1ST REPORT OF THE

ENVIRONMENTAL AND ECOLOGICAL PLANNING ADVISORY COMMITTEE

Meeting held on December 16, 2015, commencing at 5:07 PM, in Committee Room #3, Second Floor, London City Hall.

PRESENT: S. Levin (Chair), L. Des Marteaux, P. Ferguson, S. Hall, D. Hiscott, C. Kushnir, K. Moser, M. Murphy, S. Peirce, N. St. Amour, M. Thorne and R. Trudeau and H. Lysynski (Secretary).

ABSENT: E. Anello, C. Dyck, B. Gibson and J. Stinziano.

ALSO PRESENT: C. Creighton and J. MacKay.

I. CALL TO ORDER

1. Disclosures of Pecuniary Interest

That it **BE NOTED** that no pecuniary interests were disclosed.

II. ORGANIZATIONAL MATTERS

2. Election of Chair and Vice-Chair for term ending November 30, 2016

That S. Levin and R. Trudeau **BE APPOINTED** as Chair and Vice Chair, respectively, for the term ending November 30, 2016.

III. SCHEDULED ITEMS

3. Hydrology Presentation

That it **BE NOTED** that the attached presentation from S. Peirce, relating to hydrology, was received.

IV. CONSENT ITEMS

4. 9th Report of the Environmental and Ecological Planning Advisory Committee

That it **BE NOTED** that the 9th Report of the Environmental and Ecological Planning Advisory Committee, from its meeting held on November 19, 2015, was received.

5. 8th Report of the Trees and Forests Advisory Committee

That it **BE NOTED** that the 8th Report of the Trees and Forests Advisory Committee, from its meeting held on November 25, 2015, was received.

6. 1st Report of the Advisory Committee on the Environment

That a Working Group **BE ESTABLISHED** consisting of L. Des Marteaux, P. Ferguson, S. Hall, C. Kushnir (lead), M. Murphy and M. Watson, to review the dark sky initiative; it being noted that the 1st Report of the Advisory Committee on the Environment, from its meeting held on December 2, 2015, was received.

7. ESA Management Committee Meeting Minutes

That the following actions be taken with respect to the ESA Management Committee meeting minutes:

a) the proposed City of London multi-year Capital and Operating Budgets, as they relate to ESA management, **BE REVIEWED** at the January, 2016 Environmental and Ecological Planning Advisory Committee meeting; and,

b) the ESA Management Committee meeting minutes from its meeting held on September 10, 2015, were received.

V. SUB-COMMITTEES & WORKING GROUPS

None.

VI. ITEMS FOR DISCUSSION

8. 2016 Work Plan

That, the following actions be taken with respect to amendments to the Terms of Reference for the City of London Advisory Committees:

a) the attached 2016 Work Plan for the Environmental and Ecological Planning Advisory Committee (EEPAC) **BE FORWARDED** to the Municipal Council for consideration; and,

b) further to the Environmental Management Guidelines on the 2016 Work Plan, the Civic Administration **BE REQUESTED** to ensure that sufficient funds are included in the Multi-Year Budget to allocate appropriate resources to ensure that items in Subdivision Agreements and the supporting detailed designs are being implemented as approved, including a review of people putting gates in fences after the subdivision adjacent to an Environmentally Significant Area has been assumed; it being noted that the above-noted recommendation is included in the Beacon Environmental EIS Performance Evaluation done for the City of London, June, 2014 and reviewed by the EEPAC in June, 2014; it being further noted that an update on the implementation was presented to the Planning and Environment Committee on December 14, 2015.

9. EEPAC Representative to the Trees and Forests Advisory Committee

That C. Dyck **BE APPOINTED** as the Environmental and Ecological Planning Advisory Committee representative to the Trees and Forests Advisory Committee.

10. 2016 Planning and Design Standards for Trails in ESA's Review and Update Process - Invitation to Participate in Trails Focus Group

That L. Des Marteaux and J. Stinziano **BE APPOINTED** as the Environmental and Ecological Planning Advisory Committee representative and alternate, respectively, for the Trails Focus Group for the 2016 Planning and Design Standards for Trails in ESA's Review.

