internal report **384**

Installation, maintenance and running of gauging stations in the Swift (Ngarradj) Creek catchment, Northern Territory

Saynor MJ, Dawson JC, Smith BL, Crisp E & Moliere DR

December 2001

supervising scientist

INSTALLATION, MAINTENANCE AND RUNNING OF GAUGING STATIONS IN THE SWIFT (NGARRADJ) CREEK CATCHMENT NORTHERN TERRITORY

MJ Saynor, JC Dawson, BL Smith, E Crisp & DR Moliere

Hydrological and Ecological Processes
Environmental Research Institute of the Supervising Scientist
Locked Bag 2
Jabiru NT 0886

November 2001

eriss

ENVIRONMENTAL RESEARCH INSTITUTE OF THE SUPERVISING SCIENTIST

Contents

Figures

Tables

1 Introduction

Initial field inspections during the dry season of 1998 (September) were conducted in the Swift Creek (Ngarradj) Catchment with a view to establishing a field research program prior to the 1998/99 wet season as detailed by registry files JR-05-298 (parts 1 & 2). The following sections document the installation of the gauging stations, the wet season data collection and downloading as well as the maintenance program which is conducted.

Three gauging stations were established during November 1998 at the following sites:

- The main channel of Swift Creek upstream of all mine influences (herein called Upmain - UM), 12° 29'492"S, 132° 55' 337"E.
- The main channel of Swift Creek (herein called Swift Creek - SC) downstream of all mine influences and the tributaries of both the right and left banks, 12° 29'492"S, 132° 55' 337"E.
- The main right bank tributary (East Tributary - ET) that flows into Swift Creek between upstream and downstream gauging stations, 12° 29' 492"S, 132° 55' 337"E. There is no mining activity in this catchment.

The Swift Creek site is intended to measure any impact that the mine might have on sediment loads while the Tributary East and Upmain sites are intended to measure sediment loads in the undisturbed natural Swift Creek catchment. Tributary West (TW), also undisturbed is the largest of the left bank tributaries, draining the southern part of the catchment and has a discontinuous channel with large swampy areas. Ideally, this tributary should have been gauged, however, the nature of the channel made the installation of a gauging station an impossibility. There are three smaller right bank tributaries referred to in this report as Tributary North (TN), Tributary Central (TC) and Tributary South (TS). The Jabiluka mine is located in close proximity to these tributaries and the mining company has installed gauging stations and equipment on these streams. Figure 1 shows the location of the gauging stations and the various tributaries in the Swift Creek catchment.

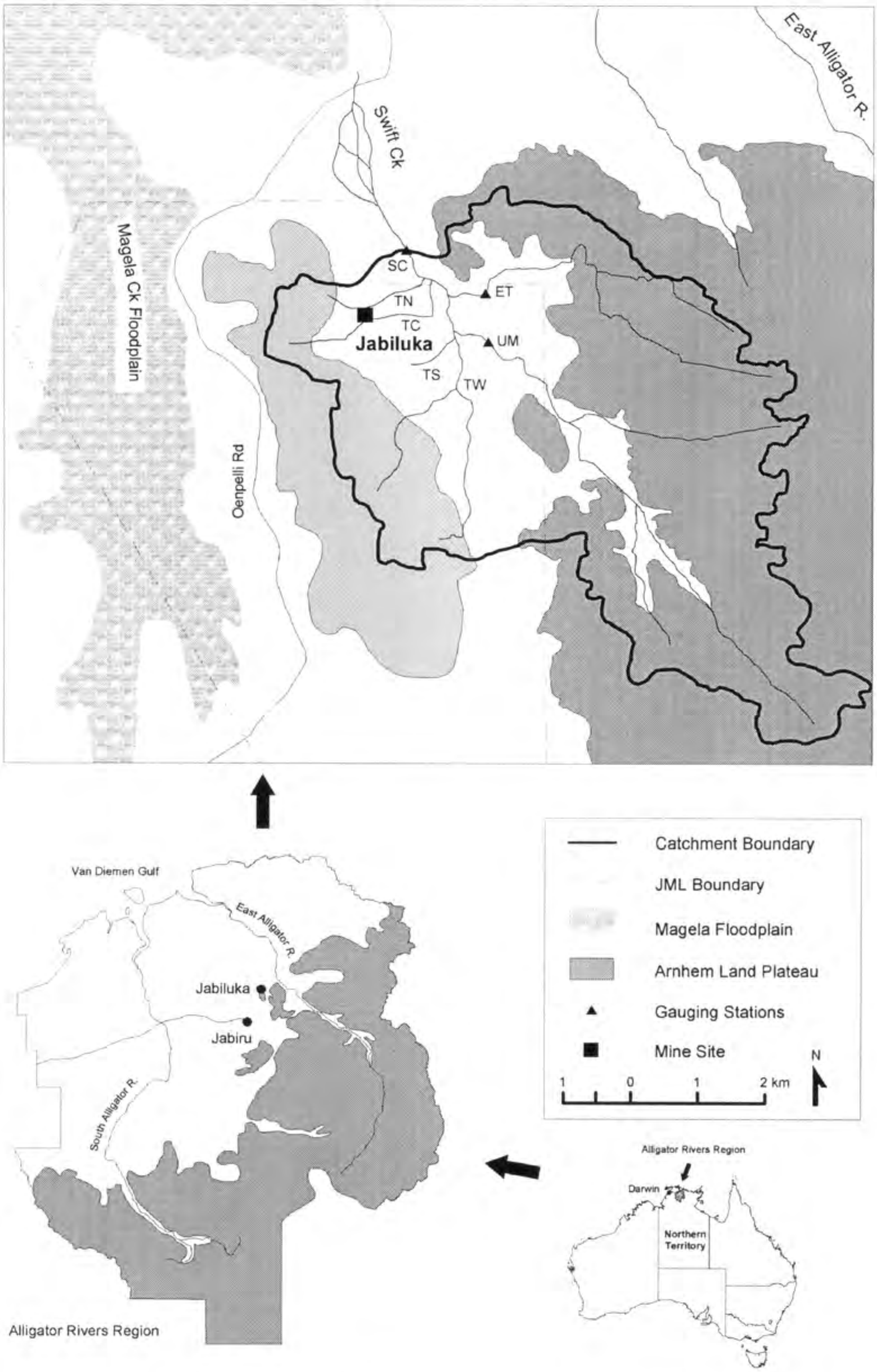


Figure 1 The Swift Creek catchment and tributaries showing the Jabiluka Mineral Lease, the minesite and the gauging station sites

2 Gauging Station Installation

Each gauging station, installed in 1998, comprises of a stilling well with an aluminum shelter to house and protect the data logging equipment.

2.1 Construction

A mini excavator was used to dig the trenches for the stilling well and the inlet pipes at each site (Figure 2). A trench was dug in the bank to a depth that was at least 0.6 m below the existing bed level at each of the sites. The stilling wells (comprising of 300 mm UPVC pipe) were cut to sufficient length to reach the base of the trench and allow 0.8 m to 1.2 m above the top of the bank. The inlet pipes consisting of 50 mm and 75 mm UPVC pipe were measured and cut to length and then epoxy bound into place. These inlet pipes were held in place by star pickets which were buried when the trench was back filled. Once the epoxy was dry the base of the stilling well was surrounded by 9-10 bags of concrete (25 kg) and left to dry. Once the concrete was dry, the area around the stilling well and inlet pipes was carefully filled in to hold them firmly in place. To protect this work and prevent stream bank erosion, shade cloth (fine meshed material) was spread over the disturbed soil (both at the top and down the bank) and secured in place using steel tent pegs.

