# Cowichan Water Use Plan

## Public Advisory Group Meeting 3

**March 8th, 2018**

*A community planning initiative in partnership with:*

compass kwl ECOFISH RESEARCH

CVRD Cowichan Watershed BOARD Catalyst

# Welcome

## Partner Organizations

CVRD

Cowichan Watershed BOARD

Catalyst

# Introductions

Q *What is one non-essential thing you wished you had if you were stranded on a deserted island?*

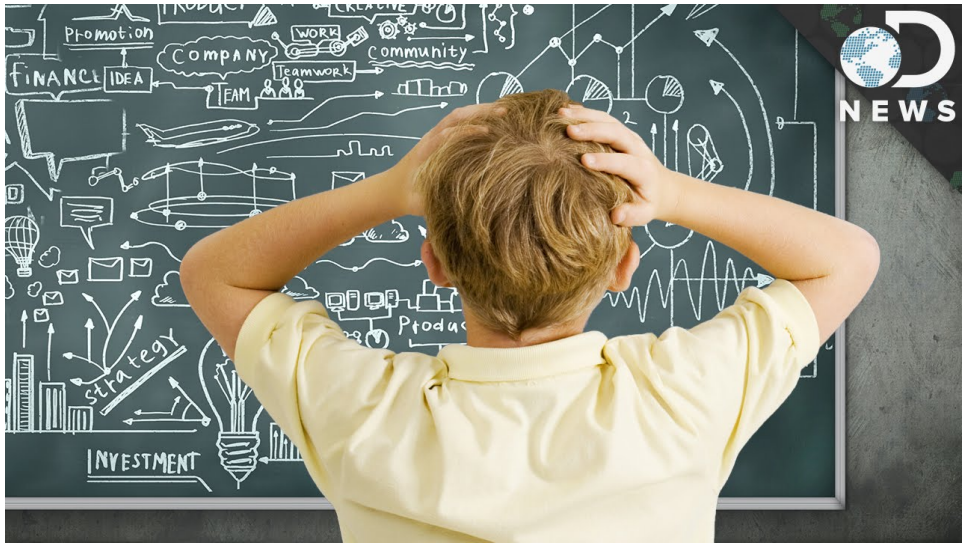
# Meeting Objectives

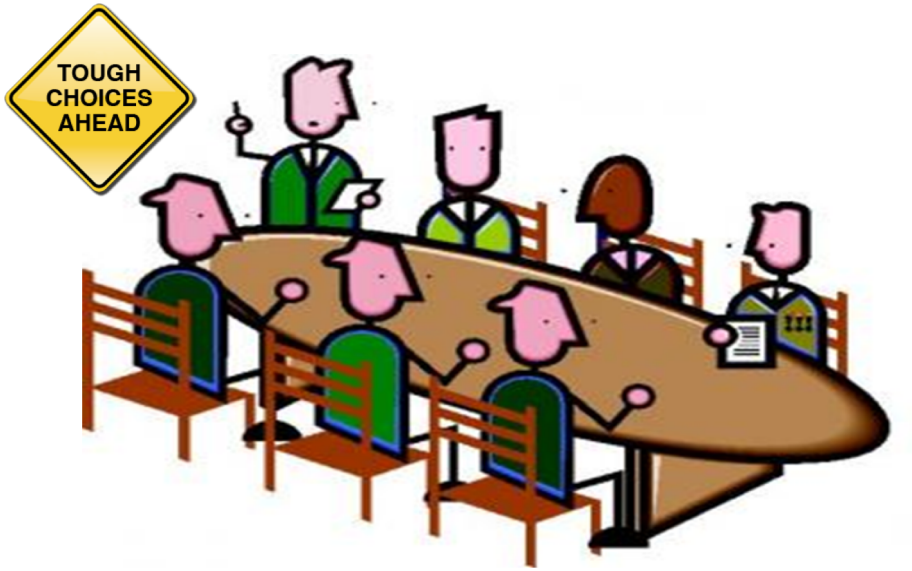
- To review and provide an update since the last meeting
- To review and discuss any updates to the PMs
- To review & discuss the new alternatives and their performance
- To undertake values-based exercises to identify emerging preferred alternatives
- To develop new and improved alternatives for our final meeting
- To discuss the next steps for engaging the public on the trade-offs and the development of a public survey
- To review the next steps of the planning process

# Draft Agenda

| | |
|---|---|
| 8:30am | **Welcome and Update** |
| 9:00am | **Objectives & Performance Measures** |
| 9:30am | **Water Use Alternatives** |
| 10:00am | **Assessing the Alternatives - Hydrology** |
| 10:30am | **Break** – *15mins (light snacks)* |
| 10:45am | **Assessing the Alternatives –Performance Measures** |
| 11:30am | **Preliminary Ranking Exercises** |
| 12:15pm | **Lunch** *(Provided) – 60mins* |
| 1:15pm | **Review and Discuss Ranking Results** |
| 2:30pm | **Break** – *15mins* |
| 2:45pm | **New Alternatives** |
| 3:45pm | **Community Engagement & Survey** |
| 4:30pm | **Adjourn** |

# About Today


Promotion
Company
WORK
Community
FINANCE
IDEA
Teamwork
FAM
Strategy
INVESTMENT
NEWS


TOUGH
CHOICES
AHEAD

# Ground Rules

- Come prepared
- Strive for Inclusion and Respect
- Challenge ideas, not people
- Speak in Terms of Interests, Not Positions
- Seek Common Ground
- Provide Rationale for Your Opinions
- Stay Focused
- Be Open-Minded, Participatory, and Concise

# Update

- Lakefront Technical Sub-Group
  - Issues definition and scoping
  - PM development and winnowing
- Aquatic & Riparian Technical Sub-Group
  - Issues definition and scoping
  - PM development
- Hydrological Modeling and calculating draft PMs
- Public Website (PAG Members listed, PAG ToR, Process Guidelines)
- Internal Website
- Other Updates?

# Past Action Items

- Kate to provide record on river beach public health closures
- Tom, Jaro and Mike McCullough to discuss timing of minimum river requirements for Round 1 alternatives and report back to consulting team.
- Compass, KWL and Ecofish to refine a set of Round 1 alternatives, complete the hydrology modeling, and assess against the performance measures
- PAG members to review meeting notes and provide comments
- Schedule and confirm upcoming PAG Meetings, as follows:
  - **PAG Mtg 4 – May 8 (Final)**

# Cowichan WUP Planning Process

## Snapshot Overview

# Cowichan WUP Process

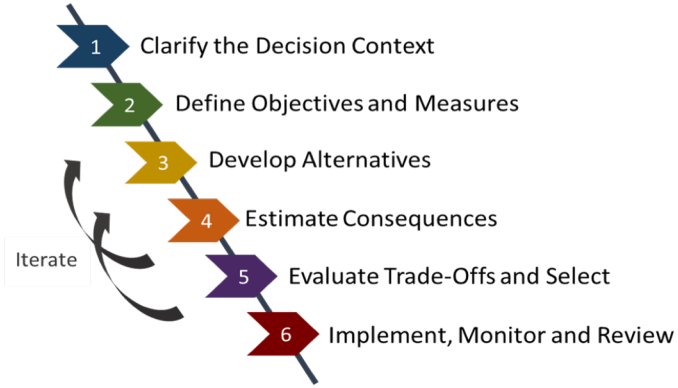
## Snapshot Overview

### Purpose

To explore and determine the best solution to meet the region's long term water use requirements for Cowichan Lake's water mgt system

### Schedule

- 4 Public Advisory Group meetings
- ~ 1 day meeting every 6 weeks
- Completion by Spring 2018

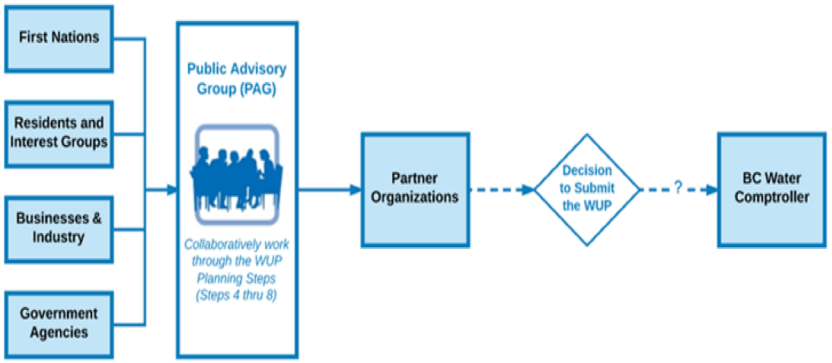


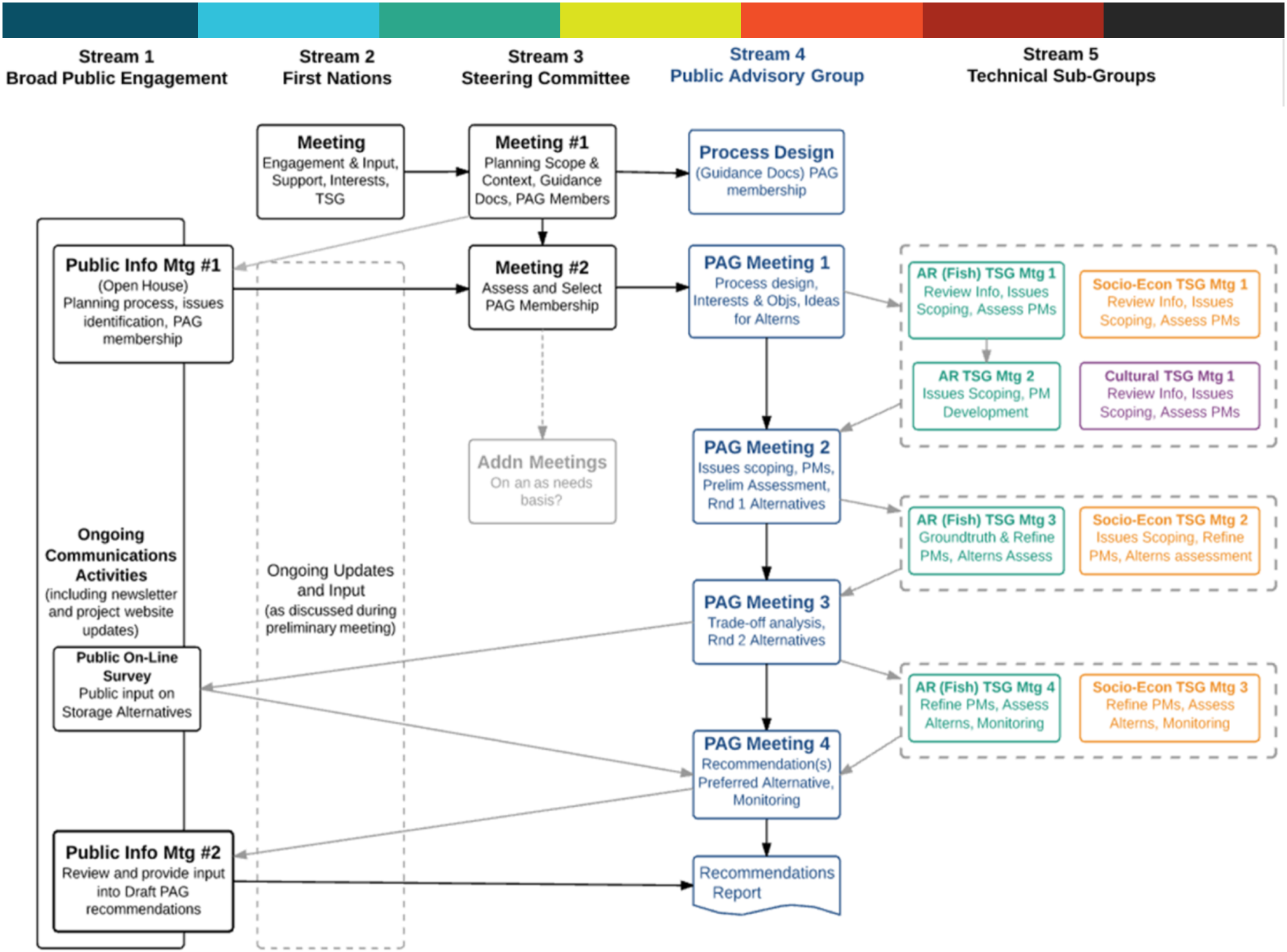

### Planning Framework

Structured Decision Making (consistent with *Provincial WUP Guidelines*)

### Public Advisory Group

To identify and assess different water use alternatives and collaboratively develop recommendations for consideration by the Partner Organization




Stream 1
Broad Public Engagement
Stream 2
First Nations
Stream 3
Steering Committee
Stream 4
Public Advisory Group
Stream 5
Technical Sub-Groups
Meeting
Engagement & Input, Support, Interests, TSG
Meeting #1
Planning Scope & Context, Guidance Docs, PAG Members
Process Design
(Guidance Docs) PAG membership
Public Info Mtg #1
(Open House)
Planning process, issues identification, PAG membership
Meeting #2
Assess and Select PAG Membership
PAG Meeting 1
Process design, Interests & Objs, Ideas for Alterns
AR (Fish) TSG Mtg 1
Review Info, Issues Scoping, Assess PMs
Socio-Econ TSG Mtg 1
Review Info, Issues Scoping, Assess PMs
AR TSG Mtg 2
Issues Scoping, PM Development
Cultural TSG Mtg 1
Review Info, Issues Scoping, Assess PMs
Addn Meetings
On an as needs basis?
PAG Meeting 2
Issues scoping, PMs, Prelim Assessment, Rnd 1 Alternatives
AR (Fish) TSG Mtg 3
Groundtruth & Refine PMs, Alterns Assess
Socio-Econ TSG Mtg 2
Issues Scoping, Refine PMs, Alterns assessment
Ongoing Communications Activities
(including newsletter and project website updates)
Ongoing Updates and Input
(as discussed during preliminary meeting)
PAG Meeting 3
Trade-off analysis, Rnd 2 Alternatives
Public On-Line Survey
Public input on Storage Alternatives
AR (Fish) TSG Mtg 4
Refine PMs, Assess Alterns, Monitoring
Socio-Econ TSG Mtg 3
Refine PMs, Assess Alterns, Monitoring
PAG Meeting 4
Recommendation(s) Preferred Alternative, Monitoring
Public Info Mtg #2
Review and provide input into Draft PAG recommendations
Recommendations Report

# Cowichan WUP Process

## Snapshot Overview

**Scope of the Planning:**

- The primary focus is on water use related to potential changes in lake levels on Cowichan Lake and potential changes in flows down the Cowichan River.
- The scope of options to be explored is constrained by those issues that can be addressed under the *Water Sustainability Act*, i.e.,
  - Minimum flow requirements to the Cowichan River,
  - Rule Curve and water levels for Cowichan Lake,
  - Water storage capacity of Cowichan Lake (e.g., weir modifications, permanent pump station, etc.)
- Datagaps will be addressed through a reliance of past studies, expert judgement, and future recommended monitoring

# Cowichan WUP

## Objectives and Performance Measures

# Preliminary Objectives Areas

- **Culture and Heritage**
  - First Nations Salmon Harvesting Rights (FSC)
  - Traditional Knowledge Transfer & Generation
  - Ceremonial Bathing (Cultural Practices)
  - Archaeological Sites (Cowichan River)
- **Environment (Cowichan River)**
  - Geomorphology
  - Connectivity (lateral)
  - Water Quality
  - Fish Passage
  - Salmonid Rearing
  - Salmonid Spawning
  - Wildlife and Riparian
- **Environment (Cowichan Lake)**
  - Water Quality
  - Vancouver Lamprey
  - Lake Littoral Habitat
  - Wildlife and Riparian
- **Industry and Commercial**
  - Catalyst Paper
  - Agriculture (Irrigation / GW Wells)
  - Commercial Fisheries
- **Lakefront Properties**
  - Flooding and Inundation
  - Private Property Lakefront Areas
  - Docks / Wharves
  - Private water pump intakes
- **Municipal**
  - Waste Water
  - Water Supply - Lake
  - Water Supply - River
- **Recreation and Tourism**
  - Lake - Recreational Beach Use
  - Lake – Boat Access / Navigation
  - River – Boating and Tubing
  - Angling / Fishing
- **Water Management**
  - Infrastructure Capital and Operating Costs

# Cowichan WUP

## Environmental Performance Measures

# Cowichan WUP

## Other Performance Measures

# Current Performance Measures

| Culture & Heritage | Performance Measure | | | |
|---|---|---|---|---|
| | **Name** | **Units** | **Preferred Direction** | **Description** |
| | FSC Harvesting | Currently using Fish PMs as an interim proxy | | |
| | Traditional Knowledge | | | |
| | Ceremonial Bathing | *Seeking direction from Cowichan Tribes and Lake Cowichan First Nation* | | |

| Industry & Commercial | Performance Measure | | | | |
|---|---|---|---|---|---|
| | **Name** | **Units** | **Preferred Direction** | **Geographic Scope** | **Description** |
| **Catalyst Paper** | Impacted operations days | days/yr | ↓ | Lower Cowichan River | Reports the average number of days river flows are below 4.5cms. Assuming an average daily withdrawal of 1.7cms by the mill, withdrawals would need to be cut back or stopped in order to maintain adequate flows in the lower river to meet environmental and community water supply needs. This assumes that any license priority would be given up in order to avoid impacts to community water supply. |
| **Agriculture** | *[Placeholder] Depends on differences in average seasonal river flows across alternatives* | | | | |
| **Commercial Fisheries** | Use Fish PMs as an interim proxy | | | | |

# Current Performance Measures

| Lakefront Properties | Performance Measure | | | | |
|---|---|---|---|---|---|
| | Name | Units | Preferred Direction | Geographic Scope | Description |
| **Flooding and inundation** | Maximum high water event | meters | ↓ | Cowichan Lake | Reports the maximum daily lake elevation over the entire dataset (2050s, and 1953-2016) during the spring control period from March 1 to April 30.<br><br>*Note. The month of February was not included as the maximum lake elevation showed no variation across the alternatives during this period. The PM was also calculated from October 1 to November 5 to capture potential changes in the fall period but similarly showed no differences in max lake levels. Maximum lake levels were also estimated for the period following the control period to the end of Nov 25 to see if there would be increased risk of flooding associated with some alternatives having higher lake levels on Nov 5 (at the end of the control period).* |
| **Private Property Lakefront Areas** | Frontage length | meters | ↑ | Representative areas[3] around Cowichan Lake | Reports the daily average lake frontage slope length for the lake elevation time series (2051-2060). Frontage length is calculated starting from the normal high-water mark (164m) as a proxy. It was agreed to use a representative vegetated/shallow slope site from Honeymoon Bay as a PM. |
| **Docks and Wharves** | *[Placeholder] Depends on the degree to which lake levels drop below zero storage. In the interim, can use the boat access / navigation PM (under Tourism and Recreation).* | | | | |
| **Private water pump intakes** | PM developed for the Town of Lake Cowichan intake will be used as a proxy for private water lines. | | | | |

# Current Performance Measures

| Municipal | Performance Measure | | | | |
|---|---|---|---|---|---|
| | Name | Units | Preferred Direction | Geographic Scope | Description |
| **Waste water dilution** | Effluent dilution ratio objective (200:1) – Upper River | days/yr | ↓ | Upper Cowichan River | Reports the average number of days river flows are below the minimum threshold needed to meet the effluent dilution ratio objective (of 200:1) for the Town of Lake Cowichan. The PM is calculated using the projected 2050s minimum effluent river flows based on average monthly flow. The required minimum monthly flow for October was assumed to be the same as for August in order to represent a dryer year (when the river is still being controlled by the weir). |
| | Effluent dilution ratio guidelines (40:1) – Lower River | days/yr | ↓ | Lower Cowichan River | Reports the average number of days river flows are below the minimum threshold needed to meet the effluent dilution ratio (40:1) guidelines for treated effluent discharged from the existing Joint Utility Board Sewage Treatment Plant (JUB STP) outfall. This includes waste water dilution needs for the Municipality of North Cowichan, the City of Duncan, Cowichan Tribes, and Areas D and E of the CVRD. |
| **Community water supply** | Intake pumping capacity – Town of Lake Cowichan | days/yr | ↓ | Cowichan Lake | Reports the average number of days lake levels are below the 161.15m, the minimum elevation for the Town of Lake Cowichan pump station to function. The minimum pumping rate is met when intake pipe at the wet well is at least half full. At lake elevations below 161.15m, the Town of Lake Cowichan will not meet its lowest pumping capacity. |
| | Intake invert elevation - Town of Lake Cowichan | days/yr | ↓ | Cowichan Lake | Reports the average number of days lake levels are below 160.80m, the elevation of the Town of Lake Cowichan water pump station intake invert (inlet pipe to pump station). If the lake goes down to 160.80m the Town is effectively out of water. |
| | *Community water supply for the communities of North Cowichan and Duncan is captured in minimum river flow requirements for lower Cowichan River effluent dilution.* | | | | |

# Current Performance Measures

| Recreation & Tourism | Performance Measure | | | | |
|---|---|---|---|---|---|
| | Name | Units | Preferred Direction | Geographic Scope | Description |
| **Lake Beach Use Areas** | Beach User Days | wt days | ↑ | Representative areas[4] around Cowichan Lake | Reports the average number of weighted beach user days during the recreational season, using a preferred beach slope length of 3m (from the water's edge to the crest of the beach slope), which was considered the optimal beach access and recreation functionality. Each beach user day has two utility weighting factors (U1 & U2) which are applied, as follows:<br>**U1 – Length of Beach** (slope length – BSL)<br>• If beach length (BSL) = 0m: **U1 = 0**<br>• If BSL = >0m to 3m: **U1 = >0 to 1**<br>• If BSL = ≥3m: **U1 = 1**<br>**U2 – Recreation Period**<br>• During peak summer season - Canada Day weekend to Labour Day weekends: **U2 = 1**<br>• Spring shoulder seasons - May Long weekend to Canada Day weekend: **U2 = 0.5**<br>• Fall shoulder season - Labour Day weekend to Thanksgiving weekend: **U2 = 0.75** |
| **Lake Boat Access / Navigation** | Decrease in dock use days | days | ↓ | Representative docks around Cowichan Lake | Reports the average number of days during the recreational season where the water depth at docks is less than 1m at different lake elevations. 1m was agreed to as a depth of water that would provide for sufficient boat draft for an average boat used for recreational purposes. The PM was developed and calculated for Point Ideal and Pine Point as two representative sites known to be sensitive to low lake levels as observed in recent dryer years. While the Pine Point Site was the most sensitive of the two sites, an average of the most shallow docks at Point Ideal were used as the lakebed elevation data was known to be of better quality at this location. |

# Current Performance Measures

| Recreation & Tourism | Performance Measure | | | | |
|---|---|---|---|---|---|
| | Name | Units | Preferred Direction | Geographic Scope | Description |
| **Boating and Tubing - River** | Decrease in summer tubing days | days | ↓ | Cowichan River | Reports the average number of days during the summer recreation season when river flows are less than 5cms and not suitable for tubing activities or impact the quality of recreational experience. The summer tubing season is defined from Canada Day weekend to the Labour Day weekend. |
| | Decrease in river boating days | Days | ↓ | Cowichan River | Reports the average number of days the year when river flows are less than 7cms and greatly impact small boat use on the river (kayak, canoe, drift boats). |
| **Angling / Fishing - River** | *Use fish PMs* | | | | |

| Water Management | Performance Measure | | | | |
|---|---|---|---|---|---|
| | Name | Units | Preferred Direction | Geographic Scope | Description |
| **Water Management** | Capital costs | $ | ↓ | Cowichan Lake and River | Reports the approximate capital costs (estimated to an order of magnitude) to build new or modify existing water management infrastructure, including to raise the weir or install a permanent pump house. |
| | Operational costs | | ↓ | Cowichan Lake and River | Reports the approximate operational costs (estimated to an order of magnitude) to operate any new or modified water management infrastructure. Operational costs include costs to mobilize temporary pumps one time per year, estimated from the 2016 assembly of emergency pumps. |

# New Performance Measure

## Lake Aesthetics (Visual Quality PM)

Provides a qualitative rating of potential visual impacts ("bathtub ring") associated with lake levels dropping below historical levels (i.e., less than "0"storage point of 161.4m) in summer / early fall

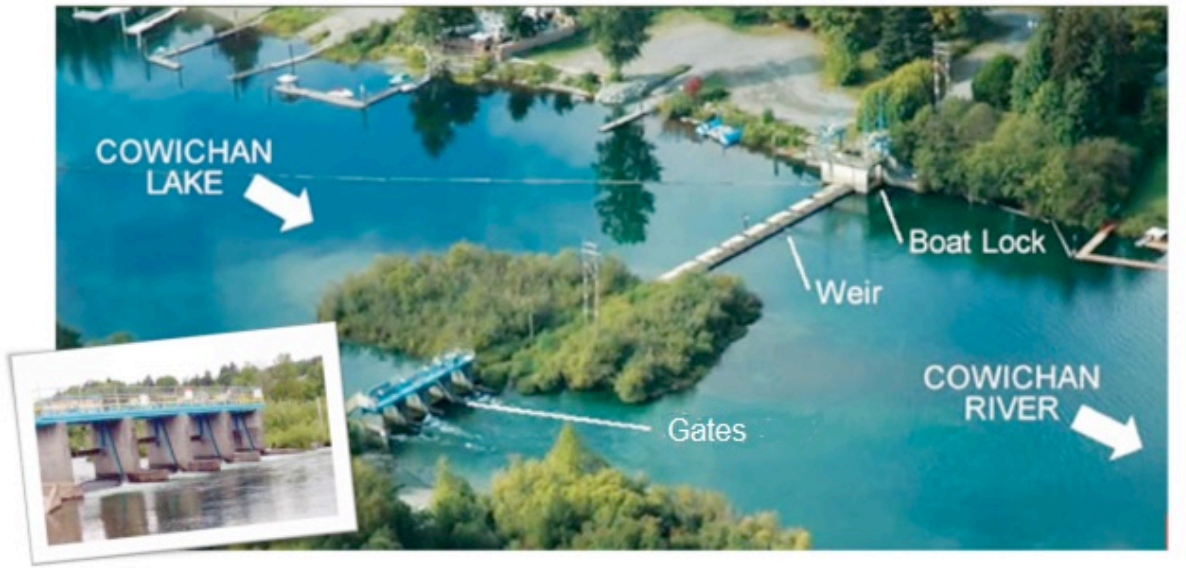
| Rating Scale | Description |
|---|---|
| 1 | **No Visual Effects** – During dryer summers (10%ile), lake levels do not drop more than 15cm below 161.4m for any extended period (i.e., < 2wks) |
| 2 | **Minor Visual Effects** – […], lake levels can drop between 0 to 30cm for extended periods (i.e., > 2 weeks) |
| 3 | **Moderate Visual Effects** – […], lake levels can drop between 31cm to 60cm for extended periods (i.e., > 2 weeks) |
| 4 | **Significant Visual Effects** – […], lake levels can drop between 61 to 90cms for extended periods of the summer and late fall. |
| 5 | **Very Significant Visual Effects** – […] lake levels can drop by > 91cms for extended periods of the summer and late fall. |

