

The Royal British Legion, Llay

Flood Consequence Assessment & Drainage Strategy

April 2018



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Introduction

Waterco Consultants have been commissioned to undertake a Flood Consequences Assessment & Drainage Strategy in relation to a proposed residential development at The Royal British Legion, Watts Dyke, Llay, Wrexham, LL12 0RL.

The purpose of this report is to outline the potential flood risk to the site, the impact of the proposed development on flood risk elsewhere, and the proposed measures which could be incorporated to mitigate the identified risk. This report has been prepared in accordance with the guidance contained in the National Planning Policy Framework (NPPF) and the National Planning Practice Guidance (NPPG). Reference has also been made to the Wrexham County Borough Council Preliminary Flood Risk Assessment (PFRA) (June 2011).

From April 2015, Wrexham County Borough Council as a Lead Local Flood Authority (LLFA) is a statutory consultee for major planning applications in relation to surface water drainage, requiring that all planning applications are accompanied by a Sustainable Drainage Strategy. The aim of the Sustainable Drainage Strategy is to identify water management measures, including Sustainable Drainage Systems (SuDS), to provide surface water runoff reduction and treatment.

This report should be read in conjunction with the Infiltration Test Report produced by Waterco Consultants in April 2018 (ref: w10229-180417-Infiltration Test Report).

Existing Conditions

The 2.18ha (hectare) development site is located in a predominantly residential area at National Grid reference: 333124E, 355330N. A location plan and aerial image are included in Appendix A.

The site comprises of the existing Royal British Legion building with associated car parking, a war memorial and landscaping. The site is bordered by Watts Dyke (Road) to the north with residential dwellings beyond, Llay New Road to the east with residential dwellings beyond, agricultural land and a wooded area to the south and residential dwellings to the west. Access to the site is provided from Watts Dyke north of the site.

Hard-standing, including the existing Royal British Legion building, car parking and access currently occupies 9,422m² or 43% of the total site area. The remaining permeable, soft landscaped areas occupy 12,378m² or 57% of the total site area.

Local Topography

Topographic levels to metres Above Ordnance Datum (m AOD) have been derived from a 1m resolution Natural Resources Wales (EA) composite 'Light Detecting and Ranging' (LiDAR) Digital Terrain Model (DTM). A review of LiDAR data shows that the site slopes from approximately 82m AOD in the south-west to approximately 76m AOD in the east. A LiDAR extract is included in Appendix B.

Ground Conditions

Reference to the British Geological Survey online mapping (1:50,000 scale) indicates that the site is underlain by superficial Glaciofluvial deposits generally comprising Sand and Gravel. The superficial deposits are identified as being underlain by the Salop Formation consisting of Mudstone, Sandstone and Conglomerate.

Waterco Consultants undertook infiltration testing in general accordance with the BRE 365 specification in April 2018 (ref: w10229-180417-Infiltration Test Report). Three trial pits were excavated onsite under the instruction and guidance of Waterco Consultants. During the excavation of trial pits, a visual inspection of the arisings generally confirmed the above geology. The strata identified on site generally comprised Made Ground to depths of approximately 0.3m, underlain by sands and gravels in TP01 and TP02. In TP03, Made Ground was recorded to a depth of approximately 0.7m, with more clay as well as sands, gravels and pebbles evident. Anecdotal information provided by a representative of The Royal British Legion, advised that land raising using imported Made Ground was undertaken, approximately 20 years ago, in the vicinity of TP03.

Groundwater was not encountered during the infiltration testing.

The Cranfield University 'Soilscapes' map indicates that the site is underlain by 'freely draining soils.' Land immediately north of the site is shown to be underlain by 'slowly permeable, seasonally wet, clayey soils'.

Local Drainage

Public sewer records have been obtained from Dwr Cymru / Welsh Water (DCWW) and are included in Appendix C. The sewer records show that there is a public foul water pumping station located on-

site in the eastern extent. Foul water from the pumping station is directed into a 225mm public foul sewer within Llay New Road east of the site. There is also a 150mm public foul sewer north of the site within Watts Dyke (Road). This sewer flows eastwards becoming 225mm in Llay New Road. Manhole SJ33552305 in Llay New Road east of the site has an identified cover level of 75.75m AOD and an invert level of 74.44m AOD.

The sewer records also identify a public surface water sewer on Llay New Road east of the site. No cover or invert levels have been provided for the surface water sewer.

Development Proposals

The development proposal is to retain the Royal British Legion building and submit a full planning application for a new car park surrounding the building. Outline planning is sought to remove the existing car park and erect 51 residential properties with associated gardens, car parking, access roads, a new retail unit, a boxing club, electricity substation and the repositioning of the war memorial. The residential element will occupy approximately 1.58ha. A proposed development plan is included in Appendix B.

The proposed development will result in an increase in hard-standing areas. Hard-standing, including the existing Royal British Legion building will occupy approximately 13,500m² or 62% of the total site area. The remaining permeable, soft landscaped areas will occupy 8,300m² or 38% of the total site area. A plan that distinguishes the areas of hardstanding is included in Appendix B.

Flood Zone Category and Policy Context

The Welsh Government 'Development Advice Map' included in Appendix D shows that the site is located within Flood Zone A – an area considered to be at little / no risk of fluvial and coastal flooding with a less than 1 in 1000 (0.1%) annual probability of flooding.

The Natural Resources Wales (NRW) 'Flood Risk – Rivers and Sea' map included in Appendix D shows that the site is located outside of the extreme 0.1% annual probability fluvial and tidal flood extent.

Local Planning Policy

The Wrexham Unitary Development Plan (UDP) contains the following policy in relation to flood risk and sustainable drainage:

Development and Flood Risk

Policy EC12 *Development (including the raising of land) within defined flood plains will only be permitted if it:*

- a) would not be subject to an unacceptable risk of flooding on-site; and/or*
- b) does not result in an unacceptable risk of flooding on or off-site; and/or*
- c) does not adversely affect flood management or maintenance schemes*

Surface Water Run-off

Policy EC13 *Development which would result in an unacceptable adverse impact on the water environment due to additional surface water run-off will not be permitted*

5.18 *Development on green field sites usually results in an increase in the amount of impermeable land. This can alter the natural water cycle as rates and volumes of surface water reaching a surface watercourse generally increase. Drains and sewers generally convey surface water from impermeable areas directly, or via a sewerage system, to a watercourse. Such arrangements not only reduce the natural recharge of groundwater, which wastes a valuable resource and increases pollution risk (for example from contaminated urban run-off and combined sewage overflows) but can also increase river flows. Increased river flows can cause physical damage to the banks and bed of a watercourse, and increase the risk of flooding.*

5.19 *Wherever practicable surface water should be disposed of as close to the source as possible. Where potential risks are identified appropriate flow attenuation facilities or mitigation measures may be a pre-requisite for development. Consideration should be given to the use of softer engineering structures referred to as Sustainable Urban Drainage Systems (SUDS). SUDS is a concept that focuses decisions about drainage design, construction and maintenance on the quality of the receiving environment and people. SUDS are physical structures built to receive surface water runoff. They typically include swales, ponds, infiltration basins and porous surfaces and should be considered as alternatives to conventional drainage where appropriate. The Environment Agency Wales can provide*

guidance on the design of SUDS and have produced a document entitled "Protecting the Quality of Our Environment, Sustainable Urban Drainage Systems - An Introduction". The Council will require the developer to demonstrate, both financially and practically, how the long term maintenance of any attenuation facilities or mitigation measures will be achieved.

National Planning Policy

In accordance with Figure 2 of TAN15: Development and Flood Risk, residential developments are considered to be 'highly vulnerable'.

The site will be located wholly within Flood Zone A. In accordance with Section 9 of TAN15, 'highly vulnerable' development is considered acceptable in Flood Zone A subject to demonstrating no increase in flood risk elsewhere.

This report focuses on the impact of the development on flood risk elsewhere, ensuring the proposal does not lead to detriment. All potential sources of flooding are assessed in the following report sections to provide context to the report.

The Wrexham County Borough Council Preliminary Flood Risk Assessment (PFRA) (June 2011) has been reviewed for site specific flooding information.

Consultation

A developer enquiry has been submitted to DCWW in December 2016. A response was received on 22nd December and is included in Appendix C. DCWW state that *'there are isolated incidents of flooding in the public sewerage system downstream of the site. We have considered the impact of the foul flows generated by the proposed development upon the local public sewerage system and concluded that it is unlikely that sufficient capacity exists to accommodate your development without causing detriment to the existing services we provide to our customers, or in regard to the protection of the environment. Accordingly, we are unable at this stage to provide you with a point of adequacy on the network.*

In light of the above our recommendation is that you instruct us to undertake a Hydraulic Modelling Assessment of the local public sewerage network. This assessment will examine the existing network and consider the impact of the introduction of flows from your development upon its performance. Where required and appropriate, the assessment will then identify solutions and points of communication to ensure that your site can be accommodated within the system.

... Alternatively, if the proposed development site is a brownfield site we are prepared to consider a foul connection into the public sewer outside the proposed development site, albeit to the historical discharge rate of the site. We would suggest investigations are undertaken by the applicant to confirm if the former development did connect into the sewer.

... In relation to the surface water flows from the proposed development, these will have to be disposed of separately by other means, such as using soakaways or discharge directly to a watercourse in liaison with the Land Drainage Authority and/ or Natural Resources Wales.'

DCWW have stated that the modelling assessment should be undertaken in advance of the planning application. In the absence of known solutions to mitigate development foul flows DCWW will not be able to support the development through the planning process.

Wrexham County Borough Council as the LLFA have been consulted to establish any site-specific requirements in relation to flood risk and surface water drainage. The council response is included in Appendix E. In relation to flood risk, Wrexham County Borough Council state:

'The boundary of the site to the north-west and south-east corners are affected by 1 in 30, 1 in 100 and 1 in 1000 year event surface water flooding and the area to the front of the legion building is affected by 1 in 100 and 1 in 1000 year event surface water flooding. There are a few incidents of historic flooding adjacent to the site to the east which involved surface water flooding and sandbag requests in 2012. The most recent incident of flooding is towards the garage to the edge of the attached map and was for gulley maintenance issues leading to surface water flooding in 2016.'

Further correspondence from the LLFA, provided to Waterco by our Client (Appendix E) states *'there is significant potential for the inclusion of infiltration techniques and Sustainable Drainage techniques to manage surface water on this site. It would appear from the pre application consultation document that Welsh Water will only consider discharge to the public sewer if infiltration or direct discharge to watercourse is not feasible. It should also be demonstrated prior to determination that if soakaway is proven to be appropriate for the site (as ground investigation report suggests) then sufficient provision can be made within the design to cater for the required attenuation volumes.*

I would request this information is submitted and agreed prior to determination as it may have an impact on proposed site layout and scale of development'.

Sources of Flooding and Probability

Fluvial & Tidal

The nearest watercourse is an unnamed watercourse located approximately 345m east of the site. This watercourse flows north-east and joins Nant-Y-Gaer which is located 590m north-east of the site at its nearest point. Nant-Y-Gaer flows south-east and joins the River Alyn which is located 700m south-west of the site at its nearest point.

The site is located within Flood Zone A on the Welsh Government Development Advice Map and lies outside the extreme 0.1% annual probability fluvial and tidal flood extent on the NRW 'Flood Risk – Rivers and Sea' map. The site is situated at a minimum level of approximately 76m AOD and is approximately 21m above the River Alyn, 16m above Nant-Y-Gaer and 11m above the unnamed watercourse to the east.

It can be concluded that the site is at low risk of fluvial and tidal flooding.

Surface Water

Surface water flooding occurs when rainwater does not drain away through the normal drainage system or soak into the ground. It is usually associated with high intensity rainfall events, but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen or developed, resulting in overland flow and ponding in depressions in topography. Surface water flooding can occur anywhere without warning. However, flow paths can be determined by consideration of contours and relative levels.

The NRW 'Risk of Flooding from Surface Water' map (Appendix D) indicates that the majority of the site is at very low risk of surface water flooding, meaning it has a less than 0.1% annual probability of flooding.

As identified on the NRW 'Risk of Flooding from Surface Water' map and by Wrexham County Borough Council in their correspondence, the boundaries of the site to the north-west and south-east corners are shown at risk of flooding. The flooding identified in the south-east corner is outside of the site boundary and associated with a topographical depression. The LiDAR extract (Appendix B) shows that the topographical depression is situated at approximately 75m AOD and 1m below adjacent site levels.

The flooding identified in the north-west corner is also associated with a topographical low point situated at 77m AOD. Site levels fall sharply in this location down to road levels in the form of an earth

embankment. Site levels at the top of the embankment are approximately 1m higher than adjacent road levels. Any potential flooding in the adjacent road has potential to affect only a minimal part of the site at the base of the grass embankment.

No surface water flow routes are identified within the site. A moderate risk of surface water flooding is identified along the existing site access road immediately north of the British Legion Building. The risk of surface water ponding within the site will be mitigated by consideration of site levels and inclusion of a sustainable drainage system.

As confirmed by Wrexham County Borough Council, there are incidents of historic flooding immediately east of the site which involved surface water flooding and sandbag requests in 2012. Council recorded historic surface water flooding events are illustrated on the 'Water Management Query' map provided by Wrexham County Borough Council in Appendix C. There are no records of past flooding affecting the site.

It can therefore be concluded that the site is at low risk of surface water flooding.

Sewer Flooding

Flooding from sewers can occur when a sewer is overwhelmed by heavy rainfall, becomes blocked, is damaged, or is of inadequate capacity. Flooding is mostly applicable to combined and surface water sewers.

The PFRA 'Sewer Flooding' map (Appendix F) obtained from the PRFA indicates that there have been a number of sewer flooding incidents within the vicinity of the site. However there are no records of sewer flooding affecting the site.

Any potential flooding of the 150mm public foul sewer in Watts Dyke (Road) would be directed westward towards a topographic low point north-west of the site. Any potential flooding of the 225mm public foul sewer and the public surface water sewer in Llay New Road would be directed south towards a topographic low point south-east of the site. The LiDAR extract (Appendix B) indicates that the site is situated above adjacent road levels and as such any potential sewer flooding arising in adjacent roads would not reach the site. It can therefore be concluded that the risk of sewer flooding is low.

Groundwater Flooding

Groundwater flooding occurs when water levels underneath the ground rise above normal levels. Prolonged heavy rainfall soaks into the ground and can cause the ground to become saturated. This results in rising groundwater levels which leads to flooding above ground.

The PRFA states that 'there were no records of past groundwater flooding within WCBC; this is due to the topography and geology of the area'. There are no records of groundwater flooding at or near to the site.

It can therefore be concluded that the risk of groundwater flooding is low.

Artificial Sources of Flooding

There are no canals within the vicinity of the site. The NRW 'Risk of Flooding from Reservoirs' map (Appendix D) shows that the site is not at risk of flooding from reservoirs.

It can therefore be concluded that the risk of flooding from artificial sources is low.

Summary of Potential Flooding

It can be concluded that the site is at low risk of flooding from all sources. A potential for surface water ponding within topographical depressions is identified however this risk will be mitigated through consideration of site levels and inclusion of a sustainable drainage system.

In accordance with Building Regulations, finished floor levels should be set a minimum of 150mm above surrounding ground levels.

Surface Water Management

The site is currently occupied by hard-standing in the form of the existing Royal British Legion building and its associated car park. It is understood from anecdotal information provided onsite (April 2018) that surface water runoff currently drains by soakaway.

The proposed development will result in an increase in hard-standing in the form of a new car park, dwellings and access roads. Approximately 13,500m² of hard-standing is proposed. This figure includes approximately 1,350 of the existing building footprint will be retained.

In order to ensure the proposed development will not increase flood risk elsewhere, surface water discharge from the site will be controlled. As no details are available regarding the existing drainage system, discharge rates from the proposed development should be limited to the greenfield rate to ensure no increase in flood risk elsewhere.

Existing greenfield runoff rates have been estimated using the FEH Method within MicroDrainage (see Appendix G). The existing QMED (equivalent to the 1 in 2 year event) greenfield runoff rate for the 2.18ha development site is 3 l/s.

A flow rate of 5 l/s is proposed for this site to ensure the drainage system is self-cleansing.

Attenuation Storage

In order to achieve a discharge rate of 5 l/s, attenuation storage will be required. A storage estimate is included in Appendix G. An estimated storage volume of 474m³ will be required to accommodate the 1 in 100 year plus 40% Climate Change (CC) event. An estimated storage volume of 232m³ will be required to accommodate the 1 in 30 year event. The storage estimates are based on storage within a tank or pond structure, an impermeable drainage area of 8,203m² which includes the new car park, dwellings and access roads and excludes the existing British Legion building and surrounding car parking, a design head of 1m and hydro-brake flow control.

The attenuation volumes should be verified when undertaking detailed drainage design.

Discharge Method

Paragraph 080 of the NPPG: Flood Risk and Coastal Change sets out the following hierarchy of drainage options: into the ground (infiltration); to a surface water body; to a surface water sewer, highway drain or another drainage system; to a combined sewer.

Infiltration

The first consideration for the disposal of surface water is infiltration (soakaways). As described above, BGS mapping indicates that the site is underlain by superficial deposits consisting of Glaciofluvial sand and gravel which is further underlain by the Salop Formation consisting of Mudstone, Sandstone and Conglomerate. The Cranfield University 'Soilscapes' map indicates that the site is underlain by 'freely draining soils.'

Infiltration tests were undertaken in April 2018 and confirmed that soakaways would be a suitable method for surface water drainage onsite, subject to appropriate sizing, design and location.

Alternative Discharge Methods

Where soakaways are not suitable a connection to watercourse is the next consideration.

The nearest watercourse is an unnamed watercourse located 345m east of the site at its nearest point. The site is separated from all nearby watercourses by third party land and therefore a direct connection to watercourse is not feasible.

DCWW in their correspondence have stated that surface water should be disposed of by soakaways or to a watercourse. However, as a direct connection to watercourse is not possible, and where soakaways are determined not suitable, a connection to the surface water sewer would be the only solution.

The DCWW sewer plan (Appendix C) indicates that there is a public surface water sewer located on Llay New Road east of the site. A connection to this sewer appears to be a feasible option, subject to agreement with DCWW. A connection to the sewer would be made at the greenfield rate of 5 l/s and a gravity connection appears feasible.

Sustainable Drainage Systems

Surface water storage should be provided in the form of Sustainable Drainage Systems (SuDS) where practical. The following SuDS options have been considered:

Soakaways

As described above, infiltration tests were undertaken in April 2018 and confirmed that soakaways would be a suitable method for surface water drainage onsite, subject to appropriate sizing, design and location.

An average roof area has been used to calculate approximate soakaway volumes for the proposed dwellings. Permeable paving has been used for individual driveways and unadopted highways. Soakaways have also been sized for each of the commercial units.

Indicative soakaway sizing calculations have been undertaken using MicroDrainage (see Appendix G). The soakaway calculations are based on an infiltration rate of 8.87×10^{-5} m/s, a cellular storage structure, a 1 in 100 year plus 40% climate change design storm event and a soakaway depth of 1m. Table 1 overleaf details the soakaway volumes and drain times;

Table 1 – Soakaway Details

Plot	Drainage Area (m ²)	Soakaway Volume (m ³)	Half Drain Time (mins)
Average residential plot	53	1.9	80
Permeable paving	3887	63.8	6
Club House	1532	71	181
Boxing unit	87	2.9	46
Retail unit	385	16.1	103
Adoptable Road	2361	111	196
Service Road	2538	119.5	196

It is not possible to size one soakaway to accommodate the surface water drainage for the whole site as it is not possible to suitably reduce the half drain time to an acceptable level (< 24hrs).

Soakaways should be located a minimum of 5m from buildings.

Swales, detention basins and ponds

The site will be occupied by buildings, an access road and private residential gardens and there is limited space to accommodate a number of above ground storage features such as ponds and basins. However a pond or basin could be situated within the area of public open space in the lower eastern extent of the site.

An open surface water attenuation feature such as a pond, basin or a swale in a residential area presents a safety risk; the hazards and appropriate mitigation should be considered at the detailed design stage.

Rainwater Harvesting

The attenuation benefits provided through the use of rainwater harvesting are considered to be limited, and would only be realised when the tanks were not full. However, rainwater harvesting techniques could be incorporated within the final design.

Green Roofs

Green roofs are not identified on development plans. Given the nature of the proposed development, the significant additional cost involved in installing and maintaining green roofs and the additional works required to allow for the additional loading on the building, green roofs are not considered a

practical option. The benefits achieved through installing a green roof would be disproportionate to the significant ongoing maintenance and construction costs involved.

Porous / Permeable Paving

Permeable paving could be incorporated within private roads, public and commercial car parking spaces and driveways. Storage would be provided within the sub-grade material prior to controlled release to the receiving sewer or infiltration to the ground. However, the internal access road that crosses the site from the northern and eastern borders of the site will be adopted. Councils are unlikely to adopt permeable surfacing. Furthermore, the road surrounding the existing club house will be trafficked with frequent HGV and heavy vehicle movements. The surfacing material required to support such HGV activity is not considered suitable for accommodating the use of permeable/porous surfacing.

Restricting porous paving to car parking spaces within the car park and the internal roads that will not be adopted and will not be utilised for HGV traffic provides a potential area of 3,887m². The car parking area could provide up to 349m³ of attenuation prior to infiltration to the ground or discharge to the ground, the calculations provided in Table 1 indicates that the volume provided is greater than that required. Further investigation into the use of porous paving will be undertaken at the detailed design stage.

The provision of storage within the sub-grade material would only be feasible in areas with a proposed gradient of <1 in 20 as detailed within CIRIA RP992/28 (Design Assessment Checklists for Permeable/Porous Pavement). Site gradients should be confirmed at the detailed design stage. The amount of storage provided within permeable paving is subject to sub-grade depth and gradient.

Underground Attenuation Tanks

Storage could be provided within underground attenuation tanks or within oversized pipes. Sufficient space for an underground tank is provided within the area of public open space and access road / turning area in the lower eastern extent of the site.

Concept Surface Water Drainage Scheme

Soakaways and permeable paving will be used where practical. Where soakaways are not feasible, surface water runoff will be discharged to the public surface water sewer located within Llay New Road, east of the site, at a rate of 5 l/s. Surface water runoff up to the 1 in 100 year plus 40% climate change allowance event will be attenuated on site. Sufficient space for attenuation storage is provided

within the area of public open space and access road / turning area in the lower eastern extent of the site.

Exceedance Event

Storage will be provided for the 1 in 100 year plus 40% CC event. Storm events in excess of the 1 in 100 year plus 40% CC event should be permitted to produce temporary shallow depth flooding within the car park, access roads and landscaped areas. Finished floor levels will be set at a minimum of 150mm above surrounding ground levels ensuring exceedance flooding will not affect the buildings.

Water Quality

In accordance with the CIRIA C753 publication 'The SuDS Manual' (2015), residential roofs have a 'very low' pollution hazard level, with low traffic roads classified as having a 'low' pollution hazard level. Table 2 below shows the pollution hazard indices for each land use.

Table 2 – Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Low Traffic Roads	Low	0.5	0.4	0.4

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' – Table 26.2

** Indices values range from 0-1.*

Where practical, runoff from roofs and roads will be directed to permeable paving and soakaways. Alternatively, there is also potential for the use of a pond or basin. Table 3 overleaf demonstrates that soakaways provide sufficient treatment. Table 4 overleaf demonstrates that a pond, basin or permeable paving provide sufficient treatment.

Table 3 – Soakaway Treatment Levels

SuDS Group	Technique	Water quality treatment potential					Hydraulic Control			
		Total suspended solids removal	Total suspended solids removal	Nutrient (phosphorus, nitrogen, removal)	Bacteria removal	Capacity to treat fine suspended sediments and dissolved pollutants	Runoff volume reduction	Suitability for flow rate control (probability)		
								0.5 (1/2 yr)	0.1-0.3 (10/30 yr)	0.01 (100 yr)
Infiltration	Soakaway	H	H	H	M	H	H	H	H	L

H = High; M = Medium; L = Low

Table extract taken from the CIRIA C697 publication 'The SuDS Manual' (2007) – Table 5.7

Table 4 – SuDS Mitigation Indices

Type of SuDS	Mitigation Indices		
	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Pond	0.7	0.7	0.5
Basin	0.5	0.5	0.6
Permeable Pavement	0.7	0.6	0.7

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' – Table 26.3

It can be concluded that ponds/basins, soakaways or permeable paving provide sufficient treatment. Sediment removal should be provided in the form of a silt trap / catch pit upstream of an attenuation storage feature or soakaway. Where attenuation is provided in a below ground attenuation tank, treatment will need to be provided by a suitably sized separator.

Maintenance

Maintenance of communal drainage features such as soakaways, ponds, basins, permeable paving or an attenuation tank will be the responsibility of the site owner. Maintenance of shared surface water drainage systems can be arranged through appointment of a site management company.

Maintenance schedules for a soakaway, pond / basin, an attenuation tank and permeable paving are included in Appendix H.

Foul Drainage

As stated in the DCWW correspondence (Appendix C), *'there are isolated incidents of flooding in the public sewerage system downstream of the site. We have considered the impact of the foul flows generated by the proposed development upon the local public sewerage system and concluded that it is unlikely that sufficient capacity exists to accommodate your development without causing detriment to the existing services we provide to our customers, or in regard to the protection of the environment. Accordingly, we are unable at this stage to provide you with a point of adequacy on the network.'*

In light of the above our recommendation is that you instruct us to undertake a Hydraulic Modelling Assessment of the local public sewerage network. This assessment will examine the existing network and consider the impact of the introduction of flows from your development upon its performance. Where required and appropriate, the assessment will then identify solutions and points of communication to ensure that your site can be accommodated within the system.'

DCWW should be instructed to undertake the hydraulic modelling in order to determine a point of connection to the public sewer system and to identify any solutions to ensure that the development can be accommodated within the public sewer system.

To achieve gravity discharge, a connection would need to be made to public combined sewer manhole SJ33552305 within Llay New Road.

An existing public foul pumping station and associated rising main are identified in the eastern extent of the site. The pumping station serves the existing Royal British Legion building. A 15m easement should be provided from habitable dwellings to the pumping station. Furthermore a 3 m easement should be provided either side of the public foul rising main.

Conclusions

The proposed development includes the retention of the Royal British Legion building and submit a full planning application for a new car park surrounding the building. Outline planning is sought to remove the existing car park and erect 51 residential properties with associated gardens, car parking, access roads, a new retail unit, a boxing club, electricity substation and the repositioning of the war memorial.

The Welsh Government Development Advice Map shows that the site is located within Flood Zone A – an area considered to be at little / no risk of fluvial and coastal flooding.

The site is shown at low risk of flooding from all sources. A potential for surface water ponding within topographical depressions is identified, however this risk will be mitigated through consideration of site levels and inclusion of a sustainable drainage system.

The proposed development will introduce impermeable drainage area in the form of dwellings, car parking and access roads. In order to ensure no increase in flood risk elsewhere, surface water runoff from the development will be restricted.

All methods of surface water discharge have been assessed. Infiltration is a suitable surface water discharge method. Where soakaways are not feasible due to design, surface water runoff will be discharged to the public surface water sewer located within Llay New Road east of the site at a rate of 5 l/s.

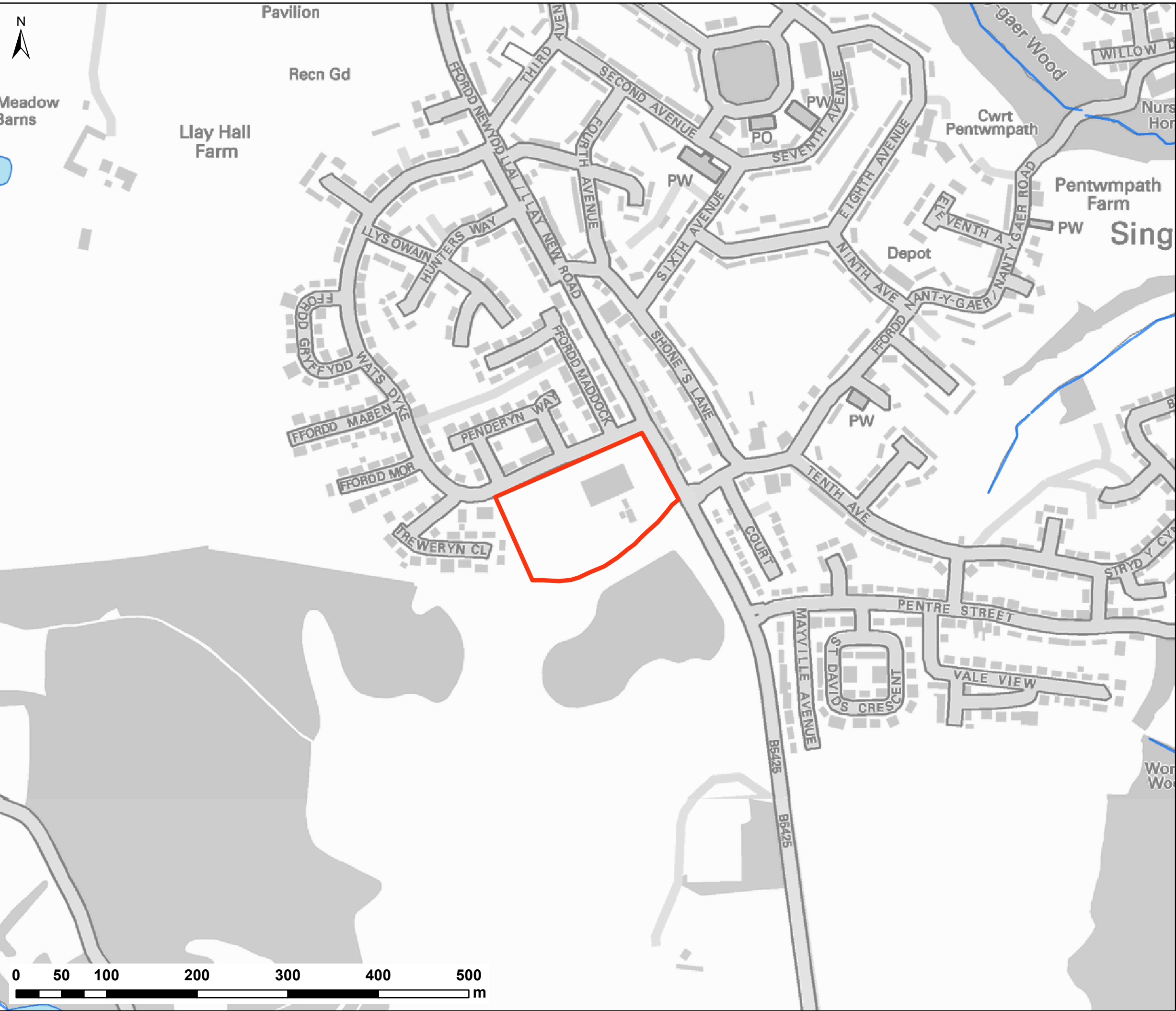
Attenuation storage will be required on site in order to restrict surface water discharge to 5 l/s. Attenuation can be provided within a pond, basin or within a below ground attenuation tank located within the area of public open space and access road / turning area in the lower eastern extent of the site.

DCWW have stated that a hydraulic modelling assessment is required to determine the impact of development foul flows on the public foul sewer system. The modelling assessment will identify any solutions required to accommodate development foul flows and will establish the point of connection.

Recommendations

1. Verify the attenuation volumes included in this report when undertaking detailed drainage design;
2. Instruct DCWW to undertake a hydraulic modelling assessment to establish the impact of the development on the public foul sewer system.

Appendix A – Location Plan and Aerial Image



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

- Site Boundary
- Watercourse

CLIENT:

THE ROYAL BRITISH
LEGION

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

**ROYAL BRITISH LEGION CLUB
LLAY, WREXHAM**

PLOT TITLE:

LOCATION PLAN

PLOT STATUS:			DATE:
FINAL			23/12/2016

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
ELO	RCL	VG	1:4,000 (UNLESS STATED OTHERWISE)

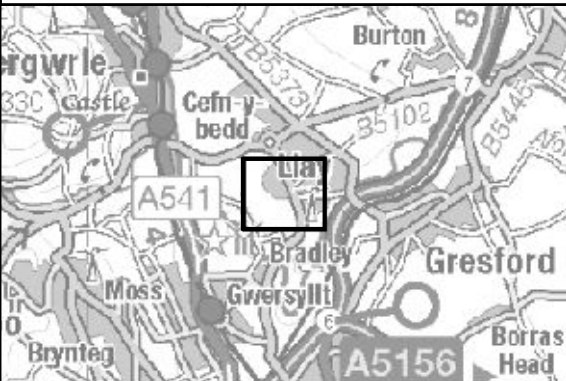
PLOT NAME:	REV:
w10229-Location_Plan	-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

— Site Boundary



CLIENT:



Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

**ROYAL BRITISH LEGION CLUB
LLAY, WREXHAM**

PLOT TITLE:

AERIAL PLAN

PLOT STATUS:

FINAL

DATE:

23/12/2016

DRAWN:

ELO

CHECKED:

RCL

APPROVED:

VG

PLOT SCALE @ A3:

1:4,000

(UNLESS STATED OTHERWISE)

PLOT NAME:

w10229-Aerial_Plan

REV:

-

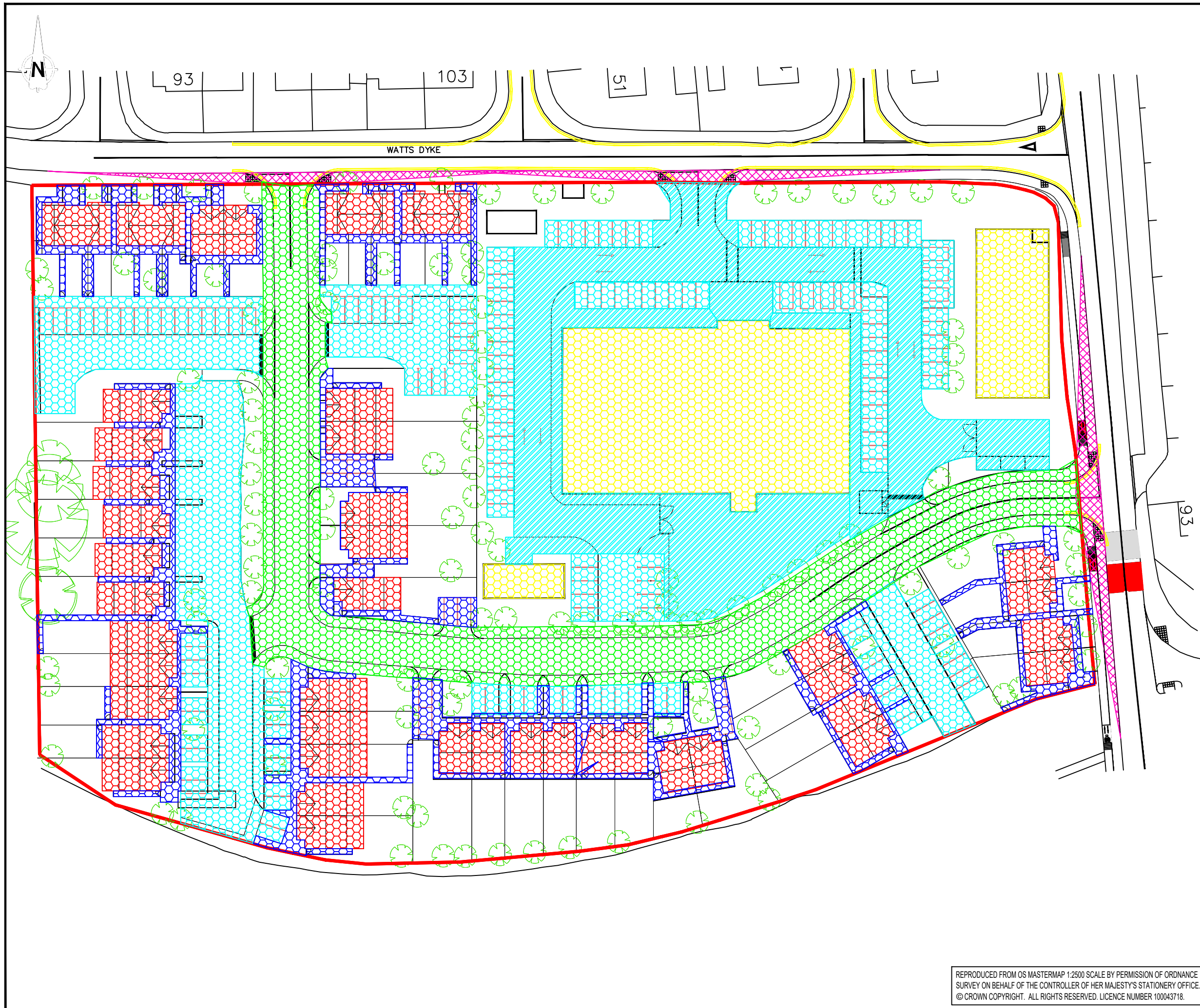
Appendix B – Development Plans and LiDAR Extract



2 Bed Townhouse (Affordable)	12
3 Bed Semi-detached	16
4 Bed Semi-detached	16
4 Bed Detached with garage	7
Total:	51

DAY Architectural Ltd

452 - 16 Wats Dyke Road, Wrexham
Proposed Indicative Plan Layout
28/03/2017



NOTES

1. ALL DIMENSIONS IN MILLIMETRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS SHOWN OTHERWISE.

KEY

HARDSTANDING AREAS

- COMMERCIAL ACCESS ROAD
- PARKING AREAS SUITABLE FOR PERMEABLE AREAS
- RESIDENTIAL PROPERTIES
- PATHS AND PAVING
- ADOPTABLE ROAD
- COMMERCIAL UNITS

X00	DD-MM-YY				
REV.	DATE	DESCRIPTION	DSGND	CHKD	APP'D

CLIENT

THE ROYAL BRITISH LEGION

PRINCIPAL DESIGNER

waterco
consultants

Waterco Ltd., Eden Court,
Lon Parcwr Business Park, Ruthin LL15 1NJ

tel (+44) 1824 702220
www.waterco.co.uk

SCHEME

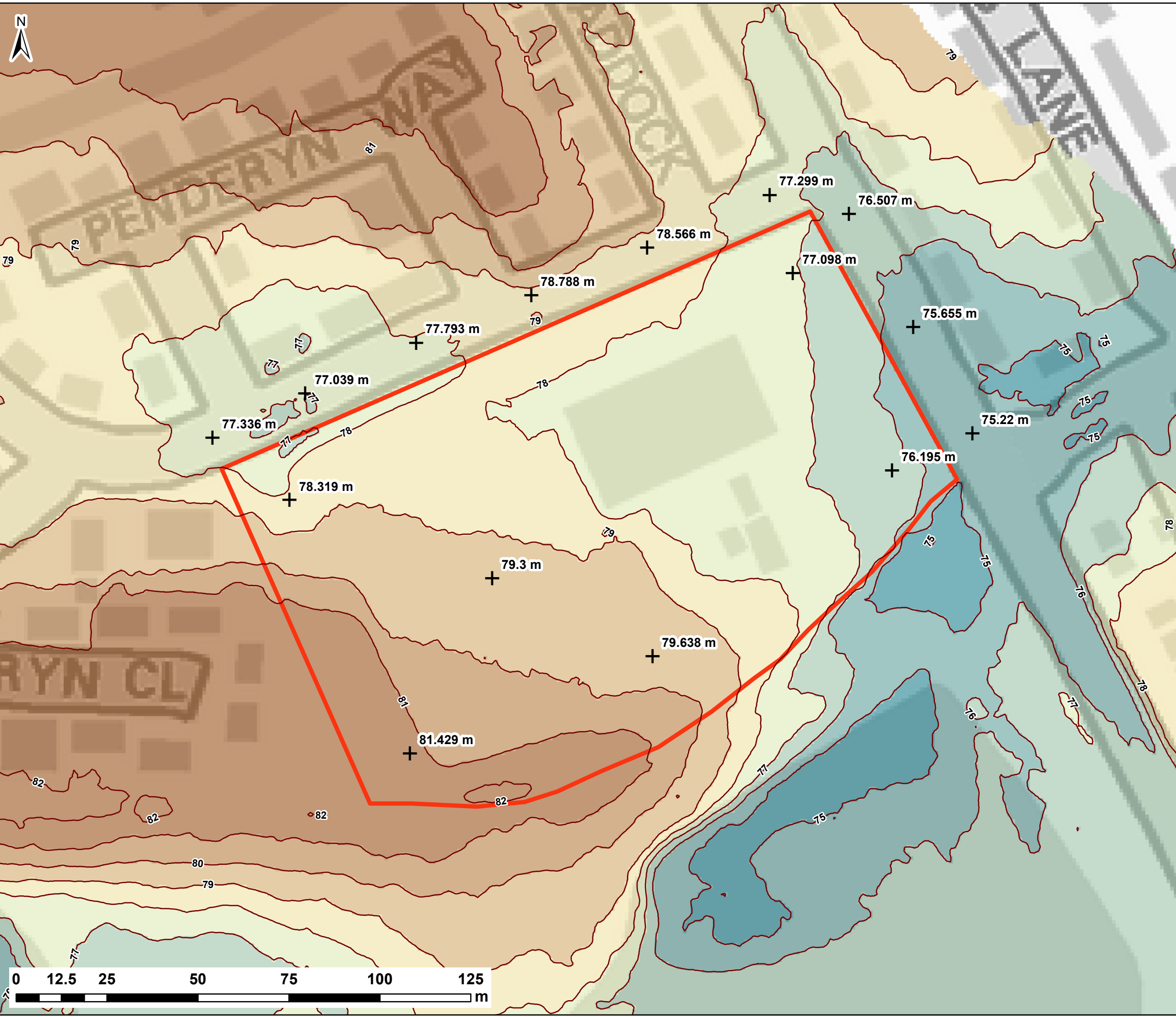
THE ROYAL BRITISH LEGION, LLAY

TITLE

HARDSTANDING AREAS

STATUS			INFORMATION		
DESIGNED JW	CHECKED JR	APPROVED VG	SCALE / SHEET SIZE NTS		
DRAWING NO. W10229			REV X00		

REPRODUCED FROM OS MASTERMAP 1:2500 SCALE BY PERMISSION OF ORDNANCE SURVEY ON BEHALF OF THE CONTROLLER OF HER MAJESTY'S STATIONERY OFFICE.
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NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

— Site Boundary

+ Spot Level

Ground Elevation (mAOD)

< 75
75 - 76
76 - 77
77 - 78
78 - 79
79 - 80
80 - 81
> 81

CLIENT:

THE ROYAL BRITISH
LEGION

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

**ROYAL BRITISH LEGION CLUB
LLAY, WREXHAM**

PLOT TITLE:

**LIDAR ELEVATIONS
(1m RESOLUTION)**

PLOT STATUS:			DATE:
FINAL			23/12/2016
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
ELO	RCL	VG	1:1,000 (UNLESS STATED OTHERWISE)
PLOT NAME:			REV:
w10229-LIDAR_Elevations			-

Appendix C – Sewer Plan and Correspondence



Dŵr Cymru
Welsh Water

Developer Services
PO Box 3146
Cardiff
CF30 0EH

Tel: +44 (0)800 917 2652
Fax: +44 (0)2920 740472
E.mail: developer.services@dwrcymru.com

Gwasanaethau Datblygu
Blwch Post 3146
Caerdydd
CF30 0EH

Ffôn: +44 (0)800 917 2652
Ffacs: +44 (0)2920 740472
E.bost: developer.services@dwrcymru.com

Miss Johanne Williams
Waterco
Waterco Ion Parcwr
Ruthin
Denbighshire
LL15 1NJ



Date: 12/12/2016
Our Ref: PPA0001776

Dear Miss Williams

Grid Ref: 333152 355354

Site Address: Royal British Legion, Watts Dyke Llay

Development: Royal British Legion, Llay

I refer to your pre-planning enquiry received relating to the above site, seeking our views on the capacity of our network of assets and infrastructure to accommodate your proposed development. Having reviewed the details submitted I can provide the following comments which should be taken into account within any future planning application for the development.

SEWERAGE

In relation to capacity to accept sewage flows from the proposed development we would confirm the following:

There are incidents of flooding in the public sewerage system downstream of this site. We have considered the impact of the foul flows generated by the proposed development upon the local public sewerage system and concluded that it is unlikely that sufficient capacity exists to accommodate your development without causing detriment to the existing services we provide to our customers, or in regard to the protection of the environment. Accordingly, we are unable at this stage to provide you with a point of adequacy on the network.

In light of the above our recommendation is that you instruct us to undertake a Hydraulic Modelling Assessment of the local public sewerage network. This Assessment will examine the existing network and consider the impact of the introduction of flows from your development upon its performance. Where required and appropriate, the Assessment will then identify solutions and points of communication to ensure that your site can be accommodated within the system.



Welsh Water is owned by Glas Cymru – a 'not-for-profit' company.
Mae Dŵr Cymru yn eiddo i Glas Cymru – cwmni 'nid-er-elw'.

We welcome correspondence in
Welsh and English

Dŵr Cymru Cyf, a limited company registered in
Wales no 2366777. Registered office: Pentwyn Road,
Nelson, Treharris, Mid Glamorgan CF46 6LY

Rydym yn croesawu gohebiaeth yn y
Gymraeg neu yn Saesneg

Dŵr Cymru Cyf, cwmni cyfyngedig wedi'i gofrestru yng
Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn
Nelson, Treharris, Morgannwg Ganol CF46 6LY.

Please note that we will seek to control the outcomes of the Hydraulic Modelling Assessment via appropriate planning conditions. However in the absence of known solutions to accommodate your site we not be able to support your development through the planning process. We therefore recommend that the Assessment is undertaken in advance of the planning application being submitted in order to avoid any subsequent delays. Further information on Hydraulic Modelling Assessments as well as any implications on the planning process is provided in the attached Advice & Guidance note.

For the developer to obtain a quotation for the hydraulic modelling assessment, we will require a fee of £250 + VAT to engage our consultants, this fee is non-refundable. We therefore recommend that the developer engages with us as early as possible to discuss their intentions.

Alternatively, if the proposed development site is a brownfield site we are prepared to consider a foul connection into the public sewer outside the proposed development site, albeit to the historical discharge rate of the site. We would suggest investigations are undertaken by the applicant to confirm if the former development did connect into the sewer. It will also be beneficial for the applicant to explore and provide evidence (i.e. drawings indicating contributing areas, discharge rates) showing if the foul and surface water flows from the existing site discharges into the public foul sewerage system. Upon receiving this information we may be able to reconsider our consultation response for this development.

In relation to the surface water flows from the proposed development, these will have to be disposed of separately by other means, such as using soakaways or discharging directly to a watercourse in liaison with the Land Drainage Authority and / or Natural Resources Wales

Please note that no highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

The Welsh Government have introduced new legislation that will make it mandatory for all developers who wish to communicate with the public sewerage system to obtain an adoption agreement for their sewerage with Dwr Cymru Welsh Water (DCWW). The Welsh Ministers Standards for the construction of sewerage apparatus and an agreement under Section 104 of the Water Industry Act (WIA) 1991 will need to be completed in advance of any authorisation to communicate with the public sewerage system under Section 106 WIA 1991 being granted by DCWW.

If any onsite or offsite sewers are to be offered for adoption they must be constructed to conform with the publication "Sewers for Adoption"- 7th Edition.

If a connection is required to the public sewerage system, the developer is advised to contact us on Tel: 0800 917 2652.

Some public sewers and lateral drains may not be recorded on our maps of public sewers because they were originally privately owned and were transferred into public ownership by nature of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011.



The presence of such assets may affect your proposal. In order to assist us in dealing with the proposal we request that you contact our Operations Contact Centre on 0800 085 3968 to establish the location and status of the sewer. Under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

SEWAGE TREATMENT

No problems are envisaged with the Water Treatment Works for the treatment of domestic discharges from this site.

I trust the above information is helpful and will assist you in forming water and drainage strategies that should accompany any future planning application. I also attach copies of our water and sewer extract plans for the area, and a copy of our Planning Guidance Note which provides further information on our approach to the planning process, making connections to our systems and ensuring any existing public assets or infrastructure located within new development sites are protected.

Please note that our response is based on the information provided in your enquiry and should the information change we reserve the right to make a new representation. Should you have any queries or wish to discuss any aspect of our response please do not hesitate to contact our dedicated team of planning officers, either on 0800 917 2652 or via email at developer.services@dwrcymru.com

Please quote our reference number in all communications and correspondence.

Yours faithfully,



Owain George
Planning Liaison Manager
Developer Services

Please Note that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter.



Dŵr Cymru
Welsh Water

PPA0001776



LEGEND(Representative of most common features)

- | | | |
|--|---|------------------------|
| Waste network: | Foul chamber | Outfall |
| Surface water chamber | Combined chamber | Lamp hole |
| Combined sewer overflow | Rising main | Storm Overflow |
| Special purpose chamber | Gravity sewer | Private sewer |
| Treatment works | Private sewer subject to Sect. 104 adaptation agreement | Private Sewer Transfer |
| Pumping station | S 104 | Lateral Drain |
| NB: Sewer symbol colour indicates type | | |
| RED | GREEN | PURPLE |
| Dashed line | Solid line | Dotted line |
| Combined Sewer | Surface Water | Foul Sewer |
| Former S21 sewers (for indicative purposes only) | Inspection Chamber | |

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of Dŵr Cymru assets there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation.

