Livable Lowlands
Livable Lowlands

- Dutch Coastal Sea Defenses have a Long Dramatic History of Successes and Failures
Me,

- Jacob Polderman, naval architect
- Born in Vlissingen,(Flushing) the Netherlands, 1937
- Naval Architect, studied in the Netherlands
- Shipyard Manager, Lloyd’s Register, Senior VP Americas
- In the US as of 1978.
Livable Lowlands

A polder:

- A lowland area surrounded by dikes

- Have an extensive drainage system, consisting of ditches/canals and either a pumping system or drainage to the sea at low tide
Livable Lowlands

- North Sea
- A large tidal difference due to the location of the country and the configuration of the coastal seas.
- A reasonable mild climate due to the warm current
- The North Sea in approximately 8000 BC, the end of the last ice age
- The melting ice made the sea water level rise
- Vegetation sprang up, growing year after year on top of the previous year’s dead plants
Livable Lowlands

- Thick layers of rotting plant material stopped the decaying process by lack of oxygen, creating material with stagnant air and water in it.
- Thus creating a thick layer cake, some of it very far from the surface.
- This material is called peat
• Cutting the peat out of the ground lowered the land somewhere around seven feet.

• Sometimes one could cut the peat until the ground water level
Livable Lowlands

- Peat being cut, to be used as fuel to heat the houses
- Peat being used to take the sea salt out, which was very much wanted in Western Europe
Livable Lowlands

- The first people settled in the south eastern part of the country around 5000 years BC
- 2000 years later people settled in the remainder of the eastern part of the country
- Another 1000 years later they settled in the northern and western part of the country
Livable Lowlands

- Several Roman time cities still exist, like:
  - Maastricht
  - Nijmegen
  - Utrecht

- Note # 5, the river flooded areas, sometimes protecting the country.
Livable Lowlands

- A major part of western Europe river systems drains into the North Sea on the Dutch Coast
- The Rhine
- The Meuse, (Maas)
- The Schelde, (Scaldis)
Livable Lowlands

- The Netherlands without sea dikes
- About two thirds of the country will be under water
- Also the rivers will flood an extensive part of the country
Livable Lowlands

• The Netherlands

• The North Sea and the protective sand dunes.

• See the grassy plants to keep the sand from blowing away
Livable Lowlands

- River pattern in Summer, water within the summer dikes
- River in Winter, water between the winter dikes
- Brick factories build on a raised area, utilizing river clay to make bricks
Livable Lowlands

- Rivers between Winter dikes
- Land between Winter and Summer dikes mainly used for cattle
- Rivers were kept dredged out to allow water to flow free to the North Sea
Livable Lowlands

• The draining of the many lakes in the western part of the Netherland started around 1600

• The main problems were political and material, like fishing, funds, sabotage, and disagreements amongst stakeholders of the lakes

• The war with Spain came to an end in 1648
Livable Lowlands

- Lakes above Amsterdam, causing floods of the surrounding lands
- In 1635 the Schermeer was pumped out and the available land used to grow crops
Livable Lowlands

• The trade with the Far East flourished, the Dutch merchants made good money

• Funds became available to drain the lakes

• This took several hundreds of years.
Livable Lowlands

- The “Zuiderzee” was used as entrance to the port of Amsterdam
- The shallow waters of the Zuiderzee eventually could not accommodate the larger merchant vessels
- A system called camels was being used
Livable Lowlands

• Eventually a canal was dug from Amsterdam to the North Sea

• To allow larger ships to reach Amsterdam

• The canal level is high, above the surrounding land, the North Sea and IJselmeer end has locks
Livable Lowlands

- Pumping out the water
- Windmills, learned from the Spanish, first used as grain mills
- They had a limited ability to raise water
Livable Lowlands

- A wind mill with turning top
- The blade shaft in the top of the windmill drives the water wheel and pushes the water up
- The average capability of pushing the water up is approximately one meter, for normal wheels.
Livable Lowlands

• In order to pump out a deeper lake or polder, a number of windmills in tandem is needed.

• The time line to pump out larger polders is very long. A better system is the Archimedesian screw as a water lifting, they are also called mortar mills.
Livable Lowlands

• They could bring up water as much as 2.5 meters

• An areal view of a polder, most of the windmills pictured are tourists attractions
Livable Lowlands

- Sea and Polder dikes

- The dikes have to be constructed of ridged materials, to avoid the washing away of parts of the dikes, or even when the pressure on one side is high, let water filter through

- Most of the dikes are covered with strong grasses
Livable Lowlands

• The tradition was to build houses on the land side of the dikes, causing serious casualties during storms.