# Cowichan WUP

## Round 2 - Water Use Alternatives

# Cowichan Weir

Constructed in 1957 – Operated by Catalyst Paper

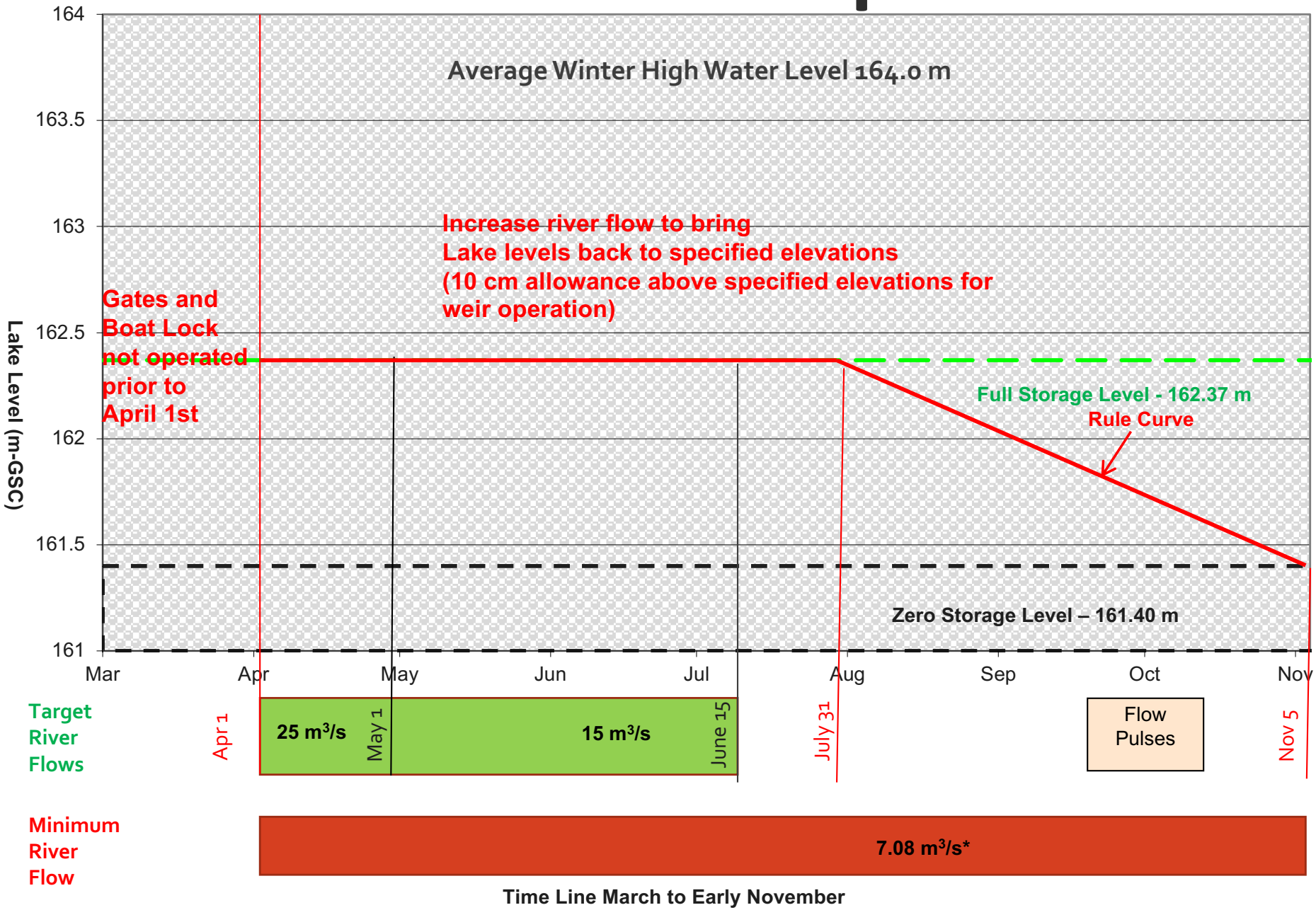



Stores 59.5 million $m^3$ of water in Cowichan Lake
(equivalent to 97 cm depth of water over lake surface)
(about 97 days of supply at minimum flow)

Original design

| Design Intent | Water Licence Flow |
|---|---|
| Maintain min. flow in Cowichan River below weir | 250 cfs (about 7 $m^3/s$) |
| Provide water for for Crofton Mill | 100 cfs (about 2.8 $m^3/s$) |
| Maintain min. flow below the Crofton Mill Pump Station | 100 cfs (about 2.8 $m^3/s$) |

# Cowichan Weir – Operation




* - 7.08 m³/s equal to 250 cfs minimum flow required by water licence

# Water Use Alternatives

## Round 2

**These new alternatives aimed to:**

- Increase storage potential in the lake in dryer years through raising the weir and through an earlier control period (starting as early as February 1);
- Minimize the frequency and magnitude of higher lake level events in the early spring by restricting the rate at which lake levels rise (i.e., releasing higher flows to the river even though water levels may not be at the top of the weir);
- Optimizing the rule curve based on meeting river environmental flow targets for fish, including hard targets (must be met) and soft targets (in wetter years when water is available);
- Adjusting the rule curve and setting variable minimum river flow targets based on the available water in the system using the forecasted inflow in wetter and dryer years from the 2050s dataset (hydrology optimized flows).
- The Round 2 alternatives include the original bookend alternatives from PAG meeting 2

# Water Use Alternatives

## Round 2

| Alternative Name | Description | Short Name |
|---|---|---|
| **Bookend Alternatives (PAG Mtg 2)** | | |
| **Alt 1 - Status Quo** | • Status Quo<br>• Current infrastructure<br>• Current rule curve | ALT1_SQ |
| **Alt 2 - Status Quo (with Pumps)** | Same as Status Quo (Alt 1) except:<br>• Temporary pumps installed (as per Catalyst's proposed 10yr interim license)<br>  ○ Pumping capacity = up to 5cms when needed | ALT2_P5 |
| **Alt 3 - Increased Weir Ht +~1.0m** | • Increased weir height +1m<br>• Current rule curve | ALT3_W+1 |
| **Alt 4 - Permanent Pump House** | • Permanent pump house built in order to pump up to 7cms (when needed)<br>• Current rule curve<br>• Maximum drawdown up to 1m below '0' supply level in reservoir | ALT4_P7 |
| **Alt 6 – Modified Rule Curve 2** | • Current infrastructure<br>• Modified Rule Curve (MRC)<br>• Eliminate increased spring flows of 25 & 15cms each year and instead target 7cms throughout control period (i.e., from April 1 to Nov 5) | ALT6_MRC2 |
| **Alt 7 – Modified Rule Curve** | • Increased weir height +1m<br>• Modified Rule Curve (MRC)<br>  ○ Start control period on March 1 (instead of April 1) to better be able to fill lake up to the top of the existing weir<br>  ○ Target 25cms spring flow release starting on March 1 until April 30 (each year)<br>• Target 15cms spring flow release is unchanged (from May 1 to June 15) | ALT7_W1M |

# Water Use Alternatives

## Round 2

| New Round 2 Alternatives | | |
|---|---|---|
| **Alt 10 - Weir Ht +0.5m, 5cms Pumps** | • Increased weir height +0.5m (i.e., 162.9m)<br>• Control Period: Starts on February 1, but restricts water levels to no more than the top of the existing weir height (i.e., 162.4m) until Feb 28; on March 1 allow water levels to rise to the full weir height (162.9m)<br>• Target flows:<br>  ○ 7cms throughout control period<br>  ○ 25cms from April 1 to June 15<br>  ○ 15cms from May 1 to June 15<br>• Pumping capacity = up to 5cms when needed | ALT10_W0.5P5 |
| **Alt 11 - Weir Ht +1m, Fish Optimized Flows** | • Increased weir height +1m (i.e., 163.4m)<br>• Control Period: Starts on February 1, but restricts water levels to no more than half the increased weir height (i.e., 162.9m) until Feb 28; on March 1 allow water levels to rise to the full weir height (163.4m)<br>• Target flows – **hard** targets (every year):<br>  ○ 7cms throughout control period<br>  ○ 25cms from February 1 to March 31<br>  ○ 15cms from April 1 to May 15<br>• Target flows – **soft** targets (wet years with sufficient inflow – lake level within 30cm full storage):<br>  ○ 25cms from February 1 to May 15<br>• Pumping capacity = up to 7cms when needed | ALT11_W1P7F |

# Water Use Alternatives

## Round 2

| New Round 2 Alternatives | | |
|---|---|---|
| **Alt 12 - Weir Ht +0.7m, Hydrology Optimized Flows** | • Increased weir height +0.7m<br>• Control Period: Starts on February 1, but restricts water levels to no more than the top of the existing weir height (162.4m); on March 1 allow levels to fill to the full weir height (163.1m)<br>• Target flows:<br>  ○ 7cms throughout control period<br>  ○ 15cms February 1 to April 30<br>• No pumps | ALT12_W0.7H1 |
| **Alt 13 - Increased Weir Ht +0.7m, Hydrology Optimized Flows** | • Increased weir height +0.7m<br>• Control Period: Starts on February 1, but restricts water levels to no more than the top of the existing weir height (162.4m), on March 1 allow level to rise to the full weir height (163.1m)<br>• Target flows - **hard** targets (dry years – meet 9 out of 10 years):<br>  ○ 7cms throughout control period<br>  ○ 15cms from February 1 to April 30<br>• Target flows - **soft** targets (wetter years – meet for above average years):<br>  ○ 25cms from February 1 to April 30<br>• Pumping capacity = up to 7cms as required | ALT13_W0.7H2 |

# Cowichan WUP

## Assessing the Water Use Alternatives

# Assessing Alternatives

**4 step approach:**

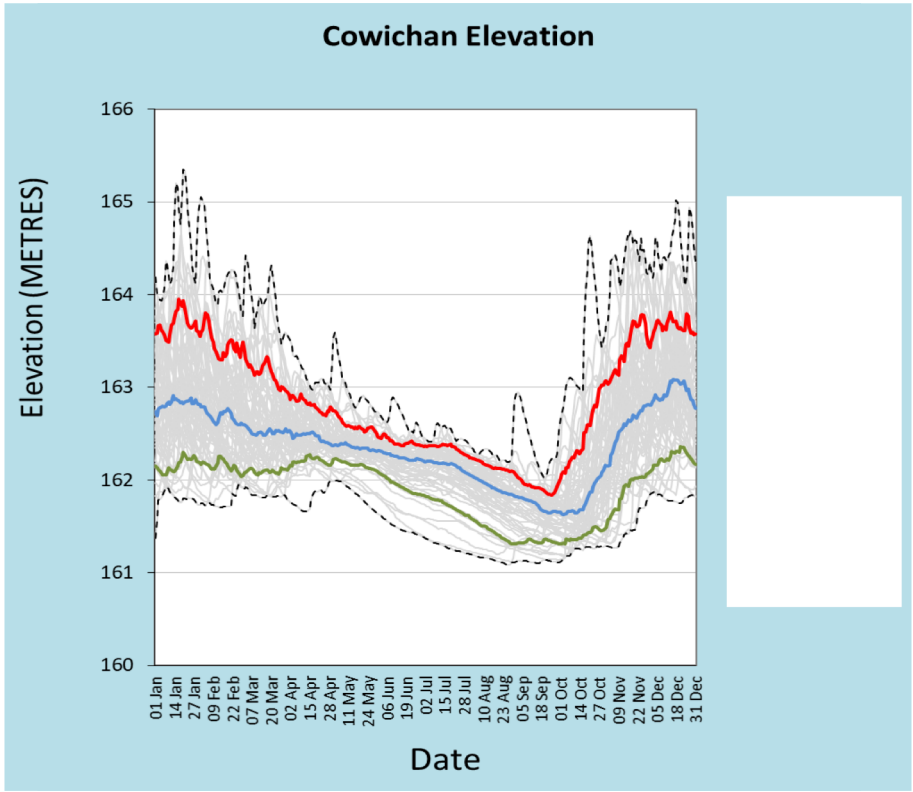
1. Review changes in hydrological conditions
   (i.e., water levels and flows)
2. Review performance measure values
3. Undertake ranking exercises
4. Facilitated discussion

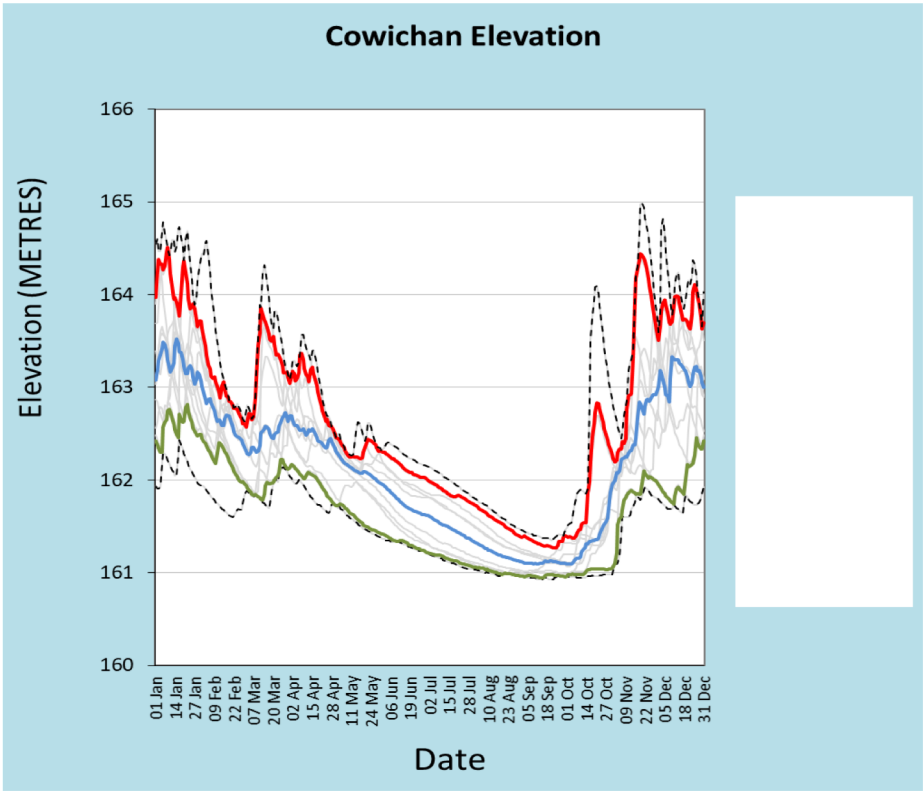
# Assessing Alternatives

## Hydrological Modeling

**A couple of points to highlight**

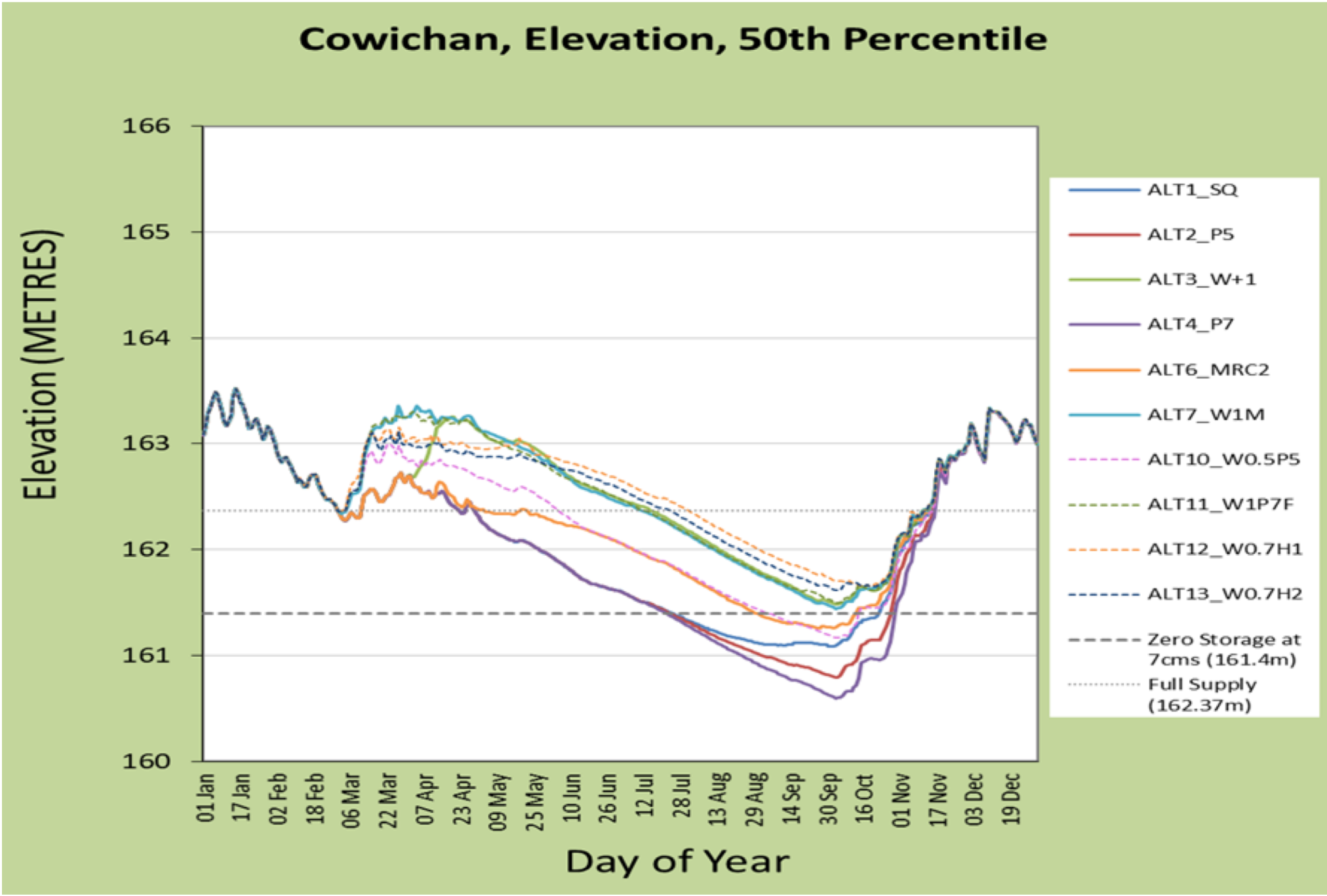
- Statistical summaries are not as meaningful when working with small datasets (n=10)

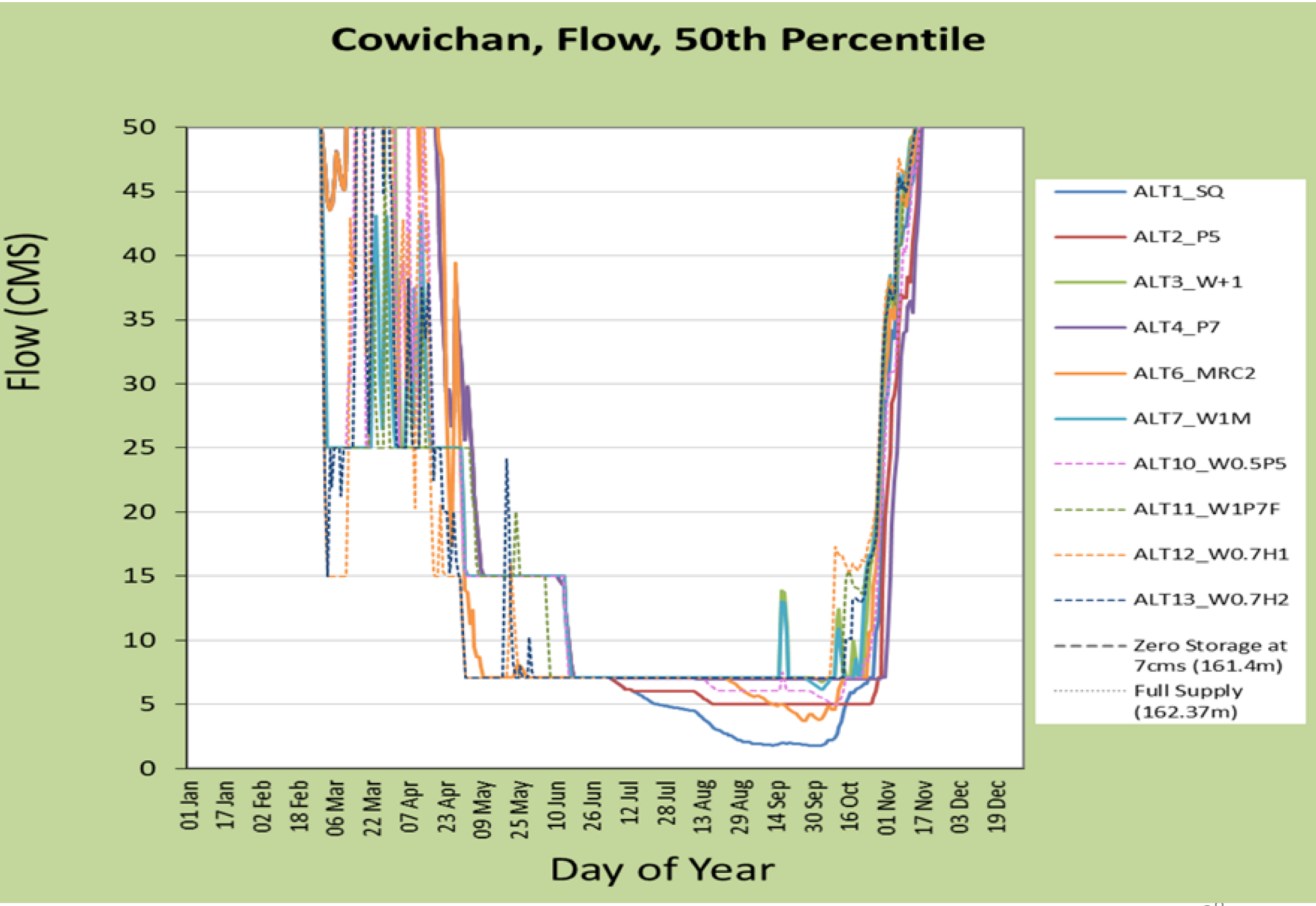


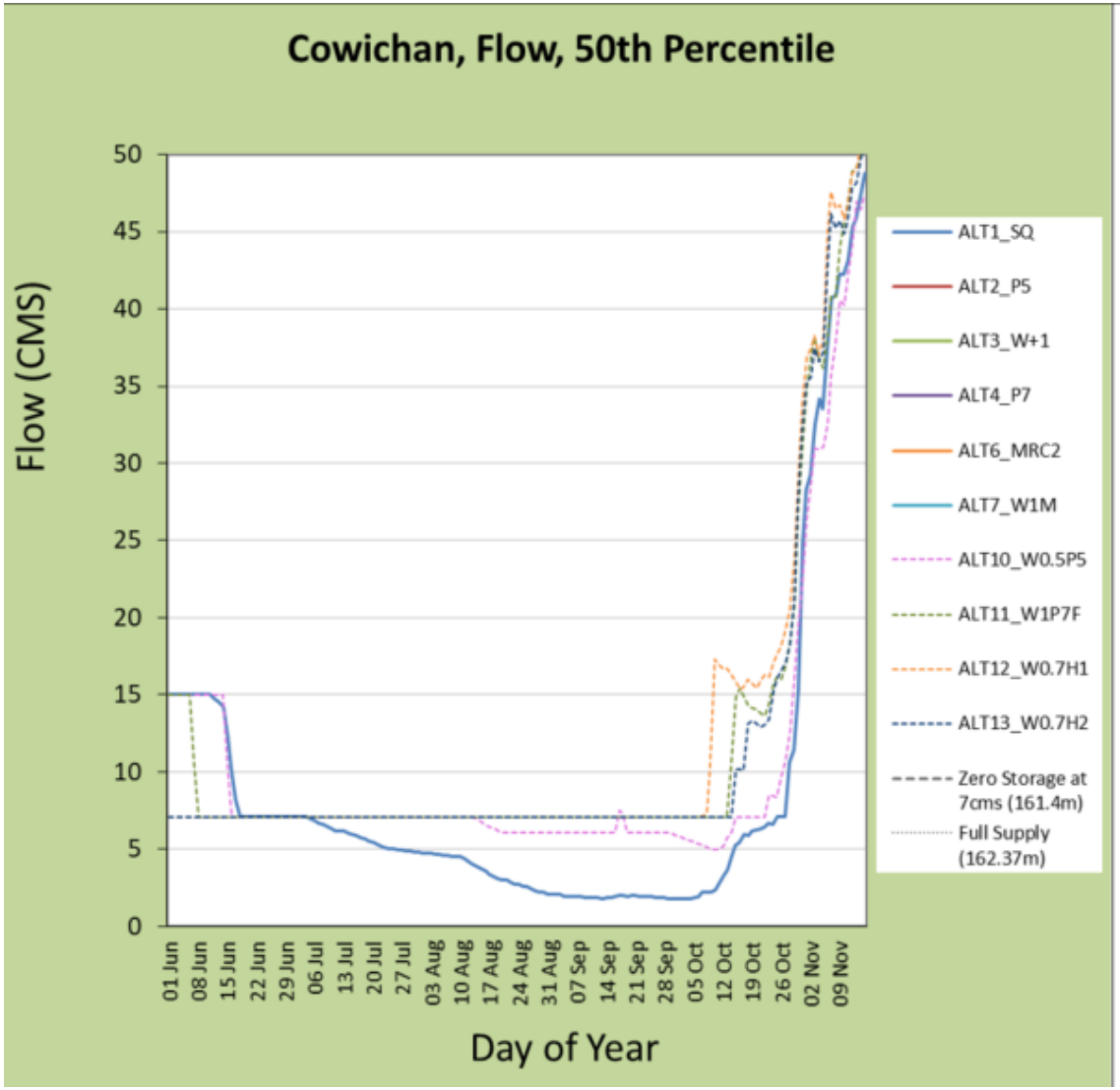



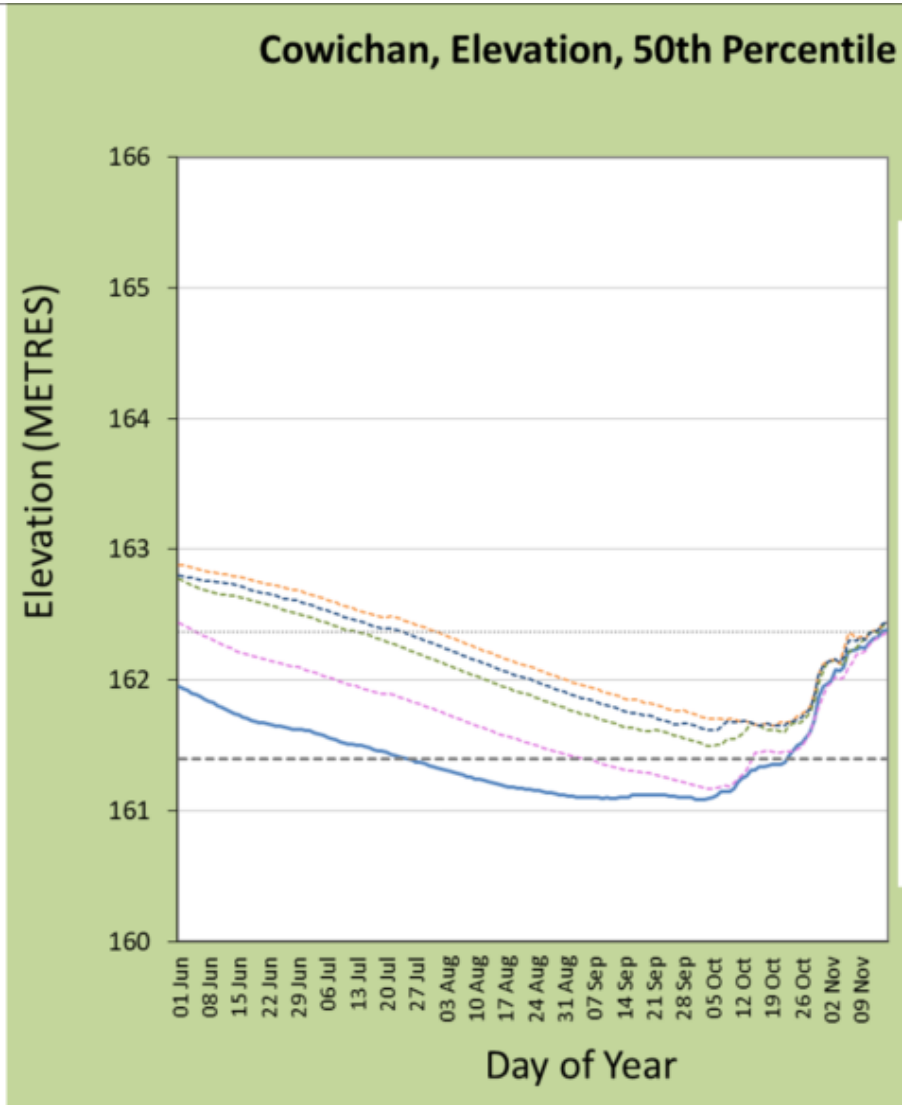
# Assessing Water Use Alternatives

## **Hydrology -** Future Simulated 2050s Dataset

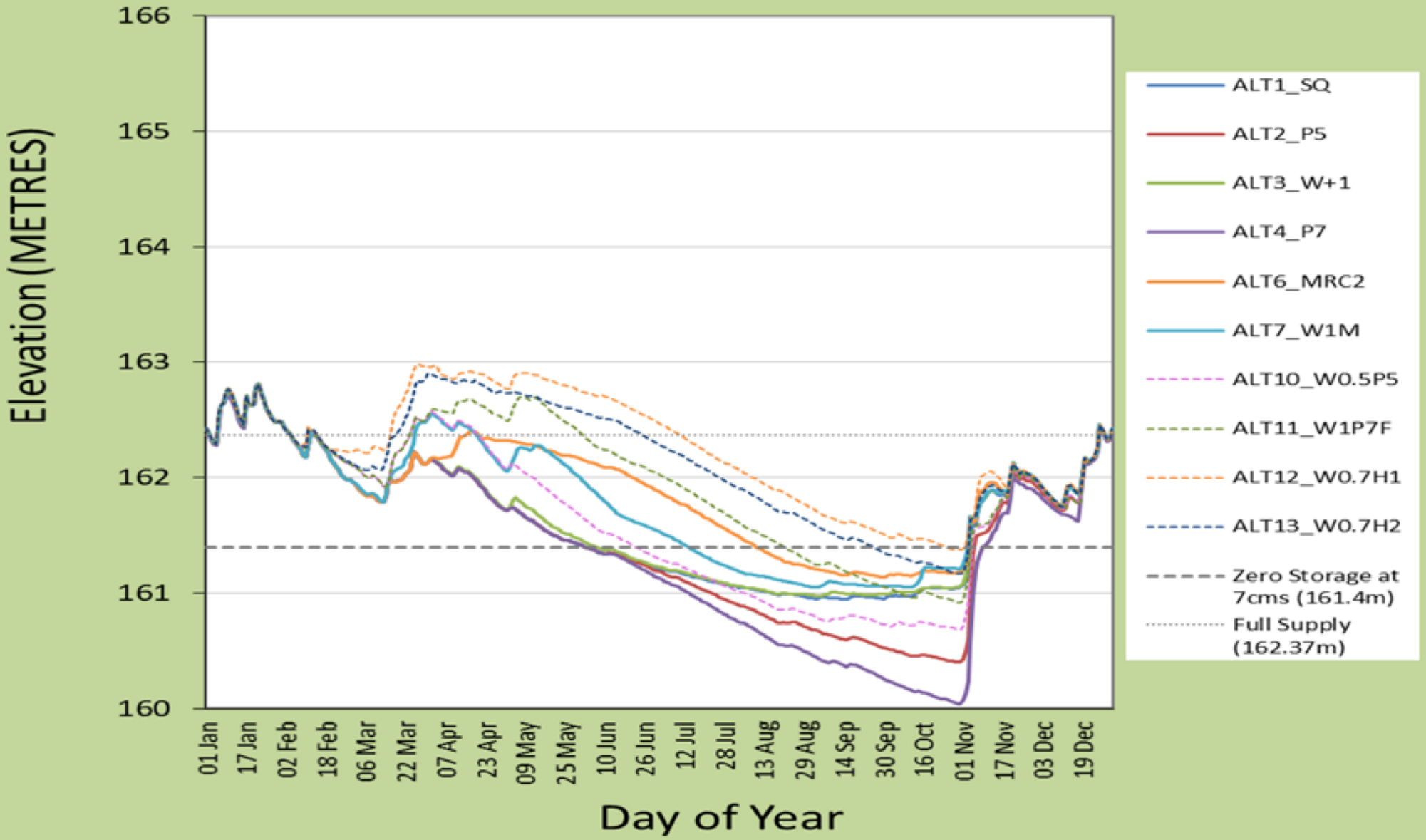

Cowichan, Elevation, 50th Percentile
Elevation (METRES)
166
165
164
163
162
161
160
01 Jan
17 Jan
02 Feb
18 Feb
06 Mar
22 Mar
07 Apr
23 Apr
09 May
25 May
10 Jun
26 Jun
12 Jul
28 Jul
13 Aug
29 Aug
14 Sep
30 Sep
16 Oct
01 Nov
17 Nov
03 Dec
19 Dec
Day of Year
ALT1_SQ
ALT2_P5
ALT3_W+1
ALT4_P7
ALT6_MRC2
ALT7_W1M
ALT10_W0.5P5
ALT11_W1P7F
ALT12_W0.7H1
ALT13_W0.7H2
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