Figure 2 Digging the trench at Swift Creek with the Mini Excavator

At the end of the inlet pipes a small piece of pipe was cut and attached with a 90° elbow (right angled joiner) so that it was pointing downstream to reduce the amount of sediment that might accumulate in the pipes. In each of the small pieces of pipe, holes were drilled at approximately 90° points around the pipe and along its length to allow water to enter and leave the stilling well. Benchmarks were established at each of the gauging station sites.

The shelter to house most of the probes and the equipment was bolted onto the top of the stilling well pipe once the ground had been backfilled (Fig 3). The shelter, an aluminium construction approximately 1m (wide) x 1m (high) x 1 m (deep) with a front opening door, was secured to the pipe by three angled braces. When the shelter was in place external instrumentation was added. The shelter contains batteries, a DT50 dataTaker data logger, a Gamet water sampler and various tools. A MSX40 (40 Watt) SOLAREX photo voltaic cells attached to a 5 m pole, located away from the treeline, is used to recharge batteries by trickle charge.

Tipping bucket raingauges or pluviometers were installed at each site to measure rainfall amount and intensity. These were located in an open space, relatively close to the shelter in accordance Bureau with Meteorology specifications.

2.2 Instrumentation

Each gauging station site has the following instrumentation and equipment

- A Data Electronics DT50, data logger,
- A Hawk water level pressure sensor as well as a backup Unidata starlogger with optical shaft encoder,
- A Greenspan turbidity meter (Model No. EC250),
- Gamet pump sampler (Waste Watcher) - Automatic water sampler (capacity of 24 samples),
- A Hydrological Services Tipping Bucket Raingauge (Model TB3) to measure rainfall,
- Other miscellaneous items such as, solar panels, staff gauges, boat, gauging wire across the channel and bench mark.

During the 1998/99 wet season (the first sampling season) a second Gamet water sampler was installed at the SC site to sample water from different heights within the water column. This sampler was housed on a shelf constructed next to the gauging station shelter (Fig 3). There were initial problems with the triggering of this water sampler (caused by a software problem) which resulted in intermittent samples during the wet season. For the 1999/00 wet season the inlet was lowered and the second sampler was triggered to run after the first sampler was full, thus giving 48 samples at the SC site between visits. Similar additional samplers were installed at the other two sites (ET and UM) during the dry season of 2000. All three sites currently have the capability to take 48 water samples between downloads with the additional sampler housed on a shelter next to the gauging station shelter.

Figure 3 The original completed gauging station (left) and with the additional stand for the second Gamet sampler (right), at Swift Creek

2.3 Wiring Diagrams of the Gauging stations

The equipment and probes are wired into the DT50 such that all of the channels and inputs are used, i.e. the data logger is utilised to its maximum potential. All of gauging stations have identical wiring configuration (figs 4 & 5).

