

Storm Water Management Plan

Prepared for

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1 Introduction

This Stormwater Management Plan (SWMP) outlines the system basis, water balance, storm event information and sizing to supplement the Operations Plan. It also discusses the monitoring framework for the stormwater management system at Sumas Gro-Media Ltd. (Sumas), located at 42481 Industrial Way, Chilliwack, British Columbia. The facility operates under a closed-loop, zero-discharge runoff management system intended to prevent stormwater or process water that has contacted wood-based materials from entering the environment. The system and management procedures described in this plan are consistent with the Environmental Management Act, and applicable provincial and municipal guidelines.

The SWMP outlines site drainage conditions, stormwater system design, hydrologic and hydraulic analysis, environmental protection measures, and operations and maintenance procedures. It supports regulatory compliance and demonstrates that the system can contain, and reuse all collected runoff within the site under a 1-in-10-year, 24-hour design storm event.

2 Site Description and Drainage Overview

The Sumas facility occupies approximately 7.1 hectares and is used for the production of “potting soil” i.e. growing media. The various blends involve feedstocks such as sawmill wood residuals, peat moss, coconut husk, sand, pumice, and nutrient blends. There are no composting operations onsite. Operations include feedstock receiving, screening, blending, storage, and packaging. The site consists of paved operational areas, unpaved mulch storage areas, and stormwater catchment system with lift stations directed to a 9,700 m³ clay-lined retention pond for runoff containment and recycling for process use.

Stormwater contacts feedstocks and leachate can be generated in operational areas. Subsequent drainages from these areas are collected through grading to ditching and/or lift stations, then conveyed to the retention pond. Water stored in the pond is either evaporated via the EcoMister HD-30 misting over the mulch pile area unit or reused for irrigating mulch piles. This system provides for a zero off-site discharge for stormwater.

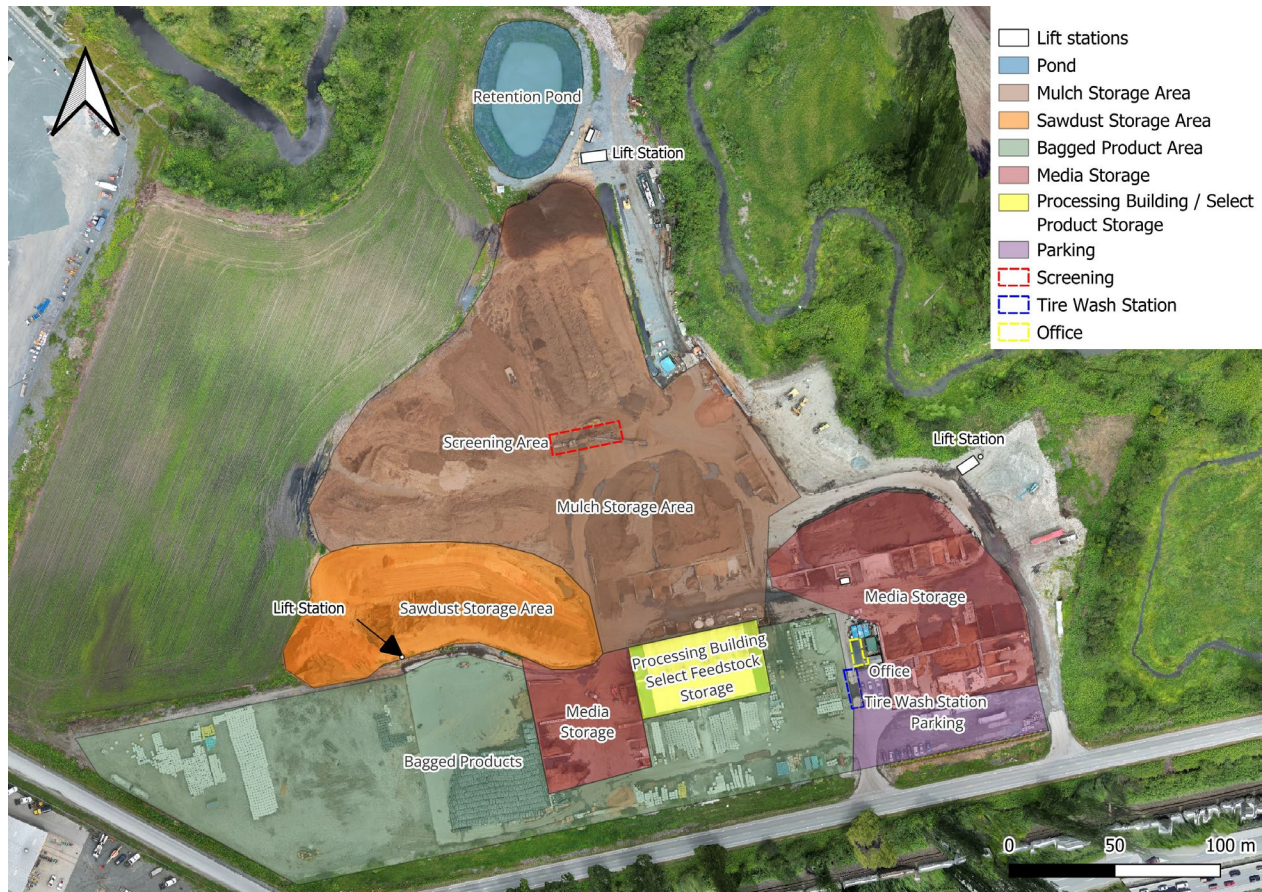


Figure 1. General Site Plan

2.1 Drainage Catchments

Table 1. Catchment Area

Catchment Area	Surface Type	Area (m ²)	Runoff Coefficient (C)	Within Catchment System
Media Storage	Paved	22,677	0.95	Yes
Mulch/Sawdust Storage	Unpaved	23,600	0.3	Yes
Retention Pond	Clay-lined	3,094.7	1.0	Yes
Bagged Storage	Paved	12,942	0.5	No
Entrance/Access	Paved	9,356	0.5	No



