Dŵr Cymru
Welsh Water

Ref 5.8O

Llanelli and Gowerton

September 2018

Contents

Executive summary

The driver for investment

In July 2014, the European Commission (EC) issued a Reasoned Opinion that the Llanelli and Gowerton area was in breach of the Urban Waste Water Treatment Directive. The EC announced their intention to submit the case to the Court of Justice of the European Union in March 2015. On the 4th May 2017 the European Court of Justice confirmed the breach.

In September 2015, we received an updated NEP from NRW, which formally added new environmental obligations, L2 drivers, which are in addition to the programme identified in our PR14 submission. These new environmental obligations, L2 drivers, require reduced storm discharge frequencies at a number of assets that discharge into the Burry Inlet shellfish waters of the Loughor Estuary by 31st December 2020.

These L2 drivers require a reduction in storm discharges to:

- 10 storm discharges at Northumberland Avenue pumping station,
- 20 storm discharges at Llanelli wastewater treatment works (WwTW), and
- 20 storm discharges at Gowerton WwTW storm tanks.

The investment

To protect the Burry Inlet Shellfish Waters (designated under the EU Shellfish Water Directive) by 31st December 2020, we needed to invest in the Llanelli and Gowerton catchments in AMP6. We considered a range of options from expensive traditional storage solutions to sustainable urban drainage systems (or RainScape). We have identified a programme of works as the most cost-effective set of solutions to make our assets compliant with the new discharge consent conditions. This includes an innovative technology from the United States, Peak Flow Equivalent Treatment (PFET), in combination with automated network control, upgraded pumps, additional Rainscape and additional network storage. The cost of this additional investment is £74 million.

Need for cost adjustment

We are including this investment as a cost adjustment in our PR19 business plan submission because it is expenditure required to meet the new environmental obligations by 31st December 2020, which were introduced following the PR14 determination. We are therefore making an additional investment of £74 million.

We propose that this is considered as transition expenditure. Although transition expenditure is typically for expenditure in year 5 of the AMP, there is no other mechanism to reconcile the additional investment that we were required to undertake.

Delivering for our customers

This work will meet the following of our customer promises:

Safeguard our environment for future generations: Meeting our NEP requirements by improving quality of water in the environment by reducing pollution events.

A better future for our communities: Improving the environment for our communities to enjoy and reducing the likelihood of pollution events.

Delivering for the future

In Welsh Water 2050, we identified future trends. The requirement for this investment is driven by the following trends:

Demographic change: Population in the areas around the estuary is predicted to increase, increasing the need for development and stress on the wastewater system.

Climate change: Predicted increases in extreme rainfall events could increase the number of Combined Sewer Overflow (CSO) discharges and incidents of flooding.

Protecting essential infrastructure: These assets will not meet our legal obligations in 2020. Therefore, we needed to upgrade current infrastructure and implement new solutions to increase storage, treat peak flows through the WwTW and reduce surface water flows.

Policy and regulatory change: We were set new National Environment Programme (NEP) obligations in September 2015, requiring us to reduce our storm water discharge frequencies in the Loughor area by 31st December 2020.

Delivering our strategic responses

In Welsh Water 2050, we set out to deliver eighteen strategic responses. This investment will contribute to the following:

Using nature to reduce flood risk and pollution: Using SuDs to reduce the risk of flooding and pollution.

Cleaner rivers and beaches: Improving our wastewater assets to improve water quality in rivers and coastal waters.

Protecting our critical wastewater assets: Implementing automated control and innovative treatment techniques will reduce risk of flooding and environmental pollution.

Achieving our measures of success

We have monitored our performance using measures of success (MoS) for AMP6. This investment has contributed to achieving the following MoS:

Measure of success	Start of AMP6 position	Benefits at the end of investment
R1- Responding to climate change – RainScape (roofs equivalent)	807	5,840

1 Delivering our customer outcomes

Need for investment

Llanelli is an urban area with a high proportion of impermeable surfaces and an ageing combined wastewater network. Gowerton is a more rural catchment which has issues with groundwater infiltration into its combined wastewater network, which is mainly laid in marshlands. These two catchments are separated by the River Loughor which discharges to the Loughor Estuary on the South West Coast of Wales. 92 CSOs from the Llanelli and Gowerton catchments discharge directly or indirectly to the Loughor Estuary.

