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# MANUAL

# OF

# OPERATIONAL PROCEDURES

# FOR

# FLOOD MITIGATION

# AT

# NORTH PINE DAM

Revision 5
July 2010

| Revision No. | Date | Amendment Details |
|---|---|---|
| 0 | 10 December 1986 | Original Issue |
| 1 | 6 October 1992 | Complete revision and re-issue |
| 2 | 13 November 1997 | Complete revision and re-issue |
| 3 | 26 July 2002 | Complete revision and re-issue |
| 4 | 5 September 2007 | Complete revision and re-issue |
| 5 | July 2010 | Complete revision and re-issue |

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# 1 INTRODUCTION

## 1.1 Preface

Given its size and location, it is imperative that North Pine Dam be operated during flood events in accordance with clearly defined procedures to minimise hazard to life and property. This manual outlines these procedures and is an approved Flood Mitigation Manual under Water Supply Act 2008.

The Manual in its current form was developed in 1992 and the basis of this document was a manual written in 1986 covering flood operations at the dam. Four revisions of the Manual have occurred since 1992 to account for updates to the Flood Alert Network and the Real Time Flood Models and to account for institutional and legislative changes.

The primary objectives of the procedures contained in this Manual are essentially the same as those contained in previous Manual versions. These objectives in order of importance are:

- Ensure the structural safety of the dam;
- Minimise disruption to the community in areas downstream of the dam;
- Retain the storage at Full Supply Level at the conclusion of the Flood Event.
- Minimise impacts to riparian flora and fauna during the drain down phase of the Flood Event.

In meeting these objectives, the dam must be operated to account for the potential effects of closely spaced Flood Events. Accordingly, normal procedures require stored floodwaters to be emptied from the dam as quickly as possible while meeting all flood mitigation objectives.

## 1.2 Meaning of Terms

In this manual, save where a contrary definition appears -

**"Act"** means the *Water Supply (Safety and Reliability) Act 2008*;

**"AEP"** means annual exceedance probability, the probability of a specified event being exceeded in any year;

**"Agency"** includes a person, a local government and a department of state government within the meaning of the Acts Interpretation Act 1954;

**"AHD"** means Australian Height Datum;

**"Chairperson"** means the Chairperson of Seqwater;

**"Chief Executive"** means the Director General of the Department of Environment and Resource Management or nominated delegate;

**"Controlled Document"** means a document subject to managerial control over its contents, distribution and storage. It may have legal and contractual implications;

**"Dam"** means the dam to which this manual applies, that is North Pine Dam;

**"Dam Supervisor"** means the senior on-site officer at North Pine Dam;

**"Duty Flood Operations Engineer"** means the Senior Flood Operations Engineer or Flood Operations Engineer rostered on duty to be in charge of Flood Operations at the dam;

**"EL"** means elevation in metres Australian Height Datum;

**"Flood Event"** is a situation where the Duty Flood Operations Engineer expects the water level at the dam to exceed the Full Supply Level;

**"Flood Operations Centre"** means the Centre used by Flood Operations Engineers to manage Flood Events;

**"Flood Operations Engineer"** means a person designated to direct flood operations at the dam in accordance with Section 2.4 of this manual;

**"FSL" or "Full Supply Level"** means the level of the water surface when the reservoir is at maximum operating level, excluding periods of flood discharge;

**"Gauge"** when referred to in (m) means river level referenced to AHD, and when referred to in ($m^3/s$) means flow rate in cubic metres per second;

**"Manual" or "Manual of Operational Procedures for Flood Mitigation at North Pine Dam"** means the current version of this manual;

**"Senior Flood Operations Engineer"** means a person designated in accordance with Section 2.3 of this manual under whose general direction the procedures in this manual must be carried out;

**"Seqwater"** means the Queensland Bulk Water Supply Authority trading as Seqwater.

## 1.3 Purpose of Manual

The purpose of this manual is to define procedures for the operation of North Pine Dam during flood events. The procedures have been developed on the basis that the structural safety of the dam is paramount within the scope of minimising the downstream impacts associated with releasing flood water from the dam.

## 1.4 Legal Authority

This manual has been prepared as a Flood Mitigation Manual in accordance with Chapter 4 Part 2 of the Act.

## 1.5 Application and Effect

The procedures in this manual apply to the operation of North Pine Dam for the purpose of flood mitigation, and operation in accordance with the manual shall give the protection from liability provided by Section 374 of the Act.

## 1.6 Date of Effect

The procedures in this manual shall have effect on and from the date on which this version of the manual is approved by gazette notice.

The manual shall remain in force for the period of approval as determined by the Chief Executive. This approval may be for a period of up to five years.

Before the approval of the manual expires, Seqwater must review and if necessary update the manual and submit a copy to the chief executive for approval.

## 1.7 Observance of Manual

This manual contains the operational procedures for North Pine Dam for the purposes of flood mitigation and must be used for the operation of the dams during flood events.

## 1.8 Provision to Variation of Manual

If Seqwater is of the opinion that this manual should be amended, altered or varied, it must submit for approval as soon as practical, an appropriate request to the Chief Executive, setting out the circumstances and the exact nature of the amendment, alteration or variation sought. The Chief Executive may accept, reject or modify the request prior to approval.

## 1.9 Distribution of Manual

Seqwater must regard the manual as a Controlled Document and ensure that only controlled manuals are used in the direction of flood mitigation activities. Agencies having copies of controlled hardcopies of the manual are listed in Appendix A. Seqwater must maintain a Register of contact persons for issued controlled hardcopies of the manual and must ensure that each issued document is updated whenever amendments or changes are approved.

# 2 DIRECTION OF OPERATIONS

## 2.1 Statutory Operation

Pursuant to the provisions of the Act, Seqwater is responsible for operating and maintaining the dam in accordance with this manual in order to retain the protection from liability afforded by the Act. Operators, employees, agents, and contractors working for Seqwater must also comply with this manual to obtain the protection of the Act.

## 2.2 Operational Arrangements

For the purposes of operation of the dam during Flood Events, Seqwater must ensure that:

- Sufficient numbers of suitably qualified personnel are available to operate the dam if a Flood Event occurs.
- Sufficient numbers of suitably qualified personnel are available to operate the Flood Operations Centre if a Flood Event occurs
- A Duty Flood Operations Engineer is on call at all times. The Duty Flood Operations Engineer must constantly review weather forecasts and catchment rainfall and must declare a Flood Event if the water level at North Pine Dam is expected to exceed Full Supply Level as a result of prevailing or predicted weather conditions.
- A Senior Flood Operations Engineer is designated to be in the charge of Flood Operations at all times during a Flood Event.
- Release of water at the dam during Flood Events is carried out under the direction of the Duty Flood Operations Engineer.
- All practical attempts are made to liaise with the Chairperson and the Chief Executive if the release of water from the Dams during a Flood Event is likely to endanger life or property.

**Comment [r1]:** There isn't anything in this list about maintaining the dam and in particular the gates in good working order.

## 2.3 Designation and Responsibilities of Senior Flood Operations Engineer

Seqwater must nominate one or more suitably qualified and experienced persons to undertake the role of Senior Flood Operations Engineer. If approved by the Chief Executive, these persons can be authorised in the Schedule of Authorities (see Section 2.6). When rostered on duty during a Flood Event, the responsibilities of the Senior Flood Engineer are as follows:

- Set the overall strategy for management of the Flood Event in accordance with the objectives of this manual.

- Provide instructions to site staff to make releases of water from the dam during Flood Events that are in accordance with this manual.
- Apply reasonable discretion in managing a Flood Event as described in Section 2.8.

Seqwater must ensure that an adequate number of Senior Flood Operations Engineers are available to manage all Flood Events.

### 2.4 Designation and Responsibilities of Flood Operations Engineer

Seqwater must nominate one or more suitably qualified and experienced persons to undertake the role of Flood Operations Engineer. If approved by the Chief Executive, these persons can be authorised in the Schedule of Authorities (see Section 2.6). When rostered on duty during a Flood Event, the responsibilities of the Flood Engineer are as follows:

- Direct the operation of the dam during a flood event in accordance with the general strategy determined by the Senior Flood Operations Engineer.
- Follow any direction from the Senior Flood Operations Engineer in relation to applying reasonable discretion in managing a Flood Event as described in Section 2.8. Unless otherwise directed, a Flood Operations Engineer is to follow this manual in managing Flood Events and is not to apply reasonable discretion unless directed by the Senior Flood Operations Engineer or the Chief Executive.
- Provide instructions to site staff to make releases of water from the dam during Flood Events that are in accordance with this manual.

Seqwater must ensure that an adequate number of Flood Operations Engineers are available to manage all Flood Events. Seqwater must also ensure that an adequate number of suitably qualified and experienced persons are available to assist the Flood Operations Engineers during all Floods Events.

### 2.5 Qualification and Experience of Engineers

#### Qualifications

All engineers referred to in Sections 2.3 and 2.4 must hold a Certificate of Registration as a Registered Professional Engineer of Queensland and must hold appropriate engineering qualifications to the satisfaction of the Chief Executive.

**Comment [r2]:** By the way when I looked at the RPEQ register today John Ruffini wasn't in there – I am sure he has been in the past.

At some stage we might want to know their plans for increasing the number of these engineers.

#### Experience

All engineers referred to in Sections 2.3 and 2.4 must, to the satisfaction of the Chief Executive, have:

1. Knowledge of design principles related to the structural, geotechnical and hydraulic design of large dams, and

2. At least a total of five years of suitable experience and demonstrated expertise in at least two of the following areas:

    - Investigation, design or construction of major dams;
    - Operation and maintenance of major dams;
    - Hydrology with particular reference to flooding, estimation of extreme storms, water management or meteorology;
    - Applied hydrology with particular reference to flood forecasting and/or flood forecasting systems.

## 2.6 Schedule of Authorities

Seqwater must maintain a Schedule of Authorities containing a list of the Senior Flood Operations Engineers and Flood Operations Engineers approved by the Chief Executive to direct flood operations at the dams during floods. A copy of the Schedule of Authorities must be provided to the Chief Executive by 30 September of each year.

Seqwater shall nominate suitably qualified and experienced engineers for registration in the Schedule of Authorities as the need arises. Each new nomination must include a validated statement of qualifications and experience as required by the Chief Executive. Seqwater must obtain the approval for all nominations from the Chief Executive prior to their inclusion in the Schedule of Authorities.

If, in the event of unforseen and emergency situations, no Senior Flood Operations Engineer or no Flood Operations Engineer is available from the Schedule of Authorities to manage a Flood Event, Seqwater must temporarily appoint a suitable person or persons and immediately seek ratification from the Chief Executive.

## 2.7 Training

Seqwater must ensure that operational personnel required for flood operations activities receive adequate training in the various activities involved in flood control operation.

**Comment [r3]:** I don't believe the chief executive is going to decide the specific training required.

**Deleted:** as required by the Chief Executive

## 2.8 Reasonable Discretion

If in the opinion of the Senior Flood Operations Engineer, it is necessary to depart from the procedures set out in this manual to meet the flood mitigation objectives set out in Section 3,

the Senior Flood Operations Engineer is authorised to adopt such other procedures as considered necessary subject to the following:

- Before exercising discretion under this Section of the manual with respect to flood mitigation operations, the Senior Flood Operations Engineer must make a reasonable attempt to consult with both the Chairperson and Chief Executive.
- The Chief Executive would normally authorise any departures from the manual. However if the Chief Executive cannot be contacted within a reasonable time, departures from the Manual can be authorised by the Chairperson.
- If both the Chairperson and the Chief Executive cannot be contacted within a reasonable time, the Senior Flood Operations Engineer may proceed with the procedures considered necessary and report such action at the earliest opportunity to the Chairperson and Chief Executive.

## 2.9 Report

Seqwater must prepare a report after each Flood Event. The report must contain details of the procedures used, the reasons therefore and other pertinent information. Seqwater must forward the report to the Chief Executive within six weeks of the completion of the Flood Event.

# 3 FLOOD MITIGATION OBJECTIVES

## 3.1 General

To meet the purpose of the flood operation procedures in this manual, the flood release objectives, listed in descending order of importance, are as follows:

- Ensure the structural safety of the dam;
- Minimise disruption to the community in areas downstream of the dam;
- Retain the storage at Full Supply Level at the conclusion of the Flood Event.
- Minimise impacts to riparian flora and fauna during the drain down phase of the Flood Event.

## 3.2 Structural Safety of Dam

The structural safety of North Pine Dam must be the first consideration in flood release operations. Failure could have catastrophic consequences due to the magnitude of flood damage that would be caused downstream, and also due to the loss of a water supply source.

The most likely cause of damage is overtopping. North Pine Dam consists of a mass concrete section, and earthen embankment sections. Concrete sections can withstand limited overtopping without damage. Embankment sections on the other hand will washout rapidly if overtopped and cause failure of the dam, resulting in severe flooding downstream. The prevention of overtopping is thus of paramount importance.

**Comment [r4]:** There are a few sentences here that warrant some thought

The safety of the dam therefore depends primarily on the proper operation of the spillway gates, which are used to control maximum flood levels. Such operation in turn relies on the proper functioning of the mechanical hoist mechanisms and their electric power supply and controls. This equipment is located within the dam structure above full supply level and can become inundated if flood releases are not initiated in a timely manner. The critical levels for the operation of the dam and the consequence of their exceedance are as follows:

**Comment [r5]:** It is not the 'safety of the dam' but the 'ability of the dam to pass floods without overtopping resulting'

**Critical Levels for North Pine Dam**

| Description | AHD (m) | Possible Consequence |
|---|---|---|
| Full supply level. | 39.60 | - |
| Radial Gate Control Gear. | 41.66 | Electric motors submerged, use of backup systems required to operate radial gates. |
| Embankment Crest. | 43.28 | Breach of embankment by erosion |

### 3.2.1 Extreme Floods and Closely Spaced Large Floods

Techniques for estimating extreme floods show that floods are possible which would overtop the dam. Such an overtopping would most likely result in failure of the dam. Such events however may require several days of intense rainfall to produce the necessary runoff.

Historical records show that there is a significant probability of two or more flood producing storms occurring in the Pine River system within a short time of each other. Therefore, unless determined otherwise by the Senior Flood Operations Engineer in accordance with Section 2.8, the aim during a Flood Event should be to empty stored floodwaters as quickly as possible while meeting all flood mitigation objectives.

### 3.3 Minimise disruption to Downstream Communities

While North Pine Dam provides only limited flood mitigation benefits in terms of retaining flood water above Full Supply Level, flood releases can result in the submergence of bridges and public areas. Accordingly, the operation of the dam should not prolong this inundation unnecessarily.

The gates of the dam should be operated such that outflow should not exceed inflow under most circumstances.

### 3.4 Retain the Storage at Full Supply Level at the Conclusion of the Flood Event

As North Pine Dam is a primary urban water supply for South East Queensland, it is important that all opportunities to fill the dam are taken. There should be no reason why the dams should not be full following a Flood Event.

### 3.5 Minimising Impacts to Riparian Flora and Fauna

During the drain down phase, consideration is to be given to minimising the impacts on riparian flora and fauna. In particular, strategies aimed at reducing fish deaths in the vicinity of the dam walls are to be instigated, provided such procedures do not adversely impact on other flood mitigation objectives.

**Formatted:** Heading 3,Transfer 3, Don't adjust space between Latin and Asian text

**Formatted:** Bullets and Numbering

**Deleted:** As indicated in the previous section, t

**Comment [r6]:** According to section 8.1 the peak inflow from critical storms may occur approximately two to four hours after the commencement of heavy rain. The critical duration for the PMP-DF is 36 hours i.e. 1.5 days

**Deleted:**

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# 4 FLOOD CLASSIFICATION

For the reference purposes of this manual, four magnitudes of flooding are classified as follows:

1. **Minor Flooding**

Causes inconvenience. Low-lying areas next to watercourses are inundated which may require the removal of stock and equipment. Minor roads may be closed and low-level bridges submerged.

2. **Moderate Flooding**

In addition to the impacts experienced during Minor Flooding, the evacuation of some houses may be required. Main traffic routes may be impacted. The area of inundation is substantial in rural areas requiring the removal of stock.

3. **Major Flooding**

In addition to the impacts experienced during Moderate Flooding, extensive rural areas and/or urban areas are inundated. Properties and towns are likely to be isolated and major traffic routes likely to be closed. Evacuation of people from flood affected areas may be required. The 1974 flood that impacted on the Ipswich and Brisbane areas is classified as a major flood.

