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End of dry stream flow measurements, Katherine and Daly River, October 2013

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Cover photo: Aerial Image of Daly River at Theyona. Sean Lawrie

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Summary

Stream flow and water quality measurements were made along the reaches of the Katherine and Daly Rivers in early October 2013. The flow increases progressively downstream with a maximum flow measured of 33.1 cumecs at Mount Nancar in the Daly River. The results obtained illustrate the contribution of flows from the different aquifers and sub catchments towards the total runoff in the Daly River.

The October 2013 stream flows are well above the average minimum flow 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 three years.

Groundwater levels were not monitored during this period.

Aim

To perform end 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 monitoring exercise serve two purposes, firstly compiling baseline information for the catchment to evaluate future stream flow and water quality measurements during the same period of the year and secondly to provide information to assist with the calibration of the hydrological model for the catchment.

Introduction

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

The Tindall Limestone Aquifer (Katherine) and Oolloo Aquifer WAP's monitoring programs are based on detailed monitoring objectives, frameworks and data requirements for each of the monitoring sites within the respective areas. The monitoring framework primarily consists of the following 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.
- snap shot of water levels and discharge in the catchment at the end of the wet and dry seasons. This information is used to assist with the calibration of hydrological model.

The Katherine Daly WAP Measurements report summarises the measurements performed during the ”snap shot” measurement exercise. The information collected during the measurement exercise is mainly used to assist with the calibration of the hydrological model used for the prediction of water levels and flows in the Tindall Limestone Aquifer (Katherine) and Oolloo aquifer areas.

The snap shot measurements are performed after the wet season or last flood event and at the end of the dry or before the first rainfall event, which are normally during the months of June and October respectively. The time frame of snap shot measurements are not fixed and can vary annually based on the weather conditions. The indicators that the user must take into account to determine the time for snap shot measurements can be categorised under the following points.

- measurement of water levels and flow at the end of the wet when the hydrograph recession leg approaches base flow and there are no further indication of rainfall in the catchment.
- measurement of water levels and flow at the end of dry before the first rains to ensure that measurements encompasses only base flow.

The hydrological information collected during the “snap shot” measurements is also used to compare current flow conditions against previous year runoff, which gives an approximation of what the flows would be by the end of the season.

Observations

The measurements were carried out from the 7 October 2013 to 18 October 2013 and the period was within the recommended timeframe as stipulated in the water monitoring programs. The monitoring performed during the “snap shot” measurement exercise consisted of surface water levels, stream flows and water quality parameters at the monitoring sites indicated on Figure 1. The requirements for the scheduled monitoring are summarised in **Appendix A** under monitoring objectives and field measurement standards. The field measurement standards are used to quantify the influences of measuring techniques and site conditions on the accuracy of the data sets collected.

Monitoring Sites

The monitoring sites documented in the Tindall Limestone (Katherine) and Oolloo aquifer water allocation plans for the “snap shot” measurement exercise are shown on Figure 1 in relation to known features. There were two monitoring sites; G8140044 and G8140222 excluded from the October 2013 monitoring as result of insufficient information supplied to technical teams.

