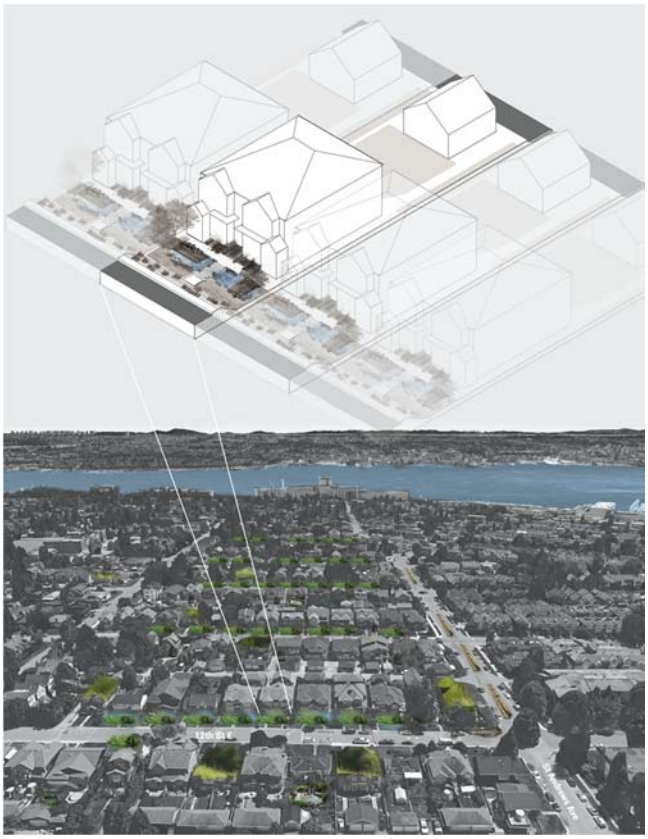
# Stormwater Design: From Source to Stream

*School of Architecture and Landscape Architecture, University of British Columbia*
Fall: 2016 | 9 Credit I Vertical Studio
*Instructor: Daniel Roehr, droehr@sala.ubc.ca*
12.9.2016



*Drawing by Anezka Gocova 2015*

**COURSE OVERVIEW**

The studio's prime goal is to explore the feasibility, functionality, visual and spatial characteristics and aesthetics of stormwater management strategies and their integration into the urban fabric in the City of North Vancouver, British Columbia, Canada (CNV). Stormwater management is part of landscape architectural design and is an important consideration for every project to reduce infrastructure needs, protect local creeks, peak-flow erosion and sedimentation, and recharge the water table.

Common stormwater management strategies include living (green) roofs, blue roofs, bioswales, rain gardens, and other water detention areas, typically referred to as Low Impact Development (LID).
Landscape architecture and architecture students' analog and digital visualization and model making skills to represent and integrate LID tools could be used as a persuasive tool for the public to accept and integrate them on public and private land. Hence in the first half of the studio (site scale) the analog skills will be intensively exercised, improved and advanced and in the second half (urban and regional scale) digital skills will be employed.

The studio's aim is to persuade the general public and the municipality of the CNV to introduce LID. The studio's outcome should provide a set of visually compelling and easily understandable design and planning recommendations to increase the implementation and financing of rainwater management in the CNV.

Landscape architecture and architecture students have the model making, "three-dimensional" visualizations and orthographic drawing skills to explore different sites at different scales, and to demonstrate the aesthetic and spatial experience of LID strategies (size, location and overflow areas on private and public land). The designs, models and drawings created by the students could be used to estimate the cost of LID measures by calculating and drawing their spatial extent to scale. These physical models and drawings can also be used to visualize aesthetic appearance and spatial integration into the city's network of private lots, public streets and open space.

But how can the landscape architect and architect play a leading role in designing LID? Their strengths are thinking about a problem holistically, as he/she is trained to build and lead construction at multiple scales from a single lot to the regional scale. Landscape architecture and architecture students can represent the non-built landscape and architecture space in physical models, images and orthographic drawings such as sections, plans, axonometrics and elevations. Further students have to be trained to analyze the existing conditions and surrounding context of a catchment area and a site from a scientific - ecological perspective with a strong spatial understanding. They also need to be trained to be aware of which specialists to approach in order to fill in any expertise gaps they have. These skills are essential in designing complex and successful LID strategies.

