Dŵr Cymru
Welsh Water

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Zonal Studies Methodology

October 2017

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Dŵr Cymru Welsh Water

3rd October 2017

Report Reference: Zonal Studies Methodology V4

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01	Ivan Gaston		Initial Issue	
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1 Executive Summary

A Zonal Study is a holistic investigation into the factors influencing performance at a Water Quality Zone level. Through the utilisation of all mains hydraulic modelling, statistical analysis and by capturing the experience and knowledge of local operations the Zonal Study is able to identify the root cause of poor performance within the Water Quality Zone in an integrated approach. All the outputs from the Zonal Studies are to be evidential, auditable and quantative. It therefore allows for targeted investment within the zone to most appropriately improve long and short term performance for the benefit of our customers and the business. Zonal Studies are a collaborative and integrated business as usual tool that will act as a streamlining tool through the capital gateway process and give a joined up strategic approach to investment (**Figure 1**).

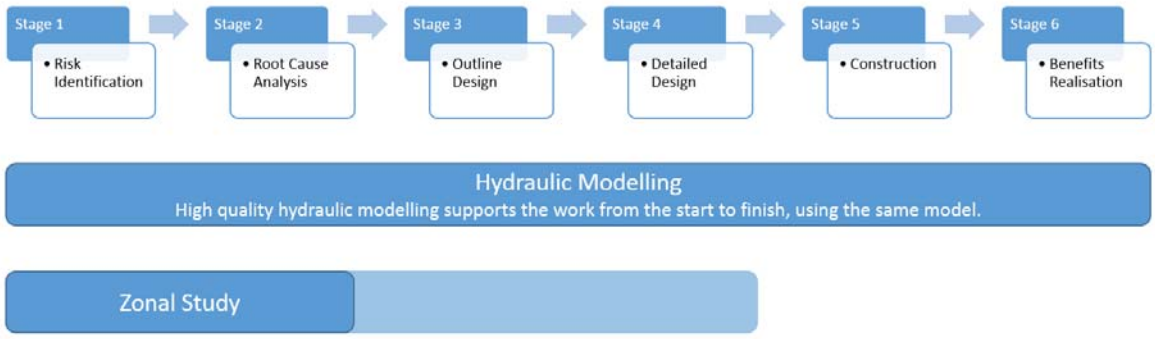


Figure 1: Zonal Studies and the Capital Gateway Process

2 Aim of Zonal Studies

The main aim of a Zonal Study is to identify investment requirements to achieve or exceed the desired performance targets while delivering regulatory outcomes, mitigating risk of asset deterioration and failure and optimising the asset whole life cost. This a cyclical process of continuous improvement, linked to other business functions, and is summarised in **Figure 2**.

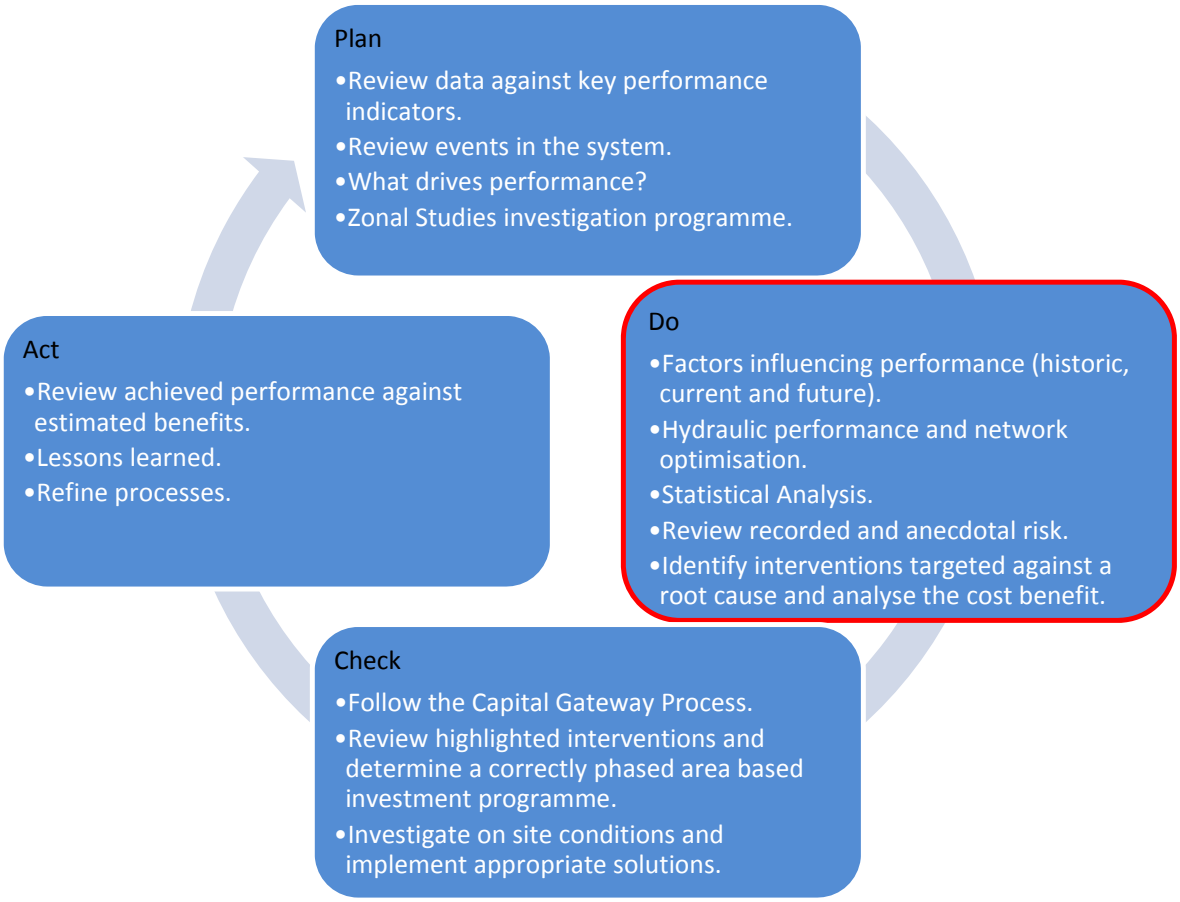


Figure 2: The Complete Zonal Studies Process

3 Zonal Study Key Steps

There are four key steps to the Zonal Studies process.

1. Targeting and Ranking
2. Root Cause Analysis
    a. Hydraulic Modelling
    b. Data Analysis
    c. Operations Workshop
3. Scheme Selection
4. Review and Finalise Reports

4 Targeting Zonal Studies

Zonal Studies are targeted by an annual assessment of key performance indicators using data from the most recent three year period. Currently the Zonal Studies programme is targeted against customer acceptability (appearance, taste and odour customer contacts). The 86 Water Quality Zones in Dŵr Cymru Welsh Waters' operating area are then ranked in ascending order (**Figure 3**), all using the software package Tableau 8.2. The Water Quality Zones are then sense checked against any capital maintenance that would have impacted the area during the three year period. This allows for the consistent and appropriate targeting of the Zonal Studies programme.

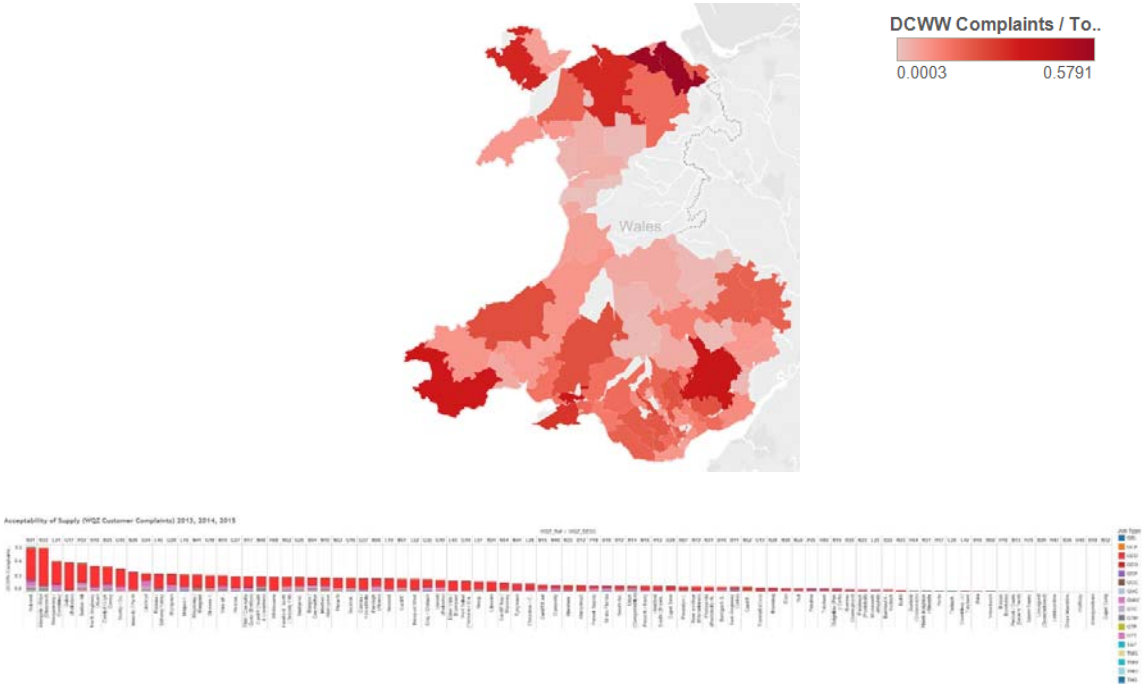


Figure 3: Performance review of Customer Acceptability

This review allows for the prioritised planning and completion of a fit for purpose all mains hydraulic model of the Water Quality Zone, led by the Dŵr Cymru Welsh Water Hydraulic Modelling Team, if one does not exist.

4.1 Measuring Performance

Dŵr Cymru Welsh Waters' Measures of Success considered in the Zonal Studies are:

- A1 Safety of Drinking Water - Considered by all MP failure codes.
- A2 Customer Acceptability of Water - Considered by all customer quality complaint codes.
- A3 Reliability of Supply - Considered by Customer Minutes Lost (CML), minutes per property.
- D2 At Risk Customers - Defined as customers who have experienced the same complaint or issue at least once a year for the last three years.
- F1 Asset Serviceability - Considered by bursts per 1000m.
- F2 Leakage - Considered by Ml/d.

As displayed on the previous page the performance of each Water Quality Zone directly aggregates to the company performance and targets. As such all benefits and impacts, whether scheme, Water Quality Zone or company, also have to be measured on the same, company level, scale.

A1 Safety and Acceptability of Drinking Water.

Although this is displayed as a percentage in the Measures of Success table it is measured as a numeric value by individual count, i.e. 2, for regulatory sample failures (MP, R1, R2, R3, R4, R5 and SX codes).

A2 Customer Acceptability of Water.

Customer Acceptability of Water is measured by complaints per 1000 population across all customer quality complaint codes. The estimated population for Dŵr Cymru Welsh Waters area of operations in August 2015 is 3,068,659. The calculation is displayed below.

Customer Acceptability of Water = (Number of Records) / 3,068,659 x 1000.

A3 Reliability of Supply.

Reliability of supply is measured by Customer Minutes Lost. The estimated number of customers for Dŵr Cymru Welsh Waters area of operations in August 2015 is 1,403,811. The calculation is displayed below.

Customer Minutes Lost (Reliability of Supply) = (time x properties) / 1,403,811 x 60.

D2 At Risk Customer Services.

Defined as customers who have experienced the same complaint or issue at least once a year for the last three years. This is measured in a numeric value by individual count.

F1 Asset Serviceability.

Asset Serviceability is measured by bursts per 1km across all mains. The estimated length of mains for Dŵr Cymru Welsh Waters area of operations in August 2015 is 28,613,443m. The calculation is below.

Asset Serviceability = (Number of bursts) / 28,613,443 x 1000.

F2 Leakage.

Leakage is currently calculated on a DMA (District Metered Area) level basis. Leakage is to be attributed to the proportion of ferrous mains within the DMA.

This can then be succinctly captured in a performance table as featured in **Table 1**. The first two columns capture the specific measure of success being looked at. The third column shows the current company performance with the performance of the Water Quality Zone being studied in brackets. The forth column shows the required AMP6 company performance targets with the required performance targets of the Water Quality Zone being studied in brackets. The fifth column displays the maximum predicted improvement in the Water Quality Zone measure of success performance post intervention. Although the Zonal Study aims to achieve or exceed the desired performance targets in each zone it is not expect that this will always be the case (note the differences between, performance, targets and maximum potential benefits in **Table 1**).

	MoS	Current Company Performance (WQZ Ref)	Required AMP 6 Company Performance (WQZ Ref)	WQZ Predicted Maximum Benefit Post Intervention
A1	Safety of Drinking Water	99.97% (0)	100% (0)	100%
A2	Customer Acceptability (contacts/1000 pop/year)	2.79 (0.06)	1.23 (0.04)	0.0396
A3	Reliability of Supply (mins/customer/year)	12.15 (0.33)	12 (0.157)	0.041
D2	'At Risk' Customers	575 (20)	425 (10)	10
F1	Asset Serviceability (bursts per km)	0.123369 (0.0017)	0.152026 (0.0014)	0.0003
F2	Leakage	175.43 Ml/d (3.29 Ml/d)	169 Ml/d (1.74 Ml/d)	2 Ml/d

Table 1: Example Performance Table

For the purposes of any study the performance and targets of each area is provided. Also provided is the data used to generate these figures.

5 Hydraulic Performance Assessments

The purpose of conducting a hydraulic performance review of the study area is to understand the constraints that the water experiences as it passes through the network and the implications that may have on the service provided to our customers.

