UUWR_34

PR24 Draft Determination: UUW Representation

Area of representation: Cost and PCD - Vyrnwy re-lining in AMP8

August 2024

This document outlines our representation in response to Ofwat's draft determination related to the enhancement case for Vyrnwy re-lining in AMP8.

Reference to draft determination documents: Enhancement feeder models – Water, PR24-DD-W-Improvements-to-taste-odour-and-colour

United Utilities

Water for the North West

1. Key points

- **The associated PCD does not protect customers from non-delivery of this enhancement case:** We provide an alternative PCD that ensure that the DWI enforcement order is delivered in full.
- **Ofwat has applied an adjustment of 10% on the basis that it has concerns the option selected may not be in the best interests of customers:** We provide evidence that the option selected is in the best interest of customers, as evidenced by the full optioneering report shared with the DWI prior to the DWI issuing its enforcement notice. We note that following the issuance of the enforcement notice, it is not open to UUW to deliver an alternative solution.
- **Ofwat has applied a 20% adjustment to enhancement costs:** We provide evidence that there are significant and elevated risks associated with the AMP8 programme that were not present for earlier phases of the project. These reflect the increasingly urbanised locations and complexity of interactions with other infrastructure such as rail.

2. UUW's PR24 proposal

The Vyrnwy Aqueduct Modernisation Programme is a multi-AMP series of projects to clean or reline 139km of pipeline which transfers treated water from Lake Vyrnwy, in North Wales, to Merseyside.

In our October 2023 business plan submission, we included an enhancement claim UUW60, (case 2) with a value of £151.128 million (100% capex) to deliver the final phases of the Vyrnwy aqueduct cleaning and relining project.

The AMP8 element of the project consists of lining 65.6km of 42” diameter pipework to fulfil the requirements of the DWI final enforcement order that UUW is subjected to.

The completion of this work is specifically intended to improve the quality and appearance of drinking water by reducing the risk of discolouration in the downstream supplies caused by elevated levels of metals within the aqueduct.

The October 2023 business plan submission included a PCD based on the number of km relined of the aqueduct, in line with a delivery profile that will meet the requirements of the DWI Enforcement Order.

3. Draft determination position

Ofwat has aggregated raw water deterioration (RWD) and taste, odour, colour (TOC) enhancement schemes to set water quality PCD’s where DWI legal instruments are in place. Whilst we agree with the use of legal instruments as a mechanism for ensuring customer protection, we note a fundamental error with the PCD applied to UUW for water quality schemes. We explain this further in Section 4 of this document.

Ofwat has concluded that there is a need for enhancement investment to deliver the required improvements but has applied a 30% downward adjustment to the enhancement allowance.

Ofwat has challenged UUW to provide additional evidence for its business plan proposals due to the high unit costs and lack of evidence of cost efficiency to justify higher costs.

4. Issues and implications

4.1 PCD

Ofwat has included the delivery of 65.6km re-lining of the Vyrnwy aqueduct in the 'Base wholesale water model funded renewals'. However, the totex allowance has been included in the Water Quality PCDs and therefore contributes to the unit rate per DWI legal instrument.

Not only does this disproportionately inflate the unit rate per DWI legal instrument for raw water quality deterioration schemes, but it also does not apply protection to customers against non-delivery of the Vyrnwy re-lining deliverable.

4.2 Best Option for Customers

Ofwat has stated it has concerns whether the investment is the best option for customers and has resultantly applied a 10% totex adjustment to the enhancement claim.

We note Ofwat's observation that the full options report was not included in this enhancement case. However this case is for the continuation of a programme of work that began in AMP7, currently funded through a cost-recovery Outcome Delivery Incentive[1,2].

Prior to the commencement of this work, we carried out initial investigations in 2010 to confirm the need to clean and the appropriateness of the technical solution proposed for the Vyrnwy aqueduct, the outcome report formed the output of step 'c' of the schedule to the Undertaking UUW33 (DWI reference NW425).

The outcome of the 2010 investigation contributed to the solution being explicit in the Final Enforcement Order to clean and refurbish the Vyrnwy aqueduct and therefore options were limited to those that would satisfy the requirements of the legal instrument. Step 3(b)(iv) of the final enforcement order required UUW *"to produce a specific action plan, based on previous commitments to clean and refurbish the Vyrnwy LDTM".*

Ofwat noted that the full options report was not submitted as evidence. This has previously been provided to the DWI and we have now included the full report as an appendix to this response.

Ofwat noted that the outcomes of the innovation workshops held with contractors were not reflected in the enhancement business case. Table 1 below outlines the technologies brought forward into the project and any areas highlighted for cost savings were factored into the estimate included in our business plan submission.

Table 1: Vyrnwy Innovation

Technology	Opportunity	Saving
Victaulic Couplings	Negates the need for traditional flanges and bolts which can introduce weak points in the pipeline.	Time
Air Pigging	Alternative pipe cleaning method that uses air instead of water. This technology reduces tanker movements, uses less water and can operate on longer lines, reducing the number of intermediate pits required.	Carbon Cost Customer impact
Pipe Pushing Machine	Device that can push a pipe for lengths over 1.5km (traditional winching only reaches up to 800m), negating the need for intermediate pits. This is the first pipe pushing machine for these diameters in Europe.	Cost Time Customer impact
Spray Cleaning	Method for internal pipe cleaning that includes a recycling tanker to reuse the water required.	Carbon
Soil Stabilisation Techniques	Made use of existing subsoil to replace traditional temporary road building (crushed stone).	Carbon Customer impact

The Air Pigging technique has saved 118 tonnes of CO_2, 1104 estimated tanker movements and 15 million litres of water.

[1] AMP7 definition documents - consolidated version (unitedutilities.com) pages 26 - 29

[2] PR19-final-determinations-United-Utilities-Outcomes-performance-commitment-appendix.pdf (ofwat.gov.uk) pages 57 - 59

4.3 Cost Efficiency

Ofwat has stated it has some concerns whether the investment is efficient and has applied a 20% downward adjustment to the enhancement allowance.

Ofwat's deep dive assessment recognised that a 2.5% efficiency target had been included in the cost build-up. This was based on a high-level assumption from a bottom-up benchmarking exercise.

During development of the October 2023 business plan, the UUW Commercial, Engineering and Capital Delivery department (CEC) reviewed the capital investment programme to determine the typical type, size, value and complexity of solutions required for the assets to be renewed or maintained across the water and wastewater infrastructure and non-infrastructure programme to ensure the procurement strategy is fit for purpose to deliver an efficient programme.

CEC then reviewed the procurement strategy to determine what type of commercial construction, supply, engineering and consultancy frameworks need to be procured to ensure that UU has the most appropriate partners in place to deliver the capital programme below budget and to the right timescales.

Each framework is going through a rigorous procurement process so that each of the bidders commercial/value, technical, health and safety, relevant experience and staff CV's can be assessed and scored, to ensure that the Framework partners chosen will have demonstrated through a competitive process, their proven technical expertise and efficient commercial pricing.

In addition, when these framework partners are utilised, dependent on the need, they will either undergo a further mini competition through the framework or they will price a single source solution, but in either approach their pricing levels will be in accordance with their competitive framework pricing levels, and they will be checked and validated against the UUW independent internal estimate. Challenges are made as necessary to ensure commercial value is maximised and as well as technical compliance.

If the framework approach is not appropriate for any project, UUW also procures direct to the market where it seeks competitive tenders from a range of suppliers/contractors and allows market forces to ensure a competitive price is obtained. These are also validated against the UUW independent internal estimate.

Once the Contract has been awarded to the successful bidder, the contract is rigorously managed by the UUW project team in accordance with the Contract. The UUW Project Manager, Quantity Surveyor, Construction Supervisor and Engineering representative will ensure that any additional variations are kept to a minimum and valued appropriately, all costs and payments are in accordance with the contract and the contractor is being monitored on site to ensure efficient delivery of construction plant and equipment and to UUW specification and standards.

Each project will be audited by UUW's cost assurance consultants to ensure that only legitimate costs are paid.

Final accounts at the end of each project are agreed timely and there is a clear escalation process to deal with any disagreements or disputes by use of senior representatives.

UUW continuously seeks lessons learnt to improve efficiency in future processes and seeks innovation to continuously improve leaner solutions and ways of working.

Risks and Opportunities

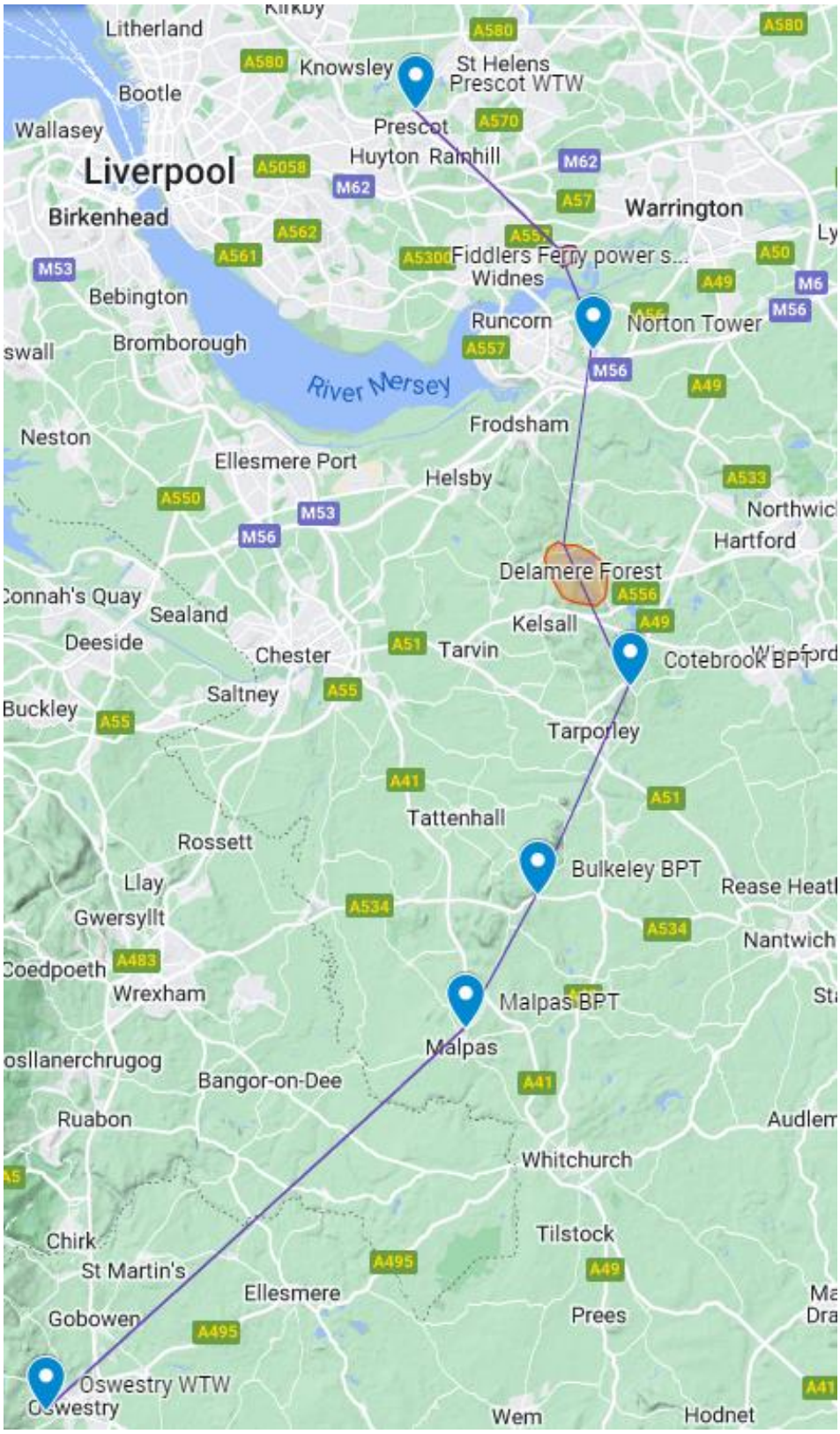
Ofwat noted that the project build-up of cost includes allocations for risks but does not include saving opportunities from the current 2020 – 2025 programme. The AMP8 programme of work involves work in the most built-up areas of the LDTM's route. Experience tells us that the risks far outweigh the opportunities when working in built-up areas. Some of the challenges identified for the final sections of the Vyrnwy re-lining project are:

- Two railway crossings near Cuerdley: if site investigations show that the sluice valves are within Network Rail land, there will be difficulties in accessing, removing and building access pits. This would result in tunnelling under the railway which is a change of scope and attracts higher costs.