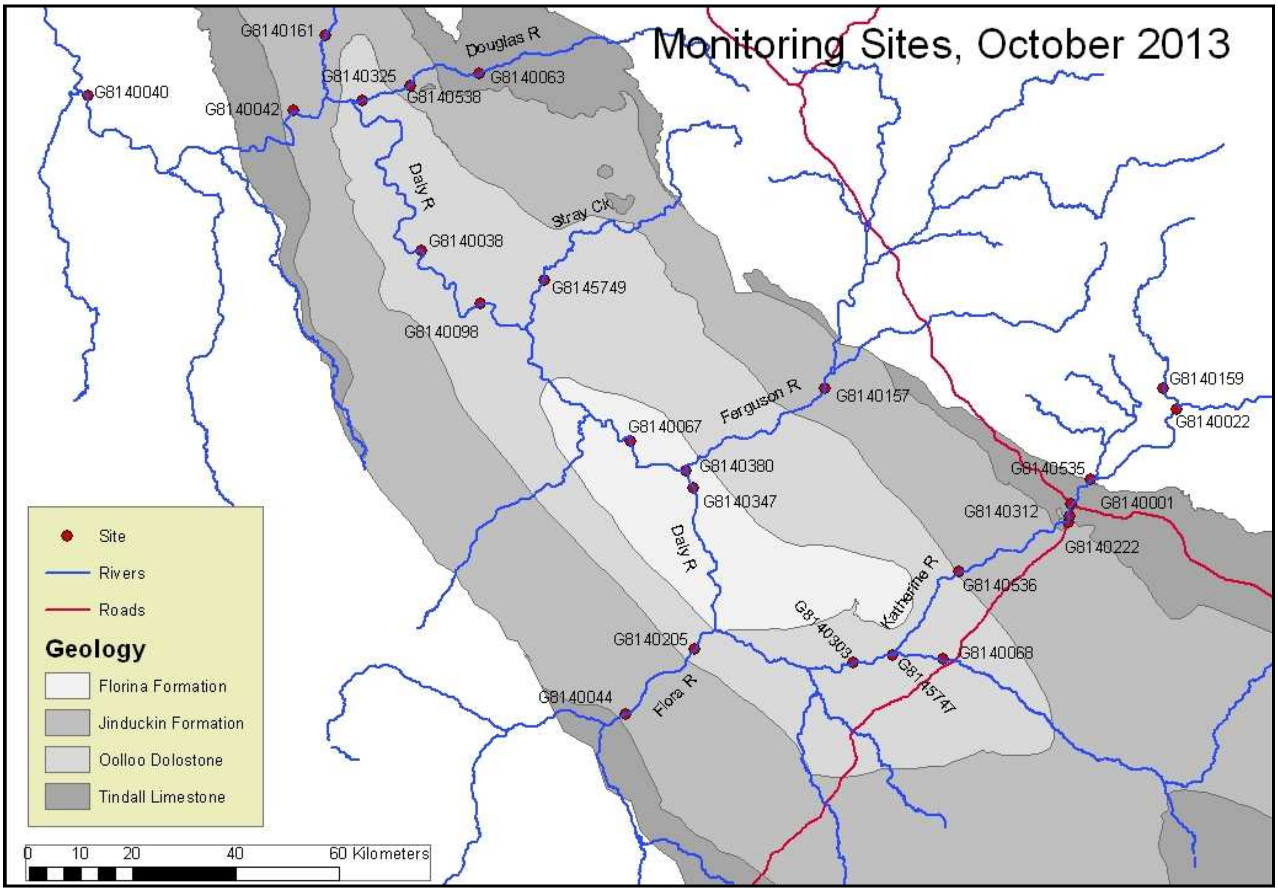

Figure 1: *Monitoring Sites, October 2013*

Water Levels

The surface water levels recorded at monitoring sites are based on gauge board readings. The water level information together with the stream flow measurements are used to further develop stage discharge relationships of each monitoring site. There were a couple of monitoring sites that are not equipped with gauge boards and as a result no water levels were taken during the site visits. The surface water level results are tabled in **Appendix B.**

Stream Flows

The stream flow measurements were performed using acoustic doppler current profiler technology and the instrument selection at each monitoring site was dependent on the site and hydraulic conditions. The flow measurements are spatially represented on Figure 2, illustrating the increase in flows as you move from the upper catchment downstream to the lower catchment. The flow measurement results are tabled in **Appendix C**.

The stream flow measurements performed are within the required standards and quality assurance protocol taken into account the site and hydraulic conditions present. The process was further quantified by applying a quality matrix to each individual measurement.