5.1 Growth and Development

As a statutory consultee Dŵr Cymru Welsh Water is frequently consulted on the capability of the networks to sustain development. Evaluating growth over the timeframe of a local development plan as part of the Zonal Study will allow for a detailed assessment of the suitability of the current network, any potential investment or even if growth can be a solution. A sequential maximum day hydraulic modelling assessment is necessary for every development within the study area in accordance with the Dŵr Cymru Welsh Water's Clean Water Modelling Specification (**Table 2**) to assess the impact of development and what, if any, new assets are required.

Development Type	Occupancy Rate	Daily Consumption per Person	Demand Profile
Residential	2.5 people per property	250 litres	Residential
Industrial (<1 ha)	90 people per hectare	250 litres	10 Hour
Industrial (1 - 3 ha)	90 people per hectare	250 litres	16 Hour
Industrial (>3 ha)	90 people per hectare	250 litres	24 Hour

Table 2: Development Consumption Rates

All developments are to be collated in the below growth table (**Table 3**). The latter two columns in this table state whether the development can be supported and from which main.

Site Ref	Name	Development Type	No. of Props / Units to be built / ha developed	Assessed Demand (l/s)	Permitted / Not Permitted	Suitable Connection (BNG)
H0303	Land adjoining Hafan y Waun	Residential	129	0.93	Permitted	123456, 123456
E4	**Goatmill Road**	**Industrial**	**10 ha**	**2.60**	**Not Permitted**	**306057, 207088**

Table 3: Growth Table

Create an A3 plot geographically displaying all development sites labelled with the site ref and identifying the sites that are not permitted. The results of the hydraulic modelling assessment are to discuss the impacts of the development on the network, if any, and levels of serviceability achieved at the development and the critical points in the network. If the current network configuration is insufficient then levels of service resolutions are to be provided as schemes and noted at the base of the table. A growth model is to be provided in **Appendix A**.

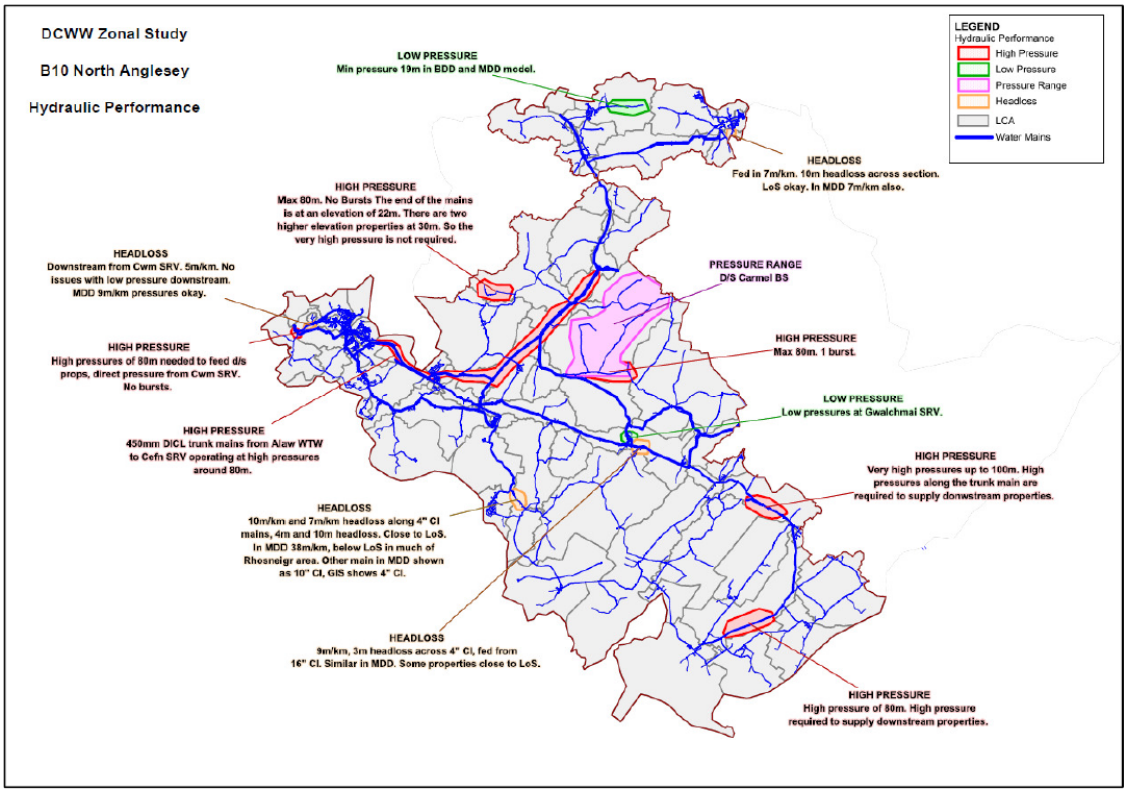
5.2 Hydraulic Performance

The below hydraulic metrics are to be analysed for current network conditions and potential network conditions following the growth assessment. A general overview of the system performance is necessary followed by detail on areas where Dŵr Cymru Welsh Water's minimum and maximum standards are breeched and to highlight any schemes that will aliveiate the issue.

Hydraulic Measure	Dŵr Cymru Welsh Water's Standards
Pressure	Minimum pressures of 20m at the customer's property. Maximum pressures in distribution areas of 70m Note pressure ranges of greater than 20m
Headloss	Maximum headloss gradients >5.0 m/km
Velocity	Note low mains velocities < 0.1 m/s Note high mains velocities > 1 m/s Maximum mains velocities > 3 m/s Note areas where shear stress is < 0.9 N/m² Note areas where water age exceeds 144 hours

Table 4: Dŵr Cymru Welsh Water's Hydraulic Standards

A summary plot highlighting areas of the network that fall outside of Dŵr Cymru Welsh Waters' tolerances concerning high pressure, low pressure, high pressure range, high headloss and high velocity is to be provided as an A4 or A3 sized image with the hydraulic analysis section for both the current and future network. See **Figure 4**.



Hydraulic Measure	Polygon Colour
High Pressure	Dark Red Outline, Light Red Fill
Low Pressure	Dark Green Outline, Light Green Fill
High Pressure Range	Dark Magenta Outline, Light Magenta Fill
High Headloss	Dark Orange Outline, Light Orange Fill
High Velocity	Dark Yellow Outline, Light Yellow Fill

Figure 5: B10 North Anglesey Hydraulic Performance Plot 2015 and Dŵr Cymru Welsh Water's Standard Legend Colours

Detailed plots of the hydraulic analysis are to be provided in **Appendix A**.

5.3 Non-Infrastructure Performance Review

Conducting a review of the non-infrastructure assets in the study area allows for the understanding of individual assets current and potential future performance and the impacts these can have on customers and the business. This is to begin at the source water and water treatment works using the most up to date corporate and operations workshop information. The below **Tables 5** and **6** set out the detail required and format for capturing service reservoir and water pumping station information.

Table 5 : N26 Maerdy Porth Service Reservoirs										
Service Reservoir	Location (BNG)	Top Water Level (AOD) (m)	Volume (m^3) and Compartments	Properties Supplied		IMS Retention Time		Modelled Retention 2016	Modelled Retention 2030 (total growth)	Asset Notes
				Total	Direct	Summer (hrs)	Winter (hrs)			
Ffaldau (Ferndale)	298800, 197350	294m	Total 6675 Tank 1 2225 Tank 2 2225 Tank 3 Mothballed Tank 4 2225	17,113 (Trebanog SRV 6,228) (Porth SRV 5,190)	5,695	19	26	50	36	Maximum depth = 6.1m. Operational depth = 4.8m. Retention exceeds 48 hours. Reduce operating level for 5 years until completion of downstream development. Asset inlet is level controlled by a ball valve. Customer acceptability contacts relating to chlorine. Secondary booster at site is not automated. Remaining asset condition is good.

Note:
Retention is to be analysed from the level of the average operating level down to the level of the outlet main or the minimum draw down level if the level of the outlet main is not available.

Table 6 : N26 Maerdy Porth Water Pumping Stations									
Water Pumping Station	Location (BNG)	Number of Pumps	kW Rating	Rated Capacity (Ml/d)	Energy Usage (kWh/Ml) and Efficiency (%)	Properties Supplied		Operation	Asset Notes
						Total	Direct		
Cymmer Hill	302368, 190587	2 (1 Isolated)	90	113m lift at 4.85 Ml/d. Model average output of 3.2 Ml/d. Insufficient capacity for future development	439.5 kWh/Ml 72.4% efficiency	Trebanog SRV (6,228)	0	Variable speed drive	PRV fitted at inlet (100m input - 20m output). No brown-out switch on WPS which trips in bad weather. Old BT comms line failures impact WPS supply. Pump number 1 needs to be reinstated to cater for future development. Building in a poor state of repair.

Where available, water pumping station surveys and energy data is provided.

5.4 Air Valve Analysis

Air in a pressurized, operating pipeline comes from three primary sources:

1. To entirely fill a pipeline with fluid, it is necessary to eliminate the air. As the line fills, much of the air will be pushed downstream to be released through air valves, hydrants, customers' taps, etc. However, air may become trapped at system high points if there is no mechanism for it to be released.
2. The water itself contains approximately 2% air by volume. During system operation, the entrained air will continuously settle out of the water and again accumulate at system high points if there is no mechanism for release.
3. The third source of air is that which enters through mechanical equipment. This includes air being forced into the system by pumps as well as air being drawn in through packing, valves etc under vacuum conditions.

The pocket(s) of air accumulating at a high point(s) can result in a line restriction. Like any restriction the pocket of air increases headloss, extends pumping cycles and increase energy consumption. The presence of air can also promote corrosion of pipes and fittings. As air continues to accumulate at system high points, the fluid velocity increases as the fluid is forced through a smaller and smaller opening.

As the pockets grow, one of two phenomena will occur. The first is a total stoppage of flow. The second, and more likely occurrence, is that the increased velocity will cause all, or part of the pocket to suddenly dislodge and be pushed downstream. The sudden and rapid change in fluid velocity when the pocket dislodges and is then stopped by another high point, can, and often will, lead to a high pressure surge (water hammer). Serious damage to valves, fittings, or even breakage of the line can occur. The most efficient method of releasing air is the use of air valves. However, if the air valve is located incorrectly or is not maintained, air will not be released and problems will arise.

Therefore the ability to introduce and remove air from a pipeline at appropriate locations is critical to maximising asset life and minimising customer disruption. Conduct a longitudinal cross section of the mains in the scheme to determine suitable air valve locations (**Figure 6**). Lidar data is to be used where available to improve the accuracy of the assessment.

Generally within an LCA, air may dissipate through customer taps. However any localised high points where air pockets may form should also be considered for any air valve location.

Note any missing or present air valves associated with bursts. Recommendations are to be made in the report for new air valves with the detailed assessment to be contained within **Appendix A**.

Sample Pipeline Profile Demonstrating Air Valve Locations					
No.	Description	Air Valve Required?	No.	Description	Air Valve Required?
1	Pump Discharge	Yes	10	Decrease Downslope	No
2	Increase Downslope	Yes	11	Low Point	No
3	Low Point	No	12	Long Ascent or Descent	Yes, every 600m max
4	Increase Upslope	No	13	Increase Upslope	No
5	Decrease Upslope	Yes	14	Decrease Upslope	Yes
6	Beginning Horizontal	Yes	15	High Point	Yes
7	Horizontal	Yes, every 600m max	16	Increase Downslope and/or PRV Angled Facing Downhill	Yes
8	Change in Hydraulic Grade Line (due to change in pipe diameter, large user offtake, etc)	Yes	17	Low Point	No
			18	High Point	Yes
			19	Decrease Downslope	No
9	End Horizontal	Yes	20	PRV on a Flat Angle	Yes

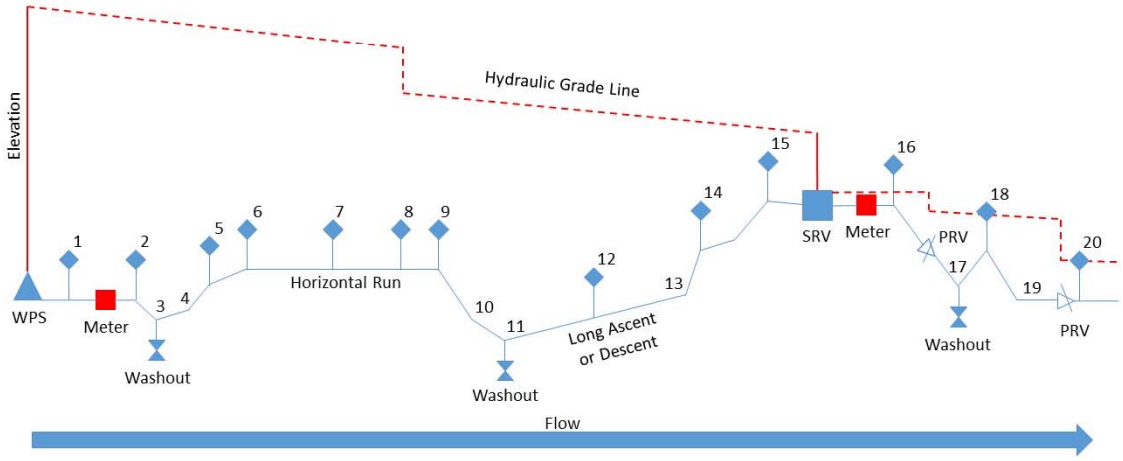


Figure 6: Sample Pipeline Profile Illustrating Air Valve Locations

5.5 Upstream Contact Tracing

Tracing helps to identify less obvious pipes that could be a cause of poor performance. Use the hydraulic model to trace upstream from each customer contact or water quality failure to identify the assets and pipes that carried the water that eventually led to a customer contact. By superimposing traces for each contact it is possible to build up a layer showing the number of times a pipe potentially contributed to a historic contact. Obviously the pipes nearest the source will be identified in every trace, but further into the system it may be possible to locate sections of mains that could be contributing to issues some distance from the contacts or failures.

