03

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.462

PEAK FLOW (cms)= 0.458 (i)
TIME TO PEAK (hrs)= 2.250
RUNOFF VOLUME (mm)= 32.837
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.502

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0012) | Area (ha)= 30.09 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 0.40

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 2.873

PEAK FLOW (cms)= 2.417 (i)
TIME TO PEAK (hrs)= 1.417
RUNOFF VOLUME (mm)= 35.346
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0031) | Area (ha)= 24.10 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.80 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 1.12

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

      ---- TRANSFORMED HYETOGRAPH ----
      TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
      hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083   6.55 | 0.833 26.53 | 1.583 12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667 12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750 10.53 | 2.50   6.87
0.333   7.79 | 1.083 33.08 | 1.833 10.53 | 2.58   6.36
0.417   9.78 | 1.167 33.08 | 1.917  9.23 | 2.67   6.36
0.500   9.78 | 1.250 20.27 | 2.000  9.23 | 2.75   5.93
0.583  13.66 | 1.333 20.27 | 2.083  8.25 | 2.83   5.93
0.667  13.66 | 1.417 15.20 | 2.167  8.25 | 2.92   5.57
0.750  26.53 | 1.500 15.20 | 2.250  7.49 | 3.00   5.57

```

Unit Hyd Qpeak (cms)= 0.822

PEAK FLOW (cms)= 0.868 (i)
TIME TO PEAK (hrs)= 2.333
RUNOFF VOLUME (mm)= 34.148
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.523

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0041) | Area (ha)= 10.73 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

      ---- TRANSFORMED HYETOGRAPH ----
      TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
      hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083   6.55 | 0.833 26.53 | 1.583 12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667 12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750 10.53 | 2.50   6.87
0.333   7.79 | 1.083 33.08 | 1.833 10.53 | 2.58   6.36
0.417   9.78 | 1.167 33.08 | 1.917  9.23 | 2.67   6.36
0.500   9.78 | 1.250 20.27 | 2.000  9.23 | 2.75   5.93
0.583  13.66 | 1.333 20.27 | 2.083  8.25 | 2.83   5.93
0.667  13.66 | 1.417 15.20 | 2.167  8.25 | 2.92   5.57
0.750  26.53 | 1.500 15.20 | 2.250  7.49 | 3.00   5.57

```

Unit Hyd Qpeak (cms)= 0.366

PEAK FLOW (cms)= 0.386 (i)
TIME TO PEAK (hrs)= 2.333
RUNOFF VOLUME (mm)= 34.068
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.521

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0051) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
| | (ha) (cms) (hrs) (mm)
-----
ID1= 1 ( 0012): 30.09 2.417 1.42 35.35
+ ID2= 2 ( 0031): 24.10 0.868 2.33 34.15
=====

```

ID = 3 (0051): 54.19 2.840 1.42 34.81

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0051) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0051): 54.19 2.840 1.42 34.81
+ ID2= 2 ( 0041): 10.73 0.386 2.33 34.07
=====
ID = 1 ( 0051): 64.92 3.047 1.50 34.69
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| RESERVOIR( 0002) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          OUTFLOW      STORAGE      OUTFLOW      STORAGE
          (cms)      (ha.m.)      (cms)      (ha.m.)
0.0000 0.0000 | 1.3450 2.1963
0.0302 0.2196 | 2.0056 2.4160
0.1060 0.4393 | 2.9861 2.6356
0.1484 0.6589 | 5.1073 3.0749
0.1976 0.8785 | 6.4750 3.5141
0.2620 1.0982 | 6.9124 3.9534
0.3256 1.3178 | 7.3312 4.3927
0.4719 1.5374 | 7.7329 4.8319
0.6161 1.7571 | 8.1186 5.2712
0.8070 1.9767 | 0.0000 0.0000

          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0051) 64.920 3.047 1.50 34.69
OUTFLOW: ID= 1 ( 0002) 64.920 0.581 4.08 34.66

PEAK FLOW REDUCTION [Qout/Qin](%)= 19.07
TIME SHIFT OF PEAK FLOW (min)=155.00
MAXIMUM STORAGE USED (ha.m.)= 1.7035
```

```
-----
| CALIB |
| NASHYD ( 0021) | Area (ha)= 19.40 Curve Number (CN)= 81.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.00 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.66
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
-----
          ---- TRANSFORMED HYETOGRAPH ----
TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083    6.55 | 0.833    26.53 | 1.583    12.37 | 2.33     7.49
0.167    6.55 | 0.917    186.64 | 1.667    12.37 | 2.42     6.87
0.250    7.79 | 1.000    186.64 | 1.750    10.53 | 2.50     6.87
0.333    7.79 | 1.083     33.08 | 1.833    10.53 | 2.58     6.36
0.417    9.78 | 1.167     33.08 | 1.917     9.23 | 2.67     6.36
0.500    9.78 | 1.250     20.27 | 2.000     9.23 | 2.75     5.93
0.583    13.66 | 1.333     20.27 | 2.083     8.25 | 2.83     5.93
0.667    13.66 | 1.417     15.20 | 2.167     8.25 | 2.92     5.57
0.750    26.53 | 1.500     15.20 | 2.250     7.49 | 3.00     5.57
```

Unit Hyd Qpeak (cms)= 1.123

PEAK FLOW (cms)= 0.960 (i)
TIME TO PEAK (hrs)= 1.750

RUNOFF VOLUME (mm)= 31.882
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.488

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0042) | Area (ha)= 40.21 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00

U.H. Tp(hrs)= 1.20

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57

Unit Hyd Qpeak (cms)= 1.280

PEAK FLOW (cms)= 1.428 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 35.350
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| RESERVOIR(0001) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
DT= 5.0 min
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.7119 0.9480
0.0123 0.0780 | 1.9253 1.1420
0.0329 0.1570 | 2.5634 1.3440
0.0407 0.2380 | 2.7870 1.5530
0.0476 0.3210 | 2.9936 1.7700
0.0805 0.4060 | 3.1872 1.9930
0.1414 0.4920 | 3.3696 2.2250
0.1808 0.5790 | 3.6262 2.5860
0.2708 0.6690 | 3.7476 2.7730
0.4375 0.7600 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0042) 40.210 1.428 2.42 35.35
OUTFLOW: ID= 1 (0001) 40.210 0.635 4.25 35.31

PEAK FLOW REDUCTION [Qout/Qin] (%)= 44.51
TIME SHIFT OF PEAK FLOW (min)=110.00
MAXIMUM STORAGE USED (ha.m.)= 0.8958


```

| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0001):  40.21  0.635  4.25  35.31
+ ID2= 2 ( 0011):  12.45  0.458  2.25  32.84
=====
ID = 3 ( 0052):  52.66  0.830  3.67  34.73

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| ADD HYD ( 0052) |
| 3 + 2 = 1 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0052):  52.66  0.830  3.67  34.73
+ ID2= 2 ( 0002):  64.92  0.581  4.08  34.66
=====
ID = 1 ( 0052):  117.58  1.401  3.83  34.69

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0052):  117.58  1.401  3.83  34.69
+ ID2= 2 ( 0021):  19.40  0.960  1.75  31.88
=====
ID = 3 ( 0052):  136.98  1.648  3.33  34.29

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| CALIB |
| NASHYD ( 0017) | Area (ha)= 32.61 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.55

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
      hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083  6.55 | 0.833  26.53 | 1.583  12.37 | 2.33  7.49
0.167  6.55 | 0.917  186.64 | 1.667  12.37 | 2.42  6.87
0.250  7.79 | 1.000  186.64 | 1.750  10.53 | 2.50  6.87
0.333  7.79 | 1.083  33.08 | 1.833  10.53 | 2.58  6.36
0.417  9.78 | 1.167  33.08 | 1.917  9.23 | 2.67  6.36
0.500  9.78 | 1.250  20.27 | 2.000  9.23 | 2.75  5.93
0.583  13.66 | 1.333  20.27 | 2.083  8.25 | 2.83  5.93
0.667  13.66 | 1.417  15.20 | 2.167  8.25 | 2.92  5.57
0.750  26.53 | 1.500  15.20 | 2.250  7.49 | 3.00  5.57

```

Unit Hyd Qpeak (cms)= 2.265

PEAK FLOW (cms)= 2.018 (i)
 TIME TO PEAK (hrs)= 1.583
 RUNOFF VOLUME (mm)= 34.541
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.529

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

| RESERVOIR( 0020) |      OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min    |
-----
      OUTFLOW      STORAGE      |      OUTFLOW      STORAGE
      (cms)        (ha.m.)      |      (cms)        (ha.m.)
      0.0000      0.0000      |      1.7783      1.1263
      0.0245      0.1030      |      1.8455      1.2511
      0.0690      0.2080      |      1.9113      1.3782
      0.1181      0.3152      |      1.9743      1.5076
      0.2257      0.4245      |      2.0363      1.6394
      0.3402      0.5360      |      2.1548      1.9101
      0.4374      0.6496      |      2.2669      2.1903
      0.7664      0.7654      |      2.3755      2.4803
      1.3220      0.8835      |      2.4795      2.7803
      1.6822      1.0038      |      2.5047      2.8569

                        AREA      QPEAK      TPEAK      R.V.
                        (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0017)      32.610      2.018      1.58      34.54
OUTFLOW: ID= 1 ( 0020)      32.610      0.667      3.00      34.51

```

```

      PEAK FLOW REDUCTION [Qout/Qin] (%) = 33.07
      TIME SHIFT OF PEAK FLOW (min) = 85.00
      MAXIMUM STORAGE USED (ha.m.) = 0.7308

```

```

-----
| DIVERTHYD( 0023) |
| IN= 1 # OUT= 5 |
-----

```

Outflow / Inflow Relationships

```

Flow 1 + Flow 2 + Flow 3 + Flow 4 + Flow 5 = Total
(cms)      (cms)      (cms)      (cms)      (cms)      (cms)
0.00      0.00      0.00      0.00      0.00      0.00
0.02      0.01      0.00      0.00      0.00      0.02
0.05      0.02      0.00      0.00      0.00      0.07
0.07      0.02      0.02      0.00      0.00      0.12
0.11      0.04      0.08      0.00      0.00      0.23
0.16      0.07      0.11      0.00      0.00      0.34
0.20      0.10      0.14      0.00      0.00      0.44
0.27      0.34      0.16      0.00      0.00      0.77
0.29      0.64      0.39      0.00      0.00      1.32
0.30      0.70      0.68      0.00      0.00      1.68
0.31      0.73      0.73      0.00      0.00      1.78
0.32      0.76      0.76      0.00      0.00      1.85
0.33      0.79      0.79      0.00      0.00      1.91
0.34      0.81      0.81      0.00      0.00      1.97
0.35      0.84      0.84      0.00      0.00      2.04
0.36      0.87      0.87      0.00      0.00      2.10
0.38      0.91      0.91      0.00      0.00      2.21
0.40      0.96      0.96      0.00      0.00      2.32
0.42      1.01      1.01      0.00      0.00      2.43
0.43      1.04      1.04      0.00      0.00      2.50

```

```

                        AREA      QPEAK      TPEAK      R.V.
                        (ha)      (cms)      (hrs)      (mm)
TOTAL HYD. (ID= 1):      32.61      0.67      3.00      34.51
=====
ID= 2 ( 3) :      16.62      0.25      3.00      34.51
ID= 3 ( 3) :      8.99      0.26      3.00      34.51
ID= 4 ( 3) :      6.99      0.15      3.00      34.51
ID= 5 ( 3) :      0.00      0.00      0.00      0.00
ID= 6 ( 3) :      0.00      0.00      0.00      0.00

```

```

-----
| ROUTEPIPE( 0028) |      PIPE Number      =      1.00
| IN= 2---> OUT= 1 |      Diameter (mm)=1650.00
| DT=  5.0 min    |      Length (m)= 500.00

```


----- Slope (m/m)= 0.005
Manning n = 0.013

<----- TRAVEL TIME TABLE ----->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	8.99	0.26	3.00	34.51	0.22	1.43
OUTFLOW: ID= 1 (0028)	8.99	0.26	3.00	34.51	0.22	1.43

| ROUTEPIPE(0030) | PIPE Number = 1.00
| IN= 2---> OUT= 1 | Diameter (mm)=1650.00
| DT= 5.0 min | Length (m)= 500.00
----- Slope (m/m)= 0.005
Manning n = 0.013

<----- TRAVEL TIME TABLE ----->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	6.99	0.15	3.00	34.51	0.17	1.25
OUTFLOW: ID= 1 (0030)	6.99	0.15	3.08	34.51	0.17	1.25

```

-----
| CALIB |
| STANDHYD ( 0019) | Area (ha)= 6.99
| ID= 1 DT= 5.0 min | Total Imp(%)= 28.00 Dir. Conn.(%)= 28.00
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.96	5.03
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	0.64	1.23
Length	(m)=	215.87	712.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
      hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083   6.55 | 0.833 26.53 | 1.583 12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667 12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750 10.53 | 2.50   6.87
0.333   7.79 | 1.083 33.08 | 1.833 10.53 | 2.58   6.36
0.417   9.78 | 1.167 33.08 | 1.917  9.23 | 2.67   6.36
0.500   9.78 | 1.250 20.27 | 2.000  9.23 | 2.75   5.93
0.583  13.66 | 1.333 20.27 | 2.083  8.25 | 2.83   5.93
0.667  13.66 | 1.417 15.20 | 2.167  8.25 | 2.92   5.57
0.750  26.53 | 1.500 15.20 | 2.250  7.49 | 3.00   5.57

```

Max.Eff.Inten. (mm/hr)=	186.64	24.61
over (min)	5.00	85.00
Storage Coeff. (min)=	3.61 (ii)	84.11 (ii)
Unit Hyd. Tpeak (min)=	5.00	85.00
Unit Hyd. peak (cms)=	0.25	0.01

TOTALS

PEAK FLOW (cms)=	0.96	0.15	0.968 (iii)
TIME TO PEAK (hrs)=	1.00	2.42	1.00
RUNOFF VOLUME (mm)=	63.35	31.37	40.32
TOTAL RAINFALL (mm)=	65.35	65.35	65.35
RUNOFF COEFFICIENT =	0.97	0.48	0.62

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 82.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0029) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
----- (ha) (cms) (hrs) (mm)
ID1= 1 ( 0019): 6.99 0.968 1.00 40.32
+ ID2= 2 ( 0028): 8.99 0.263 3.00 34.51
=====
ID = 3 ( 0029): 15.98 0.969 1.00 37.05

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0029) |

```

3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
-----	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (0029):	15.98	0.969	1.00	37.05
+ ID2= 2 (0030):	6.99	0.152	3.08	34.51
=====				
ID = 1 (0029):	22.98	0.969	1.00	36.27

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ROUTEPIPE(0032)	PIPE Number	=	1.00
IN= 2---> OUT= 1	Diameter	(mm)=	1650.00
DT= 5.0 min	Length	(m)=	500.00
-----	Slope	(m/m)=	0.005
	Manning n	=	0.013

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	16.62	0.25	3.00	34.51	0.22	1.41
OUTFLOW: ID= 1 (0032)	16.62	0.25	3.08	34.51	0.22	1.41

CALIB	
NASHYD (0018)	Area (ha)= 0.94 Curve Number (CN)= 84.0
ID= 1 DT= 5.0 min	Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----	U.H. Tp(hrs)= 0.12

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.299

PEAK FLOW (cms)= 0.169 (i)
TIME TO PEAK (hrs)= 1.000
RUNOFF VOLUME (mm)= 33.922
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.519

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0033) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0018):    0.94    0.169      1.00    33.92
+ ID2= 2 ( 0032):   16.62    0.251      3.08    34.51
=====
ID = 3 ( 0033):   17.56    0.263      3.00    34.48
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| CALIB |
| NASHYD ( 0034) | Area (ha)= 6.77 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res. (N)= 3.00
-----
U.H. Tp(hrs)= 0.50
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083    6.55 | 0.833    26.53 | 1.583    12.37 | 2.33     7.49
0.167    6.55 | 0.917    186.64 | 1.667    12.37 | 2.42     6.87
0.250    7.79 | 1.000    186.64 | 1.750    10.53 | 2.50     6.87
0.333    7.79 | 1.083    33.08 | 1.833    10.53 | 2.58     6.36
0.417    9.78 | 1.167    33.08 | 1.917     9.23 | 2.67     6.36
0.500    9.78 | 1.250    20.27 | 2.000     9.23 | 2.75     5.93
0.583   13.66 | 1.333    20.27 | 2.083     8.25 | 2.83     5.93
0.667   13.66 | 1.417    15.20 | 2.167     8.25 | 2.92     5.57
0.750   26.53 | 1.500    15.20 | 2.250     7.49 | 3.00     5.57
```

Unit Hyd Qpeak (cms)= 0.517

PEAK FLOW (cms)= 0.428 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 33.117
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.507

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| NASHYD ( 0035) | Area (ha)= 12.32 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res. (N)= 3.00
-----
U.H. Tp(hrs)= 0.55
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
```

hrs	mm/hr		hrs	mm/hr		hrs	mm/hr		hrs	mm/hr
0.083	6.55		0.833	26.53		1.583	12.37		2.33	7.49
0.167	6.55		0.917	186.64		1.667	12.37		2.42	6.87
0.250	7.79		1.000	186.64		1.750	10.53		2.50	6.87
0.333	7.79		1.083	33.08		1.833	10.53		2.58	6.36
0.417	9.78		1.167	33.08		1.917	9.23		2.67	6.36
0.500	9.78		1.250	20.27		2.000	9.23		2.75	5.93
0.583	13.66		1.333	20.27		2.083	8.25		2.83	5.93
0.667	13.66		1.417	15.20		2.167	8.25		2.92	5.57
0.750	26.53		1.500	15.20		2.250	7.49		3.00	5.57

Unit Hyd Qpeak (cms)= 0.856

PEAK FLOW (cms)= 0.758 (i)
 TIME TO PEAK (hrs)= 1.583
 RUNOFF VOLUME (mm)= 34.380
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.526

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0036) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min      |
-----
| OUTFLOW          | STORAGE          | OUTFLOW          | STORAGE          |
| (cms)            | (ha.m.)          | (cms)            | (ha.m.)          |
| 0.0000           | 0.0000           | 0.9922           | 0.4686           |
| 0.0150           | 0.0403           | 1.3581           | 0.5239           |
| 0.0508           | 0.0819           | 1.4554           | 0.5809           |
| 0.0745           | 0.1250           | 1.5104           | 0.6396           |
| 0.1065           | 0.1696           | 1.5636           | 0.6999           |
| 0.1567           | 0.2156           | 1.6156           | 0.7620           |
| 0.1928           | 0.2631           | 1.6657           | 0.8257           |
| 0.2872           | 0.3021           | 1.7150           | 0.8913           |
| 0.4020           | 0.3627           | 1.7631           | 0.9586           |
| 0.5684           | 0.4149           | 1.8561           | 1.0987           |

```

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0035)	12.320	0.758	1.58	34.38
OUTFLOW: ID= 1 (0036)	12.320	0.225	3.08	34.32

PEAK FLOW REDUCTION [Qout/Qin] (%) = 29.70
 TIME SHIFT OF PEAK FLOW (min) = 90.00
 MAXIMUM STORAGE USED (ha.m.) = 0.2766

