# Appendix 10.2 Utilities and Drainage Strategy

# LANGARTH GARDEN VILLAGE

## Utilities and Drainage Strategy

NOVEMBER 2020

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# VERSION CONTROL

| Version | Date | Author | Checker | Approver | Changes |
| --- | --- | --- | --- | --- | --- |
| P01 | 29/11/19 | P Valvona | C Nickson | C Hill | First issue (Draft) |
| P02 | 09/110/20 | P Valvona | | | Updated internal draft for Planning Application |
| 01 | 03/11/20 | M Maki / T Pearson | P Valvona | P Valvona | Issued for Planning Application |
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# 1 Background and Context

## 1.1 Scope of this document

In March 2019 Arcadis was instructed to prepare a utilities strategy for the Langarth Garden Village development, in advance of the Masterplan which was in the process of being procured by Cornwall Council (CC). The intention was to provide an early start on strategy development around, sewerage and power which are critical to the development.

The strategy covers the area within the proposed development' s planning application boundary, as per the extract in Figure 1, approximately 3.5km from west to east;


*Figure 1 – Planning application boundary*

## 1.2 Masterplan

The purpose of this document is to summarise the early strategic input on the masterplan, particularly in relation to land-take and making space for utilities and drainage. The strategy has been informed by the following documents:

- Langarth Delivery Framework Stage 0-1A Report V1.1 issued by Inner Circle in September 2019
- Langarth Garden Village Stage 0+1A Report P03 issued by AHR in September 2019
- Stage 1B Report - Langarth Garden Village_P02 issued by AHR in November 2019

The strategies set out within this report have been developed in parallel with the masterplan development and have involved third parties and stakeholders, including Cornwall Council, statutory undertakers, developers and CORMAC. These strategies have been incorporated within the Masterplan which will culminate with an outline planning application to be submitted in November 2020.

## 1.3 Northern Access Road

The Northern Access Road (NAR) is a new vehicle/pedestrian/cycle way, circa 3km long that will run through the Langarth Garden Village, providing connections to the development and the park and ride from a new junction off the A390 at West Langarth, to the Royal Cornwall Hospital Treliske at the east end .

The design and construction of the NAR is being led by CORMAC Solutions Ltd, with construction of the first element, the interim link road to the west of the Stadium, commencing in September 2020. This link road will provide construction access to Langarth Phases 1 & 2 from the A390. Subsequent phases on the NAR will be constructed between 2021 and 2024.

The construction of the NAR in advance of the development sites provides an opportunity for utilities to be incorporated within a services corridor along its length, with spurs at junction locations feeding the development plots. This will need to align with the access road layouts for the development.

The utilities strategy plans to make use of the NAR alignment such that:

- the NAR will accommodate strategic infrastructure routes for data / telecoms and 11kV power supply to the development sites
- There is potential for the NAR to provide a primary loop for water supply along its route
- Surface water SuDS features will be kept separate from development drainage SuDS where possible, taking into account the impact on the masterplan of sterilisation of development land
- Crossing points will be required at low points for surface water and foul draining, which will predominantly be flowing from south to north across the route of the NAR
- The NAR serves as a potential spine for a geothermal district heating system which is currently subject to a feasibility study

The construction of the NAR in advance of development plots means that it will be necessary to future-proof connection points by ensuring that spurs and crossing points avoid trenching works after construction.

# 2 Surface Water Drainage Management

This section provides a summary of proposed Surface Water Drainage Strategy (SWDS) presented in Flood Risk Assessment (FRA) and SWDS (document reference LAN_02.2-ARC-XX-XX-RP-Z-0007 that has been prepared by Arcadis to support the Langarth Garden Village Outline Planning Application.

## 2.1 Existing Site Drainage

Existing surface water features and catchment areas are shown in  Figure 2 and Figure 3 below:

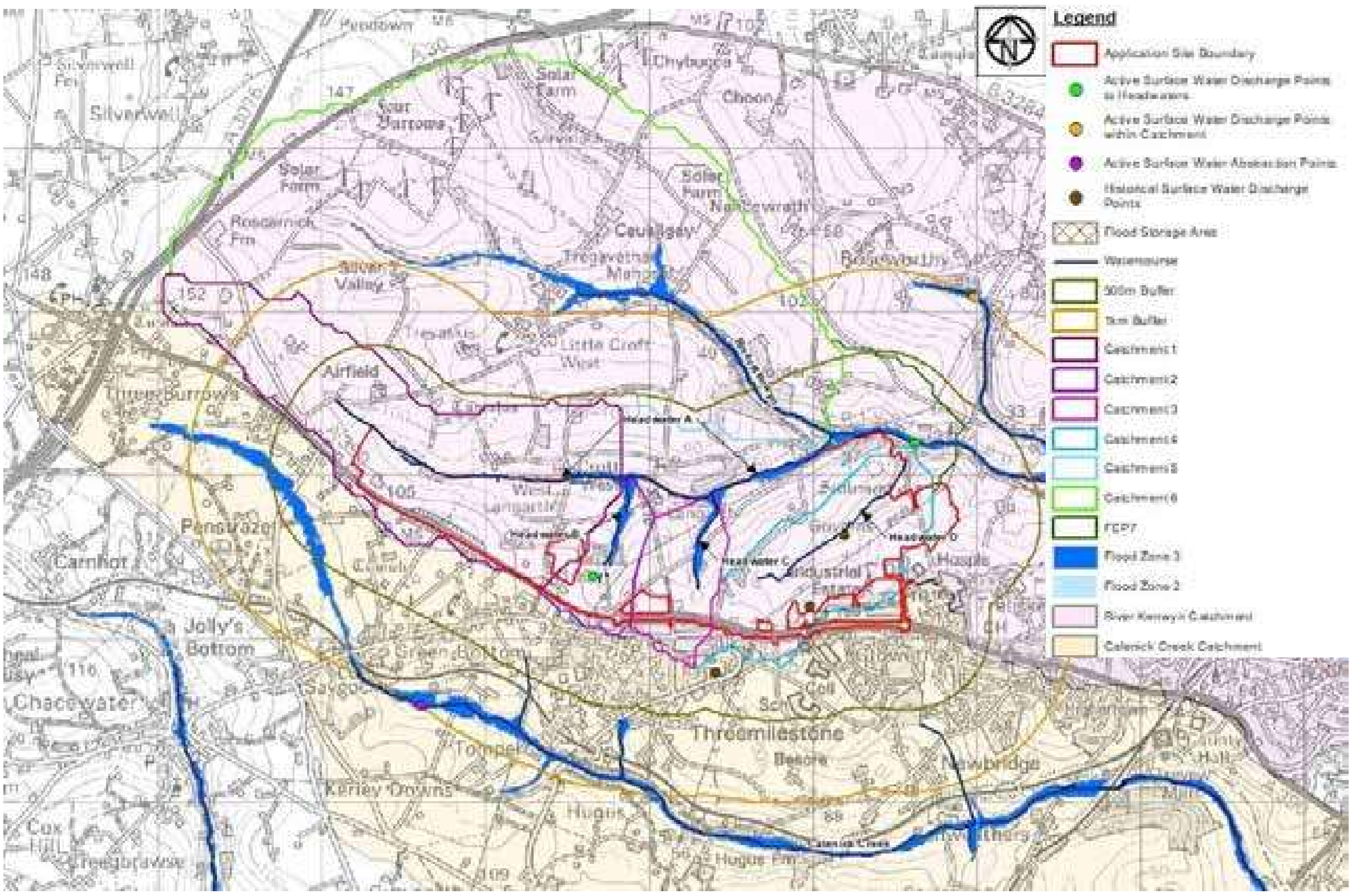



*Figure 2 - Existing Surface Water Features*

The development site sits within the South West River Basin District and is located within the Fal operational catchment. The study area is located within the Kenwyn water body area.

There are four headwaters (A, B C and D) which connect existing surface water features to the River Kenwyn.

There are six principal natural drainage sub-catchments which are described below. The total catchment area is 250.22ha.

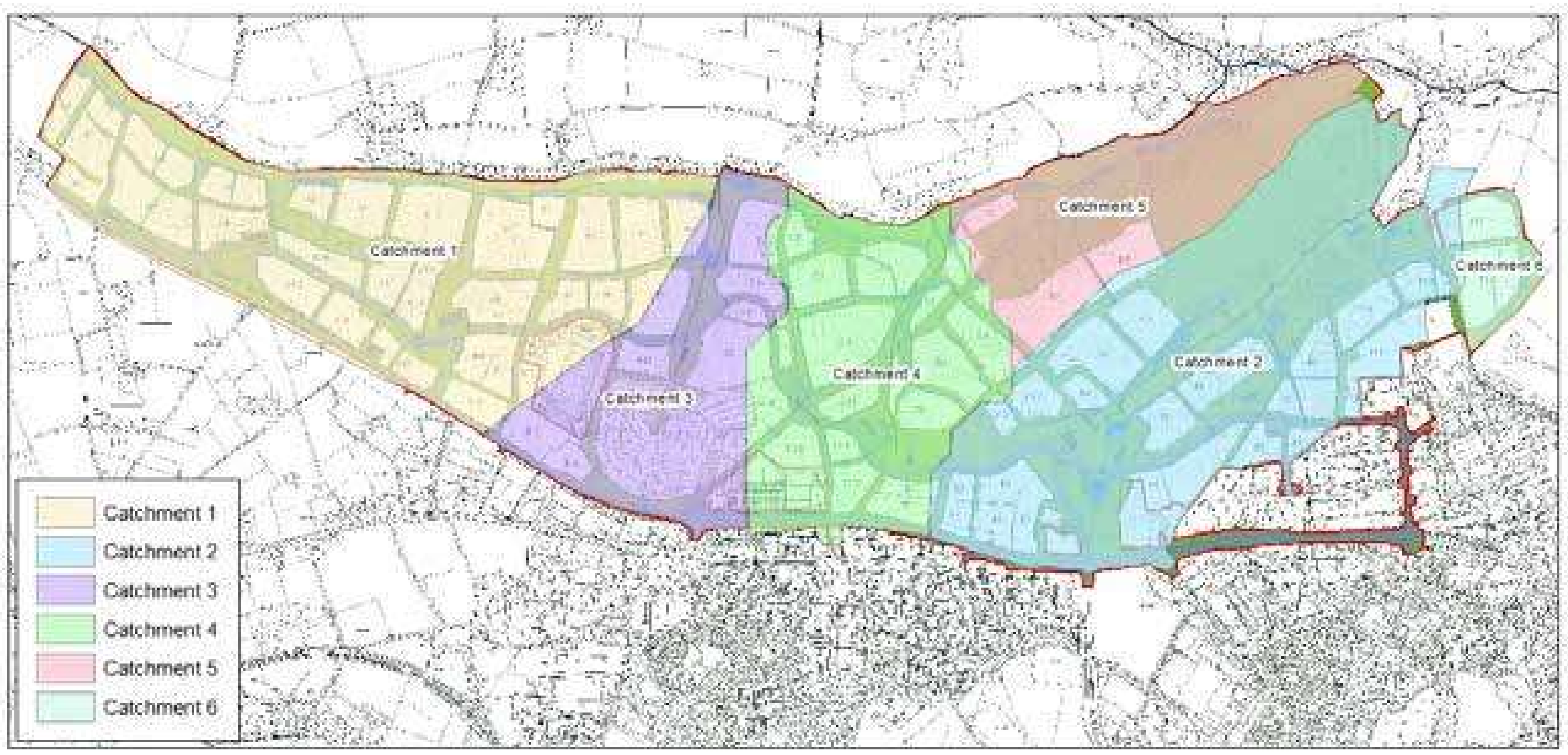



*Figure 3 - Catchments*

## 2.2 Lead Local Flood Authority (LLFA) and Environment Agency (EA) Requirements

Cornwall Council is the Lead Local Flood Authority (LLFA) for the development proposal. The LLFA and the Environment Agency (EA) have both been consulted as part of the SWDS preparation and they have provided the following feedback:

- The proposed site is largely within the Flood Zone 1 based on the Environment Agency maps and falls within two Critical Drainage Areas (CDA), namely “Truro - Kenwyn, Allen, Tregolls Rd” and the “Truro - River Tinney” as shown in Figure 4:

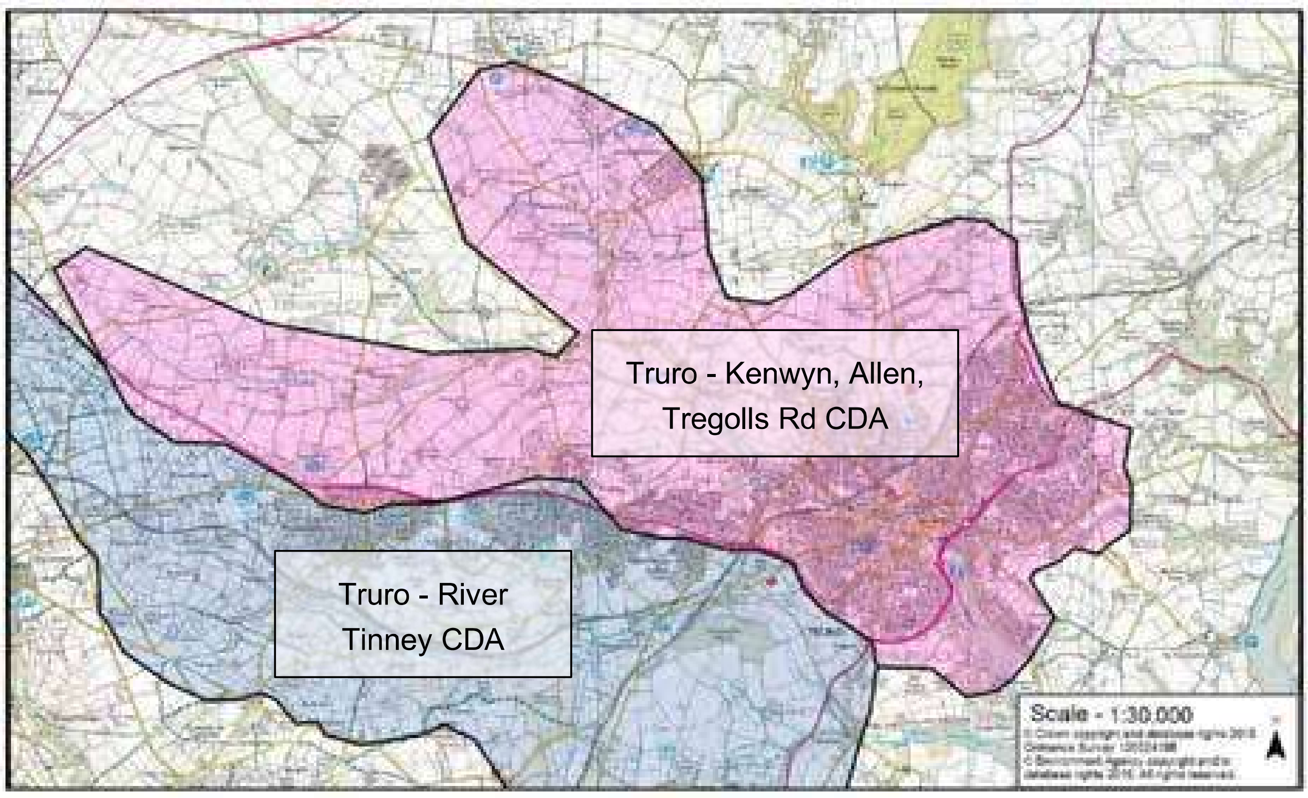



*Figure 4 - Critical Drainage Areas*

- The requirements for each CDA are different in terms of allowable greenfield runoff rates
  - 1 in 10 year for the Truro - Kenwyn, Allen, Tregolls Rd CDA; and,

  - 1 in 1 year for the Truro - River Tinney CDA.
- In both CDAs, the surface water drainage design must include features to manage water quality to protect the interest features of the River Fal Special Area of Conservation and Shellfishery.
- Greenfield runoff rates must be calculated for each catchment/phase of the proposed development. The LLFA will accept these rates based on the IH124 method as this provides lower more conservative rates. The LLFA does not accept rates based on the ADAS method.

