RIIO-GD2
Mains Replacement Cost Model Overview

February 2020

RIIO-GD2 Mains Replacement Cost Model Overview

The biggest cost driver on Mains Replacement Projects is the Mains Connections, this is where we spend most of our time and therefore cost. Unfortunately, we haven't had the data or technology available to forecast the impact of these in the past and resorted to using a forecasted cost and time per metre by diameter where the number of connections had no influence on the forecasts

We have tested and developed a very detailed costing process and model that uses the concept of Cost Components to build up a detailed forecast cost by cost heading as well as all relevant time and quantity factors from Project to Programme level.

Our goal is to ensure we have the most robust cost driver information to inform our forecasts and reporting to our stakeholders.

Workload Identification

Pipes are identified for the entire GD2 programme out to 2032 when the 30/30 programme completes (excluding dynamic growth) These pipes are grouped into projects and each pipe has very detailed and specific information to inform our cost model;

- Existing diameter and material
- Replacement diameter and method
- Number and type of services attached to the pipe
- Region

Additional Parameters

We run the workload through our purpose-built 'Python Programme' which produces the following additional information;

Mains Connection Points

Python identifies a connection point grid reference, the ° angle of a bend or change in any given pipe, we can refer to this pipe as "PON A" for this example;

- ➢ Is connection point at the end of PON A = No (This tells us it's an internal bend)
- ➢ Is Replacement technique Insertion = Yes
- ➢ Lookup "Max Insertion Bend Radius" for PON A Diameter = Not Insertable
- ➢ Therefore = **"Retrieve Live Head and Insert 1 Way"**

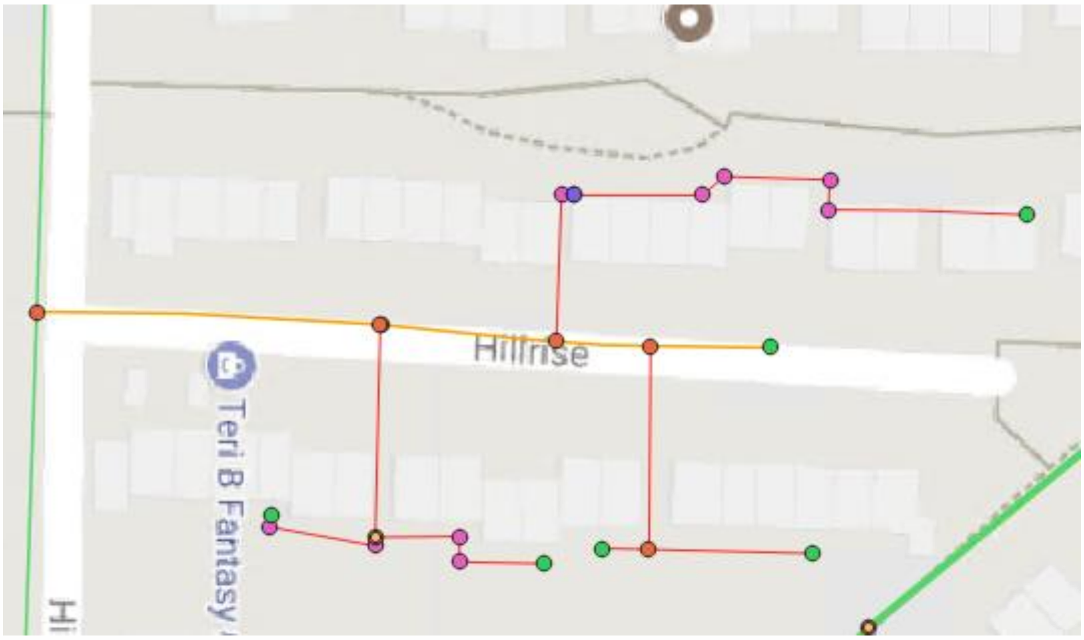
If the bend is within tolerance;

- ➢ Is connection point at the end of PON A = No (This tells us it's an internal bend)
- ➢ Is Replacement technique Insertion = Yes
- ➢ Lookup "Max Insertion Bend Radius" for PON A Diameter = Insertable
- ➢ Therefore = **No Connection**

Or, If PON A Replacement technique is Open Cut;

- ➢ Is connection point at the end of PON A = No (This tells us it's an internal bend)
- ➢ Is Replacement technique Insertion = No
- ➢ -
- ➢ Therefore = **No Connection**

Below is an example of the Python Programme Connection output for a live mains insertion scheme;

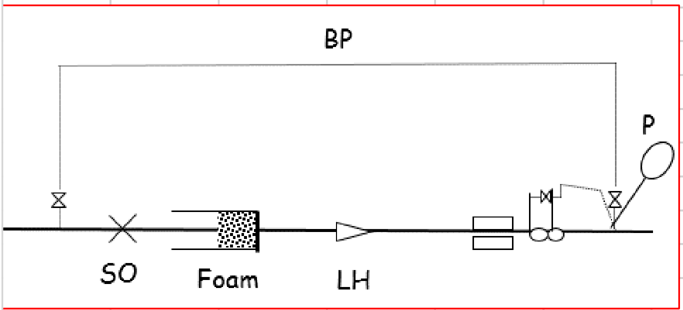


Each node indicates a potential connection point and the colours represent the connection type. These are produced in a list format based on the existing and replacement mains diameters for each pipe.