4. **Extreme Flooding**

This causes flooding impacts equal to or in excess of levels previously experienced. In addition to the impacts experienced during Major Floods, the general evacuation of people from significant populated areas is likely to be required.

It should be noted that a flood may not cause the same category of flooding along its entire length and the relevant agencies shall have regard to this when flooding is predicted. The classifications of minor, moderate and major flooding are based on the Bureau of Meteorology Standard Flood Classifications for Australia.

# 5 FLOOD MONITORING AND FORECASTING SYSTEM

**Comment [r7]:** What happens when SEQWater wants to change their flood prediction model?

## 5.1 General

A real time flood monitoring and forecasting system has been established in the dam catchment. This system employs radio telemetry to collect, transmit and receive rainfall and stream flow information. The system consists of 30 field stations that automatically record rainfall and/or river heights at selected locations in the dam catchments. Some of the field stations are owned by Seqwater with the remainder belonging to other agencies.

The rainfall and river height data is transmitted to Seqwater's Flood Operations Centre in real time. Once received in the Flood Operations Centre, the data is processed using a Real Time Flood Model (RTFM) to estimate likely dam inflows and evaluate a range of possible inflow scenarios based on forecast and potential rainfall in the dam catchments. The RTFM is a suite of hydrologic and hydraulic computer programs that utilise the real time data to assist in the operation of the dams during flood events. Seqwater is responsible for providing and maintaining the RTFM and for ensuring that sufficient data is available to allow proper operation of the RTFM during a Flood Event.

## 5.2 Operation

The Senior Flood Operations and Flood Operations Engineers use the RTFM for flood monitoring and forecasting during flood events to operate the dams in accordance with this manual. This is done by optimising releases of water from the dams to minimise the impacts of flooding in accordance with the objectives and procedures contained in this manual.

Seqwater is responsible for improving the operation of the RTFM over time by using the following processes:

- Implementing improvements based on Flood Event audits and reviews.
- Improving RTFM calibration as further data becomes available.
- Updating software in line with modern day standards.
- Improving the coverage and reliability of the data collection network to optimise data availability during Flood Events.
- Recommendations by Senior Flood Operations Engineers.

A regular process of internal audit and management review must be maintained by Seqwater to achieve these improvements.

Seqwater must also maintain a log of the performance of the data collection network. The log must include all revised field calibrations and changes to the number, type and locations of gauges. Senior Flood Operations and Flood Operations Engineers are to be notified of all significant changes to the Log.

Seqwater must also maintain a log of the performance of the RTFM. Any faults to the computer hardware or software are to be noted and promptly and appropriately attend to.

### 5.3 Storage of Documentation

The performance of any flood monitoring and forecasting system is reliant on accurate historical data over a long period of time. Seqwater must ensure that all available data and other documentation is appropriately collected and catalogued for future use.

### 5.4 Key Reference Gauges

Key field station locations have been identified for reference purposes when flood information is exchanged between authorities or given to the public. Should it be deemed desirable to relocate field stations from these locations or vary flood classification levels, agreement must first be obtained between Seqwater, Bureau of Meteorology and the Local Government within whose boundaries the locations are situated.

Gauge boards that can be read manually must be maintained by Seqwater as part of the equipment of each key field station. Where possible and practical during Flood events, Seqwater is to have procedures in place for manual reading of these gauge boards in the event of failure of field stations.

**Comment [r8]:** The gauges shown in Appendix B aren't referenced anywhere in the text.

### 5.5 Reference Gauge Values

Other agencies such as the Bureau of Meteorology, the Moreton Bay Regional Council and the Brisbane City Council have direct access to the information from field stations for flood assessment purposes. The consultation between agencies is a very important part of the assessment and prediction of flood flows and heights.

Seqwater must ensure that information relevant to the calibration of its field stations is shared with these agencies.

# 6 COMMUNICATIONS

## 6.1 Communications between Staff

Seqwater is responsible for providing and maintaining equipment to allow adequate channels of communication to exist at all times between the Seqwater Flood Operations Centre and site staff at North Pine Dam.

## 6.2 Dissemination of Information

Agencies other than Seqwater have responsibilities for formal flood predictions, the interpretation of flood information and advice to the public associated with Flood Events. Adequate and timely information is to be supplied to agencies responsible for the operation of facilities affected by flooding and for providing warnings and information to the public. Agency information requirements are generally as shown in the table below.

The Senior Flood Operations and Flood Operations Engineers must supply information to each of these agencies during Flood Events. The contact information for these Agencies and communication procedures is contained in the Emergency Action Plans for the dam and each agency is to receive updated controlled copies of these documents.

Seqwater must liaise and consult with these agencies with a view to ensuring all information relative to the flood event is consistent and used in accordance with agreed responsibilities.

**AGENCY INFORMATION REQUIREMENTS**

| Agency | Activity | Information Required from Flood Operations Centre | Trigger |
|---|---|---|---|
| Bureau of Meteorology | Issue of flood warnings | Actual and predicted lake levels and discharges | Initial gate operations and thereafter at intervals to suit forecasting requirements |
| Department of Environment and Resource Management | Review of flood operations and discretionary powers | Actual and predicted lake levels and discharges | Initial gate operations |
| Moreton Bay Regional Council | Flood level information downstream of North Pine Dam | Actual and predicted lake levels and discharges | Initial gate operations |
| Brisbane City Council | Flood level information for Brisbane City area | Nil (information obtained from BOM) | |

## 6.3 Release of Information to the Public

Seqwater is responsible for the issue of information regarding storage conditions and current and proposed releases from the dam to the public and the media.

The Bureau of Meteorology has responsibility for issuing flood warnings.

The Emergency Services Response Authorities, under the Disaster Management Act 2003, have responsibility for the preparation of a local counter disaster plan and the interpretation of flood forecast information for inclusion in their local flood warnings prepared under the flood sub plan of the counter disaster plan.

# 7 REVIEW

## 7.1 Introduction

With the passage of time, neither the technical assumptions nor the physical conditions on which this manual is based may remain unchanged. It is also recognised that the relevance of the manual may change with changing circumstances. It is important therefore, that the manual contain operational procedures which cause the assumptions and conditions upon which they are based, to be checked and reviewed regularly.

This process must involve all personnel involved in the management of Flood Events, to ensure that changes of personnel do not result in a diminished understanding of the basic principles upon which the operational procedures are based. Variations to the manual may be made in accordance with provisions in Section 1.8.

## 7.2 Personal Training

Seqwater must report to the Chief Executive by 30 September each year on the training and state of preparedness of operations personnel.

## 7.3 Monitoring and Forecasting System and Communication Networks

Seqwater must provide a report to the Chief Executive by 30 September each year on the state of the Flood Monitoring and Forecasting System and Communication Networks. The report must assess following in terms of hardware, software and personnel:

- Adequacy of the communication and data gathering facilities
- Reliability of the system over the previous period
- Reliability of the system under prolonged flood conditions
- Accuracy of forecasting flood flows and heights
- The overall state of preparedness of the system

Seqwater must take any action considered necessary for the proper functioning and improvement of this system.

## 7.4 Operational Review

After each significant flood event, Seqwater must report to the Chief Executive on the effectiveness of the operational procedures contained in this manual. This report must be submitted within six weeks of any flood event that requires mobilisation of the Flood Operations Centre.

## 7.5 Five Yearly Review

Prior to the expiry of the approval period, Seqwater must review the manual pursuant to provisions of the Act. The review is to take into account the continued suitability of the communication network and the flood monitoring and forecasting system, as well as hydrological and hydraulic engineering assessments of the operational procedures.

# 8 FLOOD RELEASE OPERATION

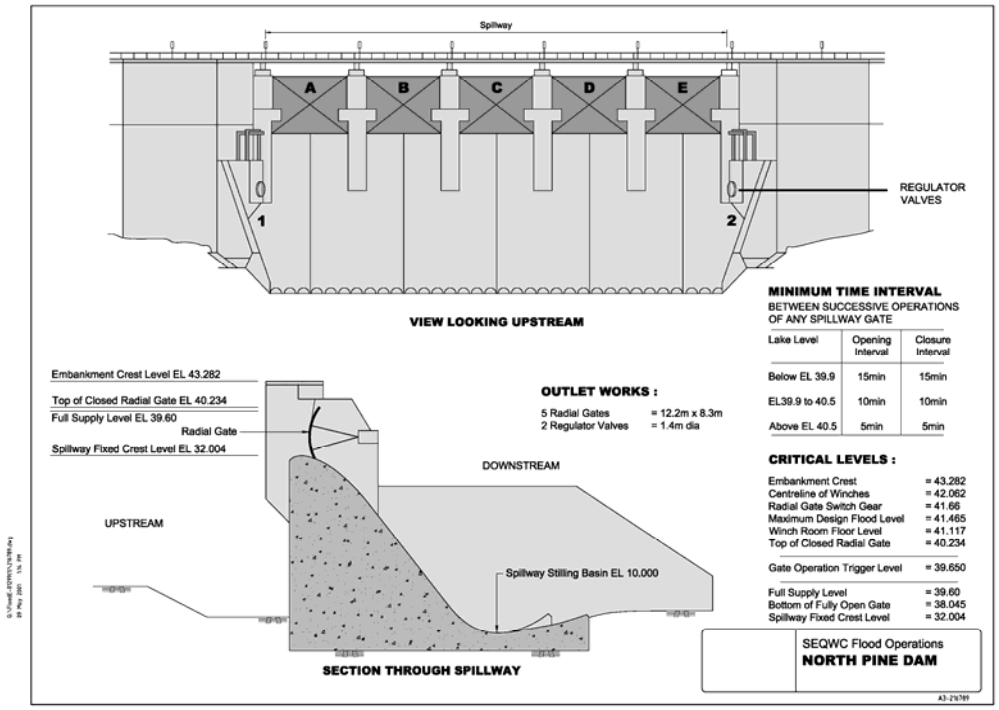
## 8.1 Introduction

North Pine dam is a water supply dam with only a small flood storage compartment above full supply level. It effectively has no significant provision for flood mitigation and once the dam is full, floods will pass through the reservoir with little mitigation. The peak inflow from critical storms may occur approximately two to four hours after the commencement of heavy rain.

**Comment [r9]:** Again there is inconsistency with Appendix E which says critical storm duration is generally 12 hours.

## 8.2 Flood Release Infrastructure

Radial Gates are the primary infrastructure used to release water during flood events at North Pine Dam. The arrangement of the Radial Gates is shown in the diagram below:




## 8.3 Initial Action

Once a Flood Event is declared, an assessment is to be made of the magnitude of the Flood Event, including:

- A prediction of the maximum storage levels in the dam.
- A prediction of the peak outflow rate from the dam.

Releases from the radial gates should not commence until the lake level exceeds FSL by 50 millimetres (39.65 m AHD).

Prior to releases from the radial gates commencing the Flood Operations Engineer must ensure that the Grant Street causeway is closed and the Moreton Bay Regional Council has been advised of the impact of the proposed flood releases on Youngs Crossing.

**Comment [r10]:** There is enough about pre-release elsewhere. Pre-release should generally be done through section 2.8.

**Deleted:** Unless a decision has been made to commence a pre-release of flood water to control the risk of dam overtopping, r

### 8.4 Flood Operations Strategies

The flood release objectives for North Pine Dam, listed in descending order of importance, are as follows:

- Ensure the structural safety of the dam;
- Minimise disruption to the community in areas downstream of the dam;
- Retain the storage at Full Supply Level at the conclusion of the Flood Event.
- Minimise impacts to riparian flora and fauna during the drain down phase of the Flood Event.

North Pine Dam effectively has no significant provision for flood mitigation and once the dam is full ensuring the structural safety of the dam is paramount. Accordingly the flood operation strategy is to pass any significant flood through the reservoir, while ensuring that peak outflow generally does not exceed peak inflow while aiming to empty stored floodwaters as quickly as possible. To achieve this strategy, the radial gate opening settings shown in Appendix C are normally used to determine flood releases.

**Comment [r11]:** English could be improved. Maybe stop the sentence here and say 'At the same time the stored floodwater should be emptied as quickly as possible.

**Comment [r12]:** There is a sentence or two in previous versions about what this entails – one gate increment for every 15 mm storage rise after 2 initial increments at 50 mm rise.. Can we get that back.

Early releases in small events are permissible to minimise downstream disruption.

Departures from the tables shown in Appendix C are allowed in the following circumstances:

- Pre-release of water is allowed to reduce the risk of dam overtopping.
- Reduction in release rate is allowed once the flood peak has passed to either minimise disruption to the community in areas downstream of the dam or to minimise impacts to riparian flora and fauna.
- At the end of a flood event, additional gate openings may be used to reduce the duration of gate operation and resulting adverse downstream impacts.

**Comment [r13]:** This is a very open-ended and virtually all-encompassing departure. I don't like it or as least make it subject to section 2.8.

**Comment [r14]:** I would have thought the real variations from the Table would come in reasonably static situations to enable gate opening to be scheduled to suit operational circumstances.

During the initial opening or final closure sequences of gate operations it is permissible to replace the discharge through a gate by the immediate opening of a regulator valve (or the reverse operation). This allows for greater control of low flows.

## 8.5 Gate Closing Strategies

In general, gate closing commences when the level in North Pine Dam begins to fall and the closing sequence is generally to occur in the reverse order to opening. The following requirements must be considered when determining gate closure sequences:

Deleted:

- Where possible, total releases during closure should not produce greater flood levels downstream than occurred during the flood event.
- The maximum discharge from the dam during closure should generally be less than the peak inflow into North Pine Dam experienced during the event.
- The aim should always be to empty stored floodwaters stored above EL 39.65m as quickly as possible after the flood peak has passed through the dam. However, provided a favourable weather outlook is available, this requirement can be relaxed for the volume between EL 39.65m and EL 39.75m, to minimise downstream impacts.

**Comment [r15]:** Is this level 39.65 or 39.6?

- To minimise the stranding of fish downstream of the dam, final closure sequences should consider Seqwater procedures relating to fish protection at the dam.

There may be a need to take into account base flow when determining final gate closure. This may mean that the lake level temporarily falls below Full Supply Level to provide for a full dam at the end of the Flood Event.

The regulators may be substituted for gate operations to manage water levels and discharges during small inflows such as during the recession of a Flood Event.

## 8.6 Gate Operation Sequences

Rapid opening of the radial gates at North Pine dam can cause undesirable rapid rises in downstream river levels. Accordingly, the aim in opening radial gates is to operate the gates one at a time at intervals that will minimise adverse impacts on the river system. The table below shows the target minimum interval for gate operations. This target interval can be reduced if the gates are at risk of being overtopped or the safety of the dam is at risk and operations are generally not allowed to fall more than three openings behind the gate opening settings contained in Appendix C.

**TARGET MINIMUM INTERVALS FOR RADIAL GATE OPENING**

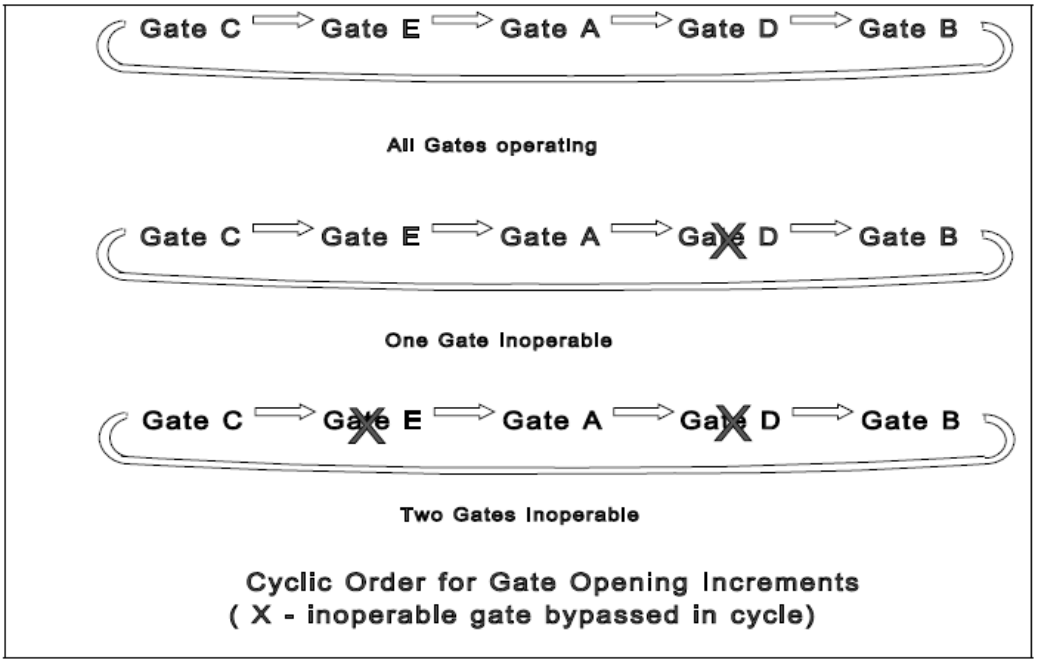
| Lake Level | Opening Interval | Closing Interval |
|---|---|---|
| Below EL 39.9m | 15 min | 15 min |
| EL 39.9m to 40.5m | 10 min | 10 min |
| Above EL 40.5m | 5 min | 5 min |

Rapid closure of radial gates is also permissible when there is a requirement to preserve storage or to reduce downstream flooding. When determining gate closure sequences, consideration should also be given to following the calculated natural recession of the flood in the river to aim to ensure that the recession impacts are not greater than those that would have been experienced had the dam not been constructed.