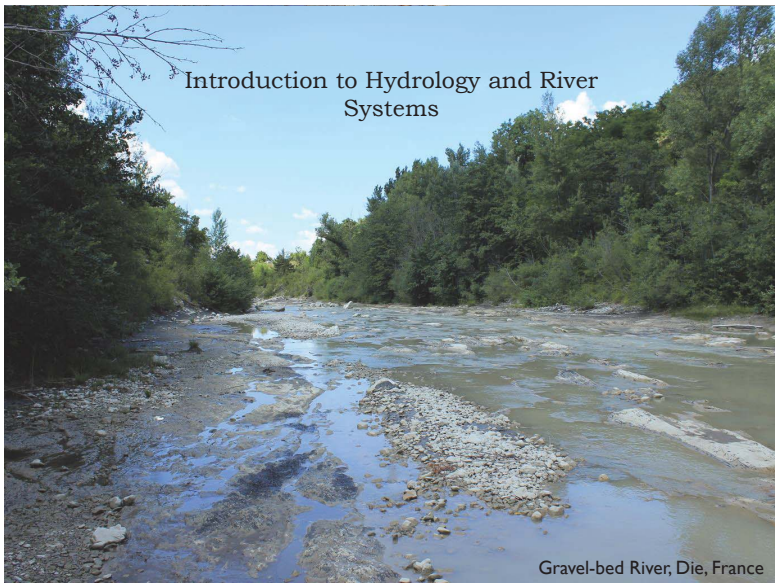
VII. DEFERRED MATTERS/ADDITIONAL BUSINESS

None.

VIII. ADJOURNMENT

The meeting adjourned at 7:37 PM.

NEXT MEETING DATE: January 21, 2016

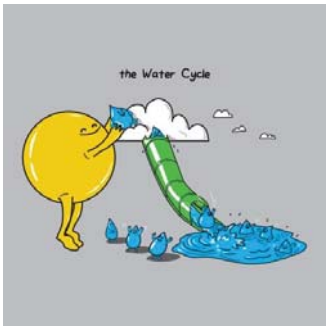


Outline

- Hydrologic cycle
- Water at the surface
- Water in streams
  - Drainage basin
  - Streams
  - Hydrographs
  - Channel morphology
- Sediment
  - Types
  - Load
- Floods and floodplains
- Human Impacts
- Measurement techniques

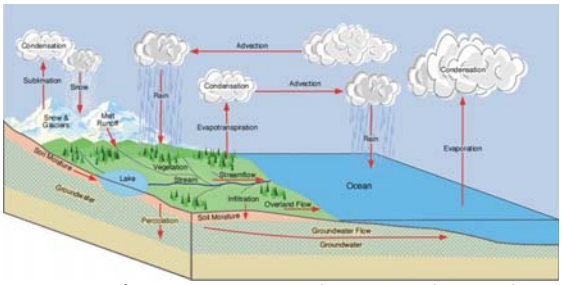
Hydrology

- Hydrologic cycle – the continuous movement of water between the atmosphere, land, plants, and water bodies.
- Hydrology - the science of water and its global circulation, distribution, and properties both at and below the Earth's surface.



www.theawkwardyeti.com

The Hydrologic Cycle



- Largest movement of water is evaporation and precipitation between the atmosphere and oceans.
- Evapotranspiration – combined processes of evaporation and transpiration (water released from plant pores) from land surface.
- Excess water that is not evaporated/transpired is concentrated in streams or infiltrated into the soil.

http://www.usask.ca/hydrology/CHOverview.php

Water at the Surface

- Interception – precipitation that doesn't make the surface because it is stopped by vegetation.

- Infiltration – flow of water into the Earth's surface via pore spaces and openings in the soil.
- Runoff (overland flow) – Water flows over the surface when precipitation exceeds infiltration rate, or the surface is impermeable.

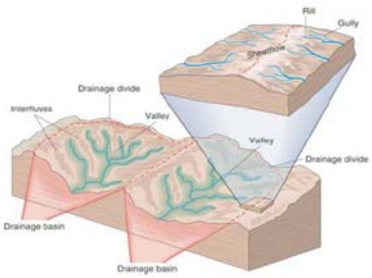
De Blij et al., 2009

Water in Streams

- Fluvial - refers to the processes and landforms related to river systems.
- Stream – any body of flowing water with measureable velocity in a channel.

