Low Carbon Asia Research Network (LoCARNet) 4th Annual Meeting
International Conference of Low Carbon Asia
Positive Action from Asia – Towards COP21 and Beyond
11-13 October 2015
DoubleTree Hotel, Johor Bahru, Malaysia

Designing Low Carbon and Climate Resilient Watershed Management

through Multi-Stakeholder Process: Study Case in the Philippines

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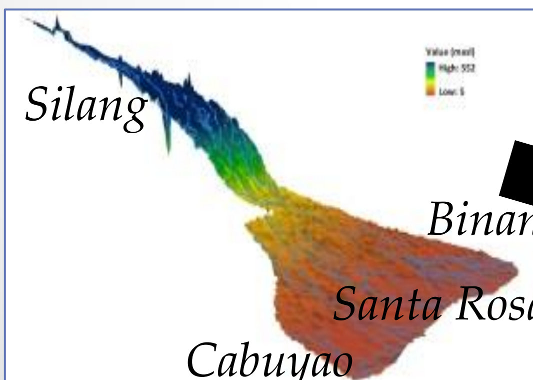
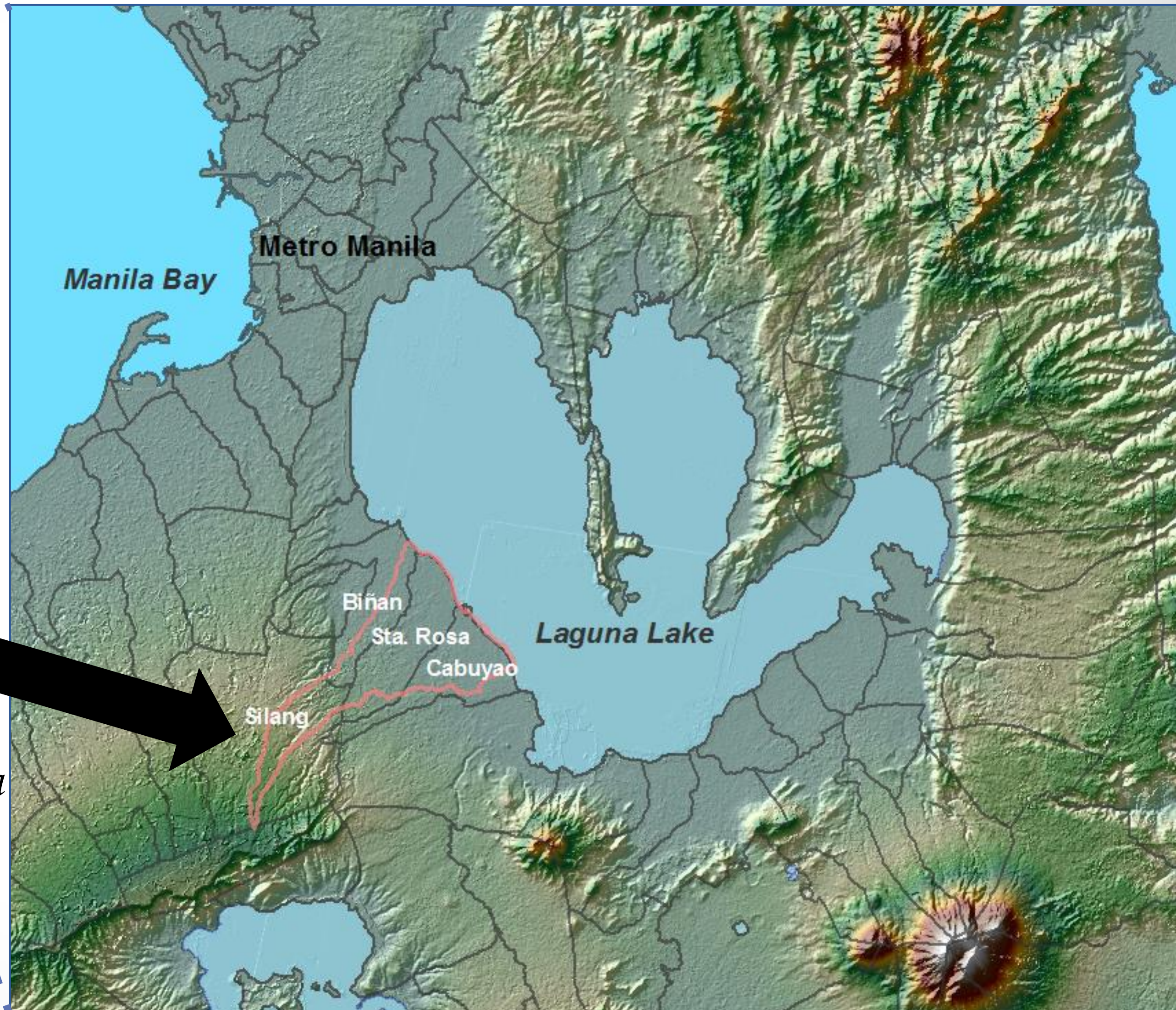
IGES/UPLB Pilot project: Study area





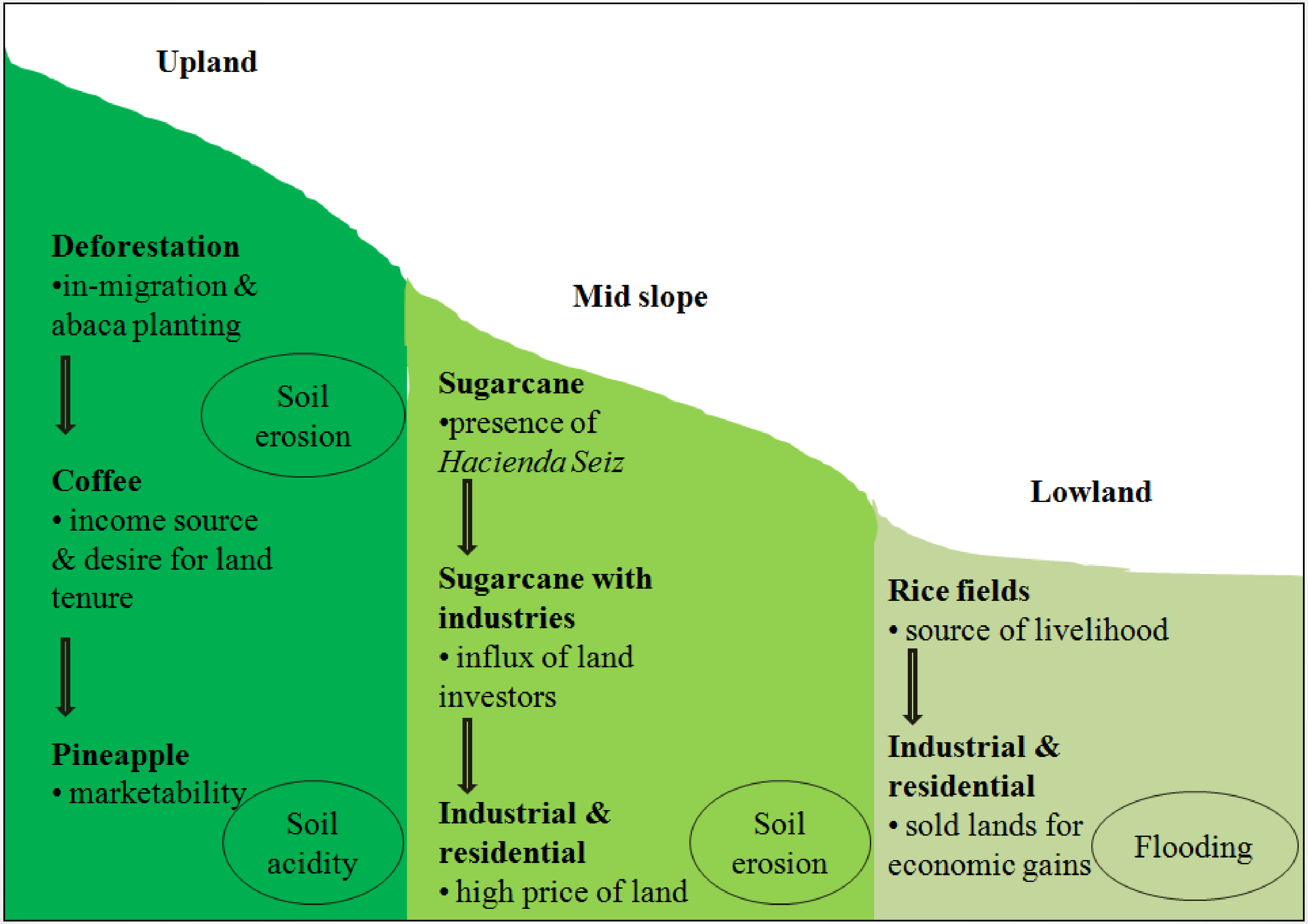
Silang-Santa Rosa Subwatershed, Philippines

Rapid Land Conversion

2007 ➞ 2014

Portion of Sta. Rosa City experiencing conversion of **Rice fields** to **Subdivisions**

