Jersey Water

Water Resources and Drought Management Plan

Appendix F.
Risk and Resilience Assessment

CONTENTS

JERSEY WATER RESOURCES AND DROUGHT MANAGEMENT PLAN

APPENDIX F. RISK AND RESILIENCE ASSESSMENT

1. PURPOSE

This appendix sets out the level of resilience exhibited by the Jersey Water supply system to key risks and issues that may affect future water resource availability and demand for water over the planning period.

2. JERSEY WATER KEY OPERATIONAL ASSETS: OVERVIEW

Jersey Water's raw water supply system consists of eleven catchment streams, seven pumped stream abstractions, one desalination plant and two groups of boreholes. These raw water supply assets feed into eight reservoirs and two raw water tanks of varying capacities. The reservoirs can be grouped into 4 different supply systems (see Appendix C for more detail).

Raw water supplies can generally be moved around from one storage asset to another but there are limits to the maximum volume of water that can be transferred due to pipe and pumping capacities. Due to more productive raw water supply catchments in the west of the island and greater storage in the east, there is a greater flexibility in moving water from west to east than in the opposite direction.

Raw water sources are typically blended at the Handois and Augrès Water Treatment Works (WTW) in differing ratios according to source availability, raw water storage levels and water quality; each WTW usually operates on a blend of two raw water sources. Once treated, water is distributed to the Handois or Augrès Treated Water Tanks and then into the wider treated water distribution system, with key service reservoirs at Westmont and Les Platons.

3. WATER QUALITY RISKS

Several raw water quality risks may impact on water supply reliability to customers.

Agricultural Runoff Risks to Water Quality

The second largest sector in Jersey's economy is agriculture, primarily comprising livestock and potato growing. Agricultural land use practices have resulted in elevated nitrate (from fertiliser application), phosphorus (principally from animal faeces) and pesticide levels.

Nitrate

Due to the abundance of farmed land, nitrate levels in some catchment streams and storage reservoirs often peak above raw water quality standards and historically this has led to some occasional breaches of the treated water quality standards at the customer tap. There have been no breaches of the treated water standard for nitrates since 2013, but management of raw water source abstraction to prevent such water quality breaches may impact on water supply reliability.

Increases in raw water nitrate concentrations are often associated with periods of increased precipitation. When levels rise in groundwater, which contributes to surface water stream flow, evidence suggest that the diffuse nitrate pollution in the groundwater is conveyed to the streams during such periods. During an ongoing drought, nitrate issues are less likely to arise, however a heavy rainfall even during a drought recovery period may lead to a flushing of recently applied nitrate fertiliser into waterbodies which can adversely affect raw water quality. The timing of nitrate application is seasonal and closely allied to the growing season for potatoes (planting from January to April, harvesting from the end of March through to July[1]).

The agricultural sector is aware of the risks nitrates pose to water quality and closely manage, control and measure nitrate application. Management techniques include the use of insoluble fertilisers, slow release fertilisers and precision dosing in place of spraying. Amongst others, these techniques significantly reduce the risk of a nitrate build-up during a prolonged dry period, absent of flushing. Nevertheless, there remains a risk that nitrate levels can rise above a level at which raw water supplies may need to be 'turned away' from storage facilities in order to protect drinking water quality, leading to a risk to water supply reliability in drought conditions.

States of Jersey Nitrate Derogation

The Water Law 1972 has set the post treatment, maximum nitrate threshold as 50 NO_3/l. Due to the intensive agriculture on the island historically causing elevated nitrate levels beyond the full control of Jersey Water's catchment management and treatment processes, the States of Jersey has permitted Jersey Water a temporary derogation (or relaxation) allowing 33% of post treatment samples to have nitrate levels between 50 NO_3/l and 70 NO_3/l. This is only a temporary relaxation and is due to expire in December 2021. A range of actions are being implemented to address this issue, including joint work between Jersey Water, States of Jersey and farming organisations under the Action for Cleaner Water Group initiative.

Other agricultural risks to water quality

Agricultural slurry stores can pose a risk to raw water quality, particularly as many are situated in close proximity to catchment streams. There is no formal proactive inspection and certification process in place for such stores, and currently no regulation or enforcement beyond the Water Pollution (Jersey) Law 2000. A significant slurry spill during June 2020 in Fern Valley resulted in the catchment being unavailable for a number of months, along with Millbrook and Dannemarche reservoirs.

