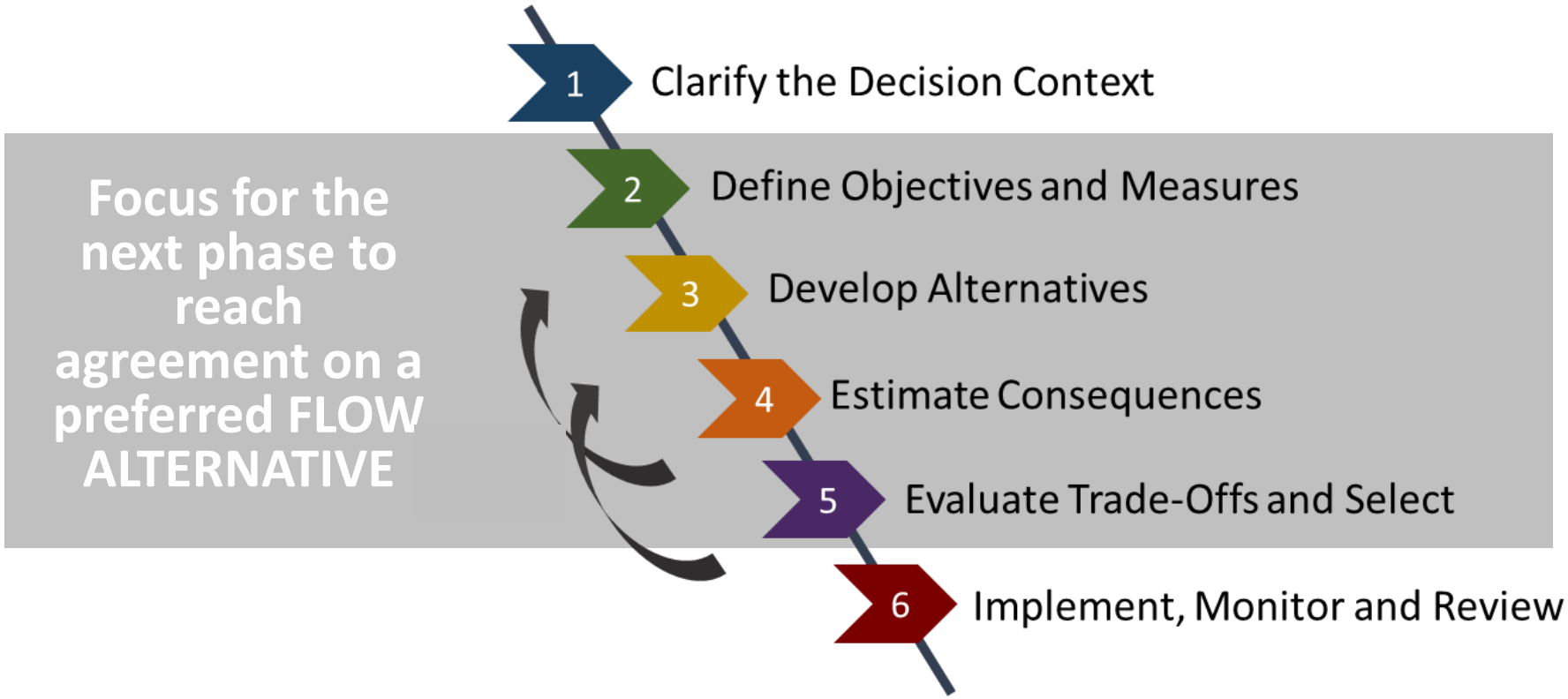
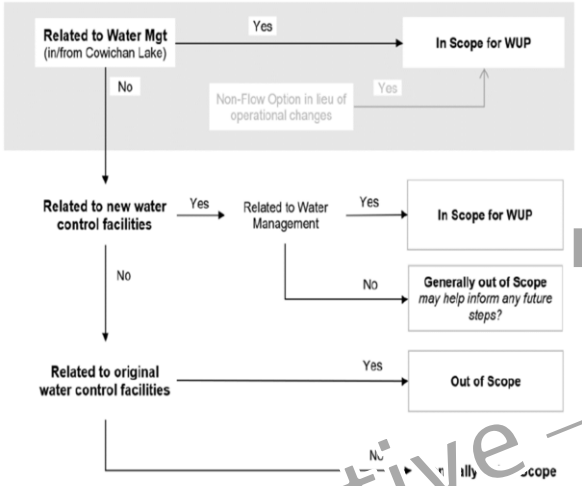
# Steps of SDM