Drivers and impacts of land cover change



Weather-related disasters: Flooding

Santa Rosa, Philippines 2014

Methodology

Scientific, Land-use, Ecosystem, Watershed Approach

Scenario development

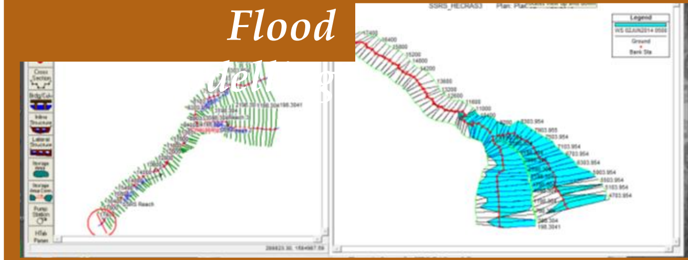
Risk assessment

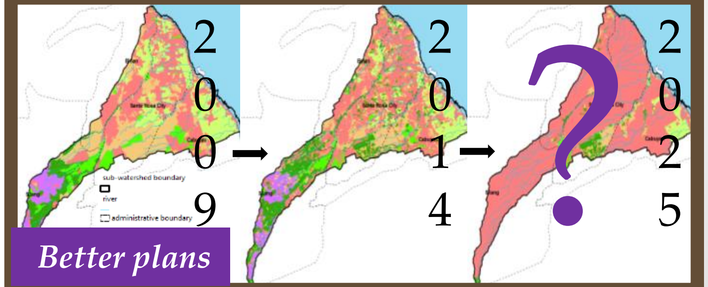
Climate change measure development

Climate-sensitive land-use planning

Stakeholder consultation

Flood

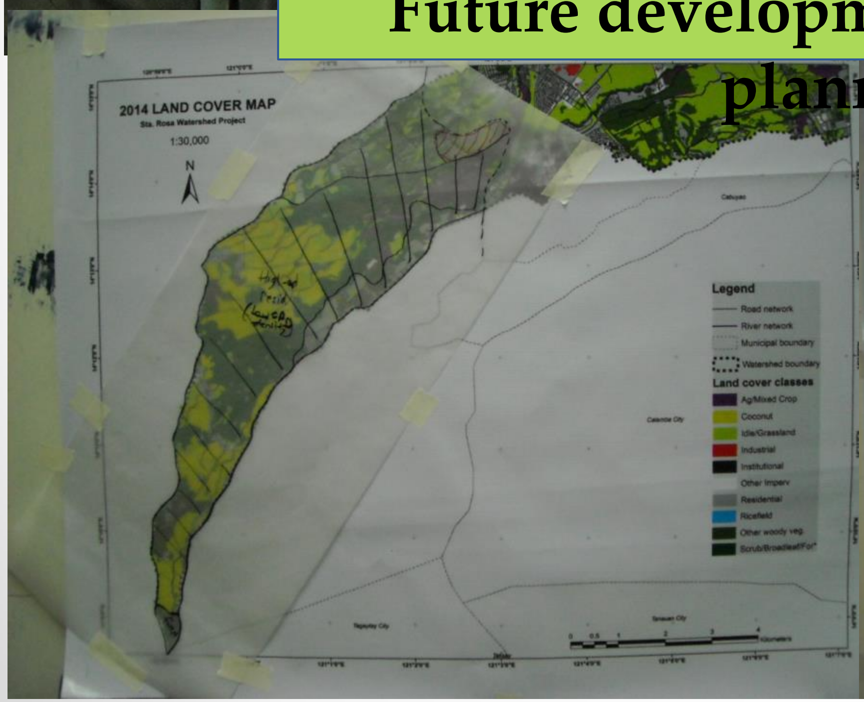


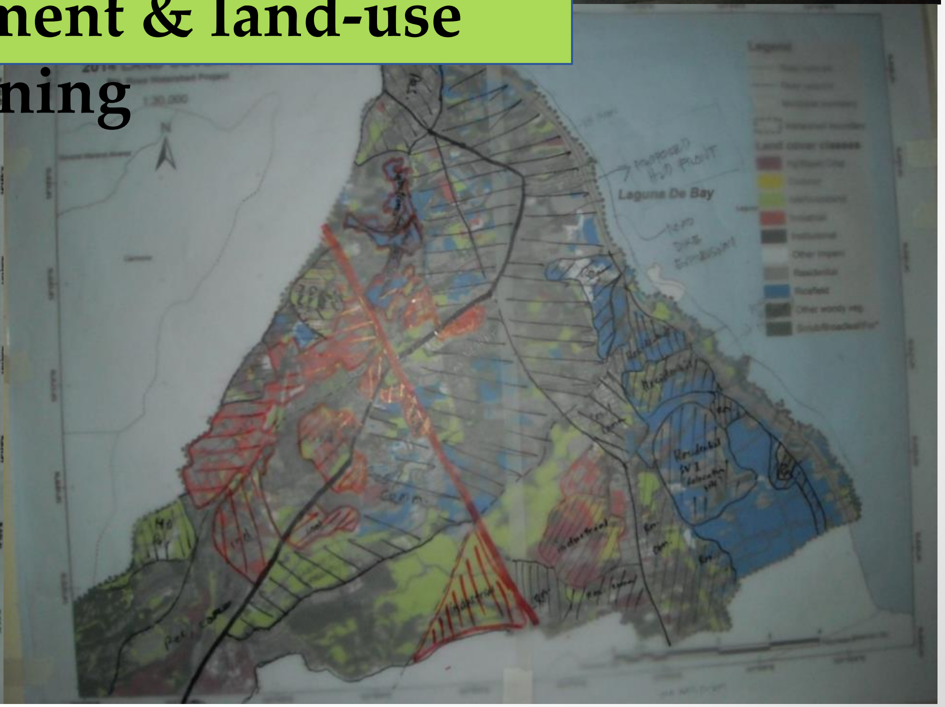


Better plans

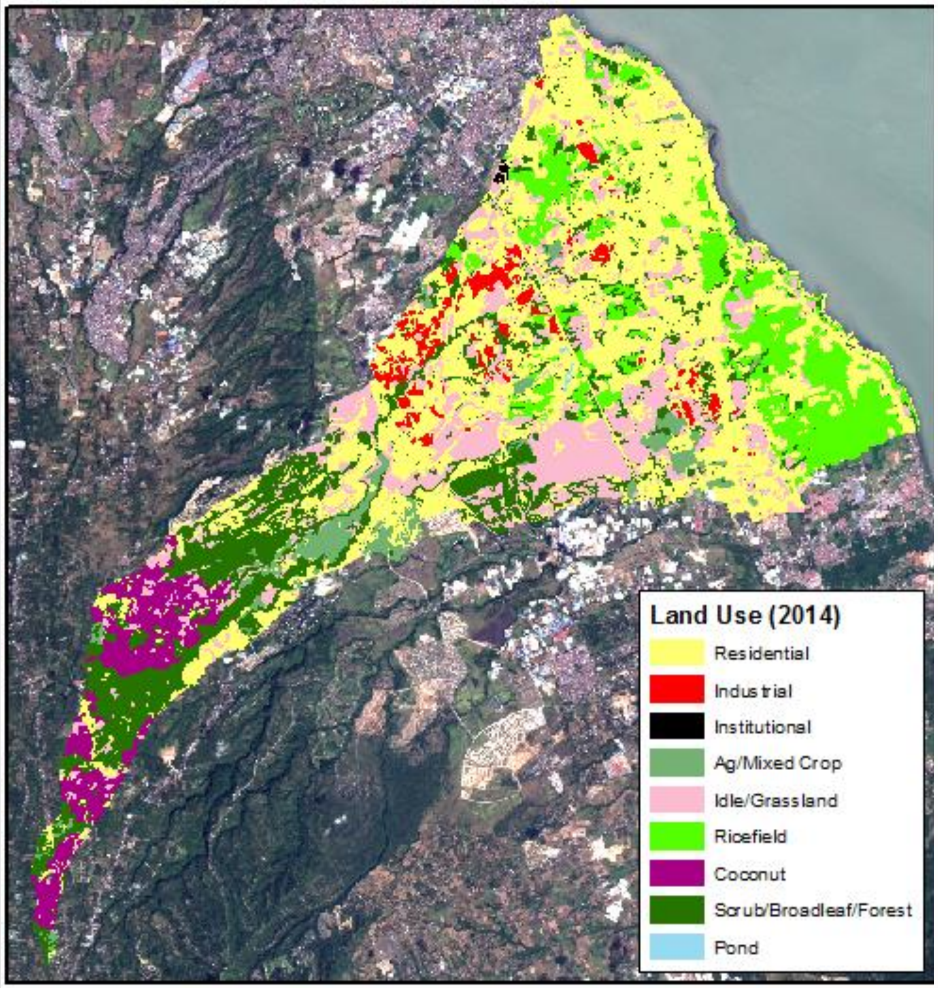
Climate sensitive plans

Consultation with local governments: Future development & land-use planning

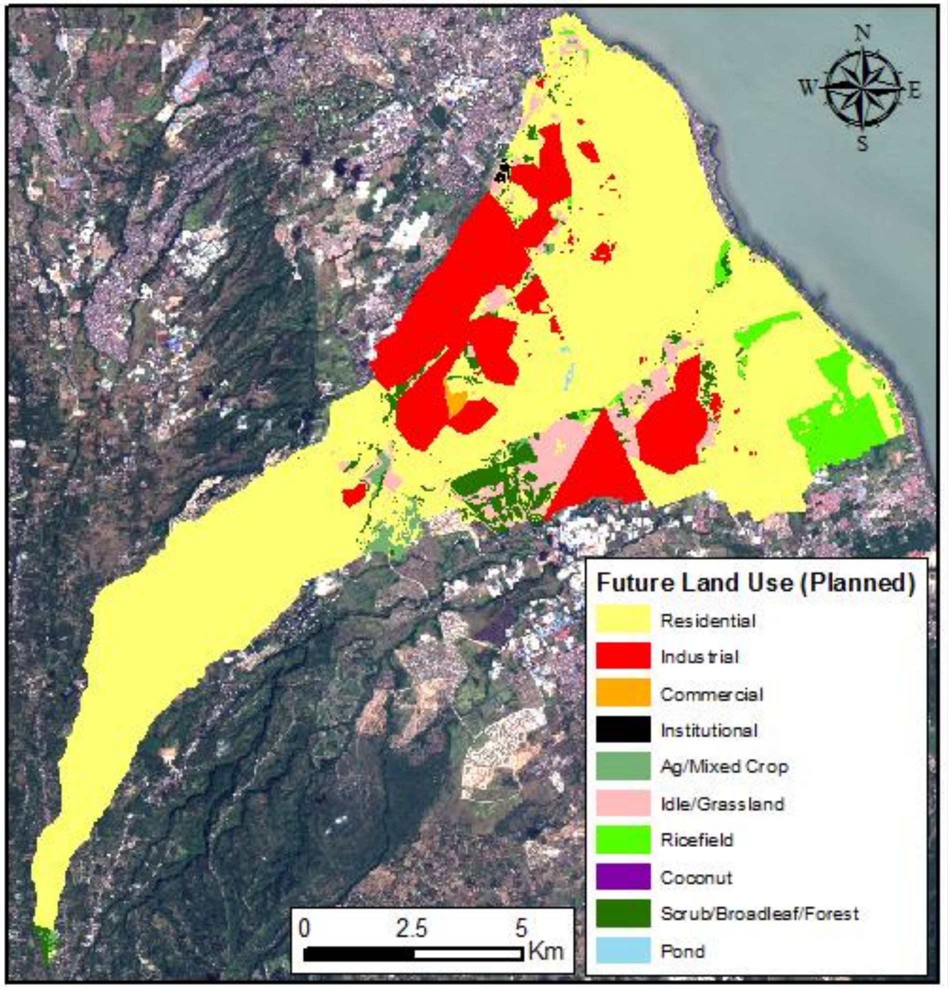




Current Land Use (2014)



Future Land Use Plan (2025)*



*Future land use plan map based on the results of a participatory land use mapping sessio
representatives from four local government units (LGUs)

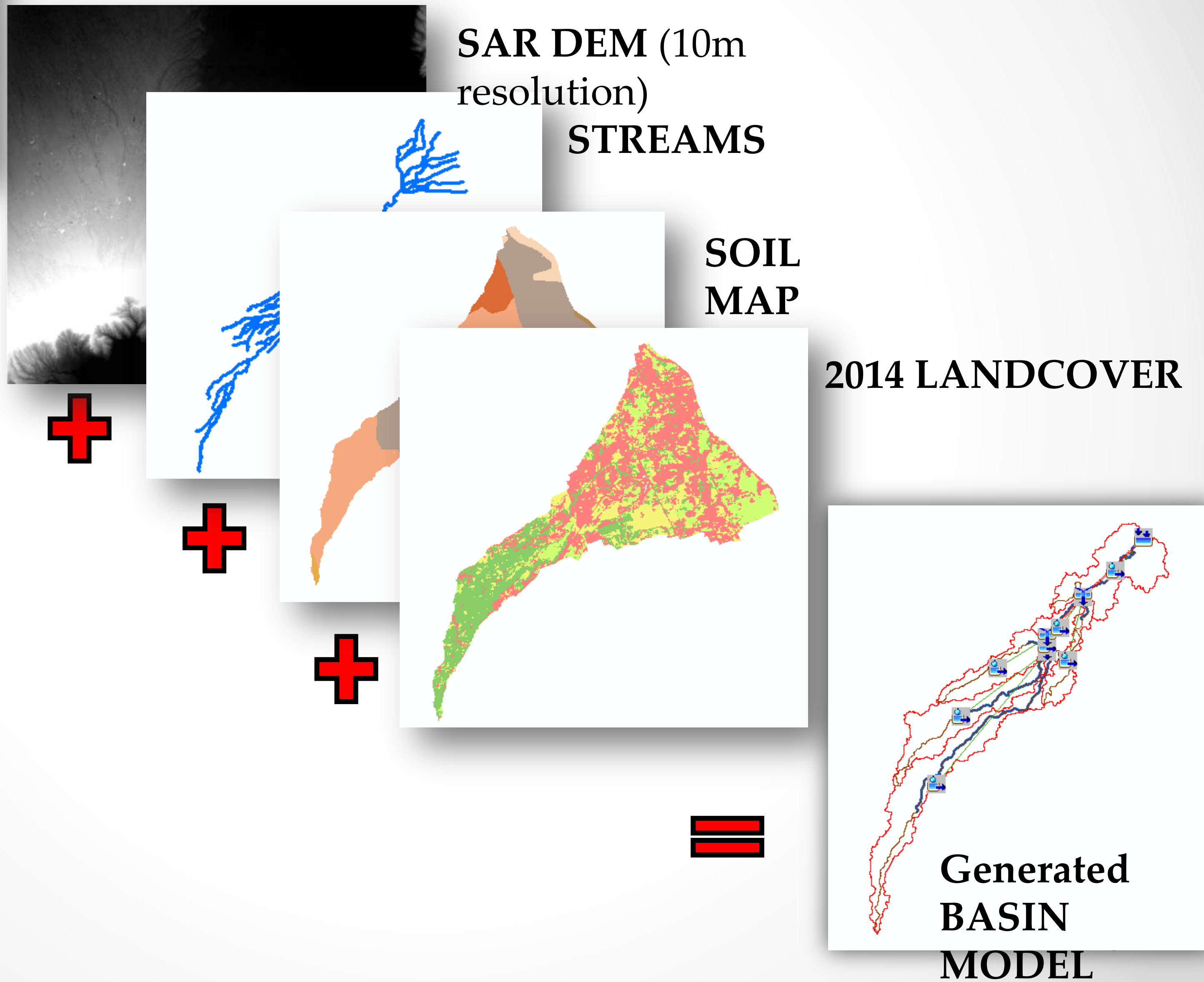
FLOOD MODELLING

Generation of Basin Model using ArcGIS10
*with **HEC-GeoHMS** and **HEC-GeoRAS** extensions*