The LLFA and EA have also provided further guidance in relation to the design of SuDS features, which has been incorporated within the proposed SWDS.

The Site falls within two Critical Drainage Areas (CDA); primarily the “Truro - Kenwyn, Allen & Tregolls Road” CDA.  A small portion of the Site in the south-eastern corner, comprising the A390 and Penventinnie Lane, falls within the “Truro - River Tinney” CDA where no site works or drainage alterations are involved.  The proposed drainage strategy will only discharge to the Kenwyn catchment and, therefore, only the requirements of this CDA are considered.

## 2.3 Site suitability for SuDS design

Greenfield runoff rates have been estimated for each principal drainage sub-catchment using the IH124 method, as per the LLFA advice received. In addition, the Revitalised Flood Hydrograph (ReFH2) method was used, using the Flood Estimation Handbook (FEH) Catchment Descriptors, to estimate the greenfield runoff rates and volumes for comparison.

Infiltration potential has been initially determined through several published data sources and from available ground investigations from the previous planning applications and Phase 1 Truro Northern Access Relief Road (NAR) investigations. Further percolation tests (in accordance with the procedures set out in BRE Digest 365 or CIRIA 156) have been undertaken by CORMAC to inform this SWDS and NAR Phase 2 SWDS where the previous data coverage was limited for designing the strategic SuDS features in order to confirm if infiltration is fully viable.

These ground investigations confirm that there are good infiltration rates across the site and that infiltration-based SuDS features would be suitable. However, further percolation tests (in accordance with the procedures set out in BRE Digest 365 or CIRIA 156) must be completed prior to the detailed design to provide adequate coverage of the site to allow an assessment to be made. These tests should be undertaken in the locations and at the effective depth of potential soakaways or infiltration-based SuDS features.

In order to minimise the risk of pollution entering groundwater and to ensure that infiltration features operate as intended the invert level of all infiltration features will need to be located more than 1m above the peak groundwater level.  Borehole monitoring is currently underway for a period of 12 months across the site to establish the peak groundwater level which will be used to inform the design of infiltration features at the reserved matters stage.

At the time of writing the results of this monitoring are not available, due to wet conditions on site preventing access for heavy machinery and restrictions in place in relation to COVID-19 in the first half of 2020. However, some trial pits did record groundwater ingress at shallow depths (less than 2 metres below ground level).  These were most notable in the lower-lying areas of the site where ground infiltration was poor, confirming infiltration-based SuDS should be avoided in these areas.

In addition, a mining risk assessment report prepared by Cormac (reference 64672 CN2000026) identifies a number of historic mining features located to the south of Maiden Green.  The report recommends that infiltration features should not be located in these areas to avoid mobilising potential contamination within the historic workings.

## 2.4 Preliminary Sustainable Drainage (SuDS) Strategy

In line with the LLFA and the NPPF requirements the Proposed Development would utilise SuDS as summarised in the following sections in order to manage surface water across the site. SuDS aim to replicate natural drainage mechanisms where possible and have multiple benefits including, but not limited to, water quality, flood risk, amenity and biodiversity.

Early consideration of surface water management provides the opportunity to use SuDS that respond to the local context and character, enriching both the natural and built environment. By fully integrating the management of surface water with the wider development objectives and by considering all space as potentially multifunctional, surface water management systems can be used to enhance development viability through the delivery of the design criteria. This can result in a number of benefits as defined in the CIRIA SuDS Manual:

- An alternative supply of water resources, to improve water security;
- Higher value amenity, recreation and education facilities within public open space;
- Improved habitats and biodiversity;
- Improved climate resilience;
- Reduced pressure on sewerage infrastructure and reduced surface water flooding;
- A mechanism for enhancing and defining the quality, character and visual aesthetics of both the built environment and green/ open space;
- A surface water management system that can be easily and cost-effectively maintained; and
- Flood risk reduction or betterment.

The following design criteria have been adopted for the preliminary SuDS design:

- CIRIA SuDS Manual best practice along with local guidance requirements;
- DEFRA Non-statutory technical standards for SuDS[7]
- The strategic surface water management objectives;
- The opportunities, constraints and challenges identified by the site and development characterisation; and
- Key stakeholder requirements, including the EA and the LLFA.

In line with SuDS principles the destination for surface water runoff that is not collected for use should be prioritised in the following order:

1. Infiltration
2. Discharge to surface waters
3. Discharge to surface water sewer, highway drain or another drainage system
4. Discharge to a combined sewer.

As highlighted above, the available infiltration data shows the potential for the use of infiltration-based SuDS features on higher ground but there are limitations on their use in lower lying areas of the site due to shallow ground water. Therefore, infiltration should be maximised across the Proposed Development where feasible. However, it is unlikely that infiltration SuDS alone is sufficient to fully manage the runoff within the site as the steep topography of the site means that large infiltration basins will be difficult to accommodate on the higher ground. Therefore, allowable discharge rates from each drainage catchment, the strategic SuDS attenuation storage requirements and key discharge points are defined and set out below to provide a fully inter-linked and integrated SuDS system within the landscape proposals.

Surface water runoff will be managed on the site in order to meet the following standards:

- Surface water drainage systems sized to cater for the 1 in 100 annual probability critical duration event plus a minimum allowance of 40% for climate change.

- Flow rates leaving the developed site must not exceed the 1 in 10 annual probability greenfield runoff rate in accordance with the requirements of the CDA.
- Overland flood flow routes will be considered at the detailed design phase.

This is in line with the following criteria applicable to the Kenwyn, Allen and Tregolls Road CDA:

"*All off-site surface water discharges from developments should mimic greenfield performance up to a maximum 1 in 10-year discharge rate. On site all surface water should be safely managed up to the 1 in 100 plus climate change conditions. This will require additional water storage areas to be created thereby contributing to a reduction in flooding downstream.*"

The Proposed Development plots have been grouped into 18 drainage zones based on the phasing and topographical constraints as shown in Figure 5. These drainage zones are located in one of the five proposed overall drainage catchments (i.e. A, B, C, D and E), which SuDS features will be located within to drain and attenuate surface water from the planned development.

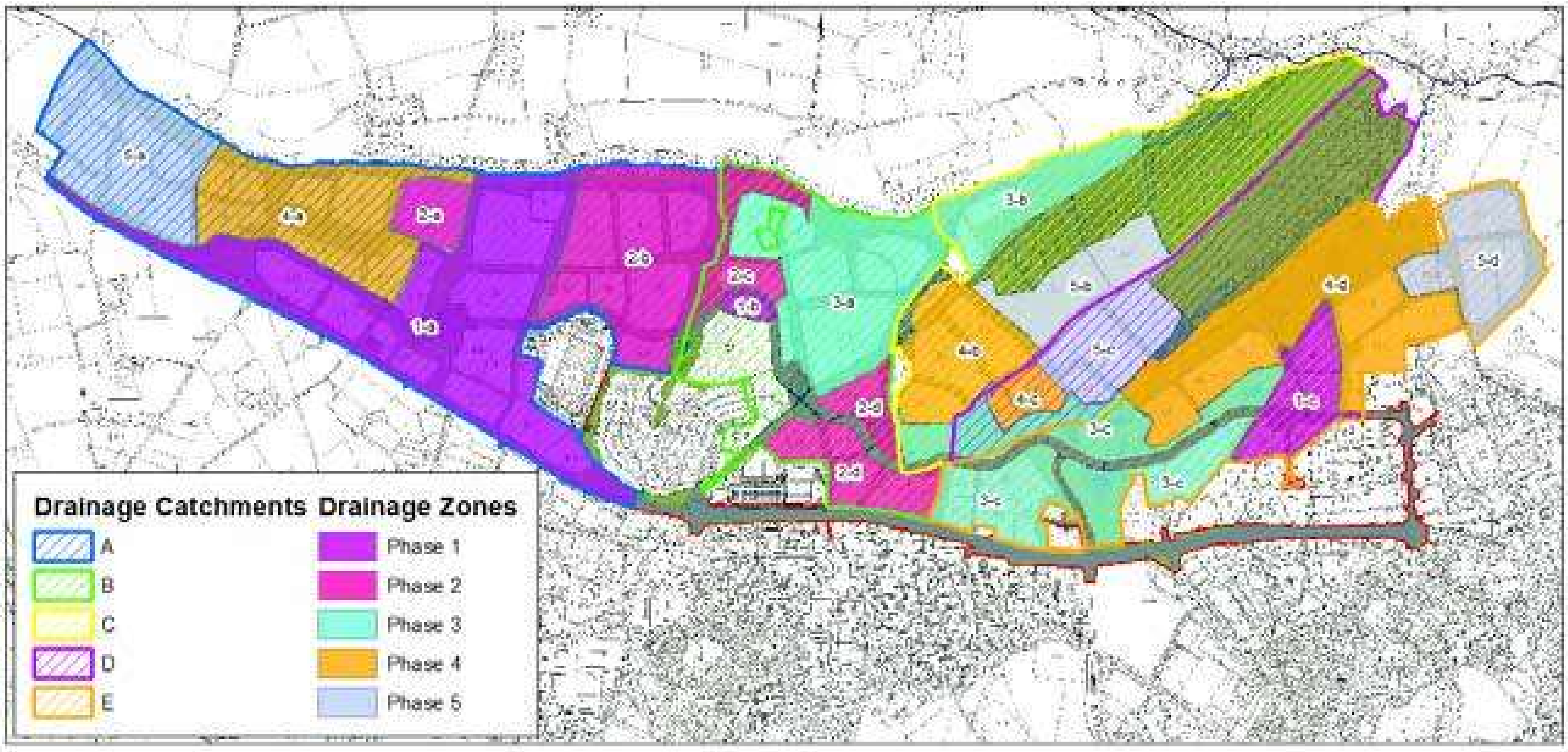



*Figure 5 – Plan showing the location of proposed drainage zones and development phasing areas*

The maximum allowable discharge rates have been calculated based on the product of estimated impermeable area and 1 in 10 annual probability specific runoff; these are summarised in Table 1:

| Drainage Zone | Impermeable Area (ha) | Maximum Allowable Discharge Rate (l/s) | Drainage Zone | Impermeable Area (ha) | Maximum Allowable Discharge Rate (l/s) |
|---|---|---|---|---|---|
| 1-a | 9.51 | 43.9 | 3-c | 3.26 | 14.2 |
| 1-b | 0.38 | 1.9 | 4-a | 3.25 | 14.8 |
| 1-c | 1.73 | 7.5 | 4-b | 2.44 | 11.5 |
| 2-a | 1.15 | 5.3 | 4-c | 0.89 | 3.9 |

| Drainage Zone | Impermeable Area (ha) | Maximum Allowable Discharge Rate (l/s) | Drainage Zone | Impermeable Area (ha) | Maximum Allowable Discharge Rate (l/s) |
|---|---|---|---|---|---|
| 2-b | 4.34 | 20.3 | 4-d | 4.55 | 17.6 |
| 2-c | 0.50 | 2.5 | 5-a | 3.22 | 14.7 |
| 2-d | 2.39 | 11.3 | 5-b | 3.15 | 15.3 |
| 3-a | 4.18 | 19.8 | 5-c | 1.75 | 7.6 |
| 3-b | 0.22 | 1.1 | 5-d | 2.14 | 11.7 |

*Table 1: Summary of impermeable area draining to strategic storage and maximum allowable peak discharge rates*
*Note: The calculations have been performed for each plot and aggregated for each drainage zone.*

## 2.5 Proposed SuDS features and locations

This long-term storage capacity can be provided by various interlinked SuDS components within the development parcels and in strategic attenuation areas across the site, whilst maximising ground infiltration as far as practicable and allowing for exceedance flows.

Figure 6 below shows where existing green infrastructure features can be used to integrate strategic SuDS features, with proposed SuDS strategy is illustrated in Figure 7.

