

MS₄ LOW IMPACT DEVELOPMENT: GUIDELINES FOR STORMWATER BEST MANAGEMENT PRACTICES

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UFSMA 2020, Virtual Conference!

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AGENDA

- Background: Review of State Guideline
- Why the UCEA LID/Stormwater Committee
- LID Standards
- UCEA Website
- Format
- Conclusion

A GUIDE TO LOW IMPACT DEVELOPMENT WITHIN UTAH

- “a reference and guide for incorporating low impact development”
- Project volume retention *goal*
- As of July 1, 2020, the following requirements apply for new development and redevelopment projects:
 - New development projects must manage rainfall on-site and prevent the off-site discharge of the precipitation from all rainfall events less than or equal to the 80th percentile rainfall event or a predevelopment hydrologic condition, whichever is less.
 - *If a redevelopment project increases the impervious surface by greater than 10%, the project shall manage rainfall on-site, and prevent the off-site discharge of the net increase in the volume associated with the precipitation from all rainfall events less than or equal to the 80th percentile rainfall event*

AUGUST 2020 CHANGES

August 2020	
Description of Changes	Impacted Sections
Updated definition of Redevelopment	<i>The 80th Percentile Volume</i>
Updated V_{goal} calculations to reflect new definition of Redevelopment	<i>The 80th Percentile Volume</i>
Updated the Commercial land use example as an example of Redevelopment	<i>Land Use Examples</i>
Replaced 90 th percentile NOAA storm depths with permittee-submitted 80 th percentile storm depths	<i>Appendix A 80th Percentile Storm Depths</i>
Updated Storm Water Quality Report Template	<i>Appendix B Storm Water Quality Report Template</i>
Updated BMP drawing notes to indicate treatment options	<i>Appendix C LID BMP Fact Sheets</i>
Added a Minimize Impervious Area fact sheet	<i>Appendix C LID BMP Fact Sheets</i>
Replaced 90 th percentile storm depth text and calculations with 80 th percentile storm depth	Throughout manual
Replaced many uses of '90 th percentile storm depth' with 'project volume retention goal' to allow for option of using the predevelopment hydrologic condition as the retention goal.	Throughout manual
Minor spelling, grammatical, and formatting updates	Throughout manual

90TH PERCENTILE - RAINFALL

PF tabular | PF graphical | Supplementary information | [Print page](#)

