South East Queensland
WATER CORPORATION
LIMITED

MANUAL

OF

OPERATIONAL PROCEDURES

FOR FLOOD RELEASES

FROM

NORTH PINE DAM

Revision No.	Date of Approval	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

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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.

Recognising this, the South East Queensland Water Board Act required that the South East Queensland Water Corporation's Technical Advisory Committee cause to be prepared a manual of operational procedures for the dam during floods. With changes to the controlling legislation, the manual became an approved flood mitigation manual under *Water Act 2000* (extract in Appendix A).

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This manual is the result of a review of the 1997 revision of the Manual. The Corporation is required to review, update the Manual if necessary, and submit it to the Chief Executive for approval prior to its expiry. Any amendments to the basic operating procedures need to be treated similarly.

An expanded flood monitoring and warning radio telemetry network (ALERT) has been installed in the Pine River catchment. Additionally a computerised flood operational model, which allows for rainfall and river modelling in real time based on data from the ALERT network has been developed, implemented and fully commissioned. The small flood storage capacity of the dam and the relatively short response time between flood producing rains and the occurrence of flooding means that prescribed operating procedures must be followed. However the ALERT and flood modelling system allows earlier warning of an imminent flood event.

The operational effectiveness of the system has led to some flexibility in the operating procedures being identified. Some minor changes to the procedures have been incorporated in this current review as a consequence.

The review has not included a formal risk management assessment process. It is intended this shall form part of a broader assessment regarding dam and flood management and then be incorporated in this manual.

Flood studies undertaken since the last review in 1997 supported the basic procedures for operation of the dam and these have not been varied. Neither have the primary objectives of ensuring safety of the dam, its ability to deal with extreme and closely spaced floods, and protection of urban areas from those defined in the original manual.

Changes from the previous revision have mostly arisen from the refinement of gate opening and closing sequences based upon experience obtained during flood events whilst using the real time flood operations model. Other changes have been necessary to fit in with the new regulatory regime provided by the commencement of *Water Act 2000*.

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1.2 Meaning of Terms

In this Manual, save where a contrary definition appears -

"Act"
means the *Water Act 2000*;

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;

"Bureau of Meteorology"
means the Commonwealth Bureau of Meteorology;

"Chairperson"
means the Chairperson of the South East Queensland Water Corporation;

"Chief Executive"
means the Chief Execu tive or Director Ge neral of the Departm ent of N atural Resources and Mines;

"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;

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

"Flood Operations Engineer"
means the person designated at the time to direct the operations of the dam under the general direction of the Senior Flood Operat ions Engineer and in accordan ce with the procedures in this manual

Deleted: "AFC"[1] or¶
"Acceptable Flood Capacity (AFC)¶
means for a specific dam the overall flood capacity, including freeboard as relevant, which provides an appropriate level of safety against a flood initiated dam failure to protect the community and environment to acceptable risk levels, within the total context of overall dam safety from all causes.¶
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"South East Queensland Water Corporation"¶
means the body corporate constituted by that name pursuant to Part III of the South East Queensland Water Board Act 1979. The Board became a government owned corporation in 2000;¶

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"DCF"[1] or¶
"Dam Crest Flood"¶
means the flood event which, when routed through the reservoir, results in a still water level in the reservoir, excluding wave effects which for an embankment is the lowset point of the embankment crest.¶
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"FSL"[1] 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
when referred to in (m^3/sec) means flow rate in cubic metres per second;

"Headworks Operator"
for the purposes of this manual the Headworks Operator is the South-East Queensland Water Corporation

"Manual" or "Manual of Operational Procedures for Flood Releases from North Pine Dam"
means the current version of this Manual;

"Senior Flood Operations Engineer"
means the person designated at the time pursuant to Section 2.1.1 of this Manual under whose direction the procedures in this Manual shall be carried out;

"South East Queensland Water Corporation"
means the body corporate constituted by that name pursuant to Part III of the South East Queensland Water Board Act 1979. The Board became a government owned corporation in 2000;

Deleted: means the agency with which the

Deleted: has entered into a contract or arrangement with respect to the operation and maintenance of the dams, for the purpose of flood mitigation;

Deleted: "IFF"[1] or¶
"Imminent Failure Flood"¶
means the flood which if exceeded would cause failure of a dam. As defined in the 1986 ANCOLD Guidelines on Design Floods for Dams;¶
¶

Deleted: "RDF"[1] or¶
"Recommended Design Flood"¶
means the flood which a dam should be designed for in accordance with accepted practices. As defined in the 1986 ANCOLD Guidelines on Design Floods for Dams;¶
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[1] For reference, these terms are described in "Guideliines on Selection of Acceptable Flood Capacity for Dams" March 2000 by the Australian National Committee on Large Dams (ANCOLD)

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1.3 Purpose of Manual

The purpose of this Manual is to define standard procedures for the operation of North Pine Dam during flood periods.

1.4 Legal Authority

This manual has been prepared in accordance with the provisions of Chapter 3 Part 6 Division 2 of the Act.

1.5 Application and Effect

The procedures in this Manual shall apply to the operation of North Pine Dam for the purpose of flood releases, and operation in accordance with the manual shall give the protection from liability provided by Section 500 of *Water Act 2000*.

1.6 Date of Effect

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

1.7 Observance of Manual

This Manual contains the operational procedures for North Pine Dam for the purposes of flood releases, and must be applied by the Headworks Operator for the operation of the dam.

1.8 Provision for Variations to Manual

If the Corporation is of the opinion that the procedures in this Manual should be amended, altered or varied, it must submit for approval as soon as practical a request, which is in accordance with the flood mitigation provisions of the *Water Act 2000*, to the Chief Executive setting out the circumstances and the exact nature of the amendment, alteration or variation sought. The Chief Executive may require the Corporation amend the Manual by written notice.

1.9 Distribution of Manual

The Corporation must regard the manual as a Controlled Document and ensure that only controlled manuals are used in the direction of flood release activities. Agencies having copies of Controlled Documents are listed in Appendix B. The Corporation must maintain a Register of Contact Persons for Controlled Documents and ensure that each issued document is updated whenever amendments are approved.

Before using this Manual for the direction of flood releases, the Headworks Operator must ensure that it is the current version of the Controlled Document.

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1.10 Authority to Use Discretion

Where it is reasonable to expect that the safety of the dam will not be reduced, temporary deviations from the procedures detailed in this manual may be made in accordance with Section 2.8.

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2 DIRECTION OF OPERATIONS

2.1 Statutory Operation

The Corporation is responsible for and has the duty for operation and maintenance of North Pine Dam, and while it may enter into contracts for the purpose of discharging these responsibilities, for the purposes of this manual the Headworks Operator is the Corporation.

2.1.1 Designation of Senior Flood Operations Engineer

The Headworks Operator must ensure that the procedures set out in this Manual are carried out under the general direction of a suitably qualified and experienced person who shall be referred to hereafter as the Senior Flood Operations Engineer. Only a person authorised in the Schedule of Authorities can give the general direction for carrying out procedures set out in this manual.

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¶

2.1.2 Designation of Flood Operations Engineers

The Headworks Operator must have available or on standby at all times a suitably qualified and experienced Flood Operations Engineer to direct the operation of the dam during floods in accordance with the general strategy determined by the Senior Flood Operations Engineer.

The Headworks Operator must ensure that flood control of the dam is under the direction of a Flood Operations Engineer at all times. Only a person authorised in the Schedule of Authorities can direct the flood operation of the dam.

The Headworks Operator must also employ an adequate number of suitably qualified and experienced persons to assist the Flood Operations Engineer in the operation of the dam during floods.

2.2 Qualifications and Experience of Engineers

2.2.1 Qualifications

All engineers referred to in Section 2.1 must meet all applicable requirements of registration or certification under any relevant State Act, and must hold appropriate engineering qualifications to the satisfaction of the Chief Executive.

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2.2.2 Experience

All engineers referred to in Section 2.1 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:

(a) Investigation, design or construction of major dams;

(b) Operation and maintenance of major dams;

(c) Hydrology with particular reference to flooding, estimation of extreme storms, water management or meteorology;

(d) Applied hydrology with particular reference to flood forecasting and flood warning systems.

2.3 Schedule of Authorities

For the purpose of directing operation of the dam during floods, a list of suitably qualified and experienced Senior Flood Operations Engineers and Flood Operations Engineers must be maintained in a Schedule of Authorities (Appendix C).

The Headworks Operator must, as the need arises, nominate suitably qualified and experienced engineers for registration in the Schedule of Authorities as Senior Flood Operations Engineers and Flood Operations Engineers. Each new nomination must include a copy of any certificate required under Section 2.2 and a validated statement of qualifications and experience.

The Headworks Operator 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, the Headworks Operator must temporarily appoint suitable persons and immediately seek ratification from the Chief Executive.

2.4 Training

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

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2.5 Dam Operation Arrangements

For the purposes of operation of the dam during times of flood, the Headworks Operator must ensure that:

(a) the operation be carried out under the general direction of the Senior Flood Operations Engineer; and

(b) in the direction of operations which may knowingly endanger life or property, the Senior Flood Operations Engineer must where practical liaise with the Chairperson of the Corporation and the Chief Executive or nominated delegate.

2.6 Responsibilities of the Senior Flood Operations Engineer

The Senior Flood Operations Engineer is responsible for the overall direction of flood operations.

Except insofar as reasonable discretion is provided for in Section 2.8 of this Manual, the Senior Flood Operations Engineer must ensure that the operational procedures for the dam shall be in accordance with this Manual.