- Severe contaminated ground at the decommissioned Fiddlers Ferry power station and the surrounding area that may require excavated material to be disposed to a licensed site, which are more costly.
- The presence of a culvert in land that belongs to Network Rail at Runcorn railway crossing has resulted in us being unable to determine the condition of the pipework in the culvert. There is a risk that the pipework is unsafe for slip lining – resolving this issue will result in additional costs and potential delays to the schedule.
- At the Prescot crossing culvert, it is anticipated that the culvert is flooded and will require pumping out. The aqueduct also bends 4 times under the culvert. This will lead to a risk that we could dislodge the pipework when slip lining and will result in additional costs for repairs.
- There is a risk that due to the location of siphon 3 (Norton Tower to Prescot) being in a built-up area, the compensation claims may escalate beyond the estimate.

Maps included at Figure 1 and Figure 2 show the route of the Vyrnwy LDTM from Oswestry to Prescot and each of the siphons along the way. Figure 2 demonstrates the locations of built-up areas along the route of the Vyrnwy LDTM, the overwhelming majority of which are where the AMP8 work is due to be completed.

Figure 1: Map of the Vyrnwy LDTM route from Oswestry WTW to Prescot WTW



Source: Google maps

Figure 2: Map of the Vyrnwy LDTM route with built-up areas highlighted

Source: ONS[3]

[3] Major Towns and Cities and Built-up Areas Swipe Map (arcgis.com)

5. Approach for final determination

Ofwat should recognise that the programme of work on the Vyrnwy LDTM has been underway for multiple AMPs and UUW is committed to delivering the solution that satisfies the DWI requirements at an efficient cost. We have worked closely with contractors throughout the duration of the project to identify areas of risk and opportunities and are continuously applying the learning from each phase of the project to the remainder of the project.

The totex adjustments applied to this enhancement case would result in an insufficient allowance to deliver the requirements of the DWI final enforcement order which will benefit over 1.38 million customers in Cheshire and Merseyside.

We believe our original business plan submission totex with respect to this case was appropriate and therefore believe that Ofwat should reinstate the full totex allowance.

We strongly recommend that Ofwat revisit the design of UUW's Base – PCDs and Water Quality – PCDs and develops a separate PCD for Vyrnwy based on adherence to the DWI Final Enforcement Order, as set out below.

We consider Ofwat should assess the additional evidence provided and reinstate the 10% totex adjustment applied for best option for customers as the solution selected for Vyrnwy LDTM has been agreed with DWI based on robust options investigations.

Ofwat should also reconsider the cost efficiency 20% totex adjustment and reinstate the full allowance in light of the additional information provided in section 4.3, particularly pertaining to the level of risk and challenge encountered when working in built-up areas.

Table 2: Redesigned PCD for Water Quality (TOC)

Company	UUW
Enhancement area	Water Quality (TOC)
PCD No.	

Common requirements	See Section 7.2.2 of Price control deliverable appendix

Additional company specific requirements	
Description	Delivery of DWI Final Enforcement Order - UUT-2020-00002_Vyrnwy_LDTM_FEO_combined_doc
Output measurement and reporting	None
Conditions on scheme	None
Assurance	None

Non-delivery PCD payment	Unit	Payment rate
Water Quality - Vyrnwy LDTM	£m per unit	151.128

RWD assessed	TOC assessed	Total WQ assessed	RWD allowed	TOC allowed	Total WQ allowed	Nr of legal instruments	Unit rate
n/a	151.128	151.128	n/a	151.128	151.128	1	151.128

Time incentives PCD rate	Unit	Under-performance	Out-performance
n/a	n/a	n/a	n/a

PCD outputs (cumulative)	Unit	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35
Discolouration, iron	DWI final enforcement order	0	0	0	0	0	1	1	1	1	1	1	1

PCD outputs (legal instruments)	Unit	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35
Discolouration, iron	DWI final enforcement order						Vyrnwy LDTM						

Appendix A Vyrnwy Aqueduct (LDTM) Modernisation Programme

United Utilities Water plc

Vyrnwy Aqueduct (LDTM)

Modernisation

Programme

UUW Project No 80063071

UUT-2020-00002

Milestone Step 3 (b) vi Report

31 December 2022

Contents

Vyrnwy Milestone Step 3.6Report

AMENDMENT SUMMARY

Issue	Date	Details	Prepared by	Authorised by
1	09/12/22	First Issue	WE	
2	16/01/23	Second Issue	CT	
3				

Glossary:

AMP	Asset Management Plan
Aqueduct	Any system of pipes, ditches, canals, tunnels, and other structures constructed to carry water from a source to a distribution point far away
BSP	Bulk Supply Point
CI	Cast Iron
DI	Ductile Iron
DMA	District Meter Area
DMZ	Demand Management Zone
DWI	Drinking Water Inspectorate
EU	European Union
FM	Flow Meter
GCN	Great Crested Newt
ID	Internal Diameter
km	kilometre
LDTM	Large Diameter Trunk Main A UU-specific term for one of a number of named systems of assets transporting large volumes of treated water as part of the regional supply system.
Ml/d	Megalitres per day
NEC3 ECC	New Engineering Contract – engineering and construction contract
Pig	A pig is a device inserted into a pipeline which travels freely through it, driven by the product flow to do a specific task (e.g. cleaning) within the pipeline.

PE	Polyethylene
PODDS	Prediction and Control Of Discolouration in Distribution Systems
Potable Water	Flow downstream of WTW (treated water)
PS/BS	Pumping Station/Booster Station
Raw Water	Flow upstream of WTW (untreated water).
SEMD	Security and Emergency Measures Direction
Slip lining	Method of inserting structural liner of smaller bore into larger host pipe.
Stick	Length of pipe
String	Length of sticks welded together
SR	Service Reservoir
TM	Trunk Main
UKWIR	UK Water Industry Research Ltd
UUW	United Utilities Water
VH	Valve House
WRIMS	Water Resource Information Management System
WSZ	Water Supply Zone
WTW	Water Treatment Works

1 SUMMARY

The Vyrnwy Large Diameter Trunk Main (LDTM) comprises three parallel water mains that transfer treated water from Oswestry Water Treatment Works (WTW) in Shropshire to Prescot Service Reservoir (SR) on the outskirts of Liverpool, a distance of 80km. The LDTM conveys up to 210 Ml/d and supplies a population of over 1,000,000 customers in Cheshire and Merseyside, although it can also supply water to parts of Lancashire and Manchester from Prescot SR via the Rivington LDTM and/or West East Link Main. The cleaning/lining of the LDTM is required to reduce the risk of iron infringements and discolouration to customers' supplies because of re-suspension of sediments left by historic deposition of iron in water leaving Oswestry WTW. Lines 1 and 2 are unlined cast iron and line 3 is bitumen lined steel. The aim of this document is to summarise an overview of the completed outline planning of the programme and provide detailed examples of areas which are in construction.

The report confirms the outline planning of the scheme has been completed, including solution selection and outline design of the entire length of the works required. The report also includes information from the first phase which has already been awarded to a construction partner.

Due to the length of the LDTM and the requirement to continue to supply water to the customers served, the detailed design on each section has been phased in such a way to maintain resilience of the system. This will ensure planning and communications are effective and carried out ahead of the work commencing. When the latest information and requirements are known they can be communicated to affected customers and stakeholders as the programme progresses.

2 INTRODUCTION – VYRNWY LDTM

a. Background

During AMP5, the Company completed the renovation of 84 km of main between Oswestry and Malpas, and cleaned Line 3 between Norton Tower and Prescot and the crossings below the River Mersey on Lines 1 and 2, thereby completing over 100 km of the original scope. A review of the current water quality and consumer complaint data showed that there had been significant improvements in both iron compliance and a reduction in discolouration contacts across the area supplied.

In addition during AMP5 research provided new insights into the potential root causes of elevated iron concentrations and discoloured water in the distribution network including the potential adverse influence of elevated manganese concentrations on iron compliance and discolouration, even when manganese was significantly less than the current water quality standard.

As a result, the Company proposed to halt the cleaning and/or lining of the Vyrnwy LDTM to continue to monitor the benefits obtained by the work carried out to date, and to install a new innovative treatment process at Oswestry WTW that is capable of realising a reduction in manganese to at or below 0.4 ug/l. This concentration had been shown to deliver improvements in discolouration contact rates downstream of WTWs where it could be achieved in 80% of samples. This programme of work was submitted in a formal request to change the technical solution for the Vyrnwy LDTM (submitted 10 June 2014) and was subsequently formalised in a revised Undertaking UUT3247 and subsequent revision to Notice UUT3477 in July 2015.

During AMP6 the Company halted delivery of the innovative solution at Oswestry WTW as it became apparent that the solution would not deliver the required outcome for realising a reduction in manganese to at or below 0.4ug/l. As a consequence the Company has restarted planning for the cleaning and/or refurbishment of the Vyrnwy LDTM to deliver the expected benefits to customers regarding discolouration. This programme of work was submitted in a formal change to the technical solution for the Vyrnwy LDTM (31 July 2020) and was subsequently formalised in a Final Enforcement Order FEO UUT_2020_00002 in August 2020.

A revised solution for work at Oswestry WTW including new emerging risks of cryptosporidium and taste & odour were incorporated into a separate Notice UUT_2020_00003 issued in August 2020.

Both Notices will complement each other to ensure that the original outcomes from our PR04 Business Plan submission of a reduction in consumer contact rate of 50% compared to contacts in the 2001 calendar year (based on contacts per 1000) are realised.

b. A summary of the Vyrnwy LDTM

The Vyrnwy LDTM consists of three potable water mains that run parallel to one another all the way from Oswestry WTW to Prescot SR, feeding various service reservoirs and distribution systems along the way (Figure 1). The system is designed to convey up to 250 Megalitres per day (Ml/d), however, the maximum and average flows are 210 Ml/d and 165 Ml/d respectively. This flow represents approximately 20% of the regional supply, supplying a population of 900,000 in Cheshire and Merseyside.

The Vyrnwy system is predominantly gravity fed from Lake Vyrnwy and operates on a continuous flow basis. Booster stations at Bickerton, Norton and Cuerdley can be used to supplement the naturally occurring head, increasing the capacity of the mains within structural limits.

Line 1

39" Cast Iron (CI) main from Oswestry WTW to Malpas Tanks approximately 29km and 42" CI main from Malpas Tanks to Prescot SR approximately 51km. Total length 80km laid between 1881 and 1892.

Line 2

39" CI main from Oswestry WTW to Malpas Tanks approximately 29km and 42" CI main from Malpas Tanks to Prescot SR approximately 51km. Total length 80km laid between 1902 and 1905.

Line 3

39" Bitumen-lined steel main with welded joints from Oswestry WTW to Willington Cross, known as the "4th Instalment" approximately 22km laid between 1948 and 1950. 39" Bitumen-lined steel main with cold caulked lead joints from Willington Cross to Malpas Tanks approximately 7km laid between 1933 and 1935. 42" Bitumen-lined steel main with cold caulked lead joints laid between 1926 and 1938.

Line 4

This line was never installed, although between Oswestry WTW and Willington Cross, some of the difficult engineering sections were constructed at the same time as the "4th Instalment" on line 3, e.g. the Shropshire Union Canal crossing 39" steel welded joints encased in a 72" concrete surround with a blank flange at each end. The approximately 35m length was laid June 1949. Land easement for the full 80km of line 4 between Oswestry WTW and Prescot SR has been held since 1947.