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)¹

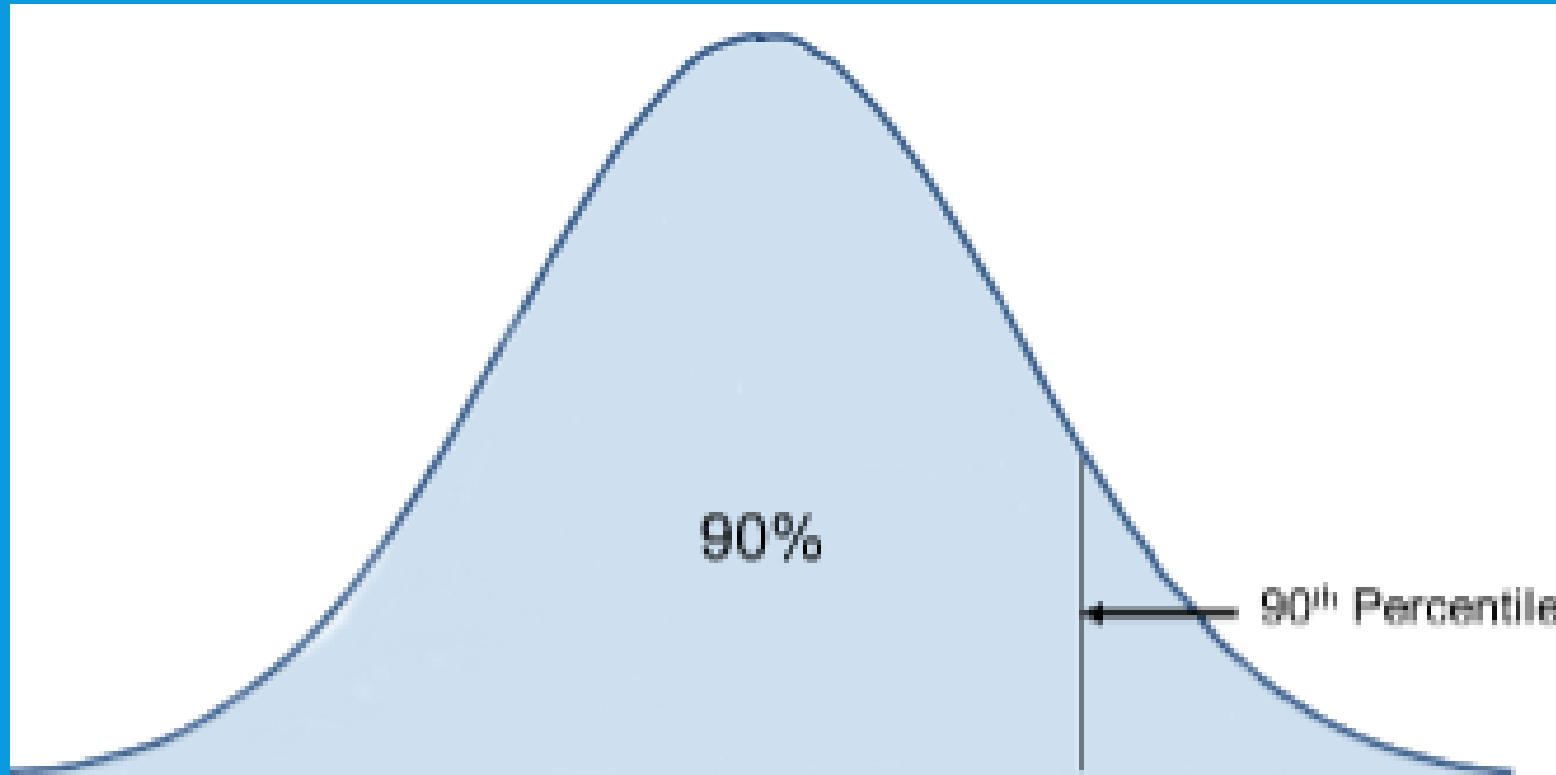
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.122 (0.107-0.143)	0.156 (0.138-0.183)	0.216 (0.187-0.253)	0.270 (0.233-0.317)	0.355 (0.297-0.418)	0.432 (0.353-0.512)	0.522 (0.418-0.624)	0.626 (0.481-0.759)	0.792 (0.580-0.978)	0.939 (0.682-1.18)
10-min	0.186 (0.163-0.218)	0.238 (0.208-0.278)	0.329 (0.285-0.385)	0.411 (0.353-0.482)	0.540 (0.452-0.636)	0.658 (0.538-0.780)	0.795 (0.632-0.949)	0.953 (0.733-1.18)	1.21 (0.883-1.49)	1.43 (1.01-1.80)
15-min	0.231 (0.201-0.270)	0.294 (0.257-0.345)	0.407 (0.353-0.477)	0.509 (0.438-0.597)	0.669 (0.561-0.789)	0.816 (0.666-0.967)	0.985 (0.784-1.18)	1.18 (0.908-1.43)	1.49 (1.10-1.85)	1.77 (1.25-2.23)
30-min	0.311 (0.271-0.364)	0.396 (0.348-0.464)	0.548 (0.475-0.642)	0.686 (0.590-0.804)	0.902 (0.755-1.06)	1.10 (0.897-1.30)	1.33 (1.05-1.59)	1.59 (1.22-1.93)	2.01 (1.48-2.48)	2.39 (1.68-3.00)
60-min	0.385 (0.335-0.460)	0.490 (0.428-0.574)	0.679 (0.588-0.794)	0.849 (0.730-0.995)	1.12 (0.934-1.32)	1.36 (1.11-1.61)	1.64 (1.31-1.98)	1.97 (1.51-2.39)	2.49 (1.83-3.07)	2.95 (2.08-3.71)
2-hr	0.472 (0.422-0.541)	0.591 (0.528-0.675)	0.781 (0.692-0.894)	0.954 (0.837-1.09)	1.23 (1.05-1.42)	1.48 (1.24-1.72)	1.78 (1.44-2.08)	2.12 (1.66-2.52)	2.66 (1.99-3.23)	3.15 (2.27-3.90)
3-hr	0.546 (0.494-0.616)	0.678 (0.615-0.783)	0.867 (0.782-0.975)	1.04 (0.928-1.17)	1.31 (1.15-1.48)	1.54 (1.32-1.75)	1.82 (1.52-2.09)	2.14 (1.74-2.54)	2.68 (2.09-3.26)	3.16 (2.38-3.94)
6-hr	0.698 (0.642-0.789)	0.860 (0.788-0.948)	1.06 (0.968-1.17)	1.23 (1.12-1.35)	1.48 (1.33-1.64)	1.70 (1.50-1.89)	1.94 (1.69-2.19)	2.22 (1.89-2.55)	2.74 (2.29-3.30)	3.19 (2.57-3.98)
12-hr	0.882 (0.811-0.964)	1.08 (0.999-1.19)	1.31 (1.20-1.44)	1.50 (1.37-1.65)	1.78 (1.61-1.95)	2.00 (1.81-2.18)	2.23 (1.99-2.49)	2.49 (2.15-2.82)	2.90 (2.45-3.35)	3.25 (2.69-4.02)
