SCALE AND IMPACT OF THE GOGO STATION IRRIGATED AGRICULTURE PROPOSAL

A response to media comments from the Proponent

Version 2

By Dr Ryan Vogwill, Hydrogeologist

About the Author

Dr Ryan Vogwill has been an influential Hydrogeologist in Western Australia for 15 years. He has undertaken project work and provided advice regarding the management of water resources and environmental impacts across most business areas and across all regions of WA, and with nationally and internationally based projects. During time working in Government, he played a significant role in establishing and in the initial application of the Perth Regional Aquifer System Model, a platform for more responsible and informed management of groundwater resources in the Perth region. He was the Supervising Hydrologist for the Natural Diversity Recovery Catchment Program in the now Department of Biodiversity, Conservation and Attractions. He was also a member of the modelling technical reference groups for Ord Stage 2 - Weaber Plains and the Southern River/Murray River MIKE-SHE modelling projects by CSIRO. He was also formerly an Associate Professor at the University of Western Australia, where he established, coordinated and was the primary lecturer for the Hydrogeology MSc course at UWA. He supervised research students and undertook research himself in ecohydrology and hydrogeology.

About Version 2

Version 2 includes additional gauging data that has become available to the author since the publication of Version 1. This occurred because a data request made via the then Department of Water website omitted data now available at http://kumina.water.wa.gov.au that the author has since been made aware of. Critical information such as this should have been provided by the proponent in their proposal to the EPA so that organisations and individuals who have an interest in the project could make an informed assessment of its potential impacts.

Version 2 has been rewritten with the gauging data from Mt Krass on the Margaret River. This version retracts comments about the availability of a water resource in the Margaret River for the proposal. However, the author's assessment of a lack of detail presented by the proponent in terms of potential impact on the lower Margaret and Fitzroy Rivers and concern for the environment in and around the project area remains largely unchanged. The potential for impact is reduced but not ameliorated by the increase in water flows in the Margaret River.

Front cover images:
Main, Dry season Fitzroy River, image: Tim Nicol.
Inset (L to R)
Nymphaea Kimberleyensis, image: Carlos Magdalena. Cherabun, image: Jason Fowler.
Margaret River in flood, image: Phillip Schubert.

Back cover images:
Main, Camballin Barrage, image: Matt Moreton-Deakin.
Inset (L to R)
Fitzroy River, image: Matt Moreton-Deakin. Dry Creekbed in the Kimberley.

CONTENTS

Scale and impact of the Gogo Station Irrigated Agriculture Proposal

A response to media comments from the Proponent

Dr Ryan Vogwill, Hydrogeologist

Environmentalists say:

- The proposal is to extract 50 billion litres from the Fitzroy River for industrial agriculture.
- That amount of water is 6.5 times the annual water usage of Broome — an unsustainable amount.

Gogo Station says:

- The proposal is modest and means taking about 0.7 per cent of the average annual flow of the Fitzroy River.
- The amount is roughly the equivalent of taking a teaspoon of water out of a one litre bucket.

Source: ABC Kimberley[1]

Summary

Gogo Station has referred a proposal for large-scale irrigation near Fitzroy Crossing in the Kimberley to the WA Environmental Protection Authority for public comment. The proposal is to take 50 billion litres of water per year from the Margaret River to irrigate approximately 4,335 hectares, and 5 billion litres of groundwater per year to irrigate 665 hectares of land to grow crops, which could include cotton. The proposal is to clear up to 8,335 hectares of land, which would become irrigation areas with associated infrastructure.