Tracing is not conclusive evidence that an asset is a current or future risk. The technique is useful in adding weight to other indications of root causes. The outputs of this analysis are to be included in a plot in the report. See **Figures 7** and **8** below.

Note the following corrections:

1. *An OpenStreetMap background must be used for each plot in a similar fashion to the **P22 Bolton Hill Overview Plot**,*
2. *Assets not highlighted in the trace must be coloured as per GIS, and*
3. *LCA boundaries should be featured and coloured as per GIS.*

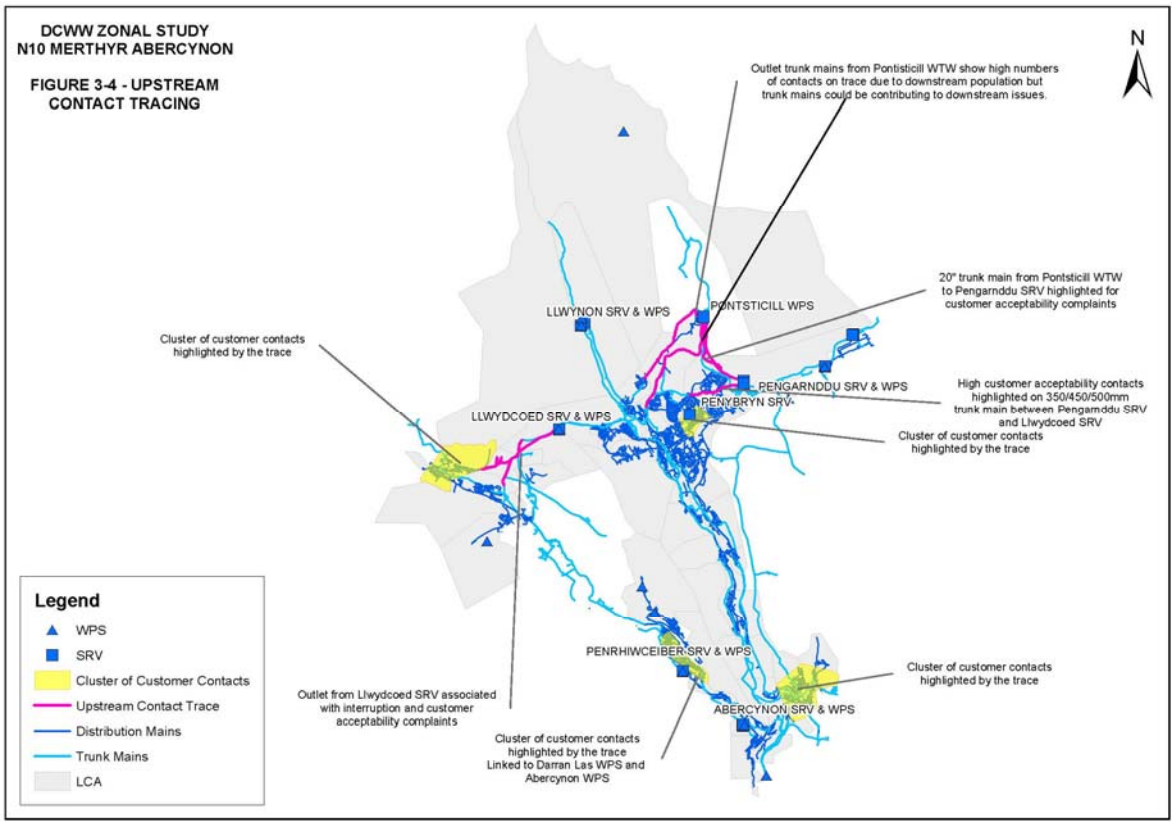


Figure 7: N10 Merthyr Abercynon Upstream Contact Trace

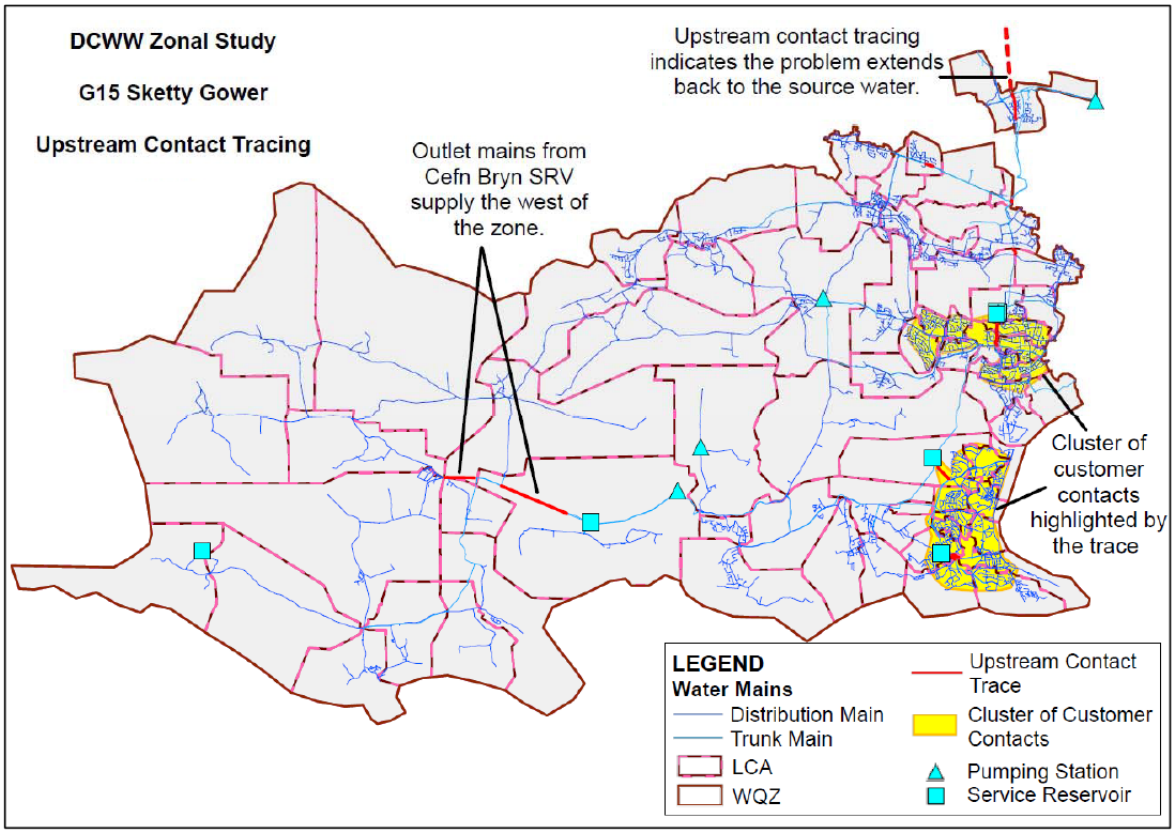


Figure 8: G15 Sketty Gower Upstream Contact Trace

5.6 Contingency Analysis

The purpose of the contingency analysis is to assess the ability to provide a water supply to customers in the event of an incident. This analysis takes account of the network capacity and focuses on rezoning the network, appropriate tankering locations and isolation areas that are too large or require a high number of valves to isolate. In any event Dŵr Cymru Welsh Water can deploy 1000m of 50mm lay flat hosing (rated at 60m) to assist as well as a tanker fleet detailed in **5.7.2. Tankering**. Following this it will be apparent what areas we can resupply and how in any incident but also areas where we would be unable to supply any service, these are to be noted in the report. The outputs of these analyses are to be discussed in the report as an assessment of the whole network contingency. Full details are to be provided in **Appendix A**.

5.6.1 Network Rezoning

In the event of an incident the primary method for ensuring the continuation of supply will be to rezone the network. This assessment looks at the ability to supply the local network if the inlet main is lost. There is a rank of five categories that is used to assess rezoning feasibility.

0 = More data required
1 = Existing contingency
2 = Existing contingency, additional resilience may benefit
3 = No effective contingency, minor solution required
4 = No contingency

0. More data required

This will be where the LCA forms the zone boundary with valves shown connecting to the adjacent zone, but the model/s for the adjacent zone are not available at the time of analysis. There are also no other points of connectivity within the zone or feasible locations to create connectivity. Consideration is still required for tankering locations and isolation areas.

1. Existing contingency

There is sufficient capacity to supply all of the LCA whilst maintaining levels of service close to that under normal operation. There are multiple alternative pathways to supply the local network. No evidence of significant risk to maintaining supply.

2. Existing contingency, additional contingency may benefit

Levels of service are maintained but the network is stressed. High headloss and velocities observed through the alternative routes leading to a large diurnal pressure range impacting performance to some degree in the adjacent LCAs. Assets such as water pumping stations or pressure reducing valves may need to be altered in this, or supplying, LCAs to accommodate the required demand. The alteration to these assets will not increase pressure by greater than 20m from normal operating conditions or exceed 70m pressure within distribution. Consider recommending additional supplies, tankering locations and reducing isolation areas.

3. No effective contingency, minor solution required

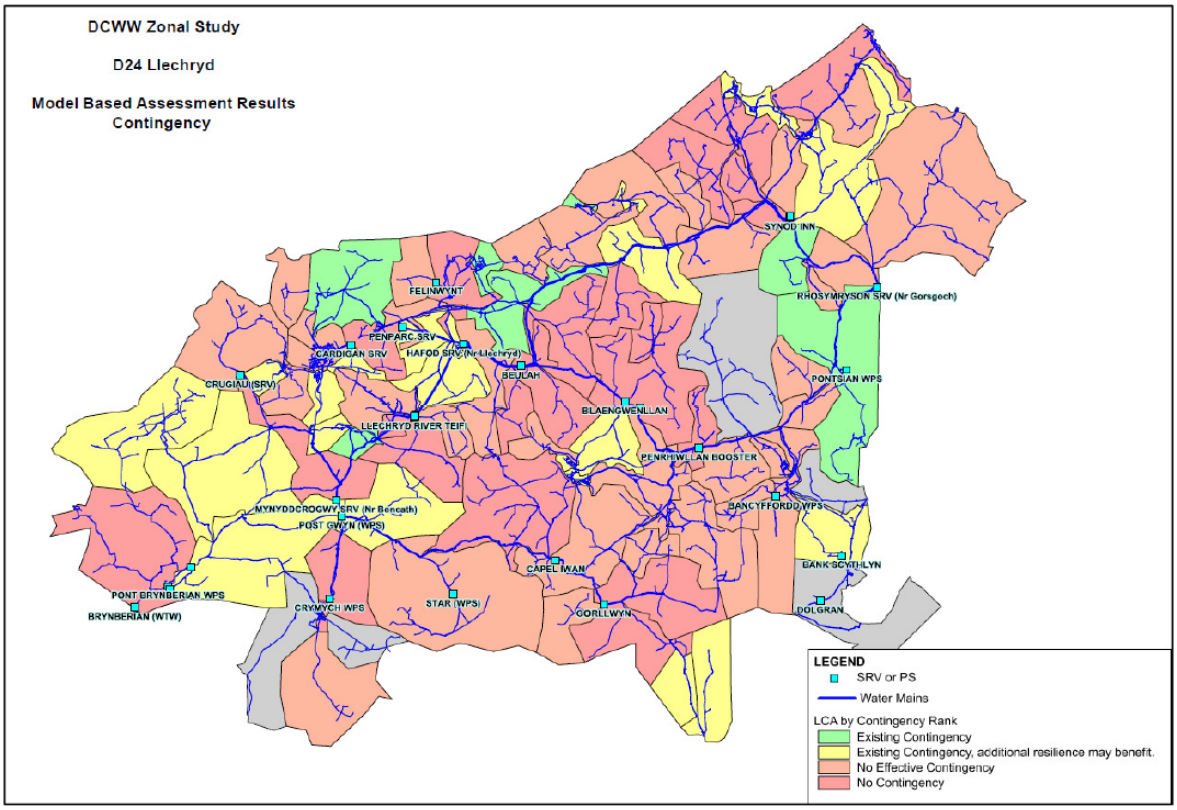
Levels of service are not maintained and the network is stressed. High headloss and velocities observed through the alternative routes leading to large diurnal range impacting performance in the adjacent LCAs.

Assets such as water pumping stations or pressure reducing valves may need to be altered in this, or supplying, LCAs to accommodate the required demand. The alteration to these assets will increase pressure by greater than 20m from normal operating conditions or exceed 70m pressure within distribution. Consider recommending additional supplies, tankering locations and reducing isolation areas.

4. No contingency

There is no contingency in this section of the network. If the inlet main is lost the LCA cannot be supplied through rezoning. Recommend contingency schemes to accommodate additional supplies, tankering locations and reducing isolation areas where relevant.

The output of this analysis is to be included as a geographical plot in the report, coloured as detailed in **Figure 9**, with full details of the analysis to be provided in **Appendix A**.