24-hr	1.05 (0.969-1.13)	1.28 (1.19-1.39)	1.54 (1.42-1.65)	1.74 (1.61-1.88)	2.02 (1.87-2.18)	2.23 (2.05-2.41)	2.44 (2.25-2.64)	2.66 (2.43-2.87)	2.94 (2.67-3.38)	3.28 (2.85-4.05)
2-day	1.22 (1.13-1.31)	1.49 (1.39-1.61)	1.78 (1.66-1.92)	2.03 (1.88-2.18)	2.35 (2.17-2.52)	2.60 (2.39-2.79)	2.85 (2.61-3.07)	3.10 (2.83-3.34)	3.44 (3.11-3.71)	3.69 (3.32-4.10)
3-day	1.32 (1.22-1.44)	1.62 (1.49-1.76)	1.94 (1.79-2.10)	2.20 (2.03-2.39)	2.57 (2.38-2.78)	2.85 (2.61-3.08)	3.14 (2.88-3.40)	3.43 (3.11-3.72)	3.82 (3.43-4.16)	4.12 (3.68-4.58)
4-day	1.43 (1.31-1.58)	1.75 (1.60-1.91)	2.09 (1.92-2.28)	2.38 (2.19-2.59)	2.78 (2.55-3.03)	3.10 (2.82-3.38)	3.42 (3.11-3.74)	3.75 (3.39-4.10)	4.20 (3.75-4.81)	4.55 (4.03-5.01)
7-day	1.66 (1.52-1.82)	2.03 (1.88-2.22)	2.42 (2.22-2.64)	2.75 (2.52-2.99)	3.18 (2.91-3.45)	3.50 (3.20-3.81)	3.84 (3.49-4.17)	4.16 (3.78-4.53)	4.59 (4.14-5.01)	4.91 (4.41-5.37)
10-day	1.86 (1.71-2.02)	2.27 (2.09-2.47)	2.70 (2.48-2.93)	3.04 (2.79-3.29)	3.49 (3.20-3.77)	3.82 (3.50-4.12)	4.15 (3.79-4.48)	4.46 (4.07-4.84)	4.86 (4.41-5.28)	5.15 (4.66-5.60)
20-day	2.42 (2.21-2.64)	2.97 (2.71-3.24)	3.51 (3.21-3.82)	3.93 (3.59-4.27)	4.46 (4.08-4.84)	4.84 (4.43-5.26)	5.21 (4.78-5.65)	5.55 (5.08-6.03)	5.96 (5.44-6.49)	6.25 (5.68-6.81)
30-day	2.90 (2.69-3.15)	3.55 (3.25-3.85)	4.19 (3.85-4.54)	4.69 (4.31-5.08)	5.34 (4.90-5.78)	5.81 (5.33-6.29)	6.27 (5.74-6.80)	6.71 (6.13-7.29)	7.26 (6.60-7.90)	7.65 (6.92-8.34)
45-day	3.55 (3.27-3.95)	4.33 (3.99-4.70)	5.08 (4.69-5.50)	5.66 (5.22-6.11)	6.38 (5.89-6.87)	6.88 (6.36-7.42)	7.39 (6.79-7.93)	7.79 (7.19-8.39)	8.29 (7.65-8.92)	8.60 (7.95-9.27)
60-day	4.18 (3.86-4.52)	5.10 (4.71-5.52)	5.97 (5.51-6.44)	6.63 (6.12-7.14)	7.46 (6.88-8.02)	8.03 (7.41-8.64)	8.57 (7.90-9.21)	9.05 (8.34-9.74)	9.61 (8.85-10.3)	9.96 (9.18-10.7)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
 Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
 Please refer to NOAA Atlas 14 document for more information.

