TONKMETER RESOURCE FACILITY CLASS B LANDFILL AREA E

STORMWATER MANAGEMENT PLAN

PROJECT NR: 26831

AUGUST 2026

TONKMETER RESOURCE FACILITY
CNR OF TONK METER ROAD & COATON AVENUE
SPRINGS
GAUTENG
1559

DMV CONSULTANTS NELSPRUIT
19 VAN RENSBURG STREET
NELSPRUIT
1200

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1. INTRODUCTION

1.1 Background

As part of Tonkmeter Resource Facility's operation of the Tonkmeter General Waste Management Facility and its intention to apply for an Amendment of their Integrated Environmental Authorisation (IEA) to raise the permitted landfill levels to 25m above natural ground, the existing Stormwater Management Plan (SMP) requires updating. DMV Consultants Nelspruit Inc. was appointed by Eco Partners to assist them with an updated Stormwater Management Plan.

1.2 Objectives

This Stormwater Management Plan have the overall objective to meet the regulatory authority approval requirements and to mitigate the potential environmental impacts of the landfill by effectively isolating the waste body from the surrounding environment. In particular, the SMP needs to: -

- Investigate both the operational phase as well as the final capped phase.
- Separate Contaminated Stormwater and Leachate from uncontaminated stormwater.
- Divert Uncontaminated Stormwater Away from the landfill into the existing major stormwater system by developing a minor stormwater system.
- Ensure that Contaminated Stormwater and Leachate ends up at the appropriate facility created for this purpose without causing further contamination.

1.3 Scope

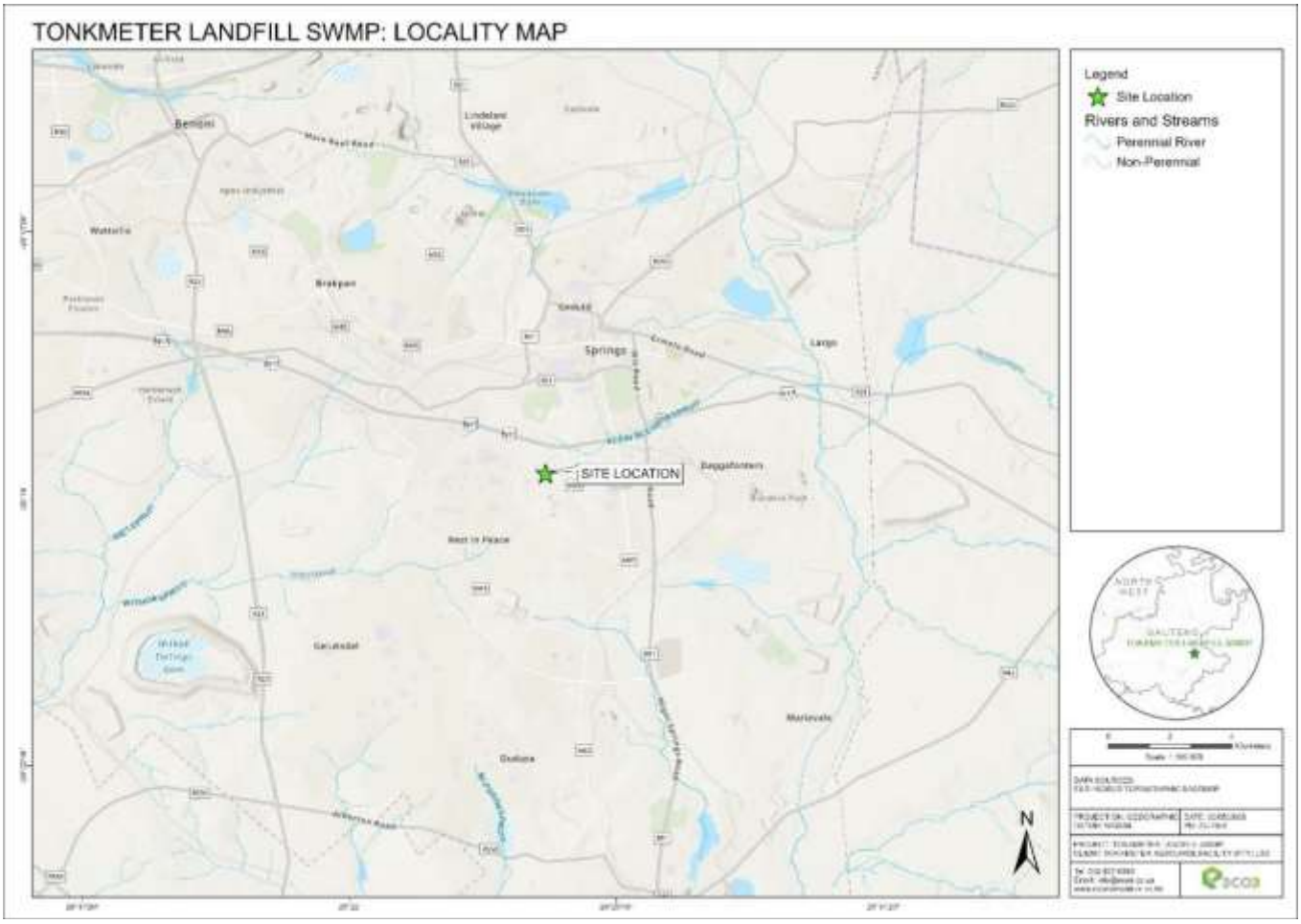
The scope of this Stormwater Management Plan includes the following:

- A site reconnaissance visit to confirm current site conditions, and to obtain existing information regarding the site.
- The landfill and its immediate surrounding areas were surveyed to produce a contour plan for design purposes. Adjacent drainage structures were also be surveyed to enable integration of the final stormwater system.
- Review of relevant reports and drawings that could have a bearing on the SMP.
- Using the topographical survey for the landfill and surrounds, as well as the previous final landform designs, the geometric design of the final landform was developed.
- Incorporation of final cover/capping design for the landfill.
- The existing leachate drainage systems are to be integrated in the SMP to ensure separation of clean and contaminated stormwater.
- Stormwater drainage design for the interim and final capped landfill facility.

Once the Stormwater Management Plan is approved, drafting of design drawings to enable the regulator to evaluate the design for approval can proceed.

1.4 Location

Tonkmeter landfill site is in Springs which fall in the Gauteng Province. A locality map below shows the location of the site relative to the major roads in the area:



The site is located on farm Rietfontein 128 IR, Portion 81 at Coordinates 26°17'33.64"S and 28°25'25.9"E.

The Locality Plan of Area E of the Tonkmeter landfill site, relative to other areas of the site, is shown on the locality plan below:



Locality Plan

2. STORMWATER MANAGEMENT

2.1 Stormwater Design Approach

The stormwater management plan has been developed to fulfil the requirements of the National Water Act, 1998 (Act 36 of 1998) (NWA) and particularly, Government Notice 704 contained in Government Gazette 20118 of June 1999 (hereafter referred to as GN 704), which deals with the separation of clean and dirty water. The NWA published by the Department of Water and Sanitation (DWS) requires adequate separation of clean and contaminated storm water and the protection of the water resources from contaminated water sources. These regulations were used to guide the design of the storm water drainage plan and the applicable recurrence interval for the design (the post closure channels were sized for the 1:50-year 24-hour storm event).

Once the landfill has been capped, all rainwater falling on the landfill can be considered clean. This water can then be channelled by conventional open stormwater systems and discharged into the nearby natural drainage courses.

In the development of the Tonkmeter landfill facility, a series of progressive phases of the landfill are to be implemented. The drainage design process ensures separation of runoff from the waste body from the surrounding catchment. Uncontaminated upslope stormwater runoff was diverted away from the landfill into the natural drainage system via cut-off drains. Contaminated runoff from the open waste surfaces as well as leachate, drains into a leachate collection system and is pumped back for storage and gradually released into the municipal sewage system for treatment and final disposal.

The hydrology of the site in terms of the final landform remains very similar to the original catchment due to the similarity of the footprint area and other catchment characteristics.

The “Technical Advisory Practice Note: Capping Closure of Waste Management Facilities and Pollution Point Sources” forms the basis of the stormwater design philosophy.

2.2. Drainage Layout

It is essential to drain surface water from the capped facility into final discharge points of the natural drainage system. This must happen whilst ensuring that the stormwater remains uncontaminated, erosion and instability of the capping cover is prevented, and free drainage takes place. To achieve this, the proposed final landform is to be profiled to ensure free draining surfaces, particularly those on top of the capped landfill. Drainage of leachate is accommodated during the design phases of the landfill, and the first phase is functioning satisfactorily. From the groundwater monitoring reports, evidence of any contamination of groundwater will be indicated if compared with results of baseline monitoring boreholes. No changes to these leachate drainage systems are envisaged.

Final shaping and capping of the landfill will be done progressively in phases over a period during which waste disposal will continue. During this operational period, clean and contaminated stormwater will require to be separated. This stormwater management plan therefore focuses on the partial and fully capped landfill. The Technical Advisory Note gives clear guidelines in terms of sloped surfaces to limit infiltration into the waste body.

To implement an effective Stormwater Management Plan, it is important to do master planning towards the final completed and capped landform to establish the end-picture. From here, the modular deployment of landfill cells and the associated interim stormwater management measures required to separate clean and contaminated water, is necessary to establish the management roadmap for the separation and diversion process of these two types of stormwaters.

The landfill landform is to be shaped and sloped to achieve free drainage before the capping is implemented. After capping, a surface drainage system will be created that ensures free draining stormwater be discharged into this new secondary system to prevent erosion of the capping material.

Free drainage will therefore rely on a system of sloped surfaces, flow diversion structures, conduits from collection points to the collection toe drain system on the perimeter of the waste disposal facility, and eventually to discharge into the natural drainage system. Protection against erosion will be achieved mostly with natural vegetation of the capping cover soil. Where required, additional measures will be implemented in the form of erosion protected lined structures, drains and conduits.

Figure 1 shows the schematic layout of the drainage elements and sub-catchments as the masterplan for the proposed final landform of this landfill site.

Details of the various drainage elements are discussed below.

The top plateau catchment area falls towards the outer circumference berm at a slope of around 2%. (Indicated in orange hatching on Figure 1 with blue arrows indicating the direction of flow) This plateau will be capped with a non-infiltration clay cover system. At the perimeter of this plateau, the steeper slope of the capped facility is protected by a berm of compacted soil of approximately 1m high (The berm is indicated on Figure 1 in green hatching). This prevents accelerate flow over the edge, where the steeper side slopes of the final landform intercept the flatter slopes of the plateau. Perimeter berms on the plateau in the form of earth-walls will create a sub-catchment area on the plateau during the final phase. This will ensure separation of flat areas where non-infiltration is the objective, from low infiltration areas on the steeper sloped faces. Transfer of stormwater from the top plateau catchment area down the steep slopes will be achieved with lined chutes for erosion protection purposes (Indicated in purple on Figure 1). Drain linings and erosion protection must be flexible to handle waste body settlement yet retain its ability to protect against erosion from high velocities. Apart from the top plateau, the final landform is shaped with distinct steeper sloped sub-catchments towards the south, north and western sides with limited infiltration into capping material (Steeper side sloped areas are indicated in pink hatching on Fig 1). The plateau area will be free draining (overland) towards the steeper side sloped areas with the outfall collector drains at the toe of these slopes (see Figure 1). These side slopes are not steeper than 1:2.5 (V:H) maximum allowed in the Technical Advisory Note but are mostly 1:3. Contour drains with concrete lined down chutes every 100m will further protect these sloped areas against erosion. Details of the contour drains will form part of the eventual capping design.

Outfall collector drains (indicated in blue lines with arrows indicating flow direction on Figure 1), will collect all the clean uncontaminated stormwater from the capped facility and drain this uncontaminated water to the site boundary, from where it is diverted into the municipal major stormwater system.