The Vyrnwy LDTM system is essentially a linear system comprising three parallel pipelines from Oswestry to Prescot. The sections between Oswestry to Malpas and the third line of the Vyrnwy between Norton Tower and Prescot were lined and/or cleaned in AMP5. The remaining sections between Malpas and Prescot are included in the scope of the FEO and are split into three sections:-

Section 1 : Malpas Tank to Cotebrook SR (18.6km)
Section 2 : Cotebrook SR to Norton Tower (17.6km)
Section 3 : Norton Tower to Prescot SR (15.2km)

Figure 1 – Schematic Layout of the Vyrnwy LDTM

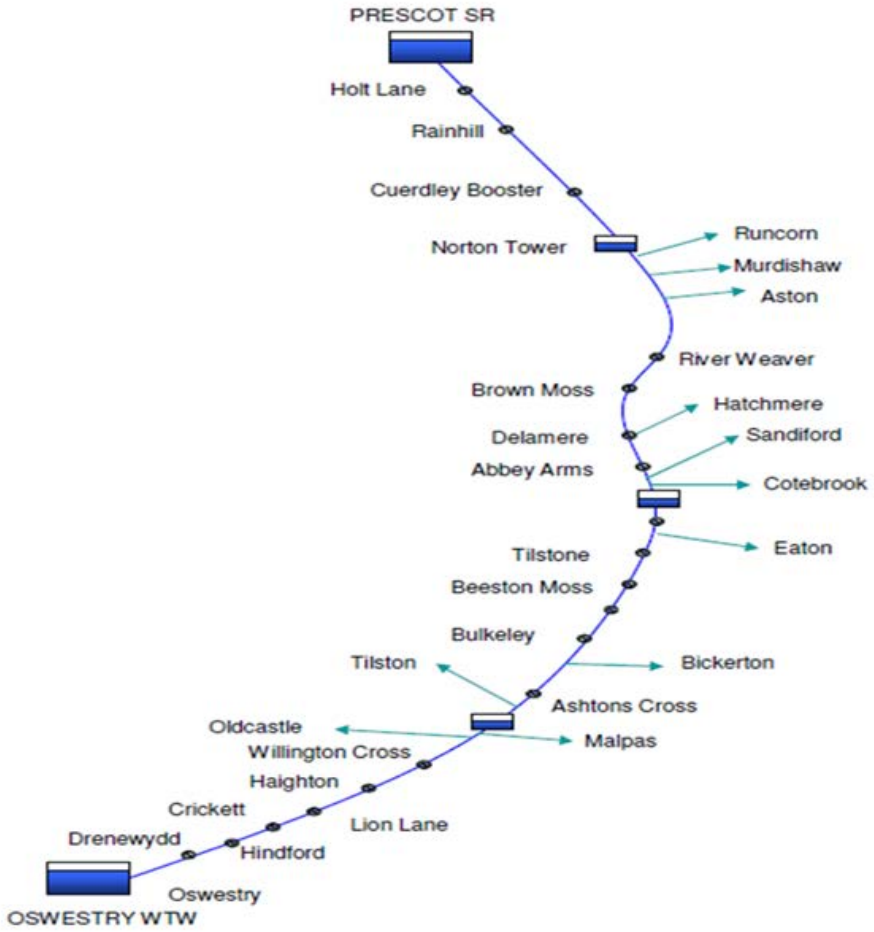


Figure 1 – Schematic Layout of the Vyrnwy LDTM

c. Vyrnwy LDTM Undertaking Milestone 3 (b) vi

Milestone 3 (b) vi' in the Vyrnwy LDTM from the Final Enforcement Order FEO UUT_2020_00002 in August 2020) reads as follows:

"vi. Complete planning for the long term solution to mitigate the risks of Iron and discoloured water in zones supplied by Oswestry treatment works and the Vyrnwy LDTM." By December 2022.

3 PROGRAMME

To manage supply and maintain resilience through the duration of the programme various tools have been utilised to ensure constraints are captured and the most efficient sequencing of the works. For example, the Operational Production Planning team have used a water resource decision support tool, MISER, in which outages can be simulated and provide outcomes to ensure production requirements are met.

In particular when evaluating the sequencing this focused on the sources at Oswestry and Huntington and the restrictions on the production capacity during any Vyrnwy LDTM cleaning outage (for example to take any section out of supply). This shows that any potential loss or reduction in supplies will need to be balanced by an increase from the other sources.

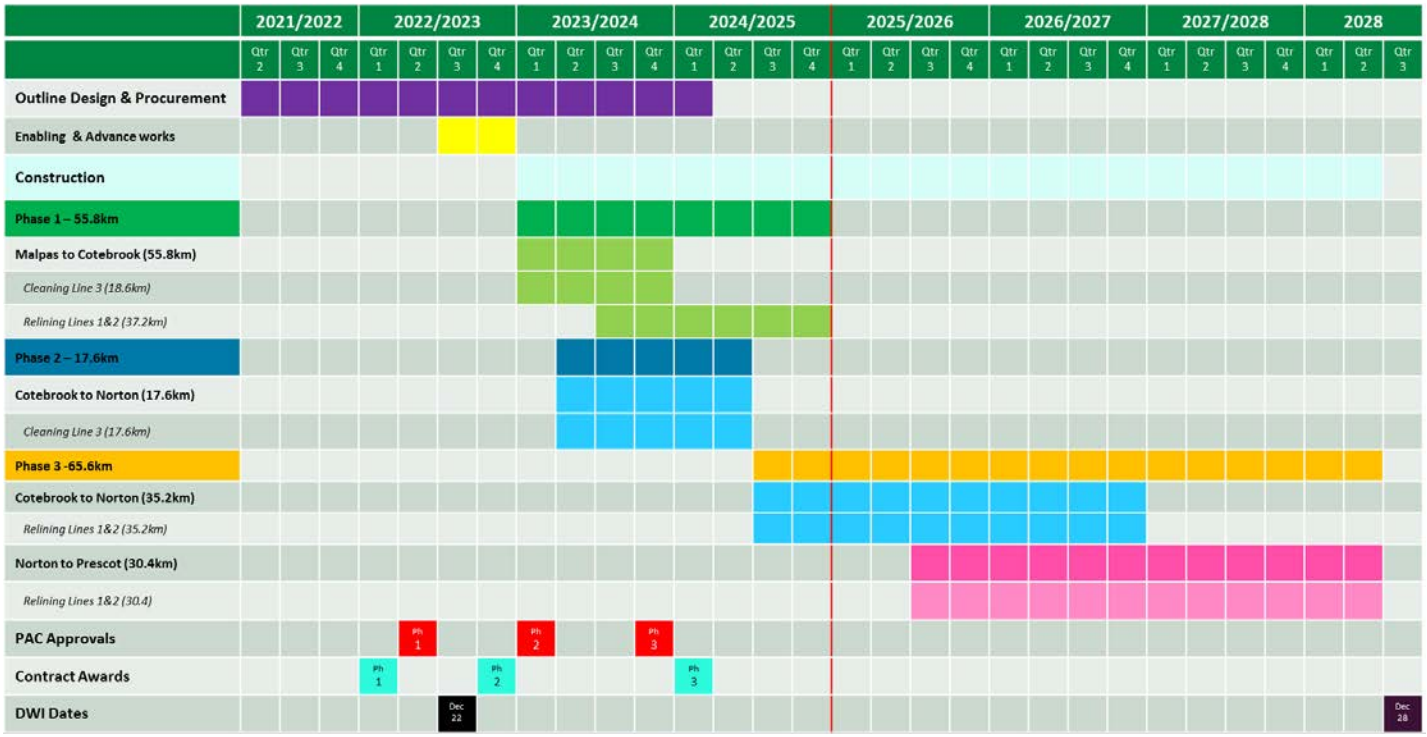
By balancing other sources (between Oswestry and Huntington) this shows that the management of supplies and production capability during all the cleaning and refurbishment scenarios allows an acceptable level of contingency to be maintained ensuring the Company standards for supply demand balance are not compromised.

The change in flow balance to facilitate the required outages of the cleaning project has informed the sequencing of cleaning outages. Significant flow increases in the LDTMs above their normal operating flows were deemed to be high risk in terms of potential discolouration. Where practicable, such flows would only be allowed once the mains had been cleaned.

Another influence on the sequencing of system outages is the preference to clean source to tap, wherever practical/feasible, water from an un-cleaned LDTM will not be allowed to enter a cleaned LDTM to minimise the risk of transferring iron and manganese deposits.

The hydraulic modelling results determined that a staged cleaning approach to the Vyrnwy LDTM cleaning project was required in order to maintain water supplies to customers and minimise any potential supply risks. Restrictions on the potential reduction in the internal diameter and length of the lining solutions will be required to achieve and maintain the supply levels.

i. The current status of the Programme is shown below:-



4 SOLUTION SELECTION

A part of the planning process it was necessary to select the correct solution dependent on the environment, these need to address the following key issues: -

i. The maintenance of supplies to all WSZs served by the LDTM during delivery of individual projects.
ii. Risks to drinking water quality during the works, e.g. discoloured water.
iii. The interface between this programme and other projects (including WTW projects such as Oswestry and the Severn Thames Transfer water trading solution).
iv. Environmental and ecological issues.
v. Land access and highways issues.
vi. Constructability issues in areas of engineering difficulty
vii. Liaison with local and national authorities and other interested parties, including the Environment Agency and Local Authorities.
viii. Disposal of water used for cleaning
ix. Schedule for delivery.

a. Cleaning Options

The three main cleaning methods available to remove deposits are the use of pigs, the use of mechanical devices (scrapers) and pressure jetting. These solutions have been investigated with the support of our construction partners and determined based on their knowledge and expertise to carry out this work on the relevant sections.

b. Cleaning by use of Pigs

Pigs are generally bullet shaped, water propelled and manufactured from polyurethane foam. They have a concave base plate that creates a pressure seal against the internal surface of the pipe in order to build up pressure to propel the pig through the main.

The polyurethane used in the manufacturing process is of varying densities. The lower density units are used first to determine the exact size of the main and the higher density for actual cleaning.

This technique is very commonly used on small diameter pipes where the volumes of water needed for each pass are not excessive. In the case of the LDTM, the volumes of water that would require disposal may be excessive and create logistical difficulties, however our supply chain partners have proposed using air pigging. Compressed air is used to drive the pig through the pipe so dramatically reducing the amount of water.

c. Cleaning by use of Pressure Jetting

This technique has been adopted for cleaning some parts of the Vyrnwy LDTM previously (mainly Line 3 between Norton Tower and Prescot).

Purpose made equipment has been developed - which involves winching a bespoke jetting head through the pipe directing jets of water against the internal surface of the pipe walls to remove the deposits. The pressure, speed of travel and number of passes through the pipeline is dependent on the depth and physical state of the deposits.

Complete removal of the deposits from the pipe surface and joints has been achieved without damaging the existing linings where they are in good condition. We are continuing

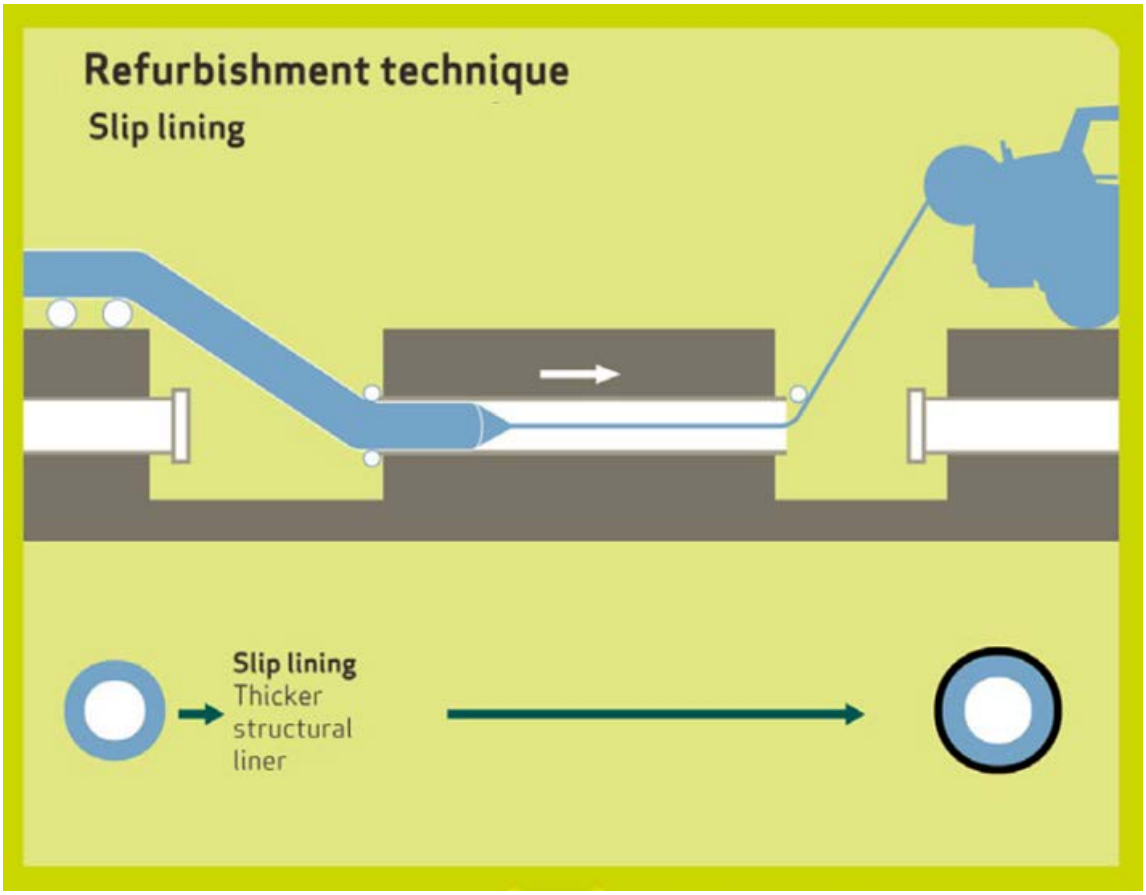
to develop and enhance the techniques employed. Some areas of lining that are in poor condition have been repaired however where more extensive repairs are required these have been recorded on the construction drawings to facilitate future maintenance work.

