

D & PJ MOLLOY

**PROPOSED BARN EGG LAYING UNIT
TALWRN FARM
LEGACY
WREXHAM
LL14 4ER**

MITIGATION DRAINAGE DESIGN

**PREPARED BY LAND DRAINAGE CONSULTANCY LTD
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CONTENTS

1.0 EXECUTIVE SUMMARY	2
2.0 SITE DETAILS	3
Site Location	3
Site Details	3
Site Photograph	4
3.0 DEVELOPMENT DETAILS	5
4.0 SURFACE WATER MITIGATION	5
Conveyance of Surface Water to Attenuation Pond from Unit Site	7
Surface Water Runoff and Attenuation Pond Storage Calculations	7
Accounting for Climate Change	7
Methodology	8
Attenuation Pond Design	9
Design of Orifice to Restrict Discharge	10
Additional Attenuation Pond Design Considerations	10
Control Off Access Track Surface Water	11
5.0 ASSESSMENT SUMMARY	11

1.0 EXECUTIVE SUMMARY

This report describes work by Land Drainage Consultancy which was commissioned by D & PJ Molloy. The planning application for single barn egg laying unit covers an area of 2138m². The site is currently a grass field, 150m north west of Talwrn Farm, Legacy, Wrexham. The total site development impermeable area including proposed access track covers approximately 3780m². Proposed access/egress is to be taken from the electricity substation site to the south west.

The proposed unit lies 20m to the south of an unnamed ordinary watercourse (stream) and 200m south west of Pentrebychan Brook. According to the Environment Agency's flood map the proposed application site lies within zone 1. This zone relates to land where flooding from rivers and the sea is very unlikely (<0.1 per cent (1 in 1000) chance of flooding occurring each year).

The proposed development will increase the impermeable area within the site and as a result runoff will be increased. A rainfall runoff method was used to calculate surface water discharge rates from impermeable areas from the proposed development.

The total development site runoff will be limited by function of a Sustainable Urban Drainage System (SuDS). Assessment of the underlying geology and soils across the application site shows limited porosity meaning soakaways are not appropriate. A single storage attenuation pond has been chosen as the most suitable method to limit surface water discharge from the site. Design of purpose built attenuation storage is proposed within the development field. Designs to mitigate against increased surface water from the development have been considered for up to the 1 in 100 year storm event. Climatic change has been factored into all design calculations.

2.0 SITE DETAILS

Site Location



Figure 1. Site Location Plan (Ordnance Survey (c) Crown Copyright 2013. All rights reserved. Licence number 100020449)

Site Details

Site Reference	LDCL_FRA084
Site Name	Talwrn Farm
Location	Legacy, Wrexham, Wales
Grid Reference	N 329236, E 348020
Proposed Development	Single barn egg laying unit, 2 No. feed bins, hardstanding parking /access areas, concrete apron, attenuation pond
Existing Land Use	Agricultural grassland
Total Application Site Area (Field)	7765 m ²
County	Wrexham County Borough
Local Planning Authority	Wrexham County Borough
Internal Drainage Board(s)	Not applicable
Waterbody(s) / Watercourses	Unnamed ordinary watercourse & Pentrebychan Brook