Focus for the next phase to reach agreement on a preferred FLOW ALTERNATIVE
1
Clarify the Decision Context
2
Define Objectives and Measures
3
Develop Alternatives
4
Estimate Consequences
5
Evaluate Trade-Offs and Select
6
Implement, Monitor and Review

# WUP Illustration


## 2 Define Objectives and Measures

### Issues Scoping




### Issues into Shortlist of Objectives

- **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 Passing
  - 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 / 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

# WUP Illustration


## 2 Define Objectives and Measures

| Objective | Performance Measure | Units |
|---|---|---|
| **Environment - River** | | |
| Fish Passage | Adult summer CHK migration (10%tile) | HSI |
| Fish Passage | Adult fall CHK migration (10%tile) | HSI |
| Lateral Connectivity | Side channel connectivity (10th %tile) | % |
| Rearing | Steelhead parr (10th %tile) | HSI |
| Rearing | Chinook fry (10th %tile) | HSI |
| Spawning | Early Steelhead incubation (10%tile) | HSI |
| **Environment - Lake** | | |
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # |
| Littoral Productivity | Littoral rearing habitat | # |
| **Industry and Commercial** | | |
| Catalyst Paper | Impacted operations days | days/yr |
| Agriculture | Placeholder | |
| Commercial Fisheries | See fish PMs | |
| **Lakefront Properties** | | |
| Flooding and innundation | Max High Water Event - Mar 1 to Apr 30 | meters |
| Private Property Lkfrnt Areas | Frontage length - un-vegetated, mod slope | meters |
| **Municipal** | | |
| Community Water Supply | Intake pumping cap. - Town of Lake Cowichan | days/yr |
| Community Water Supply | Intake invert El. - Town of Lake Cowichan | days/yr |
| Waste Water Dilution | Effl dilution ratio (200 yr) - Upper River | days/yr |
| **Recreation and Tourism** | | |
| Beach Use Areas - Lake | Beach user days - un-vegetated, steep slope | wt days |
| Boat Access/Navigtn-Lake | Decrease in dock use days | days |
| Boating & Tubing - River | Decrease in river boating days | days |
| Lake Aesthetics | Visual Quality | # |
| **Water Management** | | |
| Capital Costs | Capital costs | M$ |
| Operational Costs | AVG Operational costs (over 10yrs) | M$ |

PMs

- **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
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  - Private Property Lakefront Areas
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  - 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

# WUP Illustration


## 3 Define Alternatives

| ROUND 1 | ROUND 2 | ROUND 3 |
|---|---|---|
| Alt 1 | Alt 1 | Alt 1 |
| Alt 2 | Alt 2 | Alt 2 |
| Alt 3 | | |
| Alt 4 | | |
| Alt 5 | | |
| Alt 6 | | |
| Alt 7 | Alt 7 | Alt 7 |
| | Alt 10 | Alt 10 |
| | Alt 11 | Alt 11 |
| | Alt 12 | Alt 12 |
| | Alt 13 | Alt 13 |
| | | Alt 20 |
| | | Alt 21 |
| | | Alt 22 |
| | | Alt 23 |
| | | Alt 24 |

