MISSION CREEK WATER USE PLAN

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Prepared for:

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SUMMARY

A Water Use Plan process was carried out for a Stakeholder Committee of the Mission Creek Watershed Partnership with representation from the Black Mountain Irrigation District (BMID), South East Kelowna Irrigation District (SEKID), Regional District of Central Okanagan, the City of Kelowna, the British Columbia Ministry of Environment and other water users.

Historically, flow releases have been made from the BMID and SEKID intakes based on water license requirements and are fixed rather than variable releases. The feasibility of implementing a system of variable releases was investigated as part of the Water Use Plan process.

The Mission Creek Water Use Plan Stakeholder Committee met 4 times from February 6 2008 to June 11 2008. A preliminary operations plan was developed during the first four meetings for implementation during the summer of 2008. The committee reconvened on January 20 2009 and had the last meeting on February 23 2009 when the operations plan was finalized.

Various operation plan concepts were discussed during the stakeholder meetings. A key parameter for fish flow releases is an estimate of the natural low flows at the WSC site. During drought periods, natural flows would have been much less than average. It was agreed that an estimate of natural flows at the WSC gauge should be used for fish flows and that natural flows should be estimated as a multiplier of Pearson Creek flows. Pearson Creek is the largest unregulated tributary of Mission Creek. BC Environment flow records indicate that natural flows at the WSC gauge would be about 6 times the Pearson Creek flows. For implementation, this would best be done with a real-time gauge on Pearson Creek.

The procedure for developing the water supply operations plan for Mission Creek was to simulate operations over the 50-year period and investigate required reductions in water supply demand and fish flows in order to provide a reliable water supply for all the years of simulation.

The water supply demand was based on the 2002 demand for both SEKID and BMID. This was a year with a demand slightly greater than average.

Loch Long was not used in the analysis as it is licensed to the Crown for fish flows. Releases from Loch Long can be used to make up any shortfalls in fish flows in extreme dry years and supplement fish flows in normal moisture years.

Turtle Reservoir was included as part of SEKID storage.

Downstream releases were set at 6 times Pearson Creek flows for the period July to October. Allocation of releases was set at 87% from BMID and 13% from SEKID based on estimates of natural flows from the two catchment areas.

Flows at the WSC gauge do not need to exceed conservation flow values which are the desired target levels for fish flows in lower Mission Creek. In wet years these conservation flow values may be equalled or exceeded by unregulated flow releases.

The conservation flow values used in the plan development for capping flow releases were:

July: 2.25 m^3/s (equal to August)
August: 2.25 m^3/s
September : 1.9 m^3/s
October:1.5 m^3/s

The conservation flows listed above are the desired target levels for fish flows in lower Mission Creek. Target levels can normally only be met in wet years. A minimum flow override was used corresponding to the current minimum flow release rates which are 0.031 m^3/s from SEKID and 0.5 m^3/s from BMID.

Four drought stages are applied, Mild, Moderate, Severe and Extreme. The water supply system was simulated over 50 years with adjustment of demand factors and trigger graphs so that only the Mild and Moderate drought stages were experienced. Severe and Extreme drought conditions that could result in supply failure were avoided in the simulations by adjustment of the demand and release parameters in the model.

Trigger Graphs for BMID and SEKID are attached as Figure 5.1 and Figure 5.2 respectively. The total live storage quantities included in the trigger graphs represent the following:

	Reservoirs included in total live storage
SEKID:	McCullough, Turtle, Fish, Long Meadow and Browne Lakes
BMID:	Ideal, Graystoke, Fish Hawk

To maintain a reliable water supply (avoidance of Severe and Extreme drought stages for all 50 years in the simulation) the factors presented in the following table for demand and downstream releases should be applied. For severe and extreme droughts further reductions would be required.

Demand and release factors

Drought	Stage	BMID Factors		Pearson Multiplier
		Demand	Downstream Release	
	0	1	1	5.2
Mild	1	1	0.9	4.7
Moderate	2	1	0.9	4.7
Severe	3			
Extreme	4			

Drought	Stage	SEKID Factors		Pearson Multiplier
		Demand	Downstream Release	
	0	1	1	0.8
Mild	1	1	0.9	0.7
Moderate	2	1	0.8	0.6
Severe	3			
Extreme	4			

1. INTRODUCTION

1.1. Background

The Mission Creek Watershed Partnership retained Water Management Consultants to prepare a Water Use Plan for Mission Creek near Kelowna, BC. The Mission Creek Watershed Partnership has representation from the Black Mountain Irrigation District (BMID), South East Kelowna Irrigation District (SEKID), Regional District of Central Okanagan, the City of Kelowna, the British Columbia Ministry of Environment and other water users.

Water Use Plan Guidelines were developed by the Province and BC Hydro in 1999 to facilitate the process of stakeholder input to water management planning. The Water Use Plan process is effective for watersheds in which operation of reservoirs can be modified to address stakeholder issues. The Water Use Plan process was used in the Okanagan for the first time for operation of the reservoirs in the Trout Creek Watershed for the District of Summerland. The process was found to be very successful for resolving stakeholder issues.

One of the advantages of using the Water Use Plan process is that it provides a clearly defined framework for addressing complex issues. Developing a Water Use Plan for Mission Creek provides a plan for reservoir operations for a variety of uses. The Water Use Plan will be particularly effective in drought years for water management when the reservoirs are under stress. The plan also has the advantage of having a built-in capability to manage the reservoirs with future climate change. A trend to drier years will not necessarily require alterations to the plan as the plan will incorporate reservoir operations under drought conditions. A trend to drier years would result in more frequent uses of higher levels of demand management.

The Water Use Plan for Mission Creek defines the availability of water in each month under different drought scenarios and provides a method of allocating that water for different uses. Allocation of water under drought conditions may mean less water being available for some users. Drought conditions are defined in the plan on the basis of reservoir storage levels at different times of the year using trigger storage levels.

The two major water licence holders on Mission Creek are the Black Mountain Irrigation District (BMID) and the Southeast Kelowna Irrigation District (SEKID). The BMID intake is on the main stem of Mission Creek and releases are made from upstream reservoirs to augment unregulated flows. The SEKID intake is located on Hydraulic Creek, a tributary of Mission Creek with a confluence with Mission Creek downstream of the BMID intake. Releases are

made from reservoirs upstream of the SEKID intake to augment unregulated flows. Downstream of the confluence of Mission and Hydraulic Creeks there is a Water Survey of Canada (WSC) stream gauge.

1.2. Water Use Plan Process

The Water Use Plan (WUP) Process has been demonstrated to be successful in providing an effective framework for improved management of water resources particularly where there are reservoirs in the supply system.

The Water Use Plan process was originally developed to assist the resolution of conflicts between BC Hydro water use and fish habitat needs. Several years of costly litigation had demonstrated that a better way had to be found to manage water resources in the Province. The goal of the WUP process is to achieve consensus on a set of operating rules that satisfies the full range of water use interests at stake.

The structured framework of the Water Use Plan approach provides clarity to the decision-making process particularly regarding the roles and responsibilities of the stakeholders. The licensee, in this case the District of Summerland, leads the process, which ensures that any proposed changes to operations are voluntarily entered into by the licensee. The participating regulatory agencies maintain their role of monitoring licensee performance in accordance with the Water Use Plan.

The key principles of Water Use Planning include:

- Recognition that tradeoffs (choices) have occurred and will occur.

- Operating alternatives are examined on the basis of existing infrastructure. The potential for new dams and reservoirs is not part of the Water Use Plan process. The intention is to better manage the existing water resource within the constraints of the supply system in place.

- No changes will occur to existing legal and constitutional rights and responsibilities. The purpose of the program is to clarify obligations in detailed operating plans while maintaining the regulatory powers of the federal *Fisheries Act* and the provincial *Water Act.*

- The process is collaborative, cooperative and inclusive. The program brings together a wide variety of people to be part of decision-making.

Water Use Plans are developed within the context of the *Water Act.* The Act governs the construction, operation and maintenance of works to ensure the beneficial use of the water resource and must consider the rights of the licensee as well as the public interest.

The outcome of the planning process may be to recommend a voluntary change to operations resulting in a diminishment of water rights.

The Guidelines state that if there are financial impacts on the licensee, from reduction in water rights, compensation for losses will be an important consideration in plan implementation.

The guidelines call for consultation to be flexible to meet local circumstances and needs. Participants in the WUP process have the responsibility to:

- Articulate their interests in water management;
- Listen to and learn about other water use interests;
- Develop an information base for discussion;
- Explore the implications of a range of operating alternatives;
- Seek compromises across water uses;
- Each process will strive for consensus.

The process should foster an atmosphere of shared resource stewardship among the interested parties. This leads to a better understanding and support for resource management decisions.

Once the revised operating regime is agreed to by the consultative committee of stakeholders the licensee drafts the plan which can be reviewed by the Water Comptroller and become part of the water licence.

Preparation of a Water Use Plan requires a detailed understanding of the hydrology of the supply system and a model of the reservoir operations so that alternative operating rules can be examined.

1.3. Scope

The scope of work for Water Management Consultants for preparing the Water Use Plan for Mission Creek was as follows:

- Chair the Stakeholder Committee
- Define water use objectives with Stakeholder Committee members
- Develop a reservoir operations model and demonstrate it using current operations
- Simulate alternative operating scenarios for presentation and discussion with the committee
- Develop a preferred operating scenario with the committee
- Recommend an operating and monitoring plan
- Provide documentation of the process and the results.

The Mission Creek Water Use Plan considered alternative operating scenarios for the BMID and SEKID Reservoirs to determine the potential for improving water management for all stakeholders. The scope included investigation of the following:

1. Operational alternatives that meet the requirements of community water supply and agricultural water users.

2. Operational alternatives that meet the requirements for habitat of rainbow trout (*Oncorhynchus mykiss*) and Kokanee salmon (*Oncorhynchus nerka*).

3. Operational alternatives to address the objectives of other stakeholders regarding fisheries and water supply.

Water Use Plans are intended to address issues related to operations of facilities as they exist and do not normally encompass potential changes to physical works.

The technical basis for the community and agricultural water supply assessment was the hydrology model developed by Environment Canada for the Mission Creek Watershed and the Mission Creek Reservoir Operation Model which is described in Section 3 of this report.

The technical basis for the fisheries assessment was existing fisheries studies on Mission Creek carried out on behalf of the Ministry of Environment. Flow releases have been made from the BMID and SEKID intakes based on water license requirements and are fixed rather than variable releases. The feasibility of implementing a system of variable release was investigated as part of the Water Use Plan process.

The key flow reference point for investigating operational alternatives was flow in Mission Creek at the WSC gauge.

2. WATER SUPPLY

2.1. BMID

The BMID water supply system was described in the BMID Drought Management Plan which was prepared in 2005 (Agua Consulting, 2005). The majority of water supplied to BMID is from surface water in Mission and Scotty Creeks and this is supplemented by three groundwater wells. The primary source for BMID is Mission Creek which is the largest tributary to Okanagan Lake. The Mission Creek Water Use Plan addresses only the Mission Creek water supply source.

The Mission Creek source comprises storage reservoirs in the headwaters and a significant quantity of unregulated flow in the early summer. The capacity of the reservoir storage in Mission Creek is summarized in Table 2.1.

Table 2.1: BMID reservoirs

Reservoir	Net volume in ML	Catchment area km^2
Graystoke Reservoir	5,098	16.7
Fish Hawk Reservoir	2,275	7.4
Belgo reservoir	6,748	16.7**
Loch Long*	623	2.7
TOTAL	**14,744**	

* Loch Long storage is owned by the Crown and used for fish flow in Mission Creek. BMID operates the reservoir under the direction of BC Environment.
** Belgo Reservoir catchment area is augmented by diversions.

The average annual BMID demand on the Mission Creek source from 1991 to 2006 was 11,610 ML. Annual water demand has grown at a modest rate of 0.65% in the last 29 years (Agua Consulting, 2005). About 65% of the total consumption in 2004 was for agricultural purposes with the remainder for domestic water use including homes, commercial and industrial lots.

BMID has a demand management strategy in place to respond to drought conditions. (Agua Consulting, 2005).

2.2. SEKID

The SEKID water supply system comprises a number of reservoirs on Hydraulic Creek, a tributary of Mission Creek. The system depends primarily on the storage reservoirs with a small amount of unregulated flow. The reservoir capacities are summarized below in Table 2.2.

Table 2.2: SEKID reservoirs

Reservoir	Net volume in ML	Catchment area km^{2**}
McCullough Reservoir	16,669	19.5
Fish-Browne-Long Meadow	928	3.9
Turtle Reservoir*	2,020	1.4
TOTAL	**19,617**	

* Turtle Reservoir was recently constructed with planned operation in 2009.
** Catchment areas are augmented by diversions.

The average annual demand on the SEKID system from 1995 to 2007 was 11,080 ML, similar to the average annual Mission Creek demand. The SEKID system has more storage than the BMID system but less unregulated flow contribution. About 85% of the demand is for agricultural uses (Pike, 2005).

In 1994 SEKID installed meters for demand management. SEKID has implemented a progressive demand management program which includes an inclining block rate with allocated water according to need (Pike, 2005). The program has been particularly effective at managing drought conditions.

3. RESERVOIR OPERATIONS MODEL

3.1. Conceptual Model

The reservoir operations model was set up to balance water throughout the Mission Creek water supply system. For each reservoir the primary elements of the water balance are:

- Natural inflows to the reservoir
- Flows into the reservoir from diversions
- Reservoir releases in response to demands
- Reservoir spills
- Evaporation and precipitation on the reservoir surface

At the downstream BMID and SEKID intakes the elements of the water balance are:

- Flows from the upstream reservoirs (releases or spills)
- Natural flows from unregulated areas
- Water supply withdrawals
- Downstream releases
- Downstream spills

The reservoir operations model was set up to represent the water balance at each reservoir at the intakes and at the downstream WSC gauge. A schematic showing the main elements of the model is provided in Figure 3.1 and the layout of the reservoirs and diversions is shown in Figure 3.2.

3.2. Hydrology

Flow inputs to the reservoirs and flows from unregulated areas of the watershed were provided by Environment Canada using the HBV model. The HBV model was calibrated by Environment Canada for flows and climate data for Joe Rich creek. The model was then extended to the entire Mission Creek watershed. Each sub-catchment is a separate HBV model, a total of 28 HBV models. The input flows were weekly for the period 1954 to 2004 representing the period of record of climate data at Joe Rich Creek. Operation of the Mission Creek reservoir system is therefore over a 50-year period.

3.3. Operations rules for model calibration

The following operations rules were built into the reservoir operations model to verify that the model represented current operations.

SEKID reservoirs and diversions

The primary reservoir in the SEKID supply system is McCulloch Reservoir on Hydraulic Creek. There are three diversions into McCulloch Reservoir:

- Pooley Creek
- Myra Creek
- Stirling Creek

These diversions are operated from March until June 15.

The Fish Creek reservoir system drains to Hydraulic Creek. Fish, Long Meadow and Browne Lakes are regulated. The water from this system is rarely used unless there is a severe water shortage because the water quality in the system is poor and the lakes take more than one season to refill.

Turtle Lake Reservoir will be operational by 2009 and was included in the Water Use Plan but not in the calibration model. Turtle Lake has a small catchment area but Hydraulic Creek (downstream of the Pooely/Myra/Stirling Diversions) can be diverted into Turtle Lake to provide more storage than currently available in McCulloch Lake.

There is a diversion on Hardy Creek to Hydraulic Creek downstream of McCulloch Reservoir that is rarely used as the available water quantity is small. The Hardy Creek Diversion would only be used in very dry years.