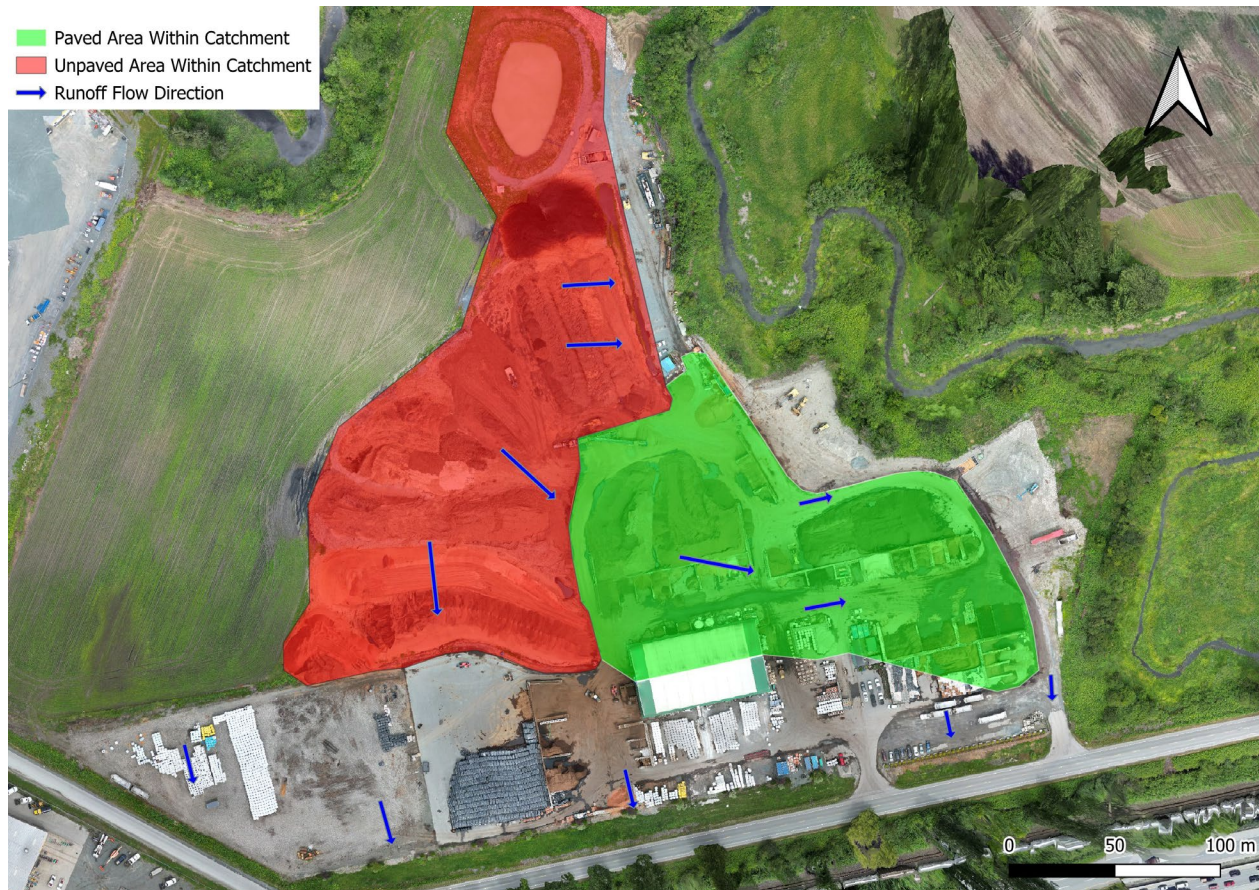


Figure 2. Catchment System and Runoff Direction

Most of the operational areas at the site are paved, with only the mulch area is unpaved. Runoff generated from both the mulch storage and media storage areas is collected through a series of ditches and lift stations. The collected water is conveyed to a clay-lined swale, which directs the flow to the lined retention pond. Water stored in the pond is subsequently evaporated or pumped back through the irrigation system to the mulch piles for moisture conditioning and reuse, maintaining a closed loop, no discharge process.

2.2 Existing Condition

The site lies within the Chilliwack–Rosedale Aquifer (Aquifer No. 6), composed of fine-grained Fraser River sediments overlying sand and gravel units. A low-permeability clay layer provides separation between surface water and groundwater. Groundwater flow is generally from west to east, discharging toward Wilson Slough and the Fraser River. The facility's grading directs all feedstock storage stockpiles area's surface runoff toward the retention pond, preventing uncontrolled releases. Please see Appendix A for detailed leachate/stormwater collection system record drawings.



3 Site Meteorology Data

3.1 Meteorology and Climate

The climate is based on data from the Agassiz Climate Station (1991–2020) (*Canadian Climate Normals Agassiz Station; Climate ID: 1100119*), showing a mean annual precipitation of 1,734 mm and an average temperature of 11 °C. The wettest month is November, with 271 mm of precipitation, used for design storm sizing.

Table 2 Agassiz (Agassiz Station) historical normals data: temperature and precipitation (1991-2020)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature													
Daily average (C)	3.5	5.3	7.3	10.4	14.2	16.4	19.0	19.0	16.2	11.2	6.4	3.5	11.0
Precipitation													
Rainfall (mm)	229.0	128.1	169.6	123.3	96.1	91.5	55.4	63.0	92.0	183.8	271.2	211.6	1714.6
Snowfall (cm)	18.2	4.7	7.2	0	0	0	0	0	0	0	7.4	14.4	52.0
Precipitation (mm)	250.2	136.6	151.8	123.0	89.7	90.7	55.1	68.7	98.3	185.4	267.8	216.8	1734.1

The rest of the climate data is also collected from Agassiz Climate Station.