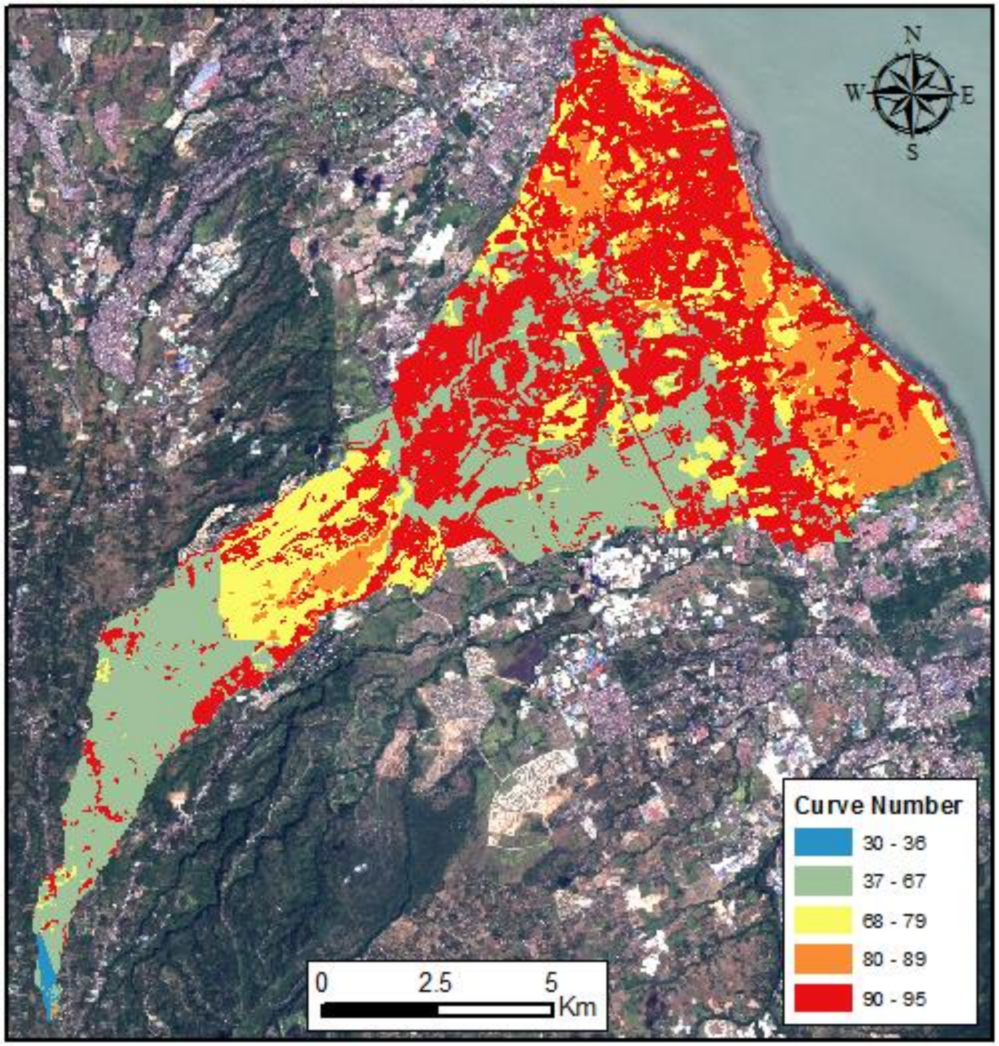
***Generation of Rainfall-Runoff Curve using HEC-HMS** :*
Hydrologic Engineering Center - Hydrologic Modeling System

***Generation of Flood Model using HEC-RAS** :*
Hydrologic Engineering Center - River Analysis System

Generation of Basin Model using ArcGIS10 with HEC-GeoHMS and HEC-GeoRAS extensions

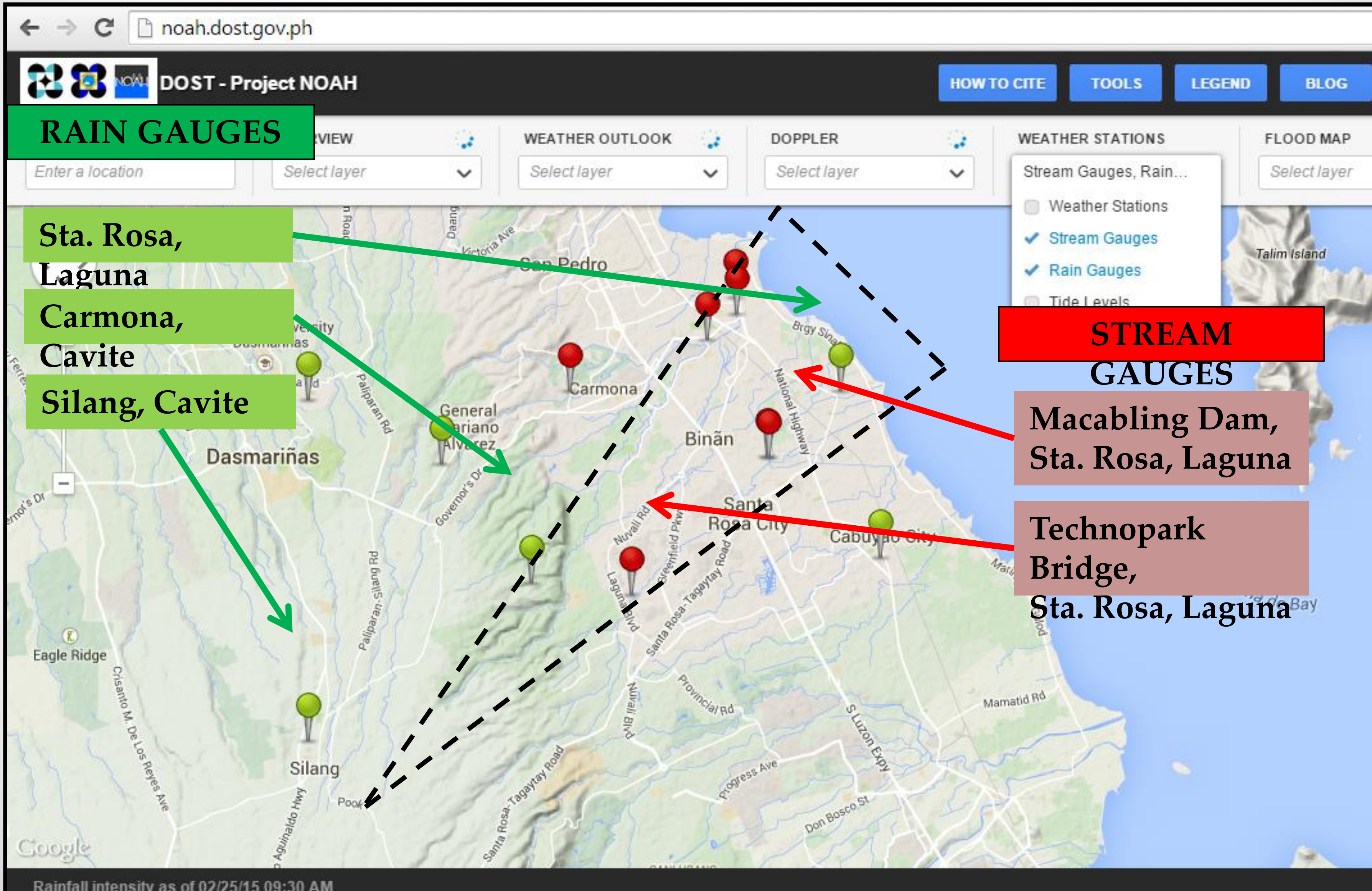


Curve Number (Runoff coefficient) Map: 2014



-Higher Curve Number values indicate higher stormwater runoff. Values are based o
land use and soil type. Curve Numbers are used for flood hazard modeling.

Collection of precipitation and discharge data from DOST-Project NOAH

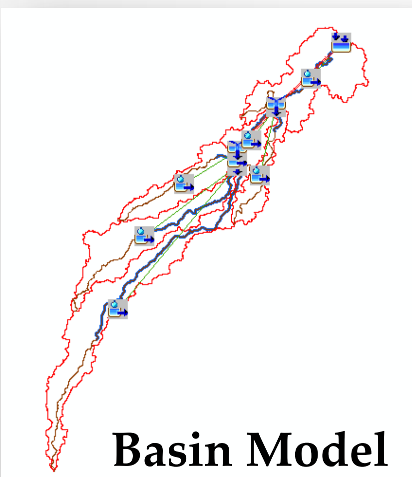


Generation of Rainfall-Runoff Curve using HEC-HMS :

Hydrologic Engineering Center - Hydrologic Modeling System

Sample Results:

(should be calibrated)



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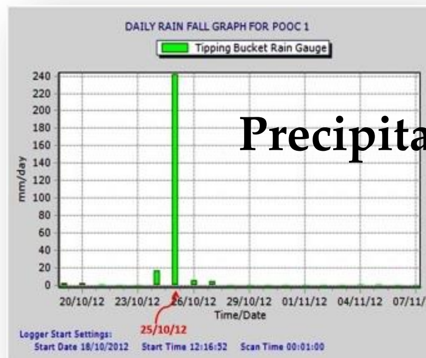