Dŵr Cymru Cymru gives this information as to the position of its underground apparatus by way of general guidance only on the basis of the best information available and no warranty as to its correctness is made in the event of excavations or other works made in the vicinity of the Company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. It must be understood that the furnishing of the information is entirely without prejudice to the provisions of the New Roads and Streetworks Act 1991 and of the Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

**EXACT LOCATIONS OF ALL APPARATUS
TO BE DETERMINED ON SITE.**

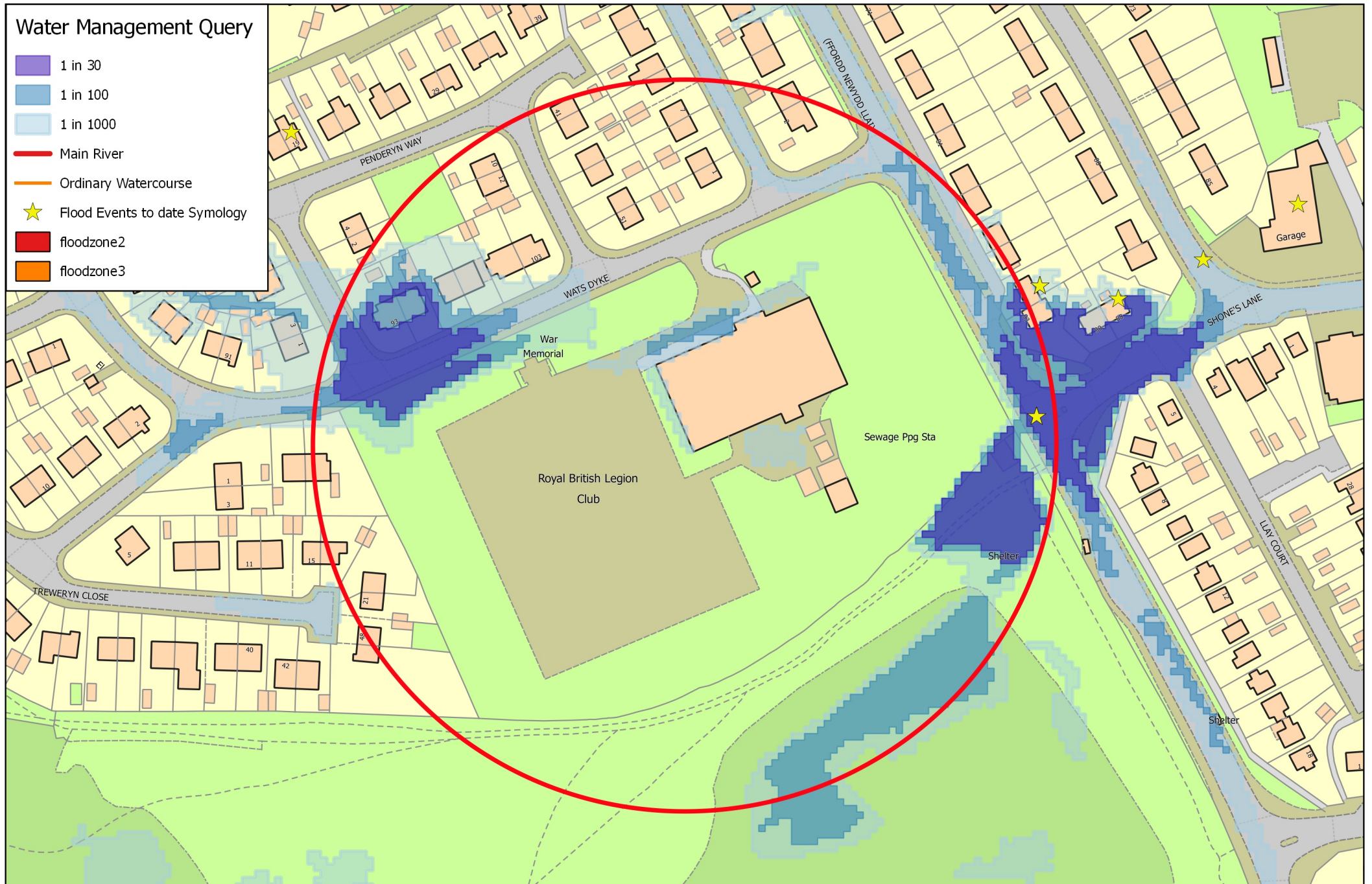
Reproduced by permission of Ordnance Survey on behalf of
HMCO. © Crown copyright and database right 2008.
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Ordnance Survey License number 100019534.

Map Ref: 333152 355354
Map scale: 1:1,000
Printed by:
Printed on:



Water Management Query

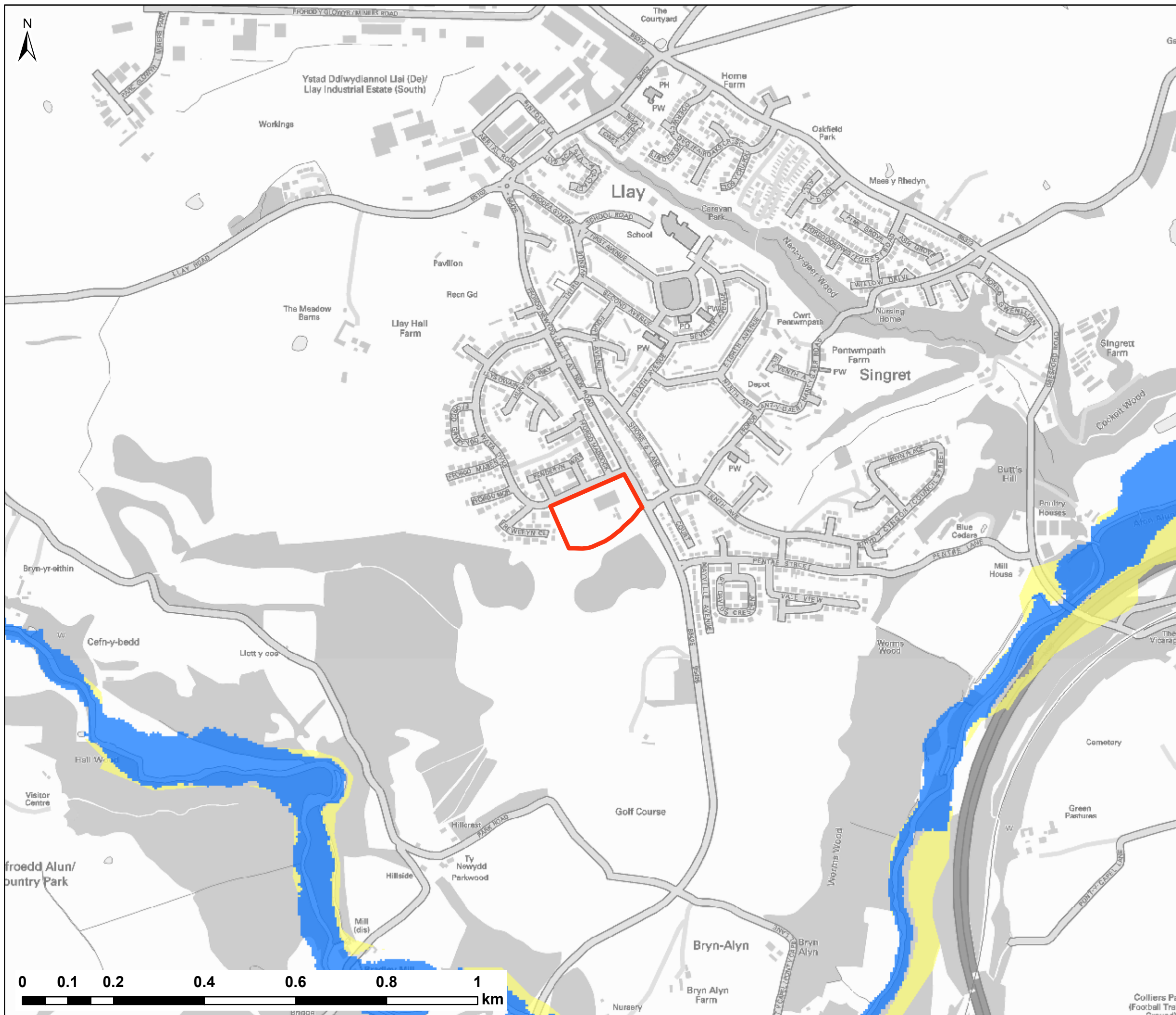
- 1 in 30
- 1 in 100
- 1 in 1000
- Main River
- Ordinary Watercourse
- Flood Events to date Symology
- floodzone2
- floodzone3



Llay British Legion

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Appendix D – Flood Maps



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

- Site Boundary
- Zone B
- Zone C1
- Zone C2

CLIENT:

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

**ROYAL BRITISH LEGION CLUB
LLAY, WREXHAM**

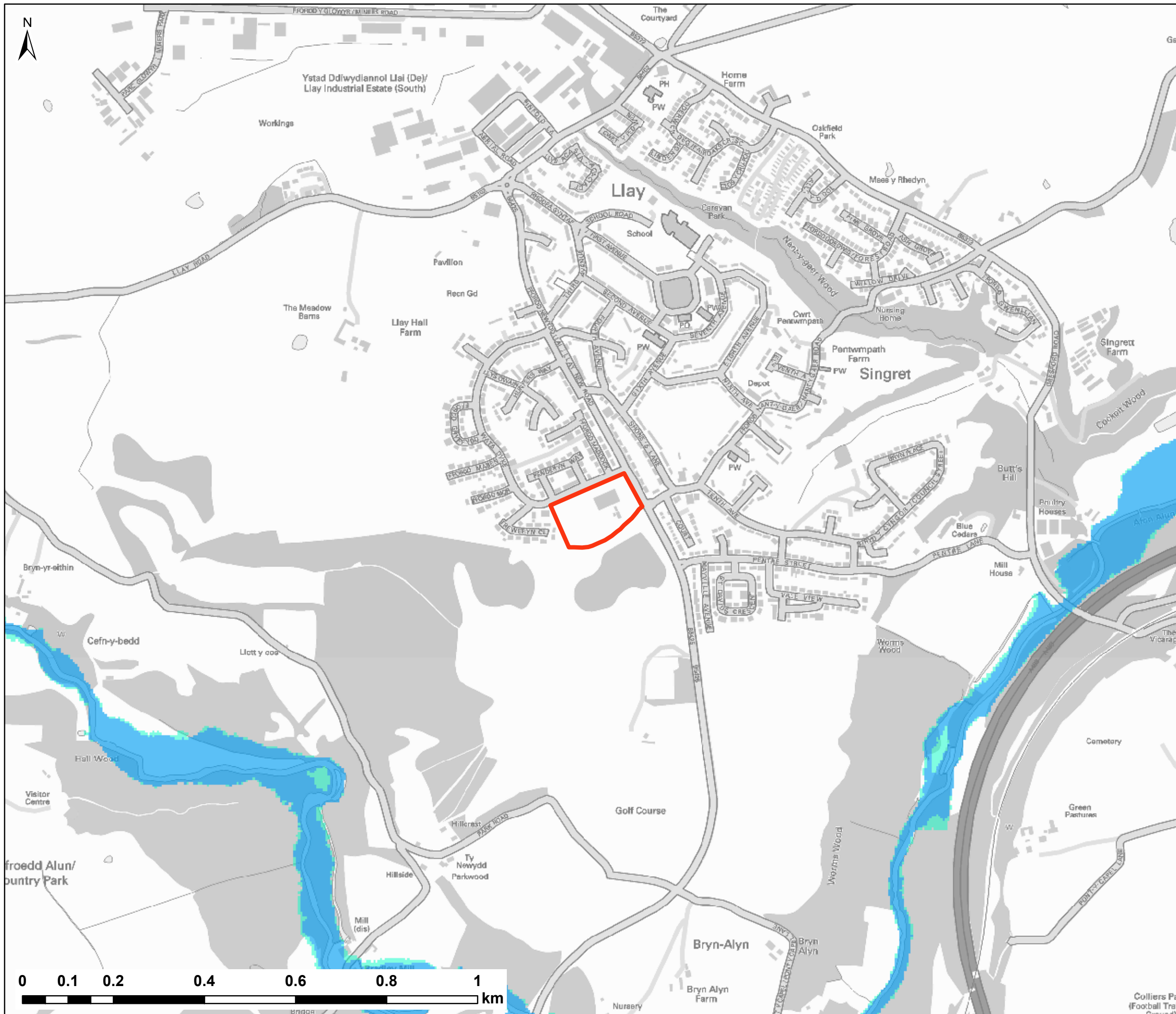
PLOT TITLE:

**WELSH GOVERNMENT
DEVELOPMENT ADVICE MAP
(DECEMBER 2016)**

PLOT STATUS:			DATE:
FINAL			23/12/2016

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
ELO	RCL	VG	1:8,000
			(UNLESS STATED OTHERWISE)

PLOT NAME:	REV:
w10229-TAN15_Maps	-



NOTES:
1) ALL DIMENSIONS ARE IN METRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE

LEGEND

- Site Boundary
- NRW Flood Zone 2
- NRW Flood Zone 3

CLIENT:

THE ROYAL BRITISH
LEGION

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

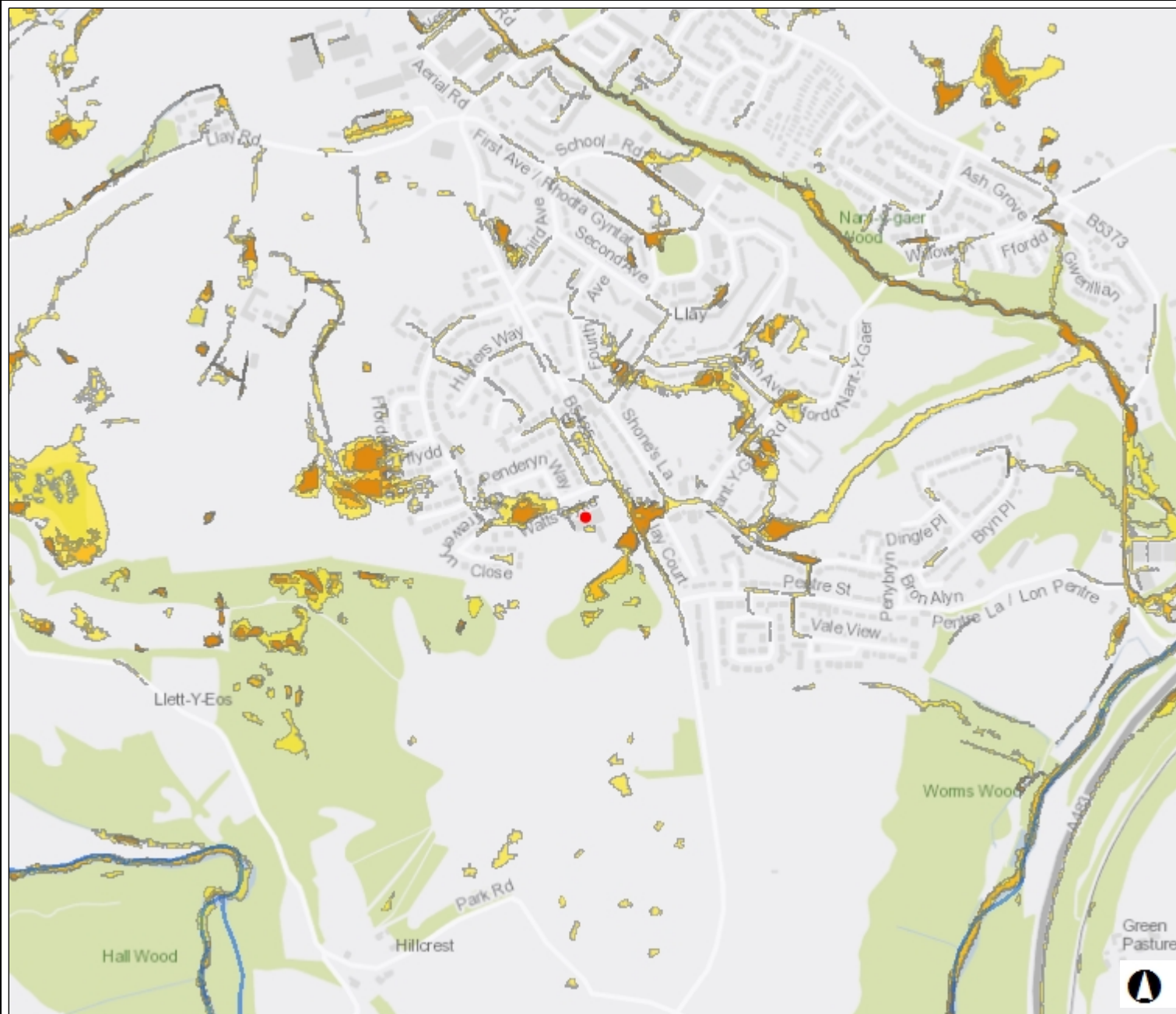
SCHEME:

**ROYAL BRITISH LEGION CLUB
LLAY, WREXHAM**

PLOT TITLE:

**NRW FLOOD MAP FOR PLANNING
DECEMBER 2016**

PLOT STATUS:			DATE:
FINAL			23/12/2016
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
ELO	RCL	VG	1:8,000 (UNLESS STATED OTHERWISE)
PLOT NAME:			REV:
w10229-NRW_FloodMaps			-



Cyfoeth Naturiol Cymru
Natural Resources Wales

Map Title

Map Perygl Llifogydd / Flood Risk Map

Allwedd / Legend

- Main rivers
- Risk of flooding from surface water - High
- Risk of flooding from surface water - Medium
- Risk of flooding from surface water - Low

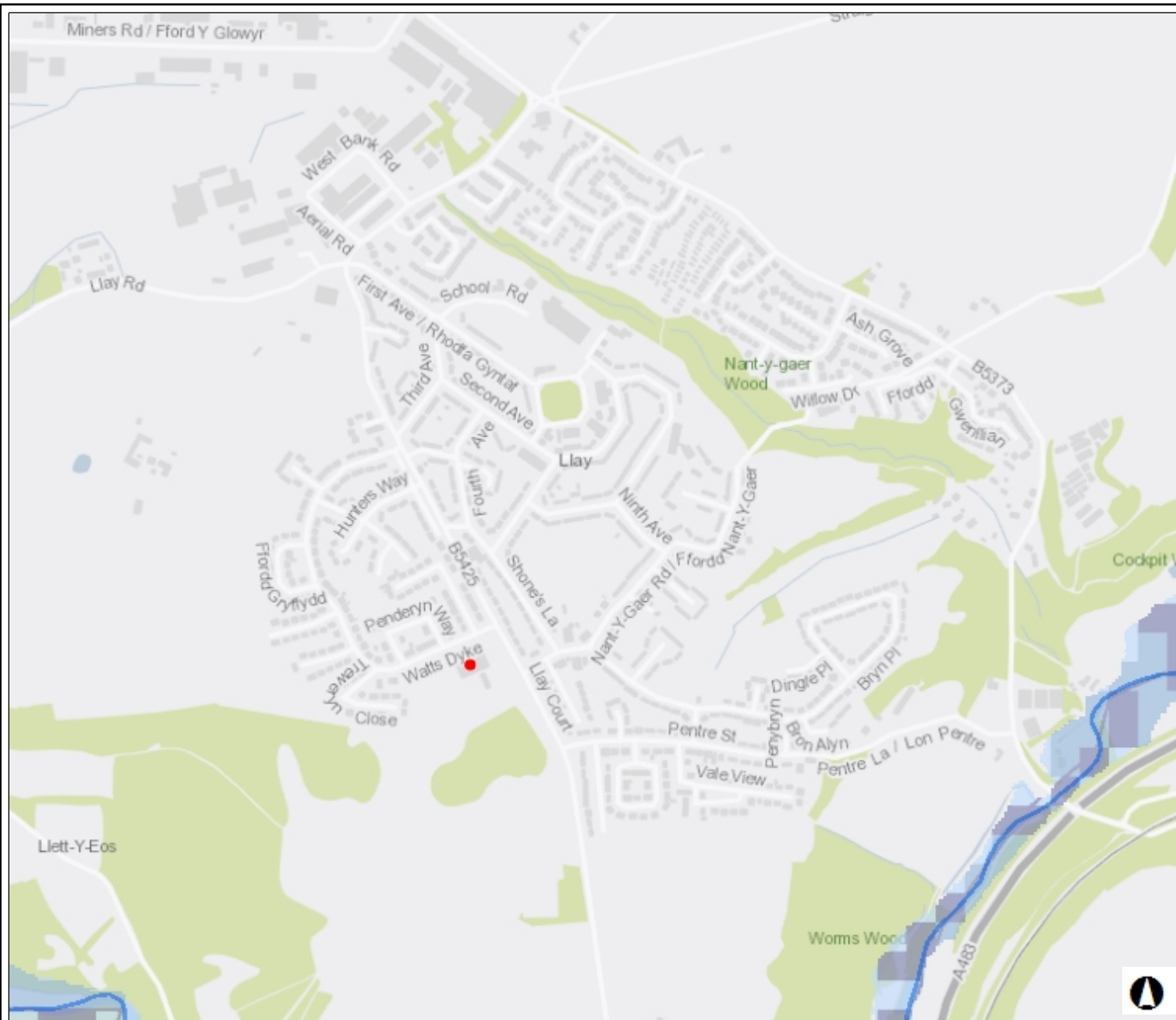
Graddfa / Scale 1: 10,185

Dyddiad / Date
03/01/2017

0.3 0 0.16 0.3 Miles

British_National_Grid

Ceir rhestr lawn o delerau ac amondau yn <https://naturalresources.wales/rhybuddsafonol> neu drwy gysylltu ag ymholiada@cymru.gov.uk.. © Hawlfraint y
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Cyfoeth Naturiol Cymru
Natural Resources Wales

Map Title

Map Perygl Llifogydd / Flood Risk Map

Allwedd / Legend

— Main rivers

Risk of Flooding from Rivers and the Sea

High

Medium

Low

Very Low

Graddfa / Scale 1: 10,185

Dyddiad / Date
03/01/2017

0.3 0 0.16 0.3 Miles

British_National_Grid

Ceir rhestr lawn o delerau ac amondau yn <https://naturalresources.wales/rhybuddsafonol> neu drwy gysylltu ag ymholiadau@cyfoethnaturiolcymru.gov.uk.. © Hawlfraint y
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Appendix E – Council Correspondence

Clare Whiting

From: Philip Forster
Sent: 03 May 2017 11:14
To: planning_admin
Subject: FW: P/2017/0314

Flood response

From: Neil Taunt
Sent: 03 May 2017 10:55
To: Philip Forster
Subject: P/2017/0314

Hi Phil.

Thank you for the recent consultation on the above outline application.

The application is supported by an FCA and Drainage Strategy that does indicate the feasibility of a sustainable surface water management strategy for the proposed development. This report details that site ground conditions are likely to be suitable for the use of soakaway for the management of surface waters generated by the development although no infiltration testing has been undertaken or submitted. The report also details, if soakaway were not shown to be feasible, with no suitable watercourse to consider a direct discharge, there is the option to discharge at an attenuated rate into public surface water sewer at an attenuated rate.

In the absence of any infiltration data the report does indicate significant surface water attenuation will be required on site (initial estimates of 474m³). This would be provided in an area of shared open space in the lower eastern extent of the site (as detailed within Appendix B of the FCA & Drainage Strategy). This approach does not appear to have been incorporated into subsequent proposed site layouts included within the application. The submitted Design and Access statement (April 2017) clearly omits any inclusion of open space or attenuation provision. Clarification is required on how surface water will be managed from the site in a sustainable manner and the recommendations of the FCA and Drainage strategy will be incorporated.

In addition, there is significant potential for the inclusion of infiltration techniques and Sustainable Drainage techniques to manage surface water on this site. It would appear from the pre application consultation document that Welsh Water will only consider discharge to the public sewer if infiltration or direct discharge to watercourse is not feasible. It should also be demonstrated prior to determination that if soakaway is proven to be appropriate for the site (as ground investigation report suggests) then sufficient provision can be made within the design to cater for the required attenuation volumes.

I would request this information is submitted and agreed prior to determination as it may have an impact on proposed site layout and scale of development. In the absence of any additional information being forthcoming I would recommend the application be refused.

If you have any questions on the above please let me know.

Many thanks

Neil

Neil Taunt MCIWEM C.WEM CEnv CSci
Uwch Swyddog Rheoli Llifogydd / Senior Flood Management Officer



☎ 01978 729734 / 07808 787632

✉ Amgylchedd a Chynllunio, Cyngor Bwrdeistref Sirol Wreccsam, De Ffordd yr Abaty, Ystad Ddiwydiannol Wreccsam, Wreccsam LL13 9PW

📄 Environment & Planning, Wrexham County Borough Council, Abbey Road South, Wrexham Industrial Estate, Wrexham LL13 9PW

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🐦 twitter.com/cbswreccsam | twitter.com/wrexhamcbc

📘 facebook.com/cyngorwreccsam | facebook.com/wrexhamcouncil

Ifan Jones

From: Carole Wright <Carole.Wright@wrexham.gov.uk>
Sent: 11 November 2016 10:32
To: Johanne Williams; planning
Cc: Neil Taunt
Subject: FW: w10229-Royal British Legion, Llay
Attachments: Llay British Legion.pdf; Management of Surface Water Generated from New Dev_E.pdf

Categories: Information received

Dear Johanne

Please find attached a map of the site indicating the areas affected by water issues. The boundary of the site to the North West and South East corners are affected by 1in30, 1in100 and 1in1000 year event surface water flooding and the area to the front of the legion building is affected by 1in100 and 1in1000 year event surface water flooding. There are a few incidents of historic flooding adjacent to the site to the East which involved surface water flooding and sandbag requests in 2012. The most recent incident of flooding is towards the garage to the edge of the attached map and was for gulley maintenance issues leading to surface water flooding in 2016.

For your information I have also attached our Management of Surface Water in New Development Guidance Note, which will explain what our requirements are in order to aid a timely decision on any proposed development.

If you require any further information please do not hesitate to contact me.

Kind regards

Carole Wright

Carole Wright - BA MBCS

Technical Flood Support Officer - Swyddog Technegol Cefnogi Llifogydd



☎ 01978 729735

✉ Wrexham County Borough Council, Environment and Planning Department Abbey Road South Wrexham Industrial Estate Wrexham LL13 9PW

✉ Cyngor Bwrdeistref Sirol Wrecsam, Amgylchedd a Chynllunio De Ffordd yr Abaty Ystâd Ddiwydiannol Wrecsam Wrecsam LL13 9PW

🌐 wrexham.gov.uk | wrecsam.gov.uk

🐦 twitter.com/wrexhamcbc | twitter.com/cbswrecsam

📘 facebook.com/wrexhamcouncil | facebook.com/cyngorwrecsam

Dear Sir / Madam,

We have been instructed to complete a Flood Consequences Assessment and Drainage Strategy for the above development. A development plan is attached for reference.

The proposed development is for 38 dwellings and for the re-location of a car park to support the existing Royal British Legion Club.

Please could you advise if you have any records of flooding affecting this site. Also, please could you advise if you have any specific requirements regarding surface water drainage for this development.

If you have any questions or require any further information, please do not hesitate to contact me.

Kind Regards,

Johanne Williams

T: 01824 702220 | **E:** Johanne.Williams@waterco.co.uk | **W:** www.waterco.co.uk



Specialists of choice for water, drainage and flood risk

Head Office	Regional	International
Ruthin, Denbighshire (+44) 1824 702220	Hanover St, Manchester (+44) 161 214 0850	Hyderabad, India (+91) 406536060

For email confidentiality, limitations and company details please see our [disclaimer webpage](#).

Registered office address: Waterco Ltd, Eden Court, Lon Parcwr Business Park, Ruthin, Denbighshire LL15 1NJ.

Registered in Wales under company no. 3577754.

Rydym yn croesawu gohebiaeth yn Gymraeg. Byddwn yn ymateb i unrhyw ohebiaeth yn Gymraeg ac ni fydd hyn yn arwain at unrhyw oedi.

Ewch i weld - mi fedrwch chi dalu, rhoi gwybod, gwneud cais, dweud eich dweud, a dod o hyd i wybodaeth ar-lein yn www.wreccsam.gov.uk. Arbedwch bapur - meddyliwch cyn argraffu!

Mae'r neges e-bost hon ac unrhyw atodiadau wedi eu bwriadu ar gyfer yr unigolyn neu'r sefydliad y'i cyfeirir atynt yn unig. Am yr amodau llawn ynglŷn â chynnwys a defnyddio'r neges e-bost hon, ac unrhyw atodiadau, cyfeiriwch at www.wreccsam.gov.uk/top_navigation/disclaimersw.htm

We welcome correspondence in Welsh. We will respond to any correspondence in Welsh and this will not lead to any delay.

Take a look - you can pay, report, request, have your say and find information online at www.wrexham.gov.uk. Save paper - think before you print!

This e-mail message and any attachments are intended solely for the individual or organisation to whom it is addressed. For full conditions in relation to content and use of this e-mail message and any attachments, please refer to www.wrexham.gov.uk/top_navigation/disclaimers.htm

Appendix F – PFRA Map

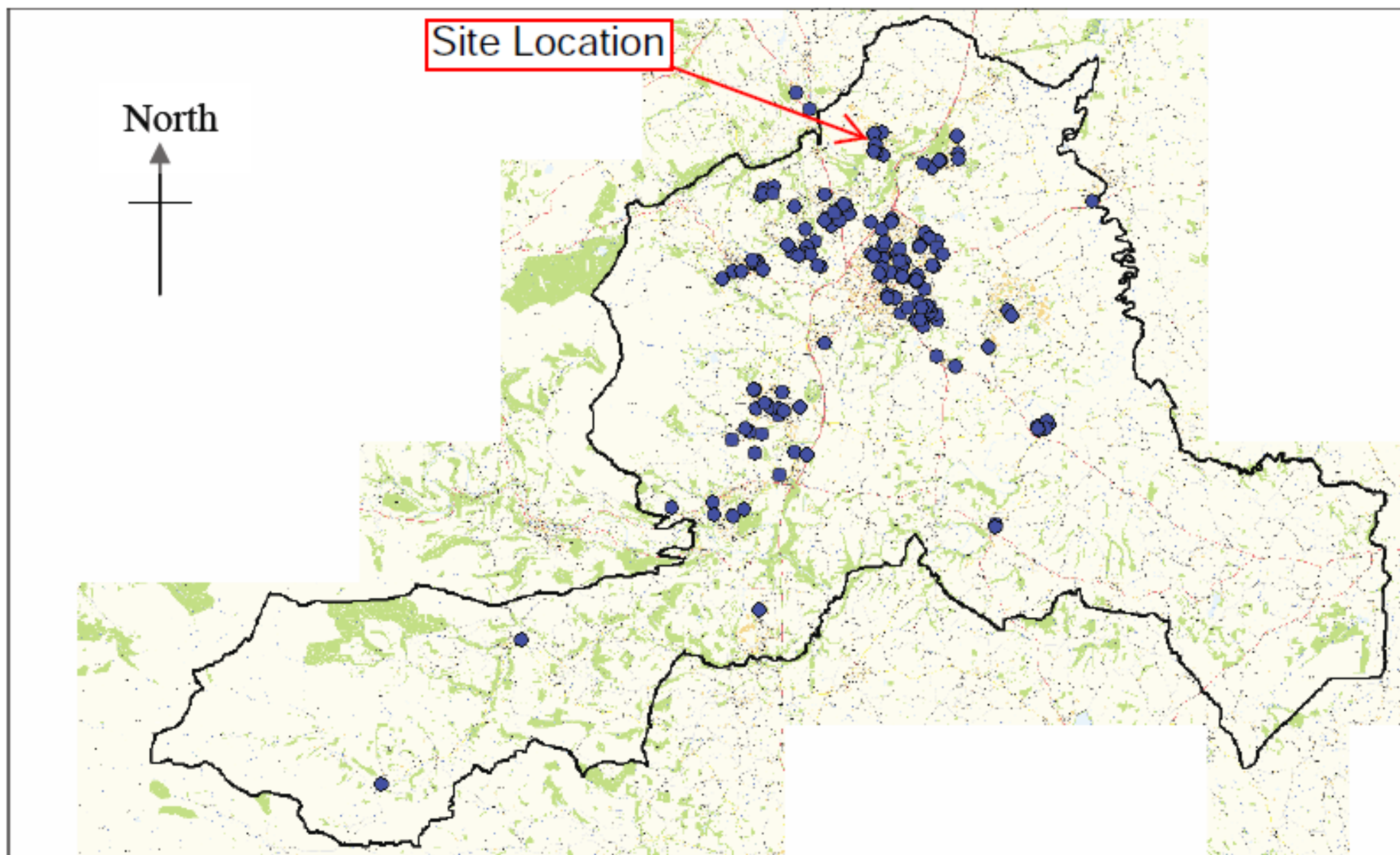


Figure 4 - Sewer Flooding Incident

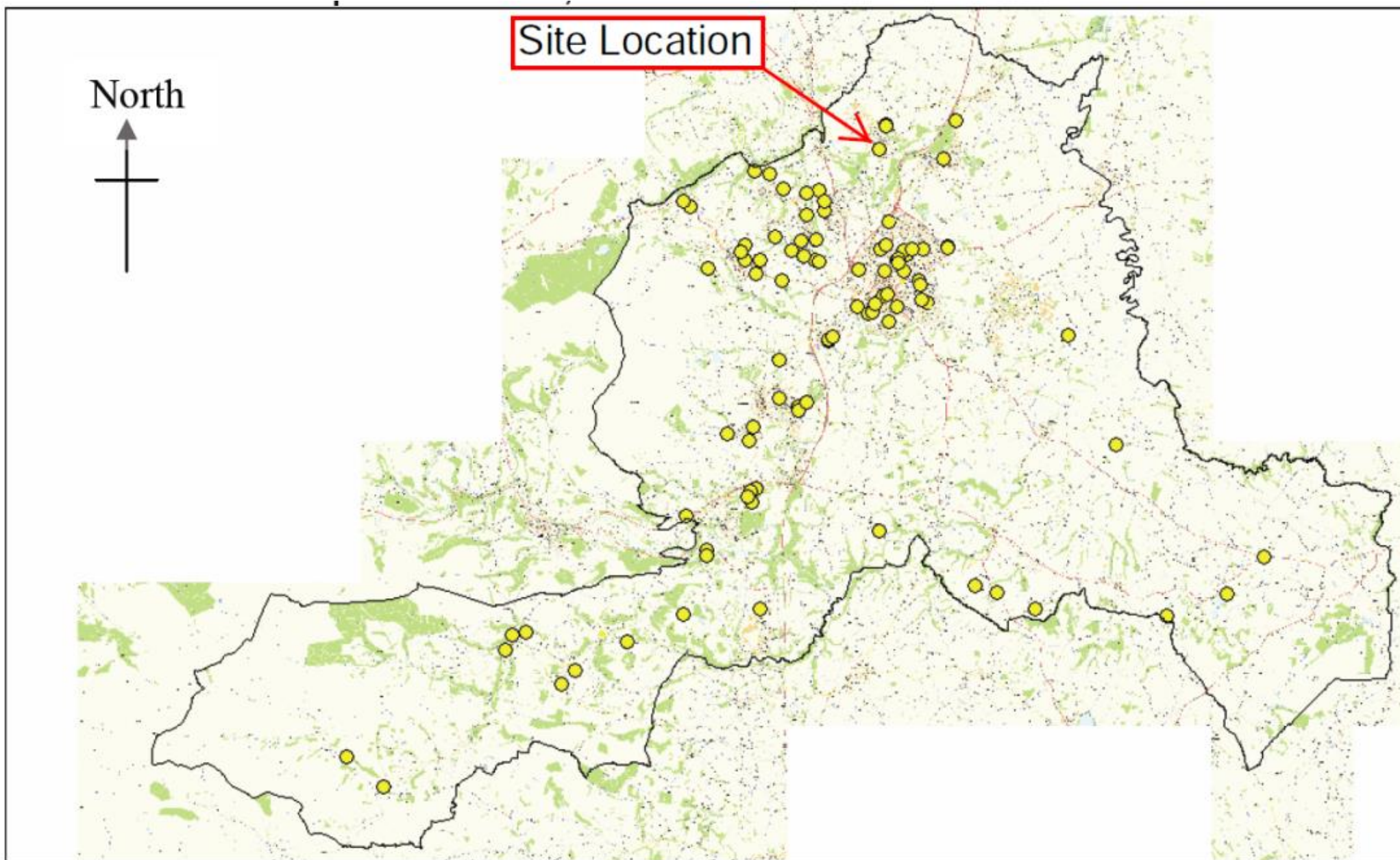


Figure 3 - Flooding Incidents within WCBC

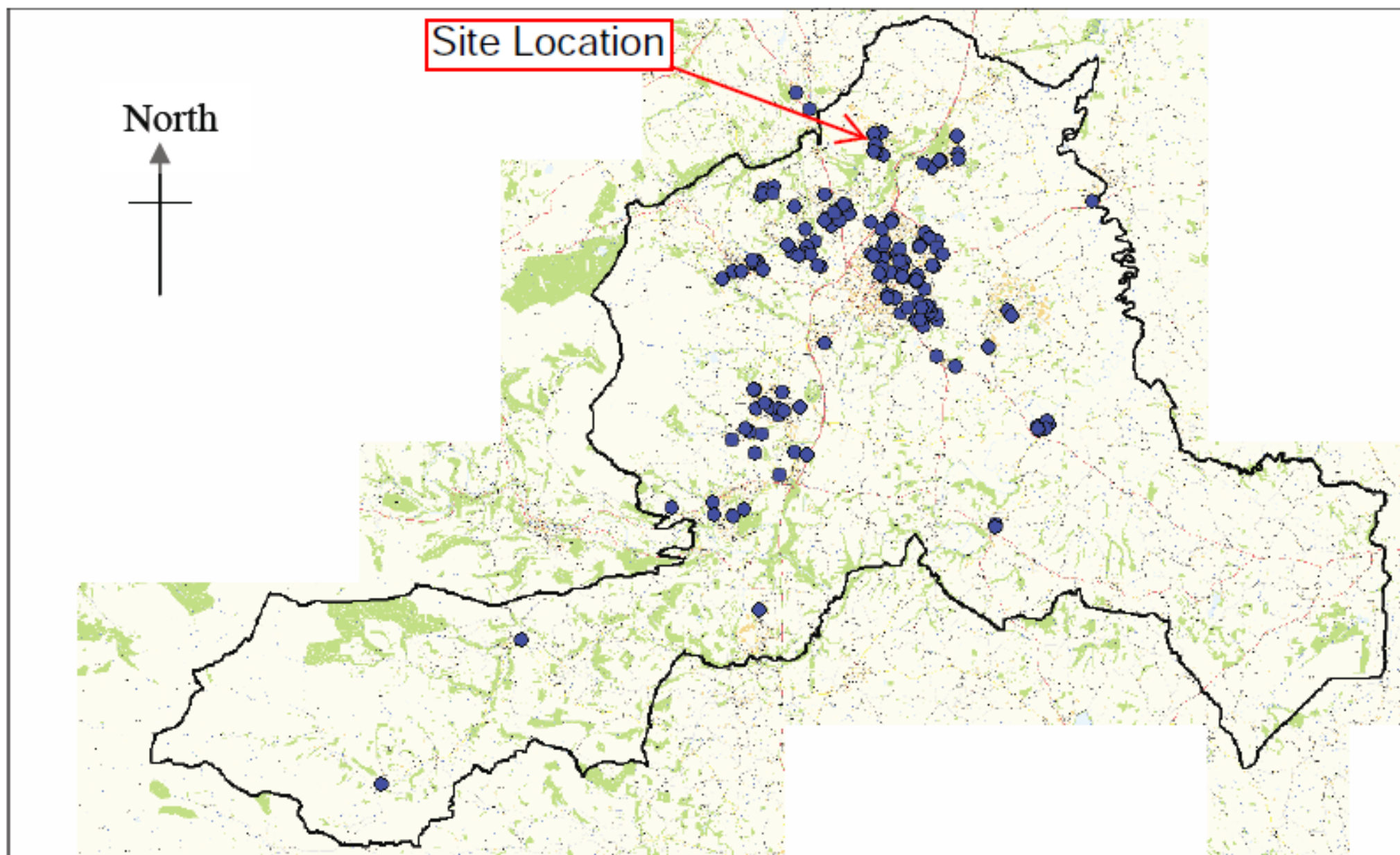


Figure 4 - Sewer Flooding Incident

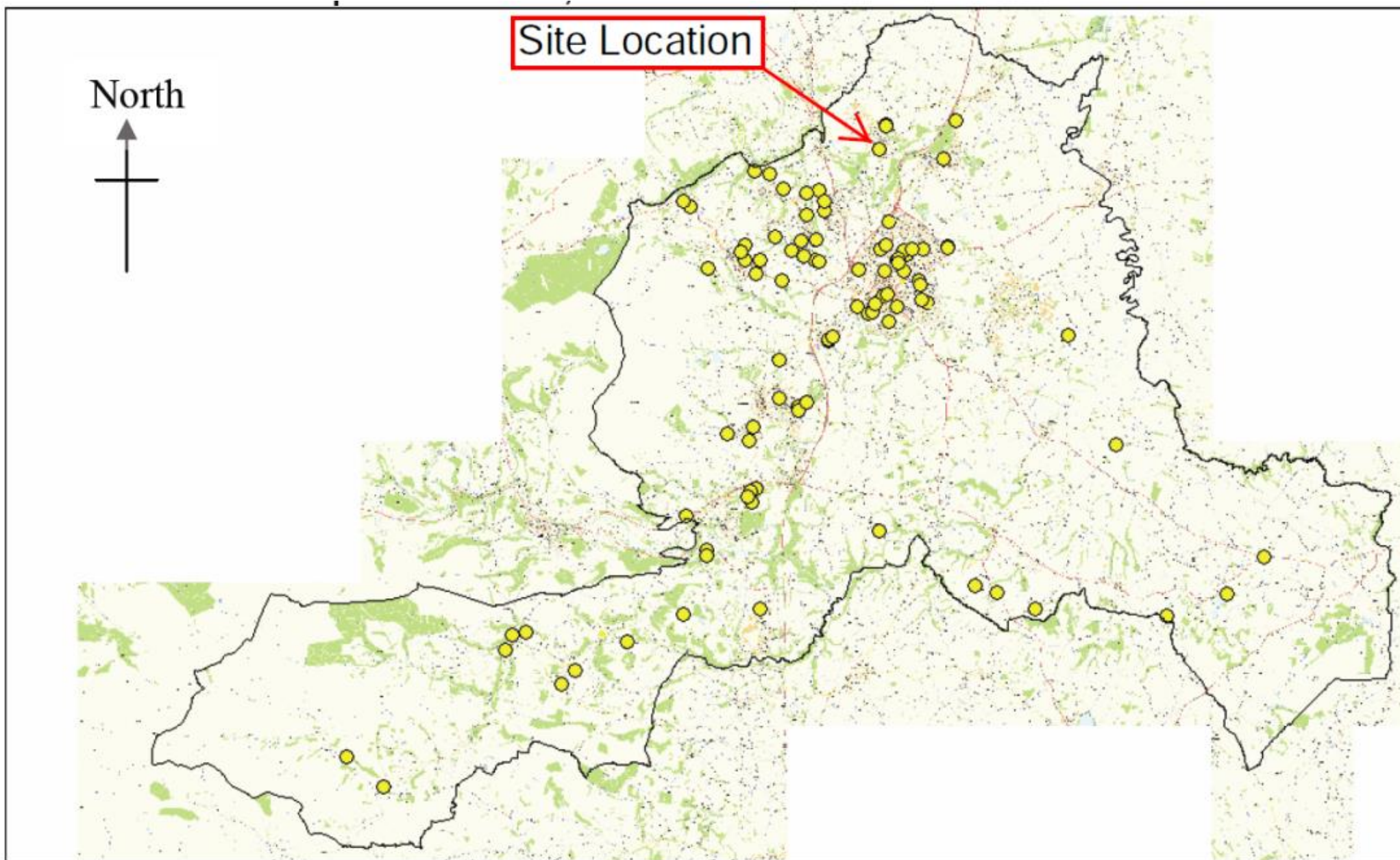


Figure 3 - Flooding Incidents within WCBC

Appendix G – MicroDrainage Runoff and Storage Calculations

Waterco Ltd		Page 1
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	The Royal British Legion Llay Greenfield Runoff	
Date 05/01/2017 File	Designed by IJ Checked by AW	
XP Solutions Source Control 2016.1		
<u>FEH Mean Annual Flood</u> Input Site Location SAAR (mm) 767 SPRHOST 32.500 FARL 1.000 Area (ha) 2.000 URBEXT (1990) 0.2417 BFIHOST 0.587 Results QMED Rural (l/s) 3.0 QMED Urban (l/s) 4.2		
©1982-2016 XP Solutions		

Waterco Ltd		Page 1
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Adoptable Road	
Date 20-Apr-18 2:17 PM File W10229-180419-ADOPTABLE...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 196 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	9.305	1.305	4.4	75.2	0 K
30 min Summer	9.442	1.442	4.9	84.9	0 K
60 min Summer	9.560	1.560	5.4	93.4	0 K
120 min Summer	9.626	1.626	5.7	98.0	0 K
180 min Summer	9.640	1.640	5.7	99.0	0 K
240 min Summer	9.645	1.645	5.8	99.4	0 K
360 min Summer	9.637	1.637	5.7	98.8	0 K
480 min Summer	9.613	1.613	5.6	97.1	0 K
600 min Summer	9.583	1.583	5.5	95.0	0 K
720 min Summer	9.549	1.549	5.4	92.6	0 K
960 min Summer	9.510	1.510	5.2	89.8	0 K
1440 min Summer	9.421	1.421	4.8	83.4	0 K
2160 min Summer	9.301	1.301	4.3	74.9	0 K
2880 min Summer	9.205	1.205	3.9	68.0	0 K
4320 min Summer	9.025	1.025	3.2	55.2	0 K
5760 min Summer	8.906	0.906	2.7	46.8	0 K
7200 min Summer	8.821	0.821	2.4	40.7	0 K
8640 min Summer	8.759	0.759	2.1	36.2	0 K
10080 min Summer	8.709	0.709	1.9	32.7	0 K
15 min Winter	9.432	1.432	4.9	84.2	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	174.711	0.0	16
30 min Summer	101.253	0.0	31
60 min Summer	58.681	0.0	60
120 min Summer	34.008	0.0	116
180 min Summer	24.717	0.0	142
240 min Summer	19.709	0.0	174
360 min Summer	14.325	0.0	242
480 min Summer	11.423	0.0	310
600 min Summer	9.583	0.0	378
720 min Summer	8.302	0.0	446
960 min Summer	6.772	0.0	578
1440 min Summer	5.082	0.0	838
2160 min Summer	3.814	0.0	1216
2880 min Summer	3.111	0.0	1588
4320 min Summer	2.227	0.0	2332
5760 min Summer	1.756	0.0	3056
7200 min Summer	1.461	0.0	3752
8640 min Summer	1.257	0.0	4496
10080 min Summer	1.107	0.0	5240
15 min Winter	174.711	0.0	16

Waterco Ltd		Page 2
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Adoptable Road	
Date 20-Apr-18 2:17 PM File W10229-180419-ADOPTABLE...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	9.586	1.586	5.5	95.2	0 K
60 min Winter	9.723	1.723	6.1	105.0	Flood Risk
120 min Winter	9.804	1.804	6.4	110.7	Flood Risk
180 min Winter	9.808	1.808	6.4	111.0	Flood Risk
240 min Winter	9.808	1.808	6.4	111.0	Flood Risk
360 min Winter	9.777	1.777	6.3	108.8	Flood Risk
480 min Winter	9.729	1.729	6.1	105.4	Flood Risk
600 min Winter	9.676	1.676	5.9	101.6	0 K
720 min Winter	9.622	1.622	5.7	97.7	0 K
960 min Winter	9.549	1.549	5.4	92.6	0 K
1440 min Winter	9.411	1.411	4.8	82.7	0 K
2160 min Winter	9.246	1.246	4.1	71.0	0 K
2880 min Winter	9.123	1.123	3.6	62.2	0 K
4320 min Winter	8.923	0.923	2.8	47.9	0 K
5760 min Winter	8.800	0.800	2.3	39.2	0 K
7200 min Winter	8.717	0.717	1.9	33.3	0 K
8640 min Winter	8.657	0.657	1.7	29.0	0 K
10080 min Winter	8.611	0.611	1.5	25.7	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	101.253	0.0	30
60 min Winter	58.681	0.0	60
120 min Winter	34.008	0.0	114
180 min Winter	24.717	0.0	146
240 min Winter	19.709	0.0	182
360 min Winter	14.325	0.0	260
480 min Winter	11.423	0.0	334
600 min Winter	9.583	0.0	404
720 min Winter	8.302	0.0	476
960 min Winter	6.772	0.0	616
1440 min Winter	5.082	0.0	880
2160 min Winter	3.814	0.0	1272
2880 min Winter	3.111	0.0	1644
4320 min Winter	2.227	0.0	2380
5760 min Winter	1.756	0.0	3112
7200 min Winter	1.461	0.0	3824
8640 min Winter	1.257	0.0	4576
10080 min Winter	1.107	0.0	5256

