

Towards resilient groundwater and surface water management in New Orleans

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Climate change

- Accelerated sea level rise
- Extreme weather events

Socio-economic development

- Urbanization and population growth
- Increased water demand

Sea level rise
3 - 10 mm/year



Subsidence
6 - 100 mm/year



Impacts

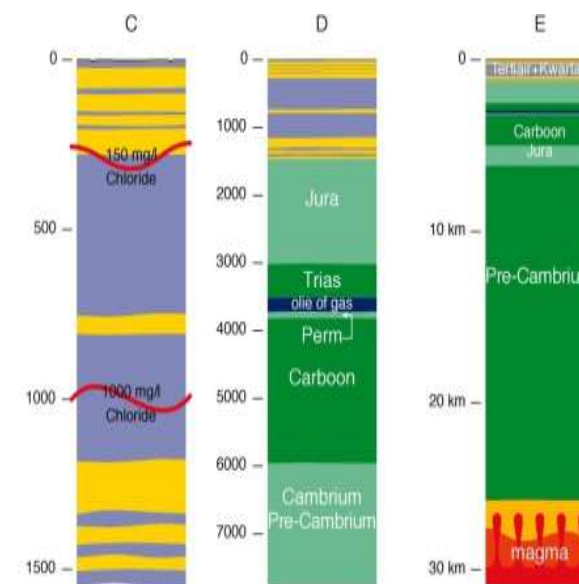
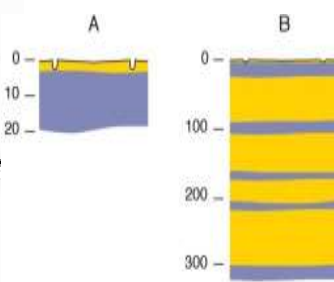
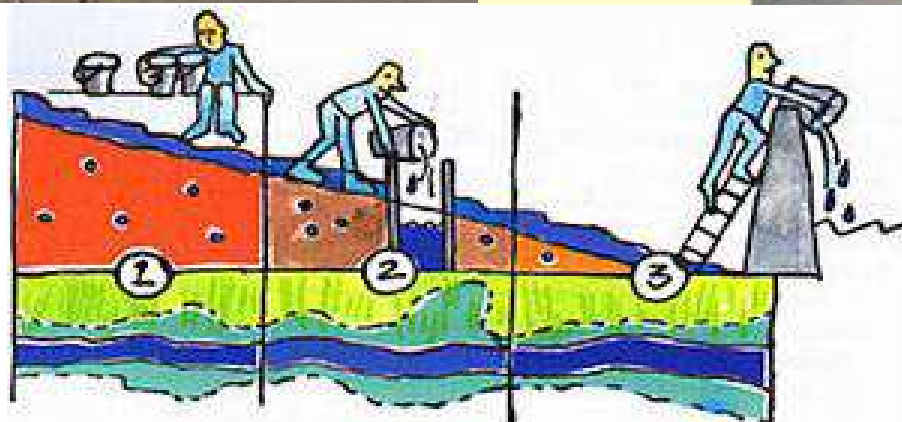
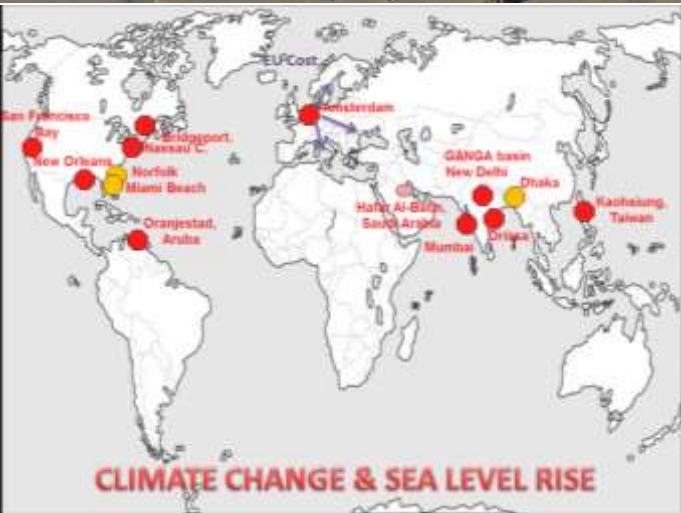
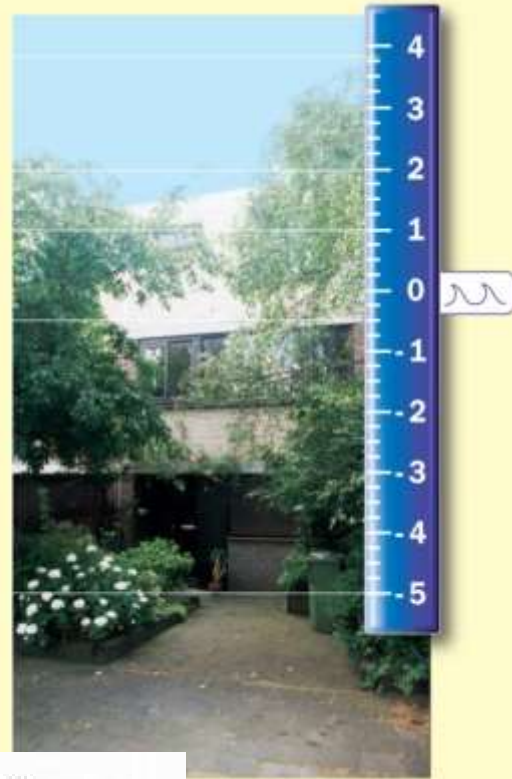
- Increased flood risk
- Damage to buildings, infrastructure
- Disruption of water management

Causes

- Groundwater extraction
- Oil, gas, coal mining
- Tectonics



1-2-1953 +3.85m NAP (s.l.)
 roof +2m NAP (s.l.)
 high tide +1m NAP (s.l.)
 low tide -0.5m NAP (s.l.)
 surface level -5m NAP (s.l.)



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Gentilly Resilience District Publ



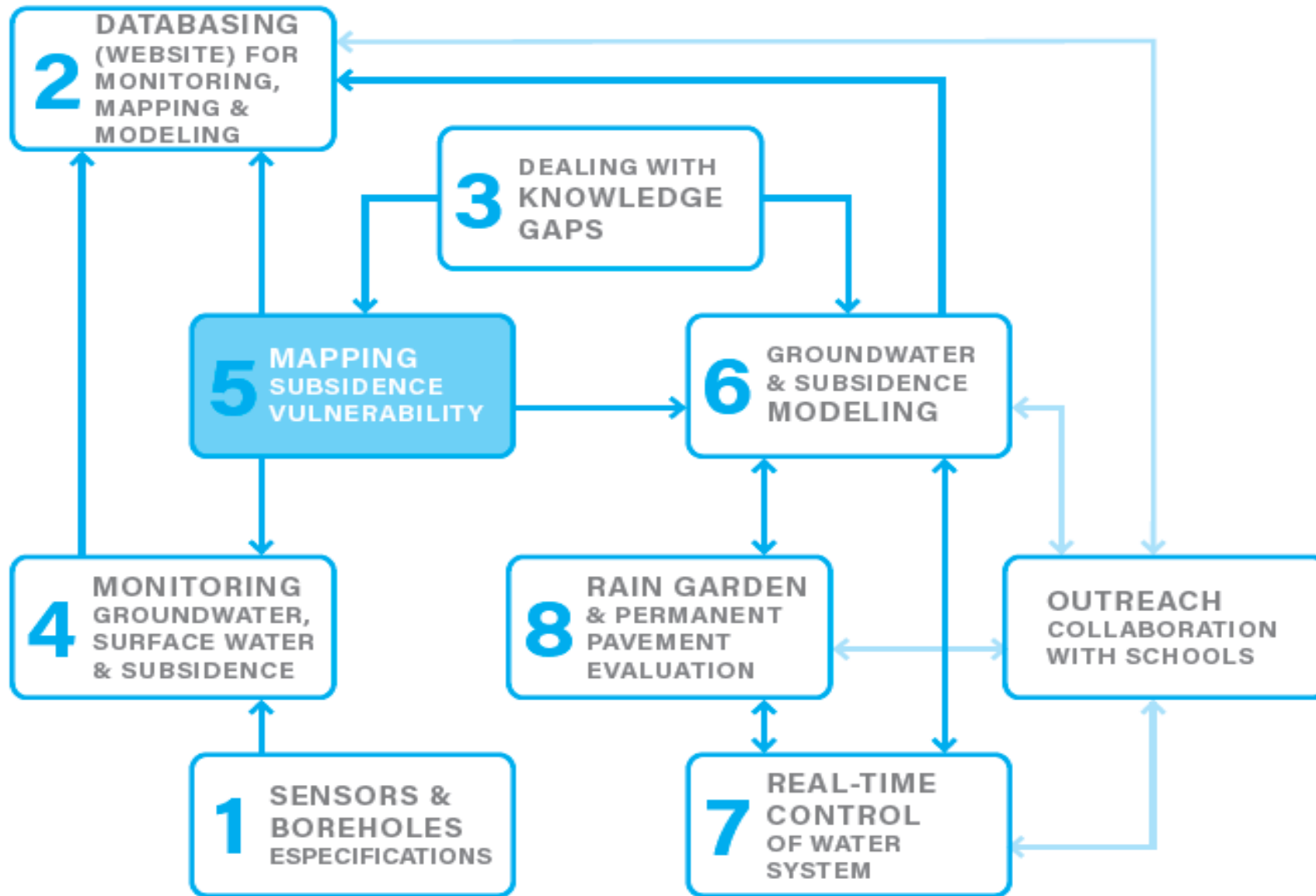


Figure 1.1. Phases of the project

CONTENTS.

1. WHY WE ARE SINKING?

- SOIL AND GEOLOGY
- CHANGING LANDSCAPE → TRANSFORMATION FROM CYPRESS SWAMPS INTO URBAN AREA
 - Industrial cypress logging boom,
 - Canals
 - Draining underground infrastructure and growing surface impermeability

2. What more? Climate change and sea level rise.

3. What can we do about it?

- Better understand the underground and water system
 - Mapping
 - Monitoring
 - Modeling
 - Better planning
- Retain, store and infiltrate rain water
- Reduce subsidence









