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DEPARTMENT OF  
NATURAL RESOURCES, ENVIRONMENT, THE ARTS AND SPORT

# Daly low flow gaugings

## October 2009



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Cover photo: Flow measurements in Flora \ Daly River. Hayden Lowe \ Justin Ahearn

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# 1. Introduction

The Hydrographic division was requested to perform low flow gaugings and water quality measurements in the Daly River for the studying of the interaction between surface water and groundwater systems. The week of the 28 September 2009 was selected for this project to be able to determine the groundwater discharge at the end of the dry season before the rainy season starts.

The Groundwater division supplied a list of monitoring sites consisting of Site numbers and coordinates. **Of the sites identified twelve sites are not existing gauging sites and the data collected at these sites were registered to the closest Water Quality site in the area.** For future data use and reporting please refer to the site table under point 3 and especially the “Associated WQ Site” column.

# 2. Planning

The monitoring points that were identified by the Groundwater division were divided into two groups, namely the “Upper” and “Lower” Daly River Sites. The following personnel, as indicated in the table below made up the two teams.

Team	Name
Upper Daly River	Justin Ahearn
	Hayden Lowe
Lower Daly River	Tony Boland
	Daniel Wagenaar

The itinerary for the project was planned for five working days from 28/09/2009 until 02/10/2009 to complete the project. The Upper Daly Team was based at Katherine (Hotel) and Flora sites (Camping) during the duration of the project. The Lower Daly team was based at Theyona (camping) for the first two days and the rest of the week at Douglas Research farm (Accommodation).

Each team was responsible to ensure that the required equipment for this project is operational and available in the vehicle. Special attention was given to the following gauging and navigation equipment before the departure date. Each instrument was tested regarding power supply, communication and general operations.

Category	Equipment	Model	
Flow Measurement	Aluminium Boat		
	Outboard	Yamaha 15hp	
	ADCP Gauging Equipment	Rio Grande 1200 + Mounting Brackets	
		StreamPro	
		Flow Tracker	
Conventional Gauging Equipment	C2 Current Meter		
	C20 Current Meter		
Water Quality	Hydro Lab	Quanta	
	Sample Bottles		
Navigation	GPS + Maps	Garmin	
Computer	Laptop		

### 3. Monitoring Sites

The following tables show the sites that have been identified by Groundwater division for this study. The order of the monitoring sites in the tables is according to site numbers.

#### Upper Daly River

Site Number	Site Name	Associated WQ Site	Easting	Northing
G8140001	Katherine River at Railway Bridge		204328	8399285
G8140067	Daly River at Dorrivale crossing		775769	8410498
G8140205	Flora River at Upstream Stoney Creek	G8145021	779330	8366854
G8140222	Katherine River at Low Level Bridge		203778	8396235
G8140303	Katherine River D/S of King River		820953	8373326
G8140346	Daly River 100m D/S of Flora/Kath. Junction – spring 22		791443	8378055
G8140347	Daly River at Florina Homestead Crossing		787728	8402581
G8140380	Fergusson River at confluence with Daly River		787098	8405155
G8140535	Katherine River at Ironwood Station		207411	8403558
G8140536	Katherine River at Wilden Station		185506	8387267
G8145132	Flora River u/s Daly junction		791312	8377882
G8145232	Katherine River 300m d/s Limestone Creek		806600	8371034
G8145694	Katherine River u/s of Flora River		791560	8377778
G8145747	King River 50m U/S of Katherine River		820973	8373294
G8145748	Daly River on Florina STN below rapids		791738	8385560
Site 10	Limestone Creek – Estim. Flow and do EC/ph etc in Limestone Ck.			
Site 11	Katherine River access via Scott Ck. Station	G8145230	796166	8375562
Site 12	Daly River D/S of Dorrivale Crossing	G8145629	767643	8416828