Contingency Rank	Leakage Control Area Colour
0 - More Data Required	Dark Grey Outline, Light Grey Fill
1 - Existing Contingency	Dark Green Outline, Light Green Fill
2 - Existing Contingency, additional contingency may benefit	Dark Yellow Outline, Light Yellow Fill
3 - No Effective Contingency, minor solution required	Dark Orange Outline, Light Orange Fill
4 - No Contingency	Dark Red Outline, Light Red Fill

Figure 9: D24 Llechryd Contingency Analysis Plot and Dŵr Cymru Welsh Water's Contingency Analysis Legend Colours

5.6.2 Tankering

With tough targets to achieve for Customer Minutes Lost tankers are now being used not just to help manage large incidents but reduce the impact of smaller incidents on day-to-day network operations. Dŵr Cymru Welsh Water employ three sizes of tankers:

Tanker Type	Number of Tankers	Tanker Size	Pumped Delivery Flow	Pumped Delivery Head	Tanker Retention Time
Artic	16	25m³	10 l/s	70m	Due to refilling times the retention time of a tanker cannot be less than 2 hours at maximum demand.
Demountable	7	18m³	10 l/s	70m	
Rigid	5	13m³	10 l/s	70m	

Table 7: Dŵr Cymru Welsh Water's Tanker Capacity

An appropriate size tanker and amount of tankers should be recommended based on the flow in every Leakage Control Area. The tankers would be ideally placed to ensure that minimum levels of service are maintained, to prevent flow reversal and, where possible, pass through the meter site for proof of flowing water to the regulator. However it is accepted that some Leakage Control Areas may be required to be split up into several tankering isolated areas due to the local conditions, such as configuration, demand or topography. Relevant recommendations should be made regarding extra XOX (valve, hydrant, valve) complexes required to support a tanker or multiple tanker locations within a Leakage Control Area or given area. The outputs of this assessment are to be discussed in the report, and in detail in **Appendix A**, and are to be provided as a shapefile of hydrant locations and their respective supply areas.

5.6.3 Isolation Areas

The size of an isolation area can cause a large impact on the properties affected and the operational mitigation used in the event of an incident. By assessing the below conditions appropriate recommendations can be made for the installation of XOX (valve, hydrant, valve) complexes.

1. Identify mains at risk of >3hr repair by material/size and mitigation available.
2. Identify mains with 5 or more valve operations to isolate.
3. Identify areas with a high number of properties in an isolation area.

5.7 Network Optimisation

Strategic or local network optimisation is to be employed to help run the network more effectively, reducing the need for capital investment and maximising the operational life of an asset or system. Identify any opportunities to optimise and rationalise the network and assets.

5.8 Critical Assets

The contingency analysis also has to take into account critical assets and crossings that are within the study area. The definition of a critical asset is contained in **Table 8** below.

Asset Type	Criticality Definition
Source Water	Population Served > 5000
WTW	Population Served (direct feed) > 5000
WPS	Direct Population Served > 5000
SRV	Population directly served > 5000 and or with a cascade to another SRV with < 20 hrs Storage
Trunk Mains both Potable and Raw Water including pipe bridges	Population Served >5000, not able to be served by alternative source. Crossing vital infrastructure, rail – Main line e.g. Paddington Swansea and Holyhead Rail Classification. Crossing vital infrastructure, major road e.g. M4, A5, A470, A483, A465, A40, A49. Watercourse crossings Unable to isolate and rezone 450mm plus > 15 bar

Table 8: Critical Asset Definition

However a critical asset is also quantified as an asset that, in the event of a failure, Dŵr Cymru Welsh Water would be unable to maintain supply by any means to affected areas. The contingency assessments conducted in the Zonal Study allow us to understand the ability to isolate, rezone and tanker to any area. Any asset that:

1. Cannot be isolated while maintaining supply through a rezone or a short bypass,
2. Affected areas cannot be rezoned onto another supply, or
3. Requires > 50% tankering capacity at any one time to supply affected areas

Are to be noted as critical assets in the study area. The use of a plot to present the findings is acceptable where relevant. The Zonal Study is also to note where there are pipes crossing water courses, railway crossings and major highway crossings on a plot.

5.9 Corporate Contingency Plans

Although the condition and capacity of the network and assets are important the study should also look at the availability of wider strategic plans such as; Total Loss Contingency Plans, Water Resources Plan, Drought Provision, etc. Summarise the content of these documents for the relevant zone and evaluate if these plans available, appropriate and up to date.

5.10 Is the Network Suitable?

A conclusion should be made at the end of the hydraulic performance analysis reflecting on the results of the assessments. Highlight key issues identified and the suitability of the network, and assets within it, in its current format and for future purposes.

6 Data Analysis

Data analysis simplifies the relationship between cause and effect of incidents within the network over time. This data is often held in different corporate systems and brining it together allows us to paint a picture of an area's performance. The assessments conducted in this section must consider the results from the hydraulic assessments. **Acceptable Water Quality Sample Codes.xlsx** has been provided as an attachment to this document and is to be used in the below assessments.

6.1 Chronological Analysis

A Chronological analysis will assess the correlations between contacts, failures (PVC and threshold across all determinands and parameters), bursts and pipe materials and condition. This will allow a simplified attribution of a failure and an impact. It will highlight the larger issues in an area as well as smaller continuous background issues. Relevant discussion is required in the report highlight key issues, trends and causes. An example of a Chronological Analysis plots can be found in **Appendix A**.

6.2 Spatial Analysis

Spatial Analysis will allow for the assessment of the geographical clustering of issues (contacts, failures, bursts, etc). This will aid in analysing interdependencies between issues and potential common causes. Relevant discussion is required in the report highlight key issues, trends and causes. An example of Spatial Analysis plots can be found in **Appendix A**.

6.3 Leakage Analysis

Leakage performance and targets are provided at a District Metered Area (DMA) level. These targets are set against our end of AMP6 targets which represents a tougher challenge than the 'best achieved leakage to date' figure. Correlate leakage against areas, material types and metering confidence from available sources and provide relevant commentary with and accompanying appropriately sized plot.

6.4 Corporate Risk

It is important to review the risk that is already kept within the corporate systems in the form of Drinking Water Safety Plans and Investment Manager Risks and Needs. Do the risks raised in either of these align to issues brought forth in the hydraulic and data analyses?

7 Operations Workshop

An operations workshop will follow the desktop review (performance assessment, risk review, hydraulic and statistical analysis). The aim of the operations workshop is to capture the knowledge and experience of the people who work the assets on a day to day basis. This allows the Zonal Study to identify anecdotal risks that are not otherwise captured within the corporate systems. This is an opportunity to highlight areas of poor performance and also to flag up opportunities for network optimisation to improve the way the system operates and performs.

Findings from the analysis conducted to date, problem areas and suggested interventions are discussed with key stakeholders who run and influence the systems.

The framework partner is required to have conducted the analyses before the workshop and send relevant informative plots with some narrative to the named Dŵr Cymru Welsh Water Project Manager. The Project Manager will then distribute these to the stakeholders. These plots and the results of the investigations conducted prior to the workshop will be used to question the stakeholders during the break out session.

Operations Workshop attendees to include, but not restricted to:

- Water Assets representative to chair
- Asset Performance Manager
- Water Asset Engineers and Technicians
- Distribution Manager
- Network Analyst
- Operations Supervisor, Inspectors and Technicians
- Leakage Manager, Supervisor and Technician (upstream and downstream losses)
- Catchment Scientist
- ME&I Supervisor
- Production Operations Supervisor and Engineers
- Process Scientist
- Water Quality Scientist
- Network and Production Risk Managers
- Hydraulic Modelling Team Representative
- Developer Services Representative
- Framework Partner

Outline agenda:

- Attendee introductions and an introduction to Zonal Studies (5 mins)
- Understanding of the zone operation (35 mins)
    - Introduction to the operation of the zone
    - Source Water and Water Treatment Works – historic, current and future issues
    - Asset performance review (Service Reservoirs and Water Pumping Stations)
- Identified zonal issues (35 mins)
    - Review of Drinking Water Safety Plans, IM Risks and Needs
    - Schemes currently in AMP6 plan
- Break (10 mins)
- Break out session (30 mins)
- Potential solutions (35 mins)
    - Review Performance data – capture operational mitigations
        - Hydraulic Performance
        - Water Quality and Customer Acceptability

        - Customer Minutes Lost and Contingency
        - Leakage
        - Reactive Activity
    - Framework Partner identified holistic solutions, opportunities and queries
- AOB and meeting close out (5 mins)

A key output from the operations workshop are the annotated A0 schematic and GIS plots from the breakout session as these are detailed and geographically reference issues. The framework partner is to make an electronic copy of these onto one A0 GIS plot updated with the detailed notes of the discussion held and overlaid with the key points from the hydraulic and spatial analysis provided at the workshop (see **Appendix A**).

8 Root Cause Analysis

Following the completion of the assessments in Sections 5, 6 and 7, the results must be brought together using the below fishbone diagram (**Figure 10**) to understand the root cause of the identified problem. This will allow for the appropriate identification of scheme types.

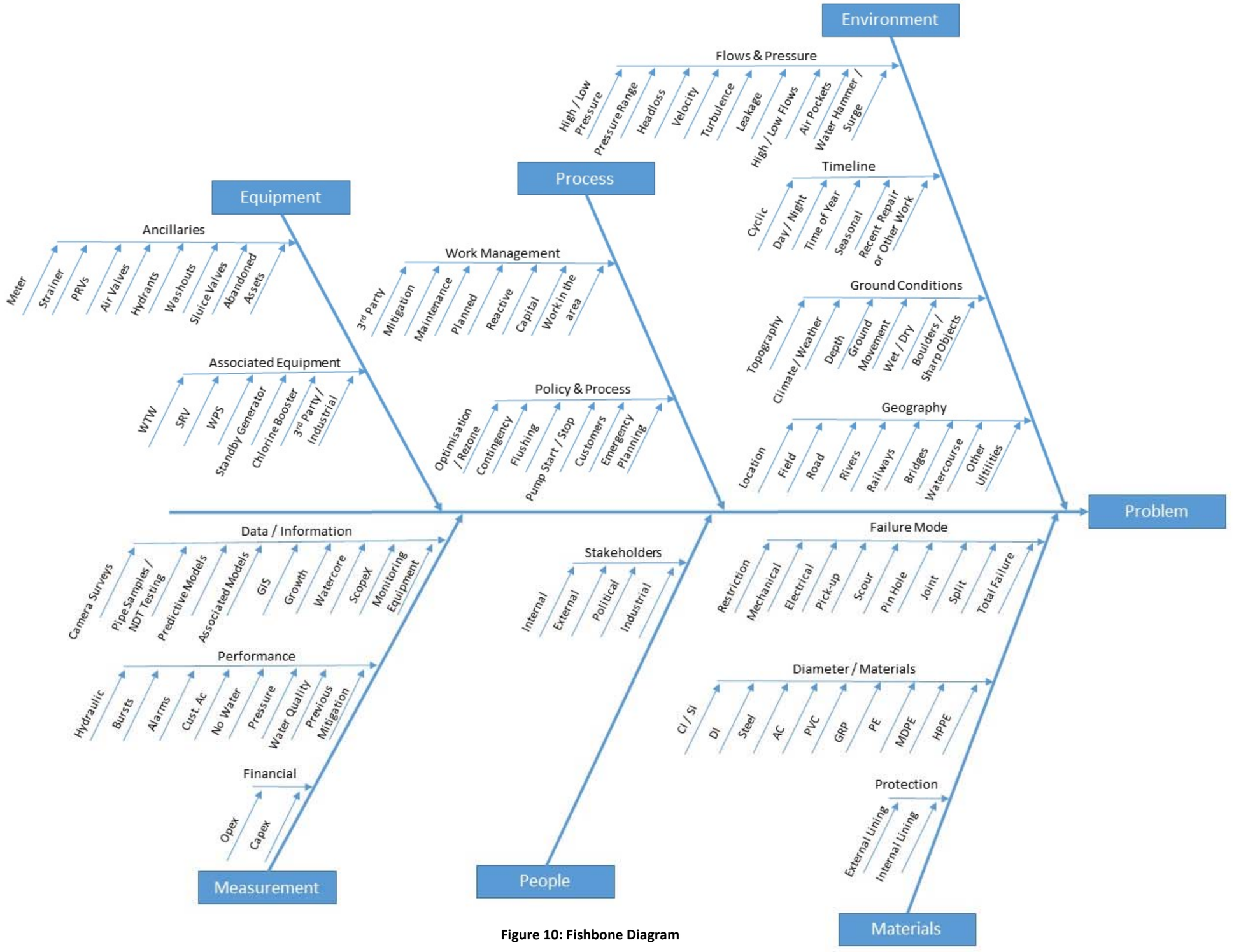


Figure 10: Fishbone Diagram

9 Scheme Selection

9.1 Scheme Types

Each scheme proposed in the Zonal Study has to be feasible and proportionate to long term performance improvements. For example, a trunk main has a low velocity due to its size and is causing dirty water. The system cannot be optimised to increase the flow to a reasonable level. Therefore cleaning is not a viable option so a renewal with a recommendation of downsizing should be promoted. Dŵr Cymru Welsh Water considers eight scheme types, as detailed in **Table 9**. The requirements for each scheme in the schemebook can be found in **Appendix B**.

