

Storm Networks Analysis During Extreme Hydrologic Events

**Employing Computer Softwares in
Modeling Networks' Performance**

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**Workshop on Climate Change
Adaptation in Human Settlements
Using Integrated Water Resources
Management (IWRM) Tools
(Amman, 22-24 May 2016)**

WHY We Should Take More Frequent Extreme Hydrology Events Into Consideration ?

SPM 1.4 Extreme events

Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions. {1.4}

Page 7, IPCC's Climate Change 2014 Synthesis Report

SPM 2.2 Projected changes in the climate system

Surface temperature is projected to rise over the 21st century under all assessed emission scenarios. It is *very likely* that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent in many regions. The ocean will continue to warm and acidify, and global mean sea level to rise. {2.2}

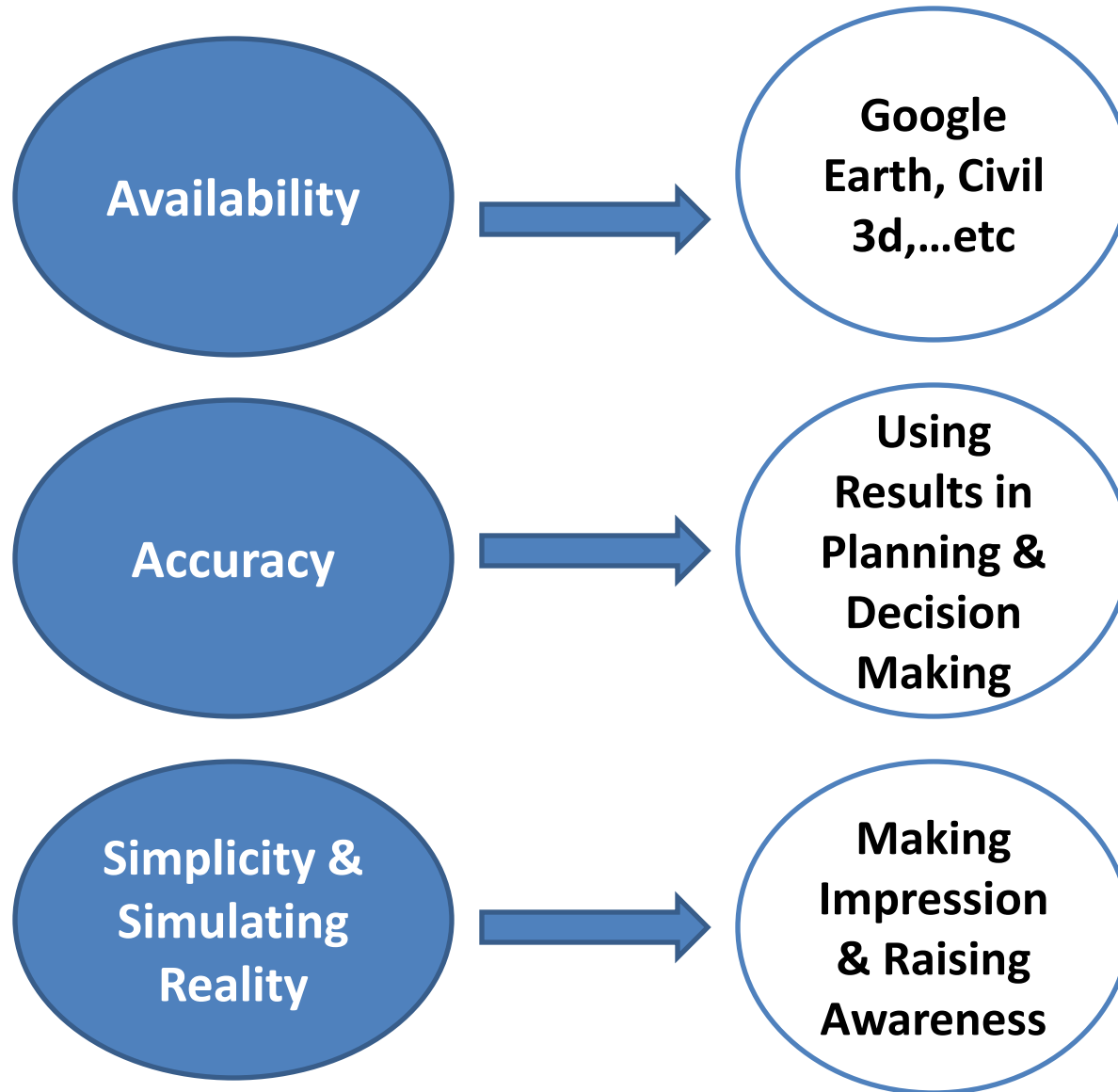
Page 8, IPCC's Climate Change 2014 Synthesis Report

“More severe precipitation patterns associated with a warmer world are already showing up”