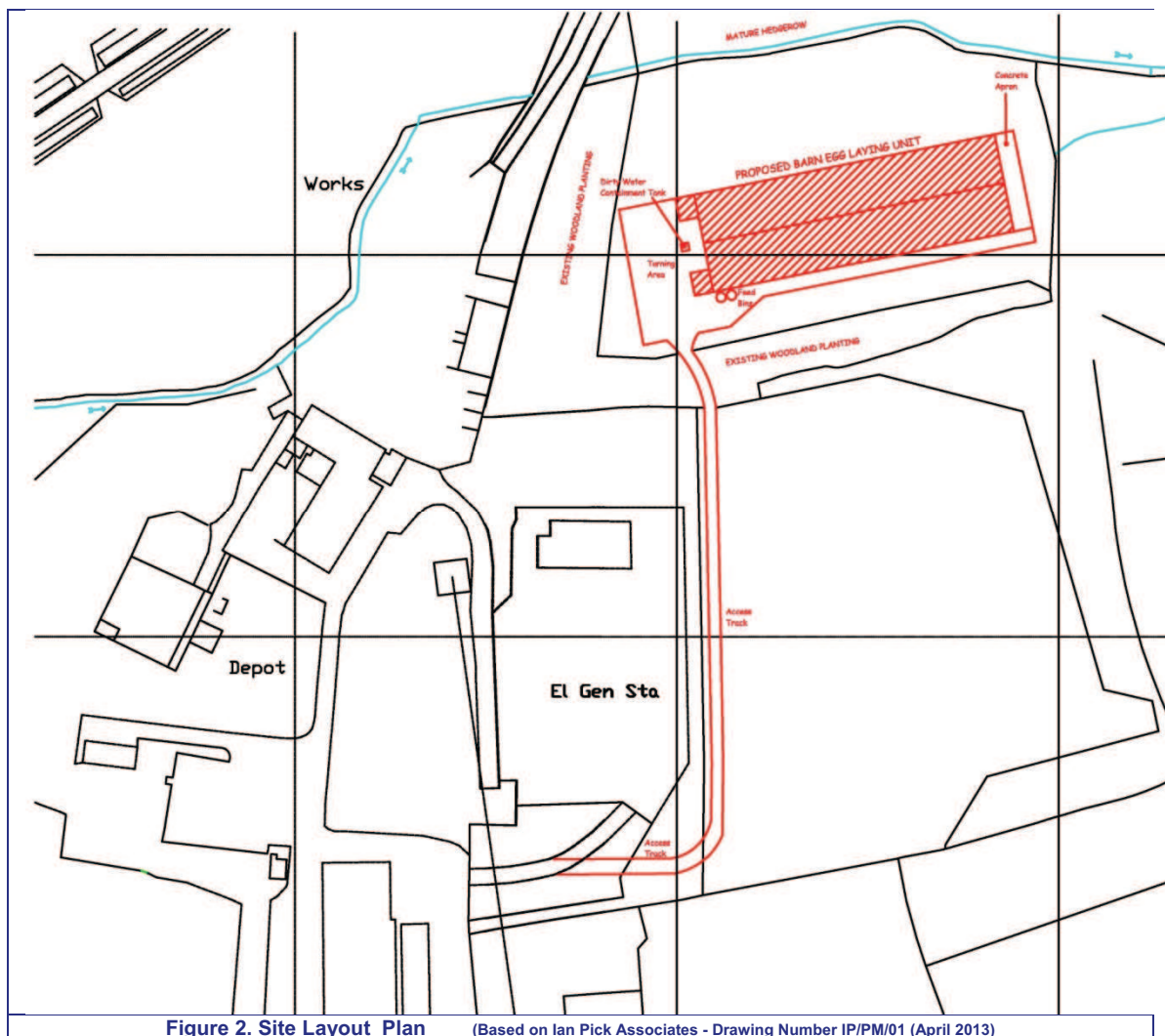


Figure 2. Site Layout Plan (Based on Ian Pick Associates - Drawing Number IP/PM/01 (April 2013))

Site Photograph



Figure 3. Photograph of site looking west from existing site access point (May 2013)

The application site lies 1.0km north west of Pentre Bychan village and is set within a grassland field currently used for silage production. The site is surrounded by small grassland paddocks and small pockets of woodland which provide ideal screening of the site. A large electricity substation is situated 50m to the south west of the site. Access to the proposed development is to be taken from the substation along the boundary of an adjoining grassland field (See Figure 2).

The field site covers an area of approximately 0.77ha and is bounded by mature hedgerows to the north and east and relatively new woodland plantations to the west and south. A drainage ditch runs along the eastern boundary and passes under a culvert beneath the existing site access point. A larger stream flows west to east along the northern boundary and discharges into a large pond set within a neighboring field. This stream eventually discharges into Pentre Bychan Brook 200m to the east.

Ground levels across the application site have been surveyed to Ordnance Datum using GPS to an accuracy of 100mm. The site slopes west to east and is most elevated in the south west corner at 146.150m (AOD). The lowest part of the field is in the north east with land levels as low as 142.949 m (AOD) (See all levels on plan at Appendix).

The field across which it is proposed to construct a new section of access track from the substation is generally flat but there is a slight degree of fall from south to north towards the site.

It is thought that the field site is drained west to east by a clay tile under-drainage system. The applicant / site owner confirmed that this system is likely to be blocked and ceases to function.

Soils across this field are recognised as being slowly permeable, seasonally wet, acid loams and clays.

The annual average rainfall for this location of 882mm suggests that the climate is relatively wet compared to the UK average.

