



# SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)

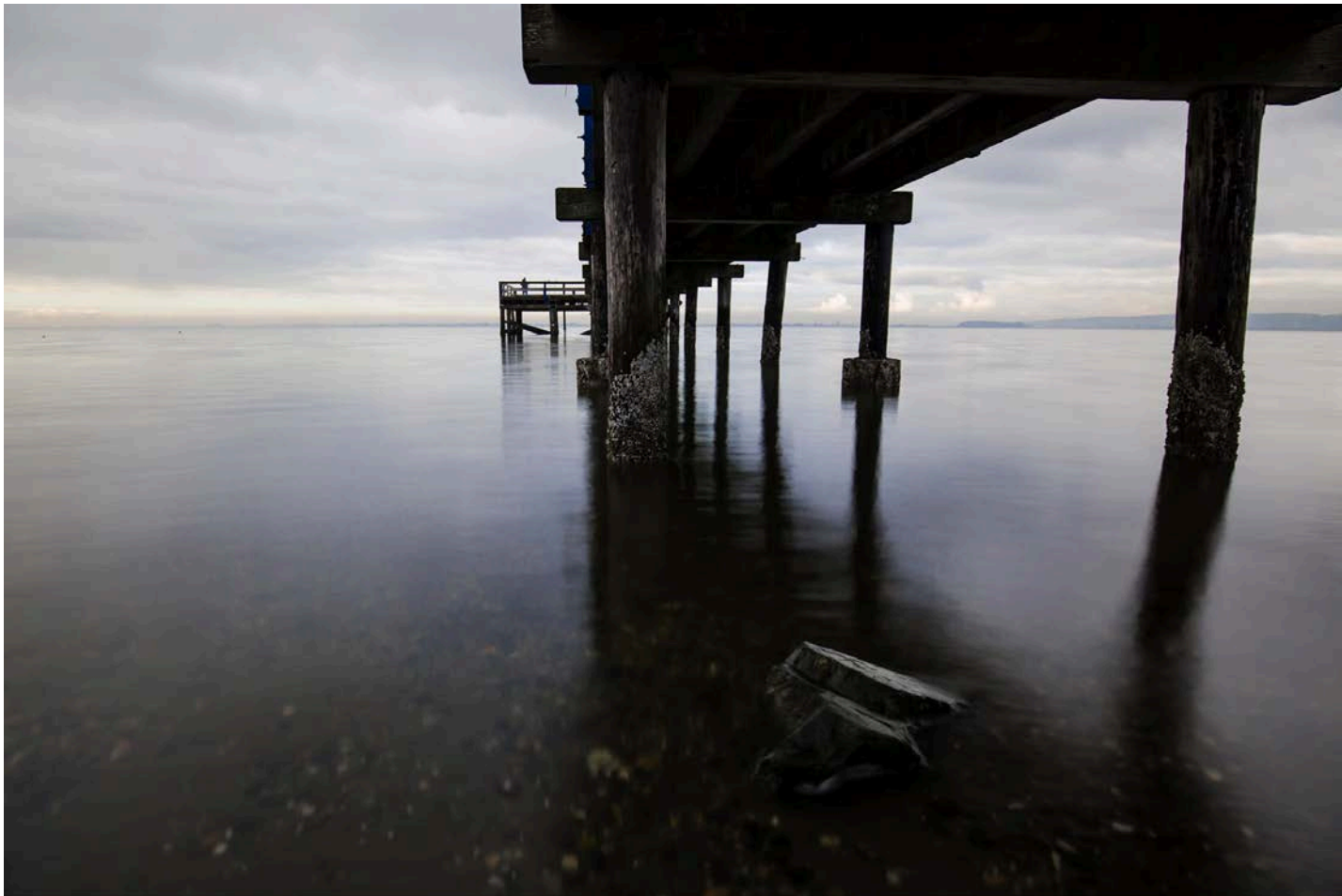
## Phase 1 Open House

CFAS Open House

# Photo Contest Winners

**#SurreyCoastal**

# Activity



**Gail Stephan**

Under crescent beach pier.... Great place to take a long exposure any time of year!



# Nature



**borntodub (William Churchill-Browne)**

Autumn is my favorite time of year. #sunshine



# Storm



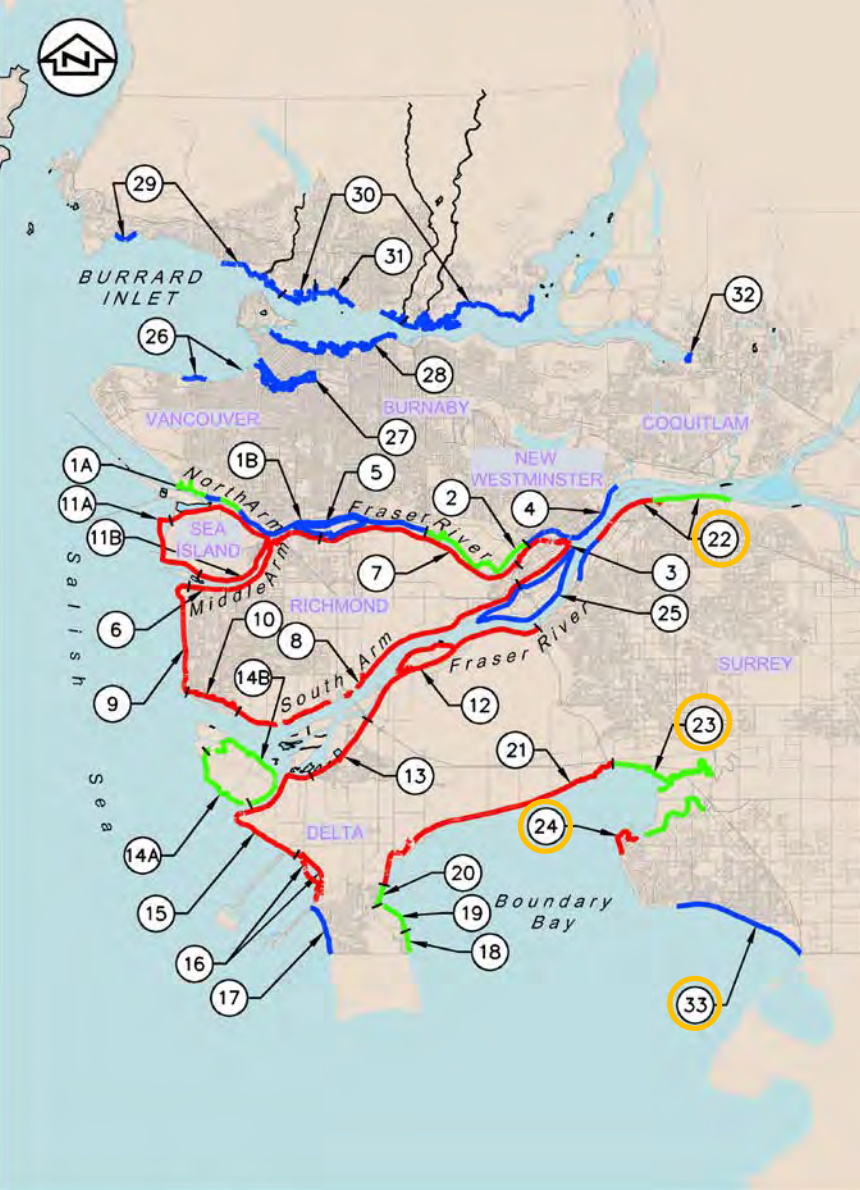
**Simrandevgun**  
**(Simran Devgun)**  
#solace #truesurrey

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# PROJECT OVERVIEW

# Project Overview

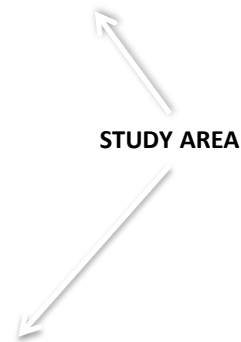
- 2011 Provincial Guidelines on sea level rise published
- Outlined expected sea level rise and flood protection requirements
- 2012 report estimated the cost to adapt flood protection to meet the rise in sea level predicted by 2100
- \$9.5 Billion estimate for Lower Mainland
  - Estimate of works in Surrey, \$1.5B





# SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)

- Mayor & Council adopted recommendations to develop a Coastal Strategy Feb 22, 2016 under Corporate Report No. R034;2016
  - Continuing commitment to participatory planning
- CFAS anticipated to be complete by end of 2018
- Large study area with many communities, stakeholders and partners