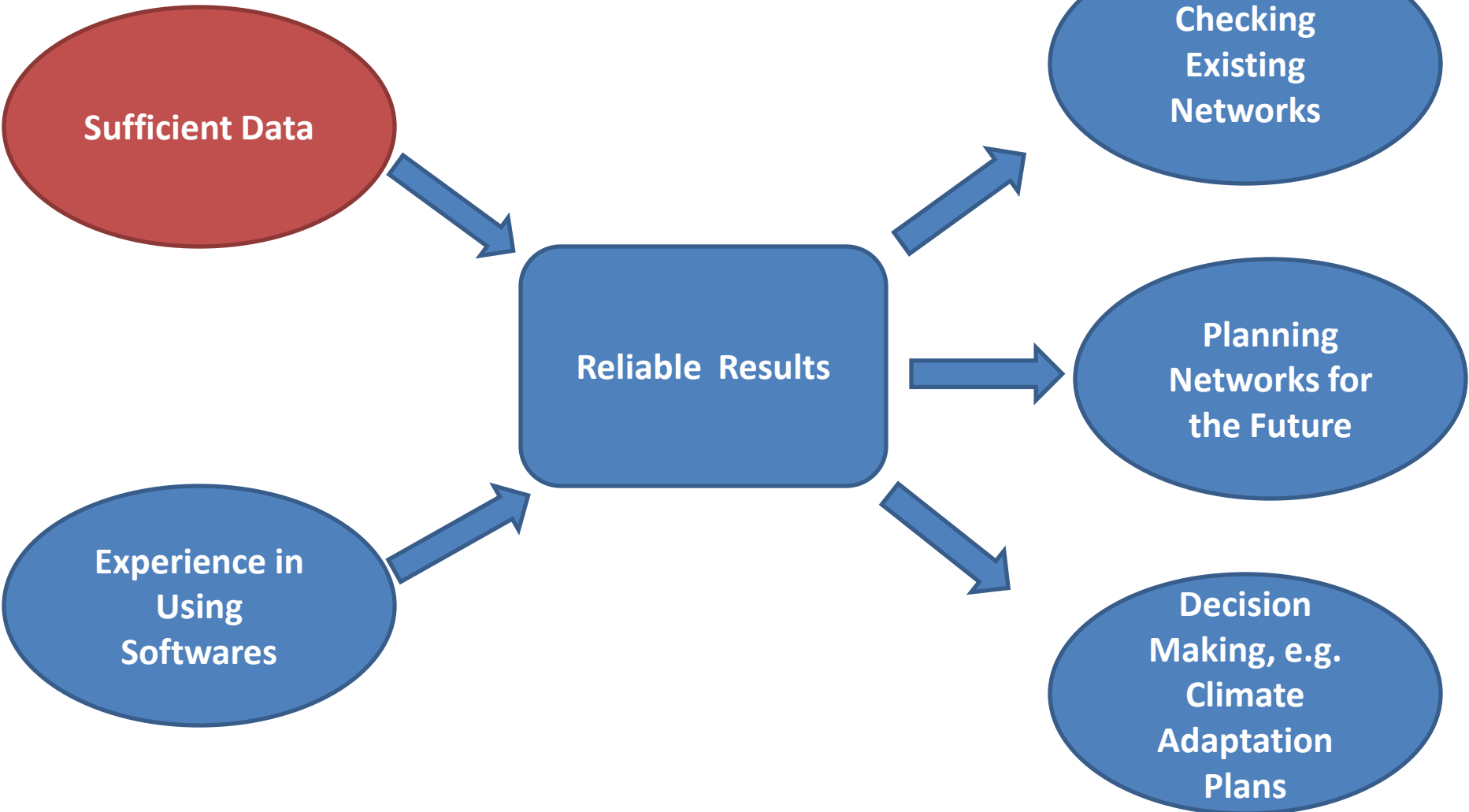
Kevin Trenberth, senior scientist and head of the climate analysis section of the independent National Center for Atmospheric Research (NCAR) in Boulder, Colo.

<http://www.livescience.com/10325-living-warmer-2-degrees-change-earth.html> (December 8, 2012)

PRO's of Employing Softwares in Analysis



Accuracy



Making Impression



<http://www.cbc.ca/news/trending/thin-bear-photo-kerstin-1.3232725>

"Climate change is undeniable, It is happening and we have to do something about it. And this photo, I can say to all of you: Look at it." Said Kerstin Langenberger, a German national who works as a photographer and a conservationist who took this picture in Svalbard, Northern Norway and posted it on Facebook.



+52,000 Shares

Where Does Concern about Climate Change Rank?

How **concerned** are people worldwide about **climate change**?

Worldwide, people are much less concerned about climate change. Developing countries in particular rank it low.

Percentage of times each issue appeared in the top three worries for respondents:

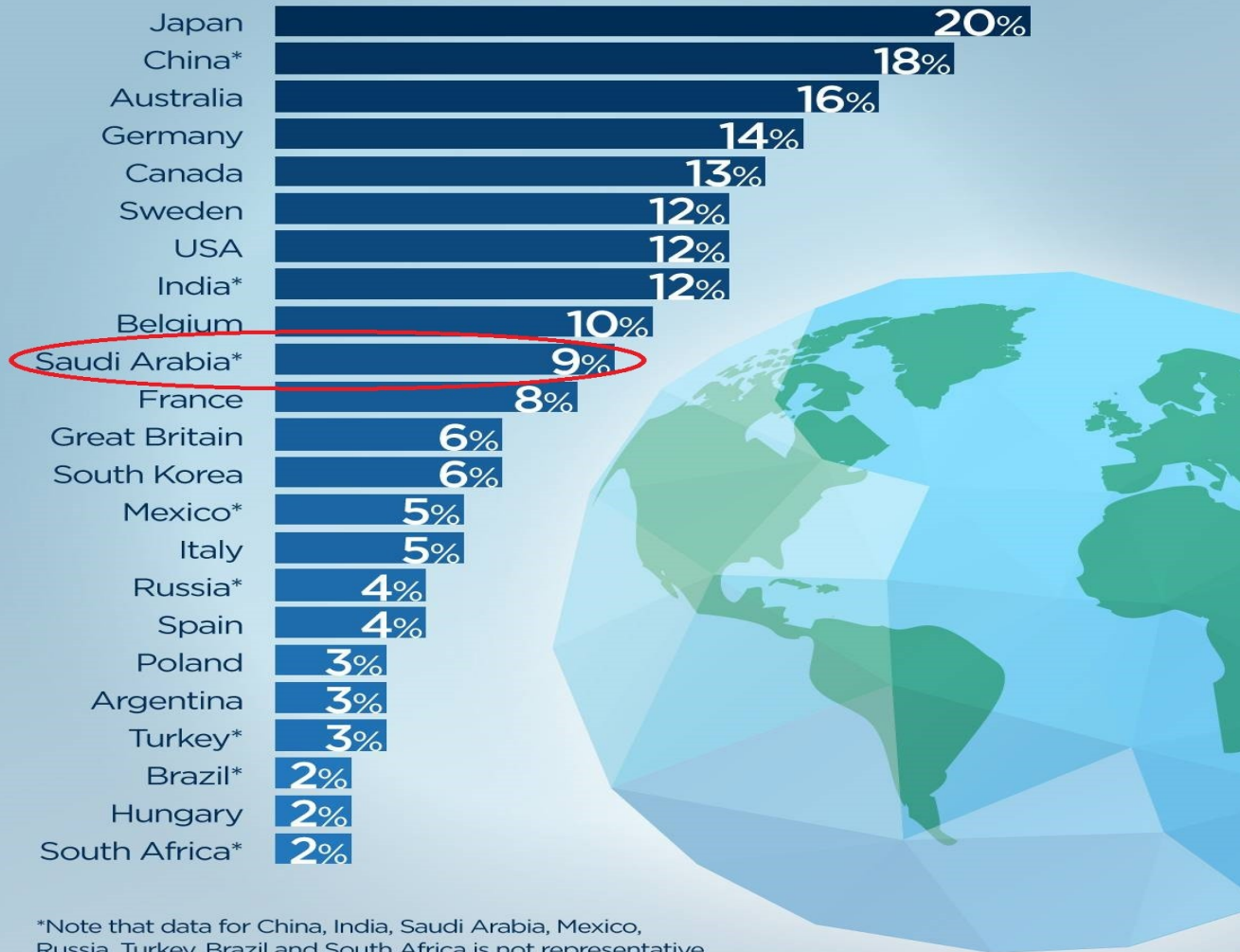


© Global News / Ipsos

According to Mike Colledge, president of Canadian public affairs at Ipsos: *“In developing countries, it’s really not an issue.”*

