# Celtic Energy Ltd., Nant Helen Site : Main Void, Outlet 'H', other NRW permit discharge points & Spot Levels


Ref : NH Sect 4.2 b

*Doc Reference* : NH Table 7.2 notes

- *'Overall Depth (metres)'* : The mine's operational sump depth reaches 15m in parts but due to the local geology, the way it's been excavated and the way it is managed, an average depth is approximately 6m. The surface-level again will vary slightly but can be considered to be at 95m aod.

- *'Area of Excavation (square metres)'* : Again, the area of the operational sump will vary with the requirements of the site but can be considered as 8300m$^2$ as a maximum.

- *'Pump level etc.'* : The current set-up [introduced in October 2016], as shown in doc NH Sect 4.2b & in *NH Sect 8.4a* involves an electric submersible pump attached to a pontoon that pumps water from the sump [95m aod] to an intermediate tank, approximately halfway up the void [142m aod], then in turn is pumped the rest of the way by another electric pump up to 'H-lagoons' [194m aod] and then on to 'Outlet H' for discharge from the site [192m aod], unless some has been drawn-off for dust-suppression purposes.

  : The future set-up [ from January 2020 ], as proposed and shown in doc *NH Sect8.4b* will involve an 8" diesel high-head pump, pumping direct from the north-wall end of the sump all the way up to H-lagoons in one lift. The reason for change is because although the electric set-up is low-maintenance, this current 2-stage electric set-up and its pipe-lines will then be in the way of the shale-tipping progress of the operation. However, the volumes pumped will be the same as the current and past set-ups.

  n.b.: This single-lift diesel-powered pumping system was how the site was de-watered prior to October 2016.

<<< --- >>>

*Doc Reference* : NH Table 8.1 notes

- *'Abstraction location' :* The Main Void Sump is the source for mine de-watering. When water for dust suppression is required, it is taken at or from H-lagoons and is water that would otherwise have left site as mine-dewatering.

- *'Period of abstraction' :* Mine de-watering is pretty-much a 24/7 activity BUT there are times of maintenance, repairs , breakdown, movement of items for operational reasons that in total are likely to add up to about 15 days per year, hence *( -15 days )*

  *"Dry Working Days"* refer to the days when water bowsers are operational. These were estimated using the past five years of rainfall at the site on available working days. The rainfall stats are in doc ref, *NH Sect 8.4g : "NH Rainfall 2014-18"* and the categorisation and reasoning behind the figures used in the calculations are displayed in doc ref, *NH Sect 8.4i "NH Dust Suppression Calculations".*

- *'Max quantities abstracted' :*
  - De-watering : The max hrs, peak-flow, $m^3$/hr & $m^3$/day are straight calculations from our peak instantaneous flow-rate over an hour, then a 24hr day. However, the annual max is calculated from a 350 day year at a rate of 135 ltr/sec ( 486 cu/hr ) which is top-end of our usual normal flow-rate which is nearer 120 ltr/sec ( 432 cu/hr ).
  - Dust Suppression : The max $m^3$/day is calculated from the total number of loads all three bowsers would spread on a dry day. The annual figure is derived from the number of loads spread on non-wet available days throughout the year. Again the reasoning behind these figures are displayed in doc ref, *NH Sect 8.4i "NH Dust Suppression Calculations".*

- *Note :* The site was put into a 'Care & Maintenance' condition in November 2016 which meant that mining operations ceased ( including dust suppression duties ) but de-watering continued at the same rate with the site manned by a skeleton staff, maintaining the site ready for an operational re-start in January 2019.

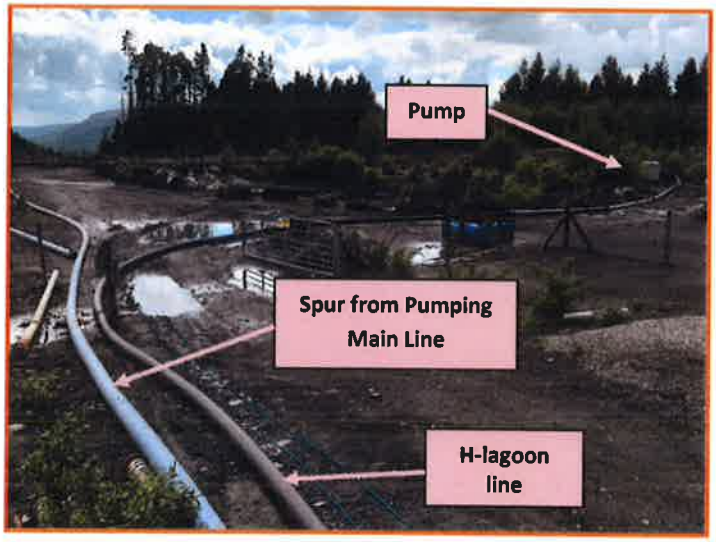
<<< --- >>>

## NH Sect 8.4 a : Current Main Void de-watering set-up

Main Void sump from intermediate stage-pump level

Main Void sump with submersible pump

Intermediate stage-pump




Water Bowser option [*direct from main-line or 'H' lagoons*]

Notched weir at Outlet 'H'

Outlet 'H'

# NH Sect 8.4 b : Proposed Future void de-water set-up


NH Sect 8.4 b

*Doc Reference* : NH Sect 8.4 c Pumping notes

- *Main Void Sump & Pumps :* To allow the removal, transportation & tipping of shales plus the recovery of coal as the mining operation progresses, a low-point sump has to be in place and maintained. Although the precise location and area of the main sump may alter in line with the operation, its function and rate of de-watering remains steady. Its other function is to retain a body of water sufficient for the purposes of mining operational area dust suppression.

- Prior to October 2016, the de-watering pump used at sump-level was a 8" high-head pump ( Pioneer CX200 ) using a single-lift pipeline up to H-lagoons area.

- Although, the site was "moth-balled" in November 2016, de-watering had to continue to maintain low-level water in the void, so works could resume whenever required, which it did in January 2019. An electric-powered submersible 2-stage system was installed in October 2016 to minimise the manpower required to maintain it. The system consisted of a Flygt 170kw submersible in the main void sump, pumping to an intermediary tank where it was boosted up to H-lagoons using a Flygt 125kw submersible pump. This arrangement remains in place at the moment and is shown in doc.ref.: *NH Sect 8.4a*.

- Now mining operations are again underway, the 2-stage pipeline route will shortly be interfering with operational progress. The intention is to return to a diesel-powered 8" high-head single-lift set-up as previously employed at the site [ proposal shown in doc ref : *NHSect 8.4b* ]. As mentioned above, this will not alter discharge volumes at 'Outlet H'.

- The restoration profile and requirements for the site are under serious appraisal both with us and interested parties and a number of options are being considered. At this stage, it is most unlikely that de-watering at the site will be required beyond 2022 and could be ceased at the end of the current coaling plan in the first half of 2021 but these dates are not yet definitive.

- Outlet 'H' :- The discharge facilities & arrangements at this location have been long-agreed with NRW and the NRW sampling records will also give some historical record of activity at the location over the years. On site, Celtic staff have primarily been concerned with controlling quality and not exceeding the allowable discharge limit of 150 ltr/sec. Measurement & quantity records have not been recorded although the facility exists if so required going forward.

- Powys CC & NRW references :
  - Planning Ref : Powys, P/2011/0217
  - NRW Discharge ( Outlet 'H' ) : BPO345401
  - Environmental Permit Ref : Powys, (B)PPC2(A)

merebrook consulting
AN idom GROUP COMPANY
CALCULATION SHEET

| | |
|---|---|
| Job Title: NANT HELEN FLOW MONITORING | Job No: |
| | Doc Ref: |
| | Rev No: |
| Element: WEIR DESIGN | Sheet: of |
| | Made by: DRT |
| | Checked by: |
| Client: | Date: |

DESIGN OF PERMANENT STRUCTURE TO MEASURE OUTFLOW OF WATER FOR NANT HELEN OPEN-CAST COAL MINE.

DEPENDING ON REQUIRED STRUCTURE I HAVE IDENTIFIED TWO OPTIONS

1) BROAD-CRESTED RECTANGULAR WEIR
2) THIN PLATE WEIR

DETERMINE SIZES FOR OPTION 1).

FOR A RECTANGULAR BROAD-CRESTED WEIR

$$Q\ (\text{in } m^3/s) = \left[\frac{2}{3}\right]^{3/2} g^{1/2}\, b\, C\, h_1^{3/2}$$

TO CALCULATE FLOW OVER STRUCTURE WE NEED TO ASSUME DIMENSIONS BASED ON SITE SPECIFIC CONDITIONS.

L (LENGTH OF WEIR IN DIRECTION OF FLOW) = 1m
P (HEIGHT OF WEIR [BED TO CREST]) = 1m

$\therefore$ C = 0.855 (DISCHARGE CO-EFFICIENT) => for $h_1$ = 0.2m
= 0.850 => for $h_1$ = 0.1m
= 0.864 => for $h_1$ = 0.3m

[$h_1$ = FLOW HEIGHT OF WATER OF WEIR]

FLOW MAX IS IN THE REGION OF 200l/s => $0.2 m^3/s$

DETERMINE BASE WIDTH (b) FOR MAX FLOW BEING $0.2 m^3/s$ & $h_1$ @ 0.3m

$$\therefore\ 0.2 m^3/s = 0.544 \times 9.81^{0.5} \times 0.864 \times 0.3^{1.5} m \times b$$

$$b = \frac{0.544 \times (9.81^{0.5}) \times 0.864 \times 0.3^{1.5}}{0.2}$$

$\therefore$ b = 1.209m

TAKING b AS 1.2m FLOW RATES FOR 0.1m & 0.2m ARE;

$h_1$ @ 0.1m => Q = $0.055 m^3/s$ => 55 l/s
$h_1$ @ 0.2m => Q = $0.156 m^3/s$ => 156 l/s

STRUCTURE IS ADEQUATE.