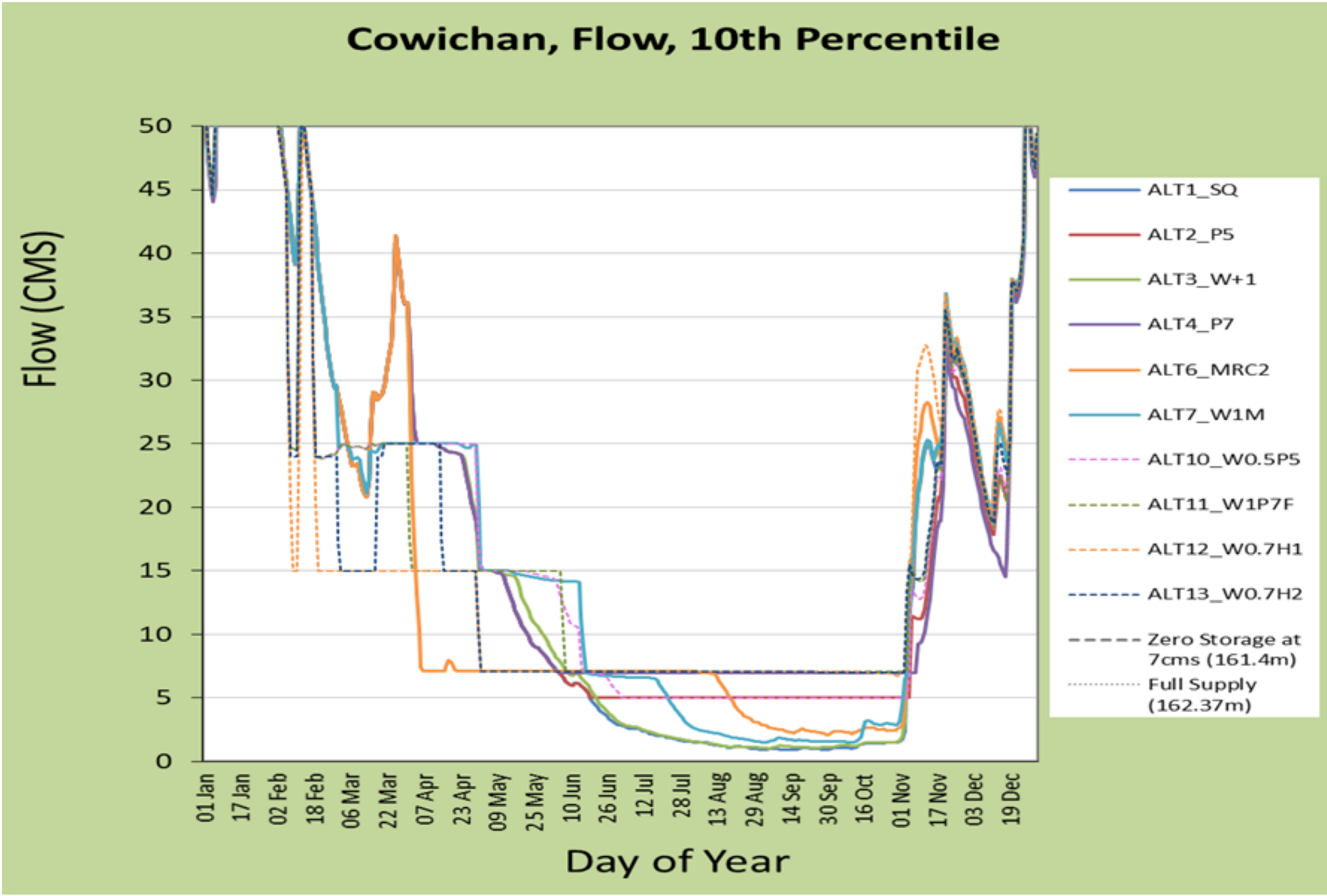

Cowichan, Flow, 50th Percentile
Flow (CMS)
50
45
40
35
30
25
20
15
10
5
0
01 Jan
17 Jan
02 Feb
18 Feb
06 Mar
22 Mar
07 Apr
23 Apr
09 May
25 May
10 Jun
26 Jun
12 Jul
28 Jul
13 Aug
29 Aug
14 Sep
30 Sep
16 Oct
01 Nov
17 Nov
03 Dec
19 Dec
Day of Year
ALT1_SQ
ALT2_P5
ALT3_W+1
ALT4_P7
ALT6_MRC2
ALT7_W1M
ALT10_W0.5P5
ALT11_W1P7F
ALT12_W0.7H1
ALT13_W0.7H2
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

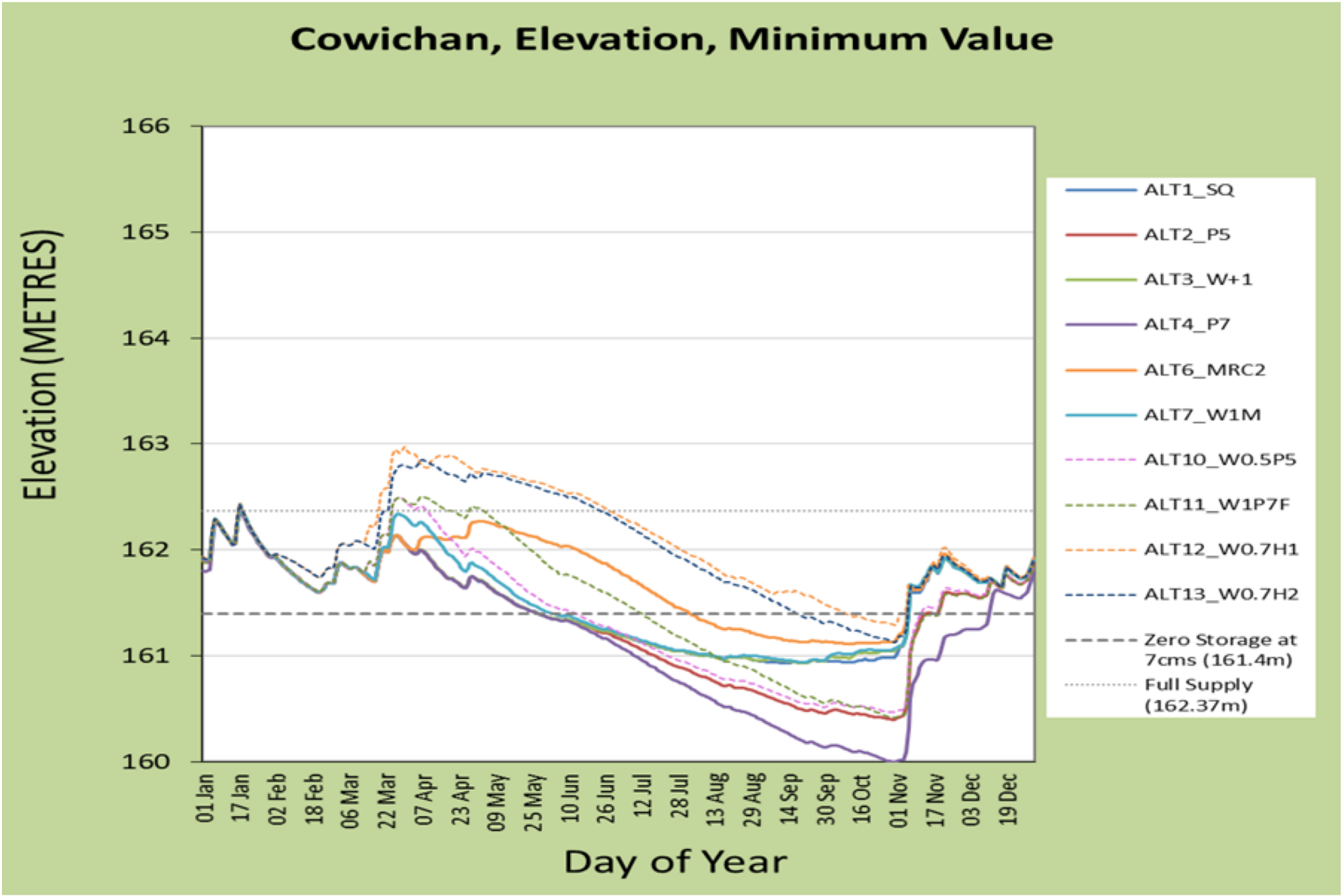

Cowichan, Flow, 50th Percentile
Flow (CMS)
50
45
40
35
30
25
20
15
10
5
0
01 Jun
08 Jun
15 Jun
22 Jun
29 Jun
06 Jul
13 Jul
20 Jul
27 Jul
03 Aug
10 Aug
17 Aug
24 Aug
31 Aug
07 Sep
14 Sep
21 Sep
28 Sep
05 Oct
12 Oct
19 Oct
26 Oct
02 Nov
09 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT3_W+1
ALT4_P7
ALT6_MRC2
ALT7_W1M
ALT10_W0.5P5
ALT11_W1P7F
ALT12_W0.7H1
ALT13_W0.7H2
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

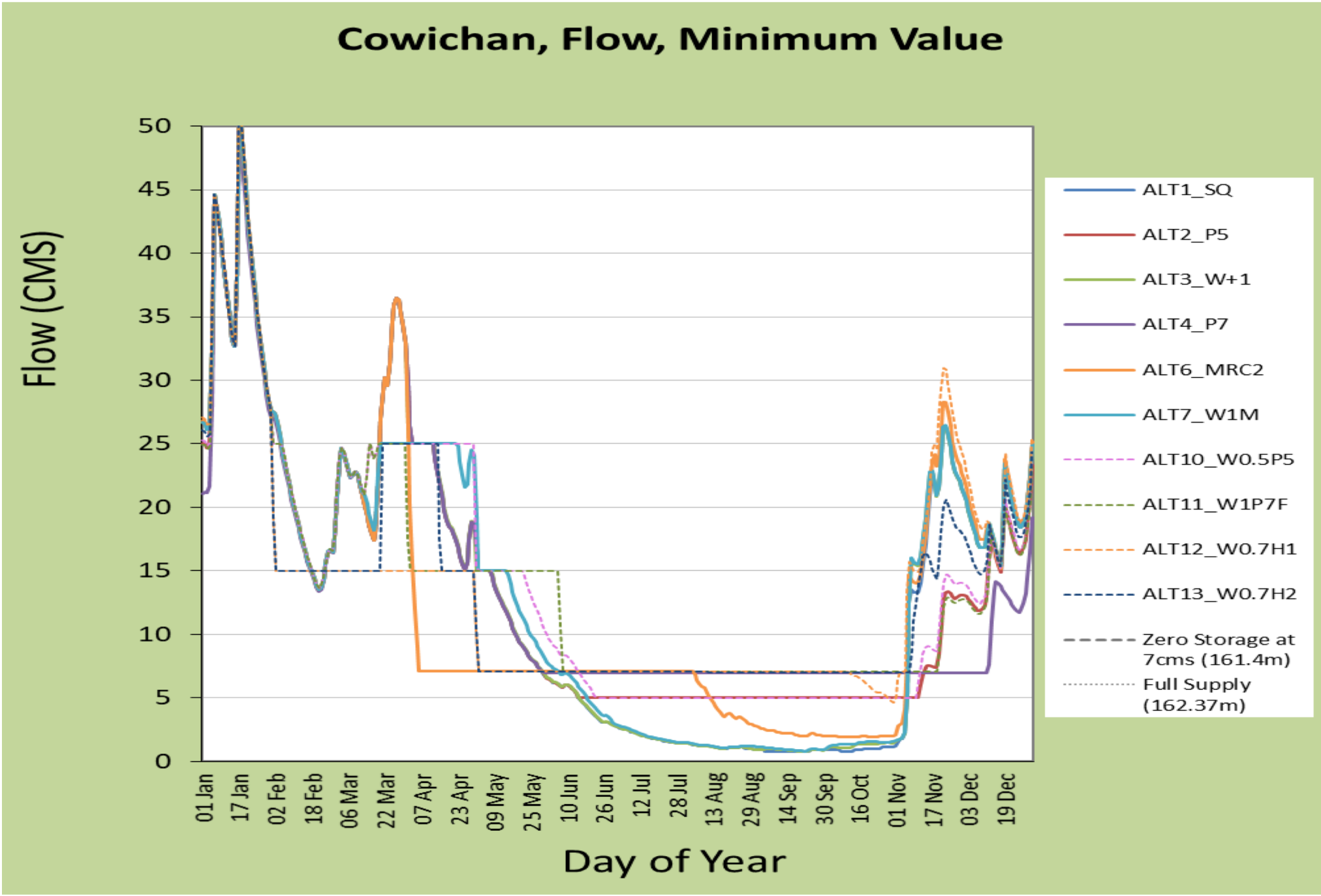

Cowichan, Elevation, 50th Percentile
Elevation (METRES)
166
165
164
163
162
161
160
01 Jun
08 Jun
15 Jun
22 Jun
29 Jun
06 Jul
13 Jul
20 Jul
27 Jul
03 Aug
10 Aug
17 Aug
24 Aug
31 Aug
07 Sep
14 Sep
21 Sep
28 Sep
05 Oct
12 Oct
19 Oct
26 Oct
02 Nov
09 Nov
Day of Year

# Cowichan, Elevation, 10th Percentile




Cowichan, Flow, 10th Percentile
Flow (CMS)
50
45
40
35
30
25
20
15
10
5
0
01 Jan
17 Jan
02 Feb
18 Feb
06 Mar
22 Mar
07 Apr
23 Apr
09 May
25 May
10 Jun
26 Jun
12 Jul
28 Jul
13 Aug
29 Aug
14 Sep
30 Sep
16 Oct
01 Nov
17 Nov
03 Dec
19 Dec
Day of Year
ALT1_SQ
ALT2_P5
ALT3_W+1
ALT4_P7
ALT6_MRC2
ALT7_W1M
ALT10_W0.5P5
ALT11_W1P7F
ALT12_W0.7H1
ALT13_W0.7H2
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)


Cowichan, Elevation, Minimum Value
Elevation (METRES)
166
165
164
163
162
161
160
01 Jan
17 Jan
02 Feb
18 Feb
06 Mar
22 Mar
07 Apr
23 Apr
09 May
25 May
10 Jun
26 Jun
12 Jul
28 Jul
13 Aug
29 Aug
14 Sep
30 Sep
16 Oct
01 Nov
17 Nov
03 Dec
19 Dec
Day of Year
ALT1_SQ
ALT2_P5
ALT3_W+1
ALT4_P7
ALT6_MRC2
ALT7_W1M
ALT10_W0.5P5
ALT11_W1P7F
ALT12_W0.7H1
ALT13_W0.7H2
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)


Cowichan, Flow, Minimum Value
Flow (CMS)
50
45
40
35
30
25
20
15
10
5
0
01 Jan
17 Jan
02 Feb
18 Feb
06 Mar
22 Mar
07 Apr
23 Apr
09 May
25 May
10 Jun
26 Jun
12 Jul
28 Jul
13 Aug
29 Aug
14 Sep
30 Sep
16 Oct
01 Nov
17 Nov
03 Dec
19 Dec
Day of Year
ALT1_SQ
ALT2_P5
ALT3_W+1
ALT4_P7
ALT6_MRC2
ALT7_W1M
ALT10_W0.5P5
ALT11_W1P7F
ALT12_W0.7H1
ALT13_W0.7H2
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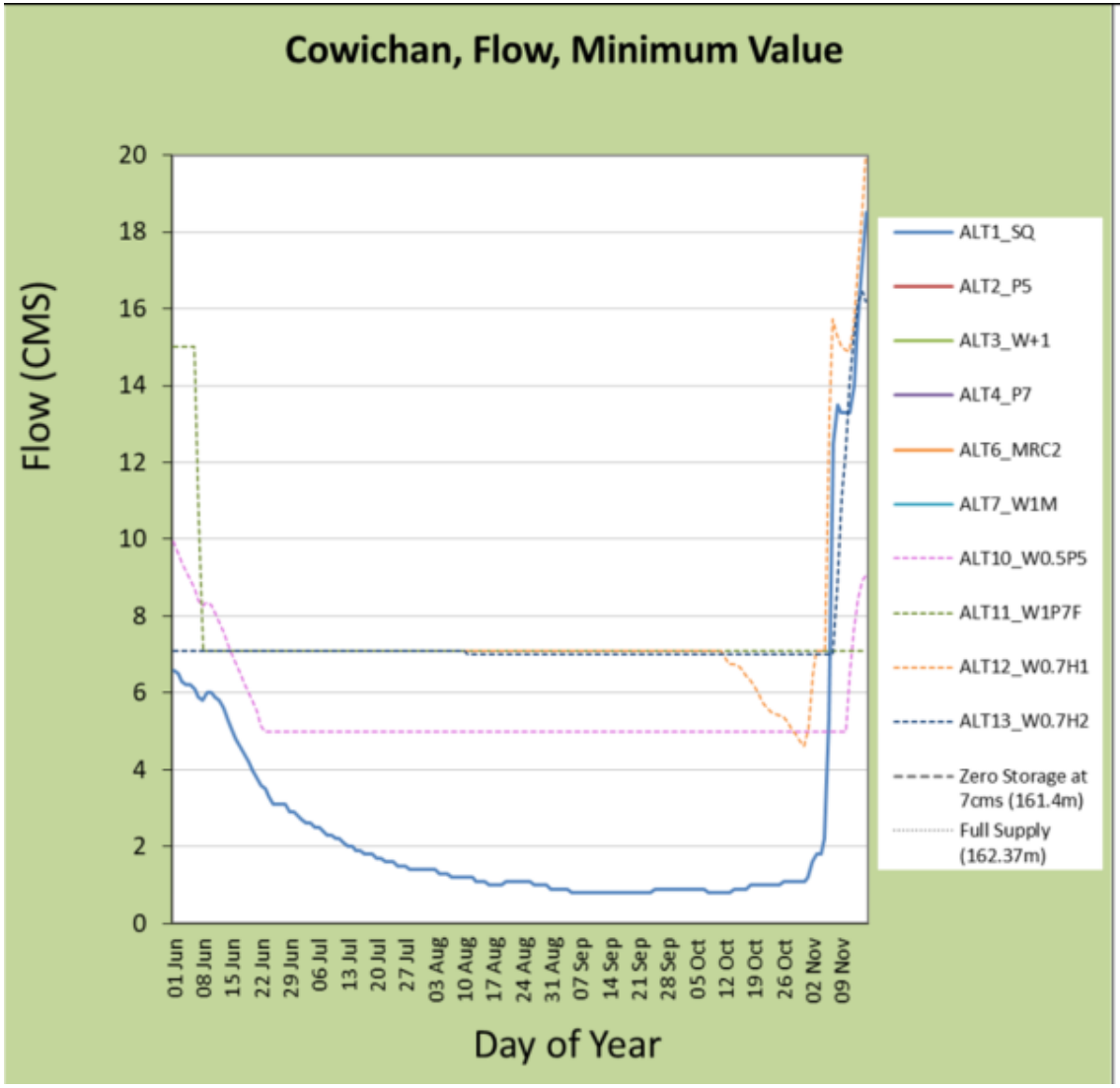
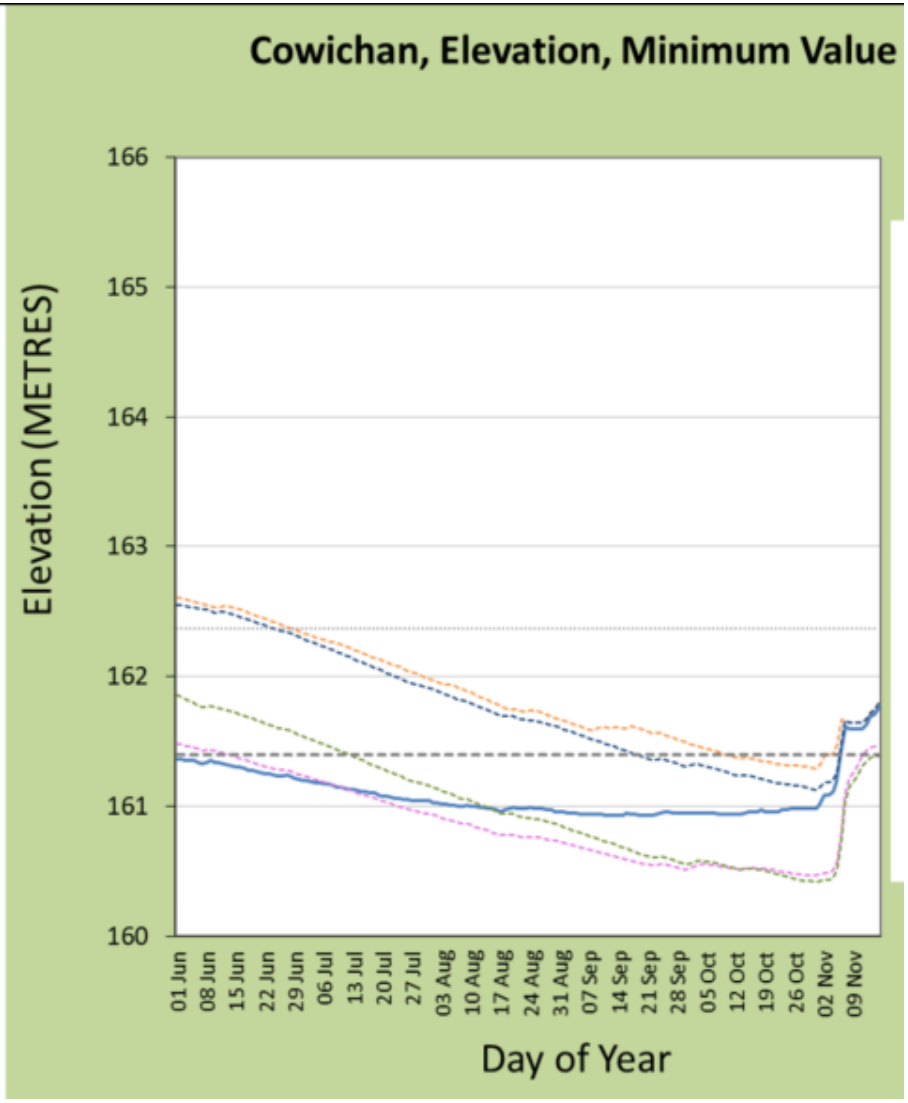
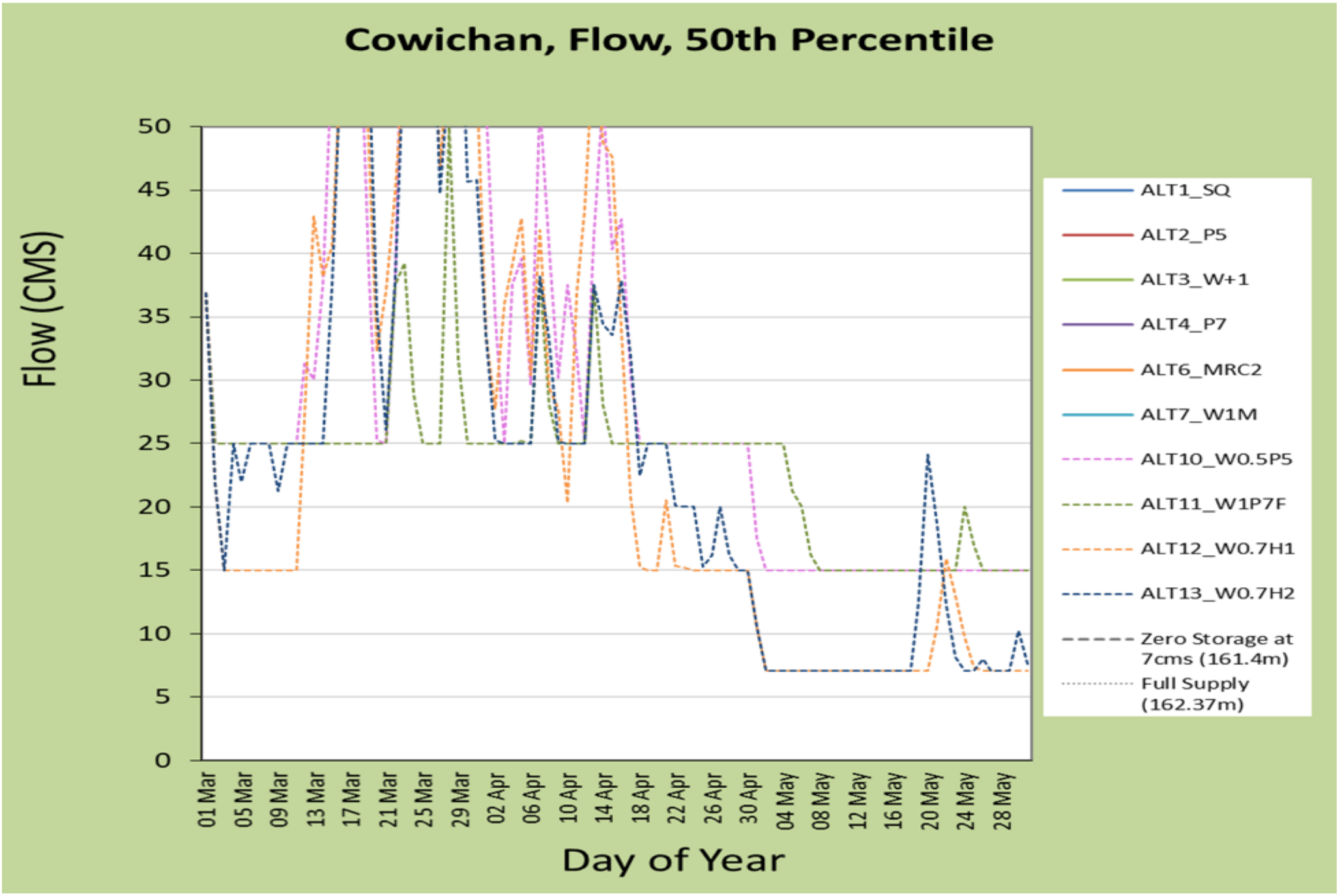
Full Supply (162.37m)