Nutrient loading from agricultural runoff does lead to problems with algal blooms in the raw water reservoirs which can lead to less efficient treatment and may give rise to taste and odour issues in drinking water supplies to customers.

Risks from application of pesticides, herbicides and fungicides remains a challenge for the management of water quality in the Jersey Water catchments. Recent work (since 2016) with the Action for Cleaner Water Group has reduced the risk through the control of certain products within

[1] https://jerseyroyals.co.uk/about-us/ accessed 15/05/2020

certain catchments, whilst Jersey Water has invested in the use of Powdered Activated Carbon dosing at its treatment works to manage the risks to treated water quality.

These raw water quality risks may also lead to raw water supplies being 'turned away' and leading to a supply deficiency in drought conditions.

PFOS/PFOA Raw Water Quality Issues

The output of the St Ouen's boreholes is presently constrained due to groundwater chemical pollution. Historic firefighting foam from the Jersey Airport fire training ground has leaked into the environment and groundwater via seepage and/or due to a lack of self-contained drainage facilities historically at the airport. Key chemical components of the foam have been detected in groundwater samples, namely perfluorooctane sulphonate (PFOS) and perfluorooctanoic acid (PFOA)[2]. PFOS and PFOA are persistent organic pollutants which do not degrade.

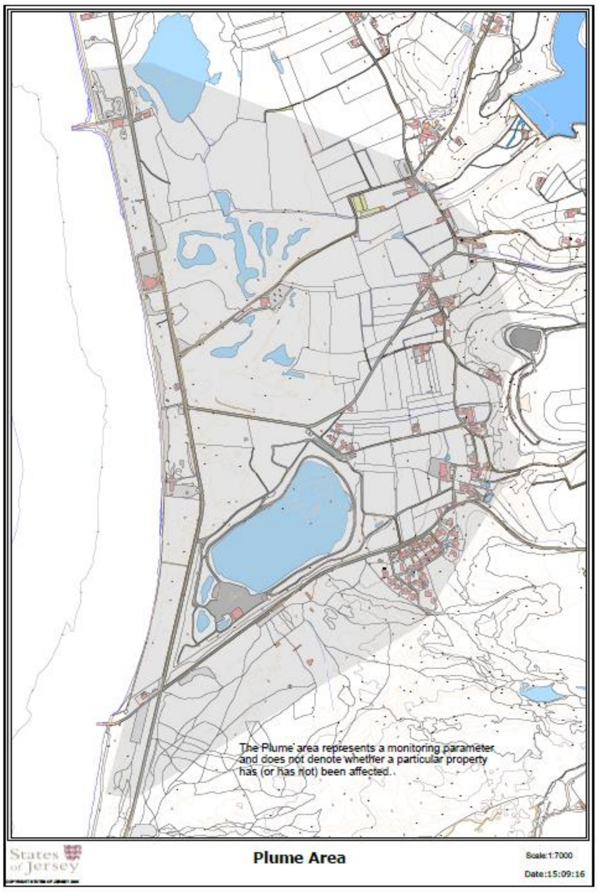
To the east of Jersey Airport, the Pont Marquet catchment stream is also affected by the same PFOS/PFOA historic pollution, albeit at lower levels. At the time of writing, data collection for this source is still ongoing but this has the potential to further constrain abstraction and blending opportunities in the Val de la Mare supply system.

Current UK Drinking Water Inspectorate (DWI) guidelines are at 1µg/l for PFOS and 5µg/l for PFOA in treated water supplies. Currently, St Ouen's boreholes output has been reduced from around 1 Ml/d to 0.3 Ml/d to ensure that drinking water supplies continue to meet these standards and to minimise the risk of drawing the contaminated plume further towards the boreholes. **Figure F.1** shows the extent of the PFOS/PFOA contamination plume. The existing water treatment processes are not sufficient to remove the PFOS/PFOA at higher borehole outputs, but it is considered that Granular Activated Carbon (GAC) processes can effectively address the current levels of contamination and may be a solution in the future.

Within the European Union it is understood that the forthcoming revisions to the Drinking Water Directive include the provision for a new limit specifically of 0.1ug/l for total PFAS. Jersey Water is currently compliant with this lower limit, but a lower future regulatory standard may reduce the flexibility and blending opportunities from affected sources.