NM Sect 8.4 d (Page (2) of 4)

merebrook consulting
AN rdom GROUP COMPANY
CALCULATION SHEET

| | |
|---|---|
| Job Title: NANT HELEN FLOW MONITORING | Job No |
| | Doc Ref |
| | Rev No |
| Element: WEIR DESIGN | Sheet of |
| | Made by DRT |
| | Checked by |
| Client | Date |

DETERMINE SIZES FOR OPTION 2)

FOR A THIN PLATED WEIR

$$Q\ (\text{in } m^3/s) = C_d \frac{2}{3}\sqrt{2g}\, b_e h_e^{3/2}$$

where $C_d$ = coefficient of discharge
$b_e$ = effective breadth
$h_e$ = effective head

$$C_d = f\left[\frac{b}{B}, \frac{h}{p}\right] \quad \text{and} \quad b_e = b + k_b \;\&\; h_e = h + k_h$$

If we assume the overall plate width (B) = 1.8m and the opening width (b) = 0.72m

$\therefore \frac{b}{B} = 0.4 \Rightarrow$ from experiment $C_d = a + a'\left(\frac{h}{p}\right)$

which is given in figure 4 BS ISO 1438:2008

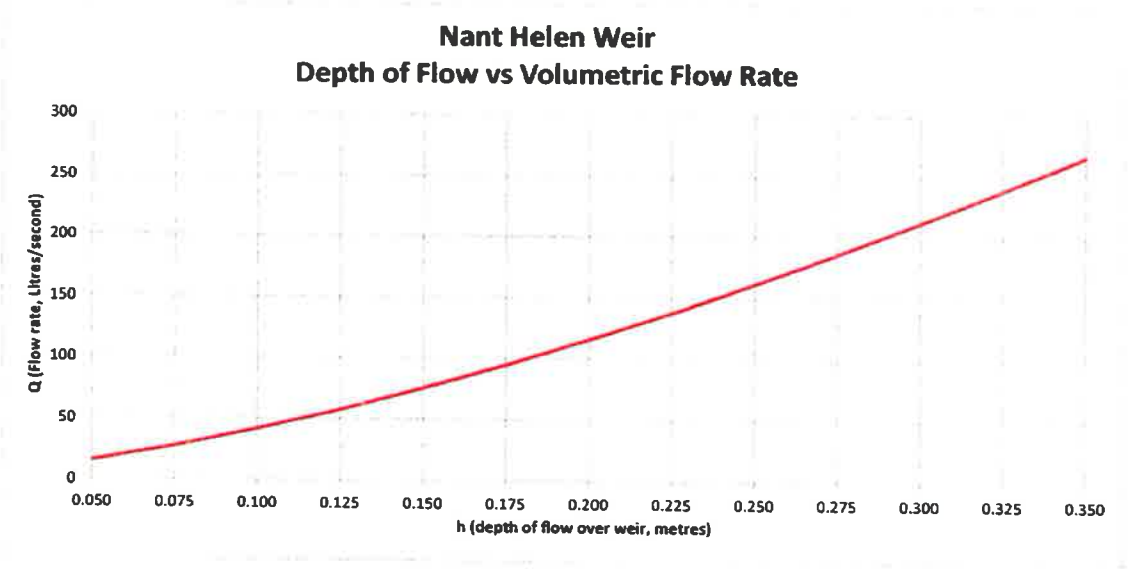
$a = 0.591$ & $a' = 0.0058$

$C_d$ is then calculated for the differing values of h over the weir plate. This allows us to determine Q
Fig(1) shows calculations of these values & corresponding values

SELECTION
FLAT PLATE WEIR IS THE PREFERED OPTION FOR EASE OF CONSTRUCTION AND ABILITY TO BE PRE-FRABRICATED.

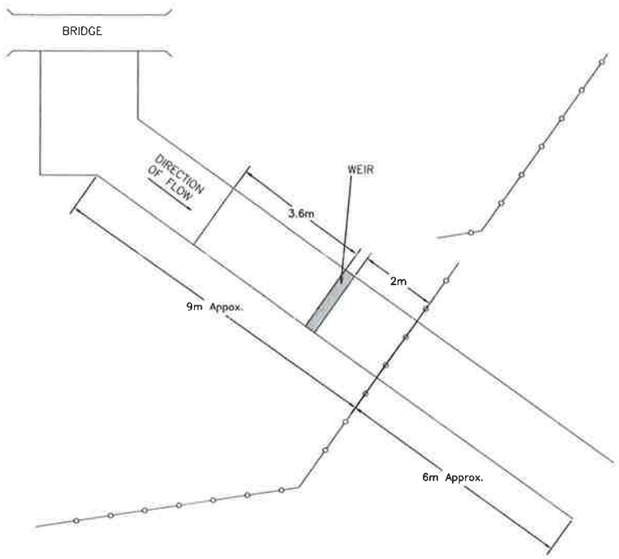
$\therefore$ DETAIL 1.8m WIDE PLATE WITH 720mm CUT-OUT FOR FLOW MONITORING.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q (l/s) | (flow rate) | 14.56208 | 26.52281 | 40.68288 | 56.75646 | 74.5511 | 93.92608 | 114.7729 | 137.0046 | 160.5497 | 185.3483 | 211.3489 | 238.5072 | 266.784 | 326.5592 | 357.9992 | 390.4397 |
| Q | (flow rate m3/s) | 0.014562 | 0.026523 | 0.040683 | 0.056756 | 0.074551 | 0.093926 | 0.114773 | 0.137005 | 0.16055 | 0.185348 | 0.211349 | 0.238507 | 0.266784 | 0.326559 | 0.357999 | 0.39044 |
| B | (plate width) | 1.8 | | | | | | | | | | | | | | | |
| b | (plate opening width) | 0.72 | | | | | | | | | | | | | | | |
| Cd | (co-efficient of discharge) | 0.59245 | 0.593175 | 0.5939 | 0.594625 | 0.59535 | 0.596075 | 0.5968 | 0.597525 | 0.59825 | 0.598975 | 0.5997 | 0.600425 | 0.60115 | 0.6026 | 0.603325 | 0.60405 |
| a | co-efficient | 0.591 | | | | | | | | | | | | | | | |
| a' | co-efficient | 0.0058 | | | | | | | | | | | | | | | |
| h | (depth of flow over plate) | 0.05 | 0.075 | 0.1 | 0.125 | 0.15 | 0.175 | 0.2 | 0.225 | 0.25 | 0.275 | 0.3 | 0.325 | 0.35 | 0.4 | 0.425 | 0.45 |
| p | (bottom of plate to bottom of opening) | 0.2 | | | | | | | | | | | | | | | |
| be | effective width | 0.7227 | | | | | | | | | | | | | | | |
| he | effective head | 0.051 | 0.076 | 0.101 | 0.126 | 0.151 | 0.176 | 0.201 | 0.226 | 0.251 | 0.276 | 0.301 | 0.326 | 0.351 | 0.401 | 0.426 | 0.451 |

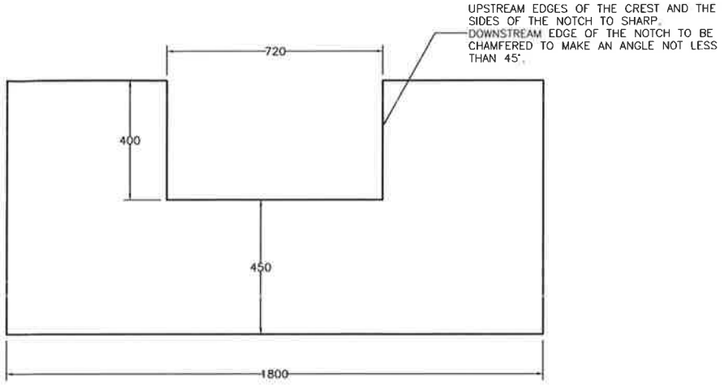



NM Sect 8.4d (Page (B)54)

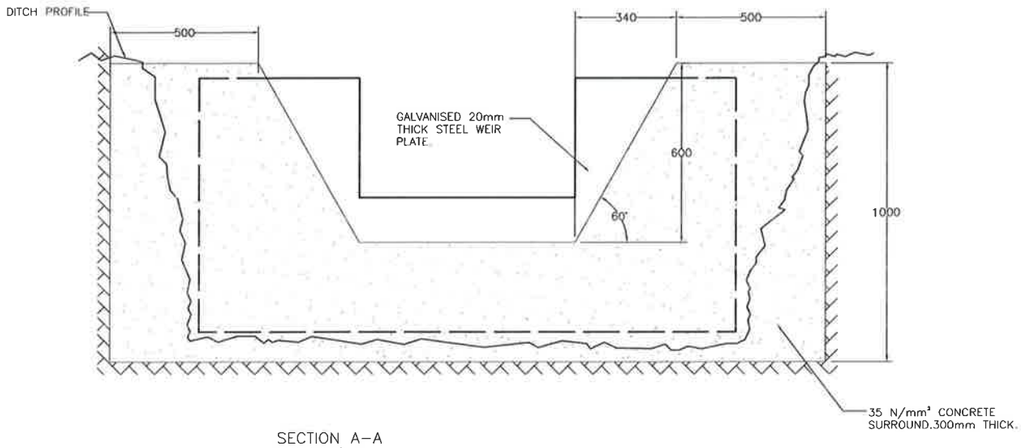
NH Sect 8.4 d (Page 4 of 74).