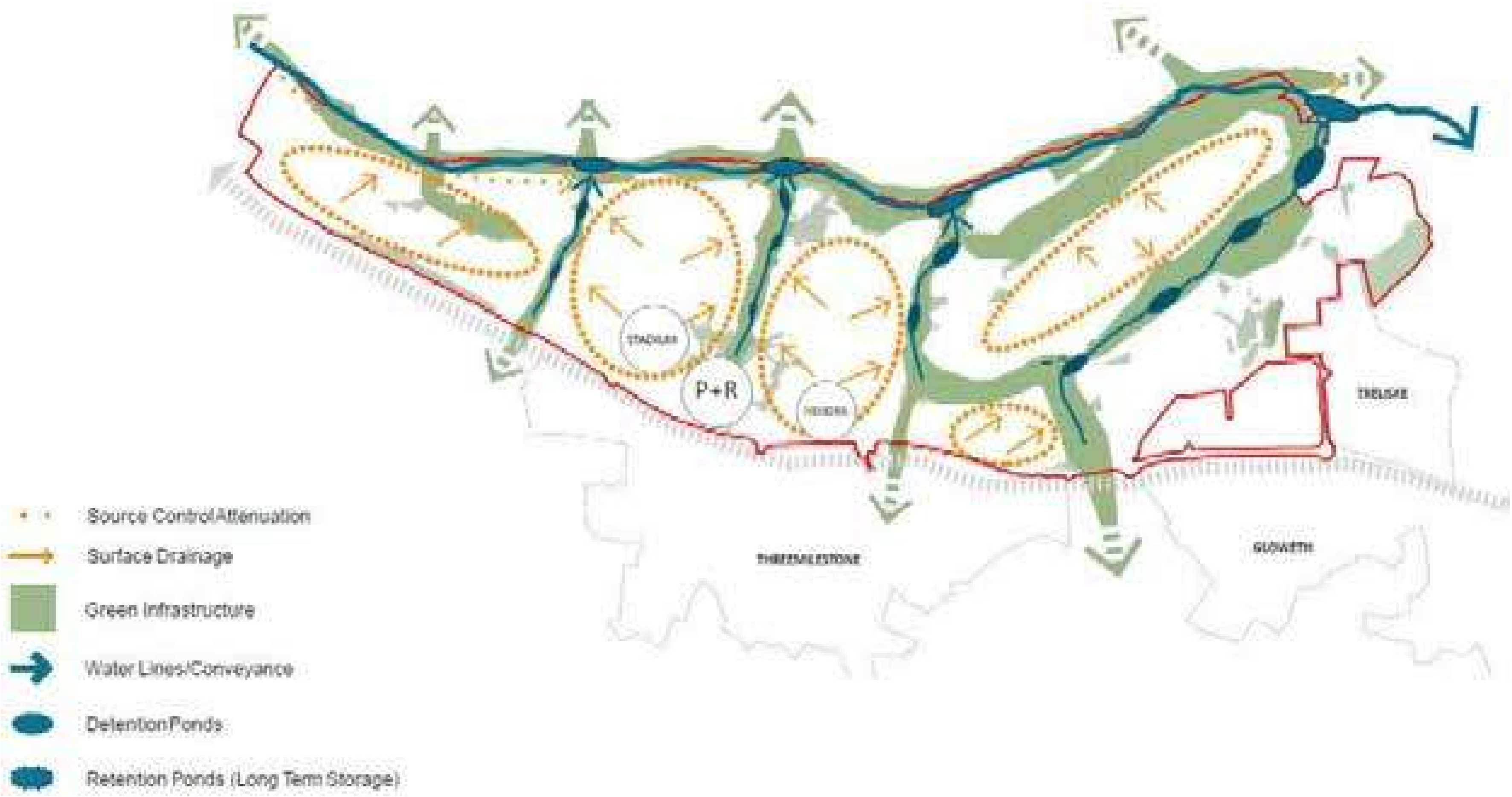



*Figure 6 – Masterplan SuDS features integration with green infrastructure*

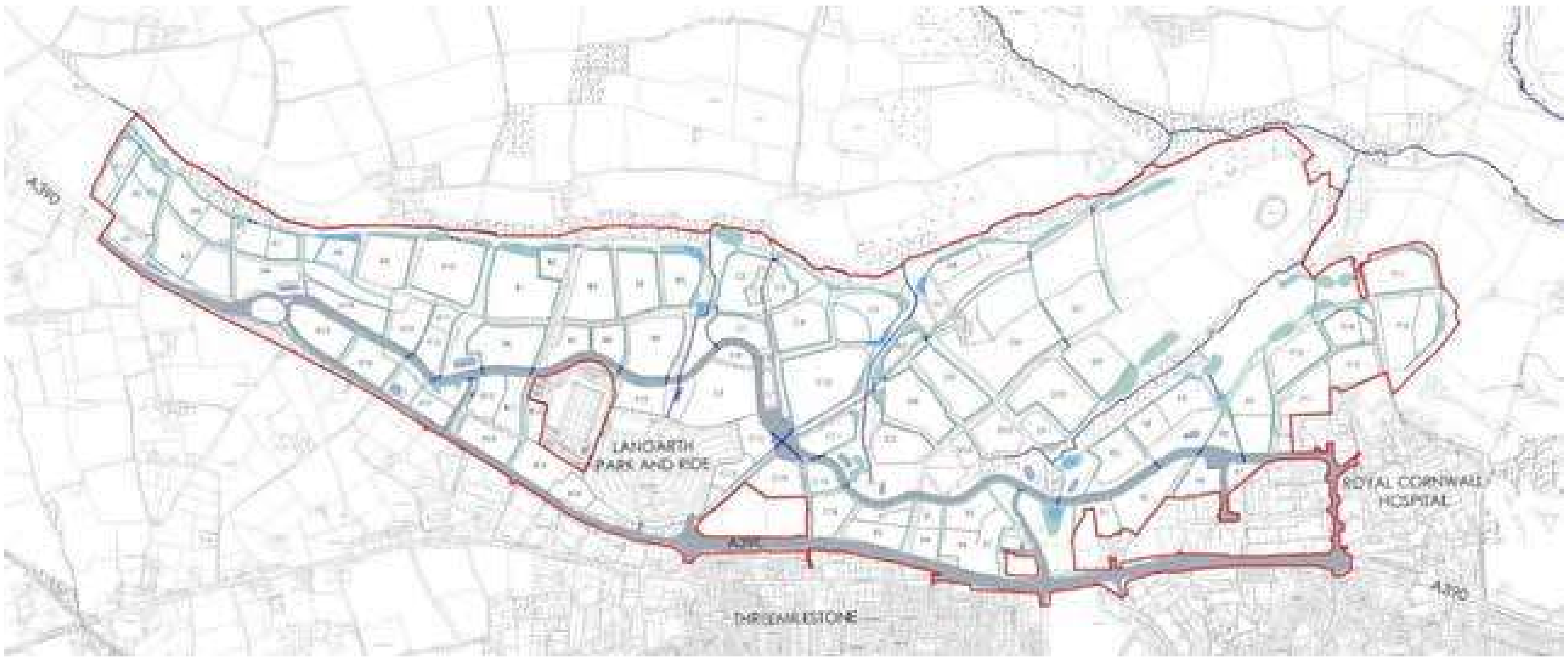



*Figure 7 – SuDS Strategy*

There is further potential to incorporate SuDS storage (incl. natural flood management measures) within the existing small local watercourses and their floodplain (e.g. Headwater B, C and D) if they can be enhanced as part of the proposed development. This is particularly relevant as the local drainage catchments associated with these existing small watercourses are mainly limited to the planning application redline boundary (shown in Figure 1). Therefore, these watercourses primarily receive surface water discharge from the proposed development, they could be enhanced and incorporated within a holistic and an integrated surface water drainage strategy to maximise the potential flood risk and wider environmental benefits.

The location of these SuDS features is flexible and they can be adjusted to suit layout requirements as part of the reserved matters. A swale width of 6m has been currently assumed, though this could be increased depending on the orientation of swale/hedgerow against the actual ground slope. In some places it may be necessary to provide bunding on the lower part of the swale (through localised cut & fill) to channel water/encourage infiltration.

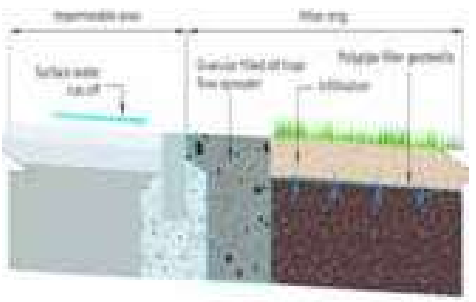
The location of SuDS features will need to take into consideration tree root protection zones and buffer zones to hedgerows to prevent root damage from construction and localised increases in ground water levels.

As well as components located in the main development character areas, larger scale strategic components are likely to be required outside of these areas, within the strategic green space, to provide the necessary infiltration and long-term attenuation storage for the larger storm events. These should be sized through balancing the development requirements against the surface water management requirements and would be in place prior to the commencement of development construction for each phase as appropriate, along with the necessary treatment stages to address water quality and silt management needs.

Examples of potential SuDS features and their application are also presented Table 2:

*Table 2: SuDS Components and Application*

| SuDS Component | | Description and Function | Benefits Provided* | Application: Residential Parcels | Application: Employment Parcels | Application: Primary Access Roads | Application: Green Infrastructure |
|---|---|---|---|---|---|---|---|
| Green Roofs |  | A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation. | Attenuation, Water Treatment, Biodiversity, Education, Amenity, Microclimate, (Open Space, Water Reuse, Character) | | ✓ | | |
| Soakaways / Infiltration Trenches |  | Where infiltration is suitable, soakaways allow water to infiltrate into the ground and can be used to drain roofs, roads and other paved areas. At a plot level, soakaways can be set into household gardens. | Attenuation, Water Treatment, Infiltration, (Biodiversity, Amenity) | ✓ | ✓ | ✓ | ✓ |
| Permeable Paving |  | Permeable paving allows surface water to soak through to storage media below. From there it can either infiltrate into the ground where ground conditions are favourable or be discharged down the SuDS train. Permeable paving can be located along non-adoptable roads and in parking areas. | Attenuation, Water Treatment, (Infiltration, Water Re-Use) | ✓ | ✓ | | |

| SuDS Component | | Description and Function | Benefits Provided* | Application | | | |
|---|---|---|---|---|---|---|---|
| | | | | Residential Parcels | Employment Parcels | Primary Access Roads | Green Infrastructure |
| Filter Strips |  | Filter strips are grassed or planted areas that runoff can run across to promote infiltration and cleansing. Filter strips can be located alongside roads and typically require less space that swales. | Water Treatment, Infiltration, (Attenuation, Open Space) | | ✓ | ✓ | |
| Swales |  | Swales are vegetated shallow depressions designed to convey and filter water. These can be 'wet' where water gathers above the surface, or 'dry' where water gathers in a gravel layer beneath. Can be lined or unlined to allow infiltration. Swales can exist alongside roads and within blue/green corridors. | Attenuation, Water Treatment, Biodiversity, Education, Amenity, Microclimate (Open Space, Infiltration, Character), | ✓ | ✓ | ✓ | ✓ |
| Bioretention Areas |  | A vegetated area with gravel and sand layers below designed to channel, filter and cleanse water vertically. Water can infiltrate into the ground below or drain to pipework and be conveyed elsewhere. Bioretention systems can be integrated with tree-pits or gardens and can be in any urban environment. | Attenuation, Water Treatment, Biodiversity, Education, Amenity, Microclimate, (Infiltration), | ✓ | ✓ | ✓ | ✓ |

| SuDS Component | | Description and Function | Benefits Provided* | Application: Residential Parcels | Application: Employment Parcels | Application: Primary Access Roads | Application: Green Infrastructure |
|---|---|---|---|---|---|---|---|
| Underground Storage |  | Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation. | Attenuation, (Infiltration) | | ✓ | | ✓ |
| Infiltration and Detention Basins |  | Infiltration and detention basins are usually dry but during heavy storms they can be wet. Basins can provide infiltration and storage and can be located in areas of open space. Due to them also being 'wet' they can be designed to provide multi-functionality. | Attenuation, Water Treatment, Biodiversity, Education, Amenity, Open Space, Character, Microclimate, (Infiltration), | | | | ✓ |
| Wetlands/ Ponds |  | Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment. | Attenuation, Water Treatment, Biodiversity, Education, Amenity, Open Space, Character, Microclimate, (Infiltration), | | ✓ | | ✓ |

* Benefits shown in brackets can potentially be achieved through good design

## 2.6 NAR Drainage

In line with the Interim Surface Water Strategy Design Development Update provided by CORMAC[1], the design has worked on the principle that the proposed Truro NAR Road Drainage System will fully accommodate the runoff from the NAR (i.e. for the 1 in 100 annual probability event with 40% climate change allowance) and there is no need to provide additional attenuation stage within the proposed Langarth Development SuDS system.

The extract below is from CORMAC drawing 1665_CSL_HDG_00MZ_DR_D_0030 P01 which shows details of attenuation storage required for the NAR:

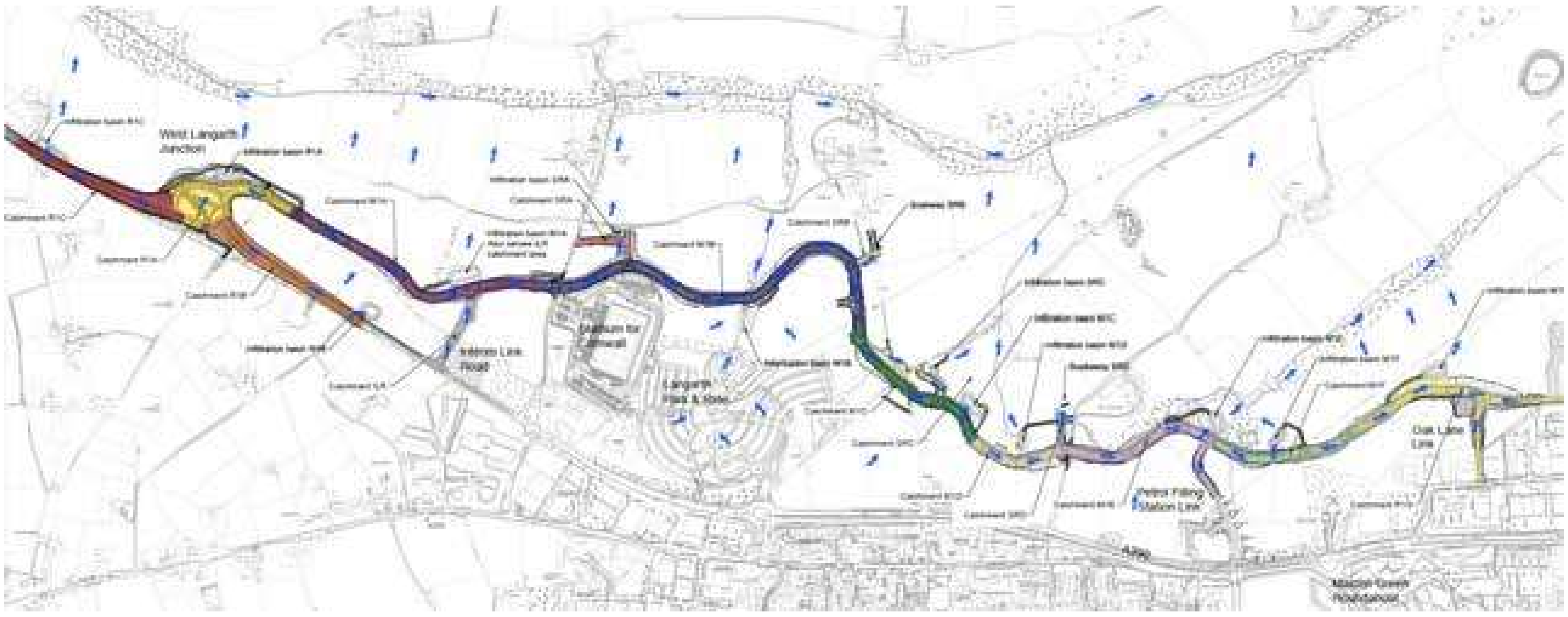



*Figure 8 – Conceptual Basin Sizing for NAR SuDS.*

As with SuDs features discussed previously for the main development site, there is some flexibility in the location and geometry of these features around the Masterplan requirements. It is recognised that the Masterplan, the NAR design and the development sites SuDS solutions will be co-ordinated to ensure a fully integrated solution but providing a stand-alone NAR drainage design at this stage provides an indication of the attenuation volumes along the route. The integration of designs now needs to be developed as a priority.