[2] www.jerseyairport.com/SiteCollectionDocuments/PFOS%20MalB%20Technical%20Report.pdf accessed 15/11/2018

Figure F.1 St Ouen's Aquifer PFOS Plume Area 2005



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4. ISOLATED POSITION

Due to the Jersey being an island that is relatively remote from the UK and France mainland, there is a longer lead time to bring in imported materials such as water treatment chemicals and replacement parts for water supply infrastructure. Additionally, Jersey is not readily able to tanker or ship water into the island during a drought or other water supply emergency, and the availability of such water tanker vessels at short notice is very limited. As a result, Jersey Water operates a critical spares policy and a high standard of asset maintenance to reduce the risks associated with these longer supply chain delivery timescales. This provides a high degree of resilience for the raw water supply system and consequently a low outage risk.

5. POWER SUPPLY OUTAGE RISK

Between 90% and 95% of Jersey's power is imported from France via three electricity supply links across two routes, with the remainder of the power provide by the States of Jersey power plant at La Collette. Electricity supplies on the island are therefore relatively robust and reliable. Jersey Water's key water supply assets, including La Rosière desalination plant, Augrès and Handois WTWs, abstraction pumps and pumped transfers are all fed by the Jersey electricity distribution grid. Backup power generation is available at the two WTWs (including the coverage of Handois Treated Water Pumping Station) and three of the critical raw water pumping stations in case of a loss of power supply. Two mobile generators are also available to support treated water distribution pumping if required.

Jersey Electricity has a Customer Minutes Loss[3] performance of 8 minutes indicating a high level of electricity supply reliability. Given this performance and the availability of Jersey Water's back-up power generators, it is unlikely that Jersey Water will lose power supplies and be unable to abstract and treat water for any material duration of time that would adversely impact water supplies to customers for more than a few hours.