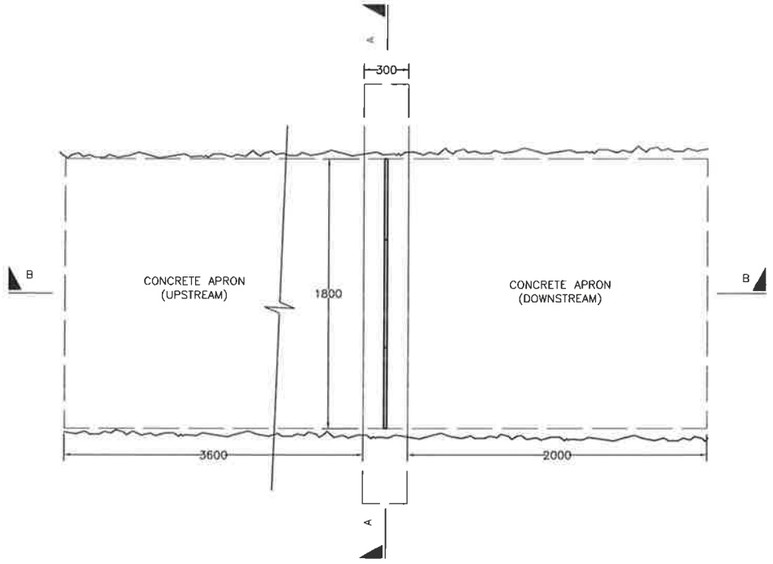

LOCATION PLAN
NTS



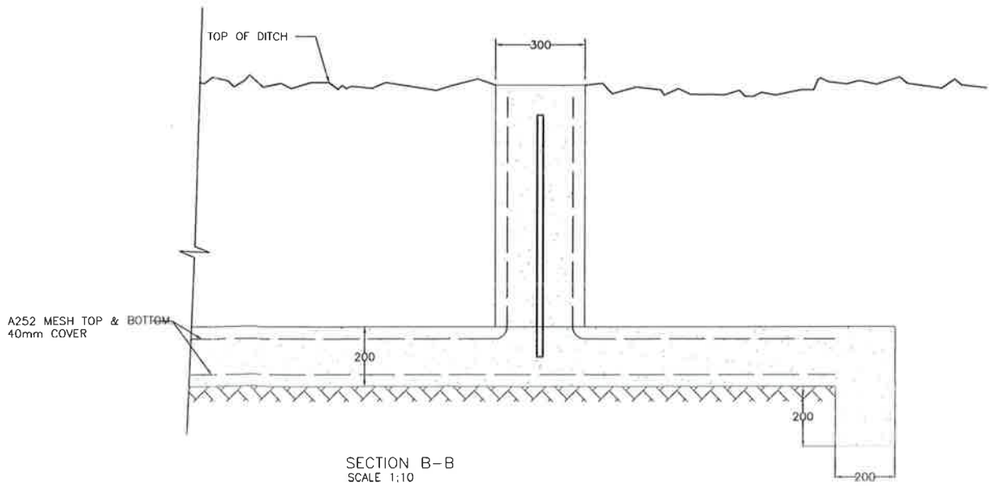

WEIR PLATE DIMENSIONS
SCALE 1:10




SECTION A–A
SCALE 1:10




PLAN ON WEIR
SCALE 1:20




SECTION B–B
SCALE 1:10

NOTES

1. ALL DIMENSIONS GIVEN IN MILLIMETERS.
2. DO NOT SCALE FROM THIS DRAWING. USE DIMENSIONS PROVIDED.
3. COVER TO ALL REINFORCEMENT TO BE 40MM, UNLESS NOTED OTHERWISE.
4. REINFORCEMENT SHALL BE GRADE B500. MESH FABRIC SHALL BE IN ACCORDANCE WITH BS 4483.
5. WEIR DESIGN TO BS ISO 1438:2008.
6. WEIR PLATE SHALL BE VERTICAL AND PERPENDICULAR TO THE WALLS OF THE CHANNEL. THE INTERSECTION OF THE WEIR PLATE WITH THE WALLS AND FLOOR OF THE CHANNEL SHALL BE WATERTIGHT AND FIRM.

| | | | |
|---|---|---|---|
| First Issue | 03.12.12 | HT | DRT | MB |
| Revision Details | - | Dwn | Chd | Appd |

Client: CELTIC ENERGY

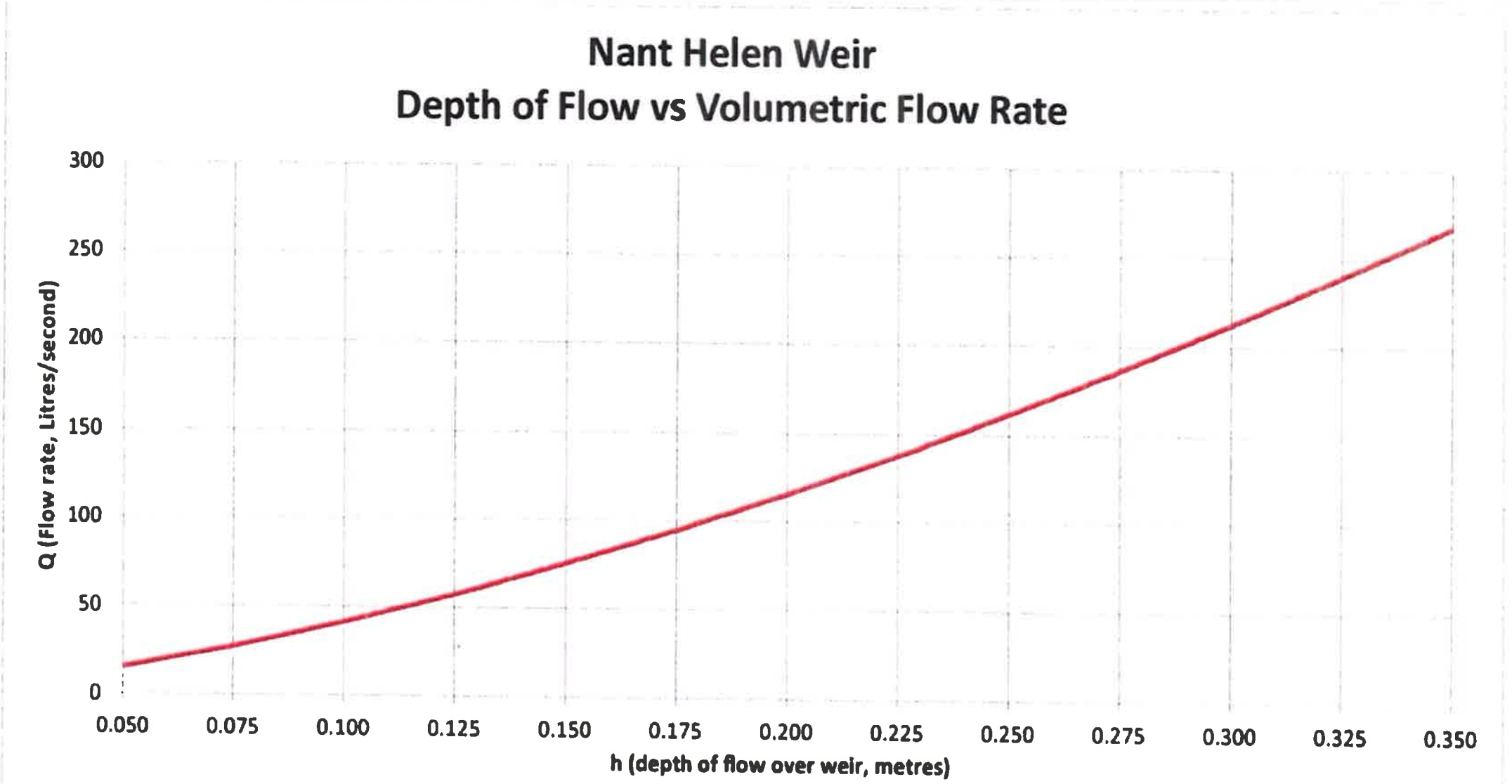
Project: NANT HELEN OPEN CAST COAL MINE OUTFALL MONITORING

Dwg Title: THIN PLATE WEIR DESIGN

| Job No. | Dwg No. | Revision |
|---|---|---|
| 15808 | SK001 | - |
| Scale: AS SHOWN | Date: DEC 2012 | Frame Dimensions mm: (A1) 791 x 544 |
| Drawn: HT | Checked: DRT | Approved: MB |


London
Kent
Derby
Cardiff
merebrook consulting
AN slrm GROUP COMPANY

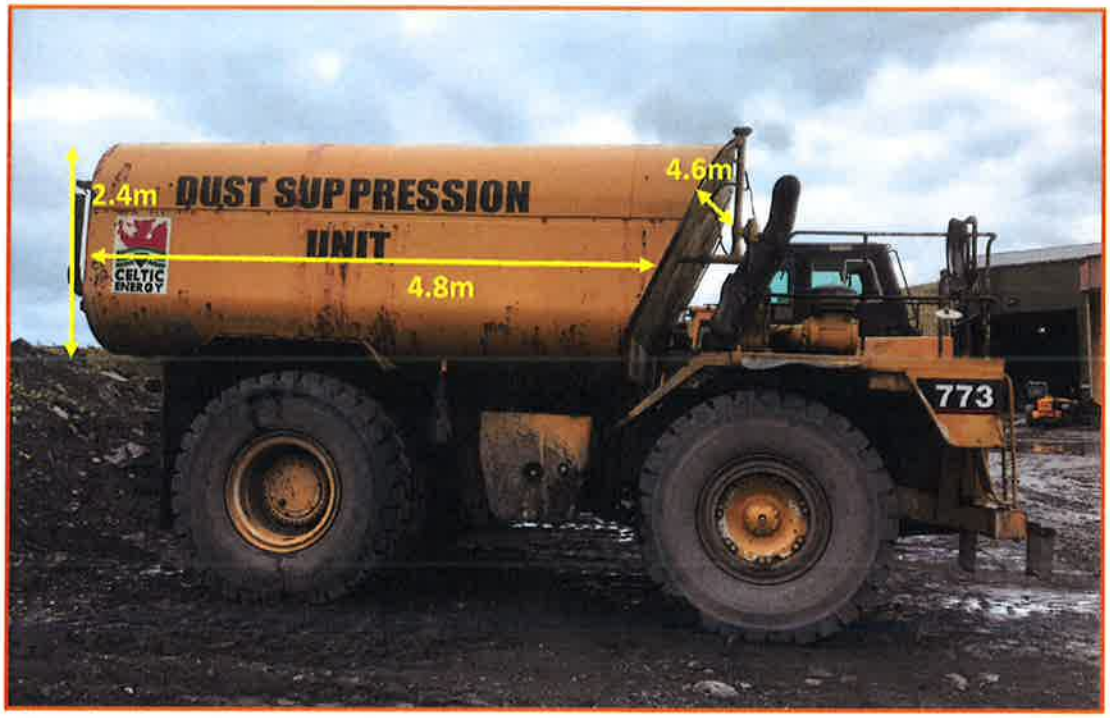
NH Sect 8.4 e


Nant Helen Weir
Depth of Flow vs Volumetric Flow Rate
Q (Flow rate, Litres/second)
300
250
200
150
100
50
0
0.050
0.075
0.100
0.125
0.150
0.175
0.200
0.225
0.250
0.275
0.300
0.325
0.350
h (depth of flow over weir, metres)

NH Sect 8.4 f (Page 1 of 72)

## NH Sect 8.4 f : Water Bowsers & dimensions

**Cat 773 Water Bowser :**




**Volvo A35 Water Bowser :**

NH Sect 8.4f (Page 2 of 2)

**Tractor & Tank Water Bowser :**


<<< --- >>>

NH Sect 5.4g (Page 1 of 5)