Scheme Types	Heading and Scheme Colours	Scheme Definitions
Mains Renewal	Orange (R: 247, G: 150, B: 70)	Evidence of deterioration (bursts, NDT testing results, hydraulic restrictions, elevated irons/quality failures, etc).
Mains Cleaning	Green (R: 146, G: 208, B: 80)	Evidence of issues effecting customer acceptability or water quality failures and no evidence of deterioration.
Abandonment	Red (R: 244, G: 0, B: 0)	There is no longer a requirement for an asset in the network.
Pressure Management	Sky Blue (asset circled in red) (R: 102, G: 255, B: 255)	Installing or reconfiguring existing pressure regulating equipment.
Contingency	Blue (asset circled in red) (R: 0, G: 112, B: 192)	Schemes proposed to improve network contingency (XOX (valve, hydrant, valves), fixed jumper hydrants, connecting mains, tanks, pumping stations, etc)
Network Optimisation	Purple (R: 153, G: 0, B: 153)	Air valve installations. Reconfiguration of the operation of the network by altering the sources or trunks that an area is fed from, creating or combining network areas or by reconfiguring the way water flows in a network.
Investigation	Yellow (R: 255, G: 255, B: 0)	Dŵr Cymru Welsh Water to investigate further. An effect can be observed but no evidence can be provided for a root cause. An asset is suspected of being a cause. Developments that cannot be supported or require network alterations are required to be investigation schemes.
Monitoring	Pink (R: 255, G: 51, B: 204)	An area of concern or a potential issue that may impact measures of success.

Table 9: Dŵr Cymru Welsh Water's Scheme Colours and Descriptions

9.2 Scheme Costs

All solutions, unless otherwise stated, are to be costed using the Dŵr Cymru Welsh Water Solution Target Pricing Tool. Standardised costs are applied to the remaining scheme types. This should generate a cost above what would be expected in reality which is taken into account by Dŵr Cymru Welsh Water when assessing which schemes to progress after the final report. It is also recognised that schemes may contains aspects of other scheme types, such as a new link main as a contingency scheme. These are to be costed in the standardised methods for the relevant aspects.

9.2.1 Mains Renewals

All mains renewals are to be costed using the method; open cut urban, all depths and a new long side service connection for each service connected to the asset. The size of the main is to be costed using the existing, or metric equivalent, of the main being replaced. If there is the requirement or opportunity to downsize or upsize the main then this should be noted in the scheme description and scheme sheet but not costed for.

9.2.2 Mains Cleaning

All mains cleaning schemes are to be costed at £35 per meter.

9.2.3 Abandonment

All abandonments are to be costed using the cutting and capping per mains size method as determined in the Solution Target Pricing Tool. If new services are needed the cost as a service in a mains renewal.

9.2.4 Pressure Management

All pressure management schemes are to be costed using the method:
New PRV: £10,800.
Optimising (flow modulation on existing PRV at a meter): £2,500.
Optimising (reducing or increasing a fixed pressure outlet): £500.
These do not include valve operations outside of the PRV complex.

9.2.5 Contingency

To install a new hydrant costs £3,000 and new valve costs are detailed below. These are inclusive of enabling costs and double flow stops.

Valve Size	Cost to Install a Valve
< 100mm	£6,000
100 – 150mm	£12,000
150 – 200mm	£20,000
200 – 450mm	£30,000
450 – 700mm	£71,000
700 – 1000mm	£91,000
> 1000mm	£152,000

9.2.6 Network Optimisation

The PRV optimising costs are stated above and the valve operating costs are detailed below.

Valve Size	Time Required and Hourly Cost	Cost to Plan Work and Operate Valve
< 100mm	4 hours at £40 per hour	£160
100 – 150mm	8 hours at £40 per hour	£320
150 – 200mm	10 hours at £40 per hour	£400
200 – 450mm	16 hours at £40 per hour	£640
450 – 700mm	24 hours at £40 per hour	£960
700 – 1000mm	32 hours at £40 per hour	£1,280
> 1000mm	40 hours at £40 per hour	£1,600

A cost of £104.52 per Ml for 2.5 times the volume of the main if an optimisation will result in flow reversals or for increased demands at the required peak flow. An additional cost of £30 per hour for operations time to flush is required.

9.3 Cost Benefit Analysis

The cost benefit analysis for the proposed interventions utilises an adapted version of the Dŵr Cymru Welsh Water Cost Benefit Methodology, which will be provided for the study. The slight change is that the Dŵr Cymru Welsh Water Cost Benefit Methodology focuses on specific contacts as opposed to potential number of affected customers. By focusing on the risk and not the contacts the Zonal Study is able to more effectively target long term performance. The outputs of the cost benefit methodology give a 'for every £1 spent = £x benefit' for each scheme. This is then plotted on a curve against the cumulative cost of solutions with specific solutions labelled. See **Figure 11** for an example. Solutions are required to be named according to their cost benefit ranking (i.e. 1, 2, 3, etc…) which is to be considerate of interdependencies as described in the cost benefit methodology.

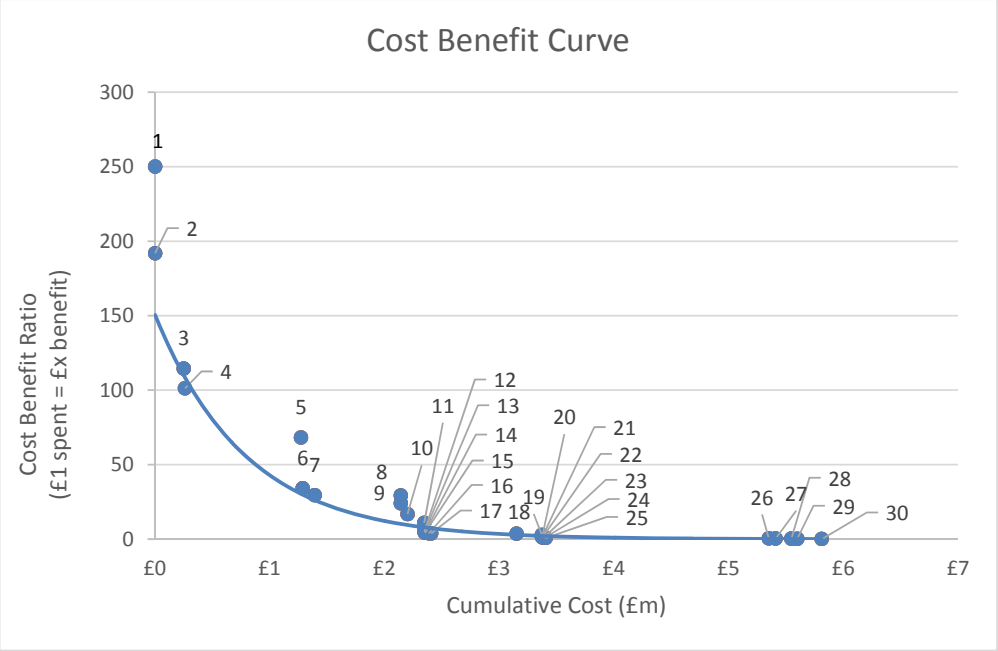


Figure 11: Cost Benefit Curve

In the Scheme Benefits section of the report, below the cost benefit curve, a table of solutions by cumulative cost, in cost benefit ranking order, is required (**Table 10**).

Cumulative Cost (£m)	Solutions	No. of Solutions
0-1	1, 2, 3, 4	4
1-2	5, 6, 7	3
2-3	8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18	11
3-4	19, 20, 21, 22, 23, 24, 25	7
4-5		0
5-6	26, 27, 28, 29, 30	5
Monitoring	31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41	11
Investigation	42, 43, 44, 45, 46, 47, 48	7

Table 10: Optimised Solutions Output

10 Appendix A

10.1 Hydraulic Performance Plots

Create appropriately sized (A3 or A4) hydraulic performance plots for current and future conditions across the below measures. Areas that exceed Dŵr Cymru Welsh Water's minimum and maximum standards, as shown in **Table 3**, are to be annotated with an explaination of the impact. The future plots are to be annotated with any deterioration or improvement and the impact. The hydraulic model for growth accompanies this appendix. See **N10 Merthyr Abercynon Hydraulic Analysis.pdf**.

10.1.1 Minimum and Maximum Pressure

Pressure	Pipe Colour
< 10m	Red
10 – 15m	Orange
15 – 30m	Yellow
30 – 45m	Green
45 – 70m	Blue
> 70m	Black

10.1.2 Pressure Range

Pressure Range	Pipe Colour
< 5 m	Blue
5 – 10 m	Green
10 – 15 m	Yellow
15 – 20 m	Orange
20 – 30 m	Red
> 30 m	Red (double thickness), labelled with pressure range

10.1.3 Maximum Velocity

Pipe Velocity	Pipe Colour
< 0.5 m/s	Blue
0.5 – 1.0 m/s	Green
1.0 – 1.5 m/s	Yellow
1.5 – 2.0 m/s	Orange
2.0 – 3.0 m/s	Red
> 3.0 m/s	Red (double thickness), labelled with velocity

10.1.4 Maximum Headloss

Pipe Headloss Gradient	Pipe Colour
< 1.0 m/km	Blue
1.0 – 2.5 m/km	Green
2.5 – 5.0 m/km	Yellow
5.0 – 10.0 m/km	Orange
10.0 – 20.0 m/km	Red
> 20.0 m/km	Red (double thickness), labelled with headloss gradient

10.1.5 Water Age

Water Age	Pipe Colour
< 24 hrs	Blue
24 – 48 hrs	Green
48 – 72 hrs	Yellow
72 – 96 hrs	Orange
96 – 144 hrs	Red
> 144 hrs	Red (double thickness), labelled with water age

10.1.6 Shear Stress

Shear Stress	Pipe Colour
< 0.01 N/m²	Red
0.01 – 0.1 N/m²	Orange
0.1 – 0.5 N/m²	Yellow
0.5 – 0.9 N/m²	Green
0.9 – 1.5 N/m²	Blue
> 1.5 N/m²	Black

Note the following corrections:

1. *Remove Facilities Annotation and Facilities Color By from the legend,*
2. *An OpenStreetMap background must be used for each plot in a similar fashion to the **P22 Bolton Hill Overview Plot**, and*
3. *LCA boundaries should be featured and coloured as per GIS.*

10.2 Air Valve Analysis

Create an appropriately sized plot for containing the locations of recommended air valve locations. Attach with this an excel file displaying the locations (in BNG and latitude - longitude) and the elevation of the proposed asset and provide a GIS shapefile of the locations, see **Air Valve Analysis.xlsx** and **H24 Air Valve Analysis** attached.

Note the following corrections:

1. *Air valve symbology must be consistent with DCWW GIS (◆ R: 0, G: 92, B: 230),*
2. *An OpenStreetMap background must be used for each plot in a similar fashion to the **P22 Bolton Hill Overview Plot**, and*
3. *LCA boundaries should be featured and coloured as per GIS.*

10.3 Contingency Analysis

Attach an A3 plot of the contingency assessment and an excel file displaying the relevant information required for both the rezoning and tankering assessments, see **Contingency Analysis.xlsx** and **G16 Swansea Morriston Contingency Plots.pdf** attached. Also create GIS shapefiles for the rezoning analysis, tankering points and the polygons for the areas that the tankers supply. The content of the hydraulic assessment must state what actions we would need to take, identifying asset IPIDs and grid references from GIS, and what service customers would receive as a result.

10.4 Chronological Analysis

Please see the attachments **G19 Port Talbot Chronological Analysis** and **G19 Port Talbot Mains Repair Analysis**.

Note that Customer Acceptability has been referred to as discolouration in the Chronological Analysis example. This must consider all of the factors that affect Customer Acceptability and not only discolouration.

10.5 Spatial Analysis

Please see the attachments **G15 Sketty Gower Water Quality Analysis, L21 Abergavenny Cwmtillery Customer Acceptability Analysis, L21 Abergavenny Cwmtillery Customer Minutes Lost Analysis,** and **L45 Rassau Sirhowy Burst Analysis**.

Note the following corrections:

1. *An OpenStreetMap background must be used for each plot in a similar fashion to the **P22 Bolton Hill Overview Plot**, and*
2. *LCA boundaries should be featured and coloured as per GIS.*

10.6 Operations Workshop Plot

Please see the attachments **B10 Anglesey North Operations Workshop Original** and **B10 Anglesey North Operations Workshop Notes**.

11 Appendix B

11.1 Scheme Overview Plot

Please see the attachment **P22 Bolton Hill Overview Plot**.

Note the following corrections:

1. *The legend must be labelled as scheme type not intervention type,*
2. *The legend needs to be updated to the full set of scheme types,*
3. *Abbreviations are not to be used to describe scheme types,*
4. *Water mains must be coloured as per GIS, and*
5. *LCA boundaries should be featured and coloured as per GIS.*

11.2 Schemebook

The Scheme Book has been developed to suit the requirements of Dŵr Cymru Welsh Water. See **Pages 34 - 49**, each box is explained below:

Page 1 - Scheme Summary:

1. WQZ: This is the Water Quality Zone reference number
2. LCA: This is the reference number of the specific Leakage Control Area which contains the solution.
3. LCA Name: This is the name of the Leakage Control Area which contains the solution.
4. Scheme: This is the cost beneficial rank of the scheme and acts as the scheme number.
5. Pressure Management. This is the specific type of scheme.
6. Dŵr Cymru Welsh Water logo and space for contractor logo.
7. Description. Explanation of the root cause, impact and the proposed solution
8. Details about the scheme drivers, benefiting properties and measures of success that are benefited
9. Predecessor Scheme: A scheme on which the success of other schemes relies
10. Dependant Scheme: A scheme that relies on the implementation of a predecessor scheme.
11. Impacts on the measures of success and the cost of the solution.
12. Image of the proposed scheme containing all relevant information (associated contacts, identified assets and network details), using Dŵr Cymru Welsh Water GIS symbology and an OpenStreetMap background.
13. Legend.
14. Coordinates at the location of an asset installation (such as a service reservoir, water pumping station, valve, hydrant, etc.) or the hydraulic start point of a scheme.
15. Partner Ref: This is the unique identifier used by each partner.
16. Date of Production: This is the date that the scheme has been produced.