# 3 Foul Drainage

## 3.1 Existing Foul Drainage Network

The development area is largely rural and there are generally no foul sewers in this location with the exception of the south east corner in the area of Maiden Green junction and the hospital.

The approach to sewerage provision for the Langarth sites has until recently been down to individual developers to consider their own site needs. This has led to a piecemeal approach which has held back developer commitment due to the significant investments required, with no clear and equitable mechanism for sharing / recovery of initial investment costs.

The default arrangement for the provision of wastewater services for new developments is through application to the incumbent water company, which for Cornwall is South West Water (SWW). As a utility company, SWW has powers to construct new sewers on third party land so as to enable sewerage on development land which cannot connect directly to a public sewer.

[1] Truro Northern Access Road (TNAR) Surface Water Management Strategy Design Development Interim Update, CORMAC Solutions, Report Ref. EDG01665-CSL-HDG-00MZ-RP-CD 0001 P02, August 2019

In 2018 the developer Inox submitted outline proposals prepared by SWW to discharge conditions relating to PA15/11489 Reserve Matters application. SWW proposed to transfer all foul sewage from the development to their existing Newham Sewage Treatment Plant (STP), that serves the City of Truro, via their existing Calenick Pumping Station (PS). The proposals also required a new pumping station located in the north east corner of the development to convey the sewage to Calenick PS from where the flow is pumped to Newham STP. A trunk gravity sewer would also be needed from West Langarth to the pumping station to transfer any flows generated from the west to mid development.

In the early part of 2020, a requisition process was commenced between a consortium of developers (including Inox) and SWW around a single application to serve the whole development area and not just the land owned by Inox at the time. Inox are also engaging separately with SWW for the requisition of a gravity trunk sewer to serve their land and CC land to the west. SWW have prepared a revised preliminary design, consisting of two pumping station and rising main to their Newham Sewage Treatment Plant (STP), which is being upgraded to receive additional flows. SWW are quoting 18 months for design and construction with the aim of achieving an in-service date of April 2022 to align with the construction programme for the early phases of development. This will therefore require the requisition agreement between the consortium and SWW to be in place by the end of October 2020. Should this not come forward at an appropriate time then Cornwall Council will step in to ensure that the drainage is provided to the development, with costs recovered via a S106 arrangement.

## 3.2 Drainage Strategy – Network Layout

The topography of the site is suitable for a gravity network, with the land generally falling from south the north towards the water course at the norther boundary of the site.

Whilst the NAR will provide a suitable route for non-gravity services such as power, water and telecoms, it is not suitable for sewerage as it runs generally from west to east and rises and falls along its route.

There are several small valley features which generally run south-north and provide suitable routes for gravity sewer connection. These routes are typically within green fringes at the edges of the proposed development plots and therefore will avoid sterilisation of development land.

The northern boundary of the site provides a suitable route for the main trunk sewer to connect to the proposed SWW pumping stations, with the ground gently falling to the east along

The above arrangement lends itself to the following network structure, as illustrated in figure 9 below. The network will comprise:

- Lateral sewers serving development plots, generally flowing from south to north;
- A trunk gravity sewer along the northern boundary of the site, flowing west to east; and
- SWW pumping stations and rising main to convey flows to the Calenick pumping station and onwards to Newham Sewage Treatment Works (STP).

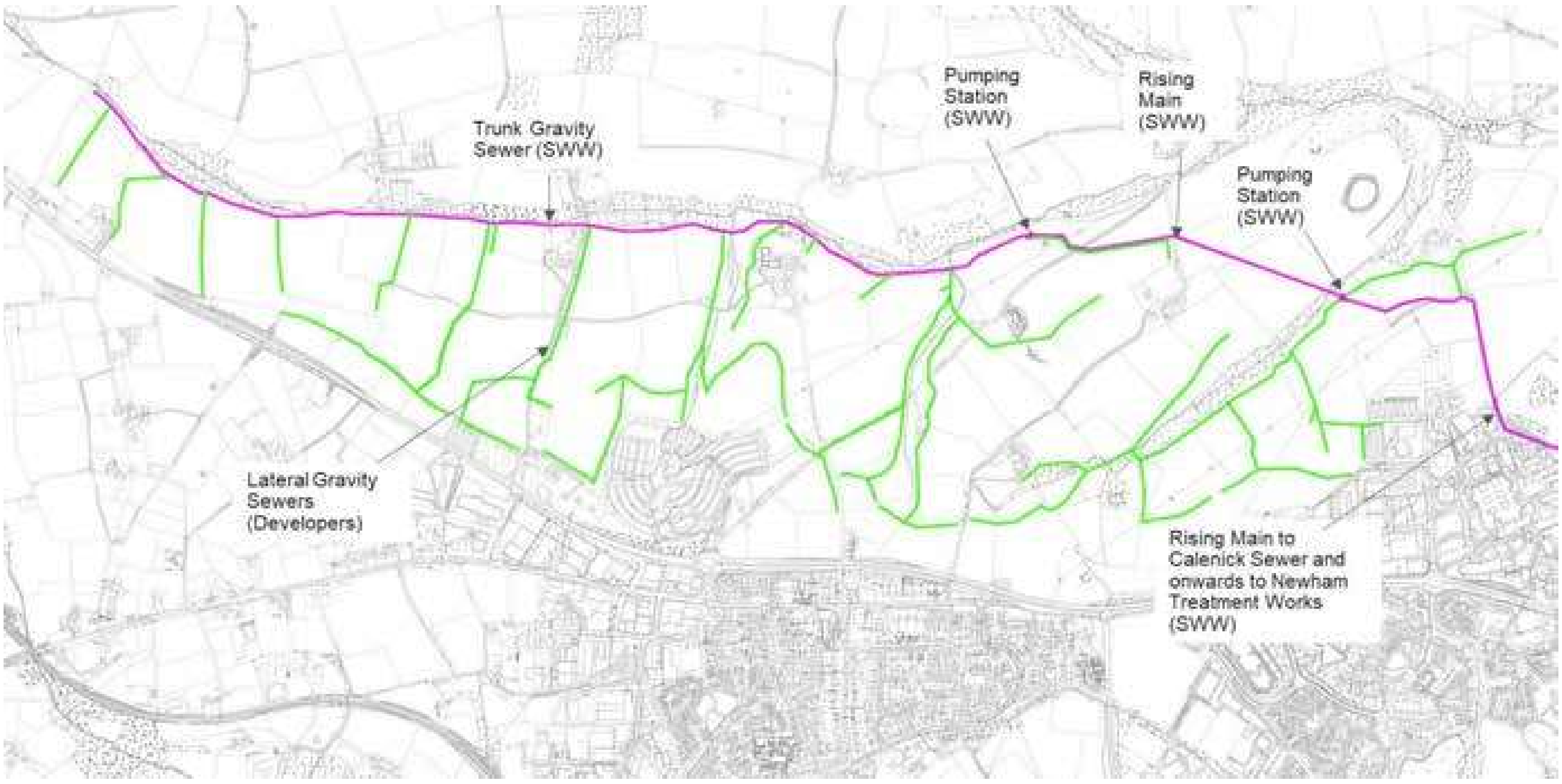



*Figure 9 – Strategic Foul Sewer Infrastructure*

## 3.3 Foul sewer Capacity

Maximum average daily flows have been calculated for water consumption at each of the development sites. These calculations are based on the Masterplan prepared by AHR in November 2020. A summary of the water demand by development zone is presented Section 0.The current total dwellings for the entire masterplan is 3,800, comprising 3,550 dwellings and 250 student accommodation / key worker. Allowing for non-residential flows brings the population equivalent to circa 4,200 dwellings. Preliminary flows have been derived for the Stadium by WSP taking into account various occupancy and usage scenarios and are included in the above.

The pumping station and trunk sewer connecting the western Langarth sites are being designed by SWW. SWW preliminary design is based on 5598 dwellings, which provides adequate capacity for the currently proposed development plus headroom for future growth if necessary. The pumping stations will be designed to operate at 65 l/s (3 x dry weather flow).

For the purposes of NAR crossing, initial flows from each plot will be derived from potable water consumption flows. These flows will also be compared against the requirements of Sewers for Adoption 7th Edition which sets out the following basis for peak flow rates for hydraulic design:

| | |
|---|---|
| Dwellings | 4,000 litres per dwelling per day |
| Domestic element of non-residential development | 0.6 litres per second per hectare |
| Trade effluent, | 0.7 litres per second per hectare |

As the timescales for the NAR will result in its construction ahead of housing development, the sizing of upstream networks and crossing point details will need to be determined in the absence of site layouts, based on the above design criteria.

# 4 Water Supply

## 4.1 Existing water network - location and capacity

As with foul sewerage, water services for the site are limited to local supplies for existing dwellings. There is an older 8" trunk main which crosses the site in a NNE direction from the A390 and past West Langarth and a more recent 315mm OD main which runs along the northern edge of the A390. SWW's preference is to serve the LGV development from the newer A390 main.

## 4.2 Water Supply Strategy – Network Layout

SWW have provided a requisition offer to Inox for the first 572 homes being constructed within Phases 1 and 2 at the western end of the development. This requisition has been transferred over to CC as part of their land purchase from Inox earlier this year. The requisition will enable an initial connection to the A390, which is planned for November 2020 as part of the Interim Link Road works. The requisition will be updated to reflect the current Masterplan proposals covering Inox and CC land ownership.

Development plots towards the eastern end of the site are likely to be fed by existing supplies in the vicinity of the hospital.

Whilst the initial connection on the A390 will be sized for more than 572 homes, SWW are considering additional connection points to their mains for subsequent phases to provide resilience and operational flexibility.

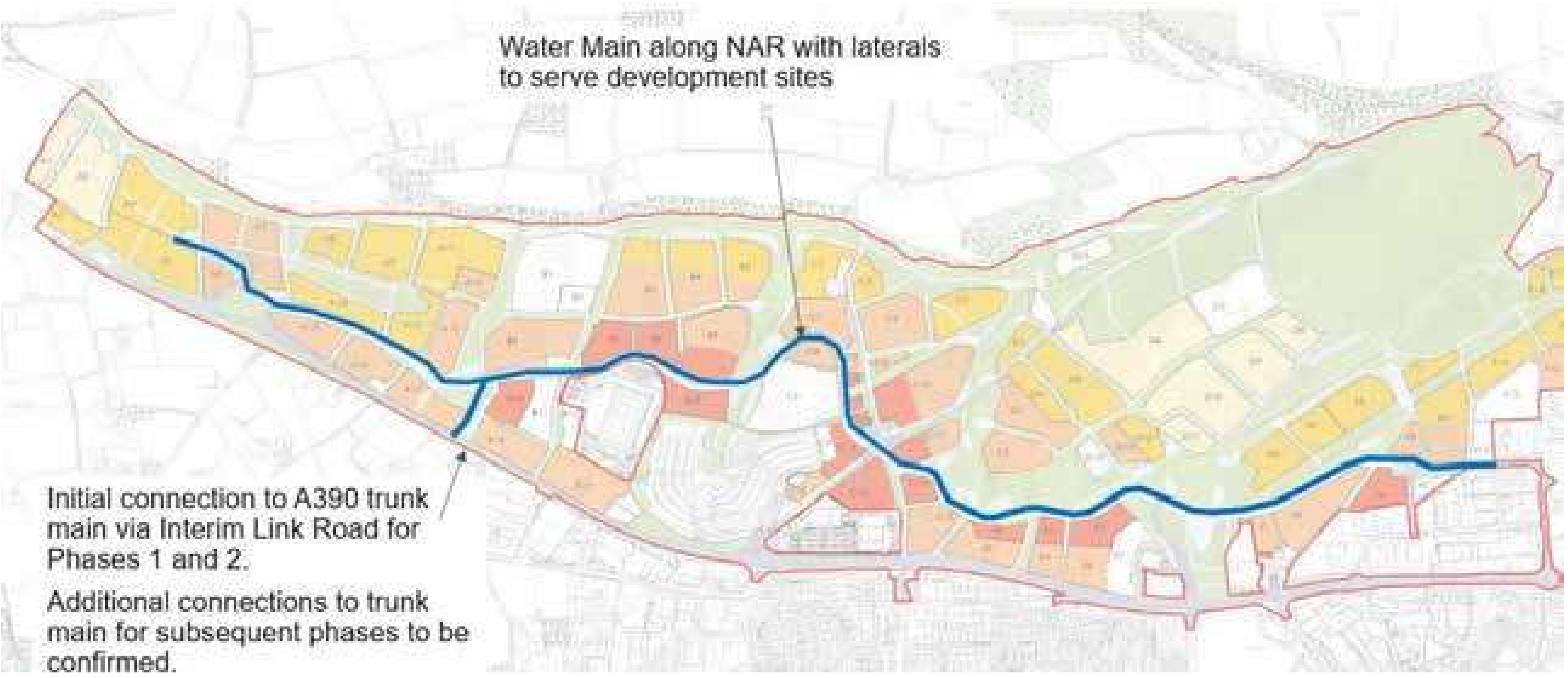



*Figure 10 – Strategic Water Supply Route*

## 4.3 Water Demands

Initial flow estimates have been prepared based on the AHR Masterplan options issued in October 2020 and Option demands are presented in Table 3 below:

| Row Labels | Residential Water Demand l/d | Non-residential Water Demand l/d | Total Water Demand l/d | Flow l/s (over 8 hours) |
|---|---|---|---|---|
| Zone A - Rural / Gateway | 281,585 | 0 | 281,585 | 9.8 |
| Zone B - Sport / Wellness | 198,024 | 42,894 | 240,918 | 8.4 |
| Zone C - Community | 199,160 | 7,613 | 206,773 | 7.2 |
| Zone D - History / Cultural | 143,699 | 9,244 | 152,943 | 5.3 |
| Zone E - Research / Learning | 60,457 | 761 | 61,218 | 2.1 |
| Zone F - Health | 215,547 | 59,810 | 275,357 | 9.6 |
| **Grand Total** | **1,098,472** | **120,323** | **1,218,794** | **42.4** |

*Table 3: Masterplan Option 2 Water Demand*

The demands have been calculated on population equivalents using current building regulations demand of 125 litres per person per day and industry standard demand rates for non-residential uses.