Cleaning by use of pressure jetting has been successfully applied on significant lengths of LDTMs previously and the techniques have since developed further.

d. Slip Lining

In the majority of circumstances, a new polyethylene (PE) pipe will be threaded through the existing pipe, the new PE pipe's internal diameter is 900mm versus the existing pipe which is 1066mm leaving enough space to thread the pipe through and to go around bends up to 11 degrees. The annulus will then be grouted at each end of the pipe to seal it to stop ingress. The pipe will be either SDR17 or SDR21 pressure rating dependent on the requirements of that section.

ii. Diagram of method to be employed.



iii. **Photo of pipe being winched out of host pipe.**

iv. **Photo of pipe being pulled into host pipe**

v. Photo of pipe string ready to be pulled into host pipe.

e. Trenchless & Open Cut

Where canals, rivers, motorways and railway lines are to be crossed and it's not possible to use winching techniques, either open cut or trenchless solutions will be employed.

We are not expecting to use trenchless & open cut techniques extensively within our proposed solution for the Vyrnwy Aqueduct (LDTM) Modernisation Programme. The main area where this technique is likely to be used is within areas such as Fiddlers Ferry Power Station where open cut techniques mitigate the contaminated ground conditions and urban areas where access is difficult and trenchless solution may offer less customer invasive solution. The final solution is still being considered by our supply chain partners in these challenging areas.

Each Siphon has been assessed to determine the best solution based on needs – summary of technique and/or solution listed below:

vi. Solution at each area

Section	Line 1	Line 2	Line 3
Siphon 1 - Malpas to Cotebrook 18.6km per line	Structural Lining PE	Structural Lining PE	Cleaning Air Pigging
Siphon 2 - Cotebrook to Norton Tower 17.6km per line	Structural Lining PE	Structural Lining PE	Jet Cleaning
Siphon 3 - Norton Tower to Prescot	Structural Lining PE	Structural Lining PE	Completed*

*Line 3 was jet cleaned as part of the original programme of work, to facilitate the cleaning of the Dee LDTM, and is therefore out of scope of this programme.

f. Advanced Enabling Works

As the Vyrnwy LDTM consists of three parallel pipelines, a reduced supply can be maintained during the isolation of a section of pipeline between crossovers. Some enabling works such as minor pipeline alterations to maintain supplies at bulk supply points will be required to enable suitable sections of pipelines to be isolated.

g. Areas of Engineering Difficulty

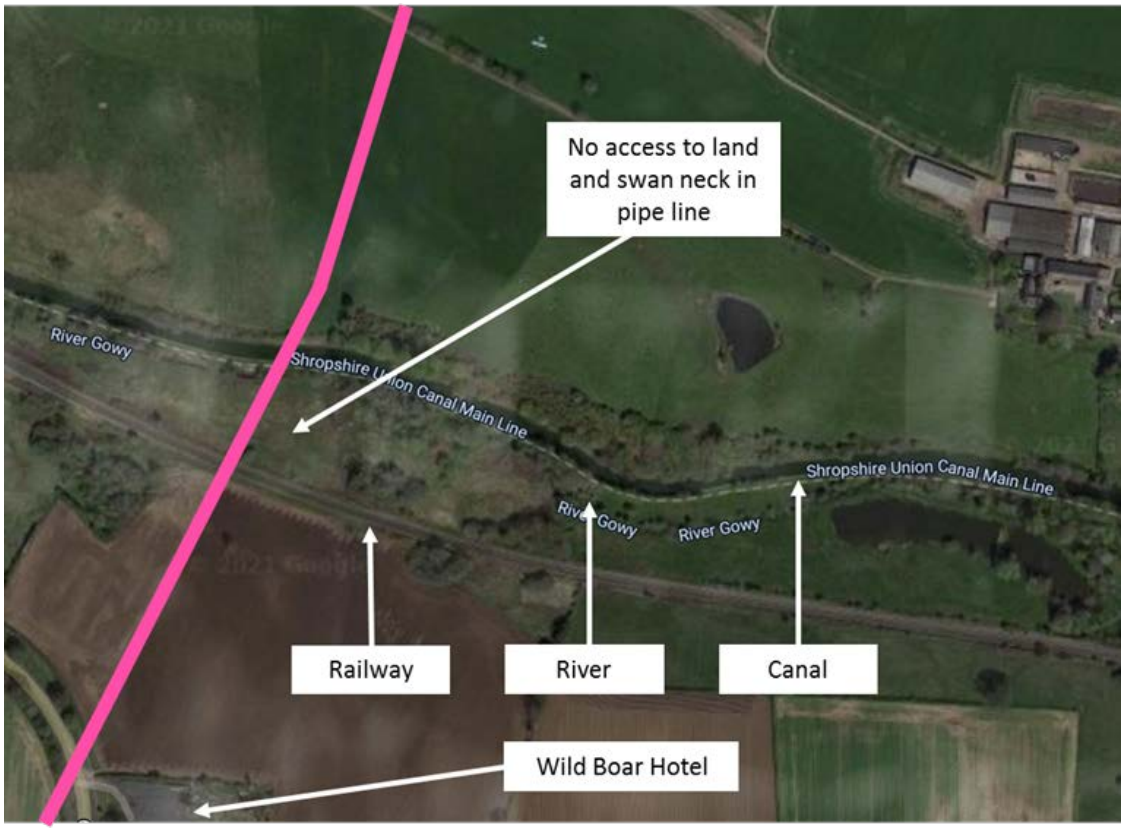
There are a number of locations along the route of the Vyrnwy LDTM that cross Rivers, Canals, Railways and Motorways and current slip lining techniques cannot be used. These are difficult due to the location and extremely close proximity to 3rd party interfaces (Such as the Forestry Commission, Network Rail or Highways England) or that the bend under the obstacle is more than 11 degrees and therefore pipe pushing/pulling cannot be employed.

We are working with our supply chain, and the stakeholders/customers to finalise the solutions for these difficult engineering sections, each one will be different due to the land and level of difficulty. Below are some examples:-

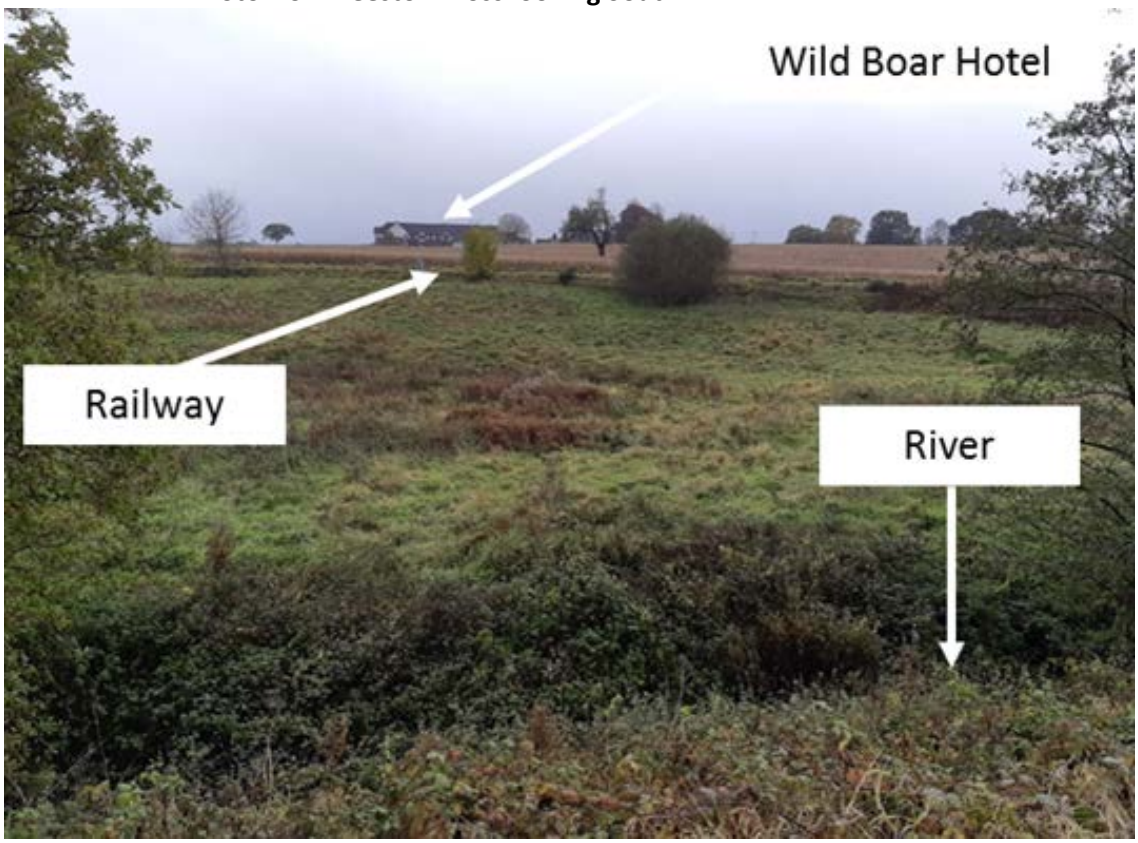
Beeston Moss

Beeston Moss is an area between Malpas and Cotebrook, the LDTM at this point crosses under a railway, under a river and finally under a canal. At each point the current pipelines bend in a 'swan neck' to avoid the obstacle. As the pipe is limited to 11 degrees of flex and the swan neck can be up to 25degrees, the push / pull method cannot be used.

vii. Satellite photo of Beeston Moss showing obstacles



viii. Photo from Beeston Moss looking South



In this case we have specified to the supply chain partner a tunneling technique is to be used, to run 2 new pipes under all of the obstacles. The supply chain partner is looking at alternative methods such as exposing the swan necks and putting the pipe in a joint at a time. A full inspection of the pipe at this location has been completed, and the detailed design is being worked though by the supply chain partner.

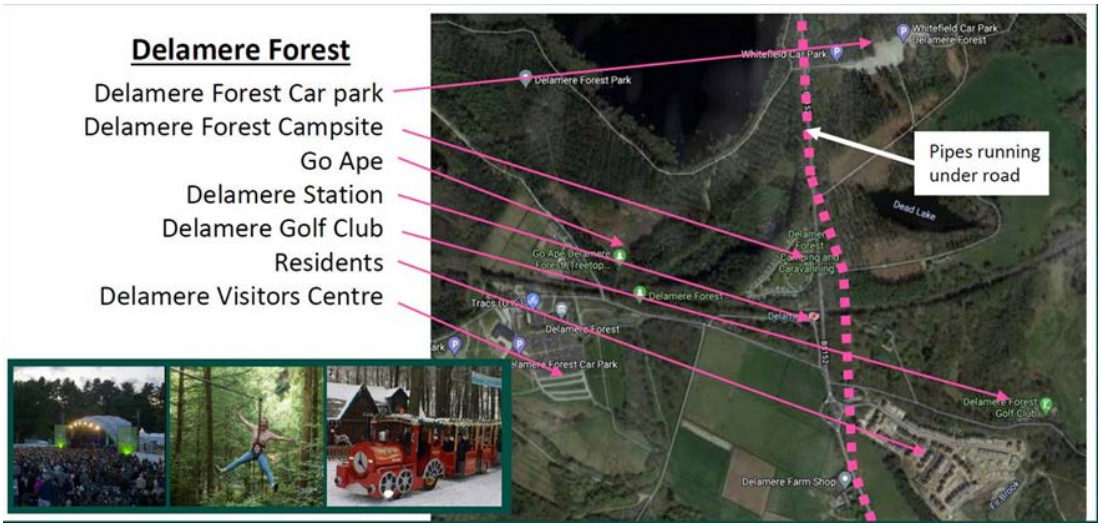
Delamere Forest

Delamere Forest is located between Cotebrook and Norton Tower, it is a popular tourist location in Cheshire with over one million visitors per year, and boasts concerts, Go Ape activities, Christmas fairs and holiday lodgings. The Forest is managed by the Forestry Commission.

The location of the LDTM within this section runs beneath the access road that connects the forest car parks and visitor centres to the main roads in the area. The LDTM runs for approximately 2km under the carriageway, requiring substantial road closures for prolonged periods to undertake the work.