```

-----
| ADD HYD ( 0037) |
| 1 + 2 = 3       |
-----
| ID1= 1 ( 0034): | AREA   QPEAK  TPEAK  R.V.
| + ID2= 2 ( 0036): | (ha)   (cms)   (hrs)   (mm)
| =====
| ID = 3 ( 0037):  | 19.09  0.492   1.58   33.90

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB          |
| NASHYD ( 0045) | Area   (ha)= 2.10  Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia     (mm)= 4.30  # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= 0.14

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.573

PEAK FLOW (cms)= 0.313 (i)
 TIME TO PEAK (hrs)= 1.083
 RUNOFF VOLUME (mm)= 31.669
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.485

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | NASHYD (0046) | Area (ha)= 1.31 Curve Number (CN)= 82.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res.(N)= 3.00

 U.H. Tp(hrs)= 0.08

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.625

PEAK FLOW (cms)= 0.288 (i)
 TIME TO PEAK (hrs)= 1.000
 RUNOFF VOLUME (mm)= 30.101
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.461

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | NASHYD (0047) | Area (ha)= 1.89 Curve Number (CN)= 83.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00

 U.H. Tp(hrs)= 0.22

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.328

PEAK FLOW (cms)= 0.219 (i)

TIME TO PEAK (hrs)= 1.167

RUNOFF VOLUME (mm)= 33.075

TOTAL RAINFALL (mm)= 65.350

RUNOFF COEFFICIENT = 0.506

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

Alternative Method 1
100-year 4-hour Chicago

=====
V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTTT TTTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\fd0ed113-301b-4971-bb0b-12742810f8a8\s
Summary filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\fd0ed113-301b-4971-bb0b-12742810f8a8\s

DATE: 07-15-2025 TIME: 08:41:59

USER:

COMMENTS: _____

** SIMULATION : 100-year-4hr-Chicago **

| CHICAGO STORM | IDF curve parameters: A=1032.793
| Ptotal= 70.38 mm | B= 0.000
| | C= 0.743

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.00 5.06 | 1.00 26.53 | 2.00 10.53 | 3.00 5.93
0.17 5.69 | 1.17 186.64 | 2.17 9.23 | 3.17 5.57
0.33 6.55 | 1.33 33.08 | 2.33 8.25 | 3.33 5.25
0.50 7.79 | 1.50 20.27 | 2.50 7.49 | 3.50 4.97
0.67 9.78 | 1.67 15.20 | 2.67 6.87 | 3.67 4.72
0.83 13.66 | 1.83 12.37 | 2.83 6.36 | 3.83 4.51

| CALIB |


```

| NASHYD ( 0011) | Area (ha)= 12.45 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.10 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.03

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51

```

Unit Hyd Qpeak (cms)= 0.462

PEAK FLOW (cms)= 0.479 (i)
TIME TO PEAK (hrs)= 2.500
RUNOFF VOLUME (mm)= 36.792
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.523

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0012) | Area (ha)= 28.68 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.41

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51

```

Unit Hyd Qpeak (cms)= 2.672

PEAK FLOW (cms)= 2.374 (i)
TIME TO PEAK (hrs)= 1.750
RUNOFF VOLUME (mm)= 39.464
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.561

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0031) | Area (ha)= 25.70 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.80 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.11

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 5.06 | 1.083 26.53 | 2.083 10.53 | 3.08 5.93
0.167 5.06 | 1.167 26.53 | 2.167 10.53 | 3.17 5.93
0.250 5.69 | 1.250 186.64 | 2.250 9.23 | 3.25 5.57
0.333 5.69 | 1.333 186.64 | 2.333 9.23 | 3.33 5.57
0.417 6.55 | 1.417 33.08 | 2.417 8.25 | 3.42 5.25
0.500 6.55 | 1.500 33.08 | 2.500 8.25 | 3.50 5.25
0.583 7.79 | 1.583 20.27 | 2.583 7.49 | 3.58 4.97
0.667 7.79 | 1.667 20.27 | 2.667 7.49 | 3.67 4.97
0.750 9.78 | 1.750 15.20 | 2.750 6.87 | 3.75 4.72
0.833 9.78 | 1.833 15.20 | 2.833 6.87 | 3.83 4.72
0.917 13.66 | 1.917 12.37 | 2.917 6.36 | 3.92 4.51
1.000 13.66 | 2.000 12.37 | 3.000 6.36 | 4.00 4.51

```

Unit Hyd Qpeak (cms)= 0.884

PEAK FLOW (cms)= 0.942 (i)
 TIME TO PEAK (hrs)= 2.667
 RUNOFF VOLUME (mm)= 37.031
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.526

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0041) | Area (ha)= 10.73 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 5.06 | 1.083 26.53 | 2.083 10.53 | 3.08 5.93
0.167 5.06 | 1.167 26.53 | 2.167 10.53 | 3.17 5.93
0.250 5.69 | 1.250 186.64 | 2.250 9.23 | 3.25 5.57
0.333 5.69 | 1.333 186.64 | 2.333 9.23 | 3.33 5.57
0.417 6.55 | 1.417 33.08 | 2.417 8.25 | 3.42 5.25
0.500 6.55 | 1.500 33.08 | 2.500 8.25 | 3.50 5.25
0.583 7.79 | 1.583 20.27 | 2.583 7.49 | 3.58 4.97
0.667 7.79 | 1.667 20.27 | 2.667 7.49 | 3.67 4.97
0.750 9.78 | 1.750 15.20 | 2.750 6.87 | 3.75 4.72
0.833 9.78 | 1.833 15.20 | 2.833 6.87 | 3.83 4.72
0.917 13.66 | 1.917 12.37 | 2.917 6.36 | 3.92 4.51
1.000 13.66 | 2.000 12.37 | 3.000 6.36 | 4.00 4.51

```

Unit Hyd Qpeak (cms)= 0.366

PEAK FLOW (cms)= 0.403 (i)
 TIME TO PEAK (hrs)= 2.667
 RUNOFF VOLUME (mm)= 38.105

TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0051) |
| 1 + 2 = 3 |
|-----|
| ID1= 1 ( 0012): | AREA   QPEAK   TPEAK   R.V.
|                   | (ha)   (cms)   (hrs)   (mm)
| + ID2= 2 ( 0031): | 28.68  2.374  1.75  39.46
|                   | 25.70  0.942  2.67  37.03
|=====|
| ID = 3 ( 0051): | 54.38  2.849  1.83  38.31
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0051) |
| 3 + 2 = 1 |
|-----|
| ID1= 3 ( 0051): | AREA   QPEAK   TPEAK   R.V.
|                   | (ha)   (cms)   (hrs)   (mm)
| + ID2= 2 ( 0041): | 54.38  2.849  1.83  38.31
|                   | 10.73  0.403  2.67  38.10
|=====|
| ID = 1 ( 0051): | 65.11  3.088  1.83  38.28
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| RESERVOIR( 0002) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
|-----|
| OUTFLOW   STORAGE | OUTFLOW   STORAGE
| (cms)      (ha.m.) | (cms)      (ha.m.)
| 0.0000     0.0000 | 1.3450     2.1963
| 0.0302     0.2196 | 2.0056     2.4160
| 0.1060     0.4393 | 2.9861     2.6356
| 0.1484     0.6589 | 5.1073     3.0749
| 0.1976     0.8785 | 6.4750     3.5141
| 0.2620     1.0982 | 6.9124     3.9534
| 0.3256     1.3178 | 7.3312     4.3927
| 0.4719     1.5374 | 7.7329     4.8319
| 0.6161     1.7571 | 8.1186     5.2712
| 0.8070     1.9767 | 0.0000     0.0000
|
| AREA   QPEAK   TPEAK   R.V.
| (ha)   (cms)   (hrs)   (mm)
| INFLOW : ID= 2 ( 0051) | 65.110  3.088  1.83  38.28
| OUTFLOW: ID= 1 ( 0002) | 65.110  0.674  4.67  38.25
```

PEAK FLOW REDUCTION [Qout/Qin] (%)= 21.84
TIME SHIFT OF PEAK FLOW (min)=170.00
MAXIMUM STORAGE USED (ha.m.)= 1.8243

```
-----
| CALIB |
| NASHYD ( 0021) | Area (ha)= 19.40 Curve Number (CN)= 81.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.00 # of Linear Res. (N)= 3.00
|-----| U.H. Tp(hrs)= 0.66
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
```

0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 1.123

PEAK FLOW (cms)= 1.007 (i)
 TIME TO PEAK (hrs)= 2.083
 RUNOFF VOLUME (mm)= 35.760
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.508

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0042) | Area (ha)= 40.21 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.20

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 1.280

PEAK FLOW (cms)= 1.490 (i)
 TIME TO PEAK (hrs)= 2.750
 RUNOFF VOLUME (mm)= 39.468
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.561

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0001) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----

```

OUTFLOW	STORAGE	OUTFLOW	STORAGE
(cms)	(ha.m.)	(cms)	(ha.m.)
0.0000	0.0000	0.7119	0.9480
0.0123	0.0780	1.9253	1.1420
0.0329	0.1570	2.5634	1.3440

0.0407	0.2380		2.7870	1.5530
0.0476	0.3210		2.9936	1.7700
0.0805	0.4060		3.1872	1.9930
0.1414	0.4920		3.3696	2.2250
0.1808	0.5790		3.6262	2.5860
0.2708	0.6690		3.7476	2.7730
0.4375	0.7600		0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0042)	40.210	1.490	2.75	39.47
OUTFLOW: ID= 1 (0001)	40.210	0.704	4.67	39.43

PEAK FLOW REDUCTION [Qout/Qin] (%) = 47.22
 TIME SHIFT OF PEAK FLOW (min) = 115.00
 MAXIMUM STORAGE USED (ha.m.) = 0.9427

```

-----
| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0001):  40.21  0.704    4.67    39.43
+ ID2= 2 ( 0011):  12.45  0.479    2.50    36.79
=====
ID = 3 ( 0052):  52.66  0.914    4.25    38.81
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0052) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0052):  52.66  0.914    4.25    38.81
+ ID2= 2 ( 0002):  65.11  0.674    4.67    38.25
=====
ID = 1 ( 0052):  117.77  1.573    4.42    38.50
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0052):  117.77  1.573    4.42    38.50
+ ID2= 2 ( 0021):  19.40  1.007    2.08    35.76
=====
ID = 3 ( 0052):  137.17  1.810    4.17    38.11
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| NASHYD ( 0017) | Area (ha)= 32.52 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.70 # of Linear Res. (N)= 3.00
-----
U.H. Tp (hrs)= 0.52
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
  
```

0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57
0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 2.389

PEAK FLOW (cms)= 2.200 (i)
TIME TO PEAK (hrs)= 1.833
RUNOFF VOLUME (mm)= 38.642
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.549

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0020)| OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min      |
-----

```

	OUTFLOW (cms)	STORAGE (ha.m.)		OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000		1.7783	1.1263
	0.0245	0.1030		1.8455	1.2511
	0.0690	0.2080		1.9113	1.3782
	0.1181	0.3152		1.9743	1.5076
	0.2257	0.4245		2.0363	1.6394
	0.3402	0.5360		2.1548	1.9101
	0.4374	0.6496		2.2669	2.1903
	0.7664	0.7654		2.3755	2.4803
	1.3220	0.8835		2.4795	2.7803
	1.6822	1.0038		2.5047	2.8569

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0017)	32.520	2.200	1.83	38.64
OUTFLOW: ID= 1 (0020)	32.520	0.723	3.17	38.61

PEAK FLOW REDUCTION [Qout/Qin] (%)= 32.87
TIME SHIFT OF PEAK FLOW (min)= 80.00
MAXIMUM STORAGE USED (ha.m.)= 0.7504

```

-----
| DIVERTHYD( 0023)|
| IN= 1  # OUT= 5 |
-----

```

Outflow / Inflow Relationships

Flow 1 (cms)	Flow 2 (cms)	Flow 3 (cms)	Flow 4 (cms)	Flow 5 (cms)	Total (cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.01	0.00	0.00	0.00	0.02
0.05	0.02	0.00	0.00	0.00	0.07
0.07	0.02	0.02	0.00	0.00	0.12
0.11	0.04	0.08	0.00	0.00	0.23
0.16	0.07	0.11	0.00	0.00	0.34
0.20	0.10	0.14	0.00	0.00	0.44
0.27	0.34	0.16	0.00	0.00	0.77
0.29	0.64	0.39	0.00	0.00	1.32
0.30	0.70	0.68	0.00	0.00	1.68
0.31	0.73	0.73	0.00	0.00	1.78
0.32	0.76	0.76	0.00	0.00	1.85

0.33	0.79	0.79	0.00	0.00	1.91
0.34	0.81	0.81	0.00	0.00	1.97
0.35	0.84	0.84	0.00	0.00	2.04
0.36	0.87	0.87	0.00	0.00	2.10
0.38	0.91	0.91	0.00	0.00	2.21
0.40	0.96	0.96	0.00	0.00	2.32
0.42	1.01	1.01	0.00	0.00	2.43
0.43	1.04	1.04	0.00	0.00	2.50

		AREA	QPEAK	TPEAK	R.V.
		(ha)	(cms)	(hrs)	(mm)
TOTAL	HYD. (ID= 1):	32.52	0.72	3.17	38.61
=====					
ID= 2	(3)	: 16.07	0.26	3.17	38.61
ID= 3	(3)	: 9.48	0.30	3.17	38.61
ID= 4	(3)	: 6.97	0.16	3.17	38.61
ID= 5	(3)	: 0.00	0.00	0.00	0.00
ID= 6	(3)	: 0.00	0.00	0.00	0.00

```

-----
| ROUTEPIPE( 0028)|   PIPE Number      =   1.00
| IN= 2---> OUT= 1 |   Diameter      (mm)=1650.00
| DT=  5.0 min    |   Length        (m)= 500.00
-----
|                   |   Slope          (m/m)=  0.005
|                   |   Manning n      =   0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	9.48	0.30	3.17	38.61	0.24	1.51
OUTFLOW: ID= 1 (0028)	9.48	0.30	3.25	38.61	0.24	1.51

```

-----
| ROUTEPIPE( 0030)|   PIPE Number      =   1.00
| IN= 2---> OUT= 1 |   Diameter      (mm)=1650.00
| DT=  5.0 min    |   Length        (m)= 500.00
-----
|                   |   Slope          (m/m)=  0.005
|                   |   Manning n      =   0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40

0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	6.97	0.16	3.17	38.61	0.18	1.26
OUTFLOW: ID= 1 (0030)	6.97	0.16	3.25	38.61	0.18	1.26

```

| CALIB |
| STANDHYD ( 0019) | Area (ha)= 6.99
| ID= 1 DT= 5.0 min | Total Imp(%)= 28.00 Dir. Conn.(%)= 28.00

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.96	5.03
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	0.64	1.23
Length (m)=	215.87	712.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Max.Eff.Inten.(mm/hr)=	186.64	25.57
over (min)	5.00	85.00
Storage Coeff. (min)=	3.61 (ii)	82.89 (ii)
Unit Hyd. Tpeak (min)=	5.00	85.00
Unit Hyd. peak (cms)=	0.25	0.01

TOTALS

PEAK FLOW (cms)=	0.96	0.16	0.969 (iii)
TIME TO PEAK (hrs)=	1.33	2.67	1.33
RUNOFF VOLUME (mm)=	68.38	35.29	44.55
TOTAL RAINFALL (mm)=	70.38	70.38	70.38

RUNOFF COEFFICIENT = 0.97 0.50 0.63

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 82.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0029) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
|-----| (ha) (cms) (hrs) (mm)
ID1= 1 ( 0019): 6.99 0.969 1.33 44.55
+ ID2= 2 ( 0028): 9.48 0.303 3.25 38.61
=====
ID = 3 ( 0029): 16.47 0.970 1.33 41.13
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0029) |
| 3 + 2 = 1 | AREA QPEAK TPEAK R.V.
|-----| (ha) (cms) (hrs) (mm)
ID1= 3 ( 0029): 16.47 0.970 1.33 41.13
+ ID2= 2 ( 0030): 6.97 0.155 3.25 38.61
=====
ID = 1 ( 0029): 23.44 0.970 1.33 40.38
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ROUTEPIPE( 0032) | PIPE Number = 1.00
| IN= 2---> OUT= 1 | Diameter (mm)=1650.00
| DT= 5.0 min | Length (m)= 500.00
|-----| Slope (m/m)= 0.005
Manning n = 0.013
```

<----- TRAVEL TIME TABLE ----->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	16.07	0.26	3.17	38.61	0.22	1.43

OUTFLOW: ID= 1 (0032) 16.07 0.26 3.25 38.61 0.22 1.43

```
-----
| CALIB |
| NASHYD ( 0018) | Area (ha)= 0.94 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.12
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 5.06 | 1.083 26.53 | 2.083 10.53 | 3.08 5.93
0.167 5.06 | 1.167 26.53 | 2.167 10.53 | 3.17 5.93
0.250 5.69 | 1.250 186.64 | 2.250 9.23 | 3.25 5.57
0.333 5.69 | 1.333 186.64 | 2.333 9.23 | 3.33 5.57
0.417 6.55 | 1.417 33.08 | 2.417 8.25 | 3.42 5.25
0.500 6.55 | 1.500 33.08 | 2.500 8.25 | 3.50 5.25
0.583 7.79 | 1.583 20.27 | 2.583 7.49 | 3.58 4.97
0.667 7.79 | 1.667 20.27 | 2.667 7.49 | 3.67 4.97
0.750 9.78 | 1.750 15.20 | 2.750 6.87 | 3.75 4.72
0.833 9.78 | 1.833 15.20 | 2.833 6.87 | 3.83 4.72
0.917 13.66 | 1.917 12.37 | 2.917 6.36 | 3.92 4.51
1.000 13.66 | 2.000 12.37 | 3.000 6.36 | 4.00 4.51
```

Unit Hyd Qpeak (cms)= 0.299

PEAK FLOW (cms)= 0.178 (i)
TIME TO PEAK (hrs)= 1.333
RUNOFF VOLUME (mm)= 37.965
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.539