2.7 Responsibilities of the Flood Operations Engineer

The Flood Operations Engineer must apply the operational procedures in accordance with this manual and the direction set for flood operations. In so doing, account must be taken of prevailing weather conditions, the probability of follow up storms and the ability of the dam to discharge excess flood waters in the period between rainfall events or in the period from the time of detection of conditions associated with the development of storm cells to the likely time of occurrence of the rainfall.

2.8 Reasonable Discretion

If in the opinion of the Senior Flood Operations Engineer, based on available information and professional experience, it is necessary to depart from the procedures set out in this manual, the Senior Flood Operations Engineer is authorised to adopt such other procedures as considered necessary to meet the situation, provided that the Senior Flood Operations Engineer observes the flood release objectives set out in Section 3 of this Manual when exercising such reasonable discretion.

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Before exercising discretion under this Section of the Manual with respect to flood release operations, the Senior Flood Operations Engineer must consult with such of the following persons as are available at the time that the discretion has to be exercised:

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the Chairperson of the Corporation, and

the Chief Executive or nominated delegate.

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If not able to contact any of the above within a reasonable time, the Senior Flood Operations Engineer may proceed with such other procedures considered as necessary to meet the situation and report such action at the earliest opportunity to the above persons.

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2.9 Report

The Senior Flood Operations Engineer must prepare a report to the Headworks Operator after each event that requires flood operation of the dam and the report must contain details of the procedures used, the reasons therefore and other pertinent information. The Headworks Operator shall forward a copy of the report to the Chief Executive within six weeks of the event referred to.

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3 FLOOD RELEASE 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:

(a) Ensure the structural safety of the dam;

(b) Minimise disruption to urban and rural life in the valleys of the North Pine River and its major tributaries; and

(c) Retain storage at the full supply level.

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. Failure of such sections is rare but when they do occur, they occur suddenly without warning, creating very severe and destructive flood waves. 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.

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 just above full supply level and can become inundated. Once inundated, the electric winches will not work and backup systems which themselves may not be able to respond quickly enough to handle large flows will be needed to adjust gate positions.

The critical levels for the operation of the dam and the consequence of their exceedance are as follows:

Description	AHD (m)	Possible Consequence
Embankment Crest	43.28	Breach of embankment by erosion
Radial Gate Switch Gear	41.66	Electric motors submerged, backup opening system required
Above Full Supply Level at Start of Storm	39.60	Reduced capacity to handle large floods

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3.3 Extreme Floods and Closely Spaced Large Floods

The spillway of North Pine Dam has adequate capacity with gates operating correctly to handle current maximum estimates of runoff from precipitation. Techniques for estimating extreme floods have in the past had a tendency to increase flood magnitudes as more has become known about possible flooding. There is still a very remote possibility that floods are possible which would overtop the dam. Such events however require intense rainfall to produce the necessary runoff. Pre-release of storage at flood producing levels could reduce the risk of overtopping but this may result in discharges exceeding inflows. Such a measure should be taken only after careful consideration of the reliability of precipitation forecasts and of perceived antecedent conditions.

Anticipated reservoir levels for various magnitude inflows under normal gate operations and with one gate inoperable in the closed position are as follows:

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NORTH PINE DAM
ESTIMATED PEAK LAKE LEVELS

Average Recurrence Interval of Inflows (Years)	Normal Gate Operations (m AHD)	One Gate Inoperable (m AHD)
2	39.88	39.86
5	40.02	39.97
10	40.10	40.04
20	40.19	40.12
50	40.32	40.23
100	40.42	40.34
200	40.44	40.53
500	40.59	40.68
1 000	40.73	40.77
10 000	41.06	41.32
100 000	41.47	42.23
PMF	42.38	43.22

Source: Pine River System Hydraulic Model - Interim Report on North Pine Dam Dambreak Analysis, April 1993
Crest of embankment is EL 43.28.

Historical records show that there is a significant probability of two or more flood producing storms occurring in the Brisbane area within a short time of each other.

In order to be prepared to meet such a situation the stored flood waters from one storm should be discharged from the dam after a flood as quickly as would be consistent with the other major operating principles.

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3.4 Maintenance of Full Supply Level

North Pine Dam provides water for the cities of Brisbane and Redcliffe and for the Shires of Caboolture and Pine Rivers. For this reason the storage level after a flood release must be near full supply level. Failure to achieve this objective may place the water supply to these areas at unnecessary risk.

3.5 Disruption to Downstream Areas

Under normal flood situations, community disruption will be limited to inundation of bridges and low-lying paddocks.

In the case of major floods, several houses immediately downstream of the dam may be subject to partial inundation.

In the case of dam break, floods can be generated which are well in excess of natural floods. Dam break floods or the detection of situations that may result in dam break shall be grounds for the emergency evacuation of threatened areas by the appropriate counter disaster agencies.

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4 FLOOD CLASSIFICATION

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

Minor Flooding
This causes inconvenience such as closing minor roads and the submergence of low-level bridges. Some urban properties are affected.

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Moderate Flooding
This causes inundation of low-lying areas and may require the evacuation of some houses and/or business premises. Traffic bridges may be closed.

Major Flooding
This causes flooding of appreciable urban Areas. Properties may become isolated. Major disruption occurs to traffic. Evacuation of many houses and business premises may be required.

Extreme Flooding
This causes flooding well in excess of floods in living memory and general evacuation of whole areas are likely to be required.

Usually a flood does not cause the same category of flooding along its entire length and the relevant agencies must 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)

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5 FLOOD MONITORING AND WARNING SYSTEM

5.1 General

A real time flood monitoring and warning system is established in the Pine River catchment. This system is an event reporting radio telemetry system, (ALERT), used to collect, transmit and receive rainfall and streamflow information. The system consists of field stations which automatically record rainfall and/or river heights at selected locations in the catchments.

The rainfall and river height data is transmitted by radio telemetry, via repeater stations, to base stations at the head office of the Headworks Operator (and the Corporation). There the data is processed in real time by computer programs to assess what is occurring in the catchments in terms of flood flows and what could occur if weather conditions continued, or changed.

Other agencies with their own base stations can, and do, receive data transmissions direct, and so collect and are able to process rainfall and streamflow information appropriate to their needs.

The real time flood model (RTFM) is a suite of hydrologic and hydraulic computer programs that utilise the real time ALERT data to assist in the operation of the dams during flood events.

5.2 Operation

The Headworks Operator is responsible for operating the computer model provided by the Corporation for flood monitoring and forecasting during flood events to optimise flood gate operations and minimise the impacts of flooding.

It is the responsibility of the Corporation to maintain and keep calibrated its own equipment; and to enter into such arrangements with other agencies or to provide such further equipment as the Corporation deems necessary for the Headworks Operator to properly operate the computer model for flood monitoring and forecasting.

A system such as this is expected to improve over time due to:

- improved operation and reliability with experience,
- improved calibration as further data becomes available,
- software upgrades, and
- the number, type and locations of sensors being varied.

A regular process of internal audit and management review must be maintained to achieve this.

A log of the performance of all field equipment necessary to properly operate the real time flood operations model must be kept by the Corporation. The log is to also include all revised field calibrations and changes to the number, type and locations of gauges. Entries onto the log are to be notified to the Headworks Operator without delay in writing.

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A log of the performance of the system (ALERT and RTFM) shall be kept by the Senior Flood Operations Engineer. Any faults to the computer hardware or software, and any faults to field equipment which the Corporation has not advised the Headworks Operator of, are to be notified to the Corporation without delay in writing. The Corporation must promptly attend to the faults.

Whenever the Senior Flood Operations Engineer considers that the performance and functionality of the system can be improved, by whatever means, a recommendation must be made to the Headworks Operator accordingly. The Headworks Operator must promptly consider, act on, or refer such recommendations to the Corporation as it considers appropriate.

5.3 Storage of Documentation

The performance of any flood monitoring and warning system is reliant on accurate historical data over a long period of time. The Senior Flood Operations Engineer must ensure that all available data and other documentation is appropriately collected and catalogued as approved by the Corporation, for future use.

5.4 Key Reference Locations

Key field 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 alter these locations or vary flood classification levels, agreement must first be obtained between the Corporation, Headworks Operator and the Local Governments within whose boundaries the locations are situated. The locations and gauge readings at which the various classifications of flooding occur are contained in Appendix D.

Gauge boards which can be read manually must be maintained as part of the ALERT stations installed at any key reference location. The Corporation must have procedures to ensure such gauge boards are read in the event of failure of a field station to operate.

5.5 Reference Gauge Values

Other agencies such as the Bureau of Meteorology, the Pine Rivers Shire 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.

The Corporation must ensure that information relative to the calibration of the Corporations field stations is shared with such agencies.

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6 COMMUNICATIONS

6.1 Communications between Staff

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

The Headworks Operator is responsible for ensuring that adequate communication exists at all times between the Flood Operations Engineer and site staff at North Pine Dam. Where equipment deficiencies are detected during normal operations, such deficiencies are to be reported within one week to the Corporation for timely corrective action.

6.2 Dissemination of Information

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. These agencies shall include agencies holding Controlled Documents (Appendix B), and the persons listed in the Schedule of Authorities (Appendix C). For this purpose, the Corporation must maintain a Register of Contact Persons for Information, their means of contact and the type of information to be supplied to each. The Corporation must ensure that each agency receives a copy of the updated Register of Contact Persons for Information whenever amendments are made, but at least every 6 months.