For scientific and technical expertise landscape architects should work with hydrogeological and civil engineers from the outset. Engineers can not only estimate and simulate intense (e.g. 10, 20, 50, 100-year) storm events; they are the experts responsible and liable in calculating and recommending the dimensions of LID. The immediate interdisciplinary cooperation with engineers begins with the initial LID design idea and the engineer can then provide the landscape architects with the recommended dimensions of LID strategies, particularly for new developments where LID can be visualized at correct scale and context. In retrofit situations LID is often squeezed into space wherever there is room. In Delta, British Columbia for example, Dr. Sarah Howie follows a 10:1 - impervious area: rain garden ratio as a rule of thumb, but this is likely based on engineering calculations and experience over time.

**BACKGROUND**

North Vancouver has some of the highest rainfall in the region and has experienced increasingly costly, and damaging floods (last flood 5.11.2014 Vancouver Sun, Globe & Mail). The redevelopment in residential neighbourhoods and downtown areas has resulted in an increased amount of impervious surfaces, which, when left unmitigated, further worsens the health of natural systems and increases the risk of infrastructure failure. Rainwater is no longer being intercepted by tree cover, is unable to infiltrate, and rapidly runs off the impermeable surfaces where it is quickly and energetically is delivered to streams. This issue is typical of all developing or redeveloping cities, not just in the CNV.

Over the last fifteen years house sizes have dramatically increased on existing private building lots in the District and City of North Vancouver, as well as driveway sizes. Most municipalities allow maximum total impervious area

(TIA) to be 60% for a residential lot, but many homeowners pave their yards and boulevards in contravention of the bylaw and enforcement of non-structural elements on property is challenging.

This phenomenon especially occurs in cities where land prices are rapidly rising and the value of the land results in developers maximizing the size and complexity of homes (e.g. secondary suites, laneway housing). Consequently, this spike in land prices causes an increase in house footprint size on existing lots due to higher living space demand, especially from investors who are either used to larger houses or would like to increase the selling value of their lot by increasing the house size. Thus housing size increase reduces pervious surfaces for rainwater to infiltrate at source into the ground. The existing stormwater infrastructure is overloaded with the extra rainwater, especially in intense storm events, causing massive flooding in neighborhoods. The quick delivery of additional stormwater in pipes further damages the ecology and wildlife of nearby streams due to more and faster flowing water from stormwater pipe outfalls, and decreased water quality.

Two possible scenarios to remedy the situation include (1) changing zoning to enable taller (two to three storey) buildings on the existing lots while limiting their footprint size, or (2) continuing to allow larger building footprints (one to two storeys maximum) on existing lots and adding Low Impact Development (LID) stormwater management features. The LID features would then change the TIA to an Effective Impervious Area, where private lots would infiltrate stormwater, instead of overburdening the existing stormwater infrastructure. Both building strategies have visual implications on the landscape. The former alters the city skyline through increasing the vertical height of buildings; the latter alters the aesthetic of typical lots.

The studio will explore the latter remedy and discuss strategies to make LID more accepted by the public. LID could be described as emulating the stormwater function that a site had in its natural state, before modern development practices.

In order to introduce LID in cities, the public and local government officials need to be convinced that LID is a feasible option and can be implemented in an effective and thoughtful way. LID needs to become an accepted strategy to manage stormwater at source on private and public land.

In our studio David Matsubara Civil Engineer from the CNV and Sarah Primeau Landscape Architect at space2place and design lead for a current stormwater project in the CNV will act as professional advisors throughout the studio.

In this context, the students will:

1. develop clear and innovative graphic representation techniques (both analog and digital) for communicating designs ideas at site, urban and regional scale.

2. understand Low Impact Development strategies, and how and where to apply the different LID tools in the CNV.

3. acquire understanding of the site at different scales and contexts using a range of diverse sources and techniques: including careful critical site observation, mapping, GIS data, historic documents, maps, news media, photography, and especially hand drawings (visual note taking).

4. explore and analyze the CNV region using the tools of mapping, diagramming and sketching to see/read, study, and graphically represent the status quo of the site.

5. design at different scales, using the reverse design strategy, site and details first before urban and regional scale.

6. learn how to represent the proposals visually (analog and digital), physically and orally to the residents of the CNV and municipal staff of the CNV.

**COURSE STRUCTURE**

In an effort to stimulate cross-disciplinarily and collaborative research and design, the studio is open to students from landscape architecture and architecture.

The studio has three design phases:
In the first students will work individually at the site scale, in the second students work in pairs at urban scale and in the third students work in groups of four at regional scale.

