Penshurst Adaptive Wastewater – Benefits Analysis

Wannon Water

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Report statement

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Summary of key issues

This report details the potential economic benefits that will accrue from proceeding with the proposed adaptive wastewater solution for Penshurst in the Southern Grampians Shire. The analysis uses a framework established by the Cooperative Research Centre for Water Sensitive Cities to examine market and non-market benefits that are likely to accrue from the implementation of the proposed $13.8 million investment.

Market benefits are those that can be assessed through referencing existing markets for goods and services, such as construction activities where the expected costs of purchasing and installing the infrastructure can be ascertained. Non-market benefits complement market-based analysis. These benefits are not traded in traditional markets and therefore a monetary value must be determined to define / quantify the benefit.

The benefits assessment compared two scenarios:

1. Business as usual scenario where the current situation is maintained. In this instance this involves
    - the gradual replacement of existing on-site wastewater systems on 'as needs' basis
    - continuation of current legislated planning and development constraints due to on-site wastewater that act to severely limit residential and commercial development
    - continued population decline at an annual rate of 0.70%, which is the rate of population decline experienced in Penshurst between 2001 – 2016.
2. The situation if the proposed solution proceeds, development constrains are removed and the rate of population decline is reduced and over time population increases

In total 21 potential benefits where identified, of which this project will deliver 10 different benefit types. Six of these have been able to be reliably quantified:

- The market-based benefits expected to accrue from this project include construction benefits as well as benefits accruing from a slowing and then reversal of current population decline. Potential tourism benefits are identified but have not been quantified
- Non-market-based benefits where a value has been determined include those arising from improved amenity and recreational values, improved water quality and pollution reduction and removal
- Non-market-based benefits identified but where no value has been attributed include improved storm water management, carbon sequestration, reduced flood damage risks and enhanced supply and quality of wastewater

Pollution removal directly leads to improved health outcomes for residents, a major benefit of this project as the current level of wastewater management provides roughly half of the minimum recommended level of disease protection according to Australian and global (World Health Organisation) guidelines.

The total expected economic value of the project over 25 years totals $41.6m. Construction will require the employment of 20 people for 2 years and due to reductions in the rate of population decline, and over time population attraction, the population will increase to 490. This is around 67 more than the current population and 136 more people than if the current rate of decline continues until 2046. The additional population over business as usual will support an additional 33 FTEs.

The following summarises the results of this benefits analysis:

Category	Subcategory	Include (Y/N/ ?)	Quantify	NPV @ 7% ($m)
Market based benefits	Construction	✓	✓	7.9
	Population growth	✓	✓	21.0
	Tourism	×	×	
Green infrastructure	Amenity values	✓	✓	1.9
	Recreational values	✓	✓	
	Health benefits due to reduced air pollution	×		
	Energy saved	×		
Ecological & environmental value of water	Water quality value	✓	✓	8.6
	Habitat conservation value	×		
	Aesthetic value	×		
	Economic value of local storm water management	✓	×	
Climate change mitigation	Urban heat island effect mitigation	×		
	Carbon sequestration	✓	×	
	Reduced carbon emissions	×		
Non-point source pollution	Value of pollution removal (health benefit)	✓	✓	2.2
Flood hazard reduction	Flood damage	✓	×	
	Flood mitigation and risk	×		
Recharge & improved groundwater quality	Direct uses of groundwater	×		
	Non-use values of groundwater	×		
Water supply & pricing	Enhanced supply and improved quality	×		
Wastewater management	Enhanced supply and improved quality	✓	×	
Totals				$41.6

1. Introduction

This paper summarises the benefits that can be expected to arise should the proposed Adaptive Wastewater Solutions be implemented in the township of Penshurst. The analysis is based on the preferred Solutions Package 2 – Gravity Sewer to Local Cluster Management System (SP2), which has been identified in preliminary studies as the preferred option for the necessary infrastructure development.

Details of the proposed solution are contained in the report Adaptive Wastewater Solutions for Small Towns - Penshurst and Cudgee: Options Analysis Report, Version 2, dated 27 August 2020 and are outlined in Appendix A to this report.

> **Economic or financial benefits?**
>
> Economic and financial analyses have similar features, in that both seek to measure the impacts (benefits and costs) of a wastewater / sewerage scheme. The key difference is that financial analysis includes only the costs and benefits to specific organisations (internal impacts), while economic analysis considers the costs and benefits to the wider economy or to society as a whole (external impacts). The benefit categories considered in this analysis are based on economic analysis.

1.1 Framework for analysis

The framework for the analysis is based on the market and non-market benefits that are expected to accrue should the SP2 project proceed. A working paper produced by the Cooperative Research Centre for Water Sensitive Cities, Review of nonmarket value for water sensitive cities and practices: An update (2017),[1] develops a useful framework for more detailed benefits analysis of the proposed Penshurst Infrastructure Investment and has been applied in this report.