# Study area @ a glance

## COMMUNITIES AND PEOPLE



Many residential areas and neighbourhoods  
Semiahmoo First Nation  
1,500+ residents  
Approximately 20% of Surrey's land area

## PARKS AND ENVIRONMENT



Destination regional and City parks  
Beaches and recreation areas  
Critical foreshore, coastal, and riparian areas

## LOCAL AND REGIONAL ECONOMY



700+ jobs  
Over \$100M in annual farm gate revenue  
Over \$1B in assessed property value  
Almost \$25B annual truck and rail freight traffic

## INFRASTRUCTURE



Over 10km of Provincial Highways  
Over 200,000 vehicle trips a day  
Over 30km of railway (freight, passenger)

# Surrey CFAS Process





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# COASTAL FLOODING & SEA LEVEL RISE

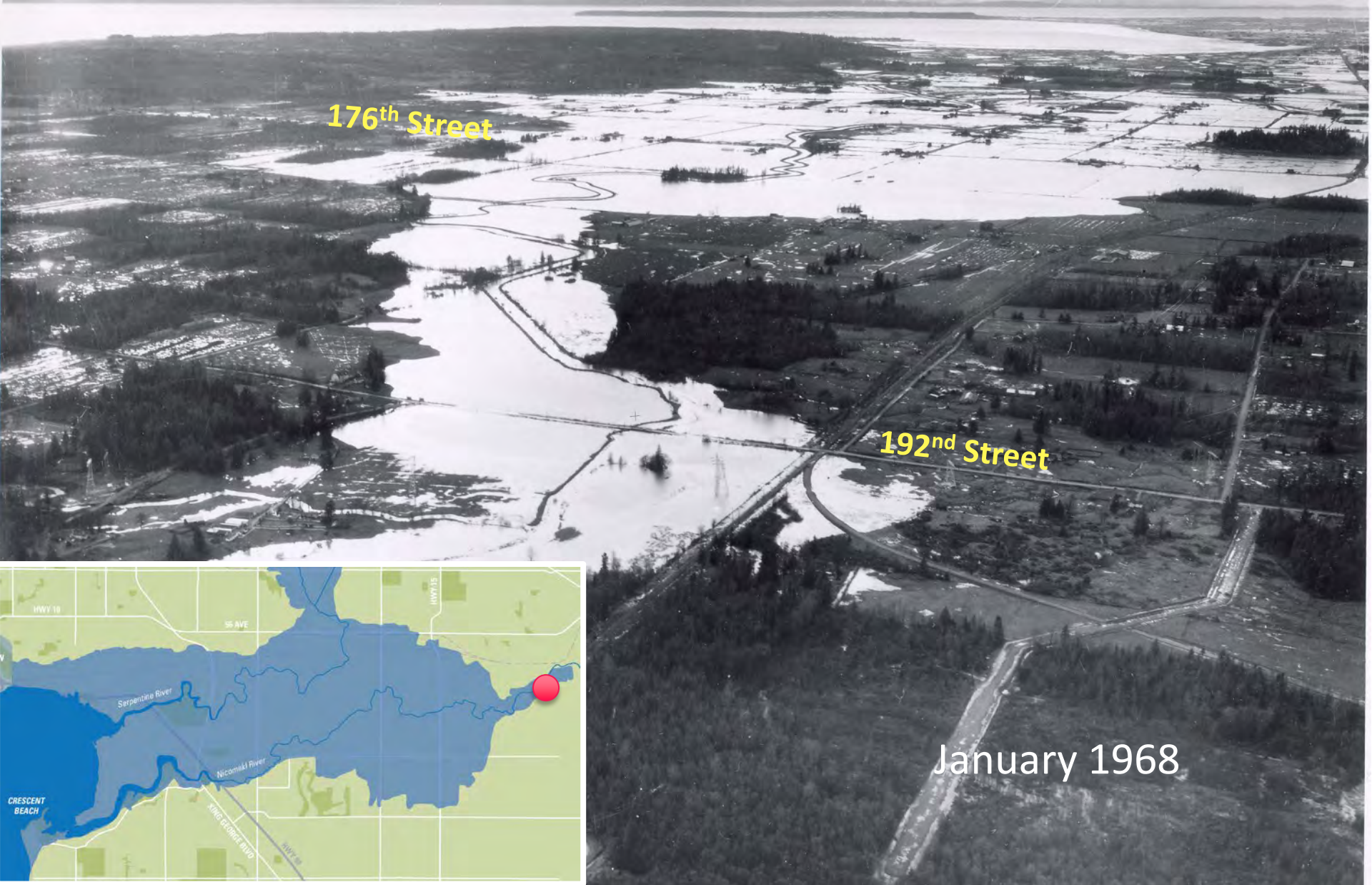
# Surrey's Coastal Floodplain



- A natural floodplain
- Regularly experiences coastal flooding
- Ocean-driven flooding (storm surges, king tides)
- River-driven flooding (rain storms, rapid snow melt)