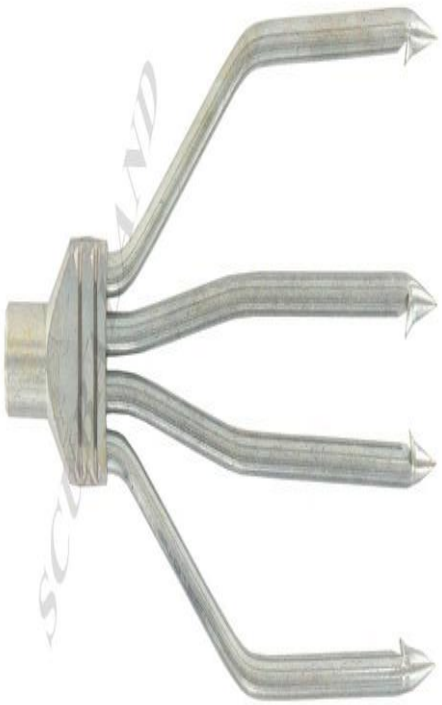
### Menu

- River Stage Levels (key times)
  - ❑ 0m
  - ❑ +/- 0.3m
  - ❑ +/- 0.4m
  - ❑ +/- 0.5m
  - ❑ +/-0.6m
  - ❑ +/- 0.7m
  - ❑ +/- 1.0m
- Lower summer lake levels
  - ❑ 0m
  - ❑ -0.15m
  - ❑ -0.3m
  - ❑ -1.0m
  - ❑ -1.5m
- Decreased fisheries flows
  - ❑ 15/25cms Spring flows
  - ❑ Summer min base flows
    - ➢ 5cms
    - ➢ <4.5cms
- Earlier release / fill dates
  - ❑ Mar 1
  - ❑ Feb 1