## 8.7 Protection of the Spillway

To minimise potential damage to the dissipater and the river-bed and banks downstream, the gates must be opened incrementally in accordance with the cyclic sequences shown below.

**Gate Operation Sequence**




## 8.8 Gate Failure or Malfunction Procedures

Where one or more gates are inoperable, the sequencing outlined in section 8.7 (above) still applies, except that the inoperable gates must be ignored in the cycle and their increments passed on to the next gate in the sequence. The cumulative number of increments taken by all gates at any particular lake level thus remains unaltered save that the total number of available gate increments has been reduced by inoperable gates. Appendix C contains tables of gate position settings against lake levels for the situations where all gates are operating and where one gate is inoperable.

## 8.9 Radial Gate Turbulence Considerations

Comment [r16]: I still contend this situation should never happen. You would need to be drawing down the storage to well below full supply level and that is well outside where this manual goes.

Unless in the process of lifting the gates clear of the flow, the bottom edge of the radial gates must always be at least 500 millimetres below the release flow surface. Having the bottom edge of the gates closer to the release flow surface than 500 millimetres may cause unusual turbulence that could adversely impact on the gates. This procedure has never been undertaken in practice and should be observed closely when being undertaken. Variations to the procedure are allowed to protect the structural safety of the dam.

This circumstance is unlikely to occur except under a rare set of conditions.

## 8.10 Lowering Radial Gates that have been lifted Clear of the Release Flow

When lowering radial gates that have been lifted clear of the release flow, the bottom edge of the gates must be lowered at least 500 millimetres into the flow. Lowering gates into the release flow less than this amount may cause unusual turbulence that could adversely impact on the gates. This procedure has never been undertaken in practice and should be observed closely when being undertaken. Variations to the procedure are allowed to protect the structural safety of the dam.

This circumstance is unlikely to occur except under a rare set of conditions.

Comment [r17]: There is room for a section on relationship with the Emergency Action Plan somewhere not necessarily here.

# 9 EMERGENCY

## 9.1 Introduction

While every care has been exercised in the design and construction of the dam, there still remains a low risk that the dam may develop an emergency condition either through flood events or other causes. Experience elsewhere in the world suggests that vigilance is required to recognise emergency flood conditions such as:

- Occurrence of a much larger flood than discharge capacity of the dam;
- Occurrence of a series of large storms in a short period;
- Failure of one or more gates during a flood;
- Development of a piping failure through the embankment;
- Damage to the dam by earthquake;
- Damage to the dam as an act of war or terrorism; and
- Other rare mechanisms.

Responses to these and other conditions are included in the North Pine Dam - Emergency Action Plan.

## 9.2 Overtopping of Dam

Whatever the circumstances, every endeavour must be made to prevent overtopping of North Pine Dam by the progressive opening of operative spillway gates. Overtopping of the dam is likely to result in a dam failure.

Overtopping may result from inundation the radial gate control equipment and subsequent loss of gate control. Gate openings may be such to ensure this does not occur.

**Comment [r18]:** Is this may or must?

## 9.3 Communications Failure

If communications are lost between the Flood Operations Centre and the dam, the officers in charge at the dam are to adopt the procedures set out below. The Dam Supervisor at North Pine Dam is to assume responsibility for flood releases from the Dam. Once it has been established that communications have been lost, the Dam Supervisor at North Pine Dam is to:-

- Take all practicable measures to restore communications and periodically check the lines of communication for any change;
- Follow the procedures set out below to determine the relevant magnitude and duration of releases from North Pine Dam;
- Log all actions in the Event Log;

- Ensure the dam is at full supply level at the end of the event;
- Remain in the general vicinity of the dam while on duty.

**Comment [r19]:** this is a natural outcome of following Appendix C settings.

The radial gate opening and closing sequences to be used is as set out in Appendix C. The table below shows the target minimum interval for gate operations. This target interval can be reduced if the gates are at risk of being overtopped or the safety of the dam is at risk and operations are not allowed to fall more than three openings behind the gate opening settings contained in Appendix C.

**TARGET MINIMUM INTERVALS FOR RADIAL GATE OPENING UNDER LOSS OF COMMUNICATIONS**

| Lake Level | Opening Interval | Closing Interval |
|---|---|---|
| Below EL 39.9m | 15 min | 15 min |
| EL 39.9m to 40.5m | 10 min | 10 min |
| Above EL 40.5m | 5 min | 5 min |

In the event of one or more radial gates becoming jammed, the remaining gates are to be operated to provide the same total opening for a particular storage level, as shown Appendix C. In these circumstances, gates are generally operated in the order of C, E, A, D, B moving through the sequence shown in the tables.

In a loss of communication scenario, the bulkhead gate is not to be used. At the end of the event, the full supply level of the storage is to be achieved.

# APPENDIX A
# AGENCIES HOLDING CONTROLLED COPIES OF THIS MANUAL

| Agency | Responsible Person | Location |
|---|---|---|
| Seqwater | Dam Safety and Source Operations Manager | Brisbane |
| Seqwater | Principal Engineer Dam Safety | Ipswich |
| Seqwater | Storage Supervisor | North Pine Dam |
| Seqwater Op | erations Coordinator | North Coast |
| Seqwater | Senior Flood Operations Engineer | Flood Operations Centre, Brisbane |
| Department of Environment and Resource Management | Director Dam Safety | Brisbane |
| Department of Community Safety | Duty Officer – Disaster Management Service | Brisbane |
| Moreton Bay Regional Council | Local Disaster Response Coordinator | Caboolture |
| Brisbane City Council | Local Disaster Response Coordinator | Brisbane |
| Emergency Management Queensland | Regional Director, Brisbane District | Brisbane |

# APPENDIX B
# KEY REFERENCE GAUGES

## Moreton Bay Regional Council

| Gauge | Flood Classification | | | |
|---|---|---|---|---|
| | Minor | Moderate | Major | 1974 Flood |
| Grant Street, Whiteside | Any release from dam | - - | | - |
| Youngs Crossing | 8-10$m^3/s$ | | | |
| Railway Bridge, Wyllie Park, Petrie | 4.0m | 5.0m 6. | 0m 5.1 | m |
| Railway Bridge, South Pine River, Bald Hills | - 3. | 5m | 6.0m | 5.18m |

Note: Heights are in metres AHD

# APPENDIX C
# GATE & VALVE SETTINGS

Discharge from North Pine Dam may be controlled by:

- Five radial gates
- Two regulator valves, and/or;
- A low level river release valve with a daily capacity of about 85 ML/d.

## RADIAL GATE SETTINGS

| Gate Setting | Gate Opening (m) | Top of Gate (EL) | Gate Setting | Gate Opening (m) | Top of Gate (EL) |
|---|---|---|---|---|---|
| 1 | 0.152 | 40.362 | 13 | 3.810 | 41.885 |
| 2 | 0.457 | 40.547 | 14 | 4.115 | 41.940 |
| 3 | 0.762 | 40.720 | 15 | 4.420 | 41.984 |
| 4 | 1.067 | 40.886 | 16 | 4.724 | 42.016 |
| 5 | 1.372 | 41.041 | 17 | 5.029 | 42.037 |
| 6 | 1.676 | 41.185 | 18 | 5.334 | 42.047 |
| 7 | 1.981 | 41.316 | 19 | 5.639 | 42.047 |
| 8 | 2.286 | 41.349 | 20 | 5.944 | 42.047 |
| 9 | 2.591 | 41.549 | 21 | 6.248 | 42.047 |
| 10 | 2.896 | 41.650 | 22 | 6.553 | 42.047 |
| 11 | 3.200 | 41.740 | 23* | 6.858 | 42.047 |
| 12 | 3.505 | 41.817 | | | |

* Gate should be fully open

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## RADIAL GATE SETTINGS

| All Gates Operational | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 39.600 | closed | closed c | losed c | losed | closed | 0 | 0 | - |
| 39.650 closed | | closed | 1 | closed | closed | 1 | 16 | C |
| 39.700 closed | | closed | 1 | closed | 1 | 2 | 32 | E |
| 39.715 1 | | closed | 1 | closed | 1 | 3 | 48 | A |
| 39.730 1 | | closed | 1 | 1 | 1 | 4 | 64 | D |
| 39.745 | 1 1 1 1 | | | | 1 | 5 | 80 | B |
| 39.760 | 1 1 2 1 | | | | 1 | 6 | 104 | C |
| 39.775 | 1 1 2 1 | | | | 2 | 7 | 129 | E |
| 39.790 | 2 1 2 1 | | | | 2 | 8 | 153 | A |
| 39.805 | 2 1 2 2 | | | | 2 | 9 | 177 | D |
| 39.820 | 2 2 2 2 | | | | 2 | 10 | 201 | B |
| 39.835 | 2 2 3 2 | | | | 2 | 11 | 228 | C |
| 39.850 | 2 2 3 2 | | | | 3 | 12 | 254 | E |
| 39.865 | 3 2 3 2 | | | | 3 | 13 | 281 | A |
| 39.880 | 3 2 3 3 | | | | 3 | 14 | 307 | D |
| 39.895 | 3 3 3 3 | | | | 3 | 15 | 334 | B |
| 39.910 | 3 3 4 3 | | | | 3 | 16 | 362 | C |
| 39.925 | 3 3 4 3 | | | | 4 | 17 | 390 | E |
| 39.940 | 4 3 4 3 | | | | 4 | 18 | 417 | A |
| 39.955 | 4 3 4 4 | | | | 4 | 19 | 445 | D |
| 39.970 | 4 4 4 4 | | | | 4 | 20 | 473 | B |
| 39.985 | 4 4 5 4 | | | | 4 | 21 | 500 | C |
| 40.000 | 4 4 5 4 | | | | 5 | 22 | 527 | E |
| 40.015 | 5 4 5 4 | | | | 5 | 23 | 554 | A |
| 40.030 | 5 4 5 5 | | | | 5 | 24 | 581 | D |
| 40.045 | 5 5 5 5 | | | | 5 | 25 | 608 | B |
| 40.060 | 5 5 6 5 | | | | 5 | 26 | 636 | C |
| 40.075 | 5 5 6 5 | | | | 6 | 27 | 664 | E |
| 40.090 | 6 5 6 5 | | | | 6 | 28 | 692 | A |
| 40.105 | 6 5 6 6 | | | | 6 | 29 | 720 | D |
| 40.120 | 6 6 6 6 | | | | 6 | 30 | 748 | B |
| 40.135 | 6 6 7 6 | | | | 6 | 31 | 776 | C |
| 40.150 | 6 6 7 6 | | | | 7 | 32 | 804 | E |
| 40.165 | 7 6 7 6 | | | | 7 | 33 | 832 | A |
| 40.180 | 7 6 7 7 | | | | 7 | 34 | 860 | D |
| 40.195 | 7 7 7 7 | | | | 7 | 35 | 888 | B |
| 40.210 | 7 7 8 7 | | | | 7 | 36 | 916 | C |
| 40.225 | 7 7 8 7 | | | | 8 | 37 | 943 | E |
| 40.240 | 8 7 8 7 | | | | 8 | 38 | 970 | A |
| 40.255 | 8 7 8 8 | | | | 8 | 39 | 998 | D |
| 40.270 | 8 8 8 8 | | | | 8 | 40 | 1025 | B |
| 40.285 | 8 8 9 8 | | | | 8 | 41 | 1052 | C |
| 40.300 | 8 8 9 8 | | | | 9 | 42 | 1079 | E |
| 40.315 | 9 8 9 8 | | | | 9 | 43 | 1106 | A |
| 40.330 | 9 8 9 9 | | | | 9 | 44 | 1133 | D |
| 40.345 | 9 9 9 9 | | | | 9 | 45 | 1160 | B |

| All Gates Operational | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 40.360 9 | | 9 | 10 | 9 | 9 | 46 | 1187 | C |
| 40.375 9 | | 9 | 10 | 9 | 10 | 47 | 1213 | E |
| 40.390 10 | | 9 | 10 | 9 | 10 | 48 | 1240 | A |
| 40.405 10 | | 9 | 10 | 10 | 10 | 49 | 1266 | D |
| 40.420 | 10 | 10 10 | 10 | | 10 | 50 | 1293 | B |
| 40.435 | 10 | 10 11 | 10 | | 10 | 51 | 1320 | C |
| 40.450 | 10 | 10 11 | 10 | | 11 | 52 | 1347 | E |
| 40.465 | 11 | 10 11 | 10 | | 11 | 53 | 1374 | A |
| 40.480 | 11 | 10 11 | 11 | | 11 | 54 | 1401 | D |
| 40.495 | 11 | 11 11 | 11 | | 11 | 55 | 1428 | B |
| 40.510 | 11 | 11 12 | 11 | | 11 | 56 | 1455 | C |
| 40.525 | 11 | 11 12 | 11 | | 12 | 57 | 1482 | E |
| 40.540 | 12 | 11 12 | 11 | | 12 | 58 | 1510 | A |
| 40.555 | 12 | 11 12 | 12 | | 12 | 59 | 1537 | D |
| 40.570 | 12 | 12 12 | 12 | | 12 | 60 | 1564 | B |
| 40.585 | 12 | 12 13 | 12 | | 12 | 61 | 1593 | C |
| 40.600 | 12 | 12 13 | 12 | | 13 | 62 | 1621 | E |
| 40.615 | 13 | 12 13 | 12 | | 13 | 63 | 1650 | A |
| 40.630 | 13 | 12 13 | 13 | | 13 | 64 | 1678 | D |
| 40.645 | 13 | 13 13 | 13 | | 13 | 65 | 1707 | B |
| 40.660 | 13 | 13 14 | 13 | | 13 | 66 | 1736 | C |
| 40.675 | 13 | 13 14 | 13 | | 14 | 67 | 1765 | E |
| 40.690 | 14 | 13 14 | 13 | | 14 | 68 | 1794 | A |
| 40.705 | 14 | 13 14 | 14 | | 14 | 69 | 1823 | D |
| 40.720 | 14 | 14 14 | 14 | | 14 | 70 | 1852 | B |
| 40.735 | 14 | 14 15 | 14 | | 14 | 71 | 1883 | C |
| 40.750 | 14 | 14 15 | 14 | | 15 | 72 | 1914 | E |
| 40.765 | 15 | 14 15 | 14 | | 15 | 73 | 1946 | A |
| 40.780 | 15 | 14 15 | 15 | | 15 | 74 | 1978 | D |
| 40.795 | 15 | 15 15 | 15 | | 15 | 75 | 2009 | B |
| 40.810 | 15 | 15 16 | 15 | | 15 | 76 | 2044 | C |
| 40.825 | 15 | 15 16 | 15 | | 16 | 77 | 2079 | E |
| 40.840 | 16 | 15 16 | 15 | | 16 | 78 | 2114 | A |
| 40.855 | 16 | 15 16 | 16 | | 16 | 79 | 2148 | D |
| 40.870 | 16 | 16 16 | 16 | | 16 | 80 | 2183 | B |
| 40.885 | 16 | 16 17 | 16 | | 16 | 81 | 2222 | C |
| 40.900 | 16 | 16 17 | 16 | | 17 | 82 | 2260 | E |
| 40.915 | 17 | 16 17 | 16 | | 17 | 83 | 2299 | A |
| 40.930 | 17 | 16 17 | 17 | | 17 | 84 | 2337 | D |
| 40.945 | 17 | 17 17 | 17 | | 17 | 85 | 2376 | B |
| 40.960 | 17 | 17 18 | 17 | | 17 | 86 | 2415 | C |
| 40.975 | 17 | 17 18 | 17 | | 18 | 87 | 2453 | E |
| 40.990 | 18 | 17 18 | 17 | | 18 | 88 | 2491 | A |
| 41.005 | 18 | 17 18 | 18 | | 18 | 89 | 2530 | D |
| 41.020 | 18 | 18 18 | 18 | | 18 | 90 | 2568 | B |
| 41.035 | 18 | 18 19 | 18 | | 18 | 91 | 2601 | C |
| 41.050 | 18 | 18 19 | 18 | | 19 | 92 | 2635 | E |