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The Flood Operations Engineer must supply information (refer Section 6.3) to each of these contact persons during dam releases.

All enquiries other than provided for in the Register of Contact Persons for Information, either to the Headworks Operator, the Senior Flood Operations Engineer, the Flood Operations Engineer or dam site staff must be referred to the Corporation. The Corporation must provide a mechanism to receive these enquiries from the time it is advised that releases from the dam is likely until flood release operations are completed.

Some agencies have responsibilities for formal flood predictions, the interpretation of flood information and advice to the public. The Corporation, Headworks Operator, Senior Flood Operations Engineer and Flood Operations Engineer must liaise and consult with those agencies with a view to ensuring all information relative to the flood event is consistent, and used and disseminated in accordance with agreed responsibilities.

6.3 Nature of Information

When, in the opinion of the Flood Operations Engineer, a flood situation is imminent and gate operations are likely, the Flood Operations Engineer must advise those listed in the Register of Contact Persons for Information of :

(a) the current and proposed releases from the dam, and
(b) the estimated flow rates and water heights at the key reference locations listed below:
- Grant Street at Whiteside

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- Railway Bridge on North Pine River at Wylie Park, Petrie
- Railway Bridge on South Pine River at Bald Hills

This information is to be updated at intervals as better and more accurate information becomes available.

6.4 Release of Information to the Public

The Corporation 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 severe weather warnings.

The Emergency Services Response Authorities, under the State Counter Disaster Organisation Act 1975, have responsibility for the preparation of a local counter disaster plan hence the interpretation of dam release information for inclusion in their local flood warnings prepared under the flood sub plan of the counter disaster plan.

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7 REVIEW

7.1 Introduction

This review of the Manual has addressed the mechanisms of delegation and control of the dam in periods of operation of the dam for flood releases. The dam may overtop in the eventuality that the flood-gate control systems fail to operate or partially malfunction during the passage of a major flood or combination of floods.

Procedures and systems have been developed since the last revision that should enable lower risk operation of the dam for flood release purposes. This technology is intended to provide longer warning times and the capability of examining options to optimise the safety of the dams and minimise the hazard potential and risk to the community.

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 in themselves cause the Manual's procedures, and the assumptions and conditions upon which they are based, to be checked and reviewed regularly.

The checking and reviewing process must involve the Headworks Operator and all associated operations personnel in order 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 Personnel Training

The Headworks Operator must prepare a report by 30th September each year on the training and state of preparedness of operations personnel. A copy of this report must be forwarded to the Chief Executive of the Department of Natural Resources and Mines.

7.3 Monitoring and Warning System and Communication Networks

The Headworks Operator must prepare a report by the 1st May and 1st November of each year; and after each flood event. The report must assess in terms of hardware, software and personnel, the :

- 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, and
- the overall state of preparedness of the system.

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The Corporation must review the report, and taking into account its own log of the performance of the field equipment, take any action considered necessary for the proper functioning and improvement of the system. A copy of this report must be forwarded to the Chief Executive of the Department of Natural Resources and Mines.

7.4 Operational Review

After each significant flood event, the Corporation must review the effectiveness of the operational procedures contained in this manual. The Headworks Operator is required to prepare a report for submission to the Corporation within six weeks of any flood event that requires mobilisation of the Flood Control Centre.

Deleted: The Headworks Operator by the 30 September of each year, after every event that results in flood operation of the dam and at other times as appropriate, must review the adequacy of the communication and data gathering facilities and make recommendations to the Corporation regarding improving reliability and performance.¶
¶

7.5 Five Yearly Review

Prior to expiry of approval of the Manual, the Corporation must review and if necessary update the Manual and provide a copy to the chief executive for approval pursuant to Section 499 of the Act. The review is to take into account the continued suitability of the communication network, and the flood monitoring and warning system as well as hydrological and hydraulic engineering assessments of the operational procedures.

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8 FLOOD RELEASE OPERATION

8.1 Introducti on

North Pine dam is a water supply dam with only a small flood storage compartment above full supply level. It effectively has no provision for flood mitigation. The peak inflow from critical storms may occur approximately two to four hours after the commencement of heavy rain. Because of this, operation of the dam during flood periods is restricted to satisfying the flood release objectives and the rapid response of the catchment to flood rains. Once the dam is full, floods will pass through the reservoir with little mitigation.

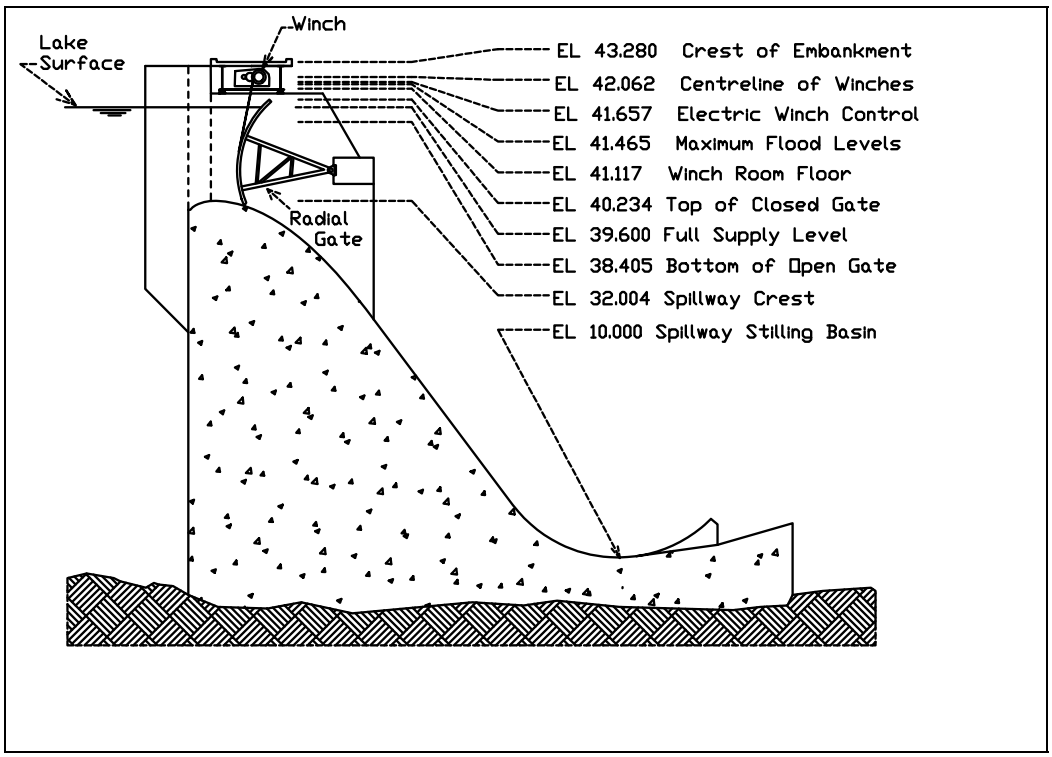

Figure 8.1 Section of North Pine Dam Spillway

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8.2 Initial Action

With the onset of heavy rain, initial runoff is to be stored until the lake level exceeds FSL by 50mm, whereafter the spillway gates must be used to control lake level in accordance with the procedures laid out herein. This action is to keep Young's Crossing open for as long as possible.

The Dam Supervisor must ensure that the gates on the road approaches to the Grant Street causeway are also closed before flood releases occur.

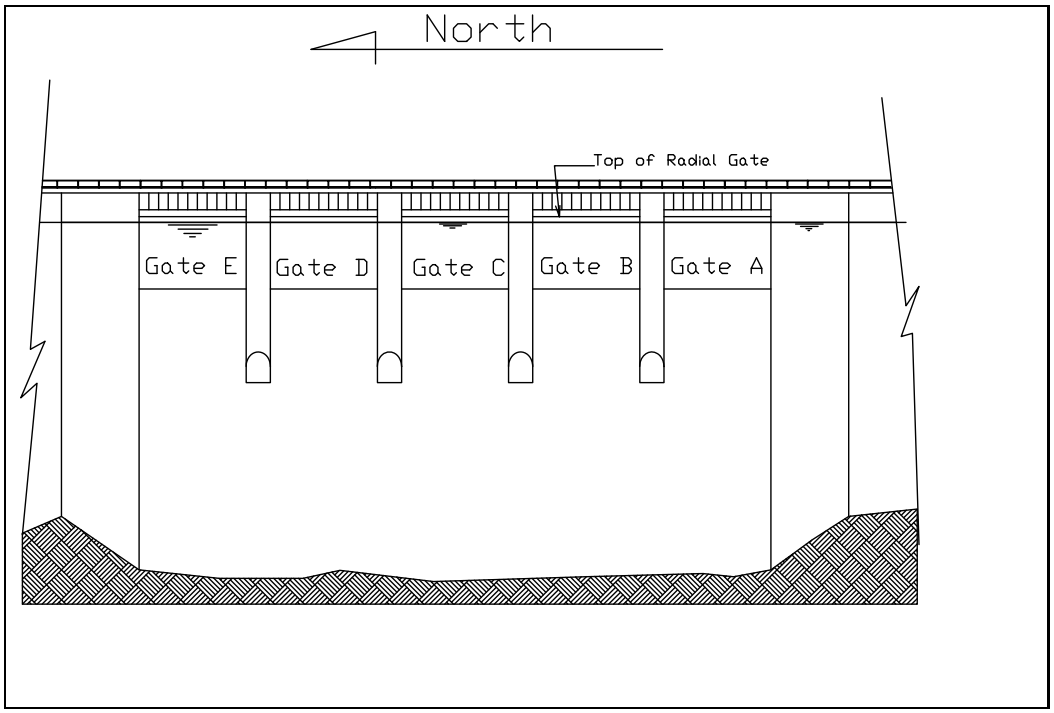

Figure 8.2 View of spillway looking downstream.