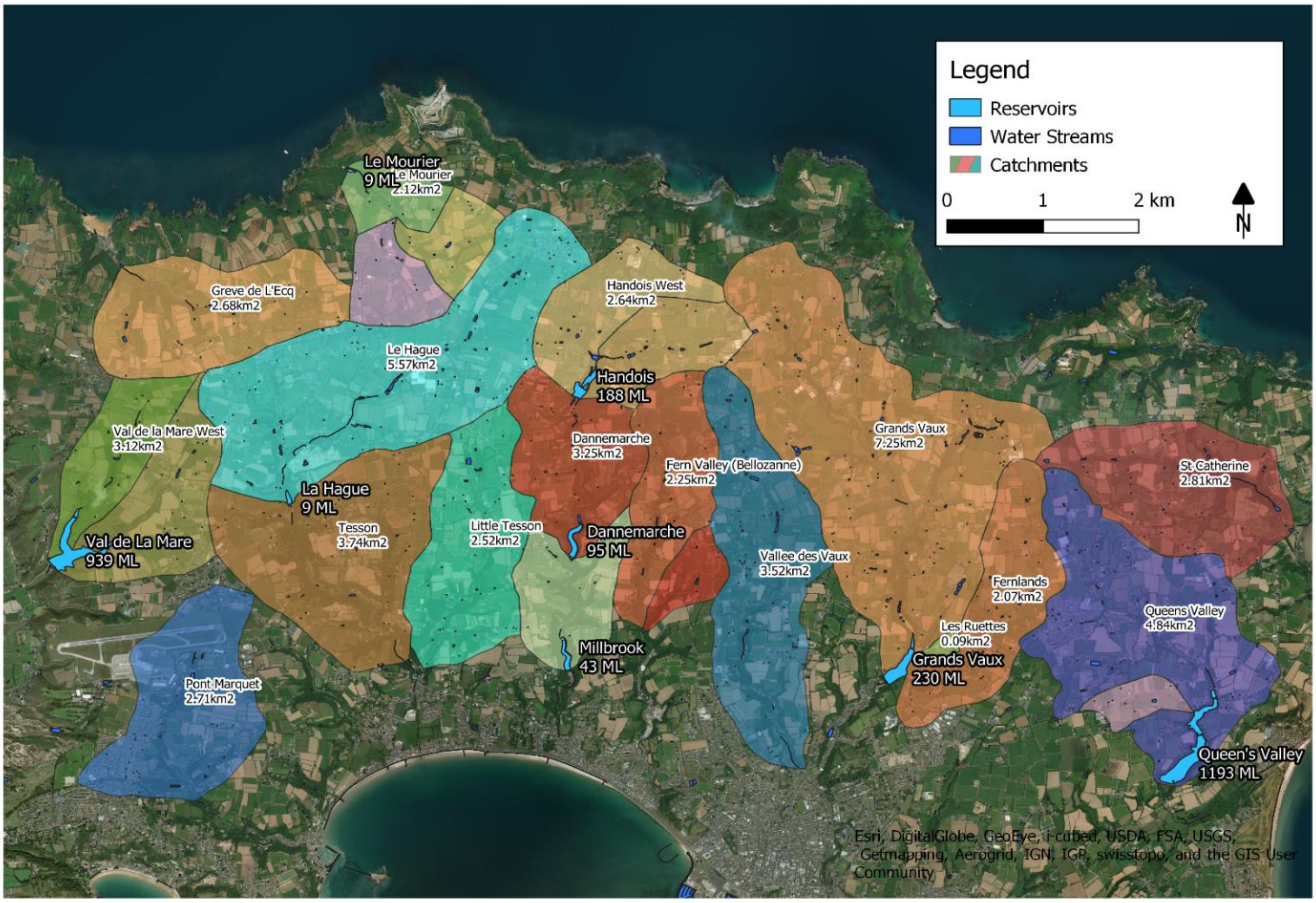
6. WEST TO EAST RAW WATER CONVEYANCE

There is a raw water supply and storage disparity between the west and the east of the island, with a much greater reliable yield in the west (principally from La Rosière desalination plant) but with the largest raw water storage reservoir in the east (Queen's Valley Reservoir). **Figure F.2** shows the size of Jersey catchments and their associated reservoirs. West to East raw water conveyance from areas with large catchments (west) to areas with a high storage capacity (east) can take place, but with some limitations on the volumes that can be transferred, via an indirect route through a washout into the Grands Vaux catchment stream, then by onward pumping to Queen's Valley. More water could be moved from west to east if a new dedicated West to East raw water main was laid from Mont Gavey to Queen's Valley. This would allow more western sources to supplement Queen's Valley storage whilst also being able to continue abstracting water from Queen's Valley for treatment. If the supply system can be adapted to facilitate increased water transfers across the island, additional water supply resilience would be delivered both during drought and in the event of any major raw water infrastructure outages (e.g. due to asset failure, major reservoir remedial works or prolonged adverse raw water quality). This enhancement to the raw water supply system would also help improve the ability for blending of freshwater sources with desalination water supplies from La Rosière desalination plant[4], particularly if the option to increase the output of La Rosière were to be implemented providing an additional 5.4 Ml/d of reliable supply. The West to East transfer enhancement is considered further in Appendix I (Option Appraisal) and Appendix J (Programme Appraisal and Decision-Making).

[3] Average of total length of time electricity supplies were interrupted during a year per customer. From: www.jec.co.uk/about-us/responsibility/security-of-supply. Accessed 20/12/2018.

[4] The transfer of desalinated water from Val de la Mare uses the existing Val de la Mare pumping main, and so a new valving arrangement would be required in order to prevent desalinated water entering Mont Gavey tank and arriving for treatment at Handois. Remineralisation options for desalinated water would need to be considered as part of the potential further expansion of La Rosiere and are likely to provide a more robust solution.

Figure F.2 Jersey Water Catchments and Supply Reservoirs



7. BLENDING REQUIREMENTS FOR DESALINATION

Whilst La Rosière desalination plant provides a high degree of water resources resilience, there is a requirement for the desalination water supply to be blended with freshwater prior to full treatment at the water treatment works. In normal operation, this is usually achieved by blending the desalination water with water from Val de la Mare reservoir (and associated freshwater sources in the Val de la Mare raw water system) prior to full treatment at Handois WTW. Blending in the smaller reservoirs in Waterworks Valley is not a viable option due to their small capacity (and particularly in drought when reservoir storage is low). This means that maintaining sufficient supply availability from the Val de la Mare reservoir system is critical to ensure the resilience benefits of La Rosière desalination plant are available in the event of drought or a supply outage elsewhere in the raw water supply system. Risks of outages to the Val de la Mare reservoir system therefore need to be carefully managed and reduced to as low as reasonably practicable to ensure adequate dilution of the desalination water. Water quality deterioration (including risk of algal blooms in the reservoir) and reservoir safety risks are the main risks to be managed at Val de la Mare: there is a robust dam safety inspection and maintenance regime in place to manage dam safety risks, a bypass is in operation on one of the two main inflow streams to Val de la Mare reservoir to be able to divert water of adverse water quality and work is continuing to manage the catchment risks with landowners.