| All Gates Operational | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Level (m AHD)** | **Gate A** | **Gate B** | **Gate C** | **Gate D** | **Gate E** | **Total Opening** | **Discharge ($m^3$/sec)** | **Gates Operated** |
| 41.065 | 19 | 18 19 | 18 | | 19 | 93 | 2668 | A |
| 41.080 | 19 | 18 19 | 19 | | 19 | 94 | 2701 | D |
| 41.095 | 19 | 19 19 | 19 | | 19 | 95 | 2734 | B |
| 41.110 | 19 | 19 20 | 19 | | 19 | 96 | 2773 | C |
| 41.125 | 19 | 19 20 | 19 | | 20 | 97 | 2806 | E |
| 41.140 | 20 | 19 20 | 19 | | 20 | 98 | 2842 | A |
| 41.155 | 20 | 19 20 | 20 | | 20 | 99 | 2878 | D |
| 41.170 | 20 | 20 20 | 20 | | 20 | 100 | 2913 | B |
| 41.185 | 20 | 20 21 | 20 | | 20 | 101 | 3026 | C |
| 41.200 | 20 | 20 21 | 20 | | 21 | 102 | 3142 | E |
| 41.215 | 21 | 20 21 | 20 | | 21 | 103 | 3260 | A |
| 41.230 | 21 | 20 21 | 21 | | 21 | 104 | 3382 | D |
| 41.245 | 21 | 21 21 | 21 | | 21 | 105 | 3506 | B |
| 41.260 | 21 | 21 22 | 21 | | 21 | 106 | 3515 | C |
| 41.275 | 21 | 21 22 | 21 | | 22 | 107 | 3524 | E |
| 41.290 | 22 | 21 22 | 21 | | 22 | 108 | 3532 | A |
| 41.305 | 22 | 21 22 | 22 | | 22 | 109 | 3541 | D |
| 41.320 | 22 | 22 22 | 22 | | 22 | 110 | 3550 | B |
| 41.335 | 22 | 22 23 | 22 | | 22 | 111 | 3559 | C |
| 41.350 | 22 | 22 23 | 22 | | 23 | 112 | 3567 | E |
| 41.365 | 23 | 22 23 | 22 | | 23 | 113 | 3576 | A |
| 41.380 | 23 | 22 23 | 23 | | 23 | 114 | 3585 | D |
| 41.395 | 23 | 23 23 | 23 | | 23 | 115 | 3594 | B |

| Gate A Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 39.600 | closed | closed | closed | closed | closed | 0 | 0 | - |
| 39.650 | closed | closed | 1 | closed | closed | 1 | 16 | C |
| 39.700 | closed | closed | 1 | closed | 1 | 2 | 32 | E |
| 39.715 | closed | closed | 1 1 1 | | | 3 | 48 | D |
| 39.730 | closed | 1 | 1 1 1 | | | 4 | 64 | B |
| 39.745 | closed | 1 | 2 1 1 | | | 5 | 88 | C |
| 39.760 | closed | 1 | 2 1 2 | | | 6 | 112 | E |
| 39.775 | closed | 1 | 2 2 2 | | | 7 | 137 | D |
| 39.790 | closed | 2 | 2 2 2 | | | 8 | 161 | B |
| 39.805 | closed | 2 | 3 2 2 | | | 9 | 187 | C |
| 39.820 | closed | 2 | 3 2 3 | | | 10 | 213 | E |
| 39.835 | closed | 2 | 3 3 3 | | | 11 | 240 | D |
| 39.850 | closed | 3 | 3 3 3 | | | 12 | 266 | B |
| 39.865 | closed | 3 | 4 3 3 | | | 13 | 294 | C |
| 39.880 | closed | 3 | 4 3 4 | | | 14 | 322 | E |
| 39.895 | closed | 3 | 4 4 4 | | | 15 | 349 | D |
| 39.910 | closed | 4 | 4 4 4 | | | 16 | 377 | B |
| 39.925 | closed | 4 | 5 4 4 | | | 17 | 404 | C |
| 39.940 | closed | 4 | 5 4 5 | | | 18 | 430 | E |
| 39.955 | closed | 4 | 5 5 5 | | | 19 | 457 | D |
| 39.970 | closed | 5 | 5 5 5 | | | 20 | 484 | B |
| 39.985 | closed | 5 | 6 5 5 | | | 21 | 512 | C |
| 40.000 | closed | 5 | 6 5 6 | | | 22 | 539 | E |
| 40.015 | closed | 5 | 6 6 6 | | | 23 | 567 | D |
| 40.030 | closed | 6 | 6 6 6 | | | 24 | 595 | B |
| 40.045 | closed | 6 | 7 6 6 | | | 25 | 623 | C |
| 40.060 | closed | 6 | 7 6 7 | | | 26 | 650 | E |
| 40.075 | closed | 6 | 7 7 7 | | | 27 | 678 | D |
| 40.090 | closed | 7 | 7 7 7 | | | 28 | 706 | B |
| 40.105 | closed | 7 | 8 7 7 | | | 29 | 732 | C |
| 40.120 | closed | 7 | 8 7 8 | | | 30 | 759 | E |
| 40.135 | closed | 7 | 8 8 8 | | | 31 | 786 | D |
| 40.150 | closed | 8 | 8 8 8 | | | 32 | 812 | B |
| 40.165 | closed | 8 | 9 8 8 | | | 33 | 839 | C |
| 40.180 | closed | 8 | 9 8 9 | | | 34 | 866 | E |
| 40.195 | closed | 8 | 9 9 9 | | | 35 | 893 | D |
| 40.210 | closed | 9 | 9 9 9 | | | 36 | 920 | B |
| 40.225 | closed | 9 | 10 | 9 | 9 | 37 | 946 | C |
| 40.240 | closed | 9 10 | | 9 10 | | 38 | 972 | E |
| 40.255 | closed | 9 | 10 10 10 | | | 39 | 998 | D |
| 40.270 | closed | 10 10 10 10 | | | | 40 | 1024 | B |
| 40.285 | closed | 10 11 10 10 | | | | 41 | 1050 | C |
| 40.300 | closed | 10 11 10 11 | | | | 42 | 1077 | E |
| 40.315 | closed | 10 11 11 11 | | | | 43 | 1103 | D |
| 40.330 | closed | 11 11 11 11 | | | | 44 | 1130 | B |
| 40.345 | closed | 11 12 11 11 | | | | 45 | 1156 | C |

| Gate A Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 40.360 | closed | 11 | 12 | | | 46 | 1183 | E |
| 40.375 | closed | 11 | 12 | | | 47 | 1210 | D |
| 40.390 | closed | 12 | 12 | | | 48 | 1237 | B |
| 40.405 | closed | 12 | 13 | | | 49 | 1264 | C |
| 40.420 | closed | 12 | 13 | | | 50 | 1292 | E |
| 40.435 | closed | 12 | 13 | | | 51 | 1320 | D |
| 40.450 | closed | 13 | 13 | | | 52 | 1348 | B |
| 40.465 | closed | 13 | 14 | | | 53 | 1377 | C |
| 40.480 | closed | 13 | 14 | | | 54 | 1405 | E |
| 40.495 | closed | 13 | 14 | | | 55 | 1433 | D |
| 40.510 | closed | 14 | 14 | | | 56 | 1462 | B |
| 40.525 | closed | 14 | 15 | | | 57 | 1492 | C |
| 40.540 | closed | 14 | 15 | | | 58 | 1523 | E |
| 40.555 | closed | 14 | 15 | | | 59 | 1554 | D |
| 40.570 | closed | 15 | 15 | | | 60 | 1585 | B |
| 40.585 | closed | 15 | 16 | | | 61 | 1619 | C |
| 40.600 | closed | 15 | 16 | | | 62 | 1653 | E |
| 40.615 | closed | 15 | 16 | | | 63 | 1687 | D |
| 40.630 | closed | 16 | 16 | | | 64 | 1721 | B |
| 40.645 | closed | 16 | 17 | | | 65 | 1759 | C |
| 40.660 | closed | 16 | 17 | | | 66 | 1797 | E |
| 40.675 | closed | 16 | 17 | | | 67 | 1834 | D |
| 40.690 | closed | 17 | 17 | | | 68 | 1872 | B |
| 40.705 | closed | 17 | 18 | | | 69 | 1911 | C |
| 40.720 | closed | 17 | 18 | | | 70 | 1949 | E |
| 40.735 | closed | 17 | 18 | | | 71 | 1988 | D |
| 40.750 | closed | 18 | 18 | | | 72 | 2026 | B |
| 40.765 | closed | 18 | 19 | | | 73 | 2060 | C |
| 40.780 | closed | 18 | 19 | | | 74 | 2094 | E |
| 40.795 | closed | 18 | 19 | | | 75 | 2127 | D |
| 40.810 | closed | 19 | 19 | | | 76 | 2161 | B |
| 40.825 | closed | 19 | 20 | | | 77 | 2277 | C |
| 40.840 | closed | 19 | 20 | | | 78 | 2395 | E |
| 40.855 | closed | 19 | 20 | | | 79 | 2516 | D |
| 40.870 | closed | 20 | 20 | | | 80 | 2639 | B |
| 40.885 | closed | 20 | 21 | | | 81 | 2645 | C |
| 40.900 | closed | 20 | 21 | | | 82 | 2650 | E |
| 40.915 | closed | 20 | 21 | | | 83 | 2655 | D |
| 40.930 | closed | 21 | 21 | | | 84 | 2660 | B |
| 40.945 | closed | 21 | 22 | | | 85 | 2667 | C |
| 40.960 | closed | 21 | 22 | | | 86 | 2674 | E |
| 40.975 | closed | 21 | 22 | | | 87 | 2680 | D |
| 40.990 | closed | 22 | 22 | | | 88 | 2687 | B |
| 41.005 | closed | 22 | 23 | | | 89 | 2694 | C |
| 41.020 | closed | 22 | 23 | | | 90 | 2701 | E |
| 41.035 | closed | 22 | 23 | | | 91 | 2708 | D |
| 41.050 | closed | 23 | 23 | | | 92 | 2715 | B |

| Gate A Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 41.065 | closed | 23 23 23 | 23 23 | | | 92 | 2722 | - |
| 41.080 | closed | 23 23 23 | 23 23 | | | 92 | 2729 | - |
| 41.095 | closed | 23 23 23 | 23 23 | | | 92 | 2736 | - |
| 41.110 | closed | 23 23 23 | 23 23 | | | 92 | 2742 | - |
| 41.125 | closed | 23 23 23 | 23 23 | | | 92 | 2749 | - |
| 41.140 | closed | 23 23 23 | 23 23 | | | 92 | 2756 | - |
| 41.155 | closed | 23 23 23 | 23 23 | | | 92 | 2763 | - |
| 41.170 | closed | 23 23 23 | 23 23 | | | 92 | 2770 | - |
| 41.185 | closed | 23 23 23 | 23 23 | | | 92 | 2777 | - |
| 41.200 | closed | 23 23 23 | 23 23 | | | 92 | 2784 | - |
| 41.215 | closed | 23 23 23 | 23 23 | | | 92 | 2791 | - |
| 41.230 | closed | 23 23 23 | 23 23 | | | 92 | 2798 | - |
| 41.245 | closed | 23 23 23 | 23 23 | | | 92 | 2805 | - |
| 41.260 | closed | 23 23 23 | 23 23 | | | 92 | 2812 | - |
| 41.275 | closed | 23 23 23 | 23 23 | | | 92 | 2819 | - |
| 41.290 | closed | 23 23 23 | 23 23 | | | 92 | 2826 | - |
| 41.305 | closed | 23 23 23 | 23 23 | | | 92 | 2833 | - |
| 41.320 | closed | 23 23 23 | 23 23 | | | 92 | 2840 | - |
| 41.335 | closed | 23 23 23 | 23 23 | | | 92 | 2847 | - |
| 41.350 | closed | 23 23 23 | 23 23 | | | 92 | 2854 | - |
| 41.365 | closed | 23 23 23 | 23 23 | | | 92 | 2861 | - |
| 41.380 | closed | 23 23 23 | 23 23 | | | 92 | 2868 | - |
| 41.395 | closed | 23 23 23 | 23 23 | | | 92 | 2875 | - |

| Gate B Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 39.600 | closed | closed | closed | closed | closed | 0 | 0 | - |
| 39.650 | closed | closed | 1 | closed | closed | 1 | 16 | C |
| 39.700 | closed | closed | 1 | closed | 1 | 2 | 32 | E |
| 39.715 | 1 | closed | 1 | closed | 1 | 3 | 48 | A |
| 39.730 | 1 | closed | 1 | 1 | 1 | 4 | 64 | D |
| 39.745 | 1 | closed | 2 | 1 | 1 | 5 | 88 | C |
| 39.760 | 1 | closed | 2 | 1 | 2 | 6 | 112 | E |
| 39.775 | 2 | closed | 2 | 1 | 2 | 7 | 137 | A |
| 39.790 | 2 | closed | 2 | 2 | 2 | 8 | 161 | D |
| 39.805 | 2 | closed | 3 | 2 | 2 | 9 | 187 | C |
| 39.820 | 2 | closed | 3 | 2 | 3 | 10 | 213 | E |
| 39.835 | 3 | closed | 3 | 2 | 3 | 11 | 240 | A |
| 39.850 | 3 | closed | 3 | 3 | 3 | 12 | 266 | D |
| 39.865 | 3 | closed | 4 | 3 | 3 | 13 | 294 | C |
| 39.880 | 3 | closed | 4 | 3 | 4 | 14 | 322 | E |
| 39.895 | 4 | closed | 4 | 3 | 4 | 15 | 349 | A |
| 39.910 | 4 | closed | 4 | 4 | 4 | 16 | 377 | D |
| 39.925 | 4 | closed | 5 | 4 | 4 | 17 | 404 | C |
| 39.940 | 4 | closed | 5 | 4 | 5 | 18 | 430 | E |
| 39.955 | 5 | closed | 5 | 4 | 5 | 19 | 457 | A |
| 39.970 | 5 | closed | 5 | 5 | 5 | 20 | 484 | D |
| 39.985 | 5 | closed | 6 | 5 | 5 | 21 | 512 | C |
| 40.000 | 5 | closed | 6 | 5 | 6 | 22 | 539 | E |
| 40.015 | 6 | closed | 6 | 5 | 6 | 23 | 567 | A |
| 40.030 | 6 | closed | 6 | 6 | 6 | 24 | 595 | D |
| 40.045 | 6 | closed | 7 | 6 | 6 | 25 | 623 | C |
| 40.060 | 6 | closed | 7 | 6 | 7 | 26 | 650 | E |
| 40.075 | 7 | closed | 7 | 6 | 7 | 27 | 678 | A |
| 40.090 | 7 | closed | 7 | 7 | 7 | 28 | 706 | D |
| 40.105 | 7 | closed | 8 | 7 | 7 | 29 | 732 | C |
| 40.120 | 7 | closed | 8 | 7 | 8 | 30 | 759 | E |
| 40.135 | 8 | closed | 8 | 7 | 8 | 31 | 786 | A |
| 40.150 | 8 | closed | 8 | 8 | 8 | 32 | 812 | D |
| 40.165 | 8 | closed | 9 | 8 | 8 | 33 | 839 | C |
| 40.180 | 8 | closed | 9 | 8 | 9 | 34 | 866 | E |
| 40.195 | 9 | closed | 9 | 8 | 9 | 35 | 893 | A |
| 40.210 | 9 | closed | 9 | 9 | 9 | 36 | 920 | D |
| 40.225 | 9 | closed | 10 | 9 | 9 | 37 | 946 | C |
| 40.240 | 9 | closed | 10 | 9 | 10 | 38 | 972 | E |
| 40.255 | 10 | closed | 10 | 9 | 10 | 39 | 998 | A |
| 40.270 | 10 | closed | 10 | 10 | 10 | 40 | 1024 | D |
| 40.285 | 10 | closed | 11 | 10 | 10 | 41 | 1050 | C |
| 40.300 | 10 | closed | 11 | 10 | 11 | 42 | 1077 | E |
| 40.315 | 11 | closed | 11 | 10 | 11 | 43 | 1103 | A |
| 40.330 | 11 | closed | 11 | 11 | 11 | 44 | 1130 | D |
| 40.345 | 11 | closed | 12 | 11 | 11 | 45 | 1156 | C |