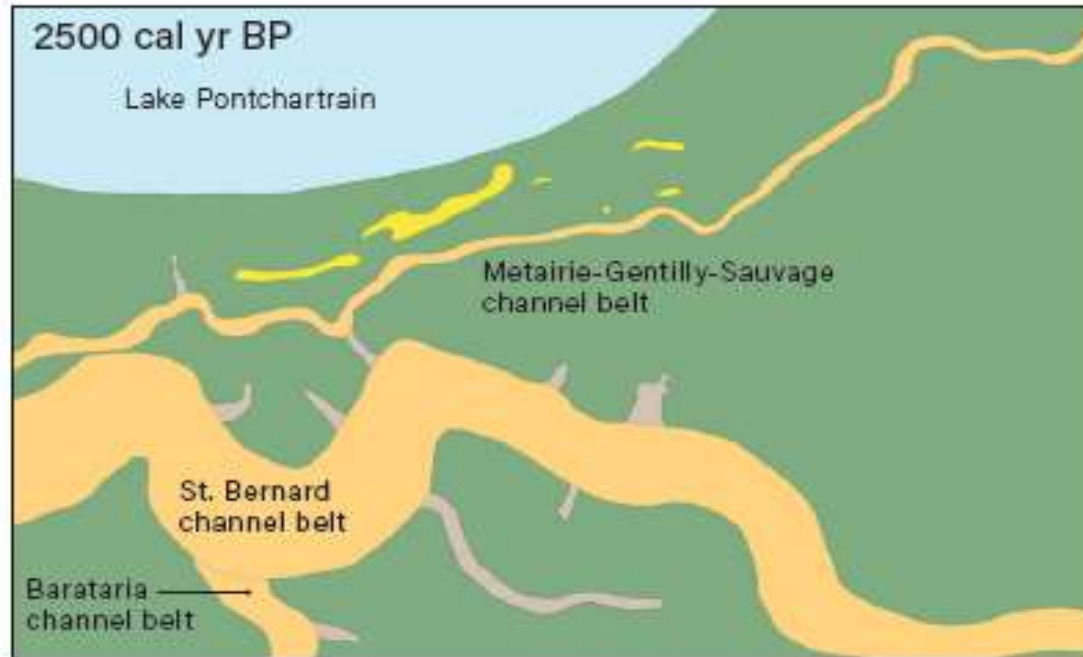
4500 cal yr BP - Pine Barrier Islands

Lake Pontchartrain



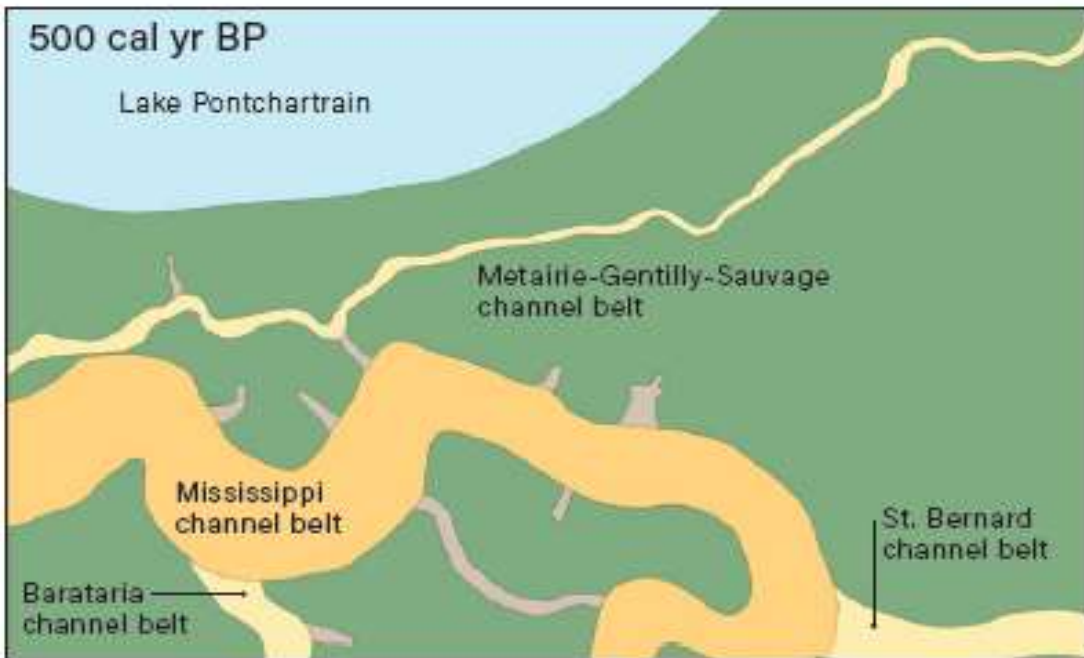
2500 cal yr BP

Lake Pontchartrain



500 cal yr BP

Lake Pontchartrain





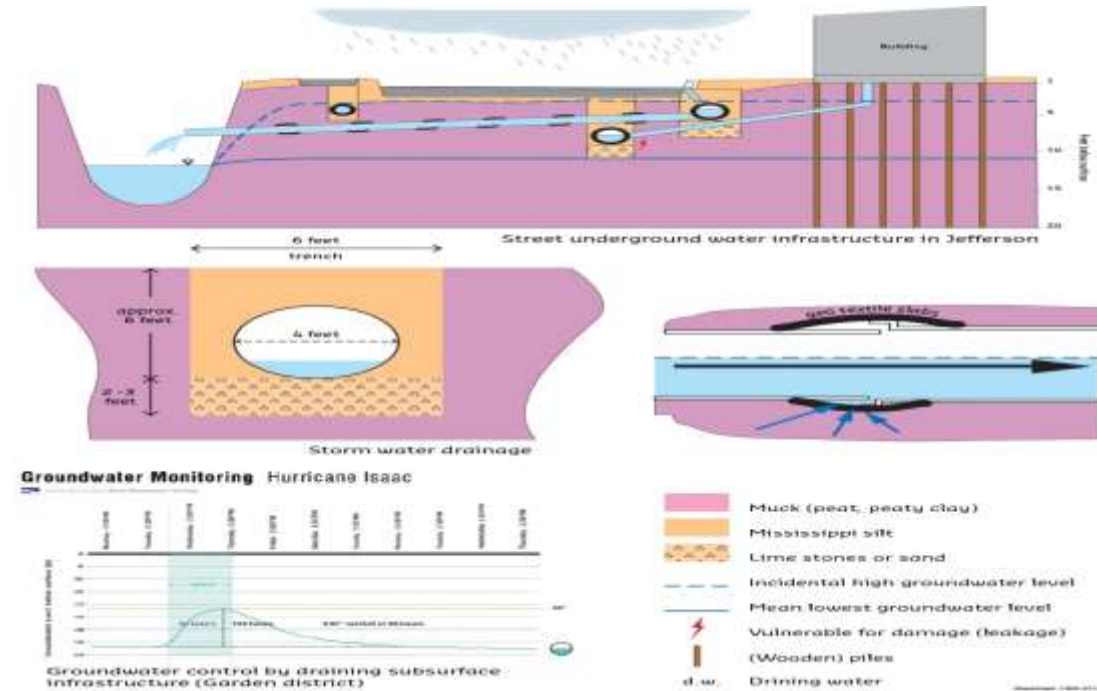
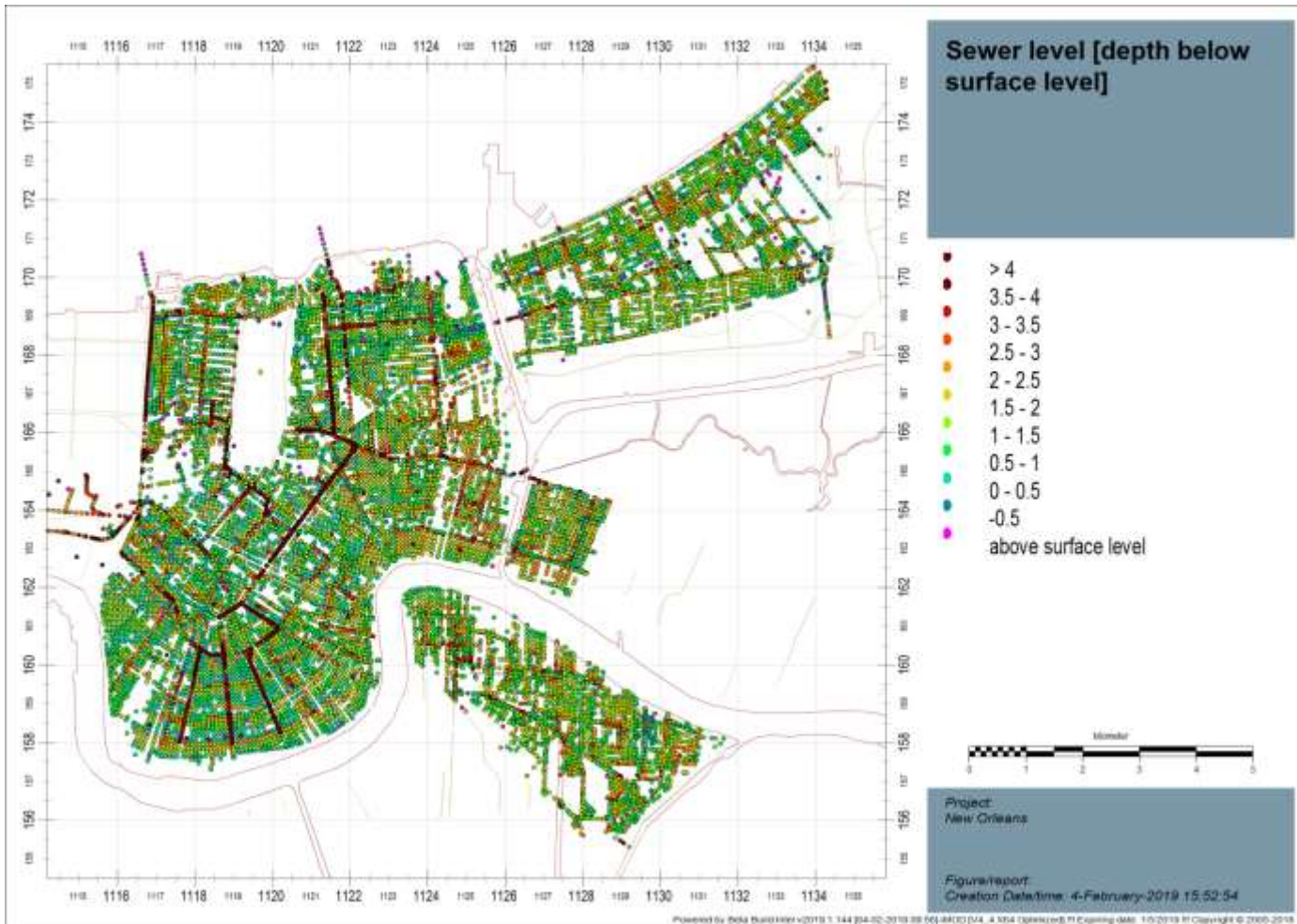
DRAINAGE & CHANGING LANDSCAPE



**NDRC: NEW ORLEANS
LONDON AVENUE CANAL**







Urbanization and groundwater drainage



Adding French drains during renovations?

Impermeable flexible connections?

PROJECT TITLE: _____

SUBJECT: _____

BY: _____ DATE: _____

CHECKED BY: _____

PAGE: _____

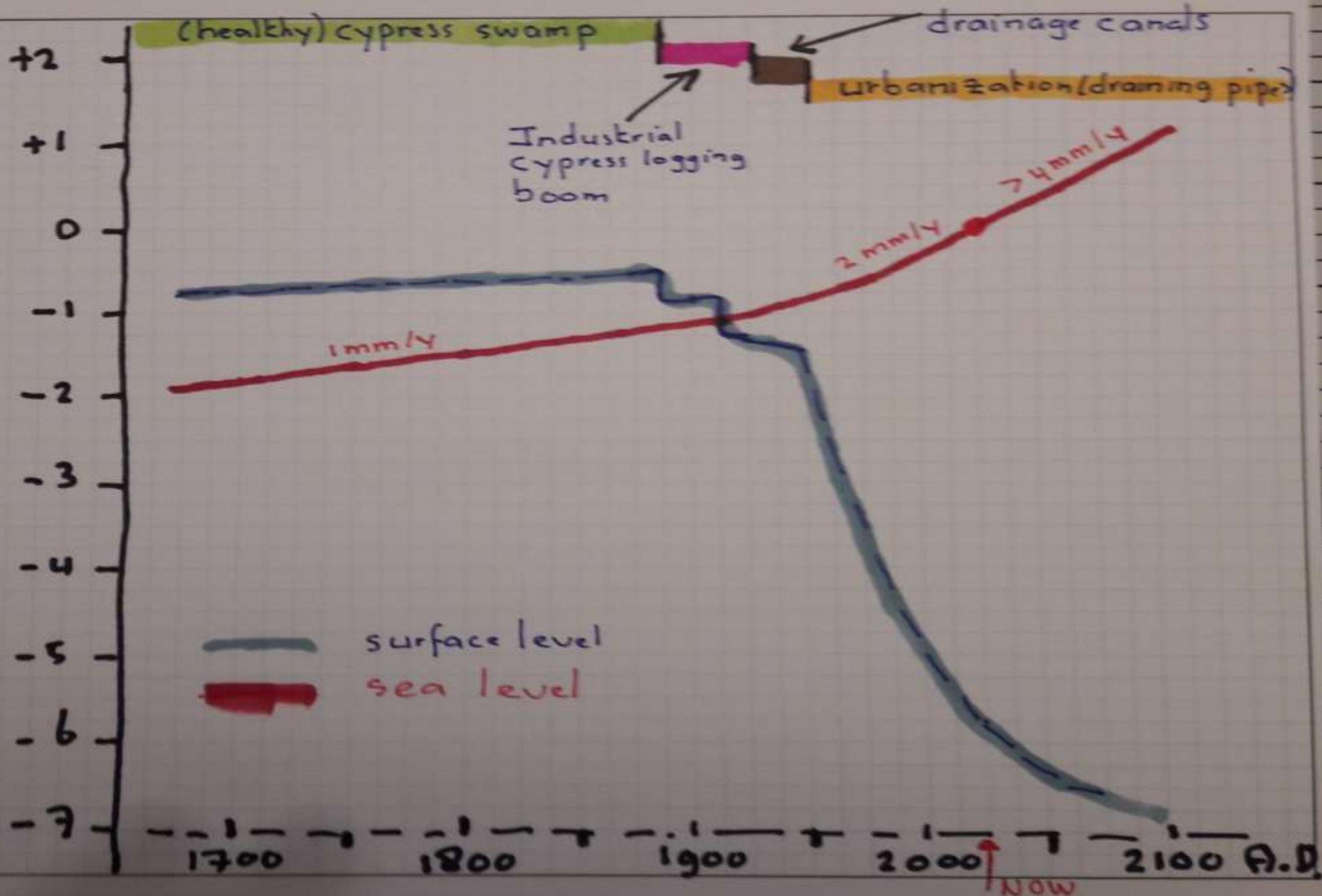
JOB NO: _____


DATE: _____



EUSTIS
ENGINEERING L.L.C.
SINCE 1944

feet: sea level





**SHALLOW SUBSIDENCE
VULNERABILITY
IN NEW ORLEANS**

**DRAFT VERSION
MARCH 2019**

Dutch researchers dig into New Orleans to study subsidence

Updated Nov 15; Posted Nov 15



Gallery: Dutch soil borings on November 13, 2018

The collage includes several articles:

- John School Board sued over chemical plant**: Demands students near Denka be relocated.
- Absorbing solutions**: Groundwater management could be key to limiting subsidence, flooding in New Orleans, scientists say.
- Orleans Parish superintendent to close four schools**: OneApp enrollment opens next week.
- Smiley Anders**: Days the 'card'.
- City Council members raise budgets**: Administration reorganize offices.