• The dikes are many times used as cattle meadows. The ditch on the inside of the dike as a means to keep the dike dry.
Livable Lowlands

- The outside/seaside of the dikes needs to be reinforced to withstand the force of the sea/lake
- Naturally shaped rocks are used to cover the outside of the dike
Livable Lowlands

• The seaside of the dike needs to have a good slope, to break the force of the storm water

• Vertical walls create a spectacular effect, but are also very problematic

• They are subject to serious damage and overtopping, they also need a good base
Livable Lowlands

Vertical walls
At the seafront in Vlissingen

Ships anchored waiting to go to Antwerp
Livable Lowlands

More vertical walls

The wooden poles and breakwater helps, but not at extreme high tides
Livable Lowlands

- Overtopping of a vertical wall

- The promenade
  The seawall was constructed originally in the Napoleonic times.
Livable Lowlands

- More overtopping
- The salty seawater gushing into the town
- See the anchored ships, awaiting better weather
Livable Lowlands

- The results of overtopping of a vertical wall
What’s this?

Livable Lowlands

• The results of overtopping of a dike during a storm, the shore/land side of the dike is badly eroded

• The sea side is covered with sand bags to avoid a break through of the dike

• Also note the house on the inside of the dike
Livable Lowlands

- The result of serious overtopping, a total collapse of a dike.
- The results are very visible
- Also see the houses built close to the dike
• When building a dike which has to start in the water, a proper foundation has to be arranged

• Traditionally this is done by a large float made of willow tree branches
Willow branches plaited and bound together to form a large float, being ballasted with rocks.

The float when ballasted to be sunk to the bottom, to form the underwater foundation of a dike.
Livable Lowlands

- Willow trees of which branches are used for the large floats, grow along the major Dutch rivers, the many drainage ditches and in marsh land

- They are cut and bundled as in the picture on the right
Livable Lowlands

• Workers, cutting and bundling the willow tree branches.

• This was a tradition for several hundreds of years

• In special south and east of Rotterdam
Livable Lowlands

- **Buildings**

- Ground layers and building foundations necessary in the west of the Netherlands

- This was necessary to avoid sinking and uneven sinking of the buildings,
Livavle Lowlands

• Buildings

• Pilings using long wooden pine trunks, sunk below the ground water were used.

• Later the wooden piles were replaced by reinforced concrete ones

• Basements are rare in the western parts of the Netherlands
• In the SW of the Netherlands is the Province of Zeeland

• In the south on the North Sea is the entrance of the river Schelde which leads to Antwerp, is the island of Walcheren located

• 1944 after D day, there is an urgent need for the allies for a port to transport their supplies through
Livable Lowlands

- This port was going to be Antwerp, Belgium
- Walcheren was strategically located at the entrance of the waterway to Antwerp
- It was heavily fortified by the Germans and as such controlled the access to the river
Livable Lowlands

• The allies needed to occupy the island, solutions, bomb the island, or flood the island

• The island was heavily populated by German soldiers, resulting in opting for the flooding

• On 3 October 1944 at high water, they bombed the first dike, Westkapelle
This was followed on 11 October by the bombing of the remaining three areas of Veere, Vlissingen and Rammekens.

The island flooded within a few days, driving a part of the population and the Germans out to other part of the country.

Others remained in some higher areas, such as Middelburg.
Livable Lowlands

• Or they remained on the upper floors of their houses

• Some German soldiers left the island some retreated in the dunes

• After the flooding, the allies shelled and bombed the hide-outs

• This virtually destroying towns like Westkapelle, Middelburg partially and Vlissingen
Livable Lowlands

• The island was liberated in November 1944, together with the lands on either side of the river to Antwerp

• The river was cleared of mines and after that ships could go to Antwerp

• The island remained flooded with four broken dikes for one year.
• The Shipyard in Vlissingen opened up very soon, to repair the damaged ships from the allies

• To allow some of the workers back in Vlissingen a low dike was made around the center part of the City

• However, in January 1945 a severe storm broke the dike and most of the city flooded again
Livable Lowlands

• Willem Ruys

• Under construction in Vlissingen in 1945

• The shipyard was in the middle of the town
Livable Lowlands

- **Westkapelle,**

- Walcheren island in 1944

- The west coast of the island of Walcheren has sand dunes, except in some smaller areas
• Westkapelle