The above table excludes the Stadium which will add 136,872 litres per day, though noting that this will be provided via its own dedicated supply from the A390 via the Park and Ride, along with gas and telecoms.

## 4.4 Water Resource and Conservation

The site sits within the Colliford Water Resource Zone (WRZ), which covers most of Cornwall except the north east of the county. The Colliford WRZ includes Penzance, Falmouth, Newquay, Truro and Bodmin. According to their recently published Water Resource Management Plan, SWW consider that the Colliford WRZs will be in surplus throughout the planning period, which extends to 2045. This takes into account various forecast scenarios for demand and supply.

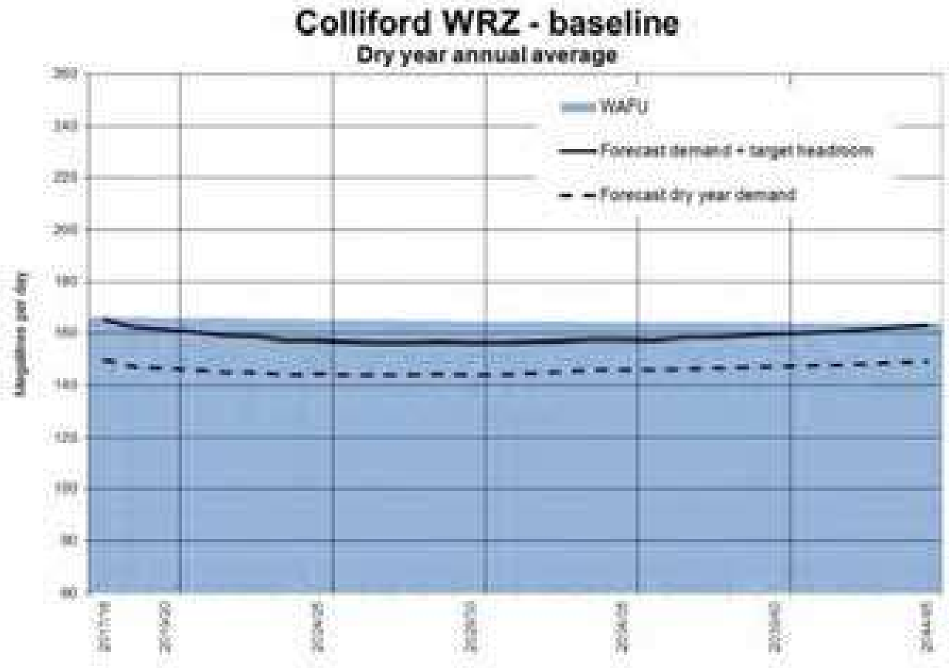



*Figure 11 - Colliford WRZ Baseline Supply Demand Forecast*

As part of the sustainability aspirations for the development, there are opportunities to reduce and to re-use water within the site, which in turn would reduce the demand placed on water from SWW. Treating water carries financial as well as environmental costs through carbon emissions, therefore minimisation and re-use should be considered in support of Cornwall's zero carbon strategy. This should include:

- Behavioural change initiatives at community level and through schools to reduce demand
- Promotion of water saving devices as part of the specification for all new buildings
- Integration of SuDS storage features to provide irrigation water green amenity spaces
- Rainwater harvesting for non-potable uses
- Grey water re-use

These ideas should be integrated with the Masterplan principles and as part of further design development.

# 5 Energy

## 5.1 Energy Strategy

As part of the Utilities Strategy, an Energy Strategy document has been prepared by Arcadis for the Langarth development (Document reference LAN_04-ARC-XX-XX-RP-Z-1100), covering:

- Legislative policies and targets
- An energy assessment for the site as a whole for different scenarios against baseline
- Technology Review
- The future energy market
- Commentary on model scenarios against Cornwall Council's zero carbon targets.

The modelling for the energy assessment has also allowed for peak power calculations to be determined for each scenario considered.

Cornwall Council's declaration in 2019 of a 'Climate Emergency' and of the need for the development to achieve zero or negative carbon emissions has driven this energy strategy to go beyond the local planning policy, which currently  a minimum carbon target for the proposed development, which would be set at a 19% reduction on the Dwelling Emission Rate (DER) against the Target Emission Rate (TER) based on the 2013 Edition of the 2010 Building Regulations (Part L).

An approach using the Energy Hierarchy of **Be Lean** (considering energy efficiency measures), **Be Clean** (assessing the potential for district heating) and **Be Green** (introduction of low and zero carbon energy generation) has been used against current Part L 2020 of Building Regulations.

Baseline energy consumption and carbon emissions have been calculated with an energy prediction model using SAP and SBEM calculations – the government approved calculation methodology for assessing Building Regulation Compliance.

Indicative Be Lean measures have been modelled to assess the potential for energy and carbon reduction from these measures.

Energy Modelling has shown that energy efficiency and using Air Source Heat Pump (ASHP) heating has potential to make an improvement on Building Regulations Part L1A and L2A 2013 of around 60.8% using energy efficiency measures alone.

The proposed development would be electrically heated using ASHP technology. High efficiency and low noise technology will be specified to ensure benefits are maximised.  Solar photovoltaic (PV) panels will be specified throughout the development as it is considered to be the most suitable low and zero carbon technology.

Energy modelling has shown that fabric and systems energy efficiency measures as well as PV systems have the potential to make an improvement on Building Regulations Part L1A and L2A 2020 of 103.8% i.e. carbon negative.

The graph in Figure 12 summarises the carbon dioxide emissions for the building after each stage of the energy hierarchy has been applied based on Building Regulations for the entire Development.

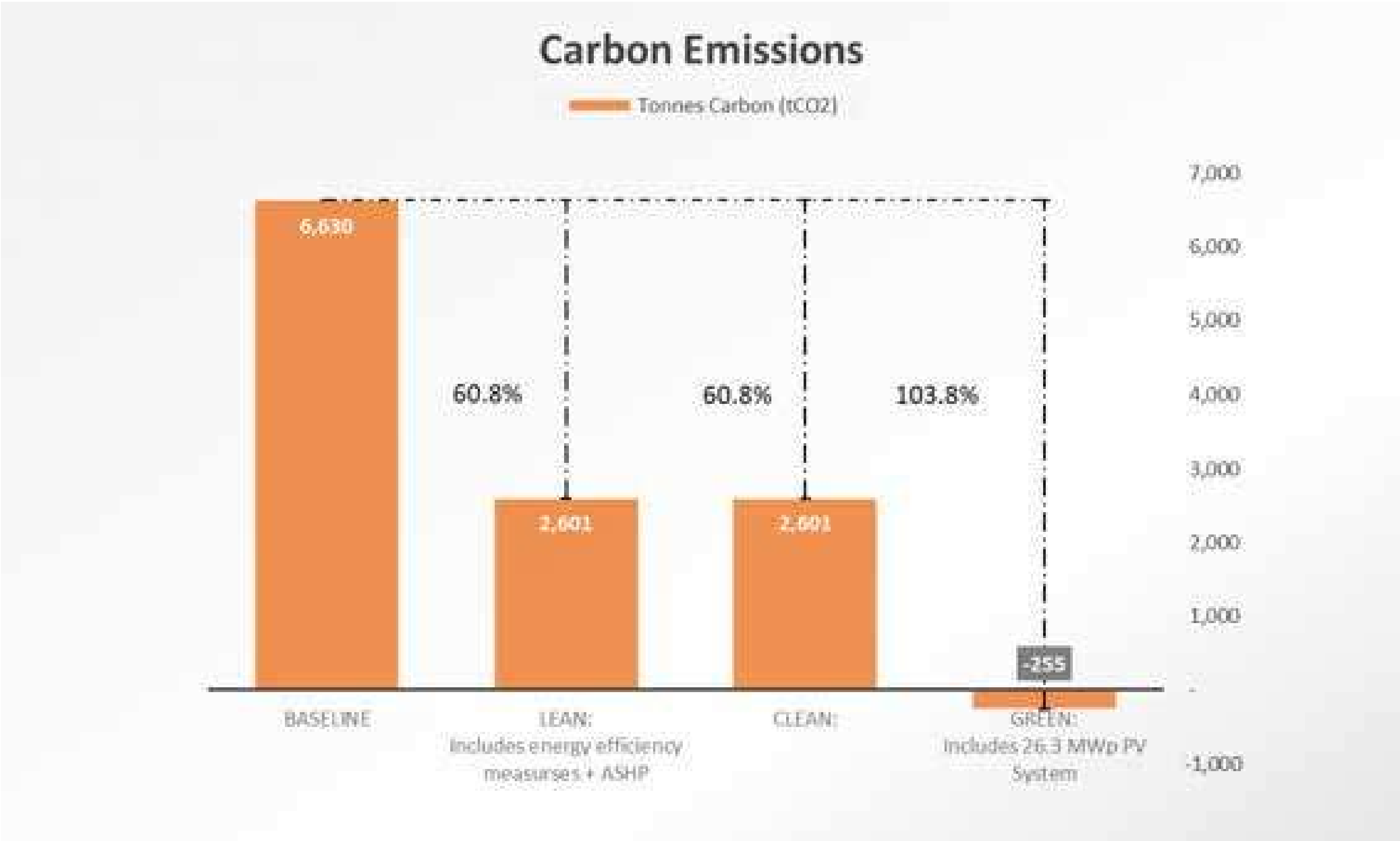



*Figure 12 - Energy Assessment Carbon Savings against Building Regulations Baseline*

Furthermore, the proposed solution is futureproofed as the targets of the building regulations become more stringent and electricity carbon factor reduces, which reduces the benefit of solar PV. The carbon savings may reduce; however, the PV system will still provide a direct benefit to the tenant/homeowner in terms of offsetting energy from the grid.

## 5.2 District Heating

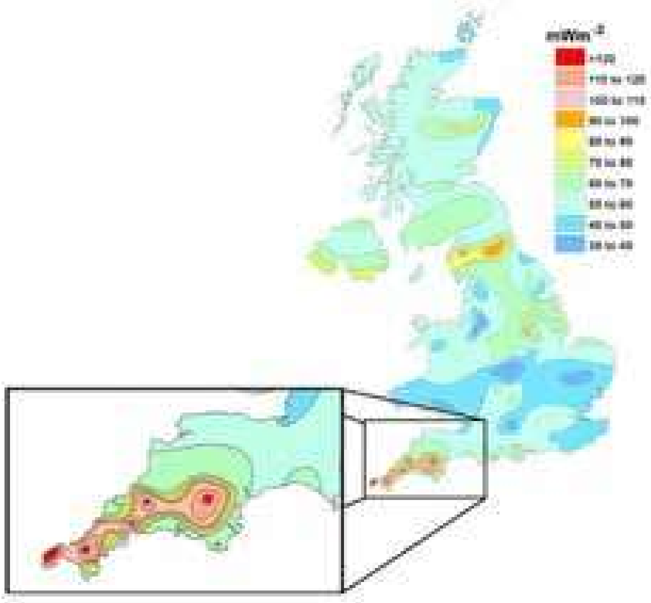
The modelling for the strategy has been based on established and proven technologies (fabric first + ASHP + Solar PV) to provide certainty of delivery. This approach would allow stand-alone construction and would not be reliant on district heating central heating sources.

However, district heating is increasingly being seen as bringing significant benefits on new build schemes where below ground heating networks can be readily and cost effectively incorporated as part of general infrastructure construction.

Gas fired CHP plants have successfully been used as a reliable heat source for district heating, though this clearly is no longer compatible with a move to zero carbon and avoidance of fossil fuels. District heating schemes will therefore need to look at alternative low carbon heat sources, such as energy from waste, industrial heat recovery or large-scale ground source heat pump boreholes.

Interest is growing in the potential for hydrogen to fill the gap that will be left by non-use of natural gas. Technically the use of hydrogen in the gas network seems viable, though production of hydrogen at very large scale is some way off and will require renewable electricity in order to generate clean hydrogen. There will be a huge demand from existing gas installations and potentially hydrogen vehicles as well, so including gas-based CHP to new developments will add to this challenge.

Fortunately, Cornwall is uniquely placed to take advantage heat from granite which can be used as a source of geothermal energy, also referred to as “Hot Rocks”. Cornwall’s rocks are hotter than anywhere else in the UK, making this the best place to exploit geothermal energy for both heat and power.



The heat flow and geological maps show in red where the granite outcrops at surface. Elsewhere, it is covered by other rocks but can still be reached by drilling.