Collecting new data

THE NEW ORLEANS ADVOCATE

Today's Mortgage Rate: **3.93%** APR 15 Year Fixed

Interest Amount: **\$225,000**

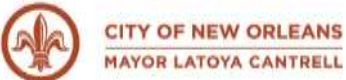
Calculate Payment

CAUGHT THE FLU? WE'LL COME TO YOU.

Head Respirators

Scientists look to soil samples to predict future sinking, flooding in New Orleans

BY FAIMON A. ROBERTS III | PROBERTS@THEADVOCATE.COM NOV 12, 2018 7:15 PM



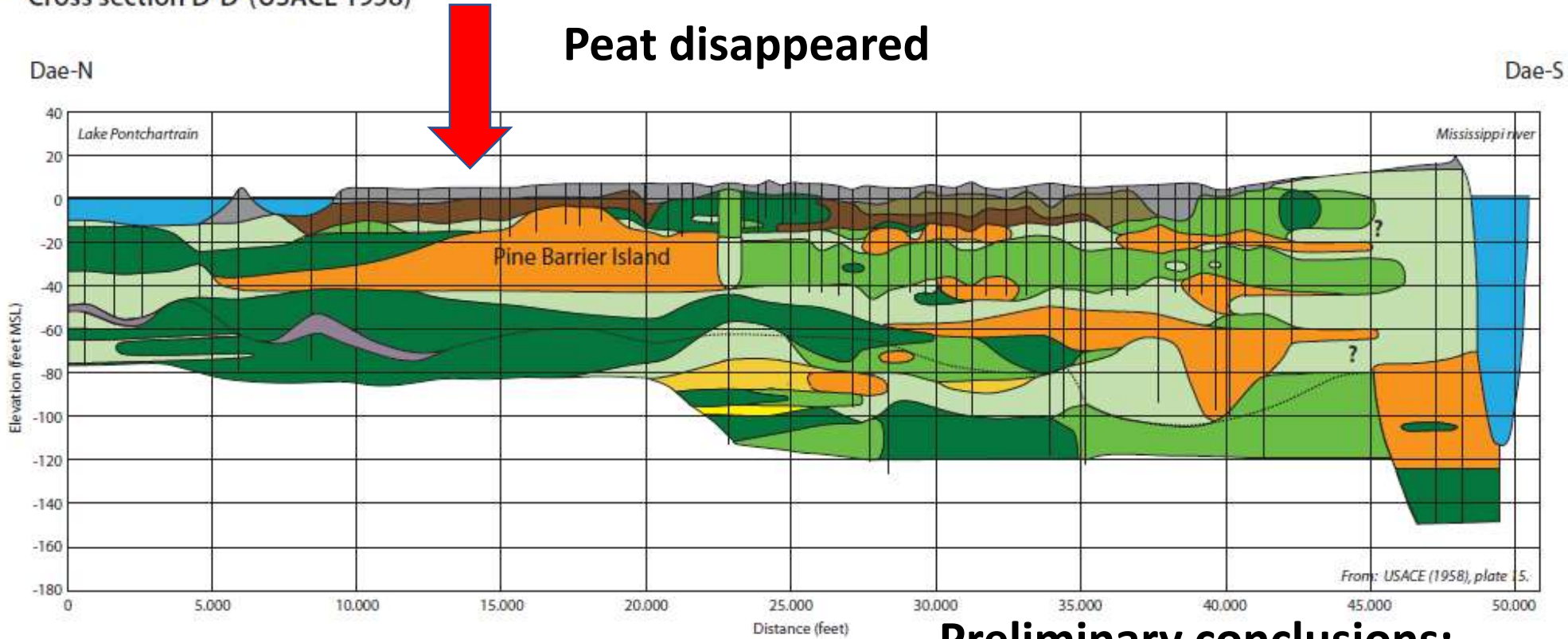
Gentilly Resilience District Public Lecture Series Groundwater, Subsidence & Green Infrastructure
Issue Date: 19-Aug-19 Version: 01





Cross section D-D' (USACE 1958)

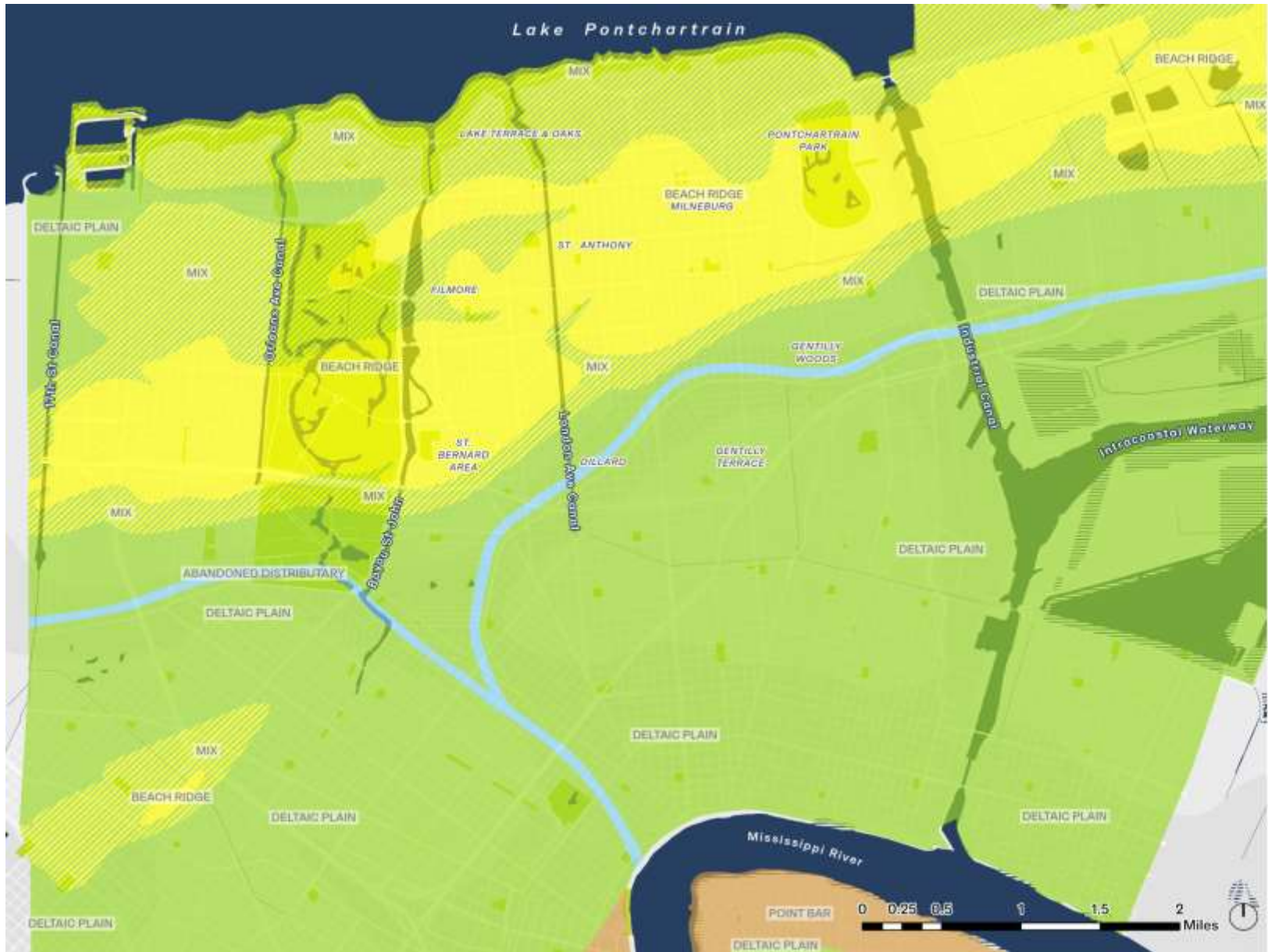
Peat disappeared



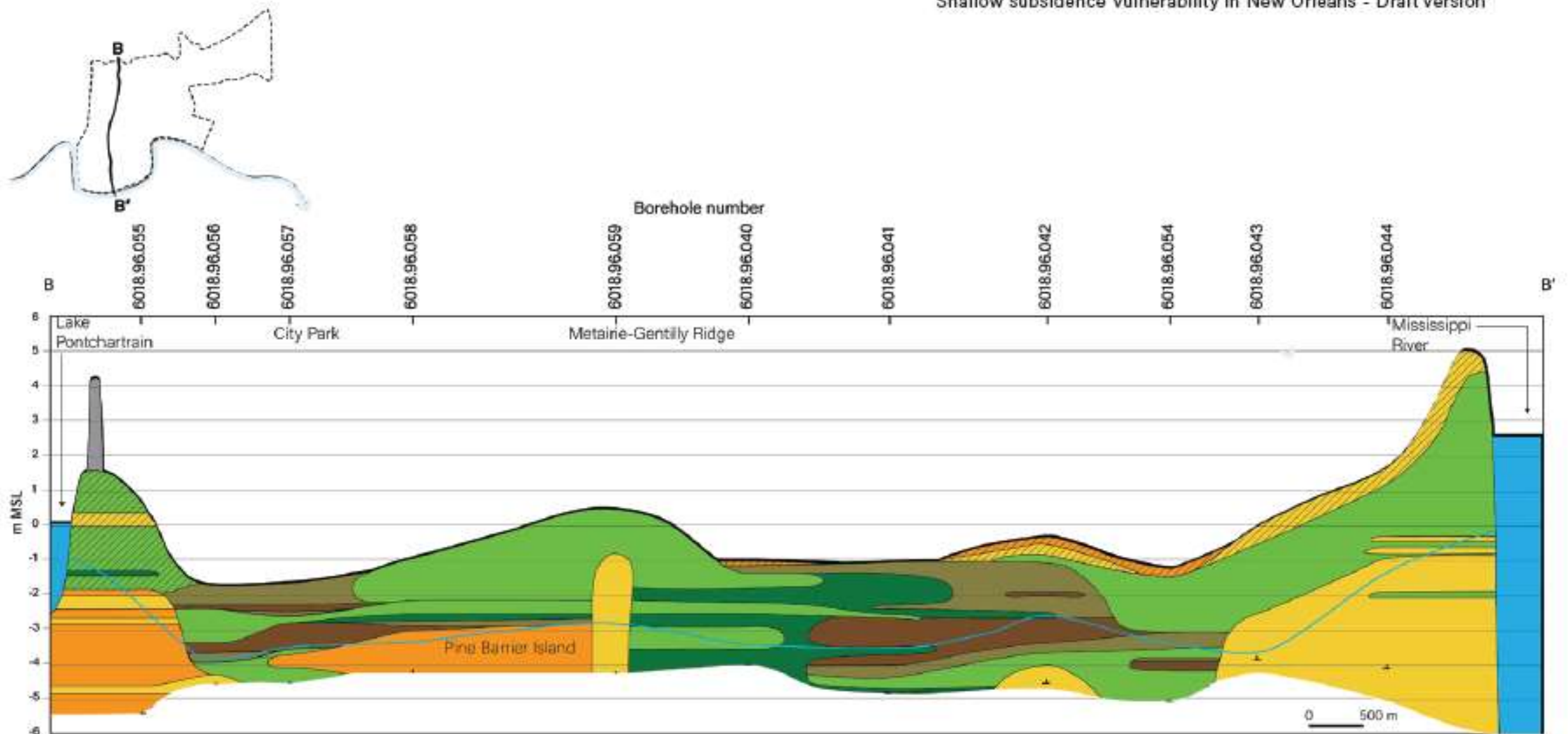
Legend		
Peat, humus, organic matter	Silt	Weathered Pleistocene
Organic clay	Silty sand, sandy silt	Pleistocene surface
Clay	Sand	
Clayey silt, silty clay	Fill	
Sandy clay, clayey sand	Coring	