• The dike at low tide

• Note how close the houses were to the flooded channel
Livable Lowlands

- Westkapelle
- Where the dike used to be
- The currents slowly washes away the remainder of the dike
Livable Lowlands

- Westkapelle
- Bombing of the dikes
- It took three air raids to open this part of the dikes
Livable Lowlands

- Vlissingen
- The boulevard, used to be a promenade
- Most of the houses were very badly damaged
Livable Lowlands

- Vlissingen

- The promenade looking north

- It took years to rebuild this
• Westkapelle

• A part of the town which was not destroyed

• The trees are dead
Livable Lowlands

- Aagtekerke

- Mother and child wading through the water to the walkway

- They could only do this at low tide
Livable Lowlands

- Serooskerke
- The flooded village center
- Still some people were living there, on the second floor
- A small boat was used for transportation
Livable Lowlands

- Westkapelle

- The allied troops marching into the destroyed town, at low tide

- The old light house in a distance
• Walcheren

• The island after the water was pumped out

• A ghost’s land, dead trees, plants and even grass
- Serooskerke
- Another farmers village
- A local farmer’s way of transportation
- He knows where the road is, to avoid deep areas and the mines
Livable Lowlands

- **Walcheren**

- The center of the island

- Some 20 kilometers in diameter, 13.5 miles
Livable Lowlands

- Westkapelle
- Outside the town
- Nothing but water, driftwood and dead animals
Livable Lowlands

- Walcheren

- Allied soldiers rounding up German soldiers

- Ducks, trucks which float, with propulsion
Livable Lowlands

- Middelburg

- After the liberation in November 1944

- The damaged town hall and tower in the background
Livable Lowlands

- Middelburg

- Damaged and destroyed houses

- The town-hall tower in the background
Livable Lowlands

- Middelburg

- The historical town hall rebuild

- The town used to be a flourishing port town
Livable Lowlands

- Vlissingen

- Flooded houses at low tide

- Boats for transportation for people who live above the water
Livable Lowlands

- Westkapelle
- After the island was drained
- Most of the houses were destroyed
Livable Lowlands

• Walcheren

• Two farmer’s women in local costumes living with the water

• Some people lived under those circumstances for almost a year
Livable Lowlands

- **Meliskerke**

- A small farmers village on the island

- See the make shift walkway to a dry area, at low tide
Livable Lowlands

- **Vlissingen**

- The dike west of Vlissingen after it was closed off from the North Sea in late 1945

- The dike is still very fragile
Livable Lowlands

- North Sea and Coastal Storm in 1953
- Severe flooding in Britain, Belgium, North Germany and the Netherlands
- Many people drowned in the nights of 31 January – 1 February in the Netherlands only, 1836 people drowned overnight
Livable Lowlands

• The shape of the North Sea shows a gradual narrowing to the south.

• This caused the water to rise in the narrower areas with the wind coming from the north.

• This happened in January 1953.
• In the night of January 31, 1953 the high water tide was a spring tide

• The water level was raised by 2.5 meters along the Dutch Coast
Livable Lowlands

• The storm surge was less but still considerable, along the English, Belgium and North German Coast

• Still many people drowned in those countries, but considerable less than in the Netherlands
Livable Lowlands

• The boulevard in Vlissingen during good summer weather

• Also one can see the additional slope placed in front of the vertical promenade wall after the 1953 storm
The stormy waters washed away a part of the promenade overnight.

A deep hole was made in the pavement and the sea wall.
Livable Lowlands

- Volunteers filled jute bags with sand to cover the holes in the dikes

- This was the afternoon of February 1
Livable Lowlands

• Another picture of the damage

• Showing how much had washed away of the sea wall in one night
Livable Lowlands

- Water being washed over the sea wall
- Run into the town
- Ships at anchor awaiting better weather
Livable Lowlands

- See the force of the water
- The waves being smashed against the brick wall
Livable Lowlands

• A lonely statue in a distance being washed by sea water

• It is the locally born Michiel de Ruyter

• The admiral of the Dutch navy in the seventeen century times.
• Many sea dikes were overtopped, washing away the inside of the dikes

• Some of them collapsed completely
Livable Lowlands

- Broken Sea Dike, allowing the currents of the flood water to wash away a large gap in the dike

- The tidal effect creates a deep channel in front of both sides of the dike
Livable Lowlands

- The town of Vlissingen on a sunny day

- Located in the Southern part of the Island of Walcheren

- Walcheren which was inhabited in the Roman times by Friesians
The promenade of Vlissingen in the afternoon of 31 January 1953

Massive amounts of water being thrown over the houses of the boulevard