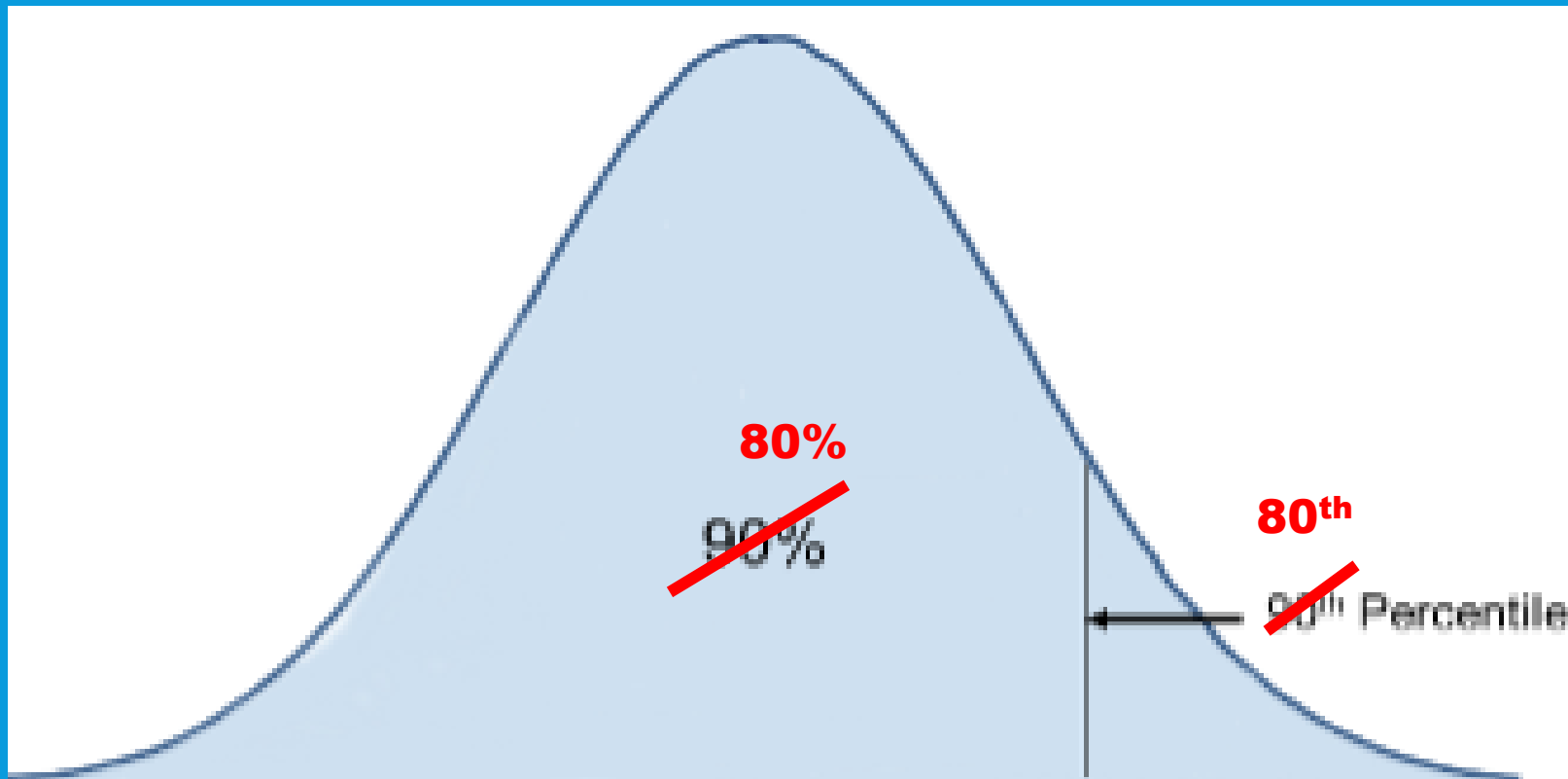
Estimates from the table in CSV format: [Precipitation frequency estimates](#) | [Submit](#)