[1] Gunawardena et al (2017)

2. Benefits analysis

This section considers the possible economic benefits that may arise from the SP2 project and the extent to the project can be expected to deliver the benefits. Benefits are broken into two categories, market based and non-market-based benefits.

It is not necessary that water conserving projects stack up economically[2]. Water infrastructure projects should be evaluated against economic criteria and shown as economically viable once the social and environmental considerations have been considered.

The market prices for goods and services provide the basis for the benefits analysis. Although market prices in water and wastewater markets can be affected by government policy and incentives such as subsidies, they are the most reliable source of estimating benefits.

Nonmarket methods are used to complement market values. These approaches recognise that benefits accrue to stakeholders from water and wastewater-based investments that are not traded in traditional markets and, therefore, a monetary value must be determined for this benefit type.

It is not always possible to impute a monetary value to non-market assets due to a number of factors, such as differences in underlying cost structures like travel costs, localisation of benefits to a particular study area and the temporal dimension of studies; that is, benefits accrue to a particular point in time. It is also recognised that transfer errors – assuming that a benefit in a location can be recognised in another – can range between 50% - 200%. Therefore, it is important to consider whether an identified benefit can be recognised, and to what extent in a comparable project.

This paper applies market and non-market values to the proposed SP2 adaptive wastewater investment. Where a non-market benefit type is recognised, an assessment of whether an accepted valuation can be applied has been undertaken, and if considered suitable, recognised. Where such a benefit is likely to occur but it is not considered possible to attribute a monetary value due to factors such as a lack of detailed information, this is noted.

When assessing the level of benefits, their sequence and timing, the proposed SP2 investment is considered against a basecase situation, a situation where no investment occurs is referred to as business as usual. Under this scenario:

- This represents continuation of the existing situation into the future with no additional external assistance provided to homeowners from agencies like Wannon Water. We note that outcomes of Council's Domestic Wastewater Management Planning and stakeholder engagement indicate business as usual is unlikely to meet regulatory or community objectives.
- Upgrade of systems by owners over time as necessary.
- Limited / no capacity for town renewal / growth.
- Continuation of owner managed on-site wastewater management systems; effectively a "do nothing" scenario. Alterations or upgrades to existing on-site systems to occur only as necessary, e.g. because of dwelling extensions or a system failure.

[2] For example, it has been estimated that the net cost to the Victorian community over 20 years for managing the desalination plant is between $2.7 - $3.7 billion (Productivity Commission, 2011).

3. Market based benefits

There are three primary market-based benefits from an investment in SP2:

1. Initial economic benefits arising from construction
2. Ongoing project maintenance
3. Supporting population retention and longer-term population growth

These are considered in turn on the impact to the Southern Grampians Shire Local Government Area. The analysis uses the AURIN Economic Impact Assessment tool[3] to assist in determining the economic impact of the identified benefit streams.

Construction and maintenance costs have been sourced from Adaptive Wastewater Solutions for Small Towns - Penshurst and Cudgee: Options Analysis Report,[4] and Cost-benefit analysis, funding and governance case – Penshurst wastewater functional design (2021)[5].

It is assumed that all sewer construction and maintenance services / activities can be sourced from within the LGA through a combination of Council and Wannon Water capabilities.

3.1 Construction cost benefits

The estimated construction cost of installing the wastewater system is $13.82 million. The assets have a useful life of 25 years. There is an anticipated renewal cost of $0.92 million with operating costs expected to be around $0.18 million per annum.

The basecase involves the gradual replacement of existing systems, as well as expected maintenance and upkeep costs. Should SP2 proceed, the basecase capital and operating costs associated with the existing systems will not be incurred. Therefore, to determine the net construction impact, construction and operating costs associated with the basecase need to be subtracted from the expected SP2 related expenditures. The net figures over 25 years are provided in Table 1.

Table 1 - Construction and operational expenditure

	Capital ($m)	Operating and renewal (m$)	Total ($m)
SP2 works	13.82	0.48	14.30
Less business-as-usual basecase	3.75		3.75
Totals	10.07	0.46	10.55

[3] http://eiat.aurin.org.au/#/eiat/home

[4] Decentralised Water Consulting, Version 2 dated 27 August 2020

[5] Frontier Economics (2021)

The economic impact of this expenditure is estimated in Table 2.

Table 2 - Economic impact of construction

	Direct	Flow on	Total
Output ($m)	10.55	7.68	18.23
Value added ($m)	4.61	3.35	7.96
Employment	18	22	40

The economic impact of the construction is predominately over the first two years, with 20 FTE needed for two years to support construction. The economic value created over 25 years is estimated to be $7.96 million.

Once operational, the net ongoing economic benefits from construction related activities are minor.