Waterco Ltd		Page 3
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Adoptable Road	
Date 20-Apr-18 2:17 PM File W10229-180419-ADOPTABLE...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.407	Cv (Summer)	0.750
Return Period (years)	100	D3 (1km)	0.290	Cv (Winter)	0.840
FEH Rainfall Version	1999	E (1km)	0.286	Shortest Storm (mins)	15
Site Location		F (1km)	2.420	Longest Storm (mins)	10080
C (1km)	-0.025	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.328	Winter Storms	Yes		

Time Area Diagram

Total Area (ha) 0.236

Time (mins)	Area
From:	To: (ha)

0	1 0.236
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Waterco Ltd		Page 4
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Adoptable Road	
Date 20-Apr-18 2:17 PM File W10229-180419-ADOPTABLE...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Model Details

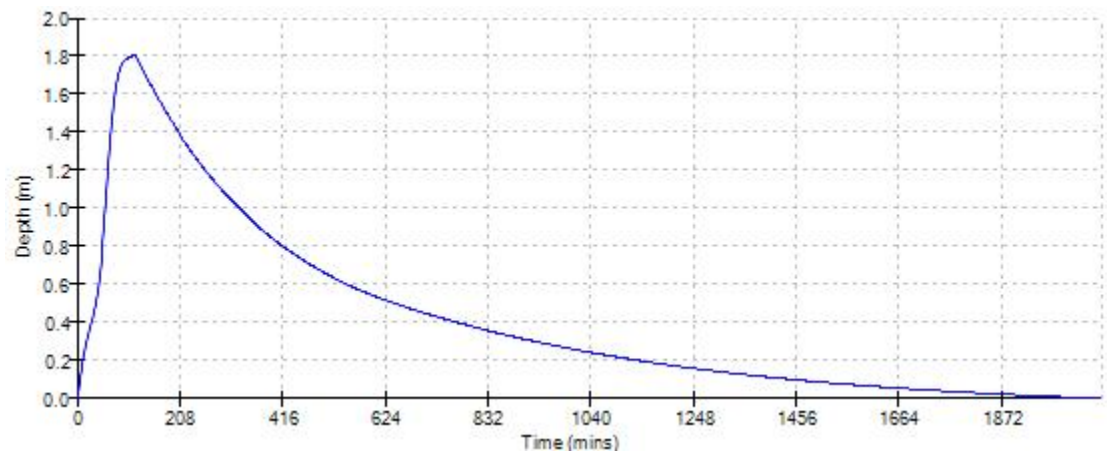
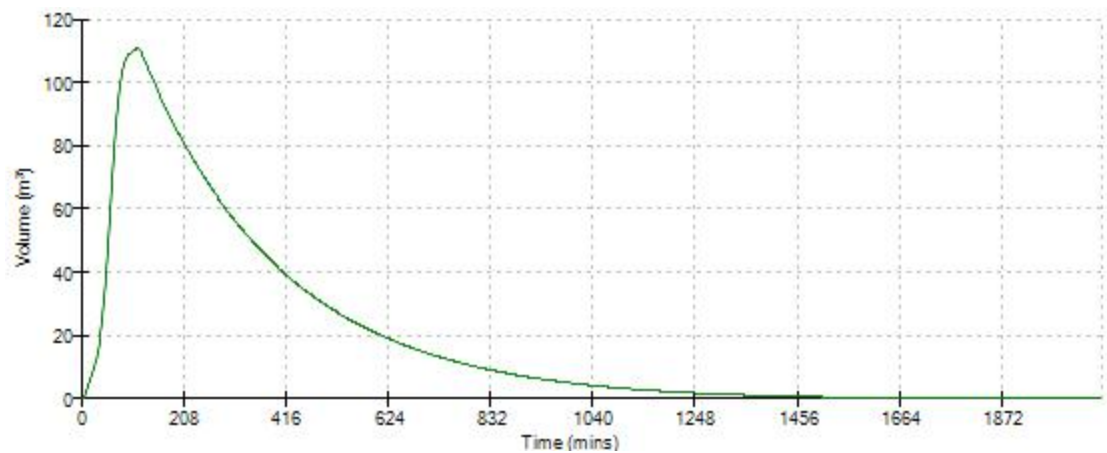
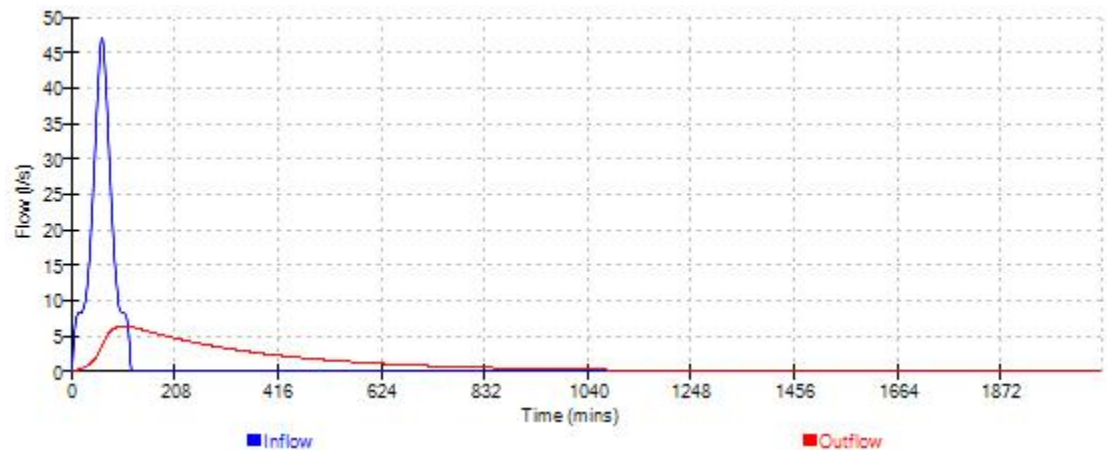
Storage is Online Cover Level (m) 10.000

Trench Soakaway Structure

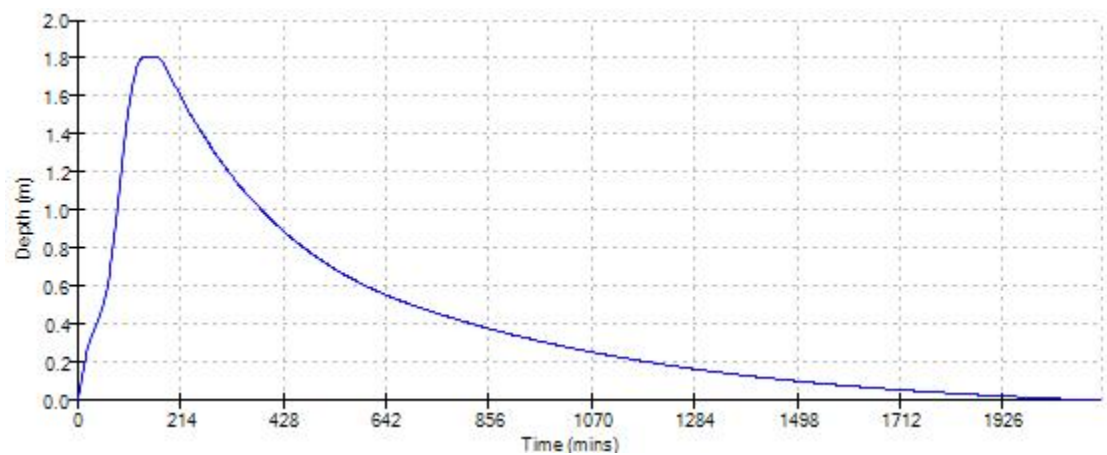
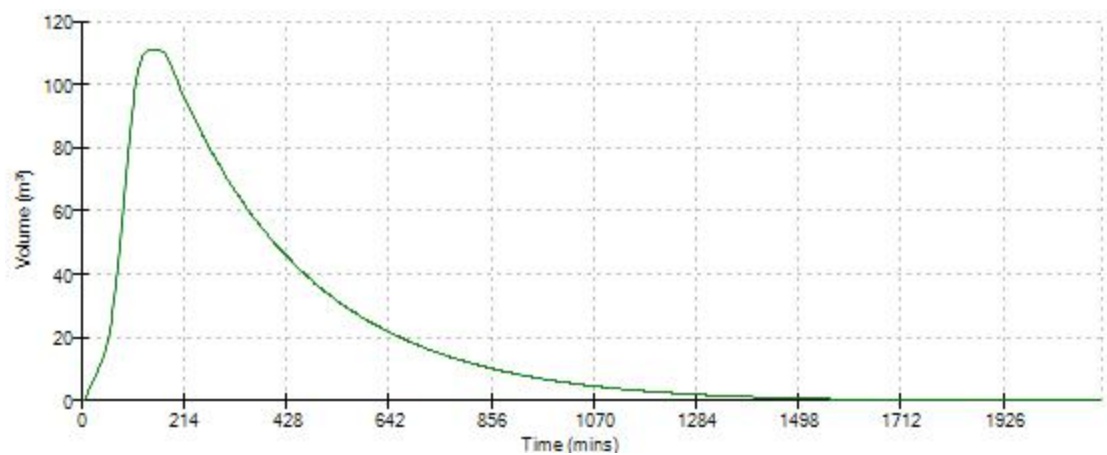
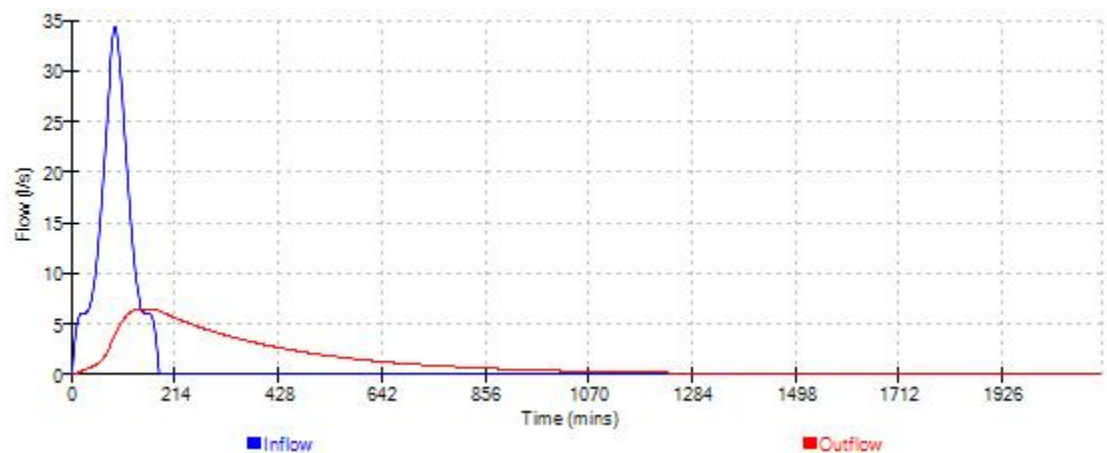
Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.31900	Trench Length (m)	25.0
Safety Factor	1.2	Slope (1:X)	50.0
Porosity	0.95	Cap Volume Depth (m)	9.000
Invert Level (m)	8.000	Cap Infiltration Depth (m)	9.000

Waterco Ltd		Page 5
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Adoptable Road	
	Date 20-Apr-18 2:17 PM File W10229-180419-ADOPTABLE... XP Solutions	
		Designed by Johanne.Williams Checked by Josh Rigby Source Control 2017.1.2

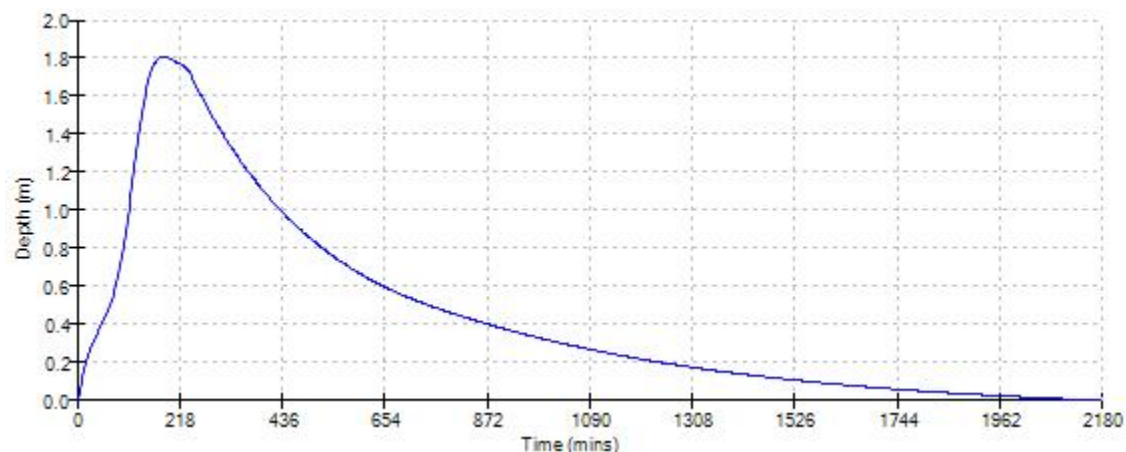
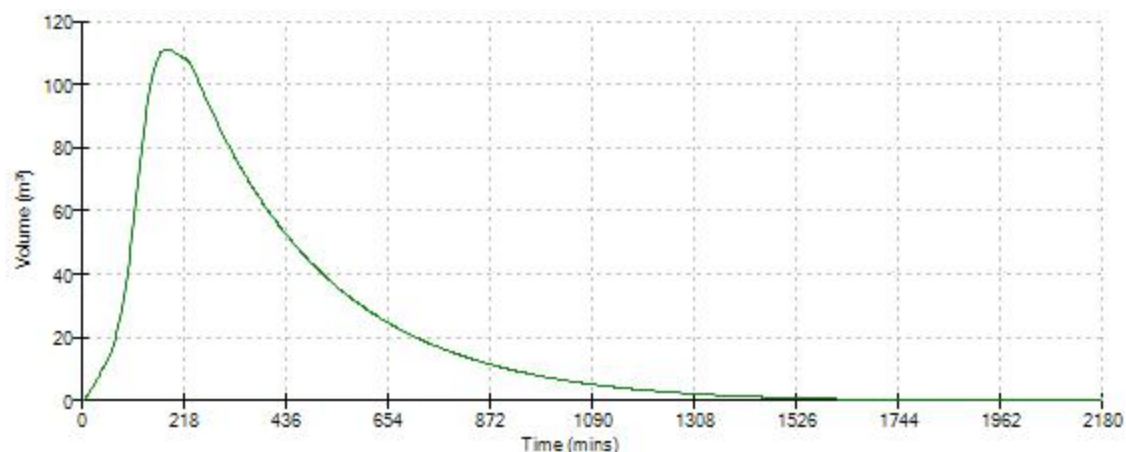
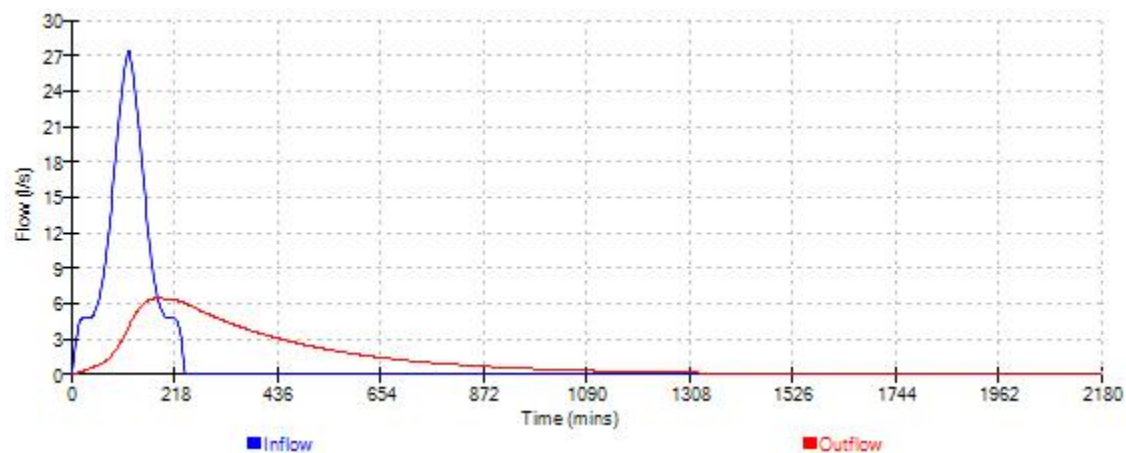
Event: 120 min Winter



Event: 180 min Winter



Event: 240 min Winter



Waterco Ltd		Page 1
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Boxing Unit	
Date 20-Apr-18 7:52 AM File w10229-180419-boxing.SRCX	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 46 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	8.661	0.661	0.7	2.5	0 K
30 min Summer	8.673	0.673	0.7	2.6	0 K
60 min Summer	8.649	0.649	0.7	2.5	0 K
120 min Summer	8.584	0.584	0.6	2.2	0 K
180 min Summer	8.523	0.523	0.6	2.0	0 K
240 min Summer	8.471	0.471	0.6	1.8	0 K
360 min Summer	8.383	0.383	0.5	1.5	0 K
480 min Summer	8.313	0.313	0.5	1.2	0 K
600 min Summer	8.256	0.256	0.4	1.0	0 K
720 min Summer	8.210	0.210	0.4	0.8	0 K
960 min Summer	8.147	0.147	0.4	0.6	0 K
1440 min Summer	8.071	0.071	0.3	0.3	0 K
2160 min Summer	8.043	0.043	0.3	0.2	0 K
2880 min Summer	8.035	0.035	0.2	0.1	0 K
4320 min Summer	8.025	0.025	0.2	0.1	0 K
5760 min Summer	8.020	0.020	0.1	0.1	0 K
7200 min Summer	8.017	0.017	0.1	0.1	0 K
8640 min Summer	8.014	0.014	0.1	0.1	0 K
10080 min Summer	8.013	0.013	0.1	0.0	0 K
15 min Winter	8.750	0.750	0.7	2.9	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	174.711	0.0	15
30 min Summer	101.253	0.0	28
60 min Summer	58.681	0.0	44
120 min Summer	34.008	0.0	78
180 min Summer	24.717	0.0	112
240 min Summer	19.709	0.0	146
360 min Summer	14.325	0.0	210
480 min Summer	11.423	0.0	274
600 min Summer	9.583	0.0	336
720 min Summer	8.302	0.0	396
960 min Summer	6.772	0.0	512
1440 min Summer	5.082	0.0	748
2160 min Summer	3.814	0.0	1096
2880 min Summer	3.111	0.0	1452
4320 min Summer	2.227	0.0	2200
5760 min Summer	1.756	0.0	2936
7200 min Summer	1.461	0.0	3592
8640 min Summer	1.257	0.0	4320
10080 min Summer	1.107	0.0	5064
15 min Winter	174.711	0.0	15

Waterco Ltd		Page 2
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Boxing Unit	
Date 20-Apr-18 7:52 AM File w10229-180419-boxing.SRCX	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	8.772	0.772	0.8	2.9	0 K
60 min Winter	8.740	0.740	0.7	2.8	0 K
120 min Winter	8.648	0.648	0.7	2.5	0 K
180 min Winter	8.560	0.560	0.6	2.1	0 K
240 min Winter	8.485	0.485	0.6	1.8	0 K
360 min Winter	8.363	0.363	0.5	1.4	0 K
480 min Winter	8.271	0.271	0.5	1.0	0 K
600 min Winter	8.199	0.199	0.4	0.8	0 K
720 min Winter	8.142	0.142	0.4	0.5	0 K
960 min Winter	8.072	0.072	0.3	0.3	0 K
1440 min Winter	8.042	0.042	0.3	0.2	0 K
2160 min Winter	8.031	0.031	0.2	0.1	0 K
2880 min Winter	8.026	0.026	0.2	0.1	0 K
4320 min Winter	8.018	0.018	0.1	0.1	0 K
5760 min Winter	8.015	0.015	0.1	0.1	0 K
7200 min Winter	8.012	0.012	0.1	0.0	0 K
8640 min Winter	8.010	0.010	0.1	0.0	0 K
10080 min Winter	8.009	0.009	0.1	0.0	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	101.253	0.0	29
60 min Winter	58.681	0.0	46
120 min Winter	34.008	0.0	84
180 min Winter	24.717	0.0	120
240 min Winter	19.709	0.0	156
360 min Winter	14.325	0.0	222
480 min Winter	11.423	0.0	286
600 min Winter	9.583	0.0	348
720 min Winter	8.302	0.0	406
960 min Winter	6.772	0.0	518
1440 min Winter	5.082	0.0	728
2160 min Winter	3.814	0.0	1088
2880 min Winter	3.111	0.0	1472
4320 min Winter	2.227	0.0	2132
5760 min Winter	1.756	0.0	2944
7200 min Winter	1.461	0.0	3728
8640 min Winter	1.257	0.0	4408
10080 min Winter	1.107	0.0	5056

Waterco Ltd		Page 3
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Boxing Unit	
Date 20-Apr-18 7:52 AM File w10229-180419-boxing.SRCX	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.407	Cv (Summer)	0.750
Return Period (years)	100	D3 (1km)	0.290	Cv (Winter)	0.840
FEH Rainfall Version	1999	E (1km)	0.286	Shortest Storm (mins)	15
Site Location		F (1km)	2.420	Longest Storm (mins)	10080
C (1km)	-0.025	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.328	Winter Storms	Yes		

Time Area Diagram

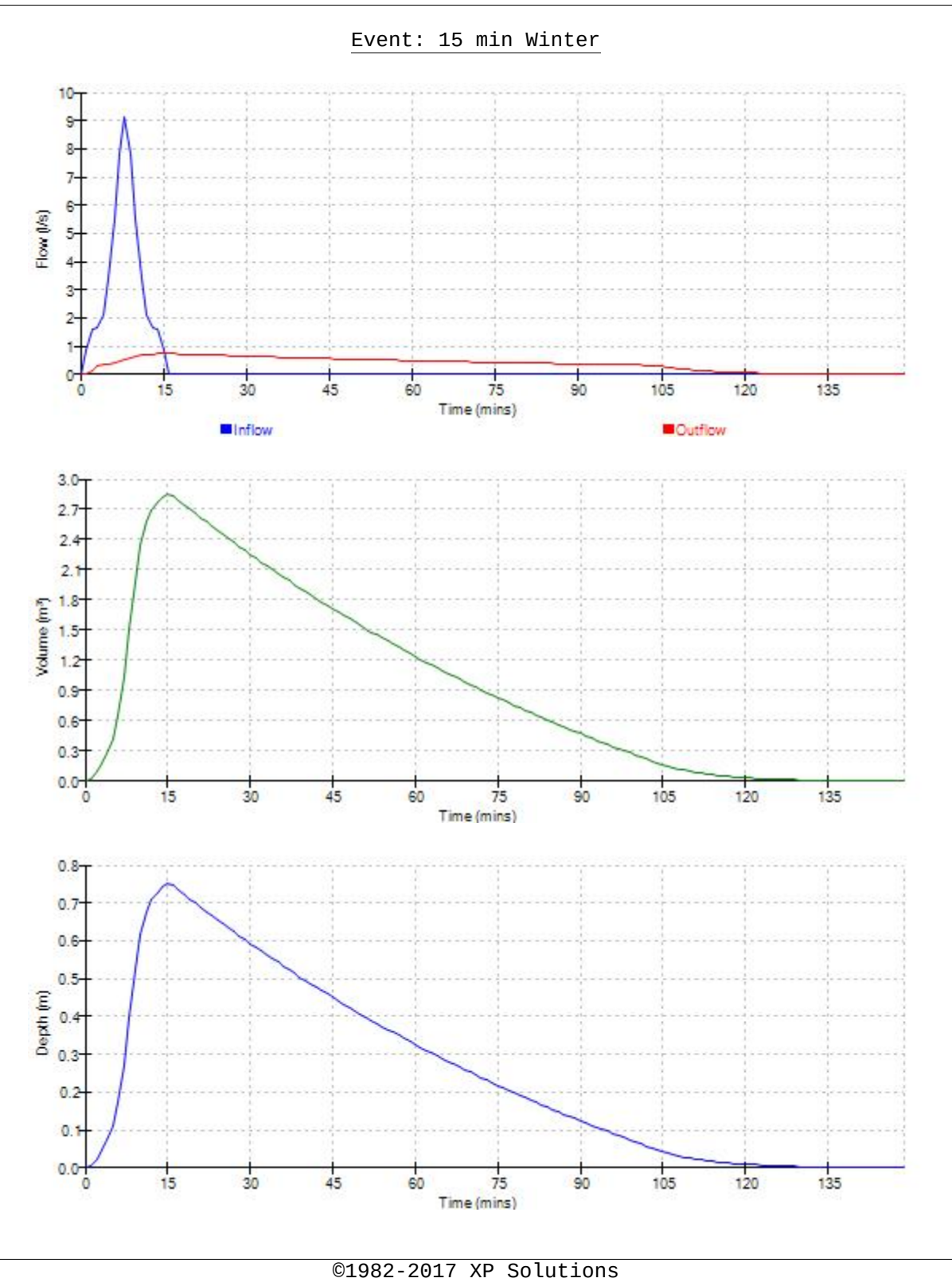
Total Area (ha) 0.009

Time (mins) Area
From: To: (ha)

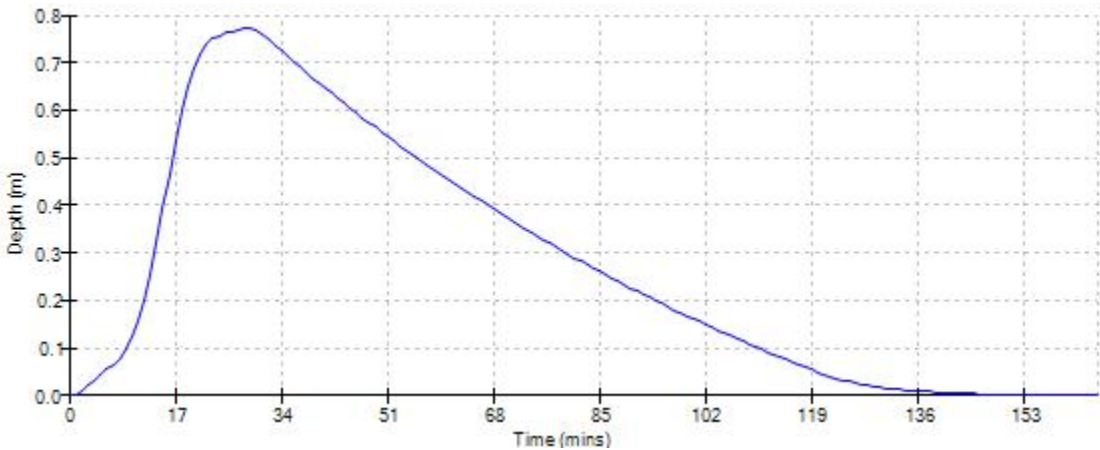
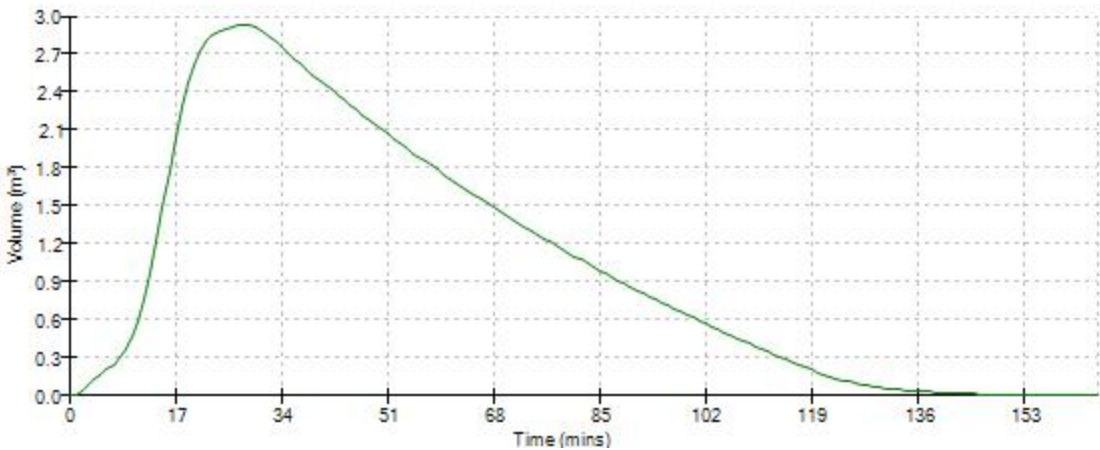
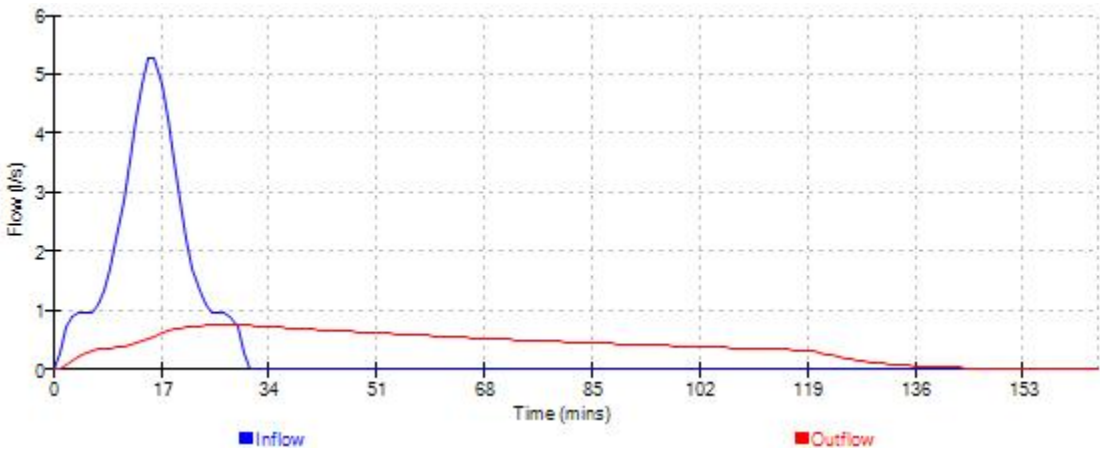
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Waterco Ltd		Page 4																				
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Boxing Unit																					
Date 20-Apr-18 7:52 AM File w10229-180419-boxing.SRCX	Designed by Johanne.Williams Checked by Josh Rigby																					
XP Solutions																						
Source Control 2017.1.2																						
Model Details Storage is Online Cover Level (m) 10.000 House Soakaway Structure <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.31900</td><td>Pit Width (m)</td><td>2.000</td></tr><tr><td>Infiltration Coefficient Side (m/hr)</td><td>0.31900</td><td>Number Required</td><td>1</td></tr><tr><td>Safety Factor</td><td>1.2</td><td>Cap Volume Depth (m)</td><td>9.000</td></tr><tr><td>Porosity</td><td>0.95</td><td>Cap Infiltration Depth (m)</td><td>9.000</td></tr><tr><td>Invert Level (m)</td><td>8.000</td><td></td><td></td></tr></table>			Infiltration Coefficient Base (m/hr)	0.31900	Pit Width (m)	2.000	Infiltration Coefficient Side (m/hr)	0.31900	Number Required	1	Safety Factor	1.2	Cap Volume Depth (m)	9.000	Porosity	0.95	Cap Infiltration Depth (m)	9.000	Invert Level (m)	8.000		
Infiltration Coefficient Base (m/hr)	0.31900	Pit Width (m)	2.000																			
Infiltration Coefficient Side (m/hr)	0.31900	Number Required	1																			
Safety Factor	1.2	Cap Volume Depth (m)	9.000																			
Porosity	0.95	Cap Infiltration Depth (m)	9.000																			
Invert Level (m)	8.000																					
©1982-2017 XP Solutions																						

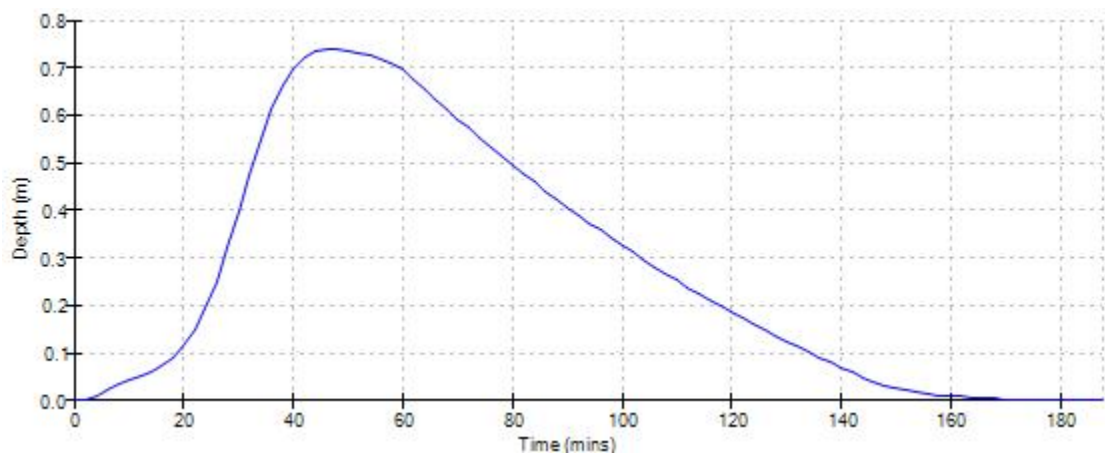
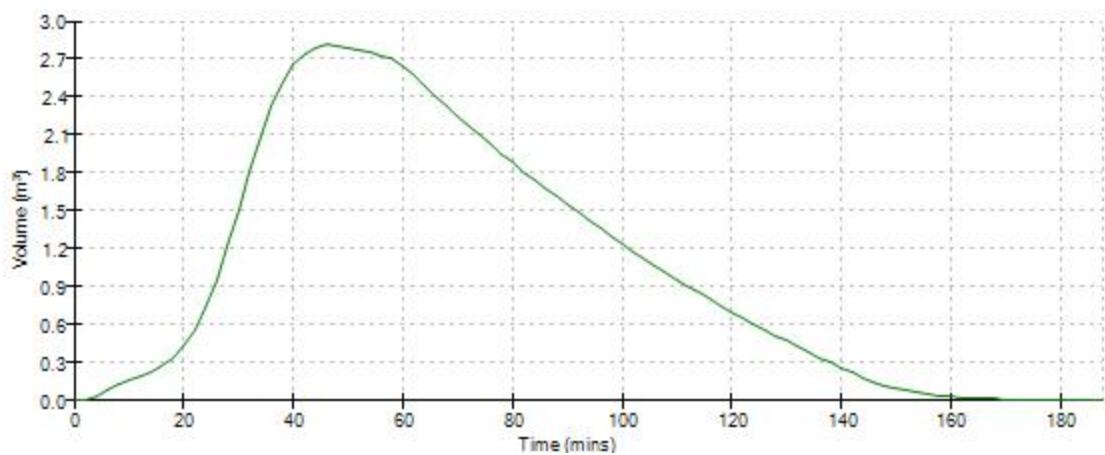
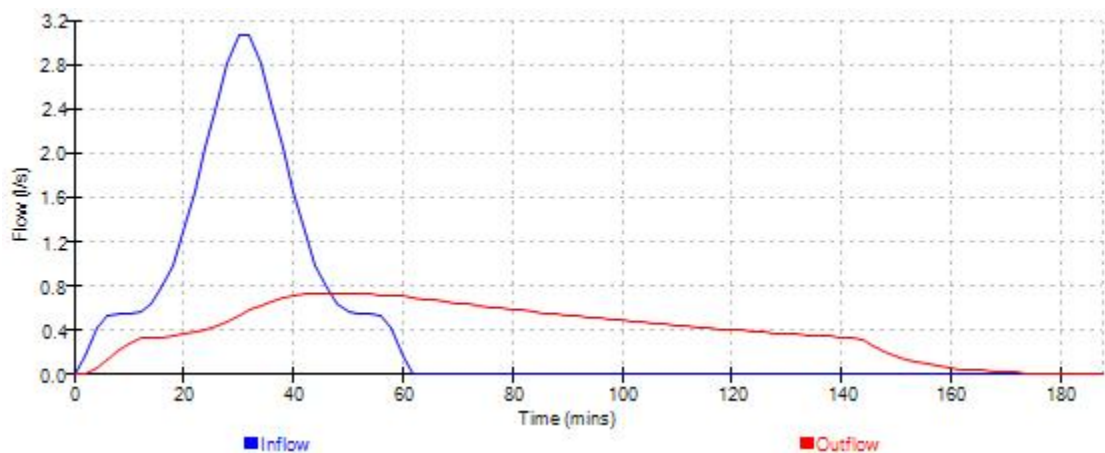
Waterco Ltd		Page 5
Eden Court	W10229 - Royal British Legion	
Lon Parcwr Business Park	Llay	
Denbighshire LL15 1NJ	Boxing Unit	
Date 20-Apr-18 7:52 AM	Designed by Johanne.Williams	
File w10229-180419-boxing.SRCX	Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	



Event: 30 min Winter



Event: 60 min Winter



Waterco Ltd		Page 1
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Soakaway - average	
Date 20-Apr-18 7:42 AM File W10229-180419-SOAKAWAYS...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 80 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	8.400	0.400	0.2	1.5	0 K
30 min Summer	8.434	0.434	0.3	1.7	0 K
60 min Summer	8.447	0.447	0.3	1.7	0 K
120 min Summer	8.448	0.448	0.3	1.7	0 K
180 min Summer	8.439	0.439	0.3	1.7	0 K
240 min Summer	8.426	0.426	0.3	1.6	0 K
360 min Summer	8.397	0.397	0.2	1.5	0 K
480 min Summer	8.369	0.369	0.2	1.4	0 K
600 min Summer	8.345	0.345	0.2	1.3	0 K
720 min Summer	8.324	0.324	0.2	1.2	0 K
960 min Summer	8.296	0.296	0.2	1.1	0 K
1440 min Summer	8.254	0.254	0.2	1.0	0 K
2160 min Summer	8.212	0.212	0.1	0.8	0 K
2880 min Summer	8.183	0.183	0.1	0.7	0 K
4320 min Summer	8.139	0.139	0.1	0.5	0 K
5760 min Summer	8.114	0.114	0.1	0.4	0 K
7200 min Summer	8.097	0.097	0.1	0.4	0 K
8640 min Summer	8.084	0.084	0.0	0.3	0 K
10080 min Summer	8.075	0.075	0.0	0.3	0 K
15 min Winter	8.449	0.449	0.3	1.7	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	174.711	0.0	16
30 min Summer	101.253	0.0	30
60 min Summer	58.681	0.0	50
120 min Summer	34.008	0.0	82
180 min Summer	24.717	0.0	116
240 min Summer	19.709	0.0	152
360 min Summer	14.325	0.0	218
480 min Summer	11.423	0.0	284
600 min Summer	9.583	0.0	348
720 min Summer	8.302	0.0	410
960 min Summer	6.772	0.0	538
1440 min Summer	5.082	0.0	780
2160 min Summer	3.814	0.0	1148
2880 min Summer	3.111	0.0	1504
4320 min Summer	2.227	0.0	2244
5760 min Summer	1.756	0.0	2944
7200 min Summer	1.461	0.0	3672
8640 min Summer	1.257	0.0	4408
10080 min Summer	1.107	0.0	5144
15 min Winter	174.711	0.0	15

Waterco Ltd		Page 2
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Soakaway - average	
Date 20-Apr-18 7:42 AM File W10229-180419-SOAKAWAYS...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	8.488	0.488	0.3	1.9	0 K
60 min Winter	8.502	0.502	0.3	1.9	0 K
120 min Winter	8.496	0.496	0.3	1.9	0 K
180 min Winter	8.476	0.476	0.3	1.8	0 K
240 min Winter	8.453	0.453	0.3	1.7	0 K
360 min Winter	8.409	0.409	0.2	1.6	0 K
480 min Winter	8.370	0.370	0.2	1.4	0 K
600 min Winter	8.338	0.338	0.2	1.3	0 K
720 min Winter	8.311	0.311	0.2	1.2	0 K
960 min Winter	8.275	0.275	0.2	1.0	0 K
1440 min Winter	8.224	0.224	0.1	0.9	0 K
2160 min Winter	8.177	0.177	0.1	0.7	0 K
2880 min Winter	8.148	0.148	0.1	0.6	0 K
4320 min Winter	8.109	0.109	0.1	0.4	0 K
5760 min Winter	8.086	0.086	0.1	0.3	0 K
7200 min Winter	8.072	0.072	0.0	0.3	0 K
8640 min Winter	8.062	0.062	0.0	0.2	0 K
10080 min Winter	8.055	0.055	0.0	0.2	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	101.253	0.0	29
60 min Winter	58.681	0.0	56
120 min Winter	34.008	0.0	88
180 min Winter	24.717	0.0	126
240 min Winter	19.709	0.0	162
360 min Winter	14.325	0.0	230
480 min Winter	11.423	0.0	298
600 min Winter	9.583	0.0	362
720 min Winter	8.302	0.0	426
960 min Winter	6.772	0.0	556
1440 min Winter	5.082	0.0	806
2160 min Winter	3.814	0.0	1168
2880 min Winter	3.111	0.0	1528
4320 min Winter	2.227	0.0	2248
5760 min Winter	1.756	0.0	2992
7200 min Winter	1.461	0.0	3680
8640 min Winter	1.257	0.0	4416
10080 min Winter	1.107	0.0	5136

Waterco Ltd		Page 3
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Soakaway - average	
Date 20-Apr-18 7:42 AM File W10229-180419-SOAKAWAYS...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.407	Cv (Summer)	0.750
Return Period (years)	100	D3 (1km)	0.290	Cv (Winter)	0.840
FEH Rainfall Version	1999	E (1km)	0.286	Shortest Storm (mins)	15
Site Location		F (1km)	2.420	Longest Storm (mins)	10080
C (1km)	-0.025	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.328	Winter Storms	Yes		

Time Area Diagram

Total Area (ha) 0.005

Time (mins) Area
From: To: (ha)

0 1 0.005

Waterco Ltd		Page 4
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Soakaway - average	
Date 20-Apr-18 7:42 AM File W10229-180419-SOAKAWAYS...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions Source Control 2017.1.2		

Model Details

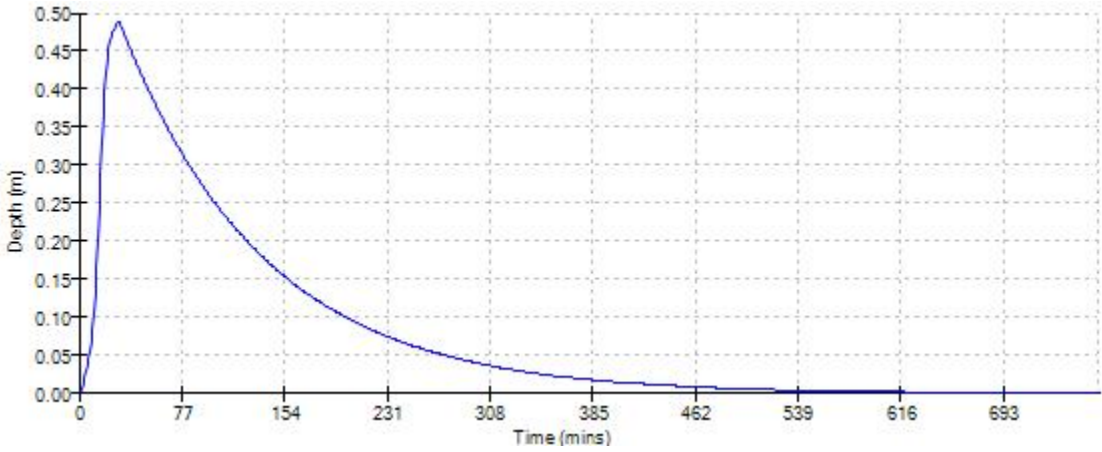
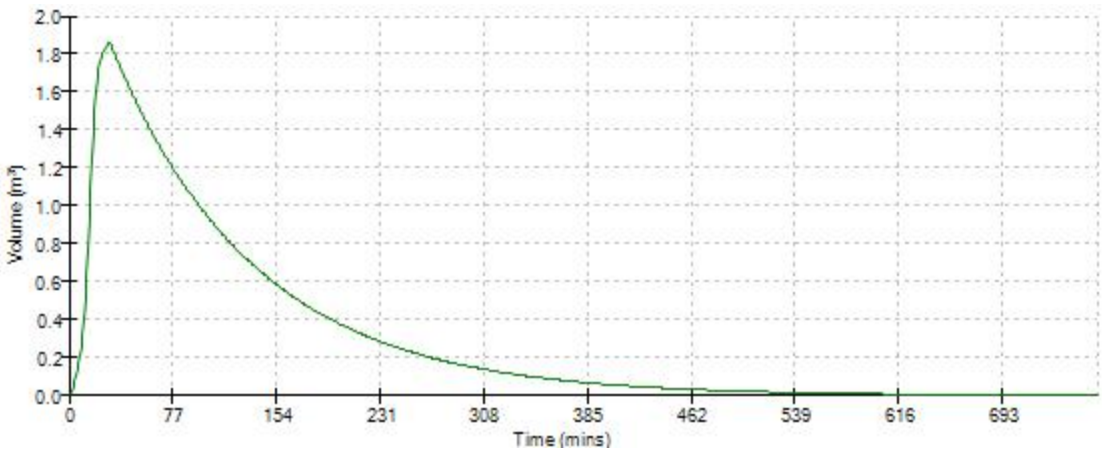
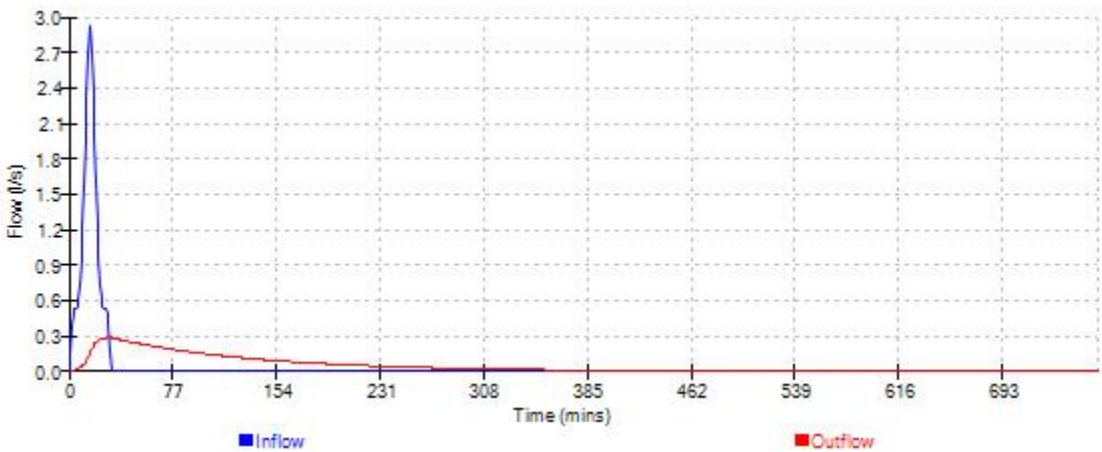
Storage is Online Cover Level (m) 10.000