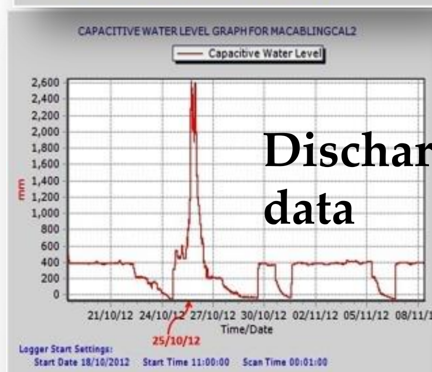

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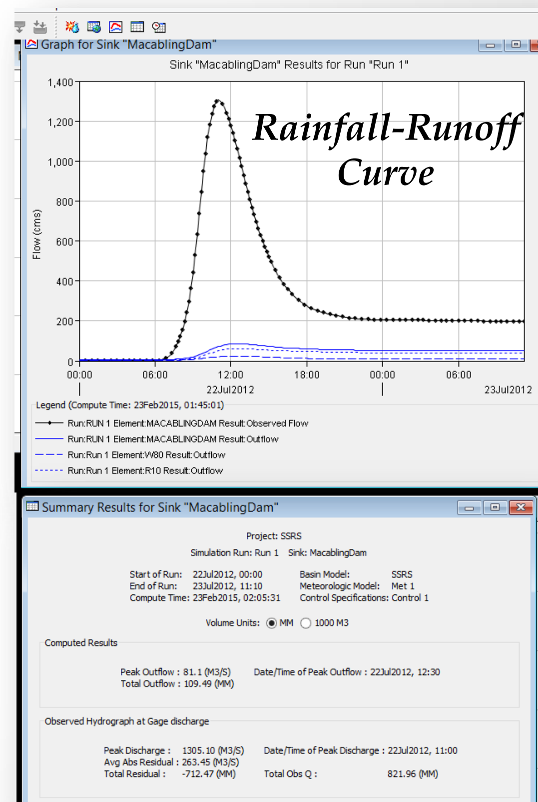
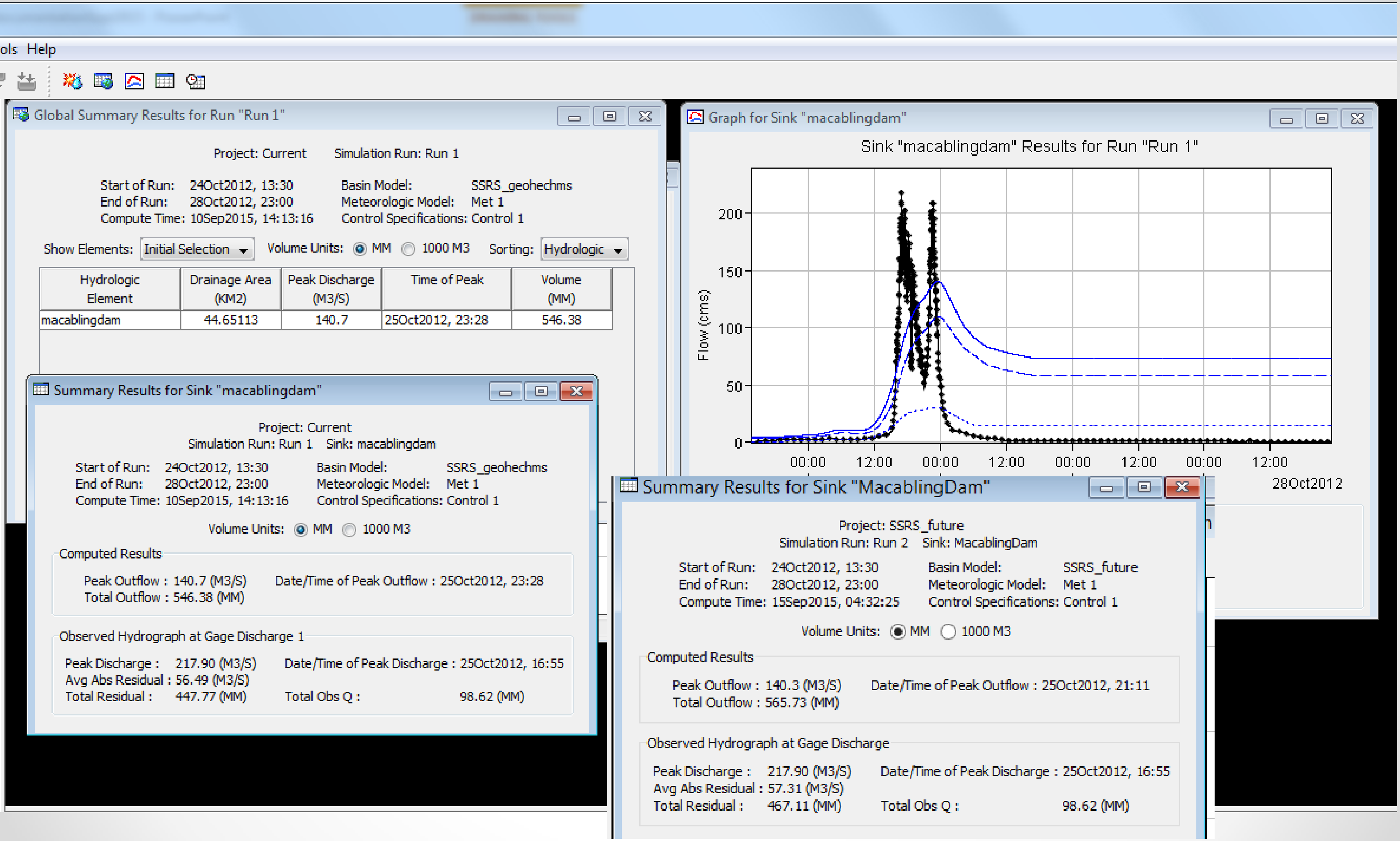
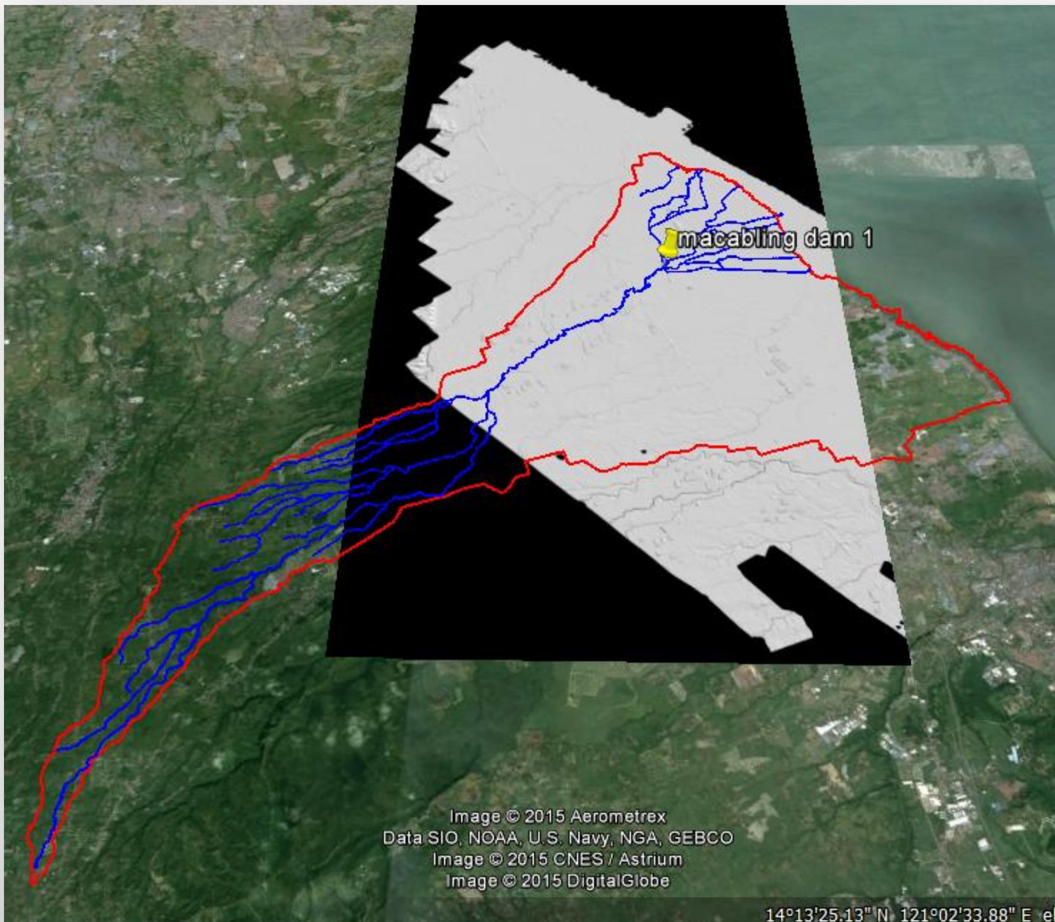


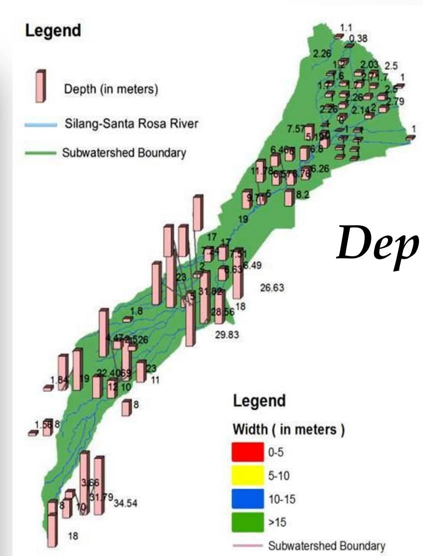
Initial Run


ols Help
Global Summary Results for Run "Run 1"
Project: Current Simulation Run: Run 1
Start of Run: 24Oct2012, 13:30
End of Run: 28Oct2012, 23:00
Compute Time: 10Sep2015, 14:13:16
Basin Model: SSRS_geohechms
Meteorologic Model: Met 1
Control Specifications: Control 1
Show Elements: Initial Selection
Volume Units: MM 1000 M3
Sorting: Hydrologic
Hydrologic Element
Drainage Area (KM2)
Peak Discharge (M3/S)
Time of Peak
Volume (MM)
macablingdam
44.65113
140.7
25Oct2012, 23:28
546.38
Graph for Sink "macablingdam"
Sink "macablingdam" Results for Run "Run 1"
Flow (cms)
0
50
100
150
200
00:00
12:00
00:00
12:00
00:00
12:00
00:00
12:00
28Oct2012
Summary Results for Sink "macablingdam"
Project: Current
Simulation Run: Run 1 Sink: macablingdam
Start of Run: 24Oct2012, 13:30
End of Run: 28Oct2012, 23:00
Compute Time: 10Sep2015, 14:13:16
Basin Model: SSRS_geohechms
Meteorologic Model: Met 1
Control Specifications: Control 1
Volume Units: MM 1000 M3
Computed Results
Peak Outflow : 140.7 (M3/S)
Total Outflow : 546.38 (MM)
Date/Time of Peak Outflow : 25Oct2012, 23:28
Observed Hydrograph at Gage Discharge 1
Peak Discharge : 217.90 (M3/S)
Avg Abs Residual : 56.49 (M3/S)
Total Residual : 447.77 (MM)
Date/Time of Peak Discharge : 25Oct2012, 16:55
Total Obs Q : 98.62 (MM)
Summary Results for Sink "MacablingDam"
Project: SSRS_future
Simulation Run: Run 2 Sink: MacablingDam
Start of Run: 24Oct2012, 13:30
End of Run: 28Oct2012, 23:00
Compute Time: 15Sep2015, 04:32:25
Basin Model: SSRS_future
Meteorologic Model: Met 1
Control Specifications: Control 1
Volume Units: MM 1000 M3
Computed Results
Peak Outflow : 140.3 (M3/S)
Total Outflow : 565.73 (MM)
Date/Time of Peak Outflow : 25Oct2012, 21:11
Observed Hydrograph at Gage Discharge
Peak Discharge : 217.90 (M3/S)
Avg Abs Residual : 57.31 (M3/S)
Total Residual : 467.11 (MM)
Date/Time of Peak Discharge : 25Oct2012, 16:55
Total Obs Q : 98.62 (MM)

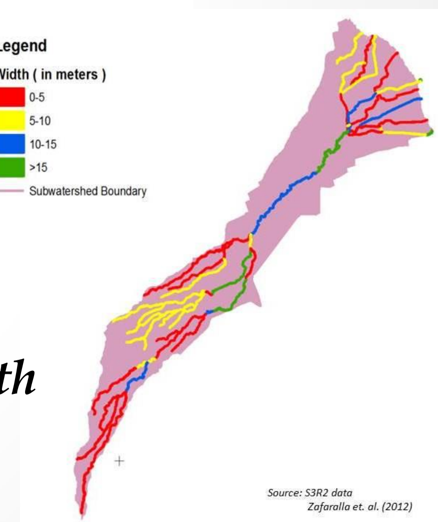
Generation of Flood Model using HEC-RAS : Hydrologic Engineering Center - River Analysis System