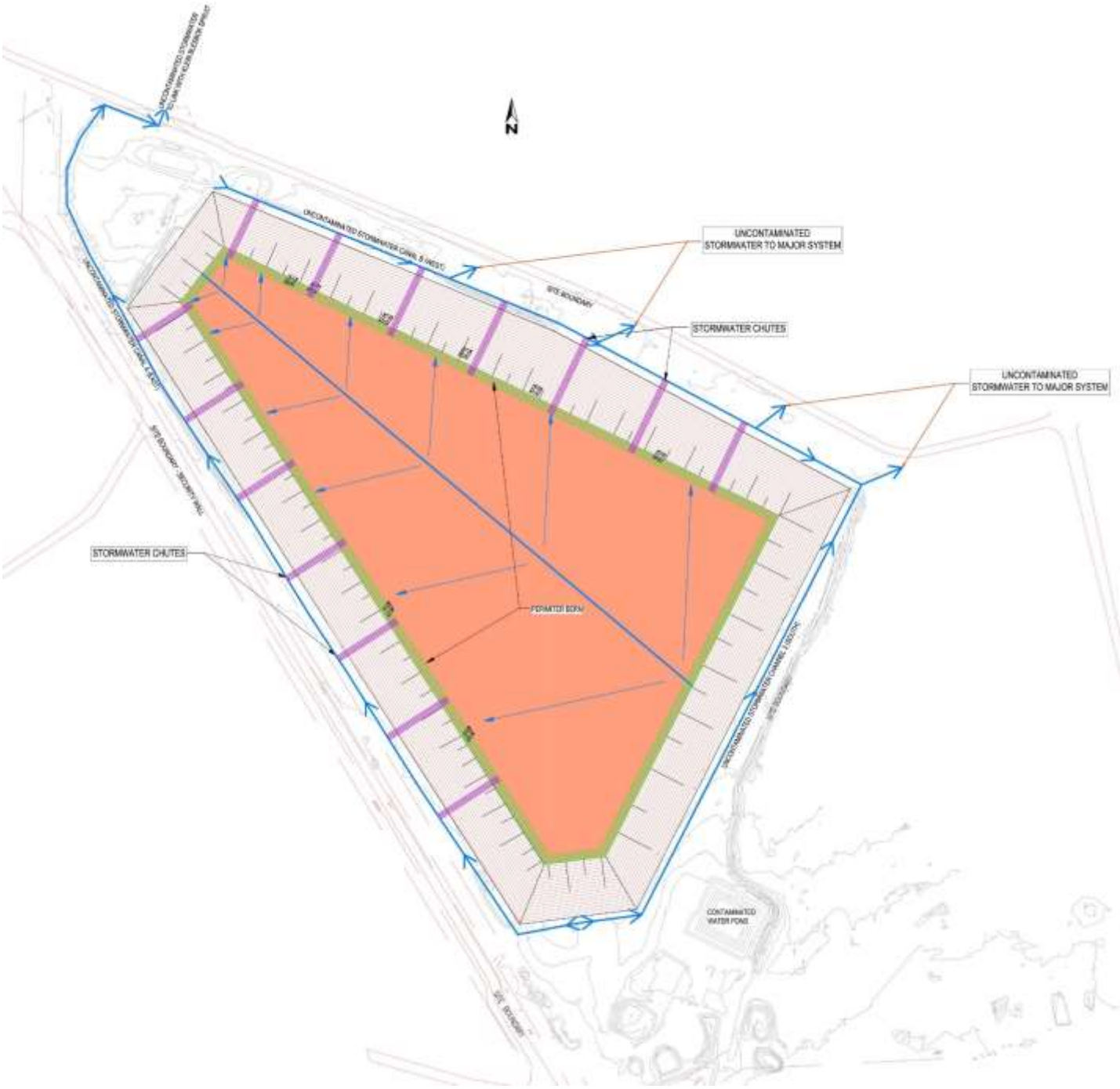


Figure 1: Final Landform with Drainage Elements and Sub-Catchment Layout

Figure 2 shows the schematic masterplan layout of the cell development for the contaminated water in the form of leachate. Each cell will have its individual leachate sump where leachate will collect. This leachate is pumped via a raising main towards the leachate storage tanks located at the contaminated water pond.

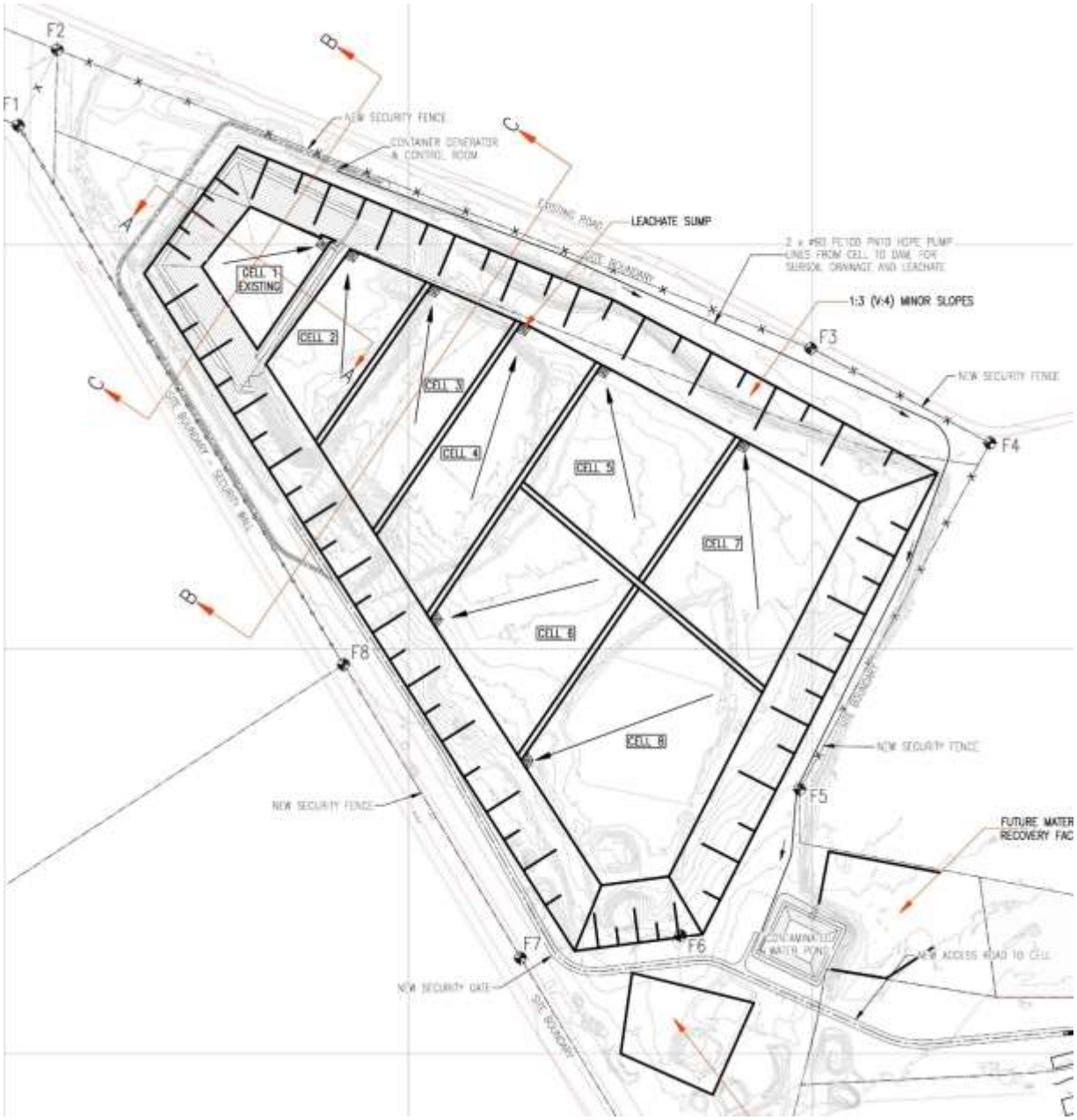


Figure 2: Cell Layout

The Fig 2 layout proposes an eight-cell development. This should however not be seen as final due to the commercial and other factors which may result in further interim phases or cell combinations. A modular phasing principle illustrated here will however be the approach.

For the interim phases, during which waste disposal operations will continue in Phase 1 and eventually Phase 2, management of the capping and disposal will require that clean and contaminated stormwater be separated. These interim stormwater accommodation measures are indicated on Fig 3, showing the existing schematic layout below:



Figure 3: Existing Layout

A system of berms will be used to isolate the operational areas from those of the final landform with capping and drainage features as well as undeveloped areas not yet prepared for waste disposal. Waste disposal will continue at these operational areas within the demarcated landfill defined by these berms until the interim final landform is achieved. This process will also create an access bench just below the operational areas for future access to the capped faces on the sloped landform for inspection and maintenance purposes.

From the topographical survey of the Tonkmeter Landfill, the site lies inside an existing worked-out quarry. This topography causes stormwater entering the site to remain there because there is no outflow due to the low-lying nature caused by the quarrying excavation. This trapped stormwater can therefore only be managed by active pumping or evaporation.

A phased development approach of the landfill is followed. Cells will be modularly developed in a specific order from Northeast to Southwest. This cell layout is indicated in figure 2. Cell 1, which is at this stage the only operational cell is also the deepest point of the site. Each new cell will have a lesser depth with cell floors rising from Cell 1 to Cell 8. Through a system of berms which separates cells, trapped water, which is uncontaminated, will be diverted from lower lying to higher lying areas inside the old quarry. This uncontaminated water can be pumped towards the clean water system located away from the landfill site.

Separation berms in the form of cross-walls will create cells which are compartmentalized sub-catchment areas during the interim phases. Future capped compartments will be free draining (overland) towards its lowest point, where the collected stormwater flows into an outlet system of collector drains. Operational areas will be continuously drained via the leachate collection system.

There are existing access roads to the operational areas which will be shaped to have a crossfall towards the collector drains and the access across these drains will be over a pipe culvert hump to cross the berm.

In practice the phase 1 operational area will proceed to be filled from the current level to a level below final landform level that provides for the capping layers. In this process all contaminated rainwater is isolated inside Cell 1 by the berm layout. This contaminated water drains as leachate to the Northwestern corner of Cell 1 where it is collected and pumped to the leachate storage tanks at the contaminated water pond. Similarly, the berm upstream of Cell 1 will ensure that uncontaminated stormwater inside the quarry will be stored in the temporary storage facilities created upstream from this separation berm, from where this uncontaminated stormwater can be pumped away to the primary drainage system.

Once Cell 1 nears capacity due to filling, Cell 2 will be prepared for operation, by installation of the berm upstream of Cell 2 and the completion of the lining and leachate drainage of Cell 2. As soon as Cell 2 is operational, all stormwater in this cell will be regarded as contaminated and will therefore be collected as leachate in the North corner of this cell from where it will be pumped to the leachate facility. Figure 4 is a schematic layout of this phase:



Figure 4: Cell 1 Final Landform with Cell 2 prepared for landfill operation

Stormwater upstream of Cell 2 will remain uncontaminated and stored in the temporary storage facilities, to be pumped away to the primary clean water drainage system. When Cell 2 nears capacity, Cell 3 will be prepared for filling in the same way and the above process will repeat itself. A progressive displacement of uncontaminated temporary stormwater storage by development of modular landfill cells in a phased approach will therefore result that uncontaminated stormwater will become contaminated and converted to leachate as the phase progress. Figures 5, 6 and 7 are schematic layouts of these following phases:



Figure 5: Cell 1&2 Final Landform with Cell 3&4 prepared for landfill operation



Figure 6: Cell 1, 2, 3 & 4 Final Landform with Cell 5 & 6 prepared for landfill operation



Figure 7: Cell 1, 2, 3, 4, 5 & 6 Final Landform with Cell 7 & 8 prepared for landfill operation

As soon as the capping process is progressively phased in, the contaminated water that ends up as leachate will be reduced until a fully capped facility will produce virtually no leachate.

