WATER DESIGN ENGINEERS
— Solving water in the landscape —

Technical Note

Project	Construction & Maintenance of SuDS Features, Field Place Estate
Client	Schulenberg Farms Ltd
Purpose	Discharge of conditions 1 and 2 with respect to planning application DC/24/0220 (applicant: Mr Kenneth Prichard Jones)
Date	21st November 2024

The client has been granted planning permission for the 'deposit of topsoil and chalk for biodiversity and agricultural improvement with improved access' at Field Place Estate, Broadbridge Heath. The associated drainage works, as outlined in the approved Flood Risk Assessment (WDE, 05.07.24) include the creation of new ditches adjacent to the access track which discharge to a new pond in the NW corner of Reservoir Field, with other portions of the access track draining to two new swales discharging into Lake 3 and Lake 4. Details of the flow control measures at each of these attenuation features, along with the construction and maintenance details for all drainage components are required to discharge planning conditions 1 and 2. This technical note should be read in conjunction with the following drawings:

- 24291_ENV_ZZ_DR_D-0101_01 General Arrangement Plan of New Permanent Access Track from OGRW to Lake 4 Berm
- 24291_ENV_ZZ_DR_D-0102_01 General Arrangement Plan of New Access Track within Reservoir Field
- 24291_ENV_ZZ_DR_D-0103_01 Lake 3 and 4 Swale Detail
- 24291_ENV_ZZ_DR_D-0104_01 NW Pond Detail
- 24291_ENV_ZZ_DR_D-0105_00 Weir Plate and Protective Screen Detail

1 Flow Control Measures

Due to the very low allowable discharge from each of the swales, 'Hydrorock aquifer blocks' have been specified for the underdrain to regulate the discharge through the bottom of the swale. These blocks are effectively 'sponges' made from mineral wool, with a central outlet through the middle. Water from the upstream drainage flows over the shingle / sand and soaks into blocks. The movement of water through the blocks is by capillary action, which restricts how fast the water leaves the bocks through the central outlet pipe. In order for the capillary action to work, the upstream end of the central pipe within the blocks is connected to an atmospheric vent.

Each of the specified BD112 Hydrorock aquifer blocks provides a controlled outlet flow of 0.046 l/s. Therefore, a specific number of blocks can be joined end to end to provide the desired total outlet flow. The blocks can be cut to length as required so that a specific total flow is provided.

The table on the following page shows the number of blocks and resulting outlet flow provided, plus the temporary storage volume for each of the swales.

Swale	Temporary Storage Volume	No. of BD112 Blocks	Outlet Flow
Connecting to Lake 3	12.5 m^3	3.5 (3 whole blocks plus one cut to length of 600 mm)	3.5 x 0.046 = **0.16 l/s**
Connecting to Lake 4	13.5 m^3	3.7 (3 whole blocks plus one cut to length of 840 mm)	3.7 x 0.046 = **0.17 l/s**

The temporary storage volume within each of the swales is provided by the railway sleeper dam, which allows the water level to rise above the swale bed (shingle layer) by 300 mm during the design storm event (1 in 100 years + climate change allowance). Larger events will cause the water level to rise further, until reaching the overflow 600 mm above the shingle layer. The overflow consists of a rectangular-notch weir at the top of the railway sleeper dam.

The outlet flow discharging from the NW Pond in Reservoir Field is controlled by a 30° V-notch weir. Discharge over the weir in terms of flow vs head is defined by the following formula:

$$Q = Cd\ 8/15\ \sqrt{2g}\ \tan(\Theta/2)\ H^{5/2}$$

Whereby:
Q = Flow (m^3/s)
Cd = Coefficient of discharge (dimensionless), assumed to be 0.59
g = acceleration due to gravity, 9.81 m/s
Θ = Angle of v-notch in degrees
H = Head, vertical height of water level above the invert of the v-notch (m)

The following table shows the calculated flow, Q (expressed in l/s by multiplying by 1000) for a range of values for H. The allowable discharge for the design event (1.18 l/s) and corresponding value of H (0.100 m) is shown in bold.

H (m)	Q (l/s)
0.010	0.00
0.020	0.02
0.030	0.06
0.040	0.12
0.050	0.21
0.060	0.33
0.070	0.48
0.080	0.68
0.090	0.91
0.100	**1.18**
0.110	1.50
0.120	1.86
0.130	2.28
0.140	2.74
0.150	3.25
0.160	3.82

H (m)	Q (l/s)
0.170	4.45
0.180	5.13
0.190	5.88
0.200	6.68

With a surface area of 918.13 m^2, the NW Pond provides a temporary storage volume of 91.81 m^3 when the depth is 0.100 m above the invert level of the V-notch.