Main Link Categories: [Home](#) | [OWP](#)

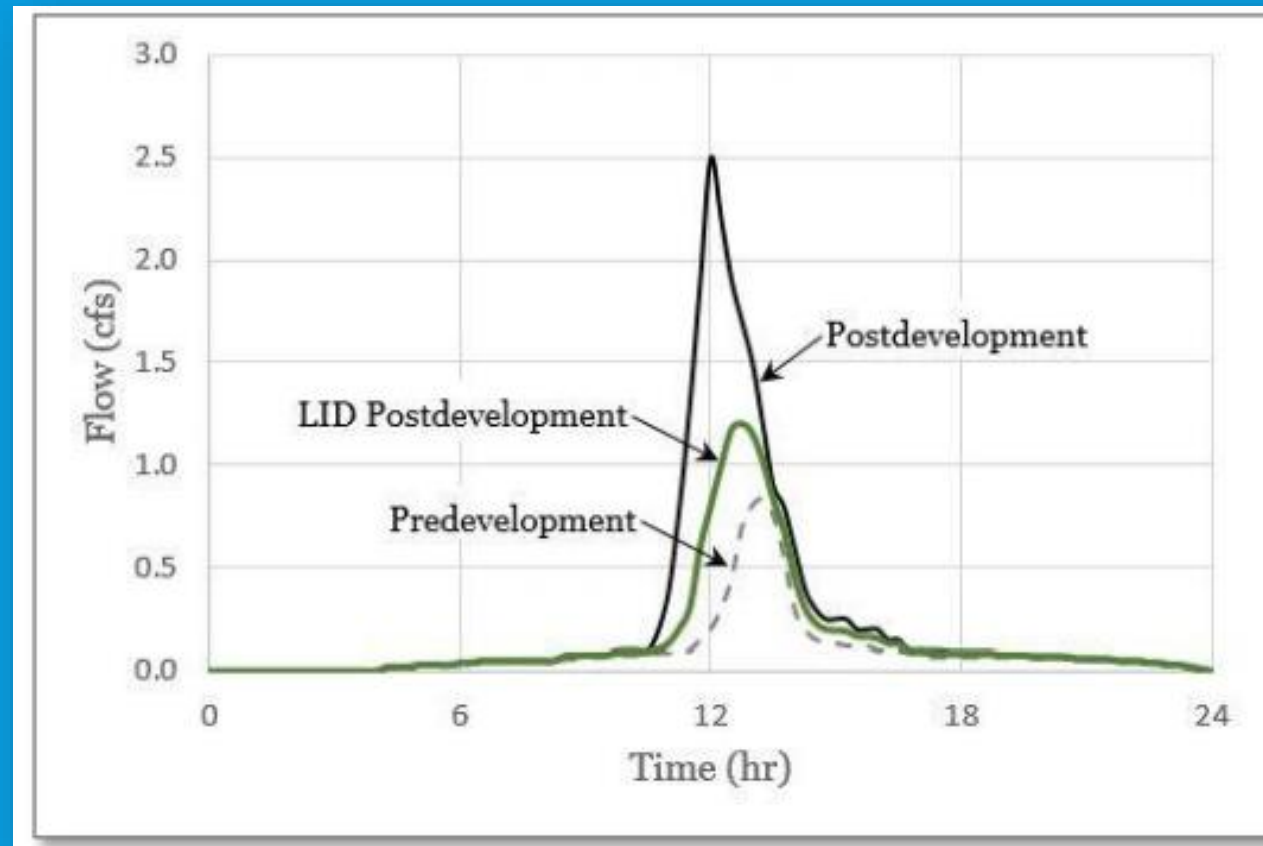
90TH PERCENTILE - CONCEPT



80TH PERCENTILE



HYDROGRAPH COMPARISON



VOLUMES - DEFINITION

- V_{goal} for New Development: The volume of runoff generated within the project's limits of disturbance over a 24-hour period during the 80th percentile storm event or a predevelopment condition, whichever is less
- V_{goal} for Redevelopment: For a redevelopment project that results in a net increase in impervious surface greater than 10%, V_{goal} is the net increase in volume between the existing condition and the proposed condition generated by the 80th percentile storm event over a 24-hour period
- Water Quality Volume, WQV – The volume of runoff generated within a BMP's drainage area over a 24-hour period during the 80th percentile storm event.

WHY THE UCEA LID/STORMWATER COMMITTEE?

- The committee is the result of the Utah City Engineers Association to be proactive to meet the State/Federal requirements on LID and stormwater BMPs
- The Committee act under the UCEA Board
- The Committee goals are to
 - Collect and/or prepare LID/Stormwater guidance and standards that could be used of adoption (and could be adapted to the needs of the agency)
 - Compile applicable methods and constructability for using LIDs
 - Organize the information into a user friendly format
 - Publish the information on the website
 - Continue to improve and maintain the library of standards
 - Support agencies with issues related to LID/Stormwater

LID/STORMWATER COMMITTEE

- Composed by City Engineers/Assistants and Consultants
- Virtually meets to review and discuss current needs for the local government to meet State and Federal requirement
- Worked on the science of water infiltration as it relates to hydraulic/LID methods
- Compiled, reviewed and published 11 standards LID/BMPs

INFILTRATION

Methods of Measurement for Stormwater

UCEA	In-Situ Conditions		In-Situ or Post Construction Conditions			Other methods	Recommendations
Storm Water Task Force	Double-Ring Infiltrometer	Test Pit Percolation	Borehole Permeameter	Laboratory Testing			
Recommended Methods of Measurement for Infiltration Rates			Cased (fixed)	Rigid Wall, compaction Mold Permeameter	Backpressure, Flexible Wall, one confining stress Permeameter		
Test Method	ASTM D5093/D3385	According to Utah DEQ - Water Quality, Onsite Wastewater Program	ASTM 6391 / USBR 7310	ASTM D5856	ASTM D5084	Other constant head permeability tests that utilize in-situ conditions and are accompanied by a recognized published source reference.	Recommend Multiple tests based on Sq Ft of Stormwater system
Additional test / methods needed	Subsurface investigation prior - must know the soil strata so that test can be performed on accurate elevation	Use a Certified Wastewater technician	Subsurface investigation prior - must know the soil strata so that test can be performed accurately	Undisturbed or recompacted samples	Undisturbed samples	Such as: ASTM D8152, ASTM D5126, ASTM D2434	
Depth of Testing possible	Surface	Surface or excavation	Variable (any depth)	Any	Any		
Test Result	Infiltration Rate (ft/s) (*1)	Percolation Rate (minutes per inch)	Hydraulic Conductivity (ft/min)	Hydraulic Conductivity (ft/min)	Hydraulic Conductivity (ft/min)		
Best Soils for test	Fine Grained - Uniform	All types	All types - Uniform sites	Granular	Fine Grained		
Best Uses							
Bioretention	X	X	X	X	X		
Infiltration Trench		X	X	X	X		
Permeable Pavement	X	X		X	X		
Infiltration Basin	X	X	X	X	X		
Dry Well			X	X	X		
Retention Basin	X	X	X		X		
Chemical Pond	X (Elevations correct)		X		X		
Underground Detention	Elevations correct		X	X	X		
Other	Poor connection between ring wall in soils could cause overestimation	Use Reduction factors on values and convert to infiltration rates	May underestimate infiltration rate			Make sure they include how test was done and a copy of standard.	

