

## **TERM OF REFERENCE 4: FORECASTING, ALERTS AND WARNINGS**

*The use and efficiency of forecasting, community alerts, warnings and public information by authorities in responding to flood events.*

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### **1 A SINGLE SOURCE OF PUBLIC FLOOD WARNINGS AND ALERTS**

- (a) During a potential flood emergency it is important that there is a single source of information. Mixed messages can lead to confusion, unnecessary damage to property and even lives being lost. The Bureau of Meteorology (BoM) provides a flood warning service for Tasmanian rivers. The Bureau delivers this service through its Flood Warning Centre and Regional Forecasting Centre based in Hobart.
- (b) The warnings BoM provide are used by the Police, State Emergency Service (SES) and local authorities to plan their emergency responses.
- (c) Hydro Tasmania does not provide flood warnings to the public nor does it provide predictions about the level of flooding as it could lead to mixed messages or confusion about what the situation is.
- (d) Information on the flood warning services provided by BoM is available at:  
<http://www.bom.gov.au/water/floods/floodWarningServices.shtml>
- (e) The Tasmanian flood warnings are available at:  
<http://www.bom.gov.au/tas/warnings/index.shtml>

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### **2 HYDRO TASMANIA COLLECTS A RANGE OF WATER MONITORING DATA**

#### **2.1 Water Monitoring Data**

- (a) The water level, flow and rainfall monitoring sites operated by Hydro Tasmania are for the purpose of operating a hydro-generation system and in accordance with its operational requirements.
- (b) Hydro Tasmania operates a network of automatic rain gauges, river level/flow sites and lake level probes which cover a wide geographic area associated with hydro generation activities.

- (c) Typically Hydro Tasmania collects rainfall, level and flow data every half hour from its monitoring stations.

## **2.2 Hydro Tasmania's network**

- (a) There are a range of water monitoring sites throughout Tasmania, each of which have an identified owner. These owners include Hydro Tasmania, TasWater, Tasmanian Irrigation, BoM and Department of Primary Industry, Parks, Water and Environment (DPIPWE).
- (b) Hydro Tasmania's hydrometric network comprises:
  - (i) 48 pluviographs (rain gauges)
  - (ii) 63 river (includes canals and flumes) level and flow sites
  - (iii) 47 lake (or pond) levels
- (c) The owner of each site is responsible for all aspects of the operation of the site including periodic downloading of the data. Once the data is available in the site owner's database it is transferred to other data users who may require it.
- (d) Historically multiple data users were able to obtain information directly from each site but this led to difficulty identifying problems when a site failed. For example, it was often not clear which of the multiple users' equipment had failed causing a lack of access to the data for all users. The current system resolved this issue.

## **2.3 Data acquisition methods and rates**

- (a) Hydro Tasmania's network typically consists of remote solar powered sites, with data recorded on site by a data logger. Lakes and rivers record a value on the logger every 15 minutes and rain gauges record totals every 5 minutes.
- (b) The data logger transmits a data file every 30 minutes via Internet Protocol (IP) communications (the internet) using 3G or satellite connections to a File Transfer Protocol (FTP) site. These devices can be subject to the same poor signal strength, high traffic load and bad weather issues as mobile phones.

Data files are re-transmitted by the logger if it detects that poor communications has prevented successful data transmission.