<http://globalnews.ca/news/2366032/climate-change-a-low-priority-for-most-canadians-poll>, November 29, 2015

Percentage of people, by country, who rank climate change as a top priority:



*Note that data for China, India, Saudi Arabia, Mexico, Russia, Turkey, Brazil and South Africa is not representative of the general population - just of highly educated, wealthier, often urban residents with internet access.

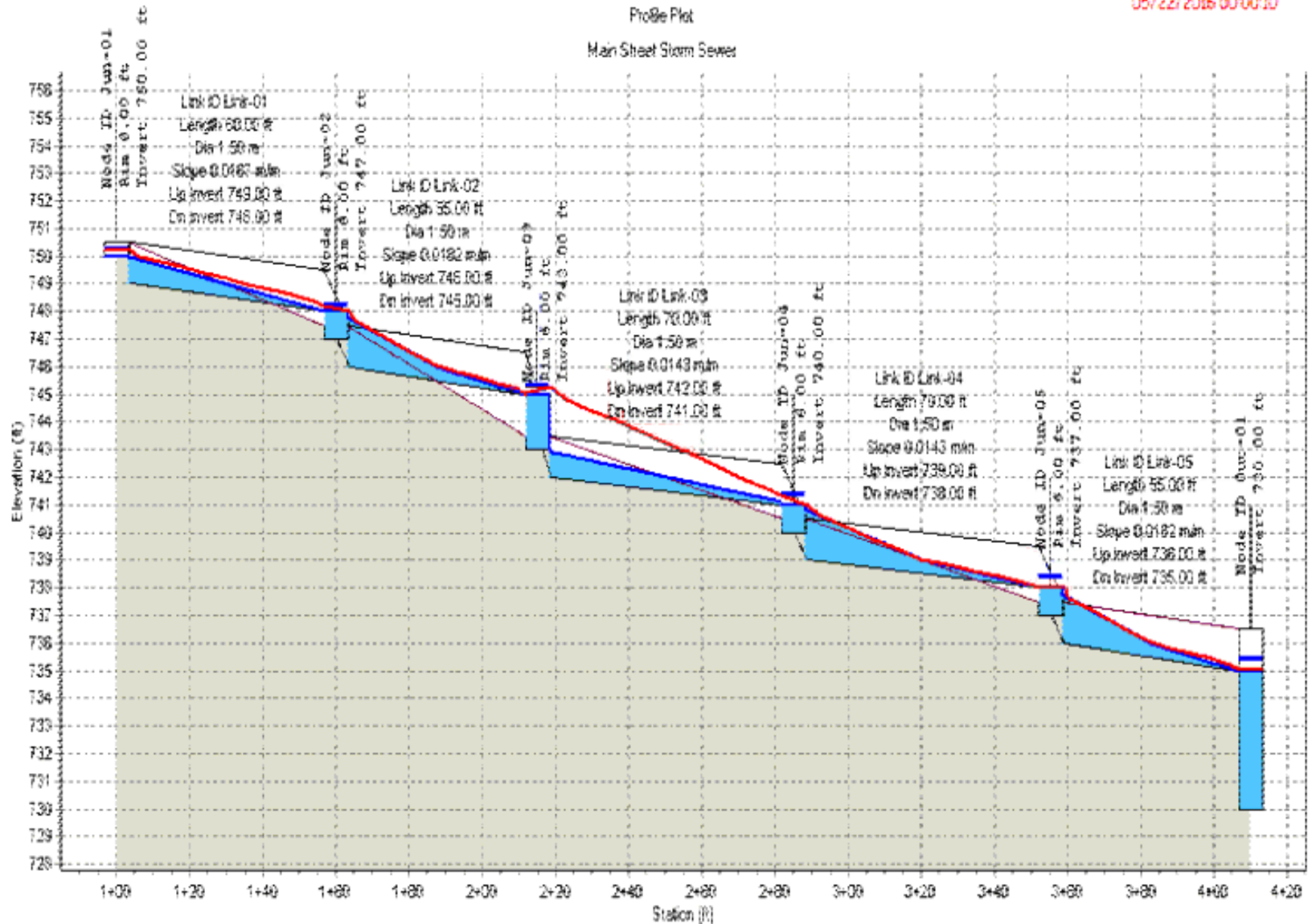
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<http://globalnews.ca/news/2366032/climate-change-a-low-priority-for-most-canadians-poll>,

November 29, 2015

Sample

05/22/2016 00:00:10



Main Softwares Used

```
graph TD; A([Main Softwares Used]) --> B[AutoCAD Civil 3d 2012  
Topography (From Google Earth) & Network Layout]; A --> C[Storm and Sanitary Analysis (SSA)  
Design & Analysis According to Different Scenarios];
```

AutoCAD Civil 3d 2012

Topography (From Google Earth) & Network Layout

Storm and Sanitary
Analysis (SSA)

Design & Analysis
According to Different
Scenarios

AutoCAD Civil 3d 2012

Software's Main Uses:



Surveying

Highways Design
and Q.S.