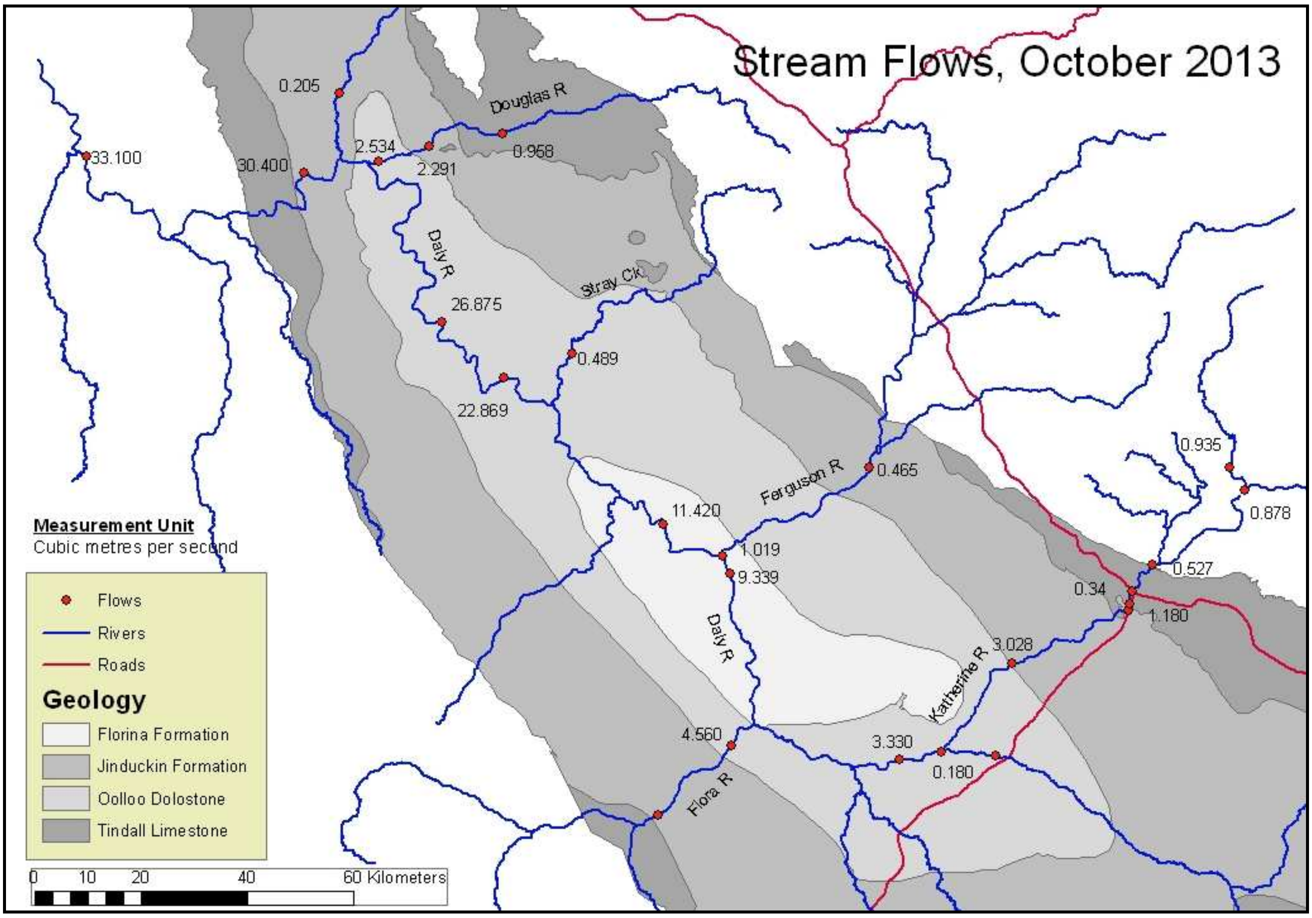

Figure 2: *Stream Flows, October 2013*

Water Quality

The water quality monitoring that was performed consisted of insitu measurements with multiparameter instrument and water samples. The insitu measurements were performed with a Hydrolab Quanta and the field parameters measured are summarised in Table 1.1. In addition to the Hydrolab instrument a Hack instrument was used for turbidity measurements.

Table 1.1

Hydrolab Quanta	Hack
• Electrical Conductivity (EC • pH • Dissolved Oxygen (DO) • Temperature	• Turbidity

The water quality samples taken during the field measurements were general parameters, total nutrients and filtered nutrients. The analysis of the water quality samples will be an addendum to the report due to the time frame required for analysing the samples. The water quality insitu measurements are tabled in **Appendix D.**

The water quality measurements performed are within the required standards and quality assurance protocol taken into account the site conditions. The process was further quantified by ensuring that instrumentation was calibrated before and after the "snap shot" measurement exercise. Post processing was performed on the insitu measurements by adjusting the data sets for of sensor drift using the pre and post calibration results.

Rainfall

Rainfall data was collated from monitoring sites in the catchment over the same period as the “snap shot” measurements exercise to identify if local runoff affected the field measurements.

The rainfall data transmitted via telemetry from monitoring sites to Hydstra database was used for this purpose.

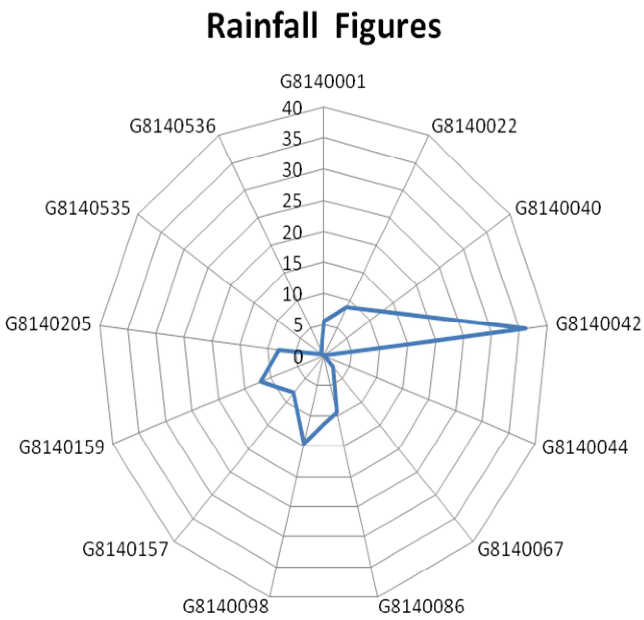

Figure 3 Rainfall Figures

Discussion

Stream Flows

The measurements performed in the Katherine and Daly River catchments comply with the continuity principle and are consistent with increasing flow moving downstream towards the lower catchment.

There are some cases where major discrepancies exist between measured flow and latest rating curve values in Hydstra. This is described to the following aspects that have an influence on the relationship between measured flow and current rating curve.

- unstable low flow stage discharge relationship
- the control is not dominant feature and is affected by changes down stream
- the low flow stage discharge relationship not sufficiently developed.

Monitoring sites that do not have a stage discharge relationship in Hydstra are flagged with a 9999.99 code.

The increase in stream flows from the upper to lower catchment in the Katherine and Daly River systems are illustrated in Figure 4. The tributaries to the main river reach are also indicated on the graph, showing the flow contribution from each tributary.

