Northern Territory Government

DEPARTMENT OF LAND RESOURCE MANAGEMENT

End of Wet Season Stream Flow Measurements, Katherine and Daly Rivers, June 2014

Report .07/2014D
Sean Lawrie
June 2014

Bibliographic Reference
Lawrie, S (June 2014), End of Wet Season stream flow measurements, Katherine and Daly Rivers, June 2014, Northern Territory Government Department of Land Resource Management, Technical Report No. .07/2014D

ISBN	1-74350-064-5	978-1-74350-064-4	End of Wet Season stream flow measurements, Katherine and Daly Rivers, June 2014.

For further information contact:
Department of Land Resource Management
PO Box 496, Palmerston, NT, 0831
Australia

Cover photo: Daly River, Oolloo crossing. Sean Lawrie

Table of Contents

Summary

Stream flow and water quality measurements were made along the reaches of the Katherine and Daly Rivers in early June 2014. The flow increases progressively downstream with a maximum flow measured of 43.7 cumecs in the Daly River at Mount Nancar. The results illustrate the contribution of flows from the different aquifers and sub catchments relative to the total runoff in the Daly River.

The June 2014 stream flows are well above the average June/July flows from 1961 to 2012 at the individual monitoring sites. The stream flow measurements do indicate that there is a reduction in base flows over the last four years.

Groundwater levels were not monitored during this period.

Aim

To perform beginning of the dry stream flow and water quality measurements in the Katherine and Daly River catchments encompassing the greater part of the Tindall Limestone and Oolloo aquifers. The June monitoring exercise is intended to provide baseline information of base flow conditions for evaluation against end of dry season results.

Introduction

Water Allocation Plans (WAPs) for the Tindall Limestone (Katherine) and Oolloo aquifer aim to ensure that water allocation management is done in a sustainable manner to preserve the resource for future generations. Monitoring programs developed for each of the WAP's ensure that all monitoring complies with Department Strategies, Water Allocation Plans and Water Resource Assessment requirements.

The monitoring program consists of two categories.

- continuous monitoring of stage and discharge for the development of stage discharge relationships. This information is used to perform flow calculations and statistical analysis of catchment characteristics.
- snapshot measurements of water levels and discharges at the beginning and end of the dry season. This information is used to assist with the calibration of the hydrological model which predicts water level and flows in the Tindall Limestone Aquifer (Katherine) and Oolloo Aquifer regions.

Two sets of measurements are performed annually, usually in June and October however the timing aims to comply with the following criteria.

- measurement of water levels and flow at the beginning of the dry season when the hydrograph recession leg approaches base flow and there are no indications of further rainfall in the catchment.

- measurement of water levels and flow as late as possible in the dry season but prior to the first rains to ensure that measurements reflect the lowest flow conditions of the year.

Data collected during the June exercise is also used to compare current flow against previous year runoff, giving an indication of flows likely by the end of the season.

Observations

Measurements were carried out from the 2 June 2014 to 13 June 2014 as stipulated in the 2013/14 Water Monitoring Program. Monitoring consisted of surface water levels, stream flows and water quality parameters at the monitoring sites indicated on Figure 1. The monitoring requirements are summarised in **Appendix A,** Table 1.1; factors, which influence data quality, are summarised in point 2 Field Measurement Standards.