# Nant Helen Rainfall

## 2014

| Jan | mm | Feb | mm | Mar | mm | Apr | mm | May | mm | June | mm | July | mm | Aug | mm | Sept | mm | October | mm | November | mm | December | mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 20.4 | 1 | 9.7 | 1 | 12.2 | 1 | 0.5 | 1 | 4 | 1 | 1.4 | 1 | | 1 | 10 | 1 | 0.2 | 1 | 3.2 | 1 | 32.4 | 1 | 0.2 |
| 2 | 20.4 | 2 | 9.7 | 2 | 12.2 | 2 | 0.3 | 2 | | 2 | 0.7 | 2 | | 2 | 10 | 2 | | 2 | | 2 | 32.4 | 2 | |
| 3 | 15.1 | 3 | 8.7 | 3 | 0.4 | 3 | 1.6 | 3 | | 3 | 6.9 | 3 | 3.6 | 3 | | 3 | | 3 | 12.6 | 3 | 6.4 | 3 | |
| 4 | 15.1 | 4 | 15.8 | 4 | | 4 | 18.7 | 4 | | 4 | 22.3 | 4 | 26.8 | 4 | 11.6 | 4 | | 4 | 12.6 | 4 | 1.6 | 4 | |
| 5 | 15.2 | 5 | 9.6 | 5 | 1.2 | 5 | 18.7 | 5 | 10.8 | 5 | | 5 | | 5 | 19.6 | 5 | | 5 | 12.6 | 5 | | 5 | |
| 6 | 20.7 | 6 | 18.7 | 6 | 17.4 | 6 | 18.7 | 6 | 1.5 | 6 | 7.5 | 6 | | 6 | 0.2 | 6 | | 6 | 16.9 | 6 | 22.8 | 6 | 7.5 |
| 7 | 10.9 | 7 | 22.3 | 7 | | 7 | 10 | 7 | 8.9 | 7 | 7.5 | 7 | 3.9 | 7 | | 7 | | 7 | 5.7 | 7 | 14.2 | 7 | 7.5 |
| 8 | 21 | 8 | 22.3 | 8 | | 8 | 0.1 | 8 | 12.2 | 8 | 7.5 | 8 | 1 | 8 | | 8 | | 8 | 40.1 | 8 | 14.2 | 8 | 2.5 |
| 9 | 1.1 | 9 | 22.3 | 9 | | 9 | | 9 | 11.2 | 9 | 5.3 | 9 | | 9 | 13.8 | 9 | | 9 | 26.7 | 9 | 14.2 | 9 | 21.5 |
| 10 | 6.3 | 10 | 29.2 | 10 | | 10 | | 10 | 11.2 | 10 | 6.4 | 10 | | 10 | 13.8 | 10 | | 10 | 8.8 | 10 | 20.2 | 10 | 3.7 |
| 11 | 6.3 | 11 | 5.2 | 11 | | 11 | | 11 | 11.2 | 11 | 0.1 | 11 | | 11 | 0.5 | 11 | | 11 | 8.8 | 11 | 16.8 | 11 | 31.8 |
| 12 | 6.3 | 12 | 21.2 | 12 | | 12 | | 12 | 3.5 | 12 | | 12 | 5.4 | 12 | 4.9 | 12 | | 12 | 8.8 | 12 | 3.3 | 12 | 2.9 |
| 13 | 7.5 | 13 | 3.2 | 13 | | 13 | | 13 | 0.2 | 13 | | 13 | | 13 | 1.2 | 13 | | 13 | 3.8 | 13 | 15.5 | 13 | 2.9 |
| 14 | 15.1 | 14 | 10 | 14 | | 14 | | 14 | | 14 | | 14 | 4.2 | 14 | 2.8 | 14 | | 14 | 2.8 | 14 | 3.3 | 14 | 2.9 |
| 15 | 19 | 15 | 10 | 15 | | 15 | | 15 | | 15 | 0.4 | 15 | 1.5 | 15 | | 15 | | 15 | 11.6 | 15 | 3.3 | 15 | 0.9 |
| 16 | 16.7 | 16 | 10 | 16 | | 16 | | 16 | | 16 | | 16 | 3.6 | 16 | | 16 | | 16 | 6.4 | 16 | 3.3 | 16 | 19.7 |
| 17 | 8.5 | 17 | 25.5 | 17 | 1 | 17 | | 17 | | 17 | | 17 | 0.5 | 17 | 2.4 | 17 | | 17 | 11.5 | 17 | 0.2 | 17 | 5.2 |
| 18 | 8.5 | 18 | 4.1 | 18 | 0.6 | 18 | | 18 | 9.5 | 18 | | 18 | 0 | 18 | 0.7 | 18 | | 18 | 11.5 | 18 | | 18 | 23.1 |
| 19 | 8.5 | 19 | 15.3 | 19 | 0.1 | 19 | 3.5 | 19 | 4.7 | 19 | | 19 | 5.6 | 19 | 4.5 | 19 | 0.1 | 19 | 11.5 | 19 | 1.4 | 19 | 6.1 |
| 20 | 0.2 | 20 | 4 | 20 | 12.9 | 20 | 3.5 | 20 | 0.1 | 20 | | 20 | 5.6 | 20 | 0.1 | 20 | | 20 | 16.8 | 20 | 0.6 | 20 | 6.1 |
| 21 | 9.2 | 21 | 8.9 | 21 | 5.6 | 21 | 3.5 | 21 | 2.1 | 21 | | 21 | | 21 | 9.8 | 21 | | 21 | 2 | 21 | 15.3 | 21 | 6.1 |
| 22 | 2.1 | 22 | 8.9 | 22 | 5.6 | 22 | 3.4 | 22 | 5.8 | 22 | | 22 | | 22 | 6.3 | 22 | | 22 | 0.4 | 22 | 15.3 | 22 | |
| 23 | 6.8 | 23 | 8.9 | 23 | 5.6 | 23 | 1.4 | 23 | 8.8 | 23 | | 23 | | 23 | 6.3 | 23 | 8 | 23 | 13.5 | 23 | | 23 | |
| 24 | 10.8 | 24 | 19.5 | 24 | 6.2 | 24 | | 24 | 8.8 | 24 | | 24 | | 24 | 6.3 | 24 | | 24 | 2.9 | 24 | | 24 | |
| 25 | 10.8 | 25 | 2.1 | 25 | 0.9 | 25 | 7.6 | 25 | 8.8 | 25 | | 25 | | 25 | 6.3 | 25 | 6.4 | 25 | 2.9 | 25 | 1.5 | 25 | |
| 26 | 10.8 | 26 | 22.4 | 26 | 0.2 | 26 | 7.6 | 26 | | 26 | 6.3 | 26 | | 26 | | 26 | | 26 | 2.9 | 26 | 0.3 | 26 | |
| 27 | 10.8 | 27 | 10.1 | 27 | 0.2 | 27 | 7.6 | 27 | 6.9 | 27 | | 27 | 1.8 | 27 | 6.7 | 27 | | 27 | | 27 | | 27 | 46.9 |
| 28 | 13 | 28 | | 28 | 4 | 28 | 0.2 | 28 | 1.4 | 28 | 1.6 | 28 | | 28 | 7.4 | 28 | 4.4 | 28 | | 28 | | 28 | |
| 29 | 3.7 | | | 29 | 4 | 29 | | 29 | 2.4 | 29 | | 29 | | 29 | 5.7 | 29 | 0.1 | 29 | | 29 | | 29 | |
| 30 | | | | 30 | | 30 | 6 | 30 | | 30 | | 30 | | 30 | 5.7 | 30 | 1.8 | 30 | | 30 | | 30 | |
| 31 | 42 | | | 31 | 5.8 | | | 31 | | | | 31 | 12.2 | 31 | 5.7 | | | 31 | | | | 31 | 3.8 |
| **M tots** | **362.8** | | **357.6** | | **96.1** | | **112.9** | | **134** | | **73.9** | | **75.7** | | **162.3** | | **21.0** | | **257.3** | | **238.5** | | **201.3** |
| Dry | 3 | | 1 | | 17 | | 17 | | 9 | | 18 | | 19 | | 10 | | 24 | | 7 | | 12 | | 6 |
| S/Dry | 2 | | 5 | | 2 | | 3 | | 4 | | 0 | | 4 | | 3 | | 0 | | 6 | | 3 | | 4 |
| Wet | 18 | | 18 | | 7 | | 6 | | 8 | | 7 | | 4 | | 13 | | 2 | | 13 | | 10 | | 8 |
| Avb dys | 23 | | 24 | | 26 | | 26 | | 21 | | 25 | | 27 | | 26 | | 26 | | 26 | | 25 | | 18 |

Annual Rainfall : 2093 mm / 82 inches

| | | | | % |
|---|---|---|---|---|
| Dry | 0 -1.9mm | | 143 | 49 |
| S/Dry | 2 - 4.9mm | | 36 | 12 |
| Wet | 5mm + | | 114 | 39 |
| Avlbl Days | | | 293 | |

Key

: Sundays

: Shutdown

Green : Shared figures

NH Sect 8.4g (Page 2 of 5)