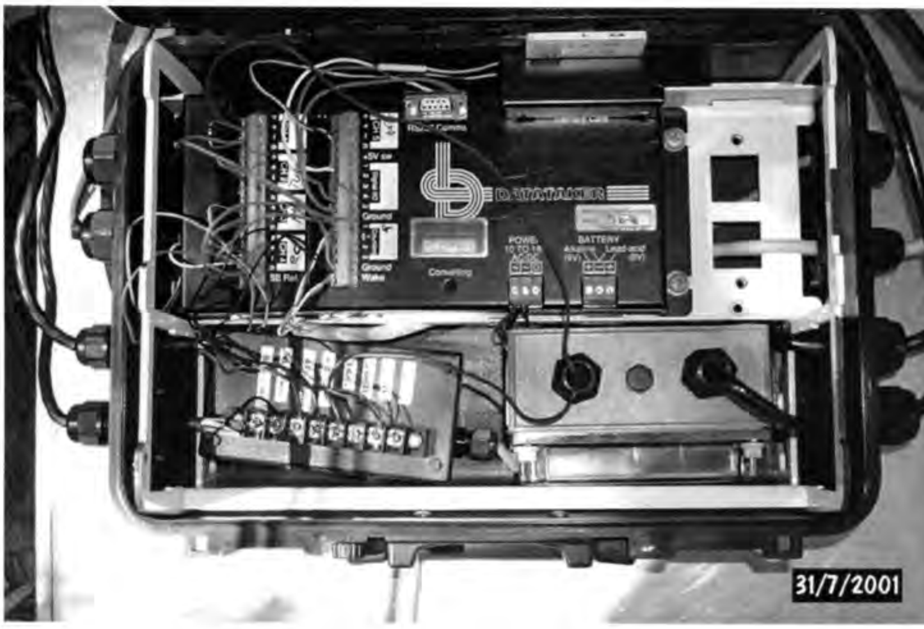


Figure 4 Picture of the wiring in the data taker DT50s

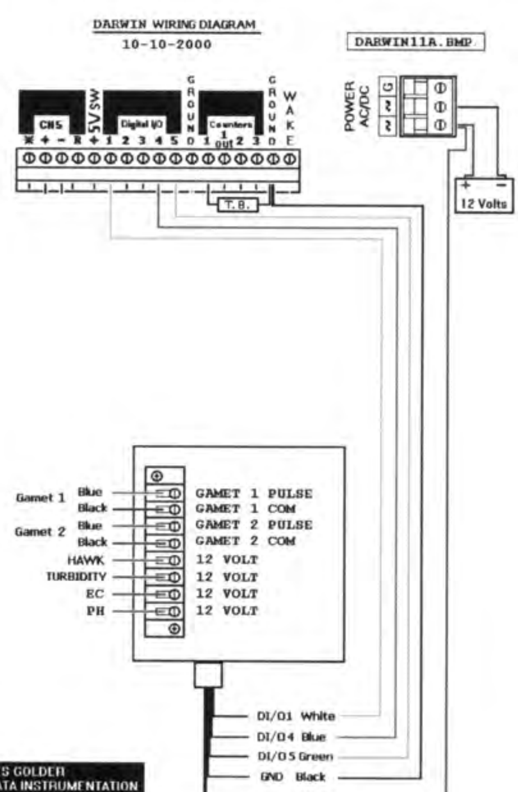


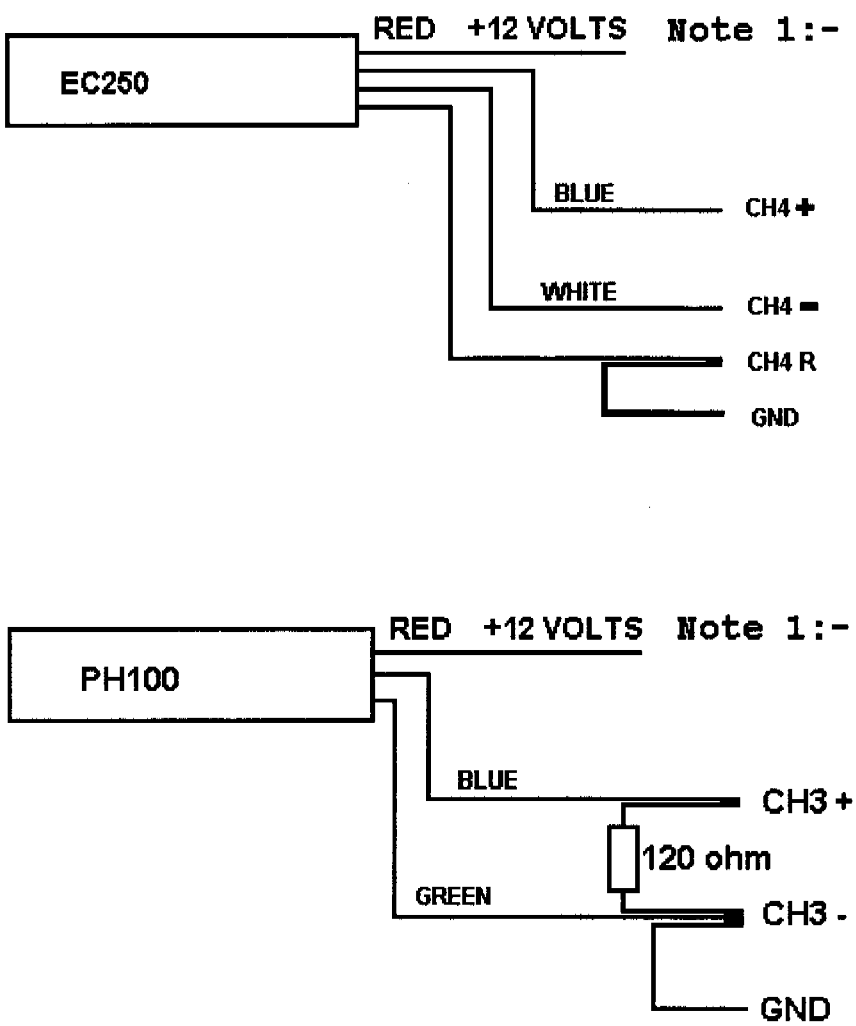
Figure 5 Wiring diagram for the power connections and the pulse connection for the Gamet samplers

The wiring diagrams for each of the individual sensors are shown in figures 6 to 8.

EC and PH Probe interconnection drawings

modified 29-11-99 link ch4 R and GND

DARWIN11 B.BMP



Note 1
Connect this to
battery if testing
or connect to relay
box if in service.

Figure 6 Identifies the wire colour and connection procedure for the EC and pH probes

Probe interconnection drawings

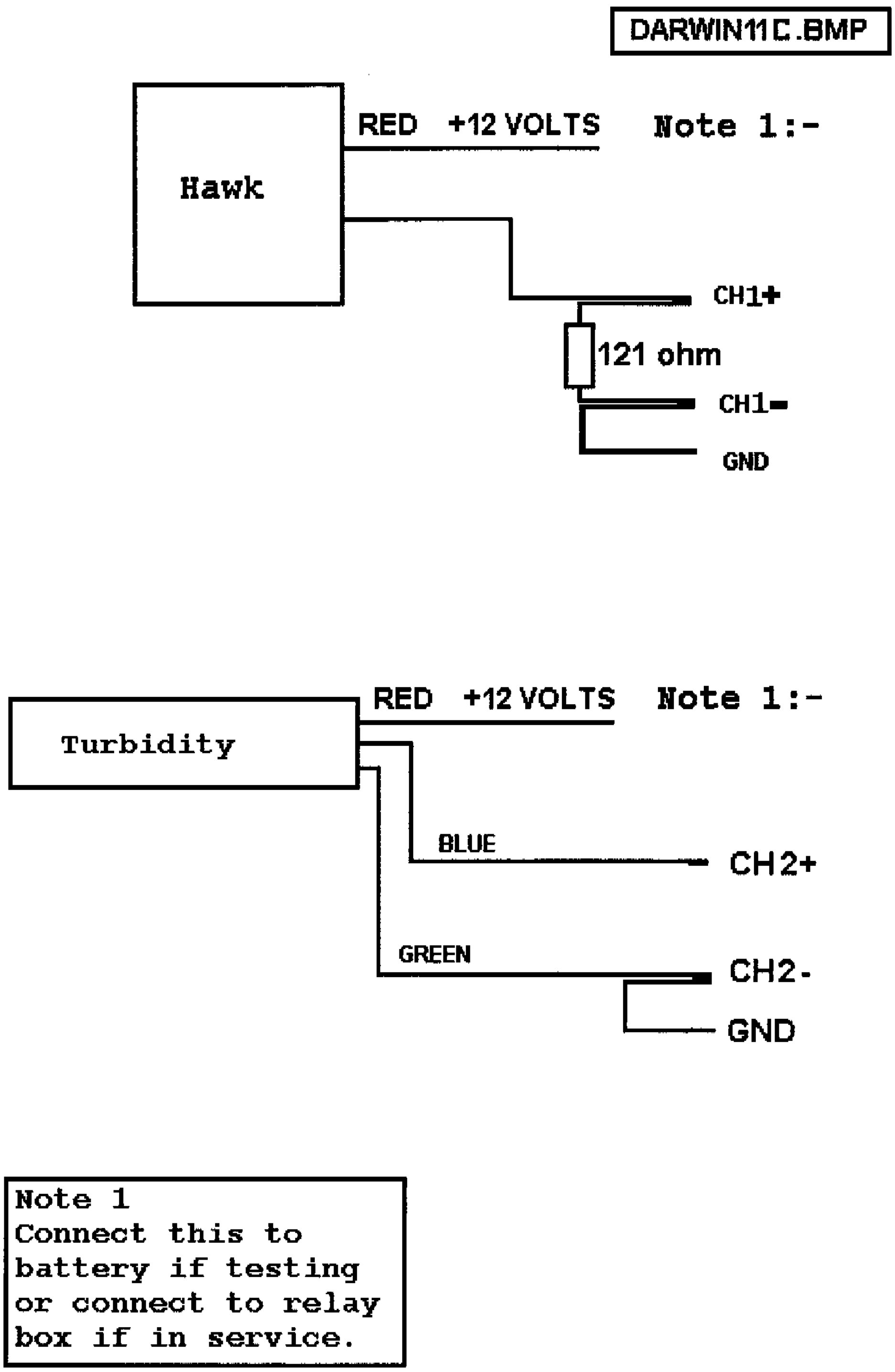


Figure 7 Identifies the wire colour and connection procedure for the Pressure Transducer (Hawk) and the Turbidity Probe

PLUVIOMETER [TIPPING BUCKET] INSTALLATION DRAWING.