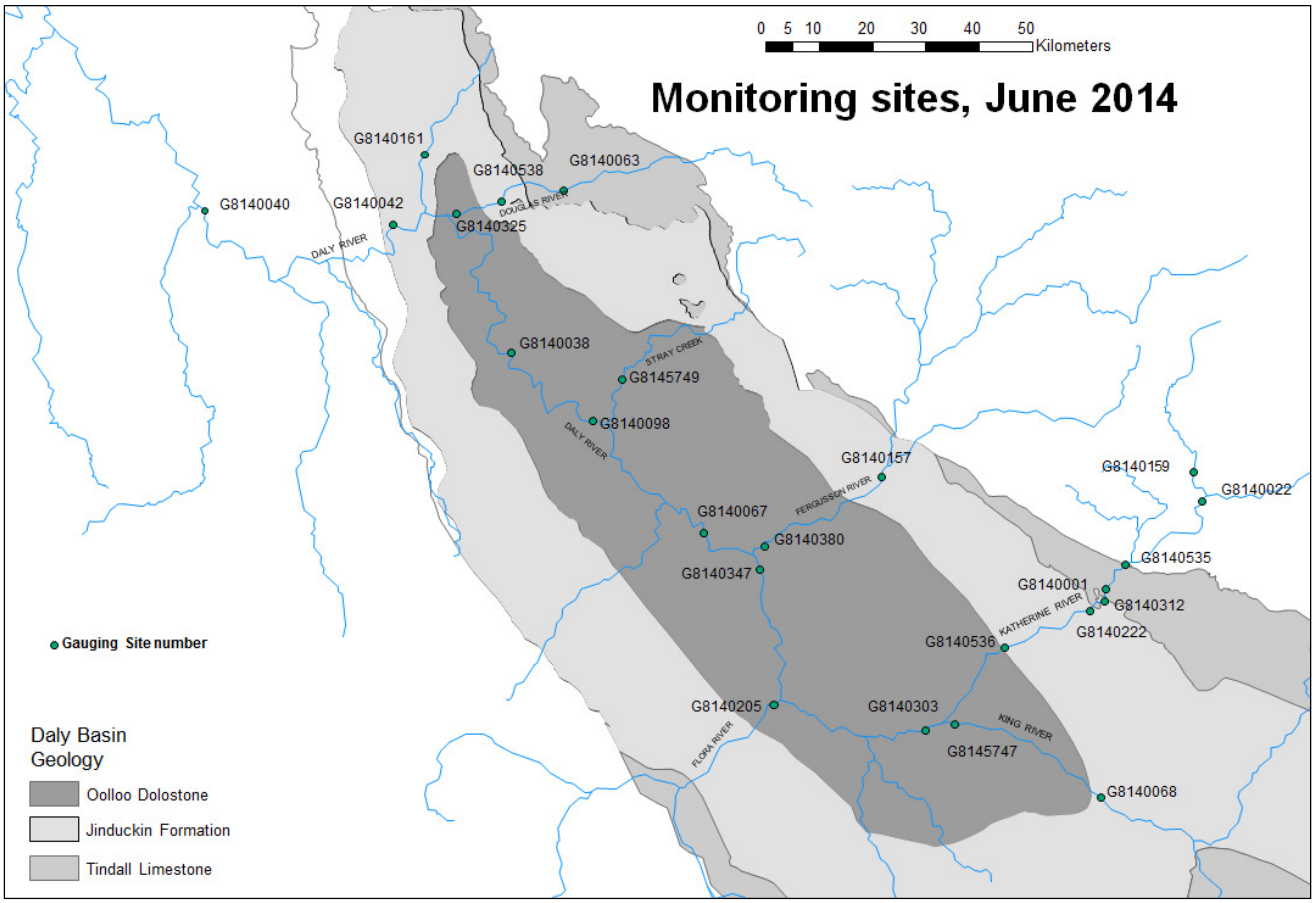

Figure 1: *Monitoring Sites, June 2014*

Water Levels

Surface water levels at monitoring sites are based on gauge board readings. The water level information together with the stream flow measurements are used to further develop the stage/discharge relationships of each monitoring site. Not all monitoring sites are

equipped with gauge boards consequently some sites had no water levels recorded. The surface water level results are tabled in **Appendix B.**

Stream Flows

The stream flow measurements were performed using a range of acoustic doppler current profiler (ADCP) instruments. Site hydraulic conditions determined which ADCP was selected, to maximise the accuracy of the flow measurements. Location of the flow measurements are depicted in Figure 2. As expected, flows increase from the upper catchment downstream to the lower catchment. Flow measurement results are tabled in **Appendix C**.

Flow measurements were performed to the required standards and quality assurance protocols were adhered to. Relative accuracy was quantified by applying a quality matrix to each individual measurement.

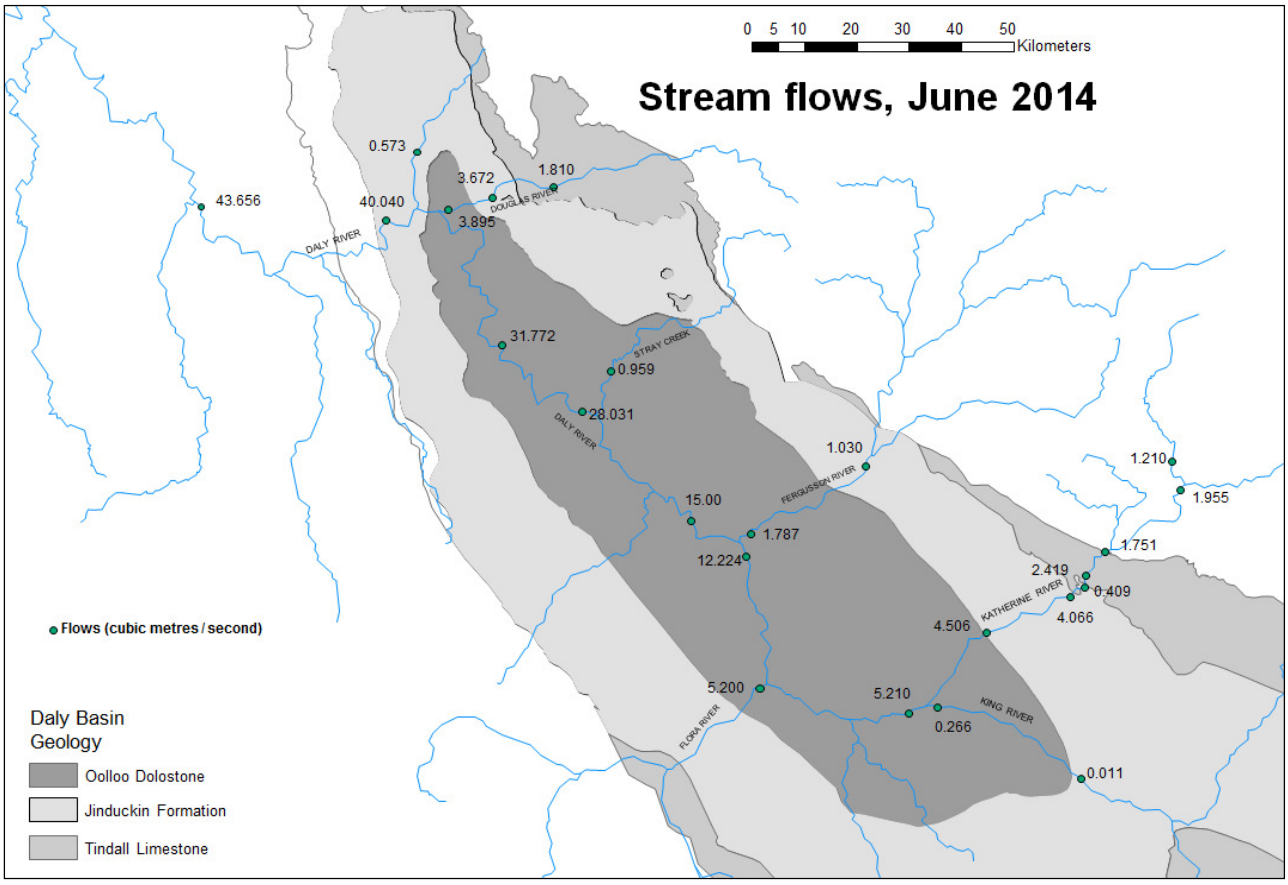

Figure 2: *Stream Flows, June 2014*

Water Quality

Water quality monitoring involved taking in-situ measurements with a Hydrolab Quanta multi-parameter sonde and collection of water samples see Table 1.1.