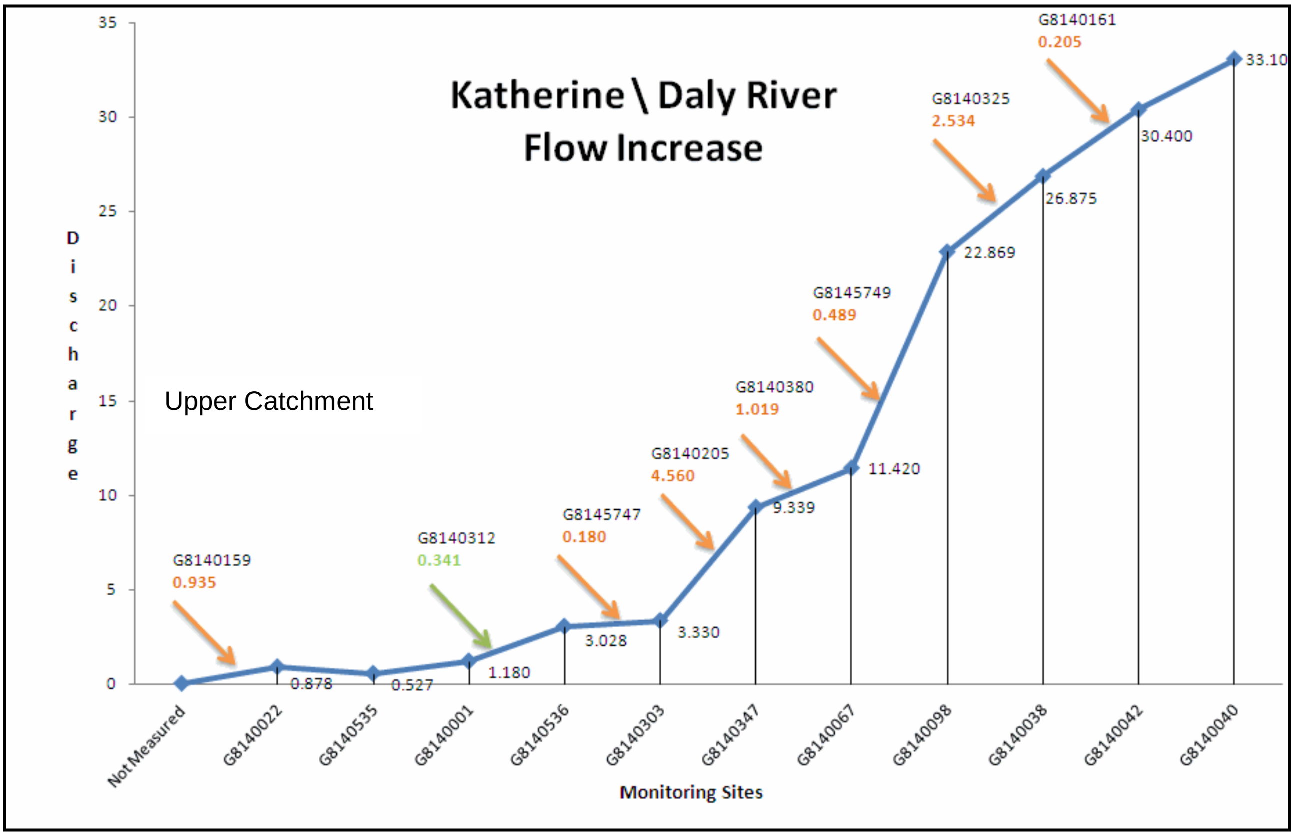

Figure 4 Increasing Flows

From the flow information it is evident that there exist two significant flow contributions to the catchment runoff, the first being the Tindall Limestone discharge in the upper reaches of the Flora River and the second contribution is where the Daly River is crossing from the Florina formation to the Oolloo Dolostone.

The contribution of flows from the different sub catchments \ geology formations to the total catchment runoff in the Katherine River and Daly River catchments are summarised in Table 1.2.

Table 1.2

Aquifer	Catchment	Flows (m^3/s)	Total Flow (m^3/s)
Tindall Limestone	Katherine	2.501	13.211
	Flora	4.560	
	Fergusson	0.465	
	Stray Creek	0.489	
	Douglas	2.291	
	Green Ant	0.205	
	Lower Daly	2.700	
Oolloo	Katherine \ Daly	20.094	19.889
		Total Catchment	33.100

The stream flows measured in October 2013 at Katherine Railway Bridge (G8140001), Dorisvale (G8140067) and Mount Nancar (G8140040) are graphically shown in Figure 5 against the minimum annual flows from 1961 to 2012 at each of the monitoring sites. The October 2013 stream flows are well above the average minimum flow at each of the respective sites although the flows do indicate that there is a reduction in base flows over the past three years.