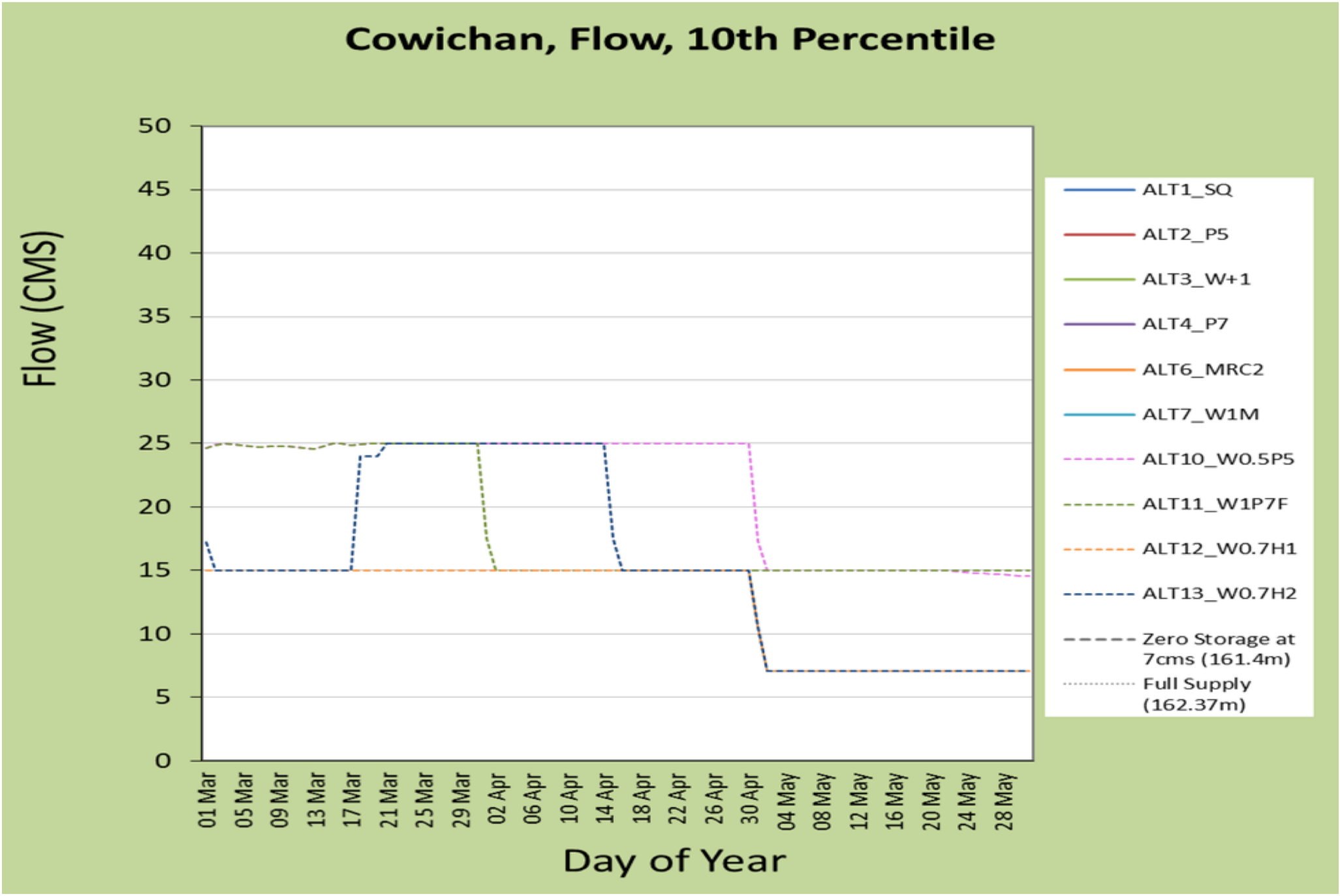

Cowichan, Flow, Minimum Value
Flow (CMS)
20
18
16
14
12
10
8
6
4
2
0
01 Jun
08 Jun
15 Jun
22 Jun
29 Jun
06 Jul
13 Jul
20 Jul
27 Jul
03 Aug
10 Aug
17 Aug
24 Aug
31 Aug
07 Sep
14 Sep
21 Sep
28 Sep
05 Oct
12 Oct
19 Oct
26 Oct
02 Nov
09 Nov
Day of Year
ALT1_SQ
ALT2_P5
ALT3_W+1
ALT4_P7
ALT6_MRC2
ALT7_W1M
ALT10_W0.5P5
ALT11_W1P7F
ALT12_W0.7H1
ALT13_W0.7H2
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

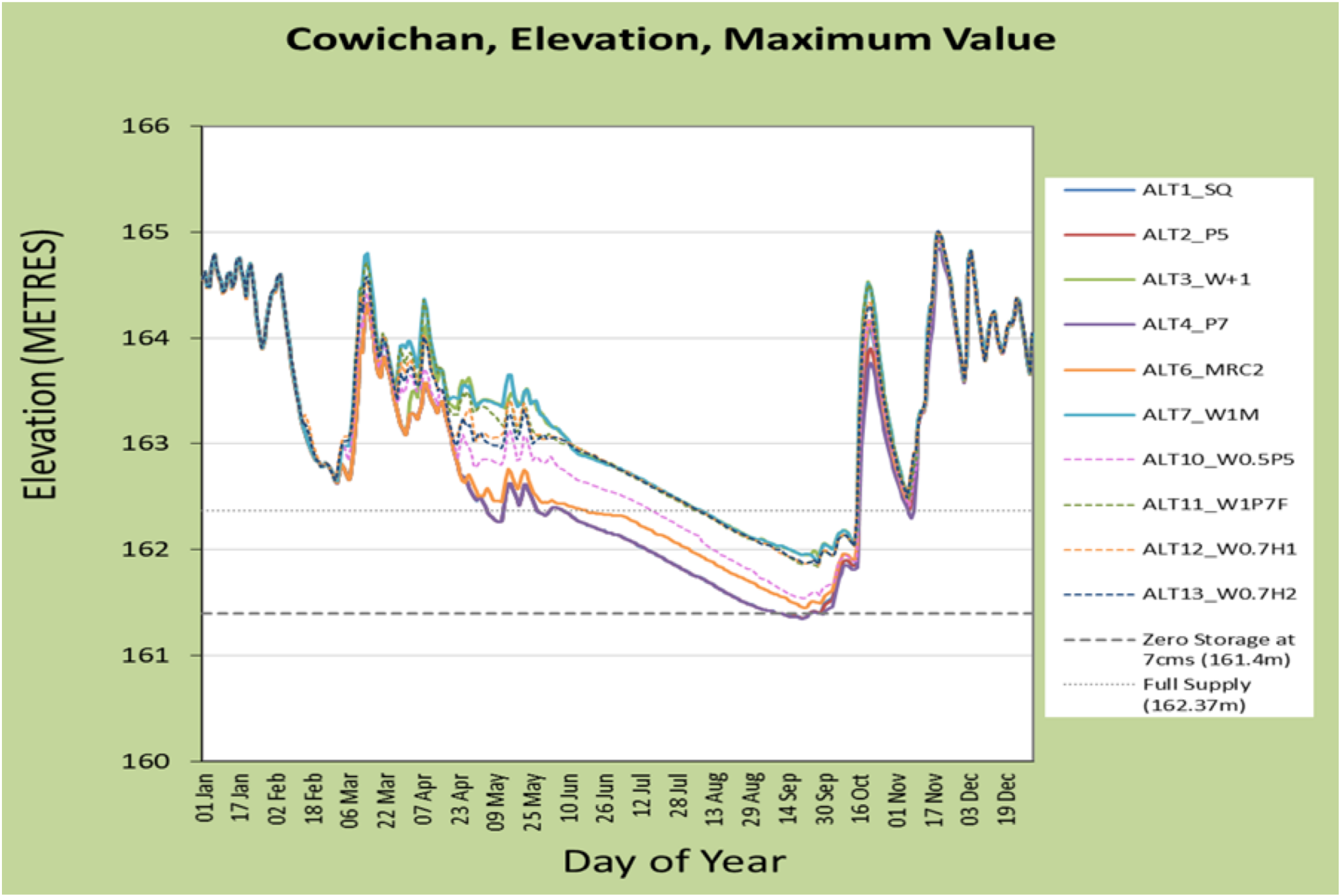

Cowichan, Elevation, Minimum Value
Elevation (METRES)
166
165
164
163
162
161
160
01 Jun
08 Jun
15 Jun
22 Jun
29 Jun
06 Jul
13 Jul
20 Jul
27 Jul
03 Aug
10 Aug
17 Aug
24 Aug
31 Aug
07 Sep
14 Sep
21 Sep
28 Sep
05 Oct
12 Oct
19 Oct
26 Oct
02 Nov
09 Nov
Day of Year

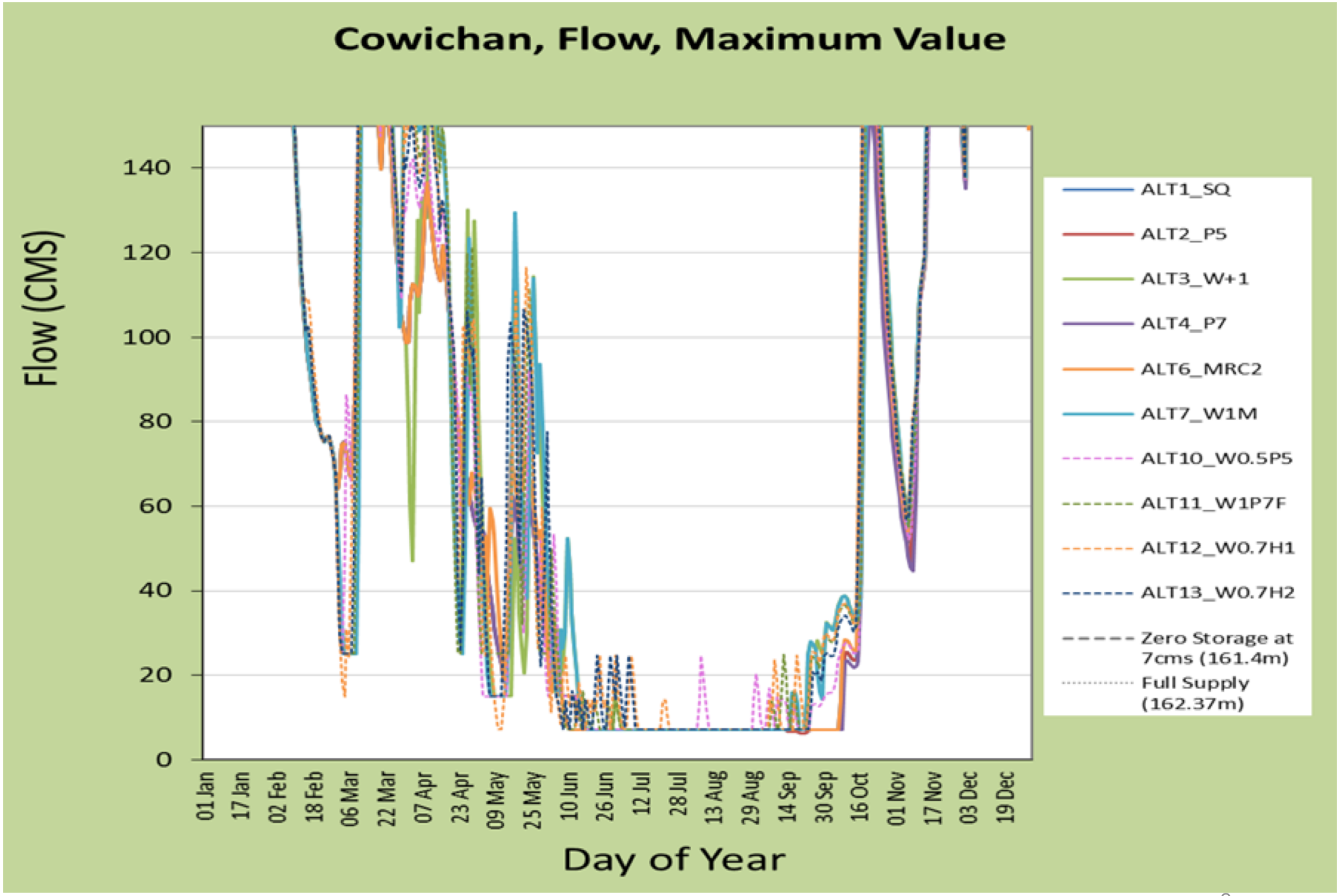
# Spring Fisheries Target Flows



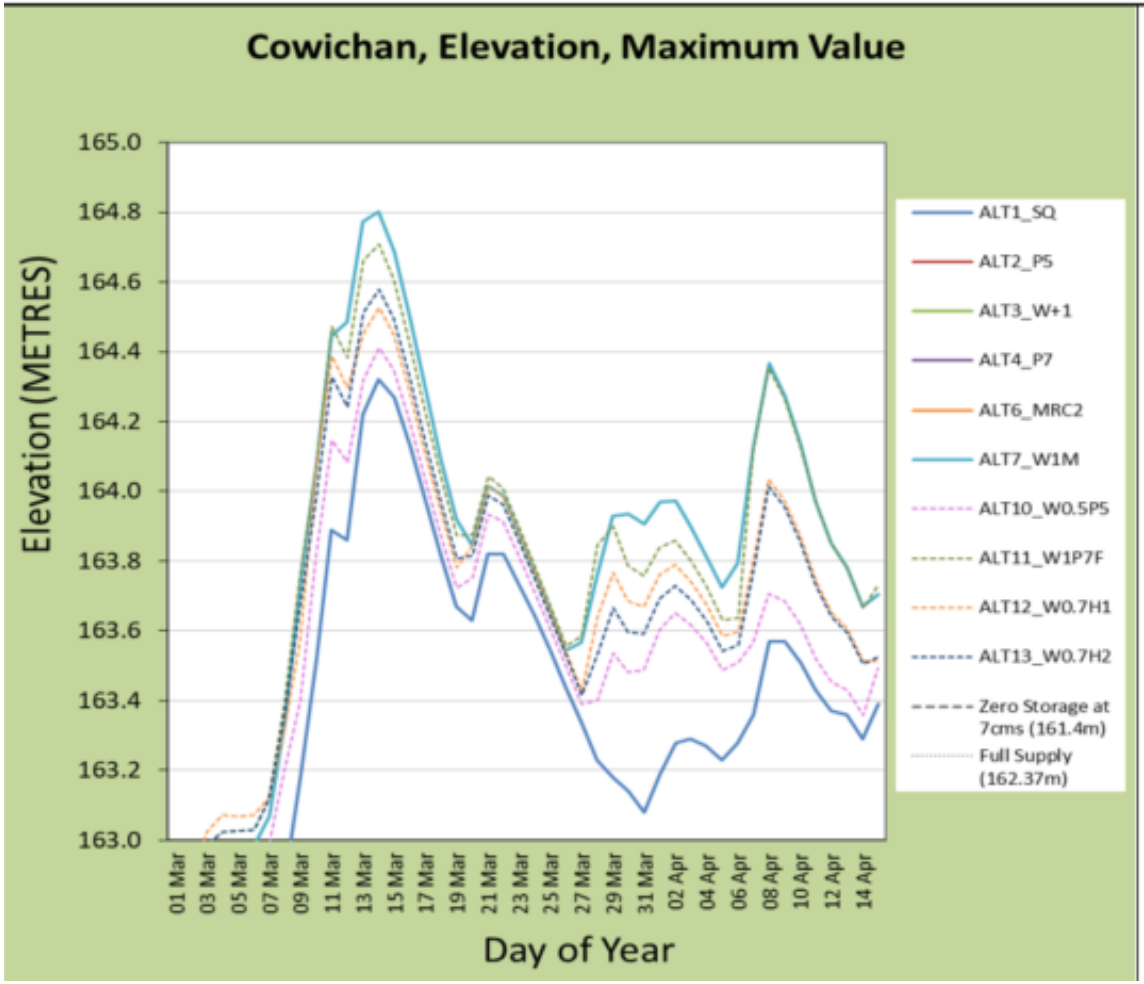
# Spring Fisheries Target Flows

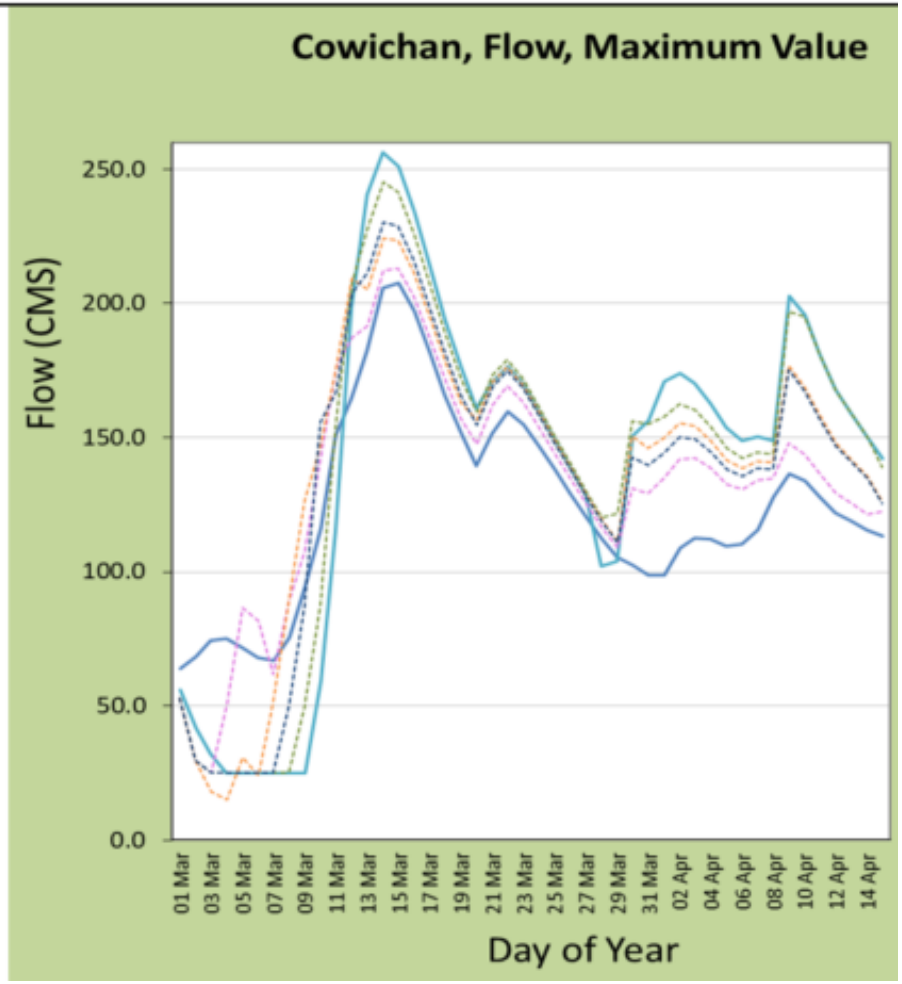



Cowichan, Elevation, Maximum Value
Elevation (METRES)
166
165
164
163
162
161
160
01 Jan
17 Jan
02 Feb
18 Feb
06 Mar
22 Mar
07 Apr
23 Apr
09 May
25 May
10 Jun
26 Jun
12 Jul
28 Jul
13 Aug
29 Aug
14 Sep
30 Sep
16 Oct
01 Nov
17 Nov
03 Dec
19 Dec
Day of Year
ALT1_SQ
ALT2_P5
ALT3_W+1
ALT4_P7
ALT6_MRC2
ALT7_W1M
ALT10_W0.5P5
ALT11_W1P7F
ALT12_W0.7H1
ALT13_W0.7H2
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

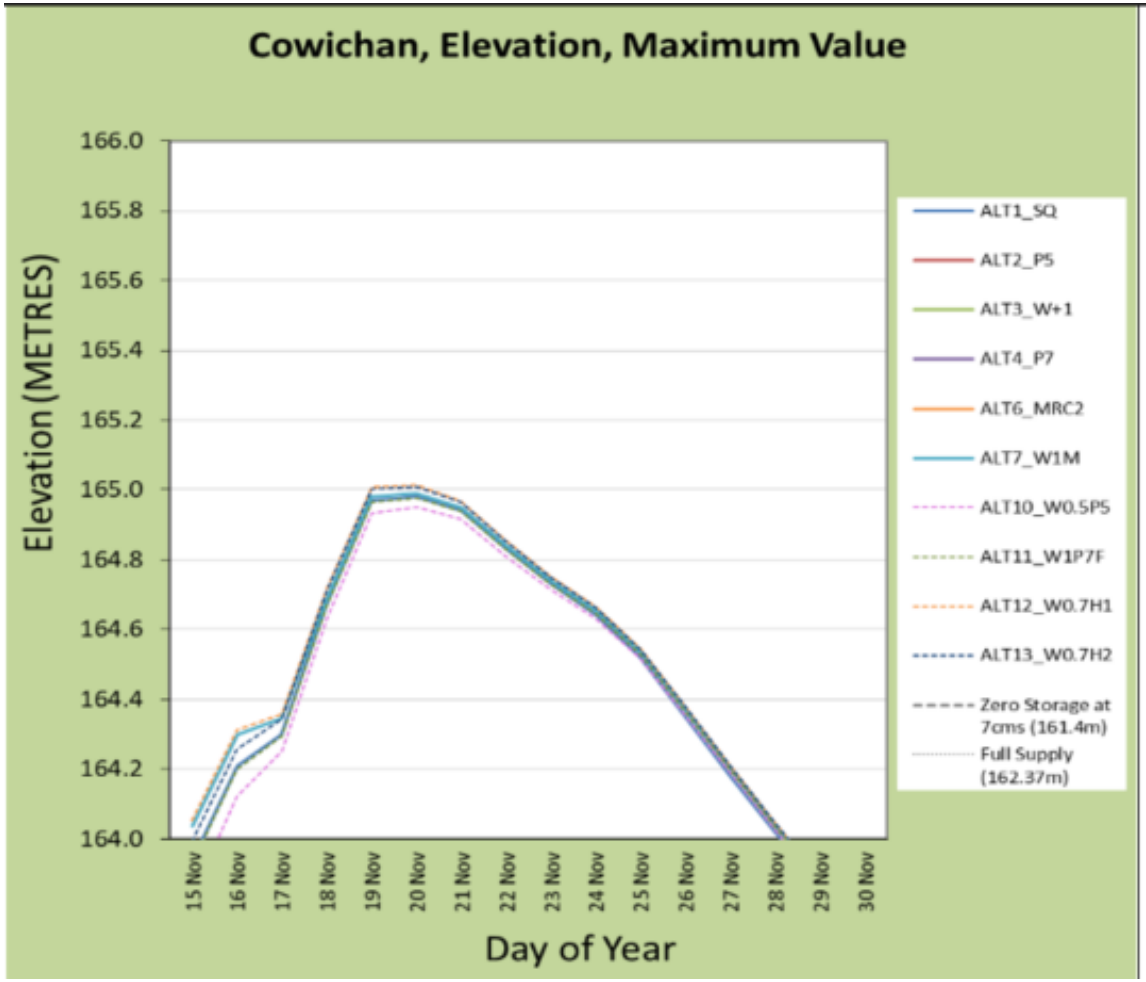

Cowichan, Flow, Maximum Value
Flow (CMS)
0
20
40
60
80
100
120
140
01 Jan
17 Jan
02 Feb
18 Feb
06 Mar
22 Mar
07 Apr
23 Apr
09 May
25 May
10 Jun
26 Jun
12 Jul
28 Jul
13 Aug
29 Aug
14 Sep
30 Sep
16 Oct
01 Nov
17 Nov
03 Dec
19 Dec
Day of Year
ALT1_SQ
ALT2_P5
ALT3_W+1
ALT4_P7
ALT6_MRC2
ALT7_W1M
ALT10_W0.5P5
ALT11_W1P7F
ALT12_W0.7H1
ALT13_W0.7H2
Zero Storage at 7cms (161.4m)
Full Supply (162.37m)

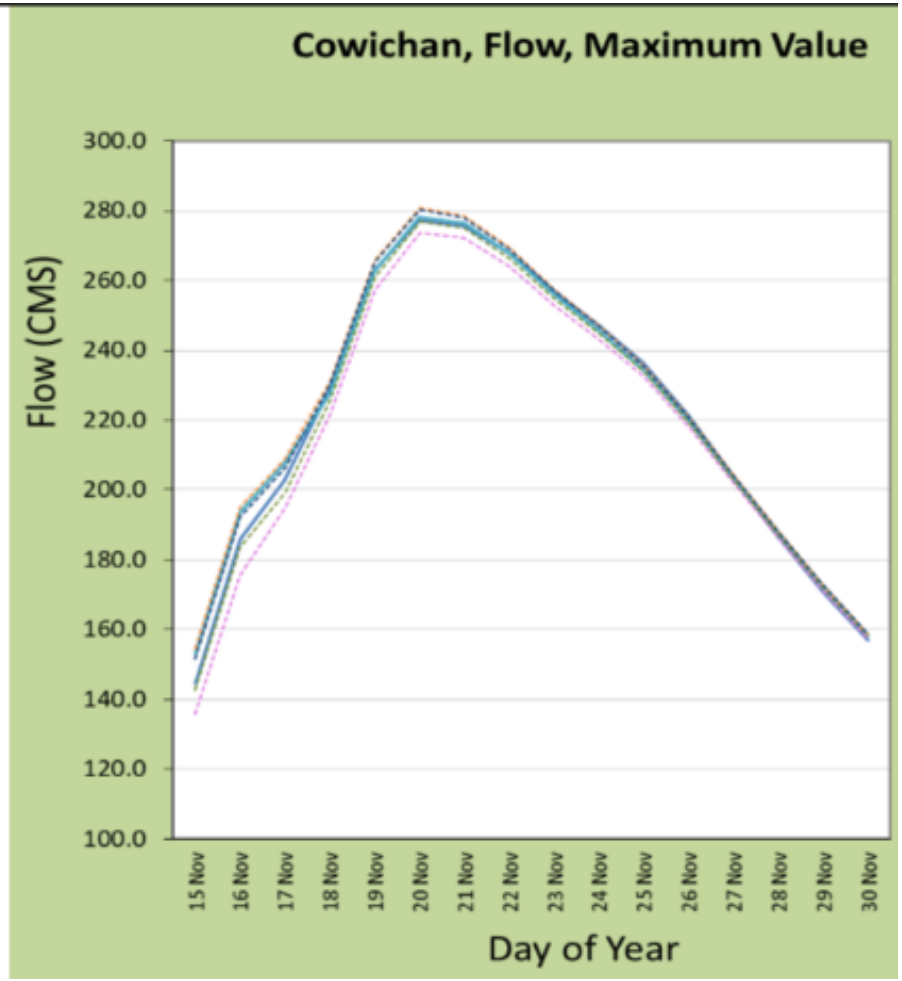
# Wet Spring Period – March 1 to April 15