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0033) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
| | (ha) (cms) (hrs) (mm)
-----
ID1= 1 ( 0018): 0.94 0.178 1.33 37.97
+ ID2= 2 ( 0032): 16.07 0.263 3.25 38.61
=====
ID = 3 ( 0033): 17.01 0.276 3.17 38.57
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| CALIB |
| NASHYD ( 0034) | Area (ha)= 6.82 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.50
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 5.06 | 1.083 26.53 | 2.083 10.53 | 3.08 5.93
0.167 5.06 | 1.167 26.53 | 2.167 10.53 | 3.17 5.93
0.250 5.69 | 1.250 186.64 | 2.250 9.23 | 3.25 5.57
```

0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 0.521

PEAK FLOW (cms)= 0.454 (i)
 TIME TO PEAK (hrs)= 1.833
 RUNOFF VOLUME (mm)= 37.133
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.528

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0035) | Area (ha)= 12.17 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.55
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN			
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr			
0.083	5.06		1.083	26.53		2.083	10.53		3.08	5.93
0.167	5.06		1.167	26.53		2.167	10.53		3.17	5.93
0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57
0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 0.845

PEAK FLOW (cms)= 0.786 (i)
 TIME TO PEAK (hrs)= 1.917
 RUNOFF VOLUME (mm)= 38.478
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.547

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0036) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----

```

OUTFLOW	STORAGE	OUTFLOW	STORAGE	
(cms)	(ha.m.)	(cms)	(ha.m.)	
0.0000	0.0000		0.9922	0.4686
0.0150	0.0403		1.3581	0.5239
0.0508	0.0819		1.4554	0.5809
0.0745	0.1250		1.5104	0.6396
0.1065	0.1696		1.5636	0.6999
0.1567	0.2156		1.6156	0.7620

0.1928	0.2631		1.6657	0.8257
0.2872	0.3021		1.7150	0.8913
0.4020	0.3627		1.7631	0.9586
0.5684	0.4149		1.8561	1.0987

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0035)	12.170	0.786	1.92	38.48
OUTFLOW: ID= 1 (0036)	12.170	0.239	3.42	38.42

PEAK FLOW REDUCTION [Qout/Qin] (%) = 30.42
 TIME SHIFT OF PEAK FLOW (min) = 90.00
 MAXIMUM STORAGE USED (ha.m.) = 0.2824

```

-----
| ADD HYD ( 0037) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0034):    6.82    0.454    1.83    37.13
+ ID2= 2 ( 0036):   12.17    0.239    3.42    38.42
=====
ID = 3 ( 0037):   18.99    0.520    1.92    37.96
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| NASHYD ( 0045) | Area (ha)= 2.10 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res. (N)= 3.00
-----
      U.H. Tp(hrs)= 0.14
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
      hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083    5.06 | 1.083    26.53 | 2.083    10.53 | 3.08     5.93
0.167    5.06 | 1.167    26.53 | 2.167    10.53 | 3.17     5.93
0.250    5.69 | 1.250   186.64 | 2.250     9.23 | 3.25     5.57
0.333    5.69 | 1.333   186.64 | 2.333     9.23 | 3.33     5.57
0.417    6.55 | 1.417    33.08 | 2.417     8.25 | 3.42     5.25
0.500    6.55 | 1.500    33.08 | 2.500     8.25 | 3.50     5.25
0.583    7.79 | 1.583    20.27 | 2.583     7.49 | 3.58     4.97
0.667    7.79 | 1.667    20.27 | 2.667     7.49 | 3.67     4.97
0.750    9.78 | 1.750    15.20 | 2.750     6.87 | 3.75     4.72
0.833    9.78 | 1.833    15.20 | 2.833     6.87 | 3.83     4.72
0.917   13.66 | 1.917    12.37 | 2.917     6.36 | 3.92     4.51
1.000   13.66 | 2.000    12.37 | 3.000     6.36 | 4.00     4.51
  
```

Unit Hyd Qpeak (cms) = 0.573

PEAK FLOW (cms) = 0.329 (i)
 TIME TO PEAK (hrs) = 1.417
 RUNOFF VOLUME (mm) = 35.572
 TOTAL RAINFALL (mm) = 70.382
 RUNOFF COEFFICIENT = 0.505

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0046) | Area (ha)= 1.31 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res. (N)= 3.00
-----
      U.H. Tp(hrs)= 0.08
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 0.625

PEAK FLOW (cms)= 0.301 (i)
TIME TO PEAK (hrs)= 1.333
RUNOFF VOLUME (mm)= 33.811
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.480

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0047) | Area (ha)= 1.89 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00

U.H. Tp(hrs)= 0.22

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----							
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 0.328

PEAK FLOW (cms)= 0.230 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 37.086
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.527

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

Alternative Method 1
100-year 3-hour Chicago

V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\817e0409-366f-4744-8e23-802eae9b8041\s
Summary filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\817e0409-366f-4744-8e23-802eae9b8041\s

DATE: 07-15-2025 TIME: 08:41:58

USER:

COMMENTS:

** SIMULATION : 100-year-3hr-Chicago **

| CHICAGO STORM | IDF curve parameters: A=1032.793
| Ptotal= 65.35 mm | B= 0.000
C= 0.743

used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

Table with 8 columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. Rows show rainfall intensity data at various time intervals.

| CALIB |
| NASHYD (0011) | Area (ha)= 12.45 Curve Number (CN)= 82.0
|ID= 1 DT= 5.0 min | Ia (mm)= 3.10 # of Linear Res.(N)= 3.00

----- U.H. Tp(hrs)= 1.03

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.462

PEAK FLOW (cms)= 0.458 (i)
TIME TO PEAK (hrs)= 2.250
RUNOFF VOLUME (mm)= 32.837
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.502

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0012) | Area (ha)= 28.68 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 0.41

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 2.672

PEAK FLOW (cms)= 2.268 (i)
TIME TO PEAK (hrs)= 1.417
RUNOFF VOLUME (mm)= 35.347
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0031) | Area (ha)= 25.70 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.80 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 1.11

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   6.55 | 0.833  26.53 | 1.583  12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667  12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750  10.53 | 2.50   6.87
0.333   7.79 | 1.083  33.08 | 1.833  10.53 | 2.58   6.36
0.417   9.78 | 1.167  33.08 | 1.917   9.23 | 2.67   6.36
0.500   9.78 | 1.250  20.27 | 2.000   9.23 | 2.75   5.93
0.583  13.66 | 1.333  20.27 | 2.083   8.25 | 2.83   5.93
0.667  13.66 | 1.417  15.20 | 2.167   8.25 | 2.92   5.57
0.750  26.53 | 1.500  15.20 | 2.250   7.49 | 3.00   5.57
```

Unit Hyd Qpeak (cms)= 0.884

PEAK FLOW (cms)= 0.901 (i)
TIME TO PEAK (hrs)= 2.333
RUNOFF VOLUME (mm)= 33.071
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.506

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| NASHYD ( 0041) | Area (ha)= 10.73 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.12
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   6.55 | 0.833  26.53 | 1.583  12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667  12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750  10.53 | 2.50   6.87
0.333   7.79 | 1.083  33.08 | 1.833  10.53 | 2.58   6.36
0.417   9.78 | 1.167  33.08 | 1.917   9.23 | 2.67   6.36
0.500   9.78 | 1.250  20.27 | 2.000   9.23 | 2.75   5.93
0.583  13.66 | 1.333  20.27 | 2.083   8.25 | 2.83   5.93
0.667  13.66 | 1.417  15.20 | 2.167   8.25 | 2.92   5.57
0.750  26.53 | 1.500  15.20 | 2.250   7.49 | 3.00   5.57
```

Unit Hyd Qpeak (cms)= 0.366

PEAK FLOW (cms)= 0.386 (i)
TIME TO PEAK (hrs)= 2.333
RUNOFF VOLUME (mm)= 34.068
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.521

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0051) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
----- (ha) (cms) (hrs) (mm)
ID1= 1 ( 0012): 28.68 2.268 1.42 35.35
+ ID2= 2 ( 0031): 25.70 0.901 2.33 33.07
=====
```


ID = 3 (0051): 54.38 2.719 1.50 34.27

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0051) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0051): 54.38 2.719 1.50 34.27
+ ID2= 2 ( 0041): 10.73 0.386 2.33 34.07
=====
ID = 1 ( 0051): 65.11 2.942 1.50 34.24
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| RESERVOIR( 0002) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          OUTFLOW      STORAGE      OUTFLOW      STORAGE
          (cms)      (ha.m.)      (cms)      (ha.m.)
0.0000 0.0000 | 1.3450 2.1963
0.0302 0.2196 | 2.0056 2.4160
0.1060 0.4393 | 2.9861 2.6356
0.1484 0.6589 | 5.1073 3.0749
0.1976 0.8785 | 6.4750 3.5141
0.2620 1.0982 | 6.9124 3.9534
0.3256 1.3178 | 7.3312 4.3927
0.4719 1.5374 | 7.7329 4.8319
0.6161 1.7571 | 8.1186 5.2712
0.8070 1.9767 | 0.0000 0.0000

          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0051) 65.110 2.942 1.50 34.24
OUTFLOW: ID= 1 ( 0002) 65.110 0.572 4.08 34.21

PEAK FLOW REDUCTION [Qout/Qin] (%) = 19.44
TIME SHIFT OF PEAK FLOW (min) = 155.00
MAXIMUM STORAGE USED (ha.m.) = 1.6899
```

```
-----
| CALIB |
| NASHYD ( 0021) | Area (ha)= 19.40 Curve Number (CN)= 81.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.00 # of Linear Res. (N)= 3.00
-----
U.H. Tp(hrs)= 0.66
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57
```

Unit Hyd Qpeak (cms)= 1.123

PEAK FLOW (cms)= 0.960 (i)
TIME TO PEAK (hrs)= 1.750

RUNOFF VOLUME (mm)= 31.882
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.488

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0042) | Area (ha)= 40.21 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00

U.H. Tp(hrs)= 1.20

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57

Unit Hyd Qpeak (cms)= 1.280

PEAK FLOW (cms)= 1.428 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 35.350
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| RESERVOIR(0001) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
DT= 5.0 min
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.7119 0.9480
0.0123 0.0780 | 1.9253 1.1420
0.0329 0.1570 | 2.5634 1.3440
0.0407 0.2380 | 2.7870 1.5530
0.0476 0.3210 | 2.9936 1.7700
0.0805 0.4060 | 3.1872 1.9930
0.1414 0.4920 | 3.3696 2.2250
0.1808 0.5790 | 3.6262 2.5860
0.2708 0.6690 | 3.7476 2.7730
0.4375 0.7600 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0042) 40.210 1.428 2.42 35.35
OUTFLOW: ID= 1 (0001) 40.210 0.635 4.25 35.31

PEAK FLOW REDUCTION [Qout/Qin] (%)= 44.51
TIME SHIFT OF PEAK FLOW (min)=110.00
MAXIMUM STORAGE USED (ha.m.)= 0.8958


```

| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0001):  40.21  0.635  4.25  35.31
+ ID2= 2 ( 0011):  12.45  0.458  2.25  32.84
=====
ID = 3 ( 0052):  52.66  0.830  3.67  34.73

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| ADD HYD ( 0052) |
| 3 + 2 = 1 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0052):  52.66  0.830  3.67  34.73
+ ID2= 2 ( 0002):  65.11  0.572  4.08  34.21
=====
ID = 1 ( 0052):  117.77  1.390  3.83  34.44

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0052):  117.77  1.390  3.83  34.44
+ ID2= 2 ( 0021):  19.40  0.960  1.75  31.88
=====
ID = 3 ( 0052):  137.17  1.634  3.33  34.08

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| CALIB |
| NASHYD ( 0017) | Area (ha)= 32.52 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.52

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
      hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083  6.55 | 0.833  26.53 | 1.583  12.37 | 2.33  7.49
0.167  6.55 | 0.917  186.64 | 1.667  12.37 | 2.42  6.87
0.250  7.79 | 1.000  186.64 | 1.750  10.53 | 2.50  6.87
0.333  7.79 | 1.083  33.08 | 1.833  10.53 | 2.58  6.36
0.417  9.78 | 1.167  33.08 | 1.917  9.23 | 2.67  6.36
0.500  9.78 | 1.250  20.27 | 2.000  9.23 | 2.75  5.93
0.583  13.66 | 1.333  20.27 | 2.083  8.25 | 2.83  5.93
0.667  13.66 | 1.417  15.20 | 2.167  8.25 | 2.92  5.57
0.750  26.53 | 1.500  15.20 | 2.250  7.49 | 3.00  5.57

```

Unit Hyd Qpeak (cms)= 2.389

PEAK FLOW (cms)= 2.092 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 34.541
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.529

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

| RESERVOIR( 0020) |      OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min    |
-----
                OUTFLOW    STORAGE    |    OUTFLOW    STORAGE
                (cms)      (ha.m.)    |    (cms)      (ha.m.)
                0.0000      0.0000    |    1.7783      1.1263
                0.0245      0.1030    |    1.8455      1.2511
                0.0690      0.2080    |    1.9113      1.3782
                0.1181      0.3152    |    1.9743      1.5076
                0.2257      0.4245    |    2.0363      1.6394
                0.3402      0.5360    |    2.1548      1.9101
                0.4374      0.6496    |    2.2669      2.1903
                0.7664      0.7654    |    2.3755      2.4803
                1.3220      0.8835    |    2.4795      2.7803
                1.6822      1.0038    |    2.5047      2.8569

                AREA      QPEAK      TPEAK      R.V.
                (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0017)    32.520      2.092      1.50      34.54
OUTFLOW: ID= 1 ( 0020)    32.520      0.668      2.92      34.51

                PEAK FLOW REDUCTION [Qout/Qin](%)= 31.92
                TIME SHIFT OF PEAK FLOW (min)= 85.00
                MAXIMUM STORAGE USED (ha.m.)= 0.7308

```

```

-----
| DIVERTHYD( 0023) |
| IN= 1   # OUT= 5 |
-----

```

Outflow / Inflow Relationships

```

Flow 1 + Flow 2 + Flow 3 + Flow 4 + Flow 5 = Total
(cms)      (cms)      (cms)      (cms)      (cms)      (cms)
0.00      0.00      0.00      0.00      0.00      0.00
0.02      0.01      0.00      0.00      0.00      0.02
0.05      0.02      0.00      0.00      0.00      0.07
0.07      0.02      0.02      0.00      0.00      0.12
0.11      0.04      0.08      0.00      0.00      0.23
0.16      0.07      0.11      0.00      0.00      0.34
0.20      0.10      0.14      0.00      0.00      0.44
0.27      0.34      0.16      0.00      0.00      0.77
0.29      0.64      0.39      0.00      0.00      1.32
0.30      0.70      0.68      0.00      0.00      1.68
0.31      0.73      0.73      0.00      0.00      1.78
0.32      0.76      0.76      0.00      0.00      1.85
0.33      0.79      0.79      0.00      0.00      1.91
0.34      0.81      0.81      0.00      0.00      1.97
0.35      0.84      0.84      0.00      0.00      2.04
0.36      0.87      0.87      0.00      0.00      2.10
0.38      0.91      0.91      0.00      0.00      2.21
0.40      0.96      0.96      0.00      0.00      2.32
0.42      1.01      1.01      0.00      0.00      2.43
0.43      1.04      1.04      0.00      0.00      2.50

                AREA      QPEAK      TPEAK      R.V.
                (ha)      (cms)      (hrs)      (mm)
TOTAL HYD. (ID= 1):    32.52      0.67      2.92      34.51
=====
ID= 2 ( 3) :    16.57      0.25      2.92      34.51
ID= 3 ( 3) :     8.99      0.26      2.92      34.51
ID= 4 ( 3) :     6.96      0.15      2.92      34.51
ID= 5 ( 3) :     0.00      0.00      0.00      0.00
ID= 6 ( 3) :     0.00      0.00      0.00      0.00

```

```

-----
| ROUTEPIPE( 0028) |      PIPE Number      =    1.00
| IN= 2---> OUT= 1 |      Diameter (mm)=1650.00
| DT=  5.0 min    |      Length (m)= 500.00

```

----- Slope (m/m)= 0.005
Manning n = 0.013

<----- TRAVEL TIME TABLE ----->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	8.99	0.26	2.92	34.51	0.22	1.43
OUTFLOW: ID= 1 (0028)	8.99	0.26	3.00	34.51	0.22	1.43

| ROUTEPIPE(0030) | PIPE Number = 1.00
| IN= 2---> OUT= 1 | Diameter (mm)=1650.00
| DT= 5.0 min | Length (m)= 500.00
----- Slope (m/m)= 0.005
Manning n = 0.013

<----- TRAVEL TIME TABLE ----->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	6.96	0.15	2.92	34.51	0.17	1.25
OUTFLOW: ID= 1 (0030)	6.96	0.15	3.00	34.51	0.17	1.25

```

-----
| CALIB |
| STANDHYD ( 0019) | Area (ha)= 6.99
| ID= 1 DT= 5.0 min | Total Imp(%)= 28.00 Dir. Conn.(%)= 28.00
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.96	5.03
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	0.64	1.23
Length	(m)=	215.87	712.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
      hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083   6.55 | 0.833 26.53 | 1.583 12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667 12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750 10.53 | 2.50   6.87
0.333   7.79 | 1.083 33.08 | 1.833 10.53 | 2.58   6.36
0.417   9.78 | 1.167 33.08 | 1.917  9.23 | 2.67   6.36
0.500   9.78 | 1.250 20.27 | 2.000  9.23 | 2.75   5.93
0.583  13.66 | 1.333 20.27 | 2.083  8.25 | 2.83   5.93
0.667  13.66 | 1.417 15.20 | 2.167  8.25 | 2.92   5.57
0.750  26.53 | 1.500 15.20 | 2.250  7.49 | 3.00   5.57

```

Max.Eff.Inten. (mm/hr)=	186.64	24.61
over (min)	5.00	85.00
Storage Coeff. (min)=	3.61 (ii)	84.11 (ii)
Unit Hyd. Tpeak (min)=	5.00	85.00
Unit Hyd. peak (cms)=	0.25	0.01

TOTALS

PEAK FLOW (cms)=	0.96	0.15	0.968 (iii)
TIME TO PEAK (hrs)=	1.00	2.42	1.00
RUNOFF VOLUME (mm)=	63.35	31.37	40.32
TOTAL RAINFALL (mm)=	65.35	65.35	65.35
RUNOFF COEFFICIENT =	0.97	0.48	0.62

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 82.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0029) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
----- (ha) (cms) (hrs) (mm)
ID1= 1 ( 0019): 6.99 0.968 1.00 40.32
+ ID2= 2 ( 0028): 8.99 0.263 3.00 34.51
=====
ID = 3 ( 0029): 15.98 0.969 1.00 37.05

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0029) |

```

3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
-----	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (0029):	15.98	0.969	1.00	37.05
+ ID2= 2 (0030):	6.96	0.152	3.00	34.51
=====				
ID = 1 (0029):	22.94	0.969	1.00	36.28

