GUTTERS

GARDENS

ROOFTOPS

TAPS

LO Congress, January 8, 2015

With appreciation to Landscape Ontario

LO Congress, January 8, 2015

University of Guelph, Ridgetown Campus 1994 to 2010

"Associate Diploma in Horticulture"
"Skills Ontario / Skills Canada"
"World Skills"

Gaia College – Online since 2011

"SketchUp Pro for Landscape Design"
Development, Facilitation
"Rainwater Management"
Development, Facilitation
(Seneca and Humber Colleges, Toronto)
(Royal Roads University, Victoria, BC)
"Ecological Landscape Design"
Co-Facilitation

Horticulture Centre of the Pacific since 2011

"Landscape Horticulturist" (Apprenticeship)

Canadian Association for Rainwater Management

"From Gutters to Gardens, From Rooftops to Taps"
Development, Delivery, Training Program Management

Ken Nentwig BLA MLA CLP CLD

Mission Statement:

"To bring awareness, educate, and conduct research in best practices for rainwater and stormwater management across Canada."

CANARM

CANADIAN ASSOCIATION FOR RAINWATER MANAGEMENT

Formed 2012

Urban (Built Environment) WATER CYCLE*

FROM TAP…..

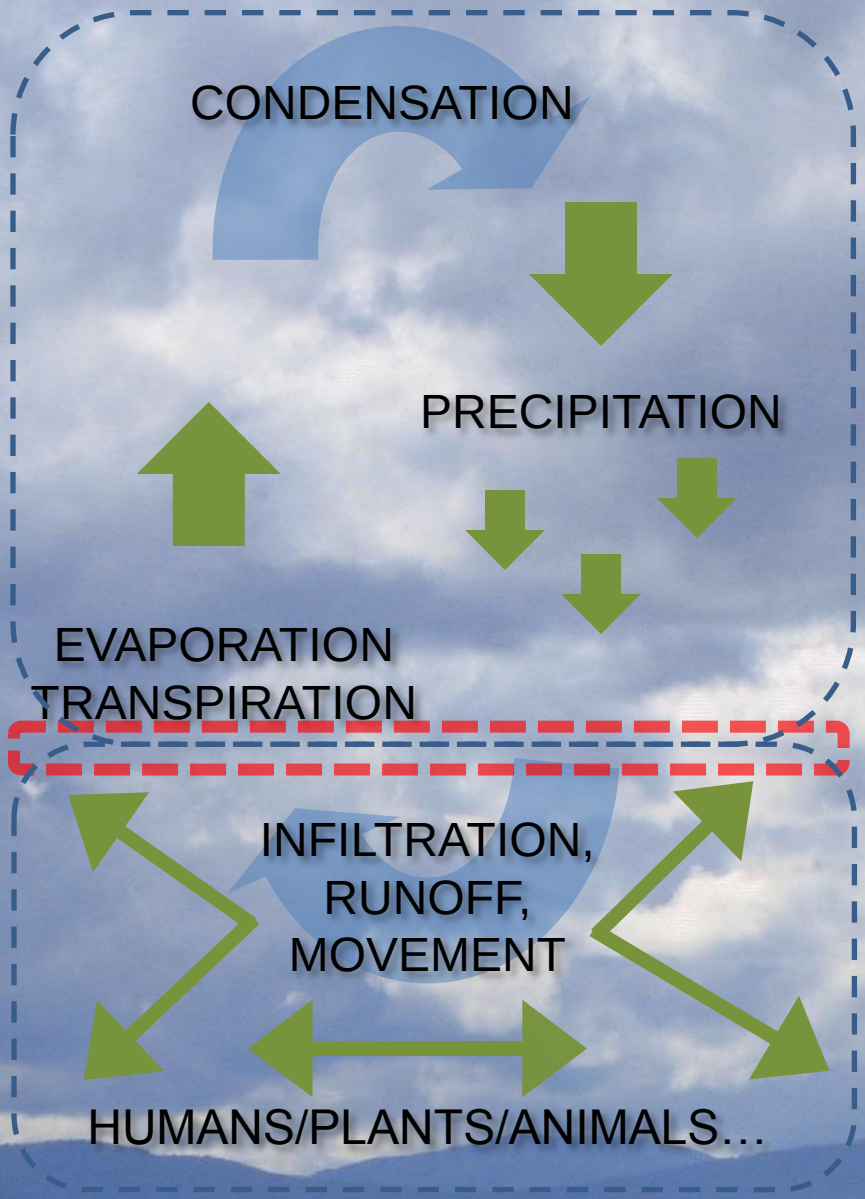
…TO DRAIN

FROM ROOF….

…TO STORM and SEWER DRAINS

* "Stormwater Planning", 2002

Nature's WATER CYCLE



Moving from REACTIVE Peak Flows to PROACTIVE Volume Management

RAINWATER MANAGEMENT....

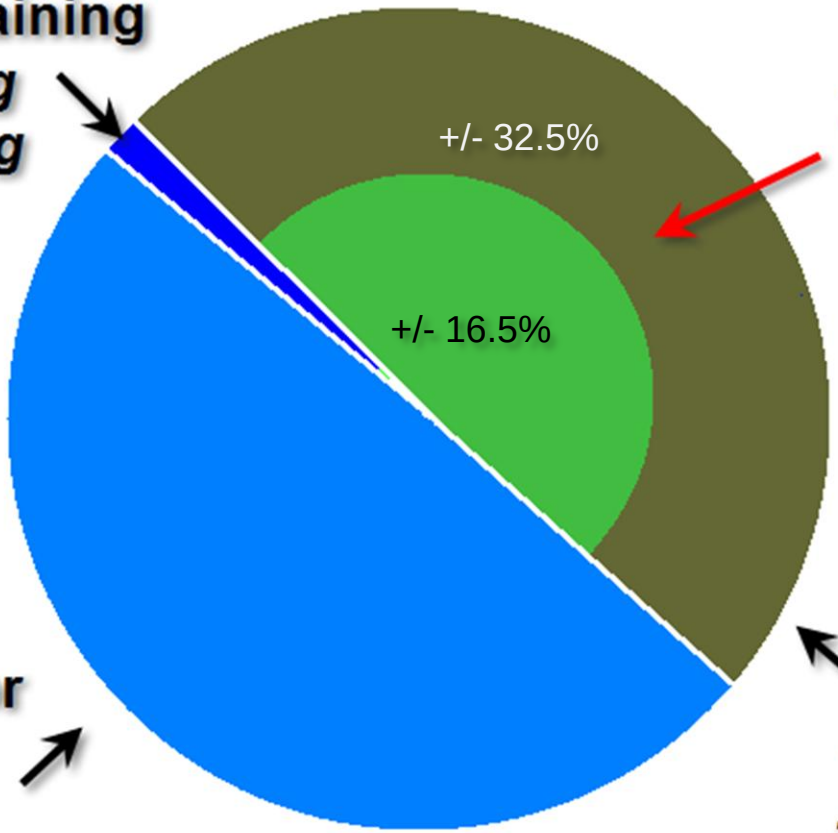
Reduces demand on potable water resources and infrastructure

Reduces demand on stormwater infrastructure, by helping to reduce or eliminate environmental pollution, and by helping to reduce flooding

Increases aquifer and ground water recharge

Utilizes untapped resources and is environmentally sound

Breakdown of residential water use



2% Life Sustaining
- *Cooking*
- *Drinking*

2/3 of Garden and Lawn watering is wasted

+/- 49% Indoor
- *Kitchen*
- *Bathroom*
- *Laundry*

+/- 49% Outdoor
- *Gardens/Lawns*
- *Vehicle Washing*

CRD: "A Homeowner's Guide to Outdoor Water Use" - April 2009

1 ORANGE
50 litres

1 CUP COFFEE
130 litres

1 HEAD LETTUCE
300 litres

1 kg CORN
585 litres

1 kg WHEAT
730 litres

1 EGG
1,515 litres

1 kg RICE
1,550 litres

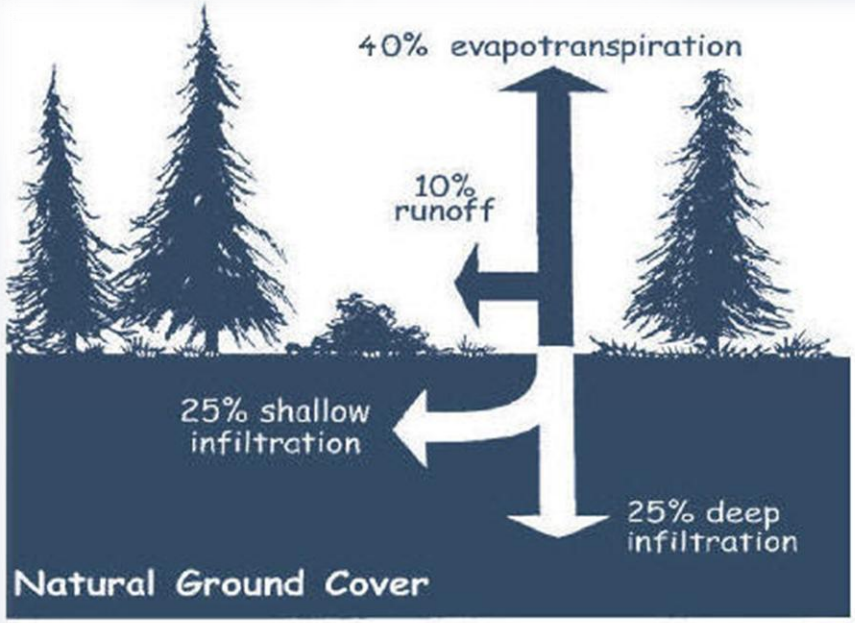
1 kg SOYBEANS
1,925 litres

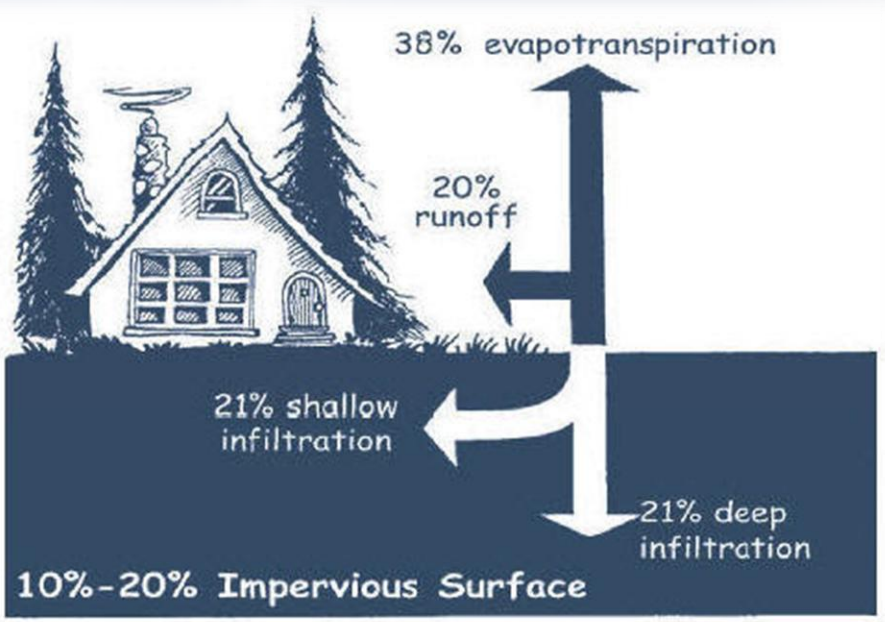
1 kg BEEF
15,400 litres

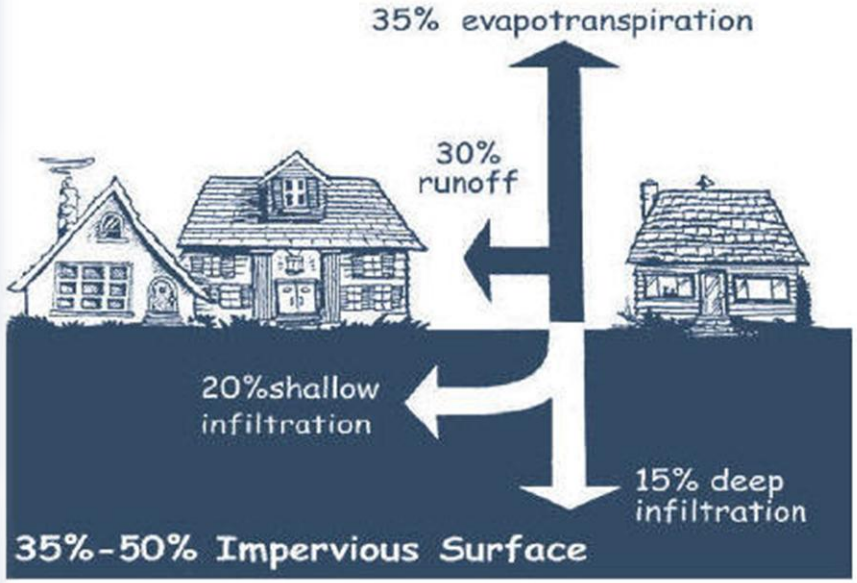
100 sq m LAWN
*50,000 litres**

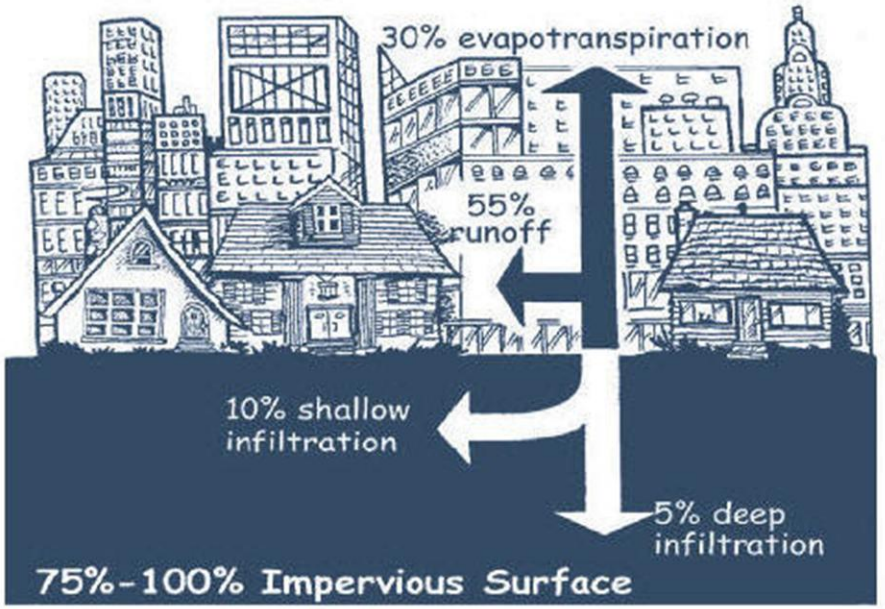
*20 WEEKS

Average 'Bucket Print' for everyday items…..