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8.3 Gate Operation

To minimise potential damage to the dissipator and the river-bed and banks downstream, the gates must be opened incrementally in accordance with the cyclic sequences shown in Figure 8.3. There is to be no more than one increment between any two operable spillway gates.

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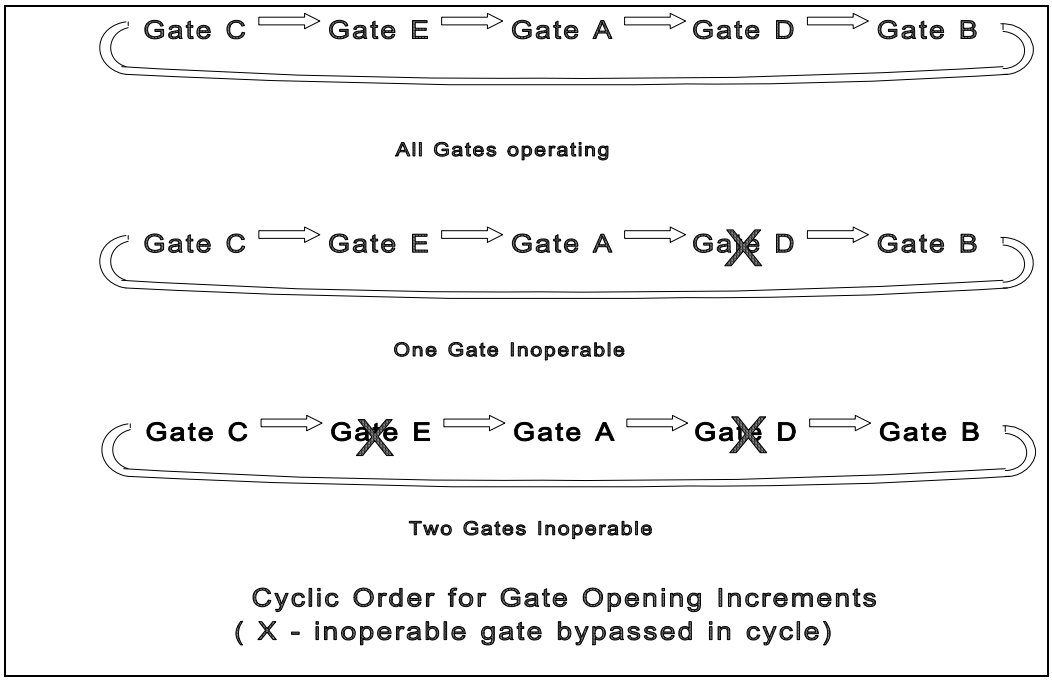

Figure 8.3 Gate Operation Sequence

The operating rule involves assigning gate positions to corresponding lake levels in the reservoir, as detailed in Appendix E.

As the lake level rises, the gates are to be opened in cyclic sequence to positions assigned for the current lake level. A gate opening increment is required for each water level rise of 15 mm, except for the initial two increments that involve water level rises of 50 mm.

As the lake level falls, the gates are to be closed in the reverse of the order shown in Figure 8.3. During small, long duration flood events, extra gate openings may be used on the falling limb of the storage levels to minimise the duration of gate operation. Such openings should not result in discharges that are higher than the peak discharge encountered on the rising limb of the flood event. Gate opening sequences should be in accordance with Figure 8.3 and minimum gate opening and closing intervals should be observed at all times during this operation.

Where one or more gates are inoperable, the same sequencing 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

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by inoperable gates. The process is illustrated in Figure 8.3 where inoperable gates have been crossed out.

Appendix E contains tables of gate position settings against lake levels for the situations where all gates are operating and where one gate is inoperable.

The minimum time interval between increments of gates in the spillway must be determined by prevailing circumstances. Short time intervals between successive increments of the gates can cause surging of the riverdownstream of the dam This is undesirable as it may damage banks or put at risk near-st ream po pulation and property. The adopt ion of long periods between increments could resu lt in excessive maximum flood l evels wit hin t he dam. Th e hi gher maximum flood levels are associated with higher probabilities of damage or failure of the dam.

It is therefore necessary to consider two situations for the operation of the gates:

(1) Gradually varying lake levels where long intervals between gate increments are sufficient to control the lake level; and

(2) Rapidly varying lake levels where high inflows are causing the lake level to rise rapidly.

In the case of gradually varying lake levels, the m inimum tim e interval between successi ve operations of any spillway gate must be determined by the lake level as shown below:

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

8.4 Oper ating Procedure

Spillway gates are to be opened to successi ve settings in t he order specified in Ap pendix E subject to the provisions of Section 8.3 above.

If, because of com pliance with the provisions of Se ction 8.3 and the high inflow rate, the minimum gate s ettings o f App endix E canno t be maintained, the time intervals bet ween successive openings are to be halved.

If the actual gate settings fall more than three settings below the cumulative number of minimum settings of Table E.1, then successive gate operations are to be carried out as rapidly as possible until the minimum settings are achieved.

As soon as the lake level begins to fall, the gates are to be closed in the order specified in Appendix E. At no time are the gate settings to be less than those specified in Appendix E. As noted in Section 8.3 for small floods of long duration, additional gate openings may be

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used to reduce the duration of gate operation. Such openings should not result in discharges that are higher than the peak discharge encountered on the rising limb of the flood event. Gate opening sequences should be in accordance with Figure 3 and minimum gate opening and closing intervals should be observed at all times during this operation.

To prevent the stranding of fish downstream of North Pine Dam after flood events final closure should be as slow as practicable and whenever practicable, closure should be on a weekend so that volunteer rescuers can be mobilised.

The last gate closing is to take place when the lake level falls to EL 39.550.

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9 EMERGENCY

9.1 Introducti on

While every care has been exercised in the designand 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 s uggests th at vig ilance is requ ired to recogni se 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;
- Other rarer mechanisms.

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Responses to th ese and o ther conditions are included in separate Emergency Act ion Plans.

9.2 Communications Failure

In the event of normal communications being lost between the Flood Operations Engineer and North Pine dam, the Dam Supervisor is to adopt the procedure set out in Section 8.3 above.

9.3 Spillway Gate/Gates Out of Service

In the event of one or more spillway gates being out of service, the remaining operable gates are to be opened in the cyclic order as shown in Figure 8.3.

The provisions of Section 8.3 are to be applied in this case also.

9.4 E quipment Failure

In the event of an electrical failure of the gate lifting machinery, the gates are to be operated using the auxiliary compressed air drive mechanism.

Further details of the auxiliary equipment are contained in Appendix F.

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APPENDIX A EXTRACT FROM ACT

EXTRACT FROM WATER ACT 2000

Division 2 – Flood Mitigation

Owners of certain dams must prepare flood mitigation manual

496.(1) A regulation may nominate an owner of a dam as an owner who must prepare a manual (a "flood mitigation manual") of operational procedures for flood mitigation for the dam.

(2) The regulation must nominate the time by which the owner must comply with section 497(1).

Approving flood mitigation manual

497.(1) The owner must give the chief executive a copy of the flood mitigation manual for the chief executive's approval.

(2) The chief executive may, by gazette notice, approve the manual.

(3) The approval may be for a period of not more than 5 years.

(4) The chief executive may get advice from an advisory council before approving the manual.

Amending flood mitigation manual

498.(1) The chief executive may require the owner, by notice, to amend the flood mitigation manual.

(2) The owner must comply with the chief executive's request under subsection (1).

(3) The chief executive must, by gazette notice, approve the manual as amended.

(4) The approval of the manual as amended must be for-

(a) the balance of the period of the approval for the manual before amendment; or

(b) a period of not more than 5 years from the day the manual as amended was approved.

(5) The chief executive may get advice from an advisory council before approving the manual as amended.

Regular reviews of flood mitigation manual

499. Before the approval for the flood mitigation manual expires, the owner must-

(a) review, and if necessary, update the manual; and

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(b) give a copy of it to the chief executive under section 497.

Protection from liability for complying with flood mitigation manual

500.(1) The chief executive or a member of the council does not incur civil liability for an act done, or omission made, honestly and without negligence under this division.

(2) An owner who observes the operational procedures in a flood mitigation manual approved by the chief executive does not incur civil liability for an act done, or omission made, honestly and without negligence in observing the procedures.

(3) If subsection (1) or (2) prevents civil liability attaching to a person, the liability attaches instead to the State.

(4) In this section-

"**owner**" includes-

(a) a director of the owner or operator of the dam; or

(b) an employee of the owner or operator of the dam; or

(c) an agent of the owner or operator of the dam.

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APPENDIX B AGENCIES HOLDING DOCUMENTS

AGENCIES HOLDING CONTROLLED DOCUMENTS
OF
MANUAL OF OPERATIONAL PROCEDURES
FOR FLOOD RELEASES
FROM
NORTH PINE DAM

Dam Owner	South East Queensland Water Corporation
Emergency Services	Department of Emergency Services, Disaster Management Service Brisbane City Counter Disaster Committee Pine Rivers Shire Counter Disaster Committee
Severe Weather Warning Authority	Bureau of Meteorology
Primary Response Authorities	Brisbane City Council Pine Rivers Shire Council
Regulator	Department of Natural Resources and Mines
Schedule of Authorities, Appendix C	Persons listed in Appendix C

The Corporation must keep a register of contact persons for controlled documents (Section 1.9 refers).