# Late Fall Rain Events – Nov 15 to Nov 30



# Assessing Water Use Alternatives

## Performance Measures

HANDOUT CONSEQUENCE TABLE

# Draft Performance Measures

## Culture and Heritage

- Specific PMs have not been developed at this time
- Propose that the fish PMs be used as an interim proxy for FSC rights and transfer of traditional knowledge
- PMs for cultural practices (e.g., ceremonial bathing) [placeholder]

# Draft Performance Measures

## Aquatic & Riparian Ecosystems

# Draft Performance Measures

## Lake Aesthetics

***New***

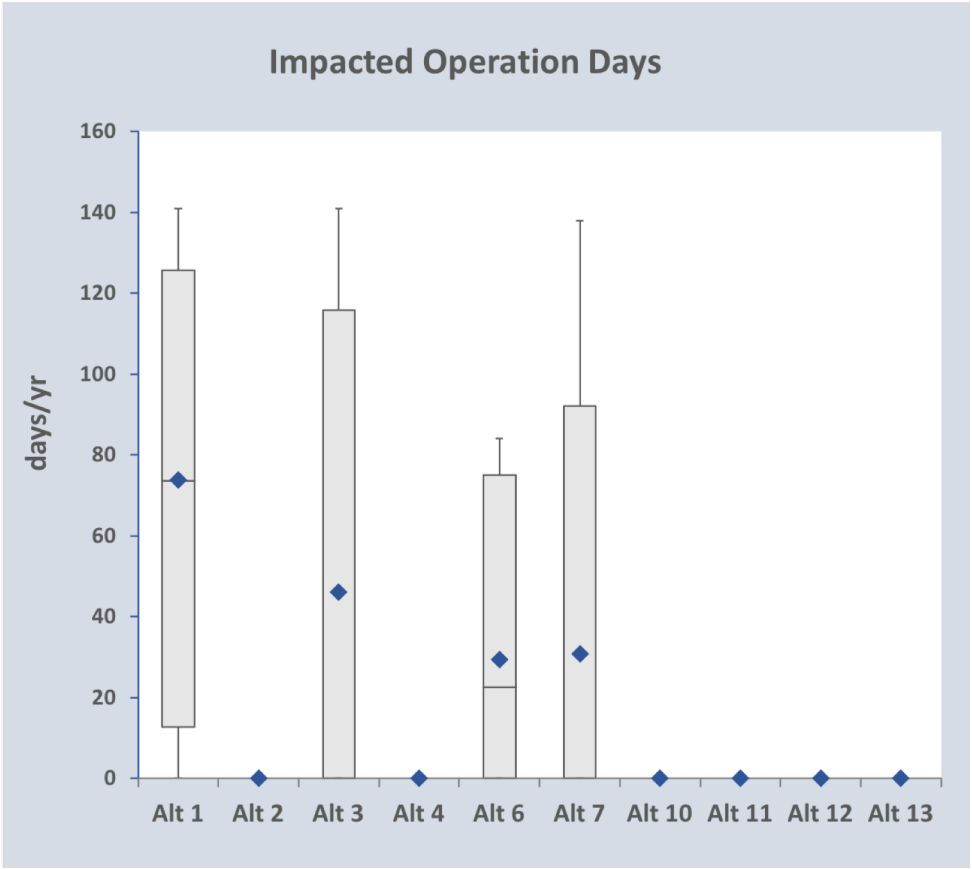
- Provides a qualitative rating of potential visual impacts("bathtub ring") associated with lake levels in the summer if they fall below historical "0" storage level (i.e., 161.4m)

| Rating Scale | Description |
|---|---|
| 1 | **No Visual Effects** – During dryer summers (10%ile), lake levels do not drop more than 15cm below 161.4m for any extended period (i.e., < 2wks) |
| 2 | **Minor Visual Effects** – […], lake levels can drop between 0 to 30cm for extended periods (i.e., > 2 weeks) |
| 3 | **Moderate Visual Effects** – […], lake levels can drop between 31cm to 60cm for extended periods (i.e., > 2 weeks) |
| 4 | **Significant Visual Effects** – […], lake levels can drop between 61 to 90cms for extended periods of the summer and late fall. |
| 5 | **Very Significant Visual Effects** – […] lake levels can drop by > 91cms for extended periods of the summer and late fall. |

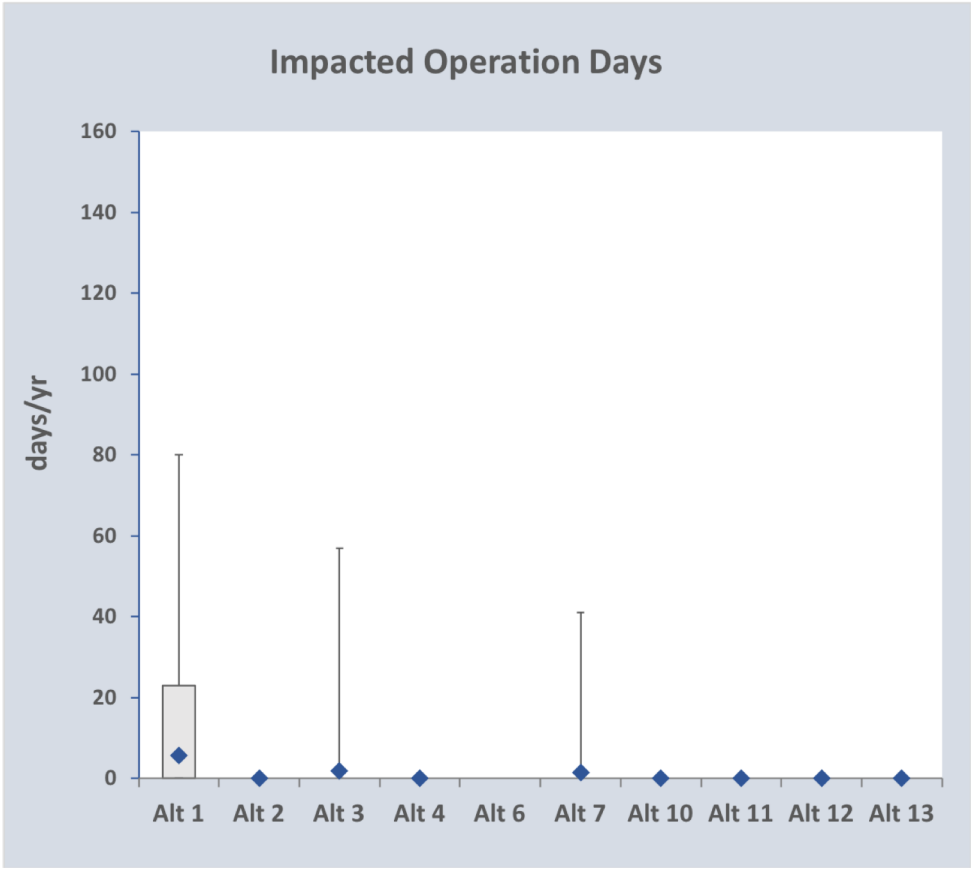
# Draft Performance Measures

## Industry and Commercial

### 2050s




### Historical

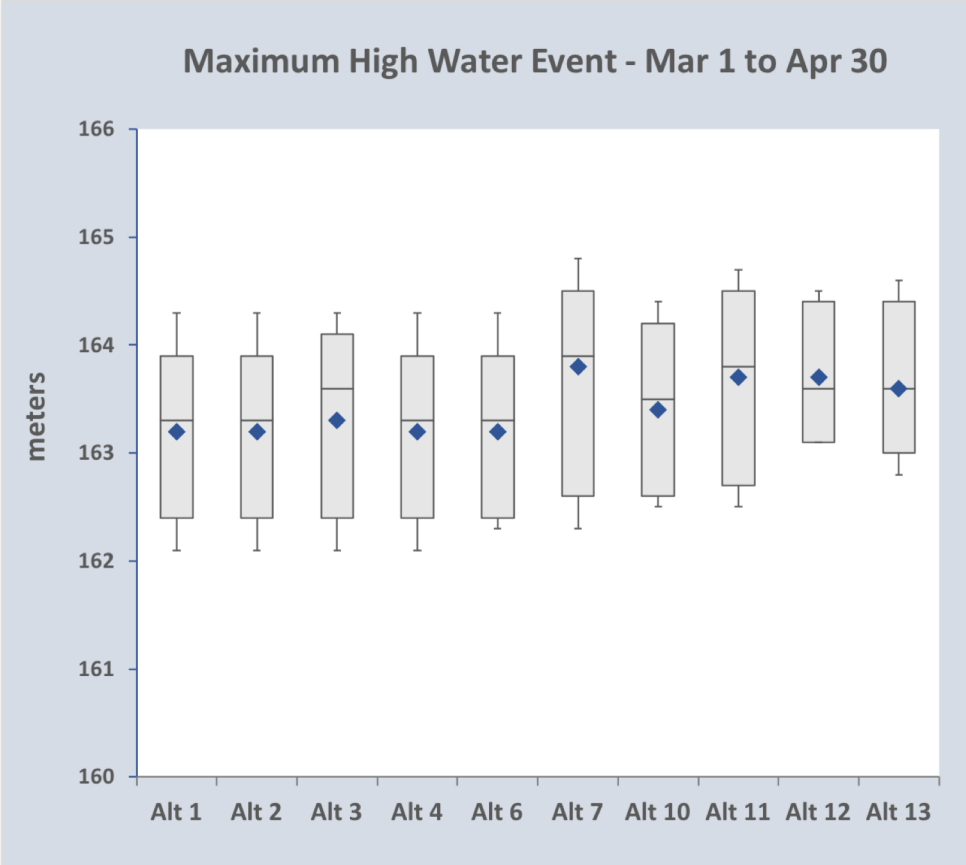



*Note: Alt 6 has not been modelled for the historical dataset*

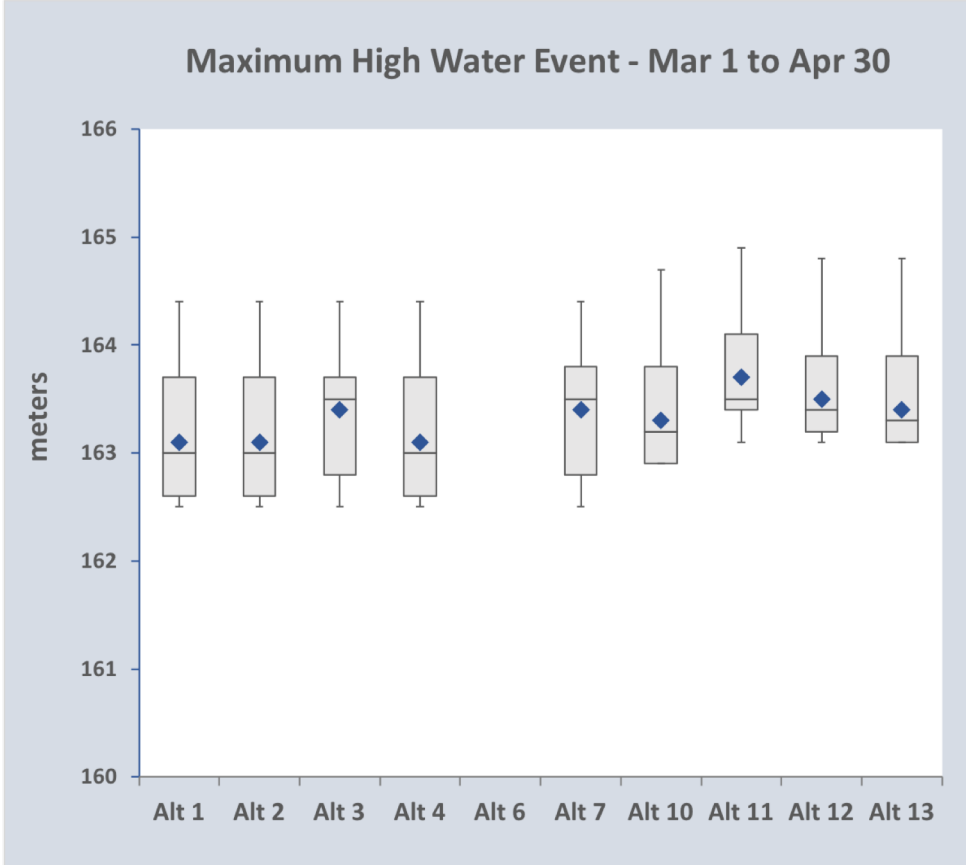
# Draft Performance Measures

## Flooding and Inundation

### 2050s




### Historical

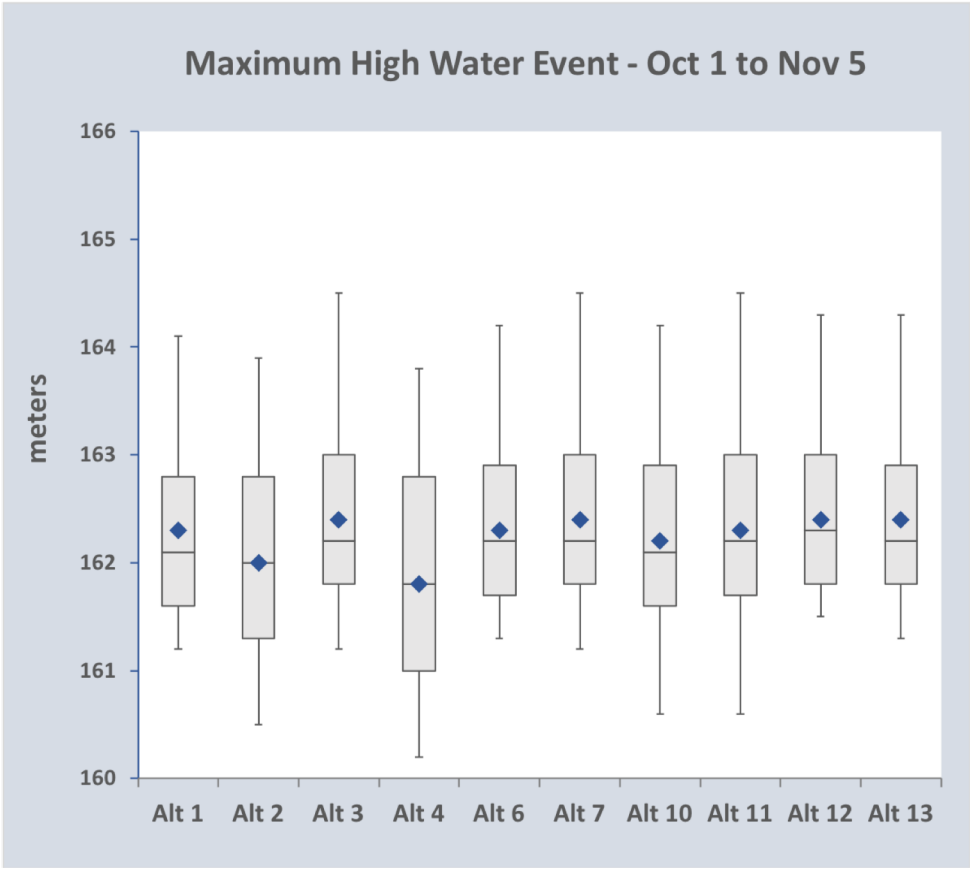



*Note: Alt 6 has not been modelled for the historical dataset*

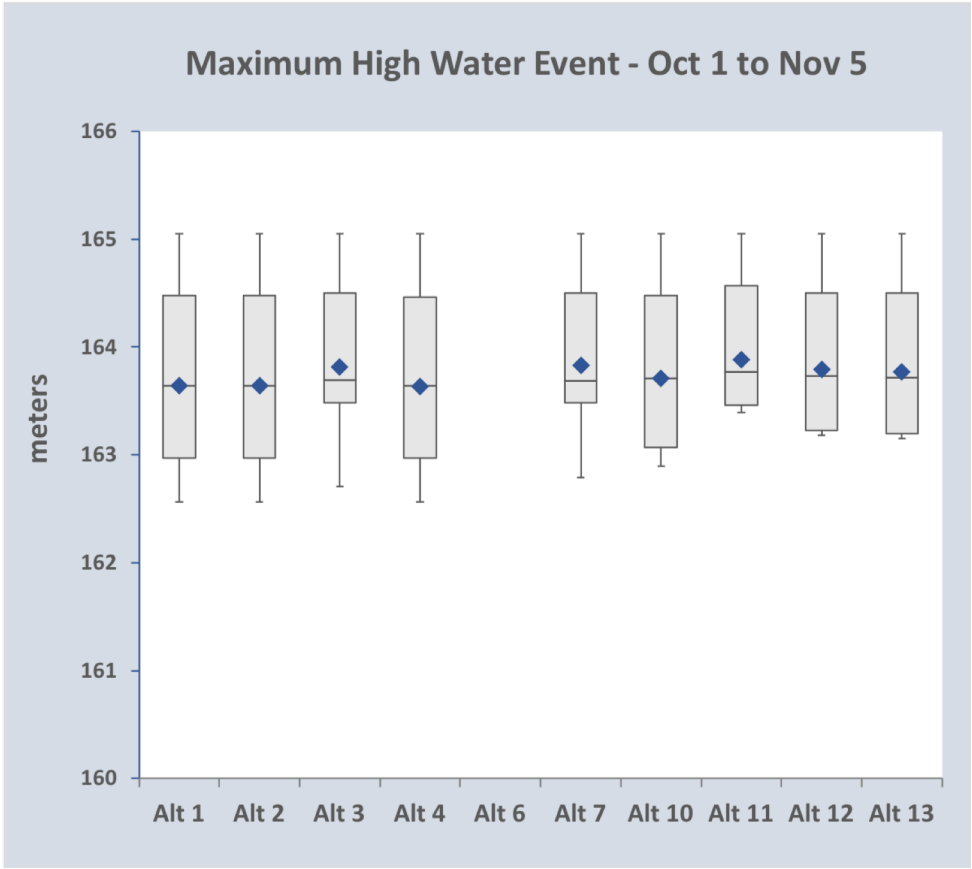
# Draft Performance Measures

## Flooding and Inundation

### 2050s




### Historical

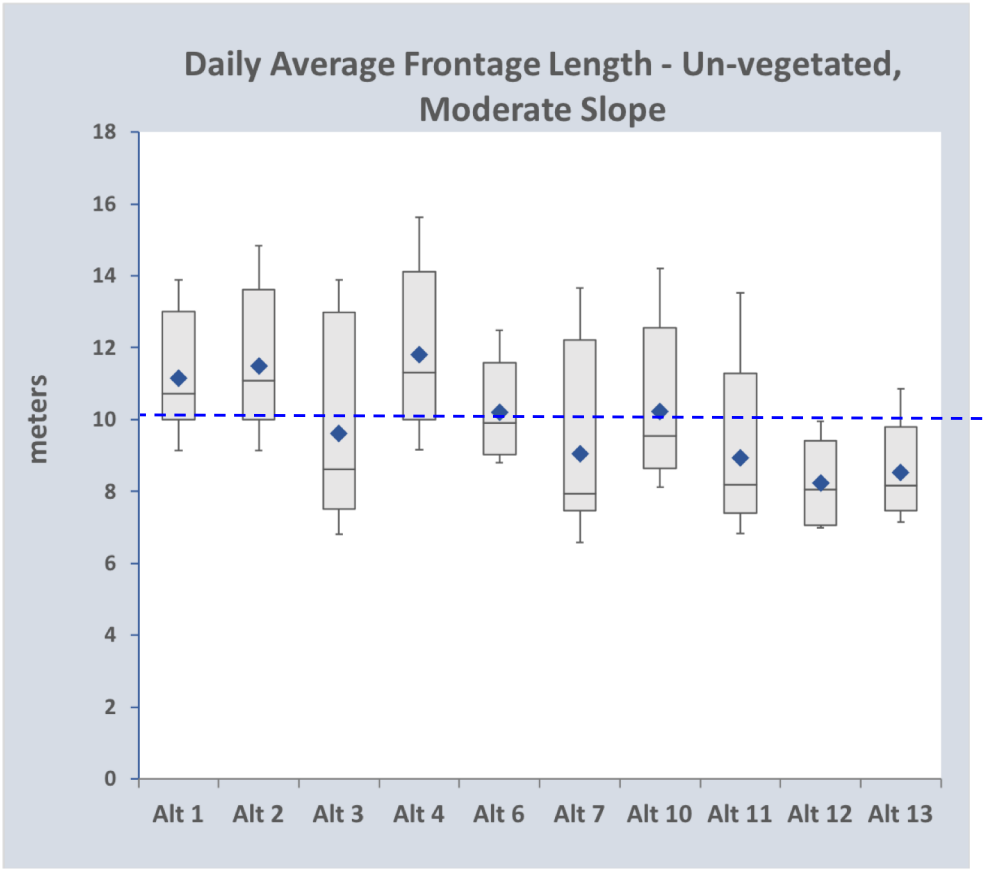



*Note: Alt 6 has not been modelled for the historical dataset*

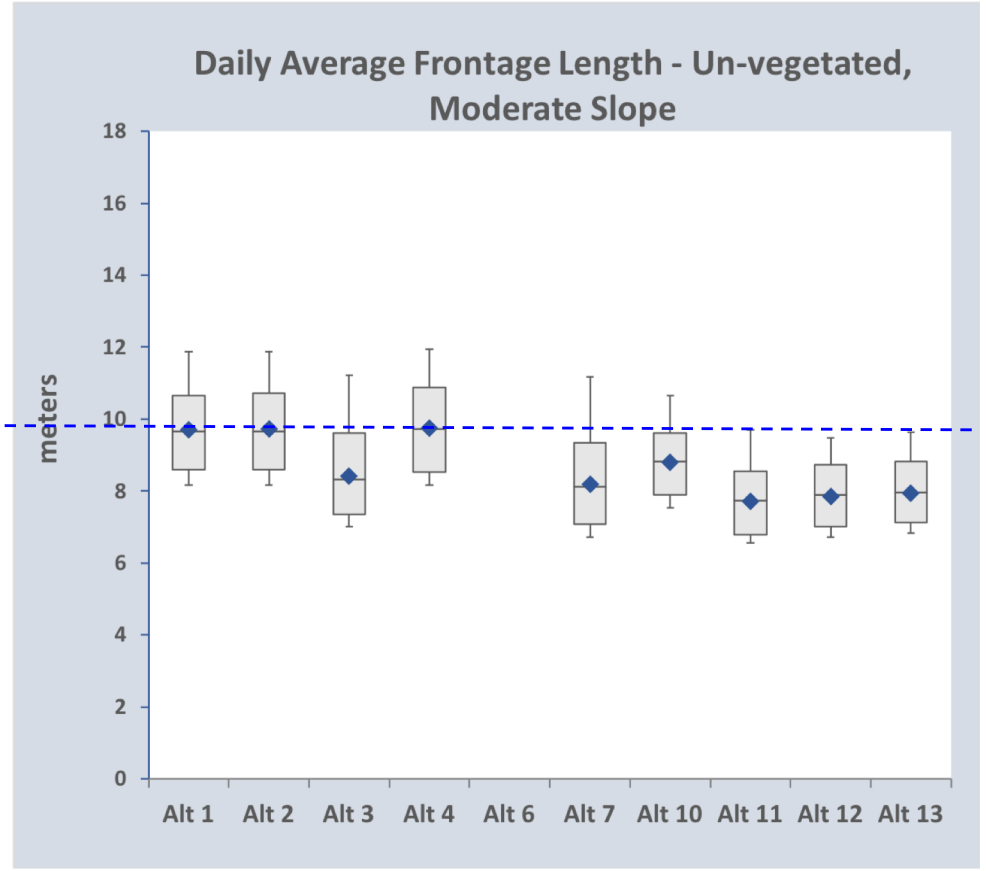
# Draft Performance Measures

## Private Property Lakefront Areas

### 2050s




### Historical

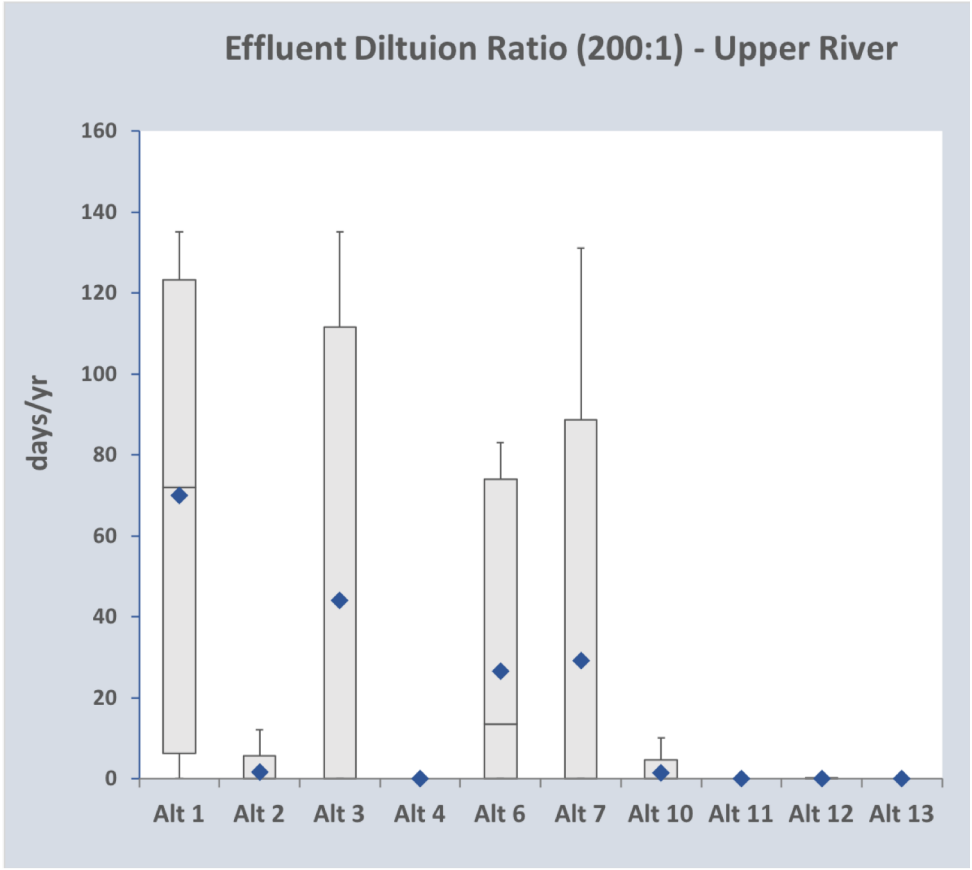



*Note: Alt 6 has not been modelled for the historical dataset*

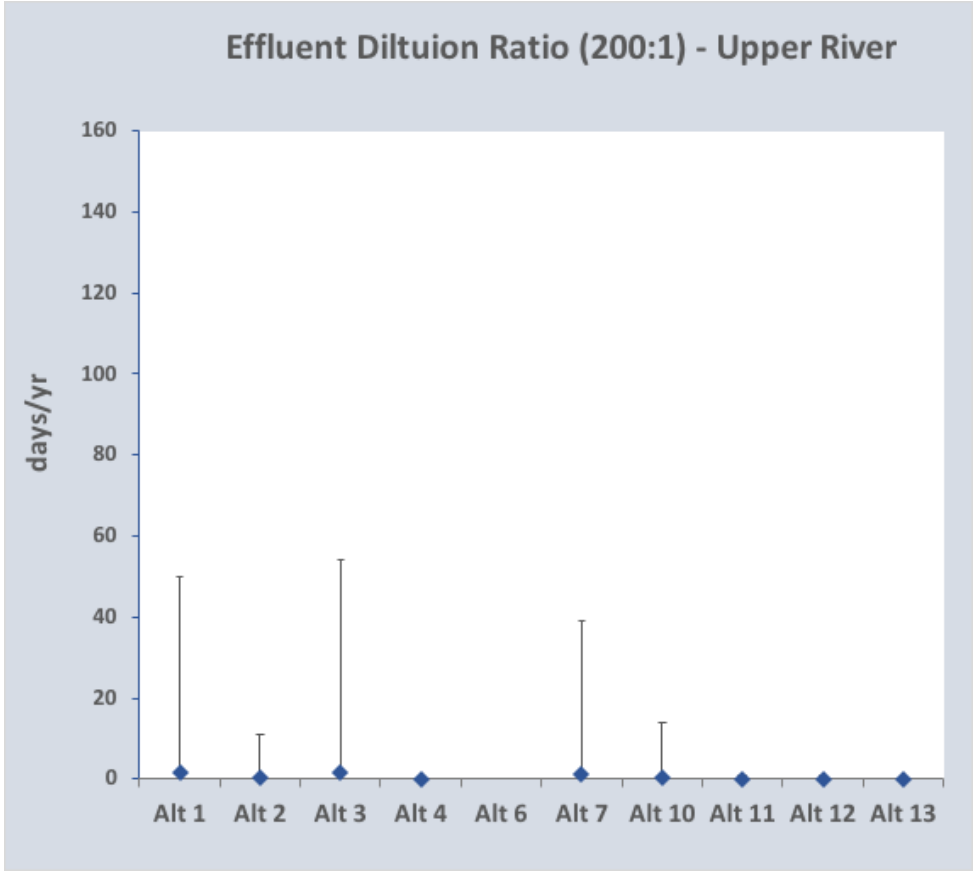
# Draft Performance Measures

## Waste Water Dilution

### 2050s




### Historical

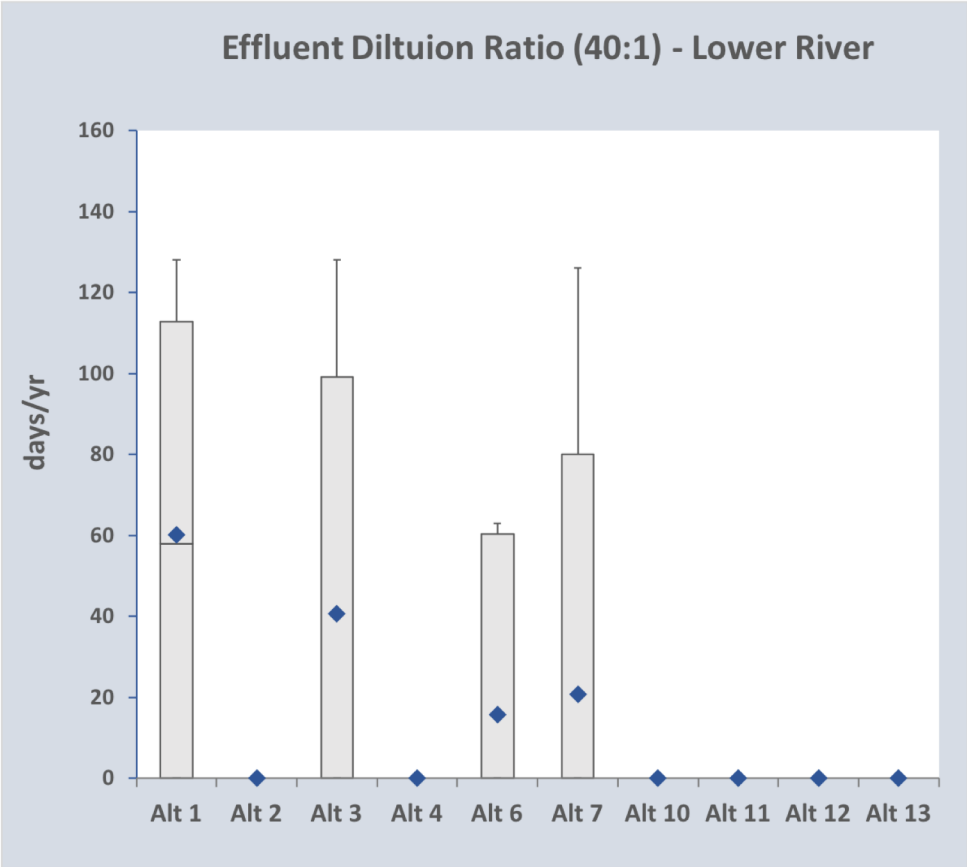



*Note: Alt 10 does not meet the Upper River objective in early November for two years in the 2050s record. The min flow threshold is based on an **average** monthly effluent discharge rate which has been calculated higher discharges throughout the month. The actual river flow needed to meet the 200:1 objective would be lower on days in the month that are dryer.*