# Coastal Flooding in Surrey



176th Street

192nd Street

January 1968





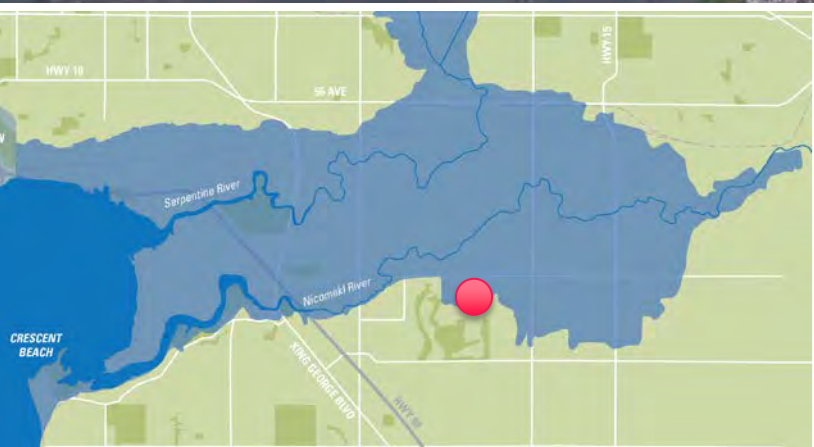


Hwy 10

168th Street

40th Avenue

January 2009







Winter 2016



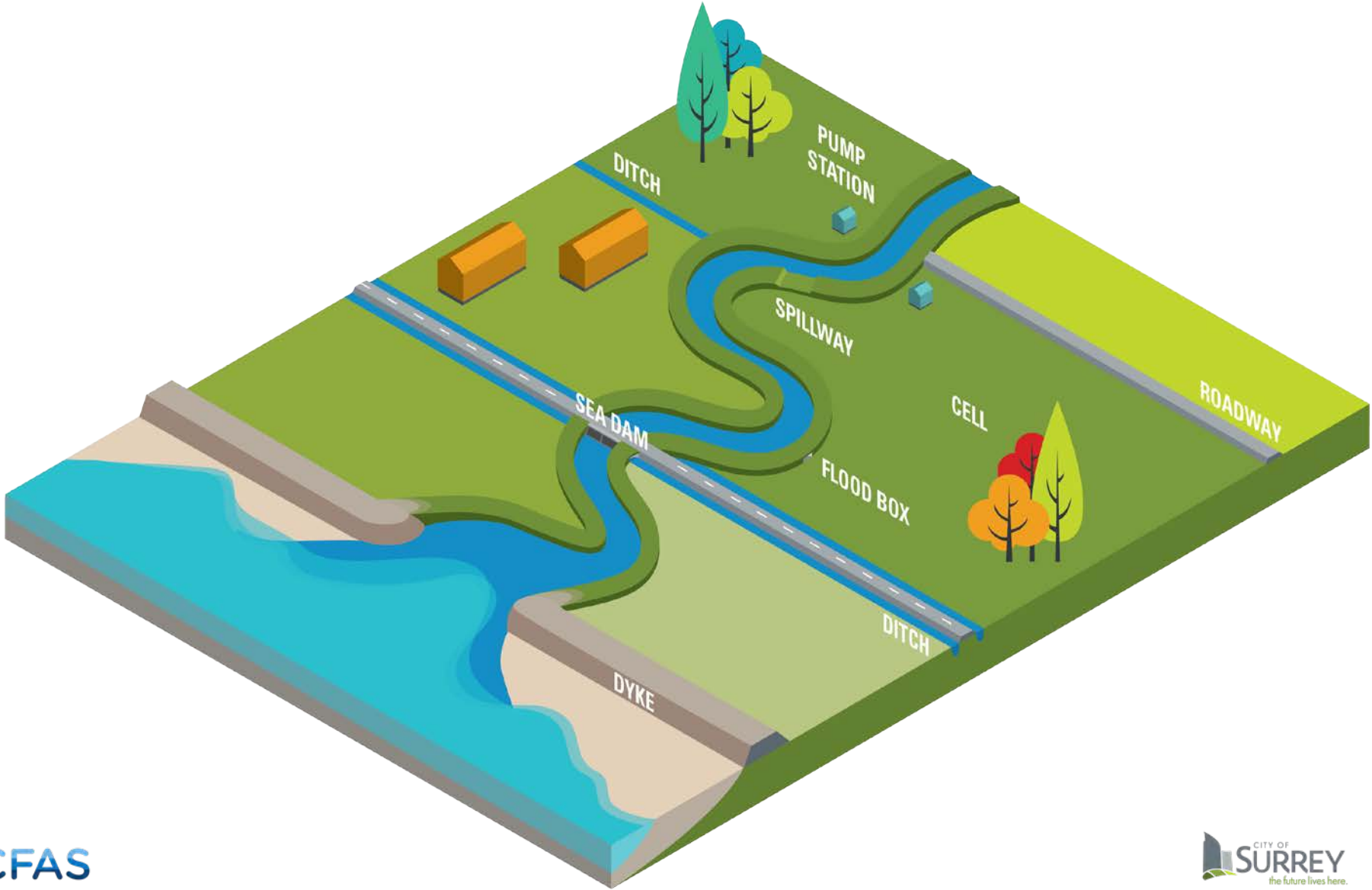
# Flood Management

- A long history of work
- 1890's first dykes





# Flood management



# COASTAL AND RIVER FLOODING

1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100 2100

## Major Coastal and River Flood Events



### A Changing Shoreline

In 1890, dyking of Mud Bay begins. Shortly afterwards, dyking and damming of the Serpentine and Nicomekl Rivers begins. By 1953, a timber sea wall at Crescent Beach is constructed.

Since then, residents of Surrey's Coastal Floodplain have relied on a system of dykes and sea dams to protect themselves from ocean and river flooding.

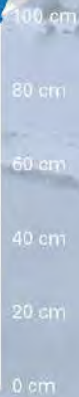


Sea Level Rise



TODAY

1  
Metre



### An Evolving Future

As our climate continues to change and sea levels continue to rise over the coming years, it is anticipated that the frequency and intensity of major coastal and river floods will also increase.

The Province has directed municipalities to plan for at least 1m sea level rise by 2100. In Surrey, and elsewhere in the Lower Mainland, most drainage systems are not designed for projected changes.

Photo credit: City of Surrey Archives and Museum

# Climate Change and Coastal Floods

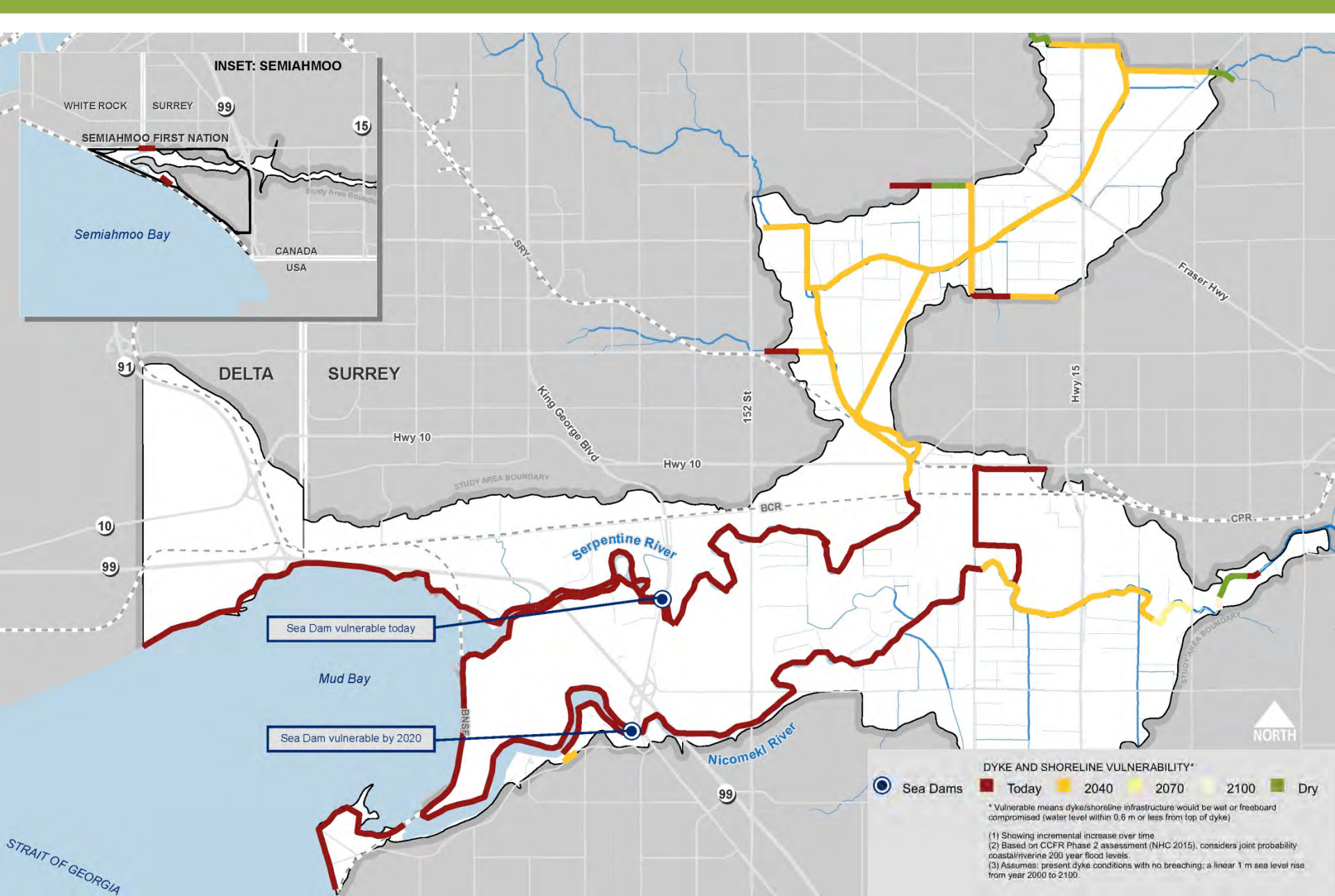
- Coastal cities around the world are facing same challenges
- Province directed municipalities to plan for at least 1 m sea level rise by 2100
- In Surrey and elsewhere most drainage systems not designed for projected changes

**100cm** 

THE EXPECTED SEA LEVEL RISE  
OVER THE NEXT 100 YEARS IN  
SURREY IMPACTING ABOUT  
20% OF SURREY'S LAND AREA









# Extreme Floods

- Climate change is affecting intensity and frequency of storms and flood events
- Extreme floods of today become more frequent in the future