Storm and
Sanitary
Networks Layout

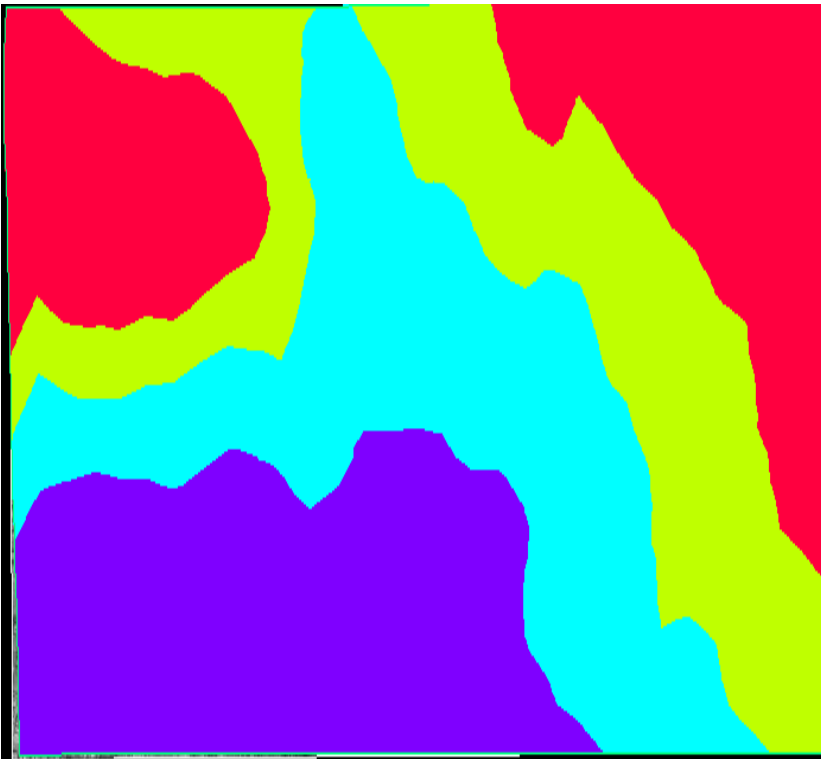
Google Earth and Civil 3d



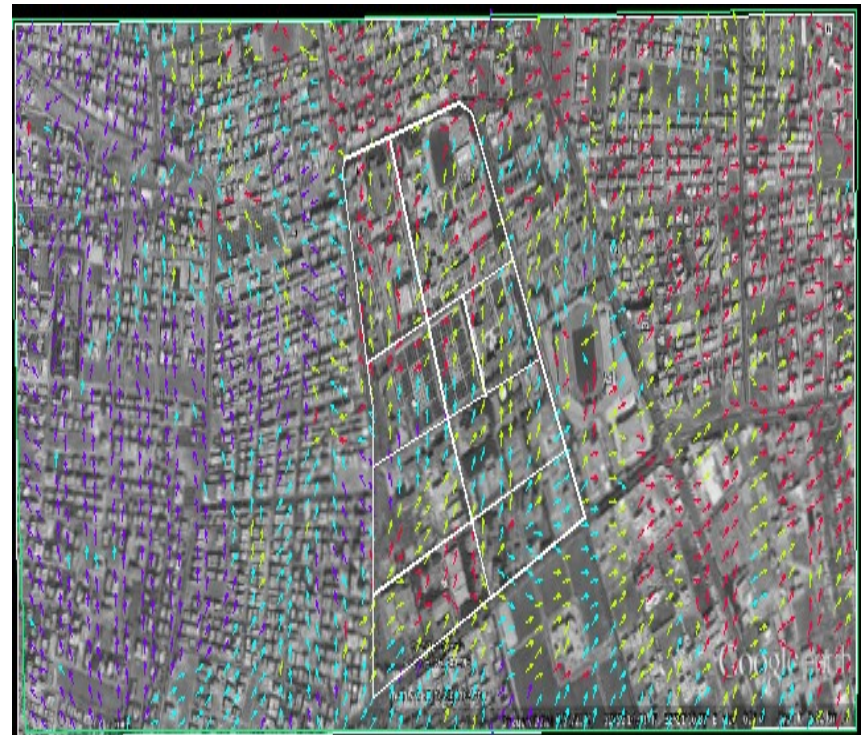
A certain location's
Topography
(elevations, contour
lines, slopes...etc) in
Google Earth

Import

AutoCAD Civil
3d



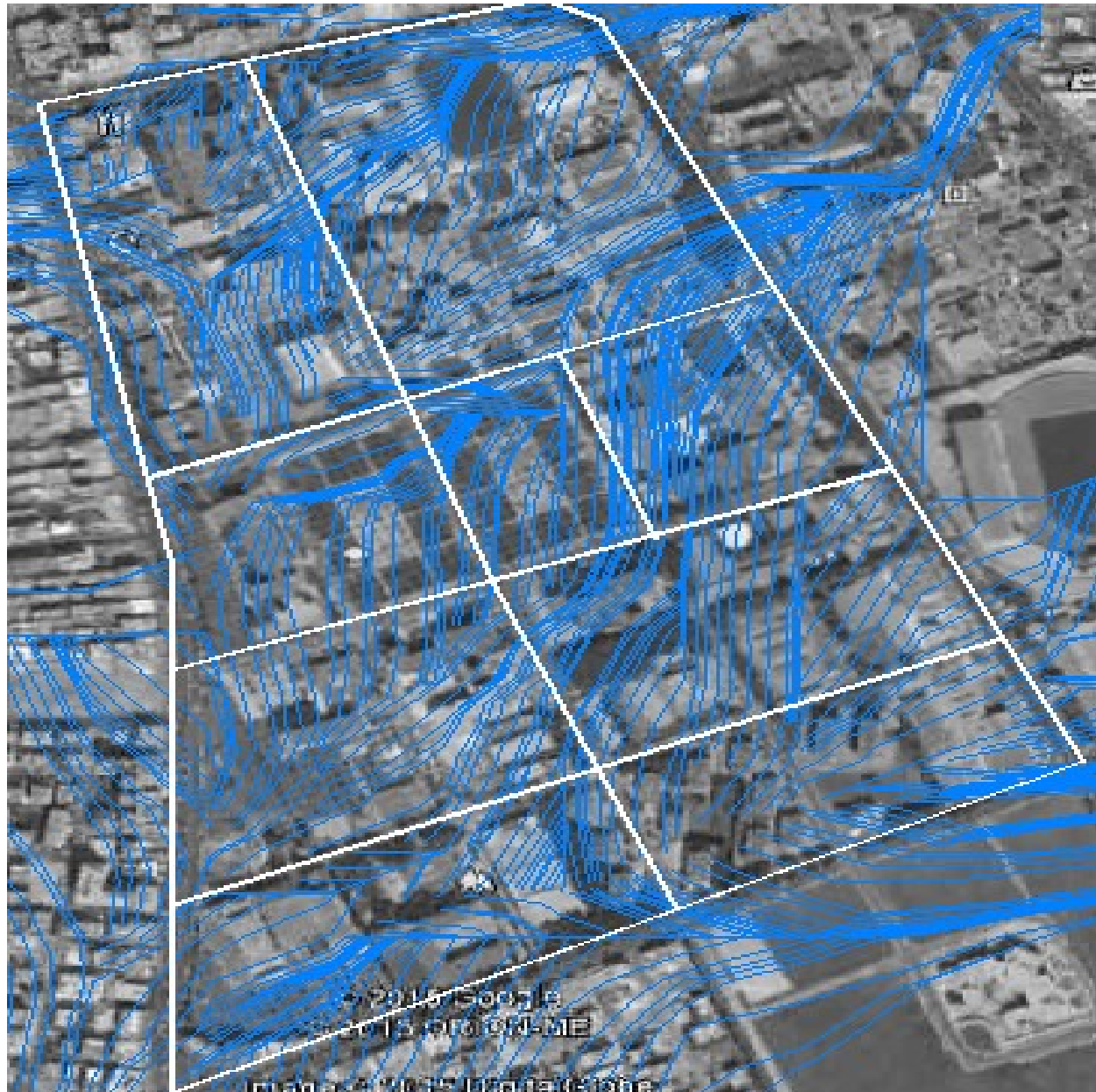
Elevations Table				
Number	Minimum Elevation	Maximum Elevation	Area	Color
1	552.32	586.97	1002399.35	Red
2	586.97	596.41	1027238.50	Yellow
3	596.41	610.71	1071612.47	Cyan
4	610.71	656.20	989596.69	Purple



