# East West Rail Phase 2

## Technical Note: Runoff Coefficients for Temporary Compound A1

## Discipline/Grip Stage: Temporary Compounds/GRIP5

## Document Number: 133735_RW-EWR-XX-A1-RP-DH-001102

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## Document History

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| **Project:** | **East West Rail Phase 2** | **To:** | **Richard Bennett** |
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## 1. Introduction

The purpose of this technical note is to set out the rationale for determining greenfield runoff rates and runoff coefficients for the drainage design to serve temporary compound A1.

## 2. Greenfield runoff calculations

Greenfield runoff rates for the A1 compound have been calculated using the Wallingford greenfield runoff estimation tool. In the calculation Soil Type 4 (with SPR value of 0.47) has been adopted as being most representative of on-site soil conditions.

Site excavation has classified subsoil across the site as dry firm clay. Insitu infiltration tests undertaken early in 2020 have also confirmed infiltration rates to be very low and representative of soils with poor drainage characteristics. This factual information in conjunction with Table 1 below supports the selection of Soil Type 4 in our greenfield runoff calculations. A summary of the infiltration testing results at A1 compound is provided in technical note 133735_RW-EWR-XX-A1-RP-DH-001101.

| General Soil Description | Runoff potential | Soil Class |
|---|---|---|
| Well drained sandy, loamy or earthy peat soils<br>Less permeable loamy soils over clayey soils on plateaux adjacent to very permeable soils in valleys | Very low | S1 |
| Very permeable soils (e.g. gravel, sand) with shallow groundwater<br>Permeable soil over rocks<br>Moderately permeable soils some with slowly permeable sub-soils | Low | S2 |
| Very fine sands, silts and sedimentary clays<br>Permeable soils (e.g. gravel, sand) with shallow groundwater in low lying areas<br>Mixed areas of permeable and impermeable soils in similar proportions | Moderate | S3 |
| Clayey or loamy soils | High | S4 |
| Soils of wet uplands:<br>Bare rocks or cliffs<br>Shallow, permeable rock soils on steep slopes<br>Peat with impermeable layers at shallow depth | Very High | S5 |

Table 1: Institute of Hydrology method of assessment for soil classification

The greenfield runoff rates for compound A1 are shown in table 2 below. Peak discharges from the attenuation basins will be limited to these rates:

| **Northern catchment** | | **Southern catchment** | |
|---|---|---|---|
| 1 in 1 yr | 4.22 l/s | 1 in 1 yr | 8.00 l/s |
| 1 in 30 yr | 11.41 l/s | 1 in 30 yr | 21.65 l/s |
| 1 in 100 yr | 15.82 l/s | 1 in 100 yr | 30.02 l/s |

Table 2: Summary of greenfield runoff rates for A1 compound

## 3. Runoff coefficients for hydraulic modelling

The following runoff coefficients have been modelled for the A1 compound drainage design as set out in Drainage Strategy (document ref: 133735_2A-EWR-OXD-CC_A1-RP-DH-000001):

| Surface Characteristic | Runoff Coefficient | Comments |
|---|---|---|
| **Compound Infrastructure** | | |
| Paved areas – asphalt or concrete | 1.00 | N/A |
| Buildings – site cabins and shelters | 1.00 | |
| Granular Paved Areas – car park and welfare areas | 0.50 | N/A |
| Grassed Areas – verges and vegetated areas | 0.15 (Gradient <15%) | N/A |
| **Stockpile & Laydown Areas** | | |
| Granular Stockpiles – ballast, aggregates & crushed materials | 0.50 | It has been assumed that granular stockpile areas will have similar characteristics to ballasted track bed. Voids between aggregates and texture of aggregates will cause runoff reduction. |
| Topsoil Storage – placed on native soil | 0.40 | The stockpiled material will have voids resulting in runoff reduction. Topsoil mounds will be constructed with 1:1 side slopes and level tops. They are to be seeded to encourage water retention. |
| Laydown Areas – granular material (not paved) | 0.50 | N/A |

Table 3: Summary of runoff coefficients applied in the drainage design.

Areas of the site allocated for material stockpiling and parking will be constructed using a 200mm thick layer of Class 6F5 material (recycled equivalent of Class 6F2. Refer to Table 6/5 of Series 600 Earthworks - Specification for Highway Works). This material is commonly used for capping and is comprised predominantly of aggregate sized between 10mm and 80mm; when placed the material is compacted but due to its composition the layer will have a voided structure. This will have the effect of reducing peak runoff rates (holding back some water within the voids) and volumes at outfalls. As such, a runoff coefficient of 0.5 is considered appropriate and has been adopted for these areas.

Excavated topsoil (for re-use) will be stockpiled in mounds with a level top and battered sides; all mounds will be grass-seeded to support sediment management, reduce runoff rates and encourage infiltration into the mound. For these reasons a runoff coefficient of 0.4 is considered appropriate and has been adopted for the topsoil storage area.

Haul roads and buildings have been represented within the hydraulic model as surfaces that are 100% impermeable to recognise the compacting effect that heavy construction plant will have, resulting in high rates of runoff.

The runoff coefficients adopted for this design have been determined with reference to published guidance and criteria applied to other civil engineering projects. For example, DMRB CD 521 (Table 4) recommends that runoff coefficients for cuttings should be 0.26 for low permeability soils; design standards for Crossrail (Table 5) suggest where ballast is used on clay formation (as per the proposals for A1 compound), that a runoff coefficient

of 0.60 is suitable. Given that compound A1, topographically, is relatively flat (<2% gradient), we consider that coefficients of 0.50 for stockpile/car parking areas and 0.40 for topsoil storage areas are appropriate for application to this design.

5.6.2 Values of the run-off coefficient coefficient $\alpha$ may be estimated from:

**Table 5.6.2 Run-off coefficients for cuttings**

| Soil type | Antecedent wetness | $\alpha$ |
|---|---|---|
| High permeability | low<br>medium<br>high | 0.07<br>0.11<br>0.13 |
| Medium permeability | low<br>medium<br>high | 0.11<br>0.16<br>0.20 |
| Low permeability | low<br>medium<br>high | 0.14<br>0.21<br>0.26 |

Table 4: Extract from DRMB standard CD 521 for recommended runoff rates

| Area | Run-off coefficient | Comment |
|---|---|---|
| Roofed buildings | 0.95 | |
| Road/ Pavements | 0.75 - 0.95 | Use 0.95 if discharge is to soakaway |
| Ballast on Clay Formation | 0.6 | |
| Ash on clay formation | 0.4 | |
| Ballast on sand/gravel formation | 0.1 | |
| Grassed banks | 0.6 | Cuttings and embankments |
| Grasslands/ verges – sandy soil | 0.05 - 0.10 | Flat, gradient 2% or less |
| Grasslands/ verges - sandy soil | 0.10 - 0.15 | Average, gradient 2 – 7% |
| Grasslands/ verges – sandy soil | 0.15 - 0.2 | Steep, gradient 7 – 15% |
| Grasslands/ verges – heavy soil | 0.13 –0.17 | Flat, gradient 2% or less |
| Grasslands/ verges – heavy soil | 0.18 – 0.25 | Average, gradient 2 – 7% |
| Grasslands/ verges – heavy soil | 0.25 –0.35 | Steep, gradient 7 – 15% |

Table 5: Recommended runoff coefficients within Crossrail drainage design standard CR-STD-303-6

**EWR Alliance**
**2nd Floor**
**Phoenix House**
**Elder Gate**
**Milton Keynes**
**MK9 1AW**