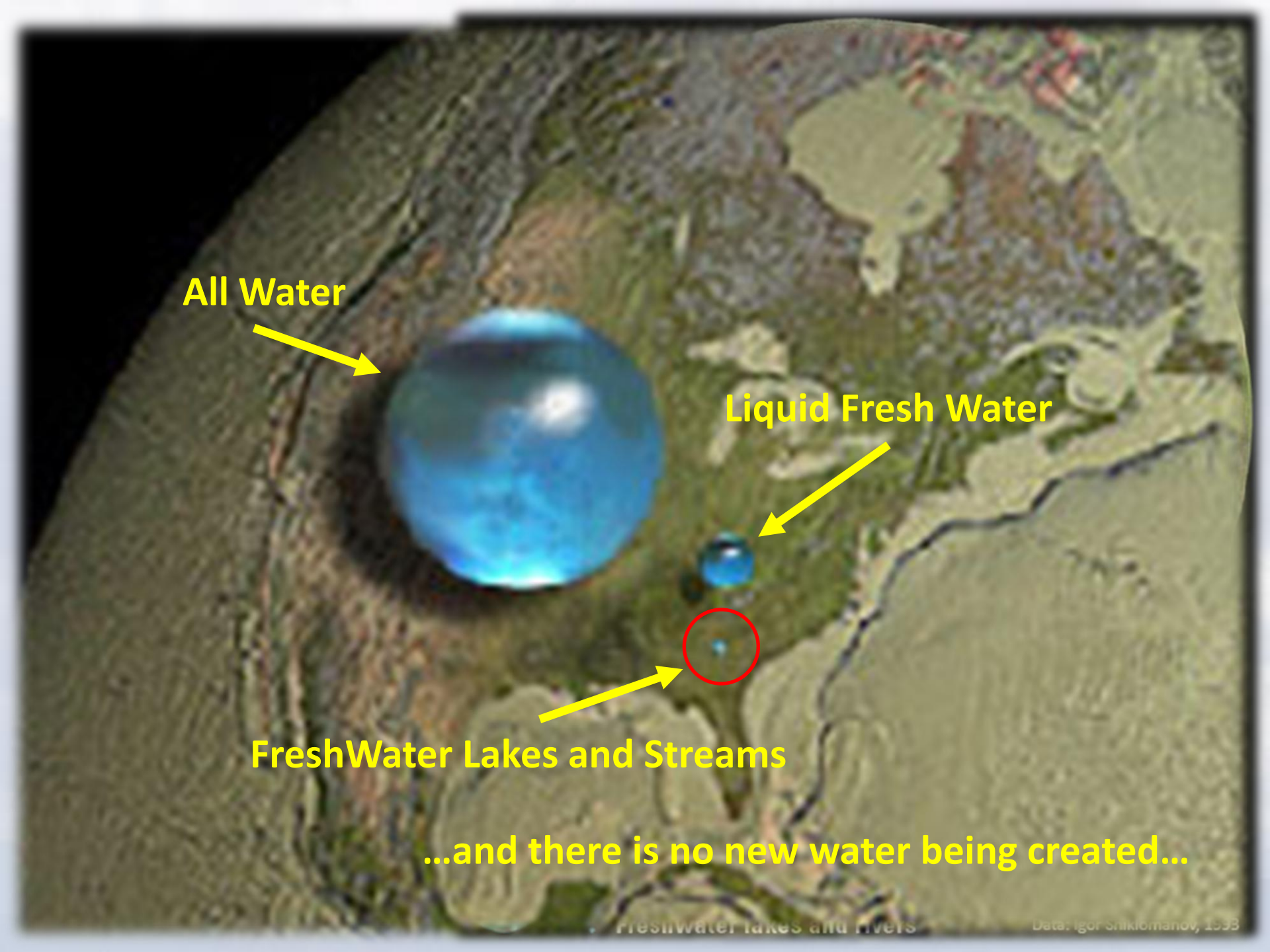








Adapted from: "Managing Storm Water Runoff", 2007. University of Wisconsin Extension


All Water
Liquid Fresh Water
FreshWater Lakes and Streams
…and there is no new water being created…

Water Problems...

What can we do better?

Change is not easy....

Sweden, Sept 14, 1959 5:00 PM

Switch from left-side to right-side driving

RAINWATER ….

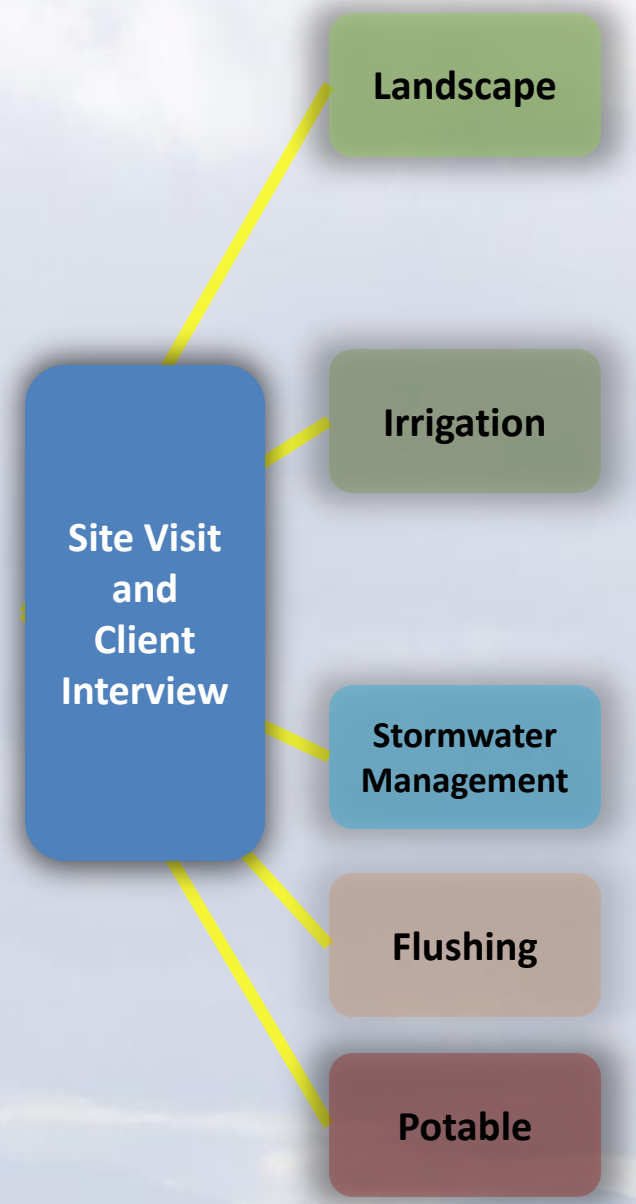
- is available almost everywhere, most of the time

- is generally clean, relatively uncontaminated

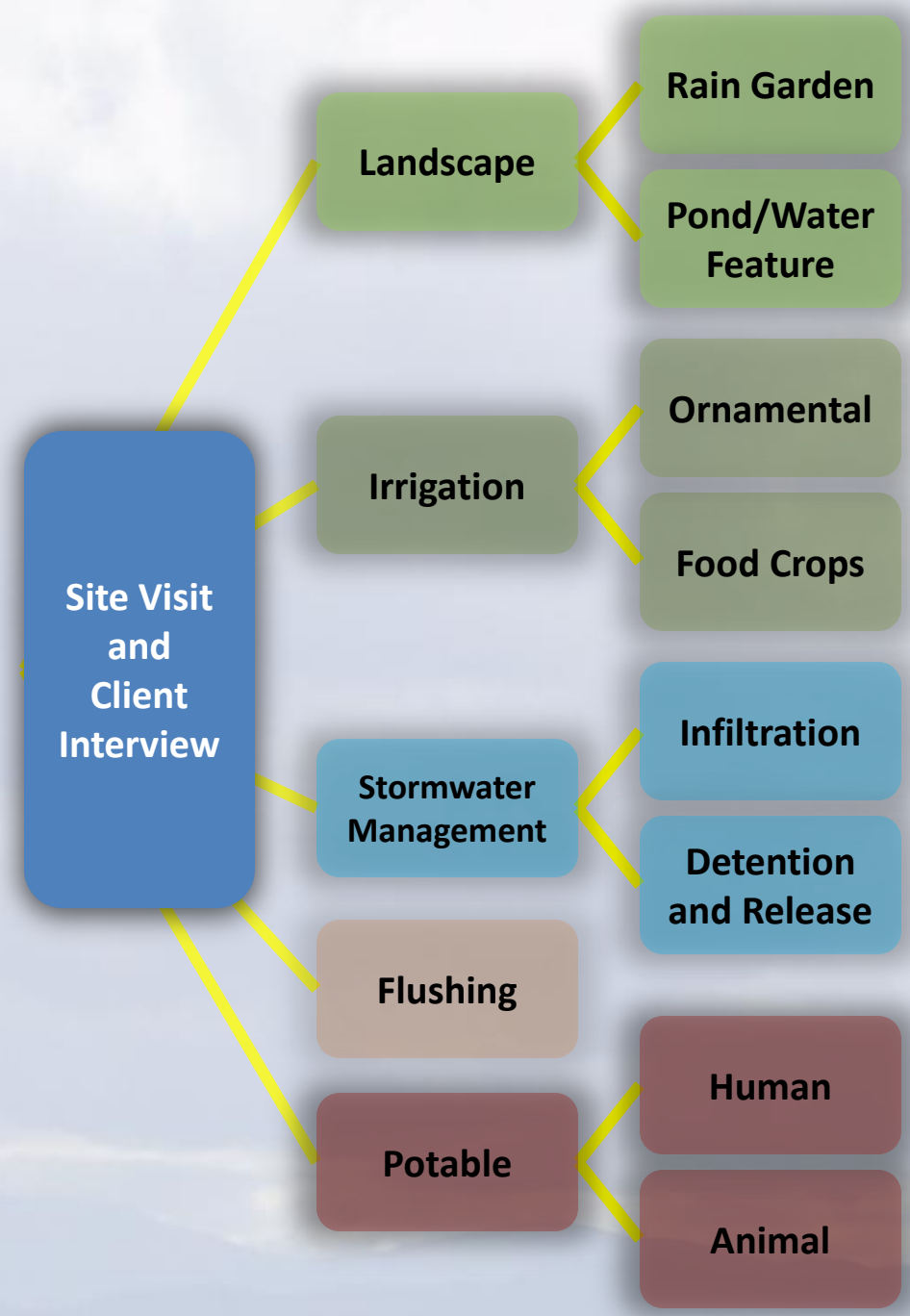
- can be stored and/or treated

- is an ‘untapped’ resource

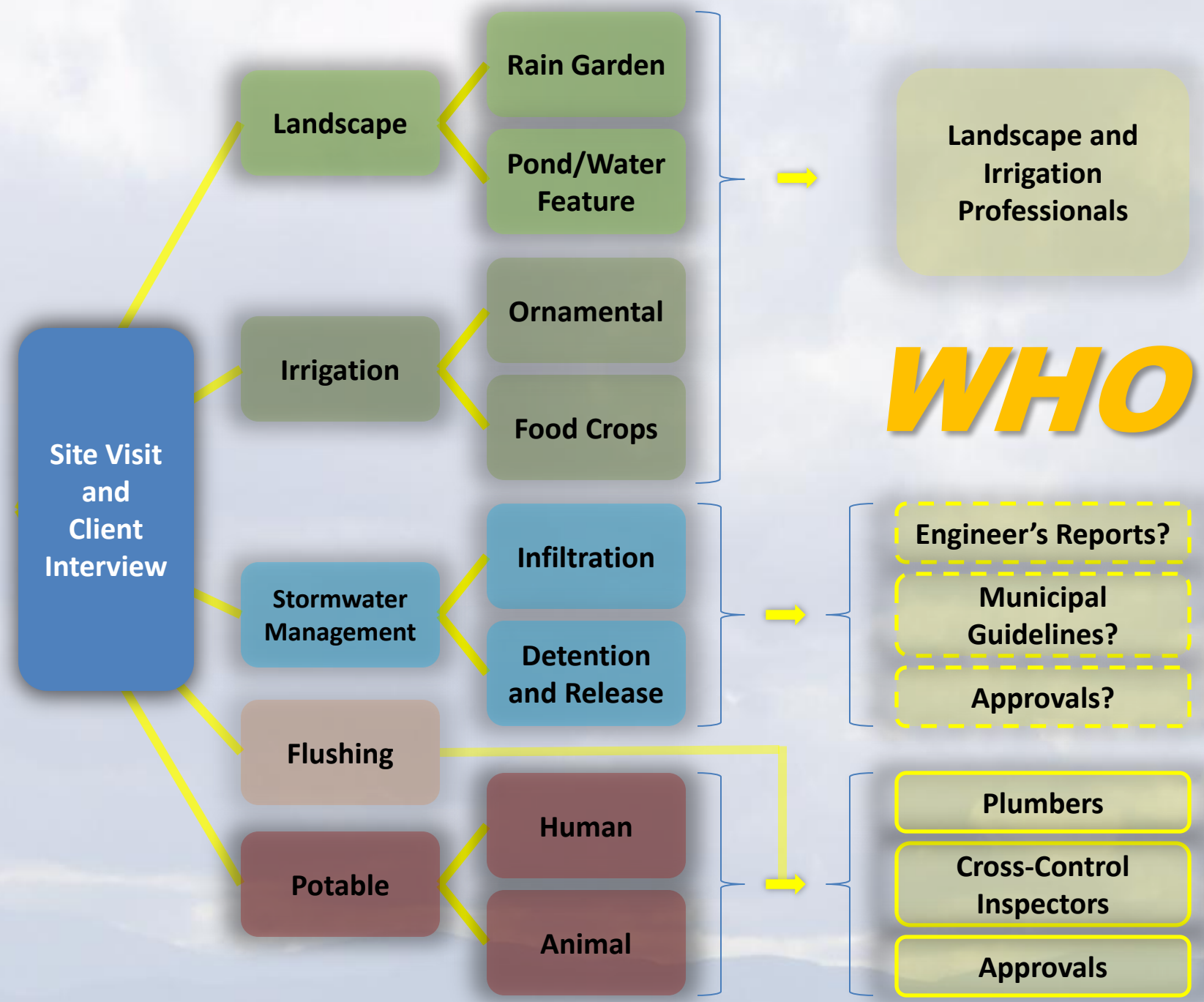
- can help to solve or mitigate a number of problems


Site Visit and Client Interview
Landscape
Irrigation
Stormwater Management
Flushing
Potable

WHY


Site Visit and Client Interview
Landscape
Rain Garden
Pond/Water Feature
Irrigation
Ornamental
Food Crops
Stormwater Management
Infiltration
Detention and Release
Flushing
Potable
Human
Animal

WHAT


Site Visit and Client Interview
Landscape
Rain Garden
Pond/Water Feature
Irrigation
Ornamental
Food Crops
Landscape and Irrigation Professionals
WHO
Stormwater Management
Infiltration
Detention and Release
Engineer's Reports?
Municipal Guidelines?
Approvals?
Flushing
Potable
Human
Animal
Plumbers
Cross-Control Inspectors
Approvals

Demand and Uses	A	+/- 300 litres per person per day in Canada
Climate Data		Monthly Historic Averages for local region, Environment Canada statistics