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ROUTEPIPE(0032)	PIPE Number	=	1.00
IN= 2---> OUT= 1	Diameter	(mm)=	1650.00
DT= 5.0 min	Length	(m)=	500.00
-----	Slope	(m/m)=	0.005
	Manning n	=	0.013

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	16.57	0.25	2.92	34.51	0.22	1.41
OUTFLOW: ID= 1 (0032)	16.57	0.25	3.00	34.51	0.22	1.41

CALIB	
NASHYD (0018)	Area (ha)= 0.94 Curve Number (CN)= 84.0
ID= 1 DT= 5.0 min	Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----	U.H. Tp(hrs)= 0.12

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.299

PEAK FLOW (cms)= 0.169 (i)
TIME TO PEAK (hrs)= 1.000
RUNOFF VOLUME (mm)= 33.922
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.519

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0033) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
|-----| (ha) (cms) (hrs) (mm)
ID1= 1 ( 0018): 0.94 0.169 1.00 33.92
+ ID2= 2 ( 0032): 16.57 0.252 3.00 34.51
=====
ID = 3 ( 0033): 17.51 0.263 2.92 34.48
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| CALIB |
| NASHYD ( 0034) | Area (ha)= 6.82 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res. (N)= 3.00
|-----| U.H. Tp(hrs)= 0.50
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57
```

Unit Hyd Qpeak (cms)= 0.521

PEAK FLOW (cms)= 0.431 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 33.117
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.507

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| NASHYD ( 0035) | Area (ha)= 12.17 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res. (N)= 3.00
|-----| U.H. Tp(hrs)= 0.55
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
```


hrs	mm/hr		hrs	mm/hr		hrs	mm/hr		hrs	mm/hr
0.083	6.55		0.833	26.53		1.583	12.37		2.33	7.49
0.167	6.55		0.917	186.64		1.667	12.37		2.42	6.87
0.250	7.79		1.000	186.64		1.750	10.53		2.50	6.87
0.333	7.79		1.083	33.08		1.833	10.53		2.58	6.36
0.417	9.78		1.167	33.08		1.917	9.23		2.67	6.36
0.500	9.78		1.250	20.27		2.000	9.23		2.75	5.93
0.583	13.66		1.333	20.27		2.083	8.25		2.83	5.93
0.667	13.66		1.417	15.20		2.167	8.25		2.92	5.57
0.750	26.53		1.500	15.20		2.250	7.49		3.00	5.57

Unit Hyd Qpeak (cms)= 0.845

PEAK FLOW (cms)= 0.749 (i)
 TIME TO PEAK (hrs)= 1.583
 RUNOFF VOLUME (mm)= 34.380
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.526

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0036) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min      |
-----
| OUTFLOW          | STORAGE          | OUTFLOW          | STORAGE          |
| (cms)            | (ha.m.)          | (cms)            | (ha.m.)          |
| 0.0000           | 0.0000           | 0.9922           | 0.4686           |
| 0.0150           | 0.0403           | 1.3581           | 0.5239           |
| 0.0508           | 0.0819           | 1.4554           | 0.5809           |
| 0.0745           | 0.1250           | 1.5104           | 0.6396           |
| 0.1065           | 0.1696           | 1.5636           | 0.6999           |
| 0.1567           | 0.2156           | 1.6156           | 0.7620           |
| 0.1928           | 0.2631           | 1.6657           | 0.8257           |
| 0.2872           | 0.3021           | 1.7150           | 0.8913           |
| 0.4020           | 0.3627           | 1.7631           | 0.9586           |
| 0.5684           | 0.4149           | 1.8561           | 1.0987           |

```

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0035)	12.170	0.749	1.58	34.38
OUTFLOW: ID= 1 (0036)	12.170	0.219	3.08	34.32

PEAK FLOW REDUCTION [Qout/Qin] (%)= 29.25
 TIME SHIFT OF PEAK FLOW (min)= 90.00
 MAXIMUM STORAGE USED (ha.m.)= 0.2741

```

-----
| ADD HYD ( 0037) |
| 1 + 2 = 3       |
-----
| ID1= 1 ( 0034): | AREA   QPEAK   TPEAK   R.V.
| + ID2= 2 ( 0036): | (ha)   (cms)   (hrs)   (mm)
| =====
| ID = 3 ( 0037):  | 18.99  0.495   1.58   33.89

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB          |
| NASHYD ( 0045) | Area   (ha)= 2.10 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia     (mm)= 4.30 # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= 0.14

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.573

PEAK FLOW (cms)= 0.313 (i)

TIME TO PEAK (hrs)= 1.083

RUNOFF VOLUME (mm)= 31.669

TOTAL RAINFALL (mm)= 65.350

RUNOFF COEFFICIENT = 0.485

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | NASHYD (0046) | Area (ha)= 1.31 Curve Number (CN)= 82.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res.(N)= 3.00

 U.H. Tp(hrs)= 0.08

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.625

PEAK FLOW (cms)= 0.288 (i)

TIME TO PEAK (hrs)= 1.000

RUNOFF VOLUME (mm)= 30.101

TOTAL RAINFALL (mm)= 65.350

RUNOFF COEFFICIENT = 0.461

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | NASHYD (0047) | Area (ha)= 1.89 Curve Number (CN)= 83.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00

 U.H. Tp(hrs)= 0.22

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.328

PEAK FLOW (cms)= 0.219 (i)

TIME TO PEAK (hrs)= 1.167

RUNOFF VOLUME (mm)= 33.075

TOTAL RAINFALL (mm)= 65.350

RUNOFF COEFFICIENT = 0.506

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

Alternative Method 2
100-year 4-hour Chicago

V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\8d8bd1e4-de99-4c23-afa2-3b0e4eafb146\s
Summary filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\8d8bd1e4-de99-4c23-afa2-3b0e4eafb146\s

DATE: 07-15-2025 TIME: 09:58:34

USER:

COMMENTS:

** SIMULATION : 100-year-4hr-Chicago **

| CHICAGO STORM | IDF curve parameters: A=1032.793
| Ptotal= 70.38 mm | B= 0.000
C= 0.743

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

Table with 8 columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. Rows show rainfall intensity data at various time intervals.

| CALIB |
| NASHYD (0011) | Area (ha)= 12.45 Curve Number (CN)= 82.0

|ID= 1 DT= 5.0 min | Ia (mm)= 3.10 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 1.03

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 0.462

PEAK FLOW (cms)= 0.479 (i)
TIME TO PEAK (hrs)= 2.500
RUNOFF VOLUME (mm)= 36.792
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.523

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0012) | Area (ha)= 28.74 Curve Number (CN)= 84.0
|ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 0.41

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 2.677

PEAK FLOW (cms)= 2.379 (i)
TIME TO PEAK (hrs)= 1.750
RUNOFF VOLUME (mm)= 39.464
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.561

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0031) | Area (ha)= 25.07 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.80 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.14

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083  5.06 | 1.083  26.53 | 2.083  10.53 | 3.08  5.93
0.167  5.06 | 1.167  26.53 | 2.167  10.53 | 3.17  5.93
0.250  5.69 | 1.250 186.64 | 2.250   9.23 | 3.25  5.57
0.333  5.69 | 1.333 186.64 | 2.333   9.23 | 3.33  5.57
0.417  6.55 | 1.417  33.08 | 2.417   8.25 | 3.42  5.25
0.500  6.55 | 1.500  33.08 | 2.500   8.25 | 3.50  5.25
0.583  7.79 | 1.583  20.27 | 2.583   7.49 | 3.58  4.97
0.667  7.79 | 1.667  20.27 | 2.667   7.49 | 3.67  4.97
0.750  9.78 | 1.750  15.20 | 2.750   6.87 | 3.75  4.72
0.833  9.78 | 1.833  15.20 | 2.833   6.87 | 3.83  4.72
0.917 13.66 | 1.917  12.37 | 2.917   6.36 | 3.92  4.51
1.000 13.66 | 2.000  12.37 | 3.000   6.36 | 4.00  4.51

```

Unit Hyd Qpeak (cms)= 0.840

PEAK FLOW (cms)= 0.901 (i)
 TIME TO PEAK (hrs)= 2.667
 RUNOFF VOLUME (mm)= 37.031
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.526

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0041) | Area (ha)= 10.73 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083  5.06 | 1.083  26.53 | 2.083  10.53 | 3.08  5.93
0.167  5.06 | 1.167  26.53 | 2.167  10.53 | 3.17  5.93
0.250  5.69 | 1.250 186.64 | 2.250   9.23 | 3.25  5.57
0.333  5.69 | 1.333 186.64 | 2.333   9.23 | 3.33  5.57
0.417  6.55 | 1.417  33.08 | 2.417   8.25 | 3.42  5.25
0.500  6.55 | 1.500  33.08 | 2.500   8.25 | 3.50  5.25
0.583  7.79 | 1.583  20.27 | 2.583   7.49 | 3.58  4.97
0.667  7.79 | 1.667  20.27 | 2.667   7.49 | 3.67  4.97
0.750  9.78 | 1.750  15.20 | 2.750   6.87 | 3.75  4.72
0.833  9.78 | 1.833  15.20 | 2.833   6.87 | 3.83  4.72
0.917 13.66 | 1.917  12.37 | 2.917   6.36 | 3.92  4.51
1.000 13.66 | 2.000  12.37 | 3.000   6.36 | 4.00  4.51

```

Unit Hyd Qpeak (cms)= 0.366

PEAK FLOW (cms)= 0.403 (i)
 TIME TO PEAK (hrs)= 2.667
 RUNOFF VOLUME (mm)= 38.105
 TOTAL RAINFALL (mm)= 70.382

RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0051) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0012):  28.74  2.379    1.75    39.46
+ ID2= 2 ( 0031):  25.07  0.901    2.67    37.03
=====
ID = 3 ( 0051):  53.81  2.818    1.75    38.33
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0051) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0051):  53.81  2.818    1.75    38.33
+ ID2= 2 ( 0041):  10.73  0.403    2.67    38.10
=====
ID = 1 ( 0051):  64.54  3.051    1.83    38.29
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| RESERVOIR( 0002) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          OUTFLOW      STORAGE      | OUTFLOW      STORAGE
          (cms)      (ha.m.)      | (cms)      (ha.m.)
0.0000      0.0000      | 1.3450      2.1963
0.0302      0.2196      | 2.0056      2.4160
0.1060      0.4393      | 2.9861      2.6356
0.1484      0.6589      | 5.1073      3.0749
0.1976      0.8785      | 6.4750      3.5141
0.2620      1.0982      | 6.9124      3.9534
0.3256      1.3178      | 7.3312      4.3927
0.4719      1.5374      | 7.7329      4.8319
0.6161      1.7571      | 8.1186      5.2712
0.8070      1.9767      | 0.0000      0.0000
```

```

          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0051)  64.540      3.051      1.83      38.29
OUTFLOW: ID= 1 ( 0002)  64.540      0.660      4.67      38.26
```

PEAK FLOW REDUCTION [Qout/Qin] (%) = 21.64
TIME SHIFT OF PEAK FLOW (min) = 170.00
MAXIMUM STORAGE USED (ha.m.) = 1.8084

```
-----
| CALIB |
| NASHYD ( 0021) | Area (ha) = 19.40 Curve Number (CN) = 81.0
| ID= 1 DT= 5.0 min | Ia (mm) = 3.00 # of Linear Res. (N) = 3.00
-----
          U.H. Tp(hrs) = 0.66
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083      5.06 | 1.083     26.53 | 2.083     10.53 | 3.08      5.93
```

0.167	5.06		1.167	26.53		2.167	10.53		3.17	5.93
0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57
0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 1.123

PEAK FLOW (cms)= 1.007 (i)
 TIME TO PEAK (hrs)= 2.083
 RUNOFF VOLUME (mm)= 35.760
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.508

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0042) | Area (ha)= 40.21 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.20
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08     5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17     5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25     5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33     5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42     5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50     5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58     4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67     4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75     4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83     4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92     4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00     4.51
  
```

Unit Hyd Qpeak (cms)= 1.280

PEAK FLOW (cms)= 1.490 (i)
 TIME TO PEAK (hrs)= 2.750
 RUNOFF VOLUME (mm)= 39.468
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.561

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0001) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
OUTFLOW    STORAGE | OUTFLOW    STORAGE
(cms)      (ha.m.) | (cms)      (ha.m.)
0.0000     0.0000 | 0.7119     0.9480
0.0123     0.0780 | 1.9253     1.1420
0.0329     0.1570 | 2.5634     1.3440
0.0407     0.2380 | 2.7870     1.5530
  
```


0.0476	0.3210		2.9936	1.7700
0.0805	0.4060		3.1872	1.9930
0.1414	0.4920		3.3696	2.2250
0.1808	0.5790		3.6262	2.5860
0.2708	0.6690		3.7476	2.7730
0.4375	0.7600		0.0000	0.0000

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0042)	40.210	1.490	2.75	39.47
OUTFLOW: ID= 1 (0001)	40.210	0.704	4.67	39.43

PEAK FLOW REDUCTION [Qout/Qin](%)= 47.22
 TIME SHIFT OF PEAK FLOW (min)=115.00
 MAXIMUM STORAGE USED (ha.m.)= 0.9427

```

-----
| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0001):  40.21  0.704    4.67   39.43
+ ID2= 2 ( 0011):  12.45  0.479    2.50   36.79
=====
ID = 3 ( 0052):  52.66  0.914    4.25   38.81
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0052) |
| 3 + 2 = 1 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0052):  52.66  0.914    4.25   38.81
+ ID2= 2 ( 0002):  64.54  0.660    4.67   38.26
=====
ID = 1 ( 0052):  117.20  1.558    4.42   38.51
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0052):  117.20  1.558    4.42   38.51
+ ID2= 2 ( 0021):  19.40  1.007    2.08   35.76
=====
ID = 3 ( 0052):  136.60  1.794    4.08   38.12
  
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| NASHYD ( 0017) | Area (ha)= 33.05 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.55
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
      hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083    5.06 | 1.083    26.53 | 2.083    10.53 | 3.08    5.93
0.167    5.06 | 1.167    26.53 | 2.167    10.53 | 3.17    5.93
0.250    5.69 | 1.250   186.64 | 2.250     9.23 | 3.25    5.57
  
```

0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 2.295

PEAK FLOW (cms)= 2.147 (i)
TIME TO PEAK (hrs)= 1.917
RUNOFF VOLUME (mm)= 38.642
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.549

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0020) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min      |
-----

```

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	1.7783	1.1263
0.0245	0.1030	1.8455	1.2511
0.0690	0.2080	1.9113	1.3782
0.1181	0.3152	1.9743	1.5076
0.2257	0.4245	2.0363	1.6394
0.3402	0.5360	2.1548	1.9101
0.4374	0.6496	2.2669	2.1903
0.7664	0.7654	2.3755	2.4803
1.3220	0.8835	2.4795	2.7803
1.6822	1.0038	2.5047	2.8569

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0017)	33.050	2.147	1.92	38.64
OUTFLOW: ID= 1 (0020)	33.050	0.740	3.25	38.61

PEAK FLOW REDUCTION [Qout/Qin] (%)= 34.47
TIME SHIFT OF PEAK FLOW (min)= 80.00
MAXIMUM STORAGE USED (ha.m.)= 0.7565

```

-----
| DIVERTHYD( 0023) |
| IN= 1  # OUT= 5  |
-----

```

Outflow / Inflow Relationships

Flow 1 (cms)	Flow 2 (cms)	Flow 3 (cms)	Flow 4 (cms)	Flow 5 (cms)	Total (cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.01	0.00	0.00	0.00	0.02
0.05	0.02	0.00	0.00	0.00	0.07
0.07	0.02	0.02	0.00	0.00	0.12
0.11	0.04	0.08	0.00	0.00	0.23
0.16	0.07	0.11	0.00	0.00	0.34
0.20	0.10	0.14	0.00	0.00	0.44
0.27	0.34	0.16	0.00	0.00	0.77
0.29	0.64	0.39	0.00	0.00	1.32
0.30	0.70	0.68	0.00	0.00	1.68
0.31	0.73	0.73	0.00	0.00	1.78
0.32	0.76	0.76	0.00	0.00	1.85
0.33	0.79	0.79	0.00	0.00	1.91

0.34	0.81	0.81	0.00	0.00	1.97
0.35	0.84	0.84	0.00	0.00	2.04
0.36	0.87	0.87	0.00	0.00	2.10
0.38	0.91	0.91	0.00	0.00	2.21
0.40	0.96	0.96	0.00	0.00	2.32
0.42	1.01	1.01	0.00	0.00	2.43
0.43	1.04	1.04	0.00	0.00	2.50

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD. (ID= 1):	33.05	0.74	3.25	38.61
=====				
ID= 2 (3) :	16.24	0.27	3.25	38.61
ID= 3 (3) :	9.76	0.32	3.25	38.61
ID= 4 (3) :	7.05	0.16	3.25	38.61
ID= 5 (3) :	0.00	0.00	0.00	0.00
ID= 6 (3) :	0.00	0.00	0.00	0.00

```

-----
| ROUTEPIPE( 0028)|      PIPE Number      =    1.00
| IN= 2---> OUT= 1 |      Diameter      (mm)=1650.00
| DT=  5.0 min    |      Length        (m)= 500.00
-----
|                  |      Slope          (m/m)=  0.005
|                  |      Manning n      =    0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	9.76	0.32	3.25	38.61	0.25	1.54
OUTFLOW: ID= 1 (0028)	9.76	0.32	3.25	38.61	0.25	1.53

```

-----
| ROUTEPIPE( 0030)|      PIPE Number      =    1.00
| IN= 2---> OUT= 1 |      Diameter      (mm)=1650.00
| DT=  5.0 min    |      Length        (m)= 500.00
-----
|                  |      Slope          (m/m)=  0.005
|                  |      Manning n      =    0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67