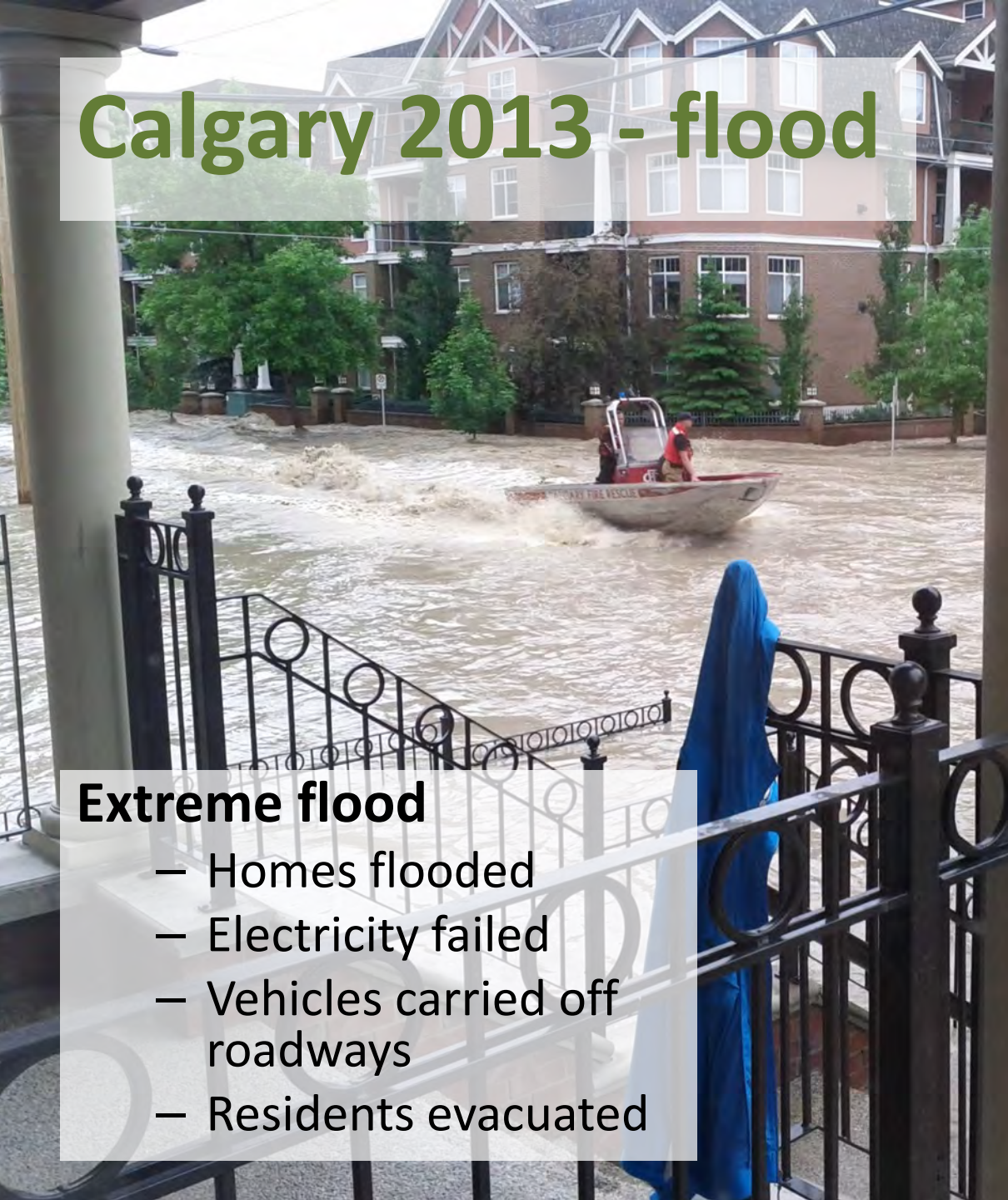
# Extreme Flood Events

- Flood of 1948
  - +1 metre depth
  - flowing water





# Calgary 2013 - flood



## Extreme flood

- Homes flooded
- Electricity failed
- Vehicles carried off roadways
- Residents evacuated









# Flood Frequency

**0.5%**

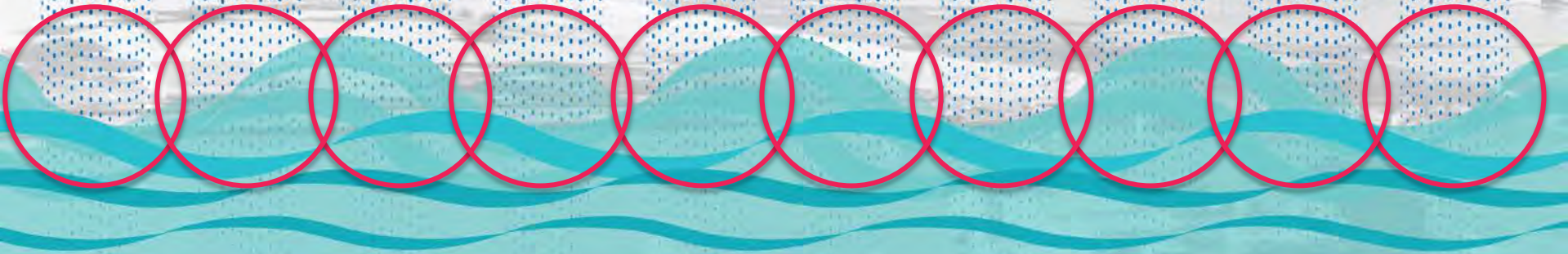
chance of an  
extreme  
flood today





# Flood Frequency

**50%**  
chance of an  
extreme  
flood in  
2100





# Hazards and Impacts



- Agriculture
- Community and Residential
- Environment and Recreation
- Transportation and Infrastructure
- Local and Regional Economy



CFAS Open House

# ADAPTATION PATHWAYS



# Adaptation Approaches

**Protect**



**Accommodate**



**Retreat**



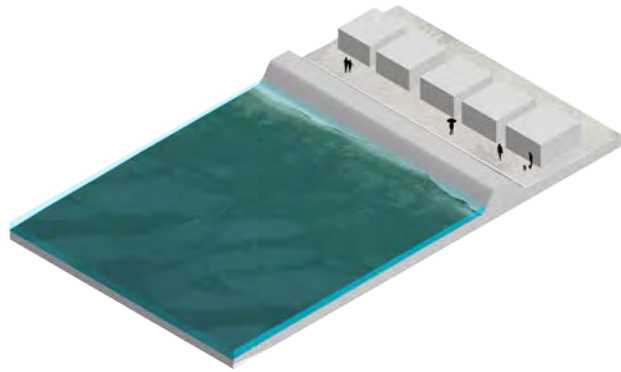
# Adaptation Approaches



Combination



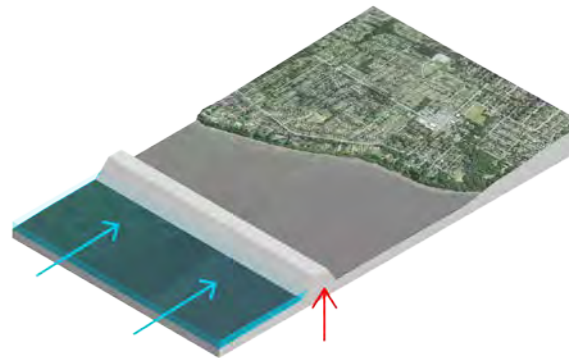
**Protect**



Raise Coastal and River Dykes



Offshore Barrier Islands



Offshore Sea Barrier



Breakwater or  
Jetty

Offshore  
Islands

33

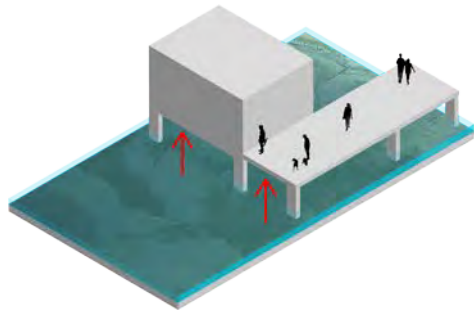




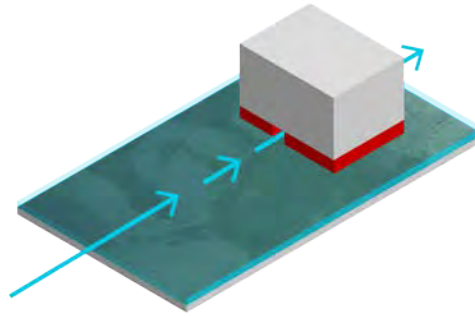
Source: <http://www.industrytap.com/the-great-wall-of-louisiana/677>