Table 1.1

Hydrolab Quanta	Water Samples
• Electrical Conductivity (EC) • pH • Dissolved Oxygen (DO) • Temperature	• Turbidity • General Parameters • Total Nutrients • Filtered Nutrients

Water quality measurements were performed to the required standards and quality assurance protocol, taking into account site conditions. Probes were calibrated prior to and after the snapshot measurement exercise and results adjusted for sensor drift. In-situ field results are presented in Appendix D.

Nutrients.

Nutrients occur naturally in rivers, but can also originate from human activities such as fertilizer application, storm runoff from pastoral and agricultural land, and wastewater.

Water samples were collected for analysis of soluble (nitrite (NO2), nitrate (NO3), filterable reactive phosphorus(FRP)) and total nutrients (total nitrogen (TN), total phosphorus (TN)), Soluble nutrient samples were filtered through a 0.45 µm filter in the field. All samples were refrigerated immediately after collection and frozen prior to sending to the laboratory. Samples were analysed according to APHA standard methods. The results are presented in Appendix E.

Rainfall

Telemetry rainfall data was collected from monitoring sites in the catchment over the same period as the snapshot measurements exercise to identify if local runoff affected any field measurements.

Discussion

Stream Flows

The majority of measurements performed in the Katherine and Daly River catchments comply with the continuity principle with increasing flow moving downstream towards the lower catchment. The exception is where a lower flow was observed at G8140535 (Katherine River at Ironwood Station) than at G8140022 (Katherine River at Nitmiluk Centre).

There are some cases where major discrepancies exist between measured flow and latest rating curve values in Hydstra. Aspects that influence the relationship include the following:

- unstable low flow stage discharge relationship
- control is not dominant feature and is affected by changes down stream
- the low flow stage/discharge relationships require further development.

Monitoring sites that do not have a stage discharge relationship in Hydstra show a rating deviation of 9999.99%.

The increase in stream flows from the upper to lower catchment in the Katherine and Daly River systems are illustrated in Figure 4. Flow contribution from each tributary is as indicated.

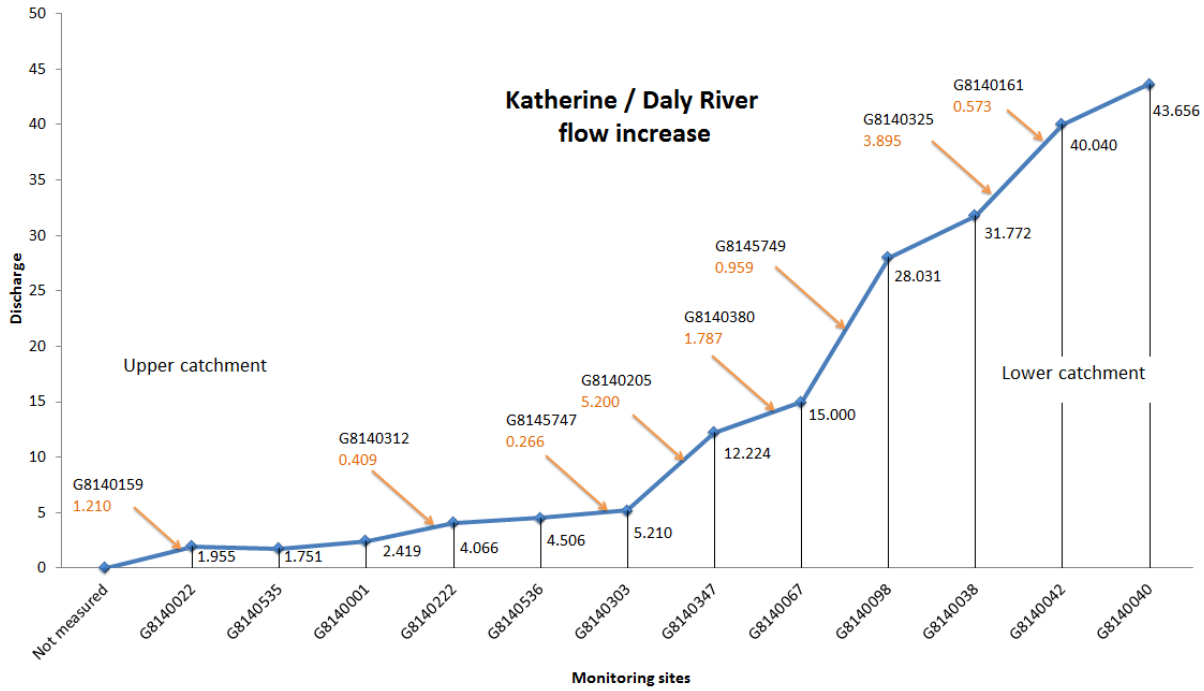

Figure 4 Increasing Flows

Two significant flow contributions to stream flow are evident; the first being the Tindall Limestone discharge in the upper reaches of the Flora River and the second where the Daly River crosses from the Florina Formation to the Oolloo Dolostone.

The contribution of flows from the sub catchments/geology formations relative to the total Katherine Daly catchment runoff is summarised in Table 1.2.

Table 1.2

Aquifer	Catchment	Flows (m^3/s)	Total Flow (m^3/s)
Tindall Limestone	Katherine	5.210	21.240
	Flora	5.200	
	Fergusson	1.787	
	Stray Creek	0.959	
	Douglas	3.895	
	Green Ant	0.573	
	Lower Daly	3.616	
Oolloo	Katherine / Daly		22.416
		Total Catchment	43.656

The stream flows measured in June 2014 at Katherine Railway Bridge (G8140001), Dorisvale (G8140067) and Mount Nancar (G8140040) are graphically shown in Figure 5 against the average June flows (or July if the June data was unusable) from 1961 to 2012 at each of the monitoring sites. The June 2014 stream flows are well above the average minimum flow at each of the respective sites although the flows do indicate that there has been a reduction in June/July average flows over the past four years.