SEKID operations

At the SEKID intake, up to 2800 gpm (0.2 m^3/s) is released downstream with a minimum of 0.031 m^3/s. Releases are not made from storage until the unregulated and declining spring flow in Hydraulic Creek is equal to the demand plus downstream releases.

SEKID applies an allotment system with an inclined block rate. At the start of the season, a District-wide allotment is made based on the quantity of water in storage.

BMID reservoirs and diversions

The reservoirs in the system are Ideal Lake (Belgo Lake), Graystoke Lake, Fish Hawk Lake and Loch Long. There are two diversions into Ideal Lake; Mugford Diversion is operated continuously, Hilda Creek Diversion is opened around June 1 and stays operating until October.

BMID Operations

The BMID intake on Mission Creek releases 35 acre feet per day (0.5 m^3/s) downstream at all times. The BMID demand and release requirement is met by unregulated flow until the flow in Mission Creek declines and the demand increases such that releases need to be made to maintain the demand. In the spring freshet, the treatment plant is operating.

Releases are first made from Ideal Lake because the water quality is poor and the treatment plant at the intake continues to operate. Around July 15 the flow from Ideal Lake is reduced to a constant 10 acre feet per day (0.14 m^3/s) and Fish Hawk Lake is opened to provide a constant 21 acre feet per day (0.3 m^3/s). The remainder of the demand is met by variable releases from Graystoke Lake.

Loch Long is operated by BMID for fisheries flows from September 1 to October 15. The released flows are 0.2 m^3/s until the storage is expended.

3.4. Other water licences

In addition to the BMID and SEKID water licences there are an estimated 1,480 ML of annual water licences on Mission Creek upstream of the WSC gauge. These licences were included in the model with the same demand pattern as BMID and were assumed to be fully operational.

3.5. Model calibration

The model was set up to track total storage levels in all reservoirs. For BMID operations the model tracked total storage in Ideal, Graystoke and Fish Hawk, (not Loch Long). For SEKID total storage was tracked in McCullough and Fish-Browne-Long Meadow. Demands were set at the recorded demand levels for each year.

Releases and spills from the BMID intake were combined with SEKID releases and spills from the SEKID intake to simulate the total flow in Mission Creek at the WSC gauge.

The reservoir operations model requires input of reservoir inflows and flows from unregulated areas which were provided by Environment Canada. Initial runs of the model indicated flows at the WSC gauge to be about 60% too high and that inflows to the reservoirs were also too high. The HBV-EC model had been calibrated by Environment Canada to flows on Joe Rich Creek, a gauge location close to the climate monitoring location. The adjustment for precipitation inputs at higher elevations was based on judgement, because gauges recording natural flows were not available at higher elevations in the Mission Creek watershed. The major sources of error were likely as follows:

- Errors in the HBV-EC adjustment of the precipitation inputs at higher elevations
- Tracking of soil moisture storage in dry years so that fall runoff is properly represented
- Operation of the reservoirs that deviated from the operations plan described in Section 3.3

Calibration adjustments were made to the HBV-EC model in an attempt to improve the representation of flows throughout the Mission Creek watershed. In addition, the release from the BMID intake from July to October was increased to 0.75 m^3/s because BMID usually released more than the minimum in the operating rules to ensure flow availability for fish.

Obtaining a reasonable match for the time series of total reservoir storage and flows at the WSC gauge proved a challenging exercise for the years from 2000 to 2004 when climatic data for the HBV-EC model and water supply demand data were both available. Some years resulted in a better calibration than others. Complete calibration results for total BMID storage are shown in Figure 3.3 and for McCullough Reservoir (SEKID) storage in Figure 3.4. Modelled and recorded flows at the Mission Creek WSC gauge are shown in Figure 3.5.

The overall calibration of the hydrologic model should be considered unresolved. While the match to the reservoir operation data is fair, the current model consistently underestimates flows at the WSC gauge in most years. The hydrologic model calibration should be revisited when the Water Use Plan is updated.

4. WATER USE PLAN PROCESS

The Mission Creek Water Use Plan Stakeholder Committee met 4 times from February 6 2008 to June 11 2008. A preliminary operations plan was developed during the first four meetings for implementation on the summer of 2008. The committee reconvened on January 20 2009 and had the last meeting on February 23 2009 when the operations plan was finalized. A complete set of notes from the stakeholder meetings are included in Appendix 1.

4.1. Objectives

At the first meeting of the Stakeholder Committee, water use plan objectives for each of the stakeholders were discussed. The purpose of this was for each of the stakeholders to understand the objectives of other participants. During the process, the objectives of all stakeholders are considered but not all may be met in the final operations plan. While some of the objectives are explicitly met by the operations plan others are not addressed. However many of the objectives that were not explicitly addressed are not compromised by the operations plan.

The initial objectives that were presented at the February 6, 2008 meeting were as follows:

South East Kelowna Irrigation District

- Community and Agricultural demand levels equivalent to 1998 levels.
- Reservoir inflows based on the design drought of two consecutive years of 59% of mean annual runoff.
- Severe or extended drought: Agricultural demands no less than 80% of drought year allotment, domestic and commercial uses restricted to inside use with limited hand watering only.
- Maintain reservoir levels in the fall to replenish with average inflows.

The average annual allocation in SEKID is 625 mm (27 inches) which is reduced during a drought scenario by implementing a drought allocation.

Black Mountain Irrigation District

To have sufficient water to allow for continued agriculture and domestic use for our current and projected water demands. As increased water demands will result in additional storage, we believe that current water estimates will suffice for at least a 5 year horizon. Specific objectives are as follows:

1. To operate to maximize the usage of Fish Hawk, Graystoke, and Loch Long at times when our water treatment plant is off-line.
2. To operate and utilize Ideal Lake water during freshet and when our WTP is running.
3. To construct Black Mountain Reservoir within the City of Kelowna City limits to allow for off-line storage on Mission Creek within a time frame of 5 years
4. To have secure water from our storage reservoirs for the purposes and uses of the water district rate payers.
5. In the event of droughts, to cut back water usage in accordance with our Drought Plan and to adjust the flows so that extended droughts do not result in unnecessary hardship on our ratepayers, particularly the ones that require the water for their livelihood (Farmers, growers, gardeners)
6. To support fish habitat in those cases where water is not being utilized by our "Grade C" customers. (lands with water rights but not currently irrigated)
7. Through this Water Use Plan, understand better the base stream flows that are present in the creek during various seasonal variations and drought scenarios so that all parties understand the base requirements and the importance of storage.
8. To understand the watershed impacts of water demand that would result from agricultural growth for an irrigated area increasing from 4,115 acres to as high as 8,000 acres. This land area is identified in the BMID Capital Works Plan.

Ministry of Agriculture and Lands

- Sufficient water allocation should be made for all those who have water rights to be able to irrigate.

- All currently dry lands within the ALR should be considered for future irrigation water.

Ministry of Environment- fisheries

Mission Creek is the most important spawning tributary for kokanee and rainbow trout on Okanagan Lake. Historically, Mission Creek supported up to 80% of the stream spawning Kokanee and over 50% of the Rainbow Trout from Okanagan Lake. Minimum fisheries flows are critical to survival and recovery of the Okanagan lake sports fishery.

The Mean Annual Discharge (MAD) in Mission Creek is 7-8 m^3/s. The ideal flows, when water is available in wet years, would be conservation flows which are 30% of MAD in August and 25% MAD in September and 20% MAD in October.

In dry years, natural flow levels in Lower Mission Creek would be the objective. Natural flow levels are variable and decrease in drought years. Phil Epp noted that a system could be used using recorded flows in Pearson Creek as an index to drought severity.

A legislative requirement exists under Section 30 of the Federal Fisheries Act to provide minimum fish flows and screening within all irrigation facilities. As such, permanent screening is required on all irrigation intakes/diversions off Mission Creek to preclude access to both juvenile and adult salmonids.

Ministry of Environment- Water Stewardship Division

Jane Bender noted that no additional irrigation licences will be issued on Mission Creek unless they are supported by storage. Key objectives are:

- Water Stewardship Division, our vision is Water for BC; Safe, Sustainable and Values by all.
- Water Stewardship places priority on partnerships and capacity building as we are participating in here.
- With increasing population and other impacts on Mission Creek, we need to be planning and protecting our resource to ensure it is sustainable for future generations.
- Water licensed quantities should be met
- Farming must be recognized as a water use
- All water users should be metered
- All intakes should be screened to protect fisheries resources

Central Okanagan Regional District

Leigh Hartley articulated the range of interests of the region:

- In-stream values for fisheries
- Community expectations for flows in streams at all times
- Regional park planning includes additional land holdings in the Mission Creek watershed
- Flood hazards and erosion control
- Water quality and quantity to support community growth
- Some First Nations ALR lands do not have water licences and need to be considered

Benvoulin Water Users

Benvoulin Water Users have about 400 acres under irrigation. Surface conveyance is used for distribution. Primary objective is to be able to continue to irrigate.

South Kelowna Water Users

The area is about 100 acres with about 70 acres active. Objectives include:

- Ability to continue to irrigate
- Facilitate agriculture first and residential development second
- Provide water to all ALR lands

4.2. Operations Plan Development

Various operation plan concepts were discussed during the stakeholder meetings. A key parameter for fish flow releases is an estimate of the natural low flows at the WSC site. During drought periods, natural flows would have been much less than average. It was agreed that an estimate of natural flows at the WSC gauge should be used for fish flows and that natural flows should be estimated as a multiplier of Pearson Creek flows, an unregulated tributary of Mission Creek. BC Environment flow records indicate that natural flows at the WSC gauge would be about 6 times the Pearson Creek flows. This is a similar system that was developed for the Trout Creek Water Use Plan for the District of Summerland. For implementation, this would best be done with a real-time gauge on Pearson Creek.

It is understood that priority has been given by the Province for a new stream gauge at the Pearson Creek site. However no progress has been made on implementation primarily because of WSC staff shortages in the Okanagan. BC Environment has been using a pressure transducer at the Foolhen Road Bridge and recommends that this be the permanent site. The Foolhen Road Bridge site is good for current metering at high flows. A rating curve has been developed at the new site but additional measurements would be required every few years to account for bed shifts. The transducer housing also needs to be made secure. As the Water Use Plan proposes to use this site as an index of natural flows, BMID may have to manage the site until WSC increases staffing.

The performance of the plans was compared with conservation flows expressed as a percentage of mean annual discharge (MAD) in Mission Creek at the WSC gauge. The MAD at the WSC gauge was estimated to be 7.5 m^3/s.

August 30% MAD = 2.25 m^3/s
September 25% MAD = 1.9 m^3/s
October 20% MAD =1.5 m^3/s

The conservation flows listed above are the desired target levels for fish flows in lower Mission Creek. As will be shown in Section 5, target levels can normally only be met in wet years.

5. MISSION CREEK WATER SUPPLY OPERATIONS PLAN

5.1. Operating Scenario

The procedure for developing the water supply operations plan for Mission Creek was to simulate operations over the 50-year period and investigate required reductions in water supply demand and fish flows in order to provide a reliable water supply for all the years of simulation. The model was set up based on the following scenario:

The water supply demand was based on the 2002 demand for both SEKID and BMID. This was a year with a demand slightly greater than average.

Loch Long was not used in the analysis as it is licensed to the Crown for fish flows. Releases from Loch Long can be used to make up any shortfalls in fish flows in extreme dry years.

Turtle Reservoir was included as part of SEKID storage.

Downstream releases were set at 6 times Pearson Creek flows for the period July to October. Allocation of releases was set at 87% from BMID and 13% from SEKID based on estimates of natural flows from the two catchment areas.

Flows at the WSC gauge do not need to exceed conservation flow values:

July: 2.25 m^3/s (equal to August)
August: 2.25 m^3/s
September : 1.9 m^3/s
October:1.5 m^3/s

The July conservation flow value cap was set equal to the August value because the flow conditions in the second half of July are similar to August. In the first half of July the freshet conditions continue to provide significant unregulated flows.

A minimum flow override was used corresponding to the current minimum flow release rates which are 0.031 m^3/s from SEKID and 0.5 m^3/s from BMID.

Four drought stages are proposed, Mild, Moderate, Severe and Extreme. This is the same nomenclature used in the BMID Drought Management Plan (Agua Consulting, 2005) The

water supply system was simulated over 50 years with adjustment of demand factors and trigger graphs so that only the Mild and Moderate drought stages were experienced. Severe and Extreme drought conditions that could result in supply failure were avoided in the simulations by adjustment of the demand and release parameters in the model.

Trigger Graphs for BMID and SEKID are attached as Figure 5.1 and Figure 5.2 respectively. The total live storage quantities included in the trigger graphs represent the following:

	Reservoirs included in total live storage
SEKID:	McCullough, Turtle, Fish, Long Meadow and Browne Lakes
BMID:	Ideal, Graystoke, Fish Hawk

Total storage for these was tracked in the model against the trigger graphs and the drought stage determined.

The trigger graphs use Julian days for the x- axis which is the day of the year from 1 to 365. This provides the most accurate x- axis and avoids confusion over whether the start day or end day of a month is indicated by a month label.

5.2. Simulation of operations plan

To maintain a reliable water supply (avoidance of Severe and Extreme drought stages for all 50 years in the simulation) it was found that the water supply demands did not have to be reduced and relatively minor reductions in fish flows would be required. The factors are presented in Table 5.1 for demand and downstream releases.

Table 5.1: Demand and release factors

Stage	BMID Factors		Pearson Multiplier
	Demand	Downstream Release	
0	1	1	5.2
1	1	0.9	4.7
2	1	0.9	4.7
3			
4			

Stage	SEKID Factors		Pearson Multiplier
	Demand	Downstream Release	
0	1	1	0.8
1	1	0.9	0.7
2	1	0.8	0.6
3			
4			

The final column is the Pearson Creek multiplier based on a 6 times multiplier with an overall split of 87:13 between BMID and SEKID. This ratio should be reviewed following several

years of operational experience. Factors were not derived for Stages 3 and 4 as entering these drought stages would risk water supplies. During actual operations, if these stages are entered, reductions in demand and downstream releases would be required.

Use of this operations plan will mean operating with lower reservoir levels more frequently in the late summer and fall. Figures 5.3 and 5.4 show the modelled total storage for a sample of modelled years for the BMID reservoirs and the SEKID reservoirs. The actual reservoir total storage in 2003 is also shown. For the BMID total storage in Figure 5.3, it can be seen that the modelled total storage levels in 2003 are well below the 2003 recorded levels. The total SEKID storage in Figure 5.4 included Turtle Reservoir but even then the modelled total storage is below the storage recorded in 2003. Implementation of this operations plan will require a different operations philosophy with less emphasis on conserving storage in the late summer and fall.

Figure 5.5 shows the frequency of BMID drought stages over the simulation period. The number of months in the various drought stages is shown in Figure 5.6 which demonstrates that BMID would enter Stage 1 and 2 droughts infrequently. The frequency of SEKID drought stages over the simulation period is shown in Figure 5.7 and the number of months in the various drought stages is shown in Figure 5.8. Compared with BMID, these figures show that SEKID will more often experience mild and moderate drought stages.

Figure 5.9 shows the monthly flows below the SEKID and BMID intakes for the years 2000 to 2004. Figure 5.10 shows the same data for the year 2003. Except in the winter months, releases are generally more than the minimum of 0.031 m^3/s from the SEKID intake and 0.5 m^3/s from the BMID intake.

5.3. Fish flows

Fish flow targets were set provisionally at % of MAD at the WSC gauge which is about 7.5 m^3/s.