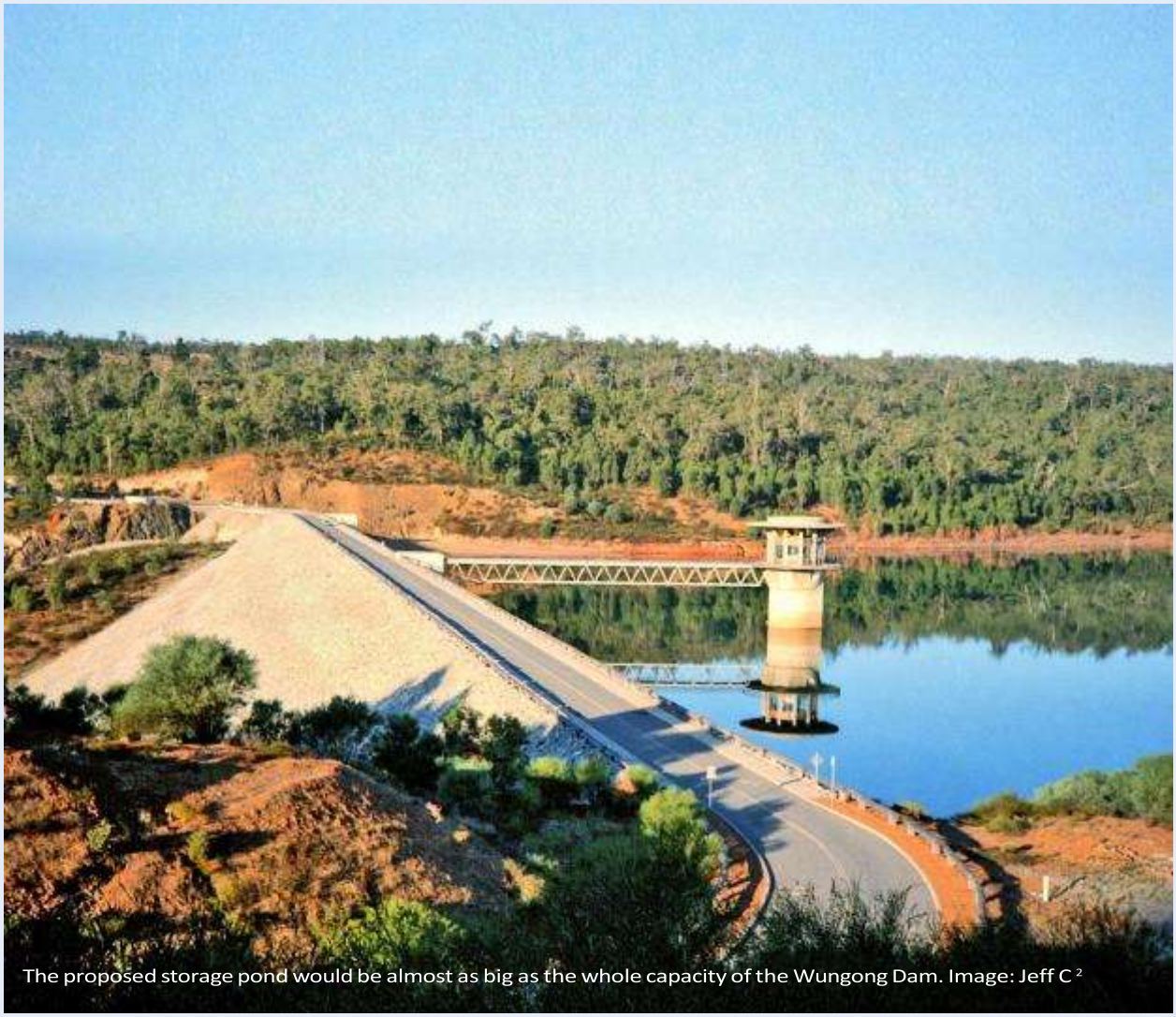
In response to concerns from environmental groups about proposed water extraction and land clearing, Gogo Station has claimed that the proposed water allocation is modest and represents about 0.7% of the average annual flow of the Fitzroy River. This paper examines that assertion and finds that it is not an accurate reflection of the impact of the proposed water extraction.