2.3. Hydrology

From the process described above, various permanent and interim measures are affected to ensure that clean and contaminated stormwater are separately collected, stored, diverted and managed to the required regulatory standards. To ensure this, each element has to be adequately sized and the materials to be used evaluated as suitable for purpose. Hydrological calculations inform the flows and volumes of stormwater yield. Once this is available, the various elements used as measures to address the Stormwater Management could be sized for this purpose. Form GN 704 follows that infrastructure is to be designed to manage up to a 1:50-year storm event for clean water systems.

Various South African Weather Stations in the vicinity of the site, with rainfall records stretching several decades are available. Rainfall Stations within a 10km radius of the site were identified. These include 0476736W, 0476764W, 0476802W, 0476644W, 0476737W and 0476673W. Corresponding rainfall records vary from 96 years for 0476736W, 80 years for 0476766W, 65 years for 0476802W, 46 years for 0476644W, 48 years for 0476737W and 65 years for 047663W. The catchment characteristics have been determined and the Mean Annual Precipitation (MAP) that applies to this site is 713 mm, which is the average for these stations. The following Peak Runoff results were calculated, using the Rational Method. This method uses a depth-duration-frequency diagram from HRU report 2/78. A simplified hydrograph for the Rational Method, as proposed in the SANRAL Drainage Manual, Edition 6 was used to calculate run-off volumes. This simplified hydrograph method is however regarded as less accurate and these calculated run-off volumes were only used as a control. Actual rainfall depth values from available statistics for the Springs Weather Station 0476736W were used to determine volumes. Software from Sinotech's Utility Programs for Drainage was used for the analysis and this is attached as Annexure A. A summary of the results is detailed in Table 1.

Table 1: 1:50-Year 24-hour storm event sub-catchment results

Name	Area (m^2)	Slope (%)	Tc (min)	Runoff volume (Ml)	Peak Runoff (m^3/s)	Runoff Coefficient
A1	22404	0	17.90	2.029	1.26	0.35
A2	26400	15.8	5.5	0.264	0.535	0.268
A3	34038	0.9	12.9	1.145	0.987	0.489
A4	155970	1.05	14	5	3.975	0.445
A5	71477	0.5	9	1.47	1.816	0.371
A6	23080	0.93	24	1.136	0.526	0.52
A7	15621	4.7	1.9	0.079	0.464	0.403

Figure 8 below shows the schematic layout of the various sub catchment areas used to determine the peak flows for the hydraulic calculations as well as the yields of stormwater volumes for the evaluation of temporary facilities.

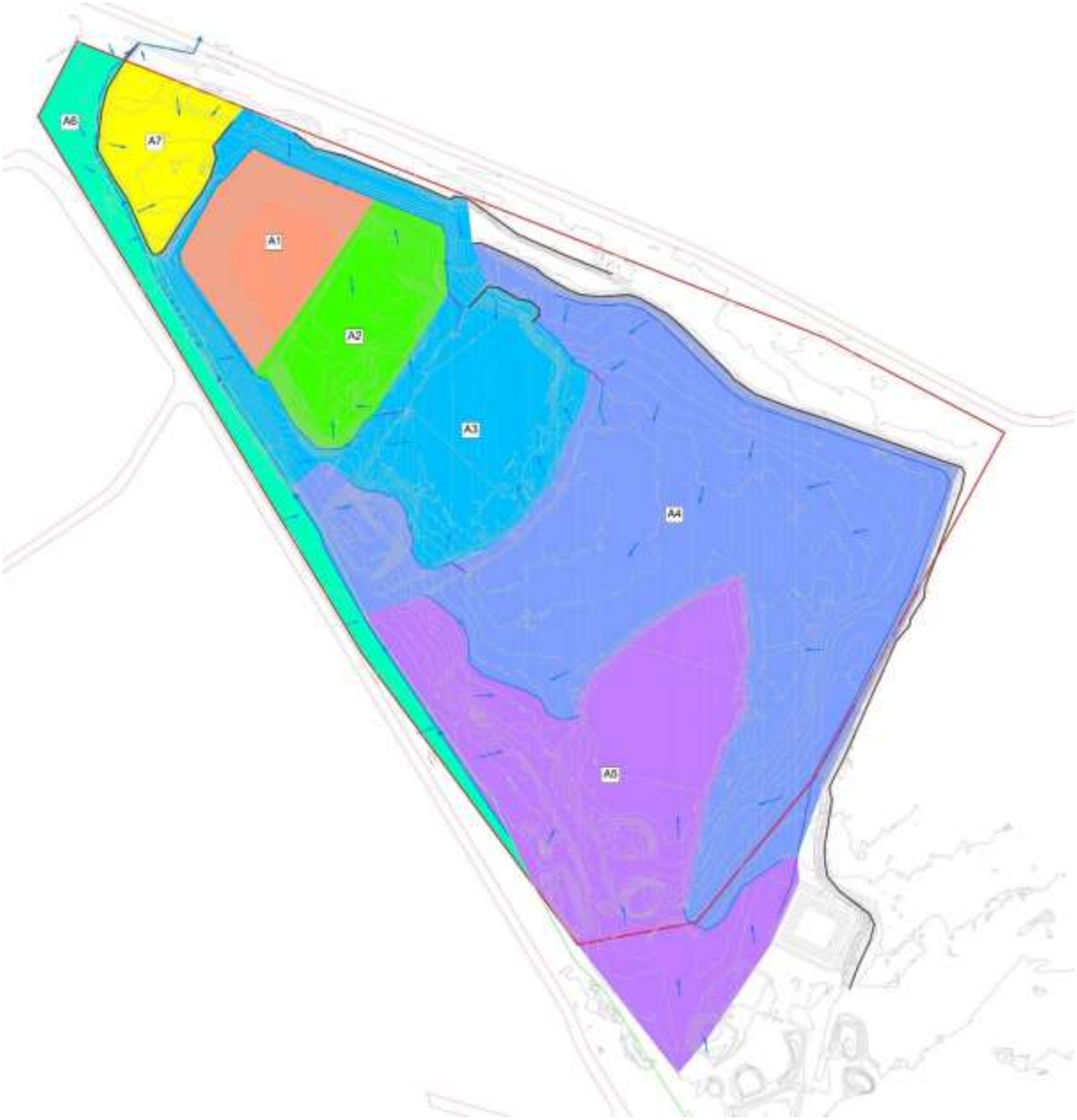


Figure 8: Sub-Catchment Layout

The temporary drainage facilities will be in the form of earth lined channels excavated into the drainage basins on flat slopes to prevent erosion. The typical section of these channels will be triangular with side slopes of 1:3 vertical to horizontal. Excavated material is to be placed as a berm on the downstream side of each channel for emergency freeboard at the same slopes.

Figure 9 shows a schematic layout of Canal Sub-Catchment areas:

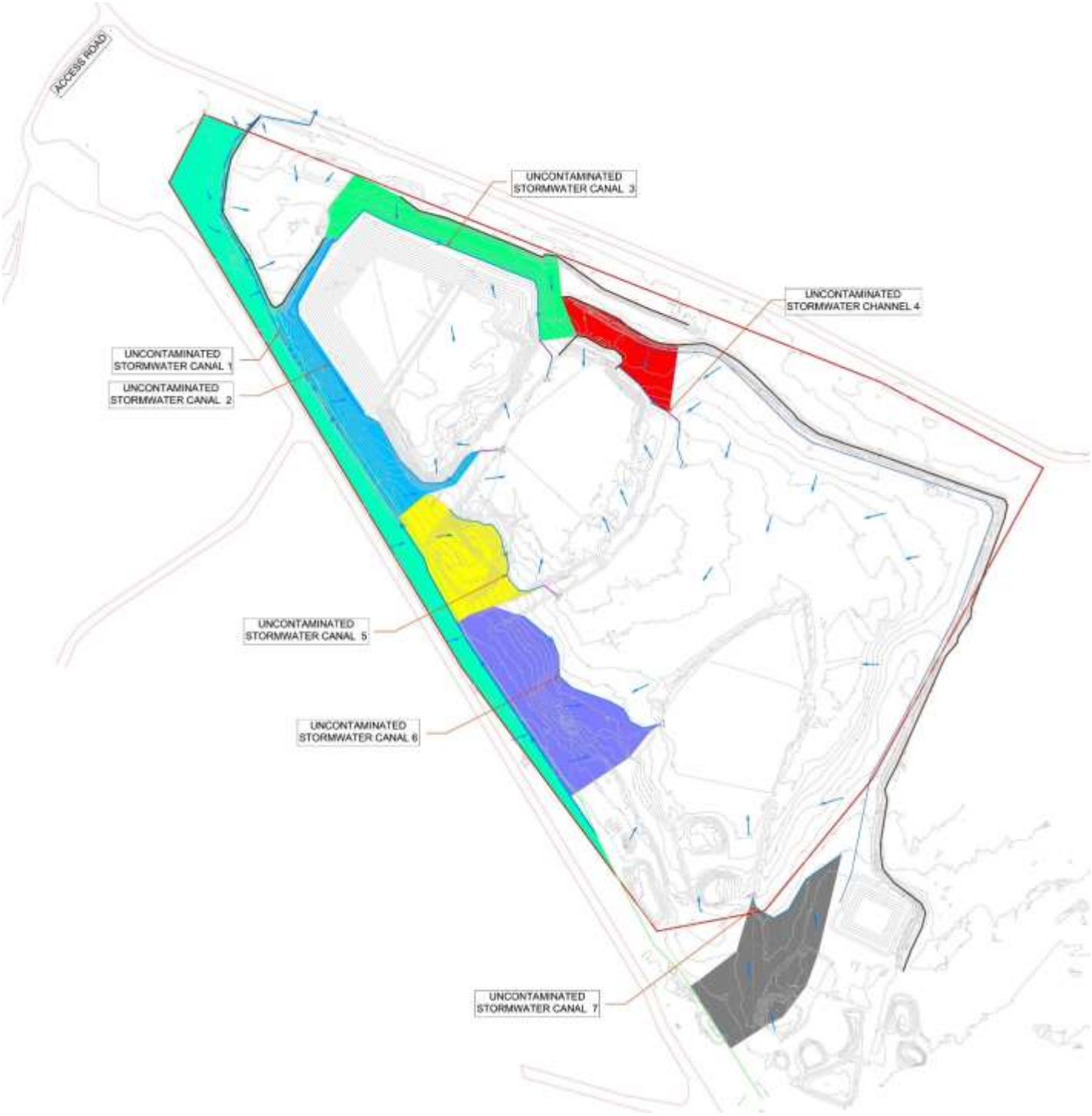


Figure 9: Canal Sub-Catchment Layout (Temporary Uncontaminated Drainage Canals)

Uncontaminated stormwater from the access road will be diverted from Catchment A6 along CH 1 to the property boundary and uncontaminated stormwater from Catchment A2 will be stored in the temporary storage facility nr. 2, before being pumped away into the major system.

Uncontaminated stormwater from Catchment A3 will all be diverted to temporary storage facility nr. 3 by CH2 and CH3 temporary drains as well as overland flow inside A3. The uncontaminated stormwater will be pumped away into the major system.

Uncontaminated stormwater from Catchment A4 will be diverted to temporary storage facility nr. 4 via CH4 and CH5 temporary drains as well as overland flow in this catchment. The uncontaminated stormwater will be pumped away into the major system.

Uncontaminated stormwater from Catchment A5 will be diverted to temporary storage facility nr. 5 via CH6 and CH7 temporary drains as well as overland flow. The uncontaminated stormwater will be pumped away into the major system. Progressive development of new cells will, over time, displace the temporary drains and storage facilities.