De Blij et al., 2009

The Drainage Basin

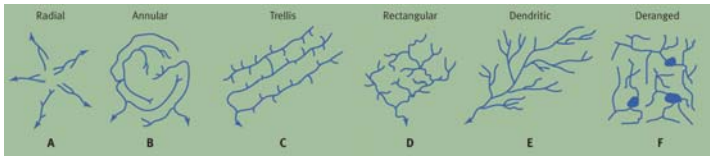


- A drainage basin (a.k.a. watershed or catchment) is the area drained by a river or lake.
- A drainage divide is the topographic boundary of a drainage basin that separates the drainage of one basin from another.
- A stream network is all of the streams from the headwaters to the main (trunk) river within a drainage basin.

http://www.geography.hunter.cuny.edu/

Drainage Basin Hydrology

- Drainage density - the total length of stream channels per unit areas of a drainage basin (km/km^2).
- Pattern provides insight into geology and topography.



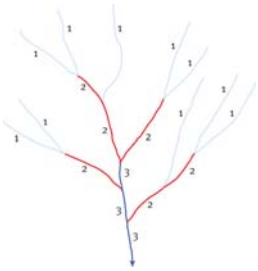
De Blij et al., 2009

Canadian Context

De Blij et al., 2009

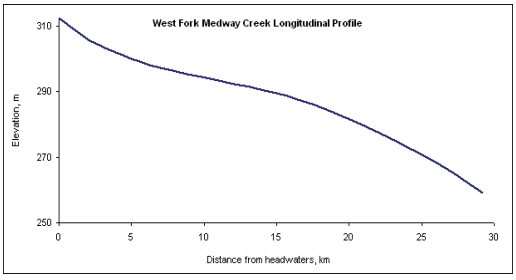
Stream Order

- Streams within the network are assigned a rank according to size (or position within the network).
  - Smallest streams = first-order
  - When 2 first-order streams join = second-order



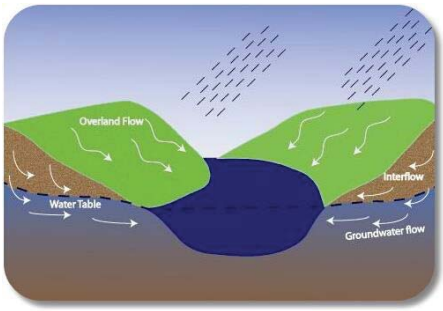
The Longitudinal Profile

- The stream profile can be straight, concave, convex or a combination due to knickpoints (abrupt changes in gradient).

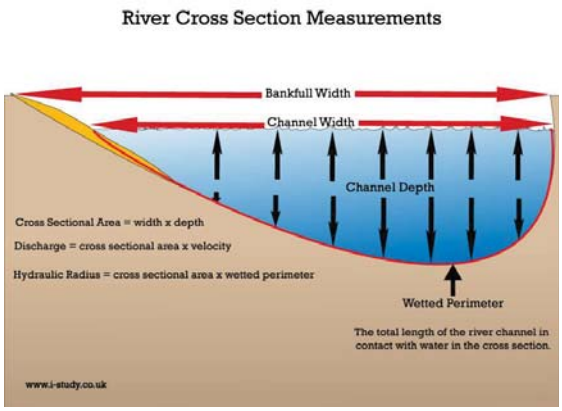


Stream Channels

- Water moves to streams because of gravity and gradient in three ways: overland flow (runoff or sheetflow), throughflow (interflow) and baseflow (groundwater flow).



https://www.dwa.gov.za/groundwater/groundwater_dictionary/index.html?introduction_interflow.htm



http://www.geo41.com/stream-management-strategies/

Fluvial Processes

- Streamflow is the gravitational movement of water in channels.
  - It is measured by discharge, which is the volume of flow per unit time (units are usually m^3/s).
- Discharge (Q) is a function of the channel shape and flow:
  - $Q = wdv$
  - Where w = channel width, d = channel depth and v = velocity (distance/time) for a given cross-section.
- Moving from the headwaters to the outlet, discharge usually increases.