| Gate B Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 40.360 | 11 closed | 12 | | 11 | 12 | 46 | 1183 | E |
| 40.375 | 12 closed | 12 | | 11 | 12 | 47 | 1210 | A |
| 40.390 | 12 closed | 12 | | 12 | 12 | 48 | 1237 | D |
| 40.405 | 12 closed | 13 | | 12 | 12 | 49 | 1264 | C |
| 40.420 | 12 closed | 13 | | 12 | 13 | 50 | 1292 | E |
| 40.435 | 13 closed | 13 | | 12 | 13 | 51 | 1320 | A |
| 40.450 | 13 closed | 13 | | 13 | 13 | 52 | 1348 | D |
| 40.465 | 13 closed | 14 | | 13 | 13 | 53 | 1377 | C |
| 40.480 | 13 closed | 14 | | 13 | 14 | 54 | 1405 | E |
| 40.495 | 14 closed | 14 | | 13 | 14 | 55 | 1433 | A |
| 40.510 | 14 closed | 14 | | 14 | 14 | 56 | 1462 | D |
| 40.525 | 14 closed | 15 | | 14 | 14 | 57 | 1492 | C |
| 40.540 | 14 closed | 15 | | 14 | 15 | 58 | 1523 | E |
| 40.555 | 15 closed | 15 | | 14 | 15 | 59 | 1554 | A |
| 40.570 | 15 closed | 15 | | 15 | 15 | 60 | 1585 | D |
| 40.585 | 15 closed | 16 | | 15 | 15 | 61 | 1619 | C |
| 40.600 | 15 closed | 16 | | 15 | 16 | 62 | 1653 | E |
| 40.615 | 16 closed | 16 | | 15 | 16 | 63 | 1687 | A |
| 40.630 | 16 closed | 16 | | 16 | 16 | 64 | 1721 | D |
| 40.645 | 16 closed | 17 | | 16 | 16 | 65 | 1759 | C |
| 40.660 | 16 closed | 17 | | 16 | 17 | 66 | 1797 | E |
| 40.675 | 17 closed | 17 | | 16 | 17 | 67 | 1834 | A |
| 40.690 | 17 closed | 17 | | 17 | 17 | 68 | 1872 | D |
| 40.705 | 17 closed | 18 | | 17 | 17 | 69 | 1911 | C |
| 40.720 | 17 closed | 18 | | 17 | 18 | 70 | 1949 | E |
| 40.735 | 18 closed | 18 | | 17 | 18 | 71 | 1988 | A |
| 40.750 | 18 closed | 18 | | 18 | 18 | 72 | 2026 | D |
| 40.765 | 18 closed | 19 | | 18 | 18 | 73 | 2060 | C |
| 40.780 | 18 closed | 19 | | 18 | 19 | 74 | 2094 | E |
| 40.795 | 19 closed | 19 | | 18 | 19 | 75 | 2127 | A |
| 40.810 | 19 closed | 19 | | 19 | 19 | 76 | 2161 | D |
| 40.825 | 19 closed | 20 | | 19 | 19 | 77 | 2277 | C |
| 40.840 | 19 closed | 20 | | 19 | 20 | 78 | 2395 | E |
| 40.855 | 20 closed | 20 | | 19 | 20 | 79 | 2516 | A |
| 40.870 | 20 closed | 20 | | 20 | 20 | 80 | 2639 | D |
| 40.885 | 20 closed | 21 | | 20 | 20 | 81 | 2645 | C |
| 40.900 | 20 closed | 21 | | 20 | 21 | 82 | 2650 | E |
| 40.915 | 21 closed | 21 | | 20 | 21 | 83 | 2655 | A |
| 40.930 | 21 closed | 21 | | 21 | 21 | 84 | 2660 | D |
| 40.945 | 21 closed | 22 | | 21 | 21 | 85 | 2667 | C |
| 40.960 | 21 closed | 22 | | 21 | 22 | 86 | 2674 | E |
| 40.975 | 22 closed | 22 | | 21 | 22 | 87 | 2680 | A |
| 40.990 | 22 closed | 22 | | 22 | 22 | 88 | 2687 | D |
| 41.005 | 22 closed | 23 | | 22 | 22 | 89 | 2694 | C |
| 41.020 | 22 closed | 23 | | 22 | 23 | 90 | 2701 | E |
| 41.035 | 23 closed | 23 | | 22 | 23 | 91 | 2708 | A |
| 41.050 | 23 closed | 23 | | 23 | 23 | 92 | 2715 | D |

| Gate B Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Level (m AHD)** | **Gate A** | **Gate B** | **Gate C** | **Gate D** | **Gate E** | **Total Opening** | **Discharge ($m^3$/sec)** | **Gates Operated** |
| 41.065 | 23 closed | 23 | | 23 | 23 | 92 | 2722 | - |
| 41.080 | 23 closed | 23 | | 23 | 23 | 92 | 2729 | - |
| 41.095 | 23 closed | 23 | | 23 | 23 | 92 | 2736 | - |
| 41.110 | 23 closed | 23 | | 23 | 23 | 92 | 2742 | - |
| 41.125 | 23 closed | 23 | | 23 | 23 | 92 | 2749 | - |
| 41.140 | 23 closed | 23 | | 23 | 23 | 92 | 2756 | - |
| 41.155 | 23 closed | 23 | | 23 | 23 | 92 | 2763 | - |
| 41.170 | 23 closed | 23 | | 23 | 23 | 92 | 2770 | - |
| 41.185 | 23 closed | 23 | | 23 | 23 | 92 | 2777 | - |
| 41.200 | 23 closed | 23 | | 23 | 23 | 92 | 2784 | - |
| 41.215 | 23 closed | 23 | | 23 | 23 | 92 | 2791 | - |
| 41.230 | 23 closed | 23 | | 23 | 23 | 92 | 2798 | - |
| 41.245 | 23 closed | 23 | | 23 | 23 | 92 | 2805 | - |
| 41.260 | 23 closed | 23 | | 23 | 23 | 92 | 2812 | - |
| 41.275 | 23 closed | 23 | | 23 | 23 | 92 | 2819 | - |
| 41.290 | 23 closed | 23 | | 23 | 23 | 92 | 2826 | - |
| 41.305 | 23 closed | 23 | | 23 | 23 | 92 | 2833 | - |
| 41.320 | 23 closed | 23 | | 23 | 23 | 92 | 2840 | - |
| 41.335 | 23 closed | 23 | | 23 | 23 | 92 | 2847 | - |
| 41.350 | 23 closed | 23 | | 23 | 23 | 92 | 2854 | - |
| 41.365 | 23 closed | 23 | | 23 | 23 | 92 | 2861 | - |
| 41.380 | 23 closed | 23 | | 23 | 23 | 92 | 2868 | - |
| 41.395 | 23 closed | 23 | | 23 | 23 | 92 | 2875 | - |

| Gate C Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Level (m AHD)** | **Gate A** | **Gate B** | **Gate C** | **Gate D** | **Gate E** | **Total Opening** | **Discharge ($m^3$/sec)** | **Gate Operated** |
| 39.600 | closed c | losed c | losed c | losed | closed | 0 | 0 | - |
| 39.650 | closed c | losed c | losed c | losed | 1 | 1 | 16 | E |
| 39.700 | 1 | closed c | losed c | losed | 1 | 2 | 32 | A |
| 39.715 1 | | closed | closed | 1 | 1 | 3 | 48 | D |
| 39.730 | 1 1 | | closed | 1 1 | | 4 | 64 | B |
| 39.745 | 1 1 | | closed | 1 2 | | 5 | 88 | E |
| 39.760 | 2 1 | | closed | 1 2 | | 6 | 112 | A |
| 39.775 | 2 1 | | closed | 2 2 | | 7 | 137 | D |
| 39.790 | 2 2 | | closed | 2 2 | | 8 | 161 | B |
| 39.805 | 2 2 | | closed | 2 3 | | 9 | 187 | E |
| 39.820 | 3 2 | | closed | 2 3 | | 10 | 213 | A |
| 39.835 | 3 2 | | closed | 3 3 | | 11 | 240 | D |
| 39.850 | 3 3 | | closed | 3 3 | | 12 | 266 | B |
| 39.865 | 3 3 | | closed | 3 4 | | 13 | 294 | E |
| 39.880 | 4 3 | | closed | 3 4 | | 14 | 322 | A |
| 39.895 | 4 3 | | closed | 4 4 | | 15 | 349 | D |
| 39.910 | 4 4 | | closed | 4 4 | | 16 | 377 | B |
| 39.925 | 4 4 | | closed | 4 5 | | 17 | 404 | E |
| 39.940 | 5 4 | | closed | 4 5 | | 18 | 430 | A |
| 39.955 | 5 4 | | closed | 5 5 | | 19 | 457 | D |
| 39.970 | 5 5 | | closed | 5 5 | | 20 | 484 | B |
| 39.985 | 5 5 | | closed | 5 6 | | 21 | 512 | E |
| 40.000 | 6 5 | | closed | 5 6 | | 22 | 539 | A |
| 40.015 | 6 5 | | closed | 6 6 | | 23 | 567 | D |
| 40.030 | 6 6 | | closed | 6 6 | | 24 | 595 | B |
| 40.045 | 6 6 | | closed | 6 7 | | 25 | 623 | E |
| 40.060 | 7 6 | | closed | 6 7 | | 26 | 650 | A |
| 40.075 | 7 6 | | closed | 7 7 | | 27 | 678 | D |
| 40.090 | 7 7 | | closed | 7 7 | | 28 | 706 | B |
| 40.105 | 7 7 | | closed | 7 8 | | 29 | 732 | E |
| 40.120 | 8 7 | | closed | 7 8 | | 30 | 759 | A |
| 40.135 | 8 7 | | closed | 8 8 | | 31 | 786 | D |
| 40.150 | 8 8 | | closed | 8 8 | | 32 | 812 | B |
| 40.165 | 8 8 | | closed | 8 9 | | 33 | 839 | E |
| 40.180 | 9 8 | | closed | 8 9 | | 34 | 866 | A |
| 40.195 | 9 8 | | closed | 9 9 | | 35 | 893 | D |
| 40.210 | 9 9 | | closed | 9 9 | | 36 | 920 | B |
| 40.225 9 | | 9 | closed | 9 | 10 | 37 | 946 | E |
| 40.240 | 10 9 | | closed | 9 10 | | 38 | 972 | A |
| 40.255 10 | | 9 | closed | 10 | 10 | 39 | 998 | D |
| 40.270 | 10 | 10 c | losed 1 | 0 | 10 | 40 | 1024 | B |
| 40.285 | 10 | 10 c | losed 1 | 0 | 11 | 41 | 1050 | E |
| 40.300 | 11 | 10 c | losed 1 | 0 | 11 | 42 | 1077 | A |
| 40.315 | 11 | 10 c | losed 1 | 1 | 11 | 43 | 1103 | D |
| 40.330 | 11 | 11 c | losed 1 | 1 | 11 | 44 | 1130 | B |
| 40.345 | 11 | 11 c | losed 1 | 1 | 12 | 45 | 1156 | E |

| Gate C Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 40.360 | 12 | 11 c | losed 1 | 1 | 12 | 46 | 1183 | A |
| 40.375 | 12 | 11 c | losed 1 | 2 | 12 | 47 | 1210 | D |
| 40.390 | 12 | 12 c | losed 1 | 2 | 12 | 48 | 1237 | B |
| 40.405 | 12 | 12 c | losed 1 | 2 | 13 | 49 | 1264 | E |
| 40.420 | 13 | 12 c | losed 1 | 2 | 13 | 50 | 1292 | A |
| 40.435 | 13 | 12 c | losed 1 | 3 | 13 | 51 | 1320 | D |
| 40.450 | 13 | 13 c | losed 1 | 3 | 13 | 52 | 1348 | B |
| 40.465 | 13 | 13 c | losed 1 | 3 | 14 | 53 | 1377 | E |
| 40.480 | 14 | 13 c | losed 1 | 3 | 14 | 54 | 1405 | A |
| 40.495 | 14 | 13 c | losed 1 | 4 | 14 | 55 | 1433 | D |
| 40.510 | 14 | 14 c | losed 1 | 4 | 14 | 56 | 1462 | B |
| 40.525 | 14 | 14 c | losed 1 | 4 | 15 | 57 | 1492 | E |
| 40.540 | 15 | 14 c | losed 1 | 4 | 15 | 58 | 1523 | A |
| 40.555 | 15 | 14 c | losed 1 | 5 | 15 | 59 | 1554 | D |
| 40.570 | 15 | 15 c | losed 1 | 5 | 15 | 60 | 1585 | B |
| 40.585 | 15 | 15 c | losed 1 | 5 | 16 | 61 | 1619 | E |
| 40.600 | 16 | 15 c | losed 1 | 5 | 16 | 62 | 1653 | A |
| 40.615 | 16 | 15 c | losed 1 | 6 | 16 | 63 | 1687 | D |
| 40.630 | 16 | 16 c | losed 1 | 6 | 16 | 64 | 1721 | B |
| 40.645 | 16 | 16 c | losed 1 | 6 | 17 | 65 | 1759 | E |
| 40.660 | 17 | 16 c | losed 1 | 6 | 17 | 66 | 1797 | A |
| 40.675 | 17 | 16 c | losed 1 | 7 | 17 | 67 | 1834 | D |
| 40.690 | 17 | 17 c | losed 1 | 7 | 17 | 68 | 1872 | B |
| 40.705 | 17 | 17 c | losed 1 | 7 | 18 | 69 | 1911 | E |
| 40.720 | 18 | 17 c | losed 1 | 7 | 18 | 70 | 1949 | A |
| 40.735 | 18 | 17 c | losed 1 | 8 | 18 | 71 | 1988 | D |
| 40.750 | 18 | 18 c | losed 1 | 8 | 18 | 72 | 2026 | B |
| 40.765 | 18 | 18 c | losed 1 | 8 | 19 | 73 | 2060 | E |
| 40.780 | 19 | 18 c | losed 1 | 8 | 19 | 74 | 2094 | A |
| 40.795 | 19 | 18 c | losed 1 | 9 | 19 | 75 | 2127 | D |
| 40.810 | 19 | 19 c | losed 1 | 9 | 19 | 76 | 2161 | B |
| 40.825 | 19 | 19 c | losed 1 | 9 | 20 | 77 | 2277 | E |
| 40.840 | 20 | 19 c | losed 1 | 9 | 20 | 78 | 2395 | A |
| 40.855 | 20 | 19 c | losed 2 | 0 | 20 | 79 | 2516 | D |
| 40.870 | 20 | 20 c | losed 2 | 0 | 20 | 80 | 2639 | B |
| 40.885 | 20 | 20 c | losed 2 | 0 | 21 | 81 | 2645 | E |
| 40.900 | 21 | 20 c | losed 2 | 0 | 21 | 82 | 2650 | A |
| 40.915 | 21 | 20 c | losed 2 | 1 | 21 | 83 | 2655 | D |
| 40.930 | 21 | 21 c | losed 2 | 1 | 21 | 84 | 2660 | B |
| 40.945 | 21 | 21 c | losed 2 | 1 | 22 | 85 | 2667 | E |
| 40.960 | 22 | 21 c | losed 2 | 1 | 22 | 86 | 2674 | A |
| 40.975 | 22 | 21 c | losed 2 | 2 | 22 | 87 | 2680 | D |
| 40.990 | 22 | 22 c | losed 2 | 2 | 22 | 88 | 2687 | B |
| 41.005 | 22 | 22 c | losed 2 | 2 | 23 | 89 | 2694 | E |
| 41.020 | 23 | 22 c | losed 2 | 2 | 23 | 90 | 2701 | A |
| 41.035 | 23 | 22 c | losed 2 | 3 | 23 | 91 | 2708 | D |
| 41.050 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2715 | B |