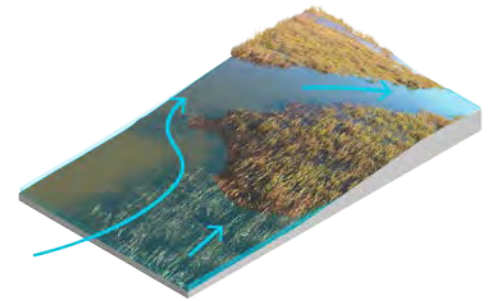
# Accommodate



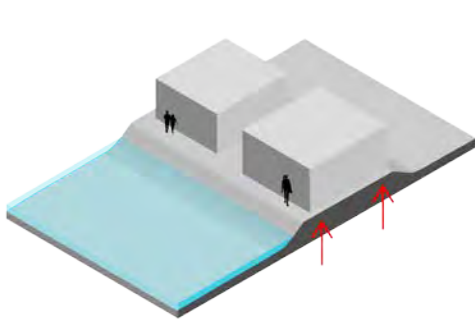
Raised Structures



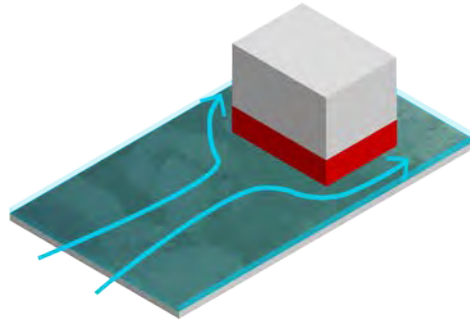
Wet Proofing



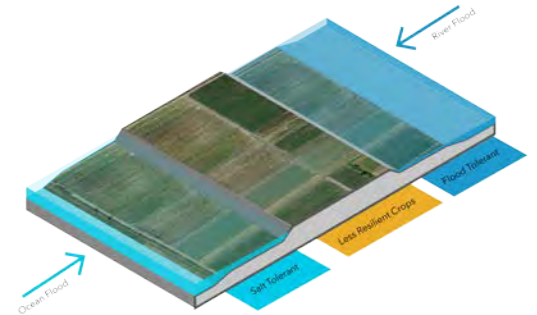
Wetland Restoration



Build on Fill



Dry Proofing



Crop Reorganization



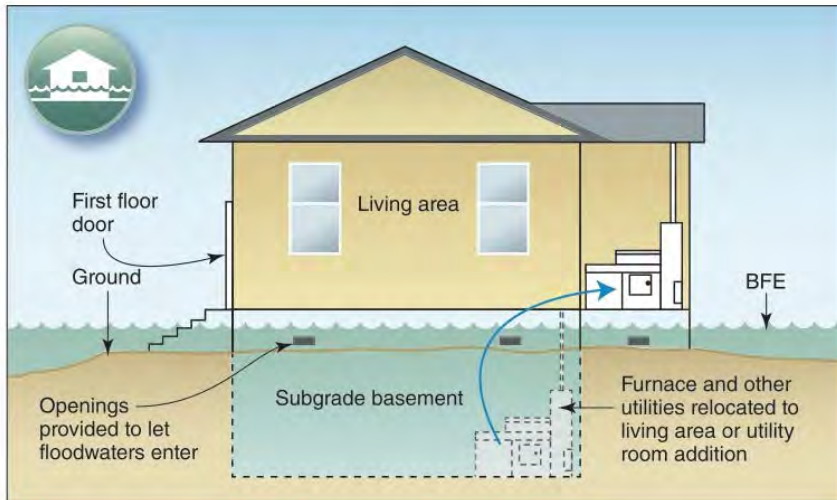
## Housing on pile foundations in Rotterdam

<http://frameworks.ced.berkeley.edu/2015/a-modest-proposal-adapting-to-sea-level-rise/>



## Coastal marsh restoration

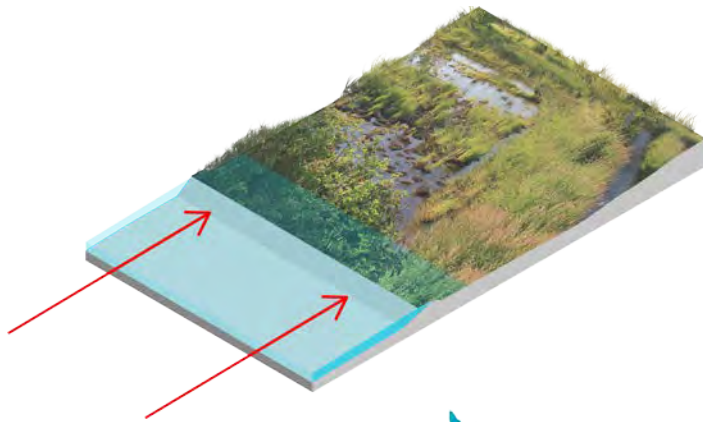
<https://blog.savesfbay.org/2014/04/climate-report-supports-wetland-restoration-as-sea-level-rise-adaptation-strategy/>



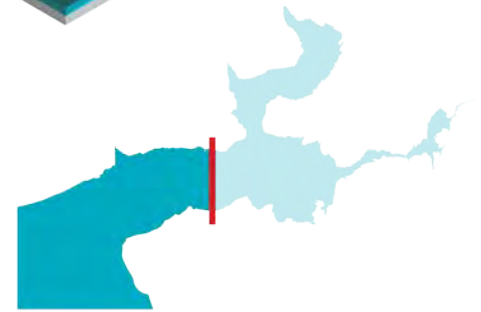
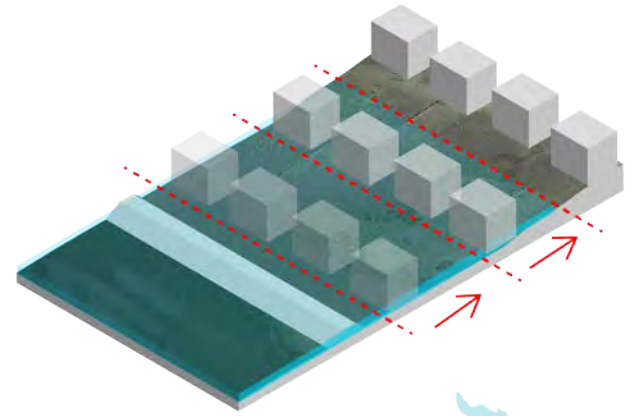
## Wet Proofing Strategies

<http://cnycn.org/2014/10/copin-g-with-big-flood-insurance-changes-in-nyc-part-iv-mitigation/>

Retreat



Complete Retreat



Managed Retreat





© Terry Whittaker/2020VISION / Rex

## Retreat at Abbots Hall Farm, Essex UK

<http://factfile.org/8-facts-about-abbotts-hall-farm>

# Learning from International Experts







LANDSCAPE ARCHITECTS

Alexander Herrebout  
Jorne van de Water

**LINT**  
landscape interventions

FLOOD RISK CONSULTANT

Ric Huting

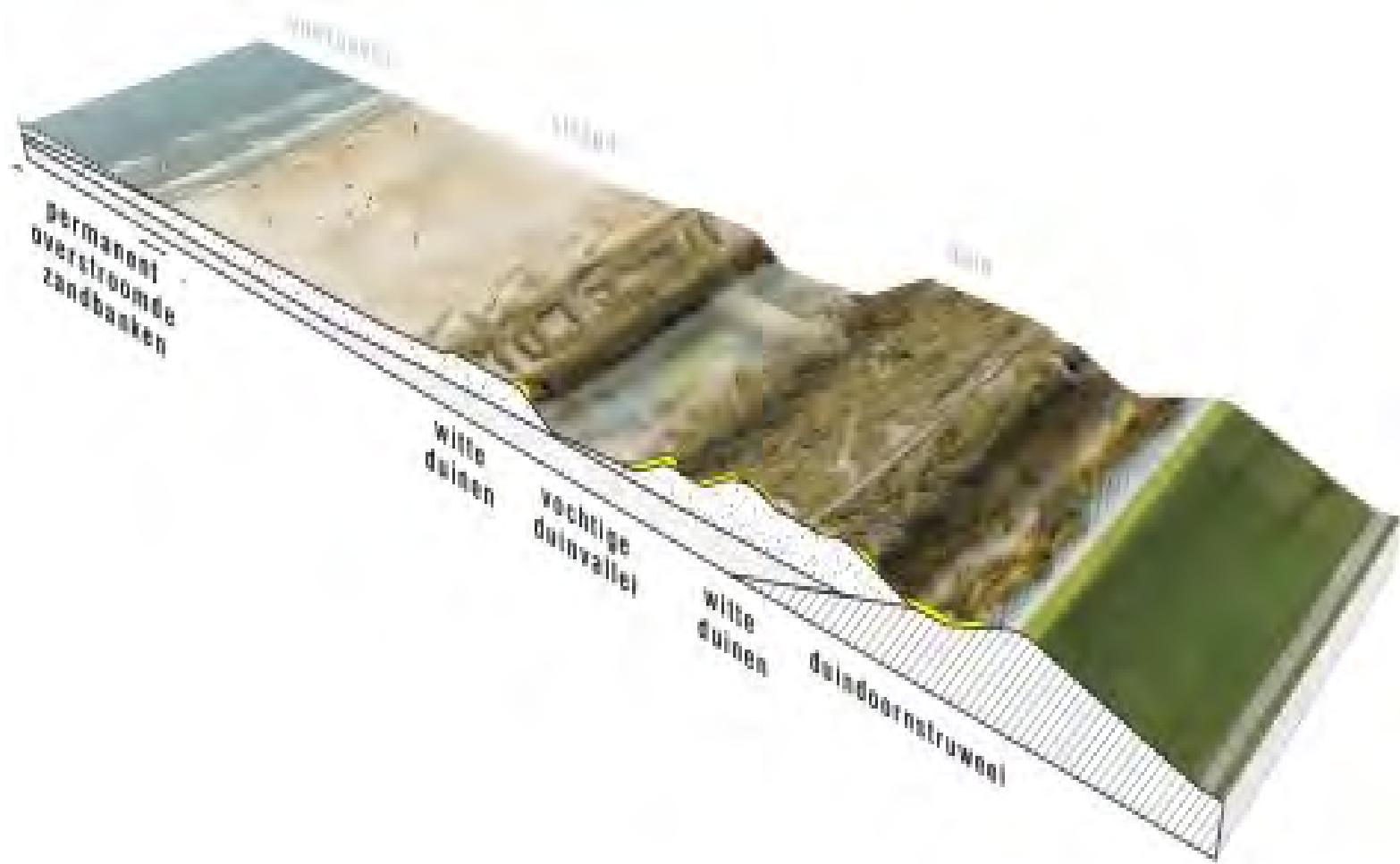
 **Royal  
HaskoningDHV**  
*Enhancing Society Together*