- August 30% MAD = 2.25 m^3/s
- September 25% MAD = 1.9 m^3/s
- October 20% MAD =1.5 m^3/s

The model tracks how well system meets targets by counting occurrences in these ranges:

- 75–100% of target
- 50-75 % of target
- 25-50% of target
- 0-25% of target

Figure 5.11 shows the number of weeks in August, September and October over the modelling period that flows at the WSC gauge were within the above ranges. Blank spaces indicate that the flows were above the conservation flow targets. As can be seen in Figure 5.11, flows in August, September and October will be at 75% of conservation targets or above in most years. There are only 9 years out of 50 when flows would be between 25 and 50% of targets and the duration would typically last one to two weeks. There is only one week in the 50 year period when conservation flows would be less than 25% of target. This

demonstrates that in most years a high percentage of conservation flows can be provided in Mission Creek which also benefits other downstream users.

This analysis is based on the conditions without the operation of Loch Long as the licence is owned by the Crown. Releases from Loch Long will increase the reliability of downstream flows for fisheries and other users.

The Water Use Plan for Mission Creek should be reviewed every 5 years or so to compare operational experience with planned performance. Principles of adaptive management should be applied so that operations can be modified in response to changing conditions and improved understanding of the hydrology of Mission Creek.

6. CONCLUSIONS

1. A Water Use Plan process was carried out for a Stakeholder Committee of the Mission Creek Watershed Partnership with representation from the Black Mountain Irrigation District (BMID), South East Kelowna Irrigation District (SEKID), Regional District of Central Okanagan, the City of Kelowna, the British Columbia Ministry of Environment and other water users.

2. Flow releases have been made from the BMID and SEKID intakes based on water license requirements and are fixed rather than variable releases. The feasibility of implementing a system of variable releases was investigated as part of the Water Use Plan process.

3. A reservoir simulation model was developed to simulate the operation of the BMID and SEKID water supply system on Mission Creek. The model used weekly flow estimates provided by the Environment Canada HBV-EC model which used climate data for a 50-year period on Joe Rich Creek, a tributary of Mission Creek.

4. The Mission Creek water supply system was simulated based on current operating rules to verify the hydrologic and reservoir operation models. It was found that adjustments had to be made to the HBV-EC flow values to match the records of reservoir levels. While the match to the reservoir operation data is fair, the current model consistently underestimates flows at the WSC gauge in most years. The hydrologic model calibration should be revisited when the Water Use Plan is updated

5. An operations plan was developed based on providing fish flows downstream of the BMID and SEKID intakes using flows on Pearson Creek (an unregulated tributary of Mission Creek) as an index of natural flows at the WSC gauge.

6. Based on the findings of this study the Mission Creek Watershed can support increased downstream flows for fisheries and other users without compromising water supply for irrigation and community use. This is because BMID has a large watershed area with reliable snow accumulation and the addition of Turtle Reservoir increases supply reliability for SEKID.

7. Fish flow conservation targets would frequently be met in wet years for August, September and October. There are only 9 years out of 50 when flows would be between 25 and 50% of targets and the duration would typically last one to two

weeks. There is only one week in the 50 year period when conservation flows would be less than 25% of target. Releases from Loch Long were not included in this analysis and will increase the reliability of downstream flows for fisheries and other users.

8. The operations plan will result in operating with lower reservoir levels more frequently in the late summer and fall. Implementation of this operations plan will require a different operations philosophy with less emphasis on conserving storage in the late summer and fall.

9. The Water Use Plan for Mission Creek should be reviewed every 5 years or so to compare operational experience with planned performance. Principles of adaptive management should be applied so that operations can be modified in response to changing conditions and improved understanding of the hydrology of Mission Creek.

7. REFERENCES

Agua Consulting, 1995. 2005 Drought Management Plan. Report to the Black Mountain Irrigation District

Pike, Toby, 2005. Agricultural Water Conservation Review. Internal Report to the South East Kelowna Irrigation District.

FIGURES

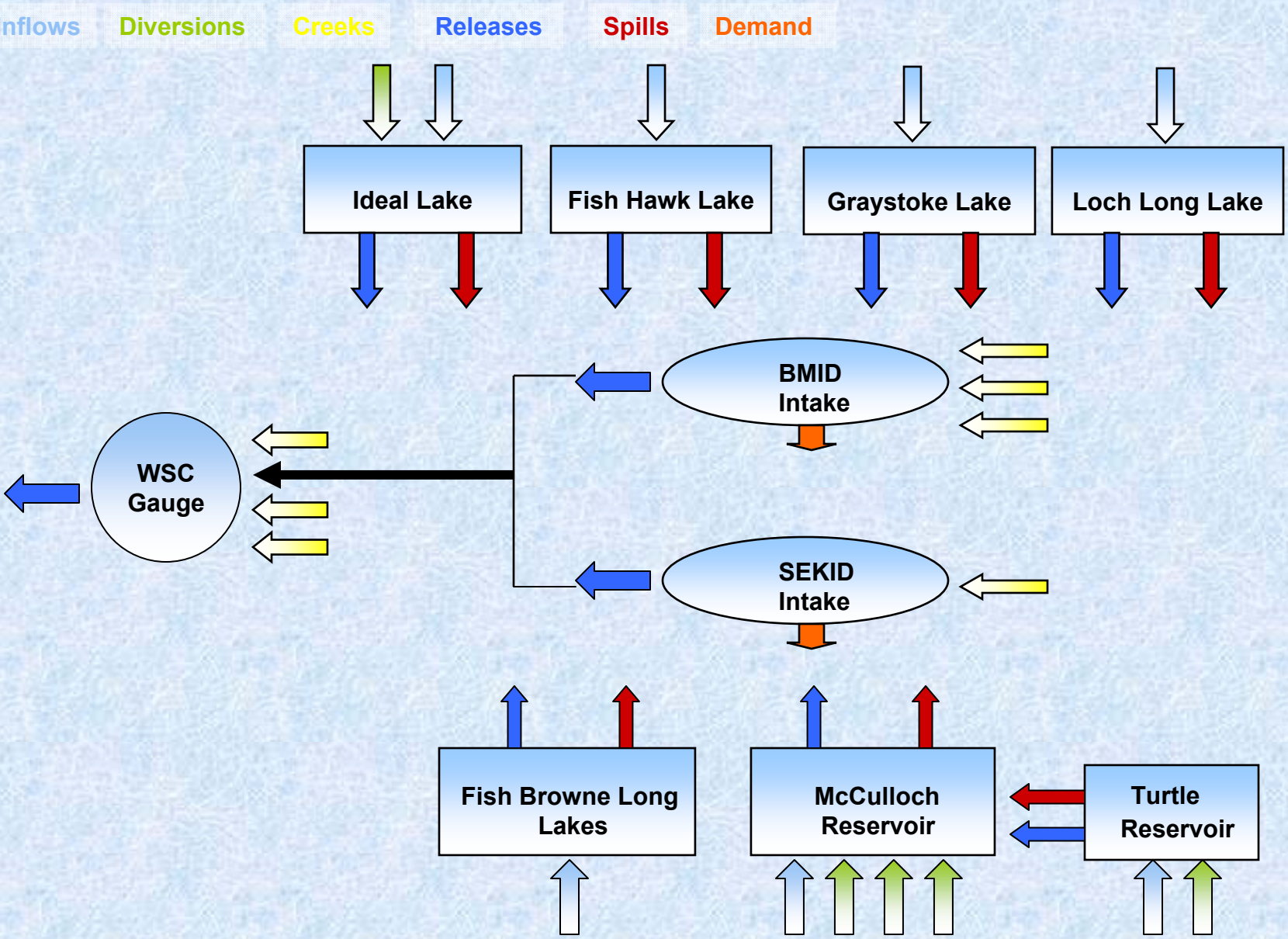

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Figure 3.1 Operations Model Schematic

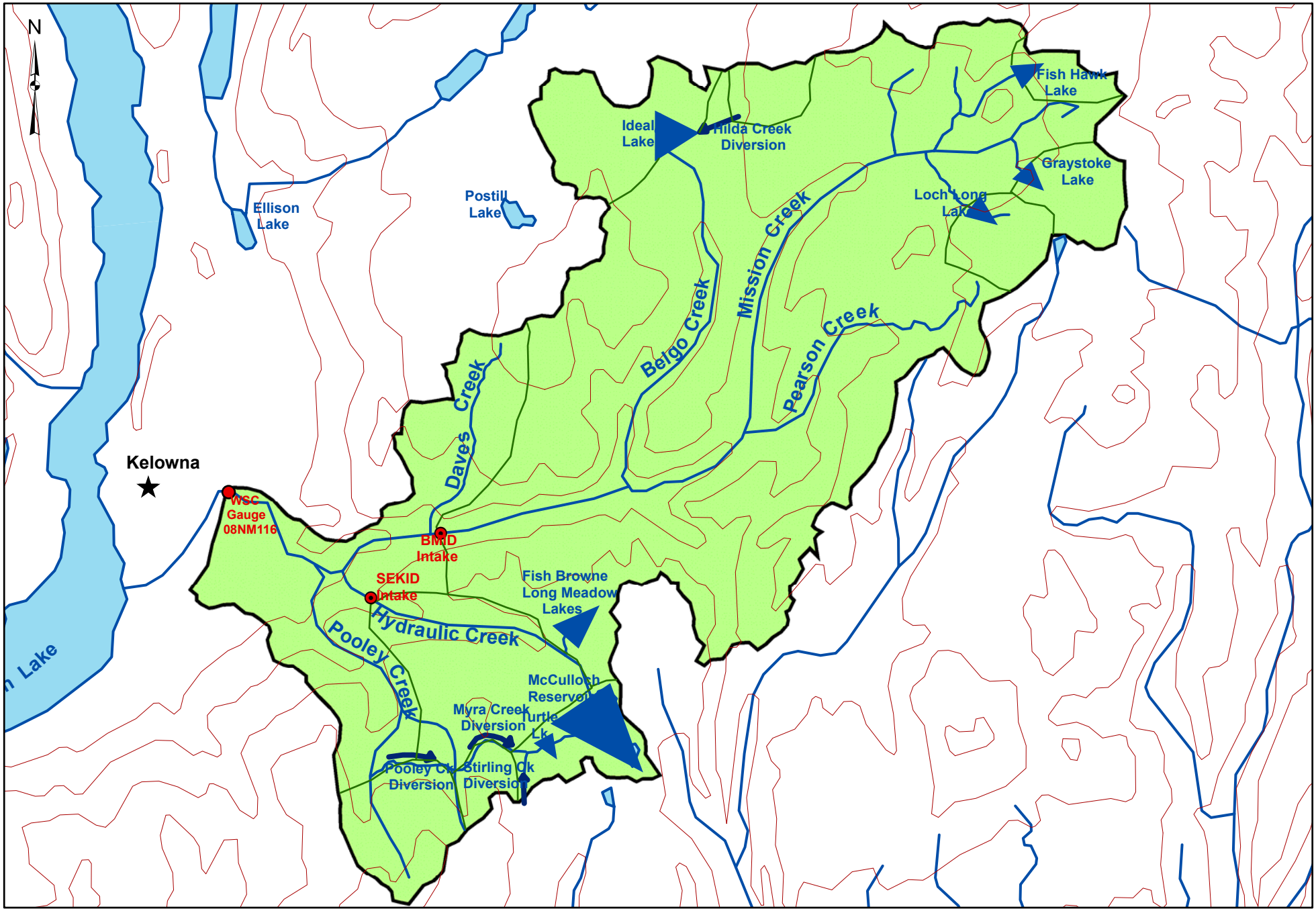

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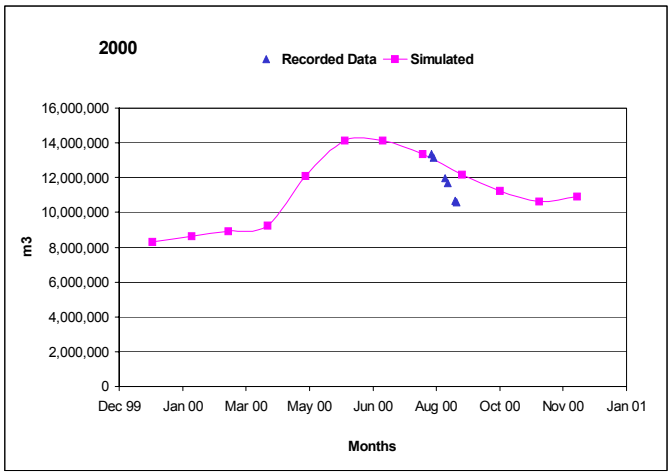
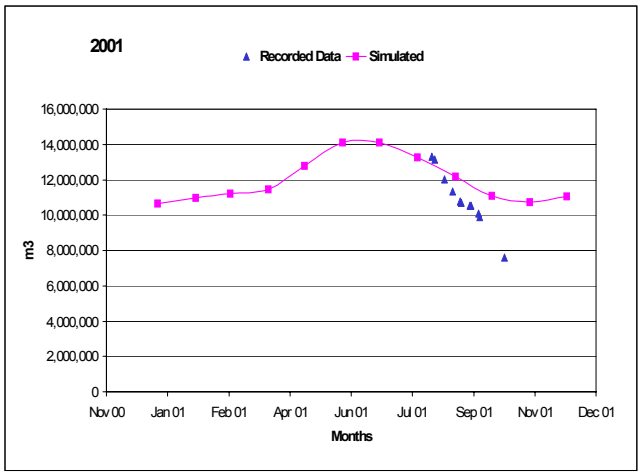
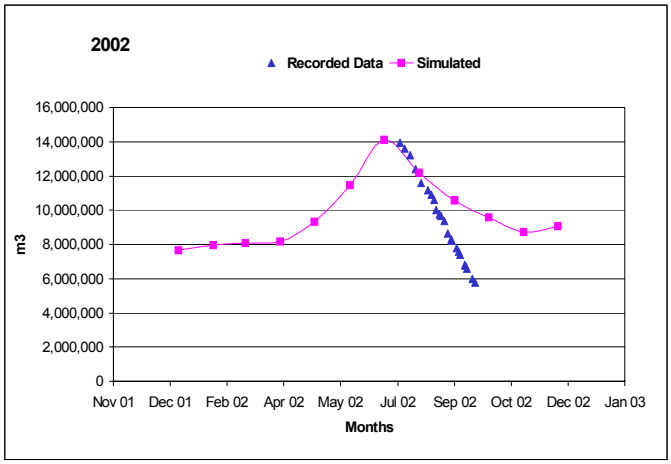
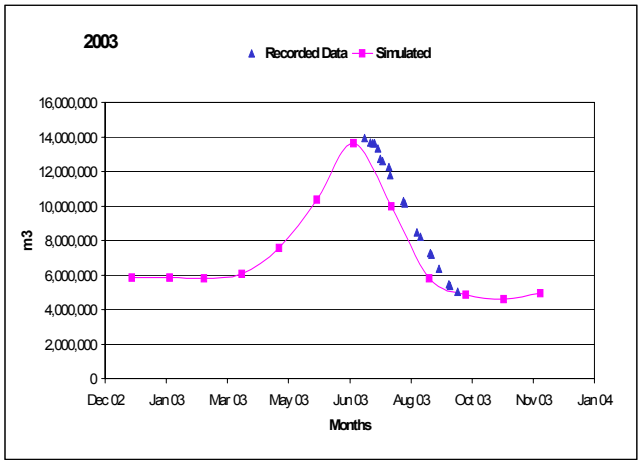
Figure 3.2 Operations Model Layout