Key reasons for this assertion being inaccurate are:

- The proposal is to take water from the Margaret River, a tributary of the Fitzroy River, so it is unclear why they are comparing their proposed allocation to the Fitzroy River water flows. **An analysis of publicly available information about flow volumes show that in one in five years 50GL would be greater than 5% of the annual flow. Average annual take from the Margaret River would likely be in the range of 3.3-9.1% of flow.**
- Percentage of average annual flow is not a good indicator of the impact potential of the project on the River system. Flow in the river is highly variable inter-annually and throughout the year. For the 59 years from 1957 to 2014, 50GL represents 0.5% to 35% of the total flow in the Fitzroy River. **In one in five years, the proposed take is over 5% of the total Fitzroy River flow, and in one in ten years it is over 10% of flow — a significant impact on the river in the years when it is most vulnerable to water abstraction.**
- The project needs to be considered in the context of other possible water extraction projects. The allocation of water from the Fitzroy catchment should be scaled to allow for annual flow variation, and should be reduced to zero in the years when flow volume is very low. **It is not clear if the project could survive with multiple years of zero water allocations.**

[1] http://www.abc.net.au/news/rural/2017-09-25/green-groups-launch-campaign-against-gogo-irrigation-plans/8980912 accessed 16.10.2017

- The proposal to store up to 200 GL during flows typical of a big wet would require an approximate dam area of 6,400 hectares, assuming the dam could be built to 3 metre water depth. Water would evaporate at a rate of around 100GL per year, potentially emptying the dam within two years from evaporation alone.
- When a take of 45GL from the Yaragadee aquifer in the Southwest was proposed, $12m was spent on 5 years of investigations, which resulted in the proposal being abandoned because of its environmental impacts and lack of public support.
- **To put 50GL in context, 50 GL is more water than can be stored in the Stirling Dam and almost as much as can be stored in the Wungong Dam. It is equivalent to 10% of the water in Sydney Harbour.**
  200 GL is more water than is stored in any of the individual dams in the Southwest and nearly 1/3 of the 630 GL total capacity of all the Southwest's dams. 200 GL is 40% of the water held in Sydney Harbour.
- Government studies have identified that the project could impact on Geikie (Darngku) Gorge, and assessment of these impacts are not mentioned by the proponent in the referral information.[2]



The proposed storage pond would be almost as big as the whole capacity of the Wungong Dam. Image: Jeff C [2]

[2] Department of Water (DoW), (2017), West Kimberley Water for Food Project, GoGo Station & lower Fitzroy scan of surface water dependent values.

[3] Under Creative Commons, source: https://www.flickr.com/photos/88572252@N06/19982239542

Key Points

Further background and detail on the summary and additional concerns:

1) Why is the proponent comparing the proposed abstraction to the total annual flow in the Fitzroy River? The proposed abstraction point is on the Margaret River and the percentage of flow this allocation would constitute is at least double that in the Fitzroy, and can be as high as 13% of the flow in the Margaret River in the years for which data is available. Longer term data is available for the Fitzroy River and some of these years have lower flow than those available in the Margaret River data sets.

   Further, the proponent is asking for approval to take up to 200GL of water in years where there are sufficient flows. This means that in years where the percentage of flow that 50GL would represent is lower; it is likely that the proponent would in reality be taking up to 200GL. Under the proposed gravity fed design, it could be difficult for the proponent to limit the take. It is therefore assumed that when 50GL is less than 5% of total flow, up to 200GL take is possible. Under this scenario the average annual percentage take from the Margaret River is estimated as in the range of between 3.3% and 9.1% of flow (see Table 3).

   Maximum take could be as high as 19%. 50GL alone is more than 5% of flow in the Margaret River in one in five years.

   The analysis above is based on data from Mt Krass Station (1964-2017) with incomplete data years removed.

   Detailed modelling would be required to properly estimate the total take from the river, and understand the risk and magnitude of impacts on the dependent ecosystems.

2) The abstraction point is located on the Margaret River and there are dependant ecosystems (aquatic and terrestrial) between the surface water abstraction point and the junction of the Fitzroy and Margaret rivers. Blariyaning Creek and Mount Pierre Creek may have conservation values that would be impacted if these creeks were used as a 'water supply canal' for the project. My previous advice on the Gogo Station proposal provides maps of these Groundwater Dependent Ecosystems.[4] No information is provided on how the 50 GL/y (or 200 GL/y during high flow years) of water extraction is going to affect those ecosystems.