Page 2 - Scheme Justification:

1. The first six details (top row) are a replication of the first page.
2. Properties on the Main: This is the total properties directly connected to the identified asset.
3. Scheme Length (m): This is the total meterage of the scheme
4. Proposed Mains in Scope: These are specific details of the mains or assets in the scope of the scheme. This can be split into two columns of tables depending on the detail of each scheme.

a. Mains based details are to be summarised in a table by Material, Lining Type, Diameter and Length (m) with a sub total for each material type and a total length for the scheme. This table can be split into two columns if the volume of information is too high to retain in one (as shown on Mains Cleaning and Mains Renewal examples).
b. Valve and hydrant details

5. Total Properties Benefiting: This is the total amount of properties in the benefit polygon of the scheme. It is to be summarised at Leakage Control Area level, if the entire Leakage Control Area benefits, by LCA Ref, LCA Name and LCA No. of Properties. If not all of the LCA will benefit then it is to be summarised at postcode level by Street, Town, Postcode and No. of Properties. This can be split into two columns of tables depending on the detail. On all tables the total number of properties benefiting is to be stated.
6. Burst History: Details are to be summarised in a table by Job Number, Burst Date, Cause Code and Mains IPID for the scheme.
7. Attributable Water Quality and Customer Contact History: The Study Period (3 yrs) informs the investment and the scoring, the Historic (3-5 yrs) is just for information to the reader.

11.3 GIS Shapefiles

Shapefiles must be produced by scheme type for:

1. The scheme details, containing asset information, and
2. The risk polygons of the area affected by each scheme.

11.4 Needs Scoring Sheet

See the **Zonal Studies Needs Scoring Sheet.xlsx**. This spreadsheet summarises all the scheme justification information required to rapidly input schemes into Investment Manager and progress them through the Capital Gateway Process. It also contains information that necessary for internal reporting purposes.

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Mains Cleaning** Dŵr Cymru Welsh Water

Description:

Scheme Driver:
No. of props benefited:
Benefits:

Dependent Scheme:
Predecessor Scheme:

Leakage Benefit (ML/d):
Burst Benefit (no./km/yr):
Props at Risk Benefit (no.):

CML Benefit (mins/cust/yr):
Customer Aceptability Benefit (complaints/1000pop/yr):

Cost (£k):
Quality Benefit (PCV failures per yr):

Legend
(Items are not to scale)

- Customer Acceptability Complaint (with volume)
- Reliability of Supply Complaint (with volume)
- Low Pressure Compliant (with volume)
- High Pressure Compliant (with volume)
- PCV Failure
- Threshold Failure (TLV)
- At Risk' Customer
- New or adjusted assets (PRVs, valves, hydrants, XOXs, etc.) use DCWW symbology circled in red

All other symbols use standard DCWW GIS symbology

Coordinates: 254146, 201770

Partner Ref: MC_251436D1_01

Date of Production: 13/09/2017

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Mains Cleaning** Dŵr Cymru Welsh Water

Properties on the Main: 100 **Total Scheme Length (m):** 3894

Proposed Mains in Scope

Material	Lining Type	Diameter	Length (m)
AC	Unknown	102	272
AC	Unknown	76	170
		AC Total	**442**
CI	Cement Mortar	90	3452
		CI Total	**3452**
		Scheme Total Length	**3894**

Material	Lining Type	Diameter	Length (m)
AC	Unknown	102	272
AC	Unknown	76	170
		AC Total	**442**
CI	Cement Mortar	90	1151
CI	Cement Mortar	90	1151
CI	Cement Mortar	90	1151
		CI Total	**3453**

Material	Lining Type	Diameter	Length (m)
uPVC	Unknown	102	272
uPVC	Unknown	76	170
		uPVC Total	**442**
DI	Cement Mortar	90	3452
		DI Total	**3452**
		Scheme Total Length	**7789**

Total Properties Benefiting

LCA Ref	LCA Name	LCA No. of Properties
251427D1	Alexandra Road	869
251438D1	Dafen Ind. Est	2217
	Total Number of Properties Benefiting:	**3086**

Street	Town	Postcode	Props.
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XB	15
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1

Street	Town	Postcode	Props.
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	2
	Total Number of Props Benefiting:		**3894**

Burst History

Job Number	Burst Date	Cause Code	Mains IPID

Attributable Water Quality and Customer Contact History

	Study Period (3 yrs)	Historic (3-5yrs)
Linked Acceptability Contact		
Linked No Water Contact		
Linked WQ PCV Failure		

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Mains Renewal** Dŵr Cymru Welsh Water

Description:

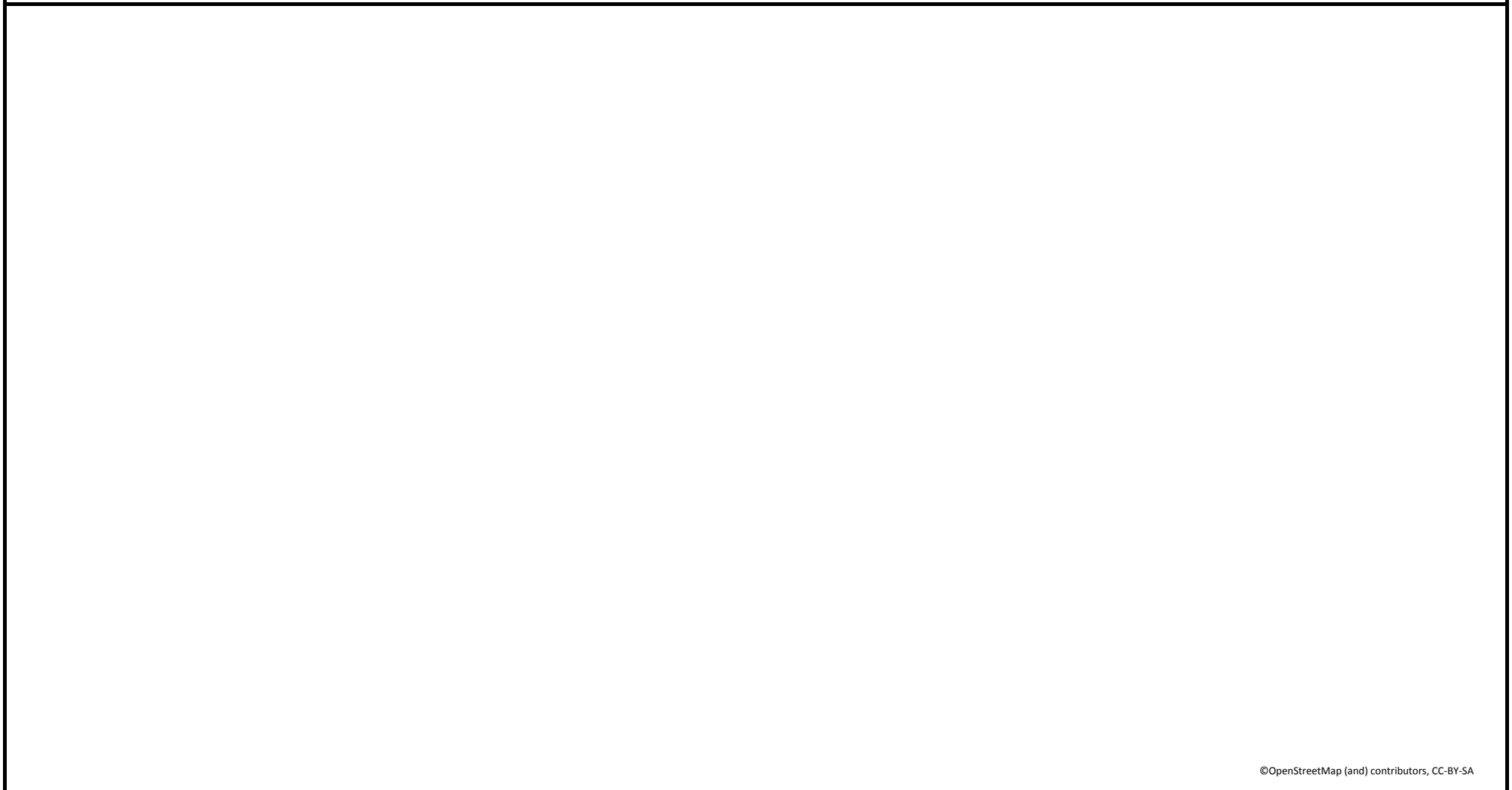
Scheme Driver:
No. of props benefited:
Benefits:

Dependent Scheme:
Predecessor Scheme:

Leakage Benefit (ML/d):
Burst Benefit (no./km/yr):
Props at Risk Benefit (no.):

CML Benefit (mins/cust/yr):
Customer Aceptability Benefit (complaints/1000pop/yr):

Cost (£k):
Quality Benefit (PCV failures per yr):



Legend
(Items are not to scale)

- Customer Acceptability Complaint (with volume)
- Reliability of Supply Complaint (with volume)
- Low Pressure Compliant (with volume)
- High Pressure Compliant (with volume)
- PCV Failure
- Threshold Failure (TLV)
- At Risk' Customer
- New or adjusted assets (PRVs, valves, hydrants, XOXs, etc.) use DCWW symbology circled in red

All other symbols use standard DCWW GIS symbology

Coordinates: 254146, 201770

Partner Ref: MR_251436D1_01

Date of Production: 13/09/2017

WQZ: | **LCA Ref:** | **LCA Name:** | **Scheme:** | **Mains Renewal** | Dŵr Cymru Welsh Water

Properties on the Main: 100 **Total Scheme Length (m):** 3894

Proposed Mains in Scope

Material	Lining Type	Diameter	Length (m)
AC	Unknown	102	272
AC	Unknown	76	170
		AC Total	**442**
CI	Cement Mortar	90	3452
		CI Total	**3452**
		Scheme Total Length	**3894**

Material	Lining Type	Diameter	Length (m)
AC	Unknown	102	272
AC	Unknown	76	170
		AC Total	**442**
CI	Cement Mortar	90	1151
CI	Cement Mortar	90	1151
CI	Cement Mortar	90	1151
		CI Total	**3453**

Material	Lining Type	Diameter	Length (m)
uPVC	Unknown	102	272
uPVC	Unknown	76	170
		uPVC Total	**442**
DI	Cement Mortar	90	3452
		DI Total	**3452**
		Scheme Total Length	**7789**

Total Properties Benefiting

LCA Ref	LCA Name	LCA No. of Properties
251427D1	Alexandra Road	869
251438D1	Dafen Ind. Est	2217
	Total Number of Properties Benefiting:	**3086**

Street	Town	Postcode	Props.
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XB	15
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1

Street	Town	Postcode	Props.
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	1
Hendy	Pontarddulais	SA4 0XY	2
	Total Number of Props Benefiting:		**3894**

Burst History

Job Number	Burst Date	Cause Code	Mains IPID

Attributable Water Quality and Customer Contact History

	Study Period (3 yrs)	Historic (3-5yrs)
Linked Acceptability Contact		
Linked No Water Contact		
Linked WQ PCV Failure		

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Abandonment** Dŵr Cymru Welsh Water

Description:

Scheme Driver:
No. of props benefited:
Benefits:

Dependent Scheme:
Predecessor Scheme:

Leakage Benefit (ML/d):
Burst Benefit (no./km/yr):
Props at Risk Benefit (no.):

CML Benefit (mins/cust/yr):
Customer Aceptability Benefit (complaints/1000pop/yr):

Cost (£k):
Quality Benefit (PCV failures per yr):

Legend
(Items are not to scale)

- Customer Acceptability Complaint (with volume)
- Reliability of Supply Complaint (with volume)
- Low Pressure Compliant (with volume)
- High Pressure Compliant (with volume)
- PCV Failure
- Threshold Failure (TLV)
- At Risk' Customer
- New or adjusted assets (PRVs, valves, hydrants, XOXs, etc.) use DCWW symbology circled in red

All other symbols use standard DCWW GIS symbology

Coordinates: 254146, 201770

Partner Ref: AB_251436D1_01

Date of Production: 13/09/2017

WQZ: | LCA Ref: | LCA Name: | Scheme: | Abandonment | Dŵr Cymru Welsh Water

Properties on the Main: 100 **Total Scheme Length (m):** 3894

Proposed Mains in Scope

Material	Lining Type	Diameter	Length (m)
AC	Unknown	102	272
AC	Unknown	76	170
		AC Total	**442**
CI	Cement Mortar	90	3452
		CI Total	**3452**
		Scheme Total Length	**3894**

Proposed Assets in Scope

Asset Description	Asset ID	Diameter			X	Y
Darren SRV	292373	350	AC	1946	248423	190015

Total Properties Benefiting

LCA Ref	LCA Name	LCA No. of Properties
251427D1	Alexandra Road	869
251438D1	Dafen Ind. Est	2217
	Total Number of Properties Benefiting:	**3086**

Burst History

Job Number	Burst Date	Cause Code	Mains IPID

Attributable Water Quality and Customer Contact History

	Study Period (3 yrs)	Historic (3-5yrs)
Linked Acceptability Contact		
Linked No Water Contact		
Linked WQ PCV Failure		

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Pressure Management** Dŵr Cymru Welsh Water

Description:

Scheme Driver:
No. of props benefited:
Benefits:

Dependent Scheme:
Predecessor Scheme:

Leakage Benefit (ML/d):
Burst Benefit (no./km/yr):
Props at Risk Benefit (no.):

CML Benefit (mins/cust/yr):
Customer Aceptability Benefit (complaints/1000pop/yr):

Cost (£k):
Quality Benefit (PCV failures per yr):

Legend
(Items are not to scale)

- Customer Acceptability Complaint (with volume)
- Reliability of Supply Complaint (with volume)
- Low Pressure Compliant (with volume)
- High Pressure Compliant (with volume)
- PCV Failure
- Threshold Failure (TLV)
- At Risk' Customer
- New or adjusted assets (PRVs, valves, hydrants, XOXs, etc.) use DCWW symbology circled in red