Downstream DSM (2m) from LiDAR data ✚ **River Characteristics** =

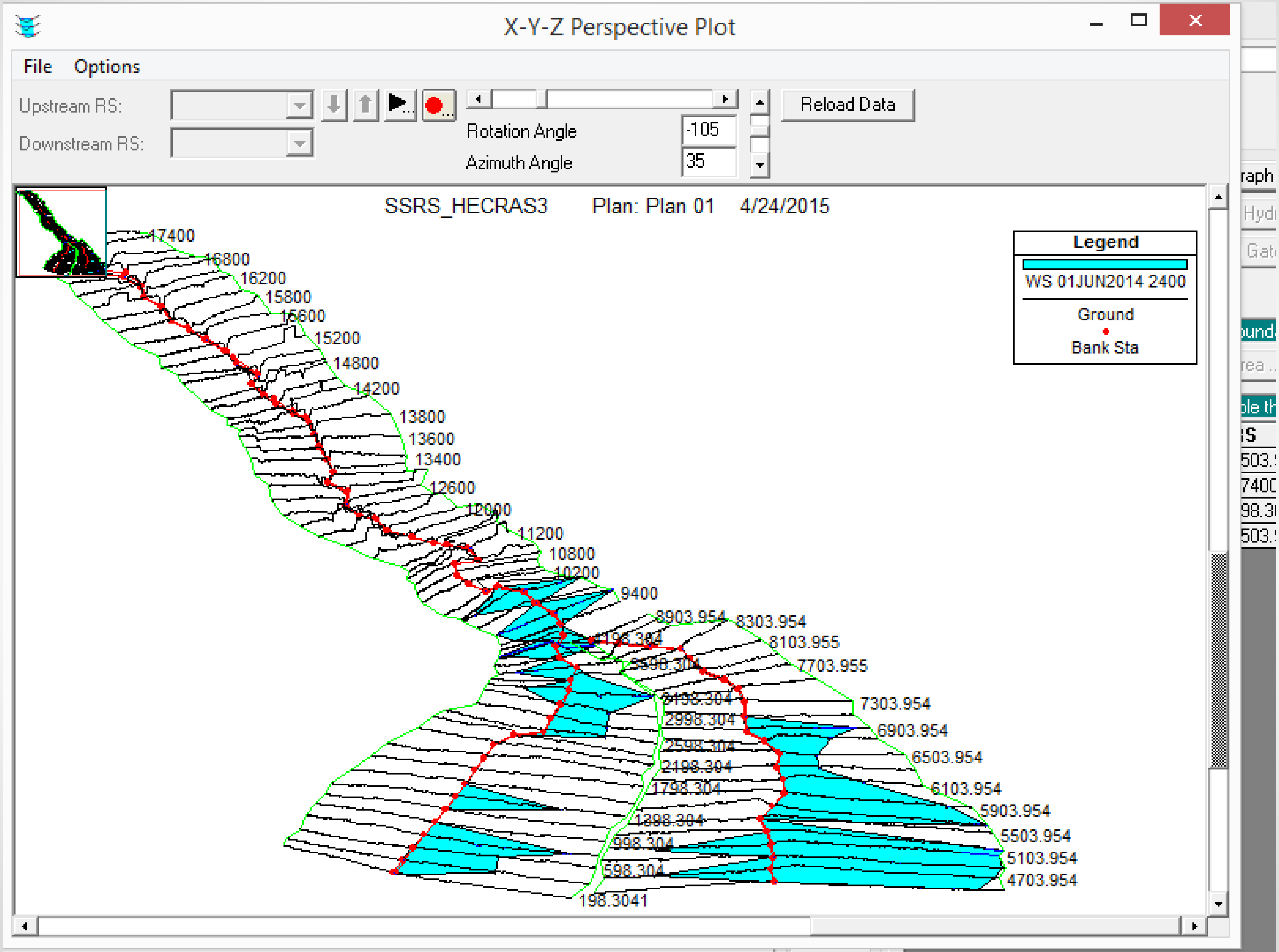




Depth



Width


X-Y-Z Perspective Plot
File
Options
Upstream RS:
Downstream RS:
Reload Data
Rotation Angle
-105
Azimuth Angle
35
SSRS_HECRAS3
Plan: Plan 01
4/24/2015
Legend
WS 01JUN2014 2400
Ground
Bank Sta
17400
16800
16200
15800
15600
15200
14800
14200
13800
13600
13400
12600
12000
11200
10800
10200
9400
8903.954
8303.954
8103.955
7703.955
7303.954
6903.954
6503.954
6103.954
5903.954
5503.954
5103.954
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2998.304
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2198.304
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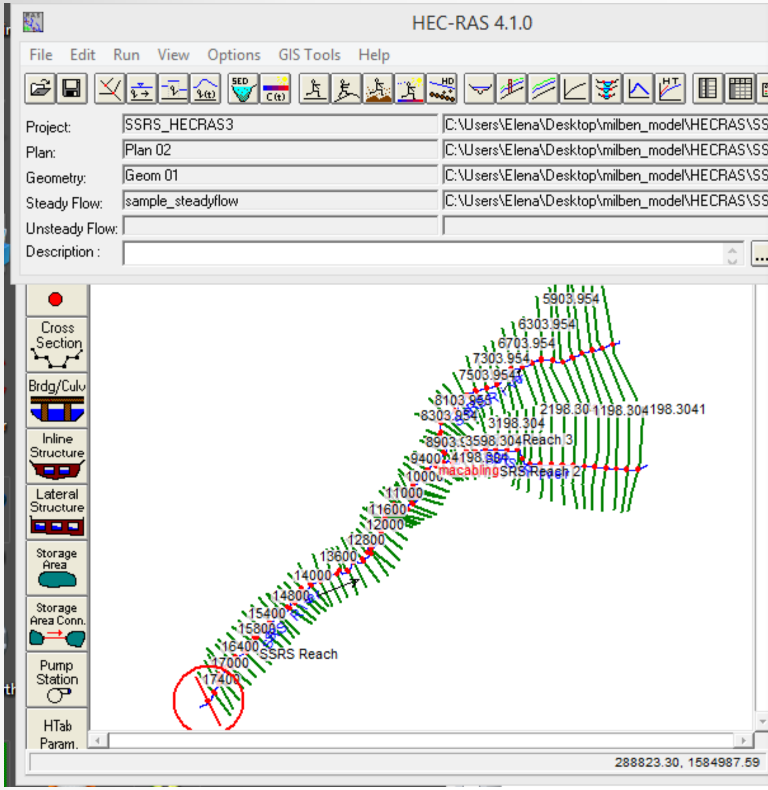
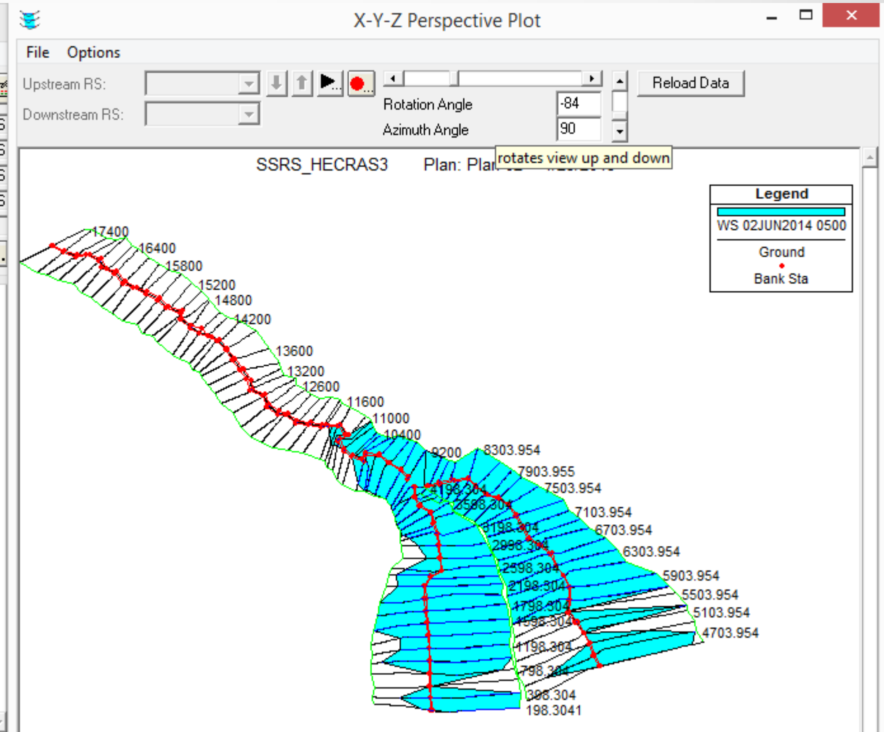
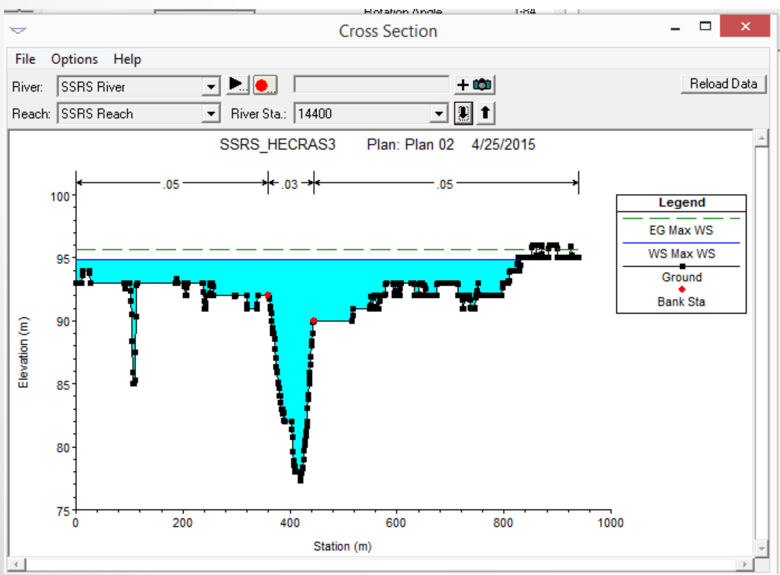
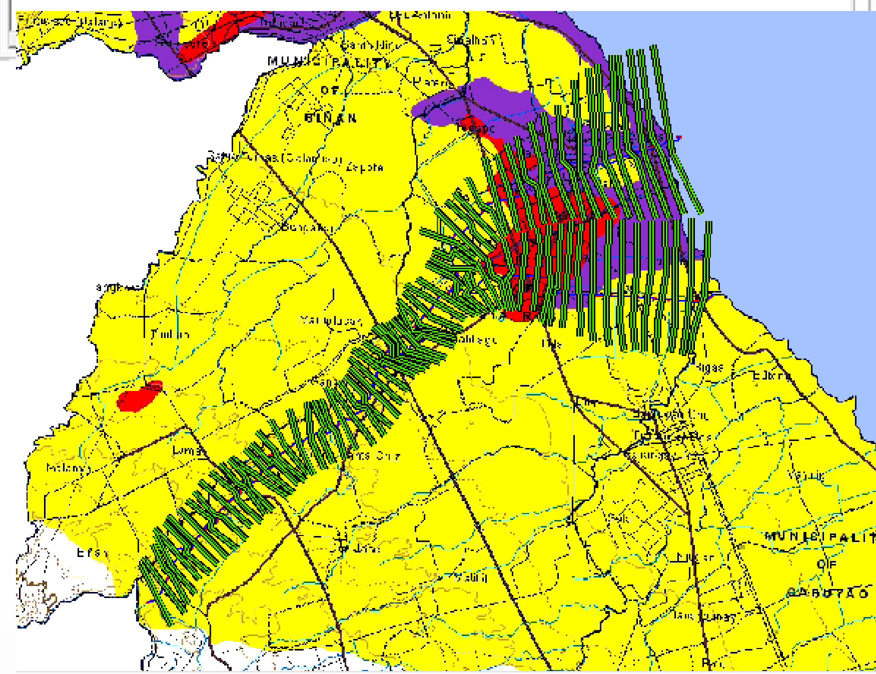
1398.304
998.304
598.304
198.3041