The following Peak Runoff results were calculated, using the Rational Method. Software from Sinotech's Utility Programs for Drainage was used for the analysis. Results are attached as Annexure B.

From the above, capacities to be determined here and sizing of drainage elements include the following Sub-Catchments: -

Table 2: 1:50-Year 24-hour storm event canal sub-catchment results

Conduit	Sub-Catchment Area (m^2)	Flow (m^3/s)	Flow Depth (m)
CANAL 1	23080	0.526	0.4
CANAL 2	10848	0.387	0.4
CANAL 3	10553	0.375	0.4
CANAL 4	5832	0.236	0.35
CANAL 5	10011	0.402	0.4
CANAL 6	17795	0.782	0.4
CANAL 7	14772	0.618	0.4

A layout of the temporary storage ponds shown in Figure 3 and the related sub-catchments shown in Figure 8, relates to the calculations of required storage volumes for the ponds. As mentioned previously, the volumes stated in Table 1 were only used as a control measure. Storage volumes indicated in Table 3 are based on point rainfall values for the station closest to the site.

Although the rainfall depth for the 1:50-year return period 24-hour duration storm is 122.6 mm for the Springs Weather Station nr. 0476736W, determining same by using Fig 3.8 of the SANRAL Drainage Manual Edition 6, resulted in a lightly higher figure of 160 mm. A conservative approach was therefore followed by using the 1:100-year return period 24-hour duration storm flood depth of 141.6 mm for station 0476736W. Storage facilities required to store the yield of the 1:100-Year stormwater event are: -

Table 3: 1:100-Year 24-hour storm event storage volume results

Temporary Storage Facility Nr.	Stored Volume Required for 1:100-Year Rainfall Depth m^3
1	2212
2	3737
3	4820
4	22078
5	10120

2.4. Hydraulic Calculations - Stormwater Conduit Sizing

The elements of the stormwater conduits conveying stormwater include lined open drains, concrete lined chutes and collector drains. These elements were sized, and the results are summarized in Table 4 below. Along some sections of the open drains, velocities increase to levels which will require additional protection against erosion and or slope adjustment by earthworks during the capping process. It is also clear that the expected flow conditions in the network are mostly sub-critical due to the flat slopes determined by the landfill topography. Freeboard in the drains were adjusted upward to provide a conservative approach on sections where change of flow direction may result in flow conditional changes.

Software from Sinotech's Utility Programs for Drainage was used for the analysis and this is attached as Annexure C.

Table 4: Properties of conduits required to convey 1:50-year peak flows

Name	Length (m)	Depth (m)	Bottom Width (m)	Side Slope L (1: V)	Side Slope R (1: V)	Slope (m/m)	Max Flow (m^3/s)	Max Velocity (m/s)	Design Flow (m^3/s)	Design Velocity (m/s)	Flow Depth (m)	Flow Depth / Full Depth
CANAL 1	1000	0.7	0	0.33	0.33	0.007	1.8	1.4	0.526	1.096	0.4	0.57
CANAL 2	410	0.7	0	0.33	0.33	0.012	2.35	1.85	0.387	0.806	0.4	0.57
CANAL 3	320	0.7	0	0.33	0.33	0.008	1.01	1.51	0.375	0.781	0.4	0.57
CANAL 4	140	0.6	0	0.33	0.33	0.028	3.6	2.829	0.236	0.492	0.32	0.53
CANAL 5	165	0.7	0	0.33	0.33	0.008	1.92	1.51	0.402	0.837	0.4	0.57
CANAL 6	220	0.7	0	0.33	0.33	0.012	2.35	1.85	0.782	1.63	0.4	0.57
CANAL 7	140	0.7	0	0.33	0.33	0.0095	2.09	1.65	0.618	1.288	0.4	0.57
CHUTES	75	0.5	1.0	0	0	0.067	3.7	7.3	0.28	3.25	0.086	0.172
CANAL A	1000	0.725	1.0	0.33	0.33	0.007	7.623	3.31	3	2.6	0.475	0.68
CANAL B	690	0.8	1.0	0.33	0.33	0.003	6.066	2.28	2.5	1.82	0.55	0.7
CANAL C	679	0.55	1.0	0.33	0.33	0.012	5.4	3.7	1.53	2.68	0.3	0.55

2.5. Drain Details

Based on the sizing of the drains, the drain around the toe of the capped landfill will be a trapezoidal shaped drain with varying dimensions to accommodate the design flows in Table 4. The drain is to be lined with an erosion protective lining.

2.6. Culverts at Temporary Road Crossings

From Table 4 above, the temporary road crossings by Canals 2, 3, 4 and 5 can all be accommodated with a 600 mm pipe culvert.

3. LEACHATE MANAGEMENT

The masterplan layout of the cell development for the processing of contaminated water in the form of leachate forms the basis of the leachate management system. A Detail Design Report for Area E of the Tonkmeter Class B Landfill (Peter Legg Consulting 2020) details the infrastructure for leachate management.

In each developed cell of the landfill, a leachate system which includes perforated HDPE pipes in a leachate drainage network, collects leachate and drains via collector pipes to a leachate sump at the lowest point of each cell. From design drawings received from Peter Legg Consulting, this sump, which has a penstock shaft on a concrete base (1200mm internal diameter) is constructed by placing HDPE prefabricated manhole extensions vertically to raise the structure incrementally as the landfill level increases. These sumps are equipped with submersible pumps which pumps leachate via 315mm pumping risers to connect with the leachate rising main. This rising main diverts leachate towards the leachate storage tanks.

Leachate is discharged from here into the municipal sewer under permit.

As mentioned previously, once Cell 1 nears capacity, Cell 2 will be prepared for operation. As soon as Cell 2 is operational, before landfill activities start, all stormwater in this cell will be regarded as contaminated and will be collected, to be pumped to the contaminated storage pond. Further cell development will follow this same modular approach as waste levels on the operational cell nears levels of the separation berm between the cells. Once filling of each newly developed cell with waste occurs, leachate will be pumped to the leachate storage tanks and eventual disposal into the municipal sewer. Volumes of leachate were calculated and are based on the rainfall data included above. Table 5 below indicates the calculated volumes: -

Table 5: 1:50-Year 24-hour storm event storage volume results

Cell Nr.	Volume (m^3)
CELL 1	3778
CELL 2	3888
CELL 3	4543
CELL 4	5183
CELL 5 & 6	10440
CELL 7 & 8	19080

The required pumping rates were determined for each cell. These are based on a 72hr drawdown period for the 1:50-Year event and are summarized below: -

Table 6: 1:50-Year 24-hour storm event storage volume results and drawdown rates

Cell Nr.	Storage Volume (m^3)	Drawdown Flow Rate (ℓ/s)
CELL 1	3778	15
CELL 2	3888	15
CELL 3	4543	17.5
CELL 4	5183	20
CELL 5 & 6	10440	40
CELL 7 & 8	19080	74

4. REFERENCES

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Department of Water Affairs and Forestry (1998. Waste Management Series. Minimum Requirements for Waste Disposal by Landfill. 2nd Edition).

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Peter Legg Consulting. Detailed Design Report for Area E of the Tonkmeter Class B Landfill.

R. Meyer. The Establishment of Monitoring Boreholes for Monitoring Groundwater Quality at Cell 1 of the New Tonkmeter Waste Disposal Facility situated in Area E of Portion 81 of The Farm Rietfontein 128-IR, Springs, Gauteng Province.

REPORT BY:



P.A. NICHOLSON
PR. ENG.
DIRECTOR

ANNEXURE A
CATCHMENT CALCULATIONS

Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: AREA A2
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL A2 RUN OFF.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= AREA A2
Date	= 2026/08/20
Area of catchment	= 0.026 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.063 km
Flow of water	= Overland flow
Height difference	= 8.0 m
Value of r for over land flow	= Clean soil (r=0,1)
Rainfall region	= Inland
Area distribution	= Rural: 50 %, Urban: 0 %, Lakes: 50 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	50	Very permeable	0	Thick bush & forests	0
Flat area	0	Permeable	0	Light bush & cultivated land	0
Hilly	50	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.12698 m/m
Time of concentration	= 5.5 min

The time of concentration is less than 6 minutes. A concervative point rainfall was determined.

Run-off factor

Rural - C1	= 0.535
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.268

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.09	10.5	100.0	105.4	0.75	20.1	0.153
1:5	0.09	14.3	100.0	143.5	0.80	21.4	0.222
1:10	0.09	18.2	100.0	181.6	0.85	22.7	0.298
1:20	0.09	22.4	100.0	224.2	0.90	24.1	0.390
1:50	0.09	29.1	100.0	291.4	0.95	25.4	0.535
1:100	0.09	35.9	100.0	358.6	1.00	26.8	0.693

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

The software programs were developed for the convenience of its users. Although every reasonable effort has been made to ensure that the programs are accurate and reliable the program developers, Sinotech CC, accept no liability of any kind for any results, interpretation thereof or any use

Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: AREA A3
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL A3 RUN OFF.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= AREA A3
Date	= 2026/08/20
Area of catchment	= 0.034 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.44 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 3.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 79 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	79	Very permeable	0	Thick bush & forests	0
Flat area	11	Permeable	0	Light bush & cultivated land	0
Hilly	10	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.00909 m/m
Time of concentration	= 12.9 min
Run-off factor	
Rural - C1	= 0.489
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.489

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.22	17.5	100.0	81.4	0.75	36.6	0.282
1:5	0.22	23.9	100.0	110.9	0.80	39.1	0.409
1:10	0.22	30.2	100.0	140.3	0.85	41.5	0.550
1:20	0.22	37.3	100.0	173.2	0.90	44.0	0.719
1:50	0.22	48.5	100.0	225.2	0.95	46.4	0.987
1:100	0.22	59.7	100.0	277.1	1.00	48.9	1.279

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: AREA A4
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL A4 RUN OFF.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= AREA A4
Date	= 2026/08/20
Area of catchment	= 0.156 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.56 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 5.0 m
Rainfall region	= Inland
Area distribution	= Rural: 86 %, Urban: 0 %, Lakes: 14 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	14	Very permeable	0	Thick bush & forests	0
Flat area	81	Permeable	0	Light bush & cultivated land	0
Hilly	5	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.0119 m/m
Time of concentration	= 14.0 min
Run-off factor	
Rural - C1	= 0.517
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.445

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.23	18.4	100.0	78.6	0.75	33.3	1.135
1:5	0.23	25.0	100.0	107.0	0.80	35.6	1.649
1:10	0.23	31.7	99.9	135.4	0.85	37.8	2.217
1:20	0.23	39.1	99.9	167.2	0.90	40.0	2.897
1:50	0.23	50.8	99.9	217.3	0.95	42.2	3.975
1:100	0.23	62.6	99.9	267.4	1.00	44.5	5.148

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: AREA A5
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL A5 RUN OFF.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= AREA A5
Date	= 2026/08/20
Area of catchment	= 0.072 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.22 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 1.0 m
Rainfall region	= Inland
Area distribution	= Rural: 71 %, Urban: 0 %, Lakes: 29 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	29	Very permeable	0	Thick bush & forests	0
Flat area	50	Permeable	0	Light bush & cultivated land	0
Hilly	21	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.00606 m/m
Time of concentration	= 8.9 min
Run-off factor	
Rural - C1	= 0.522
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.371

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.15	13.9	100.0	93.8	0.75	27.8	0.518
1:5	0.15	18.9	100.0	127.8	0.80	29.7	0.753
1:10	0.15	23.9	100.0	161.7	0.85	31.5	1.012
1:20	0.15	29.5	100.0	199.6	0.90	33.4	1.323
1:50	0.15	38.3	99.9	259.5	0.95	35.2	1.816
1:100	0.15	47.2	99.9	319.3	1.00	37.1	2.352

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: AREA A6
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL A6 RUN OFF.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= AREA A6
Date	= 2026/08/20
Area of catchment	= 0.023 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.997 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 7.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	100	Permeable	0	Light bush & cultivated land	0
Hilly	0	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.00936 m/m
Time of concentration	= 24.0 min
Run-off factor	
Rural - C1	= 0.520
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.520

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.40	24.1	100.0	60.3	0.75	39.0	0.150
1:5	0.40	32.8	100.0	82.1	0.80	41.6	0.218
1:10	0.40	41.5	100.0	103.9	0.85	44.2	0.293
1:20	0.40	51.3	100.0	128.3	0.90	46.8	0.384
1:50	0.40	66.7	100.0	166.8	0.95	49.4	0.526
1:100	0.40	82.1	100.0	205.3	1.00	52.0	0.682

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: AREA A7
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL A7 RUN OFF.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= AREA A7
Date	= 2026/08/20
Area of catchment	= 0.015 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.084 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 3.0 m
Rainfall region	= Inland
Area distribution	= Rural: 79 %, Urban: 0 %, Lakes: 21 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	21	Very permeable	0	Thick bush & forests	0
Flat area	79	Permeable	0	Light bush & cultivated land	0
Hilly	0	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.04762 m/m
Time of concentration	= 1.9 min

The time of concentration is less than 6 minutes. A concervative point rainfall was determined.