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APPENDIX C SCHEDULE OF AUTHORITIES

AUTHORITY	AGENCY/ PERSON	APPROVED BY	APPROVAL DATE	REFERENCE
Senior Flood Operations Engineer	Robert Arnold Ayre SunWater	Chief Executive	Date of approval of this Manual	
	John Lawrence Ruffini Department of Natural Resources and Mines	Chief Executive	Date of approval of this Manual	
Flood Operations Engineer	Peter Hugh Allen Department of Natural Resources and Mines	Chief Executive	Date of approval of this Manual	
	Robert Arnold Ayre SunWater	Chief Executive	Date of approval of this Manual	
	John Lawrence Ruffini Department of Natural Resources and Mines	Chief Executive	Date of approval of this Manual	
	Donald James Cock Department of Natural Resources and Mines	Chief Executive	Date of approval of this Manual	
	Toby Leonard McGrath SunWater	Chief Executive	Date of Approval of this Manual	

APPENDIX D KEY REFERENCE LOCATIONS

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PINE RIVERS SHIRE

	FLOOD CLASSIFICATION			
Gauge	**Mi nor**	**Moderate**	**Major**	**19 74 Flood**
Grant Street, Whiteside	an y release fro m dam			
Railway Bridge, Wyllie Park, Petrie	4.0	5.0	6.0	5.1
Railway Bridge, South Pine River, Bald Hills		3.5	6.0	5.18

Values are in metres AHD
Dam Supervisor to close gates on road approaches to the Grant Street causeway before releases occur (Section 8.2 refers).

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APPENDIX E TABLES OF GATE SETTINGS

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Object of Tables:

To provide the target gate settings for any particular lake level in situations when all gates are operational or when one gate is inoperable.

Method of Use:

For rising lake level:

As the lake surface reaches each level shown in the left column, one gate has to be opened to the next setting. This continues until the limit of movement of the gates (setting 23) is reached.

For falling lake level:

As the lake surface falls below each level shown in the left column, one gate has to be closed to the next setting.

Cautionary Notes:

(1) The discharges shown in the right hand columns of Tables E are estimates only and may be revised when actual measurements can be taken.

(2) The actual openings of the gates are set by electro-mechanical controls. As no direct measurement of gate position is available and these settings could drift with time, the actual openings may vary slightly from those originally determined. The discharges indicated are estimated on the basis of the design openings.

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			

Design Spillway Gate Settings

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Table E.1 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM
(All gates are operational)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
39.600	closed	closed	closed	closed	closed	0
39.650	closed	closed	1	closed	closed	19
39.700	closed	closed	1	closed	1	38
39.715	1	closed	1	closed	1	57
39.730	1	closed	1	1	1	77
39.745	1	1	1	1	1	96
39.760	1	1	2	1	1	130
39.775	1	1	2	1	2	164
39.790	2	1	2	1	2	198
39.805	2	1	2	2	2	233
39.820	2	2	2	2	2	267
39.835	2	2	3	2	2	298
39.850	2	2	3	2	3	329
39.865	3	2	3	2	3	360
39.880	3	2	3	3	3	391
39.895	3	3	3	3	3	423
39.910	3	3	4	3	3	452
39.925	3	3	4	3	4	481
39.940	4	3	4	3	4	511
39.955	4	3	4	4	4	540
39.970	4	4	4	4	4	570
39.985	4	4	5	4	4	599
40.000	4	4	5	4	5	628
40.015	5	4	5	4	5	657
40.030	5	4	5	5	5	686
40.045	5	5	5	5	5	716
40.060	5	5	6	5	5	745
40.075	5	5	6	5	6	775
40.090	6	5	6	5	6	805
40.105	6	5	6	6	6	835
40.120	6	6	6	6	6	866
40.135	6	6	7	6	6	896
40.150	6	6	7	6	7	927
40.165	7	6	7	6	7	957
40.180	7	6	7	7	7	988
40.195	7	7	7	7	7	1019
40.210	7	7	8	7	7	1048
40.225	7	7	8	7	8	1078
40.240	8	7	8	7	8	1108
40.255	8	7	8	8	8	1137
40.270	8	8	8	8	8	1167
40.285	8	8	9	8	8	1198
40.300	8	8	9	8	9	1229
40.315	9	8	9	8	9	1259
40.330	9	8	9	9	9	1290
40.345	9	9	9	9	9	1321
40.360	9	9	10	9	9	1352
40.375	9	9	10	9	10	1383
40.390	10	9	10	9	10	1413
40.405	10	9	10	10	10	1444
40.420	10	10	10	10	10	1475

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Table E.1 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(All gates are operational)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
40.435	10	10	11	10	10	1507
40.450	10	10	11	10	11	1538
40.465	11	10	11	10	11	1570
40.480	11	10	11	11	11	1602
40.495	11	11	11	11	11	1633
40.510	11	11	12	11	11	1663
40.525	11	11	12	11	12	1692
40.540	12	11	12	11	12	1721
40.555	12	11	12	12	12	1751
40.570	12	12	12	12	12	1781
40.585	12	12	13	12	12	1808
40.600	12	12	13	12	13	1836
40.615	13	12	13	12	13	1864
40.630	13	12	13	13	13	1892
40.645	13	13	13	13	13	1920
40.660	13	13	14	13	13	1947
40.675	13	13	14	13	14	1975
40.690	14	13	14	13	14	2002
40.705	14	13	14	14	14	2030
40.720	14	14	14	14	14	2057
40.735	14	14	15	14	14	2084
40.750	14	14	15	14	15	2111
40.765	15	14	15	14	15	2138
40.780	15	14	15	15	15	2165
40.795	15	15	15	15	15	2192
40.810	15	15	16	15	15	2218
40.825	15	15	16	15	16	2244
40.840	16	15	16	15	16	2270
40.855	16	15	16	16	16	2297
40.870	16	16	16	16	16	2323
40.885	16	16	17	16	16	2349
40.900	16	16	17	16	17	2375
40.915	17	16	17	16	17	2400
40.930	17	16	17	17	17	2426
40.945	17	17	17	17	17	2452
40.960	17	17	18	17	17	2477
40.975	17	17	18	17	18	2503
40.990	18	17	18	17	18	2528
41.005	18	17	18	18	18	2553
41.020	18	18	18	18	18	2579
41.035	18	18	19	18	18	2603
41.050	18	18	19	18	19	2628
41.065	19	18	19	18	19	2653
41.080	19	18	19	19	19	2677
41.095	19	19	19	19	19	2702
41.110	19	19	20	19	19	2895
41.125	19	19	20	19	20	3090
41.140	20	19	20	19	20	3288
41.155	20	19	20	20	20	3489
41.170	20	20	20	20	20	3692

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Table E.1 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(All gates are operational)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
41.185	20	20	21	20	20	3702
41.200	20	20	21	20	21	3712
41.215	21	20	21	20	21	3366
41.230	21	20	21	21	21	3553
41.245	21	21	21	21	21	3742
41.260	21	21	22	21	21	3752
41.275	21	21	22	21	22	3762
41.290	22	21	22	21	22	3772
41.305	22	21	22	22	22	3782
41.320	22	22	22	22	22	3792
41.335	22	22	23	22	22	3802
41.350	22	22	23	22	23	3812
41.365	23	22	23	22	23	3822
41.380	23	22	23	23	23	3832
41.395	23	23	23	23	23	3842

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Table E.2 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM
(GATE A STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
39.600	inoperable	closed	closed	closed	closed	0
39.650	inoperable	closed	1	closed	closed	19
39.700	inoperable	closed	1	closed	1	38
39.715	inoperable	0	1	1	1	57
39.730	inoperable	1	1	1	1	77
39.750	inoperable	1	2	1	1	111
39.765	inoperable	1	2	1	2	145
39.780	inoperable	1	2	2	2	179
39.795	inoperable	2	2	2	2	213
39.810	inoperable	2	3	2	2	244
39.825	inoperable	2	3	2	3	275
39.840	inoperable	2	3	3	3	306
39.855	inoperable	3	3	3	3	337
39.870	inoperable	3	4	3	3	366
39.885	inoperable	3	4	3	4	396
39.900	inoperable	3	4	4	4	425
39.915	inoperable	4	4	4	4	454
39.930	inoperable	4	5	4	4	483
39.945	inoperable	4	5	4	5	512
39.960	inoperable	4	5	5	5	541
39.975	inoperable	5	5	5	5	570
39.990	inoperable	5	6	5	5	599
40.005	inoperable	5	6	5	6	629
40.020	inoperable	5	6	6	6	659
40.035	inoperable	6	6	6	6	689
40.050	inoperable	6	7	6	6	719
40.065	inoperable	6	7	6	7	749
40.080	inoperable	6	7	7	7	779
40.095	inoperable	7	7	7	7	810
40.110	inoperable	7	8	7	7	839
40.125	inoperable	7	8	7	8	868
40.140	inoperable	7	8	8	8	897
40.155	inoperable	8	8	8	8	926
40.170	inoperable	8	9	8	8	956
40.185	inoperable	8	9	8	9	987
40.200	inoperable	8	9	9	9	1017
40.215	inoperable	9	9	9	9	1047
40.230	inoperable	9	10	9	9	1077
40.245	inoperable	9	10	9	10	1108
40.260	inoperable	9	10	10	10	1138
40.275	inoperable	10	10	10	10	1168
40.290	inoperable	10	11	10	10	1199
40.305	inoperable	10	11	10	11	1230
40.320	inoperable	10	11	11	11	1261
40.335	inoperable	11	11	11	11	1292
40.350	inoperable	11	12	11	11	1321
40.365	inoperable	11	12	11	12	1350
40.380	inoperable	11	12	12	12	1379
40.395	inoperable	12	12	12	12	1408
40.410	inoperable	12	13	12	12	1435