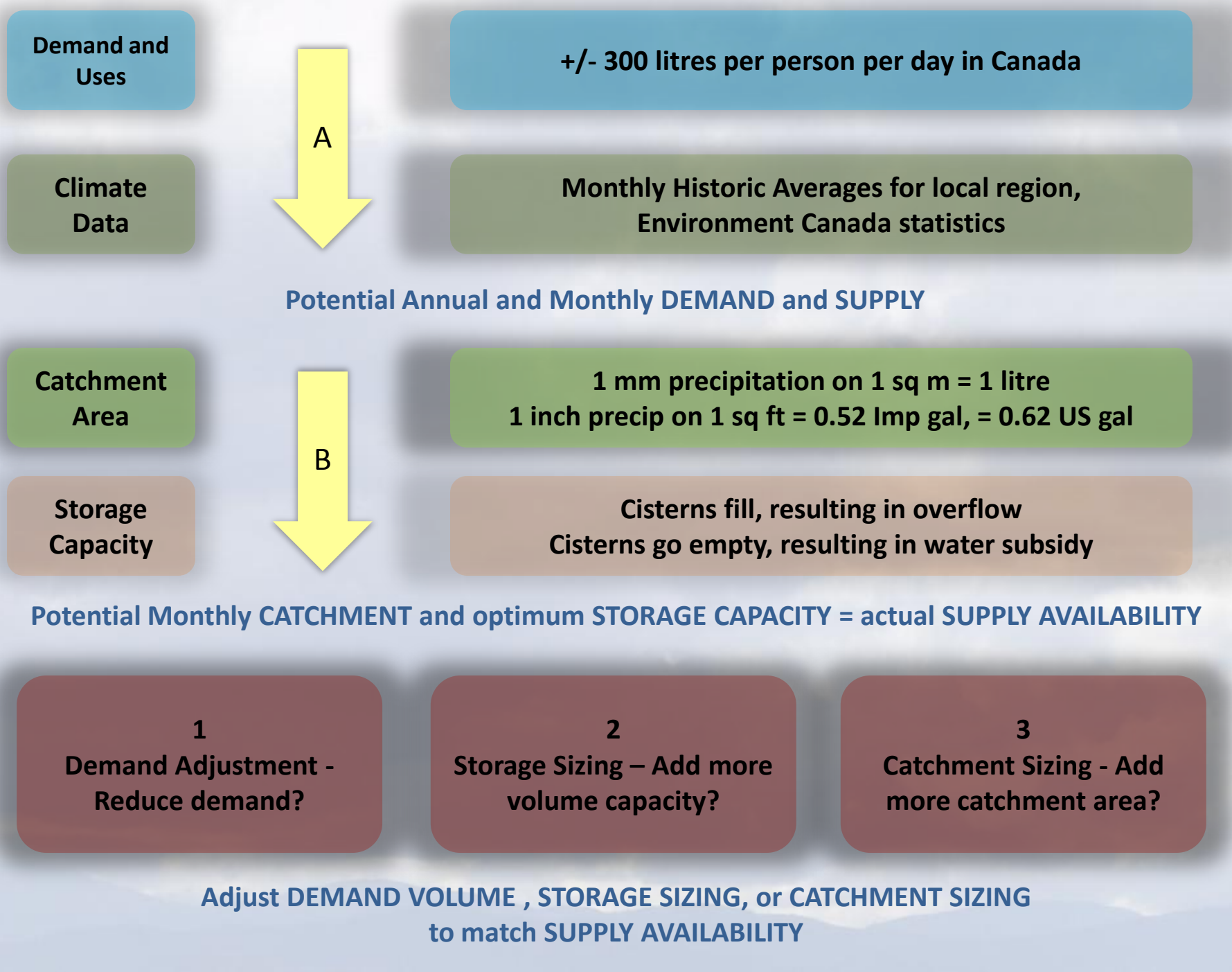
Potential Monthly DEMAND and SUPPLY

Demand and Uses	A	+/- 300 litres per person per day in Canada
Climate Data		Monthly Historic Averages for local region, Environment Canada statistics

Potential Monthly DEMAND and SUPPLY

Catchment Area	B	1 mm precipitation on 1 sq m = 1 litre 1 inch precip on 1 sq ft = 0.52 Imp gal, = 0.62 US gal
Storage Capacity		Cisterns fill, resulting in overflow Cisterns go empty, resulting in water subsidy

Potential Monthly CATCHMENT and optimum STORAGE CAPACITY = actual SUPPLY AVAILABILITY


Demand and Uses
+/- 300 litres per person per day in Canada
A
Climate Data
Monthly Historic Averages for local region, Environment Canada statistics
Potential Annual and Monthly DEMAND and SUPPLY
Catchment Area
1 mm precipitation on 1 sq m = 1 litre
1 inch precip on 1 sq ft = 0.52 Imp gal, = 0.62 US gal
B
Storage Capacity
Cisterns fill, resulting in overflow
Cisterns go empty, resulting in water subsidy
Potential Monthly CATCHMENT and optimum STORAGE CAPACITY = actual SUPPLY AVAILABILITY
1
Demand Adjustment - Reduce demand?
2
Storage Sizing – Add more volume capacity?
3
Catchment Sizing - Add more catchment area?
Adjust DEMAND VOLUME , STORAGE SIZING, or CATCHMENT SIZING
to match SUPPLY AVAILABILITY