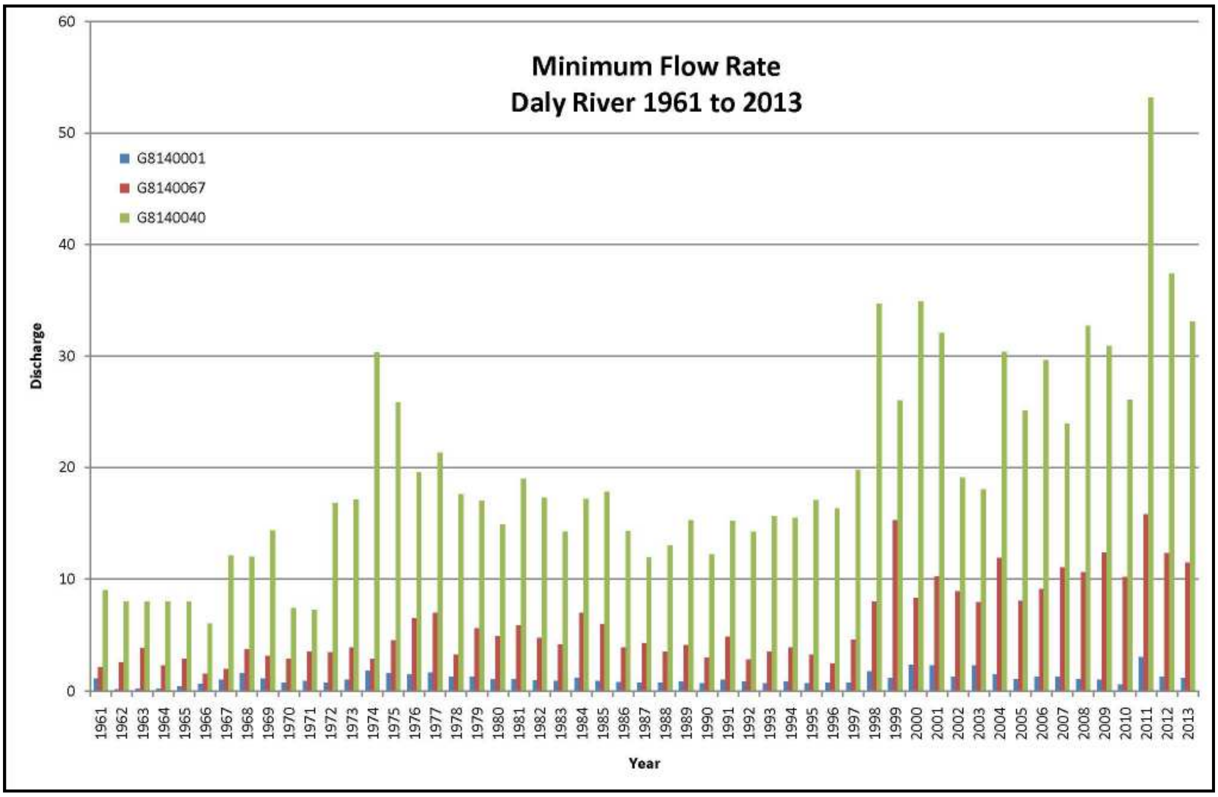

Figure 5 Minimum Annual Flows

Substantial flow measurements were performed in the past at the various monitoring sites and only during the last four years measurements were synchronised within a specific time frame to give a more realistic overview of the catchment conditions. The stream flow measurements performed during the past four years from 2010 until 2013 during the months of September and October in the main river reach are graphically displayed in Figure 6.