DARWIN6F.BMP

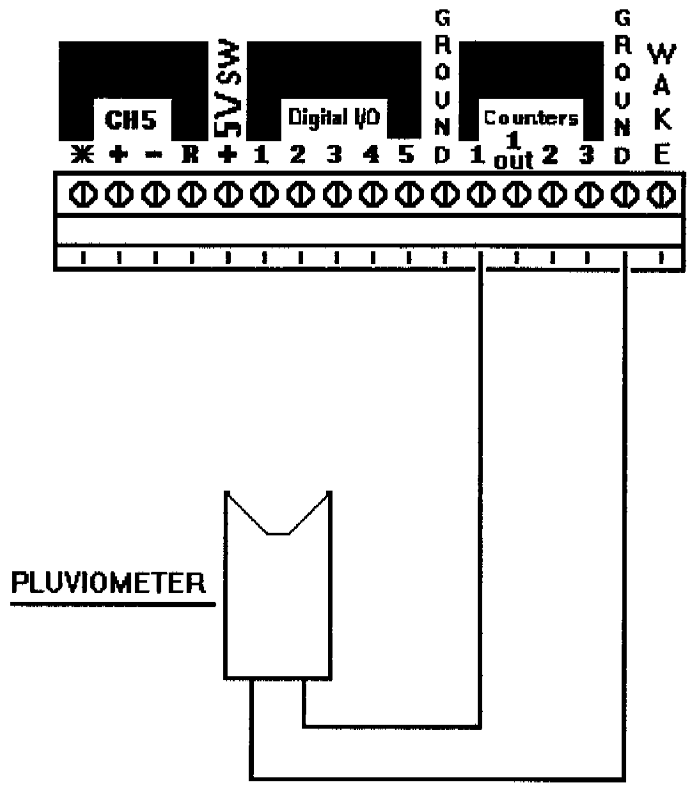


Figure 8 Wiring Diagram for the Tipping Bucket Raingauge

All wiring diagrams have been drawn and supplied by Les Golder.

3 Downloading of data at the gauging stations

The gauging stations are visited on a weekly basis during the wet season to collect samples and download the data loggers. All of the probes, except the shaft encoder, are connected to and store data in the Data Electronics DT50. The shaft encoder is connected to a Unidata datalogger and the data are used as a back up for the pressure transducer. The DT50 is downloaded each week and the Unidata data logger is down loaded once a month. During every download, information **MUST** be entered on gauging station data sheets. A copy of the gauging station data sheet is shown in Appendix 1.

3.1 Downloading the DT50

To download the DT50 connect the Palmtop computer to the DT50 using the supplied cable. On the DT50 the cable is plugged into the RS 232 port.

Turn the Palmtop on, and the DOS prompt should be on the screen with the following directory structure **A:/DT.** If not complete one of the following:

- If the Palmtop has the cursor at the DOS prompt, but in C Drive (C:/), then type **A:**(enter)
- If the palm top is in any of the Hewlett Packard applications press the ALT key, this should highlight the File menu, (press enter) and then use the arrow keys to move the cursor down to Exit, then press enter. This should return to a Hewlett Packard Screen. At this screen select the blue key which has **&...** on it. This key is in the second row, six keys in from the left side of the key board. This should bring up a screen headed with "More Applications". Depressing the Alt key will bring up the Application Menu, press the enter Key and use the arrows to move down to **Terminate All,** press enter and a screen will ask you if you want to terminate all applications and return to DOS. Select OK and you will return to the DOS prompt.

Type DT to enter the determinal software which runs the data logger. The screen should say dataTaker found – Baud rate of 4800, and then be split horizontally into two screens. The lower screen allows commands to be entered whilst the top screen shows the output.

At each gauging station, 2 files need to be downloaded to the A drive. The file name consists of the station abbreviation and the date in the form of month, day, year, followed by a dot and then a file extension (i.e ET012701.A06, SC031701.X10). In the file extension, a letter (X or A) will be used to show what type of download it is, followed by the number of the download (i.e A10 or X10 is the 10th download of data for the wet season at that site).

- A = all probe and sensor data.
- X = date, time and water level height data of the samples taken by the Gamet.

To download press **ALT U** and a screen with various options will appear. Select the A or X schedule by using the arrow keys to either advance through the screen of go backwards to the bottom of the right column. At the file name prompt type in the appropriate filename, e.g. A\:UP122701.A12. When the download has been completed use the arrow keys to change the extension in the file name to X, e.g. A\:UP122701.X12. These files will be saved to the A:\DT\ directory by default.

Once the files have been downloaded and saved it is important to exit the DT software and check that the files have been successfully saved. To do this press the ESC key and select to exit from DT.

Type DIR at the prompt and check that the files that have just been downloaded are in the directory.

If the files are in the correct directory then the DT50 needs to have the data cleared from its internal memory and then the program reset. Enter the DT software again (by typing DT) and once in the software and with the cursor in the lower screen type:

CDATA (press ALT L), repeat this several times to ensure that the DT50 is awake and has understood the commands. The ALT–L command is used to send the command line rather than pressing enter, e.g.

CDATA (ALT-L)
CDATA (ALT-L)
CDATA (ALT-L)

Sending the command at least three times ensures that the DT50 is awake and receives the command. To save battery power the DT50 enters a sleep mode and wakes when keys are pressed. To ensure that any command has been accepted by the DT50 the command should appear in the top screen.

To reset the DT50 type:

RESET (ALT-L).

The top screen should say initalising and then give a time and date with the stage height from the pressure transducer. Wait for a reading to be displayed. Press ESC and exit from the DT software

3.2 Shortened version to download the DT50

Turn the Palmtop on

At DOS prompt type **A:\DT. (if not at DOS prompt see section 3.1 above).**
The screen should say dataTaker found – Baud rate of 4800.
To download press **ALT U.** Use the arrow keys to change the download type to A schedule.

Enter the file name e.g. :UM122701.A12.

When the first download is complete change the download type to X schedule.

Enter the file name e.g. :UM122701.X12.

Exit DT using ESC key and selecting YES

Type DIR at the DOS prompt and check that the files that have just been downloaded are in the directory.

Type DT

CDATA – ALT L 3 times to ensure that the data are cleared.
RESET (ALT-L) to reset the DT50.

Check that the DT50 is collecting data, press ESC and then turn the Palmtop off.

3.3 Trouble shooting tips

In the first wet season of monitoring (1998/99) there was a problem with the date chip in the ET gauging station. The following commands were used to correct the date if it was incorrect and have been left in this manual, just in case.

CHECK that the time and date are correct. To check the date and time at any time type

T (ALT-L) for time and **D (ALT-L)** for the date

To reset incorrect times type:
T = HH:MM:SS (ALT-L) (e.g. T=09:20:30).

To reset incorrect dates type:
D = DD/MM/YYYY (e.g. D=17/01/2001).

3.4 Downloading the Unidata Starlogger

The Shaft encoder is downloaded using the supplied adapter that plugs into the data logger (it is different from the connector used to download the DT50). The cover that houses the Unidata Starlogger is held in place by six hex head bolts. These need to be undone with a 6mm (Check diameter) alan key.

The following DOS commands should be used to change from the DT directory to the PDL directory, which is the directory that stores the shaft encoder data.

Turn on computer and connect cable to the logger.

In DOS to change up a directory use **CD..**.