Preliminary conclusions;

- The inventory was successful;
- Peat at surface is nearly gone with the exception of Lakeview;
- Still peat levels below MLG
- Still a lot of soft (and organic) clays



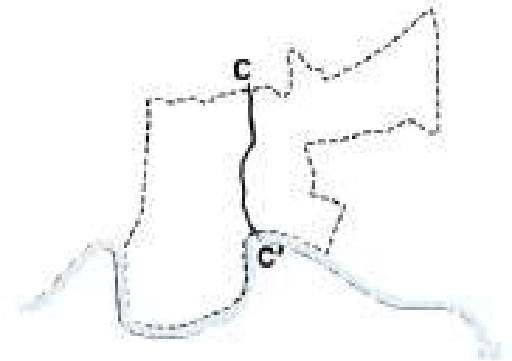
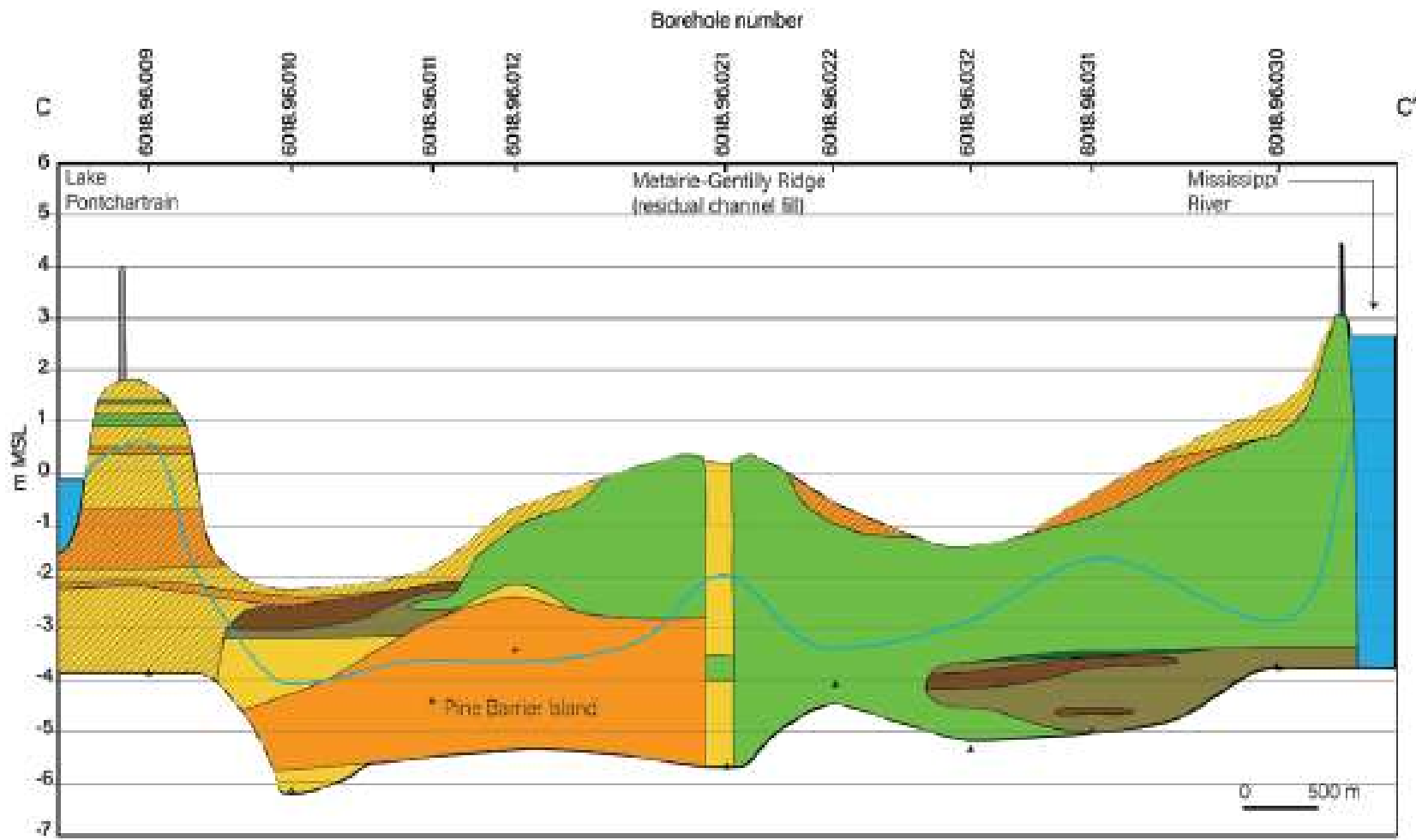
WAGGONNER & BALL



Legend

- | | |
|-------------------------------|--------------------------|
| ■ Peat, humus, organic matter | ■ Silt |
| ■ Organic clay | ■ Silty sand, sandy silt |
| ■ Clay | ■ Sand |
| ■ Clayey silt, silty clay | ▨ Fill |
| ■ Sandy clay, clayey sand | ■ Dike |
| | ⊥ End of borehole |

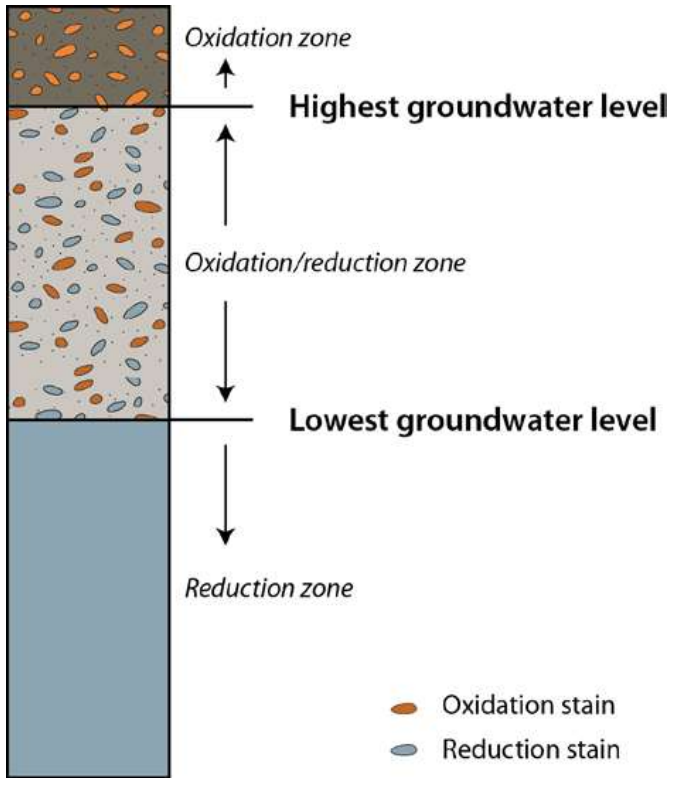
Shallow subsidence Vulnerability in New Orleans - Draft version

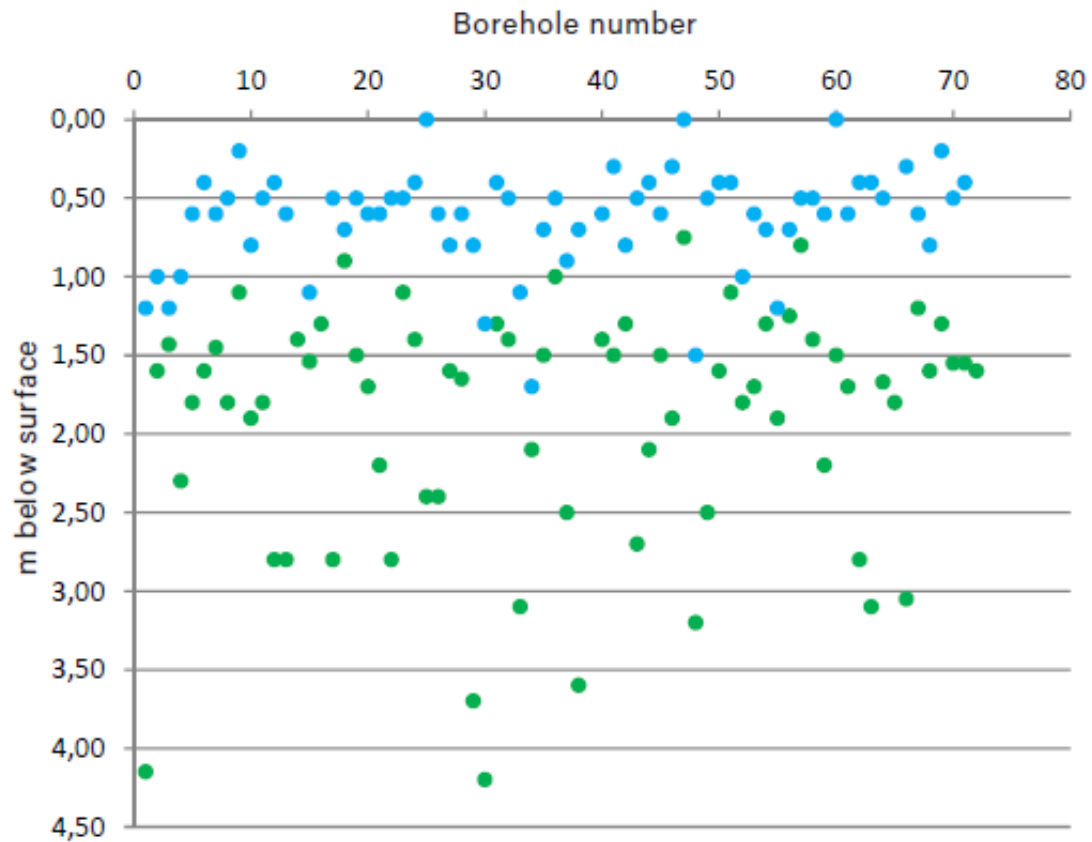


- Legend**
- Peat, humus, organic matter
 - Organic clay
 - Clay
 - Clayey silt, silty clay
 - Sandy clay, clayey sand
 - Silt
 - Silty sand, sandy silt
 - Sand
 - Fill
 - Dike
 - ⊥ End of borehole