Multiple Test Recommendations from across the Nation

Colorado	Austin, TX	LA County - Percolation Test Requirements		
Perform at least one test for every 40,000 ft ² and at least two tests for sites between 40,000 ft ² and 160,000 ft ² . (Colorado BioRetention)	The proposed footprint of the control must be evaluated via test pits, probes, borings, or similar means at a minimum frequency of one test location per 500 square feet	Scale	Size	Min. Test Duration
		Small Scale	>1,000 Gallons	2 hours
		Mid-Scale	1,000 - 10,000 Gallons	4 hours
		Large Scale	>10,000 Gallons	6 hours

New York State and Maryland

Table D-1 Infiltration Testing Summary Table

Type of Facility	Initial Feasibility Testing	Concept Design Testing (initial testing yields a rate greater than 0.5"/hr)	Concept Design Testing (initial testing yields a rate lower than 0.5"/hr)
I-1 (trench)	1 field percolation test, test pit not	1 infiltration test and 1 test pit per 50' of trench	not acceptable practice

Virginia

Table 8A.1. Soil Explorations Required for Hydrologic Soil Group Classification

Mapping unit or DA size		
< 0.5 ac	> 0.5 ac; < 2.0 ac	> 2 ac
1 Soil Profile Pit 1 Soil Boring	1 Soil Profile Pit 4 Soil Borings	1 additional Soil Profile Pit ¹ 2 additional Soil Borings ¹

¹ For each additional 2 acres

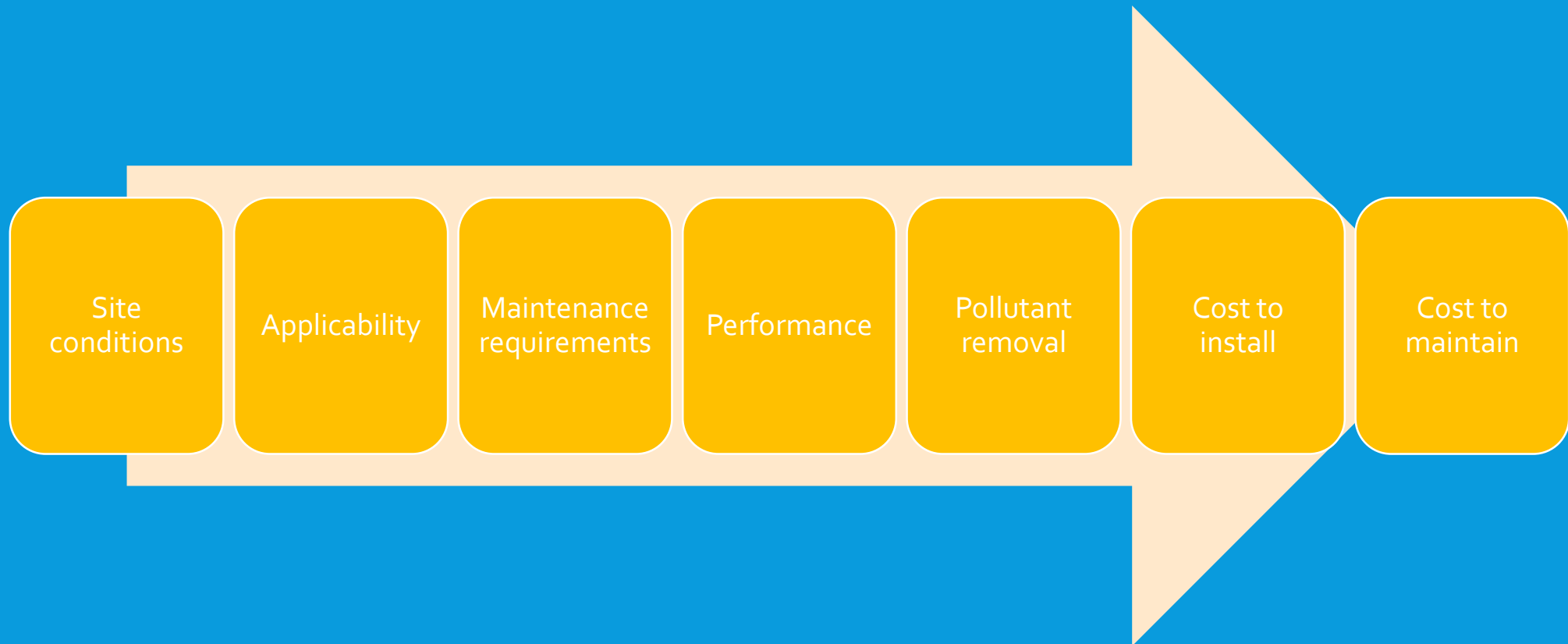
INFILTRATION/SOIL HYDRAULIC CONDUCTIVITY

NRCS Hydrologic Soil Group ↕	Typical Soil Texture ↕	Saturated Infiltration Rate (mm/h)* ↕	Saturated Infiltration Rate (in/h)* ↕	Porosity ↕	Field Capacity ↕
A	Sand	200	8.0	0.437	0.062
A	Loamy Sand	50	2.0	0.437	0.105
B	Sandy Loam	25	1.0	0.453	0.190
B	Loam	12.7*	0.5	0.463	0.232
C	Silt Loam	6.3*	0.25	0.501	0.284
C	Sandy Clay Loam	3.8*	0.15	0.398	0.244
D	Clay Loam & Silty Clay Loam	<2.3	<0.09	0.465	0.325
D	Clay	<1.3	<0.05	0.475	0.378

OBJECTIVE

- Reduce the storm water runoff from urbanized developments.
- The suggested BMPs were selected primarily to suit the varying hydro-meteorological conditions in the state of Utah.