Our supply chain partners, the Forestry Commission and Cheshire West & Chester Council are working through solutions to ensure access can be maintained through the forest during the works, and the programme avoids the busy periods such as summer and Christmas. We are reviewing innovative techniques of pipe pushing that can reduce the level of roadworks required to a minimum to keep the traffic flowing and not impact the visitors. Work in this section commences in late 2023.

ix. Photo from above of the LDTM through Delamere Forest

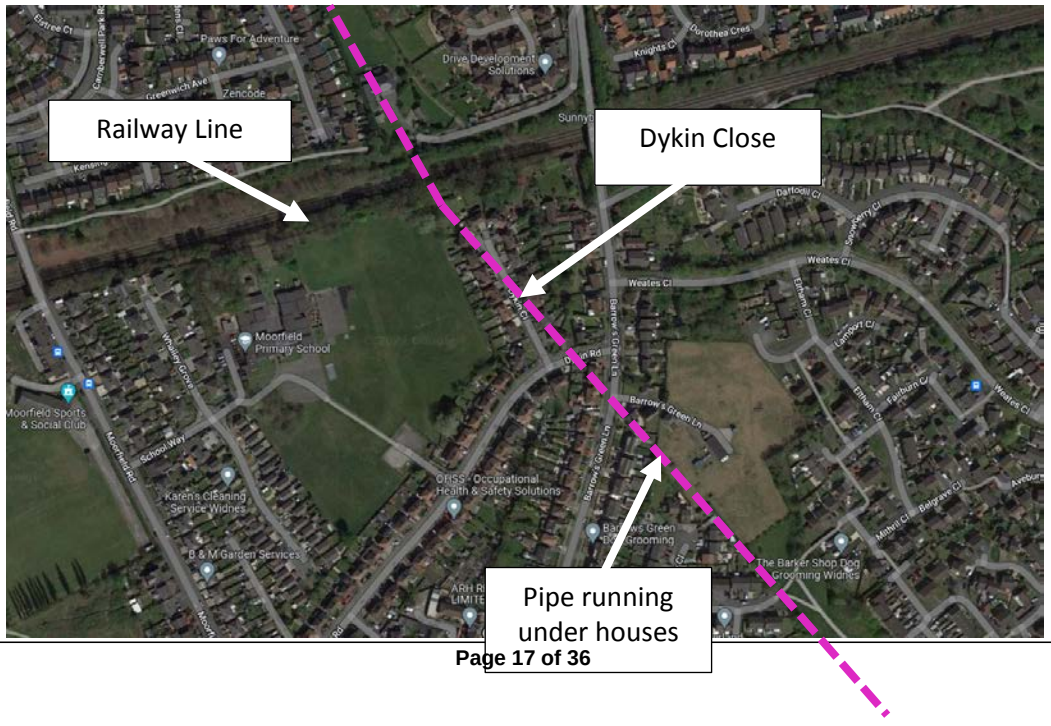


Cuerdley Railway Crossing

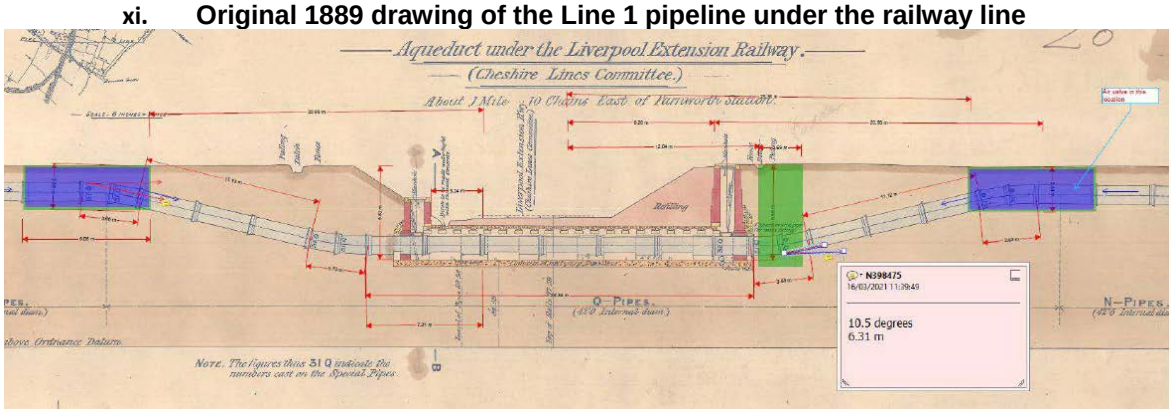
Cuerdley crossing is an area where the LDTM crosses under the Liverpool to Manchester rail link in a cut (i.e. the railway is cut into the ground and runs below ground level). During development in the 1950s the easement has been encroached by houses being built on and around the pipelines up to the rail crossing. This makes the area very congested, including air valves and access points now in customers' back gardens.

As the LDTM drops below the railway at this point, the bends are more than the 11 degrees allowable for pipe pulling/pushing, therefore alternative methods are required to reline and clean this section. We are working with the supply chain partners on a solution which involves taking over four customer gardens to work in and a solution to directional drill or tunnel under the whole area. This section is due to be completed in 2026.

x. Photo of Cuerdley Crossing, Widnes



xi. **Original 1889 drawing of the Line 1 pipeline under the railway line**



h. Delivery Strategy

Phase 1 Section–1 Malpas to Cotebrook

All the outline design is now complete, with the first phase between Malpas & Cotebrook undergoing the final enabling and advance works. This works comprises construction of the haul roads to the work areas, and the installation of new sampling and flushing points. This work is due to be completed in January 2023 ready for the main works to commence in February 2023.

Customer & Stakeholder liaison is ongoing, and all planning permissions have been submitted to the local authorities.

Work has already commenced on the refurbishment of Bickerton PS, which comprises new efficient motors and refurbishment of the original pumps from 1956.

The contract to complete all phase 1 was awarded in September 2022 to Avove (formerly Amey), under the NEC3 form of contract[1]. Contract completion for this phase is estimated in Autumn 2025.

Phase 2 Section–2 Cotebrook to Norton Tower

We have engaged with the OCU (Infrastructure specialist contractors) for early contractor involvement in the outline design and negotiations with major stakeholders such as the Forestry Commission and Network rail who will be impacted by the works. The contract is due to be finalised in January 2023, with negotiated award by spring 2023, with the works commencing in summer 2023, for completion in Winter 2027.

Phase 3 Section–3 Cotebrook to Prescot Relining

The outline design is now complete, there are a number of engineering challenges within this section which we are working with the supply chain to find suitable solutions to. This area contains Fiddlers Ferry power station that is due to be demolished in 2023 and a network rail crossing which is surrounded by houses so access is very difficult.

We are currently completing the commercial strategy for this phase, as the works cannot commence until Phase 1 is complete due to production planning restrictions (ensuring resilience on the system) The plan is for this work to be tendered in 2024, this will also ensure the economic climate will have stabilized including the volatility on the price of PE pipe.

[1] NEC3 ECC–The New Engineering Contract3 - Engineering and Construction Contract has been utilised to manage the programme effectively through a recognised commercial model https://www.apm.org.uk/resources/find-a-resource/what-is-nec3/

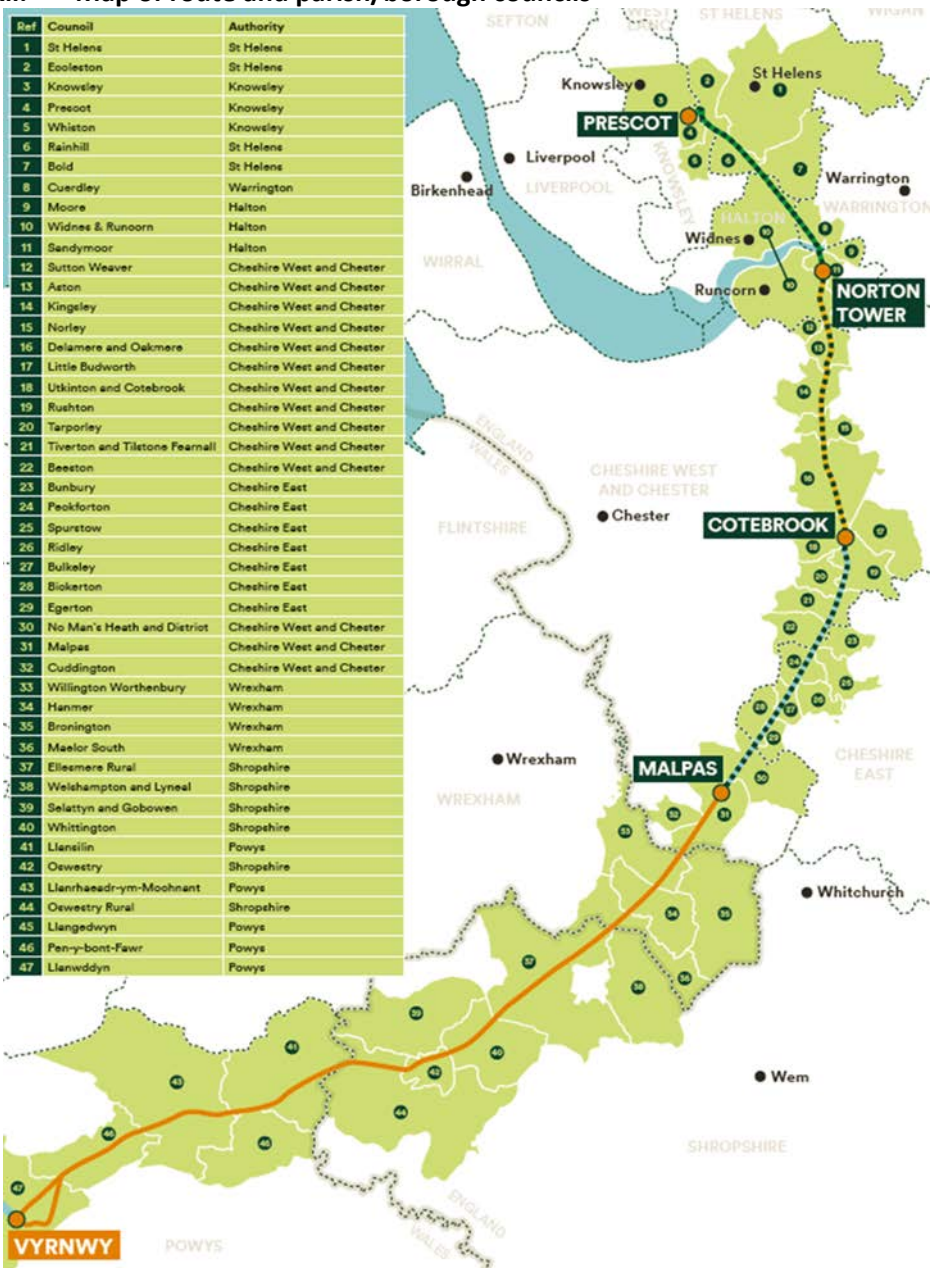
5 PLANNING

The scheme has required significant consultation with the local authorities, even though the LDTM has been in place for 130 years, planning permission is required for access from the highways, development of compounds and road closures/ traffic measures where these cannot be avoided.

We have engaged with 31 Parish councils and 7 borough councils about the scheme, to get feedback and on phase 1 to gain planning permission for access roads. The planning permissions require a number of ecological and archeological studies to be completed prior to submission. These have been completed for Phase 1 and are underway for Phase 2. The studies are only valid for three years, so they will be commenced on phase 3 in 2024 so the information remains within the window of construction activities.

xii. Map of route and parish/borough councils

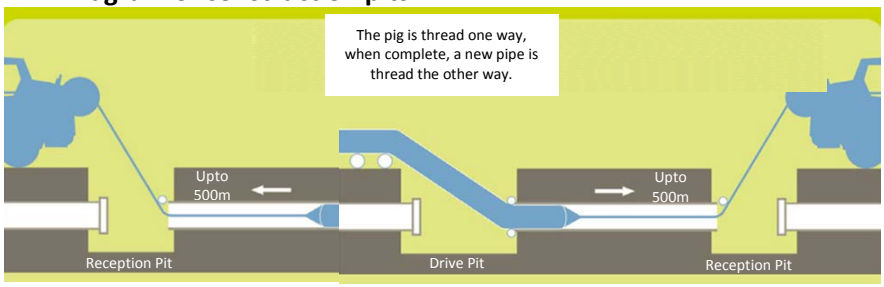
Ref	Council	Authority
1	St Helens	St Helens
2	Eccleston	St Helens
3	Knowsley	Knowsley
4	Prescot	Knowsley
5	Whiston	Knowsley
6	Rainhill	St Helens
7	Bold	St Helens
8	Cuerdley	Warrington
9	Moore	Halton
10	Widnes & Runcorn	Halton
11	Sandymoor	Halton
12	Sutton Weaver	Cheshire West and Chester
13	Aston	Cheshire West and Chester
14	Kingsley	Cheshire West and Chester
15	Norley	Cheshire West and Chester
16	Delamere and Oakmere	Cheshire West and Chester
17	Little Budworth	Cheshire West and Chester
18	Utkinton and Cotebrook	Cheshire West and Chester
19	Rushton	Cheshire West and Chester
20	Tarporley	Cheshire West and Chester
21	Tiverton and Tilstone Fearnall	Cheshire West and Chester
22	Beeston	Cheshire West and Chester
23	Bunbury	Cheshire East
24	Peckforton	Cheshire East
25	Spurstow	Cheshire East
26	Ridley	Cheshire East
27	Bulkeley	Cheshire East
28	Blakerton	Cheshire East
29	Egerton	Cheshire East
30	No Man's Heath and District	Cheshire West and Chester
31	Malpas	Cheshire West and Chester
32	Cuddington	Cheshire West and Chester
33	Willington Worthenbury	Wrexham
34	Hanmer	Wrexham
35	Bronington	Wrexham
36	Maelor South	Wrexham
37	Ellesmere Rural	Shropshire
38	Welshampton and Lyneal	Shropshire
39	Selattyn and Gobowen	Shropshire
40	Whittington	Shropshire
41	Llansilin	Powys
42	Oswestry	Shropshire
43	Llanrhaeadr-ym-Mochnant	Powys
44	Oswestry Rural	Shropshire
45	Llangedwyn	Powys
46	Pen-y-bont-Fawr	Powys
47	Llanwddyn	Powys



a. Planning tools

Using the techniques described earlier, the pipeline needs to be exposed via excavation approximately every 500 metres. A section of the pipeline will be removed to allow the new pipe to be threaded through. The excavations are called 'pits' and are split into threes; a central drive pit where the pipe will be threaded in, and at either end a reception pit where the pipe will be winched out.