To change into a directory type **CD (directory name) e.g. CD PDL (name of directory that has the software to download the shaft encoder).**

In the PDL directory type **CD PDL. (to run the PDL software)**

The PDL menu screen has 7 options. Choose **Use a Scheme (Press enter).**

Select from the required scheme from the list e.g. **TRIB (ET), UPPER** (UM), **MAIN (SC).**

A menu then appears with 8 options. Choose **Unload Data from Logger (Press enter).**

Follow the prompts to complete the download.

After the download has been successful remember to choose from the menu. **Program Logger with Scheme** (Press enter).

After programming the logger, check that the logger is recording correctly. Select:

Scheme Test mode, (Press enter).

When the correct date comes up and the height is being shown, exit out of this screen by **pressing the space bar**, followed by pressing **Quit.** Press ESC to exit from the program.

Do not computer off until you are back to the prompt **A:\PDL**

The file will be converted and downloaded on return to the laboratory. (See section 5.1.2)

3.5 Tips for using the HP Palmtop

If the screen freezes and Ctrl, Alt, Del (system reset) doesn't work then a **Hard Reset** needs to be executed by pressing Ctrl, On key and orange arrow simultaneously. A sheet in the Pelican case should show how to complete a **Hard Reset.**

To change into a specific directory use **CD (directory name) e.g. CD DT** (to enter Determinal software)

To change up a directory type **CD.. i.e.** to go from **A:\DT** to **A:** type **CD..**

To change drives use drive required:
- **A:**
- **C:**

To change from DOS into the functions on the HP type **200** at any prompt e.g.:

- C:\DT **200**
- A:\ **200**

This will take you to an organiser which should say that there are no messages. Exit or cancel out of the organiser.

On the Palmtop HP a program called **Filer** is used to organise files (it is like explorer in Windows NT). To enter **Filer** use the first blue key to the right of the Tab key (there is a picture of a file on the key). **Filer** is reasonably self explanatory with a menu along the bottom of the screen referring to the help keys. To exit out of **Filer** depress the **ALT** key, then press the enter key to see the menu. Use the arrow to select **EXIT** and press enter.

To exit out of these functions and return to DOS all the functions will have to be selected at once. This is done by depressing the last blue key along the row which has **&...** on it. A screen will appear with lots of functions, with a heading of **More Applications.**

Depress the **ALT** key, and then press enter to see the menu. Highlight **Terminate ALL** using the arrows and then press enter. This will bring up a Terminate System Manager screen with **OK** highlighted. Depress **Enter** and this should return you to the DOS menu.

3.6 Datataker DT50 command files

Each of the three sites has a command file that runs the probes and stores the data. These files are essentially the same with only several parameters changed within them. The differences are the sample interval on the rise and the fall of the stage and also the height at which the Turbidity Probe is told to sample above. The command files are called Upmain, Easttrib and Swiftcrk and the number refers to the version that is currently being used (table 1). This version number is updated when changes are made to the command files. Table 1 shows current command file versions and also the stage heights for Gamet sampling and turbidity readings. The command files are located in the directory:

R:\31\Jabiluka\Admin\Gauge Stns\cmdfiles\ and command files used during the 2000/2001 wet season are given in Appendix 2.

Table 1 2000/2001 stage heights for Gamet samples and turbidity readings and also command file version number

Command File	Stage heights for Gamet Sample Rise	Stage heights for Gamet Sample Fall	Stage Height above which Turbidity Probe samples
Upmain11.cmd	0.100	0.125	0.400
Easttrib11.cmd	0.075	0.100	0.350
Swiftcrk10.cmd	0.100	0.125	0.500

4 Other activities during weekly visit

During each weekly visit the following activities should be completed (except when there is not sufficient water depth). An information data sheet (copy in appendix 1) should be filled in with all relevant data and observations. All of the work in the stream is carried out at the gauging wire, which should have a tape stretched across the creek for all of the measurements. Most of the time the water level is low enough to allow wading to obtain the samples, however if the water level is above 0.5 m then the boat must be used for safety reasons. All three gauging stations sites have a boat stationed on the bank with connections to fix it to the gauging wire. A look out is maintained at all times during gauging from a position at least two meters from the waters edge.

4.1 Suspended sediment sampler

On first arrival at the site a suspended sediment sample should be collected using the depth integrated suspended sediment sampler (DH-48). The sampler is assembled and the number of handle extensions determined by the depth of the water. The sampler should be lowered until it is just above the bed surface and then raised at an even speed (called a vertical). A series of verticals across the channel should be sampled. This method is called The Equal Transit Rate method (Guy & Norman 1970) and is described in Erskine et al 2001. The sample should be transferred to a marked prepared sample bottle for transport back to the laboratory. A similar sample should be collected just prior to leaving the site using the same procedure.

4.2 Velocity Area gauging

A velocity area gauging should be completed at the gauging wire. For all flows over 0.4 of a meter the large velocity meter (OSS-B1) should be used. The smaller velocity meter (OTT-C31) should be used when the flows are lower then 0.4 meter. The detail of the bank and bed should be measured where the water is still or very slow moving by recording the depth of water where there is a change in the bank or bed. The velocity area gauging should commence where the water starts to flow and a minimum of 10 readings should be taken across the flowing water cross section. The 10 readings are taken so that one reading is not representative of more than 10 % of the flowing water (Gregory and Walling, 1973). As a general rule of thumb the distance between the measurements once the water has started to flow or move is shown in table 2. When the water is 0.6 m or less, the propeller should be set at 0.6 of the water depth and if the water depth is greater than 0.6 m then two readings should be made at 0.2 and 0.8 of the water depth.

Table 2 Approximate distances between verticals during a velocity gauging

Station Name	Distance (m)
East Tributary (ET)	0.3
Upper Main (UM)	0.4
Swift Creek (SC)	0.5

All readings and observations associated with the velocity area gauging should be written (recorded) on the gauging data sheets that are kept in the Pelican case. These gaugings also provide important information on the bed levels during the wet season so it is important to complete a gauging during each trip.

4.3 Bedload sampling

Samples of bedload are collected using a Helley Smith pressure difference bedload sampler (Helley & Smith 1971) across the stream bed. The bedload sampler is kept on the stream bed for a known period of time and this time recorded on the data sheets. These samples should be taken from the cross section where there is sand present that appears to be actively moving. The location of the sand boundaries are determined using the measuring tape along the cross section and recorded on the data sheets. Bedload samples are taken at even spacing across the stream bed (the locations are recorded). It is important that samples (minimum of 4 samples) be taken on a transect (pass) across and then a second transect back across the stream (at the same locations). Samples should be transferred into clearly marked bags after collection at each location, for transportation back to the laboratory.

4.4 Water Samples in the Gamet sampler

Once the data has been downloaded from the DT50 (section 3.1) bottles in the Gamet sampler that have collected water need to be changed. The top of the Gamet needs to be carefully removed and then lids placed on the top of each the sample bottles. It is a straight swap with another set of bottles. The 24 bottles fit neatly into a hobby box for the transport back to the laboratory. Once all the sample bottles have been swapped then the top should be replaced on the Gamet sampler, which then needs to be reset. This is done by depressing the keys on the controller.

Initially the Set Parameters Key is pressed and after a beep the display will ask a series of questions. To answer the questions, use either the **Yes** of **No** touch pads. Variable numerical values are set by pressing the **Up** or **Down** keys. The purge and sample times for Gamet samplers at each of the sites is listed in table 3.