Reaching the hot granite has been achieved by Geothermal Engineering Limited (GEL)GEL, through drilling two deep geothermal wells from its site at United Downs, near Redruth, into the fault zone; one for injection at a depth of 2,393m and one for production at a depth of 5,275m. Temperature at the bottom of the production well is expected to be about 190 ˚C. Water will be pumped from the production well, fed through a heat exchanger and then re-injected into the ground to pick up more heat from the granite in a continuous cycle. The extracted heat will be used to supply a demonstration power plant. Pilot plant will be 1MWe. Potential to increase to 3MWe, though limited by grid constraints.

Initial discussions with GEL has suggested that the site at Langarth is not quite as good as at United Downs in geothermal terms, but still has good potential for heat, with less certainty over power production. There is also the possibility of transferring heat from United Downs to Langarth. The project can potentially flow temperatures of about 85 ˚C as “waste heat”. This is equivalent to a constant all year-round heat generation of more than 6MWth. Using appropriate thermal storage, this can cover the heat demand of the entire proposed Langarth development.

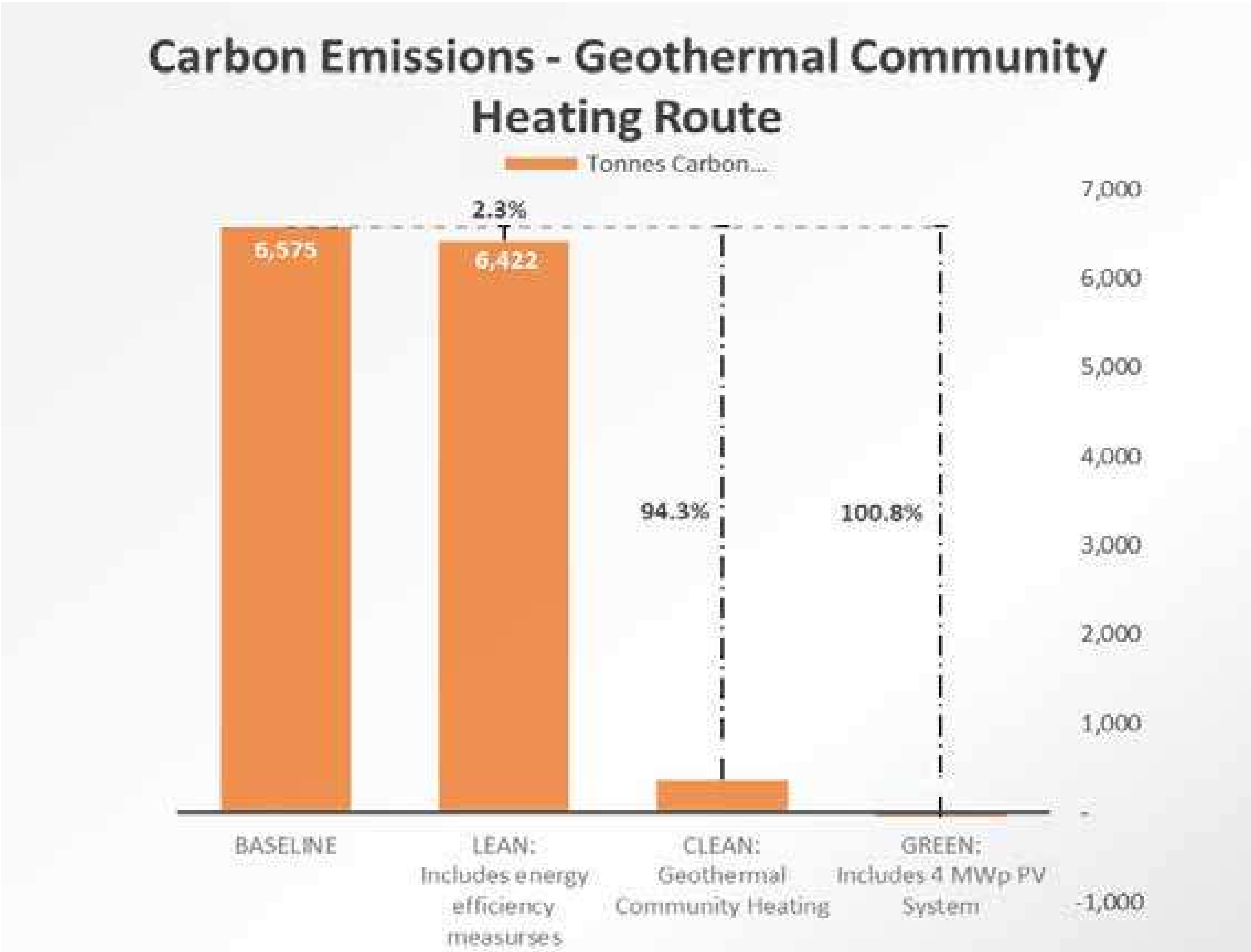



*Figure 13 - Energy Assessment for geothermal source*

Whilst the timescales for development might not meet the start of construction, there is potentially a significant gain to be had through tapping into this geothermal source, whether this is at the site or piped from United Downs. This could be employed on later phases on development as the feasibility, both technically and economically is established. As such, Cornwall Council has secured funding from BEIS to undertake a feasibility study into the potential for geothermal energy from the United Downs site to serve district heating networks for Langarth. The study is ongoing and is due to report its findings in December 2020.

## 5.3 Delivery and Other Opportunities

The energy strategy has set bold ambitions around zero carbon which are fully supported by the project team and Cornwall Council. On Council owned land, delivery will be within their power and so it is entirely possible to achieve these goals provided that the economic case can be made and funds secured.

For sites to be delivered by third party developers, these targets could potentially be challenged. It is therefore important that, for the Council to achieve their ambitions, there will need to be measures in place to ensure that the developers deliver housing that is a close to the Council's aspirations as possible. This will require a combination of planning condition requirements, stipulated standards within the masterplan and design codes and through legal agreements.

Langarth offers many opportunities for the Council to express its ambitions in providing sustainable green energy for new developments:

- The development will look to include smart infrastructure potentially including battery storage as part of the technology mix to enable home and business owners to have control over their energy needs.
- On a community level large scale wind or solar could provide a wider community benefit and these will be investigated further.
- There is significant potential for solar PV outside the immediate development area, e.g., Park and Ride and Stadium roof. This could be combined with direct DC storage for feeding back into EV charging points.
- Similarly, all public buildings, car parks and community buildings to have Solar PV, potentially owned by the Council in some form.
- Innovative energy generating and storage features could be integrated as part of a wider awareness raising and educational theme, e.g.,
  - Physical energy storage (flywheels, pumped water storage)
  - Power generating out-door gym
  - Hydro energy in streams
  - Small-scale wind generation (Heli coils, wind trees)
  - Solar PV on covered walkways, access track etc
  - Using Langarth as test bed for research and educational institutions
- The large-scale incorporation of Solar PV, together with a potential district heating scheme, offers a revenue opportunity for the Council through the establishment of an ESCo or MUSCo.
- Planting trees as part of the zero-carbon target

Turning these ideas into reality will require working with stakeholders, communities and technology providers, to develop and refine proposal within the changing energy landscape to ensure that potential technology options, smart services and innovations can be included in the energy strategy.

# 6 Power Network

## 6.1 Existing Network Capacity

Power provision to the Langarth sites is by default provided by the Distribution Network Operator (DNO), which for the South West is provided by Western Power Distribution (WPD).

Until Cornwall Council's involvement earlier in 2019, there was no overall power strategy for the site, with the two major developers (Inox and Walker Developments) in separate negotiations with WPD to secure power for their sites. WPD have made supply offers to two of the developers:

| | |
|---|---|
| INOX | 11MVA |
| Walker Developments (WD) | 6MVA |

The above approach would have involved the construction of separate primary substations, in relatively close proximity to each other, resulting in additional cost and land-take. The Council has been instrumental in leading a collaborative approach to reserving power and there is agreement among developers for CC to lead the power strategy for the site as a whole, with proportionate recovery of costs from developers. As a consequence, CC have secured an offer of 18MVA to cover the whole of the site via a single primary substation.

Incorporation of a high proportion of solar PV forms part of the energy strategy, which will generate surplus, particularly during the summer months. This is seen as a potential income generation opportunity for a Council owned ESCo, provided that there is sufficient capacity within the grid for export. The Council is in the process of securing export capacity with WPD for the site as a whole.

The Council is also exploring the incorporation of off-site renewable generation via private wire as part of the overall renewable energy strategy for the site, including geothermal and wind generation.

WPD have confirmed that there is no spare capacity on the 11kV networks. They have also confirmed that currently there is insufficient capacity on the 33kV circuit which runs through the Langarth sites. However, additional capacity can be provided with some upstream reinforcement. This would require installation of a new primary substation for the site which would supply a new 11kV network and substations for serving the development sites, along with a new 33kV circuit back to Truro BSP sub-station.

## 6.2 Demand Assessment

As part of the Energy Assessment, an energy model for the entire was prepared to test the various energy scenarios, based on the land allocations issued by AHR in October 2020.

The table below presents the energy demand for the Be Green option, i.e., net zero carbon:

| | Diversified Load MW | | |
|---|---|---|---|
| | Domestic | Non-Domestic | Total |
| Space Heating | 5.1 | 0.9 | 6.0 |
| Hot Water | 2.9 | 0.1 | 2.9 |
| Regulated Electricity | 1.1 | 0.4 | 1.5 |
| Unregulated Electricity | 4.4 | 0.4 | 4.7 |
| EV charging | 3.6 | 0.0 | 3.6 |
| **Total** | **17.1** | **1.7** | **18.8** |

*Table 4: Preliminary Power Demand Assessment for Langarth*

It should be noted that these are the peak demands which are forecast to occur at the end of the development, which for planning purposes is taken as 2049.

A large component of the peak demand relates to EV charging, for which there is little data available on large-scale demand. The assessment assumes all vehicles will be EVs by 2049 and that car ownership and travel patterns will be similar to those today. It does not take into account demand management through smart charge points or local storage, and so this peak demand figure may be able to be reduced based on technologies to be implemented over the next 25 years. Taking this into account, the forecast suggests that the existing 18MVA supply agreement could be sufficient for the development, subject to agreement with WPD.

## 6.3 Power Supply Strategic infrastructure

The early construction of the NAR provides an opportunity for the 11kV to be routed along its length and to serve the individual plots via new development access roads. Provision will need to be made within the NAR services corridors to allow cable ducts and future connections points.

The proposed site has been selected on the basis that it is on Council owned land and on its proximity to the NAR and the overhead 33kV supply which runs across the site.

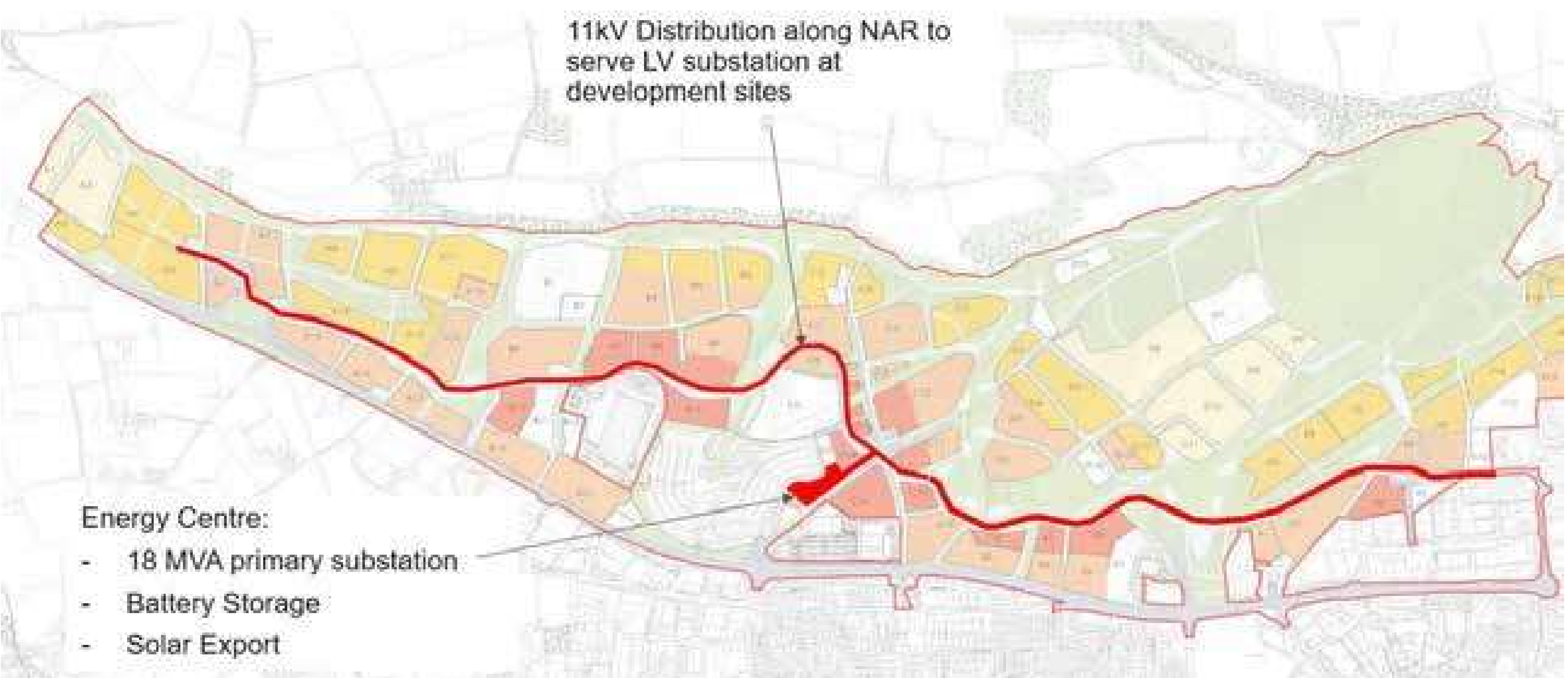



*Figure 14 - Proposed Strategic Power Infrastructure*

## 6.4 Procurement and Construction

Installation of the primary substation, 11kV network, distribution substations, the low voltage mains cables, and the services connecting premises to the mains are contestable work, which means that they are open to competition. In many cases, developers choose to use Independent Connection Providers (ICPs) for contestable work. Contestable work is put out to competitive tender.