# Markerwadden





# Hondsbossche zeekering



# Sand Engine





# Houtribdijk



# Dike reinforcement Ameland





# Afsluitdijk



# Noordwaard





# IJsseldelta bypass





# Ruimte voor de Waal Nijmegen

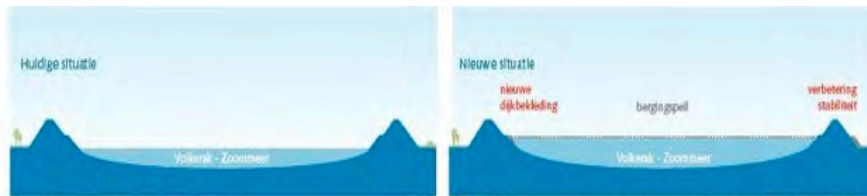




# Volkerak Zoommeer

## Waterberging Volkerak-Zoommeer

Het Volkerak-Zoommeer wordt geschikt gemaakt als tijdelijke berging voor rivierwater in extreme situaties. Inzet van de waterberging biedt Zuidwest-Nederland bescherming in geval van gesloten stormvloedkeringen en zeer hoge afvoeren van de rivieren; een uitzonderlijke combinatie. De kans dat Waterberging Volkerak-Zoommeer ingezet wordt is 1/1400<sup>e</sup> per jaar.



De vaste waterstand op het Volkerak-Zoommeer is rood NAP.

Bij inzet van het Volkerak-Zoommeer voor waterberging stijgt de waterstand in 24 uur tot circa NAP + 2,30 m. Het water zal na openen van de stormvloedkeringen weer naar zee worden afgevoerd.



Bij dreigende stormvloed sluiten de Maaslandkering en Hartelkering. In die omstandigheid zijn ook de Haringvlietsluzen gesloten. Als de rivierafvoeren tegelijkertijd zeer hoog zijn, kan het waterpeil in het Hollandsch Diep en Haringvliet tot een gevaarlijk niveau stijgen, omdat het rivierwater niet meer kan wegstromen. Door het rivierwater tijdelijk te bergen in het Volkerak-Zoommeer, wordt de waterstand op het Haringvliet met circa 0,1 meter verlaagd. Als deze keringen weer open gaan, kan het rivierwater via het Haringvliet weer naar zee stromen.

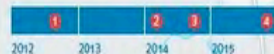
### Legenda:

- plangebied
- keringen en sluzen
- rijlooiing
- landsgrens

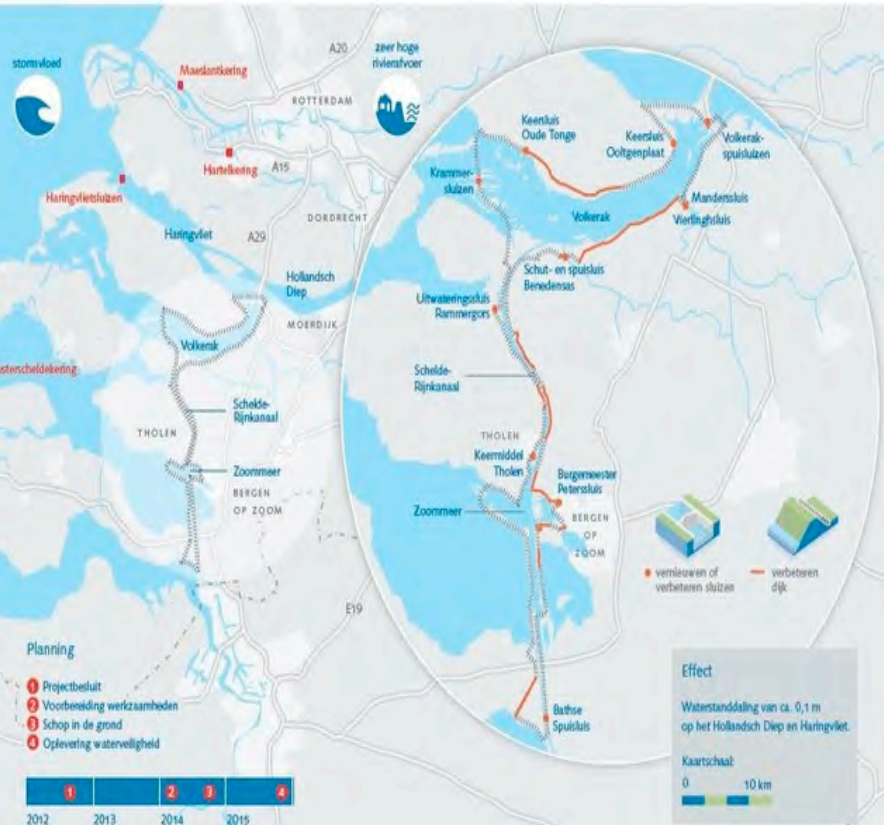


### Planning

- 1 Projectbesluit
- 2 Voorbereiding werkzaamheden
- 3 Schop in de grond
- 4 Oplevering waterveiligheid



www.ruimtevoerder.nl



### Effect

Waterstanddaling van ca. 0,1 m op het Hollandsch Diep en Haringvliet.