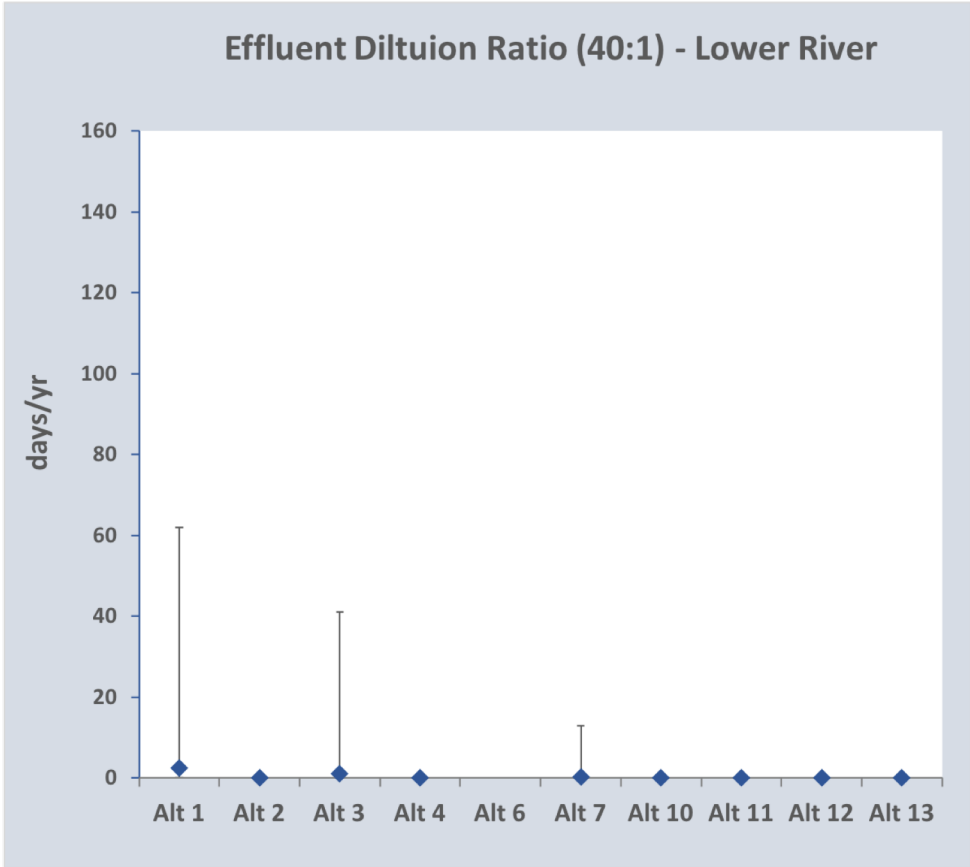
# Draft Performance Measures

## Waste Water Dilution

### 2050s




### Historical

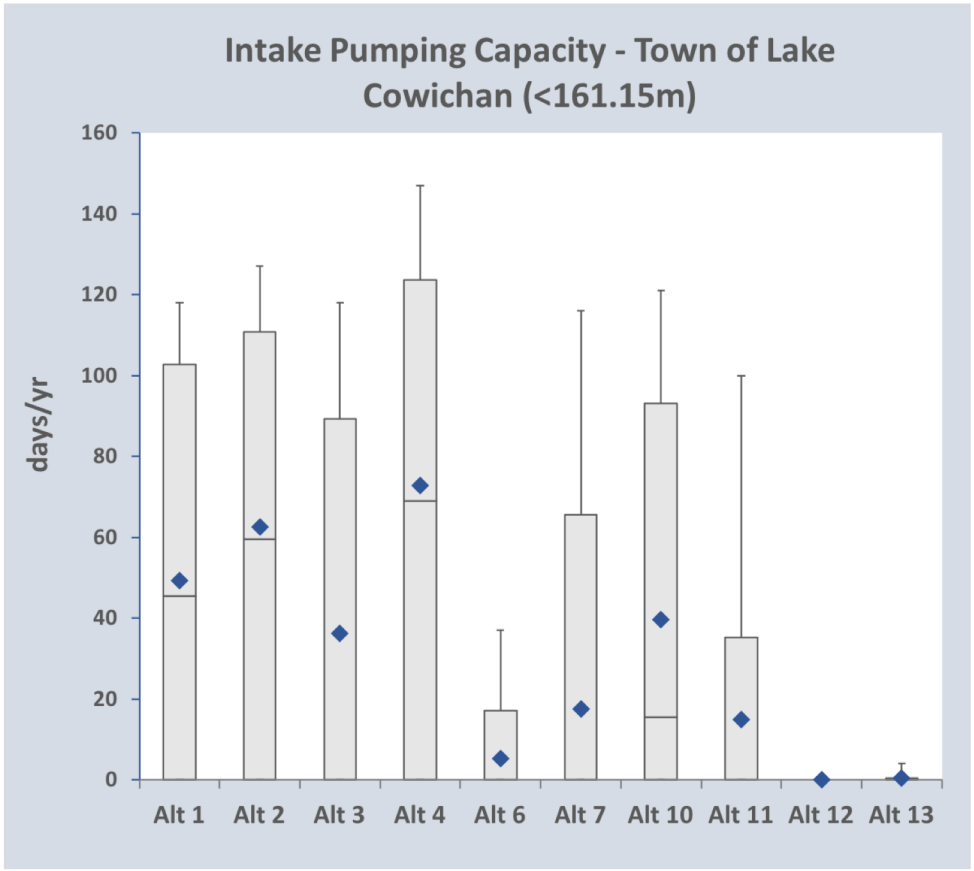



*Note: Alt 10 does not meet the Upper River objective in early November for two years in the 2050s record. The min flow threshold is based on an **average** monthly effluent discharge rate which has been calculated higher discharges throughout the month. The actual river flow needed to meet the 200:1 objective would be lower on days in the month that are dryer.*