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Table E.2 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(GATE A STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
40.425	inoperable	12	13	12	13	1462
40.440	inoperable	12	13	13	13	1489
40.455	inoperable	13	13	13	13	1517
40.470	inoperable	13	14	13	13	1543
40.485	inoperable	13	14	13	14	1570
40.500	inoperable	13	14	14	14	1597
40.515	inoperable	14	14	14	14	1623
40.530	inoperable	14	15	14	14	1649
40.545	inoperable	14	15	14	15	1675
40.560	inoperable	14	15	15	15	1702
40.575	inoperable	15	15	15	15	1728
40.590	inoperable	15	16	15	15	1753
40.605	inoperable	15	16	15	16	1779
40.620	inoperable	15	16	16	16	1804
40.635	inoperable	16	16	16	16	1830
40.650	inoperable	16	17	16	16	1855
40.665	inoperable	16	17	16	17	1879
40.680	inoperable	16	17	17	17	1904
40.695	inoperable	17	17	17	17	1929
40.710	inoperable	17	18	17	17	1954
40.725	inoperable	17	18	17	18	1978
40.740	inoperable	17	18	18	18	2002
40.755	inoperable	18	18	18	18	2027
40.770	inoperable	18	19	18	18	2050
40.785	inoperable	18	19	18	19	2074
40.800	inoperable	18	19	19	19	2097
40.815	inoperable	19	19	19	19	2121
40.830	inoperable	19	20	19	19	2290
40.845	inoperable	19	20	19	20	2461
40.860	inoperable	19	20	20	20	2634
40.875	inoperable	20	20	20	20	2810
40.890	inoperable	20	21	20	20	2818
40.905	inoperable	20	21	20	21	2826
40.920	inoperable	20	21	21	21	2835
40.935	inoperable	21	21	21	21	2843
40.950	inoperable	21	22	21	21	2851
40.965	inoperable	21	22	21	22	2859
40.980	inoperable	21	22	22	22	2867
40.995	inoperable	22	22	22	22	2884
41.010	inoperable	22	23	22	22	2893
41.025	inoperable	22	23	22	23	2901
41.040	inoperable	22	23	23	23	2909
41.055	inoperable	23	23	23	23	2917
41.070	inoperable	23	23	23	23	2926
41.085	inoperable	23	23	23	23	2934
41.100	inoperable	23	23	23	23	2942
41.115	inoperable	23	23	23	23	2950
41.130	inoperable	23	23	23	23	2959
41.145	inoperable	23	23	23	23	2967
41.160	inoperable	23	23	23	23	2975
41.175	inoperable	23	23	23	23	2984

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Table E.2 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(GATE A STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
41.190	inoperable	23	23	23	23	2992
41.205	inoperable	23	23	23	23	3000
41.220	inoperable	23	23	23	23	3009
41.235	inoperable	23	23	23	23	3017
41.250	inoperable	23	23	23	23	3025
41.265	inoperable	23	23	23	23	3034
41.280	inoperable	23	23	23	23	3042
41.295	inoperable	23	23	23	23	2050
41.310	inoperable	23	23	23	23	3059
41.325	inoperable	23	23	23	23	3067
41.340	inoperable	23	23	23	23	3075
41.355	inoperable	23	23	23	23	3084
41.370	inoperable	23	23	23	23	3092
41.385	inoperable	23	23	23	23	3100
41.400	inoperable	23	23	23	23	

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Table E.3 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM
(GATE B STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
39.600	closed	inoperable	closed	closed	closed	0
39.650	closed	inoperable	1	closed	closed	19
39.700	closed	inoperable	1	closed	1	38
39.715	1	inoperable	1	closed	1	57
39.730	1	inoperable	1	1	1	77
39.750	1	inoperable	2	1	1	111
39.765	1	inoperable	2	1	2	145
39.780	2	inoperable	2	1	2	179
39.795	2	inoperable	2	2	2	213
39.810	2	inoperable	3	2	2	244
39.825	2	inoperable	3	2	3	275
39.840	3	inoperable	3	2	3	306
39.855	3	inoperable	3	3	3	337
39.870	3	inoperable	4	3	3	366
39.885	3	inoperable	4	3	4	396
39.900	4	inoperable	4	3	4	425
39.915	4	inoperable	4	4	4	454
39.930	4	inoperable	5	4	4	483
39.945	4	inoperable	5	4	5	512
39.960	5	inoperable	5	4	5	541
39.975	5	inoperable	5	5	5	570
39.990	5	inoperable	6	5	5	599
40.005	5	inoperable	6	5	6	629
40.020	6	inoperable	6	5	6	659
40.035	6	inoperable	6	6	6	689
40.050	6	inoperable	7	6	6	719
40.065	6	inoperable	7	6	7	749
40.080	7	inoperable	7	6	7	779
40.095	7	inoperable	7	7	7	810
40.110	7	inoperable	8	7	7	839
40.125	7	inoperable	8	7	8	868
40.140	8	inoperable	8	7	8	897
40.155	8	inoperable	8	8	8	926
40.170	8	inoperable	9	8	8	956
40.185	8	inoperable	9	8	9	987
40.200	9	inoperable	9	8	9	1017
40.215	9	inoperable	9	9	9	1047
40.230	9	inoperable	10	9	9	1077
40.245	9	inoperable	10	9	10	1108
40.260	10	inoperable	10	9	10	1138
40.275	10	inoperable	10	10	10	1168
40.290	10	inoperable	11	10	10	1199
40.305	10	inoperable	11	10	11	1230
40.320	11	inoperable	11	10	11	1261
40.335	11	inoperable	11	11	11	1292
40.350	11	inoperable	12	11	11	1321
40.365	11	inoperable	12	11	12	1350
40.380	12	inoperable	12	11	12	1379
40.395	12	inoperable	12	12	12	1408
40.410	12	inoperable	13	12	12	1435

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Table E.3 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(GATE B STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
40.425	12	inoperable	13	12	13	1462
40.440	13	inoperable	13	12	13	1489
40.455	13	inoperable	13	13	13	1517
40.470	13	inoperable	14	13	13	1543
40.485	13	inoperable	14	13	14	1570
40.500	14	inoperable	14	13	14	1597
40.515	14	inoperable	14	14	14	1623
40.530	14	inoperable	15	14	14	1649
40.545	14	inoperable	15	14	15	1675
40.560	15	inoperable	15	14	15	1702
40.575	15	inoperable	15	15	15	1728
40.590	15	inoperable	16	15	15	1753
40.605	15	inoperable	16	15	16	1779
40.620	16	inoperable	16	15	16	1804
40.635	16	inoperable	16	16	16	1830
40.650	16	inoperable	17	16	16	1855
40.665	16	inoperable	17	16	17	1879
40.680	17	inoperable	17	16	17	1904
40.695	17	inoperable	17	17	17	1929
40.710	17	inoperable	18	17	17	1954
40.725	17	inoperable	18	17	18	1978
40.740	18	inoperable	18	17	18	2002
40.755	18	inoperable	18	18	18	2027
40.770	18	inoperable	19	18	18	2050
40.785	18	inoperable	19	18	19	2074
40.800	19	inoperable	19	18	19	2097
40.815	19	inoperable	19	19	19	2121
40.830	19	inoperable	20	19	19	2290
40.845	19	inoperable	20	19	20	2461
40.860	20	inoperable	20	19	20	2634
40.875	20	inoperable	20	20	20	2810
40.890	20	inoperable	21	20	20	2818
40.905	20	inoperable	21	20	21	2826
40.920	21	inoperable	21	20	21	2835
40.935	21	inoperable	21	21	21	2843
40.950	21	inoperable	22	21	21	2851
40.965	21	inoperable	22	21	22	2859
40.980	22	inoperable	22	21	22	2867
40.995	22	inoperable	22	22	22	2884
41.010	22	inoperable	23	22	22	2893
41.025	22	inoperable	23	22	23	2901
41.040	23	inoperable	23	22	23	2909
41.055	23	inoperable	23	23	23	2917
41.070	23	inoperable	23	23	23	2926
41.085	23	inoperable	23	23	23	2934
41.100	23	inoperable	23	23	23	2942
41.115	23	inoperable	23	23	23	2950
41.130	23	inoperable	23	23	23	2959
41.145	23	inoperable	23	23	23	2967
41.160	23	inoperable	23	23	23	2975
41.175	23	inoperable	23	23	23	2984

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Table E.3 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(GATE B STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
41.190	23	inoperable	23	23	23	2992
41.205	23	inoperable	23	23	23	3000
41.220	23	inoperable	23	23	23	3009
41.235	23	inoperable	23	23	23	3017
41.250	23	inoperable	23	23	23	3025
41.265	23	inoperable	23	23	23	3034
41.280	23	inoperable	23	23	23	3042
41.295	23	inoperable	23	23	23	2050
41.310	23	inoperable	23	23	23	3059
41.325	23	inoperable	23	23	23	3067
41.340	23	inoperable	23	23	23	3075
41.355	23	inoperable	23	23	23	3084
41.370	23	inoperable	23	23	23	3092
41.385	23	inoperable	23	23	23	3100
41.400	23	inoperable	23	23	23	3109