| Gate C Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Level (m AHD)** | **Gate A** | **Gate B** | **Gate C** | **Gate D** | **Gate E** | **Total Opening** | **Discharge ($m^3$/sec)** | **Gate Operated** |
| 41.065 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2722 - | |
| 41.080 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2729 - | |
| 41.095 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2736 - | |
| 41.110 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2742 - | |
| 41.125 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2749 - | |
| 41.140 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2756 - | |
| 41.155 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2763 - | |
| 41.170 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2770 - | |
| 41.185 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2777 - | |
| 41.200 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2784 - | |
| 41.215 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2791 - | |
| 41.230 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2798 - | |
| 41.245 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2805 - | |
| 41.260 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2812 - | |
| 41.275 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2819 - | |
| 41.290 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2826 - | |
| 41.305 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2833 - | |
| 41.320 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2840 - | |
| 41.335 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2847 - | |
| 41.350 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2854 - | |
| 41.365 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2861 - | |
| 41.380 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2868 - | |
| 41.395 | 23 | 23 c | losed 2 | 3 | 23 | 92 | 2875 | - |

| Gate D Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 39.600 | closed | closed | closed | closed | closed | 0 | 0 | - |
| 39.650 | closed | closed | 1 | closed | closed | 1 | 16 | C |
| 39.700 | closed | closed | 1 | closed | 1 | 2 | 32 | E |
| 39.715 | 1 | closed | 1 | closed | | 1 | 3 | 48 | A |
| 39.730 | 1 | | 1 | 1 | closed | 1 | 4 | 64 | B |
| 39.745 | 1 | | 1 | 2 | closed | 1 | 5 | 88 | C |
| 39.760 | 1 | | 1 | 2 | closed | 2 | 6 | 112 | E |
| 39.775 | 2 | | 1 | 2 | closed | 2 | 7 | 137 | A |
| 39.790 | 2 | | 2 | 2 | closed | 2 | 8 | 161 | B |
| 39.805 | 2 | | 2 | 3 | closed | 2 | 9 | 187 | C |
| 39.820 | 2 | | 2 | 3 | closed | 3 | 10 | 213 | E |
| 39.835 | 3 | | 2 | 3 | closed | 3 | 11 | 240 | A |
| 39.850 | 3 | | 3 | 3 | closed | 3 | 12 | 266 | B |
| 39.865 | 3 | | 3 | 4 | closed | 3 | 13 | 294 | C |
| 39.880 | 3 | | 3 | 4 | closed | 4 | 14 | 322 | E |
| 39.895 | 4 | | 3 | 4 | closed | 4 | 15 | 349 | A |
| 39.910 | 4 | | 4 | 4 | closed | 4 | 16 | 377 | B |
| 39.925 | 4 | | 4 | 5 | closed | 4 | 17 | 404 | C |
| 39.940 | 4 | | 4 | 5 | closed | 5 | 18 | 430 | E |
| 39.955 | 5 | | 4 | 5 | closed | 5 | 19 | 457 | A |
| 39.970 | 5 | | 5 | 5 | closed | 5 | 20 | 484 | B |
| 39.985 | 5 | | 5 | 6 | closed | 5 | 21 | 512 | C |
| 40.000 | 5 | | 5 | 6 | closed | 6 | 22 | 539 | E |
| 40.015 | 6 | | 5 | 6 | closed | 6 | 23 | 567 | A |
| 40.030 | 6 | | 6 | 6 | closed | 6 | 24 | 595 | B |
| 40.045 | 6 | | 6 | 7 | closed | 6 | 25 | 623 | C |
| 40.060 | 6 | | 6 | 7 | closed | 7 | 26 | 650 | E |
| 40.075 | 7 | | 6 | 7 | closed | 7 | 27 | 678 | A |
| 40.090 | 7 | | 7 | 7 | closed | 7 | 28 | 706 | B |
| 40.105 | 7 | | 7 | 8 | closed | 7 | 29 | 732 | C |
| 40.120 | 7 | | 7 | 8 | closed | 8 | 30 | 759 | E |
| 40.135 | 8 | | 7 | 8 | closed | 8 | 31 | 786 | A |
| 40.150 | 8 | | 8 | 8 | closed | 8 | 32 | 812 | B |
| 40.165 | 8 | | 8 | 9 | closed | 8 | 33 | 839 | C |
| 40.180 | 8 | | 8 | 9 | closed | 9 | 34 | 866 | E |
| 40.195 | 9 | | 8 | 9 | closed | 9 | 35 | 893 | A |
| 40.210 | 9 | | 9 | 9 | closed | 9 | 36 | 920 | B |
| 40.225 | 9 | | 9 | 10 | closed | 9 | 37 | 946 | C |
| 40.240 | 9 | | 9 | 10 | closed | 10 | 38 | 972 | E |
| 40.255 | 10 | | 9 | 10 | closed | 10 | 39 | 998 | A |
| 40.270 | 10 | 10 | 10 | | closed | 10 | 40 | 1024 | B |
| 40.285 | 10 | 10 | 11 | | closed | 10 | 41 | 1050 | C |
| 40.300 | 10 | 10 | 11 | | closed | 11 | 42 | 1077 | E |
| 40.315 | 11 | 10 | 11 | | closed | 11 | 43 | 1103 | A |
| 40.330 | 11 | 11 | 11 | | closed | 11 | 44 | 1130 | B |
| 40.345 | 11 | 11 | 12 | | closed | 11 | 45 | 1156 | C |

| Gate D Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 40.360 | 11 | 11 | 12 | closed | 12 | 46 | 1183 | E |
| 40.375 | 12 | 11 | 12 | closed | 12 | 47 | 1210 | A |
| 40.390 | 12 | 12 | 12 | closed | 12 | 48 | 1237 | B |
| 40.405 | 12 | 12 | 13 | closed | 12 | 49 | 1264 | C |
| 40.420 | 12 | 12 | 13 | closed | 13 | 50 | 1292 | E |
| 40.435 | 13 | 12 | 13 | closed | 13 | 51 | 1320 | A |
| 40.450 | 13 | 13 | 13 | closed | 13 | 52 | 1348 | B |
| 40.465 | 13 | 13 | 14 | closed | 13 | 53 | 1377 | C |
| 40.480 | 13 | 13 | 14 | closed | 14 | 54 | 1405 | E |
| 40.495 | 14 | 13 | 14 | closed | 14 | 55 | 1433 | A |
| 40.510 | 14 | 14 | 14 | closed | 14 | 56 | 1462 | B |
| 40.525 | 14 | 14 | 15 | closed | 14 | 57 | 1492 | C |
| 40.540 | 14 | 14 | 15 | closed | 15 | 58 | 1523 | E |
| 40.555 | 15 | 14 | 15 | closed | 15 | 59 | 1554 | A |
| 40.570 | 15 | 15 | 15 | closed | 15 | 60 | 1585 | B |
| 40.585 | 15 | 15 | 16 | closed | 15 | 61 | 1619 | C |
| 40.600 | 15 | 15 | 16 | closed | 16 | 62 | 1653 | E |
| 40.615 | 16 | 15 | 16 | closed | 16 | 63 | 1687 | A |
| 40.630 | 16 | 16 | 16 | closed | 16 | 64 | 1721 | B |
| 40.645 | 16 | 16 | 17 | closed | 16 | 65 | 1759 | C |
| 40.660 | 16 | 16 | 17 | closed | 17 | 66 | 1797 | E |
| 40.675 | 17 | 16 | 17 | closed | 17 | 67 | 1834 | A |
| 40.690 | 17 | 17 | 17 | closed | 17 | 68 | 1872 | B |
| 40.705 | 17 | 17 | 18 | closed | 17 | 69 | 1911 | C |
| 40.720 | 17 | 17 | 18 | closed | 18 | 70 | 1949 | E |
| 40.735 | 18 | 17 | 18 | closed | 18 | 71 | 1988 | A |
| 40.750 | 18 | 18 | 18 | closed | 18 | 72 | 2026 | B |
| 40.765 | 18 | 18 | 19 | closed | 18 | 73 | 2060 | C |
| 40.780 | 18 | 18 | 19 | closed | 19 | 74 | 2094 | E |
| 40.795 | 19 | 18 | 19 | closed | 19 | 75 | 2127 | A |
| 40.810 | 19 | 19 | 19 | closed | 19 | 76 | 2161 | B |
| 40.825 | 19 | 19 | 20 | closed | 19 | 77 | 2277 | C |
| 40.840 | 19 | 19 | 20 | closed | 20 | 78 | 2395 | E |
| 40.855 | 20 | 19 | 20 | closed | 20 | 79 | 2516 | A |
| 40.870 | 20 | 20 | 20 | closed | 20 | 80 | 2639 | B |
| 40.885 | 20 | 20 | 21 | closed | 20 | 81 | 2645 | C |
| 40.900 | 20 | 20 | 21 | closed | 21 | 82 | 2650 | E |
| 40.915 | 21 | 20 | 21 | closed | 21 | 83 | 2655 | A |
| 40.930 | 21 | 21 | 21 | closed | 21 | 84 | 2660 | B |
| 40.945 | 21 | 21 | 22 | closed | 21 | 85 | 2667 | C |
| 40.960 | 21 | 21 | 22 | closed | 22 | 86 | 2674 | E |
| 40.975 | 22 | 21 | 22 | closed | 22 | 87 | 2680 | A |
| 40.990 | 22 | 22 | 22 | closed | 22 | 88 | 2687 | B |
| 41.005 | 22 | 22 | 23 | closed | 22 | 89 | 2694 | C |
| 41.020 | 22 | 22 | 23 | closed | 23 | 90 | 2701 | E |
| 41.035 | 23 | 22 | 23 | closed | 23 | 91 | 2708 | A |
| 41.050 | 23 | 23 | 23 | closed | 23 | 92 | 2715 | B |

| Gate D Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 41.065 | 23 23 23 | | | closed | 23 | 92 | 2722 | - |
| 41.080 | 23 23 23 | | | closed | 23 | 92 | 2729 | - |
| 41.095 | 23 23 23 | | | closed | 23 | 92 | 2736 | - |
| 41.110 | 23 23 23 | | | closed | 23 | 92 | 2742 | - |
| 41.125 | 23 23 23 | | | closed | 23 | 92 | 2749 | - |
| 41.140 | 23 23 23 | | | closed | 23 | 92 | 2756 | - |
| 41.155 | 23 23 23 | | | closed | 23 | 92 | 2763 | - |
| 41.170 | 23 23 23 | | | closed | 23 | 92 | 2770 | - |
| 41.185 | 23 23 23 | | | closed | 23 | 92 | 2777 | - |
| 41.200 | 23 23 23 | | | closed | 23 | 92 | 2784 | - |
| 41.215 | 23 23 23 | | | closed | 23 | 92 | 2791 | - |
| 41.230 | 23 23 23 | | | closed | 23 | 92 | 2798 | - |
| 41.245 | 23 23 23 | | | closed | 23 | 92 | 2805 | - |
| 41.260 | 23 23 23 | | | closed | 23 | 92 | 2812 | - |
| 41.275 | 23 23 23 | | | closed | 23 | 92 | 2819 | - |
| 41.290 | 23 23 23 | | | closed | 23 | 92 | 2826 | - |
| 41.305 | 23 23 23 | | | closed | 23 | 92 | 2833 | - |
| 41.320 | 23 23 23 | | | closed | 23 | 92 | 2840 | - |
| 41.335 | 23 23 23 | | | closed | 23 | 92 | 2847 | - |
| 41.350 | 23 23 23 | | | closed | 23 | 92 | 2854 | - |
| 41.365 | 23 23 23 | | | closed | 23 | 92 | 2861 | - |
| 41.380 | 23 23 23 | | | closed | 23 | 92 | 2868 | - |
| 41.395 | 23 23 23 | | | closed | 23 | 92 | 2875 | - |

| Gate E Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Level (m AHD)** | **Gate A** | **Gate B** | **Gate C** | **Gate D** | **Gate E** | **Total Opening** | **Discharge ($m^3$/sec)** | **Gate Operated** |
| 39.600 | closed closed closed closed | | | | closed | 0 | 0 | - |
| 39.650 | closed | closed | 1 closed | | closed 1 | | 16 | C |
| 39.700 | 1 closed | | 1 closed | | closed 2 | | 32 | A |
| 39.715 | 1 closed | | 1 | 1 | closed 3 | | 48 | D |
| 39.730 | 1 1 1 1 | | | | closed | 4 | 64 | B |
| 39.745 | 1 1 2 1 | | | | closed | 5 | 88 | C |
| 39.760 | 2 1 2 1 | | | | closed | 6 | 112 | A |
| 39.775 | 2 1 2 2 | | | | closed | 7 | 137 | D |
| 39.790 | 2 2 2 2 | | | | closed | 8 | 161 | B |
| 39.805 | 2 2 3 2 | | | | closed | 9 | 187 | C |
| 39.820 | 3 2 3 2 | | | | closed | 10 | 213 | A |
| 39.835 | 3 2 3 3 | | | | closed | 11 | 240 | D |
| 39.850 | 3 3 3 3 | | | | closed | 12 | 266 | B |
| 39.865 | 3 3 4 3 | | | | closed | 13 | 294 | C |
| 39.880 | 4 3 4 3 | | | | closed | 14 | 322 | A |
| 39.895 | 4 3 4 4 | | | | closed | 15 | 349 | D |
| 39.910 | 4 4 4 4 | | | | closed | 16 | 377 | B |
| 39.925 | 4 4 5 4 | | | | closed | 17 | 404 | C |
| 39.940 | 5 4 5 4 | | | | closed | 18 | 430 | A |
| 39.955 | 5 4 5 5 | | | | closed | 19 | 457 | D |
| 39.970 | 5 5 5 5 | | | | closed | 20 | 484 | B |
| 39.985 | 5 5 6 5 | | | | closed | 21 | 512 | C |
| 40.000 | 6 5 6 5 | | | | closed | 22 | 539 | A |
| 40.015 | 6 5 6 6 | | | | closed | 23 | 567 | D |
| 40.030 | 6 6 6 6 | | | | closed | 24 | 595 | B |
| 40.045 | 6 6 7 6 | | | | closed | 25 | 623 | C |
| 40.060 | 7 6 7 6 | | | | closed | 26 | 650 | A |
| 40.075 | 7 6 7 7 | | | | closed | 27 | 678 | D |
| 40.090 | 7 7 7 7 | | | | closed | 28 | 706 | B |
| 40.105 | 7 7 8 7 | | | | closed | 29 | 732 | C |
| 40.120 | 8 7 8 7 | | | | closed | 30 | 759 | A |
| 40.135 | 8 7 8 8 | | | | closed | 31 | 786 | D |
| 40.150 | 8 8 8 8 | | | | closed | 32 | 812 | B |
| 40.165 | 8 8 9 8 | | | | closed | 33 | 839 | C |
| 40.180 | 9 8 9 8 | | | | closed | 34 | 866 | A |
| 40.195 | 9 8 9 9 | | | | closed | 35 | 893 | D |
| 40.210 | 9 9 9 9 | | | | closed | 36 | 920 | B |
| 40.225 9 | | 9 | 10 | 9 | closed | 37 | 946 | C |
| 40.240 | 10 9 | | 10 9 | | closed | 38 | 972 | A |
| 40.255 10 | | 9 | 10 | 10 | closed | 39 | 998 | D |
| 40.270 | 10 10 10 10 | | | | closed | 40 | 1024 | B |
| 40.285 | 10 10 11 10 | | | | closed | 41 | 1050 | C |
| 40.300 | 11 10 11 10 | | | | closed | 42 | 1077 | A |
| 40.315 | 11 10 11 11 | | | | closed | 43 | 1103 | D |
| 40.330 | 11 11 11 11 | | | | closed | 44 | 1130 | B |
| 40.345 | 11 11 12 11 | | | | closed | 45 | 1156 | C |