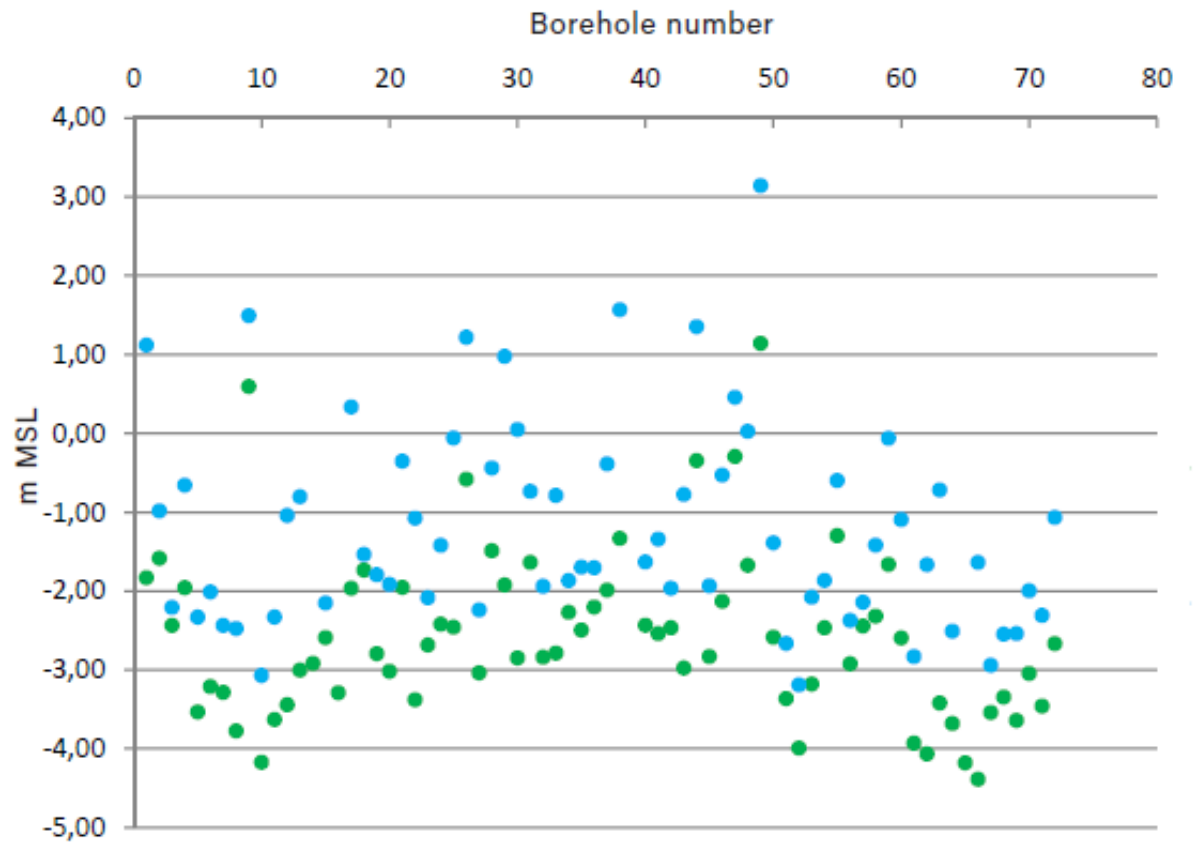
Determination groundwater level





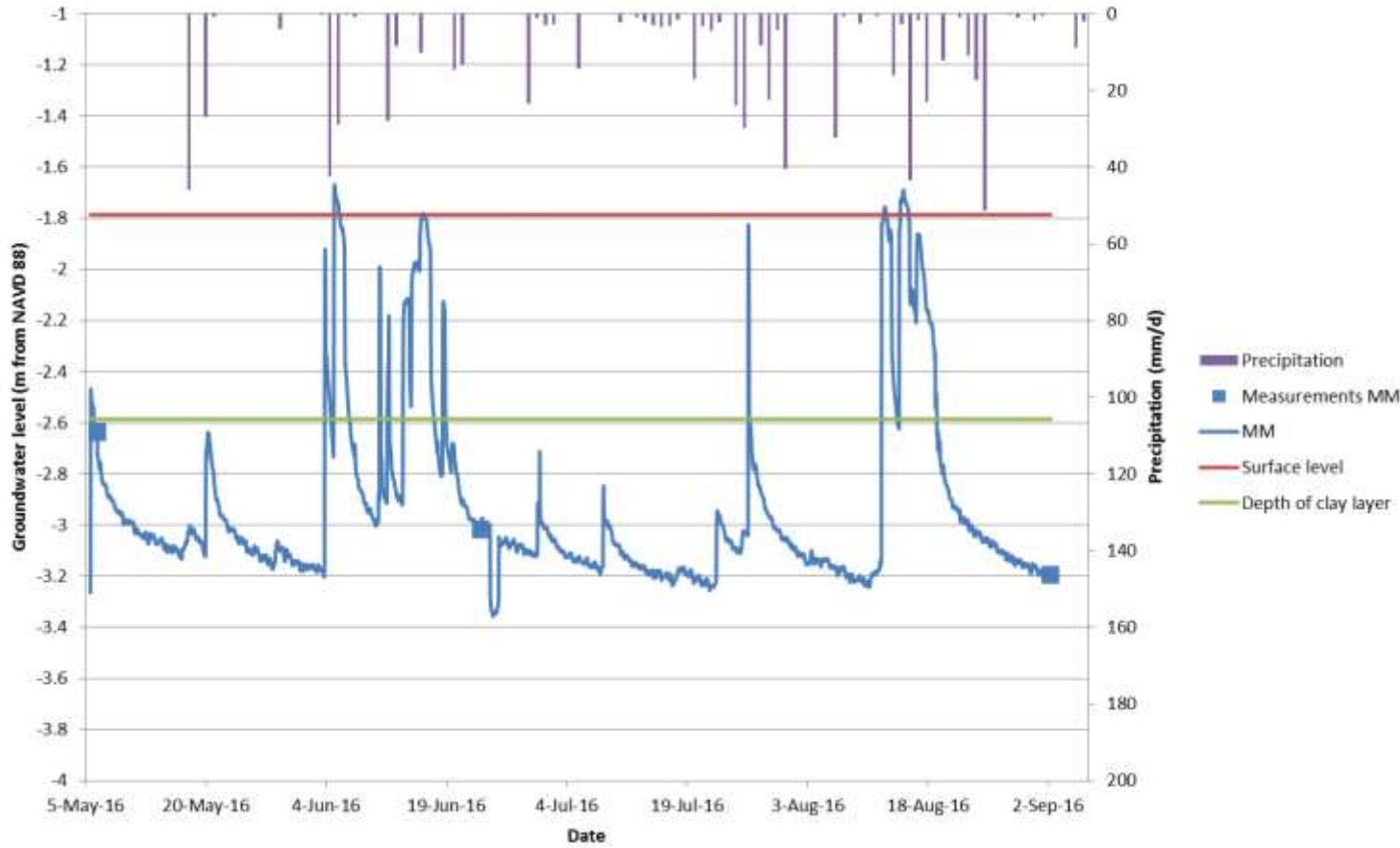


● Lowest GW level (m below surface) ● Highest GW level (m below surface)

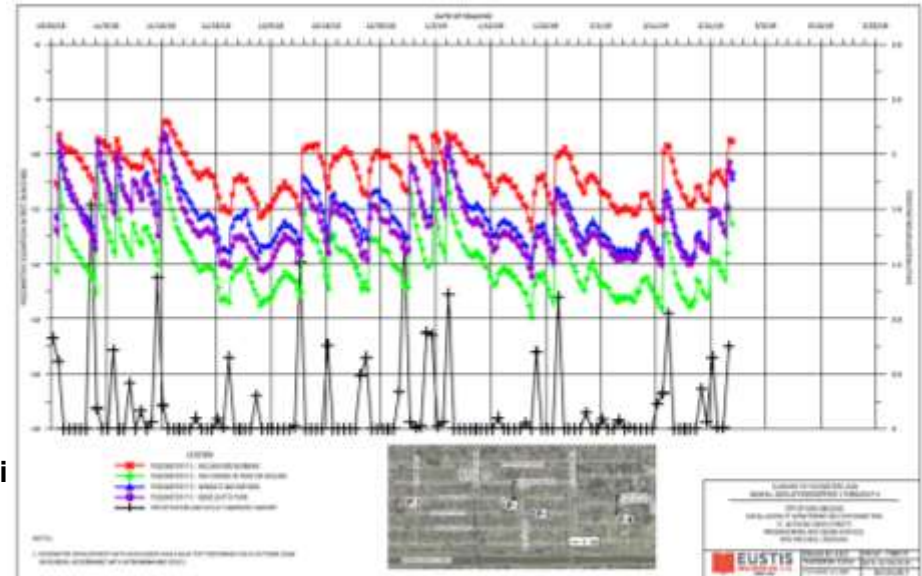


● Lowest GW level (m below surface) ● Highest GW level (m below surface)

Corrected groundwater levels MM



Groundwater level contours (June 23th, 2016) in feet below sea level (from -8 in the south to -11 in North)