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Table E.4 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM
(GATE C STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
39.600	closed	closed	inoperable	closed	closed	0
39.650	closed	closed	inoperable	closed	1	19
39.700	1	closed	inoperable	closed	1	38
39.715	1	closed	inoperable	1	1	57
39.730	1	1	inoperable	1	1	77
39.750	1	1	inoperable	1	2	111
39.765	2	1	inoperable	1	2	145
39.780	2	1	inoperable	2	2	179
39.795	2	2	inoperable	2	2	213
39.810	2	2	inoperable	2	3	244
39.825	3	2	inoperable	2	3	275
39.840	3	2	inoperable	3	3	306
39.855	3	3	inoperable	3	3	337
39.870	3	3	inoperable	3	4	366
39.885	4	3	inoperable	3	4	396
39.900	4	3	inoperable	4	4	425
39.915	4	4	inoperable	4	4	454
39.930	4	4	inoperable	4	5	483
39.945	5	4	inoperable	4	5	512
39.960	5	4	inoperable	5	5	541
39.975	5	5	inoperable	5	5	570
39.990	5	5	inoperable	5	6	599
40.005	6	5	inoperable	5	6	629
40.020	6	5	inoperable	6	6	659
40.035	6	6	inoperable	6	6	689
40.050	6	6	inoperable	6	7	719
40.065	7	6	inoperable	6	7	749
40.080	7	6	inoperable	7	7	779
40.095	7	7	inoperable	7	7	810
40.110	7	7	inoperable	7	8	839
40.125	8	7	inoperable	7	8	868
40.140	8	7	inoperable	8	8	897
40.155	8	8	inoperable	8	8	926
40.170	8	8	inoperable	8	9	956
40.185	9	8	inoperable	8	9	987
40.200	9	8	inoperable	9	9	1017
40.215	9	9	inoperable	9	9	1047
40.230	9	9	inoperable	9	10	1077
40.245	10	9	inoperable	9	10	1108
40.260	10	9	inoperable	10	10	1138
40.275	10	10	inoperable	10	10	1168
40.290	10	10	inoperable	10	11	1199
40.305	11	10	inoperable	10	11	1230
40.320	11	10	inoperable	11	11	1261
40.335	11	11	inoperable	11	11	1292
40.350	11	11	inoperable	11	12	1321
40.365	12	11	inoperable	11	12	1350
40.380	12	11	inoperable	12	12	1379
40.395	12	12	inoperable	12	12	1408
40.410	12	12	inoperable	12	13	1435

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Table E.4 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(GATE C STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
40.425	13	12	inoperable	12	13	1462
40.440	13	12	inoperable	13	13	1489
40.455	13	13	inoperable	13	13	1517
40.470	13	13	inoperable	13	14	1543
40.485	14	13	inoperable	13	14	1570
40.500	14	13	inoperable	14	14	1597
40.515	14	14	inoperable	14	14	1623
40.530	14	14	inoperable	14	15	1649
40.545	15	14	inoperable	14	15	1675
40.560	15	14	inoperable	15	15	1702
40.575	15	15	inoperable	15	15	1728
40.590	15	15	inoperable	15	16	1753
40.605	16	15	inoperable	15	16	1779
40.620	16	15	inoperable	16	16	1804
40.635	16	16	inoperable	16	16	1830
40.650	16	16	inoperable	16	17	1855
40.665	17	16	inoperable	16	17	1879
40.680	17	16	inoperable	17	17	1904
40.695	17	17	inoperable	17	17	1929
40.710	17	17	inoperable	17	18	1954
40.725	18	17	inoperable	17	18	1978
40.740	18	17	inoperable	18	18	2002
40.755	18	18	inoperable	18	18	2027
40.770	18	18	inoperable	18	19	2050
40.785	19	18	inoperable	18	19	2074
40.800	19	18	inoperable	19	19	2097
40.815	19	19	inoperable	19	19	2121
40.830	19	19	inoperable	19	20	2290
40.845	20	19	inoperable	19	20	2461
40.860	20	19	inoperable	20	20	2634
40.875	20	20	inoperable	20	20	2810
40.890	20	20	inoperable	20	21	2818
40.905	21	20	inoperable	20	21	2826
40.920	21	20	inoperable	21	21	2835
40.935	21	21	inoperable	21	21	2843
40.950	21	21	inoperable	21	22	2851
40.965	22	21	inoperable	21	22	2859
40.980	22	21	inoperable	22	22	2867
40.995	22	22	inoperable	22	22	2884
41.010	22	22	inoperable	22	23	2893
41.025	23	22	inoperable	22	23	2901
41.040	23	22	inoperable	23	23	2909
41.055	23	23	inoperable	23	23	2917
41.070	23	23	inoperable	23	23	2926
41.085	23	23	inoperable	23	23	2934
41.100	23	23	inoperable	23	23	2942
41.115	23	23	inoperable	23	23	2950
41.130	23	23	inoperable	23	23	2959
41.145	23	23	inoperable	23	23	2967
41.160	23	23	inoperable	23	23	2975
41.175	23	23	inoperable	23	23	2984

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Table E.4 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(GATE C STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
41.190	23	23	inoperable	23	23	2992
41.205	23	23	inoperable	23	23	3000
41.220	23	23	inoperable	23	23	3009
41.235	23	23	inoperable	23	23	3017
41.250	23	23	inoperable	23	23	3025
41.265	23	23	inoperable	23	23	3034
41.280	23	23	inoperable	23	23	3042
41.295	23	23	inoperable	23	23	2050
41.310	23	23	inoperable	23	23	3059
41.325	23	23	inoperable	23	23	3067
41.340	23	23	inoperable	23	23	3075
41.355	23	23	inoperable	23	23	3084
41.370	23	23	inoperable	23	23	3092
41.385	23	23	inoperable	23	23	3100
41.400	23	23	inoperable	23	23	3109

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Table E.5 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM
(GATE D STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
39.600	closed	closed	closed	inoperable	closed	0
39.650	closed	closed	1	inoperable	closed	19
39.700	closed	closed	1	inoperable	1	38
39.715	1	closed	1	inoperable	1	57
39.730	1	1	1	inoperable	1	77
39.750	1	1	2	inoperable	1	111
39.765	1	1	2	inoperable	2	145
39.780	2	1	2	inoperable	2	179
39.795	2	2	2	inoperable	2	213
39.810	2	2	3	inoperable	2	244
39.825	2	2	3	inoperable	3	275
39.840	3	2	3	inoperable	3	306
39.855	3	3	3	inoperable	3	337
39.870	3	3	4	inoperable	3	366
39.885	3	3	4	inoperable	4	396
39.900	4	3	4	inoperable	4	425
39.915	4	4	4	inoperable	4	454
39.930	4	4	5	inoperable	4	483
39.945	4	4	5	inoperable	5	512
39.960	5	4	5	inoperable	5	541
39.975	5	5	5	inoperable	5	570
39.990	5	5	6	inoperable	5	599
40.005	5	5	6	inoperable	6	629
40.020	6	5	6	inoperable	6	659
40.035	6	6	6	inoperable	6	689
40.050	6	6	7	inoperable	6	719
40.065	6	6	7	inoperable	7	749
40.080	7	6	7	inoperable	7	779
40.095	7	7	7	inoperable	7	810
40.110	7	7	8	inoperable	7	839
40.125	7	7	8	inoperable	8	868
40.140	8	7	8	inoperable	8	897
40.155	8	8	8	inoperable	8	926
40.170	8	8	9	inoperable	8	956
40.185	8	8	9	inoperable	9	987
40.200	9	8	9	inoperable	9	1017
40.215	9	9	9	inoperable	9	1047
40.230	9	9	10	inoperable	9	1077
40.245	9	9	10	inoperable	10	1108
40.260	10	9	10	inoperable	10	1138
40.275	10	10	10	inoperable	10	1168
40.290	10	10	11	inoperable	10	1199
40.305	10	10	11	inoperable	11	1230
40.320	11	10	11	inoperable	11	1261
40.335	11	11	11	inoperable	11	1292
40.350	11	11	12	inoperable	11	1321
40.365	11	11	12	inoperable	12	1350
40.380	12	11	12	inoperable	12	1379
40.395	12	12	12	inoperable	12	1408
40.410	12	12	13	inoperable	12	1435