Slope Arrows Table			
Number	Minimum Slope	Maximum Slope	Color
1	0.00%	2.51%	Red
2	2.51%	4.10%	Yellow
3	4.10%	6.58%	Cyan
4	6.58%	360.07%	Purple

Modifications in the view of Surface's Topography done in AutoCAD Civil 3d

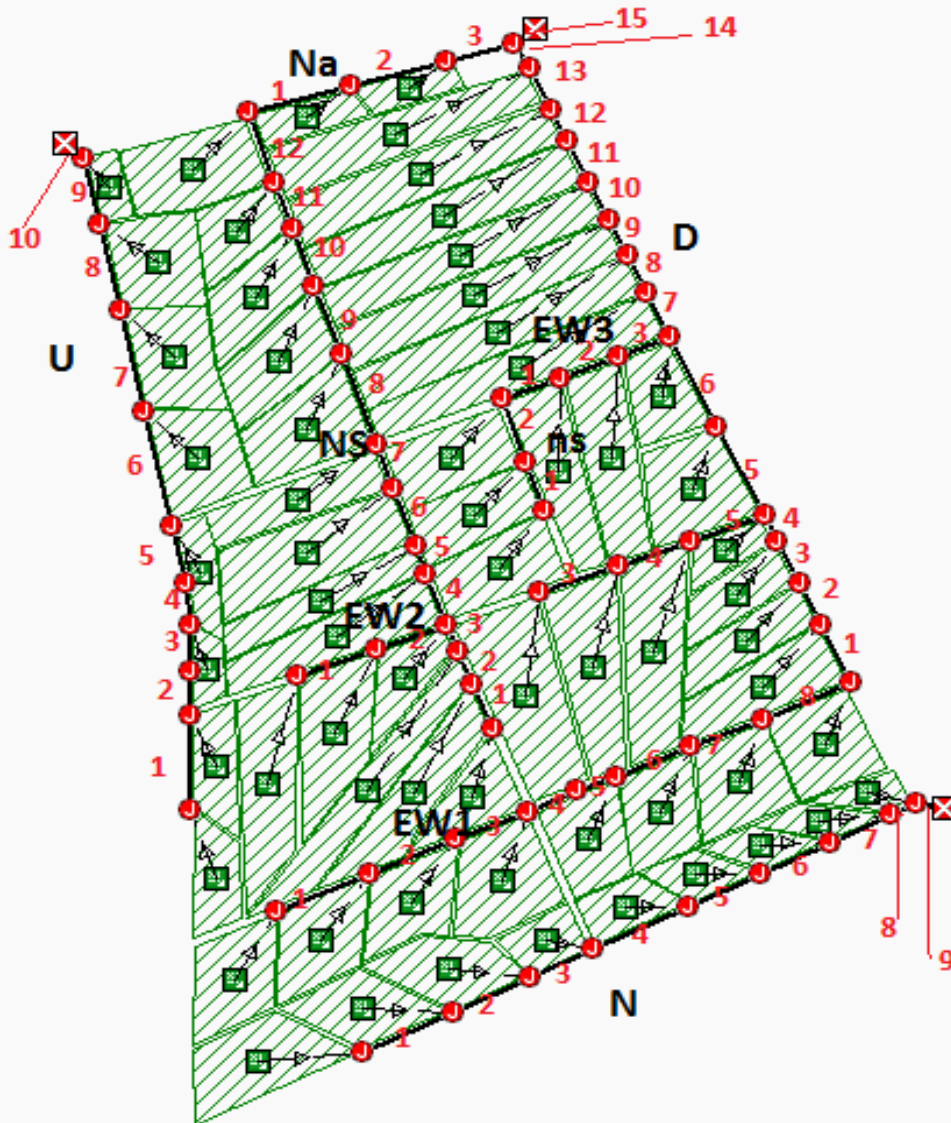
Water Drop Command





A Storm Network Layout as Appears in AutoCAD Civil 3d

Storm and Sanitary Analysis (SSA)