Living Water Smart

Stormwater Planning BC

The State of the Water Mo

CMHC: Guidelines for I
Rainwater Harvesting

Primer for Integrated Ra
Groundwater Managem

Green Bylaws Toolkit a
Toolkit

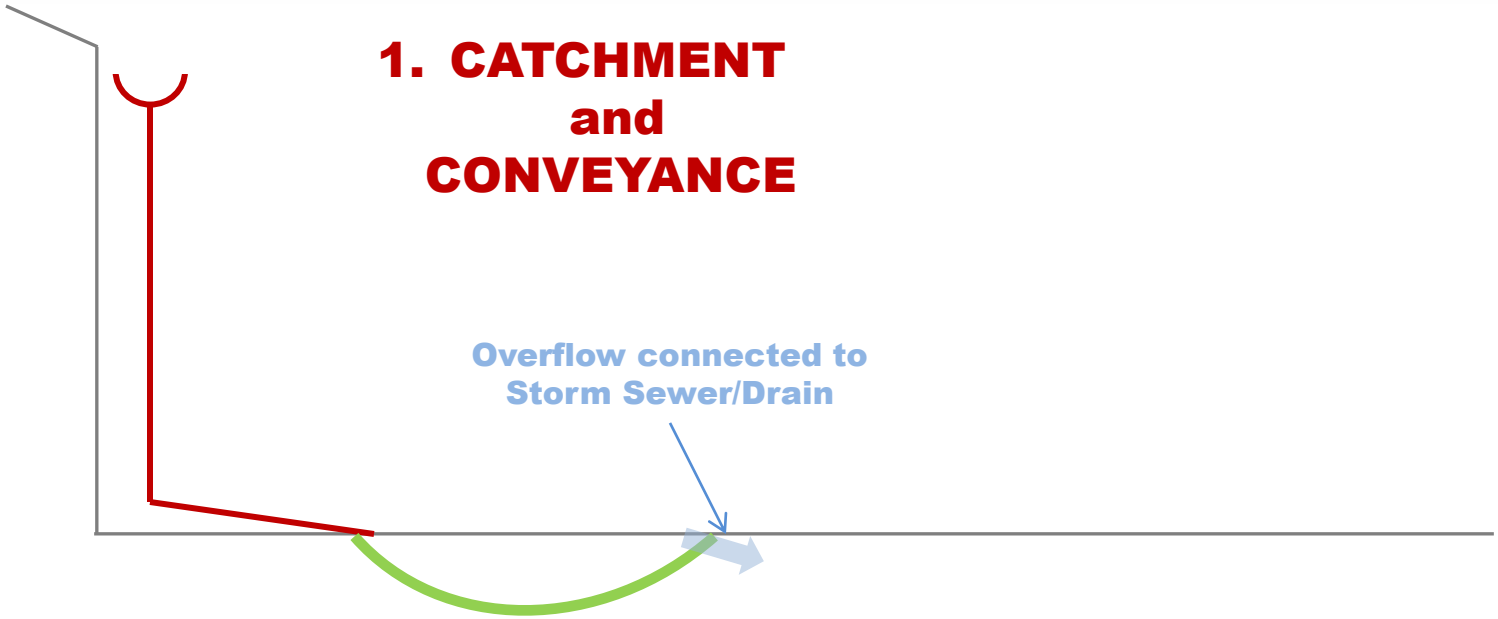
Application of the Wa

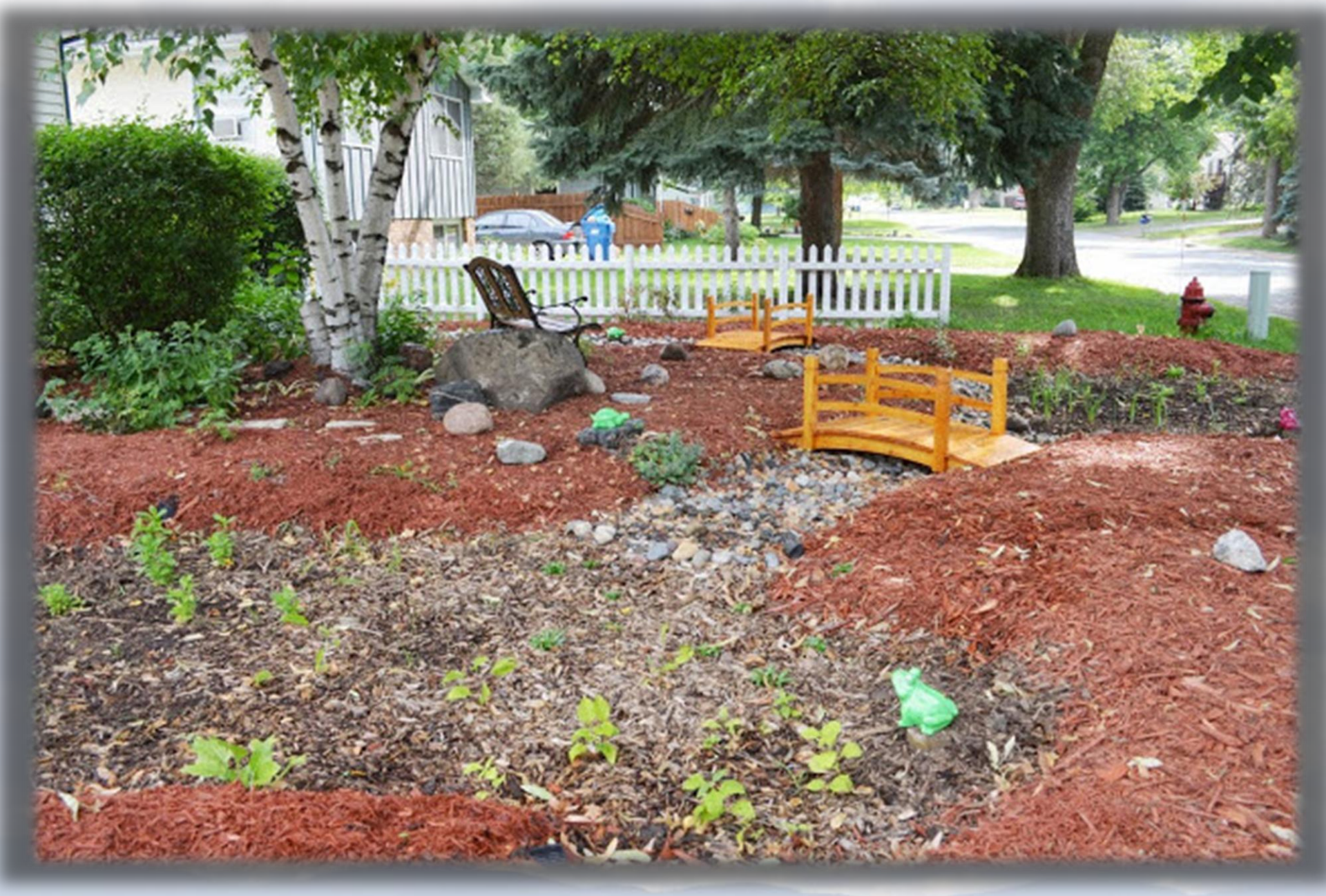
Thinking Beyond Pip

Integrated Rainwat

LEED Canada Guid
Construction

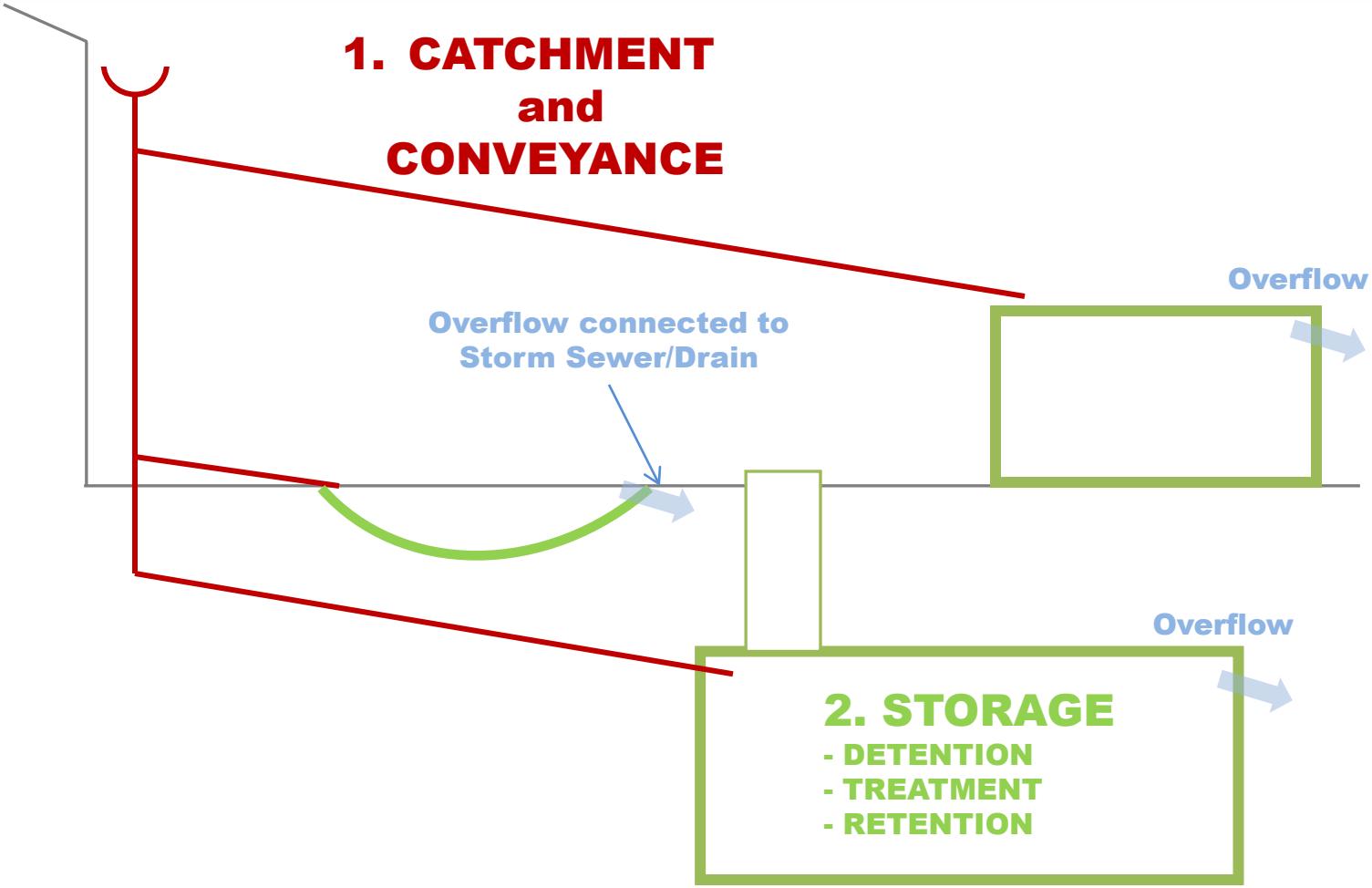
RWH Systems – Overview





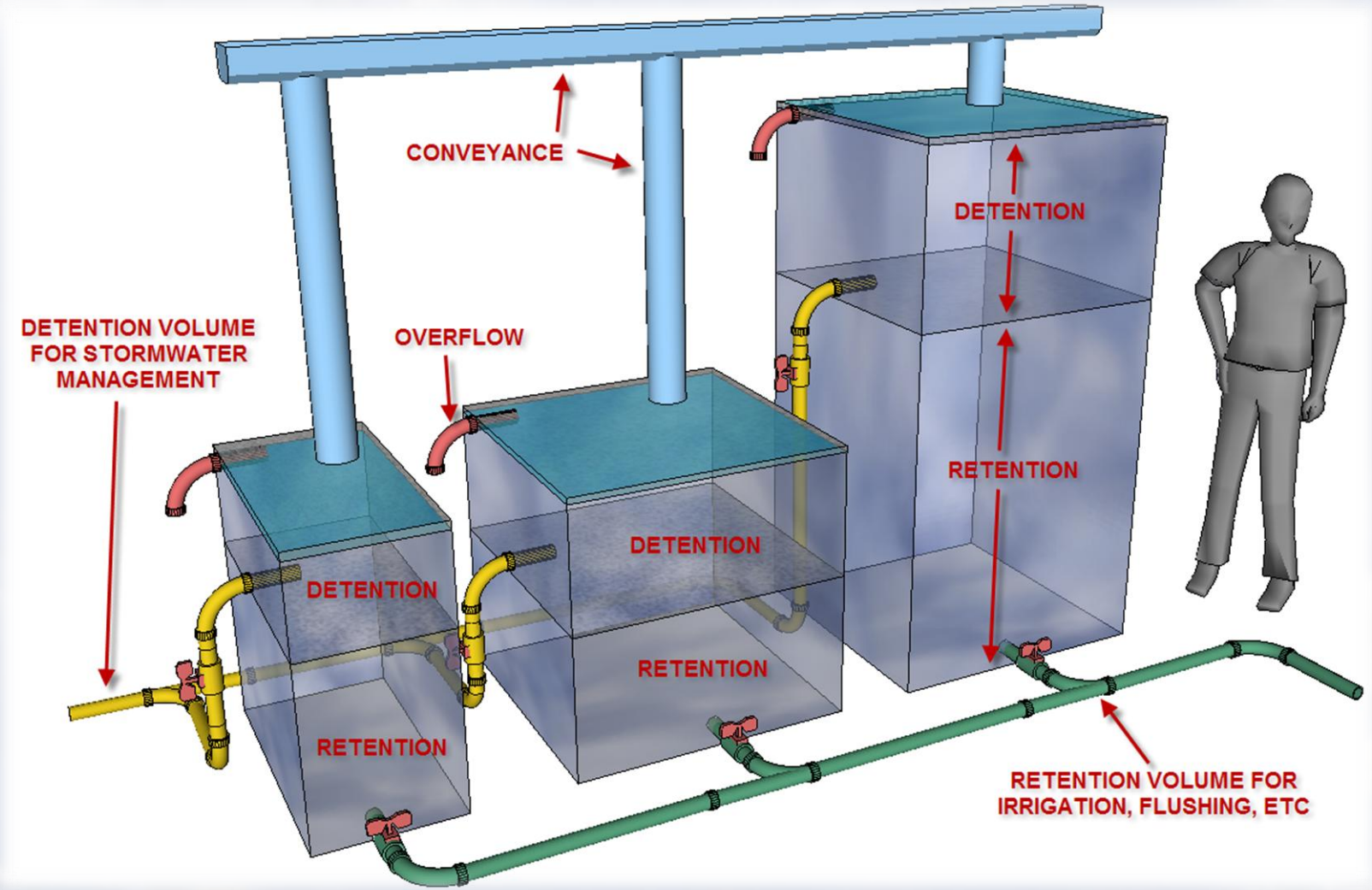
Permeable Pavements

RWH Systems – Overview



http://www.vanislewater.calls.net/rainwater-catchment-storage

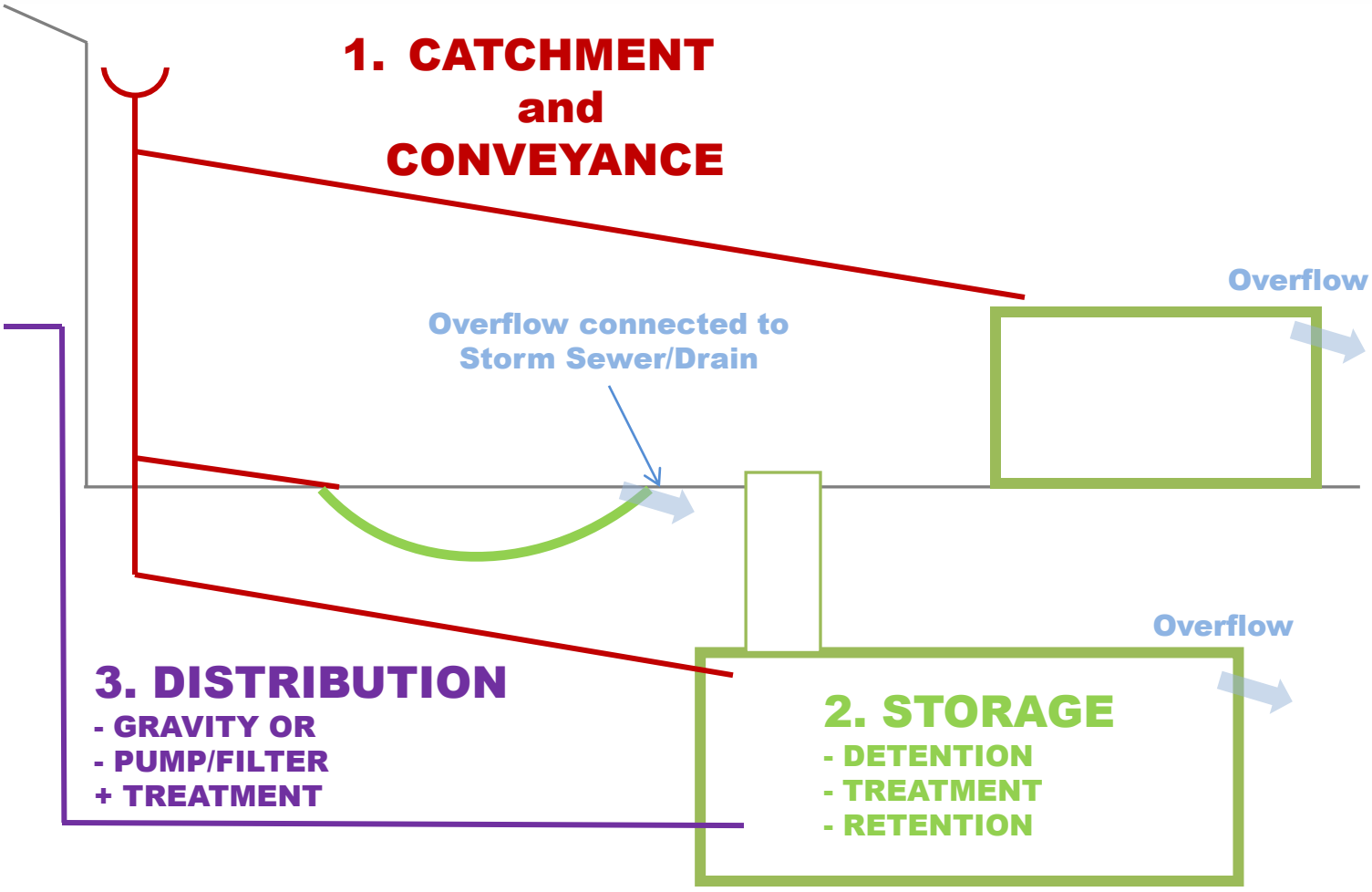
Retention/Detention vs Runoff



tp://www.wikihow.com/Create-a-Rain-Garden

www.houzz.com/french-drain

RWH Systems – Overview

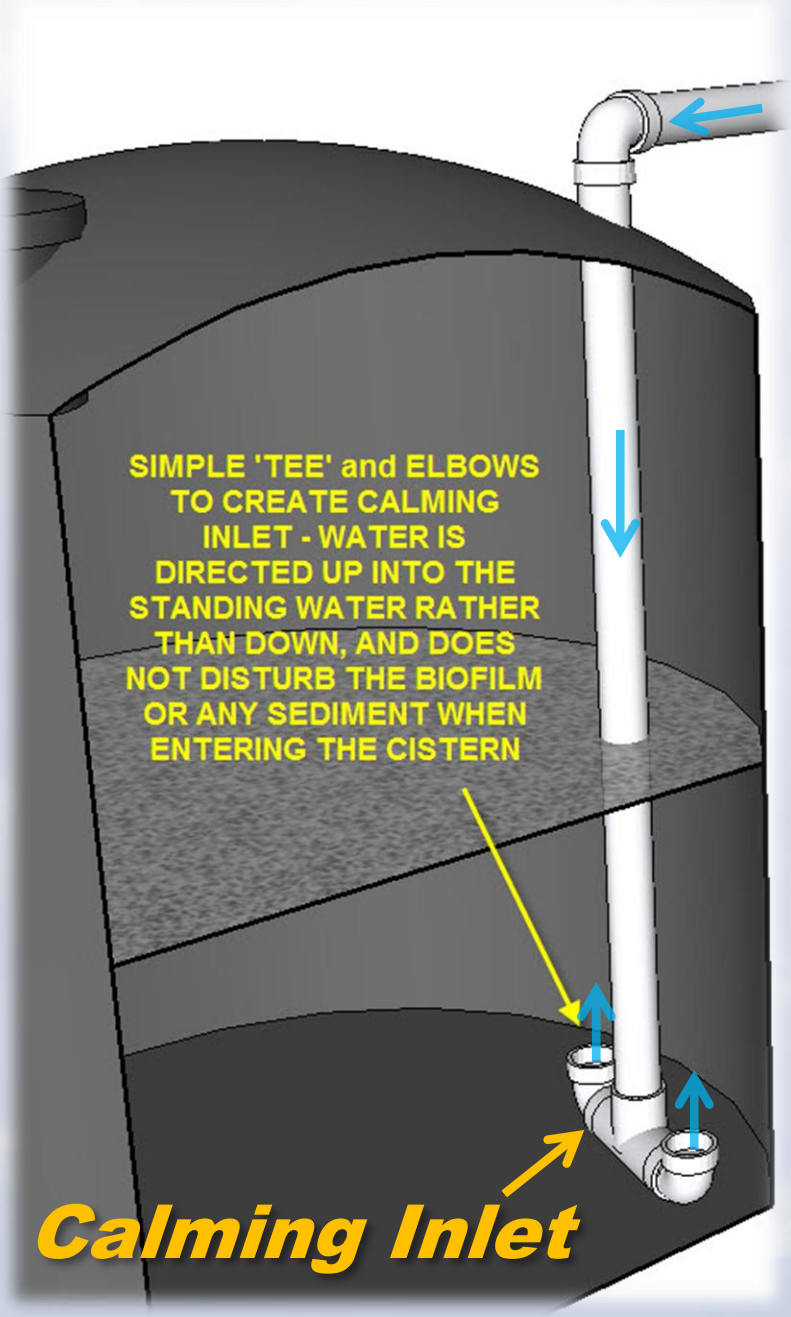


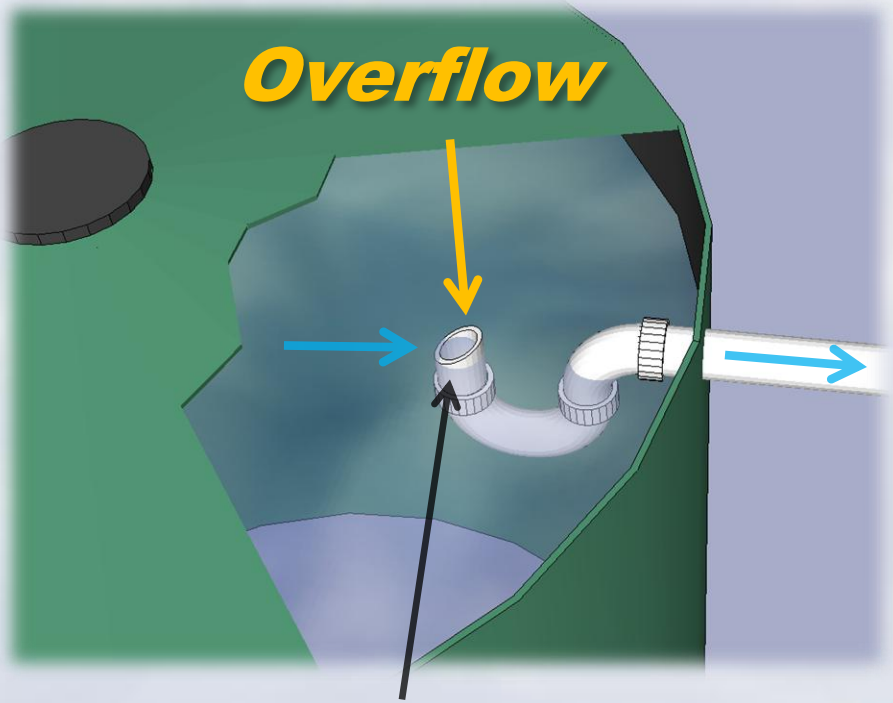
Got RAINWATER?

Designer Tanks and Cisterns

Back yard becomes a cistern.....