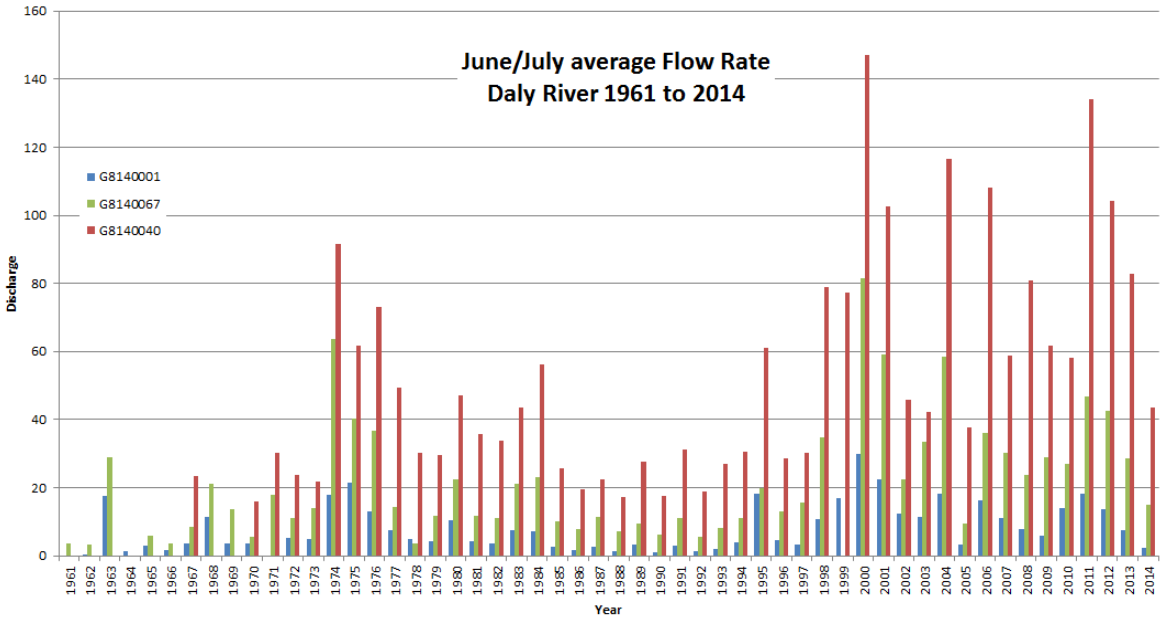

Figure 5 June/July average flows

Historically there have been regular flow measurements performed at the various monitoring sites, however it is only in the last 5 years that the measurements have been conducted concurrently allowing a snapshot view of the relative contributions of groundwater discharge for each river section. May/June flows from 2010-14 are displayed in Figure 6

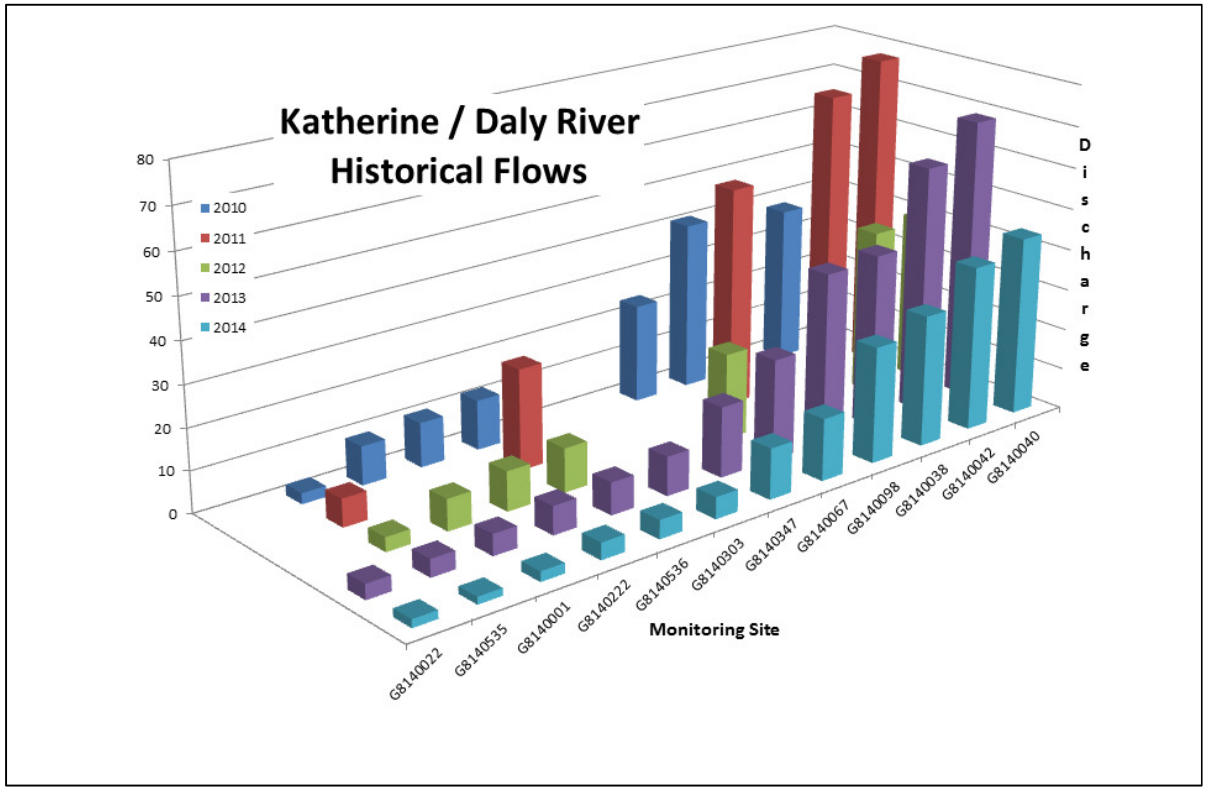

Figure 6 Historical Flows

The total rainfall during 1 May to 30 April of each water allocation plan year is graphically shown in Figure 7 for Katherine Railway Bridge (G8140001), Dorisvale (G8140067) and Mount Nancar (G8140040). Although there is not a clear correlation at all monitoring sites between the reduction in flows in Figure 6 and the total rainfall it does verify the variation in base flows over the period.