The Fitzroy is home to a vast number of species, like these giant waterlilies and Cherabun, whose life cycles are linked to the variable flow of the river. Images: Carlos Magdalena, Jason Fowler.

[4] See Table 2 and Notes on Table 2 on page 7.
[5] See maps in 'Review of Water issues around Gogo Station Irrigated Agriculture Proposal' by R Vogwill: http://www.likenowhereelse.org.au/future_fitzroy

3) In terms of the 50 GL allocation as a percentage of the total flow in the Fitzroy River, the average does not tell the complete story. **50 GL varies from 0.13% to 35% of the total flow.** In 12 of the years from 1957 to 2014 this is more than 5% of the total flow. In 6 years this is more than 10% of the total flow. The 200 GL take proposed varies from 0.5% to 139% (average 2.9%) of the annual flow and is more than 5% in 30 years and more than 10% in 16 years from 1957 to 2014 (see Table 1). It is very unclear under what circumstances the proponent would take 200 GL, and how it would be stored.

4) The analogy of a teaspoon in a 1-litre bucket (with reference to 50GL/y being 0.7% of the total annual average flow of 6961 GL) is not particularly useful; it needs to be put in the context of other potential water uses, as well as the environment and cultural values. As pointed out above, 50 GL is a greater proportion of the total annual flow in many of the years (see point 3 above). 5% is comparable to 1 scoop of ice-cream in a 1 litre punnet; 10% is two scoops.

5) One of the main issues for the whole Fitzroy catchment (including the Margaret River) is how you allocate water resources in what is a highly variable flow regime. In the highest flow years 50 GL is not a large proportion of the total annual flow and should have minimal impacts on the overall flow of the river that year as an isolated allocation. However, 5% to 10% of the flow is much more significant in low-flow years. But what happens if there are 10 or 20 more similar proposals? Any allocation in the Fitzroy Catchment will likely need to be able to be scaled (with 0% allocations being an appropriate option in low flow years). **What happens to this project if the proponents cannot take surface water for 2 or 3 years?** Storing water on site will be difficult owing to the high evaporation rates and the volume of water they are proposing to take during high flows. This is expanded upon in the next point.

6) How can the proponent store the 200 GL of water they propose to take in flood years? 50 GL is 10% of the water held in Sydney Harbour, or enough water to fill 20,000 Olympic swimming pools. 200 GL is 40% of the water in Sydney Harbour or enough water to fill 80,000 Olympic swimming pools. Even if the water storage facility was 3m deep (unlikely, given the landscape), 200 GL would require an 8km x 8km storage facility (64 square km or 6400 ha), which is well over half the proposed freehold area of 8986 ha (89.86 square km). Such an area would be exposed to rapid evaporation as detailed below.

a. the potential evaporation is 2000mm (or 2m) per year in the area

b. this needs to be corrected for a relatively deep-water body by using a 'pan to lake correction factor' of approximately 0.7, which equates to 1.4m per year of evaporation from a fresh, deep water body. The evaporation pans used by BoM to measure potential evaporation are small, shallow and wide, so more easily evaporated than a large water body.

c. **Even if the water storage facility could be constructed, the contents would evaporate in 2 years, losing just under 100 GL per year.** A more extensive, shallower storage would lose more water to evaporation.

7) Putting 50 GL in the context of water allocations in Southwest WA:

   a. South West Yarragadee — In this project the Water Corporation was the proponent, seeking approval for a 45 GL/y allocation from the Yarragadee aquifer in the Southern Perth Basin. The water was to be used in the Integrated Water Supply System, which supplies much of the coastal Southwest and some of the inland areas. After 5 years of investigations costing over $12 m, the proposal was rejected over concerns about environmental impacts and social license to operate (the people of the Southern Perth Basin didn't want the water to be used in other jurisdictions).

   b. 50 GL is more water than can be stored in the Stirling Dam and almost as much as can be stored in the Wungong Dam. 200 GL is more water than is stored in any of the individual dams in the southwest and nearly 1/3 of the 630 GL total capacity of all the Southwest's dams.

   c. Perth's groundwater water use from Gnangara Mound (our premier drinking water aquifer) had a total of 238 GL/y allocated in 2013–14 across public and private supplies so the 50 GL Gogo Station Allocation is 21% and 200 GL is 84%.

   d. In 2004, a total of 600 GL of groundwater was abstracted from about 152 000 bores in both the Perth Metropolitan Groundwater and Gingin Groundwater Areas. Of this, 487 GL was from the Perth Metropolitan Groundwater Area, and 113GL from the Gingin Groundwater Area, where water uses are mostly horticultural.