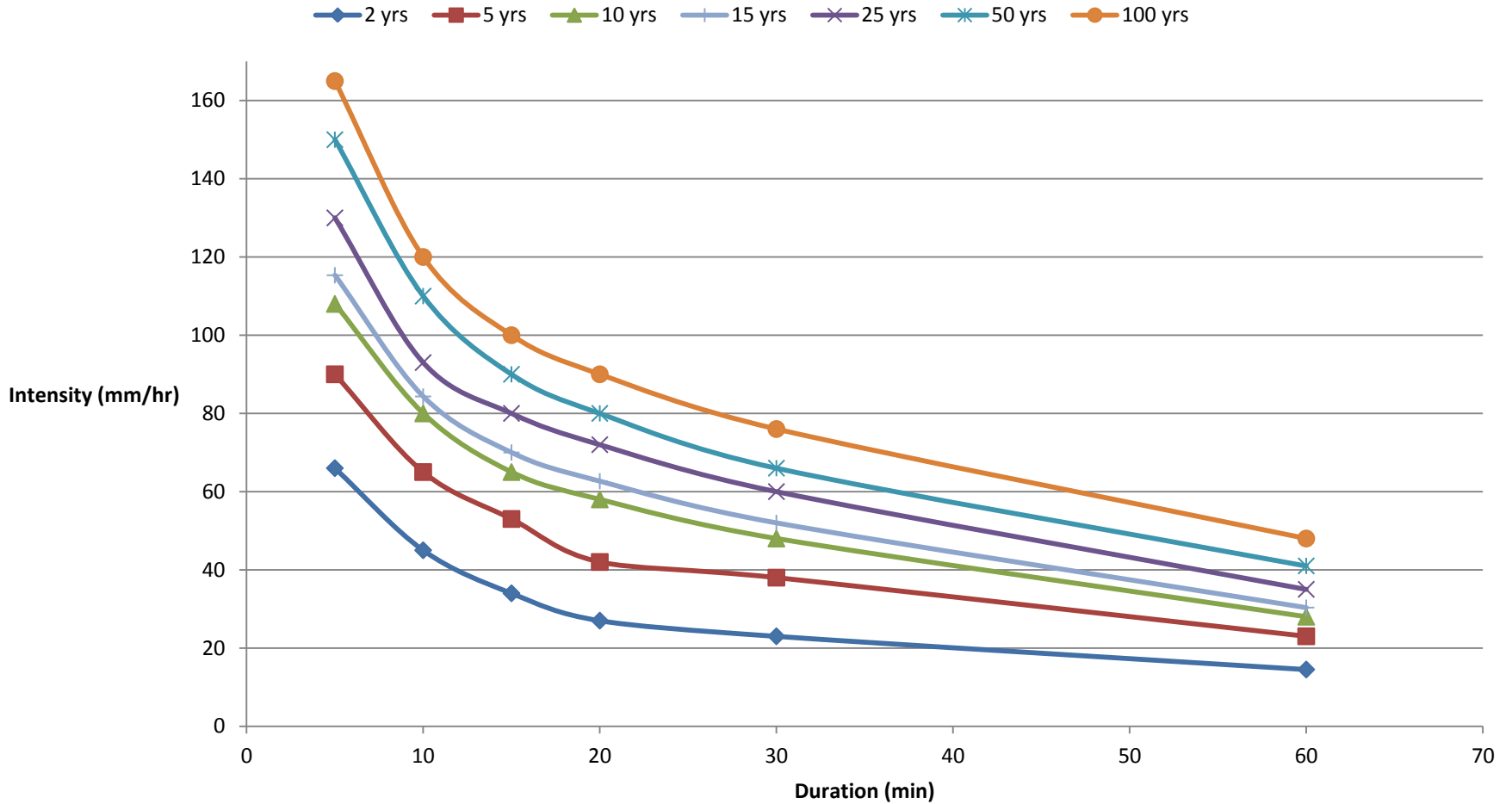


Softwares Abilities Under Consideration

Storm Networks Analysis

Sanitary Networks Analysis

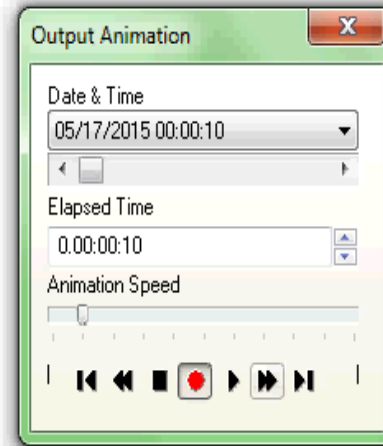
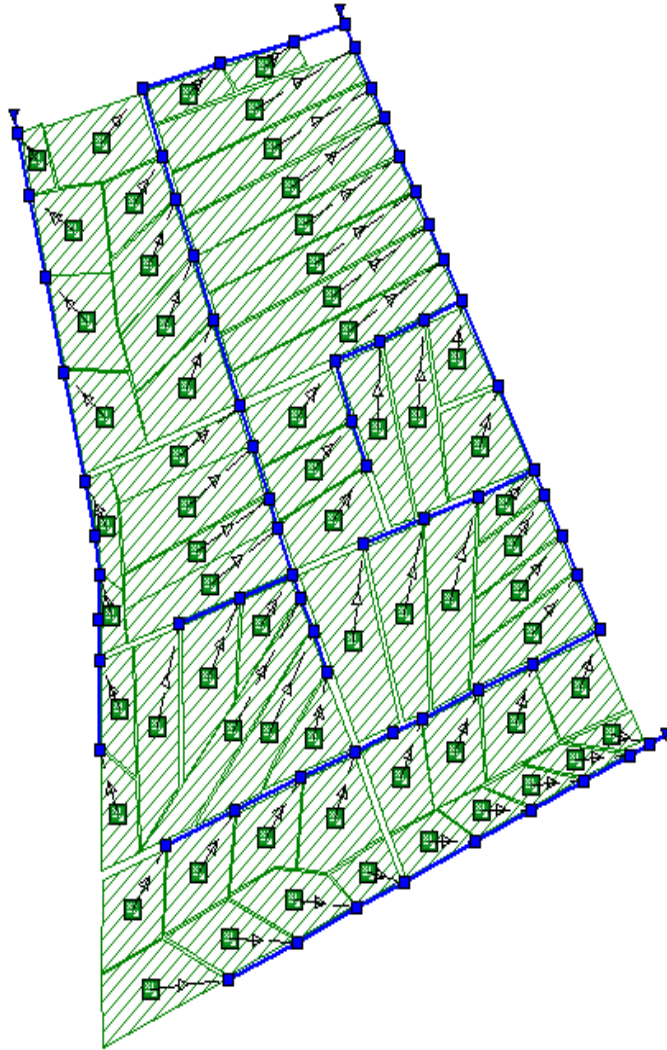
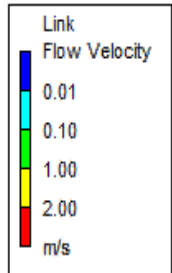
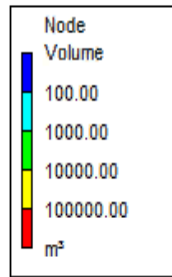
IDF curves