This business case is to meet new National Environment Programme (NEP) obligations, related to L2 drivers, introduced in September 2015, following the submission of the AMP6 business plan. It required an updated AMP6 investment programme which covers the Llanelli urban catchments and Gowerton rural catchments, to reduce CSO discharges into the Burry Inlet Shellfish Waters within the estuary. This area is covered by environmental quality objectives including Shellfish Water Directive, Bathing Waters Directive, and Sensitive Water under the Urban Waste Water Treatment Directive.

In 2009, the public and other interested parties were concerned with the large number of cockle deaths and drew attention to the storm water discharges from the sewerage systems in the Llanelli and Gowerton catchments. In July 2014, the European Commission (EC) issued a Reasoned Opinion that the Llanelli and Gowerton area was in breach of the Urban Waste Water Treatment Directive. The EC announced their intention to submit the case to Court of Justice of the European Union in March 2015. In September 2015, we received an updated NEP from NRW, which formally added new environmental obligations called L2 drivers in the Llanelli and Gowerton area. These L2 drivers required us to reduce our storm discharges at three key assets to an average annual operating frequency of ten discharges for assets that discharge directly into the Loughor Estuary and 20 discharges per annum for those that discharge indirectly i.e. to a connecting watercourse. This resulted in the following consent changes to three of our key assets in the catchments:

- Reduction to 10 storm discharges at Northumberland Avenue pumping station,
- Reduction to 20 storm discharges at Llanelli wastewater treatment works (WwTW), and
- Reduction to 20 storm discharges at Gowerton WwTW storm tanks.

The NEP works related to L2 drivers have been delivered in addition to the programme identified in our PR14 submission, related to the S1 drivers and will be completed by 31st December 2020. A summary of the consent changes relating to the new L2 NEP drivers is provided in Table 1.

NEP Driver	Unique ID	Scheme Name/Name of Discharge	Included in PR14	Proposed Consent	Changes to NEP
L2	**6DC002682**	**NORTHUMBERLAND PS (STORM/EMER)**	**No**	**10 spills per annum**	**Added to NEP September 2015 with 31st December 2020 required completion date**
L2	**6DC002683**	**GOWERTON WWTW VICTORIA ROAD GOWER**	**No**	**20 spills per annum**	
L2	**6DC002684**	**Llanelli STW Storm**	**No**		

Note:
L2 driver - Locally significant measures not eligible under WFD, or any other driver, but needs to meet regulatory requirements as required by Welsh Government.

Table 1: Loughor schemes identified in the AMP6 NEP as revised in September 2015

Views of our customers and stakeholders

We have worked closely with key stakeholders throughout AMP6. We worked jointly with NRW and the Welsh Government to develop robust solutions to meet the NEP drivers, which provide the best outcomes for both our customers and the environment. We have consulted on these plans with Welsh Government Ministers, Members of Parliament, Welsh Assembly Members and Councillors.

We also collaborated with Llanelli Flooding Forum, Llanelli local councils, and Carmarthenshire County Council, Llanelli Chamber of Commerce and local stakeholder groups.

It is clear that our customers support our efforts to reduce pollution to rivers and beaches. During our consultation for Welsh Water 2050 in the summer of 2017, which engaged with 19,980 of our customers, our customers ranked cleaner rivers and beaches as a highly important aspect of our plans[i]. More than 90% of our customers consider that it is vital to protect rivers and beaches from pollution and other environmentally damaging influences[ii].

Benefits of investment

Reducing discharges to meet new NEP obligations

The main output of the additional investment will be meeting our new statutory environmental obligations as detailed in the updated NEP4.2. The environmental obligations will support achievement of Class B for shellfish beds in the Loughor Shellfish Waters, which are designated under the Shellfish Waters Directive, and prevent deterioration of shellfish beds to class C.

Protecting our customers from flooding

Alongside the drivers of the NEP, the investment programme for Llanelli and Gowerton is also designed to achieve the wider benefit of protecting customers at risk of internal flooding during a one in ten year event.

2 Options

Options

The NEP L2 Drivers, issued by NRW in September 2015 (shown in Table 2), place outcomes on Llanelli WwTW, Gowerton WwTW and Northumberland Avenue SPS.