Table 3 Purge and sample times for each of the Gamet water samples

Station	Purge Time (Secs)	Sample Run Time (Secs)
Easttrib (ET)	10	35
Upmain (UM)	5	15
Swift Crk (SC)	5	15

The commands to reset the Gamet water sampler are as follows:

Set Parameters **YES.**
Peristaltic **YES.**
Purge T **(input the purge time generally abut 5-6 seconds) YES.**
Pump Run **(input time for the pump run various between sites) YES.**
S-Interval **(leave as zero) YES.**
Check Sample Size **NO.**
Delay St **(leave as zero) YES.**
Samples/Btle = **01 YES.**
Btles/Sample **= 01 YES.**
# of Bottles = 24 **YES.**
Time Mode = **NO.**
Float Mode = **NO.**
Hi Rate Run = **NO.**
Pulse Mode = **YES.**
Pulse Number = 01 **YES.**

Move the control Knob away from 24 so that when the **Yes** button is depressed the knob will move to position the spout in the correct place.

Start Run = YES.

The Gamet sampler is now primed and ready for use.

4.5 Bedform description

It is important to try and describe the bedforms and dunes that are present in the stream bed during each visit. It is generally possible to see the bedforms and dunes that are present unless the water is deeper than about 1.2 m when the turbidity and water colour make it difficult to distinguish the bedforms. Ripples are less than or equal to 4 cm in height whilst dunes are greater than 4 cm (W.D Erskine pers. comm. 1999). It is possible to have ripples on top of dunes and thus both types of bed forms are present and should be noted. In some instances particularly, after large flows, there may be a large dune or sediment slug present that has a leading face of 0.5 m (these have been noticed mainly at SC). The height of these large scale bedforms should also be noted on the data sheets. It is also important to note other conditions of the bed that are present during each visit, for example the mud layer that appears at ET and has also been seen on at least one occasion at SC. Also, in some instances (particularly at SC) there is root mat underneath the sand layers that is visible (or can be felt) when all the sand has been scoured out by large flows and there has not been an infilling sequence yet.

Record all observations and measurements on the gauging station data sheets.

4.6 Tape measure

Prior to leaving the site make sure that all the equipment is securely packed away and make sure that the tape measure is collected from its span across the creek as it is easy to forget it.

5 On return to Laboratory

On return to the laboratory it is important to store the data safely, place copies of the data recording sheets on the relevant registry files and to dry out all the equipment in preparation for the next time that it is used.

5.1 Storage of the data

5.1.1 Storing DT50 data

The data that has been downloaded from the DT50 should be copied into the relevant directories on the R:\ drive. To download the data, the flash card (memory card) should be carefully removed from the Palmtop HP and inserted in the Flash card reader. The files can then be transferred to the network using Windows NT explorer. The files are selected (from D drive) and moved to the R:\ drive. The directories that they are stored in are

R:\31\Jabiluka\projects\hudrology\data\runoff\download*Station name**year*.

5.1.2 Storing shaft encoder data

The shaft encoder data is downloaded approximately once a month and the data should be also be stored securely on the R :/ Drive. Initially in the field a data file is created which has to be unloaded from the Palmtop HP and moved to the relevant directory on R Drive. To unload the data the following commands should be followed:

Turn on Computer (HP)

To change into a directory use **CD (directory name) e.g. CD PDL**

In the PDL directory type **CD PDL**

This will bring PDL menu screen up with 7 options. Choose **Use a Scheme, Enter**

Select from the list of schemes the one you need e.g. **TRIB, UPPER, MAIN**

A menu then appears with 8 options. Choose **Display all Unload Files, Enter**

Select the file you want **Enter**

Page down through plots until you get to Output data to Scrn

You can keep **Paging Down** or **Pressing Crtl Break**, which gives you 3 options. Choose A)bort to write the DMP. file to a Dat. file, ready for transferring to your main computer.

Once the file has been downloaded it should be transferred onto the network, described in 5.1.1.

The same procedure using Windows Explorer NT is used to transfer the files to R:\31\Jabiluka\projects\hydrology\data\download*station name**relvant year*

5.2 Data recording sheets

The data recording sheets need to be stored in a registry file as well as in files that are kept in the Hydrological and Ecological Processes work areas. The original recording sheet is photocopied and one is kept in the relevant lever arch folder and the other is kept on one of the following Registry files.

JR-05-315	Swift Creek Gauging Station (Swift Creek)
JR-05-316	Upper Main Swift Creek Gauging Station (Upmain)
JR-05-317	East Tributary Gauging Station Swift Creek (East Trib)

The data from the recording sheets is also entered into an Access data base file newmonitoringshhets .mdb, which, is located in the following directory on the R Drive.

R:\31\Jabiluka\Admin\Gauge Stns\Monitoring sheets.

5.3 Sediment samples

The bedload samples should all be carefully transferred into pre-weighed containers and placed in the oven to dry at 105° ready for sieving. Deionised water is used to wash the entire sample into aluminium containers that have been dried and pre-weighed. The name of the sample should be clearly written on the container and the containers placed in the oven for several days to ensure that the sample is oven dry.

The suspended sediment and Gamet samples are all stored carefully awaiting the determination of pH, Conductivity, Turbidity and then the filtration process.

5.4 Equipment

On return from the field the bags for the Helley Smith sampler should be hung up to dry and the velocity gauge should be laid out to dry as well. Once a month the oil level in the velocity gauge should be checked to ensure that there is a sufficient to allow it to run smoothly (properly). If it has been raining during the field day then all the wet equipment/gear should be carefully laid out to dry in particular the blue tarpaulin which is used to protect the electronic equipment when the data are being downloaded.

6 Gauging Station Maintenance

Prior to the onset of the next wet season (late September or early November) the gauging station and equipment should be checked and prepared for the wet season data gathering. Some activities should be done annually and others should be done every three years.

6.1 Yearly maintenance

Each year the following should be undertaken to ensure that good quality reliable data are collected from each of the gauging stations.

- Calibrate turbidity, pH and conductivity probes,
- Check calibration of pluviometers,
- Service the Gamet samplers, peristaltic pumps,
- Check all batteries (including memory card and Unidata Starlogger),
- Check Solar panel is working,
- Calibrate probes,
- Check the stilling well for sedimentation and also check survey the stilling well,
- Clean out the gauging station inlet pipes,
- Check wiring of the DT50's and specifically check for ants in electronics,
- Check that the correct command files are running each station,
- Check calibrate and clean pluviometer,
- Inspect and clear helicopter landing area, and
- Clear any vegetation from around the pluviometers.

At the end of the wet, clear and maintain a fire break around the gauging station.

6.2 Maintenance required at 3 yearly intervals

Every three years the following items should be replaced or serviced;

- Replace all batteries,
- Replace or clean intake tubing for the gamets,
- Remove one of the shelters to check sediment levels in the stilling wells,
- Clean the Solar panels, and
- Re-lacquer internal circuitry.