#### Lower Daly River

Site Number	Site Name	Associated WQ Site	Easting	Northing
G8140003	Daly River at Police Station		684830	8477572
G8140038	Daly River at Ooloo Road Crossing		743162	8443266
G8140040	Daly River at Mount Nancar		687474	8470184
G8140042	Daly River at 2km downstream of Beeboom Crossing		721334	8466964
G8140098	Daly River at Theyona Station		752931	8434086
G8140325	Douglas River at Lower Crossing	G8145386	733132	8469137
G8140393	Daly River At Junction Stray Creek (Downstream)		760725	8429229
G8140538	Douglas River at Tippera Waterhole	G8140322	739230	8470860
G8145395	Stray Creek @ 30m U/S Daly River confluence		760516	8429769
G8145749	Stray Creek @ Fleming Road Crossing		763573	8438009
Site 1	Daly River U/S Theyona GS - Site 1	G8145161	763138	8422160
Site 2	Daly River U/S Theyona GS - Site 2 U/S spring (Creek) on RB	G8145602	761595	8423658
Site 3	Daly River U/S Theyona GS - Site 3	G8145601	761448	8425115
Site 4	Daly River U/S Theyona GS - Site 4	G8145640	761427	8426500
Site 5	Daly River U/S Theyona GS - Site 5	G8145641	761522	8427405
Site 6	Daly River U/S Theyona GS - Site 6	G8140341	758485	8430337
Site 7	Daly River D/S Theyona GS - Site 7	G8145654	749171	8433010
Site 8	Daly River D/S Ooloo Crossing - Site 8	G8145669	740535	8451486
Site 9	Daly River D/S Ooloo Crossing - Site 9	G8145049	738450	8461340

## 4. Current Gaugings

### 4.1 Gauging equipment

The following instrument specifications were used as a guide for the selection of equipment during the current gaugings at each monitoring site.

Gauging Equipment	Gauging Method	Requirements
Rio Grande 1200 + Mounting Brackets	Boat \ Tagline	Cover basically all flow conditions where depth is more than 0.3m. Preferred site conditions where water depth >3m for all velocities. Instrument very accurate in measuring high and low velocities in deep pools >3m.
StreamPro	Boat \ Tagline or Traveller	Cover basically all flow conditions where water depth is between 0.15 – 4m maximum.
Flow Tracker	Wading	Operating Depth: >0.020m Velocity: 0.001 – 4m/s

### 4.2 Gauging Accuracy

#### 4.2.1 Factors Influencing Accuracy

The accuracy of the gaugings performed at the various monitoring sites is within required standards (5% of the mean) used by the Hydrographic division. Factors that had an influence on the accuracy are the following:

- **W:** Wind: The wind causes the water level to oscillate 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 position of some monitoring sites did not comply with Hydraulic (**H**) requirements for gaugings and in some cases the site has been moved or flagged as indicated in the comment section in the following tables. Some of the Hydraulic requirements the sites did not comply with are the following:

- 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.

#### **4.2.2 Accuracy**

The gauging results as showed in the tables indicates that there is a uniform increase in flow as you move downstream, which confirms the consistency and accuracy of the gaugings.

The following sites indicated that there were less flow present than the sites upstream of them.

- G8140346                      Possible overestimation due to site conditions
- G8140347
- Site 2
- G8140098

After evaluation of the gaugings at these 4 sites, the quality of data is still within acceptable standards and is well below the 5% margin that is applied by Hydrographic division. The reduction in flow can be due to the site conditions or that there are no significant changes in flow in that specific river reach. **Taken the instrument accuracy and site conditions into account it is safe to say that there were very little or no change in flow conditions rather than a reduction in flow.**

### 4.3 Gauging Results

The following tables show the current gauging results that were obtained at the various sites. The stream flow data is graphically displayed on a Geology map in **Appendix A**. The gain in stream flows is displayed on a Geology map in **Appendix B**. Monitoring sites are listed from the upstream to the downstream position; therefore the flow is increasing as listed in the table.