      50 GL/y Gogo Station Allocation is 8.3% of all the groundwater used in Perth in 2004, and 200 GL is 33% (most up-to-date total figures available are from Davidson and Yu, 2006).

The Camballin Barrage on the Fitzroy River has already caused issues for the migration of endangered sawfish. Image: Matt Moreton-Deakin.

8) In prior advice the Department of Water has recommended a number of studies be carried out by proponents before large surface water allocations are made. These recommendations are not referenced or addressed in the proponents report. They include concerns about impacts on Geikie Gorge and this risk is not mentioned in the proponents provided documentation.

The recommendations from the Department are listed below[6]:

a. We recommend that further work be undertaken by proponents to demonstrate that water extraction (and diversion) does not influence hydrological processes and inland water environmental quality important for maintaining:

- In-stream and aquatic habitat for high risk, high value species likely to be threatened and priority species.
- Geikie Gorge's environmental, cultural and social values.
- Riparian and/or ground-water-dependent vegetation.
- Values associated with aquatic habitats, including, rivers, creeks, pools, wetlands, billabongs and springs on GoGo Station.

The lack of these recommended studies suggests that the proponent has not collected adequate information to be making bold statements about the lack of impact on the Fitzroy and Margaret Rivers in the media.

9) The proponent makes contradictory statements about the management of hydrological flows across the proposed development area, these are:

The project will include a surrounding levee bank which will encompass the agricultural land to enable management of internal runoff, create a barrier for biosecurity to avoid rouge crop spread from within the development to the surrounding grassland area, including various storm detention system to capture and settle internal storm runoff and any materials/crop matter washed from the fields.

And;

Within the primary development area, natural floodways will be retained as areas of native vegetation. Preservation of these floodways minimises the impact of the development on natural hydrological regimes within the locality. Floodways will also function as corridors of native vegetation to permit habitat connectivity across the development.

These contradictions suggest that adequate thought has not yet been given to the design of the proposal for the proponent to be making bold statements about the lack of impact on the Fitzroy and Margaret Rivers in the media.

[6] Department of Water (DoW), (2017), West Kimberley Water for Food Project, GoGo Station & lower Fitzroy scan of surface water dependent values.

Table 1:
Annual Flow in the Fitzroy and percentage flow made up by 50GL and 200 GL

Year	Annual Flow (GL)	50 GL as % of total flow	200 GL as % of total flow
1957	545.6	9.2	36.7
1958	360.5	13.9	55.5
1959	2783	1.8	7.2
1960	4790	1.0	4.2
1961	838.6	6.0	23.8
1962	143	35.0	139.9
1963	3815	1.3	5.2
1964	369.1	13.5	54.2
1965	772.4	6.5	25.9
1966	2260	2.2	8.8
1967	8726	0.6	2.3
1968	6661	0.8	3.0
1969	5542	0.9	3.6
1970	279	17.9	71.7
1971	3794	1.3	5.3
1972	1564	3.2	12.8
1973	3353	1.5	6.0
1974	8767	0.6	2.3
1975	3272	1.5	6.1
1976	37840	0.1	0.5
1977	35460	0.1	0.6
1978	36900	0.1	0.5
1979	33970	0.1	0.6
1980	3540	1.4	5.6
1981	294.1	17.0	68.0
1982	11050	0.5	1.8
1983	11350	0.4	1.8
1984	10250	0.5	2.0
1985	609.2	8.2	32.8
1986	9111	0.5	2.2
1987	3550	1.4	5.6
1988	791.1	6.3	25.3
1989	2182	2.3	9.2
1990	1342	3.7	14.9
1991	10160	0.5	2.0
1992	467.4	10.7	42.8
1993	13280	0.4	1.5
1994	2667	1.9	7.5
1995	11290	0.4	1.8
1996	3220	1.6	6.2
1997	8249	0.6	2.4
1998	2546	2.0	7.9
1999	7245	0.7	2.8
2000	16940	0.3	1.2
2001	9749	0.5	2.1
2002	8531	0.6	2.3
2003	2802	1.8	7.1
2004	5989	0.8	3.3
2005	981	5.1	20.4
2006	7645	0.7	2.6
2007	4232	1.2	4.7
2008	4929	1.0	4.1
2009	8135	0.6	2.5
2010	1041	4.8	19.2
2011	19970	0.3	1.0
2012	3875	1.3	5.2
2013	1627	3.1	12.3
2014	5239	1.0	3.8
Av	6961.4	0.7	2.9