We considered various options at each site to meet our NEP L2 drivers and ensure that we progressed cost-effective solutions. These included:

- Sustainable urban drainage systems (RainScape)
- Asset optimisation to automate control of the network to maximise storage;
- Sewer rehabilitation to reduce infiltration;
- Storm water storage and treatment;
- Increased Pass Forward Flow (PFF) on our existing assets;
- Peak Flow Equivalent Treatment (PFET) plants; and
- Increased treatment capacity.

We have undertaken an assessment of multiple options for sub-programmes to arrive at our chosen schemes. These sub-programmes fall into two areas:

- Gowerton WWTW
- Llanelli WWTW and Northumberland SPS

Gowerton WwTW

Currently the maximum expected inflow into Gowerton WwTW is 2,285l/s from the upstream catchment comprising of five main subcatchments:

- Rhosog;
- Penclawdd/Crofty;
- Gowerton;
- Killay/Waunaerlwydd; and
- Blaen-y-maes.

At this WwTW, once pass forward flow is achieved through treatment and the storm tanks are filled, peak flow discharges to Loughor Estuary. Three options were considered to reduce the storm discharges to 20 per annum.

Option 1: New 195l/s WwTW in Rhosog Catchment (Capex: £47m)
This solution had high costs and it would introduce a new wastewater discharge point, a less preferable option environmentally to NRW. A new WwTW would also take up significant footprint, and the proposed site was located on Green Belt land adjacent to a strategic housing site for Swansea Council's Local Development Plan (LDP). For these reasons, it was discounted.

Option 2: RainScape (Capex £24m)
This solution also had a high cost and would involve a significant amount of disruption in the Gowerton catchment including a number of individual roof disconnections from the combined sewer.

Option 3: 300l/s Peak Flow Equivalent Treatment (PFET) plant (to meet 20 storm discharges) (Capex £16m)
This was the preferred solution as it was the most cost-effective. It was therefore taken forward to detailed design.

Llanelli WwTW & Northumberland SPS

Llanelli WwTW serves the population of Llanelli (61,901). Currently, in storm events and once treatment capacity was exceeded, Llanelli utilises 3,500m^3 of storage before returning the settled storm effluent back to the work's inlet. Once storage capacity is exceeded, screened effluent discharges to the Loughor Estuary via a storm UV disinfection plant.

Northumberland SPS receives flow from both Northumberland and Dafen catchments via gravity sewers as well as catchment flows from Pwll and Cambrian SPS. Once pumping capacity is exceeded, effluent discharges.

Three combined options were considered to reduce the storm discharges to 20 discharges at Llanelli WwTW and 10 discharges at Northumberland SPS.

Option 1: 216,000m^3 storage at Llanelli WwTW and 22,500m^3 storage at Northumberland SPS

Site	Option	Capex
Gowerton WwTW	Option 1: New 195l/s WwTW in Rhosog Catchment	£47m
	Option 2: RainScape	£24m
	Option 3: 300l/s PFET plant (20 spills)	**£16m**
Llanelli WwTW and Northumberland SPS	Llanelli and Northumberland option 1: Northumberland SPS and Llanelli WWTW Storage	£276m
	Llanelli and Northumberland option 2: 650l/s PFET plant, asset optimisation, 2.5ha RainScape, new 2,000m3 storage tank, increased PFF	**£36m**
	Northumberland option 3: 61ha RainScape and asset optimisation	£71m

(£276m)
This solution was discounted as it had a high cost and there is lack of space to construct this size of storage in the existing footprints. In addition, this solution is technically infeasible as the tanks at Llanelli WwTW would be unable to pass water to treatment quickly enough after a rainfall event to continue to reduce storm water discharges during subsequent rainfall events in this area.

Option 2: 650l/s PFET plant and asset optimisation, 2.5ha Rainscape and a new 2,000m^3 storage tank (Capex: £36m)
This was the preferred solution and was therefore taken forward to detailed design because it was the most cost-effective solution. The RainScape and storage tank reduced the volume of storm discharges reaching the WwTW and the PFET plant allowed the reduction of storm spills by treating more flow through the works. It uses a small footprint and can treat dilute flows to the discharge consent standards with low energy demands.