House Soakaway Structure

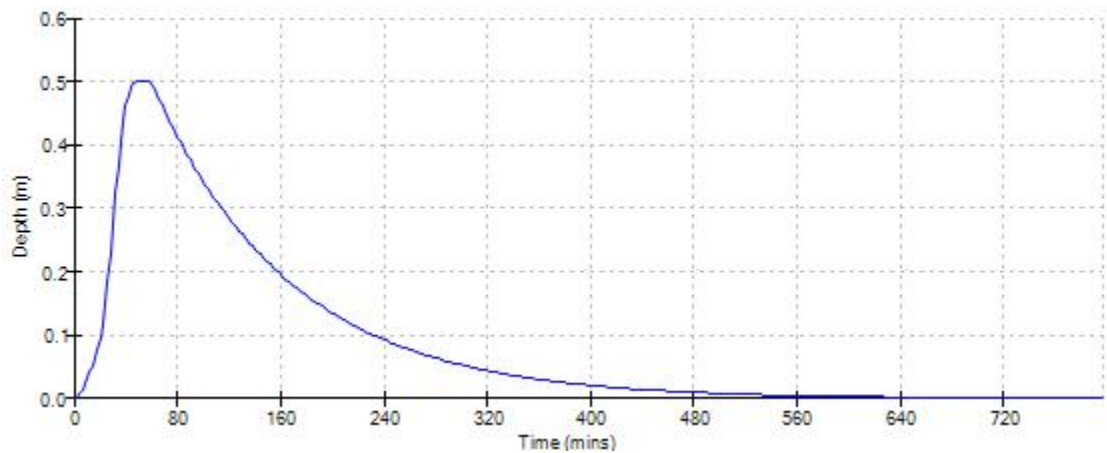
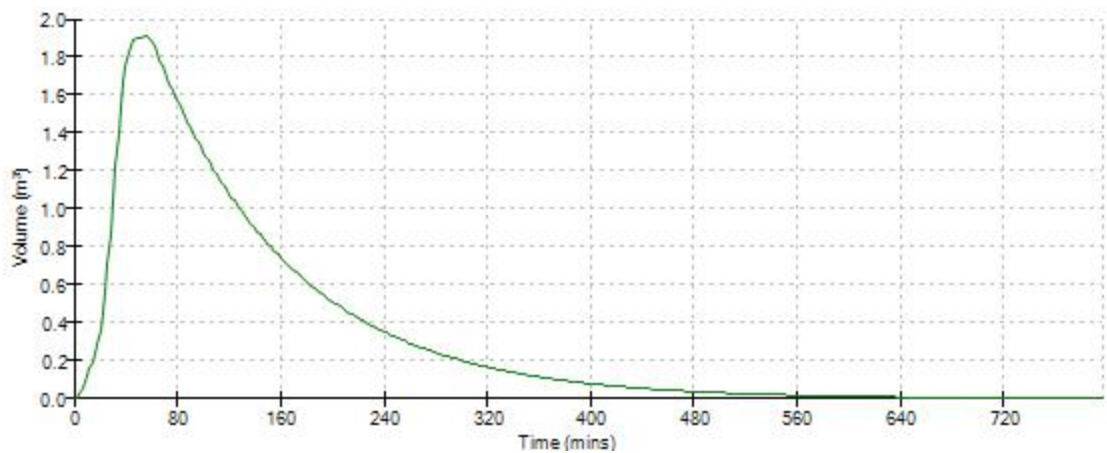
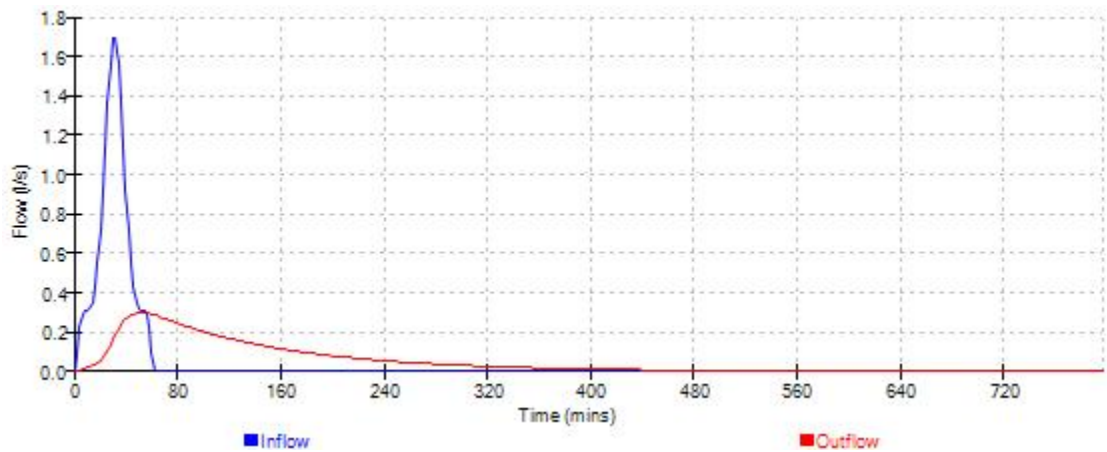
Infiltration Coefficient Base (m/hr) 0.00000	Pit Width (m) 2.000
Infiltration Coefficient Side (m/hr) 0.31900	Number Required 1
Safety Factor 1.2	Cap Volume Depth (m) 9.000
Porosity 0.95	Cap Infiltration Depth (m) 9.000
Invert Level (m) 8.000	

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Event: 30 min Winter

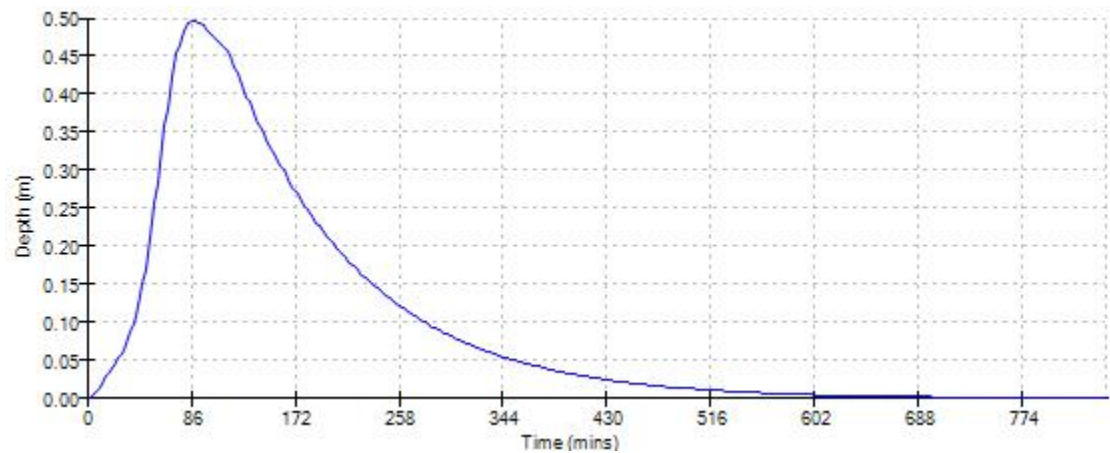
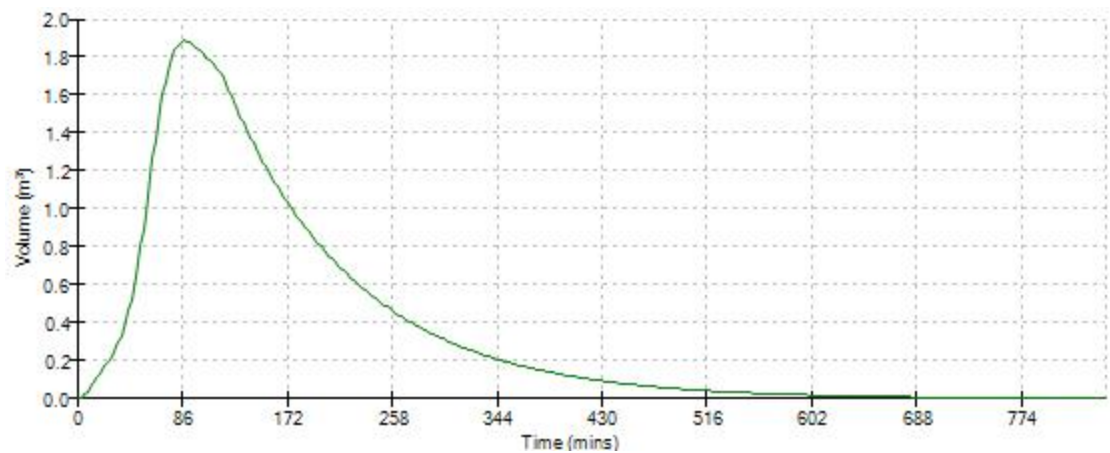
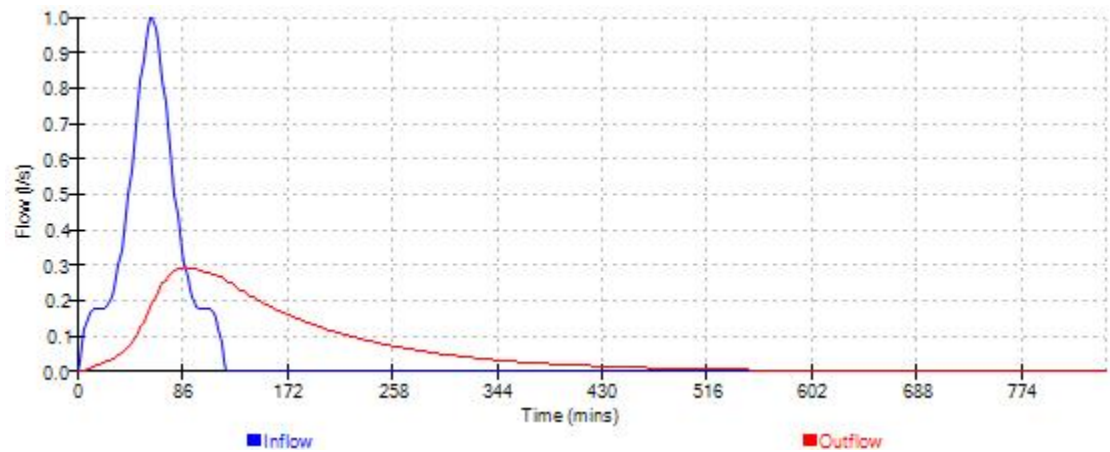


Event: 60 min Winter



Waterco Ltd		Page 7
Eden Court	W10229 - Royal British Legion	
Lon Parcwr Business Park	Llay	
Denbighshire LL15 1NJ	Soakaway - average	
Date 20-Apr-18 7:42 AM	Designed by Johanne.Williams	
File W10229-180419-SOAKAWAYS...	Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Event: 120 min Winter



Waterco Ltd		Page 1
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Club House	
Date 20-Apr-18 8:03 AM File w10229-180419-clubhouse...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 181 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	9.288	1.288	3.0	48.6	0 K
30 min Summer	9.433	1.433	3.4	54.8	0 K
60 min Summer	9.556	1.556	3.7	60.1	0 K
120 min Summer	9.617	1.617	3.9	62.7	0 K
180 min Summer	9.632	1.632	3.9	63.4	0 K
240 min Summer	9.636	1.636	4.0	63.5	0 K
360 min Summer	9.623	1.623	3.9	63.0	0 K
480 min Summer	9.593	1.593	3.8	61.7	0 K
600 min Summer	9.557	1.557	3.7	60.1	0 K
720 min Summer	9.518	1.518	3.6	58.5	0 K
960 min Summer	9.472	1.472	3.5	56.5	0 K
1440 min Summer	9.371	1.371	3.2	52.2	0 K
2160 min Summer	9.240	1.240	2.9	46.6	0 K
2880 min Summer	9.136	1.136	2.6	42.2	0 K
4320 min Summer	8.946	0.946	2.1	34.0	0 K
5760 min Summer	8.822	0.822	1.8	28.7	0 K
7200 min Summer	8.734	0.734	1.6	25.0	0 K
8640 min Summer	8.669	0.669	1.4	22.2	0 K
10080 min Summer	8.617	0.617	1.2	20.0	0 K
15 min Winter	9.424	1.424	3.4	54.5	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	174.711	0.0	16
30 min Summer	101.253	0.0	31
60 min Summer	58.681	0.0	60
120 min Summer	34.008	0.0	112
180 min Summer	24.717	0.0	140
240 min Summer	19.709	0.0	170
360 min Summer	14.325	0.0	240
480 min Summer	11.423	0.0	308
600 min Summer	9.583	0.0	378
720 min Summer	8.302	0.0	442
960 min Summer	6.772	0.0	576
1440 min Summer	5.082	0.0	836
2160 min Summer	3.814	0.0	1212
2880 min Summer	3.111	0.0	1584
4320 min Summer	2.227	0.0	2332
5760 min Summer	1.756	0.0	3056
7200 min Summer	1.461	0.0	3752
8640 min Summer	1.257	0.0	4496
10080 min Summer	1.107	0.0	5240
15 min Winter	174.711	0.0	16

Waterco Ltd		Page 2
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Club House	
Date 20-Apr-18 8:03 AM File w10229-180419-clubhouse...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	9.589	1.589	3.8	61.5	0 K
60 min Winter	9.731	1.731	4.2	67.6	Flood Risk
120 min Winter	9.808	1.808	4.4	70.9	Flood Risk
180 min Winter	9.811	1.811	4.4	71.0	Flood Risk
240 min Winter	9.807	1.807	4.4	70.8	Flood Risk
360 min Winter	9.767	1.767	4.3	69.1	Flood Risk
480 min Winter	9.709	1.709	4.1	66.7	Flood Risk
600 min Winter	9.648	1.648	4.0	64.0	0 K
720 min Winter	9.587	1.587	3.8	61.4	0 K
960 min Winter	9.504	1.504	3.6	57.9	0 K
1440 min Winter	9.351	1.351	3.2	51.4	0 K
2160 min Winter	9.174	1.174	2.7	43.8	0 K
2880 min Winter	9.044	1.044	2.4	38.2	0 K
4320 min Winter	8.835	0.835	1.8	29.3	0 K
5760 min Winter	8.709	0.709	1.5	23.9	0 K
7200 min Winter	8.623	0.623	1.3	20.2	0 K
8640 min Winter	8.562	0.562	1.1	17.6	0 K
10080 min Winter	8.516	0.516	1.0	15.6	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	101.253	0.0	30
60 min Winter	58.681	0.0	60
120 min Winter	34.008	0.0	114
180 min Winter	24.717	0.0	144
240 min Winter	19.709	0.0	182
360 min Winter	14.325	0.0	258
480 min Winter	11.423	0.0	330
600 min Winter	9.583	0.0	402
720 min Winter	8.302	0.0	474
960 min Winter	6.772	0.0	608
1440 min Winter	5.082	0.0	878
2160 min Winter	3.814	0.0	1256
2880 min Winter	3.111	0.0	1640
4320 min Winter	2.227	0.0	2376
5760 min Winter	1.756	0.0	3112
7200 min Winter	1.461	0.0	3824
8640 min Winter	1.257	0.0	4576
10080 min Winter	1.107	0.0	5248

Waterco Ltd		Page 3
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Club House	
Date 20-Apr-18 8:03 AM File w10229-180419-clubhouse...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FEH	D2 (1km) 0.407	Cv (Summer) 0.750
Return Period (years)	100	D3 (1km) 0.290	Cv (Winter) 0.840
FEH Rainfall Version	1999	E (1km) 0.286	Shortest Storm (mins) 15
Site Location		F (1km) 2.420	Longest Storm (mins) 10080
C (1km)	-0.025	Summer Storms Yes	Climate Change % +40
D1 (1km)	0.328	Winter Storms Yes	

Time Area Diagram

Total Area (ha) 0.153

Time (mins)	Area
From:	To: (ha)

0	1 0.153
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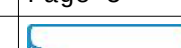
Waterco Ltd		Page 4
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Club House	
Date 20-Apr-18 8:03 AM File w10229-180419-clubhouse...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Model Details

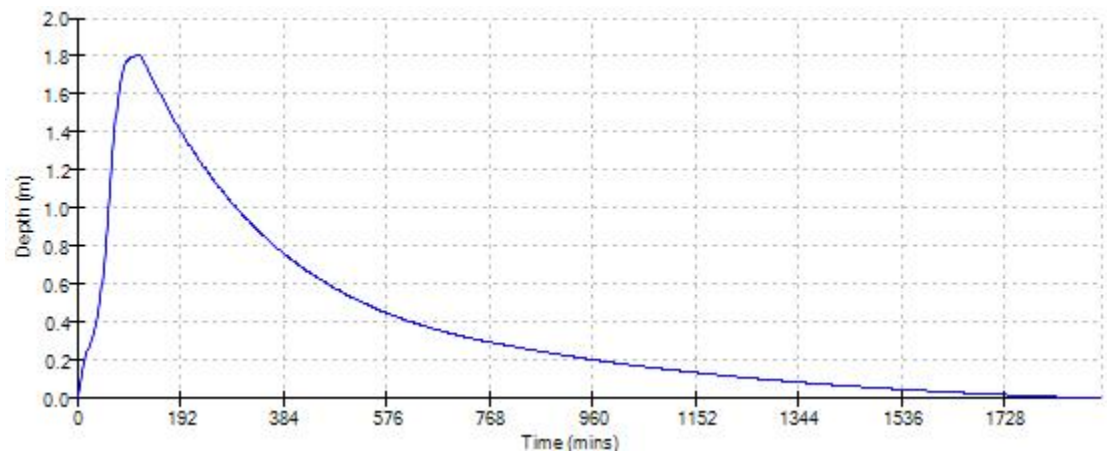
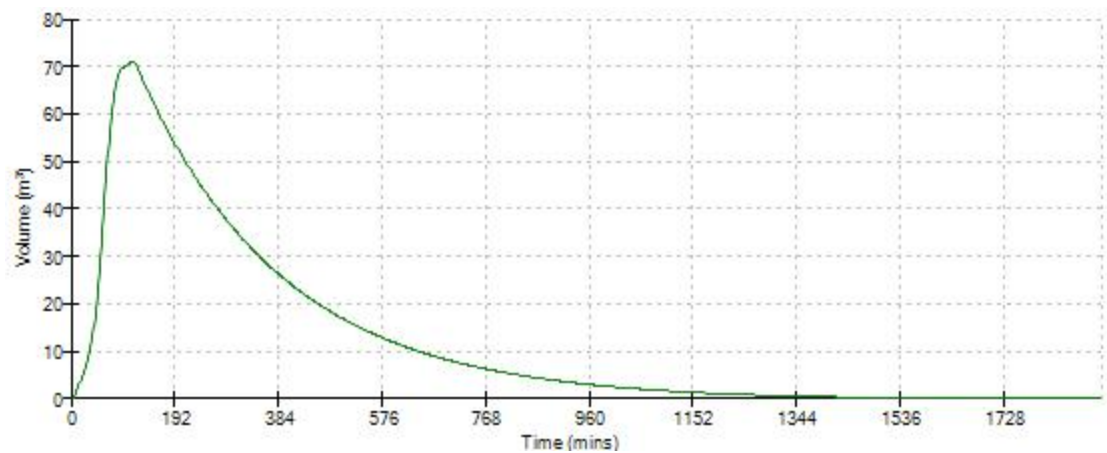
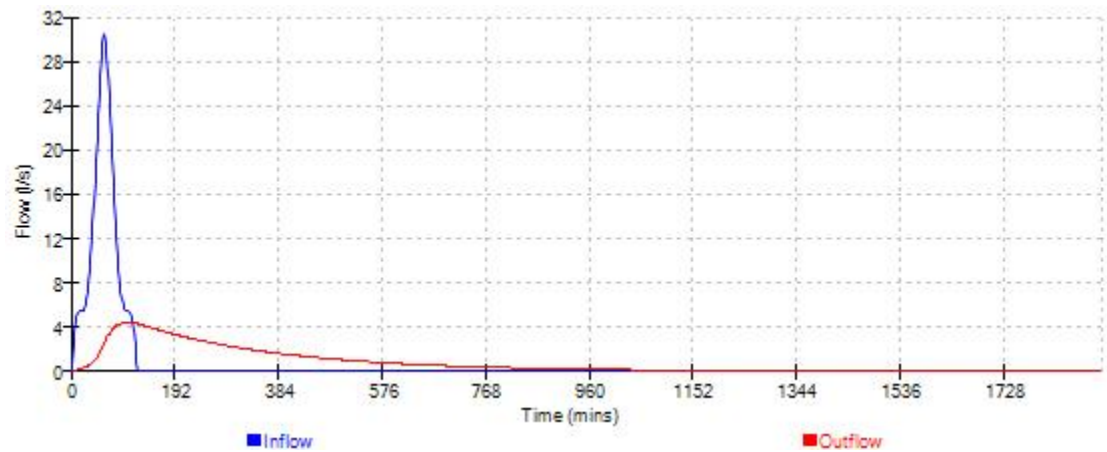
Storage is Online Cover Level (m) 10.000

Trench Soakaway Structure

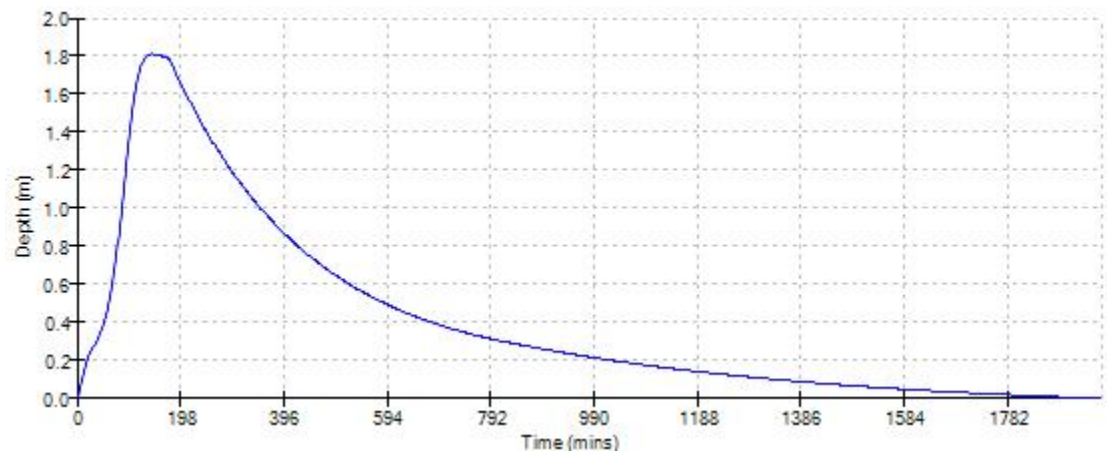
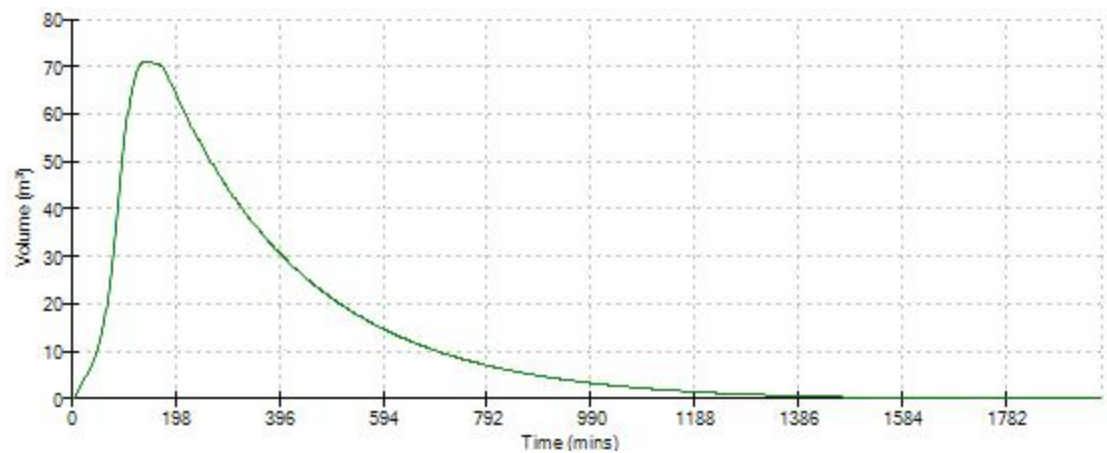
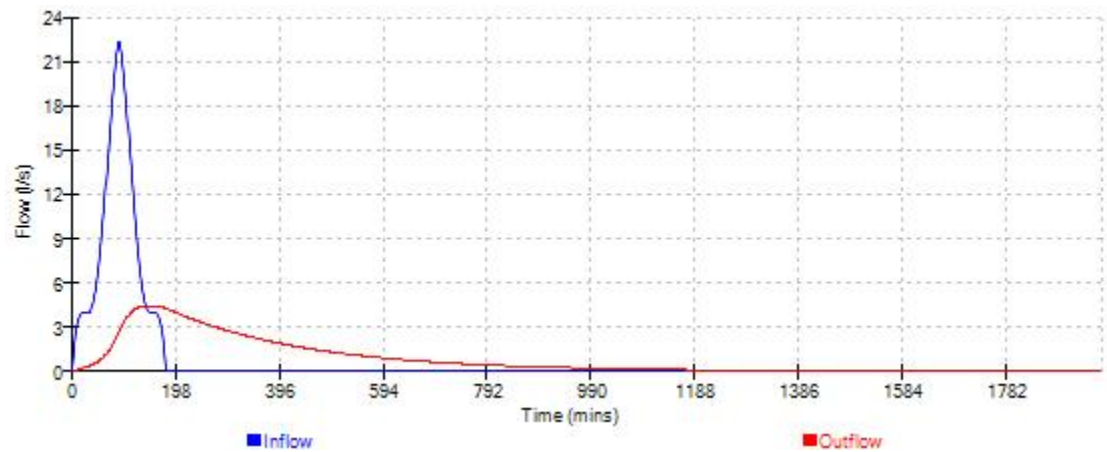
Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.31900	Trench Length (m)	15.0
Safety Factor	1.2	Slope (1:X)	50.0
Porosity	0.95	Cap Volume Depth (m)	9.000
Invert Level (m)	8.000	Cap Infiltration Depth (m)	9.000

Waterco Ltd		Page 5
Eden Court	W10229 - Royal British Legion	
Lon Parcwr Business Park	Llay	
Denbighshire LL15 1NJ	Club House	
Date 20-Apr-18 8:03 AM	Designed by Johanne.Williams	
File w10229-180419-clubhouse...	Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

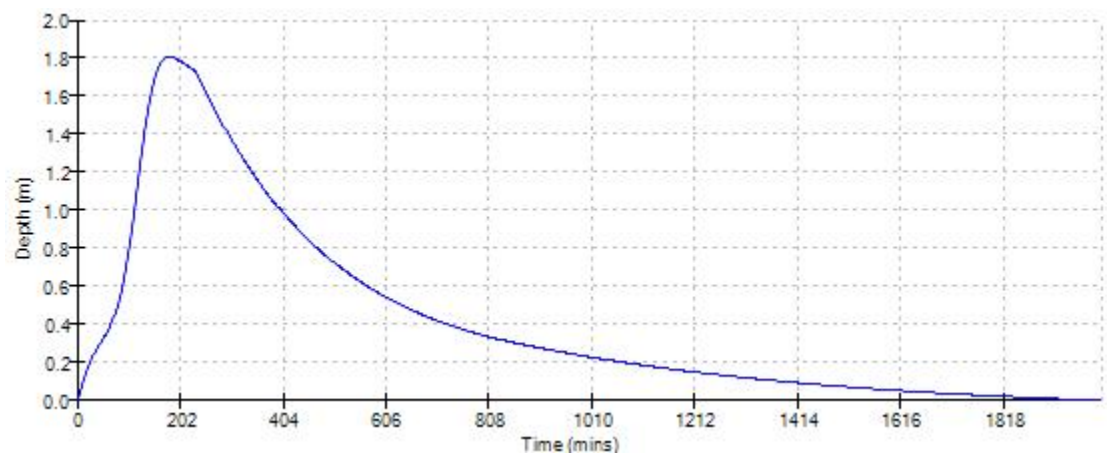
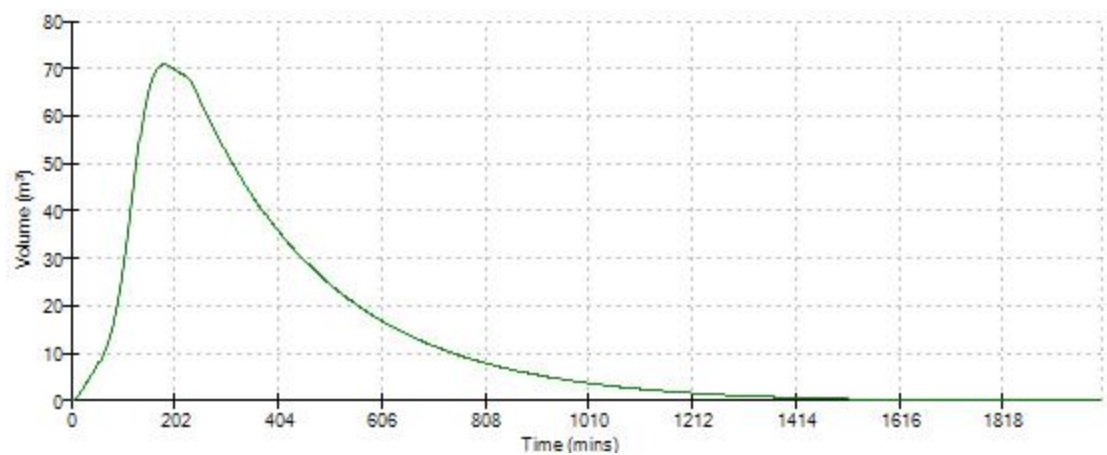
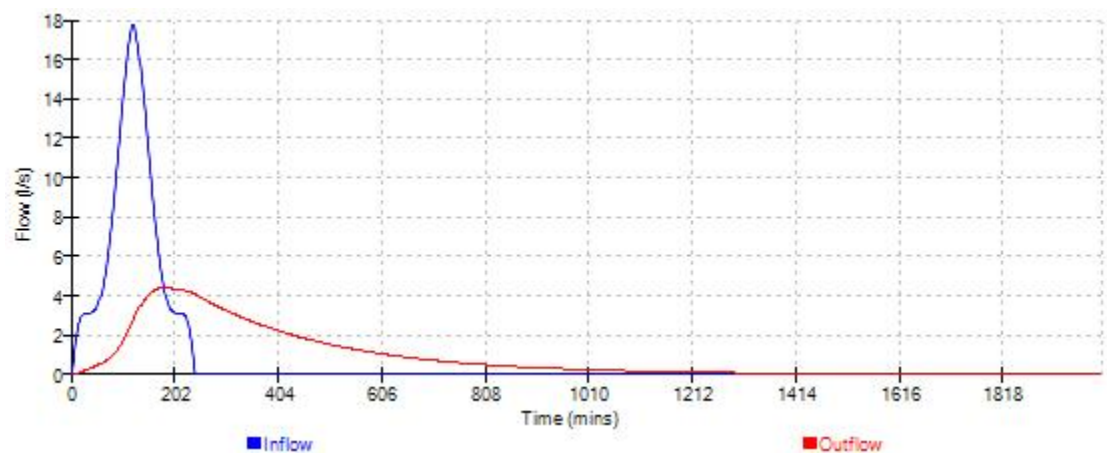
Event: 120 min Winter



Event: 180 min Winter



Event: 240 min Winter



Waterco Ltd		Page 1
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Permeable Paving	
Date 20-Apr-18 7:49 AM File w10229-180419-paving.SRCX	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 6 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	9.896	0.196	144.9	57.7	Flood Risk
30 min Summer	9.882	0.182	134.6	49.8	Flood Risk
60 min Summer	9.853	0.153	112.8	34.9	Flood Risk
120 min Summer	9.816	0.116	85.5	20.0	Flood Risk
180 min Summer	9.793	0.093	68.9	13.1	Flood Risk
240 min Summer	9.779	0.079	58.2	9.2	Flood Risk
360 min Summer	9.760	0.060	44.1	5.4	Flood Risk
480 min Summer	9.750	0.050	36.6	3.7	Flood Risk
600 min Summer	9.745	0.045	30.2	3.1	Flood Risk
720 min Summer	9.742	0.042	26.4	2.7	Flood Risk
960 min Summer	9.738	0.038	21.6	2.2	Flood Risk
1440 min Summer	9.733	0.033	16.3	1.6	Flood Risk
2160 min Summer	9.729	0.029	12.2	1.2	Flood Risk
2880 min Summer	9.726	0.026	9.8	1.0	Flood Risk
4320 min Summer	9.722	0.022	7.0	0.7	Flood Risk
5760 min Summer	9.720	0.020	5.8	0.6	Flood Risk
7200 min Summer	9.718	0.018	4.7	0.5	Flood Risk
8640 min Summer	9.717	0.017	4.1	0.4	Flood Risk
10080 min Summer	9.715	0.015	3.4	0.4	Flood Risk
15 min Winter	9.906	0.206	152.3	63.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	174.711	0.0	10
30 min Summer	101.253	0.0	18
60 min Summer	58.681	0.0	34
120 min Summer	34.008	0.0	64
180 min Summer	24.717	0.0	94
240 min Summer	19.709	0.0	124
360 min Summer	14.325	0.0	184
480 min Summer	11.423	0.0	242
600 min Summer	9.583	0.0	306
720 min Summer	8.302	0.0	362
960 min Summer	6.772	0.0	484
1440 min Summer	5.082	0.0	724
2160 min Summer	3.814	0.0	1088
2880 min Summer	3.111	0.0	1460
4320 min Summer	2.227	0.0	2184
5760 min Summer	1.756	0.0	2936
7200 min Summer	1.461	0.0	3552
8640 min Summer	1.257	0.0	4264
10080 min Summer	1.107	0.0	5104
15 min Winter	174.711	0.0	11

Waterco Ltd		Page 2
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Permeable Paving	
Date 20-Apr-18 7:49 AM File w10229-180419-paving.SRCX	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	9.884	0.184	135.7	50.7	Flood Risk
60 min Winter	9.844	0.144	106.5	31.2	Flood Risk
120 min Winter	9.798	0.098	72.6	14.6	Flood Risk
180 min Winter	9.775	0.075	55.2	8.3	Flood Risk
240 min Winter	9.760	0.060	44.5	5.5	Flood Risk
360 min Winter	9.747	0.047	33.0	3.3	Flood Risk
480 min Winter	9.742	0.042	26.4	2.7	Flood Risk
600 min Winter	9.739	0.039	22.2	2.2	Flood Risk
720 min Winter	9.736	0.036	18.9	2.0	Flood Risk
960 min Winter	9.733	0.033	15.8	1.6	Flood Risk
1440 min Winter	9.728	0.028	11.8	1.2	Flood Risk
2160 min Winter	9.724	0.024	8.7	0.9	Flood Risk
2880 min Winter	9.722	0.022	7.3	0.7	Flood Risk
4320 min Winter	9.719	0.019	5.2	0.5	Flood Risk
5760 min Winter	9.716	0.016	3.9	0.4	Flood Risk
7200 min Winter	9.715	0.015	3.4	0.4	Flood Risk
8640 min Winter	9.714	0.014	3.0	0.3	Flood Risk
10080 min Winter	9.713	0.013	2.6	0.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	101.253	0.0	20
60 min Winter	58.681	0.0	36
120 min Winter	34.008	0.0	66
180 min Winter	24.717	0.0	94
240 min Winter	19.709	0.0	124
360 min Winter	14.325	0.0	184
480 min Winter	11.423	0.0	244
600 min Winter	9.583	0.0	300
720 min Winter	8.302	0.0	366
960 min Winter	6.772	0.0	482
1440 min Winter	5.082	0.0	748
2160 min Winter	3.814	0.0	1084
2880 min Winter	3.111	0.0	1436
4320 min Winter	2.227	0.0	2148
5760 min Winter	1.756	0.0	2816
7200 min Winter	1.461	0.0	3664
8640 min Winter	1.257	0.0	4440
10080 min Winter	1.107	0.0	4976

Waterco Ltd		Page 3
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Permeable Paving	
Date 20-Apr-18 7:49 AM File w10229-180419-paving.SRCX	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions Source Control 2017.1.2		

Rainfall Details

Rainfall Model	FEH	D2 (1km) 0.407	Cv (Summer) 0.750
Return Period (years)	100	D3 (1km) 0.290	Cv (Winter) 0.840
FEH Rainfall Version	1999	E (1km) 0.286	Shortest Storm (mins) 15
Site Location		F (1km) 2.420	Longest Storm (mins) 10080
C (1km)	-0.025	Summer Storms Yes	Climate Change % +40
D1 (1km)	0.328	Winter Storms Yes	

Time Area Diagram

Total Area (ha) 0.389

Time (mins)	Area
From:	To: (ha)
0	1 0.389

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Waterco Ltd		Page 4
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Permeable Paving	
Date 20-Apr-18 7:49 AM File w10229-180419-paving.SRCX	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

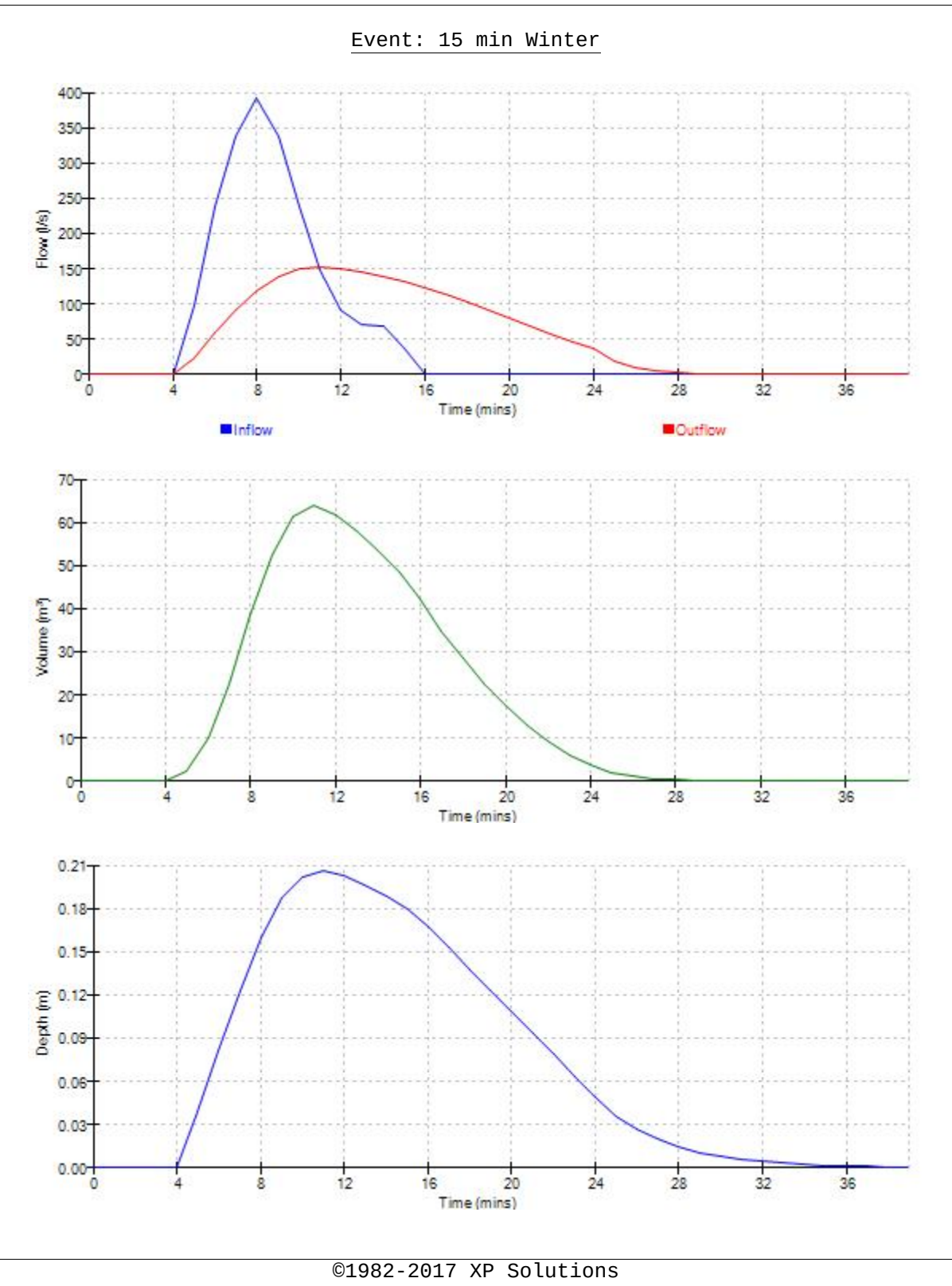
Model Details

Storage is Online Cover Level (m) 10.000

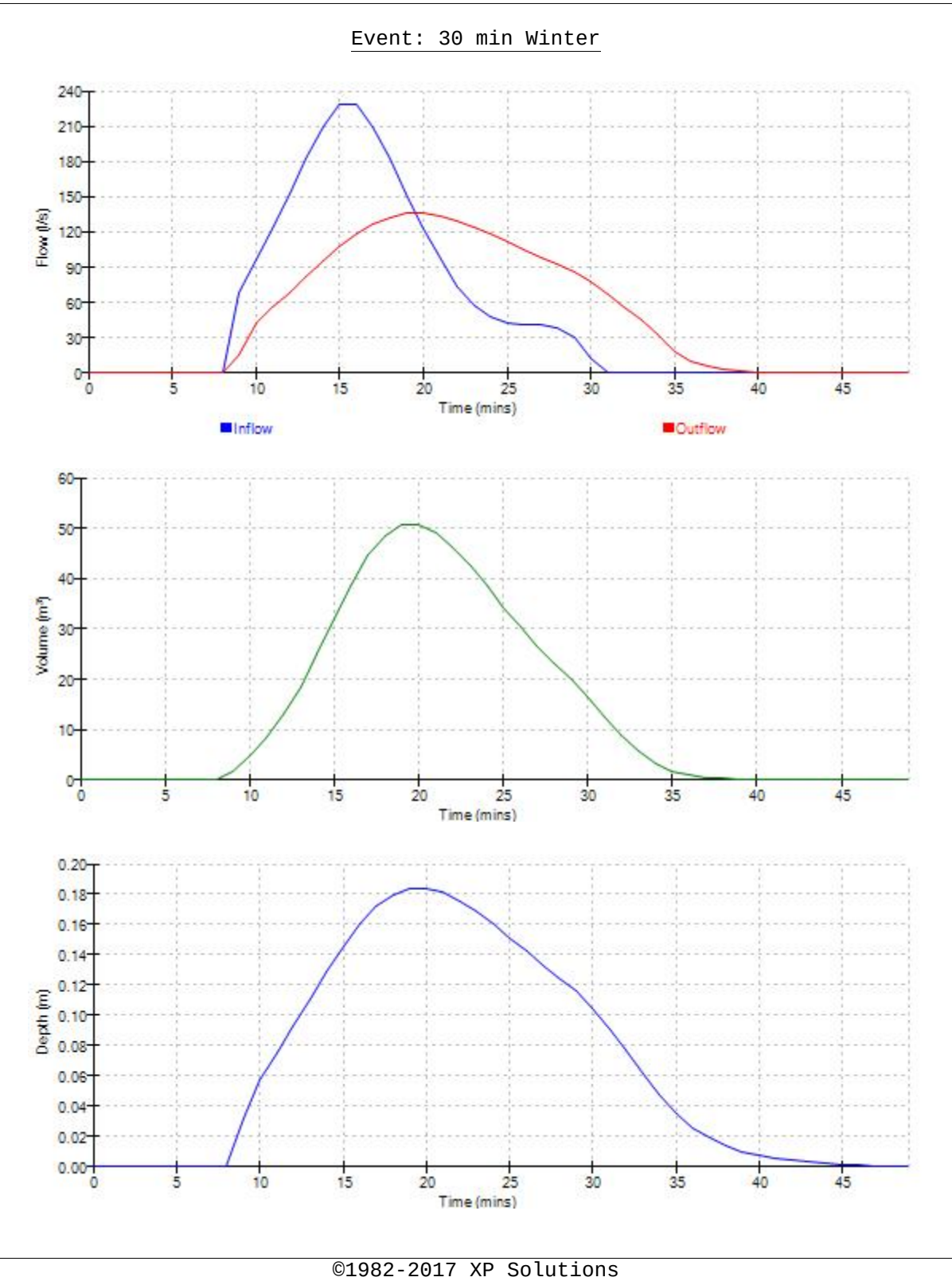
Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.31900	Width (m)	100.0
Membrane Percolation (mm/hr)	1000	Length (m)	38.0
Max Percolation (l/s)	1055.6	Slope (1:X)	100.0
Safety Factor	1.2	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.700	Membrane Depth (m)	0

Waterco Ltd		Page 5
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay	
	Permeable Paving	
Date 20-Apr-18 7:49 AM	Designed by Johanne.Williams	
File w10229-180419-paving.SRCX	Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	



Waterco Ltd		Page 6
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay	
	Permeable Paving	
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File w10229-180419-paving.SRCX	Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	



Waterco Ltd			Page 1		
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ		W10229 - Royal British Legion Llay Service Road			
Date 20-Apr-18 2:22 PM File w10229-180419-service r...		Designed by Johanne.Williams Checked by Josh Rigby			
XP Solutions		Source Control 2017.1.2			
Summary of Results for 100 year Return Period (+40%)					
Half Drain Time : 196 minutes.					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	9.386	1.386	4.7	80.9	0 K
30 min Summer	9.533	1.533	5.3	91.4	0 K
60 min Summer	9.660	1.660	5.8	100.5	0 K
120 min Summer	9.731	1.731	6.1	105.5	Flood Risk
180 min Summer	9.746	1.746	6.2	106.6	Flood Risk
240 min Summer	9.752	1.752	6.2	107.0	Flood Risk
360 min Summer	9.743	1.743	6.2	106.3	Flood Risk
480 min Summer	9.717	1.717	6.1	104.5	Flood Risk
600 min Summer	9.685	1.685	5.9	102.2	0 K
720 min Summer	9.648	1.648	5.8	99.6	0 K
960 min Summer	9.606	1.606	5.6	96.6	0 K
1440 min Summer	9.510	1.510	5.2	89.8	0 K
2160 min Summer	9.381	1.381	4.7	80.6	0 K
2880 min Summer	9.278	1.278	4.2	73.2	0 K
4320 min Summer	9.084	1.084	3.4	59.4	0 K
5760 min Summer	8.957	0.957	2.9	50.3	0 K
7200 min Summer	8.865	0.865	2.5	43.8	0 K
8640 min Summer	8.797	0.797	2.3	39.0	0 K
10080 min Summer	8.744	0.744	2.0	35.2	0 K
15 min Winter	9.522	1.522	5.3	90.6	0 K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
15 min Summer	174.711	0.0	16		
30 min Summer	101.253	0.0	31		
60 min Summer	58.681	0.0	60		
120 min Summer	34.008	0.0	116		
180 min Summer	24.717	0.0	142		
240 min Summer	19.709	0.0	174		
360 min Summer	14.325	0.0	242		
480 min Summer	11.423	0.0	310		
600 min Summer	9.583	0.0	378		
720 min Summer	8.302	0.0	446		
960 min Summer	6.772	0.0	578		
1440 min Summer	5.082	0.0	838		
2160 min Summer	3.814	0.0	1216		
2880 min Summer	3.111	0.0	1588		
4320 min Summer	2.227	0.0	2332		
5760 min Summer	1.756	0.0	3056		
7200 min Summer	1.461	0.0	3752		
8640 min Summer	1.257	0.0	4496		
10080 min Summer	1.107	0.0	5240		
15 min Winter	174.711	0.0	16		
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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Service Road	
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XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	9.688	1.688	5.9	102.5	0 K
60 min Winter	9.835	1.835	6.6	113.0	Flood Risk
120 min Winter	9.923	1.923	6.9	119.2	Flood Risk
180 min Winter	9.927	1.927	6.9	119.5	Flood Risk
240 min Winter	9.927	1.927	6.9	119.5	Flood Risk
360 min Winter	9.894	1.894	6.8	117.1	Flood Risk
480 min Winter	9.842	1.842	6.6	113.4	Flood Risk
600 min Winter	9.784	1.784	6.3	109.3	Flood Risk
720 min Winter	9.726	1.726	6.1	105.2	Flood Risk
960 min Winter	9.648	1.648	5.8	99.6	0 K
1440 min Winter	9.500	1.500	5.2	89.0	0 K
2160 min Winter	9.322	1.322	4.4	76.4	0 K
2880 min Winter	9.190	1.190	3.9	67.0	0 K
4320 min Winter	8.974	0.974	3.0	51.6	0 K
5760 min Winter	8.842	0.842	2.4	42.2	0 K
7200 min Winter	8.753	0.753	2.1	35.8	0 K
8640 min Winter	8.688	0.688	1.8	31.2	0 K
10080 min Winter	8.639	0.639	1.6	27.7	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	101.253	0.0	30
60 min Winter	58.681	0.0	60
120 min Winter	34.008	0.0	114
180 min Winter	24.717	0.0	146
240 min Winter	19.709	0.0	182
360 min Winter	14.325	0.0	260
480 min Winter	11.423	0.0	334
600 min Winter	9.583	0.0	404
720 min Winter	8.302	0.0	476
960 min Winter	6.772	0.0	616
1440 min Winter	5.082	0.0	880
2160 min Winter	3.814	0.0	1272
2880 min Winter	3.111	0.0	1644
4320 min Winter	2.227	0.0	2380
5760 min Winter	1.756	0.0	3112
7200 min Winter	1.461	0.0	3824
8640 min Winter	1.257	0.0	4576
10080 min Winter	1.107	0.0	5256

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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Service Road	
Date 20-Apr-18 2:22 PM File w10229-180419-service r...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.407	Cv (Summer)	0.750
Return Period (years)	100	D3 (1km)	0.290	Cv (Winter)	0.840
FEH Rainfall Version	1999	E (1km)	0.286	Shortest Storm (mins)	15
Site Location		F (1km)	2.420	Longest Storm (mins)	10080
C (1km)	-0.025	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.328	Winter Storms	Yes		

Time Area Diagram

Total Area (ha) 0.254

Time (mins)	Area
From:	To: (ha)

0	1 0.254
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Waterco Ltd		Page 4
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Service Road	
Date 20-Apr-18 2:22 PM File w10229-180419-service r...	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions Source Control 2017.1.2		

