Drought Issues in the Okanagan Basin
Local Purveyor Perspective

Drought Management Workshop

July 23, 2009, Kelowna, BC
Presenter: Bob Hrasko, P.Eng

Presentation Outline

- Current Use and Reservoir Storage
- Drought Planning Tools
- Drought Plan Implementation Tools

Okanagan Valley

- 8,000 km^2 watershed
  averages <0.60m of precip. annually
  and < 0.10m of runoff annually
- One of the driest climates in Canada
- High agricultural component
- High Drought Risk
- Current Okanagan Lake has heightened awareness of our water resource (not yet by public)

Where does it Rain?

(from Sustainable Water Strategy)

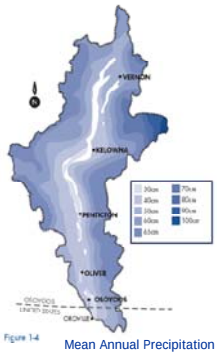
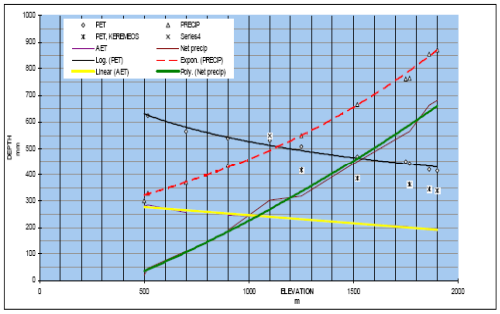


Figure 1-4 Mean Annual Precipitation

1 way in – Precipitation

2 ways out – Evaporation (E) Evapotranspiration (ET) and down the Okanagan River Channel

Elevation – Precipitation Relationship



Source - Developed by R.Allard, Golder (Okanagan Water Supply and Demand Study) in conjunction with Agua Consulting I

Utility Licenses

- Licensed Allocation
  Issued based on water availability, beneficial use, population and irrigated land area. Consumptive licensing are the domestic (WWLA) and irrigation (IRR) licenses
- Storage Licenses
  Issued in conjunction with WWLA and IRR licenses. Storage Licensing has not been issued by Province on the Valley Lakes
- Differing approaches in Watersheds vs. supply from Valley Lakes

Water Usage in Okanagan Valley

OKANAGAN BASIN - WATER LICENSE SUMMARY						
Number of Water Licenses (all types)	3981					
WWLA licenses (domestic)	149,039	ML	30.2%			
Irrigation Licenses (agriculture)	344,197	ML	69.8%			
Conservation Licenses (in stream flow)					26,550	ML
Total for Off-Stream Use	**493,236**	**ML**	**100.0%**			
	422,494	by 57 water utilities				
	361,655	85.6% by 17 largest water utilities				
OKANAGAN BASIN - WATER USAGE SUMMARY			**%**	**Indoor**	**Outdoor**	**Other**
Agriculture	138,860	ML	58.2%		58.24%	
Domestic Outdoor	45,994	ML	19.3%		19.29%	
Domestic Indoor	26,787	ML	11.2%	11.24%		
Unaccounted for Water	11,353	ML	4.8%			4.76%
Golf Course	7,470	ML	3.1%		3.13%	
Industrial - Commerical - Institutional	3,793	ML	1.6%	1.59%		
Parks - Open Space	3,761	ML	1.6%		1.58%	
Residual	392	ML	0.2%		0.16%	
Total Basin Usage	**238,410**	**ML**	**100.0%**	**12.8%**	**82.4%**	**4.8%**