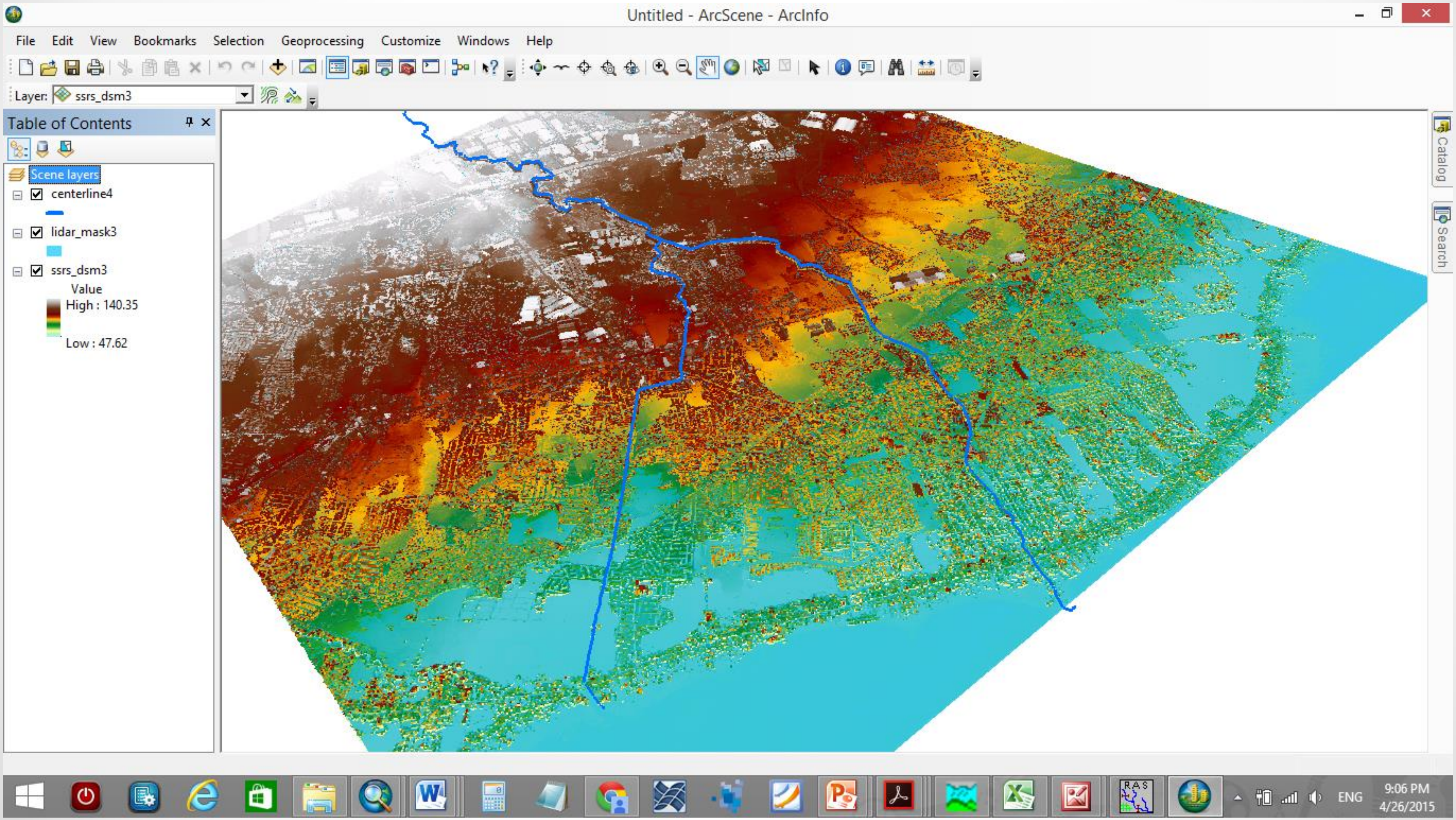

HEC-RAS 4.1.0
File Edit Run View Options GIS Tools Help
Project: SSRS_HECRAS3
Plan: Plan 02
Geometry: Geom 01
Steady Flow: sample_steadyflow
Unsteady Flow:
Description :
Cross Section
Brdg/Culv
Inline Structure
Lateral Structure
Storage Area
Storage Area Conn.
Pump Station
HTab Param.
SSRS Reach
288823.30, 1584987.59


X-Y-Z Perspective Plot
File Options
Upstream RS:
Downstream RS:
Rotation Angle -84
Azimuth Angle 90
Reload Data
rotates view up and down
SSRS_HECRAS3
Legend
WS 02JUN2014 0500
Ground
Bank Sta


Cross Section
File Options Help
River: SSRS River
Reach: SSRS Reach
River Sta.: 14400
Reload Data
SSRS_HECRAS3 Plan: Plan 02 4/25/2015
.05
.03
.05
Legend
EG Max WS
WS Max WS
Ground
Bank Sta
Elevation (m)
Station (m)

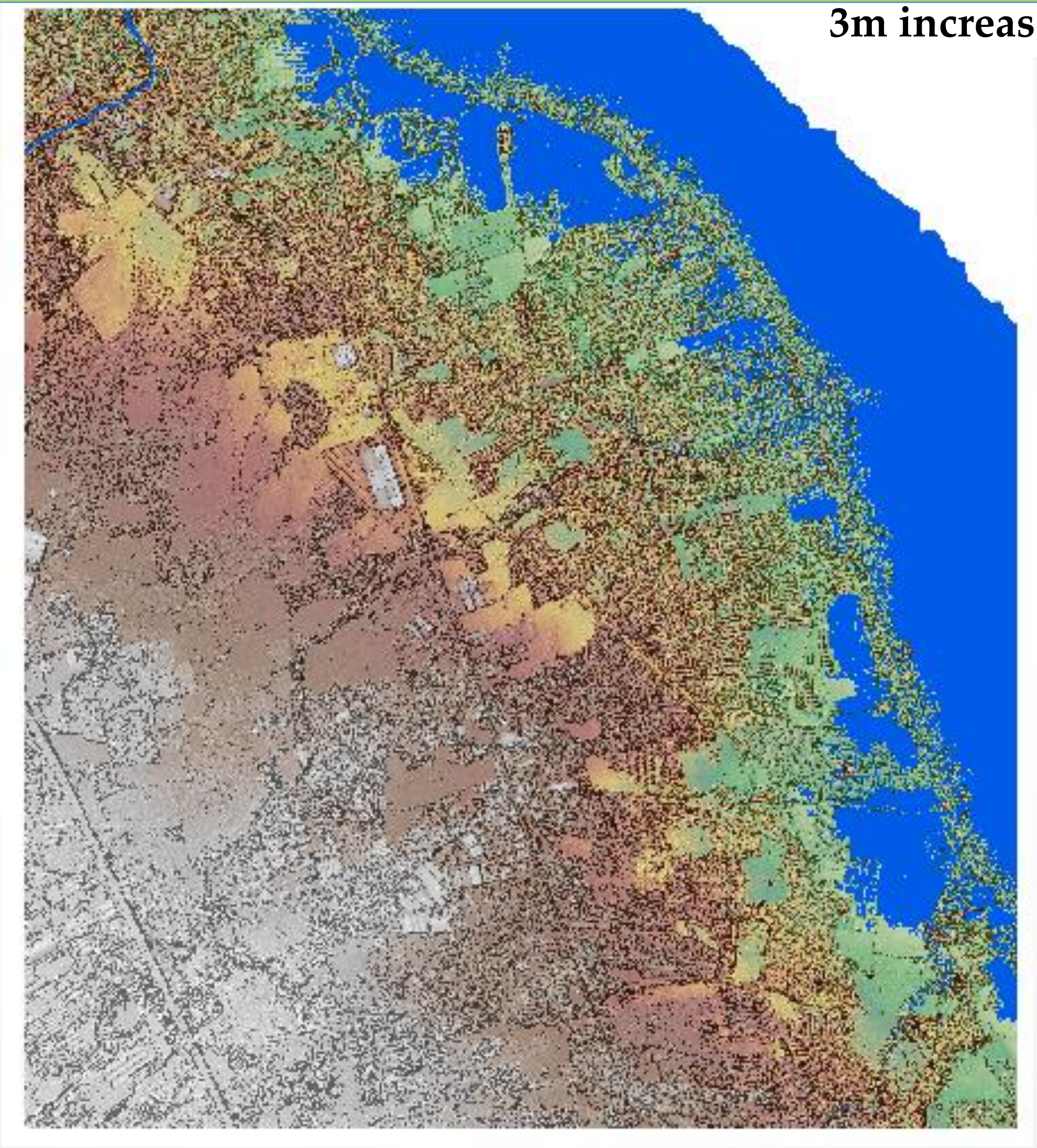


#5 *Visualization using RAS Mapper or ArcScene*



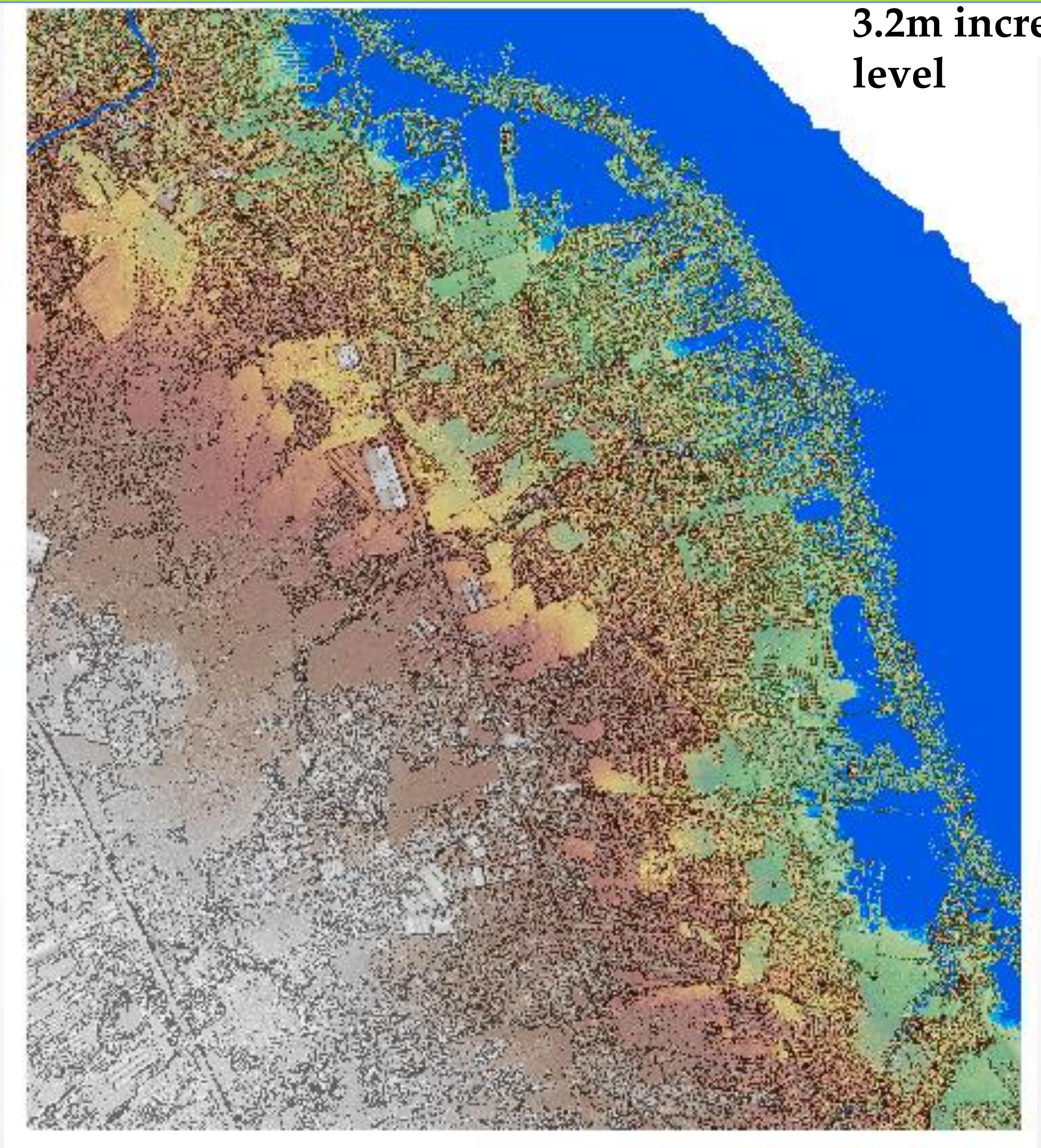
Flooding Scenarios caused by increase in Lake's water level