Hydrographs

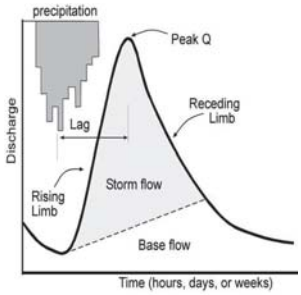
- Hydrograph – Graphical representation of how discharge changes over time in a particular channel.
  - Discharge responds to the spatial and temporal variability in input (precipitation) and the structure of the watershed and river network.
- Quickflow (storm flow) – the rapid increase in discharge due to a precipitation event.
- Baseflow – the continuity of flow, even during dry periods, largely as a result of slower groundwater inputs.

Quickflow vs Baseflow

Etobicoke Creek

N. Bergman

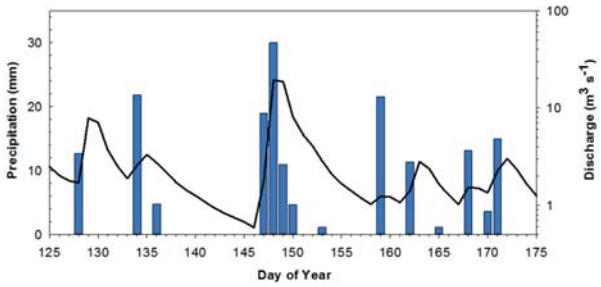
Hydrographs



- Rising Limb – represents increase in discharge due to inputs from the surface and storage.
- Receding (falling) Limb – represents the withdrawal of water from the catchment.
- Lag time – the period of time between the peak rainfall and the peak discharge.
- Why is there a lag time?

http://www.geogonline.org.uk/storm_hydrograph.htm

Medway Creek Example



Channel Types

- Bedrock channels – water flows over the local bedrock. Bedrock channels are fixed in position for long periods of time.
- Alluvial channels – water flows through unconsolidated sediment particles that can be eroded, transported, and deposited by the flow.
  - Sediment transport in alluvial rivers is a function of flow turbulence, sediment size, sediment shape, and sediment structures.
  - Alluvial channels can further be classified as sand-bed (< 2mm) or gravel-bed (> 2mm) based on their dominant grain size.

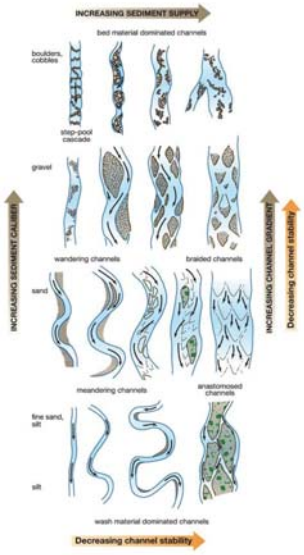
Channel Pattern

- Channel pattern – plan-view form of a river reach
  - Originally straight, meandering and braiding although terms like anabranching, anastomosed, and wandering are also used.

Meandering Braiding Anastomosing

What kind of channel is this?

Chris Hadfield, 2013



- Factors influencing channel pattern:
  - Slope
  - Discharge
  - Sediment supply
  - Sediment size

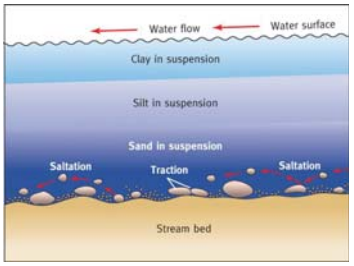
Sediment

Diameter (mm)	Diameter (phi)	Wentworth Size Class	
4096	-12		Boulder
256	-8	Gravel	Cobble
64	-6		Pebble
4	-2		Granule
2	-1		Very Coarse Sand
1	0		Coarse Sand
0.5	1	Sand	Medium Sand
0.25	2		Fine Sand
0.125	3		Very Fine Sand
0.0625	4		Coarse Silt
0.0313	5		Medium Silt
0.0156	6	Silt	Fine Silt
0.0078	7		Very Fine Silt
0.0039	8		Clay
0.00006	14	Mud	

http://www.geog.ucl.ac.uk/

Sediment Load

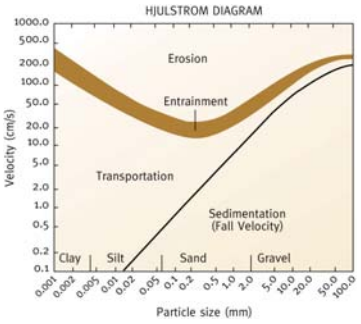
- Sediment load – mass of sediment transported over a given time.
  - Wash load – fines not sourced from the bed or banks of a channel.
  - Bed-material load – material found in the bed and banks subject to erosion, transport, and deposition.
    - Suspended load
      - Small grains held in suspension by flow turbulence.
    - Bed load
      - Larger grains that are transported close to the bed via rolling, sliding(traction), and saltating.