Run-off factor

Rural - C1	= 0.510
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.403

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.03	10.5	100.0	105.4	0.75	30.2	0.133
1:5	0.03	14.3	100.0	143.5	0.80	32.2	0.192
1:10	0.03	18.2	100.0	181.6	0.85	34.2	0.259
1:20	0.03	22.4	100.0	224.1	0.90	36.2	0.338
1:50	0.03	29.1	100.0	291.4	0.95	38.2	0.464
1:100	0.03	35.9	100.0	358.6	1.00	40.3	0.601

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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ANNEXURE B

PEAK RUNOFF RESULTS
CANAL SUB-CATCHMENT
CALCULATIONS

Utility Programs for Drainage
Flood calculations



Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: CANAL 1
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL CHANNEL 1.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= CANAL 1
Date	= 2026/08/20
Area of catchment	= 0.023 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.997 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 7.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	100	Permeable	0	Light bush & cultivated land	0
Hilly	0	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.00936 m/m
Time of concentration	= 24.0 min
Run-off factor	
Rural - C1	= 0.520
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.520

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.40	24.1	100.0	60.3	0.75	39.0	0.150
1:5	0.40	32.8	100.0	82.1	0.80	41.6	0.218
1:10	0.40	41.5	100.0	103.9	0.85	44.2	0.293
1:20	0.40	51.3	100.0	128.3	0.90	46.8	0.384
1:50	0.40	66.7	100.0	166.8	0.95	49.4	0.526
1:100	0.40	82.1	100.0	205.3	1.00	52.0	0.682

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: CANAL 2
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL CANAL 2.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= CANAL 2
Date	= 2026/08/20
Area of catchment	= 0.011 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.44 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 3.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	10	Permeable	0	Light bush & cultivated land	0
Hilly	90	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.00909 m/m
Time of concentration	= 12.9 min
Run-off factor	
Rural - C1	= 0.592
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.592

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.22	17.5	100.0	81.4	0.75	44.4	0.110
1:5	0.22	23.9	100.0	110.9	0.80	47.4	0.160
1:10	0.22	30.2	100.0	140.3	0.85	50.3	0.216
1:20	0.22	37.3	100.0	173.2	0.90	53.3	0.282
1:50	0.22	48.5	100.0	225.2	0.95	56.2	0.387
1:100	0.22	59.7	100.0	277.2	1.00	59.2	0.501

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: CANAL 3
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL CANAL 3.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= CANAL 3
Date	= 2026/08/20
Area of catchment	= 0.011 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.32 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 2.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	90	Permeable	0	Light bush & cultivated land	0
Hilly	10	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.00833 m/m
Time of concentration	= 10.5 min
Run-off factor	
Rural - C1	= 0.528
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.528

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.17	15.4	100.0	88.5	0.75	39.6	0.107
1:5	0.17	21.0	100.0	120.5	0.80	42.2	0.156
1:10	0.17	26.6	100.0	152.5	0.85	44.9	0.209
1:20	0.17	32.8	100.0	188.3	0.90	47.5	0.273
1:50	0.17	42.7	100.0	244.8	0.95	50.2	0.375
1:100	0.17	52.5	100.0	301.3	1.00	52.8	0.486

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: CANAL 4
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL CANAL 4.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= CANAL 4
Date	= 2026/08/20
Area of catchment	= 0.006 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.14 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 3.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	90	Permeable	0	Light bush & cultivated land	0
Hilly	10	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.02857 m/m
Time of concentration	= 3.4 min

The time of concentration is less than 6 minutes. A concervative point rainfall was determined.

Run-off factor

Rural - C1	= 0.528
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.528

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.06	10.5	100.0	105.4	0.75	39.6	0.067
1:5	0.06	14.3	100.0	143.5	0.80	42.2	0.098
1:10	0.06	18.2	100.0	181.6	0.85	44.9	0.131
1:20	0.06	22.4	100.0	224.2	0.90	47.5	0.172
1:50	0.06	29.1	100.0	291.5	0.95	50.2	0.236
1:100	0.06	35.9	100.0	358.7	1.00	52.8	0.305

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: CANAL 5
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL CANAL 5.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= CANAL 5
Date	= 2026/08/20
Area of catchment	= 0.01 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.162 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 1.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	90	Permeable	0	Light bush & cultivated land	0
Hilly	10	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.00823 m/m
Time of concentration	= 6.2 min
Run-off factor	
Rural - C1	= 0.528
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.528

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.10	10.8	100.0	104.4	0.75	39.6	0.115
1:5	0.10	14.7	100.0	142.1	0.80	42.2	0.167
1:10	0.10	18.6	100.0	179.9	0.85	44.9	0.224
1:20	0.10	23.0	100.0	222.1	0.90	47.5	0.293
1:50	0.10	29.9	100.0	288.7	0.95	50.2	0.402
1:100	0.10	36.8	100.0	355.3	1.00	52.8	0.521

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: CANAL 6
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL CANAL 6.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= CANAL 6
Date	= 2026/08/20
Area of catchment	= 0.018 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.22 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 2.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	20	Permeable	0	Light bush & cultivated land	0
Hilly	80	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.01212 m/m
Time of concentration	= 6.8 min
Run-off factor	
Rural - C1	= 0.584
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.584

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.11	11.5	100.0	101.9	0.75	43.8	0.223
1:5	0.11	15.7	100.0	138.8	0.80	46.7	0.324
1:10	0.11	19.9	100.0	175.7	0.85	49.6	0.436
1:20	0.11	24.5	100.0	216.9	0.90	52.6	0.570
1:50	0.11	31.9	100.0	281.9	0.95	55.5	0.782
1:100	0.11	39.2	100.0	347.0	1.00	58.4	1.013

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: CANAL 7
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NKMETER LANDFILL CANAL 7.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= CANAL 7
Date	= 2026/08/20
Area of catchment	= 0.015 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.14 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 1.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	80	Permeable	0	Light bush & cultivated land	0
Hilly	20	Semi-permeable	100	Grasslands	0
Steep areas	0	Impermeable	0	Bare	100

Average slope	= 0.00952 m/m
Time of concentration	= 5.3 min

The time of concentration is less than 6 minutes. A concervative point rainfall was determined.

Run-off factor

Rural - C1	= 0.536
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.536

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.09	10.5	100.0	105.4	0.75	40.2	0.177
1:5	0.09	14.3	100.0	143.5	0.80	42.9	0.256
1:10	0.09	18.2	100.0	181.6	0.85	45.6	0.345
1:20	0.09	22.4	100.0	224.2	0.90	48.2	0.451
1:50	0.09	29.1	100.0	291.4	0.95	50.9	0.618
1:100	0.09	35.9	100.0	358.7	1.00	53.6	0.801

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: FINAL LANDFORM SOUTH CANAL CATCHMENT A
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NAL LANDFORM SOUTH CHANNEL CATCHMENT A.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= FINAL LANDFORM SOUTH CANAL CATCHMENT A
Date	= 2026/08/20
Area of catchment	= 0.2 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.997 km
Flow of water	= Overland flow
Height difference	= 7.0 m
Value of r for over land flow	= Clean soil (r=0,1)
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	90	Permeable	0	Light bush & cultivated land	0
Hilly	10	Semi-permeable	100	Grasslands	100
Steep areas	0	Impermeable	0	Bare	0

Average slope	= 0.00702 m/m
Time of concentration	= 39.3 min
Run-off factor	
Rural - C1	= 0.458
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.458

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.66	29.4	100.0	44.8	0.75	34.4	0.855
1:5	0.66	40.0	100.0	61.0	0.80	36.6	1.242
1:10	0.66	50.6	100.0	77.2	0.85	38.9	1.670
1:20	0.66	62.5	99.9	95.3	0.90	41.2	2.183
1:50	0.66	81.2	99.9	123.9	0.95	43.5	2.995
1:100	0.66	100.0	99.9	152.5	1.00	45.8	3.880

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: FINAL LANDFORM SOUTH CANAL CATCHMENT B
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM NAL LANDFORM SOUTH CHANNEL CATCHMENT B.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= FINAL LANDFORM SOUTH CANAL CATCHMENT B
Date	= 2026/08/20
Area of catchment	= 0.178 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.89 km
Flow of water	= Overland flow
Height difference	= 3.0 m
Value of r for over land flow	= Clean soil (r=0,1)
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	90	Permeable	0	Light bush & cultivated land	0
Hilly	10	Semi-permeable	100	Grasslands	100
Steep areas	0	Impermeable	0	Bare	0

Average slope	= 0.00337 m/m
Time of concentration	= 44.2 min
Run-off factor	
Rural - C1	= 0.458
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.458

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.74	30.6	100.0	41.5	0.75	34.4	0.704
1:5	0.74	41.7	100.0	56.5	0.80	36.6	1.023
1:10	0.74	52.7	100.0	71.5	0.85	38.9	1.376
1:20	0.74	65.1	100.0	88.2	0.90	41.2	1.798
1:50	0.74	84.6	99.9	114.7	0.95	43.5	2.467
1:100	0.74	104.1	99.9	141.1	1.00	45.8	3.196

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: TOP OF FINAL LANDFORM SOUTH CAPPING CATCHMENT A
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM P OF FINAL LANDFORM SOUTH CAPPING CATCHMENT A.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= TOP OF FINAL LANDFORM SOUTH CAPPING CATCHMENT A
Date	= 2026/08/20
Area of catchment	= 0.103 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.69 km
Flow of water	= Overland flow
Height difference	= 13.8 m
Value of r for over land flow	= Clean soil (r=0,1)
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	100	Permeable	0	Light bush & cultivated land	0
Hilly	0	Semi-permeable	100	Grasslands	100
Steep areas	0	Impermeable	0	Bare	0

Average slope	= 0.020 m/m
Time of concentration	= 25.9 min
Run-off factor	
Rural - C1	= 0.450
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.450

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.43	24.9	100.0	57.7	0.75	33.8	0.558
1:5	0.43	34.0	100.0	78.6	0.80	36.0	0.810
1:10	0.43	43.0	100.0	99.5	0.85	38.3	1.089
1:20	0.43	53.1	100.0	122.8	0.90	40.5	1.423
1:50	0.43	69.0	100.0	159.6	0.95	42.8	1.953
1:100	0.43	84.9	99.9	196.5	1.00	45.0	2.530