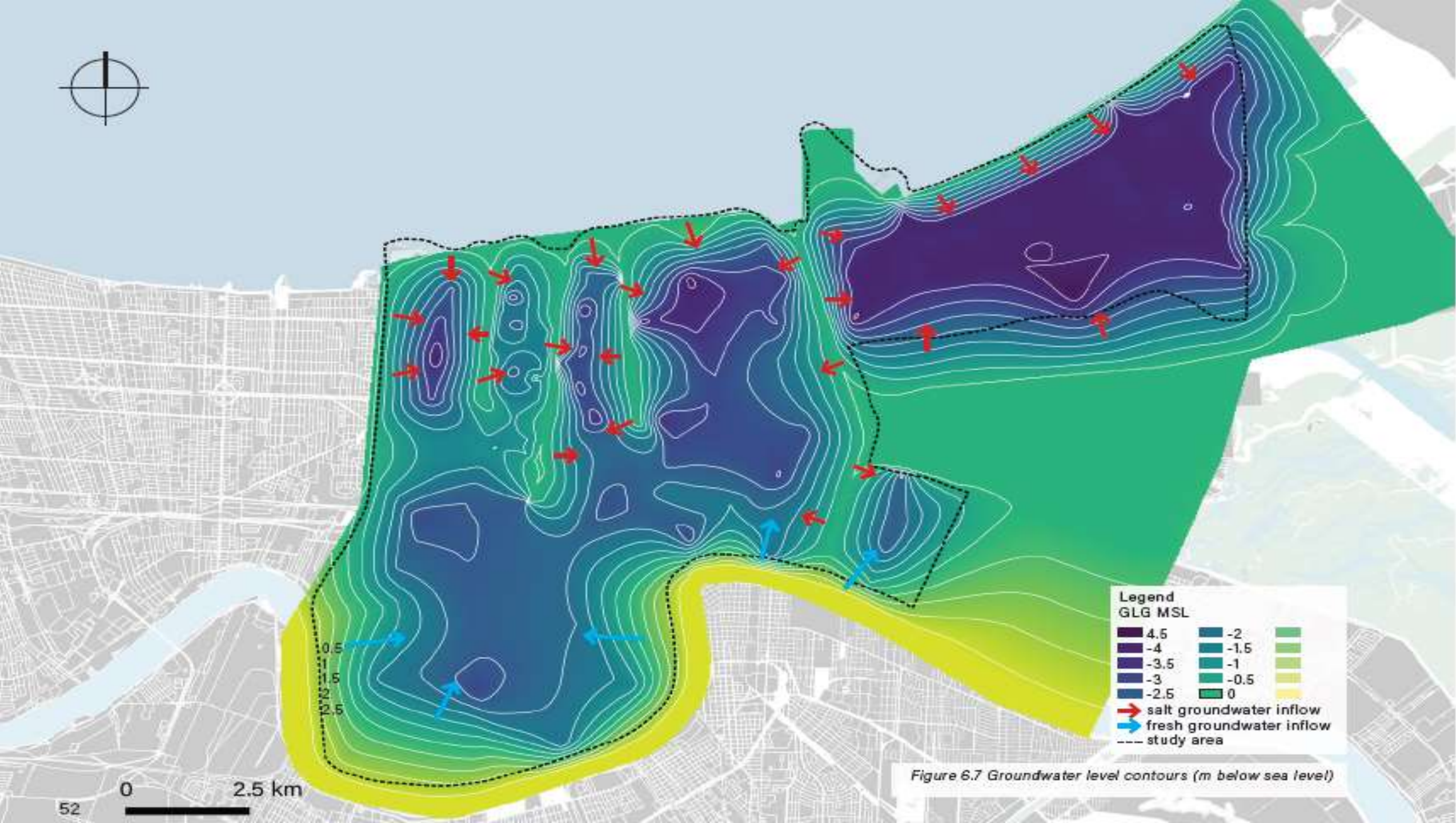
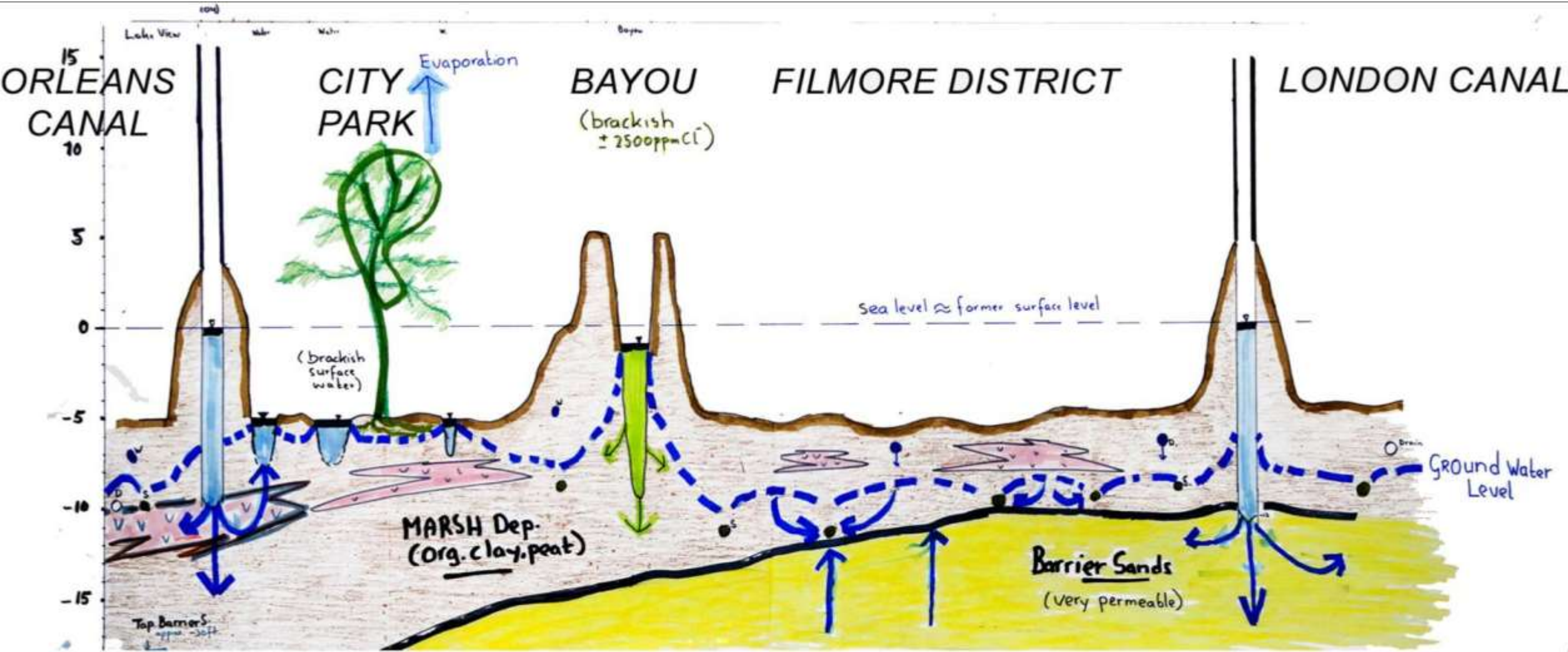
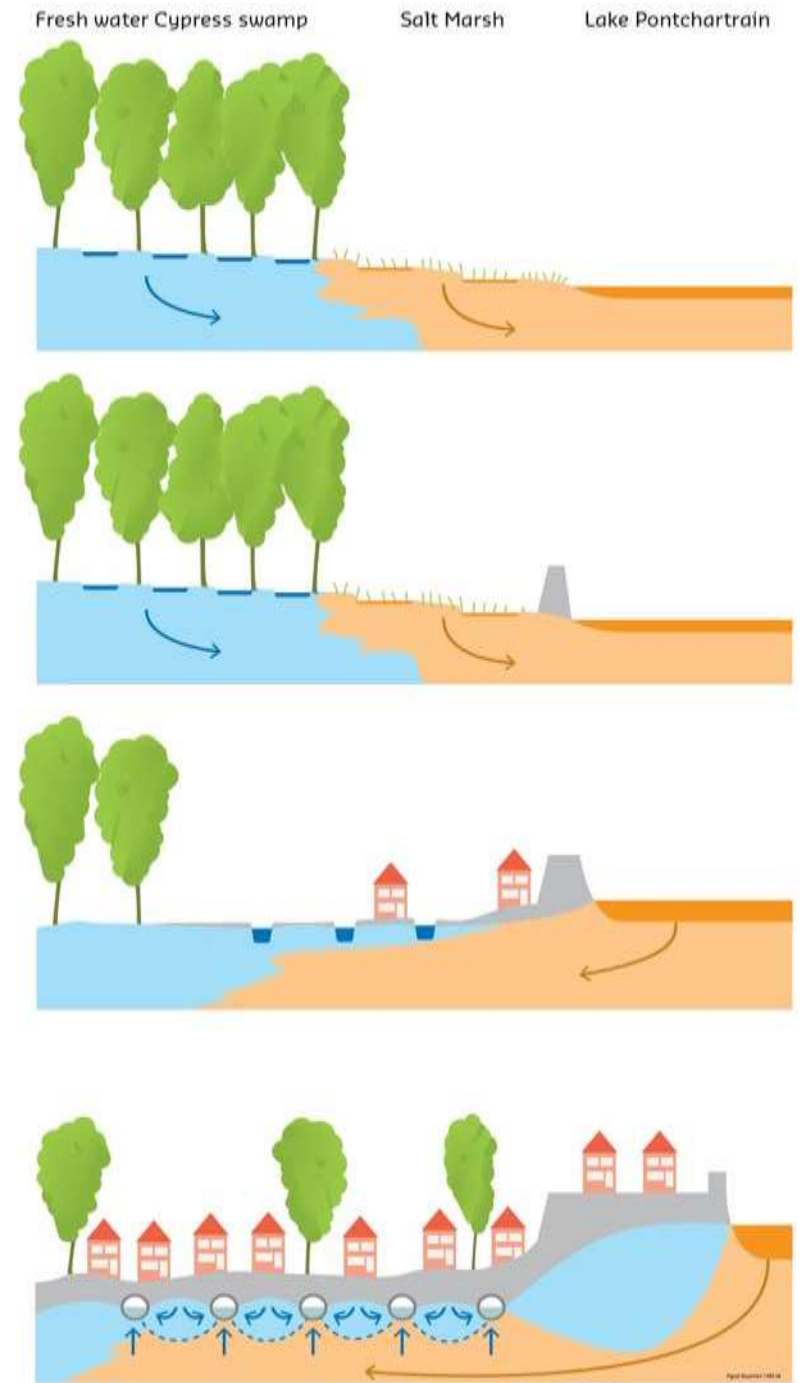
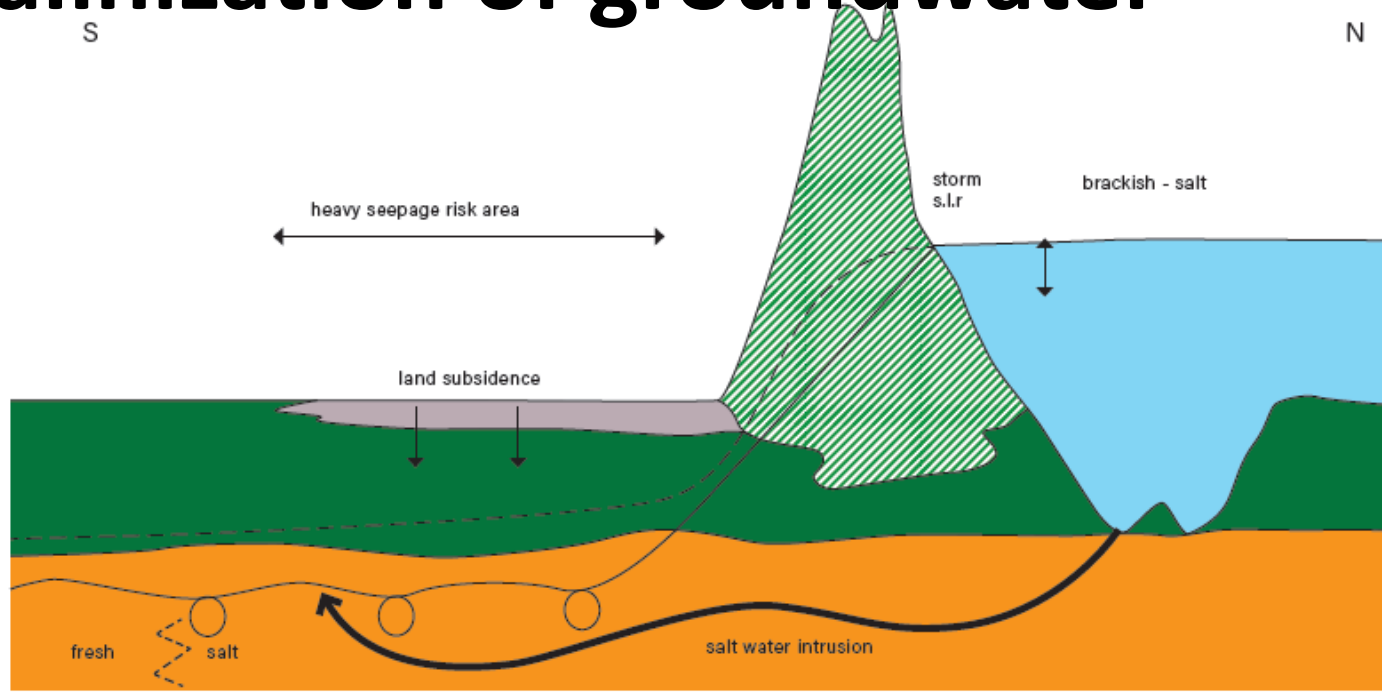


Figure 6.7 Groundwater level contours (m below sea level)



Salinization of groundwater



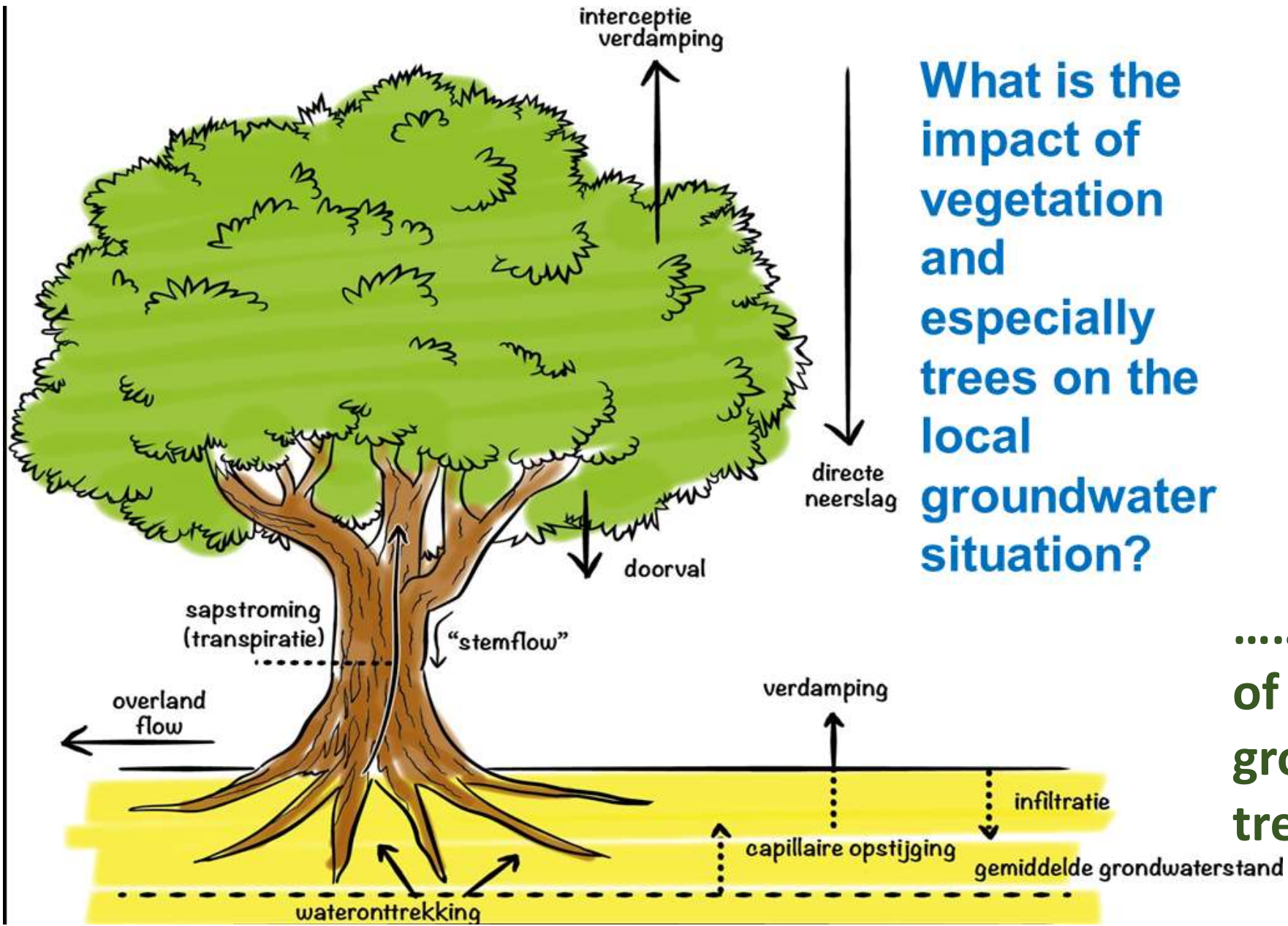


**EC puddles 1.3 mS/cm,
Borehole 1.5 mS/cm**

Tipping point trees: 1.5 -2 mS/cm



Salinization is already a reality



What is the impact of vegetation and especially trees on the local groundwater situation?

.....and what is the impact of salinization and rising groundwater levels on trees?