3m increase in water level



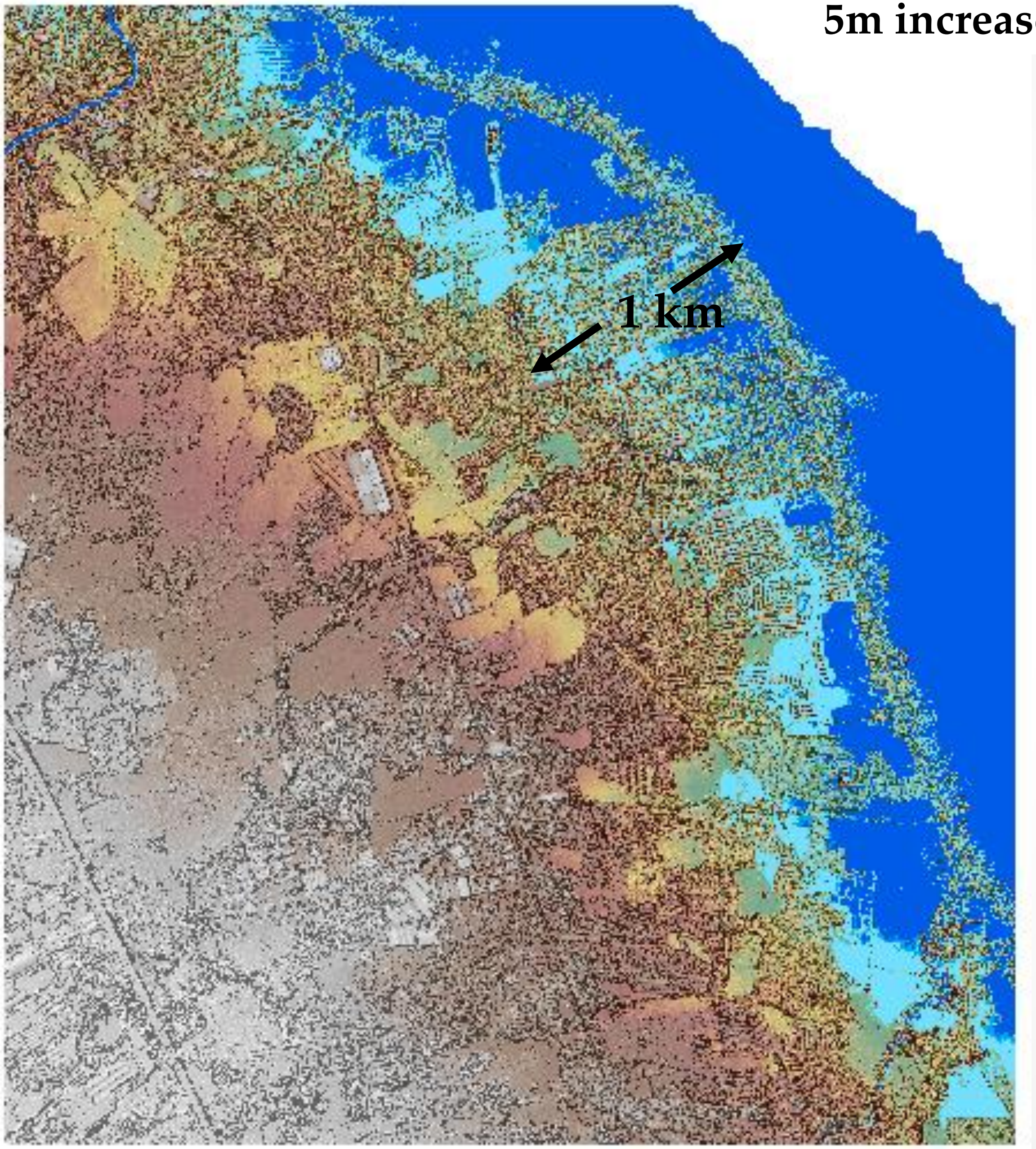
Flooding Scenarios caused by increase in Lake's water level

3.2m increase in water level

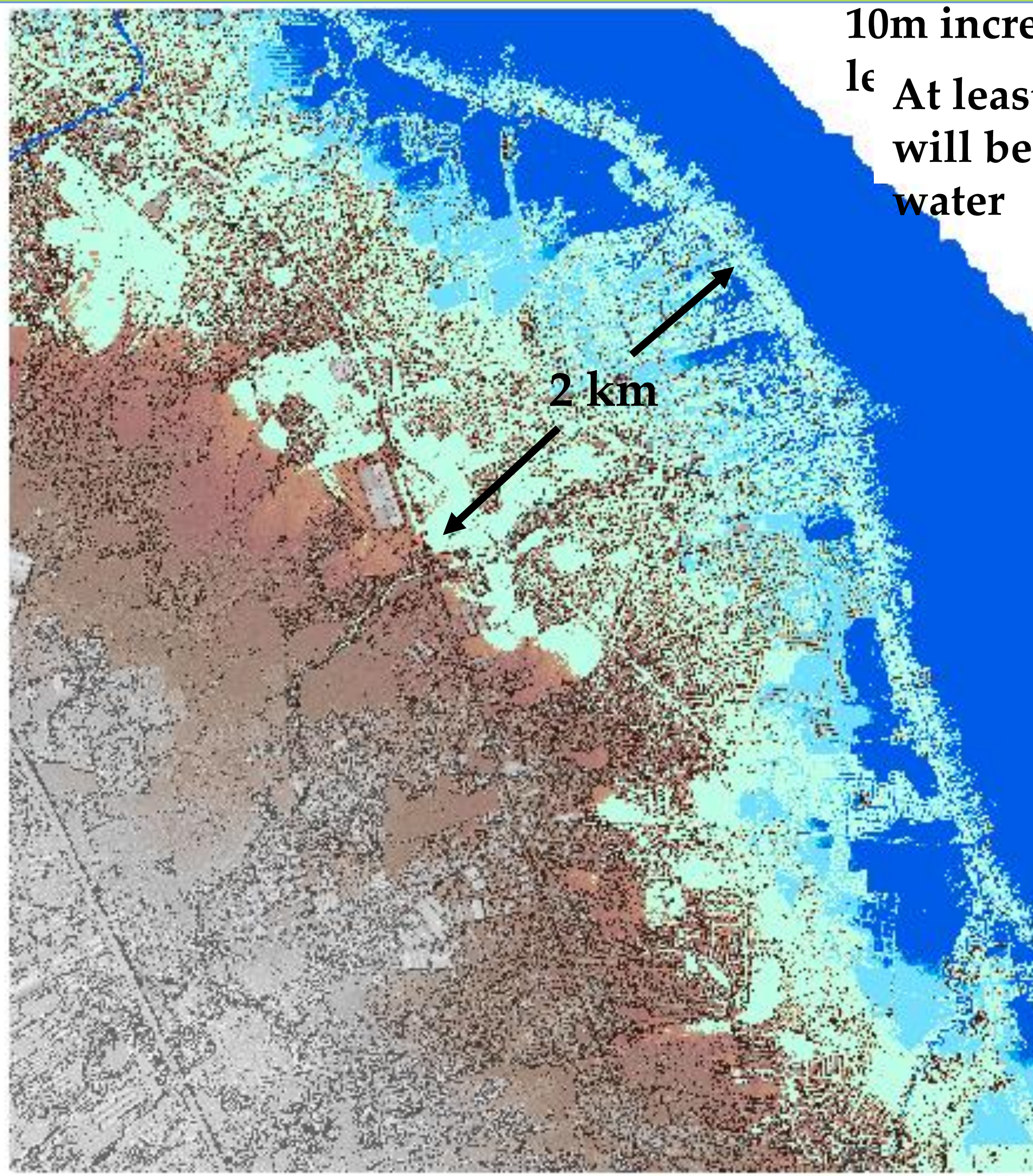


Flooding Scenarios caused by increase in Lake's water level

5m increase in water level



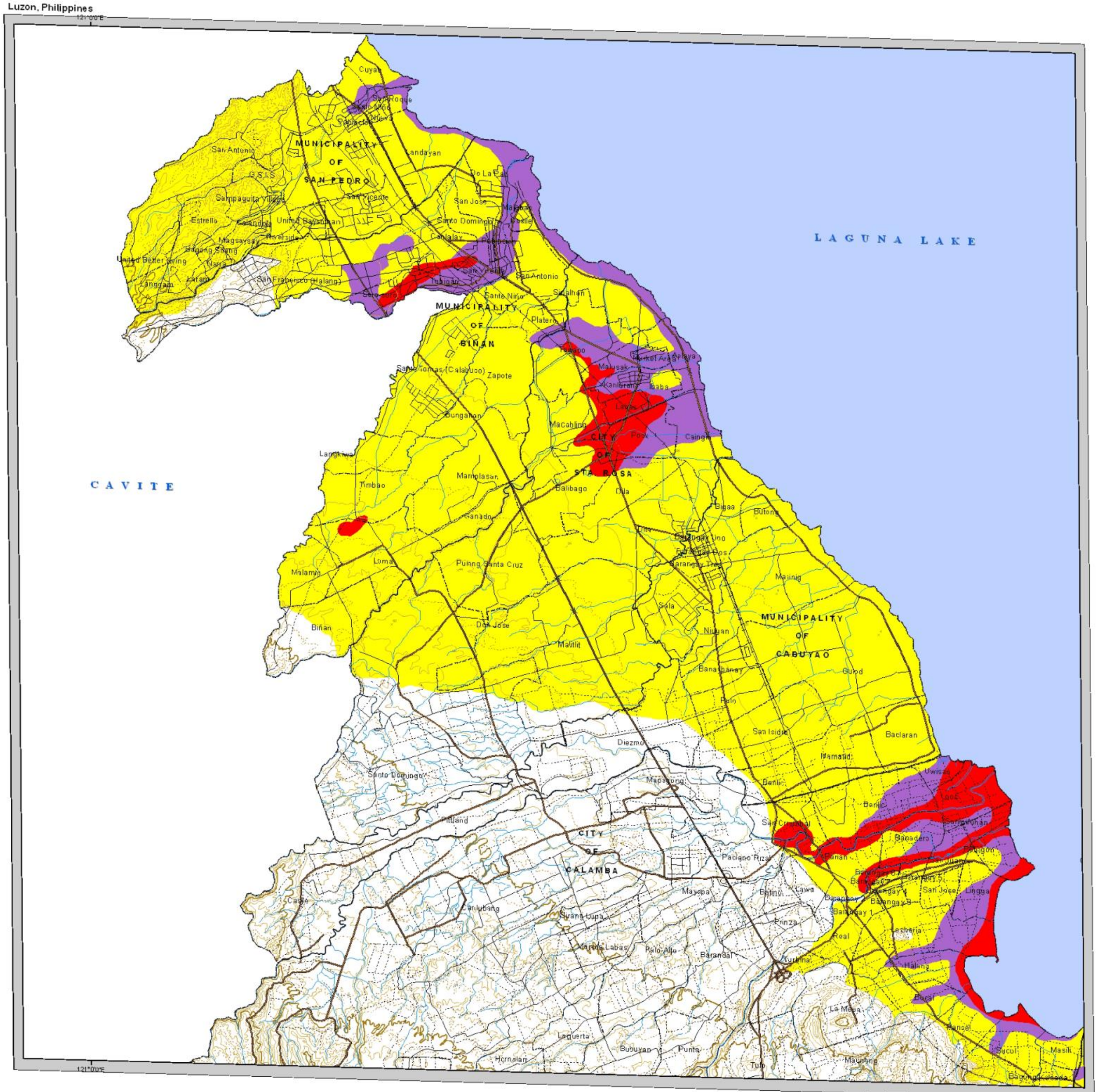
Flooding Scenarios caused by increase in Lake's water level