Model Details

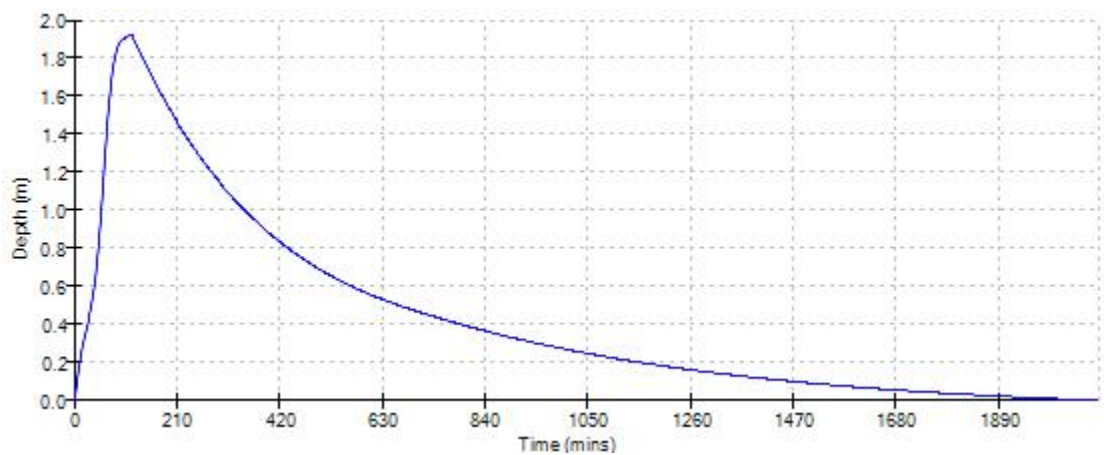
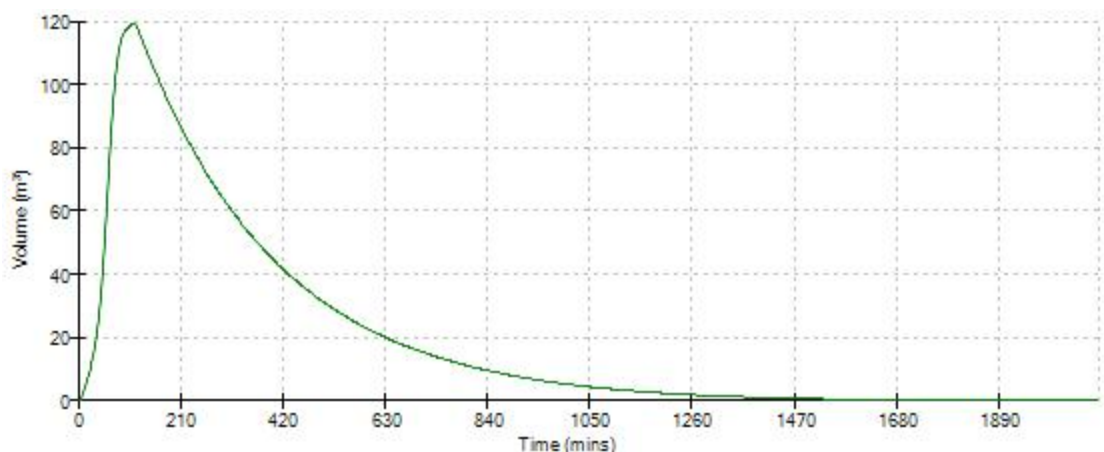
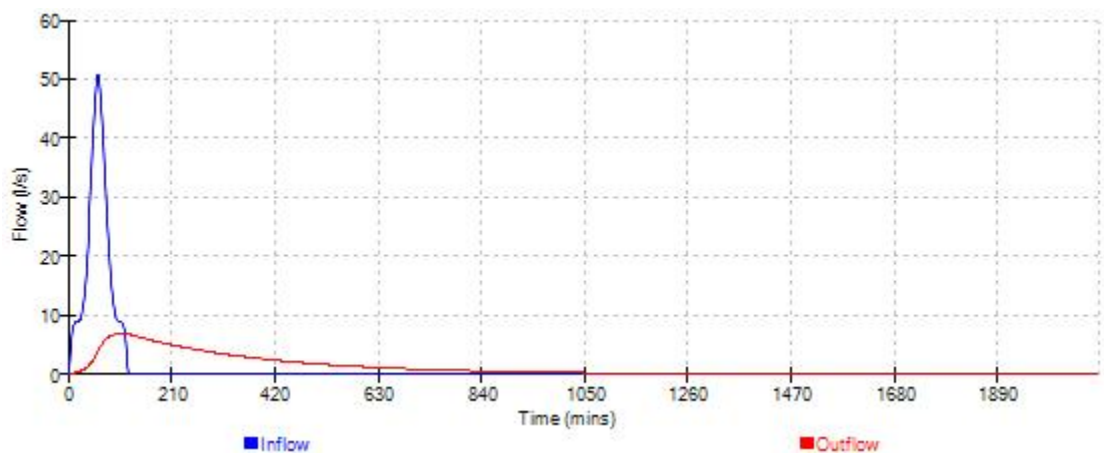
Storage is Online Cover Level (m) 10.000

Trench Soakaway Structure

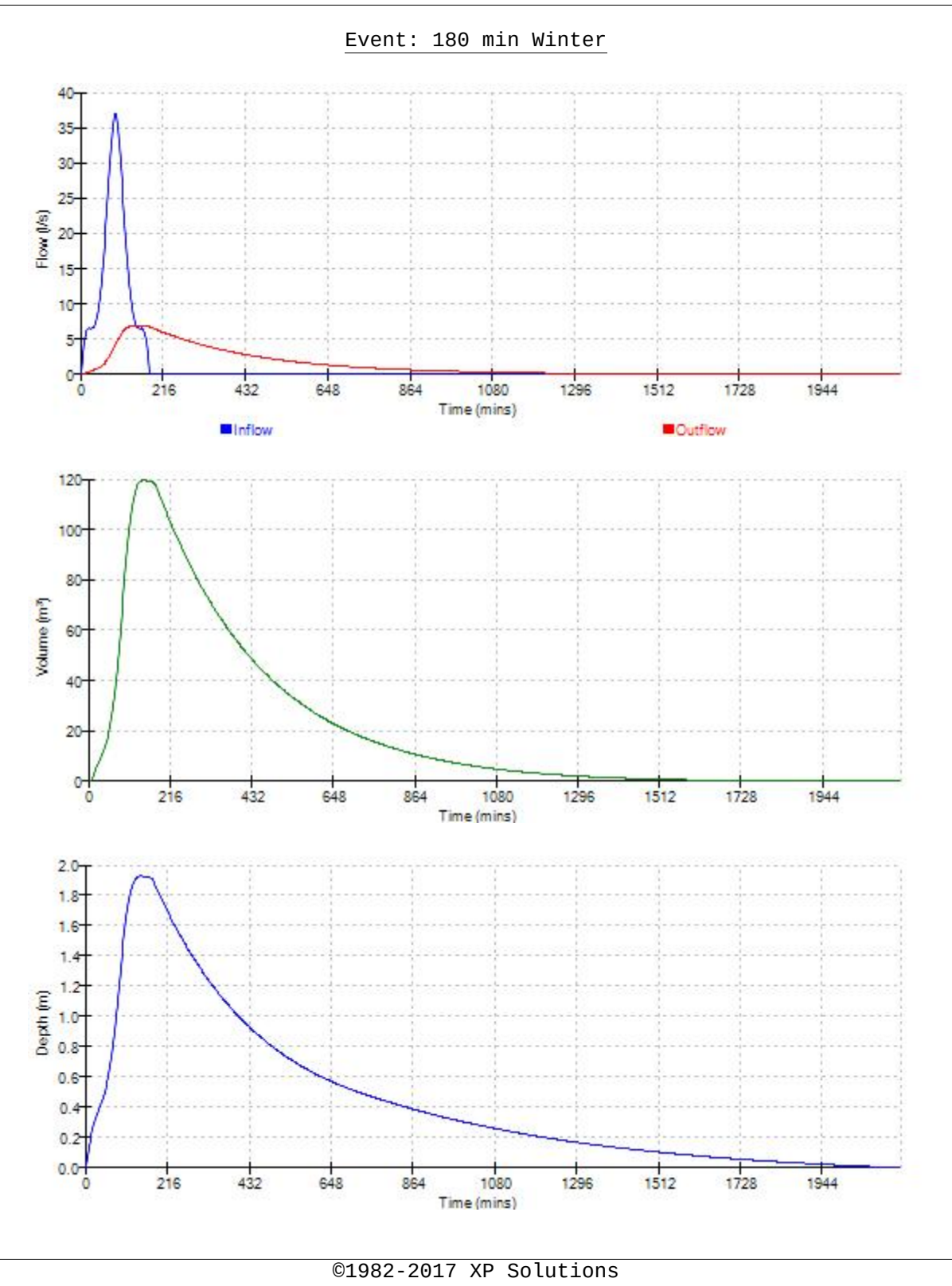
Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.31900	Trench Length (m)	25.0
Safety Factor	1.2	Slope (1:X)	50.0
Porosity	0.95	Cap Volume Depth (m)	9.000
Invert Level (m)	8.000	Cap Infiltration Depth (m)	9.000

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Event: 120 min Winter

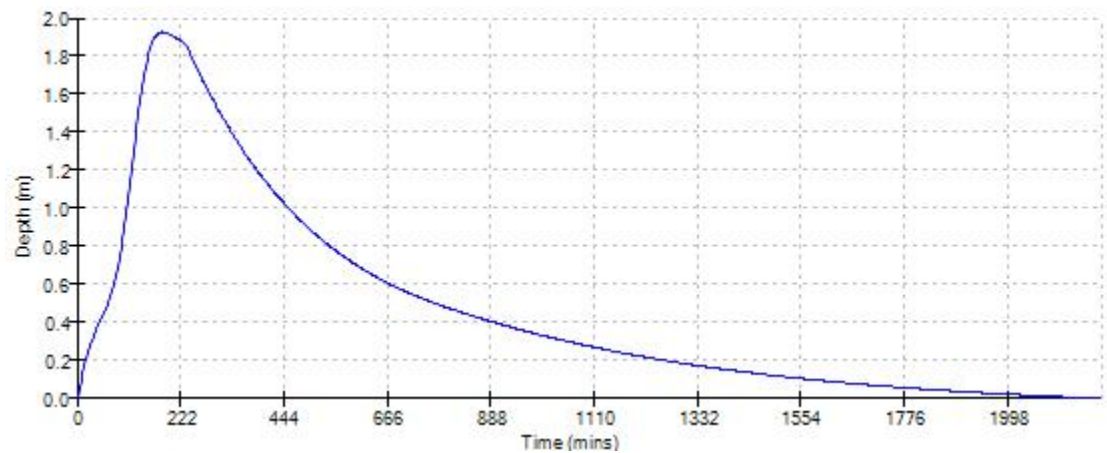
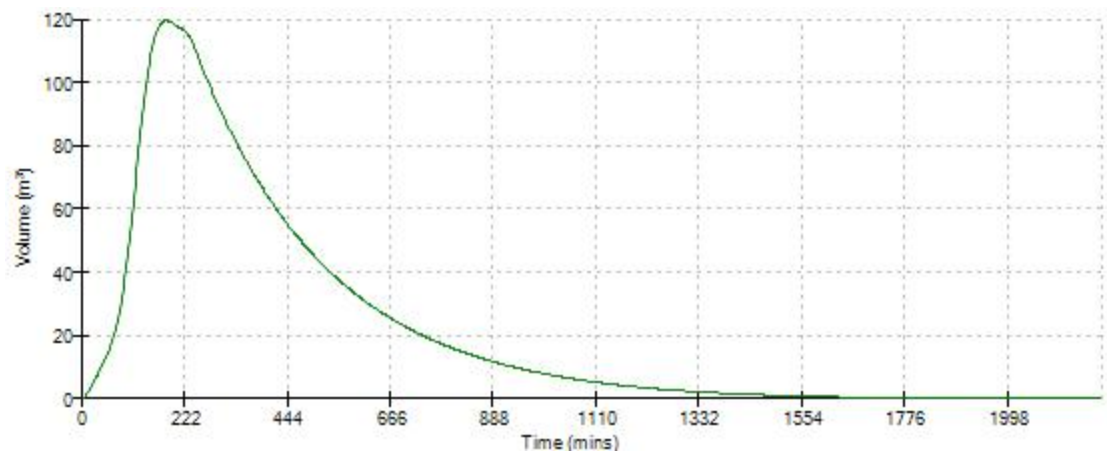
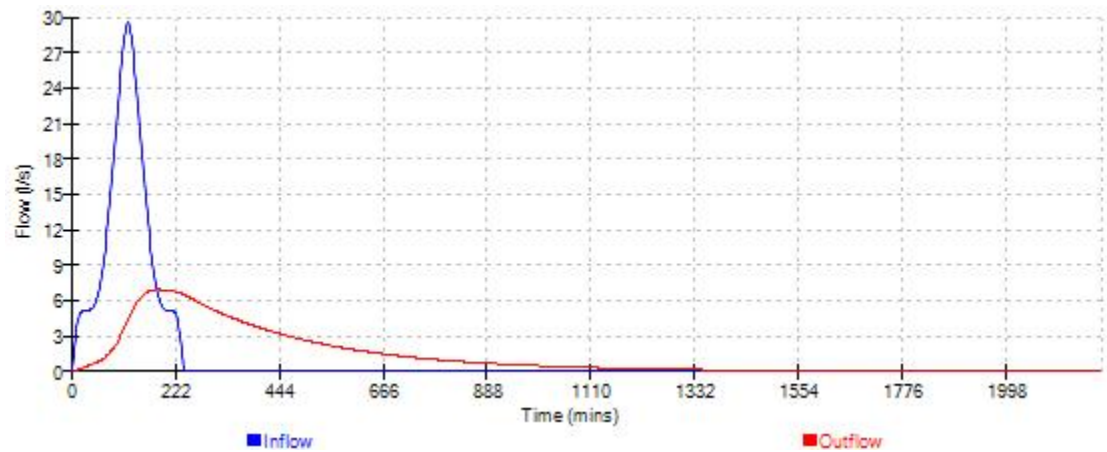


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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Service Road	
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Event: 240 min Winter



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XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 103 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	9.327	1.327	1.3	12.1	0 K
30 min Summer	9.460	1.460	1.5	13.4	0 K
60 min Summer	9.539	1.539	1.5	14.1	0 K
120 min Summer	9.562	1.562	1.6	14.4	0 K
180 min Summer	9.557	1.557	1.6	14.3	0 K
240 min Summer	9.536	1.536	1.5	14.1	0 K
360 min Summer	9.473	1.473	1.5	13.5	0 K
480 min Summer	9.404	1.404	1.4	12.9	0 K
600 min Summer	9.337	1.337	1.3	12.2	0 K
720 min Summer	9.275	1.275	1.3	11.6	0 K
960 min Summer	9.193	1.193	1.2	10.9	0 K
1440 min Summer	9.058	1.058	1.0	9.6	0 K
2160 min Summer	8.912	0.912	0.9	8.2	0 K
2880 min Summer	8.808	0.808	0.8	7.2	0 K
4320 min Summer	8.639	0.639	0.6	5.6	0 K
5760 min Summer	8.535	0.535	0.5	4.6	0 K
7200 min Summer	8.465	0.465	0.4	3.9	0 K
8640 min Summer	8.414	0.414	0.4	3.5	0 K
10080 min Summer	8.376	0.376	0.3	3.1	0 K
15 min Winter	9.480	1.480	1.5	13.6	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	174.711	0.0	16
30 min Summer	101.253	0.0	30
60 min Summer	58.681	0.0	60
120 min Summer	34.008	0.0	88
180 min Summer	24.717	0.0	122
240 min Summer	19.709	0.0	156
360 min Summer	14.325	0.0	226
480 min Summer	11.423	0.0	292
600 min Summer	9.583	0.0	356
720 min Summer	8.302	0.0	424
960 min Summer	6.772	0.0	548
1440 min Summer	5.082	0.0	794
2160 min Summer	3.814	0.0	1168
2880 min Summer	3.111	0.0	1528
4320 min Summer	2.227	0.0	2252
5760 min Summer	1.756	0.0	2992
7200 min Summer	1.461	0.0	3680
8640 min Summer	1.257	0.0	4416
10080 min Summer	1.107	0.0	5144
15 min Winter	174.711	0.0	16

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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Retail Store	
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XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	9.635	1.635	1.6	15.1	0 K
60 min Winter	9.731	1.731	1.7	16.0	Flood Risk
120 min Winter	9.741	1.741	1.7	16.1	Flood Risk
180 min Winter	9.715	1.715	1.7	15.8	Flood Risk
240 min Winter	9.668	1.668	1.7	15.4	0 K
360 min Winter	9.560	1.560	1.6	14.3	0 K
480 min Winter	9.454	1.454	1.5	13.3	0 K
600 min Winter	9.358	1.358	1.4	12.4	0 K
720 min Winter	9.273	1.273	1.3	11.6	0 K
960 min Winter	9.157	1.157	1.1	10.5	0 K
1440 min Winter	8.979	0.979	1.0	8.8	0 K
2160 min Winter	8.804	0.804	0.8	7.2	0 K
2880 min Winter	8.690	0.690	0.7	6.1	0 K
4320 min Winter	8.525	0.525	0.5	4.5	0 K
5760 min Winter	8.430	0.430	0.4	3.6	0 K
7200 min Winter	8.369	0.369	0.3	3.0	0 K
8640 min Winter	8.326	0.326	0.3	2.6	0 K
10080 min Winter	8.294	0.294	0.3	2.3	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	101.253	0.0	30
60 min Winter	58.681	0.0	58
120 min Winter	34.008	0.0	92
180 min Winter	24.717	0.0	132
240 min Winter	19.709	0.0	168
360 min Winter	14.325	0.0	240
480 min Winter	11.423	0.0	310
600 min Winter	9.583	0.0	378
720 min Winter	8.302	0.0	446
960 min Winter	6.772	0.0	576
1440 min Winter	5.082	0.0	824
2160 min Winter	3.814	0.0	1192
2880 min Winter	3.111	0.0	1560
4320 min Winter	2.227	0.0	2292
5760 min Winter	1.756	0.0	3000
7200 min Winter	1.461	0.0	3744
8640 min Winter	1.257	0.0	4488
10080 min Winter	1.107	0.0	5152

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XP Solutions	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.407	Cv (Summer)	0.750
Return Period (years)	100	D3 (1km)	0.290	Cv (Winter)	0.840
FEH Rainfall Version	1999	E (1km)	0.286	Shortest Storm (mins)	15
Site Location		F (1km)	2.420	Longest Storm (mins)	10080
C (1km)	-0.025	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.328	Winter Storms	Yes		

Time Area Diagram

Total Area (ha) 0.039

Time (mins)	Area
From:	To: (ha)

0	1 0.039
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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Retail Store	
Date 20-Apr-18 8:08 AM File w10229-180419-Store.SRCX	Designed by Johanne.Williams Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

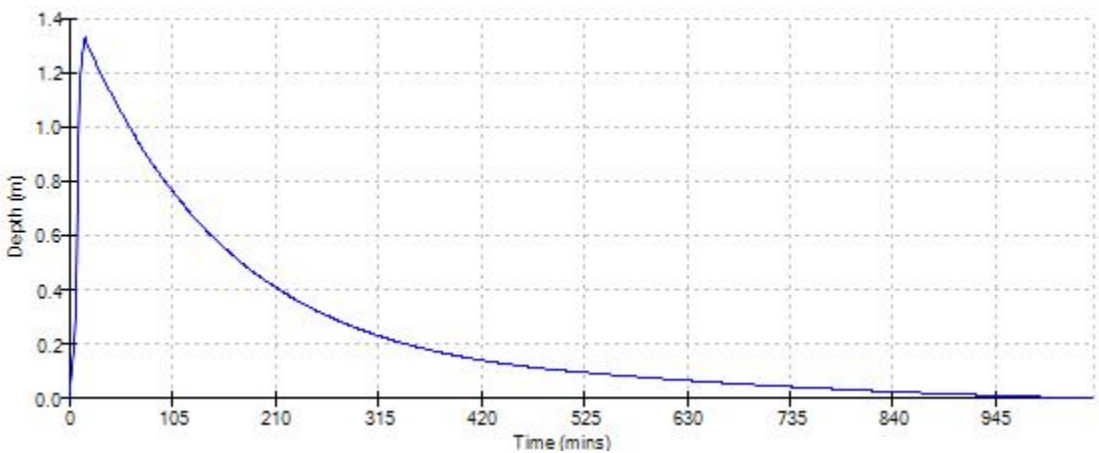
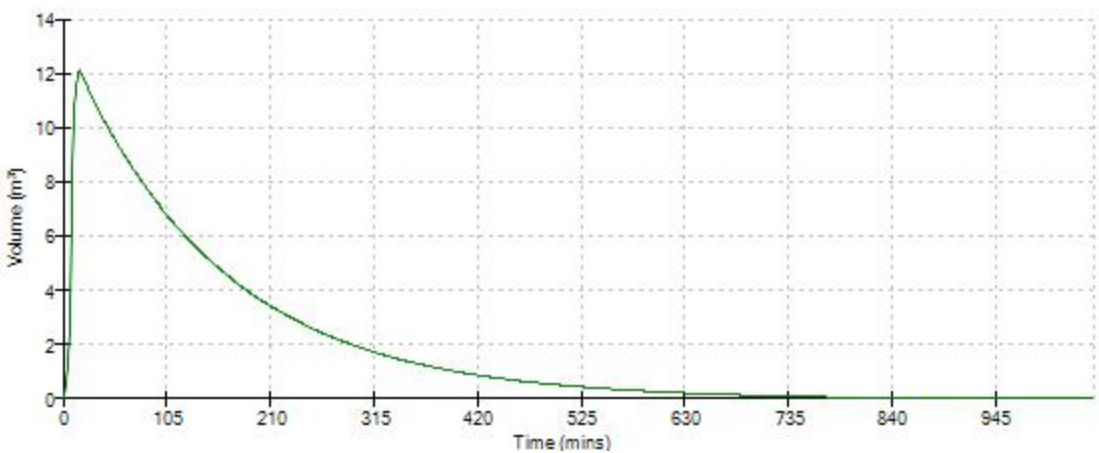
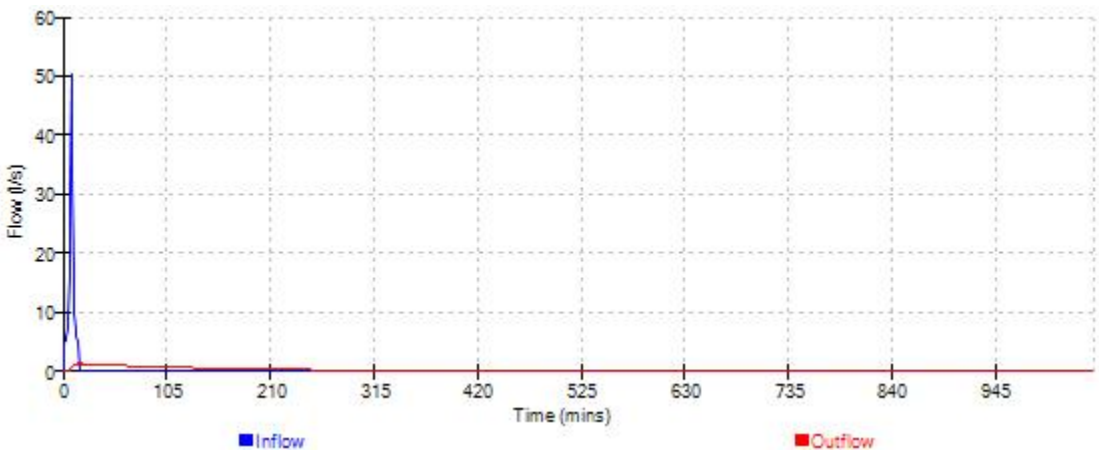
Model Details

Storage is Online Cover Level (m) 10.000

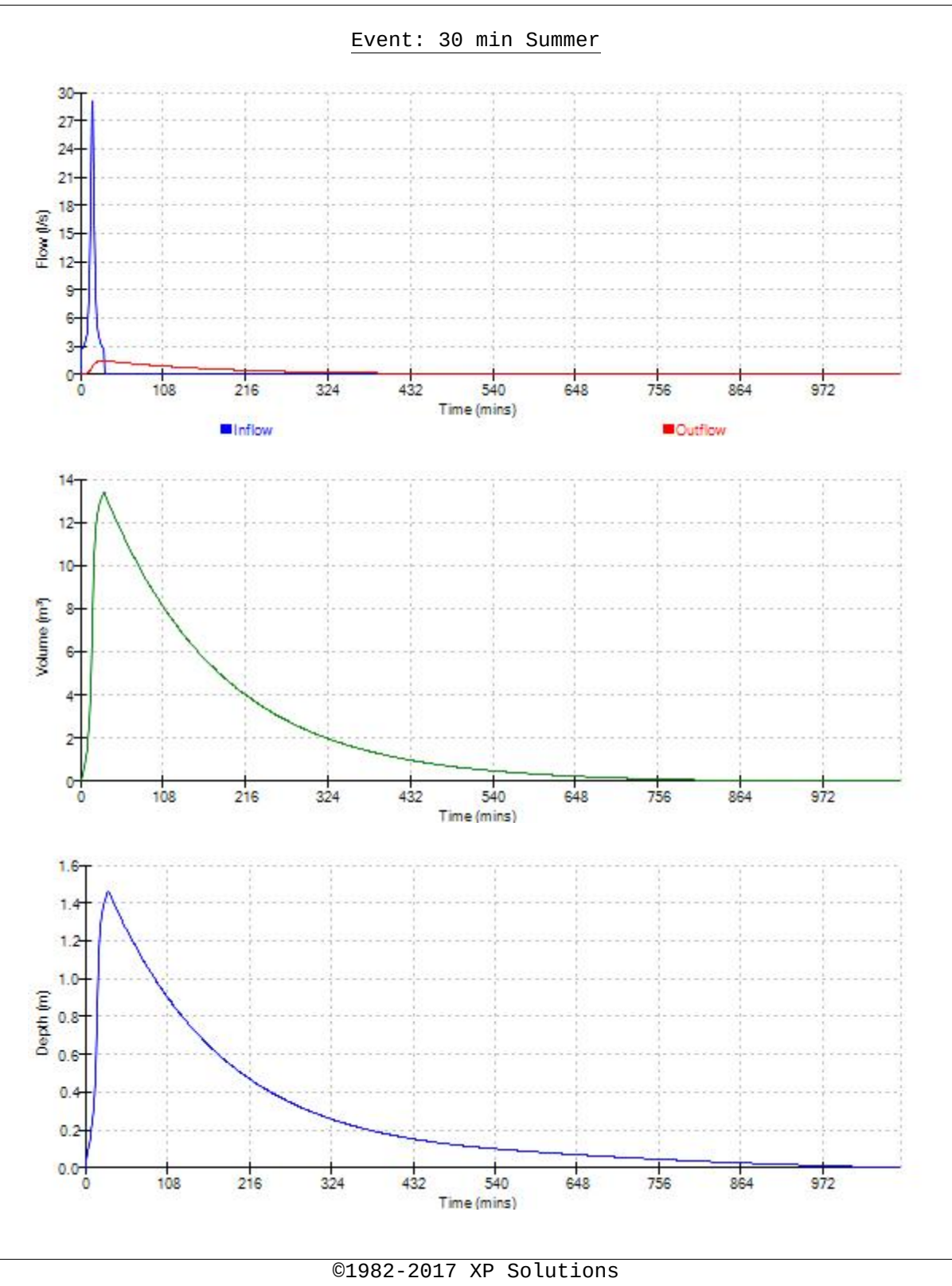
Trench Soakaway Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	2.0
Infiltration Coefficient Side (m/hr)	0.31900	Trench Length (m)	5.0
Safety Factor	1.2	Slope (1:X)	50.0
Porosity	0.95	Cap Volume Depth (m)	9.000
Invert Level (m)	8.000	Cap Infiltration Depth (m)	9.000

Event: 15 min Summer

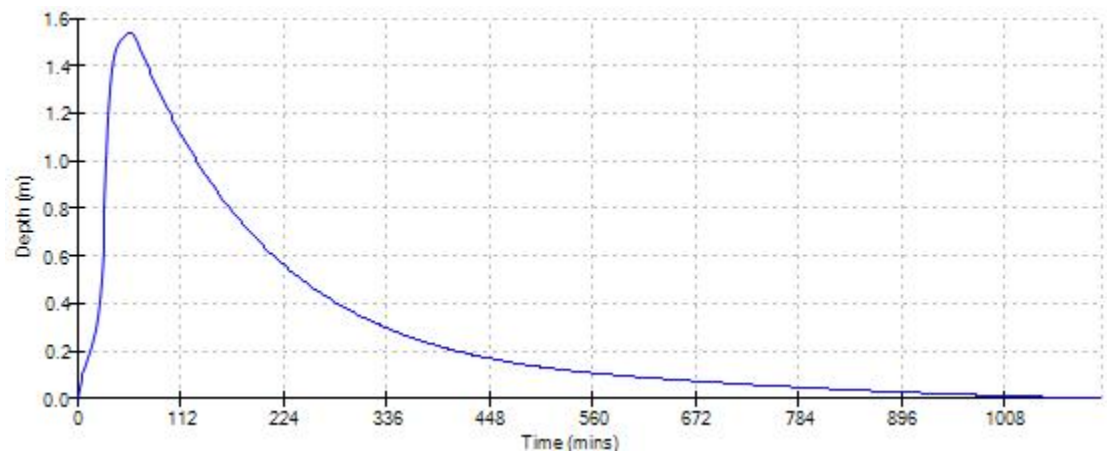
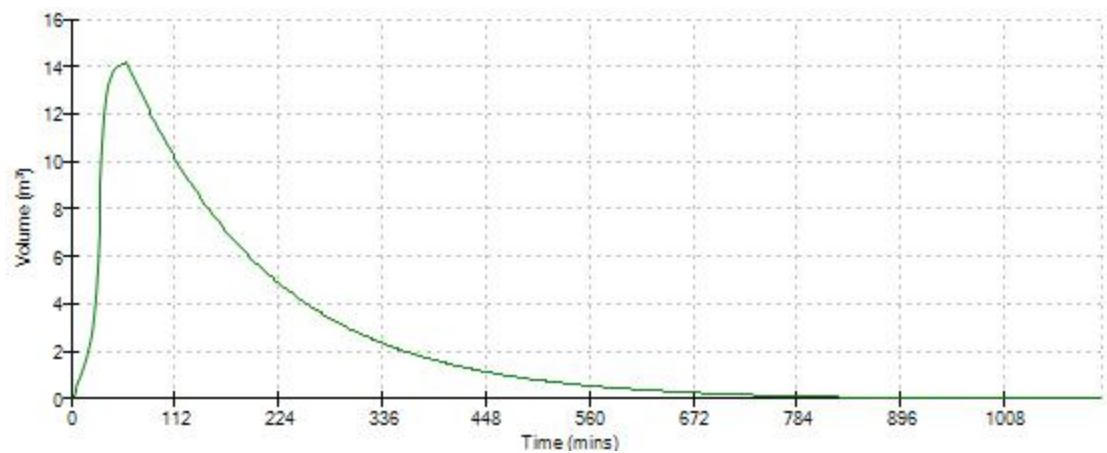
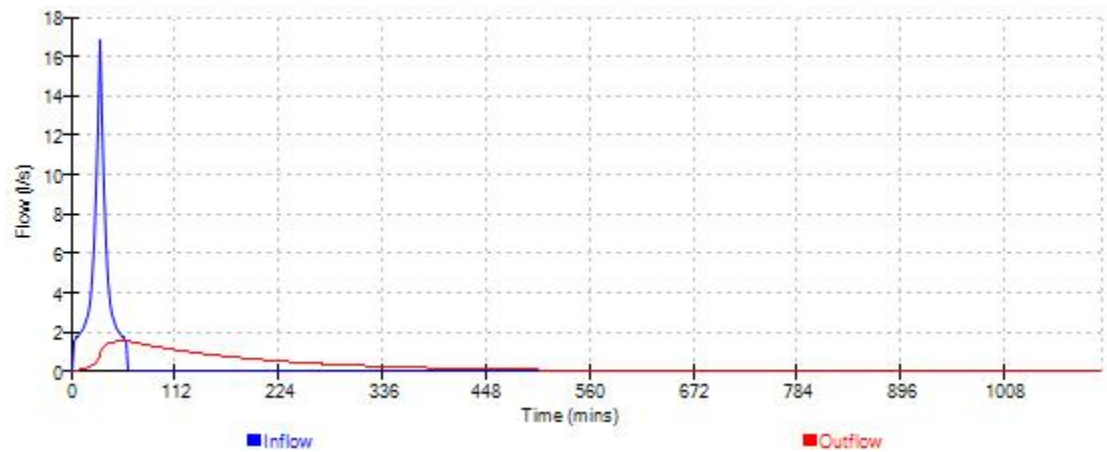


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File w10229-180419-Store.SRCX		Source Control 2017.1.2
XP Solutions		



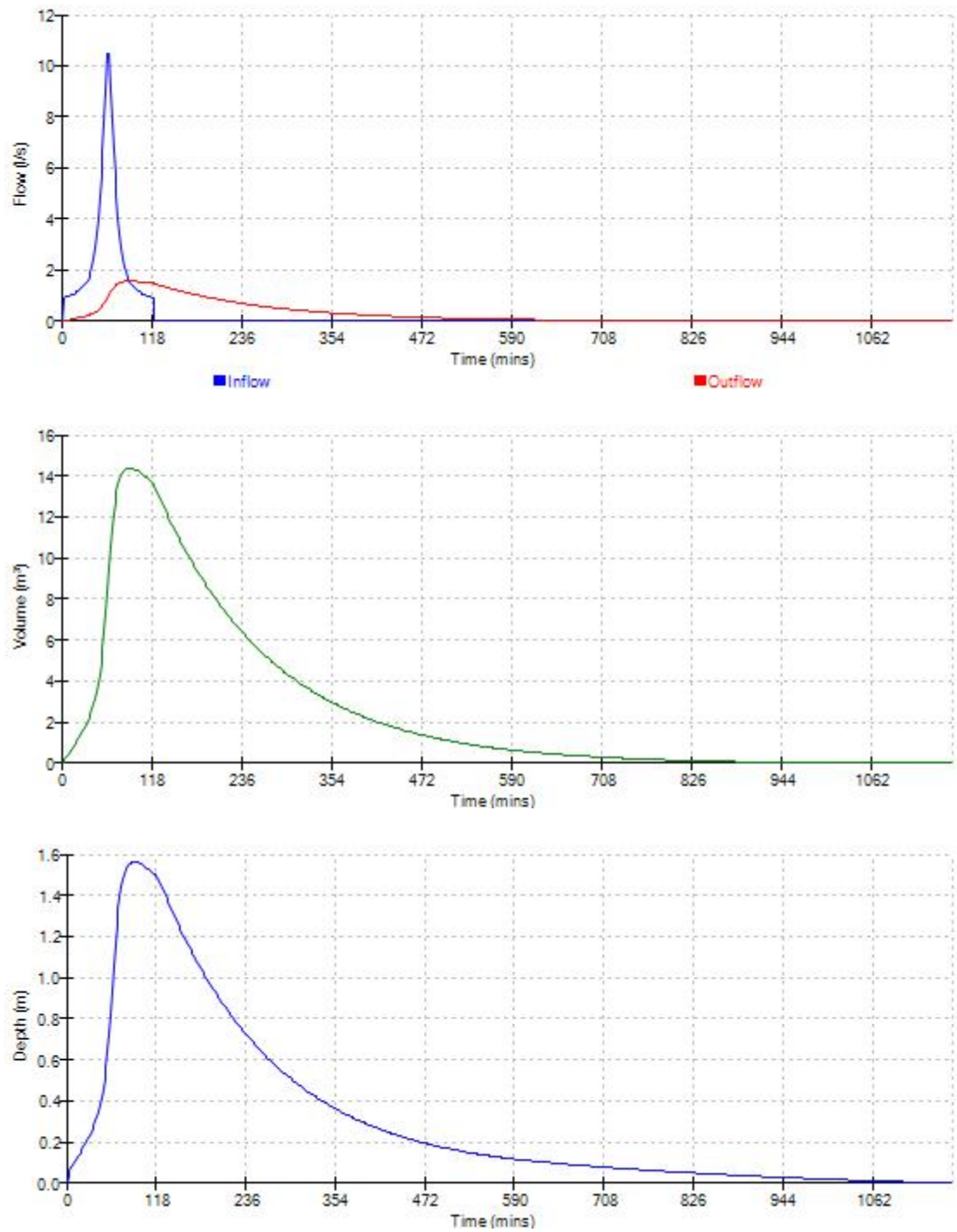
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	Designed by Johanne.Williams Checked by Josh Rigby	
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XP Solutions		

Event: 60 min Summer



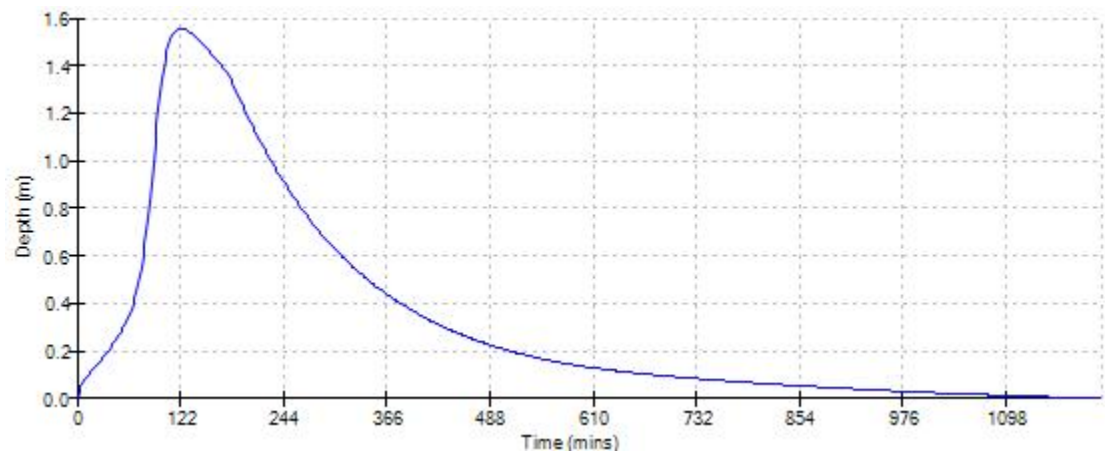
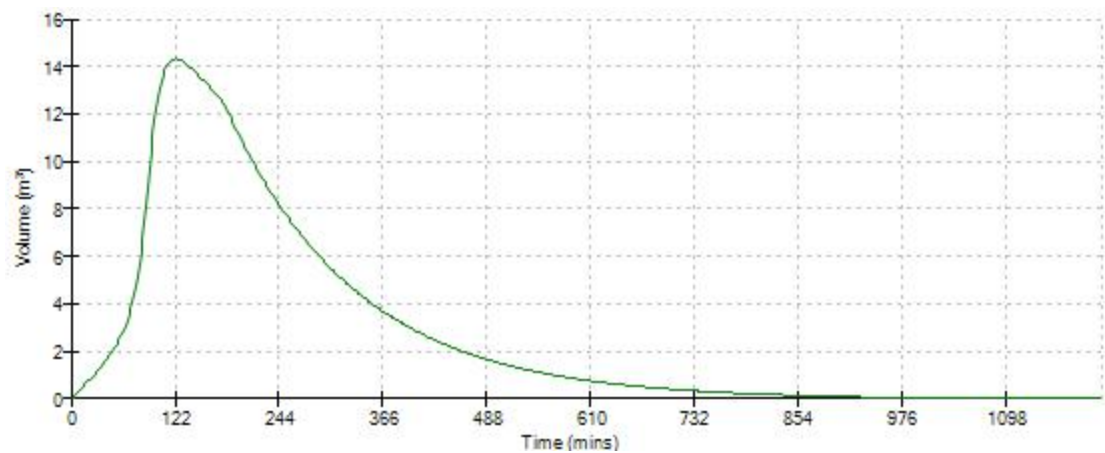
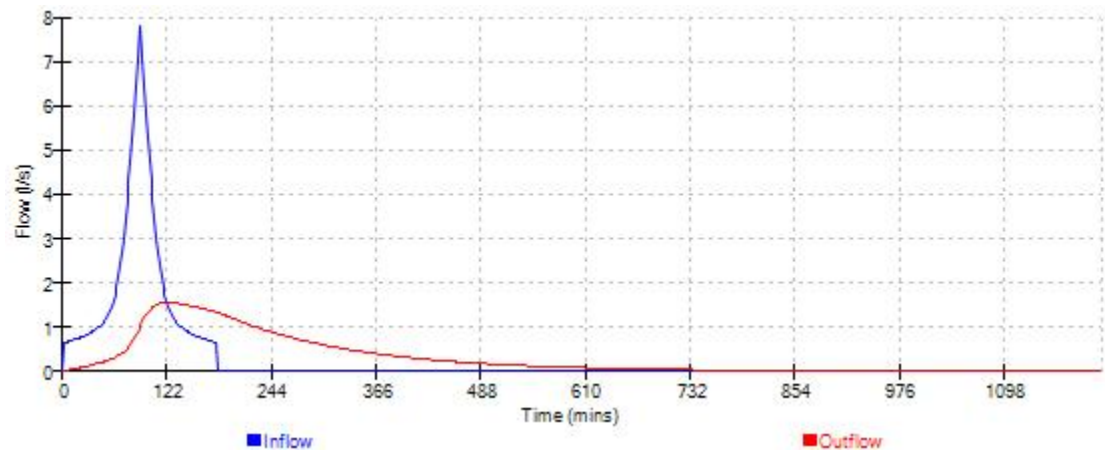
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		Designed by Johanne.Williams Checked by Josh Rigby Source Control 2017.1.2

Event: 120 min Summer

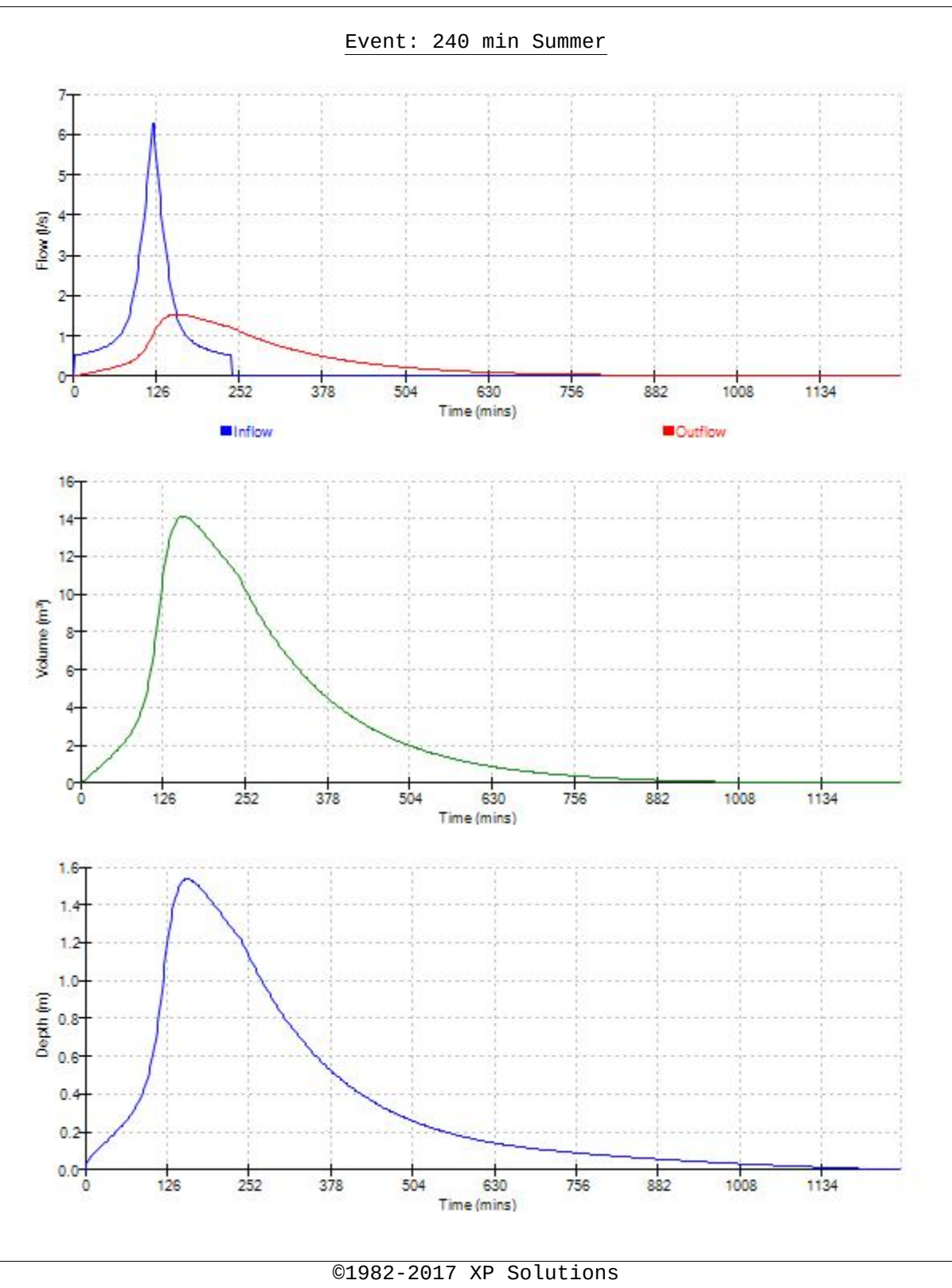


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Eden Court	W10229 - Royal British Legion	
Lon Parcwr Business Park	Llay	
Denbighshire LL15 1NJ	Retail Store	
Date 20-Apr-18 8:08 AM	Designed by Johanne.Williams	
File w10229-180419-Store.SRCX	Checked by Josh Rigby	
XP Solutions	Source Control 2017.1.2	

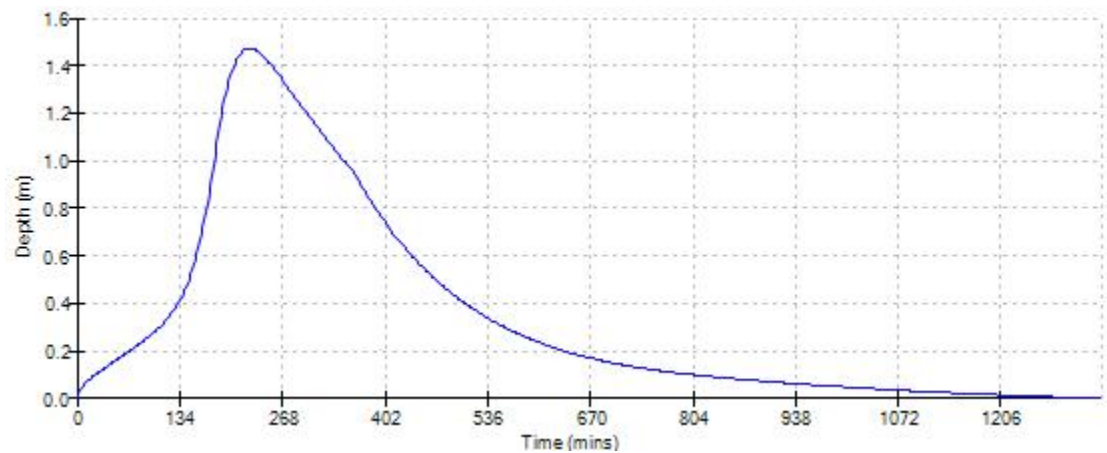
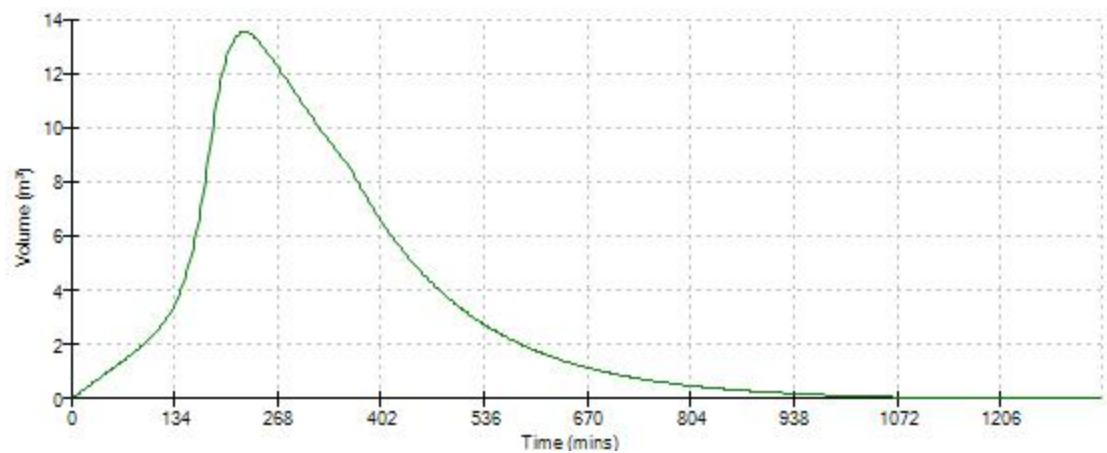
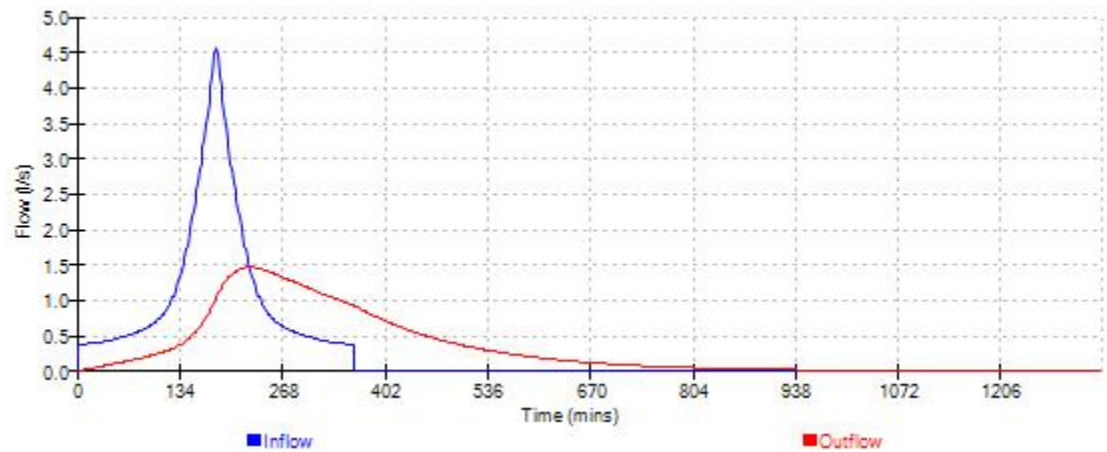
Event: 180 min Summer