The main difference of this studio to most SALA studio practice and set up is the reverse order of design, from small (site) to large (regional) instead of large down to small scale. LID is best designed starting at site (private) scale, before the urban and regional scale. Reason being that site scale can be achieved instantly, while urban and regional scale need approval from the municipality. The challenge at site scale is the emergency overflow of LID onto public land. Hence the studio being a hypothetical exercise, the intensive design of this studio is placed at the beginning of the semester when students are not stressed with multiple hand in's. Further most studios spend an extensive, exhaustive period of time on analysis at the beginning; in this studio the major analysis will be done by group work at urban and regional scale in the middle of the semester, while individual site analysis will be kept to a minimum at the beginning, to focus on design. The latter part of the studio is in pairs and groups, where coordination between colleagues and teamwork will be practiced. The final presentation of the studio will be an exhibition at CNV city hall to practice public presentation.

Phase 1 - Week 1-5 **Individual**
Phase 2 - Week 6-9 **Pairs**
Phase 3 - Week 10-13 **Teams & Exhibition**

Design tools in studio are also prescribed for each phase. In phase 1 (site), students are encouraged mainly to hand draw and build physical models. In phase 2 (urban) and phase 3 (regional) digital tools for mapping, GIS and CAD drawings are preferred.

**DELIVERABLES**

**Phase 1 Site - individual**
1 site plan & context 1:100 & 1 site plan 1:50
2 sections 1:100 & 2 sections 1:50
2 elevations 1:100
1 eye-level & 1 aerial perspective (11x17min)

3-4 hand crafted models and 3-D sections exploring above and below ground – cardboard 1:100 and 1:50
10 pages 11x17 analysis (digital layout)
diagrams (digital and hand drawings)
hand-sketches
concept diagrams

**Phase 2 Urban - pair**
1 site plan 1:1000 or 1:2000 (scale approved by instructor) &1 site plan 1:500
2 sections 1:200 & 2 section 1:100
2 aerial perspectives
laser cut wood model
diagrams
analysis 20 pages 11x17 (digital layout)
concept diagrams

**Phase 3 Regional - team**
1 site plan (scale tba)
6 sections 1:500 & 2 sections 1:200
diagrams
analysis 40 pages 11x17
concept diagrams

**Exhibition concept, preparation and execution (whole studio)**

**EVALUATION**
Deadlines are "dead"- lines, late hand in only with dr. note - otherwise zero grade!
**Studio absence only with dr. note and email to instructor Tuesday or Friday morning "before" studio!**

**Phase 1** (50%) - **individual grade**
**Phase 2** (20%) - **pair grades**
**Phase 3** (30%) - **team grades**

**EVALUATION CRITERIA Phase 1,2&3**
**passion, production, intellectual content, craftsmanship, representational quality & skill, artistic and technical creativity, technical know-how and acquired knowledge integration, studio input, social competence in team work**

**MEETINGS**
Individual progress meetings after phase 1 and team meetings phase 3 at the end of the semester

**SCHEDULE**
**The schedule is subject to change! Please review updated version regularly on UBC Connect**
Studio: 1:30 – 6:00pm Tuesday & Friday
Office Hours only Tuesday or Friday morning: email instructor for extra individual, pair or team advice!

**Unannounced class, group or individual pinups on "<u>any</u>" Tuesday or Friday during the semester!**

**WEEK 1**

Tuesday 16-09-06 SALA Studio Student Presentation

Friday 16-09-09 Introduction Studio & Phase 1, Analysis & Optional Site Visit – **MCML 256**

**WEEK 2**

Tuesday 16-09-13 Studio & Lectures *"LID Engineering & Hydrology"* - David Matsubara, CNV, 1:30-3:30pm – **MCML 370**

Friday 16-09-16 Studio & Lecture *"CNV Stormwater Study"* - Sarah Primeau, space2place, 2:00-3:30pm – **MCML 370**

**WEEK 3**

Tuesday 16-09-20 Studio & Lecture *"LID Aesthetics - Form & Function"* - Daniel Roehr, SALA, 1:30-3:30pm – **MCML 370**

Friday 16-09-23 Studio & Lecture *"Hand Drawing"* - Eason Li Connect Landscape Architecture, 1:30-3:30pm – **MCML 370**

**WEEK 4**

Tuesday 16-09-27 Studio

Friday 16-09-30 Studio

**WEEK 5**

Tuesday 16-10-04 Studio

**Friday 16-10-07 REVIEW Phase 1 (MAJOR INDIVIDUAL REVIEW) – MCML 370**

**WEEK 6**

**Monday 16-10-10 Individual Progress Meetings**

Tuesday 16-10-11 Studio & Intro Phase 2, Pair Analysis, *"Thesis Presentation"* - Anezka Gocova – **MCML 370**