# WUP Illustration


## 4 Estimate Consequences

**4 step approach:**

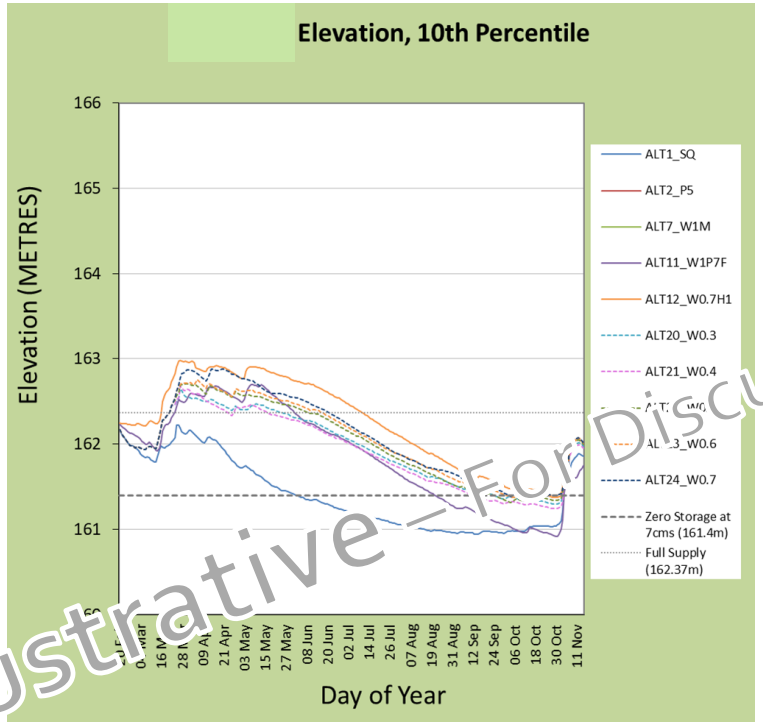


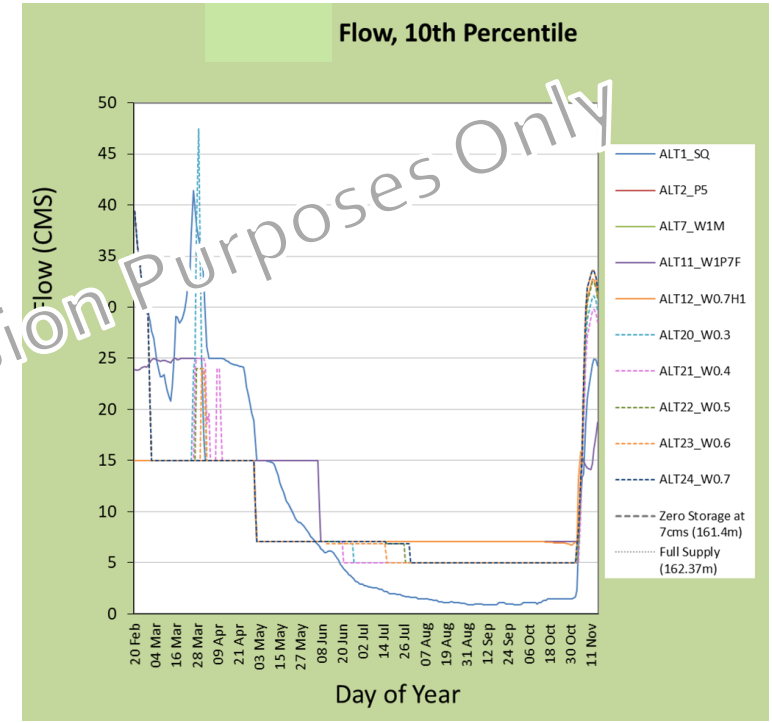
1. Reviewed changes in hydrological conditions (i.e., water levels and flows)
2. Reviewed performance measure values
3. Reviewed supplemental information
4. Structured discussions