3.2 Population impacts

The Victorian Government[6] notes that the current fragmented and inflexible wastewater management regulatory framework is an inhibitor to the viability and potential growth of small towns. The various localised strategic documents[7] underpinning this project identify the potential for it to support population growth in a best case and population retention in a worst case. The population of Penshurst has been declining, as shown in Table 3.

Table 3 - Population analysis

	2001	2006	2011	2016	Total
Population	487	461	469	438	
Movement		-26	8	-31	-49
% decline		-5.3%	1.7%	-6.6%	-10.1%
GAGR – 2001 - 2016					-0.70%

Over the period 2001 – 2016, the population declined at an average annual rate of 0.70%, with the estimated residential population in 2016 of 438 persons, compared to 487 persons in 2001. This is consistent with the broader Southern Grampians Shire region,[8] where population has declined from 16,705 in 2010 to 16,134 in 2020, an average annual decline of 0.35%.

Providing acceptable wastewater and sewerage standards is expected to contribute to arresting the population decline; the question is to what extent. We have been advised[9] that several households have recently moved from Penshurst after having developments rejected because of land constraints associated with wastewater management. Unless this situation is reversed, it is anticipated further population losses to the township will occur due to households not being able to complete renovations, extensions, and common place developments due to land and associated wastewater constraints.

[6] DEDJTR (2015)

[7] For example, Southern Grampians Shire Council Plan 2017 – 2021, Penshurst Community and Structure Plan

[8] Source: Australian Bureau of Statistics, Regional Population Growth, Australia (3218.0)

[9] Southern Grampians Shire Representative

Victoria in Future (VIF) population forecasts for the Southern Grampians Shire LGA excluding Hamilton forecast confirm this trend, with an average annual population decline between 2021 and 2036 of 0.79%, consistent with the declines in Penshurst over the past 20 years.

3.2.1 The impact of population declines

It seems reasonable, based on these forecasts, to use Penshurst's recent average annual rate of population decline (0.70%) as the basecase scenario. Should this rate of population decline continue, it is estimated that Penshurst's population will decline to around 354 people by 2046, a cumulative decline of 16%. With an average household size of 2.26 people[10], this equates to a decline of 30 households.

The decline in population has a deleterious impact on local economic activity as the local economy contracts. With forecast population declines, it is estimated that the cumulative impact on the local economy in net present value terms (NPV) @ 7% to 2046 totals $19 million, with the loss of around 33 full time employees (FTEs). The sectors most impacted include agriculture, health, education, and retail.

A declining population also has flow on effects that are difficult to quantify, but nonetheless would be deleterious to economic activity in Penshurst including:

- Decline in occupancy rates, which according to VIF (2019)[11] are currently around 85%. Assuming a loss of 30 households, occupancy rates would decline to around 71% by 2046
- The decline in occupancy leads to houses and commercial properties becoming vacant, which in turn leads to the vacant properties becoming run down and derelict. By 2046 it is estimated that unoccupied dwellings increase from an estimated 33 to 63, a 91% increase
- As housing supply continues to exceed demand, there will be a lowering of property values which in turn leads to lower rating incomes, property taxes and stamp duty revenues
- Lower population levels also reduces the efficiency of infrastructures which calls into question issues pertaining to infrastructures and services such as schools, community health, recreation assets and public transport.

3.2.2 Arresting the population decline

The extent to which the wastewater infrastructure can arrest this rate of decline is subjective. To infer that it can completely reverse this trend would be optimistic. With wastewater systems currently below acceptable standards, however, and service limitations affecting residential and commercial development due to wastewater constraints, installation of new infrastructure that eliminates these growth constraints it is reasonable to assume that SP2 will support population retention, and over the longer term, population growth, a position consistent with current Victorian Government policy.

We are advised that there are currently businesses in the township who want to expand, and others interested in conducting business from within existing sites in Penshurst but are inhibited by onsite wastewater constraints including lack of land to dispose and treat wastewater.[12]

Using scenarios to model changes to population growth / decline rates due to wastewater infrastructure investment highlights the impact the investment could potentially make. Three models with a positive 0.05%, 0.10% and 0.15% annual change against the basecase (average annual decline of 0.7%) have been

[10] Victoria in Future 2019 (VIF2019) Population and Household Projections,

[11] Victoria in Future 2019 (VIF2019) Population and Household Projections

[12] Southern Grampians Shire Representative

developed. Table 4 shows the following population, economic value added and employment impacts across the Southern Grampian Shire of the three scenarios:

Table 4 - Scenario analysis

	Scenarios			
	Base	.05%	.10%	.15%
Population (2046)	354	417	490	575
Population impact		63	136	221
% change		18%	38%	62%
Employment creation (2046)		31	67	110
Cumulative GRP ($m)		10.1	21	33
CAGR (2021-2046)	-0.70%	-0.08%	0.54%	1.21%

To stabilise the population at existing levels by 2045 (around 426 residents), the wastewater project must support average annual population increases of .056%.