Friday 16-10-14 Studio & Site Visit

**WEEK 7**

Tuesday 16-10-18 Studio

Friday 16-10-21 Studio

**WEEK 8**

Tuesday 16-10-25 Studio

Friday 16-10-28 Studio

**WEEK 9**

Tuesday 16-11-01 Studio

**Friday 16-11-04 REVIEW Phase 2**

**WEEK 10**

Tuesday 16-11-08 Studio & Intro Phase 3, Team Analysis, Lecture TBA – **MCML 370**

Friday 16-11-11 Studio Team Analysis, Model

**WEEK 11**
Tuesday 16-11-15 Studio
Friday 16-11-18 Studio

**WEEK 12**
Tuesday 16-11-22 Studio
Friday 16-11-25 Studio

**WEEK 13**
Tuesday 16-11-29 Studio
Friday 16-11-02 Studio

**WEEK 14**
**FINAL REVIEW & EXHIBITION Phase 1,2,3 Date & Location tba**
Group Final Meeting tba
Exhibition Location & Dates tba

**ACADEMIC INTEGRITY**

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

**PLAGIARISM**

Plagiarism is not tolerated in this course or any UBC courses. See UBC's Academic Honesty and Standards: http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,286,0,0#15620

To see how UBC defines plagiarism see: http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,959

To learn about the disciplinary measure that may result if a student has been caught plagiarizing see: http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,960

**READINGS**

*Books, Journal Articles and Manuals*

**Sitelines,** *Water Balance Pathway To A Water-Resilient Future* - http://sitelines.org/media-zone/sitelines-newsletter. 6/2016.

**Sitelines**, *Living Systems in Landscapes* - http://sitelines.org/media-zone/sitelines-newsletter. 8/2016.

Engel, Katalina et al., *Big Cities. Big Water. Big Challenges-Water in an Urbanizing World*. WWF Germany, 2011.

**Manual of Practice (MOP) 23**, Design of Urban Stormwater Controls, American Society of Civil Engineers (Reston, Va.) & Environmental and Water Resources Institute (Reston, Va.), The Water Environment Federation (WEF; Alexandria, Va.), 2012.

Roehr, D., Fassman-Beck, E., 2015. *Green Roofs in Integrated Urban Water Systems*. Oxford, England: Routledge: 1 - 178.

*Newspaper Articles and Reports - Recent Floods 2016*

**Wuhan, China** - http://www.cnbc.com/2016/07/08/typhoon-floods-chinese-stadium-like-a-bathtub.html

**Maryland, US** - http://www.cnn.com/2016/07/31/us/maryland-flooding/

**Berlin, Germany**- http://www.thelocal.de/20160617/heavy-rain-brings-flood-risk-to-berlin-weather-germany

**London, UK** - http://www.standard.co.uk/news/london/london-flooding-cars-submerged-and-tube-stations-shut-as-more-flash-floods-hit-the-capital-a3279686.html

**Louisiana** - http://www.cnn.com/2016/08/18/us/louisiana-flooding/

*Websites Manuals*

**Waterbucket.ca: -** http://waterbucket.ca

**Environmental Protection Agency** (EPA, US) - https://www3.epa.gov

**LID Guide Toronto and Region** - http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/low-impact-development-stormwater-management-planning-and-design-guide/

**Urban Stormwater Management BC** -http://www.env.gov.bc.ca/wld/instreamworks/urbanstormwater.htm

**Stormwater Planning: A Guidebook for BC** - http://www.toolkit.bc.ca/resource/stormwater-planning-guidebook-british-columbia

**Stormwater Management Metro Vancouver** - http://www.metrovancouver.org/services/liquid-waste/drainage/stormwater-management/Pages/default.aspx

**City of North Vancouver Stormwater Management Guidelines** (pdf on UBC Connect)

**Washington State Reports -** http://www.ecy.wa.gov/programs/wq/stormwater/manual.html

*Movies*

**Drainscape** - *https://www.youtube.com/watch?v=p_LXQGqUj9o*

*Representation*

Alexander, Bryan. 2011. *The new digital storytelling: Creating narratives with new media*. Santa Barbara, Calif: Praeger.

Banu Inanc Uyan Dur. 2014. *Data visualization and infographics in visual communication design education at the age of information.* Journal of Arts and Humanities 3 (5): 39.

Berlanger, Blake, and Urton, Ellen. 2014. *Situating Eidetic Photomontage In Contemporary Landscape Architecture.* Landscape Journal 33 (2): 109-126.

Bishop, Ian. 2015. *Location based information to support understanding of landscape futures.* Landscape and Urban Planning 142: 120-131.

Cairo, Alberto. 2012. *The Functional Art: An introduction to information graphics and visualization*. New Riders; 1 edition.