# Nant Helen Rainfall

## 2015

| Jan | mm | Feb | mm | Mar | mm | Apr | mm | May | mm | June | mm | July | mm | Aug | mm | Sept | mm | October | mm | November | mm | December | mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1 | | 1 | 1.9 | 1 | 1.3 | 1 | 0 | 1 | 59.8 | 1 | 0.8 | 1 | 3.7 | 1 | | 1 | | 1 | | 1 | 1.9 |
| 2 | | 2 | | 2 | 7 | 2 | 3.2 | 2 | 14.2 | 2 | 2 | 2 | 1.7 | 2 | 3.7 | 2 | 1.1 | 2 | | 2 | | 2 | 33.5 |
| 3 | | 3 | | 3 | 0.1 | 3 | 3.2 | 3 | 14.2 | 3 | | 3 | 2.1 | 3 | 3.4 | 3 | 0.2 | 3 | | 3 | 9 | 3 | 34.2 |
| 4 | 55.1 | 4 | | 4 | | 4 | | 4 | 14.2 | 4 | 0.2 | 4 | 2.1 | 4 | 13.2 | 4 | | 4 | 4.8 | 4 | 6.1 | 4 | 6.2 |
| 5 | 5.3 | 5 | | 5 | | 5 | | 5 | 8.2 | 5 | | 5 | 2.1 | 5 | 8.6 | 5 | 0.2 | 5 | 10.9 | 5 | 10.8 | 5 | 6.2 |
| 6 | 1.1 | 6 | | 6 | | 6 | | 6 | 11.9 | 6 | 1.9 | 6 | 9.4 | 6 | 0.1 | 6 | | 6 | 11.5 | 6 | 16.8 | 6 | 6.2 |
| 7 | 45 | 7 | | 7 | 5.6 | 7 | | 7 | 0.2 | 7 | | 7 | 7.5 | 7 | | 7 | | 7 | | 7 | 16.8 | 7 | 13.4 |
| 8 | 14.9 | 8 | | 8 | | 8 | | 8 | 3.5 | 8 | | 8 | 0.8 | 8 | | 8 | | 8 | | 8 | 16.8 | 8 | 1.3 |
| 9 | 10.6 | 9 | | 9 | 9.7 | 9 | | 9 | 3.5 | 9 | | 9 | | 9 | 9.7 | 9 | | 9 | | 9 | 24.2 | 9 | 7.9 |
| 10 | 10.6 | 10 | | 10 | | 10 | 1.8 | 10 | 3.5 | 10 | | 10 | 7.1 | 10 | 3 | 10 | | 10 | | 10 | 13 | 10 | 9.2 |
| 11 | 10.6 | 11 | | 11 | 3 | 11 | | 11 | 1.4 | 11 | | 11 | 7.1 | 11 | | 11 | 6.4 | 11 | | 11 | 7.4 | 11 | 12.9 |
| 12 | 25.6 | 12 | 0.2 | 12 | 19.5 | 12 | 1.6 | 12 | | 12 | 5.5 | 12 | 7.1 | 12 | | 12 | 6.4 | 12 | | 12 | 15.2 | 12 | 12.9 |
| 13 | 17.5 | 13 | 10.5 | 13 | 1.9 | 13 | 0.1 | 13 | 1.4 | 13 | 5.5 | 13 | 16.4 | 13 | 8.3 | 13 | 6.4 | 13 | | 13 | 11.2 | 13 | 12.9 |
| 14 | 33.9 | 14 | 10.5 | 14 | | 14 | | 14 | 8.4 | 14 | | 14 | 9 | 14 | 0.6 | 14 | 29.3 | 14 | | 14 | 11.2 | 14 | 7.8 |
| 15 | 20 | 15 | 10.5 | 15 | | 15 | | 15 | | 15 | | 15 | | 15 | | 15 | 1.4 | 15 | | 15 | 11.2 | 15 | 37.5 |
| 16 | 3.1 | 16 | 0.2 | 16 | 4.4 | 16 | 0.4 | 16 | | 16 | 0.8 | 16 | 2.6 | 16 | | 16 | | 16 | | 16 | 17.6 | 16 | 9.4 |
| 17 | | 17 | | 17 | | 17 | | 17 | 19.7 | 17 | 6.4 | 17 | | 17 | | 17 | 6.5 | 17 | | 17 | 10.9 | 17 | 11.4 |
| 18 | | 18 | 12.4 | 18 | | 18 | | 18 | 11.2 | 18 | | 18 | 4.6 | 18 | 2.5 | 18 | | 18 | | 18 | 13.7 | 18 | 20.1 |
| 19 | | 19 | 15.4 | 19 | | 19 | | 19 | 4.5 | 19 | 2.3 | 19 | | 19 | 15 | 19 | | 19 | | 19 | 4.8 | 19 | 20.1 |
| 20 | 9.6 | 20 | 10 | 20 | | 20 | | 20 | | 20 | 2.3 | 20 | 3.4 | 20 | 24.5 | 20 | 10 | 20 | 13 | 20 | 5.3 | 20 | 20.1 |
| 21 | 0.1 | 21 | 10 | 21 | | 21 | | 21 | 1.8 | 21 | 2.3 | 21 | 1.2 | 21 | 15 | 21 | 12.2 | 21 | 3.9 | 21 | 4.1 | 21 | 30.9 |
| 22 | | 22 | 10 | 22 | | 22 | | 22 | | 22 | | 22 | 3.2 | 22 | 15 | 22 | 5.6 | 22 | 0.4 | 22 | 4.1 | 22 | 22.4 |
| 23 | 6.2 | 23 | 7.7 | 23 | 3.5 | 23 | | 23 | 0.5 | 23 | | 23 | 4.2 | 23 | 15 | 23 | 8.1 | 23 | 5.6 | 23 | 4.1 | 23 | |
| 24 | 6.2 | 24 | 9.9 | 24 | 1.2 | 24 | 5.3 | 24 | | 24 | | 24 | 8.6 | 24 | 0.1 | 24 | 0.8 | 24 | 5.6 | 24 | 3.8 | 24 | |
| 25 | 6.2 | 25 | 18.3 | 25 | 6.6 | 25 | | 25 | | 25 | 0.1 | 25 | 8.6 | 25 | 35 | 25 | | 25 | | 25 | 2.1 | 25 | 62.3 |
| 26 | 0.2 | 26 | 0.2 | 26 | 0.1 | 26 | | 26 | | 26 | 3.2 | 26 | 8.6 | 26 | 7.6 | 26 | | 26 | 0.1 | 26 | 2.5 | 26 | |
| 27 | 8.2 | 27 | 7.2 | 27 | 9.2 | 27 | 0.9 | 27 | 1.5 | 27 | 3.2 | 27 | 4.7 | 27 | 9.2 | 27 | | 27 | 4.6 | 27 | 15.7 | 27 | |
| 28 | 4.4 | 28 | 7.2 | 28 | 9.2 | 28 | 11.7 | 28 | 11.8 | 28 | 3.2 | 28 | 1 | 28 | 7.2 | 28 | | 28 | 10 | 28 | 15.7 | 28 | |
| 29 | 5.9 | | | 29 | 9.2 | 29 | 1.6 | 29 | 5 | 29 | | 29 | 0.1 | 29 | 7.2 | 29 | | 29 | 12.3 | 29 | 15.7 | 29 | 52.2 |
| 30 | | | | 30 | 13.3 | 30 | | 30 | 5 | 30 | | 30 | | 30 | 7.2 | 30 | | 30 | 5 | 30 | 33.5 | 30 | |
| 31 | 7 | | | 31 | 0.1 | | | 31 | 5 | | | 31 | | 31 | | | | 31 | | | | 31 | 41.7 |
| **M tots** | **307.3** | | **140.2** | | **105.5** | | **31.1** | | **150.6** | | **98.7** | | **124** | | **214.8** | | **94.6** | | **87.7** | | **323.3** | | **494.6** |
| Dry | 7 | | 13 | | 15 | | 22 | | 11 | | 17 | | 11 | | 10 | | 19 | | 17 | | 1 | | 3 |
| S/Dry | 2 | | 0 | | 3 | | 2 | | 3 | | 5 | | 8 | | 4 | | 0 | | 2 | | 6 | | 0 |
| Wet | 15 | | 11 | | 8 | | 2 | | 6 | | 4 | | 8 | | 12 | | 7 | | 8 | | 18 | | 17 |
| Avb dys | 24 | | 24 | | 26 | | 26 | | 20 | | 26 | | 27 | | 26 | | 26 | | 27 | | 25 | | 20 |

Annual Rainfall : 2172 mm / 86 inches

| | | | | % |
|---|---|---|---|---|
| Dry | 0 -1.9mm | | 146 | 49 |
| S/Dry | 2 - 4.9mm | | 35 | 12 |
| Wet | 5mm + | | 116 | 39 |
| Avlbl Days | | | 297 | |

Key

: Sundays

: Shutdown

Green : Shared figures

NH Sect 8.4g (Page 3 of 5)