Table 3. Agassiz Station Climate Data

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily Average Temperature (°C)	3.5	5.3	7.3	10.4	14.2	16.4	19	19	16.2	11.2	6.4	3.5
Daily Average Temperature (K)	276.65	278.45	280.45	283.55	287.35	289.55	292.15	292.15	289.35	284.35	279.55	276.65
Atmospheric Pressure (kPa)	101.7	101.6	101.4	101.4	101.4	101.4	101.5	101.4	101.4	101.5	101.5	101.5
Atmospheric Pressure (Pa)	101700	101600	101400	101400	101400	101400	101500	101400	101400	101500	101500	101500
Average vapour pressure (Pa)	700	700	800	900	1100	1400	1600	1600	1400	1100	800	600
Wind speed (km/h)	10.3	8.4	6.7	6.1	5.4	4.8	4.6	4.3	4.9	5.7	7.9	9.9
Wind speed (m/s)	2.86	2.33	1.86	1.69	1.5	1.3	1.28	1.19	1.36	1.58	2.19	2.7



3.2 Intensity-Duration-Frequency (IDF) Data

The 1 in 10-year storm are calculated with IDF curve value retrieved from Chilliwack Microwave Station (Appendix B). The IDF value selected is highlighted in red.

Table 4. Chilliwack Station IDF Data

Duration	2 years	5 years	10 years	25 years	50 years	100 years	#Years (1974 - 2017)
5 min	3.8	5	5.8	6.9	7.7	8.4	25
10 min	5.4	7.8	9.4	11.5	13	14.5	25
15 min	6.6	9.5	11.4	13.8	15.6	17.4	25
30 min	9.6	13.3	15.7	18.8	21.1	23.4	25
1 hr	10	12.8	14.6	17	18.7	20.4	16
2 hr	14	16.8	18.6	21	22.7	24.4	16
6 hr	27	31.7	34.9	38.8	41.7	44.6	16
12 hr	39.8	46.8	51.5	57.3	61.7	66	16
24 hr	55.1	66.4	74	83.4	90.5	97.5	16

4 Retention Pond Sizing and Flow Requirement

4.1 Methodology

The stormwater capacity design was developed using both average monthly rainfall data and intensity–duration–frequency (IDF) statistics for the Chilliwack region. The highest precipitation typically occurs between October and March, corresponding to the period of greatest stormwater load. Runoff volumes were calculated for the site catchments using the Rational Method, as the total contributing area is less than 65 hectares.

Runoff coefficients were assigned according to surface characteristics following the *Runoff Coefficient Fact Sheet (2011)*. Calculations were performed for the total catchment area to estimate the expected storage requirement under average monthly rainfall and under the 1-in-10-year, 24-hour design storm event.

Table 5. Lined retention pond capacity on November rainfall storage

Sub Catchment	Catchment Area	Runoff Coefficient	Rainfall	Volume
Unit	m ²		mm	m ³
Paved Catchment Area	22,677	0.95	271.2	5842.5
Unpaved Mulch Storage Area	23,066	0.3	271.2	1876.6
Retention Pond	3,094.7	1	271.2	839.3
Total:	48,837.7		Lined Pond Capacity:	8558.4

The November rainfall scenario represents the highest monthly precipitation. Operationally, the retention pond is to act as ballast between storms to allow for the recycling of water at a reasonable rate that exceeds the average peak monthly volume of 9,809m³ while ensuring that freeboard is maintained to accommodate a 24hr duration, 1-in-10-year storm event.

For design verification, IDF data from the Chilliwack Microwave Station (Environment and Climate Change Canada) were applied to determine rainfall intensity for a 1-in-10-year, 24-hour storm event. The results are summarized below.

Table 6. Runoff from 1-in-10-year 24 hr event from catchment area

Sub Catchment	Catchment Area	Runoff Coefficient	IDF	Volume (+20%)
Unit	m ²		mm/24hr	m ³
Paved Catchment Area	22,677	0.95	74	1913
Unpaved Mulch Storage Area	23,066	0.3	74	614.5
Retention Pond	3,094.7	1	74	274.8
Total:	48,837.7		Lined Pond Capacity:	2802.3

The 1-in-10-year, 24-hour storm event is estimated to generate approximately 2,802 m³ of runoff. To account for potential increases in precipitation intensity and variability, an additional 20% contingency has been applied to the volume when assessing retention pond capacity. The pond is therefore required to maintain adequate freeboard to accommodate this adjusted volume under all conditions. The November rainfall scenario presented in Table 5 provides a more conservative assessment, confirming that the pond has sufficient capacity to manage both short-term storm events and seasonal accumulation without risk of overflow given adequate freeboard is maintained.

4.2 As-built Retention Pond Capacity

A detailed topographic survey completed by Weaver Technical Corp. in 2025 confirmed the final as-built configuration of the retention pond constructed by Sumas in 2024. The pond's design parameters and volumetric characteristics are summarized below.

Table 7. Retention Pond Parameters

Parameter	Value	Unit
Pond length	70	m
Pond width	45	m
Pond depth	5	m
Pond water depth	4.7	m
Pond slope	2	
Dugout volume	10666.7	m ³
Water volume	9742.2	m ³



1:10 yr 24 hr storm volume	3211.9	m ³
Operating holding volume	6939.9	m ³
Water height at holding volume	3.7	m
Freeboard Required to 24hr Duration Accommodate 1-in-10- year storm	1.3	m

The retention pond provides a total storage capacity of 9,742 m³. The operational freeboard is required to be maintained at approximately 1.3 m, ensuring the pond can accommodate extreme rainfall events without risk of overflow.

Water collected and stored in the pond must be either evaporated through the EcoMister system or recirculated to the mulch storage area via the sprinkler network.

4.3 Pond Evaporation Calculation

The use of the Ecomister and the sprinkler must not result in a positive feedback condition which would require a discharge of stormwater. Subsequently the evaporation rate has been estimated to ensure that the recycle rate for stormwater to the mulching process (a heat intensive and water consuming process) is not overcome by the total precipitation.