...cistern becomes a yard ornament



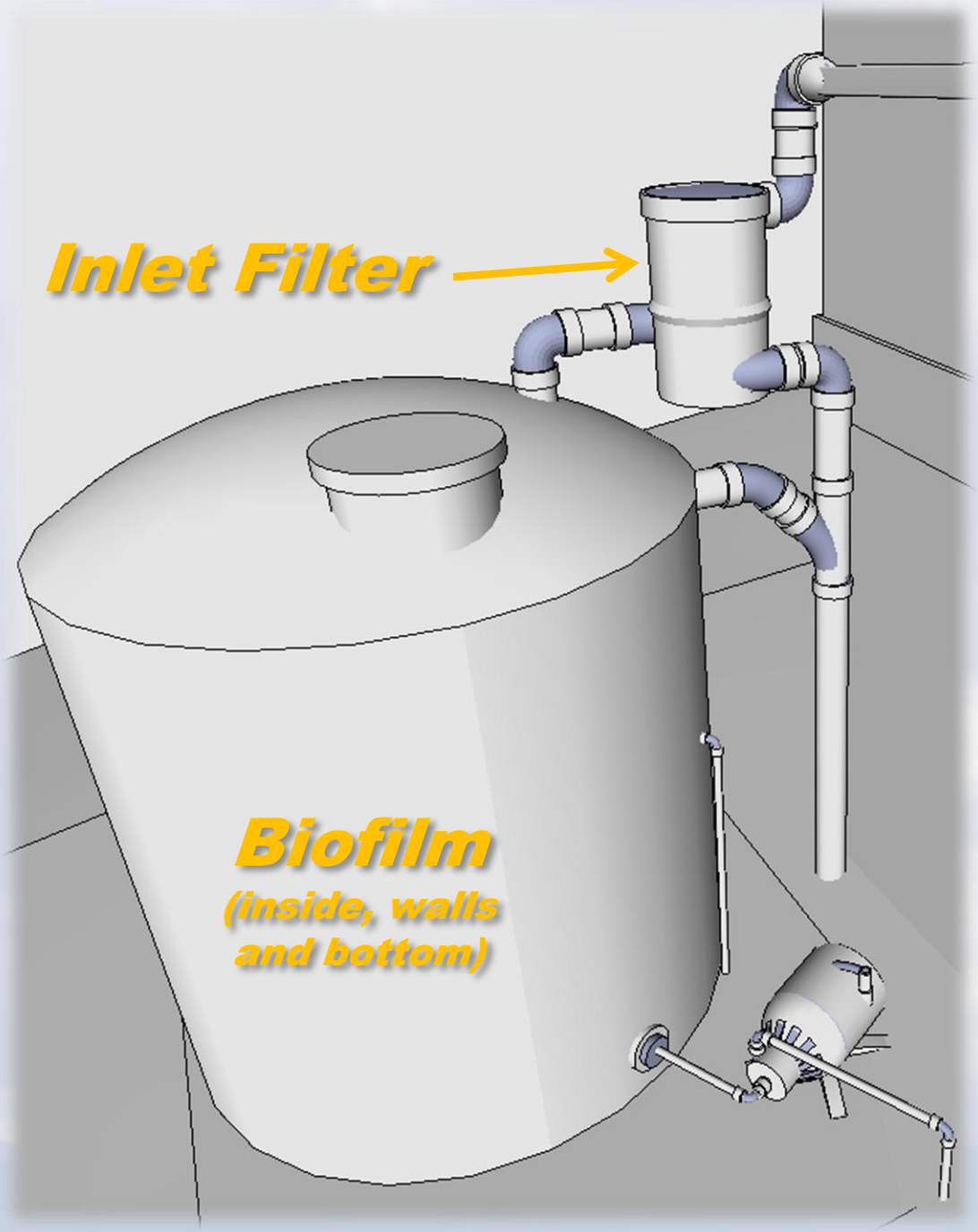


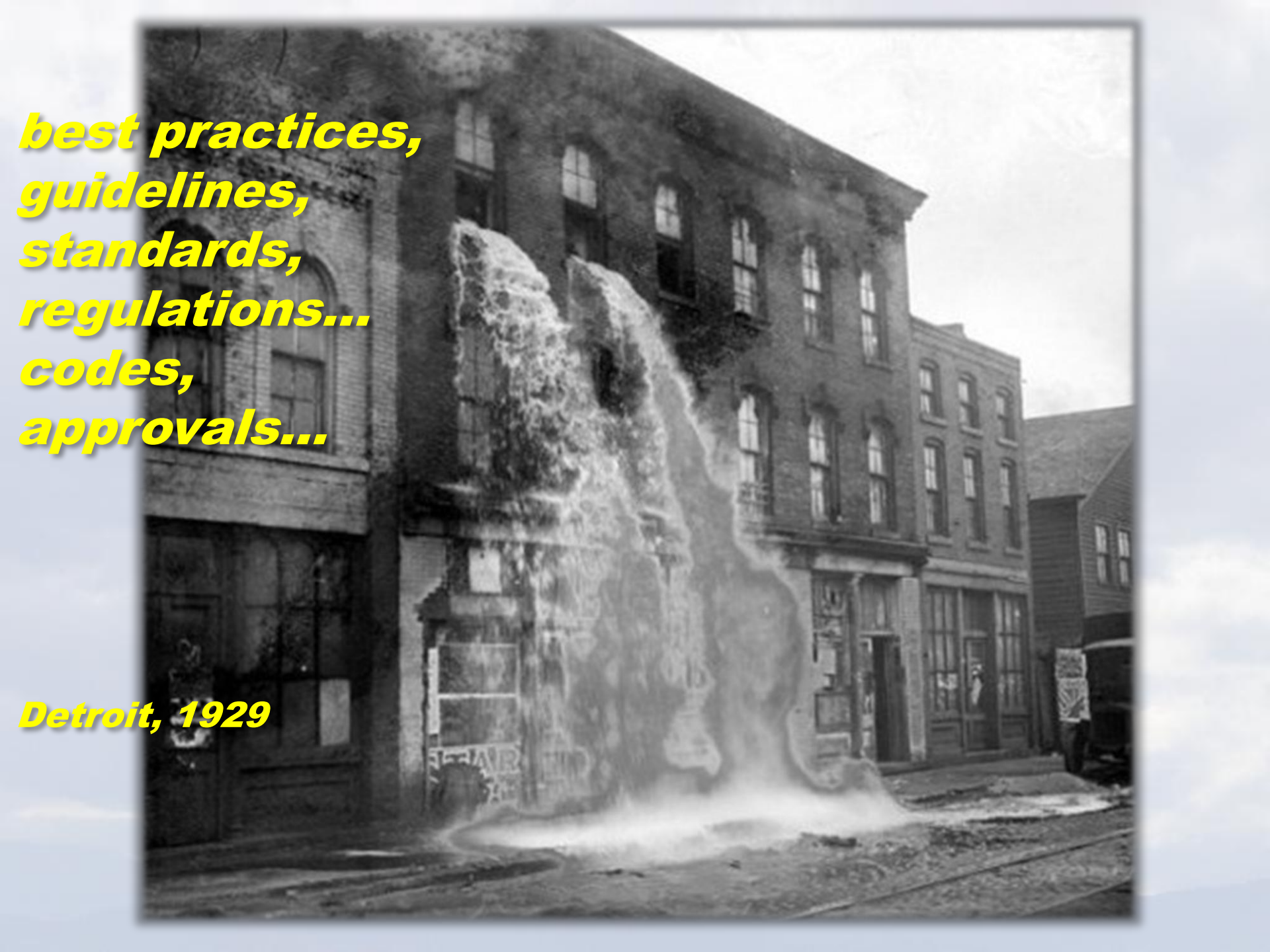
The overflow has a tapered inlet to siphon dust particles off the top surface, and a trap (U-shaped section). It is connected to the storm drain or other approved outlet

Using gravity to fill storage tanks and cisterns is simple and less expensive that pump and pressure line components. Downspout and pipe joints must be tightly sealed against leaks and insect/vermin entry.

A good filter (400 microns or finer) will keep the water clean and prevent buildup of sludge on the bottom. Additional filtering for irrigation may be necessary,

A thin ‘slimy’ layer is called ‘biofilm’, and can often be beneficial to the quality of the stored water.




best practices,
guidelines,
standards,
regulations...
codes,
approvals...
Detroit, 1929

Definition: *Rainwater* means *storm sewage* runoff…

7.1.5.3. Water Distribution Systems

…

(2) *Storm sewage* or *greywater* that is free of solids and treated to conform to Article 7.7.4.1. is permitted to be used as a water supply for,

(a) water closets,

(b) urinals,

(c) sub-surface irrigation, or

(d) the priming of *traps*.

7.1.5.3. Water Distribution Systems (cont'd)

(3) *Rainwater* that is free of solids and treated to conform to Article 7.7.4.1. is permitted to be used as a water supply for,

(a) clothes washers,
(b) laundry trays,
(c) mop sinks,
(d) bedpan washers,
(e) water closets,
(f) urinals,
(g) hose bibbs,
(h) sub-surface irrigation, or
(i) the priming of *traps*.

7.4.2.2. Connection of Overflows from Rainwater Tanks

(1) Where an overflow from a *rainwater* tank is connected to a *storm drainage system*, it shall be connected by,

(a) an *air break*, or

(b) a *backwater valve…*

7.7.1.1. Non-Potable Connection

(2) Make-up water may be supplied to the non-*potable water system*

(a) by a reduced pressure *backflow preventer*, or

(b) By an *air gap…*

(3) Where a clothes washer is supplied by a *rainwater* system and a *potable water system…*

(a) area isolation, and

(b) premise isolation

7.7.2.1. Markings Required

(1) Non-*potable* water piping shall be identified…

(2) …. in accordance with Section 12 of CAN/CSA-B128.1,
"Design and Installation of Non-Potable Water Systems".

(3) A sign containing the words
NON-POTABLE WATER, DO NOT DRINK…

7.7.4.1. Conformance to Standards

(1) Non-*potable water systems* for re-use purposes shall be designed, constructed and installed to conform to good engineering practice appropriate to the circumstances such as described in,

(a) the ASHRAE Handbooks,

(b) ASPE Data Books, or

(c) CAN/CSA-B128.1, "Design and Installation of Non-Potable Water Systems".

"From Gutter to Garden, From Rooftop to Tap"

GUTTERS

Collection and Conveyance

RWH PRACTITIONER

- Design, Install, Maintain

GARDENS

Irrigation or Infiltration

LANDSCAPE and RWH

- Design, Install, Maintain

ROOFTOPS

Collection, Quality, Storage

RWH SYSTEM MANAGEMENT

- Water Quality

TAPS

Potable Uses

INSPECTOR

- Cross-Control Certification

Ready to be immersed?

Case Studies:

Case Studies:

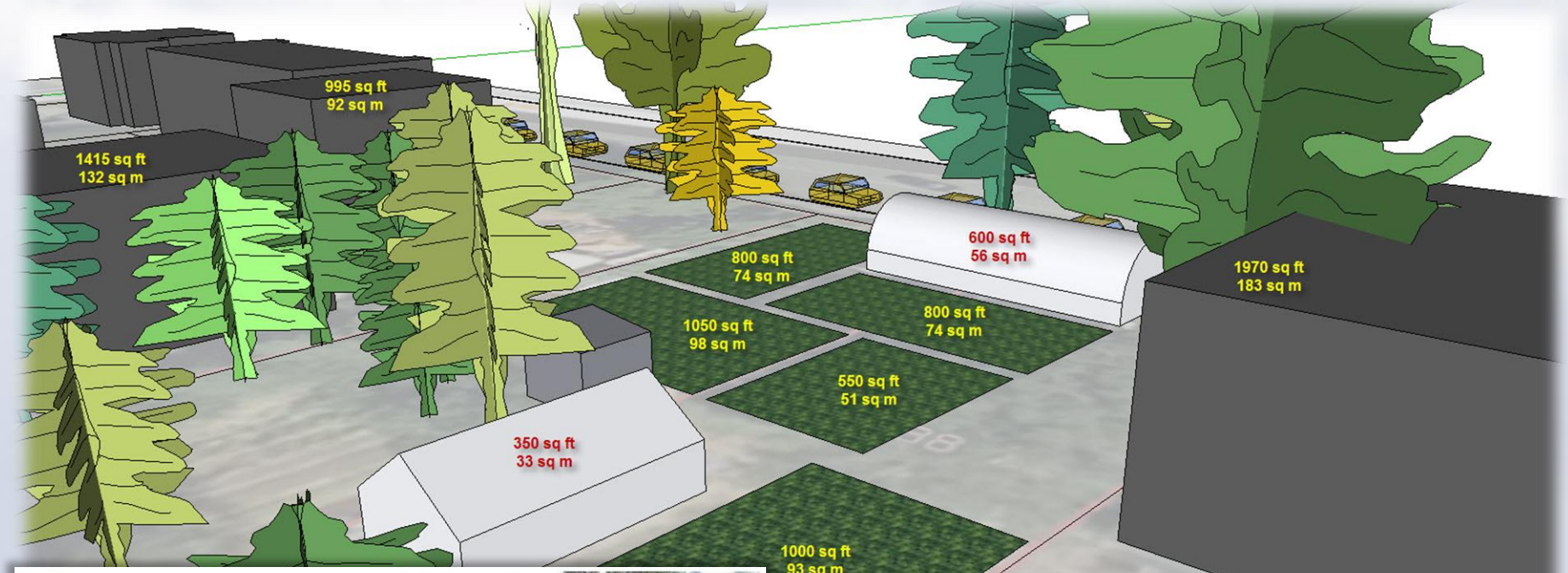
Irrigation, Flushing, Water for Animals

Stormwater Management

Abkhazi Garden, Victoria

‘Raingarden’, with no stormwater connection

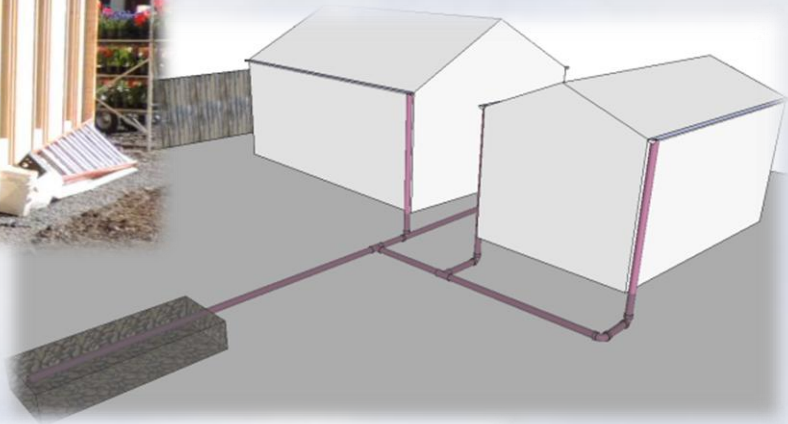
Urban Agriculture

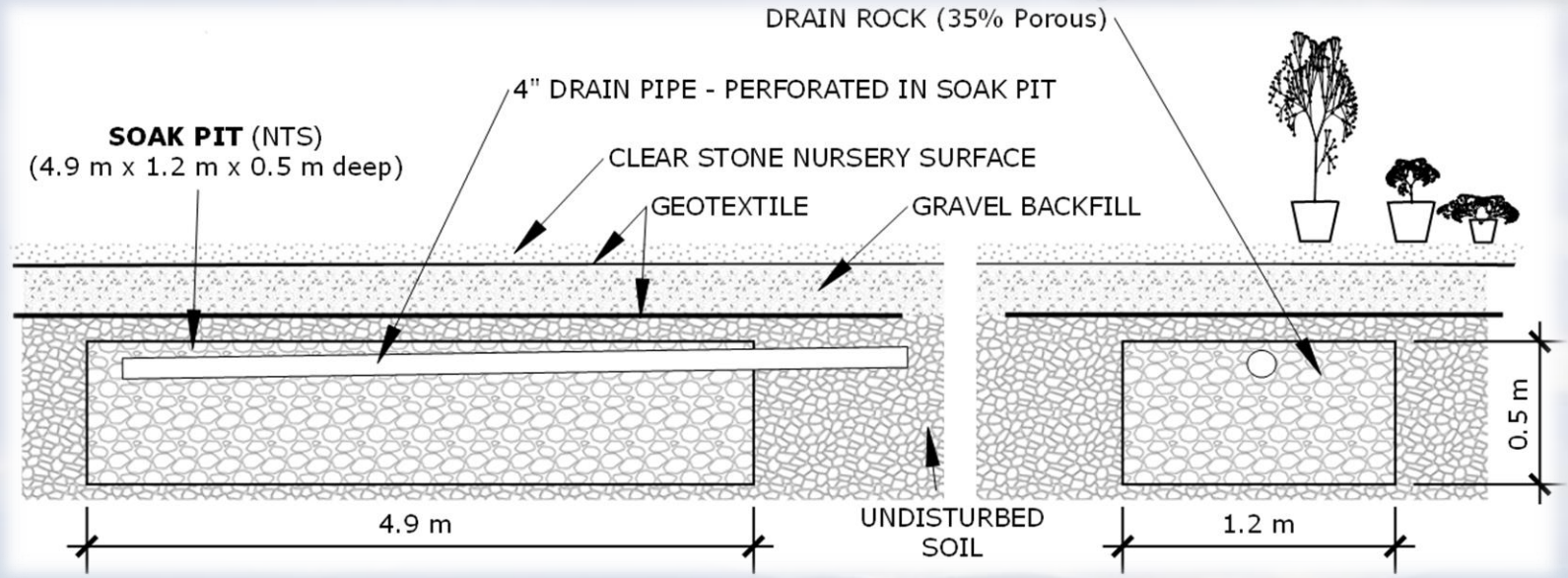


Mason Street City Farm, Victoria

Highly productive, no stormwater runoff

Stormwater Infiltration

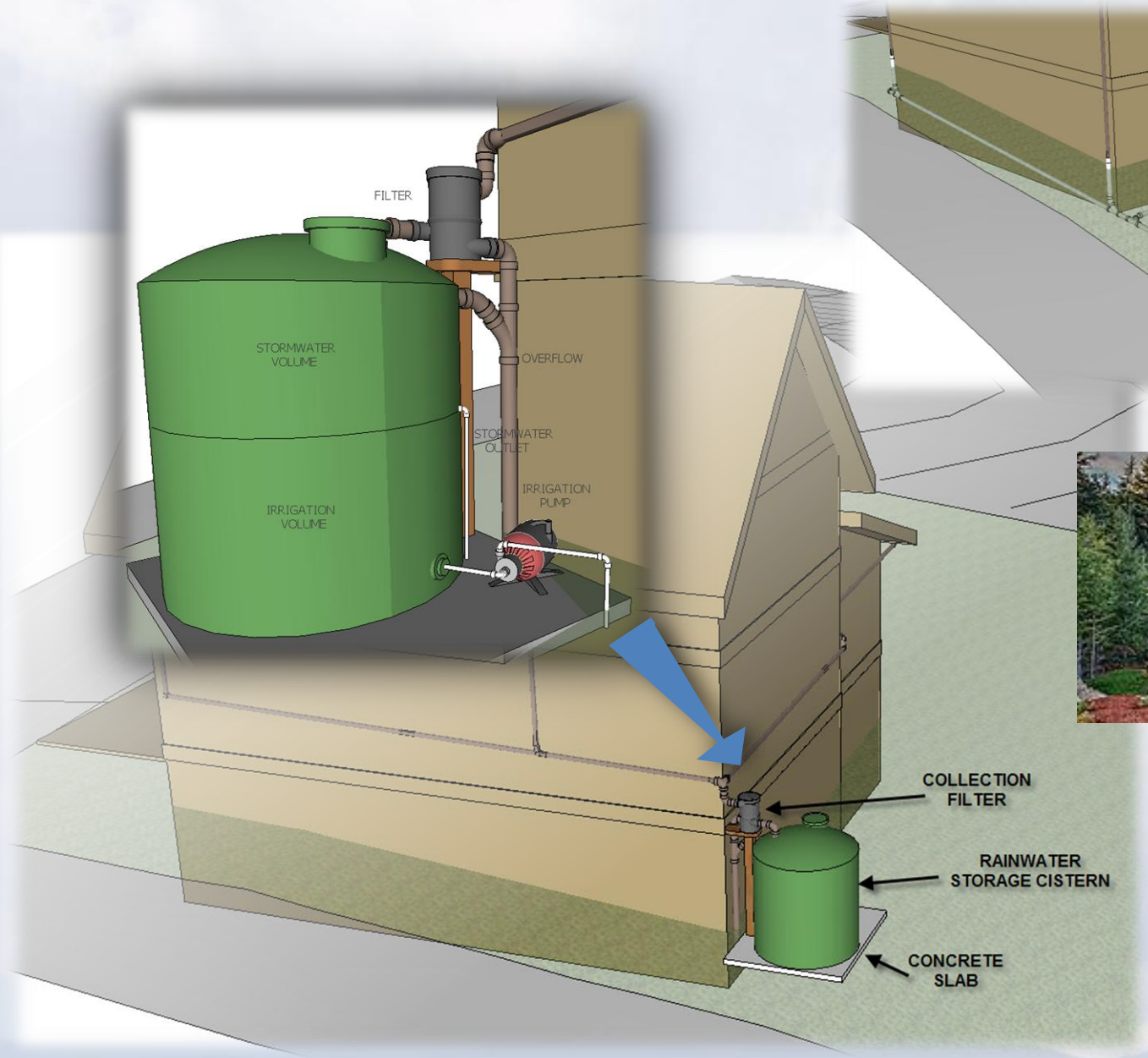


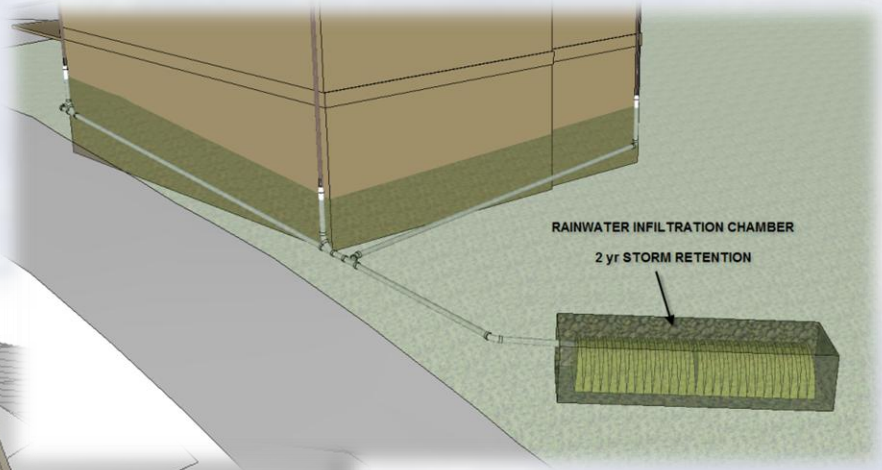


Down To Earth Gardens and Nursery, Victoria

Building permit approval

Stormwater + Irrigation



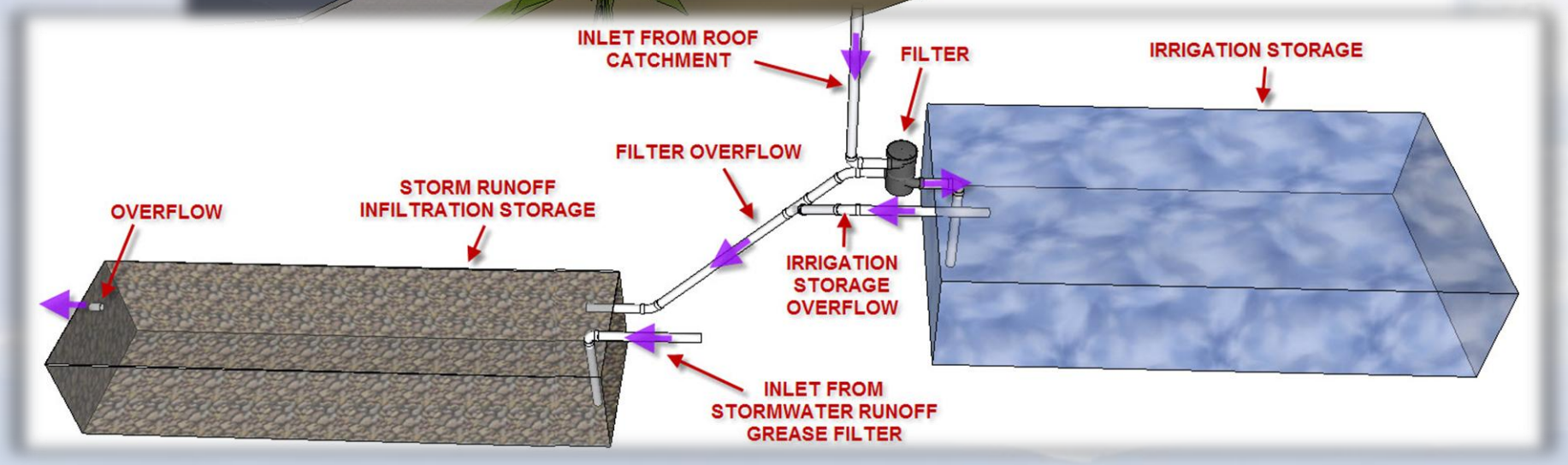


Elkington Forest is a project of Living Forest Communities, in partnership with The Trust for Sustainable Forestry

Elkington Forest, CVRD

Rainwater for gardens, meet zero-runoff criteria

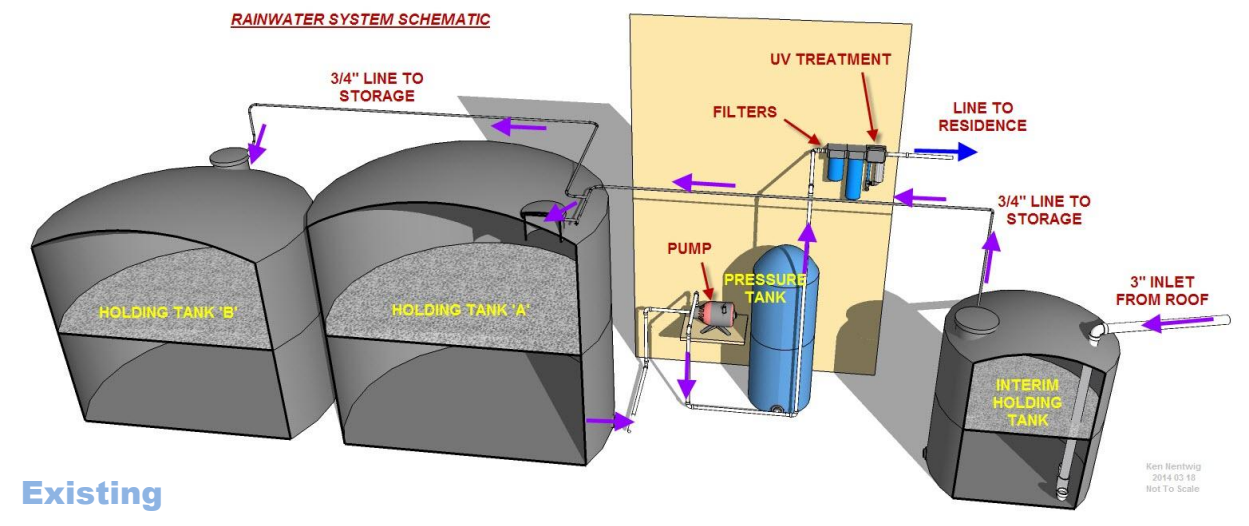
Stormwater + Irrigation

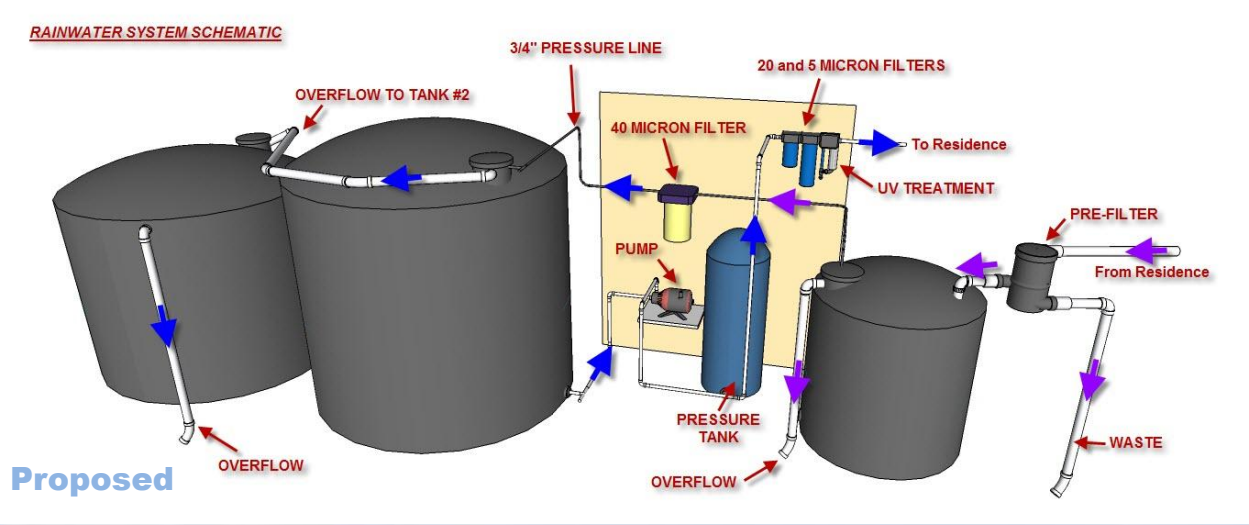


Site Plan Review, Development Agreement, CRD

Pending approvals

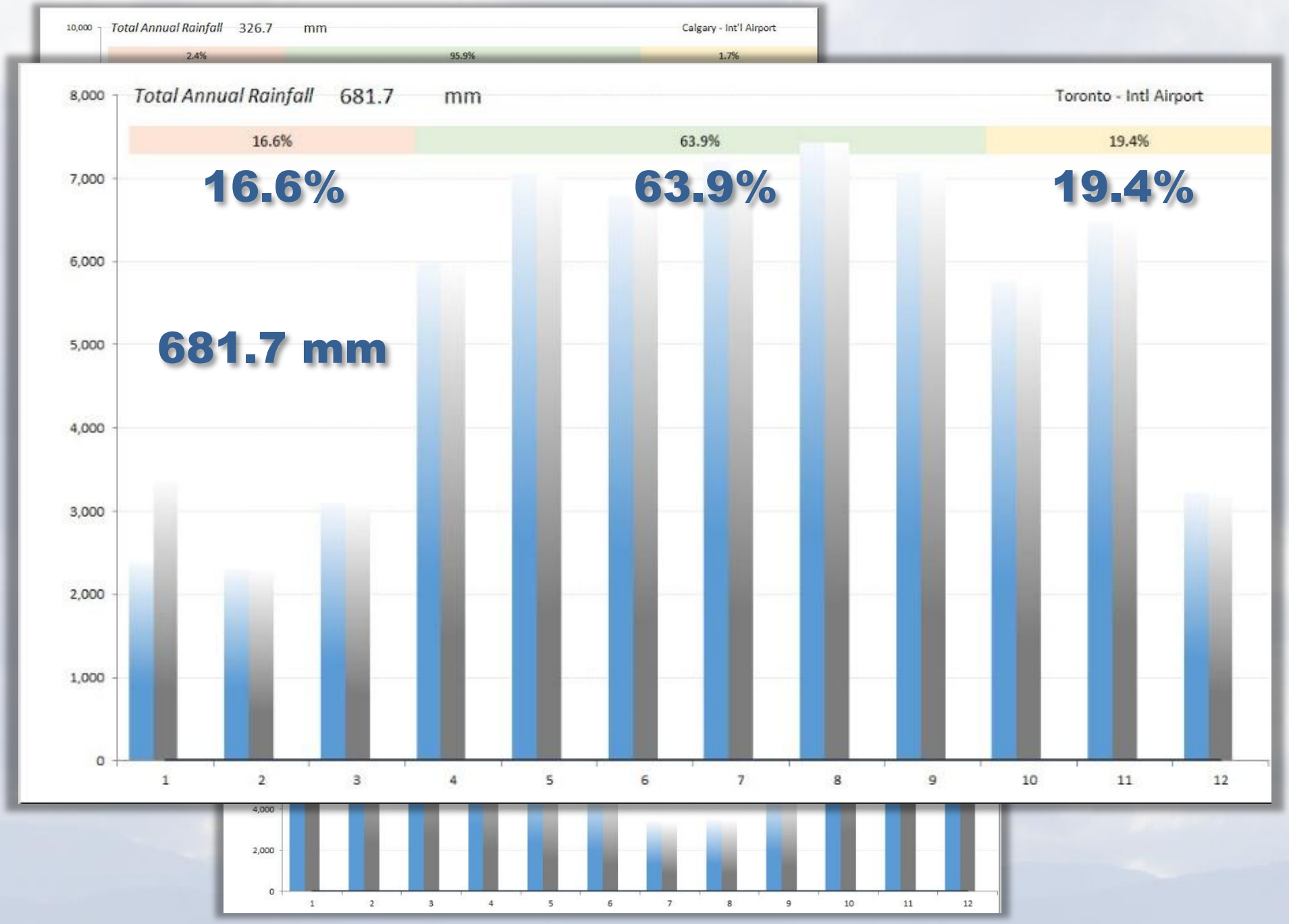
Potable System (existing)