All other symbols use standard DCWW GIS symbology

Coordinates: 254146, 201770

Partner Ref: AB_251436D1_01

Date of Production: 13/09/2017

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Pressure Management** Dŵr Cymru Welsh Water

Properties on the Main: 100 **Total Scheme Length (m):** 300

Proposed Alter / New PRVs

Asset Description	Mains IPID	Diameter			X	Y
New PRV set at 20m	292373	152	AC	1946	248423	190015
Set existing PRV to 20m	292373	152	AC	1946	248423	190015

Proposed Alter / New WPS

Asset Description	Asset ID	Diameter			X	Y
New WPS set at 50m out	292373	152	AC	1946	248423	190015

Total Properties Benefiting

LCA Ref	LCA Name	LCA No. of Properties
251427D1	Alexandra Road	869
251438D1	Dafen Ind. Est	2217
	Total Number of Properties Benefiting:	**3086**

Burst History

Job Number	Burst Date	Cause Code	Mains IPID

Attributable Water Quality and Customer Contact History

	Study Period (3 yrs)	Historic (3-5yrs)
Linked Acceptability Contact		
Linked No Water Contact		
Linked WQ PCV Failure		

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Contingency**

Dŵr Cymru Welsh Water

Description:

Scheme Driver:
No. of props benefited: From 3086 to 1025
Benefits:

Dependent Scheme:
Predecessor Scheme:

Leakage Benefit (ML/d):
Burst Benefit (no./km/yr):
Props at Risk Benefit (no.):

CML Benefit (mins/cust/yr):
Customer Aceptability Benefit (complaints/1000pop/yr):

Cost (£k):
Quality Benefit (PCV failures per yr):

Legend
(Items are not to scale)

- Customer Acceptability Complaint (with volume)
- Reliability of Supply Complaint (with volume)
- Low Pressure Compliant (with volume)
- High Pressure Compliant (with volume)
- PCV Failure
- Threshold Failure (TLV)
- At Risk' Customer
- New or adjusted assets (PRVs, valves, hydrants, XOXs, etc.) use DCWW symbology circled in red

All other symbols use standard DCWW GIS symbology

Coordinates: 254146, 201770

Partner Ref: CO_251436D1_01

Date of Production: 13/09/2017

WQZ: | LCA Ref: | LCA Name: | Scheme: | Contingency | Dŵr Cymru Welsh Water

Properties on the Main: 100 **Total Scheme Length (m):** 442

Proposed New Valves

Asset Description	Mains IPID	Diameter			X	Y
New Open Valve	292373	152	AC	1946	248423	190015
New Closed Valve	292374	152	CI (Cement Mortar)	1930	248423	190015

Proposed New Hydrants

Asset Description	Mains IPID	Diameter			X	Y
New Hydrant	292373	152	AC	1946	248423	190015

Proposed New PRVs

Asset Description	Mains IPID	Diameter			X	Y
New PRV set at 20m	292373	152	AC	1946	248423	190015

Proposed New Mains

Material	Lining Type	Diameter	Length (m)
MDPE	None	90	442
		Scheme Total	**442**

Total Properties Benefiting

LCA Ref	LCA Name	LCA No. of Properties
251427D1	Alexandra Road	869
251438D1	Dafen Ind. Est	2217
	Total Number of Properties Benefiting:	**3086**

Burst History

Job Number	Burst Date	Cause Code	Mains IPID

Attributable Water Quality and Customer Contact History

	Study Period (3 yrs)	Historic (3-5yrs)
Linked Acceptability Contact		
Linked No Water Contact		
Linked WQ PCV Failure		

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Network Optimisation** Dŵr Cymru Welsh Water

Description:

Scheme Driver:
No. of props benefited:
Benefits:

Dependent Scheme:
Predecessor Scheme:

Leakage Benefit (ML/d):
Burst Benefit (no./km/yr):
Props at Risk Benefit (no.):

CML Benefit (mins/cust/yr):
Customer Aceptability Benefit (complaints/1000pop/yr):

Cost (£k):
Quality Benefit (PCV failures per yr):

Legend
(Items are not to scale)

- Customer Acceptability Complaint (with volume)
- Reliability of Supply Complaint (with volume)
- Low Pressure Compliant (with volume)
- High Pressure Compliant (with volume)
- PCV Failure
- Threshold Failure (TLV)
- At Risk' Customer
- New or adjusted assets (PRVs, valves, hydrants, XOXs, etc.) use DCWW symbology circled in red

All other symbols use standard DCWW GIS symbology

Coordinates: 254146, 201770

Partner Ref: NO_251436D1_01

Date of Production: 13/09/2017

WQZ: | LCA Ref: | LCA Name: | Scheme: | Network Optimisation | Dŵr Cymru Welsh Water

Properties on the Main: 100 **Total Scheme Length (m):** 3894

Proposed Mains in Scope

Material	Lining Type	Diameter	Length (m)
AC	Unknown	102	272
AC	Unknown	76	170
		AC Total	**442**
CI	Cement Mortar	90	3452
		CI Total	**3452**
		Scheme Total Length	**3894**

Proposed Valves in Scope

Asset Description	Mains IPID	Diameter			X	Y
Open Valve	292373	152	AC	1946	248423	190015
Close Valve	292374	152	CI (Cement Mortar)	1930	248423	190015

Proposed PRVs in Scope

Asset Description	Mains IPID	Diameter			X	Y
Set existing PRV to 20m	292373	152	AC	1946	248423	190015

Proposed Assets in Scope

Asset Description	Asset ID	Diameter			X	Y
Set WPS to 50m outlet	292373	152	AC	1946	248423	190015

Total Properties Benefiting

LCA Ref	LCA Name	LCA No. of Properties
251427D1	Alexandra Road	869
251438D1	Dafen Ind. Est	2217
	Total Number of Properties Benefiting:	**3086**

Burst History

Job Number	Burst Date	Cause Code	Mains IPID

Attributable Water Quality and Customer Contact History

	Study Period (3 yrs)	Historic (3-5yrs)
Linked Acceptability Contact		
Linked No Water Contact		
Linked WQ PCV Failure		

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Investigation**

Dŵr Cymru Welsh Water

Description:

Scheme Driver:
No. of props benefited:
Benefits:

Dependent Scheme:
Predecessor Scheme:

Leakage Benefit (ML/d):
Burst Benefit (no./km/yr):
Props at Risk Benefit (no.):

CML Benefit (mins/cust/yr):
Customer Aceptability Benefit (complaints/1000pop/yr):

Cost (£k):
Quality Benefit (PCV failures per yr):

Legend
(Items are not to scale)

- Customer Acceptability Complaint (with volume)
- Reliability of Supply Complaint (with volume)
- Low Pressure Compliant (with volume)
- High Pressure Compliant (with volume)
- PCV Failure
- Threshold Failure (TLV)
- At Risk' Customer
- New or adjusted assets (PRVs, valves, hydrants, XOXs, etc.) use DCWW symbology circled in red

All other symbols use standard DCWW GIS symbology

Coordinates: 254146, 201770

Partner Ref: IN_251436D1_01

Date of Production: 13/09/2017

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Investigation** Dŵr Cymru Welsh Water

Properties on the Main: 100 **Total Scheme Length (m):** 3894

Proposed Mains in Scope

Material	Lining Type	Diameter	Length (m)
AC	Unknown	102	272
AC	Unknown	76	170
		AC Total	**442**
CI	Cement Mortar	90	3452
		CI Total	**3452**
		Scheme Total Length	**3894**

Total Properties Benefiting

LCA Ref	LCA Name	LCA No. of Properties
251427D1	Alexandra Road	869
251438D1	Dafen Ind. Est	2217
	Total Number of Properties Benefiting:	**3086**

Burst History

Job Number	Burst Date	Cause Code	Mains IPID

Attributable Water Quality and Customer Contact History

	Study Period (3 yrs)	Historic (3-5yrs)
Linked Acceptability Contact		
Linked No Water Contact		
Linked WQ PCV Failure		

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Monitoring** Dŵr Cymru Welsh Water

Description:

Scheme Driver:
No. of props benefited:
Benefits:

Dependent Scheme:
Predecessor Scheme:

Leakage Benefit (ML/d):
Burst Benefit (no./km/yr):
Props at Risk Benefit (no.):

CML Benefit (mins/cust/yr):
Customer Aceptability Benefit (complaints/1000pop/yr):

Cost (£k):
Quality Benefit (PCV failures per yr):

Legend
(Items are not to scale)

- Customer Acceptability Complaint (with volume)
- Reliability of Supply Complaint (with volume)
- Low Pressure Compliant (with volume)
- High Pressure Compliant (with volume)
- PCV Failure
- Threshold Failure (TLV)
- At Risk' Customer
- New or adjusted assets (PRVs, valves, hydrants, XOXs, etc.) use DCWW symbology circled in red

All other symbols use standard DCWW GIS symbology

Coordinates: 254146, 201770

Partner Ref: MO_251436D1_01

Date of Production: 13/09/2017

WQZ: **LCA Ref:** **LCA Name:** **Scheme:** **Monitoring** Dŵr Cymru Welsh Water

Properties on the Main: 100 **Total Scheme Length (m):** 3894

Proposed Mains in Scope

Material	Lining Type	Diameter	Length (m)
AC	Unknown	102	272
AC	Unknown	76	170
		AC Total	**442**
CI	Cement Mortar	90	3452
		CI Total	**3452**
		Scheme Total Length	**3894**

Total Properties Benefiting

LCA Ref	LCA Name	LCA No. of Properties
251427D1	Alexandra Road	869
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	Total Number of Properties Benefiting:	**3086**

Burst History

Job Number	Burst Date	Cause Code	Mains IPID

Attributable Water Quality and Customer Contact History

	Study Period (3 yrs)	Historic (3-5yrs)
Linked Acceptability Contact		
Linked No Water Contact		
Linked WQ PCV Failure		

12 Appendix C

- Zonal Study Summary Report (Should not exceed 5-6 pages).
  - Cover Page.
  - Introduction – What is a Zonal Study and why has this zone been selected
    - Study Area Issues Summary – An overview of the main factors influencing performance within the study area.
  - Study Area – Brief description of the study area, the network and how it is supplied, customers served, seasonal or user driven large demand changes and elevation variances. Include a figure of the study area.
  - Solutions – A solutions and scheme benefit summary (including benefits table, cost benefit curve and optimised solutions output table).

13 Review and Finalise Reports

13.1 Report Structure

Executive Summary Brief outline of the report and a summary of conclusions and recommendations

Introduction A general introduction including the purpose of the study, performance and targets against measures of success (use **Table 1**), Key drivers and deliverables.

Study Area Description A detailed description of the study area from source to tap.

Root Cause Analysis Detailed review of the hydraulic, statistical and risk analyses.

Solutions Summary A summary of the solutions identified, accompanied by an overview plot, and detail for any non-standard analyses or solutions.

Scheme Benefits Detailed conclusions covering an overview of the impacts on the measures of success, highlighting of other issues, scheme benefits summary, predicted performance improvement and the cost benefit analysis.

Appendix A Hydraulic Analysis, Air Valve Analysis, Contingency Analysis and Shapefiles, Chronological Analysis, Spatial Analysis and Ops Workshop Plots.

Appendix B Scheme Overview Plot, Schemebook, Scheme GIS Shapefiles, Needs Scoring Sheet.

Appendix C Executive Summary Report

13.2 Reporting Standards

Parameter	Details	Example/Notes/Actions
Attachment Names	Draft and Final Report Summary Report Growth Model Air Valve Analysis Contingency Analysis Contingency Shapefiles Needs Scoring Sheet Shapefiles	WQZ Ref WQZ Name Draft/Final Zonal Study Report WQZ Ref WQZ Name Zonal Study Summary Report WQZ Ref WQZ Name Growth Model MDD WQZ Ref WQZ Name Air Valve Analysis.xlsx WQZ Ref WQZ Name Contingency Analysis.xlsx WQZ Ref WQZ Name Tankering Points/Supply Area Polygons WQZ Ref WQZ Name Needs Scoring Sheet WQZ Ref WQZ Name Scheme Type Points/Lines/Polygons
Boundary / Location Name	Water Quality Zone District Metered Area Leakage Control Area	WQZ Reference WQZ Name DMA Name (DMA Reference) LCA Name (LCA Reference)
Unsuitable Assets / Asset Operation	GRP Mains Ball Valves Manual Chlorine Dosing SRV Retention >48 hours Abandoned assets not severed from the system	Replace / Abandon Change Controller Automated Dosing Optimise the tank/supplied areas or abandon if not needed. Abandon
Acronyms	All	To be avoided as much as reasonably possible

13.3 Review Sessions

13.3.1 Draft Review

The operations review meeting follows the issuing of the Draft Zonal Study Report. The aim of this meeting is to ensure that the Final Zonal Study Report is sufficiently accurate to enable the sign off of the report and the progression of the proposed solutions through the capital gateway process. The meeting will highlight any inaccuracies that may have been featured in the report and will review proposed solutions.

Operations Review Meeting attendees to include, but not restricted to:

- Water Assets representative to chair
- Asset Performance Manager
- Water Asset Engineers and Technicians
- Distribution Manager
- Network Analyst
- Operations Supervisor, Inspectors and Technicians
- Leakage Manager, Supervisor and Technician (upstream and downstream losses)
- Catchment Scientist
- ME&I Supervisor
- Production Operations Supervisor and Engineers
- Process Scientist
- Water Quality Scientist
- Network and Production Risk Managers
- Hydraulic Modelling Team Representative
- Developer Services Representative
- Capital Delivery Representative
- Framework Partner

Outline agenda:

- Attendee introductions and an introduction to the Zonal Study Report (5 mins).
- The framework partner will present the report and its findings covering off the following points on a chapter by chapter basis (30 mins):
    - What does the chapter aim to achieve
    - What analysis was conducted
    - Key points that the analysis displayed
- The framework partner will then present the Scheme Book and the root causes each scheme targets (60 mins).
- AOB and meeting close out (5 mins)

Alterations made to the report and the schemes following the review process are to be documented. This document is to be provided with the final report.