Estimate that 48.3% of Basin Licenses are Utilized

Source – Dobson Water Management and Use Report

Largest Water Users in Okanagan Valley

	WATER UTILITY	Population (No.)	Licensed (ML)	SW Used (ML)	GW Used (ML)	TOTAL (ML)	License Used (%)
1	**Greater Vernon Water****	48,656	86,227	22,419	65	**22,484**	26.1%
2	**City of Kelowna**	50,595	49,545	16,439	0	**16,439**	33.2%
3	**Black Mountain Irrigation District**	19,025	27,783	12,840	842	**13,682**	49.2%
4	**Town of Osoyoos (rural)**	698	0	9,898	3,138	**13,036**	
5	**City of Penticton**	30,147	36,242	12,287	0	**12,287**	33.9%
6	**District of Summerland**	10,359	26,013	11,547	296	**11,843**	45.5%
7	**South East Kelowna Irrigation District****	6,343	41,966	10,550	404	**10,954**	26.1%
8	**Town of Oliver (Rural)**	1,455	47,142	9,010	1,462	**10,472**	22.2%
9	**Glenmore-Ellison Improvement District**	11,447	15,115	6,360	2,043	**8,403**	55.6%
10	**District of Lake Country**	11,914	37,105	7,073	41	**7,114**	19.2%
11	**Westbank Irrigation District**	12,961	17,768	5,383	0	**5,383**	30.3%
12	**Rutland Waterworks District**	13,301	0	0	4,594	**4,594**	
13	**Lakeview Irrigation District**	11,292	20,669	4,429	0	**4,429**	21.4%
14	**District of Peachland**	4,091	15,485	3,437	166	**3,603**	23.3%
15	**Town of Oliver (urban)**	4,023	0		2,515	**2,515**	
16	**Kaleden Irrigation District**	1,572	6,925	1,865	0	**1,865**	26.9%
17	**City of Armstrong****	3,949	3,700	1,298	0	**1,298**	35.1%
18	**West Kelowna Estates (RDCO)***	2,736	1,529	881	0	**881**	57.6%
19	**Town of Osoyoos**	4,131	0	0	597	**597**	
	TOTALS	**248,695**	**433,214**	**135,716**	**16,163**	**151,879**	**35.1%**

Source – Dobson Water Management and Use Report

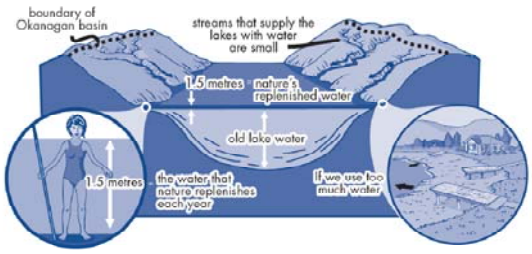
Current Water Storage Status

Utility	Total Storage (ML)	Ave Storage - July 20 Annually (ML)	Actual Storage July 20, 2009 (ML)	% of Normal
Lakeview Irrigation District	8,376	7,900	8,376	106%
Black Mountain Irrigation District	15,558	15,250	15,250	100%
District of Summerland	16,995	15,135	15,135	100%
District of Lake Country	22,271	19,728	19,584	100%
City of Penticton	13,691	12,959	12,310	95%
Westbank Irrigation District	10,048	8,000	6,950	87%
Greater Vernon Water	22,000	19,228	15,960	83%
Glenmore-Ellison Improvement District	8,714	7,540	6,015	80%
South East Kelowna Irrigation District	17,545	15,725	9,000	57%
Okanagan Lake Supplied Utilities (lake elev.)	342.50	342.35	341.95	
(storage)	424,150	372,000	225,860	61%

Localized drought protected by storage. The aggregate total (Okanagan Lake) is not.

Myth of Abundance

(from Sustainable Water Strategy)



Perception of Valley Lake Storage

Valley Lake	Area (ha.)	HWL	LWL	Depth	Storage (ML)	Est. Evaporation (m depth)	Evap. (ML)	Net amount Accounting for Evap. (ML)
Wood Lake	931	391.7	391.2	0.50	4,655	0.8	7,448	-2,793
Kalamalka Lake	2590	391.7	391.2	0.50	12,950	0.8	20,720	-7,770
Okanagan Lake	35100	342.5	341.3	1.20	421,200	0.9	315,900	105,300
Skaha Lake	1966	338.1	337.5	0.60	11,796	0.9	17,694	-5,898
Vaseaux Lake	300			0.00	0	1.0	3,000	-3,000
Osoyoos Lake	2330	277.8	277.4	0.40	9,320	1.1	25,630	-16,310
VALLEY LAKE STORAGE					**459,921**			**69,529**

If we want to use more of the valley lakes as storage
Variable use depth must be > Annual evaporation amount

Source – Dobson Water Management and Use Report

Basis for Assessing Drought Frequency

Figure 3.4 - Drought Frequency Available Runoff -

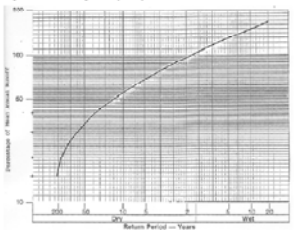


Table 3.4 - Frequency Event Annual Runoff in ML

Drought Frequency	Lambly Creek	Fish Flow	Percent of Ave. Year	Available Flow (ML)
1: 10 wet year	78,350	18,845	150%	60,305
Average year	46,900	10,045	100%	36,855
1:10 year drought	29,700	10,845	80%	15,750
1:25 year drought	23,450	10,845	60%	13,405
1:50 year drought	15,945	10,845	34%	5,901
1:100 year drought	12,194	10,845	26%	2,149
1:200 year drought	7,973	10,845	17%	-2,072
Catchment Area	340 km2			

* consists of 36.7 ML/day for 6 mo. in summer

* consists of 14.35 ML/day for 6 mos. in offseason

Without adequate catchment area and appropriate storage, a drought will compound through a multi-year drought cycle!