De Blij et al., 2009

Factors in Stream Erosion

- Stream capacity – maximum sediment load a stream can carry at a given discharge.
- Stream competency – maximum size of sediment a stream can carry, which is a factor of velocity.
- Factors influencing sediment transport:
  - Turbulence
  - Grain size
  - Grain shape
  - Bed arrangement

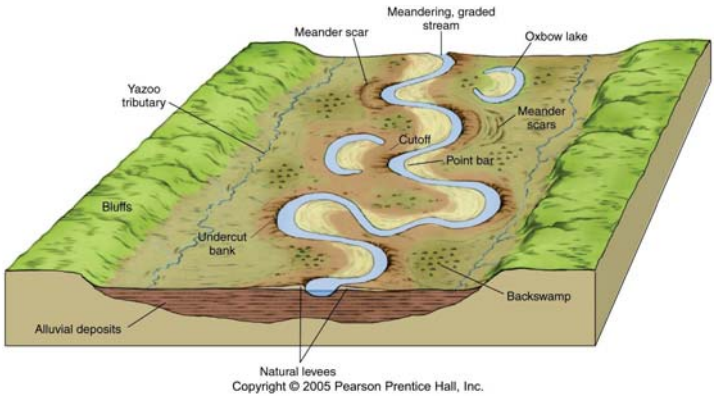


De Blij et al., 2009

Floods

- Flood – stream discharge overflows the channel banks onto the floodplain.
- Overbank floods occur ~1.5-2 years
- ~98-99% of streamflows are within channel
  - Still have erosional power, especially when vegetation is spatially or temporally limited
- Return period: amount of time, on *average*, between events of a similar magnitude.
  - Inverse of probability
    - E.g. The 100 year flood has a occurrence probability of 1/100 or 1% ***in any given year***, while a 10 year flood has an occurrence probability of 1/10 or 10% in any given year.

Floodplain Analysis



Human Impacts

- Most rivers in the world have been subjected to some form of human intervention, for example:
  - Channelization
  - Damming
  - Water extraction
  - Gravel extraction
  - Land-use change
  - Climate change
  - Etc.

Los Angeles River

"To tame flooding in the 1930s, the Army Corps of Engineers encased three-quarters of the river in a concrete ditch."

http://news.nationalgeographic.com/news/2014/07/140719-los-angeles-river-restoration-kayaking-greenway/

Yangtze River, China

Construction on the Three Gorges Dam began in 1994 and ended in 2006. The dam resulted in the displacement of over a million people, the inundation of ~ 15 000km^2 of land, (including ecologically sensitive areas) and has changed local precipitation patterns as far as 160 km away.

1987 2006 www.nasa.gov

Highland Creek, Toronto

This area was previously occupied by the creek. To prevent further erosion into the banks, they moved the river and vegetated the area.

SP, 2012

Debris flow prevention – Takayama, Japan

SP, 2015

Fluvial Processes and Measurement Techniques

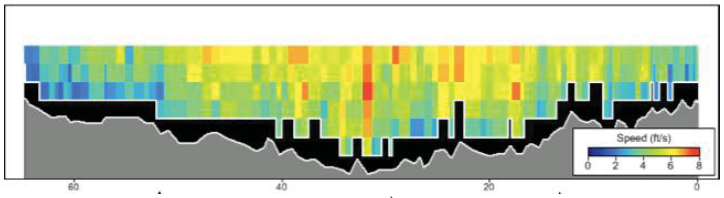
- Flow in rivers
- Channel geometry
- Morphology and topography
- Bed material
- Sediment transport

Measuring Velocity

- Velocity - rate at which the position of a given body changes with time (LT^{-1}).
  - Change in velocity = acceleration or deceleration
- Turbulence in flows is generated from fluids coming in contact with solid boundaries or other fluid parcels with different properties (i.e. velocity, density, temperature or pressure).
  - Turbulence at channel boundaries causes flow to slow down.