CRITERIA



CONTENT

Recommended
specifications

Schematic
design

Construction
sequencing

STORM WATER STANDARDS LIBRARY

Downloadable
Material

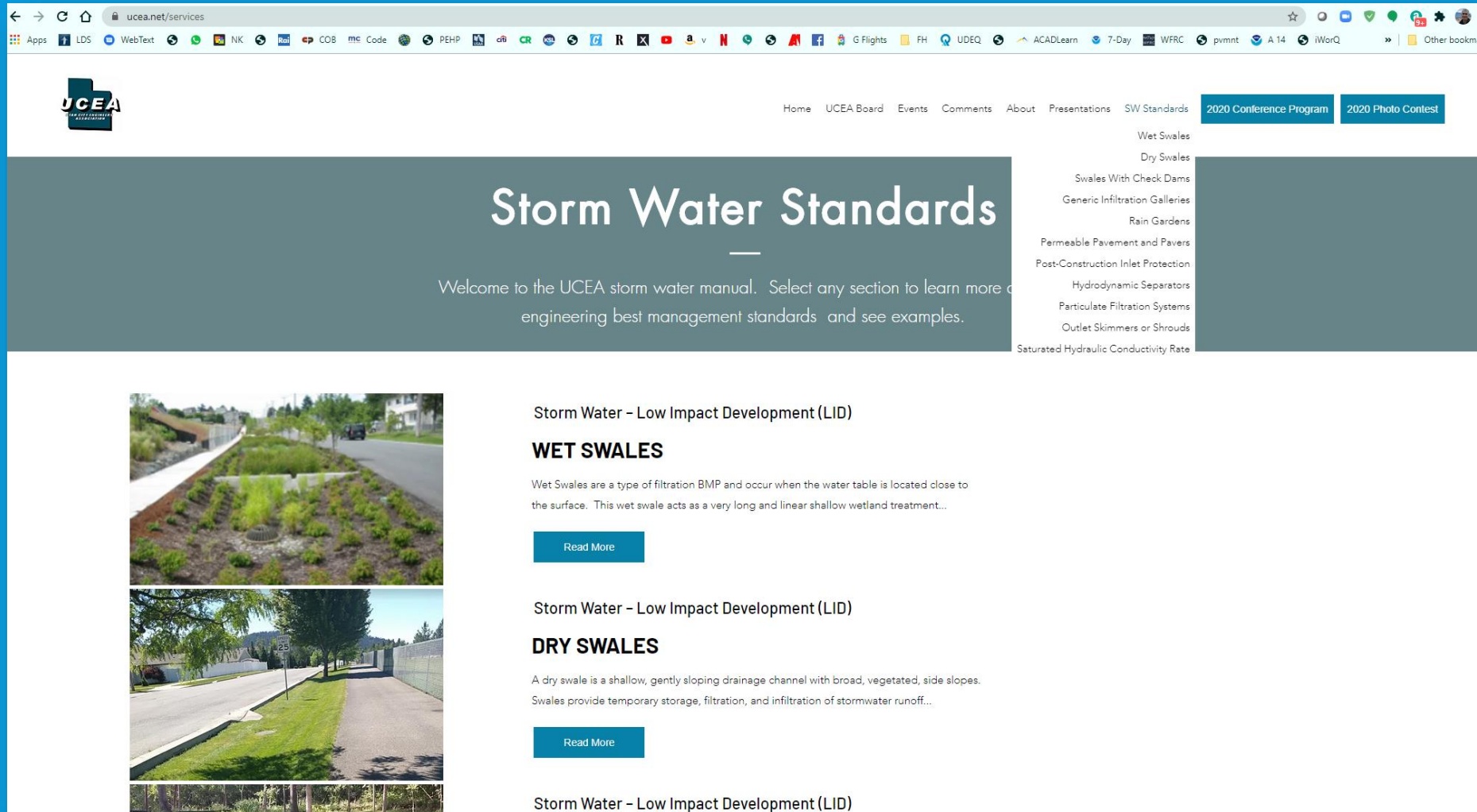
CAD resources

Technical
references.