If the mid-point (0.1% average annual increase over basecase) was taken, then by 2046 the population of Penshurst would be around 490 residents, a 38% increase on existing levels.

The NPV @7% of the cumulative economic value added or created through population growth compared to the basecase would be around $21 million and an additional 67 people would be employed across the Southern Grampians Shire LGA. The sectors where the largest employment growth would occur are outlined in Table 5:

Table 5 - Expected FTE growth

Sector	FTE	% total
Agriculture, Forestry and Fishing	13	19%
Health Care and Social Assistance	11	16%
Retail Trade	7	10%
Education and Training	6	9%
Accommodation and Food Services	4	6%
Public Administration and Safety	4	6%
Other	22	34%
Total	**67**	**100%**

3.3 Tourism potential

Destination based businesses, which focus on tourism (such as restaurants and accommodation houses), have been established in many rural and regional townships; there is no reason why such businesses would not be established in Penshurst, taking advantage of its location and natural and heritage assets. There is anecdotal evidence of demand for local accommodation to service demand for the CFA training ground, tourist and people visiting families.

There would appear to be an opportunity to grow the tourism sector above the levels forecast (11 FTE from retail, accommodation, and food services) provided the necessary infrastructure, including the proposed SP2 project are developed.

There is currently no accommodation in the township. Penshurst is located close to iconic tourism destinations of Budj Bim and the Great Ocean Road and is on the Great Southern Touring Route. The township is close-by Port Fairy, Dunkeld and other south coast townships which have established events calendars. Recent funding to upgrade the Volcanic Discovery Centre as well as growth in the broader tourism offering of the Great South Coast Region also present opportunities to develop the town's tourism industry. By way of example, doubling the forecast growth of the tourism sector would result in the following economic outcomes, over and above those expected to arise from just population growth:

- 15 new FTEs (11 direct, 4 indirect)
- Annual valued added increases to the local economy totalling $1.2 million

This said, and despite the towns potential to develop a tourism industry without SP2 proceeding there is little prospect of the industry developing other than to service passing traffic from existing stores.

3.4 Other economic benefits

In addition to these direct benefits, increased population within Penshurst would support other positive economic impacts, including:

- An expectation that property values would increase as demand for housing within the township increased. The higher demand could be offset to some extent by increasing housing supply, which is generally accepted to have positive economic effects through construction
- Higher property values should increase Council rating income, and state government property related taxation, such as land tax and stamp duties, as they are calculated based on the underlying asset value
- Higher resident numbers generally result in more efficient use of assets and infrastructures, resulting in productivity improvements, e.g. class sizes for education can be increased creating economies of scale and community health assets and medical services can move from part time service delivery models to ones closer to full operating capacity
- Public transport services can be reinstated, with greater levels of demand warranting services
- There is a greater likelihood that increased commercial activities will emerge that are needed to support the local population, e.g. general retail store and cafes arise from the relocation of people with existing businesses that are not "location dependant", such as internet-based retail businesses.

4. Non-market benefits

In addition to the market benefits identified above, there are a range of non-market benefits that are likely to be created by this project. This section reviews the major accepted non-market benefits associated with wastewater projects of the type envisaged by SP2.

4.1 Non-market benefits from Green infrastructure

Green infrastructure benefits relate to and can be broken down into the following benefit streams:

4.1.1 Amenity values

Amenity values arise from improved liveability and use of greenspaces and the associated externalities of improved land use. These benefits are typically recognised through higher housing values which reflect the amenity value attached to the land. Attributes that determine the nature and extent of amenity benefits include location, quality, functions, and size of the green space.

There is a consensus, supported by numerous research studies[13], that projects such as SP2 will result in improved amenity, particularly with this project contributing to the maintenance of public spaces to a higher quality during dry periods.

4.1.2 Recreational values

In a similar vein, recycled water irrigation can maintain the quality of greenspace for recreation purposes. Such improvements provide benefits to those who use the greenspaces and also through the encouragement of higher rates of recreation in the community. Water Services Australia (2019)[14] estimates that an uplift in active recreation is around 5% when greenspaces are of a higher quality.

4.1.3 Health benefits due to reduced air pollution

Increased number of trees and greenspace can remove air pollution by the interception of particulate matter on plant surfaces and the absorption of gaseous pollutants through leaf stomata. Unsurprisingly, the literature on this benefit has largely concentrated on urban areas. Penshurst would have relatively low levels of air pollution and the increases in green foliage from this project would not be sufficient to deliver material benefits of this type.

There is a growing body of literature around the health benefits of having contact with nature. As much of this has been set in urban settings and the proximity of residents to greenspaces and the difficulties in attributing an economic value to the benefits, it is not possible to deliver a firm economic value arising from the health benefits of having contact with nature to this project. It is worth noting, however, that the results of the studies are generally positive due to links between greenspace and mental and physical health. To this extent, SP2 is likely to deliver some health benefits from increasing the opportunities to interact with nature.