Option 3: 61ha RainScape and asset optimisation (£71m)
This solution was discounted as it was found that it had a poor benefit cost ratio and did not cut discharges to the required level to be compliant.

The capex costs for the options for the schemes are shown in Table 3.

Table 2: The Capex costs associated with each option for the L2 drivers. Preferred solution is highlighted in bold text.

Station Road and RainScape

Station Road is within the Northumberland Catchment which is a fully combined, busy urban centre hemmed in by roads and railways.
It serves a population of 43,500 including Pwll, Cambrian and Burry Port all of which are pumped into Northumberland SPS. The catchment generates significant run-off during rainfall with over 100ha of impermeable area connected to the local combined sewer.

After rigorous design, optioneering and risk and value workshops, the best long-term catchment solution was a RainScape based strategy. There are limited existing watercourses or surface water drainage systems in Llanelli town centre.

The objective of the Station Road Tunnel Sewer is to provide a conduit for surface water separation connections within central Llanelli, which once implemented will reduce the CSO spill frequency and volume at Northumberland SPS This is a critical scheme within DCWW's Rainscape strategy. The new Station Road sewer will be capable of conveying the long term proposal of completely separate highway and roof drainage.

Along with the RainScape schemes at Asda Phase 2 and Emma Street projects, this supports the NEP obligation for Northumberland SPS.

3 Preferred option

NEP4 L2 Drivers

Our solutions to meet the NEP4 L2 Drivers, issued by NRW in September 2015, are detailed below and together require a total investment of £73.8 million. Our preferred options were focused around including innovation to improve efficiency and ensure that we achieve the most cost-effective solutions for our customers.

Gowerton WwTW

Our solution will reduce the number of storm water discharges at Gowerton WwTW to an average frequency of 20 per annum as required in the NEP. Elements of the solution are as follows:

- PFET will treat 300l/s of flow at Gowerton WwTW. This will be in parallel with the existing main Full Flow to Treatment (FFT) and will be utilised prior to the system filling the storm storage tanks. This will increase Gowerton's total treatment capacity to 912l/s.
- A blending chamber will be constructed to mix FFT and PFET flows. This enables the composition of the treated discharge to comply with consents.
- A smart control system will be implemented at the site to manage flows efficiently.

Llanelli WWTW & Northumberland SPS

Llanelli WwTW

Our solution will reduce the number of storm water discharges at Llanelli WwTW to 20 storm water discharges per annum and Llanelli's storm UV plant will be decommissioned. Elements of the solution are as follows:

- PFET will increase Llanelli's total treatment capacity to 1,249l/s.
- A new blending chamber will be installed to enable the composition of treated discharge to comply.
- Smart telemetry link - a new telemetry link will be created between Northumberland SPS, Bynea SPS and Llanelli SPS to manage the flows across the catchments and optimize the use of existing storage.
- The storm storage return pumps will be reviewed to achieve maximum optimisation of the work's 3,800 m^3 storage.

Northumberland SPS

For Northumberland SPS, a combined programme of works is required to reduce the number of discharges at Northumberland Avenue SPS to ten discharges per annum and Northumberland's UV plant will be decommissioned. They include:

- Pump upgrade - existing foul and storm pumps will be replaced. Foul pumps will be replaced with variable speed pumps capable of passing forward up to 1,100l/s. Storm pumps will be replaced to achieve their 3,370l/s design capacity. This increases the pass forward flow to Llanelli WwTW.
- Wet well modifications - removing hydraulic inefficiencies and providing optimal pump operating conditions.
- New 2,000m^3 storage tank, which balances flows - the existing storm pump return will be upgraded to a 200l/s variable speed pump.
- Smart telemetry link between Northumberland SPS, Bynea SPS and Llanelli SPS to ensure we do not overload the works

Along with these investments at assets we have developed a programme of Rainscape network solutions as follows:

- Cambrian Rainscape, a Rainscape scheme of 2.5 ha.
- Asda RainScape, a RainScape scheme of 0.63ha.
- Emma Street RainScape, a RainScape scheme of 6.1ha.
- New Station Road tunnel and pumping station, a purpose-built surface water conduit and pumping station to facilitate the RainScape strategy. The tunnel will initially serve 18.75ha of RainScape though it is designed to accommodate up to 40ha in the future which

could serve most of the highways and front roofs in central Llanelli in the future.