Supply Side vs. Demand Side Management

- **Supply Side Management** is managing the physical aspects of water supply including water source capacity, water storage, transmission and treatment capacity to meet forecasted water demand
- **Demand Side Management** is managing water usage, through education, regulation, pricing, and other means in order to influence water use habits (focus on efficiencies and beneficial use of water)

Supply-Side-Management Opportunities

- Adequate Infrastructure to meet Demands
- Higher Elevation Storage
- Groundwater Development (increased GW usage)
- Emergency Connections and contingency supplies (extreme)

Demand-Side-Management Opportunities

- Education
- Regulation
- Metering
- Pricing
- Pressure Management
- Education

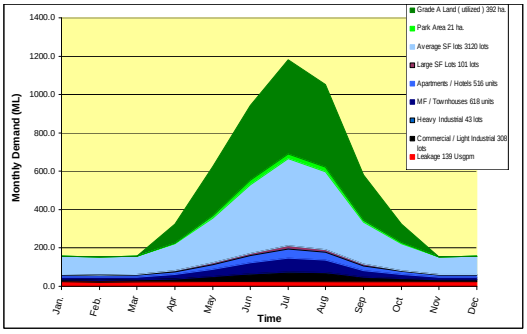
Drought Plan Considerations

- Developing a "*Utility-Water-Demand-Profile*"
  - Determine Leakage (UFW)
  - Estimate Water Demand per User Group
  - Develop Profile over the Seasonal variations
  - Understand varying demand conditions
  - Understand Max Day Use and Annual Use
- Understand historic trends and future direction

Simple Leakage Check

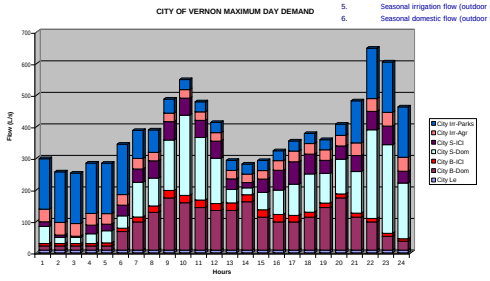
- Leakage may not be lost to hydrological cycle as it goes to GW, but it is lost to lower users for beneficial use

Utility Water Demand Profile Annual Average Demands



Utility Water Demand Profile
Maximum Day Demand

1. Leakage
2. Base metered flow (winter)
3. Base domestic flow (remainder of indoor winter use)
4. Seasonal metered flows (summer MDD)
5. Seasonal irrigation flow (outdoor use, MDD)
6. Seasonal domestic flow (outdoor use, MDD)

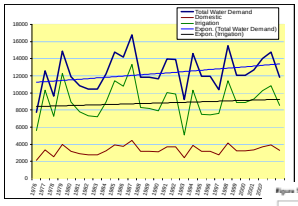


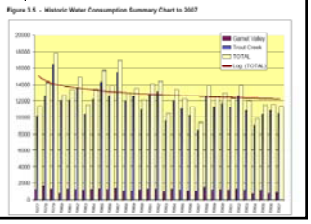
Max Day Demand vs. Annual Demand

Different Parameters that provide different insight

- Maximum Day Demand
  - Flow parameter
  - Controls water hammer and spikes, less wear on distribution system
  - Used to size system components
  - Potentially Lower power costs for pumping
  - Used to Determine distribution system capacity
- Average Annual Demand
  - Allocation Parameter, How much is used in a year
  - Considers annual average
  - Volumetric Parameter

Historic Demand - Need to Normalize Demands



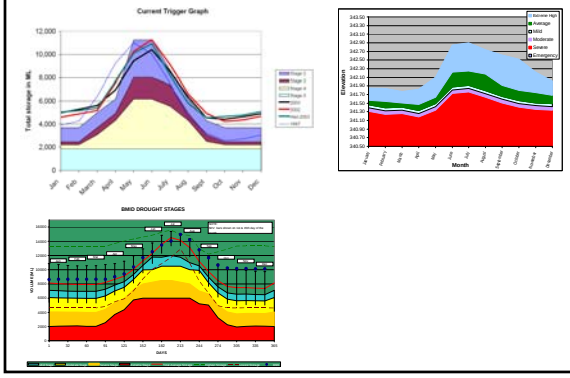


Factors Affecting Water Demand

- Changes in Crop Type
- Densification occurs on previously developed lands so no additional outdoor demand
- Education
- Metering, particularly when combined with pricing
- Climate Change

2% Population increase does not = 2% Water Demand increase

Drought Triggers



Drought Planning Factors

- Define what is an average year
- Understand Moisture Deficits and what is normal
- Length of high water demand season may be longer
- Manage storage by reliability to fill
- Must consider existing land gradation commitments to agriculture
- Cost-Benefit Analysis on Securing Water

Utility Considerations
Build More Storage, Develop GW or Metering?