Table 2:
Surface water flow data for Margaret River at Mt Krass and percentage flow made up by 50GL and 200GL

Year	Annual Flow (GL)	Days Missing	50 GL as % of total flow	200GL as % of annual flow
1964		365		
1965	113.09	265	44.21 note missing days	176.85 note missing days
1966	1403.91	0	3.56	14.25
1967	2511.36	0	1.99	7.96
1968	2398.58	0	2.08	8.34
1969	1533.12	0	3.26	13.05
1970	377.11	0	13.26	53.04
1971	1701.67	0	2.94	11.75
1972	676.55	0	7.39	29.56
1973	1141.29	0	4.38	17.52
1974	3436.75	0	1.45	5.82
1975	1322.78	0	3.78	15.12
1976	1957.88	0	2.55	10.22
1977	795.09	0	6.29	25.15
1978	2074.70	0	2.41	9.64
1979	560.61	89	8.92 note missing days	35.68 note missing days
1980	0	365	NR	NR
1981	0	365	NR	NR
1982	0	365	NR	NR
1983	0	365	NR	NR
1984	0	365	NR	NR
1985	0	365	NR	NR
1986	0	365	NR	NR
1987	0	365	NR	NR
1988	0	365	NR	NR
1989	0	365	NR	NR
1990	0	365	NR	NR
1991	0	365	NR	NR
1992	0	365	NR	NR
1993	0	365	NR	NR
1994	0	365	NR	NR
1995	0	365	NR	NR
1996	68.09	319	73.44 note missing days	293.74 note missing days
1997	3105.73	0	1.61	6.44
1998	1342.36	0	3.72	14.90
1999	2829.64	0	1.77	7.07
2000	2335.43	199	2.14	8.56
2001	7024.03	0	0.71	2.85
2002	4055.71	0	1.23	4.93
2003	2299.27	0	2.17	8.70
2004	2820.08	0	1.77	7.09
2005	705.01	0	7.09	28.37
2006	2757.70	0	1.81	7.25
2007	2648.50	0	1.89	7.55
2008	2335.94	0	2.14	8.56
2009	2674.57	0	1.87	7.48
2010	878.53	0	5.69	22.77
2011	8879.44	0	0.56	2.25
2012	2006.91	0	2.49	9.97
2013	1010.88	0	4.95	19.78
2014	2978.12	0	1.68	6.72
2015	1236.19	0	4.04	16.18
2016	723.65	0	6.91	27.64
2017	4605.41	39	1.09	4.34

Table 3:

Estimation of the average percentage of annual flow that would be taken from the Margaret River

The low range assumes that 50GL is taken in all years. The high range assumes that 50GL will be taken in 'low flow' years, but up to 200GL could be taken in 'high flow' years. 'Low flow' years are those where 50GL is more than 5% of the annual flow in the Margaret River, all other years are considered 'high flow' for this estimation.

Years with high number of missing days have been removed.