# Nant Helen Rainfall

## 2016

| Jan | mm | Feb | mm | Mar | mm | Apr | mm | May | mm | June | mm | July | mm | Aug | mm | Sept | mm | October | mm | November | mm | December | mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14.3 | 1 | 5.8 | 1 | 6.4 | 1 | 9.0 | 1 | 5.6 | 1 | | 1 | 0.7 | 1 | 41.2 | 1 | 5.3 | 1 | 4.8 | 1 | | 1 | |
| 2 | 20.1 | 2 | 2.4 | 2 | 4.2 | 2 | 9.0 | 2 | 5.6 | 2 | | 2 | 0.7 | 2 | 12.4 | 2 | 25.1 | 2 | 4.8 | 2 | | 2 | |
| 3 | 20.1 | 3 | 4.6 | 3 | 5.7 | 3 | 9.0 | 3 | | 3 | | 3 | 0.7 | 3 | 6.6 | 3 | 25.1 | 3 | | 3 | 1.2 | 3 | |
| 4 | 22.9 | 4 | 0.6 | 4 | 1.9 | 4 | 1.4 | 4 | | 4 | | 4 | 3.4 | 4 | 1.7 | 4 | 25.1 | 4 | | 4 | 0.4 | 4 | |
| 5 | 8.5 | 5 | 30.2 | 5 | 1.9 | 5 | 2.8 | 5 | | 5 | | 5 | | 5 | 2.9 | 5 | 6.1 | 5 | | 5 | 0.4 | 5 | |
| 6 | 8.6 | 6 | 30.2 | 6 | 1.9 | 6 | 0.9 | 6 | 1.7 | 6 | 1.5 | 6 | 1.5 | 6 | 2.9 | 6 | | 6 | | 6 | 0.4 | 6 | |
| 7 | 2 | 7 | 30.2 | 7 | 1.3 | 7 | 0.5 | 7 | 1.7 | 7 | | 7 | 10.9 | 7 | 2.9 | 7 | 4.4 | 7 | | 7 | 0.3 | 7 | 17.4 |
| 8 | 15.9 | 8 | 6.6 | 8 | 18.4 | 8 | 2.1 | 8 | 1.7 | 8 | | 8 | 15.3 | 8 | | 8 | 13.5 | 8 | | 8 | 14.5 | 8 | 0.8 |
| 9 | 15.9 | 9 | 10.5 | 9 | 0.1 | 9 | 2.1 | 9 | 19.6 | 9 | | 9 | 15.3 | 9 | | 9 | 7.1 | 9 | | 9 | 0.4 | 9 | 6.1 |
| 10 | 15.9 | 10 | 0.1 | 10 | | 10 | 2.1 | 10 | 3.8 | 10 | 6.9 | 10 | 15.3 | 10 | | 10 | 7.1 | 10 | | 10 | | 10 | 6.1 |
| 11 | 1.8 | 11 | 6.7 | 11 | | 11 | 12.2 | 11 | | 11 | 6.9 | 11 | 4.6 | 11 | | 11 | 7.1 | 11 | | 11 | 3.0 | 11 | 6.1 |
| 12 | 6.7 | 12 | 1.1 | 12 | | 12 | | 12 | | 12 | 6.9 | 12 | | 12 | | 12 | | 12 | | 12 | 3.0 | 12 | 3.6 |
| 13 | 17.8 | 13 | | 13 | | 13 | 1.9 | 13 | | 13 | 14.6 | 13 | | 13 | | 13 | 3 | 13 | | 13 | 3.0 | 13 | 11.8 |
| 14 | 6.4 | 14 | | 14 | | 14 | 0.3 | 14 | | 14 | 14.4 | 14 | 0.8 | 14 | | 14 | | 14 | 9.0 | 14 | 8.4 | 14 | |
| 15 | 2.5 | 15 | | 15 | | 15 | 0.6 | 15 | | 15 | 3.7 | 15 | 5.5 | 15 | | 15 | | 15 | 9.0 | 15 | 4.8 | 15 | 3.8 |
| 16 | 2.5 | 16 | 19.3 | 16 | | 16 | 0.6 | 16 | | 16 | 3.2 | 16 | 5.5 | 16 | | 16 | 0.2 | 16 | 9.0 | 16 | 6.4 | 16 | |
| 17 | 2.5 | 17 | 6.4 | 17 | | 17 | 0.6 | 17 | 22.8 | 17 | 13.0 | 17 | 5.5 | 17 | | 17 | 0.2 | 17 | 6.5 | 17 | 4.2 | 17 | |
| 18 | 0.4 | 18 | 1.4 | 18 | | 18 | | 18 | 3.2 | 18 | 13.0 | 18 | | 18 | 7.9 | 18 | 0.2 | 18 | | 18 | 10.2 | 18 | |
| 19 | | 19 | 10.1 | 19 | | 19 | | 19 | 9.3 | 19 | 13.0 | 19 | | 19 | 25.0 | 19 | | 19 | | 19 | 10.2 | 19 | 0.4 |
| 20 | | 20 | 10.1 | 20 | | 20 | | 20 | 13.9 | 20 | 1.8 | 20 | | 20 | 25.0 | 20 | | 20 | | 20 | 10.2 | 20 | |
| 21 | 14.6 | 21 | 10.1 | 21 | | 21 | | 21 | 13.9 | 21 | 0.2 | 21 | 2.3 | 21 | 25.0 | 21 | 5.6 | 21 | | 21 | 18.4 | 21 | 11 |
| 22 | 7.7 | 22 | 0.4 | 22 | | 22 | 2.0 | 22 | 13.9 | 22 | | 22 | 1.4 | 22 | 13.2 | 22 | 0.4 | 22 | | 22 | | 22 | 2.4 |
| 23 | 7.7 | 23 | | 23 | | 23 | 2.0 | 23 | 0.2 | 23 | 3.1 | 23 | 1.4 | 23 | 0.2 | 23 | 9.9 | 23 | 0.5 | 23 | | 23 | 5.9 |
| 24 | 7.7 | 24 | | 24 | 17.4 | 24 | 2.0 | 24 | | 24 | 3.5 | 24 | 1.4 | 24 | | 24 | 9.9 | 24 | 4.9 | 24 | | 24 | 5.9 |
| 25 | 7.4 | 25 | | 25 | 17.4 | 25 | | 25 | | 25 | 3.5 | 25 | | 25 | 3.1 | 25 | 9.9 | 25 | 0.6 | 25 | | 25 | 5.9 |
| 26 | 76.3 | 26 | | 26 | 17.4 | 26 | | 26 | | 26 | 3.5 | 26 | 13.7 | 26 | 4.9 | 26 | 15.4 | 26 | 0.8 | 26 | | 26 | |
| 27 | 2.6 | 27 | | 27 | 17.4 | 27 | | 27 | | 27 | | 27 | | 27 | 4.9 | 27 | 1.4 | 27 | | 27 | | 27 | |
| 28 | 18 | 28 | | 28 | 17.4 | 28 | | 28 | | 28 | 11.6 | 28 | 6.8 | 28 | 4.9 | 28 | 15.3 | 28 | | 28 | | 28 | 0.3 |
| 29 | 43.5 | 29 | 22.7 | 29 | 14.7 | 29 | 5.6 | 29 | | 29 | 22.1 | 29 | 2.4 | 29 | | 29 | 8.5 | 29 | | 29 | | 29 | |
| 30 | | | | 30 | | 30 | 5.6 | 30 | | 30 | 6.1 | 30 | 2.4 | 30 | 0.8 | 30 | 4.8 | 30 | | 30 | | 30 | 0.3 |
| 31 | 8.7 | | | 31 | | | | 31 | | | | 31 | 2.4 | 31 | 1.4 | | | 31 | | | | 31 | 9.5 |
| M tots | 379.0 | | 209.5 | | 143.5 | | 72.3 | | 116.9 | | 152.5 | | 119.9 | | 186.9 | | 210.6 | | 49.9 | | 99.4 | | 97.3 |
| Dry | 5 | | 12 | | 18 | | 16 | | 16 | | 8 | | 14 | | 15 | | 10 | | 21 | | 16 | | 11 |
| S/Dry | 4 | | 2 | | 1 | | 5 | | 2 | | 5 | | 5 | | 5 | | 3 | | 2 | | 4 | | 3 |
| Wet | 15 | | 11 | | 5 | | 5 | | 6 | | 9 | | 7 | | 7 | | 13 | | 3 | | 6 | | 6 |
| Avb dys | 24 | | 25 | | 24 | | 26 | | 24 | | 22 | | 26 | | 27 | | 26 | | 26 | | 26 | | 20 |

Annual Rainfall : 1838 mm / 72 inches

| | | | | % |
|---|---|---|---|---|
| Dry | 0 -1.9mm | | 162 | 55 |
| S/Dry | 2 - 4.9mm | | 41 | 14 |
| Wet | 5mm + | | 93 | 31 |
| Avlbl Days | | | 296 | |

Key

: Sundays

: Shutdown

Green : Shared figures

n.b. : December's rainfall is from East Pit's record

NH Sect 8.4g (Page (4) of 5)

# Nant Helen Rainfall

## 2017

| Jan | mm | Feb | mm | Mar | mm | Apr | mm | May | mm | June | mm | July | mm | Aug | mm | Sept | mm | October | mm | November | mm | December | mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 21.5 | 1 | 3.2 | 1 | 10.5 | 1 | 0 | 1 | 0 | 1 | 1.5 | 1 | 14 | 1 | | 1 | 13.3 | 1 | 0 | 1 | 1.5 |
| 2 | | 2 | 6.5 | 2 | 4.2 | 2 | 10.5 | 2 | 0 | 2 | 0 | 2 | 1.5 | 2 | 16 | 2 | 5 | 2 | 0.5 | 2 | 0 | 2 | 1.5 |
| 3 | 0.3 | 3 | 3.9 | 3 | 8.4 | 3 | 9.5 | 3 | 0 | 3 | | 3 | 3.2 | 3 | 6 | 3 | 5 | 3 | 0 | 3 | 0 | 3 | 1.5 |
| 4 | | 4 | 3.9 | 4 | 8.4 | 4 | 0 | 4 | 0 | 4 | 11.8 | 4 | 0 | 4 | 0 | 4 | 8.5 | 4 | 2 | 4 | 4.2 | 4 | 0.2 |
| 5 | 0.3 | 5 | 3.9 | 5 | 8.4 | 5 | 0 | 5 | 0 | 5 | 68.5 | 5 | 0 | 5 | | 5 | 4.1 | 5 | | 5 | 4.2 | 5 | 0.8 |
| 6 | | 6 | 6.3 | 6 | 1.8 | 6 | 0 | 6 | 0 | 6 | 0.3 | 6 | 0 | 6 | | 6 | 0 | 6 | | 6 | 0 | 6 | 44 |
| 7 | | 7 | 1.5 | 7 | 8.8 | 7 | | 7 | 0 | 7 | 44.8 | 7 | 0 | 7 | 0 | 7 | 16.5 | 7 | 3.5 | 7 | 16.5 | 7 | 1.3 |
| 8 | 23.3 | 8 | 0 | 8 | 4.6 | 8 | | 8 | 0 | 8 | 16.5 | 8 | 0 | 8 | 0 | 8 | | 8 | 3.5 | 8 | 0.7 | 8 | 8.5 |
| 9 | 6.9 | 9 | 0 | 9 | 4.3 | 9 | 0 | 9 | 0 | 9 | 9 | 9 | 0 | 9 | 17.7 | 9 | 8 | 9 | 2 | 9 | 1.5 | 9 | 8.5 |
| 10 | 1.4 | 10 | 0 | 10 | 0.5 | 10 | 0 | 10 | 0 | 10 | 9 | 10 | 5.2 | 10 | 0 | 10 | 8 | 10 | 4.7 | 10 | 6.8 | 10 | 8.5 |
| 11 | 2.6 | 11 | 0 | 11 | 0.5 | 11 | 0 | 11 | 5.1 | 11 | 9 | 11 | 8.5 | 11 | | 11 | 1.2 | 11 | 13 | 11 | 6.8 | 11 | 0 |
| 12 | | 12 | 0 | 12 | 0.5 | 12 | 0.1 | 12 | 6.6 | 12 | 0.1 | 12 | 0 | 12 | 3.3 | 12 | 20 | 12 | 8 | 12 | 6.8 | 12 | 10 |
| 13 | 6.2 | 13 | 0 | 13 | 0.4 | 13 | 0 | 13 | 6.6 | 13 | 0 | 13 | 0 | 13 | 3.3 | 13 | 5.4 | 13 | | 13 | 1.5 | 13 | 6 |
| 14 | 6.2 | 14 | 0.3 | 14 | 0 | 14 | 1.3 | 14 | 6.6 | 14 | 0 | 14 | 3.6 | 14 | 7.3 | 14 | 18 | 14 | 6 | 14 | 3 | 14 | 4 |
| 15 | 6.2 | 15 | 2 | 15 | 0 | 15 | 1.3 | 15 | 35 | 15 | 2.6 | 15 | 3.6 | 15 | 0 | 15 | | 15 | 6 | 15 | 0.8 | 15 | 2.7 |
| 16 | 0.3 | 16 | 0.3 | 16 | 0.6 | 16 | 1.3 | 16 | 18.8 | 16 | 0 | 16 | 3.6 | 16 | 27.6 | 16 | 8.7 | 16 | 0.1 | 16 | 2.5 | 16 | 2.7 |
| 17 | 0.3 | 17 | 0 | 17 | 11 | 17 | 0 | 17 | 0.8 | 17 | | 17 | 0 | 17 | 3.6 | 17 | 8.7 | 17 | | 17 | 0 | 17 | 2.7 |
| 18 | | 18 | 0.6 | 18 | 11 | 18 | 0 | 18 | 0 | 18 | 0 | 18 | 1.8 | 18 | 0 | 18 | 0.3 | 18 | | 18 | 5 | 18 | 0 |
| 19 | | 19 | 0.6 | 19 | 11 | 19 | 0.3 | 19 | 3.9 | 19 | 0 | 19 | 6.6 | 19 | 7 | 19 | 0 | 19 | 10.5 | 19 | 5 | 19 | 0 |
| 20 | 0.2 | 20 | 4.2 | 20 | 13.2 | 20 | 0 | 20 | 3.9 | 20 | 0 | 20 | 10.2 | 20 | 7 | 20 | 22 | 20 | 12.8 | 20 | 9.2 | 20 | 10.2 |
| 21 | 0.2 | 21 | 2.8 | 21 | 35 | 21 | 0 | 21 | 3.9 | 21 | 0 | 21 | 22.7 | 21 | 1.5 | 21 | 0 | 21 | 12.8 | 21 | 20.1 | 21 | 4.5 |
| 22 | 0.2 | 22 | 11 | 22 | 0.1 | 22 | | 22 | 0 | 22 | 0 | 22 | 22.7 | 22 | 0.4 | 22 | 0 | 22 | 12.8 | 22 | 28 | 22 | 0 |
| 23 | | 23 | 0.2 | 23 | 0 | 23 | 0 | 23 | 2.5 | 23 | 2.6 | 23 | 22.7 | 23 | 0 | 23 | 13.5 | 23 | 8.3 | 23 | 1.5 | 23 | 1.6 |
| 24 | | 24 | 19.6 | 24 | | 24 | 0.4 | 24 | 0 | 24 | 2.6 | 24 | 0 | 24 | 0 | 24 | 13.5 | 24 | 24.5 | 24 | 6 | 24 | 4.3 |
| 25 | | 25 | 19.6 | 25 | | 25 | 2.1 | 25 | 0 | 25 | 2.6 | 25 | 6 | 25 | 0 | 25 | 0 | 25 | 0.5 | 25 | 6 | 25 | 16.4 |
| 26 | | 26 | 19.6 | 26 | 0 | 26 | 0 | 26 | 3.1 | 26 | | 26 | 0 | 26 | | 26 | 0 | 26 | 1.5 | 26 | 6 | 26 | 8.9 |
| 27 | 10 | 27 | 2.3 | 27 | 0 | 27 | 0.3 | 27 | 3.1 | 27 | 5.5 | 27 | 20.2 | 27 | 0 | 27 | 11.5 | 27 | 0 | 27 | 7 | 27 | 18.2 |
| 28 | 10 | 28 | 2.1 | 28 | 16.5 | 28 | 4.4 | 28 | 3.1 | 28 | 0.1 | 28 | 7.6 | 28 | 1.3 | 28 | 0 | 28 | 0 | 28 | 1.5 | 28 | 1.2 |
| 29 | 10 | | | 29 | 31.7 | 29 | 4.4 | 29 | 0.2 | 29 | 1.6 | 29 | 7.6 | 29 | 1 | 29 | 0 | 29 | 0 | 29 | | 29 | 13.3 |
| 30 | 4 | | | 30 | 8.5 | 30 | 4.4 | 30 | 1.5 | 30 | 1.5 | 30 | 7.6 | 30 | | 30 | 13.3 | 30 | | 30 | | 30 | 11 |
| 31 | 17.5 | | | 31 | 10.5 | | | 31 | 0 | | | 31 | | 31 | | | | 31 | | | | 31 | 12.6 |
| M tots | 107.1 | | 132.7 | | 203.1 | | 50.8 | | 104.7 | | 188.1 | | 166.4 | | 117.0 | | 191.2 | | 146.3 | | 150.6 | | 206.6 |
| Dry | 12 | | 11 | | 12 | | 20 | | 14 | | 14 | | 13 | | 18 | | 13 | | 14 | | 13 | | 9 |
| S/Dry | 2 | | 7 | | 4 | | 3 | | 5 | | 3 | | 3 | | 2 | | 1 | | 5 | | 3 | | 4 |
| Wet | 6 | | 6 | | 11 | | 2 | | 5 | | 6 | | 10 | | 7 | | 12 | | 7 | | 10 | | 6 |
| Avb dys | 20 | | 24 | | 27 | | 25 | | 24 | | 23 | | 26 | | 27 | | 26 | | 26 | | 26 | | 19 |

Annual Rainfall : 1765mm / 70 inches

| | | | | % |
|---|---|---|---|---|
| Dry | 0 -1.9mm | | 163 | 56 |
| S/Dry | 2 - 4.9mm | | 42 | 14 |
| Wet | 5mm + | | 88 | 30 |
| Avlbl Days | | | 293 | |

Key

: Sundays

: Shutdown

Green : Shared figures

n.b. : Rainfall recorded at East Pit site ( SA18 1UP )

Nth. Sect 8.4g (Page (5) of 5)

# Nant Helen Rainfall

## 2018

| Jan | mm | Feb | mm | Mar | mm | Apr | mm | May | mm | June | mm | July | mm | Aug | mm | Sept | mm | October | mm | November | mm | December | mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 1 | | 1 | 0 | 1 | 14 | 1 | 56 | 1 | 0 | 1 | 1 | 1 | 0.5 | 1 | | 1 | 2.5 | 1 | 0 | 1 | 13 |
| 2 | 5.7 | 2 | 2.2 | 2 | 0 | 2 | 14 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | | 2 | 1.5 | 2 | 11.3 | 2 | 13 |
| 3 | 17.5 | 3 | 2.2 | 3 | 8.5 | 3 | 3.5 | 3 | 0 | 3 | 0 | 3 | 0 | 3 | 1.2 | 3 | 1 | 3 | 0.5 | 3 | 11.3 | 3 | 4 |
| 4 | 7 | 4 | 2.2 | 4 | 8.5 | 4 | 5.5 | 4 | 3 | 4 | 0 | 4 | 0 | 4 | 1.2 | 4 | 0 | 4 | 0 | 4 | 11.3 | 4 | 13 |
| 5 | 5.2 | 5 | | 5 | 14 | 5 | 0 | 5 | 0 | 5 | 0 | 5 | 0 | 5 | 1.2 | 5 | 0 | 5 | 1.7 | 5 | 2 | 5 | 27.5 |
| 6 | | 6 | | 6 | 1 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 0 | 6 | 1 | 6 | 1.7 | 6 | 20 | 6 | 37 |
| 7 | 3.5 | 7 | | 7 | 12 | 7 | 5.3 | 7 | 0 | 7 | 5 | 7 | 0 | 7 | 0 | 7 | 2.8 | 7 | 1.7 | 7 | 17 | 7 | 0 |
| 8 | 0 | 8 | 2.5 | 8 | 0 | 8 | 5.3 | 8 | 0 | 8 | 0 | 8 | 0 | 8 | 0 | 8 | 2.8 | 8 | 2.5 | 8 | 4 | 8 | 5.2 |
| 9 | 4.5 | 9 | 38 | 9 | 0 | 9 | 8.5 | 9 | 0 | 9 | 0 | 9 | 0 | 9 | 6 | 9 | 2.8 | 9 | 0 | 9 | 20.7 | 9 | 5.2 |
| 10 | 0 | 10 | 11.5 | 10 | 26 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 10 | 4 | 10 | 11.5 | 10 | 3 | 10 | 20.7 | 10 | 5.2 |
| 11 | 0 | 11 | 11.5 | 11 | 26 | 11 | 0 | 11 | 8.5 | 11 | 0 | 11 | 0 | 11 | 17.1 | 11 | 4.5 | 11 | 37 | 11 | 20.7 | 11 | 0.5 |
| 12 | 0 | 12 | 15 | 12 | 1.5 | 12 | 0.3 | 12 | 0 | 12 | 0 | 12 | 5 | 12 | 17.1 | 12 | 0 | 12 | 32.1 | 12 | 15 | 12 | 1.5 |
| 13 | 10.2 | 13 | 10.5 | 13 | 0 | 13 | 0 | 13 | 0 | 13 | 9 | 13 | 0 | 13 | 17.1 | 13 | 0 | 13 | 39.5 | 13 | 7.5 | 13 | 0 |
| 14 | 10.2 | 14 | 13 | 14 | 21 | 14 | 5.5 | 14 | 0 | 14 | 0 | 14 | 0 | 14 | 5.9 | 14 | 6.7 | 14 | 39.5 | 14 | 0.3 | 14 | 0 |
| 15 | 15 | 15 | 0 | 15 | 13 | 15 | 5.5 | 15 | 0 | 15 | 3.3 | 15 | 0 | 15 | 25 | 15 | 6.7 | 15 | 0 | 15 | 1 | 15 | 8.8 |
| 16 | 1 | 16 | 2.3 | 16 | 1.5 | 16 | 1 | 16 | 0 | 16 | 3.3 | 16 | 0 | 16 | 0 | 16 | 6.7 | 16 | 3 | 16 | 0 | 16 | 8.8 |
| 17 | 15.5 | 17 | 2.3 | 17 | | 17 | 23 | 17 | 0 | 17 | 3.3 | 17 | 1.5 | 17 | 2.9 | 17 | 16 | 17 | 0 | 17 | 0 | 17 | 8.8 |
| 18 | 0.5 | 18 | 2.3 | 18 | | 18 | 0.3 | 18 | 0 | 18 | 2 | 18 | 1.2 | 18 | 2.9 | 18 | 10.5 | 18 | 0 | 18 | 0 | 18 | 7 |
| 19 | 0 | 19 | 0 | 19 | 0 | 19 | 0 | 19 | 0 | 19 | 1 | 19 | 0 | 19 | 2.9 | 19 | 16.5 | 19 | 1 | 19 | 0 | 19 | 44.5 |
| 20 | 21.5 | 20 | 0 | 20 | 0 | 20 | 0 | 20 | 0 | 20 | 0 | 20 | 1 | 20 | 2.9 | 20 | 54 | 20 | 1 | 20 | 0 | 20 | 13.5 |
| 21 | 21.5 | 21 | 0 | 21 | 0 | 21 | 0 | 21 | 0 | 21 | 0 | 21 | 0 | 21 | 1.5 | 21 | 4.2 | 21 | 1 | 21 | 0 | 21 | 14 |
| 22 | 17.5 | 22 | 0 | 22 | 18 | 22 | 1 | 22 | 0 | 22 | 0 | 22 | 0 | 22 | 5.2 | 22 | 4.2 | 22 | 0 | 22 | 0 | 22 | 8 |
| 23 | 0.5 | 23 | 0 | 23 | 0 | 23 | 5 | 23 | 0 | 23 | 0 | 23 | 0.2 | 23 | 0.6 | 23 | 4.2 | 23 | 0 | 23 | 1 | 23 | 4 |
| 24 | 9 | 24 | 0 | 24 | 0 | 24 | 23 | 24 | 0 | 24 | 0 | 24 | 0 | 24 | 8.7 | 24 | 0 | 24 | 0 | 24 | 0 | 24 | 3.4 |
| 25 | | 25 | 0 | 25 | 4 | 25 | 3.5 | 25 | 0 | 25 | 0 | 25 | 0 | 25 | 8.7 | 25 | 0 | 25 | 0 | 25 | 0 | 25 | 1.2 |
| 26 | 4.3 | 26 | 0 | 26 | 8 | 26 | 5.5 | 26 | 0 | 26 | 0 | 26 | 0 | 26 | 8.7 | 26 | 0 | 26 | 2.2 | 26 | 0 | 26 | 1.1 |
| 27 | 4.3 | 27 | 0 | 27 | 1 | 27 | 2.2 | 27 | 34 | 27 | 0 | 27 | 22.6 | 27 | | 27 | 0 | 27 | 2.2 | 27 | 31.5 | 27 | 0 |
| 28 | 4.3 | 28 | 0 | 28 | 7.5 | 28 | 2.2 | 28 | | 28 | 0 | 28 | 22.6 | 28 | 1 | 28 | 0 | 28 | 2.2 | 28 | 25.5 | 28 | 0 |
| 29 | 4 | | | 29 | 14 | 29 | 2.2 | 29 | 0 | 29 | 0 | 29 | 22.6 | 29 | 0 | 29 | 0 | 29 | 0 | 29 | 18.5 | 29 | 1.6 |
| 30 | 5.5 | | | 30 | 14 | 30 | | 30 | 0 | 30 | 0 | 30 | 1.5 | 30 | 0 | 30 | 0 | 30 | 0 | 30 | 13 | 30 | 2.3 |
| 31 | 1.5 | | | 31 | 14 | | | 31 | 2.5 | | | 31 | 1 | 31 | 0 | | | 31 | 11.5 | | | 31 | |
| **M tots** | **198.7** | | **115.5** | | **213.5** | | **136.3** | | **104** | | **26.9** | | **80.2** | | **142.3** | | **156.1** | | **187.3** | | **252.3** | | **252.1** |
| Dry | 10 | | 14 | | 15 | | 12 | | 20 | | 19 | | 23 | | 15 | | 13 | | 17 | | 12 | | 5 |
| S/Dry | 4 | | 5 | | 0 | | 5 | | 0 | | 3 | | 0 | | 4 | | 5 | | 6 | | 2 | | 1 |
| Wet | 7 | | 5 | | 12 | | 8 | | 2 | | 2 | | 3 | | 8 | | 7 | | 4 | | 12 | | 12 |
| Avb dys | 21 | | 24 | | 27 | | 25 | | 22 | | 24 | | 26 | | 27 | | 25 | | 27 | | 26 | | 18 |