No.	SOURCE CAPACITY PROJECTS	ML Secured	Project Cost	Cost / ML
32	TROUT CREEK RESERVOIR - LEAKAGE CONTROL	730	$ 232,033	$ 318
4	REMOTE READ AGRICULTURE METERS	432	$ 291,077	$ 674
24	TROUT CREEK INTAKE MONITORING & CONTROLS	330	$ 255,639	$ 775
22	ADDITIONAL GROUNDWATER CAPACITY	413	$ 347,875	$ 842
9	OKANAGAN LAKE PUMP STATION (PHASE 1)	5141	$ 5,253,229	$ 1,022
39	SITE 13 RESERVOIR (3,700 ML)	3700	$ 4,199,800	$ 1,135
47	LOWER TOWN LAKE INTAKE - SOURCE UPGRADE	402	$ 569,250	$ 1,416
27	SITE 2 RESERVOIR, 7600 ML + PITIN CREEK DIVERSION	7600	$ 12,037,229	$ 1,584
3	DOMESTIC METERING PROGRAM	405	$ 674,800	$ 1,666
40	SITE 9 RESERVOIR, KATHLEEN CREEK (1,600 ML)	1600	$ 2,828,793	$ 1,768
41	SITE 1 RESERVOIR, UPPER TROUT CREEK (2220 ML)	2220	$ 4,797,386	$ 2,161
50	OKANAGAN LAKE PUMP STN - PEACH ORCHARD DR.	12000	$ 31,092,000	$ 2,591

	PROJECT	ML / Diverted	Project Cost	$ / ML
n/a	Groundwater Development **	1200	$ 275,000	$ 229
9	Scotty Creek System Separation	1730	$ 424,155	$ 245
2	Agricultural Meters	1256	$ 423,140	$ 337
24	Mission Lake Reservoir	2280	$ 1,179,454	$ 517
20	Cornish / Morrison Road Separation	750	$ 404,484	$ 539
18	SCADA	400	$ 227,700	$ 569
14	Loch Long Reservoir	1850	$ 1,502,820	$ 812
36	Fish Hawk Reservoir - Raising	4680	$ 4,245,467	$ 907
39	Loch Oiche	1110	$ 1,135,000	$ 1,023
39	Murray Meadows Reservoir	2880	$ 4,325,000	$ 1,502
39	Site 3 Reservoir	2712	$ 5,660,000	$ 2,087
28	Domestic Metering	750	$ 1,618,925	$ 2,159
15	Black Mountain Reservoir	4600	$ 12,904,650	$ 2,805
39	Loch Lost Reservoir	435	$ 1,425,000	$ 3,276

** (reference GEID New Airport Well 2)

Water Allocation to Irrigation

- Price is usually a taxed rate per acre for an assigned annual depth of water
- Most irrigation connections are now metered
- Over use, pay additional when there is water. Can be cut off completely when there is not!
- Simple, effective
- Responsibility left to the user to manage their allotment

Domestic Pricing Strategies

Rate Types

- Flat Rate
- Volumetric Rate
- Base Charge plus Inclining Block Rate
- Declining Block Rate

Must Know the Fixed and Variable Costs

Assignment of allocation volume is not common

Domestic Allocation Considerations

- Base Rate increases should be based on increased service costs, otherwise rich will be able to afford water and poor will not.
- Health Issue - Must maintain minimal service levels (can with reduced pressure)
- Severe drought, Australia, base emergency allocation assessed by persons/residence
- Recent AWWA Article - Recent legal challenge that high Drought pricing for excess use didn't relate to cost of service. Courts agreed with Utility as base rate was maintained affordable, but excess use charge was assessed in order to secure water for all !

Summary

- We need to balance supply and demand side management techniques in our approach (we need to manage both)
- Difference in long term plans and emergency plans
- Trigger graphs are a key component to drought plans
- Base minimum allotments have to be determined
- Allotment limits should be considered for all users
- Call drought stages early to avoid moving to the more severe stages later

Questions