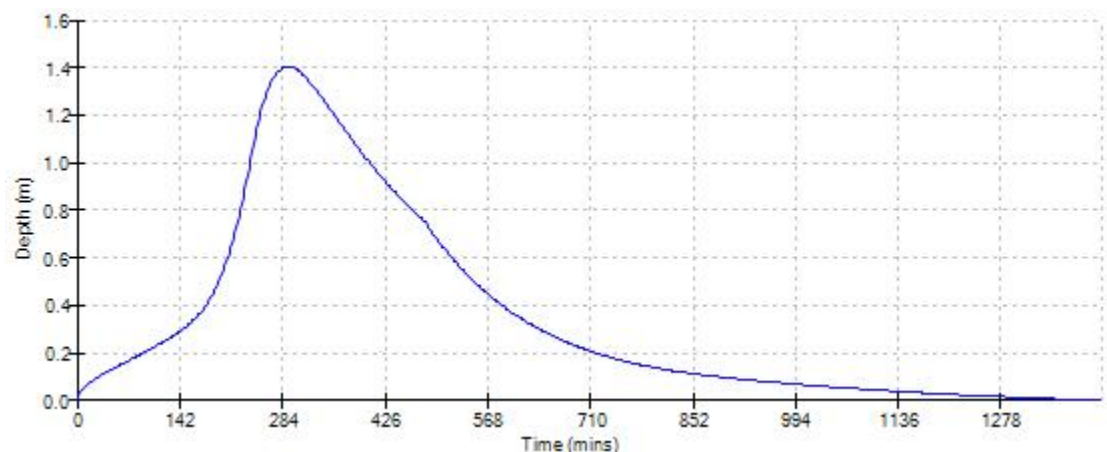
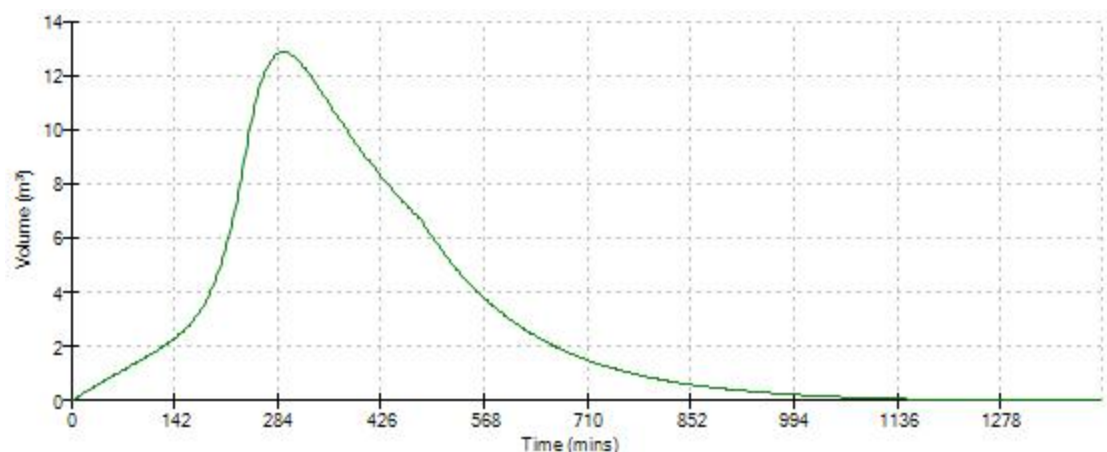
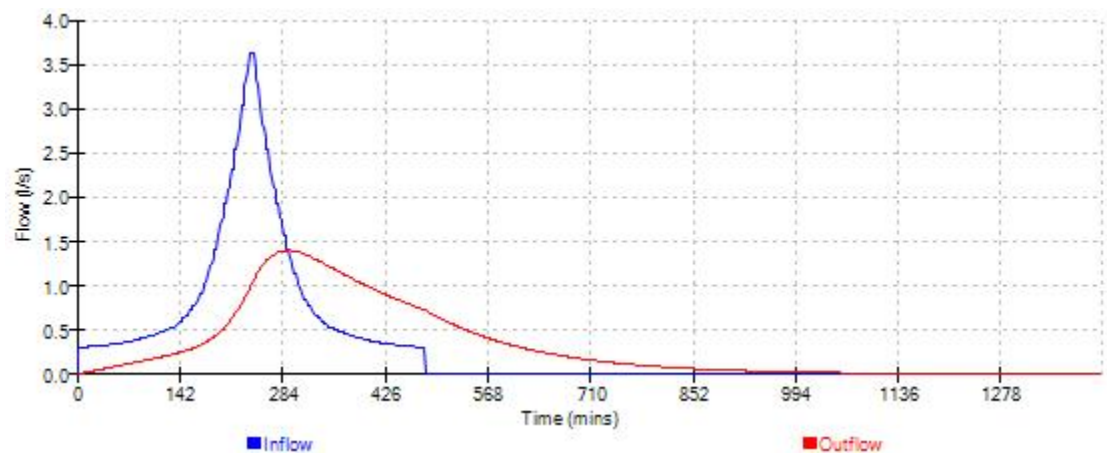
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	Date 20-Apr-18 8:08 AM File w10229-180419-Store.SRCX XP Solutions	
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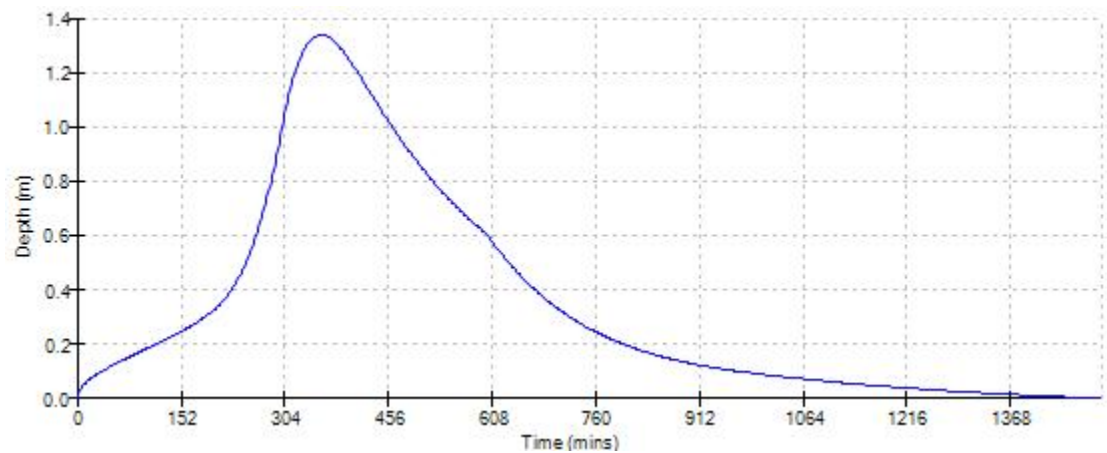
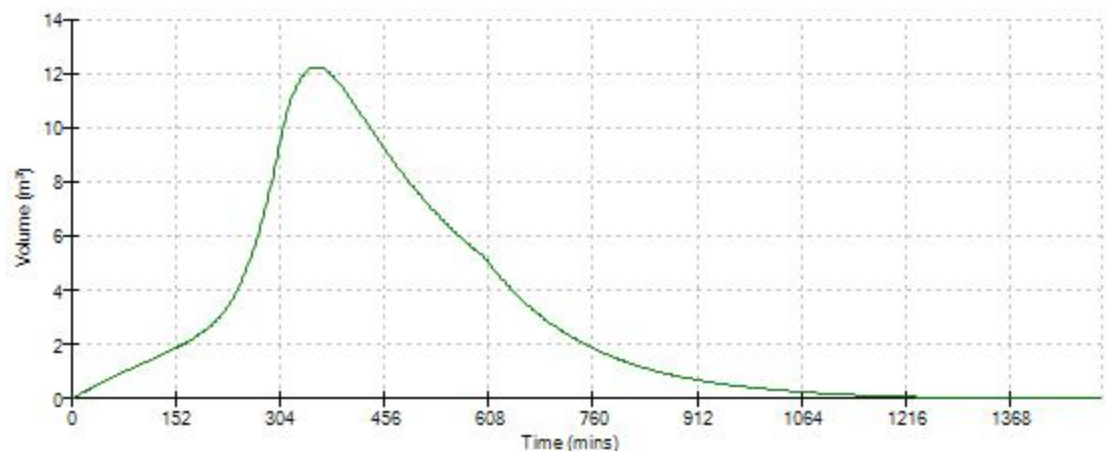
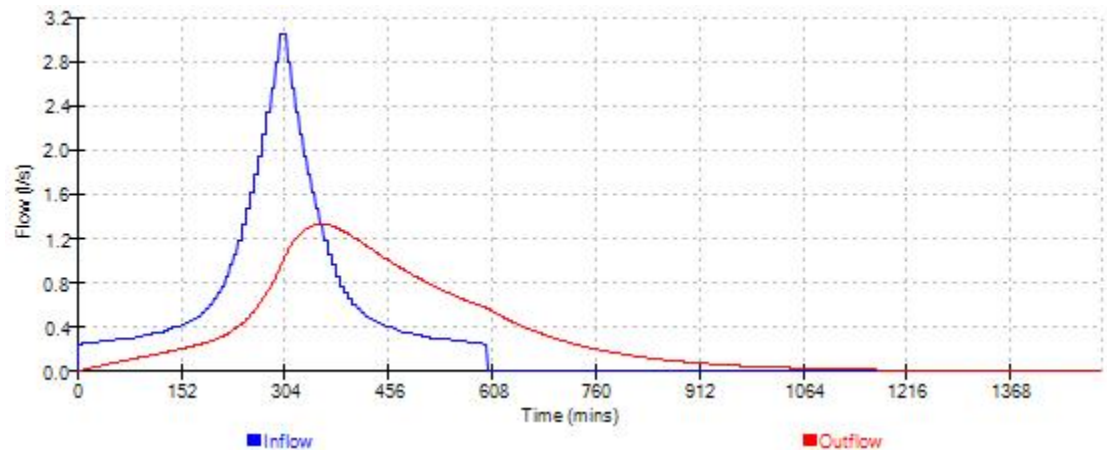
Event: 360 min Summer



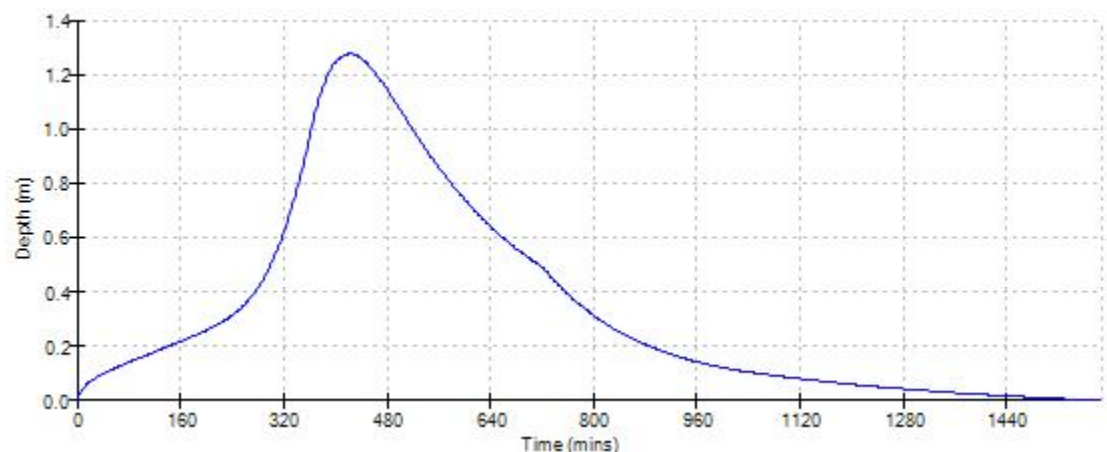
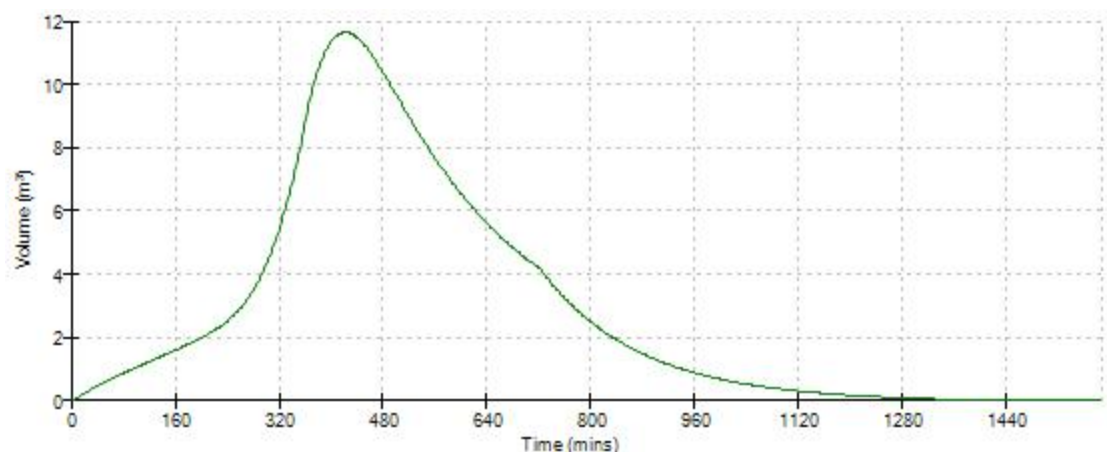
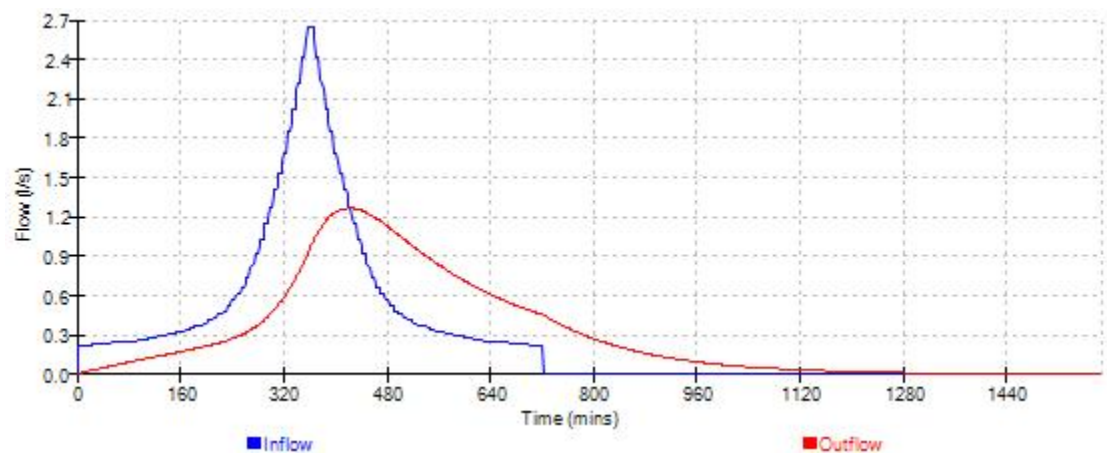
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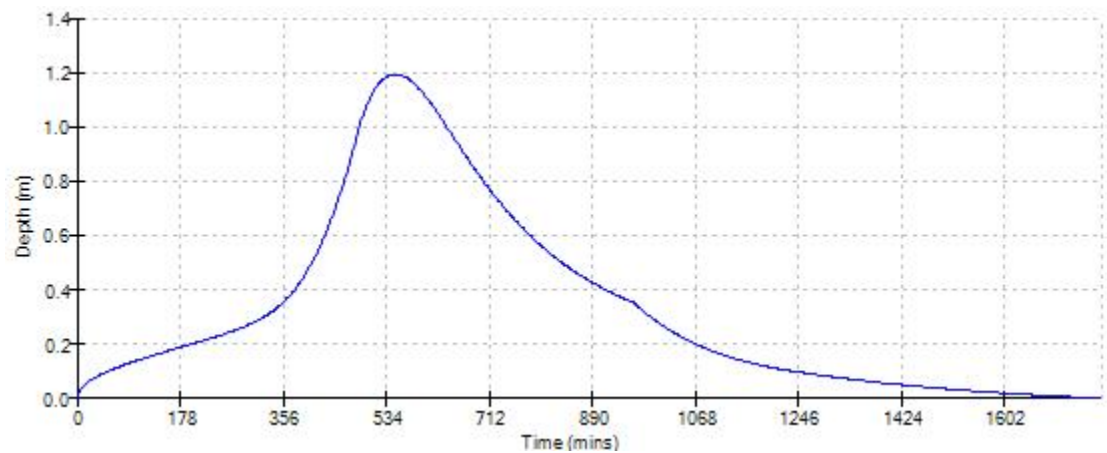
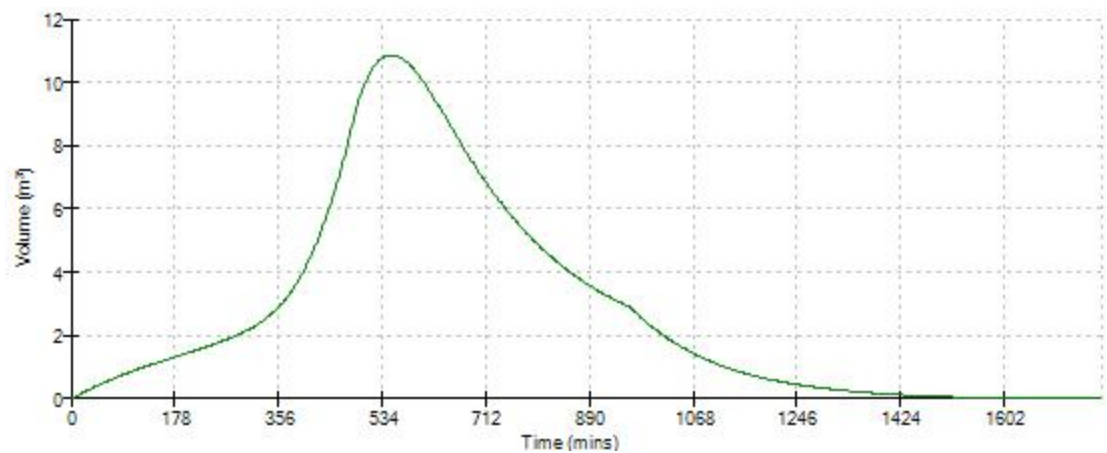
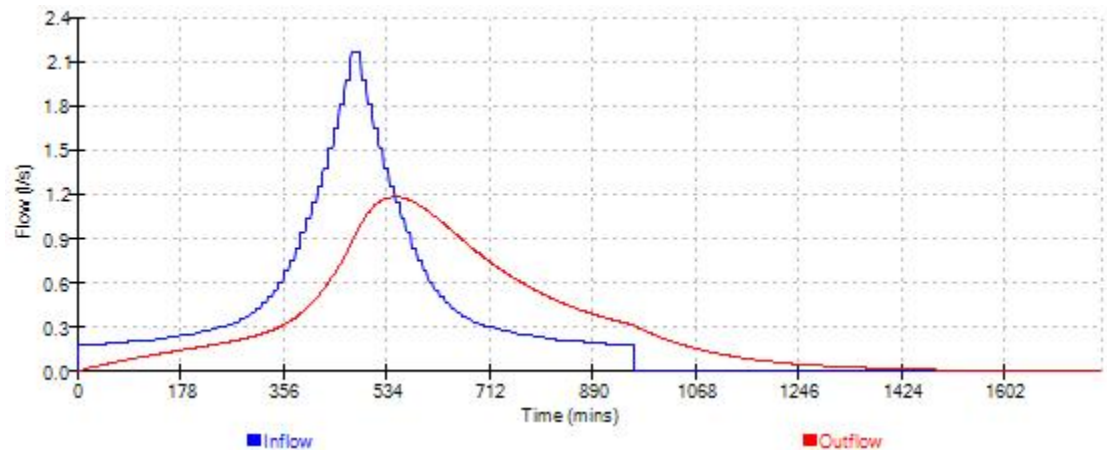
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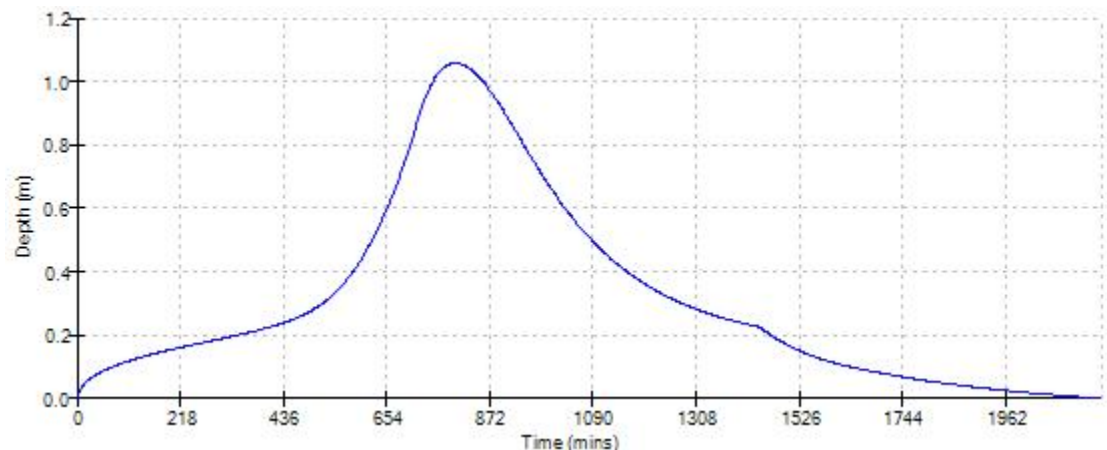
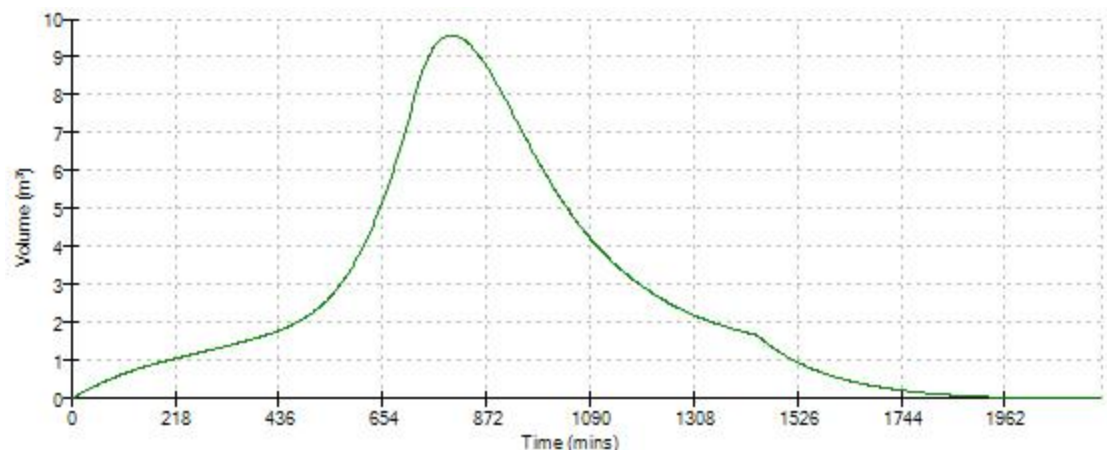
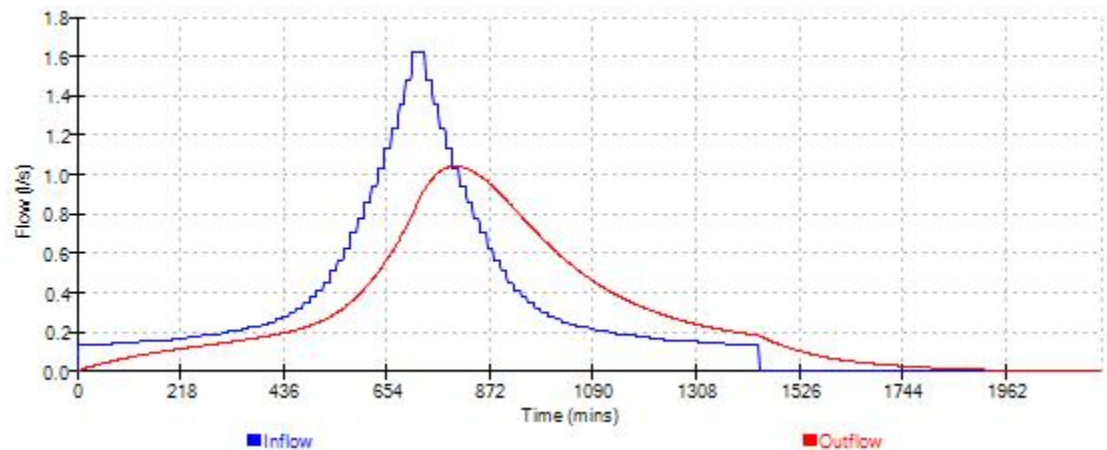
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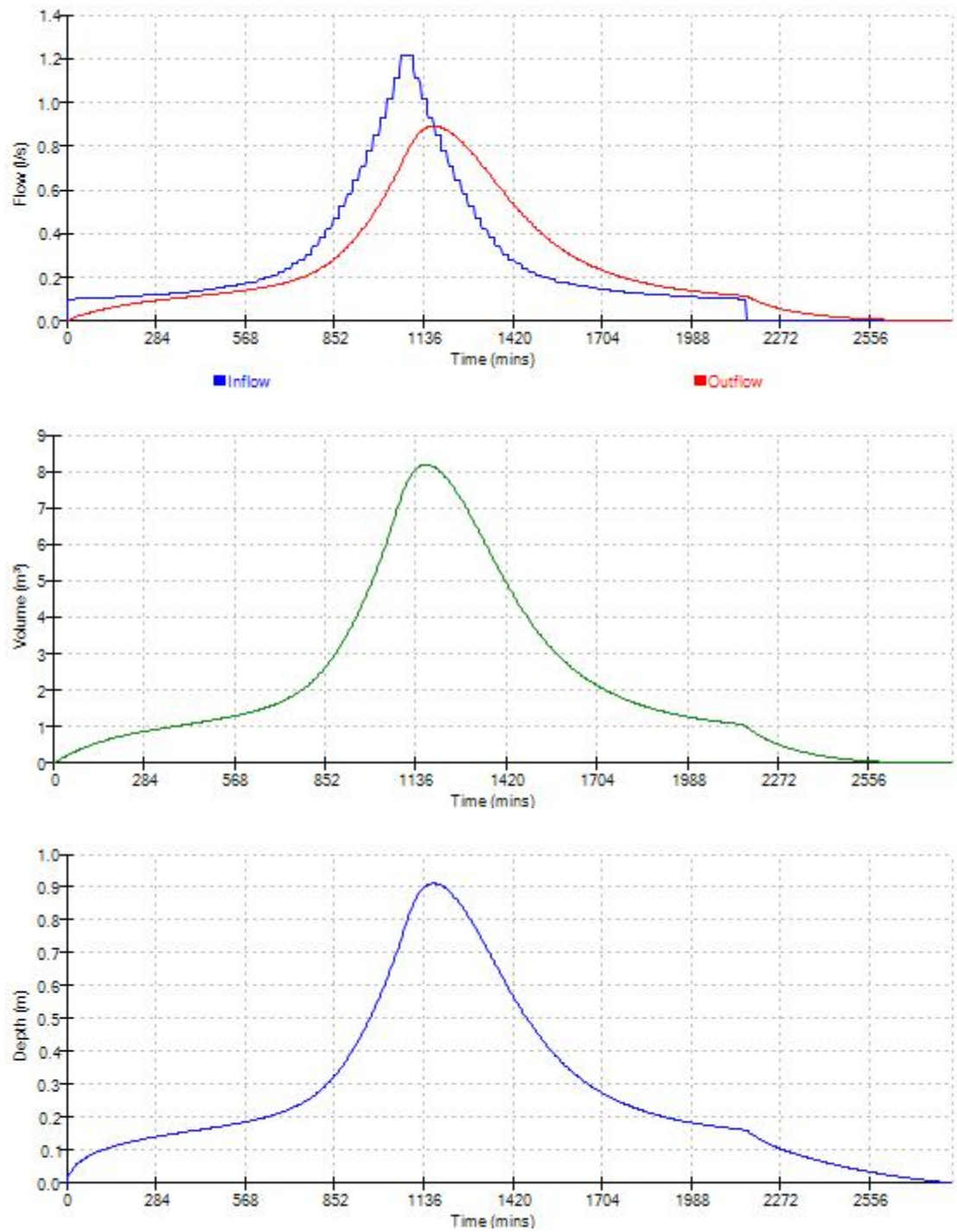
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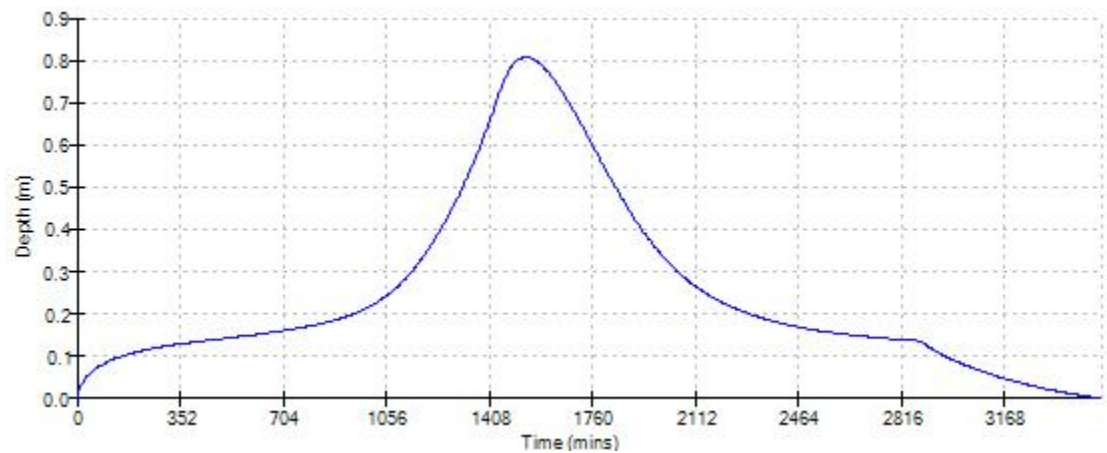
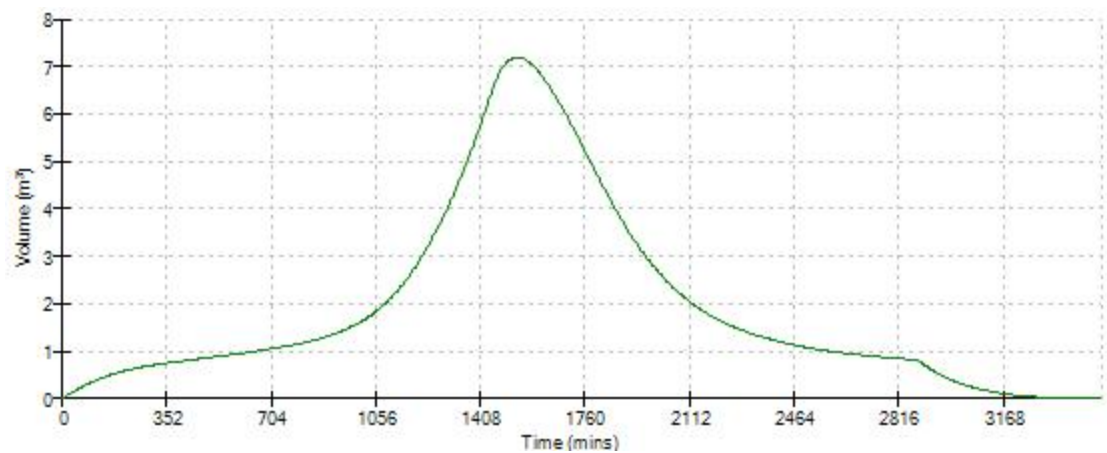
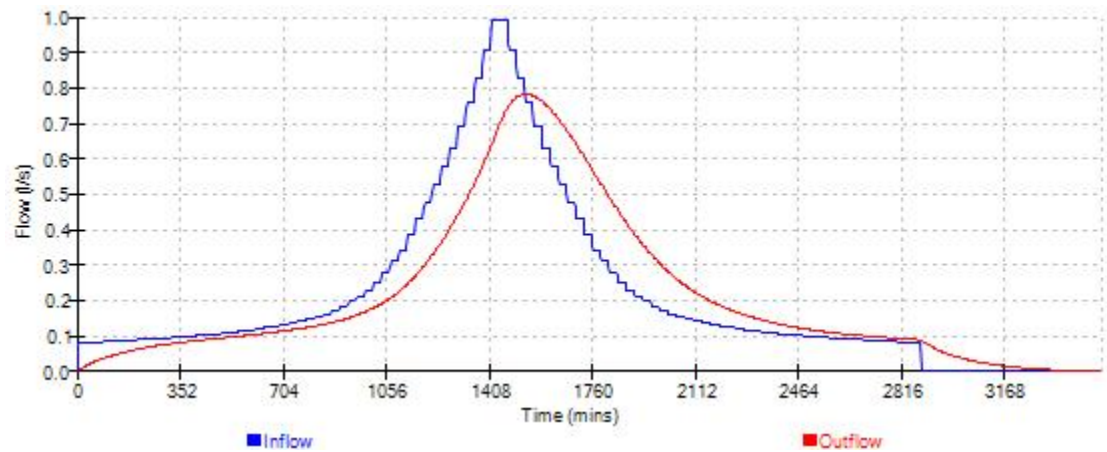
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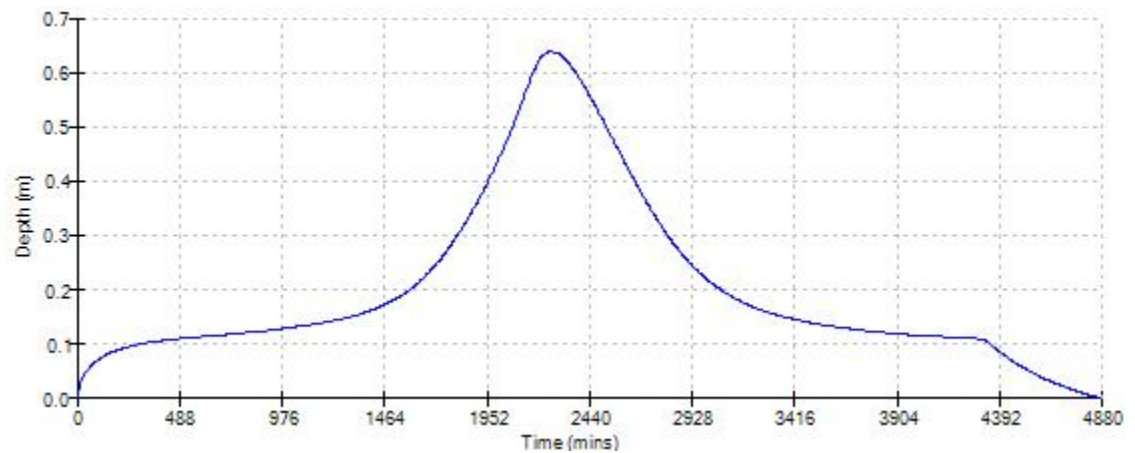
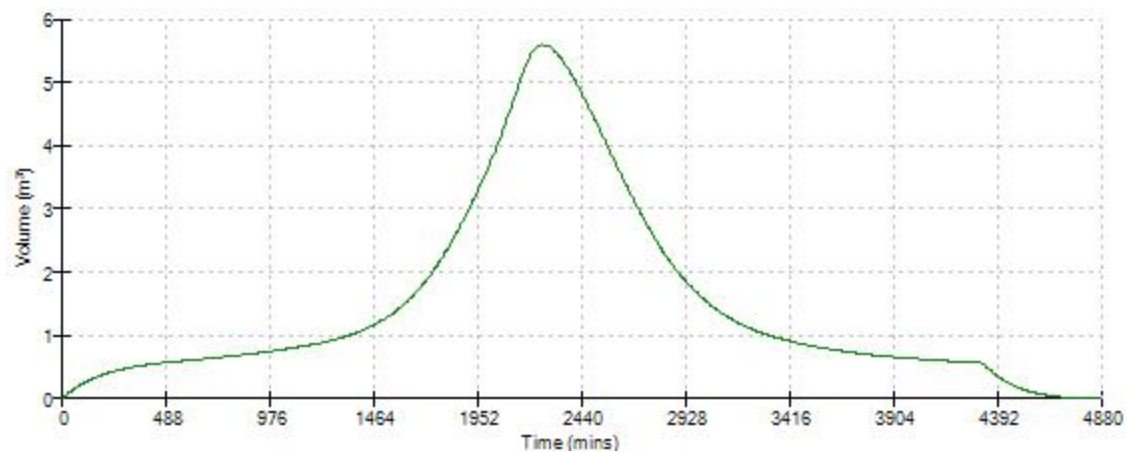
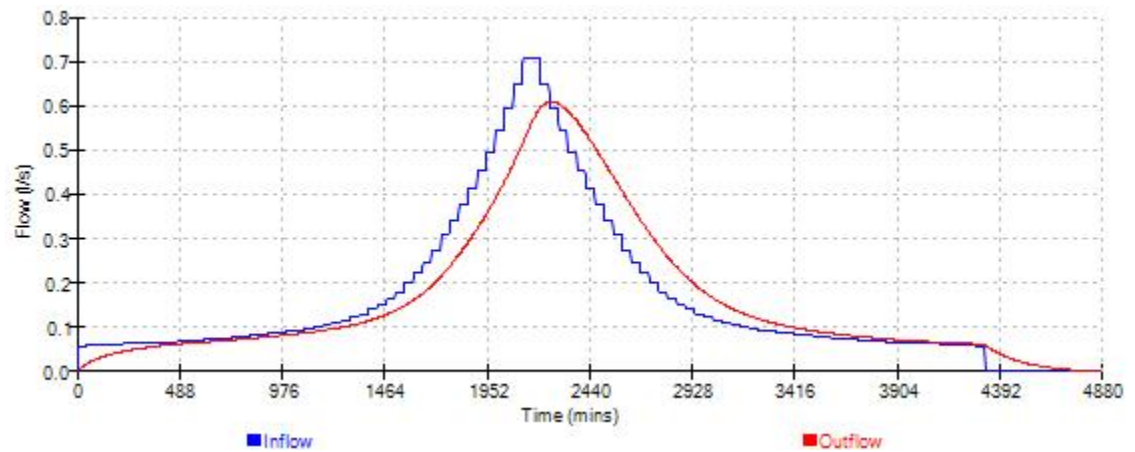
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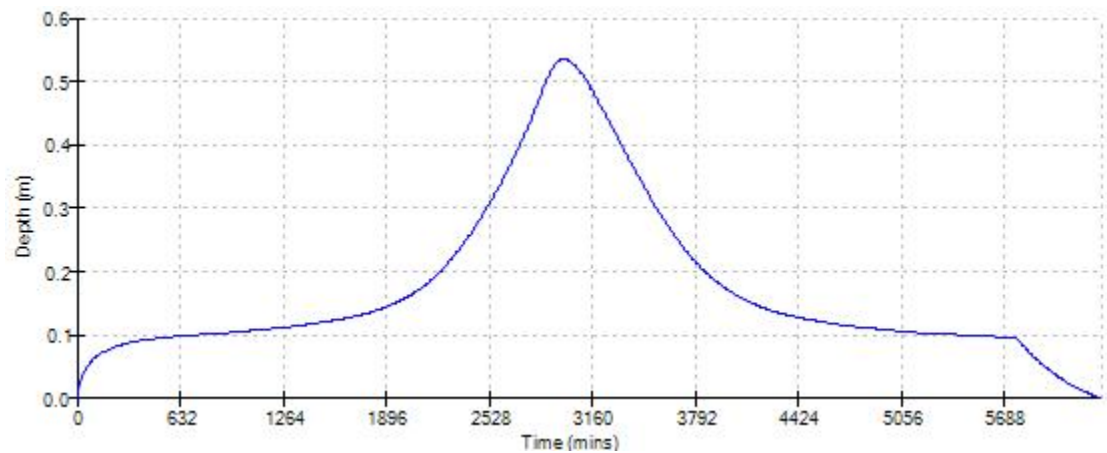
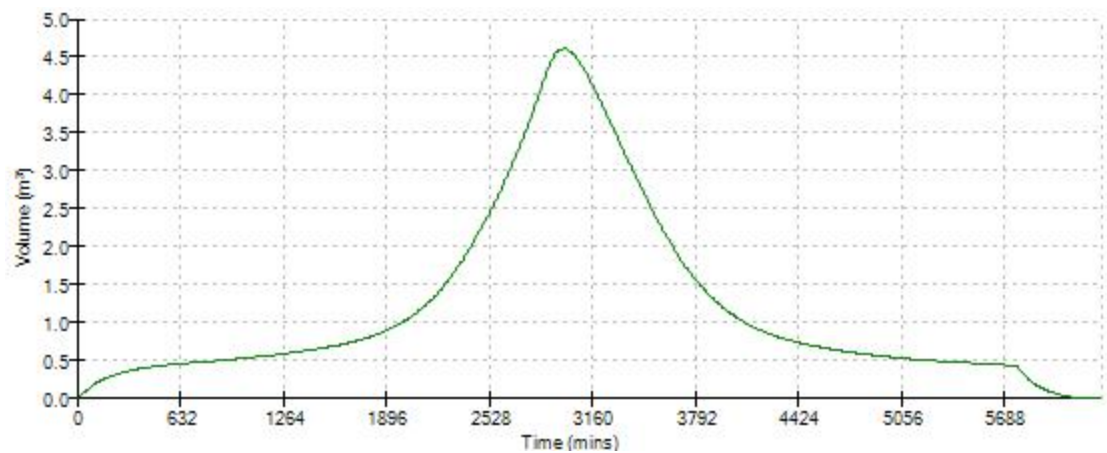
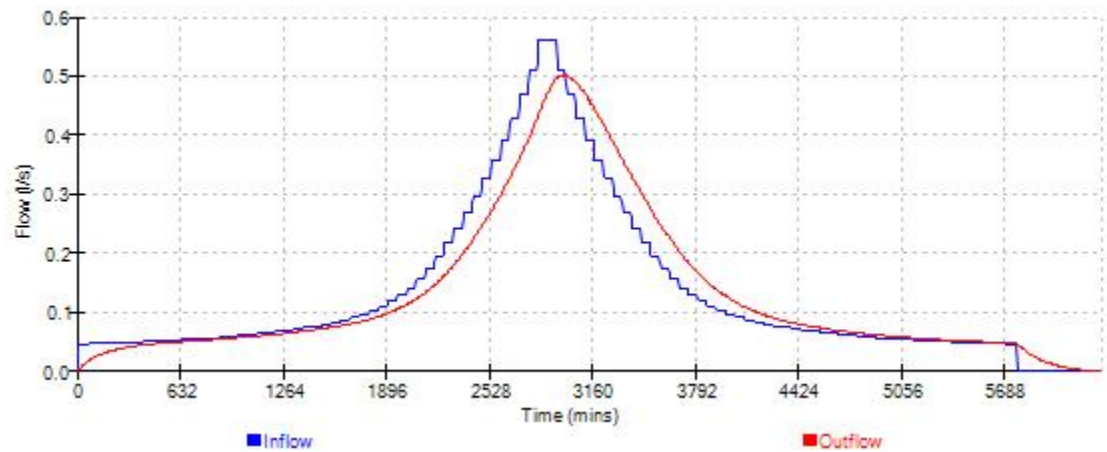
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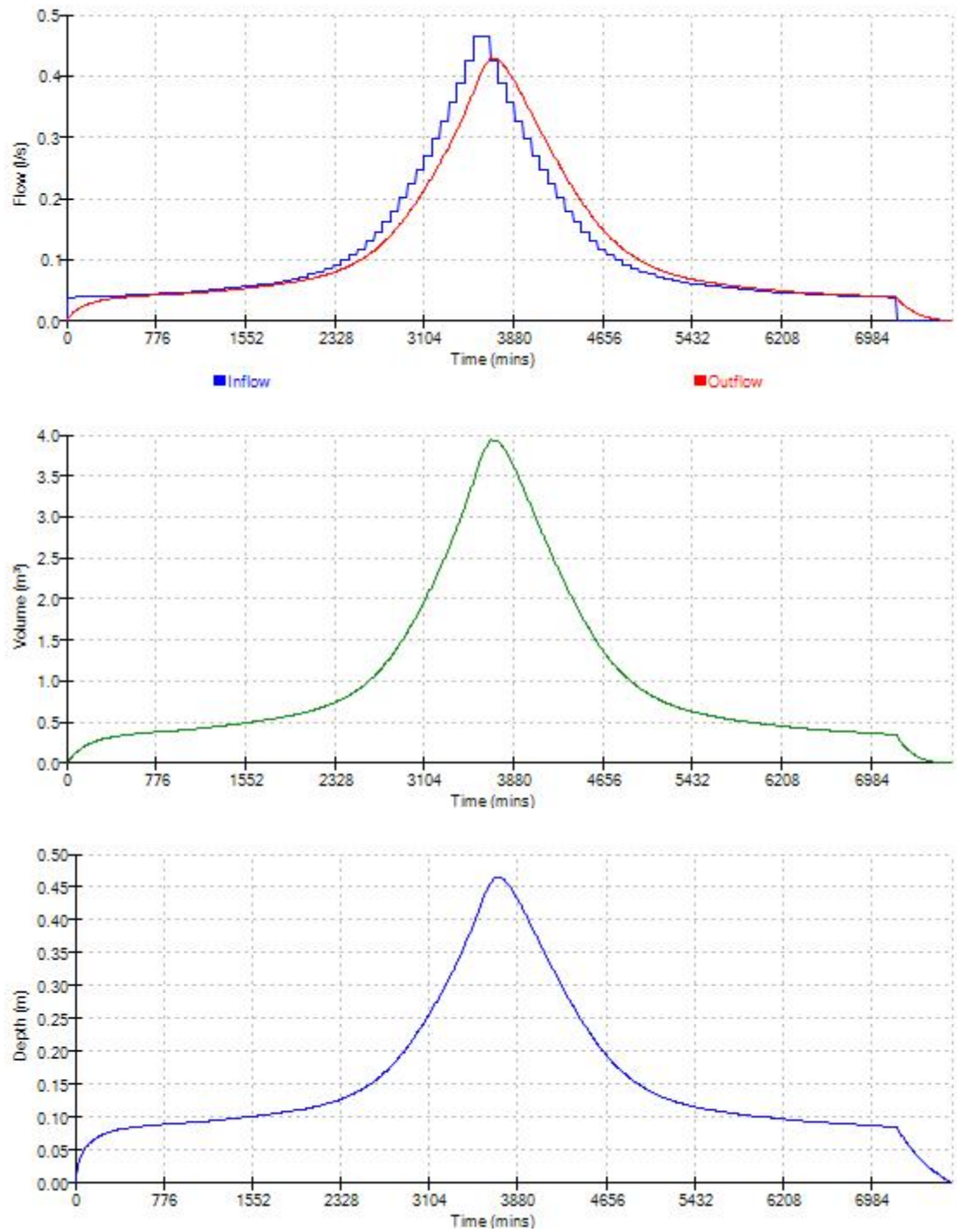
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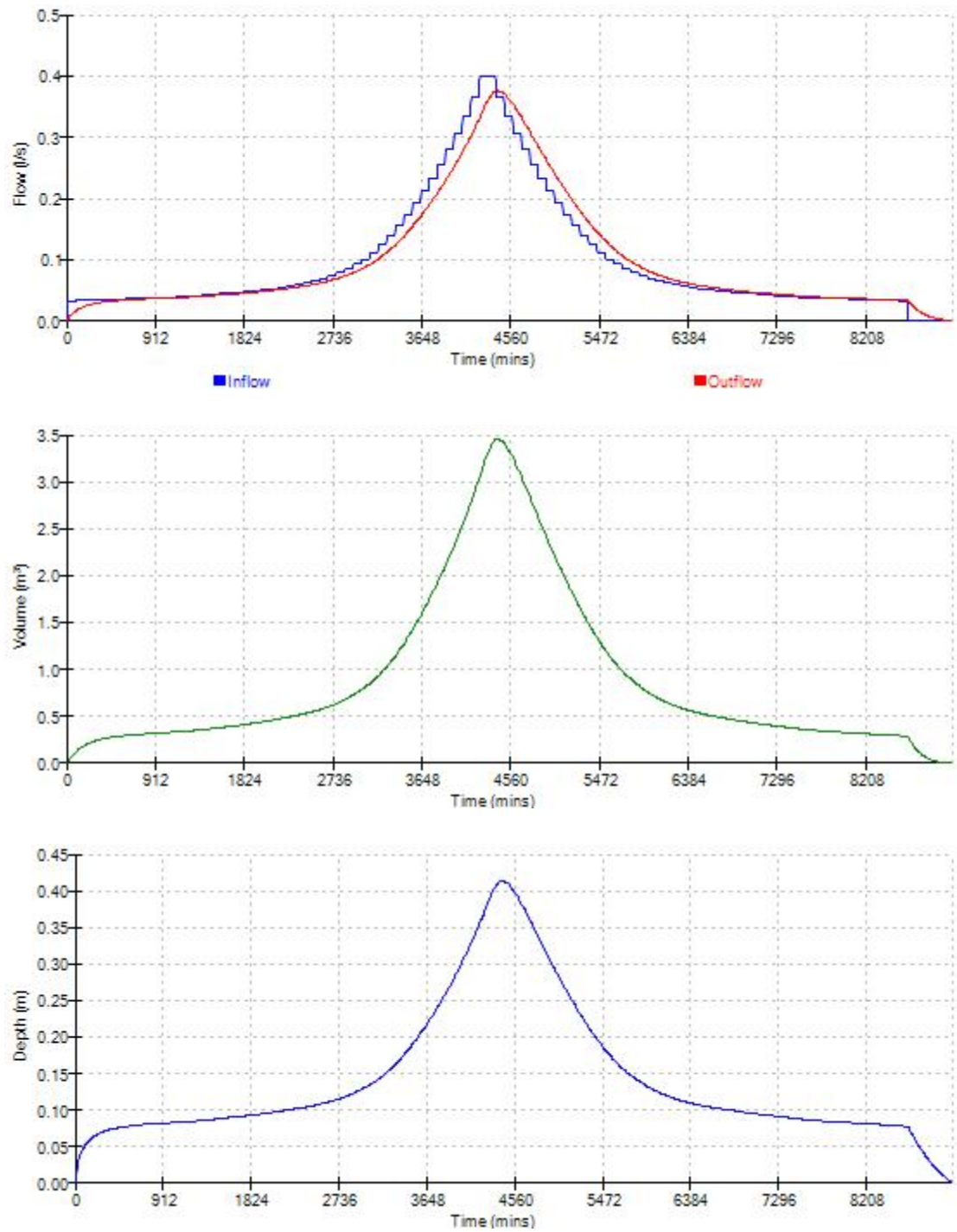
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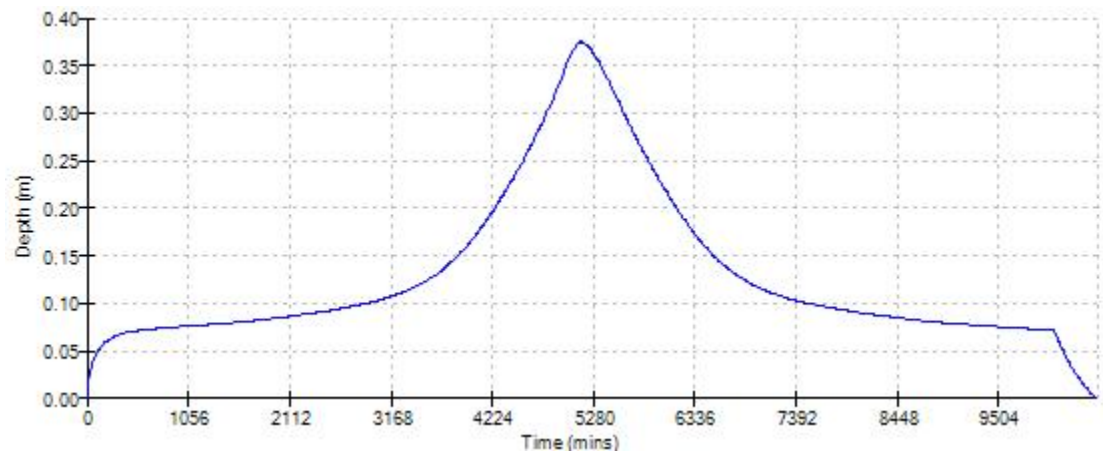
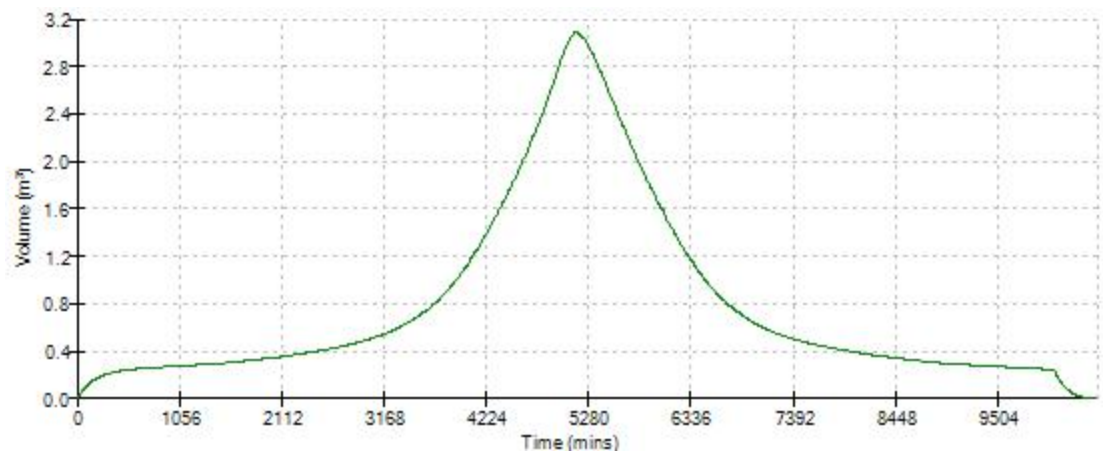
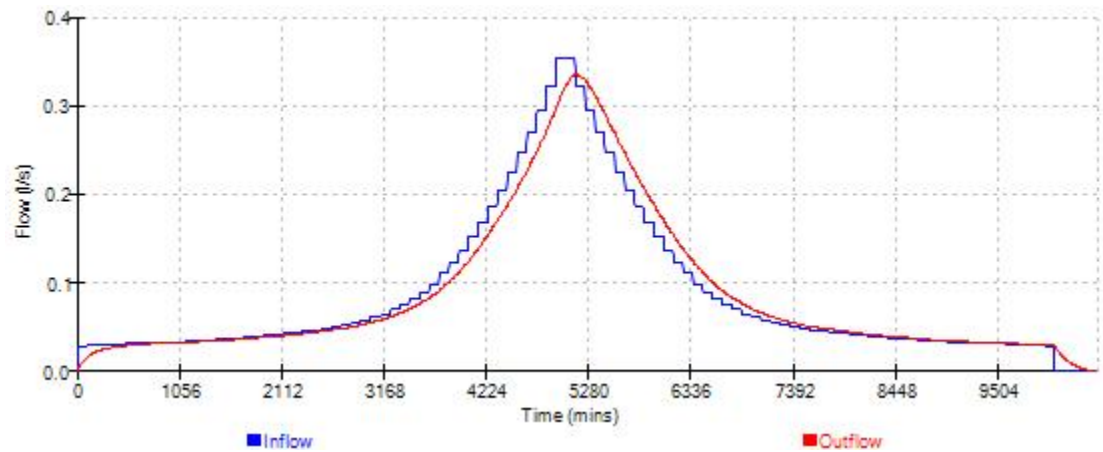
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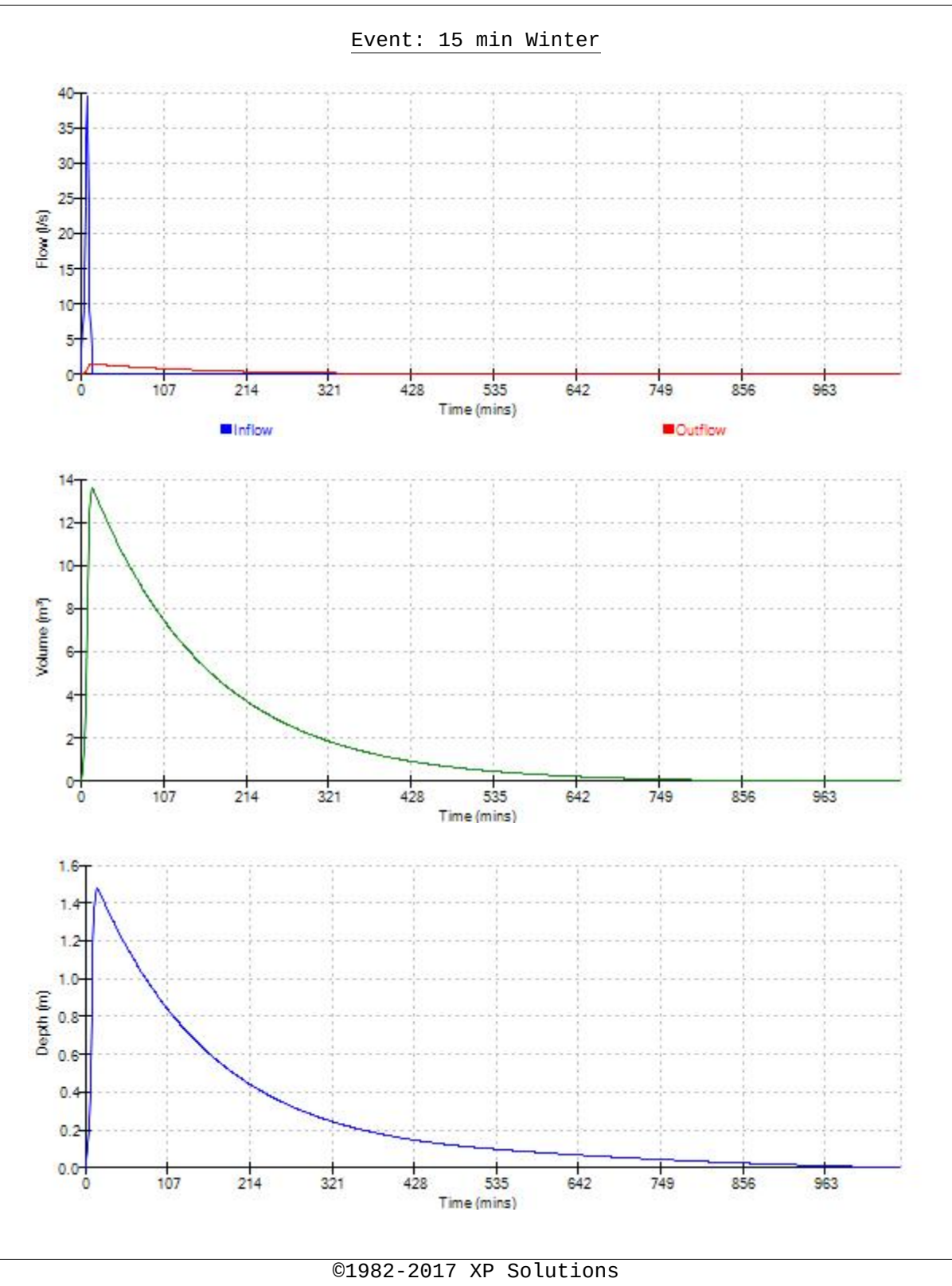
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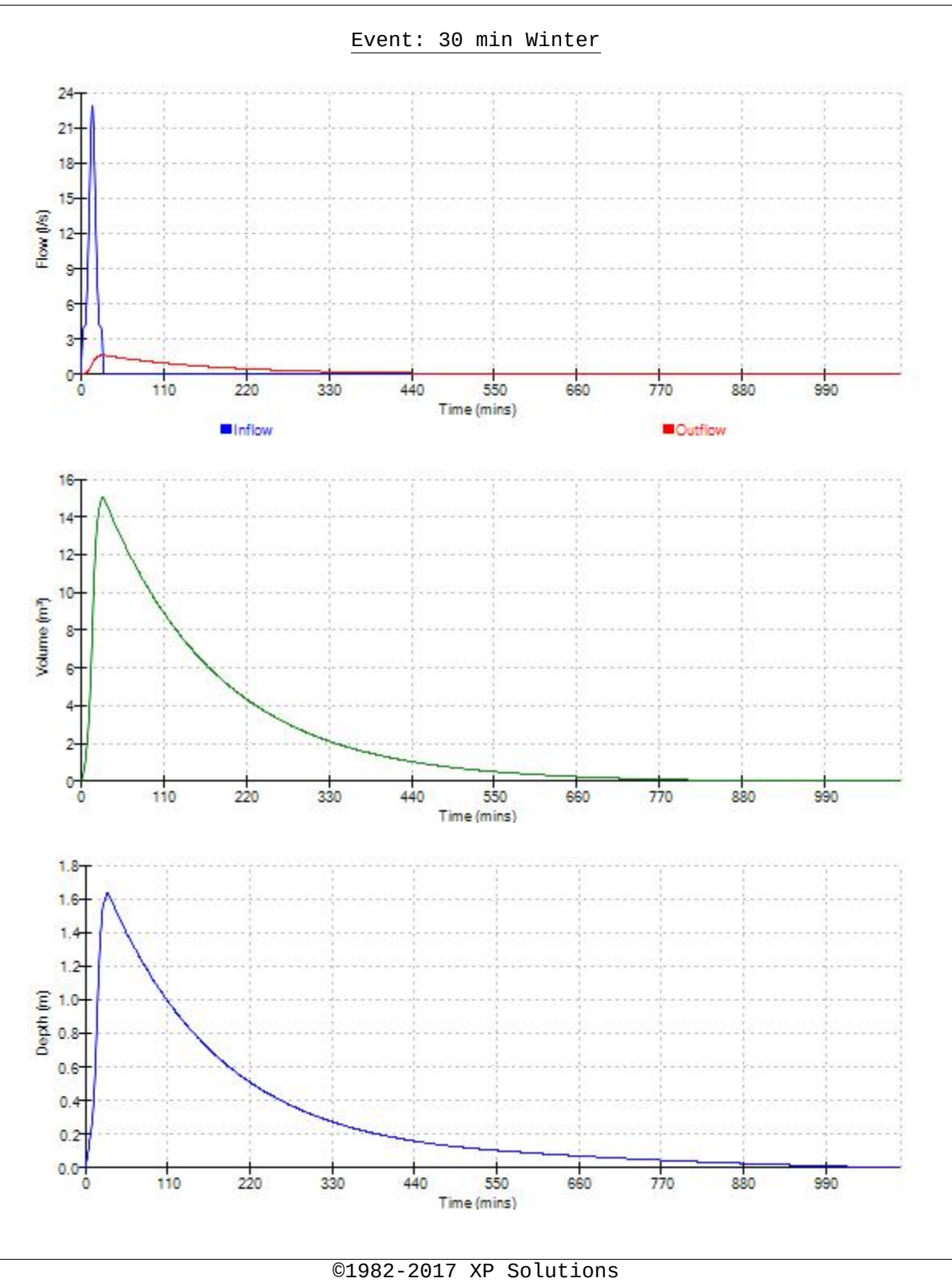
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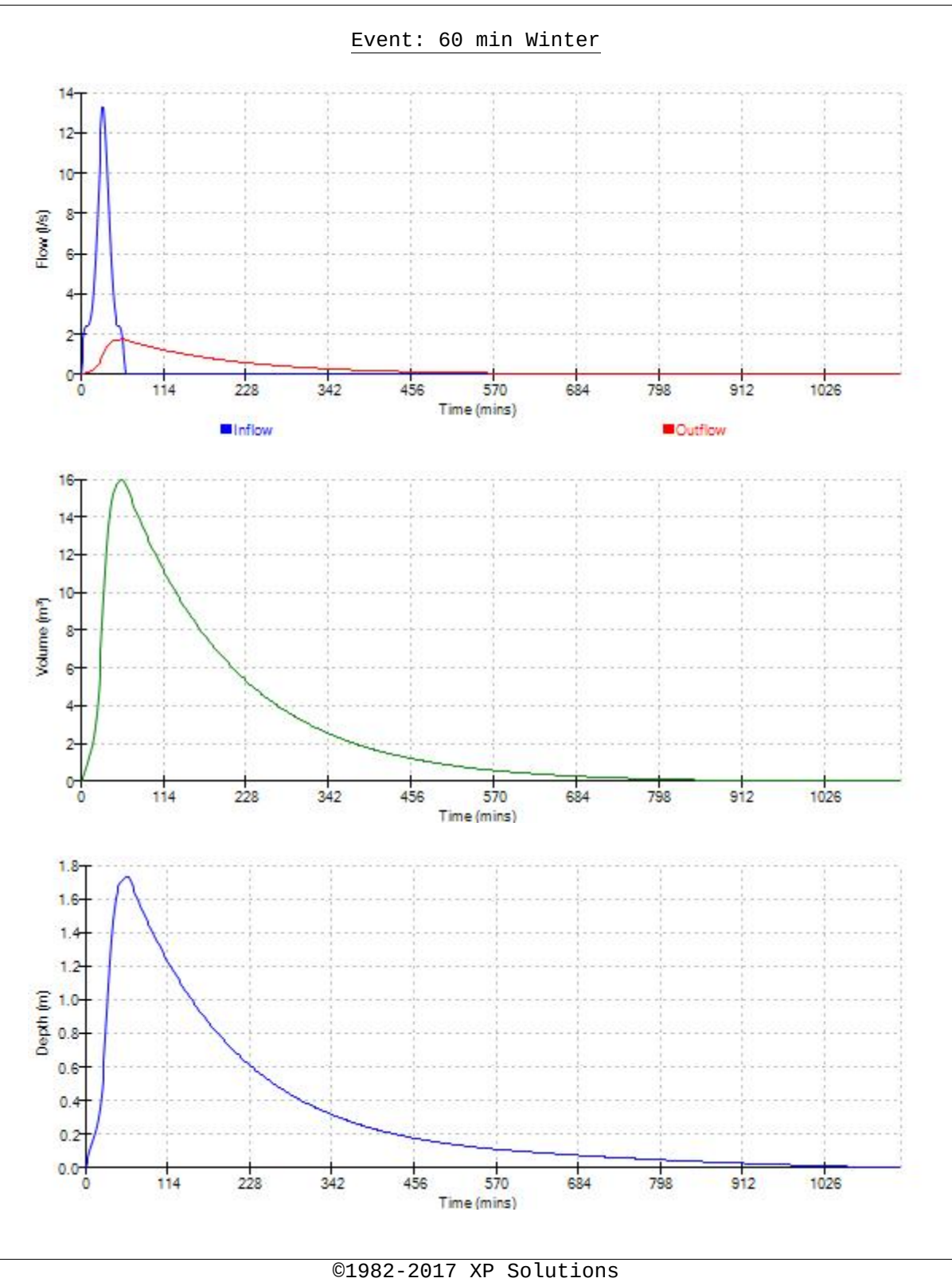
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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	W10229 - Royal British Legion Llay Retail Store	
	Designed by Johanne.Williams Checked by Josh Rigby	
Date 20-Apr-18 8:08 AM File w10229-180419-Store.SRCX		
XP Solutions		Source Control 2017.1.2