There are three ways that distribution infrastructure can be owned:

- **Private wire**: the asset is privately owned, often only serving the single customer that owns it. In some cases, private wires can serve multiple customers, but this is administratively complicated. This is not suited for serving a new residential development.
- **DNO**: the asset is owned by the legacy Distribution Network Operator (DNO) which has a regional monopoly on electricity distribution.
- **IDNO**: the asset is owned by an Independent Distribution Network Operator (IDNO) which operates according to rules similar to those of a DNO.

The potential for a Local Authority such as Cornwall Council becoming an IDNO in itself in order to hold power assets is theoretically possible, though being an IDNO brings with it many layers of regulatory responsibility and risk; independents are regulated in much the same way as incumbents. It is however possible that an IDNO arrangement can be established between CC and an existing IDNO, whereby the assets could be retained so as to allow for control over connections by developers in return for contributions towards costs.

DNOs and IDNOs charge a small fee for distributing power which is bundled into the customer's bill by the electricity supplier, this is called a Distribution Use of System (DUoS) charge. Adopting an asset has value for the DNO/IDNO as they will be able to recover DUoS payments over the asset lifetime, therefore IDNOs (but not DNOs) will pay an asset fee to the developer or ICP in return for the asset.

There are two ways this transaction can be structured:

- The ICP does not charge the developer for installing the electrical infrastructure, or they charge a steeply discounted rate. The ICP contracts with an IDNO and sells them the asset.
- The developer pays the ICP to install the asset and collects the asset fee from the IDNO directly.

In either case, the cost of installing the asset is reduced for the developer.

There are technical constraints on an incumbent's network that limit how much additional load can be connected before reinforcement work is required. When a developer (or an IDNO) requests a connection that requires non-contestable work, the incumbent DNO follows the Common Connection Charging Methodology (CCCM) to determine the cost.

The cost of reinforcement work is apportioned according to the CCCM between the party requesting the connection and the DNO.

If work is carried out and paid for in full and a future developer makes an additional application for a connection, this can trigger a partial rebate to the original developer funded by the connection charge to the new developer. Since this only applies to the work funded in full and not to the apportioned reinforcement work at higher voltages, this will lead to higher total costs between the two developers than a single application in many cases.

In cases where a development is considered speculative, the reinforcement cost is not apportioned and must be paid for in full by the party requesting the connection.

The CCCM requires costs to be based on the Minimum Scheme, which is the scheme that has the lowest capital cost to supply the Required Capacity. The DNO may choose to specify an Enhanced Scheme that has additional capacity however it may not charge for those additional costs.

The Council is currently exploring options for the delivery of the primary sub-station through the IDNO / joint IDNO ownership option. This will provide CC with greater control over future connections / capacity and will provide a mechanism for recovery of costs from developers. It could also provide long-term revenue through an ESCo arrangement.

# 7 Telecoms and Digital Networks

## 7.1 Introduction

In keeping with Cornwall Council's objectives for Langarth Garden Village to create a built environment that meets the needs of the population rather than for developers, the strategic vision for technology is approached from the same philosophy.

The development of technology and what it can be used for is only limited to the imagination. Two interrelated drivers exist for this. The first is to consider what new technology can deliver in terms of new services. The second is to take a business and user perspective first and therefore define the services before designing and deploying any technology.

The issue is that technology races ahead so fast which in turn often changes people's behaviours and culture. The aim then for any strategic technology vision is to develop a roadmap that creates a built environment that can change and adapt to new advances in both technology and social trends and so to be as future-proof as possible. To achieve this, some long-range forward thinking is required to inform the build of the village environment.

Developing a strategic view for technology and telecoms for the Garden Village development is approached in four stages:

1. Future vision of society and technology
2. Services and Applications
3. Infrastructure Architecture
4. Infrastructure Delivery

## 7.2 A Future Vision

How the population lives today is massively different to how it was just 30 years ago. We have gone from red phone boxes and long waiting lists for a telephone line and rotary dial phone in red, black or ivory. Basically, not a lot of choice. TV had two channels. People generally went to work locally. For the general population the internet didn't exist. Wind forward to 2019 and we live in world hardly recognisable with mobile smartphones, Apps, multi-channel streaming media, online shopping and banking and now many people work-from-home. Technology underpins these social changes. This is just the beginning.

Wind forward another 30 or 50 years. It would not be surprising if that world is totally unrecognisable from today. Some of the technology themes may well include:

- Transport as a Service where people do not own cars
- Driverless and autonomous vehicles
- Reduced working hours driven by robotics
- Automation leading to increased leisure time
- Food and other daily household item delivered by drone or robots
- People living a lot longer with medical monitoring systems the norm
- Energy and especially electricity are generated totally in a renewable way
- A calm, less noisy, less frantic environment
- Access to education and training regardless of location
- Clean air and water
- Plenty of recreational facilities


The fundamentals of Maslow's hierarchy, where the basic needs are to be met by the new garden village.

When the basic needs are met then people can release their full potential as they work their way up the hierarchy.

**This in turn helps lead to unimpeded social mobility**.

In the workplace, employees are demanding consumer-like experiences to match the technology found in their personal lives, with greater flexibility on where and how they work. Work is personal and employees want the opportunity to choose their workstyles, schedules and tools.

For a progressive new village, the telecommunications infrastructure should be a seamless future-proof, high capacity resilient network to support current and innovative services. People, devices and the environment would interact with each other as they live, work, and play.

It is recognised that by deploying high-speed giga-bit telecoms infrastructure unleashes economic potential in the countryside where cities currently benefit from this technology.

## 7.3 Services and Applications

Technology based services and applications will inform the underlying telecom infrastructure. Developing the theme of environment interactivity is seen as a key enabler to make an environment less hectic, less busy, more serene and yet supporting productivity.

Various futuristic scenarios can be envisioned such as:

### *Autonomous Vehicles and Transport as a Service*

Car ownership may no longer exist. With moving to a Transport as a Service (TaaS) model, it can be envisioned that transport would be summoned using a smartphone App or by speaking into your watch and a vehicle appears outside within a few minutes. This is already here to a certain extent with Uber and Lift services. Taking this a step further, it can be envisioned that Big Data and Artificial Intelligence (AI) would have already predicted when you need it and the transport is already waiting outside.

With vehicles interacting with each other and with the road infrastructure, there may be no traffic lights. Stopping at lights wastes time and when the lights go green vehicles then burn a lot of fuel and hence emit emissions. With fast connectivity (e.g. 5G) and advanced AI based algorithms the vehicles would interleave across junctions without stopping! This may be farfetched but why not? In the medium term, where vehicles that are still driven by humans, vehicles would adhere to speed limits controlled by the road infrastructure. Information networks will seek to smooth out the start and finish times of a working day reducing and even eliminating the 'busy' or 'rush' hour. Congested transport systems with standing room only or busy road highways will be nuisances of a bygone age.

Busses are expected to be electric and autonomous. Information on bus timetables will be presented on digital screens near bus stops and relayed to smartphone Apps.

High speed connectivity will be required between vehicles the road infrastructure to support this vision.

### *Shopping*

As well as on-line shopping, a trend is for cashier-free tills at supermarkets. Go in and pick up the goods and products you want then and just walk out. The technology will know what you have picked up and automatically charge your bank card. This is how *Amazon Go* works. This will need secure Wi-Fi or similar in-building coverage.

When shopping on-line, drones and robots would deliver your purchases autonomously to your home. This is already starting to happen in Milton Keynes.

### *Health*

Medical services that monitor people's health as with Apple's Watch which has fall detection and heart rate monitoring built in and alerts medical services. This is especially relevant as the population demographic becomes older.

Hospitals and services will need high speed data and be resilient from power and system failures. Remote medical consultation via computer or smartphone will be common. This is already happening with smartphone Apps such as Babylon. Specialist medical experts that are miles away will provide real-time diagnostics.

In an emergency such as fire, the building will automatically contact a hospital and relay images and health details to practitioners who in turn may attend. Robotic health care assistants that work alongside doctors and nurses, who may well be remote, provide health care and in extreme cases provide surgery under the control of a remote doctor who has access to a patient's complete medical history regardless of location.

### *Energy*

Telecommunications infrastructure can help people reduce energy usage – information gathered in real-time will information when energy is needed delivered from stored electricity that have been charged from renewable sources.

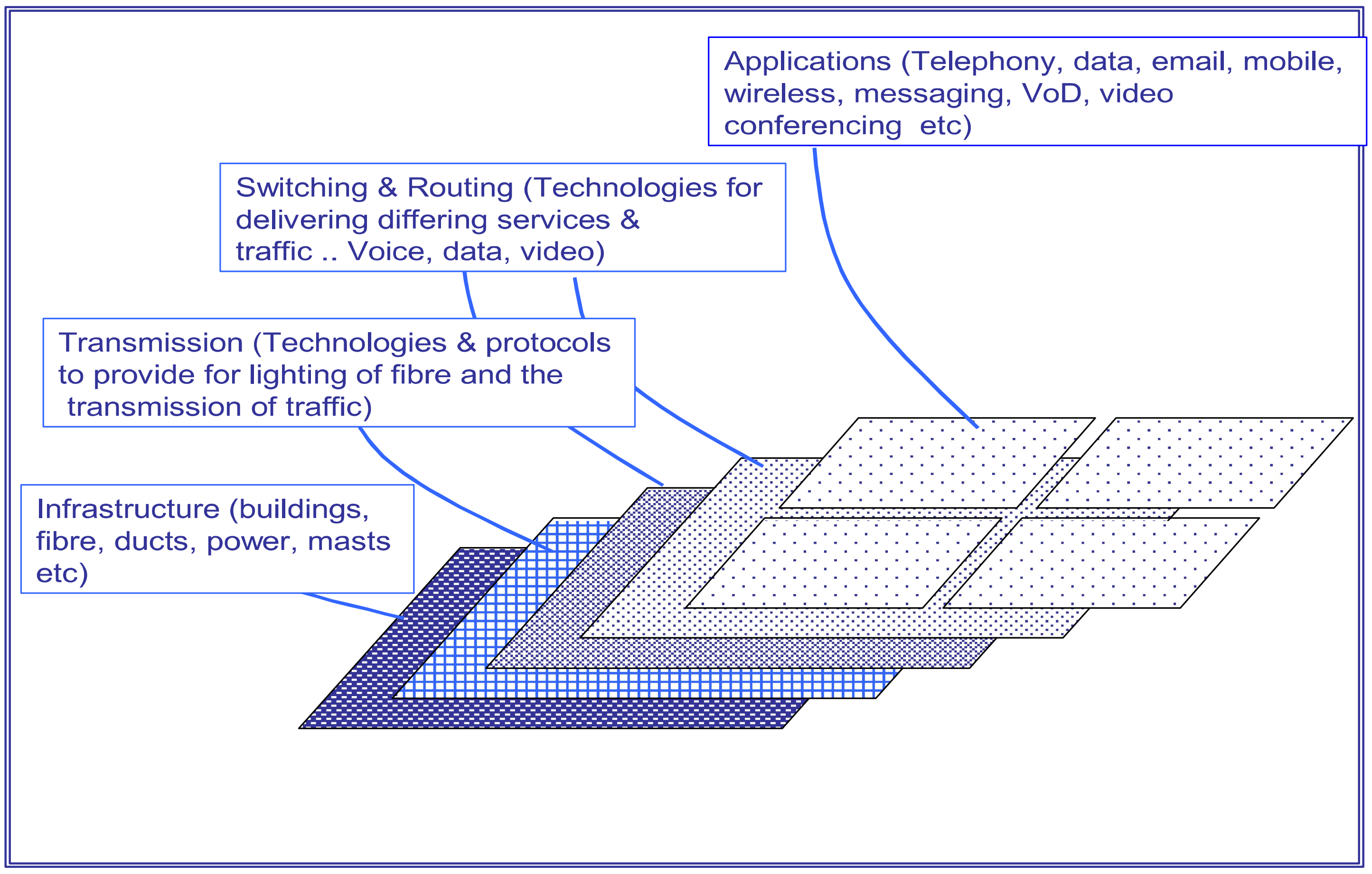
Citizens of the new village will live in an invisible digital bubble. Devices carried or embedded into clothing interact with other systems of water, waste, and energy to provide a rich experience in an environmentally sustainable manner.

The list is endless. It can all change and the applications and services are limited only to the imagination. The vision for Langarth Garden Village is one where information flows in a seamless and ubiquitous manner, supporting and optimising the various systems, and enhancing the lives of the people who live, work and visit it. The telecoms infrastructure needs to be flexible and future-proof where possible.

## 7.4 Telecoms Infrastructure Architecture.

The telecoms infrastructure would take a layered approach. The applications and services touched on earlier sit at the top. It is this top layer that users interact with and how they experience the various services.

The information generated and received by these applications will be distributed to other devices and systems by flowing up and down the various telecom systems such as fibre optics cables via ducts and switching networks to radio (5G) masts or directly to premises. This is depicted below:




It is expected that Cloud services will play a big part in a future telecoms network. AI and Big Data will be prevalent. With Cloud, a lot less, if any, equipment will reside on premises. So, the telecoms infrastructure needs to be fast, reliable and robust.

High-speed fibre broadband and radio networks transform the way people work and play. It enables businesses to work more productively as well as opening new opportunities for leisure and lifelong learning.

### *Topology*

Based on the community needs and the expected future developments in AI, 5G, 6G, autonomous vehicles, TaaS etc, the telecoms infrastructure should be strategically deployed and consist of a backbone high-speed fibre-link which in turn spreads to key points over a hub & spoke or ring type topology to buildings, transmission towers (e.g. 5G) and installations. This will support technologies which ensure that all telecoms traffic categories can be carried and should be engineered to provide a minimum of “five 9’s”[2] availability, N+1 resiliency and multi-terabit capacity. This means that the cable infrastructure will not be the limiting factor in getting and maintaining telecoms services to the consumer.

Linking buildings with high-speed optical rings that provide resilience and high capacity will form part of the backbone telecommunications network infrastructure to provide ubiquity, flexibility and robustness. This in turn would link to networks outside of the village. The approach to this project is integration and convergence as opposed to bolting on disparate technology infrastructure which would otherwise require duplication of effort to install, commission and support.