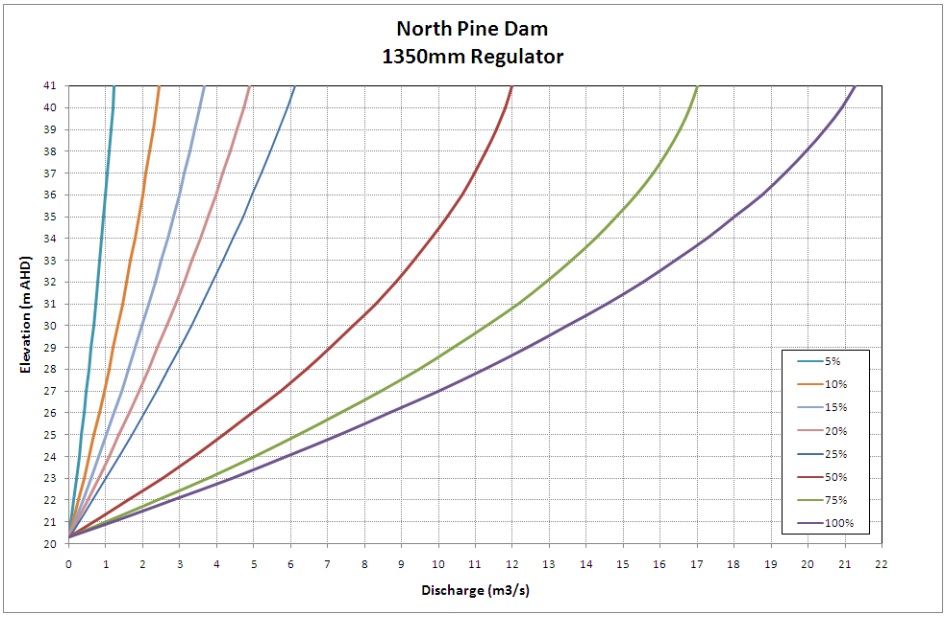
| Gate E Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level (m AHD) | Gate A | Gate B | Gate C | Gate D | Gate E | Total Opening | Discharge ($m^3$/sec) | Gate Operated |
| 40.360 | 12 11 | 12 11 | | | closed | 46 | 1183 | A |
| 40.375 | 12 11 | 12 12 | | | closed | 47 | 1210 | D |
| 40.390 | 12 12 | 12 12 | | | closed | 48 | 1237 | B |
| 40.405 | 12 12 | 13 12 | | | closed | 49 | 1264 | C |
| 40.420 | 13 12 | 13 12 | | | closed | 50 | 1292 | A |
| 40.435 | 13 12 | 13 13 | | | closed | 51 | 1320 | D |
| 40.450 | 13 13 | 13 13 | | | closed | 52 | 1348 | B |
| 40.465 | 13 13 | 14 13 | | | closed | 53 | 1377 | C |
| 40.480 | 14 13 | 14 13 | | | closed | 54 | 1405 | A |
| 40.495 | 14 13 | 14 14 | | | closed | 55 | 1433 | D |
| 40.510 | 14 14 | 14 14 | | | closed | 56 | 1462 | B |
| 40.525 | 14 14 | 15 14 | | | closed | 57 | 1492 | C |
| 40.540 | 15 14 | 15 14 | | | closed | 58 | 1523 | A |
| 40.555 | 15 14 | 15 15 | | | closed | 59 | 1554 | D |
| 40.570 | 15 15 | 15 15 | | | closed | 60 | 1585 | B |
| 40.585 | 15 15 | 16 15 | | | closed | 61 | 1619 | C |
| 40.600 | 16 15 | 16 15 | | | closed | 62 | 1653 | A |
| 40.615 | 16 15 | 16 16 | | | closed | 63 | 1687 | D |
| 40.630 | 16 16 | 16 16 | | | closed | 64 | 1721 | B |
| 40.645 | 16 16 | 17 16 | | | closed | 65 | 1759 | C |
| 40.660 | 17 16 | 17 16 | | | closed | 66 | 1797 | A |
| 40.675 | 17 16 | 17 17 | | | closed | 67 | 1834 | D |
| 40.690 | 17 17 | 17 17 | | | closed | 68 | 1872 | B |
| 40.705 | 17 17 | 18 17 | | | closed | 69 | 1911 | C |
| 40.720 | 18 17 | 18 17 | | | closed | 70 | 1949 | A |
| 40.735 | 18 17 | 18 18 | | | closed | 71 | 1988 | D |
| 40.750 | 18 18 | 18 18 | | | closed | 72 | 2026 | B |
| 40.765 | 18 18 | 19 18 | | | closed | 73 | 2060 | C |
| 40.780 | 19 18 | 19 18 | | | closed | 74 | 2094 | A |
| 40.795 | 19 18 | 19 19 | | | closed | 75 | 2127 | D |
| 40.810 | 19 19 | 19 19 | | | closed | 76 | 2161 | B |
| 40.825 | 19 19 | 20 19 | | | closed | 77 | 2277 | C |
| 40.840 | 20 19 | 20 19 | | | closed | 78 | 2395 | A |
| 40.855 | 20 19 | 20 20 | | | closed | 79 | 2516 | D |
| 40.870 | 20 20 | 20 20 | | | closed | 80 | 2639 | B |
| 40.885 | 20 20 | 21 20 | | | closed | 81 | 2645 | C |
| 40.900 | 21 20 | 21 20 | | | closed | 82 | 2650 | A |
| 40.915 | 21 20 | 21 21 | | | closed | 83 | 2655 | D |
| 40.930 | 21 21 | 21 21 | | | closed | 84 | 2660 | B |
| 40.945 | 21 21 | 22 21 | | | closed | 85 | 2667 | C |
| 40.960 | 22 21 | 22 21 | | | closed | 86 | 2674 | A |
| 40.975 | 22 21 | 22 22 | | | closed | 87 | 2680 | D |
| 40.990 | 22 22 | 22 22 | | | closed | 88 | 2687 | B |
| 41.005 | 22 22 | 23 22 | | | closed | 89 | 2694 | C |
| 41.020 | 23 22 | 23 22 | | | closed | 90 | 2701 | A |
| 41.035 | 23 22 | 23 23 | | | closed | 91 | 2708 | D |
| 41.050 | 23 23 | 23 23 | | | closed | 92 | 2715 | B |

| Gate E Stuck or Inoperable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Level (m AHD)** | **Gate A** | **Gate B** | **Gate C** | **Gate D** | **Gate E** | **Total Opening** | **Discharge ($m^3$/sec)** | **Gate Operated** |
| 41.065 | 23 23 23 | 23 | | | closed | 92 | 2722 - | |
| 41.080 | 23 23 23 | 23 | | | closed | 92 | 2729 - | |
| 41.095 | 23 23 23 | 23 | | | closed | 92 | 2736 - | |
| 41.110 | 23 23 23 | 23 | | | closed | 92 | 2742 - | |
| 41.125 | 23 23 23 | 23 | | | closed | 92 | 2749 - | |
| 41.140 | 23 23 23 | 23 | | | closed | 92 | 2756 - | |
| 41.155 | 23 23 23 | 23 | | | closed | 92 | 2763 - | |
| 41.170 | 23 23 23 | 23 | | | closed | 92 | 2770 - | |
| 41.185 | 23 23 23 | 23 | | | closed | 92 | 2777 - | |
| 41.200 | 23 23 23 | 23 | | | closed | 92 | 2784 - | |
| 41.215 | 23 23 23 | 23 | | | closed | 92 | 2791 - | |
| 41.230 | 23 23 23 | 23 | | | closed | 92 | 2798 - | |
| 41.245 | 23 23 23 | 23 | | | closed | 92 | 2805 - | |
| 41.260 | 23 23 23 | 23 | | | closed | 92 | 2812 - | |
| 41.275 | 23 23 23 | 23 | | | closed | 92 | 2819 - | |
| 41.290 | 23 23 23 | 23 | | | closed | 92 | 2826 - | |
| 41.305 | 23 23 23 | 23 | | | closed | 92 | 2833 - | |
| 41.320 | 23 23 23 | 23 | | | closed | 92 | 2840 - | |
| 41.335 | 23 23 23 | 23 | | | closed | 92 | 2847 - | |
| 41.350 | 23 23 23 | 23 | | | closed | 92 | 2854 - | |
| 41.365 | 23 23 23 | 23 | | | closed | 92 | 2861 - | |
| 41.380 | 23 23 23 | 23 | | | closed | 92 | 2868 - | |
| 41.395 | 23 23 23 | 23 | | | closed | 92 | 2875 | - |

## 1350mm Regulator

| EL | Opening (%) | | | | | | | | Opening (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 10 | 15 | 20 | 25 | 50 | 75 | 100 | 5 | 10 | 15 | 20 | 25 | 50 | 75 | 100 |
| m AHD | m3/s | | | | | | | | ML/d | | | | | | | |
| 20.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.7 | 1.0 | 1.2 | 5 | 9 | 14 | 18 | 23 | 59 | 87 | 102 |
| 22.0 | 0.1 | 0.3 | 0.4 | 0.5 | 0.6 | 1.6 | 2.4 | 2.8 | 11 | 22 | 33 | 44 | 55 | 139 | 208 | 243 |
| 23.0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 2.5 | 3.7 | 4.4 | 17 | 34 | 52 | 69 | 86 | 217 | 323 | 379 |
| 24.0 | 0.3 | 0.5 | 0.8 | 1.1 | 1.3 | 3.4 | 5.0 | 5.9 | 23 | 47 | 70 | 93 | 117 | 291 | 432 | 508 |
| 25.0 | 0.3 | 0.7 | 1.0 | 1.4 | 1.7 | 4.2 | 6.2 | 7.3 | 29 | 59 | 88 | 117 | 146 | 362 | 536 | 632 |
| 26.0 | 0.4 | 0.8 | 1.2 | 1.6 | 2.0 | 5.0 | 7.4 | 8.7 | 35 | 70 | 105 | 140 | 176 | 429 | 635 | 751 |
| 27.0 | 0.5 | 0.9 | 1.4 | 1.9 | 2.4 | 5.7 | 8.4 | 10.0 | 41 | 82 | 122 | 163 | 204 | 493 | 729 | 863 |
| 28.0 | 0.5 | 1.1 | 1.6 | 2.1 | 2.7 | 6.4 | 9.5 | 11.2 | 46 | 93 | 139 | 185 | 232 | 554 | 817 | 970 |
| 29.0 | 0.6 | 1.2 | 1.8 | 2.4 | 3.0 | 7.1 | 10.4 | 12.4 | 52 | 104 | 155 | 207 | 259 | 611 | 899 | 1071 |
| 30.0 | 0.7 | 1.3 | 2.0 | 2.6 | 3.3 | 7.7 | 11.3 | 13.5 | 57 | 114 | 171 | 228 | 285 | 665 | 976 | 1166 |
| 31.0 | 0.7 | 1.4 | 2.2 | 2.9 | 3.6 | 8.3 | 12.1 | 14.5 | 62 | 124 | 186 | 249 | 311 | 716 | 1048 | 1256 |
| 32.0 | 0.8 | 1.6 | 2.3 | 3.1 | 3.9 | 8.8 | 12.9 | 15.5 | 67 | 134 | 201 | 269 | 336 | 763 | 1115 | 1340 |
| 33.0 | 0.8 | 1.7 | 2.5 | 3.3 | 4.2 | 9.3 | 13.6 | 16.4 | 72 | 144 | 216 | 288 | 360 | 807 | 1176 | 1418 |
| 34.0 | 0.9 | 1.8 | 2.7 | 3.6 | 4.4 | 9.8 | 14.2 | 17.3 | 77 | 153 | 230 | 307 | 383 | 847 | 1231 | 1491 |
| 35.0 | 0.9 | 1.9 | 2.8 | 3.8 | 4.7 | 10.2 | 14.8 | 18.0 | 81 | 162 | 244 | 325 | 406 | 884 | 1281 | 1558 |
| 36.0 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 10.6 | 15.3 | 18.7 | 86 | 171 | 257 | 343 | 428 | 918 | 1326 | 1619 |
| 37.0 | 1.0 | 2.1 | 3.1 | 4.2 | 5.2 | 11.0 | 15.8 | 19.4 | 90 | 180 | 270 | 360 | 450 | 949 | 1366 | 1674 |
| 38.0 | 1.1 | 2.2 | 3.3 | 4.4 | 5.4 | 11.3 | 16.2 | 19.9 | 94 | 188 | 282 | 376 | 470 | 976 | 1400 | 1724 |
| 39.0 | 1.1 | 2.3 | 3.4 | 4.5 | 5.7 | 11.6 | 16.5 | 20.5 | 98 | 196 | 294 | 392 | 490 | 999 | 1428 | 1768 |
| 40.0 | 1.2 | 2.4 | 3.5 | 4.7 | 5.9 | 11.8 | 16.8 | 20.9 | 102 | 204 | 306 | 408 | 510 | 1020 | 1452 | 1806 |
| 41.0 | 1.2 | 2.4 | 3.7 | 4.9 | 6.1 | 12.0 | 17.0 | 21.3 | 106 | 211 | 317 | 423 | 528 | 1036 | 1469 | 1838 |

**Comment [r20]:** Is there a minimum opening that should be used?




# APPENDIX D

# NORTH PINE DAM AUXILIARY EQUIPMENT

[redacted]

# APPENDIX E

## HYDROLOGIC INVESTIGATIONS

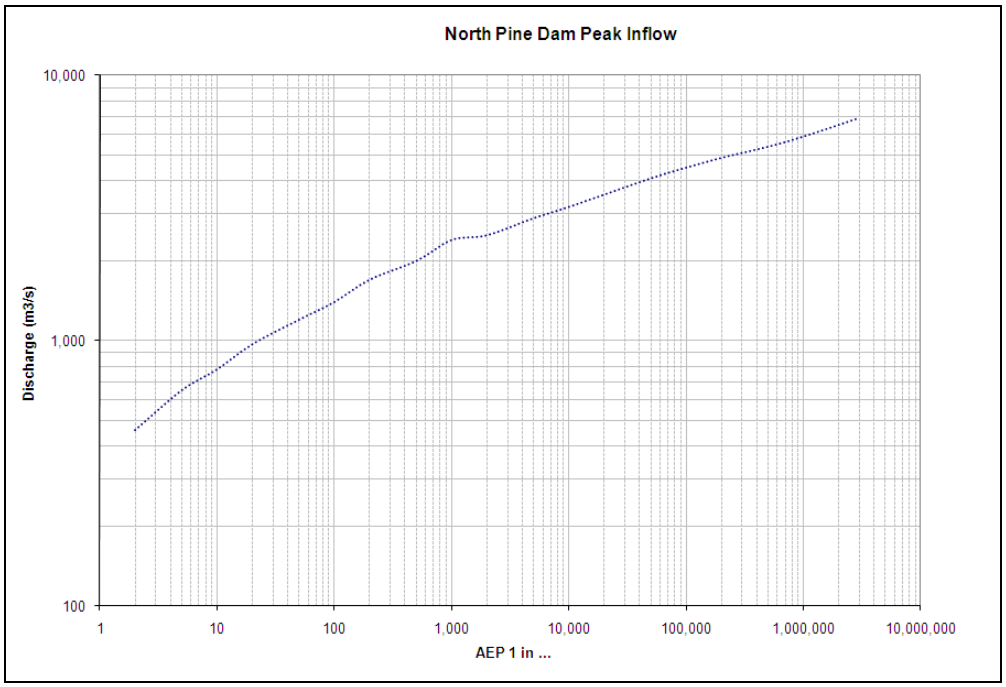
The design flood hydrology for North Pine Dam was updated by SunWater in October 2007 (North Pine Dam Design Flood Hydrology, Oct 2007).

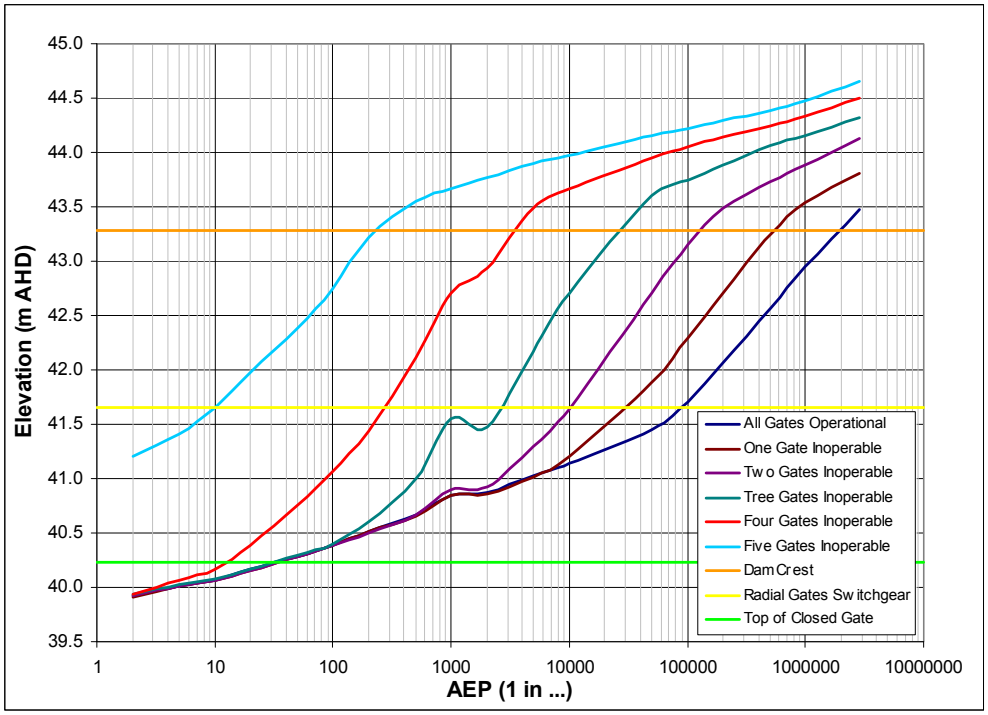
Flood frequency analysis of the flood records at GS120101a Youngs Crossing (pre dam) suggested that the 1974 flood was about a 1 in 100 AEP event.