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

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Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: TOP OF FINAL LANDFORM SOUTH CAPPING CATCHMENT B
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM P OF FINAL LANDFORM SOUTH CAPPING CATCHMENT B.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= TOP OF FINAL LANDFORM SOUTH CAPPING CATCHMENT B
Date	= 2026/08/20
Area of catchment	= 0.08 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.7 km
Flow of water	= Overland flow
Height difference	= 13.8 m
Value of r for over land flow	= Clean soil (r=0,1)
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	100	Permeable	0	Light bush & cultivated land	0
Hilly	0	Semi-permeable	100	Grasslands	100
Steep areas	0	Impermeable	0	Bare	0

Average slope	= 0.01971 m/m
Time of concentration	= 26.2 min
Run-off factor	
Rural - C1	= 0.450
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.450

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.44	25.1	100.0	57.4	0.75	33.8	0.431
1:5	0.44	34.1	100.0	78.2	0.80	36.0	0.625
1:10	0.44	43.2	100.0	98.9	0.85	38.3	0.841
1:20	0.44	53.3	100.0	122.1	0.90	40.5	1.099
1:50	0.44	69.3	100.0	158.8	0.95	42.8	1.508
1:100	0.44	85.3	100.0	195.4	1.00	45.0	1.954

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

The software programs were developed for the convenience of its users. Although every reasonable effort has been made to ensure that the programs are accurate and reliable the program developers, Sinotech CC, accept no liability of any kind for any results, interpretation thereof or any use made of the results obtained with these programs. All users of these programs do so entirely at

Utility Programs for Drainage
Flood calculations



Sinotech

Project name: TONKMETER LANDFILL
Analysed by: PA NICHOLSON
Name of river:
Description of site: TOP OF FINAL LANDFORM SOUTH CAPPING CATCHMENT C
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM P OF FINAL LANDFORM SOUTH CAPPING CATCHMENT C.fld
Date: 20 August 2026

Flood Frequency Analysis: Rational Method

Project	= TONKMETER LANDFILL
Analysed by	= PA NICHOLSON
Name of river	=
Description of site	= TOP OF FINAL LANDFORM SOUTH CAPPING CATCHMENT C
Date	= 2026/08/20
Area of catchment	= 0.063 km²
Dolomitic area	= 0.0 %
Mean annual rainfall (MAR)	= 713.00 mm
Length of longest watercourse	= 0.68 km
Flow of water	= Defined water course
Height difference along 10-85 slope	= 6.0 m
Rainfall region	= Inland
Area distribution	= Rural: 100 %, Urban: 0 %, Lakes: 0 %

Catchment description - Urban area (%)

Lawns		Residential and industry		Business	
Sandy, flat (<2%)	0	Houses	0	City centre	0
Sandy, steep (>7%)	0	Flats	0	Suburban	0
Heavy soil, flat (<2%)	0	Light industry	0	Streets	0
Heavy soil, steep (>7%)	0	Heavy industry	0	Maximum flood	0

Catchment description - Rural area (%)

Surface slopes		Permeability		Vegetation	
Lakes and pans	0	Very permeable	0	Thick bush & forests	0
Flat area	95	Permeable	0	Light bush & cultivated land	0
Hilly	5	Semi-permeable	100	Grasslands	100
Steep areas	0	Impermeable	0	Bare	0

Average slope	= 0.01176 m/m
Time of concentration	= 16.4 min
Run-off factor	
Rural - C1	= 0.454
Urban - C2	= 0.000
Lakes - C3	= 0.000
Combined - C	= 0.454

The HRU, Report 2/78, Depth-Duration-Frequency diagram was used to determine the point rainfall.

Return Period (years)	Time of concentration (hours)	Point rainfall (mm)	ARF (%)	Average intensity (mm/h)	Factor Ft	Runoff coefficient (%)	Peak flow (m³/s)
1:2	0.27	20.0	100.0	73.3	0.75	34.1	0.437
1:5	0.27	27.2	100.0	99.8	0.80	36.3	0.635
1:10	0.27	34.5	100.0	126.4	0.85	38.6	0.853
1:20	0.27	42.5	100.0	156.0	0.90	40.9	1.115
1:50	0.27	55.3	100.0	202.8	0.95	43.1	1.530
1:100	0.27	68.1	100.0	249.5	1.00	45.4	1.983

Run-off coefficient percentage includes adjustment saturation factors (Ft) for steep and impermeable catchments

Calculated using Utility Programs for Drainage 1.1.0

The software programs were developed for the convenience of its users. Although every reasonable effort has been made to ensure that the programs are accurate and reliable the program developers, Sinotech CC, accept no liability of any kind for any results, interpretation thereof or any use made of the results obtained with these programs. All users of these programs do so entirely at their own risk. Copyright (C) 2009 SINOTECH CC, www.sinotechcc.co.za, software@sinotechcc.co.za

ANNEXURE C

HYDRAULIC CALCULATIONS
STORMWATER CONDUIT SIZING

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 1 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 1 DESIGN.bhp

BASIC HYDRAULIC CALCULATIONS

INPUT DATA

Channel shape selected:	Triangular
Friction calculation method:	Manning formula
Flow rate (Q):	0.526 m³/s
Channel slope (S):	0.007 m/m
Roughness coefficient (n):	0.027 s/m^1/3
Normal depth (Yn):	0.410 m (Solved)
Left side slope (Sl):	0.333 m/m
Right side slope (Sr):	0.333 m/m

RESULTS

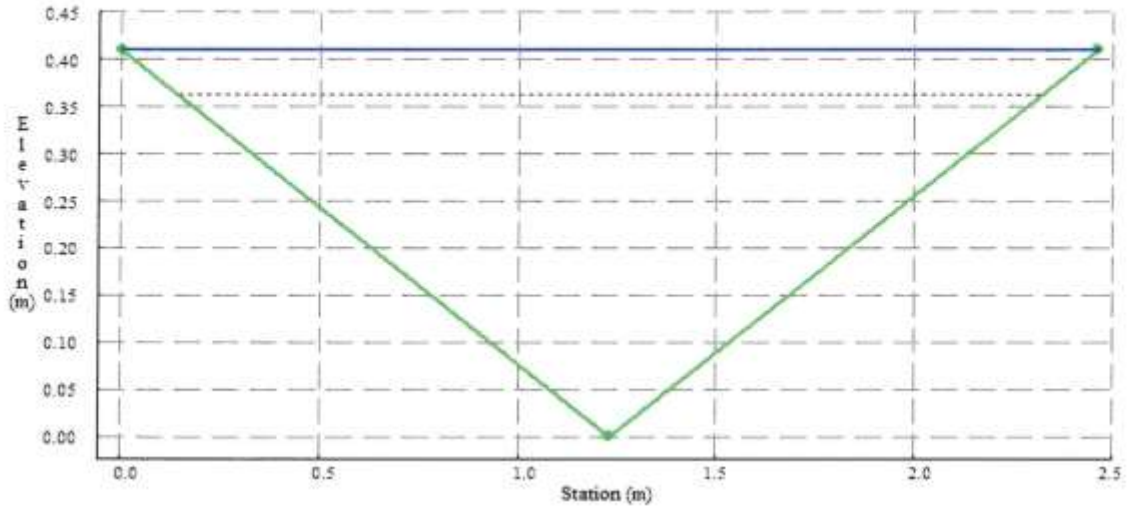
Flow area (A):	0.505 m²
Wetted perimeter (P):	2.597 m
Hydraulic radius (R):	0.195 m
Top width (B):	2.464 m
Critical depth (Yc):	0.362 m
Critical slope (Sc):	0.01356 m/m
Velocity (V):	1.041 m/s
Velocity head (Hv):	0.055 m
Specific energy (Es):	0.465 m
Froude number (Fr):	0.7336
Flow type:	Subcritical

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 1 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 1 DESIGN.bhp



LEGEND:

- Normal flow depth (Yn)
- Critical flow depth (Yc)

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 2 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 2 DESIGN.bhp

BASIC HYDRAULIC CALCULATIONS

INPUT DATA

Channel shape selected:	Triangular
Friction calculation method:	Manning formula
Flow rate (Q):	0.387 m³/s
Channel slope (S):	0.012 m/m
Roughness coefficient (n):	0.027 s/m^1/3
Normal depth (Yn):	0.331 m (Solved)
Left side slope (Sl):	0.333 m/m
Right side slope (Sr):	0.333 m/m

RESULTS

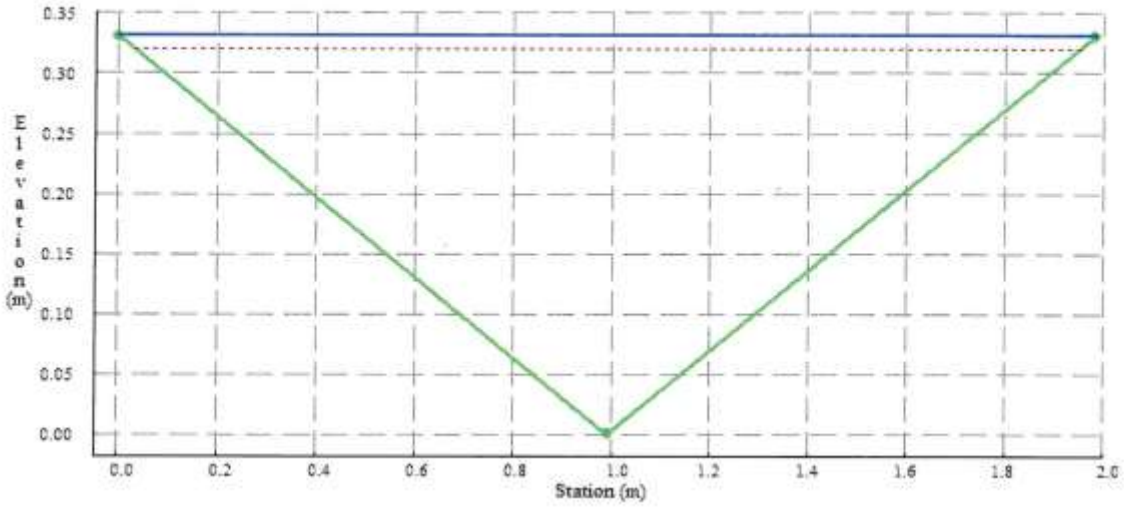
Flow area (A):	0.328 m²
Wetted perimeter (P):	2.092 m
Hydraulic radius (R):	0.157 m
Top width (B):	1.985 m
Critical depth (Yc):	0.321 m
Critical slope (Sc):	0.01412 m/m
Velocity (V):	1.180 m/s
Velocity head (Hv):	0.071 m
Specific energy (Es):	0.401 m
Froude number (Fr):	0.9265
Flow type:	Subcritical

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 2 DESIGN
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LEGEND:

- Normal flow depth (Yn)
- Critical flow depth (Yc)

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 3 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 3 DESIGN.bhp

BASIC HYDRAULIC CALCULATIONS

INPUT DATA

Channel shape selected:	Triangular
Friction calculation method:	Manning formula
Flow rate (Q):	0.375 m^3/s
Channel slope (S):	0.008 m/m
Roughness coefficient (n):	0.027 s/m^1/3
Normal depth (Yn):	0.352 m (Solved)
Left side slope (Sl):	0.333 m/m
Right side slope (Sr):	0.333 m/m