3.0 DEVELOPMENT DETAILS

The proposal is for the erection of a single building to be used as a barn egg laying unit. The proposed building is of steel portal frame construction and extends to 80.250m L x 25.910m W and includes two store rooms on the western facade. The overall development proposal includes the proposed unit, 2 No. feed bins, and hardstanding for parking and access at the western end of the building, and a concrete apron at the eastern end. Cut and fill will be carried out in order to achieve a level platform on which to construct the unit and parking area. Hardstanding areas will be constructed with crushed stone to provide a permeable surface. The proposed development includes 2138m² of building, and a further 129m² of impermeable concrete apron. The total amount of impermeable surface provided by the development is therefore 2267m². The total development footprint including proposed access track covers approx. 3780m².

4.0 SURFACE WATER MITIGATION

The construction of roofed and concreted areas on greenfield sites increases the peak surface flows and can contribute to on and off site flooding. Increased runoff from the development may increase pressure on receiving watercourses.

This assessment considers Sustainable Urban Drainage systems (SuDS) that will be implemented to ensure that total runoff from the site (post-development) is limited to an acceptable rate.

Both feasibility and design of SuDS are heavily influenced by the site topographical, geological and groundwater conditions. Local soils and the underlying geology have naturally low infiltration potential. Soakaways are therefore not considered appropriate for this site and development. It is proposed to discharge all clean surface water from the development into a specially designed attenuation pond. This will be constructed upon land immediately north of the unit, within the development site field.

Dirty water from the barn unit will enter a containment tank and will be kept separate from clean surface water deriving from the roof and hard standing areas. Any silt / debris from the hard standing areas will be given the opportunity to settle within the proposed attenuation pond.

At present a small scrape approximate 60m² is positioned upon the eastern boundary of this field and is ideally situated to expand for use as an attenuation pond (See Figure 5). The scrape was constructed to both collect surface water from this field site and help drain saturated soils during particularly wet periods. An adjacent drainage ditch along the eastern boundary is also suitable to discharge restricted clean water flows into from the development site.

Initial examination of existing land levels, levels of this pond, the adjacent ditch, larger pond to the east and anticipated development levels show that there is insufficient depth and cover to generate sufficient additional attenuation storage from the existing scrape/pond for the calculated volumes of runoff from the entire development site. Design of a new onsite pond is described in following sections of this report.



Figure 5. Photograph of existing scrape/pond (May 2013)

Conveyance of Surface Water to Attenuation Pond from Unit Site

Gutters will convey roof water into downpipes at corners of the barn unit. Gravel filled trenches containing drainage pipes will intercept surface water from both the concrete apron and graveled areas. The conveyance pipes will be graded within the development platform (cut and fill) area and should be graded down to the attenuation pond upon the northern boundary of the development / barn unit (See plan at Appendix). Here water from the trenches and down pipes will be collected in a short section of open concrete channel laid between the proposed attenuation pond and barn unit.

Surface water run-off calculations and attenuation pond design details are listed in the following sections of this report.

Surface Water Runoff and Attenuation Pond Storage Calculations

Using the *ADAS345 Peak Flow Method* an accurate assessment of the site specific existing greenfield runoff rate has been calculated. Variables inputted into this calculation include: *length of catchment; area of catchment; height; annual average rainfall; soil type and percentage of urban area; and return period*. Results show an estimated greenfield runoff rate of 27.78l/s for a catchment area of 3.3ha. Proportionally, the greenfield runoff rate for the proposed development area (0.37ha) equates to 3.0l/s for the 1 in 1 year event. Table 1 below shows the comparison between runoff rates for the development area under both pre and post construction conditions for a range of return periods:

Return Period	Pre-construction site greenfield runoff rate (l/s)	Post-construction site runoff rate (l/s)
1 in 1 year	3.0	5
1 in 10 year	6.1	5
1 in 20 year	7.6	5
1 in 50 year	9.9	5
1 in 100 year	12.2	5

Table 1. Pre - Post development site runoff rates

Restricting the proposed development site runoff to the greenfield runoff rate for the 1 in 1 year return period (3.0l/s) would require a very small orifice plate on the attenuation pond outfall. This would be prone to blockages from debris and may result in system failure. In accordance to the code of good practice, it is purposed to restrict total site runoff to 5l/s up to the 1 in 100 year event.

Accounting for Climate Change

To account for the perceived effects of climate change on peak intensity rainfall and peak river flows, the Environment Agency request that an additional 20% capacity must be factored into all design calculations.