8. RISK AND RESILIENCE ASSESEMENT

Tables F.1 to **F.4** summarise the assessment of the impact of a range of plausible risk scenarios that may affect supply reliability to customers under different demand and supply conditions, as well as against future demand projections. These scenarios include:

- zero output from St. Ouen's Boreholes due to PFOS/PFOA contamination
- risk of elevated raw water nitrate concentrations, thereby limiting use of some raw water sources to maintain treated water quality standards at the customers' tap
- loss of one of the four main raw water supply systems (Grands Vaux, Water Works Valley, Queen's Valley, Val de la Mare) to a major pollution incident or other unplanned incident
- total loss of output from one or both of the La Rosière desalination plant treatment streams
- outages for each of the two water treatment works.

A range of 'double jeopardy' scenarios have also been considered to represent very low probability but high-risk situations. For each scenario, the tables below indicate the likely scale of any water supply deficit.

A series of assumptions have been made in-order to complete the risk and resilience assessment. These assumptions are set out below.

Key assumptions:

1. Peak week demand can be met by maximising supply from other raw water storage reservoirs for this 7-day period even in drought conditions.
2. Peak week demand can be met without using the La Rosière desalination plant even in drought conditions by maximising supplies from reservoirs for this 7-day period.
3. Scenario linked to elevated nitrate levels would affect all supply-demand conditions. This scenario assumes a worse case position where 10% of reservoir supplies (10,000 m^3 in a dry year[5]) are affected by elevated nitrate concentrations (although improved land use management practices make this scenario very unlikely, but the scenario has been set to provide a "stress test" for the raw water supply system).
4. The La Rosière desalination plant does not normally contribute to the water supply in a 'normal' year when there are adequate water supplies from the freshwater sources.
5. If there is no supply available from Val de la Mare reservoir, water from the La Rosière desalination plant **cannot be used** as there would be insufficient freshwater supplies available to dilute the desalination water from other sources prior to treatment. This limits the resilience afforded by the desalination plant in any scenario where Val de la Mare reservoir supplies are not available.
6. Water from La Rosière desalination plant can be conveyed to Grands Vaux for blending/dilution, if necessary, but this is dependent on not taking any raw water supplies from the eastern sources as there is only the single main from the East.

[5] The figure of 10,000m^3 is relatively high compared to nitrate figures since 2015 where there has been increased use of nitrate management, control and measurement by the agricultural sector.

7. The 'Dry year peak week' demand figure is given as dry year peak week plus an additional 10% of dry year peak week to cater for uncertainty in the demand forecast.
8. Dry year demand forecasts for future years include dry weather effects and climate change impacts.

Conservative estimates for the Handois Treatment Work capacity (25 Ml/d) have been used to represent an operational treatment capacity that is sustainable over a period of months, rather than use the maximum design capacity of 28 Ml/d which may not necessarily be sustained continuously over a period of months. **Annex A** sets out the key asset capacity assumptions used in this risk and resilience assessment.

Below is the key to the colour coding used in the following risk scenario assessment tables (**Tables F.1 to F.4**). The volumetric values in the coloured cells indicate the estimated scale of the supply surplus (postive values) or deficit (negative values) in cubic metres per day (m^3/d) arising in the specified scenario. A supply deficit indicates a failure to supply customers at the tap, with the greater the scale of the supply deficit, the greater the number of customers that would be impacted.

Key:	10,000+	10,000 to 5,000	5,000 to 1,000	1,000 to 0	0 to -1,000	-1,000 to -5,000	-5,000 to -10,000	-10,000-

Table F.1 Resilience Assessment for Risk Scenarios at 2018 Demand Levels

At the 2018 demand levels, the raw water supply system demonstrates an overall reasonably high level of resilience under normal weather and demand conditions. Under single impact scenarios, a temporary supply deficit may occur under normal year conditions if Val de la Mare reservoir was lost to a pollution event or La Rosière desalination plant had an outage of one or both treatment streams. The loss of Handois WTW production has a significant impact under any peak week demand scenario, indicating the key importance of this asset. The loss of any asset has a significant impact under dry year-annual average supply-demand conditions as it increases the existing initial supply-demand deficit. The loss of both desalination streams at the La Rosière plant would lead to a deficit of over 10,000 m^3/d in dry weather conditions when freshwater sources are limited. The loss of Val de la Mare reservoir has a double impact on supply in that it also would preclude use of the La Rosière desalination plant due to a lack of sufficient freshwater to blend with the desalination water supply.