0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	7.05	0.16	3.25	38.61	0.18	1.26
OUTFLOW: ID= 1 (0030)	7.05	0.16	3.33	38.61	0.18	1.26

```

| CALIB |
| STANDHYD ( 0019) | Area (ha)= 6.99
| ID= 1 DT= 5.0 min | Total Imp(%)= 28.00 Dir. Conn.(%)= 28.00

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.96	5.03
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	0.64	1.23
Length	(m)=	215.87	712.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Max.Eff.Inten.(mm/hr)=	186.64	25.57
over (min)	5.00	85.00
Storage Coeff. (min)=	3.61 (ii)	82.89 (ii)
Unit Hyd. Tpeak (min)=	5.00	85.00
Unit Hyd. peak (cms)=	0.25	0.01

TOTALS

PEAK FLOW (cms)=	0.96	0.16	0.969 (iii)
TIME TO PEAK (hrs)=	1.33	2.67	1.33
RUNOFF VOLUME (mm)=	68.38	35.29	44.55
TOTAL RAINFALL (mm)=	70.38	70.38	70.38
RUNOFF COEFFICIENT =	0.97	0.50	0.63

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 82.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0029) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0019):    6.99    0.969    1.33    44.55
+ ID2= 2 ( 0028):    9.76    0.316    3.25    38.61
=====
ID = 3 ( 0029):   16.75    0.970    1.33    41.09
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0029) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0029):   16.75    0.970    1.33    41.09
+ ID2= 2 ( 0030):    7.05    0.157    3.33    38.61
=====
ID = 1 ( 0029):   23.80    0.970    1.33    40.35
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ROUTEPIPE( 0032) |
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          PIPE Number      = 1.00
          Diameter (mm)=1650.00
          Length (m)= 500.00
          Slope (m/m)= 0.005
          Manning n      = 0.013
```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	16.24	0.27	3.25	38.61	0.22	1.44
OUTFLOW: ID= 1 (0032)	16.24	0.27	3.25	38.61	0.22	1.44

```

-----
| CALIB |
| NASHYD ( 0018) | Area (ha)= 0.94 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51

```

Unit Hyd Qpeak (cms)= 0.299

PEAK FLOW (cms)= 0.178 (i)
 TIME TO PEAK (hrs)= 1.333
 RUNOFF VOLUME (mm)= 37.965
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.539

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0033) |
| 1 + 2 = 3 |
-----
AREA    QPEAK    TPEAK    R.V.
(ha)    (cms)    (hrs)    (mm)
ID1= 1 ( 0018):  0.94  0.178  1.33  37.97
+ ID2= 2 ( 0032): 16.24  0.267  3.25  38.61
=====
ID = 3 ( 0033):  17.18  0.279  3.25  38.57

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| NASHYD ( 0034) | Area (ha)= 6.82 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.50

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57

```

0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 0.521

PEAK FLOW (cms)= 0.454 (i)
 TIME TO PEAK (hrs)= 1.833
 RUNOFF VOLUME (mm)= 37.133
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.528

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0035) | Area (ha)= 12.23 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.54

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN			
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr			
0.083	5.06		1.083	26.53		2.083	10.53		3.08	5.93
0.167	5.06		1.167	26.53		2.167	10.53		3.17	5.93
0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57
0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 0.865

PEAK FLOW (cms)= 0.800 (i)
 TIME TO PEAK (hrs)= 1.917
 RUNOFF VOLUME (mm)= 38.478
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.547

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0036) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----

```

OUTFLOW	STORAGE	OUTFLOW	STORAGE	
(cms)	(ha.m.)	(cms)	(ha.m.)	
0.0000	0.0000		0.9922	0.4686
0.0150	0.0403		1.3581	0.5239
0.0508	0.0819		1.4554	0.5809
0.0745	0.1250		1.5104	0.6396
0.1065	0.1696		1.5636	0.6999
0.1567	0.2156		1.6156	0.7620
0.1928	0.2631		1.6657	0.8257

0.2872	0.3021		1.7150	0.8913
0.4020	0.3627		1.7631	0.9586
0.5684	0.4149		1.8561	1.0987

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0035)	12.230	0.800	1.92	38.48
OUTFLOW: ID= 1 (0036)	12.230	0.242	3.33	38.42

PEAK FLOW REDUCTION [Qout/Qin] (%)= 30.28
TIME SHIFT OF PEAK FLOW (min)= 85.00
MAXIMUM STORAGE USED (ha.m.)= 0.2836

| ADD HYD (0037) |
1 + 2 = 3
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 (0034): 6.82 0.454 1.83 37.13
+ ID2= 2 (0036): 12.23 0.242 3.33 38.42
=====

ID = 3 (0037): 19.05 0.522 1.92 37.96

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| NASHYD (0045) | Area (ha)= 2.10 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.14

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 0.573

PEAK FLOW (cms)= 0.329 (i)
TIME TO PEAK (hrs)= 1.417
RUNOFF VOLUME (mm)= 35.572
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.505

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0046) | Area (ha)= 1.31 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.08

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51
```

Unit Hyd Qpeak (cms)= 0.625

PEAK FLOW (cms)= 0.301 (i)
TIME TO PEAK (hrs)= 1.333
RUNOFF VOLUME (mm)= 33.811
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.480

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| NASHYD ( 0047) | Area (ha)= 1.89 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.22
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51
```

Unit Hyd Qpeak (cms)= 0.328

PEAK FLOW (cms)= 0.230 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 37.086
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.527

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

Alternative Method 2
100-year 3-hour Chicago

V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\24ff2439-96ac-483e-8fee-940e8134ba3d\s
Summary filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\24ff2439-96ac-483e-8fee-940e8134ba3d\s

DATE: 07-15-2025 TIME: 09:58:33

USER:

COMMENTS:

** SIMULATION : 100-year-3hr-Chicago **

| CHICAGO STORM | IDF curve parameters: A=1032.793
| Ptotal= 65.35 mm | B= 0.000
C= 0.743

used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

Table with 8 columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. Rows show rainfall intensity data at various time intervals.

| CALIB |
| NASHYD (0011) | Area (ha)= 12.45 Curve Number (CN)= 82.0
|ID= 1 DT= 5.0 min | Ia (mm)= 3.10 # of Linear Res.(N)= 3.00

----- U.H. Tp(hrs)= 1.03

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.462

PEAK FLOW (cms)= 0.458 (i)
TIME TO PEAK (hrs)= 2.250
RUNOFF VOLUME (mm)= 32.837
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.502

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0012)	Area (ha)=	28.74	Curve Number (CN)=	84.0	
ID= 1 DT= 5.0 min	Ia (mm)=	2.70	# of Linear Res.(N)=	3.00	
-----	U.H. Tp(hrs)=	0.41			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 2.677

PEAK FLOW (cms)= 2.273 (i)
TIME TO PEAK (hrs)= 1.417
RUNOFF VOLUME (mm)= 35.347
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0031)	Area (ha)=	25.07	Curve Number (CN)=	82.0	
ID= 1 DT= 5.0 min	Ia (mm)=	2.80	# of Linear Res.(N)=	3.00	
-----	U.H. Tp(hrs)=	1.14			

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

      ---- TRANSFORMED HYETOGRAPH ----
      TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
      hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083   6.55 | 0.833 26.53 | 1.583 12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667 12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750 10.53 | 2.50   6.87
0.333   7.79 | 1.083 33.08 | 1.833 10.53 | 2.58   6.36
0.417   9.78 | 1.167 33.08 | 1.917  9.23 | 2.67   6.36
0.500   9.78 | 1.250 20.27 | 2.000  9.23 | 2.75   5.93
0.583  13.66 | 1.333 20.27 | 2.083  8.25 | 2.83   5.93
0.667  13.66 | 1.417 15.20 | 2.167  8.25 | 2.92   5.57
0.750  26.53 | 1.500 15.20 | 2.250  7.49 | 3.00   5.57

```

Unit Hyd Qpeak (cms)= 0.840

PEAK FLOW (cms)= 0.861 (i)
TIME TO PEAK (hrs)= 2.333
RUNOFF VOLUME (mm)= 33.071
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.506

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0041) | Area (ha)= 10.73 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

      ---- TRANSFORMED HYETOGRAPH ----
      TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
      hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083   6.55 | 0.833 26.53 | 1.583 12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667 12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750 10.53 | 2.50   6.87
0.333   7.79 | 1.083 33.08 | 1.833 10.53 | 2.58   6.36
0.417   9.78 | 1.167 33.08 | 1.917  9.23 | 2.67   6.36
0.500   9.78 | 1.250 20.27 | 2.000  9.23 | 2.75   5.93
0.583  13.66 | 1.333 20.27 | 2.083  8.25 | 2.83   5.93
0.667  13.66 | 1.417 15.20 | 2.167  8.25 | 2.92   5.57
0.750  26.53 | 1.500 15.20 | 2.250  7.49 | 3.00   5.57

```

Unit Hyd Qpeak (cms)= 0.366

PEAK FLOW (cms)= 0.386 (i)
TIME TO PEAK (hrs)= 2.333
RUNOFF VOLUME (mm)= 34.068
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.521

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0051) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
----- (ha) (cms) (hrs) (mm)
ID1= 1 ( 0012): 28.74 2.273 1.42 35.35
+ ID2= 2 ( 0031): 25.07 0.861 2.33 33.07
=====

```

ID = 3 (0051): 53.81 2.685 1.50 34.29

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0051) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0051): 53.81 2.685 1.50 34.29
+ ID2= 2 ( 0041): 10.73 0.386 2.33 34.07
=====
ID = 1 ( 0051): 64.54 2.908 1.50 34.25
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| RESERVOIR( 0002) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          OUTFLOW      STORAGE      OUTFLOW      STORAGE
          (cms)      (ha.m.)      (cms)      (ha.m.)
0.0000 0.0000 | 1.3450 2.1963
0.0302 0.2196 | 2.0056 2.4160
0.1060 0.4393 | 2.9861 2.6356
0.1484 0.6589 | 5.1073 3.0749
0.1976 0.8785 | 6.4750 3.5141
0.2620 1.0982 | 6.9124 3.9534
0.3256 1.3178 | 7.3312 4.3927
0.4719 1.5374 | 7.7329 4.8319
0.6161 1.7571 | 8.1186 5.2712
0.8070 1.9767 | 0.0000 0.0000

          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0051) 64.540 2.908 1.50 34.25
OUTFLOW: ID= 1 ( 0002) 64.540 0.561 4.17 34.22

PEAK FLOW REDUCTION [Qout/Qin](%)= 19.29
TIME SHIFT OF PEAK FLOW (min)=160.00
MAXIMUM STORAGE USED (ha.m.)= 1.6733
```

```
-----
| CALIB |
| NASHYD ( 0021) | Area (ha)= 19.40 Curve Number (CN)= 81.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.00 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.66
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
-----
          ---- TRANSFORMED HYETOGRAPH ----
          TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
          hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57
```

Unit Hyd Qpeak (cms)= 1.123

PEAK FLOW (cms)= 0.960 (i)
TIME TO PEAK (hrs)= 1.750

RUNOFF VOLUME (mm)= 31.882
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.488

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0042) | Area (ha)= 40.21 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00

U.H. Tp(hrs)= 1.20

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57

Unit Hyd Qpeak (cms)= 1.280

PEAK FLOW (cms)= 1.428 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 35.350
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| RESERVOIR(0001) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
DT= 5.0 min
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.7119 0.9480
0.0123 0.0780 | 1.9253 1.1420
0.0329 0.1570 | 2.5634 1.3440
0.0407 0.2380 | 2.7870 1.5530
0.0476 0.3210 | 2.9936 1.7700
0.0805 0.4060 | 3.1872 1.9930
0.1414 0.4920 | 3.3696 2.2250
0.1808 0.5790 | 3.6262 2.5860
0.2708 0.6690 | 3.7476 2.7730
0.4375 0.7600 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0042) 40.210 1.428 2.42 35.35
OUTFLOW: ID= 1 (0001) 40.210 0.635 4.25 35.31

PEAK FLOW REDUCTION [Qout/Qin] (%)= 44.51
TIME SHIFT OF PEAK FLOW (min)=110.00
MAXIMUM STORAGE USED (ha.m.)= 0.8958


```

| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0001):  40.21  0.635  4.25  35.31
+ ID2= 2 ( 0011):  12.45  0.458  2.25  32.84
=====
ID = 3 ( 0052):  52.66  0.830  3.67  34.73

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| ADD HYD ( 0052) |
| 3 + 2 = 1 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0052):  52.66  0.830  3.67  34.73
+ ID2= 2 ( 0002):  64.54  0.561  4.17  34.22
=====
ID = 1 ( 0052):  117.20  1.378  3.83  34.45

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0052):  117.20  1.378  3.83  34.45
+ ID2= 2 ( 0021):  19.40  0.960  1.75  31.88
=====
ID = 3 ( 0052):  136.60  1.621  3.33  34.08

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| CALIB |
| NASHYD ( 0017) | Area (ha)= 33.05 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.55

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
      hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083  6.55 | 0.833  26.53 | 1.583  12.37 | 2.33  7.49
0.167  6.55 | 0.917  186.64 | 1.667  12.37 | 2.42  6.87
0.250  7.79 | 1.000  186.64 | 1.750  10.53 | 2.50  6.87
0.333  7.79 | 1.083  33.08 | 1.833  10.53 | 2.58  6.36
0.417  9.78 | 1.167  33.08 | 1.917  9.23 | 2.67  6.36
0.500  9.78 | 1.250  20.27 | 2.000  9.23 | 2.75  5.93
0.583  13.66 | 1.333  20.27 | 2.083  8.25 | 2.83  5.93
0.667  13.66 | 1.417  15.20 | 2.167  8.25 | 2.92  5.57
0.750  26.53 | 1.500  15.20 | 2.250  7.49 | 3.00  5.57

```

Unit Hyd Qpeak (cms)= 2.295

PEAK FLOW (cms)= 2.045 (i)
TIME TO PEAK (hrs)= 1.583
RUNOFF VOLUME (mm)= 34.541
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.529

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

| RESERVOIR( 0020)|      OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min    |
-----
      OUTFLOW      STORAGE      |      OUTFLOW      STORAGE
      (cms)        (ha.m.)      |      (cms)        (ha.m.)
      0.0000      0.0000      |      1.7783      1.1263
      0.0245      0.1030      |      1.8455      1.2511
      0.0690      0.2080      |      1.9113      1.3782
      0.1181      0.3152      |      1.9743      1.5076
      0.2257      0.4245      |      2.0363      1.6394
      0.3402      0.5360      |      2.1548      1.9101
      0.4374      0.6496      |      2.2669      2.1903
      0.7664      0.7654      |      2.3755      2.4803
      1.3220      0.8835      |      2.4795      2.7803
      1.6822      1.0038      |      2.5047      2.8569

      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0017)      33.050      2.045      1.58      34.54
OUTFLOW: ID= 1 ( 0020)      33.050      0.685      2.92      34.51

      PEAK FLOW REDUCTION [Qout/Qin](%)= 33.48
      TIME SHIFT OF PEAK FLOW (min)= 80.00
      MAXIMUM STORAGE USED (ha.m.)= 0.7370

```

```

-----
| DIVERTHYD( 0023)|
| IN= 1   # OUT= 5 |
-----

```

Outflow / Inflow Relationships

```

Flow 1 + Flow 2 + Flow 3 + Flow 4 + Flow 5 = Total
(cms)      (cms)      (cms)      (cms)      (cms)      (cms)
0.00      0.00      0.00      0.00      0.00      0.00
0.02      0.01      0.00      0.00      0.00      0.02
0.05      0.02      0.00      0.00      0.00      0.07
0.07      0.02      0.02      0.00      0.00      0.12
0.11      0.04      0.08      0.00      0.00      0.23
0.16      0.07      0.11      0.00      0.00      0.34
0.20      0.10      0.14      0.00      0.00      0.44
0.27      0.34      0.16      0.00      0.00      0.77
0.29      0.64      0.39      0.00      0.00      1.32
0.30      0.70      0.68      0.00      0.00      1.68
0.31      0.73      0.73      0.00      0.00      1.78
0.32      0.76      0.76      0.00      0.00      1.85
0.33      0.79      0.79      0.00      0.00      1.91
0.34      0.81      0.81      0.00      0.00      1.97
0.35      0.84      0.84      0.00      0.00      2.04
0.36      0.87      0.87      0.00      0.00      2.10
0.38      0.91      0.91      0.00      0.00      2.21
0.40      0.96      0.96      0.00      0.00      2.32
0.42      1.01      1.01      0.00      0.00      2.43
0.43      1.04      1.04      0.00      0.00      2.50

      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
TOTAL HYD. (ID= 1):      33.05      0.68      2.92      34.51
=====
ID= 2 ( 3) :      16.75      0.26      2.92      34.51
ID= 3 ( 3) :      9.24      0.28      2.92      34.51
ID= 4 ( 3) :      7.06      0.15      2.92      34.51
ID= 5 ( 3) :      0.00      0.00      0.00      0.00
ID= 6 ( 3) :      0.00      0.00      0.00      0.00

```

```

-----
| ROUTEPIPE( 0028)|      PIPE Number      =      1.00
| IN= 2---> OUT= 1 |      Diameter (mm)=1650.00
| DT=  5.0 min    |      Length (m)= 500.00

```


----- Slope (m/m)= 0.005
Manning n = 0.013

<----- TRAVEL TIME TABLE ----->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	9.24	0.28	2.92	34.51	0.23	1.46
OUTFLOW: ID= 1 (0028)	9.24	0.28	3.00	34.51	0.23	1.45

| ROUTEPIPE(0030) | PIPE Number = 1.00
| IN= 2---> OUT= 1 | Diameter (mm)=1650.00
| DT= 5.0 min | Length (m)= 500.00
----- Slope (m/m)= 0.005
Manning n = 0.013

<----- TRAVEL TIME TABLE ----->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	7.06	0.15	2.92	34.51	0.18	1.25
OUTFLOW: ID= 1 (0030)	7.06	0.15	3.00	34.51	0.17	1.25

```

-----
| CALIB |
| STANDHYD ( 0019) | Area (ha)= 6.99
| ID= 1 DT= 5.0 min | Total Imp(%)= 28.00 Dir. Conn.(%)= 28.00
-----

```

```

                IMPERVIOUS    PERVIOUS (i)
Surface Area    (ha)=        1.96        5.03
Dep. Storage    (mm)=        2.00        5.00
Average Slope    (%)=        0.64        1.23
Length          (m)=       215.87       712.00
Mannings n      =         0.013        0.250

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
      hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083   6.55 | 0.833 26.53 | 1.583 12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667 12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750 10.53 | 2.50   6.87
0.333   7.79 | 1.083 33.08 | 1.833 10.53 | 2.58   6.36
0.417   9.78 | 1.167 33.08 | 1.917  9.23 | 2.67   6.36
0.500   9.78 | 1.250 20.27 | 2.000  9.23 | 2.75   5.93
0.583  13.66 | 1.333 20.27 | 2.083  8.25 | 2.83   5.93
0.667  13.66 | 1.417 15.20 | 2.167  8.25 | 2.92   5.57
0.750  26.53 | 1.500 15.20 | 2.250  7.49 | 3.00   5.57

```

```

Max.Eff.Inten.(mm/hr)= 186.64 24.61
over (min)           5.00 85.00
Storage Coeff. (min)= 3.61 (ii) 84.11 (ii)
Unit Hyd. Tpeak (min)= 5.00 85.00
Unit Hyd. peak (cms)= 0.25 0.01

```

TOTALS