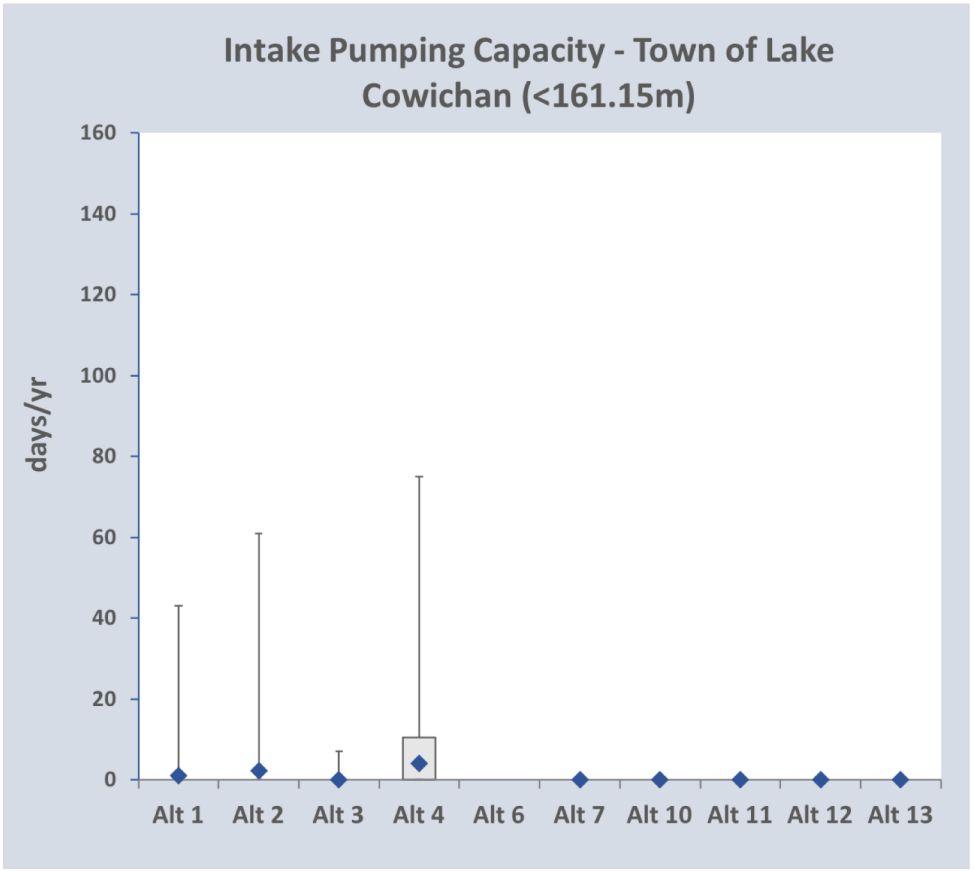
# Draft Performance Measures

## Community Water Supply

### 2050s



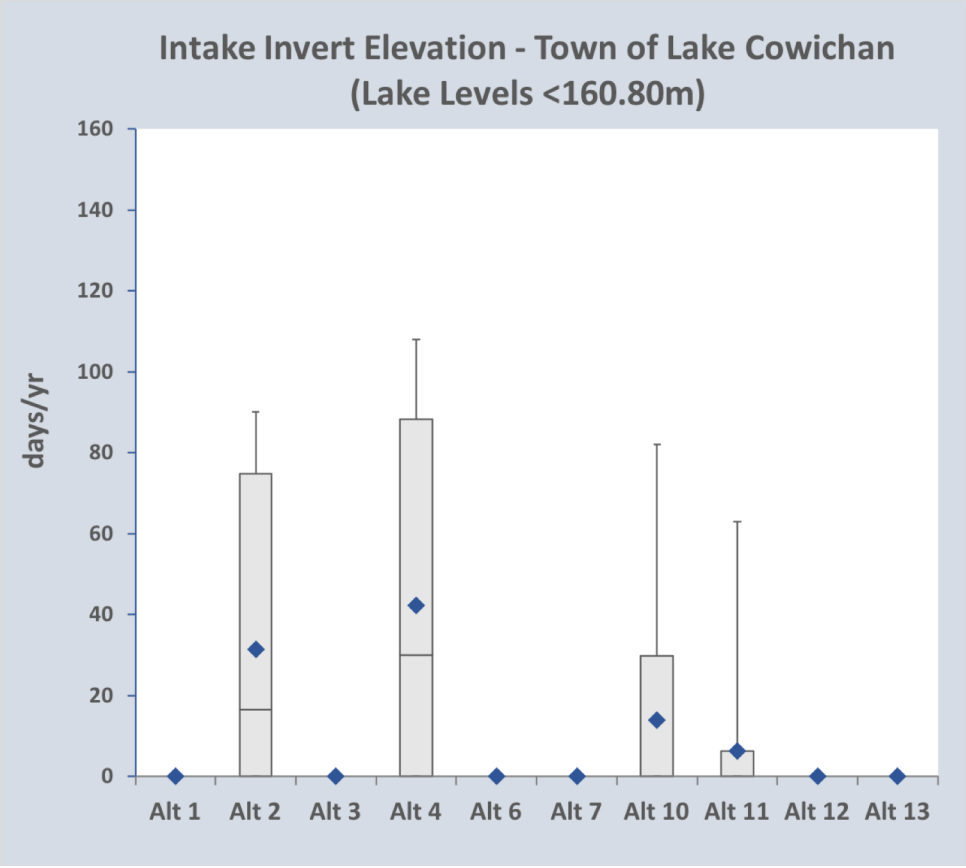

### Historical



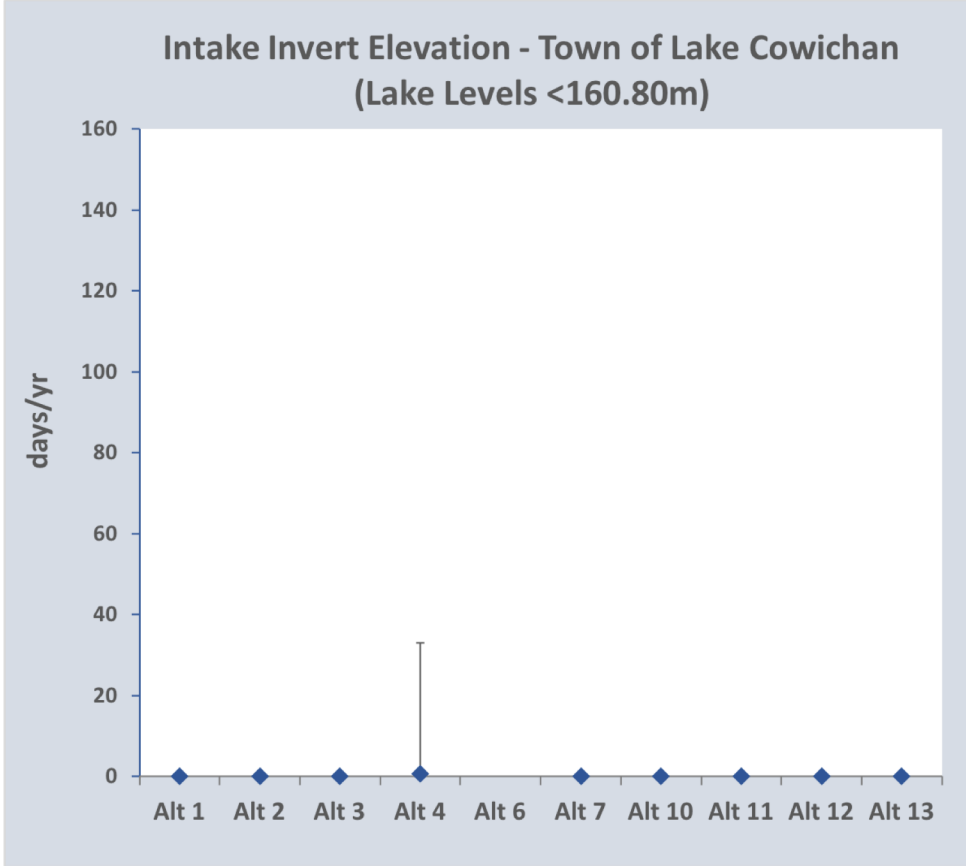
# Draft Performance Measures

## Community Water Supply

### 2050s




### Historical



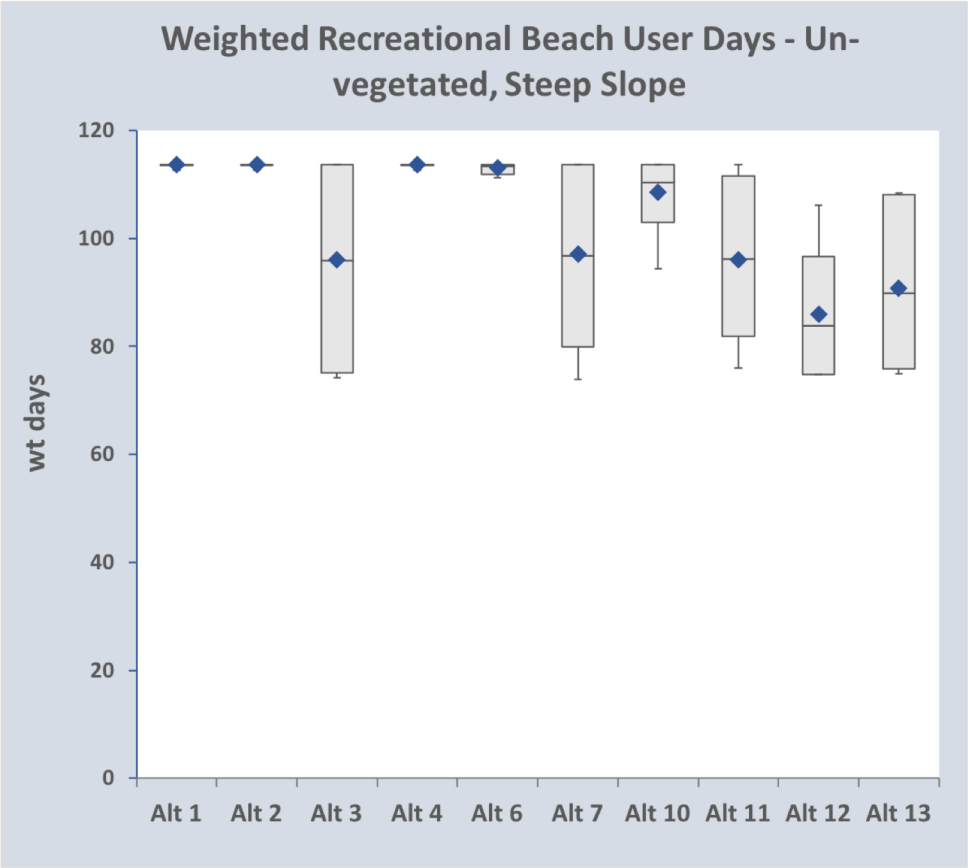
# Draft Performance Measures

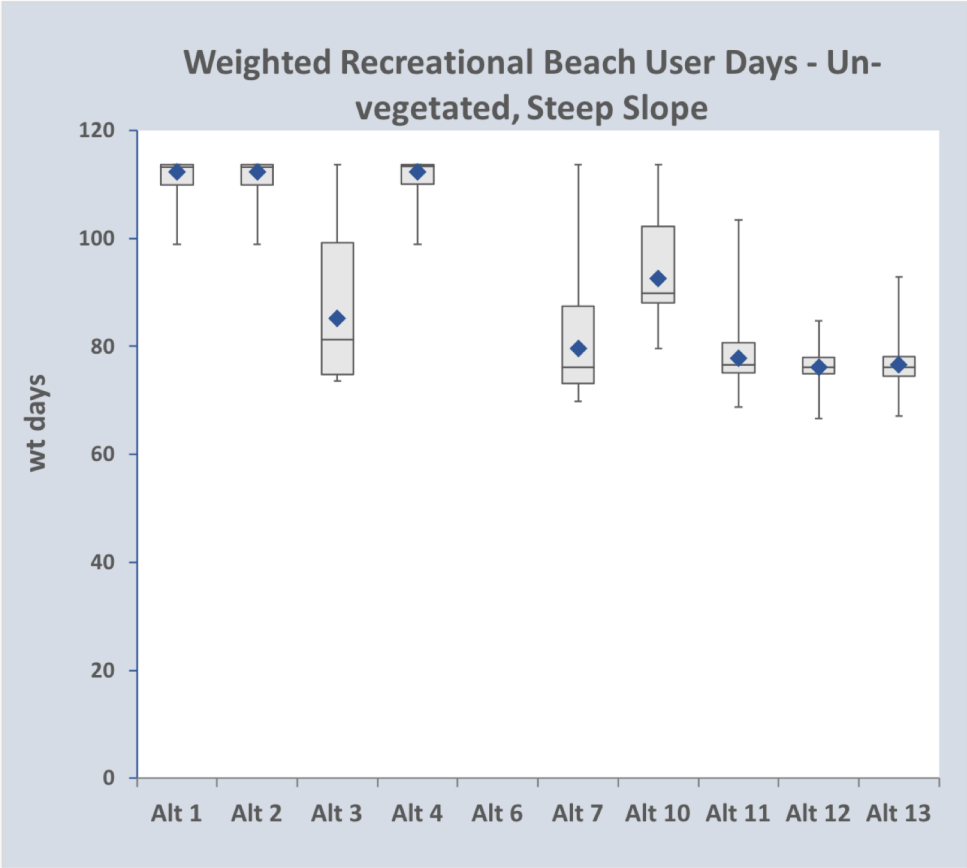
## Recreational Beach Use - Lake

2050 s

*PM direction:*
*Higher is better*

Historical



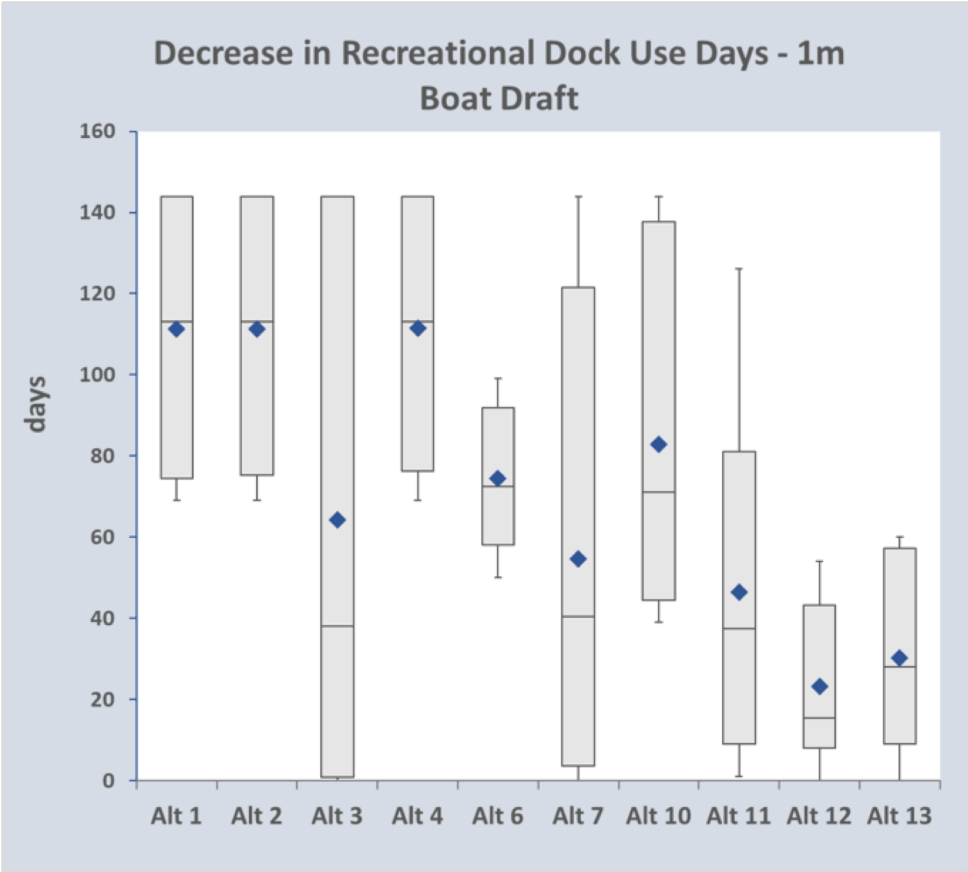
# Draft Performance Measures

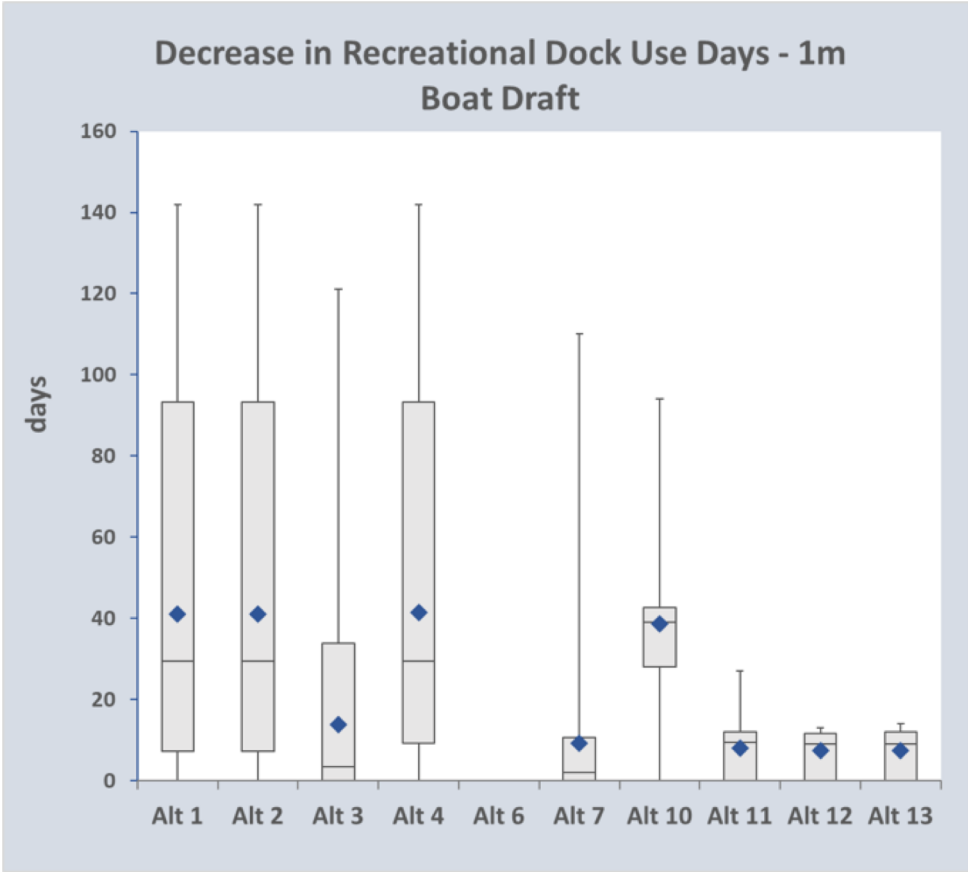
## Boat Access and Navigation - Lake

2050s

*PM direction:*
*Less is better*

Historical




*Note: Alt 6 has not been modelled for the historical dataset*

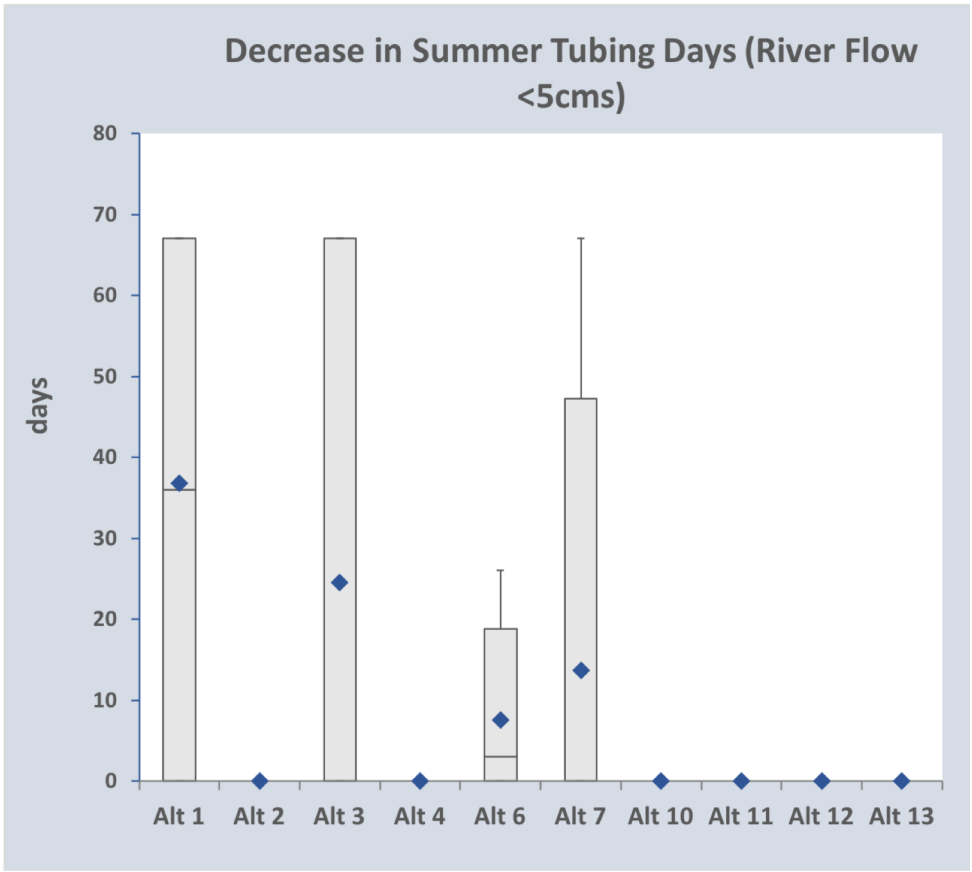
# Draft Performance Measures

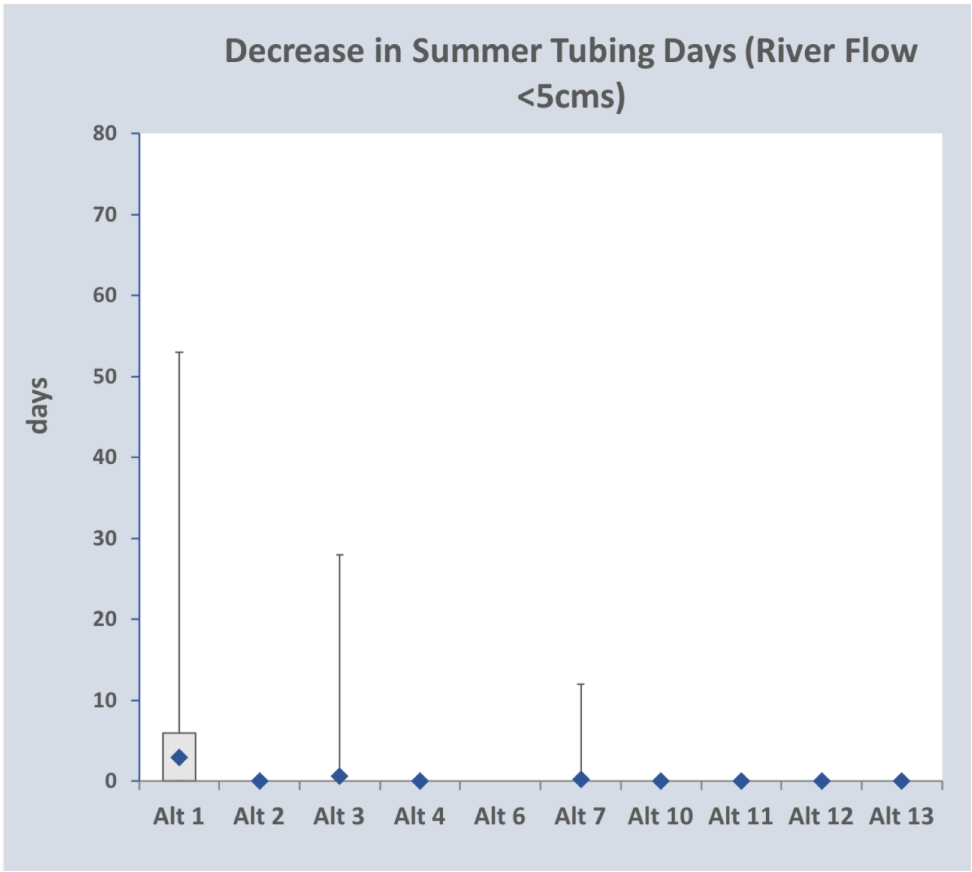
## Boating and Tubing - River

2050s

*PM direction:*
*Less is better*

Historical



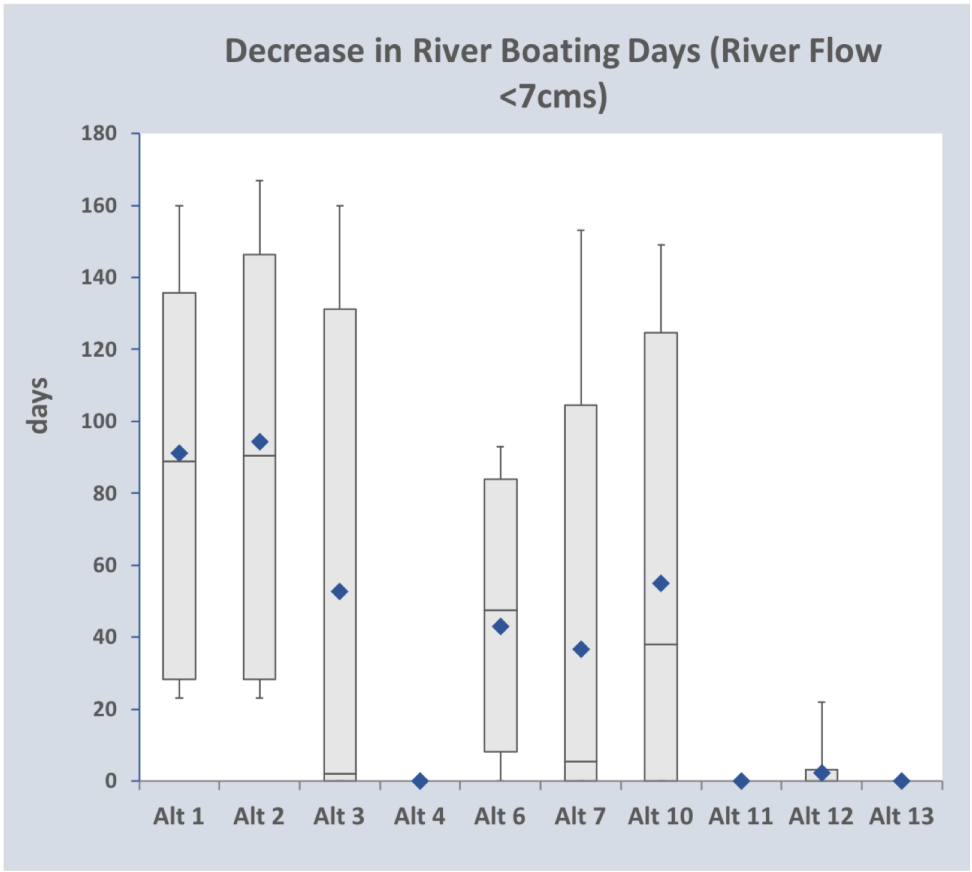
# Draft Performance Measures

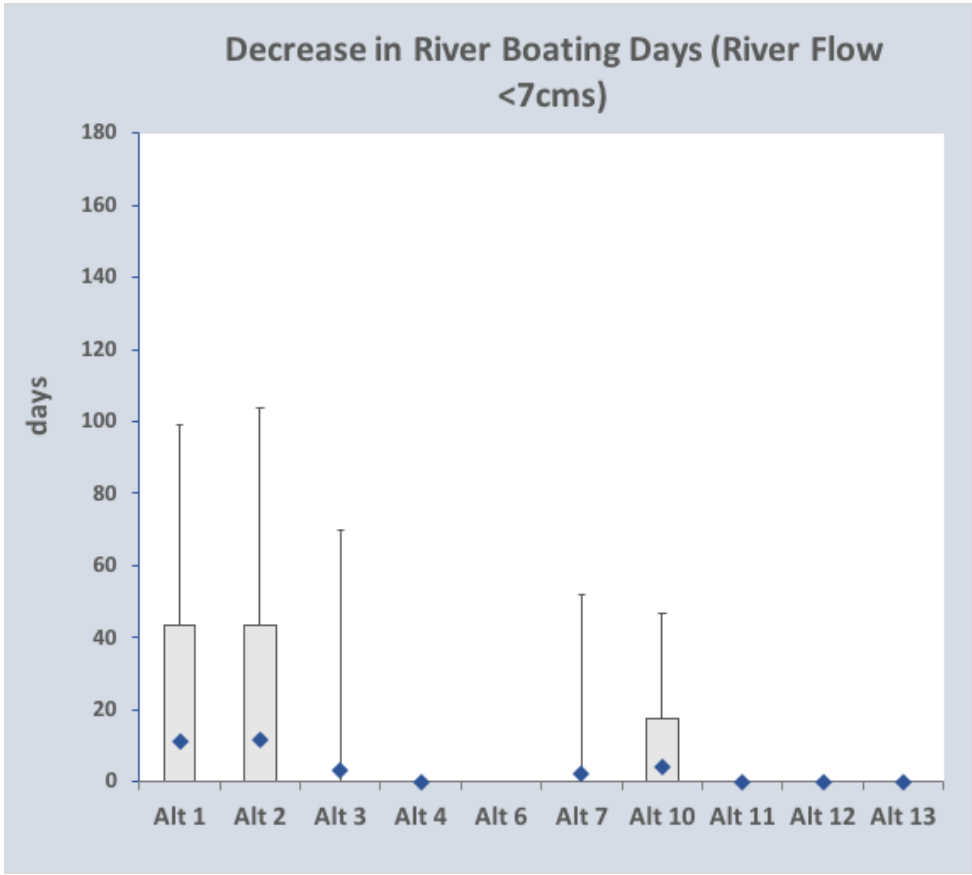
## Boating and Tubing - River

2050s

*PM direction:*
*Less is better*

Historical



# Draft Performance Measures

## Water Management

- Cost estimates from the 2015 Cowichan Lake Storage Options Review and Catalyst estimates for raising the weir 1m and to mobilize and operate temporary pumps
- Capital costs:
  - $6M - permanent pumphouse
  - $20M - raise weir 1m (less for a lower height increase)
- Operational costs:
  - $500K / mobilization of temporary pumps
  - $100K / year for operation of permanent pump house

| PM | Units | Dir. | Alt1 | Alt 2 | Alt 3 | Alt 4 | Alt 6 | Alt 7 | Alt 10 | Alt 11 | Alt 12 | Alt 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Capital costs** | M$ | ↓ | 0 | 0 | 20 | 6 | 0 | 20 | 15 | 26 | 18 | 24 |
| **Operational costs (over 10yrs)** | M$ | ↓ | 0 | 5 | 0 | 1 | 0 | 0 | 4 | 1 | 0 | 1 |

# Round 2 - Consequence Table

# Round 2 - Consequence Table

| Objective | Performance Measure | Units | Dir | Alt 1 | Alt 2 | Alt 3 | Alt 4 | Alt 6 | Alt 7 | Alt 10 | Alt 11 | Alt 12 | Alt 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Environment - River** | | | | | | | | | | | | | |
| Fish Passage | Adult summer CHK migration (10%tile) | HSI | H | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 |
| Fish Passage | Adult fall CHK migration (10%tile) | HSI | H | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 |
| Lateral Connectivity | Side channel connectivity (10th %tile) | % | H | 0.78 | 0.78 | 0.84 | 0.84 | 0.84 | 0.89 | 0.89 | 0.89 | 0.84 | 0.84 |
| Rearing | Steelhead parr (10th %tile) | HSI | H | 0.00 | 0.75 | 0.00 | 0.80 | 0.09 | 0.00 | 0.75 | 0.00 | 0.80 | 0.80 |
| Rearing | Chinook fry (10th %tile) | HSI | H | 0.39 | 0.39 | 0.39 | 0.39 | 0.00 | 0.44 | 0.49 | 0.44 | 0.25 | 0.25 |
| Spawning | Early Steelhead incubation (10%tile) | HSI | H | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.35 | 0.45 | 0.08 | 0.00 | 0.00 |
| **Environment - Lake** | | | | | | | | | | | | | |
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # | L | 3 | 5 | 3 | 6 | 2 | 2 | 4 | 3 | 1 | 2 |
| Littoral Productivity | Littoral rearing habitat | # | H | 0.45 | 0.10 | 0.46 | 0.10 | 0.59 | 0.53 | 0.27 | 0.44 | 0.78 | 0.63 |
| **Industry and Commercial** | | | | | | | | | | | | | |
| Catalyst Paper | Impacted operations days | days/yr | L | 74 | 0 | 0 | 0 | 23 | 0 | 0 | 0 | 0 | 0 |
| **Lakefront Properties** | | | | | | | | | | | | | |
| Flooding and innundation | Max High Water Event - Mar 1 to Apr 30 | meters | L | 164.3 | 164.3 | 164.3 | 164.3 | 164.3 | 164.8 | 164.4 | 164.7 | 164.5 | 164.6 |
| Private Property Lkfrnt Areas | Frontage length - un-vegetated, mod slope | meters | H | 10.7 | 11.1 | 8.6 | 11.3 | 9.9 | 7.9 | 9.6 | 8.2 | 8.1 | 8.2 |
| **Municipal** | | | | | | | | | | | | | |
| Community Water Supply | Intake pumping cap. - Town of Lake Cowicha | days/yr | L | 45.5 | 59.5 | 0.0 | 69.0 | 0.0 | 0.0 | 15.5 | 0.0 | 0.0 | 0.0 |
| Community Water Supply | Intake invert El. - Town of Lake Cowichan | days/yr | L | 0.0 | 16.5 | 0.0 | 30.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Waste Water Dilution | Effl dilution ratio (200:1) – Upper River | days/yr | L | 72.0 | 0.0 | 0.0 | 0.0 | 13.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Waste Water Dilution | Effluent dilution ratio (40:1) – Lower River | days/yr | L | 58.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Recreation and Tourism** | | | | | | | | | | | | | |
| Beach Use Areas - Lake | Beach user days - un-vegetated, steep slope | wt days | H | 113.8 | 113.8 | 95.9 | 113.8 | 113.4 | 96.9 | 110.3 | 96.2 | 83.8 | 89.9 |
| Boat Access/Navigtn-Lake | Decrease in dock use days | days | L | 113.0 | 113.0 | 38.0 | 113.0 | 72.5 | 40.5 | 71.0 | 37.5 | 15.5 | 28.0 |
| Boating & Tubing - River | Decrease in summer tubing days | days | L | 36 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| Boating & Tubing - River | Decrease in river boating days | days | L | 44.5 | 45.5 | 0 | 0 | 7 | 0 | 12 | 0 | 0 | 0 |
| Lake Aesthetics | Visual Quality | # | L | 3 | 5 | 3 | 5 | 2 | 3 | 4 | 3 | 1 | 2 |
| **Water Management** | | | | | | | | | | | | | |
| Capital Costs | Capital costs | M$ | L | 0 | 0 | 20 | 6 | 0 | 20 | 15 | 26 | 18 | 24 |
| Operational Costs | AVG Operational costs (over 10yrs) | M$ | L | 0.0 | 5.0 | 0.0 | 1.0 | 0.0 | 0.0 | 4.0 | 1.0 | 0.0 | 1.0 |

# Round 2 - Consequence Table

| Objective | Performance Measure | Units | Dir | Alt 2 | Alt 10 | Alt 11 | Alt 12 | Alt 13 |
|---|---|---|---|---|---|---|---|---|
| **Environment - River** | | | | | | | | |
| Fish Passage | Adult summer CHK migration (10%tile) | HSI | H | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 |
| Fish Passage | Adult fall CHK migration (10%tile) | HSI | H | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 |
| Lateral Connectivity | Side channel connectivity (10th %tile) | % | H | 0.78 | 0.89 | 0.89 | 0.84 | 0.84 |
| Rearing | Steelhead parr (10th %tile) | HSI | H | 0.75 | 0.75 | 0.00 | 0.80 | 0.80 |
| Rearing | Chinook fry (10th %tile) | HSI | H | 0.39 | 0.49 | 0.44 | 0.25 | 0.25 |
| Spawning | Early Steelhead incubation (10%tile) | HSI | H | 0.31 | 0.45 | 0.08 | 0.00 | 0.00 |
| **Environment - Lake** | | | | | | | | |
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # | L | 5 | 4 | 3 | 1 | 2 |
| Littoral Productivity | Littoral rearing habitat | # | H | 0.10 | 0.27 | 0.44 | 0.78 | 0.63 |
| **Industry and Commercial** | | | | | | | | |
| Catalyst Paper | Impacted operations days | days/yr | L | 0 | 0 | 0 | 0 | 0 |
| **Lakefront Properties** | | | | | | | | |
| Flooding and innundation | Max High Water Event - Mar 1 to Apr 30 | meters | L | 164.3 | 164.4 | 164.7 | 164.5 | 164.6 |
| Private Property Lkfrnt Areas | Frontage length - un-vegetated, mod slope | meters | H | 11.1 | 9.6 | 8.2 | 8.1 | 8.2 |
| **Municipal** | | | | | | | | |
| Community Water Supply | Intake pumping cap. - Town of Lake Cowicha | days/yr | L | 59.5 | 15.5 | 0.0 | 0.0 | 0.0 |
| Community Water Supply | Intake invert El. - Town of Lake Cowichan | days/yr | L | 16.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| Waste Water Dilution | Effl dilution ratio (200:1) – Upper River | days/yr | L | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Waste Water Dilution | Effluent dilution ratio (40:1) – Lower River | days/yr | L | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Recreation and Tourism** | | | | | | | | |
| Beach Use Areas - Lake | Beach user days - un-vegetated, steep slope | wt days | H | 113.8 | 110.3 | 96.2 | 83.8 | 89.9 |
| Boat Access/Navigtn-Lake | Decrease in dock use days | days | L | 113.0 | 71.0 | 37.5 | 15.5 | 28.0 |
| Boating & Tubing - River | Decrease in summer tubing days | days | L | 0 | 0 | 0 | 0 | 0 |
| Boating & Tubing - River | Decrease in river boating days | days | L | 45.5 | 12 | 0 | 0 | 0 |
| Lake Aesthetics | Visual Quality | # | L | 5 | 4 | 3 | 1 | 2 |
| **Water Management** | | | | | | | | |
| Capital Costs | Capital costs | M$ | L | 0 | 15 | 26 | 18 | 24 |
| Operational Costs | AVG Operational costs (over 10yrs) | M$ | L | 5.0 | 4.0 | 1.0 | 0.0 | 1.0 |

# Round 2 - Consequence Table

| Objective | Performance Measure | Units | Dir | Alt 2 | Alt 10 | Alt 11 | Alt 12 | Alt 13 |
|---|---|---|---|---|---|---|---|---|
| **Environment - River** | | | | | | | | |
| Fish Passage | Adult summer CHK migration (10%tile) | HSI | H | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 |
| Fish Passage | Adult fall CHK migration (10%tile) | HSI | H | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 |
| Lateral Connectivity | Side channel connectivity (10th %tile) | % | H | 0.78 | 0.89 | 0.89 | 0.84 | 0.84 |
| Rearing | Steelhead parr (10th %tile) | HSI | H | 0.75 | 0.75 | 0.00 | 0.80 | 0.80 |
| Rearing | Chinook fry (10th %tile) | HSI | H | 0.39 | 0.49 | 0.44 | 0.25 | 0.25 |
| Spawning | Early Steelhead incubation (10%tile) | HSI | H | 0.31 | 0.45 | 0.08 | 0.00 | 0.00 |
| **Environment - Lake** | | | | | | | | |
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # | L | 5 | 4 | 3 | 1 | 2 |
| Littoral Productivity | Littoral rearing habitat | # | H | 0.10 | 0.27 | 0.44 | 0.78 | 0.63 |
| **Lakefront Properties** | | | | | | | | |
| Flooding and innundation | Max High Water Event - Mar 1 to Apr 30 | meters | L | 164.3 | 164.4 | 164.7 | 164.5 | 164.6 |
| Private Property Lkfrnt Areas | Frontage length - un-vegetated, mod slope | meters | H | 11.1 | 9.6 | 8.2 | 8.1 | 8.2 |
| **Municipal** | | | | | | | | |
| Community Water Supply | Intake pumping cap. - Town of Lake Cowicha | days/yr | L | 59.5 | 15.5 | 0.0 | 0.0 | 0.0 |
| Community Water Supply | Intake invert El. - Town of Lake Cowichan | days/yr | L | 16.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Recreation and Tourism** | | | | | | | | |
| Beach Use Areas - Lake | Beach user days - un-vegetated, steep slope | wt days | H | 113.8 | 110.3 | 96.2 | 83.8 | 89.9 |
| Boat Access/Navigtn-Lake | Decrease in dock use days | days | L | 113.0 | 71.0 | 37.5 | 15.5 | 28.0 |
| Boating & Tubing - River | Decrease in river boating days | days | L | 45.5 | 12 | 0 | 0 | 0 |
| Lake Aesthetics | Visual Quality | # | L | 5 | 4 | 3 | 1 | 2 |
| **Water Management** | | | | | | | | |
| Capital Costs | Capital costs | M$ | L | 0 | 15 | 26 | 18 | 24 |
| Operational Costs | AVG Operational costs (over 10yrs) | M$ | L | 5.0 | 4.0 | 1.0 | 0.0 | 1.0 |

# Round 2 - Consequence Table

| Objective | Performance Measure | Units | Dir | Alt 2 | Alt 10 | Alt 11 | Alt 12 | Alt 13 |
|---|---|---|---|---|---|---|---|---|
| **Environment - River** | | | | | | | | |
| Fish Passage | Adult summer CHK migration (10%tile) | HSI | H | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 |
| Fish Passage | Adult fall CHK migration (10%tile) | HSI | H | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 |
| Lateral Connectivity | Side channel connectivity (10th %tile) | % | H | 0.78 | 0.89 | 0.89 | 0.84 | 0.84 |
| Rearing | Steelhead parr (10th %tile) | HSI | H | 0.75 | 0.75 | 0.00 | 0.80 | 0.80 |
| Rearing | Chinook fry (10th %tile) | HSI | H | 0.39 | 0.49 | 0.44 | 0.25 | 0.25 |
| Spawning | Early Steelhead incubation (10%tile) | HSI | H | 0.31 | 0.45 | 0.08 | 0.00 | 0.00 |
| **Environment - Lake** | | | | | | | | |
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # | L | 5 | 4 | 3 | 1 | 2 |
| Littoral Productivity | Littoral rearing habitat | # | H | 0.10 | 0.27 | 0.44 | 0.78 | 0.63 |
| **Lakefront Properties** | | | | | | | | |
| Flooding and innundation | Max High Water Event - Mar 1 to Apr 30 | meters | L | 164.3 | 164.4 | 164.7 | 164.5 | 164.6 |
| Private Property Lkfrnt Areas | Frontage length - un-vegetated, mod slope | meters | H | 11.1 | 9.6 | 8.2 | 8.1 | 8.2 |
| **Municipal** | | | | | | | | |
| Community Water Supply | Intake pumping cap. - Town of Lake Cowicha | days/yr | L | 59.5 | 15.5 | 0.0 | 0.0 | 0.0 |
| Community Water Supply | Intake invert El. - Town of Lake Cowichan | days/yr | L | 16.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Recreation and Tourism** | | | | | | | | |
| Beach Use Areas - Lake | Beach user days - un-vegetated, steep slope | wt days | H | 113.8 | 110.3 | 96.2 | 83.8 | 89.9 |
| Boat Access/Navigtn-Lake | Decrease in dock use days | days | L | 113.0 | 71.0 | 37.5 | 15.5 | 28.0 |
| Boating & Tubing - River | Decrease in river boating days | days | L | 45.5 | 12 | 0 | 0 | 0 |
| Lake Aesthetics | Visual Quality | # | L | 5 | 4 | 3 | 1 | 2 |
| **Water Management** | | | | | | | | |
| Capital Costs | Capital costs | M$ | L | 0 | 15 | 26 | 18 | 24 |
| Operational Costs | AVG Operational costs (over 10yrs) | M$ | L | 5.0 | 4.0 | 1.0 | 0.0 | 1.0 |

# Assessing Water Use Alternatives

## Ranking Exercises

# Assessing Alternatives

## Ranking Exercises

**Purpose**:

- To get a sense of PAG members' priorities
- To explore which alternatives may be heading in the right direction
- To gain insight towards building more broadly supported alternatives

**Assumptions:**

- Alterns 1 and the Bookend Alternatives are sub-optimal and not likely lead to a broad agreement
- Alt 2 makes sense to keep as it is the defacto status quo and is not associated with increasing the weir height

# Assessing Alternatives

## Two Ranking Exercises will be undertaken

1. Direct Ranking
2. Swing Weighting

**Note:**

- **Neither one is right. Both provide an alternative means of exploring priorities and values individually and collectively**
- **Purpose is help structure and facilitate group discussions afterwards on elements of a preferred alternative(s)**

# Direct Ranking

STEP 1: Rank each alternative from #1 (best) to #5 (worst). Try to avoid ties.

STEP 2: Distribute 100 points to the #1 (best) ranked alternative

STEP 3: Distribute a lesser amount of points to the next best ranked (#2) alternative relative to #1. And repeat for the others

*Check:* *Do a check on the relative difference between points with other rankings*

# Direct Ranking

## Direct Ranking - FORM #1

| Alternative | Rank | Weight |
|---|---|---|
| Alt 2 | 2 | 95 |
| Alt 10 | 3 | 50 |
| Alt 11 | 4 | 20 |
| Alt 12 | 1 | 100 |
| Alt 13 | 5 | 1 |

# Direct Ranking

## Fill out the ranking sheet..

Make sure you add your first **name at the TOP of the Sheet**

# Swing Weighting

- An alternative way to assess alternatives according to the performance measures
- Provides a way to gain insight into the relative importance of each performance measure according to the improvements (**worst** to **best**) that can be made
- "Swing" refers to the importance of moving **one** performance measure from its worst to best value

# Swing Weighting

**STEP 1:** Rank each performance measure within each objective category according to the most important to you to change from **worst to best** as your #1 Rank.

Repeat for #2, #3, …….