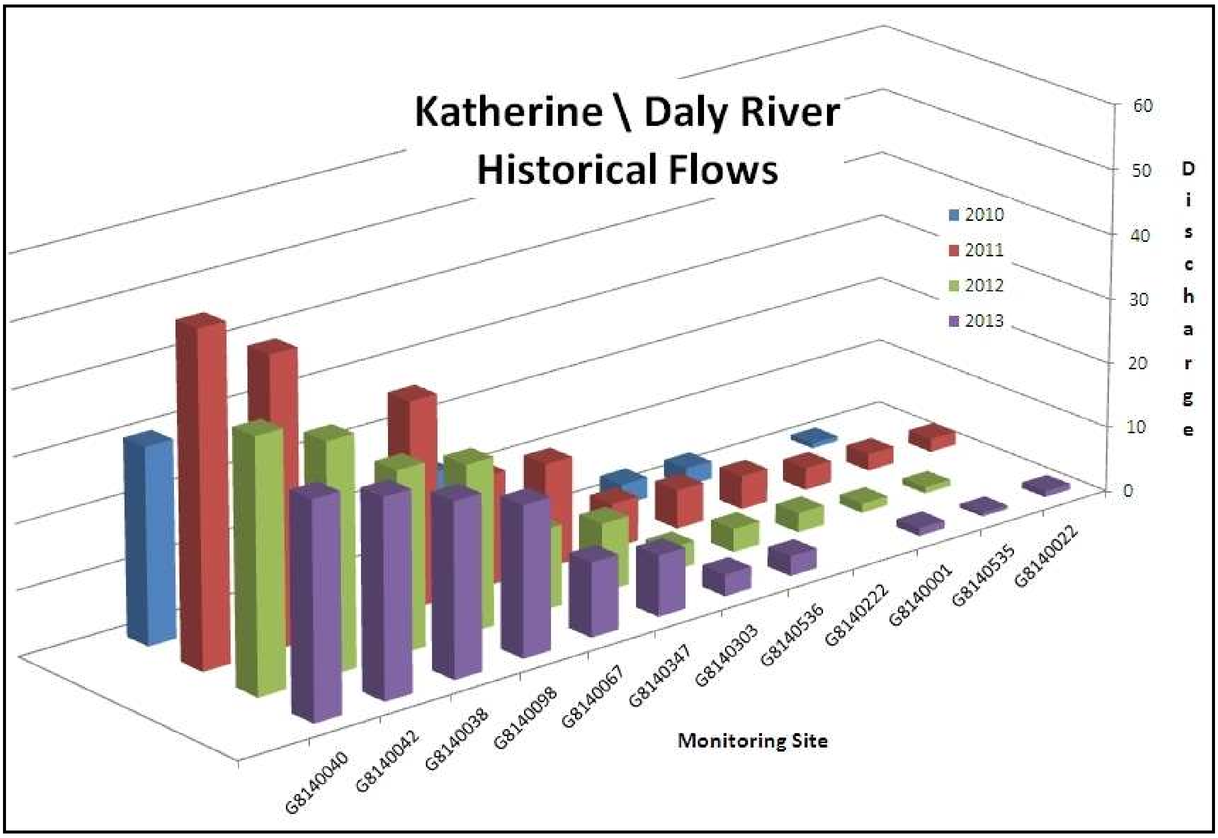

Figure 6 Historical Flows

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) monitoring sites. 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.

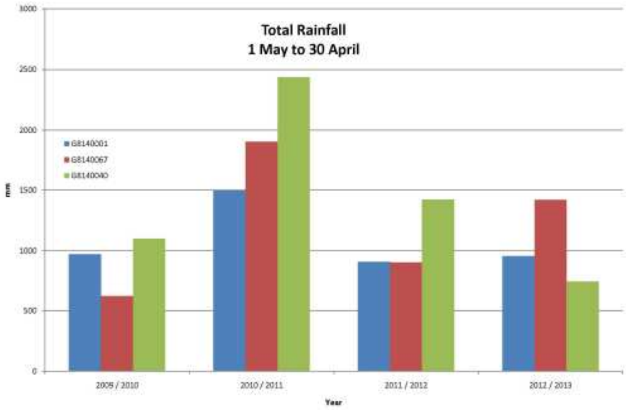

Figure 7 Total Rainfall

Water Quality

Electrical Conductivity (EC)

The electrical conductivity results vary between the monitoring points, however the data do indicate that recharge from Tindall Limestone aquifer especially in smaller tributaries have a higher electrical conductivity. This is confirmed where the electrical conductivity increase by an order of ten in the Katherine River at monitoring points downstream Ironwood (G8140535), which is located upstream of the Tindall limestone aquifer boundary.

pH

The pH results vary between 6.77 at the lower scale at Seventeen Mile Creek (G8140159) to 8.15 at the upper scale at Stray Creek (G8145749), which falls within the Australian guidelines for fresh water of 6.5 – 9.0.

Dissolved Oxygen (DO)

The DO results at the monitoring points with high EC indicates the opposite of theoretical relationship between salinity and dissolved oxygen, where the level of dissolved oxygen will decrease when the salinity increases. There are however a number of other factors that can affect the DO level such as temperature, diffusion from surrounding air, waste product of photosynthesis and aeration. The monitoring points with high EC 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

The turbidity is relatively low with the lowest value of 0.15 measured at Katherine Hot Springs (G8140312) and the highest values of 3 recorded in the lower Daly. The results do not show a specific trend and are probably based on the site conditions present at the site.

Temperature

The water temperatures vary between 28 C to 33 C. The measurement time during the day does not seem to affect the measurements.

Rainfall

The base flow conditions during the "Snap Shot" measurement exercise could be affected as result of surface water runoff generated by rainfall in the immediate catchment. The total rainfall figures from 1 October to 19 October 2013 at each of the monitoring sites are supplied in Figure 3. The rainfall events at G8140042 and G8140098 occurred 24 hours before the flow measurements were performed at the respective monitoring sites.

Conclusion

The structured monitoring frame work is aimed in better understanding of the groundwater and surface water interactions. It is therefore essential that future monitoring exercises performed in similar manner focusing on the monitoring program requirements as well as the recommendations from the assessment of the data collected.

There were areas where insufficient data was collected and this constrained the assessment process in those specific catchment areas. It is recommended that monitoring programs be reviewed to include required monitoring and that future measurement exercises be based on those requirements.