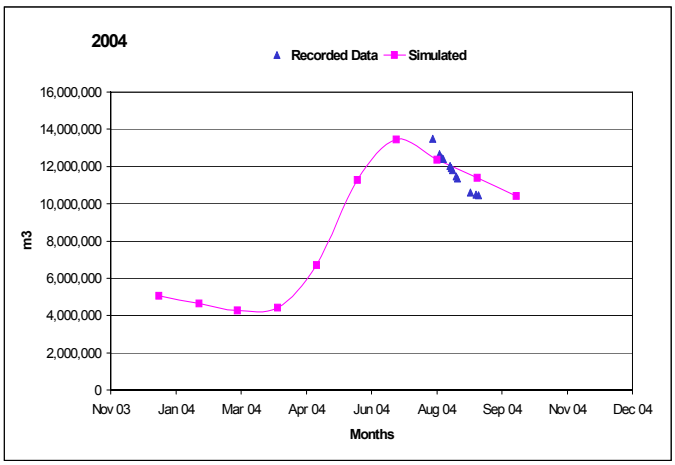


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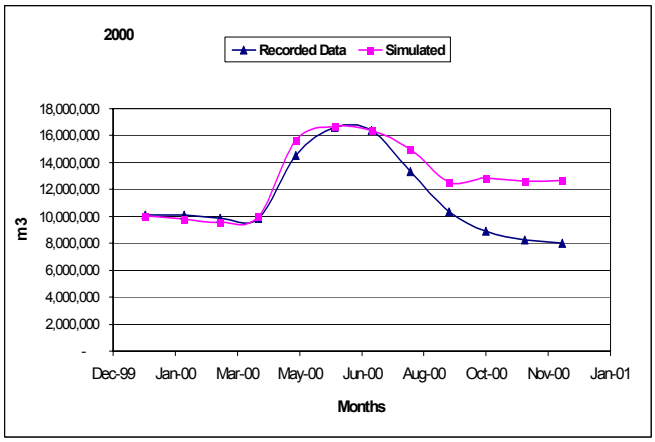
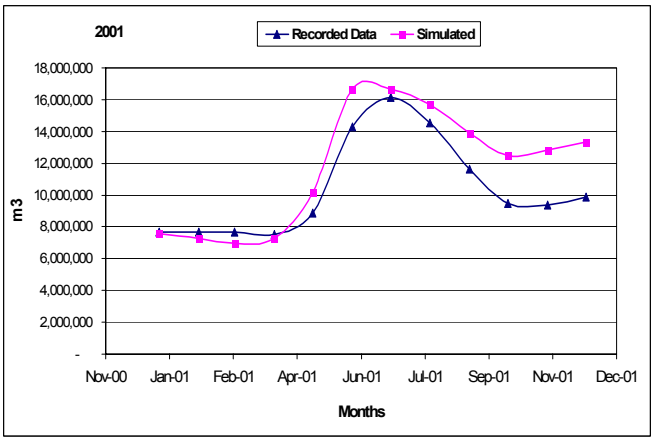
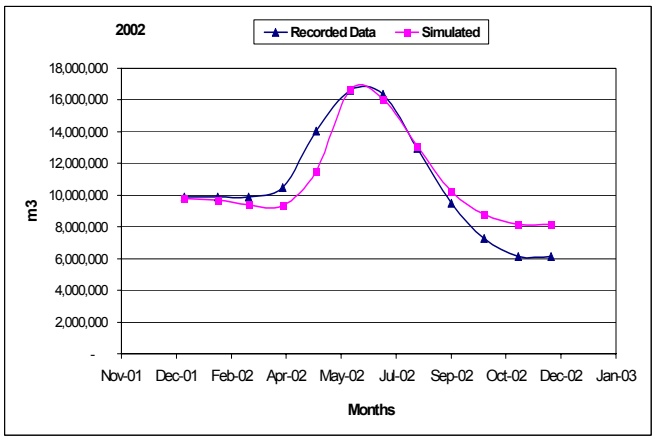
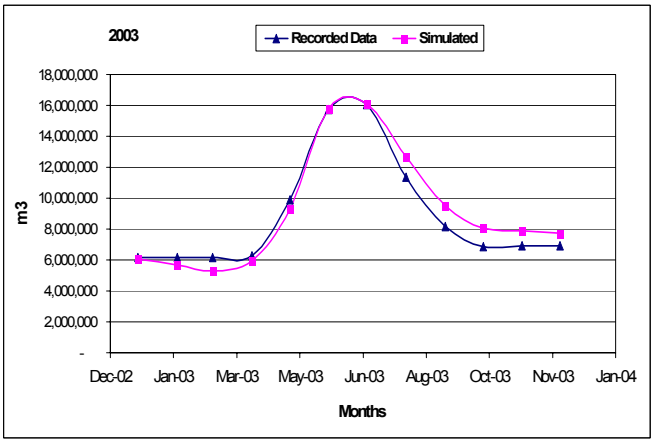
Figure 3.3 Model calibration results for total BMID storage









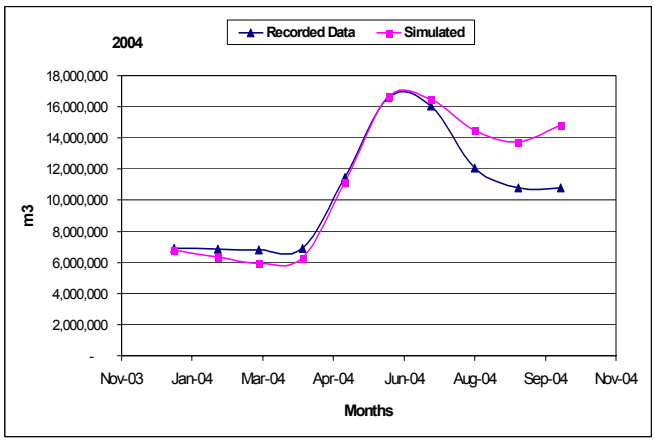


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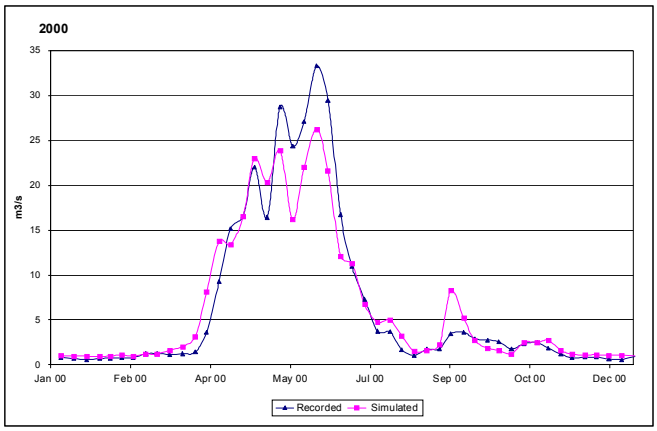
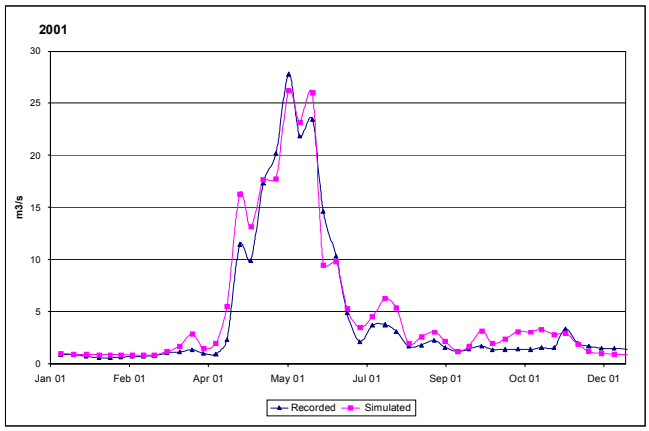
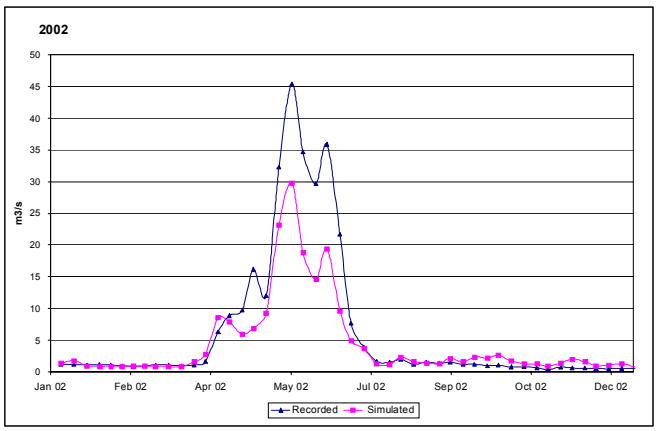
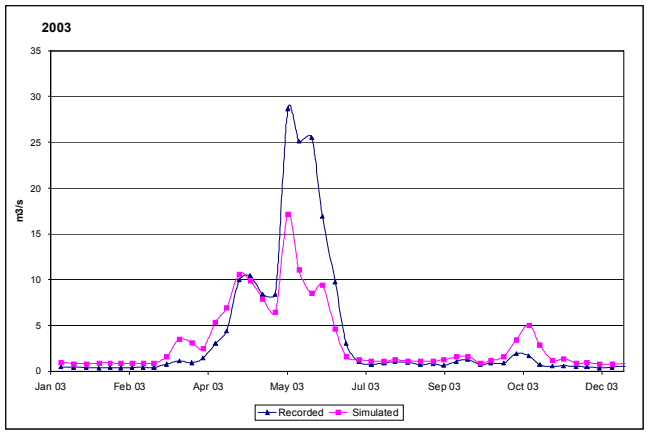
Figure 3.4 Model calibration results for McCulloch Reservoir storage









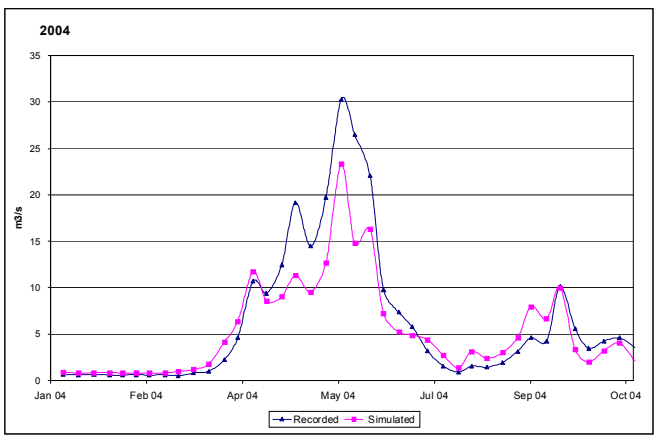


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Figure 3.5 Model calibration results for total Mission Creek flows at the WSC gauge

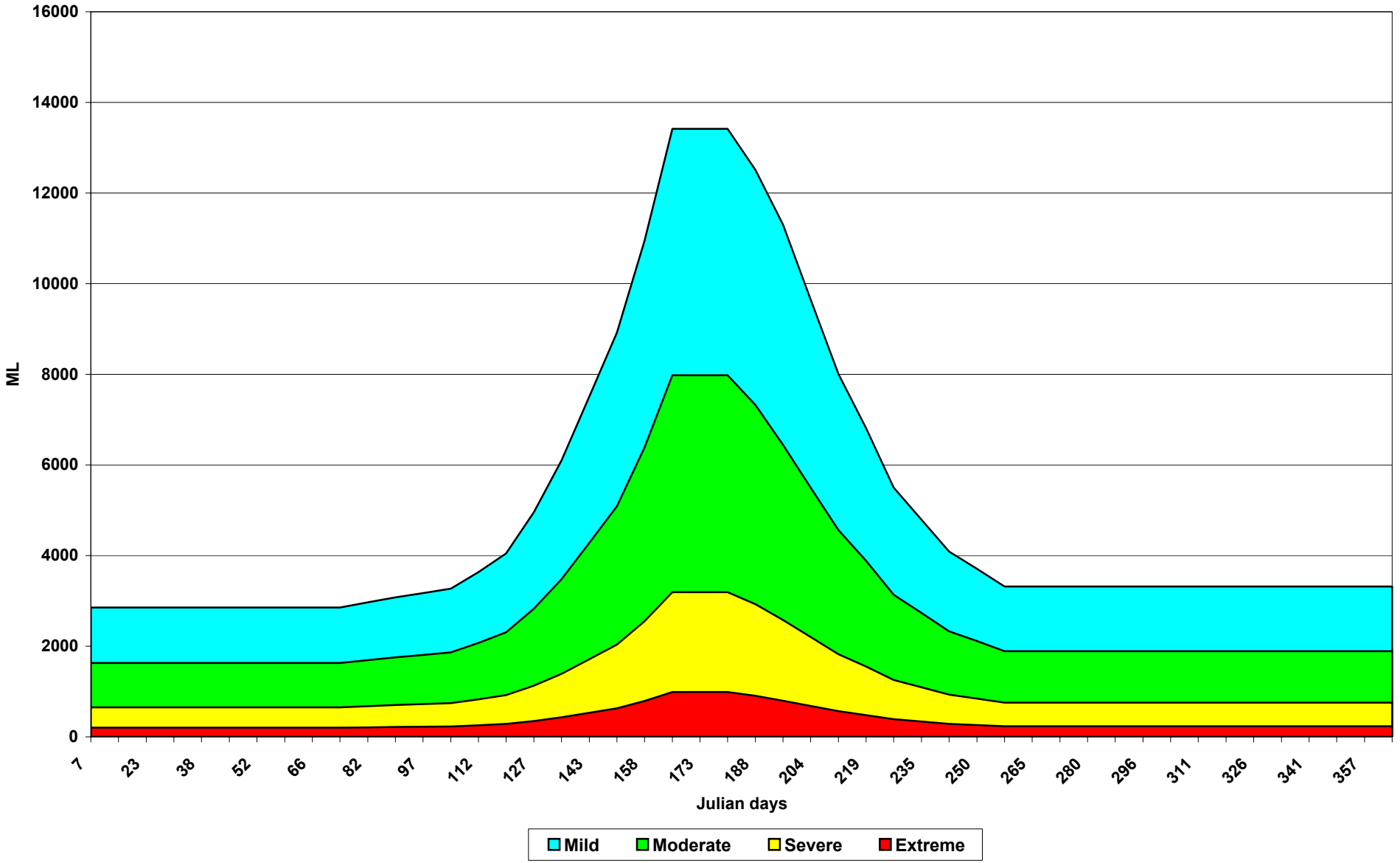

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Figure 5.1 BMID Drought Stage Trigger Graph