xiii. Diagram of construction pits

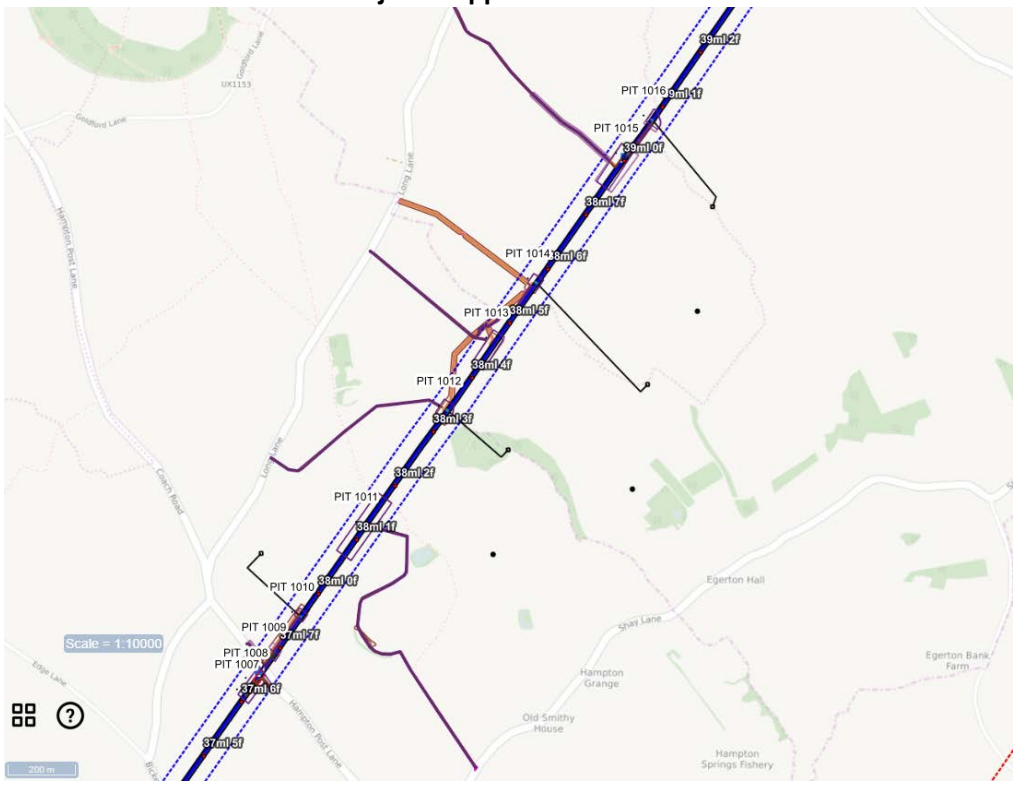


Where cleaning is required, the same pit locations will be used. However, as the equipment is smaller (being remote controlled, connected by an umbilical cable and hosing), a manway is cut into the top of the pipe to allow access. This process of cleaning is quicker and less invasive than the relining works.

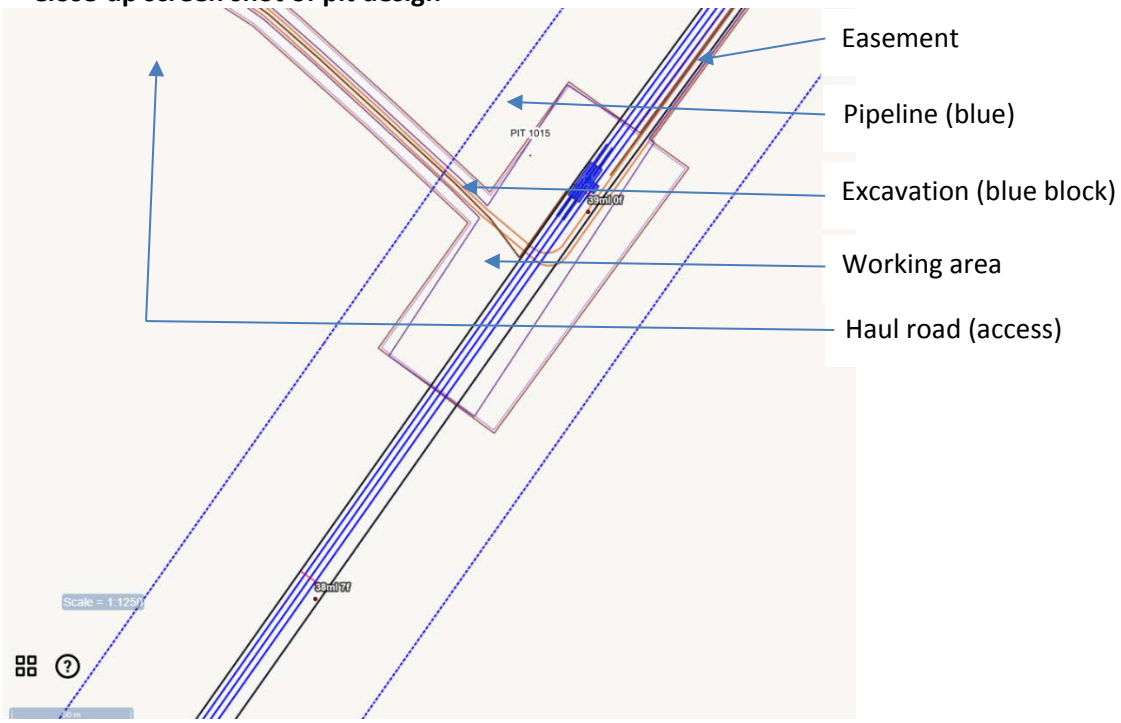
With the location of the pits in a mix of fields and within urban areas, we have used a software tool called project mapper, which allows us to draw the pits and haul roads onto the system, and also identify who owns the land. It also helps the delivery of the pipes, as these are up to 18 metres each in length and require significant articulated lorry traffic to gain access to the reception pits.

Further excavations will be required for air valves and flushing points to be exposed and connected to the new pipeline.

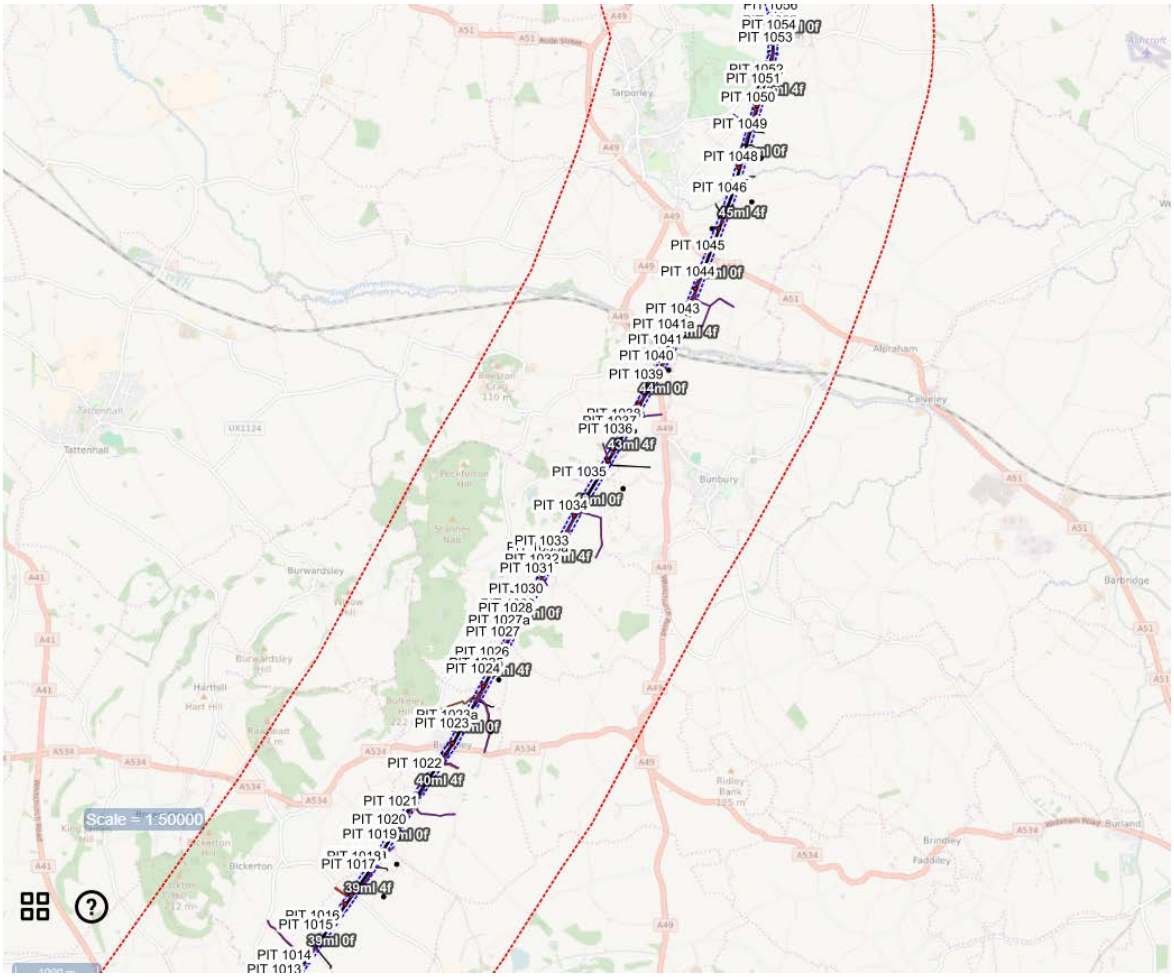
xiv. Screenshots from Project mapper software



xv. Close-up screen shot of pit design



xvi. High level screen shot showing location of access pits



xvii. Project Mapper Satellite view of Siphon 3 showing access pits

6 STAKEHOLDER & CUSTOMER MANAGEMENT

Although work is being carefully managed to ensure that there is no impact on the quality of water supplied to customers, the Vyrnwy Aqueduct (LDTM) Modernisation Programme is an extensive programme to be carried out over AMP 7 & 8 and due to the geographic span there is a high potential to impact on United Utilities' customers from the work itself. To manage the communication with all customers and stakeholders, a Stakeholder Management Plan has been developed ensuring communications are proactive and of high quality.

This document sets out the approach of the intended engagement programme in support of the refurbishment and includes:

- Engaging and communicating with a range of key local stakeholders, including elected county, local and parish council members – *utilising their current communication channels, getting feedback and adapting approaches based on this.*
- Ongoing communication with elected representatives ensuring they remain fully informed regarding progress, issues and how United Utilities has responded to these, together with feedback.
- Engagement and consultation with the local communities – *carried out by digital and face to face channels.*
- Ensuring maximum engagement with the communities whilst overcoming restrictions such as customer working patterns, utilising appropriate communication tools.

Further to work undertaken in previous AMPs, stakeholders have been gathered into the following four groups: -

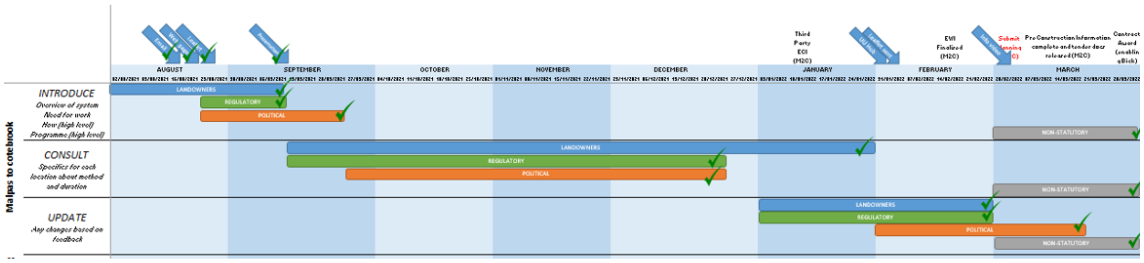
- Those involved in delivering the programme.
- Customers affected by the programme.
- Programme sponsors/supporters.
- Those interested in the programme.