As a general comment, health benefits due to reduced air pollution, to the extent they existed and where valued would likely be recognised as part of the amenity benefits stream.

[13] Gunawardena et al (2017) pp 45 – 49 for detailed literature analysis

[14] https://www.wsaa.asn.au/publication/health-benefits-water-centric-liveable-communities

4.1.4 Energy saved

Increases in urban trees have been shown to reduce electricity consumption, especially in summer due to the cooling and shading effects of the trees. This project is not expected to deliver these benefits.

4.1.5 Valuing nonmarket benefits from Green infrastructure

SP2 will deliver amenity and recreation benefits. As detailed above, such benefits are generally reflected in the underlying property values. There is a wide range of values that have been calculated to reflect the economic impact of green infrastructure. Many of these are location and time specific, meaning it is not feasible to attribute the calculated values to this study without amendment. The most recent study under Australian circumstances was completed by Rosetti (2013),[15] which found around 8% of property valuation being attributable to greenspace. Although within the Australian context, this study was completed for Australian capital cities, so needs to be adjusted for Penshurst.

An average uplift of 4% (50% of the Rosetti study) on the average property valuation for Southern Grampians Shire across Penshurst housing stock (301 houses), results in amenity and recreational benefits of $1.9 million in NPV @ 7% terms.

[15] Rossetti J (2013

4.2 Ecological and environmental value of water

The ecological and environmental value of water can be summarised in terms of water quality value, habitat conservation and aesthetics. Most of the economic literature around the ecological and environmental valuation of water has an urban context, whereby urbanisation and population growth results in increased flows to waterways and environmental ecosystems. While care should be taken when applying the results of these studies to the Penshurst case, it is clear from the numerous studies undertaken in this area that there is a clear non-market value attached to water quality. Therefore, as a general principle, projects which are expected to result in improvements in water quality, such as this one, will generate economic impacts.

4.2.1 Water quality value

One of the primary outcomes from this project is an expected increase in water quality. The current situation highlights the need for improvement in relation to wastewater:

- Penshurst is the most densely populated unsewered small town within the SGSC municipality.
- Council's recent septic system audit identified ~93% (189) on-site systems inspected were not performing satisfactorily and did not meet current public health and environmental standards.
- A number of the systems were old (~40-50 years) and can be considered beyond their design life.
- There were a small number of properties where no formal on-site wastewater management system existed and either blackwater and/or greywater may have been discharged informally to the ground surface.

In relation to water quality, the data indicated elevated E. coli bacteria results for three (of four) of the ponds tested in 2016 (210 to 390 orgs/100mL) and 510 orgs/100mL reading in Pond 4 in 2011. The average total nitrogen readings have slightly reduced over the sampling period from ~12 to 9mg/L across the ponds.

The challenge from an economic valuation standpoint is to determine the extent of the improvement in water quality due to reduced pollutants in the system. It is expected that pollutant flow compared to the basecase will be reduced by 87%, with TP and TN reduced by 96% and 99% respectively.

Melbourne Water has established a maximum cost of constructing wetlands of $6,645/kg/year of nitrogen removed and a weighted average cost of $3,926/kg/year as a stormwater offset cost. The maximum construction valuation cannot be transferred across without adjustment, as it is based on large constructed urban wetlands, and likely uses alternative technologies than those proposed under SP2. This is, therefore, a different context to the proposed SP2 project. Notwithstanding the context for the valuation, the actual valuation figure does represent local construction costs and is a recent calculation. These factors present as major advantages over other alternatives.

Using the lower figure of $3,936/kg/year is conservative and effectively eliminates some of the benefits inherent in the higher figure such, as improved amenity and recreational benefits resulting from the construction of the wetlands.

Applying the expected impacts of the reduced pollutants with the conservative valuation figure ($3,936/kg/year), the economic benefit (NPV @ 7%) arising from the reduced pollutant flow will be $8.6 million over 25 years.

4.2.2 Habitat conservation value

Several studies have identified the economic value of habitat conservation. Amenity and recreational values and protection of endangered species, provides future research value with areas of rare species having noticeably higher economic values.

Amenity and recreational valuation have previously been considered, and while SP2 does enhance local greenspace, there are not likely to be any material economic impacts arising from habitat conservation.

4.2.3 Aesthetic value

Aesthetic value and recreational value are different concepts. Water has an aesthetic value independent of recreational value. People visit water bodies to enjoy the aesthetic properties without necessarily engaging in recreational activities. Property values increase in areas surrounding or near to attractive water bodies and decline around polluted waterways.

SP2 may have some indirect benefits improving the aesthetic value of Penshurst's waterways and surrounding water bodies; however, they are unlikely to be material and are not recognised as a benefit arising from this project.