	YEAR : 2018					Impact Scenarios										Double Jeopardy Impact Scenarios			
						St. Ouens	Elevated nitrate levels	Grands Vaux	Water Works Valley	Queen's Valley	Val de La Mare	Desal (1 Stream)	Desal Stream 1 + 2	WTW Augres	WTW Handois	Water Works Valley + Val de La Mare	Desal (Stream 1) + Val de la Mare	Desal (Stream 1+2) + Val de la Mare	WTW Handois + Queens Valley
	Demand		Supply		Surplus/ Deficit	Nil Output	Reduced output from raw water sources	Loss of supply from pollution				Loss of output		Loss of output		Loss of output			
	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)
Supply - Demand Conditions	Normal Year Peak Week	25824	Peak WTW Capacity	39000	13,176	13,176	12,176	13,176	13,176	13,176	13,176	13,176	13,176	-824	-11,824	13,176	13,176	13,176	-11,824
	Dry Year Peak Week	26798	Peak WTW Capacity	39000	12,202	12,202	11,202	12,202	12,202	12,202	12,202	12,202	12,202	-1,798	-12,798	12,202	12,202	12,202	-12,798
	Dry Year Peak Week +10%	29798	Peak WTW Capacity	39000	9,202	9,202	8,202	9,202	9,202	9,202	9,202	9,202	9,202	-4,798	-15,798	9,202	9,202	9,202	-15,798
	Normal Year Annual Average	19713	Average Supply	23000	3,287	2,987	2,287	1,957	1,697	747	-10,933	-2,113	-7,513	5,287	-5,713	-12,523	-10,933	-10,933	-5,713
	Dry Year Annual Average	20456	WAFU	19209	-1,247	-1,547	-2,247	-2,577	-2,837	-3,787	-15,467	-6,647	-12,047	4,544	-6,456	-17,057	-15,467	-15,467	-6,456

Table F.2 Resilience Assessment for Risk Scenarios at 2025 Forecast Demand Levels

As demand increases, the level of risk to water supplies increases and the magnitude of deficit increases. The loss of Queen's Valley Reservoir would now cause a supply deficit under normal year annual average-average demand conditions. This indicates that moving forward, there is a need to consider additional water sources and supply resilience enhancements over the coming decade.

	YEAR : 2025					Impact Scenarios										Double Jeopardy Impact Scenarios			
						St. Ouens	Elevated nitrate levels	Grands Vaux	Water Works Valley	Queen's Valley	Val de La Mare	Desal (1 Stream)	Desal Stream 1 + 2	WTW Augres	WTW Handois	Water Works Valley + Val de La Mare	Desal (Stream 1) + Val de la Mare	Desal (Stream 1+2) + Val de la Mare	WTW Handois + Queens Valley
						Nil Output	Reduced output from raw water sources	Loss of supply from pollution				Loss of output		Loss of output		Loss of output			
	Demand		Supply		Surplus/ Deficit														
	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)
Supply - Demand Conditions	Normal Year Peak Week	27003	Peak WTW Capacity	39000	11997	11,997	10,997	11,997	11,997	11,997	11,997	11,997	11,997	-2,003	-13,003	11997	11997	11997	-13003
	Dry Year Peak Week	28075	Peak WTW Capacity	39000	10925	10,925	9,925	10,925	10,925	10,925	10,925	10,925	10,925	-3,075	-14,075	10925	10925	10925	-14075
	Dry Year Peak Week +10%	30882.5	Peak WTW Capacity	39000	8117.5	8,118	7,118	8,118	8,118	8,118	8,118	8,118	8,118	-5,883	-16,883	8117.5	8117.5	8117.5	-16883
	Normal Year Annual Average	20613	Average Supply	23000	2387	2,087	1,387	1,057	797	-153	-11,833	-3,013	-8,413	4,387	-6,613	-13423	-11833	-11833	-6613
	Dry Year Annual Average	21432	WAFU	18784	-2648	-2,948	-3,648	-3,978	-4,238	-5,188	-16,868	-8,048	-13,448	3,568	-7,432	-18458	-16868	-16868	-7432

Table F.3 Resilience Assessment for Risk Scenarios at 2035 Forecast Demand Levels

Under 2035 conditions, the resilience of the supply system in a dry year peak deteriorates further. The loss of any raw water storage reservoir will have an effect under normal year annual average conditions. Measures will need to be considered to address these risks in the future.