Using the above scheme as an example, the pink dots represent a bend radius greater than what is possible to insert through as per the “Max Insertion Bend Radius” Lookup table referred to previously therefore requiring us to Retrieve the live head and insert after the obstruction – In this occasion the main getting stuck in the bend.

See schematic below and a list of options available based on the existing diameter.

Retrieve live head and live insert 1 way;



Index
LHd_Ret_1WIns

Index	Existing Dia
LHd_Ret_1WIns_LP_3_	3
LHd_Ret_1WIns_LP_4_	4
LHd_Ret_1WIns_LP_5_	5
LHd_Ret_1WIns_LP_6_	6
LHd_Ret_1WIns_LP_7_	7
LHd_Ret_1WIns_LP_8_	8
LHd_Ret_1WIns_LP_9_	9
LHd_Ret_1WIns_LP_10_	10
LHd_Ret_1WIns_LP_12_	12
LHd_Ret_1WIns_LP_14_	14
LHd_Ret_1WIns_LP_16_	16
LHd_Ret_1WIns_LP_18_	18
LHd_Ret_1WIns_LP_24_	24

We use the existing diameter as the differentiator as this is what drives the flow stopping requirements, excavation size and time – Replacement diameter has very little impact on the overall cost at this point in comparison.

The Index codes above are for one specific connection type, we have a suite of 15 different types which can be grouped into an array of combinations.

Other connection types and Main Laying techniques follow the same process as above to produce the most accurate and robust information to forecast using our cost components.

Service Connection Points

Services follow the same process as the above although much more straight forward, We use the grid references produced by the aforementioned nodes to determine the surface category of the existing main and the attached services as show in in the example below;

CONNECTION	A	B	PON_TYPE	PROJECT_REF	SURFACE_TYPE	OS_THEME	REINSTATEMENT_TYPE
LHD_Ret_1WIns	210011312	0	Internal Connection	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
LHD_Ret_1WIns	210011312	0	Internal Connection	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
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LHD_Ret_1WIns	210011312	0	Internal Connection	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
LHD_Ret_1WIns	210011312	0	Internal Connection	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
No end connection	210011312	210011327	HEAD	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
THd_PeinMet	210011312	210011343	HEAD	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
THd_PeinMet	210011312	1000169500	HEAD	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
No end connection	210011312	210011380	HEAD	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
TLg_Met_Ins	210011312	210011329	LEG	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
1WIns	210011312	210011313	Pipe end to end	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
No Connection	210011312	210011379	Pipe end to end	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)
TLg_Met_Ins	210011312	210011384	LEG	1000033949	ROAD	Roads Tracks And Paths	Carriageway type 4 (up to 0.5 MSA)

Key of headings: Connection – Mains Connection type from cost model, "A" – Parent PON, "B" – Connected PON, PON Type – Location of connection i.e. Tee is split into Tee Head and Tee Leg Internal connection is an in line bend.

In the above example we can see that PON 210011312 ("A" Column) is in the Carriageway Type 4 (Reinstatement Type Column). If there were a number of different surface categories listed for one PON then we would assign it to whichever is the majority to determine the surface category of the PON.

Cost Components

The Cost Components sit behind the lookups used in the cost model, SQL and Python Programme and are produced from first principles using industry standards and WWU's policies and procedures, providing us with vital safety factors such as minimum excavation size for a given Engineering Operation, examples of these are;

- WW/PR/ML/1 (Work Procedure for Pipe System Construction)
- WW/PR/GR/1 (Work Procedure for Main Laying - General Requirements)
- WW/PR/SL/1 (Work Procedure for Service Laying)

There are 3 main Cost Components in Mains Replacement;

- Mains Connections – Connection types for all mains arrangements and sizes
- Main Laying – Open Cut and insertion across all diameters
- Services – a suite of service types rolled up into relays of steel services and transfers of PE services

They are built up from first principles and contain very specific cost drivers which include;

- Excavation size
- Pipe & Fittings
- Aggregate Quantities

Cost component	Method of calculating workload	Method of calculating cost
Pipe and fittings	Based on workload and connection/service type	Rate per metre/component from current procured contracts
Excavation size	Based on industry and WWU policies and procedures - standards	Cost is linked to aggregate quantities
Aggregate quantities	Based on excavation size	Rate per tonne from current procured contracts – including regional rate differences
Connection types	Current working practices for each connection type established	Each connection type has a different complexity of drivers based on Pipe and fittings, excavation sizes, aggregates and labour & plant time required.
Number services	Based on workload	Rate per service type based on current working practices
Replacement technique	Based on workload	Time to excavate for different techniques, aggregate requirements and plant necessary to support technique