The interests and expectations of each group were previously assessed, together with current communication platforms utilised by United Utilities. From that data, a plan was created to address what needs to be communicated, level of information required, by whom, using which method and at what frequency. This plan is subject to continual development throughout the programme and reviewed as the effectiveness of each communication has been tested and periodic lesson learnt reviews.

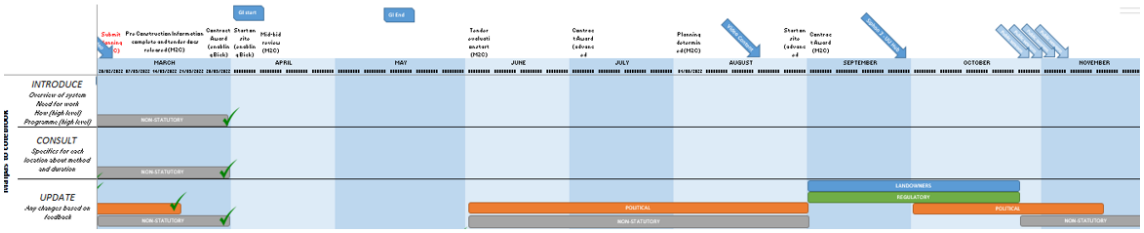
We proactively communicate with our customers whenever it is believed that there is a potential for any impact upon them. This is planned and will be managed via a project level communications plan.

xviii. An Example of the communications programme – Section 1

August 2021 – March 2022



March 2022 – September 2023



a. Methods of Communication

Engagement with stakeholders

The local parish councils, district and borough councilors, local planning authorities and county councilors (where applicable) and other relevant stakeholders are being kept informed of the proposals and how United Utilities plans to deliver the project. United Utilities will continue to engage and update as the project progresses.

Elected representatives are having face to face or video conference meetings with the project team to discuss the plans in more detail, taking their feedback and answer any questions.

Contact with stakeholders is being maintained throughout the project including the results of all consultation as well as how the designs have evolved in reaction to feedback received.

Domestic Customers

It is important that we carefully consider the use of a range of communication strategies, at both generic and site specific level. In determining our communication strategy, we will carefully consider a wide range of additional matters, including for example risk, safety and security issues, and any impact and mitigations to our priority care customers.

We plan to use the following methods of communication: -

Media: We have developed a media relations strategy, with the objective of achieving communication at a generic and/or site-specific basis. We have used this approach for previous LDTM programmes.

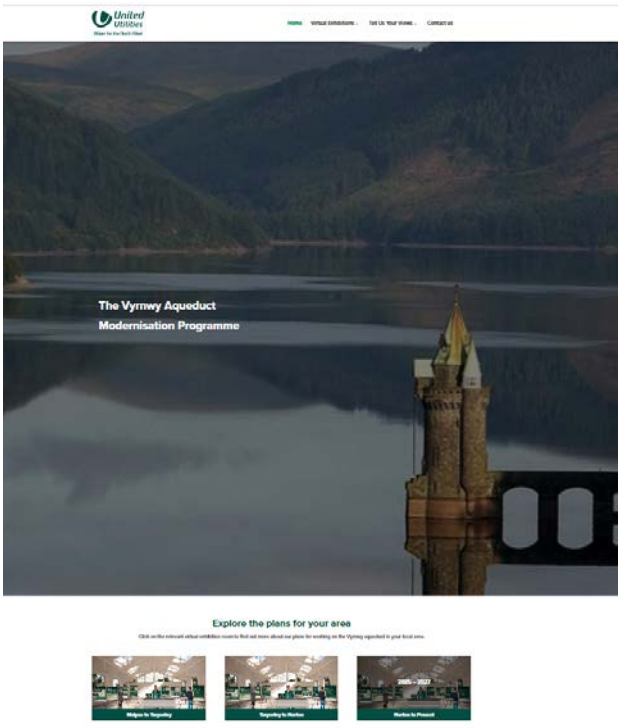
Leaflets: We have produced leaflets for distribution for the programme and will develop individual project letter drops to be distributed locally and via our Mobile Visitor Centre.

xix. Copy of the customer leaflet

- Advertisements: We have identified the use of advertisements to raise awareness, at local and regional level. This approach could be used to communicate specific messages relating to the project. We targeted the use of outside media such as billboards and bus shelters in those areas identified as being highly likely to experience service or traffic disruption.

- Programme Website: We have developed a specific programme website as a method of communication and to provide regular update and individual project information. (www.uuhub.co.uk/vyrnwy)

xx. Customer website screenshot



- **Letters**: We will use specific letters regarding the programme for customers directly affected by the works. We have used this approach on previous works on the LDTM, with letters previously sent to over 280,000 customers.

- **Virtual Visitors Centre**: With the COVID19 pandemic, alternative ways of reaching out to customers needed to be considered, as part of this the virtual visitor centre was produced, so customers can view the works from home, but has the look and feel of a visitor centre.

xxi. Virtual visitor centre

- **Mobile Visitor Centre**: We have commissioned a dedicated Mobile Visitor Centre (MVC) to use for customer drop-in events as part of our communication strategy as a source of local information for residents, both prior to and during the works. This has been designed specifically for the more rural areas.

- **Site Banners** : We will develop and adopt a construction site banner communication strategy which involves posting information on the fencing around construction work areas.

b. Engagement with third-party groups

In parallel with the initial engagement with councilors, key stakeholders and local neighbours regarding the scheme, we have undertaken a phase of outreach and engagement focused on third-party groups, such as community organisations, relevant interested parties and businesses.

United Utilities understands the importance of engaging with third-party groups at an early stage. In this respect, local third-party groups have been invited to view the proposals via the newsletter, project website, and virtual exhibition.

c. Incident Management

We are aware of the risks to water quality and continuity of supply associated with this programme. We consider these risks as part of any customer communication strategy and before carrying out any planned work.

We ensure that any communications undertaken during an incident are in line with our current incident management procedures.

Customer communications are tailored to suit customers by using various channels and formats. This includes consideration of our domestic and business customers differing needs.

7 RESOURCES

a. Management Structure

A dedicated full time programme management team has been established to coordinate activity on the Vyrnwy Programme to manage risk and ensure delivery. The management team consists of the following:

- Programme Manager
- Engineering Manager
- Project Managers
- Construction Supervisors
- Commercial Manager
- Asset Manager
- Regional Supplies Manager

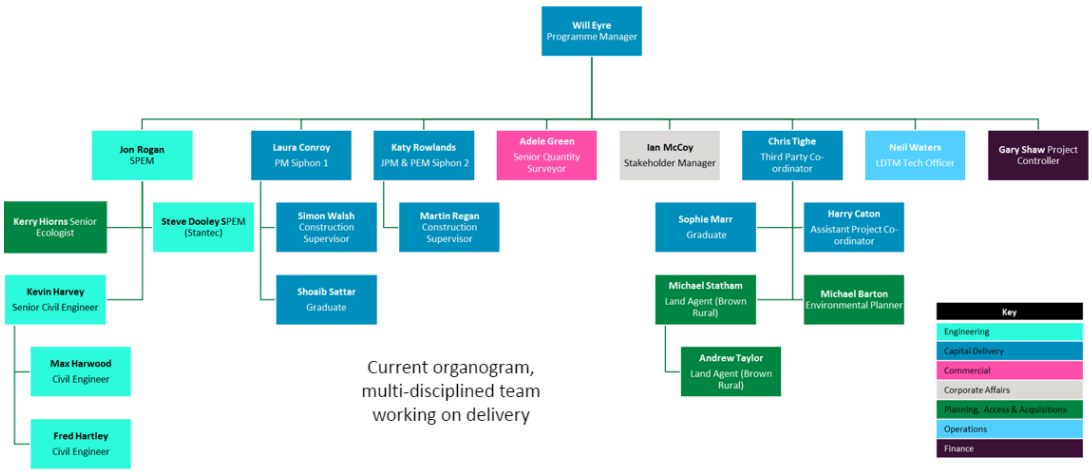
b. Project Team Support Functions

The Management team are supported by a number of other functions that operate under a matrix management structure. The time spent on the project is variable dependent on the role and the timing within the lifecycle of the project.

The main roles are as follows:

- Design Engineers (Various Disciplines)
- Commercial and Finance staff
- Regional Supplies operational staff
- Project Controls
- Project Planner
- Risk Analysts
- Construction Supervisors
- Third Party and Stakeholder Management staff
- Customer Communications staff
- Landowner Liaison

xxii. Organogram of the delivery team.



Current organogram, multi-disciplined team working on delivery

8 PROGRAMME GOVERNANCE

In order to challenge and advise on programme progress, risks and issues, a cross-business Programme Board has been established. Members of the Board are drawn from Asset Management, Commercial, Engineering, Operations, Customer, Production Planning, Scientific Services, Finance and Regulatory Control within United Utilities. This group meet on a monthly basis and review the report produced by the Programme Manager. Progress against schedule, strategy, cost and risk are considered and solutions proposed for implementation by the Programme Manager. Any risks or issues that require escalation or attention at a more senior level will be elevated to the relevant United Utilities Board through this meeting.

a. Coordination Group (Regional Supplies)

It has been identified due to the duration of the works and the impact the Vyrnwy Programme has on the regional supply demand balance it is necessary to increase the focus on the relationship with other projects and operational activities within the United Utilities region.

The programme has dependencies with other capital projects such as Oswestry WTW, Prescot SR and Huntington WTW and also the potential to link closely to the Severn Thames Transfer water trading proposals currently being developed.

In order to manage the relationship between these projects and the wider regional supply demand balance a Water Systems Management Group has been established and meets on a monthly basis. The group is a mixture of senior managers from both water supply and water networks, project managers, regional supplies managers, production planning managers and operational mangers from the Integrated Control Centre in United Utilities. The group are broadly to:

- Provide a holistic view of the relationship between capital projects.
- Understand the reduction in capacity of the Vyrnwy LDTM at any point and the impact this has on the regional supplies balance.
- Monitor impacts of weather events on the project (e.g. dry events)
- Ensure that future operational interventions on the regional system are controlled
- Control and approve planned shutdowns of lengths of the LDTM pipelines.
- Review progress against plan

As part of our standard procedures we also ensure Water Quality is at the forefront of our planning activities and are adopting ‘Construct Clean’ best practice (see 8.e for more details) following our Water Quality First approach. The programme has regular attendance at the Water Quality Risk Board (for each package of work as per planned updates and for assessment of risks to water quality for standalone activities planned when required).

b. Programme Management

All Capital Projects within United Utilities are managed in a consistent manner. The Framework for this is the Digital Delivery Library (DDL). The DDL communicates how we deliver projects and batches within United Utilities in a controlled and consistent way. It contains all of the required processes, templates and key documents necessary for successful delivery.

The Vyrnwy Aqueduct (LDTM) Modernisation Programme will be managed in accordance with the Digital Delivery Library framework.

The DDL is centered on Association of Project Management (APM) frameworks and is split into a number of phases within the project lifecycle as follows:

- Identify Phase
- Define Phase
- Delivery phase
- Close Phase

Each phase has a related "Tube map" which details the required steps and iterations necessary in order to deliver a successful project.

Each phase is summarized below:

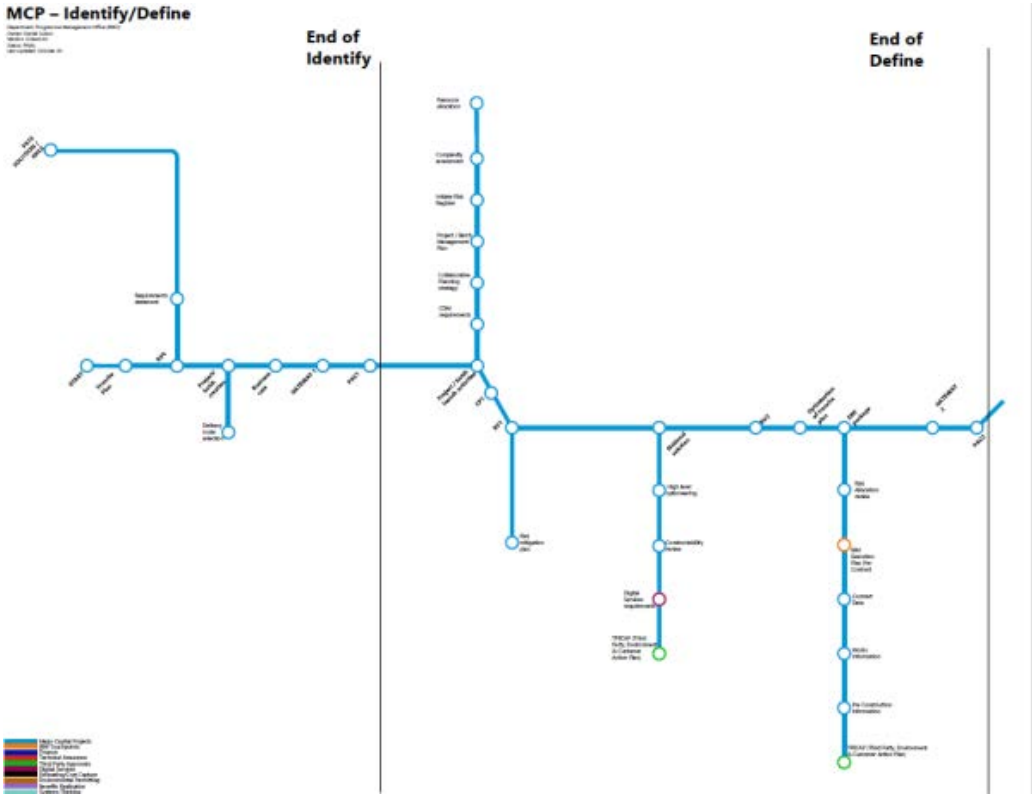
Identify

The main purpose of the Identify phase is to identify, confirm and prioritise requirements. In order to ensure that the business is investing in the right interventions, requirements are tested through the Risk and Value process at Risk and Value 0 (RV0). During this phase requirements are prioritised by the Strategic Programme Boards and form part of the Strategic Business Case. At the end of the Identify phase the Strategic Business Case is reviewed at Gateway 1 which provides both governance and assurance, making sure that all of the required activities have been undertaken and the project or programme is set up for success. Financial governance is undertaken at Programme Approval Committee 1 (PAC1) which approves funding for the Define phase.