# WUP Illustration


## 4 Estimate Consequences

1. Review changes in hydrological conditions (i.e., water levels and flows)



# WUP Illustration


## 4 Estimate Consequences

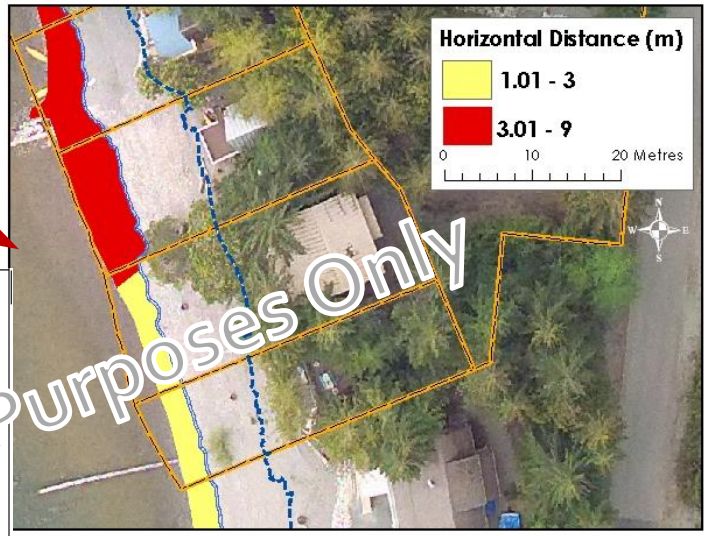
2. Review performance measure values

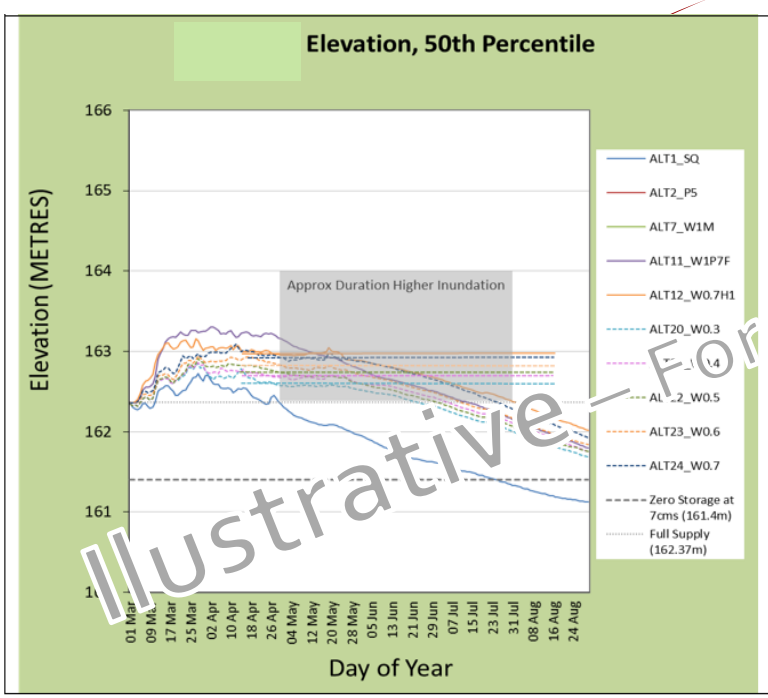
| Objective | Performance Measure | Units | Dir | Alt 1 | Alt 2 | Alt 11 | Alt 12 | Alt 20 | Alt 21 | Alt 22 | Alt 23 | Alt 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Environ - River (10%ile PMs)** | | | | | | | | | | | | |
| Fish Passage | 10%ile - Adult summer CHK migration | HSI | H | 0.00 | 0.00 | 0.09 | 0.09 | 0.00 | 0.00 | 0.08 | 0.00 | 0.08 |
| Fish Passage | 10%ile - Adult fall CHK migration | HSI | H | 0.00 | 0.00 | 0.26 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lateral Connectivity | 10%ile - Side channel connectivity | % | H | 0.78 | 0.78 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Rearing | 10%ile - Steelhead parr | HSI | H | 0.00 | 0.75 | 0.80 | 0.80 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Rearing | 10%ile - Chinook fry | HSI | H | 0.39 | 0.39 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Spawning | 10%ile - Early Steelhead incubation | HSI | H | 0.31 | 0.31 | 0.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Environment - Lake** | | | | | | | | | | | | |
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # | L | 7 | 9 | 8 | 6 | 6 | 5 | 4 | 3 | 2 |
| Littoral Productivity | Littoral rearing habitat | # | H | 0.45 | 0.10 | 0.4 | 0.78 | 0.72 | 0.68 | 0.73 | 0.72 | 0.78 |
| **Lakefront Properties** | | | | | | | | | | | | |
| Flooding and innundation | Max High Water Event - Mar 1 to Apr 30 | meters | L | 164.3 | 164.3 | 164.7 | 164.5 | 164.3 | 164.3 | 164.3 | 164.3 | 164.3 |
| Private Property Lkfrnt Areas | Frontage length - un-vegetated, mod slope | meters | L | 10.7 | 11.1 | 8.2 | 8.1 | 9.1 | 9.0 | 8.7 | 8.4 | 8.3 |
| **Municipal** | | | | | | | | | | | | |
| Community Water Supply | Intake pumping cap. - Town of Lk Cowichan | days/yr | L | 45.5 | 59.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Community Water Supply | Intake invert El. - Town of Lk Cowichan | days/yr | L | 0.0 | 16.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Recreation and Tourism** | | | | | | | | | | | | |
| Beach Use Areas - Lake | Beach use days - un-vegetated, steep slope | wt days | H | 0.0 | 0.0 | 17.6 | 30.0 | 4.8 | 10.0 | 9.0 | 16.9 | 27.3 |
| Boat Access/Navigtn-Lake | Decrease in dock use days | days | L | 113.0 | 113.0 | 37.5 | 15.5 | 51.5 | 42.5 | 46.0 | 36.0 | 26.0 |
| Lake Aesthetics | Visual Quality | # | L | 3 | 5 | 3 | 1 | 2 | 2 | 2 | 1 | 1 |
| **Water Management** | | | | | | | | | | | | |
| Capital Costs | Capital costs | M$ | L | 0 | 0 | 26 | 18 | 12 | 13.5 | 15 | 16.5 | 18 |
| Operational Costs | AVG Operational costs (over 10yrs) | M$ | L | 0.0 | 5.0 | 1.0 | 0.0 | 2.5 | 2.0 | 2.5 | 2.5 | 1.0 |

# WUP Illustration


## 4 Estimate Consequences

3. Review supplemental information




Using the median value to represent average lake levels through the spring and summer, the inundation effects are a max of:

- Alt 11: up to 70cm for ~10wks
- Alt 12: up to 55cm for ~12wks
- Alt [illegible]: up to 15cm for ~ 7wks
- Alt 21: up to 25cm for ~8wks
- Alt 22: up to 30cm for ~ 8wks
- Alt 23: up to 40cm for ~9wks
- Alt 24: up to 45cm for ~11wks