To estimate the evaporation rate from the retention pond, the surface water temperature of the mulch stockpiles was conservatively assumed to correspond to the average monthly air temperature recorded at the Agassiz Climate Station. Based on these temperature values and applying standard evaporation equations, the average annual evaporation rate for the pond was calculated to be approximately 0.486 kg/m²/hr. This rate represents the mean evaporation potential over the course of a year under local climatic conditions.

A summary of the estimated monthly evaporation rates is provided in the table below, with detailed calculation steps illustrated in Figure 3.

However, if using Annual average for calculation, the total evaporated water from pond is round 4300 m³/year. This calculation will be researched upon and refined for the next submission.

Table 8. Evaporation rate by month, calculated using meteorological and climatic data from Agassiz Station and calculation formula in Figure 5.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Daily Average Temperature (°C)	3.5	5.3	7.3	10.4	14.2	16.4	19.0	19.0	16.2	11.2	6.4	3.5	11.0
Daily Average Temperature (K)	276.7	278.5	280.5	283.6	287.4	289.6	292.2	292.2	289.4	284.4	279.6	276.7	284.2
Atmospheric Pressure (kPa)	101.7	101.6	101.4	101.4	101.4	101.4	101.5	101.4	101.4	101.5	101.5	101.5	101.5
Atmospheric Pressure (Pa)	101700.0	101600.0	101400.0	101400.0	101400.0	101400.0	101500.0	101400.0	101400.0	101500.0	101500.0	101500.0	101500.0
Average vapour pressure (Pa)	700.0	700.0	800.0	900.0	1100.0	1400.0	1600.0	1600.0	1400.0	1100.0	800.0	600.0	1000.0
Wind speed (km/h)	10.3	8.4	6.7	6.1	5.4	4.8	4.6	4.3	4.9	5.7	7.9	9.9	6.6
Wind speed (m/s)	2.9	2.3	1.9	1.7	1.5	1.3	1.3	1.2	1.4	1.6	2.2	2.8	1.8
Saturation pressure of water vapour (Pa)	783.0	888.3	1019.7	1257.5	1614.5	1859.6	2190.7	2190.7	1836.0	1326.3	958.6	783.0	1308.8
*Maximum saturation humidity ratio at the same temperature as the water surface (kg/kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Humidity ratio (kg/kg)													
Water surface area (m2)	3094.7	3094.7	3094.7	3094.7	3094.7	3094.7	3094.7	3094.7	3094.7	3094.7	3094.7	3094.7	3094.7
Evaporation coefficient (kg/m2h)	79.4	69.3	60.4	57.2	53.5	50.3	49.3	47.7	50.9	55.1	66.7	77.3	59.8
Average evaporated water per hour (kg/h)	1185.2	1177.1	1180.3	1382.4	1666.2	1809.9	2092.4	2027.2	1805.3	1403.7	1224.0	1156.0	1504.4
Average evaporated water per square meter per hour (kg/m2/h)	0.38	0.38	0.38	0.45	0.54	0.58	0.68	0.66	0.58	0.45	0.40	0.37	0.49
Total Evaporated water from Pond in a year (m3/year)													13179

Figure 3. Calculation formulae used to determine evaporation rate for retention pond

Evaporation

The amount of evaporated water can be expressed as:

$$g_s = \Theta A (x_s - x) / 3600 \quad (1)$$

or

$$g_h = \Theta A (x_s - x)$$

where

g_s = amount of evaporated water per second (kg/s)

g_h = amount of evaporated water per hour (kg/h)

$\Theta = (25 + 19 v)$ = evaporation coefficient (kg/m²h)

v = velocity of air above the water surface (m/s)

A = water surface area (m²)

x_s = maximum humidity ratio of saturated air

at the same temperature as the water surface (kg/kg) (kg H₂O in kg Dry Air)

x = humidity ratio air (kg/kg) (kg H₂O in kg Dry Air)

Humidity ratio

Based on the [Ideal Gas Law](#) the humidity ratio can be expressed as

$$x = 0.62198 p_w / (p_a - p_w) \quad (2)$$

where

p_w = partial pressure of water vapor in moist air (Pa, psi)

p_a = atmospheric pressure of moist air (Pa, psi)

The maximum amount of water vapor in the air is achieved when $p_w = p_{ws}$ the saturation pressure of water vapor at the actual temperature. (2) can be modified to:

$$x_s = 0.62198 p_{ws} / (p_a - p_{ws}) \quad (3)$$

where

x_s = maximum saturation humidity ratio of air (kg_{water}/kg_{air}, lb_{water}/lb_{dry_air})

p_{ws} = saturation pressure of water vapor

Saturation pressure of water vapour

The maximum saturation pressure of the water vapor in moist air varies with the temperature of the air vapor mixture and can be expressed as:

$$p_{ws} = e^{(77.3450 + 0.0057 T - 7235 / T) / T^{8.2}} \quad (1)$$

where

p_{ws} = water vapor saturation pressure (Pa)

e = the constant 2.718.....

T = dry bulb temperature of the moist air (K)

4.4 Pond Overflow Control

If the water level in the pond rises to the overflow pipe approximately 0.5m below the top of the pond, the 300 mm steel overflow pipe would drain the overflow water to the field to the west side of the site, avoiding direct discharge to Wilson Slough. This pipe allows for overflow without catastrophic failure of the berm, but is not to be used for discharge otherwise except in an extreme flooding scenario.