7 Acknowledgments

Wayne Erskine and Ken Evans assisted greatly with the initial field reconnaissance and helping to decide on the location of the gauging stations. ERA allowed and continue to allow access on to the Jabiluka Mineral Lease. Parks Australia North were also consulted with regard to the installations.

8 References

Erskine WD, Saynor MJ, Evans KG & Boggs GS 2001. *Geomorphic research to determine the off-site impacts of the Jabiluka Mine on Swift (Ngarradj) Creek, Northern Territory.* Supervising Scientist Report 158, Supervising Scientist, Darwin.

Guy HP & Norman VW 1970. Field methods for measurement of fluvial sediment. Techniques of Water-resource Investigations of the United States Geological Survey C2(3).

Gregory KJ & Walling DE 1973. *Drainage basin form and process.* Edward Arnold, London, 120–145.

Helley EJ & Smith W 1971. Development and calibration of a pressure difference bedload sampler. US Geological Survey Open File Report.

Appendix 1

2000/2001 Wet Season Monitoring Data Recording Sheet

Time of arrival	
Gauge Height	

Site		Date	
Sheet Prepared by			

Suspended Sediment No	Time	Gauge Height
Distances		
1		
2		
3		
4		

Download No.	
Time	
Period or record	

Time		Gauge height	
Time		Gauge height	

Velocity Gauging

Orange Mark LB	m	Orange Mark RB	m		
Waters Edge LB	m	Start Time		Gauge Height	
Waters Edge RB	m	Finish Time		Gauge Height	

Record values on Velocity Gauging sheets

Bedload sampling

Sample No	Time In	Time out	Gauge Height
SELB			
SERB			

Raingauge

Bulk	mm
Ants	

Power

Solar	
Logger	
Gamet 1	
Gamet 2	

Gamet Automatic Sampler

No. of Samples	
Emptied	
Reset	

Bedforms	Tick as Approp.	Height (cm)	Dist. apart (cm)	Continuo Yes/No	Form -*Concave Straight	Firm or Soft Bed
None or						
Ripples <						
Dunes > 4cm						
Longitudinal						
Sand Slug >20cm						

* Concave downstream - looking downstream
* Convex upstream - looking downstream

Departure		Gauge Height	

Appendix 2

This appendix contains the command files that were used during the 2000/2001 wet season. Any text that it preceded by a ' is a remark to tell you about a particular part of the program and not actually part of the commands.

A2.1 Upmain command file

```
'UPMAIN11.CMD
'This program uses DataTaker DT50 to record the output of a
'Hawk Liquid level probe  logged on Channel 1.
'which in turn drives TWO Gamet water samplers. When the first is full the second takes over.
'Greenspan Turbidity sensor is logged on Channel 2.
'Greenspan pH sensor is logged on Channel 3.
'Greenspan EC sensor is logged on Channel 4+.
'Greenspan EC sensor temperature is logged on Channel 4-.
'temperature TK is logged on channel 5
'A Pluviometer is also logged on Counter 1.
'This program was developed by L. Golder for Currumbene Hydrological.(21-9-99)
'modified 9/10/00
'This command file was implemented 25/10/00
H
H
H
CPROG
CPROG
CPROG
RESET
\W5
CDATA
;H
;CLEAR
;CARDID="UPMAIN11"
;/T/D/o/u/n/c
;S2=0,2,0,100"water height in mm" 'or S2=0,10.6,0,100 for the 10.6 metre probe
;S3=0,250,0,2500"NTU" 'span for the turbidity probe 250 NTU
;S4=0,14,0,100"ph"
;S5=0,1000,0,2500"uS"
;S6=0,50,0,2500"degC"
;P10=2000  'ADC settling time
;P15=1 'forced sleep mode
;P22=44 'comma deliminator in unload mode
;P31=1  'date format
;P32=5 '5 significant figures
;$="Sample Taken"
;21CV(W)=0.100  '  rise above last height to activate sampler
;22CV(W)=0.125  '  fall below last height to activate sampler
;30CV(W)=0.400   '  min height at which turbidity data is read and logged
;26CV(W)=0     ' sample number for No 1 sampler
;36CV(W)=0     ' sample number for No 2 sampler
```

```
;98CV(W)=0
;BEGIN
;    CARDID
;    4DSO(W,5000)=1
;    1L(121,S2,FF3,=23CV)  'reads Hawk depth
;    24CV(W)=23CV+21CV     'upper limit for  sampler
;    25CV(W)=23CV-22CV     'lower limit for  sampler
;    4DSO(W,2000)=0
;RA6M
;    4DSO(W,5000)=1
;    1L(121,S2,FF3,=20CV)      'reads Hawk depth
;    2V(W,S3,FF0,=31CV)        'reads Turbidity
;    31CV(W)=31CV-(20CV<30CV)*(31CV)     'depth is less than 30cv return a 0
;    31CV(FF0)                  'Turbidity
;    3L(120,S4,FF1,=32CV)  'ph value
;    4+V(S5,FF1,=33CV)     'electrical conductivity
;    4-V(S6,FF1,=34CV)     'temperature
;    4DSO(W,2000)=0
;    5TK               'temperature
;    1HSC(R,=35CV)         'tipping bucket
;RX
;    20CV(FF3)  'water height
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    $
;    26CV(FF2,"No 1 sample count")
;    36CV(FF2,"No 2 sample count")
;RZ6M
;          IFR1(20CV(=23CV)>24CV)"[24CV(W)=24CV+21CV   25CV(W)=25CV+21CV
26CV(W)=26CV+1 1DSO(W,100,R)=1 X]"
;                   IFR2(23CV<25CV)"[24CV(W)=24CV-22CV    25CV(W)=25CV-22CV
26CV(W)=26CV+1 1DSO(W,100,R)=1 X]"
;    IFR3(26CV>24)"[HZ1 HZ2 GZ4 GZ5]"
;          IFR4(20CV(=23CV)>24CV)"[24CV(W)=24CV+21CV   25CV(W)=25CV+21CV
36CV(W)=36CV+1 5DSO(W,100,R)=1 X]"
;                   IFR5(23CV<25CV)"[24CV(W)=24CV-22CV    25CV(W)=25CV-22CV
36CV(W)=36CV+1 5DSO(W,100,R)=1 X]"
;    IFR6(36CV>24)"[HZ4 HZ5]"
;END
;LOGON
;G
;HZ4 HZ5
```