# WUP Illustration


## 5 Evaluate Trade-Offs and Select

| Objective | Performance Measure | Units | Dir | Alt 1 | Alt 2 | Alt 11 | Alt 12 | Alt 20 | Alt 21 | Alt 22 | Alt 23 | Alt 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Environ - River (MEDIAN PMs)** | | | | | | | | | | | | |
| Fish Passage | MEDIAN - Adult summer CHK migration | HSI | H | 0.05 | 0.05 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| Fish Passage | MEDIAN - Adult fall CHK migration | HSI | H | 0.00 | 0.00 | 0.26 | 0.26 | 0.13 | 0.18 | 0.13 | 0.13 | 0.26 |
| Lateral Connectivity | MEDIAN - Side channel connectivity | % | H | 0.90 | 0.90 | 0.87 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Rearing | MEDIAN - Steelhead parr | HSI | H | 0.05 | 0.75 | 0.80 | 0.80 | 0.78 | 0.80 | 0.78 | 0.80 | 0.80 |
| Rearing | MEDIAN - Chinook fry | HSI | H | 0.51 | 0.51 | 0.50 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Spawning | MEDIAN - Early Steelhead incubation | HSI | H | 1.00 | 1.00 | 0.50 | 0.00 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| **Environment - Lake** | | | | | | | | | | | | |
| Vancouver Lamprey | Lamprey rearing habitat (Scale 1-6) | # | L | 7 | 9 | 8 | 1 | 6 | 4 | 4 | 3 | 2 |
| Littoral Productivity | Littoral rearing habitat | # | H | 0.45 | 0.10 | 0.44 | 0.78 | 0.72 | 0.68 | 0.73 | 0.72 | 0.78 |
| **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 | 164.3 | 164.3 | 164.3 | 164.3 |
| Private Property Lkfrnt Areas | Frontage length - un-vegetated, mod slope | meters | H | 10.7 | 11.2 | 8.1 | 8.1 | 9.1 | 9.0 | 8.7 | 8.4 | 8.3 |
| **Municipal** | | | | | | | | | | | | |
| Community Water Supply | Intake pumping cap. - Town of Lk Cowichan | days/yr | L | 0.0 | 59.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Community Water Supply | Intake invert El. - Town of Lk Cowichan | days/yr | L | 0.0 | 16.5 | 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, mod slope | wt days | H | 0.0 | 0.0 | 17.6 | 30.0 | 4.8 | 10.0 | 9.0 | 16.9 | 27.3 |
| Boat Access/Navigtn-Lake | Decrease in dock use days | days | L | 113.0 | 113.0 | 37.5 | 15.5 | 51.5 | 42.5 | 46.0 | 36.0 | 26.0 |
| Lake Aesthetics | Visual Quality | # | L | 3 | 5 | 3 | 1 | 2 | 2 | 2 | 1 | 1 |
| **Water Management** | | | | | | | | | | | | |
| Capital Costs | Capital costs | M$ | L | 0 | 0 | 26 | 18 | 12 | 13.5 | 15 | 16.5 | 18 |
| Operational Cost | AVG Operational costs (over 10yrs) | M$ | L | 0.0 | 5.0 | 1.0 | 0.0 | 2.5 | 2.0 | 2.5 | 2.5 | 1.0 |

# WUP Illustration


## 5 Evaluate Trade-Offs and Select

Reaching agreement on a collective solution ….

### Values Assessment - Round 1

**Direct Weighting**

| | Alt 2 | Alt 10 | Alt 11 | Alt 12 | Alt 13 |
|---|---|---|---|---|---|
| 1 | 21% | 50% | 5% | 11% | 13% |
| 2 | 28% | 24% | 15% | 30% | 3% |
| 3 | 9% | 18% | 29% | 24% | 21% |
| 4 | 7% | 24% | 1% | 34% | 34% |
| 6 | 6% | 22% | 25% | 19% | 28% |
| 7 | 76% | 15% | 1% | 4% | 4% |
| 8 | 50% | 10% | 10% | 10% | 20% |
| 9 | 12% | 12% | 21% | 30% | 24% |
| 10 | 0% | 2% | 22% | 43% | 32% |
| 11 | 0% | 27% | 9% | 45% | 18% |
| 12 | 2% | 10% | 34% | 24% | 31% |
| 13 | 4% | 20% | 16% | 40% | 20% |
| 14 | 0% | 23% | 31% | 20% | 26% |
| 15 | 16% | 25% | 9% | 31% | 19% |
| 16 | 3% | 25% | 28% | 22% | 22% |
| 17 | 29% | 7% | 14% | 43% | 7% |
| 18 | 0% | 17% | 42% | 21% | 21% |
| 19 | 3% | 16% | 31% | 25% | 25% |