- (c) Approximately every 30 minutes any new files arriving at the FTP site are processed and archived to the Hydro Tasmania database. Under normal operations data is up to 45-60 minutes old when it arrives on the Hydro Tasmania database.
- (d) There are a number of hydrometric sites which use the more robust and high frequency SCADA network for transmitting data to Hydro Tasmania's hydrometric database. The SCADA network is Hydro Tasmania's highly reliable power station control system which connects Hydro Tasmania's major infrastructure by a high speed (non-public) network. Sites connected to this network are generally limited to those sites in close proximity to major infrastructure (e.g. power stations and intakes). Data is then transmitted from the SCADA system to Hydro Tasmania's hydrometric database every 30 minutes. The number of sites connected using this method is:
  - (i) 26 lake and pond levels
  - (ii) 4 river levels (and flow)
- (e) Three SCADA river level sites mentioned above (Forth River below Paloona Power Station, Forth River above Lemonthyme Power Station and Derwent River below Meadowbank Power Station) also send data to Hydro Tasmania via an IP communications (internet) connection. This provides communications redundancy at these three sites if the SCADA at the nearby power station is unavailable.
- (f) Equipment redundancy is uncommon in our hydrometric network.

## **2.4 Conversion of river level to river flow data**

- (a) It should be noted that none of Hydro Tasmania's river sites measure flow directly. Rather, river level is measured and converted to a flow. This is consistent with industry practice and equipment.
- (b) To calculate river flow a relationship between river height and river flow is established over time by taking physical measurements of the flow over a

range of heights. These spot flow measurements are called gaugings.

- (c) A height to flow graph ('rating curve') is established by fitting a line of best fit through these gauging points.
- (d) The river site will usually have a number of rating curves over its history as the relationship between height and flow changes when the river cross-section changes. Changes to the river cross-section normally occur during a major flood as material is either deposited or eroded at the site.
- (e) It is rare (unlikely) that a gauging will have been obtained at or near the highest recorded river level. River flows above the highest recorded gauging are an estimate using both practitioner judgement and industry adopted methods for rating curve extension.

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### **3 HYDRO TASMANIA'S DATA IS USED FOR A RANGE OF PURPOSES**

#### **3.1 Data is used to enable Hydro Tasmania's operations**

- (a) As noted above, the primary purpose of the water level, flow and rainfall monitoring sites operated by Hydro Tasmania is to assist Hydro Tasmania in operating a hydro-generation system and in accordance with its operational requirements.
- (b) Some of the data that Hydro Tasmania collects is used in its internal water prediction models. These water flow models were developed for operational and asset management purposes. The outputs from these models are not provided to external agencies as they were specifically designed for Hydro Tasmania's internal purposes.

#### **3.2 Some data is published on Hydro Tasmania's website**

- (a) Data is regularly published to Hydro Tasmania's publicly accessible web site. Many of the lake levels, rainfall and river flows are published here: <http://www.hydro.com.au/water/water-levels-and-flows-map>
- (b) Data is published via static lake, river and rainfall plots (as PDFs). The frequencies at which these are created and published are:

- (c) Lake levels: every 3 hours. Combining this with the normal data acquisition delays this can mean that the published data is up to 4 hours old.
- (d) River levels, river flows and rainfall: every hour. Combining this with the normal data acquisition delays this can mean that the published data is approximately 2 hours old.

### **3.3 Some data is provided to BoM**

- (a) A selection of river level, river flow and rainfall data is regularly automatically exported to BoM via text file to an FTP site.
- (b) The data transferred to BoM comprises:
  - (i) 32 river levels
  - (ii) 30 river flows
  - (iii) 9 lake levels
  - (iv) 26 rainfall sites
- (c) The latest available data is transferred to an FTP site hosted by BoM every 30 minutes. Combining this with the normal data acquisition delays means that under normal operations the data can be up to 1 – 1.5 hours old at time of export. The time for BoM to ingest this data into their hydrometric database is not known by Hydro Tasmania.
- (d) This data is then accessible by the general public via the BoM flood warning services.

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## **4 HYDRO TASMANIA'S INTERACTIONS WITH BOM**

- (a) Hydro Tasmania assists BoM by providing access to flow, water level and rainfall data which BoM then uses as part of its flood prediction models. Hydro Tasmania has been providing this information for over 10 years. This information is incorporated into BoM's flow forecasting models and is an input that assists them in deciding when to issue a flood warning or flood alert.