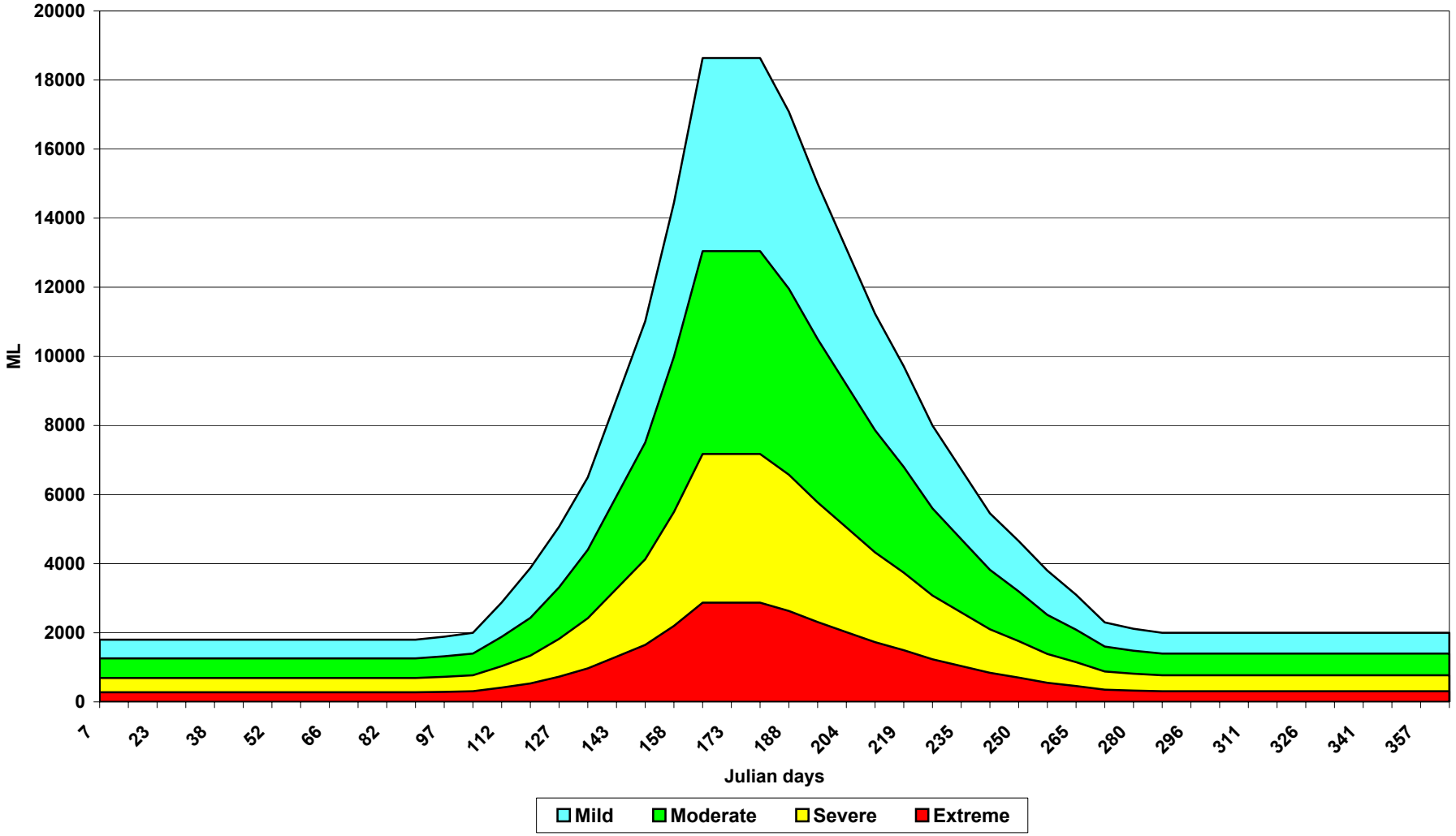

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Figure 5.2 SEKID Drought Stage Trigger Graph

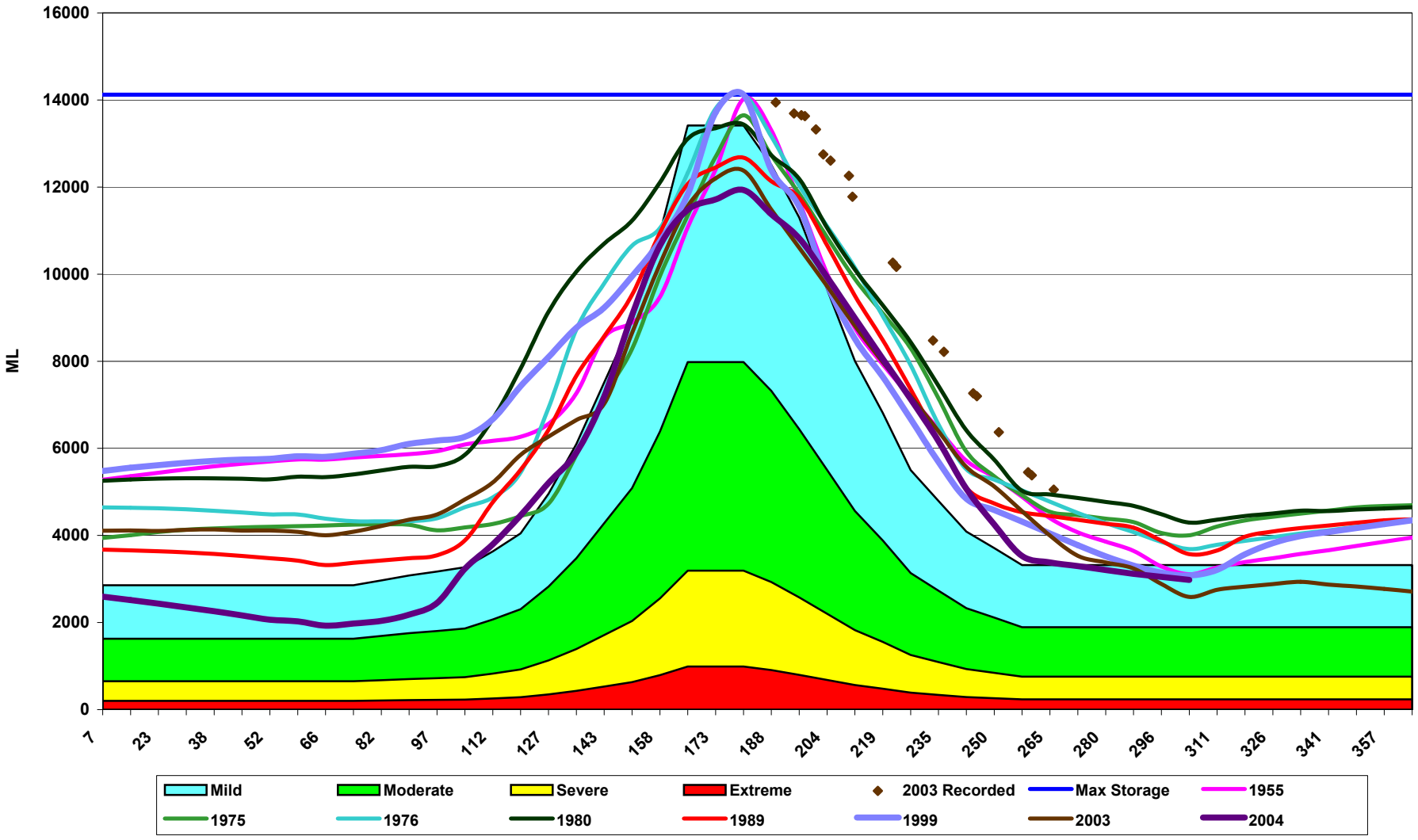

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Figure 5.3 BMID simulated total reservoir storage

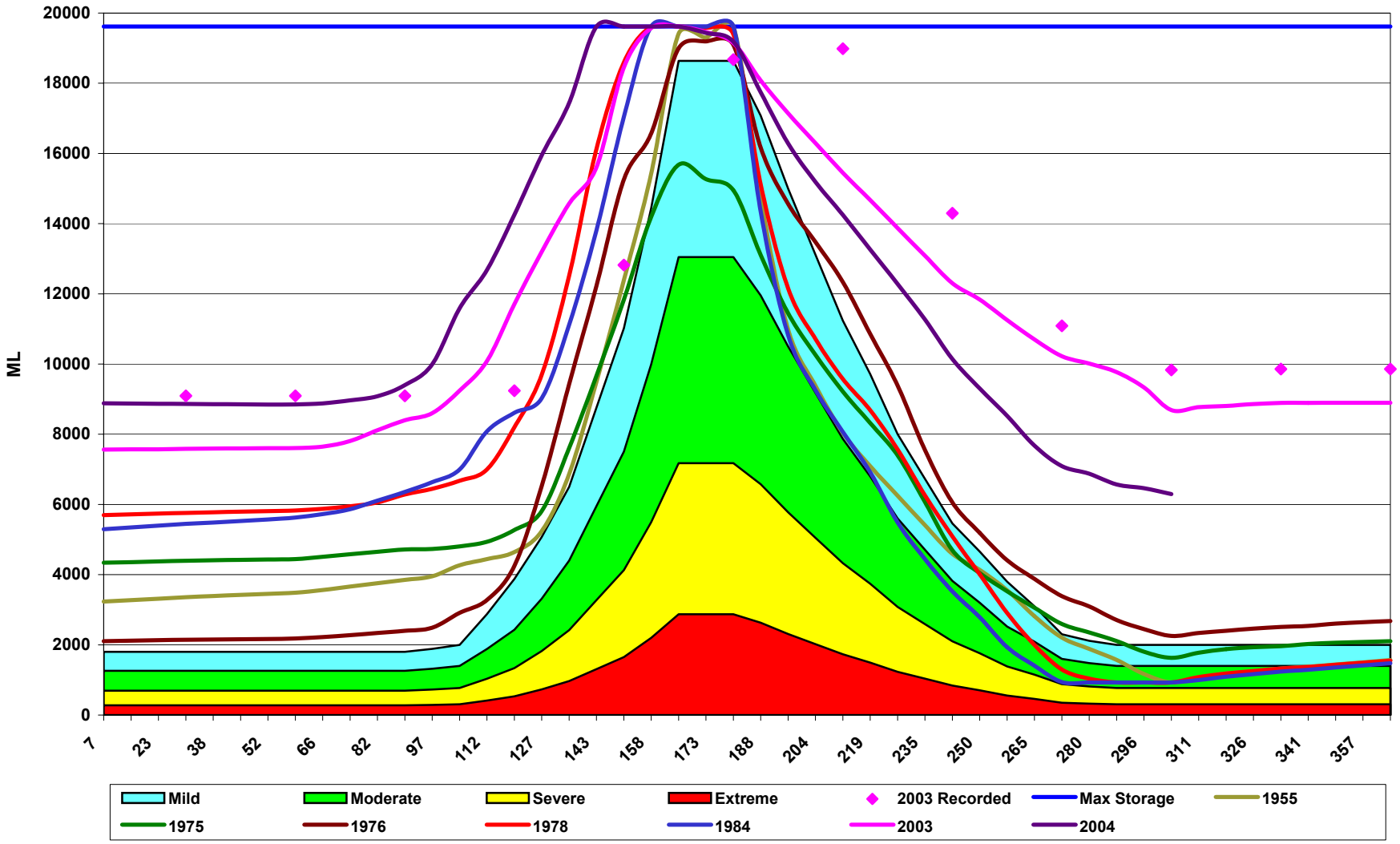

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Figure 5.4 SEKID simulated total reservoir storage

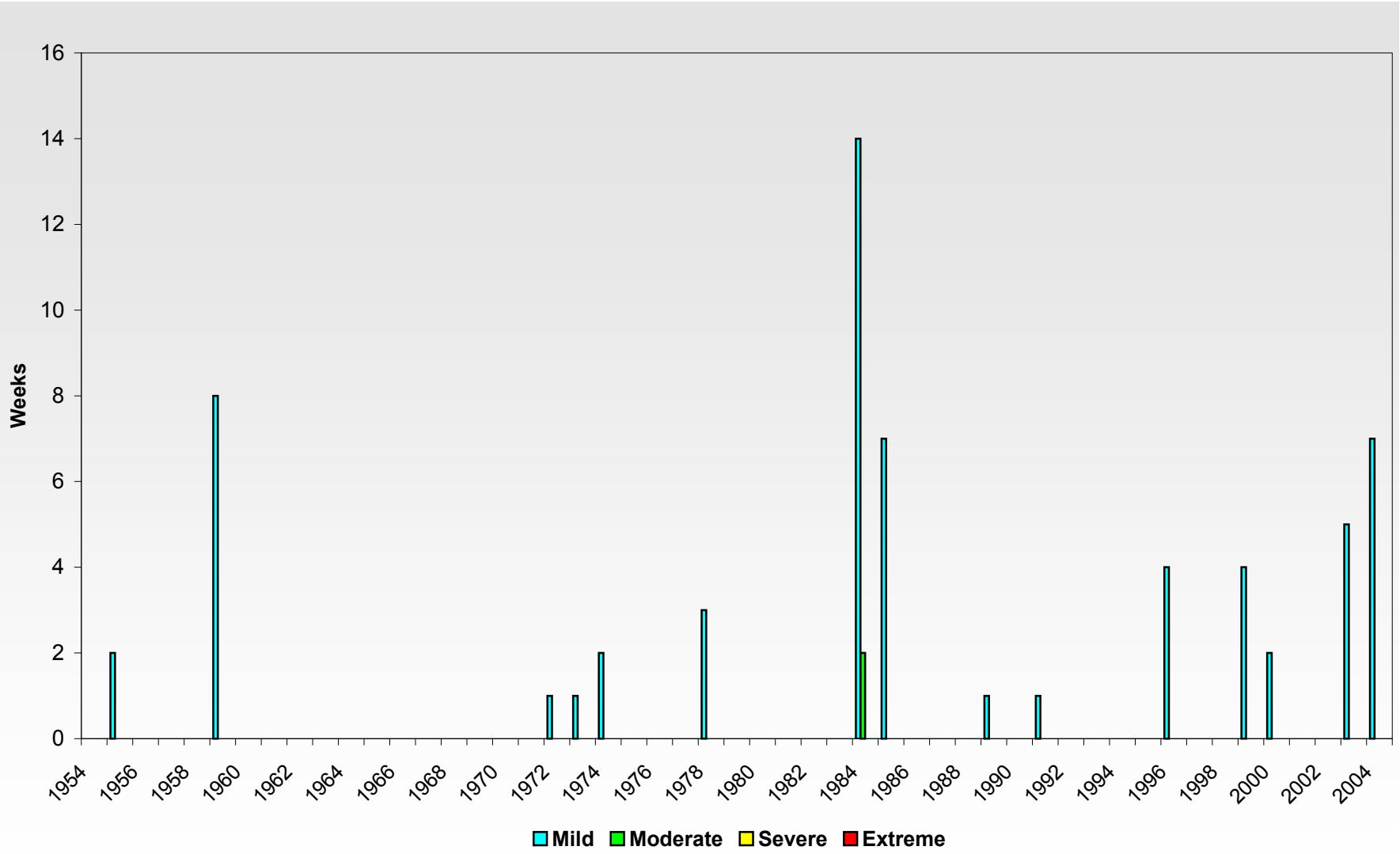

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Figure 5.5 Frequency of BMID drought stage

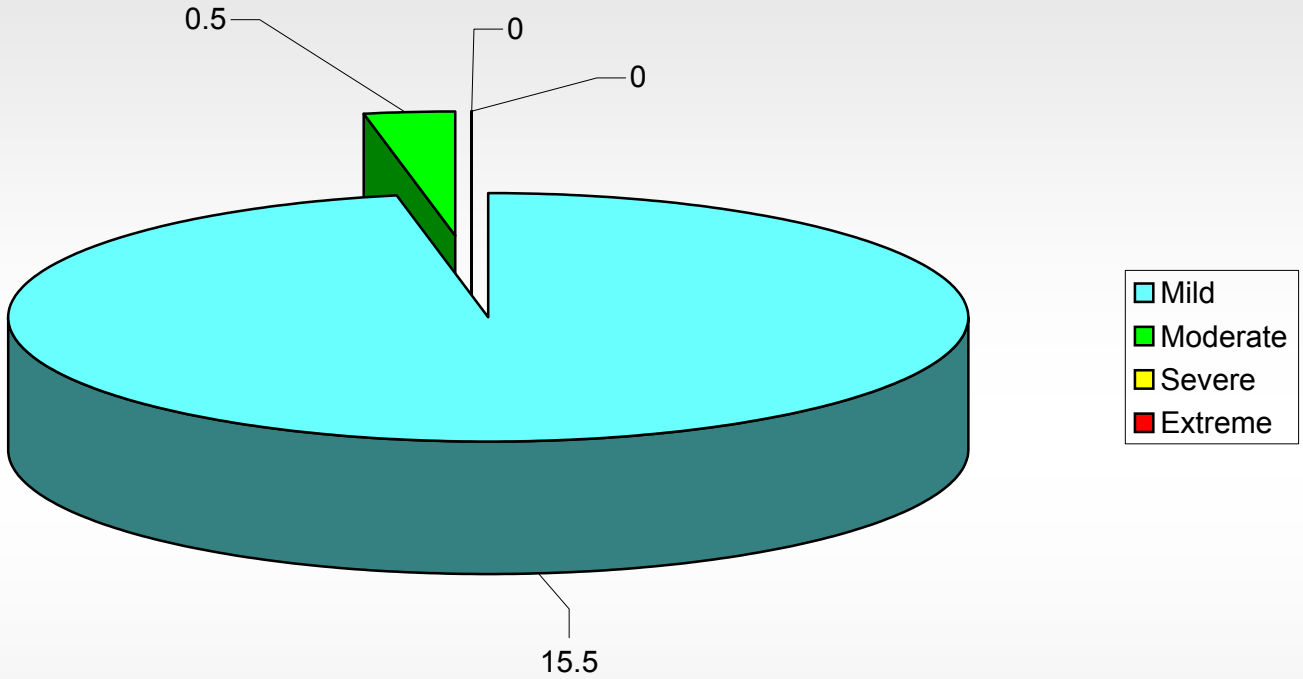

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Figure 5.6 Number of months of BMID drought stages