13.3.2 Final Review

The signoff meeting is the final stage of the Zonal Study review. The aim of this meeting is to gain the approval of the report, its findings and the proposed solutions. This will enable the implementation of the proposed solutions through the capital gateway process.

Attendees to include, but not restricted to:

- Water Assets Network Lead
- Asset Performance Manager
- Water Asset Engineers
- Network Analyst
- Distribution Manager
- Head of Distribution
- Head of Water Assets
- Head of Capital Delivery
- Hydraulic Modelling Manager
- Capital Delivery Manager
- Framework Partner

Agenda

- Attendee introductions and an introduction to the Zonal Study Report (5 mins)
- Review the report and its findings against the draft review (40 mins)
- The framework partner will then present the Scheme Book and the root causes each scheme targets (40 mins).
- Signoff the report:
    - Asset Performance Manager
    - Distribution Manager
    - Head of Distribution

14 Project Management and Timescales

Dŵr Cymru Welsh Water project roles are allocated at the outset of each Zonal Study accompanied by relevant contact information. Any enquiries regarding the project are to be directed to the named Dŵr Cymru Welsh Water Project Manager. A project schedule is provided in **Table 11** (this only provides example allocated time and not specific dates).

Milestone	Time Allocated (Weeks)	Cumulative Time (Weeks)
Project award and commencement	-	-
Data collection and verification	1	1
Statistical analysis	3	4
Hydraulic analysis	3	7
Operations workshop	1	8
Root cause analysis	1	9
Solution development	4	13
Draft report with all supporting information	1	14
Review meeting	2	16
Final report with all supporting information	1	17
Project sign off	1	18

Table 11: Project Schedule

This is to be presented in a format similar to the below Gantt Chart (**Figure 12**) inclusive of the modelling activities relevant to the study area.

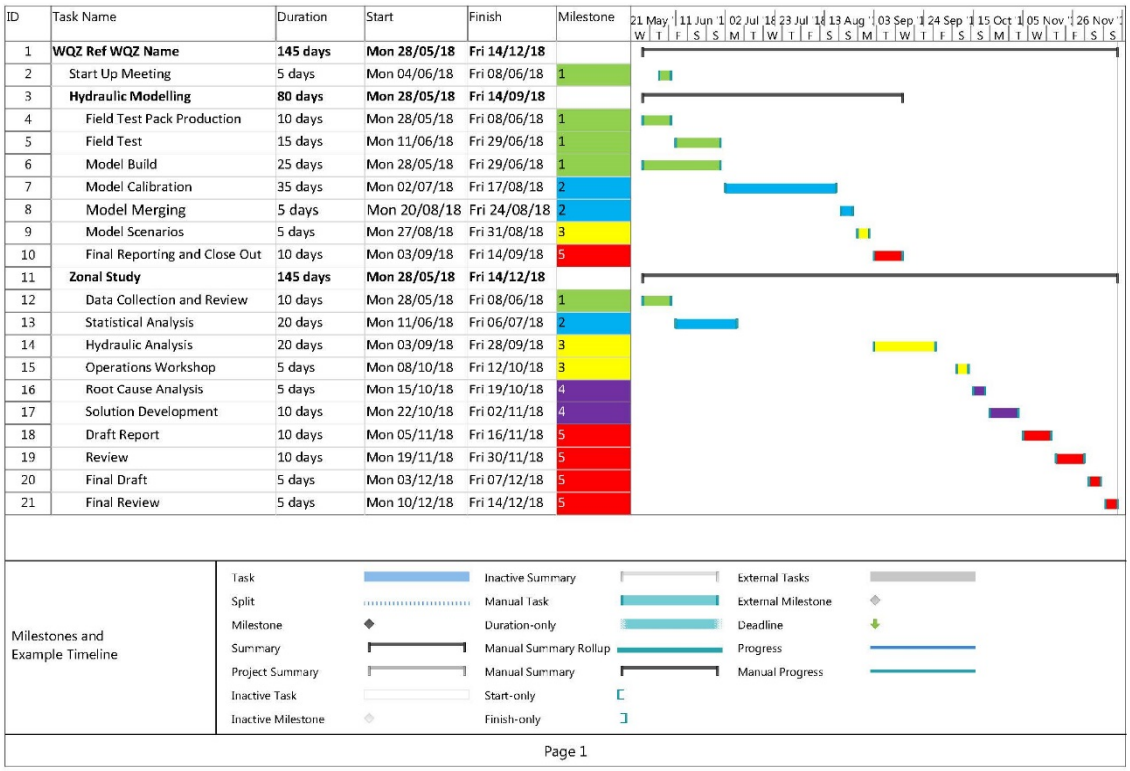

Figure 12: Example Gantt Chart

The schedule provided should be achievable with adequate resource assigned to deliver the project requirements. At the outset of each project, the framework partner must identity the team responsible for completion, using an organogram. Detail should be provided around how each resource will be allocated, and for what percentage of the element, through the project Gantt chart. This will also be accompanied with a profile of spend for the duration of the project. Any changes to these should be clearly communicated prior to change.

14.1 Progress Reporting

The project plan will be used to inform progress reporting between the Framework Partner and the Dŵr Cymru Welsh Water Project Manager, based around key activities. Additional meetings can be called at the discretion of the Dŵr Cymru Welsh Water Project Manager. The Framework Partner is responsible for taking minutes at all meetings which must be issued in less than 2 working days of the date of the meeting. Dŵr Cymru Welsh Water will provide a minutes template to be followed with this document. All meetings will be informed by the project plan. Issue and opportunity reporting is not restricted to these forums and is encouraged through regular contact with the Project Manager.

14.1.1 Weekly Conference Calls

Weekly conference calls are to be held to discuss the day to day progress of the project, to identify risks and opportunities and to take appropriate action to ensure the success of the project. The date, time and duration of the calls is to be determined by the Dŵr Cymru Welsh Water Project Manager at the outset of the project. The Framework Partner must issue the agenda, with detail on each topic to be covered, 24 hours in advance of the call.

14.1.2 Milestone Meetings

Milestone meetings will be determined by the Dŵr Cymru Welsh Water Project Manager at the outset of the project. This meeting will focus on the accuracy and quality of specific elements of work. The Framework Partner must provide the relevant outputs for review prior to the meeting. Once all elements of the milestone have been completed and accepted, and issues have been rectified, the partner is cleared to continue onto the next stage and invoice for the work conducted as part of the milestone.

Milestone	Budget Release	Hydraulic Modelling Contents	Zonal Studies Contents
1	15%	Start Up Meeting Field Test Pack Production Field Test Model Build	Data Collection and Review
2	15%	Model Calibration Model Merging	Statistical Analysis
3	15%	Model Scenarios	Hydraulic Analysis Operations Workshop
4	15%		Root Cause Analysis Solutions Development
5	40%	Final Reporting and Close Out	Draft Report Draft Review Final Draft Final Review Head of Service Sign Off

A milestone report is also to be issued detailing the work conducted during the milestones, the issues encountered and how they were resolved and opportunities for improvement.

14.2 Payments

A PO set up by DCWW at the project start up. Payments are to be made on a milestone basis upon satisfactory completion of all work within the milestone (as detailed in **14.1.2**). Invoices are to follow the format provided by DCWW with expenses for each project to be detailed.

14.3 Project Close out

The project will be formally closed, and the final invoice will be paid, following the business acceptance of the Zonal Study and Hydraulic Model. The PO will be closed at this stage.

14.4 Performance Monitoring

Monitoring of performance will be conducted at the end of each milestone and project. Each partner will be scored against the below criteria and will be given feedback on their performance. Poor performance will affect the awarding of any future work.

Performance Area	Performance Criteria	Suppliers Score	Notes
1 Resource	Provision and availability of appropriate resource		
	Provision and availability of appropriate equipment		
	Average : Resource		
2 Delivery & Finance	Delivery of ordered work against schedule		
	Quality of project management		
	Cost		
	Average : Delivery		
3 Quality	Quality of deliverables		
	Quality of progress reporting		
	Required rework		
	Average : Quality		
4 Relationship	Understanding client needs		
	Communication		
	Honesty and openness		
	Problem solving and resolution		
	Average : Relationship		
	Total		

Suppliers Scoring Criteria			
Below	Achieved	Exceeded	Outstanding
1	2	3	4
The partner has not completed the majority of their objectives and has not consistently performed at the standard expected.	The partner has completed all of their objectives and/or has consistently performed at the standard expected.	The partner has completed all of their objectives, added value through their contribution, and has consistently performed above the standard expected.	The partner has achieved outstanding results against all of their objectives through exceptional contribution and consistently performed far beyond the standard expected; through the addition of value and innovation.

15 Data Sources

Where possible data is to be used from business as usual processes to minimise duplicated effort. As information changes overtime always ensure that the most up to date methodology, specifications and information sources are being used. If any issues with data collection are experienced contact the named Dŵr Cymru Welsh Water Project Manager

Category	Data - Description	Source	Sourced By
AIM Deterioration Modelling Outputs and Asset Condition Data	Trunk AIM Data	Asset Strategy	DCWW
	Distribution AIM Data	Asset Strategy	DCWW
	Non-infrastructure AIM Data	Asset Strategy	DCWW
	Service Reservoir condition data	SRV Benchmarking Matrix	DCWW
AMP6 MoS Figures and Performance	MoS Figures and WQZ Performance and Targets	Tableau	DCWW
	CML Performance	Tableau	DCWW
	Customer Acceptability Performance	Tableau	DCWW
	Water Quality Performance	Tableau	DCWW
	Asset Performance Data (unplanned maintenance)	Tableau	DCWW
At Risk Customers	At Risk Customers	Water Compliance	DCWW
Capital Delivery Tracker	AMP6 Schemes and Shapefiles	Infozone	DCWW
DG2 Register	DG2 Register	Water Compliance	DCWW
Drought Measures Report	Appendix 1 – Water Resource Zone Summaries	Dŵr Cymru Welsh Water Website	DCWW
Drinking Water Safety Plans	Catchments	Investment Manager	DCWW
	Water Treatment Works	Investment Manager	DCWW
	Networks	Investment Manager	DCWW
	Service Reservoirs	Investment Manager	DCWW
DWI Events	Index of DWI Events and Actions	Water Assets	DCWW
Cost Benefit Analysis	Cost Benefit Methodology for Zonal Studies V4	Water Assets	DCWW
Customer Complaints and Quality Data Shapefiles	Quality Sample Data	QDB	DCWW
	Customer Complaint (Quality)	GIS	Framework Partner
	Customer Complaint (Interruption)	GIS	Framework Partner
	Customer Complaint (Low Pressure)	GIS	Framework Partner
	Customer Complaint (High Pressure)	GIS	Framework Partner
	DG7 Customers	GIS	Framework Partner
Network Shapefiles	Cl. Boundary Valves	GIS	Framework Partner
	Cl. Pipe Repairs	GIS	Framework Partner
	Cl. Control Valves	GIS	Framework Partner
	Cl. Hydrants	GIS	Framework Partner
	Cl. Meter	GIS	Framework Partner
	Cl. Network Structure	GIS	Framework Partner
	Cl. System Valves (Distribution)	GIS	Framework Partner
	Cl. System Valves (Trunk)	GIS	Framework Partner
	Cl. Water Main	GIS	Framework Partner

	Water Quality Zone	GIS	Framework Partner
	DMA	GIS	Framework Partner
	LCA	GIS	Framework Partner
	Postcode	GIS	Framework Partner
	Customer Info	GIS	Framework Partner
	Seeded Properties	GIS	Framework Partner
	Lidar	GIS Team	DCWW
Background Layers	OS OpenMap Local	GIS	Framework Partner
	OpenStreetMap	Open Street Map	Framework Partner
Growth	Local Development Plans	Local Authority	Framework Partner
	Committed Sites	Developer Services	DCWW
	Joint Housing Land Availability	Developer Services	DCWW
	Infill	Developer Services	DCWW
	Development Plans - Objections	Developer Services	DCWW
	Dŵr Cymru Welsh Water Clean Water Hydraulic Modelling Specification	Hydraulic Modelling Team	DCWW
Investment Manager Reports	WQZ Risks Report	Investment Manager	DCWW
	WQZ Needs Report	Investment Manager	DCWW
	WQZ Solutions Report	Investment Manager	DCWW
IMS Documents	Water Treatment Works	Infozone	Framework Partner
	Service Reservoirs	Infozone	Framework Partner
	Water Pumping Stations	Infozone	Framework Partner
Leakage Spreadsheet	DMA Leakage Performance and Targets	Water Demand Management Team	DCWW
Hydraulic Models and Reports	Calibrated, BDD and MDD	Hydraulic Modelling Team	DCWW
Quality Sample Data	Data for all determinands / parameters	Water Assets	DCWW
Reactive Activity	High frequency alarm analysis conclusions	Smart Hub	DCWW
	Network - Reactive Activity	GIS and SAP	DCWW
Schematics	Schematic of the WQZ	Infozone	Framework Partner
Total Loss Contingency Manual	Measures identified to improve network resilience	Infozone	Framework Partner
Water Resources Management Plan	Water Supply Demand Balance	Dŵr Cymru Welsh Water Website	DCWW