Define

The main purpose of the Define phase is to manage the number of assumptions and risks on a project or batch to an acceptable level before awarding a contract. Risk and Value is a key activity within the Define phase as it helps to understand the root cause, site performance and also validate the notional solution that has been developed. All of which reduce the level of uncertainty on the scheme and assist in answering if the requirement is affordable. The Define phase is also when the Employer's Works Information (EWI) is produced which is a key document in specifying and describing the work the Contractor is to undertake.

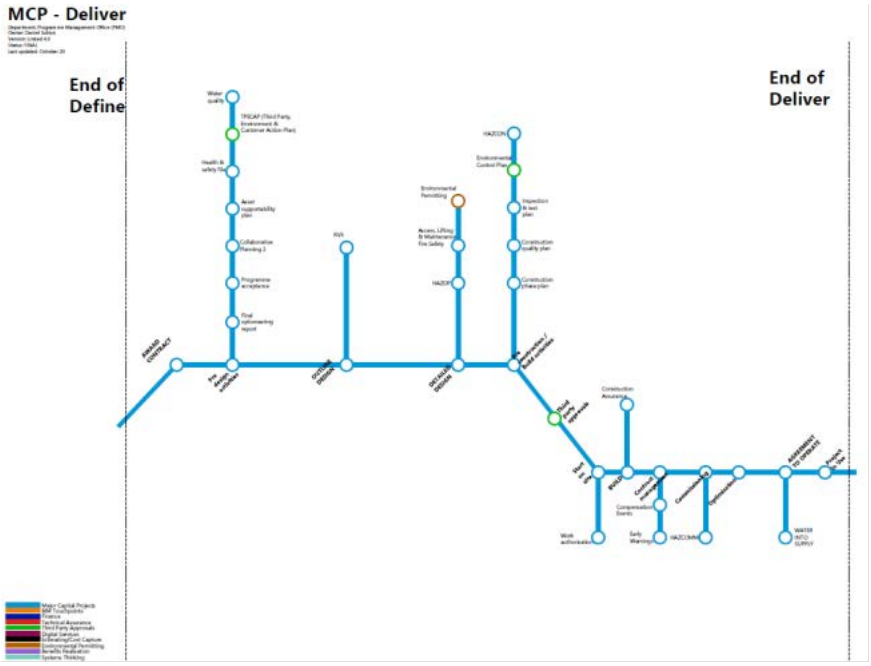
xxiii. Diagram 6a- Identify/Define Phase Tube Map



Deliver

The main purpose of the Deliver phase is to achieve the requirements and new capability outlined in the commercial contract. Within this phase working collaboratively is key as most if not all of the key stakeholders will be involved with the delivery of the project or batch. A significant milestone towards the end of this phase is the Agreement to Operate. This ensures that the Employer has delivered against all of the agreed requirements and the new / modified asset is compliant and can become operationally live.

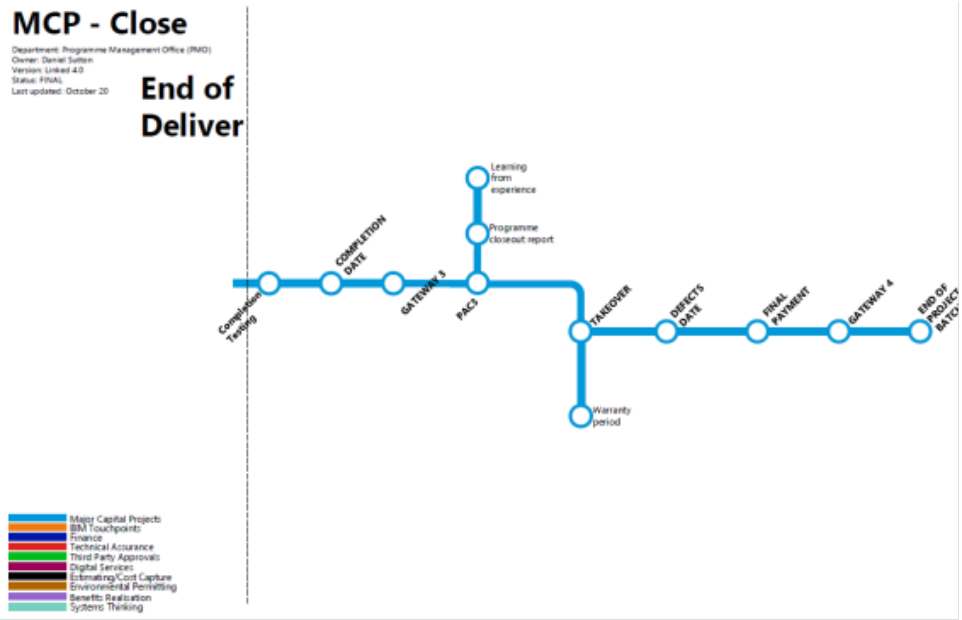
xxiv. Diagram 6b- Deliver Phase Tube Map



Close

The main purpose of the Close phase is to ensure that all of the requirements outlined in the commercial contract are delivered. Towards the end of the Close phase the Programme Approval Committee (PAC) 3 meeting is undertaken. This is to review that the project or batch is ready to be closed, but also to ensure the benefits will be delivered and the out-turn costs align to what was initially approved.

xxv. Diagram 6c- Close Phase Tube Map



c. Risk Management

Risk Management on this programme will be carried out in accordance with the United Utilities Risk Management Procedure. This process is aligned to the Association for Project Management (APM) Project Risk Analysis & Management (PRAM) guide and follows the steps outlined below:

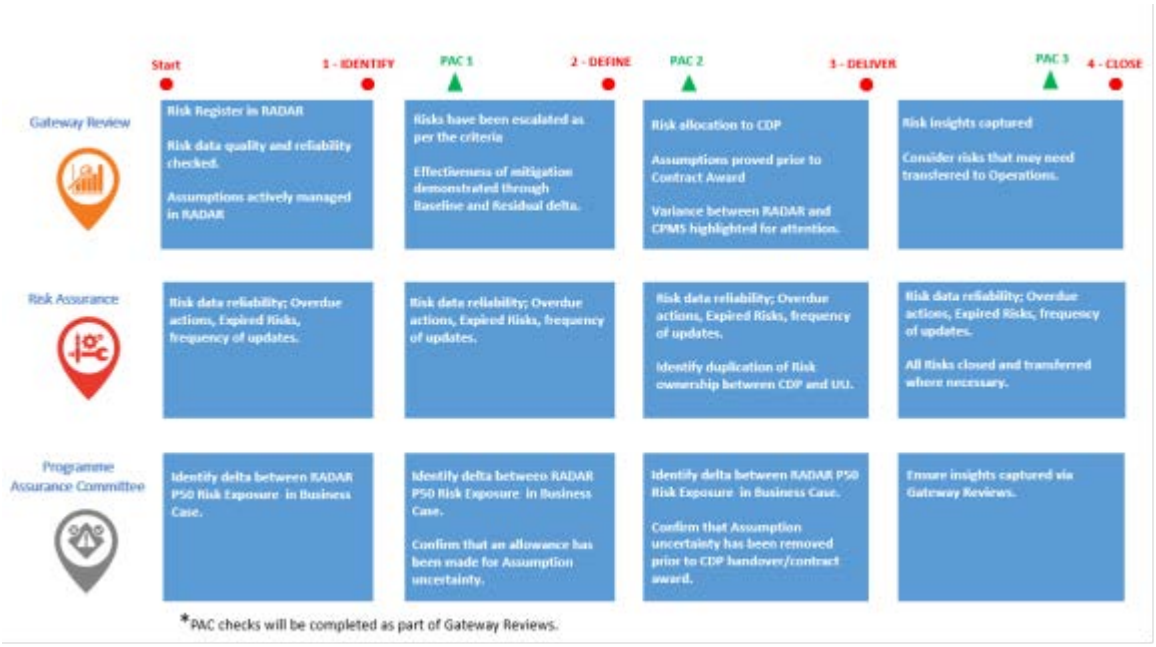
- Initiate Risk Management Planning, defining the process, terminology, categories, output, participants and responsibilities.
- Identify risks and described in term of causes, events and consequences
- Assess in terms of probability, cost, time and reputation before and after the response implementation
- Plan & implement responses - Determine the risk strategy and identify optimal response to effectively manage a potential threat or opportunity.
- Analyse and report risk and response status
- Review report and escalate all risks and response activities where appropriate
- Monitor overall effectiveness of project risk process activity & identify additional Control measures

Risks are recorded and managed in United Utilities risk database called RADAR on a regular basis and reported on monthly.

d. Risk Management Governance

Risk Management governance is in place to ensure risk data across the Portfolio is reliable, consistent and of sufficient quality to make decisions. The processes and checks developed are in place to assure risk data across the Risk Hierarchy including Strategic Programme risks.

xxvi. Key checks in place across the Project lifecycle



e. Construction

United Utilities have a number of construction supervisors who have extensive experience in the management of construction site activities. Their valuable experience is used throughout the project lifecycle to ensure that the proposed solution is deliverable. The input that construction supervisors have on the project can be summarised, but not limited to:

- Solution selection
- Constructability reviews
- Input into the form of contract (EWI)
- Evaluation of tender submissions
- Health, safety and environmental management on site
- Quality assurance on site
- Management of stakeholders, contractors, customers etc. during construction works
- Liaison with United Utilities operational staff
- Management of site hygiene practices
- Assurance of evidence pack documentation.

f. Mains Hygiene Practices

We recognise that this work represents a potential opportunity for contamination to enter the system. Accordingly, specific precautions are needed during this work to minimise the risk. This risk is being managed according to our Mains Hygiene Practices document (ref. 60133).

This details: -

- The classification of personnel, including operational precautions, contractual requirements, the briefing of personnel and the need for a medical assessment card.
- Site cleanliness, including management of potential contamination, prevention of ingress and capping/sealing of pipes when not in use.
- The tools and equipment used, including cleaning and disinfection procedures.
- The use of DWI approved materials.
- The disinfection of new and rehabilitated mains, including the procedures to be adopted.
- Actions to be taken in the event of a suspected contamination event.
- Water quality sampling procedures and requirements.

We are also trialing the 'Clean Construction' methodology from the wider United Utilities Water Quality First programme, this approach has further rigor through assurance inspections, engagement with the supply chain, inductions and toolbox talks and overall understanding of water hygiene practices, even for those who are not directly involved in the works.

The photographs below show where this has been employed, with clear site standards, tool box talks to engage with the supply chain, best practice with clearly identified disinfection bottles and magnetic drill bits to capture swarf during any cutting.

xxvii. Photos of Construct Clean Construction example

g. Operational Considerations

The Vyrnwy Programme requires the isolation and drain down of sections of strategically important major water mains. Some of these pipelines have not been isolated in full, or part sections, for long durations potentially for a number of years since their original construction. However, the water supply demands remain and therefore a detailed LDTM outage programme has been developed.

Large parts of Cheshire and Merseyside are supplied from the Vyrnwy and Dee LDTMs. A number of detailed Synergee hydraulic models were constructed by the United Utilities engineering team, in conjunction with United Utilities operations, in order to assess the various cleaning outages and their impact on the supply of water to customers. Average peak demand figures were agreed for each area supplied as well as achievable production figures for Oswestry and Huntington WTWs and any restriction on raw water supplies or abstraction licenses. Any available contingency measures such as borehole supplies and cross connection with other LDTMs have also been considered.

There are a number of key customers, primarily large industrial process based users, who have specific water quality and supply needs which have to be considered during the outages. These customers were consulted and their needs incorporated into the outage programme.