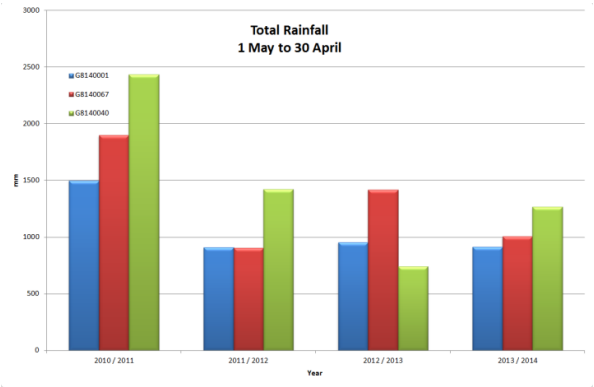

Figure 7 Total Rainfall

Water Quality

Electrical Conductivity (EC)

The electrical conductivity results vary between the monitoring points, however the data does indicate that recharge from Tindall Limestone aquifer especially in smaller tributaries has a higher electrical conductivity. This is confirmed where the electrical conductivity increases by an order of ten in the Katherine River between Ironwood, upstream of the Tindall limestone aquifer boundary and Katherine Railway Bridge, downstream of the divide.

pH

The pH results range from 6.9 to 7.9 for all sites sampled, which falls within the Australian guidelines for fresh water of 6.5 – 9.0.

Dissolved Oxygen (DO)

Factors that can affect the DO results include temperature, diffusion from surrounding air, waste product of photosynthesis and aeration. Monitoring points with high DO values are located in tributaries that contain a number of rock bars, which assist with the aeration process resulting in a higher DO value.

Turbidity

Turbidity values ranged from 1.0 to 4.1 NTU for all river and tributary sites upstream of the Daly / Green Ant Creek confluence, with the exception of Katherine Hot Springs which had a very low value of 0.1 NTU. Values for Green Ant Creek, Beeboom and Mount Nancar were > 37 NTU, these values were considered unreliable and consequently omitted..

Temperature

The water temperature in the Katherine Daly River varied between 25.8℃ and 29.0℃, with 31.5℃ water measured at Katherine Hot Springs. A Minimum temperature of 20.6 ℃ was recorded at Green Ant Creek.

Total nutrients

Total nitrogen and phosphorus concentrations ranged from 70 to 330 µg/L and 9 to 27 µg/L respectively. The highest concentrations were found in the Katherine River, downstream of the township.

Soluble nutrients

Nitrite and ammonia concentrations were low at all sites with concentrations of <10 µg/L at all sites. Nitrate concentrations varied widely from <1 to 127 µg/L with higher levels of nitrate found in the Katherine and Douglas Rivers. Soluble phosphorus ranged from <1 to 8 µg/L.

Rainfall

The total rainfall figures from 13th May to 13th June 2014 at each of the monitoring sites are supplied in Figure 3. 4mm of rainfall recorded at G8140159 occurred after the flow measurements were performed at this and other sites in the immediate vicinity. Base flow

conditions during the snapshot measurement exercise were not affected by surface water runoff generated by rainfall in the immediate catchment

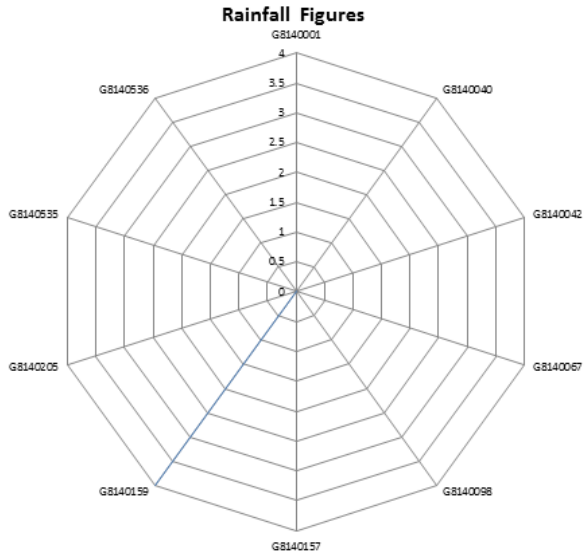

Figure 3 Rainfall Figures

Conclusion

The monitoring framework was developed to understand groundwater and surface water interactions better. This snapshot measurement exercise successfully contributed to this process and built upon results from similar exercises conducted in October 2009, May 2013 and October 2013. Patterns of groundwater discharge are consistent despite different rainfall distribution and totals.

Assessment of the flow measurements has resulted in the snapshot measurement sites for 2014/15 being revised. Katherine River at Nimiluk (G8140022), Flora River at Kathleen Falls (G8140044) and King River at the old Victoria Highway (G8140068) have been removed from the site list. A new site on Green Ant Creek closer to the confluence with the Daly will be investigated, in preference for G8140161. To increase knowledge of the relative flow contributions from the Edith and Fergusson Rivers, 6 new sites are proposed for the October 2014 snapshot exercise, above and within sections where the Rivers intercept the Tindal Aquifer.

The October 2014 exercise will incorporate groundwater measurements at a number of key bores.

Appendix A - Monitoring Requirements

1. Objectives

The monitoring objectives of Tindall Limestone Aquifer (Katherine) and Oolloo Aquifer WAP's are documented in the monitoring programs under *Monitoring Objectives* as shown in the Surface Water and Groundwater monitoring frameworks in *Diagram 1.0* and *Diagram 1.1* respectively. The monitoring objectives for the snapshot measurements are based on surface water and groundwater monitoring requirements as documented in Table 1.1.

Table 1.1

Measurement	Surface Water	Groundwater
Water Level	Gauge Board / Survey	Dip Tape
Discharge	Flow Measurement	Flow Measurement at Springs
Water Quality	Field parameters (EC, temperature, pH and DO), Major Ions, Nutrients and Metals.	Field parameters (EC, temperature, pH and DO), Major Ions, Nutrients and Metals.