	YEAR : 2035					Impact Scenarios										Double Jeopardy Impact Scenarios			
						St. Ouens	Elevated nitrate levels	Grands Vaux	Water Works Valley	Queen's Valley	Val de La Mare	Desal (1 Stream)	Desal Stream 1 + 2	WTW Augres	WTW Handois	Water Works Valley + Val de La Mare	Desal (Stream 1) + Val de la Mare	Desal (Stream 1+2) + Val de la Mare	WTW Handois + Queens Valley
	Demand		**Supply**		**Surplus/ Deficit**	Nil Output	Reduced output from raw water sources	Loss of supply from pollution				Loss of output		Loss of output		Loss of output			
	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)
Supply - Demand Conditions	Normal Year Peak Week	28494	Peak WTW Capacity	39000	10506	10,506	9,506	10,506	10,506	10,506	10,506	10,506	10,506	-3,494	-14,494	10506	10506	10506	-14494
	Dry Year Peak Week	29724	Peak WTW Capacity	39000	9276	9,276	8,276	9,276	9,276	9,276	9,276	9,276	9,276	-4,724	-15,724	9276	9276	9276	-15724
	Dry Year Peak Week +10%	32696.4	Peak WTW Capacity	39000	6303.6	6,304	5,304	6,304	6,304	6,304	6,304	6,304	6,304	-7,696	-18,696	6303.6	6303.6	6303.6	-18696
	Normal Year Annual Average	21751	Average Supply	23000	1249	949	249	-81	-341	-1,291	-12,971	-4,151	-9,551	3,249	-7,751	-14561	-12971	-12971	-7751
	Dry Year Annual Average	22690	WAFU	18176	-4514	-4,814	-5,514	-5,844	-6,104	-7,054	-18,734	-9,914	-15,314	2,310	-8,690	-20324	-18734	-18734	-8690

Table F.4 Resilience Assessment for Risk Scenarios at 2045 Forecast Demand Levels

By 2045 there is a supply deficit under a greater number of scenarios but there remains a supply surplus in every peak week demand scenario excluding those scenarios involving water treatment works outages. Measures will need to be considered to address these increasing risks by 2045.

	YEAR : 2045					Impact Scenarios										Double Jeopardy Impact Scenarios			
						St. Ouens	Elevated nitrate levels	Grands Vaux	Water Works Valley	Queen's Valley	Val de La Mare	Desal (1 Stream)	Desal Stream 1 + 2	WTW Augres	WTW Handois	Water Works Valley + Val de La Mare	Desal (Stream 1) + Val de la Mare	Desal (Stream 1+2) + Val de la Mare	WTW Handois + Queens Valley
						Nil Output	Reduced output from raw water sources	Loss of supply from pollution				Loss of output		Loss of output		Loss of output			
	Demand		**Supply**		**Surplus/ Deficit**														
Supply - Demand Conditions	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)	(m3d)
	Normal Year Peak Week	29884	Peak WTW Capacity	39000	9116	9,116	8,116	9,116	9,116	9,116	9,116	9,116	9,116	-4,884	-15,884	9116	9116	9116	-15884
	Dry Year Peak Week	31279	Peak WTW Capacity	39000	7721	7,721	6,721	7,721	7,721	7,721	7,721	7,721	7,721	-6,279	-17,279	7721	7721	7721	-17279
	Dry Year Peak Week+ 10%	34406.9	Peak WTW Capacity	39000	4593.1	4,593	3,593	4,593	4,593	4,593	4,593	4,593	4,593	-9,407	-20,407	4593.1	4593.1	4593.1	-20407
	Normal Year Annual Average	22812	Average Supply	23000	188	-112	-812	-1,142	-1,402	-2,352	-14,032	-5,212	-10,612	2,188	-8,812	-15622	-14032	-14032	-8812
	Dry Year Annual Average	23877	WAFU	17569	-6308	-6,608	-7,308	-7,638	-7,898	-8,848	-20,528	-11,708	-17,108	1,123	-9,877	-22118	-20528	-20528	-9877

9. CONCLUSIONS

The resilience assessment shows that the Jersey raw water supply system and water treatment works assets are typically resilient under dry year peak week demand conditions, unless there is a total outage of one of the two water treatment works for more than 24 hours (with service reservoir storage supporting demand for outages of a shorter duration) – this is a low risk given the high standard of maintenance of both of the treatment works and the critical spares policy of Jersey Water, as well as the availability of standby generators in the event of a grid power failure.