Methodology

It is proposed to restrict additional surface water flows from the proposed development for up to the 1 in 100 year rainfall event via a purposed built attenuation pond. The volume of flood storage required has been calculated using the Rational Method:

$$Q = 2.78KiA$$

Where Q = Peak flow in litres per second
 i = Rainfall intensity during 1 in 100 year storm
 A = Area
 K = Runoff coefficient
 A = 2267m² of roofing and concrete areas
 K¹ = 0.90
 1513m² of gravelled access tracks and car parking areas
 K² = 0.65
 K (average) = 0.80 based on proportion of K¹ and K²

Description	Area	Outfall
Grassed	0m ²	N/A
Roofing	2138m ²	Attenuation Pond
Concrete	129m ²	Attenuation Pond
Graveled (Parking/turning area)	1047m ²	Attenuation Pond
Main Access Track	466m ²	Attenuation Pond
Total	3780m ²	

Table 2. Post development site composition

Intensities from the 1 in 100 year storm have been predicted and the storage volume calculated for various different storm durations as per the table below:

Storm Duration	Intensity mm/hour	Ka 0.80 x 0.3780 = 0.30	Volume of Runoff m ³	Restricted discharge = 5 l/sec m ³	Storage Volume Required m ³
10 mins	190mm	0.30	95m ³	3m ³	92m ³
30 mins	85mm	0.30	127m ³	9m ³	118m ³
1 hour	60mm	0.30	180m ³	18m ³	162m ³
2 hours	40mm	0.30	240m ³	36m ³	204m³
3 hours	16mm	0.30	144m ³	53m ³	91m ³

Table 3. Rational Method Storage Volume Calculations (*Exc 20% for climate change)

The maximum storage volume required to restrict flows to 5 l/s during a 1 in 100 year storm is 204m³. Including 20% extra storage capacity for the effects climate change, the total required development site flood storage volume is **244m³**.

Attenuation Pond Design

An existing scrape / pond to the north east of the proposed poultry would ideally be expanded to create adequate attenuation storage (See Appendix). However, study of land levels and anticipated development levels show that there is insufficient cover and depth to generate flood storage at this particular location. Details of the existing scrape/pond are listed below and is shown on the plan at Appendix:

Existing Scrape / Pond Details:

Average existing ground level surrounding pond	= 143.200m AOD
Pond base level	= 142.500m AOD
Pond resting water level	= 142.700m AOD
Pond flood water level	= 142.900m AOD
Effective flood storage depth	= 0.400m
Pond maximum freeboard	= 0.100m
Estimated Flood Storage Volume	= 25m ³ (Approx)
Outfall invert level	= N/A
Adjacent Drainage ditch water level (16/05/13*)	= 142.473m AOD

To obtain a flood storage volume of 244m³ a pond surface area of 406m² is required. This is based on a 206m² of maximum effective flood storage depth at 0.7m (144m³) and 200m² of effective flood storage depth at 0.5m (100m³). From safety, ecological and aesthetical points of view it would be sensible to construct the attenuation pond 14m W x 29m L in a natural shape with natural, more shallow profiles (See Appendix). There will be sufficient additional storage to account for rain falling on into the attenuation pond.

Flood storage will be accommodated at and below exiting ground levels. An outfall level and therefore resting water level of 143.00m (AOD) is proposed. The drain inlet level into the attenuation pond should be set at 143.70m (AOD) meaning an effective flood storage depth of 0.7m will be achievable. An embankment should be constructed around the attenuation pond from arisings and will prevent potential influx of off-development site surface water. A minimum freeboard of 0.5m should be provided above the maximum flood storage level or 0.5m above minimum ground levels (Whichever is lower).

The attenuation pond should be constructed approximately 10m away from the building unit at the location shown on the plan at Appendix. A specially designed outfall pipe (see following section) will convey water from the attenuation pond into a shallow scrape which will be extended out of the existing pond to the north east of the development site. Another small scrape / channel should be constructed to link the smaller existing pond to the larger pond in the adjacent field (See plan at Appendix). The scrapes / channels should be graded will sufficient fall to provide a flow route from the attenuation pond. The scrapes / channels should not be graded too steeply as scour and erosion of the channel / scrape bed may occur during peak flows. The proposed level of the attenuation pond outfall is approximately 0.5m higher than the existing water level of the large pond to the east. An embankment to the east of the larger pond restricts water within this pond. A culvert within the bank acts to discharge water from this large pond. The approximate top level along this embankment was measured at approximately 143.000m (AOD) and means water levels within this pond and the drainage system may rise to a maximum of 143.000m (AOD) before topping over this embankment. Therefore the outfall level of the attenuation pond must be at or above this level to prevent water from backing up the system which could surcharge the attenuation pond.