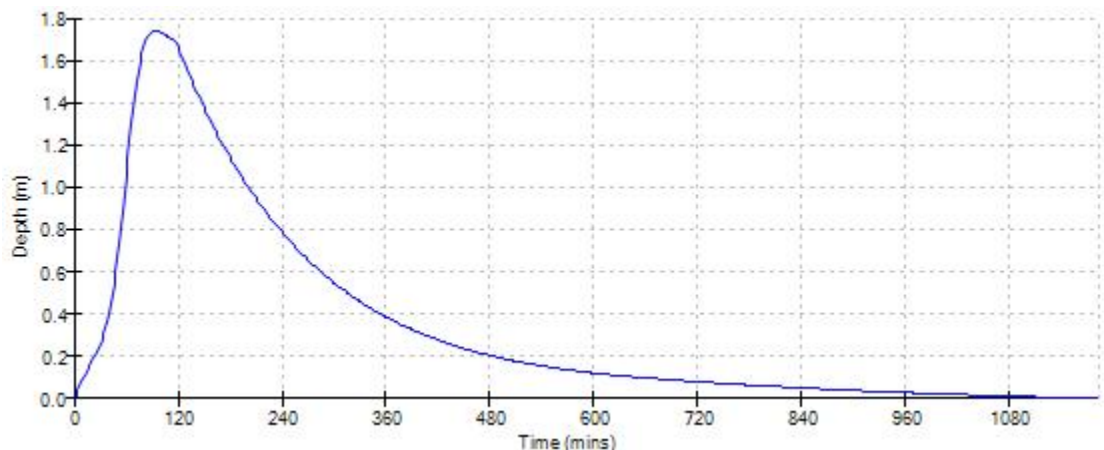
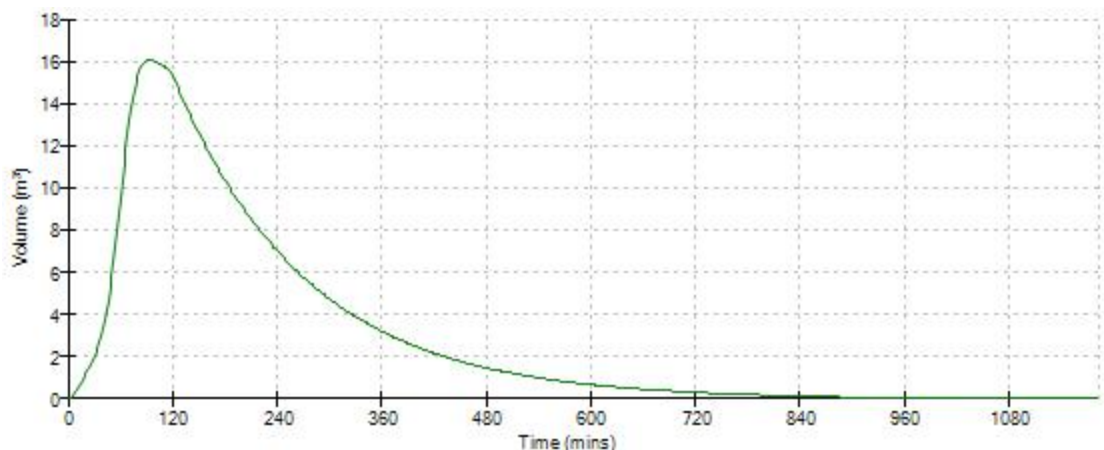
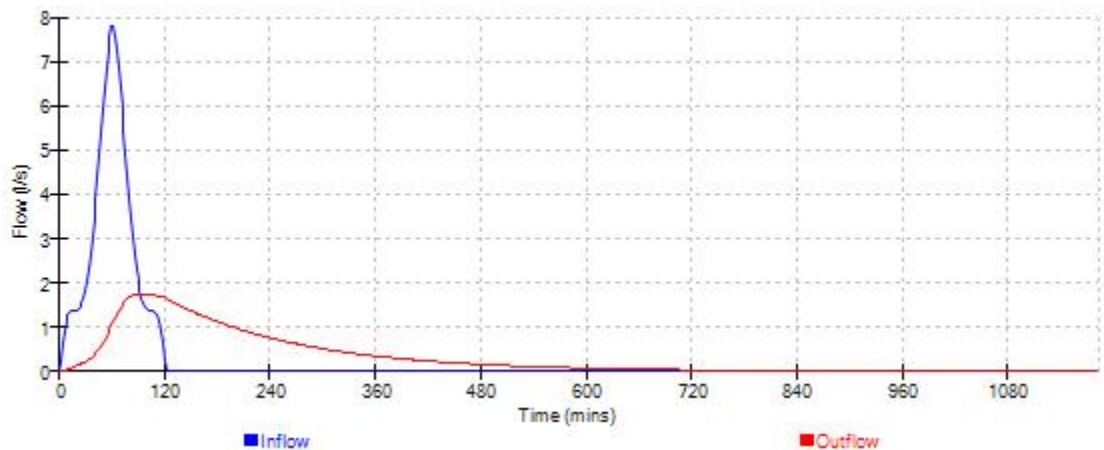
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Lon Parcwr Business Park	Llay	
Denbighshire LL15 1NJ	Retail Store	
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XP Solutions	Source Control 2017.1.2	