Kaartschaal: 0 10 km

# NIEUWE KWELDERS

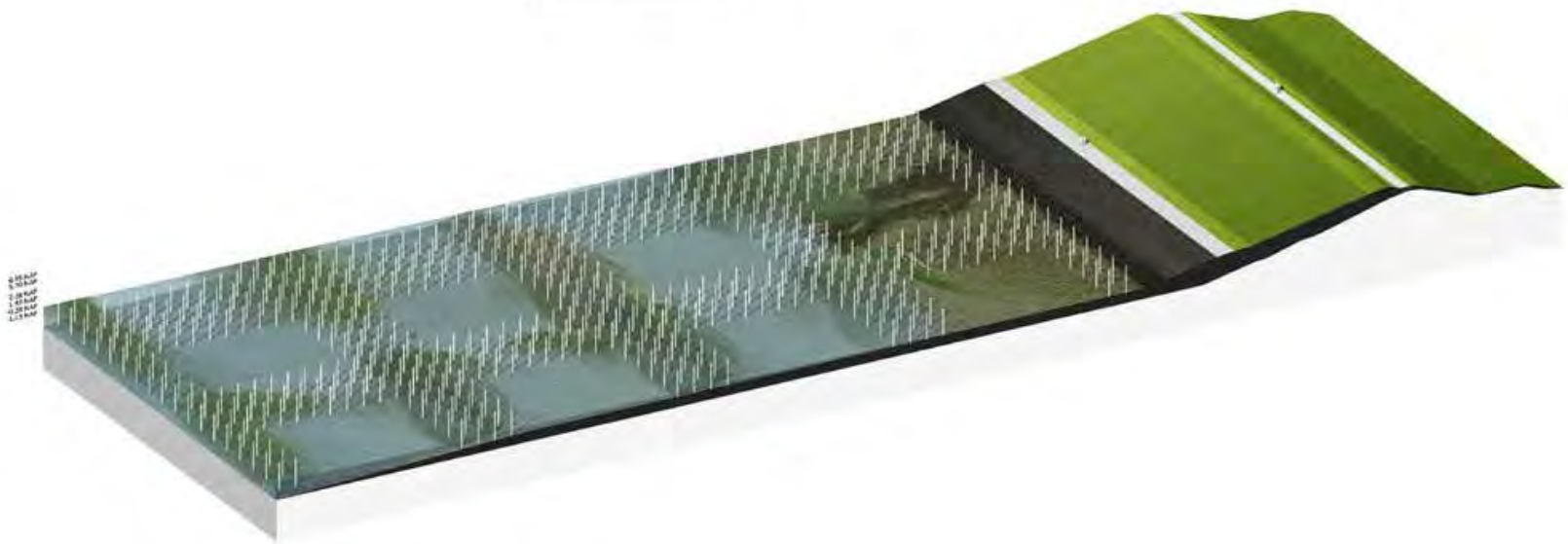




# BESTAANDE SITUATIE



# INGREEP: PALENGRID



ingreep: plaatsen palengrid



# CLIMAX: SOORTENRIJKDOM EN GEBRUIK



# NIEUWE KWELDERS



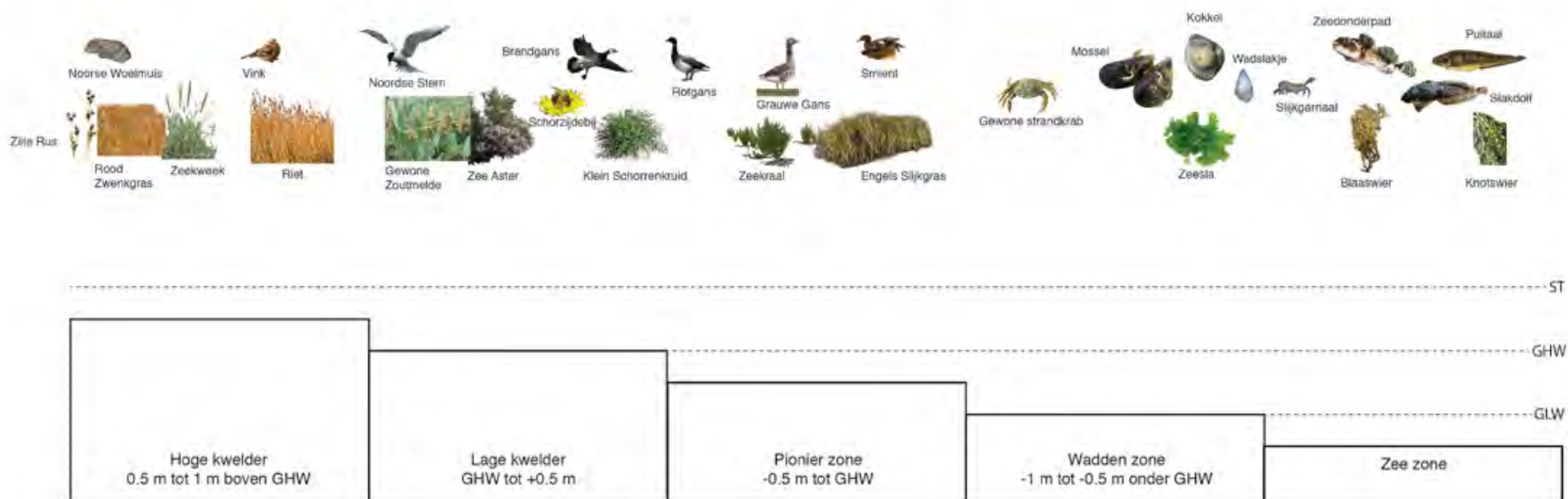


# NIEUWE KWELDERS



# BESTAANDE KWELDERS

## Soortenmatrix



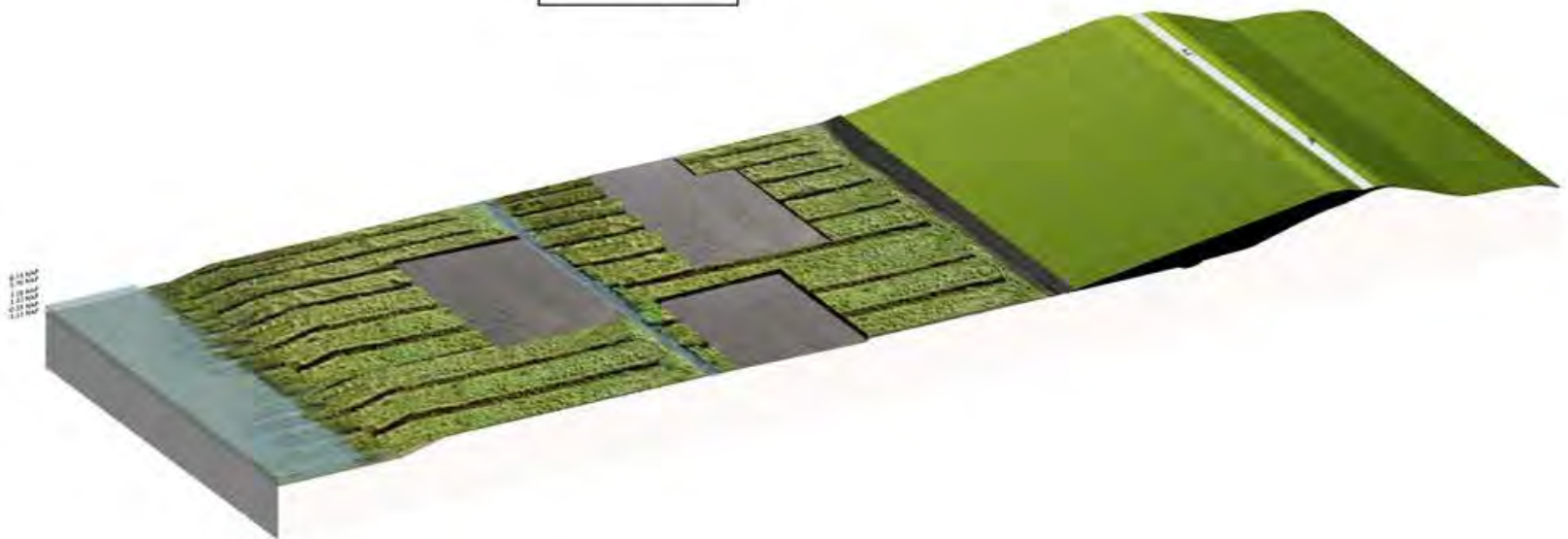
Soortenmatrix kwelder: afhankelijk van de invloed van eb enloed zijn er verschillende kweldertypen te onderscheiden, hierin ligt een kans om een grote ecologische rijkdom te creëren