Annual Rainfall : 1865mm / 73 inches

| | | | | % |
|---|---|---|---|---|
| **Dry** | 0 -1.9mm | | 175 | **60** |
| **S/Dry** | 2 - 4.9mm | | 35 | **12** |
| **Wet** | 5mm + | | 82 | **28** |
| Avlbl Days | | | 292 | |

Key

: Sundays

: Shutdown

Green : Shared figures

n.b. : Rainfall recorded at East Pit site ( SA18 1UP )

- Although there may be peak instantaneous flows approaching the 150 ltr/sec discharge limit ( possibly 145 ltr/sec ), the ambient flow-rate is normally around 120 ltr/sec. For the purposes of this application, we have chosen a flow-rate of 135 ltr/sec which over the course of a year comfortably covers the volumes discharged.

- Annual Discharge Volume Calculation :
  - Volume Flow rate = 135 ltr/sec
  - 135 x 3600 = 486,000 ltr/hr = 486 $m^3$/hr
  - 486 x 24hrs = 11,664 $m^3$/day
  - Using a 350 day year ( *as explained in doc ref : NH Table 8.1 notes* )
  - 11,664 x 350 = 4,082,400 $m^3$/year
  - LESS amount taken for dust suppression over the year = 122,047$m^3$
  - Annual Total Discharge Volume : 4,082,400 – 122,047 = **3,960,353$m^3$**

- Cost calculation :
  - Standard Unit Charge [ 2018/19 per 1000$m^3$ ] is £14.40 ( Wales, excl. Severn catchment )
  - Charge Factors etc. :
    - Source Factor = 1.0
    - Season Factor : All Year = 1.0
    - Loss Factor : De-watering = 0.003
    - Adj. Source Factor : non-tidal = 1.0
    - Environmental Improvement Unit Charge ( £/000$m^3$ ) = Nil
    - Advertising Admin Charge ( £100 ) : tbc by NRW if required
  - Calculation :

    Annual Charge + Compensation Charge ....

    [ *Volume x Source Factor x Season Factor x Loss Factor x Adj.SF x SUC (£/000$m^3$)* ] plus

    [ *Volume x Season Factor x Loss Factor x Adj.SF x EIUC ( **nil** )* ]

    = [ 3,960.353 (*3,960,353/1000*) x 1 x 1 x 0.003 x 1 x £14.40 ] + [ 3,960.53 x 1 x 0.003 x 1 x 0 ]

    = [ £171.09 ] + [ 0 ]

    = **£171.09**

NH Sect 8.4 i (Page 1 of 3)

*Doc Reference* : NH Sect 8.4 i - Dust Suppression Calculations

- Dust suppression for the haul & access roads is an intermittent activity during the year and is only required when the mining operation is ongoing AND the weather is either dry or 'semi-dry'. Weather conditions are key, so we have analysed the rainfall stats for the site over five years ( 2014-2018 ) and categorised the available working days into dry (0 -1.9mm), semi-dry (2-4.9mm) & wet (5mm+). These are fairly arbitrary categories but we feel they pretty well represent the requirements for our dust suppression.

- Average weather conditions :
  Summarised table from Rainfall Analysis sheets ( *doc. ref. : NH Sect 8.4 g* )

| | *Percentage of Days* | | | | | |
|---|---|---|---|---|---|---|
| *Daily Rainfall categories* | *2014* | *2015* | *2016* | *2017* | *2018* | Mean |
| *Dry (0 – 1.9mm)* | 49 | 49 | 55 | 56 | 60 | 54 |
| *Semi-Dry (2 – 4.9mm)* | 12 | 12 | 14 | 14 | 12 | 13 |
| *Wet ( 5mm + )* | 39 | 39 | 31 | 30 | 28 | 33 |

- Required days & Availability :
  - Operational days in year :-
    - 365 – 15 [ weekday shut-down periods ( Christmas & Whitsun ) ]
      – 52 Sundays
      - 52 Saturdays
      – 4 other Bank Holidays
      = 242 days
  - Machine availability :-
    - The truck-bowsers are old converted dumptrucks and are not anywhere near as reliable as the front-line haulage plant, similarly the tractors are support rather than front-line plant , so we've estimated a generous 85% machines availability .
    - This equates to 242 days x 85% = **205 bowser-available days per year**.
  - Weather factor :-
    - From the table above, the requirement split for the 205 days is as follows :
      - Dry Days : 205 x 54% = **110 days**
      - Semi-Dry : 205 x 13% = **27 days**
      - Wet Days : 202 x 33% = **68 days**

Ntl Sect 8.4 i (Page 2 of 3)

❖ Number of loads spread per day & volume per year :

| Description | Cat 773 Bowser ( Haul Roads only ) | Volvo A35 Bowser ( Haul Roads only ) | Tractor & tank ( All Roads ) |
|---|---|---|---|
| Typical Fill Time | 15 mins | 10 mins | 10 mins |
| Spread time ( Dry ) | 45 mins | 30 mins | 20 mins |
| Spread time ( Semi-Dry ) | 60 mins | 50 mins | 30 mins |
| Dry cycle-time | 60 mins | 40 mins | 30 mins |
| Semi Dry cycle-time | 75 mins | 50 mins | 40 mins |
| Shift Time | 16 hrs | 12 hrs | 12 hrs |
| 'In-play' time | 14 hrs | 10 hrs | 10 hrs |
| Theoretical Maximum Loads / day ( Dry ) | 14 | 15 | 20 |
| Theoretical Maximum Load / day (Semi-Dry) | 11 | 12 | 15 |
| **Operational losses of 1 load am & 1 load pm PLUS extended distance travel losses of 1 load am & 1 load pm** | | | |
| Practical Loads / day ( Dry ) | 10 | 11 | 16 |
| Practical Loads / day ( Semi-Dry ) | 7 | 8 | 11 |
| Full Capacity ( $m^3$ ) | 4.6 x 4.8 x 2.4 = 53$m^3$ | 1.3 x 3.3 x 5.5 = 23.5$m^3$ minus 1$m^3$ for rear-axles area = 22.5$m^3$ | 3000 gallons : x 4.546 = 13,600 ltrs = 13.6 $m^3$ |
| Fill capacity = 95% | 53 x 95% = **50.4$m^3$** | 22.5 x 95% = **21.4$m^3$** | 13.6 x 95% = **12.9$m^3$** |
| Annual Volumes Dry | 110 x 10 x 50.4 = 55,440 | 110 x 11 x 21.4 = 25,894 | 110 x 16 x 12.9 = 22,704 |
| Annual Volumes Semi-Dry | 27 x 7 x 50.4 = 9,526 | 27 x 8 x 21.4 = 4,622 | 27 x 11 x 12.9 = 3,831 |
| Total Annual Volumes per vehicle | **64,966 $m^3$** | **30,516 $m^3$** | **26,535 $m^3$** |
| Total Annual Volume | **122,047 $m^3$** | | |

NH Sect 8.4i ( Page (3) of 3 )

- Cost calculation :
  - Standard Unit Charge [ 2018/19 per 1000$m^3$ ] is £14.40 ( Wales, excl. Severn catchment )
  - Charge Factors etc. :
    - Source Factor = 1.0
    - Season Factor : All Year = 1.0
    - Loss Factor : Dust suppression = 1.0
    - Adj. Source Factor : non-tidal = 1.0
    - Environmental Improvement Unit Charge ( £/000$m^3$ ) = Nil
    - Advertising Admin Charge ( £100 ) : tbc by NRW if required
  - Calculation :

    Annual Charge + Compensation Charge ....

    [ *Volume x Source Factor x Season Factor x Loss Factor x Adj.SF x SUC (£/000$m^3$)* ] plus

    [ *Volume x Season Factor x Loss Factor x Adj.SF x EIUC ( **nil** )* ]

    = [ 122.047 (*122,047/1000*) x 1 x 1 x 1.0 x 1 x £14.40 ] + [ 3,960.53 x 1 x 1.0 x 1 x 0 ]

    = [ £1757.48 ] + [ 0 ]

    = **£1757.48**

<<< --- >>>