```

PEAK FLOW (cms)= 0.96 0.15 0.968 (iii)
TIME TO PEAK (hrs)= 1.00 2.42 1.00
RUNOFF VOLUME (mm)= 63.35 31.37 40.32
TOTAL RAINFALL (mm)= 65.35 65.35 65.35
RUNOFF COEFFICIENT = 0.97 0.48 0.62

```

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 82.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0029) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
----- (ha) (cms) (hrs) (mm)
ID1= 1 ( 0019): 6.99 0.968 1.00 40.32
+ ID2= 2 ( 0028): 9.24 0.276 3.00 34.51
=====
ID = 3 ( 0029): 16.23 0.969 1.00 37.01

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0029) |

```

3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
-----	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (0029):	16.23	0.969	1.00	37.01
+ ID2= 2 (0030):	7.06	0.153	3.00	34.51
=====				
ID = 1 (0029):	23.29	0.969	1.00	36.25

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ROUTEPIPE(0032)	PIPE Number	=	1.00
IN= 2---> OUT= 1	Diameter	(mm)=	1650.00
DT= 5.0 min	Length	(m)=	500.00
-----	Slope	(m/m)=	0.005
	Manning n	=	0.013

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	16.75	0.26	2.92	34.51	0.22	1.42
OUTFLOW: ID= 1 (0032)	16.75	0.25	3.00	34.51	0.22	1.41

CALIB	
NASHYD (0018)	Area (ha)= 0.94 Curve Number (CN)= 84.0
ID= 1 DT= 5.0 min	Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----	U.H. Tp(hrs)= 0.12

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.299

PEAK FLOW (cms)= 0.169 (i)
TIME TO PEAK (hrs)= 1.000
RUNOFF VOLUME (mm)= 33.922
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.519

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0033) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0018):    0.94    0.169      1.00    33.92
+ ID2= 2 ( 0032):   16.75    0.255      3.00    34.51
=====
ID = 3 ( 0033):   17.69    0.267      3.00    34.48
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| CALIB |
| NASHYD ( 0034) | Area (ha)= 6.82 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res. (N)= 3.00
-----
          U.H. Tp(hrs)= 0.50
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083    6.55 | 0.833    26.53 | 1.583    12.37 | 2.33     7.49
0.167    6.55 | 0.917    186.64 | 1.667    12.37 | 2.42     6.87
0.250    7.79 | 1.000    186.64 | 1.750    10.53 | 2.50     6.87
0.333    7.79 | 1.083    33.08 | 1.833    10.53 | 2.58     6.36
0.417    9.78 | 1.167    33.08 | 1.917     9.23 | 2.67     6.36
0.500    9.78 | 1.250    20.27 | 2.000     9.23 | 2.75     5.93
0.583   13.66 | 1.333    20.27 | 2.083     8.25 | 2.83     5.93
0.667   13.66 | 1.417    15.20 | 2.167     8.25 | 2.92     5.57
0.750   26.53 | 1.500    15.20 | 2.250     7.49 | 3.00     5.57
```

Unit Hyd Qpeak (cms)= 0.521

PEAK FLOW (cms)= 0.431 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 33.117
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.507

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| NASHYD ( 0035) | Area (ha)= 12.23 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res. (N)= 3.00
-----
          U.H. Tp(hrs)= 0.54
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
```

hrs	mm/hr		hrs	mm/hr		hrs	mm/hr		hrs	mm/hr
0.083	6.55		0.833	26.53		1.583	12.37		2.33	7.49
0.167	6.55		0.917	186.64		1.667	12.37		2.42	6.87
0.250	7.79		1.000	186.64		1.750	10.53		2.50	6.87
0.333	7.79		1.083	33.08		1.833	10.53		2.58	6.36
0.417	9.78		1.167	33.08		1.917	9.23		2.67	6.36
0.500	9.78		1.250	20.27		2.000	9.23		2.75	5.93
0.583	13.66		1.333	20.27		2.083	8.25		2.83	5.93
0.667	13.66		1.417	15.20		2.167	8.25		2.92	5.57
0.750	26.53		1.500	15.20		2.250	7.49		3.00	5.57

Unit Hyd Qpeak (cms)= 0.865

PEAK FLOW (cms)= 0.762 (i)
 TIME TO PEAK (hrs)= 1.583
 RUNOFF VOLUME (mm)= 34.380
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.526

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0036) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min      |
-----
| OUTFLOW          | STORAGE          | OUTFLOW          | STORAGE          |
| (cms)            | (ha.m.)          | (cms)            | (ha.m.)          |
| 0.0000           | 0.0000           | 0.9922           | 0.4686           |
| 0.0150           | 0.0403           | 1.3581           | 0.5239           |
| 0.0508           | 0.0819           | 1.4554           | 0.5809           |
| 0.0745           | 0.1250           | 1.5104           | 0.6396           |
| 0.1065           | 0.1696           | 1.5636           | 0.6999           |
| 0.1567           | 0.2156           | 1.6156           | 0.7620           |
| 0.1928           | 0.2631           | 1.6657           | 0.8257           |
| 0.2872           | 0.3021           | 1.7150           | 0.8913           |
| 0.4020           | 0.3627           | 1.7631           | 0.9586           |
| 0.5684           | 0.4149           | 1.8561           | 1.0987           |

```

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0035)	12.230	0.762	1.58	34.38
OUTFLOW: ID= 1 (0036)	12.230	0.222	3.08	34.32

PEAK FLOW REDUCTION [Qout/Qin] (%)= 29.14
 TIME SHIFT OF PEAK FLOW (min)= 90.00
 MAXIMUM STORAGE USED (ha.m.)= 0.2753

```

-----
| ADD HYD ( 0037) |
| 1 + 2 = 3       |
-----
| ID1= 1 ( 0034): | AREA   QPEAK  TPEAK  R.V.
| + ID2= 2 ( 0036): | (ha)   (cms)   (hrs)   (mm)
| =====
| ID = 3 ( 0037): | 19.05  0.497   1.58   33.89

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB          |
| NASHYD ( 0045) | Area   (ha)= 2.10  Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia     (mm)= 4.30  # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= 0.14

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.573

PEAK FLOW (cms)= 0.313 (i)
 TIME TO PEAK (hrs)= 1.083
 RUNOFF VOLUME (mm)= 31.669
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.485

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | NASHYD (0046) | Area (ha)= 1.31 Curve Number (CN)= 82.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res.(N)= 3.00

 U.H. Tp(hrs)= 0.08

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.625

PEAK FLOW (cms)= 0.288 (i)
 TIME TO PEAK (hrs)= 1.000
 RUNOFF VOLUME (mm)= 30.101
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.461

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | NASHYD (0047) | Area (ha)= 1.89 Curve Number (CN)= 83.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00

 U.H. Tp(hrs)= 0.22

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.328

PEAK FLOW (cms)= 0.219 (i)

TIME TO PEAK (hrs)= 1.167

RUNOFF VOLUME (mm)= 33.075

TOTAL RAINFALL (mm)= 65.350

RUNOFF COEFFICIENT = 0.506

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

Alternative Method 3
100-year 4-hour Chicago

V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\6b665f1c-f49f-4b45-b43e-935b6c3980b7\s
Summary filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\6b665f1c-f49f-4b45-b43e-935b6c3980b7\s

DATE: 07-15-2025 TIME: 10:17:31

USER:

COMMENTS:

** SIMULATION : 100-year-4hr-Chicago **

| CHICAGO STORM | IDF curve parameters: A=1032.793
| Ptotal= 70.38 mm | B= 0.000
C= 0.743

used in: INTENSITY = A / (t + B)^C

Duration of storm = 4.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

Table with 8 columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. Rows show rainfall intensity data at various time intervals.

| CALIB |
| NASHYD (0011) | Area (ha)= 12.45 Curve Number (CN)= 82.0

|ID= 1 DT= 5.0 min | Ia (mm)= 3.10 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 1.03

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 0.462

PEAK FLOW (cms)= 0.479 (i)
TIME TO PEAK (hrs)= 2.500
RUNOFF VOLUME (mm)= 36.792
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.523

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0012) | Area (ha)= 29.27 Curve Number (CN)= 84.0
|ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= 0.40

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 2.795

PEAK FLOW (cms)= 2.465 (i)
TIME TO PEAK (hrs)= 1.667
RUNOFF VOLUME (mm)= 39.464
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.561

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0031) | Area (ha)= 25.41 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.80 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.17

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083  26.53 | 2.083  10.53 | 3.08   5.93
0.167   5.06 | 1.167  26.53 | 2.167  10.53 | 3.17   5.93
0.250   5.69 | 1.250 186.64 | 2.250   9.23 | 3.25   5.57
0.333   5.69 | 1.333 186.64 | 2.333   9.23 | 3.33   5.57
0.417   6.55 | 1.417  33.08 | 2.417   8.25 | 3.42   5.25
0.500   6.55 | 1.500  33.08 | 2.500   8.25 | 3.50   5.25
0.583   7.79 | 1.583  20.27 | 2.583   7.49 | 3.58   4.97
0.667   7.79 | 1.667  20.27 | 2.667   7.49 | 3.67   4.97
0.750   9.78 | 1.750  15.20 | 2.750   6.87 | 3.75   4.72
0.833   9.78 | 1.833  15.20 | 2.833   6.87 | 3.83   4.72
0.917  13.66 | 1.917  12.37 | 2.917   6.36 | 3.92   4.51
1.000  13.66 | 2.000  12.37 | 3.000   6.36 | 4.00   4.51

```

Unit Hyd Qpeak (cms)= 0.830

PEAK FLOW (cms)= 0.895 (i)
TIME TO PEAK (hrs)= 2.750
RUNOFF VOLUME (mm)= 37.031
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.526

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0041) | Area (ha)= 10.73 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083  26.53 | 2.083  10.53 | 3.08   5.93
0.167   5.06 | 1.167  26.53 | 2.167  10.53 | 3.17   5.93
0.250   5.69 | 1.250 186.64 | 2.250   9.23 | 3.25   5.57
0.333   5.69 | 1.333 186.64 | 2.333   9.23 | 3.33   5.57
0.417   6.55 | 1.417  33.08 | 2.417   8.25 | 3.42   5.25
0.500   6.55 | 1.500  33.08 | 2.500   8.25 | 3.50   5.25
0.583   7.79 | 1.583  20.27 | 2.583   7.49 | 3.58   4.97
0.667   7.79 | 1.667  20.27 | 2.667   7.49 | 3.67   4.97
0.750   9.78 | 1.750  15.20 | 2.750   6.87 | 3.75   4.72
0.833   9.78 | 1.833  15.20 | 2.833   6.87 | 3.83   4.72
0.917  13.66 | 1.917  12.37 | 2.917   6.36 | 3.92   4.51
1.000  13.66 | 2.000  12.37 | 3.000   6.36 | 4.00   4.51

```

Unit Hyd Qpeak (cms)= 0.366

PEAK FLOW (cms)= 0.403 (i)
TIME TO PEAK (hrs)= 2.667
RUNOFF VOLUME (mm)= 38.105
TOTAL RAINFALL (mm)= 70.382

RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0051) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0012):  29.27  2.465    1.67    39.46
+ ID2= 2 ( 0031):  25.41  0.895    2.75    37.03
=====
ID = 3 ( 0051):  54.68  2.881    1.75    38.33
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0051) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0051):  54.68  2.881    1.75    38.33
+ ID2= 2 ( 0041):  10.73  0.403    2.67    38.10
=====
ID = 1 ( 0051):  65.41  3.092    1.83    38.30
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| RESERVOIR( 0002) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          OUTFLOW      STORAGE      | OUTFLOW      STORAGE
          (cms)      (ha.m.)      | (cms)      (ha.m.)
0.0000      0.0000      | 1.3450      2.1963
0.0302      0.2196      | 2.0056      2.4160
0.1060      0.4393      | 2.9861      2.6356
0.1484      0.6589      | 5.1073      3.0749
0.1976      0.8785      | 6.4750      3.5141
0.2620      1.0982      | 6.9124      3.9534
0.3256      1.3178      | 7.3312      4.3927
0.4719      1.5374      | 7.7329      4.8319
0.6161      1.7571      | 8.1186      5.2712
0.8070      1.9767      | 0.0000      0.0000
```

```

          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0051)  65.410      3.092      1.83      38.30
OUTFLOW: ID= 1 ( 0002)  65.410      0.673      4.67      38.27
```

PEAK FLOW REDUCTION [Qout/Qin] (%) = 21.78
TIME SHIFT OF PEAK FLOW (min) = 170.00
MAXIMUM STORAGE USED (ha.m.) = 1.8234

```
-----
| CALIB |
| NASHYD ( 0021) | Area (ha) = 19.40 Curve Number (CN) = 81.0
| ID= 1 DT= 5.0 min | Ia (mm) = 3.00 # of Linear Res. (N) = 3.00
-----
U.H. Tp(hrs) = 0.66
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083      5.06 | 1.083     26.53 | 2.083     10.53 | 3.08      5.93
```

0.167	5.06		1.167	26.53		2.167	10.53		3.17	5.93
0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57
0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 1.123

PEAK FLOW (cms)= 1.007 (i)
 TIME TO PEAK (hrs)= 2.083
 RUNOFF VOLUME (mm)= 35.760
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.508

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0042) | Area (ha)= 40.21 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.20
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51
  
```

Unit Hyd Qpeak (cms)= 1.280

PEAK FLOW (cms)= 1.490 (i)
 TIME TO PEAK (hrs)= 2.750
 RUNOFF VOLUME (mm)= 39.468
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.561

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0001) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
OUTFLOW    STORAGE | OUTFLOW    STORAGE
(cms)      (ha.m.) | (cms)      (ha.m.)
0.0000     0.0000 | 0.7119     0.9480
0.0123     0.0780 | 1.9253     1.1420
0.0329     0.1570 | 2.5634     1.3440
0.0407     0.2380 | 2.7870     1.5530
  
```

0.0476	0.3210		2.9936	1.7700
0.0805	0.4060		3.1872	1.9930
0.1414	0.4920		3.3696	2.2250
0.1808	0.5790		3.6262	2.5860
0.2708	0.6690		3.7476	2.7730
0.4375	0.7600		0.0000	0.0000

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0042)	40.210	1.490	2.75	39.47
OUTFLOW: ID= 1 (0001)	40.210	0.704	4.67	39.43

PEAK FLOW REDUCTION [Qout/Qin](%)= 47.22
TIME SHIFT OF PEAK FLOW (min)=115.00
MAXIMUM STORAGE USED (ha.m.)= 0.9427

| ADD HYD (0052) |
1 + 2 = 3
ID1= 1 (0001): 40.21 0.704 4.67 39.43
+ ID2= 2 (0011): 12.45 0.479 2.50 36.79
=====

ID = 3 (0052):	52.66	0.914	4.25	38.81

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (0052) |
3 + 2 = 1
ID1= 3 (0052): 52.66 0.914 4.25 38.81
+ ID2= 2 (0002): 65.41 0.673 4.67 38.27
=====

ID = 1 (0052):	118.07	1.571	4.42	38.51

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| ADD HYD (0052) |
1 + 2 = 3
ID1= 1 (0052): 118.07 1.571 4.42 38.51
+ ID2= 2 (0021): 19.40 1.007 2.08 35.76
=====

ID = 3 (0052):	137.47	1.806	4.17	38.12

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| NASHYD (0017) | Area (ha)= 32.33 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.70 # of Linear Res.(N)= 3.00

U.H. Tp(hrs)= 0.55

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN		TIME	RAIN		TIME	RAIN		TIME	RAIN
hrs	mm/hr		hrs	mm/hr		hrs	mm/hr		hrs	mm/hr
0.083	5.06		1.083	26.53		2.083	10.53		3.08	5.93
0.167	5.06		1.167	26.53		2.167	10.53		3.17	5.93
0.250	5.69		1.250	186.64		2.250	9.23		3.25	5.57

0.333	5.69		1.333	186.64		2.333	9.23		3.33	5.57
0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 2.245

PEAK FLOW (cms)= 2.100 (i)
TIME TO PEAK (hrs)= 1.917
RUNOFF VOLUME (mm)= 38.642
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.549

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0020) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min      |
-----
| OUTFLOW          | STORAGE          | OUTFLOW          | STORAGE          |
| (cms)            | (ha.m.)          | (cms)            | (ha.m.)          |
| 0.0000           | 0.0000           | 1.7783           | 1.1263           |
| 0.0245           | 0.1030           | 1.8455           | 1.2511           |
| 0.0690           | 0.2080           | 1.9113           | 1.3782           |
| 0.1181           | 0.3152           | 1.9743           | 1.5076           |
| 0.2257           | 0.4245           | 2.0363           | 1.6394           |
| 0.3402           | 0.5360           | 2.1548           | 1.9101           |
| 0.4374           | 0.6496           | 2.2669           | 2.1903           |
| 0.7664           | 0.7654           | 2.3755           | 2.4803           |
| 1.3220           | 0.8835           | 2.4795           | 2.7803           |
| 1.6822           | 1.0038           | 2.5047           | 2.8569           |
|
| AREA             | QPEAK            | TPEAK            | R.V.             |
| (ha)             | (cms)            | (hrs)            | (mm)             |
INFLOW : ID= 2 ( 0017) 32.330 2.100 1.92 38.64
OUTFLOW: ID= 1 ( 0020) 32.330 0.711 3.25 38.61

```

PEAK FLOW REDUCTION [Qout/Qin] (%)= 33.85
TIME SHIFT OF PEAK FLOW (min)= 80.00
MAXIMUM STORAGE USED (ha.m.)= 0.7460

```

-----
| DIVERTHYD( 0023) |
| IN= 1 # OUT= 5   |
-----

```

Outflow / Inflow Relationships

Flow 1 + Flow 2 + Flow 3 + Flow 4 + Flow 5 = Total					
(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.01	0.00	0.00	0.00	0.02
0.05	0.02	0.00	0.00	0.00	0.07
0.07	0.02	0.02	0.00	0.00	0.12
0.11	0.04	0.08	0.00	0.00	0.23
0.16	0.07	0.11	0.00	0.00	0.34
0.20	0.10	0.14	0.00	0.00	0.44
0.27	0.34	0.16	0.00	0.00	0.77
0.29	0.64	0.39	0.00	0.00	1.32
0.30	0.70	0.68	0.00	0.00	1.68
0.31	0.73	0.73	0.00	0.00	1.78
0.32	0.76	0.76	0.00	0.00	1.85
0.33	0.79	0.79	0.00	0.00	1.91

0.34	0.81	0.81	0.00	0.00	1.97
0.35	0.84	0.84	0.00	0.00	2.04
0.36	0.87	0.87	0.00	0.00	2.10
0.38	0.91	0.91	0.00	0.00	2.21
0.40	0.96	0.96	0.00	0.00	2.32
0.42	1.01	1.01	0.00	0.00	2.43
0.43	1.04	1.04	0.00	0.00	2.50