Residential, CRD

Operational, successfully


Total Annual Rainfall 326.7 mm
Calgary - Int'l Airport
2.4%
95.9%
1.7%
Total Annual Rainfall 681.7 mm
Toronto - Intl Airport
16.6%
63.9%
19.4%
16.6%
63.9%
19.4%
681.7 mm
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1
2
3
4
5
6
7
8
9
10
11
12

Case Studies: Client Interview

Home Purchase and Renovation:

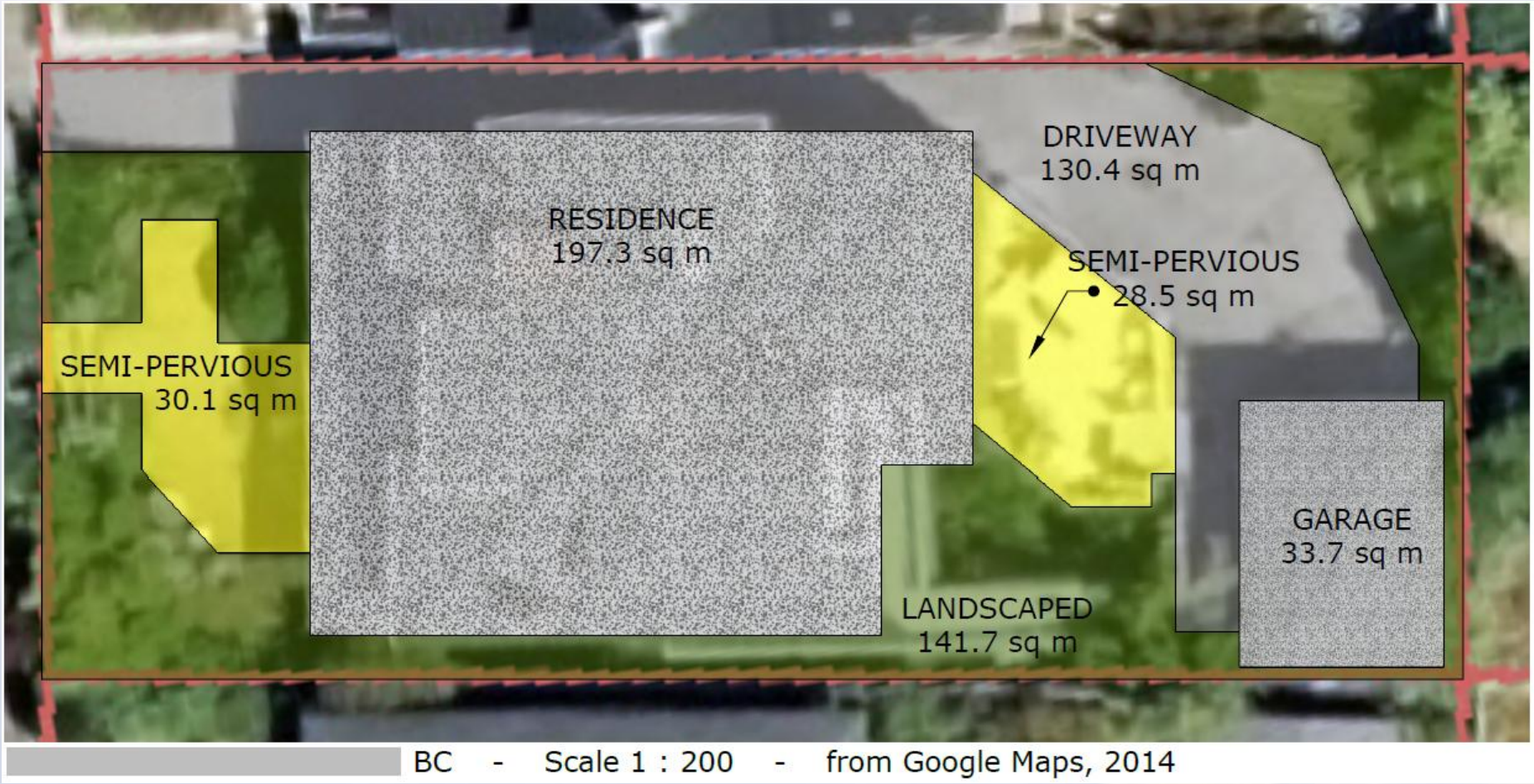
Older home (100 yr) in established urban area; purchasing as income property (3 units); owners want to be 'green', and to incorporate RWH for irrigation of garden areas; municipality has a stormwater utility billing system, rebates for mitigation available

Downspouts are disconnected and drain onto the lawn areas

Offer to Purchase includes building inspection and report; there are no leaks, but the perimeter drain needs attention

Inspection of perimeter drains (by a qualified firm, owner is also a CANARM graduate!) reveals that some work needs to be completed, but also that there is no connection to the municipal stormwater drain (storm sewer)

Case Studies: Site Analysis



- **Google Map screen capture**
- **Scaled, shaded and annotated in SketchUp Pro**

Case Studies: Concept Development

The Rational Equation Formula (LMNO): Q = CiA

Where Q = peak discharge (cu m / sec)
C = runoff co-efficient (0.35 or 35%, and 1.0 or 100%)
i = storm intensity* (mm / hr *or portion*)
A = area of pervious, semi-pervious or impervious surface(s)

The Simple Volume Formula (CMHC): V = CiAT

Where V = volume of catchment (cu m / hr)
C = runoff co-efficient (0.35 or 35%, and 1.0 or 100%)
i = storm intensity* (mm / hr *or portion*)
A = area of pervious, semi-pervious or impervious surface(s)
T = storm duration (1 hr)

a.k.a. 'RESEARCH'

- **Stormwater Management design criteria for City of Victoria**
- **Calculations of pre- and post-development scenarios**
- **Determination of (probable) SWM detention requirements**
  - **using Rational Equation Formula (Engineering)**
  - **using Simple Volume Formula (CANARM)**
- **Comparison of results and documentation**

Case Studies: Concept Development

	Source A	Source B
Pre-Development Scenario: *537 sq m; **8 mm/15 min**; runoff co-efficient 0.35*		
PEAK DISCHARGE	0.0017 cu m / sec	
VOLUME		6.01 cu m / hr
**BC Building Code (CODE)*		
Post-Development Scenario: *361.4 sq m impervious; **8 mm/15 min**; runoff co-efficient 1.0*		
PEAK DISCHARGE	0.0032 cu m / sec	
VOLUME		11.58 cu m / hr
*175.6 sq m semi-pervious; **8 mm/15 min**; runoff co-efficient 0.35*		
PEAK DISCHARGE	0.0006 cu m / sec	
VOLUME		1.96 cu m / hr
Sum of Post-Development:		
PEAK DISCHARGE	0.0038 cu m / sec	
VOLUME		13.54 cu m / hr
Difference from Pre-Development:		
PEAK DISCHARGE	0.0021 cu m / sec	
VOLUME		7.53 cu m / hr
STORM VOLUME in 15 MINUTES:		
	1.88 cu m	**1.88 cu m**

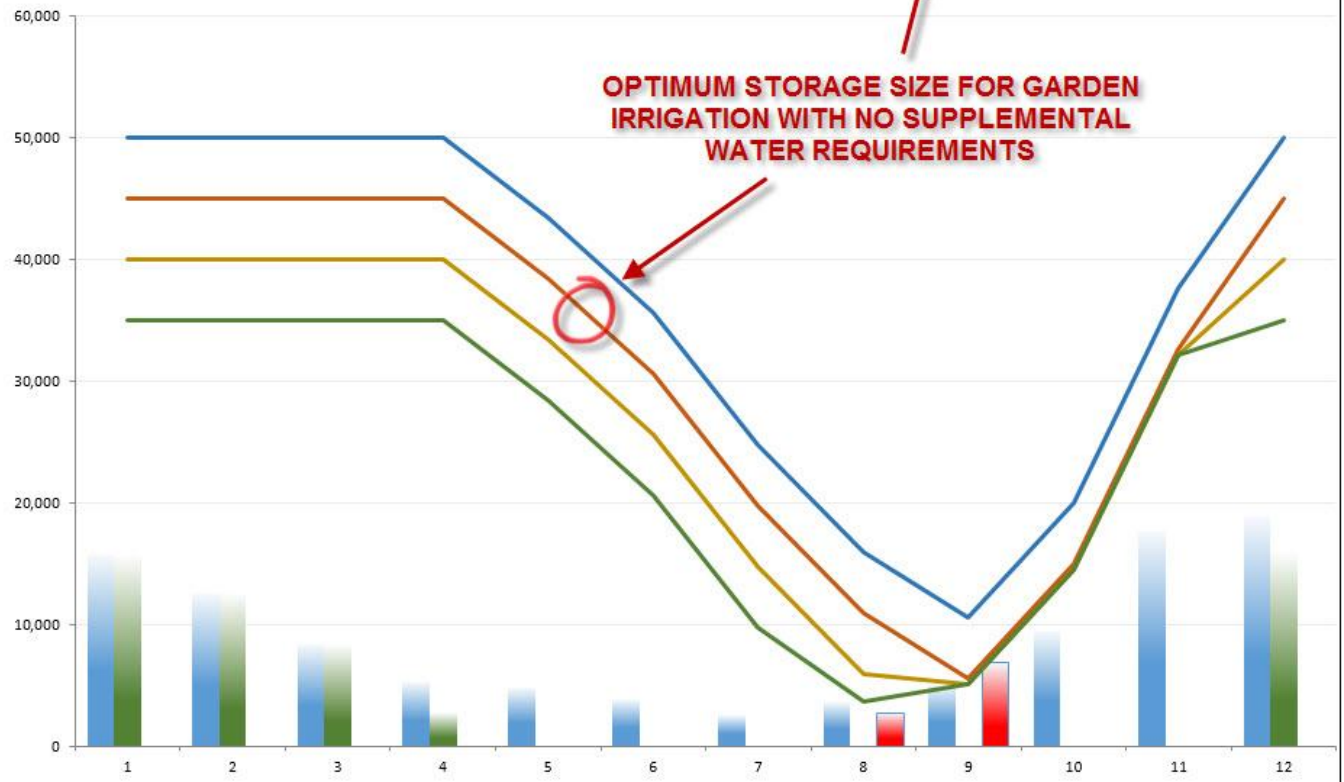
KDA: Kenwood Design Associates
Ken Nentwig BLA MLA CLP CLD 250 999 2472 ken.nentwig@gmail.com

SWM Detention Results

Case Studies: Concept Development

Victoria, BC	
Inches of Total Required Precipitation per week	1
Catchment Efficiency (%)	80%
Catchment Area (sq m)	231
Garden Area (sq m)	145
Number of Users (Flushing, Non-Potable only)	0
Initial Cistern Size (litres)	35,000
Cistern Size Increments (litres)	5,000
Jan. Start Residual (litres) (Less than or Equal to Dec Residual)	35,000
CISTERN BEING GRAPHED	1

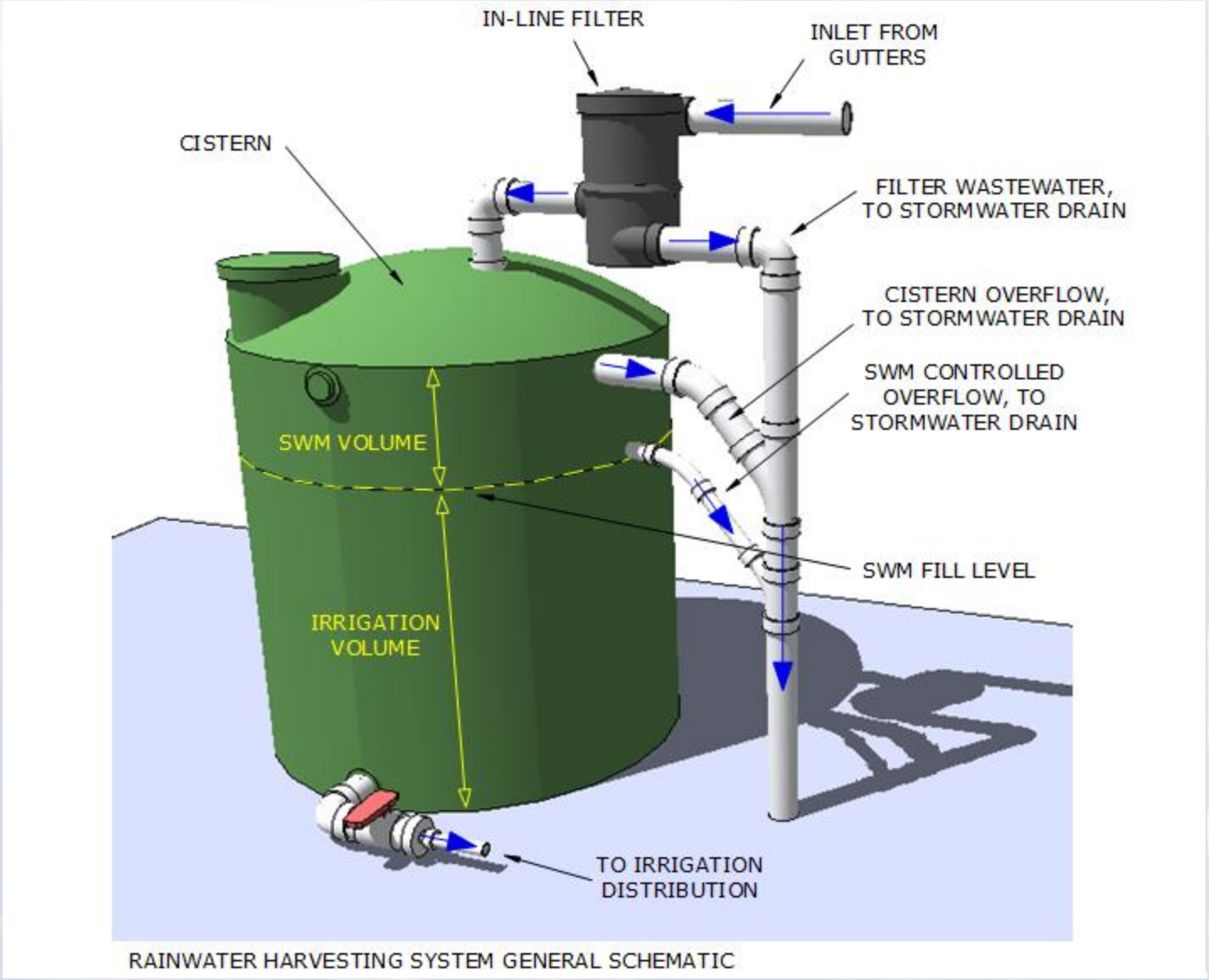
Cistern #1		Cistern #2		Cistern #3		Cistern #4	
Size (litres)	35,000	Size (litres)	40,000	Size (litres)	45,000	Size (litres)	50,000
Residual, Dec 31 (litres)	35,000	Residual, Dec 31 (litres)	40,000	Residual, Dec 31 (litres)	45,000	Residual, Dec 31 (litres)	50,000
Supplement (litres)	9,527	Supplement (litres)	4,527	Supplement (litres)	0	Supplement (litres)	0
Overflow (litres)	55,453	Overflow (litres)	50,453	Overflow (litres)	45,927	Overflow (litres)	45,927



More Research: RWH for Irrigation

- **Demand based on area and intensity, in addition to natural rainfall**
- **Analysis of supply based on catchment (roof) area and climate data**
- **Optimum sizing of cistern/storage: *no supplemental water required***

Case Studies: Conceptual Design



Awaiting presentation to municipal authorities

Case Studies: Client Interview

Subdivision Agreement and Lot 'D' Site Plan:

New subdivision, infill site in semi-rural location; full municipal services available

Owners want to incorporate RWH for the landscaping, design work to be coordinated with engineering, survey, builder, and city approvals due to road extension, terrain, and surface runoff from neighbor property to the East