The monitoring requirements for the snapshot measurements at each monitoring site are detailed in the *Monitoring Requirements* of Tindall Limestone Aquifer (Katherine) and Oolloo aquifer WAP's monitoring programs.

2. Field Measurement Standards

Water Levels

The main factors that have an influence on the accuracy of water level measurements at surface water and groundwater monitoring sites summarised in Table 1.2.

Table 1.2

Type	Conditions	Influences	Description
Surface Water	Hydraulic	Wave action	Waves created during high flows, wind and or turbulence at gauge plates
		Instrument Location	Point of measurement is a significant distance from gauge plates, especially during high flows.
		River Bend (outside)	Water level higher at the outside of the bend.
		River Bend (inside)	Water level lower at the inside of the bend.
		Velocity	High velocities creates turbulence, etc.
		Turbulence	Eddies / turbulence created at gauge boards. Create difficulty in reading due to fluctuations in water level.
		Back Flow	Back flow creates difficulties in reading gauge plates
	Site	Sediment	Sediment deposition at gauge plates. Gauge plates can be buried under sediment.
		Debris	Debris that is deposited at gauge plates. Difficult to take readings without maintenance

Type	Conditions	Influences	Description
			work
	Gauge Plates	Unstable gauge posts	Gauge posts that are unstable create inaccuracies in the gauge plate heights.
		Unreadable gauge plates	Gauge plates that are in a bad condition is difficult to read and create inaccuracies in the readings
		Gauge Plate Numbers	Missing numbers create confusion and can create mistakes of up to 1m in gauge plate readings.
		Surveys	In correct surveys and adjustments on gauge plates causes error in gauge plate readings.
Ground water	Production Boreholes	Size of Well	Insufficient space to perform water level measurements with existing equipment
		Pumping	Pumping operations influences the water level measurements
	Casing Collar	Unstable casing	Unstable casing causes errors in the water level measurement
	Level Indicators	Equipment condition	Instruments with faded increments can cause errors in measurements.
		Increments	Course increments on tape measure will lead to different interpolation of values

Stream Flow

The factors influencing the accuracy of the discharge measurements can be categorised under environmental and system influences. System influences are created by the type of instrumentation used and can be minimised if standards are followed. Environmental influences have a much greater impact as this is result of site conditions and actions by operator and for this reason will be discussed in further detail. Environmental factors that have an influence on the accuracy are the following:

- **W**: Wind: The wind causes the water level to osculate which has a large effect on the flow if the wind direction is parallel with the flow direction.
- **LP**: Large pools: Reduce velocity drastically
- **WG**: Water grass: Influences the flow measurements, very high inaccuracies with depth and velocity measurements.
- **A**: Algae growth: Algae that floats in the water influence the signal strength of the ADCP.

The Hydraulic (**H**) requirements of a monitoring section are essential for accurate discharge measurements. The monitoring site needs to comply with the following hydraulic requirements during the gauging section selection process:

- Uniform cross section
- Flow in the stream should be confined to a single well-defined channel with stable banks.

- Bends upstream of site must be avoided if possible
- Steep slopes upstream should be avoided if possible.
- Avoid deep pools that can influence the flow
- Avoid prominent obstructions in a pool or excessive plant growth that can affect the flow pattern.
- Turbulence / eddies must be avoided if possible.
- Negative / back flow must be avoided at all times.

The abbreviations for the various factors as indicated in the above information (highlighted in bold) is shown in the gauging result tables indicating the various influences encountered at each site.

Water Quality

- Instrument / Sensor calibration.
- Compliance of water sampling procedure.
- The measurement location should be as close as practical to the mid-point of the stream.
- The sensors should be as close to the surface as possible.
- Turbulence (waves, eddies) at the surface should be avoided; the measurement point should be moved away from these areas as physical-chemical parameters will be affected.
- Standing water at the edges of streams should be avoided, as these are not representative of the stream.
- Deep pools with very low flow should be sampled as close as possible to the centre of the main pool.

Appendix B – Water Levels

Site Number	Site Name	Date	Time	Level	Site Influences
G8140159	Seventeen Mile Creek at Waterfall View	03/06/2014	14:41	0.738	
G8140022	Katherine River at Nitmiluk Centre	03/06/2014	10:37	-1.532	
G8140535	Katherine River @ Ironwood Station	02/06/2014	15:42	1.411	
G8140001	Katherine River at Railway Bridge	04/06/2014	15:27	0.290	
G8140312	Katherine Hot Springs	04/06/2014		None	
G8140222	Katherine River @ Low Level Bridge	04/06/2014	16:40	0.288	
G8140536	Katherine River @ Wilden Station	05/06/2014	10:50	1.050	
G8140068	King River D/S Victoria Highway	03/06/2014	15:07	0.378	
G8145747	King River 50 metres US from Katherine River	03/06/2014		None	
G8140303	Katherine River at D/S King River	03/06/2014		None	
G8140205	Flora River @ Upstream Stoney Creek	04/06/2014	13:18	1.551	
G8140347	Daly River at Florina Homestead Crossing	11/06/2014		None	
G8140157	Fergusson River upstream of Bondi Creek	05/06/2014	11:51	2.690	
G8140380	Fergusson River at Confluence Daly River	05/06/2014		None	
G8140067	Daly River at upstream Dorisvale Crossing	02/06/2014	13:46	1.968	
G8145749	Stray Creek @ Fleming Road Crossing	02/06/2014	16:59	2.610	
G8140098	Daly River @ Theyona Station	04/06/2014	11:31	1.465	
G8140038	Daly River at Oolloo Road Crossing	03/06/2014	10:11	25.745	
G8140063	Douglas River Downstream Old Douglas Homestead	02/06/2014	14:04	0.837	
G8140538	Douglas River @ Tipperary Waterhole	03/06/2014	14:31	2.158	
G8140325	Douglas River at Tipperary Crossing	05/06/2014	11:44	2.232	
G8140161	Green Ant Creek at Tipperary	11/06/2014	14:13	0.700	
G8140042	Daly River at 2km downstream of Beeboom Crossing	10/06/2014	15:56	1.029	
G8140040	Daly River at Mount Nancar	12/06/2014	15:34	2.204	

Note: No water level measurements were performed at groundwater monitoring sites

Appendix C – Flow Measurements

The descriptions of “Site Influence” indicators are documented in Section 4.2.1.