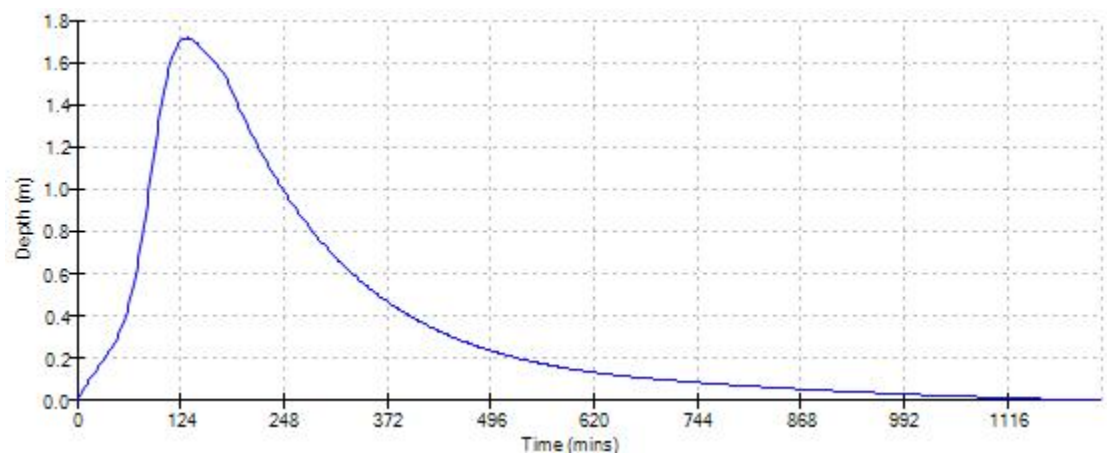
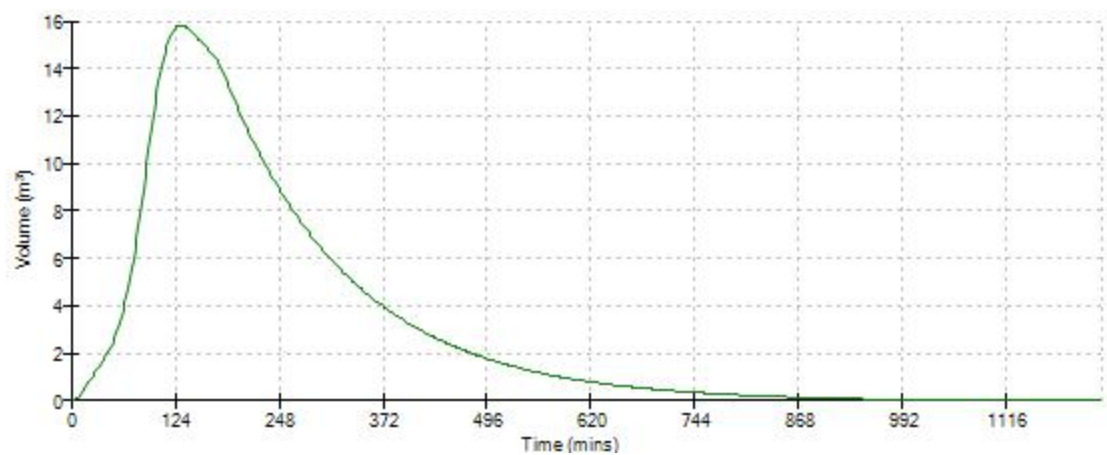
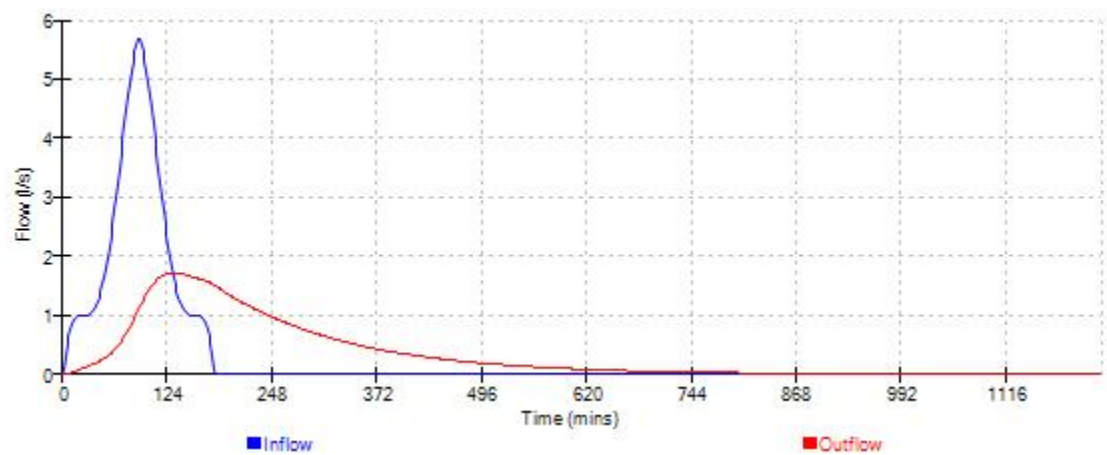
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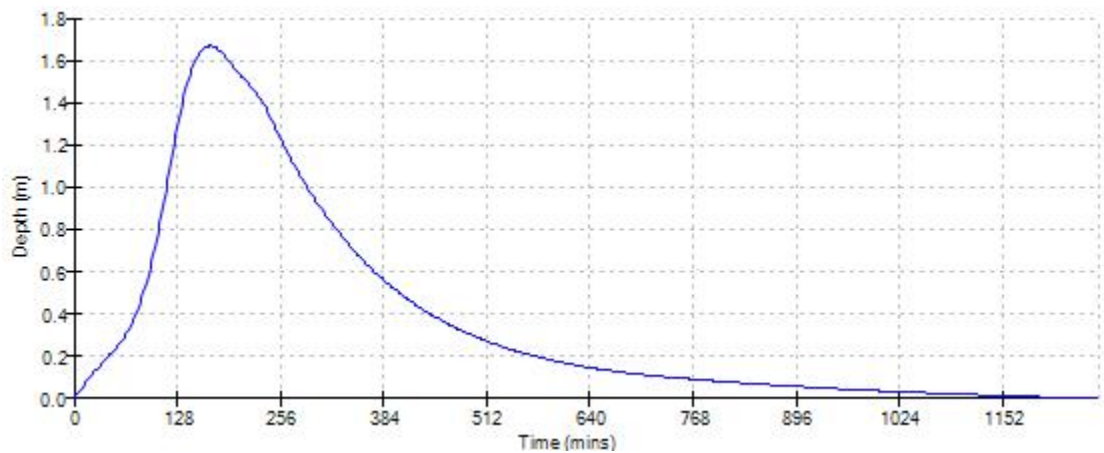
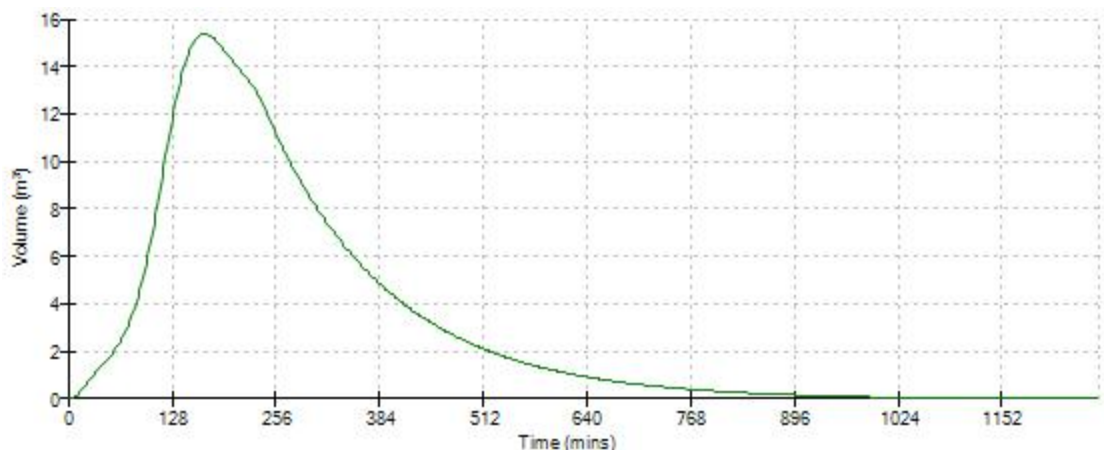
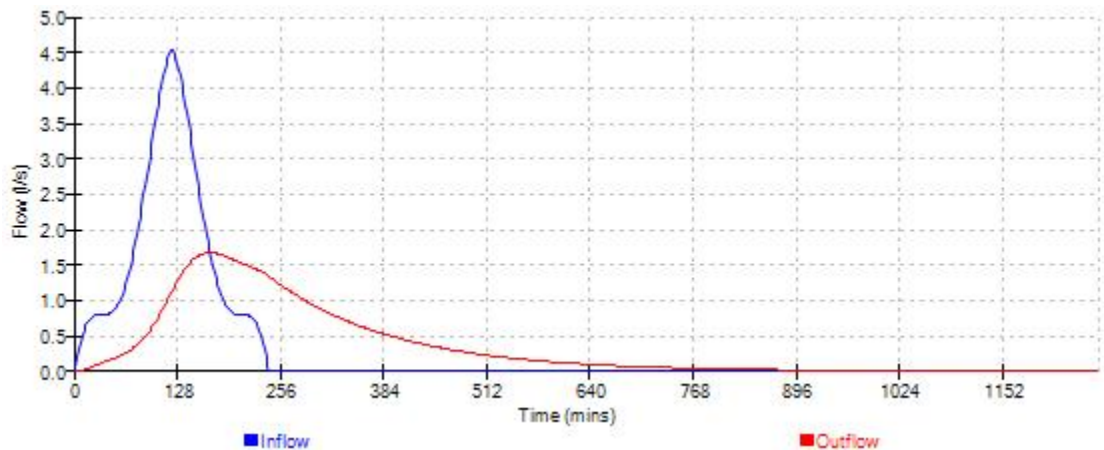
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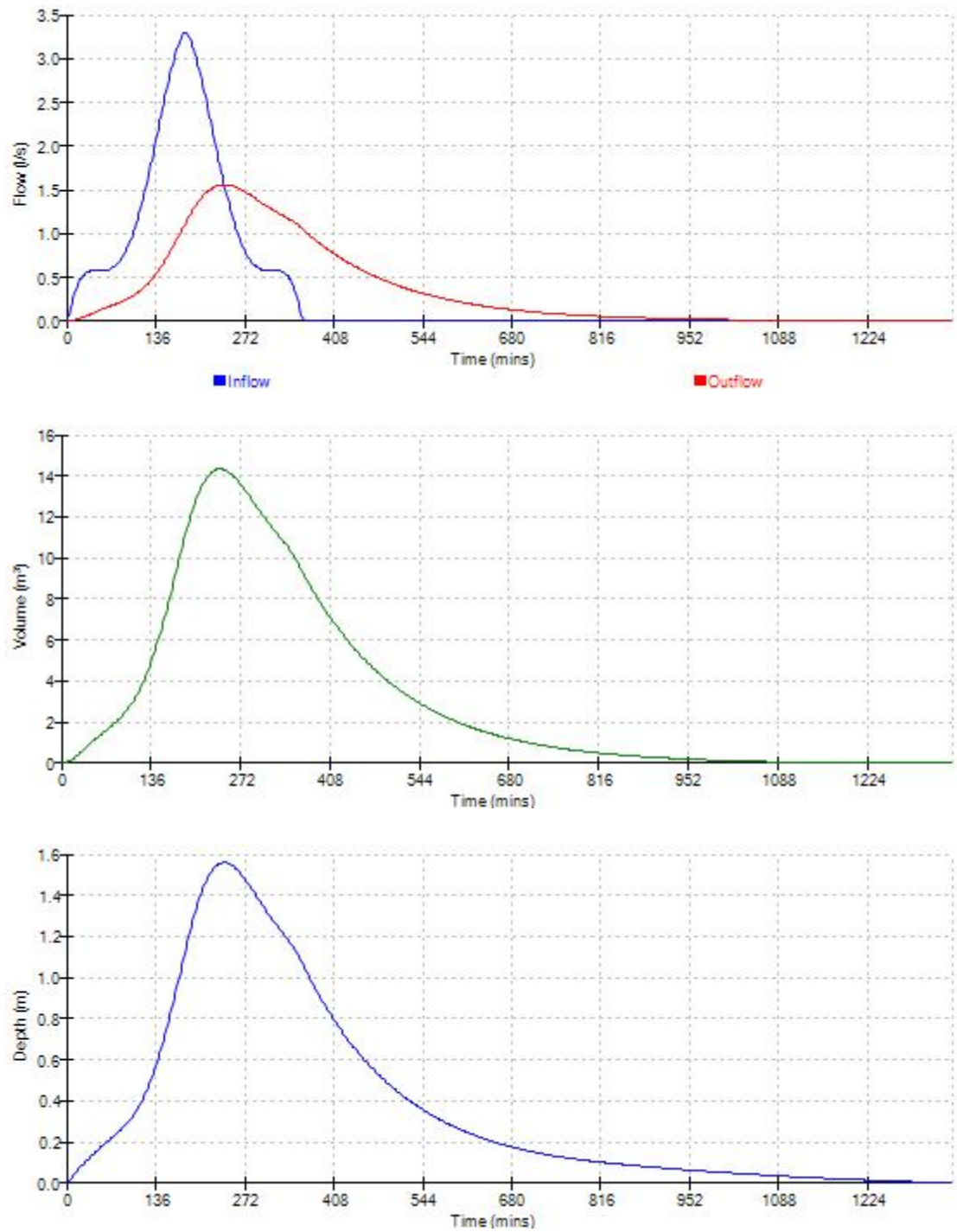
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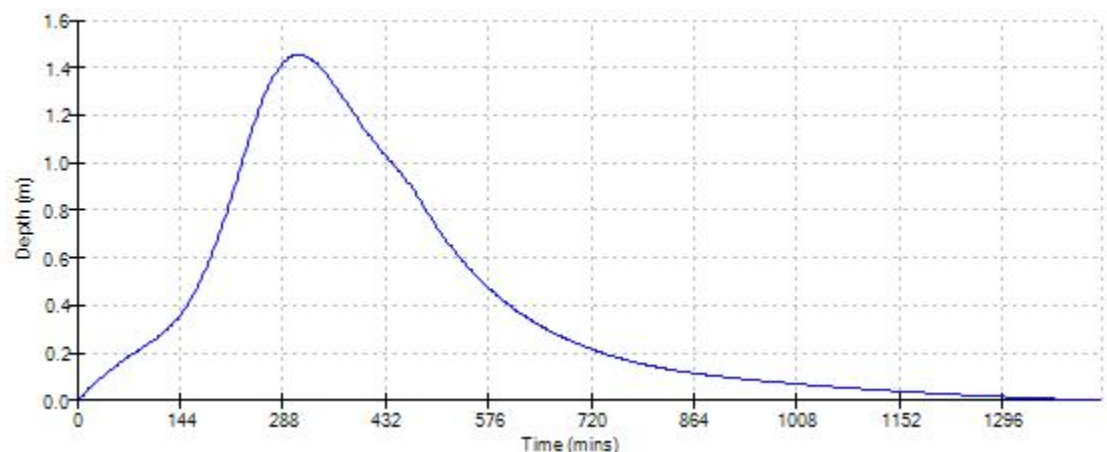
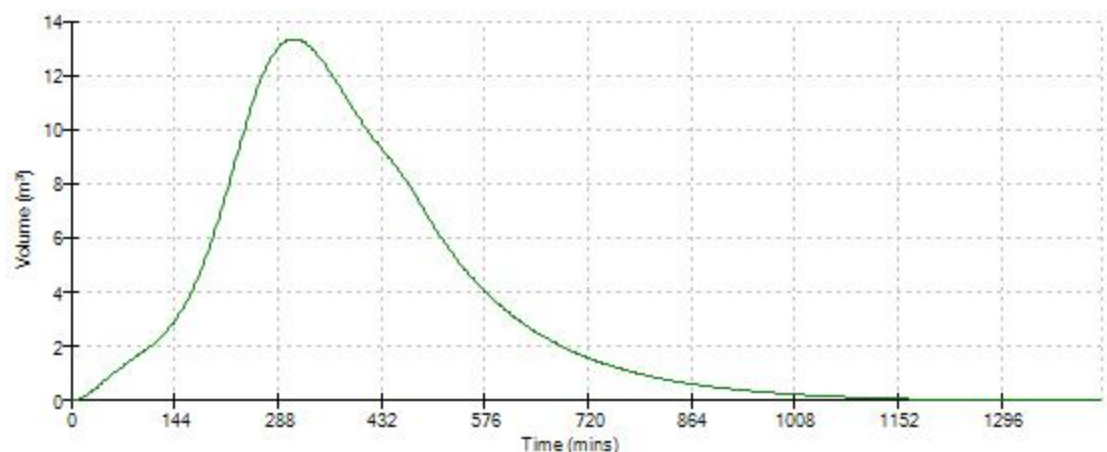
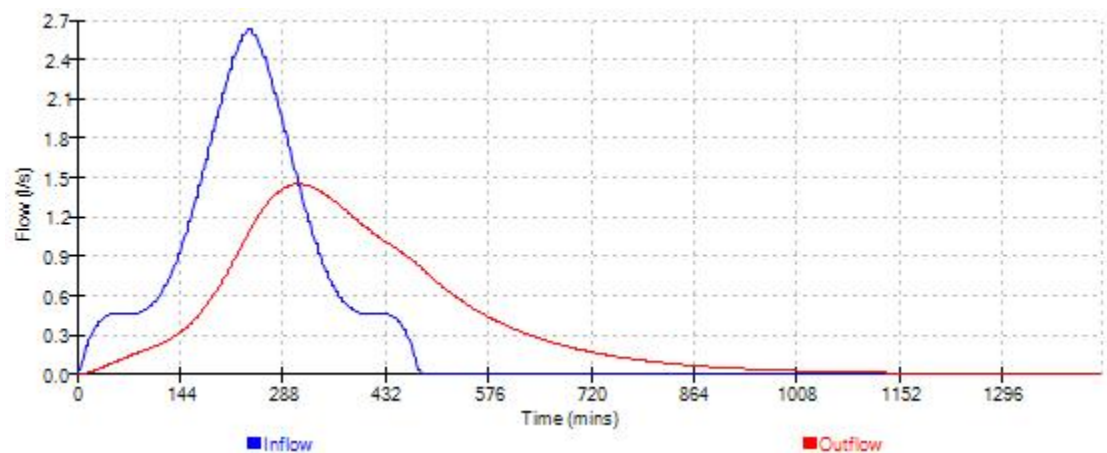
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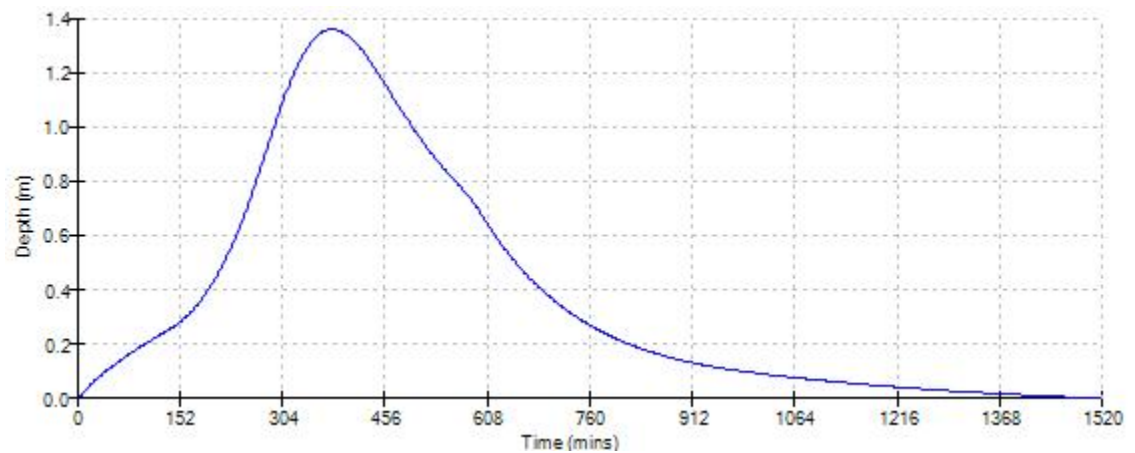
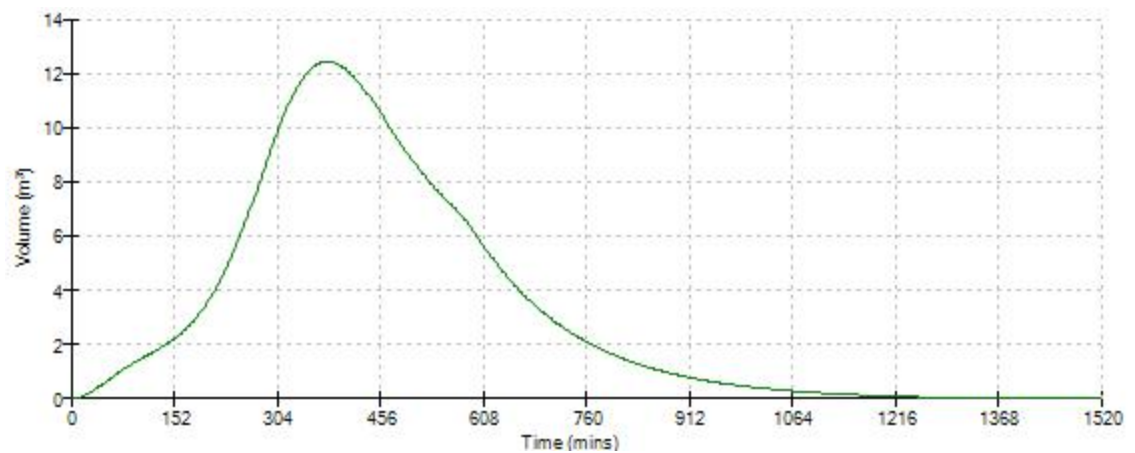
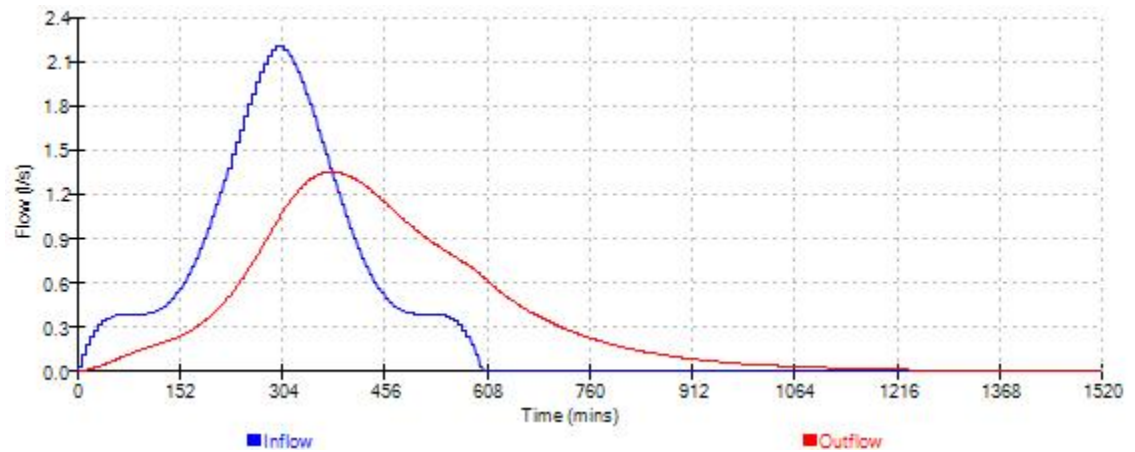
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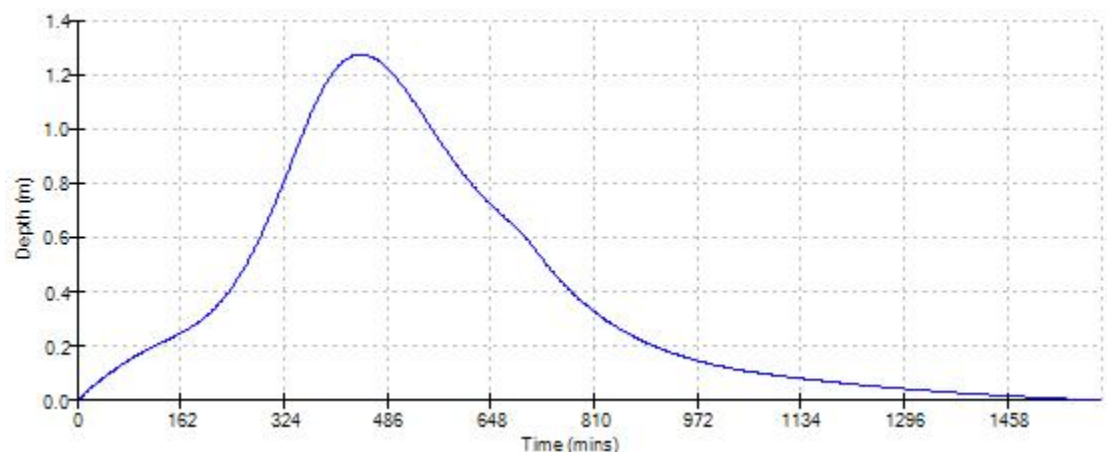
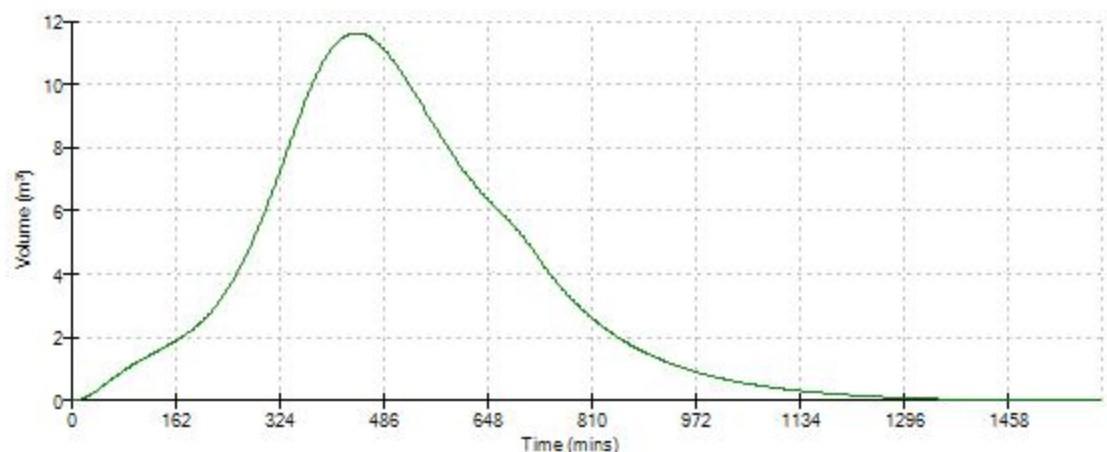
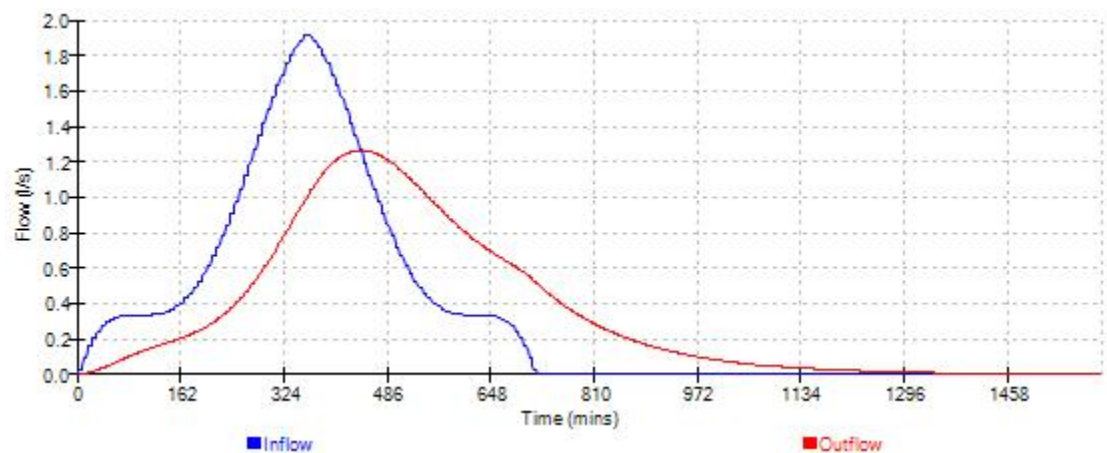
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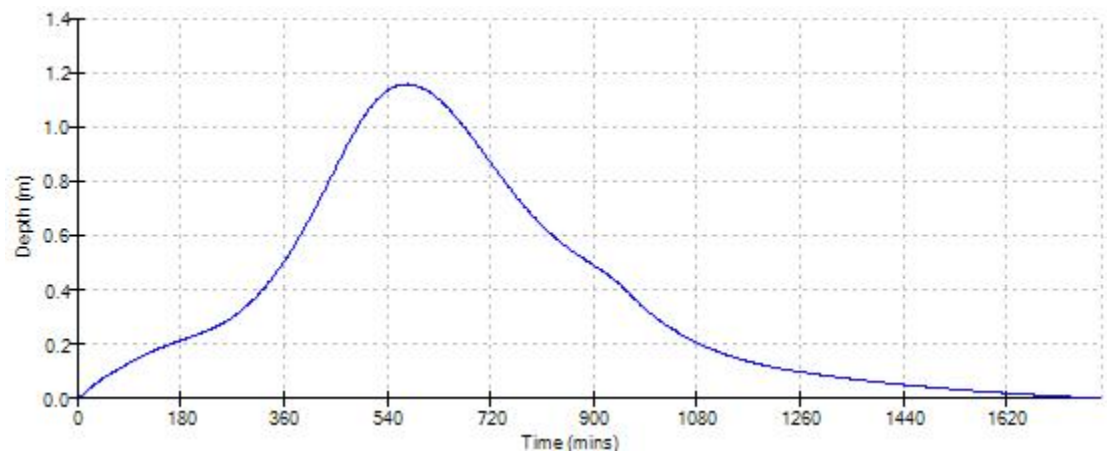
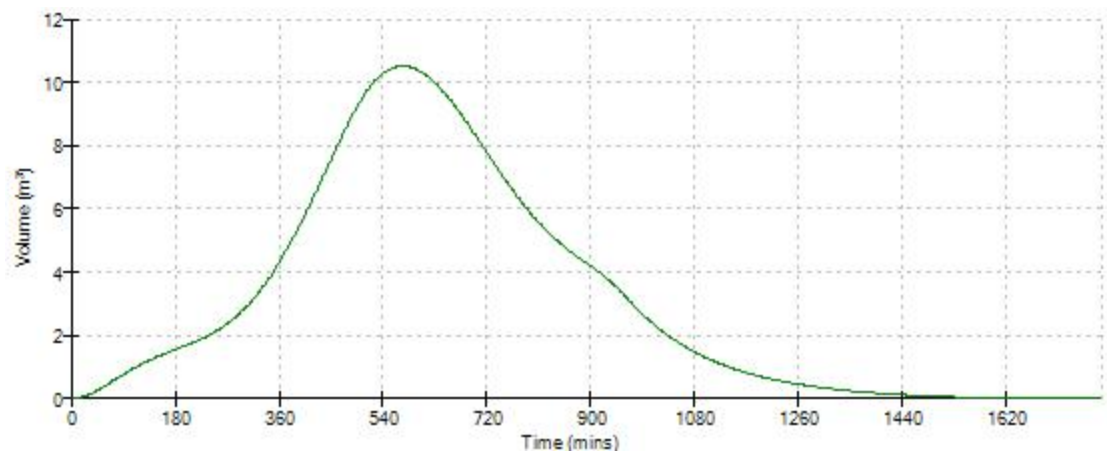
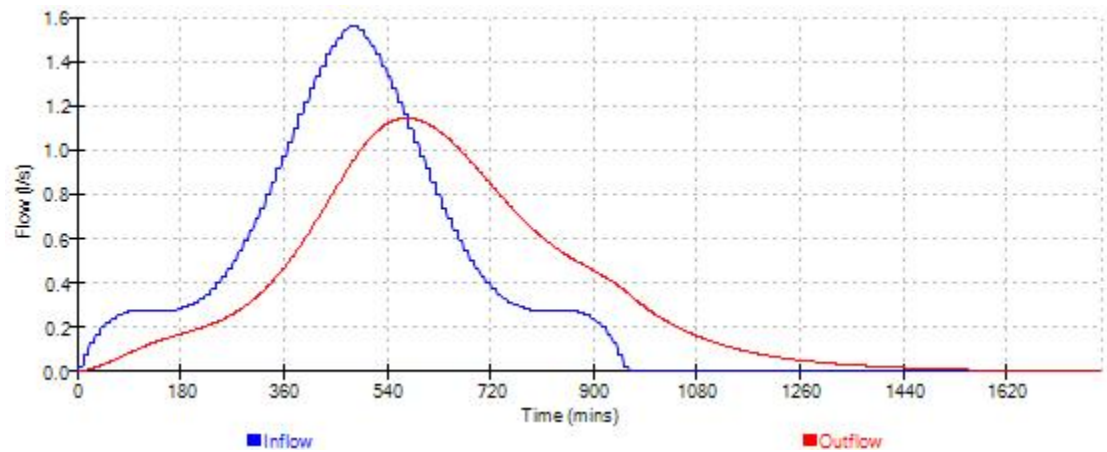
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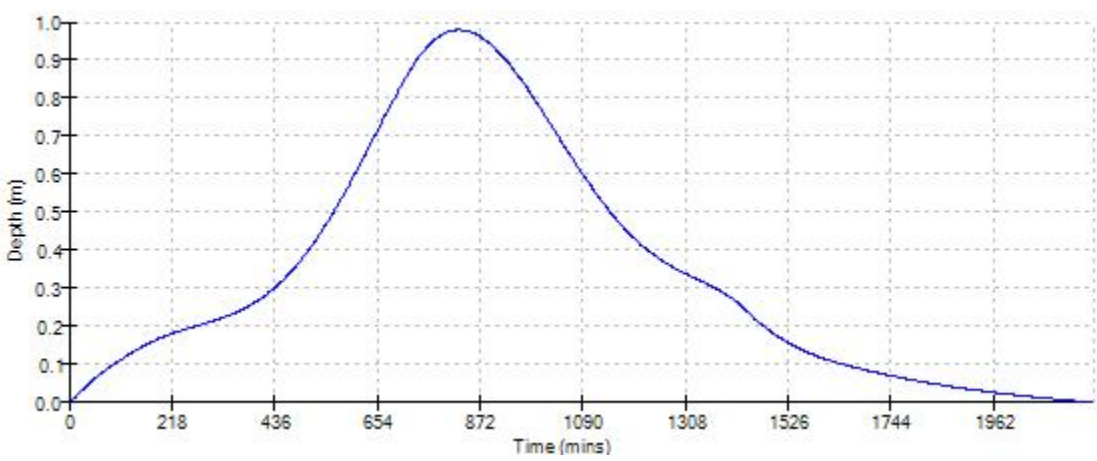
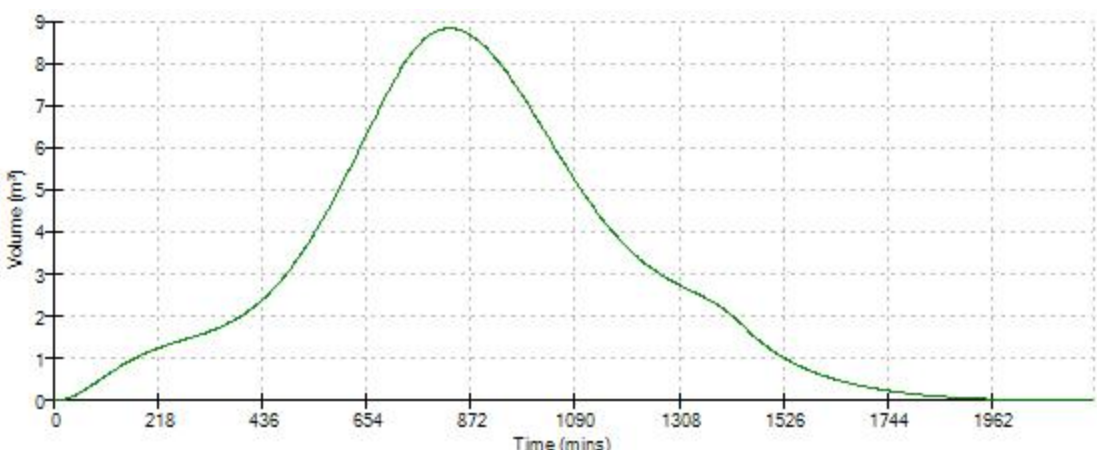
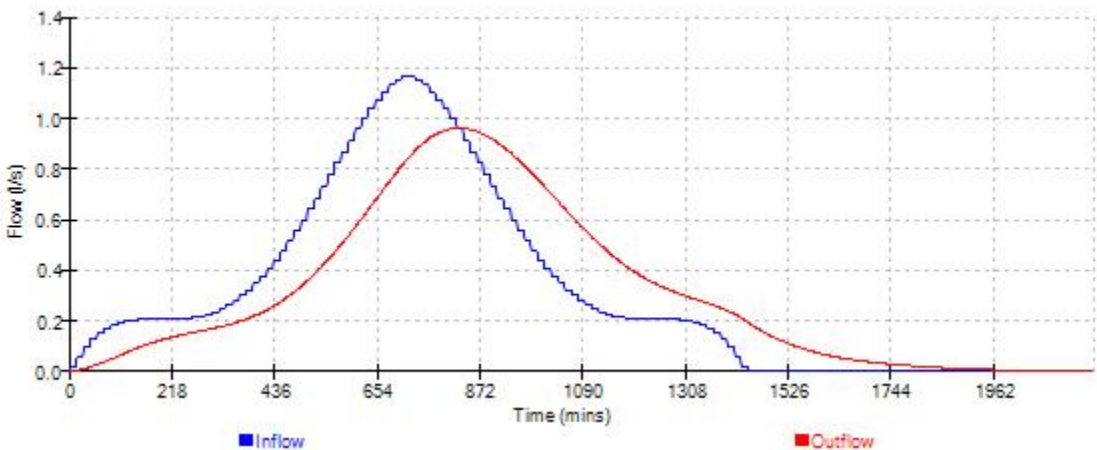
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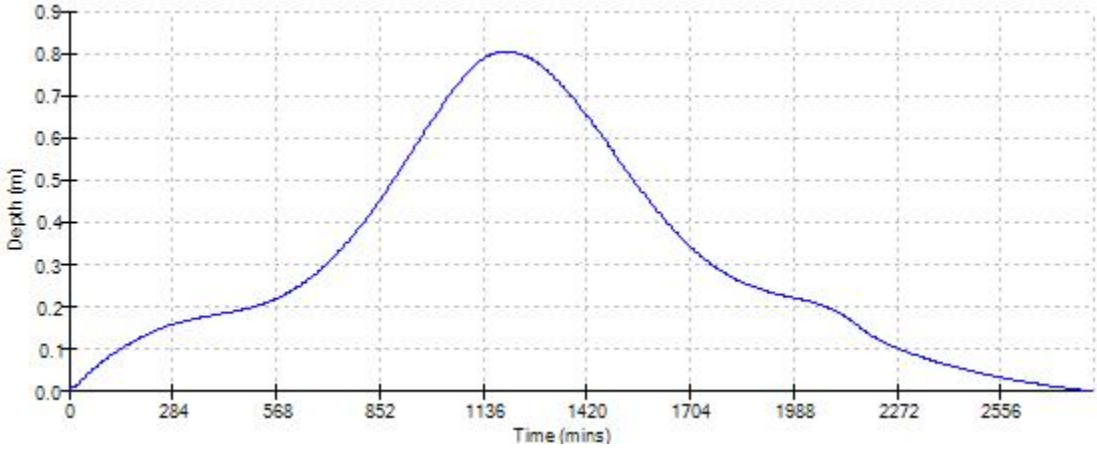
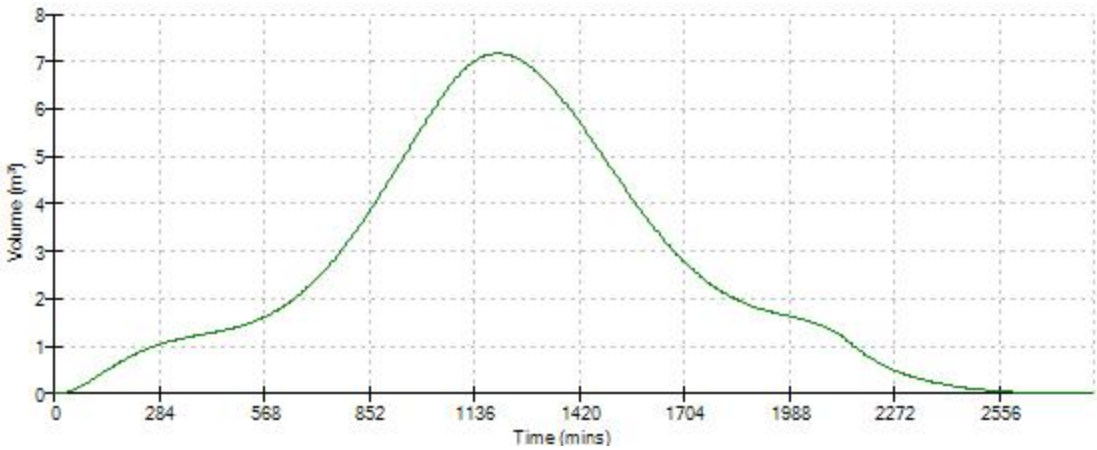
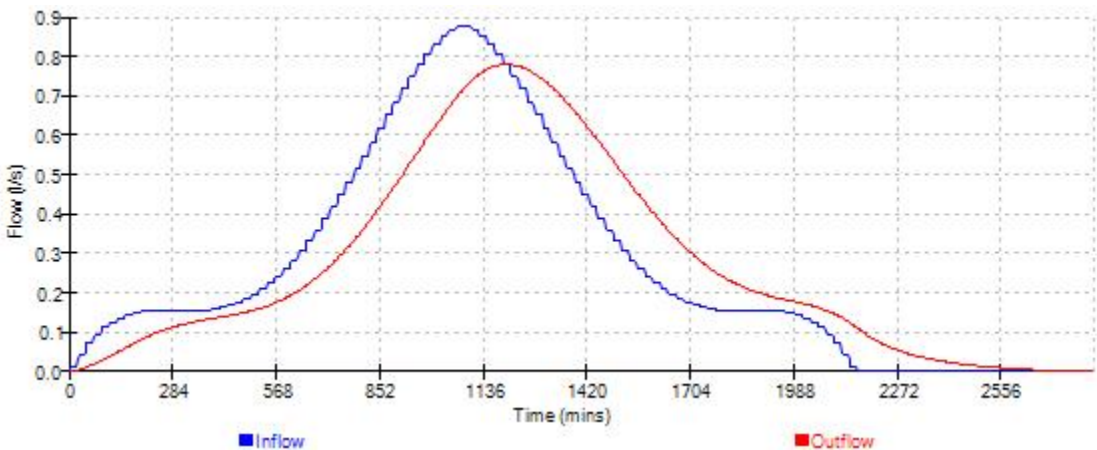
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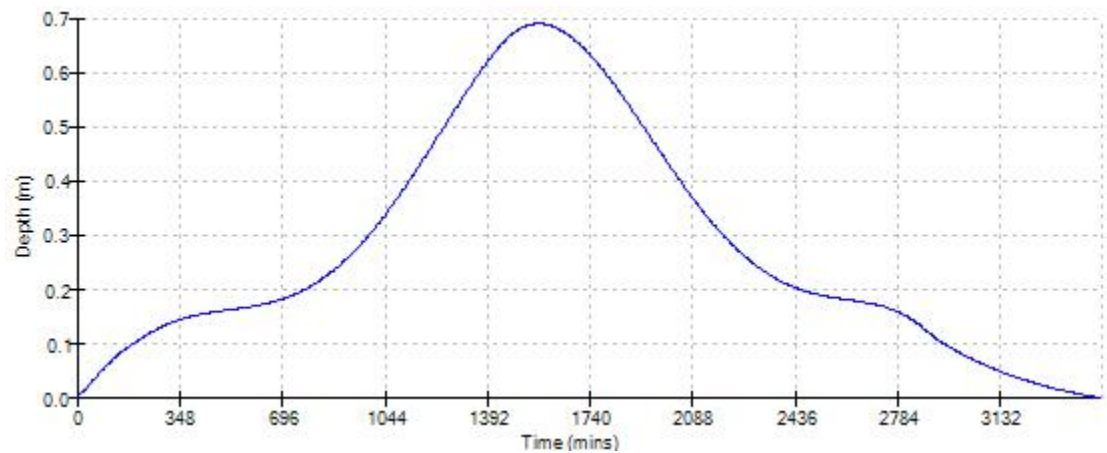
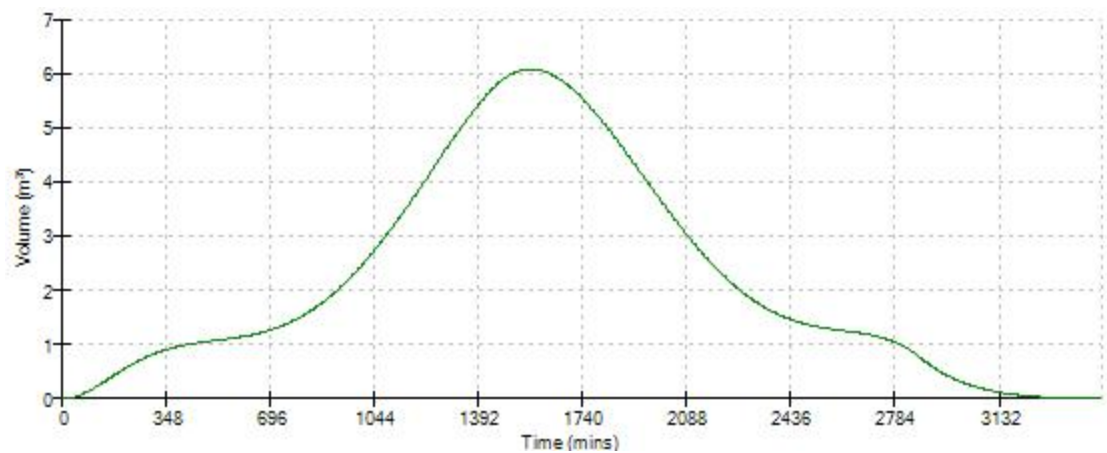
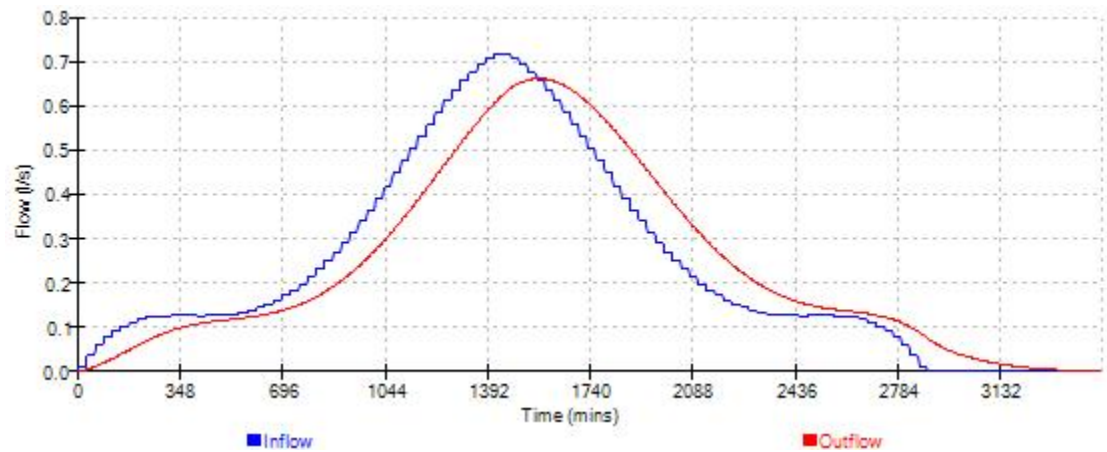
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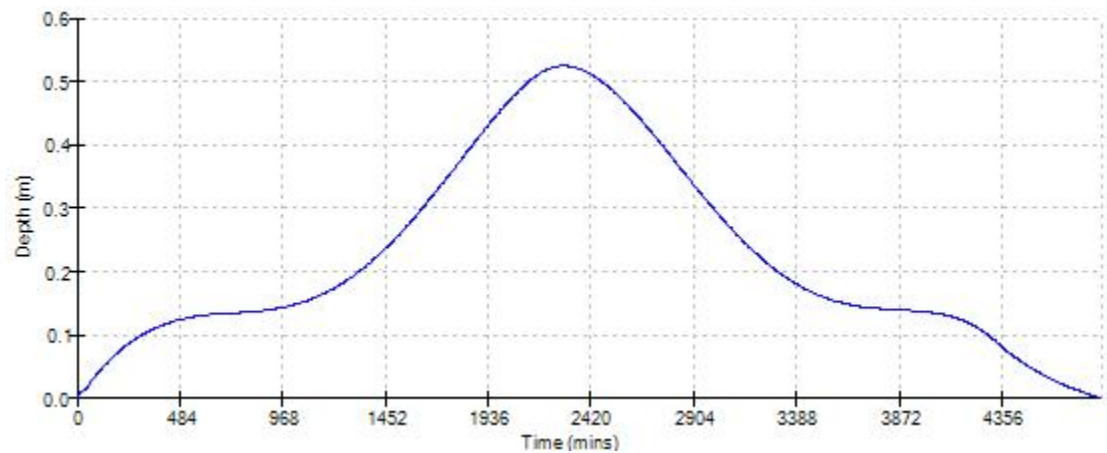
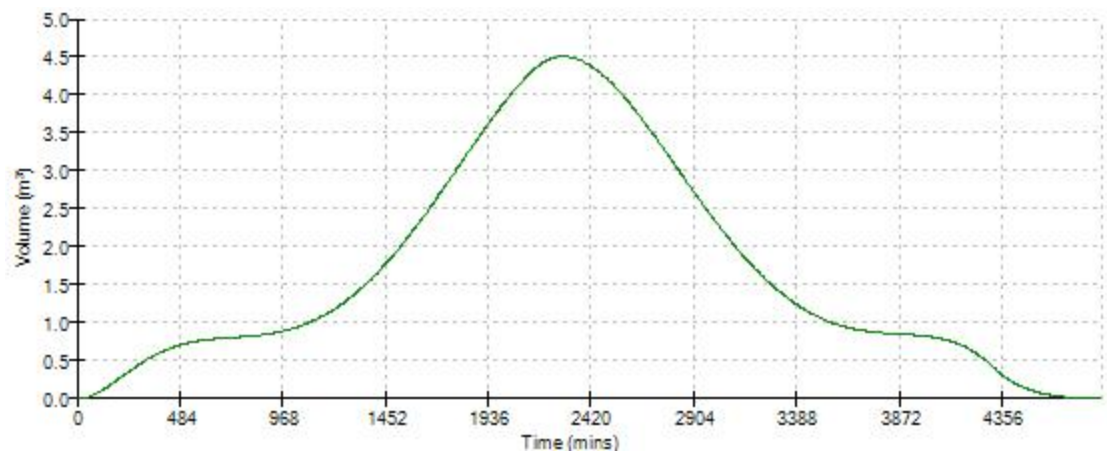
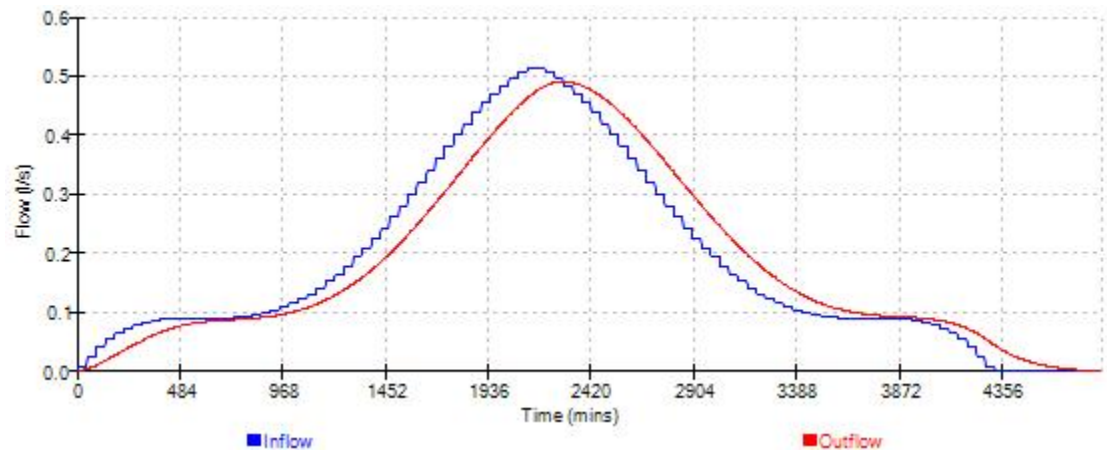
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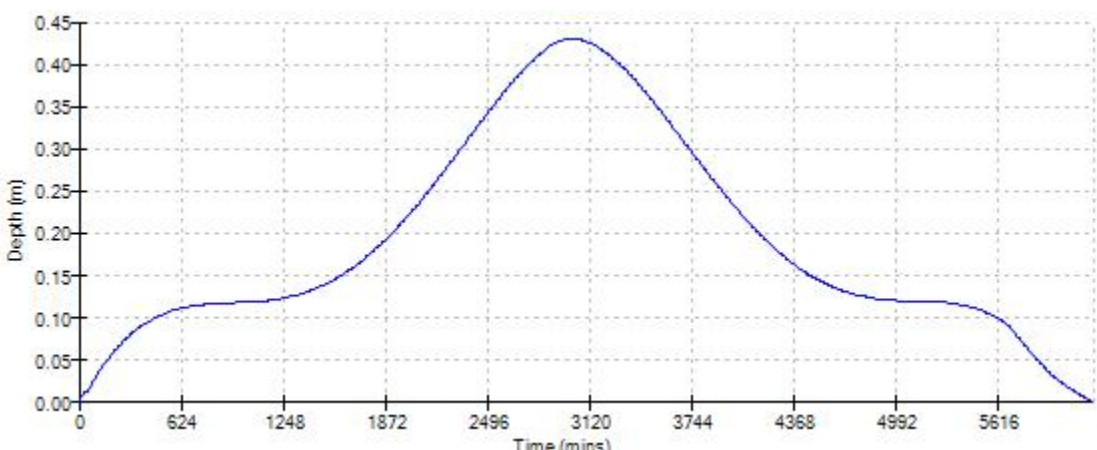
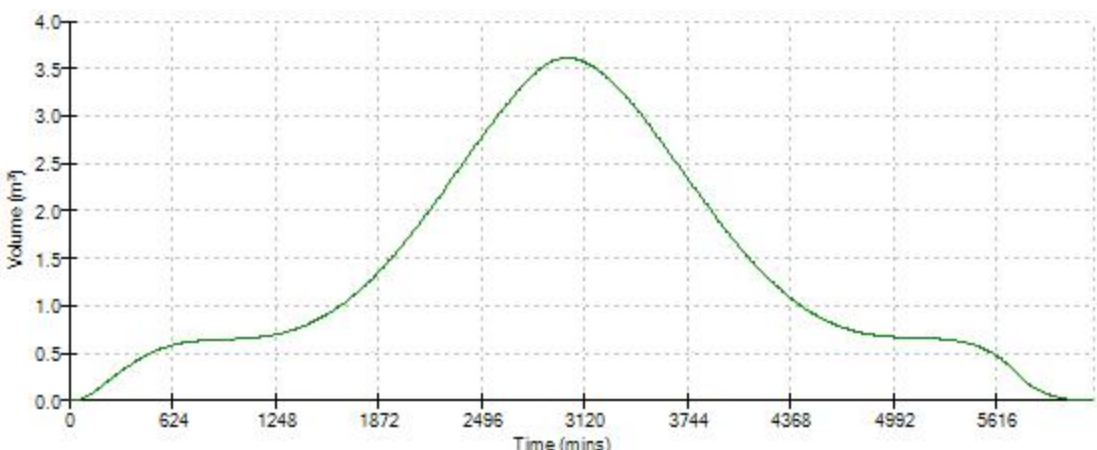
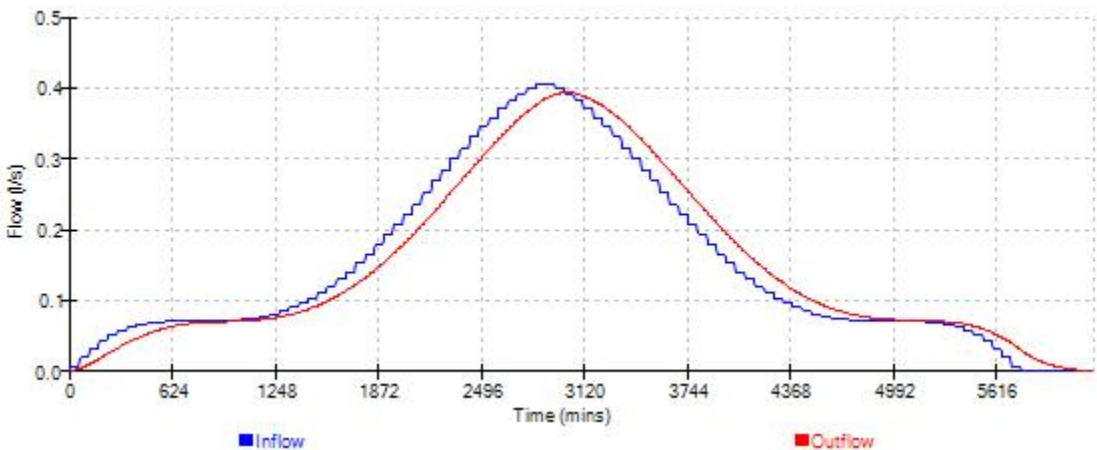
Event: 2880 min Winter



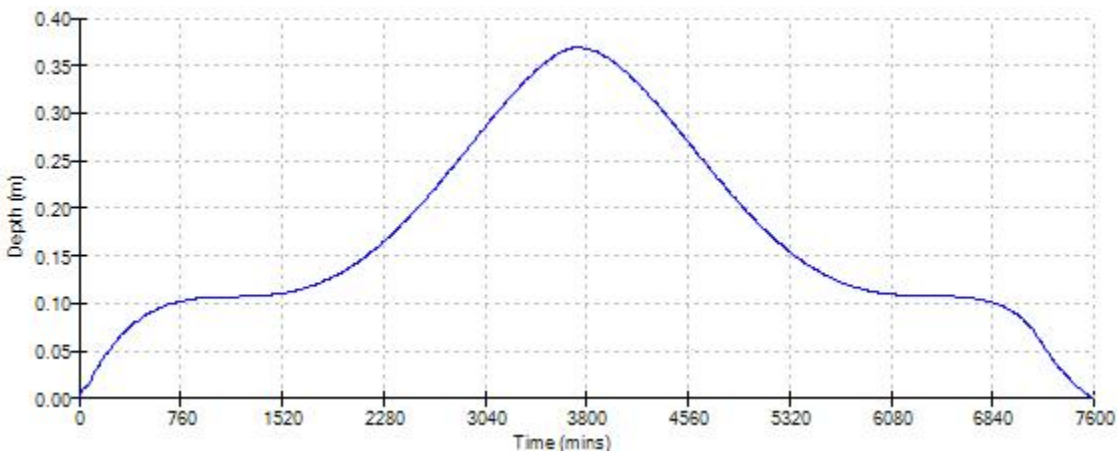
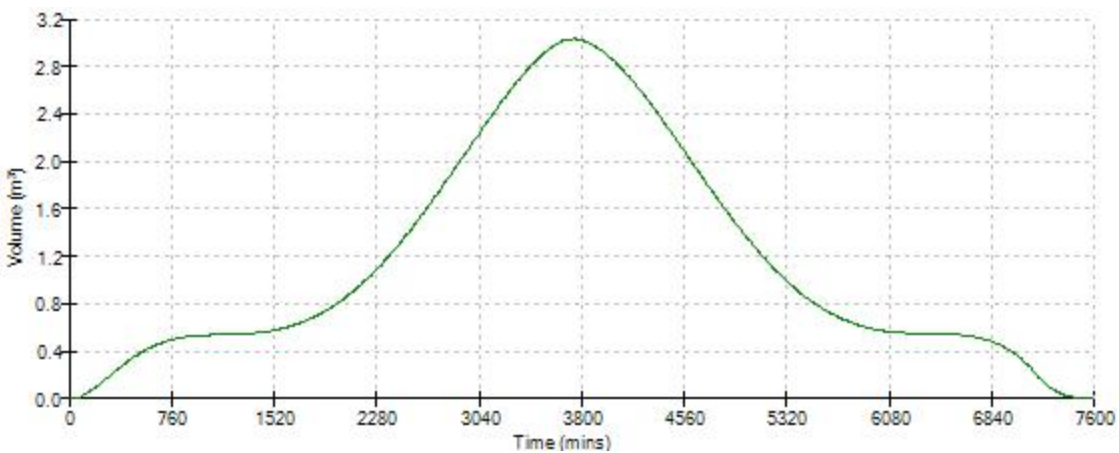
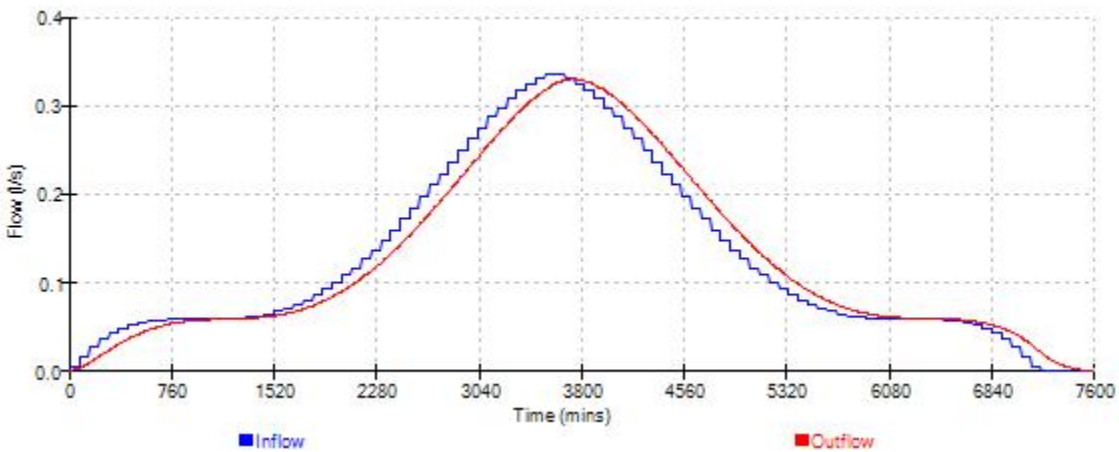
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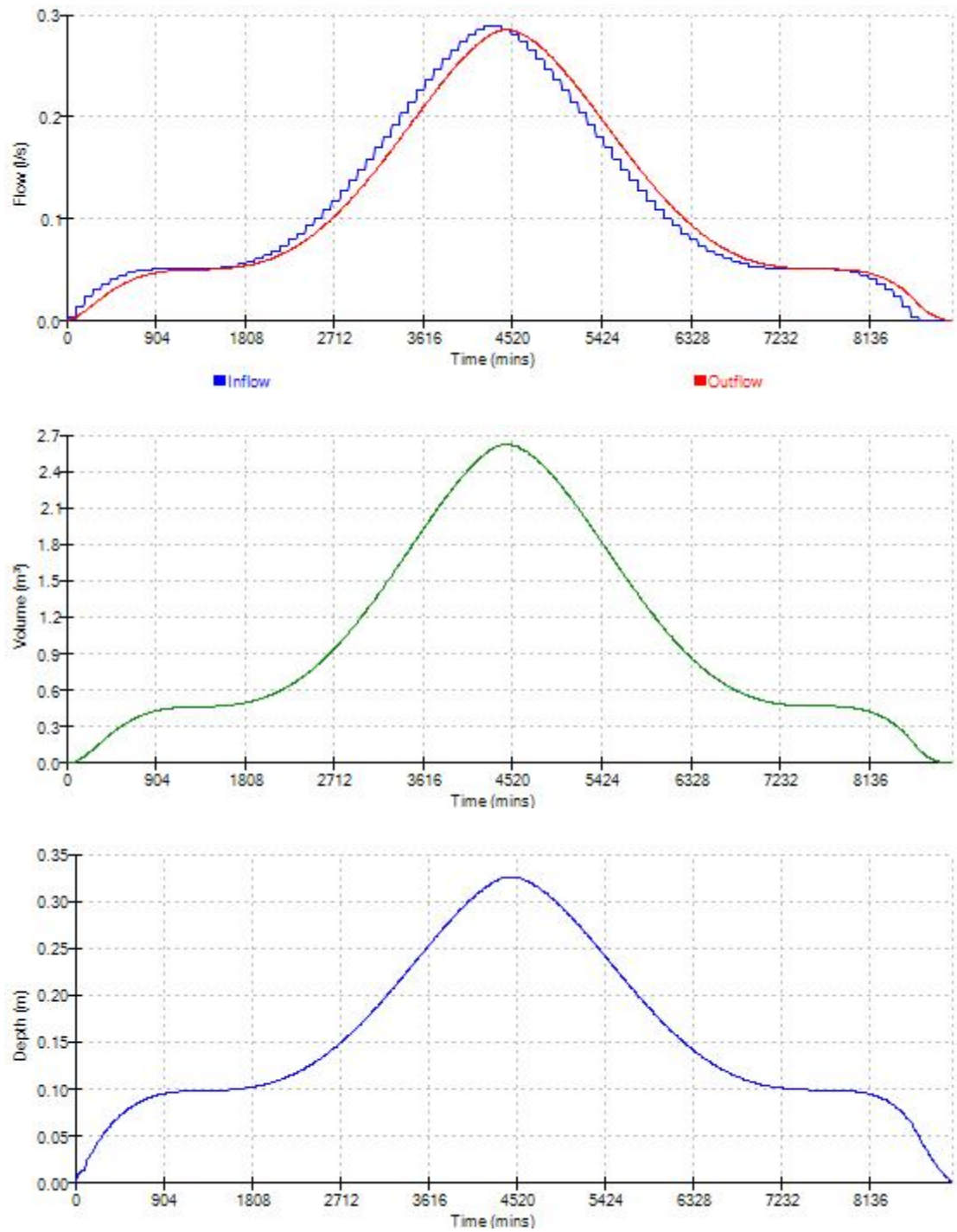
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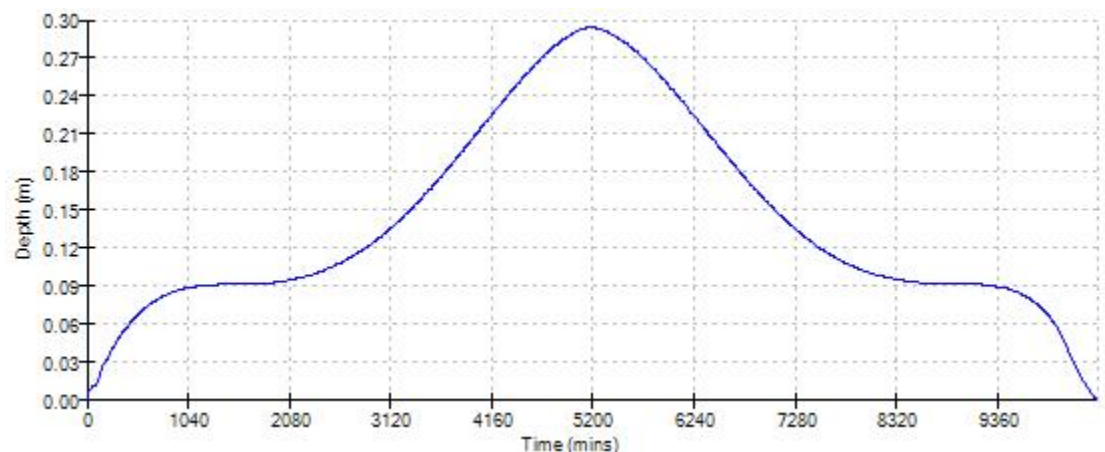
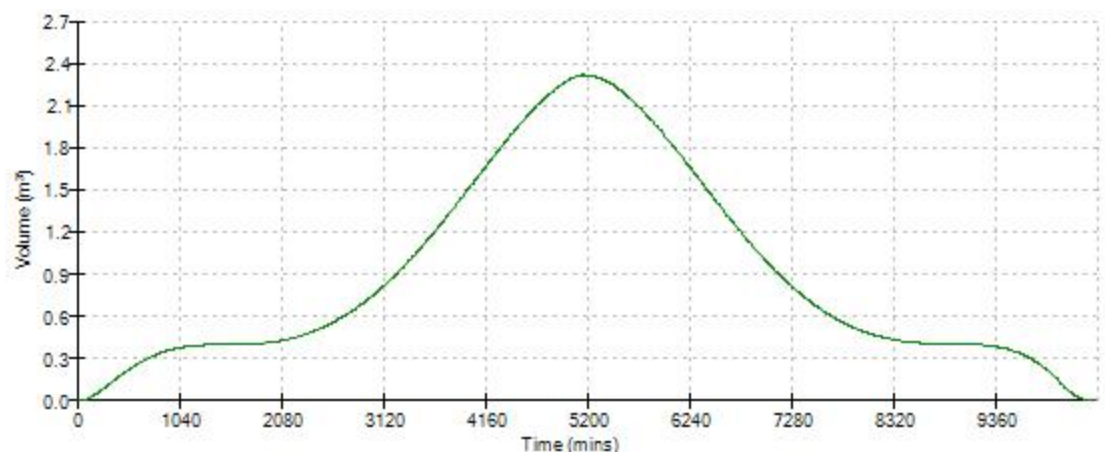
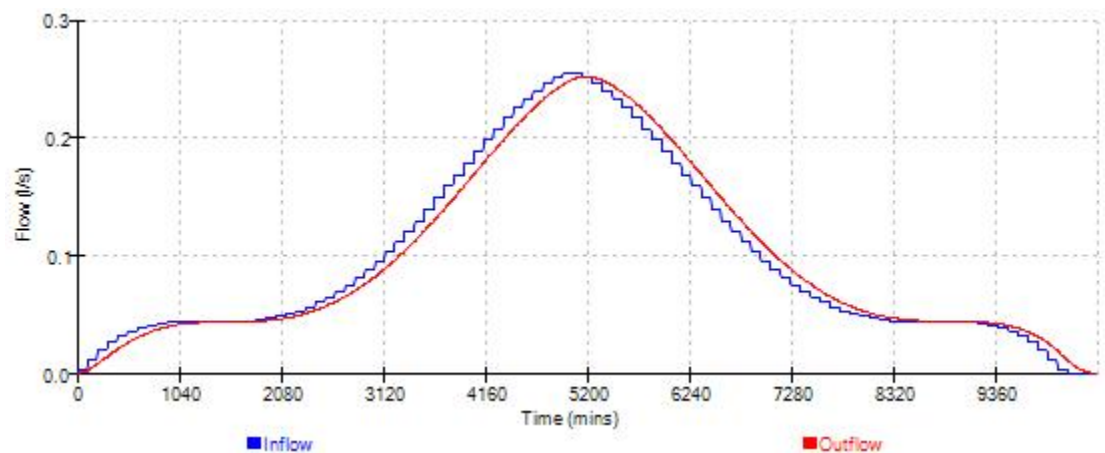
Event: 7200 min Winter



Event: 8640 min Winter



Event: 10080 min Winter



Appendix H – Maintenance Schedules

Operation and Maintenance Requirements for Soakaways

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor inspection tube or chamber and inside of concrete manhole rings.	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs.	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation.	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Ref. Table 13.1, CIRIA C753 'The SuDS Manual

The maintenance requirements detailed above are to be undertaken by the site owner.

Name:

Position:

Date:

**Signed on behalf
Of site owner**

Operation and Maintenance Requirements for Ponds and Wetlands

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season), or as required
	Cut the meadow grass	Half yearly (spring - before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage, and / or physical damage.	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options.	Half yearly
	Check any mechanical devices e.g. penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1m above water level	Annually
	Remove sediment from any forebay	Every 1 – 5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, e.g. 25-50 years
Remedial actions	Repair erosion or other damage	As required
	Replant where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair/rehabilitate of Inlets, outlets and overflows	As required

Ref. Table 23.1 CIRIA C753 'The SuDS Manual'

The maintenance requirements detailed above are to be undertaken by the site owner

Name:

Position:

Date:

**Signed on behalf
of site owner**

Operation and Maintenance Requirements for Permeable Paving

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and move contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level or the paving	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Inspect for evidence of poor operation and / or weed growth – if required, take remedial action	Three-monthly, 48hr after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Ref. Table 20.15, CIRIA C753 'The SuDS Manual

The maintenance requirements detailed above are to be undertaken by the site owner.

Name:

Position:

Date:

**Signed on behalf
Of the site owner**

Operation and Maintenance Requirements for Attenuation Storage Tanks

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Ref. Table 21.3, CIRIA C753 'The SuDS Manual'

The maintenance requirements detailed above are to be undertaken by the site owner.

Name:

Position:

Date:

Signed on behalf
Of the site owner