4.5 Mulch Recycled Water Evaporation Calculation

Evaporation has been estimated using two methods: Dalton's Law for evaporation from a free-water surface (Huffman et al., 2013) and the Penman-Monteith Combination Method for evapotranspiration (Allen et al., 1998) with coefficients for bare coarse soil. Each method has limitations. Dalton's Law accounts for the elevated temperature of the mulch piles but is primarily suited for open-water conditions and may overestimate evaporation if applied directly, as some irrigated water may percolate through the piles without sufficient exposure for evaporation. However, the mulch piles do retain and gradually release moisture as vapour, likely approximating the modelled rates. Some of the applied water may also return to the pond or infiltrate through pore channels, depending on droplet size and soil structure. Use of fine misting is expected to increase efficiency by enhancing surface adsorption and promoting evaporation.

In contrast, the Penman-Monteith method uses ambient air temperature and does not account for internal heat generated within the mulch piles, resulting in an underestimation of actual evaporation. In practice, the true evaporation rate is expected to fall between the two estimates, though its exact value cannot be confirmed. For this Technical Assessment Report (TAR), the Penman-Monteith method has been adopted as a conservative basis for calculation. Further investigation is recommended to refine both evaporation and infiltration estimates. Water consumption by microbial activity has not yet been quantified and is expected to be substantial, as similar biological processes such as composting can result in water losses exceeding 50% of initial moisture, requiring continuous water input to maintain moisture levels above 50%.

4.5.1 Dalton's Law for Evaporation

Dalton's Law. Dalton's law for evaporation from free-water surfaces is

$$E = C(e_s - e_a) \quad (4.2)$$

where E = rate of evaporation (mm/day),

C = a constant (mm day⁻¹ kPa⁻¹),

e_s = saturation vapor pressure at the temperature of the water surface (kPa),

e_a = actual vapor pressure of the air (e_s of the air times relative humidity) (kPa).

Rohwer (1931) evaluated the constant C in Equation 4.2 as (in SI units, mm/day)

$$C = (3.30 + 1.973 U_{0.15})(1.465 - 0.00548P) \quad (4.3)$$

where $U_{0.15}$ = average water surface wind velocity (estimated to be at a height of 0.15 m)
(m/s),

P = atmospheric pressure (kPa).

Figure 4. Dalton's Law Formula



Table 9. Mulch Evaporation Calculation using Dalton's Law

Dalton type evaporation method	Free water surface	at 35C											
Mulch Evap													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
e0(35C)	5.63 kPa												
Wind speed (m/s) (u)	2.86111	2.33333	1.86111	1.69444	1.5	1.33333	1.27778	1.19444	1.36111	1.58333	2.19444	2.75	1.8333333
Daily Average Temperature (°C)	3.5	5.3	7.3	10.4	14.2	16.4	19	19	16.2	11.2	6.4	3.5	11
relative humidity (RH) (%)	74.7	65	63.6	58.6	57.6	60.6	57.1	56.1	60.1	69.8	75.9	76.2	64.6
Average vapour pressure (Pa)	700	700	800	900	1100	1400	1600	1600	1400	1100	800	600	
ambient vapour pressure (kPa)(e0)	4.20561	3.6595	3.58068	3.29918	3.24288	3.41178	3.21473	3.15843	3.38363	3.92974	4.27317	4.29006	
e0 - ea	1.42439	1.9705	2.04932	2.33082	2.38712	2.21822	2.41527	2.47157	2.24637	1.70026	1.35683	1.33994	
Atmospheric Pressure (kPa) (P)	101.7	101.6	101.4	101.4	101.4	101.4	101.5	101.4	101.4	101.5	101.5	101.5	101.5
$F(u) = (3.30 + 1.973u)(1.465 - 0.00548P)$ (mm/daykPa)	8.11921	7.17836	6.33981	6.04079	5.69194	5.39292	5.29006	5.14374	5.44276	5.83793	6.93366	7.92979	
E (mm/day)	11.5649	14.145	12.9923	14.08	13.5873	11.9627	12.7769	12.7131	12.2264	9.92599	9.4078	10.6254	
Days	31	28	31	30	31	30	31	31	30	31	30	31	
E (mm/month)	358.512	396.059	402.761	422.4	421.208	358.881	396.085	394.107	366.793	307.706	282.234	329.389	4436.1338
E (m/year)													4.4361338
E (Total) (m3/year)													104692.76

4.5.2 Penman-Monteith Combination Method

The FAO Penman-Monteith equation calculates the evapotranspiration of an established baseline: a hypothetical field of crop 0.12 m high, with surface resistance of 70 s/m, and an albedo of 0.23.



$$ET_0 = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T + 273} u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)} \quad (6)$$

where

ET_0 reference evapotranspiration [mm day^{-1}],
 R_n net radiation at the crop surface [$\text{MJ m}^{-2} \text{day}^{-1}$],
 G soil heat flux density [$\text{MJ m}^{-2} \text{day}^{-1}$],
 T mean daily air temperature at 2 m height [$^{\circ}\text{C}$],
 u_2 wind speed at 2 m height [m s^{-1}],
 e_s saturation vapour pressure [kPa],
 e_a actual vapour pressure [kPa],
 $e_s - e_a$ saturation vapour pressure deficit [kPa],
 Δ slope vapour pressure curve [$\text{kPa } ^{\circ}\text{C}^{-1}$],
 γ psychrometric constant [$\text{kPa } ^{\circ}\text{C}^{-1}$].

Figure 5. Penman-Monteith Method

Using the calculated ET_0 , the evapotranspiration of a bare field can be calculated by multiplying it by a factor K_c .

Bare soil

Single crop coefficient

Where the ground is left mostly bare following harvest, then the K_c following harvest will be strongly influenced by the frequency and amount of precipitation. K_c for bare soil can be calculated as $K_c = K_{c \text{ ini}}$ where $K_{c \text{ ini}}$ is calculated using the procedure of Chapter 6.

From the crop coefficient curve the K_c value for any period during the growing period can be graphically or numerically determined. Once the K_c values have been derived, the crop evapotranspiration, ET_c , can be calculated by multiplying the K_c values by the corresponding ET_0 values.