CITY OF NEW ORLEANS
MAYOR LATOYA CANTRELL




GENTILLY
Resilience
DISTRICT



Gentilly Resilience District Public Lecture Series Groundwater, Subsidence & Green Infrastructure
Issue Date: 19-Aug-19 Version: 01

Plants, maybe even houses need deep watering in this dry season



BY R. STEPHANIE BRUNO | Special to The Advocate NOV 4, 2016 - 8:45 PM 



How dry is it? It's so dry that Catholics are praying for wine to turn into water; so dry that rain barrels have security guards; so dry that fire hydrants are chasing dogs: so dry that. ...

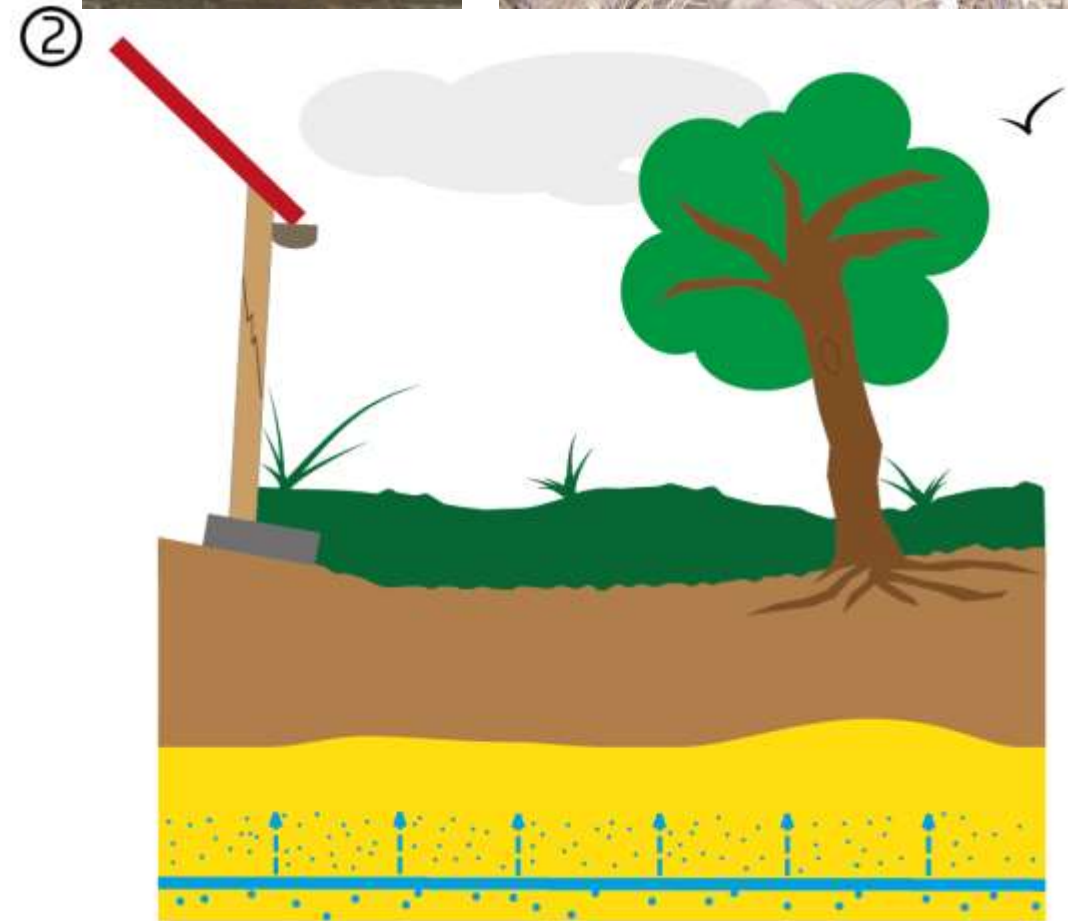
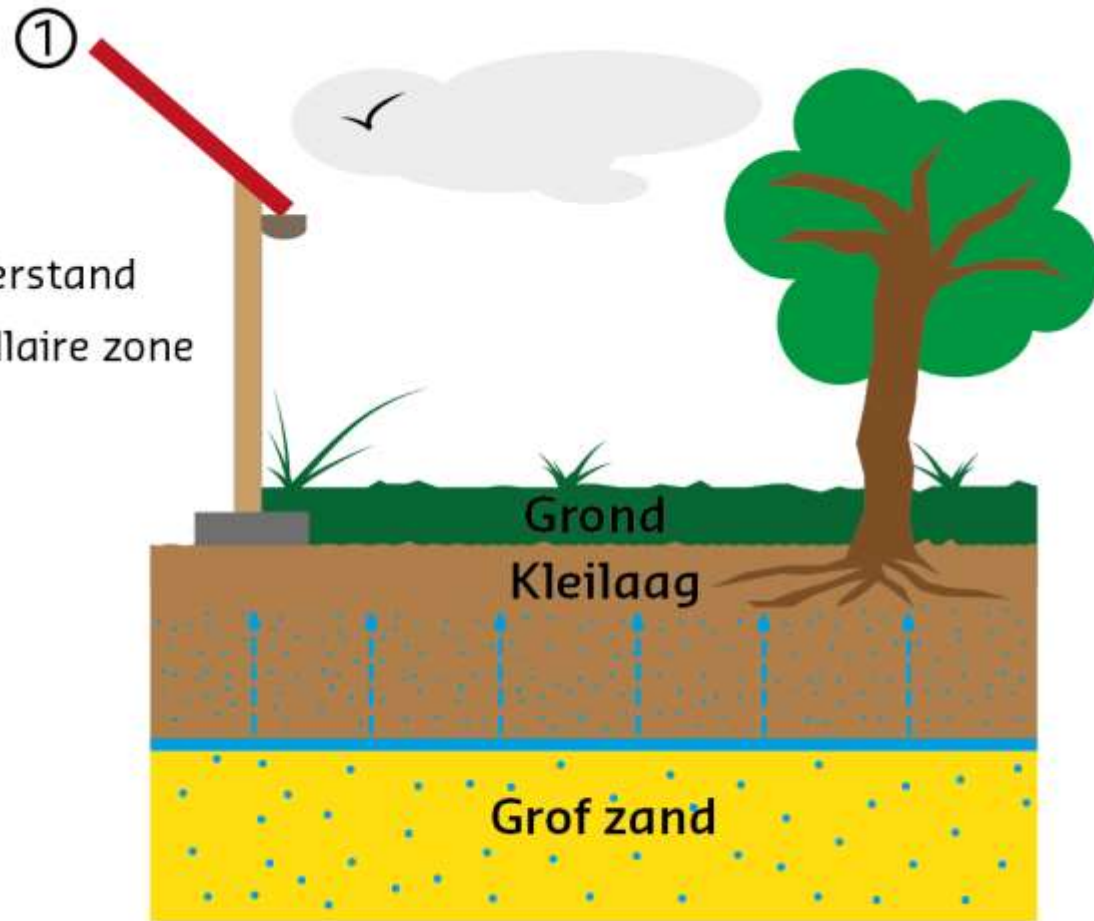


Homeland
Security

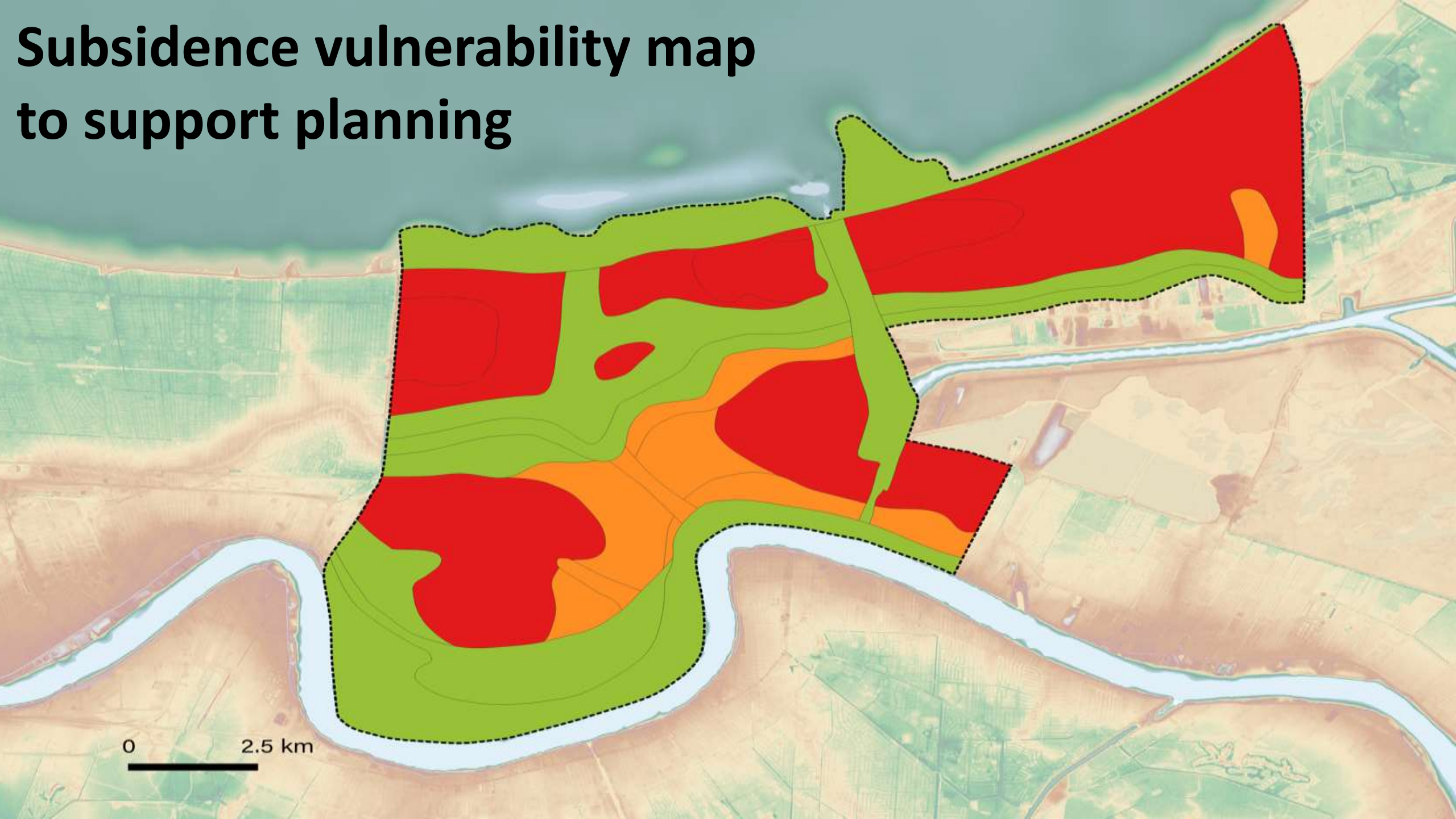
**DROUGHT IMPACTS TO CRITICAL
INFRASTRUCTURE**

April 23, 2015, 1430 EST

SHRINK & SWELL?