The land where it is proposed to construct an attenuation pond is approximately 0.75m higher than the water level of the stream / ditch that flows 20m to the north. It is unlikely that water from this stream will flood over land into the proposed pond.

Proposed Attenuation Pond Details:

Average existing ground level surrounding pond	= 144.300m - 145.000m (AOD)
Pond base level	= 142.400m AOD
Pond restricted outfall invert level	= 143.000m AOD
Pond resting water level	= 143.000m AOD
Pond flood water level	= 143.700m AOD
Drain Inlet invert level	= 143.700m AOD
Effective flood storage depth	= 0.700m
Pond maximum freeboard	= 0.500m
Estimated Flood Storage Volume	= 244m ³

Design of Orifice to Restrict Discharge

An orifice can control the discharge from the attenuation pond and restrict it to the required 5 l/s. The size of the orifice is dependent on the average 'head' of water available i.e. the difference between the resting and flood water levels.

On the assumption that the maximum design water depth above resting water level is 0.70m then an orifice of 63mm diameter would be required to restrict the discharge to 5 l/s. This has been calculated in accordance with the formula:

$$Q = 2.1 D^2 H^{0.5}$$

where	Diameter, D	= 63 mm
and	Average head, H	= 0.35 metres
then	Flow, Q	= 5 litres per second

Additional Attenuation Pond Design Considerations

It is important that the outfall / orifice from the attenuation pond is kept unsurcharged and runs freely, even in storm conditions for the balancing provision to function as designed. Regular inspection and maintenance of the pond is recommended in order to sustain its functionality.

It is necessary to provide an emergency route for surplus water should the outfall from the attenuation pond ever become blocked or an exceptional storm occurs (>1 in 100 years). A cut within the bank of the attenuation pond set to 143.700m (AOD) will allow safe discharge of water across the site field without flooding the development site, third party land and or properties.

Deeper excavations within the attenuation pond and scrape below the resting water level will allow silt / debris to settle and prevent possible blockages. Deeper excavations will also ensure that the pond holds water for much of the year and will enable its potential as a wildlife habitat to be maximized.

Installation of an oil separator is recommended to treat water flowing from surfaces where there will be regular vehicular traffic. Alternatively, a penstock valve could be installed at the point of

outfall from the attenuation pond. The valve could effectively close off the system and prevent discharge of contaminated water into sensitive watercourses and would facilitate cleanup operation.

During rainfall events of a high magnitude it is important to allow surface water which may gather across access / parking areas a safe escape route preventing potential surface water flooding across the site.

Control Off Access Track Surface Water

The construction of an access track (466m²) will generate increased surface water compared to its existing greenfield state. SuDs must be implemented to ensure that surface water flows are not increased. This can be mitigated by providing an opportunity for the surface water to flow into gravelled trenches approximately 1.20m deep around the edge of the access track (See plan at Appendix). The track should be slightly cambered to divert surface water towards the trench. A drain should be provided approximately 0.45m above the bottom of the trench where water will be gathered and will be given the opportunity to infiltrate. The storage created in the void space within the stone will also help buffer flows. The drain will not start to run until this storage has been filled and the water level is 0.45m above the bottom of the trench. Gravel within the trench will filter any particulates washed off the access track. The drainage pipe within the trench should be graded with the natural lie of the field towards and under an existing small drainage ditch. There is sufficient cover to install the drain beneath the base of ditch (See plan at Appendix 2). The track side drain should be connected into the piped drainage system surrounding the development site. This mitigation approach will ensure surface flows do not exceed existing rates.

5.0 ASSESSMENT SUMMARY

This report details SuDS that will limit total site runoff from a proposed barn egg laying unit and associated infrastructure to the permitted 5 l/s rate. A specially designed attenuation pond is proposed to the north of the development and is linked to an existing scrape / pond. It is proposed to discharge site water from this pond via a restricted orifice and this will be limited to 5 l/s up to the 1 in 100 year storm event. Design of a french-drain alongside the proposed new access track is also recommended in order to attenuate anticipated runoff from the graveled surfaces.