2 Construction

The construction of each of the swales should be undertaken as follows:

1. Excavation to required depth and profile
2. Laying of woven geotextile
3. Backfilling of 100mm depth of sand
4. Installation of Hydrorock blocks (3 whole blocks plus one cut to length)
5. Installation of shuttering for concrete dam footing, with Hydrorock block outlet pipe connection passing through shuttering (puddle flange should be used to prevent seepage)
6. Pouring of concrete dam footing
7. Removal of shuttering
8. Installation of railway sleeper dam / weir: Bottom layer should be bolted to concrete footing, and each subsequent layer should be bolted to the next (using countersunk holes). Silicone sealant should be used between each layer.
9. Installation of supporting wooden stakes
10. Installation of vent pipe and cowling for Hydrorock blocks
11. Backfilling of 100 mm of sand to sides / top of Hydrorock blocks
12. Backfilling of 200 mm of gravel on top of sand
13. Backfilling of soil to correct profile within swale (banked sides up to top of railway sleeper dam, making good around the end of the connecting inlet pipe)
14. Backfilling of soil in front of concrete footing / above Hydrorock block outlet pipe
15. Installation of rock mattress (scour protection)
16. Exposed, profiled soil should be seeded with native grasses / wildflowers which are suited to ephemerally wet conditions and are of local provenance. If seeding does not take place until Autumn, then covering of the soil with protective coir matting within the swale is likely to be required to prevent soil erosion over the winter months (when there is no established vegetation to hold the soil together).

The construction of the NW pond should be undertaken as follows:

1. Excavation to required depth and profile (bottom profile of the pond and depth of permanent pool is not essential to attenuation function and is therefore unspecified to provide flexibility for clients ecological / amenity requirements).
2. Compaction of bentonite enriched soil to line and level for foundation of railway sleeper dam

3. Installation of railway sleeper dam / weir: Bottom layer should be embedded within bentonite enriched soil, and each subsequent layer should be bolted to the next (using countersunk holes). Silicone sealant should be used between each layer.
4. Installation of supporting wooden stakes
5. Installation of the stainless steel V-notch plate: silicone sealant should be used in addition to the fixing bolts so that water cannot weep out behind the plate.
6. Installation of rock mattress (scour protection) on downstream side of the railway sleeper dam
7. Backfilling of compacted soil to correct profile inside and outside of the railway sleeper dam
8. Ensure that the top of the pond embankment is at least the height of the railway sleeper dam all the way around (to provide a total depth of 400 mm from the invert level of the V-notch to the top of the bank).
9. Exposed, profiled soil should be seeded with native grasses / wildflowers which are suited to ephemerally wet conditions and are of local provenance. If seeding does not take place until Autumn, then covering of the soil with protective coir matting around the weir area is likely to be required to prevent soil erosion over the winter months (when there is no established vegetation to hold the soil together).

3 Maintenance

Maintenance of the two swales should be as per Table 17.1 of the SuDS Manual (CIRIA C753). A copy of this table is provided in section 5.3 of the approved Flood Risk Assessment (WDE, 05.07.24). In addition to this, the following activities must be undertaken:

- Replacement of the sand and gravel filter layers overlying the Hydrorock aquifer blocks should be undertaken every ten years, or when suspected blockage of the Hydrorock aquifer blocks is not remedied by the removal of silt / mulch over the surface of the gravel.

Maintenance of the NW Pond in Reservoir Field should be as per Table 23.1 of the SuDS Manual (CIRIA C753). A copy of this table is provided in section 5.3 of the approved Flood Risk Assessment (WDE, 05.07.24). In addition to this, the following activities must be undertaken:

- Monthly inspection of the protective screen in front of the V-notch weir, removing any accumulated debris as required

- Monthly inspection of the V-notch weir, removing any pond weed / biofouling on the face of the plate or on the profile of the notch.

Maintenance of the French drain which drains the trackway to Lake 4 should be as per Table 16.1 of the SuDS Manual (CIRIA C753). A copy of this table is provided in section 5.3 of the approved Flood Risk Assessment (WDE, 05.07.24).

Maintenance of the drainage ditches which drain the trackway connecting to OGRW and the trackways in Reservoir Field should be done in autumn months to limit impact on wildlife. The ditches should be cleared of accumulating silt and mulch, and encroaching vegetation should be mowed and/or cut back so that the cross sectional profile of the ditch channel is not restricted.