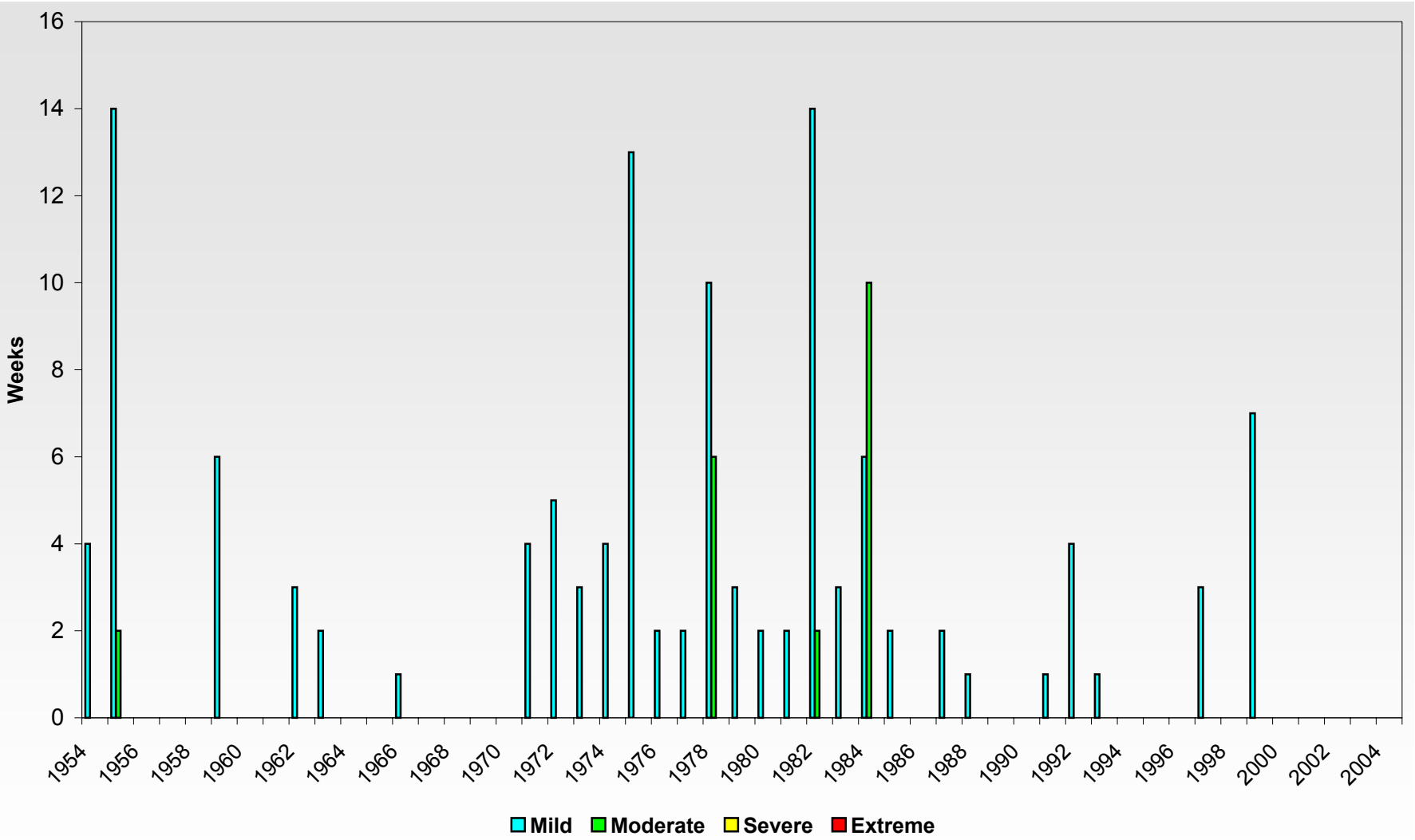

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Figure 5.7 Frequency of SEKID drought stage

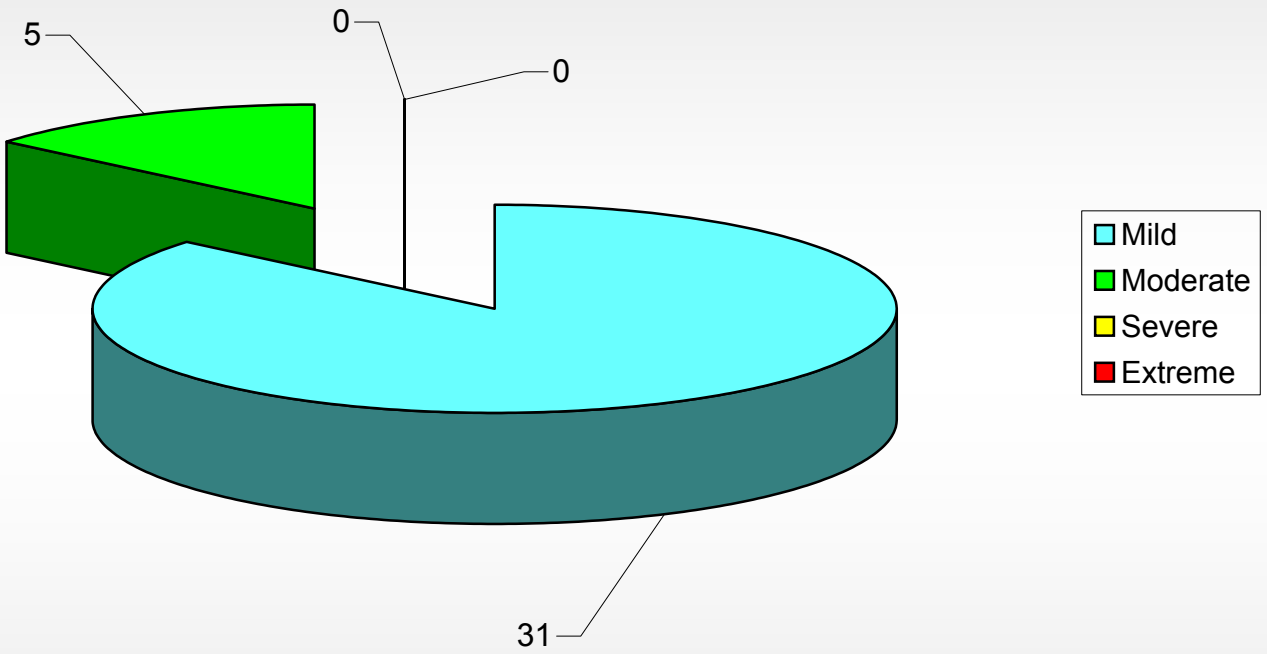

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Figure 5.8 Number of months of SEKID drought stages

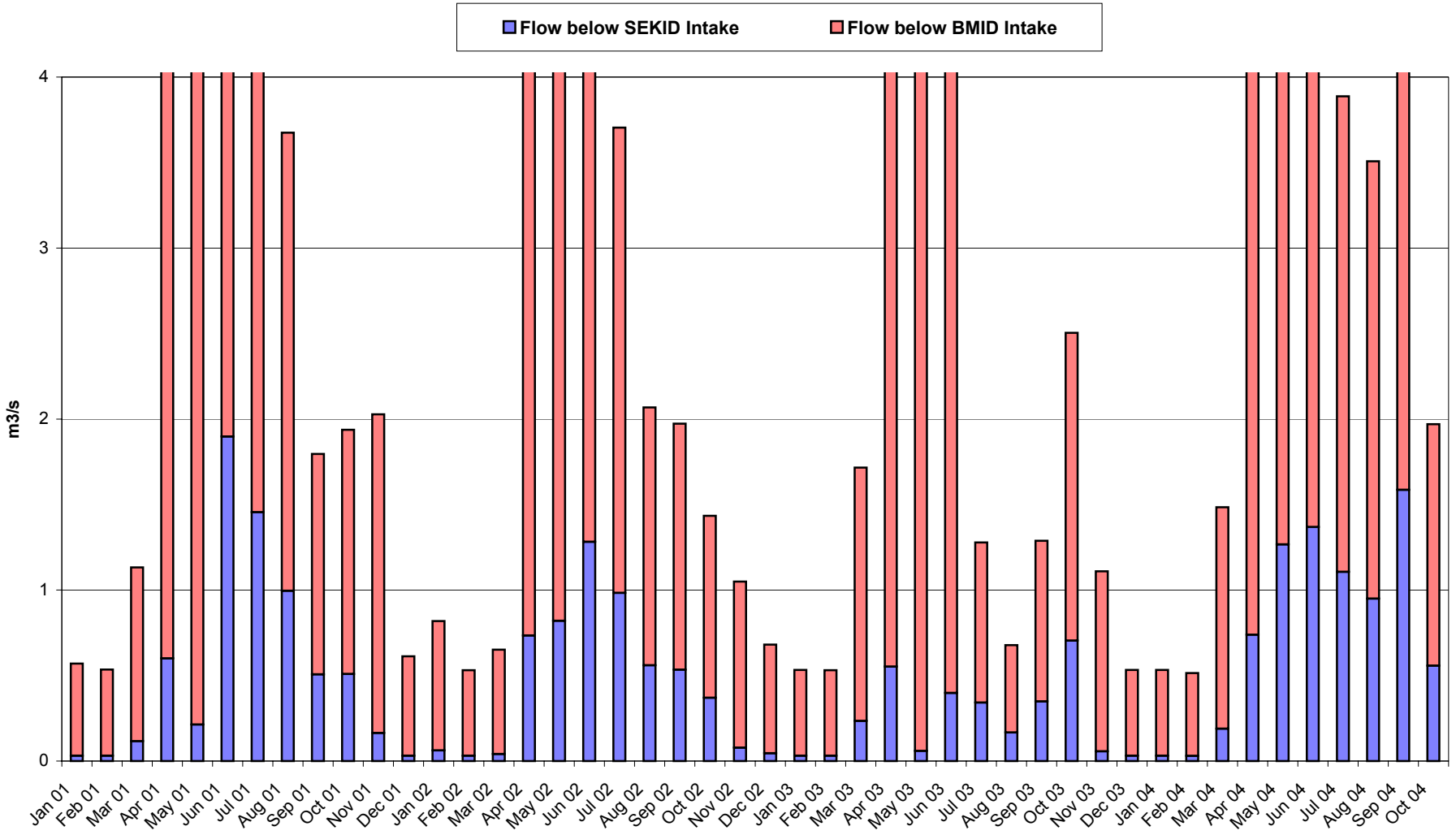

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Figure 5.9 Monthly flows below SEKID and BMID intakes from 2001 to 2004

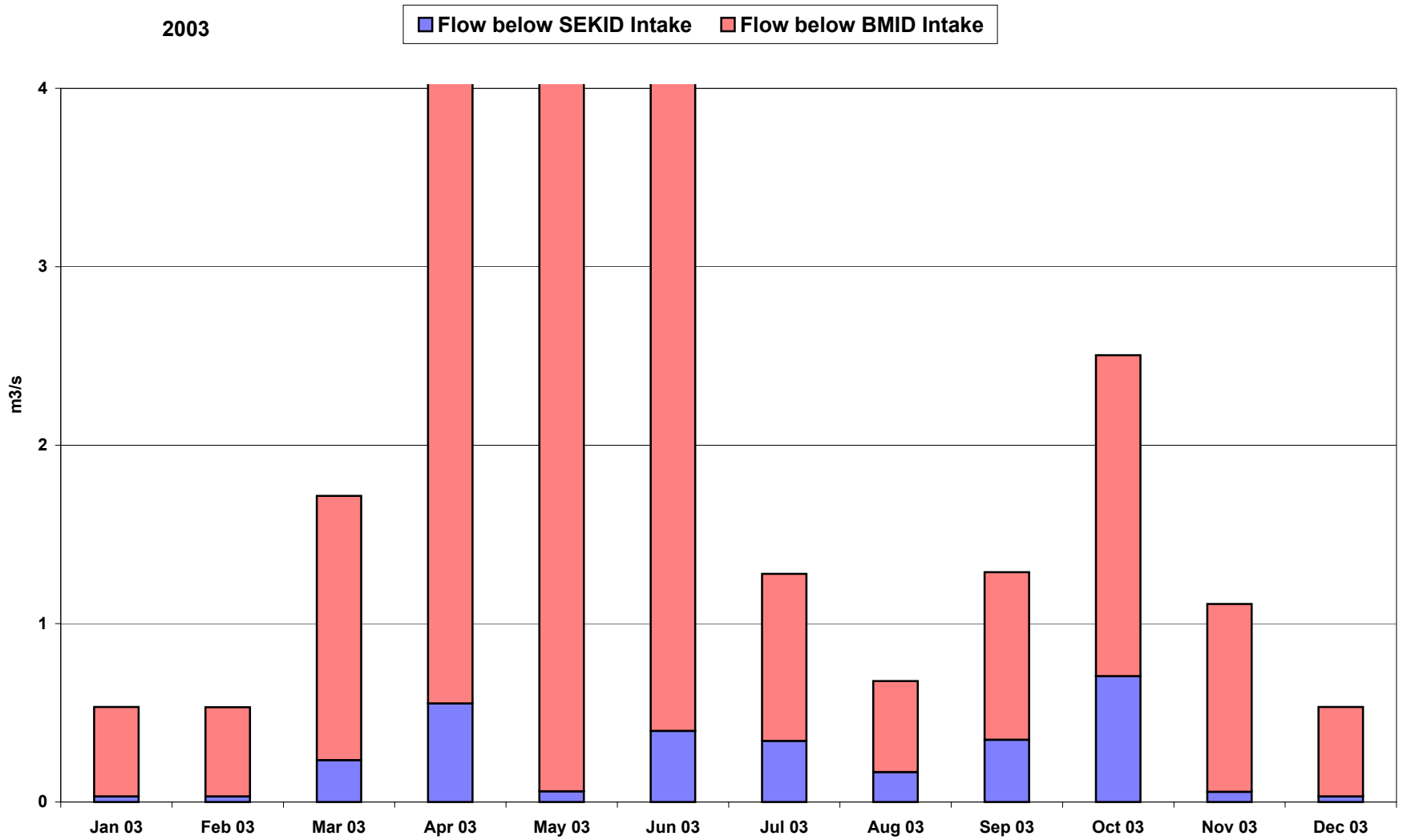

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Figure 5.10 Monthly flows below SEKID and BMID intakes for 2003