FIGURE 30. Average $K_{c\ ini}$ as related to the level of ET_o and the interval between irrigations greater than or equal to 40 mm per wetting event, during the initial growth stage for coarse textured soils

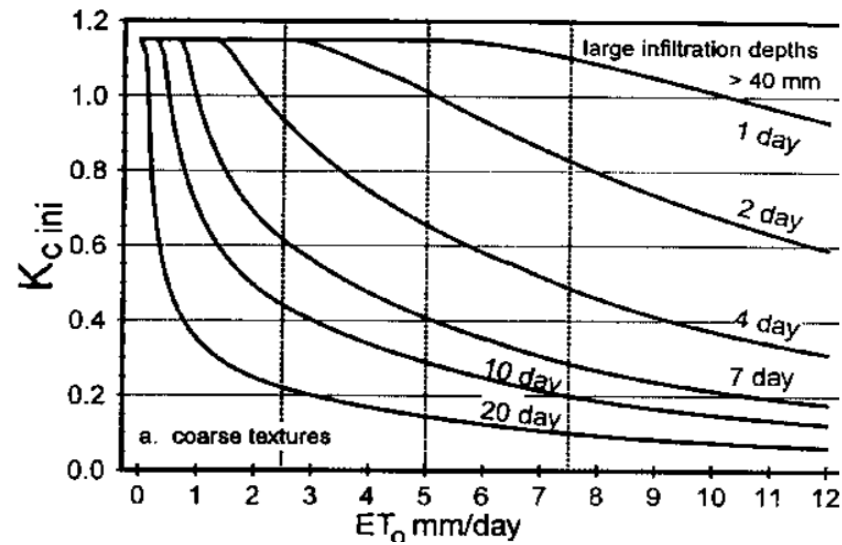


Table 10. Mulch Evaporation Calculation with Penman Monteith Method

	KC:	1.15											
Penman evapotranspiration method													
Mulch evap	Area:	23600	doesn't account for the 35C mulch										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rn (MJ m-2/day)	3.1	6.2	11.0	13.8	20.6	23.7	21.3	17.9	12.2	7.0	4.1	2.4	
G (Heat flux density to the soil (MJ m-2/day)	0	0	0	0	0	0	0	0	0	0	0	0	
slope of saturation vapour pressure (kPa/C)	0.056	0.062	0.070	0.084	0.105	0.119	0.137	0.137	0.117	0.088	0.066	0.056	
y Psychrometric constant (kPa/C)	0.068	0.068	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067	
T mean daily temperature (C)	3.5	5.3	7.3	10.4	14.2	16.4	19.0	19.0	16.2	11.2	6.4	3.5	
atmospheric pressure(kPa)	101.7	101.6	101.4	101.4	101.4	101.4	101.5	101.4	101.4	101.5	101.5	101.5	
u daily wind speed (m/s)	2.861	2.333	1.861	1.694	1.500	1.333	1.278	1.194	1.361	1.583	2.194	2.750	
u2 mean daily wind speed at 2m (m/s)	2.140	1.745	1.392	1.267	1.122	0.997	0.956	0.893	1.018	1.184	1.641	2.057	
es mean saturation vapour pressure (kPa)	0.785	0.891	1.023	1.261	1.619	1.865	2.197	2.197	1.842	1.330	0.961	0.785	
ea mean actual vapour pressure (kPa)	0.586	0.579	0.650	0.739	0.933	1.130	1.255	1.233	1.107	0.929	0.730	0.598	
ET0 (mm/day)	0.950	1.625	2.519	3.409	5.275	6.229	6.087	5.246	3.562	1.934	1.129	0.815	
Days	31	28	31	30	31	30	31	31	30	31	30	31	
ET0 (m/month)	0.0295	0.0455	0.0781	0.1023	0.1635	0.1869	0.1887	0.1626	0.1069	0.0600	0.0339	0.0253	
ET0 mulch (m3/month)	695.2	1074.1	1842.6	2413.5	3858.9	4410.2	4453.5	3838.1	2521.8	1415.0	799.5	596.6	27918.817
ET mulch (m3/yr)													32106.64



4.6 Water Balance Summary

The water balance modelling is based on theoretical approaches and a combination of assumed and measured parameters related to evaporation, runoff, water retained in mulch, from which infiltration is derived. Full Calculation can be found in TAR's Appendix I. This is a preliminary assessment of the water balance on the site. which gives the most conservative numbers for evaporation and infiltration. More research will be conducted to derive a more precise model.

Table 11. Water Balance Summary

Parameters	Value	Unit
Annual runoff to retention pond	58073	m ³ /yr
Input into Mulch (Precipitation + Irrigation)	82697	m ³ /yr
Evaporation from pond	13178	m ³ /yr
Evaporation from Mulch (Penman-Monteith Method)	32107	m ³ /yr
Evaporation from Mulch (Dalton's Law)	104693	m ³ /yr
Water retained in mulch	9836	m ³ /yr
Infiltration (Most conservative estimate)	21000	m ³ /yr

5 Stormwater Flow Analyses

5.1 Runoff Analysis of Catchment Area

Weaver performed an analysis of the system to determine its established storm intensity fecundity. A 1-in-2-year, 15-minute storm and a 1 in 10 year, 24hr duration event was used to

determine system flow capacity. The event produces a rainfall intensity of approximately 6.6 mm, representing short-duration, high-intensity rainfall typical for the region.

Runoff was estimated for both paved and unpaved catchment areas. The paved catchment, including the main operational and apron areas (totaling 22,677 m²), generates a peak flow of approximately 142.2 m³/hr (626 GPM). This runoff is collected through the site ditch network and conveyed to the east and north lift stations, where it is pumped to the retention pond.

The unpaved mulch storage area (totaling 23,066 m²) generates a peak flow of approximately 45.7 m³/hr (201 GPM). Runoff from this area is conveyed by gravity through the southern drainpipes and eastern clay-lined swale. It is first collected by drainpipes in the south and pumped to the surface at the northeast corner of the main building to flow toward the southeast lift station, which pumps the water north through the clay-lined swale and ultimately to the retention pond via the north lift station.