Corner, James and Alex S. MacLean. 1996. *Taking measures across the American landscape*. New Haven: Yale University Press.

Corner, James. *The Agency of Mapping: Speculation, Critique and Invention.* In Mappings, ed Denis Cosgrove (London: Reakton Books, 1999): 214-252.

Crampton, Jeremy W. 2010. Mapping: *A critical introduction to cartography and GIS*. 1st ed. Chichester, U.K; Malden, MA: Wiley-Blackwell.

Fisher, Howard T. 1982. *Mapping information: The graphic display of quantitative information.* Cambridge, MA: Abt Associates.

Foo, Katherine, Emily Gallagher, Ian Bishop, and Annette M. Kim. 2015. *Special Issue: Critical Approaches to Landscape Visualization*. Landscape and Urban Planning 142: 80-244.
Hutchison, Edward. 2011. *Drawing for landscape architecture: Sketch to screen to site*. New York, N.Y: Thames & Hudson.
Knaflic, Cole Nussbaumer. 2015. *Storytelling with data: A data visualization guide for business professionals*. John Wiley & Sons Inc.
Krum, Randy. 2014. *Cool infographics: Effective communication with data visualization and design*. 1st ed. Indianapolis, IN: Wiley.
Kullmann, Karl. 2014. *Hyper-realism and loose-reality: the limitations of digital realism and alternative principles in landscape design visualization.* Journal of Landscape Architecture. 3: 20-31.
Lankow, Jason, Josh Ritchie, Ross Crooks, Ebrary. 2012. *Infographics: The power of visual storytelling*. 1. Aufl.;1; ed. Hoboken, N.J: John Wiley & Sons, Inc.
MacEachren, Alan M. 1995. *How maps work: Representation, visualization, and design*. New York: Guilford Press.
Mccandless, David. 2000. *Information Is Beautiful*. Collins.
Mccandless, David. 2014. *Knowledge Is Beautiful: A Visual Miscellaneum of Compelling Information*. Harper Design.
Mertens, Elke. 2010. *Visualizing landscape architecture: Functions, concepts, strategies*. Basel, Switzerland, Boston: Birkhaeuser.
Rendgen, Sandra, Julius Wiedemann, Paolo Ciuccarelli, Richard Saul Wurman, Simon Rogers, and Nigel Holmes. 2012. *Information graphics*. Köln: Taschen.
Sheppard, Eric. 2005. Knowledge production through critical GIS: Genealogy and prospects. *Cartographica* 40 (4): 5-21.
Steele, Julie. 2010. *Beautiful visualization: Looking at data through the eyes of experts*. Sebastopol, CA: O'Reilly.
Tufte, Edward R. 1990. *Envisioning information*. Cheshire, Conn: Graphics Press
Tufte, Edward R. 2001. *The visual display of quantitative information*. 2nd ed. Cheshire, Conn: Graphics Press.
Tufte, Edward R. 2001. *The visual display of quantitative information*. 2nd ed. Cheshire, Conn: Graphics Press.
Vasin, Yu G., and L. I. Lebedev. 2012. *An effective format for representing graphic information*. *Pattern Recognition and Image Analysis* 22 (2): 393-8.
Waldheim, Charles, Andrea Hansen, and James S. Ackerman. 2014. *Composite landscapes: Photomontage and landscape architecture*. Ostfildern, Germany: Hatje Cantz Verlag.
Ware, Colin. 2008. *Visual thinking: For design*. San Diego: Morgan Kaufmann.
Wildbur, Peter. 1989. *Information graphics: A survey of typographic, diagrammatic, and cartographic communication.* New York: Van Nostrand Reinhold.

**GRADING STANDARDS**

This studio will be graded in accordance with SALA & UBC General Grading Practices, and the SALA/UBC Faculty of Graduate Studies Definition of Satisfactory Progress.

SALA/ UBC General Grading Practices:

90–100 A+

85–89 A (Clearly excellent engagement, knowledge and performance)

80–84 A-

76–79 B+

72–75 B (Good -grasp of material with evidence in work products)

68–71 B-

64–67 C+

60–63 C (Satisfactory comprehension and work products, little initiative)

55–59 C-

50–54 D (Unsatisfactory comprehension and work products)

0–49 F (Fail)

SALA/ UBC Faculty of Graduate Studies: Definition of Satisfactory Progress:

**A minimum of 60% must be obtained in any course taken by a student enrolled in a master's program for the student to be granted pass standing. However, only 6 credits of pass standing may be counted towards a master's program. For all other courses, a minimum of 68% must be obtained.**
**When repeating a failed required course, a minimum mark of 74% must be obtained.**