Site Number	Site Name	River System	Flow m^3/s	Date	Gauging Instrument	Site Influences	Rating Deviation%	Comment
G8140159	Seventeen Mile Creek at Waterfall View	Tributary	1.210	03/06/2014	Streampro		3.17	
G8140022	Katherine River at Nitmiluk Centre	Main Reach	1.955	03/06/2014	Streampro		-2.50	
G8140535	Katherine River @ Ironwood Station	Main Reach	1.751	02/06/2014	Streampro		8.03	
G8140001	Katherine River at Railway Bridge	Main Reach	2.419	04/06/2014	Streampro		-6.36	
G8140312	Katherine Hot Springs	Tributary	0.409	04/06/2014	Streampro		9999.99	
G8140222	Katherine River @ Low Level Bridge	Main Reach	4.066	04/06/2014	Streampro		-0.46	
G8140536	Katherine River @ Wilden Station	Main Reach	4.506	05/06/2014	Streampro		0.27	
G8140068	King River D/S Victoria Highway	Tributary	0.011	03/06/2014	FlowTracker		22.29	
G8145747	King River 50 metres US from Katherine River	Tributary	0.266	03/06/2014	Streampro		9999.99	
G8140303	Katherine River at D/S King River	Main Reach	5.210	03/06/2014	Streampro		9999.99	
G8140205	Flora River @ Upstream Stoney Creek	Tributary	5.200	04/06/2014	Monitor 1200		6.62	
G8140347	Daly River at Florina Homestead Crossing	Main Reach	12.224	11/06/2014	Streampro		9999.99	
G8140157	Fergusson River upstream of Bondi Creek	Tributary	1.030	05/06/2014	Streampro		13.67	
G8140380	Fergusson River at Confluence Daly River	Tributary	1.787	05/06/2014	Streampro		9999.99	
G8140067	Daly River at upstream Dorisvale Crossing	Main Reach	15.000	02/06/2014	Monitor 1200		-3.30	
G8145749	Stray Creek @ Fleming Road Crossing	Tributary	0.959	02/06/2014	Streampro		-14.08	
G8140098	Daly River @ Theyona Station	Main Reach	28.031	04/06/2014	Streampro	W	1.76	
G8140038	Daly River at Oolloo Road Crossing	Main Reach	31.772	03/06/2014	Streampro	W	3.27	

Site Number	Site Name	River System	Flow m^3/s	Date	Gauging Instrument	Site Influences	Rating Deviation%	Comment
G8140063	Douglas River Downstream Old Douglas Homestead	Tributary	1.810	02/06/2014	Streampro		1.15	
G8140538	Douglas River @ Tipperary Waterhole	Tributary	3.672	03/06/2014	Streampro		8.00	
G8140325	Douglas River at Tipperary Crossing	Tributary	3.895	05/06/2014	Streampro		-7.43	
G8140161	Green Ant Creek at Tipperary	Tributary	0.573	11/06/2014	Streampro		-0.50	
G8140042	Daly River at 2km downstream of Beeboom Crossing	Main Reach	40.040	10/06/2014	Streampro		-3.17	
G8140040	Daly River at Mount Nancar	Main Reach	43.656	12/06/2014	Streampro		-9.17	

Appendix D – Water Quality Field Measurements

Quanta turbidity probes have been found to produce unreliable results. Turbidity readings listed below were measured in the lab from water samples taken at site. One of the Quantas used to measure field parameters was found to have a faulty pH sensor; highlighted red below.

Site Number	Site Name	Date	Time	Temp	pH	D.O.	DO	E.C.	Turb 1 250mL	Turb 2 250mL	Turbidity	Total Nutrient	Nutrient Filtered
				(˚C)		(mg/L)	% sat	(µS/cm)	(NTU)	(NTU)	Sample (250mL)	Sample (250mL)	Sample (125mL)
G8140159	Seventeen Mile Creek at Waterfall View	03/06/2014	15:18	26.25		7.36	91	22	1.64	1.23	✓	✓	✓
G8140022	Katherine River at Nitmiluk Centre	03/06/2014	10:55	25.85		7.45	92	26	1.90	1.79	✓	✓	✓
G8140535	Katherine River @ Ironwood Station	02/06/2014	16:10	28.40		7.63	98	33	2.15	1.86	✓	✓	✓
G8140001	Katherine River at Railway Bridge	04/06/2014	16:05	27.74		6.74	86	265	1.60	1.66	✓	✓	✓
G8140312	Katherine Hot Springs	04/06/2014	13:29	31.45		1.02	14	715	0.17	0.14	✓	✓	✓
G8140222	Katherine River @ Low Level Bridge	04/06/2014	17:20	29.05		5.77	75	429	1.96	2.18	✓	✓	✓
G8140536	Katherine River @ Wilden Station	05/06/2014	11:10	26.75		6.55	82	485	1.36	1.28	✓	✓	✓
G8140068	King River D/S Victoria Highway	03/06/2014	15:30	27.37	6.98	5.67	72	437	4.89	4.15	✓	✓	✓
G8145747	King River 50 metres US from Katherine River	03/06/2014	11:05	24.95	7.71	7.58	92	745	1.03	0.89	✓	✓	✓
G8140303	Katherine River at D/S King River	03/06/2014	10:30	26.13	7.73	7.27	90	521	1.38	1.23	✓	✓	✓
G8140205	Flora River @ Upstream Stoney Creek	04/06/2014	13:45	27.55	7.58	7.33	93	694	1.02	1.05	✓	✓	✓
G8140347	Daly River at Florina Homestead Crossing	11/06/2014	16:30	27.25		7.61	96	597	1.93	1.49	✓	✓	✓
G8140157	Fergusson River upstream of Bondi Creek	05/06/2014	12:20	26.20	7.46	6.46	80	533	2.34	2.45	✓	✓	✓
G8140380	Fergusson River at Confluence Daly River	05/06/2014	15:15	27.18		7.46	94	574	2.31	2.09	✓	✓	✓
G8140067	Daly River at upstream Dorisvale Crossing	02/06/2014	14:30	27.90	7.72	6.86	88	576	4.06	3.80	✓	✓	✓
G8145749	Stray Creek @ Fleming Road Crossing	02/06/2014	17:20	27.35	7.88	7.45	94	570	1.09	1.14	✓	✓	✓
G8140098	Daly River @ Theyona Station	04/06/2014	12:15	28.13	7.41	7.16	92	605	2.84	2.30	✓	✓	✓
G8140038	Daly River at Oolloo Road Crossing	03/06/2014	10:37	27.71	7.55	7.53	96	623	1.93	1.86	✓	✓	✓
G8140063	Douglas River Downstream Old Douglas Homestead	02/06/2014	14:47	28.69	6.98	5.48	71	374	1.07	1.29	✓	✓	✓
G8140538	Douglas River @ Tipperary Waterhole	03/06/2014	15:19	28.27	7.22	5.81	75	507	2.00	2.04	✓	✓	✓