Raw water supply system and treatment works asset resilience over a longer duration (months) - including during non-drought years – is lower. There is the potential for water supply failure risks if there are major raw water and treatment asset outages over a prolonged period (1 month or greater), even under average summer demand conditions. The scale of risk increases over the planning period as demand is forecast to continue to increase over the 25-year planning period.

It is important that these risk scenarios are considered and solutions or mitigation and/or contingency measures are developed. Several resilience enhancement options have been considered as part of the development of the Water Resources and Drought Management Plan are set out in Appendix I, in particular consideration of enhancement to west to east transfers given the resilience risks identified in the above assessment. Further work is also being carried out by Jersey Water through its operational and asset management planning activities to address resilience risks and develop capital or operational solutions where this is cost-effective, taking account of the impact of water supply failure on customers.

The resilience assessment highlights the criticality of the inter-dependency of the Val de la Mare reservoir supplies and use of La Rosière desalination plant due to the need for blending of the desalination water with sufficient freshwater supplies. The resilience assessment has highlighted the critical importance of avoiding any loss or reduced supplies from Val de la Mare reservoir in order to ensure that blending of the desalination water from La Rosière can be achieved. Water quality is the key outage risk to be managed at Val de la Mare reservoir and further water quality protection measures beyond those already in place for the Val de la Mare catchment are recommended, including additional catchment management measures to reduce the risks presented by nitrate, pesticide and nutrient runoff from agricultural land use.

Consideration may also be given to provision of a re-mineralisation process within the raw water supply system to modify the chemistry of the desalination water prior to treatment at Handois WTW which would reduce the reliance on the need for blending with freshwater supplies from Val de la Mare reservoir. Additionally, the existing asset management and operational plan for Val de la Mare reservoir and the blending of the desalination water should be reviewed to establish whether any improvements can be made to reduce the risks associated with the blending process.

Details on the supply resilience options considered as part of the Water Resources and Drought Management Plan are set out in Appendix I.

Annex A. Key Asset Capacity Assumptions

The following table sets out key asset capacity assumptions used in this risk and resilience assessment.

Site / Asset	Theoretical maximum Ml/d	Operational maximum Ml/d	Maximum used in Risk & Resilience Assessment	Reasoning / description for value used on Risk & Resilience Assessment
Handois WTW	28	28	25	Assessment is based on a throughput that can be reliably sustained for at least 1 week or more, rather than a daily instantaneous maximum. This recognises the need for backwashing and other operations that temporarily reduce throughput. A conservative value has been adopted, recognising that at any one particular time there may be a degree of minor outage affecting the WTW throughput.
Augrès WTW	20	17	14	Max output through 1 UV Reactor is 14 Ml/d, can operate second reactor but hydraulic maximum for onward distribution is approximately 17Ml/d, including 6 Ml/d from Maufant Booster to LPSR & Eastern Distribution. Assessment is based on a throughput that can be reliably sustained for at least 1 week or more, rather than a daily instantaneous maximum. This recognises need for backwashing and other operations that temporarily reduce throughput. A conservative value has been adopted recognising that at any one particular time there may be a degree of minor outage affecting the WTW throughput.
St Ouen's Boreholes	1.0 Ml/d	0.3 Ml/d	0.3 Ml/d	The operational maximum value has been used in the assessment which reflects the constraints on abstraction from the St Ouen's boreholes due to the historic PFOS contamination of the aquifer upgradient of the boreholes.

La Rosière desalination plant	10.8 Ml/d	5.4 Ml/d for each of Stage 10.8 Ml/d for both Stages	5.4 Ml/d for each of Stage 10.8 Ml/d for both Stages	Operational maximum has been assumed. A more conservative value has not been applied for the assessment as the water is not being treated for direct supply so some minor reductions in output within a day do not materially affect supplies to customers.
Reliable yield of reservoir systems	N/A	N/A	1.39 Ml/d Grands Vaux 1.62 Ml/d Water Works Valley 2.6 Ml/d Queen's Valley 3.42 Ml/d Val de La Mare	Reliable yields (deployable output) values have been used in the assessment based on those set out in Appendix C to ensure consistency and based on the worst historic drought (which approximates to around a 1 in 200 year drought event). The Val de la Mare reservoir system yield used in this assessment excludes the benefit from the desalination plant and the St Ouen's boreholes that are included in the yield value presented in Appendix C.