The IDF curves were created based on data from Consulting Engineering Center (CEC), IDF relation manual

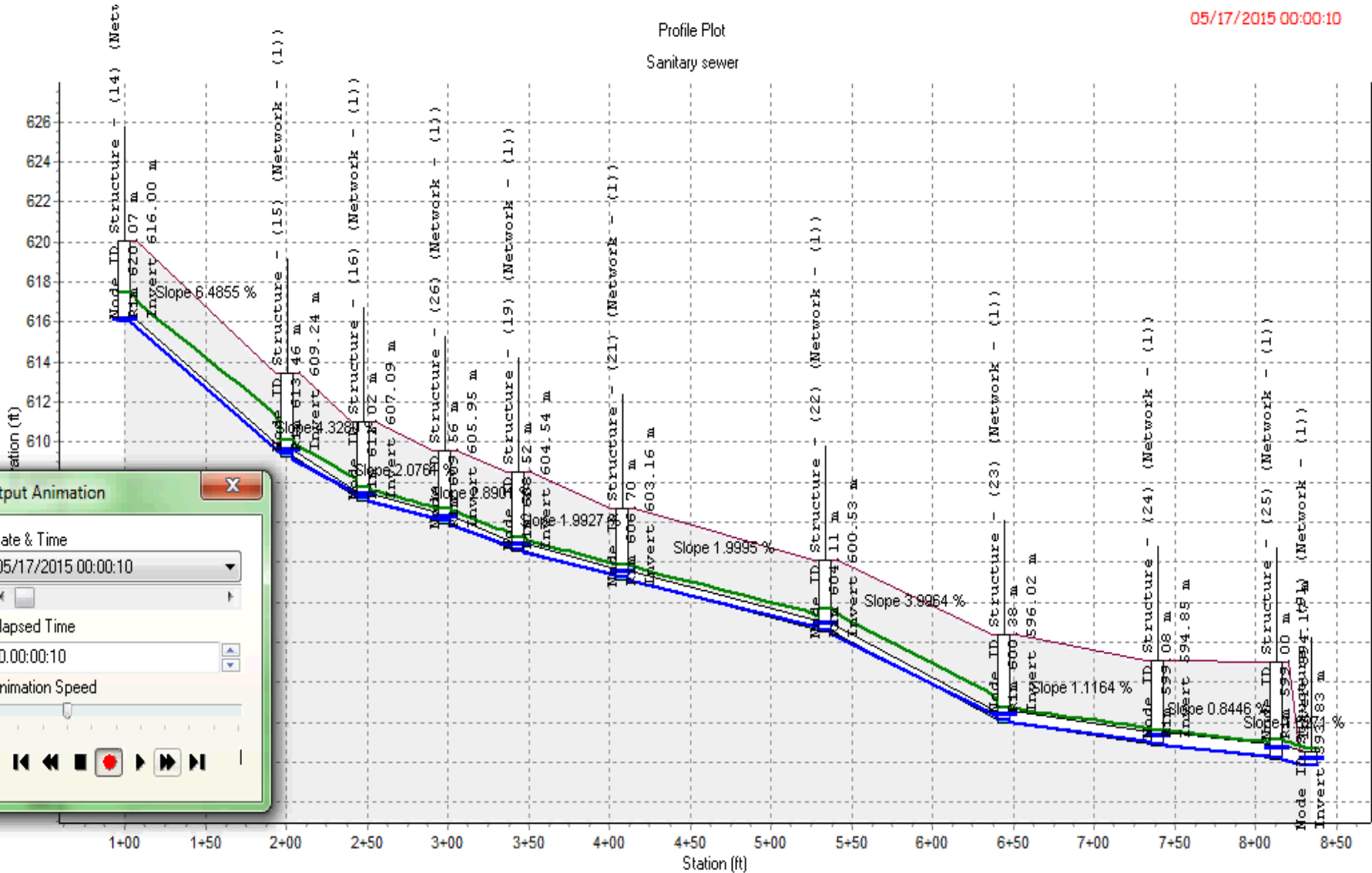
Table 2.4: GHG scenarios and the projected effect on precipitation and temperature per year on country level (TNC)

		RCP 4.5				RCP 8.5				
		Year	Minimum	Medium	Maximum Reference	Year	Minimum	Medium	Maximum	Reference
Precipitation (mm)	2035	-15.9	-8.2	9.2	-3.0	2035	-20.4	-12.9	-0.5	-12.9
	2055	-24.2	-15.4	0.7	-15.4	2055	-26.5	-15.0	-7.0	-12.9
	2085	-22.5	-13.6	-5.7	-12.0	2085	-38.0	-21.9	-10.9	-14.8
Mean Temperature	2035	0.9	1.2	1.8	1.2	2035	1.3	1.6	2.2	1.6
	2055	1.6	1.7	2.5	1.8	2055	2.1	2.6	3.4	2.6
	2085	1.8	2.1	2.8	2.5	2085	3.8	4.0	5.1	4.0
Maximum Temperature	2035	1.0	1.1	1.8	1.1	2035	1.3	1.5	2.3	1.5
	2055	1.6	1.7	2.5	1.7	2055	2.2	2.6	3.5	2.5
	2085	1.7	2.1	2.8	2.5	2085	3.8	4.1	5.0	3.9
Minimum Temperature	2035	0.9	1.1	1.7	1.3	2035	1.2	1.6	2.1	1.7
	2055	1.5	1.7	2.4	1.8	2055	2.0	2.5	3.3	2.7
	2085	1.7	2.0	2.8	2.5	2085	3.7	4.0	5.1	4.0