These sub-programmes provide both compliance with Shellfish Water Requirements in Loughor Estuary, by reducing discharge frequencies, and providing flood protection for our communities. We have worked extensively with NRW to produce a robust programme that meets environmental obligations whilst providing the best outcomes for both our customers and the environment.

Cost

The total cost of these schemes is £73.8m with the spend per year shown in Table 3.

2015-16	2016-17	2017-18	2018-19	2019-20	Total
£0m	£4.3m	£18.2m	£30.9m	£20.4m	£73.8m

Table 3: Current proposed PR19 Transition Investment Profile. Total Costs 2017-2018 price based and post efficiency. All costs rounded to the nearest £0.1m.

The following costs, detailed in Table 4, are associated with the programme we have developed.

Category	Sub-programme	Scheme	Forecast outturn (£m)	Total costs	Total by category (£m)
NEP4.2	Loughor L2 drivers	Llanelli PFET	52.0	50.5	50.5
		Gowerton PFET			
		Northumberland Avenue SPS PFF			
		Station Road, Llanelli	24.0	23.3	23.3
		Asda Phase 2, Llanelli			
		Emma Street, Llanelli			
PR19 Llanelli and Gowerton Transition Programme			76.0	73.8	

Table 4: Costs associated with each scheme. Total costs based on 2017-18 price base and post efficiency

4 Cost efficiency and innovation

Summary of innovation in this project

The adoption of Rainscape, smart sewers and PFET in our solutions has saved over £200m of capex compared to the traditional solutions of building a new WwTW and storage for the Llanelli and Gowerton L2 schemes and reduced operating costs from pumping of surface water.

RainScape

Welsh Water has implemented retro-fit SuDS or RainScape on several of the projects to reduce surface water flows entering the combined sewer network and reduce CSO spills. Welsh Water has been an earlier adopter of SuDS in the UK, learning lessons from Portland, Oregon and Malmo, Sweden.

Retro-fit green infrastructure has not been installed on this scale for this application anywhere in the world. In total 50 green surface planted features which control surface water during and after rainfall have been installed – an unprecedented amount in one catchment.

Our RainScape methodologies have been used to produce national guidance documents and standard details and our case studies are recognised nationally as best practice.

Smart sewers

We have installed new sensor technology, called smart sewers, across the wastewater network which continually measures flow and depth.

Our new assets (pumps, flow controls and storage systems) have live telemetry which can communicate and respond to live conditions. This optimises the network's operation and protects areas under greatest stress. The system can use forecast data to prepare our network based on the incoming weather. This optimises the storage and operation within the catchment.

This smart approach has saved building 50,000 cubic metres of new storage. One notable smart link (a complex control philosophy between Bynea SPS, Northumberland SPS and Llanelli WwTW) will result in £8.5m in savings compared to a traditional solution of increasing storage and pass forward flow.

Peak Flow Equivalent Treatment

Our implementation of Peak Flow Equivalent Treatment (PFET) technology is the first time it has been used in the UK as a treatment solution providing blended effluent that is compliant with permits.

PFET is based on a Danish technology of blending treated effluent and peak flow treatment. We undertook a study of the technologies used worldwide and identified two as pilots, WesTech FlexFilter and Evoqua Co Mag.

- WesTech FlexFilter: a simple gravity system requiring no moving parts, through innovative application of a hydrostatic force it filters both large and small particles through a porosity gradient within the filter. This technology is currently utilised in storm water treatment in the USA.
- Evoqua Co Mag: an innovative process that utilises chemicals & magnetite to make a ballasted floc to sink all solids quickly as they are denser making settlement much more efficient increasing hydraulic capacity. This is not new to the UK but it is in this application, and it is completely new to DCWW. The process is utilised in wet weather treatment in the USA.

These pilot trials ran in Gowerton from September 2016 to May 2017. We assessed the performance to treat Full Flow to Treatment (FFT) to a level equivalent to secondary treatment at Llanelli and Gowerton WwTW against a range of trial scenarios. We identified that the WesTech FlexFilter was the most appropriate as it adequately treated flows for all scenarios, including during high solids loading for a limited period, it is simpler to operate and has a lower operating cost than the Co-Mag.