#### Upper Daly River

Site Number	Site Name	River System	Flow m <sup>3</sup> /s	Date	Gauging Instrument	Site Influences	Accuracy %	Comment
G8140535	Katherine River at Ironwood Station	Katherine	0.545	28/09/2009	StreamPro		3.31	
G8140001	Katherine River at Railway Bridge	Katherine	1.23	28/09/2009	StreamPro		1.97	
G8140222	Katherine River at Low Level Bridge	Katherine	2.53	28/09/2009	StreamPro		0.96	
G8140536	Katherine River at Wilden Station	Katherine	2.86	30/09/2009	StreamPro		0.56	
G8145747	King River 50m U/S of Katherine River	King	0.226	29/09/2009	StreamPro		1.88	
G8140303	Katherine River D/S of King River	Katherine	3.23	29/09/2009	StreamPro		1.92	
Site 10	Limestone Creek - Estim. flow and do EC/ph etc in Limestone Ck.	Limestone	0.02	29/09/2009	Estimate		-----	
G8145232	Katherine River 300m d/s Limestone Creek	Katherine	3.32	29/09/2009	StreamPro		1.87	
Site 11	Katherine River access via Scott Ck. Station	Katherine	3.51	01/10/2009	StreamPro		2.79	
G8145694	Katherine River u/s of Flora River	Katherine	3.87	01/10/2009	StreamPro		1.46	
G8140205	Flora River at Upstream Stoney Creek	Flora	4.21	29/09/2009	StreamPro		3.58	
G8145132	Flora River u/s Daly junction	Flora	4.33	01/10/2009	StreamPro	H	2.68	Site conditions are not ideal
G8140346	Daly River 100m D/S of Flora/Kath. Junction - spring 22	Daly	9.84	01/10/2009	StreamPro	H	2.91	Site conditions are not ideal, accuracy of gaugings are questionable.
G8140347	Daly River at Florina Homestead Crossing	Daly	8.98	30/09/2009	StreamPro		1.29	
G8145748	Daly River on Florina STN below rapids	Daly	10.2	01/10/2009	StreamPro	H	3.85	Site conditions are not ideal, accuracy of gaugings are questionable. Majority of flow are confined in left bank channel



Site Number	Site Name	River System	Flow m <sup>3</sup> /s	Date	Gauging Instrument	Site Influences	Accuracy %	Comment
G8140380	Fergusson River at confluence with Daly River	Fergusson	0.545	30/09/2009	StreamPro		3.46	
G8140067	Daly River at Dorrissvale crossing	Daly	10.2	02/10/2009	StreamPro		1.30	
Site 12	Daly River D/S of Dorrissvale Crossing	Daly	11.1	02/10/2009	StreamPro		1.47	

## Lower Daly River

Site Number	Site Name	River System	Flow m <sup>3</sup> /s	Date	Gauging Instrument	Site Influences	Accuracy %	Comment
Site 1	Daly River U/S Theyona GS - Site 1	Daly	11.0	29/09/2009	StreamPro		3.23	
Site 2	Daly River U/S Theyona GS - Site 2 U/S spring (Creek) on RB	Daly	10.6	29/09/2009	1200 Rio Grande	H	3.79	Water mode selected in software could have influenced the measurements.
Site 3	Daly River U/S Theyona GS - Site 3	Daly	14.4	29/09/2009	StreamPro	H	3.16	
Site 4	Daly River U/S Theyona GS - Site 4	Daly	15.7	30/09/2009	1200 Rio Grande	A	0.53	
Site 5	Daly River U/S Theyona GS - Site 5	Daly	17.2	30/09/2009	1200 Rio Grande	A	1.41	
G8140393	Daly River At Junction Stray Creek (Downstream)	Daly	17.7	30/09/2009	1200 Rio Grande		1.19	Site location is in the Daly River <b>upstream</b> of the confluence with Stray Creek and <b>NOT</b> downstream as indicated in the site name.
G8145749	Stray Creek @ Fleming Road Crossing	Stray	0.573	28/09/2009	StreamPro		1.18	
G8145395	Stray Creek @ 30m U/S Daly River confluence	Stray	None					The gauging method that needed to be used at the site was the wading method. This created problems due to the crocodiles present in the water
Site 6	Daly River U/S Theyona GS - Site 6	Daly	20.1	30/09/2009	StreamPro		2.6	
G8140098	Daly River at Theyona Station	Daly	19.5	01/10/2009	StreamPro	WG, A, W	1.69	Measurements done direct upstream of control. Large