## BESTAANDE SITUATIE



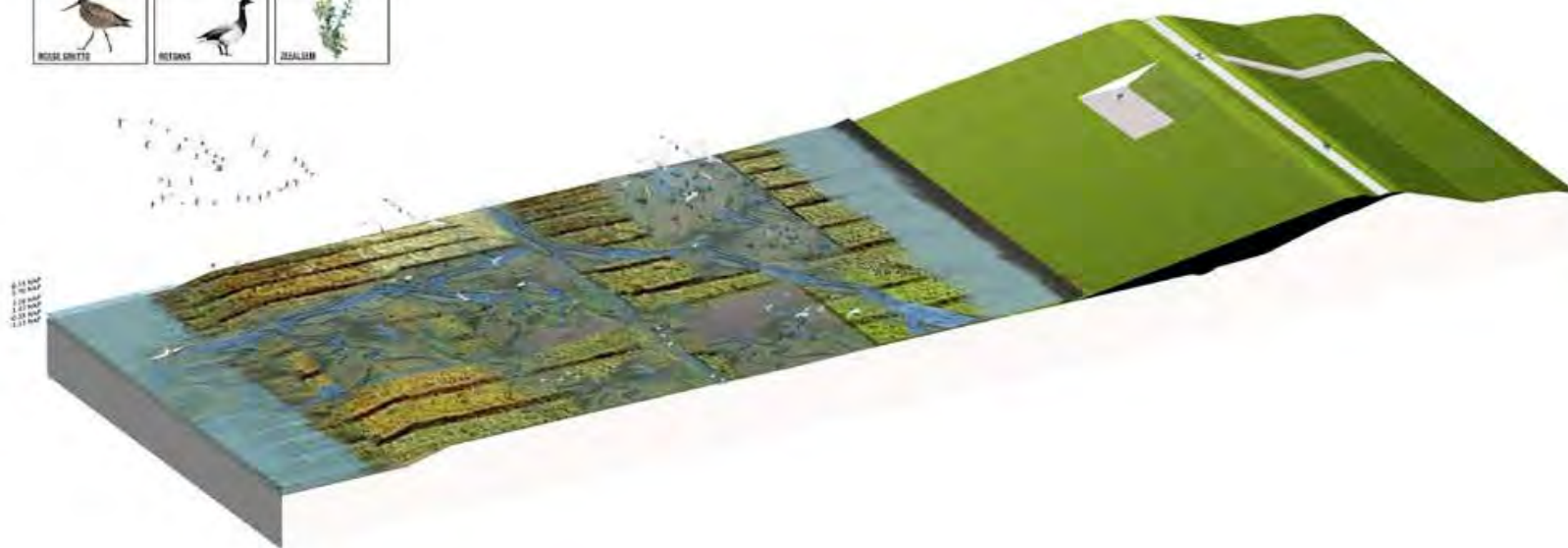


## INGREEP: VERGRAVEN, VERSTEVIGEN DIJK MET GEWONNEN KLEI



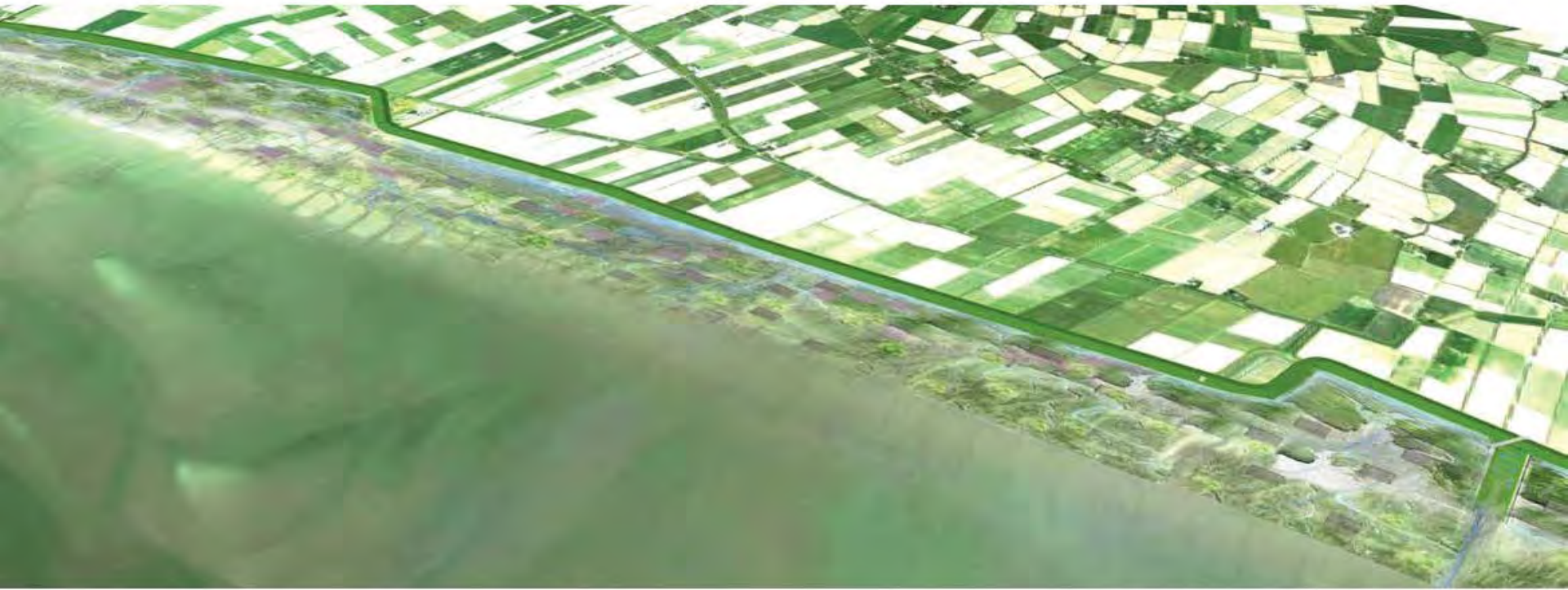
ingreep: vergraven, klei wordt gebruikt om de dijk te verstevigen

# CLIMAX: SOORTENRIJKDOM EN GEBRUIK



bij vloed zullen de vergraven delen onder water lopen

## BESTAANDE KWELDERS





## NIEUWE ZOETWATERSPUI ZORGT VOOR GELEIDELIJKE OVERGANGEN

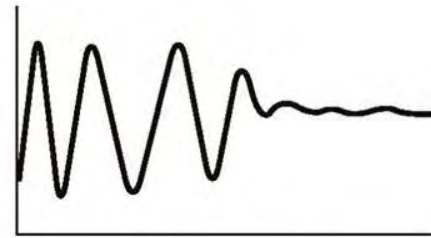


## GRADIENTRIJKE DIJK



# SPUISLUIS

**+2,0m**  
zeespiegelstijging



dynamiek systeem













4513 Hoofdplaat





4513 Нос



















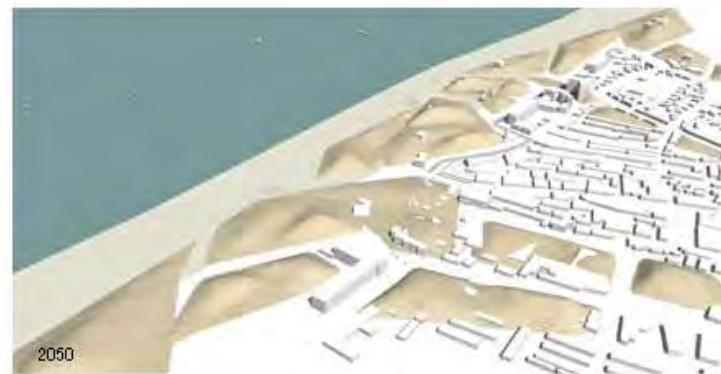
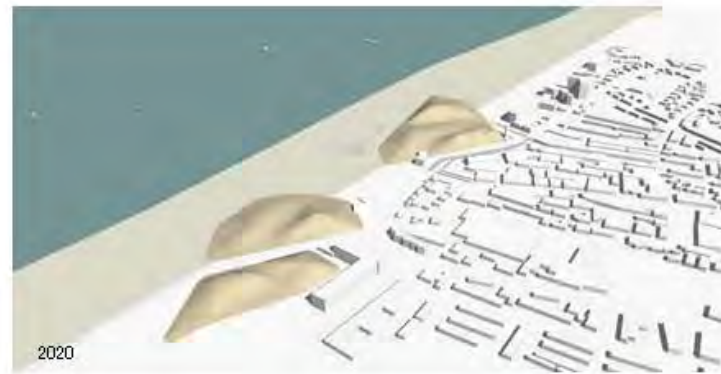
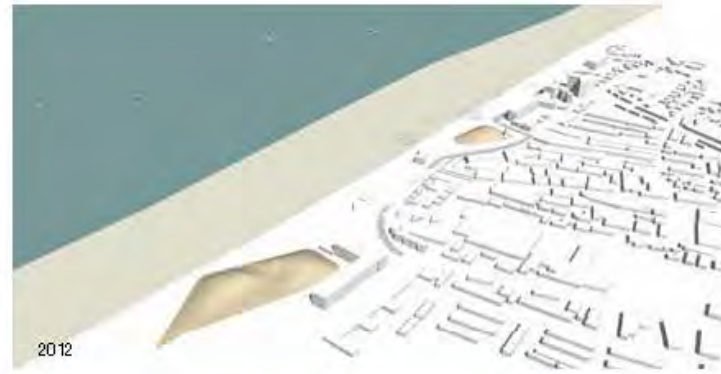


## Ontwerpen aan de zandige kust

Integrale toekomstperspectieven voor het Waddengebied,  
de Hollandse Kustboog en de Noordkust Walcheren



- Delta programma Kust - TU Delft - Gemeente Den Haag - Provincie Fryslân - Provincie Zuid-Holland - Provincie Noord-Holland - Provincie Zeeland - Van Oord - Stimuleringsfonds Creatieve Industrie -







CFAS Open House

# NEXT STEPS



# CFAS Next Steps



# More information?







# SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)

Thank you!