Llanelli and Gowerton

Partnering and co-creation

When developing this programme, we worked jointly with NRW and the Welsh Government. This enabled us to challenge and influence the NEP at each step of its evolution, producing a robust programme that meets our environmental obligations, whilst providing the best outcomes for both our customers and the environment. We also collaborated with Carmarthenshire Council and NRW and have developed strong relationships in the region. We have a quarterly working group with the council reducing the impact on customers by co-ordinating road closures and collaborative working by using council highway drains rather than laying new pipes.

Impact on customer bills

We confirm that we have undertaken the best value options to meet our NEP requirements, through our gateway delivery process. We also create schemes that provide us with benefits long term. For example, the RainScape and infiltration removal elements have provided us with significant costs savings in pumping costs alone. Due to our unique customer ownership model, the costs savings accrued will be passed on to our customers through affordable bills and customer dividends.

5 Delivery

Procurement

This investment is being procured through Welsh Water's framework and delivered by our Alliance partners.

Risk mitigation and customer protection

We recognise that the biggest uncertainties associated with the project are the following:

Regulator action: Our programme is supported by NRW, and we are actively engaged in discussions with them to reach the most effective solution to achieve the required environmental outcome and best outcome for our customers.

Programme

The following programme of schemes has been undertaken, shown in Table 5.

Investment	Sub-programme	Scheme	Delivery year
PR19 transitional	Loughor L2 drivers	Llanelli WwTW PFET	GW4. Planned construction completion 2020.
		Gowerton WwTW PFET	GW4. Planned construction completion 2020.
		Northumberland Avenue SPS PFF	GW4. Planned construction completion 2020.
	Station Road, Llanelli- support to L2 drivers at Llanelli and Northumberland	Station Road, Llanelli	On site. Planned completion 2018.
		Asda Phase 2, Llanelli	On site. Planned completion April 2018.
		Emma Street, Llanelli	On site. Planned completion April 2019.

Table 5: Programme of schemes

6 Assurance

Governance

We have a capital investment process that all capital projects must pass through to ensure there is sufficient scrutiny and challenge from senior management.

There are six stages of the capital investment process and a gateway between each stage. The gateway defines the requirements that are to be met before a project can be approved to move to the next stage. The gateways are as follows:

1. Commit to risk;
2. Commit to feasibility;
3. Commit to solution;
4. Commit to delivery / start on site; and
5. Commit to handover.

Our Capital Programme Board (CPB) has the authority to approve projects through the gateways. The approach provides strong governance for approving investment decisions and is transparent and fully auditable.

As part of the assurance process in developing the Loughor programme, CPB have been regularly updated by means of board papers and presentations. All schemes in the programme are being progressed through this gateway process and are at varying gateways - ranging from Gateway 3 to Gateway 5.

Gowerton PFET and Northumberland have been passed through Gateway 4 in April 2018 and to the Capital Programme Board for ratification on 3rd May. Llanelli will go through Gateway 4 to Board in September 2018.

Customer consultation assurance

Our communications team has opened a RainScape information station in Llanelli town centre, creating a dedicated exhibition van, liaised with more than 3,500 customers, issued over 11,500 letters, hosted public exhibitions and surgeries and answered all questions openly and honestly. This has been the foundation for the successful delivery of our programme to date.

Public consultation was undertaken which included exhibitions for local residents and visits to local schools by our education team. We developed a programme of activities, called Living and Learning with Water, for primary school children to learn about the water cycle, water supply, water conservation and rivers.

CPB Month	Focus Paper Title
Oct-17	Gateway 3 Approval for L2 Loughor Programme
Nov-16	Llanelli Rainscape – Station Road Tunnel GW4 scheme approval
Feb-16	Loughor Estuary proposed AMP6 investment
Aug-15	Impact of Loughor commitment on Water AMP6 programme
Jul-15	Impact of Loughor commitment on Waste AMP6 programme
Jul-15	Llanelli Gowerton RainScape Schemes Programme Governance
Jun-15	5.3 WFD Managing Uncertainty and Loughor Investment

Table 6: Paper presented to Capital Programme Board

Supporting Documents

5.8O.1: NRW Letter- Amended National Environment Programme (NEP): 9th September 2015

References

[i] WW2050 Qualitative Debrief, 2017- engaging with 108 customers

[ii] Summer Consultation, Welsh Water 2050, 2017