FORMAT

The screenshot shows a web browser window displaying the Minnesota Stormwater Manual website. The browser's address bar shows the URL: `stormwater.pca.state.mn.us/index.php?title=Main_Page`. The browser's toolbar includes various icons for navigation and search. The website header features a "WIKI" logo with a cloud and rain icon, a search bar, and a "Log in" link. Below the header, there are two information boxes. The first box states: "Information: We have begun adding hover box (mouse over) text so users can see the contents on a particular page. Hover your mouse over the bolded text **See contents** next to each link below to see the contents on the linked page." The second box states: "Information: Taking advantage of the wiki technology, we continue to update this manual as resources allow. We continue to value your input. If you have comments or suggestions on the format please send them to us using the *Help Improve this Page* box at the bottom of most pages or send an email to [Mike.Trojan at the MPCA](mailto:Mike.Trojan@theMPCA)." Below the information boxes, a welcome message reads: "Welcome to the **Minnesota Stormwater Manual** website. This website was developed using Mediawiki, a wiki application that allows for easy editing and that has powerful search abilities. See [Introduction to the wiki](#) for more information." The main content area is divided into three sections: "Introduction to the Minnesota Stormwater Manual" with a bulleted list of links: "About the Minnesota Stormwater Manual", "Help", and "Disclaimers"; "Stormwater concepts and stormwater management" with a bulleted list: "General stormwater information", "Stormwater treatment concepts - **See contents**", "Alleviating compaction from construction activities", "Liners for stormwater management", "Green Infrastructure for stormwater management", "Information on soil - **See contents**", and "Compost and stormwater management"; and "Stormwater issues" with a bulleted list: "Stormwater pollutants - **See contents**", "Stormwater infiltration - **See contents**", "Protection and restoration of receiving waters", "Minnesota specific issues - **See contents**", "Stormwater and landscape guidance for solar farms and solar projects", and "Guidance for managing sediment and wastes collected by pretreatment practices". To the right of the "Stormwater issues" section, there is a screenshot of a software interface and a text box that reads: "To download the Minimal Impact Design Standards (MIDS) calculator, [link here](#). To see changes from Version 2, [link here](#). Note that Version 3 is Windows 10 compliant and Version 2 files can be loaded into Version 3." Below this, there is a "Check it out" button with a clipboard icon and a text box that reads: "The Interstate Technology and Regulatory Council (ITRC) released a new guidance document called **Stormwater Best Management Practices Performance Evaluation**." On the left side of the page, there is a "NAVIGATION" sidebar with links for "Main page", "Table of contents", "Index (Categories)", "What's new", "Response to comments", "Future updates", "Events", "In the News", "Funding", "Recent changes", "Help", "Export to pdf", and "TOOLS" including "What links here", "Related changes", "Special pages", "Printable version", "Permanent link", and "Page information". Below the navigation sidebar, there is a "MPCA LINKS" section with links for "MPCA Homepage", "Stormwater", and "Policies / Disclaimers".

CURRENT WEB INTERFACE



The screenshot shows a web browser window with the URL `ucea.net/services`. The page features the UCEA logo on the left and a navigation menu on the right. The main content area has a dark grey header with the title "Storm Water Standards" and a welcome message. Below this, there are three sections, each with a photograph and a "Read More" button. The first section is titled "Storm Water - Low Impact Development (LID) WET SWALES" and includes a description of wet swales. The second section is titled "Storm Water - Low Impact Development (LID) DRY SWALES" and includes a description of dry swales. The third section is partially visible and titled "Storm Water - Low Impact Development (LID)".

ucea.net/services

Apps LDS WebText NK COB Code PEHP cfb CR R X v H G Flights FH UDEQ ACADLearn 7-Day WFRC pvmnt A 14 iWorQ Other bookmarks

UCEA

Home UCEA Board Events Comments About Presentations SW Standards **2020 Conference Program** **2020 Photo Contest**

Storm Water Standards

Welcome to the UCEA storm water manual. Select any section to learn more about engineering best management standards and see examples.

- Wet Swales
- Dry Swales
- Swales With Check Dams
- Generic Infiltration Galleries
- Rain Gardens
- Permeable Pavement and Pavers
- Post-Construction Inlet Protection
- Hydrodynamic Separators
- Particulate Filtration Systems
- Outlet Skimmers or Shrouds
- Saturated Hydraulic Conductivity Rate

Storm Water - Low Impact Development (LID)

WET SWALES

Wet Swales are a type of filtration BMP and occur when the water table is located close to the surface. This wet swale acts as a very long and linear shallow wetland treatment...

[Read More](#)

Storm Water - Low Impact Development (LID)

DRY SWALES

A dry swale is a shallow, gently sloping drainage channel with broad, vegetated, side slopes. Swales provide temporary storage, filtration, and infiltration of stormwater runoff...

[Read More](#)

Storm Water - Low Impact Development (LID)

STANDARDIZED LIBRARY

- Provide standardized and normalized comparison between various storm water BMPs
- Include advantages, disadvantages and site applicability from a water quantity and quality perspectives.
- Currently the library includes:
 - Wet and dry swales
 - Check dams
 - Generic infiltration galleries
 - Rain gardens
 - Permeable pavement/pavers
 - Post-construction inlet protection
 - Hydrodynamic separators
 - Particulate filtration systems
 - Outlet skimmers.

UCEA LID/STORMWATER COMMITTEE COOPERATION

Utah League
of Cities and
Towns

Utah
Department of
Environmental
Quality

Utah
Homebuilders
Association

Local
engineers,
consultants &
vendors

Utah City Engineers
Association

DEMO