Flow in Channels

- Cross-sectional velocity
  - Cross-sectional profile shows how velocity changes from bank to bank
- Vertical velocity
  - Vertical profiles show how velocity changes with depth



Distance (ft)

http://www.eg.bucknell.edu/sri/research/fluvial_processes.php

Measuring Velocity

- Floats
- Current meter
- Acoustic Doppler velocimeter (ADV) + Acoustic Doppler current profilers

http://www.hydrobios.de/en/products/flow-and-current-meters/rod-held-current-meter-rhcm/
://www.nortek-as.com/en/products/velocimeters/vector

Measuring Discharge

- Discharge – measurement of streamflow, or volume per unit time (L^3T^{-1}).

- Methods
  - $Q = UA$, where U is velocity
  - Volumetric method
  - Rating curves
  - Weirs

Channel Geometry

- Based on the simple continuity equation, $Q = wdv$, changes in discharge must be accommodated by changes in width, depth, and velocity:

$$W = aQ^b$$
$$d = cQ^f$$
$$v = kQ^m$$
$$ack = 1$$
$$b + f + m = 1$$

- Typical at-a-station values: b= 0.26, f = 0.40, m = 0.34
  - Ex. 10% increase in Q would be expected to cause a 2.6% increase in width, 4% increase in depth and a 3.4% increase in velocity.

Bed-material

- Bed-material – alluvial sediment on the bed and in the banks of rivers.

- Surface Sampling
  - Pebble counts
  - Grid sampling
  - Areal sampling

- Volumetric Sampling
  - Bulk sieving

SP and PA, 2014

Measuring Suspended Load

- Suspended Load – sediment travelling within the flow, supported by fluid turbulence.

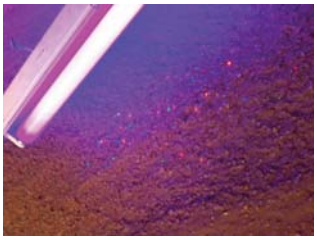
- Methods
  - Collect water-sediment mixture
    - Point samplers
    - Depth-integrating samplers
    - Isokinetic samplers

http://www.hoskin.ca/catalog/index.php?main_page=index&cPath=1_626_627

Measuring Bedload

- Bedload - sediment that moves by rolling, sliding or saltating.

- Methods:
  - Portable samplers
  - Traps
  - Bedload formulas
  - Morphological method



http://www.rickly.com/ss/images/HELLEY.JPG

Sunwapta River, Alberta, Canada

Advisory Committee Work Plan – 2016

December 2015

Activity	Background	Responsibility	Timeline	Strategic Plan Alignment
Environmental Management Guidelines	• Literature review of research on buffers and buffer effectiveness • Review of data collection standards and protocols for Community Plans, Area Plans and Secondary Plans • More detailed and more consistent direction regarding restoration • Ensure hydrology is addressed properly and the proper language is used	Lauren, Michael, Caitlin for Aquatic aspects	Consistent with Planning Department's 2 Year Work Plan and staff's direction	3E
Invasive Species	• Assisting staff in developing Invasive Species Plan • Committee members expertise will be applied to the development of the Plan and review of drafts	tbd	Consistent with Planning Department's 2 Year Work Plan and staff's direction	3E
Enforcement By-law	• Possibly develop an Encroachment By-law to regulate unauthorized land uses into publicly owned portions of the Natural Heritage System	tbd	One year. Requires review of other municipal by laws	3E
Collaboration with other Advisory Committees	• An EEPAC representative is cross appointed to ACE. Where appropriate, EEPAC members will provide advice to its representative on this body. EEPAC does have representation on the Trees and Forests Advisory Committee.	As needed	As needed	3E
Review of Environmental Impact Studies and Environmental Assessments	• The main role of EEPAC is to provide a technical review of the work done by consultants for the city and private proponents.	Assigned as needed based on expertise	Within timeline requested by city staff file manager	3E