4.2.4 Economic value of local storm water management

This form of economic value has been of particular interest in Australian environments in relation to different types of services, e.g. avoiding water restrictions, reduction in peak flooding, the heath of local waterways, payment for rainwater tanks and local drainage restoration projects. In each of these areas there has been a positive willingness to pay and / or value uplift in property prices.

The SP2 project will create economic value through enhanced storm water management. There is evidence that currently overflow of dark, and greywater occurs under such circumstances. Assessing the benefits would be challenging and to the extent they arise are likely to be recognised in the increased amenity benefits noted above. Notwithstanding, there is quite strong economic valuation evidence that residents value water sensitive design outcomes and are willing to pay for them.

4.3 Climate change mitigation options

Cities and towns can be vulnerable to climate change impacts such as heatwaves, floods, droughts, and other extreme events. To this end, there is an emerging area of investigation into assessing the economic value of climate change mitigation infrastructures implemented as part of water and wastewater projects. One of the challenges in this area is not to double count benefits that arise from climate change mitigation which are also valued as part the green infrastructure benefits.

4.3.1 Urban heat effect mitigation

Using urban green and blue infrastructure to mitigate the impacts of urban heat retention and intensity has been researched in several studies. While these have generally found correlations between lower temperatures and the development of the green and blue infrastructures, valuing this has proven more problematic. Valuation has focussed on reducing rates of mortality and morbidity in cities due to heat effects, energy usage and productivity impacts.

SP2 will not have any direct urban heat benefits over and above those already identified, such as improvement in the quality greenspaces.

4.3.2 Carbon sequestration

Green infrastructures can also increase the rate of carbon sequestration, mitigating climate change. Studies in this area have tended to focus on larger scale urban forest projects. The extent to which benefits accrue is dependent on the nature and type of green space and can be impacted by other factors such as weather and location.

While not a direct objective of SP2, there is likely to be some very minor carbon sequestration benefits that arise from improved greenspaces and vegetation surrounding waterways. Valuing this benefit is not possible without a detailed understanding of the nature of the vegetation and the extent to which it would be a source of greater sequestration because of the SP2 project.

4.3.3 Reduced carbon emissions

Improvements in waterways, greenspaces and vegetation will, prima facie, reduce carbon emissions. This project also involves the construction of new wastewater management systems, however, and ongoing costs in the operations of those systems, are generally carbon emitting activities.

The extent to which the project results in carbon emissions, compared to any potential reductions in emissions arising from it, would need to be assessed before a judgement is possible regarding a reduction or increase in carbon emissions stemming from the project.

If emissions created because of the project proceeding exceeded emissions reduction, the economic valuation would need to include an estimate of the disbenefit.

4.4 Non-point source pollution

Stormwater and wastewater runoff contains pollution from a variety of sources such as lawns, carparks, roads, and highways. Such non-point source pollution is now considered to be the dominant pollution type in many urban water systems. Containments are many and varied and often location specific and include sediment, nutrients, pathogens, and chemicals. These containments enter waterbodies through the drain network and can seep into groundwater systems, often transferring to streams fed through groundwater systems. Studies into the economic valuation of reducing or eliminating non-point source pollution have tended to focus on the health-related costs created by the pollution.

Within the study area there is evidence that failing sewers are adding to the nutrient load creating algal bloom in the Penshurst gardens.

Figure 1 - Algal bloom at Penshurst gardens

The impact on community health from pollutants in wastewater systems has been extensively studied and measured through a measure known as a disability-adjusted life year (DALY). Total DALYs reflect the total disease burden that can be attributed to wastewater and stormwater management. The World Health Organisation (WHO) and Environmental Protection Council (EPHC) require proposed activities to not create a disease burden that is greater than 10-6 DALYs/person/year. This threshold effectively provides a baseline of “acceptable” health outcomes arising from pollutants in wastewater systems. Figure 2 shows the WHO threshold DALYs, as well as for the existing systems and SP2.