**Swing Weighting**

| | Alt 2 | Alt 10 | Alt 11 | Alt 12 | Alt 13 |
|---|---|---|---|---|---|
| 1 | 12% | 28% | 18% | 27% | 16% |
| 2 | 8% | 21% | 19% | 31% | 21% |
| 3 | 11% | 22% | 15% | 32% | 20% |
| 4 | 10% | 20% | 19% | 31% | 21% |
| 6 | 13% | 20% | 17% | 31% | 19% |
| 7 | 23% | 20% | 11% | 32% | 14% |
| 8 | 11% | 19% | 18% | 31% | 21% |
| 9 | 11% | 22% | 18% | 31% | 18% |
| 10 | 10% | 21% | 17% | 31% | 21% |
| 11 | 5% | 19% | 18% | 31% | 23% |
| 12 | 19% | 21% | 18% | 31% | 18% |
| 13 | 6% | 26% | 21% | 26% | 21% |
| 14 | 11% | 21% | 9% | 32% | 16% |
| 15 | 11% | 20% | 13% | 31% | 20% |
| 16 | 22% | 26% | 19% | 31% | 22% |
| 17 | 8% | 22% | 20% | 32% | 20% |
| 18 | 9% | 25% | 16% | 31% | 20% |
| 19 | 8% | 19% | 21% | 31% | 21% |

### Round 2

| PAG Member | ALT 1 SQ | ALT 2 SQ w/Pumps | ALT 11 W_1.0 F | ALT 12 W_0.7 H | ALT 20 W_0.3 | ALT 21 W_0.4 | ALT 22 W_0.5 | ALT 23 W_0.6 | ALT 24 W_0.7 |
|---|---|---|---|---|---|---|---|---|---|
| A | 0 | ac | a | a | ac | ac | ac | ac | ac |
| B | 0 | 0 | 0 | e | 0 | 0 | 0 | 0 | 0 |
| C | 0 | 0 | a | ac | a | a | e | a | e |
| D | 0 | 0 | a | 0 | 0 | 0 | 0 | 0 | a |
| E | 0 | ac | ac | ac | ac | ac | ac | ac | ac |
| F | 0 | a | a | 0 | 0 | 0 | 0 | 0 | a |
| G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| H | 0 | 0 | ac | ac | ac | ac | ac | ac | ac |
| I | 0 | a | a | a | a | a | a | a | a |
| J | 0 | 0 | a | a | ac | ac | a | ac | ac |
| K | 0 | 0 | ac | ac | ac | ac | ac | e | e |
| L | 0 | 0 | e | e | 0 | 0 | 0 | 0 | e |
| M | 0 | 0 | 0 | 0 | ac | ac | ac | 0 | 0 |
| N | 0 | 0 | e | e | ac | ac | ac | ac | e |
| O | 0 | 0 | 0 | e | 0 | 0 | 0 | 0 | 0 |
| P | 0 | ac | ac | ac | ac | ac | a | e | e |
| Q | 0 | 0 | ac | ac | 0 | 0 | ac | ac | e |

### Round 3

| PAG | ALT X |
|---|---|
| A | Ac |
| B | Ac |
| C | e |
| D | Ac |
| E | e |
| F | Ac |
| H | e |
| I | Ac |
| J | Ac |
| K | e |
| L | Ac |
| M | e |
| N | e |
| O | Ac |
| P | e |
| Q | Ac |
| R | Ac |
| S | Ac |

# Nechako WEI Work Planning