Site Number	Site Name	River System	Flow m <sup>3</sup> /s	Date	Gauging Instrument	Site Influences	Accuracy %	Comment
								amount of water grass on the right bank as well as algae growth present in water which influences the ADCP measurements.
Site 7	Daly River D/S Theyona GS - Site 7	Daly	20.6	01/10/2009	StreamPro		1.2	
G8140038	Daly River at Ooloo Road Crossing	Daly	22.4	02/10/2009	StreamPro		1.4	Measurements done downstream of crossing
Site 8	Daly River D/S Ooloo Crossing - Site 8	Daly	24.1	02/10/2009	StreamPro		0.94	
Site 9	Daly River D/S Ooloo Crossing - Site 9	Daly	25.1	02/10/2009	StreamPro		1.47	
G8140325	Douglas River at Lower Crossing	Douglas	2.37	01/10/2009	StreamPro		2.94	
G8140538	Douglas River at Tippera Waterhole	Douglas	1.91	01/10/2009	StreamPro	H	4.31	Gaugings performed direct upstream of control. River cross section is also narrowing towards control.
G8140042	Daly River at 2km downstream of Beeboom Crossing	Daly	27.2	03/10/2009	StreamPro		0.49	
G8140040	Daly River at Mount Nancar	Daly	28.5	03/10/2009	StreamPro	H	4.41	Site conditions are not ideal, accuracy of gaugings are questionable. Majority of flow are confined in left bank channel
G8140003	Daly River at Police Station	Daly	29.0	03/10/2009	StreamPro		0.49	

## 5. Water Quality Parameters

Water quality parameters and samples were obtained at each gauging site as shown in the following tables. The water quality sample data will be supplied at a later date by the contracted laboratory.

Monitoring sites are listed from the upstream to the downstream position. Water quality data is also included in the following Excel spreadsheet.

“F:\5 NR\5-8 Technical Services\5-8--7  
Hydrographic\Hydrographic\Stations\G8140000\Documentation\Daly River Groundwater  
2009\20091014 Daly River Water Quality Results .xls”.

## Upper Daly River

Site Number	Site Name	Date	Time	Temp (°C)	pH	E.C. (µS/cm)	D.O. (mg/L)	Turb (NTU)	General Chemistry Sample (500mL)	Heavy Isotope Sample (50mL)
G8140535	Katherine River at Ironwood Station	28/09/2009		<b>No Water Quality Measurement</b>						
G8140001	Katherine River at Railway Bridge	28/09/2009		<b>No Water Quality Measurement</b>						
G8140222	Katherine River at Low Level Bridge	28/09/2009		<b>No Water Quality Measurement</b>						
G8140536	Katherine River at Wilden Station	30/09/2009	12:09	28.14	7.6	574	7.85	0	6	6
G8145747	King River 50m U/S of Katherine River	29/09/2009	11:15	26.2	7.66	717	8.87	0	1	1
G8140303	Katherine River D/S of King River	29/09/2009	11:48	28.2	7.71	549	8.81	0	2	2
Site 10	Limestone Creek - Estim. flow and do EC/ph etc in Limestone Ck.	29/09/2009	14:13	27.53	7.65	901	9.48	0	3	3
G8145232	Katherine River 300m d/s Limestone Creek	29/09/2009	15:00	29.21	7.7	560	8.03	0	4	4
Site 11	Katherine River access via Scott Ck. Station	1/10/2009	10:14	28.32	7.63	565	7.79	0	9	9
G8145694	Katherine River u/s of Flora River	1/10/2009	11:36	28.6	7.63	573	7.44	0.2	10	10
G8140205	Flora River at Upstream Stoney Creek	30/09/2009	8:25	28.48	7.3	685	7.87	0	5	5
G8145132	Flora River u/s Daly junction	1/10/2009	12:44	29.39	7.72	664	8.02	0	11	11
G8140346	Daly River 100m D/S of Flora/Kath. Junction - spring 22	1/10/2009	13:38	29.43	7.67	627	8.03	0.3	12	12
G8140347	Daly River at Florina Homestead Crossing	1/10/2009	16:30	29.04	7.62	629	7.91	1.3	13	13
G8145748	Katherine?(Daly) River on Florina STN below rapids	30/09/2009	16:30	29.11	7.67	593	8.43	0.8	8	8
G8140380	Fergusson River at confluence with Daly River	30/09/2009	14:57	29.02	7.71	619	7.9	0.4	7	7
G8140067	Daly River at Dorrsvale crossing	2/10/2009	16:10	30.55	7.69	579	8.11	1.1	15	15
Site 12	Daly River D/S of Dorrsvale Crossing	2/10/2009	13:05	30.34	7.61	561	7.81	1	14	14