5G aims to provide high speed connections with low latency. This is key in supporting many of the future services discussed earlier. 5G is expected to complement high-speed fibre. 5G could be used as a

[2] 99.999% availability uptime

broadband connection to premises although the higher frequencies may mean radio penetration deep into buildings will be more challenging compared to 3G and 4G. Fibre optics, however, can provide that high-speed connection to premises. It is expected that 5G radio antennas will be densely distributed across key parts of the village to support applications such as the Internet-of-Things (IoT). 5G would then complement a high-speed fibre-to-the-premises network in terms of digital access. The 5G radio antennas themselves would have a 'backhaul' fixed network which will typically be fibre optic or point-to-point microwave radio.

### *Critical Infrastructure*

Critical Telecom Infrastructure is required for key community services such as for:

- Hospital and medical surgeries
- Vehicle and pedestrian traffic lights control systems
- Police & security and deployment of CCTV
- Fire and Ambulance

This infrastructure would typically use dual or multiple telecoms links together with well-defined business continuity and disaster recovery systems and processes.

### *Cornwall Stadium*

A 10,000 seat Stadium for Cornwall is proposed at the centre of the development. This will require -speed backbone fibre link(s) into the stadium area. A high capacity radio network such as 4G and 5G will be required within the Stadium itself to support visitors' mobile devices. This will need to be a separate project and workstream within the overall Garden Village project.

### *Green Open Spaces*

Telecoms infrastructure, especially radio masts, can be an eyesore for most people. Green infrastructure such as open spaces and corridors as an important theme for the Garden Village. So disguised radio mast that blend into the surrounding scenery would be part of the telecom's infrastructure design.

### *Community Networks*

As mobile devices have untethered people from location as they interact with internet-based services, local hotspots would be deployed strategically across the village.

Deploying local Wi-Fi and on street charging points around the Garden Village will support this. These can also be used for help points in case of emergency.

Built in screens can provide a range of information from advertising through to transport times and weather warnings.

### *Network Equipment*

The design and layout of the telecoms infrastructure network will typically be based on surveys by a third-party telecoms provider.

Some key points of this:

- Fibre optic network infrastructure would be deployed along the main road routes as they are built together with other utilities such as water, sewage and electricity.
- Equipment rooms will be needed to house 19" cabinets. Main equipment rooms are required for each Mobile Network Operator (for 5G for example). Depending on how large the area is that requires 5G coverage. Further Sub Equipment Room (SER's) will be required for example at the Park & Ride and the Stadium areas as well as to serve roads where autonomous vehicles are expected to travel. These equipment rooms can be a room, street cabinet furniture or space on a wall. In this room or on walls would be placed repeaters and radio units.
- It is expected that as 5G will operate at much higher frequencies than 4G then more radio antennas will be required to cover a similar area. Radio antennas would be against walls or against the roof in a building for indoor radio coverage. Radio antennas can also be installed on poles and separate masts for outdoor situations.
- fibre optic cables and ducts will be required between MER and SER's.  Coax cables between SER's and radio passive antennas (passive antennas do not need a power supply). Active antennas require a power supply and it is expected that 5G will use active antennas. Power will therefore be required to be supplied to these radio antennas and so will be future proof. Hybrid cables (fibre and power) or separate cables for power and coax would run between radio antenna and SER.

### *Telecoms Infrastructure Illustration.*

The diagram below provides an illustration of the telecoms infrastructure. Essentially the backbone network would be fibre optics (blue in the diagram) that run alongside the roads. The main telecoms infrastructure is expected to be in the main A-road so connection would be required from that to the Garden Village network. This would be done be deploying small buildings or equipment rooms. fibre optics would run to strategically located 4G & 5G radio masts. In the denser areas such as shopping, car parks, leisure and Stadium areas then many radio (5G) and Wi-Fi antenna would be deployed and served from the backbone fibre optic network. Equipment rooms and connectivity sites would be required.

A detailed site survey would be needed to be undertaken by telecoms providers to locate the fibre infrastructure and radio masts based on the ground typology and actual buildings.

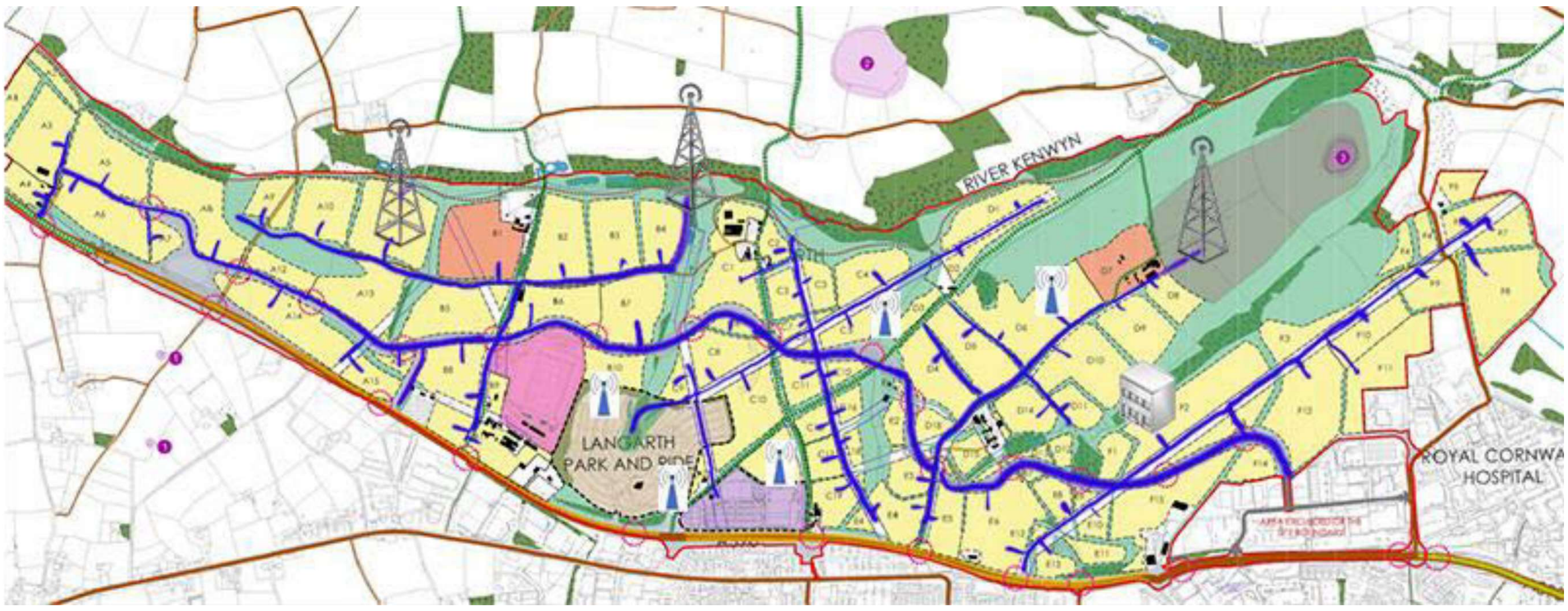



*Figure 15 - Illustrative Telecoms Network Infrastructure*

## 7.5 Network Delivery

### *Network Rollout*

The major cost of implementing new gigabit and terabit networks is in the ground works plus the resulting disruption caused. This is significantly reduced where this ducting and cabling is provided as part of the early stages of the development such as roads and other utilities. The opportunity then is with careful planning, these costs could be minimal to maximise the return on investment in these infrastructures.

Current main telecoms (trunk) infrastructure is expected to be in the A390 main carriageway. It will be necessary to tap into this route to pick up services that route to ISPs and main telecoms network providers. New telecom infrastructure is needed to run alongside the Northern Access Route (NAR) which will run from a new gateway at West Langarth through to the A390 roundabout at the Royal Cornwall Hospital to the east.

The strategic roadmap for the Langarth Garden Village would therefore be deployed in phases as other utilities rollout and as the new road and pedestrian routes are built.

By forward thinking through the overall design and build of the village, the telecommunications network infrastructure can be deployed in the most environmentally sustainable manner. Good strategic planning will save energy, costs, and time by planning the build. Key factors of this include:

- Key to the deploying a fibre-optic network requires the necessary cooperation and partnering with the other infrastructure utilities such as gas, electricity, water and waste, to simultaneously deploy the telecoms network alongside these other utilities. Typically, 70% - 80% of the cost of deploying a new network is attributable to the ground works of excavation and reinstatement. Deploying telecoms when other utilities are built will save time, cost and energy during deployment as well as reducing any subsequent disruption to people and transportation in the future.
- Properties and buildings would during the building phase incorporate high speed structured cabling that links to the external high-speed rings. Buildings should be designed to be “smart” from the beginning.
- Mobile and wireless infrastructure would be deployed within buildings and across the village including open spaces to provide seamless and ubiquitous access to information and services.

### *Infrastructure Partners*

Select partners who may be willing to pay for all or part of the deployment of ducts and fibres across the village. Termination and demarcation points will need to be identified to allow other network vendors to deliver their services such as a 5G mesh network using the backhaul fibre optic network.

Revenue share may well be a requirement with any infrastructure partner. A key commercial consideration would be to ensure that infrastructure sharing is not precluded and that an open access network is available to allow third-party providers to offer competitive services.

## 7.6 Telecoms Strategy Summary

The key themes for the Langarth Garden Village telecoms deployment would consist of the following:

- Assume that there will be advanced innovative services and applications, some of which have not been invented yet, that will require a high-speed, ubiquitous, reliable and robust telecoms infrastructure.
- Telecommunications infrastructure should be planned to be put in place from the very beginning alongside the other utility and service networks such as water, power, and sewage.
- Partner with key network infrastructure suppliers and ensure open and flexible contracts to avoid restricting competition.
- Deploy a fixed fibre-optic network into ducts alongside other utilities. This will form a backbone high speed telecom network into homes and into key commercial and public buildings as well as to mobile radio and community Wi-Fi antenna.
- Radio networks such as for 4G and 5G will require a network vendor to survey and plan radio mast deployment for radio cell coverage. The radio services would complement the high-speed broadband fibre connection into local premises (i.e. for the local loop).
- Design into the village scheme green telecom infrastructure such as roadside cabinets and masts to be in keeping with a serene and pleasant environment for people to live and work.

This is the high-level strategic view for the Langarth Garden Village. The next step would be to design the detailed telecoms infrastructure deployment in partnership with Cornwall Council and the Master planners (AHR) and to select telecom suppliers through government tender procurement processes.

# 8 Utilities Strategy Summary

## 8.1 Surface Water Drainage

| Aims | Strategy | Opportunities |
|---|---|---|
| • Better than green field run-off<br>• Easy to maintain<br>• Take advantage of landscape character<br>• Integration with green infrastructure<br>• Innovative approaches on SuDS features<br>• Better quality water and<br>• Added value amenity space | • Make use of good infiltration capacity for disposal to ground<br>• Work with topography and landscape<br>• Keep adoptable roads and NAR assets separate to simplify ownership and maintenance<br>• Use a range of features suitable for different locations<br>• Connect new water courses to valley features / existing water courses, which will assist phasing | • Good design can create enhanced amenity assets<br>• Integration with green infrastructure<br>• Increase in bio-diversity<br>• Reduced site runoff<br>• Storage can be used for non-potable applications, e.g., irrigation of green spaces |

## 8.2 Foul Drainage

| Aims | Strategy | Opportunities |
|---|---|---|
| • Provide development plots which have easy access to sewerage<br>• Use topography for gravity sewers<br>• Allow for future development phasing and NAR crossings<br>• Provide sufficient capacity for future demands | • Independent assessment of South West Water (SWW) proposals undertaken by Arcadis in 2018 confirming suitability of proposed solution.<br>• SWW are providing a new public trunk sewer, new pumping station and rising main to serve the whole of the site<br>• Individual development plots to connect via gravity using valley features<br>• NAR crossing for both to be provided in advance | • Opportunity to trunk sewer use route for cycleway / pedestrian access |

## 8.3 Water Supply

| Aims | Strategy | Opportunities |
|---|---|---|
| • Provide development plots which have easy access to water<br>• Allow for future development phasing and NAR crossings<br>• Provide sufficient capacity for future demands | • Water supply to be provided by SWW from local trunk mains<br>• NAR crossing for both to be provided in advance | • Behavioural change initiatives at community level and through schools to reduce demand<br>• Promotion of water saving devices as part of the specification for all new buildings<br>• Integration of SuDS storage features to provide irrigation water green amenity spaces<br>• Rainwater harvesting for non-potable uses<br>• Grey water re-use |

## 8.4 Energy

| Aims | Strategy | Opportunities |
|---|---|---|
| • Alignment with Climate Change Emergency and Zero Carbon by 2030<br>• Council owned assets to be net zero carbon<br>• Provide sufficient power for Langarth without taking all grid capacity<br>• Allow Council control over connections with recovery of costs from developers | • Energy strategy prepared showing that zero carbon can be achieved through fabric + ASHP + Solar PV<br>• Alternative district heating system supplied by geothermal being explored<br>• Single sub-station location on Council owned land near P&R<br>• Grid storage at sub-station<br>• Solar Park at P&R with storage<br>• Solar PV on public buildings | • Council ESCo to own energy assets and to generate income stream<br>• Off-site renewable generation as part of Council ESCo<br>• Export potential for surplus PV generation<br>• Innovative energy generating and storage features could be integrated as part of a wider awareness raising and educational theme<br>• Tree planting to further offset carbon<br>• Deep geothermal generating power and heat<br>• Local biomass generation (e.g., Anaerobic digestion) |

## 8.5 Telecoms and Digital Networks

| Aims | Strategy | Opportunities |
|---|---|---|
| • Provide a robust architecture to carry the highest speeds available<br>• Incorporate latest available technologies and thinking, such as 5G and Smart Communities<br>• Create a digital infrastructure that is future-proofed for technologies not yet available<br>• Design of visible infrastructure to integrate with garden village aesthetics | • Deploy fixed fibre to the premises (FTTP) network into ducts alongside other utilities serving homes, commercial and public buildings<br>• Partner with key network infrastructure suppliers and ensure open and flexible contracts to avoid restricting competition.<br>• Allow for 5G network and plan radio mast deployment for radio cell coverage | • Community Wi-Fi<br>• Enabling infrastructure for IoT and autonomous vehicles<br>• Revenue potential from leasing space and ducts<br>• Big data analytics for utilities, transport, energy use etc. |

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