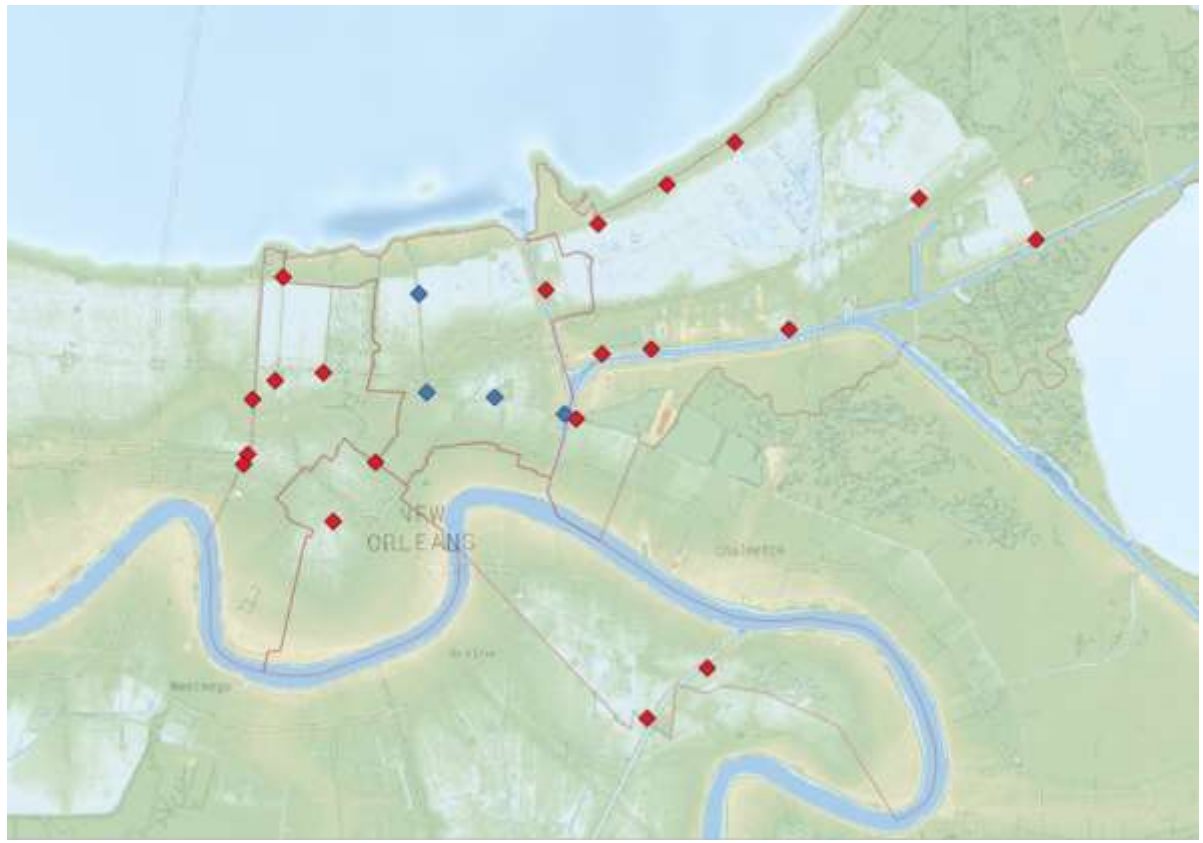
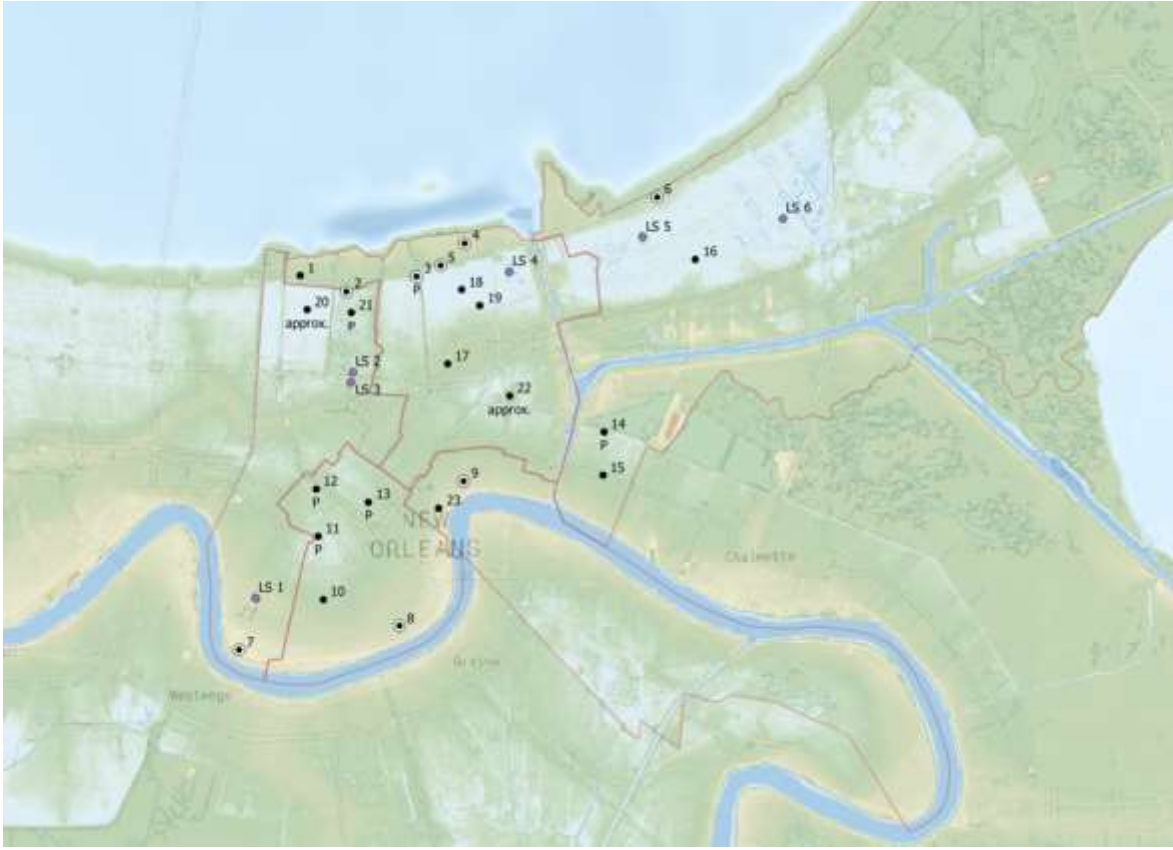
Subsidence vulnerability map to support planning



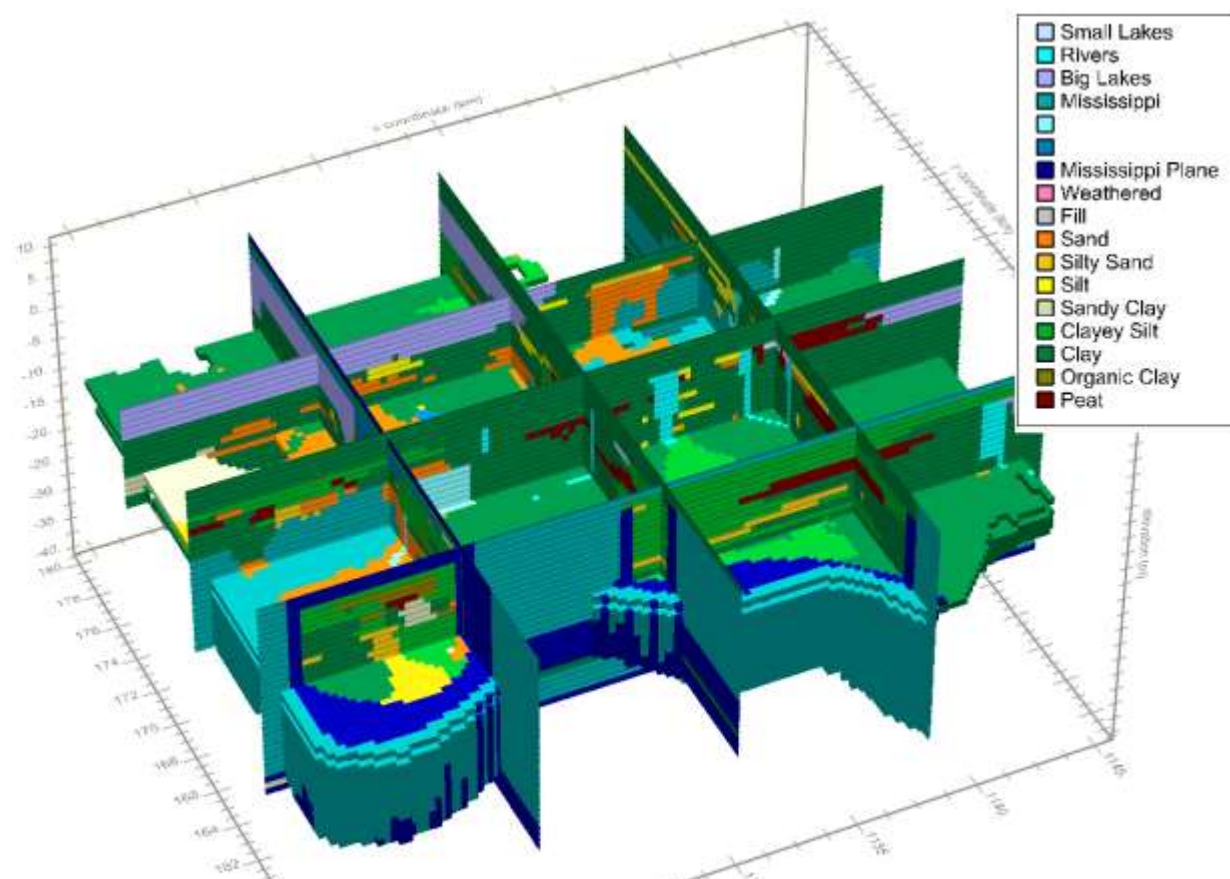
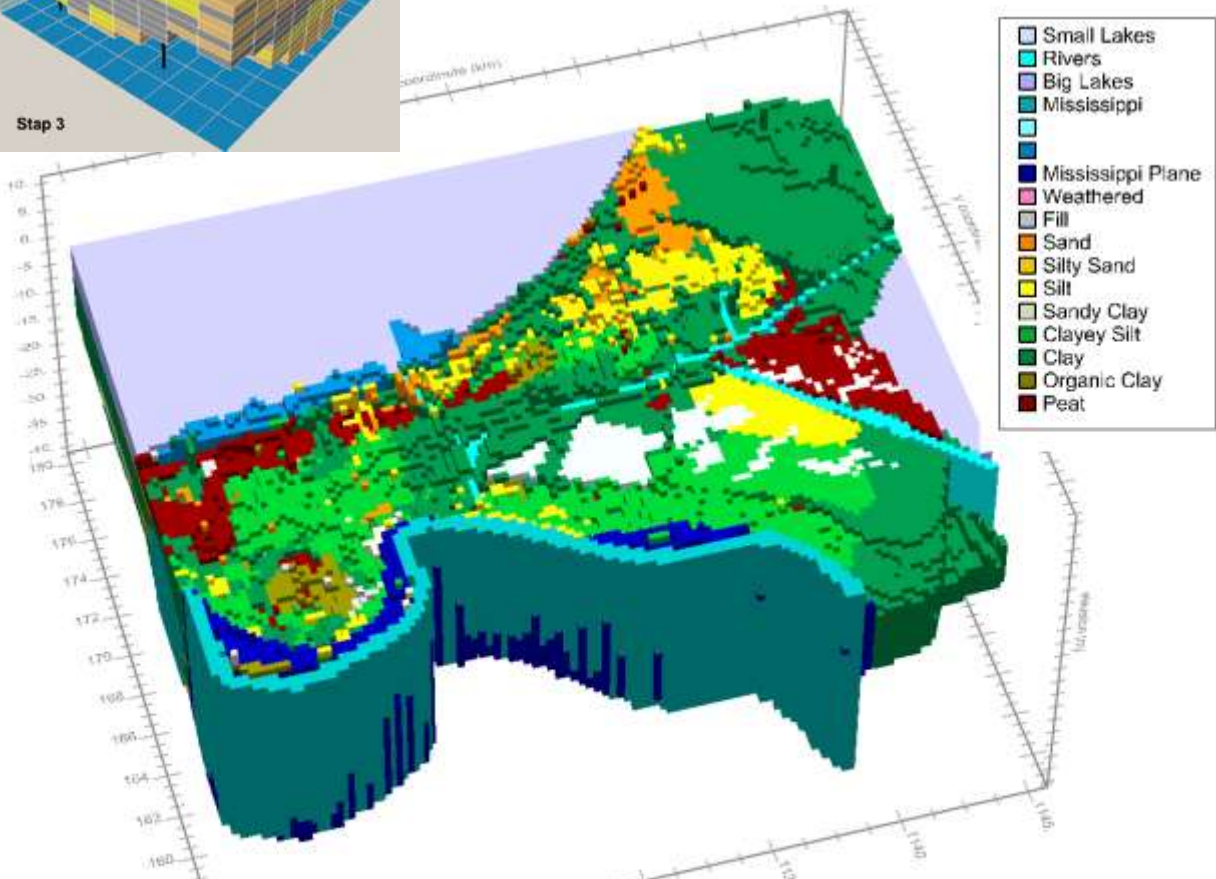
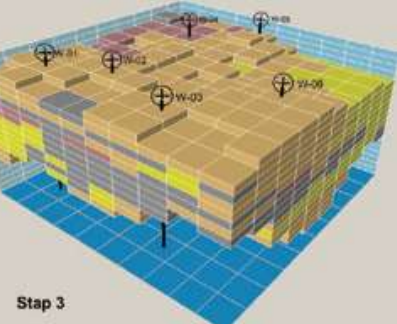
0 2.5 km

Towards a City wide water monitoring system

(with the help of citizens? ... → your private observation well)



Groundwater modeling



Calculating effect sea level rise, climate change and renovation activities



Keep YOUR rain at your own property