## Lower Daly River

Site Number	Site Name	Date	Time	Temp (°C)	pH	E.C. (µS/cm)	D.O. (mg/L)	Turb (NTU)	General Chemistry Sample (500mL)	Heavy Isotope Sample (50mL)
Site 1	Daly River U/S Theyona GS - Site 1	29/09/2009	12:05	27.48	7.97	557	7.15	2.5	Top 1	Top 1
Site 2	Daly River U/S Theyona GS - Site 2 U/S spring (Creek) on RB	29/09/2009	13:26	28.61	8.04	557	7.54	4.1	Site 2	S2
Site 3	Daly River U/S Theyona GS - Site 3	29/09/2009	16:00	32.03	7.15	612	6.98	1.7	Site 3	S3
Site 4	Daly River U/S Theyona GS - Site 4	30/09/2009	9:44	28.92	7.61	593	6.49	3.4	Site 4	S4
Site 5	Daly River U/S Theyona GS - Site 5	30/09/2009	10:50	29.54	7.4	602	7.04	2.4	Site 5	S5
G8140393	Daly River At Junction Stray Creek (Downstream)	30/09/2009	12:45	29.71	7.49	599	7.32	2.3	WQ1	WQ1
G8145749	Stray Creek @ Fleming Road Crossing	28/09/2009	13:58	27.49	8.03	554	8.26	0.8	SC	SC
G8145395	Stray Creek @ 30m U/S Daly River confluence	30/09/2009	14:37	30.41	7.62	599	8.25	4.7	WQ2	WQ2
Site 6	Daly River U/S Theyona GS - Site 6	30/09/2009	16:26	30.53	7.61	600	7.78	2.4	Site 6	S6
G8140098	Daly River at Theyona Station	1/10/2009	7:44	29.52	7.65	604	6.36	1.3	TGS	TGS
Site 7	Daly River D/S Theyona GS - Site 7	1/10/2009	10:48	29.97	7.9	609	7.13	1.6	Site 7	S7
G8140038	Daly River at Ooloo Road Crossing	2/10/2009	8:17	29.82	7.96	623	6.89	2.3	OOL	OOL
Site 8	Daly River D/S Ooloo Crossing - Site 8	2/10/2009	10:18	30.5	8.13	627	6.92	2.9	Site 8	S8
Site 9	Daly River D/S Ooloo Crossing - Site 9	2/10/2009	12:05	30.29	8.08	629	7.4	2.7	Site 9	S9
G8140325	Douglas River at Lower Crossing	1/10/2009	15:58	29.79	8.04	519	6.84	2	DG2	DG2
G8140538	Douglas River at Tippera Waterhole	1/10/2009	18:20	30.14	7.62	527	6.42	1.6	DG1	DG1
G8140042	Daly River at 2km downstream of Beeboom Crossing	3/10/2009	9:58	29.6	8.26	603	7.67	1.2	BB	BB
G8140040	Daly River at Mount Nancar	3/10/2009	14:10	31.31	8.42	574	7.4	5.9	MTN	MTN
G8140003	Daly River at Police Station	3/10/2009	15:34	31.38	8.41	569	7.51	5	PS	PS

## **6. Documentation**

All reports and data associated with the selected sites have been archived under the following directory. A sub-directory has been created for each site where gaugings and photographs have been placed.

“F:\5 NR\5-8 Technical Services\5-8--7  
Hydrographic\Hydrographic\Stations\G8140000\Documentation\Daly River Groundwater  
2009”

All gaugings performed at monitoring sites with allocated site numbers have been registered on Hydstra and the data files been stored under the following directory.

“H:\hyd\LOG\Gaugings”

## **7. Operations \ Experience**

### **7.1 Upper Daly River**

The sites near the junction of Katherine, Flora and Daly Rivers were accessed by boat from Florina station. The remaining sites were accessed by vehicle from where the boat was launched to perform the required measurements.