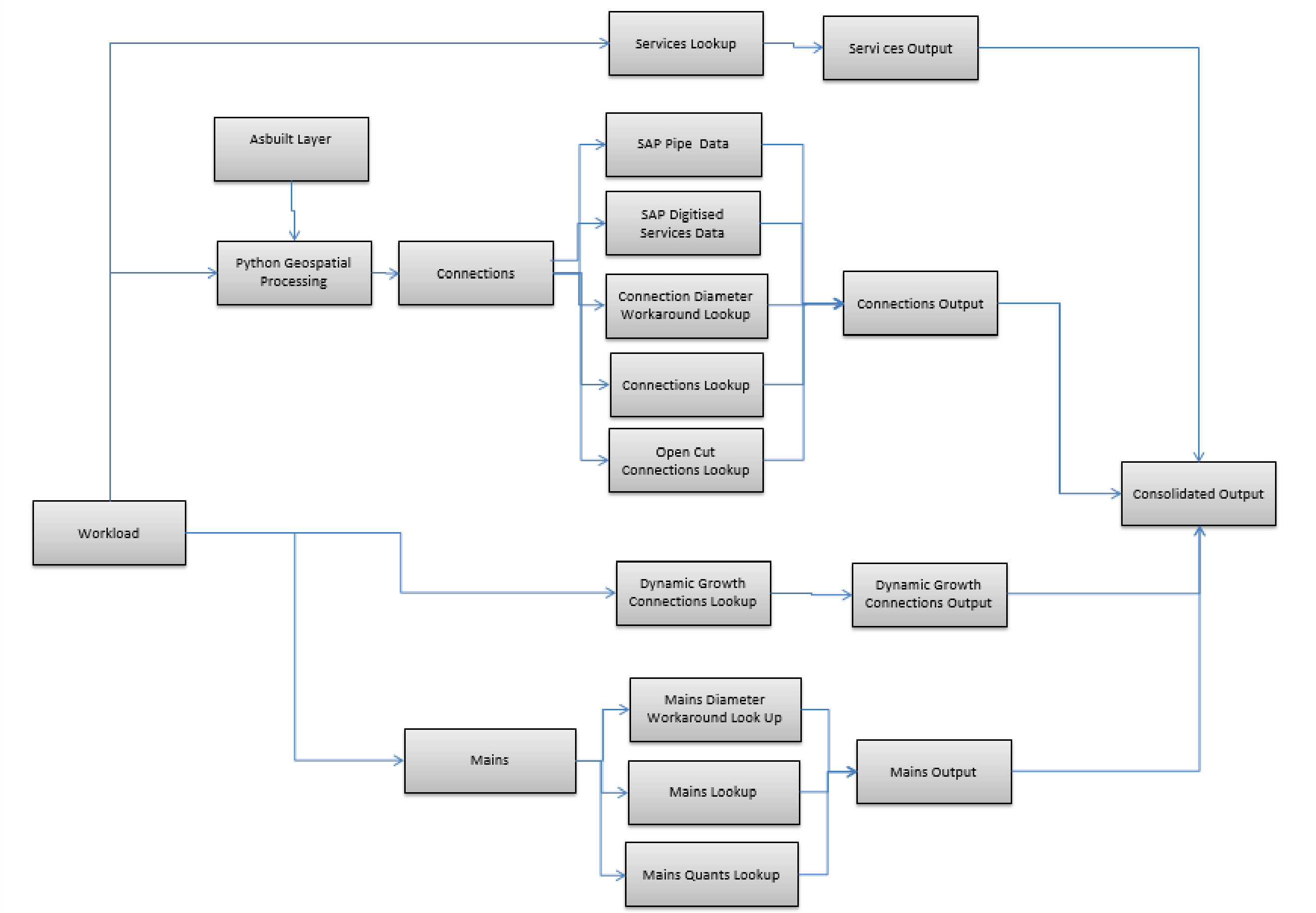
Outputs

Through multiplying the Workload and Additional Parameters against the specific Cost Component we can estimate the costs at a very granular level by pipe, project, region through to RIIO GD2 Programme level.

Identifying the Region is especially important to take account of the differing rates for activities such as 3rd party services for Reinstatement, Quarry costs etc. across our geography.

Outputs process map

This demonstrates a simplified process flow of our Mains Replacement costing model, The top (1st) section is the Services flow, 2nd is the Mains Connections, 3rd is the Dynamic Growth Connections and 4th is the Main Laying flow.



The result of the above process allows us to fully understand our forecasted unit cost and the elements which are the main cost drivers.

If you have any questions or require further clarifications, please contact The Business Strategy team or Kelvyn Griffiths (kelvyn.griffiths@wwutilities.co.uk).