RESULTS

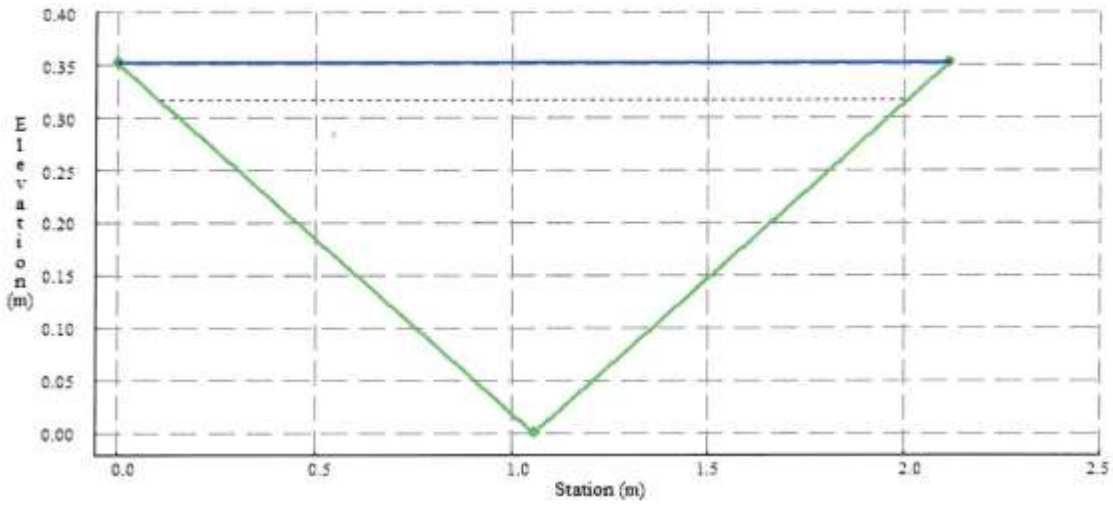
Flow area (A):	0.373 m^2
Wetted perimeter (P):	2.231 m
Hydraulic radius (R):	0.167 m
Top width (B):	2.117 m
Critical depth (Yc):	0.317 m
Critical slope (Sc):	0.01418 m/m
Velocity (V):	1.005 m/s
Velocity head (Hv):	0.052 m
Specific energy (Es):	0.404 m
Froude number (Fr):	0.7647
Flow type:	Subcritical

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 3 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 3 DESIGN.bhp



LEGEND:

- Normal flow depth (Yn)
- Critical flow depth (Yc)

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 4 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 4 DESIGN.bhp

BASIC HYDRAULIC CALCULATIONS

INPUT DATA

Channel shape selected:	Triangular
Friction calculation method:	Manning formula
Flow rate (Q):	0.236 m³/s
Channel slope (S):	0.028 m/m
Roughness coefficient (n):	0.027 s/m^1/3
Normal depth (Yn):	0.234 m (Solved)
Left side slope (Sl):	0.333 m/m
Right side slope (Sr):	0.333 m/m

RESULTS

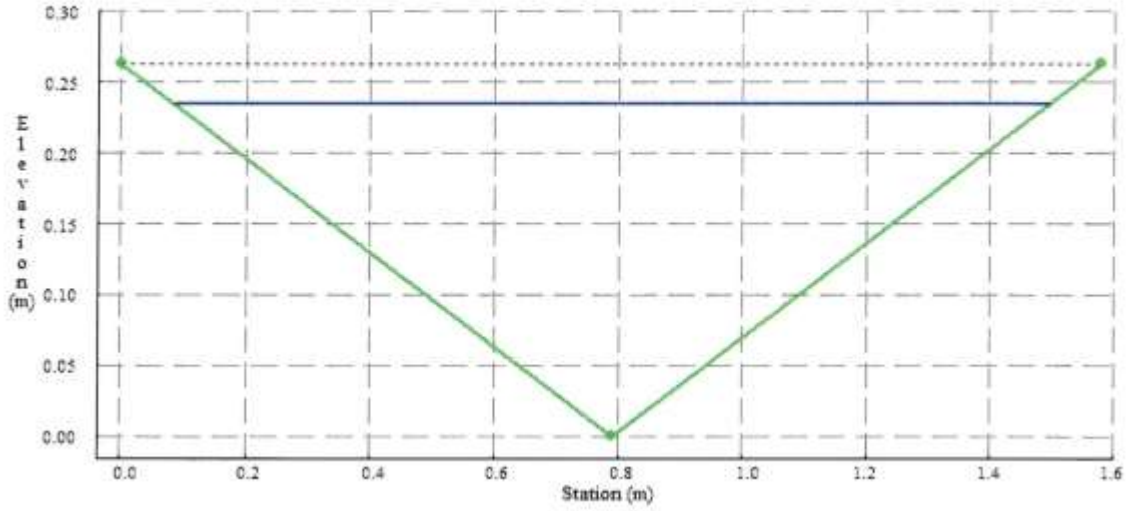
Flow area (A):	0.165 m²
Wetted perimeter (P):	1.483 m
Hydraulic radius (R):	0.111 m
Top width (B):	1.407 m
Critical depth (Yc):	0.263 m
Critical slope (Sc):	0.01508 m/m
Velocity (V):	1.432 m/s
Velocity head (Hv):	0.105 m
Specific energy (Es):	0.339 m
Froude number (Fr):	1.3364
Flow type:	Supercritical

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 4 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 4 DESIGN.bhp



LEGEND:

- Normal flow depth (Yn)
- Critical flow depth (Yc)

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 5 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 5 DESIGN.bhp

BASIC HYDRAULIC CALCULATIONS

INPUT DATA

Channel shape selected:	Triangular
Friction calculation method:	Manning formula
Flow rate (Q):	0.402 m³/s
Channel slope (S):	0.008 m/m
Roughness coefficient (n):	0.027 s/m^1/3
Normal depth (Yn):	0.362 m (Solved)
Left side slope (Sl):	0.333 m/m
Right side slope (Sr):	0.333 m/m

RESULTS

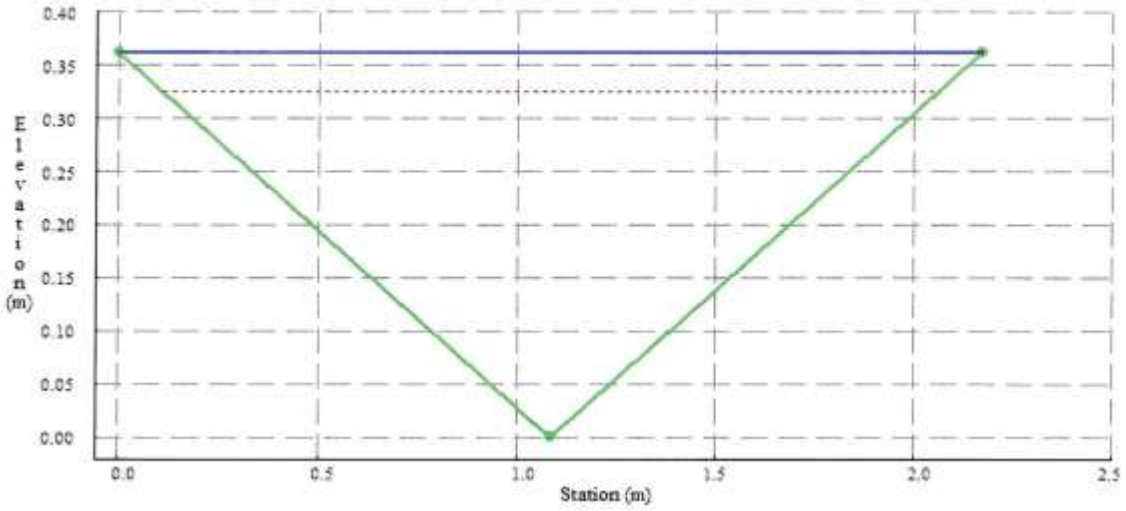
Flow area (A):	0.393 m²
Wetted perimeter (P):	2.290 m
Hydraulic radius (R):	0.172 m
Top width (B):	2.173 m
Critical depth (Yc):	0.325 m
Critical slope (Sc):	0.01405 m/m
Velocity (V):	1.023 m/s
Velocity head (Hv):	0.053 m
Specific energy (Es):	0.415 m
Froude number (Fr):	0.7680
Flow type:	Subcritical

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 5 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 5 DESIGN.bhp



LEGEND:

- Normal flow depth (Yn)
- Critical flow depth (Yc)

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 6 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 6 DESIGN.bhp

BASIC HYDRAULIC CALCULATIONS

INPUT DATA

Channel shape selected:	Triangular
Friction calculation method:	Manning formula
Flow rate (Q):	0.782 m³/s
Channel slope (S):	0.012 m/m
Roughness coefficient (n):	0.027 s/m^1/3
Normal depth (Yn):	0.430 m (Solved)
Left side slope (Sl):	0.333 m/m
Right side slope (Sr):	0.333 m/m

RESULTS

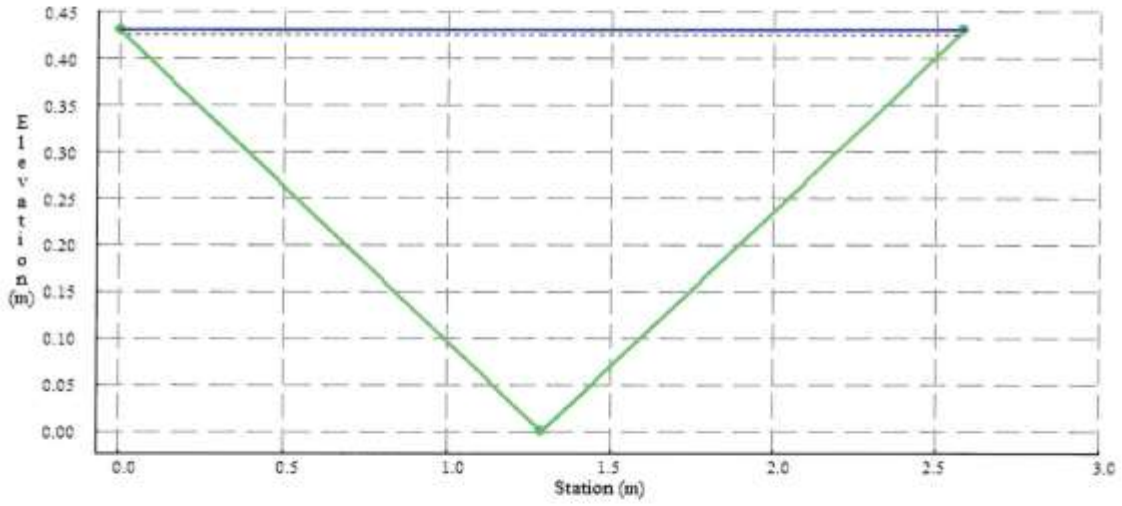
Flow area (A):	0.556 m²
Wetted perimeter (P):	2.724 m
Hydraulic radius (R):	0.204 m
Top width (B):	2.584 m
Critical depth (Yc):	0.425 m
Critical slope (Sc):	0.01286 m/m
Velocity (V):	1.407 m/s
Velocity head (Hv):	0.101 m
Specific energy (Es):	0.531 m
Froude number (Fr):	0.9682
Flow type:	Subcritical

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 6 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 6 DESIGN.bhp



LEGEND:

- Normal flow depth (Yn)
- Critical flow depth (Yc)

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 7 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 7 DESIGN.bhp

BASIC HYDRAULIC CALCULATIONS

INPUT DATA

Channel shape selected:	Triangular
Friction calculation method:	Manning formula
Flow rate (Q):	0.618 m³/s
Channel slope (S):	0.0095 m/m
Roughness coefficient (n):	0.027 s/m^1/3
Normal depth (Yn):	0.412 m (Solved)
Left side slope (Sl):	0.333 m/m
Right side slope (Sr):	0.333 m/m