These combined flows represent the total stormwater volumes that the lift stations and ditching system are designed to manage under the 1-in-2-year, 15-minute storm event.

Table 12. Run-off flow rates

Sub-Catchment	Catchment Area	C	IDF	Discharge	
	m ²		mm/hr	m ³ /hr	GPM
Paved Catchment Area	22,677	0.95	6.6	142.2	626
Unpaved Mulch Storage Area	23,066	0.3	6.6	45.7	201.2
Retention Pond	3,094.7	1			

Table 13. Southeast Lift Station Flowrate Calculation (one pump)

Southeast lift station to swale:		
Height difference	2.94	m
	9.66	ft
Pipe size	150	mm
Pipe length	190	m
	623.2	ft
Additional eq. length from fittings	26.7	ft
Total effective length	649.9	ft
Head loss	1	ft/100ft
Total head loss in pipe	16.16	ft
Flowrate	350	GPM
	2,291	m ³ /d



Table 14. North Lift Station Flowrate Calculation (one pump)

North lift station to pond:		
Height difference	3.93	m
	12.9	ft
Pipe size	100	mm
Pipe length	13	m
	42.64	ft
Additional eq. length from fittings	17.7	ft
Total effective length	60.34	ft
Head loss	6.5	ft/100ft
Total head loss in pipe	16.83	ft
Flowrate	350	GPM
	2,291	m ³ /d

Both the southeast and north lift stations are equipped with two KTZ47.5 pumps. Based on pump curves, each pump is predicted to achieve 350 GPM given the minimal head loss. With both pumps operating, each lift station has a total discharge capacity of 700 GPM, or 3,810 m³/d providing sufficient capacity to handle the 1-in-2-year, 15-minute storm event. A 24hr duration, 1 in 10-year return requires 3041.2m³ pumping capacity per day and is subsequently accommodated by this pumping system as well with a 25% contingency.

5.2 Runoff Analysis of Non-Catchment Area

Non-catchment areas of the site consist primarily of the bagged storage area and gravel-surfaced sections. These areas are not part of the stormwater collection system and do not include any exposed feedstock. The bagged materials are sealed and impervious to precipitation, while the surrounding ditching and gravel area promotes natural infiltration.

Runoff from these surfaces drains by sheet flow to the south roadside ditch (Industrial Way roadside ditching) located along the property boundary. According to site observations by Sumas, no measurable runoff has been observed during rainfall events since the facility was constructed, indicating effective infiltration. The ditching along industrial way is blind on both ends and does not connect to surface water bodies or drainages. Because these areas are isolated from material handling and storage zones, and the ditching does not connect to anything, no contaminants are expected discharged from these areas.

6 Stormwater Management System

6.1 Site grading

The paved operational areas and mulch storage zones are graded to direct surface flow toward the stormwater collection network shown in Figure 2. The grading ensures that all runoff is conveyed by gravity to the collection ditches and subsequently to the lift stations for controlled pumping.

6.2 Ditching/Lift station design

The stormwater conveyance system includes three main ditch segments and three lift stations operating in series:

6.2.1 Southern Ditch and South Lift Station:

A 4-inch PVC French drain beneath the south ditch collects runoff from the mulch area and conveys it to the south lift station. This station is also directly integrated with the irrigation system, allowing captured runoff to be pumped through sprinklers for reuse in mulch pile moisture conditioning. The pump in the lift station can also be connected to a 4-inch HDPE line that discharges to the northwest corner of the building where it can be discharged to the paved surface with grading that directs stormwater to the southeast basin that goes to the southeast lift station to the retention pond.

6.2.2 Southeast Lift Station and East Swale:

A gravity-fed 8-inch PVC line collects runoff from the media storage area and directs it to the southeast lift station, consisting of a drive-in basin and a pump chamber. Any water not collected by the gravity line flows on the surface to the southeast lift station. The drive-in basin measures 9.8 m long, 4.6 m wide, and 1.5 m deep and has a ramp for a skid steer to add and remove material. The basin has a mulch filter to aid in removing large particles and debris in runoff. The pump chamber measures 2.1 m in diameter and 2.7 m deep. Dual 6-inch HDPE forcemains convey the pumped flow northward along the east boundary to a clay-lined swale “ditch” at the northeast corner of the mulch area. The clay-lined swale also receives runoff from the northern portion of the mulch area and routes it to the north lift station.

6.2.3 North Lift Station and Utility Room Connection:

The north lift station consists of a 11.6 m × 4.6 m drive-in basin, 2.1 m deep with a similar ramp and mulch filter as the southeast drive-in basin. The connected pump chamber measures 1.2 m x 2.4 m and 2.1 m deep. It pumps collected water through dual 6-inch HDPE forcemains to the

utility room, which supplies water to the sprinkler and EcoMister systems. A 4-inch HDPE overflow pipe connects the north lift station directly to the retention pond.

6.3 Leachate and stormwater recycle system

Stormwater collected from the mulch and paved areas is stored in the clay-lined retention pond, which serves as both an evaporation basin and a water source for irrigation. The utility room adjacent to the pond houses two pumps that supply water through the sprinkler and EcoMister system, returning it to the mulch piles for reuse and evaporation. This closed-loop design prevents any off-site discharge.

6.3.1 Piping materials

Except for the PVC piping used in the south French drain, all other ditches and conveyance systems are constructed with HDPE piping. In areas where no subsurface pipe is installed, such as the northeast clay-lined swale, the clay layer functions as a barrier that prevents downward seepage of collected stormwater.

The clay material underlying the swale system was tested and found to have a hydraulic conductivity of 1.2×10^{-7} cm/s, which meets the functional equivalency of a low-permeability liner. For comparison, engineered geomembrane liners used in stormwater retention and leachate containment systems are typically required to have a hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/s, as specified by the BC Ministry of Environment Technical Guidance on Landfill Design (*Landfill Criteria For Municipal Solid Waste*, 2016).