RUNPROG

A2.2 Easttrib command file

```
'EASTTRIB11.CMD
'This program uses DataTaker DT50 to record the output of a
'Hawk Liquid level probe  logged on Channel 1.
'which in turn drives TWO Gamet water samplers. When the first is full the second takes over.
'Greenspan Turbidity sensor is logged on Channel 2.
'Greenspan ph sensor is logged on Channel 3.
'Greenspan EC sensor is logged on Channel 4+.
'Greenspan EC sensor temperature is logged on Channel 4-.
'temperature TK is logged on channel 5
'A Pluviometer is also logged on Counter 1.
'This program was developed by L. Golder for Currumbene Hydrological.(21-9-99)
'modified 9/10/00 & by M.J. Saynor 25/10/00
'This command file was implemented 25/10/00
H
H
H
CPROG
CPROG
CPROG
RESET
\W5
CDATA
;H
;CLEAR
;CARDID="EASTTRIB11"
;/T/D/o/u/n/c
;S2=0,2,0,100"water height in mm" 'or S2=0,10.6,0,100 for the 10.6 metre probe
;S3=0,250,0,2500"NTU" 'span for the turbidity probe 250 NTU
;S4=0,14,0,100"ph"
;S5=0,1000,0,2500"uS"
;S6=0,50,0,2500"degC"
;P10=2000  'ADC settling time
;P15=1 'forced sleep mode
;P22=44 'comma deliminator in unload mode
;P31=1  'date format
;P32=5 '5 significant figures
;$="Sample Taken"
;21CV(W)=0.075  '   rise above last height to activate sampler
;22CV(W)=0.100  '   fall below last height to activate sampler
;30CV(W)=0.350   '   min height at which turbidity data is read and logged
;26CV(W)=0      'sample number for No 1 sampler
;36CV(W)=0      'sample number for No 2 sampler
;98CV(W)=0
;BEGIN
;    CARDID
;    4DSO(W,5000)=1
;    1L(121,S2,FF3,=23CV)  'reads Hawk depth
```

```
;    24CV(W)=23CV+21CV    'upper limit for  sampler
;    25CV(W)=23CV-22CV    'lower limit for  sampler
;    4DSO(W,2000)=0
;RA6M
;    4DSO(W,5000)=1
;    1L(121,S2,FF3,=20CV)       'reads Hawk depth
;    2V(W,S3,FF0,=31CV)         'reads Turbidity
;    31CV(W)=31CV-(20CV<30CV)*(31CV)     'depth is less than 30cv return a 0
;    31CV(FF0)                   'Turbidity
;    3L(120,S4,FF1,=32CV)   'ph value
;    4+V(S5,FF1,=33CV)      'electrical conductivity
;    4-V(S6,FF1,=34CV)      'temperature
;    4DSO(W,2000)=0
;    5TK                 'temperature
;    1HSC(R,=35CV)          'tipping bucket
;RX
;    20CV(FF3)  'water height
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    $
;    26CV(FF2,"No 1 sample count")
;    36CV(FF2,"No 2 sample count")
;RZ6M
;           IFR1(20CV(=23CV)>24CV)"[24CV(W)=24CV+21CV   25CV(W)=25CV+21CV
26CV(W)=26CV+1 1DSO(W,100,R)=1 X]"
;                    IFR2(23CV<25CV)"[24CV(W)=24CV-22CV    25CV(W)=25CV-22CV
26CV(W)=26CV+1 1DSO(W,100,R)=1 X]"
;    IFR3(26CV>24)"[HZ1 HZ2 GZ4 GZ5]"
;           IFR4(20CV(=23CV)>24CV)"[24CV(W)=24CV+21CV   25CV(W)=25CV+21CV
36CV(W)=36CV+1 5DSO(W,100,R)=1 X]"
;                    IFR5(23CV<25CV)"[24CV(W)=24CV-22CV    25CV(W)=25CV-22CV
36CV(W)=36CV+1 5DSO(W,100,R)=1 X]"
;    IFR6(36CV>24)"[HZ4 HZ5]"
;END
;LOGON
;G
;HZ4 HZ5
RUNPROG
```

A2.3 Swiftcrk command file

```
'SWIFTCRK10.CMD
'This program uses DataTaker DT50 to record the output of a
'Hawk Liquid level probe  logged on Channel 1.
'which in turn drives TWO Gamet water samplers. When the first is full the second takes over.
'Greenspan Turbidity sensor is logged on Channel 2.
'Greenspan ph sensor is logged on Channel 3.
'Greenspan EC sensor is logged on Channel 4+.
'Greenspan EC sensor temperature is logged on Channel 4-.
'temperature TK is logged on channel 5
'A Pluviometer is also logged on Counter 1.
'This program was developed by L. Golder for Currumbene Hydrological.(21-9-99)
'This file was adapted slightly by Mike Saynor 26-11-99 and Seaman (12-10-00)
'This command file was used for the 1999-00 wet season
H
H
H
CPROG
CPROG
CPROG
RESET
\W5
CDATA
;H
;CLEAR
;CARDID="SWIFTCRK10"
;/T/D/o/u/n/c
;S2=0,2,0,100"water height in mm" 'or S2=0,10.6,0,100 for the 10.6 metre probe
;S3=0,250,0,2500"NTU" 'span for the turbidity probe 250 NTU
;S4=0,14,0,100"ph"
;S5=0,1000,0,2500"uS"
;S6=0,50,0,2500"degC"
;P10=2000  'ADC settling time
;P15=1 'forced sleep mode
;P22=44 'comma deliminator in unload mode
;P31=1  'date format
;P32=5 '5 significant figures
;$="Sample Taken"
;21CV(W)=0.1   '  rise above last height to activate sampler
;22CV(W)=0.125   '  fall below last height to activate sampler
;30CV(W)=0.500    '  min height at which turbidity data is read and logged
;26CV(W)=0      'sample number for No 1 sampler
;36CV(W)=0      'sample number for No 2 sampler
;98CV(W)=0
;BEGIN
;    CARDID
;    1L(120,S2,FF3,=23CV)  'reads Hawk depth
;    24CV(W)=23CV+21CV    'upper limit for  sampler
;    25CV(W)=23CV-22CV    'lower limit for  sampler
```

```
;RA6M
;    1L(120,S2,FF3,=20CV)       'reads Hawk depth
;    2V(W,S3,FF0,=31CV)         'reads Turbidity
;    31CV(W)=31CV-(20CV<30CV)*(31CV)       'depth is less than 30cv return a 0
;    31CV(FF0)                  'Turbidity
;    3L(120,S4,FF1,=32CV)   'ph value
;    4+V(S5,FF1,=33CV)      'electrical conductivity
;    4-V(S6,FF1,=34CV)      'temperature
;    5TK                    'temperature
;    1HSC(R,=35CV)          'tipping bucket
;RX
;    20CV(FF3)  'water height
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    11SV   'forces a zero
;    $
;    26CV(FF2,"No 1 sample count")
;    36CV(FF2,"No 2 sample count")
;RZ6M
;            IFR1(20CV(=23CV)>24CV)"[24CV(W)=24CV+21CV   25CV(W)=25CV+21CV
26CV(W)=26CV+1 1DSO(W,100,R)=1 X]"
;                    IFR2(23CV<25CV)"[24CV(W)=24CV-22CV    25CV(W)=25CV-22CV
26CV(W)=26CV+1 1DSO(W,100,R)=1 X]"
;    IFR3(26CV>24)"[HZ1 HZ2 GZ4 GZ5]"
;            IFR4(20CV(=23CV)>24CV)"[24CV(W)=24CV+21CV   25CV(W)=25CV+21CV
36CV(W)=36CV+1 5DSO(W,100,R)=1 X]"
;                    IFR5(23CV<25CV)"[24CV(W)=24CV-22CV    25CV(W)=25CV-22CV
36CV(W)=36CV+1 5DSO(W,100,R)=1 X]"
;    IFR6(36CV>24)"[HZ4 HZ5]"
;END
;LOGON
;G
;HZ4 HZ5
RUNPROG
```