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## **5 JUNE 2016 FLOOD EVENTS**

### **5.1 Known data acquisition issues during June 2016 floods**

- (a) As would normally be expected there were a number of data acquisition issues and extended data delays during the June 2016 flood event, caused by issues related to the floods. These sites are not specifically designed for the purpose of flood gauging and are therefore prone to failure in flood events. Hydro Tasmania ceased publishing any data that was inaccurate as a result of these issues once the inaccuracies were identified. Once issues were resolved where possible, the provision of information recommenced. In some instances this was not possible, for example, the monitoring station at Ouse below Staff House Creek was completely washed away in the floods. The specific issues which Hydro Tasmania is aware of are set out in the following section.

### **5.2 Data communications delay or failure**

- (a) Several sites experienced extended data delay or unavailability due to communications.
- (i) Iris River at Middlesex Plains. Data was unavailable throughout the flood event (peak). Communications resumed several days later without Hydro Tasmania intervention. It is assumed that the Telstra 3G service was unavailable.
- (ii) Meander River at Deloraine communications stopped on Monday morning 06/06/2016. The issue was determined by Hydro Tasmania staff on site to be a 3G modem. Modem was reset and data transmission resumed Monday afternoon.

### **5.3 Level instrument/data issues or failure**

Several sites experienced level data failure during the event:

- (a) South Esk at Llewellyn. The water level instrument which relies on a differential gas pressure measurement developed a leak at high level (pressure). An under-recorded flood peak was returned by the instrument.

Due to the floods, this was difficult to identify and was detected and advised by BoM on Tuesday Morning 7 June 2016. Hydro Tasmania staff travelled from Hobart and rectified the issue around midday.

- (b) Ouse at Staff House Creek. The site was completely destroyed (washed away) before the flood had peaked. See photos at Annexure A.
- (c) Ouse River at Ashton. Nearing the peak of the flood (Monday 01:30 pm) an electronics cable was damaged by debris causing the instrument to stop. Hydro Tasmania staff gained access to the site on Tuesday morning 07/06/2016 and rectified the problem.
- (d) Ouse River at 3B Weir. The water level instrument which relies on a differential gas pressure measurement developed as issue at high level (pressure), assumed to be a gas leak. An under-recorded flood peak was returned by the instrument. The issue was detected post the flood peak and repairs carried out in the following weeks by replacing the water level sensor.
- (e) Mersey River at Liena. The water level instrument float became stuck in the well after the flood peak had passed and the level was receding. The float remained stuck until access to site was gained on 22 June 2016 via an alternative route.
- (f) Shannon River at St Patricks Plain. The water level instrument float reached its maximum level and hit the bottom of the recorder bench close to the flood peak (within 100mm). Correct values resumed once level dropped below the bench height.
- (g) Lake River at Parknook. The water level instrument float became partially caught near the flood peak (within 300mm). Data continued throughout the flood event but with some error.
- (h) Fisher River above Lake Mackenzie. An instrument cable was damaged by debris around midday on Sunday 5 June 2016 and data stopped. The site required a helicopter trip and was repaired on 10 November 2016.

#### **5.4 Impacts of the floods on accuracy of future water monitoring data**

- (a) As a result of the June floods a large number of Hydro Tasmania's river sites

have experienced significant river section change. Accordingly, there will be an increased uncertainty in the high flow rating curve relationships until new high stage gaugings are obtained over the coming years.

- (b) During the June 2016 flood at a number of locations the high river levels exceeded the rating curve (flow) relationships that Hydro Tasmania had previously developed. Therefore flow data was unavailable from the time the level exceeded the top of existing rating curve until these were manually extended.
- (c) This issue became apparent to Hydro Tasmania on Monday morning 6 June 2016 and “emergency” extensions were completed by early Monday afternoon.



**ANNEXURE A**

**PHOTOS OF OUSE BELOW STAFF HOUSE CREEK – PRE AND POST FLOOD**