Year	Annual Flow (GL)	Days Missing	Low range (50 GL taken)	High range (50GL taken for 'low flow' years, 200 GL taken for 'high flow' years)
1966	1403.91	0	3.56	14.25
1967	2511.36	0	1.99	7.96
1968	2398.58	0	2.08	8.34
1969	1533.12	0	3.26	13.05
1970	377.11	0	13.26	13.26
1971	1701.67	0	2.94	11.75
1972	676.55	0	7.39	7.39
1973	1141.29	0	4.38	17.52
1974	3436.75	0	1.45	5.82
1975	1322.78	0	3.78	15.12
1976	1957.88	0	2.55	10.22
1977	795.09	0	6.29	6.29
1978	2074.70	0	2.41	9.64
1997	3105.73	0	1.61	6.44
1998	1342.36	0	3.72	14.9
1999	2829.64	0	1.77	7.07
2001	7024.03	0	0.71	2.85
2002	4055.71	0	1.23	4.93
2003	2299.27	0	2.17	8.7
2004	2820.08	0	1.77	7.09
2005	705.01	0	7.09	7.09
2006	2757.70	0	1.81	7.25
2007	2648.50	0	1.89	7.55
2008	2335.94	0	2.14	8.56
2009	2674.57	0	1.87	7.48
2010	878.53	0	5.69	5.69
2011	8879.44	0	0.56	2.25
2012	2006.91	0	2.49	9.97
2013	1010.88	0	4.95	19.78
2014	2978.12	0	1.68	6.72
2015	1236.19	0	4.04	16.18
2016	723.65	0	6.91	6.91
2017	4605.41	39	1.09	4.34
Average			3.34%	9.16%

Selected References:

CSIRO. (2009). Water in the Fitzroy region Water in the Timor Sea Drainage Division. A report to the Australian Government from the CSIRO Northern Australia Sustainable Yields Project (pp. 61-128). Australia: CSIRO Water for a Healthy Country Flagship.

Davidson, W.A., & Yu, X., 2006, Perth regional aquifer modelling system (PRAMS) model development: Hydrogeology and groundwater modelling, Western Australia Department of Water, Hydrogeological record series HG 20.

Department of Water (DoW). (2017). West Kimberley Water for Food Project GoGo focus area - scan of groundwater dependent values. Water allocation planning internal report no. 3 May.

Department of Water (DoW), (2017), West Kimberley Water for Food Project, GoGo Station & lower Fitzroy scan of surface water dependent values.

Morgan, D., Thorburn, D., Fenton, J., Wallace-Smith, H., and Goodson, S. (2005). Influence of the Camballin Barrage on fish communities in the Fitzroy River, Western Australia. Murdoch University/Kimberley Land Council/Department of Environment report to Land and Water Australia.

Murray-Darling Basin Authority (MDBA). (2010). Guide to the proposed Basin Plan. Volume 1: Overview, Murray–Darling Basin Authority, Canberra.

Sinclair Knight Merz (SKM). (2010). Atlas of Groundwater Dependent Ecosystems (GDE Atlas), Phase 2, TASK 5 REPORT: IDENTIFYING AND MAPPING GDES. SKM Melbourne Australia.

SMK. (2017). GOGO STATION – SURFACE IRRIGATION DEVELOPMENT PROPOSAL, REFERRAL TO ENVIRONMENTAL PROTECTION AUTHORITY: SUPPORTING DOCUMENTATION. SMK Consultants Pty
Ltd.

Warfe, D. M., Petit, N. E., Magierowski, R. H., Pusey, B. J., Davies, P. M., Douglas, M. M. and Bunn, S. E. (2013). Hydrological connectivity structures concordant plant and animal assemblages according to niche rather than dispersal processes. Freshwater Biology, 58: 292–305. doi: 10.1111/fwb.12058

Vogwill R. 2016. Water Resources of the Mardoowarra (Fitzroy River) Catchment. The Wilderness Society. ISBN: 978-0-646-94928-4.

Winter T.C., Harvey J.W., Franke O.L., Alley W.M., Reston V.A. (1998). Ground Water and Surface Water - A Single Resource, Circular 1139, United States Geological Survey (USGS).