### **7.2 Lower Daly River**

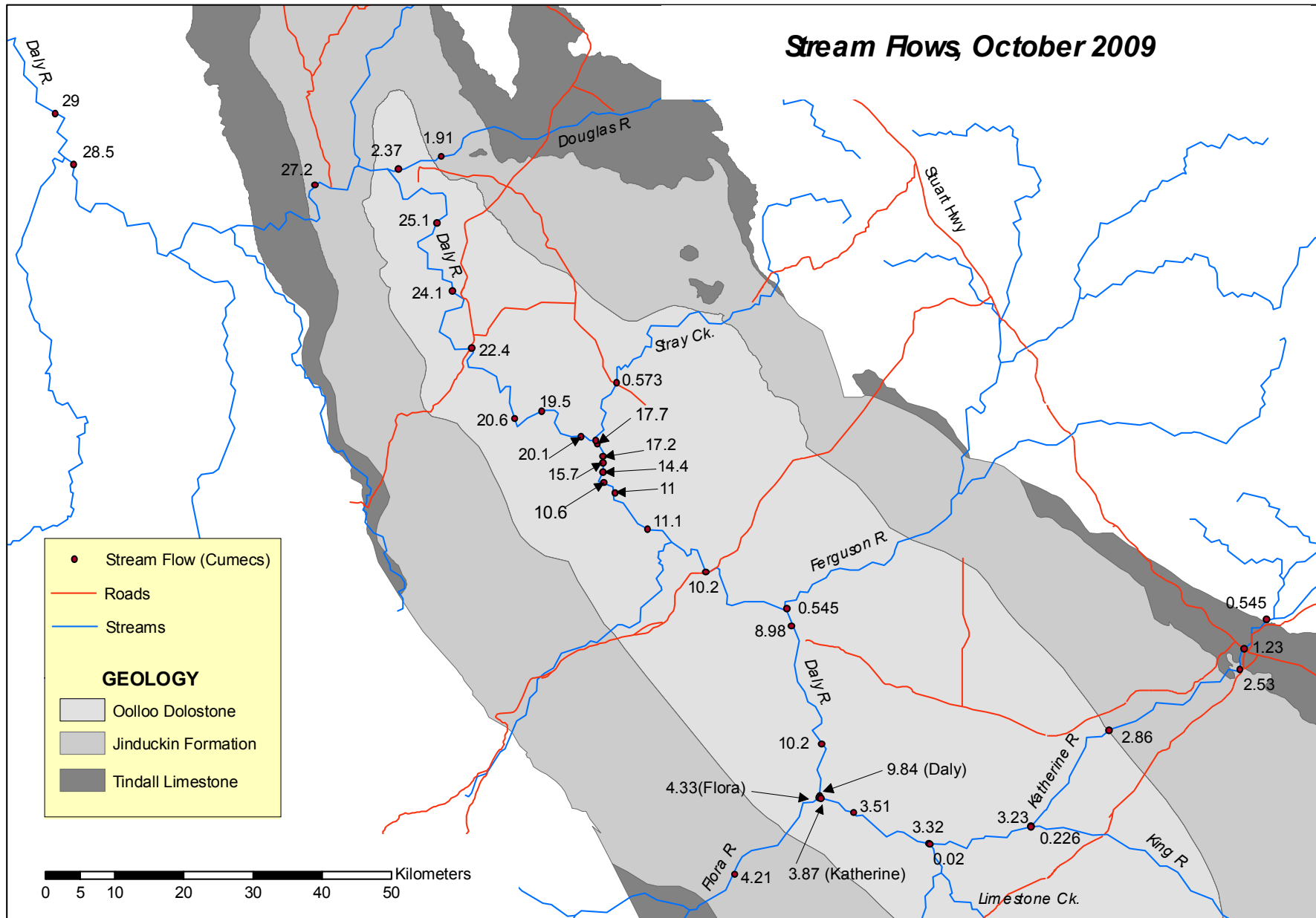
Initial planning was to launch from Theyona but due site conditions it was decided to launch from Ooloo Crossing. The decision to launch from Ooloo Crossing resulted in additional half day work for Sites 1 to 7. This extra time was due to 4 hour travel time as well as numerous rock bars that had to be crossed. The sites 8 and 9 located downstream of Ooloo Crossing were easily accessed by boat. The remaining sites were accessed by vehicle from where the boat was launched to perform the required measurements.

## **8. Recommendation**

The number of days earmarked for this project was insufficient, especially for the Lower Daly River Sites and is recommended that at least 6 days be allocated for these sites. The total number of personnel required is 5, breaking into teams of three (Lower Daly) and two (Upper Daly) using the local area vehicle and land Cruiser as transport.

It is also recommended for the Lower Daly team that the boat and equipment be transported via road to Dorrisvale Crossing (G8140067). From Dorrisvale the measuring team can move downstream collecting the required measurements while the third member setup camps at designated points.

# Appendix A



# Appendix B