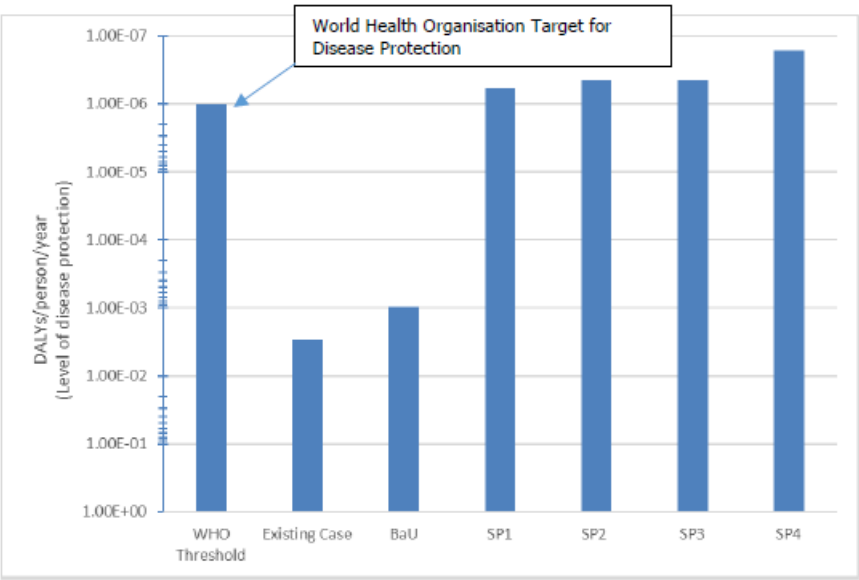

Figure 2 - DALYs analysis[16]

For Penshurst, both the existing case and business as usual scenarios are estimated to only provide roughly half of the minimum recommended level of disease protection according to Australian and global guidelines This includes the business-as-usual scenario where it is assumed there is a gradual upgrade of systems by property owners under a business-as-usual scenario. SP2 will achieve the minimum WHO target.

SP2 will improve health outcomes, as measured by DALYs, and accordingly creates economic value through avoiding future health costs. The value of a DALY lost is set to the value of a statistical life year as described by the Department of Prime Minister and Cabinet guidance note, equal to $201,905.[17] Using this value, adjusted for the improvement in health outcomes of 1.3 DALYs, results in an estimated health benefit from SP2 of $2.2 million in NPV @ 7% terms.

[16] Decentralised Water Consulting, Version 2 dated 27 August 2020

[17] Department of Prime Minister and Cabinet, 2014, Best Practice Regulation Guidance Note Value of statistical life, available from http://www.pmc.gov.au/sites/default/files/publications/Value_of_Statistical_Life_guidance_note.pdf

4.5 Flood hazard reduction

Flood is the most common form of natural disaster in Australia. Stormwater and mainstream flow can contribute to these floods. There are a range of costs that are effectively avoided with appropriate mitigation infrastructures, including:

- Direct costs related to damages to properties from the flood impact
- Business costs related to the loss of productivity from inability to undertake normal activities in the flood affected areas
- Indirect costs can be longer term and include the impacts on directly impacted areas. Example of such costs include production losses, inconvenience of post-flood recovery
- Intangible impacts are non-market in nature, such as environmental and health impacts

Risk mitigation costs refer to the preventive measures taken to reduce the impact of flood mitigation. These costs can also be direct, indirect, and intangible.

Typically, ex-post cost estimation is used to estimate the potential flood damage risks and, therefore, costs in a given location. Care needs to be given to:

- Separate financial and economic benefit – losses suffered from business closure may be offset by gains in reconstruction activities
- Ensure valuation focuses on the benefits of flood control measures rather than the costs associated with flood damage

The SP2 project is likely to have some minor flood reduction related benefits as there is evidence that current systems overflow; however, determining the value would require a detailed analysis of the catchment area and the potential impacts arising from a flood. The valuation of the benefit in Penshurst is likely to be reflected in property price values which have been previously captured to value amenity.

4.6 Recharge and improved groundwater quality

Groundwater is often an important source of fresh water and can support complex ecosystems and agricultural production. The economic valuation of groundwater has typically focussed on the role groundwater plays as a water supply source. Groundwater valuation is location specific with higher valuations generally attaching to public and industry use compared to alternative uses such as agricultural production.

A criticism of the approaches adopted is their failure to consider the non-extractive or option values, only considering the consumptive value, e.g. in forestry or when long-term production decisions are taken with the knowledge that the resource is available in the future should surface water become unavailable.

4.6.1 Direct use values of groundwater

Direct use valuations focus on the role of groundwater as a supply source. The following provides an indicative guide to groundwater use valuation:[18]

Table 6 - Economic value of direct use of groundwater

Use	Low ($/ML)	High ($M/L)
Agriculture - irrigation	30/ML	500ML
Mining	500/ML	5,000/ML
Urban water supply	1,000/ML	3,000/ML
Households	1,400/ML	6,400/ML
Manufacturing / industry	1,000/ML	3,000/ML

Bore water extraction data shows that around 71/ML/yr of groundwater is currently being extracted in Penshurst.

Although the reductions in pollutants may result in improvements in groundwater quality, there is no evidence that the usage of groundwater resources will increase because of SP2.

4.6.2 Non-use value of groundwater

Non-use value of groundwater is the value of groundwater resource that is not currently used but may be used sometime in the future. There is also an existence value which is the value of preserving the groundwater resource as it currently stands with no intention to use it in the future. These valuations are hard to quantify as they are not linked to any tradeable good.

In relation to SP2, the project does not impact on future groundwater use, so to this extent the non-use value of groundwater remains unchanged. As such, there is no non-use value of groundwater arising from this project.