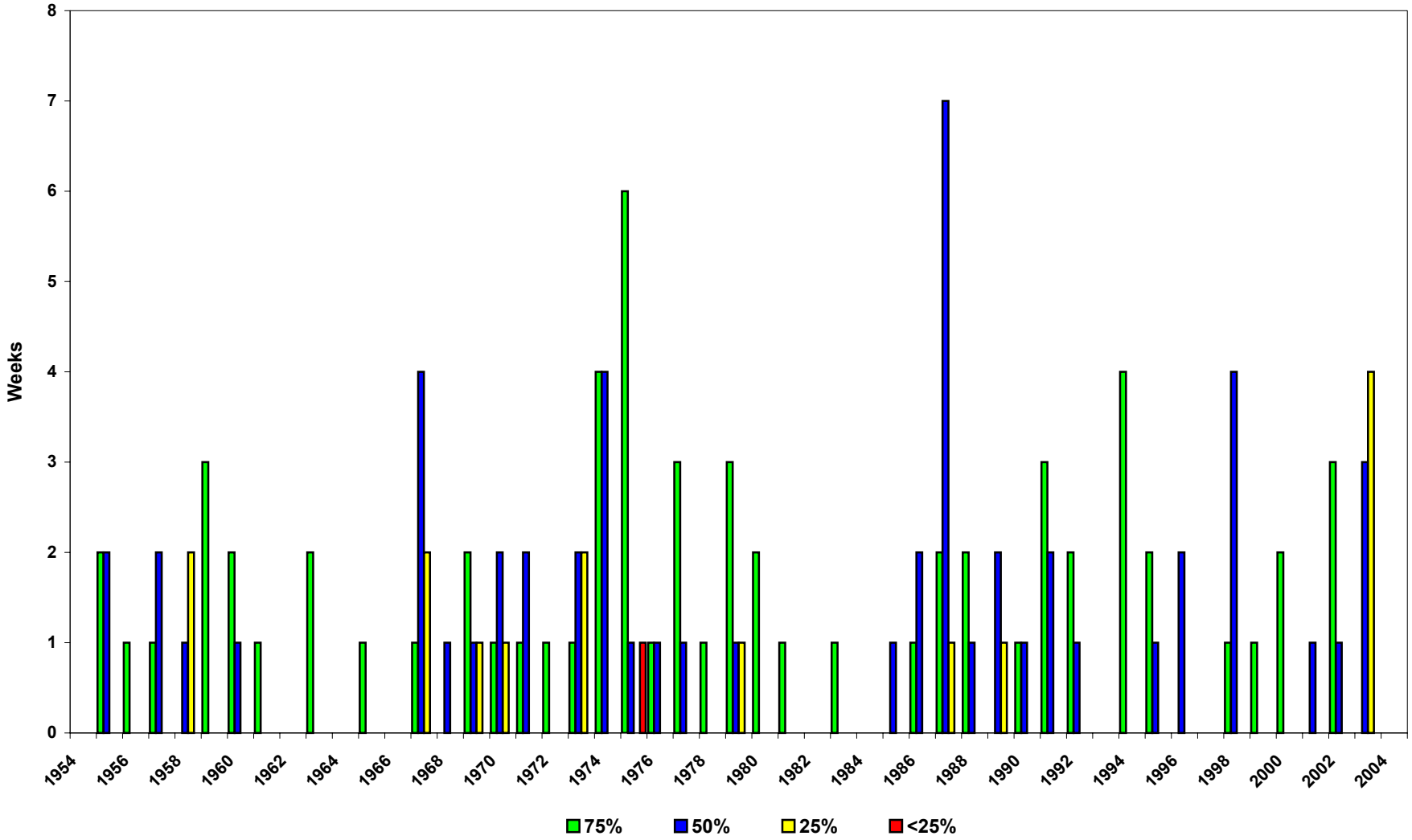

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Figure 5.11 Frequency of weekly fish flows targets in Aug, Sep and Oct

APPENDIX 1

MISSION CREEK WATER USE PLAN

FINAL NOTES OF STAKEHOLDER MEETING #1
February 6 2008

Kalamoir Room
Regional District of Central Okanagan

Notes prepared by David Sellars

Attendance

David Sellars	Water Management Consultants	dsellars@watermc.com
Bob Hrasko	Black Mountain Irrigation District	rhrasko@shaw.ca
Toby Pike	Southeast Kelowna Irrigation District	pike@sekid.ca
Paul Askey	BC Environment	Paul.Askey@gov.bc.ca
Phil Epp	BC Environment	Phil.Epp@gov.bc.ca
Jane Bender	BC Environment	Jane.Bender@gov.bc.ca
Ray Rampone	South Kelowna Water Users	rrampone@shaw.ca
Tony Cetinski	South Kelowna Water Users	suncatcherfarm@shaw.ca
Tim Culos	Benvoulin Water Users	2190 Benvoulin Road Kelowna, BC V1W 2C6
Kevin Day	Benvoulin Water Users	2225 Burtch Rd Kelowna, BC V1Y 7Z5
Leah Hartley	Central Okanagan Regional District	leah.hartley@cord.bc.ca
Ted Van der Gulik	BC Agriculture and Lands	Ted.vanderGulik@gov.bc.ca

1. Water Use Plan Process and Schedule

The steps in the Water Use Plan (WUP) Process and the proposed overall schedule were reviewed.

A question was asked regarding any planned public consultation. David Sellars noted that this could be included later if it was appropriate to explain the plan to a larger group. The current process does not include public consultation as technical issues are best resolved by a smaller group of stakeholders.

Ted van der Gulik asked why the process was initiated. Phil Epp responded that the Ministry was concerned about low flows for supporting fisheries in Mission Creek and a more formal process of setting low flows would be an advantage.

Ted van der Gulik commented on the need for DFO sign-off. It was noted by Paul Askey that a memorandum of agreement between DFO and the BC Ministry of Environment is in the works regarding the Ministry being responsible for interior fish. It was agreed that Paul Askey/Tara White would request a letter from DFO authorizing BC Environment to represent DFO interests in the WUP.

ACTION ITEM: Paul Askey/Tara White to request letter from DFO.

The schedule for preparation of the Water Use Plan will require stakeholder meetings approximately once a month until early June. Three more stakeholder meetings are envisaged.

2. Preliminary Scope Statement

The Preliminary Scope Statement was discussed and revisions have been included on the attached.

3. Current Reservoir Operations

The current reservoir operations in Mission Creek were presented and discussed.

4. Objectives

The objectives for each of the stakeholders were presented as follows:

South East Kelowna Irrigation District

- Community and Agricultural demand levels equivalent to 1998 levels
- Reservoir inflows based on the design drought of two consecutive years of 59% of mean annual runoff
- Severe or extended drought: Agricultural demands no less than 80% of drought year allotment, domestic and commercial uses restricted to inside use with limited hand watering only.
- Maintain reservoir levels in the fall to replenish with average inflows.

The drought year allotment in SEKID is 27 inches.

Black Mountain Irrigation District

To have sufficient use to allow for continued agriculture and domestic use for our current and projected water demands. As increased water demands will result in additional storage, we believe that t current water estimates will suffice for at least a 5 year horizon. Specific objectives are as follows:

1. To operate to maximize the usage of Fishhawk, Graystoke, and Loch Long at times when our water treatment plant is off-line

2. To operate and utilize Ideal Lake water during freshet and when our WTP is running
3. To construct Black Mountain Reservoir within the City of Kelowna City limits to allow for off-line storage on Mission Creek within a time frame of 5 years
4. To have secure water from our storage reservoirs for the purposes and uses of the water district rate payers.
5. In the event of droughts, to cut back water usage in accordance with our Drought Plan and to adjust the flows so that extended droughts do not result in unnecessary hardship on our ratepayers, particularly the ones that require the water for their livelihood (Farmers, growers, gardeners)
6. To support fish habitat in those cases where water is not being utilized by our "Grade C" customers. (lands with water rights but not currently irrigated)
7. Through this Water Use Plan, understand better the base stream flows that are present in the creek during various seasonal variations and drought scenarios so that all parties understand the base requirements and the importance of storage
8. To understand the watershed impacts of water demand that would result from agricultural growth for an irrigated area increasing from 4,115 acres to as high as 8,000 acres. This land area is identified in the BMID Capital Works Plan.

Ministry of Agriculture and Lands

- Sufficient water allocation should be made for all those who have water rights to be able to irrigate.

- All currently dry lands within the ALR should be considered for future irrigation water.

Ted Van der Gulik will provide data on different irrigated land scenarios from his model.

Ministry of Environment- fisheries

Paul Askey noted that Mission Creek is the major nursery for Kokanee and Rainbow in the Okanagan.

The Mean Annual Discharge (MAD) in Mission Creek is 7-8 m^3/s. The ideal flows, when water is available in wet years, would be conservation flows which are 30% of MAD in August and 25% MAD in September and 20% MAD in October.

In dry years, natural flow levels in Lower Mission Creek would be the objective. Natural flow levels are variable and decrease in drought years. Phil Epp noted that a system could be used using recorded flows in Pearson Creek as an index to drought severity.

Ministry of Environment- Water Stewardship Division

Jane Bender noted that no additional irrigation licences will be issued on Mission Creek unless they are supported by storage. Key objectives are:

- Water Stewardship Division, our vision is Water for BC; Safe, Sustainable and Values by all.
- Water Stewardship places priority on partnerships and capacity building as we are participating in here.
- With increasing population and other impacts on Mission Creek, we need to be planning and protecting our resource to ensure it is sustainable for future generations.
- Water licensed quantities should be met
- Farming must be recognized as a water use
- All water users should be metered
- All intakes should be screened to protect fisheries resources

Central Okanagan Regional District

Leigh Hartley articulated the range of interests of the region:

- In-stream values for fisheries
- Community expectations for flows in streams at all times
- Regional park planning includes additional land holdings in the Mission Creek watershed
- Flood hazards and erosion control
- Water quality and quantity to support community growth
- Some First Nations ALR lands do not have water licences and need to be considered

Benvoulin Water Users

About 400 acres under irrigation. Surface conveyance is used for distribution. Primary objective is to be able to continue to irrigate.

South Kelowna Water Users

The area is about 100 acres with about 70 acres active. Objectives include:

- Ability to continue to irrigate
- Facilitate agriculture first and residential development second
- Provide water to all ALR lands

5. Next meeting

The next meeting was set for Wednesday April 2 at 11.00 am at Central Okanagan Regional District Offices. At that meeting the Mission Creek Reservoir Operation Model will be reviewed and preliminary findings on water supply and use will be available reflecting the above objectives.

MISSION CREEK WATER USE PLAN

FINAL NOTES OF STAKEHOLDER MEETING #2
April 2 2008

Whitehaven Room
Regional District of Central Okanagan

Notes prepared by David Sellars

Attendance

David Sellars	Water Management Consultants	dsellars@watermc.com
Bob Hrasko	Black Mountain Irrigation District	rhrasko@shaw.ca
Toby Pike	Southeast Kelowna Irrigation District	pike@sekid.ca
Tara White	BC Environment	Tara.White@gov.bc.ca
Phil Epp	BC Environment	Phil.Epp@gov.bc.ca
Jane Bender	BC Environment	Jane.Bender@gov.bc.ca
Solvej Patschke	BC Environment	Solvej.Patschke@gov.bc.ca
Ray Rampone	South Kelowna Water Users	rrampone@shaw.ca
Tony Cetinski	South Kelowna Water Users	suncatcherfarm@shaw.ca
Kevin Day	Benvoulin Water Users	2225 Burtch Rd Kelowna, BC V1Y 7Z5
Brent Magnan	Central Okanagan Regional District	brent.magnan@cord.bc.ca
Ted Van der Gulik	BC Agriculture and Lands	Ted.vanderGulik@gov.bc.ca

1. Action items from previous meeting

Outstanding:

Ted van der Gulik commented on the need for DFO sign-off. It was noted by Paul Askey that a memorandum of agreement between DFO and the BC Ministry of Environment is in the works regarding the Ministry being responsible for interior fish. It was agreed that Paul Askey/Tara White would request a letter from DFO authorizing BC Environment to represent DFO interests in the WUP.

ACTION ITEM: Paul Askey/Tara White to request letter from DFO.

2. Model status

David Sellars presented the current model status. Environment Canada has provided input flows for reservoirs and unregulated areas using the HBV-EC model. Calibration was to data from Joe Rich Creek. The input flows were used in the Reservoir Operation Model to simulate flows at the WSC gauge on Mission Creek downstream of the BMID and SEKID intakes. Initial results indicated total flow volumes too high. WMC is working with Environment Canada to revise model parameters to provide flows that better match flows at the WSC gauge and operation data at the reservoirs. This process has not yet been completed.

Preliminary calibration results were presented comparing reservoir operation results and modelled downstream flows at the WSC gauge. It was observed that much of the BMID reservoir operation data is interpolated from spot measurements. Future calibration presentations will include only the spot measurements as the interpolations can be misleading, particularly in the first six months of the year when there are no spot measurements available because of the difficulty of site access.

Possible evaluation tools were also presented including fish flow targets as a percentage of mean annual discharge and frequency of reservoirs entering different drought stages.

Kevin Day noted that fish flow targets do not included downstream users. Phil Epp said that his measurements showed that groundwater discharge compensated. The flows downstream of the lower irrigation intakes are roughly equal to the flow at the gauge. David Sellars commented that to include the details of the groundwater behaviour in Lower Mission Creek within the model, would be complex and require more data than currently available. Bob Hrasko noted that 8-9 acre-feet per day are lost between the BMID intake and the WSC gauge.

3. Operation plan concept

Various operation plan concepts were discussed. It was agreed that an estimate of natural flows at the WSC gauge should be used for fish flows and that natural flows should be estimated as a multiplier of Pearson Creek flows. For implementation, this would best be done with a real-time gauge on Pearson Creek which should be recommended for installation before the 2009 season. For 2008, visits to the gauge could be made weekly and flows estimated from the staff gauge level (or data logger) using the established rating curve.

ACTION ITEM: Participants on the Okanagan Basin Hydrometric Committee should recommend priority be given to a full Water Survey of Canada gauge on Pearson Creek with real-time functionality.

4. Scenarios

The following scenarios for testing with the model for the next meeting were agreed upon:

1. Current conditions based on 2002 demands for BMID and SEKID.

2. 10-year growth demands based on additional:

    - 500 acres and 2000 connections for BMID
    - 200 acres and 200 connections for SEKID

3. Current licenced obligations

ACTION ITEM: Bob and Toby to provide WMC with estimates of demand for Scenarios 2 and 3.

For an ultimate irrigation scenario Ted offered to provide demands from the irrigation demand model which is under development.

The effect of the proposed Gopher Flats Reservoir (off-line storage) will be included in all scenarios (with and without). Gopher Flats will be filled with Mission Creek water in the winter and after the freshet when the water quality improves.

ACTION ITEM: Bob to provide WSC with elevation-area-capacity curves for Gopher Flats Reservoir.

Bob commented that it would be useful to have inflow estimates for the high elevation reservoirs from the calibrated model. This would be included in the final report.

Brent Magnan asked about the effects of the mountain pine beetle on the watershed hydrology. David said that modelling WMC had recently completed on the Nicola Watershed showed that water yields increased as the pine beetle areas increased. With eventual re-growth of the affected areas the yields decreased back to current conditions. For the long-term it is probably best to base the Water Use Plan on the current conditions (more conservative).

5. Next meeting

The next meeting was set for Wednesday May 14 at 11.00 am at Central Okanagan Regional District Offices.