**STEP 2:** Distribute 100 points to the Rank #1 Performance Measure

**STEP 3:** Distribute whatever proportion less than 100 to the Rank #2 Performance Measure according to its importance relative to the Rank #1.

*for example…*

# Swing Weighting

| Environment - River | Performance Measure | Unit | Dir | Worst | Best | Rank | Weight |
|---|---|---|---|---|---|---|---|
| Fish Passage | Adult summer CHK migration (10%tile) | HSI | H | 0.00 | 0.09 | 6 | 1 |
| Fish Passage | Adult fall CHK migration (10%tile) | HSI | H | 0.00 | 0.20 | 3 | 50 |
| Lateral Connectivity | Side channel connectivity (10th %tile) | % | H | 0.78 | 0.89 | 5 | 10 |
| Rearing | Steelhead parr (10th %tile) | HSI | H | 0.00 | 0.80 | 1 | 100 |
| Rearing | Chinook fry (10th %tile) | HSI | H | 0.25 | 0.49 | 2 | 95 |
| Spawning | Early Steelhead incubation (10%tile) | HSI | H | 0.00 | 0.45 | 4 | 20 |

# Swing Weighting

| Environment - River | Performance Measure | Unit | Dir | Worst | Best | Rank | Weight |
|---|---|---|---|---|---|---|---|
| Fish Passage | Adult summer CHK migration (10%tile) | HSI | H | 0.00 | 0.09 | 6 | 1 |
| Fish Passage | Adult fall CHK migration (10%tile) | HSI | H | 0.00 | 0.20 | 3 | 50 |
| Lateral Connectivity | Side channel connectivity (10th %tile) | % | H | 0.78 | 0.89 | 5 | 10 |
| Rearing | Steelhead parr (10th %tile) | HSI | H | 0.00 | 0.80 | 1 | 100 |
| Rearing | Chinook fry (10th %tile) | HSI | H | 0.25 | 0.49 | 2 | 95 |
| Spawning | Early Steelhead incubation (10%tile) | HSI | H | 0.00 | 0.45 | 4 | 20 |

**Environment - Lake**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # | L | 5 | 1 | 1 | 100 |
| Littoral Productivity | Littoral rearing habitat | # | H | 0.10 | 0.78 | 2 | 50 |

# Swing Weighting

| Environment - River | Performance Measure | Unit | Dir | Worst | Best | Rank | Weight |
|---|---|---|---|---|---|---|---|
| Fish Passage | Adult summer CHK migration (10%tile) | HSI | H | **0.00** | **0.09** | 6 | 1 |
| Fish Passage | Adult fall CHK migration (10%tile) | HSI | H | **0.00** | **0.20** | 3 | 50 |
| Lateral Connectivity | Side channel connectivity (10th %tile) | % | H | **0.78** | **0.89** | 5 | 10 |
| Rearing | Steelhead parr (10th %tile) | HSI | H | **0.00** | **0.80** | 1 | 100 |
| Rearing | Chinook fry (10th %tile) | HSI | H | **0.25** | **0.49** | 2 | 95 |
| Spawning | Early Steelhead incubation (10%tile) | HSI | H | **0.00** | **0.45** | 4 | 20 |
| **Environment - Lake** | | | | | | | |
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # | L | **5** | **1** | 1 | 100 |
| Littoral Productivity | Littoral rearing habitat | # | H | **0.10** | **0.78** | 2 | 50 |
| **Lakefront Properties** | | | | | | | |
| Flooding and inundation | Max High Water Event - Mar 1 to Apr 30 | meters | L | **164.7** | **164.3** | **1** | **100** |
| Pvt Property Lkfrnt Areas | Frontage length - un-vegetated, mod slope | meters | H | **8.1** | **11.1** | **2** | **95** |

# Swing Weighting

| Environment - River | Performance Measure | Unit | Dir | Worst | Best | Rank | Weight |
|---|---|---|---|---|---|---|---|
| Fish Passage | Adult summer CHK migration (10%tile) | HSI | H | **0.00** | **0.09** | 6 | 1 |
| Fish Passage | Adult fall CHK migration (10%tile) | HSI | H | **0.00** | **0.20** | 3 | 50 |
| Lateral Connectivity | Side channel connectivity (10th %tile) | % | H | **0.78** | **0.89** | 5 | 10 |
| Rearing | Steelhead parr (10th %tile) | HSI | H | **0.00** | **0.80** | 1 | 100 |
| Rearing | Chinook fry (10th %tile) | HSI | H | **0.25** | **0.49** | 2 | 95 |
| Spawning | Early Steelhead incubation (10%tile) | HSI | H | **0.00** | **0.45** | 4 | 20 |
| **Environment - Lake** | | | | | | | |
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # | L | **5** | **1** | 1 | 100 |
| Littoral Productivity | Littoral rearing habitat | # | H | **0.10** | **0.78** | 2 | 50 |
| **Lakefront Properties** | | | | | | | |
| Flooding and inundation | Max High Water Event - Mar 1 to Apr 30 | meters | L | **164.7** | **164.3** | 1 | 100 |
| Pvt Property Lkfrnt Areas | Frontage length - un-vegetated, mod slope | meters | H | **8.1** | **11.1** | 2 | 95 |
| **Municipal** | | | | | | | |
| Community Water Supply | Intake pumping cap. - Town of Lake Cowichan | days/yr | L | **59.5** | **0** | **2** | **75** |
| Community Water Supply | Intake invert El. - Town of Lake Cowichan | days/yr | L | **16.5** | **0** | **1** | **100** |

# Swing Weighting

**STEP 4:** Rank each objective category relative to each other according to the relative improvements across all the performance measures for that category from **worst to best** as your #1 Rank.

Repeat for #2, #3, …….

**STEP 5:** Distribute 100 points to the Rank #1 Objective Category.

**STEP 6:** Distribute whatever proportion less than 100 to the Rank #2 Objective Category according to its importance relative to the Rank #1.

*for example…*

# Swing Weighting

| | Performance Measure | Unit | Dir | Worst | Best | Rank | Weight |
|---|---|---|---|---|---|---|---|
| **Environment - River** | | | | | | | |
| Fish Passage | Adult summer CHK migration (10%tile) | HSI | H | 0.00 | 0.09 | | |
| Fish Passage | Adult fall CHK migration (10%tile) | HSI | H | 0.00 | 0.20 | | |
| Lateral Connectivity | Side channel connectivity (10th %tile) | % | H | 0.78 | 0.89 | 2 | 90 |
| Rearing | Steelhead parr (10th %tile) | HSI | H | 0 | 0.80 | | |
| Rearing | Chinook fry (10th %tile) | HSI | H | 0.25 | 0.49 | | |
| Spawning | Early Steelhead incubation (10%tile) | HSI | H | 0.00 | 0.45 | | |
| **Environment - Lake** | | | | | | | |
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # | L | 5 | 1 | 4 | 50 |
| Littoral Productivity | Littoral rearing habitat | # | H | 0.10 | 0.78 | | |
| **Lakefront Properties** | | | | | | | |
| Flooding and inundation | Max High Water Event - Mar 1 to Apr 30 | meters | L | 164.7 | 164.3 | 3 | 80 |
| Pvt Property Lkfrnt Areas | Frontage length - un-vegetated, mod slope | meters | H | 8.1 | 11.1 | | |
| **Municipal** | | | | | | | |
| Community Water Supply | Intake pumping cap. - Town of Lake Cowichar | days/yr | L | 59.5 | 0.0 | 6 | 1 |
| Community Water Supply | Intake invert El. - Town of Lake Cowichan | days/yr | L | 16.5 | 0.0 | | |
| **Recreation and Tourism** | | | | | | | |
| Beach Use Areas - Lake | Beach user days - un-vegetated, steep slope | wt days | H | 83.8 | 113.8 | | |
| Boat Access/Navigtn-Lake | Decrease in dock use days | days | L | 113 | 15.5 | 1 | 100 |
| Boating & Tubing - River | Decrease in river boating days | days | L | 45.5 | 0 | | |
| Lake Aesthetics | Visual Quality | # | L | 5 | 1 | | |
| **Water Management** | | | | | | | |
| Capital Costs | Capital costs | M$ | L | 26 | 0.0 | 5 | 40 |
| Operational Costs | AVG Operational costs (over 10yrs) | M$ | L | 5 | 0.0 | | |

# Swing Weighting

**Fill out the ranking sheet..**

**LUNCH….**

# New Water Use Alternatives

## Round 3

# Water Use Alternatives

## Round 3

**Purpose**:

- Identify parameters and ideas towards improved alternatives
- Want clear direction from PAG members on elements of new alternatives that should be explored
- Idea is that these alternatives will be modelled and explored in detail at the final May PAG Meeting
- Goal is to identify maybe 3 or 4 new hybrid alternatives

# Water Use Alternatives

## Round 3

## Some Elements to Consider

### Ramping Rates

- Current Ramping Rates
  - 2cms/day for April 1
  - 1cms/day for May/June
  - 0.5cms for remainder of control period
- Typically operators ramp faster at higher flows. E.g., faster rate from 50cms to 25cms. Also rates are normally tied to stage level rates at the range of lower flows – e.g., 2cm/hr
- Current rates appear to be quite conservative at mid range of dlows and can result in a “loss” of storage. E.g., lake levels can drop by 10cm or more as flows are ramped down from 50 to 25cms (i.e., equiv to 10 – 7cms days)

# Water Use Alternatives

## Round 3

**Discussion at ARTSG…**

| Month | Target ($m^3/s$) | Min. ($m^3/s$) | | Alternative |
|---|---|---|---|---|
| April (1-15) | 40 | 25 | 15 | 20 |
| April (16-30) | 35 | 25 | 15 | 20 |
| May (1-15) | 35 | 20 | 7 | 15 |
| May (16-31) | 30 | 20 | 7 | 15 |
| June (1-15) | 30 | 15 | 7 | 7 |
| June (16-30) | 30 | 7 | 7 | 6 |
| July (1-15) | 10 | 7 | 7 | 5 |
| July (16-31) | 10 | 7 | 7 | 5 |
| Aug (1-15) | 10 | 7 | 7 | 5 |
| Aug (16-31) | 10 | 7 | 7 | 5 |
| Sept (1-15) | 10 | 7 | 7 | 5 |
| Sept (16-30) | 10 | 7 | 7 | 5 |
| Oct (1-15) | 15 | 7 | 7 | 5* |
| Oct (16-31) | 15 | 7 | 7 | 5* |
| SUM | 290 | 168 | 114 | 123 |
| SUM (M $m^3$) | 381.5 | 221.3 | | |

notes from ARTSG mtg:

- first 2 cols are from Ayers et al doc, and are essentially rule curves when there is lots of water and a modest amount
- 3rd col was drafted to aid discussion about preferred rule curve for a low water year
- the last column was developed as an alternative when there is very little water available
- these "alternatives" can serve as rule curves to guide in-season mgmt when there is very little water
- more input is needed
- (* Implement passage flows if available)

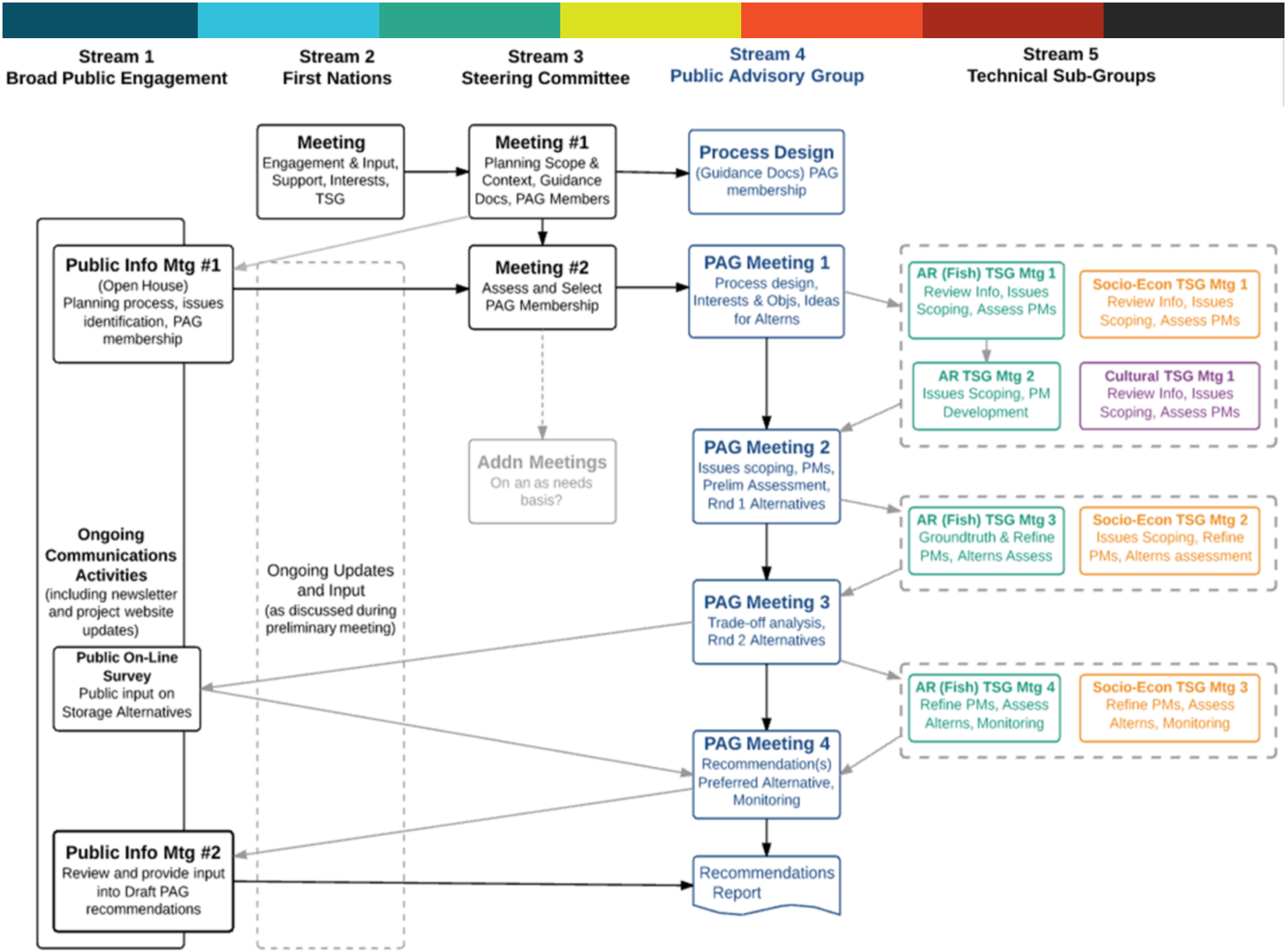
# Water Use Alternatives

## Round 3

### Some Elements to Consider

### Other?

# Community Engagement & Survey


Stream 1
Broad Public Engagement
Stream 2
First Nations
Stream 3
Steering Committee
Stream 4
Public Advisory Group
Stream 5
Technical Sub-Groups
Meeting
Engagement & Input, Support, Interests, TSG
Meeting #1
Planning Scope & Context, Guidance Docs, PAG Members
Process Design
(Guidance Docs) PAG membership
Public Info Mtg #1
(Open House)
Planning process, issues identification, PAG membership
Meeting #2
Assess and Select PAG Membership
PAG Meeting 1
Process design, Interests & Objs, Ideas for Alterns
AR (Fish) TSG Mtg 1
Review Info, Issues Scoping, Assess PMs
Socio-Econ TSG Mtg 1
Review Info, Issues Scoping, Assess PMs
AR TSG Mtg 2
Issues Scoping, PM Development
Cultural TSG Mtg 1
Review Info, Issues Scoping, Assess PMs
Addn Meetings
On an as needs basis?
PAG Meeting 2
Issues scoping, PMs, Prelim Assessment, Rnd 1 Alternatives
AR (Fish) TSG Mtg 3
Groundtruth & Refine PMs, Alterns Assess
Socio-Econ TSG Mtg 2
Issues Scoping, Refine PMs, Alterns assessment
Ongoing Communications Activities
(including newsletter and project website updates)
Ongoing Updates and Input
(as discussed during preliminary meeting)
PAG Meeting 3
Trade-off analysis, Rnd 2 Alternatives
Public On-Line Survey
Public input on Storage Alternatives
AR (Fish) TSG Mtg 4
Refine PMs, Assess Alterns, Monitoring
Socio-Econ TSG Mtg 3
Refine PMs, Assess Alterns, Monitoring
PAG Meeting 4
Recommendation(s) Preferred Alternative, Monitoring
Public Info Mtg #2
Review and provide input into Draft PAG recommendations
Recommendations Report

# Public Engagement - Online Survey

## Survey Objectives

- Education piece to help inform the public on the process and broader trade-offs that need to be made (including that there are no winners and losers)
- Gain a better understanding of values and interests of the broader public to support PAG members in weighing the different alternatives and to make an informed recommendation

# Public Engagement - Online Survey

## Survey Format

- Open to all residents and visitors Cowichan Lake and Cowichan River 18 years or older (limit one time per person)
- Develop following best practices for survey design, using simple, clear and neutral language, and avoid leading questions or introducing any bias
- Delivered via Survey Monkey or a similar online survey platform with the availability to submit in hardcopy (to CVRD office?)
- Advertised through www.CowichanWUP.ca and PAG member organizations distribution lists
- Open for approx. 3 weeks ending by April 20th to allow time to compile and assess the results for PAG Mtg #4 pre-read

# Public Engagement - Online Survey

## Survey Content & Questions

**Introduction:**

- Background on the process to date, objectives of the Cowichan WUP, and how this survey will help inform the PAG

**Demographics:**

- Age
- Affiliations
- Relationship to Cowichan Lake & River
  - Permanent or seasonal resident
  - Property owner - primary or secondary resident
  - Proximity of residence to Cowichan Lake & River (i.e. within 100m)
  - Use of Cowichan Lake & River (i.e. recreation, water supply..)

# Public Engagement - Online Survey

## Survey Content & Questions

**Questions on Community Priorities - Values and Interests:**

- What **relative importance** do you place on the various types of values and interests for Cowichan Lake & River?
- What is your **level of concern** for each of the following potential issues associated with water management in Cowichan Lake & River?

# Public Engagement - Online Survey

## Survey Content & Questions

**Questions on Community Priorities - Key Trade-offs**

- Provide a high level overview of findings from the Bookend and Round 2 alternatives
- Highlight the key elements that are trying to be balanced in the alternatives in light of the increasing water insecurity in the future, for example:
  - Avoiding higher lake levels in the spring (during high inflow events) to avoid increased risk of inundation and flooding of lakefront areas
  - Maintaining access and functionality of beach areas and recreation facilities throughout the summer time and early fall period
  - Maintaining river flows for fish, recreation, tourism, municipal water supply and wastewater dilution, and industrial interests (e.g., Catalyst Paper)
  - Maintaining lake levels for aquatic habitat of threatened species in the lake and to avoid unsightly visual effects with lake levels falling below historical levels
  - Maintaining spring and fall pulse flows for fish and fish habitat down the Cowichan River

# Public Engagement - Online Survey

## Survey Questions

### Questions on Community Priorities - Key Trade-offs

*How important is to you to:*

- **Lake Levels:**
  - avoid lower than historical lake levels in the summer?
  - avoid higher than historical lake levels in the spring?
- **High Spring River Flows:**
  - maintain river flows for fish in the spring?
- **Summer River Flows:**
  - maintain river flows for fish in the late summer?
  - maintain river flows for recreation in the summer?
  - maintain river flows for other socio-economic values in the summer (mill operations, waste water dilution)?

# Public Engagement - Online Survey

## Next Steps

- **Timeline:**
  - March 23 - Draft survey for feedback and input
  - Week of March 26 – Finalize survey
  - April 1 to 20 – Survey is live
  - April 20 to 30 – Assess results (include in PAG Mtg #4 pre-read)
- **PAG members:**
  - Volunteers to test the draft survey
  - Help with advertising

# Other Public Engagement

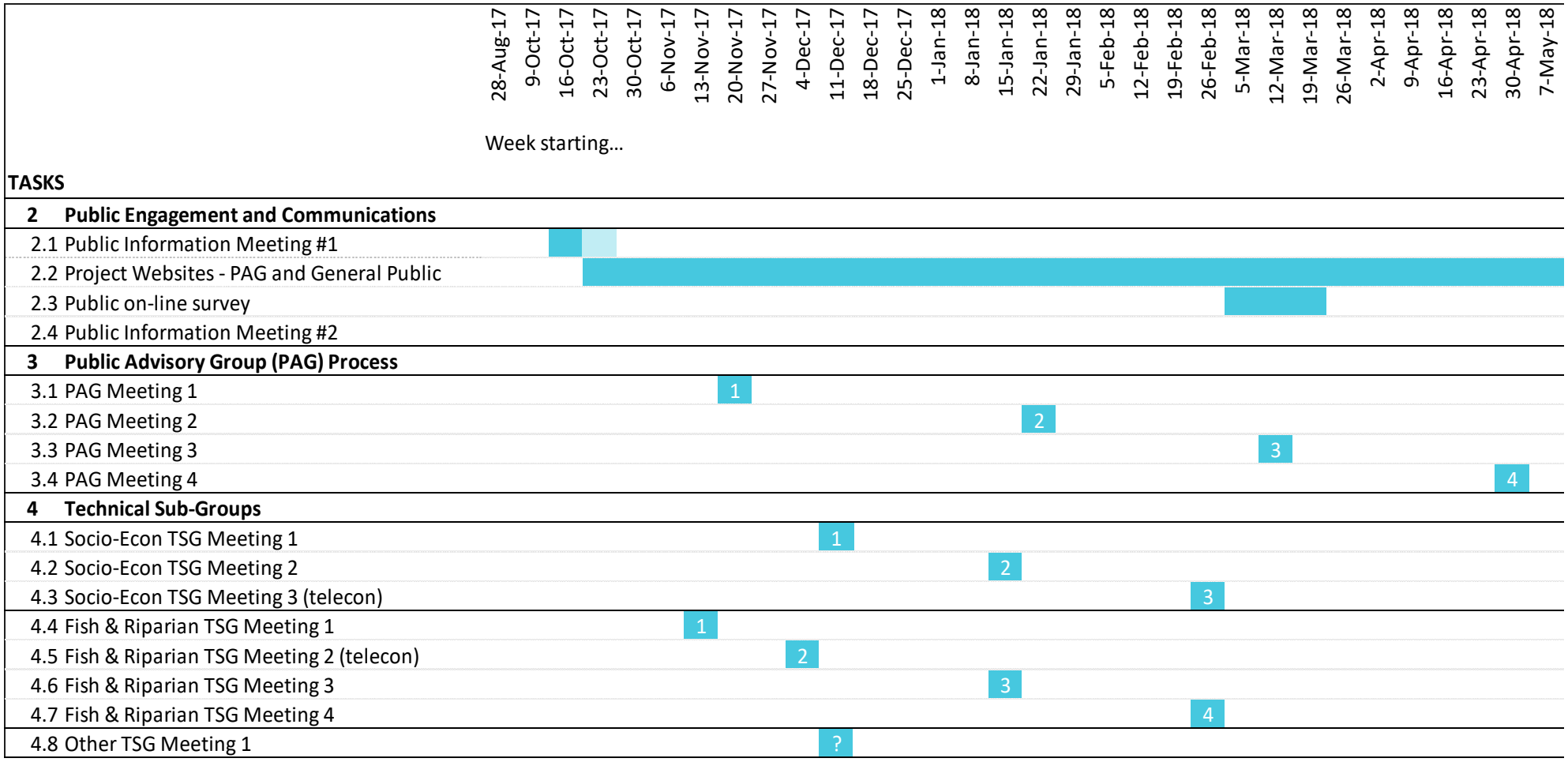
## Public Meeting #2

- Public Information meeting to report out on the outcomes of the process
- PAG members present in person to speak to their experience and recommendations on a preferred alternative
- Week of May 28 or June 4 ?

# Next Steps

# Tentative Schedule

**TASK SCHEDULE**



# Upcoming Meetings

## Public Engagement

- Online Survey – *April 1 to April 20*
- Public Info Meeting #2 – *week of May 26 or June 4*

## PAG Meetings

- PAG Meeting 4 – May 8 (final)

## Aquatic & Riparian Technical Sub-Group

- ARTSG Meeting 5 – ?

## Lakefront Technical Sub-Group

- LFTSG 5 – ?

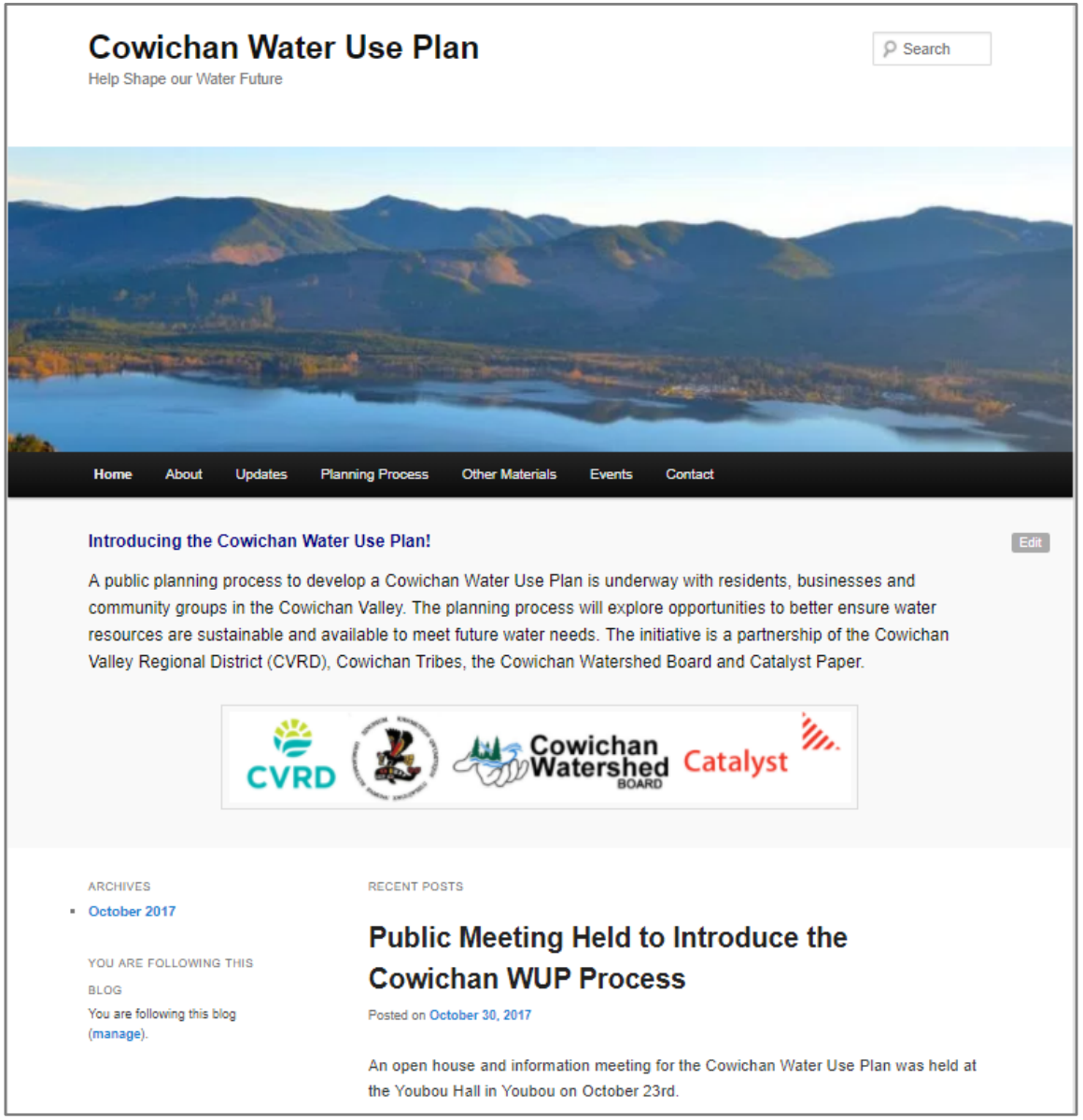
# Next Steps

- Draft Meeting notes
- Communication in between meetings
- Access to presentation materials and other reference materials

# Next Steps

Also regular updates to the public Cowichan WUP website at:

https://cowichanwup.ca/



# Thanks!

Anything else?