Groundwater monitoring was not performed during the measurement exercise and it is recommended that groundwater monitoring sites be identified for the 2014 monitoring program. This information will give a more complete image of the catchment and aquifer conditions and will assist greatly in the assessment process.

Appendix A - Monitoring Requirements

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 snap shot 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, temp, pH and DO), Major Ions, Nutrients and Metals.	Field parameters (EC, temp, pH and DO), Major Ions, Nutrients and Metals.

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

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 collected at gauge plates.

Type	Conditions	Influences	Description
			Difficult to take readings without maintenance 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
G8140001	Katherine River at Railway Bridge	17/10/2013	0921	0.245	
G8140022	Katherine River at Nitmiluk Centre	15/10/2013	1613	-1.618	
G8140038	Daly River at Oolloo Road Crossing	16/10/2013	1024	25.698	
G8140040	Daly River at Mount Nancar	18/10/2013	0953	1.920	
G8140042	Daly River at 2km downstream of Beeboom Crossing	17/10/2013	0900	0.932	
G8140044	Flora River Upstream of Kathleen Falls				
G8140063	Douglas River Downstream Old Douglas Homestead	14/10/2013	1402	0.710	
G8140067	Daly River at upstream Dorisvale Crossing	07/10/2013	1354	1.798	
G8140068	King River D/S Victoria Highway	08/10/2013	1442	0.484	
G8140098	Daly River @ Theyona Station	15/10/2013	0928	1.414	
G8140157	Fergusson River upstream of Bondi Creek	10/10/2013	0916	2.580	
G8140159	Seventeen Mile Creek at Waterfall View	15/10/2013	1158	0.705	
G8140161	Green Ant Creek at Tipperary	16/10/2013	1500	0.647	
G8140205	Flora River @ Upstream Stoney Creek	09/10/2013	1119	1.539	
G8140222	Katherine River @ Low Level Bridge				
G8140303	Katherine River at D/S King River	08/10/2013	0959	none	
G8140312	Katherine Hot Springs	25/10/2013	1030	0.600	
G8140325	Douglas River at Tipperary Crossing	17/10/2013	1048	2.148	
G8140347	Daly River at Florina Homestead Crossing	17/10/2013	1303	none	
G8140380	Fergusson River at Confluence Daly River	16/10/2013	1716	none	
G8140535	Katherine River @ Ironwood Station	14/10/2013	1538	1.315	
G8140536	Katherine River @ Wilden Station	16/10/2013	1121	0.925	
G8140538	Douglas River @ Tippera Waterhole	17/10/2013	1432	2.060	
G8145747	King River 50 meters US from Katherine River	08/10/2013	1054	none	
G8145749	Stray Creek @ Fleming Road Crossing	16/10/2013	1338	2.450	

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
G8140001	Katherine River at Railway Bridge	Main Reach	1.180	17/10/2013	StreamPro	None	-5.72	
G8140022	Katherine River at Nitmiluk Centre	Main Reach	0.878	15/10/2013	StreamPro	None	-13.41	
G8140038	Daly River at Oolloo Road Crossing	Main Reach	26.875	16/10/2013	StreamPro	W	0	
G8140040	Daly River at Mount Nancar	Main Reach	33.100	18/10/2013	StreamPro		-8.29	
G8140042	Daly River at 2km downstream of Beeboom Crossing	Main Reach	30.400	17/10/2013	StreamPro		-17.54	
G8140044	Flora River Upstream of Kathleen Falls	Tributary						
G8140063	Douglas River Downstream Old Douglas Homestead	Tributary	0.958	14/10/2013	StreamPro	None	-2.68	
G8140067	Daly River at upstream Dorisvale Crossing	Main Reach	11.420	07/10/2013	StreamPro		-2.76	
G8140068	King River D/S Victoria Highway	Tributary	0.008	08/10/2013	Flow Tracker			
G8140098	Daly River @ Theyona Station	Main Reach	22.869	15/10/2013	StreamPro	WG	22.56	
G8140157	Fergusson River upstream of Bondi Creek	Tributary	0.465	10/10/2013	StreamPro		12.41	
G8140159	Seventeen Mile Creek at Waterfall View	Tributary	0.935	15/10/2013	StreamPro	None	2.58	
G8140161	Green Ant Creek at Tipperary	Tributary	0.205	16/10/2013	Flow Tracker		-26.51	
G8140205	Flora River @ Upstream Stoney Creek	Tributary	4.560	09/10/2013	Monitor 1200		-1.14	
G8140222	Katherine River @ Low Level Bridge	Main Reach						
G8140303	Katherine River at D/S King River	Main Reach	3.330	08/10/2013	StreamPro		9999.99	
G8140312	Katherine Hot Springs	Spring	0.341	25/10/2013			9999.99	
G8140325	Douglas River at Tipperary Crossing	Tributary	2.534	17/10/2013	StreamPro	W	4.9	