[18] Deloitte Access Economics (2013)

4.7 Water security and supply

This aspect of valuation focuses on what economic value is created when water supply is improved and restrictions during periods of water shortage are avoided or reduced, or improvements in water quality and reliability are achieved.

Most of these studies have focussed on developing countries where there are issues in the ability to access water in the first instance. To the extent the studies have been undertaken in developed countries they have tended to focus on improvements in water quality, e.g. fishing, boating and swimming. A Victorian study indicated residents would be prepared to pay several times the normal water price to avoid water restrictions during drought periods. Another Australian study showed a clear value for providing recycled water for outdoor use.

The SP2 project does not deliver economic benefits from providing additional water security and supply.

4.8 Wastewater management

In Australia around 10% of wastewater is recycled for reuse. Recycled wastewater can be used by households, industries, agriculture, and natural ecosystems. Being able to capture, recycle and use wastewater, therefore, has an economic value; the end use being a major determinant of the economic value. There is a view supported in the literature that the public is increasingly willing to pay for recycled wastewater water.

The SP2 project involves the construction of local gravity sewers to direct sewage from the 217 smaller, constrained properties to local, cluster systems within road reserves. It incorporates recirculating, lined, planted evapotranspiration beds (Rhizopod™ or similar) with winter storage to treat and reuse water for landscape watering. Excess recycled water will be stored and used for public open space irrigation in warmer months.

The project seeks to improve and source additional water for outdoor use from the wastewater system and therefore, does create a wastewater management value. The challenge is in determining whether this exceeds the amenity value identified above. The most suitable studies have focussed on what residents would be willing to pay for use on their properties for additional water, whereas the proposal under SP2 is for public use, a benefit more readily associated with public amenity. The benefit from the additional water supply is therefore considered as part of the broader amenity benefit identified.

Appendix A - Proposed solution

The preferred solution is referred to as SP2 - Gravity Sewer to Local Cluster Management Systems:

> *The current preferred wastewater servicing option is Solution Package 2 (SP2). It offers a cost-effective way to address current constraints to managing wastewater on-site for the majority of properties within the township zone whilst also achieving other water cycle and liveability benefits by beneficially reusing 100% of wastewater, close to source, to create enhanced public open space. It is a relatively low energy and low maintenance concept; however, the decentralised nature of infrastructure will require adaptation with respect to governance and operation. It is envisaged that refinement of the CBA will result in a BCR of 1 or higher for SP2*[19].

All raw wastewater to drain to enhanced local precinct / cluster treatment and reuse systems via gravity sewers. These cluster reuse systems have been sized and costed for significantly higher levels of reuse which eliminates the need for downstream infrastructure. This option provides enhanced ability for commercial and property renewal / growth and includes more capacity for growth whilst meeting EPA requirements.

Table 7 - Summary of SP2

Summary	Component	Description
Wastewater Discharge (gravity sewer) of all wastewater to local precinct / cluster treatment and reuse systems. On-property management / reuse (only where full containment is possible).	On-property	• Upgrade existing septic systems to achieve full on-site containment on larger lots (84 lots) where feasible – secondary treatment system (e.g. aerated treatment unit or recirculating media filters) with subsurface irrigation or evapotranspiration absorption (ETA) trenches to meet regulatory (EPA CoP) requirements. • Decommission existing septic system for properties that cannot fully contain all wastewater on-site (217 lots). Discharge of all wastewater to new gravity sewer. • All systems managed by single competent and accountable authority (upgrade works and operation).
	Collection	• Gravity sewer collecting all wastewater from properties within Service Area where full containment is not achievable. Conveyance to local cluster treatment / reuse systems.
	Treatment	• Treat sewage from smaller properties utilising evapotranspiration / wetland treatment (e.g. Rhizopod) system at nominated reserves / public open spaces for subsurface irrigation reuse (greening of public open space – approximately 6 hectares in total) at sustainable rates. • Winter storage and enhanced evapotranspiration of Rhizopod enables discharge to the environment to be prevented.
	Environmental / Human Health	• ≥96% TN/TP reduction in wastewater nutrient loads. • Achievement of human health protection targets.
	Liveability	• Establish and maintain green open space throughout town.
	Water cycle	• Establish local cluster irrigation (greening and planting of public open space) at feasible locations (road reserves / public open space). Reduced water extraction / demand for residential and road reserve / public open space land application. • Significantly improved wastewater management (flow and pollutant loads) into existing ponds / wetlands which are directly connected to groundwater. • Significantly improved human health risks from reduced affluent exposure potential.

[19] Decentralised Water Consulting (2020)

	Long-term growth	• Capacity for town renewal / growth to better match long-term community and Council expectations. Cluster systems based on existing dwellings increasing to four-bedroom dwellings on existing lots in the long term.

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