An animation in the entire network using SSA during a specified storm

Profile Plot
Sanitary sewer



Output Animation

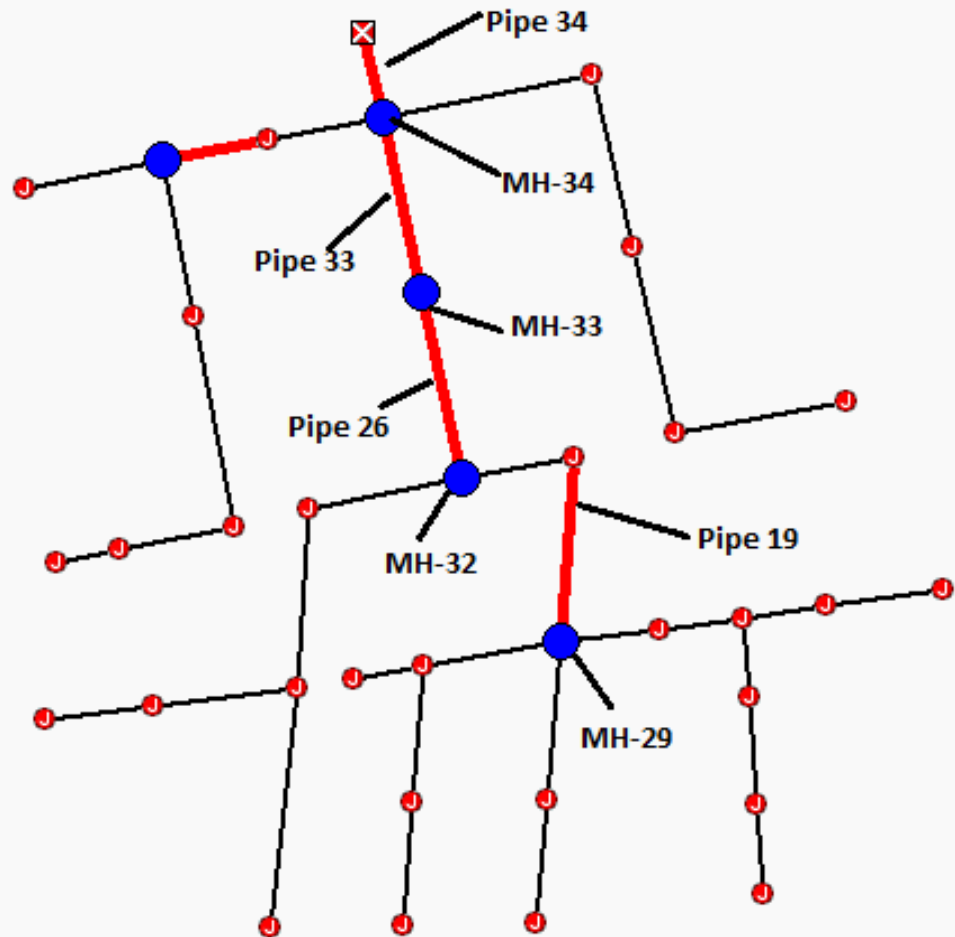
Date & Time
05/17/2015 00:00:10

Elapsed Time
0:00:00:10

Animation Speed

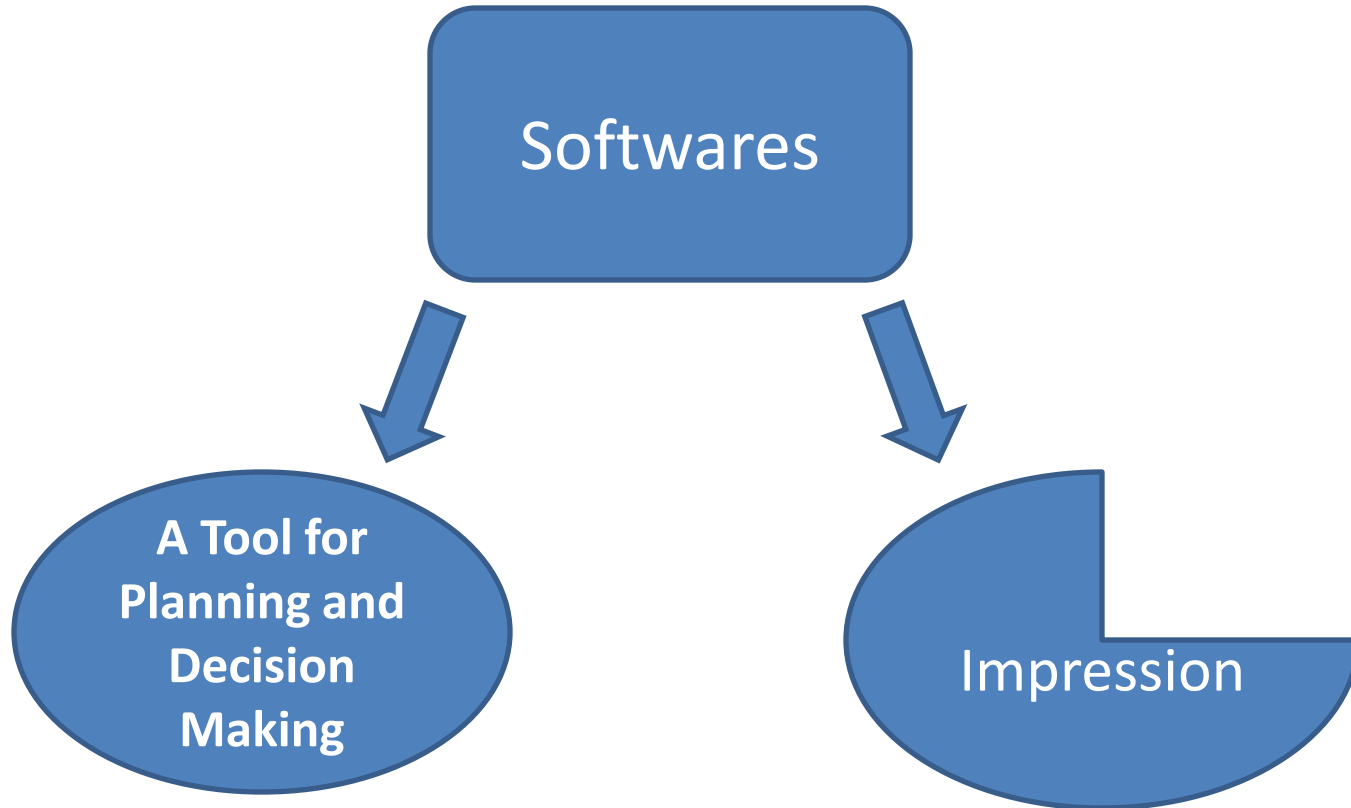
⏪ ⏩ ⏹ ⏸ ⏪ ⏩

An animation in a pipe section using SSA during the specified storm



Flooded Network after Analysis by SSA Software

Conclusion



Thank You