Site Number	Site Name	River System	Flow m^3/s	Date	Gauging Instrument	Site Influences	Rating Deviation%	Comment
G8140347	Daly River at Florina Homestead Crossing	Main Reach	9.339	17/10/2013	StreamPro	None	9999.99	
G8140380	Fergusson River at Confluence Daly River	Tributary	1.019	16/10/2013	StreamPro	None	9999.99	
G8140535	Katherine River @ Ironwood Station	Main Reach	0.527	14/10/2013	StreamPro	None	35.85	
G8140536	Katherine River @ Wilden Station	Main Reach	3.028	16/10/2013	StreamPro	None	10.63	
G8140538	Douglas River @ Tippera Waterhole	Tributary	2.291	17/10/2013	StreamPro	W	4.33	
G8145747	King River 50 meters US from Katherine River	Tributary	0.180	08/10/2013	StreamPro		9999.99	
G8145749	Stray Creek @ Fleming Road Crossing	Tributary	0.489	16/10/2013	StreamPro	None	9999.99	

Appendix D – Water Quality Measurements

The Turbidity measurements from the Hydrolab must be ignored based on the reliability of the sensors.

Site Number	Site Name	Date	Time	Temp (˚C)	pH	D.O. (mg/L)	DO % sat	E.C. (µS/cm)	Turb 1 (NTU)	Turb 2 (NTU)	General Chemistry Sample (500mL)	Total Nutrient Sample (250mL)	Nutrient Filtered Sample (125mL)
G8140001	Katherine River at Railway Bridge	18/10/2013	10:40	30.61	6.89	4.00	54	463	3		✓	✓	✓
G8140022	Katherine River at Nitmiluk Centre	15/10/2013	17:00	31.42	6.95	7.89	107	20	2		✓	✓	✓
G8140038	Daly River at Oolloo Road Crossing	16/10/2013	11:05	31.21	7.77	6.68	90	623	3		✓	✓	✓
G8140040	Daly River at Mount Nancar	18/10/2013	10:50	31.49	7.90	7.23	98	571	2		✓	✓	✓
G8140042	Daly River at 2km downstream of Beeboom Crossing	17/10/2013	09:00	31.28	7.77	7.42	101	601	2		✓	✓	✓
G8140044	Flora River Upstream of Kathleen Falls										x	x	x
G8140063	Douglas River Downstream Old Douglas Homestead	14/10/2013	14:42	31.52	7.11	5.23	71	423	1		✓	✓	✓
G8140067	Daly River at upstream Dorisvale Crossing	07/10/2013	14:00	31.40	7.94	9.93	135	595	1.43	1.58	✓	✓	✓
G8140068	King River D/S Victoria Highway	08/10/2013	14:20	32.90	7.62	9.19	128	531	2.57	2.53	✓	✓	✓
G8140098	Daly River @ Theyona Station	15/10/2013	10:41	31.69	7.49	5.74	78	613	3		✓	✓	✓
G8140157	Fergusson River upstream of Bondi Creek	10/10/2013	09:35	30.08	7.82	10.07	134	753	1.75	2.03	✓	✓	✓
G8140159	Seventeen Mile Creek at Waterfall View	15/10/2013	13:10	28.85	6.77	7.86	102	18	2		✓	✓	✓
G8140161	Green Ant Creek at Tipperary	16/10/2013	16:00	28.95	7.66	4.29	56	534	2		✓	✓	✓
G8140205	Flora River @ Upstream Stoney Creek	09/10/2013	09:45	31.21	7.73	10.67	144	676	0.74	0.82	✓	✓	✓
G8140222	Katherine River @ Low Level Bridge										x	x	x
G8140303	Katherine River at D/S King River	08/10/2013	10:20	30.20	7.95	10.51	140	612	1.14	1.08	✓	✓	✓
G8140312	Katherine Hot Springs	25/10/2013	10:12	31.50	7.13	1.10	15	691	0.15		x	x	x
G8140325	Douglas River at Tipperary Crossing	17/10/2013	11:58	30.62	7.93	6.1	82	527	2		✓	✓	✓
G8140347	Daly River at Florina Homestead Crossing	17/10/2013	14:00	31.18	7.88	7.94	107	619	2		✓	✓	✓
G8140380	Fergusson River at Confluence Daly River	17/10/2013	11:30	30.35	7.64	6.81	91	637	3		✓	✓	✓
G8140535	Katherine River @ Ironwood Station	14/10/2013	15:20	31.26	6.82	7.10	96	33	1		✓	✓	✓
G8140536	Katherine River @ Wilden Station	16/10/2013	11:10	30.65	7.67	6.64	89	584	1		✓	✓	✓
G8140538	Douglas River @ Tippera Waterhole	17/10/2013	15:28	31.71	7.61	5.63	77	537	2		✓	✓	✓
G8145747	King River 50 meters US Katherine River	08/10/2013	11:20	29.84	7.90	10.68	141	742	0.93	0.95	✓	✓	✓
G8145749	Stray Creek @ Fleming Road Crossing	16/10/2013	13:51	29.59	8.15	7.92	104	551	<1		✓	✓	✓