Site Number	Site Name	Date	Time	Temp	pH	D.O.	DO	E.C.	Turb 1 250mL	Turb 2 250mL	Turbidity	Total Nutrient	Nutrient Filtered
				(˚C)		(mg/L)	% sat	(µS/cm)	(NTU)	(NTU)	Sample (250mL)	Sample (250mL)	Sample (125mL)
G8140325	Douglas River at Tipperary Crossing	05/06/2014	12:51	27.32	7.48	6.51	82	500	1.38	1.66	✓	✓	✓
G8140161	Green Ant Creek at Tipperary	11/06/2014	14:39	20.66	7.92	8.22	92	518			✓	✓	✓
G8140042	Daly River at 2km downstream of Beeboom Crossing	10/06/2014	16:25	25.97	7.95	7.96	98	602			✓	✓	✓
G8140040	Daly River at Mount Nancar	12/06/2014	16:30	25.07	7.97	7.87	96	590			✓	✓	✓

Appendix E – Water Quality - Nutrients

Sites are in upstream to downstream order. All nutrient concentrations are given in mg/L

Site Number	Site Name	Date	Time	NH3_N	NO2_N	NO3_N	PO4_P	Total N	Total P
G8140159	Seventeen Mile Creek at Waterfall View	03/06/2014	15:18	0.007	0.002	<0.001	0.002	0.11	0.016
G8140022	Katherine River at Nitmiluk Centre	03/06/2014	10:55	0.005	0.001	<0.001	<0.001	0.17	0.014
G8140535	Katherine River @ Ironwood Station	02/06/2014	16:10	0.002	0.001	0.004	0.003	0.2	0.019
G8140001	Katherine River at Railway Bridge	04/06/2014	16:05	0.002	<0.001	0.077	0.006	0.23	0.009
G8140312	Katherine Hot Springs	04/06/2014	13:29	0.001	0.004	0.12	0.007	0.19	0.025
G8140222	Katherine River @ Low Level Bridge	04/06/2014	17:20	<0.001	0.003	0.114	0.004	0.33	0.015
G8140536	Katherine River @ Wilden Station	05/06/2014	11:10	0.01	0.002	0.127	0.005	0.28	0.016
G8140068	King River D/S Victoria Highway	03/06/2014	15:30	0.009	0.0005	0.005	0.006	0.23	0.019
G8145747	King River 50 metres US from Katherine River	03/06/2014	11:05	0.004	0.002	0.009	0.006	0.11	0.027
G8140303	Katherine River at D/S King River	03/06/2014	10:30	0.007	0.002	0.051	0.003	0.21	0.016
G8140205	Flora River @ Upstream Stoney Creek	04/06/2014	13:45	0.004	0.003	0.009	0.008	0.12	0.02
G8140347	Daly River at Florina Homestead Crossing	11/06/2014	16:30	0.005	0.001	0.025	0.004	0.15	0.022
G8140157	Fergusson River upstream of Bondi Creek	05/06/2014	12:20	0.002	0.001	0.016	0.005	0.18	0.019
G8140380	Fergusson River at Confluence Daly River	05/06/2014	15:15	0.004	0.002	0.003	0.004	0.15	0.022
G8140067	Daly River at upstream Dorisvale Crossing	02/06/2014	14:30	0.005	0.002	0.017	0.005	0.15	0.019
G8145749	Stray Creek @ Fleming Road Crossing	02/06/2014	17:20	0.004	0.003	0.01	0.005	0.15	0.018
G8140098	Daly River @ Theyona Station	04/06/2014	12:15	0.003	0.001	0.021	0.006	0.15	0.022
G8140038	Daly River at Oolloo Road Crossing	03/06/2014	10:37	0.001	0.002	0.023	0.007	0.13	0.021
G8140063	Douglas River Downstream Old Douglas Homestead	02/06/2014	14:47	0.004	0.002	0.078	0.001	0.2	0.021
G8140538	Douglas River @ Tipperary Waterhole	03/06/2014	15:19	0.009	<0.001	0.058	0.004	0.19	0.017
G8140325	Douglas River at Tipperary Crossing	05/06/2014	12:51	0.008			0.004	0.22	0.023
G8140161	Green Ant Creek at Tipperary	11/06/2014	14:39	0.007	0.002	0.037	0.007	0.13	0.015
G8140042	Daly River at 2km downstream of Beeboom Crossing	10/06/2014	16:25	0.003	0.005	0.019	0.003	0.07	0.013
G8140040	Daly River at Mount Nancar	12/06/2014	16:30	<0.001	0.004	0.019	0.006	0.07	0.016