RESULTS

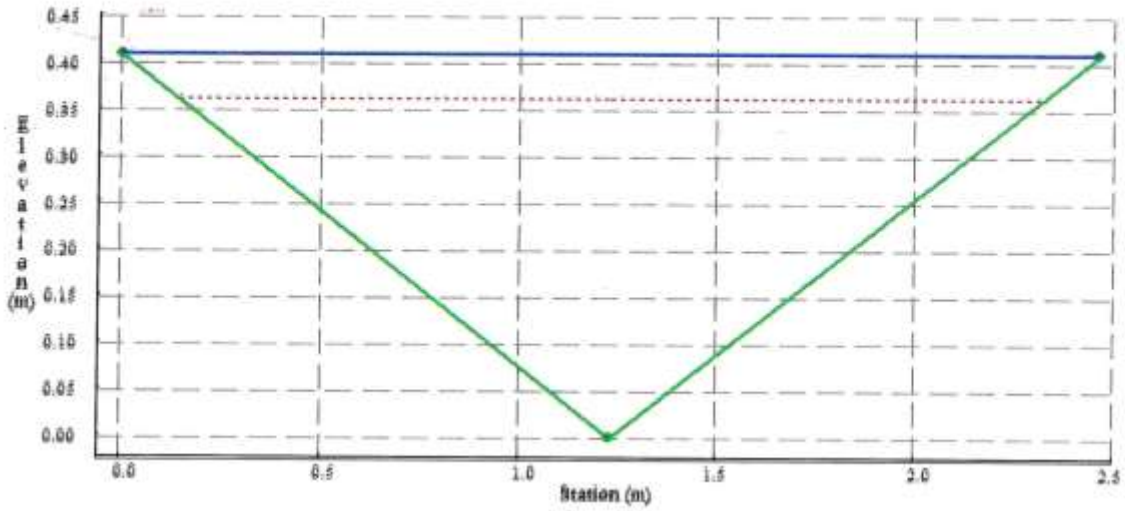
Flow area (A):	0.505 m²
Wetted perimeter (P):	2.597 m
Hydraulic radius (R):	0.195 m
Top width (B):	2.464 m
Critical depth (Yc):	0.362 m
Critical slope (Sc):	0.01356 m/m
Velocity (V):	1.041 m/s
Velocity head (Hv):	0.055 m
Specific energy (Es):	0.465 m
Froude number (Fr):	0.7336
Flow type:	Subcritical

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: CANAL 7 DESIGN
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\CANAL 7 DESIGN.bhp



LEGEND:

- Normal flow depth (Yn)
- Critical flow depth (Yc)

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 21 August 2026
Description: FINAL LANDFORM CANAL A
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\FINAL LANDFORM CANAL A.bhp

BASIC HYDRAULIC CALCULATIONS

INPUT DATA

Channel shape selected:	Trapezium
Friction calculation method:	Manning formula
Flow rate (Q):	3 m^3/s
Channel slope (S):	0.007 m/m
Roughness coefficient (n):	0.014 s/m^1/3
Normal depth (Yn):	0.475 m (Solved)
Left side slope (Sl):	0.333 m/m
Right side slope (Sr):	0.333 m/m
Bottom width (b):	1 m

RESULTS

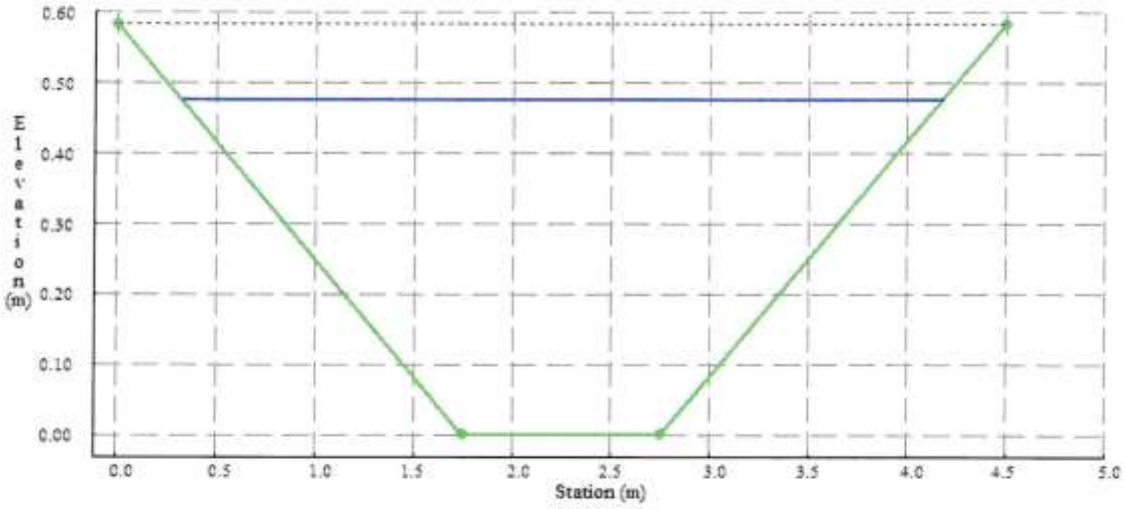
Flow area (A):	1.152 m^2
Wetted perimeter (P):	4.006 m
Hydraulic radius (R):	0.288 m
Top width (B):	3.852 m
Critical depth (Yc):	0.583 m
Critical slope (Sc):	0.00286 m/m
Velocity (V):	2.604 m/s
Velocity head (Hv):	0.346 m
Specific energy (Es):	0.820 m
Froude number (Fr):	1.5201
Flow type:	Supercritical

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 21 August 2026
Description: FINAL LANDFORM CANAL A
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\FINAL LANDFORM CANAL A.bhp



LEGEND:

- Normal flow depth (Yn)
- Critical flow depth (Yc)

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 19 July 2009
Description: FINAL LANDFORM CANAL B
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\FINAL LANDFORM CANAL B.bhp

BASIC HYDRAULIC CALCULATIONS

INPUT DATA

Channel shape selected:	Trapezium
Friction calculation method:	Manning formula
Flow rate (Q):	2.5 m³/s
Channel slope (S):	0.003 m/m
Roughness coefficient (n):	0.014 s/m^1/3
Normal depth (Yn):	0.531 m (Solved)
Left side slope (Sl):	0.333 m/m
Right side slope (Sr):	0.333 m/m
Bottom width (b):	1 m

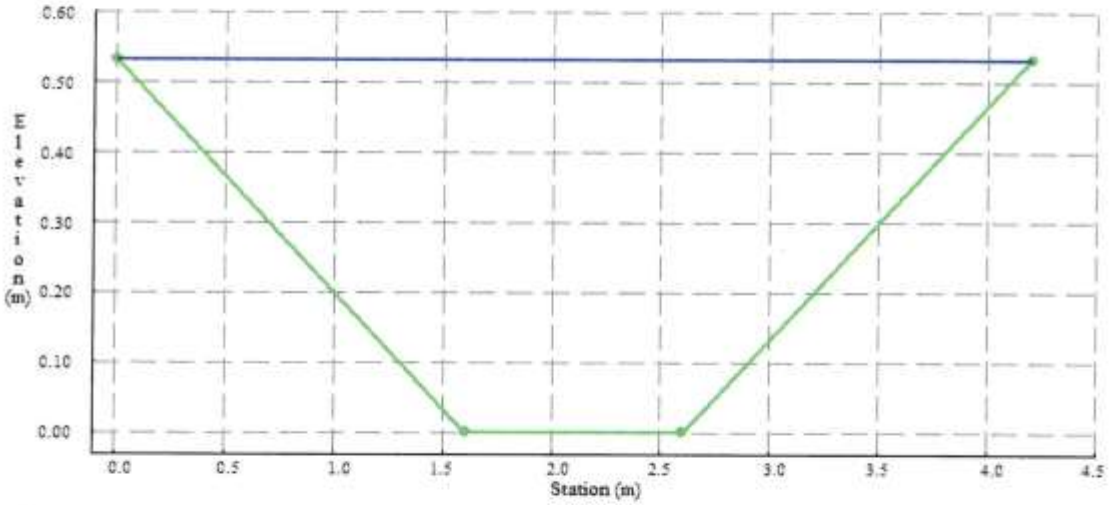
RESULTS

Flow area (A):	1.378 m²
Wetted perimeter (P):	4.361 m
Hydraulic radius (R):	0.316 m
Top width (B):	4.189 m
Critical depth (Yc):	0.534 m
Critical slope (Sc):	0.00294 m/m
Velocity (V):	1.815 m/s
Velocity head (Hv):	0.168 m
Specific energy (Es):	0.699 m
Froude number (Fr):	1.0103
Flow type:	Supercritical

Utility Programs for Drainage
Basic hydraulic calculations



Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 19 July 2009
Description: FINAL LANDFORM CANAL B
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\FINAL LANDFORM CANAL B.bhp



LEGEND:

- Normal flow depth (Yn)
- Critical flow depth (Yc)

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: FINAL LANDFORM CANAL C
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\FINAL LANDFORM CANAL C.bhp

BASIC HYDRAULIC CALCULATIONS

INPUT DATA

Channel shape selected:	Trapezium
Friction calculation method:	Manning formula
Flow rate (Q):	1.53 m³/s
Channel slope (S):	0.012 m/m
Roughness coefficient (n):	0.014 s/m^1/3
Normal depth (Yn):	0.302 m (Solved)
Left side slope (Sl):	0.333 m/m
Right side slope (Sr):	0.333 m/m
Bottom width (b):	1 m

RESULTS

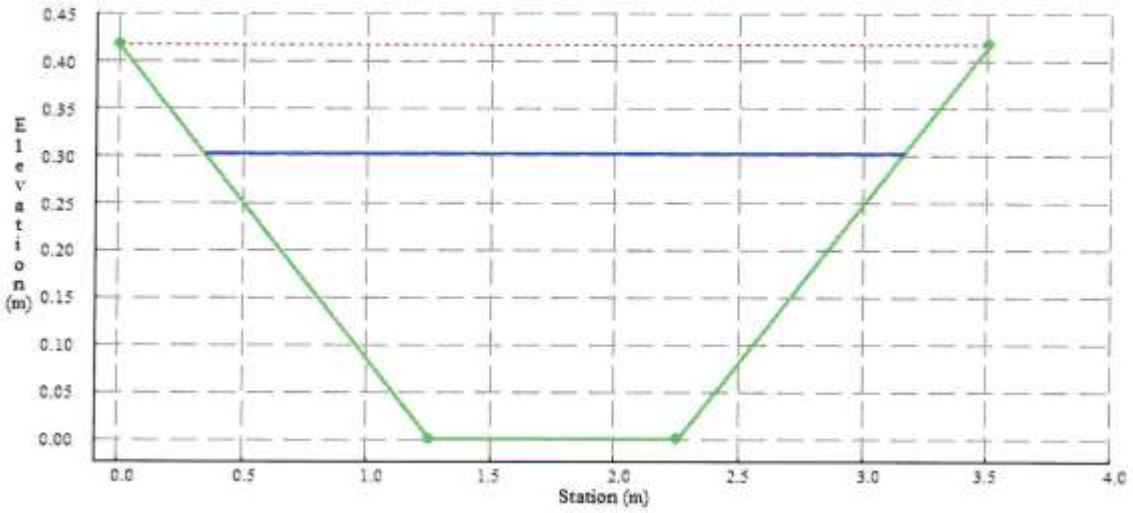
Flow area (A):	0.576 m²
Wetted perimeter (P):	2.912 m
Hydraulic radius (R):	0.198 m
Top width (B):	2.814 m
Critical depth (Yc):	0.418 m
Critical slope (Sc):	0.00313 m/m
Velocity (V):	2.656 m/s
Velocity head (Hv):	0.360 m
Specific energy (Es):	0.662 m
Froude number (Fr):	1.8746
Flow type:	Supercritical

Utility Programs for Drainage
Basic hydraulic calculations



Sinotech

Project: TONKMETER LANDFILL
River:
Designer: PA NICHOLSON
Date: 27 August 2026
Description: FINAL LANDFORM CANAL C
Filename: P:\Projekte\2026\26831 TONKMETER WASTE DISPOSAL FACILITY\UTILITY PROGRAM\FINAL LANDFORM CANAL C.bhp



LEGEND:

- Normal flow depth (Yn)
- Critical flow depth (Yc)