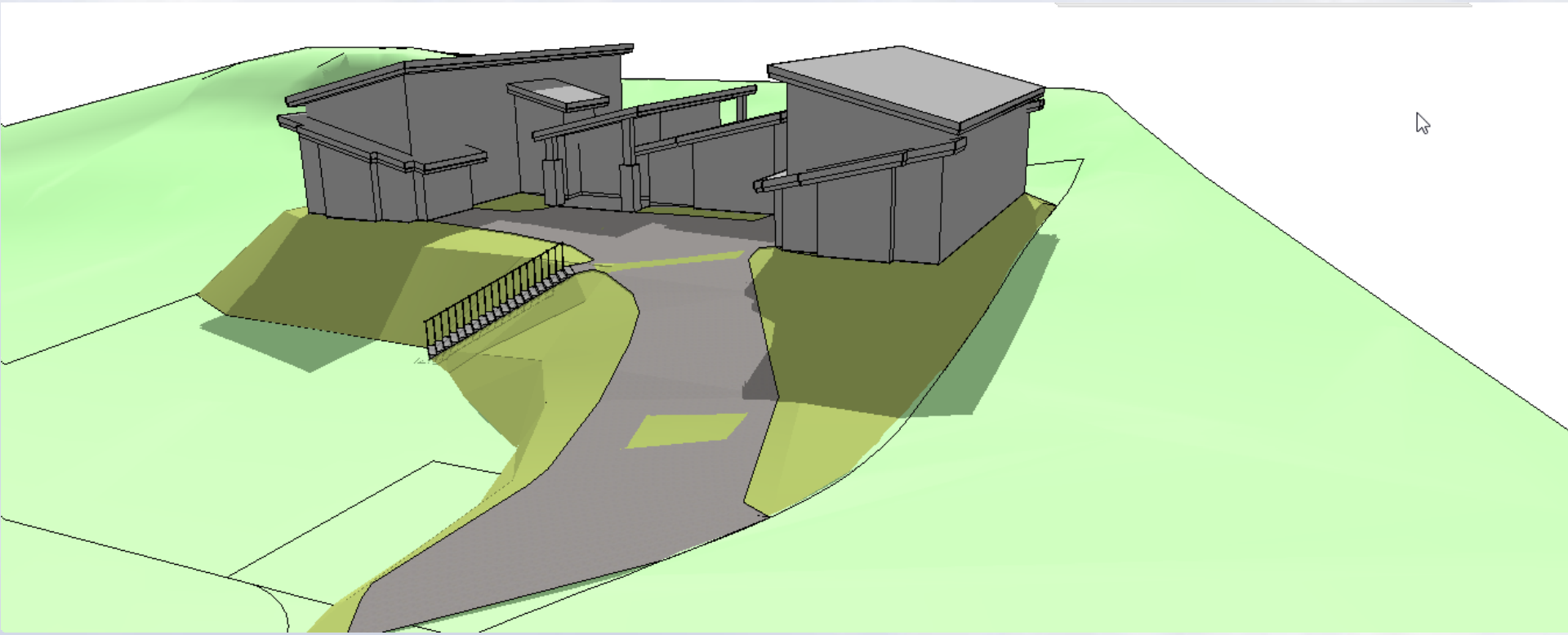
Requires a site plan and coordinated design of sanitary and storm sewer connections from the building to the street; engineers are required for the municipally-approved portions; RWH system design with SWM incorporated

Case Studies: Site Analysis

a.k.a. 'RESEARCH'

- **Base plan and building layout**
- **Property layout and terrain/grading**
- **Services connections**

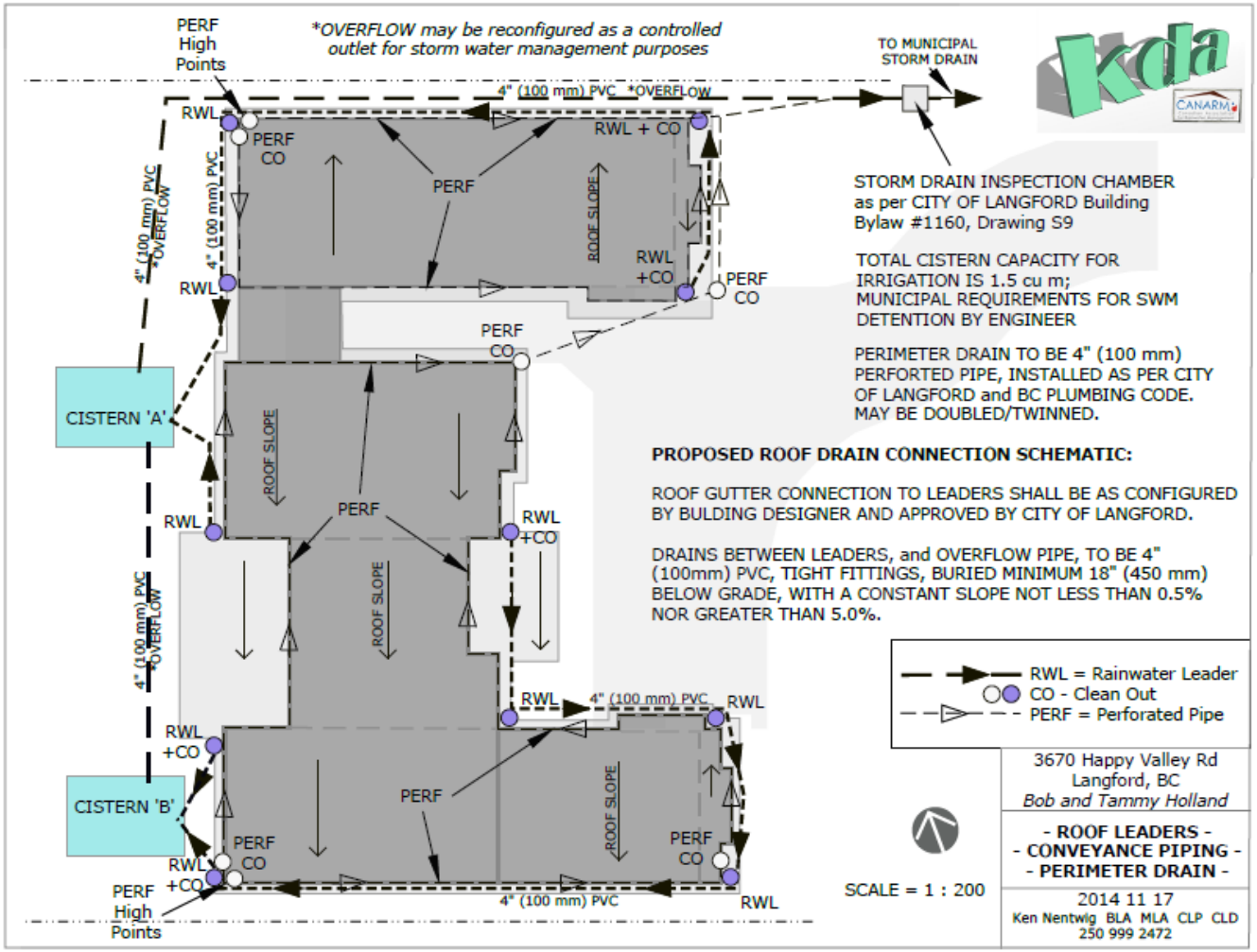
Case Studies: Concept Development



3D Terrain and Building Model

- **Roof configurations; slopes and new terrain**
- **Landscaped and paved areas**
- **Location and orientation of the building**
- **Visualization for the client of site constraints and possibilities**

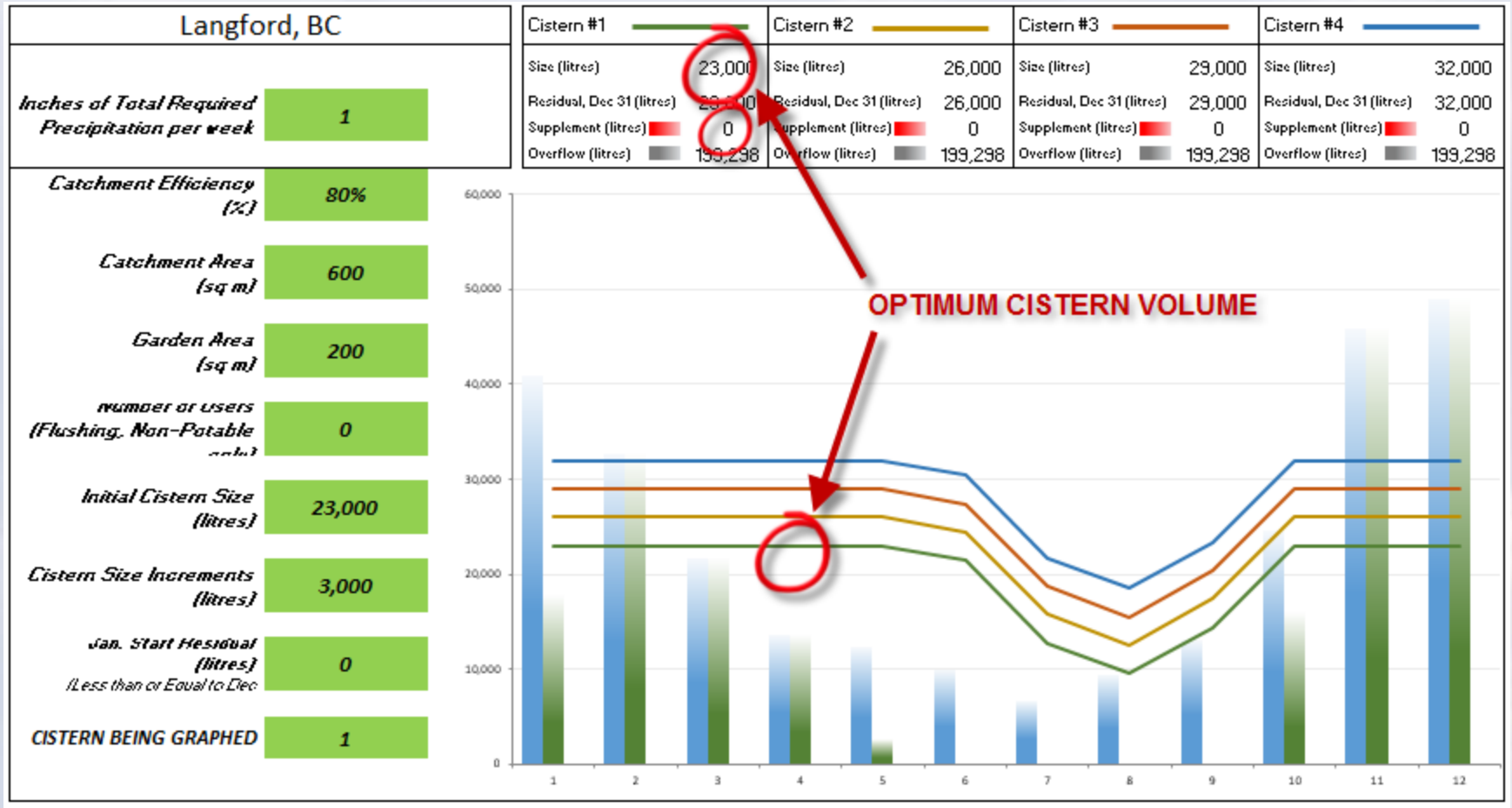
Case Studies: Concept Development



a.k.a. 'RESEARCH'

- **Stormwater Management design criteria for City of Langford**
- **Calculations of pre- and post-development scenarios**
- **Determination of (probable) SWM detention requirements**
- **Compilation of results and documentation**

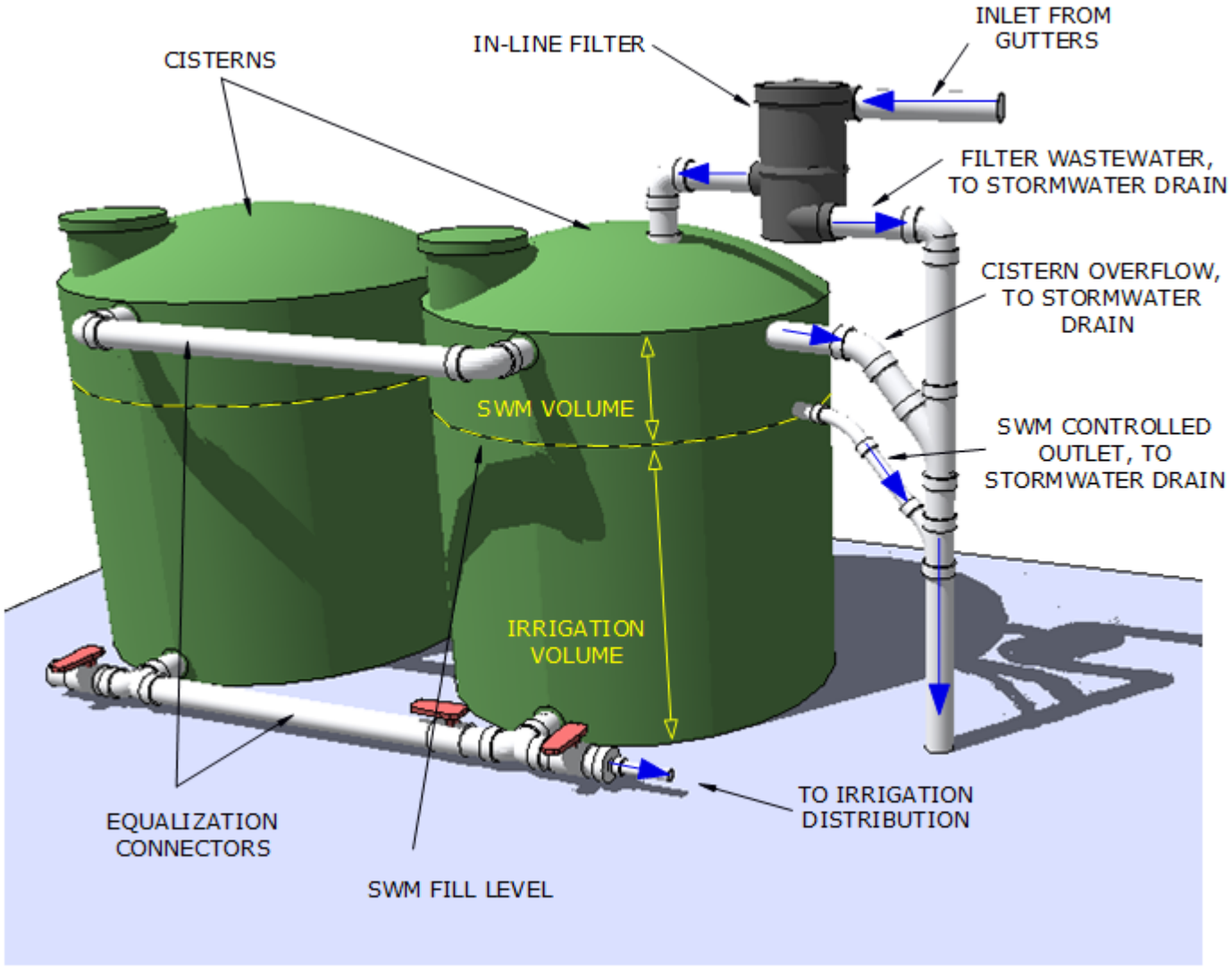
Case Studies: Concept Development



a.k.a. 'RESEARCH'

- **Determination of RWH demand and supply**
- **Compilation of results and documentation**

Case Studies: Conceptual Design



RAINWATER HARVESTING SYSTEM GENERAL SCHEMATIC: MULTIPLE CISTERN UNITS

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Thanks....

Questions?