An URBS runoff-routing model of the North Pine was developed and calibrated to three pre-dam floods and four post dam events. While there was a reasonable amount of rainfall data available, calibration of the model was hampered by the lack of key water level data; gauge heights at Youngs Crossing in 1974 (due to gauge failure) and North Pine Dam headwater levels in post dam events.

Design rainfalls were determined using the methodologies outlined in the Generalised Short Duration Method and Generalised Tropical Storm Method Revised. The appropriate temporal patterns suggested by these methodologies were adopted.

The flows derived using the design event approach closely matched pre-dam flood frequency estimates, giving a degree of confidence in the adopted methodology.





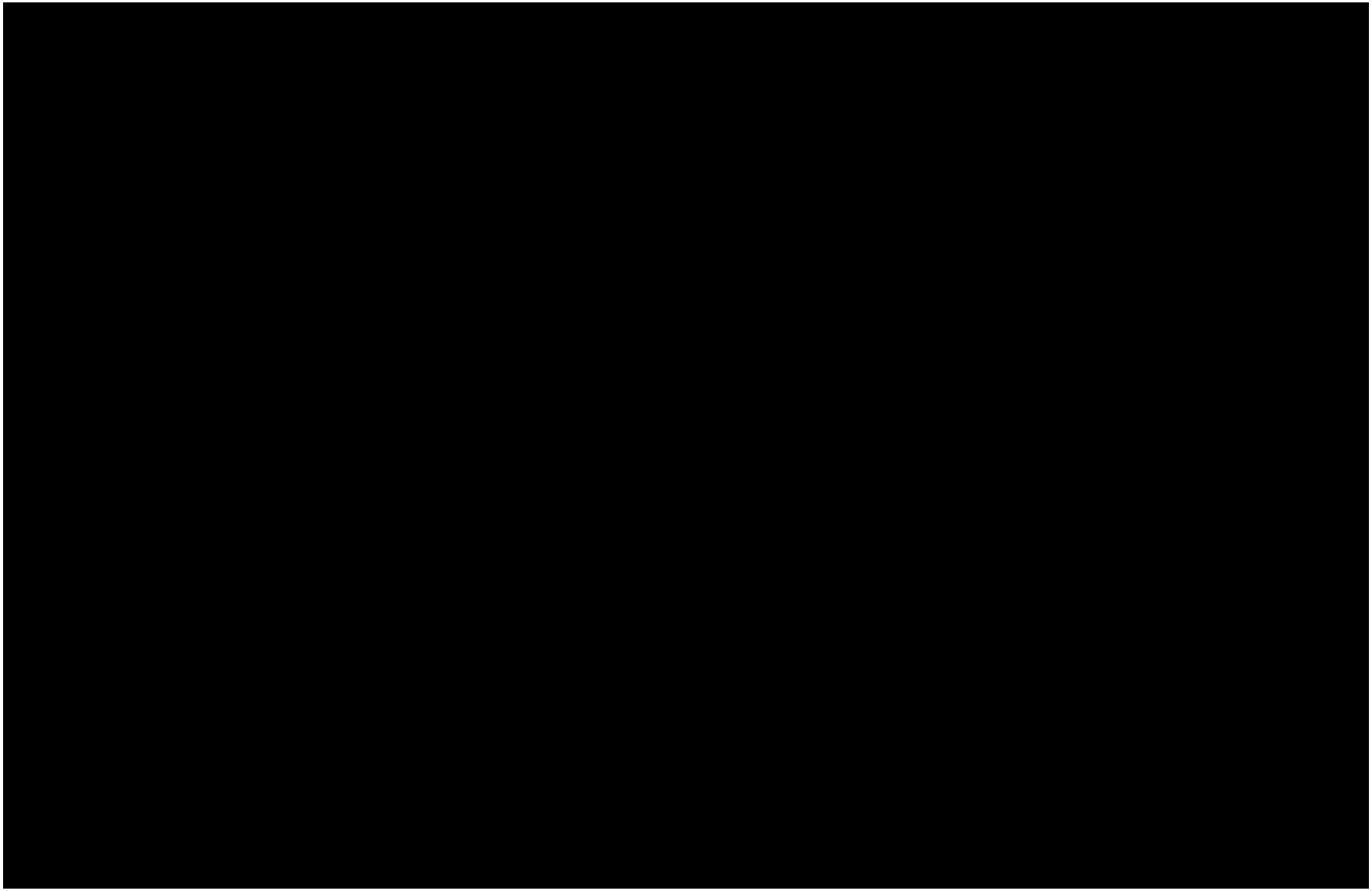

Based on the findings of this hydrologic study for North Pine Dam, it is concluded that;

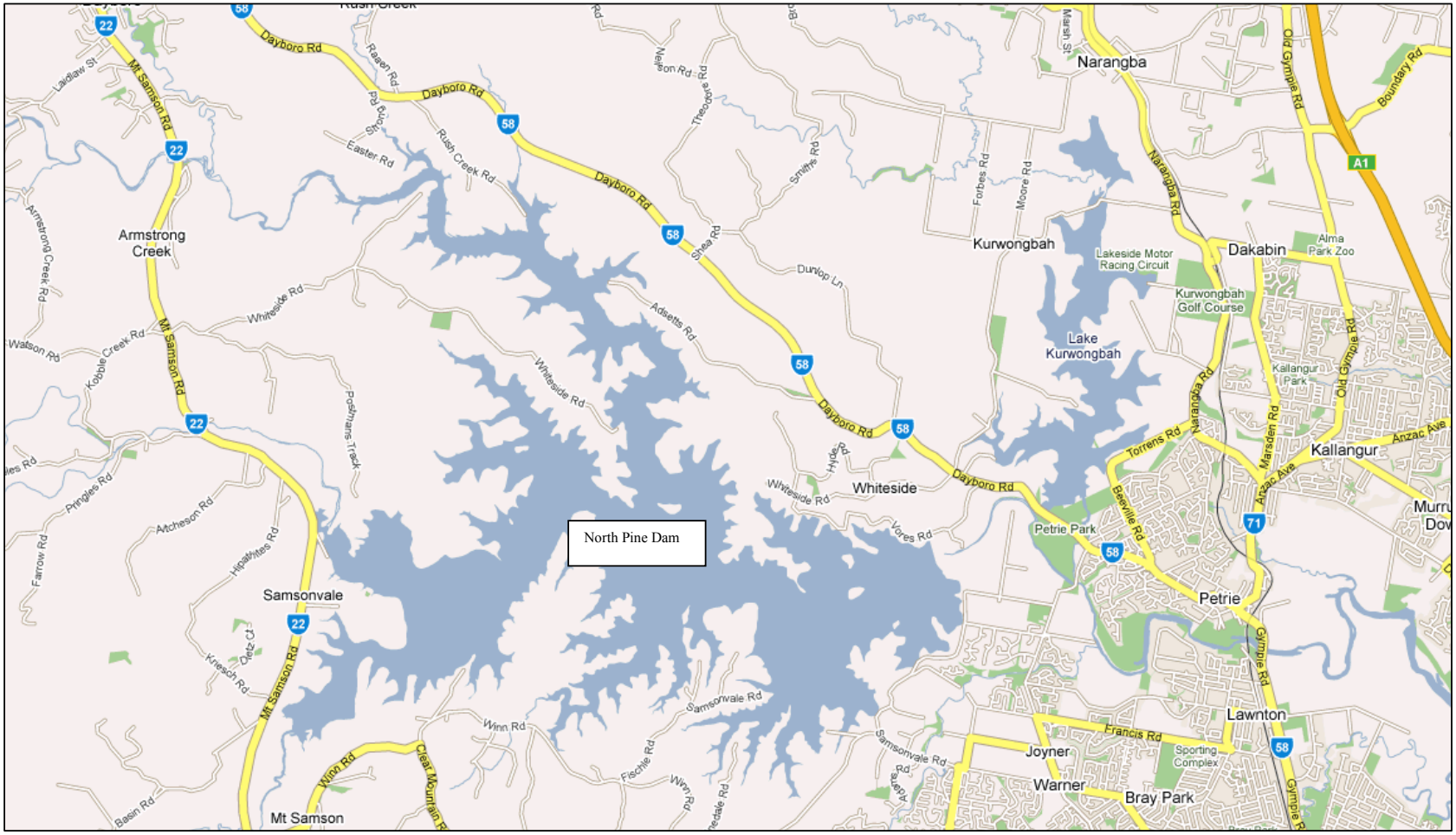
- The notional AEP of the PMP for North Pine Dam is 1 in 2,900,000.
- The critical storm duration for the inflow is generally the 12 hour storm except for the very frequent and very rare events which tend to be longer.
- The 24 hour PMPDF produces the highest peak inflow of 6,900 $m^3/s$.
- Under normal conditions with all gates operating, the critical duration of the outflow remains generally as 12 hours for events between 1 in 20 and 1 in 200 AEP and for the 1 in 2000 AEP event. For other AEPs, the critical duration increases up to 36 hours.
- The Acceptable Flood Capacity with one gate inoperable is approximately 3,960 $m^3/s$ or 61% of the PMPDF for the 24 hour critical duration storm.
- With all gates operating normally,
    - The 36 hour PMPDF produces the highest peak outflow of 5,400 $m^3/s$.
    - The AEP of the DCF is about 1 in 2,000,000.
    - In the PMPDF, the dam crest is overtopped for a period of about 12 hours, reached a maximum height of 0.19 metres above the crest.
    - The PMF outflow may be as high as 6,500 $m^3/s$ for a critical duration storm of 36 hours.
- With one gate inoperable,
    - The 36 hour PMPDF produces the highest peak outflow of 5,800 $m^3/s$.
    - The AEP of the DCF is about 1 in 550,000.

- With one gate inoperable, In the PMPDF, the dam crest is overtopped for a period of about 23 hours, reached a maximum height of 0.53 metres above the crest.

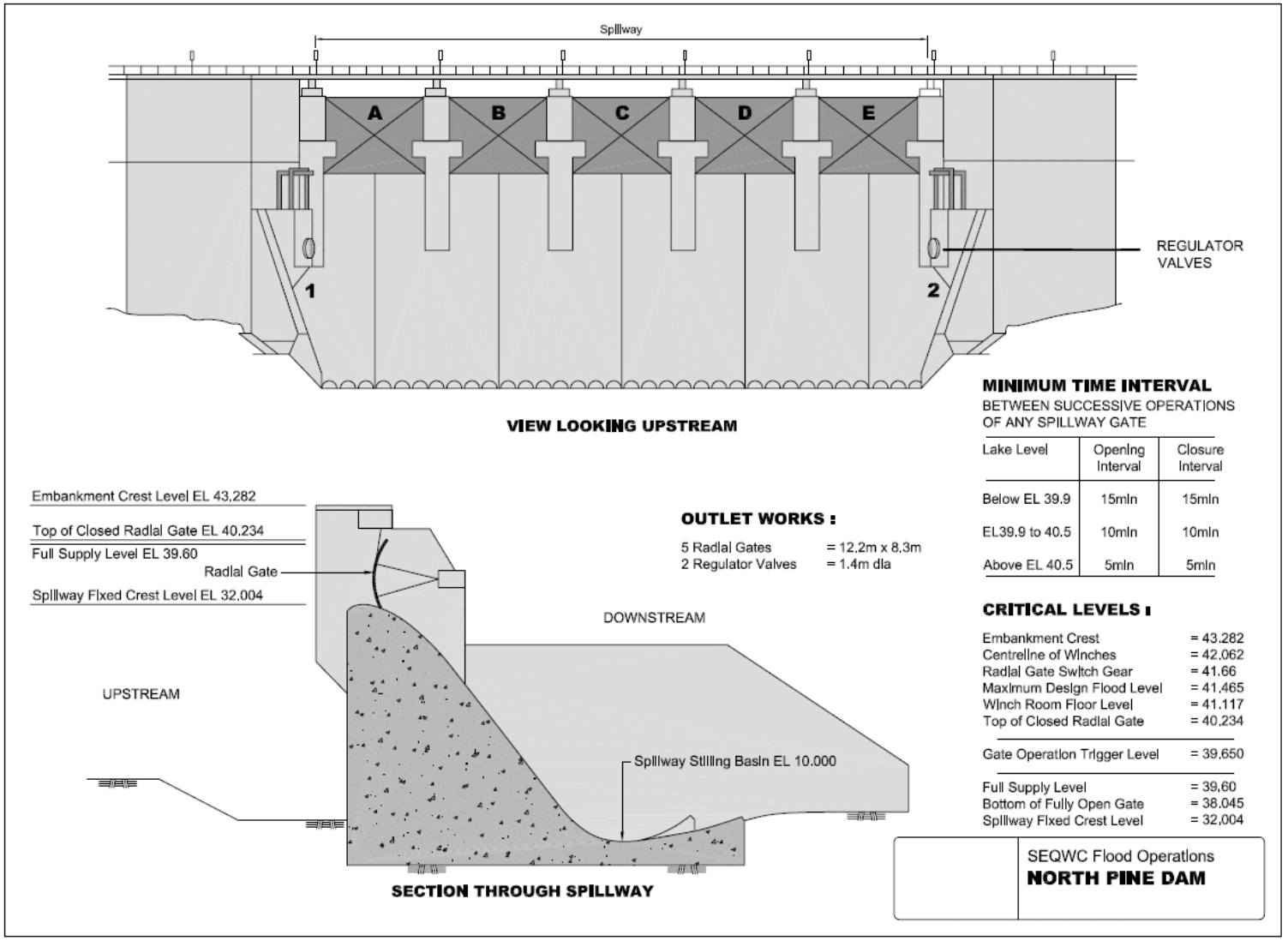
- **APPENDIX F**

# NORTH PINE DAM
# PLANS, MAPS AND PHOTOGRAPHS




North Pine Dam
Armstrong Creek
Samsonvale
Mt Samson
Whiteside
Kurwongbah
Lake Kurwongbah
Narangba
Dakabin
Kallangur
Petrie
Petrie Park
Lawnton
Joyner
Warner
Bray Park
Dayboro Rd
Mt Samson Rd
Whiteside Rd
Samsonvale Rd
Winn Rd
Rush Creek Rd
Adsetts Rd
Torrens Rd
Anzac Ave
Gympie Rd
Old Gympie Rd
Narangba Rd
Beeville Rd
Francis Rd
Lakeside Motor Racing Circuit
Kurwongbah Golf Course
Alma Park Zoo
Kallangur Park
Sporting Complex


Grant St
Lake Kurwongbah
North Pine Dam
Youngs Crossing
Petrie


Spillway
A
B
C
D
E
1
2
REGULATOR VALVES
VIEW LOOKING UPSTREAM
Embankment Crest Level EL 43.282
Top of Closed Radial Gate EL 40.234
Full Supply Level EL 39.60
Radial Gate
Spillway Fixed Crest Level EL 32.004
UPSTREAM
DOWNSTREAM
Spillway Stilling Basin EL 10.000
SECTION THROUGH SPILLWAY
OUTLET WORKS :
5 Radial Gates = 12.2m x 8.3m
2 Regulator Valves = 1.4m dia
MINIMUM TIME INTERVAL
BETWEEN SUCCESSIVE OPERATIONS OF ANY SPILLWAY GATE
Lake Level | Opening Interval | Closure Interval
Below EL 39.9 | 15min | 15min
EL39.9 to 40.5 | 10min | 10min
Above EL 40.5 | 5min | 5min
CRITICAL LEVELS :
Embankment Crest = 43.282
Centreline of Winches = 42.062
Radial Gate Switch Gear = 41.66
Maximum Design Flood Level = 41.465
Winch Room Floor Level = 41.117
Top of Closed Radial Gate = 40.234
Gate Operation Trigger Level = 39.650
Full Supply Level = 39.60
Bottom of Fully Open Gate = 38.045
Spillway Fixed Crest Level = 32.004
SEQWC Flood Operations
NORTH PINE DAM