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Table E.5 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(GATE D STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
40.425	12	12	13	inoperable	13	1462
40.440	13	12	13	inoperable	13	1489
40.455	13	13	13	inoperable	13	1517
40.470	13	13	14	inoperable	13	1543
40.485	13	13	14	inoperable	14	1570
40.500	14	13	14	inoperable	14	1597
40.515	14	14	14	inoperable	14	1623
40.530	14	14	15	inoperable	14	1649
40.545	14	14	15	inoperable	15	1675
40.560	15	14	15	inoperable	15	1702
40.575	15	15	15	inoperable	15	1728
40.590	15	15	16	inoperable	15	1753
40.605	15	15	16	inoperable	16	1779
40.620	16	15	16	inoperable	16	1804
40.635	16	16	16	inoperable	16	1830
40.650	16	16	17	inoperable	16	1855
40.665	16	16	17	inoperable	17	1879
40.680	17	16	17	inoperable	17	1904
40.695	17	17	17	inoperable	17	1929
40.710	17	17	18	inoperable	17	1954
40.725	17	17	18	inoperable	18	1978
40.740	18	17	18	inoperable	18	2002
40.755	18	18	18	inoperable	18	2027
40.770	18	18	19	inoperable	18	2050
40.785	18	18	19	inoperable	19	2074
40.800	19	18	19	inoperable	19	2097
40.815	19	19	19	inoperable	19	2121
40.830	19	19	20	inoperable	19	2290
40.845	19	19	20	inoperable	20	2461
40.860	20	19	20	inoperable	20	2634
40.875	20	20	20	inoperable	20	2810
40.890	20	20	21	inoperable	20	2818
40.905	20	20	21	inoperable	21	2826
40.920	21	20	21	inoperable	21	2835
40.935	21	21	21	inoperable	21	2843
40.950	21	21	22	inoperable	21	2851
40.965	21	21	22	inoperable	22	2859
40.980	22	21	22	inoperable	22	2867
40.995	22	22	22	inoperable	22	2884
41.010	22	22	23	inoperable	22	2893
41.025	22	22	23	inoperable	23	2901
41.040	23	22	23	inoperable	23	2909
41.055	23	23	23	inoperable	23	2917
41.070	23	23	23	inoperable	23	2926
41.085	23	23	23	inoperable	23	2934
41.100	23	23	23	inoperable	23	2942
41.115	23	23	23	inoperable	23	2950
41.130	23	23	23	inoperable	23	2959
41.145	23	23	23	inoperable	23	2967
41.160	23	23	23	inoperable	23	2975
41.175	23	23	23	inoperable	23	2984

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Table E.5 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(GATE D STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
41.190	23	23	23	inoperable	23	2992
41.205	23	23	23	inoperable	23	3000
41.220	23	23	23	inoperable	23	3009
41.235	23	23	23	inoperable	23	3017
41.250	23	23	23	inoperable	23	3025
41.265	23	23	23	inoperable	23	3034
41.280	23	23	23	inoperable	23	3042
41.295	23	23	23	inoperable	23	2050
41.310	23	23	23	inoperable	23	3059
41.325	23	23	23	inoperable	23	3067
41.340	23	23	23	inoperable	23	3075
41.355	23	23	23	inoperable	23	3084
41.370	23	23	23	inoperable	23	3092
41.385	23	23	23	inoperable	23	3100
41.400	23	23	23	inoperable	23	3109

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Table E.6 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM
(GATE E STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
39.600	closed	closed	closed	closed	inoperable	0
39.650	closed	closed	1	closed	inoperable	19
39.700	1	closed	1	closed	inoperable	38
39.715	1	closed	1	1	inoperable	57
39.730	1	1	1	1	inoperable	77
39.750	1	1	2	1	inoperable	111
39.765	2	1	2	1	inoperable	145
39.780	2	1	2	2	inoperable	179
39.795	2	2	2	2	inoperable	213
39.810	2	2	3	2	inoperable	244
39.825	3	2	3	2	inoperable	275
39.840	3	2	3	3	inoperable	306
39.855	3	3	3	3	inoperable	337
39.870	3	3	4	3	inoperable	366
39.885	4	3	4	3	inoperable	396
39.900	4	3	4	4	inoperable	425
39.915	4	4	4	4	inoperable	454
39.930	4	4	5	4	inoperable	483
39.945	5	4	5	4	inoperable	512
39.960	5	4	5	5	inoperable	541
39.975	5	5	5	5	inoperable	570
39.990	5	5	6	5	inoperable	599
40.005	6	5	6	5	inoperable	629
40.020	6	5	6	6	inoperable	659
40.035	6	6	6	6	inoperable	689
40.050	6	6	7	6	inoperable	719
40.065	7	6	7	6	inoperable	749
40.080	7	6	7	7	inoperable	779
40.095	7	7	7	7	inoperable	810
40.110	7	7	8	7	inoperable	839
40.125	8	7	8	7	inoperable	868
40.140	8	7	8	8	inoperable	897
40.155	8	8	8	8	inoperable	926
40.170	8	8	9	8	inoperable	956
40.185	9	8	9	8	inoperable	987
40.200	9	8	9	9	inoperable	1017
40.215	9	9	9	9	inoperable	1047
40.230	9	9	10	9	inoperable	1077
40.245	10	9	10	9	inoperable	1108
40.260	10	9	10	10	inoperable	1138
40.275	10	10	10	10	inoperable	1168
40.290	10	10	11	10	inoperable	1199
40.305	11	10	11	10	inoperable	1230
40.320	11	10	11	11	inoperable	1261
40.335	11	11	11	11	inoperable	1292
40.350	11	11	12	11	inoperable	1321
40.365	12	11	12	11	inoperable	1350
40.380	12	11	12	12	inoperable	1379
40.395	12	12	12	12	inoperable	1408
40.410	12	12	13	12	inoperable	1435

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Table E.6 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(GATE E STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE CUMECS)
40.425	13	12	13	12	inoperable	1462
40.440	13	12	13	13	inoperable	1489
40.455	13	13	13	13	inoperable	1517
40.470	13	13	14	13	inoperable	1543
40.485	14	13	14	13	inoperable	1570
40.500	14	13	14	14	inoperable	1597
40.515	14	14	14	14	inoperable	1623
40.530	14	14	15	14	inoperable	1649
40.545	15	14	15	14	inoperable	1675
40.560	15	14	15	15	inoperable	1702
40.575	15	15	15	15	inoperable	1728
40.590	15	15	16	15	inoperable	1753
40.605	16	15	16	15	inoperable	1779
40.620	16	15	16	16	inoperable	1804
40.635	16	16	16	16	inoperable	1830
40.650	16	16	17	16	inoperable	1855
40.665	17	16	17	16	inoperable	1879
40.680	17	16	17	17	inoperable	1904
40.695	17	17	17	17	inoperable	1929
40.710	17	17	18	17	inoperable	1954
40.725	18	17	18	17	inoperable	1978
40.740	18	17	18	18	inoperable	2002
40.755	18	18	18	18	inoperable	2027
40.770	18	18	19	18	inoperable	2050
40.785	19	18	19	18	inoperable	2074
40.800	19	18	19	19	inoperable	2097
40.815	19	19	19	19	inoperable	2121
40.830	19	19	20	19	inoperable	2290
40.845	20	19	20	19	inoperable	2461
40.860	20	19	20	20	inoperable	2634
40.875	20	20	20	20	inoperable	2810
40.890	20	20	21	20	inoperable	2818
40.905	21	20	21	20	inoperable	2826
40.920	21	20	21	21	inoperable	2835
40.935	21	21	21	21	inoperable	2843
40.950	21	21	22	21	inoperable	2851
40.965	22	21	22	21	inoperable	2859
40.980	22	21	22	22	inoperable	2867
40.995	22	22	22	22	inoperable	2884
41.010	22	22	23	22	inoperable	2893
41.025	23	22	23	22	inoperable	2901
41.040	23	22	23	23	inoperable	2909
41.055	23	23	23	23	inoperable	2917
41.070	23	23	23	23	inoperable	2926
41.085	23	23	23	23	inoperable	2934
41.100	23	23	23	23	inoperable	2942
41.115	23	23	23	23	inoperable	2950
41.130	23	23	23	23	inoperable	2959
41.145	23	23	23	23	inoperable	2967
41.160	23	23	23	23	inoperable	2975
41.175	23	23	23	23	inoperable	2984

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Table E.6 - MINIMUM GATE SETTINGS FOR NORTH PINE DAM (Continued)
(GATE E STUCK OR INOPERABLE)

LEVEL (m AHD)	GATE A	GATE B	GATE C	GATE D	GATE E	DISCHARGE (CUMECS)
41.190	23	23	23	23	inoperable	2992
41.205	23	23	23	23	inoperable	3000
41.220	23	23	23	23	inoperable	3009
41.235	23	23	23	23	inoperable	3017
41.250	23	23	23	23	inoperable	3025
41.265	23	23	23	23	inoperable	3034
41.280	23	23	23	23	inoperable	3042
41.295	23	23	23	23	inoperable	2050
41.310	23	23	23	23	inoperable	3059
41.325	23	23	23	23	inoperable	3067
41.340	23	23	23	23	inoperable	3075
41.355	23	23	23	23	inoperable	3084
41.370	23	23	23	23	inoperable	3092
41.385	23	23	23	23	inoperable	3100
41.400	23	23	23	23	inoperable	3109

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APPENDIX G STORAGE AND INFLOW DETERMINATION

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Lake Level EL (m)	Storage 10^6 m^3	Inflow Rate* m^3/s
39.0	187	5.8
39.2	191	5.9
39.4	196	6.0
39.6	200	6.1
39.8	205	6.2
40.0	209	6.3
40.2	214	6.4
40.4	218	6.5
40.6	223	6.6
40.8	228	6.8
41.0	233	6.9
41.2	238	7.0
41.4	243	7.1
41.6	248	7.2
41.8	253	7.3
42.0	258	7.4
42.2	264	7.5
42.4	270	7.7
42.6	275	7.8
42.8	281	7.9
43.0	287	8.1
43.2	292	8.2
43.3	295	8.3

* This is the net inflow that causes the reservoir to rise 1 mm in one hour with the spillway gates functioning normally.

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