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
TOTAL HYD. (ID= 1):	32.33	0.71	3.25	38.61
=====				
ID= 2 (3) :	16.04	0.26	3.25	38.61
ID= 3 (3) :	9.33	0.30	3.25	38.61
ID= 4 (3) :	6.96	0.15	3.25	38.61
ID= 5 (3) :	0.00	0.00	0.00	0.00
ID= 6 (3) :	0.00	0.00	0.00	0.00

```

-----
| ROUTEPIPE( 0028)|      PIPE Number      =    1.00
| IN= 2---> OUT= 1 |      Diameter      (mm)=1650.00
| DT=  5.0 min    |      Length        (m)= 500.00
-----
|                   |      Slope          (m/m)=  0.005
|                   |      Manning n      =    0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	9.33	0.30	3.25	38.61	0.24	1.49
OUTFLOW: ID= 1 (0028)	9.33	0.29	3.33	38.61	0.24	1.49

```

-----
| ROUTEPIPE( 0030)|      PIPE Number      =    1.00
| IN= 2---> OUT= 1 |      Diameter      (mm)=1650.00
| DT=  5.0 min    |      Length        (m)= 500.00
-----
|                   |      Slope          (m/m)=  0.005
|                   |      Manning n      =    0.013

```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67

0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	6.96	0.15	3.25	38.61	0.18	1.26
OUTFLOW: ID= 1 (0030)	6.96	0.15	3.33	38.61	0.18	1.25

```

| CALIB |
| STANDHYD ( 0019) | Area (ha)= 6.99
| ID= 1 DT= 5.0 min | Total Imp(%)= 28.00 Dir. Conn.(%)= 28.00

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.96	5.03
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	0.64	1.23
Length	(m)=	215.87	712.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Max.Eff.Inten.(mm/hr)=	186.64	25.57
over (min)	5.00	85.00
Storage Coeff. (min)=	3.61 (ii)	82.89 (ii)
Unit Hyd. Tpeak (min)=	5.00	85.00
Unit Hyd. peak (cms)=	0.25	0.01

TOTALS

PEAK FLOW	(cms)=	0.96	0.16	0.969 (iii)
TIME TO PEAK	(hrs)=	1.33	2.67	1.33
RUNOFF VOLUME	(mm)=	68.38	35.29	44.55
TOTAL RAINFALL	(mm)=	70.38	70.38	70.38
RUNOFF COEFFICIENT	=	0.97	0.50	0.63

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 82.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0029) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0019):    6.99    0.969    1.33    44.55
+ ID2= 2 ( 0028):    9.33    0.294    3.33    38.61
=====
ID = 3 ( 0029):   16.32    0.970    1.33    41.15
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0029) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0029):   16.32    0.970    1.33    41.15
+ ID2= 2 ( 0030):    6.96    0.155    3.33    38.61
=====
ID = 1 ( 0029):   23.28    0.970    1.33    40.39
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ROUTEPIPE( 0032) |
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          PIPE Number      = 1.00
          Diameter (mm)=1650.00
          Length (m)= 500.00
          Slope (m/m)= 0.005
          Manning n      = 0.013
```

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	16.04	0.26	3.25	38.61	0.22	1.43
OUTFLOW: ID= 1 (0032)	16.04	0.26	3.33	38.61	0.22	1.43

```

-----
| CALIB |
| NASHYD ( 0018) | Area (ha)= 0.94 Curve Number (CN)= 84.0
|ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51

```

Unit Hyd Qpeak (cms)= 0.299

PEAK FLOW (cms)= 0.178 (i)
 TIME TO PEAK (hrs)= 1.333
 RUNOFF VOLUME (mm)= 37.965
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.539

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0033) |
| 1 + 2 = 3 |
-----
AREA    QPEAK    TPEAK    R.V.
(ha)    (cms)    (hrs)    (mm)
ID1= 1 ( 0018):  0.94  0.178    1.33   37.97
+ ID2= 2 ( 0032): 16.04  0.261    3.33   38.61
=====
ID = 3 ( 0033):  16.98  0.273    3.25   38.57

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| CALIB |
| NASHYD ( 0034) | Area (ha)= 6.82 Curve Number (CN)= 83.0
|ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.50

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs     mm/hr | hrs     mm/hr | hrs     mm/hr | hrs     mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57

```

0.417	6.55		1.417	33.08		2.417	8.25		3.42	5.25
0.500	6.55		1.500	33.08		2.500	8.25		3.50	5.25
0.583	7.79		1.583	20.27		2.583	7.49		3.58	4.97
0.667	7.79		1.667	20.27		2.667	7.49		3.67	4.97
0.750	9.78		1.750	15.20		2.750	6.87		3.75	4.72
0.833	9.78		1.833	15.20		2.833	6.87		3.83	4.72
0.917	13.66		1.917	12.37		2.917	6.36		3.92	4.51
1.000	13.66		2.000	12.37		3.000	6.36		4.00	4.51

Unit Hyd Qpeak (cms)= 0.521

PEAK FLOW (cms)= 0.454 (i)
 TIME TO PEAK (hrs)= 1.833
 RUNOFF VOLUME (mm)= 37.133
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.528

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB          |
| NASHYD ( 0035)| Area      (ha)= 12.06 Curve Number (CN)= 84.0
|ID= 1 DT= 5.0 min | Ia        (mm)= 3.90 # of Linear Res.(N)= 3.00
-----
                        U.H. Tp(hrs)= 0.55
  
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
      hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083    5.06 | 1.083    26.53 | 2.083    10.53 | 3.08    5.93
0.167    5.06 | 1.167    26.53 | 2.167    10.53 | 3.17    5.93
0.250    5.69 | 1.250   186.64 | 2.250     9.23 | 3.25    5.57
0.333    5.69 | 1.333   186.64 | 2.333     9.23 | 3.33    5.57
0.417    6.55 | 1.417    33.08 | 2.417     8.25 | 3.42    5.25
0.500    6.55 | 1.500    33.08 | 2.500     8.25 | 3.50    5.25
0.583    7.79 | 1.583    20.27 | 2.583     7.49 | 3.58    4.97
0.667    7.79 | 1.667    20.27 | 2.667     7.49 | 3.67    4.97
0.750    9.78 | 1.750    15.20 | 2.750     6.87 | 3.75    4.72
0.833    9.78 | 1.833    15.20 | 2.833     6.87 | 3.83    4.72
0.917   13.66 | 1.917    12.37 | 2.917     6.36 | 3.92    4.51
1.000   13.66 | 2.000    12.37 | 3.000     6.36 | 4.00    4.51
  
```

Unit Hyd Qpeak (cms)= 0.838

PEAK FLOW (cms)= 0.779 (i)
 TIME TO PEAK (hrs)= 1.917
 RUNOFF VOLUME (mm)= 38.478
 TOTAL RAINFALL (mm)= 70.382
 RUNOFF COEFFICIENT = 0.547

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| RESERVOIR( 0036)| OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min      |
-----
      OUTFLOW      STORAGE | OUTFLOW      STORAGE
      (cms)        (ha.m.) | (cms)        (ha.m.)
      0.0000      0.0000 | 0.9922      0.4686
      0.0150      0.0403 | 1.3581      0.5239
      0.0508      0.0819 | 1.4554      0.5809
      0.0745      0.1250 | 1.5104      0.6396
      0.1065      0.1696 | 1.5636      0.6999
      0.1567      0.2156 | 1.6156      0.7620
      0.1928      0.2631 | 1.6657      0.8257
  
```

0.2872	0.3021		1.7150	0.8913
0.4020	0.3627		1.7631	0.9586
0.5684	0.4149		1.8561	1.0987

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0035)	12.060	0.779	1.92	38.48
OUTFLOW: ID= 1 (0036)	12.060	0.235	3.42	38.42

PEAK FLOW REDUCTION [Qout/Qin] (%)= 30.14
TIME SHIFT OF PEAK FLOW (min)= 90.00
MAXIMUM STORAGE USED (ha.m.)= 0.2806

| ADD HYD (0037) |
1 + 2 = 3
AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
ID1= 1 (0034): 6.82 0.454 1.83 37.13
+ ID2= 2 (0036): 12.06 0.235 3.42 38.42
=====

ID = 3 (0037): 18.88 0.520 1.92 37.96

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

| CALIB |
| NASHYD (0045) | Area (ha)= 2.10 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.14

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	5.06	1.083	26.53	2.083	10.53	3.08	5.93
0.167	5.06	1.167	26.53	2.167	10.53	3.17	5.93
0.250	5.69	1.250	186.64	2.250	9.23	3.25	5.57
0.333	5.69	1.333	186.64	2.333	9.23	3.33	5.57
0.417	6.55	1.417	33.08	2.417	8.25	3.42	5.25
0.500	6.55	1.500	33.08	2.500	8.25	3.50	5.25
0.583	7.79	1.583	20.27	2.583	7.49	3.58	4.97
0.667	7.79	1.667	20.27	2.667	7.49	3.67	4.97
0.750	9.78	1.750	15.20	2.750	6.87	3.75	4.72
0.833	9.78	1.833	15.20	2.833	6.87	3.83	4.72
0.917	13.66	1.917	12.37	2.917	6.36	3.92	4.51
1.000	13.66	2.000	12.37	3.000	6.36	4.00	4.51

Unit Hyd Qpeak (cms)= 0.573

PEAK FLOW (cms)= 0.329 (i)
TIME TO PEAK (hrs)= 1.417
RUNOFF VOLUME (mm)= 35.572
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.505

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0046) | Area (ha)= 1.31 Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res. (N)= 3.00

U.H. Tp (hrs)= 0.08

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51
```

Unit Hyd Qpeak (cms)= 0.625

PEAK FLOW (cms)= 0.301 (i)
TIME TO PEAK (hrs)= 1.333
RUNOFF VOLUME (mm)= 33.811
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.480

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| NASHYD ( 0047) | Area (ha)= 1.89 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res. (N)= 3.00
-----
U.H. Tp (hrs)= 0.22
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs    mm/hr | hrs    mm/hr | hrs    mm/hr | hrs    mm/hr
0.083   5.06 | 1.083   26.53 | 2.083   10.53 | 3.08    5.93
0.167   5.06 | 1.167   26.53 | 2.167   10.53 | 3.17    5.93
0.250   5.69 | 1.250  186.64 | 2.250    9.23 | 3.25    5.57
0.333   5.69 | 1.333  186.64 | 2.333    9.23 | 3.33    5.57
0.417   6.55 | 1.417   33.08 | 2.417    8.25 | 3.42    5.25
0.500   6.55 | 1.500   33.08 | 2.500    8.25 | 3.50    5.25
0.583   7.79 | 1.583   20.27 | 2.583    7.49 | 3.58    4.97
0.667   7.79 | 1.667   20.27 | 2.667    7.49 | 3.67    4.97
0.750   9.78 | 1.750   15.20 | 2.750    6.87 | 3.75    4.72
0.833   9.78 | 1.833   15.20 | 2.833    6.87 | 3.83    4.72
0.917  13.66 | 1.917   12.37 | 2.917    6.36 | 3.92    4.51
1.000  13.66 | 2.000   12.37 | 3.000    6.36 | 4.00    4.51
```

Unit Hyd Qpeak (cms)= 0.328

PEAK FLOW (cms)= 0.230 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 37.086
TOTAL RAINFALL (mm)= 70.382
RUNOFF COEFFICIENT = 0.527

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

Alternative Method 3
100-year 3-hour Chicago

V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTT TTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\412c6336-616f-46e3-89d8-e25e89bdd9f4\s
Summary filename: C:\Users\CAKK072000\AppData\Local\Civica\XH5\1fc8c6ba-c089-4a7c-9924-7f19dee13d05\412c6336-616f-46e3-89d8-e25e89bdd9f4\s

DATE: 07-15-2025 TIME: 10:17:30

USER:

COMMENTS:

** SIMULATION : 100-year-3hr-Chicago **

| CHICAGO STORM | IDF curve parameters: A=1032.793
| Ptotal= 65.35 mm | B= 0.000
C= 0.743

used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

Table with 8 columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. Rows show rainfall intensity data at various time intervals.

| CALIB |
| NASHYD (0011) | Area (ha)= 12.45 Curve Number (CN)= 82.0
|ID= 1 DT= 5.0 min | Ia (mm)= 3.10 # of Linear Res.(N)= 3.00

----- U.H. Tp(hrs)= 1.03

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.462

PEAK FLOW (cms)= 0.458 (i)
TIME TO PEAK (hrs)= 2.250
RUNOFF VOLUME (mm)= 32.837
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.502

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB							
NASHYD (0012)		Area (ha)=	29.27	Curve Number (CN)=	84.0		
ID= 1 DT= 5.0 min		Ia (mm)=	2.70	# of Linear Res.(N)=	3.00		
-----		U.H. Tp(hrs)=	0.40				

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 2.795

PEAK FLOW (cms)= 2.351 (i)
TIME TO PEAK (hrs)= 1.417
RUNOFF VOLUME (mm)= 35.346
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB							
NASHYD (0031)		Area (ha)=	25.41	Curve Number (CN)=	82.0		
ID= 1 DT= 5.0 min		Ia (mm)=	2.80	# of Linear Res.(N)=	3.00		
-----		U.H. Tp(hrs)=	1.17				

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

      ---- TRANSFORMED HYETOGRAPH ----
      TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
      hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083   6.55 | 0.833 26.53 | 1.583 12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667 12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750 10.53 | 2.50   6.87
0.333   7.79 | 1.083 33.08 | 1.833 10.53 | 2.58   6.36
0.417   9.78 | 1.167 33.08 | 1.917  9.23 | 2.67   6.36
0.500   9.78 | 1.250 20.27 | 2.000  9.23 | 2.75   5.93
0.583  13.66 | 1.333 20.27 | 2.083  8.25 | 2.83   5.93
0.667  13.66 | 1.417 15.20 | 2.167  8.25 | 2.92   5.57
0.750  26.53 | 1.500 15.20 | 2.250  7.49 | 3.00   5.57

```

Unit Hyd Qpeak (cms)= 0.830

PEAK FLOW (cms)= 0.857 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 33.071
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.506

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| CALIB |
| NASHYD ( 0041) | Area (ha)= 10.73 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.90 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 1.12

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

      ---- TRANSFORMED HYETOGRAPH ----
      TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
      hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083   6.55 | 0.833 26.53 | 1.583 12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667 12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750 10.53 | 2.50   6.87
0.333   7.79 | 1.083 33.08 | 1.833 10.53 | 2.58   6.36
0.417   9.78 | 1.167 33.08 | 1.917  9.23 | 2.67   6.36
0.500   9.78 | 1.250 20.27 | 2.000  9.23 | 2.75   5.93
0.583  13.66 | 1.333 20.27 | 2.083  8.25 | 2.83   5.93
0.667  13.66 | 1.417 15.20 | 2.167  8.25 | 2.92   5.57
0.750  26.53 | 1.500 15.20 | 2.250  7.49 | 3.00   5.57

```

Unit Hyd Qpeak (cms)= 0.366

PEAK FLOW (cms)= 0.386 (i)
TIME TO PEAK (hrs)= 2.333
RUNOFF VOLUME (mm)= 34.068
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.521

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0051) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
----- (ha) (cms) (hrs) (mm)
ID1= 1 ( 0012): 29.27 2.351 1.42 35.35
+ ID2= 2 ( 0031): 25.41 0.857 2.42 33.07
=====

```


ID = 3 (0051): 54.68 2.742 1.42 34.29

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| ADD HYD ( 0051) |
| 3 + 2 = 1 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0051): 54.68 2.742 1.42 34.29
+ ID2= 2 ( 0041): 10.73 0.386 2.33 34.07
=====
ID = 1 ( 0051): 65.41 2.949 1.50 34.25
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| RESERVOIR( 0002) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min |
-----
          OUTFLOW      STORAGE      OUTFLOW      STORAGE
          (cms)      (ha.m.)      (cms)      (ha.m.)
0.0000 0.0000 | 1.3450 2.1963
0.0302 0.2196 | 2.0056 2.4160
0.1060 0.4393 | 2.9861 2.6356
0.1484 0.6589 | 5.1073 3.0749
0.1976 0.8785 | 6.4750 3.5141
0.2620 1.0982 | 6.9124 3.9534
0.3256 1.3178 | 7.3312 4.3927
0.4719 1.5374 | 7.7329 4.8319
0.6161 1.7571 | 8.1186 5.2712
0.8070 1.9767 | 0.0000 0.0000

          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
INFLOW : ID= 2 ( 0051) 65.410 2.949 1.50 34.25
OUTFLOW: ID= 1 ( 0002) 65.410 0.570 4.17 34.22

PEAK FLOW REDUCTION [Qout/Qin](%)= 19.33
TIME SHIFT OF PEAK FLOW (min)=160.00
MAXIMUM STORAGE USED (ha.m.)= 1.6867
```

```
-----
| CALIB |
| NASHYD ( 0021) | Area (ha)= 19.40 Curve Number (CN)= 81.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.00 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.66
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
-----
          ---- TRANSFORMED HYETOGRAPH ----
          TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
          hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57
```

Unit Hyd Qpeak (cms)= 1.123

PEAK FLOW (cms)= 0.960 (i)

TIME TO PEAK (hrs)= 1.750

RUNOFF VOLUME (mm)= 31.882
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.488

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| NASHYD (0042) | Area (ha)= 40.21 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 2.70 # of Linear Res.(N)= 3.00

U.H. Tp(hrs)= 1.20

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----
TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083 6.55 | 0.833 26.53 | 1.583 12.37 | 2.33 7.49
0.167 6.55 | 0.917 186.64 | 1.667 12.37 | 2.42 6.87
0.250 7.79 | 1.000 186.64 | 1.750 10.53 | 2.50 6.87
0.333 7.79 | 1.083 33.08 | 1.833 10.53 | 2.58 6.36
0.417 9.78 | 1.167 33.08 | 1.917 9.23 | 2.67 6.36
0.500 9.78 | 1.250 20.27 | 2.000 9.23 | 2.75 5.93
0.583 13.66 | 1.333 20.27 | 2.083 8.25 | 2.83 5.93
0.667 13.66 | 1.417 15.20 | 2.167 8.25 | 2.92 5.57
0.750 26.53 | 1.500 15.20 | 2.250 7.49 | 3.00 5.57

Unit Hyd Qpeak (cms)= 1.280

PEAK FLOW (cms)= 1.428 (i)
TIME TO PEAK (hrs)= 2.417
RUNOFF VOLUME (mm)= 35.350
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.541

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| RESERVOIR(0001) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
DT= 5.0 min
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
0.0000 0.0000 | 0.7119 0.9480
0.0123 0.0780 | 1.9253 1.1420
0.0329 0.1570 | 2.5634 1.3440
0.0407 0.2380 | 2.7870 1.5530
0.0476 0.3210 | 2.9936 1.7700
0.0805 0.4060 | 3.1872 1.9930
0.1414 0.4920 | 3.3696 2.2250
0.1808 0.5790 | 3.6262 2.5860
0.2708 0.6690 | 3.7476 2.7730
0.4375 0.7600 | 0.0000 0.0000

AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW : ID= 2 (0042) 40.210 1.428 2.42 35.35
OUTFLOW: ID= 1 (0001) 40.210 0.635 4.25 35.31

PEAK FLOW REDUCTION [Qout/Qin] (%)= 44.51
TIME SHIFT OF PEAK FLOW (min)=110.00
MAXIMUM STORAGE USED (ha.m.)= 0.8958


```

| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0001):  40.21  0.635  4.25  35.31
+ ID2= 2 ( 0011):  12.45  0.458  2.25  32.84
=====
ID = 3 ( 0052):  52.66  0.830  3.67  34.73

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| ADD HYD ( 0052) |
| 3 + 2 = 1 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 3 ( 0052):  52.66  0.830  3.67  34.73
+ ID2= 2 ( 0002):  65.41  0.570  4.17  34.22
=====
ID = 1 ( 0052):  118.07  1.387  3.83  34.45

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| ADD HYD ( 0052) |
| 1 + 2 = 3 |
-----
      AREA      QPEAK      TPEAK      R.V.
      (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0052):  118.07  1.387  3.83  34.45
+ ID2= 2 ( 0021):  19.40  0.960  1.75  31.88
=====
ID = 3 ( 0052):  137.47  1.629  3.33  34.09

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

| CALIB |
| NASHYD ( 0017) | Area (ha)= 32.33 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.70 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= 0.55

```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME      RAIN | TIME      RAIN | TIME      RAIN | TIME      RAIN
      hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
0.083   6.55 | 0.833  26.53 | 1.583  12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667  12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750  10.53 | 2.50   6.87
0.333   7.79 | 1.083  33.08 | 1.833  10.53 | 2.58   6.36
0.417   9.78 | 1.167  33.08 | 1.917   9.23 | 2.67   6.36
0.500   9.78 | 1.250  20.27 | 2.000   9.23 | 2.75   5.93
0.583  13.66 | 1.333  20.27 | 2.083   8.25 | 2.83   5.93
0.667  13.66 | 1.417  15.20 | 2.167   8.25 | 2.92   5.57
0.750  26.53 | 1.500  15.20 | 2.250   7.49 | 3.00   5.57

```

Unit Hyd Qpeak (cms)= 2.245

PEAK FLOW (cms)= 2.001 (i)
TIME TO PEAK (hrs)= 1.583
RUNOFF VOLUME (mm)= 34.541
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.529

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| RESERVOIR(0020) |
| IN= 2---> OUT= 1 |
DT= 5.0 min

OVERFLOW IS OFF

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	1.7783	1.1263
0.0245	0.1030	1.8455	1.2511
0.0690	0.2080	1.9113	1.3782
0.1181	0.3152	1.9743	1.5076
0.2257	0.4245	2.0363	1.6394
0.3402	0.5360	2.1548	1.9101
0.4374	0.6496	2.2669	2.1903
0.7664	0.7654	2.3755	2.4803
1.3220	0.8835	2.4795	2.7803
1.6822	1.0038	2.5047	2.8569

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0017)	32.330	2.001	1.58	34.54
OUTFLOW: ID= 1 (0020)	32.330	0.656	3.00	34.51

PEAK FLOW REDUCTION [Qout/Qin] (%) = 32.80
TIME SHIFT OF PEAK FLOW (min) = 85.00
MAXIMUM STORAGE USED (ha.m.) = 0.7268

| DIVERTHYD(0023) |
IN= 1 # OUT= 5

Outflow / Inflow Relationships

Flow 1 + Flow 2 + Flow 3 + Flow 4 + Flow 5 = Total

(cms)	(cms)	(cms)	(cms)	(cms)	(cms)
0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.01	0.00	0.00	0.00	0.02
0.05	0.02	0.00	0.00	0.00	0.07
0.07	0.02	0.02	0.00	0.00	0.12
0.11	0.04	0.08	0.00	0.00	0.23
0.16	0.07	0.11	0.00	0.00	0.34
0.20	0.10	0.14	0.00	0.00	0.44
0.27	0.34	0.16	0.00	0.00	0.77
0.29	0.64	0.39	0.00	0.00	1.32
0.30	0.70	0.68	0.00	0.00	1.68
0.31	0.73	0.73	0.00	0.00	1.78
0.32	0.76	0.76	0.00	0.00	1.85
0.33	0.79	0.79	0.00	0.00	1.91
0.34	0.81	0.81	0.00	0.00	1.97
0.35	0.84	0.84	0.00	0.00	2.04
0.36	0.87	0.87	0.00	0.00	2.10
0.38	0.91	0.91	0.00	0.00	2.21
0.40	0.96	0.96	0.00	0.00	2.32
0.42	1.01	1.01	0.00	0.00	2.43
0.43	1.04	1.04	0.00	0.00	2.50

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
TOTAL HYD. (ID= 1):	32.33	0.66	3.00	34.51
=====				
ID= 2 (3) :	16.54	0.25	3.00	34.51
ID= 3 (3) :	8.84	0.26	3.00	34.51
ID= 4 (3) :	6.95	0.15	3.00	34.51
ID= 5 (3) :	0.00	0.00	0.00	0.00
ID= 6 (3) :	0.00	0.00	0.00	0.00

| ROUTEPIPE(0028) |
| IN= 2---> OUT= 1 |
| DT= 5.0 min |

PIPE Number = 1.00
Diameter (mm)=1650.00
Length (m)= 500.00

----- Slope (m/m)= 0.005
Manning n = 0.013

<----- TRAVEL TIME TABLE ----->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	8.84	0.26	3.00	34.51	0.22	1.42
OUTFLOW: ID= 1 (0028)	8.84	0.25	3.08	34.51	0.22	1.42

| ROUTEPIPE(0030) | PIPE Number = 1.00
| IN= 2---> OUT= 1 | Diameter (mm)=1650.00
| DT= 5.0 min | Length (m)= 500.00
----- Slope (m/m)= 0.005
Manning n = 0.013

<----- TRAVEL TIME TABLE ----->

DEPTH (m)	VOLUME (cu.m.)	FLOW RATE (cms)	VELOCITY (m/s)	TRAV.TIME min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	MAX DEPTH (m)	MAX VEL (m/s)
INFLOW : ID= 2 (0023)	6.95	0.15	3.00	34.51	0.17	1.25
OUTFLOW: ID= 1 (0030)	6.95	0.15	3.08	34.51	0.17	1.25

```

-----
| CALIB |
| STANDHYD ( 0019) | Area (ha)= 6.99
| ID= 1 DT= 5.0 min | Total Imp(%)= 28.00 Dir. Conn.(%)= 28.00
-----

```

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.96	5.03
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	0.64	1.23
Length	(m)=	215.87	712.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```

----- TRANSFORMED HYETOGRAPH -----
      TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
      hrs  mm/hr | hrs  mm/hr | hrs  mm/hr | hrs  mm/hr
0.083   6.55 | 0.833 26.53 | 1.583 12.37 | 2.33   7.49
0.167   6.55 | 0.917 186.64 | 1.667 12.37 | 2.42   6.87
0.250   7.79 | 1.000 186.64 | 1.750 10.53 | 2.50   6.87
0.333   7.79 | 1.083 33.08 | 1.833 10.53 | 2.58   6.36
0.417   9.78 | 1.167 33.08 | 1.917  9.23 | 2.67   6.36
0.500   9.78 | 1.250 20.27 | 2.000  9.23 | 2.75   5.93
0.583  13.66 | 1.333 20.27 | 2.083  8.25 | 2.83   5.93
0.667  13.66 | 1.417 15.20 | 2.167  8.25 | 2.92   5.57
0.750  26.53 | 1.500 15.20 | 2.250  7.49 | 3.00   5.57

```

Max.Eff.Inten. (mm/hr)=	186.64	24.61
over (min)	5.00	85.00
Storage Coeff. (min)=	3.61 (ii)	84.11 (ii)
Unit Hyd. Tpeak (min)=	5.00	85.00
Unit Hyd. peak (cms)=	0.25	0.01

TOTALS

PEAK FLOW (cms)=	0.96	0.15	0.968 (iii)
TIME TO PEAK (hrs)=	1.00	2.42	1.00
RUNOFF VOLUME (mm)=	63.35	31.37	40.32
TOTAL RAINFALL (mm)=	65.35	65.35	65.35
RUNOFF COEFFICIENT =	0.97	0.48	0.62

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 82.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

-----
| ADD HYD ( 0029) |
| 1 + 2 = 3 | AREA QPEAK TPEAK R.V.
----- (ha) (cms) (hrs) (mm)
ID1= 1 ( 0019): 6.99 0.968 1.00 40.32
+ ID2= 2 ( 0028): 8.84 0.255 3.08 34.51
=====
ID = 3 ( 0029): 15.83 0.969 1.00 37.07

```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```

-----
| ADD HYD ( 0029) |

```

3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.
-----	(ha)	(cms)	(hrs)	(mm)
ID1= 3 (0029):	15.83	0.969	1.00	37.07
+ ID2= 2 (0030):	6.95	0.151	3.08	34.51
=====				
ID = 1 (0029):	22.78	0.969	1.00	36.29

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ROUTEPIPE(0032)	PIPE Number	=	1.00
IN= 2---> OUT= 1	Diameter	(mm)=	1650.00
DT= 5.0 min	Length	(m)=	500.00
-----	Slope	(m/m)=	0.005
	Manning n	=	0.013

<----- TRAVEL TIME TABLE ----->

DEPTH	VOLUME	FLOW RATE	VELOCITY	TRAV.TIME
(m)	(cu.m.)	(cms)	(m/s)	min
0.09	.216E+02	0.0	0.80	10.40
0.17	.600E+02	0.1	1.25	6.67
0.26	.108E+03	0.3	1.61	5.18
0.35	.164E+03	0.6	1.91	4.36
0.43	.225E+03	1.0	2.18	3.83
0.52	.290E+03	1.4	2.41	3.46
0.61	.358E+03	1.9	2.61	3.19
0.69	.428E+03	2.4	2.79	2.99
0.78	.499E+03	2.9	2.95	2.83
0.87	.570E+03	3.5	3.08	2.70
0.96	.642E+03	4.1	3.20	2.61
1.04	.712E+03	4.7	3.29	2.53
1.13	.780E+03	5.2	3.36	2.48
1.22	.844E+03	5.8	3.41	2.44
1.30	.905E+03	6.2	3.44	2.43
1.39	.961E+03	6.6	3.43	2.43
1.48	.101E+04	6.9	3.40	2.45
1.56	.105E+04	6.9	3.31	2.52
1.65	.107E+04	6.5	3.02	2.76

<---- hydrograph ----> <-pipe / channel->

	AREA	QPEAK	TPEAK	R.V.	MAX DEPTH	MAX VEL
	(ha)	(cms)	(hrs)	(mm)	(m)	(m/s)
INFLOW : ID= 2 (0023)	16.54	0.25	3.00	34.51	0.22	1.41
OUTFLOW: ID= 1 (0032)	16.54	0.25	3.08	34.51	0.22	1.41

CALIB	
NASHYD (0018)	Area (ha)= 0.94 Curve Number (CN)= 84.0
ID= 1 DT= 5.0 min	Ia (mm)= 3.90 # of Linear Res.(N)= 3.00
-----	U.H. Tp(hrs)= 0.12

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.299

PEAK FLOW (cms)= 0.169 (i)
TIME TO PEAK (hrs)= 1.000
RUNOFF VOLUME (mm)= 33.922
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.519

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| ADD HYD ( 0033) |
| 1 + 2 = 3 |
-----
          AREA      QPEAK      TPEAK      R.V.
          (ha)      (cms)      (hrs)      (mm)
ID1= 1 ( 0018):    0.94    0.169      1.00    33.92
+ ID2= 2 ( 0032):   16.54    0.249      3.08    34.51
=====
ID = 3 ( 0033):   17.48    0.261      3.00    34.48
```

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

```
-----
| CALIB |
| NASHYD ( 0034) | Area (ha)= 6.82 Curve Number (CN)= 83.0
| ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res. (N)= 3.00
-----
U.H. Tp(hrs)= 0.50
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
hrs      mm/hr | hrs      mm/hr | hrs      mm/hr | hrs      mm/hr
0.083    6.55 | 0.833    26.53 | 1.583    12.37 | 2.33     7.49
0.167    6.55 | 0.917    186.64 | 1.667    12.37 | 2.42     6.87
0.250    7.79 | 1.000    186.64 | 1.750    10.53 | 2.50     6.87
0.333    7.79 | 1.083    33.08 | 1.833    10.53 | 2.58     6.36
0.417    9.78 | 1.167    33.08 | 1.917     9.23 | 2.67     6.36
0.500    9.78 | 1.250    20.27 | 2.000     9.23 | 2.75     5.93
0.583   13.66 | 1.333    20.27 | 2.083     8.25 | 2.83     5.93
0.667   13.66 | 1.417    15.20 | 2.167     8.25 | 2.92     5.57
0.750   26.53 | 1.500    15.20 | 2.250     7.49 | 3.00     5.57
```

Unit Hyd Qpeak (cms)= 0.521

PEAK FLOW (cms)= 0.431 (i)
TIME TO PEAK (hrs)= 1.500
RUNOFF VOLUME (mm)= 33.117
TOTAL RAINFALL (mm)= 65.350
RUNOFF COEFFICIENT = 0.507

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----
| CALIB |
| NASHYD ( 0035) | Area (ha)= 12.06 Curve Number (CN)= 84.0
| ID= 1 DT= 5.0 min | Ia (mm)= 3.90 # of Linear Res. (N)= 3.00
-----
U.H. Tp(hrs)= 0.55
```

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

```
----- TRANSFORMED HYETOGRAPH -----
TIME    RAIN | TIME    RAIN | TIME    RAIN | TIME    RAIN
```


hrs	mm/hr		hrs	mm/hr		hrs	mm/hr		hrs	mm/hr
0.083	6.55		0.833	26.53		1.583	12.37		2.33	7.49
0.167	6.55		0.917	186.64		1.667	12.37		2.42	6.87
0.250	7.79		1.000	186.64		1.750	10.53		2.50	6.87
0.333	7.79		1.083	33.08		1.833	10.53		2.58	6.36
0.417	9.78		1.167	33.08		1.917	9.23		2.67	6.36
0.500	9.78		1.250	20.27		2.000	9.23		2.75	5.93
0.583	13.66		1.333	20.27		2.083	8.25		2.83	5.93
0.667	13.66		1.417	15.20		2.167	8.25		2.92	5.57
0.750	26.53		1.500	15.20		2.250	7.49		3.00	5.57

Unit Hyd Qpeak (cms)= 0.838

PEAK FLOW (cms)= 0.742 (i)
 TIME TO PEAK (hrs)= 1.583
 RUNOFF VOLUME (mm)= 34.380
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.526

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| RESERVOIR( 0036) | OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT= 5.0 min      |
-----
| OUTFLOW          | STORAGE          | OUTFLOW          | STORAGE          |
| (cms)            | (ha.m.)          | (cms)            | (ha.m.)          |
| 0.0000           | 0.0000           | 0.9922           | 0.4686           |
| 0.0150           | 0.0403           | 1.3581           | 0.5239           |
| 0.0508           | 0.0819           | 1.4554           | 0.5809           |
| 0.0745           | 0.1250           | 1.5104           | 0.6396           |
| 0.1065           | 0.1696           | 1.5636           | 0.6999           |
| 0.1567           | 0.2156           | 1.6156           | 0.7620           |
| 0.1928           | 0.2631           | 1.6657           | 0.8257           |
| 0.2872           | 0.3021           | 1.7150           | 0.8913           |
| 0.4020           | 0.3627           | 1.7631           | 0.9586           |
| 0.5684           | 0.4149           | 1.8561           | 1.0987           |

```

	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0035)	12.060	0.742	1.58	34.38
OUTFLOW: ID= 1 (0036)	12.060	0.215	3.17	34.32

PEAK FLOW REDUCTION [Qout/Qin] (%)= 28.93
 TIME SHIFT OF PEAK FLOW (min)= 95.00
 MAXIMUM STORAGE USED (ha.m.)= 0.2722

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| ADD HYD ( 0037) |
| 1 + 2 = 3       |
-----
| ID1= 1 ( 0034): | AREA   QPEAK  TPEAK  R.V.
| + ID2= 2 ( 0036): | (ha)   (cms)   (hrs)   (mm)
| =====
| ID = 3 ( 0037): | 18.88  0.494   1.58   33.89

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NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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-----
| CALIB          |
| NASHYD ( 0045) | Area   (ha)= 2.10  Curve Number (CN)= 82.0
| ID= 1 DT= 5.0 min | Ia     (mm)= 4.30  # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= 0.14

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NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.573

PEAK FLOW (cms)= 0.313 (i)
 TIME TO PEAK (hrs)= 1.083
 RUNOFF VOLUME (mm)= 31.669
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.485

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | NASHYD (0046) | Area (ha)= 1.31 Curve Number (CN)= 82.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.30 # of Linear Res.(N)= 3.00

 U.H. Tp(hrs)= 0.08

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.625

PEAK FLOW (cms)= 0.288 (i)
 TIME TO PEAK (hrs)= 1.000
 RUNOFF VOLUME (mm)= 30.101
 TOTAL RAINFALL (mm)= 65.350
 RUNOFF COEFFICIENT = 0.461

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 | CALIB |
 | NASHYD (0047) | Area (ha)= 1.89 Curve Number (CN)= 83.0
 | ID= 1 DT= 5.0 min | Ia (mm)= 4.10 # of Linear Res.(N)= 3.00

 U.H. Tp(hrs)= 0.22

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

----- TRANSFORMED HYETOGRAPH -----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.083	6.55	0.833	26.53	1.583	12.37	2.33	7.49
0.167	6.55	0.917	186.64	1.667	12.37	2.42	6.87
0.250	7.79	1.000	186.64	1.750	10.53	2.50	6.87
0.333	7.79	1.083	33.08	1.833	10.53	2.58	6.36
0.417	9.78	1.167	33.08	1.917	9.23	2.67	6.36
0.500	9.78	1.250	20.27	2.000	9.23	2.75	5.93
0.583	13.66	1.333	20.27	2.083	8.25	2.83	5.93
0.667	13.66	1.417	15.20	2.167	8.25	2.92	5.57
0.750	26.53	1.500	15.20	2.250	7.49	3.00	5.57

Unit Hyd Qpeak (cms)= 0.328

PEAK FLOW (cms)= 0.219 (i)

TIME TO PEAK (hrs)= 1.167

RUNOFF VOLUME (mm)= 33.075

TOTAL RAINFALL (mm)= 65.350

RUNOFF COEFFICIENT = 0.506

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