Accordingly, the existing compacted clay layer at the site provides sufficient containment performance comparable to a geomembrane liner, ensuring negligible infiltration and protection of groundwater beneath the swale and pond system.

6.3.2 Sprinkler

The sprinkler system forms part of the stormwater recycling network and is designed to distribute captured runoff and pond water evenly over the mulch storage area. The system consists of multiple high-capacity sprinkler heads connected via 1.5-inch diameter fire hoses to the 6-inch HDPE force main running from the north lift station and utility room and south lift station. Operating pressure within the sprinkler lines ranges between 310 and 380 kPa (45–55 psi), sufficient to provide a distribution radius of approximately 12 – 15 m per unit. Sprinkler heads are mounted on mobile stands that can be relocated to match stockpile layout and rotated to optimize coverage uniformity. The flow to each sprinkler can be adjusted through manual valves at each connection point, allowing for control of application rate depending on weather, storage pond level, and pile conditions.

The sprinklers operate primarily during dry or moderate weather to recycle stored runoff water back onto the mulch piles. This achieves three technical objectives: (1) maintain surface moisture to suppress fugitive dust; (2) moderate internal mulch temperature to minimize spontaneous heating; and (3) increase overall evaporative loss by spreading water over a large surface area. The moisture applied to the mulch is partially absorbed and retained in pore spaces before being lost to the atmosphere through vapour diffusion. This process effectively converts the mulch stockpiles into distributed evaporation fields, complementing the function of the EcoMister and extending the system's total evaporative capacity.

6.3.3 EcoMister

The evaporation subsystem consists of one EcoMister HD-30 unit installed adjacent to the retention pond. The EcoMister draws water from the pond through a 4-inch HDPE suction line connected to a floating intake to prevent sediment entrainment. Water is pumped through a multi-nozzle atomization ring that generates a fine mist with droplet diameters between 80 – 120 microns, which are then dispersed by an integrated axial-flow blower rated at 10 kW. The fine droplet size and high discharge velocity maximize the air–water interface, allowing for rapid phase change and high evaporation efficiency.

The system can operate at variable flow rates between 250 and 400 GPM (57 – 91 m³/h) depending on ambient conditions. Under optimal conditions (air temperature > 25 °C, RH < 60 %), the EcoMister achieves evaporation rates approaching 35,000 – 36,000 m³ per year, effectively managing the site's retained water volume during summer months. During cooler or humid conditions, the EcoMister can operate in “low velocity” mode, functioning as a supplemental irrigation sprayer to distribute water over the mulch area. The unit's location near the pond allows for direct recirculation of runoff without overloading the lift stations, and its performance is controlled by manual or automatic operation based on weather and storage pond levels.

6.3.4 Pumps

Stormwater conveyance throughout the site is achieved through a network of submersible pumps located at the north, east, and west (south) lift stations. Each lift station houses two KTZ 47.5 submersible pumps (Tsurumi, 10 hp, 600 V, three-phase) configured for redundancy and automatic alternating duty. Each pump provides a nominal discharge rate of 350 GPM (79.5 m³/h) against a total dynamic head (TDH) of 15–17 ft (4.6–5.2 m). The dual-pump configuration allows either pump to operate independently during low-flow periods or simultaneously during high-intensity rainfall, providing a total lift station capacity of 700 GPM (159 m³/h).

The pumps are float-actuated and automatically start when the sump level rises above a set threshold. Flow is conveyed through HDPE force mains ranging from 100 mm to 150 mm diameter, depending on station location. The east lift station transfers runoff collected from the

southern and eastern ditch systems to the clay-lined swale, while the north lift station conveys this flow into the retention pond or directly to the sprinklers or EcoMister. The utility room draws water from the retention pond and routed through dedicated control valves either to the EcoMister or to the sprinkler network, depending on operational needs. A 4-inch HDPE pressure overflow line from the utility room provides hydraulic relief to the retention pond, preventing over-pressurization of the EcoMister.

7 Stormwater Operation Requirements

This document is to be used with the Stormwater System Operational Manual. Refer to Operational Manual for all operational requirements and needs.

8 Closure

If you have any questions or require additional clarification regarding this analysis, please feel free to reach out to the undersigned.

Sincerely,
Han Lei Huang, B.Tech., B.A.Sc.
Chris Webster, EIT

Review and Input by:
Tim Weaver, P.L.Eng., R.P.Bio., EP.

List of References

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Appendix A: Leachate/Stormwater System Record Drawing



- Notes:
- 1. Boundary data has been sourced from ParcelMap BC (PMBC)
 - 2. Contours (0.5m)
 - 3. Aerial Image is indicative only and has not been ortho-rectified
 - 4. Building and block walls outlines are indicative only
 - 5. Pond volume estimated at approx. 11000-14000m³
 - 6. Site spot elevations picked up by WeaverTech on 05/07/23 (in yellow) and on 14/03/24 (in black)
 - 7. The location of utilities were not verified by WeaverTech.

PREPARED BY:						CLIENT:		DESIGN BY:				DWG TITLE:	
WeaverTech Science - Construction - Engineering PERMIT TO PRACTICE NUMBER:1001178		SEAL REV DATE REVISIONS BY		SUMAS GRO MEDIA Innovative Growing Media Solutions 42481 Industrial Way, Chilliwack, BC V2R 0P4		DRAWN BY:		CW		LEACHATE COLLECTION SYSTEM AS BUILT			
						APPROVED BY:		TW					
						DATE:		OCT 10, 2025					
						SCALE:		1:1000@A1					
								DWG NO: 268-C-01		REV NO: 0			

Appendix B: IDF Curves

Short Duration Rainfall Intensity–Duration–Frequency Data

2022/10/31

Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée

