



info@larkarchitects.co.uk  
www.larkarchitects.co.uk  
01535 630772

# SURFACE WATER CALCULATIONS

Proposed Extension & Garage  
21 Ash Grove, Sutton in Craven

REF No. 1149-110

October 2022

### Design Settings

|                       |                   |                                      |               |
|-----------------------|-------------------|--------------------------------------|---------------|
| Rainfall Methodology  | FSR               | Maximum Time of Concentration (mins) | 30.00         |
| Return Period (years) | 100               | Maximum Rainfall (mm/hr)             | 50.0          |
| Additional Flow (%)   | 0                 | Minimum Velocity (m/s)               | 1.00          |
| FSR Region            | England and Wales | Connection Type                      | Level Soffits |
| M5-60 (mm)            | 17.300            | Minimum Backdrop Height (m)          | 0.200         |
| Ratio-R               | 0.300             | Preferred Cover Depth (m)            | 1.200         |
| CV                    | 0.750             | Include Intermediate Ground          | ✓             |
| Time of Entry (mins)  | 4.00              | Enforce best practice design rules   | ✓             |

### Nodes

| Name     | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Easting (m) | Northing (m) | Depth (m) |
|----------|-----------|---------------|-----------------|---------------|-------------|--------------|-----------|
| RE       | 0.009     | 4.00          | 109.200         |               | 24.983      | 77.826       | 0.500     |
| S1       | 0.015     | 4.00          | 109.200         | 300           | 24.918      | 71.968       | 0.700     |
| S2       |           |               | 109.200         | 300           | 29.962      | 71.864       | 0.790     |
| Soakaway |           |               | 109.100         |               | 33.004      | 71.894       | 0.700     |

### Links

| Name  | US Node | DS Node  | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|-------|---------|----------|------------|-------------|-----------|-----------|----------|-------------|----------|---------------|--------------|
| 1.000 | RE      | S1       | 11.850     | 0.600       | 108.700   | 108.550   | 0.150    | 79.0        | 100      | 4.23          | 50.0         |
| 1.001 | S1      | S2       | 7.100      | 0.600       | 108.500   | 108.410   | 0.090    | 78.9        | 100      | 4.36          | 50.0         |
| 1.002 | S2      | Soakaway | 1.000      | 0.600       | 108.410   | 108.400   | 0.010    | 100.0       | 100      | 4.39          | 50.0         |

| Name  | Vel (m/s) | Cap (l/s) | Flow (l/s) | US Depth (m) | DS Depth (m) | Σ Area (ha) | Σ Add Inflow (l/s) | Pro Depth (mm) | Pro Velocity (m/s) |
|-------|-----------|-----------|------------|--------------|--------------|-------------|--------------------|----------------|--------------------|
| 1.000 | 0.866     | 6.8       | 1.2        | 0.400        | 0.550        | 0.009       | 0.0                | 29             | 0.652              |
| 1.001 | 0.867     | 6.8       | 3.3        | 0.600        | 0.690        | 0.024       | 0.0                | 49             | 0.858              |
| 1.002 | 0.769     | 6.0       | 3.3        | 0.690        | 0.600        | 0.024       | 0.0                | 52             | 0.781              |

### Pipeline Schedule

| Link  | Length (m) | Slope (1:X) | Dia (mm) | Link Type | US CL (m) | US IL (m) | US Depth (m) | DS CL (m) | DS IL (m) | DS Depth (m) |
|-------|------------|-------------|----------|-----------|-----------|-----------|--------------|-----------|-----------|--------------|
| 1.000 | 11.850     | 79.0        | 100      | Circular  | 109.200   | 108.700   | 0.400        | 109.200   | 108.550   | 0.550        |
| 1.001 | 7.100      | 78.9        | 100      | Circular  | 109.200   | 108.500   | 0.600        | 109.200   | 108.410   | 0.690        |
| 1.002 | 1.000      | 100.0       | 100      | Circular  | 109.200   | 108.410   | 0.690        | 109.100   | 108.400   | 0.600        |

| Link  | US Node | Dia (mm) | Node Type | MH Type   | DS Node  | Dia (mm) | Node Type | MH Type   |
|-------|---------|----------|-----------|-----------|----------|----------|-----------|-----------|
| 1.000 | RE      |          | Junction  |           | S1       | 300      | Manhole   | Adoptable |
| 1.001 | S1      | 300      | Manhole   | Adoptable | S2       | 300      | Manhole   | Adoptable |
| 1.002 | S2      | 300      | Manhole   | Adoptable | Soakaway |          | Junction  |           |

### Simulation Settings

|                      |                   |                            |        |
|----------------------|-------------------|----------------------------|--------|
| Rainfall Methodology | FSR               | Analysis Speed             | Normal |
| FSR Region           | England and Wales | Skip Steady State          | x      |
| M5-60 (mm)           | 17.300            | Drain Down Time (mins)     | 240    |
| Ratio-R              | 0.300             | Additional Storage (m³/ha) | 20.0   |
| Summer CV            | 0.750             | Check Discharge Rate(s)    | x      |
| Winter CV            | 0.840             | Check Discharge Volume     | x      |

### Storm Durations

|    |    |    |     |     |     |     |     |     |     |     |      |
|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 |
|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|------|

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) | Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 1                     | 0                     | 0                     | 0                     | 100                   | 30                    | 0                     | 0                     |
| 30                    | 0                     | 0                     | 0                     |                       |                       |                       |                       |

**Node Soakaway Carpark Storage Structure**

|                             |         |                           |         |               |       |
|-----------------------------|---------|---------------------------|---------|---------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 108.400 | Slope (1:X)   | 300.0 |
| Side Inf Coefficient (m/hr) | 0.34521 | Time to half empty (mins) | 377     | Depth (m)     | 0.500 |
| Safety Factor               | 2.0     | Width (m)                 | 3.000   | Inf Depth (m) |       |
| Porosity                    | 0.95    | Length (m)                | 7.500   |               |       |

**Rainfall**

| Event                     | Peak Intensity (mm/hr) | Average Intensity (mm/hr) | Event                               | Peak Intensity (mm/hr) | Average Intensity (mm/hr) |
|---------------------------|------------------------|---------------------------|-------------------------------------|------------------------|---------------------------|
| 1 year 15 minute summer   | 85.719                 | 24.256                    | 30 year 360 minute summer           | 30.833                 | 7.934                     |
| 1 year 15 minute winter   | 60.154                 | 24.256                    | 30 year 360 minute winter           | 20.042                 | 7.934                     |
| 1 year 30 minute summer   | 58.154                 | 16.455                    | 30 year 480 minute summer           | 24.497                 | 6.474                     |
| 1 year 30 minute winter   | 40.810                 | 16.455                    | 30 year 480 minute winter           | 16.275                 | 6.474                     |
| 1 year 60 minute summer   | 41.189                 | 10.885                    | 30 year 600 minute summer           | 20.198                 | 5.525                     |
| 1 year 60 minute winter   | 27.365                 | 10.885                    | 30 year 600 minute winter           | 13.801                 | 5.525                     |
| 1 year 120 minute summer  | 26.962                 | 7.125                     | 30 year 720 minute summer           | 18.101                 | 4.851                     |
| 1 year 120 minute winter  | 17.913                 | 7.125                     | 30 year 720 minute winter           | 12.165                 | 4.851                     |
| 1 year 180 minute summer  | 21.544                 | 5.544                     | 30 year 960 minute summer           | 14.995                 | 3.948                     |
| 1 year 180 minute winter  | 14.004                 | 5.544                     | 30 year 960 minute winter           | 9.933                  | 3.948                     |
| 1 year 240 minute summer  | 17.551                 | 4.638                     | 30 year 1440 minute summer          | 11.004                 | 2.949                     |
| 1 year 240 minute winter  | 11.660                 | 4.638                     | 30 year 1440 minute winter          | 7.395                  | 2.949                     |
| 1 year 360 minute summer  | 13.958                 | 3.592                     | 100 year +30% CC 15 minute summer   | 349.494                | 98.895                    |
| 1 year 360 minute winter  | 9.073                  | 3.592                     | 100 year +30% CC 15 minute winter   | 245.259                | 98.895                    |
| 1 year 480 minute summer  | 11.281                 | 2.981                     | 100 year +30% CC 30 minute summer   | 241.455                | 68.323                    |
| 1 year 480 minute winter  | 7.495                  | 2.981                     | 100 year +30% CC 30 minute winter   | 169.442                | 68.323                    |
| 1 year 600 minute summer  | 9.435                  | 2.581                     | 100 year +30% CC 60 minute summer   | 171.189                | 45.240                    |
| 1 year 600 minute winter  | 6.446                  | 2.581                     | 100 year +30% CC 60 minute winter   | 113.734                | 45.240                    |
| 1 year 720 minute summer  | 8.559                  | 2.294                     | 100 year +30% CC 120 minute summer  | 109.695                | 28.989                    |
| 1 year 720 minute winter  | 5.752                  | 2.294                     | 100 year +30% CC 120 minute winter  | 72.879                 | 28.989                    |
| 1 year 960 minute summer  | 7.237                  | 1.906                     | 100 year +30% CC 180 minute summer  | 85.537                 | 22.012                    |
| 1 year 960 minute winter  | 4.794                  | 1.906                     | 100 year +30% CC 180 minute winter  | 55.601                 | 22.012                    |
| 1 year 1440 minute summer | 5.482                  | 1.469                     | 100 year +30% CC 240 minute summer  | 67.980                 | 17.965                    |
| 1 year 1440 minute winter | 3.684                  | 1.469                     | 100 year +30% CC 240 minute winter  | 45.164                 | 17.965                    |
| 30 year 15 minute summer  | 209.035                | 59.150                    | 100 year +30% CC 360 minute summer  | 52.012                 | 13.384                    |
| 30 year 15 minute winter  | 146.691                | 59.150                    | 100 year +30% CC 360 minute winter  | 33.809                 | 13.384                    |
| 30 year 30 minute summer  | 142.808                | 40.410                    | 100 year +30% CC 480 minute summer  | 41.110                 | 10.864                    |
| 30 year 30 minute winter  | 100.216                | 40.410                    | 100 year +30% CC 480 minute winter  | 27.313                 | 10.864                    |
| 30 year 60 minute summer  | 100.425                | 26.539                    | 100 year +30% CC 600 minute summer  | 33.751                 | 9.232                     |
| 30 year 60 minute winter  | 66.720                 | 26.539                    | 100 year +30% CC 600 minute winter  | 23.061                 | 9.232                     |
| 30 year 120 minute summer | 64.150                 | 16.953                    | 100 year +30% CC 720 minute summer  | 30.135                 | 8.076                     |
| 30 year 120 minute winter | 42.620                 | 16.953                    | 100 year +30% CC 720 minute winter  | 20.252                 | 8.076                     |
| 30 year 180 minute summer | 50.118                 | 12.897                    | 100 year +30% CC 960 minute summer  | 24.809                 | 6.533                     |
| 30 year 180 minute winter | 32.578                 | 12.897                    | 100 year +30% CC 960 minute winter  | 16.434                 | 6.533                     |
| 30 year 240 minute summer | 39.982                 | 10.566                    | 100 year +30% CC 1440 minute summer | 18.034                 | 4.833                     |
| 30 year 240 minute winter | 26.563                 | 10.566                    | 100 year +30% CC 1440 minute winter | 12.120                 | 4.833                     |

