Water Balance Analysis

- Water Balance Model does not yet allow for ponds, precipitation harvesting, and capture and re-use of stormwater for irrigation purposes
- Objectives:
  - Provide adequate storage for extreme event
  - Minimize discharge to nearby stream
  - Minimize impacts on existing wetland resources
Water Balance Analysis

Fictional 100 ha subdivision composed of:

• 22% roads
• 52% residential
  (70/30 split single-family vs. multi-family)
• 8% commercial
• 10% municipal reserve
• 5% environmental reserve
  (50/50 split wetland and other ER lands)
• 3% public utility lot (wet pond)
Water Balance Analysis

Roads
- 22 ha
- 80% impervious
- no BMPs

Single-Family Residential
- 36.4 ha
- 45% impervious
- 50% of pervious area composed of absorbent landscaping (300 mm thick, silt-loam)
- 60% of hard areas drain onto absorbent landscaping
Water Balance Analysis

Multi-Family Residential
- 15.6 ha
- 75% impervious
- 50% of hard area covered by green roof
- 90% of green roof and 20% of remaining hard area to capture and re-use system
  (5 m³/ha/day and 100 m³/ha storage)

Commercial
- 8 ha
- 80% impervious
- 40% of hard area covered by green roof
- 90% of green roof and 20% of remaining hard area to capture and re-use system
  (7.5 m³/ha/day and 150 m³/ha storage)
Water Balance Analysis

Municipal Reserve
- 10 ha
- 90% irrigated from runoff collected in wet pond
  (25 mm each week during summer season)

Environmental Reserve
- 5 ha
- 50% of non-wetland area irrigated from runoff collected in wet pond
- treated runoff from wet pond used to replenish moisture in wetland during dry spells
Use of Stormwater for Irrigation is NOT new

- From 'Green' Irrigation at City Golf Courses and Parks at City of Calgary website:
  - It’s cheaper than using treated drinking water
  - Reduces our impact on our water treatment plants,
  - The energy savings we realize by not treating this water reduces our carbon emissions
  - And we reduce the impact on our stormwater system.
- Quote:
  
  Work on new parks and sport’s field, including projects in Coventry Hills and Citadel, will make use of storm ponds and pump houses for irrigation. “The cost reductions are significant for The City,” says Gourdeau. “It will cost only 25 per cent of what is would cost if we were to use potable water to irrigate.”

- Greg Shymanski, the City’s golf course operations coordinator says,
  
  “Very fundamentally, it’s economic. It’s much cheaper for The City and lessens the impact on our infrastructure.”
Bioretention (raingardens), (bio)swales and permeable pavement not considered at this time. They would be a bonus!
Water Balance Analysis

Wet Pond
- 3 ha
- permissible discharge at 1 L/s/ha
- emergency pump to wetland
- accumulated water used for irrigation of MR and ER, and replenishment of moisture in wetland
Understanding of historical precipitation patterns is paramount when interpreting results of water balance analyses.
### Precipitation vs. Runoff vs. Discharge to Stream

#### Year starting in 1960

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Average</th>
<th>Median</th>
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<tbody>
<tr>
<td>Precipitation</td>
<td>256</td>
<td>590</td>
<td>406</td>
<td>401 mm</td>
</tr>
<tr>
<td>Runoff</td>
<td>52</td>
<td>205</td>
<td>100</td>
<td>95 mm</td>
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<td></td>
<td>20</td>
<td>38</td>
<td>24</td>
<td>23 % of precipitation</td>
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<tr>
<td>Discharge to Stream</td>
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<td>29 mm</td>
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<tr>
<td></td>
<td>0</td>
<td>20</td>
<td>8</td>
<td>7 % of precipitation</td>
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</tbody>
</table>
**Operation of Wet Pond**

- **Emergency Pump Flow to Wetland** starting at 1050.50 m. Only active 5 years over period of record.
- **Discharge to Stream at 1.0 L/s/ha** starting at 1050.00 m.
Operation of Wetland

- Minimum water level at 1050.200 m
- Requires make-up water to be sustained

- No direct discharge from catchment
- Only treated stormwater to replenish wetland

- Compensation may not be required!
- Other operational schemes are possible

- Emergency Pump Flow from Wet Pond