MISSION CREEK WATER USE PLAN

FINAL NOTES OF STAKEHOLDER MEETING #3
May 14 2008

Whitehaven Room
Regional District of Central Okanagan

Notes prepared by David Sellars

Attendance

David Sellars	Water Management Consultants	dsellars@watermc.com
Bob Hrasko	Black Mountain Irrigation District	rhrasko@shaw.ca
Toby Pike	Southeast Kelowna Irrigation District	pike@sekid.ca
Tara White	BC Environment	Tara.White@gov.bc.ca
Phil Epp	BC Environment	Phil.Epp@gov.bc.ca
Jane Bender	BC Environment	Jane.Bender@gov.bc.ca
Glen Wood		Wood60@telus.net
Brent Magnan	Central Okanagan Regional District	brent.magnan@cord.bc.ca
Ted Van der Gulik	BC Agriculture and Lands	Ted.vanderGulik@gov.bc.ca

1. Action items from previous meeting

Outstanding:

ACTION ITEM: Paul Askey/Tara White to request letter from DFO.

Letter from DFO was requested by Tara White on April 3.

ACTION ITEM: Participants on the Okanagan Basin Hydrometric Committee should recommend priority be given to a full Water Survey of Canada gauge on Pearson Creek with real-time functionality.

No meetings of the hydrometric committee have been held.

2. Model status

David Sellars presented the current model status. Environment Canada has provided input flows for reservoirs and unregulated areas using the HBV-EC model. Calibration was to data from Joe Rich Creek. The input flows were used in the Reservoir Operation Model to simulate flows at the WSC gauge on Mission Creek downstream of the BMID and SEKID intakes.

Preliminary calibration results were presented comparing reservoir operation results and modelled downstream flows at the WSC gauge. It was noted that the calibration requires significant compromises most likely because of the requirement to extrapolate temperature and precipitation inputs from point measurements. Bob Hrasko said that the calibration should focus on fitting the reservoir operations rather than the total flow at the downstream gauge. Phil Epp requested a comparison with Pearson Creek flows.

3. Preliminary model results

Some preliminary model results were presented. The group requested the following changes to the outputs:

- Change the colour scheme to make red the worst case condition and green the best.
- SEKID minimum flows should be 31 L/s (500 gpm)
- Adjust drought stage for SEKID reservoir in the winter as flows are continuously released.
- Exclude Gopher Flats reservoir
- Add Stage 0 (non-drought) to factor tables
- Add minimum flow footnote to tables
- Show fish flow performance as ratio of Mission Creek flow to Pearson Creek flow.
- Use drought factors of 0.95, 0.9 and 0.8 with minimum of 0.7

4. Scenarios

The following scenarios for the preliminary operation plan were agreed upon. Current licenced obligations will be used for future planning.

1. Current conditions based on 2002 demands for BMID and SEKID.

2. 10-year growth demands based on additional:

    - 500 acres and 2000 connections for BMID
    - 200 acres and 200 connections for SEKID

Glen Wood noted that it is critical to have adequate water in September / October for fruit trees to absorb water before the winter.

For future planning Jane Bender noted that as far as MOE are concerned, Mission Creek is fully recorded .New licences will only be considered if backed up by storage.

5. Next meeting

The next meeting was set for Wednesday June 11 at 11.00 am at Central Okanagan Regional District Offices.

MISSION CREEK WATER USE PLAN

NOTES OF STAKEHOLDER MEETING #4
June 11 2008

Whitehaven Room
Regional District of Central Okanagan

Notes prepared by David Sellars

Attendance

David Sellars	Water Management Consultants	dsellars@watermc.com
Bob Hrasko	Black Mountain Irrigation District	rhrasko@shaw.ca
Toby Pike	Southeast Kelowna Irrigation District	pike@sekid.ca
Tara White	BC Environment	Tara.White@gov.bc.ca
Phil Epp	BC Environment	Phil.Epp@gov.bc.ca
Solvej Patschke	BC Environment	Solvej.Patschke@gov.bc.ca
Brent Magnan	Central Okanagan Regional District	brent.magnan@cord.bc.ca

1. Action items from previous meeting

Outstanding:

ACTION ITEM: Paul Askey/Tara White to request letter from DFO.

Tara advised that DFO has authorized BC Environment to represent DFOs interests in the Mission Creek Water Use Plan. The only exception is statutory decision making.

ACTION ITEM: Participants on the Okanagan Basin Hydrometric Committee should recommend priority be given to a full Water Survey of Canada gauge on Pearson Creek with real-time functionality.

Phil Epp will follow up with the chair of the committee.

2. Model status

David Sellars presented the current model status with adjusted HBV parameters adjusted to fit the BMID reservoir operations rather than the total flow at the downstream gauge. Environment Canada has provided input flows for reservoirs and unregulated areas using the HBV-EC model. Calibration was to data from Joe Rich Creek. The input flows were used in the Reservoir Operation Model to simulate flows at the WSC gauge on Mission Creek downstream of the BMID and SEKID intakes.

The current calibration is reasonable for the SEKID operations and is conservative regarding BMID operations. Flows at the WSC gauge are generally too low. A discussion on the model outputs concluded that more water had probably been released from the BMID reservoirs from 2000 to 2004 than is currently in the operations plan. It was thought that the calibration shown at the May meeting was likely to be a more correct representation of the hydrologic inputs.

ACTION ITEM: David Sellars to send out May set of calibration graphs to Bob Hrasko for distribution.

ACTION ITEM: David Sellars to send HBV flow outputs for original EC base case, May calibration and June adjustment to Bob Hrasko and Phil Epp.

3. Preliminary Operations Plan

A preliminary operations plan for 2008 was presented based on the adjusted HBV parameters and avoidance of Stage 3 and Stage 4 drought over the 50-year modelling period. It was recognized that using this operations plan would be conservative for 2008. However it is unlikely that there will be water shortages this year so using the plan will provide an opportunity to test out some of the procedures. Phil Epp requested that the downstream release factor for 2008 be 1.0 for drought stage 0 rather than the 0.4 on the model simulations.

Phil will set up the temporary stream gauge at Pearson Creek with a data logger. Phil will provide a staff gauge plate for the staff gauge extension and BMID staff will assist Phil with the installation. Phil will provide a Pearson Creek flow rating table to BMID and SEKID.

BMID staff will read the staff gauge once a week and downstream flows for SEKID and BMID will be set based on the flow multipliers.

In previous years, operation of Loch Long has been at the request of the Ministry. It is proposed that BMID make the decisions when to release Loch Long flows as part of meeting the overall downstream flow release requirements.

The Preliminary Operations Plan is attached.

4. Next meeting

It was agreed that we would reconvene in the fall to report on the 2008 operations and make a decision on the hydrologic inputs for the final operations plan.

MISSION CREEK WATER USE PLAN

2008 PRELIMINARY OPERATIONS PLAN FOR MISSION CREEK

The preliminary Trigger Graphs for SEKID and BMID are attached as Figure 1 and Figure 2. The live storage quantities included in the trigger graphs represent the following:

	Reservoirs included in total live storage
SEKID	McCullough, Turtle, Fish, Long Meadow and Browne Lakes
BMID	Ideal, Graystoke, Fishhawk

Total storage for these reservoirs should be tracked against the trigger graphs and the drought stage determined. As Turtle Reservoir will not be operational until 2009, the amount of storage allocated for this reservoir should be zero.

The trigger graphs use Julian days for the x- axis which is the day of the year from 1 to 365. This provides the most accurate x- axis and avoids confusion over whether the start day or end day of a month is indicated by a month label. For the final operating plan, the trigger graphs could be reset to months and/or an Excel tracking spreadsheet provided which tracks operations against the trigger graph.

The allocation of flow releases downstream between SEKID and BMID has been set at 26% and 74%. The base case target release is set at 6 times Pearson Creek flows. Flow releases for the base case from SEKID would then be 1.6 times Pearson Creek flows and flow releases from BMID would be 4.4 times Pearson Creek flows. In drought stages the releases would be factored as shown in the following table but not more than the conservation flows need to be released. In the event that the factored flows are less than minimum flows, the minimum should be released.

Stage	**Demand Factors**	**Pearson Creek multiplier**	
		SEKID	**BMID**
0	1	1.6	4.4
1	0.95	0.3	0.9
2	0.9	0.2	0.4
3	0.8	0.1	0.2
4	0.7	0	0

Minimum flow releases: SEKID: 0.032 m^3/s
BMID: 0.50 $m^{3/}s$

Conservation flows. Flows at WSC gauge do not need to exceed the following values:

August 30% MAD = 2.25 m^3/s
September 25% MAD = 1.9 m^3/s
October 20% MAD =1.5 m^3/s

Demand Factors

The Demand Factors shown in the above table represent target reductions based on the 2002 demand. For example, in a Stage 2 drought conservation measures taken in advance, or emergency demand reduction measures should be taken to reduce the demand to 90% of the 2002 demand. This target can be tracked against recorded demand to determine whether targets are being achieved and whether additional measures are necessary.

Loch Long

BMID will make the decisions regarding operation of Loch Long as part of meeting downstream flow requirements.

Duration of Operations Plan

This operations plan will only be in place for the summer and fall of 2008. A final operations plan will be developed in the fall of 2008.

MISSION CREEK WATER USE PLAN

NOTES OF STAKEHOLDER MEETING #5
January 20 2009

Board Room
Black Mountain Irrigation District
285 Gray Road Kelowna.

Notes prepared by David Sellars

Attendance

David Sellars	Water Management Consultants	dsellars@slb.com
Bob Hrasko	Black Mountain Irrigation District	rhrasko@shaw.ca
Toby Pike	Southeast Kelowna Irrigation District	pike@sekid.ca
Tara White	BC Environment	Tara.White@gov.bc.ca
Phil Epp	BC Environment	Phil.Epp@gov.bc.ca
Jane Bender	BC Environment	Jane.Bender@gov.bc.ca
Keri McMahon	Central Okanagan Regional District	Keri.mcmahon@cord.bc.ca
Kevin Day	Benvoulin Water Users	2225 Burtch Rd Kelowna, BC V1Y 7Z5

1. Action items from previous meeting

Outstanding:

ACTION ITEM: Paul Askey/Tara White to request letter from DFO.

Tara advised that DFO has authorized BC Environment (by email from Mike Crowe) to represent DFOs interests in the Mission Creek Water Use Plan. The only exception is statutory decision making.

ACTION ITEM: Participants on the Okanagan Basin Hydrometric Committee should recommend priority be given to a full Water Survey of Canada gauge on Pearson Creek with real-time functionality.

Phil Epp talked to Bruce Letvak and priority has been given to the Pearson Creek site. However no progress has been made on implementation primarily because of WSC staff shortages in the Okanagan. Phil has been using a pressure transducer at the Foolhen Road Bridge and recommends that this be the permanent site because the landowner at the WSC site is requesting a payment. The Foolhen Road Bridge site is good for current metering at high flows. Phil has developed a rating curve at the new site but additional measurements would be required every few years to account for bed shifts. The transducer housing also needs to be made secure. As the Water Use Plan proposes to use this site as an index of natural flows, BMID may have to manage the site until WSC increases staffing.

2. Review of Operating Rule developed in spring 2008

David Sellars presented the 2008 preliminary operations plan for Mission Creek. It was noted that the plan for Loch Long is incorrect. BMID will not be making the decisions on operation of Loch Long as part of meeting downstream flow requirements. Loch Long releases will be over and above the downstream requirements.

It was also noted that there should be a cap on the required downstream flows in June and July similar to the conservation flow caps from August to October. It was suggested that the August conservation flows be used as the cap in July and that there be no requirement to meet downstream flows in the freshet as there is so much unregulated flow anyway.

These two changes will be implemented in the final model.

3. Operation in Summer 2008

The year 2008 represented an average year in terms of operation. Downstream flows were always above 0.5 m^3/s at the BMID intake. There was 710 acre-feet left in Graystoke Reservoir at the end of the season.

The McCulloch reservoir filled to capacity this year (13,475 AF). The SEKID surface water demand was 8,719 AF and the storage supply at December 31, 2008 was about 5,700 AF.

4. Hydrologic model

David Sellars reviewed the current model status with HBV parameters adjusted to fit the BMID reservoir operations rather than the total flow at the downstream gauge. Environment Canada has provided input flows for reservoirs and unregulated areas using the HBV-EC model. Calibration was to data from Joe Rich Creek. The input flows were used in the Reservoir Operation Model to simulate flows at the WSC gauge on Mission Creek downstream of the BMID and SEKID intakes.

The current calibration is reasonable for the SEKID operations and is conservative regarding BMID operations. Flows at the WSC gauge are generally too low. Phil Epp suggested a hybrid approach using the calibration presented by WMC in April 2008 for

the freshet (November to July 15) and the calibration presented in June from July 15 to the end of October.

5. Budget

David Sellars advised that the total spent was $68,000 and the current budget is $75,000. Bob Hrasko indicated that a total budget of $85,000 could be made available.

It was agreed that further iterations of the model would be carried out using the hybrid hydrology approach discussed under Item 4 and the changes noted in Item 3 would also be implemented. Another meeting would be held to discuss the results. There would not be a need for a meeting to discuss the Draft Report as this could be done by conference call and email. David Sellars will confirm that the project can be completed for the remaining budget of $17,000 plus GST.

6. Next meeting

It was agreed that the next meeting will be at BMID on Monday February 23 at 11.00 am

MISSION CREEK WATER USE PLAN

FINAL NOTES OF STAKEHOLDER MEETING #6
February 23 2009

Board Room
Black Mountain Irrigation District
285 Gray Road Kelowna.

Notes prepared by David Sellars

Attendance

David Sellars	Water Management Consultants	dsellars@slb.com
Bob Hrasko	Black Mountain Irrigation District	rhrasko@shaw.ca
Toby Pike	Southeast Kelowna Irrigation District	pike@sekid.ca
Phil Epp	BC Environment	Phil.Epp@gov.bc.ca
Jane Bender	BC Environment	Jane.Bender@gov.bc.ca
Ted Van der Gulik	BC Agriculture and Lands	Ted.vanderGulik@gov.bc.ca
Solvej Patschke	BC Environment	Solvej.Patschke@gov.bc.ca

1. Action items from previous meeting

Outstanding:

None

2. Review of Revisions to calibration

David Sellars presented the revised calibrations using the hybrid approach suggested by Phil Epp at the January meeting using the calibration presented by WMC in April 2008 for the freshet (November to July 15) and the calibration presented in June from July 15 to the end of October . While the SEKID reservoir and the WSC gauge flows are represented quite well by the model, the BMID total storage was still not satisfactory for some years. It was noted that the recorded data points were too low for the BMID total storage. An error in the recorded data for Graystoke reservoir will be corrected for the calibration presented in the Water Use Plan report.

3. Operations Plan

David Sellars presented the proposed operations plan with the revised inflows. The plan is based on avoiding Stage 3 or 4 drought levels in the 50-year simulation period. The plan does not require reductions in demand for Stage 1 and 2 levels. Relatively minor reductions factors for downstream releases (based on 6 times Pearson Creek flows) are required. Based on the current hydrology model output values, it was found that the watershed can support increased fish flows without compromising water supply for irrigation and community use because of the relatively high reliability of the Mission Creek water resource, specifically:

- BMID – has a large watershed area with reliable snow accumulation
- SEKID – the addition of Turtle Reservoir increases supply reliability

4. Report

A Draft Report on the Water Use Plan will be prepared by Water Management Consultants. Some key issues that should be included in the report were discussed including:

- An automated real-time gauging station on Pearson Creek is required for implementation of the plan

- A recommendation on baseline and future monitoring of the fisheries resource should be included so that improvements can be quantified following implementation of the Water Use Plan.

5. Next meeting

This is the last meeting of the Stakeholder Committee. The Draft Report will be discussed by conference call.