**Results for 1 year Critical Storm Duration. Lowest mass balance: 97.42%**

| Node Event        | US Node  | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m <sup>3</sup> ) | Flood (m <sup>3</sup> ) | Status     |
|-------------------|----------|-------------|-----------|-----------|--------------|----------------------------|-------------------------|------------|
| 15 minute winter  | RE       | 10          | 108.727   | 0.027     | 1.1          | 0.0099                     | 0.0000                  | OK         |
| 15 minute winter  | S1       | 10          | 108.548   | 0.048     | 2.9          | 0.0239                     | 0.0000                  | OK         |
| 720 minute winter | S2       | 510         | 108.545   | 0.135     | 0.3          | 0.0096                     | 0.0000                  | SURCHARGED |
| 720 minute winter | Soakaway | 510         | 108.545   | 0.145     | 0.3          | 2.8322                     | 0.0000                  | OK         |

| Link Event (Upstream Depth) | US Node  | Link         | DS Node  | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m <sup>3</sup> ) |
|-----------------------------|----------|--------------|----------|---------------|----------------|----------|----------------------------|
| 15 minute winter            | RE       | 1.000        | S1       | 1.1           | 0.634          | 0.161    | 0.0204                     |
| 15 minute winter            | S1       | 1.001        | S2       | 2.9           | 0.773          | 0.424    | 0.0265                     |
| 720 minute winter           | S2       | 1.002        | Soakaway | 0.3           | 0.301          | 0.048    | 0.0078                     |
| 720 minute winter           | Soakaway | Infiltration |          | 0.1           |                |          |                            |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 97.42%**

| Node Event        | US Node  | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|-------------------|----------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 15 minute summer  | RE       | 10          | 108.743   | 0.043     | 2.6          | 0.0156        | 0.0000     | OK         |
| 480 minute winter | S1       | 360         | 108.703   | 0.203     | 0.9          | 0.1013        | 0.0000     | SURCHARGED |
| 480 minute winter | S2       | 360         | 108.703   | 0.293     | 0.9          | 0.0208        | 0.0000     | SURCHARGED |
| 480 minute winter | Soakaway | 360         | 108.703   | 0.303     | 0.8          | 6.2033        | 0.0000     | OK         |

| Link Event (Upstream Depth) | US Node  | Link         | DS Node  | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) |
|-----------------------------|----------|--------------|----------|---------------|----------------|----------|---------------|
| 15 minute summer            | RE       | 1.000        | S1       | 2.6           | 0.784          | 0.385    | 0.0409        |
| 480 minute winter           | S1       | 1.001        | S2       | 0.9           | 0.357          | 0.126    | 0.0556        |
| 480 minute winter           | S2       | 1.002        | Soakaway | 0.8           | 0.405          | 0.137    | 0.0078        |
| 480 minute winter           | Soakaway | Infiltration |          | 0.3           |                |          |               |

**Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 97.42%**

| Node Event        | US Node  | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m <sup>3</sup> ) | Flood (m <sup>3</sup> ) | Status     |
|-------------------|----------|-------------|-----------|-----------|--------------|----------------------------|-------------------------|------------|
| 480 minute winter | RE       | 360         | 108.888   | 0.188     | 0.6          | 0.0676                     | 0.0000                  | SURCHARGED |
| 480 minute winter | S1       | 360         | 108.888   | 0.388     | 1.5          | 0.1935                     | 0.0000                  | SURCHARGED |
| 480 minute winter | S2       | 360         | 108.887   | 0.477     | 1.5          | 0.0339                     | 0.0000                  | SURCHARGED |
| 480 minute winter | Soakaway | 360         | 108.887   | 0.487     | 1.5          | 10.1440                    | 0.0000                  | OK         |

| Link Event (Upstream Depth) | US Node  | Link         | DS Node  | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m <sup>3</sup> ) |
|-----------------------------|----------|--------------|----------|---------------|----------------|----------|----------------------------|
| 480 minute winter           | RE       | 1.000        | S1       | 0.6           | 0.466          | 0.087    | 0.0927                     |
| 480 minute winter           | S1       | 1.001        | S2       | 1.5           | 0.394          | 0.222    | 0.0556                     |
| 480 minute winter           | S2       | 1.002        | Soakaway | 1.5           | 0.405          | 0.242    | 0.0078                     |
| 480 minute winter           | Soakaway | Infiltration |          | 0.5           |                |          |                            |

Report No: 1149\_110 – Surface Water Calculations  
Project Details: 21 Ash Grove, Sutton in Craven  
Date: October 2022