10m increase in water le

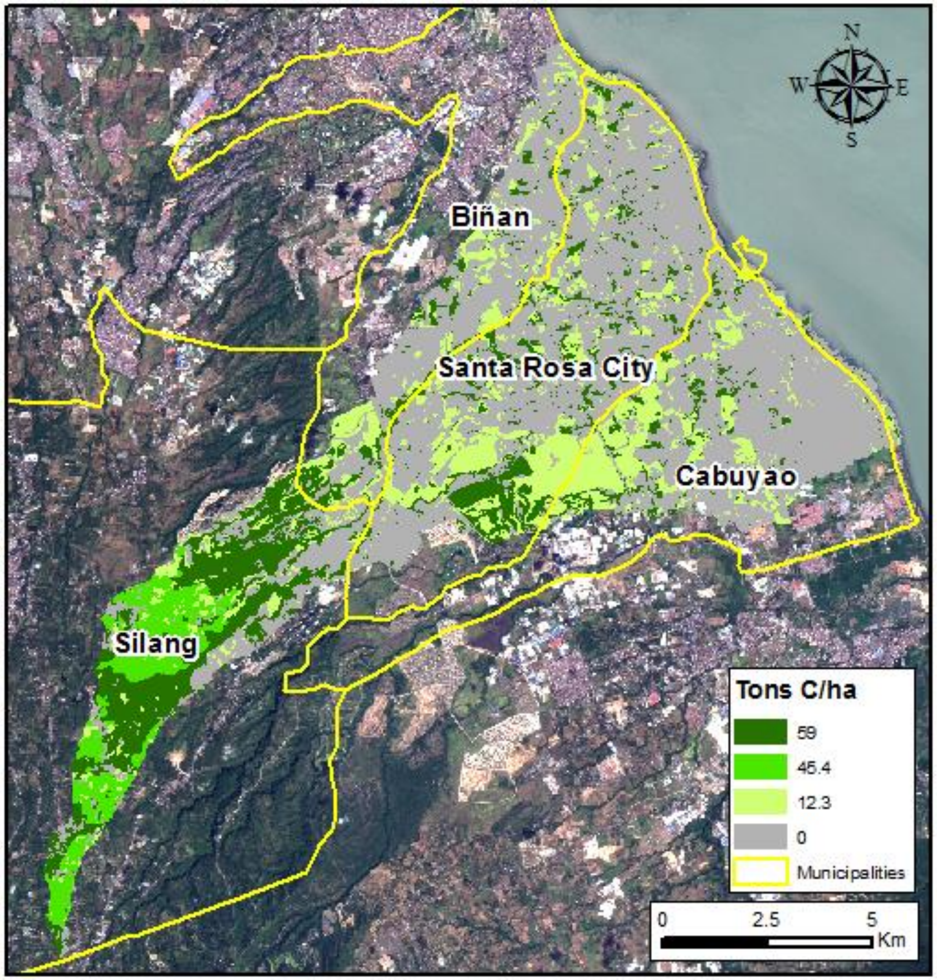
At least 5 barangays will be submerged in water

THE READY PROJECT:FLOOD HAZARD MAP OF STA. ROSA

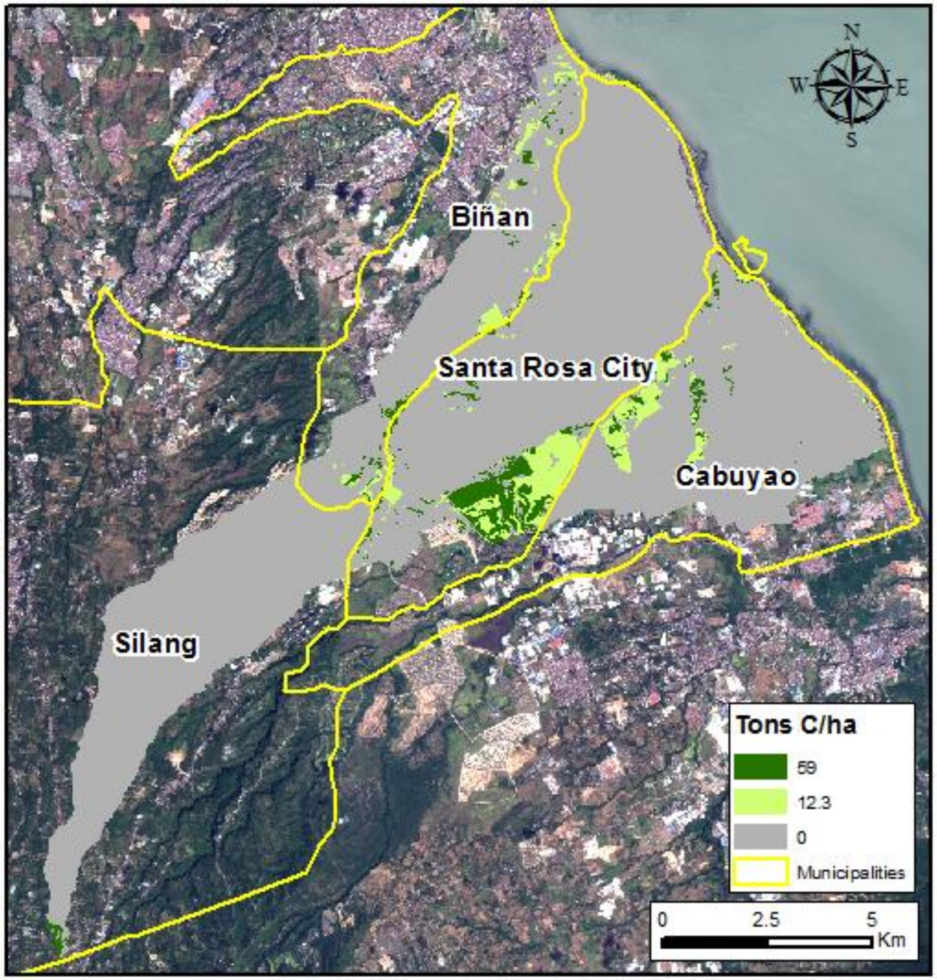


Change in C storage: 2014-2025

2014 Above-ground Biomass



2025 Above-ground Biomass



CO_2 emissions from LU change in Silang-Santa Rosa subwatershed

- Above-ground biomass (2014) = **173,189 tons C**
- Above-ground biomass (2025) = **29,281 tons C**
- Change 2014 to 2025 = **-143,908 tons C [-83%]**
- CO_2 emissions = **143,908 x 3.67 = 528,142 tons CO_2**

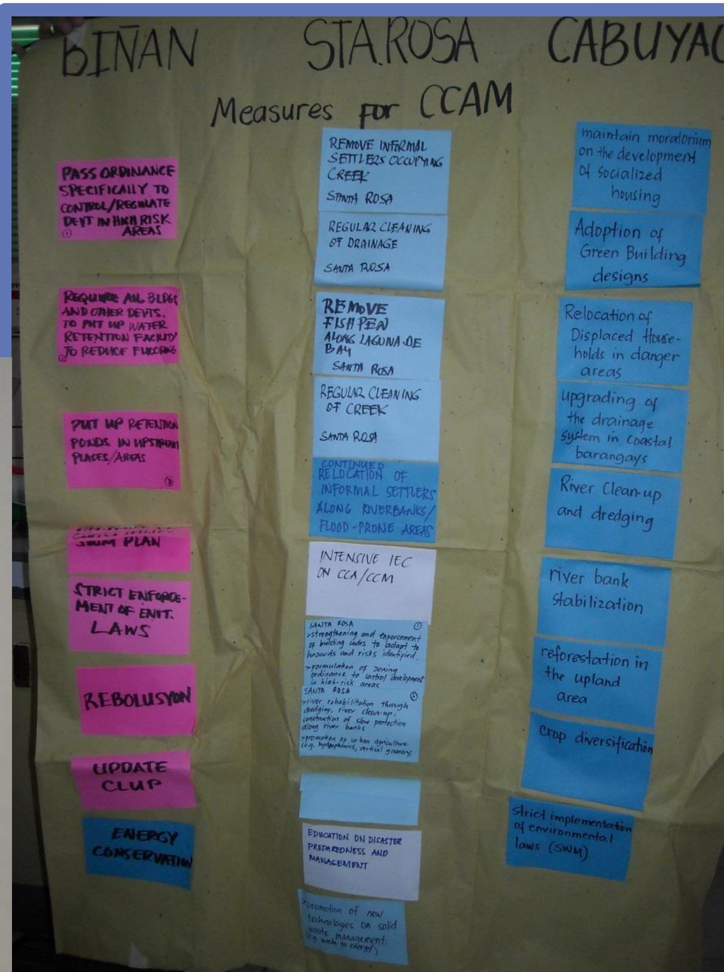
Reducing CO_2 emissions from LU change

Possible activities

- Reforestation along riverbanks
- Maintaining existing vegetation in new developments
- Preserving existing forest/agro-forest lands with high C storage

- **Next step:** Calculate CO_2 emissions for alternative land use development scenarios (i.e. with adaptation/mitigation actions
- taken).

Consultation meeting with LGUs: Climate Change measures



Possible measures for climate change mitigation (CCM) and adaptation (CCA) (example)

Category	Measures	CCM	CCA
Improved land-use	**Development control** in high-risk areas		○
	Green space, urban greening	○	○
Flood-tolerant, environment-conscious building	Strengthened **building codes** in high-risk areas (e.g., embankment, high-floored housing)		○
	Roof greening, **green building**	○	○
Ecosystem-based, integrated watershed management	Maintenance and improvement of watershed protection function (flood alleviation, water retention ability) of ecosystem		
	Development control in upriver areas		○
	Afforestation & reforestation	○	○
	Watercourse management (e.g., riverbank reinforcement, dredging, river cleaning)		○
	Change in varieties and cultivation methods of agricultural products to prevent soil runoff		○

Preliminary list of climate change measures by local governments

- **Zoning/building ordinance**
- **River rehabilitation**
- **Information, Education, and communication (IEC)**
- Run-off mitigation development
- Green space/building/urban agriculture
- Relocation of informal settlers
- Strict law enforcement

Capacity building & public awareness

- **Training needs assessments** on CCA, CCM , disaster preparedness and management
  - Develop survey/assessment instrument to determine the needs for training and other IEC; Conduct the TNA
- **Development of campaign materials and training modules** for CCA, CCM , disaster preparedness and management
  - Develop campaign materials and training modules for CCA, CCM , disaster preparedness and management
- **Conduct of trainings and events**
  - Organize trainings and events to increase awareness and preparedness

Inter-city cooperation

Memorandum of agreement (MOA) for cooperation

Establishment of Council for Integrated Watershed Management

December 2, 2014

Catalyzed by 5-year WWF

Institutional building: Strengthen IWMC

- Review MOA / legal documents and plans
- Identify gaps/needs
- **Help establish/facilitate regular communication** among local governments and with LLDA
- **Help create workplan/action plan**
- **Provide technical assistance** or connect with experts/institutions
- **Share information, experience, and lessons learned** with other local government with similar climate change problems in and beyond the Lake Laguna watersheds

Conclusion/key messages

- **Improving land-use planning** can be one of successful approaches for effectively addressing weather-related disasters such as floods, integrating climate change adaptation and mitigation measures.
- Land-use approach is **a systematic process with multiple steps**: 1) Scenario development, 2) Risk assessment, 3) Climate change measure development, and 4) Climate-sensitive land-use planning.
- **Targeting/managing river basin as a whole with inter-city cooperation** will help address climate-related disasters (e.g., floods) downstream.
- **Ecosystem-based, integrated watershed management** can provide technically- and economically-feasible solutions and co-benefits to address conservation and climate disasters at the same time.

Key messages (2)

- **Experiences and lessons learned from the Silang-Santa Rosa pilot** will be shared with other Subwatersheds facing similar problems.
- **IGES/UPLB would like to continue to support** LGUs in the Philippines and beyond in cooperation with National Governments by:
  - Developing flood risk maps under future scenarios
  - Helping develop/refine measures
  - Strengthening capacity of Integrated Watershed Management Council
  - Proposing joint research
  - Explore further cooperation with institutions and universities

THANK YOU VERY MUCH!